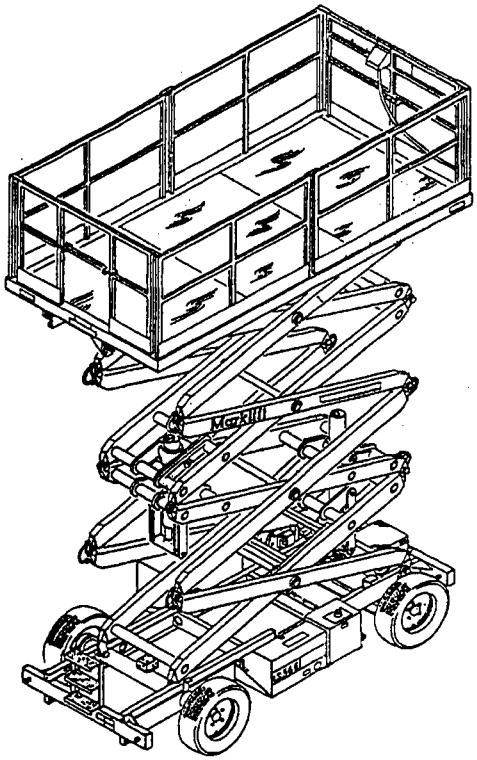
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED SCISSOR OPERATION MAINTENANCE AND PARTS MANUAL



Model
LS36E
Shown

Models: LS30E & LS36E

FIRST EDITION: September 1989

Mark Industries

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17221

Mark Industries

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Mark Industries

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INTRODUCTION

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 dealer. If this is impossible, please contact the Mark Industries Service Department at (714) 879-6275 ext. 362.

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 model capacity, pressure settings and serial number can be found on the ID plate mounted on the rear of the frame assembly.

The serial number should be used when ordering parts. This will help our parts department give 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.

Description	Model	
	LS 30 E	LS 36 E
Height –		
Working (maximum)	36' (10.97m)	42' (12.80m)
Platform (maximum)	30' (9.14m)	36' (10.97m)
Platform (minimum)	50" (1.27m)	56.5" (1.44m)
Length (overall)	146" (3.71m)	146" (3.71m)
Width (overall)	72" (1.83m)	72" (1.83m)
Platform –		
Dimenions (inside)	66"x142"	66"x142"
	(1.68m x 3.61m)	(1.68m x 3.61m)
Safety Rail Height	42" (1.06m)	42" (1.06m)
Toeplate Height	6" (.15m)	6" (.15m)
Load Capacity (evenly distributed)	1500 lbs. (680 kg)	1000 lbs. (454 kg)
Wheel Base	93" (2.36m)	93" (2.36m)
Wheel Track	63" (1.60m)	63" (1.60m)
Turning Radius (inside)	13' (3.96m)	13' (3.96m)
Drive speed — Creep	0.5 mph (8 km/hr)	0.5 mph (.8 km/hr)
Low	1.5 mph (2.4 km/hr)	1.5 mph (2.4 km/hr)
High	2.5 mph (4.1 km/hr)	2.5 mph (4.1 km/hr)
High Speed cut-out	12' (3.66m)	12' (3.66m)
Lift/Lower Speed (maximum load)	71/30 sec.	73/39 sec.
Power System	24 VDC	24 VDC
Battery Voltage	6 VDC	6 VDC
Capacities		
Battery	375 amp/hr (4)	375 amp/hr (4)
Hydraulic Tank	10 gal (37.85l)	10 gal (37.85l)
Battery Charger	40 amp	40 amp
Tire Size (Monofilled)	P235/60R14	P235/60R14
Shipping Weight	5800 lbs. (2631 kg)	6860 lbs. (3112 kg)
Shipping cube	378 cu. ft.	409 cu. ft.
	(10.70 m^3)	(11.50 m^3)

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. 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.

Mark Industries

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

WARRANTY REGISTRATION

Purchaser

Company Name

Address

Telephone

Date shipment received

Date of invoice

Date unit put into service

Unit will be used

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.

REV.

SCISSOR LIFT 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 (Items 1, 17, 26).

		YES	NO
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.	Electrical schematic received	☐	☐
6.	All controls (aerial & ground) are identified and operate correctly	☐	☐
7.	Stop switches operate properly (aerial & ground)	☐	☐
8.	Platform guard rails, secure and undamaged	☐	☐
9.	Platform access gate works properly	☐	☐
10.	Horn and beacon operate properly (optional)	☐	☐
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 level _____.	☐	☐
18.	Hydraulic tank and fittings free of leaks	☐	☐
19.	Drive motors free of leaks	☐	☐
20.	Battery water level	☐	☐
21.	Coolant hoses and fittings free of leaks	☐	☐
22.	Manual overrides operate properly	☐	☐
23.	All electrical connections tight	☐	☐
24.	Hydraulic manifold valve and fittings free of leaks	☐	☐
25.	110V generator operates properly (optional)	☐	☐
26.	Wheel lug nuts torqued to _____. lbs	☐	☐

MODEL	SERIAL NUMBER
INSPECTOR	OPTIONS

The MARKLIFT conforms to applicable ANSI and OSHA requirements. 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 person 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. **Do Not** change, vary, or alter the equipment in any way.

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

9. **Do Not** store loose material in the work platform such as pipe, rope, extension cords, wire or miscellaneous boxes. If it is 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.

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

11. The **MARKLIFT** is a non-insulated personnel carrier and must not be operated within 10 feet of a 50,000 volt line. (See Division Of Industrial Safety for required clearances from overhead high voltage lines.)

12. Under no circumstances should horse play be tolerated on the **MARKLIFT.**

13. **Do Not** drive on uneven, sloping or soft terrain that sets the unit in an out-of-level condition of more than 6 degrees fore and aft, or 3 degrees side to side.

14. **Do Not** drive the platform into objects.

15. **Do Not** lean over platform guard railings to perform work.

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

17. **Do Not** raise or lower platform into objects.

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

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

20. When a machine is not in use, remove the key from the ground control panel to prevent unauthorized use.

21. When working under the elevated platform, always remember to raise the **Safety Support Arm** to prevent accidental platform descent.

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 of 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."**

DANGER, EMERGENCY, WARNING 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** can be replaced if the existing decal(s) is worn-out, torn, or illegible.

LOAD CAPACITY 1000 LBS.
(EVENLY DISTRIBUTED LOAD) 2024

LS36E

LOAD CAPACITY 1500 LBS.
(EVENLY DISTRIBUTED LOAD) 2026

LS30E

CAUTION
MONOFILLED TIRES ONLY
CAUTION 2175

DO NOT LIFT
FROM THIS END
3041

CAUTION UNLAWFUL TO OPERATE THIS EQUIPMENT WITHIN 10 FEET OF HIGH VOLTAGE LINES CAUTION
2014

GUARD RAILS ARE FOR YOUR SAFETY
CAUTION DO NOT REMOVE CAUTION
OPERATING THIS MACHINE WITHOUT GUARD RAILS COULD RESULT IN DEATH OR SERIOUS INJURY
21180

WARNING: LIGHT INDICATES UNSTABLE CONDITION ◯ PLATFORM WILL LOWER AUTOMATICALLY
215

WARNING

DO NOT WORK UNDERNEATH THIS LIFT

UNLESS IT IS MECHANICALLY LOCKED.

SEE SERVICE MANUAL FOR LOCATION AND USE OFMECHANICAL LOCKS
2016

GENERAL DECALS
LS 30 E

DECAL P/N	DECAL DESCRIPTION LS 30 E	LOCATION	QTY
67673	Decal Set	All Standard Decals	1
30310	Switch	Final Assy	1
32518	Power On/Off	Final Assy	1
2008	Control Box	Final Assy	1
2015	Warning - Unstable Condition	Final Assy	1
2014	Caution - High Voltage Lines	Final Assy	1
31260	Marklift (Scissor Machine)	Final Assy	2
2003	Battery Water Level	Final Assy	1
2005	Battery Charger Plug	Final Assy	1
182102	Operation Instructions	Final Assy	1
20661	Plate ANSI A92	Final Assy	1
2026	Load Capacity 1500 lbs.	Final Assy	4
2041	Do Not Lift This End	Final Assy	2
20660	Nameplate, I.D.	Final Assy	1
2017	Hydraulic System Fluid	Final Assy	2
2016	Do Not Work Under...	Final Assy	2
2019	Emergency Lowering Valve	Final Assy	1
130596	'A Product of Mark Industries'	Final Assy	2
130606	Freewheeling Valve	Final Assy	1
130820	Operation & Safety Handbook	Final Assy	1
31109	Caution Scissor Guard Rails	Final Assy	1
30520	Nameplate - Patent Numbers (Scissors)	Final Assy	1
160137	Tape Warning (Final Assy)	Final Assy	1
181728	Panel Strip (Final Assy)	Final Assy	2
181737	LS 30 E	Final Assy	2
32588	Circuit Breaker	Final Assy	1
32589	110 VAC	Final Assy	1
22175	Monofilled tires	Final Assy	4

GENERAL DECALS
LS 36 E

DECAL P/N	DECAL DESCRIPTION LS36E	LOCATION	QTY
67668	Decal Set	All Standard Decals	1
30310	Switch	Final Assembly	1
32518`	Power On/Off	Final Assembly	1
2008	Control Box	Final Assembly	1
2015	Warning—Unstable Condition	Final Assembly	1
2014	Caution High Voltage Lines	Final Assembly	1
130606	Freewheeling Valve	Final Assembly	1
130596	A Product of Mark Industries	Final Assembly	2
2017	Hydraulic System Fluid	Final Assembly	2
2024	Load Capacity 1000 lbs.	Final Assembly	4
31260	Marklift (Scissors)	Final Assembly	2
2041	Do Not Lift This End	Final Assembly	2
2019	Emergency Lowering Valve	Final Assembly	1
2005	Battery Charger Plug	Final Assembly	1
20661	Plate, ANSI A92	Final Assembly	1
20660	Nameplate, I.D.	Final Assembly	1
2003	Battery Water Level	Final Assembly	1
2016	Do Not Work Under	Final Assembly	2
182102	Operation Instructions	Final Assembly	1
130820	Operation & Safety Handbook	Final Assembly	1
30520	Nameplate - Patent Numbers (Scissors)	Final Assembly	1
31109	Caution Scissor Guard Rails	Final Assembly	1
32588	Circuit Breaker	Final Assembly	1
32589	110 VAC	Final Assembly	2
160137	Tape Warning	Final Assembly	1
181728	Panel Strip	Final Assembly	2
181739	LS 36 E	Final Assembly	2
22175	Monofilled tires	Final Assy	4

UNLOADING

Before unloading the **MARKLIFT**, inspect it for any physical damage. Note any damage on the freight bill and report it to the carrier.

FREEWHEELING

The **MARKLIFT** may be freewheeled for loading, unloading and towing for a very short distance (maximum of one (1) mile), at a speed no greater than five (5) mph. (See illustration on the following page.)

> **Make sure the unit is on a level surface before attempting to freewheel the MARKLIFT.**

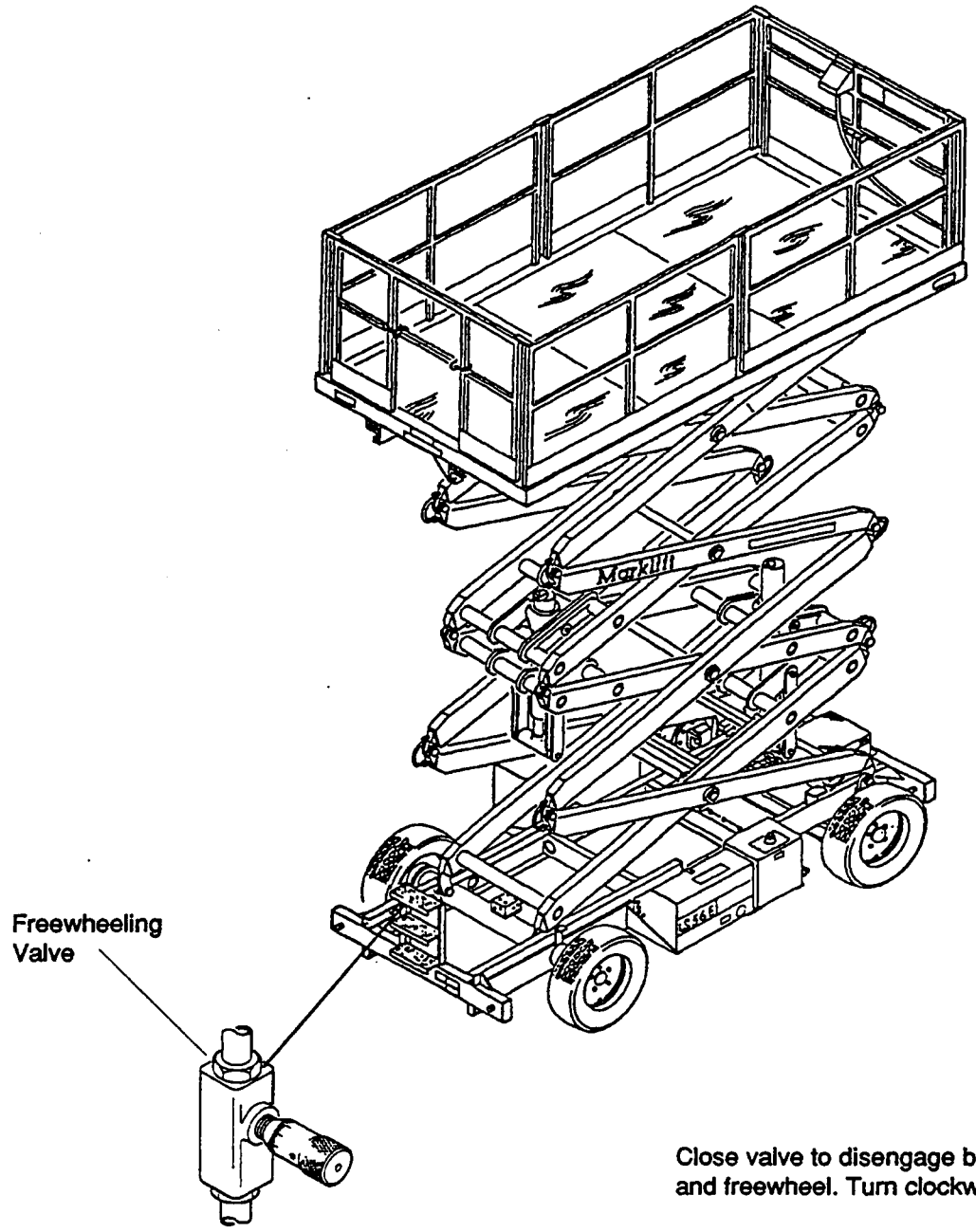
The brakes must be disengaged before the MARKLIFT can be freewheeled. Disengage the brakes by closing the freewheeling valve and momentarily activating the drive rotary switch

> **Use caution when the brakes are disengaged. Always remember to open the freewheeling valve to restore the brakes.**

Truck Transport

To transport the **MARKLIFT** over long distances, a truck or trailer must be used. If a rollback truck with a winch is used, attach the winch cable to the tiedown brackets and pull the **MARKLIFT** onto the truck. Keep the winch cable taut at all times. Be sure to open the freewheeling valve to engage the parking brakes back into the their operational mode.

When securing the **MARKLIFT** to the truck, put the chains through the tiedown brackets <u>only.</u> **DO NOT CHAIN OR STRAP OVER THE THE PLATFORM OR GUARD RAILS.** Severe damage to the scissor arms may result from excess pressure caused by securing the machine over the top of the platform.



Close valve to disengage brakes and freewheel. Turn clockwise.

Open valve to restore brakes. Turn counter-clockwise.

Shown: LS36E

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 the hydraulic oil level - sight gauge shows full when the scissor stack is fully lowered.

3. Check the battery for a 1200 ± 50 on the hydrometer. Charge the battery if its reading is below 1100. If the battery requires water, fill to the proper level **AFTER** charging. **Do Not** overfill. See page 24 for battery filling instructions.

4. Check the hydraulic valve manifold for leaks, loose fittings or loose electrical connections.

5. Check hoses for leaks.

6. Make sure that the brakes will hold the unit on an incline of up to 3 degrees.

7. Test switches: Position the selector switch to "ground", then raise the platform up and down. Position the selector switch to "aerial" and test the "drive", "steering", and "raise platform" switches.

1. STARTING

A. Aerial Control Panel

Turn master switch at ground control panel to "ON". Position selector switch to "AERIAL". Enter the platform, **ATTACH SAFETY CHAIN, GATE, OR BAR AFTER ENTERING PLATFORM.** Pull out the red emergency on/off button. Turn on power switch to activate aerial controls and warning devices.

B. Ground Control Panel

Position the selector switch to 'Ground'. Turn the ignition switch to 'On'. The unit is operational.

2. DRIVE

A. Standard Rotary Switch

Forward and reverse drive of the machine is done from the aerial control panel only. Turning the knob to forward travel; the first position is low speed, the second is high speed. Turning the knob to reverse travel; the first position is low speed, the second position is high. There is also an automatic creep speed, which will cut in whenever the platform is raised over one half of its rated height.

B. Proportional Controller Handle (Optional)

Pull the drive controller locking stem upward, then move the controller handle slowly in the direction desired. (Drive speed will respond according to amount of handle movement.)

3. STEERING

The unit may be steered from the aerial control panel only. Push the toggle switch to the left to turn the front wheels to the left. Pushing the switch to the right will cause the wheels to turn to the right. The toggle switch is a momentary switch which will automatically return to the off position when released. The wheels will remain at an angle until the toggle switch is moved in another direction.

4. RAISE PLATFORM

To raise or lower the platform from the ground control, set selector switch to the "Ground Control" position, then push the "Lift" switch up or down.

To operate from the aerial control, position the selector switch to the "Aerial" position. Raise or lower the platform by operating the "Lift/Lower" toggle switch. The toggle switch is self-centering. When it is released it will automatically set itself to center (the neutral position). The plaatform will remain stationary.

5. WARNING LIGHT AND BUZZER

As a special safety feature, the **MARKLIFT** is equipped with an "out-of- level" sensor that will automatically lower the platform whenever the **MARKLIFT** is in an unsafe out-of-level position.

An unsafe out-of-level situation is sensed by a series of mercury switches when the machine is tilted 3° or more on either side or 6° front or rear. The unsafe condition is indicated by a red warning light and buzzer, located on the top center of the aerial control box. When the warning light and buzzer are on, the platform will lower automatically. Should the warning signal sound after parking the **MARKLIFT**, reposition the unit until it is on a safe level operating surface.

6. TRAVEL WARNING HORN (OPTION)

For some industrial applications, and to meet particular safety requirements, a warning horn may be needed. The warning horn option on the **MARKLIFT** can be used as an automatic movement indicator, or manually activated, as required. The horn is activated by a three-position switch on the aerial control panel. The middle position is "Off". When the switch is positioned to the right, the horn will sound when either the drive or lift function is activated (forward and reverse, up and down).

7. STABILIZERS (Optional)

The **MARKLIFT** has been designed to meet all safety standards without the use of stabilizers. However, for increased stability, stabilizers are offered as an option.

Hydraulic Stabilizers

1. Hydraulic stabilizers can only be operated from the aerial control panel. The momentary switch is located on the bottom center of the face of the control panel and is labeled "Stabilizers".

2. Position the switch to "Down" to lower the stabilizers and "Up" to retract.

MARK INDUSTRIES recommends that the following items be checked periodically as stated below. Any machine not in safe operating condition must be removed from service until it is repaired by a qualified service person.

DAILY

1. Make sure that operation and safety decals are in place and easy to read.
2. Check hydraulic tank level.
3. Check the water level in the batteries
4. Check for loose or worn hardware.
5. Inspect the controls for proper operation.
6. Check for and correct any hydraulic leaks.
7. Check for and correct any structural damage.

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 are easy to read.
3. Check for proper brake operation.
4. Record hour meter reading.
5. Clean unit by removing all dirt, oil, and grease. The machine may be washed with soap and water. (Stay away from electrical panels and charging units.)
6. Check for and correct any hydraulic leaks.
7. Check for and correct any structural damage.
8. Check overall performance.
9. Check for wear on electrical cables and hoses.

MONTHLY (or first 50 hours)

1. Check and lubricate, if necessary.

2. Check battery condition.

3. Change the hydraulic oil return filter.

EVERY SIX MONTHS (or 100 hours)

1. Check and lubricate, if necessary.

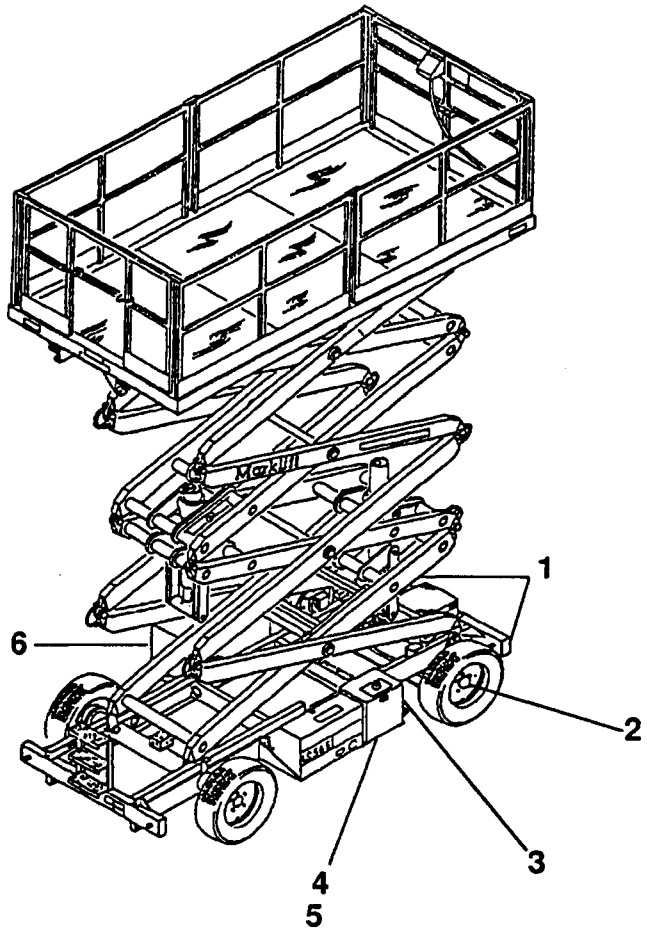
2. Change the hydraulic oil return filter.

EVERY YEAR

1. Re-pack all wheel bearings.

2. Change the hydraulic oil.

3. Change the hydraulic oil return filter.



ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
1.	Steering Yoke King Pins	Grease-Mobil (VA6L36AG)	Monthly
2.	Wheel Bearings	Grease-Mobil (VA6L36AG)	Yearly
3.	Hydraulic Return Line Filter Element	21245	100 Hours
4.	Inlet Strainer	Clean	Yearly
5.	Hydraulic Oil	ATF Dextron II	Yearly
6.	Batteries		Check Daily

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 gases formed during charging. Acid is lost 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 far below the lead plates, add only enough water to barely cover the plates before charging.

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

1. ELECTRICAL

Whenever trouble shooting 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, determined 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 power flow (electrical current) 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 a enough electrical power to operate the coil or relay), these items will not function properly.

C. Diodes can be thought of as "one way electrical check valves" they permit current flow in one direction and stop it in the opposite direction.

D. The basic purpose of the relay is to remotely operate other electrical devices.

2. HYDRAULIC

A. The various hydraulic functions are controlled by electric solenoid valves. When a slower drive speed is needed, a portion of the hydraulic fluid is routed back to the tank by the low speed flow regulator valve, reducing the speed.

B. Directional control valves have two opposed electrical coils with a moveable spool between the coils.

C. One way valves are normally open and are closed to prevent or permit passage of fluid when electrically energized.

DRIVE MOTOR

Will not run.

A. Check ground control box circuit breaker.
B. Check for low battery reading.
C. Refer to your local service facility.

Dies under load.

A. Check hydraulic pressure.
B. Refer to your local service facility.

DRIVE

Poor drive performance.

A. Make sure hydraulic system is up to recommended pressure.
B. Refer to your local service facility.

Unit will not go into high speed.

A. Check for energizing hi speed solenoid valve.
B. Refer to your local service facility.

HYDRAULIC WHEEL DRIVE MOTOR

Turns wheel while unloaded, but slows down or stops when load is applied.

A. Check hydraulic high pressure port with 3000 PSI gauge.
B. Refer to your local service facility.

HYDRAULIC PUMP

Pump producing excessive noise.

A. Check suction hose from tank to pump for kinks.
B. Check hydraulic oil level (sight gauge on tank.)
C. Check suction line fittings for tightness.
D. Check oil. See hydraulic fluid table.
E. Refer to your local service facility.

LIFT

Functions will not operate from aerial control console.

A. Check "Aerial/Ground" selector switch.
B. Check for loose wire in aerial control box.
C. Lift solenoid valve.

Functions will not operate from ground control box.

A. Check position of "Aerial/Ground" box selector switch.
B. Check for loose wire in ground control box.
C. Refer to your local service facility.

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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 (gas units)			Wheel nuts		
Fuel system (LPG/gas)			Wheel bearing		
Batteries			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		
Ground control box			Fuel level (gas units)		
Relays			Literature		
Wire connections			Options		

Code

F = Filled
R = Repaired
C = Checked
A = Adjusted
X = Needs repair

Comments

REV.

Milestone			Hydraulic fluid			
Oil company			Chevron	Gulf	Shell	Union
Brand Name			ATF Dextron II	ATF Dextron II	Donaz-T6	ATF Dextron
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°

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MARKLIFT SERVICE MAINTENANCE CHECKLIST

MODEL NUMBER ________ SERIAL NUMBER ________ DATE SOLD ________

DATE IN SERVICE ________ OPTIONS ________ WARRANTY PERIOD ________

(shaded) APPLIES TO MODELS WITH ENGINES ONLY

CODE:
C – CHECKED
A – ADJUSTED
R – REPAIRED
N – NEW PART
X – NEEDS REPAIR

Group	Items
PREVENTIVE MAINT.	OIL CHANGE; OIL FILTER; AIR FILTER; HYDRAULIC OIL CHANGE; HYDRAULIC OIL FILTER; WHEEL BEARING PACK; DRIVE MOTOR; PUMP MOTOR BRUSHES; ELECTRICAL CONTROLS; TRANS/DIFF OIL CHANGE
ELECTRICAL	TUNE UP SPARK PLUGS; GENERATOR; VOLTAGE REGULATOR; BATTERY; STARTER; POINTS / CONDENSER
HYDRAULIC	HYDRAULIC SYSTEM; LEV CYLINDER; LIFT CYLINDER SEALS; HYD CONTROL VALVE; HYDRAULIC PUMP; ROTARY MANIFOLD; LIFT ROLLERS; HYDRAULIC HOSES
	BRAKES
FUEL	FUEL SYSTEM; CARBURATOR; FUEL PUMP
STEER	STEERING; STEERING HOSES; STEER GEAR; STEER CYLINDER
TIRE	DRIVE TIRES; STEER TIRES
MAJ.	ENGINE OVERHAUL; DRIVE AXEL OVERHAUL
MISC.	

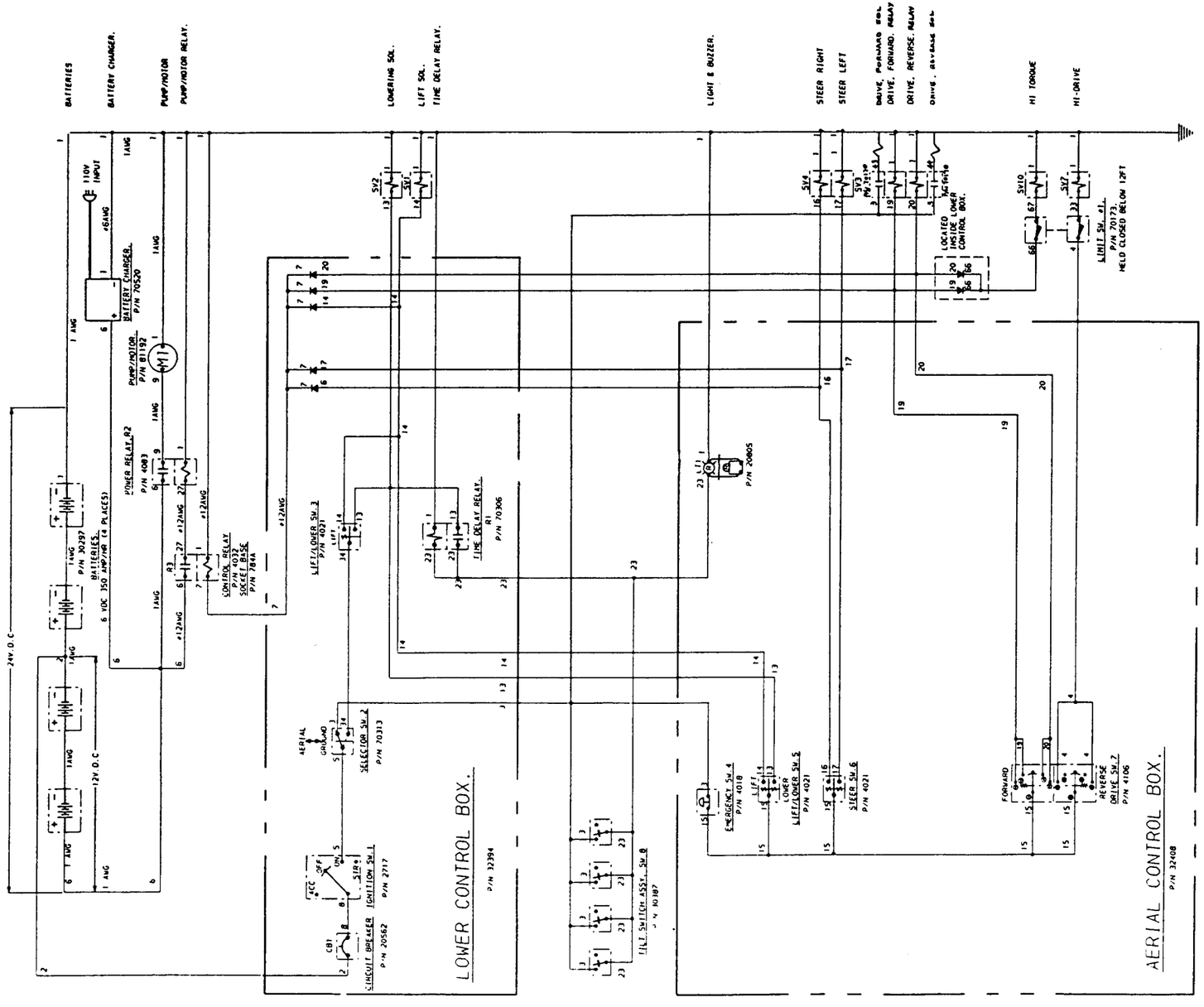
DATE	REMARKS	DATE	REMARKS	AGENCY

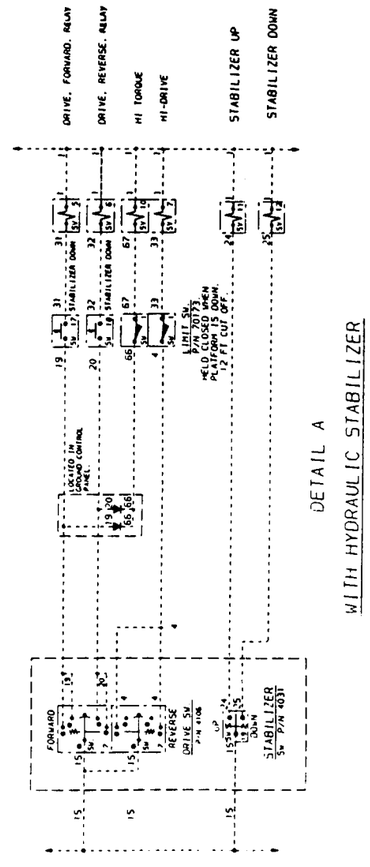
REV.

Mark Industries

TITLE	ELECTRICAL SCHEMATIC
MODEL	LS30E
NOTES	32399 REV. B

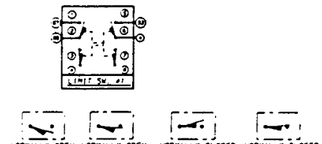
SCHEMATIC
PAGE 1



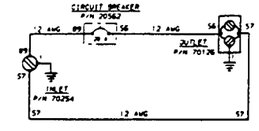


DETAIL A

WITH HYDRAULIC STABILIZER



LEGEND FOR LIMIT SWITCHES



110 A.C. WIRING.

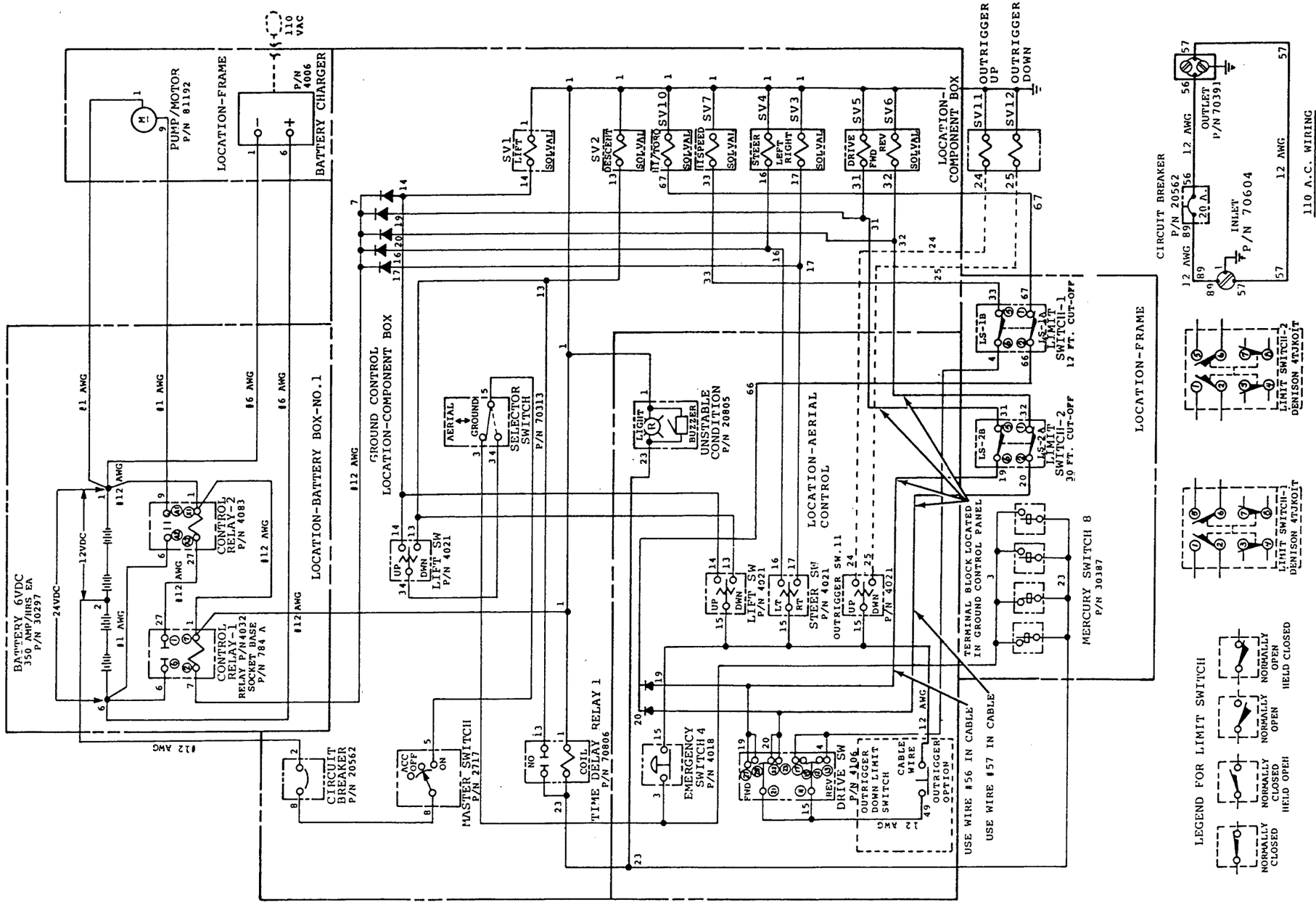
NOTES:

1. TO CONNECT GROUND CONTROL AND AERIAL CONTROL USE ARM CABLE P/N 130337.
2. FOR 110V A.C. GENERATOR OPTION SEE DWG 131529.
3. USE 6A. 1000V. DIODE P/N 70479.
4. WIRING AND SWITCHES SHOWN IN STOWED POSITION.
5. IDENTIFY EACH WIRE BY NUMBER FLAG AT THE ENDS WRAPPING COMPLETELY AROUND.
6. ALL DOTTED LINES FOR OPTION ONLY. - - -

Mark Industries

TITLE	ELECTRICAL SCHEMATIC
MODEL	LS36E
NOTES	DWG NO. 32425

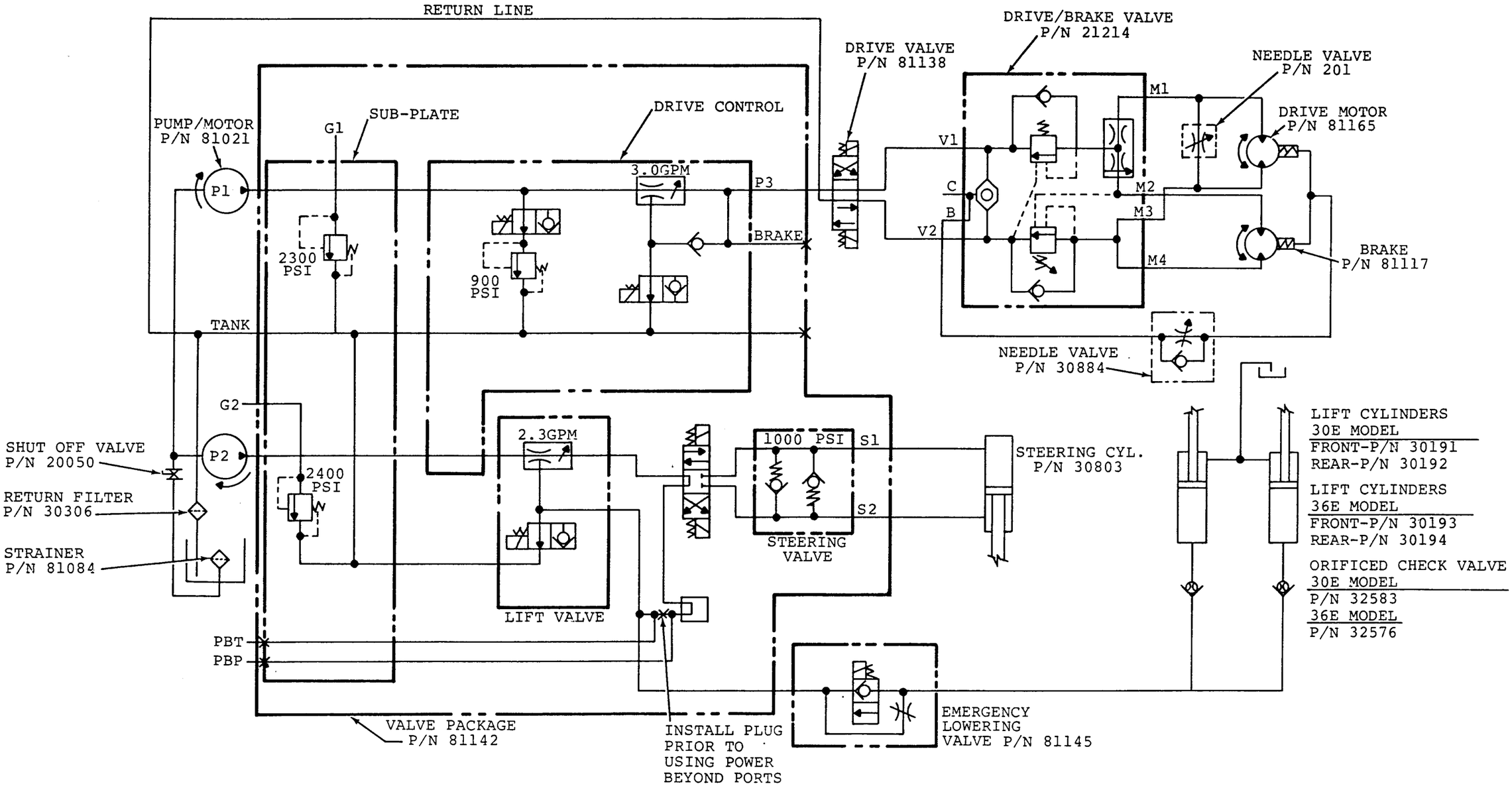
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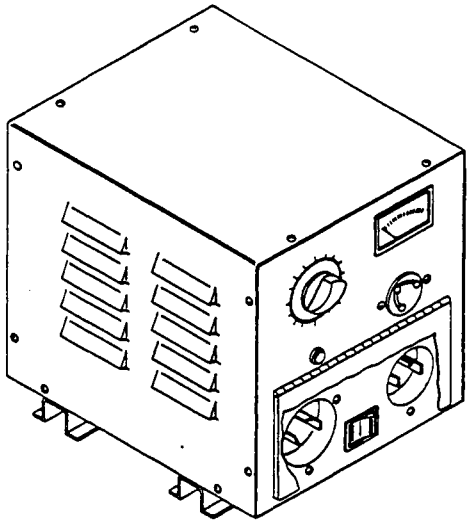


