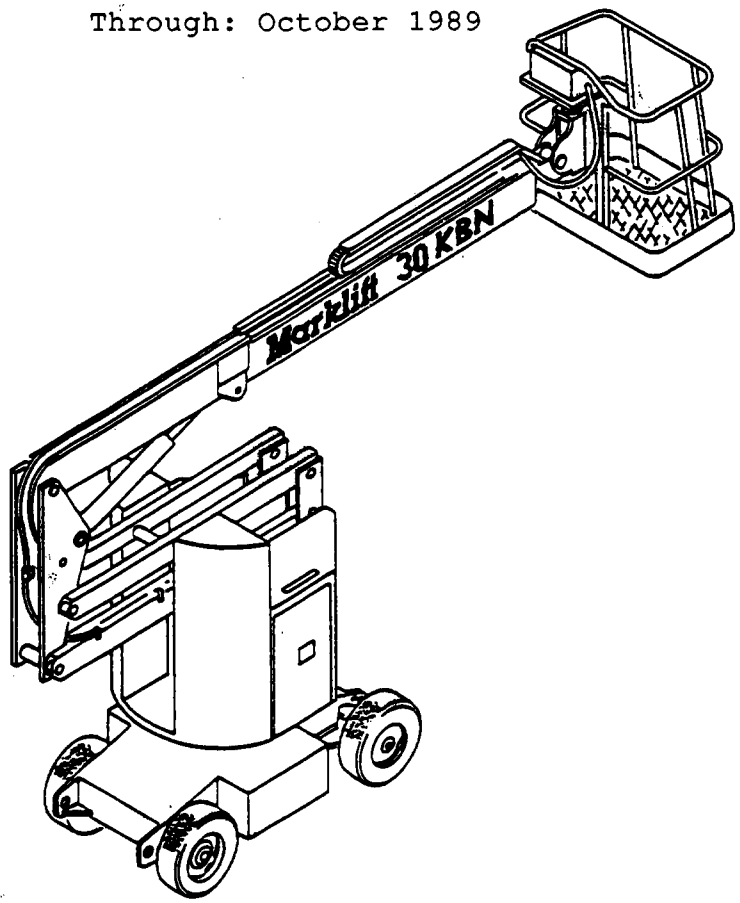
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED KNUCKLEBOOM OPERATION MAINTENANCE AND PARTS MANUAL

Through: October 1989



Model: 30KBN

FIRST EDITION: May 1988

FINAL EDITION: May 1990

Mark Industries

106 12th Street S.E.
Waverly, Iowa 50677-9466
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17301

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SERVICE BULLETINS

The purpose of this manual is to provide the customer with operation, safety, maintenance and parts information that will enhance the reliable performance of the **MARKLIFT.** Schematic and vendor information is also furnished. If additional information is needed, we urge the customer to contact the local authorized MARKLIFT dealer. If this is not possible, please contact the Mark Industries Customer Service Engineering Department at (714) 879-MARK

WARNING: IMPROPER USE OF THIS MACHINE WILL RESULT IN **SERIOUS INJURY OR DEATH!** TO PROTECT YOURSELF AND THE EQUIPMENT, **STUDY THIS MANUAL BEFORE OPERATING THE MARKLIFT.**

The platform capacity, hydraulic system pressure setting and unit serial number can be found on the ID plate mounted on the carriage assembly.The serial number should be referenced whenever ordering parts. This will help insure that you receive prompt and accurate service.

All **MARKLIFTS** are tested and operated to assure their proper operating condition before shipment. At this time, all necessary adjustments are made and an overall physical inspection is conducted. After the unit is delivered, some minor adjustments and inspections must be made before putting the unit into service. These are outlined in the **INSPECTION AND CHECKOUT** instructions in the operation section of this manual.

MARK INDUSTRIES reserves the right to continually make product and safety improvements. Your participation in implementing such improvements will be required.

Description	Model
	30KBN
Working Height	36' 0" (10.97m)
Platform Height	30' 0" (9.14m)
Load capacity unrestricted	500 lbs. (226.8 kg)
Height (stowed)	6' 7" (2.01m)
Width	4' 0" (1.22m)
Length (stowed)	15' 8" (4.78m)
Wheelbase	5' 0" (1.52m)
Turning radius	
(inside)	5'6" (1.68m)
(outside)	10' 2" (3.10m)
Tires	7.00 x 12 (pneumatic)
Turret rotation	350° noncontinuous
Turret tailswing	zero
Power source	36VDC (electric)
Travel speed	0-1.5mph (0-2.41 km/hr)
Controls	proportional drive
Hydraulic reservoir capacity	9.5 gal. (35.96 l)
Platform dimensions	30" x 48" x 42" (.76m x 1.22m x 1.07 m)
Horizontal reach	
(center of turret)	21' 8" (6.60m)
(clear reach)	19'8" (5.99m)
Weight	12,300 lbs (5579 kg)
Shipping Cube	441.52 cu. f t. (12.50 m^3)

Specifications are nominal and are subject to change due to continual design improvements.

MANUFACTURERS' LIMITED WARRANTY

Mark Industries makes no warranty, expressed or implied, on any product manufactured or sold by Mark Industries except for the following limited warranty against defect in materials and workmanship on products manufactured by Mark Industries.

> Mark Industries warrants the products manufactured by Mark Industries to be free from defects in material and workmanship under normal use and service for a period of one (1) year from the date of shipment or from date first put into service upon proper notification. This limited warranty does not extend to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries. The warranty, if any, with respect to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries is limited to the warranty, if any, extended to Mark Industries by the manufacturer of the other product, part, component, accessory or attachment.

This limited warranty does not extend to any product (or any part or parts on any product) which has been subject to improper use or application, misuse, abuse, operation beyond its rated capacity, repair or maintenance except in accordance with the sales and service manuals and special instructions of Mark Industries, or modification without the prior written authorization of Mark Industries (whether by the substitution of nonapproved parts or otherwise).

The sole obligation and liability of Mark Industries under this limited warranty (and the exclusive remedy for any purchaser, owner or user of Mark Industries products) is limited to the repair or replacement, at the option of Mark Industries, of any product (or any part or parts on any product) manufactured by Mark Industries which, within one (1) year from the date of shipment, shall have been returned to the Mark Industries facility in Brea, California (or any other location within the United States as shall be designated by Mark Industries), at no expense to Mark Industries, and demonstrated to the satisfaction of Mark Industries as being defective in material or workmanship.

To make a claim under this limited warranty, contact Mark Industries or the Mark Industries distributor from whom the product was originally purchased. A statement giving the model and serial number of the allegedly defective product, the date and a description of the alleged defect, the date of the purchase and proof of purchase and purchase date must accompany the returned product (or any part or parts of any product). Any product (or any part or parts of any product) determined by Mark Industries to be defective will be repaired or replaced, at the option of Mark Industries, free of charge, f.o.b. Brea, California. No credit will be given for any allegedly defective product (or any part or parts of any product) not returned to Mark Industries.

There are no other warranties, expressed or implied, in addition to this limited warranty. **This limited warranty is exclusive and in lieu of all other warranties, expressed or implied (in fact or by operation of law or otherwise), including the implied warranties of merchantability and fitness for a particular purpose.**

Mark Industries shall not be liable for any special, indirect or consequential damages. Further, no representation or warranty made by any person, including any representative of Mark Industries, which is inconsistent or in conflict with, or in addition to the terms of the foregoing limited warranty (or the limitations of the liability of Mark Industries as set forth above) shall be binding upon Mark Industries unless reduced to writing and approved by an officer of Mark Industries.

Tires, batteries, filter elements, electrical components are specifically excluded from this limited warranty.

Warranty effective as of 2/90

Mark Industries

P.O. Box 2255, Brea, CA 92622-2255

714-879-6275 800-448-MARK

TELEX 194402 FAX 1-714-879-8884

WARRANTY REGISTRATION

Purchaser/Dealer:

Company Name:

Address:

Telephone:

Date shipped (from invoice):

Date shipment received:

Date unit put into service:

Unit will be placed in rental fleet:

Unit will be sold:

Unit will be used for:

- ☐ Inspection
- ☐ Mining
- ☐ Welding
- ☐ Construction
- ☐ Scaffolding
- ☐ Mechanical
- ☐ General maintenance
- ☐ Heating/Air conditioning
- ☐ Carpentry
- ☐ Plumbing
- ☐ Electrical
- ☐ Sprinkler
- ☐ Painting/Sandblast
- ☐ Steel fabrication
- ☐ Rigging
- ☐ Roofing
- ☐ Glazing
- ☐ Other

Comments:

Inspection completed by: Title:

Warranty will be void unless this inspection report is postmarked to Mark Industries not more than fourteen (14) days from the date shipment is received.

NEW EQUIPMENT CONDITION REPORT

Filling in the Warranty: Please refer to the applicable decals on your machine for the figures and quantities needed to fill in the blanks below.

		YES	NO	NA
1.	Platform capacity decal _____. lbs.	☐	☐	☐
2.	All warning, caution and emergency decals installed	☐	☐	☐
3.	Operation instructions properly installed	☐	☐	☐
4.	Operation and safety handbook received	☐	☐	☐
5.	All controls (aerial & ground) are identified and operate correctly	☐	☐	☐
6.	Stop switches operate properly (aerial & ground)	☐	☐	☐
7.	Platform guard rails and other hardware, secure and undamaged	☐	☐	☐
8.	Platform access gate works properly	☐	☐	☐
9.	Horn and beacon operate properly	☐	☐	☐
10.	110V generator operates properly	☐	☐	☐
11.	Brakes adjusted and operate correctly	☐	☐	☐
12.	Circuit breakers operate properly	☐	☐	☐
13.	All hydraulic cylinders free of leaks	☐	☐	☐
14.	All hydraulic cylinder rods free of paint or scratches	☐	☐	☐
15.	Hydraulic pump free of leaks	☐	☐	☐
16.	Hydraulic hoses and fittings tight	☐	☐	☐
17.	Hydraulic oil to proper level	☐	☐	☐
18.	Hydraulic tank and fittings free of leaks	☐	☐	☐
19.	Drive motors free of leaks	☐	☐	☐
20.	Wheel lug nuts torqued to _____. Ft. lbs	☐	☐	☐
21.	Battery water level _____.	☐	☐	☐
22.	Manual overrides operate properly	☐	☐	☐
23.	All electrical connections tight	☐	☐	☐
24.	Valve manifold and fittings free of leaks	☐	☐	☐
25.	Emergency descent valve functions properly	☐	☐	☐
26.	System pressure _____. PSI	☐	☐	☐
27.	Stand-by pressure _____. PSI	☐	☐	☐
28.	Tire pressure _____. PSI	☐	☐	☐
29.	Drive wheel, torque hub oil level _____.	☐	☐	☐
30.	Engine R.P.M at idle _____ at high throttle _____.	☐	☐	☐
31.	Turret rotation gear box oil level _____.	☐	☐	☐
32	Turret ring gear bolts torqued to _____ Ft. lbs	☐	☐	☐
33.	Base ring gear bolts torqued to _____ Ft. lbs	☐	☐	☐
34.	Engine coolant (radiator) to proper level	☐	☐	☐
35.	Coolant hoses and fittings free of leaks	☐	☐	☐
36.	Electric radiator fan operates properly	☐	☐	☐
37.	Fuel tank and fitting free of leaks	☐	☐	☐
38.	Muffler is tight and free of leaks	☐	☐	☐
39.	Engine oil to proper level	☐	☐	☐
40.	Engine oil filter free of leaks	☐	☐	☐
41.	Engine alternator functions properly	☐	☐	☐
42.	Retraction cable tension _____ Ft. lbs	☐	☐	☐

MODES
SERIAL NUMBER
INSPECTOR

OPTIONS _____

When loading and unloading the **MARKLIFT**, it may be necessary to use a combination of winching and driving the boom in low drive speed. <u>The operator in the basket must wear a safety belt attached with lanyard to the safety rings provided.</u>

Make sure that the parking brake is adjusted to provide for immediate braking by opening the parking brake control valve. (See figure 1.)

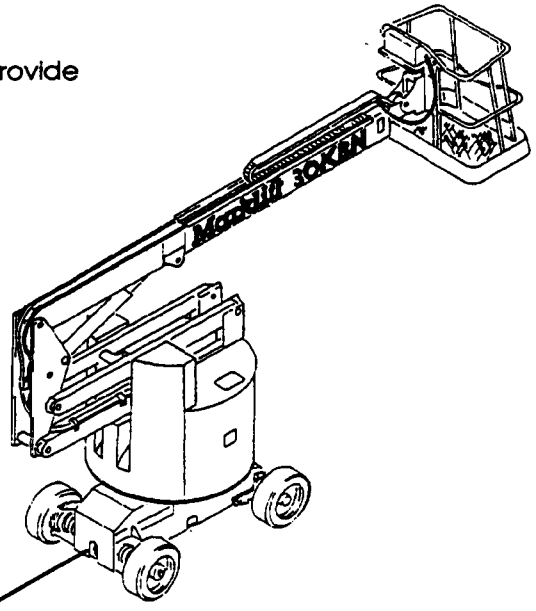


Figure 1: Parking Brake Control Valve

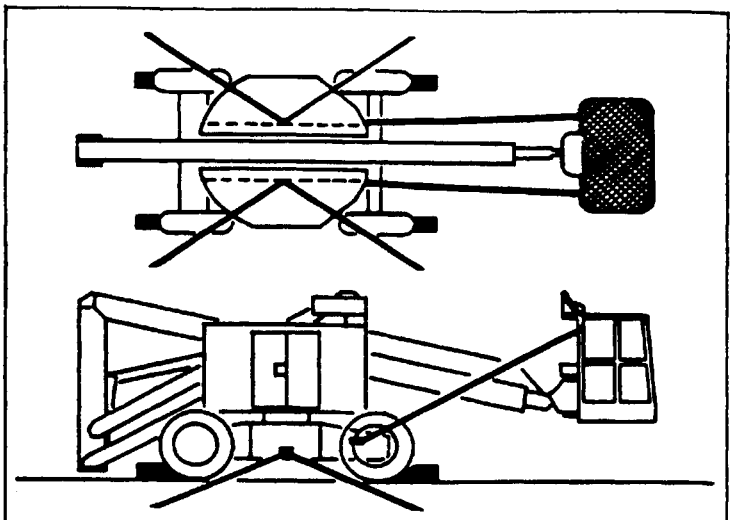
LOADING

1. With the trailer on level ground, align the tires of the **MARKLIFT** with the ramps of the trailer.

2. Attach the winch cable to the unit at the drive wheel end of the base through the tow eye.

3. Exercise great care while driving and steering the unit up the ramp, keeping all slack out of the winch cable. If the ramp is too steep for the unit to climb, the winch will pull the unit up. <u>You must keep the drive function engaged while winching, otherwise the parking brakes will prevent the wheels from rolling.</u>

4. When the **MARKLIFT** is on the truck and properly located, chain the unit down as shown in figure 2 of this instruction.



FACTORY RECOMMENDED TIE DOWN TRANSPORTING DIAGRAM

Do not use binders on the machine's platform tie lines. Individual tie lines may be tensioned by extending the boom or tilting the platform up.

Figure 2: Securing the MARKLIFT to the platform

UNLOADING

1. With the trailer on level ground, disconnect the tie-down chains from the MARKLIFT and make sure that the winch cable is still properly attached to the unit.

2. Use great care while driving and steering the unit off the trailer. Keep all slack out of the winch cable.

Warning:	**Do Not** allow slack in the winch cable when going down the ramp, because of the possibility of snapping the cable should the unit descend the ramp too fast.

3. When all the wheels are on level ground, disconnect the the winch cable from the unit.

4. Re-adjust the boom parking brakes as follows: First, close the needle valve completely. Open the valve approximately 1/8 turn then position the unit on a flat surface, with approximately 20 feet of running space. Position the boom fully down in the cradle and completely retract the boom to obtain high speed drive mode.

Drive the **MARKLIFT** approximately 15 feet with the controller handle in maximum (full on) position. Release the controller when the wheel passes next to a marker (visual indicator) on the ground. An acceptable slowing and braking distance should be within 3 feet when measured from the marker to the center of the same wheel after the unit has completely stopped. Adjust the brake control valve on the parking brakes to achieve this distance.

Warning: Do Not drive on uneven, sloping, or soft terrain that sets the unit in an out-of-level condition.

After the unit is delivered and unloaded, some minor inspections must be made before putting the unit into service. The following must be checked:

1. Visually inspect all exposed parts of the **MARKLIFT**. Secure any loose bolts and nuts. Replace any damaged hydraulic lines or broken wires. Check for any structural damage, including cut or damaged tires.

2. Check hydraulic oil level - sight gauge shows full with unit in stowed position.

3. Check batteries for 1.200 ± 50 specific gravity reading on the hydrometer. Charge the batteries if the readings are below 1.100. If batteries require water, fill to proper level AFTER charging. (Refer to battery maintenance instructions, page 27)

4. Check the hydraulic valve manifolds for leaks, loose fittings or loose wires.

5. Position ground/aerial selector switch to "Ground" then operate boom function switches. Check hoses for leaks.

6. After the ground control functions have been checked out, position the selector switch to "Aerial" for operation at the work platform. After entering the platform, depress the footswitch before using any control function switches. This electrically completes the circuit to the controls.

The **MARKLIFT** conforms to applicable ANSI and OSHA requirements at the time of shipment. Since the safety requirements made by ANSI, OSHA and the various safety boards in your area are subject to change, it is the responsibility of the owner to instruct the operators about all such current requirements.

Every operator of the MARKLIFT must read, understand and follow the safety rules set forth herein. The **MARKLIFT** self-propelled aerial work platform is a personnel lifting device, and it is essential that it be properly maintained and operated to perform all functions with maximum safety and efficiency. The operation of any new and unfamiliar equipment can be hazardous in the hands of untrained operators.

1. Inspect the machine periodically as specified in the Inspection and Checkout, and Preventive Maintenance sections and as required by ANSI, OSHA, local safety boards and the owner. All unsafe items must be corrected by a qualified service technician before use of the machine.

2. Only trained operators must be assigned to operate the **MARKLIFT.**

3. It is the responsibility of the operator to read and understand this manual and to follow all recommendations made.

4. Never exceed manufacturer's recommended platform load capacity. Remember, the load capacity of the **MARKLIFT** is the total combined weight of personnel and tools, fixtures, accessories, etc.

5. Always distribute the load evenly over the platform floor area.

6. It is recommended that head gear (hard hats) be worn by all personnel on the work platform.

7. **The MARKLIFT** platform is equipped with safety belt rings. **Each operator of the MARKLIFT must wear a body belt. The safety belt must be attached with lanyard to the provided anchor points.**

8. **Do Not** change, vary, or alter the equipment in any way.

9. **Do Not** override any hydraulic, mechanical, or electrical safety devices.

10. **Do Not** store loose material in the work platform such as pipe, rope, extension cords, wire or miscellaneous boxes. If necessary to store such items, they must be positioned in such a way that no one will trip over them when operating or working in the platform.

11. **Do Not** work on the platform if your physical condition is such that you feel dizzy or unsteady in any way.

12. The **MARKLIFT** is a non-insulated personnel carrier and must not be operated within 10 feet of a 50,000 volt line. (See Table X Division of Industrial Safety.)

13. Under no circumstances should horseplay be tolerated on the **MARKLIFT**.

14. **Do Not** operate boom functions in an out-of-level condition.

15. **Do Not** drive on uneven, sloping or soft terrain, unless the boom is fully retracted and below horizontal.

16. **Do Not** drive the carriage or platform into objects.

17. **Do Not** lean over platform rails to perform work.

18. **Do Not** use ladders or scaffolding on the platform to obtain greater height.

19. **Do Not** raise or lower the boom into objects.

20. The **MARKLIFT** structure must not be used as a welding ground. Disconnect both battery leads prior to performing any welding operations.

21. **Do Not** jump start other vehicles using the **MARKLIFT** battery.

TITLE 8 DIVISION OF INDUSTRIAL SAFETY 358.38.113
(Register 73, No. 30—7-28-73)
Article 86. Provisions for Preventing Accidents
Article 86. Provision for Preventing Accidents Due to Proximity
to Overhead Lines

2946. Provisions for Preventing Accidents Due to Proximity to Overhead Lines.

(a) **General.** No person, firm, or corporation, or agent of same, shall require or permit any employee to perform any function in proximity to energized high-voltage lines; to enter upon any land, building, or other premises and thereto engage in any excavation, demolition, construction, repair, or other operation; or to erect, install, operate, or store in or upon such premises any tools, machinery, equipment, materials, or structures (including scaffolding, house moving, well drilling, pile driving, or hoisting equipment) unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

(b) **Clearances or Safeguards Required.** Except where electrical distribution and transmission lines have been de-energized and visibly grounded or effective barriers have been erected to prevent physical and arcing contacts with the high-voltage lines, the following provisions shall be met:

(1) **Over Lines.** The operation, erection, or handling of tools, machinery, apparatus, supplies, or materials, or any part thereof, over energized high-voltage lines shall be prohibited.

(2) **Equipment and Materials in Use.** The operation, erection, or handling of tools, machinery, equipment, apparatus, materials, or supplies, or any part thereof within the minimum clearances from energized lines set forth in Table X shall be prohibited.

TABLE X
Required Clearances from Overhead High-Voltage Lines

Nominal Voltage (Phase to Phase)				Minimum Required Clearance (Feet)
	750	-	50,000	10
over	50,000	-	75,000	11
over	75,000	-	125,000	13
over	125,000	-	175,000	15
over	175,000	-	250,000	17
over	250,000	-	370,000	21
over	370,000	-	550,000	27
over	550,000	-	1,000,000	42

(3) **TRANSPORTATION OR TRANSIT.** The transportation or transit of any tool, machinery, equipment, or apparatus, or the moving of any house or other building in proximity to overhead high-voltage lines shall be expressly prohibited if at any time during such transportation or transit such tool, machinery, equipment, apparatus, or building, or any part thereof, can come closer to high-voltage lines than the minimum clearances set forth in Table Y.

Article 86. Provisions for Preventing Accidents

Except where the boom of boom-type equipment is lowered and no load is imposed thereon, the equipment in transit shall conform to the minimum required clearances set forth in Table X.

Table Y
Required Clearances from Energized High-Voltage Conductors
(While in Transit)

Nominal Voltage (Phase to Phase)			Minimum Required Clearance (Feet)
750	-	50,000	6
over 50,000	-	345,000	10
over 345,000	-	750,0000	16
over 750,000	-	1,000,000	20

(4) **Storage.** The storage of tools, machinery, equipment, supplies, materials, or apparatus under, by, or near energized high-voltage lines is hereby expressly prohibited if at any time during such handling or other manipulation it is possible to bring such tools, machinery, equipment, supplies materials, or apparatus, or any part thereof, within the minimum required clearances from high-voltage lines as set forth in Table X.

(C) The specified clearance shall not be reduced by movement due to any strains impressed (by attachments or otherwise) upon the structures supporting the high-voltage line or upon any equipment, fixtures, or attachments thereon.

(D) Insulated cage-type boom guards, boom stops, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not alter the required clearances set forth in Table X.

(E) Any overhead conductor shall be considered to be energized unless and until the person owning or operating such line verifies that the line is not energized, and the line is visibly grounded at the work site.

2947. **Warning Signs Required.** The owner, agent, or employer responsible for the operations of equipment shall post and maintain in plain view of the operator and driver on each crane, derrick, power shovel, drilling rig, hay loader, hay stacker, pile driver, or similar apparatus, a durable warning sign legible at 12 feet reading: **"Unlawful To Operate This Equipment Within 10 Feet of High-Voltage Lines of 50,000 Volts or Less."**

In addition to the above wording, the following statement in small lettering shall be provided on the warning sign: **"For Minimum Clearances of High-Voltage Lines in Excess of 50,000 Volts, See Article 86, Title 8, High-Voltage Electrical Safety Orders."**

Marklift Units With Lead Counterweight

If your **MARKLIFT** has lead counterweights, please refer to OSHA 29 CFR 19.10.1025 for requirements concerning occupational exposure to lead. It is your responsibility to obtain the regulations that pertain to lead usage for your place of employment and for the protection of your employees.

If you are unable to obtain said regulations, you may contact Mark Industries directly for assistance at (714) 879-MARK. You may also contact Mark Industries for a copy of the Material Safety Data Sheet for Lead.

DANGER, WARNING, EMERGENCY AND CAUTION DECALS

OBSERVE ALL DANGER, WARNING, CAUTION AND EMERGENCY DECALS AT THE VARIOUS LOCATIONS ON THE **MARKLIFT** IN ORDER TO TAKE TIMELY PREVENTIVE AND CORRECTIVE ACTIONS.

> It is the primary responsibility of the user and operator to be thoroughly knowledgeable of all decal information, definition and location.

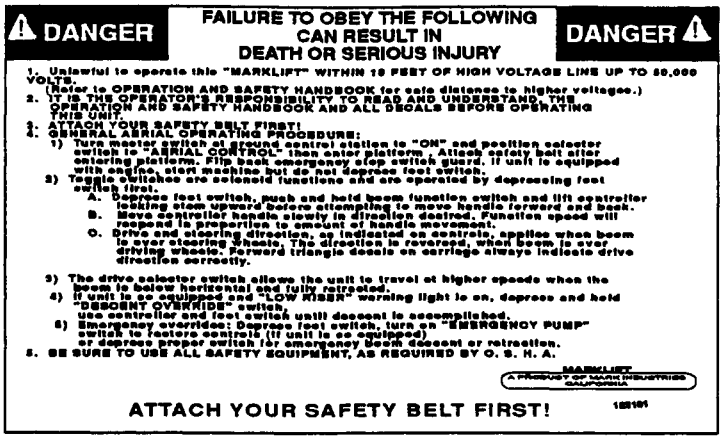
The following page illustrates a chart in which decals for the **MARKLIFT** are listed. This will enable you to replace the existing decal(s) if they become worn-out, torn, or illegible. It is essential that all decals be in a readable condition for the safe operation of the **MARKLIFT**. It is therefore recommended that they be properly maintained.

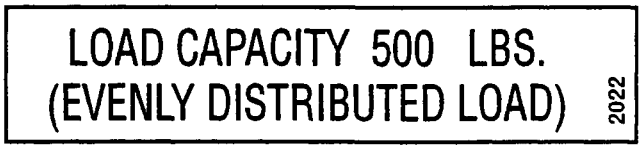
Danger, Warning and Caution are used to identify levels of hazard seriousness. Given below is a definition of each term as it applies to the decals:

- Danger (Indicated in red):
  Immediate hazards which <u>Will</u> result in severe personal injury or death.

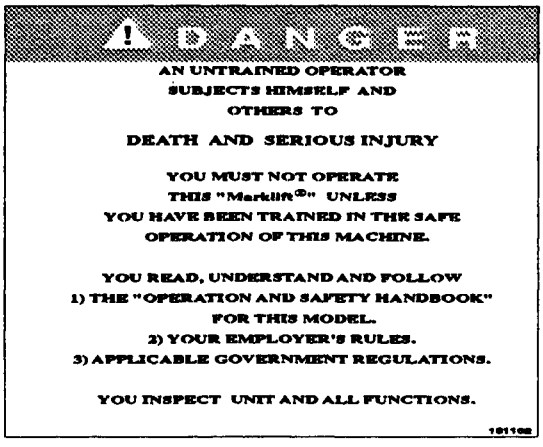
- Warning (Indicated in orange):
  Hazards or unsafe practices which <u>Could</u> result in severe personal injury or death.

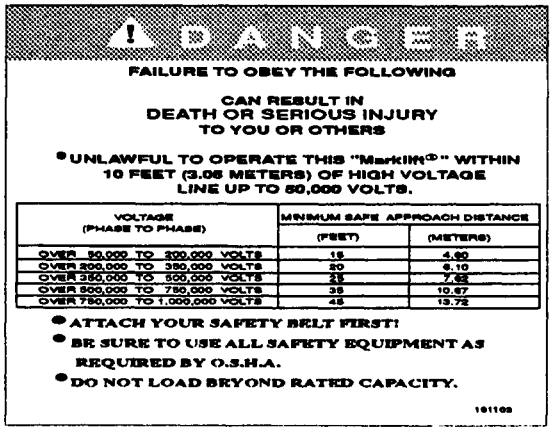
- Caution (Indicated in yellow):
  Hazards or unsafe practices which <u>Could</u> result in minor personal injury or product or property damage.

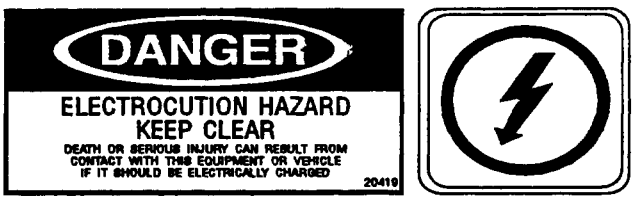

DANGER
FAILURE TO OBEY THE FOLLOWING CAN RESULT IN DEATH OR SERIOUS INJURY
DANGER
1. Unlawful to operate this "MARKLIFT" WITHIN 10 FEET OF HIGH VOLTAGE LINE UP TO 50,000 VOLTS.
(Refer to OPERATION AND SAFETY HANDBOOK for safe distance to higher voltages.)
2. IT IS THE OPERATOR'S RESPONSIBILITY TO READ AND UNDERSTAND THE OPERATION AND SAFETY HANDBOOK AND ALL DECALS BEFORE OPERATING THIS UNIT.
3. ATTACH YOUR SAFETY BELT FIRST!
4. GENERAL AERIAL OPERATING PROCEDURE:
1) Turn master switch at ground control station to "ON" and position selector switch to "AERIAL CONTROL" then enter platform. Attach safety belt after entering platform. Flip back emergency stop switch guard. If unit is equipped with engine, start machine but do not depress foot switch.
2) Toggle switches are solenoid functions and are operated by depressing foot switch first.
A. Depress foot switch, push and hold boom function switch and lift controller looking down upward before attempting to move handle forward and back.
B. Move controller handle slowly in direction desired. Function speed will respond in proportion to amount of handle movement.
C. Drive and steering direction, as indicated on controls, applies when boom is over steering wheels. The direction is reversed, when boom is over driving wheels. Forward triangle decals on carriage always indicate drive direction correctly.
3) The drive selector switch allows the unit to travel at higher speeds when the boom is below horizontal and fully retracted.
4) If unit is so equipped and "LOW RISER" warning light is on, depress and hold "DESCENT OVERRIDE" switch, use controller and foot switch until descent is accomplished.
5) Emergency override: Depress foot switch, turn on "EMERGENCY PUMP" switch to restore controls (if unit is so equipped) or depress proper switch for emergency boom descent or retraction.
5. BE SURE TO USE ALL SAFETY EQUIPMENT, AS REQUIRED BY O. S. H. A.
MARKLIFT
A PRODUCT OF MARK INDUSTRIES CALIFORNIA
ATTACH YOUR SAFETY BELT FIRST!


LOAD CAPACITY 500 LBS.
(EVENLY DISTRIBUTED LOAD)
2022


ATTACH
SAFETY
BELT
22386


DANGER
AN UNTRAINED OPERATOR
SUBJECTS HIMSELF AND
OTHERS TO
DEATH AND SERIOUS INJURY
YOU MUST NOT OPERATE
THIS "Marklift®" UNLESS
YOU HAVE BEEN TRAINED IN THE SAFE
OPERATION OF THIS MACHINE.
YOU READ, UNDERSTAND AND FOLLOW
1) THE "OPERATION AND SAFETY HANDBOOK"
FOR THIS MODEL.
2) YOUR EMPLOYER'S RULES.
3) APPLICABLE GOVERNMENT REGULATIONS.
YOU INSPECT UNIT AND ALL FUNCTIONS.


DANGER
FAILURE TO OBEY THE FOLLOWING
CAN RESULT IN
DEATH OR SERIOUS INJURY
TO YOU OR OTHERS
• UNLAWFUL TO OPERATE THIS "Marklift®" WITHIN 10 FEET (3.05 METERS) OF HIGH VOLTAGE LINE UP TO 50,000 VOLTS.
VOLTAGE (PHASE TO PHASE)
MINIMUM SAFE APPROACH DISTANCE
(FEET)
(METERS)
OVER 50,000 TO 200,000 VOLTS 15 4.60
OVER 200,000 TO 350,000 VOLTS 20 6.10
OVER 350,000 TO 500,000 VOLTS 25 7.62
OVER 500,000 TO 750,000 VOLTS 35 10.67
OVER 750,000 TO 1,000,000 VOLTS 45 13.72
• ATTACH YOUR SAFETY BELT FIRST!
• BE SURE TO USE ALL SAFETY EQUIPMENT AS REQUIRED BY O.S.H.A.
• DO NOT LOAD BEYOND RATED CAPACITY.


DANGER
ELECTROCUTION HAZARD
KEEP CLEAR
DEATH OR SERIOUS INJURY CAN RESULT FROM CONTACT WITH THIS EQUIPMENT OR VEHICLE IF IT SHOULD BE ELECTRICALLY CHARGED
20419



ATTACH YOUR SAFETY BELT FIRST!

CAUTION OPERATING THIS MACHINE WITHOUT CORRECT SAFETY BELT ATTACHMENT COULD RESULT IN DEATH OR SERIOUS INJURY CAUTION

22385

WARNING

FAILURE TO OBEY THE FOLLOWING CAN RESULT IN

DEATH OR SERIOUS INJURY

- Do not sand, grind, flame cut , brase or weld on lead counterweights or couterweight's dry primer paint without air respirator (NIOSH/MSHA TC-19C), eye protection, gloves, and protective clothing.
- Wash hands and face thoroughly after performing any of the above tasks before eating, drinking or smoking.

183301

WARNING

This counterweight contains pure LEAD, known to the State of California to cause birth defects or other reproductive harm. Wash thoroughly after handling and before eating, drinking or smoking.

DO NOT grind, drill or perform other machining on counterweight unless all requirements of OSHA 29 CFR 1910.1025 are followed. FAILURE TO DO SO CAN CAUSE LEAD POISONING. Refer to the Operation and Maintenance and Parts Manual for copy of OSHA requirements.

183302

GENERAL DECALS
30KBN

DECAL P/N	DECAL DESCRIPTION 30KBN	ASSEMBLY	QTY
67399	Decal Set	All Standard Decals	1
182703	Platform Leveling Switch	Final Assembly	1
140374	Upper Control	Upper control panel	1
140595	Tie Down Diagram	Final Assembly	2
181901	Marklift 30KBN	Final Assembly	2
20462	Forward Arrow Aft	Final Assembly	1
20896	Brake	Final Assembly	1
182101	Danger & Aerial Operation Instructions	Final Assembly	1
22385	Caution Attach Your Safety Belt	Final Assembly	2
181103	Danger Obey the Following	Final Assembly	4
181102	Danger, Do Not Operate Unless...	Final Assembly	2
2022	Load Capacity 500 lbs.	Final Assembly	1
140496	Hand Pump	Final Assembly	1
140495	Emergency	Final Assembly	1
31259	Marklift	Final Assembly	1
131061	Blue Stripe	Final Assembly	1
130596	'A Product of Mark Industries'	Final Assembly	1
20420	Tire Pressure 75 PSI	Final Assembly	2
20410	Logo Mark Industries	Final Assembly	1
2017	Hydraulic System Fluid	Final Assembly	1
20461	Forward Arrow	Final Assembly	1
22386	"D" Ring Attach Safety Belt	Final Assembly	2
20419	Danger Keep Clear	Final Assembly	2
22449	No Smoking for Electrical Booms	Final Assembly	2
2003	Battery Water Level	Final Assembly	2
130820	'Operation & Safety Handbook'	Final Assembly	1
183301	Warning Lead and Paint for CTW	Final Assembly	2
183302	Warning This Counterweight...	Final Assembly	2
20661	Plate, ANSI A92	Final Assembly	1
20660	Nameplate, Identification	Final Assembly	1
182716	Ground Control	Ground Control panel	1

OPERATION

The **MARKLIFT** can be operated from either the ground or aerial control station. To operate from either station, the key switch must be in the "ON" position.

Drive

The **MARKLIFT** Knuckle Boom can be driven only from the aerial control platform. The unit may be driven with the boom and/or turret positioned in various configurations.

1. While depressing the footswitch, lift the controller handle to unlock the controller and then push forward or pull backward on the drive control lever (located on the right side of the panel) to move the **MARKLIFT** forward or reverse. The directional arrow decals on each end of the base indicate direction of drive when the turret is properly oriented (boom over the steering wheels).

2. The **MARKLIFT** may be driven at higher speeds when the boom is below horizontal and in the cradle. When the boom is out of cradle, the unit travels in low speed only. Gradually increase speed adjusting speed according to conditions of the terrain.

3. Movement of the drive control lever also automatically releases the parking brakes. When the drive control handle is returned to the center position, the brakes will automatically apply.

STEERING

1. The **MARKLIFT** may be steered from the aerial control only. Make right and left turns while depressing the footswitch and operating the steering switch, to the left of the controller, right or left. Avoid oversteering. The steering wheels will remain in the selected position until repositioned by the operator.

2. It is not necessary to continue to operate steering in the same direction after the steering cylinder has reached its extreme stroke.

BOOM/RISER

Lift/Lower Extension/Retraction

Boom functions are fully proportional and selected by toggle switches located on the left side of the aerial control panel next to the boom controller. While depressing the footswitch, push and hold the switch in the desired operation. Then lift the controller locking stem upward and push the controller handle forward or back ward to regulate the speed of the function and the desired direction.

TURRET ROTATION

Turret rotation is grouped with the boom controls and is operated by selecting the toggle switch and moving the boom function controller in the desired direction while depressing the footswitch.The turret may be rotated 350° noncontinuously. When rotated from normal travel position, the "FORWARD" indicating decals on the base of the unit provide reference for the drive direction and platform orientation.

PLATFORM LEVELING

The **MARKLIFT** platform is automatically leveled as the boom is raised or lowered. However, the operator may wish to adjust the platform to the unit on a slope for extended periods of time or to achieve a more natural position when the boom is fully extended horizontally.

To level the platform, first depress the footswitch then operate the "Platform Levelling" switch to the desired up or down position. The platform will maintain this attitude until repostioned by the operator.The Platform Levelling switch is a momen tary switch which will return to neutral when released.

PLATFORM ROTATION

Manual Operation

Manual platform rotation is a standard feature of the **MARKLIFT.** The manual rotator is located below the aerial control station. Rotate the platform by lifting the lower part of the platform rotation handle, then push the handle to the right or left to obtain the desired position.

Power Toggle Switch Operation (Optional)

The Knuckle Boom platform may be rotated 180° (90° either side of center) which enlarges the work area. To rotate the platform, push the toggle switch in the desired direction while depressing the footswitch. The toggle switch is a momentary switch which will return to neutral when released.

NOTE: If the turret is rotated 180°, the steering and drive orientation will be reversed!

EMERGENCY AERIAL CONTROL

In case of an emergency, the **MARKLIFT** is equipped with an Emergency Stop switch located on the aerial control station. To operate, depress the footswitch and simultaneously operate the "Emergency Stop" toggle switch and the selected function.

EMERGENCY GROUND CONTROL

1. On the ground control panel, select the boom or turret function and activate switch in the desired direction.

2. To operate the handpump:

   A. Make sure that the master (key) switch is turned on.

   B. Position ground/aerial selector switch to "Ground".

   C. Position the Emergency Stop/Start switch to "START".

   D. Move the handle of the handpump forward and backward while operating the selected function switch until the desired boom position is attained.

SHUTDOWN

1. Fully retract the boom, rotate the turret so that the boom is positioned between the wheels on the steer axle and completely lower the riser.

2. Depress the safety cover on the Emergency switch, placing the switch to "STOP".

3. Turn the master switch (in the ground control panel) to "OFF" and remove the ignition key.

The following preventive maintenance information is intended as a general guide. Please refer to the vendor section of this manual for detailed information on the battery.

MARK INDUSTRIES recommends that the following items be checked according to the schedules indicated. Any machine not in safe operating condition must be removed from service until it is repaired by a qualified service person.

DAILY (Before use on each work shift)

1. Make sure that operation and safety decals are in place and readable.
2. Check the water level of the batteries, add water if required.
3. Check for loose or worn hardware, wire connections, etc., replace or repair as required.
4. Make sure the operating controls perform correctly.
5. Check for and correct any structural damage.
6. Check for and correct any hydraulic leaks.
7. Check for wear on cables and hoses, replace as required.

WEEKLY

1. Check the condition of the tires. Make sure they are free of serious cuts or defects.
2. Check that operation and safety decals are in place and readable.
3. Check for proper brake operation.
4. Make sure the batteries are fully charged.
5. Clean the unit by removing all dirt, oil, and grease. The machine may be washed with soap and water. (Remain clear of any exposed electrical panels.)
6. Check for and correct any hydraulic leaks.
7. Check for and correct any structural damage.
8. Check for good overall performance.

MONTHLY (or every 100 hours)

1. Check and lubricate, if necessary. (See lubrication instructions.)
2. Check condition of the batteries. (See battery maintenance.)
3. Change the hydraulic oil return filter.
4. Lubricate ring gear .
5. Lubricate steering linkage.
6. Check torque hub oil level.
7. Check the ring gear bolts for proper torque.

YEARLY

1. Re-pack all wheel bearings.
2. Change the hydraulic oil in the system and the reservoir.
3. Change the torque hub oil.

MARKLIFT SELF-PROPELLED BOOM
MODEL 30KBN

1. Type — EP 90

   For normal application, use EP 90. For applications where the lubricant must meet special requirements, the manufacturer of the lubricant should be able to recommend a suitable substitute.

2. Oil Temperature

   Continuous — 160° F
   Intermittent — 200° F

3. Oil Change

   Initial — After 50 hours or 50,000 revolutions of operation. Preferable in a loaded condition.

   Subsequent — 1000 hours or (1) year whichever comes first. Higher temperatures make it necessary to change oil more frequently.

4. Oil Fill Level

   To fill, open both fill plugs. Position one plug parallel to the ground. Pour oil into the top fill plug. Fill at slow pace to allow air to escape. When oil begins to leak from the fill plug which is parallel to the ground, stop filling. Close both fill plugs.

Battery Fill Instructions

Water or Acid Loss to Batteries

Water loss from the battery is mainly due to evaporation brought on by temperature rises during heavy charging cycles. A very small amount of water is lost due to hydrogen and oxygen formed during charging. Acid is lost only if the case becomes cracked or if the battery is allowed to tip over. Therefore, acid is seldom needed.

Checking the Water Level

When checking the water level, don't allow dirt to enter into the battery cells once the caps have been removed. Take particular care to avoid setting the caps down on a dirty surface. Replace the caps immediately after checking the water level.

Materials and Equipment Required

1. Battery Filler Bottle
2. Distilled Water (if available)
3. Hydrometer

Filling the Battery

Use a hydrometer to see how much charge the battery has. A reading 1.260 and above in all cells indicates fully charged. (See chart on following page.) If the battery is fully charged, add water up to the level indicator.

If the battery's water level is below the lead plates, add only enough water to barely cover the plates before charging. After the batteries are fully charged, add water up to the level indicator.

Avoid Battery Hazards !

- Batteries produce flammable and explosive gasses. Keep electric arcs, sparks, flames and lighted tabacco away from batteries.

- Battery acid will damage eyes or skin on contact. Always wear a face shield during battery maintenance to avoid acid in eyes. Also wear rubber gloves and protective clothing to keep acid off skin.

- Never check the battery by placing a metal object across the posts. Serious burns or an explosion can result.

- Charge batteries only in a well ventilated area.

Either excessive overcharge or moderate undercharge can shorten battery life. With proper attention to water level and charging time, compared to hydrometer readings, the batteries should give a long useful life.

TEMPERATURE/SPECIFIC GRAVITY CORRECTION TABLE FOR BATTERIES

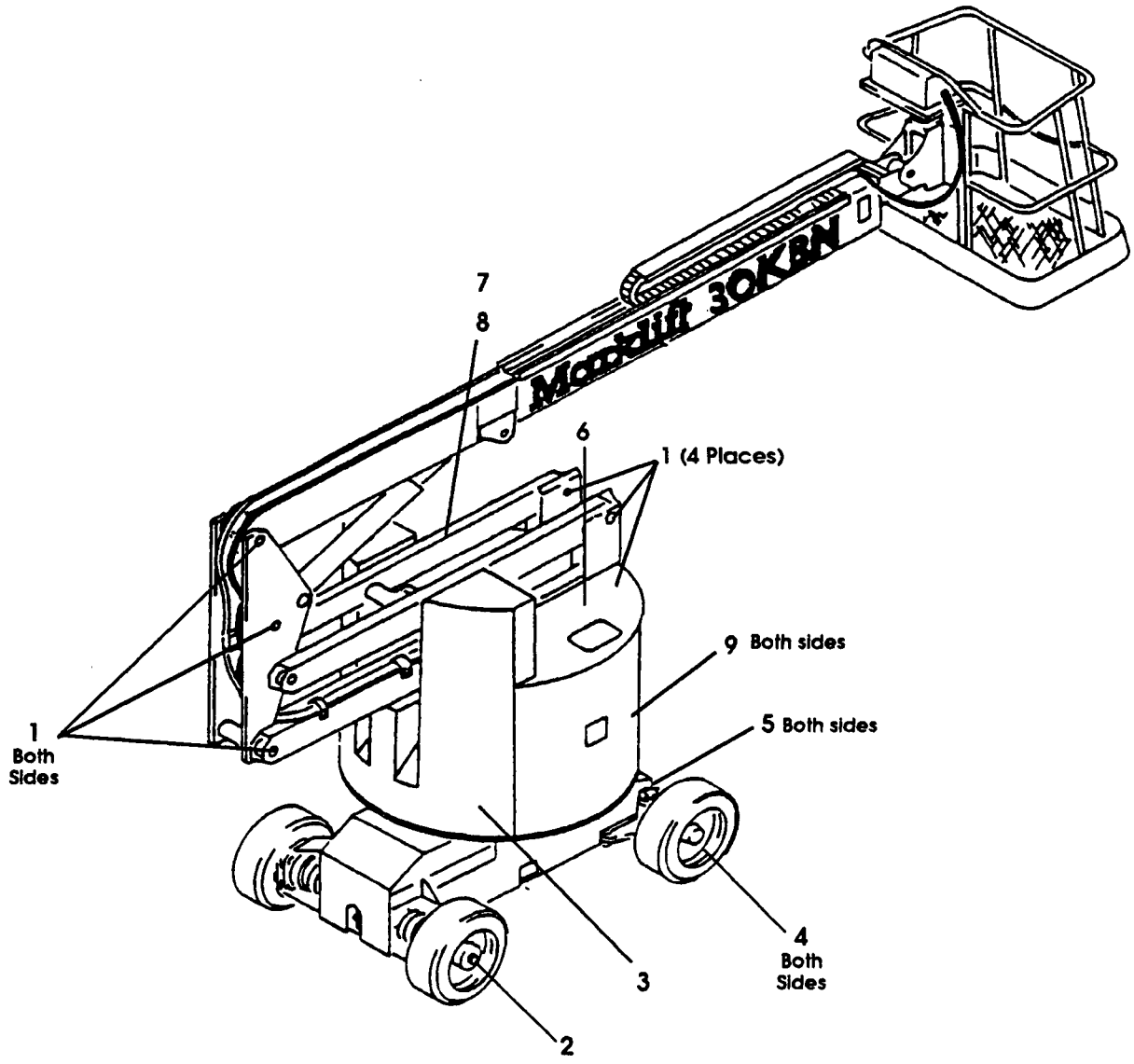
ACTUAL HYDROMETER READING AT ACTUAL TEMPERATURE°

80°F (27°C)	0°F (-18°C)	-10°F (-23°C)	-20°F (-29°C)	-30°F (-34°C)	-45°F (-43°C)	-65°F (-54°C)	Approx. State of Charge In%
1.280	1.312	1.316	1.320	1.324	1.330	1.338	100
1.250	1.282	1.286	1.290	1.294	1.300	1.308	75
1.220	1.252	1.256	1.260	1.264	1.270	1.278	50
1.190	1.222	1.226	1.230	1.234	1.240	1.248	25
1.160	1.192	1.192	1.200	1.204	1.210	1.218	0

Specific Gravity

Corrected to 80°F (17°C)	Freezing Temperature	
1.280	-90°F	-68°C
1.250	-62°F	-52°C
1.200	-16°F	-27°C
1.150	+ 5°F	-15°C
1.000	+19°F	- 7°C

Note: Cold temperatures have a numbing effect on the electroelectrochemical action of the battery, greatly reducing its capacity. Therefore, it is highly recommended that the battery be kept in an almost fully charged condition during cold weather.


Mastlift 30K&N
7
8
6
1 (4 Places)
9 Both sides
5 Both sides
1
Both
Sides
4
Both
Sides
3
2

ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
1.	Pivot Pins [1]	Grease-Mobil (VA6L36AG)	Monthly
2.	Torque Hubs [2]	Gear oil SAE 90	Check monthly/ Change yearly
3.	Ring Gear [3]	Grease Mobil	Monthly
4.	Wheel Bearings	Grease-Mobil	Yearly
5.	Steering Yoke King Pins	Grease-Mobil	Monthly
6.	Hydraulic Return Line Filter Element	Replasce 21245	100 Hours
7.	Hydraulic Fluid Reservoir	ATF Dexron II	Check level daily, change yearly
8.	Inlet Strainer	Clean	Yearly
9.	Batteries		Check water level and charge daily

Note:

1. Inspect all pivot pins to ensure they have accepted grease by cycling unit and visually inspecting points of concern.
2. See torque hub lubrication instructions.
3. Rotate gear box through entire radius in 20° increments while lubricating.

ELECTRICAL

Whenever troubleshooting any problem, begin by checking the basics. This means checking to make sure that the batteries are in good shape and have at least a three quarter charge. Determine the charge by using a hydrometer and following the battery maintenance instructions. A large percentage of electrical problems are often due to poorly charged or defective batteries.

A. If a problem seems to be electrical, refer to the schematic, (see the SCHEMATIC section for more information) and use a volt ohm meter to trace the power flow, starting at the battery and continuing through the system until the problem is located.

B. Keep in mind, if you **DO NOT** have a good ground to a valve coil, relay, etc., (even if you have enough electrical power to operate the coil or relay), these items will not function properly. Voltage readings can be misleading, if possible measure current (amperage) at the valve coil.

HYDRAULIC

A. The various hydraulic boom functions are controlled by electric solenoid valves in conjunction with a proportional control valve. When operating boom functions at a reduced speed, a portion of hydraulic fluid is routed back to the tank by a proportional unloading valve operation in conjunction with the proportional control valve, reducing the speed of that function.

B. Directional control valves are provided by individual 2-position 3-way solenoid valves.

C. Two-position valves are either normally open to allow hydraulic fluid to circulate through them until electrically closed, or normally closed to prevent passage of fluid until electrically energized.

MARKLIFT will not run.

1. Check the batteries for proper charge. (See Battery Maintenance.)
2. Check battery connections.
3. Check pump motor relay.
4. Check circuit breaker.
5. Refer to your authorized MARKLIFT dealer.

HYDRAULIC PUMP

Hydraulic pump producing excessive noise.

1. Check hydraulic oil level.
2. Check suction line fittings for tightness.
3. Check suction hose from tank to pump for kinks.
4. Refer to your authorized MARKLIFT dealer.

BOOM LIFT / RISER

MARKLIFT lift function will not work.

1. Check electric connector to lift/riser solenoid valves for security.
2. Check lift/ riser solenoid valve coil for defect.
3. Check lift/ riser solenoid valve for defect.
4. Check lift/ riser cylinder holding valve for defect.
5. Slope sensor circuit inoperative.
6. Check lift / riser function selector switch.
7. Refer to your authorized MARKLIFT dealer.

BOOM

Problems extending and retracting.

1. Check electric connector to solenoid valves for good connecton.
2. Check solenoid valve for defect.
3. Check function selector switch.
4. Slope sensor circuit inoperative.
5. Check regenerative valve for mal-functions.
6. Refer to your authorized MARKLIFT dealer.

TURRET ROTATION

Turret will not rotate.

1. Check electric connection to solenoid valve for good connection.
2. Check solenoid valve for defects.
3. Check function selector switch.
4. Slope sensor circuit inoperative.
5. Inspect woodruff key between worm gear box and orbit motor.
6. Refer to your authorized MARKLIFT dealer.

STEERING

MARKLIFT steers in only one direction.

1. Check electrical wire connection at valve coils.

2. Check valve coils for defects.
3. Check valve cartridge for defects.
4. Check toggle switch for proper electrical connection.
5. Refer to authorized MARKLIFT dealer.

DRIVE

No forward or reverse drive.

1. Check to see if drive controller output is in both directions.
2. Check forward / reverse drive solenoid valve coils.
3. Check for loose wire connections.
4. Refer to authorized MARKLIFT dealer.

No high speed.

1. Check to see if high speed limit switch arm is out of adjustment.
2. Check high speed limit switch for defects.
3. Check high speed solenoid valves (series/parallel)

No drive operation.

1. Make sure parking brake releases.
2. Check drive controller output.
3. Refer to authorized MARKLIFT dealer.

NEW EQUIPMENT MAINTENANCE RECORD

MODEL	SERIAL NUMBER
DATE	EQUIPMENT NUMBER
LOCATION	MECHANIC

ITEM	CODE	COMMENTS	ITEM	CODE	COMMENTS
Engine oil (gas units)			Safety cut-outs		
Engine oil filter (gas units)			Bushings		
Air filter (gas units)			Rollers		
Fuel filter (gas units)			Wear pad		
Tune-up (gas units)			Front end assembly		
Choke (gas units)			Tire pressure		
Engine RPM (gas units)			Tire condition		
Charging system			Wheel nuts		
Fuel system LPG/gas			Wheel bearing		
Battery(s)			Nuts and bolts		
Battery terminals			Guard rails		
Motor brushes			Lubrication		
Hydraulic fluid			Warning decals		
Hydraulic oil filter			Operating inst.		
Hydraulic systems			General decals		
Hydraulic pressure			Paint		
Hydraulic hoses			All operations		
Cylinders			Lift		
Drive motors			Steering		
Brakes			Forward drive		
Aerial control box			Tilt switches/slope sensor		
Ground control box			Fuel level (gas units)		
Relays			Literature		
Wire connections			Options		

Code

F = Filled
R = Repaired
C = Checked
A = Adjusted
X = Needs repair
NA = Not applicable

Comments

HYDRAULIC FLUID TABLE

Milestone			Hydraulic fluid			
Oil company			Chevron	Gulf	Shell	Union
Brand Name			ATF Dexron II	ATF Dexron II	Donaz-T6	ATF Dexron
Viscosity	SUS AT 100°F (37.8°C)		187.4	195	200	200
	SUS AT 210°F (98.9°C)		49.2	50.4	50	52.3
	Index	°F	153°	155°	160°	172°
		°C	67.2°	68.3°	71.1°	77.8°
Flash point		°F	400°	405°	390°	395°
		°C	204.4°	207.2°	198.9°	201.7°
Pour point		°F	-40°	-50°	-50°	-45°
		°C	-40°	-45.6°	-45.6°	-42.8°

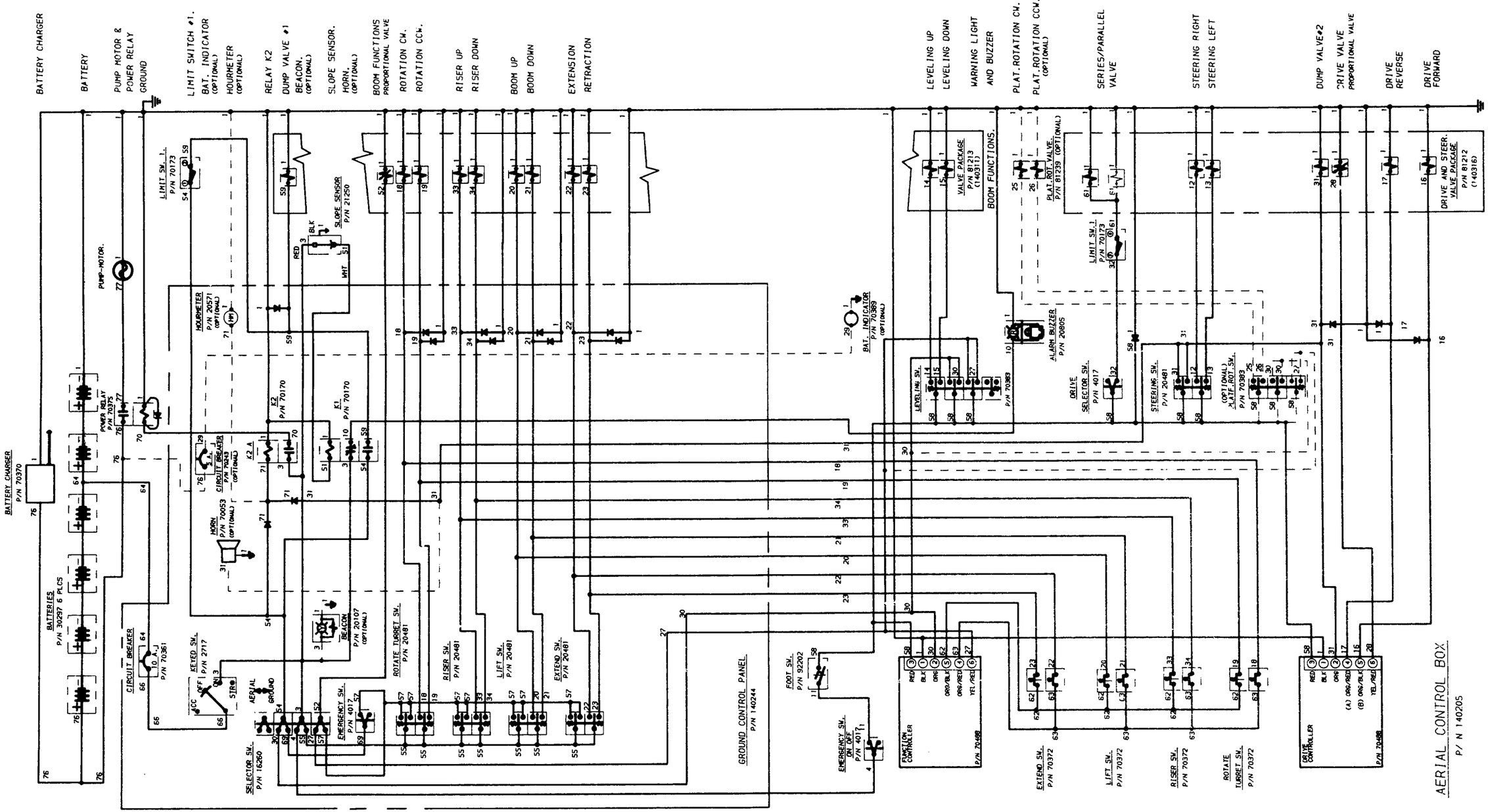
MODEL: 30KBN

PART NO.	QTY.	DESCRIPTION
70425	1	AERIAL CONTROL POTENTIOMETER
70375	2	POWER RELAY
70170	2	K 1 & 2 RELAYS
2717	2	KEY SWITCH
70479	10	DIODES
20805	2	ALARM BUZZER
70148	2	LIMIT SWITCH ARM
70173	2	LIMIT SWITCH
66212	2	MICRO SWITCH
67130	4	SEAL KIT
67148	2	SEAL KIT
67128	2	SEAL KIT
66861	2	SEAL KIT
67399	2	DECAL SET
21245	4	RETURN LINE FILTER 5 ELEMENT
66913 (L)	1	VALVE COILS (LARGE)
66914 (S)	1	VALVE COILS (SMALL)
66674	1	CHECK VALVE
4017	2	DRIVE SELECTOR SWITCH

Mark Industries

TITLE	ELECTRICAL SCHEMATIC
MODEL	30KBN
NOTES	140501 REV C

SCHEMATIC
PAGE
1

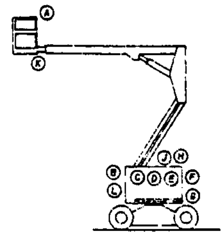


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TITLE	ELECTRICAL SCHEMATIC
MODEL	30KBN
NOTES	140501 REV C

SCHEMATIC PAGE 2

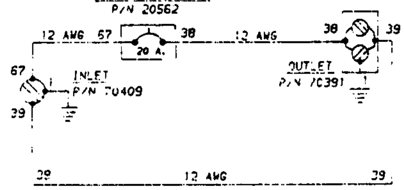
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[illegible]	1					●						
1	12	●		●	●		●	●	●	●		●
2	12	●					●	SPARE				
3	12						●			●		
4	12	●					●					
5	12	●					●					
6	12	●					●	SPARE				
7	18	●					●	SPARE				
8	18	●					●	SPARE				
9	18	●					●	SPARE				
10	18	●					●					
11	12	●									●	
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13	18	●		●			●					
14	18	●			●		●					
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28	18	●		●			●					
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30	18	●					●					
31	18	●		●			●					
32	18	●	●				●					
33	18	●			●		●					
34	18	●			●		●					
35	18	●					●	SPARE				
36	18	●					●	SPARE				
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38	12	●					●					
39	12	●					●					
40	12	●					●	SPARE				



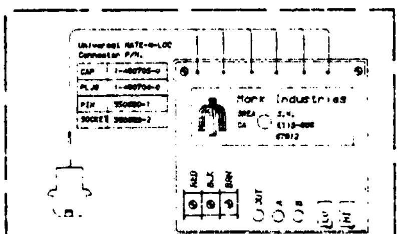
IDENT.	DESCRIPTION	LOCATION
A	UPPER CONTROL BOX.	PLATFORM
B	LIMIT SWITCH # 1.	TURRET
C	DRIVE/STEER VALVE P.	CARRIAGE
D	BOOM FUNCTIONS VALV.	TURRET
E	PUMP/MOTOR.	TURRET
F	GROUND CONTROL PANEL.	TURRET
G	BATTERIES.	TURRET
H	BATTERY CHARGER.	TURRET
J	SLOPE SENSOR.	TURRET
K	FOOT SWITCH.	PLATFORM
L	POWER RELAY.	TURRET
M	BATTERY INDICATOR. OPTION	PLATFORM
N	HORN. OPTION	TURRET
P	BEACON. OPTION	TURRET

WIRING SCHEDULE.													
NO.	AWG	A	B	C	D	E	F	G	H	J	K	L
[illegible]	18						●			●		
[illegible]	18				●		●					
[illegible]	18											
[illegible]	18		●				●					
[illegible]	18						●					
[illegible]	18											
[illegible]	18						●					
[illegible]	12	●									●	
[illegible]	18		●		●		●					
[illegible]	18											
[illegible]	18		●	●			●					
[illegible]	18	●										
[illegible]	12	●										
[illegible]	12						●	●				
[illegible]	18											
[illegible]	12						●					
[illegible]	12						●					
[illegible]	18											
[illegible]	18						●					
[illegible]	18						●					●
[illegible]	18						●					
[illegible]	12								●	●		
[illegible]	1							●				●
[illegible]	1					●						●

CIRCUIT BREAKER
P/N 20562

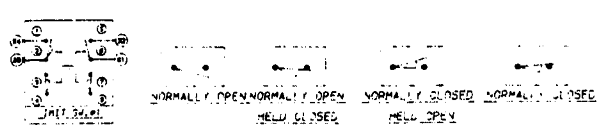


115VDC WIRING.



ROTATE WIRING	DRIVE WIRING	TERM.	COLOR	FUNCTION
1	1	1	BLACK	GROUND
30	31	2	ORG	COM
39	39	3	RED	V SUPPLY
63	17	4	ORG/RED	A
62	16	5	ORG/BLK	B
[illegible]	28	6	YEL/RED	OUT

DETAIL FOR P/N 70488 ROTATION AND DRIVE CONTROLLERS



LEGEND FOR LIMIT SWITCHES.

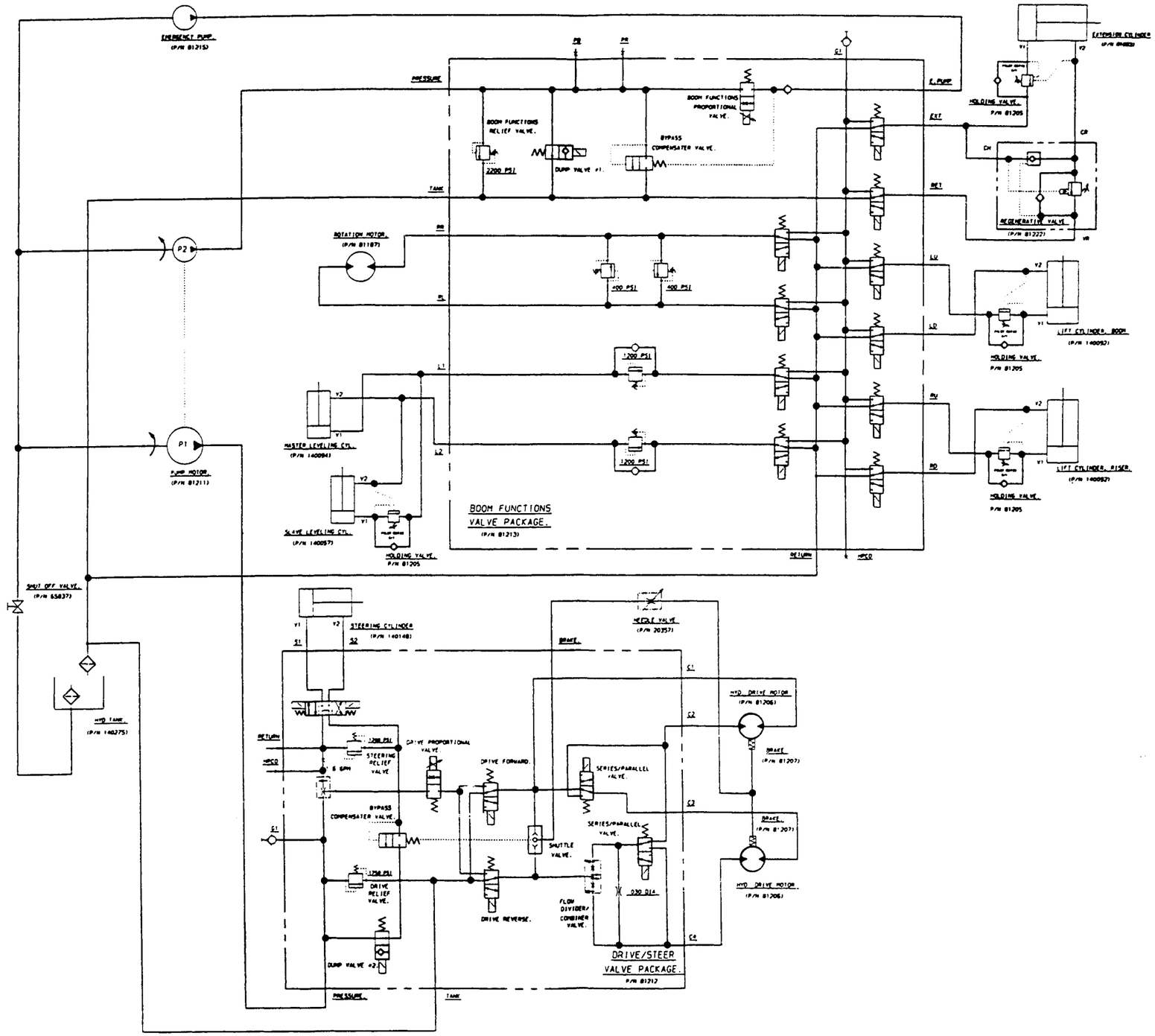
NOTES:

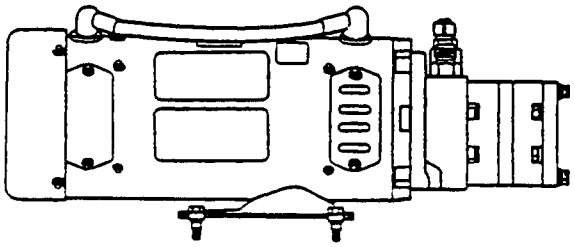
1. ALL DIODES ARE P/N 70473 UNLESS OTHERWISE SPECIFIED.
2. WIRING AND SWITCHES SHOWN IN STOWED POSITION.
3. ALL 115 A.C. WIRES ARE 12 AWG. STRANDED.
4. IDENTIFY EACH WIRE BY NUMBER FLAG AT BOTH ENDS WRAPPING COMPLETELY AROUND.
5. ALL WIRES ARE 18 AWG. STRANDED, UNLESS OTHERWISE SPECIFIED.
6. RELABEL WIRE #5 IN ARM CABLE TO WIRE #4
   USE THIS WIRE IN PARALLEL WITH #4.

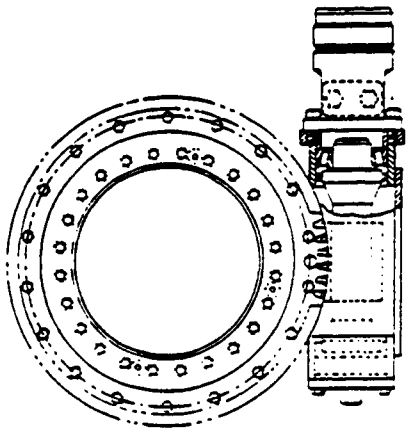
Mark Industries

TITLE	HYDRAULIC SCHEMATIC
MODEL	30KBN
NOTES	140504 REV.NC.

SCHEMATIC
PAGE
3

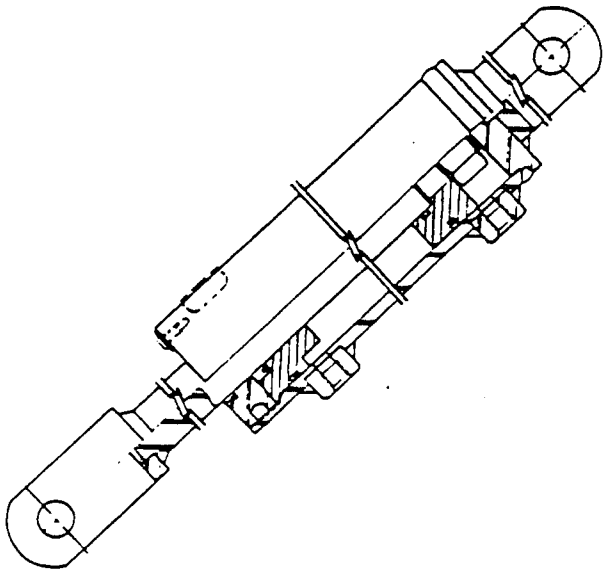


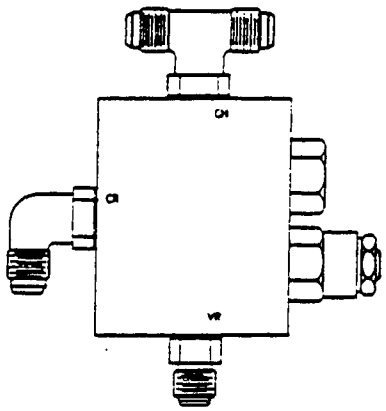




SECTION 1 CONTAINS THE FOLLOWING MATTER:

PAGE NO.	TITLE
1	NOTICE TO USERS
2	TABLE OF CONTENTS
5	HOW TO USE THE PARTS CHAPTER
7	HOW TO ORDER PARTS





DISCLAIMER

MARK INDUSTRIES strives to include in the Parts Chapter, information and illustrations that are accurate, complete, and current. Due to on-going changes and revisions by our many suppliers, it is often impossible to show all variations of a given assembly. Therefore, this information is subject to change without notice.

Despite the care and effort taken in preparing this Parts Chapter, MARK INDUSTRIES makes **no warranties** that the information and illustrations herein are totally accurate and complete.

NOTICE

The Parts Chapter, though sometimes helpful in the process of assembly/ disassembly, is **NOT** intended to be assembly/disassembly instructions.

SECTION 1 INTRODUCTION TO THE PARTS CHAPTER

PAGE NO.	TITLE
1	NOTICE TO USERS
2	TABLE OF CONTENTS
5	HOW TO USE THE PARTS CHAPTER
7	HOW TO ORDER PARTS

SECTION 2 FINAL ASSEMBLY

FIG. NO.	TITLE
1	FINAL ASSEMBLY
2	DECAL SET
3	PLATFORM ASSEMBLY
4	HOSE KIT
5	AERIAL CONTROL BOX ASSEMBLY (UNTIL MARCH 1988)
5A	AERIAL CONTROL BOX ASSEMBLY (SINCE MARCH 1988)
6	TYPICAL MANUAL ROTATOR

SECTION 3 CARRIAGE ASSEMBLY

FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY
2	STEERING CYLINDER (UNTIL LATE 1989, SOME CONCURRENT USE)
2A	STEERING CYLINDER (SINCE LATE 1989, SOME CONCURRENT USE)
3	HUB ASSEMBLY
4	ROTATION GEARBOX ASSEMBLY (UNTIL LATE 1988)
4A	ROTATION GEARBOX ASSEMBLY (SINCE LATE 1988)
5	DRIVE/STEER VALVE PACKAGE ASSEMBLY
6	BRAKE/TORQUE HUB ASSEMBLY

SECTION 4 TURRET ASSEMBLY

FIG. NO.	TITLE
1	TURRET ASSEMBLY (BEFORE OCT. 1989)
2	MASTER CYLINDER
3	BOOM LIFT
4	HYDRAULIC TANK ASSEMBLY

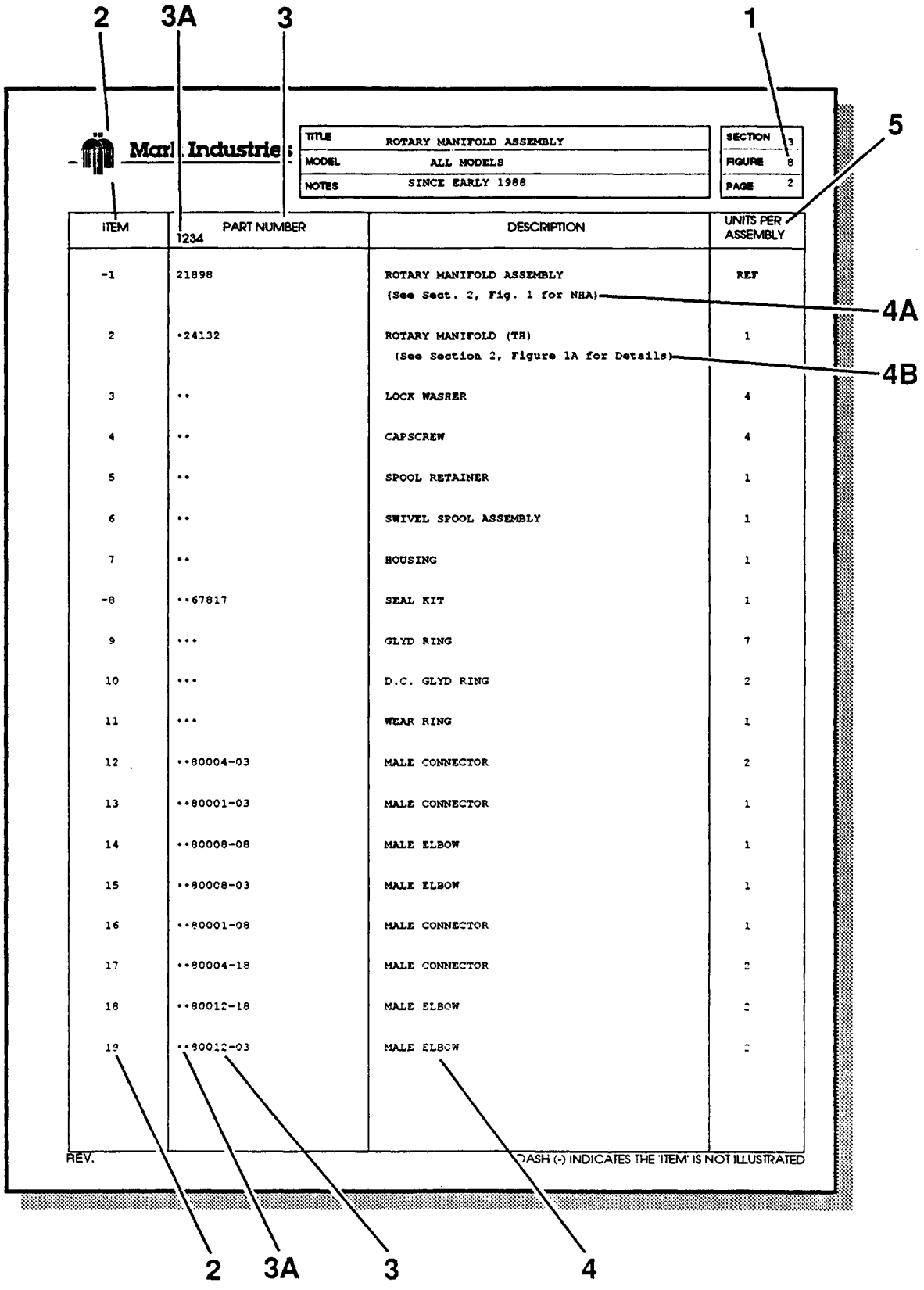
SECTION 4	TURRET ASSEMBLY (CONT'D)
FIG. NO.	TITLE
5	AUTOMATIC BATTERY CHARGER (DOMESTIC) (120 VAC/60 HZ, 36 VDC/40 AMP)
6	MANUAL BATTERY CHARGER (INTERNATIONAL) (230 VAC/50 HZ, 36 VDC/40 AMP)
6A	AUTOMATIC BATTERY CHARGER (INTERNATIONAL) (230 VAC/50 HZ, 36 VDC/40 AMP)
7	BOOM FUNCTION VALVE ASSEMBLY (UNTIL LATE 1988)
7A	BOOM FUNCTION VALVE ASSEMBLY (SINCE LATE 1988)
8	EMERGENCY PUMP ASSEMBLY (UNTIL LATE 1988)
8A	EMERGENCY PUMP ASSEMBLY (SINCE LATE 1988)
9	REGENERATIVE VALVE SUB-ASSEMBLY
10	PUMP & MOTOR ASSEMBLY (UNTIL LATE 1988)
10A	PUMP & MOTOR ASSEMBLY (SINCE LATE 1988)
11	BATTERY CABLE KIT

SECTION 5	FINAL BOOM ASSEMBLY
FIG. NO.	TITLE
1	FINAL BOOM ASSEMBLY
2	INNER BOOM ASSEMBLY
3	SLAVE CYLINDER SUB-ASSEMBLY (UNTIL EARLY 1989)
3A	SLAVE CYLINDER SUB-ASSEMBLY (SINCE EARLY 1989)
4	EXTENSION CYLINDER

SECTION 6	OPTIONS
FIG. NO.	TITLE
1	ROTATING AMBER BEACON
2	POWERED PLATFORM ROTATOR
3	2 HEADLIGHTS & 2 REAR RED LIGHTS
4	12 VOLT PLATFORM WORK LIGHT
5	LIFTING LUGS
6	MONOFILLED TIRE
7	STOP, TURN & CLEARANCE LIGHTS
8	TRAVEL WARNING HORN
9	ALL MOTION ALARM
10	BATTERY CONDITION INDICATOR GAUGE

SECTION 4 TURRET ASSEMBLY (CONT'D)

FIG. NO.	TITLE
11	AIRLINE TO PLATFORM
12	HOURMETER



Mark Industries

TITLE	ROTARY MANIFOLD ASSEMBLY
MODEL	ALL MODELS
NOTES	SINCE EARLY 1988

SECTION	3
FIGURE	8
PAGE	2

ITEM	PART NUMBER (1234)	DESCRIPTION	UNITS PER ASSEMBLY
-1	21898	ROTARY MANIFOLD ASSEMBLY (See Sect. 2, Fig. 1 for NHA)	REF
2	•24132	ROTARY MANIFOLD (TH) (See Section 2, Figure 1A for Details)	1
3	••	LOCK WASHER	4
4	••	CAPSCREW	4
5	••	SPOOL RETAINER	1
6	••	SWIVEL SPOOL ASSEMBLY	1
7	••	HOUSING	1
-8	••67817	SEAL KIT	1
9	•••	GLYD RING	7
10	•••	D.C. GLYD RING	2
11	•••	WEAR RING	1
12	••80004-03	MALE CONNECTOR	2
13	••80001-03	MALE CONNECTOR	1
14	••80008-08	MALE ELBOW	1
15	••80008-03	MALE ELBOW	1
16	••80001-08	MALE CONNECTOR	1
17	••80004-18	MALE CONNECTOR	2
18	••80012-18	MALE ELBOW	2
19	••80012-03	MALE ELBOW	2

REV. DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

1. The Parts Chapter Pagination.

   A. **SECTION** refers to the major divisions of the Parts Chapter.

   B. **FIGURE** refers to the items illustrated separately in each section.

   C. **PAGE** indicates the page number of the figure illustrated.

2. The **Item Number** corresponds to the item number shown for the part in the illustration. (Parts with *item numbers* preceded by a **dash** (-), are not illustrated.)