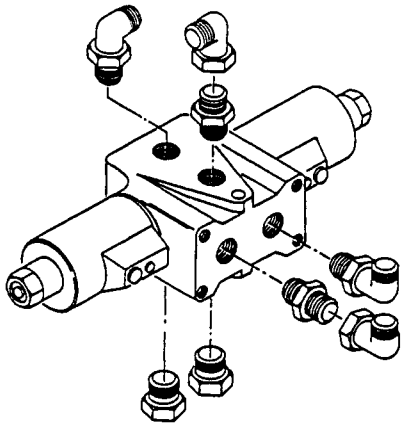
Mark Industries

TITLE	HYDRAULIC SCHEMATIC
MODEL	LS30E & LS36E
NOTES	P/N 32359

SCHE PAGE 3

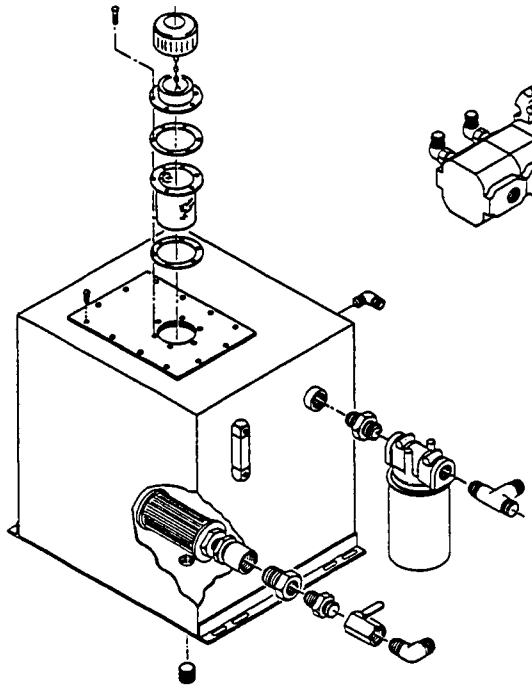


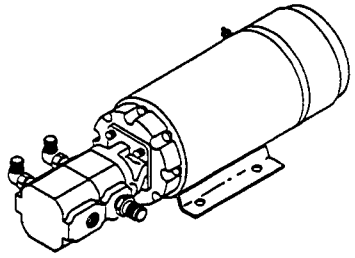


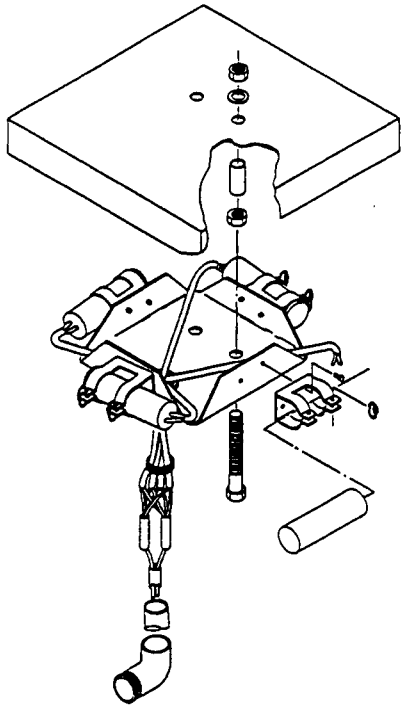


THIS SECTION 1 CONTAINS THE FOLLOWING MATTER:

PAGE NO.	TITLE
1	TABLE OF CONTENTS
4	HOW TO USE PARTS CATALOG
7	HOW TO ORDER PARTS







THIS PARTS CHAPTER CONTAINS:

SECTION 1 THE MARKLIFT PARTS CATALOG

PAGE NO.	TITLE
1	TABLE OF CONTENTS
4	HOW TO USE PARTS CATALOG
7	HOW TO ORDER PARTS

SECTION 2 FINAL ASSEMBLY

FIG. NO.	TITLE
1	FINAL ASSEMBLY (LS30E)
1A	FINAL ASSEMBLY (LS36E)
2	DECAL SET (LS30E)
2A	DECAL SET (LS36E)
3	HYDRAULIC HOSE KIT DIAGRAM (LS30E & LS36E)
4	HYDRAULIC TUBE KIT KIAGRAM (LS30E & LS36E)
5	UPPER CONTROL BOX ASSEMBLY (LS30E & LS36E)

SECTION 3 FRAME ASSEMBLY

FIG. NO.	TITLE
1	FRAME ASSEMBLY (LS30E)
1A	FRAME ASSEMBLY (LS36E)
2	TIRE & WHEEL ASSEMBLY (LS30E & LS36E)
3	DRIVE/BRAKE VALVE ASSEMBLY (LS30E & LS36E)
4	FRONT HUB ASSEMBLY (LS30E & LS36E)
5	BATTERY BOX (LS30E & LS36E)
6	HYDRAULIC COMPONENT BOX ASSEMBLY (LS30E) (SINCE JUNE 1989)
6A	HYDRAULIC COMPONENT BOX ASSEMBLY (LS36E) (SINCE JUNE 1989)
6B	HYDRAULIC COMPONENT BOX ASSEMBLY (LS30E) (UNTIL JUNE 1989)
6C	HYDRAULIC COMPONENT BOX ASSEMBLY (LS36E) (UNTIL JUNE 1989)
7	HYDRAULIC TANK ASSEMBLY (LS30E & LS36E)
8	MANUAL BATTERY CHARGER (LS30E & LS36E) (115 VAC)

SECTION 3	FRAME ASSEMBLY (CONT'D)
FIG. NO.	TITLE
8A	MANUAL BATTERY CHARGER (LS30E &LS36E)
9	PUMP & MOTOR ASSEMBLY (LS30E & LS36E)
10	TILT SWITCH ASSEMBLY (LS30E & LS36E)
11	DRIVE MOTOR & BRAKE ASSEMBLY (LS30E & LS36E)
12	STEERING CYLINDER ASSEMBLY (LS30E & LS36E)
13	FLOW CONTROL VALVE ASSEMBLY (LS30E & LS36E)
14	VALVE PACKAGE ASSEMBLY (LS30E & LS36E) (SINCE JUNE 1989)
14A	VALVE PACKAGE ASSEMBLY (LS30E & LS36E) (UNTIL JUNE 1989)
15	LOWERING CONTROL VALVE ASSEMBLY (LS30E & LS36E)
16	DRIVE SOLENOID VALVE ASSEMBLY (LS30E & LS36E)
17	ELECTRICAL PANEL ASSEMBLY (LS30E)
17A	ELECTRICAL PANEL ASSEMBLY (LS36E)
18	WHEEL MOUNTING BRAKE ASSEMBLY (LS30E & LS36E)
19	DRIVE MOTOR (LS30E & LS36E) (SINCE OCTOBER 1988)
19A	DRIVE MOTOR (LS30E & LS36E) (UNTIL OCTOBER 1988)

SECTION 4	SCISSOR ASSEMBLY
FIG. NO.	TITLE
1	SCISSOR ASSEMBLY (LS30E)
1A	SCISSOR ASSEMBLY (LS36E)
2	LOWER OUTER ARM ASSEMBLY (LS30E)
2A	LOWER OUTER ARM ASSEMBLY (LS36E)
3	MIDDLE OUTER ARM ASSEMBLY (LS30E)
3A	MIDDLE OUTER ARM ASSEMBLY (LS36E)
3B	MIDDLE OUTER ARM ASSEMBLY (LS36E)
4	UPPER OUTER ARM ASSEMBLY (LS30E)
4A	UPPER OUTER ARM ASSEMBLY (LS36E)
5	LOWER INNER ARM ASSEMBLY (LS30E)
5A	LOWER INNER ARM ASSEMBLY (LS36E)
6	MIDDLE INNER ARM ASSEMBLY (LS30E & LS36E)

SECTION 4	SCISSOR ASSEMBLY (CONT'D)
FIG. NO.	TITLE
7	UPPER INNER ARM ASSEMBLY (LS30E)
7A	UPPER INNER ARM ASSEMBLY (LS36E)
8	UPPER MIDDLE INNER ARM ASSEMBLY (LS36E)
9	INNER ARM SUPPORT ASSEMBLY (LS30E & LS36E)
10	MAIN LIFT CYLINDER ASSEMBLY (FRONT)(LS30E)
10A	MAIN LIFT CYLINDER ASSEMBLY (REAR)(LS30E)
10B	MAIN LIFT CYLINDER ASSEMBLY (FRONT)(LS36E)
10C	MAIN LIFT CYLINDER ASSEMBLY (REAR)(LS36E)

SECTION 5	DECK ASSEMBLY
FIG. NO.	TITLE
1	DECK ASSEMBLY (LS30E & LS36E)
2	SLIDE BAR ASSEMBLY (LS30E & LS36E)

SECTION 6	OPTIONS
FIG. NO.	TITLE
1	TRAVEL WARNING HORN
2	ALL MOTION ALARM
3	HOURMETER
4	ROTATING BEACON
5	12 VOLT PLATFORM WORK LIGHT
6	SWING GATE
7	REMOTE DRIVE KIT
8	FEMALE PLUG ONLY FOR REMOTE DRIVE
9	LANYARD/CONTROL BOX ONLY FOR REMOTE DRIVE KIT
10	PROPORTIONAL DRIVE CONTROLS
11	SOLID STATE SLOPE SENSOR
12	HYDRAULIC STABILIZERS
13	LIFTING LUGS
14	AUTOMATIC BATTERY CHARGER (DOMESTIC)
15	AUTOMATIC BATTERY CHARGER (INTERNATIONAL)
	PARTS & SERVICE MANUAL

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.

1A

1B

1A

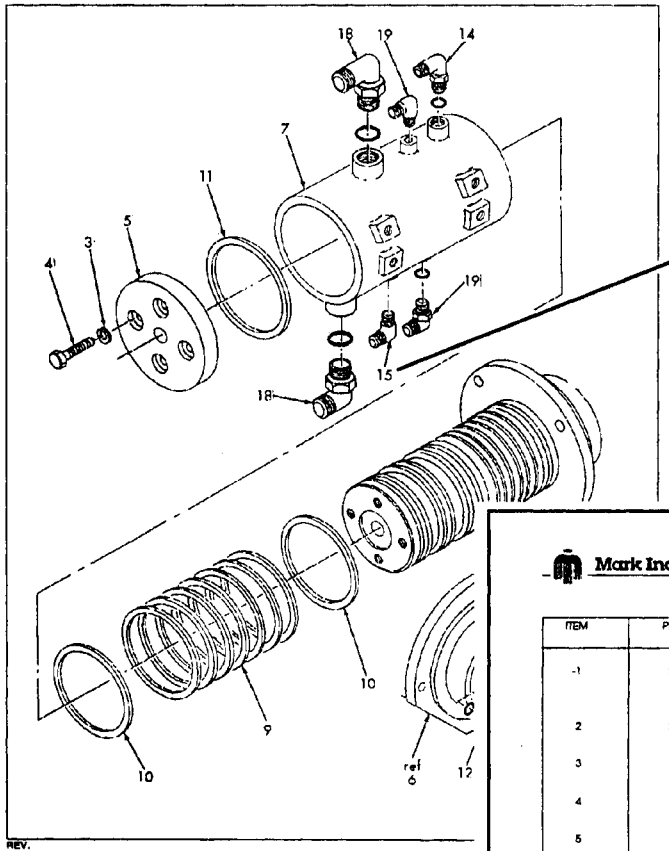
1C

1D

Mark Industries

TITLE	ROTARY MANIFOLD ASSEMBLY
MODEL	ALL MODELS
NOTES	SINCE EARLY 1988

SECTION 3
FIGURE 6
PAGE 1



REV.

Mark Industries

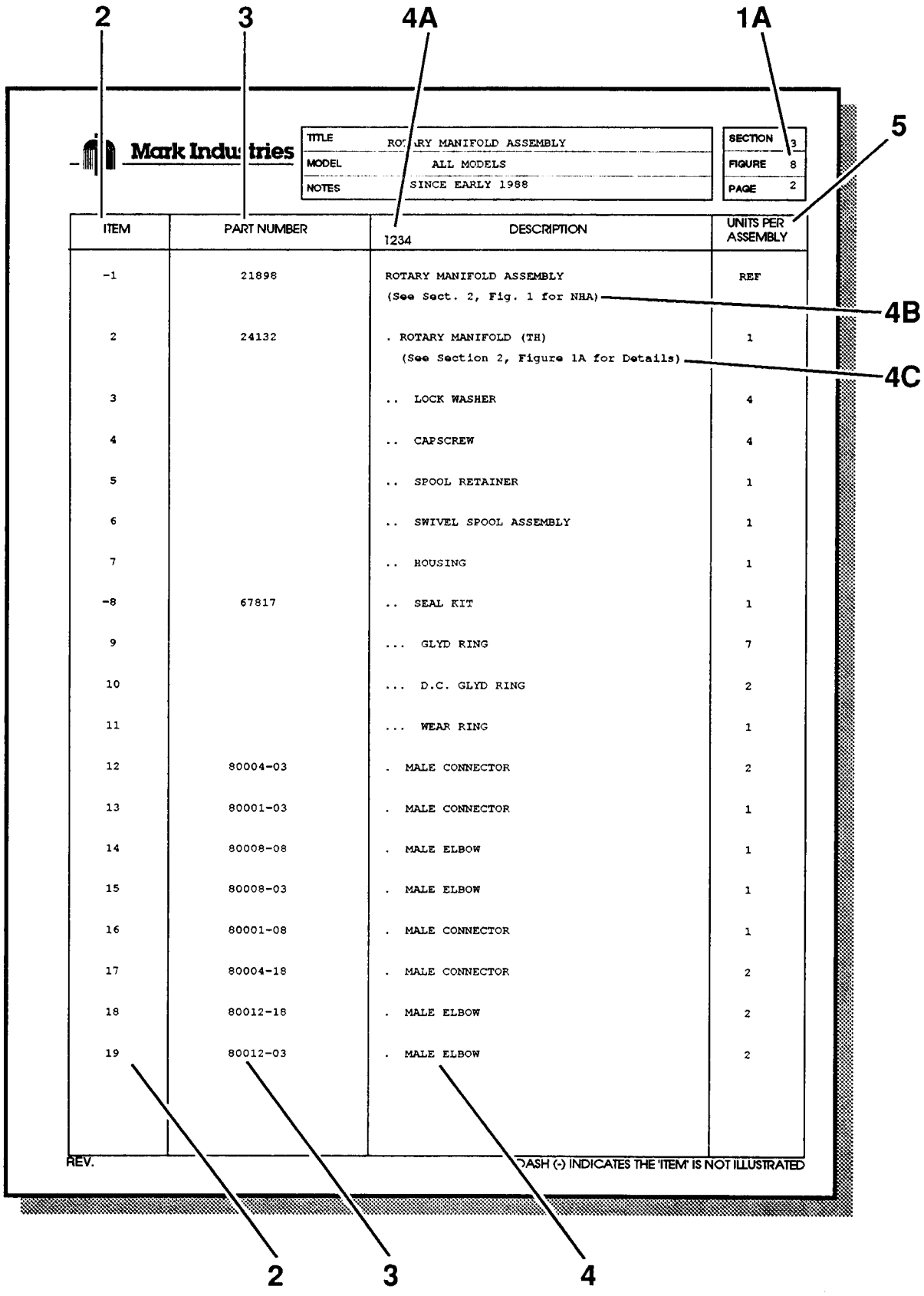
TITLE	ROTARY MANIFOLD ASSEMBLY
MODEL	ALL MODELS
NOTES	SINCE EARLY 1988

SECTION 3
FIGURE 6
PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234	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	60004-03	. MALE CONNECTOR	2
13	60001-03	. MALE CONNECTOR	1
14	60008-08	. MALE ELBOW	1
15	60008-03	. MALE ELBOW	1
16	60001-08	. MALE CONNECTOR	1
17	60004-18	. MALE CONNECTOR	2
18	60012-18	. MALE ELBOW	2
19	60012-03	. MALE ELBOW	2

REV.

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED


2
3
4A
1A
5
4B
4C
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 REF
(See Sect. 2, Fig. 1 for NHA)
2 24132 . ROTARY MANIFOLD (TH) 1
(See Section 2, Figure 1A for Details)
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
2
3
4

1. The Parts Catalog Pagination.

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

   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**.

4. Elements of the **Description**.

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

      1 2 3 4 5

      Figure Description

      . 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.

   B. **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.

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

5. **UNIT 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.

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**.

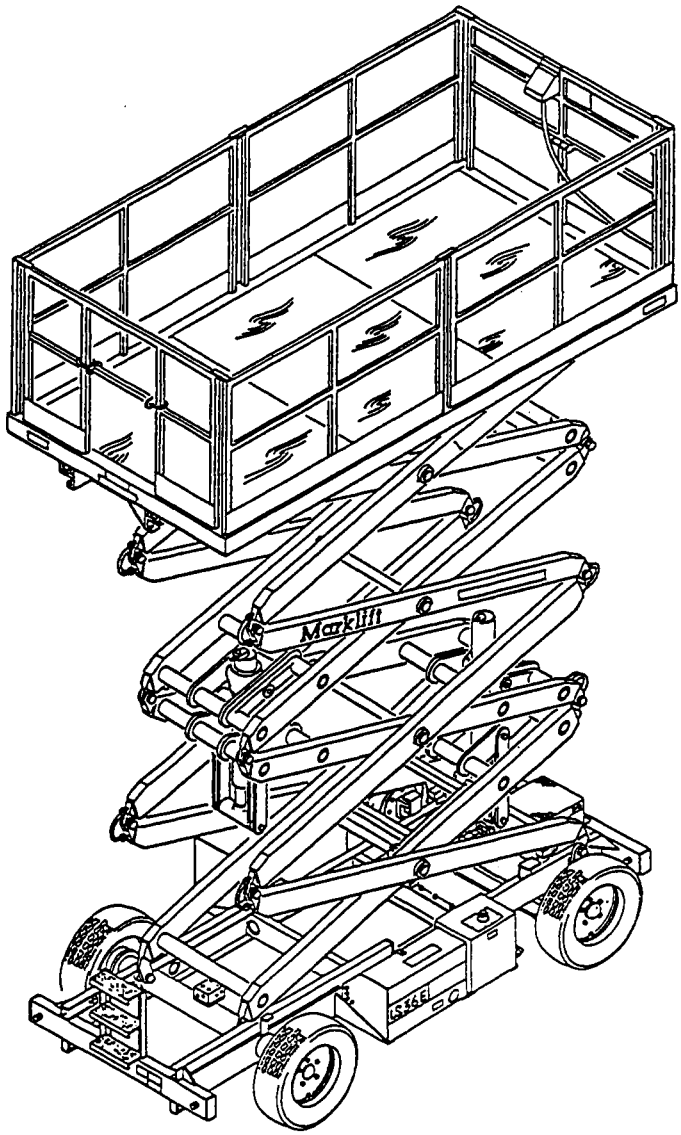
   A. By **FAX**: **(714) 879-8884**

   B. By Phone: (714) 879-MARK

   C. By Mail: MARK INDUSTRIES
   ATTENTION: PARTS DEPARTMENT
   P.O. BOX 2225
   BREA, CA. 92622

SECTION 2 CONTAINS:

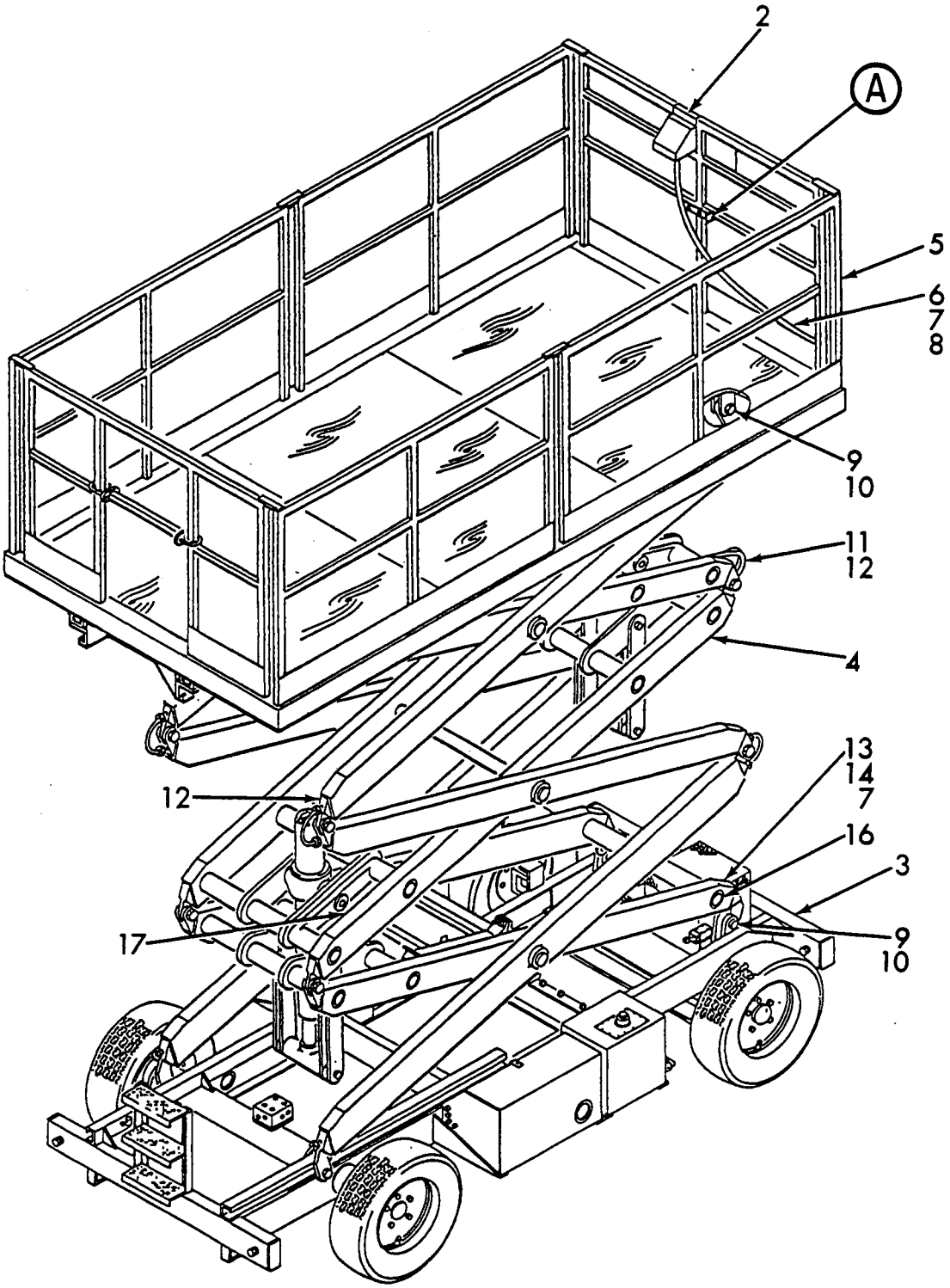
FIG. NO.	TITLE
1	FINAL ASSEMBLY (LS30E)
1A	FINAL ASSEMBLY (LS36E)
2	DECAL SET (LS30E)
2A	DECAL SET (LS36E)
3	HYDRAULIC HOSE KIT DIAGRAM (LS30E & LS36E)
4	HYDRAULIC TUBE KIT DIAGRAM (LS30E & LS36E)
5	UPPER CONTROL BOX ASSEMBLY (LS30E & LS36E)



Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	2
FIGURE	1
PAGE	1

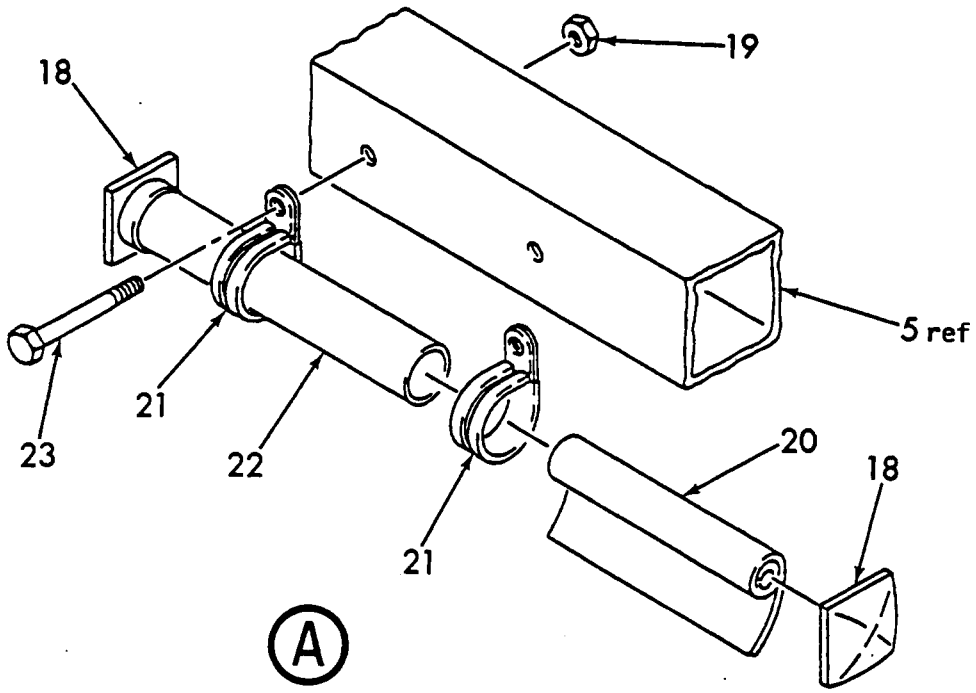


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Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	2
FIGURE	1
PAGE	2



REV.

Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	LS30E
NOTES	

SECT.	2
FIG.	1
PAGE	3

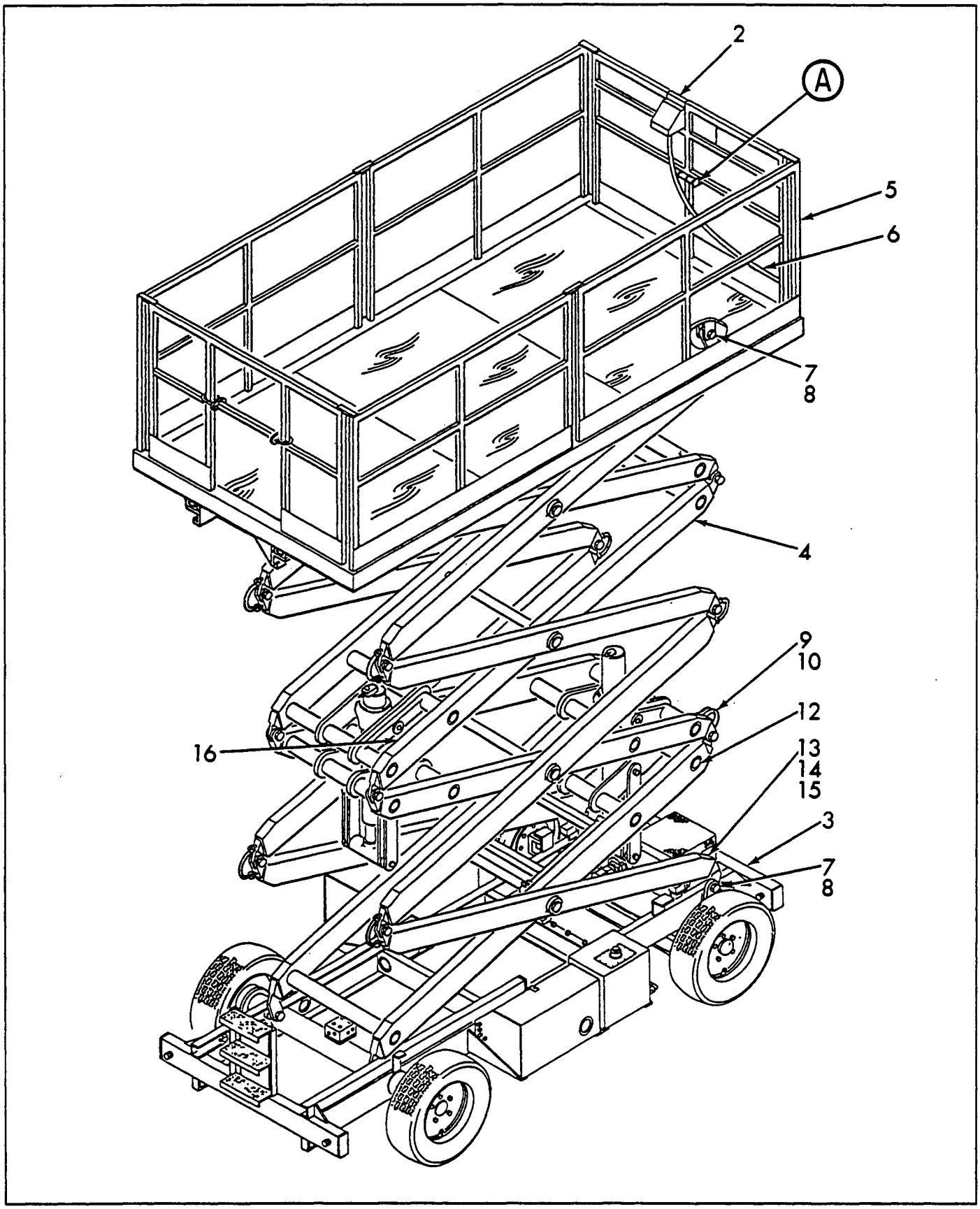
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30008	FINAL ASSEMBLY	REF
2	32408	.UPPER CONTROL BOX ASSEMBLY (See Sect. 2, Fig. 5 for Details)	1
3	32379	.FRAME ASSEMBLY (See Sect. 3, Fig. 1 for Details)	1
4	30231	.SCISSOR ASSEMBLY (See Sect. 4, Fig. 1 for Details)	1
5	32184	.DECK ASSEMBLY (See Sect. 5, Fig. 1 for Details)	1
6	130337-75	.CONDUCTOR CABLE	1
7	765	.CLAMP	24
8	375	.POP RIVET	18
9	30775	.EAR PIVOT BOLT	4
10	61304	.LOCK NUT	4
11	32402	.HYDRAULIC HOSE KIT DIAGRAM (See Sect. 2, Fig. 3 for Details)	1
12	80042-05	.UNION	4
13	80014-05	.UNION ELBOW	2
14	63651	.POP RIVET	24
-15	32405	.HYDRAULIC TUBE KIT DIAGRAM (See Sect. 2, Fig. 4 for Details)	1
16	65188	.PLUG CAP	20
17	80031-05	.UNION TEE	1
18	65842	.ANTI-ROLL CAP	2
19	60711	.LOCK NUT	2
20	17413	.SCISSOR HANDBOOK	1
21	65867	.CLAMP	2
22	130927	.PLASTIC CONTAINER	1

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
23	60315	.CAP SCREW	2
-24	32359	.HYDRAULIC SCHEMATIC (See Schematic Section)	1
-25	32399	.ELECTRICAL SCHEMATIC (See Schematic Section)	1
-26	16680	.ELECTRICAL TAPE	1 ROLL
-27	255	.CABLE TIE (LARGE)	50
-28	256	.CABLE TIE (SMALL)	50
-29	65116	.HYDRAULIC OIL	10 GAL
-30	16608	.WHITE PAINT (SPRAYLAT)	5 GAL
-31	65368	.BLUE PAINT (KRYLON)	1 CAN
-32	2673	.WHITE PAINT (KIT KOTE)	1 CAN
-33	16609	.BLUE PAINT (SPRAYLAT)	2 GAL

Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	2
FIGURE	1A
PAGE	1

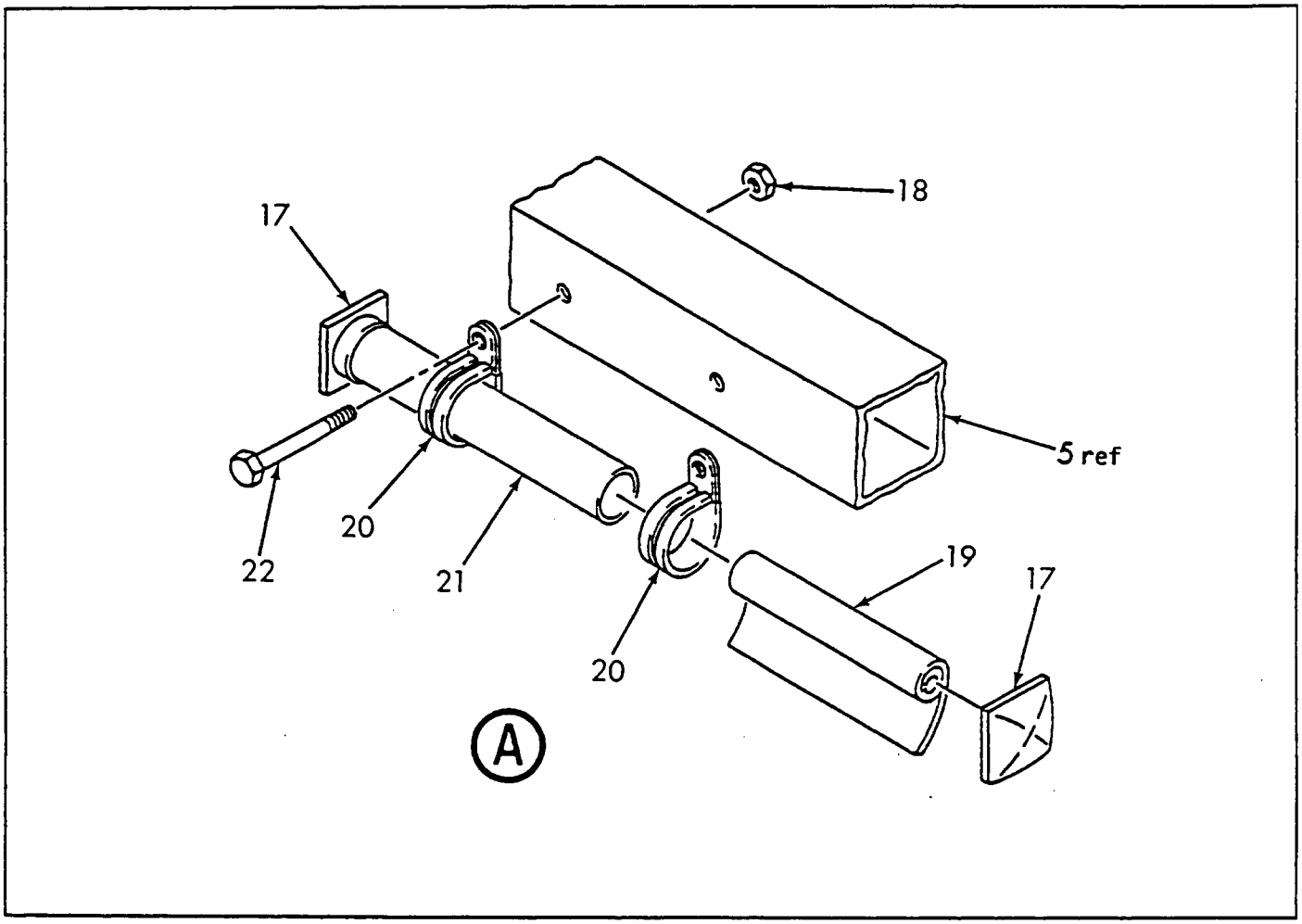


REV.

Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	2
FIGURE	1A
PAGE	2



REV.

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30008	FINAL ASSEMBLY	REF
2	32408	.UPPER CONTROL BOX ASSEMBLY (See Sect. 2, Fig. 5 for Details)	1
3	32383	.FRAME ASSEMBLY (See Sect. 3, Fig. 1A for Details)	1
4	30232	.SCISSOR ASSEMBLY (See Sect. 4, Fig. 1A for Details)	1
5	32184	.DECK ASSEMBLY (See Sect. 5, Fig. 1 for Details)	1
6	130337-75	.CONDUCTOR CABLE	1
7	30775	.EAR PIVOT BOLT	4
8	61304	.LOCK NUT	4
9	80042-05	.UNION	5
10	32402	.HYDRAULIC HOSE KIT DIAGRAM (See Sect. 2, Fig. 3 for Details)	1
-11	32405	.HYDRAULIC TUBE KIT DIAGRAM (See Sect. 2, Fig. 4 for Details)	1
12	65188	.PLUG CAP	40
13	80014-05	.UNION ELBOW	1
14	765	.CLAMP	24
15	63651	.POP RIVET	24
16	80031-05	.UNION TEE	1
17	65842	.ANTI-ROLL CAP	2
18	60711	.LOCK NUT	2
19	17413	.SCISSOR HANDBOOK	1
20	65867	.CLAMP	2
21	130927	.PLASTIC CONTAINER	1
22	60315	.CAP SCREW	2

Mark Industries

TITLE	FINAL ASSEMBLY	SECT.	2
MODEL	LS36E	FIG.	1A
NOTES		PAGE	4

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
23	32359	.HYDRAULIC SCHEMATIC (See Schematic Section)	1
-24	32425	.ELECTRICAL SCHEMATIC (See Schematic Section)	1
-25	16680	.ELECTRICAL TAPE	1 ROLL
-26	255	.CABLE TIE (LARGE)	50
-27	256	.CABLE TIE (SMALL)	50
-28	65116	.HYDRAULIC OIL	10 GAL
-29	65368	.BLUE PAINT (KRYLON)	1 CAN
-30	2673	.PAINT (KIT KOTE)	1 CAN
-31	16609	.BLUE PAINT (SPRAYLAT)	2 GAL
-32	16608	.WHITE PAINT (SPRAYLAT)	5 GAL

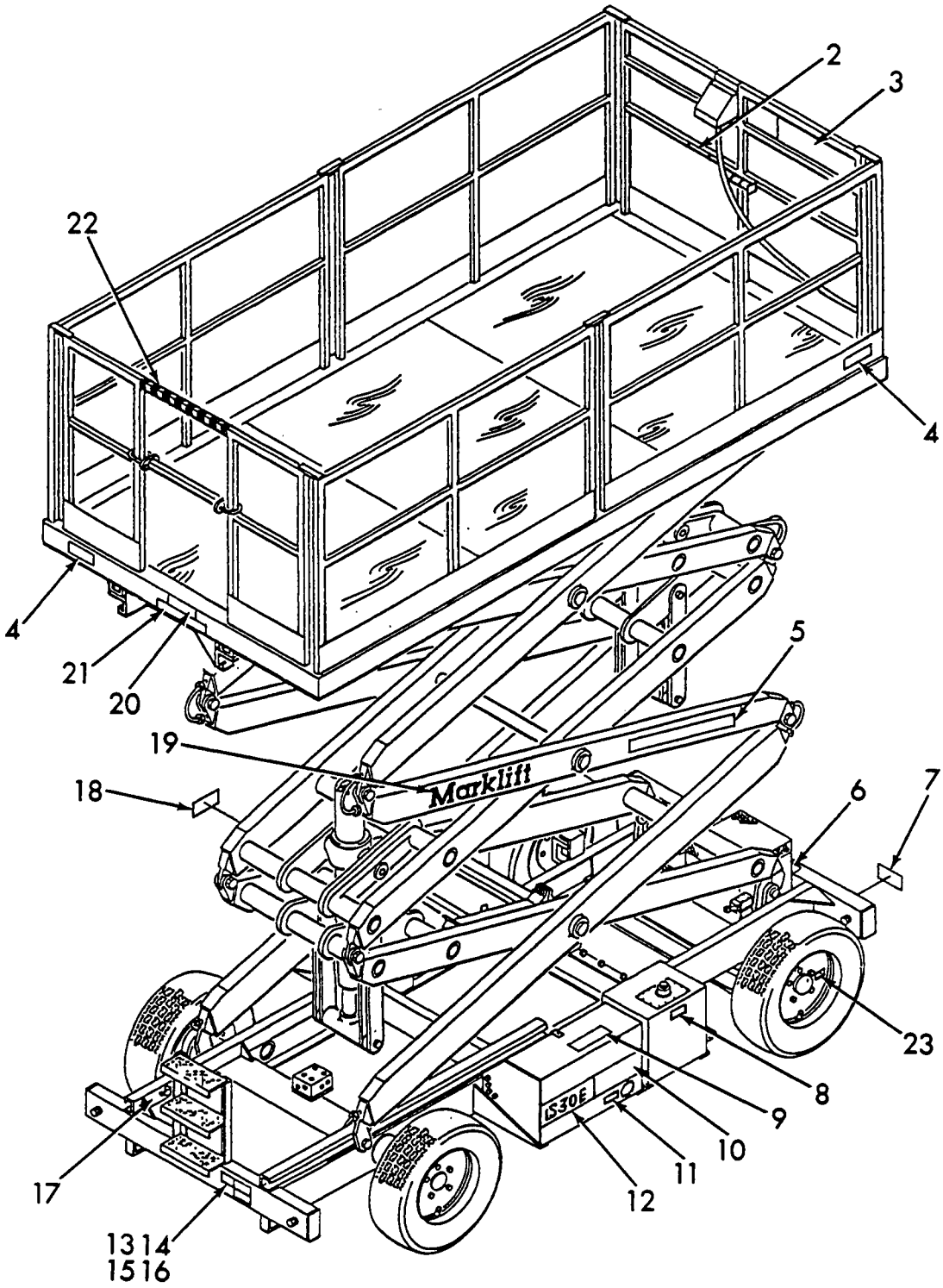
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DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	DECAL SET
MODEL	LS30E
NOTES	

SECTION	2
FIGURE	2
PAGE	1



REV.