3. Items that carry a Mark Industries **part number**.

   A. The **Indenture System** used in the Parts Chapter of this Technical Manual shows the relationship of one part to another.

      Part Number

      1 2 3 4

      . Items ***included*** as part of the **figure**.

      . . Items ***included*** as part of the **single indentured** item listed directly above it.

      . . . Items ***included*** as part of the **double indentured** item listed directly above it.

      . . . . Items ***included*** as part of the **triple indentured** item listed directly above it.

4. Elements of the **Description**.

   A. **NHA** (**N**ext **H**igher **A**ssembly) corresponds to the Section and Figure to be referred to for the major assembly that this item is part of.

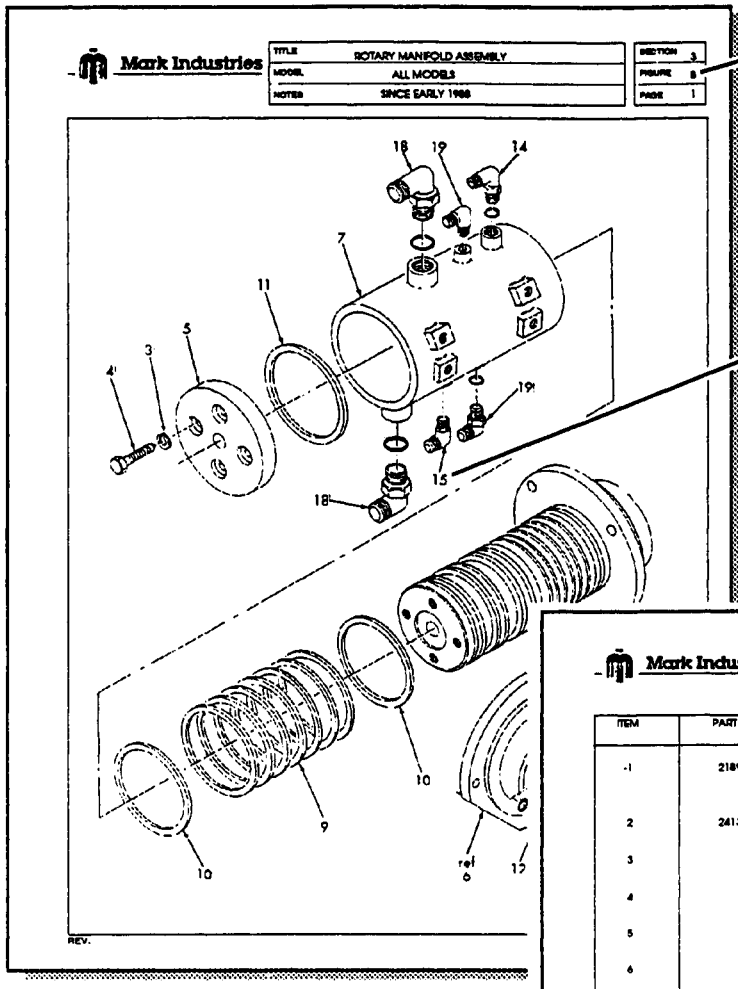
   B. **DETAILS** corresponds to the Section and Figure to be referred to for a more detailed breakdown of this item.

5. **UNITS PER ASSEMBLY** entries are as follows:

   A. **REF** indicates the item is already listed in the NHA figure.

   B. **AR** indicates the part is used in a quantity *As Required.*

   C. A **number** indicates the *quantity* of the part used in the next higher assembly.



1A

1B

1A

1D

1C

Mark Industries

TITLE ROTARY MANIFOLD ASSEMBLY
MODEL ALL MODELS
NOTES SINCE EARLY 1988
SECTION 3
FIGURE 8
PAGE 2

ITEM	PART NUMBER	1234 DESCRIPTION	UNITS PER ASSEMBLY
-1	21898	ROTARY MANIFOLD ASSEMBLY (See Sect. 2, Fig. 1 for NHA)	REF
2	24132	. ROTARY MANIFOLD (TH) (See Section 2, Figure 1A for Details)	1
3		.. LOCK WASHER	4
4		.. CAPSCREW	4
5		. SPOOL RETAINER	1
6		. SWIVEL SPOOL ASSEMBLY	1
7		.. HOUSING	1
-8	67817	.. SEAL KIT	1
9		... GLYD RING	7
10		... D.C. GLYD RING	2
11		... WEAR RING	1
12	80004-03	MALE CONNECTOR	2
13	80001-03	MALE CONNECTOR	1
14	80008-08	MALE ELBOW	1
15	80008-03	MALE ELBOW	1
16	80001-08	MALE CONNECTOR	1
17	80004-18	MALE CONNECTOR	2
18	80012-18	MALE ELBOW	2
19	80012-03	MALE ELBOW	2

REV.

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

1. Finding the Mark Industries Part Number.

   A. Using the Table of Contents, find the Section and Figure Number. Locate the correct page by referencing these numbers.

   B. Match the required part to the figure illustration. Note the Item Number.

   C. Find the Item Number on the part listing that follows the figure.

   D. Use the Mark Industries Part Number listed next to the Item Number when ordering.

2. Ordering: Listed below are the methods of ordering parts. The **preferred** method of ordering parts is by **FAX**.

   A. By **FAX**: **(714) 879-8884**

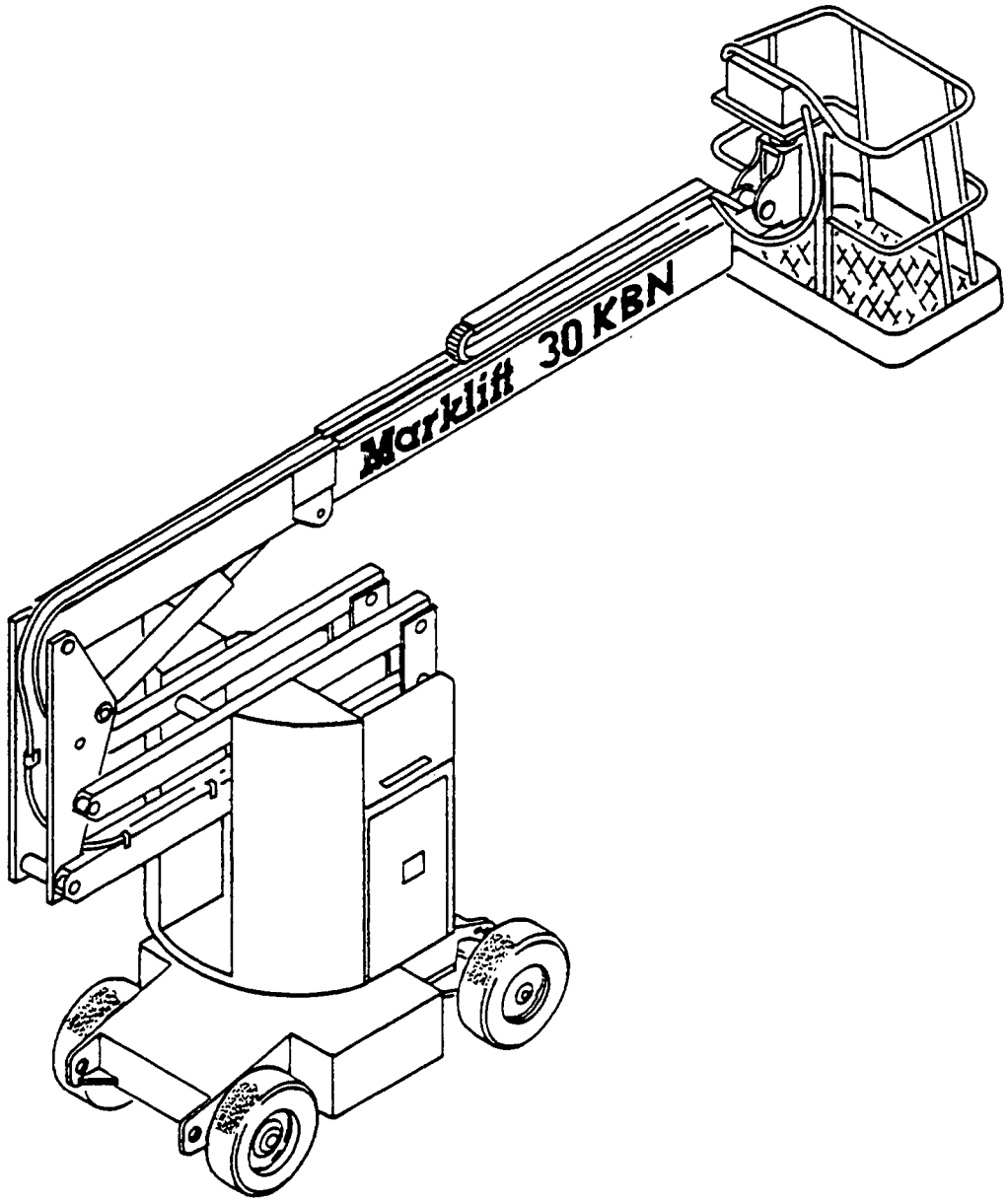
   B. By Phone: (714) 879-MARK

   C. By Mail: MARK INDUSTRIES
   ATTENTION: PARTS DEPARTMENT
   P.O. BOX 2255
   BREA, CA. 92622

MARK INDUSTRIES
205 South Puente Street
Brea, CA 92621

SECTION 2 CONTAINS:

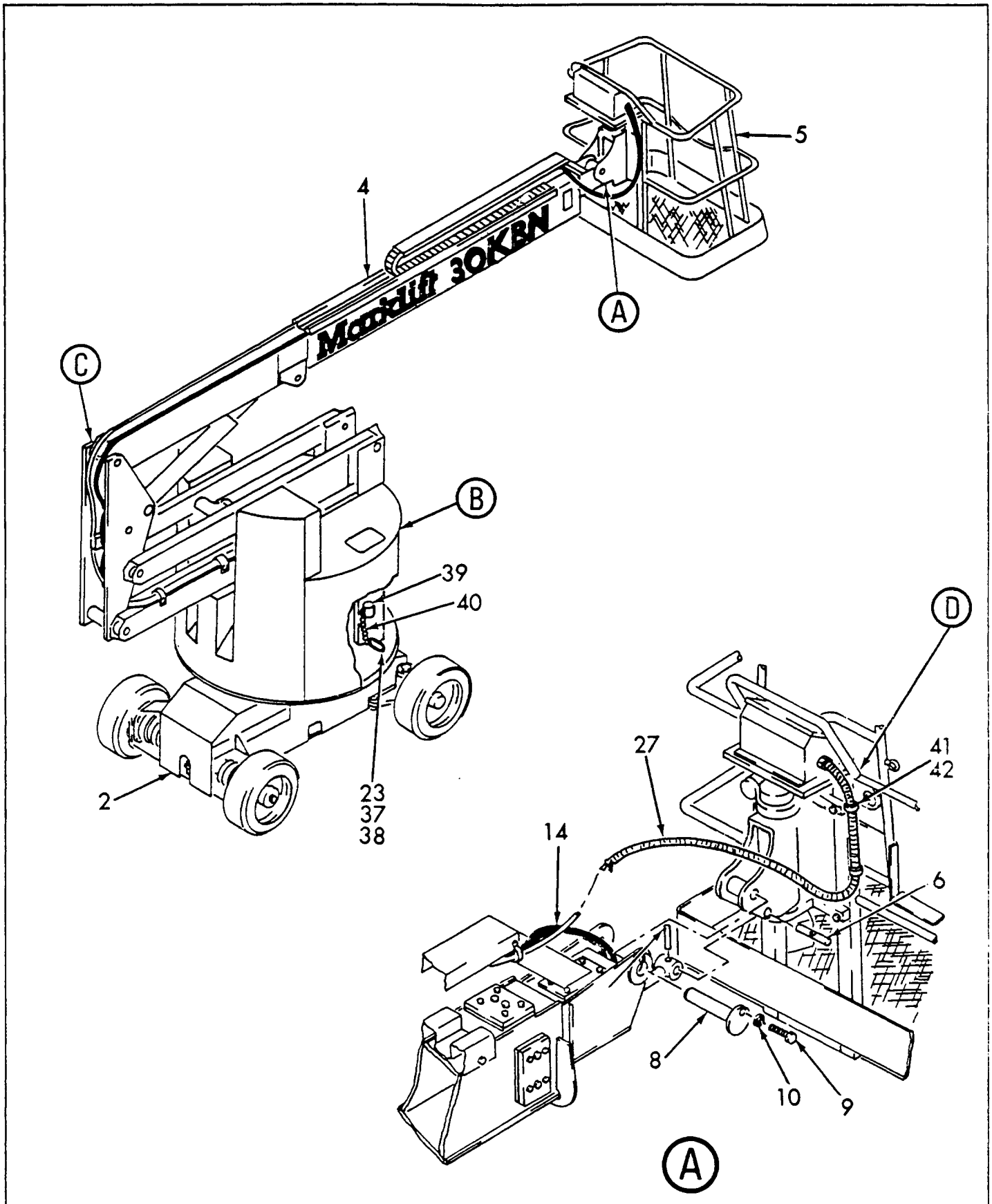
FIG. NO.	TITLE
1	FINAL ASSEMBLY
2	DECAL SET
3	PLATFORM ASSEMBLY
4	HOSE KIT
5	AERIAL CONTROL BOX ASSEMBLY (UNTIL MARCH 1988)
5A	AERIAL CONTROL BOX ASSEMBLY (SINCE MARCH 1988)
6	TYPICAL MANUAL ROTATOR

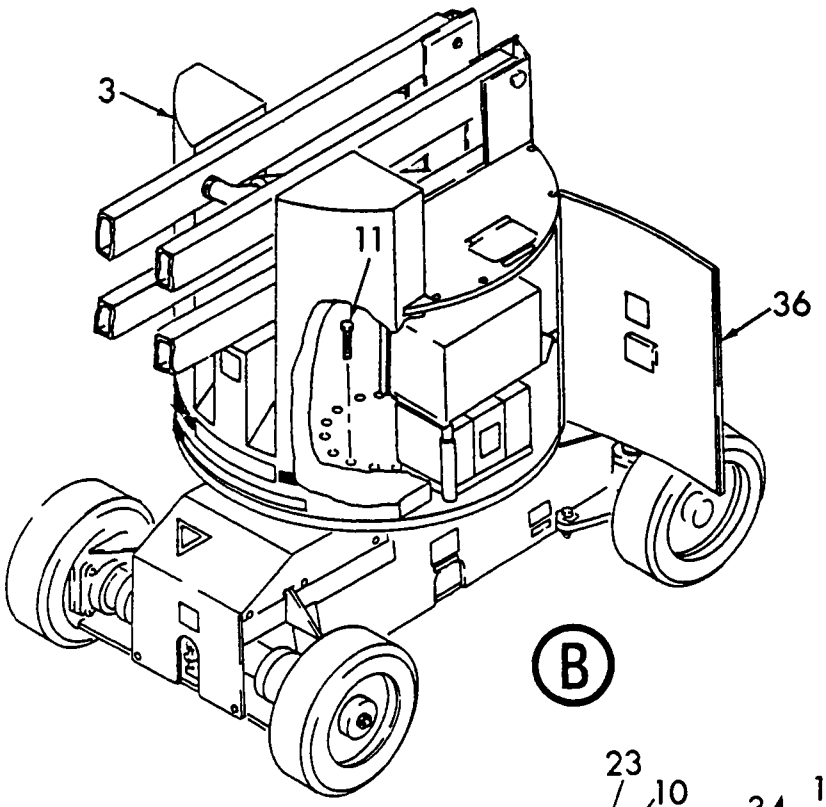


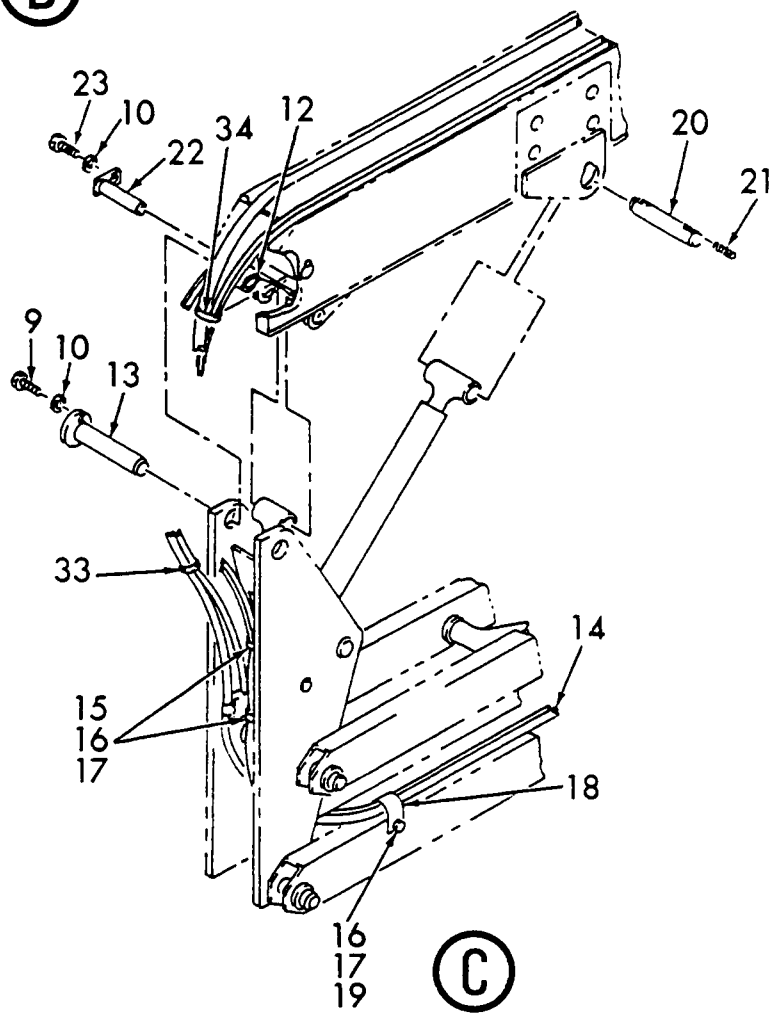
Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	2
FIGURE	1
PAGE	1



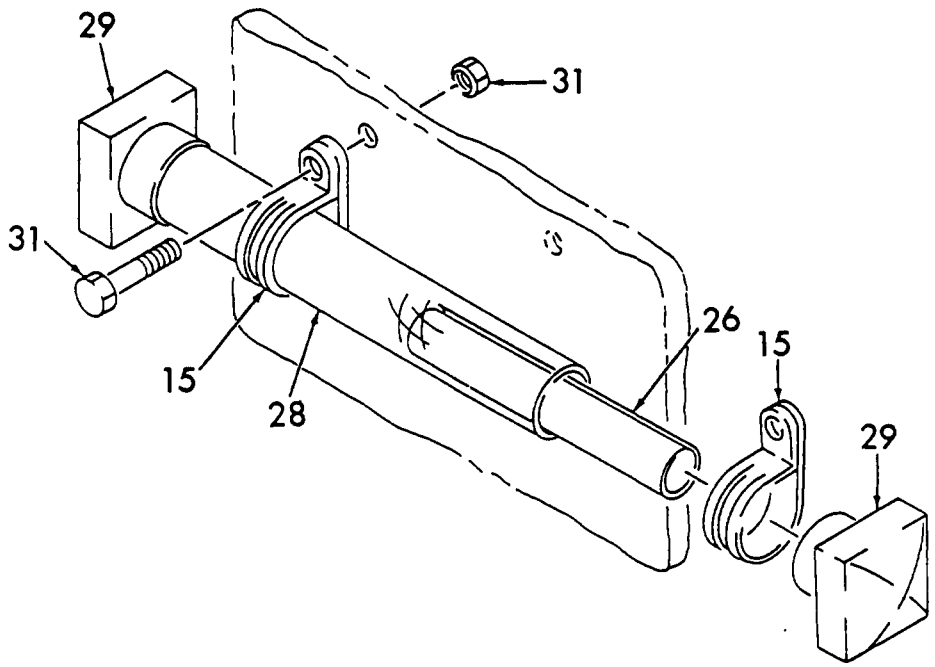

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Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	30KBN
NOTES	UNTIL OCT. 1989

SECTION	2
FIGURE	1
PAGE	3



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140001	ASSEMBLY, FINAL	REF
2	.140117	ASSEMBLY, CARRIAGE (See Sect. 3, Fig. 1 for Details)	1
3	.140116	ASSEMBLY, TURRET (See Sect. 4, Fig. 1 for Details)	1
4	.140118	ASSEMBLY, FINAL BOOM (See Sect. 5, Fig. 1 for Details)	1
5	.140157	ASSEMBLY, PLATFORM (See Sect. 2, Fig. 3 for Details)	1
6	.140437	PIN, SLAVE CYLINDER ROTATOR	1
7	.64209	PIN, ROLL	1
8	.140436	PIN, ROTATOR	1
9	.60343	SCREW, CAP	2
10	.63319	WASHER, LOCK	2
11	.60645	SCREW, CAP	18

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
12	.27289	TUBE	1
13	.140601	PIN, BOOM LIFT	1
14	.140248	DIAGRAM, HOSE KIT (See Sect. 2, Fig. 4 for Details)	1
15	.65867	CLAMP	5
16	.60309	SCREW, CAP	9
17	.63301	WASHER, LOCK	9
18	.140602	ASSEMBLY, CLAMP	6
19	.63433	WASHER, FLAT	6
20	.140489	PIN, ROD END	1
21	.62234	SCREW, SET	1
22	.140431	PIN, MASTER CYLINDER/BOOM	1
23	.60325	SCREW, CAP	5
24	.140501	SCHEMATIC, ELECTRICAL	1
25	.140504	SCHEMATIC, HYDRAULIC	1
26	.17406	HANDBOOK, OPERATION & SAFETY	1
27	.65322	COIL, PROTECTIVE PLASTIC	5 FT
28	.130927	CONTAINER, PLASTIC	1
29	.65842	CAP, ANTI-ROLL	2
30	.60315	SCREW, CAP	2
31	.60711	NUT, HEX	2
-32	.63654	RIVET, POP	8
33	.256	TIE, CABLE	50
34	.255	TIE, CABLE	50
35	.411	EXTRUSION	8 FT
-36	.16608	PAINT, WHITE	2 GAL

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	30KBN
NOTES	UNTIL OCT. 1989

SECT.	2
FIG.	1
PAGE	5

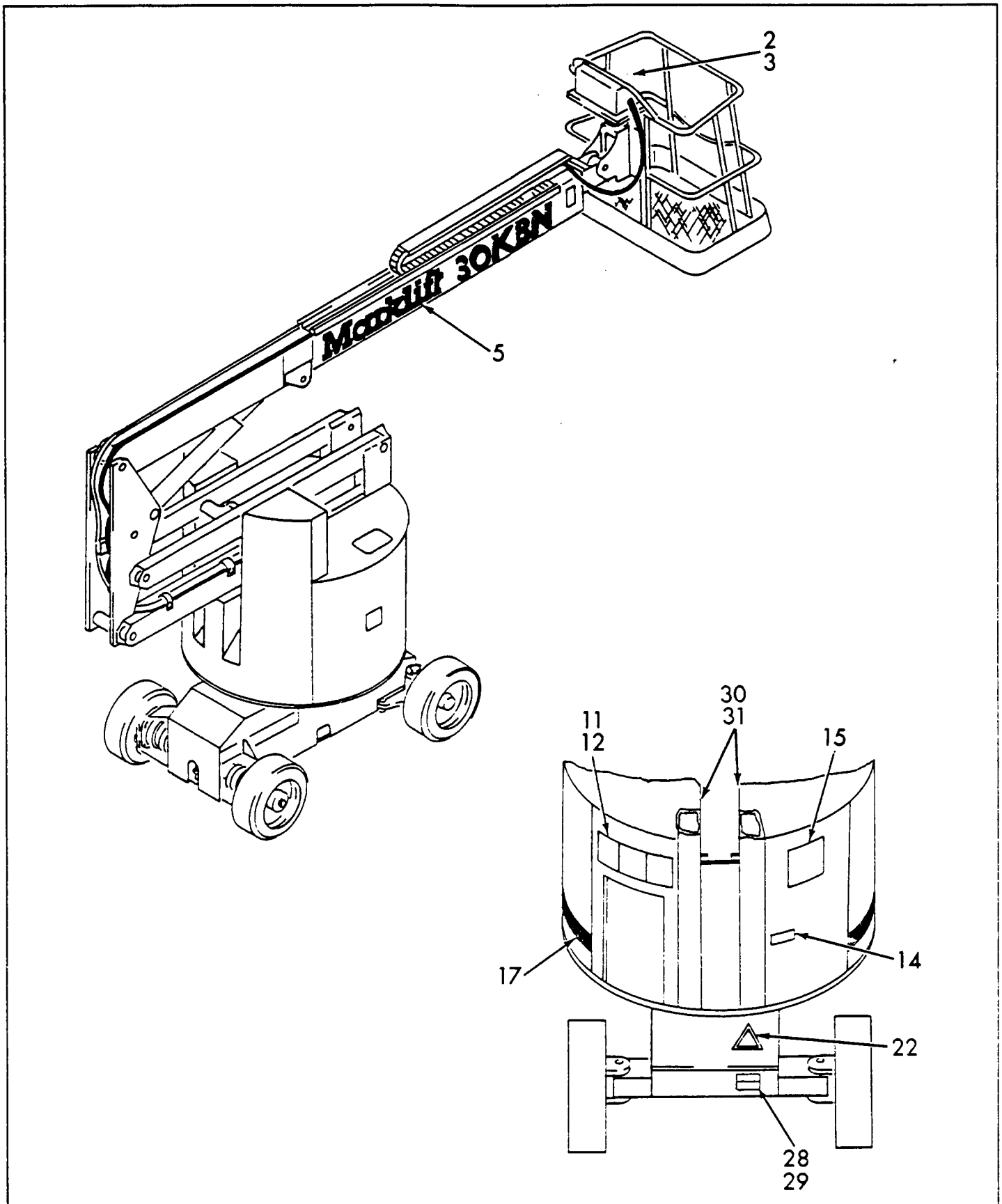
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
37	.140919	WELDMENT, ANTI-ROTATION RETAINER	1
38	.140915	WELDMENT, ANTI-ROTATION TURRET PIN	1
39	.25315	TUBE	1
40	.160173	CHAIN	1 FT
41	.16268	CLAMP, HOSE	2
42	.61921	SCREW, CAP	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	DECAL SET
MODEL	30KBN
NOTES	

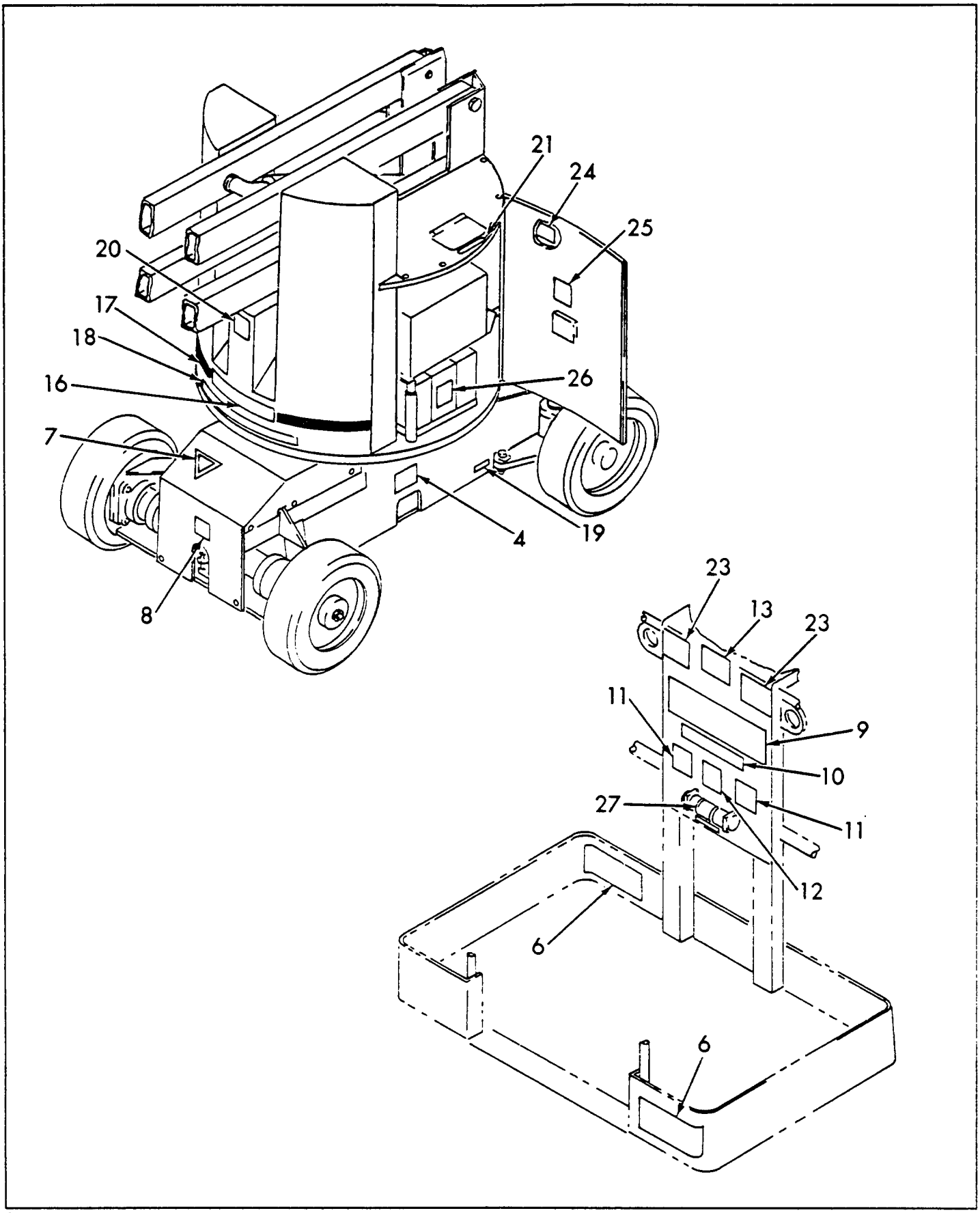
SECTION	2
FIGURE	2
PAGE	1



Mark Industries

TITLE	DECAL SET
MODEL	30KBN
NOTES	

SECTION	2
FIGURE	2
PAGE	2



Mark Industries

TITLE	DECAL SET
MODEL	30KBN
NOTES	UNTIL OCT. 1989

SECT.	2
FIG.	2
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	67399	SET, DECAL	REF
2	.182703	DECAL, PLATFORM LEVELING SWITCH	1
3	.140374	DECAL, UPPER CONTROL	1
4	.140595	DECAL, TIE DOWN DIAGRAM	2
5	.181901	DECAL, MARKLIFT 30KBN	2
6	.11064	DECAL, ATTACH SAFETY CHAIN BEFORE...	2
7	.20462	DECAL, FORWARD ARROW AFT	1
8	.20896	DECAL, BRAKE	1
9	.182101	DECAL, DANGER & AERIAL OPERATION...	1
10	.22385	DECAL, CAUTION ATTACH YOUR SAFETY...	2
11	.181103	DECAL, DANGER OBEY THE FOLLOWING	4
12	.181102	DECAL, DANGER DO NOT OPERATE...	2
13	.2022	DECAL, LOAD CAPACITY 500 LBS.	1
14	.140496	DECAL, HAND PUMP	1
15	.140495	DECAL, EMERGENCY	1
16	.31259	DECAL, MARKLIFT	1
17	.131061	DECAL, BLUE STRIPE	1
18	.130596	DECAL, A PRODUCT OF MARK INDUSTRIES	1
19	.20420	DECAL, TIRE PRESSURE 75 PSI	2
20	.20410	DECAL, MARK INDUSTRIES LOGO	1
21	.2017	DECAL, HYDRAULIC SYSTEM FLUID	1
22	.20461	DECAL, FORWARD ARROW	1
23	.22386	DECAL, "D" RING ATTACH SAFETY BEFORE...	2
24	.20419	DECAL, DANGER KEEP CLEAR	2
25	.22449	DECAL, NO SMOKING FOR ELECTRICAL...	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	DECAL SET
MODEL	30KBN
NOTES	UNTIL OCT. 1989

SECT.	2
FIG.	2
PAGE	4

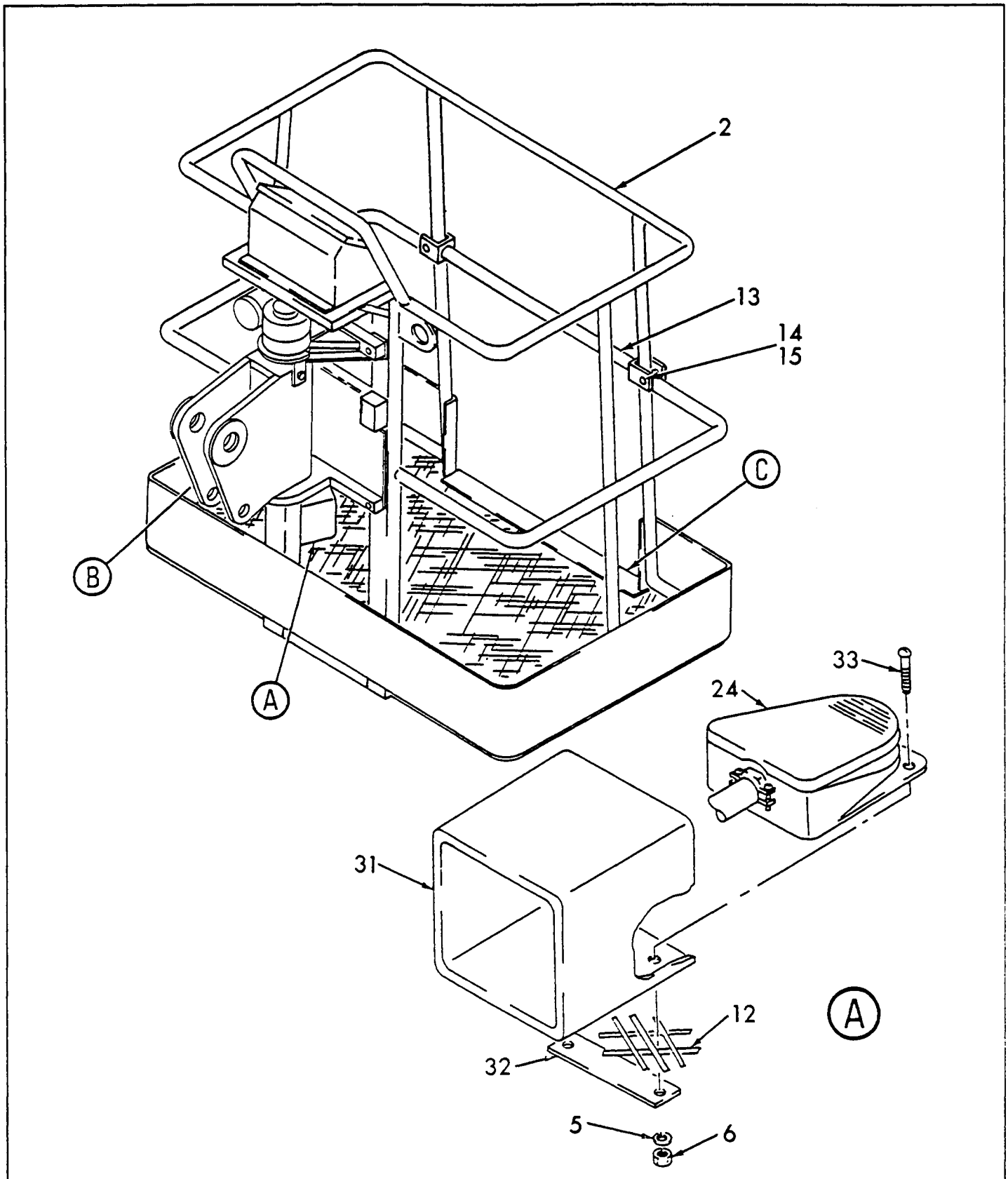
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.2003	DECAL, BATTERY WATER LEVEL...	2
27	.130820	DECAL, OPERATION & SAFETY HANDBOOK...	1
28	.20661	PLATE, ANSI A92	1
29	.20660	NAMEPLATE, IDENTIFICATION	1
30	.183301	DECAL, WARNING LEAD AND PAINT...	2
31	.183302	DECAL, WARNING THIS COUNTERWEIGHT...	2

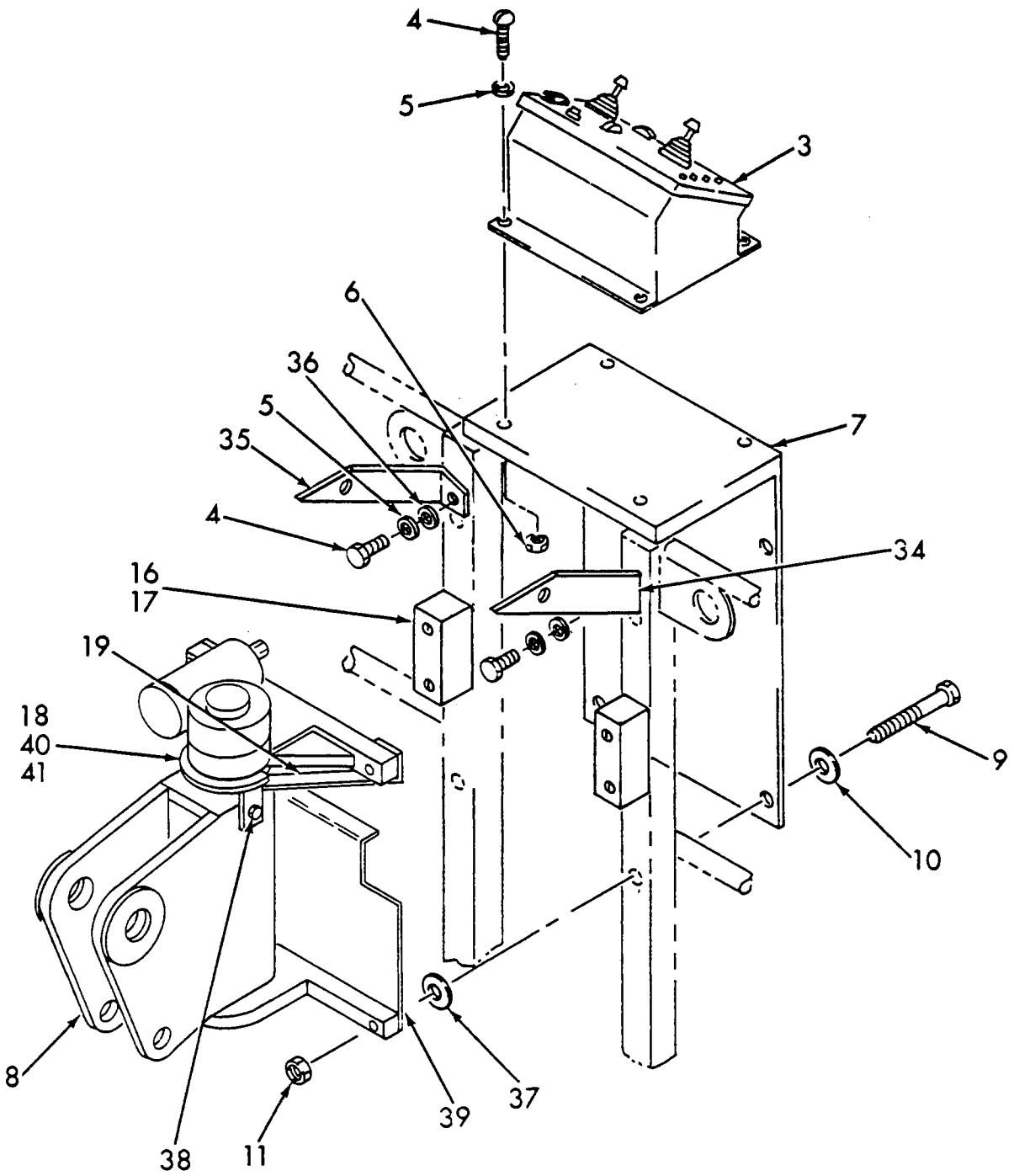
DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	PLATFORM ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	2
FIGURE	3
PAGE	1

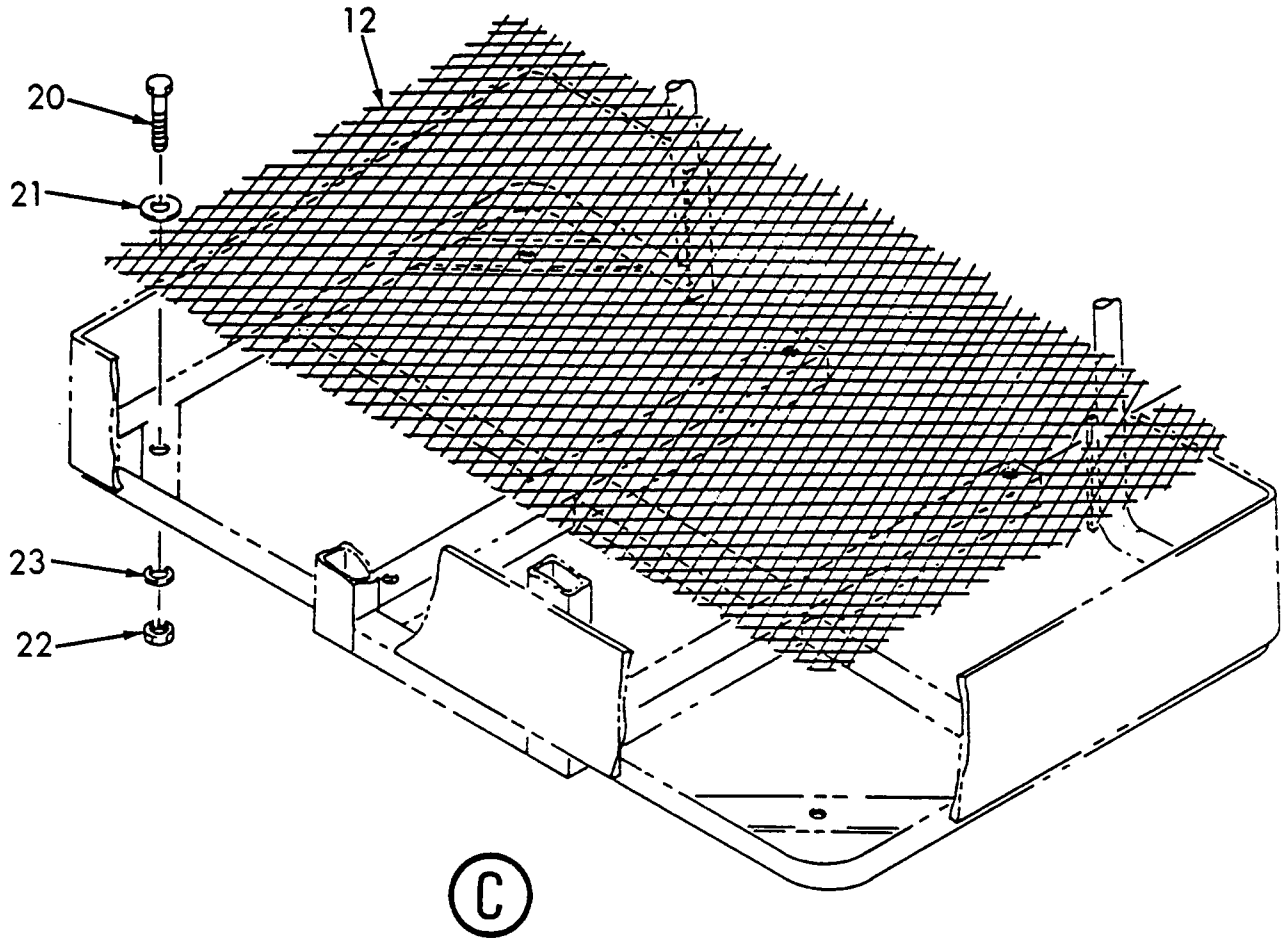



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Mark Industries

TITLE	PLATFORM ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	2
FIGURE	3
PAGE	3



Mark Industries

TITLE	PLATFORM ASSEMBLY
MODEL	30KBN
NOTES	

SECT.	2
FIG.	3
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140157	ASSEMBLY, PLATFORM (See Sect. 2, Fig. 1 for NHA)	REF
2	.140113	WELDMENT, PLATFORM	1
3	.140205	ASSEMBLY, AERIAL BOX (See Sect. 2, Fig. 5 & 5A for Details)	1
4	.62607	SCREW, MACHINE	8
5	.63413	WASHER, FLAT	10
6	.61241	NUT, LOCK	10
7	.140484	BRACKET, UPPER BOX MOUNTING	1
8	.24919	ROTATOR, MANUAL (See Sect. 2, Fig. 6 for Details)	1
9	.60549	SCREW, CAP	4
10	.63415	WASHER, FLAT	4
11	.61242	NUT, LOCK	4
12	.140509	FLOOR, PLATFORM	1
13	.141080	WELDMENT, SLIDE BAR	1
14	.160212	PIN, CLEVIS	2
15	.160213	PIN, COTTER	2
16	.140473	BUMPER	2
17	.61832	SCREW, CAP	4
18	.141342	RETAINER, COLLAR	1
19	.141341	COLLAR, MANUAL ROTATOR	1
20	.60331	SCREW, CAP	6
21	.65965	WASHER, FENDER	6
22	.61318	NUT, LOCK	6
23	.63428	WASHER, FLAT	4
24	.141094	ASSEMBLY, FOOT SWITCH	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

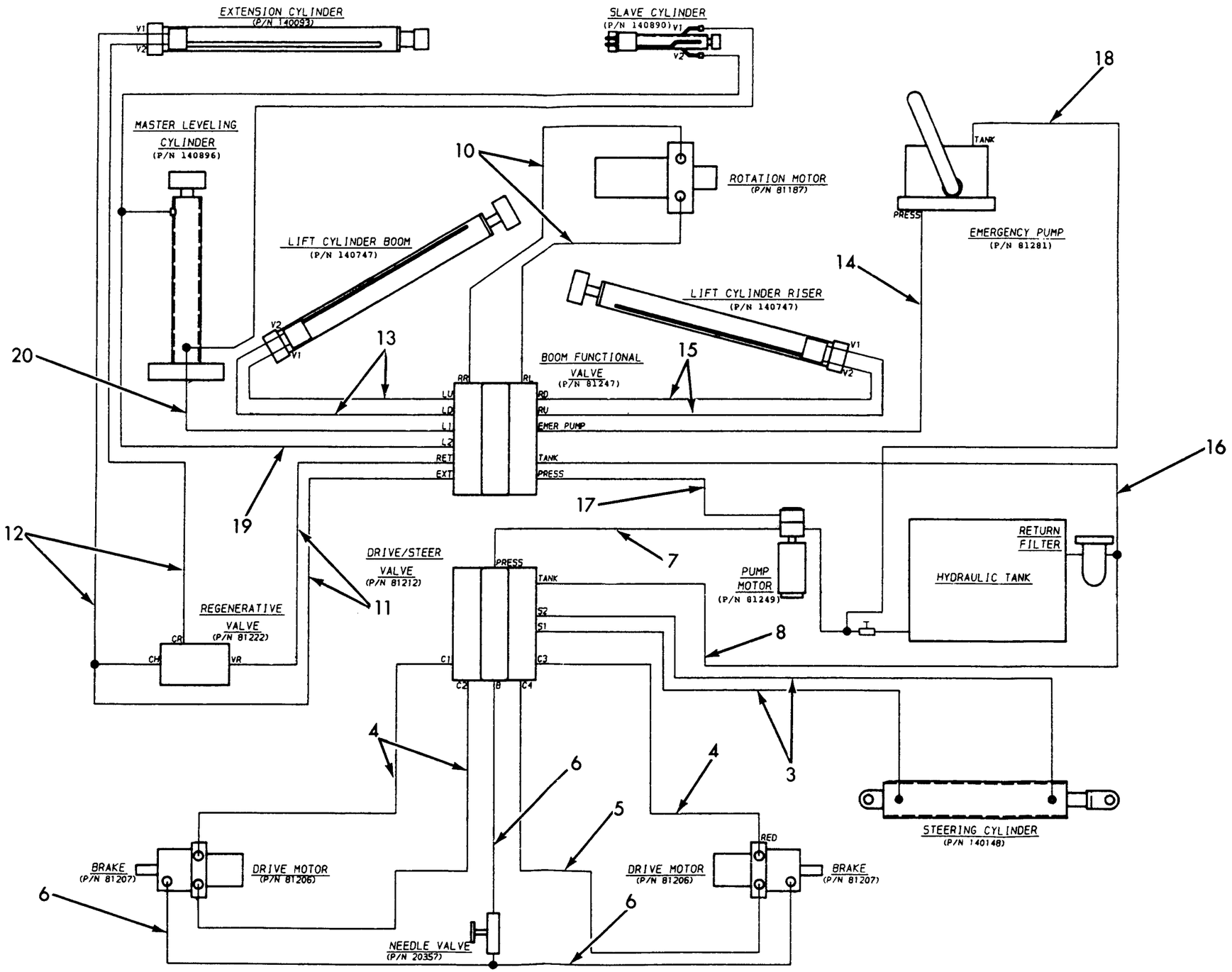
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	..92202	SWITCH, FOOT	1
26	...66336	MICROSWITCH	1
27	..2806	RELIEF, STRAIN	1
28	..4034	CABLE (12/3)	6 FT
29	..16213	CONNECTOR	2
30	..2808	NUT, LOCK	1
31	.23846	COVER, FOOT SWITCH	1
32	.23753	PLATE, DEADMAN SWITCH BACKING	1
33	.62714	SCREW, MACHINE	2
34	.140628	GUSSET (R.H.)	1
35	.140627	GUSSET (L.H.)	1
36	.63313	WASHER, LOCK	2
37	.141287	WASHER, PLATFORM/ROTATOR	4
38	.60558	SCREW, CAP	1
39	.141344	BRACKET, ANGLE	1
40	.62319	WASHER, LOCK	2
41	.60325	SCREW, CAP	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	HOSE KIT DIAGRAM
MODEL	30KBN
NOTES	

SECT.	2
FIG.	4
PAGE	1



Mark Industries

TITLE	HOSE KIT DIAGRAM	SECT.	2
MODEL	30KBN	FIG.	4
NOTES		PAGE	2

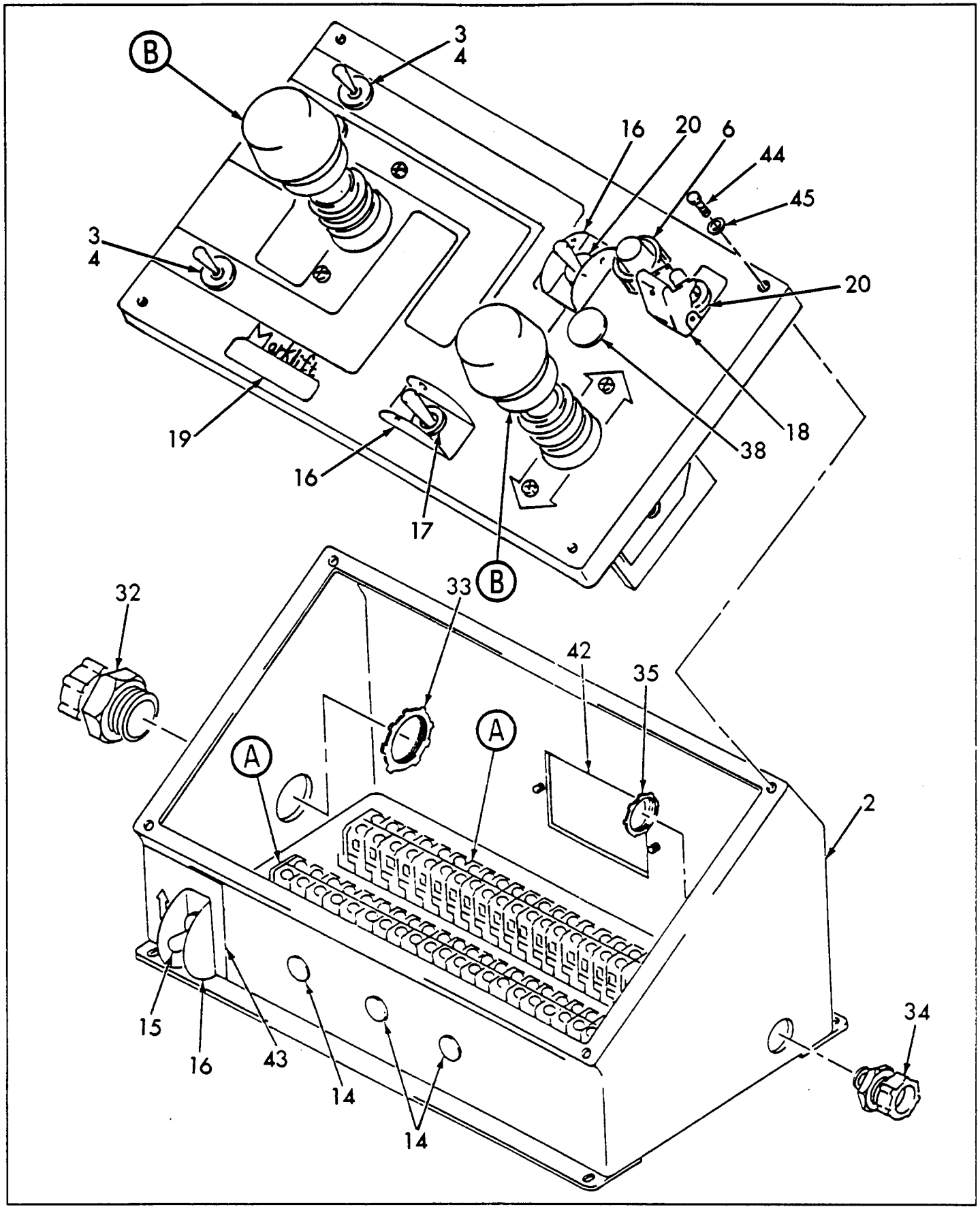
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140248	DIAGRAM, HOSE KIT (See Sect. 2, Fig. 1 for NHA)	REF
		KIT "A"	
-2	.140248	DIAGRAM, HOSE KIT	1
3	..13211-04-0464	ASSEMBLY, HOSE	2
4	..13213-08-0132	ASSEMBLY, HOSE	3
5	..13213-08-0090	ASSEMBLY, HOSE	1
6	..13210-04-0120	ASSEMBLY, HOSE	3
7	..13213-08-1050	ASSEMBLY, HOSE	1
8	..13213-10-1540	ASSEMBLY, HOSE	1
		KIT "B"	
-9	.140248	DIAGRAM, HOSE KIT	1
10	..13212-06-1380	ASSEMBLY, HOSE	2
11	..13212-06-1640	ASSEMBLY, HOSE	2
12	..13210-06-0390	ASSEMBLY, HOSE	2
13	..13212-06-1730	ASSEMBLY, HOSE	2
14	..13212-04-0374	ASSEMBLY, HOSE	1
15	..13212-06-0900	ASSEMBLY, HOSE	2
16	..13216-08-0700	ASSEMBLY, HOSE	1
17	..13213-06-0514	ASSEMBLY, HOSE	1
18	..13210-04-0240	ASSEMBLY, HOSE	1
19	..13212-04-1710	ASSEMBLY, HOSE	1
20	..13212-04-1810	ASSEMBLY, HOSE	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	UNTIL MARCH 1988

SECTION	2
FIGURE	5
PAGE	1

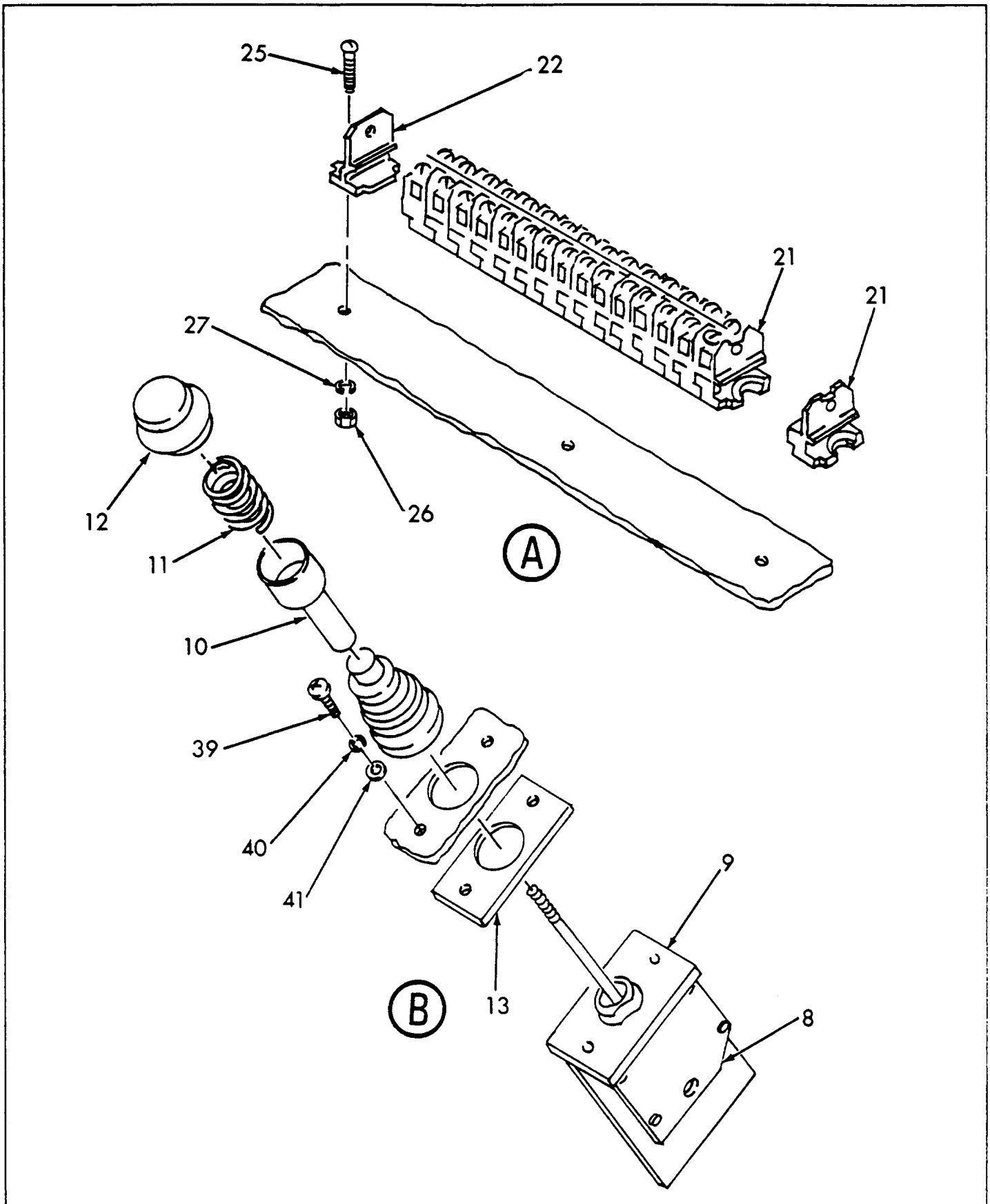


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Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	UNTIL MARCH 1988

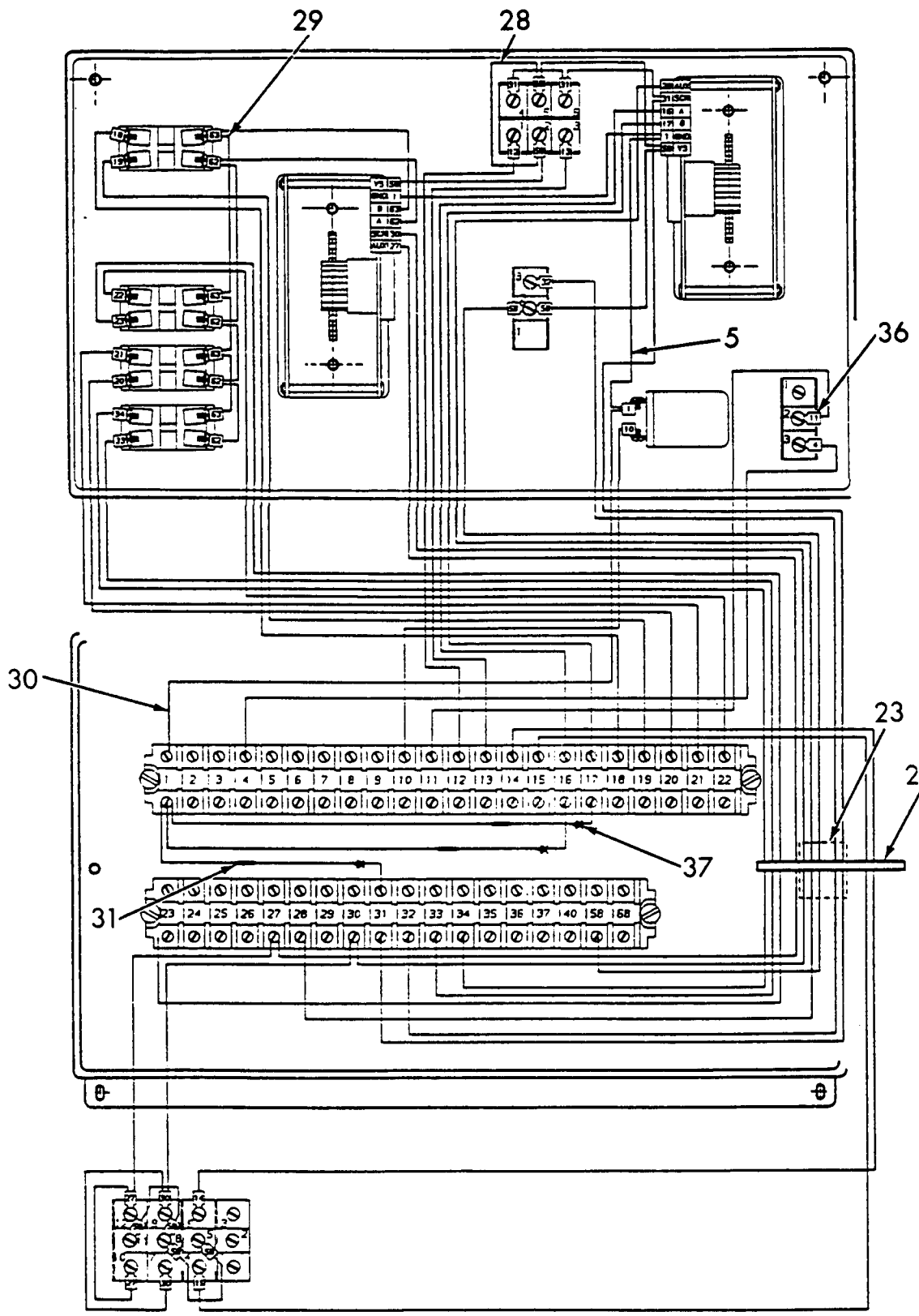
SECTION	2
FIGURE	5
PAGE	2



Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	UNTIL MARCH 1988

SECTION	2
FIGURE	5
PAGE	3



AERIAL CONTROL BOX
WIRING DIAGRAM

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	UNTIL MARCH 1988

SECT.	2
FIG.	5
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140205	ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for NHA)	REF
2	.140315	MACHINING, AERIAL CONTROL BOX	1
3	.70372	SWITCH, PUSH BUTTON	4
4	.70373	BOOT, PUSH BUTTON SWITCH	4
5	.70008	WIRE, YELLOW WITH GREEN (16 AWG)	5 FT
6	.20805	BUZZER, ALARM	1
7	.70369	CONTROLLER	2
8	..67386	ASSEMBLY, ELECTRICAL	1
9	..67385	ASSEMBLY, HOUSING & HANDLE	1
10	..67371	ASSEMBLY, SLIDE LOCK	1
11	..67372	SPRING, UPPER	1
12	..67373	KNOB, UPPER (TAPPED)	1
13	..67374	GASKET	1
14	.771	PLUG, WHITE	3
15	.70383	SWITCH, LEVELING	1
16	.20884	GUARD, SWITCH	3
17	.20481	SWITCH, TOGGLE MICROSWITCH 2TK1	
18	.70303	GUARD, SWITCH	1
19	.140374	DECAL, UPPER CONTROL	1
20	.4017	SWITCH, TOGGLE	2
21	.4027	BLOCK, TERMINAL	40
22	.117-A	END, TERMINAL BLOCK	2
23	.16214	MOUNTS	5
24	.256	TIE, CABLE	38
25	.62612	SCREW, MACHINE	6

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY	SECT.	2
MODEL	30KBN	FIG.	5
NOTES	UNTIL MARCH 1988	PAGE	5

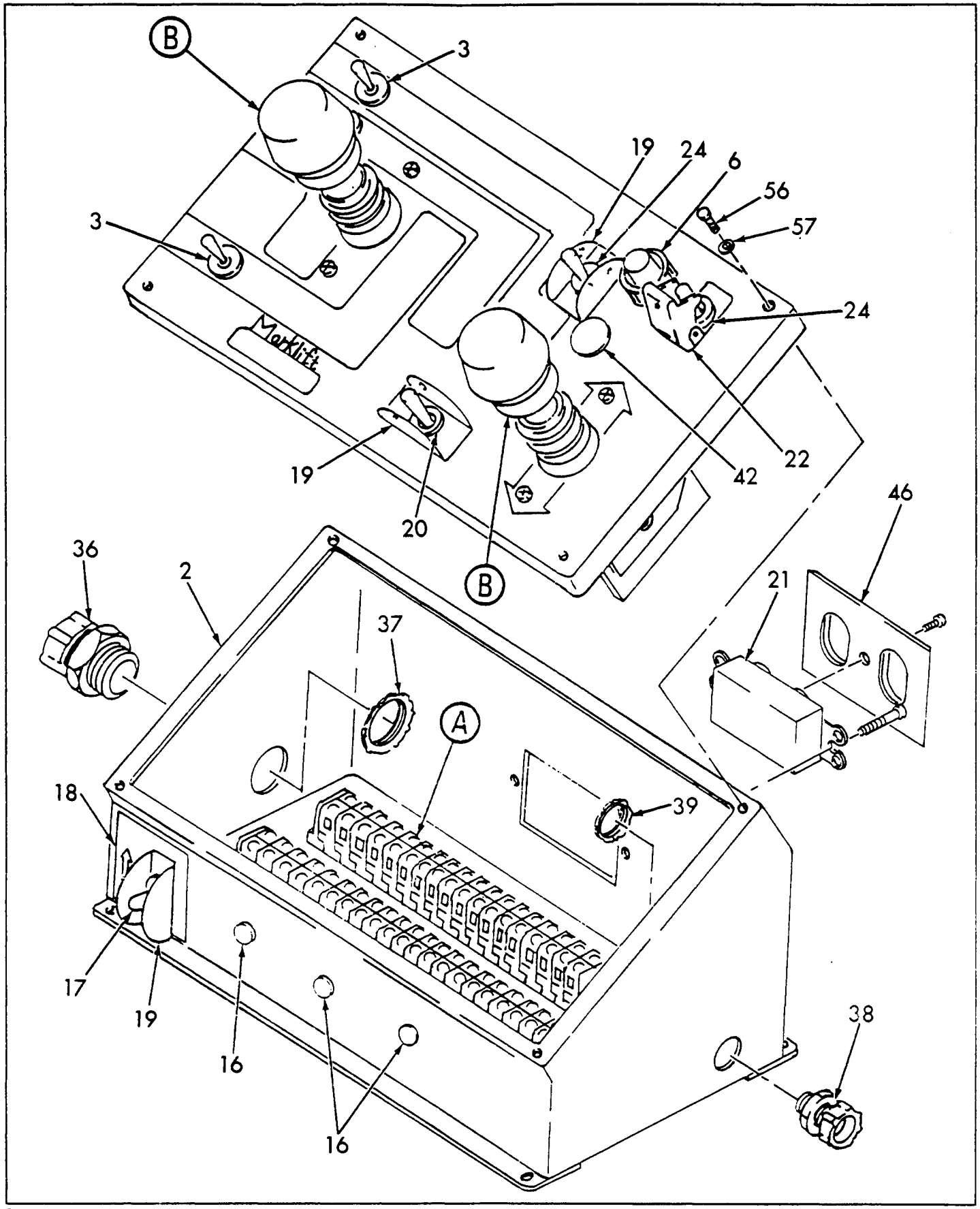
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.61502	NUT, HEX	6
27	.63312	WASHER, LOCK	6
28	.2991	WIRE, WHITE (12 AWG STRANDED)	10 FT
29	.2990	WIRE, WHITE (18 AWG STRANDED)	90 FT
30	.70098	WIRE, YELLOW WITH GREEN STRIP (12 GAUGE)	5 FT
31	.117-D	CONNECTOR, BUTT	3
32	.16215	RELIEF, STRAIN	1
33	.16105	NUT, LOCK	1
34	.2806	RELIEF, STRAIN	1
35	.2808	NUT, LOCK	1
36	.117-C	CONNECTOR, RING	24
37	.4045	DIODE	3
38	.772	PLUG, WHITE	1
39	.62703	SCREW, MACHINE	4
40	.63313	WASHER, LOCK	4
41	.63413	WASHER, FLAT	4
42	.902	PLATE, COVER	1
43	.140550	DECAL, AERIAL CONTROL SWITCH	1
44	.62611	SCREW	4
45	.63313	LOCKWASHER	4

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	SINCE MARCH 1988

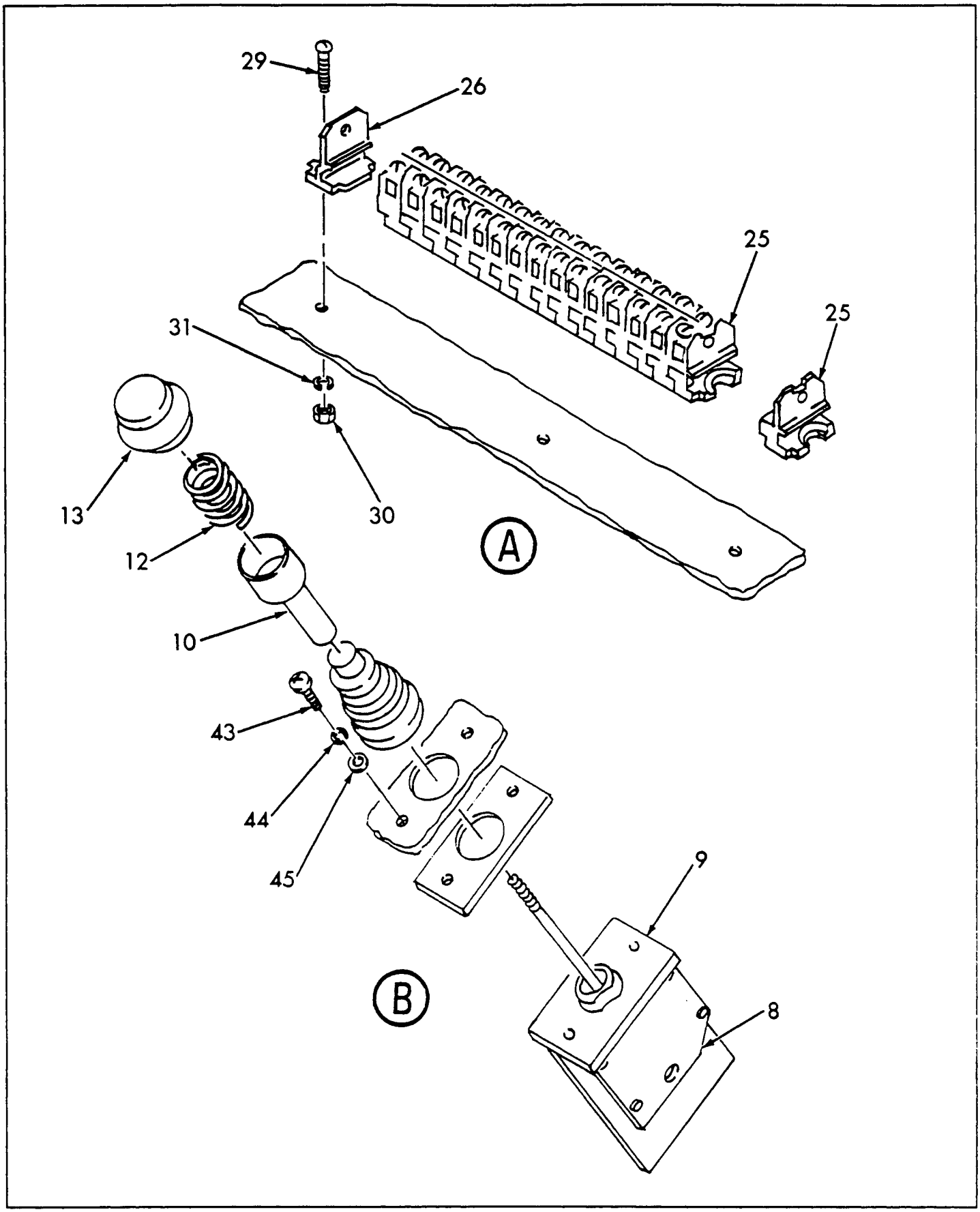
SECTION	2
FIGURE	5A
PAGE	1



Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	SINCE MARCH 1988

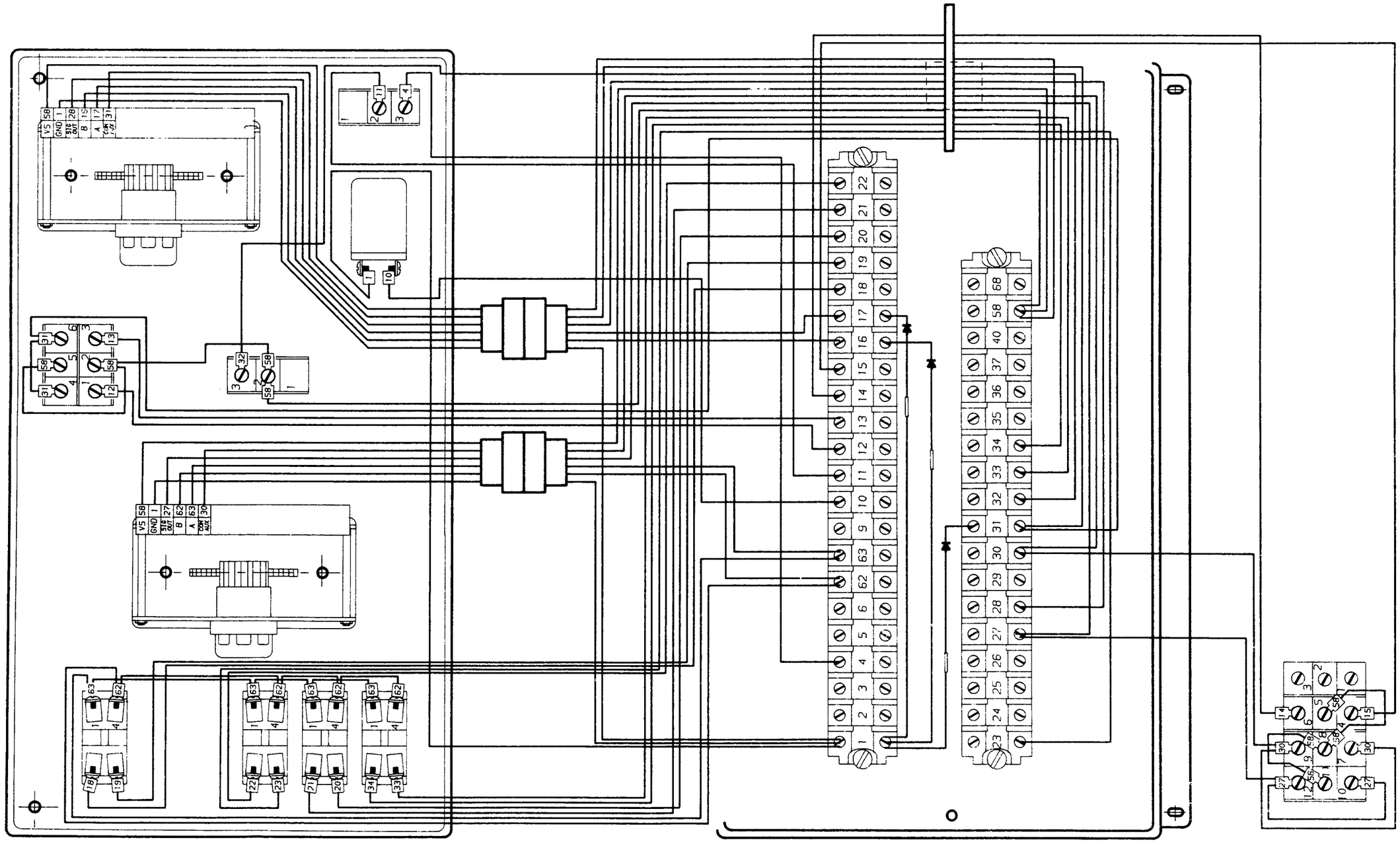
SECTION	2
FIGURE	5A
PAGE	2



Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	SINCE MARCH 1988

SECTION	2
FIGURE	5A
PAGE	3



Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	30KBN
NOTES	SINCE MARCH 1988

SECT.	2
FIG.	5A
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140205	ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for NHA)	REF
2	.140315	MACHINING, AERIAL CONTROL BOX	1
3	.70417	SWITCH, TOGGLE	4
4	.70394	CONNECTOR, TWIST-ON WIRE	2
5	.70008	WIRE, YELLOW WITH GREEN (16 AWG)	5 FT
6	.20805	BUZZER, ALARM	1
-7	.70488	CONTROLLER	2
8	..67812	BOARD, ENCAPSULATED CONTROLLER	1
9	..600006	POTENTIOMETER WITH WIRES	1
10	..600007	ASSEMBLY, SLIDE LOCK & BOOT	1
11	...600008	BOOT	1
12	..600009	SPRING, UPPER	1
13	..600010	KNOB, UPPER	1
-14	..600171	CAP, CONNECTOR (MATES WITH 70502)	1
-15	..600172	SOCKET (MATES WITH 70503)	6
16	.771	PLUG (WHITE)	3
17	.70383	SWITCH, LEVELING	1
18	.182703	DECAL, PLATFORM LEVELING SWITCH	1
19	.20884	GUARD, SWITCH	3
20	.20481	SWITCH, TOGGLE	1
21	.70391	RECEPTACLE, G.F.C.I.	1
22	.70303	GUARD, SWITCH	1
23	.140374	DECAL, UPPER CONTROL	1
24	.4017	SWITCH, TOGGLE	2
25	.4027	BLOCK, TERMINAL	40

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY	SECT.	2
MODEL	30KBN	FIG.	5A
NOTES	SINCE MARCH 1988	PAGE	5

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.117-A	END, TERMINAL BLOCK	2
27	.16214	MOUNTS	5
28	.256	TIE, CABLE	40
29	.62612	SCREW, MACHINE	6
30	.61502	NUT, HEX	6
31	.63312	WASHER, LOCK	6
32	.2991	WIRE, WHITE (12 AWG STRANDED)	10 FT
33	.2990	WIRE, WHITE (18 AWG STRANDED)	90 FT
34	.70098	WIRE, YELLOW WITH GREEN STRIPE (12 GAUGE)	5 FT
35	.117-D	CONNECTOR, BUTT	3
36	.16215	RELIEF, STRAIN	1
37	.16105	NUT, LOCK	1
38	.2806	RELIEF, STRAIN	1
39	.2808	NUT, LOCK	1
40	.117-C	CONNECTOR, RING	25
41	.70479	DIODE	3
42	.772	PLUG (WHITE)	1
43	.62703	SCREW, MACHINE	4
44	.63313	WASHER, LOCK	4
45	.63413	WASHER, FLAT	4
46	.70392	COVER, RECEPTACLE	1
47	.70162	TERMINAL	2
48	.141162	ASSEMBLY, DRIVE WIRE HARNESS	1
49	..70502	CONNECTOR, PLUG	1
50	..70503	PIN	6