Mark Industries

TITLE	DECAL SET
MODEL	LS30E
NOTES	

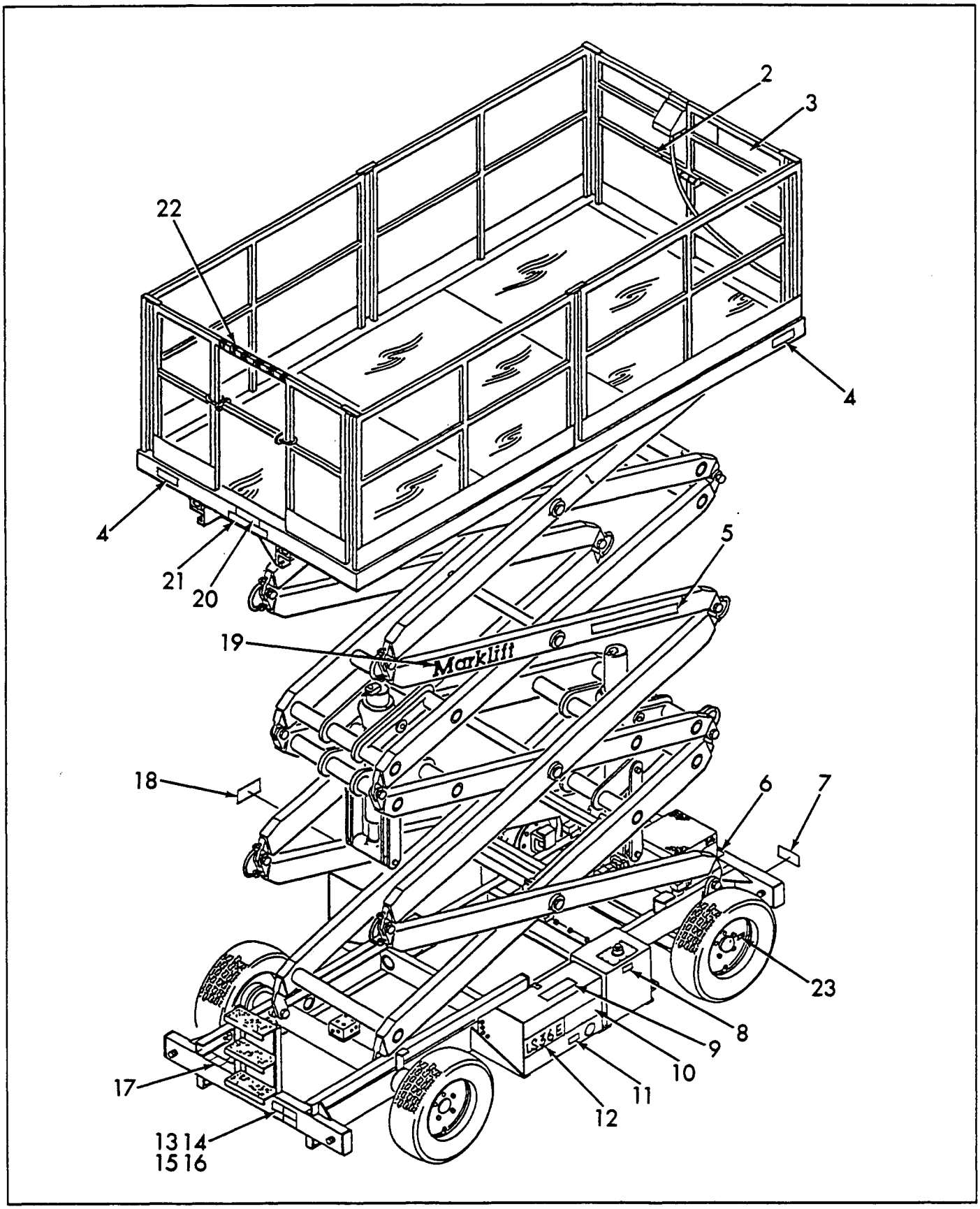
SECT.	2
FIG.	2
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	67673	DECAL SET (See Sect. 2, Fig. 1 for NHA)	REF
2	130820	.OPERATION & SAFETY HANDBOOK DECAL	1
3	182102	.OPERATION INSTRUCTIONS DECAL	1
4	2026	.LOAD CAPACITY 1500 LBS. DECAL	4
5	130596	.A PRODUCT OF MARK INDUSTRIES DECAL	2
6	2005	.BATTERY CHARGER PLUG DECAL	1
7	2041	.DO NOT LIFT DECAL	2
8	2017	.HYDRAULIC FLUID DECAL	2
9	2016	.WARNING: DO NOT WORK UNDER DECAL	2
10	181728	.PANEL STRIP DECAL	2
11	2019	.EMERGENCY LOWERING VALVE DECAL	1
12	181737	.LS30E DECAL	2
13	20660	.IDENTIFICATION NAMEPLATE	1
14	20661	.ANSI-A92 NAMEPLATE	1
15	30520	.PATENT NUMBER NAMEPLATE	1
16	375	.POP RIVET	12
17	130606	.FREE WHEELING DECAL	1
18	2003	.BATTERY WATER LEVEL DECAL	1
19	31260	.MARKLIFT DECAL	2
20	31109	.CAUTION: DO NOT REMOVE SCISSOR GUARD RAILS DECAL	1
*21	11064	.ATTACH SAFETY CHAINS BEFORE RAISING PLATFORM DECAL	1
22	160137	.WARNING TAPE	1
23	22175	.MONOFILLED TIRE DECAL	4
		*APPLIES TO OLDER MACHINES	

Mark Industries

TITLE	DECAL SET
MODEL	LS36E
NOTES	

SECTION	2
FIGURE	2A
PAGE	1



REV.

Mark Industries

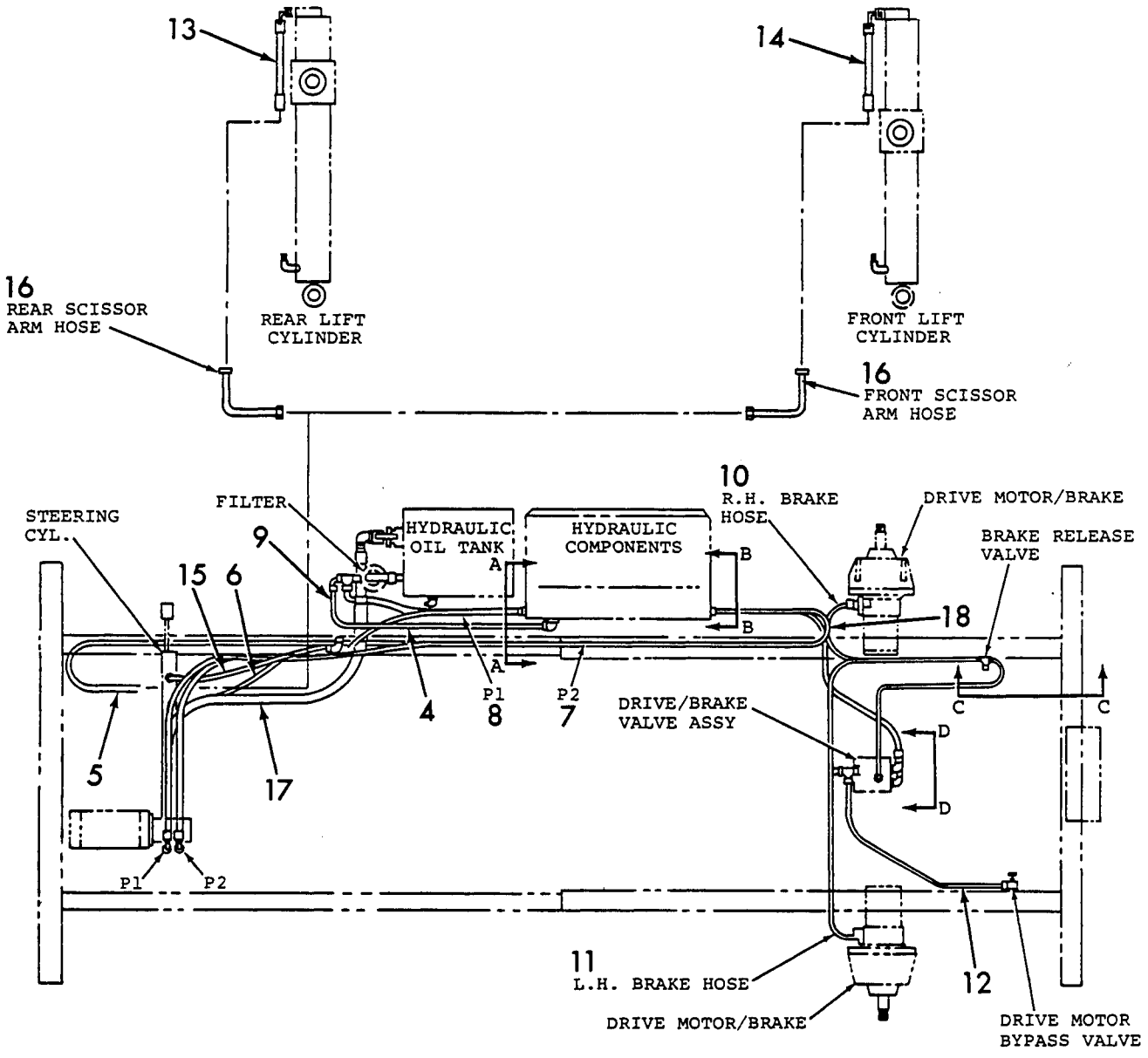
TITLE	DECAL SET	SECT.	2
MODEL	LS36E	FIG.	2A
NOTES		PAGE	2

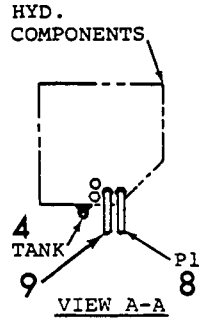
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	67668	DECAL SET (See Sect. 2, Fig. 1A for NHA)	REF
2	130820	.OPERATION & SAFETY HANDBOOK DECAL	1
3	182102	.OPERATION INSTRUCTIONS DECAL	1
4	2024	.LOAD CAPACITY 1000 LBS. DECAL	4
5	130596	.A PRODUCT OF MARK INDUSTRIES DECAL	2
6	2005	.BATTERY CHARGER PLUG DECAL	1
7	2041	.DO NOT LIFT DECAL	2
8	2017	.HYDRAULIC FLUID DECAL	2
9	2016	.WARNING: DO NOT WORK UNDER DECAL	2
10	181728	.PANEL STRIP DECAL	2
11	2019	.EMERGENCY LOWERING VALVE DECAL	1
12	181739	.LS36E DECAL	2
13	20660	.IDENTIFICATION NAMEPLATE	1
14	20661	.ANSI-A92 NAMEPLATE	1
15	30520	.PATENT NUMBER NAMEPLATE	1
16	375	.POP RIVET	12
17	130606	.FREE WHEELING DECAL	1
18	2003	.BATTERY WATER LEVEL DECAL	1
19	31260	.MARKLIFT DECAL	2
20	31109	.CAUTION: DO NOT REMOVE SCISSOR GUARD RAILS DECAL	1
*21	11064	.ATTACH SAFETY CHAINS BEFORE RAISING PLATFORM DECAL	1
22	160137	.WARNING TAPE	1
23	22175	.MONOFILLED TIRE DECAL	4
		*APPLIES TO OLDER MACHINES	

Mark Industries

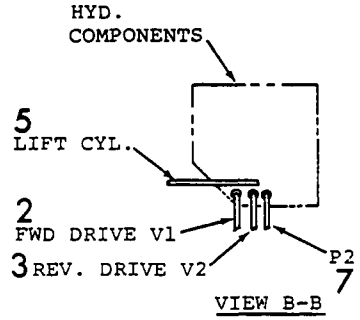
TITLE	HYDRAULIC HOSE KIT DIAGRAM
MODEL	LS30E & LS36E
NOTES	

SECTION	2
FIGURE	3
PAGE	1

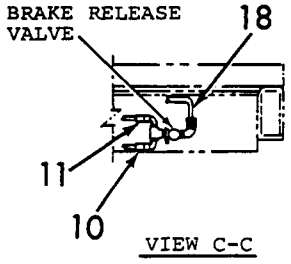




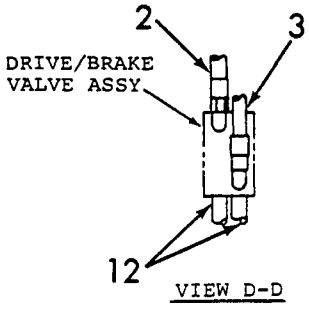
VIEW A-A



VIEW B-B



VIEW C-C



VIEW D-D

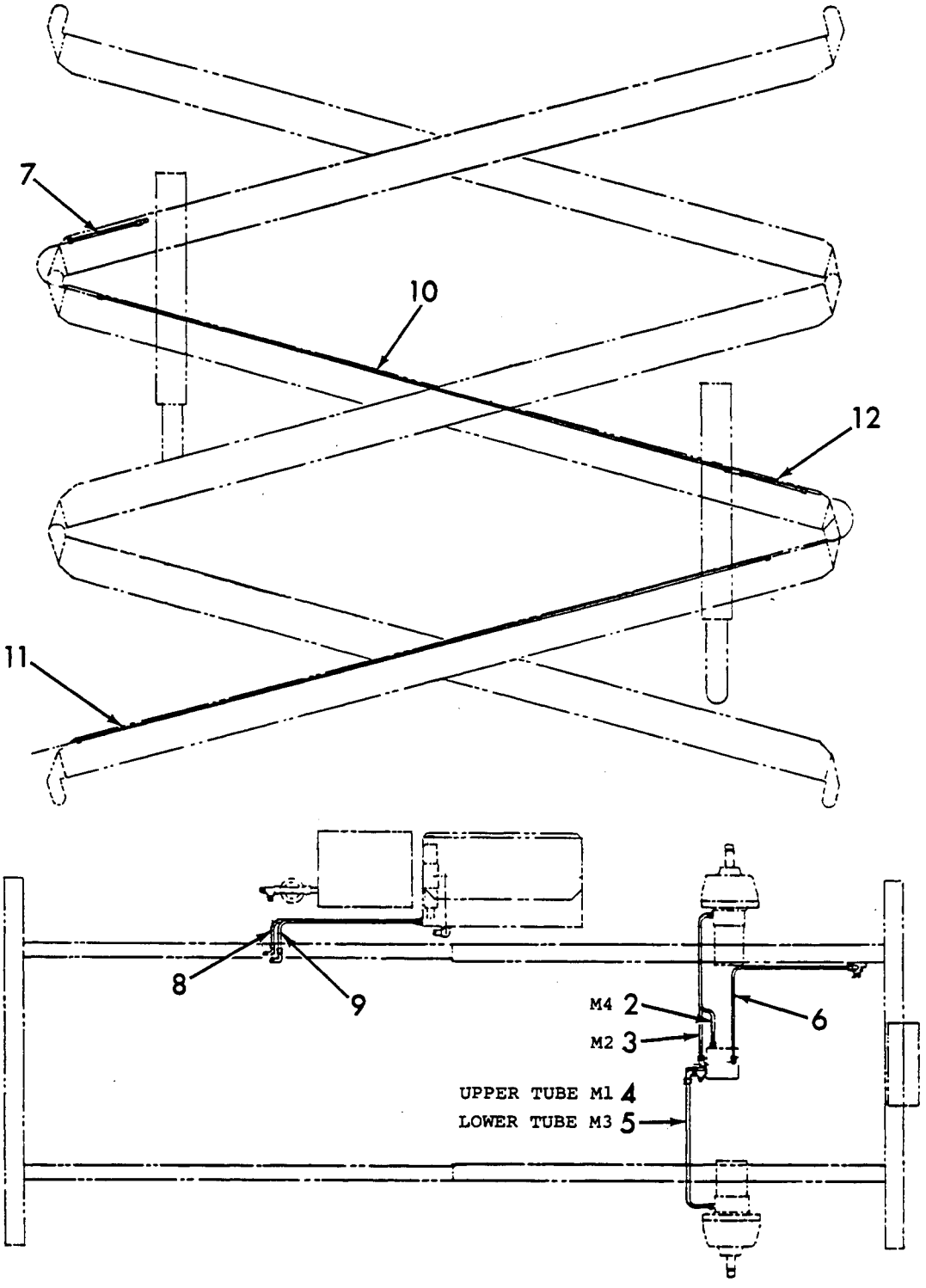
REV.

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32402	HYDRAULIC HOSE KIT DIAGRAM (See Sect. 2, Fig. 1 or 1A for NHA)	REF
2	13210-10-0430	.HOSE ASSEMBLY	1
3	13210-10-0390	.HOSE ASSEMBLY	1
4	13213-10-0340	.HOSE ASSEMBLY	1
5	13210-06-1470	.HOSE ASSEMBLY	1
6	13213-06-0290	.HOSE ASSEMBLY	1
7	13213-08-1360	.HOSE ASSEMBLY	1
8	13213-10-0750	.HOSE ASSEMBLY	1
9	13213-10-0220	.HOSE ASSEMBLY	1
10	13214-04-0350 -270	.HOSE ASSEMBLY	1
11	13214-04-0650 -270	.HOSE ASSEMBLY	1
12	13210-08-0300	.HOSE ASSEMBLY	2
13	13213-06-0250	.HOSE ASSEMBLY	1
14	13213-06-0180	.HOSE ASSEMBLY	1
15	13213-06-0260	.HOSE ASSEMBLY	1
16	13210-06-0240	.HOSE ASSEMBLY	2
17	13205-12-0570	.HOSE ASSEMBLY	1
18	13213-04-0310	.HOSE ASSEMBLY	1

Mark Industries

TITLE	HYDRAULIC TUBE KIT DIAGRAM
MODEL	LS30E & LS36E
NOTES	

SECTION	2
FIGURE	4
PAGE	1



NOTES:
1. TUBE KIT DIAGRAM IS THE SAME ON 30E, 30G & 36E, 36G THOUGH THE 36E & 36G HAS (1) SET OF ADDITIONAL ARMS.
2. SPECIFICATION FOR HYDRAULIC TUBES: D.O.M. SAE J-525

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TITLE	HYDRAULIC TUBE KIT DIAGRAM
MODEL	LS30E & LS36E
NOTES	

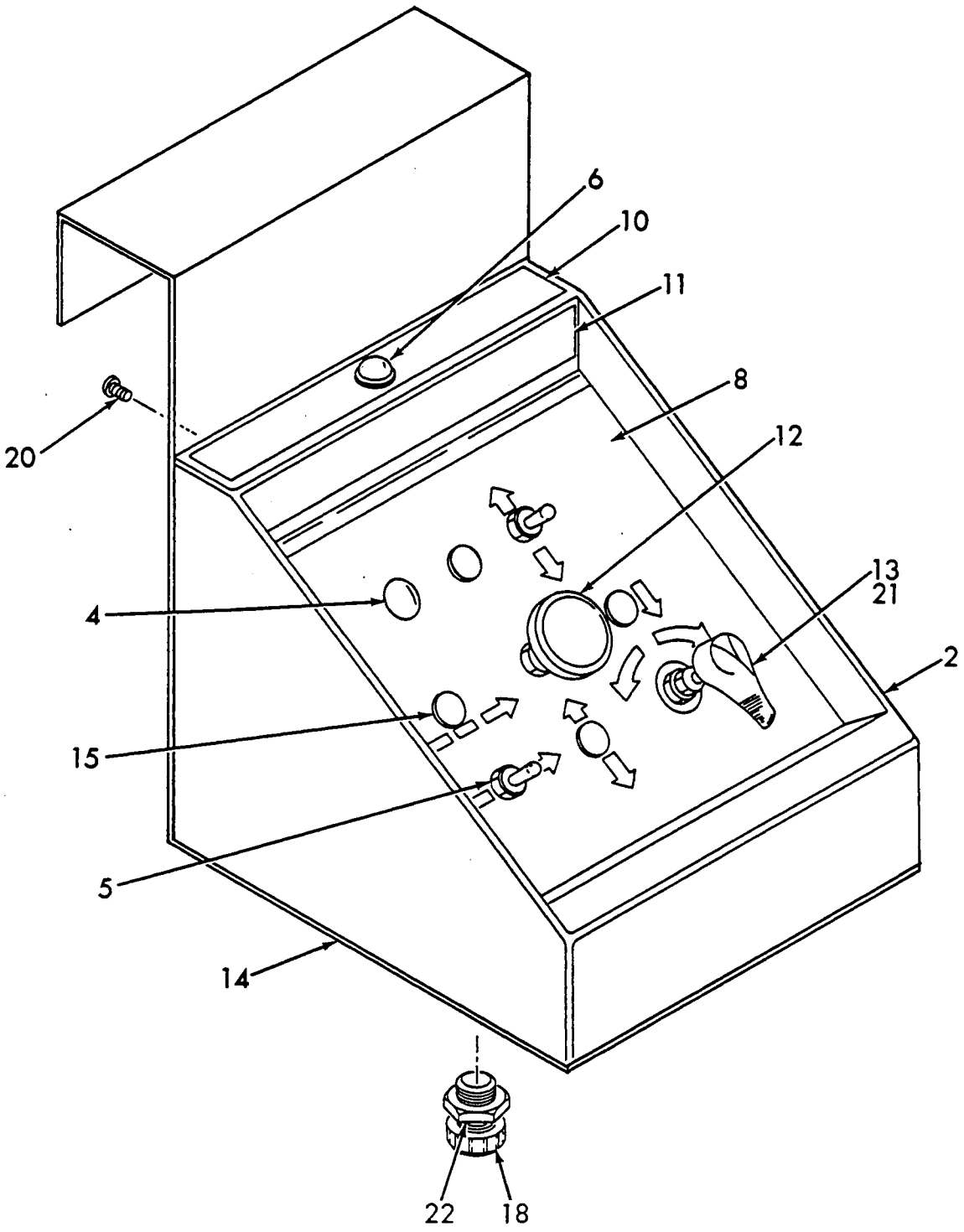
SECT.	2
FIG.	4
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32405	HYDRAULIC TUBE KIT DIAGRAM (See Sect. 2, Fig. 1 or 1A for NHA)	REF
2	32405-1	.TUBE ASSEMBLY	1
3	32405-2	.TUBE ASSEMBLY	1
4	32405-3	.TUBE ASSEMBLY	1
5	32405-4	.TUBE ASSEMBLY	1
6	32405-5	.TUBE ASSEMBLY	1
7	32405-6	.TUBE ASSEMBLY	1
8	32405-7	.TUBE ASSEMBLY	1
9	32405-8	.TUBE ASSEMBLY	1
10	32405-9	.TUBE ASSEMBLY	1
11	32405-10	.TUBE ASSEMBLY	1
12	32405-11	.TUBE ASSEMBLY	1

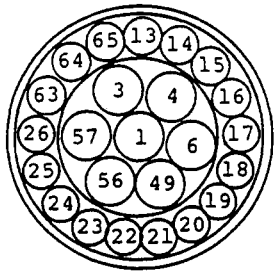
Mark Industries

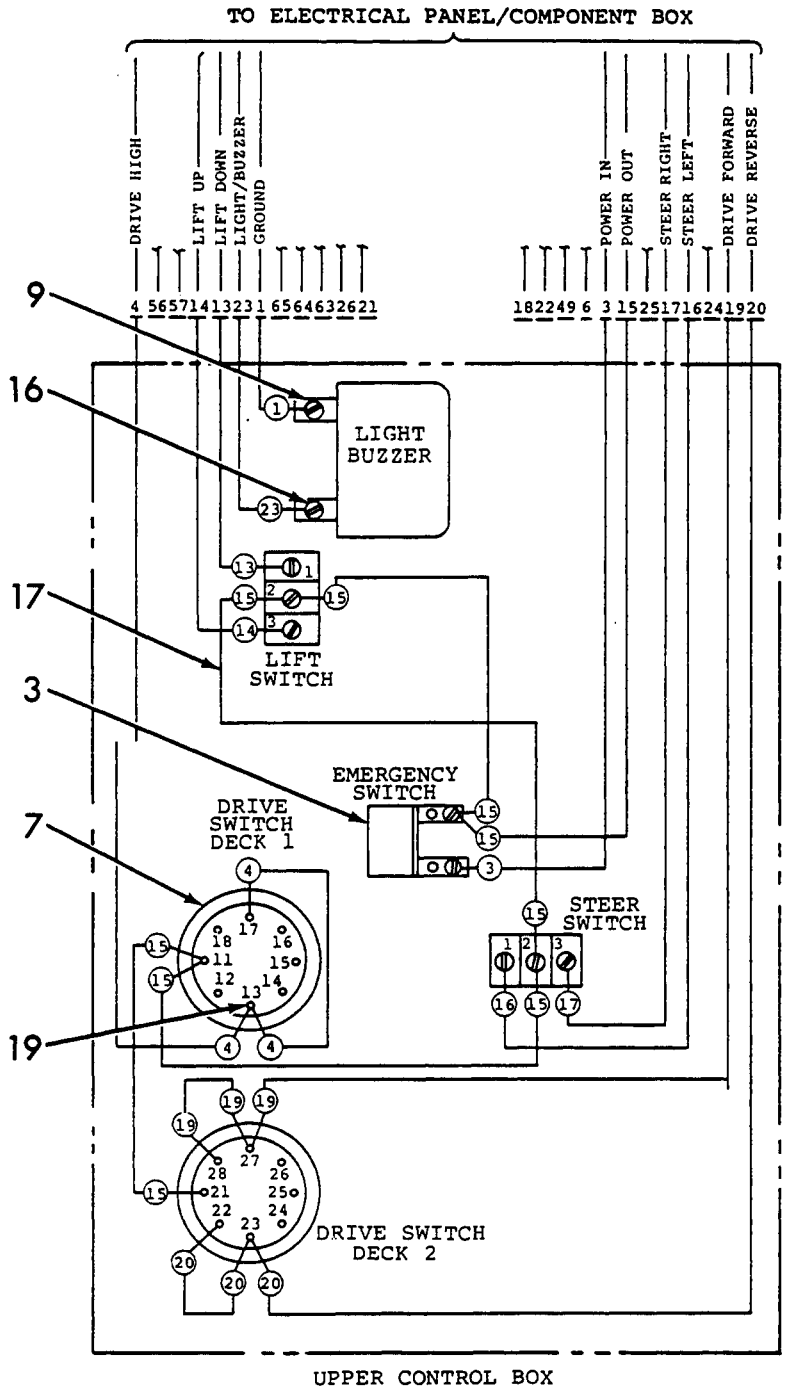
TITLE	UPPER CONTROL BOX ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	2
FIGURE	5
PAGE	1



REV.


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TO ELECTRICAL PANEL/COMPONENT BOX
DRIVE HIGH
LIFT UP
LIFT DOWN
LIGHT/BUZZER
GROUND
POWER IN
POWER OUT
STEER RIGHT
STEER LEFT
DRIVE FORWARD
DRIVE REVERSE
4 56571413231 65646326 21
182249 6 3 15251716241920
9
16
17
3
7
19
LIGHT BUZZER
LIFT SWITCH
EMERGENCY SWITCH
DRIVE SWITCH DECK 1
STEER SWITCH
DRIVE SWITCH DECK 2
UPPER CONTROL BOX

REV.

Mark Industries

TITLE	UPPER CONTROL BOX ASSEMBLY	SECT.	2
MODEL	LS30E & LS36E	FIG.	5
NOTES		PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32408	UPPER CONTROL BOX (See Sect. 2, Fig. 1 or 1A for NHA)	REF
2	31106	.CONTROL BOX MACHINING	1
3	4018	.PUSH PULL SWITCH	1
4	775	.PLUG	1
5	4021	.TOGGLE SWITCH (STEERING & LIFT)	2
6	20805	.BUZZER ALARM	1
7	4106	.5-POSITION SWITCH	1
8	2008	.DECAL	1
9	70198	.RING CONNECTOR	2
10	2015	.DECAL	1
11	2014	.DECAL	1
12	31080	.KNOB (EMERGENCY STOP)	1
13	65151	.KNOB (DRIVE CONTROL)	1
14	31107	.COVER	1
15	771	.PLUG	4
16	117-C	.RING CONNECTOR	11
17	70009	.WIRE	2 FT
18	2807	.STRAIN RELIEF	1
19	16228	.RING CONNECTOR	19
20	61724	.SELF TAPPING SCREW	6
21	62209	.SET SCREW	1
22	2809	.LOCK NUT	1

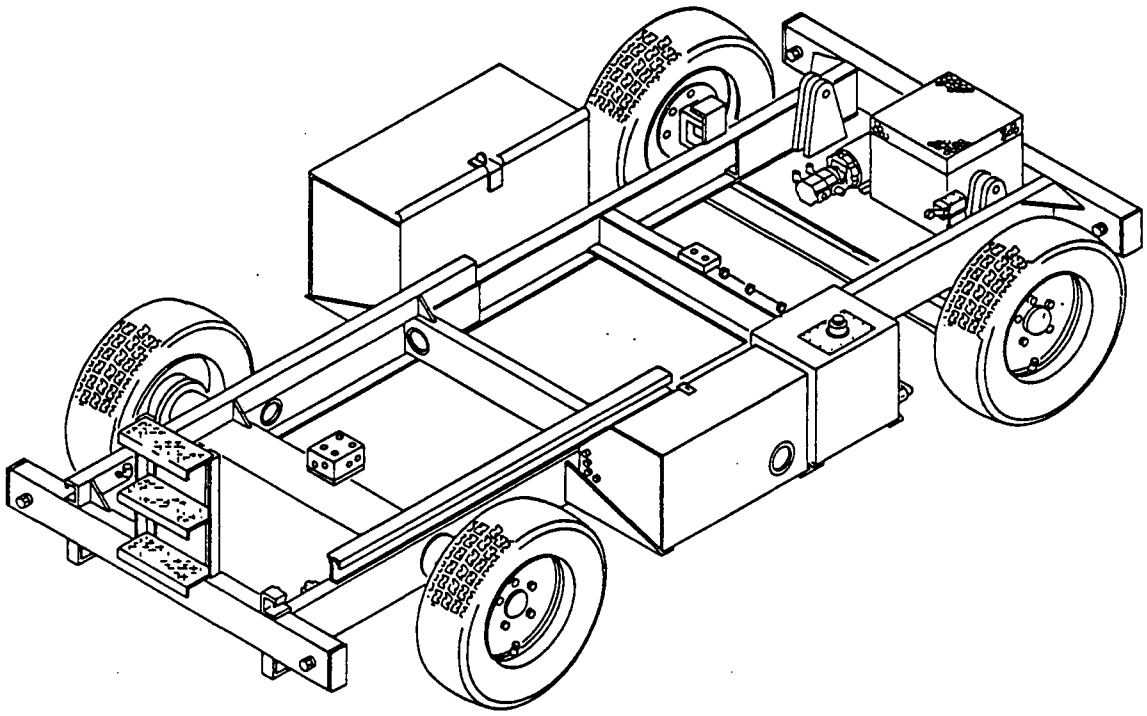
SECTION 3 CONTAINS:

FIG. NO.	TITLE
1	FRAME ASSEMBLY (LS30E)
1A	FRAME ASSEMBLY (LS36E)
2	TIRE & WHEEL ASSEMBLY (LS30E & LS36E)
3	DRIVE/BRAKE VALVE ASSEMBLY (LS30E & LS36E)
4	FRONT HUB ASSEMBLY (LS30E & LS36E)
5	BATTERY BOX (LS30E & LS36E)
6	HYDRAULIC COMPONENT BOX ASSEMBLY (LS30E) (SINCE JUNE 1989)
6A	HYDRAULIC COMPONENT BOX ASSEMBLY (LS36E) (SINCE JUNE 1989)
6B	HYDRAULIC COMPONENT BOX ASSEMBLY (LS30E) (UNTIL JUNE 1989)
6C	HYDRAULIC COMPONENT BOX ASSEMBLY (LS36E) (UNTIL JUNE 1989)
7	HYDRAULIC TANK ASSEMBLY (LS30E & LS36E)
8	MANUAL BATTERY CHARGER (LS30E & LS36E) (115 VAC)
8A	MANUAL BATTERY CHARGER (LS30E & LS36E) (230 VAC)
9	PUMP & MOTOR ASSEMBLY (LS30E & LS36E)
10	TILT SWITCH ASSEMBLY (LS30E & LS36E)
11	DRIVE MOTOR & BRAKE ASSEMBLY (LS30E & LS36E)
12	STEERING CYLINDER ASSEMBLY (LS30E & LS36E)
13	FLOW CONTROL VALVE ASSEMBLY (LS30E & LS36E)
14	VALVE PACKAGE ASSEMBLY (LS30E & LS36E) (SINCE JUNE 1989)
14A	VALVE PACKAGE ASSEMBLY (LS30E & LS36E) (UNTIL JUNE 1989)
15	LOWERING CONTROL VALVE ASSEMBLY (LS30E & LS36E)
16	DRIVE SOLENOID VALVE ASSEMBLY (LS30E & LS36E)

(CONTINUED ON NEXT PAGE)

SECTION 3 (CONT'D)

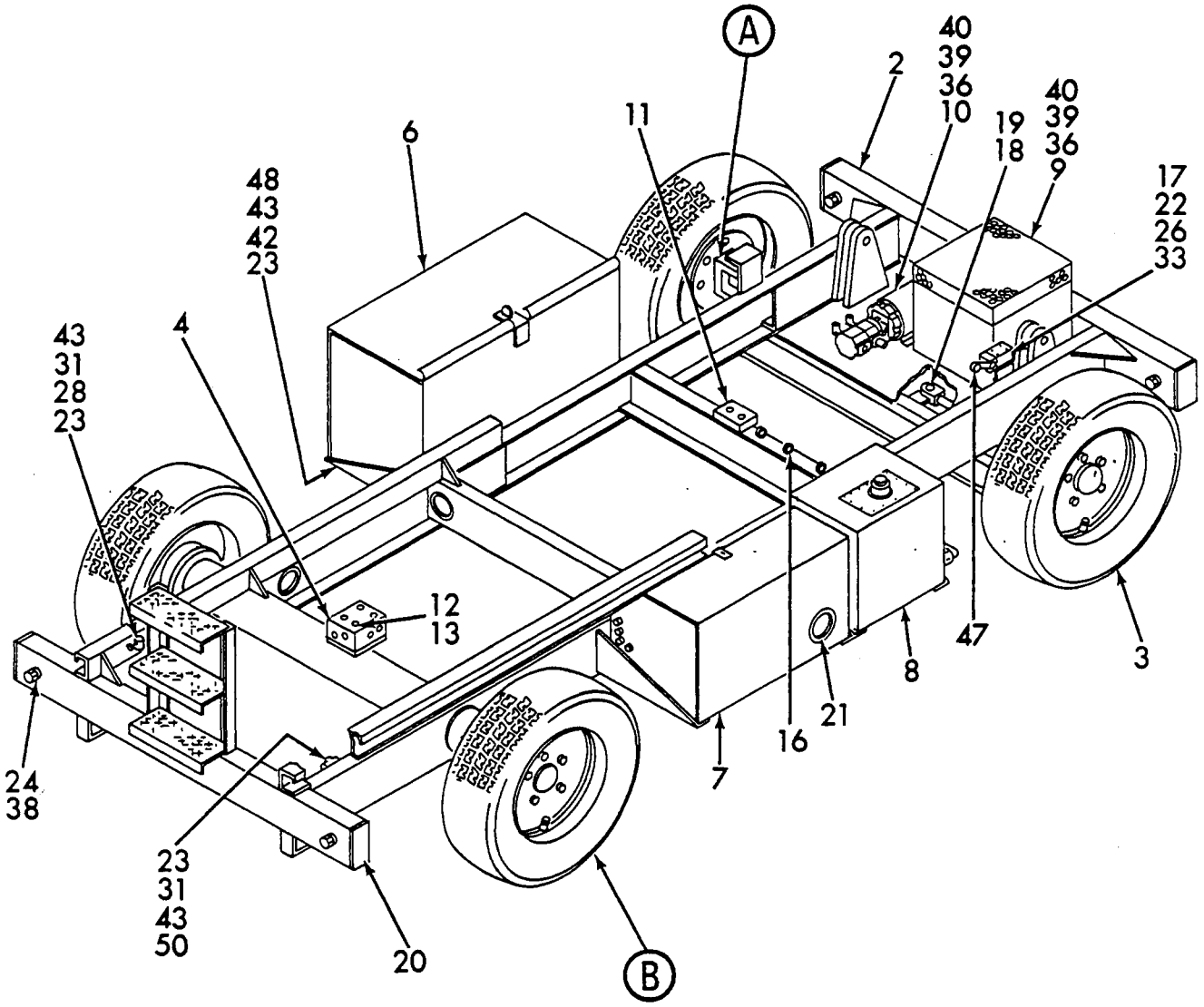
FIG. NO.	TITLE
17	ELECTRICAL PANEL ASSEMBLY (LS30E)
18	WHEEL MOUNTING BRAKE ASSEMBLY (LS30E & LS36E)
19	DRIVE MOTOR (LS30E & LS36E) (SINCE OCTOBER 1988)
19A	DRIVE MOTOR (LS30E & LS36E) (UNTIL OCTOBER 1988)



Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	3
FIGURE	1
PAGE	1

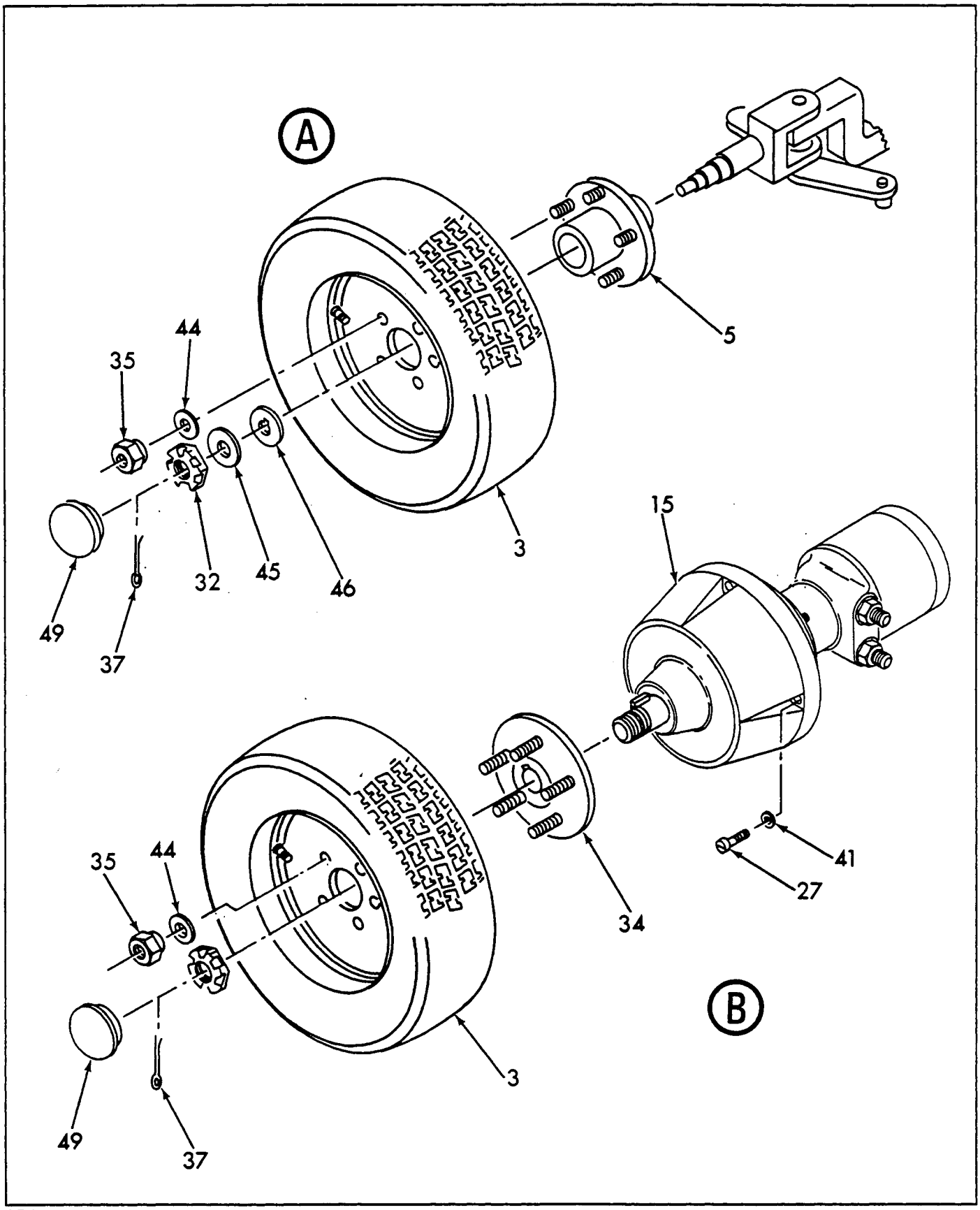


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Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	3
FIGURE	1
PAGE	2



REV.

Mark Industries

TITLE	FRAME ASSEMBLY	SECT.	3
MODEL	LS30E	FIG.	1
NOTES		PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32379	FRAME ASSEMBLY (See Sect. 2, Fig. 1 for NHA)	REF
2	32443	.FRAME WELDMENT	1
3	30358	.TIRE & WHEEL ASSEMBLY (See Sect. 3, Fig. 2 for Details)	4
4	32475	.DRIVE & BRAKE VALVE ASSEMBLY (See Sect. 3, Fig. 3 for Details)	1
5	31285	.FRONT HUB ASSEMBLY (See Sect. 3, Fig. 4 for Details)	2
6	30466	.BATTERY BOX ASSEMBLY (See Sect. 3, Fig. 5 for Details)	1
7	32375	.HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 6 for Details)	1
8	32429	.HYDRAULIC TANK ASSEMBLY (See Sect. 3, Fig. 7 for Details)	1
9	4006	.BATTERY CHARGER (See Sect. 3, Fig. 8 for Details)	1
10	32577	.HYDRAULIC PUMP & MOTOR ASSEMBLY (See Sect. 3, Fig. 9 for Details)	1
11	30387	.TILT SWITCH ASSEMBLY (See Sect. 3, Fig. 10 for Details)	1
12	60428	.CAP SCREW	2
13	63303	.LOCK WASHER	2
-14	80014-05	.UNION ELBOW	2
15	32462	.DRIVE MOTOR/BRAKE ASSEMBLY (See Sect. 3, Fig. 11 for Details)	2
16	764	.RUBBER CLAMP	4
17	70173	.LIMIT SWITCH	1
18	32584	.STEERING CYLINDER ASSEMBLY (See Sect. 3, Fig. 12 for Details)	1
19	64309	.COTTER PIN	2

Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS30E
NOTES	

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FIG.	1
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
20	30448	.BUMPER CAP	4
21	411	.EXTRUSION	5 FT.
22	2808	.LOCK NUT	1
23	63301	.LOCK WASHER	20
24	63434	.FLAT WASHER	8
-25	22	.CLAMP	2
26	62708	.MACHINE SCREW	2
27	61948	.CAP SCREW	8
28	32578	.NEEDLE VALVE ASSEMBLY	1
-29	201	..NEEDLE VALVE	1
-30	80008-13	..ELBOW	1
31	65218	.U-BOLT	2
32	16115	.SLOTTED JAM NUT	2
33	2806	.STRAIN RELIEF	1
34	30294	.DRIVE HUB	2
35	61314	.LOCK NUT	20
36	882	.LOAD/MOUNTING PAD	8
37	64310	.COTTER PIN	4
38	60324	.CAP SCREW	8
39	60702	.HEX NUT	16
40	63302	.LOCK WASHER	16
41	63305	.LOCK WASHER	8
42	60309	.CAP SCREW	16
43	60701	.HEX NUT	20
44	63501	.FLAT WASHER	20

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Mark Industries

TITLE	FRAME ASSEMBLY	SECT.	3
MODEL	LS30E	FIG.	1
NOTES		PAGE	5

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
45	63408	.FLAT WASHER	1
46	63453	.KEY WASHER	2
47	70032	.OPERATING LEVER	1
48	63401	.FLAT WASHER	12
49	16274	.DUST CAP	2
50	32579	.FLOW CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 13 for Details)	1
-51	256	.CABLE TIE	50
-52	255	.CABLE TIE	50

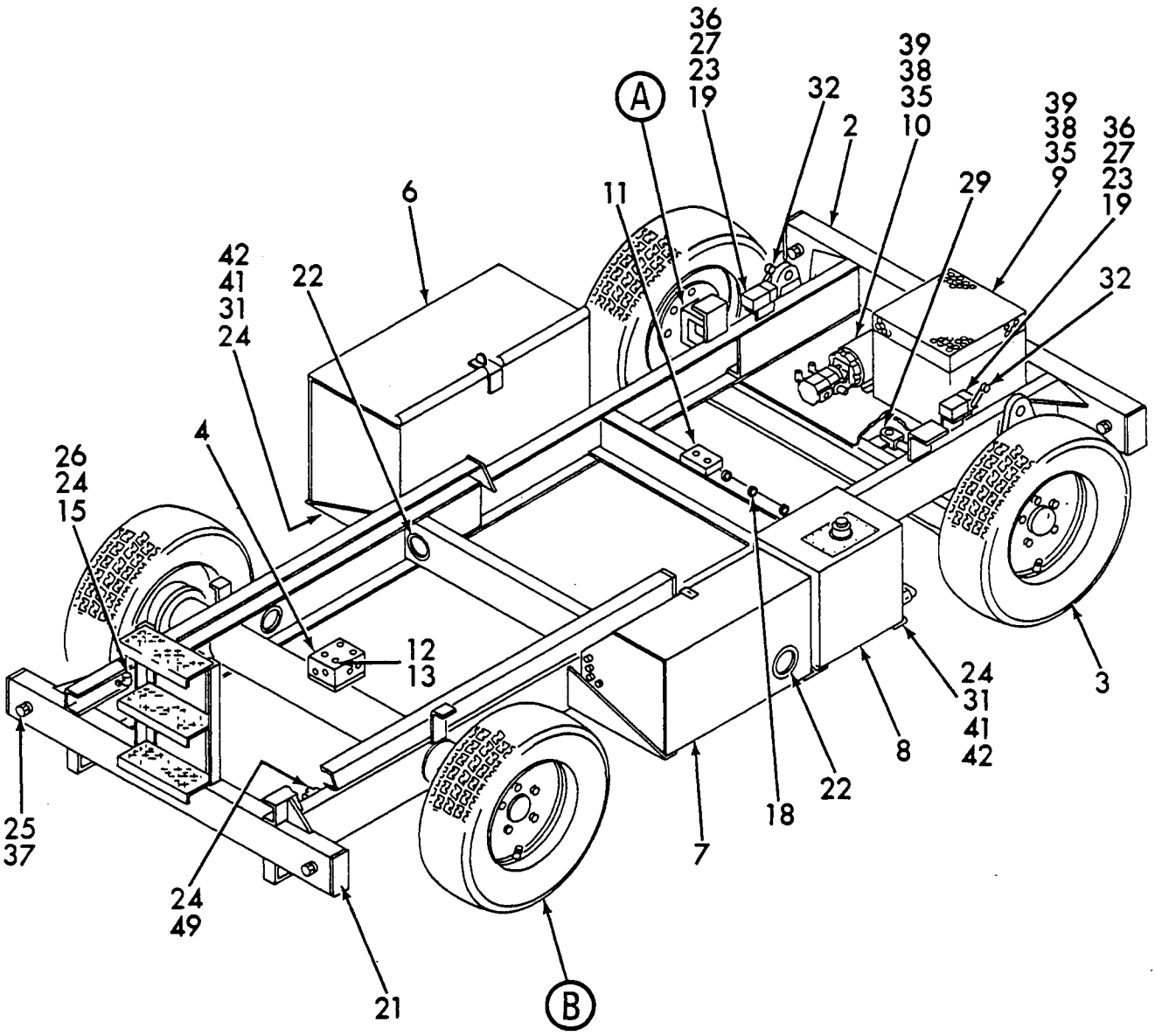
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Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS36E
NOTES	

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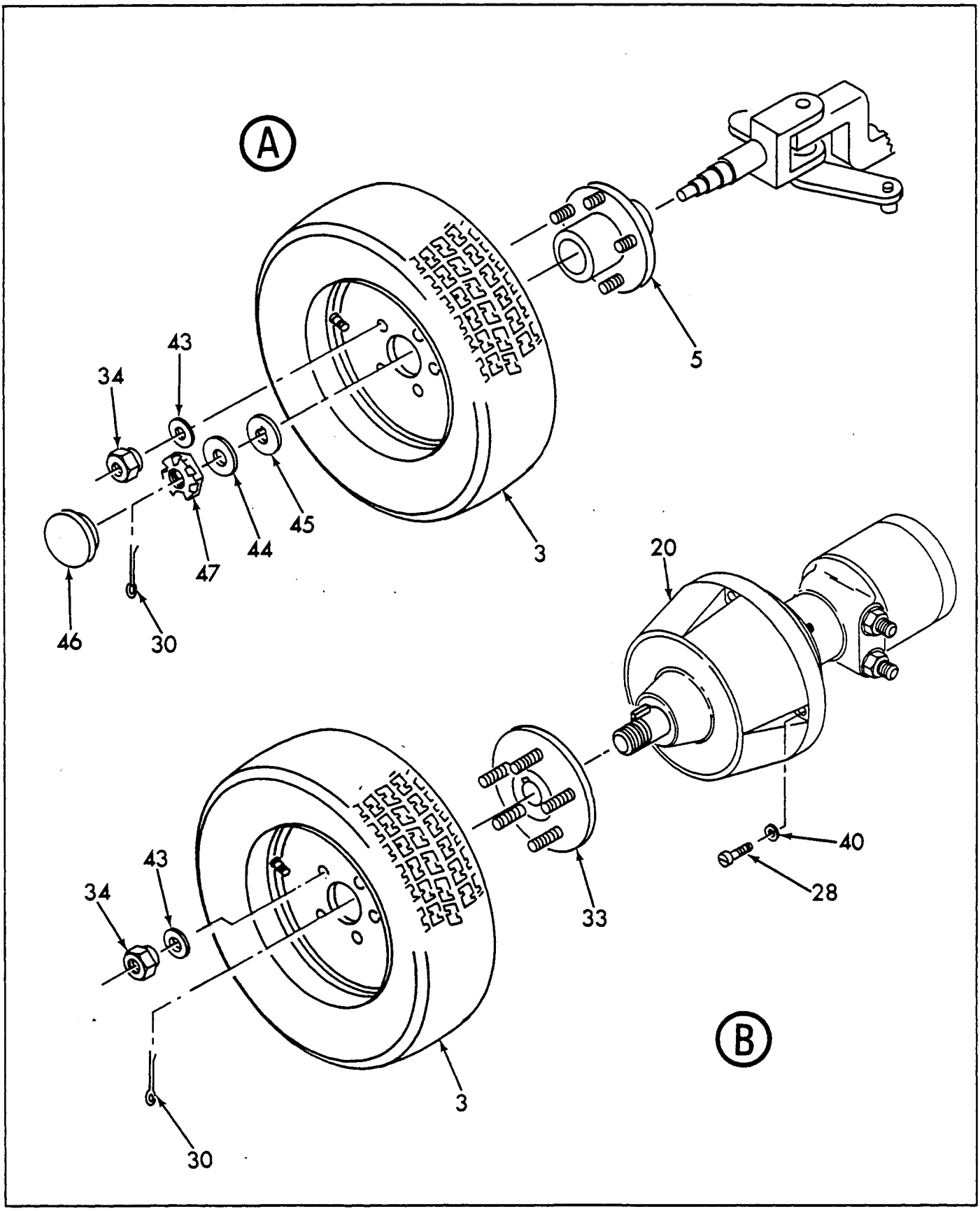


REV.

Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS36E
NOTES	

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FIGURE	1A
PAGE	2



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Mark Industries

TITLE	FRAME ASSEMBLY
MODEL	LS36E
NOTES	

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FIG.	1A
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32383	FRAME ASSEMBLY (See Sect. 2, Fig. 1A for NHA)	REF
2	32447	.FRAME WELDMENT	1
3	30358	.TIRE & WHEEL ASSEMBLY (See Sect. 3, Fig. 2 for Details)	4
4	32475	.DRIVE & BRAKE VALVE ASSEMBLY (See Sect. 3, Fig. 3 for Details)	1
5	31285	.FRONT HUB ASSEMBLY (See Sect. 3, Fig. 4 for Details)	2
6	30466	.BATTERY BOX ASSEMBLY (See Sect. 3, Fig. 5 for Details)	1
7	32484	.HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 6A for Details)	1
8	32429	.HYDRAULIC TANK ASSEMBLY (See Sect. 3, Fig. 7 for Details)	1
9	4006	.BATTERY CHARGER (See Sect. 3, Fig. 8 for Details)	1
10	32577	.HYDRAULIC PUMP & MOTOR ASSEMBLY (See Sect. 3, Fig. 9 for Details)	1
11	30387	.TILT SWITCH ASSEMBLY (See Sect. 3, Fig. 10 for Details)	1
12	60428	.CAP SCREW	2
13	63303	.LOCK WASHER	2
-14	80014-05	.UNION ELBOW	2
15	32578	.NEEDLE VALVE ASSEMBLY	1
-16	201	..NEEDLE VALVE	1
-17	80008-13	..ELBOW	1
18	764	.CLAMP	4
19	70173	.LIMIT SWITCH	2
20	32462	.DRIVE MOTOR & BRAKE ASSEMBLY (See Sect. 3, Fig. 11 for Details)	1

Mark Industries

TITLE	FRAME ASSEMBLY	SECT. 3
MODEL	LS36E	FIG. 1A
NOTES		PAGE 4

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
21	30448	.BUMPER CAP	4
22	411	.EXTRUSION	5 FT.
23	2808	.LOCK NUT	4
24	63301	.LOCK WASHER	20
25	63434	.FLAT WASHER	8
26	65218	.U-BOLT ¼-20 UNC	1
27	62708	.MACHINE SCREW	4
28	61948	.CAP SCREW	8
29	32584	.STEERING CYLINDER ASSEMBLY (See Sect. 3, Fig. 12 for Details)	1
30	64310	.COTTER PIN	4
31	63401	.FLAT WASHER	16
32	70032	.OPERATING LEVER	2
33	30294	.DRIVE HUB	2
34	61314	.LOCK NUT	20
35	882	.LOAD/MOUNTING PAD	8
36	2806	.STRAIN RELIEF	2
37	60324	.CAP SCREW	8
38	60702	.HEX NUT	16
39	63302	.LOCK WASHER	16
40	63305	.LOCK WASHER	8
41	60309	.CAP SCREW	16
42	60701	.HEX NUT	20
43	63501	.FLAT WASHER	20
44	63408	.FLAT WASHER	2
45	63453	.KEY WASHER	2

Mark Industries

TITLE	FRAME ASSEMBLY	SECT.	3
MODEL	LS36E	FIG.	1A
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
46	16274	.DUST CAP	2
47	16115	.SLOTTED JAM NUT	2
-48	22	.LARGE CLIP	1
49	32579	.FLOW CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 13 for Details)	1
50	255	.CABLE TIE	50
51	256	.CABLE TIE	50

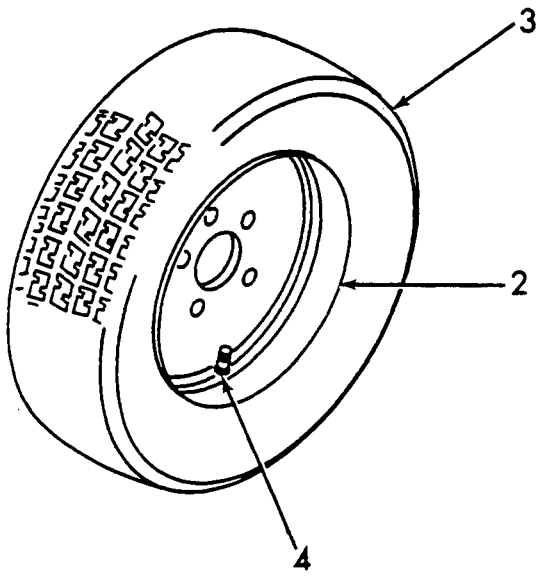
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Mark Industries

TITLE	TIRE & WHEEL ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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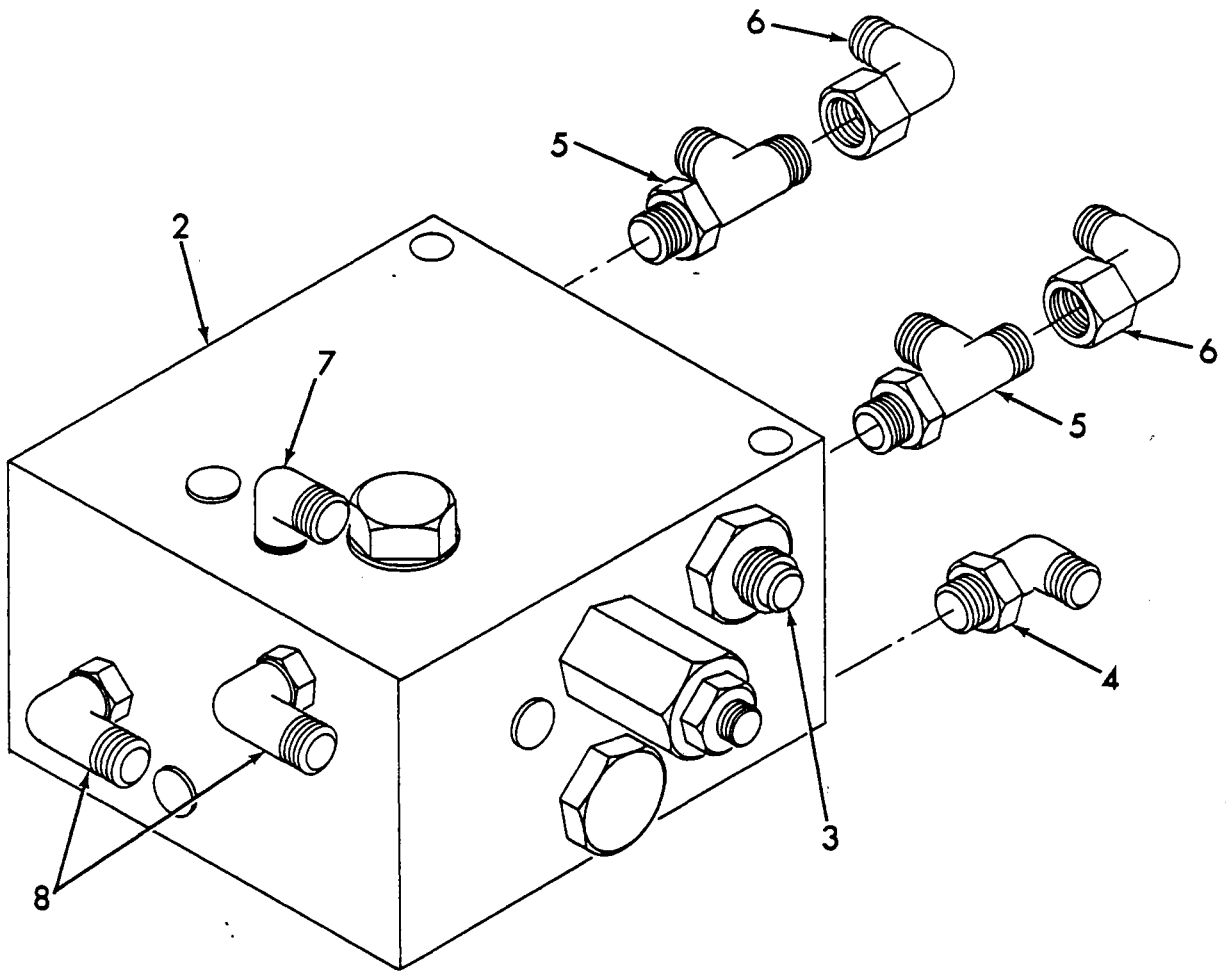
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30358	TIRE & WHEEL ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	30356	.WHEEL	1
3	30357	.TIRE	1
4	2252	.VALVE SYSTEM	1

REV.

Mark Industries

TITLE	DRIVE & BRAKE VALVE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIGURE	3
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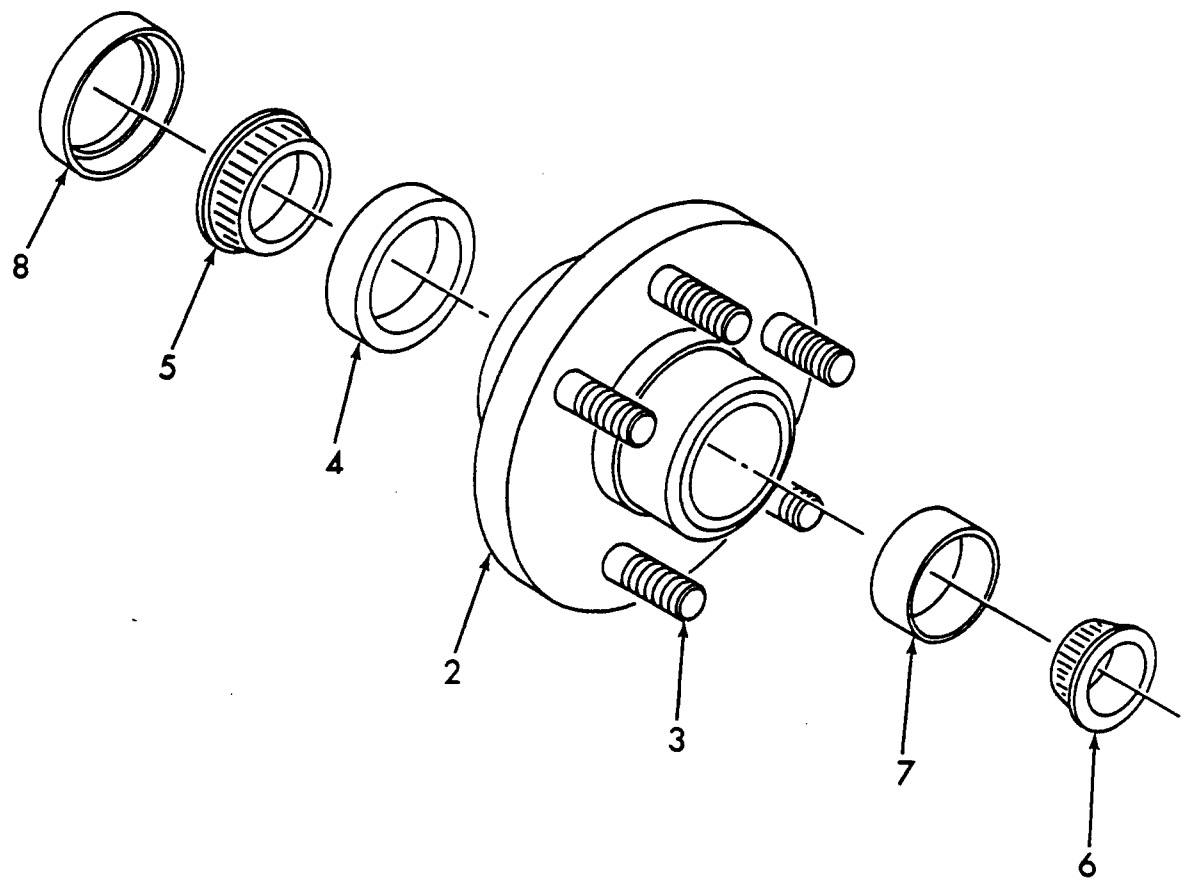
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32475	DRIVE BRAKE VALVE ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	21214	.DRIVE BRAKE VALVE	1
3	80004-11	.STRAIGHT THREAD CONNECTOR	1
4	80012-11	.STRAIGHT THREAD ELBOW	1
5	80033-11	.STRAIGHT THREAD TEE	2
6	80015-06	.SWIVEL NUT ELBOW	2
7	80008-04	.MALE ELBOW	1
8	80012-16	.STRAIGHT THREAD ELBOW	2

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Mark Industries

TITLE	HUB ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIGURE	4
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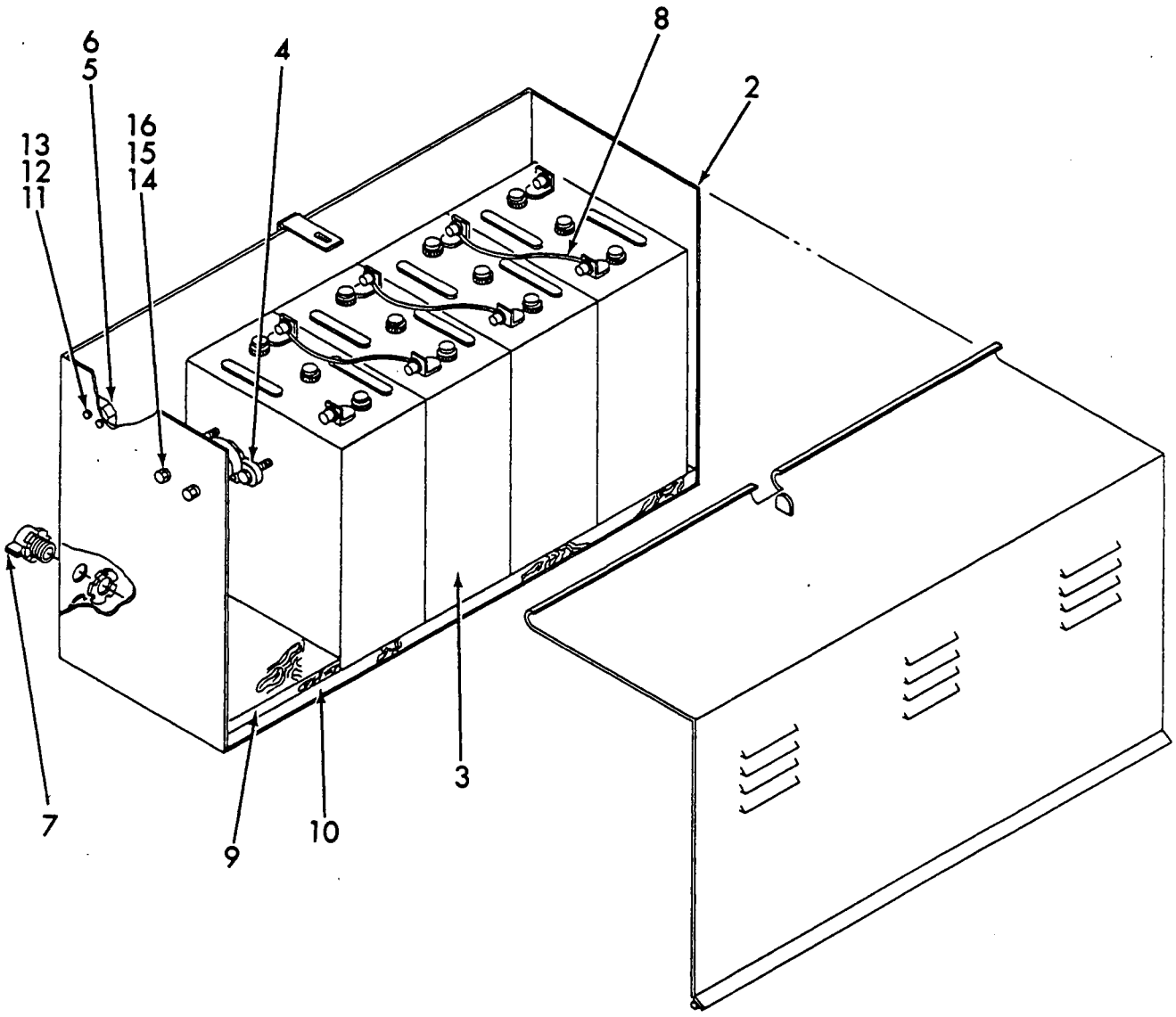
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	31285	HUB ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	31144	.HUB MACHINING	1
3	65530	.WHEEL BOLT	5
4	66136	.INNER BEARING CUP	1
5	66135	.INNER BEARING CONE	1
6	66139	.OUTER BEARING CONE	1
7	66138	.OUTER BEARING CUP	1
8	66134	.GREASE SEAL	1

REV.

Mark Industries

TITLE	BATTERY BOX ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIGURE	5
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Mark Industries

TITLE	BATTERY BOX ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIG.	5
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30466	BATTERY BOX ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	30287	.BATTERY BOX	1
3	30297	.BATTERY	4
4	4083	.RELAY (400 AMP)	1
5	784 A	.8 PIN SOCKET	1
6	4032	.RELAY	1
7	213	.CONNECTOR	2
8	13226-0120	.BATTERY CABLE	3
9	65139	.PLYWOOD	1
10	65277	.PLYWOOD	1
11	62609	.MACHINE SCREW	2
12	61501	.NUT	2
13	63311	.LOCK WASHER	2
14	60353	.CAP SCREW	2
15	60701	.NUT	2
16	63301	.LOCK WASHER	2

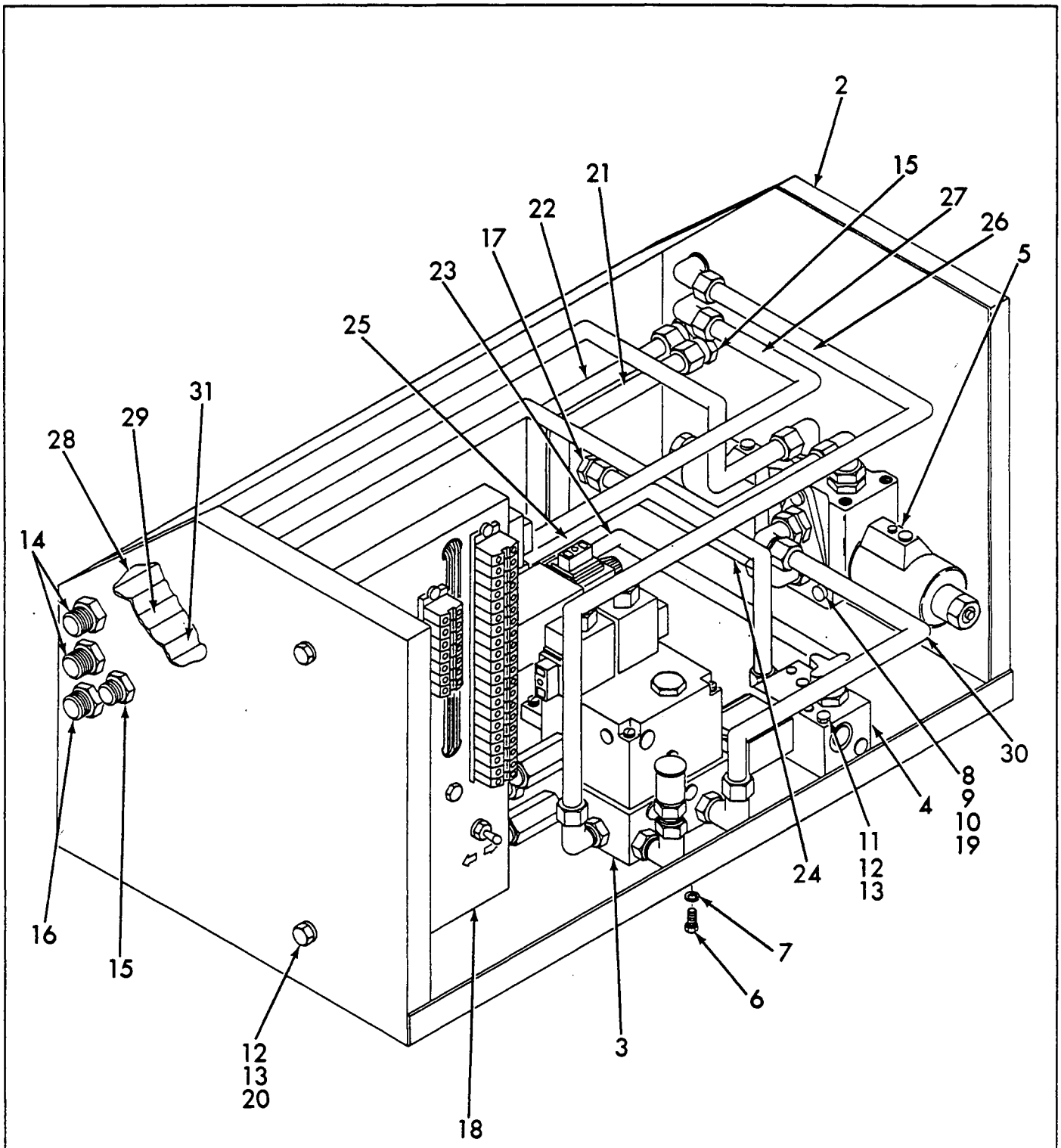
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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
NOTES	SINCE JUNE 1989

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FIGURE	6
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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
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FIG.	6
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32375	HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 1 for NHA)	REF
2	32530	.COMPONENT BOX	1
3	32761	.VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 14 for Details)	1
4	32557	.LOWERING CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 15 for Details)	1
5	32762	.DRIVE SOLENOID VALVE ASSEMBLY (See Sect. 3, Fig. 16 for Details)	1
6	60320	.CAP SCREW	2
7	63303	.LOCK WASHER	2
8	60339	.CAP SCREW	3
9	63302	.LOCK WASHER	3
10	60702	.HEX NUT	3
11	60352	.CAP SCREW	2
12	63301	.LOCK WASHER	5
13	60701	.HEX NUT	5
14	80045-07	.BULKHEAD UNION	2
15	80045-05	.BULKHEAD UNION	3
16	80045-06	.BULKHEAD UNION	1
17	80011-07	.BULKHEAD ELBOW UNION	3
18	32394	.ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 17 for Details)	1
19	63402	.FLAT WASHER	3
20	60353	.CAP SCREW	1
21	32484-1	.TUBE ASSEMBLY	1
22	32484-2	.TUBE ASSEMBLY	1
23	32484-3	.TUBE ASSEMBLY	1

Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
NOTES	SINCE JUNE 1989

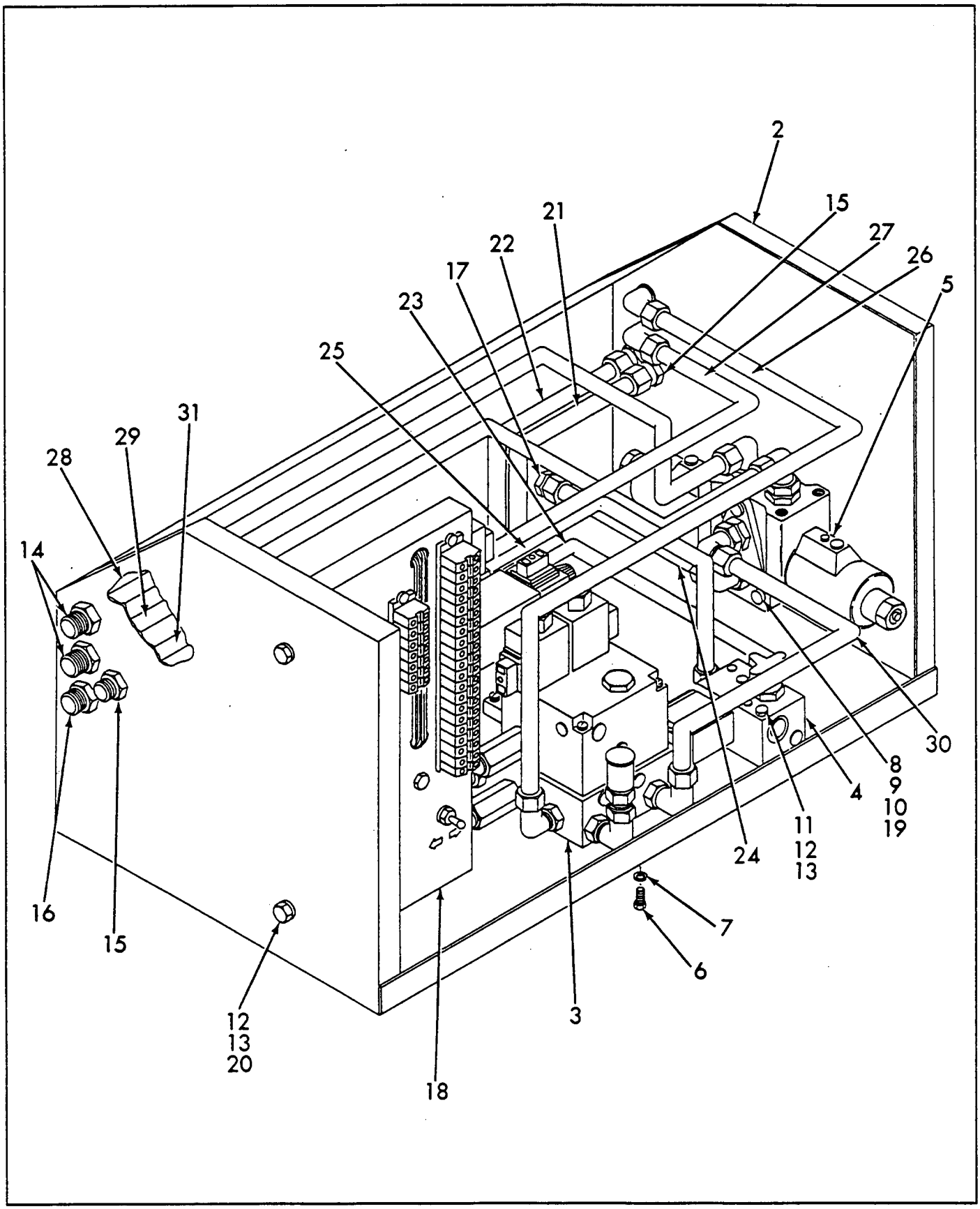
SECT.	3
FIG.	6
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
24	32484-4	.TUBE ASSEMBLY	1
25	32484-5	.TUBE ASSEMBLY	1
26	32484-6	.TUBE ASSEMBLY	1
27	32484-7	.TUBE ASSEMBLY	1
28	32484-8	.TUBE ASSEMBLY	1
29	32484-9	.TUBE ASSEMBLY	1
30	32484-10	.TUBE ASSEMBLY	1
31	32484-11	.TUBE ASSEMBLY	1

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TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS36E
NOTES	SINCE JUNE 1989

SECTION	3
FIGURE	6A
PAGE	1



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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS36E
NOTES	SINCE JUNE 1989

SECT.	3
FIG.	6A
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32484	HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 1A for NHA)	REF
2	32530	.COMPONENT BOX	1
3	32761	.VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 14 for Details)	1
4	32557	.LOWERING CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 15 for Details)	1
5	32762	.DRIVE SOLENOID VALVE ASSEMBLY (See Sect. 3, Fig. 16 for Details)	1
6	60320	.CAP SCREW	2
7	63303	.LOCK WASHER	2
8	60339	.CAP SCREW	3
9	63302	.LOCK WASHER	3
10	60702	.HEX NUT	3
11	60352	.CAP SCREW	2
12	63301	.LOCK WASHER	5
13	60701	.HEX NUT	5
14	80045-07	.BULKHEAD UNION	2
15	80045-05	.BULKHEAD UNION	3
16	80045-06	.BULKHEAD UNION	1
17	80011-07	.BULKHEAD ELBOW UNION	3
18	32481	.ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 17 for Details)	1
19	63402	.FLAT WASHER	3
20	60353	.CAP SCREW	1
21	32484-1	.TUBE ASSEMBLY	1
22	32484-2	.TUBE ASSEMBLY	1
23	32484-3	.TUBE ASSEMBLY	1

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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS 36 E
NOTES	SINCE JUNE 1989

SECT.	3
FIG.	6A
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
24	32484-4	.TUBE ASSEMBLY	1
25	32484-5	.TUBE ASSEMBLY	1
26	32484-6	.TUBE ASSEMBLY	1
27	32484-7	.TUBE ASSEMBLY	1
28	32484-8	.TUBE ASSEMBLY	1
29	32484-9	.TUBE ASSEMBLY	1
30	32484-10	.TUBE ASSEMBLY	1
31	32484-11	.TUBE ASSEMBLY	1

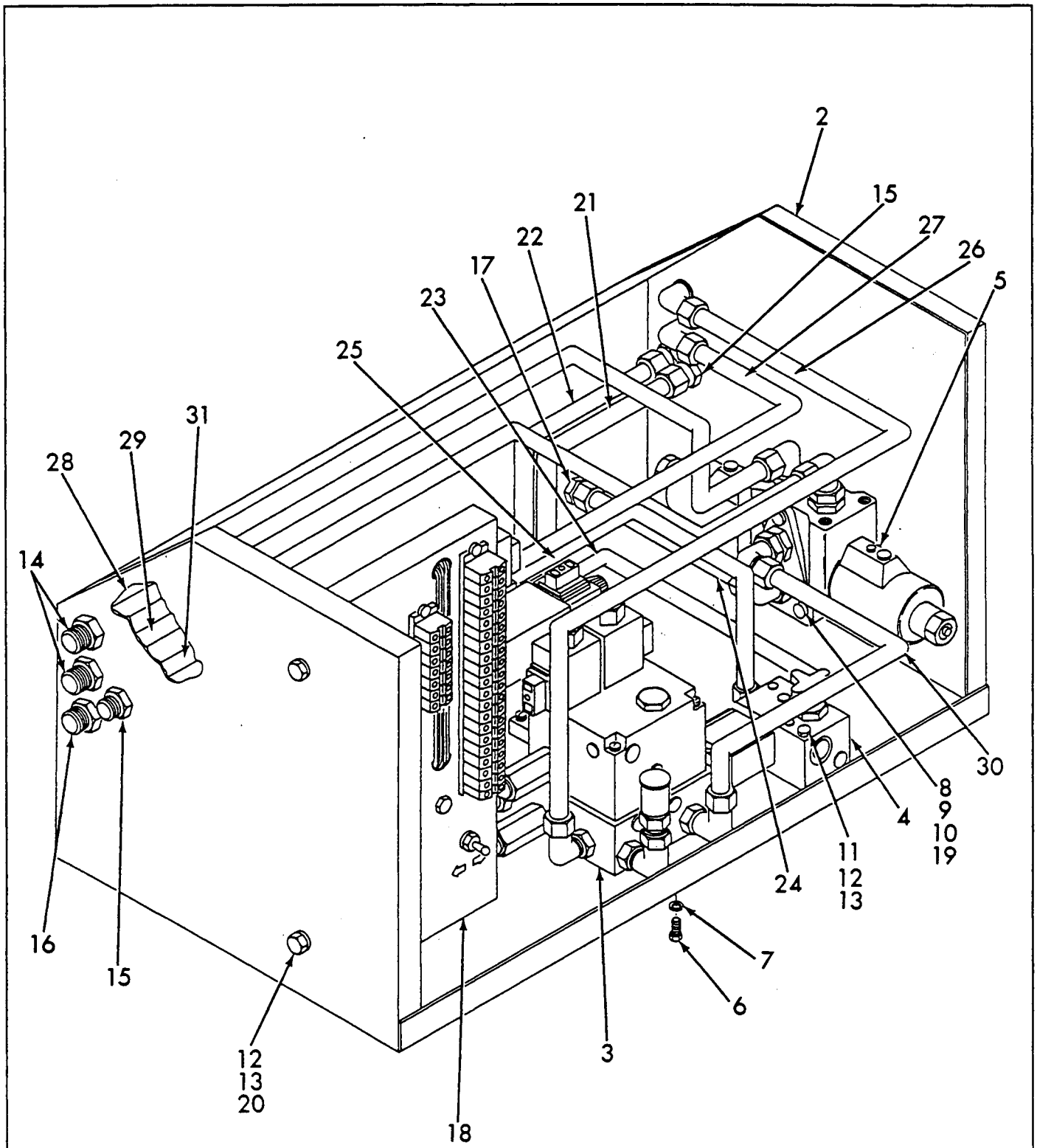
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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
NOTES	UNTIL JUNE 1989

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FIGURE	6B
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REV.

Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
NOTES	UNTIL JUNE 1989

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FIG.	6B
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32375	HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 1 for NHA)	REF
2	32530	.COMPONENT BOX	1
3	32358	.VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 14 for Details)	1
4	32557	.LOWERING CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 15 for Details)	1
5	32762	.DRIVE SOLENOID VALVE ASSEMBLY (See Sect. 3, Fig. 16 for Details)	1
6	60320	.CAP SCREW	2
7	63303	.LOCK WASHER	2
8	60339	.CAP SCREW	3
9	63302	.LOCK WASHER	3
10	60702	.HEX NUT	3
11	60352	.CAP SCREW	2
12	63301	.LOCK WASHER	5
13	60701	.HEX NUT	5
14	80045-07	.BULKHEAD UNION	2
15	80045-05	.BULKHEAD UNION	3
16	80045-06	.BULKHEAD UNION	1
17	80011-07	.BULKHEAD ELBOW UNION	3
18	32394	.ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 17 for Details)	1
19	63402	.FLAT WASHER	3
20	60353	.CAP SCREW	1
21	32484-1	.TUBE ASSEMBLY	1
22	32484-2	.TUBE ASSEMBLY	1
23	32484-3	.TUBE ASSEMBLY	1

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TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS30E
NOTES	UNTIL JUNE 1989

SECT.	3
FIG.	6B
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
24	32484-4	.TUBE ASSEMBLY	1
25	32484-5	.TUBE ASSEMBLY	1
26	32484-6	.TUBE ASSEMBLY	1
27	32484-7	.TUBE ASSEMBLY	1
28	32484-8	.TUBE ASSEMBLY	1
29	32484-9	.TUBE ASSEMBLY	1
30	32484-10	.TUBE ASSEMBLY	1
31	32484-11	.TUBE ASSEMBLY	1

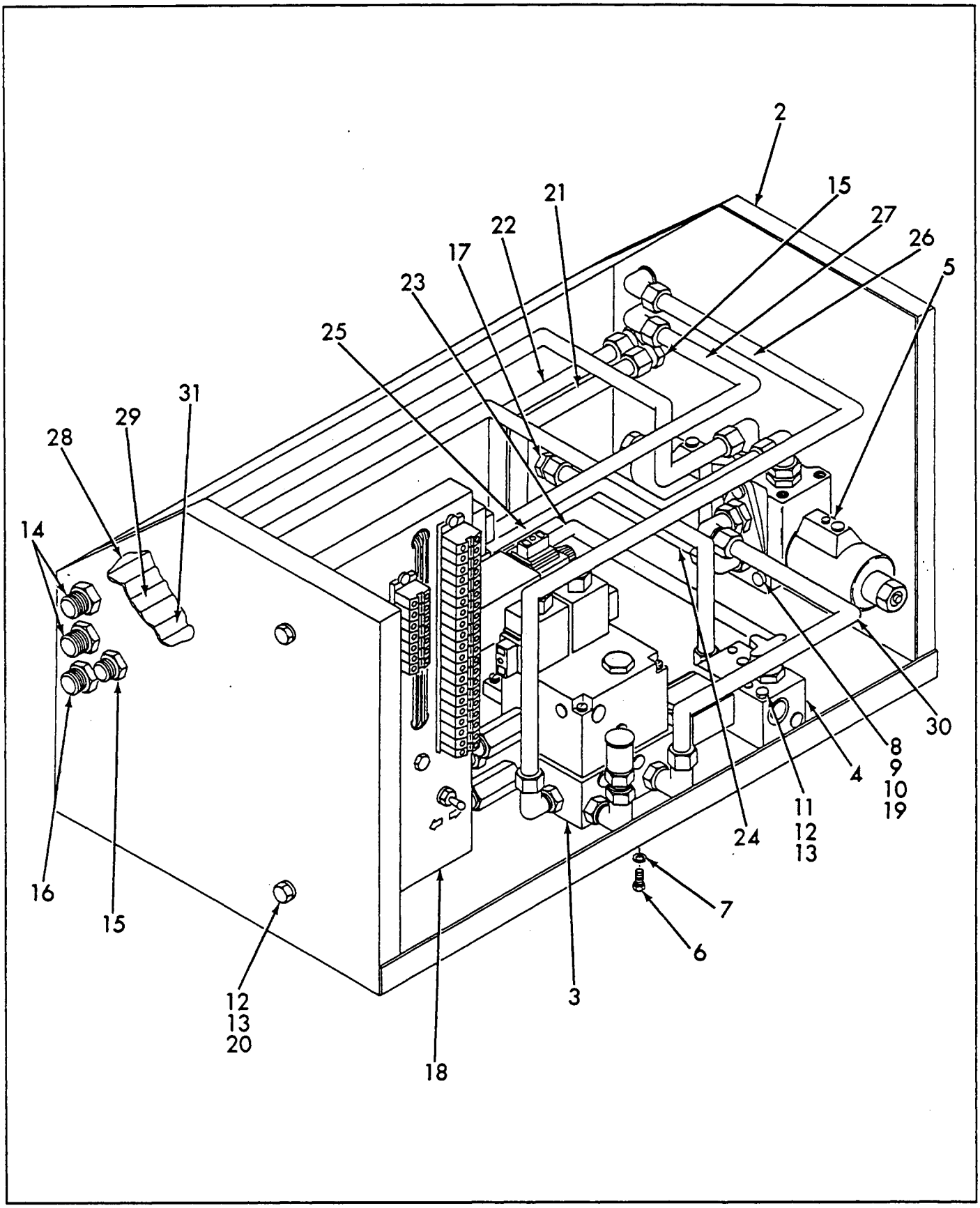
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Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS36E
NOTES	UNTIL JUNE 1989

SECTION	3
FIGURE	6C
PAGE	1



REV.

Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS36E
NOTES	UNTIL JUNE 1989

SECT.	3
FIG.	6C
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32484	HYDRAULIC COMPONENT BOX ASSEMBLY (See Sect. 3, Fig. 1A for NHA)	REF
2	32530	.COMPONENT BOX	1
3	32358	.VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 14 for Details)	1
4	32557	.LOWERING CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 15 for Details)	1
5	32762	.DRIVE SOLENOID VALVE ASSEMBLY (See Sect. 3, Fig. 16 for Details)	1
6	60320	.CAP SCREW	2
7	63303	.LOCK WASHER	2
8	60339	.CAP SCREW	3
9	63302	.LOCK WASHER	3
10	60702	.HEX NUT	3
11	60352	.CAP SCREW	2
12	63301	.LOCK WASHER	5
13	60701	.HEX NUT	5
14	80045-07	.BULKHEAD UNION	2
15	80045-05	.BULKHEAD UNION	3
16	80045-06	.BULKHEAD UNION	1
17	80011-07	.BULKHEAD ELBOW UNION	3
18	32481	.ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 17 for Details)	1
19	63402	.FLAT WASHER	3
20	60353	.CAP SCREW	1
21	32484-1	.TUBE ASSEMBLY	1
22	32484-2	.TUBE ASSEMBLY	1
23	32484-3	.TUBE ASSEMBLY	1

Mark Industries

TITLE	HYDRAULIC COMPONENT BOX ASSEMBLY
MODEL	LS36E
NOTES	UNTIL JUNE 1989

SECT.	3
FIG.	6C
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
24	32484-4	.TUBE ASSEMBLY	1
25	32484-5	.TUBE ASSEMBLY	1
26	32484-6	.TUBE ASSEMBLY	1
27	32484-7	.TUBE ASSEMBLY	1
28	32484-8	.TUBE ASSEMBLY	1
29	32484-9	.TUBE ASSEMBLY	1
30	32484-10	.TUBE ASSEMBLY	1
31	32484-11	.TUBE ASSEMBLY	1

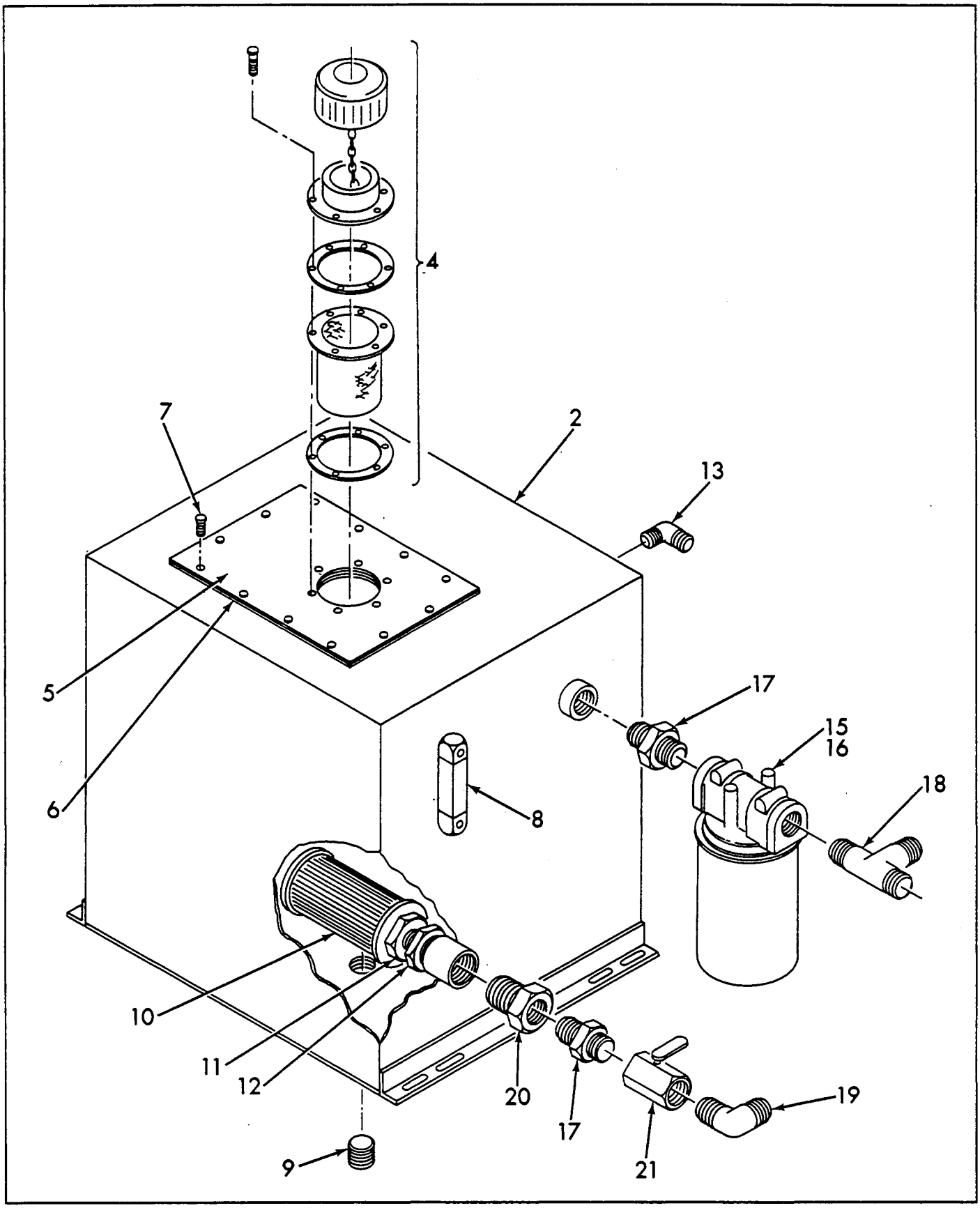
REV.

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

Mark Industries

TITLE	HYDRAULIC TANK ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	7
PAGE	1



REV.

Mark Industries

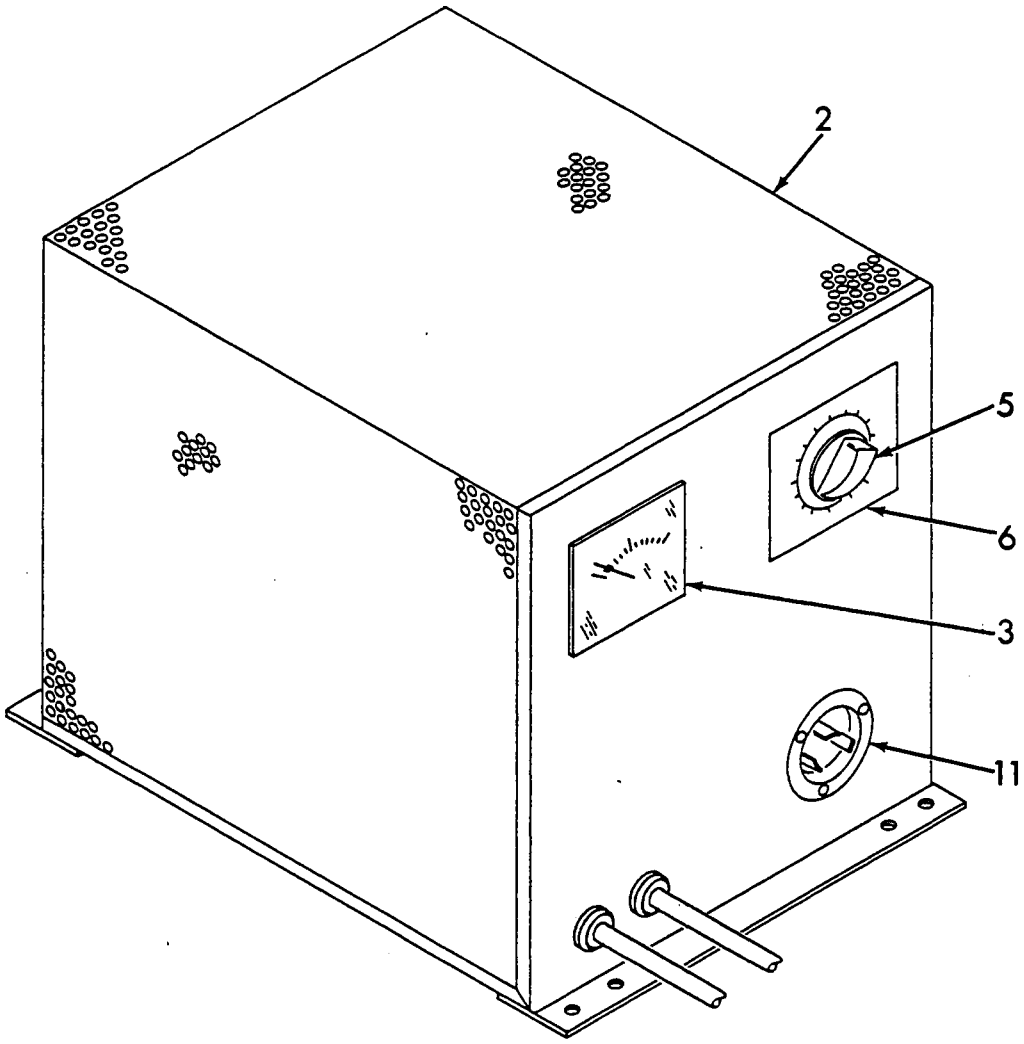
TITLE	HYDRAULIC TANK ASSEMBLY	SECT.	3
MODEL	LS30E & LS36E	FIG.	7
NOTES		PAGE	2

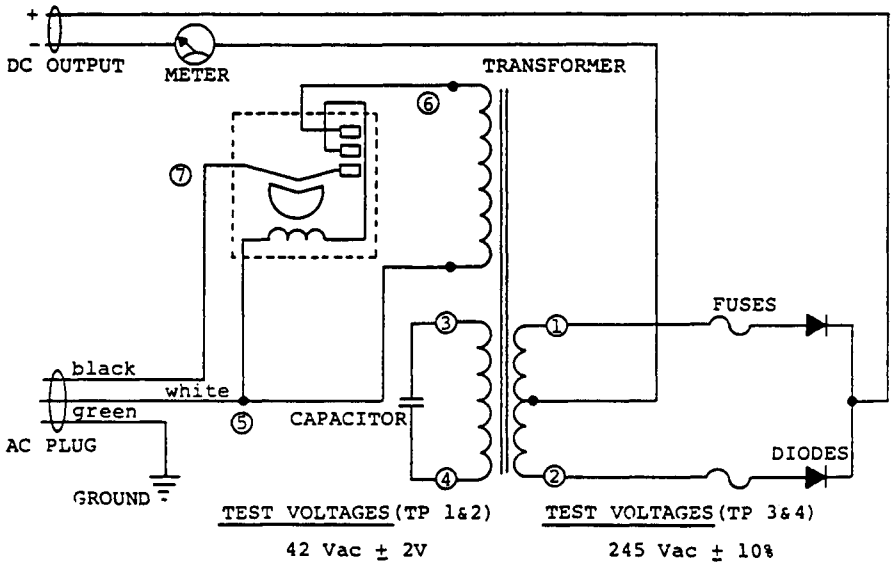
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32429	HYDRAULIC TANK ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	32366	.HYDRAULIC TANK SUB-ASSEMBLY	1
-3	32428	..HYDRAULIC TANK WELDMENT	1
4	3005	..BREATHER ASSEMBLY	1
5	8319	..HYDRAULIC TANK COVER	1
6	8320	..HYDRAULIC TANK GASKET	1
7	61718	..CAP SCREW	12
8	3018	..SIGHT GAUGE	1
9	3027	..MAGNETIC DRAIN PLUG	1
10	81084	..STRAINER	1
11	80052-12	..PIPE NIPPLE	1
12	80057-22	..PIPE REDUCER	1
13	80008-03	.MALE ELBOW	1
-14	80052-10	.PIPE NIPPLE	1
15	30306	.FILTER	1
-16	20477	..FILTER CARTRIDGE ONLY	1
17	2493	.CLOSE NIPPLE	2
18	80037-18	.MALE RUN TEE	1
19	80008-19	.MALE ELBOW	1
20	53800	.REDUCER	1
21	3033	.BALL VALVE	1

Mark Industries

TITLE	MANUAL BATTERY CHARGER
MODEL	LS30E & LS36E
NOTES	115 VAC 60 HZ/24 VDC 40 AMP

SECTION	3
FIGURE	8
PAGE	1





REV.

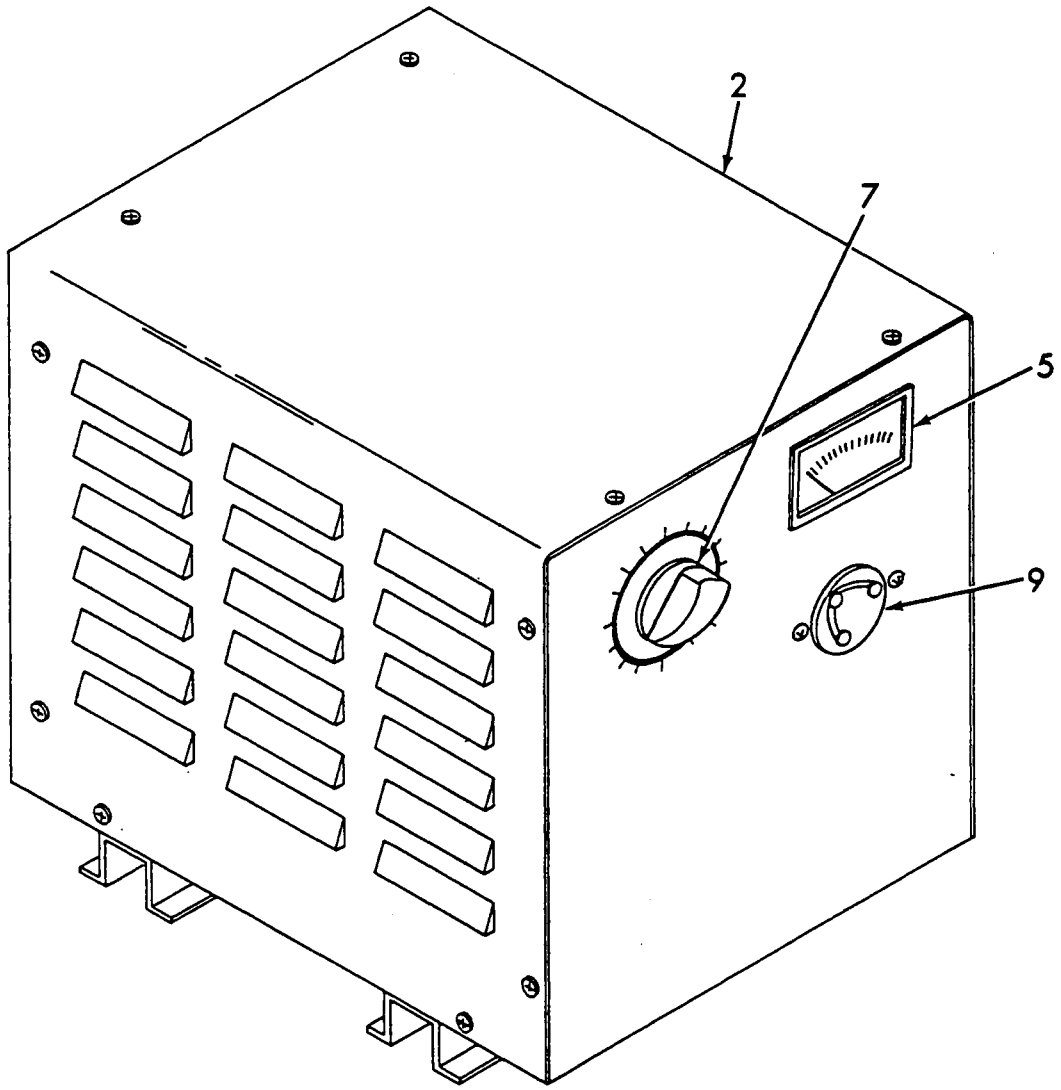
Mark Industries

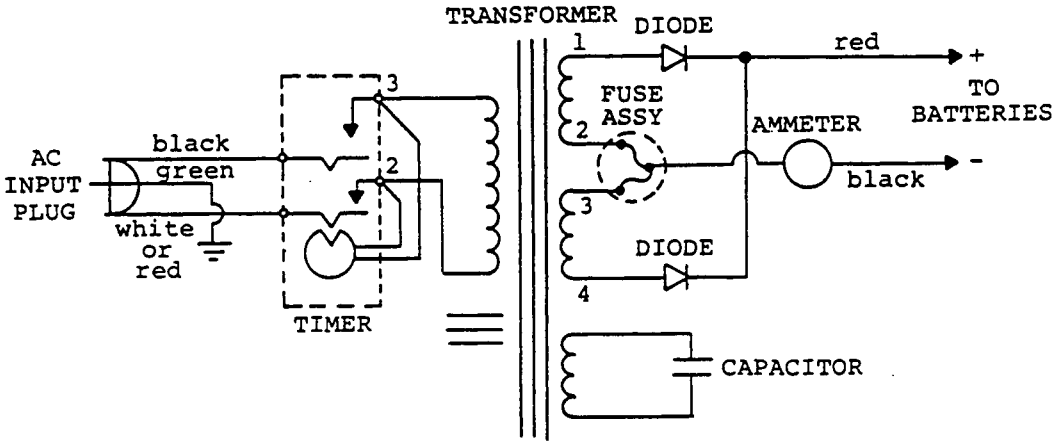
TITLE	MANUAL BATTERY CHARGER
MODEL	LS30E & LS36E
NOTES	115 VAC 60 HZ/24 VDC 40 AMP

SECT.	3
FIG.	8
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	4006	BATTERY CHARGER (BLUE CASE) (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2		.CABINET	1
3	63-F	.AMMETER	1
-4	63-D	.FUSE	2
5	63-G	.CONTROL KNOB	1
6	70000	.TIMER PLATE	1
-7	237-A	.24 HOUR TIMER	1
-8	70002	.CAPACITOR	1
-9	16251	.TRANSFORMER	1
-10	63-E	.DIODE	2
11		.RECEPTACLE	1

Mark Industries			
TITLE	MANUAL BATTERY CHARGER	SECTION	3
MODEL	LS30E & LS36E	FIGURE	8A
NOTES	230 VAC 50 HZ/24 VDC 30 AMP	PAGE	1





REV.

Mark Industries

TITLE	MANUAL BATTERY CHARGER
MODEL	LS30E & LS36E
NOTES	230 VAC 50 HZ/24 VDC 30 AMP

SECT.	3
FIG.	8A
PAGE	2

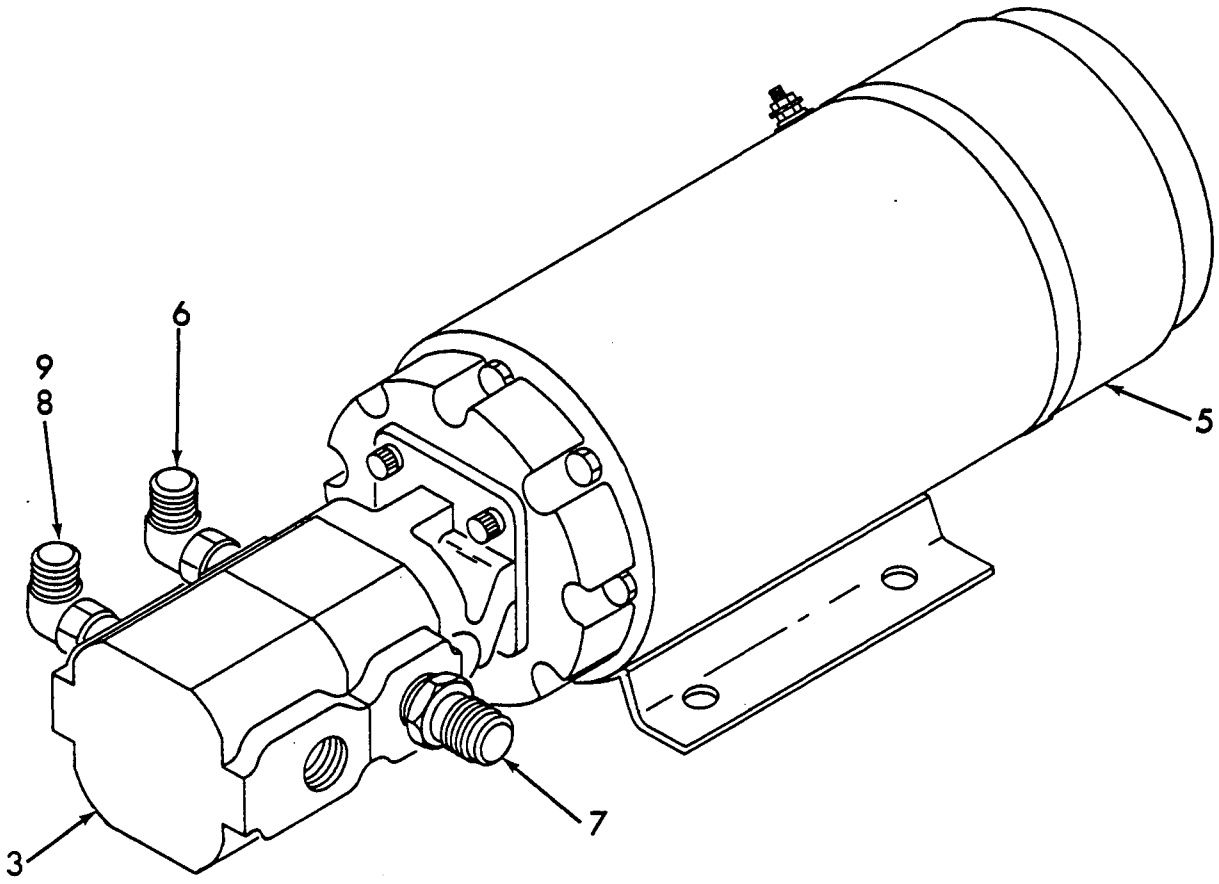
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	70430	MANUAL BATTERY CHARGER (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2		.CASE ASSEMBLY	1
-3	67973	.TRANSFORMER ASSEMBLY	1
-4	66731	.DIODE ASSEMBLY	2
5	66747	.AMMETER	1
-6	67971	.12 HOUR TIMER	1
7	66733	.TIMER KNOB	1
-8	66750	.CAPACITOR	1
-9	66727	.FUSE ASSEMBLY	1

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

Mark Industries

TITLE	PUMP & MOTOR ASSEMBLY	SECTION	3
MODEL	LS30E & LS36E	FIGURE	9
NOTES		PAGE	1



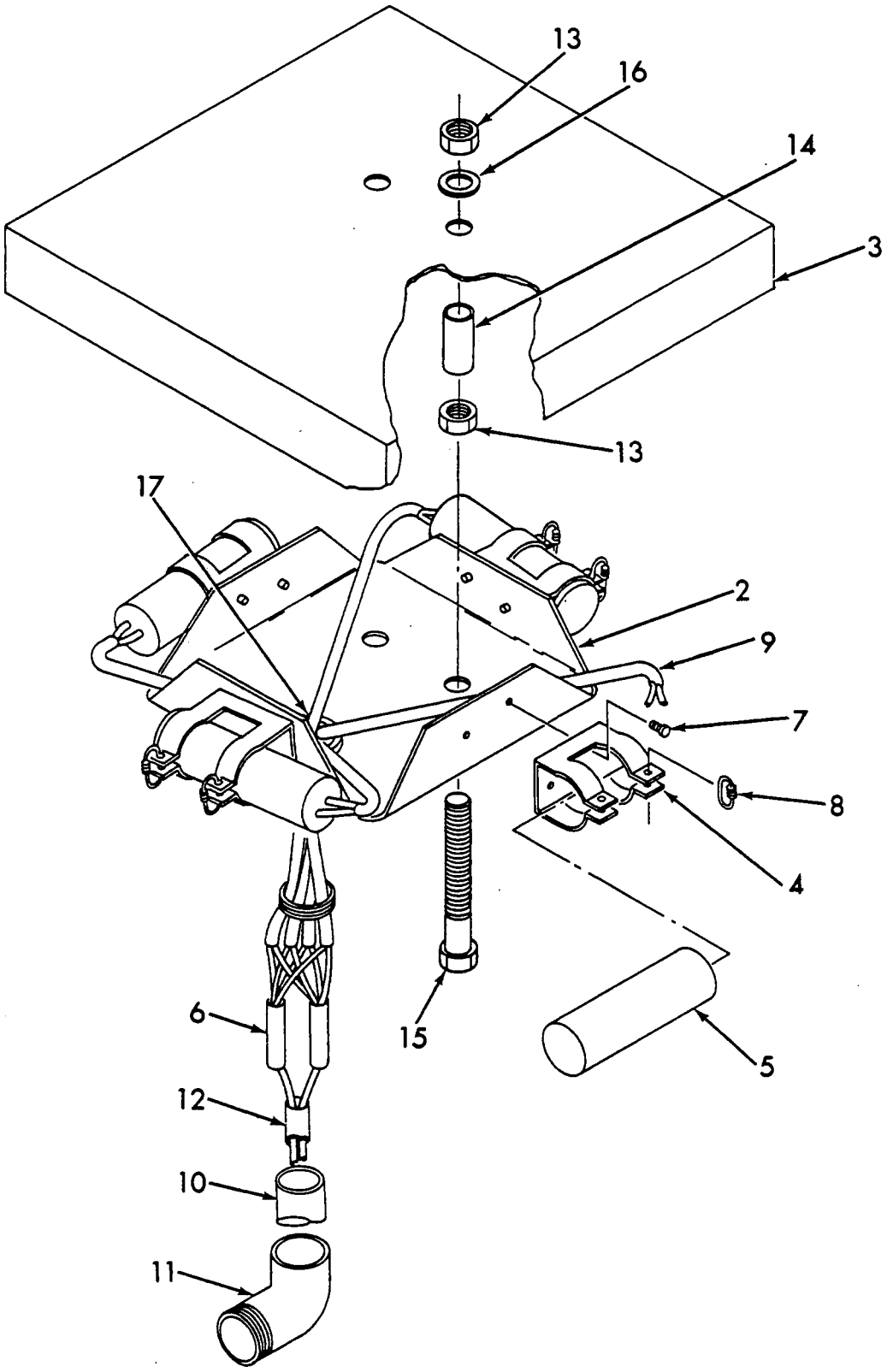
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32577	PUMP & MOTOR ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
-2	81192	.PUMP & MOTOR	1
3	67113	..PUMP	1
-4	67936	...SEAL KIT	1
5	67112	..MOTOR	1
6	80012-16	.STRAIGHT THREAD ELBOW	2
7	80001-20	.MALE CONNECTOR	1
8	80004-11	.STRAIGHT THREAD CONNECTOR	1
9	80015-06	.SWIVEL NUT ELBOW	1

REV.

Mark Industries

TITLE	TILT SWITCH ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	10
PAGE	1



REV.