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY	SECT.	2
MODEL	30KBN	FIG.	5A
NOTES	SINCE MARCH 1988	PAGE	6

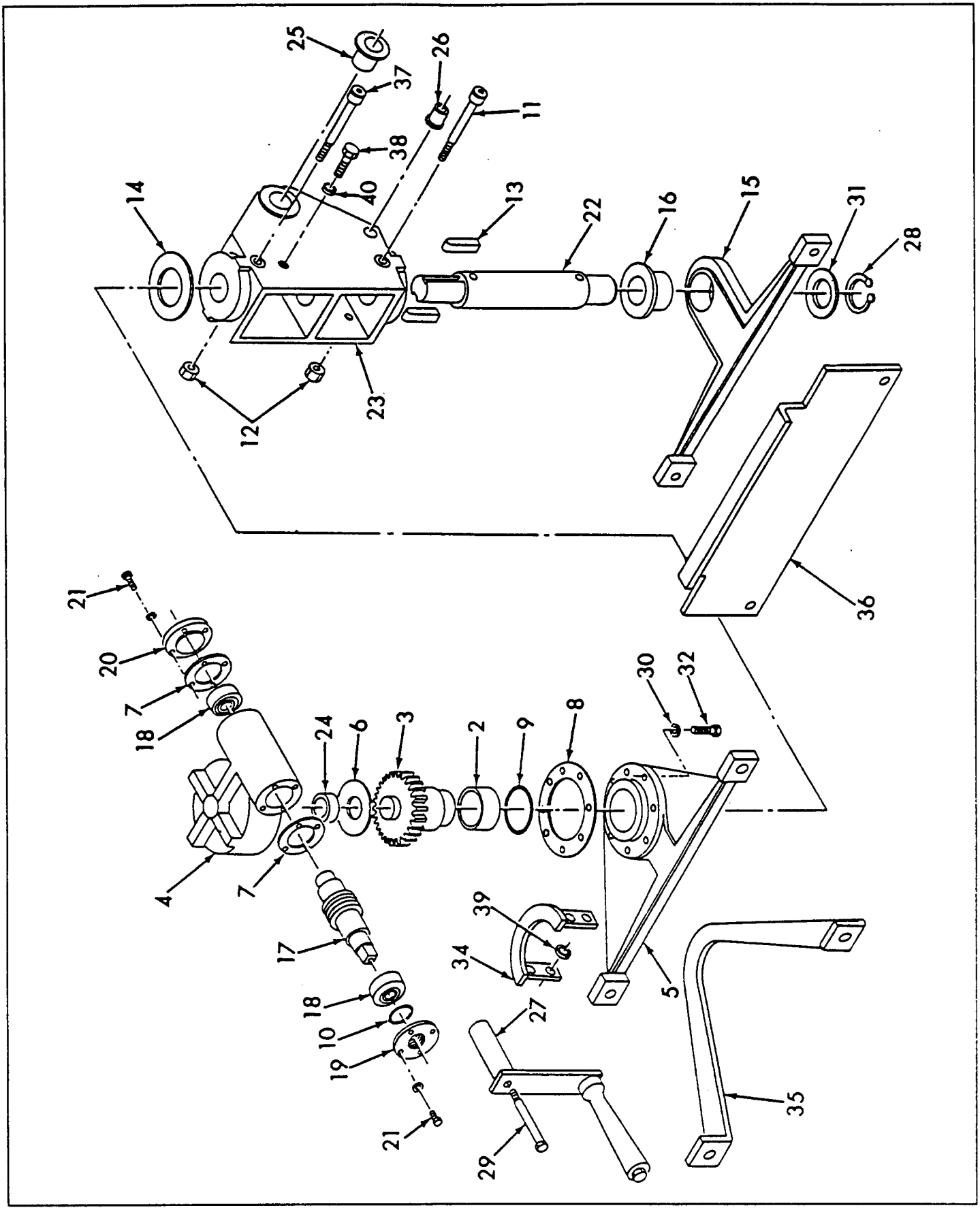
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
51	..2990	WIRE, WHITE (18 AWG STRANDED)	12 FT
52	.141144	ASSEMBLY, BOOM FUNCTION WIRE HARNESS	1
53	..70502	CONNECTOR, PLUG	1
54	..70503	PIN	6
55	..2990	WIRE, WHITE (18 AWG STRANDED)	12 FT
56	.62611	SCREW	4
57	.63313	LOCKWASHER	4

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

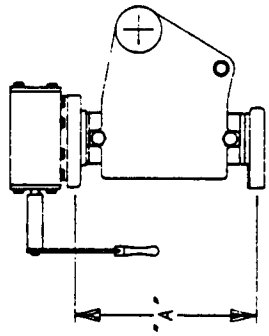
Mark Industries

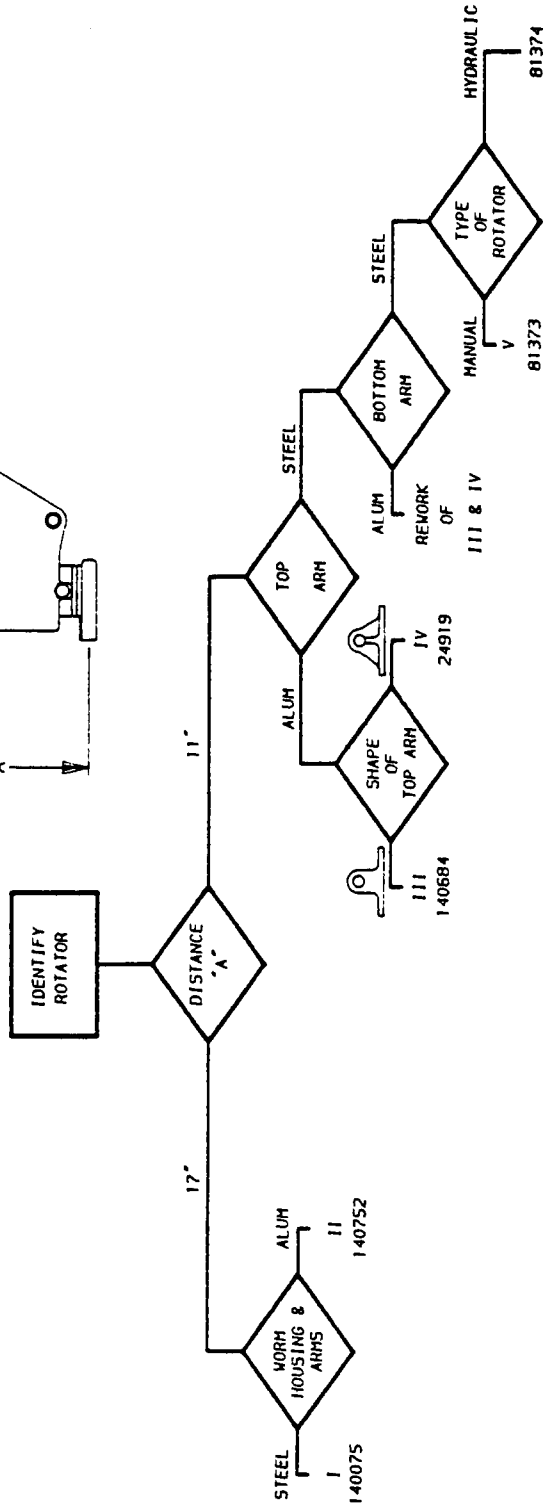
TITLE	TYPICAL MANUAL ROTATOR
MODEL	30KBN
NOTES	FROM MID 1987 UNTIL EARLY 1990

SECTION	2
FIGURE	6
PAGE	1



ROTATOR IDENTIFICATION FLOW CHART





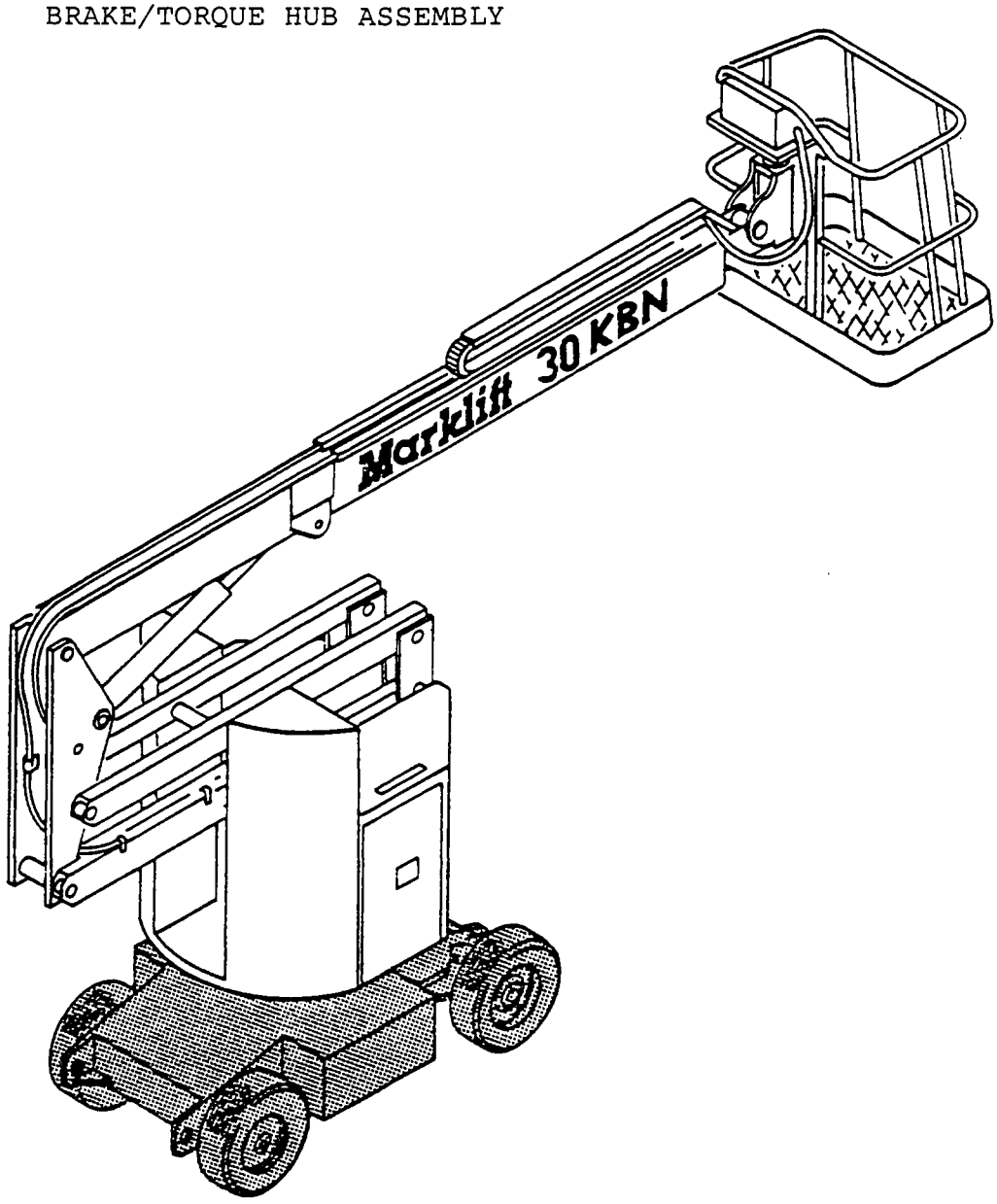
ITEM	M.I.P/N (I)	M.I.P/N (II)	M.I.P/N (III)	M.I.P/N (IV)	DESCRIPTION	QTY
-1	140075	140752	140684	24919	ASSEMBLY, ROTATOR (SEE SEC 2 FIG 1 FOR NHA)	REF
2	68030	68030	68030	68030	BUSHING	1
3	** 600278	** 600279	** 600279	600280	GEAR, BULL	1
4	+ 68033	68032	68032	68032	HOUSING, GEAR	1
5	** 68036	* 81378	* 81378	* 81378	ARM, TOP	1
6	68037	68037	68037	68037	WASHER, THRUST	1
7	68038	68038	68038	68038	GASKET, END CAP	2
8	68039	68039	68039	68039	GASKET, GEARBOX	1
9	68040	68040	68040	68040	O-RING	1
10	68041	68041	68041	68041	O-RING	1
11	600187	600187	600187	600187	BOLT	1
12	600188	600188	600188	600188	NUT W/NYLOCK	2
13	600189	600189	600189	600189	KEY	2
14	68044	68043	68043	68042	WASHER, THRUST	1
15	** 600282	600283	600283	600283	ARM, BOTTOM	1
16	68045	68045	68045	68045	BUSHING, FLANGED	1
17	600284	600285	600286	600286	GEAR, WORM	1
18	68046	68046	68046	68046	BEARING, ROLLER	2
19	600287	* 600288	600288	600288	CAP, END (THRU)	1
20	68048	68047	68047	68047	CAP, END	1
21	600192	600190	600190	600190	BOLT	8
22	** 600289	** 600290	600291	600291	PIN, MAIN	1
23	++	++	++	++	YOKE	1
24	68049	68049	68049	68049	BUSHING	1
25	68050	68050	68050	68050	BUSHING, FLANGED	2
26	68051	68051	68051	68051	BUSHING, FLANGED	2
27	* 68052	* 68052	68052	68052	CRANK, HAND	1
28	N/A	N/A	68054	68054	RING, SNAP	1
29	* 600191	* 600191	600191	600191	BOLT	1
30	N/A	N/A	63302	63302	WASHER, LOCK	8
31	N/A	N/A	N/A	600292	WASHER, FLAT	1
32	600186	600186	600186	600186	BOLT	8
-33	600193	600193	600193	600193	KIT, PROD. IMPROVEMENT	REF
34	141342	141342	141342	141342	RETAINER, COLLAR	1
35	141341	141341	141341	141341	COLLAR, ROTATOR	1
36	141344	141344	141344	141344	BRACKET, ANGLE	1
37	60558	60558	60558	60558	SCREW, CAP	1
38	60338	60338	60338	60338	SCREW, CAP	2
39	63402	63402	63402	63402	WASHER, FLAT	4
40	63303	63303	63303	63303	WASHER, LOCK	2

* Parts are not original, but are a newer "direct replacement."
** Special Order items; allow 90 days lead time.
\+ Originally made of "cast iron"; replacements are "aluminum".
++ If the yoke requires replacement, the ENTIRE rotator MUST be replaced W/81373. {Modification is necessary if the "original" rotator is P/N 140075 or 140752.}

NOTE: SEE THE "ROTATOR IDENTIFICATION FLOW CHART" TO DETERMINE WHICH ROTATOR IS APPLICABLE.

SECTION 3 CONTAINS:

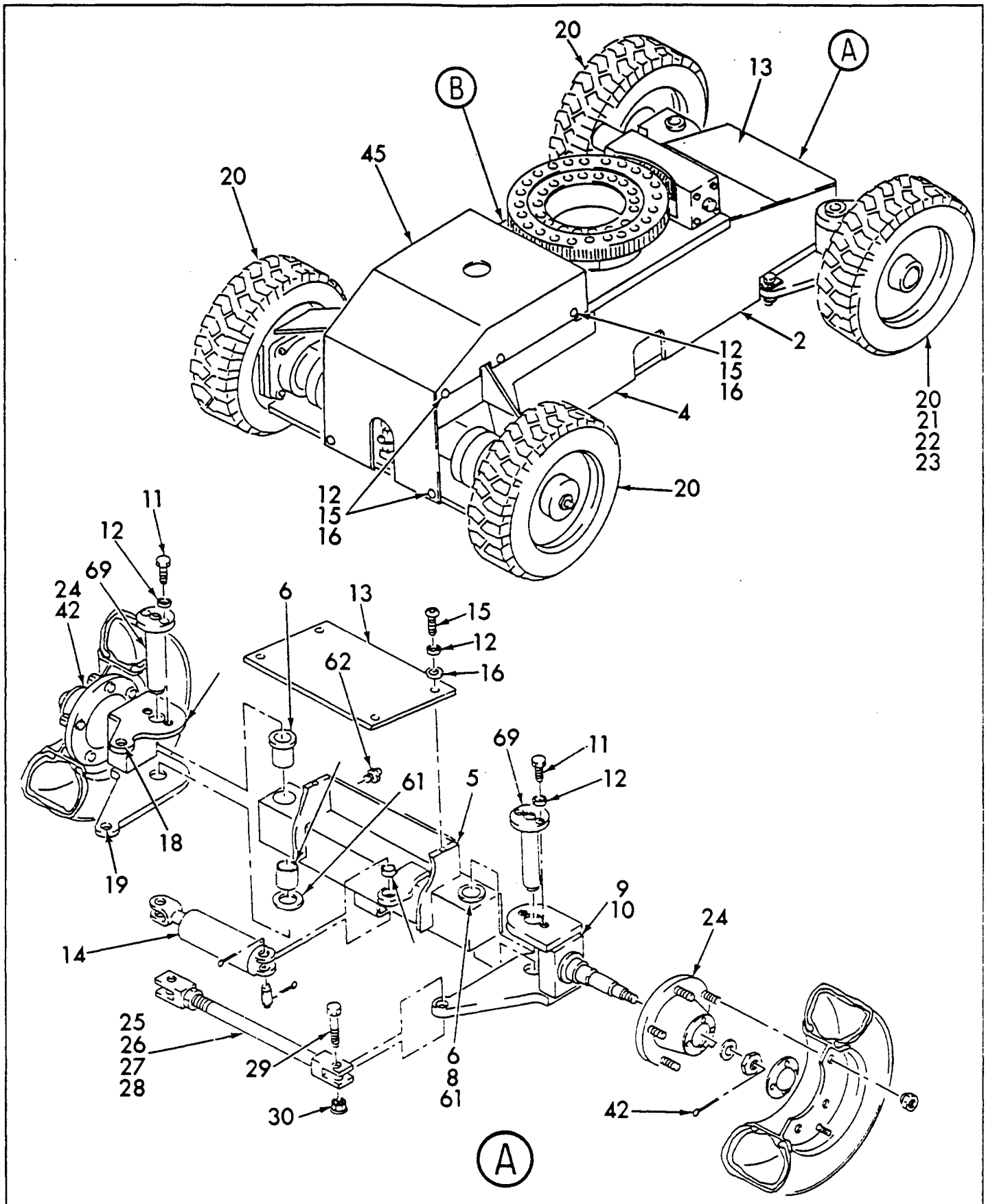
FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY
2	STEERING CYLINDER (UNTIL LATE 1989, SOME CONCURRENT USE)
2A	STEERING CYLINDER (SINCE LATE 1989, SOME CONCURRENT USE)
3	HUB ASSEMBLY
4	ROTATION GEARBOX ASSEMBLY (UNTIL LATE 1988)
4A	ROTATION GEARBOX ASSEMBLY (SINCE LATE 1988)
5	DRIVE/STEER VALVE PACKAGE ASSEMBLY
6	BRAKE/TORQUE HUB ASSEMBLY



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

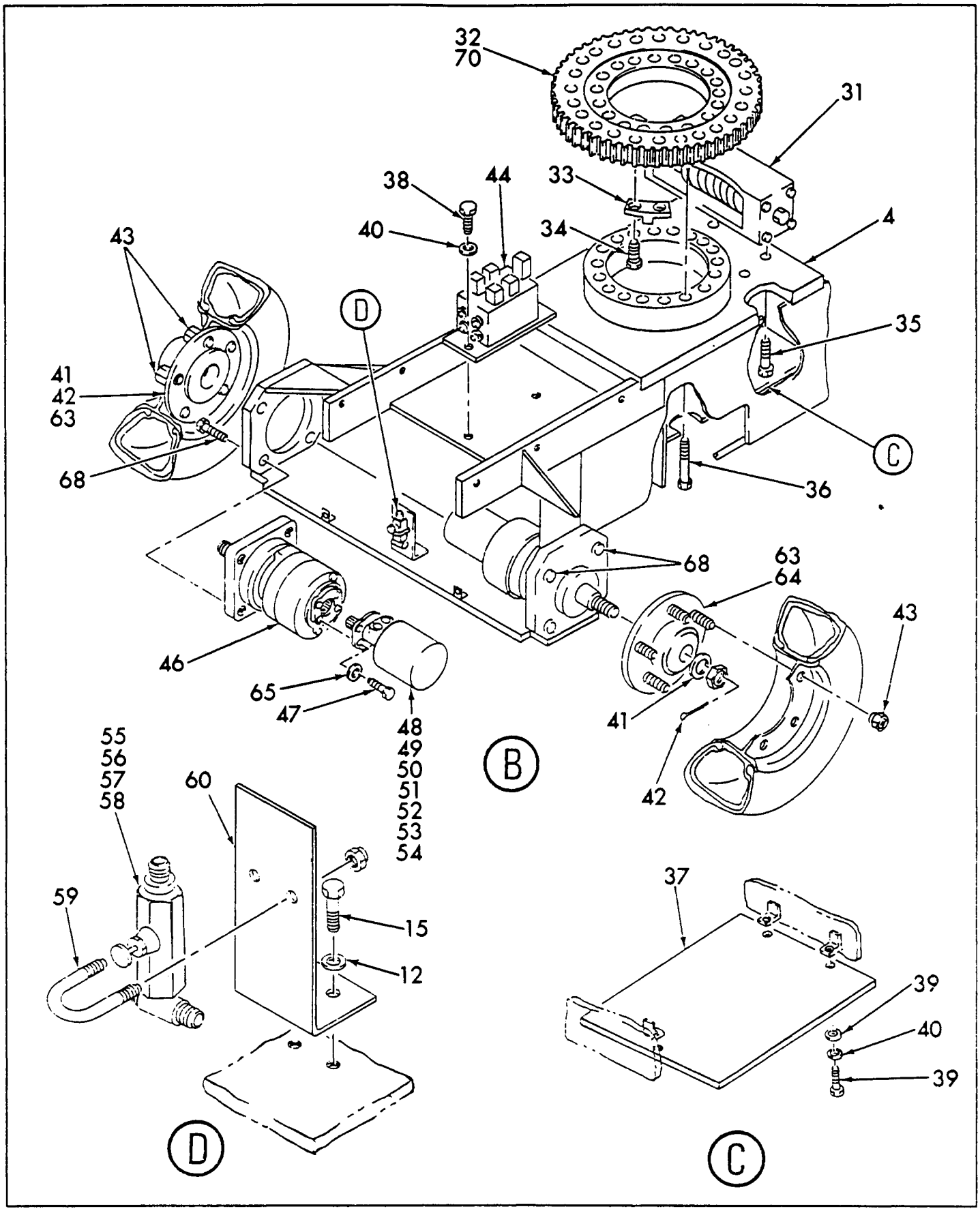
SECTION	3
FIGURE	1
PAGE	1



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECTION	3
FIGURE	1
PAGE	2



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	41KB
NOTES	BEFORE OCT. 1989

SECT.	3
FIG.	1
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140117	ASSEMBLY, CARRIAGE (See Sect. 1, Fig. 1 for NHA)	REF
2	.140609	WELDMENT, CARRIAGE	1
3	..140606	WELDMENT, CARRIAGE WITH COUNTERWEIGHT	1
4	...140217	WELDMENT, CARRIAGE	1
5	140225	MACHINING, STEERING AXLE	1
6	64910	BUSHING, FLANGED	2
7	64932	BEARING, SLEEVE	1
8	64934	BEARING, SLEEVE	2
9	.140249	YOKE & SPINDLE (L.H.)	1
10	..2265	BUSHING	1
11	.60338	SCREW, CAP	4
12	.63302	WASHER, LOCK	18
13	.140269	COVER	1
14	.140060	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 2 & 2A for Details)	1
15	.60322	SCREW, CAP	14
16	.63429	WASHER, FLAT	12
17	.140247	YOKE & SPINDLE (R.H.)(CYLINDER SIDE)	1
18	..64935	BEARING, SLEEVE	1
19	..2265	BUSHING	1
20	.140334	ASSEMBLY, STEER/DRIVE TIRE	4
21	..140332	TIRE	4
22	..140181	RIM, STEER/DRIVE	4
23	..140333	TUBE, INNER	4
24	.140089	ASSEMBLY, HUB (See Sect. 3, Fig. 3 for Details)	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECT.	3
FIG.	1
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.140246	ASSEMBLY, STEERING TIE ROD	1
26	..140277	WELDMENT, STEERING TIE ROD	1
27	..140270	YOKE, ADJUSTING TIE ROD	1
28	..60902	NUT, JAM	1
29	.65966	SCREW, SHOULDER	2
30	.61236	NUT, LOCK	2
31	.140600	ASSEMBLY, ROTATION GEARBOX (See Sect. 3, Fig. 4 & 4A for Details)	1
32	.23722	GEAR, RING	1
33	.140515	WELDMENT, ROTATION STOP	1
34	.60606	SCREW, CAP	2
35	.60640	SCREW, CAP	4
36	.60645	SCREW, CAP	24
37	.140268	BOTTOM, PAN	1
38	.60325	SCREW, CAP	5
39	.63428	WASHER, FLAT	3
40	.63319	WASHER, LOCK	7
41	.16159	WASHER	2
42	.64312	PIN, COTTER	4
43	.65117	NUT, BALL	10
44	.140316	ASSEMBLY, DRIVE/STEER VALVE PACKAGE (See Sect. 3, Fig. 5 for Details)	1
45	.140561	COVER, DRIVE MOTOR	1
46	.140596	ASSEMBLY, BRAKE/TORQUE HUB (See Sect. 3, Fig. 6 for Details)	2
47	.60622	SCREW, CAP	8
48	.140594	ASSEMBLY, DRIVE MOTOR	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

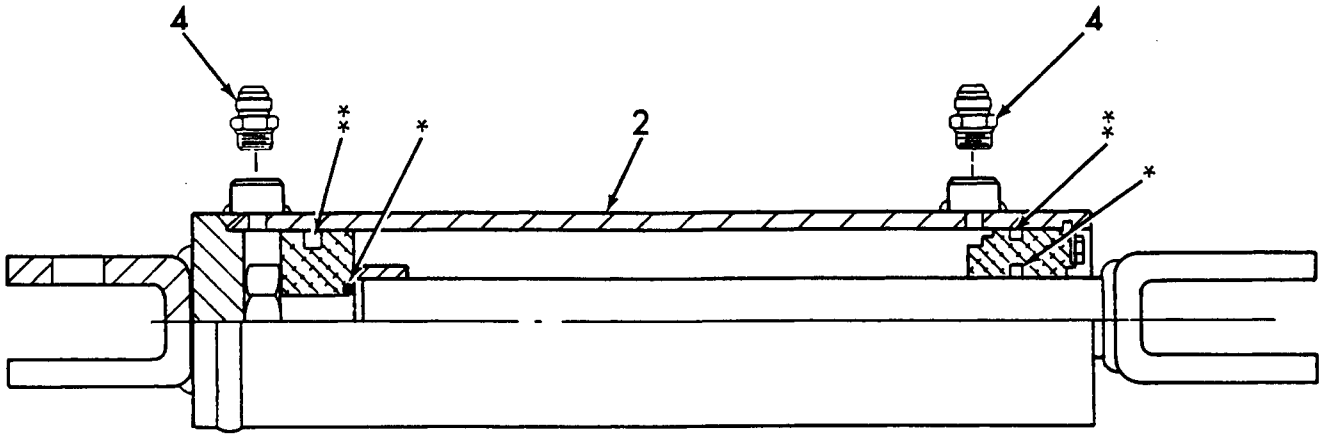
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
49	..81206	MOTOR, DRIVE (See Vendor Chapter for Details)	2
-50	...3036-A	KIT, SEAL	1
-51	...67359	LINK, DRIVE	1
-52	...66514	ASSEMBLY, COMMUTATOR	1
-53	...67358	SHAFT, COUPLING	1
54	..80004-13	CONNECTOR, STRAIGHT THREAD	4
55	.140597	ASSEMBLY, BRAKE RELEASE VALVE	1
56	..80034-04	TEE, MALE BRANCH	1
57	..20357	VALVE, NEEDLE	1
58	..80001-04	CONNECTOR, MALE	1
59	.65218	U-BOLT	1
60	.140506	BRACKET, MOUNTING	1
61	.140759	SPACER (STEERING YOKE)	2
62	.65103	FITTING, GREASE	2
63	.140090	HUB, DRIVE	2
64	..65943	BOLT, WHEEL	10
65	.63501	WASHER, FLAT	8
66	.140233	BRACKET	2
67	.60343	SCREW, CAP	2
68	.60547	SCREW, CAP	8
69	.140338	PIN, KING	2
-70	.140583	PROCEDURE, RING & WORM GEAR INSTALLATION	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	STEERING CYLINDER
MODEL	30KBN
NOTES	UNTIL LATE 1989, SOME CONCURRENT USE

SECTION	3
FIGURE	2
PAGE	1



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

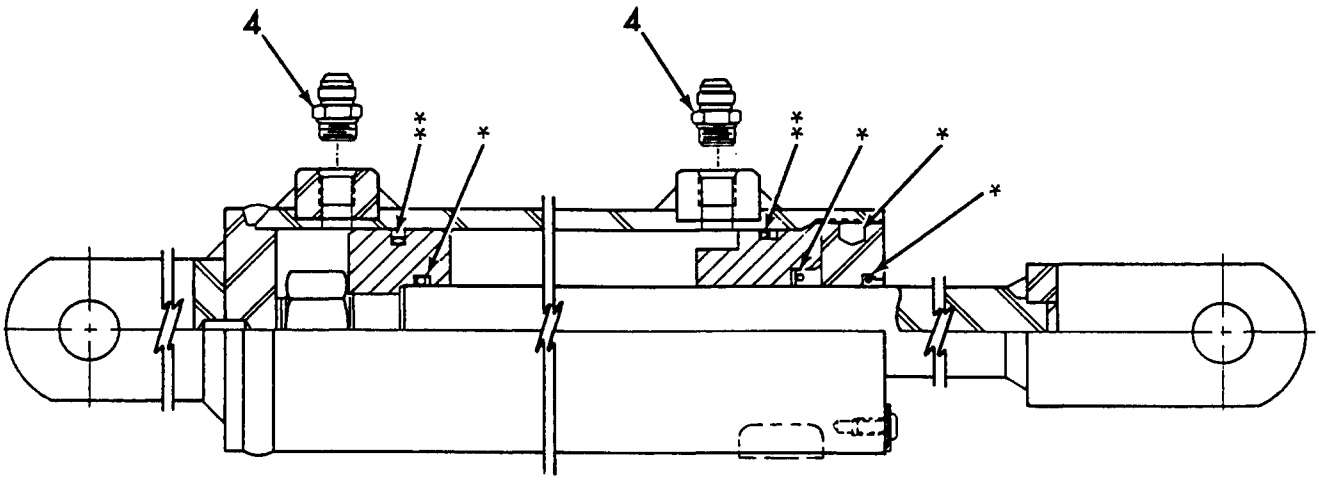
NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140060	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	.140148	CYLINDER, STEERING (SE)	1
-3	..66861	KIT, SEAL (SE)	1
4	.80004-03	CONNECTOR, STRAIGHT THREAD	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	STEERING CYLINDER
MODEL	30KBN
NOTES	SINCE LATE 1989, SOME CONCURRENT USE

SECTION	3
FIGURE	2A
PAGE	1



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

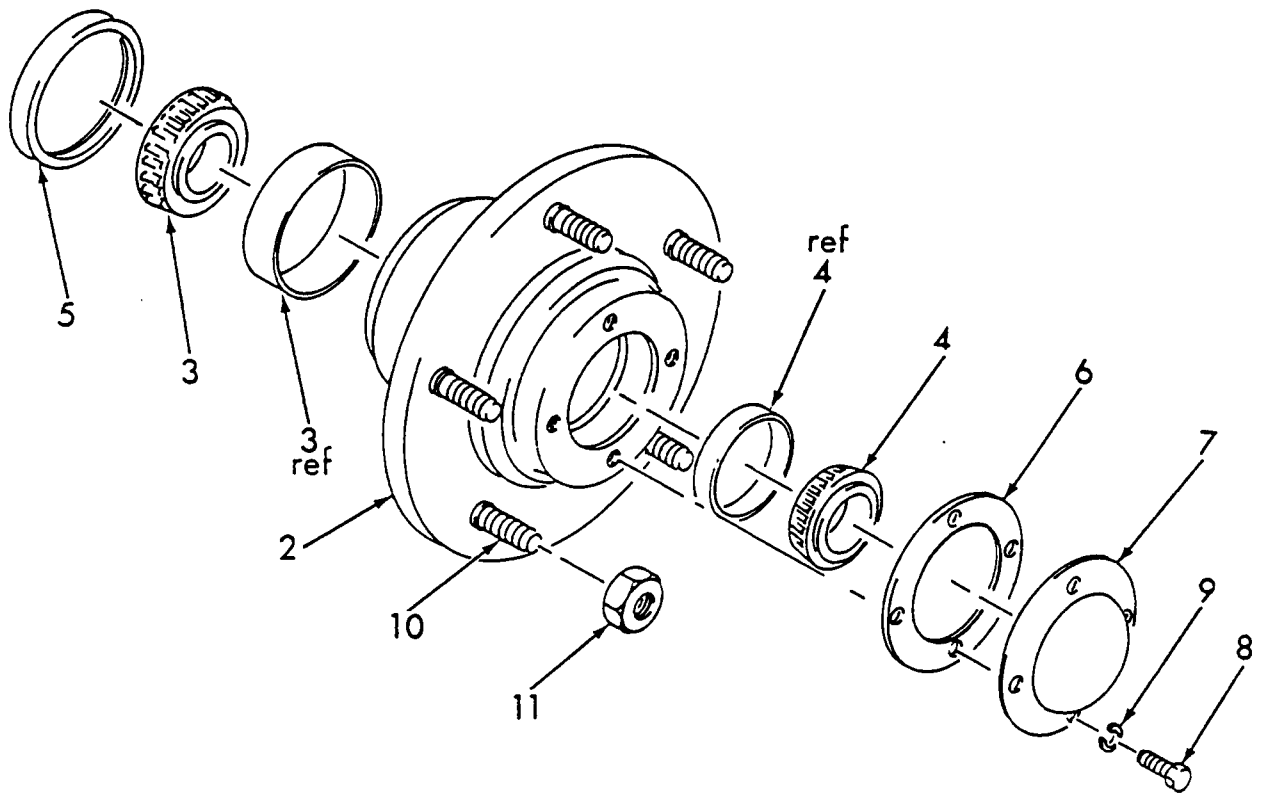
NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140060	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	.140148	CYLINDER, STEERING (GB)	1
-3	..600083	KIT, SEAL (GB)	1
4	.80004-03	CONNECTOR, STRAIGHT THREAD	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	HUB ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	3
FIGURE	3
PAGE	1

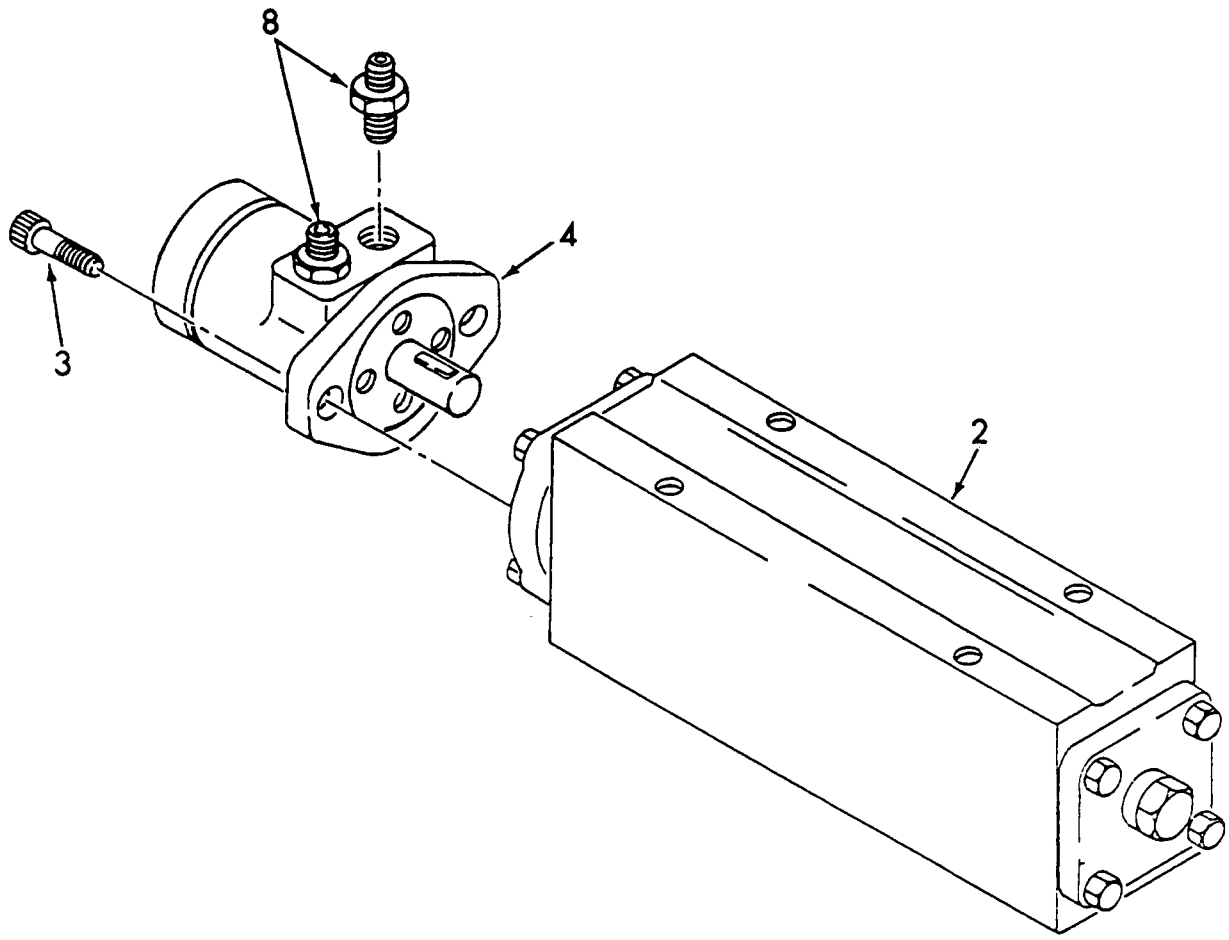


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140089	ASSEMBLY, HUB (See Sect. 3, Fig. 1 for NHA)	REF
2	.67141	HUB	1
3	.67140	CONE, INNER BEARING	1
4	.67139	CONE, OUTER BEARING	1
5	.67137	SEAL, GREASE	1
6	.67136	GASKET	1
7	.67135	CAP, GREASE	1
8	.67143	BOLT, HEX HEAD	4
9	.67144	WASHER, LOCK	4
10	.65943	BOLT, WHEEL	5
11	.67138	NUT, WHEEL	5

Mark Industries

TITLE	ROTATION GEARBOX ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECTION	3
FIGURE	4
PAGE	1

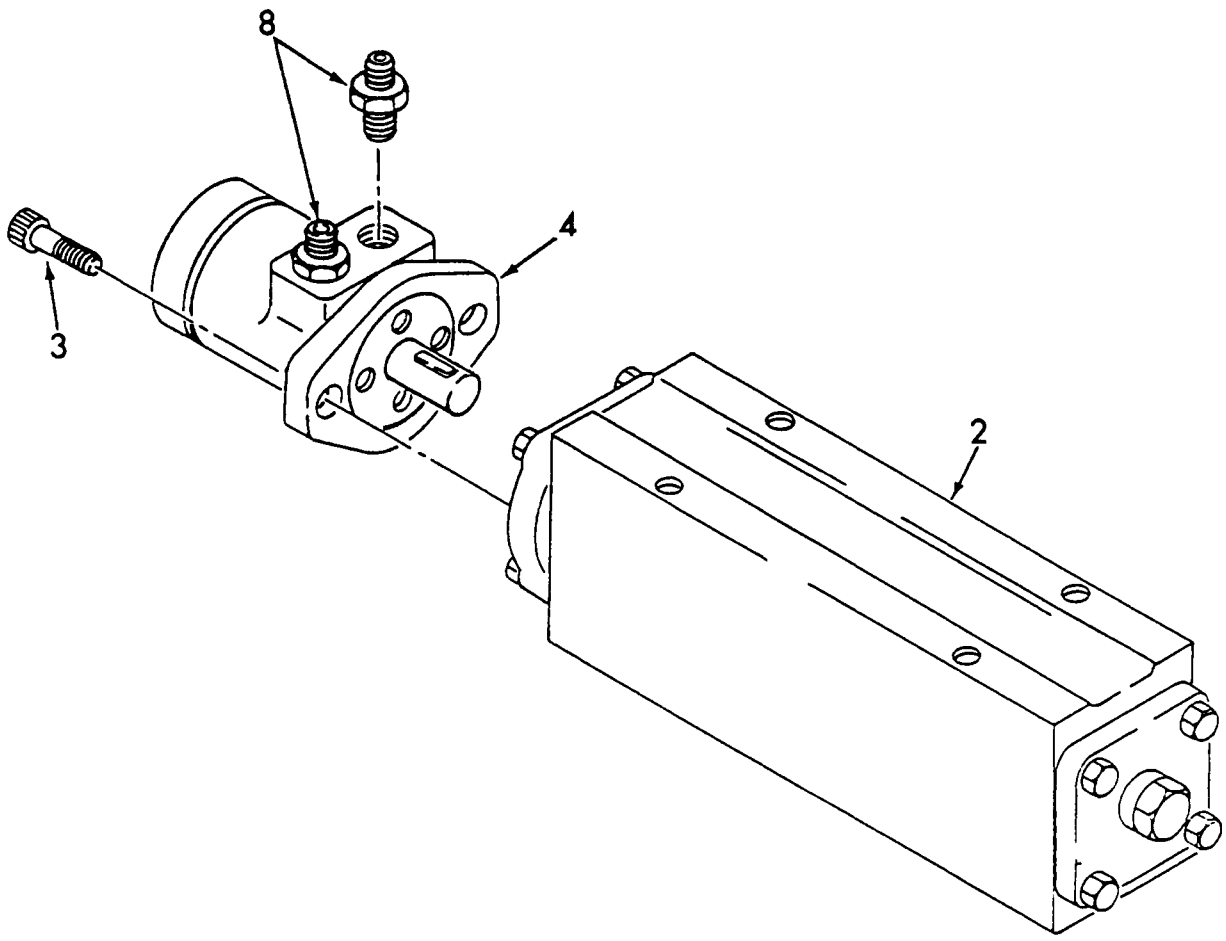


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140600	ASSEMBLY, ROTATION GEARBOX (See Sect. 3, Fig. 1 for NHA)	REF
2	.23736	ASSEMBLY, WORM GEAR	1
3	.62011	SCREW, CAP	2
4	.81187	MOTOR, HYDRAULIC (See Vendor Chapter for Details)	1
-5	..66965	KIT, SEAL	1
-6	..67354	LINK, DRIVE	1
-7	..67353	SHAFT, COUPLING	1
8	.80004-10	CONNECTOR, STRAIGHT THREAD	2

Mark Industries

TITLE	ROTATION GEARBOX ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

SECTION	3
FIGURE	4A
PAGE	1

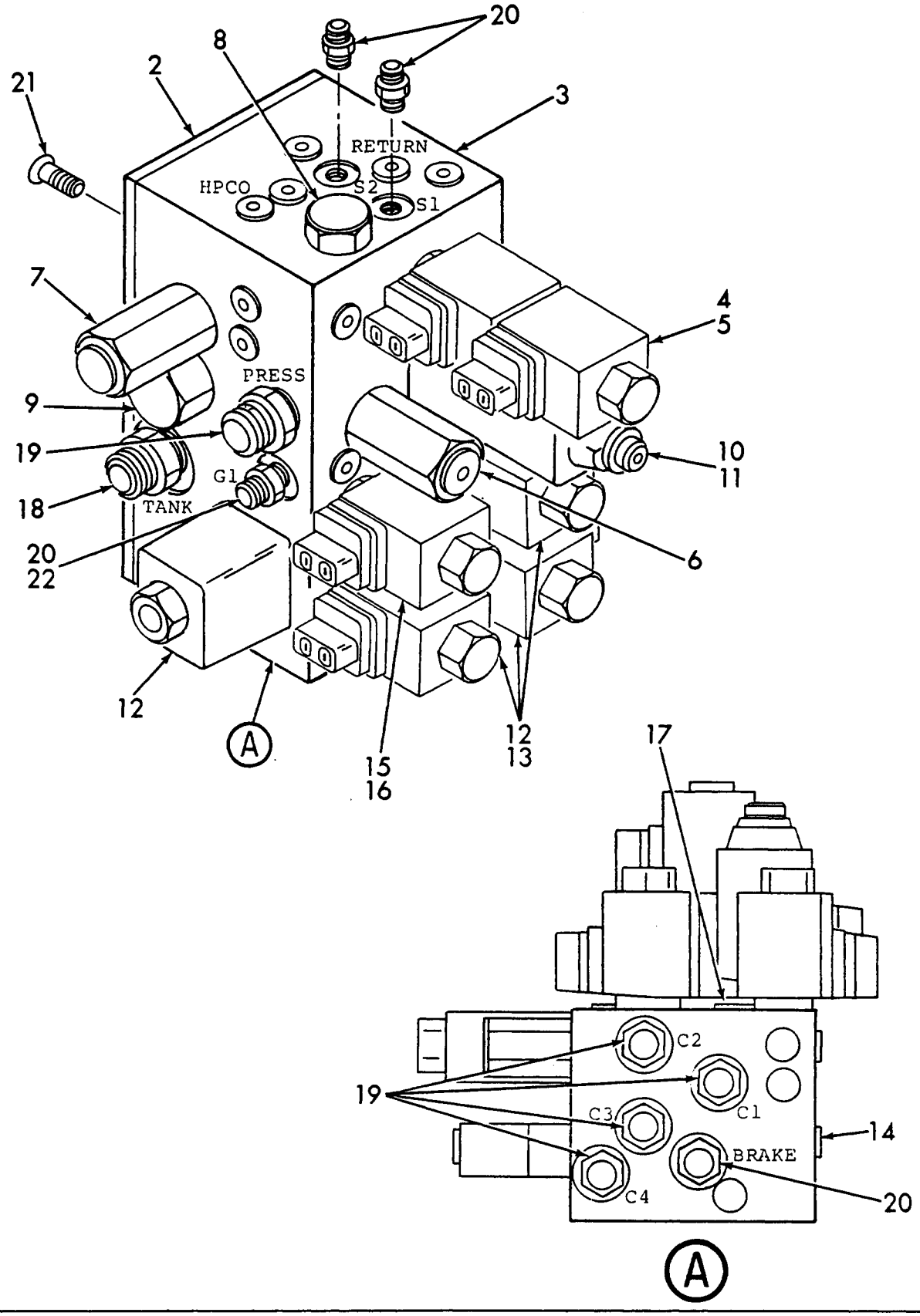


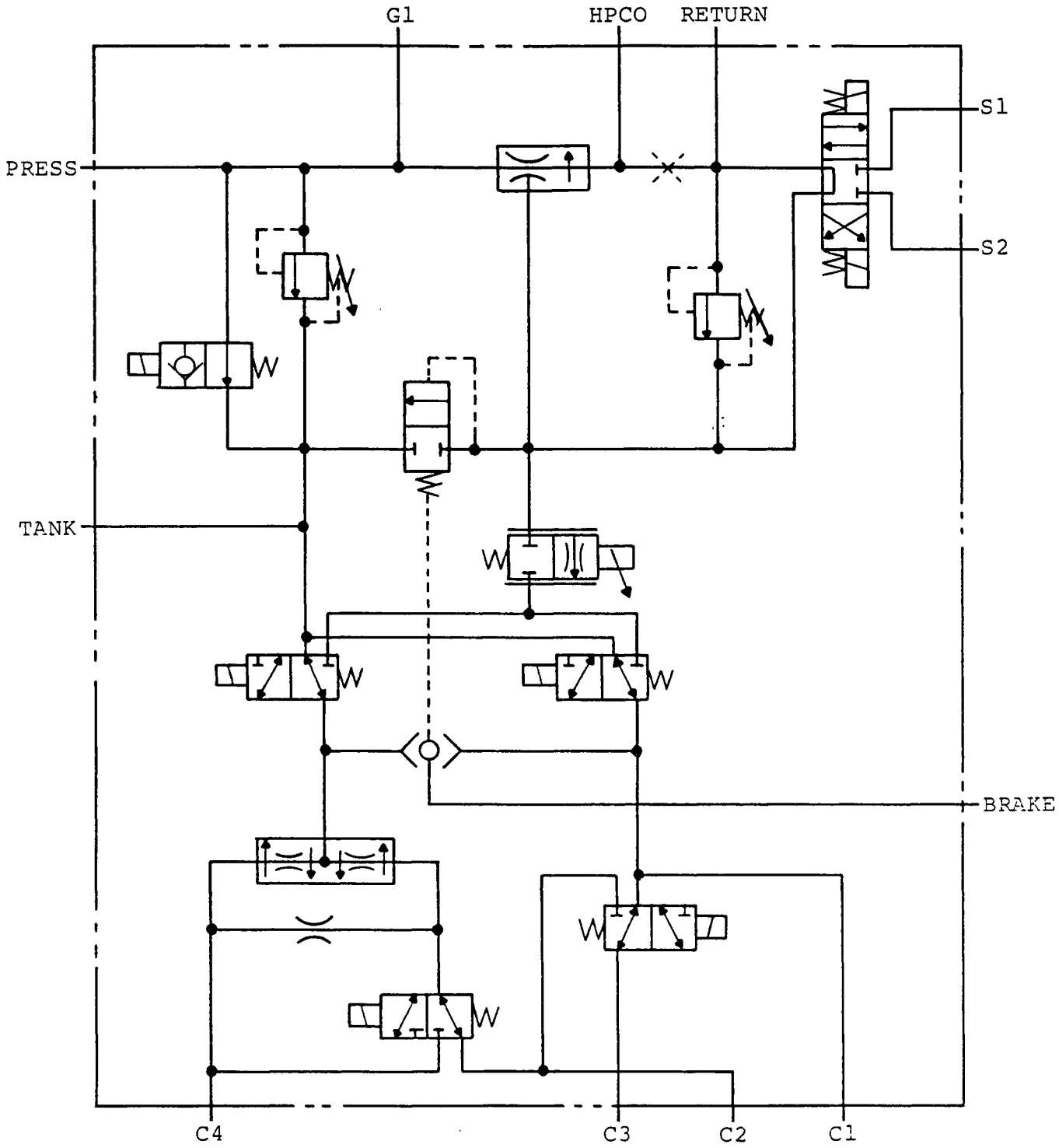
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140600	ASSEMBLY, ROTATION GEARBOX (See Sect. 3, Fig. 1 for NHA)	REF
2	.23736	ASSEMBLY, WORM GEAR	1
3	.62011	SCREW, CAP	2
4	.81278	MOTOR, HYDRAULIC (See Vendor Chapter for Details)	1
-5	..67688	KIT, SEAL	1
-6	..67691	LINK, DRIVE	1
-7	..67698	SHAFT, COUPLING	1
8	.80004-10	CONNECTOR, STRAIGHT THREAD	2

Mark Industries

TITLE	DRIVE/STEER VALVE PACKAGE ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	3
FIGURE	5
PAGE	1



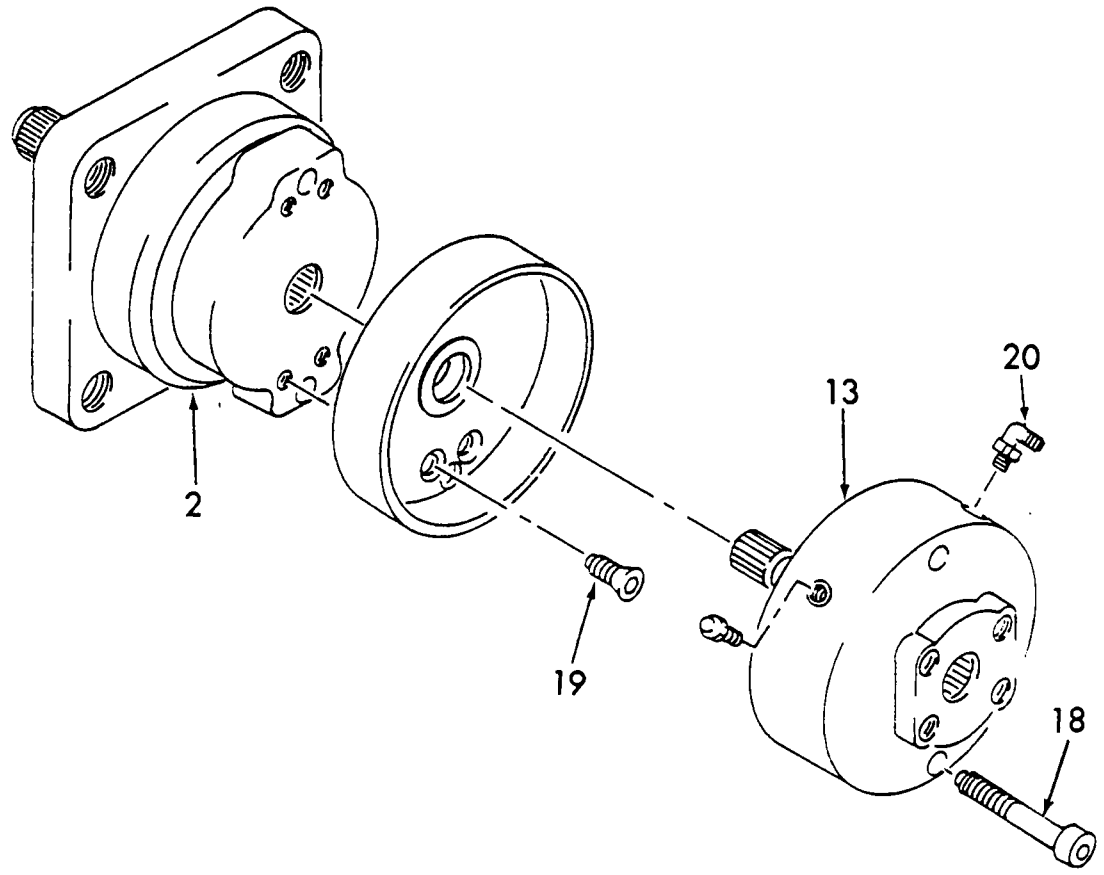

G1
HPCO
RETURN
S1
S2
PRESS
TANK
BRAKE
C4
C3
C2
C1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140316	ASSEMBLY, DRIVE/STEER VALVE PACKAGE (See Sect. 3, Fig. 1 for NHA)	REF
2	.140491	PLATE, MOUNTING	1
3	.81212	VALVE, DRIVE CONTROL	1
4	..67222	3 POSITION/4 WAY VALVE	1
5	...66863	COIL, 10 VOLT (SMALL)	2
*6	..68060	VALVE, RELIEF	1
*7	..68057	VALVE, RELIEF	1
8	..67229	REGULATOR, FLOW	1
9	..600024	VALVE, DIFFERENTIAL SENSING	1
10	..67677	VALVE, PROPORTIONAL	1
11	...600111	COIL, 12 VOLT (LARGE)	1
12	..67220	VALVE, SOLENOID	4
13	...66863	COIL, 10 VOLT (SMALL)	4
14	..600023	VALVE, SHUTTLE	1
15	..66676	VALVE, SOLENOID	1
16	...66863	COIL, 10 VOLT (SMALL)	1
17	..67219	DIVIDER/COMBINER, FLOW	1
18	.80004-15	CONNECTOR, STRAIGHT THREAD	1
19	.80004-11	CONNECTOR, STRAIGHT THREAD	5
20	.80004-03	CONNECTOR, STRAIGHT THREAD	4
21	.61813	SCREW, CAP	3
22	.80059-03	CAP	1
		NOTE: PRIOR TO USE, RELIEF VALVES WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE INDICATED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

Mark Industries

TITLE	BRAKE/TORQUE HUB ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	3
FIGURE	6
PAGE	1

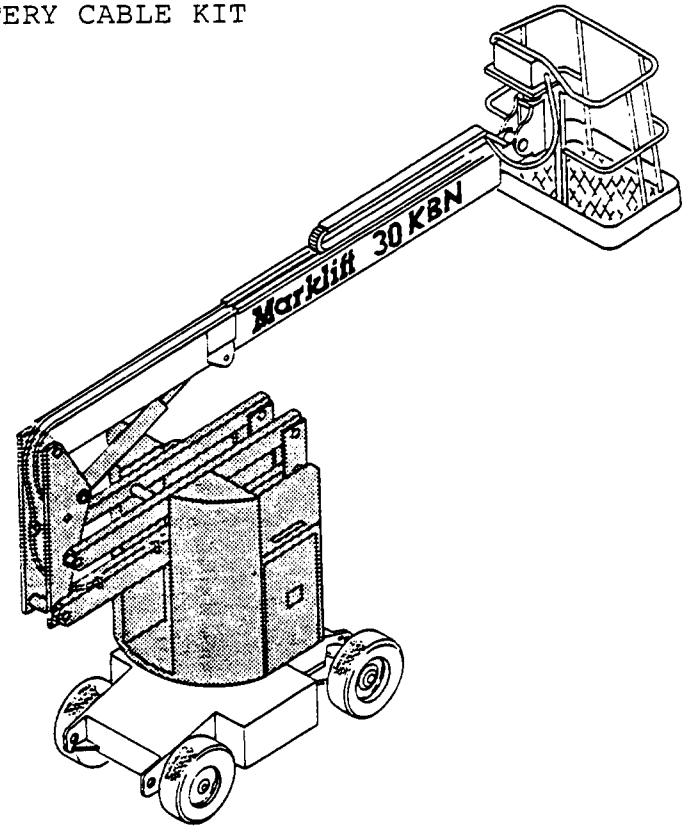


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140596	ASSEMBLY, BRAKE/TORQUE HUB (See Sect. 3, Fig. 1 for NHA)	REF
2	.81208	HUB, TORQUE (See Vendor Chapter for Details)	2
-3	..600255	SEAL, HUB/SHAFT (1B)	1
-4	..67919	CUP, BEARING (1C)	2
-5	..67925	CONE, BEARING (1D)	2
-6	..67900	WASHER, THRUST (1S)	1
-7	..67878	SHAFT/CARRIER, OUTPUT (1T)	1
-8	..600256	SEAL, SLEEVE (1U)	1
-9	..67926	ROLLER, NEEDLE (1X)	57
-10	..67901	WASHER, THRUST (1Z)	12
-11	..67883	GEAR, INPUT (9)	1
-12	..67902	WASHER, THRUST (11)	1
13	.81207	BRAKE (See Vendor Chapter for Details)	2
-14	..67641	KIT, SEAL	1
-15	..67647	KIT, LINING	1
-16	..67658	KIT, BEARING	1
-17	..67651	KIT, SPRING	1
18	..600331	SCREW, CAP	2
19	.61812	SCREW CAP	3
20	.80012-03	ELBOW,STRAIGHT THREAD	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

SECTION 4 CONTAINS:

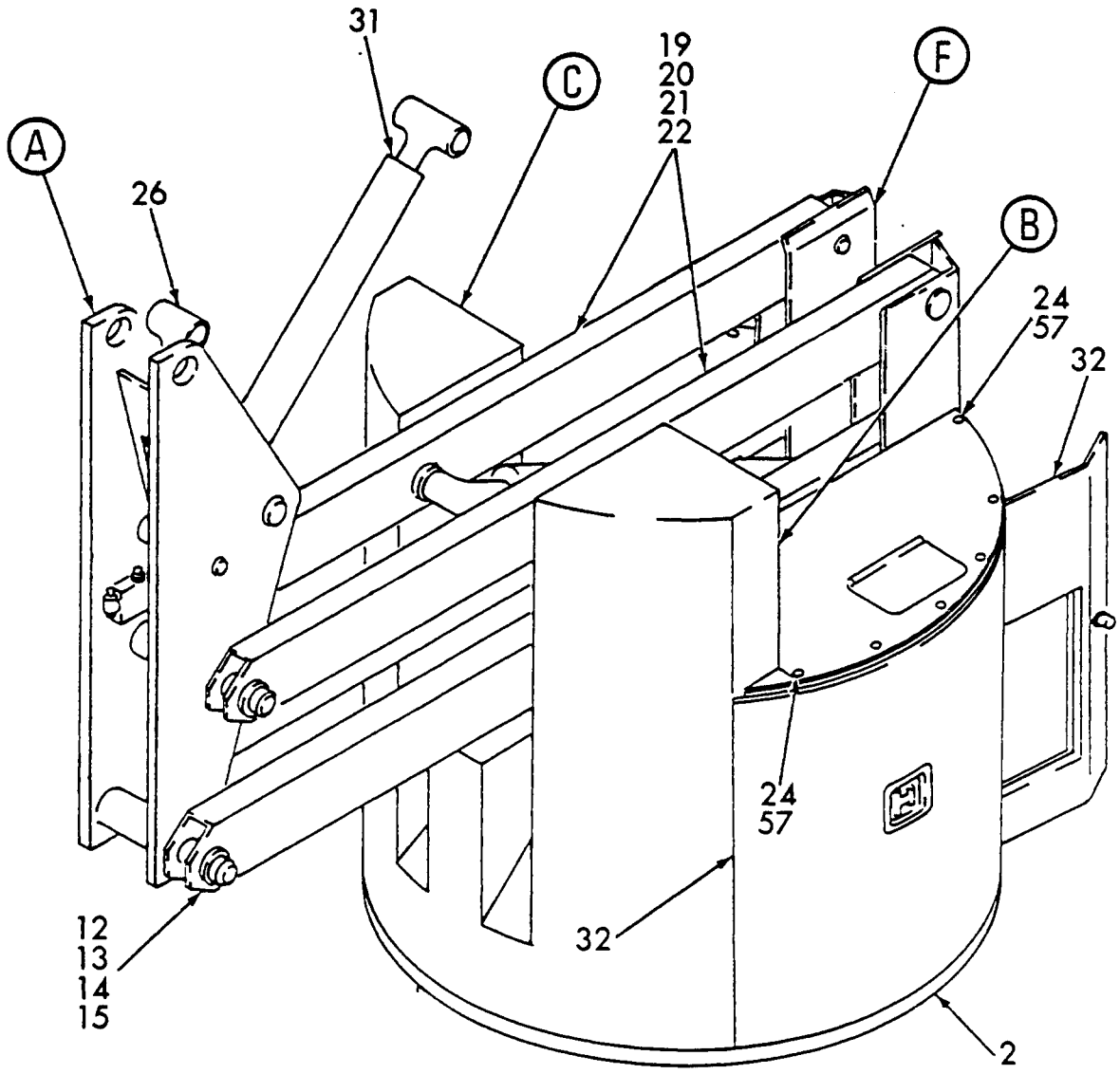
FIG. NO.	TITLE
1	TURRET ASSEMBLY (BEFORE OCT. 1989)
2	MASTER CYLINDER
3	BOOM LIFT
4	HYDRAULIC TANK ASSEMBLY
5	AUTOMATIC BATTERY CHARGER (DOMESTIC) (120 VAC/60 HZ, 36 VDC/40 AMP)
6	MANUAL BATTERY CHARGER (INTERNATIONAL) (230 VAC/50 HZ, 36 VDC/40 AMP)
6A	AUTOMATIC BATTERY CHARGER (INTERNATIONAL) (230 VAC/50 HZ, 36 VDC/40 AMP)
7	BOOM FUNCTION VALVE ASSEMBLY (UNTIL LATE 1988)
7A	BOOM FUNCTION VALVE ASSEMBLY (SINCE LATE 1988)
8	EMERGENCY PUMP ASSEMBLY (UNTIL LATE 1988)
8A	EMERGENCY PUMP ASSEMBLY (SINCE LATE 1988)
9	REGENERATIVE VALVE SUB-ASSEMBLY
10	PUMP & MOTOR ASSEMBLY (UNTIL LATE 1988)
10A	PUMP & MOTOR ASSEMBLY (SINCE LATE 1988)
11	BATTERY CABLE KIT



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

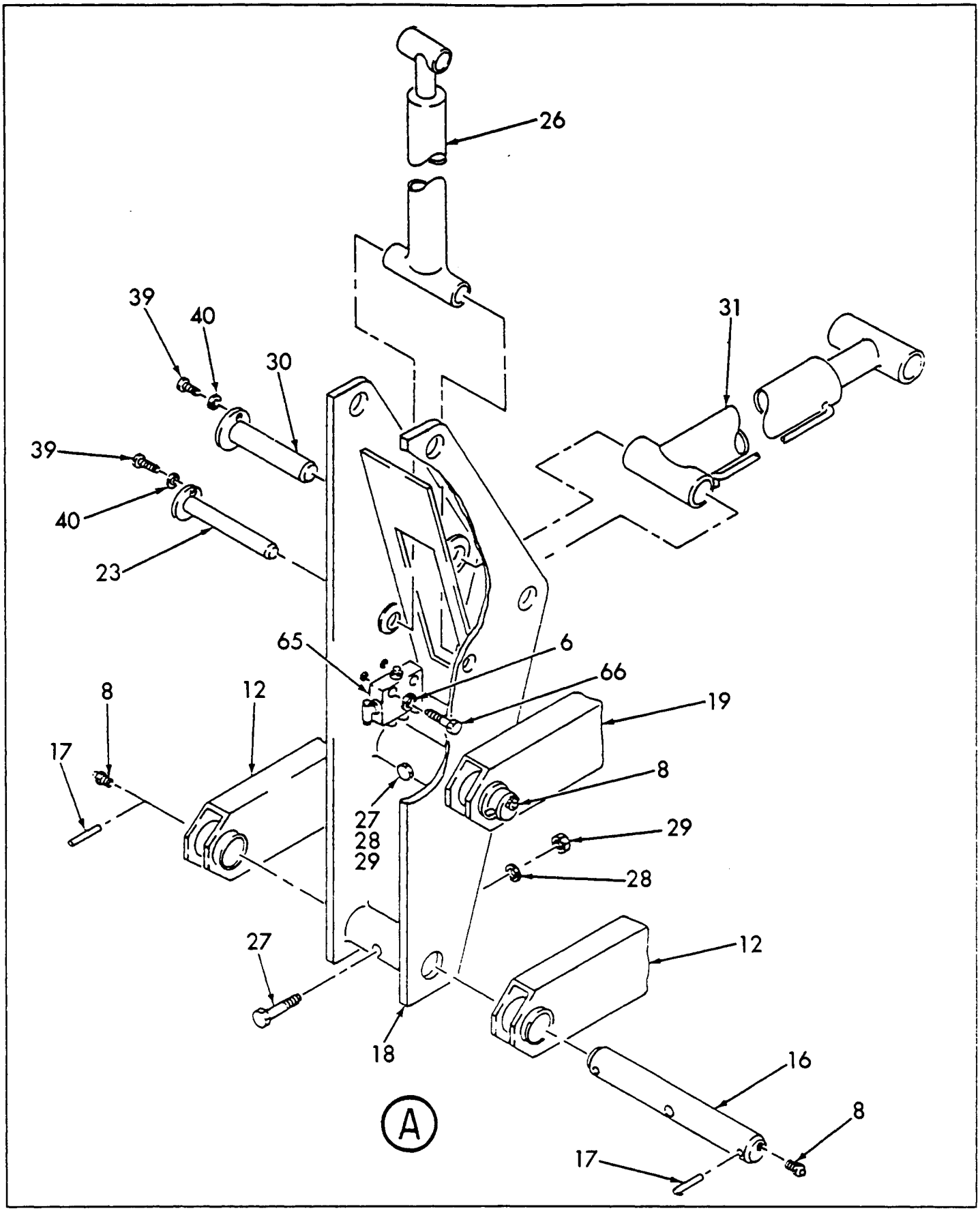
SECTION	4
FIGURE	1
PAGE	1



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

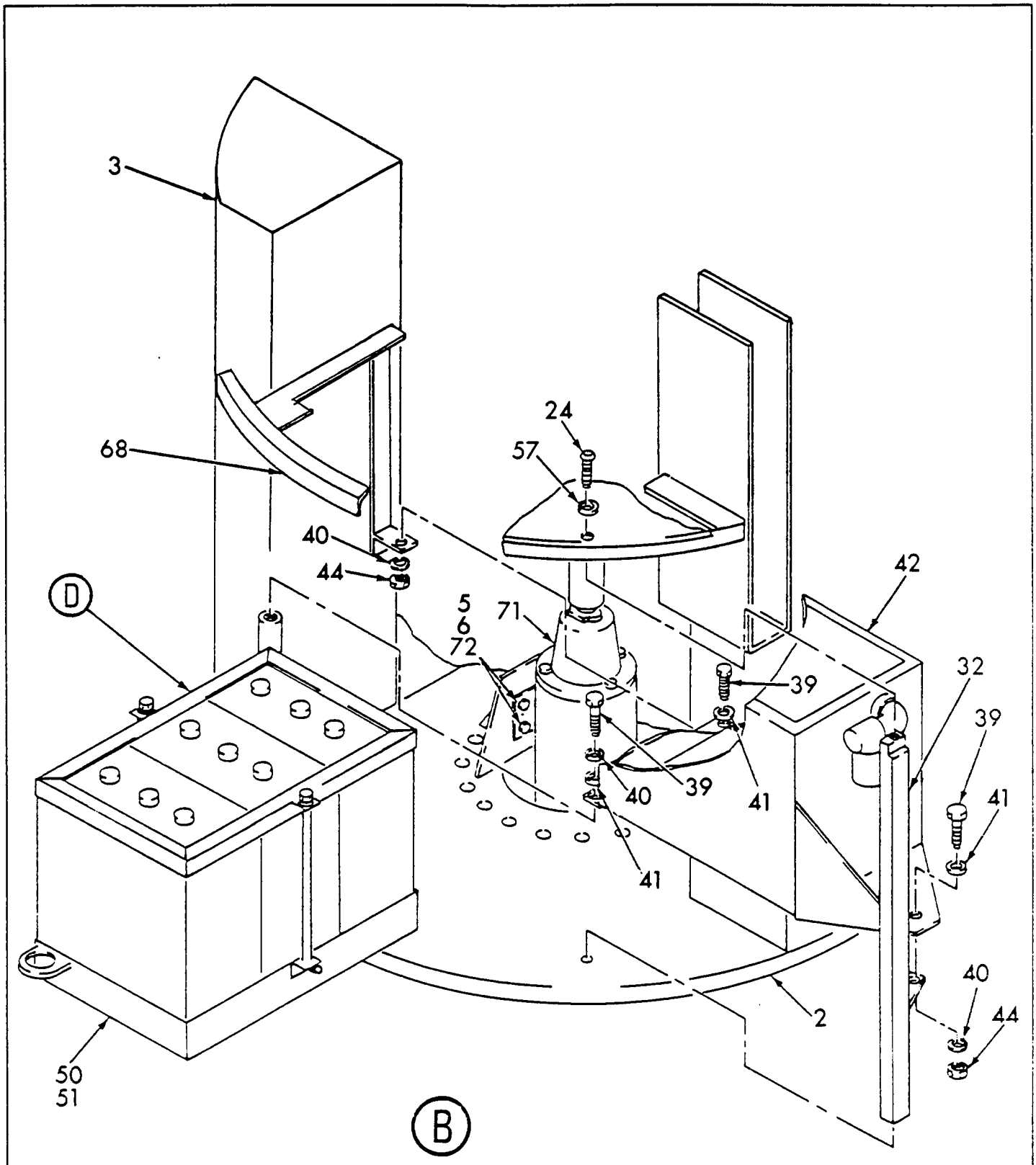
SECTION	4
FIGURE	1
PAGE	2



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

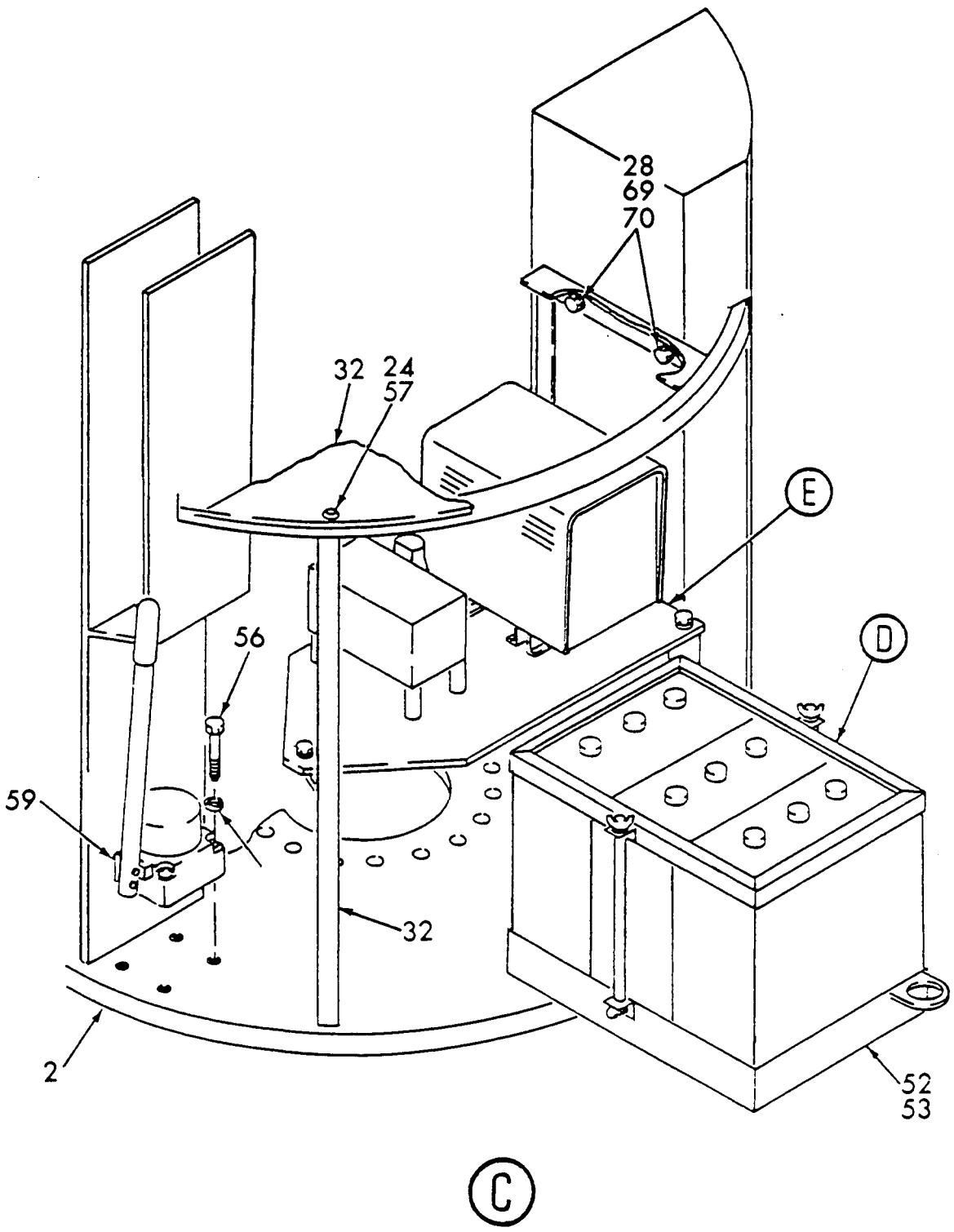
SECTION	4
FIGURE	1
PAGE	3



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

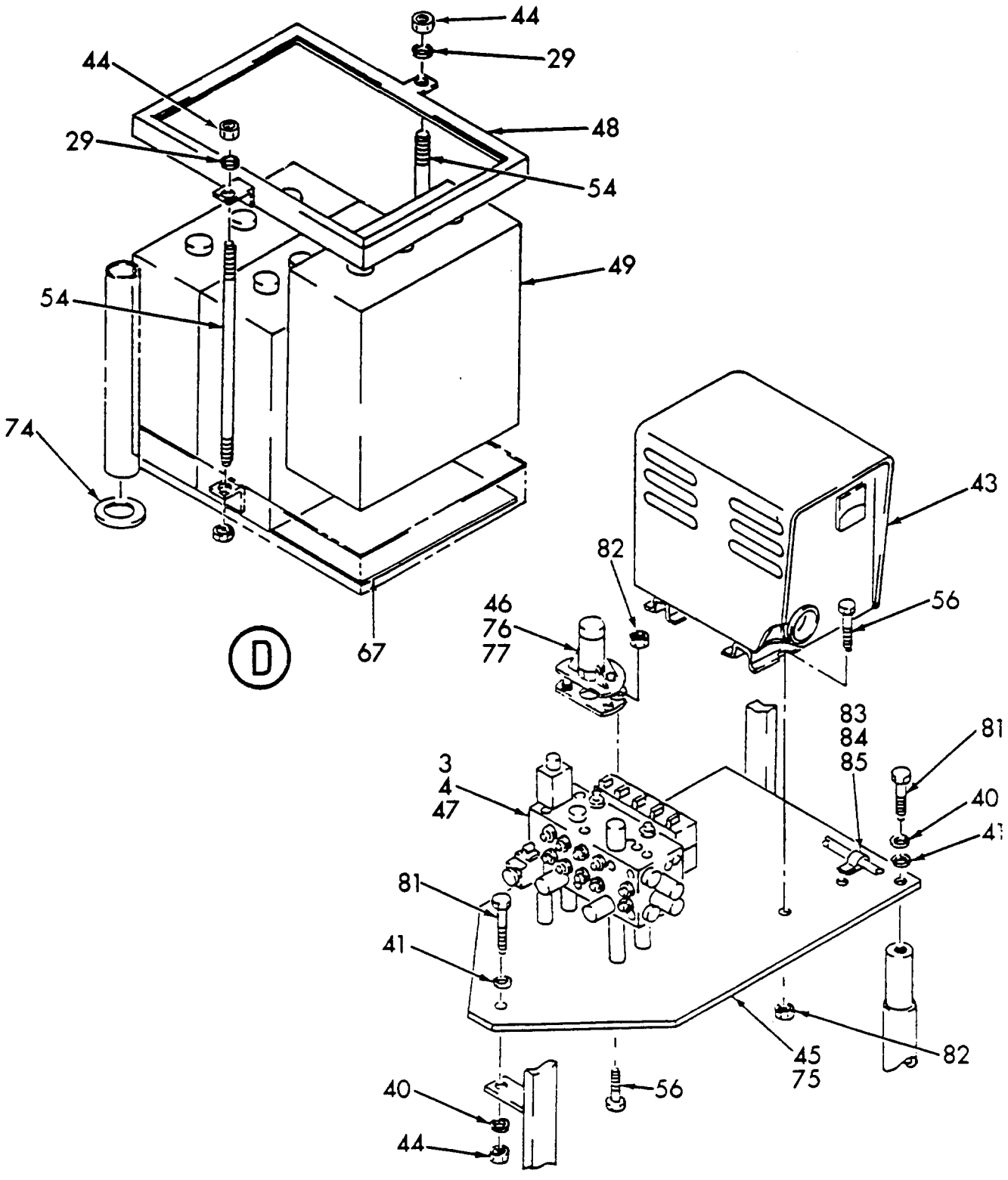
SECTION	4
FIGURE	1
PAGE	4



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

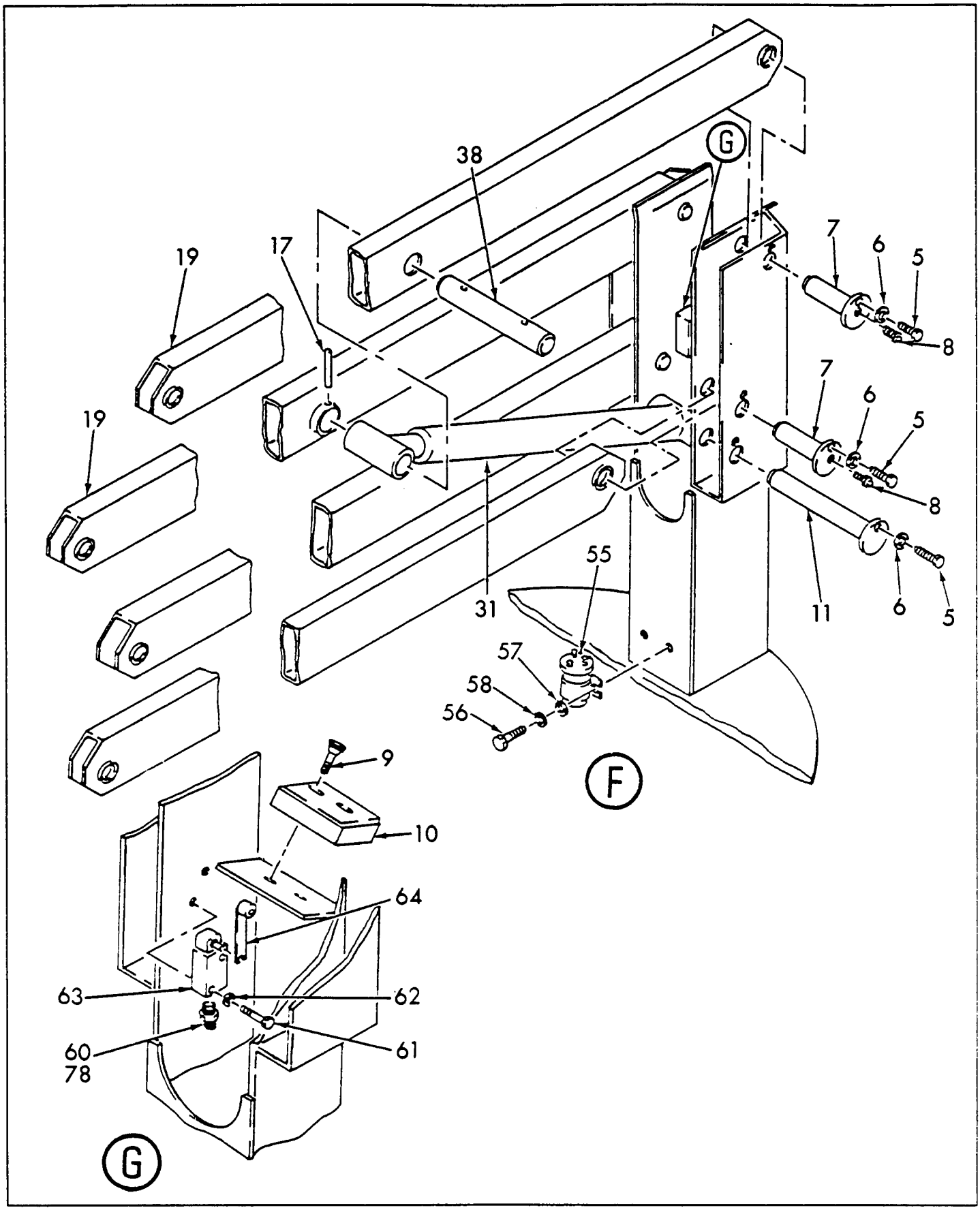
SECTION	4
FIGURE	1
PAGE	5



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECTION	4
FIGURE	1
PAGE	6



Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECT.	4
FIG.	1
PAGE	7

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140116	ASSEMBLY, TURRET (See Sect. 2, Fig. 1 for NHA)	REF
2	.140804	WELDMENT, TURRET & COUNTERWEIGHT	1
3	.60347	SCREW, CAP	4
4	.27281	TUBE	4
5	.60322	SCREW, CAP	9
6	.63302	WASHER, LOCK	11
7	.140455	PIN, RISER ARM	4
8	.65103	FITTING, GREASE	8
9	.61831	SCREW, CAP	2
10	.141238	PAD, BOOM REST	1
11	.140454	PIN, RISER (LIFT CYLINDER)	1
12	.140391	ASSEMBLY, RISER ARM	2
13	..140101	WELDMENT, RISER ARM	2
14	..140389	BUSHING, RISER	2
15	..140388	BUSHING, COLUMN	2
16	.140469	PIN, ARM/RISER	2
17	.64216	PIN, ROLL	6
18	.140140	MACHINING, RISER	1
19	.140390	ASSEMBLY, RISER ARM (CYLINDER)	2
20	..140106	WELDMENT, RISER ARM (CYLINDER)	2
21	..140389	BUSHING, RISER	2
22	..140388	BUSHING, COLUMN	2
23	.140427	PIN, MASTER CYLINDER/RISER	1
24	.61921	SCREW, CAP	30
25	.140497	WELDMENT, UPPER ANGLE (R.H.)	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	TURRET ASSEMBLY	SECT.	4
MODEL	30KBN	FIG.	1
NOTES	BEFORE OCT. 1989	PAGE	8