Mark Industries

TITLE	TILT SWITCH ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

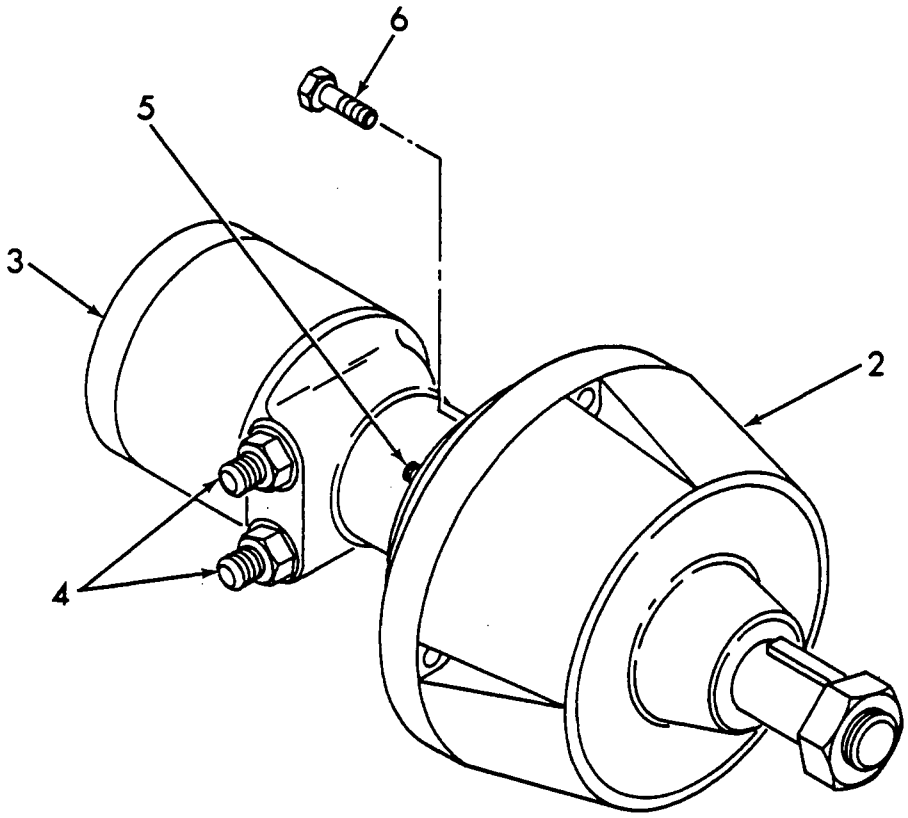
SECT.	3
FIG.	10
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30387	TILT SWITCH ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	30385	.TILT SWITCH BRACKET	1
3	30386	.TILT SWITCH COVER	1
4	199 A	.SWITCH BRACKET	4
5	4014	.MERCURY SWITCH	4
6	117-0	.BUTT CONNECTOR	2
7	62605	.ROUND HEAD SCREW	8
8		.SAFETY WIRE	8
9		.ELECTRICAL SLEEVING	4
10		.ELECTRICAL SLEEVING	1
11		.90° CONNECTOR	1
12		.ELECTRICAL CABLE	1
13	60701	.NUT	4
14	35715	.ROUND TUBE	2
15	60319	.BOLT	2
16	63301	.LOCK WASHER	2
17	61317	.NUT	1

Mark Industries

TITLE	DRIVE MOTOR & BRAKE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	11
PAGE	1



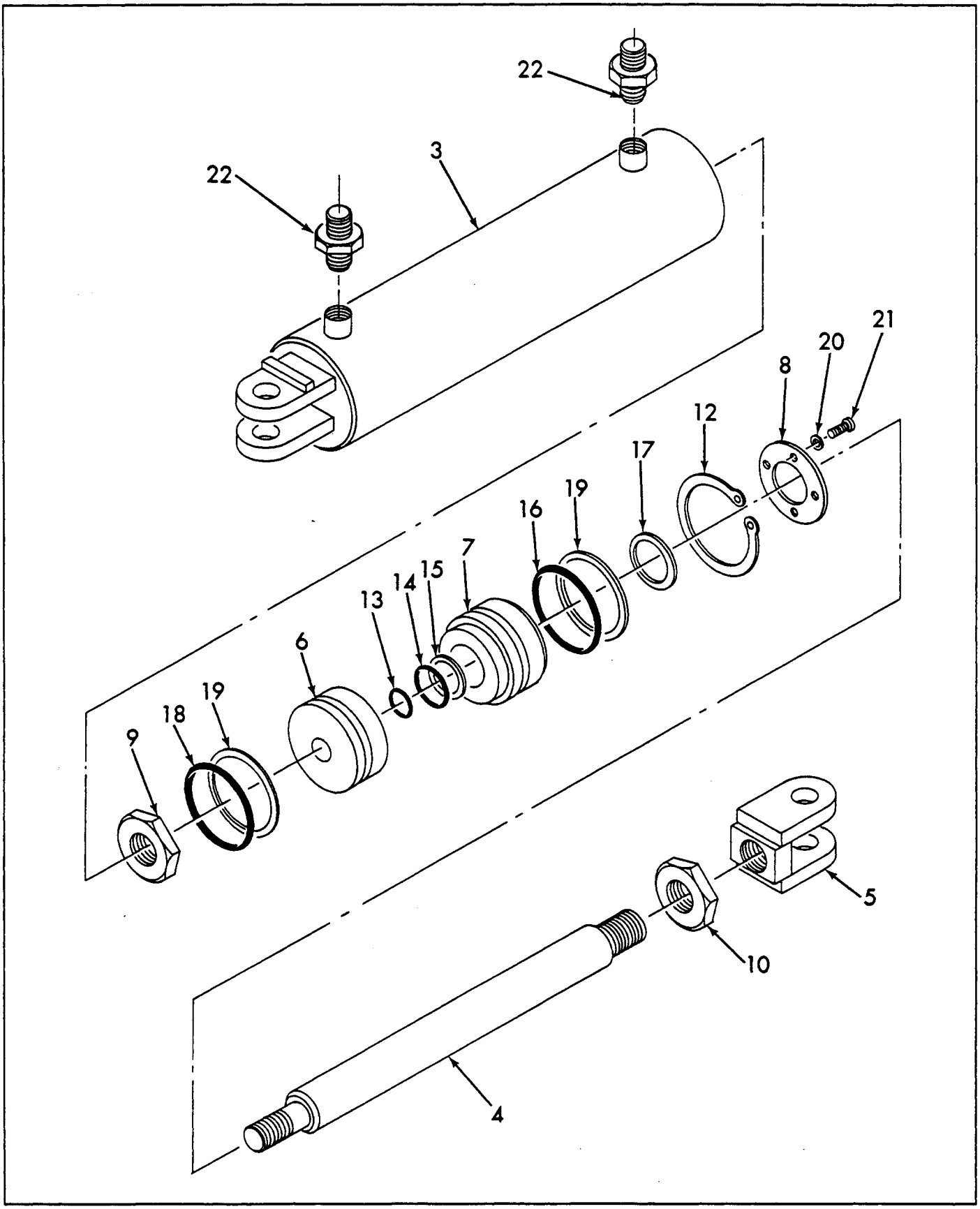
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32462	DRIVE MOTOR & BRAKE ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	81117	.WHEEL MOUNTING BRAKE (See Sect. 3, Fig. 18 for Details)	1
3	81272	.DRIVE MOTOR (See Sect. 3, Fig. 19 for Details)	1
4	80004-13	.STRAIGHT THREAD CONNECTOR	2
5	80004-03	.STRAIGHT THREAD CONNECTOR	1
6	60622	.HEX HEAD CAP SCREW	4

REV.

Mark Industries

TITLE	STEERING CYLINDER ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	12
PAGE	1



REV.

Mark Industries

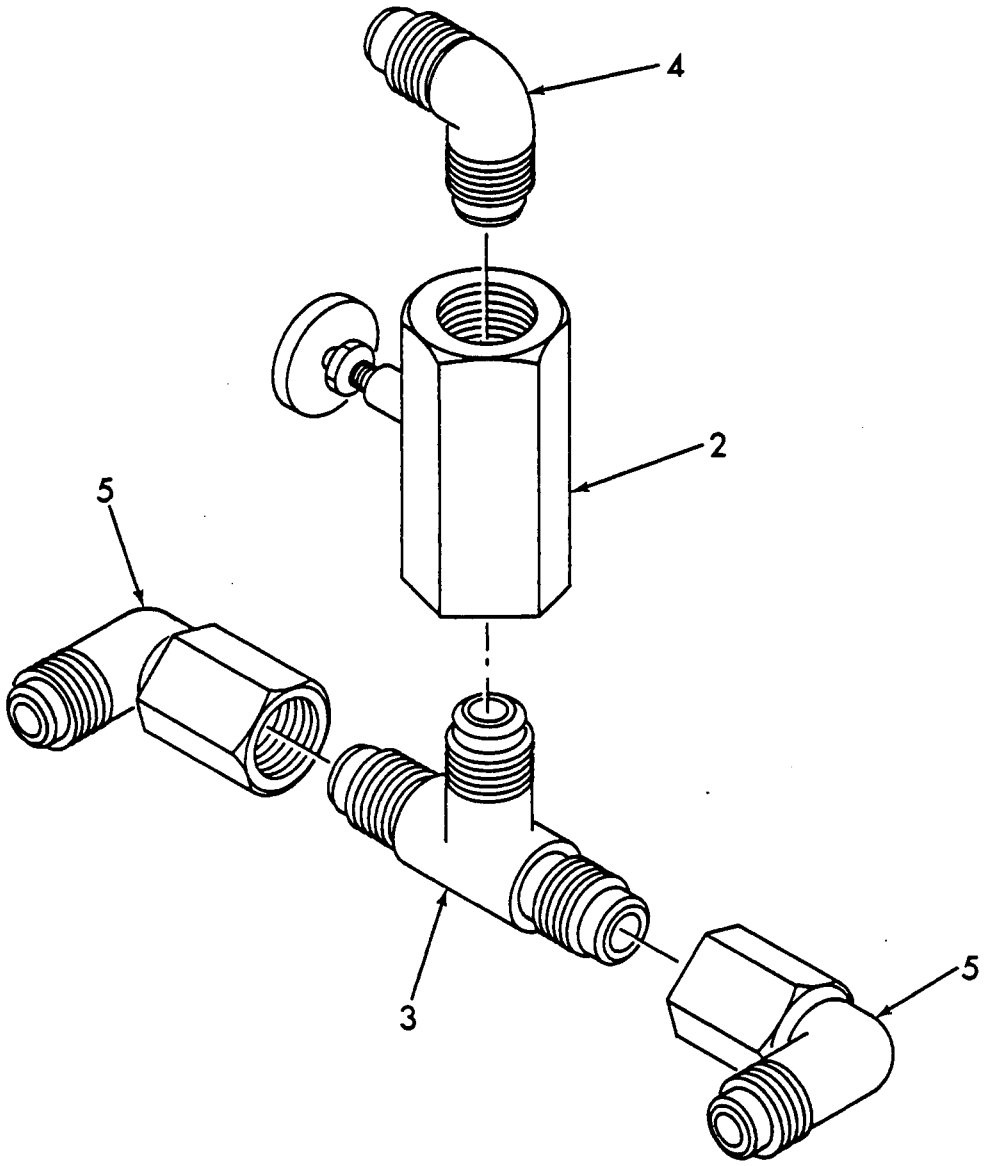
TITLE	STEERING CYLINDER ASSEMBLY	SECT. 3
MODEL	LS30E & LS36E	FIG. 12
NOTES		PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32584	STEERING CYLINDER ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
-2	30803 600248	.STEERING CYLINDER SEAL KIT TEX. Hyd.	1
3		..BARREL ASSEMBLY	1
4		..ROD	1
5		..ROD CLEVIS	1
6		..PISTON	1
7		..HEAD	1
8		..RETAINING PLATE	1
9		..NUT	1
10		..JAM NUT	1
-11	67401 66548	..SEAL KIT (SE)(LISTED) ..SEAL KIT (RA) (TEX HYD.) AFTER OCT 89.	1 1
12		...SNAP RING	1
13		...O-RING	1
14		...O-RING	1
15		...BACK-UP RING	1
16		...O-RING	1
17		...ROD WIPER	1
18		...O-RING	1
19		...BACK-UP RING	2
20		...LOCK WASHER	4
21		...ALLEN HEAD SCREW	4
22		.MALE CONNECTOR	2

Mark Industries

TITLE	FLOW CONTROL VALVE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	13
PAGE	1



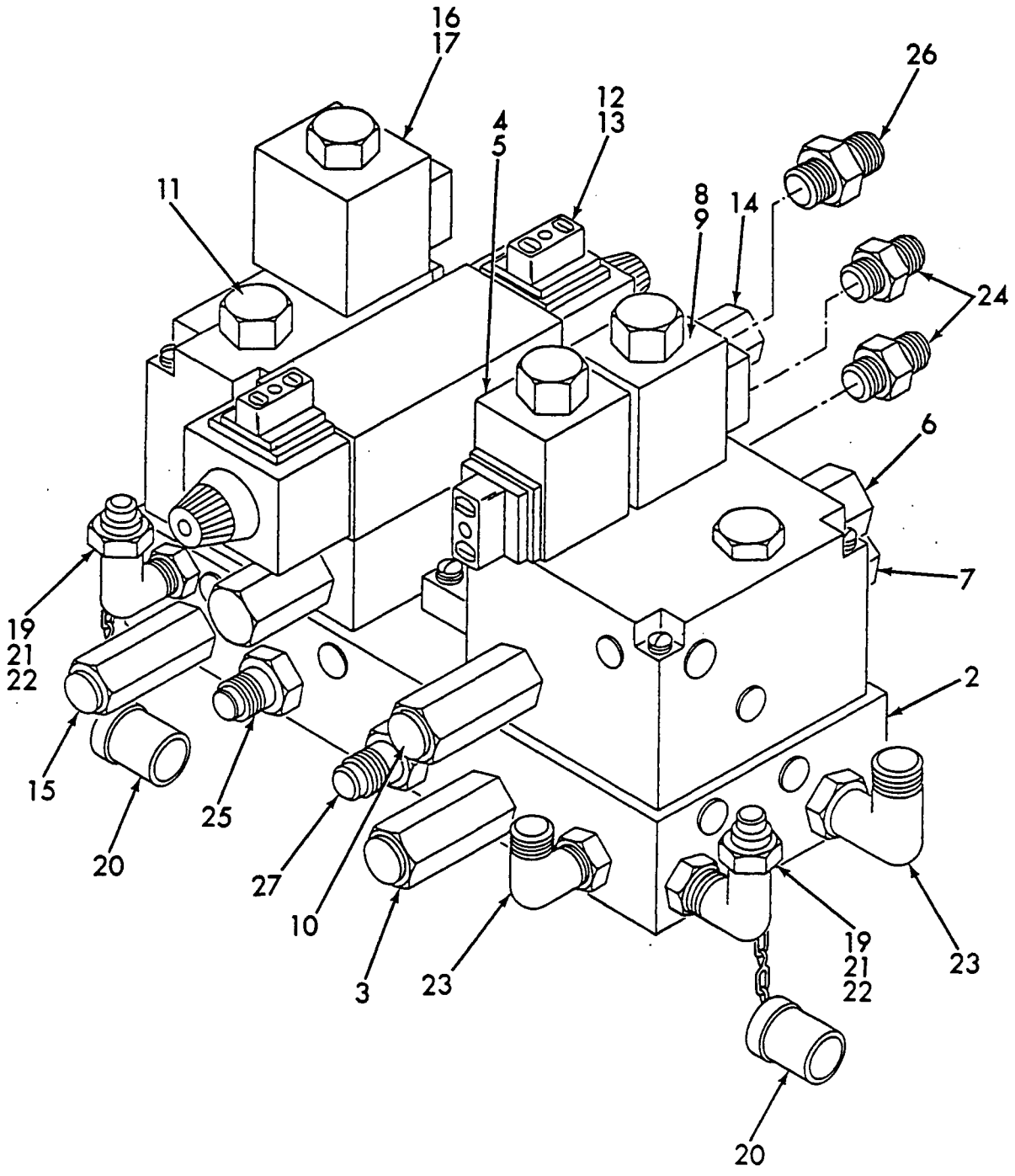
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32579	FLOW CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	20884	.FLOW CONTROL VALVE	1
3	80034-03	.MALE BRANCH TEE	1
4	80008-03	.MALE ELBOW	1
5	80015-03	.SWIVEL ELBOW	2

REV.

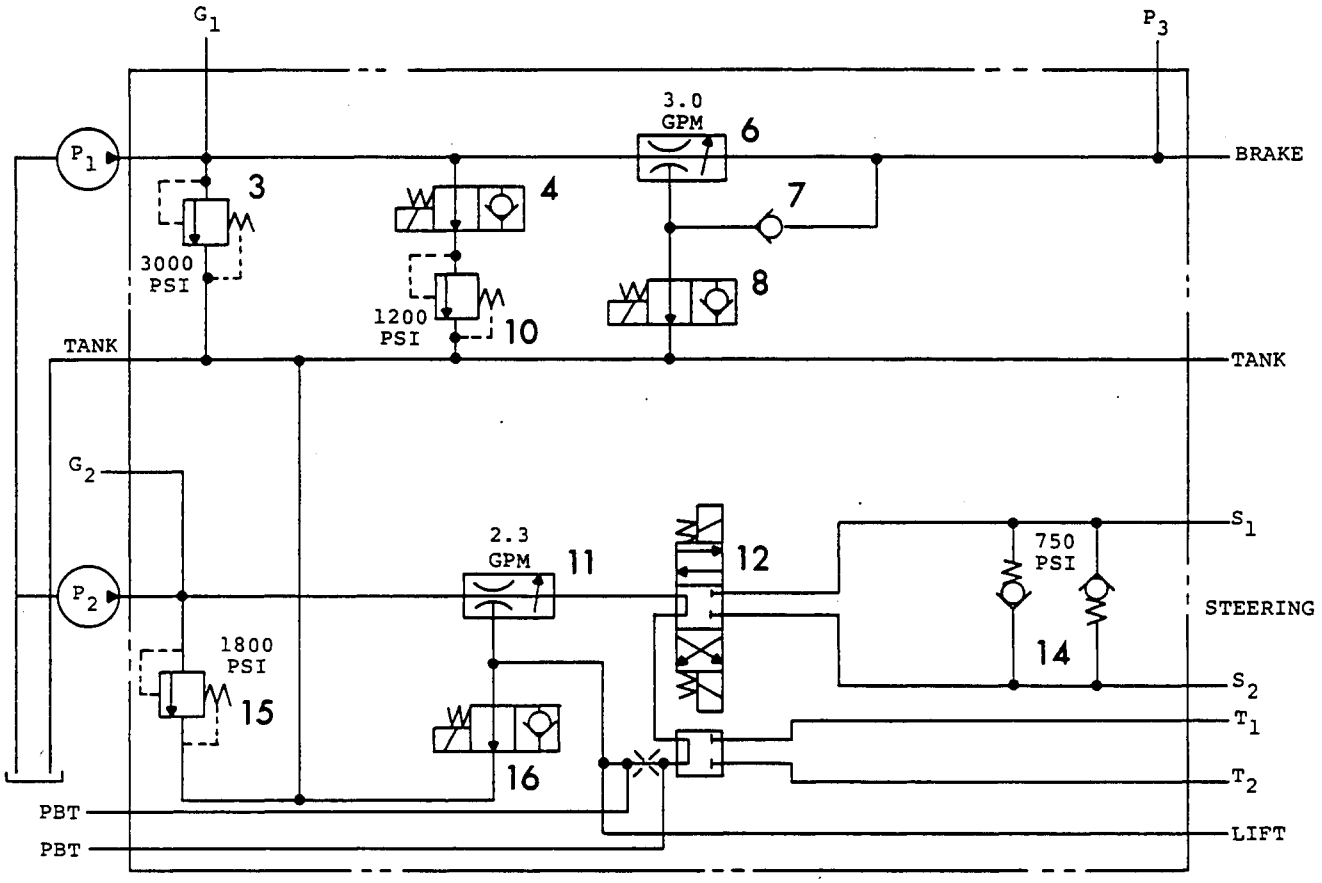
Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	WITH 10 VOLT COILS: SINCE JUNE 1989

SECTION	3
FIGURE	14
PAGE	1



REV.



INSTAL PLUG PRIOR TO USING
POWER BEYOND PORTS

REV.

Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	WITH 10 VOLT COILS: SINCE JUNE 1989

SECT.	3
FIG.	14
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32761	VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 6 or 6A for NHA)	REF
2	81262	.VALVE PACKAGE	1
*3	68060	..RELIEF VALVE	1
4	67337	..2 WAY N.O. SOLENOID	1
5	66863	...COIL (10 VOLT)	1
6	66867	..FLOW DIVIDER	1
7	66674	..CHECK VALVE	1
8	67337	..2 WAY N.O. SOLENOID	1
9	66863	...COIL (10 VOLT)	1
*10	68057	..RELIEF VALVE	1
11	67004	..FLOW REGULATOR	1
12	67991	..DO1 VALVE	1
13	66862	...COIL (10 VOLT)	2
*14	68057	..RELIEF VALVE	2
*15	68060	..RELIEF VALVE	1
16	67337	..2 WAY N.O. SOLENOID	1
17	66863	...COIL (10 VOLT)	1
-18	67943	..SEAL KIT (COMPLETE VALVE PACKAGE)	1
19	51903	.FEMALE PIPE ADAPTER	2
20	845	.QUICK DISCONNECT CAP	2
21	80022-03	.MALE PIPE ELBOW	2
22	2527	.QUICK DISCONNECT COUPLING	2
		NOTE: PRIOR TO USE, ITEMS WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE LISTED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

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

Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	WITH 10 VOLT COILS: SINCE JUNE 1989

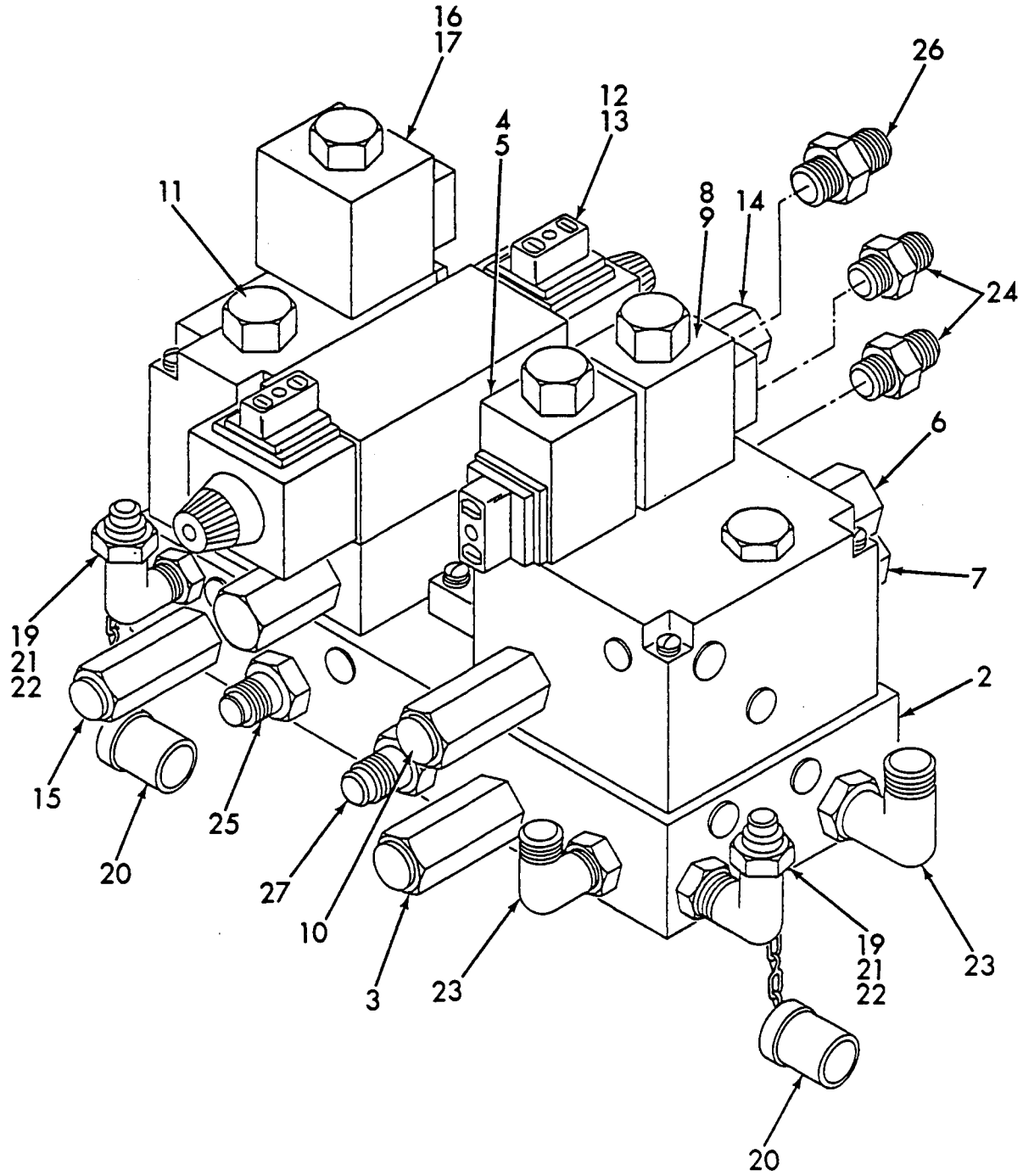
SECT.	3
FIG.	14
PAGE	4

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
23	80012-16	.STRAIGHT THREAD ELBOW	2
24	81149	.ADAPTER	2
25	80004-11	.STRAIGHT THREAD CONNECTOR	1
26	80004-09	.STRAIGHT THREAD CONNECTOR	1
27	80004-16	.STRAIGHT THREAD CONNECTOR	1

Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	UNTIL JUNE 1989

SECTION	3
FIGURE	14A
PAGE	1

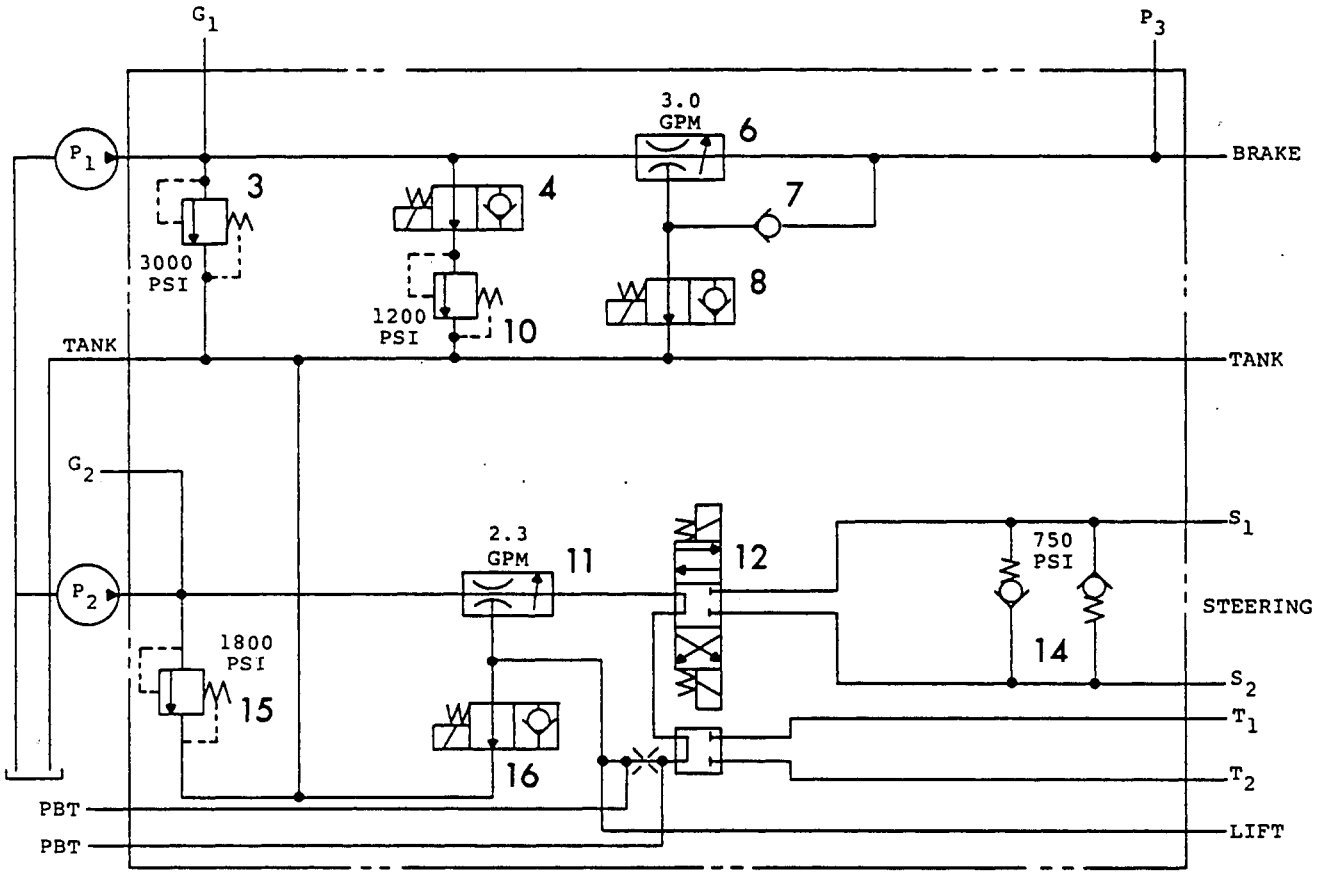


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Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	UNTIL JUNE 1989

SECTION	3
FIGURE	14A
PAGE	2



INSTAL PLUG PRIOR TO USING
POWER BEYOND PORTS

REV.

Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	UNTIL JUNE 1989

SECT.	3
FIG.	14A
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32358	VALVE PACKAGE ASSEMBLY (See Sect. 3, Fig. 6 or 6A for NHA)	REF
2	81142	.VALVE PACKAGE	1
*3	68060	..RELIEF VALVE	1
4	66920	..2 WAY N.O. SOLENOID	1
5	66914	...COIL (12 VOLT)	1
6	66867	..FLOW DIVIDER	1
7	66674	..CHECK VALVE	1
8	66920	..2 WAY N.O. SOLENOID	1
9	66914	...COIL (12 VOLT)	1
*10	68057	..RELIEF VALVE	1
11	67004	..FLOW REGULATOR	1
12	67153	..DO1 VALVE	1
13	66913	...COIL (12 VOLT)	2
*14	68057	..RELIEF VALVE	2
*15	68060	..RELIEF VALVE	1
16	66920	..2 WAY N.O. SOLENOID	1
17	66914	...COIL (12 VOLT)	1
-18	67943	..SEAL KIT (COMPLETE VALVE PACKAGE)	1
19	51903	.FEMALE PIPE ADAPTER	2
20	845	.QUICK DISCONNECT CAP	2
21	80022-03	.MALE PIPE ELBOW	2
22	2527	.QUICK DISCONNECT COUPLING	2
		NOTE: PRIOR TO USE, ITEMS WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE LISTED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

Mark Industries

TITLE	VALVE PACKAGE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	UNTIL JUNE 1989

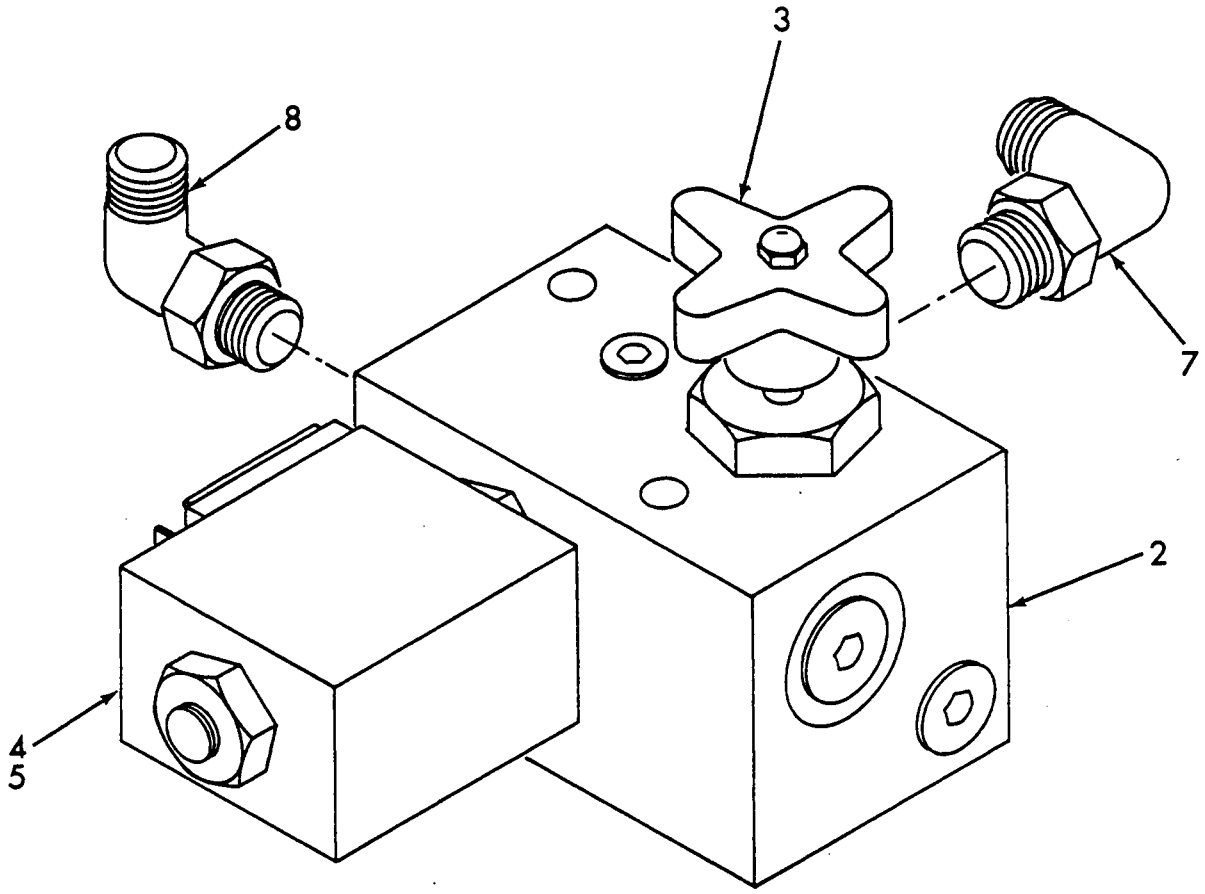
SECT.	3
FIG.	14A
PAGE	4

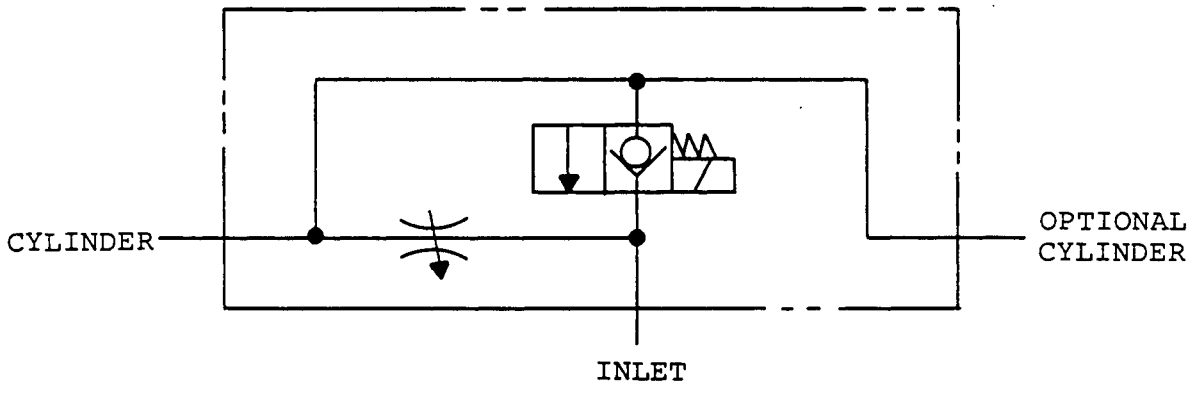
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
23	80012-16	.STRAIGHT THREAD ELBOW	2
24	81149	.ADAPTER	2
25	80004-11	.STRAIGHT THREAD CONNECTOR	1
26	80004-09	.STRAIGHT THREAD CONNECTOR	1
27	80004-16	.STRAIGHT THREAD CONNECTOR	1

Mark Industries

TITLE	LOWERING CONTROL VALVE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	15
PAGE	1





REV.

Mark Industries

TITLE	LOWERING CONTROL VALVE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECT.	3
FIG.	15
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32557	LOWERING CONTROL VALVE ASSEMBLY (See Sect. 3, Fig. 6 or 6A for NHA)	REF
2	81145	.LOWERING CONTROL VALVE	1
3	67010	..NEEDLE VALVE	1
4	81314	..CHECK SOLENOID	1
5		...COIL (12 VOLT)	1
-6	67944	..SEAL KIT (COMPLETE VALVE PACKAGE)	1
7	80012-11	.STRAIGHT THREAD ELBOW	1
8	80012-09	.STRAIGHT THREAD ELBOW	1

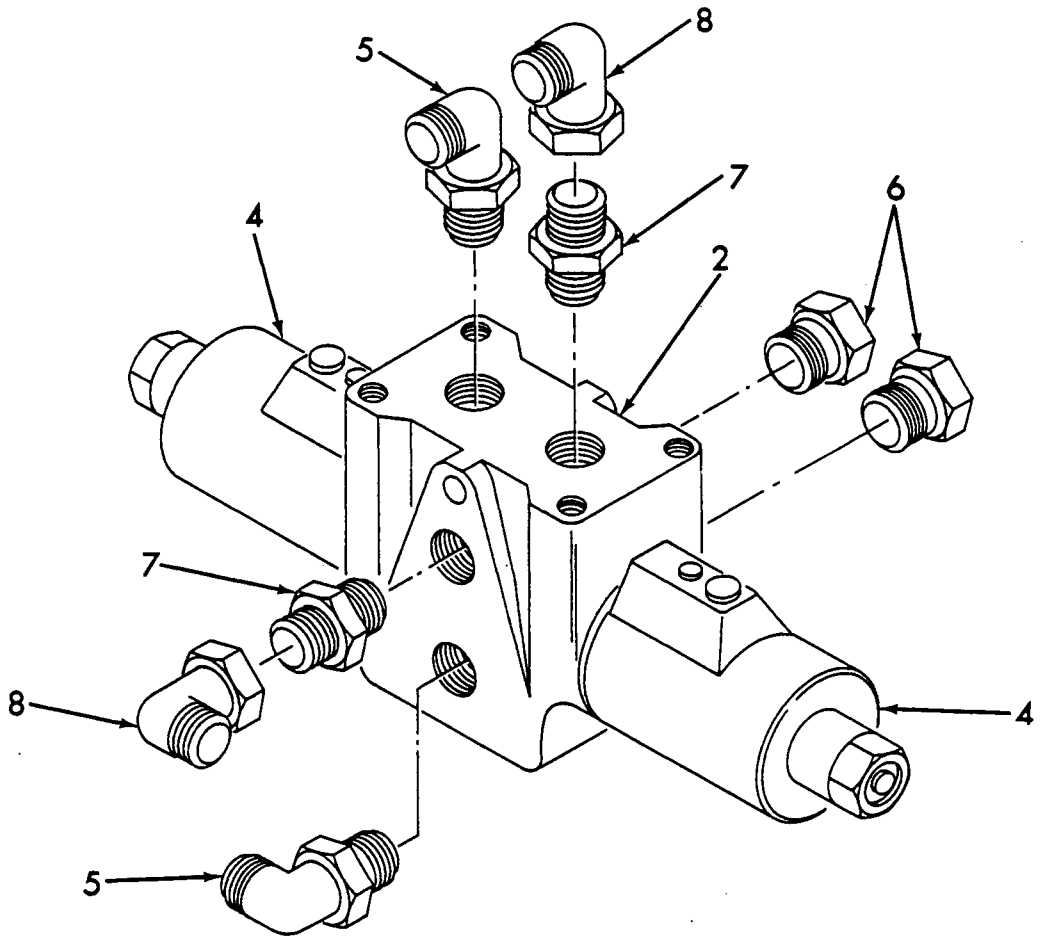
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DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	DRIVE SOLENOID VALVE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	16
PAGE	1



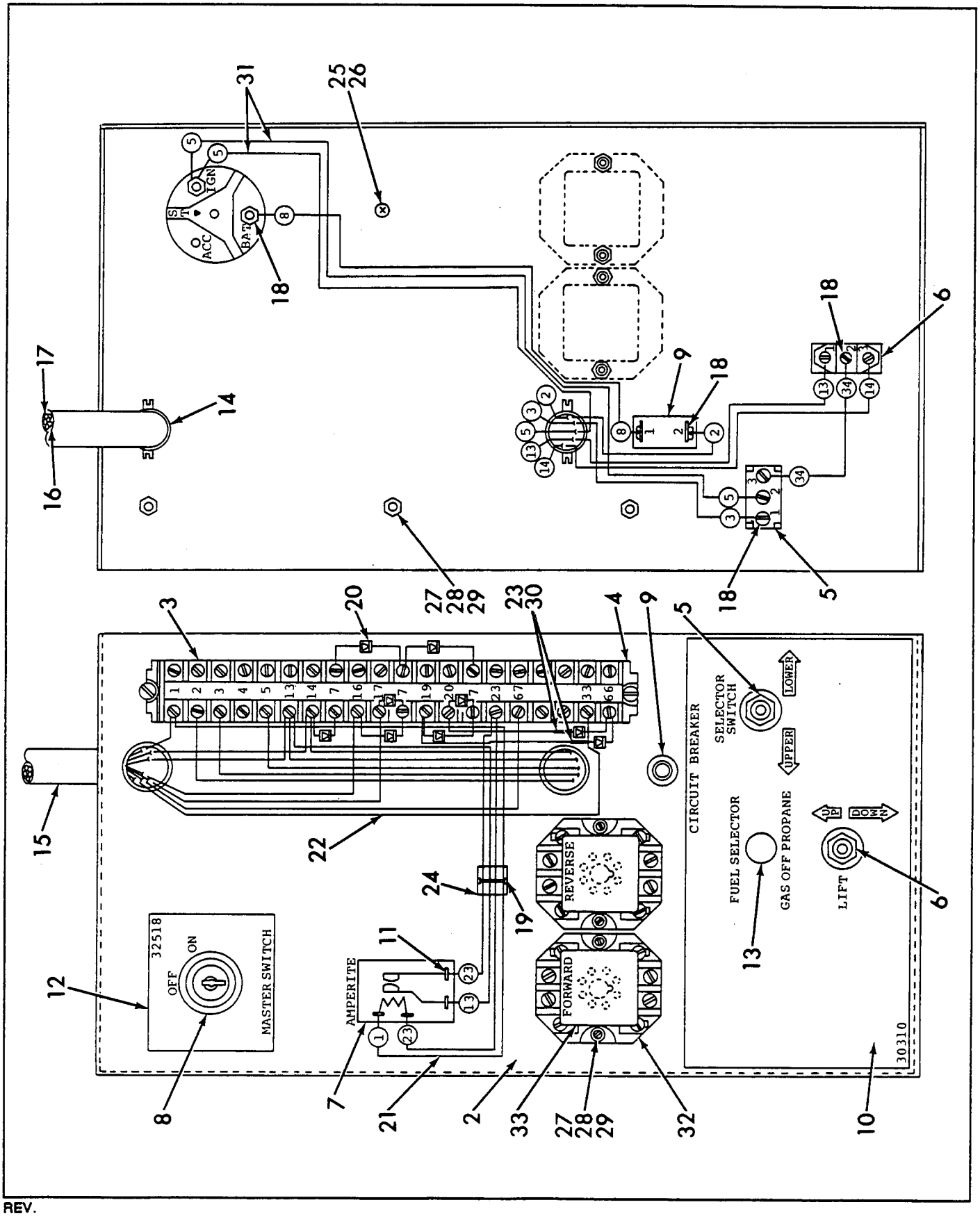
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32762	DRIVE SOLENOID VALVE ASSEMBLY (See Sect. 3, Fig. 6 or 6A for NHA)	REF
2	81302	.DRIVE SOLENOID VALVE	1
-3	68027	..SEAL KIT	2
4	68028	..COIL, 10 VOLT	2
5	80012-16	.STRAIGHT THREAD ELBOW	2
6	80051-06	.STRAIGHT THREAD PLUG	2
7	80004-16	.STRAIGHT THREAD CONNECTOR	2
8	80015-07	.SWIVEL NUT ELBOW	2

REV.