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.140062	SUB-ASSEMBLY, MASTER CYLINDER (See Sect. 4, Fig. 2 for Details)	1
27	.60388	SCREW, CAP	2
28	.90565	WASHER, FLAT	4
29	.61305	NUT, LOCK	2
30	.140601	PIN, BOOM LIFT	1
31	.140169	SUB-ASSEMBLY, BOOM LIFT CYLINDER (See Sect. 4, Fig. 3 for Details)	2
32	.140245	KIT, SHEET METAL	1
-33	..140281	METAL, TOP SHEET	2
-34	..140283	PANEL, R.H.	1
-35	..140282	PANEL, L.H.	1
-36	..140284	PANEL, CONTROL	1
-37	..140286	POST, STRIKER	2
38	.140471	PIN, ARM/CYLINDER	1
39	.60325	SCREW, CAP	5
40	.63319	WASHER, LOCK	8
41	.63428	WASHER, FLAT	6
42	.140275	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 4 for Details)	1
43	.70370	CHARGER, BATTERY (DOMESTIC)(AUTO) (See Sect. 4, Fig. 5 for Details)	1
43	.70421	CHARGER, BATTERY (INTERNATIONAL)(MANUAL) (See Sect. 4, Fig. 6 & 6A for Details)	REF
44	.60703	NUT	10
45	.140439	PLATE, MANIFOLD MOUNTING	1
46	.21250	SENSOR, SLOPE	1
47	.140827	ASSEMBLY, BOOM FUNCTION VALVE (See Sect. 4, Fig. 7 & 7A for Details)	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
48	.140462	WELDMENT, BATTERY COVER	1
49	.30297	BATTERY (6 VOLT, 350 AMP) (See Vendor Chapter for Details)	6
50	.140357	WELDMENT, BATTERY TRAY (L.H.)	1
51	..16231	BOLT, LATCH	1
52	.140387	WELDMENT, BATTERY TRAY (R.H.)	1
53	..16231	BOLT, LATCH	1
54	.63676	ROD, THREADED	2
55	.70375	RELAY, POWER (12 VDC/200 AMP)	1
56	.60309	SCREW, CAP	12
57	.63433	WASHER, FLAT	32
58	.63301	WASHER, LOCK	9
59	.140806	ASSEMBLY, EMERGENCY PUMP (See Sect. 4, Fig. 8 & 8A for Details)	1
60	.2806	RELIEF, STRAIN	1
61	.62708	SCREW, MACHINE	2
62	.63313	WASHER, LOCK	2
63	.70173	SWITCH, LIMIT	1
64	.70206	LEVER, LIMIT SWITCH	1
65	.140532	SUB-ASSEMBLY, REGENERATIVE VALVE (See Sect. 4, Fig. 9 for Details)	1
66	.60360	SCREW, CAP	2
67	.65980	PLYWOOD	2
68	.140494	WELDMENT, UPPER ANGLE (L.H.)	1
69	.60326	SCREW, CAP	4
70	.63305	WASHER, LOCK	4
71	.140700	ASSEMBLY, PUMP & MOTOR (See Sect. 4, Fig. 10 & 10A for Details)	1

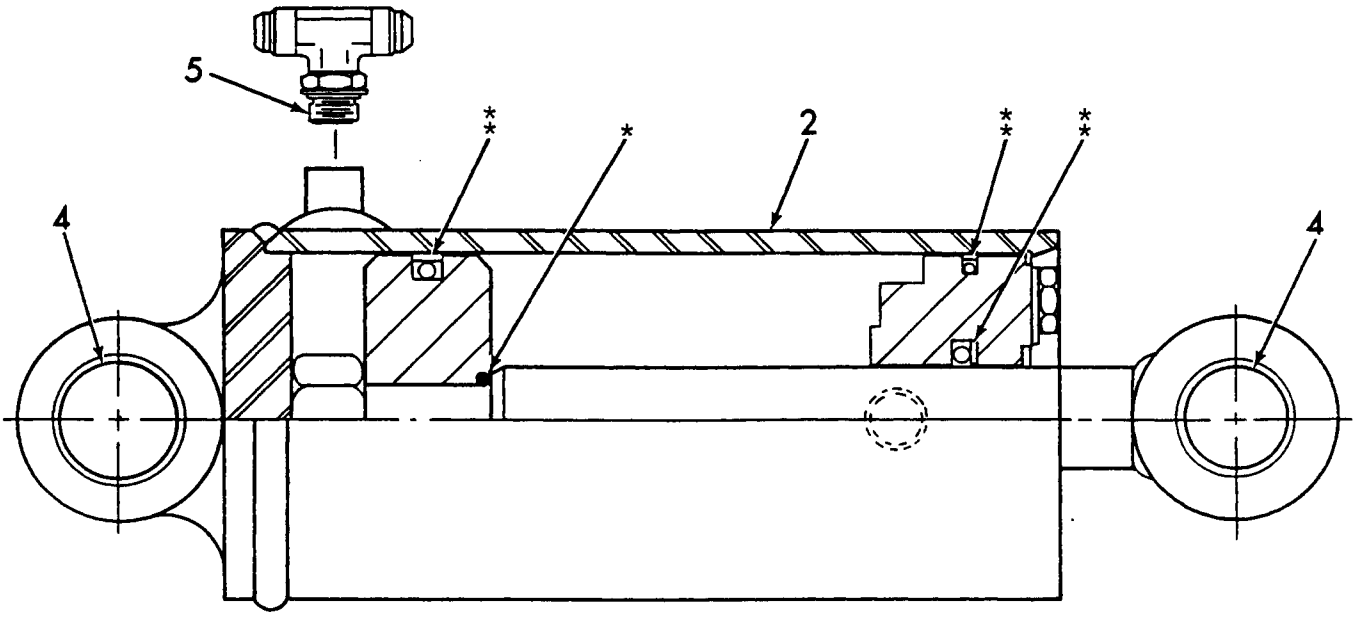
DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
72	.63434	WASHER, FLAT	4
-73	.140603	KIT, BATTERY CABLE (See Sect. 4, Fig. 11 for Details)	1
74	.130806	SPACER, CENTER	2
75	.21696	WASHER, GEARBOX	3
76	.66356	TERMINAL, FEMALE	3
77	.66357	TERMINAL, MALE	3
78	.2912	CABLE, CONDUCTOR (18 GAUGE/4 CONDUCTOR)	8
-79	.70384	CABLE, CONDUCTOR (18 GAUGE/25 CONDUCTOR)	11
-80	.70385	CABLE, CONDUCTOR (18 GAUGE/8 CONDUCTOR)	16
81	.60307	SCREW, CAP	3
82	.61239	NUT, LOCK	6
83	.62607	SCREW, MACHINE	6
84	.61241	NUT, LOCK	6
85	.65655	CLAMP, CUSHIONED	6
-86	.140716	HOSE, SUCTION (16" LONG)	1
-87	.81252	CLAMP, HOSE	2

Mark Industries

TITLE	MASTER CYLINDER SUB-ASSEMBLY
MODEL	30KBN
NOTES	

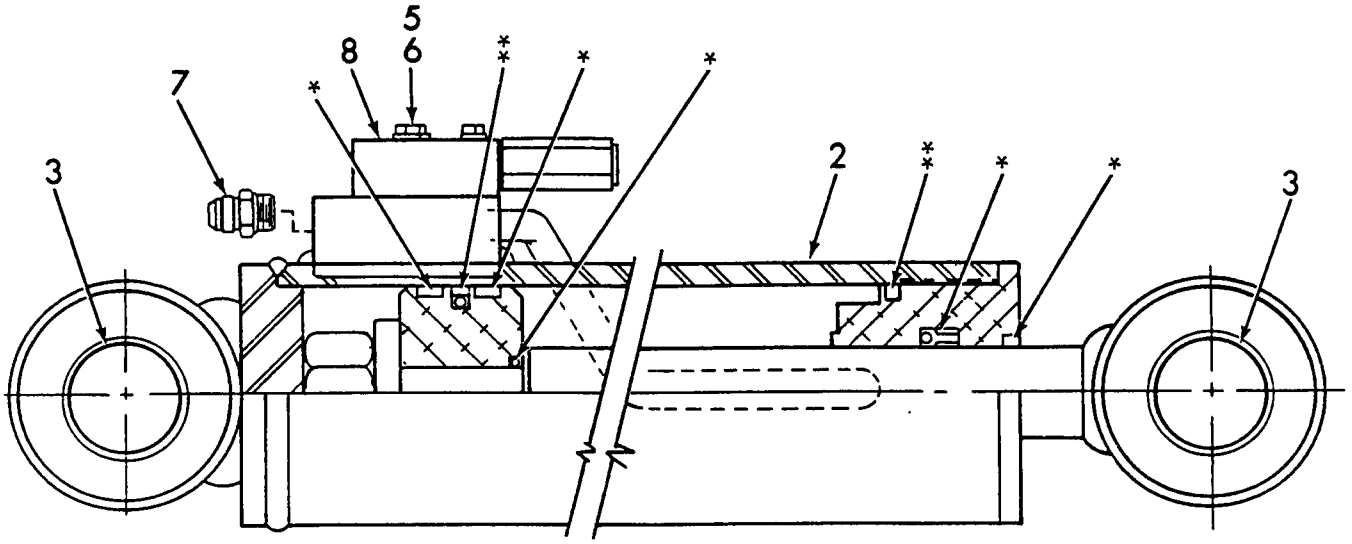
SECTION	4
FIGURE	2
PAGE	1



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140062	SUB-ASSEMBLY, CYLINDER MASTER (See Sect. 4, Fig. 1 for NHA)	REF
2	.140094	CYLINDER, MASTER (SE)	1
3	..67130	KIT, SEAL	1
4	..67191	BUSHING	1
5	.80036-03	TEE, STRAIGHT THREAD	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

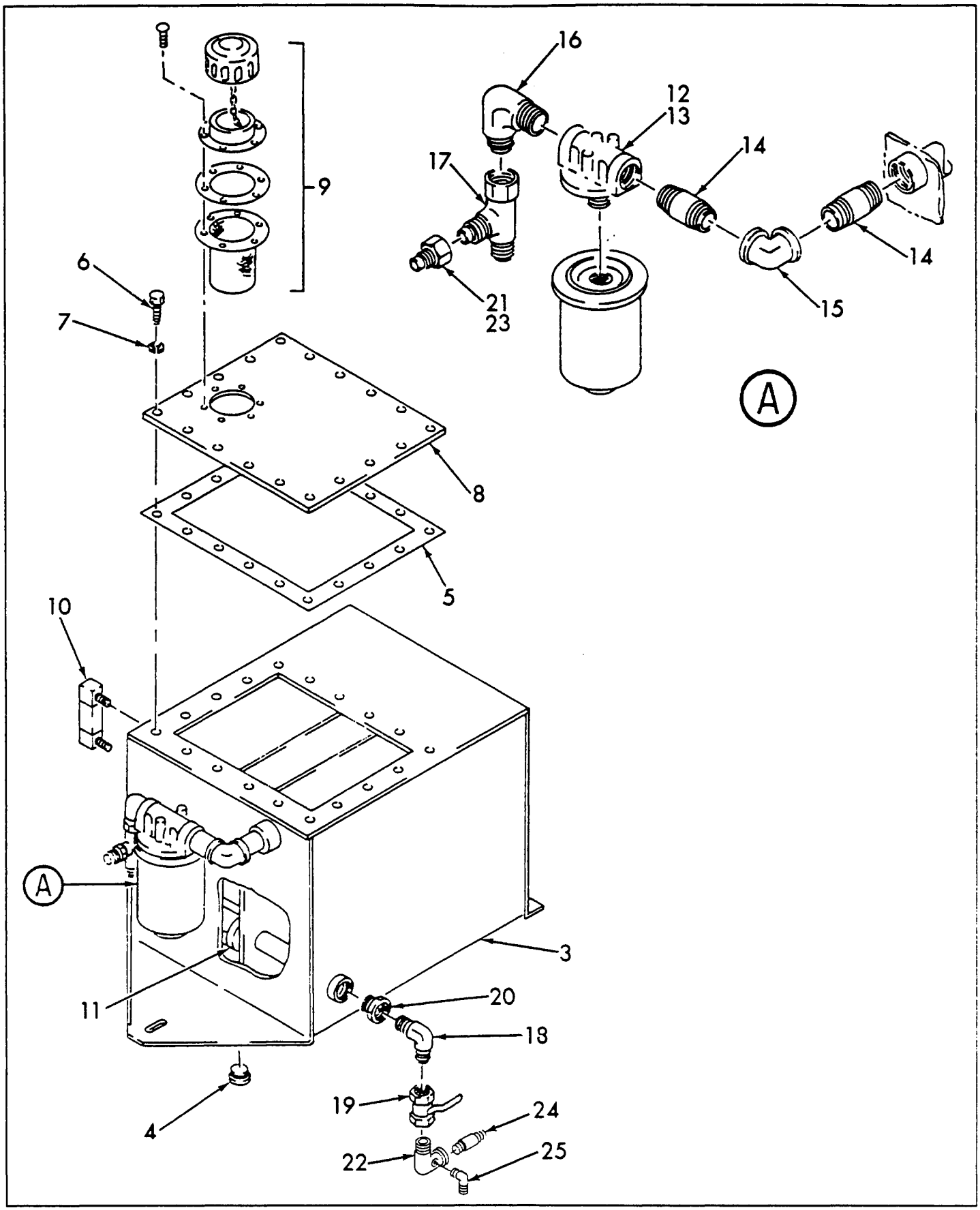
NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140169	SUB-ASSEMBLY, BOOM LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	.140747	CYLINDER, LIFT (SE)	2
3	..67180	BUSHING	4
-4	..67148	KIT, SEAL	1
5	.60319	SCREW, CAP	6
6	.63301	WASHER, LOCK	6
7	.80004-08	CONNECTOR, STRAIGHT THREAD	4
8	.81205	VALVE, HOLDING	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	HYDRAULIC TANK ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	4
FIGURE	4
PAGE	1



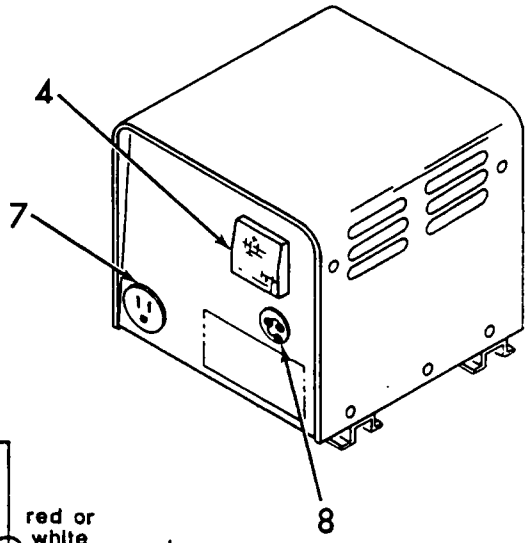
Mark Industries

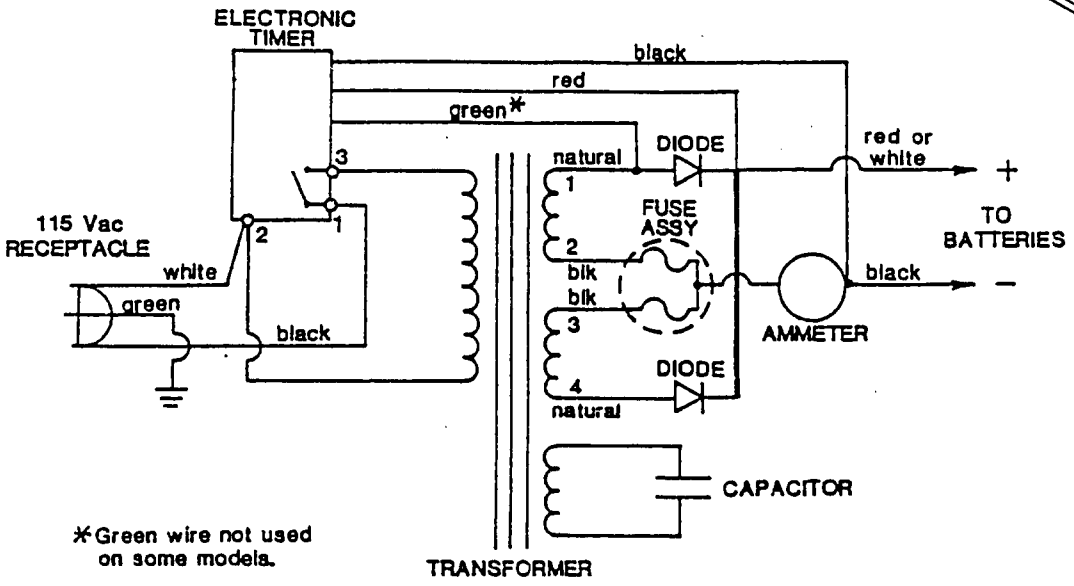
TITLE	HYDRAULIC TANK ASSEMBLY
MODEL	30KBN
NOTES	

SECT.	4
FIG.	4
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140275	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 1 for NHA)	REF
-2	.140210	SUB-ASSEMBLY, HYDRAULIC TANK	1
3	..140211	WELDMENT, HYDRAULIC TANK	1
4	..54200	PLUG, PIPE	1
5	..140213	GASKET	1
6	..60353	SCREW, CAP	18
7	..63301	WASHER, LOCK	18
8	..140212	COVER, TANK	1
9	..3005	ASSEMBLY, BREATHER CAP	1
10	..3018	GAUGE, SIGHT	1
11	..81084	STRAINER	1
12	.81209	FILTER, RETURN	1
13	..67213	CARTRIDGE, FILTER	1
14	.65802	NIPPLE	2
15	.80020-13	ELBOW, FEMALE PIPE	1
16	.80008-21	ELBOW, MALE	1
17	.80028-08	TEE, SWIVEL NUT	1
18	.80022-11	ELBOW, MALE PIPE	1
19	.3033	VALVE, BALL	1
20	.80057-17	REDUCER, PIPE THREAD	1
21	.80056-09	REDUCER, TUBE END	1
22	.140709	ELBOW, MODIFIED	1
23	.80060-08	NUT	1
24	.81251	ADAPTER	1
25	.80008-04	ELBOW, MALE	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED





ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	70370	CHARGER, AUTOMATIC BATTERY (DOMESTIC) (See Sect. 4, Fig. 1 for NHA) (See Vendor Chapter for Details)	REF
-2	.67174	ASSEMBLY, TRANSFORMER	1
-3	.66730	ASSEMBLY, DIODE	2
4	.66747	AMMETER	1
-5	.67173	ASSEMBLY, ELECTRONIC TIMER	1
-6	.66750	CAPACITOR (6.0 MFD/660 VAC)	1
7	.66734	RECEPTACLE (125 VOLT/15 AMP)	1
8	.66726	ASSEMBLY, FUSE	1

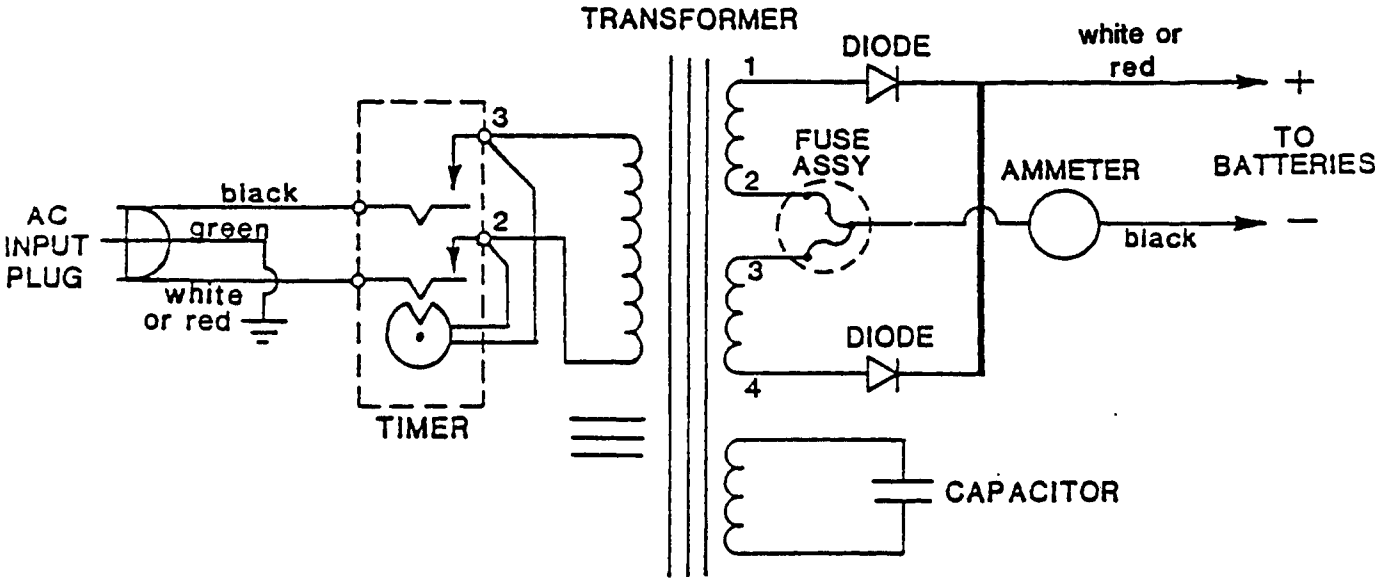


ILLUSTRATION NOT AVAILABLE

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	70421	CHARGER, MANUAL BATTERY (INTERNATIONAL) (See Sect. 4, Fig. 1 for NHA) (See Vendor Chapter for Details)	REF
-2	.67974	ASSEMBLY, TRANSFORMER	1
-3	.66730	ASSEMBLY, DIODE	2
-4	.66747	AMMETER	1
-5	.67971	TIMER, 12 HOUR	1
-6	.66733	KNOB, TIMER	1
-7	.66750	CAPACITOR (6.0 MFD/660 VAC)	1
-8	.66726	ASSEMBLY, FUSE	1

Mark Industries

TITLE	AUTOMATIC BATTERY CHARGER (INT'L)
MODEL	30KBN
NOTES	230 VAC/50 HZ, 36 VDC/40 AMP

SECTION	4
FIGURE	6A
PAGE	1

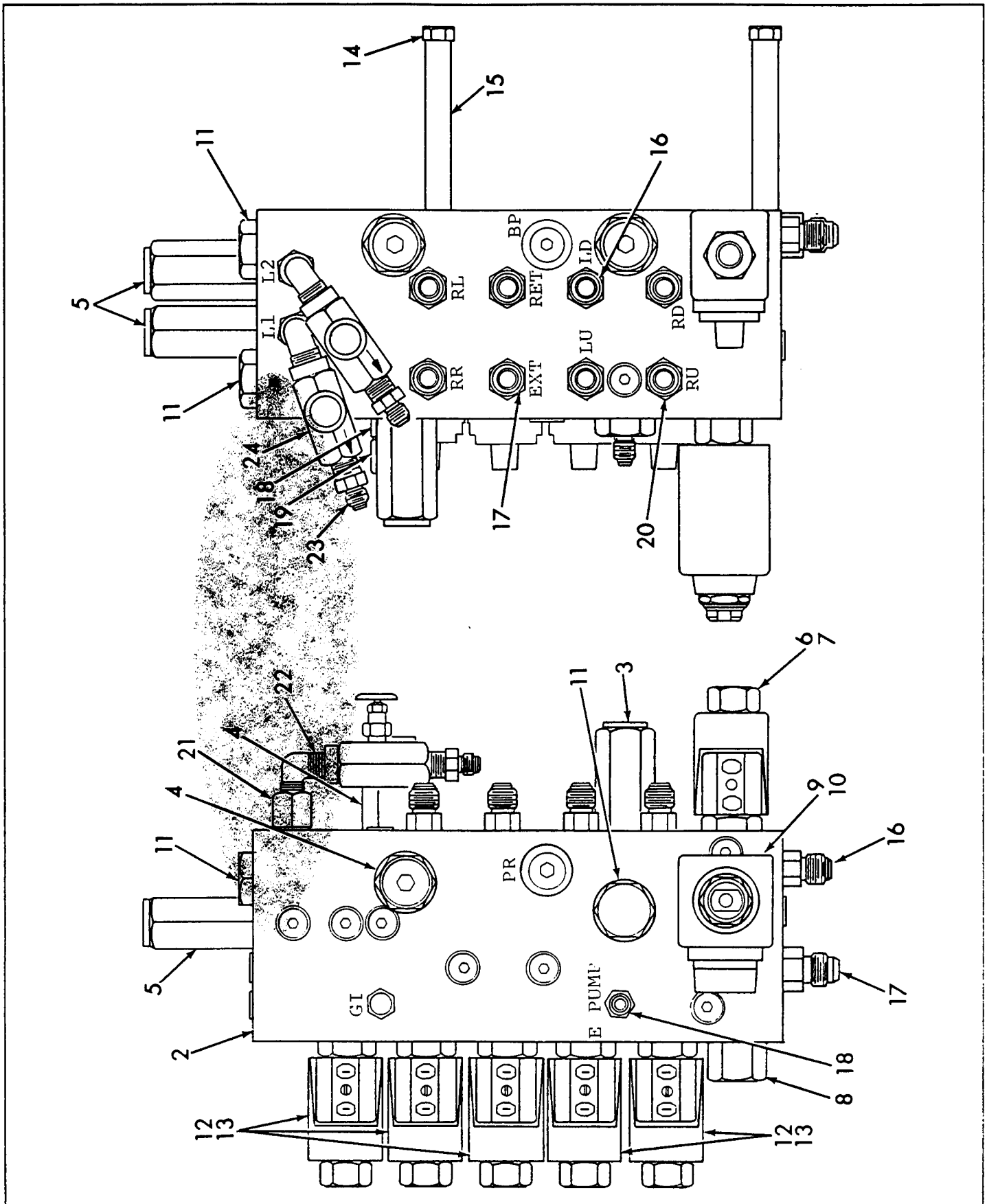
ILLUSTRATION AND SCHEMATIC NOT AVAILABLE

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	70434	CHARGER, AUTOMATIC BATTERY (INT'L) (BYC) (See Sect. 4, Fig. 1 for NHA)	REF
-2	.66726	ASSEMBLY, FUSE	1
-3	.600014	LED, GREEN	1
-4	.600015	LED, RED	1
-5	.67965	RECTIFIER, SILICON	1
-6	.67967	CAPACITOR (20 MFD)	1
-7	.67968	METER (50 AMP)	1

Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

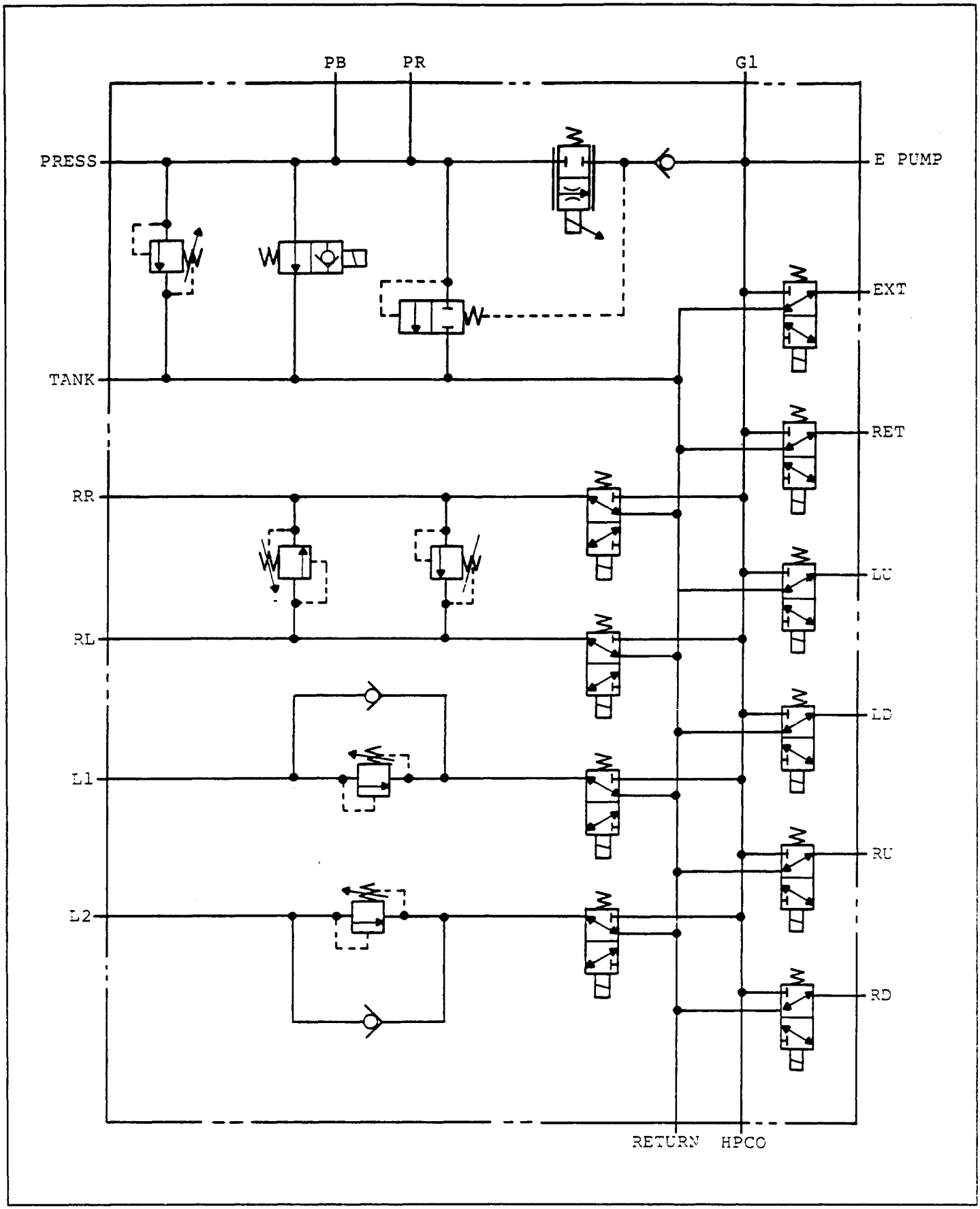
SECTION	4
FIGURE	7
PAGE	1



Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECTION	4
FIGURE	7
PAGE	2



Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECT.	4
FIG.	7
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140477	ASSEMBLY, BOOM FUNCTION VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	.81213	VALVE, FUNCTION CONTROL	1
*3	..68060	VALVE, RELIEF	1
*4	..67218	VALVE, RELIEF	2
*5	..68057	VALVE, RELIEF	2
6	..66676	VALVE, SOLENOID	1
7	...66863	COIL, 10 VOLT (SMALL)	1
8	..67338	VALVE, DIFFERENTIAL SENSING	1
9	..67225	VALVE, PROPORTIONAL SOLENOID	1
10	...600111	COIL, 12 VOLT (LARGE)	1
11	..66674	VALVE, CHECK	3
12	..67220	VALVE, SOLENOID	10
13	...66863	COIL, 10 VOLT (SMALL)	1
14	.60347	SCREW, CAP	4
15	.27281	TUBE	4
16	.80004-08	CONNECTOR, STRAIGHT THREAD	7
17	.80004-11	CONNECTOR, STRAIGHT THREAD	2
18	.80004-03	CONNECTOR, STRAIGHT THREAD	2
19	.80059-03	CAP	1
20	.140765	CONNECTOR, MODIFIED	1
21	.80063-01	ADAPTER, FEMALE PIPE	2
22	.80022-04	ELBOW, MALE PIPE	2
		NOTE: PRIOR TO USE, RELIEF VALVES WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE INDICATED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECT.	4
FIG.	7
PAGE	4

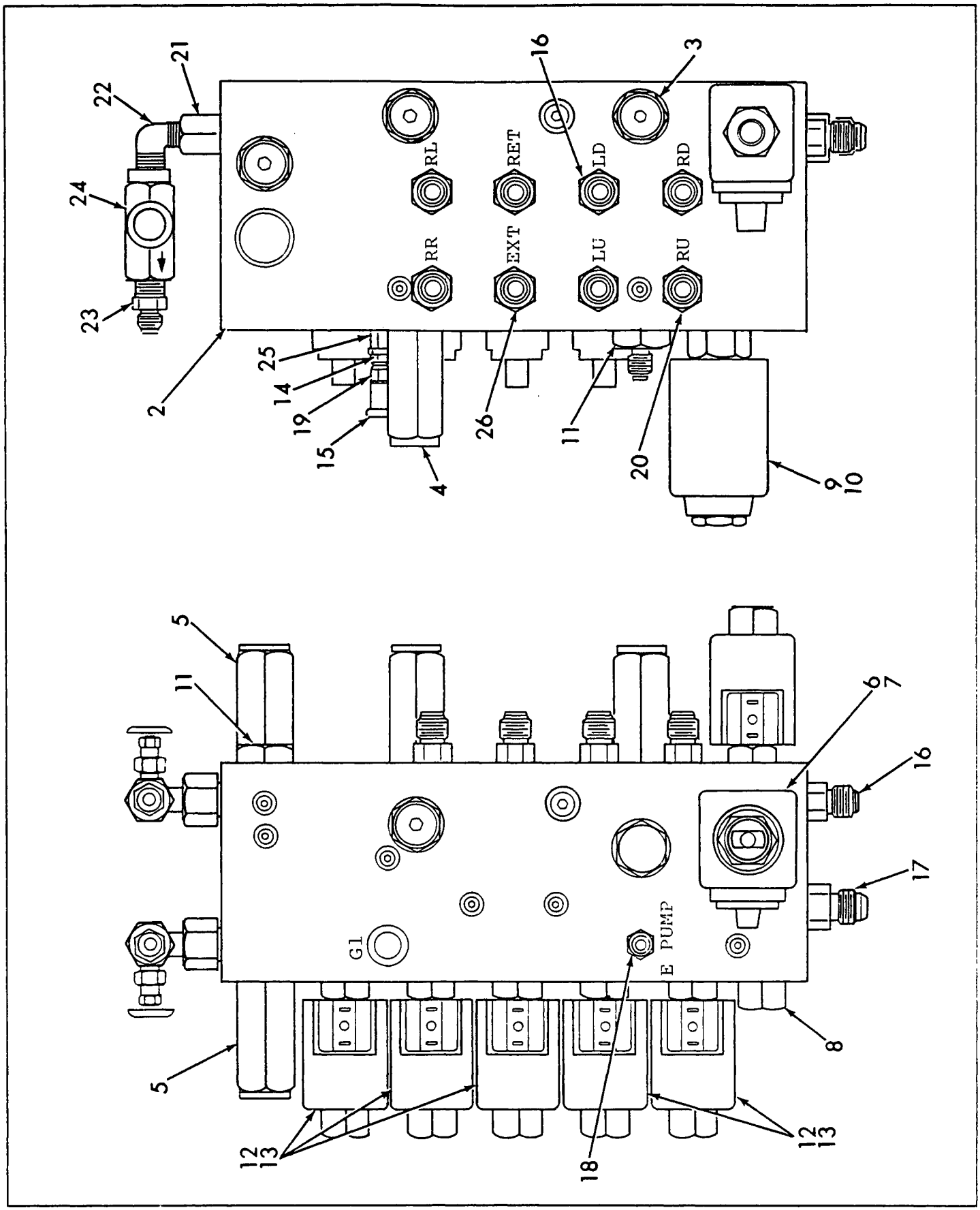
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
23	.80001-04	CONNECTOR, MALE	2
24	.20357	VALVE, NEEDLE	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

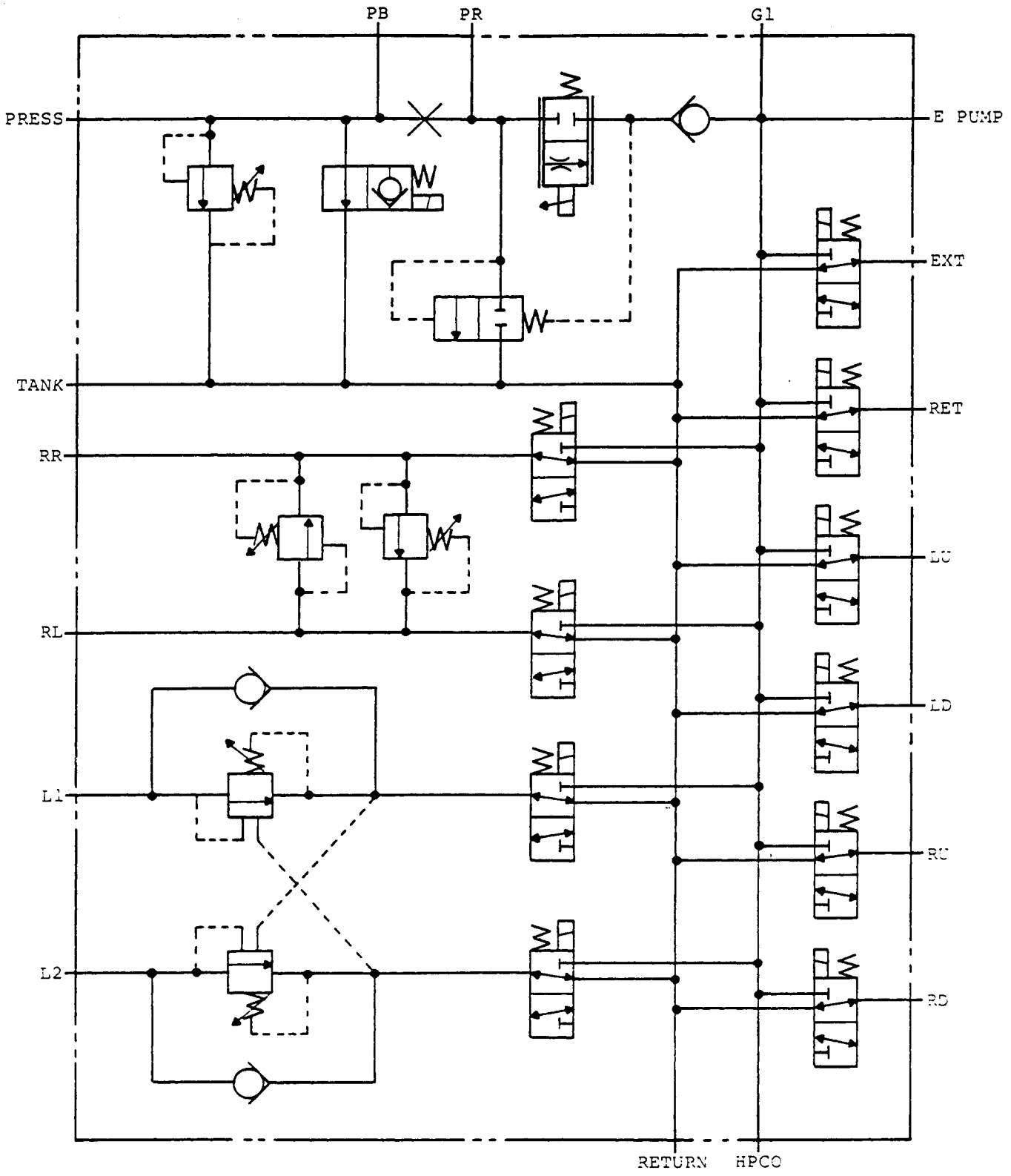
SECTION	4
FIGURE	7A
PAGE	1



Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

SECTION	4
FIGURE	7A
PAGE	2



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140827	ASSEMBLY, BOOM FUNCTION VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	.81247	VALVE, FUNCTION CONTROL	1
*3	..68060	VALVE, RELIEF	1
*4	..67218	VALVE, RELIEF	2
*5	..68057	VALVE, RELIEF	2
6	..66676	VALVE, SOLENOID	1
7	...66863	COIL, 10 VOLT (SMALL)	1
8	..67338	VALVE, DIFFERENTIAL SENSING	1
9	..67225	VALVE, PROPORTIONAL SOLENOID	1
10	...600111	COIL, 12 VOLT (LARGE)	1
11	..66674	VALVE, CHECK	3
12	..67220	VALVE, SOLENOID	10
13	...66863	COIL, 10 VOLT (SMALL)	1
14	.2527	COUPLING, QUICK DISCONNECT	1
15	.845	CAP, QUICK DISCONNECT	1
16	.80004-08	CONNECTOR, STRAIGHT THREAD	7
17	.80004-11	CONNECTOR, STRAIGHT THREAD	2
18	.80004-03	CONNECTOR, STRAIGHT THREAD	1
19	.80052-03	NIPPLE, PIPE	1
20	.140765	CONNECTOR, MODIFIED	1
21	.80063-01	ADAPTER, FEMALE PIPE	2
22	.80022-04	ELBOW, MALE PIPE	2
		NOTE: PRIOR TO USE, RELIEF VALVES WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE INDICATED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

Mark Industries

TITLE	BOOM FUNCTION VALVE ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

SECT.	4
FIG.	7A
PAGE	4

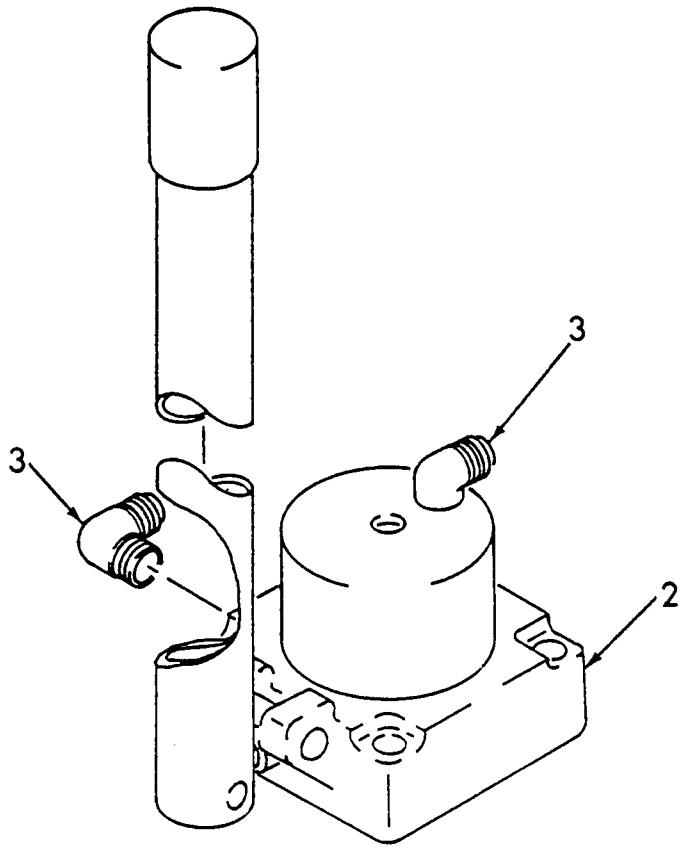
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
23	.80001-04	CONNECTOR, MALE	2
24	.20357	VALVE, NEEDLE	2
25	.51903	ADAPTER, FEMALE PIPE	1
26	.80004-09	CONNECTOR, STRAIGHT THREAD	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	EMERGENCY PUMP ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECTION	4
FIGURE	8
PAGE	1

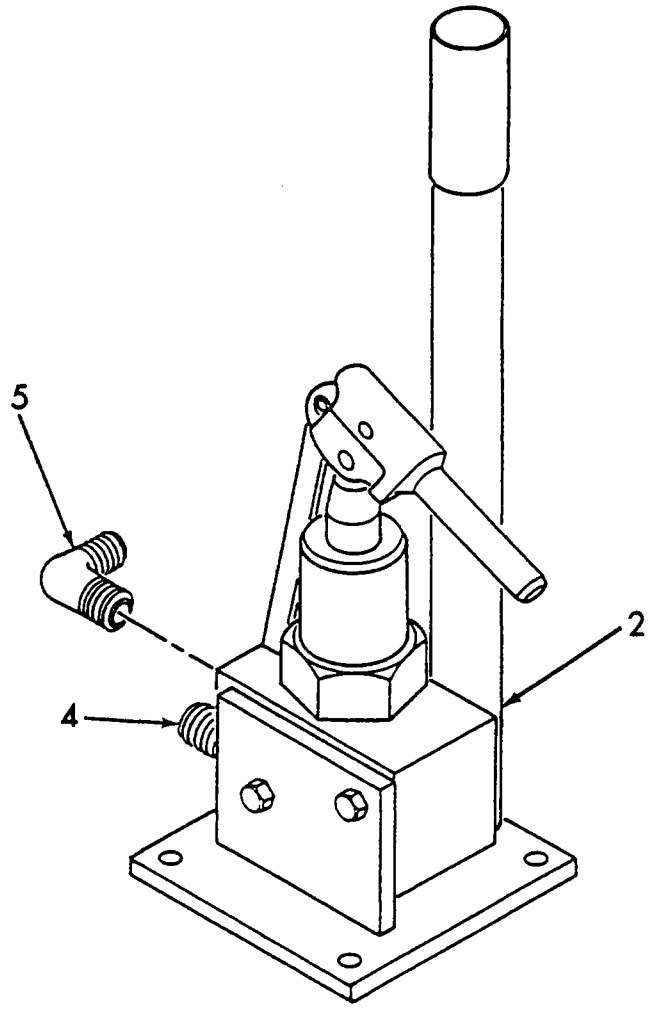


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140582	ASSEMBLY, EMERGENCY PUMP (See Sect. 4, Fig. 1 for NHA)	REF
2	.81215	PUMP, EMERGENCY	1
3	.80008-03	ELBOW, MALE	2

Mark Industries

TITLE	EMERGENCY PUMP ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

SECTION	4
FIGURE	8A
PAGE	1

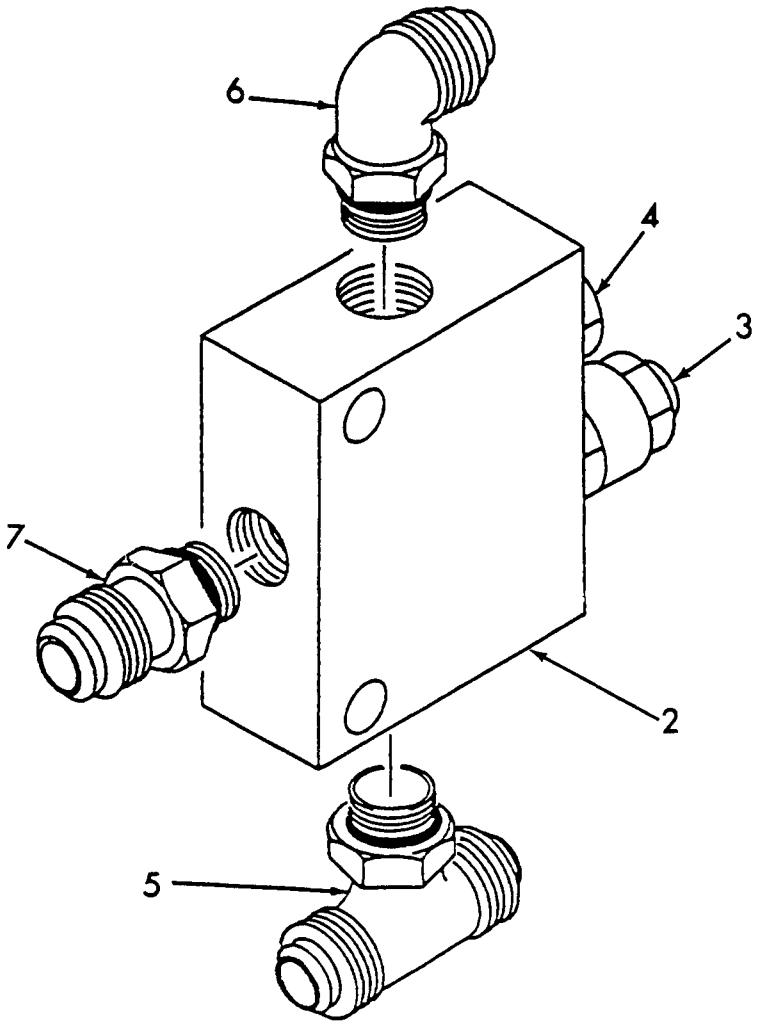


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140806	ASSEMBLY, EMERGENCY PUMP (See Sect. 4, Fig. 1 for NHA)	REF
2	.81281	PUMP, EMERGENCY	1
-3	..600031	KIT, SEAL	1
4	.80001-04	CONNECTOR, MALE	1
5	.80008-04	ELBOW, MALE	1

Mark Industries

TITLE	REGENERATIVE VALVE SUB-ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	4
FIGURE	9
PAGE	1

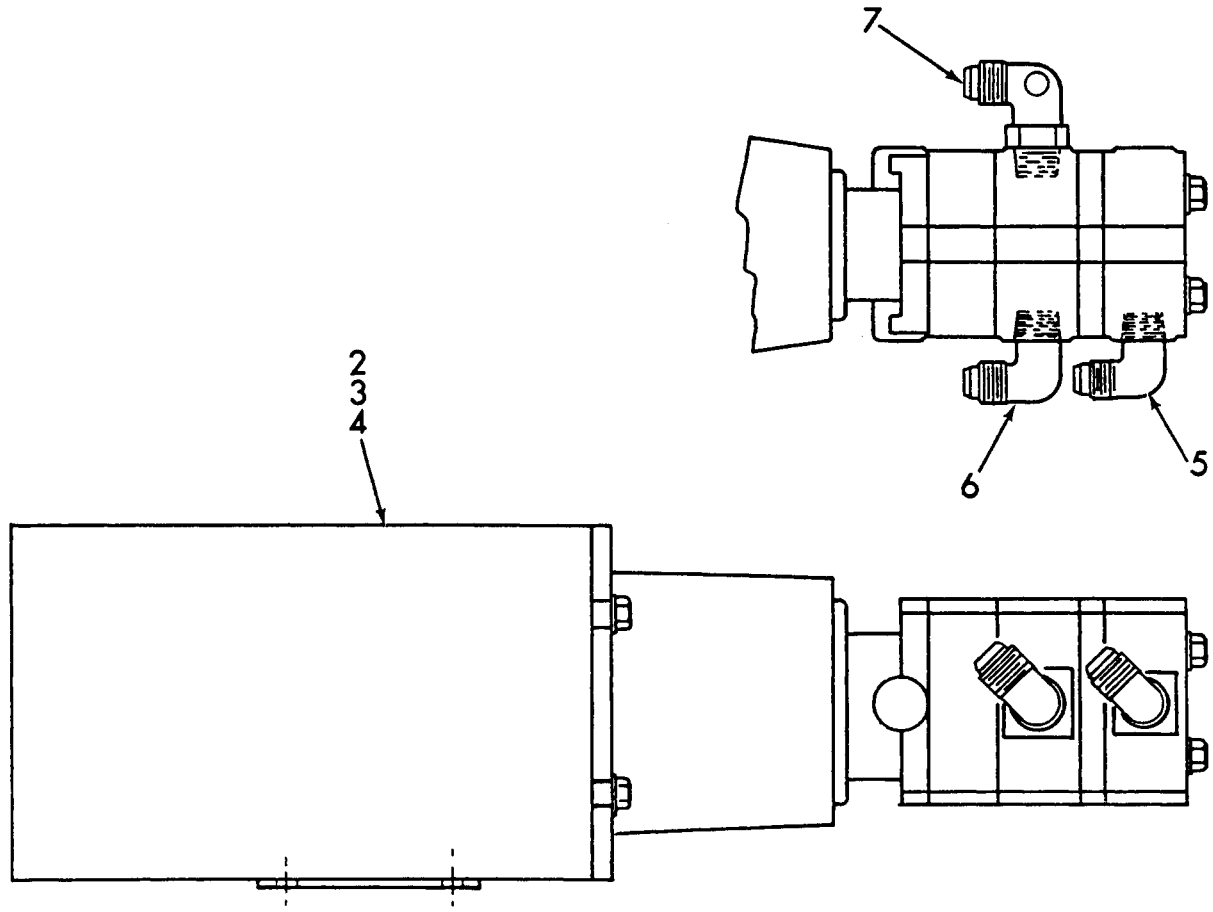


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140532	SUB-ASSEMBLY, REGENERATIVE VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	.81222	VALVE, REGENERATIVE	1
3	..67360	VALVE, COUNTERBALANCE	1
4	..67361	VALVE, CHECK	1
5	.80036-10	TEE, STRAIGHT THREAD (CH)	1
6	.80012-10	ELBOW, STRAIGHT THREAD (VR)	1
7	.80004-10	CONNECTOR, STRAIGHT THREAD (CR)	1

Mark Industries

TITLE	PUMP & MOTOR ASSEMBLY
MODEL	30KBN
NOTES	UNTIL LATE 1988

SECTION	4
FIGURE	10
PAGE	1

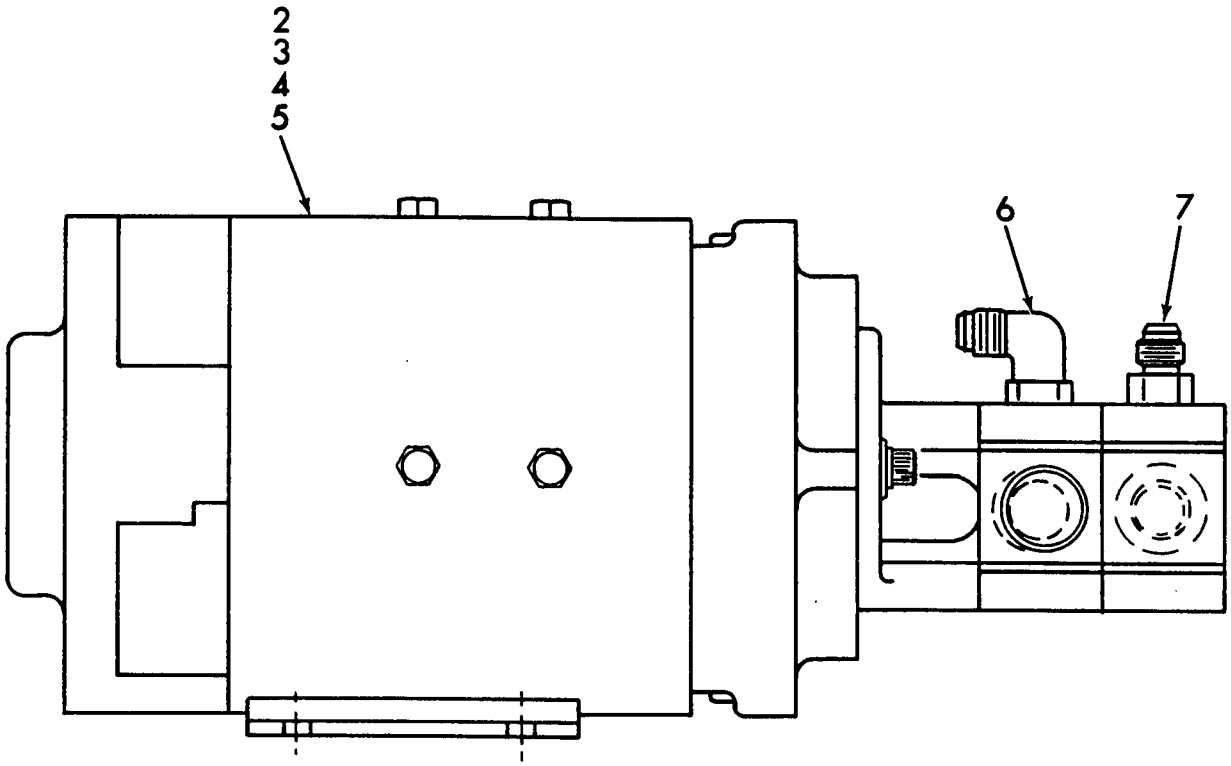


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140525	ASSEMBLY, PUMP & MOTOR (See Sect. 4, Fig. 1 for NHA)	REF
2	.81211	PUMP & MOTOR (WEB)	1
3	..67216	PUMP (ONLY)	1
4	..67215	MOTOR (ONLY)	1
5	.80008-11	ELBOW, MALE	1
6	.80008-14	ELBOW, MALE	1
7	.140555	ELBOW, MODIFIED	1

Mark Industries

TITLE	PUMP & MOTOR ASSEMBLY
MODEL	30KBN
NOTES	SINCE LATE 1988

SECTION	4
FIGURE	10A
PAGE	1

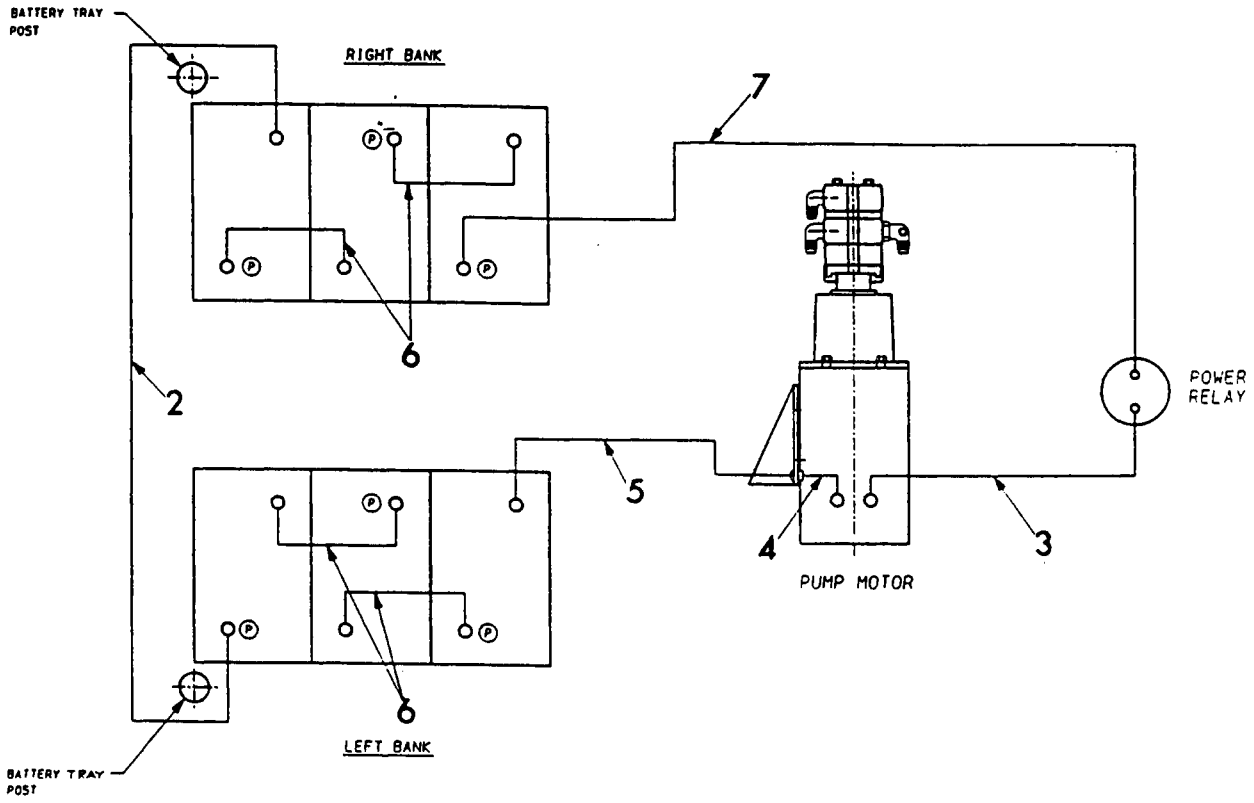


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140700	ASSEMBLY, PUMP & MOTOR (See Sect. 4, Fig. 1 for NHA)	REF
2	.81249	PUMP & MOTOR (JSB)	1
3	..67388	PUMP (ONLY)	1
4	...67934	KIT, SEAL (JSB)	1
5	..67389	MOTOR (ONLY)	1
6	.80012-09	ELBOW, STRAIGHT THREAD	1
7	.80004-11	CONNECTOR, STRAIGHT THREAD	1

Mark Industries

TITLE	BATTERY CABLE KIT
MODEL	30KBN
NOTES	

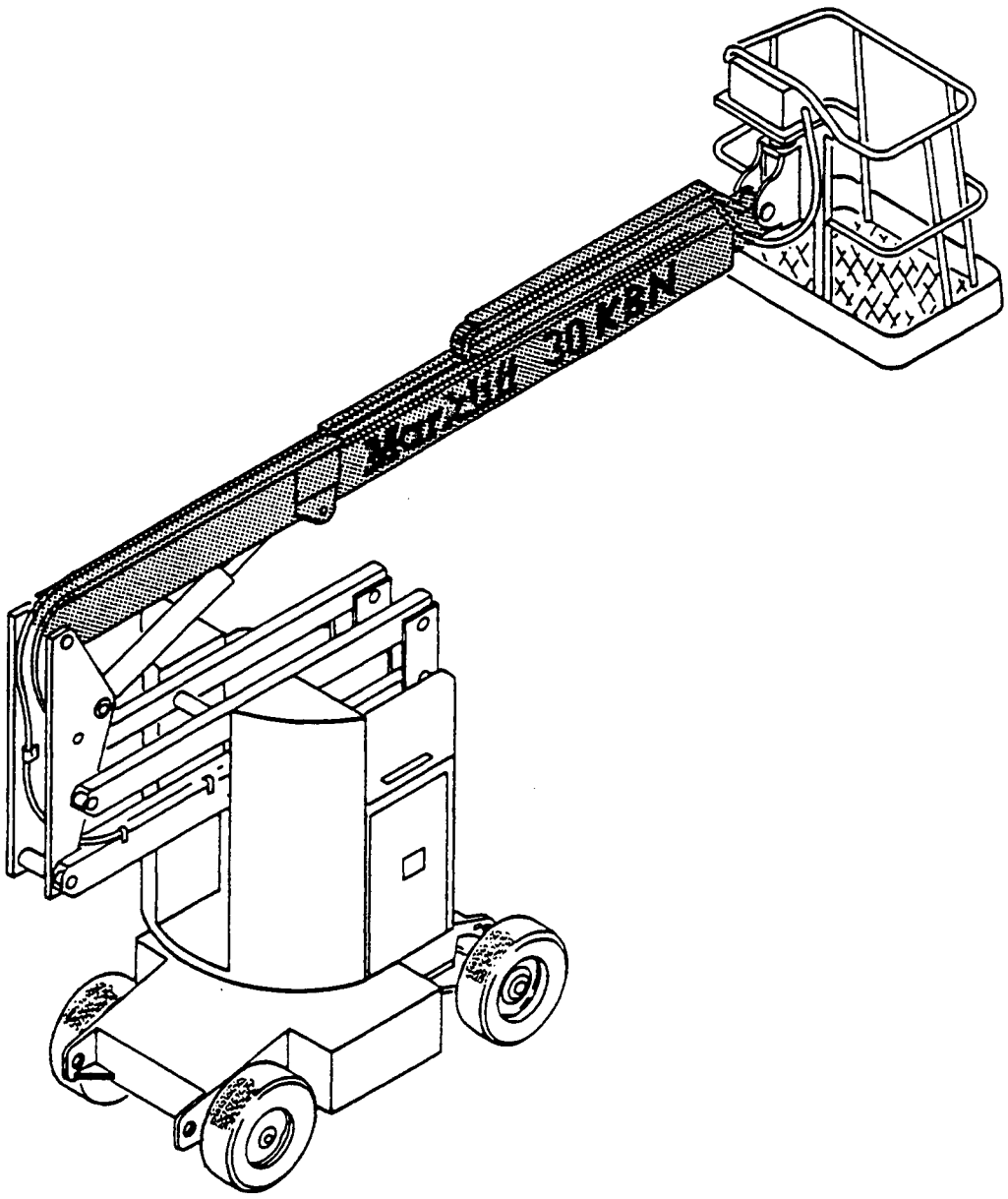
SECTION	4
FIGURE	11
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	.140603	KIT, BATTERY CABLE (See Sect. 4, Fig. 1 for NHA)	REF
2	..13226-0840	CABLE, BATTERY	1
3	..13226-1200	CABLE, BATTERY	1
4	..13226-0310	CABLE, BATTERY	1
5	..13226-0170	CABLE, BATTERY	1
6	..13226-0730	CABLE, BATTERY	1
7	..13226-0110	CABLE, BATTERY	4

SECTION 5 CONTAINS:

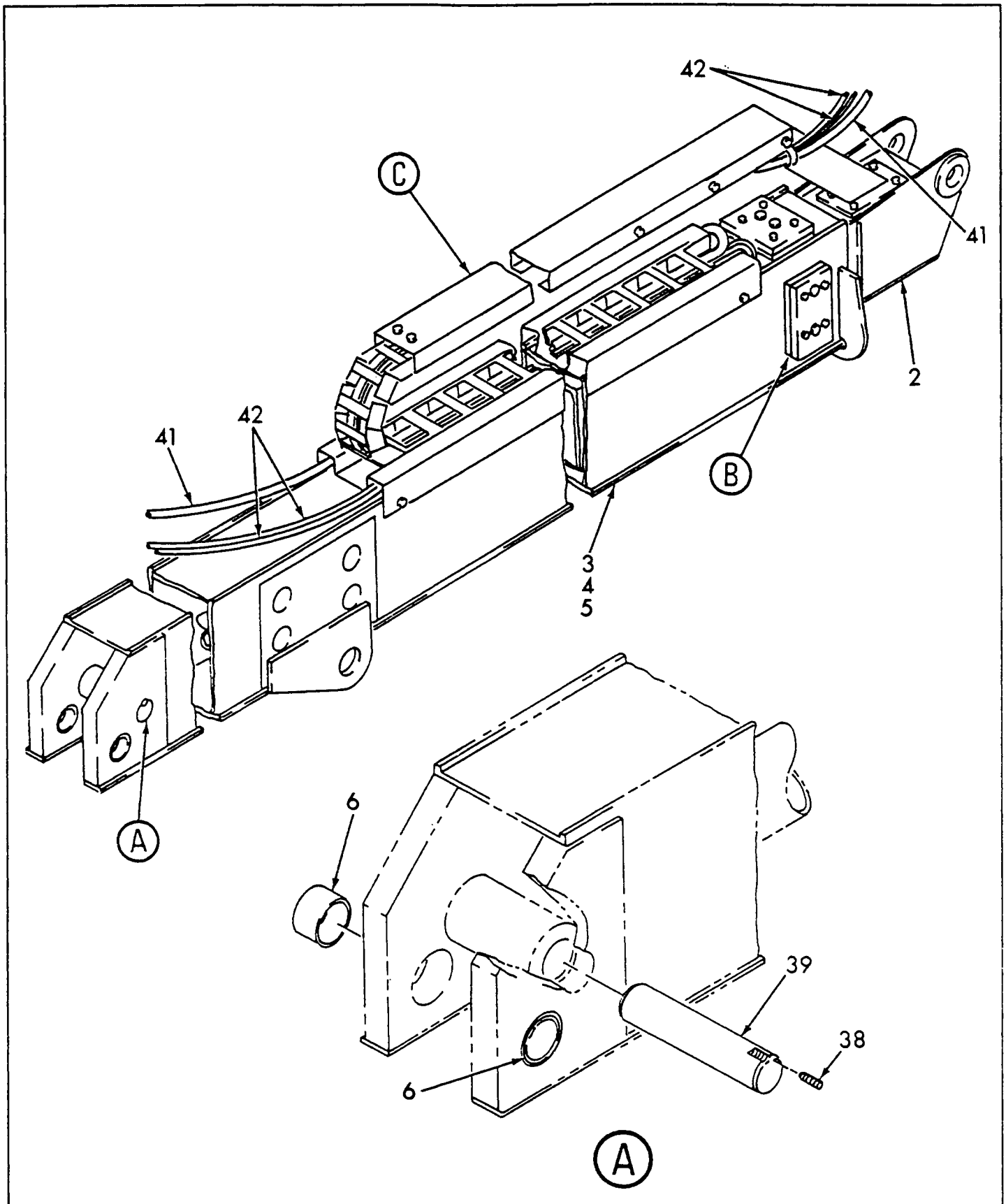
FIG. NO.	TITLE
1	FINAL BOOM ASSEMBLY
2	INNER BOOM ASSEMBLY
3	SLAVE CYLINDER SUB-ASSEMBLY (UNTIL EARLY 1989)
3A	SLAVE CYLINDER SUB-ASSEMBLY (SINCE EARLY 1989)
4	EXTENSION CYLINDER



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

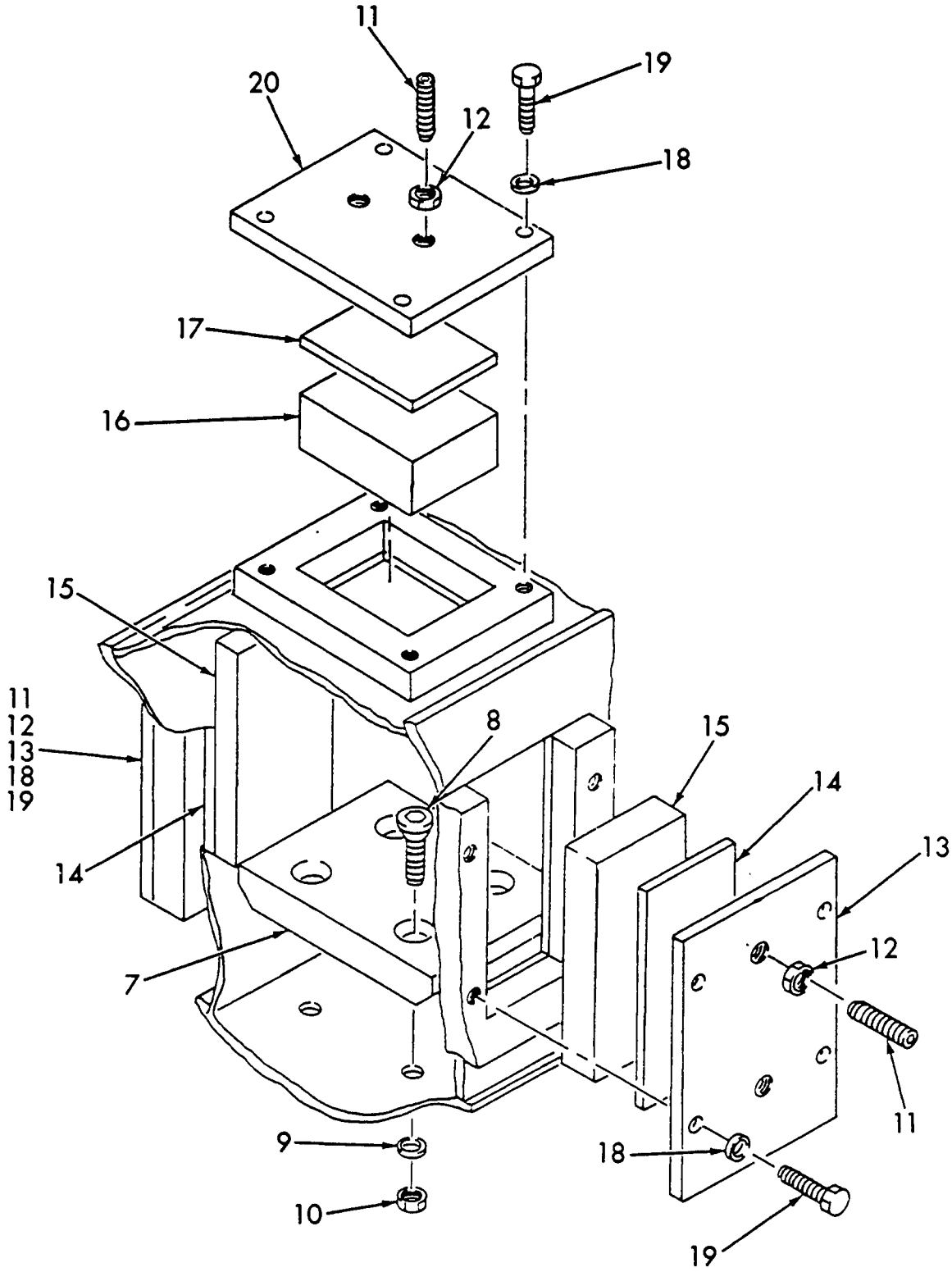
SECTION	5
FIGURE	1
PAGE	1



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

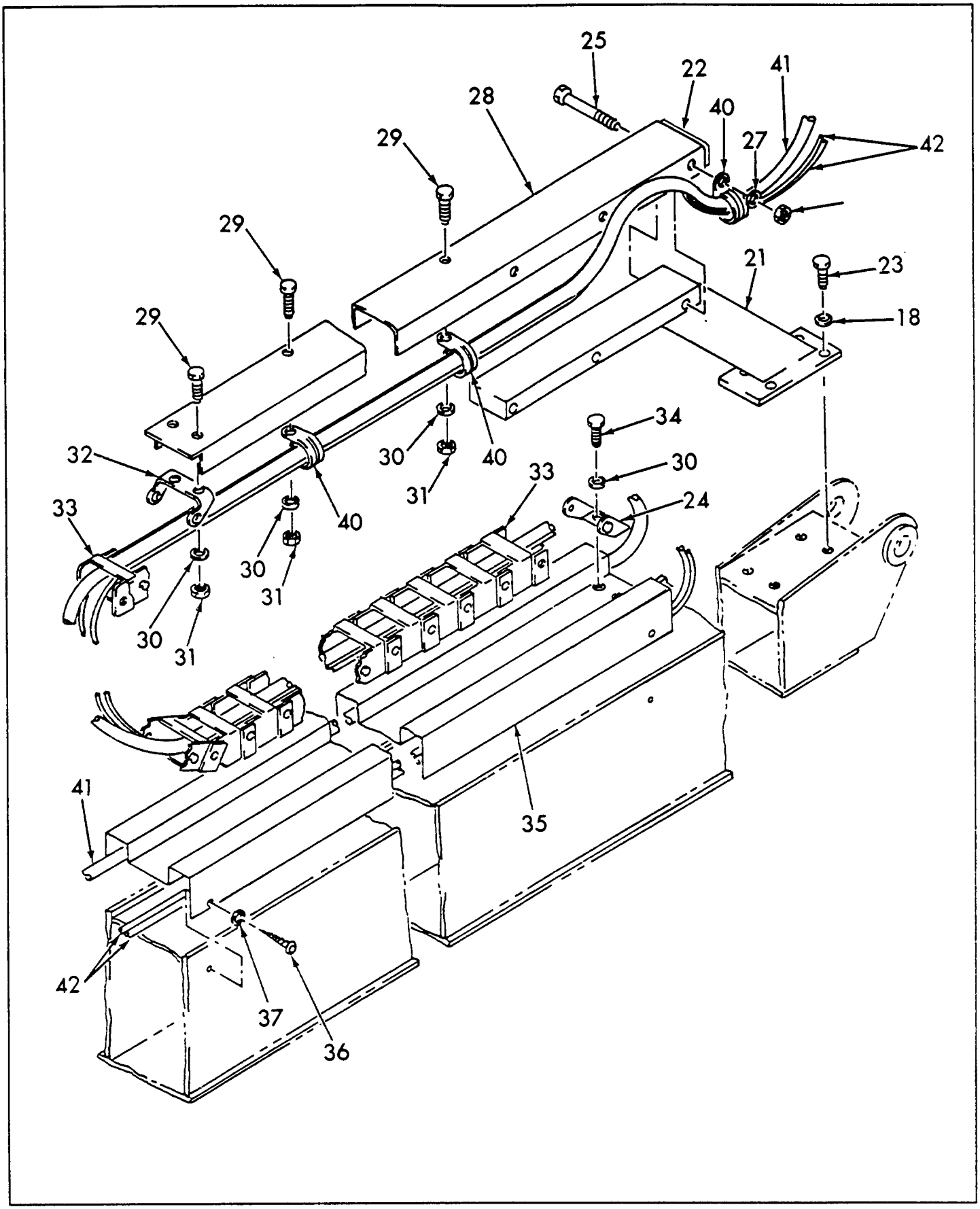
SECTION	5
FIGURE	1
PAGE	2



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECTION	5
FIGURE	1
PAGE	3



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECT.	5
FIG.	1
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140118	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	.140119	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2 for Details)	1
3	.140098	MACHINING, OUTER BOOM	1
4	..140097	WELDMENT, OUTER BOOM	1
5	...141242	PAD, BOOM WEAR	2
6	..140099	BUSHING	2
7	.140396	PAD, WEAR (OUTER BOOM BOTTOM)	1
8	.61821	SCREW, CAP	4
9	.63319	WASHER, LOCK	4
10	.60703	NUT, HEX	4
11	.62210	SCREW, SET	6
12	.60901	NUT, JAM	6
13	.140402	PLATE, SIDE COVER	2
14	.27247	STRIP	2
15	.140403	PAD, WEAR (SIDE)	2
16	.140405	PAD, WEAR (TOP)	1
17	.27250	STRIP	1
18	.63302	WASHER, LOCK	12
19	.60338	SCREW, CAP	12
20	.140406	PLATE, TOP COVER	1
21	.140399	WELDMENT, POWER TRACK BRACKET	1
22	.65390	PLUG	2
23	.60367	SCREW, CAP	4
24	.23875	BRACKET, STATIONARY (MALE)	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	30KBN
NOTES	BEFORE OCT. 1989

SECT.	5
FIG.	1
PAGE	5

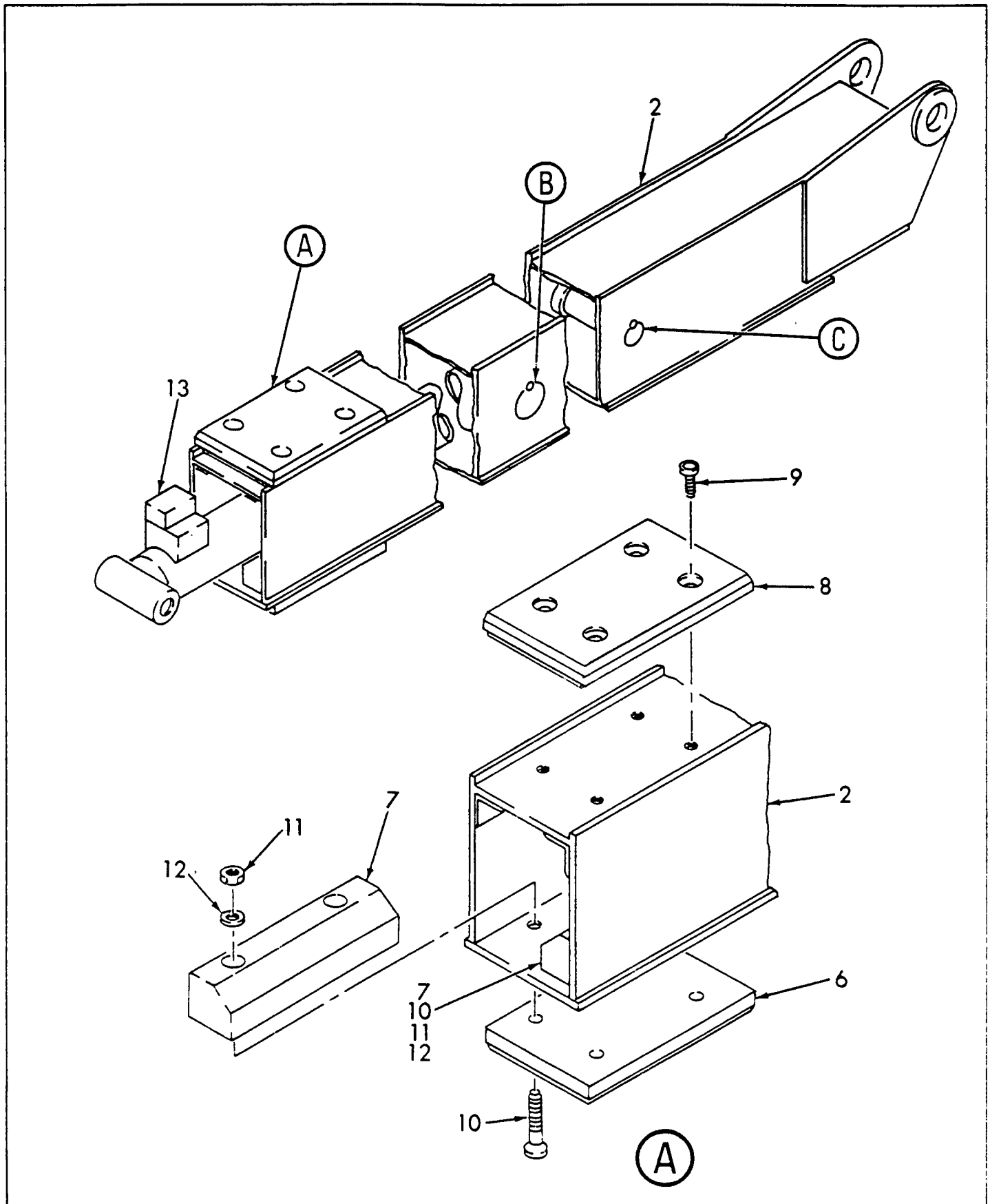
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.60429	SCREW, CAP	3
26	.61322	NUT, LOCK	3
27	.63429	WASHER, FLAT	3
28	.140342	SUPPORT, POWER TRACK	1
29	.60353	SCREW, CAP	5
30	.63433	WASHER, FLAT	7
31	.60711	NUT, HEX	5
32	.23874	BRACKET, MOVABLE (FEMALE)	1
33	.23824	TRACK, POWER (34 LINKS)	1
34	.60422	SCREW, CAP	2
35	.140201	GUIDE, POWER TRACK	1
36	.61729	SCREW, MACHINE	4
37	.63313	WASHER, LOCK	4
38	.62229	SCREW, SET (NYLON LOCK)	2
39	.140483	PIN, END CAP (EXTENSION CYLINDER)	1
40	.65867	CLAMP	3
41	.70528	CABLE (40 CONDUCTOR WITH BRAIDING)	50 FT.
42	.2568-35	HOSE, HYDRAULIC	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	30KBN
NOTES	

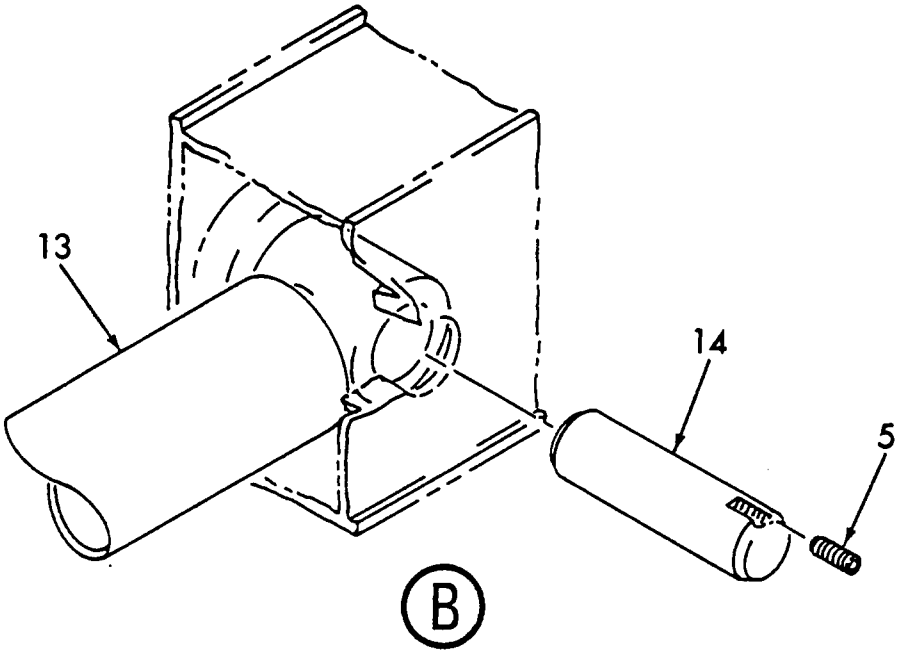
SECTION	5
FIGURE	2
PAGE	1

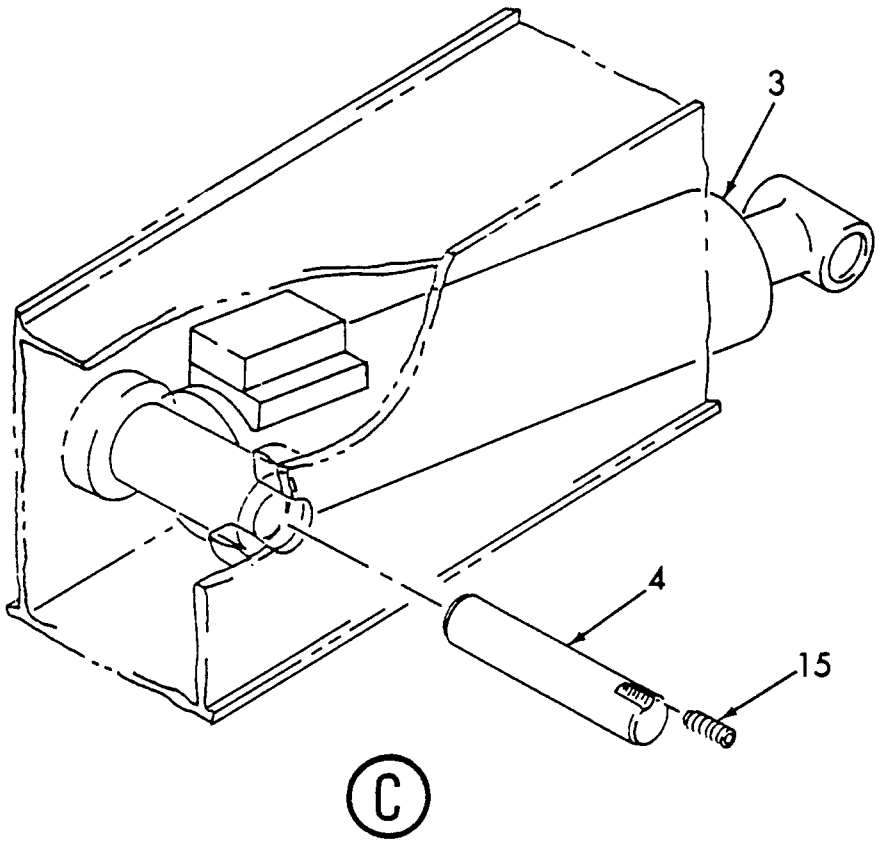


Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	30KBN
NOTES	

SECTION	5
FIGURE	2
PAGE	2





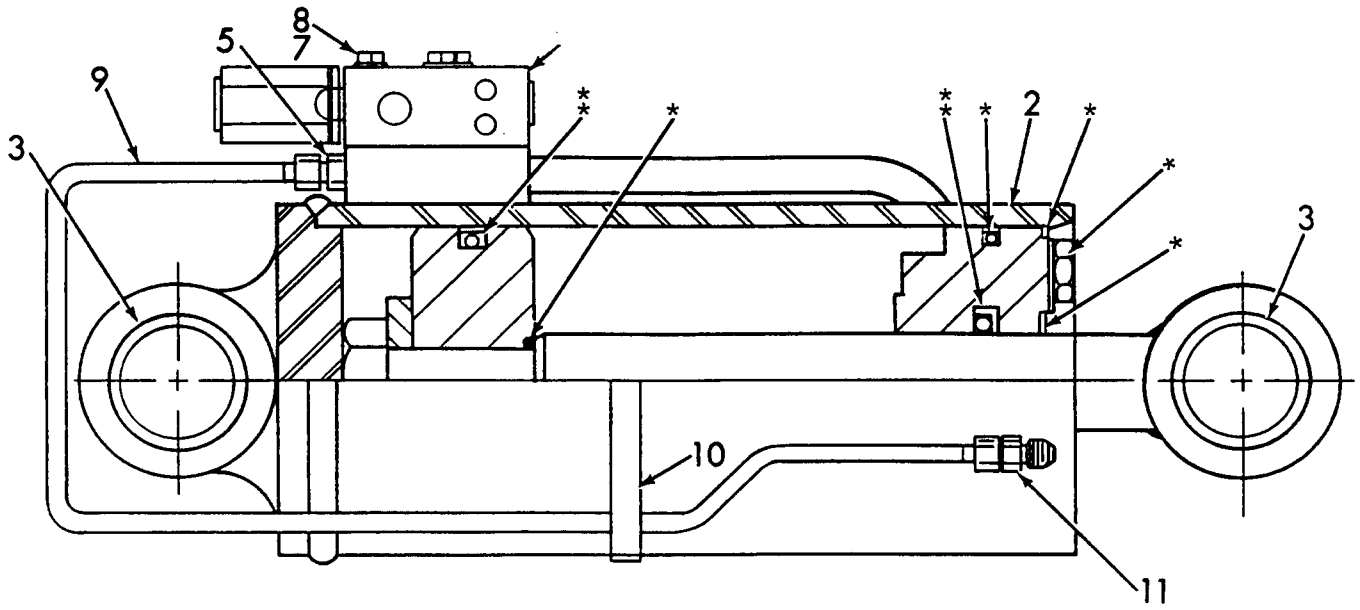
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140119	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 1 for NHA)	REF
2	.140095	MACHINING, INNER BOOM	1
3	.140946	SUB-ASSEMBLY, SLAVE CYLINDER (See Sect. 5, Fig. 3 & 3A for Details)	1
4	.140415	PIN, END CAP (SLAVE CYLINDER)	1
5	.62229	SCREW, SET (NYLON LOCK)	4
6	.140412	PAD, INNER BOOM WEAR (BOTTOM)	1
7	.140413	PAD, INNER BOOM WEAR (SIDE)	2
8	.140414	PAD, INNER BOOM WEAR (TOP)	1
9	.61829	SCREW, CAP	4
10	.61832	SCREW, CAP	4
11	.61302	NUT, HEX	4
12	.63319	WASHER, LOCK	4
13	.140170	SUB-ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 4 for Details)	1
14	.140424	PIN, EXTENSION CYLINDER (ROD END)	1
15	.62201	SCREW, SET	2

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	SLAVE CYLINDER SUB-ASSEMBLY
MODEL	30KBN
NOTES	UNTIL EARLY 1989

SECTION	5
FIGURE	3
PAGE	1



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

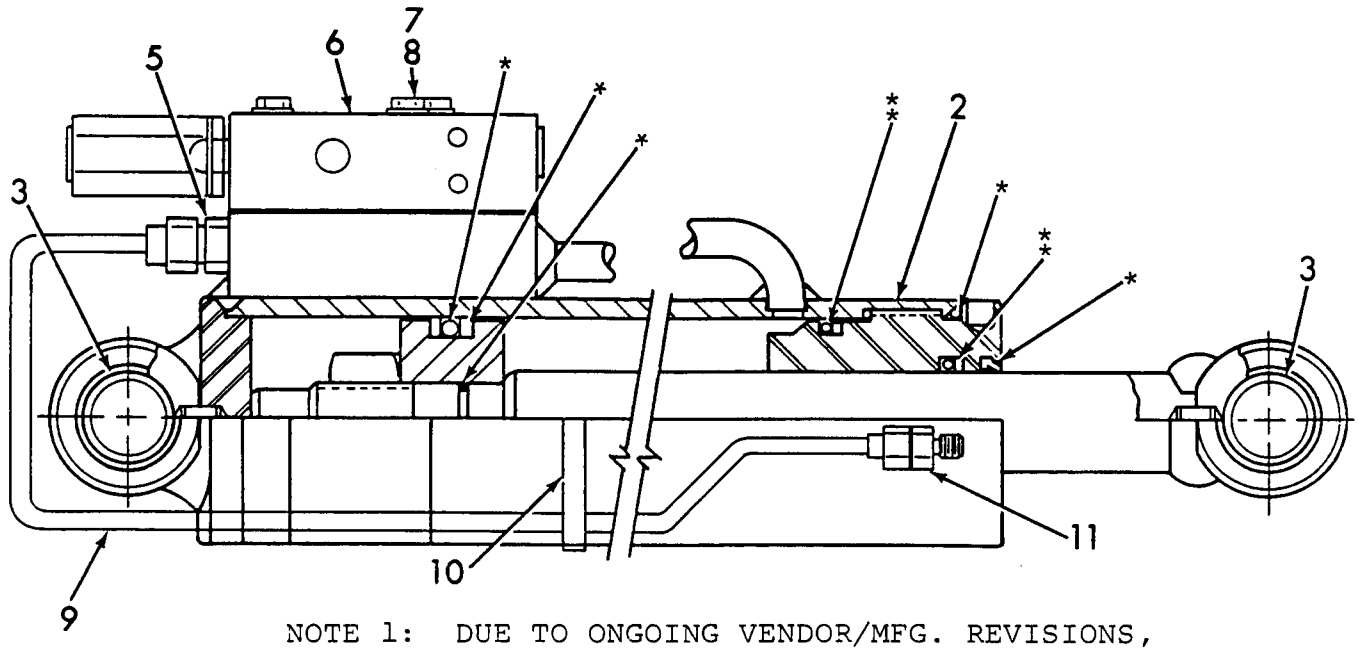
NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140058	SUB-ASSEMBLY, SLAVE CYLINDER (See Sect. 5, Fig. 2 for NHA)	REF
2	.140057	CYLINDER, SLAVE (SE)	1
3	..67191	BUSHING	4
-4	..67130	KIT, SEAL (SE)	1
5	.80004-03	CONNECTOR, STRAIGHT THREAD	2
6	.81205	VALVE, HOLDING	1
7	.60319	SCREW, CAP	3
8	.63301	WASHER, LOCK	3
9	.140058-6	ASSEMBLY, TUBE	2
10	.65111	STRAP	1
11	.80042-03	CONNECTOR, UNION	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	SLAVE CYLINDER SUB-ASSEMBLY
MODEL	30KBN
NOTES	SINCE EARLY 1989

SECTION	5
FIGURE	3A
PAGE	1



NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

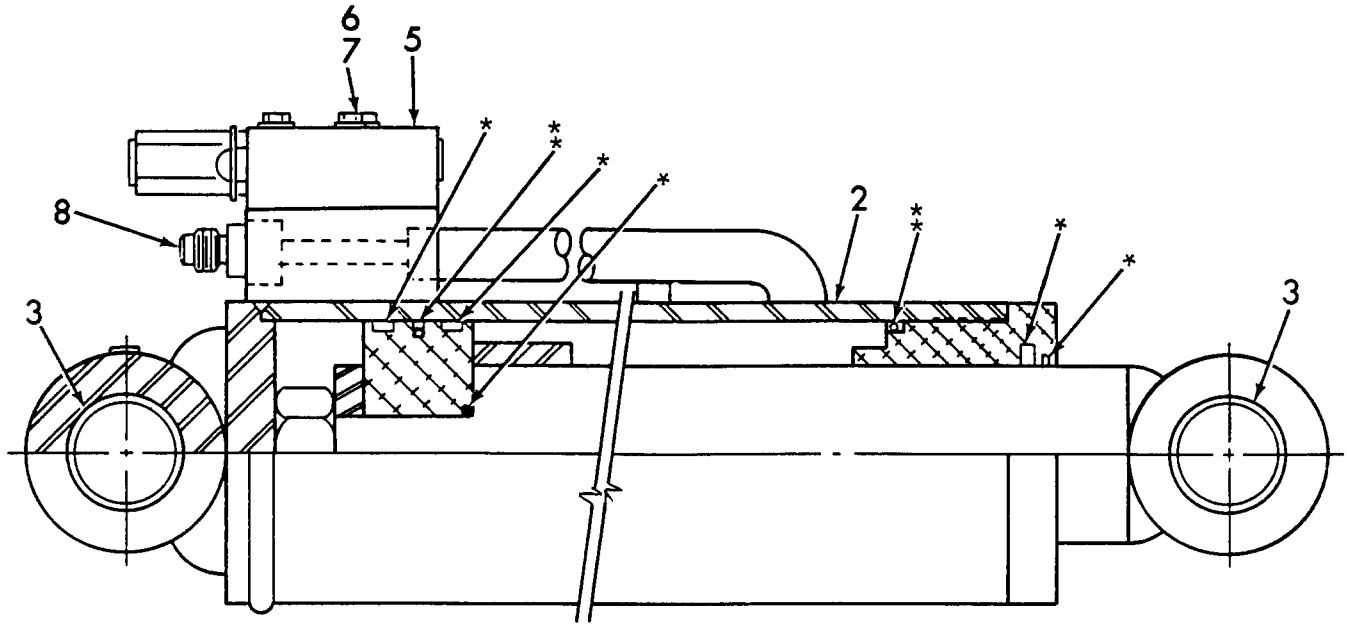
NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140946	SUB-ASSEMBLY, SLAVE CYLINDER (See Sect. 5, Fig. 2 for NHA)	REF
2	.140890	CYLINDER, SLAVE (TH)	1
3	..67999	BUSHING	4
-4	..67997	KIT, SEAL (TH)	1
5	.80004-03	CONNECTOR, STRAIGHT THREAD	2
6	.81205	VALVE, HOLDING	1
7	.60319	SCREW, CAP	3
8	.63301	WASHER, LOCK	3
9	.140058-6	ASSEMBLY, TUBE	2
10	.65111	STRAP	1
11	.80042-03	CONNECTOR, UNION	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	EXTENSION CYLINDER
MODEL	30KBN
NOTES	

SECTION	5
FIGURE	4
PAGE	1



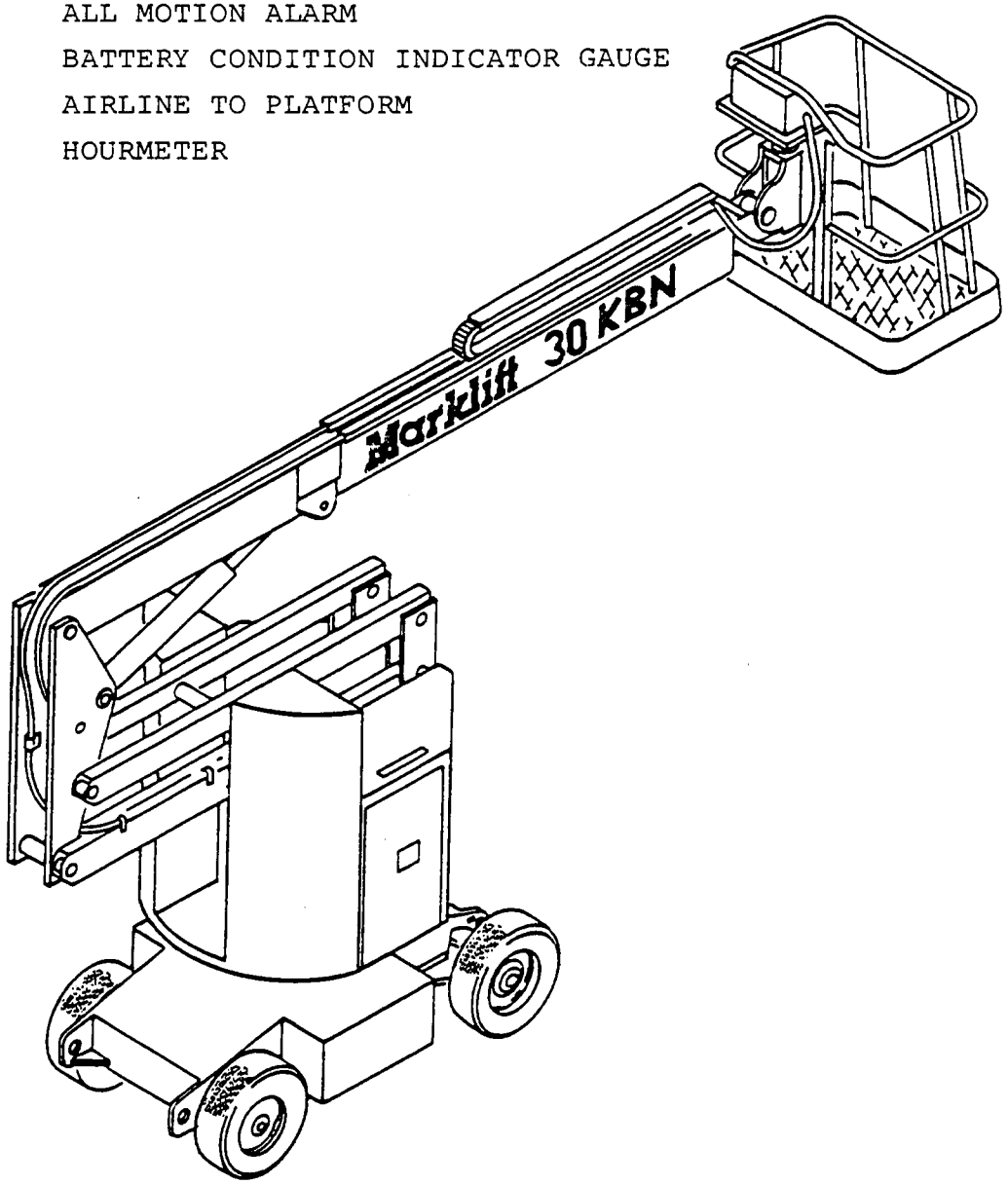
NOTE 1: DUE TO ONGOING VENDOR/MFG. REVISIONS, WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

NOTE 2: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140170	SUB-ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 2 for Details)	REF
2	.140093	CYLINDER, EXTENSION (SE)	1
3	..67180	BUSHING	4
4	..67128	KIT, SEAL (SE)	1
5	.81205	VALVE, HOLDING	1
6	.60319	SCREW, CAP	3
7	.63301	WASHER, LOCK	3
8	.80004-08	CONNECTOR, STRAIGHT THREAD	2
		NOTE 3: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

SECTION 6 CONTAINS:

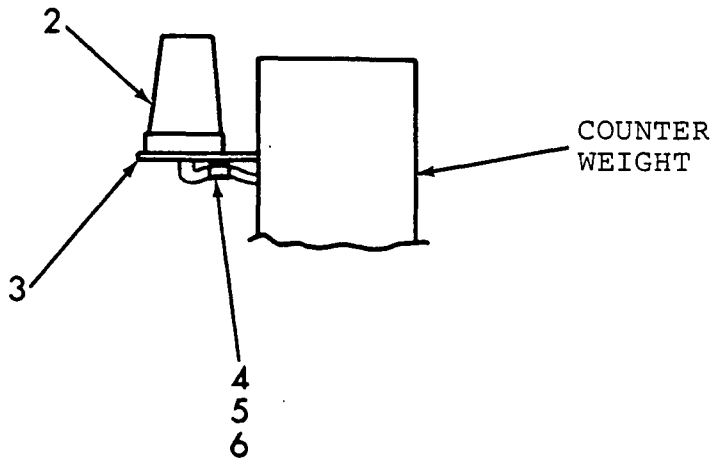
FIG. NO.	TITLE
1	ROTATING AMBER BEACON
2	POWERED PLATFORM ROTATOR
3	2 HEADLIGHTS & 2 REAR RED LIGHTS
4	12 VOLT PLATFORM WORK LIGHT
5	LIFTING LUGS
6	MONOFILLED TIRE
7	STOP, TURN & CLEARANCE LIGHTS
8	TRAVEL WARNING HORN
9	ALL MOTION ALARM
10	BATTERY CONDITION INDICATOR GAUGE
11	AIRLINE TO PLATFORM
12	HOURMETER



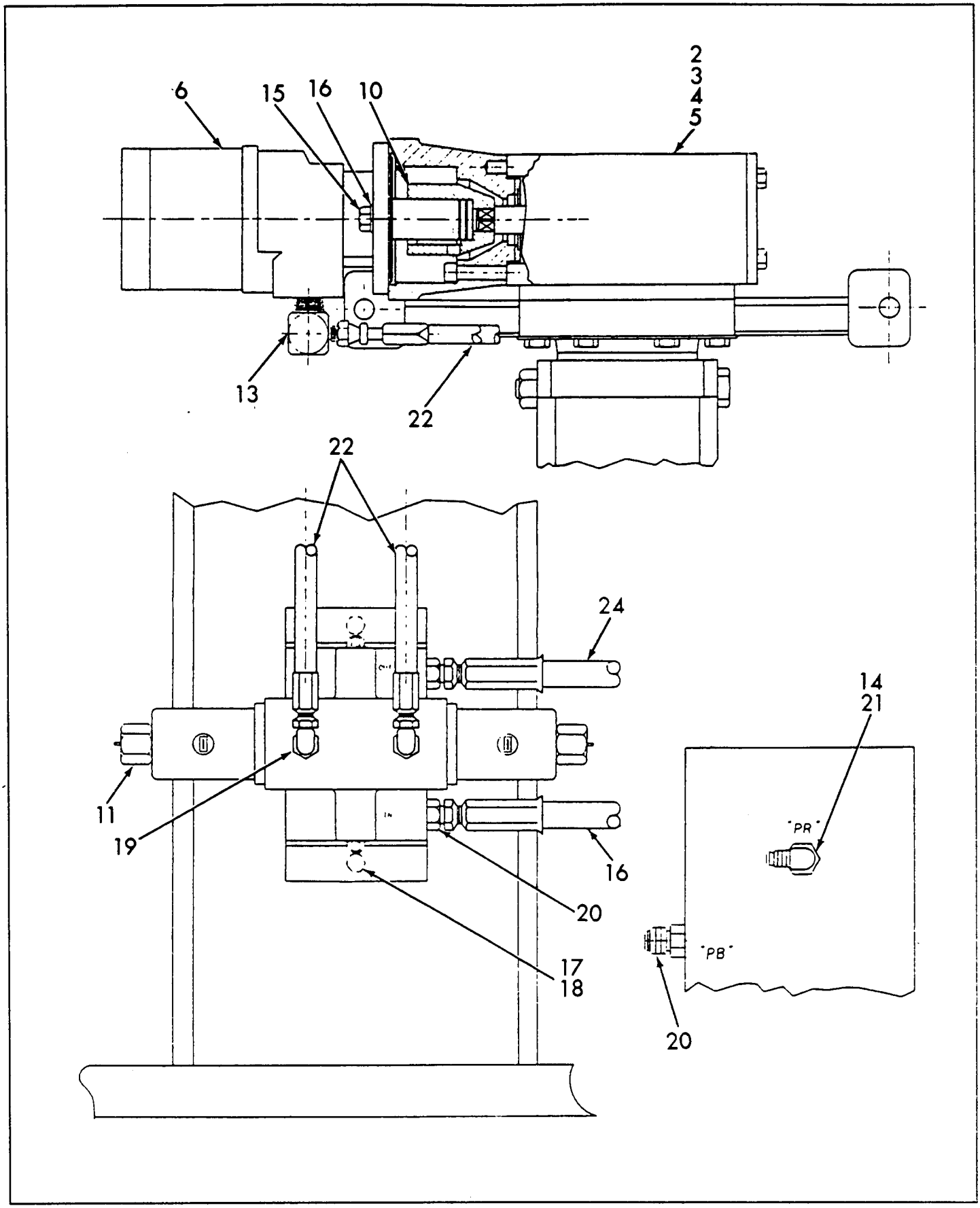
Mark Industries

TITLE	ROTATING AMBER BEACON
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	1
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140661	BEACON, ROTATING AMBER	REF
2	.20863	BEACON, ROTATING	1
3	.140864	BRACKET, MOUNTING	1
4	.2768	CABLE (SJO 18/2)(10 FT)	1
5	.764	CLAMP, RUBBER	4
6	.63657	RIVET, POP	4


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Mark Industries

TITLE	POWERED PLATFORM ROTATOR
MODEL	30KBN
NOTES	

SECT.	6
FIG.	2
PAGE	2

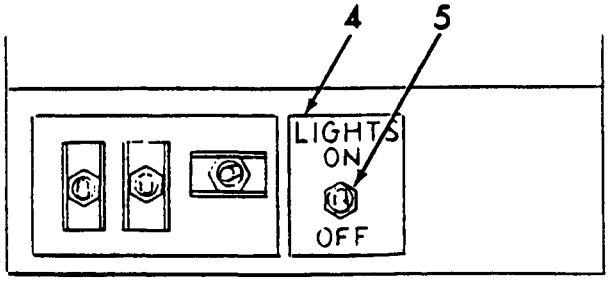
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140022	ROTATOR, POWERED PLATFORM	REF
2	.141136	SUB-ASSEMBLY, HYDRAULIC POWERED ROTATOR	1
3	..24919	ROTATOR (See Sect. 2, Fig. 6 for Details)	1
4	..140818	ADAPTER, MOTOR	1
5	..62017	SCREW, CAP	4
6	.81274	MOTOR, HYDRAULIC (See Vendor Chapter for Details)	1
-7	..67688	KIT, SEAL	1
-8	..67698	SHAFT, COUPLING	1
-9	..67690	LINK, DRIVE	1
10	.140819	SHAFT, COUPLING	1
11	.81239	VALVE (WITH CROSSOVER RELIEF)	1
-12	..16953	COIL (12 VOLT)	2
13	.80008-05	ELBOW, MALE	2
14	.80048-02	PLUG, HOLLOW HEX	2
15	.60308	SCREW, CAP	2
16	.63305	WASHER, LOCK	2
17	.60325	SCREW, CAP	2
18	.62319	WASHER, LOCK	2
19	.80012-05	ELBOW, STRAIGHT THREAD	2
20	.80004-08	CONNECTOR, STRAIGHT THREAD	3
21	.80012-08	ELBOW, STRAIGHT THREAD	1
22	.13232-04-6000	ASSEMBLY, HOSE	2
23	.13213-06-0250	ASSEMBLY, HOSE	1
24	.13213-06-0200	ASSEMBLY, HOSE	1

DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

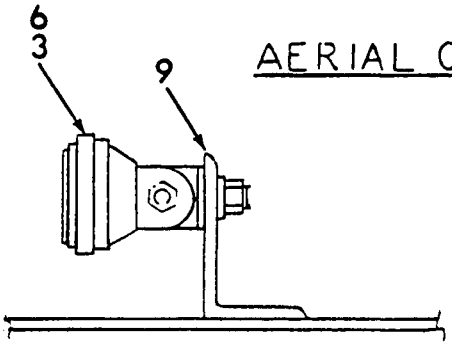
Mark Industries

TITLE	2 HEADLIGHTS & 2 REAR RED LIGHTS
MODEL	30KBN
NOTES	

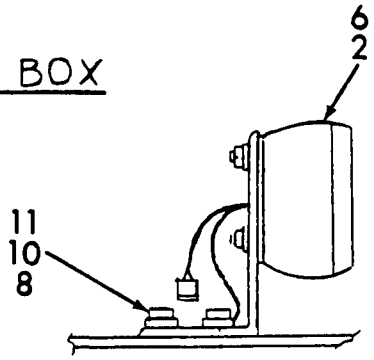
SECTION	6
FIGURE	3
PAGE	1



AERIAL CONTROL BOX



HEADLIGHT ASSY



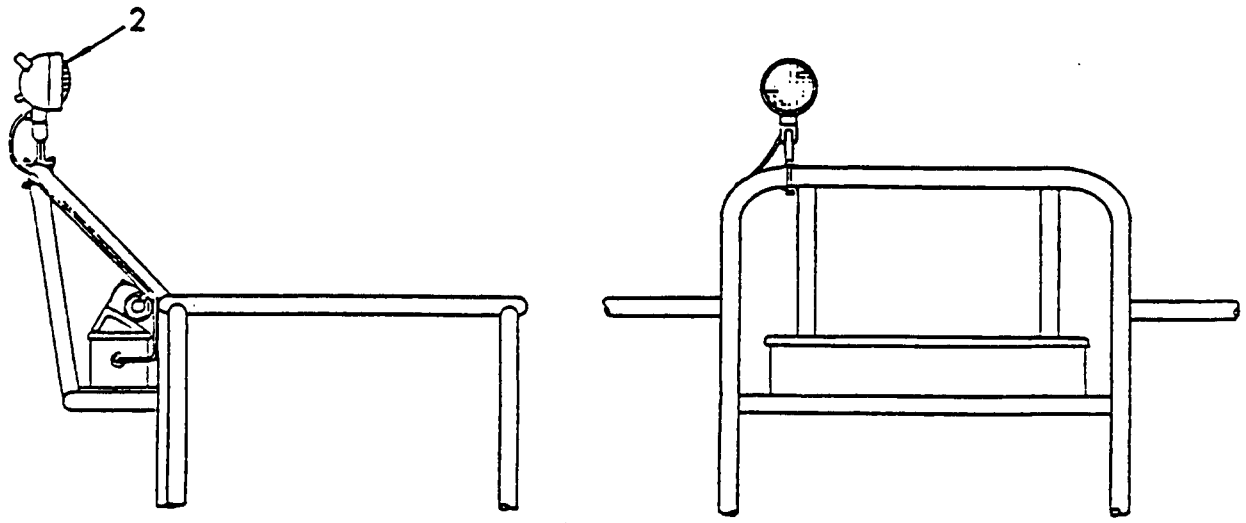
TAILLIGHT ASSY

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140662	LIGHTS, 2 HEADLIGHTS & 2 REAR RED	REF
2	.20972	LIGHT, TAIL	2
3	.20971	HEADLIGHT	2
4	.20509	DECAL, LIGHTS	1
5	.4017	SWITCH, TOGGLE	1
6	.70068	CONNECTOR	4
7	.2991	WIRE, WHITE (12 AWG STRANDED)	20 FT
8	.140894	BRACKET, REAR LIGHT	2
9	.140895	BRACKET, HEADLIGHT	2
10	.60309	SCREW, CAP	4
11	.63301	WASHER, LOCK	4

Mark Industries

TITLE	12 VOLT PLATFORM WORK LIGHT
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	4
PAGE	1

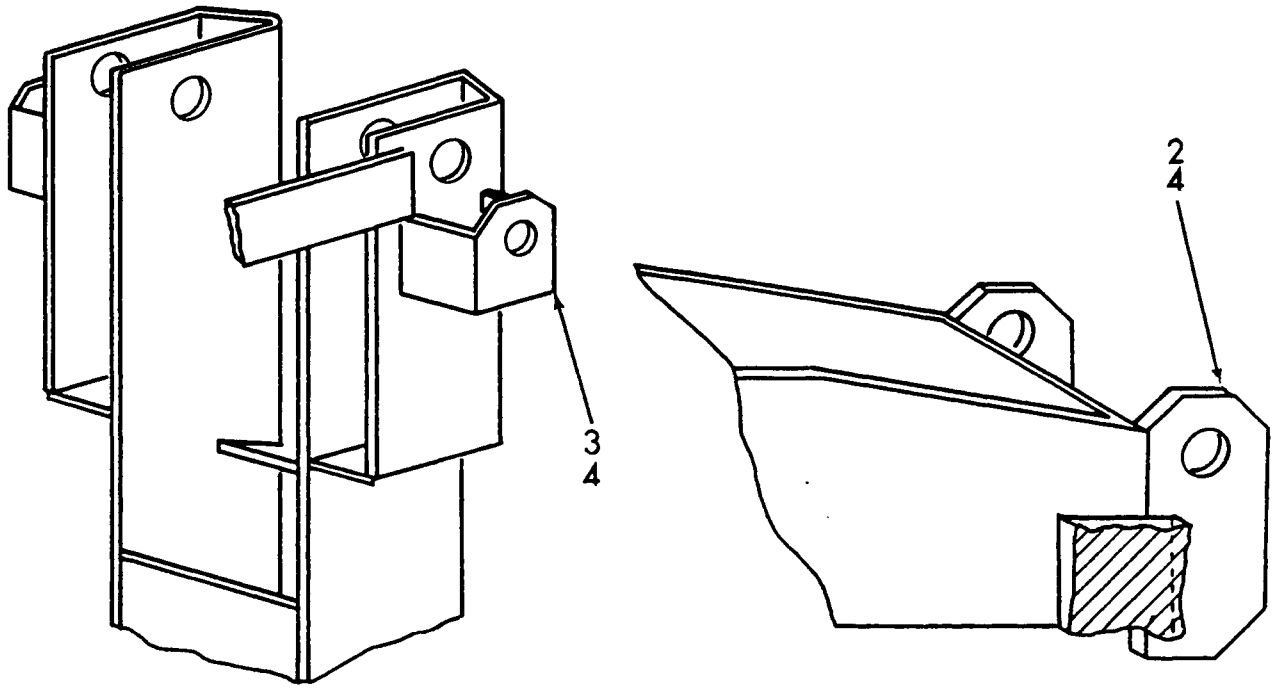


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140664	LIGHT, 12 VOLT PLATFORM WORK	REF
2	.20862	LIGHT, WORK	1
3	.255	TIE, CABLE	3

Mark Industries

TITLE	LIFTING LUGS
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	5
PAGE	1

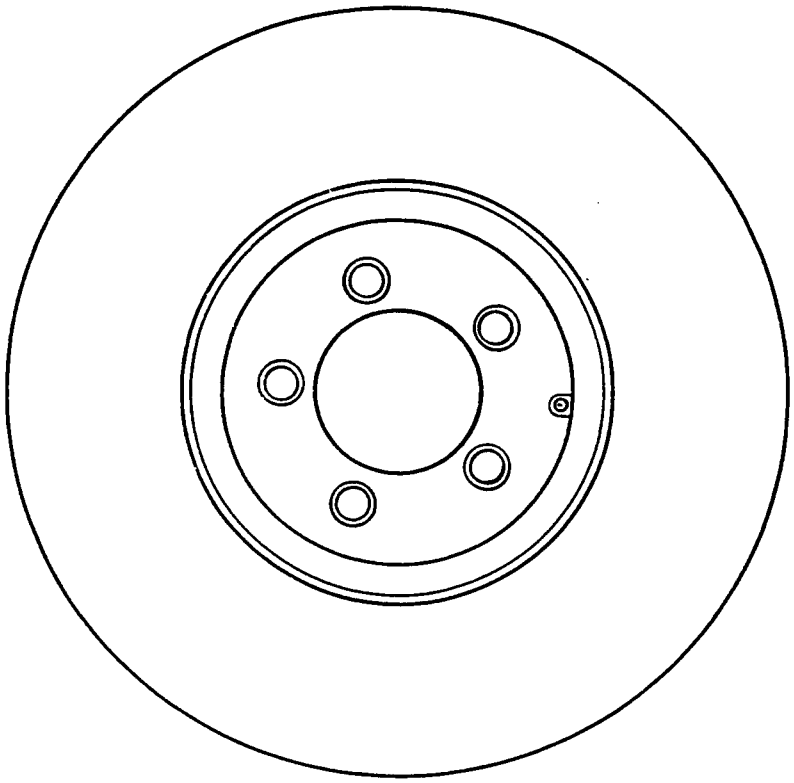


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140675	LUGS, LIFTING	REF
2	.140644	WELDMENT, LIFTING LUG	2
3	.140632	LUG, LIFTING (LOWER)	2
4	.181501	DECAL, CAUTION LIFTING LUGS	4

Mark Industries

TITLE	MONOFILLED TIRE
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	6
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140626	ASSEMBLY, STEER/DRIVE MONOFILLED TIRE	4

Mark Industries

TITLE	STOP, TURN & CLEARANCE LIGHTS
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	7
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140663	LIGHTS, STOP, TURN & CLEARANCE	REF
-2	.20509	DECAL, LIGHTS	1
-3	.2912	CABLE, CONDUCTOR (18 GA/4)	12 FT
-4	.3B	CHAIN, JACK	2 FT
-5	.70068	CONNECTOR	8
-6	.20838	LIGHT, CLEARANCE	2
-7	.2806	RELIEF, STRAIN	2
-8	.2808	NUT, LOCK	2
-9	.63303	WASHER, LOCK	4
-10	.60703	NUT, HEX	4
-11	.20866	DECAL, TURN INDICATOR	1
-12	.20864	BRACKET, CLEARANCE LIGHT MOUNTING	2
-13	.448-A	FLASHER (12 VOLT)	1
-14	.4017	SWITCH, TOGGLE	1
-15	.4019	SWITCH	1
-16	.60331	SCREW, CAP	4
-17	.63403	WASHER, FLAT	4

Mark Industries

TITLE	TRAVEL WARNING HORN
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	8
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140657	HORN, TRAVEL WARNING	1
-2	.70053	HORN, WARNING	1
-3	.60312	SCREW, CAP	2
-4	.63301	WASHER, LOCK	2
-5	.60701	NUT, HEX	2

Mark Industries

TITLE	ALL MOTION ALARM
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	9
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140660	ALARM, ALL MOTION	REF
-2	.70053	HORN, WARNING	1
-3	.60312	SCREW, CAP	2
-4	.63301	WASHER, LOCK	2
-5	.60701	NUT, HEX	2

Mark Industries

TITLE	BATTERY CONDITION INDICATOR GAUGE
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	10
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140023	GAUGE, BATTERY CONDITION INDICATOR	REF
-2	.70469	METER, BATTERY VOLTAGE	1

Mark Industries

TITLE	AIRLINE TO PLATFORM
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	11
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140672	AIRLINE TO PLATFORM	REF
-2	.160112	PLUG, HOSE	4
-3	.140815	WELDMENT, AIRLINE BRACKET	2
-4	.60312	SCREW, CAP	4
-5	.63301	WASHER, LOCK	4
-6	.60701	NUT, HEX	4
-7	.160111	SOCKET, HOSE	2
-8	.160113	CLAMP, HOSE	2
-9	.MTM 1043	HOSE, AIR (3/8")	1

Mark Industries

TITLE	HOURMETER
MODEL	30KBN
NOTES	

SECTION	6
FIGURE	12
PAGE	1

NO ILLUSTRATION AVAILABLE. PART LIST ONLY.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	140680	HOURMETER	REF
-2	.20571	METER	1
-3	.66356	TERMINAL, FEMALE	2

Mark Industries

TITLE	VENDOR CHAPTER
MODEL	30KBN

VENDOR CHAPTER CONTAINS:

SECTION	DESCRIPTION	
1	TROJAN BATTERY	P/N 30297
2	TORQMOTOR (HYDRAULIC)	P/N 81278 & P/N 81274
3	TORQMOTOR (HYDRAULIC)	P/N 81206
4	TORQMOTOR (HYDRAULIC)	P/N 81187
5	MICO DISC BRAKE	P/N 81207
6	FAIRFIELD TORQUE HUB	P/N 81208
7	LESTRONIC BATTERY CHARGER (AUTOMATIC)	P/N 70370
8	LESTRONIC BATTERY CHARGER (MANUAL)	P/N 70421

Torqmotor™

TRW

Fairfield

TROJAN
The better battery

MICO

REV.

THE 10 COMMANDMENTS OF GOOD BATTERY CARE

1. Add approved water only--never acid.
2. Keep electrolyte level above separator protectors.
3. Keep battery top clean and dry.
4. Keep flame and metal away from battery top.
5. Keep vent caps tightly in place.
6. Do not use battery with specific gravity below 1.120.
7. Cool before charging or operating if battery is above 115°F.
8. Charge only at proper voltage and ampere-hours.
9. Keep truck compartment and battery cover open during charging.
10. When in doubt, call your Trojan Battery service representative for long, reliable battery life.

Watering Instructions

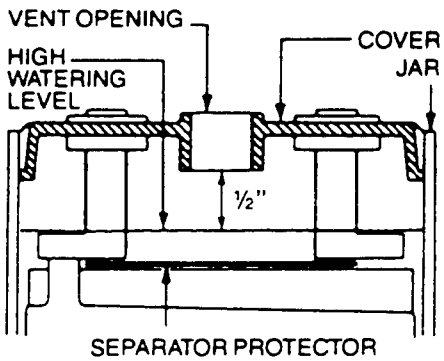
Approved Water

In most areas of the United States, tap water is satisfactory for use in lead acid batteries. The local Trojan Battery office will advise, upon request, if the public water is approved. Use distilled water when in doubt or if the public water source is not approved.

CAUTION—DO NOT OVERFILL. MOISTURE ON THE TOPS OF THE BATTERIES INDICATES OVERFILLING HAS OCCURRED.

Proper Electrolyte Level

The electrolyte level must be kept between the "High Warning Level" and the separator protectors as shown in the sketch. The batteries should be filled only at the end of the charging cycle



1. NEW BATTERY RECEIVAL AND INSTALLATION

1. **Always** inspect incoming shipments of batteries for damage.

   Look for and pay particular attention for damage to or wet spots on the shipping cartons, examine those batteries for signs of breakage.

2. If damaged batteries are found secure acknowledgment of the damage from the carrier's representative and file a claim against the transportation company. Contact your supplier for battery replacement.

3. If batteries are received wet and **not** immediately placed in service, they must be charged at regular intervals as follows:

Storage Temperature	Charge
Below 40° F	None required
40° F to 60° F	Every 2 months
60° F and above	Once a month

4. Never stack one battery directly on top of another. Post damage and/or container damage can occur from improper stacking. If batteries are stored individually, place supporting boards between layers. **Do not** stack layers more than three (3) high and rotate stock so that the oldest batteries can be used first.

5. Dry charge batteries should be activated in accordance with instructions of the battery manufacturer.

6. Batteries should be installed in accordance with the vehicle manufacturer's instructions. Connections should be made tight enabling good contact between connector lugs and battery terminals. Always charge sets of batteries immediately after installation into the car.

2. MAINTENANCE- INSPECTION PROCEDURES

1. **Water batteries at least once a week.**

   a. Add only approved water to the cells. Distilled water is recommended, high mineral content water must not be used. Maximum allowable impurities in percent-iron (.003), chloride (.004), fixed residue (.075).

   b. Remove vent caps and water batteries preferable after charging to prevent over flow of acid due to expansion.

   c. Fill all cells to the proper level. **Do not overfill cells.** Fill to level indicator or 1/2 inch over the top of the separators if there is no level indicator. Do not use a hose to water batteries.

   d. Spot check cells between weekly waterings to assure electrolyte is above separators. Excess water usage indicates the presence of any one or all of the following conditions which should be checked.

      1. Overcharging
      2. High temperature operation
      3. Nearing end of service life

   e. **Do not allow the electrolyte level to drop** below the top of the separators since this will lead to shortened battery life.

2. **Clean batteries after weekly watering or when washing cars.**

   a. Wash the tops of the batteries making sure the vent caps are in place. Do not allow water or other foreign matter to enter the cells.

   b. Use a solution of bicarbonate of soda and water to wash batteries if there is an accumulation of acid.

3. **Inspection** to insure good conditions which will give better battery service.

   a. When watering batteries inspect battery and other terminal connections for:

      1. **Corrosion** -- If any exists, clean connection and apply a non-metallic grease or protective spray to retard further corrosion.

      2. **Loose Connections** -- Be sure all connections are tight and that good contact is made between terminals.

3. **Broken or Frayed Cables** -- Be sure all cable connections are good and that no loose or broken wires are exposed. Replace any which look suspicious.

b. Once a week after the batteries have been charged, spot check two (2) or more cells for specific gravity reading. Gravity should be 1.250-1.280. If low readings are noted:

1. Check charger to insure that proper charge is being returned to the batteries.

2. Check connections as specified under **inspection 3a.**

3. Check all cells to determine if batteries are near the end of life. This should be done to the same procedure as called for under **Section IV** covering **"Troubleshooting" of batteries.**

c. On a regular interval, check car as outlined in the instruction manual for:

1. Brake drag
2. Proper tire pressure
3. Proper alignment
4. Proper lubrication
5. Proper operation of electrical system
6. Proper operation of drive and transmission system
7. Condition of charger plug and receptacle in car

Any of these conditions which are detrimental to car operation will shorten battery life.

3. CHARGING PROCEDURE

1. Become familiar with instructions issued with the charger car manual.

2. Batteries are to be charged after each day's use as soon as play has been completed. Charging between rounds is permissible if it is determined feasible to do so.

3. **Do not charge batteries** if car was not used that day.

4. **Do not allow batteries to sit in discharged condition** for prolonged periods of time.

5. **Always be sure batteries are fully charged** each day prior to starting play.

4. TROUBLE SHOOTING FOR WEAK OR BAD BATTERIES

When a car fails to operate properly performing less than one round of gold, the car is to be brought into the shop and the batteries examined as follows:

1. Check terminal connections for corrosion, loose connections and broken or frayed cables.

2. If terminal connections appear to be in good condition, check all cells with a hydrometer for variation in specific gravity among cells. A variation of .030 points or more between cells of a battery is cause for suspect. Mark the low cells.

3. Recharge the batteries as recommended by the manufacturer.

4. Read all gravities again after recharge. Be sure that batteries are fully charged at gravities of 1.250 to 1.280. If cells vary by .030 points or more it is an indication of possible trouble within that battery.

5. Connect a load tester to the set of batteries and discharge the batteries at 75 Amps and record the time to a terminal voltage of 31.5 volts. Testers are now available having an automatic Shut-Off at this voltage. New batteries should run a minimum of 75 minutes on this test.

    a. If the batteries run less than 40 minutes they have either reached the end of life or a defective battery is in the circuit. Battery replacement is then necessary.

    b. If batteries run 40-50 minutes they have lost capacity and may be nearing the end of their useful life. In golf car service one round of golf may be expected on an average golf course.

    c. If batteries run more than 50 minutes, they are in good condition and satisfactory for continued service. Prior to putting the car back in serviced it should be checked for the existence of other trouble as outlined in the instruction manual.

5. BATTERY REPLACEMENT

Defective Batteries (Premature Failures)

1. Defective battery can be determined either by observation of gravity variance at the end of the 75 Amp discharge (.030 or more points between cells of a battery) or by turning the discharge tester back on and determining the battery or cell which is defective by use of a voltmeter.
2. Mark the defective battery.
3. Recharge the batteries with the defective battery in the circuit.
4. Remove the defective battery and replace with new battery or battery of comparable age which is fully charged.

Worn Out Batteries

1. Remove old set of batteries.
2. Clean and recondition battery trays, holddowns and cables.
3. Inspect new batteries for broken containers and proper electrolyte level before installing in the car.
4. Install batteries in car being sure that they are properly held down, firm but not too tight.
5. Replace cables, being sure terminals and connectors are clean and connections are tight.
6. Apply a light coating of non-metallic grease or protective coating.

6. WINTER STORAGE OF WET BATTERIES

1. Prior to storing car, batteries should be cleaned, fully charged and properly leveled.

2. While in storage the batteries should be recharged to full charge at time intervals shown below:

Storage Temperature	Charge
Below 40° F	None required
40° F to 60° F	Every 2 months
60° F and above	Once a month

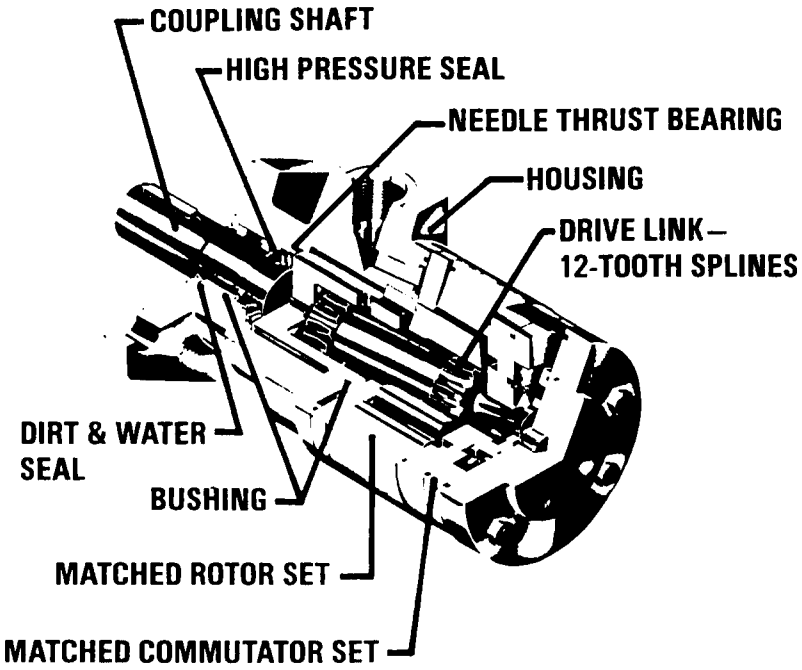
3. Check batteries after car has been removed from storage and before service begins. Follow **inspection and troubleshooting procedures** to determine the condition of the batteries.

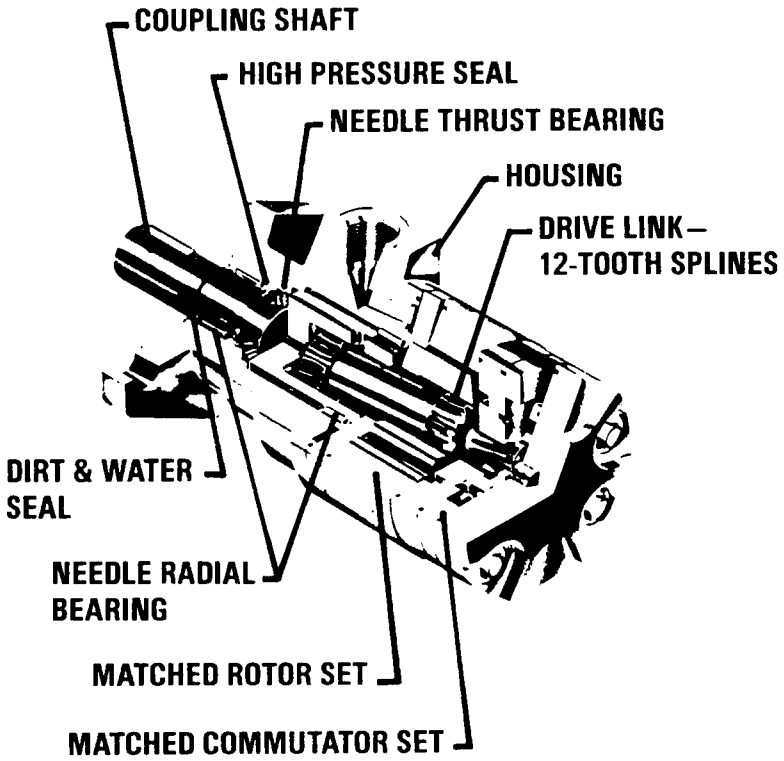
Torqmotor™

Service Procedure

MG, MF, MB, ME Series

Torqmotor™ Design Features





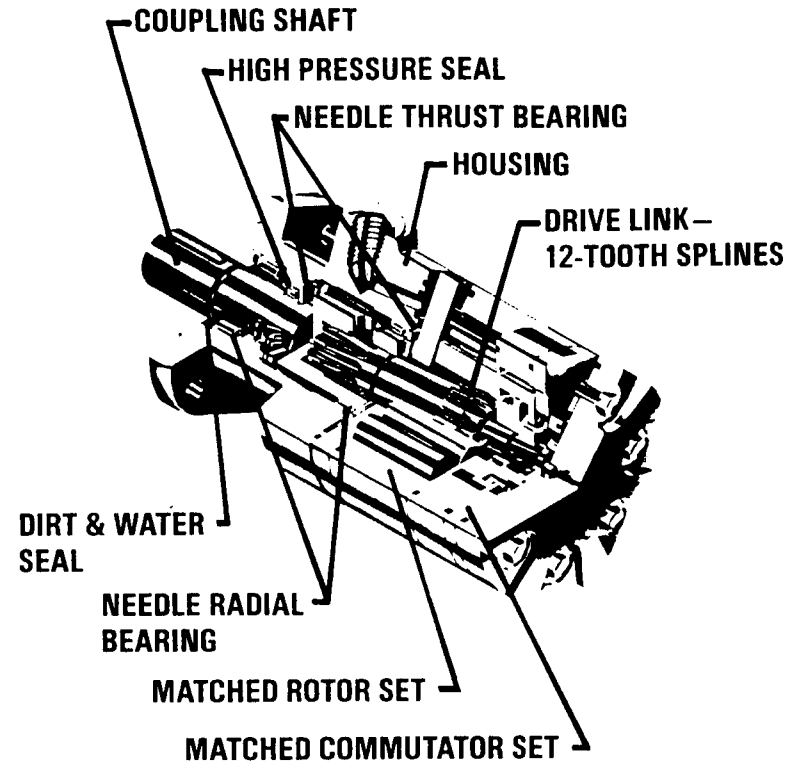
Torqmotor™ MG Series features include:

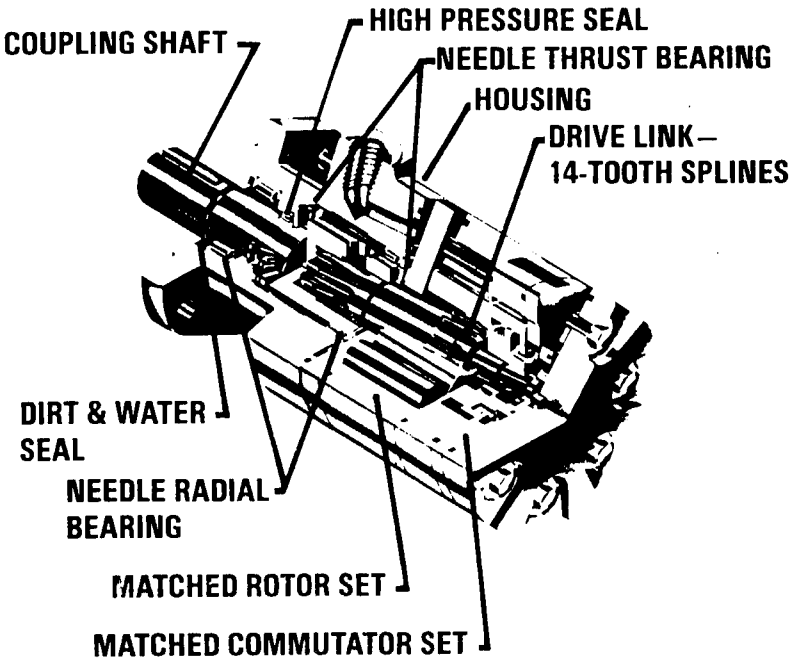
- The roller vane rotor set design offers a low-friction, wear compensation which maximizes the useful performance life of the motor.
- **Zero leak** commutation valve provides greater, more consistent volumetric efficiency.
- Design flexibility - MG offers the widest selection of shaft options, displacements and mounting flanges in the industry.
- Patented 60-40 spline member arrangement transmits more torque with less weight.
- Full flow lubrication maximizes cooling and may provide up to 50% longer life than motors not having this feature.
- Higher pressure ratings provide greater torque than competitive brands.
- Full interchangeability with other motors which are designed according to industry standards.
- Compatible with most hydraulic systems with regard to pressure, torque and speed.
- A unique high-pressure shaft seal that eliminates the need for case drains.
- Up to 13 horse power output.

Torqmotor™ MF Series features include:

- Roller vanes to reduce friction and internal leakage and to maintain efficiency.
- **Zero leak** commutation valve provides greater, more consistent volumetric efficiency.
- Wheel mount version available.
- More starting torque than competitive motors in applications where the shaft is side loaded. (Competitive brands require more pressure to start the motor.)
- A needle-roller mounted coupling shaft and steel-caged thrust bearing which can withstand 1000-pound thrust loads.
- Side load capacity is 1600 lbs (727.3 kg) maximum at center of output shaft.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing.
- Up to 17 horsepower output.
- Greater durability due to superior lubrication and minimum drive spline wear.
- Patented 60-40 spline member arrangement transmits more torque with less weight.

Torqmotor™ Design Features





Torqmotor™ MB Series features include:

- Heavy-duty thrust and roller bearings for up to twice side-load capacity to the previous motor.
- Roller vanes to reduce friction and internal leakage, and to maintain efficiency.
- A patented orbiting commutation system for less wear and longer life.
- A patented 60:40 arrangement of internal and external spline members to transmit more torque with less weight.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing.
- A unique manifold designed to improve operating efficiency.
- Up to 1000 lbs (453.6 kg) end thrust capacity in either direction.
- A design that is less sensitive to contamination than competitive motors.
- Up to 36 horsepower output.
- Greater durability because of superior lubrication and minimum drive spline wear.
- Superior low speed performance.
- **Zero leak** commutation valve provides greater, more consistent volumetric efficiency.

Torqmotor™ ME Series features include:

- Roller vanes to reduce friction and internal leakage and to maintain efficiency.
- A patented orbiting commutation system for less wear and longer life.
- A patented 60:40 arrangement of internal and external spline members to transmit more torque with less weight.
- A unique high-pressure shaft seal that eliminates the need for case drains, check valves and extra plumbing.
- A manifold designed to improve operating efficiency.
- Heavy-duty thrust and roller bearings for up to twice the side-load capacity to the previous motor.
- Up to 1000 lbs (453.6 kg) end-thrust capacity in either direction.
- A design that is less sensitive to contamination than competitive motors.
- Up to 49 horsepower output.
- Greater durability because of superior lubrication and minimum drive spline wear.
- **Zero leak** commutation valve provides greater, more consistent volumetric efficiency.

Definitions

NOTE: A NOTE provides key information to make a procedure easier or quicker to complete.

CAUTION: A CAUTION refers to procedure that must be followed to avoid damaging the Torqmotor™ or other system components.

WARNING: A WARNING REFERS TO PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE EQUIPMENT OPERATOR AND THE PERSON INSPECTING OR REPAIRING THE TORQMOTOR™

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service hydraulic motors and systems on commercial and non-commercial equipment applications. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear MG, MF, MB & ME Torqmotor Units. However, despite the care and effort taken in preparing this general Service Manual, TRW **makes no warranties** that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific Torqmotor unit, or (b) any repairs or service of a particular Torqmotor unit will result in a properly functioning Torqmotor unit.

If inspection or testing reveals evidence of abnormal wear or damage to the Torqmotor unit or if you encounter circumstances not covered in the Manual, STOP – CONSULT THE EQUIPMENT MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE A TORQMOTOR UNIT WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE TORQMOTOR UNIT.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular Torqmotor unit to (a) inspect the unit for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the equipment, or the safe operation of the Torqmotor, and (c) fully inspect and test the Torqmotor unit and the hydraulic system to insure that the repair or service of the Torqmotor unit has been properly performed and that the Torqmotor and hydraulic system will function properly.

Patents

Ross Gear Division products and systems described in this manual are protected by one or more of the following United States patents: 3,606,601. In addition, foreign patents have been issued in Canada, the United Kingdom, and West Germany.

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Introduction

Service Manual for Series MG, MF, MB, ME

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the MG, MF, MB & ME Torqmotor (low-speed, high-torque hydraulic motor).

Material in this manual is organized so you can work on the Torqmotor and get results without wasting time or being confused. To get these results, you should read this entire manual before you begin any work on the Torqmotor.

This manual also contains troubleshooting information and checklist. If you must service the Torqmotor, the checklist will help you to determine where the problem may be.

The three-column format of the Disassembly and Inspection, and Assembly sections will make it easier for you to conduct major work on the Torqmotor. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedure with photographs. Read all material carefully and pay special attention to the notes, cautions, and warnings.

A foldout page with the same Torqmotor exploded assembly view on both sides is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly and assembly procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly and assembly procedures.

Service part list charts are also provided in this manual with the part names and exploded view item numbers cross referenced to Ross Gear service part numbers.

Service parts are available through the Original Equipment Manufacturer or Ross approved MG, MF, MB & ME Distributors.

As you gain experience in servicing the Torqmotor, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Do not try to second guess the manual. If you are stuck, contact us. Servicing the Torqmotor should be a safe and productive procedure, in order for the unit to deliver the reliable, long-life operation engineered into it.

Troubleshooting Guide

NOTE: Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component other than the Torqmotor™ unit.

Preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place;
- have proper tools and materials nearby;
- have an adequate supply of clean petroleum-based solvent.

WARNING: SINCE SOLVENTS ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT, EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA AND OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

Preliminary Checks

Hydraulic systems are often trouble-free. Hence, the problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- parts damaged from impact that were not properly repaired, or that should have been replaced; and
- improper replacement parts used in previous servicing
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts.

Hydraulic Components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings and fittings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 50 micron filtration is recommended for the Torqmotor system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system. Consult the manuals published by equipment and/or component manufacturers for maximum allowable temperatures and hydraulic tests that may be necessary to run on the performance of the hydraulic components. The Torqmotor™ is not recommended for hydraulic systems with maximum temperatures above 200°F (93.3°C).

Troubleshooting Checklist

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (4) deteriorated by excess heat	Replace oil seal rings by disassembling Torqmotor™ unit.
	3. Special bolt (1, 1A, 1B or 1C) loose or its sealing area deteriorated by corrosion	(a) Loosen then tighten single bolt to torque specification. (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged	Replace seal. Disassembly of Torqmotor™ unit necessary.
	5. Worn coupling shaft (12) and internal seal (16)	Replace coupling shaft and seal by disassembling Torqmotor™ unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	(a) Replace worn rotor set by disassembling Torqmotor™ unit.
	3. Severely worn or damaged internal splines	Replace rotor set, drive link and coupling shaft by disassembling Torqmotor™ unit.
	4. Excessive heat	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate Torqmotor™ unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble Torqmotor™ unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to Torqmotor™ unit.	Locate source and eliminate cause.

CAUTION: If the hydraulic system fluid becomes overheated (in excess of 200°F (93.3°C)), seals in the system can shrink, harden or crack, thus losing their sealing ability.

Tools and Materials Required for Servicing

MG, MF, MB, ME Series Service Manual

Clean, petroleum-based solvent

Emery paper

Vise with soft jaws

Air pressure source

Arbor press

Screw driver

Masking tape

Breaker bar

Torque wrench—ft. lbs. (N m)

Sockets: 1/2 or 9/16 inch thin wall, 1 inch

Allen Sockets: 3/16, 3/8 inch

Adjustable crescent wrench or hose fitting wrenches

SAE 10W40 SE or SF oil

Special bearing mandrel for MG & MF Torqmotors (SEE FIGURE 1)

Special bearing mandrel for MB & ME Torqmotors (SEE FIGURE 2)

Feeler gage .005 inch (.13 mm)

MG & MF Torqmotors require blind hole bearing puller for 1.06 inch (26.9 mm) and 1.62 inch (41.1 mm) diameter bearing/bushing.

MB & ME Torqmotors require blind hole bearing puller for 1.40 inch dia. (35.6 mm) and 2.130 inch dia. (54.1 mm) bearing.

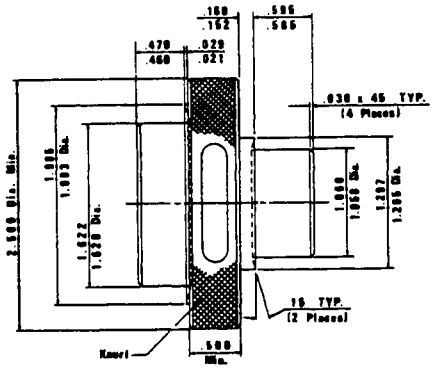
Clean corrosion resistant grease. Recommended grease is E/M Lubricant #K-70M, Ross Gear Specification #045236

NOTE: The available service seal kits include the recommended grease as a grease pack #406018

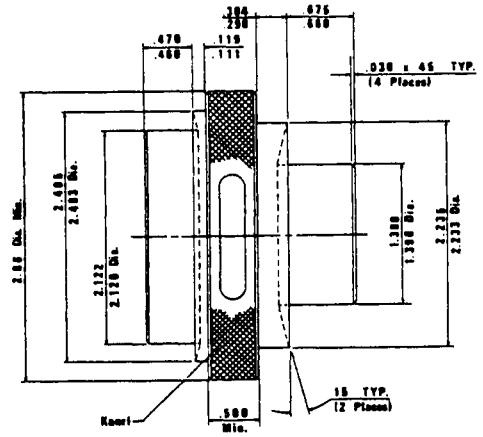
CAUTION: Mixing greases that have different bases can be detrimental to bearing life.

CONVERSIONS

INCHES	mm	INCHES	mm
.020	.51	1.060	26.92
.021	.53	1.295	32.89
.029	.74	1.297	32.94
.030	.76	1.396	35.46
.111	2.81	1.398	35.51
.119	3.02	1.620	41.15
.152	3.86	1.622	41.20
.160	4.06	1.983	50.37
.296	7.52	1.985	50.42
.304	7.72	2.120	53.85
.460	11.68	2.122	53.90
.470	11.94	2.233	56.72
.500	12.70	2.235	56.77
.585	14.86	2.483	63.07
.595	15.11	2.485	63.12
.660	16.76	2.500	63.5
.675	17.15	2.88	73.2
1.058	26.87		



(Fabricate if considered necessary)
FIGURE 1—MG & MF

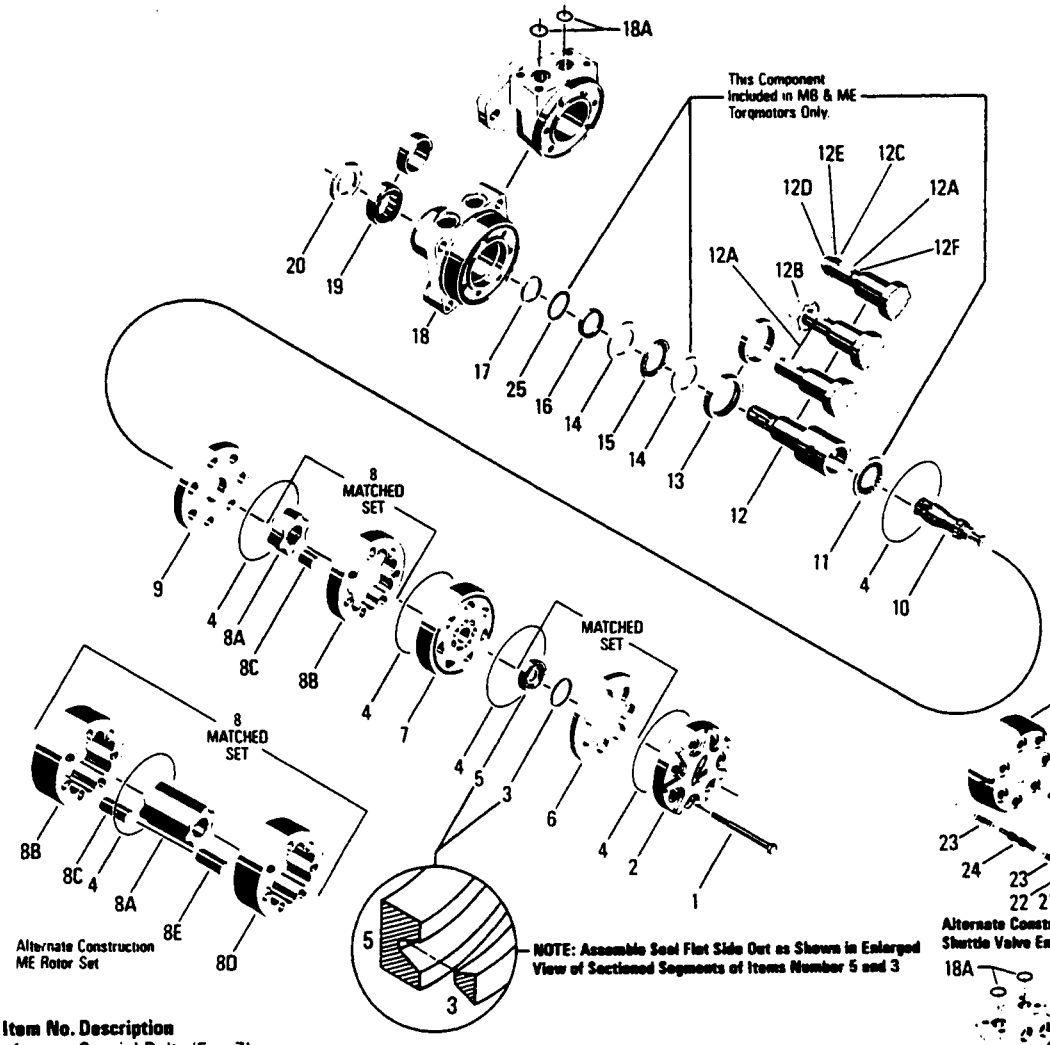


(Fabricate if considered necessary)
FIGURE 2—MB & ME

Torque Chart

Part Name	Item Number	Torque
bolt 5/16 24 UNF 2A	1, 1A, 1B or 1C	22-26 ft. lbs. (30-35 N m)
bolt 3/8 24 UNF 2A	1, 1A, 1B or 1C	45-55 ft. lbs. (60-76 N m)
bolt 5/8 18 UNF 2A	12D	140-180 ft. lbs. (190-244 N m)
nut 3/4 16 UNF 2B	12B (MG, MF)	175-255 ft. lbs. (237-305 N m)
nut 1 20 UNEF 2B	12B (MB, ME)	300-400 ft. lbs. (407-542 N m)
nut 1-1/8 18 UNEF 2B	12B (ME)	300-400 ft. lbs. (407-542 N m)

Torqmotor™ Exploded Assembly View—Typical



Item No. Description

1.	Special Bolts (5 or 7)				
1A.	Special Bolts (7)				
1B.	Special Bolts (7)	11.	Thrust Bearing	20.	Dirt & Water Seal
1C.	Special Bolts (7)	12.	Coupling Shaft	21.	Plug (2)
2.	End Cover	12A.	Key	22.	O-Ring (2)
3.	Seal Ring-Commutator	12B.	Nut	23.	Spring
4.	Seal Ring (5)	12C.	Washer	24.	Valve (Shuttle or Relief)
5.	Commutator	12D.	Bolt	25.	Backup Washer
6.	Commutator Ring	12E.	Lockwasher		
7.	Manifold	12F.	Retaining Ring		
8.	Rotor Set	13.	Bearing/Bushing, Inner		
8A.	Rotor	14.	Thrust Washer		
8B.	Stator or Stator Half	15	Thrust Bearing		
8C.	Vane (7)	16.	Seal		
8D.	Stator Half	17.	Backup Washer		
8E.	Vane (7)	18	Housing		
9.	Wear Plate	18A.	O-Ring (2)		
10.	Drive Link	19.	Bearing/Bushing, Outer		

Disassembly and Inspection

(Preparation Before Disassembly)

- Before you disassemble the Torqmotor unit or any of its components read this entire manual. It provides important information on parts and procedures you will need to know to service the Torqmotor.
- Determine whether the Torqmotor you are about to disassemble is the Small Frame Series MG or MF or the Large Frame Series MB or ME so you can follow those procedures that pertain to that Series Torqmotor. The first two letters of the "spec" number on the Torqmotor identification tag is the Series designation. Also determine the type of end cover construction from the alternate views shown on page 7A and 7B.
- The Small Frame Series MG & MF Torqmotors will have a 3.66 inch (92.9 mm) main body outside diameter and five 5/16-24 UNF 2A cover bolts. The Large Frame Series MB & ME Torqmotors will have a 5 inch (127.0 mm) main body outside diameter and seven 3/8 24 UNF 2A cover bolts.
- Refer to page 7 for tools and other items required to service the Torqmotor and have them available.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the Torqmotor. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings and immediately plug port holes and fluid lines.
- Remove the Torqmotor from system, drain it of fluid and take it to a clean work surface. (A piece of wrapping paper makes an excellent disposable top.)
- Clean and dry the Torqmotor before you start to disassemble the unit.
- As you disassemble the Torqmotor clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the Torqmotor. Replace all seals, seal rings and any damaged or worn parts with genuine Ross or OEM approved service parts.

Disassembly and Inspection

(Reference Exploded Assembly View)

place Torqmotor in a vise

1. Place the Torqmotor in a soft jawed vice, with coupling shaft (12) pointed down and the vise jaws clamping firmly on the sides of the housing (18) mounting flange or port bosses. Remove manifold port O-Rings (18A) if applicable.

WARNING

WARNING: IF THE TORQMOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

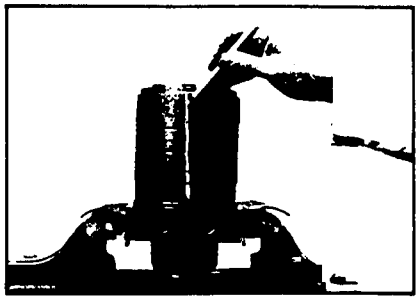


Figure 3

scribe alignment mark & loosen valve plugs

2. Scribe an alignment mark down and across the Torqmotor components from end cover (2) to housing (18) to facilitate reassembly orientation where required. Loosen two shuttle or relief valve plugs (21) for disassembly later if included in end cover. 3/16 or 3/8 inch allen wrench or 1 inch hex socket required. SEE FIGURE 3 & 4.

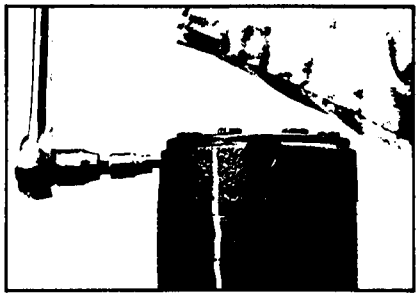


Figure 4

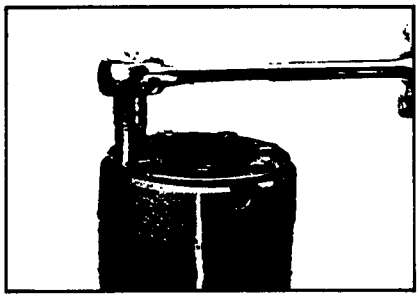


Figure 5

remove special bolts & inspect bolts

3. Remove the five or seven special ring head bolts (1, 1A, 1B, or 1C) using an appropriate 1/2 or 9/16 inch size socket. SEE FIGURE 5. Inspect bolts for damaged threads, or sealing rings, under the bolt head. Replace damaged bolts. SEE FIGURE 6.

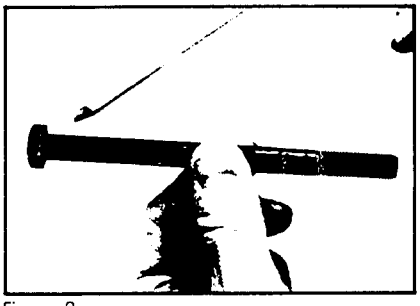


Figure 6

remove end cover & inspect bolts

4. Remove end cover assembly (2) and seal ring (4). Discard seal ring. SEE FIGURE 7.

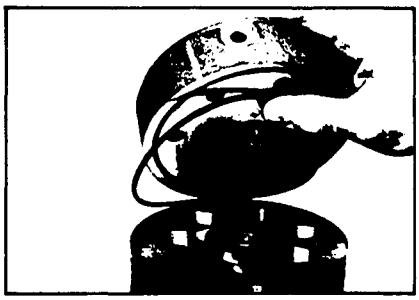


Figure 7

NOTE

NOTE: Refer to the appropriate "alternate cover construction" on page 7A or 7B to determine the end cover construction being serviced.

remove plugs and valves

5. If the end cover (2) is equipped with shuttle valve or relief valve (24) components, remove the two previously loosened plugs (21) and o-rings (22). SEE FIGURE 8.

CAUTION

CAUTION: Be ready to catch the shuttle valve or relief valve components that will fall out of the end cover valve cavity when the plugs are removed.

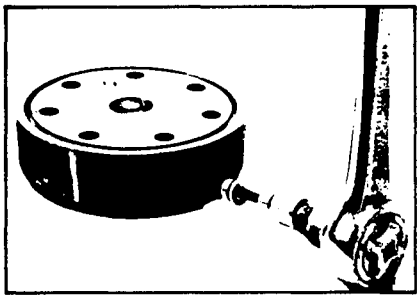


Figure 8

NOTE

NOTE: O-ring (22) is not included in seal kits but serviced separately if required.