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	3
FIGURE	17
PAGE	1



REV.

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY	SECT. 3
MODEL	LS30E	FIG. 17
NOTES		PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32394	ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 6 for NHA)	REF
2	30312	.PANEL	1
3	4027	.TERMINAL BLOCK	20
4	117-A	.TERMINAL BLOCK END	1
5	70313	.TOGGLE SWITCH	1
6	4021	.TOGGLE SWITCH	1
7	70306	.TIME DELAY RELAY	1
8	2717	.IGNITION SWITCH	1
9	20562	.CIRCUIT BREAKER	1
10	30310	.DECAL	1
11	496-A	.PUSH-ON TERMINAL	4
12	32518	.DECAL	1
13	771	.PLUG	1
14	70016	.GROMMET	2
15	130600	.CABLE CONDUCTOR	7 FT
16	70029	.CONNECTOR	8
17	70271	.CONNECTOR	5
18	117-C	.CONNECTOR RING	11
19	256	.CABLE TIE	45
20	4045	.DIODE	9
21	70008	.WIRE	2 FT
22	70232	.WIRE	7 FT
23	70233	.WIRE	10 FT
24	16214	.MOUNT	5
25	63322	.LOCK WASHER	1

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY
MODEL	LS30E
NOTES	

SECT.	3
FIG.	17
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
26	61728	.SELF TAPPING SCREW	1
27	62623	.CAP SCREW	7
28	61502	.HEX NUT	7
29	63312	.LOCK WASHER	7
30	70069	.BUTT CONNECTOR	2
31	2991	.WIRE	3 FT
32	784-A	.SOCKET	2
33	70170	.RELAY	2

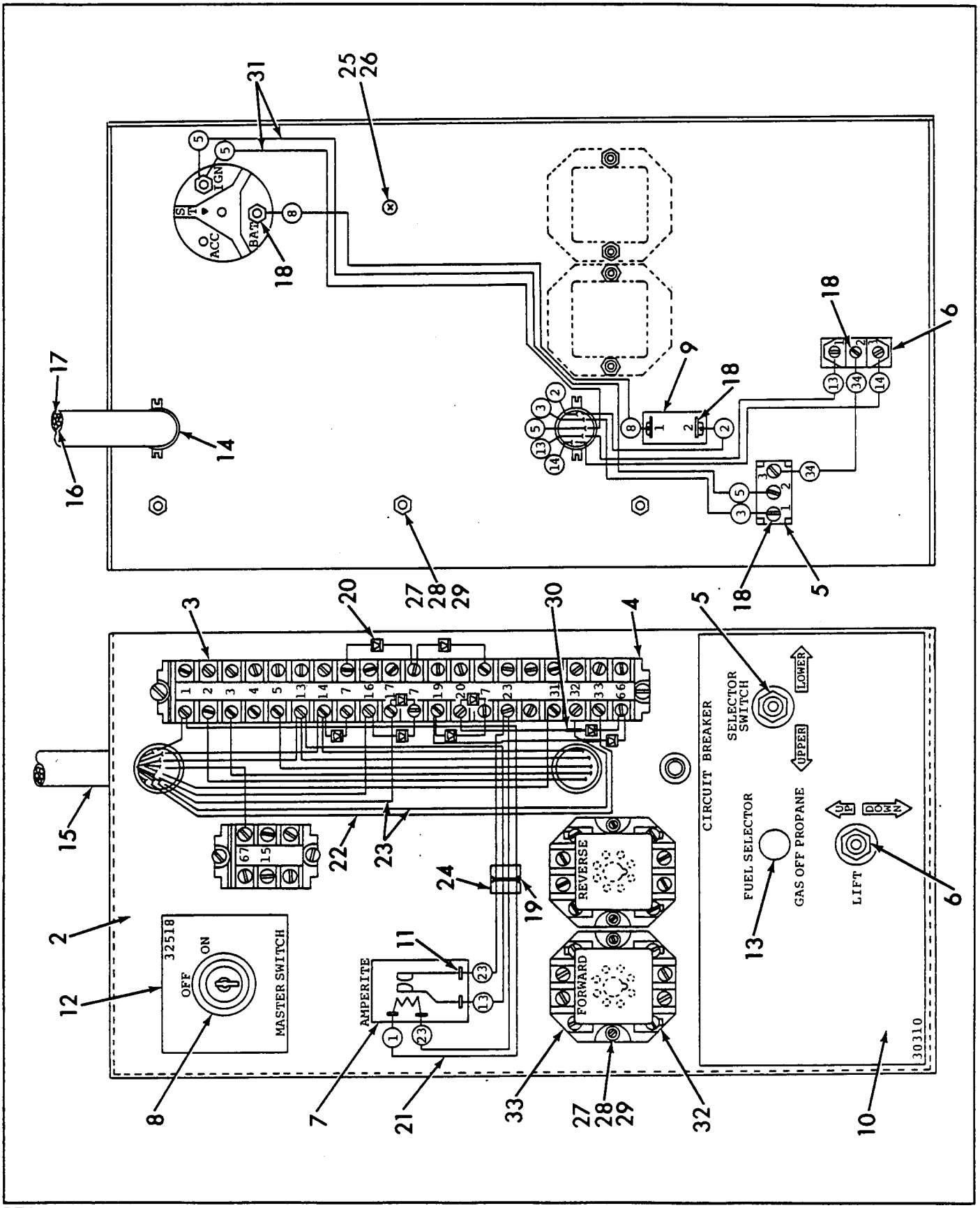
REV.

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

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	3
FIGURE	17A
PAGE	1



REV.

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY	SECT. 3
MODEL	LS36E	FIG. 17A
NOTES		PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32481	ELECTRICAL PANEL ASSEMBLY (See Sect. 3, Fig. 6A for NHA)	REF
2	30312	.PANEL	1
3	4027	.TERMINAL BLOCK	23
4	117-A	.TERMINAL BLOCK END	2
5	70313	.TOGGLE SWITCH	1
6	4021	.TOGGLE SWITCH	1
7	70306	.TIME DELAY RELAY	1
8	2717	.IGNITION SWITCH	1
9	20562	.CIRCUIT BREAKER	1
10	30310	.DECAL	1
11	496-A	.PUSH-ON TERMINAL	4
12	32518	.DECAL	1
13	771	.PLUG	1
14	70016	.GROMMET	2
15	130600	.CABLE CONDUCTOR	7 FT
16	70029	.CONNECTOR	8
17	70271	.CONNECTOR	5
18	117-C	.CONNECTOR RING	11
19	256	.CABLE TIE	45
20	4045	.DIODE	9
21	70008	.WIRE	2 FT
22	70232	.WIRE	7 FT
23	70233	.WIRE	10 FT
24	16214	.MOUNT	5
25	63322	.LOCK WASHER	1

REV.

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

Mark Industries

TITLE	ELECTRICAL PANEL ASSEMBLY	SECT. 3
MODEL	LS 36 E	FIG. 17A
NOTES		PAGE 3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
26	61728	.SELF TAPPING SCREW	1
27	62623	.CAP SCREW	9
28	61502	.HEX NUT	9
29	63312	.LOCK WASHER	9
30	70069	.BUTT CONNECTOR	2
31	2991	.WIRE	3 FT
32	784-A	.SOCKET	2
33	70170	.RELAY	2

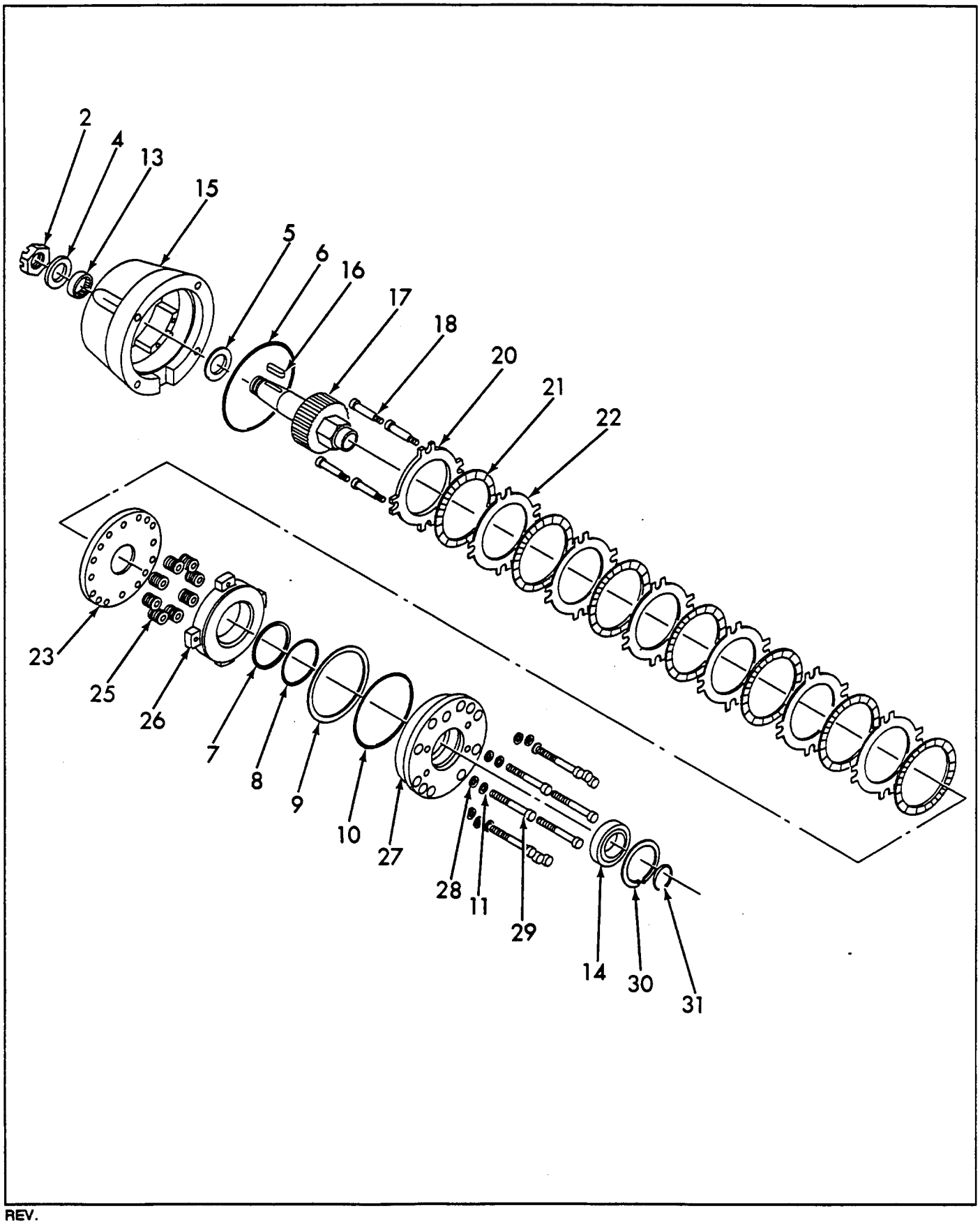
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DASH (-) INDICATES THE 'ITEM' IS NOT ILLUSTRATED

Mark Industries

TITLE	WHEEL MOUNTING BRAKE ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	3
FIGURE	18
PAGE	1



REV.

Mark Industries

TITLE	WHEEL MOUNTING BRAKE
MODEL	LS30E & LS36E
NOTES	

SECT.	3
FIG.	18
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	81117	WHEEL MOUNTING BRAKE (See Sect. 3, Fig. 11 for NHA)	REF
2		.CASTLE NUT	1
-3	66971	.SEAL KIT	1
*4		..SEAL	1
*5		..SEAL	1
*6		..O-RING	1
7		..B/U-RING	1
8		..O-RING	1
9		..B/U-RING	1
10		..O-RING	1
*11		..SEALING WASHER	10
-12	67659	.BEARING KIT	1
*4		..SEAL	1
*5		..SEAL	1
*6		..O-RING	1
*11		..SEALING WASHER	10
13		..NEEDLE BEARING	1
14		..BEARING	1
15		.WHEEL MOUNT HOUSING	1
16		.KEY	1
17		.SPLINE SHAFT ASSEMBLY	1
18		.TENSION PIN	4
-19	67646	.LINING KIT	1
*6		..O-RING	2
*11		..SEALING WASHER	10

Mark Industries

TITLE	WHEEL MOUNTING BRAKE
MODEL	LS30E & LS36E
NOTES	

SECT.	3
FIG.	18
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
20		..PRIMARY DISC	1
21		..ROTOR DISC	7
22		..STATOR DISC	7
23		.SPRING PLATE	1
-24	67652	.SPRING KIT	1
*6		..O-RING	2
*11		..SEALING WASHER	10
25		..SPRINGS-RED	6
26		.PISTON	1
27		.PRESSURE PLATE	1
28		.FLAT WASHER	10
29		.ASSEMBLY BOLT	10
30		.RETAINING RING	1
31		.RETAINING RING	1
		*INDICATES ITEM IS INCLUDED IN MORE THAN ONE KIT.	

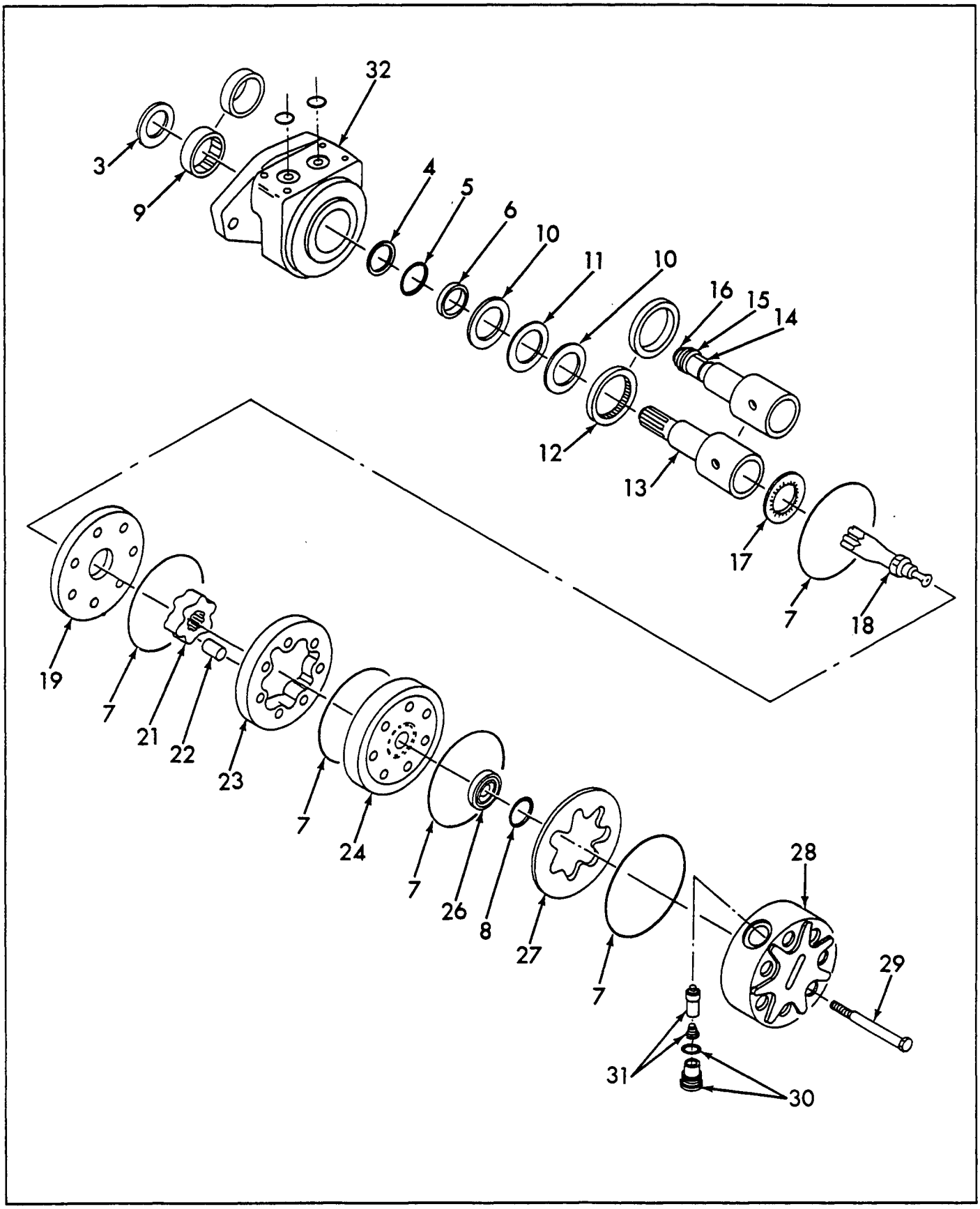
REV.

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

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	USED SINCE OCT. 1988 (REPLACES 81165)

SECTION	3
FIGURE	19
PAGE	1



REV.

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	USED SINCE OCT. 1988 (REPLACES 81165)

SECT.	3
FIG.	19
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	81272	DRIVE MOTOR (See Sect. 3, Fig. 11 for NHA)	REF
-2	67689	.SEAL KIT	1
3		..DIRT & WATER SEAL	1
4		..B/U WASHER	1
5		..B/U WASHER	1
6		..SEAL	1
7		..SEAL RING	5
8		..COMMUTATOR SEAL RING	1
9		.OUTER BEARING/BUSHING	1
10		.THRUST WASHER	2
11		.THRUST BEARING	1
12		.INNER BEARING/BUSHING	1
13	67701	.COUPLING SHAFT	1
14		.WASHER	1
15		.LOCK WASHER	1
16		.BOLT	1
17		.THRUST BEARING	1
18	67696	.DRIVE LINK	1
19		.WEAR PLATE	1
-20		.ROTOR SET (MATCHED SET)	1
21		..ROTOR	1
22		..VANE	7
23		..STATOR	1
24		.MANIFOLD	1
-25		.COMMUTATOR SET (MATCHED SET)	1

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	USED SINCE OCT. 1988 (REPLACES 81165)

SECT.	3
FIG.	19
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
26		..COMMUTATOR	1
27		..COMMUTATOR RING	1
28		.END COVER WITH RELIEF VALVE	1
29		.SPECIAL BOLTS	7
30		.PLUG & O-RING	2
31		.RELIEF VALVE	2
32		.HOUSING	1

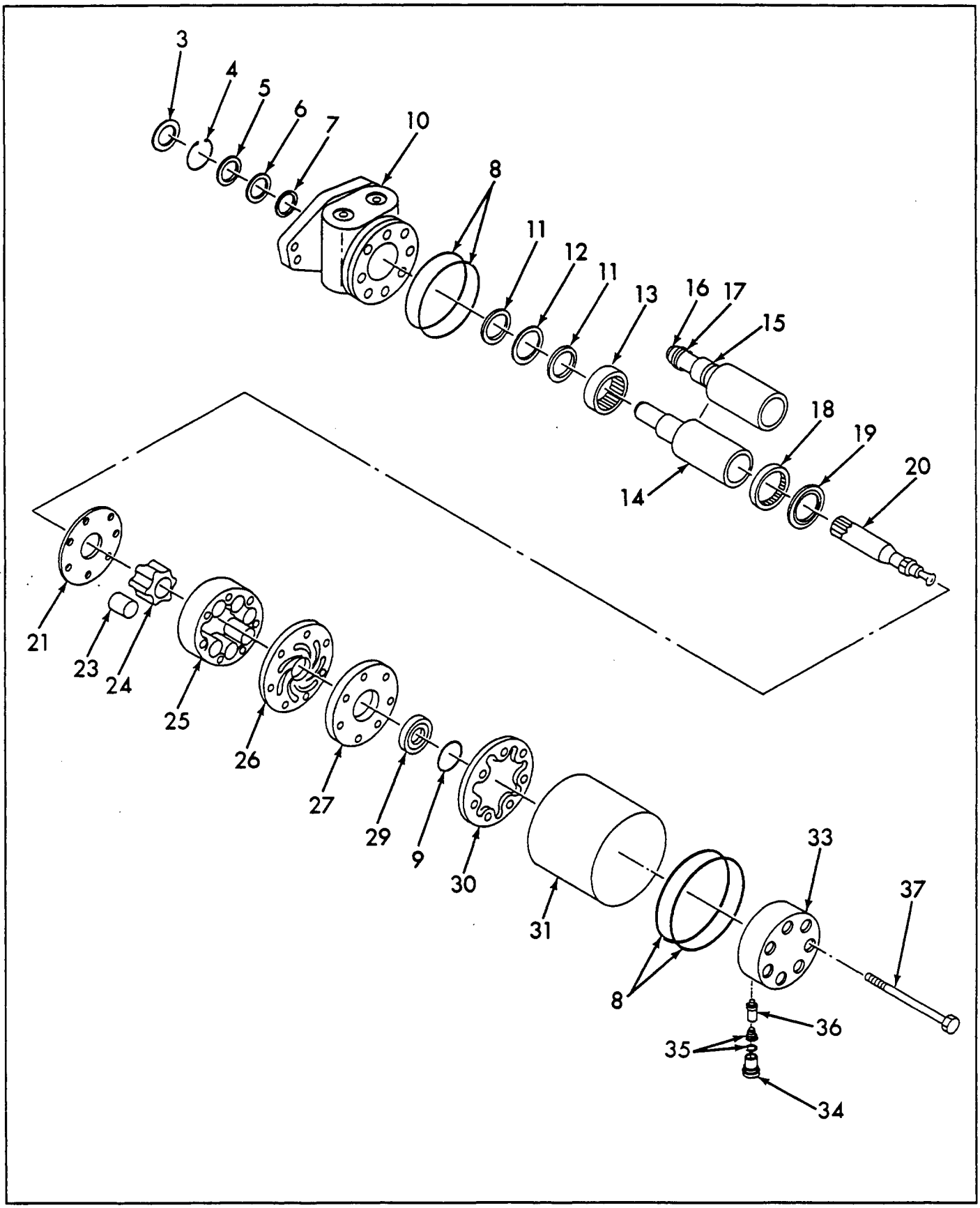
REV.

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

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	UNTIL OCT. 1988

SECTION	3
FIGURE	19A
PAGE	1



REV.

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	UNTIL OCT. 1988 (REPLACED BY 81272)

SECT.	3
FIG.	19A
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	81165	DRIVE MOTOR (See Sect. 3, Fig. 11 for NHA)	REF
-2	66162	.SEAL KIT	1
3		..SEAL	1
4		..RETAINING RING	1
5		..B/U WASHER	1
6		..WASHER	1
7		..SEAL	1
8		..SEAL RING	4
9		..SEAL RING	1
10		.HOUSING	1
11		.THRUST WASHER	2
12		.THRUST BEARING	1
13		.BEARING	1
14	67992	.COUPLING SHAFT	1
15		.WASHER	1
16		.BOLT	1
17		.LOCK WASHER	1
18		.BEARING	1
19		.THRUST BEARING	1
20	67979	.DRIVE LINK	1
21		.WEAR PLATE	1
-22		.ROTOR SET (MATCHED SET)	1
23		..VANE	7
24		..ROTOR	1
25		..STATOR	1

Mark Industries

TITLE	DRIVE MOTOR
MODEL	LS30E & LS36E
NOTES	UNTIL OCT. 1988 (REPLACED BY 81272)

SECT.	3
FIG.	19A
PAGE	3

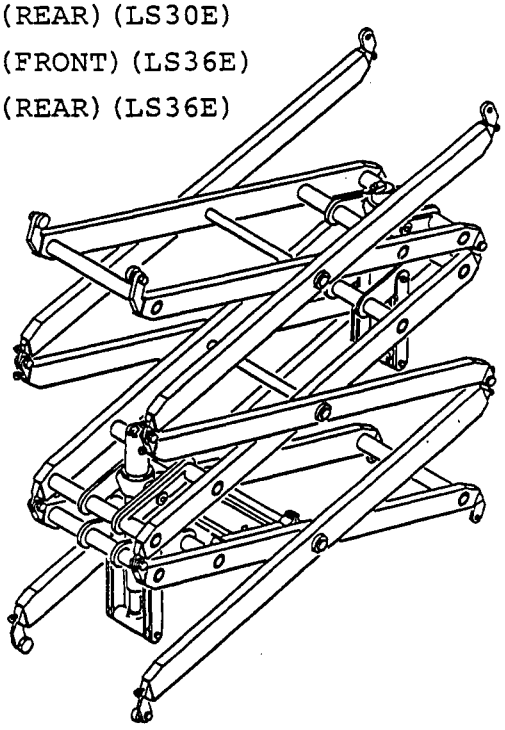
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
26		.MANIFOLD PLATE	1
27		.MANIFOLD	1
-28		.COMMUTATOR ASSEMBLY (MATCHED SET)	1
29		..COMMUTATOR	1
30		..COMMUTATOR RING	1
31		.SLEEVE	1
-32		.END COVER ASSEMBLY	1
33		..END COVER	1
34		..PLUG	2
35		..O-RING	2
36		..RELIEF VALVE CARTRIDGE	2
37		.SPECIAL BOLT	7

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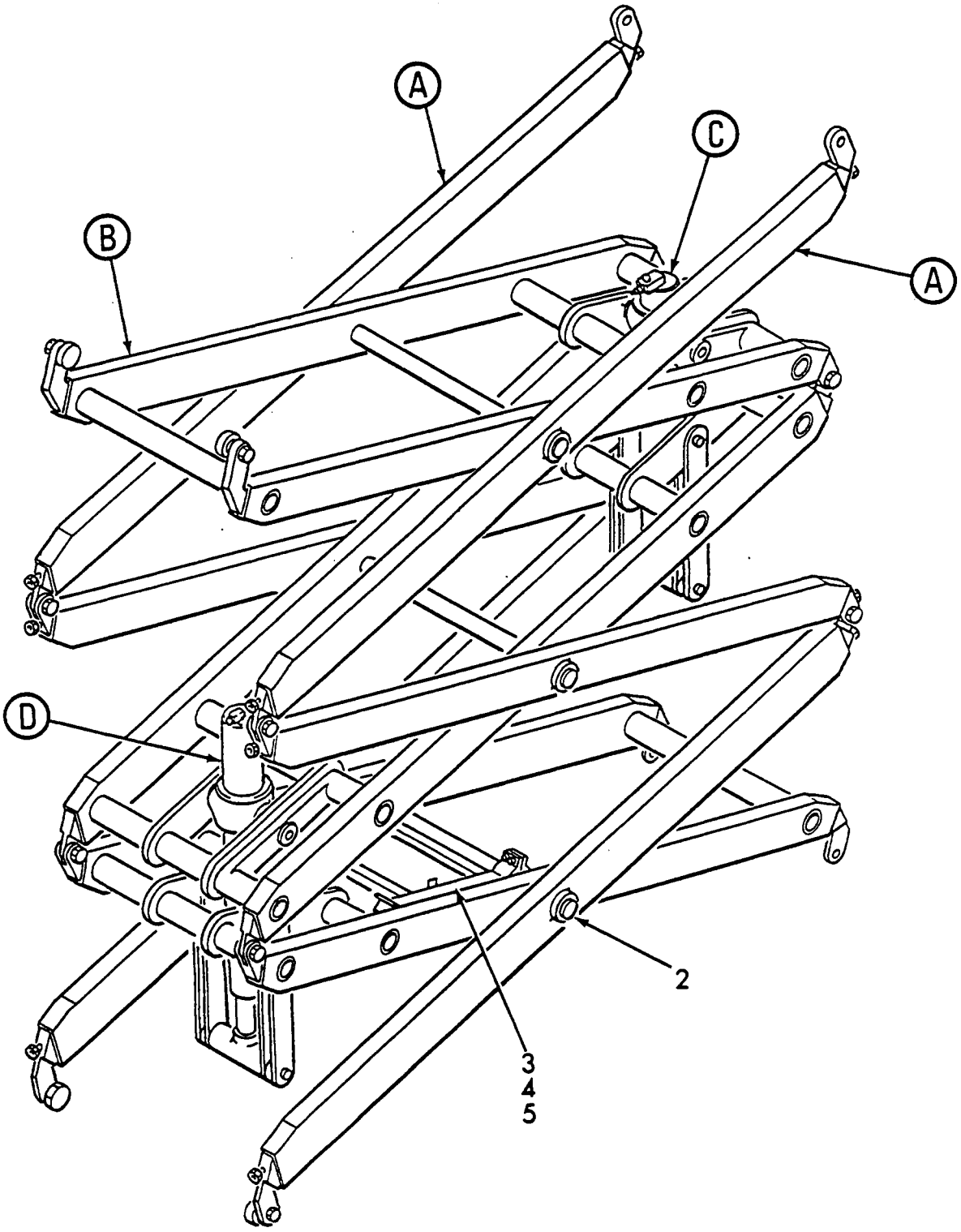
SECTION 4 CONTAINS:

FIG. NO.	TITLE
1	SCISSOR ASSEMBLY (LS30E)
1A	SCISSOR ASSEMBLY (LS36E)
2	LOWER OUTER ARM ASSEMBLY (LS30E)
2A	LOWER OUTER ARM ASSEMBLY (LS36E)
3	MIDDLE OUTER ARM ASSEMBLY (LS30E)
3A	MIDDLE OUTER ARM ASSEMBLY (LS36E)
3B	MIDDLE OUTER ARM ASSEMBLY (LS36E)
4	UPPER OUTER ARM ASSEMBLY (LS30E)
4A	UPPER OUTER ARM ASSEMBLY (LS36E)
5	LOWER INNER ARM ASSEMBLY (LS30E)
5A	LOWER INNER ARM ASSEMBLY (LS36E)
6	MIDDLE INNER ARM ASSEMBLY (LS30E & LS36E)
7	UPPER INNER ARM ASSEMBLY (LS30E)
7A	UPPER INNER ARM ASSEMBLY (LS36E)
8	UPPER MIDDLE INNER ARM ASSEMBLY (LS36E)
9	INNER ARM SUPPORT ASSEMBLY (LS30E & LS36E)
10	MAIN LIFT CYLINDER ASSEMBLY (FRONT)(LS30E)
10A	MAIN LIFT CYLINDER ASSEMBLY (REAR)(LS30E)
10B	MAIN LIFT CYLINDER ASSEMBLY (FRONT)(LS36E)
10C	MAIN LIFT CYLINDER ASSEMBLY (REAR)(LS36E)



Mark Industries

TITLE	SCISSOR ASSEMBLY	SECTION	4
MODEL	LS30E	FIGURE	1
NOTES		PAGE	1

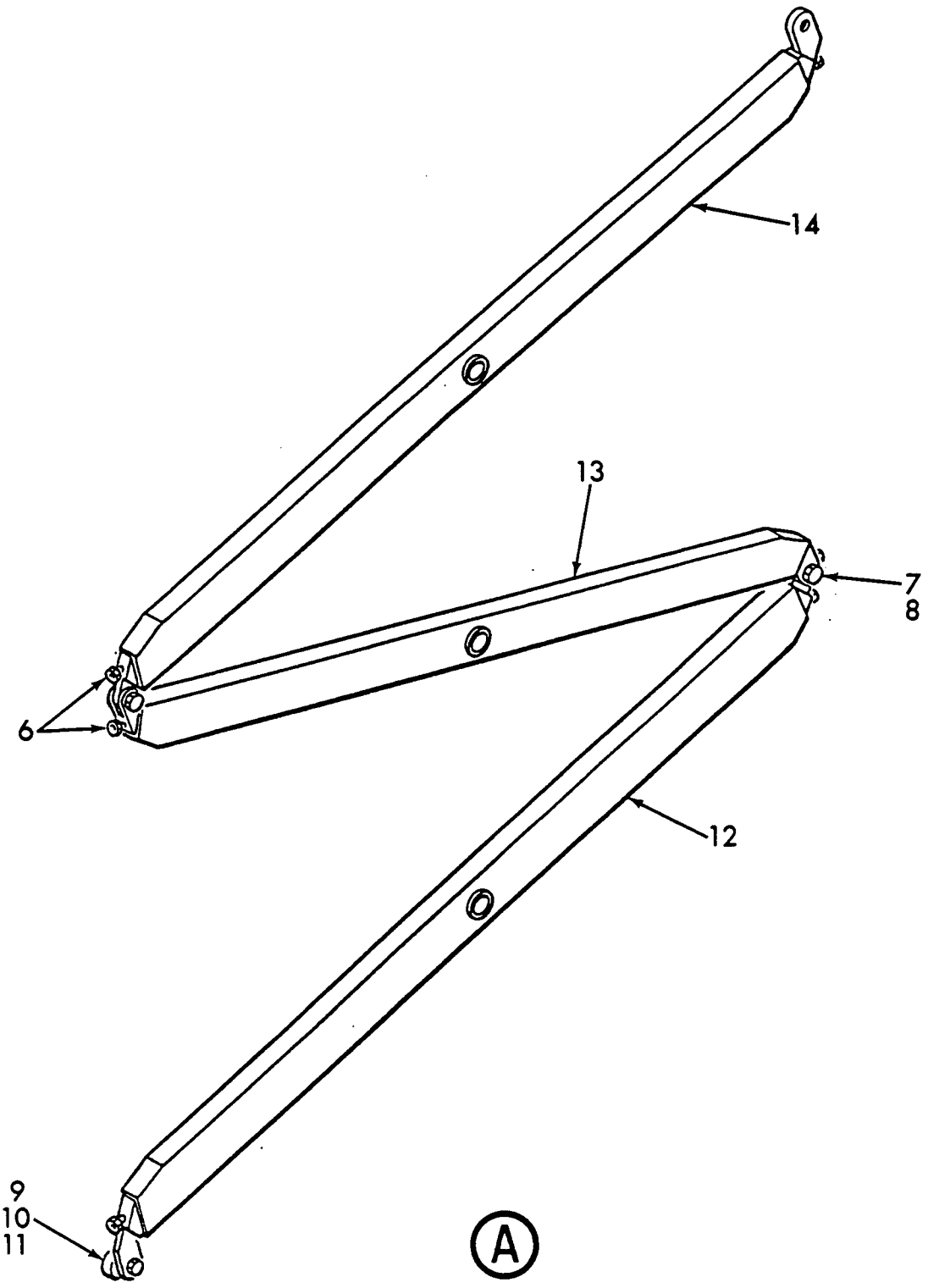


REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	1
PAGE	2

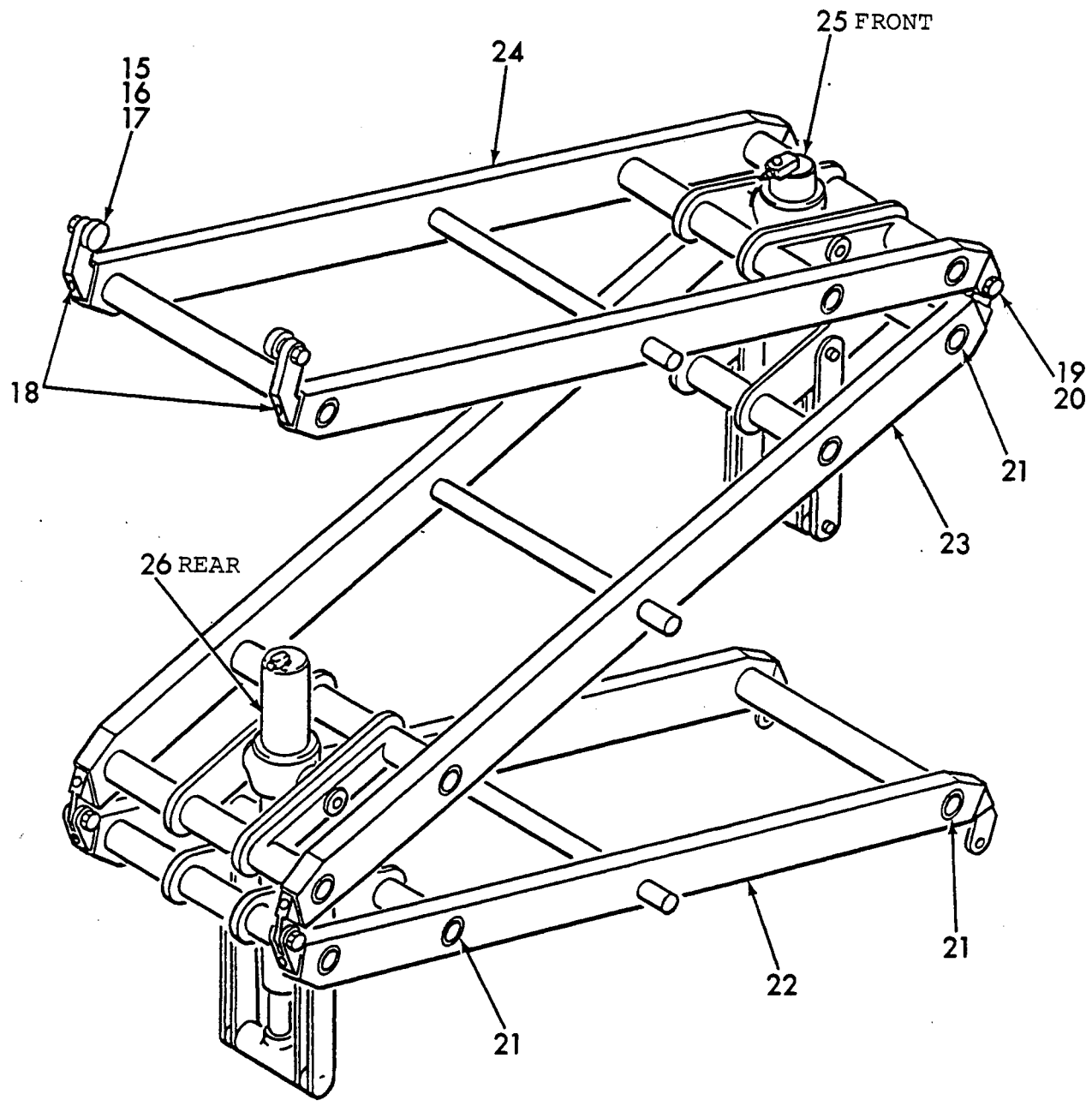


REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	1
PAGE	3



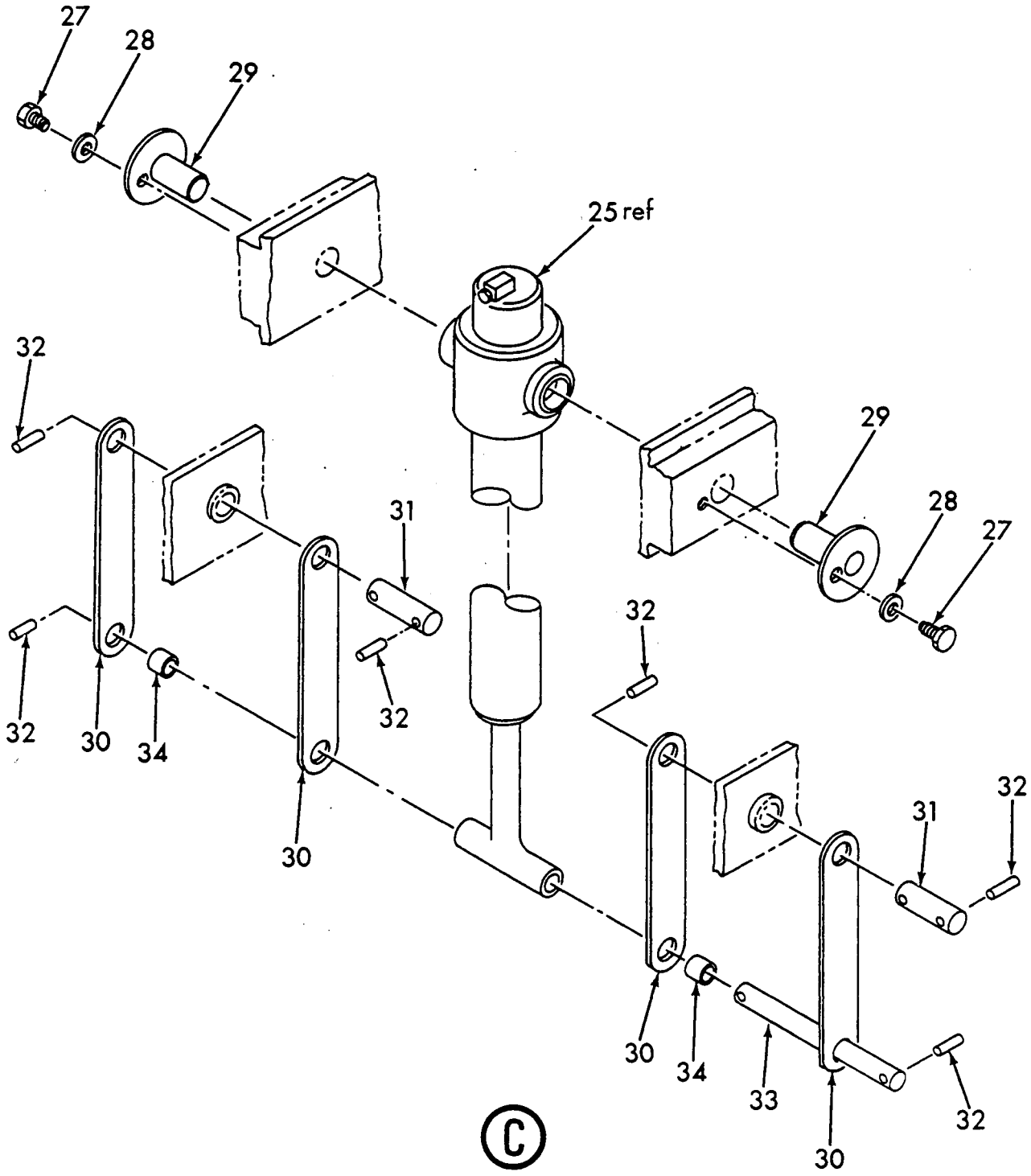
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REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	1
PAGE	4