NOTE

NOTE: The insert and if included the orifice plug in the end cover (2) must not be removed as they are serviced as an integral part of the end cover.

wash & inspect end cover

6. Thoroughly wash end cover (2) in proper solvent and blow dry. Be sure the end cover valve apertures, including the internal orifice plug, are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace end cover as necessary. SEE FIGURE 9.

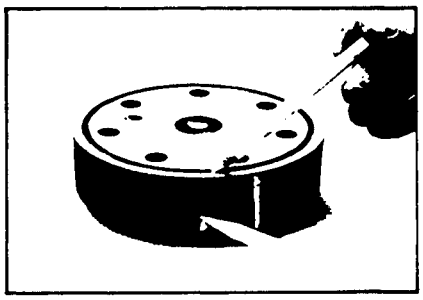


Figure 9

NOTE

NOTE: A polished pattern (not scratches) on the cover from rotation of the commutator (5) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, and rotor set.



Figure 10

remove & inspect commutator ring

7. Remove commutator ring (6). SEE FIGURE 10. Inspect commutator ring for cracks, or burrs.

remove & inspect commutator

8. Remove commutator (5) and seal ring (3). Remove seal ring from commutator, using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator for cracks or burrs, wear, scoring, spalling or brinelling. If any of these conditions exist, replace commutator and commutator ring as a matched set. SEE FIGURE 11 & 12.



Figure 11

remove manifold

9. Remove manifold (7) and inspect for cracks surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. SEE FIGURE 13. A polished pattern on the ground surfaces from commutator or rotor rotation is normal. Remove and discard the seal rings (4) that are on both sides of the manifold.

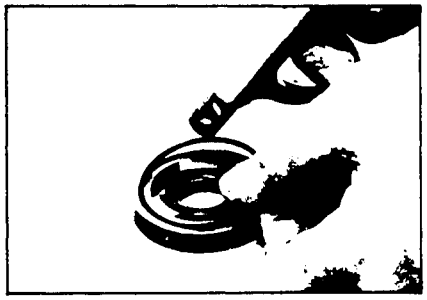


Figure 12

NOTE

NOTE: The manifold is constructed of plates bonded together to form an integral component not subject to further disassembly for service. Compare configuration of both sides of the manifold to ensure that same surface is reassembled against the rotor set.

remove & inspect rotor set & wearplate

10. Remove rotor set (8) and wearplate (9) together to retain the rotor set in its assembled form, maintaining the same rotor vane (8C) to stator (8B) contact surfaces. SEE FIGURE 14. The drive link (10) may come away from the coupling shaft (12) with the rotor set, and wearplate. You may have to shift the rotor set on the wearplate to work the drive link out of the rotor (8A) and wearplate. SEE FIGURE 15, Page 16. Inspect the rotor set in its assembled form for nicks, scoring, or spalling on any surface and for broken or worn splines. If the rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wearplate for cracks, brinelling, or scoring. Discard seal ring (4) that is between the rotor set and wearplate.



Figure 13

NOTE

NOTE: The rotor set (8) components may become disassembled during service procedures. Marking the surface of the rotor and stator that is facing UP, with etching ink or grease pencil before removal from Torqmotor will ensure correct reassembly of rotor into stator and rotor set into Torqmotor. Marking all rotor components and mating spline components for exact repositioning at assembly will ensure maximum wear life and performance of rotor set and Torqmotor.

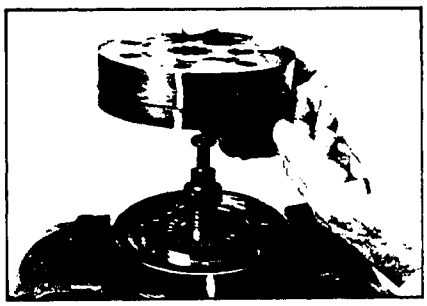


Figure 14

NOTE

NOTE: Series ME Torqmotors may have a rotor set with two stator halfs (8B & 8D) with a seal ring (4) between them and two sets of seven vanes (8C & 8E). Discard seal ring only if stator halfs become disassembled during the service procedures.

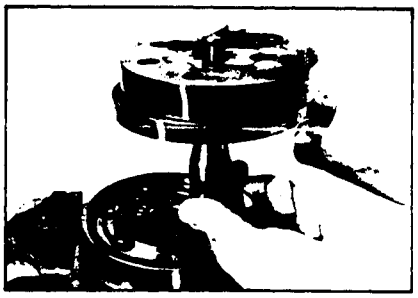


Figure 15

NOTE

NOTE: A polished pattern on the wear plate from rotor rotation is normal.

check rotor, vane clearance

11. Place rotor set (8) and wear plate (9) on a flat surface and center rotor (8A) in stator (8B) such that two rotor lobes (180 degrees apart) and a roller vane (8C) centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than .005 inches (0.13 mm) of clearance, replace rotor set. SEE FIGURE 16.

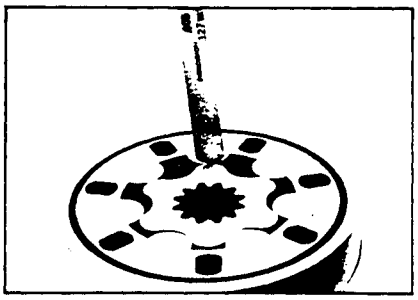


Figure 16

NOTE

NOTE: If rotor set (8) has two stator halfs (8B & 8D) and two sets of seven vanes (8C & 8E) as shown in the alternate construction ME rotor set assembly view, check the rotor lobe to roller vane clearance at both ends of rotor.

remove & inspect drive link

12. Remove drive link (10) from coupling shaft (12) if it was not removed with rotor set and wear plate. Inspect drive link for cracks and worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. SEE FIGURE 17. Remove and discard seal ring (4) from housing (18).

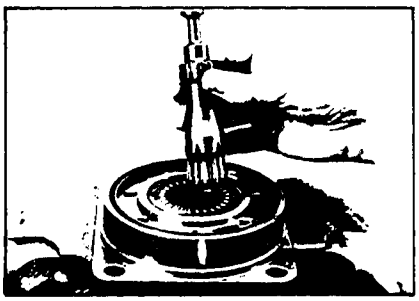


Figure 17

remove thrust bearing

13. Remove thrust bearing (11) from top of coupling shaft (12) if Torqmotor is a Series MB or ME. Inspect for wear, brinelling, corrosion and a full complement of retained rollers. SEE FIGURE 18.



Figure 18

check coupling shaft for rust or corrosion

14. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used. SEE FIGURE 19. Remove any key (12A), nut (12B), washer (12C), bolt (12D), lock washer (12E), or retaining ring (12F).

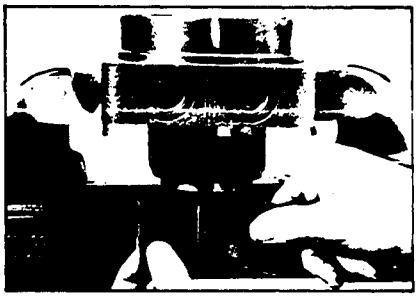


Figure 19

remove & inspect coupling shaft

15. Remove coupling shaft (12), by pushing on the output end of shaft. SEE FIGURE 20. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. SEE FIGURE 21. Replace coupling shaft if any of these conditions exist.

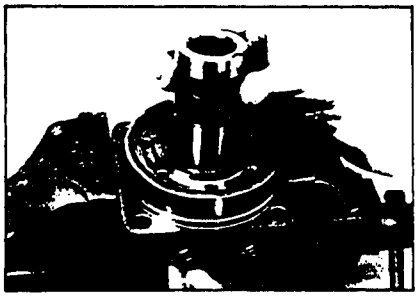


Figure 20

NOTE

NOTE: Minor shaft wear in seal area is permissible. If wear exceeds .020 inches (0.51 mm) diametrically, replace coupling shaft.

NOTE

NOTE: A slight "polish" is permissible in the shaft bearing areas. Anything more would require coupling shaft replacement.

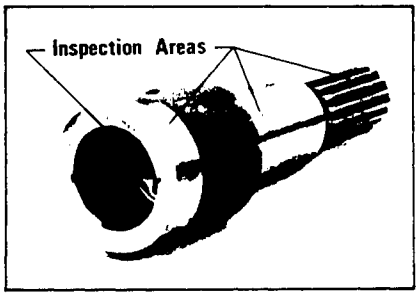


Figure 21

remove seal ring from housing

16. Remove and discard seal ring (4) from housing (18).

remove & inspect thrust washer & thrust bearing

17. Remove thrust bearing (15) and thrust washer (14) if the unit is a Series MG or MF. Inspect for wear, brinelling, corrosion and a full complement of retained rollers. SEE FIGURE 22.

NOTE

NOTE: Large Frame Series MB & ME Torqmotors have a thrust bearing (15) sandwiched between two thrust washers (14) that cannot be removed from housing (18) unless bearing (13) is removed for replacement.

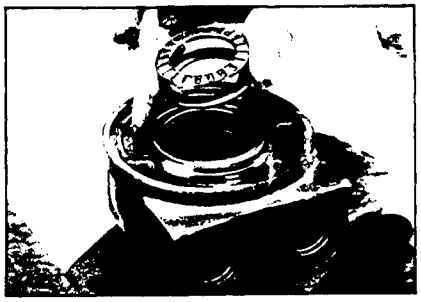


Figure 22

remove seal & washer or washers

18. Remove seal (16) and back up washer (17) from Small Frame, MG & MF housing (18). Discard both. SEE FIGURE 23.

Remove seal (16), backup washer (17), and backup washer (25) from Large Frame, Series MB & ME Torqmotor housing by working them around unseated thrust washers (14) and thrust bearing (15) and out of the housing. Discard seal and washers. SEE FIGURE 24.

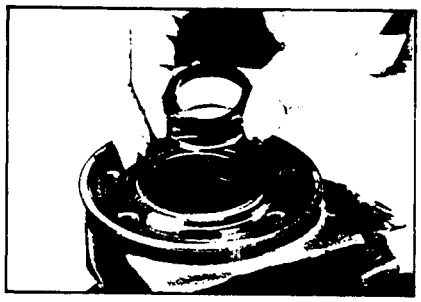


Figure 23

NOTE

NOTE: The original design units of Large Frame, Series MB & ME Torqmotors did not include backup washer (25), but must include backup washer (25) when reassembled for service.



Figure 24

remove seal

19. Remove housing (18) from vise, invert it and remove and discard seal (20). A blind hole bearing or seal puller required. SEE FIGURE 25.

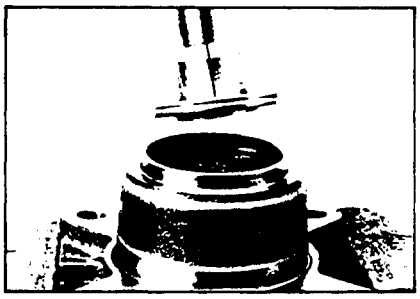


Figure 25

inspect housing assembly

20. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. SEE FIGURE 26. If the housing is defective in these areas, discard the housing assembly.

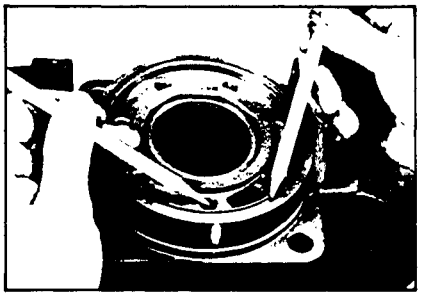


Figure 26

inspect housing bearing/bushing

21. If the housing (18) assembly has passed inspection to this point, inspect the housing bearings/bushings (19) and (13) and if they are captured in the housing cavity the two thrust washers (14) and thrust bearing (15). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and thrust washers must be free of brinelling and corrosion. SEE FIGURE 27. The MG Series bushing (19) or (13) to coupling shaft diametral clearance must not exceed .010 inch (.025 mm). A bearing, bushing, or thrust washer that does not pass inspection must be replaced. SEE FIGURE 28. If the housing has passed this inspection the disassembly of the Torqmotor is completed.

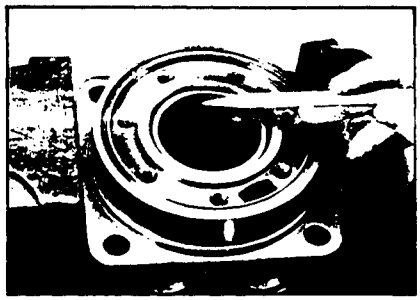


Figure 27

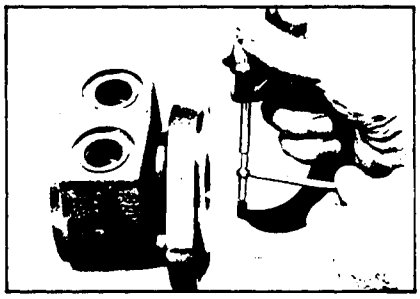


Figure 28

NOTE

NOTE: The depth or location of bearing/bushing (13) in relation to the housing wear plate surface and the depth or location of bearing/bushing (19) in relation to the beginning of bearing/bushing counter bore should be measured and noted before removing the bearings/bushings. This will facilitate the correct reassembly of new bearings/bushings. SEE FIGURE 29.

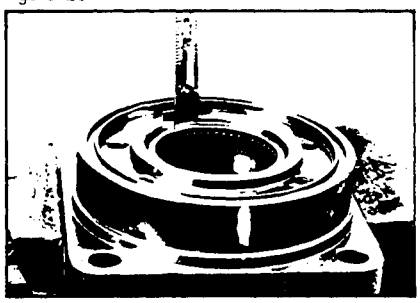


Figure 29

remove bearings or bushings & thrust washers

22. If the bearings, bushing or thrust washers must be replaced use a suitable size bearing puller to remove bearing/bushings (19) and (13) from housing (18) without damaging the housing. Remove thrust washers (14) and thrust bearing (15) if they were previously retained in the housing by bearing (13). SEE FIGURES 30 & 31.

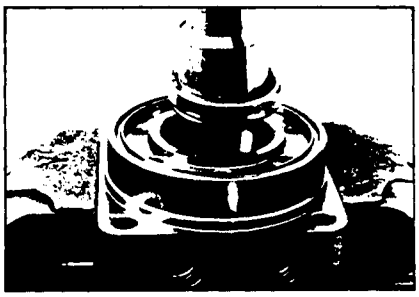


Figure 30

THE DISASSEMBLY OF TORQMOTOR IS COMPLETED.

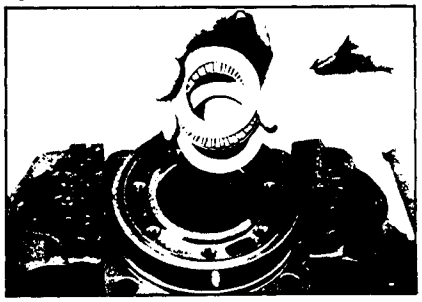


Figure 31

Torqmotor™ Assembly

- Replace all seals and seal rings with new ones each time you reassemble the Torqmotor unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.
- **NOTE: Individual seals and seal rings as well as a complete seal kit are available. SEE FIGURE 32. The parts should be available through most OEM parts distributors or Ross approved Torqmotor™ distributors. (Contact your local dealer for availability).**
- **NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.**
- Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, commutator set, manifold rotor set, wear plate and housing and from port and sealing areas.

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

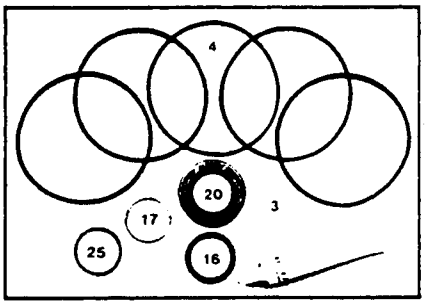
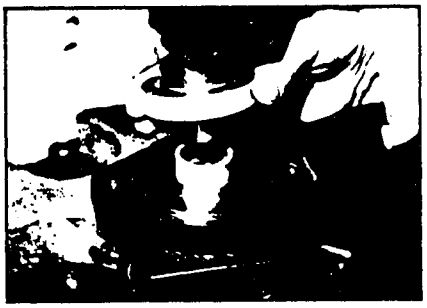


Figure 32 MB, ME seal kit

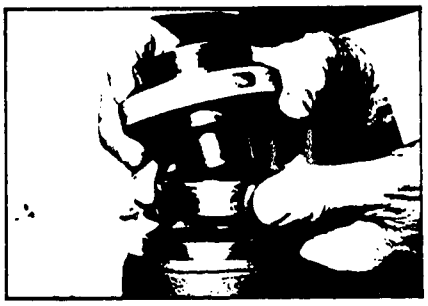
press in outer bearing/bushing

1. If the housing (18) bearing components were removed for replacement, thoroughly coat and pack a **new** outer bearing/bushing (19) with clean corrosion resistant grease recommended in the material section on page 7. Press the new bearing/bushing into the counterbore at the mounting flange end of the housing, using the appropriate sized bearing mandrel such as described in figure 1 or figure 2 on page 7 which will control the bearing/bushing depth.

   Small Frame Series MG and MF Torqmotor housings require the use of bearing mandrel shown in figure 1 on page 7 to press bearing/bushing (19) into the housing to a required depth of .151/.161 inches (3.84/4.09 mm) from the end of the bearing counterbore. SEE FIGURE 33.


Figure 33

   Large Frame Series MB and ME Torqmotor housings require the use of the bearing mandrel shown in figure 2 on page 7 to press bearing (19) into the housing to a required depth of .290/.310 inches (7.37/7.87 mm) from the outside end of the bearing counterbore. SEE FIGURE 34.


Figure 34

NOTE

NOTE: Bearing mandrel must be pressed against the lettered end of bearing shell. Take care that the housing bore is square with the press base and the bearing/bushing is not cocked when pressing a bearing/bushing into the housing.

CAUTION

CAUTION: If the bearing mandrel specified on page 7 is not available and alternate methods are used to press in bearing/bushing (13) and (19) the bearing/bushing depths specified must be achieved to insure adequate bearing support and correct relationship to adjacent components when assembled. SEE FIGURE 35.

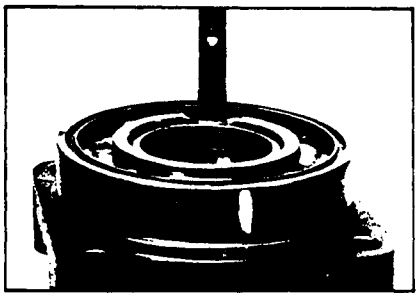


Figure 35

CAUTION

CAUTION: Because the bearing/bushings (13) and (19) have a press fit into the housing they must be discarded when removed. They must not be reused.

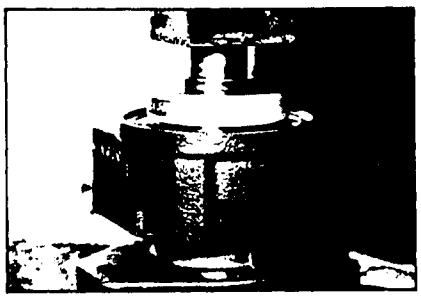


Figure 36

press in inner bearing/bushing

2. The Small Frame Series MG and MF Torqmotor inner housing bearing/bushing (13) can now be pressed into its counterbore in housing (18) flush to .03 inch (.76 mm) below the housing wear plate contact face. Use the opposite end of the bearing mandrel that was used to press in the outer bearing/bushing (19). Reference figure 1, page 7. SEE FIGURE 36.



Figure 37

The Large Frame Series MB and ME Torqmotor housing (18) requires that you assemble a **new** backup washer (17), **new** backup washer (25), **new** seal (16), with the lip facing out, **new** thrust washer (14), **new** thrust bearing (15) and a **new** second thrust washer (14) in that order before pressing in the inner housing bearing (13). SEE FIGURE 37 & 38. When these components are in place, press **new** bearing (13) into the housing (18) to a depth of .105/.125 inches (2.67/3.18) below the housing wear plate contact face. Use the opposite end of the bearing mandrel used to press in outer bearing (19). Reference figure 2, page 7. SEE FIGURE 39.



Figure 38

press in dirt & water seal

3. Apply a small amount of clean grease to a **new** dirt and water seal (20) and press it into the housing (18) outer bearing counterbore.

   The Small Frame Series MG and MF Torqmotor dirt and water seal (20) must be pressed in until its' flange is flush against the housing. SEE FIGURE 40.

   The Large Frame Series MB and ME Torqmotor dirt and water seal (20) must be pressed in with the lip facing out and until the seal is flush to .020 inches (.51 mm) below the end of housing. SEE FIGURE 41.

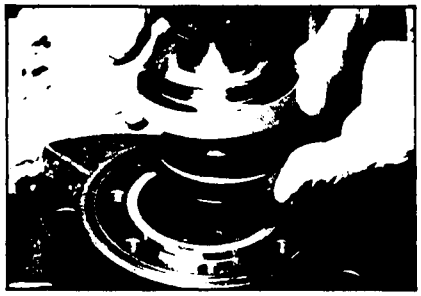


Figure 39

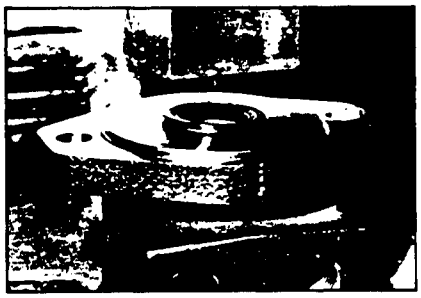


Figure 40

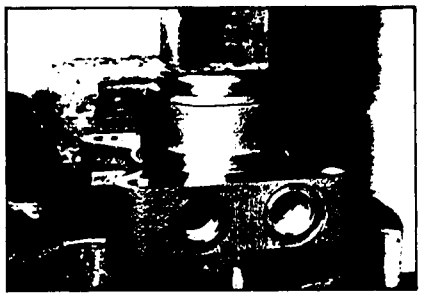


Figure 41

place housing assembly into vise

4. Place housing (18) assembly into a soft jawed vise with the coupling shaft bore down, clamping against the mounting flange. SEE FIGURE 42.

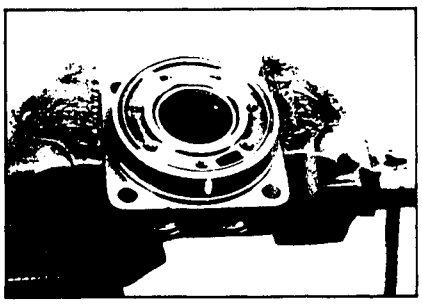


Figure 42

assemble backup washer & seal

5. On Small Frame, Series MG & MF Torqmotors assemble a **new** backup washer (17) and **new** seal (16) with the seal lip facing out, into their respective counterbores in housing (18) if they were not assembled in procedure 2.

   Large Frame, Series MB and ME Torqmotor housing (18) that did not require replacement of the bearing package will require that the two "captured" thrust washers (14) and thrust bearing (15) be unseated and vertical to the counterbore and the **new** backup washer (17), **new** backup washer (25), and **new** seal (16) be worked around the thrust bearing package and placed into their respective counterbores. The seal lip must face out of the seal counterbore. Be sure the thrust bearing package is reseated correctly after assembly of the seal and backup washer. SEE FIGURE 43 & 44.

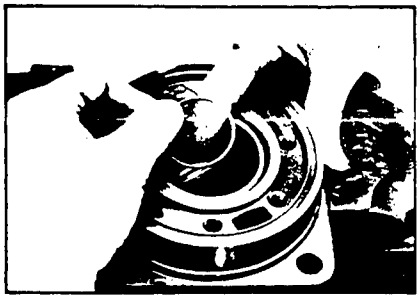


Figure 43

CAUTION

CAUTION: Original design Large Frame, MB & ME Torqmotors that do not have backup washer (25) when disassembled must be assembled with a new backup washer (17), new backup washer (25), and new seal (16).

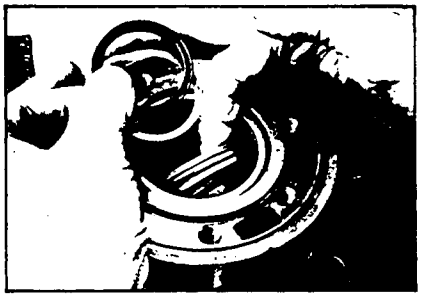


Figure 44

assemble thrust washer & bearing

6. Assemble thrust washer (14) then thrust bearing (15) that was removed from the Series MG or MF Torqmotor. SEE FIGURE 45.

NOTE

NOTE: Small Frame Series MG and MF Torqmotors require one thrust washer (14) with thrust bearing (15). The coupling shaft will be seated directly against the thrust bearing.

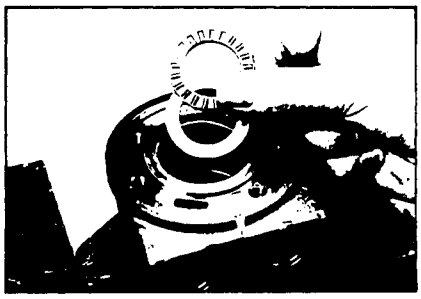


Figure 45

apply masking tape to shaft

7. Apply masking tape around splines or keyway on shaft (12) to prevent damage to seal. SEE FIGURE 46.



Figure 46

install coupling shaft

8. Be sure that a generous amount of clean corrosion resistant grease has been applied to the lower (outer) housing bearing/bushing (19). Install the coupling shaft (12) into housing (18), seating it against the thrust bearing (15) in MG and MF Series housings and against the second thrust washer (14) in MB and ME Series housings. SEE FIGURE 47.

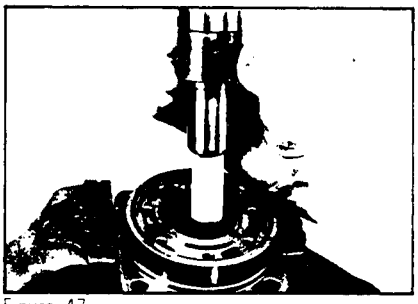


Figure 47

CAUTION

CAUTION: The outer bearing (19) is not lubricated by the system's hydraulic fluid. Be sure it is thoroughly packed with the recommended grease, Ross Gear grease specification #045236, E/M Lubricant #K-70M.

NOTE

NOTE: The coupling shaft (12) will be flush or just below the housing wear plate surface on Small Frame, Series MG and MF Torqmotors when properly seated while the coupling shaft (12) on Large Frame, Series MB and ME Torqmotors will be approximately .10 inch (2.54 mm) below the housing wear plate surface to allow the assembly of thrust bearing (11). The coupling shaft must rotate smoothly on the thrust bearing package. SEE FIGURE 48.

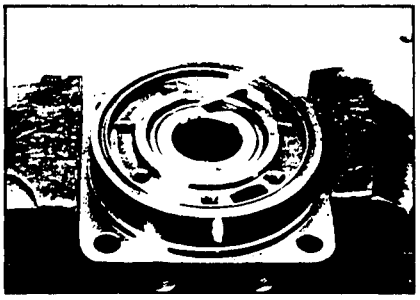


Figure 48

install thrust bearing

9. Install thrust bearing (11) onto the end of coupling shaft (12) only if you are servicing an MB or ME Series Torqmotor. SEE FIGURE 49.



Figure 49

insert seal ring

10. Apply a small amount of clean grease to a **new** seal ring (4) and insert it into the housing (18) seal ring groove. SEE FIGURE 50.

NOTE

NOTE: One or two alignment studs screwed finger tight into housing (18) bolt holes, approximately 180 degrees apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of either 3/8-24 UNF 2A or 5/16-24 UNF 2A bolts as required that are over .5 inch (12.7 mm) longer than the bolts (1, 1A, 1B or 1C) used in the Torqmotor.

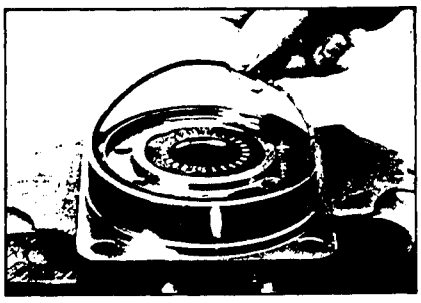


Figure 50

install drive link

11. Install drive link (10) the long splined end down into the coupling shaft (12) and engage the drive link splines into mesh with the coupling shaft splines. SEE FIGURE 51.

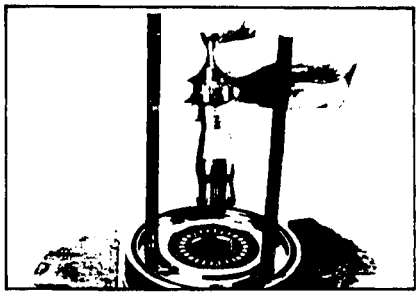


Figure 51

NOTE

NOTE: Use any alignment marks put on the coupling shaft and drive link before disassembly to assemble the drive link splines in their original position in the mating coupling shaft splines.

assemble wear plate

12. Assemble wear plate (9) over the drive link (10) and alignment studs onto the housing (18). SEE FIGURE 52.

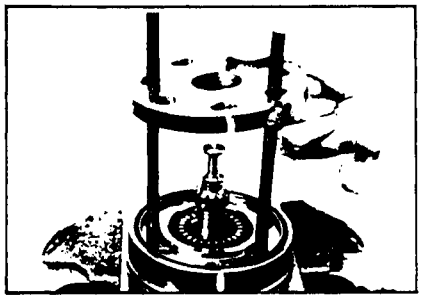


Figure 52

assemble seal ring

13. Apply a small amount of clean grease to a **new** seal ring (4) and assemble it into the seal ring groove on the wear plate side of the rotor set stator (8B). SEE FIGURE 53.

install the assembled rotor set

14. Install the assembled rotor set (8) onto wear plate (9) with rotor (8A) counterbore and seal ring side down and the splines into mesh with the drive link splines. SEE FIGURE 54.

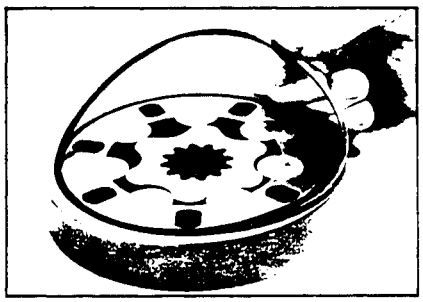


Figure 53

NOTE

NOTE: It may be necessary to turn one alignment stud out of the housing (18) temporarily to assemble rotor set (8) or manifold (7) over the drive link.

NOTE

NOTE: If necessary, go to the appropriate, "Rotor Set Component Assembly Procedure," on page 30 or 31.

NOTE

NOTE: The rotor set rotor counterbore side must be down against wear plate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore and that was not etched before disassembly can be reinstalled using the drive link spline pattern on the rotor splines if apparent, to determine which side was down. The rotor set has a seal ring groove on the wear plate contact side of the stator (8B).

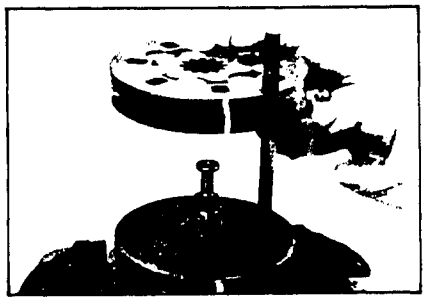


Figure 54

assemble seal ring in manifold

15. Apply clean grease to a **new** seal ring (4) and assemble it in the seal ring groove in the rotor set contact side of manifold (7). SEE FIGURE 55.

NOTE

NOTE: The manifold (7) is made up of several plates bonded together permanently to form an integral component. The manifold surface that must contact the rotor set has it's series of irregular shaped cavities on the largest circumference or circle around the inside diameter. The polished impression left on the manifold by the rotor set is another indication of which surface must contact the rotor set.



Figure 55

assemble manifold

16. Assemble the manifold (7) over the alignment studs and drive link (10) and onto the rotor set. Be sure the correct manifold surface is against the rotor set. SEE FIGURE 56.

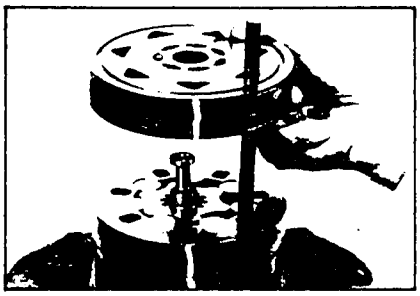


Figure 56

insert a seal in manifold

17. Apply grease to a **new** seal ring (4) and insert it in the seal ring groove exposed on the manifold. SEE FIGURE 57.

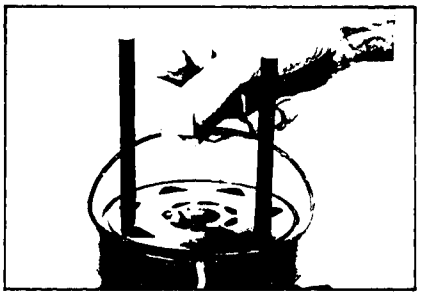


Figure 57

assemble commutator ring

18. Assemble the commutator ring (6) over alignment studs onto the manifold. SEE FIGURE 58.

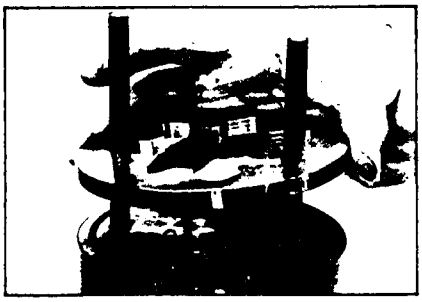


Figure 58

assemble seal & commutator

19. Assemble a **new** seal ring (3) flat side up, into commutator (5) and assemble commutator over the end of drive link (10) onto manifold (7) with seal ring side up. SEE FIGURE 59, 60.



Figure 59



Figure 60

assemble shuttle valve parts into end cover

20. If shuttle valve components items #21, #22, #23, #24 were removed from the end cover (2) turn a plug (21) with a **new** o-ring (22), loosely into one end of the valve cavity in the end cover. Insert a spring (23) the valve (24) and the second spring (23) into the other end of the valve cavity. Turn the second plug (21) with a **new** o-ring (22) loosely into the end cover valve cavity. 3/16 inch Allen wrench required. SEE FIGURE 61.

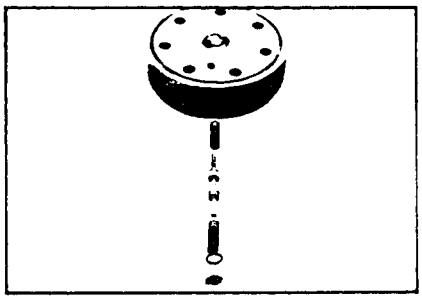


Figure 61

assemble relief valve parts in end cover

21. If relief valve components items #21, #22, #24 were removed from the end cover (2) assemble a **new** o-ring (22) on the two plugs (21). Assemble a two piece relief valve (24) in each of the plugs, with the large end of the conical spring into the plug first and the small nut of the other valve piece in the small end of the conical spring. Turn each of the plug and relief valve assemblies into the end cover loosely to be torqued later. 3/8 inch Allen or 1 inch Hex socket required. SEE FIGURE 62.

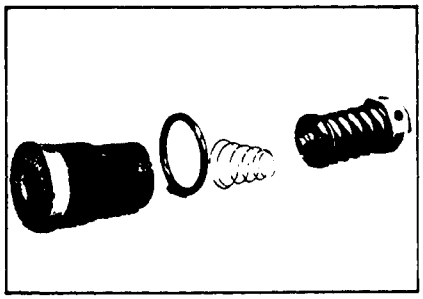


Figure 62

assemble seal ring & end cover

22. Assemble a **new** seal ring (4) into end cover (2) and assemble end cover over the alignment studs and onto the commutator set. SEE FIGURE 63, 64. If the end cover has only 5 bolt holes be sure the cover holes are aligned with the 5 threaded holes in housing (18). The correct 5 bolt end cover bolt hole relationship to housing port bosses is shown in FIGURE 65.

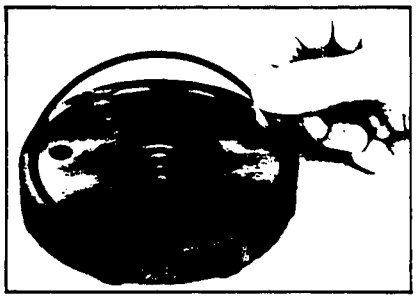


Figure 63

NOTE

NOTE: If the end cover has a valve (24) or has five bolt holes, use the line you previously scribed on the cover to radially align the end cover into its original position.

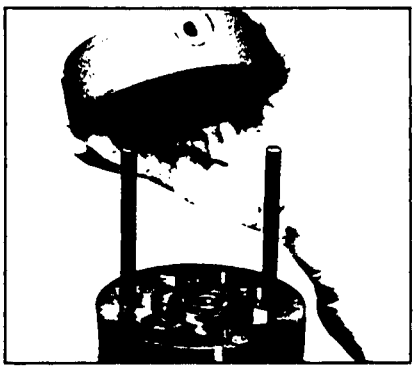


Figure 64

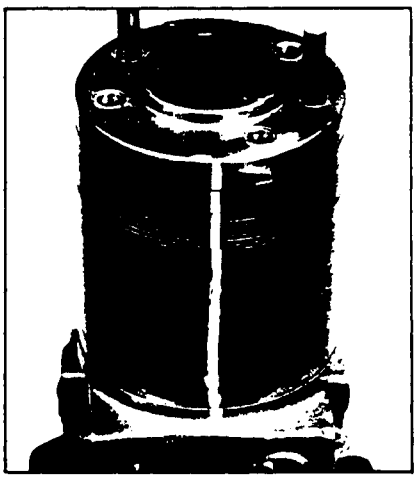


Figure 65

assemble cover bolts

23. Assemble the 5 or 7 special bolts (1, 1A, 1B or 1C) and screw in finger tight. Remove and replace the two alignment studs with bolts after the other bolts are in place. Alternately and progressively tighten the bolts to pull the end cover and other components into place with a final torque of 22-26 ft. lbs. (30-35 N m) for the five MG & MF Series 5/16 24 threaded bolts or 45-55 ft. lbs. (61-75 N m) for the seven MB & ME Series 3/8-24 threaded bolts. SEE FIGURE 66, 67, 68.

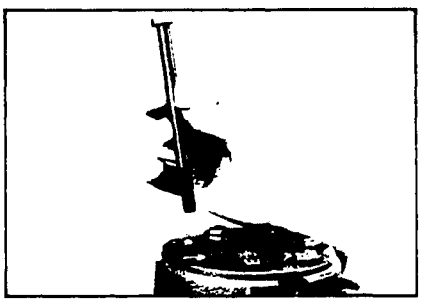


Figure 66

NOTE

NOTE: The special bolts required for use with the relief or shuttle valve (24) end cover assembly (2) are longer than the bolts required with standard end cover assembly. Refer to the individual service parts lists or parts list charts for correct service part number if replacement is required.

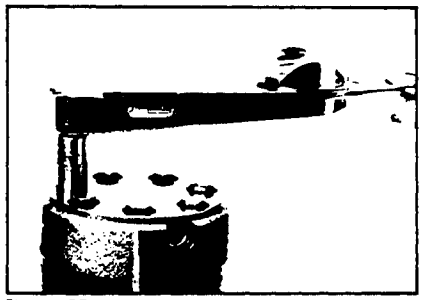


Figure 67

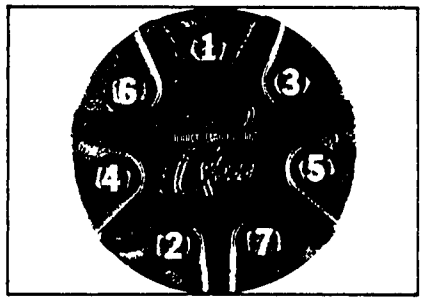


Figure 68

torque the valve plugs

24. Torque the two shuttle valve plug assemblies (21) in end cover assembly to 9-12 ft. lbs. (12-16 N m) if cover is so equipped. SEE FIGURE 69.

Torque the two relief valve plug assemblies (21) in end cover assembly to 45-55 ft. lbs. (61-75 N m) if cover is so equipped.



Figure 69

THE ASSEMBLY OF THE TORQMOTOR IS NOW COMPLETE EXCEPT FOR WOODRUFF KEY (12A), NUT (12B), WASHER (12C), BOLT (12D), LOCKWASHER (12E), RETAINER RING (12F) or PORT O-RINGS (18A) AT INSTALLATION IF APPLICABLE. SEE PAGE 33 FOR FINAL CHECKS.

Rotor Set Component Assembly Procedure

One Piece Stator Construction

A disassembled rotor (8A) stator (8B) and vanes (8C) that cannot be readily assembled by hand can be assembled by the following procedures.

assemble stator

1. Place stator (8B) onto wear plate (9) with seal ring (4) side down, after following Torqmotor assembly procedures 1 through 13. Be sure the seal ring is in place. SEE FIGURE 70.

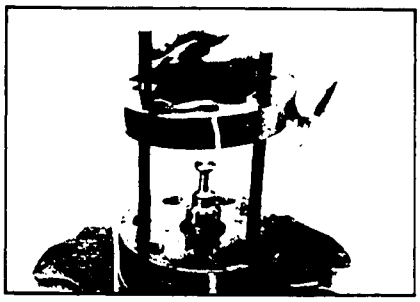


Figure 70

insert two bolts

2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate and housing bolt holes and turn two bolts (1) finger tight into bolt holes approximately 180 degrees apart to retain stator and wear plate stationary.

assemble rotor

3. Assemble the rotor (8A), counterbore down if applicable, into stator (8B), and onto wear plate (9) with rotor splines into mesh with drive link (10) splines. SEE FIGURE 71.

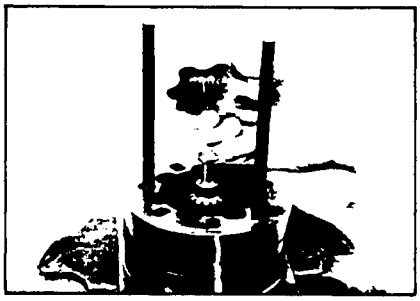


Figure 71

NOTE

NOTE: If the manifold side of the rotor was etched during Torqmotor disassembly, this side should be up. If the rotor is not etched and does not have a counterbore, use the drive link spline contact pattern apparent on the rotor splines to determine the rotor side that must be against the wear plate.

assemble vanes

4. Assemble six vanes (8C), or as many vanes that will readily assemble into the stator vane pockets. SEE FIGURE 72.



Figure 72

CAUTION

CAUTION: Excessive force used to push the rotor vanes into place could shear off the coating applied to the stator vane pockets.

assemble full complement of vanes

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator (8B), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force. SEE FIGURE 73.

remove two assembled bolts

6. Remove the two assembled bolts (1) if used to retain stator and wear plate.

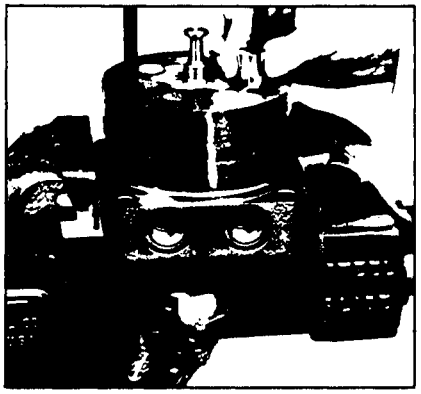


Figure 73

Go to Torqmotor assembly procedure #15, page 26 to continue Torqmotor assembly.

Rotor Set Component Assembly Procedure

Two Piece Stator Construction

A disassembled rotor set (8) that cannot be readily assembled by hand and has a two piece stator can be assembled by the following procedures.

assemble stator halfs

1. Place stator half (8B) onto wear plate (9) with seal ring (4) side down, after following Torqmotor assembly procedures 1 through 13. Be sure the seal ring is in place.

insert two alignment studs

2. Align stator bolt holes with wear plate and housing bolt holes and turn two alignment studs finger tight into bolt holes approximately 180 degrees apart to retain stator half and wear plate stationary.

assemble rotor

3. Assemble rotor (8A), counterbore down if applicable, into stator half (8B), and onto wear plate (9) with rotor splines into mesh with drive link (10) splines.

NOTE

NOTE: Use any marking you applied to rotor set components to reassemble the components in their original relationship to ensure ultimate wear life and performance.

assemble vanes

4. Assemble six vanes (8C), or as many vanes that will readily assemble into the stator vane pockets.

CAUTION

CAUTION: Excessive force used to push the rotor vanes into place could shear off the coating applied to the stator vane pockets.

assemble full complement of vanes

5. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8C) into stator half (8B), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

assemble seal ring in stator half

6. Place second stator half (8D) on a flat surface with seal ring groove up. Apply a small amount of grease to a **new** seal ring (4) and assemble it into stator half ring groove.

assemble second stator half

7. Assemble the second stator half (8D) over the two alignment studs and rotor (8A) with seal ring side down onto the first stator half (8B) aligning any timing marks applied for this purpose.

CAUTION

CAUTION: If the stator half (8B) is a different height (thickness) than stator half (8D) the stator vanes (8C) or (8E) of the same length (height) as the stator half must be reassembled in their respective stator half for the rotor set to function properly.

assemble vanes

8. Assemble six vanes (8E), or as many vanes that will readily assemble into the stator vane pockets.

assemble full complement of vanes

9. Grasp the output end of coupling shaft (12) with locking pliers or other appropriate turning device and rotate coupling shaft, drive link and rotor to seat the rotor and the assembled vanes (8E) into stator (8D), creating the necessary clearance to assemble the seventh or full complement of seven vanes. Assemble the seven vanes using minimum force.

Go to Torqmotor assembly procedure #15, page 25 to continue Torqmotor assembly.

Final Checks

Final Checks

- Pressurize the Torqmotor™ with 100 p.s.i. dry air or nitrogen and submerge in solvent to check for external leaks.
- Check Torqmotor™ for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)
- On MG & MF Series Torqmotors, pressure port with "A" cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for counter clockwise coupling shaft rotation.
- On MB & ME Series Torqmotors, pressure port with "B" cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "A" case under it is for counter clockwise coupling shaft rotation.
- Use test stand if available, to check operation of the Torqmotor™.

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.
- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

  CAUTION: Do not mix oil types. Any mixture, or an unapproved oil, could deteriorate the seals. Maintain the proper fluid level in the reservoir. When changing fluid, completely drain old oil from the system. It is suggested also that you flush the system with clean oil.

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

Maximum operating temperature 200°F (93.3°C).

Tips for Maintaining the Torqmotor™ Hydraulic System

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken Torqmotor™ component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

CAUTION: Do not weld, braze, solder or any way alter any Torqmotor™ component.

CAUTION: Maximum operating pressure must not exceed recommended Torqmotor™ pressure capacity.

CAUTION: Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

CAUTION: Do not force any coupling onto the Torqmotor™ coupling shaft as this could damage the unit internally.

Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

Torqmotor™

Service Procedure

MAB and MAE Series

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Troubleshooting Guide

NOTE: Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component other than the MAB or MAE Torqmotor™ unit.

Preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place;
- have proper tools and materials nearby;
- have an adequate supply of clean petroleum-based solvent.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

Preliminary Checks

Hydraulic systems are often trouble-free. The problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- parts damaged from impact that were not properly repaired, or that should have been replaced; and
- improper replacement parts used in previous servicing
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts.

Hydraulic Components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings and fittings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 50 micron filtration is recommended for the MAB and MAE system.

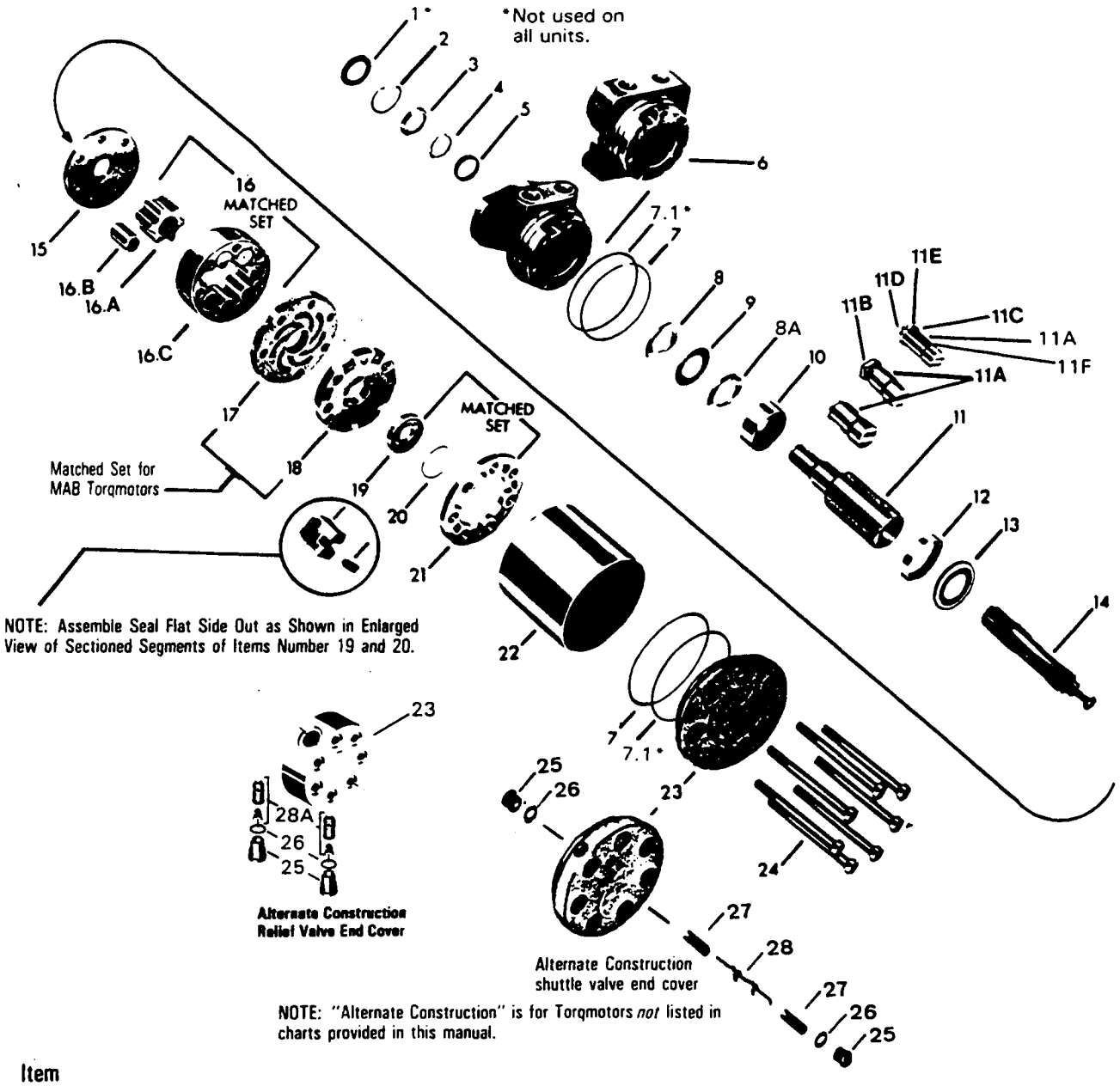
Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system. Consult the manuals published by equipment and/or component manufacturers for maximum allowable temperatures and hydraulic tests that may be necessary to run on the performance of the hydraulic components. The MAB and MAE are not recommended for hydraulic systems with maximum temperatures above 200°F (93.3°C).

MAB/MAE Torqmotor™ Exploded Assembly View—Typical



Item No.		Item No.		Item No.		Item No.	
*1.	Seal	9.	Thrust Bearing	13.	Thrust Bearing	20.	Seal Ring
2.	Retaining Ring	10.	Bearing	14.	Drive Link	21.	Commutator Ring
3.	Back-Up Washer	11.	Coupling Shaft	15.	Wear Plate	22.	Sleeve
4.	Washer	11A.	Key	16.	Rotor Set	23.	End Cover Assembly
5.	Seal	11B.	Nut	16A.	Rotor	24.	Special Bolt (7)
6.	Housing	11C.	Washer	16B.	Vane (7)	25.	Plug
7.	Seal Ring (2)	11D.	Bolt	16C.	Stator	26.	O-Ring
*7.1	Back Up Ring (2)	11E.	Lock Washer	17.	Manifold Plate	27.	Spring (2)
8.	Thrust Washer	11F.	Retaining Ring	18.	Manifold	28.	Valve (Shuttle)
8A.	Thrust Washer	12.	Bearing	19.	Commutator	28A.	Relief Valve (2) (Two piece)

Troubleshooting Checklist

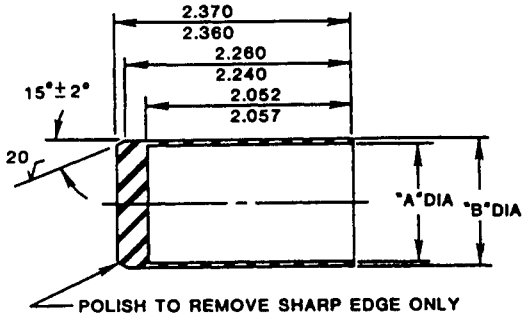
Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (7) deteriorated by excess heat	Replace oil seal rings by disassembling Torqmotor™ unit.
	3. Special bolt (24) loose or its sealing area deteriorated by corrosion	(a) Loosen then tighten single bolt to 45-55 ft.lbs. (60-76 N m)
		(b) Replace bolt.
	4. Internal shaft seal (5) worn or damaged	Replace seal. Disassembly of Torqmotor™ unit not necessary.
	5. Worn coupling shaft (11) and internal seal (5)	Replace coupling shaft and seal by disassembling Torqmotor™ unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required.
		(b) Check for and repair worn pump.
		(c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	(a) Replace worn rotor set by disassembling Torqmotor™ unit.
	3. Severely worn or damaged internal splines	Replace rotor set, drive link and coupling shaft by disassembling Torqmotor™ unit.
	4. Excessive heat	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate Torqmotor™ unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble Torqmotor™ unit, identify and remedy cause and repair, replacing parts as necessary.
	3. Lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to MAB/MAE unit.	Locate source and eliminate cause.

CAUTION: If the hydraulic system fluid becomes overheated [in excess of 200°F (93.3°C)], seals in the system can shrink, harden or crack, thus losing their sealing ability.

Patents

Ross Gear Division products and systems described in this manual are protected by one or more of the following United States patents: 3,289,602; 3,288,034; 3,452,680 and 3,606,601. In addition, patent applications have been filed in Brazil, Canada, Denmark, France, Italy, Japan, Sweden, the United Kingdom, and West Germany.

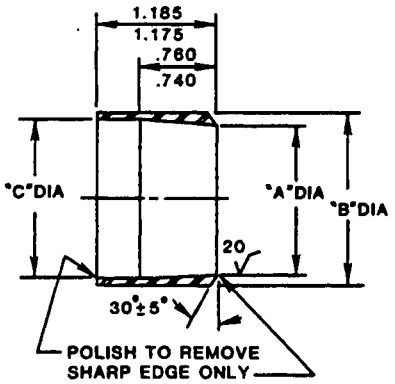
Seal Installation Tools



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"
J26751	1¼	1.252/1.258	1.290/1.280
J33074-1	1½	1.502/1.508	1.540/1.530

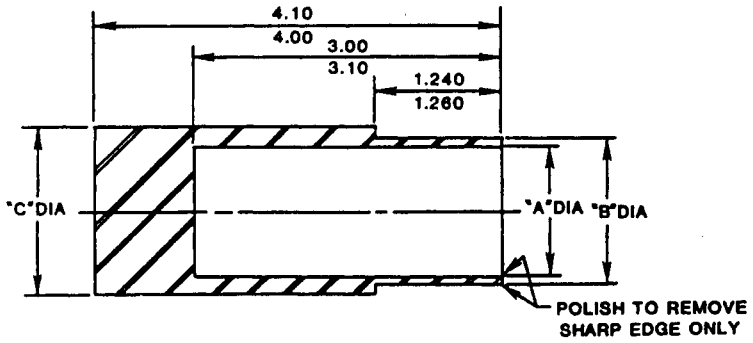
Seal Thimble
Figure 1.



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"	Dim. "C"
J26753	1¼	1.502/1.504	1.735/1.715	1.590/1.610
J33074-3	1½	1.751/1.753	1.985/1.965	1.840/1.860

Seal Compression Ring
Figure 3.



Dimensions Shown in Inches

Tool No.	Shaft Seal Dia.	Dim. "A"	Dim. "B"	Dim. "C"
J26752	1¼	1.300/1.350	1.500/1.498	1.800/1.600
J33074-2	1½	1.550/1.600	1.747/1.745	2.400/2.200

Seal Driver
Figure 2.

CONVERSIONS

Inches	mm	Inches	mm
.740	18.80	1.610	40.89
.760	19.30	1.715	43.55
1.175	29.85	1.735	44.07
1.185	30.10	1.745	44.32
1.240	31.50	1.747	44.37
1.252	31.80	1.751	44.48
1.258	31.95	1.753	44.53
1.260	32.00	1.800	45.72
1.280	32.51	1.840	46.74
1.290	32.77	1.860	47.24
1.300	33.02	2.052	52.12
1.350	34.29	2.057	52.25
1.498	38.05	2.200	55.88
1.500	38.10	2.240	56.90
1.502	38.15	2.260	57.40
1.504	38.20	2.360	59.94
1.508	38.30	2.370	60.20
1.530	38.87	2.400	60.96
1.540	39.12	3.00	76.2
1.550	39.37	3.10	78.7
1.590	40.39	4.00	101.6
1.600	40.48	4.10	104.1

NOTE: Tool Kit J26905 for 1¼ inch (32 mm) seal diameter coupling shaft includes tools J26751, J26752 and J26753.

Tool Kit J33074 for 1½ inch (38 mm) seal diameter coupling shaft includes tools J33074-1, J33074-2 and J33074-3.

Tool Kits available from: Kent-Moore, 29784 Little Mack, Roseville, Michigan 46066, Phone (313) 774-9500.

Disassembly and Inspection Procedures

PREPARATION BEFORE DISASSEMBLY

Before disconnecting hoses, thoroughly clean off all outside dirt around fittings. (After disconnecting hoses and before removing from vehicle, IMMEDIATELY plug portholes.) Drain fluid and finish cleaning and drying assembly before placing on a clean work surface. (A piece of clean paper makes an excellent disposable top.) All disassembled parts should be cleaned separately in clean petroleum-based solvent and blown dry with air to avoid nicks and burrs. Discard all seal and seal rings as they are removed from Torqmotor. Use Ross Gear Division or OEM approved service parts.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

REPLACEMENT OF HIGH PRESSURE SEAL (5) WITHOUT COMPLETE TORQMOTOR™ DISASSEMBLY

(Reference Exploded Assembly View)

1. Remove and discard dirt seal (1) and retaining ring (2) from Torqmotor. (Some applications may not require dirt seal (1).)
2. Completely fill Torqmotor with oil. Plug "A" and "B" ports and set Torqmotor in a clean pan. Place a clean rag around the coupling shaft seal area of the housing to prevent oil spray. Carefully grip coupling shaft with appropriate wrench and rotate coupling shaft rapidly in a counter-clockwise direction. Oil pressure generated by Torqmotor will eject backup washer (3), washer (4) and seal (5).
3. Select the proper seal assembly tools for the 1¼ inch (31.8 mm) or 1½ inch (38.1 mm) seal diameter coupling shaft involved. See Figures 1, 2 and 3, page 2.

   Insert the selected seal compression ring tool (Figure 3), with chamfered end inward, into housing (6) until it bottoms out. Assemble the selected seal thimble tool (Figure 1) over coupling shaft (11). Coat new seal (5) with clean grease and assemble over seal thimble with lip side inward. Push new seal (5) into housing (6) with the appropriate seal driver tool (Figure 2). Remove seal driver, thimble and compression tools.
4. Hold washer (4) between thumb and index finger and slightly collapse washer and assemble into housing (6). Assemble back-up washer (3) tab side out, and retaining ring (2). Be sure rounded edge of retaining ring is faced inward, and that back-up washer tab is between ends of retaining ring. Be sure the new retaining ring (2) is the same thickness as the one removed. (Seal kit contains two retaining rings to select from.) Apply a small amount of clean grease to the back side of new seal (1) and assemble into housing (6) if required.

TORQMOTOR DISASSEMBLY

(Reference Exploded Assembly View)

1. Place Torqmotor in a vise, clamping down on the housing (6) port bosses with the coupling shaft (11) pointed down.

WARNING: IF THE TORQMOTOR IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

2. If the end cover assembly (23) has a shuttle valve (28), scribe a line on housing (6) in some manner in line with the port in the end cover for reassembly orientation. Loosen the two plugs (25) with a 3/16 or 3/8 inch Allen wrench, for later disassembly. Remove the seven special bolts (24) using a 9/16 inch thin wall socket. Inspect bolts for damaged threads, or the sealing ring under the bolt head. Replace damaged bolts.
3. Remove end cover assembly (23) and seal ring (7) and back up ring (7.1) if included by inserting screwdriver between end cover assembly and sleeve (22). Pry up end cover assembly and lift from unit with rings attached. Discard seal ring and back up ring. It may be necessary to use a chisel and hammer to break the end cover loose.
4. If the end cover (23) has shuttle valve (28) or relief valve (28A) and the previously loosened plugs (25), remove the two plugs and o-rings (26).

   CAUTION: Be ready to catch two springs (27) and shuttle valve (28) or relief valve (28A) that will fall out of the end cover valve cavity when the plug assemblies are removed.

   Thoroughly wash cover in proper solvent and blow dry. Be sure the cover valve apertures, including the internal orifice plug, are free of contamination. Inspect end cover for cracks and the bolt head recesses for good bolt head sealing surfaces. Replace cover as necessary.

   NOTE: O-ring (26) is not included in seal kits but is serviced separately if required.
5. Remove commutator ring (21), commutator (19), seal ring (20), and manifold (18) by using two of the special bolts (24) as a lifting tool—insert the two special bolts into two holes and lift out the previously mentioned parts.
6. Remove seal ring (20) from commutator (19), using an air hose to blow air into ring groove until seal ring is lifted out and discard seal ring. Inspect commutator and commutator ring (21) for cracks or burrs. Inspect commutator for wear, scoring, spalling or brinelling. If

any of these conditions exist, replace commutator and commutator ring as a matched set.

7. Remove manifold plate (17) by again using two special bolts (24) as a lifting tool. Inspect manifold (18) and manifold plate (17) for cracks, surface scoring, brinelling or spalling. Replace manifold or manifold plate that exhibits any of these conditions. A polished pattern on the ground surfaces from commutator or rotor rotation is normal.

8. Remove rotor set (16) and wear plate (15), by again using the two bolts as a lifting tool. Retain rotor set in its assembled form, if possible, to maintain the same rotor vane to stator contact surfaces. Inspect the rotor set in its assembled form for nicks, scoring, or spalling, on any surface and broken or worn rotor splines. If any rotor set component requires replacement, the complete rotor set must be replaced as it is a matched set. Inspect the wear plate for cracks, brinelling, or scoring.

9. Place rotor set on a flat surface and center rotor (16A) in stator (16C) such that two rotor lobes (180° apart) and a roller vane (16B) centerline are on the same stator centerline. Check the rotor lobe to roller vane clearance with a feeler gage at this common centerline. If there is more than .005 inches (0.13 mm) of clearance, replace rotor set.

10. Remove drive link (14) from coupling shaft (11) if it was not removed with rotor set and wear plate. Inspect drivelink for cracks and for worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts.

11. Remove thrust bearing (13) and inspect for wear, brinelling, corrosion, and a full complement of retained rollers.

12. Remove coupling shaft (11) by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. Inspect for damaged or worn internal and external splines or keyway. Replace coupling shaft if any of these conditions exist.

    NOTE: Minor shaft wear in seal area is permissible. If wear exceeds .020 inches (0.51 mm) diametrically, replace coupling shaft.

    A slight "polish" is permissible in the shaft bearing area. Anything more would require coupling shaft replacement.

13. Remove sleeve (22) by inserting screwdriver between sleeve and housing (6) and pry up. Inspect sleeve for deformation from the original cylindrical shape to a "barrel" or "hour glass" shape. Inspect sleeve ends for severe nicks, burrs or corrosion. Replace sleeve if any of these conditions exist.

    NOTE: Minor burrs and corrision that would damage new seal rings during assembly can be removed from sleeve ends.

14. Remove seal ring (7) and back up ring (7.1) if included from housing (6) and discard seal and back up ring.

15. Remove housing (6) from vise, turn over and reclamp in vise with dirt seal (1) end pointed up.

16. Remove dirt seal (1), retaining ring (2), back-up washer (3), washer (4), and seal (5) from housing (6). Discard seals and washers but keep retaining ring (2) for comparison when selecting new retaining ring from seal kit. If burr exists on retaining ring groove, remove with a scraping tool.

17. Inspect housing (6) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. If the housing is defective in these areas, discard the housing assembly and the disassembly of the Torqmotor is complete.

18. If the housing assembly (6) has passed inspection to this point, inspect the bearings (9), (10), (12) and thrust washers (8) and (8A). The bearing rollers must be firmly retained in the bearing cages, but must rotate and orbit freely. All rollers and the thrust washers must be free of brinelling and corrosion. If the housing has passed this inspection the disassembly of the Torqmotor is completed.

19. If only the outer bearing (12) requires replacement, carefully use a suitable bearing puller to remove bearing so the housing is not damaged.

20. If bearing (10) requires replacement, use a 1.488 inch (37.80mm) maximum diameter shaft or a 1.745 inch (44.32 mm) maximum diameter shaft based on the internal seal (5) bore diameter and press out thrust washers (8), (8A), thrust bearing (9), and bearings (10) and (12). The housing wearplate face should be placed on a block of wood during the pressing operation to protect it. Discard thrust washers (8) and (8A), thrust bearings (9), and bearings (10) and (12) and replace with new parts, as parts will have been damaged when being pressed out.

    NOTE: The depth or location of bearings (10) and (12) in relation to the housing wearplate face should be measured and noted before pressing the bearings out. This will facilitate the correct reassembly of new bearings.

The disassembly of Torqmotor is completed.

TORQMOTOR ASSEMBLY PROCEDURES

(Reference Exploded Assembly View)

Replace all seals and seal rings with new ones each time you reassemble the Torqmotor unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.

NOTE: Individual seals and seal rings as well as a complete seal kit are available. The parts should be available through most OEM parts distributors or Ross approved Torqmotor distributors. (Contact your local dealer for availability.)

NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.

Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, sleeve, and housing and from port and sealing areas.

HOUSING BEARING REPLACEMENT PROCEDURES

1. If bearing components were removed for replacement, assemble new thrust washer (8), new thrust bearing (9) and new thrust washer (8A) in that order into housing (6) bearing cavity. If thrust washer (8A) has a chamfer on the inside diameter, the chamfered side must face away from thrust bearing (9).

   NOTE: Thrust washer (8A) will be identical to thrust washer (8) unless a chamfered inside diameter is required because of coupling shaft design.

   NOTE: An appropriate size piloted bearing mandrel is required to press in housing bearings.

2. If bearings (10) and (12) required are for a 2.25 inch (57.2 mm) diameter (nominal) housing bearing bore, press in new bearing (10) which is 1.0 inch (25.4 mm) long, into housing (6) bearing bore to a depth of 2.410 ± .010 inch (61.2 ± 0.254 mm), measured from the housing wear plate contact surface. Then, press in new bearing (12) which is .5 inch (12.7 mm) long into housing bearing bore to a depth of .115 ± .010 inch (2.92 ± 0.254 mm) measured from the housing wear plate contact surface.

   NOTE: Press against the lettered end of bearing cage when pressing in a roller bearing assembly.

3. If the bearings (10) and (12) required are for a 2.50 inch (63.5 mm) diameter (nominal) bearing bore, press in new bearing (10) which is 1.0 inch (25.4 mm) long into housing (6) bearing bore to a depth of 2.379 ± .010 inch (60.43 ± 0.254 mm) measured from housing wear plate contact surface. Press new bearing (12) which is identical to bearing (10) into housing bearing bore to a depth of .115 ± .010 inch (2.92 ± 0.254 mm) measured from the housing wear plate contact surface.

   NOTE: The bearings (10) and (12) must be assembled to the correct depths to assure the necessary clearance for thrust washer (8A) and thrust bearing (13) and to assure required bearing support.

TORQMOTOR ASSEMBLY

If the sealing diameter of the coupling shaft (11) is larger than any other diameter on the output end of the coupling shaft, begin the Torqmotor assembly procedures with Step 1 below. If there is a diameter on the output end of the coupling shaft equal to the sealing diameter of the coupling shaft begin the procedures with Step 6 below.

1. Place housing (6) in a vise and clamp down on housing port bosses with small bore end pointed up. Apply clean grease to new seal (5) and assemble into housing with seal lip pointed inward.
2. Hold washer (4) between thumb and index finger and slightly collapse to facilitate assembly into housing (6).
3. Assemble back-up washer (3) into housing (6) with the anti-rotation tab facing out.
4. Select a new retaining ring (2) from the seal kit, that is the same thickness as the retaining ring removed. Assemble the new retaining ring into housing (6). Be sure rounded edge of retaining ring is faced inward and that back-up washer tab is between ends of retaining ring.
5. Apply a small amount of clean grease to back side of new seal (1) and assemble into housing (6), if a seal (1) is required.
6. Invert housing (6) in vise so that the large bore end is up.
7. Apply cellophane tape around splines or keyway on coupling shaft (11) to prevent damaging seals.
8. Lubricate and assemble coupling shaft (11), firmly seating it against thrust washer (8A).
9. Assemble thrust bearing (13) onto end of coupling shaft (11).
10. Assemble drive link (14) into coupling shaft (11) with their splines in mesh. (Align hole in drive link with hole in coupling shaft (11), if applicable.)

NOTE: Two alignment studs screwed finger tight into housing (6) bolt holes, approximately 180° apart, will facilitate the assembly and alignment of components as required in the following procedures. The studs can be made by cutting off the heads of 3/8-24 UNF 2A bolts that are over .5 inch (12.7 mm) longer than the bolts (24) used in the Torqmotor.

11. Assemble wear plate (15) over drive link (14) and studs onto housing (6).
12. Install assembled rotor set (16) with counterbore in rotor (16A) down, if applicable, and splines in mesh with drive link splines.

    NOTE: If necessary, go to "Rotor, Stator, Vane Assembly" procedures on page 9.

13. Assemble manifold plate (17), manifold (18) and then the commutator ring (21) over the drive link (14) onto rotor set (16) per the exploded assembly view. Be sure swirls in manifold and manifold plate are faced together.

14. Assemble a new seal ring (20), flat side up, into commutator (19) and assemble commutator over end of drive link (14) onto manifold (18) with seal side up.

15. Assembly new back up ring (7.1) if required and new seal ring (7) on housing (6), apply a generous amount of SAE 10W40 to both ends of sleeve (22) and assemble onto housing. Make sure sleeve is sitting in a non-cocked position.

16. Turn a plug (25) with a new O-ring (26) loosely onto each end of cover (23) valve cavity if shuttle valve (28) is required.

17. Then insert a spring (27), the valve (28) and another spring (27) into the other end of the valve cavity. Turn another plug (25) with new O-ring (26) loosely into cover valve cavity.

    If relief valve (28A) components were removed from the end cover, assemble new O-ring (26) onto the relief valve plugs (25). Assemble the two piece relief valve (28A) with large end of conical spring into the plug first and the small nut of the other valve piece in the small end of the conical spring. Turn these plug and relief valve assemblies into the end cover loosely to be torqued later.

18. Assemble a new back up ring (7.1) if required and a new seal ring (7) onto end cover and assemble end cover onto sleeve (22) in a non-cocked position.

    NOTE: If the end cover has a valve (28) or (28A) use the line you previously scribed on the housing (6) to radially align the end cover port into its original position.

19. Assemble seven special bolts (24) and screw in finger tight. Removal of the two alignment studs should be made after at least two bolts have been assembled. Alternately and progressively tighten the bolts to pull end cover assembly (23) and sleeve (22) into place with a final torque of 50 ± 5 ft.lbs. (68 ± 8 N m).

    Tightening sequence:



    NOTE: The special bolt (24) required for use with the shuttle valve (28) end cover assembly (23) is longer than the bolt required with the standard end cover assembly. Refer to the individual service parts list for correct service part number.

20. Torque the two shuttle plug valve assemblies (25) into a end cover assemble to 12-19 ft.lbs. (16-26 N m). Torque the relief valve plug assemblies (25) into an end cover assembly to 45-55 ft.lbs. (61-75 N m).

21. If seal (5), washer (4), back-up washer (3), snap ring (2) and seal (1) have not yet been assembled, invert housing in vise so the coupling shaft (11) is pointing up and follow procedures #3 and #4 under "Replacement of High Pressure Seal" on page 6 to assemble these components.

The assembly of Torqmotor is now complete except for woodruff key (11A), nut (11B), washer (11C), bolt (11D), lock washer (11E) or retaining ring (11F) if applicable at Torqmotor installation. See final checks. All ports should be plugged until Torqmotor is installed in system.

ROTOR, STATOR, VANE ASSEMBLY PROCEDURE

A disassembled rotor (16A), stator (16C) and vanes (16B) that cannot be readily assembled by hand can be assembled by the following procedures.

1. Place stator (16C) onto wear plate (15) after following Torqmotor assembly procedures 1 through 11.
2. If assembly alignment studs are not being utilized, align stator bolt holes with wear plate bolt holes and turn two bolts (24) finger tight into bolt holes 180° apart to retain stator and wear plate stationary.
3. Assemble six vanes (16B) into the stator vane pockets.
4. Assemble rotor (16A), counterbore down, if applicable, into stator (16C) and onto wear plate (15) with rotor splines in mesh with drive link splines.
5. Grasp the output end of coupling shaft (11) with locking pliers or other appropriate turning devices and rotate coupling shaft, drive link and rotor to seat the rotor and assembled vanes into stator, creating necessary clearance to assemble seventh vane. Assemble the seven vanes using minimum force.
6. Remove the two assembled bolts if used to retain stator and wear plate.

Final Checks

Final Checks

- Pressurize the Torqmotor™ with 100 p.s.i. (6.9 BAR) dry nitrogen and submerge in solvent to check for external leaks.
- Check Torqmotor™ for rotation. Torque required to rotate coupling shaft should not be more than 50 ft.lbs. (68 N m)
- Pressure port with "A" cast under it on housing (6) is for counter-clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for clockwise coupling shaft rotation.
- Use test stand if available, to check operation of the Torqmotor™.

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.
- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

  CAUTION: Do not mix oil types. Any mixture, or an unapproved oil, could deteriorate the seals. Maintain the proper fluid level in the reservoir. When changing fluid, completely drain old oil from the system. It is suggested also that you flush the system with clean oil.

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

Maximum operating temperature 200°F (93.3°C).

Tips for Maintaining the Torqmotor™ Hydraulic System

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken Torqmotor™ component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

CAUTION: Do not weld, braze, solder or any way alter any Torqmotor™ component.

CAUTION: Maximum operating pressure must not exceed recommended Torqmotor™ pressure capacity.

CAUTION: Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

CAUTION: Do not force any coupling onto the Torqmotor™ coupling shaft as this could damage the unit internally.

Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

Disclaimer

This Service Manual has been prepared by TRW Ross Gear Division for reference and use by mechanics who have been trained to repair and service hydraulic motors and systems on commercial and non-commercial equipment applications. TRW Ross Gear Division has exercised reasonable care and diligence to present accurate, clear and complete information and instructions regarding the techniques and tools required for maintaining, repairing and servicing the complete line of TRW Ross Gear MAB & MAE Torqmotor Units. However, despite the care and effort taken in preparing this general Service Manual, TRW **makes no warranties** that (a) the Service Manual or any explanations, illustrations, information, techniques or tools described herein are either accurate, complete or correct as applied to a specific Torqmotor unit, or (b) any repairs or service of a particular Torqmotor unit will result in a properly functioning Torqmotor unit.

If inspection or testing reveals evidence of abnormal wear or damage to the Torqmotor unit or if you encounter circumstances not covered in the Manual, STOP – CONSULT THE EQUIPMENT MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE A TORQMOTOR UNIT WHICH HAS BEEN DAMAGED OR INCLUDES ANY PART THAT SHOWS EXCESSIVE WEAR UNLESS THE DAMAGED AND WORN PARTS ARE REPLACED WITH ORIGINAL TRW REPLACEMENT AND SERVICE PARTS AND THE UNIT IS RESTORED TO TRW'S SPECIFICATIONS FOR THE TORQMOTOR UNIT.

It is the responsibility of the mechanic performing the maintenance, repairs or service on a particular Torqmotor unit to (a) inspect the unit for abnormal wear and damage, (b) choose a repair procedure which will not endanger his/her safety, the safety of others, the equipment, or the safe operation of the Torqmotor, and (c) fully inspect and test the Torqmotor unit and the hydraulic system to insure that the repair or service of the Torqmotor unit has been properly performed and that the Torqmotor and hydraulic system will function properly.

Torqmotor™ MAG Design Features

- Displacements range from 23.6 cubic inches (387 CM^3) down to 3 cubic inches (49 CM^3) per revolution.
- Continuous rated pressure up to 1500 psi (103.4 BAR), depending on displacement with fully competitive volumetric efficiency.
- Coupling shaft mounted in steel caged needle radial and thrust bearings to withstand higher side and thrust loads.
- Optimized drive link contact with 12 tooth spline drive to reduce wear.
- Unique high pressure shaft seal allows MAG Torqmotors to be run in series without need for case drains. Only simple direct-line circuitry required.
- Standard SAE porting and mounting configurations.
- Fewer parts reduced maintenance, while maintaining quality performance.
- Full flow spline lubrication minimizes spline wear.
- Disc valve commutation maintains timing to promote efficiency and increase durability.
- Dirt and water shaft seal and corrosion resistant grease give added protection from environment.

Definitions

NOTE: **A NOTE provides key information to make a procedure easier or quicker to complete.**

CAUTION: **A CAUTION refers to procedure that must be followed to avoid damaging the MAG or other system components.**

WARNING: A WARNING REFERS TO PROCEDURES THAT MUST BE FOLLOWED FOR THE SAFETY OF THE EQUIPMENT OPERATOR AND THE PERSON INSPECTING OR REPAIRING THE MAG.

Patents

Ross Gear Division products and systems described in this manual are protected by the following United States patents: 3,606,601. In addition, patents have been issued or patent applications have been filed in Canada, Japan, The United Kingdom, and West Germany.

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Introduction

Service Manual for Model MAG

This service manual has one purpose: to guide you in maintaining, troubleshooting, and servicing the MAG Torqmotor™ (low-speed, high-torque hydraulic motor, MAG).

Material in this manual is organized so you can work on the MAG and get results without wasting time or being confused. To get these results, you should read this entire manual before you begin any work on the MAG.

This manual also contains troubleshooting information and checklist. If you must service the MAG, the checklist will help you to determine where the problem may be.

The three-column format of the Disassembly and Inspection, and Assembly sections will make it easier for you to conduct major work on the MAG. Column 1 gives a brief key for each procedure. Column 2 explains in detail the procedure you should follow. Column 3 illustrates this procedures with photographs. Pay special attention to the notes, cautions, and warnings.

A foldout page with an MAG exploded assembly view is provided in this manual. The component part names and item numbers assigned on this exploded assembly view correspond with names and item numbers (in parentheses) used in the disassembly and assembly procedures set forth in this manual. When this exploded assembly view page is folded out, you can easily identify components and locate their relative position on the exploded assembly view as you follow the disassembly and assembly procedures.

Service parts are available through the Original Equipment Manufacturer (OEM) or Ross approved MAG Distributors.

As you gain experience in servicing the MAG, you may find that some information in this manual could be clearer or more complete. If so, let us know about it. Do not try to second guess the manual; if you are stuck, contact us. Servicing the MAG should be a safe and productive procedure, in order for the unit to deliver the reliable, long-life operation engineered into it.

Troubleshooting Guide

NOTE: Before troubleshooting any system problem, check service literature published by the equipment and/or component manufacturers. Follow their instructions, if given, for checking any component other than the MAG Torqmotor™ unit.

Preparation

Make your troubleshooting easier by preparing as follows:

- work in a clean, well-lighted place;
- have proper tools and materials nearby;
- have an adequate supply of clean petroleum-based solvent.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

Preliminary Checks

Hydraulic systems are often trouble-free. The problem an operator complains of could be caused by something other than the hydraulic components.

Thus, once you have determined that a problem exists, start with the easy-to-check items, such as:

- parts damaged from impact that were not properly repaired, or that should have been replaced; and
- improper replacement parts used in previous servicing
- mechanical linkage problems such as binding, broken, or loose parts or slipping belts.

Hydraulic Components

If you think the problem is caused by a hydraulic component, start by checking the easy-to-reach items.

Check all hoses and lines for cracks, hardening, or other signs of wear. Reroute any useable hoses that are kinked, severely bent, or that rest against hot engine parts. Look for leaks, especially at couplings and fittings. Replace any hoses or lines that don't meet system flow and pressure ratings.

Next, go to the reservoir and filter or filters. Check fluid level and look for air bubbles. Check the filter(s). A filter with a maximum 50 micron filtration is recommended for the MAG system.

Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

Excessive heat in a hydraulic system can create problems that can easily be overlooked. Every system has its limitation for the maximum amount of temperature. After the temperature is attained and passed, the following can occur:

- oil seal leaks
- loss of efficiency such as speed and torque
- pump loss of efficiency
- pump failure
- hoses become hard and brittle
- hose failure

A normal temperature range means an efficient hydraulic system. Consult the manuals published by equipment and/or component manufacturers for maximum allowable temperatures and hydraulic tests that may be necessary to run on the performance of the hydraulic components. The MAG is not recommended for hydraulic systems with maximum temperatures above 200°F (93.3°C).

Troubleshooting Checklist

Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (4) deteriorated by excess heat	Replace oil seal rings by disassembling MAG unit.
	3. Special bolt (1) loose or its sealing area deteriorated by corrosion	(a) Loosen then tighten single bolt to 22-26 ft.-lbs. (30-35 N m) (b) Replace bolt.
	4. Internal shaft seal (16) worn or damaged	Replace seal by disassembling MAG unit.
	5. Worn coupling shaft (12) and internal seal (16)	Replace coupling shaft and seal by disassembling MAG unit.
Significant loss of speed under load	1. Lack of sufficient oil supply	(a) Check for faulty relief valve and adjust or replace as required. (b) Check for and repair worn pump. (c) Check for and use correct oil for temperature of operation.
	2. High internal motor leakage	(a) Replace worn rotor set by disassembling MAG unit.
	3. Severely worn or damaged internal splines	Replace rotor set, drive link and coupling shaft by disassembling MAG unit.
	4. Excessive heat	Locate excessive heat source (usually a restriction) in the system and correct the condition.
Low mechanical efficiency or undue high pressure required to operate MAG unit	1. Line blockage	Locate blockage source and repair or replace.
	2. Internal interference	Disassemble MAG unit, identify and remedy cause and repair, replacing parts as necessary.
	3. lack of pumping pressure	Check for and repair worn pump.
	4. Excessive binding or loading in system external to MAG unit	Locate source and eliminate cause.

CAUTION: If the hydraulic system fluid becomes overheated [in excess of 200°F (93.3°C.)], seals in the system can shrink, harden or crack, thus losing their sealing ability.

Tools and Materials Required for Servicing

MAG service manual

Clean, petroleum-based solvent

Emery paper

Vise with soft jaws

Air pressure source

Arbor press

Screw driver

Retaining ring pliers (internal)

Breaker bar

1/2 inch thin wall socket

Torque wrench - foot pounds or Newton meter

Adjustable crescent wrench or hose fitting wrenches

SAE 10W40 SE or SF oil

Special bearing mandrel (SEE FIGURE 1)

Feeler gage .005 inch (.13 mm)

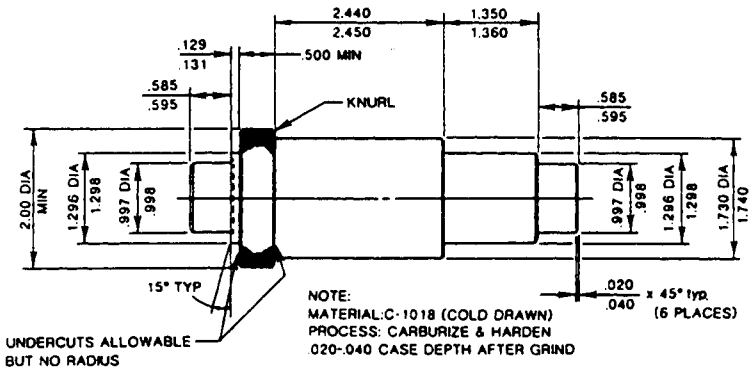
Clean corrosion resistant grease. Recommended grease is E/M Lubricant #K-70 Alternate compatible greases are:

- Shell Darina #2
- Lubriplate #930AA
- Union High Temp 2
- Sunoco High Temp 2

CAUTION: Mixing greases that have different bases can be detrimental to bearing life.

CONVERSIONS

INCHES	mm	INCHES	mm
.020	.51	1.296	32.92
.040	1.02	1.298	32.97
.129	3.28	1.350	34.29
.131	3.33	1.360	34.54
.500	12.70	1.730	43.94
.585	14.86	1.740	44.20
.595	15.11	2.00	50.8
.997	25.32	2.440	61.98
.998	25.35	2.450	62.23

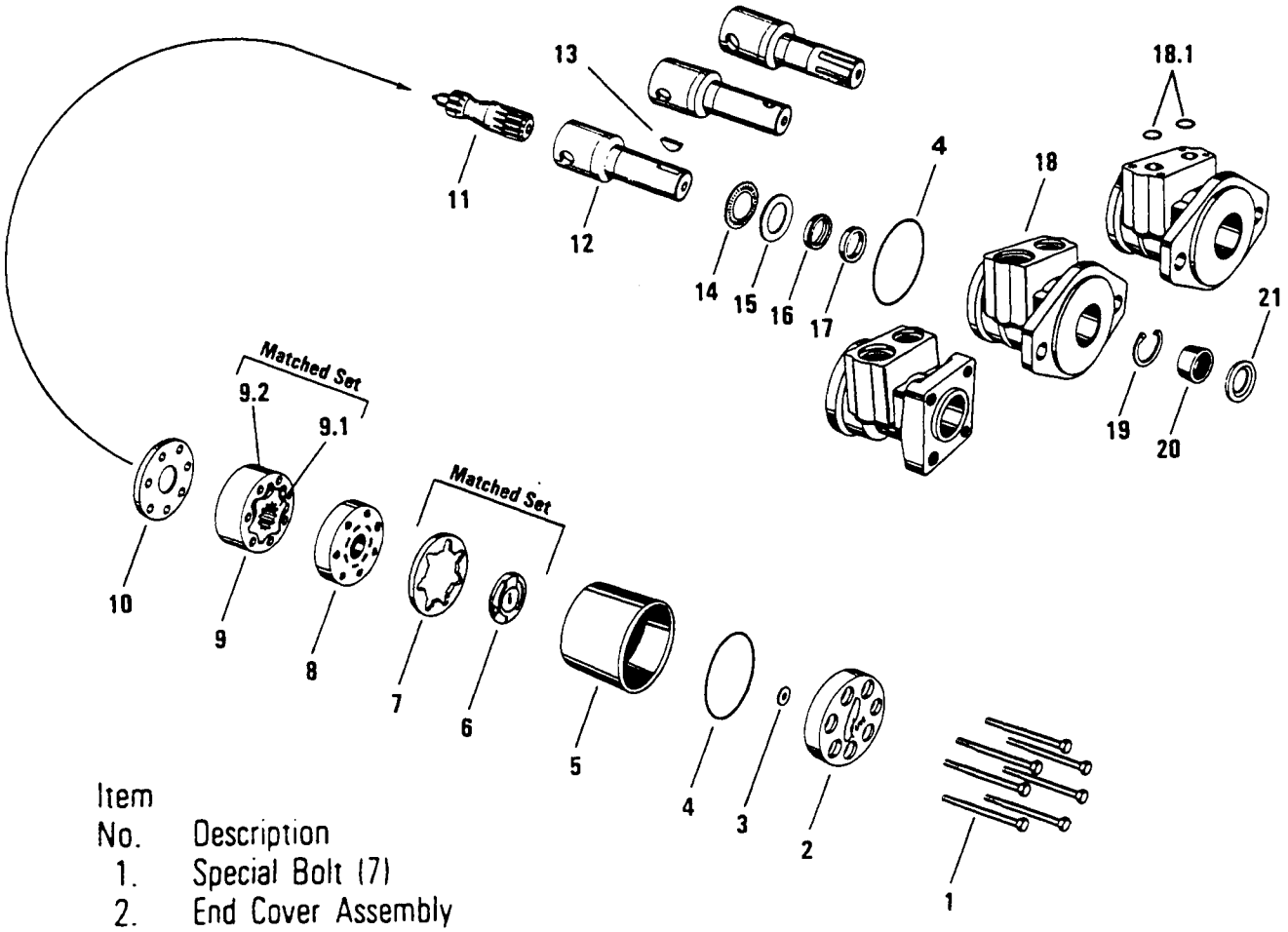


Bearing Mandrel (Fabricate if considered necessary)
Figure 1

Torque Chart

Part Name	Item Number	Torque
bolt 5/16 24 thread	1	22-26 ft. lbs. (30-35 N m)

MAG Torqmotor™ Exploded Assembly View-Typical



Item No.	Description		
1.	Special Bolt (7)	13.	Woodruff Key
2.	End Cover Assembly	14.	Thrust Bearing
3.	Washer	15.	Thrust Washer
4.	Seal Ring(2)	16.	Seal
5.	Sleeve	17.	Spacer
6.	Commutator	18.	Housing
7.	Commutator Ring	18.1	"O" Ring
8.	Manifold	19.	Retaining Ring
9.	Rotor Set	20.	Needle Bearing
9.1	Rotor	21.	Seal
9.2	Stator		
10.	Wearplate (Spacer)		
11.	Drive Link		
12.	Coupling Shaft		

MAG Torqmotor Exploded View

MAG: Disassembly and Inspection

(Preparation Before Disassembly)

- Before you disassemble the MAG Torqmotor™ unit or any of its components, read this entire manual. It provides important information on parts and procedures you will need to know to service the MAG.
- Refer to page 7A for tools and other items required to service the MAG, and have them available.
- Thoroughly clean off all outside dirt, especially from around fittings and hose connections, before disconnecting and removing the MAG. Remove rust or corrosion from coupling shaft.
- Remove coupling shaft connections and hose fittings, and immediately plug port holes and fluid lines.
- Remove the MAG from system, drain it of fluid and take it to a clean work surface. (A piece of wrapping paper makes an excellent disposable top.)
- Clean and dry the MAG before you start to disassemble the unit.
- As you disassemble the MAG, clean all parts, except seals, in clean petroleum-based solvent, and blow them dry.

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

CAUTION: Never steam or high pressure wash hydraulic components. Do not force or abuse closely fitted parts.

- Keep parts separate to avoid nicks and burrs.
- Discard all seals and seal rings as they are removed from the MAG. Replace all seals, seal rings and any damaged or worn parts with genuine Ross or OEM approved service parts.

Disassembly and Inspection

position Torqmotor™ in a vise

1. Position the MAG assembly in a soft jawed vise, with coupling shaft (12) pointed down, the vise jaws clamping firmly on the sides of the housing (18) mounting flange. SEE FIGURE 2. Remove manifold port O-Rings (18.1) if applicable.

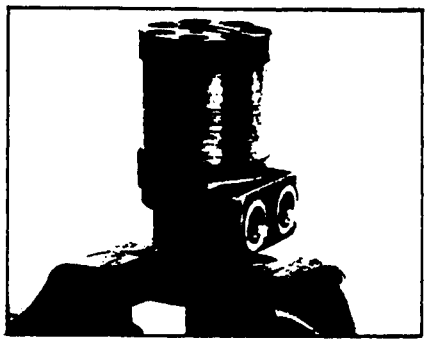


Figure 2

WARNING

WARNING: IF THE MAG ASSEMBLY IS NOT FIRMLY HELD IN THE VISE, IT COULD BE DISLODGED DURING THE SERVICE PROCEDURES, CAUSING INJURY.

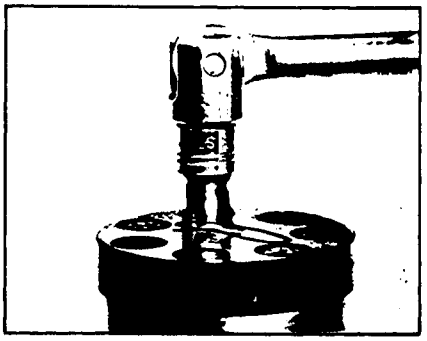


Figure 3

remove special bolts & inspect bolts

2. Remove the seven special ring head bolts (1) using a 1/2 inch thin wall socket to enter the end cover bolt head recess. SEE FIGURE 3. Inspect bolts for damaged threads, or sealing ring, under the bolt head. Replace damaged bolts. SEE FIGURE 4.

remove end cover & seal ring

3. Remove end cover assembly (2) and seal ring (4). Discard seal ring. SEE FIGURE 5.

NOTE

NOTE: The pin in the end cover must not be removed as it is serviced only as an integral part of the end cover.

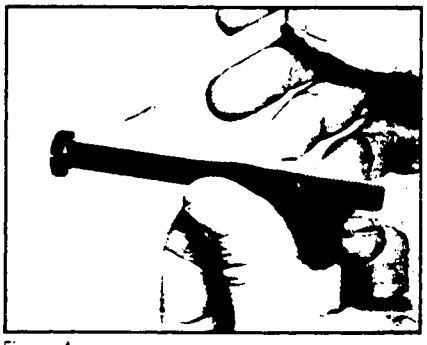


Figure 4

inspect end cover

4. Inspect the end cover (2) for severe wear, nicks, burrs and spalling on the ground surface that has the seal ring groove. Inspect the integral pin for out of round condition (flats). Inspect the bolt head recesses where the bolt head sealing ring makes contact for damage that would prohibit good sealing contact. Replace cover if any of these conditions exist.

NOTE

NOTE: A polished pattern on the cover from rotation of the commutator (6) is normal. Discoloration would indicate excess fluid temperature, thermal shock, or excess speed and require system investigation for cause and close inspection of end cover, commutator, manifold, rotor set, spacer and washer.

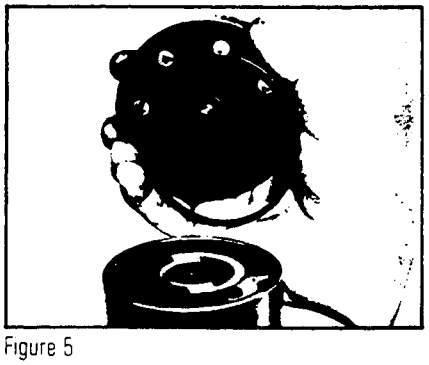


Figure 5

remove & inspect drive link washer

5. Remove drive link washer (3) from the commutator (6) or from the end cover if it was removed with the end cover. Replace washer if it shows signs of wear, spalling, nicks or is bent or has other deformation that could interfere with commutator or drive link rotation. SEE FIGURE 6.



Figure 6

remove & inspect sleeve

6. Remove sleeve (5) and inspect if for deformation from the original cylindrical shape to a "barrel" or "hour glass" shape. Inspect the ends for severe nicks or burrs. Replace sleeve if any of these conditions exist. SEE FIGURE 7.



Figure 7

NOTE

NOTE: Minor burrs can be removed.

remove & inspect commutator ring

7. Remove commutator ring (7). SEE FIGURE 8. Inspect commutator ring for cracks, or burrs.

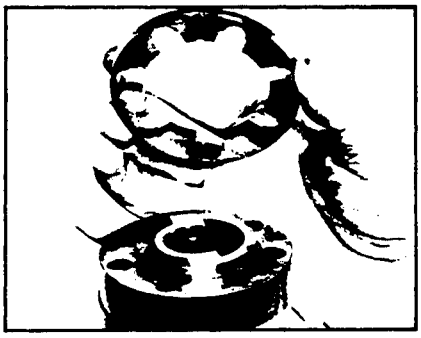


Figure 8

remove & inspect commutator

8. Remove commutator (6) and inspect its ground surfaces for scoring, spalling, brinelling (denting) or wear. SEE FIGURE 9. Inspect the drive link pin slot and cover pin hole for wear. Inspect for cracks. If any of these conditions exist replace the commutator and commutator ring as a matched set.



Figure 9

remove manifold

9. Remove manifold (8) and inspect for cracks, surface scoring, brinelling or spalling. Replace manifold if any of these conditions exist. SEE FIGURE 10. A polished pattern on the ground surfaces from commutator or rotor rotation is normal.



Figure 10

remove & inspect rotor set

10. Remove rotor set (9) retaining it in its assembled form if possible, to maintain the same rotor to stator contact surfaces. Inspect the rotor set for nicks, scoring or spalling on any surface, and broken or worn rotor splines. Replace as a matched rotor set if either component exhibits any of these conditions. SEE FIGURE 11.



Figure 11

NOTE

NOTE: The rotor (9.1) may become disassembled from stator (9.2) during service procedures. Marking the surface of the rotor and stator that is facing UP with etching ink or grease pencil before removal from Torqmotor™ will ensure correct reassembly of rotor into stator and rotor set into Torqmotor™. Be sure to remove all foreign material from rotor set before reassembly into Torqmotor™.

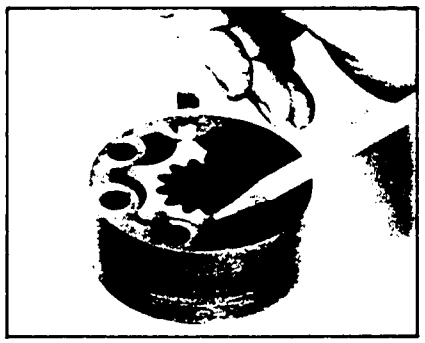


Figure 12

check rotor, stator clearance

11. Using a feeler gage, check the rotor (9.1) to stator (9.2) tip clearance with the rotor centered in the stator. SEE FIGURE 12. If there is more than .005 inches (13 mm) of clearance, replace rotor set.

remove & inpect spacer

12. Lift off wearplate (10) and inspect it for scoring or brinelling on the rotor contact surface. Inspect for cracks. Replace wearplate if any of these conditions exist. SEE FIGURE 13.

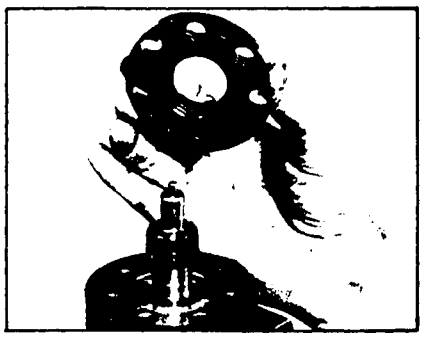


Figure 13

NOTE

NOTE: A polished pattern from rotor rotation is normal.

remove & inspect drive link

13. Remove drive link (11) and inspect it for cracks and for chipped, worn or damaged splines. No perceptible lash (play) should be noted between mating spline parts. SEE FIGURE 14. Inspect the pin in the end of the drive link for flats or wear. Replace drive link if these conditions exist.

NOTE

NOTE: The pin in the end of drive link is serviced as an integral part of the drive link and is not subject to disassembly.

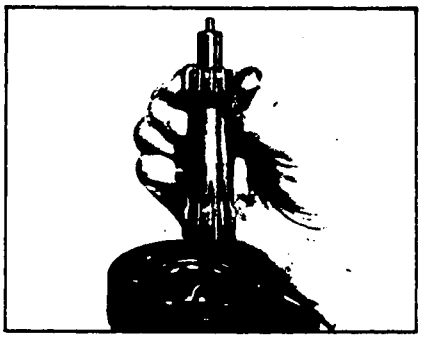


Figure 14

check coupling shaft for rust or corrosion

14. Check exposed portion of coupling shaft (12) to be sure you have removed all signs of rust and corrosion which might prevent its withdrawal through the seal and bearing. Crocus cloth or fine emery paper may be used. SEE FIGURE 15.

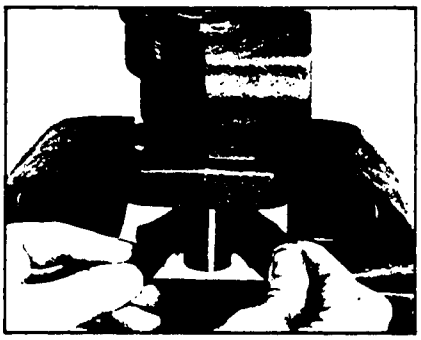


Figure 15

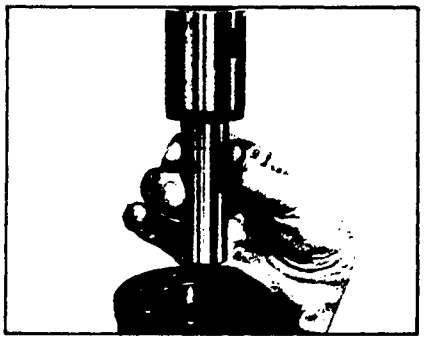


Figure 16

remove & inspect coupling shaft

15. Remove coupling shaft (12), by pushing on the output end of shaft. Inspect coupling shaft bearing and seal surfaces for spalling, nicks, grooves, severe wear or corrosion and discoloration. SEE FIGURE 16. Inspect for damaged or worn internal and external splines or keyway (FIG. 17). Replace coupling shaft if any of these conditions exist.

NOTE

NOTE: Minor shaft wear in seal area is permissible. If wear exceeds .020 inches (.51 mm) diametrically, replace coupling shaft.

A slight "polish" is permissible in the shaft bearing area. Anything more would require coupling shaft replacement.



Figure 17

remove seal ring from housing

16. Remove and discard seal ring (4) from housing (18). SEE FIGURE 18.

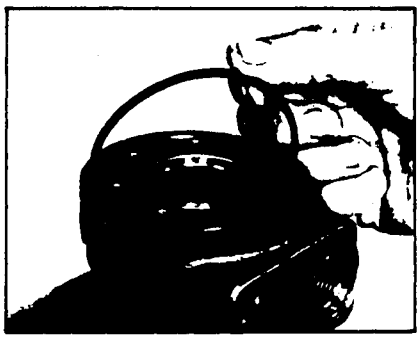


Figure 18

remove & inspect thrust bearing, washer

17. Remove thrust bearing (14) and thrust washer (15). Inspect for wear, brinelling and corrosion. The full complement of bearing rollers must be firmly retained in the bearing cage but revolve freely. Replace as required. SEE FIGURE 19.

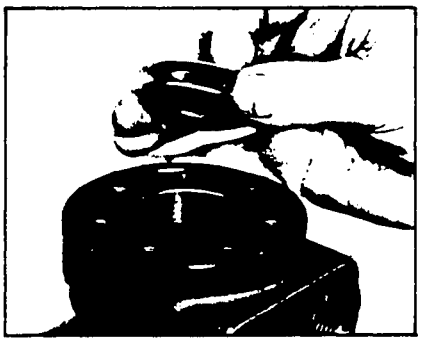


Figure 19

remove seal & spacer

18. Remove seal (16) and spacer (17). Discard both. SEE FIGURE 20.

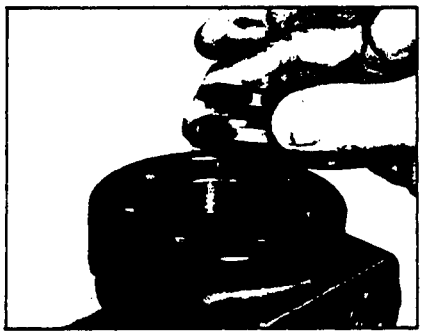


Figure 20

remove seal

19. Remove housing (18) from vise, invert it and remove and discard seal (21). SEE FIGURE 21.

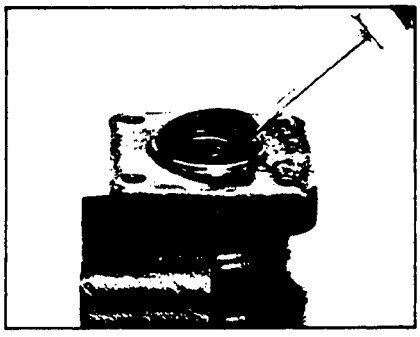


Figure 21

inspect housing assembly

20. Inspect housing (18) assembly for cracks, the machined surfaces for nicks, burrs, brinelling or corrosion. Remove burrs that can be removed without changing dimensional characteristics. Inspect tapped holes for thread damage. SEE FIGURE 22. If the housing is defective in these areas, discard the housing assembly.

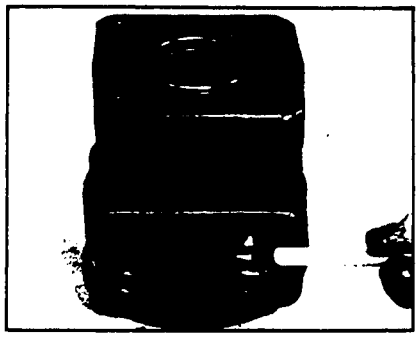


Figure 22

inspect housing bearing

21. If the housing assembly has passed inspection to this point, inspect the housing bearing (20) and retaining ring (19). The bearing rollers must be firmly retained in the bearing cage but must rotate and orbit freely. The full complement of rollers must be free of brinelling and corrosion. A bearing that does not pass this inspection must be replaced. SEE FIGURE 23.

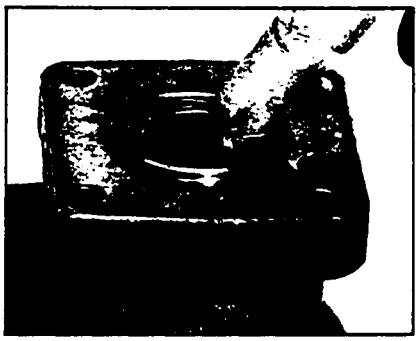


Figure 23

remove retaining ring & bearing

22. Only if the bearing (20) must be replaced, remove retaining ring (19) and press the bearing out of the mounting face end of the housing using a 1.300 inch (33.02 mm) maximum diameter shaft or appropriate bearing mandrel (reference FIG. 1). SEE FIGURE 24 & 25.

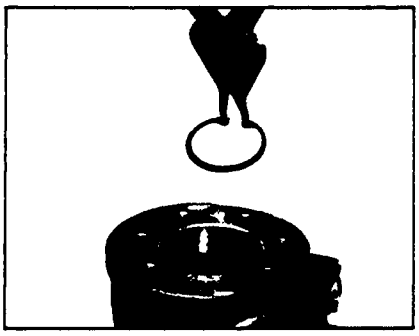


Figure 24

The MAG Torqmotor™ disassembly is now complete.

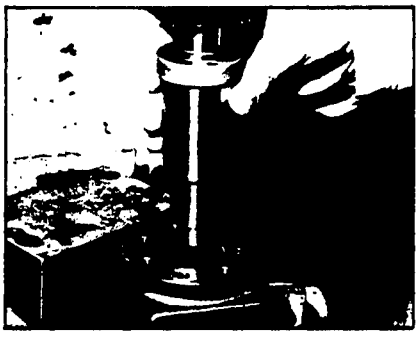


Figure 25

MAG Assembly

- Replace all seals and seal rings with new ones each time you reassemble the MAG unit. Lubricate all seals and seal rings with SAE 10W40 oil or clean grease before assembly.
- **NOTE: Individual seals and seal rings as well as a complete seal kit are available. SEE FIGURE 26. The parts should be available through most OEM parts distributors or Ross approved MAG distributors. (Contact your local dealer for availability).**
- **NOTE: Unless otherwise indicated, do not oil or grease parts before assembly.**
- Wash all parts in clean petroleum-based solvents before assembly. Blow them dry with compressed air. Remove any paint chips from mating surfaces of the end cover, sleeve, and housing and from port and sealing areas.

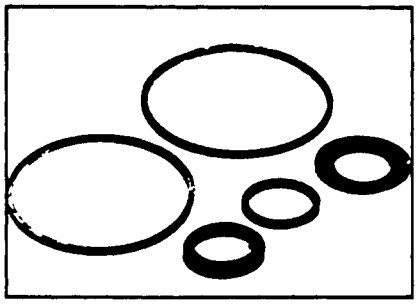


Figure 26

WARNING

WARNING: SINCE THEY ARE FLAMMABLE, BE EXTREMELY CAREFUL WHEN USING ANY SOLVENT. EVEN A SMALL EXPLOSION OR FIRE COULD CAUSE INJURY OR DEATH.

WARNING

WARNING: WEAR EYE PROTECTION AND BE SURE TO COMPLY WITH OSHA OR OTHER MAXIMUM AIR PRESSURE REQUIREMENTS.

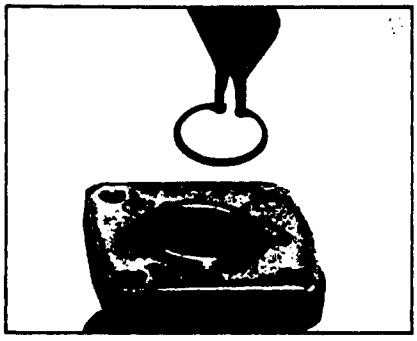


Figure 27

install retaining ring

1. If the housing (18) has been completely disassembled, place the housing, mounting flange end up, on a clean work surface. Install retaining ring (19) into the housing retaining ring groove. Be sure the rounded edge of retaining ring is facing in toward the larger housing cavity. Use appropriate retaining ring pliers. SEE FIGURE 27.

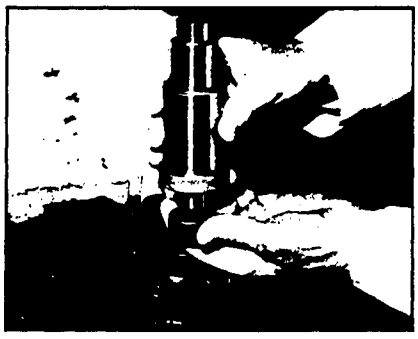


Figure 28

press in bearing

2. Thoroughly grease the rolls of a NEW bearing (20) with clean corrosion resistant grease recommended in the material section, Page 7A. Press the bearing into housing (18) from the mounting flange end of the housing bore, using bearing mandrel (special tool FIG. 1, Page 7A) against the lettered end of the bearing shell. SEE FIGURE 28 & 29. Take care during this procedure that the housing is square with the press base and that the bearing is not cocked. The bearing mandrel will control the bearing press depth to the required .135/.125 inches (3.43/3.18 mm) from the flange end of the housing.

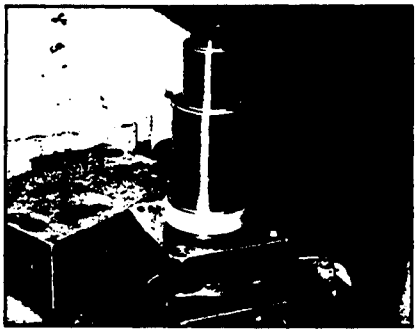


Figure 29

NOTE

NOTE: If the bearing mandrel shown is not available alternate methods may be used to press in the bearing but the bearing depth location must be maintained.

CAUTION

CAUTION: The controlled press depth of bearing (20) into the housing is required to ensure adequate bearing support, and correct bearing relationship to adjacent components when assembled.

CAUTION

CAUTION: Because the bearing (20) has a press fit into the housing, it must be discarded if removed from the housing. It must not be reused.

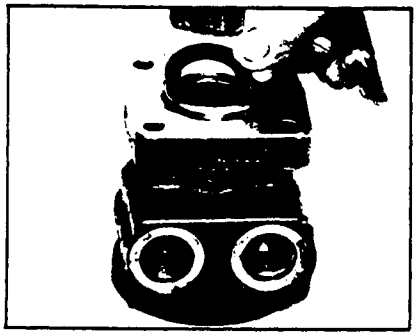


Figure 30

insert dirt & water seal

3. Place housing (18), wearplate surface down, on a clean work surface. Apply a small amount of clean grease to a NEW dirt and water seal (21) and press the seal into the housing seal cavity. The end of a hammer handle would be an appropriate tool. Be sure the seal is not cocked or deformed as it enters housing seal bore. SEE FIGURE 30.

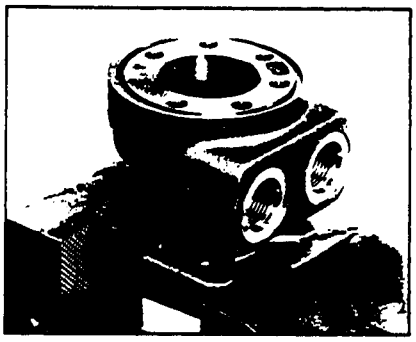


Figure 31

place housing assembly into vise

4. Place housing (18) assembly into a soft-jawed vise with coupling shaft bore down, and clamp the vise jaws against the edges of the mounting flange. SEE FIGURE 31.

install backup washer & seal

5. Apply a small amount of clean grease to a NEW seal (16). Install a NEW spacer (17) then seal (16) into housing coupling shaft bore from the sleeve end of the housing (18). Seat the spacer against the retaining ring (19) and the seal against the spacer, with the seal lip facing away from the spacer. SEE FIGURE 32.



Figure 32

install thrust washer & thrust bearing

6. Install the thrust washer (15) and then the thrust bearing (14) into housing (18), until they are seated at the bottom of the counterbore. SEE FIGURE 33.



Figure 33

install coupling shaft

7. Be sure that a generous amount of a clean corrosion resistant grease, recommended in the materials section, Page 7A, is applied to housing bearing (20). Then install coupling shaft (12) into housing (18), seating it against thrust bearing (14). SEE FIGURE 34.

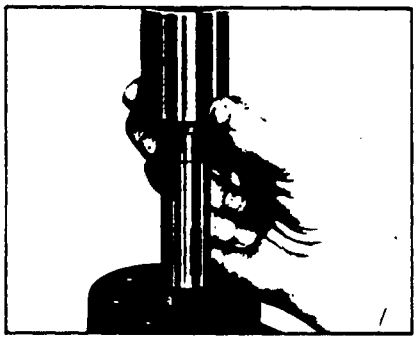


Figure 34

NOTE

NOTE: The coupling shaft must be flush with or below the housing surface when properly seated and rotate smoothly on the thrust bearing package.

insert seal ring

8. Apply a small amount of clean grease to a NEW seal ring (4) and insert it into the housing (18) seal ring groove. SEE FIGURE 35.



Figure 35

install drive link

9. Install drive link (11), pin end up, into coupling shaft (12) and engage drive link splines into mesh with coupling shaft splines. SEE FIGURE 36.

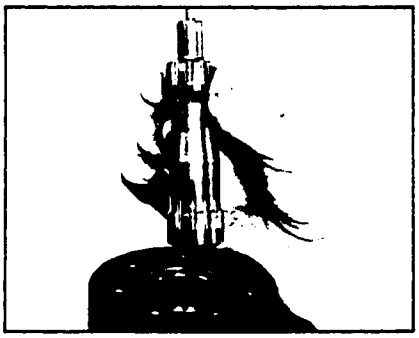


Figure 36

assemble spacer

10. Assemble wearplate (10) onto the housing (18) with recessed (cavity) side down and bolt holes aligned. SEE FIGURE 37.

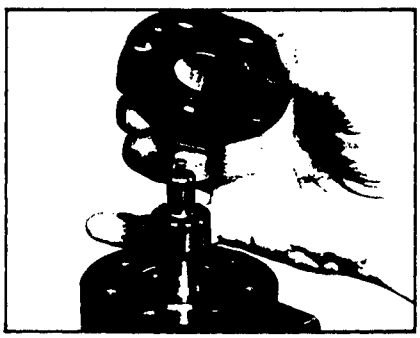


Figure 37

assemble rotor set

11. Assemble rotor set (9) onto wearplate (10) with rotor (9.1) counter bore side down and splines into mesh with drive link (11) splines. SEE FIGURE 38. Align stator bolt holes.

NOTE

NOTE: The rotor set counterbore side must be down against wearplate for drive link clearance and to maintain the original rotor-drive link spline contact. A rotor set without a counterbore can be reinstalled using the drive link spline contact pattern on the rotor splines to determine which side was down.



Figure 38

assemble manifold

12. Assemble manifold (8) onto the rotor set (9) so that the side with slots closest to the inside diameter is up. SEE FIGURE 39. Align bolt holes.

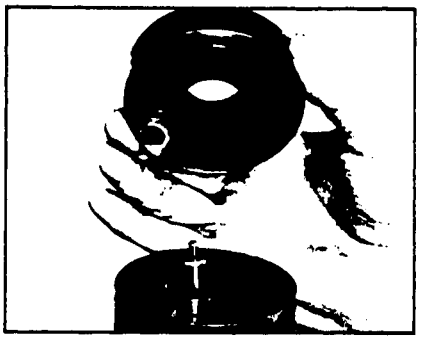


Figure 39

assemble commutator ring

13. Assemble commutator ring (7) either side up onto manifold (8) and align bolt holes. SEE FIGURE 40.



Figure 40

assemble commutator

14. Assemble commutator (6) onto manifold (8) with counterbore (washer recess) side up. The elongated hole must be engaged over the drive link (11) pin. SEE FIGURE 41.



Figure 41

assemble sleeve

15. Assemble sleeve (5) over the stacked components onto the housing (18). SEE FIGURE 42.



Figure 42

assemble washer

16. Assemble a generous amount of clean grease to washer (3) and assemble washer over pin in end cover assembly (2). SEE FIGURE 43.

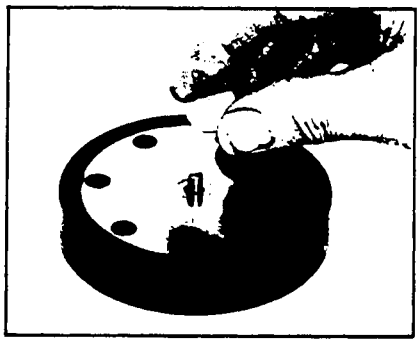


Figure 43

assemble seal ring

17. Apply a small amount of clean grease to a NEW seal ring (4) and insert it into the cover assembly (2) seal ring groove. SEE FIGURE 44.

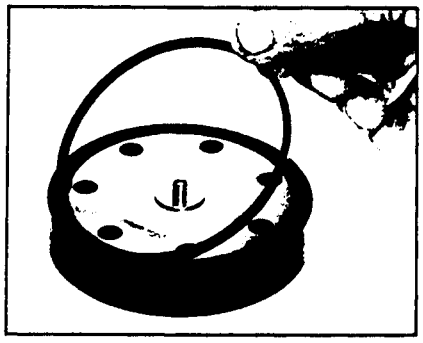


Figure 44

assemble end cover assembly

18. Assemble end cover assembly (2) with washer (3) and seal ring (4) attached onto the sleeve (5) and commutator set. The cover pin must be inserted into the center hole in the commutator (6) and the bolt holes aligned. SEE FIGURE 45.



Figure 45

NOTE

NOTE: It may be necessary to use one or two bolts (1) as probes to align the bolt holes of the components for bolt installation.

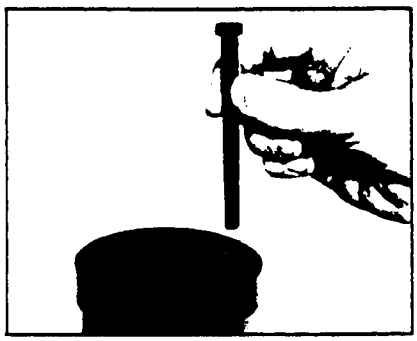


Figure 46

install and torque bolts

19. Install 7 bolts (1) into the assembly bolt holes finger tight, then torque the bolts to 22-26 foot pounds, (30-35 N.m), in the sequence shown, using a 1/2 inch, thin wall socket and appropriate torque wrench. SEE FIGURES 46, 47, 48.

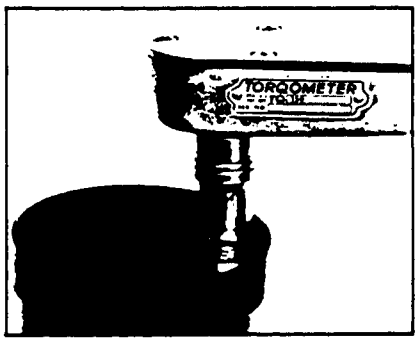


Figure 47

The assembly of the MAG Tormotor™ is now complete, except for woodruff key (13) and/or two port manifold O-Rings (18.1) if applicable at Torqmotor installation. See Page 21 for final checks.

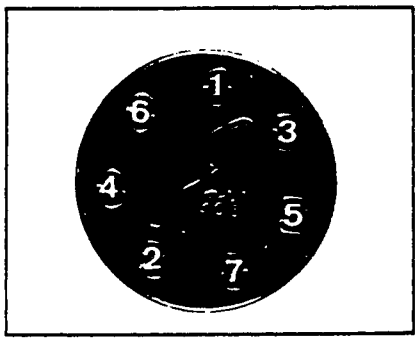


Figure 48

Final Checks

Final Checks

- Pressurize the Torqmotor™ with 100 p.s.i. dry nitrogen and submerge in solvent to check for external leaks.
- Check Torqmotor™ for rotation. Torque required to rotate coupling shaft should not be more than 50 ft. lbs. (68 N m)
- Pressure port with "A" cast under it on housing (18) is for clockwise coupling shaft rotation as viewed from the output end of coupling shaft. Pressure port with "B" cast under it is for counter clockwise coupling shaft rotation.
- Use test stand if available, to check operation of the Torqmotor™.

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

- 10W40 SE or SF manufacturers suggested oil.
- Hydraulic fluid as recommended by equipment manufacturer, but the viscosity should not drop below 50 SSU or contain less than .125% zinc anti-wear additives.

CAUTION: Do not mix oil types. Any mixture, or an unapproved oil, could deteriorate the seals. Maintain the proper fluid level in the reservoir. When changing fluid, completely drain old oil from the system. It is suggested also that you flush the system with clean oil.

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

Maximum operating temperature 200°F (93.3°C).

Tips for Maintaining the Torqmotor™ Hydraulic System

- Adjust fluid level in reservoir as necessary.
- Encourage all operators to report any malfunction or accident that may have damaged the hydraulic system or component.
- Do not attempt to weld any broken Torqmotor™ component. Replace the component with original equipment only.
- Do not cold straighten, hot straighten, or bend any Torqmotor™ part.
- Prevent dirt or other foreign matter from entering the hydraulic system. Clean the area around and the filler caps before checking oil level.
- Investigate and correct any external leak in the hydraulic system, no matter how minor the leak.
- Comply with manufacturer's specifications for cleaning or replacing the filter.

CAUTION: Do not weld, braze, solder or any way alter any Torqmotor™ component.

CAUTION: Maximum operating pressure must not exceed recommended Torqmotor™ pressure capacity.

CAUTION: Always carefully inspect any system component that may have been struck or damaged during operation or in an accident. Replace any component that is damaged or that is questionable.

CAUTION: Do not force any coupling onto the Torqmotor™ coupling shaft as this could damage the unit internally.

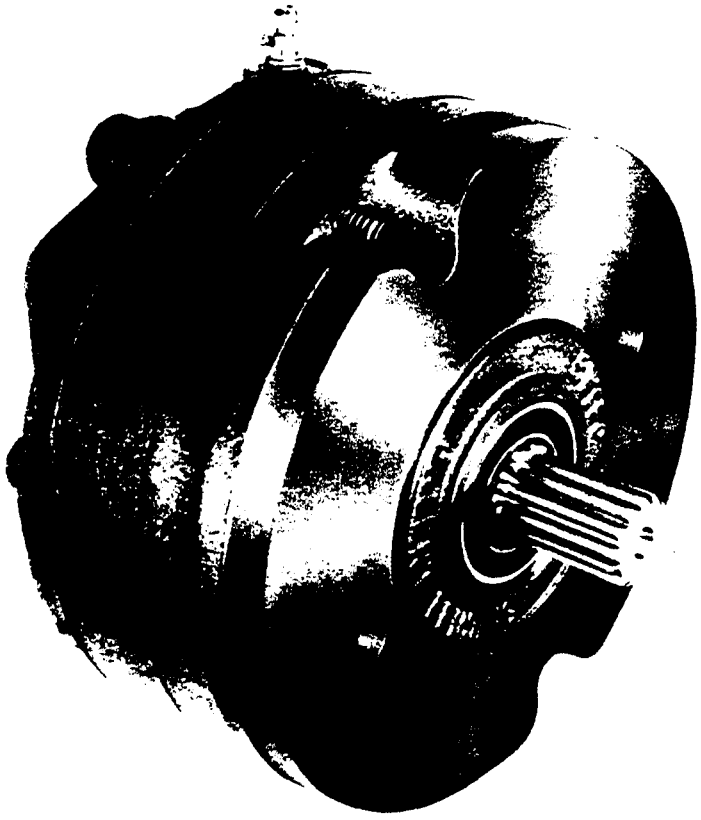
Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

SY·TEC SERIES

MULTIPLE DISC BRAKE

(dry design - SAE A size)

SERVICE MANUAL mico



mico INCORPORATED
mico WEST / SY·TEC

TYPICAL BRAKE

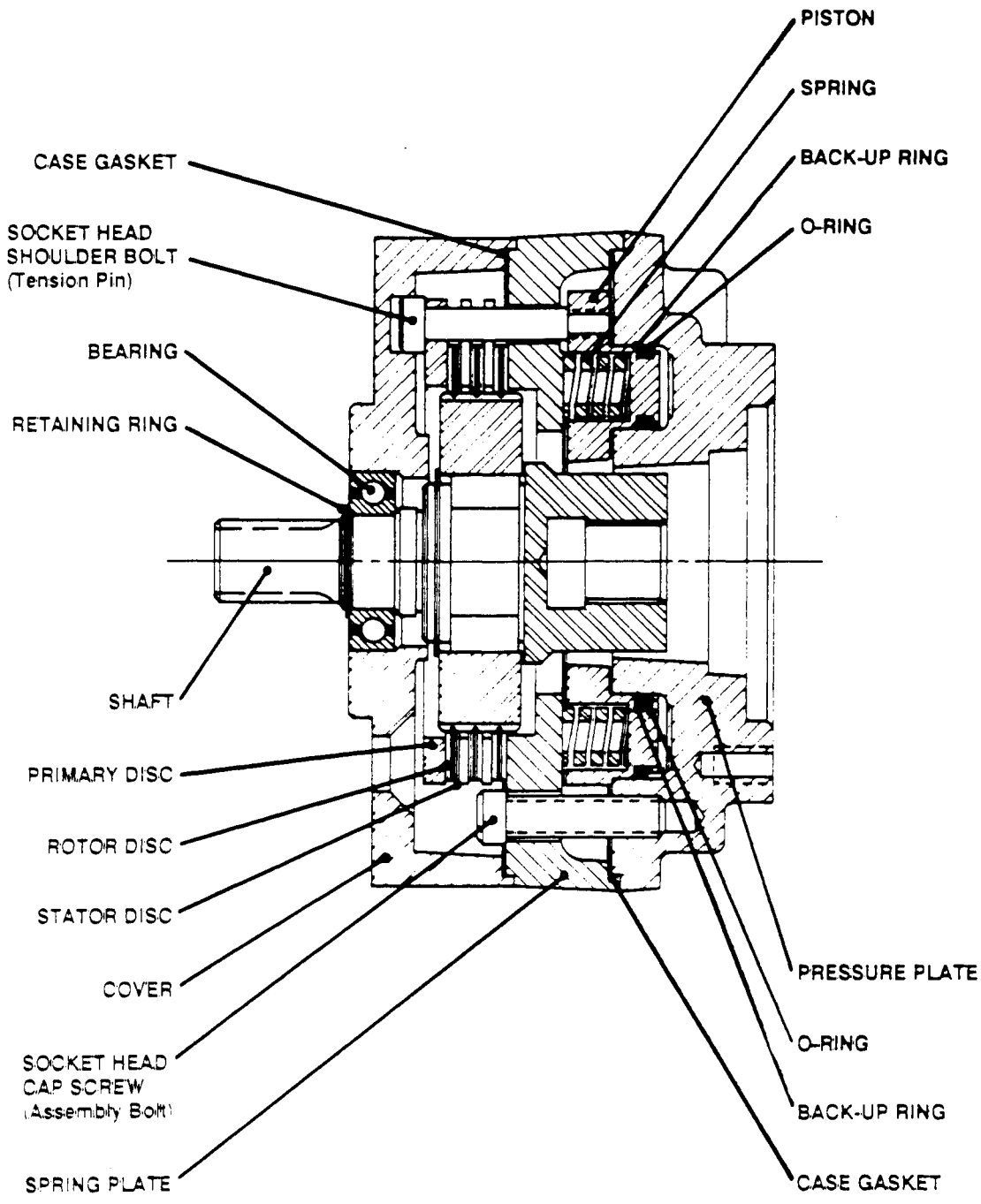


FIGURE 1

PRINCIPLES OF OPERATION

These brakes are spring-set, hydraulically released, multi-disc brakes. They are used primarily for holding loads, vehicles, conveyors, etc. in place when the hydraulic drive system is shut down or fails. Although the brakes are rated at 3,000 psi, they only require from 100 psi to 330 psi to make them function normally. The exact pressure required for operation is dependent upon the number of springs used to generate the torque necessary to hold the designed load. Thus, a brake with a full complement of springs, will generate the highest level of torque and require approximately 330 psi to fully release the brake and provide adequate running clearance for the rotor plates. A brake with the lowest arrangement of springs will have 1/4 as much torque and will require only 130 psi to fully release the brake. Consult catalog to choose the torque which best suits your design parameters.

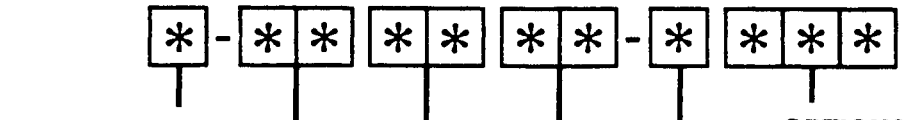
It is very important to remember that any pressure on the brake's release piston will directly effect the level of torque.

Two application examples:

1. The brake has a release pressure of 200 psi. The actuation pressure is provided by a charge pump. During certain phases of the machine's operation, the charge pump pressure dips from 200 psi to 100 psi. At 200 psi, the brake runs free (zero torque) but at 100 psi the brake will generate slightly less than half of its rated torque. The brake will drag - failure may occur. In this case, a brake should be selected which has a lower release pressure.
2. A brake has a release pressure of 200 psi. The system is set up to hold a load when a variable pump is shifted into neutral. Everything is running fine until the filter clogs, causing a buildup of back pressure in the return line to the tank. At a pressure of 60 psi, the brake will lose 25% of its holding torque; thus the load may slip. The situation can be corrected by replacing the filter or adding an extra margin of safety to your required brake torque in the initial design.

These brakes are designed to give thousands of trouble-free hours of service when set up correctly in the hydraulic circuit.

DESCRIPTION OF MODEL NUMBERS



OUTPUT FACE
A - SAE A-Mount 2-Bolt
M - MAB 4-Bolt

OUTPUT SPLINE
13 - 13T 16/32
06 - 1.0 Dia. 6B
25 - 1.25 Dia. Keyed
10 - 1.00 Dia. Keyed
14 - 14T 12/24 Spline
15 - 15T 16/32 Spline

INPUT SPLINE
13 - 13T 16/32
06 - 1.0 Dia. 6B
25 - 1.25 Dia. Keyed
10 - 1.00 Dia. Keyed
14 - 14T 12/24 Spline
15 - 15T 16/32 Spline
12 - 12T 12/24
Used on L2
Input Face only

INPUT FACE
M - MAB 4-Bolt and
SAE A-Mount 2-Bolt
R - Closed
L2 - Char-Lynn Bearingless 2000
B - SAE B-Mount 2-Bolt

OPTIONS
(Available separately
or in combination)
S - Speed Sensor
D - Double Bearing

TORQUE 1 psi = .06895 bar

Code	Standard (lbs. in.)	High (lbs. in.)	Release Pressure (psi)	Full Release Pressure (psi)
90 *		9000	300	330
70 *		7000	250	280
56 *		5600	190	220
48 *		4800	150	180
40	4000		190	220
35	3500		150	180
39		3900	135	165
29	2900		135	165
34		3400	120	150
25	2500		120	150
24		2400	100	130
18	1800		100	130

***For use with input spline codes 14 and 25 only.**

DISASSEMBLY

1. Remove two socket head assembly screws (19) from pressure plate (18).
2. Remove pressure plate (18) and spring plate (11) assembly from cover (3).
3. Remove cover (3) and spline shaft (5) assembly from reducer.
4. Remove retaining ring (1) from spline shaft (5).
5. Remove spline shaft (5) from cover (3) by tapping male end of spline shaft with soft mallet. Remove case gasket (4) from cover (3).
6. Press bearing (2) out from cover (3) only if replacing it.
7. Remove four socket head shoulder bolts (7). A suitable holding fixture is useful to hold brake in position.

   CAUTION: Do not remove shoulder bolts without pressurization of brake (approx. 300 psi) or damage may result.

8. Remove primary disc (8), rotor discs (9) and stator discs (10).
9. Remove spring plate (11) by removing two socket head cap screws (6).
10. Remove case gasket (4) from spring plate (11).
11. Before removing springs (12), note pattern for reassembly purposes.
12. Remove piston (13) by carefully exerting hydraulic pressure through brake release port on pressure plate (18).
13. Remove outside and inside o-rings (15 & 17) and outside and inside back-up rings (14 & 16) from piston (13).

    CAUTION: Care must be taken so as not to scratch or mar piston.

ASSEMBLY

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Install back-up rings (14 & 16) on piston (13) toward spring pockets.
3. Install o-rings (15 & 17) on piston (13). Be sure o-rings are flat and all twists removed.

   CAUTION: Care must be taken so as not to scratch or mar piston.

4. Lubricate piston (13) with type fluid used in the system. Carefully press piston into pressure plate (18). Be sure piston is aligned correctly at all times and that there are no extrusions. Press piston until it bottoms on pressure plate (18).
5. Install springs (12) according to pattern noted during disassembly.
6. Affix case gaskets (4) to cover (3) and spring plate (11).
7. Place pressure plate (18) assembly on a press. Using fixture, depress spring plate (11) and install two socket head assembly bolts (6). **SEE NOTE BELOW.** Torque bolts to 40 ft. lbs. A suitable holding fixture is useful to hold brake in position.
8. Install rotor discs (9) and stator discs (10). Begin with a rotor disc (9) and alternate with stator discs (10).
9. Install primary disc (8).
10. Align discs using spline shaft (5) and partially screw in four socket head shoulder bolts (7). **SEE NOTE BELOW.** Inspect for free movement of stack. Pressurize brake release port (approx. 300 psi) to release discs. Torque shoulder bolts to 20 ft. lbs. and release pressure. A suitable holding fixture is useful to hold assembly in position.

    NOTE: Bolts should have Loctite applied. Place one or two drops of Loctite to the threads.

11. Recheck that rotors are in line and centered in assembly with spline shaft (5). The shaft should move smoothly thru lining stack.
12. If bearing (2) was removed, press back into position, in cover, until it bottoms out on bore step.

    NOTE: Bearing bore should have Loctite applied. Place a light coating of Loctite to the bearing bore.

13. Press spline shaft (5) into bearing (2) until shaft bottoms on shaft shoulder. Bearing inner race must be supported during this operation.
14. Install retaining ring (1) on spline shaft (5).

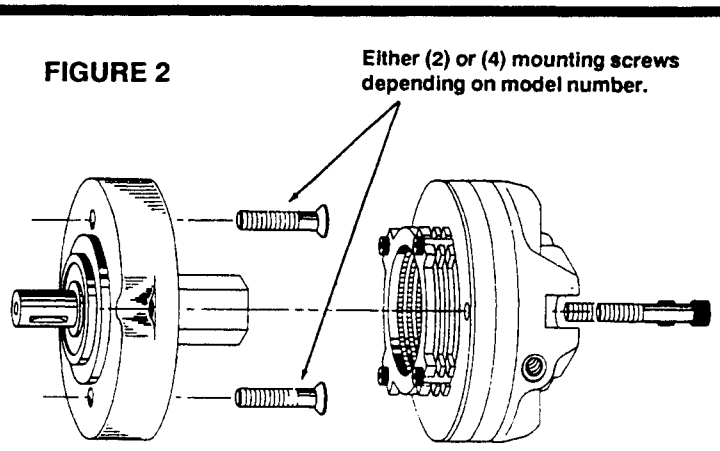
MOUNTING INSTRUCTIONS

1. Install cover/shaft assembly on gearbox using either (2) or (4) 1/2 - 13 UNC x 1.25" long flat head cap screws, depnding on brake module being used. Lubricate screw threads and torque to 80 - 90 ft. lbs.
2. Carefully assemble brake module to cover/shaft assembly with (2) bolts provided. Lubricate bolt threads and torque to 110 - 120 ft. lbs.

   CAUTION: Care must be taken to assure cover and brake module are seated properly prior to installing 9/16 - 12 UNC assembly bolts.

   Damage will occur to rotor stack or shaft snap ring if not properly seated.

FIGURE 2



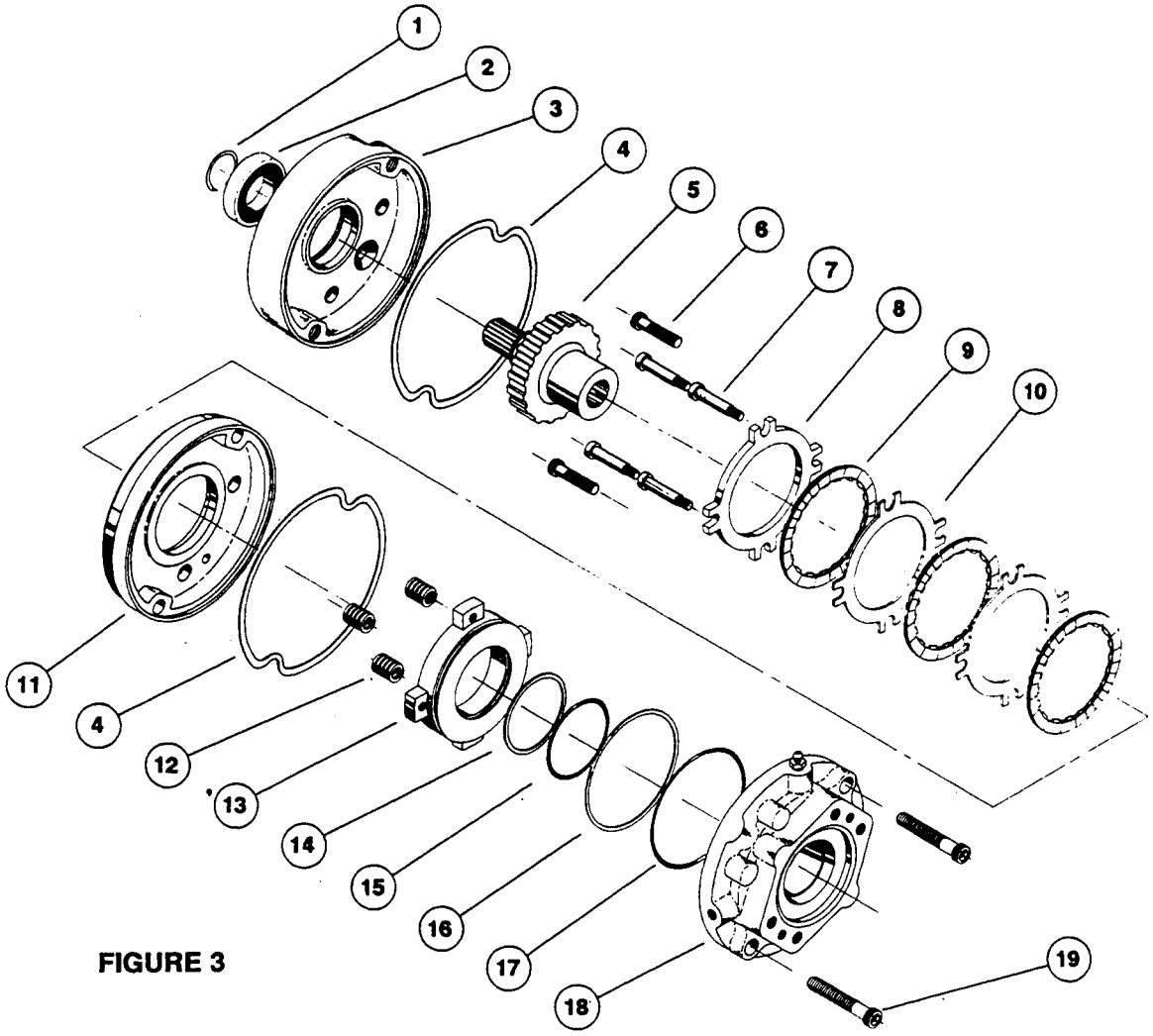


FIGURE 3

PART LIST

ITEM	DESCRIPTION
1	RETAINING RING
2	BEARING
3	COVER
4	CASE GASKET
5	SPLINE SHAFT
6	SOCKET HEAD CAP SCREW (Assembly Bolt)
7	SOCKET HEAD SHOULDER BOLT (Tension Pin)
8	PRIMARY DISC
9	ROTOR DISC
10	STATOR DISC
11	SPRING PLATE
12	SPRING
13	PISTON
14	BACK-UP RING
15	O-RING
16	BACK-UP RING
17	O-RING
18	PRESSURE PLATE
19	SOCKET HEAD ASSEMBLY SCREW

BLEEDING

1. Install brake in system and connect pressure lines.
2. Bleed pressure release section of brake by pressurizing side inlet port and allowing air to escape from top port. Pressure should not exceed 100 psi during bleeding.
3. Apply sufficient pressure to release brake and check for proper operation in system.

SERVICE DIAGNOSIS

PROBLEM	CAUSE	EXPLANATION	ACTION
Brake slips	A. Excessive pressure in hydraulic system	If there is back pressure in the brakes actuation line, the holding torque of the brakes is reduced.	Check filters, hose size, restrictions in other hydraulic components.
	B. Oil in brake if designed for dry use	Dry linings generate 66% more torque than linings saturated with oil. If the brake has oil in it, check the type of oil hydraulic or gearbox. 1. Gearbox oil 2. Hydraulic oil	Replace oil seal in brake Check motor seal Check piston seals Note: Internal components will need to be inspected, cleaned and replaced as required.
	C. Disc plates worn	The thickness of the disc stack sets the torque level. A thin stack reduces torque.	Check disc thickness
	D. Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - a rare occurrence	Check release pressure
Brake drags or runs hot	A. Low actuation pressure	The brake should be pressurized to minimum of 20 psi over the specified release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system on
	B. Bearing failure	If the bearing should fail, a large amount of drag can be generated	Replace bearing
	C. Oil in brake	Excess fill of oil in sump condition thru wet brakes can cause the unit to run hot. Also excessive rpm in sump condition.	Drain oil and refill as specified for brakes Switch to flow thru cooling.
Brake will not release	A. Stuck valve or clogged	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure - Replace defective line or component
	B. Bad o-rings	If release piston will not hold pressure, brake will not release.	Replace o-rings
	C. Discs frozen	Sy-Tec brakes are designed for only limited dynamic braking. A severe emergency stop or prolonged reduced release pressure operation may result in this type of damage.	Replace disc stack

NUMBER	DESCRIPTION	INCLUDES
RING KIT	O-ring and Back-up Ring Kit	Case Gaskets (7) Face Gasket (not shown) Oil Seal (5) Back-up Rings (17 & 19) O-rings (18 & 20) Loctite
LINING KIT	High Torque Lining Kit	Case Gaskets (7) Face Gaskets (not shown) Primary Disc (11) Stator Discs (13) Rotor Discs (12) Loctite
BEARING KIT	Bearing Kit	Case Gaskets (7) Face Gasket (not shown) Oil Seal (5) Bearing (4) Loctite
SPRING KIT	Spring Kit	Case Gaskets (7) Face Gasket (not shown) Springs - red (15) Springs - blue (15) Loctite
N/A	Standard Lining Kit	Case Gasket (7) Face Gasket (not shown) Primary Disc (11) Stator Discs (13) Rotor Discs (12) Loctite
N/A	Bearing Kit	Case Gaskets (7) Face Gasket (not shown) Oil Seal (5) Bearing (4) Loctite
N/A	Bearing Kit	Case Gaskets (7) Face Gasket (not shown) Oil Seal (5) Bearing (4) Loctite

NOTE: FOR SPEED SENSOR LINING KITS PLEASE CONSULT THE MANUFACTURER.

TORQUE-HUB®

Final Drives

ASSEMBLY-DISASSEMBLY MANUAL

FOR THE

S07A

UNIT

Fairfield Manufacturing Company Inc.

INTRODUCTION

This manual is a step-by-step guide to assembly and disassembly of torque-hub units. It is designed for the customer or shop mechanic who is repairing a particular model of torque-hub final drive. Users of this manual should note that each part mentioned is followed by an indentification number enclosed in parentheses. These part numbers may be referred to in the Parts List section of this manual and on the cross-sectional view of this unit. A print of each tool discussed in this manual is shown in the Tooling section. Users should familiarize themselves with the procedures for roll and leak testing and bolt tightening and torquing found on the following two pages before getting started.

SAFETY

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn. Heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see the word CAUTION. This indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

ROLL and LEAK TESTING

Torque-hub units should always be roll and leak tested before disassembly and after assembly to make sure that the unit's gears and sealants are working properly. The following information briefly outlines what to look for when performing these tests.

THE ROLL TEST

The purpose of a roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying a constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for proper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency.

THE LEAK TEST

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your air checker starts to fall once the unit has been pressurized. Leaks will most likely occur at the main seal or wherever "O" rings or gaskits are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where "O" rings or gaskits meet the exterior of the unit then checking for air bubbles. If a leak is detected in a seal, "O" ring, or gaskit, the part must be replaced.

TIGHTENING and TORQUING BOLTS

If an air impact wrench is used to tighten bolts, extreme care should be taken to insure that the bolts are not tightened beyond their indicated torque specification. Never use an impact wrench to tighten shoulder bolts, all shoulder bolts should be tightened by hand.

The following steps describe the proper procedure for tightening and torquing bolts or socket head cap screws in a bolt circle.

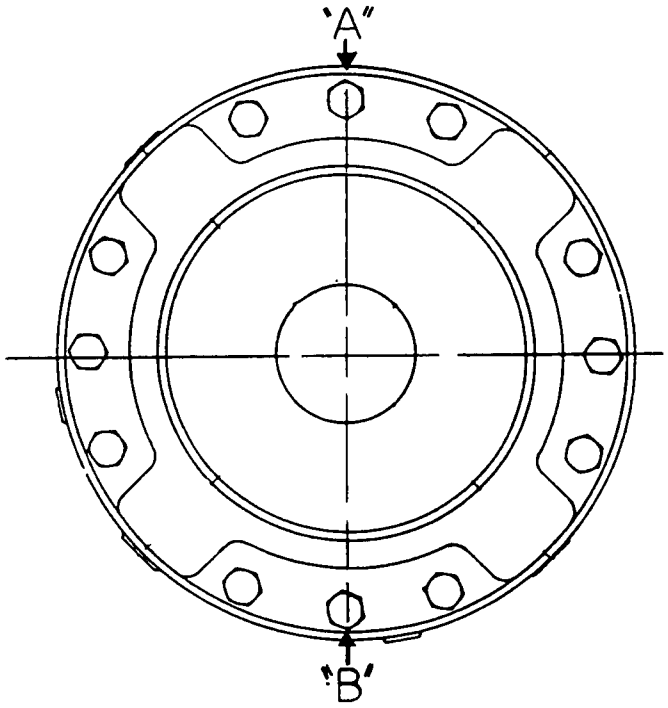
1. Tighten (but do not torque) bolt "A" until snug.

2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.

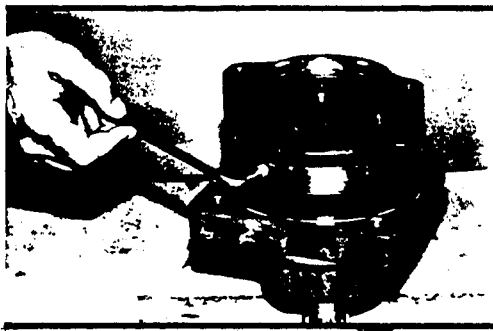
3. Continue around the bolt circle and tighten the remaining bolts.

4. Now use a torque wrench to apply the specified torque to bolt "A".

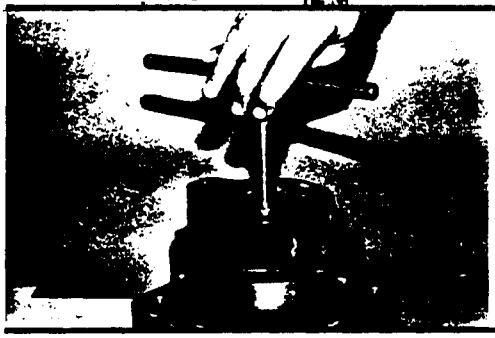
5. Continue around the bolt circle and apply an equal torque to the remaining bolts.



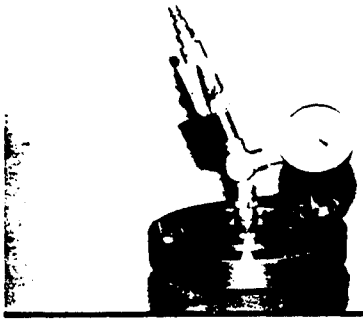
MAIN DISASSEMBLY



1. Remove the four **pipe plugs(4)** from **cover(6)** and drain the oil from the unit.



2. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. This number is the same as the last two digits in the model number found on the ID tag of the unit. For example, if the model number of this unit is S07A33304, then it should be rolled four times in each direction.



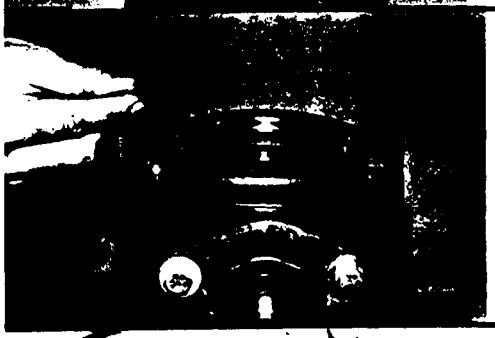
3. Leak test the unit at a pressure of 5 psi for 2-3 minutes.

4. **IF YOUR UNIT HAS A BRAKE:** follow steps 4a-e.

Main Disassembly

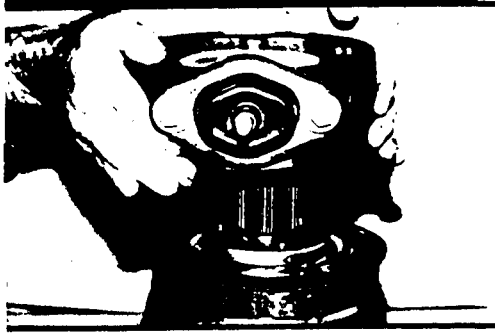


a) Remove the five **bolts(21)** from the brake's **cover(6)**.

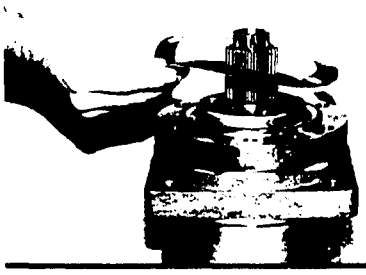


b) Remove **lock washers(22)** from **brake(6)**.

NOTE: The lock washers may have remained attached to the bolts when they were removed. If this is the case, remove the lock washers from the bolts.



c) Lift **brake(6)** off of **hub(1G)**.



d) Remove **gaskit(27)** from **hub(1G)**.

e) Continue to <u>step #6</u>.

5. **IF YOUR UNIT DOES NOT HAVE A BRAKE:** follow steps 5a-f.



a) Remove the six **bolts(12)** from the hub's **cover(6)**.



b) Remove **lock washers(14)** from **cover(6)**.

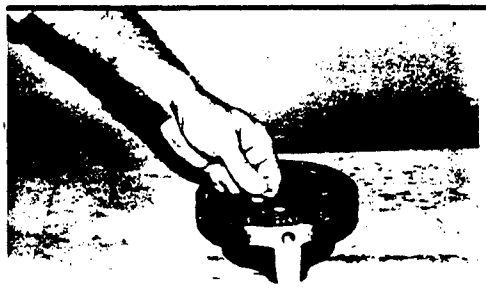
NOTE: The lock washers may have remained attached to the bolts when they were removed. If this is the case, remove the lock washers from the bolts.



c) Lift **cover(6)** off of **hub(1G)**.

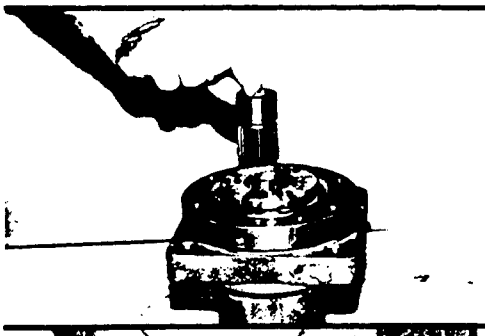


d) Remove **thrust washer(11)** from the counterbore inside **cover(6)**.

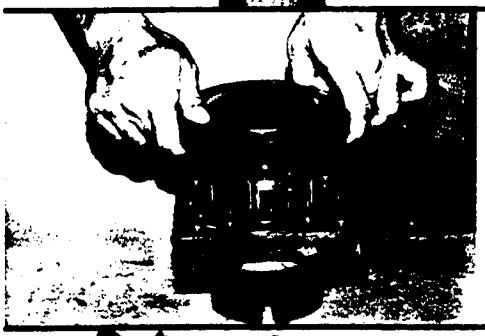


e) Remove **"O" ring(5)** from the counterbore around the edge of **cover(6)**. Discard the "O" ring.

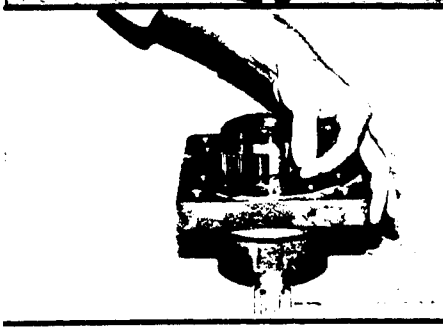
f) Continue to step #6.



6. Remove **input gear(9)** from mesh with **planet gears(1W)**.

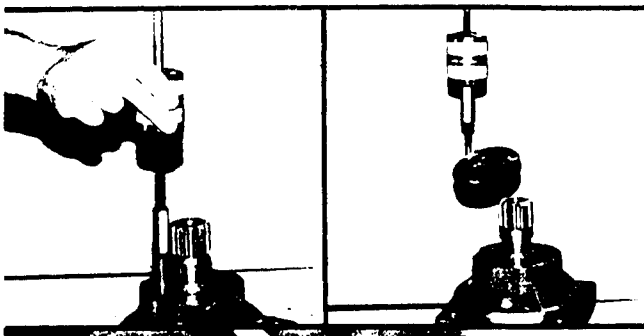


7. Remove **ring gear(2)** from **hub(1G)**.



8. Remove **"O" ring(5)** from the counterbore in **hub(1G)**.

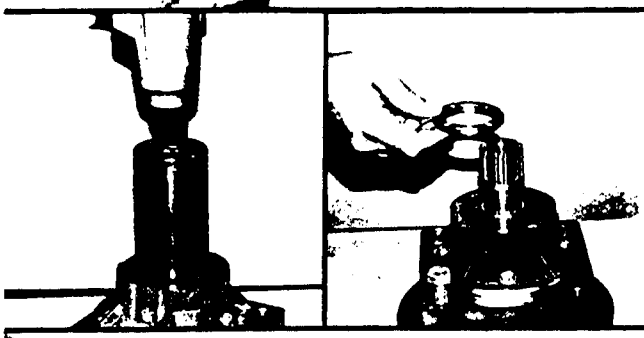
Main Disassembly



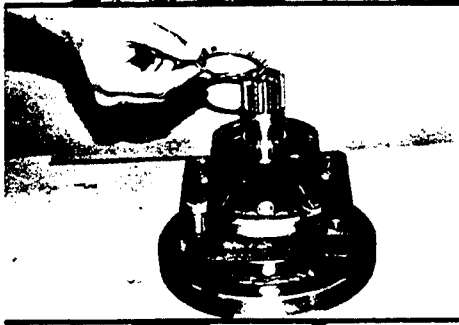
9. With **hub(1G)** on its carrier end, use a slide hammer to remove **seal (1B)** from the hub's small end. Discard the seal.



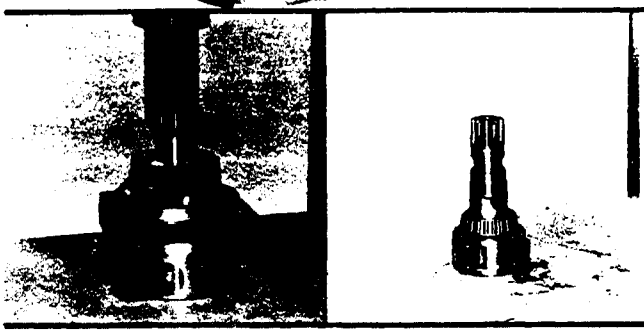
10. With a punch and hammer, straighten out the tang on **lockwasher(1F)** that has been bent into the notch in **locknut(1E)**.



11. Using a locknut wrench (tool no. T-152999), remove **locknut(1E)** from **output shaft/carrier(1T)** and discard.



12. Remove **lockwasher(1F)** from **output shaft/carrier(1T)** and discard.

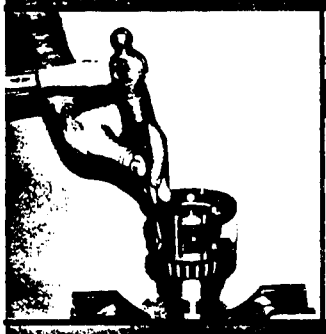


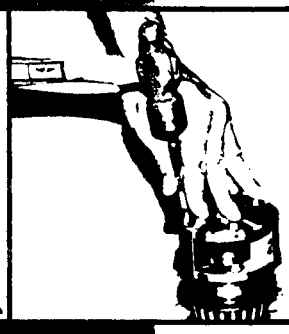
13. Raise **hub(1G)** above your work surface so that **output shaft/carrier (1T)** will fall through the bottom of the hub. Press **output shaft/carrier (1T)** out of **hub(1G)**.

Main Disassembly



14. Lift **bearing cone(1D)** out of **hub (1G)**.





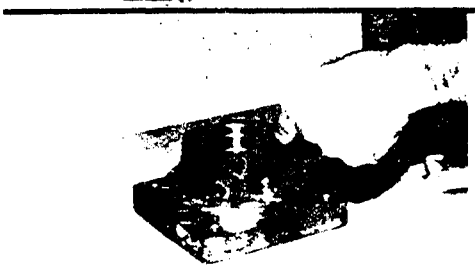
15. Using a punch and hammer, remove **bearing cone(1D)** from **output shaft/carrier(1T)**.



16. Lift out **bearing cup(1C)** from the large diameter end of **hub(1G)** or if necessary, set the hub on its large diameter end and use a punch and hammer to remove the cup.



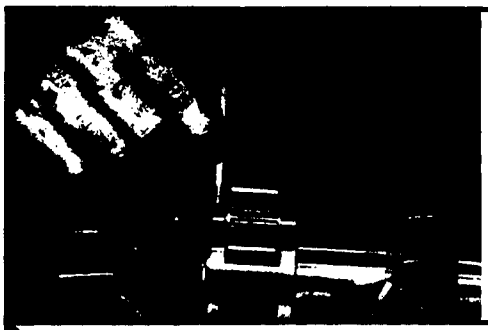
17. Set **hub(1G)** on its small diameter end. Using a punch and hammer, remove the other **bearing cup(1C)** from the hub's small diameter end.



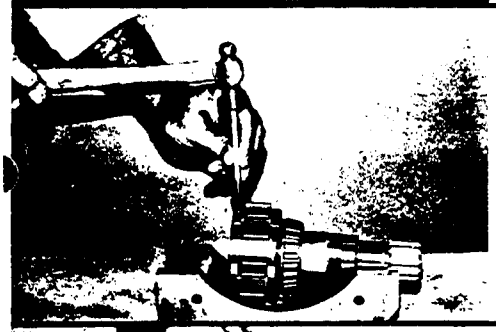
18. Remove the three **magnetic pipe plugs(1K)** from **hub(1G)**.

19. At this point the main disassembly is complete.

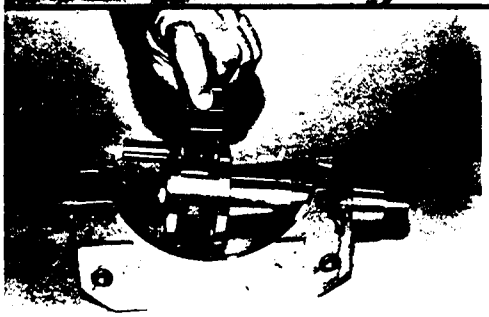
OUTPUT SHAFT/CARRIER DISASSEMBLY



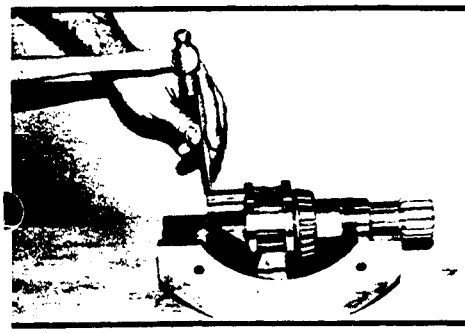
1. Locate **spring pin(1Y)** which holds **planet shaft(1V)** in **carrier housing (1T)**.



2. Drive **spring pin(1Y)** down into **planet shaft(1V)** until it bottoms against the carrier housing. If the spring pin is not completely driven into the planet shaft, damage to the carrier could occur when the shaft is removed.

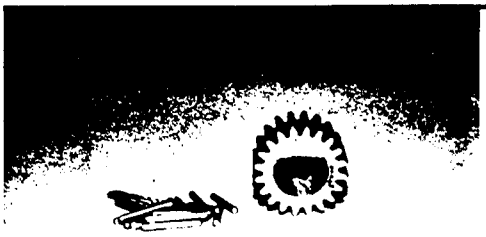


3. Remove **planet shaft(1V)** from **carrier housing(1T)**. The four **thrust washers(3B)** and **planet gear(1W)** will slide off.



4. Drive **spring pin(1Y)** out of **planet shaft(1V)**.

Output shaft/carrier Disassembly

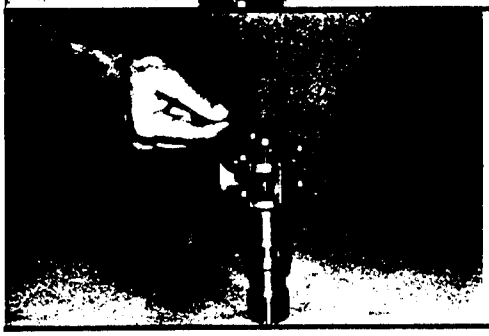


5. Remove **needle rollers(1X)** from inside **planet gear(1W)**.

6. Repeat steps 1-6 to remove the two remaining planet gears.



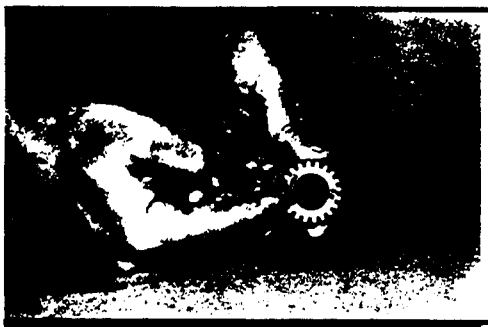
7a. **IF YOUR UNIT HAS A BRAKE:** remove **thrust spacer(29)** from the counterbore in **output shaft/carrier (1T)**.



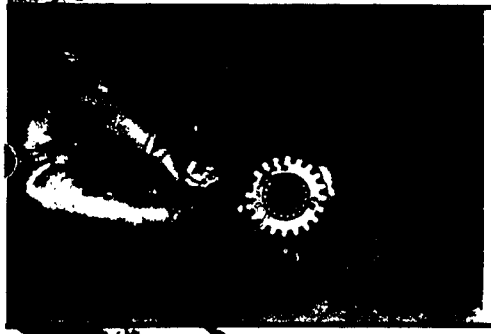
7b. **IF YOUR UNIT DOES NOT HAVE A BRAKE:** remove **thrust washer(1S)** from the counterbore in **output shaft/carrier(1T)**.

8. At this point the output shaft/ carrier disassembly is complete.

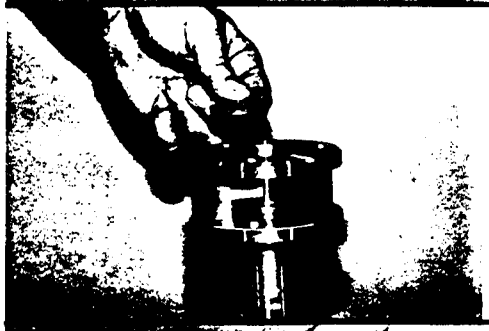
OUTPUT SHAFT/CARRIER SUB-ASSEMBLY



1. Apply grease to the inside of one **planet gear(1W)**.



2. Line the inside of **planet gear(1W)** with 19 **needle rollers(1X)**.

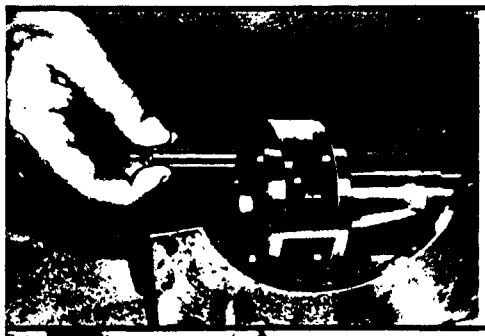


3a. **IF YOUR UNIT DOES NOT HAVE A BRAKE:** Grease one side of **thrust washer (1S)** and place it greased side down into the counterbore in **output shaft/carrier(1T)**.



3b. **IF YOUR UNIT HAS A BRAKE:** Place **thrust spacer(29)** into the counterbore in **output shaft/carrier (1T)**.

Output shaft/carrier Sub-assembly



4. Holding a **planet shaft(1V)** so that its spring pin hole is in the end nearest your hand, insert the planet shaft into one of the planet shaft holes that also has a spring pin hole in **output shaft/carrier (1T)**.

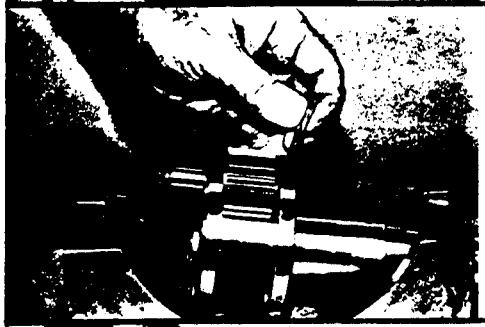


5. Place two **thrust washers(1Z)** onto the end of **planet shaft(1V)**.

NOTE: Grease or petroleum jelly may be used to keep the washers together and in place on the planet shaft.

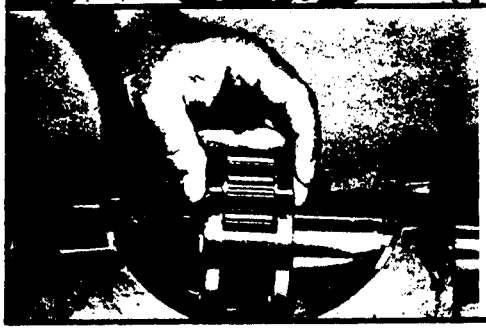


6. Following the thrust washers place **planet gear(1W)**, with needle rollers, onto **planet shaft(1V)**.



7. Following the planet gear place two more **thrust washers(1Z)** onto **planet shaft(1V)**.

NOTE: Grease or petroleum jelly may be used to hold the washers together and in place on the planet shaft.



8. Now insert **planet shaft(1V)** through the opposite planet shaft hole in **output shaft/carrier(1T)**.

Output shaft/carrier Sub-assembly



9. Using an alignment punch, align the spring pin holes in **output shaft/ carrier(1T)** and **planet shaft(1V)**.

10. Drive **spring pin(1Y)** into the aligned spring pin holes.

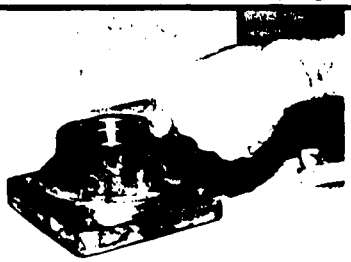
11. Repeat steps 1-2 and 4-10 to install the two remaining planet gears.

12. At this point the output shaft/ carrier sub-assembly is complete.

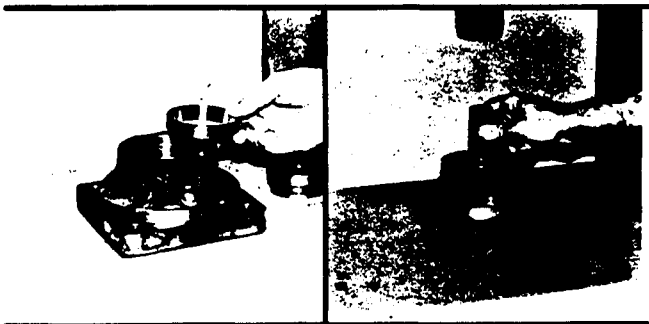
HUB-SHAFT SUB-ASSEMBLY



1. Apply a light coat of "never-seize" to the three **magnetic pipe plugs(1K)**.



2. Tighten **magnetic pipe plugs(1K)** into the three pipe plug holes in **hub(1G)**.



3. Using a bearing cup pressing fixture (tool no. T-139353), press **bearing cup(1C)** into the counterbore in the small diameter end of **hub(1G)**.

NOTE: Make sure that the cup sits square with the counterbore before pressing.



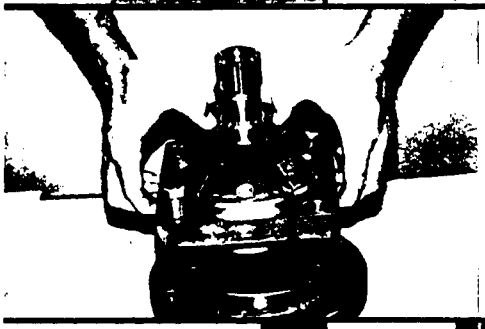
4. Depending on the width of the second **bearing cup(1C)**, the cup may slip fit into the counterbore in the large diameter end of **hub(1G)** or it may have to be pressed in. Place or press (using tool no. T-139353) **bearing cup(1C)** into the counterbore in the large diameter end of **hub(1G)**.

NOTE: Make sure that the cup sits square with the counterbore before pressing.

Hub-shaft Sub-assembly

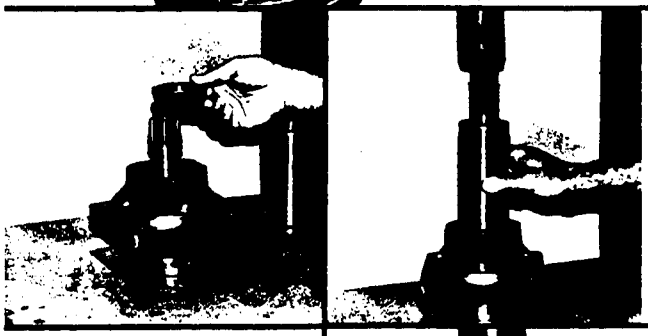


5. Using a bearing cone pressing fixture (tool no. T-148242), press **bearing cone(1D)** onto **output shaft/ carrier(1T)** so that the cone is flush against the carrier housing.

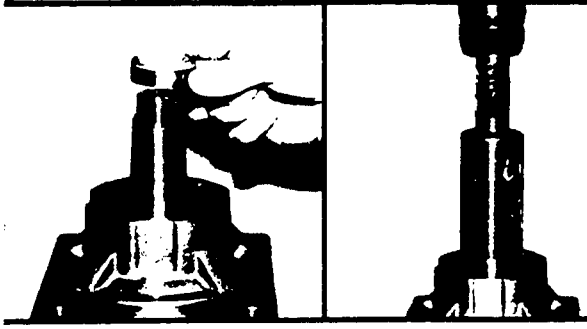


6. With large diameter end down, lower **hub(1G)** onto **output shaft/ carrier(1T).**

NOTE: The accompanying photograph shows the output shaft/carrier in an assembly base.



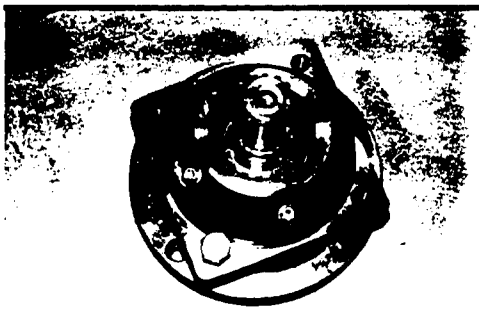
7. Using a bearing cone pressing fixture (tool no. T-148242), press **bearing cone(1D)** onto **output shaft/carrier(1T).**



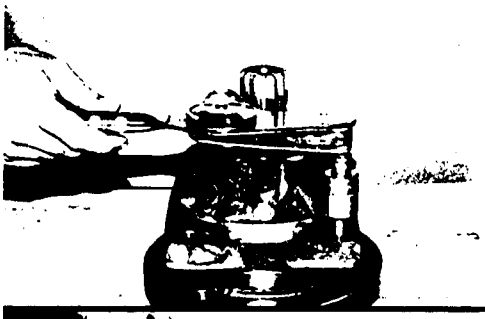
8. Using seal sleave pressing tool no. T-152878, press **seal sleave(10)** onto **output shaft/carrier(1T).**

9. Measure the initial rolling torque of **hub(1G).** To do this follow steps 9a-d.

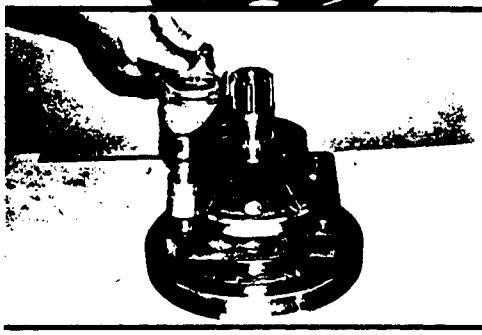
Hub-shaft Sub-assembly



a) Tighten a bolt into one of the bolt holes in the hub.



b) Place a torque wrench on the bolt so that the arm of the wrench lines up on a tangent to the circumference of the hub as shown in figure 1.



c) Keeping the wrench in this position at all times, use the arm of the wrench to guide the hub slowly around in one rotation.

d) Read the gauge on the torque wrench. The initial rolling torque should be 5-10 in.-lbs. Measure the rolling torque several times to insure an accurate reading.

IMPORTANT: If the initial rolling torque is lower than 5 in.-lbs., apply more pressure to **bearing cone(1D)** until the rolling torque falls within the 5-10 in.-lb. range. If the rolling torque is higher than 10 in.-lbs., strike the top of **spindle(1A)** once or twice with a soft face hammer to release the load on the spindle; then repeat steps 9b-d. Apply pressure as needed to the bearing cone to reach 5-10 in.-lbs.

Measuring the Rolling Torque

THE CORRECT READING CAN ONLY BE MADE IF THE TORQUE WRENCH IS PULLED SLOWLY (APPROX. 3.5 R.P.M.) AND SMOOTHLY TOWARDS YOU.

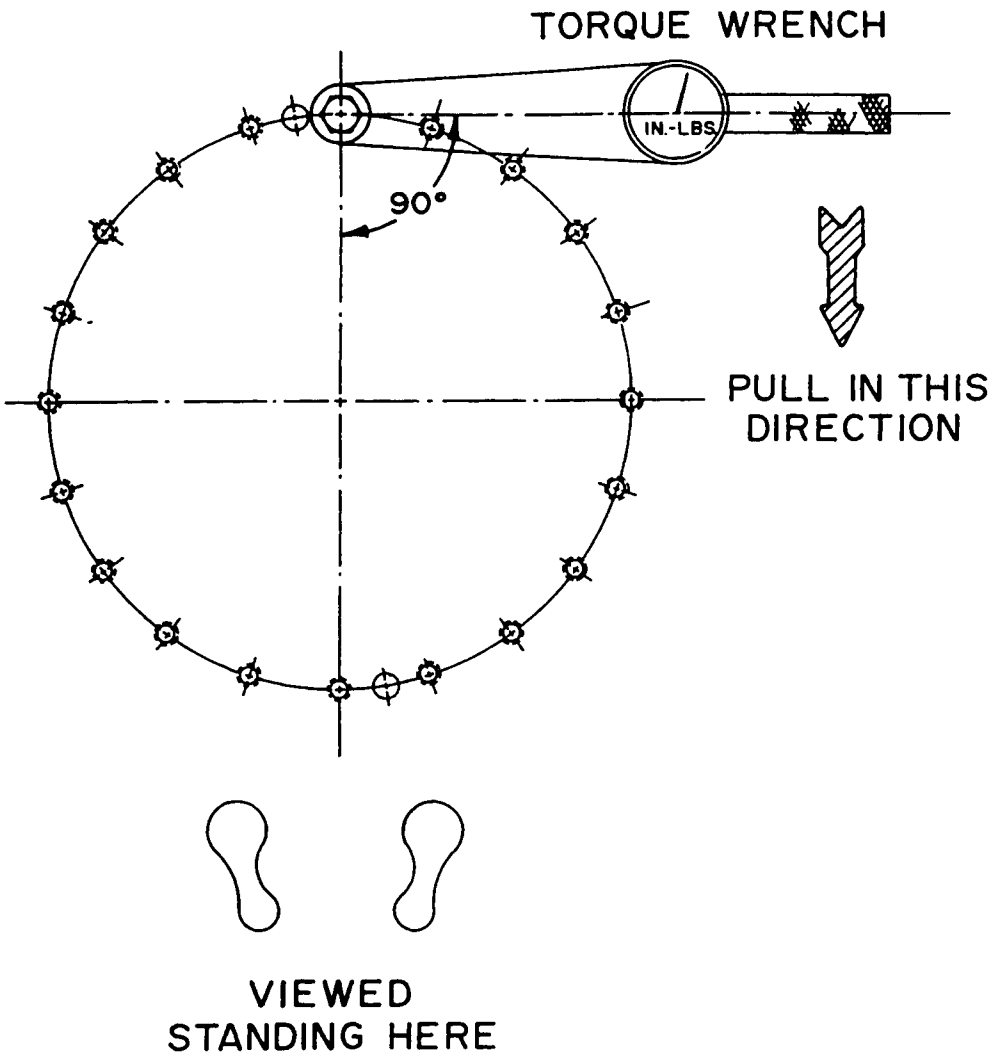
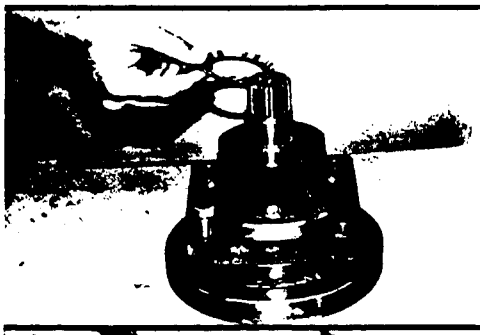


Figure 1

Hub-shaft Sub-assembly



10. Place **lockwasher(1F)** onto **output shaft/carrier(1T)**.

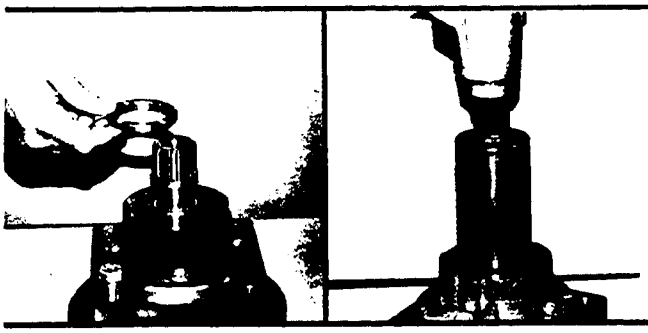


11. Spray **locknut(1E)** and **output shaft/carrier(1T)** with Locquic Primer T. Allow two minutes drying time.



12. Apply Loctite 271 to the second screwthread from the bottom of **locknut(1E)**. The bottom of the locknut has a chamfered or gradually sloped edge.

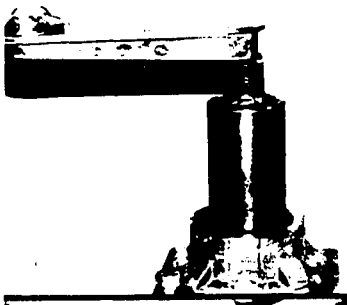
NOTE: Loctite 271 is an anaerobic adhesive. Once it has been removed from contact with air, it sets. Therefore once the locknut has been placed on the output shaft it must be tightened and torqued immediately or the adhesive will make it difficult to turn.



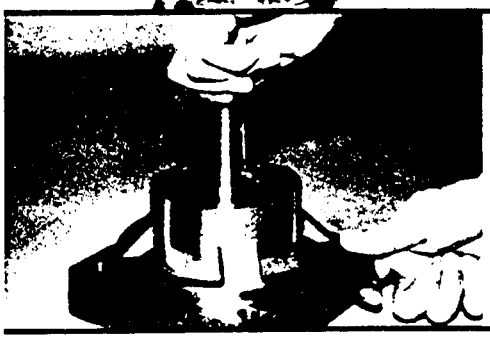
13. Using a locknut wrench (tool no. T-152999), tighten **locknut(1E)** onto **output shaft/carrier(1T)**.

Hub-shaft Sub-assembly

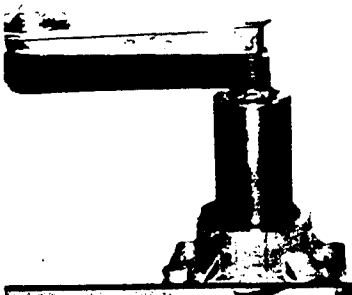
14. Using a torque wrench and locknut wrench T-152999, apply a total of 100 ft.-lbs. of torque to **locknut(1E)** as follows in steps 14a-d.



a. Apply 50 ft.-lbs. of torque to **locknut(1E)**.



b. Rotate **hub(1G)** several times in both clockwise and counterclockwise directions.



c. Continue to torque **locknut(1E)** to 100 ft.-lbs.



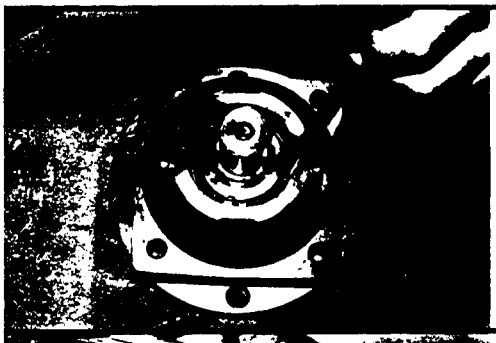
d. Rotate **hub(1G)** several times once again in both clockwise and counterclockwise directions.

Hub-shaft Sub-assembly

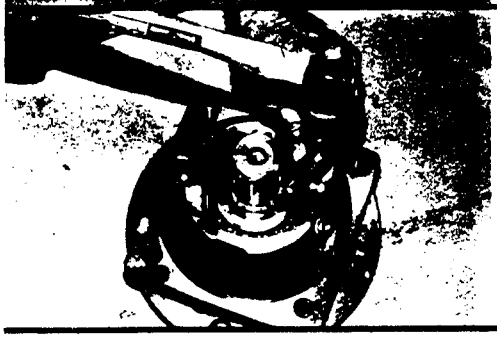
IMPORTANT: One tang on **lockwasher(1F)** must line up with one notch on **locknut(1E)**. If this is not the case, apply sufficient increased torque to **locknut(1E)** until one tang and one notch are aligned. Never loosen the locknut.

15. Measure the final rolling torque of **hub(1G)** using the same method described in steps 9a-d. The final rolling torque should be 10-15 in.-lbs. Remove the bolt from the hub.

IMPORTANT: If the rolling torque is below 10 in.-lbs., a maximum total torque of 125 ft.-lbs. may be applied to **locknut(1E)** in order to increase the rolling torque. If the rolling torque is above 15 in.-lbs., remove **locknut(1E)** using a locknut wrench (tool no. T-152999) and repeat steps 9-15.



16. Bend the aligned tang on **lockwasher(1F)** up into the notch on **locknut(1E)**.

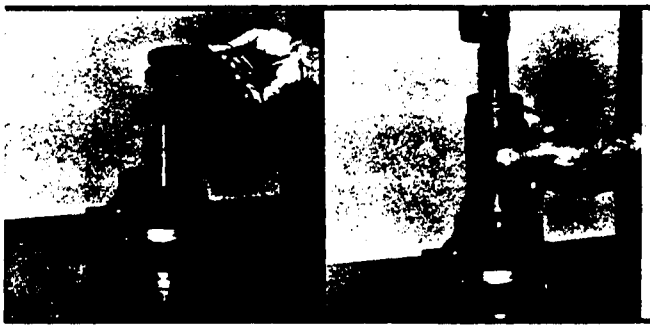


17. Using a center punch and hammer, stake **locknut(1E)** at four equally spaced points around the locknut and at a distance of 1/8 in. from its inside edge.

Hub-shaft Sub-assembly

18. At this point the hub-shaft sub-assembly is complete.

MAIN ASSEMBLY

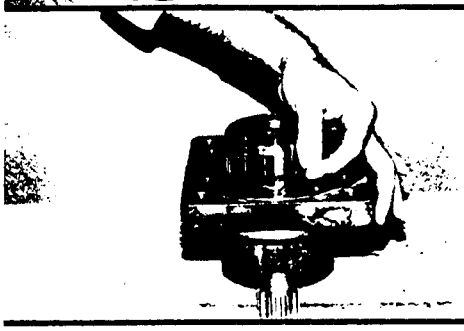


1. Using a seal pressing fixture (tool no. T-144581), press **seal(1B)** into the small diameter end of **hub(1G)**. The closed face of the seal should be up.

2. Turn **hub(1G)** over onto its output shaft.



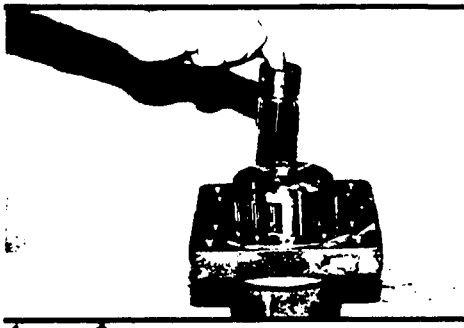
3. Grease **"O" ring(5)**.



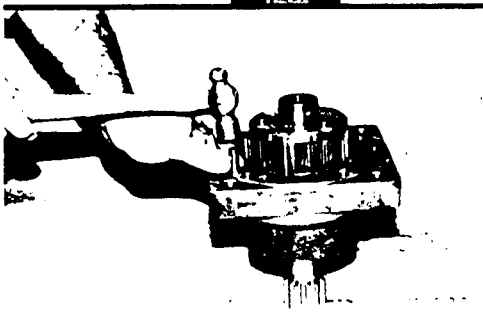
4. Place **"O" ring(5)** into the counterbore of **hub(1G)**.

CAUTION: Beware of sharp edges and burrs around the counterbore when installing the "O" ring.

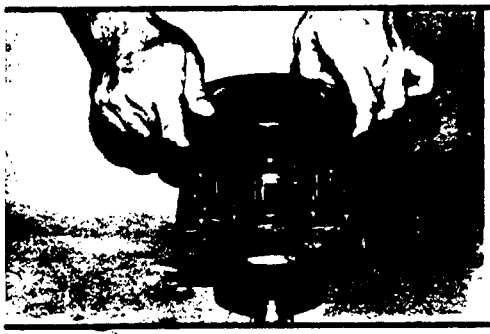
NOTE: "O" rings may be stretched to fit the counterbore. If an "O" ring has been stretched too much simply squeeze the "O" ring together bit by bit as you place it around the counterbore. It can be made to fit exactly.



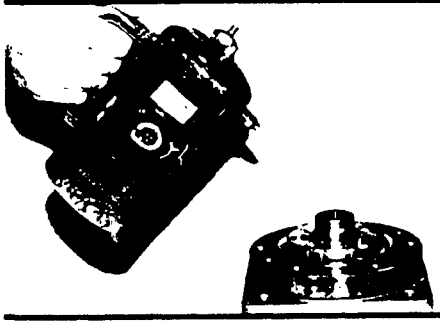
5. Insert **input gear(9)**, with gear teeth down, into mesh with **planet gears(1W)**.



6. Hammer **dowel pins(26)** into the two holes in the bolt circle in **hub(1G)** that do not have threads. The chamfered or sloped end of each dowel pin should be inserted first.



7. Place **ring gear(2)** onto **hub(1G)**. The side of the ring gear marked with an "X" should be toward the hub. Make sure that the two bolt holes on the ring gear without threads are aligned over the **dowel pins(26)**.

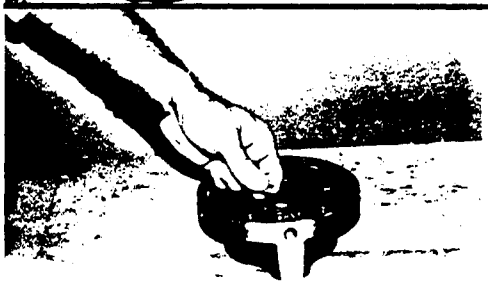


8. Oil all exposed surfaces inside **hub(1G)**.

NOTE: If your unit has a brake instead of a cover, go to the brake assembly procedure on page 26. If your unit does not have a brake continue to step # 9.



9. Grease **"O" ring(5).**



10. Place **"O" ring(5)** into the counterbore in **cover(6).**

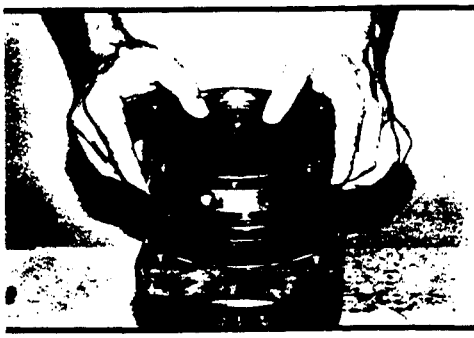
CAUTION: Beware of sharp edges and burrs around the counterbore when installing the "O" ring.

NOTE: "O" rings may be stretched to fit the counterbore. If an "O" ring has been stretched too much simply squeeze the "O" ring together bit by bit as you place it around the counterbore. It can be made to fit exactly.



11. Grease one side of **thrust washer (11)** and place it greased side down into the counterbore in **cover(6).**

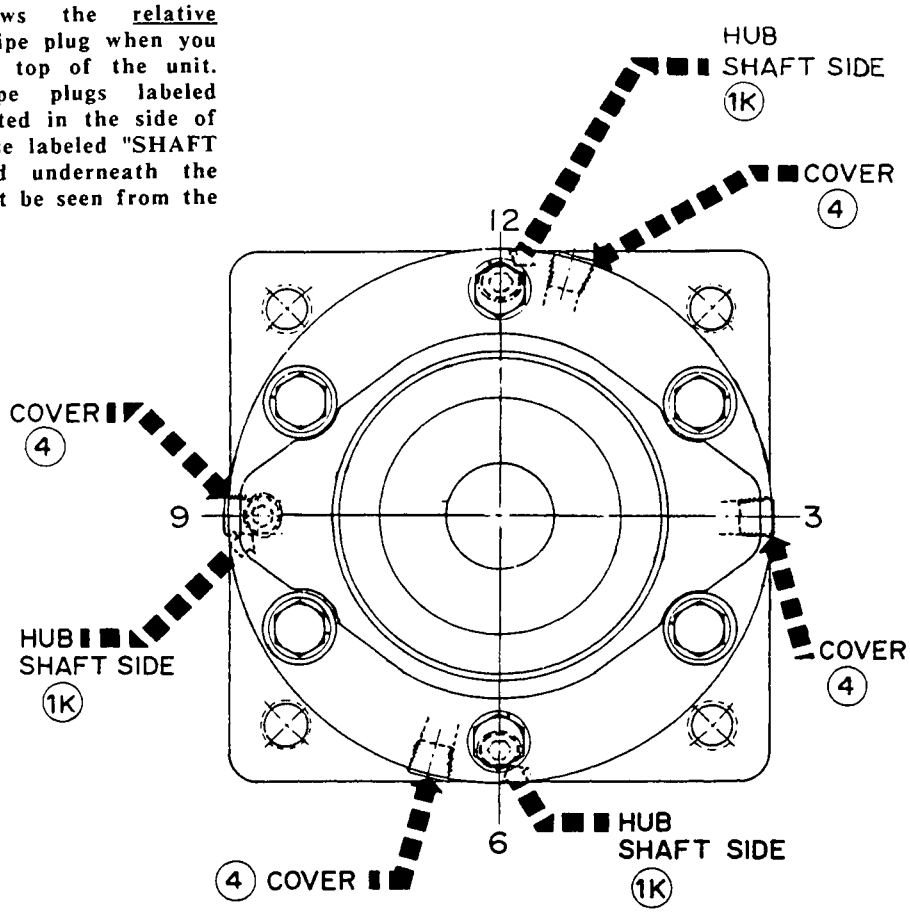
Main Assembly



12. Place cover(6) onto hub(1G). Align the pipe plug holes in cover(6) with those in hub(1G) as shown in figure 2. Make sure the bolt holes in the hub and cover are also aligned.

Pipe Plug Timing

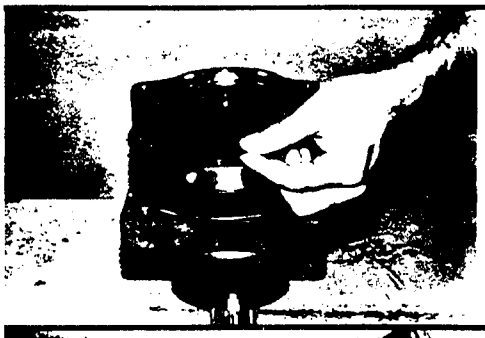
This figure shows the relative location of each pipe plug when you look down at the top of the unit. Actually, the pipe plugs labeled "COVER" are located in the side of the cover and those labeled "SHAFT SIDE" are located underneath the hub, so they cannot be seen from the view presented.



This is the most common pipe plug timing for this series. However, pipe plug timings may vary among units with different model numbers. Refer to an original assembly print of your unit to determine its correct pipe plug timing.

Figure 2

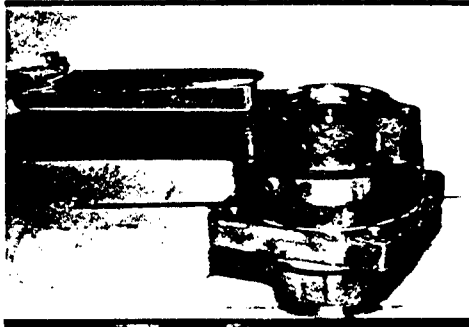
Main Assembly



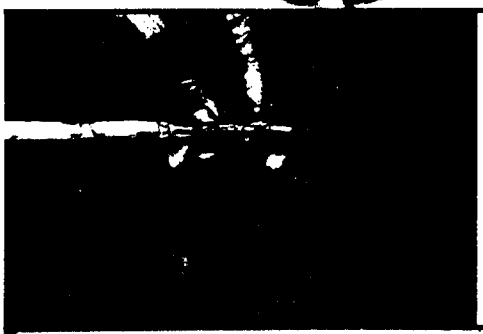
13. Place the six **lock washers(14),** with flat sides down, over the bolt holes in **cover(6).**



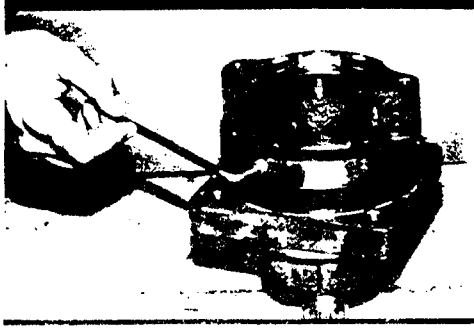
14. Insert the six **bolts(12)** into the bolt holes in **cover(6)** and tighten.



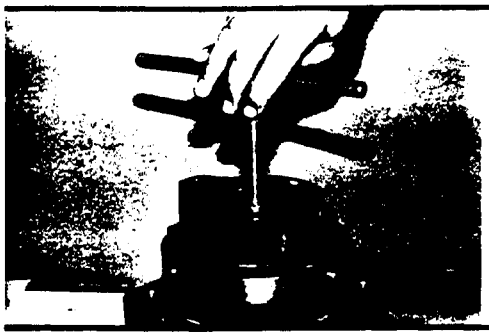
15. Apply 55-70 ft.-lbs. of torque to each bolt.



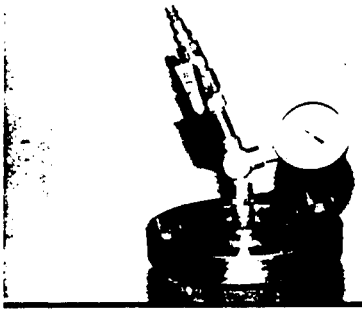
16. Apply a light coat of "never-seize" to the four **pipe plugs(4).**



17. Tighten **pipe plugs(4)** into the four pipe plug holes in **cover(6).**



18. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. This number is the same as the last two digits in the model number found on the ID tag of the unit. For example, if the model number of this unit is S07A33304, then the unit should be rolled four times in each direction.

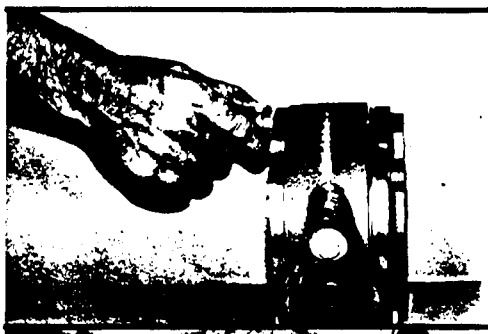


19. Leak test the unit at a pressure of 5 psi for 2-3 minutes.

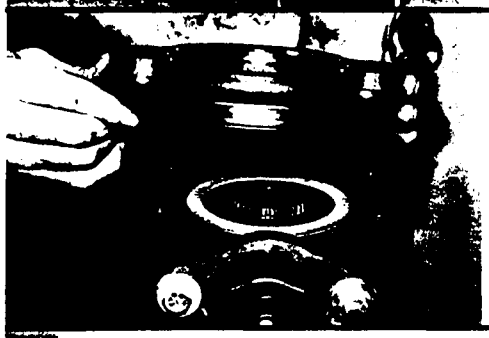
20. At this point the main assembly is complete.

BRAKE ASSEMBLY

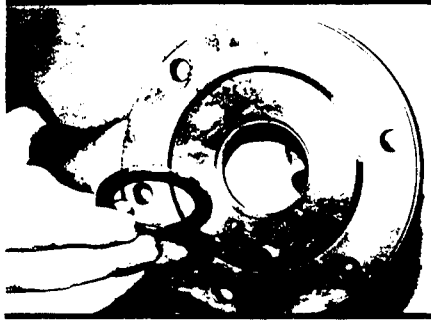
Some applications of the S07A torque-hub unit require a brake to be installed. The following steps tell how to install an assembled brake.



1. Remove the 5 bolts from the cover of **brake(6)** if this has not already been done.

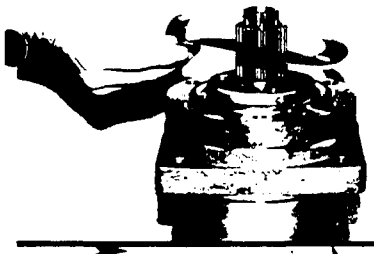


2. Remove the cover from **brake(6)**.



3. Remove the thrust washer from the counterbore in the center of the brake's cover.

Brake Assembly



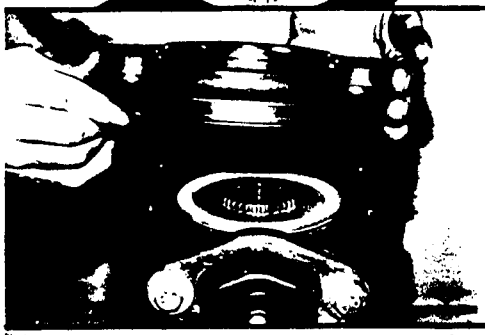
4. Align **gaskit(27)** over the bolt holes in **hub(1G)**.



5. Place **brake(6)**, without its cover, onto **hub(1G)** and align the bolt holes.

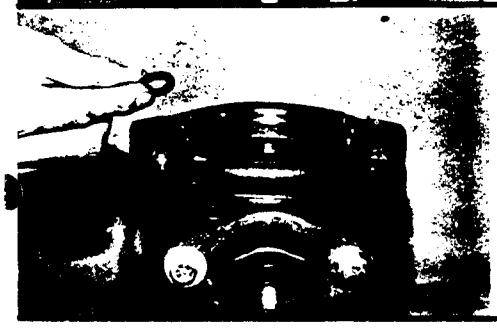


6. Grease one side of the thrust washer that was removed from the cover of **brake(6)** and place it greased side down back into the cover's counterbore.



7. Place the cover onto **brake(6)** and align the pipe plug holes in the hub and cover according to figure 3. Make sure the bolt holes in the hub and cover are aligned.

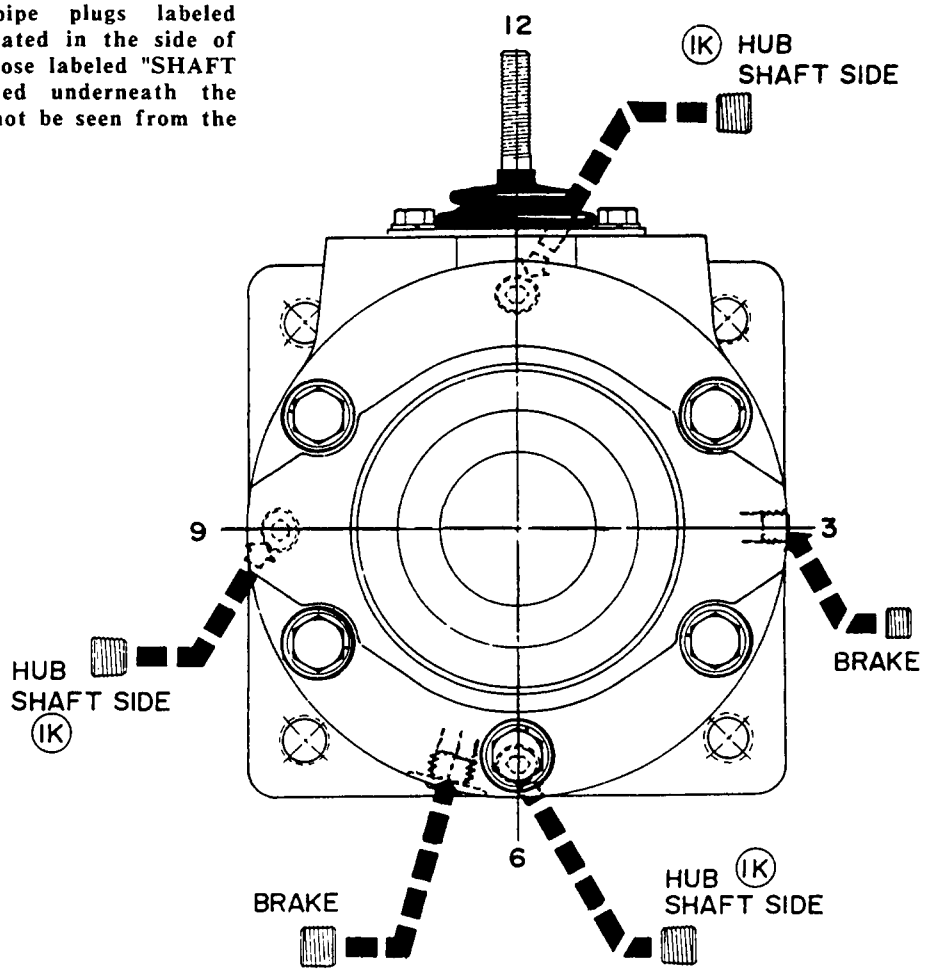
NOTE: Make sure that the gaskit already in the brake that fits underneath the brake's cover is aligned over the bolt holes in the brake before putting the cover on.



8. Place **lock washers(22)**, with flat sides down, over the five bolt holes in the cover of **brake(6)**.

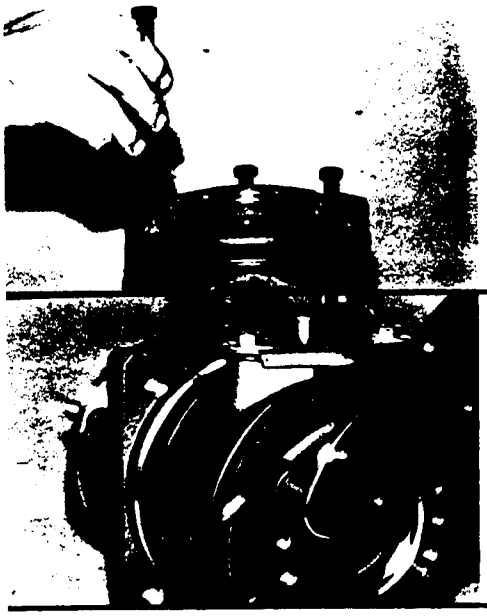
Pipe Plug Timing

This figure shows the relative location of each pipe plug when you look down at the top of the unit. Actually, the pipe plugs labeled "BRAKE" are located in the side of the brake and those labeled "SHAFT SIDE" are located underneath the hub, so they cannot be seen from the view presented.



This is the most common pipe plug timing for this series. However, pipe plug timings may vary among units with different model numbers. Refer to an original assembly print of your unit to determine its correct pipe plug timing.

Figure 3



9. Insert **bolts(21)** into the five bolt holes in the cover of **brake(6)** and tighten.

10. Apply a torque of 55-70 ft.-lbs. to each **bolt(21)**.

11. At this point the brake installation is complete.

TOOLING

The following specialized tools are used in the assembly of this unit. The tool diagrams included in this manual are intended for the customer who may wish to have a tool made. All tools exist as one piece and must be made from mild steel. All dimensions are given in inches.

OPTIONAL: In order to improve tool life, tools may be carborized and hardened. If this is done, however, the tools must be ground on all surfaces labeled with a "G" on the tool diagram.

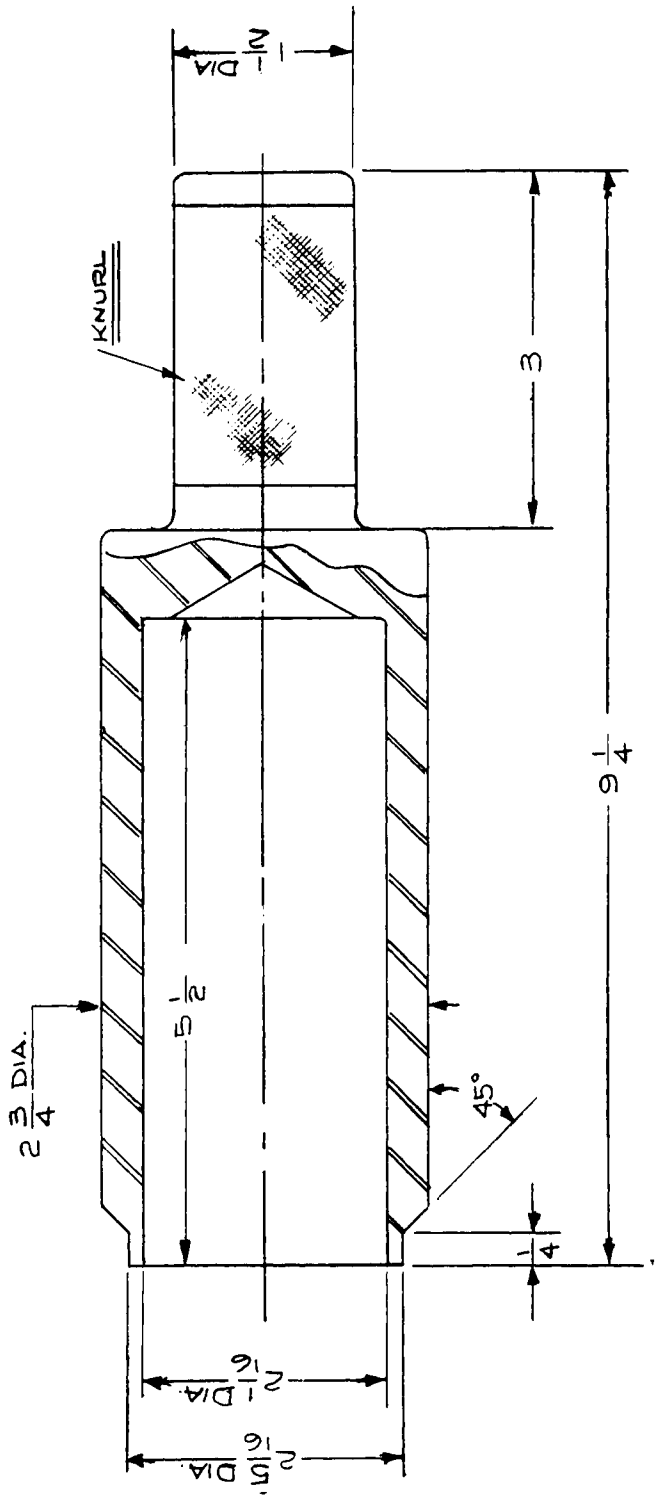
1) TOOL NO. T-148242
   BEARING CONE PRESSING FIXTURE for CONE(1D)

2) TOOL NO. T-139353
   BEARING CUP PRESSING FIXTURE for CUP(1C)

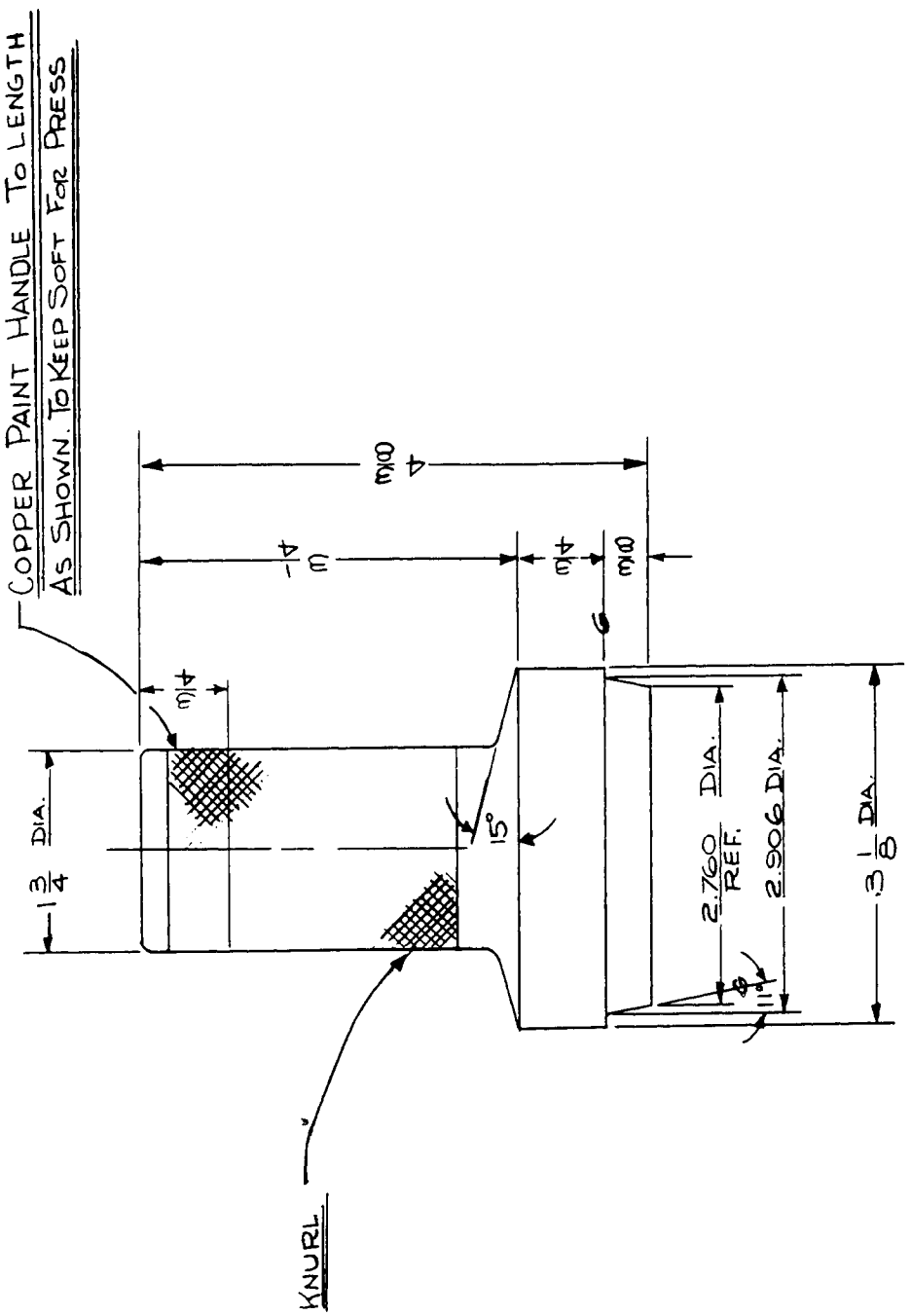
3) TOOL NO. T-152999
   LOCKNUT WRENCH for LOCKNUT(1E)

4) TOOL NO. T-144581
   SEAL PRESSING FIXTURE for SEAL(1B)

5) TOOL NO. T-152878
   SEAL SLEAVE PRESSING FIXTURE for SEAL SLEAVE(10)

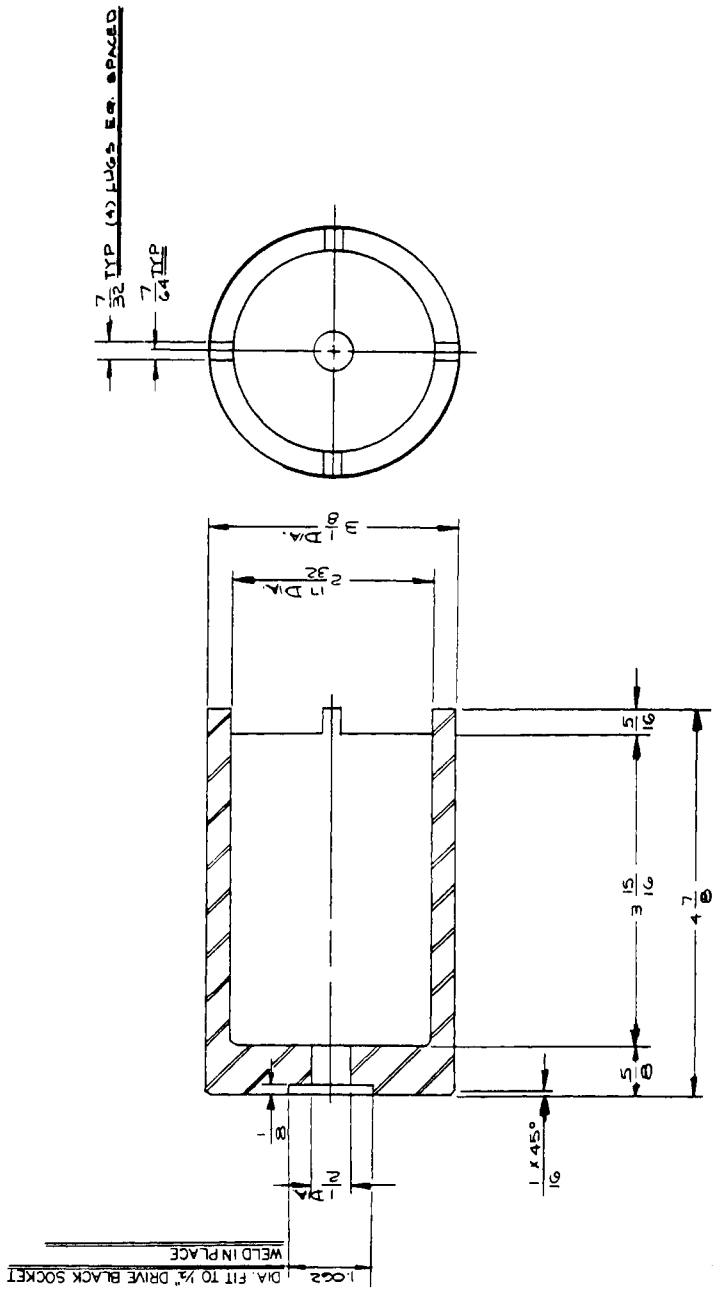


TOOL NO. T-148242
BEARING CONE PRESSING FIXTURE for CONE(1D)

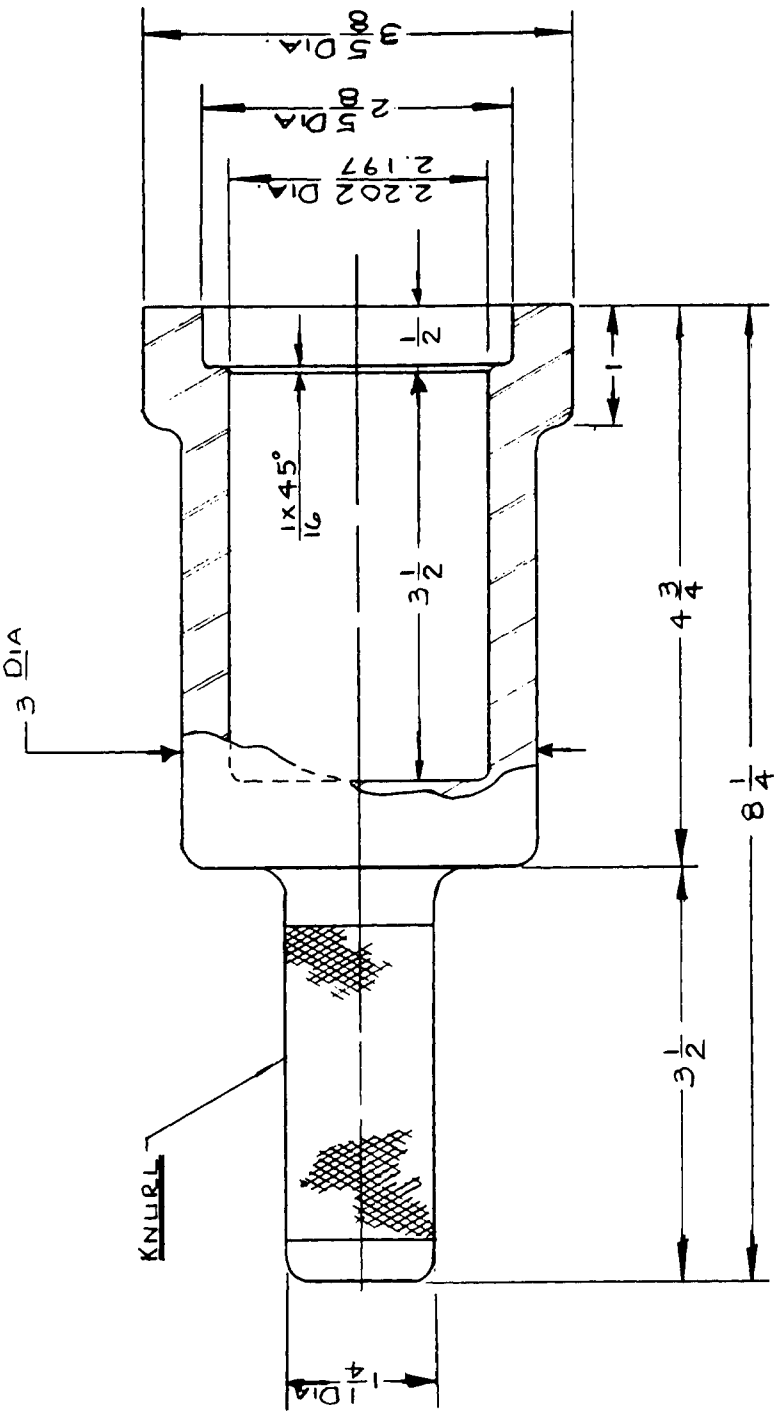


TOOL NO. T-139353
BEARING CUP PRESSING FIXTURE for CUP(1C)

USE A 1/2" DRIVE BLACK SOCKET

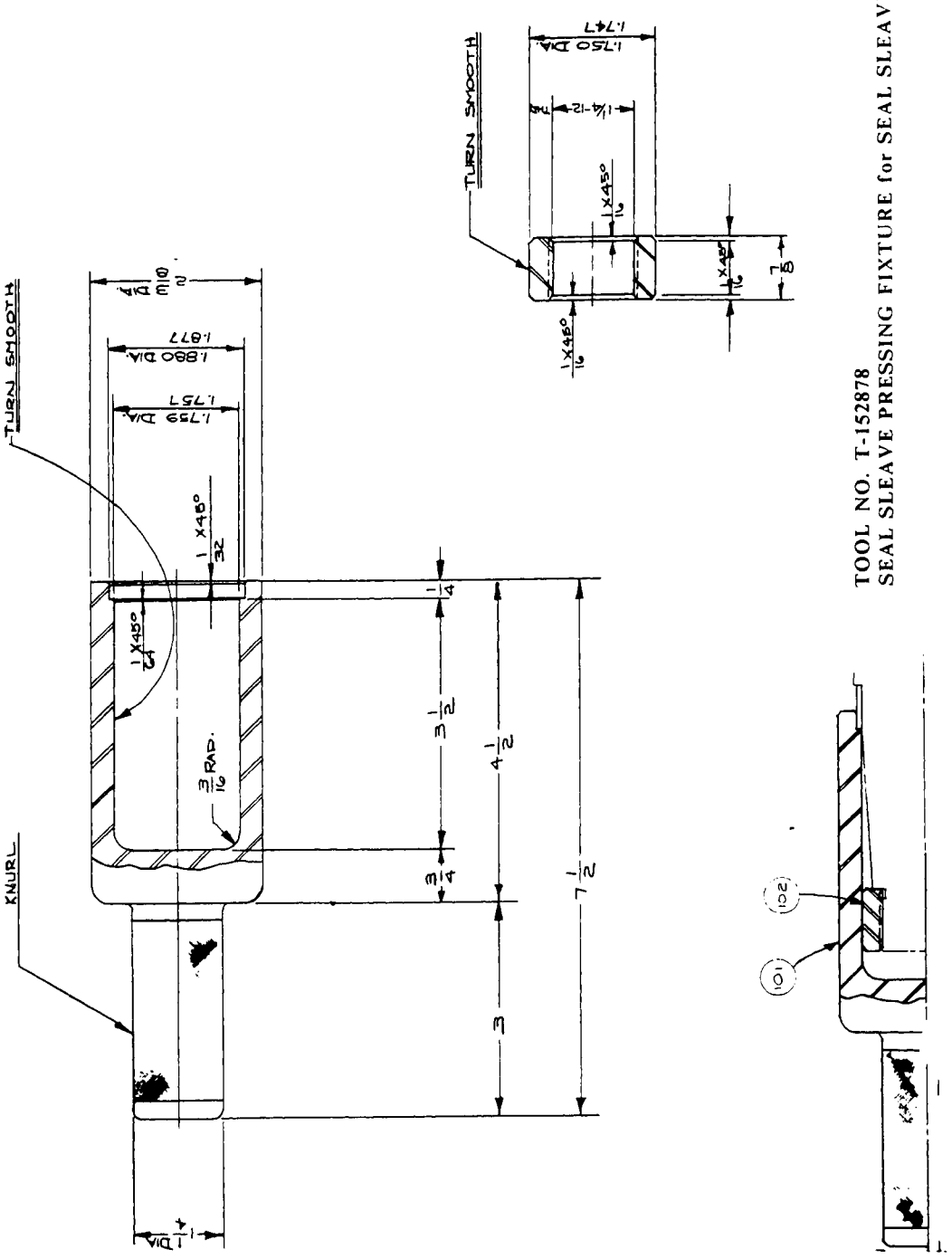


TOOL NO. T-152999
LOCKNUT WRENCH for LOCKNUT(1E)



TOOL NO. T-144581
SEAL PRESSING FIXTURE for SEAL(1B)

TOOL NO. T-152878
SEAL SLEAVE PRESSING FIXTURE for SEAL SLEAVE(10)



REV.

PARTS LIST

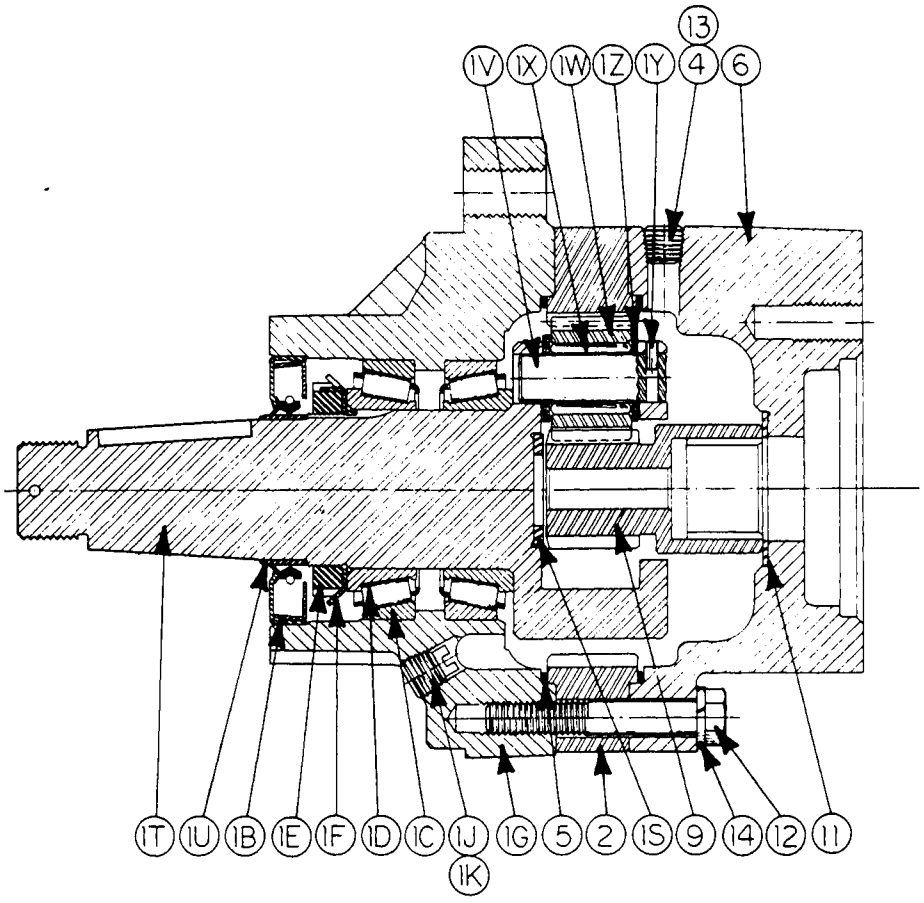
ITEM	QUANTITY	DESCRIPTION
1	1	hub-shaft sub-assembly
1B	1	seal
1C	2	bearing cup
1D	2	bearing cone
1E	1	locknut
1F	1	lockwasher
1G	1	hub
1K	3	magnetic pipe plug
1R	1	output shaft sub-assembly
1S	1	thrust washer
1T	1	output shaft/carrier
1V	3	planet shaft
1W	3	planet gear
1X	57	needle roller
1Y	3	spring pin
1Z	12	thrust washer

ADDITIONAL PARTS FOR UNITS WITHOUT A BRAKE

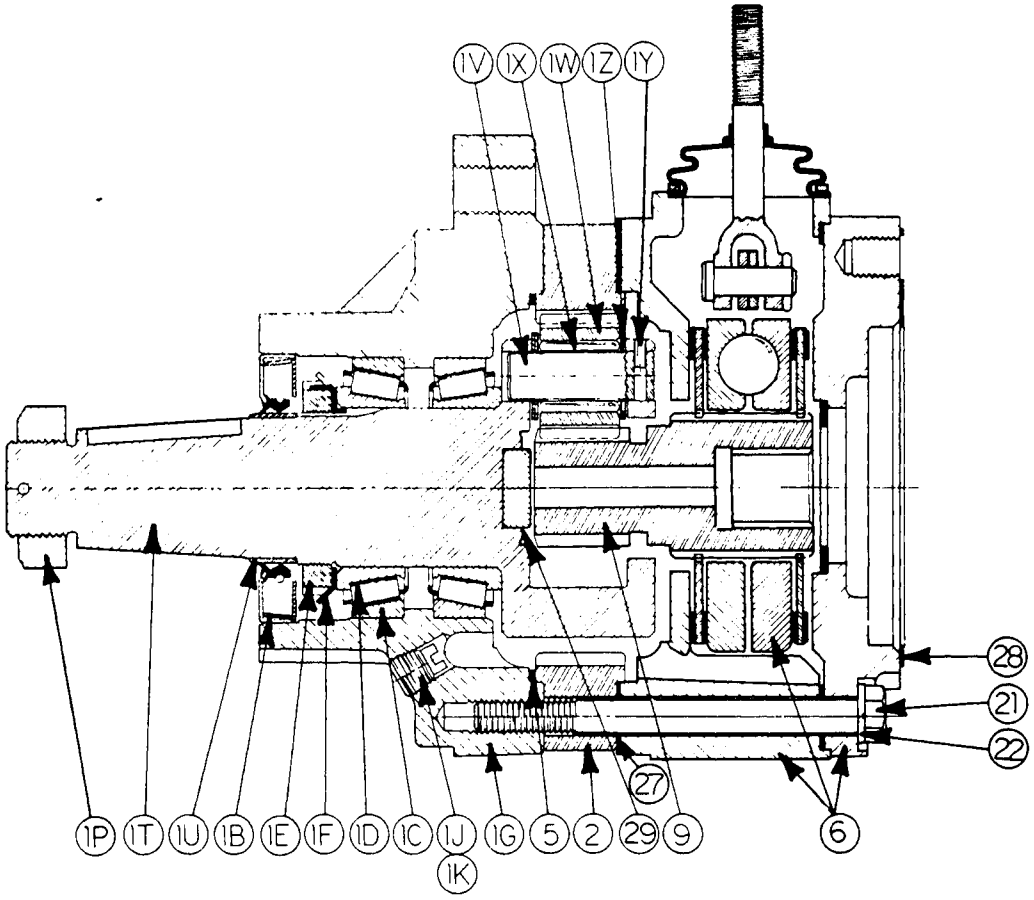
2	1	ring gear
4	4	pipe plug
5	2	"O" ring
6	1	cover
9	1	input gear
11	1	thrust washer
12	6	bolt
14	6	lock washer
24	1	ID plate
25	4	drive screw
26	2	dowel pin

ADDITIONAL PARTS FOR UNITS WITH A BRAKE

2	1	ring gear
5	1	"O" ring
6	1	brake
9	1	input gear
21	5	bolt
22	5	lock washer
24	1	ID plate
25	4	drive screw
26	2	dowel pin
27	1	gasket
29	1	thrust spacer



CROSS-SECTIONAL VIEW of SO7A WITHOUT BRAKE



CROSS-SECTIONAL VIEW of S07A WITH BRAKE

LESTRONIC II BATTERY CHARGER(S)

OPERATING INSTRUCTIONS

1. CONNECT POWER SUPPLY CORD TO PROPERLY GROUNDED OUTLET OF THE PROPER VOLTAGE AND FREQUENCY AS SPECIFIED ON THE CHARGER NAMEPLATE. CIRCUIT BREAKER OR FUSE PROTECTION IN THE AC LINE MUST BE ADEQUATE TO HANDLE THE INPUT POWER REQUIREMENTS. WHEN IT IS NECESSARY TO USE AN AC EXTENSION CORD TO THE CHARGER USE A THREE CONDUCTOR, 12 GAUGE CORD WITH GROUND AND KEEP AS SHORT AS POSSIBLE.

   IF DC OUTPUT CORD IS CONNECTED TO BATTERIES, CHARGER WILL AUTOMATICALLY TURN "ON" AFTER A SHORT DELAY.

2. CONNECT DC OUTPUT CORD TO BATTERIES (IF NOT ALREADY CONNECTED).

3. MONITOR AMMETER FOR CORRECT CHARGE RATE. NORMAL CHARGING AT THE FINISH CHARGE RATE FOR THE LAST 3 TO 5 HOURS IS IMPORTANT TO ACHIEVE EQUALIZATION OF ALL BATTERY CELLS EVERY TIME THE BATTERIES ARE CHARGED. NEW BATTERIES OR BATTERIES CHARGED IN COLD TEMPERATURES (BELOW 50 DEGREES F) WILL REQUIRE MORE TIME TO ACHIEVE FULL CHARGE.

4. CHARGER TURNS "OFF" AUTOMATICALLY WHEN BATTERIES ARE FULLY CHARGED.

CAUTION

DO NOT LEAVE CHARGER "ON" WHILE UNATTENDED FOR MORE THAN TWO CONSECUTIVE DAYS. SEVERE OVERCHARGING AND POSSIBLE DAMAGE TO BATTERIES WILL RESULT IF CHARGER SHOULD FAIL TO TURN "OFF".

MANUAL BATTERY CHARGER OPERATION

INTRODUCTION

The Lester-Matic battery charger is a highly reliable, line compensating unit. When used according to instructions, the Lester-Matic will tend to lengthen battery life with less frequent additions of water.

INITIAL INSTALLATION

Provide adequate circuit breaker or fuse protection in the AC line to which the charger is to be plugged. Refer to electrical specifications on charger nameplate for input power requirements. When it is necessary to use an AC extension cord to the charger, use a three conductor No. 12 AWG cord with ground, and keep as short as possible. Instructions printed on the charger case are for daily reference.

NORMAL OPERATION

1. Provide adequate ventilation for both batteries and charger. The convection-cooled design requires an unobstructed flow of cooling air for proper operation.

2. Connect charger DC output cord to batteries.

3. Turn timer to "ON" for well discharged batteries or to "7" for lightly discharged batteries. Charger shuts off automatically at end of set period.

The state of discharge of the batteries will be slightly different each time they are put on charge, but the Lester-Matic varies automatically the initial charge rate, and taper of charge rate over the charge period. For well discharged batteries the charge rate at the start of the charge period should correspond to the "DC AMPS" rating on the charger nameplate. The rate should then taper gradually down to a lower finish rate. Normal charging at the low finish rate during the last 1-3 hours is necessary to achieve equalization of all battery cells. This equalization period allows the specific gravity of the battery electrolyte solution to rise to its full charge value. Since the taper of the charging rate (in amps, as indicated by the ammeter needle) is controlled by the rising voltage of the batteries being charged, proper performance of the charger and resulting good battery life is dependent upon the following factors:

a. An adequate AC line to handle the power required.

b. All cells of the batteries must be good, rising to approximately 2.5 DC volts per cell while still on charge or near the end of a charging period. When in doubt, check each cell with a single cell volt-meter while still on charge. If a low reading is obtained, check the low cells with a temperature corrected hydrometer. NOTE: Hydrometer float must be thoroughly clean to obtain accurate specific gravity readings.

c. Connections on the battery terminals and connector wiring must be clean and tight.

The necessity of adding water more frequently than two or three weeks, and/or hot battery cases at the end of the charging cycle, indicates the finish rate is

NORMAL OPERATION (CONTINUED)

too high, due to one or both of the following:

a. One or more bad cells in the batteries.

b. Batteries are starting to age to the point where hours of charge should be reduced gradually to obtain prolonged battery life.

4. To determine approximate full charge at start of day's use, turn timer knob to "1". Drop of ammeter needle to the low finish rate within 15 minutes indicates full charge.

5. Always turn timer to "OFF" before disconnection charger from batteries.

STORAGE

Charger may be left connected to the batteries and should be turned on for a full charge period once a month. In extremely cold conditions it may be necessary to charge more frequently. Check with your battery manufacturer. After each charge cycle the charger should be checked to insure that it has turned off. Severe overcharging and possible damage to the batteries could result if the charger remains on for prolonged periods of time.

CAUTION

THIS CHARGER IS FOR USE ONLY ON BATTERY SYSTEMS AS SPECIFIED ON THE CHARGER NAMEPLATE. USE OTHERWISE WILL DAMAGE CHARGER AND/OR BATTERIES.

Due to the electrical characteristics of this charger, it is possible to improperly hook up batteries and not blow the fuses when charging. When installing batteries, be sure polarity is correct. With a DC voltmeter, check terminal voltage and polarity at the battery connector.

When working near capacitor terminals be sure charger is turned off. With charger "on" transformer capacitor terminals provide a very high voltage. Care is to be shown.

MALFUNCTION SYMPTOMS AND THEIR REMEDIES

The Lester-Matic charger is designed with as few parts as possible making it a very reliable unit. Since each component can be tested individually, trouble shooting is a simple task. The following is a list of symptoms with their associated test procedures and remedies.

NO TRANSFORMER HUM AND AMMETER DOES NOT REGISTER

In the event no hum is detected from the transformer, check the AC cord to be sure it is securely plugged into a live AC outlet. When three-prong or two-prong adapters are used, they tend to work loose giving a poor connection. If the cord connection is secure and still no hum is noticed, a continuity test of the AC circuit is necessary. Turn the timer to "ON" and with a suitable continuity tester, check circuit across the AC plug prongs. CIRCUIT SHOULD BE COMPLETE. If not complete, individually check the AC cord, timer, primary transformer coil, and all connections.

TRANSFORMER HUMS BUT NO AMMETER INDICATION

Inspect the charger DC output connection to the batteries and also check to insure that the batteries are connected properly. If there is still no ammeter indication, a continuity test of the charger DC circuit must be performed. Turn the timer to "OFF" and disconnect the A.C. and D.C. plugs. Perform the following tests, using a low voltage test light, to check the continuity of the DC circuit.

(a) Connect tester clip to negative (-) blade and probe to positive (+) blade. CIRCUIT SHOULD BE COMPLETE. If not complete, first check the DC fuse link. If one or both fuses have blown, the link will be broken and usually the clear plastic fuse cover will be discolored. Refer to "Fuse Link Blowing" for test procedures. If fuses are good, individually check the fuse connections, DC cord, and diode connections (each may be checked with the continuity test light).

(b) If the circuit in (a) is complete, reverse test light leads. CIRCUIT SHOULD NOT BE COMPLETE. If circuit is complete, check DC cord for a "short" between the two wires. More probably, one or both diodes have "shorted". Refer to "Fuse Link Blowing" part (b) for continuity test of diodes.

(c) If (a) and (b) check good, assume the capacitor is shorted. Remove one wire from a capacitor terminal and place continuity tester clip to one terminal and probe to other. If circuit is complete, capacitor is "shorted" and must be replaced.

CHARGER DC FUSE LINK(S) BLOWS

This condition may be caused by:

(a) Reverse polarity between charger and batteries, such as incorrect installation of batteries, wiring of DC connector or charger plug.

(b) A short circuit failure of one or both diodes. First disconnect one diode. Using a low voltage continuity tester check each diode. Then reverse the tester leads and check each diode again. If the diode conducts current in both directions the diode is shorted and must be replaced. Replace either the entire heat-sink assembly or the defective diode. When replacing a single diode be sure the new diode is pressed squarely into the hole and that it does not extend beyond the rear surface of the heat sink plate.

(c) If (a) and (b) fail to reveal the malfunction, check wiring of both charger and battery connections against their respective wiring diagrams. The charger wiring diagram is shown on the enclosed sheet along with the parts list.

CHARGER OUTPUT IS LOW

The most probable cause is one diode shorting and blowing one fuse. Refer to "Fuse Link Blowing" part (b) to check the diodes. If a diode is shorted, both the defective diode/heat sink and the defective fuse assembly must be replaced.

CHARGER DOES NOT TURN OFF

In models equipped with timers, this is due to an inoperative timer. In this case replace timer assembly.

AC LINE FUSE OR CIRCUIT BREAKER BLOWS

If this occurs when charger is turned on without being plugged into the vehicle, the AC cord, timer motor coil, or the transformer may be shorted. To check the AC cord, insure that the timer is "OFF" and connect the continuity tester across the AC plug prongs. If circuit is complete the LAC cord is shorted and must be replaced. To check the timer motor coil, disconnect one of the timer motor wires and connect continuity tester to the motor coil leads. If the lamp glows, the coil is shorted. To test the transformer, first disconnect all the secondary leads to the diodes. Then reconnect the AC cord and turn timer "ON". If the AC fuse or circuit breaker still blows, the transformer is probably shorted internally and must be replaced.

PROPER CARE OF MOTIVE POWER BATTERIES

1. New batteries should be given a full charge before their first use because it is difficult to know how long the batteries have been in storage without a charge.

2. Limit use of new batteries between charges for the first 5 cycles. New batteries and older batteries which have been in storage are not capable of their rated output until they have been discharged and charged a number of times.

3. During the first month of use, particularly when temperatures are below 60°F, new batteries should be given an extra full charge once a week. The ampere-hours of energy that batteries can deliver and their charge acceptance varies directly with battery temperature.

4. As long as the charger tapers down to the specified finish charge rate near the end of the charge cycle, the batteries should be given a full charge. All cells in a set of batteries do not react identically to the same discharge and charge current. In a normal charge, the last 1 to 3 hours at the low finish charge rate equalize the cells for better battery life.

5. When batteries age to the point where the charge rate will no longer taper into the low finish rate area, reduce the hours of charge progressively. Reducing the charge period will prevent excessive battery heating and the resultant high water use rate.

6. Prior to each day's use, turn the charger on and check to see if charger ammeter needle jumps smartly upward and then tapers down to the finish rate area within 15 minutes. This will provide a very simple means of verifying that the batteries were charged.

7. Add water carefully to the proper level in cells as required after they have beenfully charged. Do not fill them so high that they bubble over while charging. New batteries require very little addition of water, whereas very old batteries may need additional water two or three times a week. Water (electrolyte) level in the cells settles when batteries are discharged and rises during charge. The probability of overfilling can be reduced by adding water when batteries are fully charged.

8. When the temperature falls below 65°F, batteries should be placed on charge as soon after use as possible. In these low temperatures a 4 hour equalizing charge once a week will improve state of charge and battery life.

9. Keep tops of batteries and battery hold-downs clean and dry at all times. This will reduce the amount of current leakage between batteries and the frame.

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