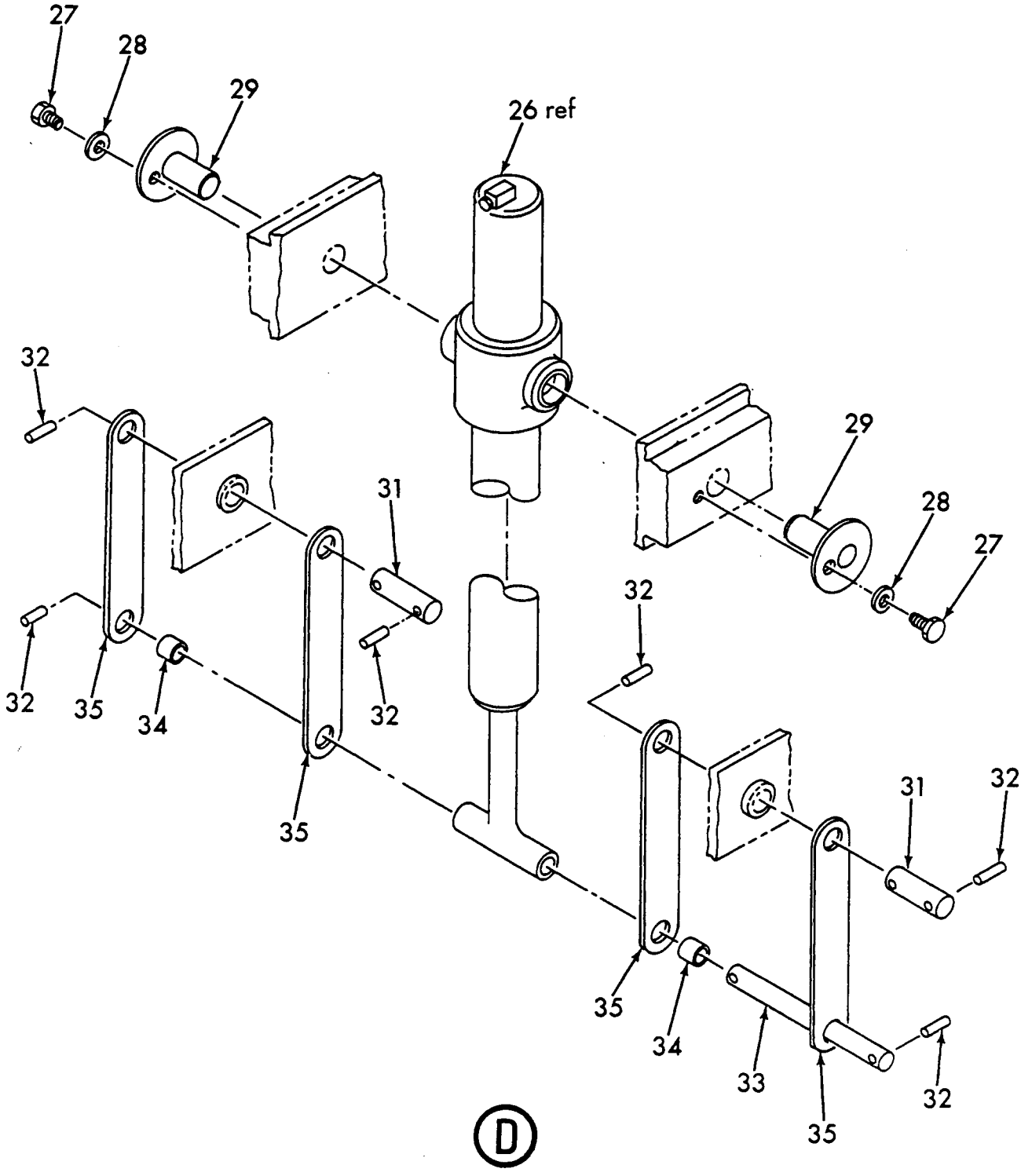
REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	1
PAGE	5

REAR



REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY	SECT.	4
MODEL	LS30E	FIG.	1
NOTES		PAGE	6

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30231	SCISSOR ASSEMBLY (See Sect. 2, Fig. 1 for NHA)	REF
2	2214	.SHAFT COLLAR	6
3	30338	.INNER ARM SUPPORT ASSEMBLY (See Sect. 4, Fig. 9 for Details)	1
4	30701	.BALL LOCK PIN	2
5	63654	.POP RIVET	2
6	2807	.STRAIN RELIEF CONNECTOR	12
7	30296	.EAR PIVOT BOLT	4
8	61304	.LOCK NUT	4
9	2380	.CAM ROLLER	2
10	30475	.ROLLER SPACER	2
11	61216	.LOCK NUT	2
12	30156	.LOWER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 2 for Details)	2
13	30158	.MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 3 for Details)	2
14	30159	.UPPER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 4 for Details)	2
15	2380	.CAM ROLLER	2
16	30475	.ROLLER SPACER	2
17	61216	.LOCK NUT	2
18	16335	.EAR PLUG	12
19	30296	.EAR PIVOT BOLT	4
20	61304	.LOCK NUT	4
21	16334	.ARM CROSS MEMBER CAP	20
22	30181	.LOWER INNER ARM ASSEMBLY (See Sect. 4, Fig. 5 for Details)	1

Mark Industries

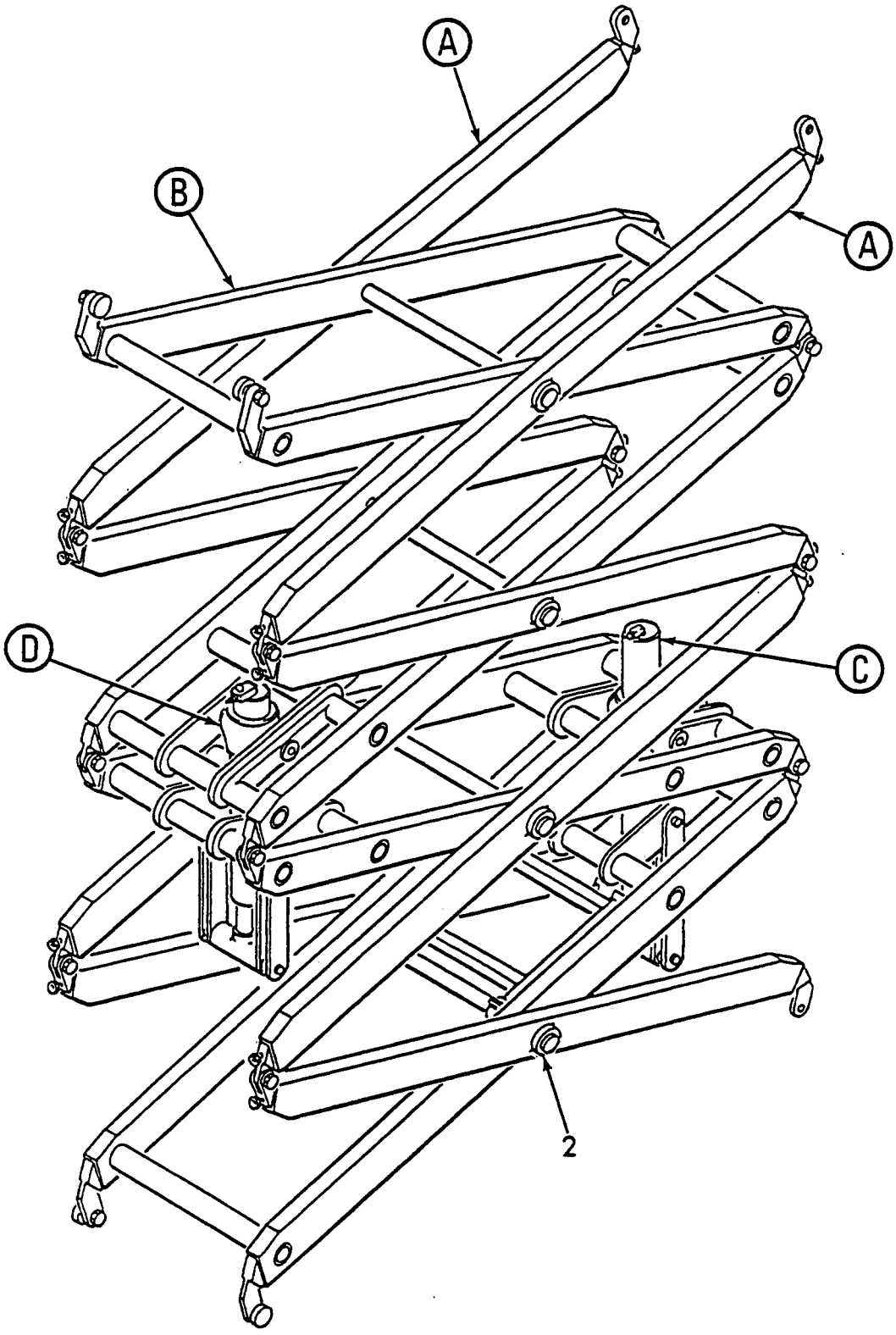
TITLE	SCISSOR ASSEMBLY	SECT.	4
MODEL	LS30E	FIG.	1
NOTES		PAGE	7

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
23	30182	.MIDDLE INNER ARM ASSEMBLY (See Sect. 4, Fig. 6 for Details)	1
24	30183	.UPPER INNER ARM ASSEMBLY (See Sect. 4, Fig. 7 for Details)	1
25	30326	.MAIN LIFT CYLINDER ASSEMBLY (FRONT) (See Sect. 4, Fig. 10 for Details)	1
26	30325	.MAIN LIFT CYLINDER ASSEMBLY (REAR) (See Sect. 4, Fig. 10A for Details)	1
27	60160	.CAP SCREW	4
28	63302	.LOCK WASHER	4
29	30151	.TRUNNION PIN	4
30	30198	.ACTUATOR STRAP (FRONT)	4
31	30195	.CYLINDER STRAP PIVOT PIN	4
32	64206	.ROLL PIN	12
33	30196	.CYLINDER PIVOT PIN	2
34	30474	.SPACER	4
35	30199	.ACTUATOR STRAP (REAR)	4

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	1A
PAGE	1

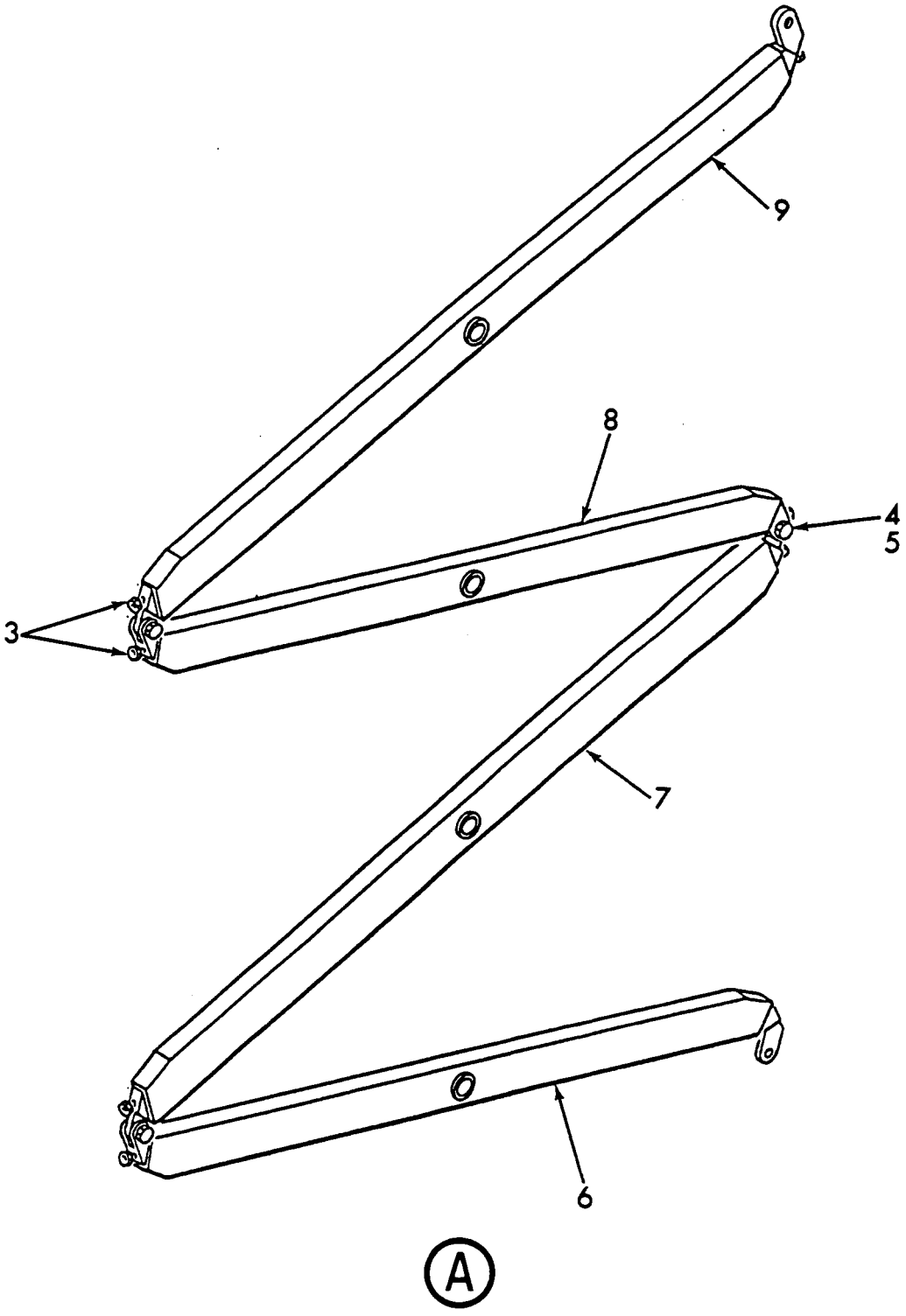


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Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	1A
PAGE	2

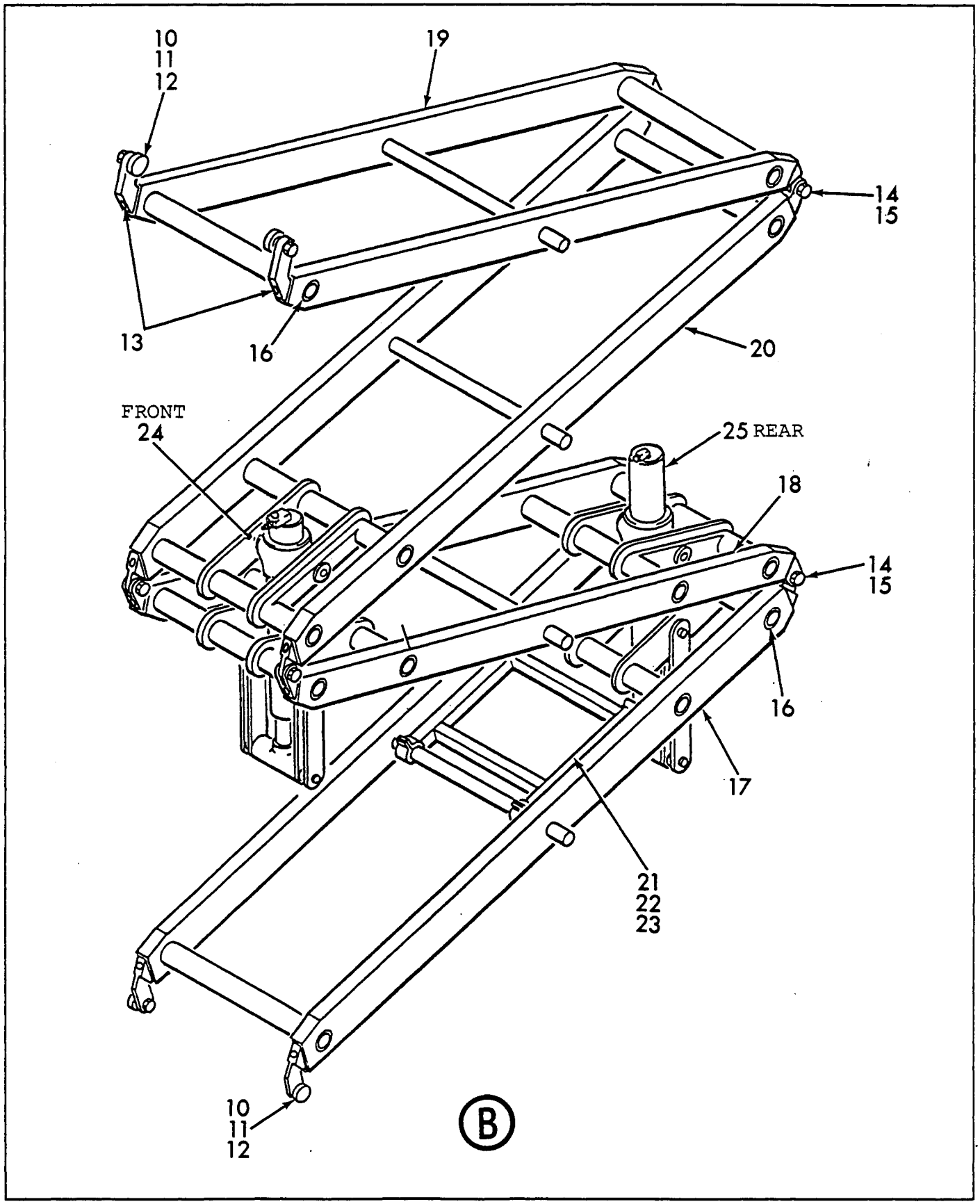


REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	1A
PAGE	3

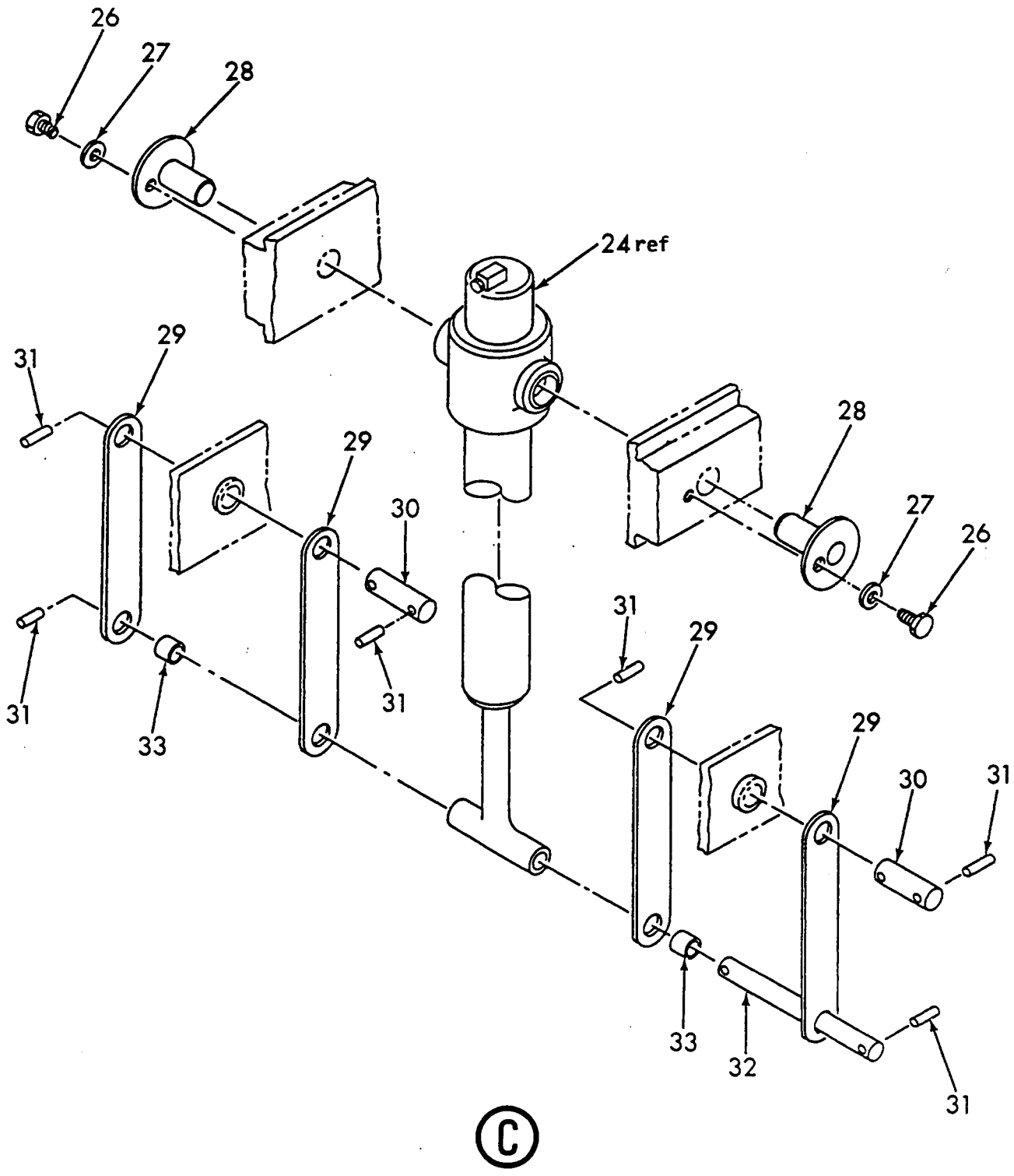


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Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	1A
PAGE	4

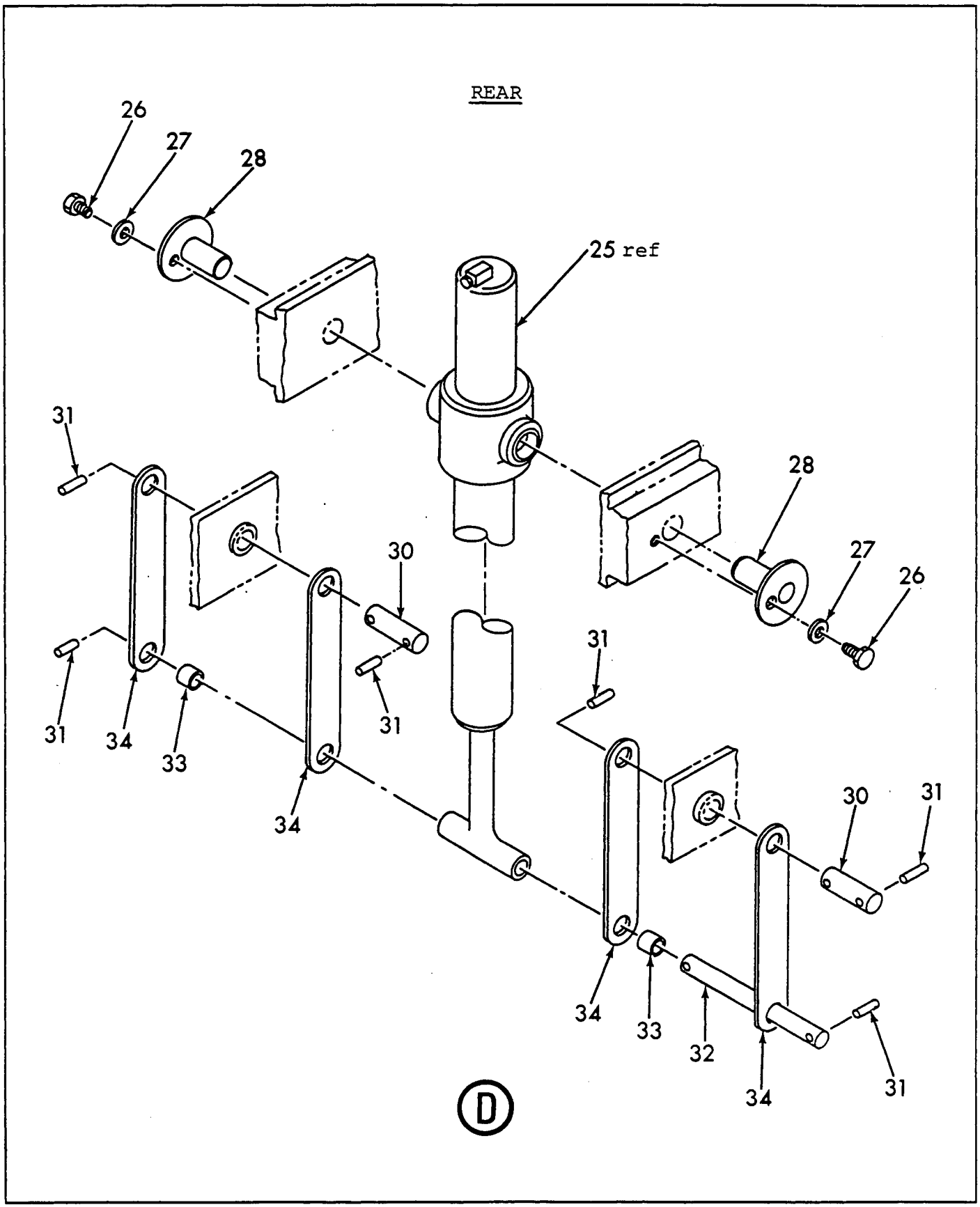


REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	1A
PAGE	5



REV.

Mark Industries

TITLE	SCISSOR ASSEMBLY	SECT.	4
MODEL	LS36E	FIG.	1A
NOTES		PAGE	6

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30232	SCISSOR ASSEMBLY (See Sect. 3, Fig. 1A for NHA)	REF
2	2214	.SHAFT COLLAR	8
3	2807	.STRAIN RELIEF CONNECTOR	16
4	30296	.EAR PIVOT BOLT	6
5	61216	.LOCK NUT	6
6	30345	.LOWER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 2A for Details)	2
7	30346	.MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 3A for Details)	2
8	30157	.MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 3B for Details)	2
9	30225	.UPPER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 4A for Details)	2
10	2380	.CAM ROLLER	4
11	30475	.ROLLER SPACER	4
12	61216	.LOCK NUT	2
13	16335	.EAR PLUG	16
14	30296	.EAR PIVOT BOLT	6
15	61304	.LOCK NUT	6
16	16334	.ARM CROSS MEMBER CAP	24
17	32747	.LOWER INNER ARM ASSEMBLY (See Sect. 4, Fig. 5A for Details)	1
18	30182	.MIDDLE INNER ARM ASSEMBLY (See Sect. 4, Fig. 6 for Details)	1
19	30185	.UPPER INNER ARM ASSEMBLY (See Sect. 4, Fig. 7A for Details)	1
20	30184	.UPPER MIDDLE INNER ARM ASSEMBLY (See Sect. 4, Fig. 8 for Details)	1
21	30338	.INNER ARM SUPPORT ASSEMBLY (See Sect. 4, Fig. 9 for Details)	1

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

Mark Industries

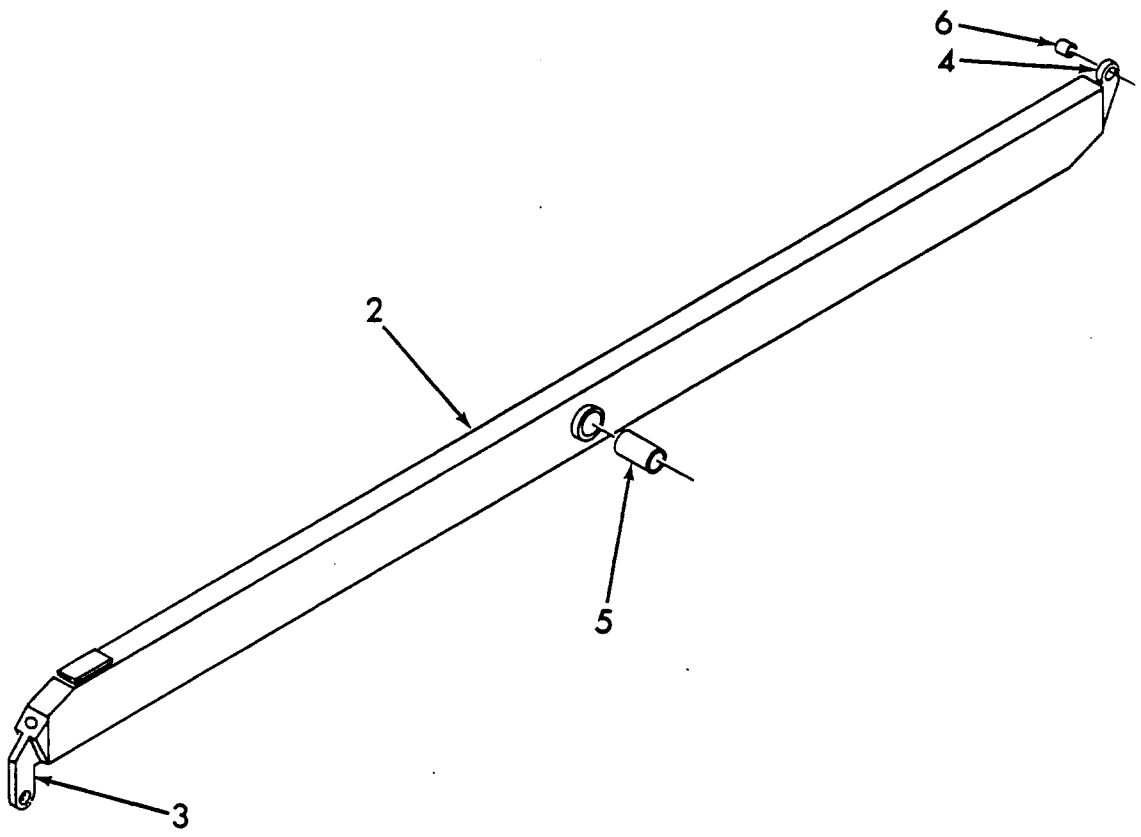
TITLE	SCISSOR ASSEMBLY	SECT.	4
MODEL	LS36E	FIG.	1A
NOTES		PAGE	7

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
22	30701	.BALL LOCK PIN	2
23	63654	.POP RIVET	2
24	30328	.MAIN LIFT CYLINDER (FRONT) (See Sect. 4, Fig. 10B for Details)	1
25	30327	.MAIN LIFT CYLINDER (REAR) (See Sect. 4, Fig. 10C for Details)	1
26	60367	.CAP SCREW	4
27	63302	.LOCK WASHER	4
28	30151	.TRUNNION PIN	4
29	30198	.ACTUATOR STRAP (FRONT)	4
30	30195	.CYLINDER STRAP PIVOT PIN	4
31	64206	.ROLL PIN	12
32	30196	.CYLINDER PIVOT PIN	2
33	30474	.SPACER	4
34	30199	.ACTUATOR STRAP (REAR)	4

Mark Industries

TITLE	LOWER OUTER ARM ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	2
PAGE	1



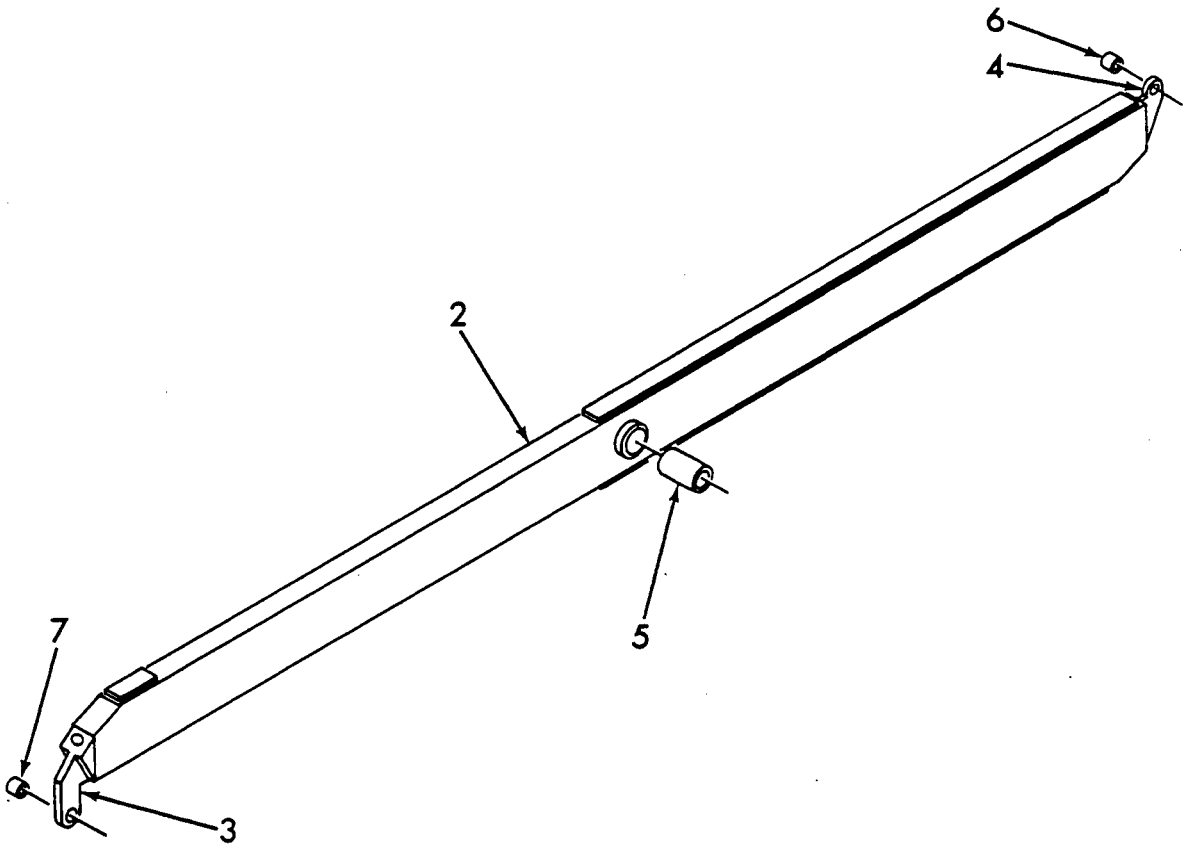
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30156	LOWER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1 for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30153	.LONG MALE EAR	1
4	30154	.SHORT MALE EAR	1
5	30207	.BUSHING	1
6	30635	.BUSHING	1

REV.

Mark Industries

TITLE	LOWER OUTER ARM ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	2A
PAGE	1



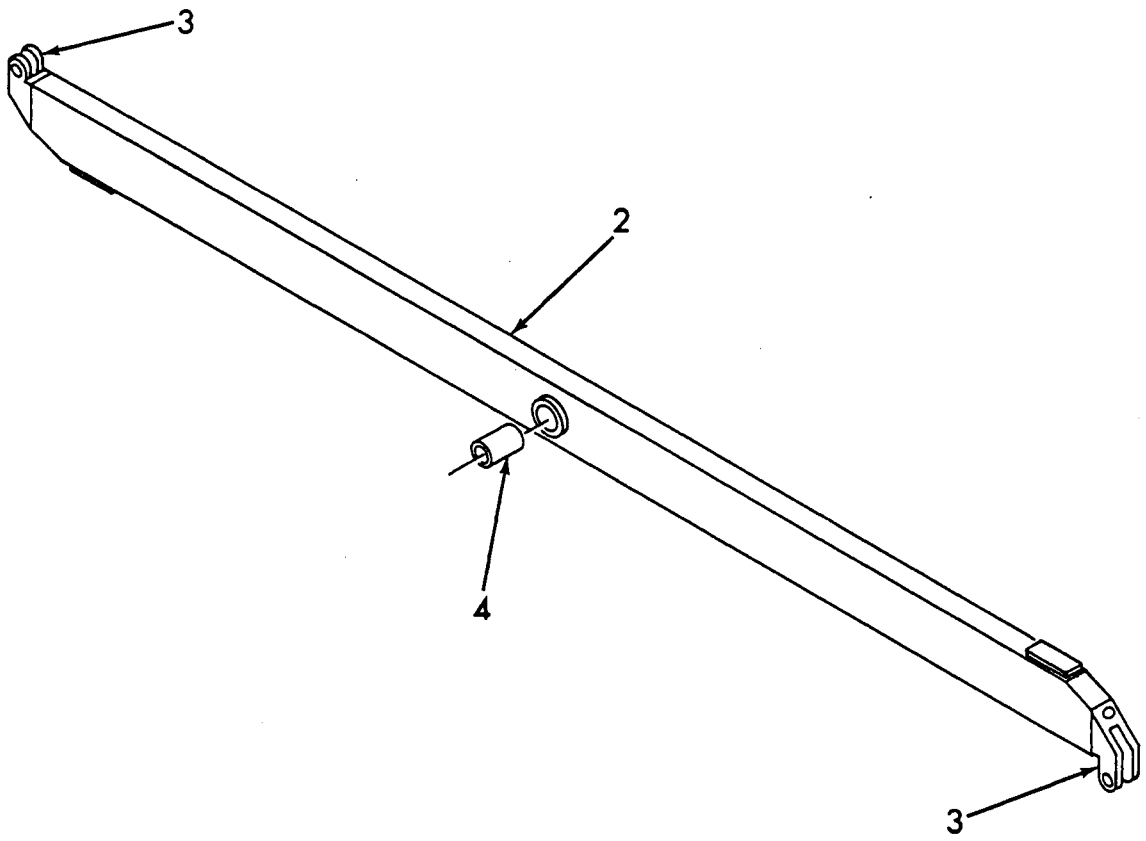
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30345	LOWER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30152	.LONG MALE EAR	1
4	30154	.SHORT MALE EAR	1
5	30207	.BUSHING	1
6	30635	.BUSHING	1
7	30186	.BUSHING	1

REV.

Mark Industries

TITLE	MIDDLE OUTER ARM ASSEMBLY
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	3
PAGE	1



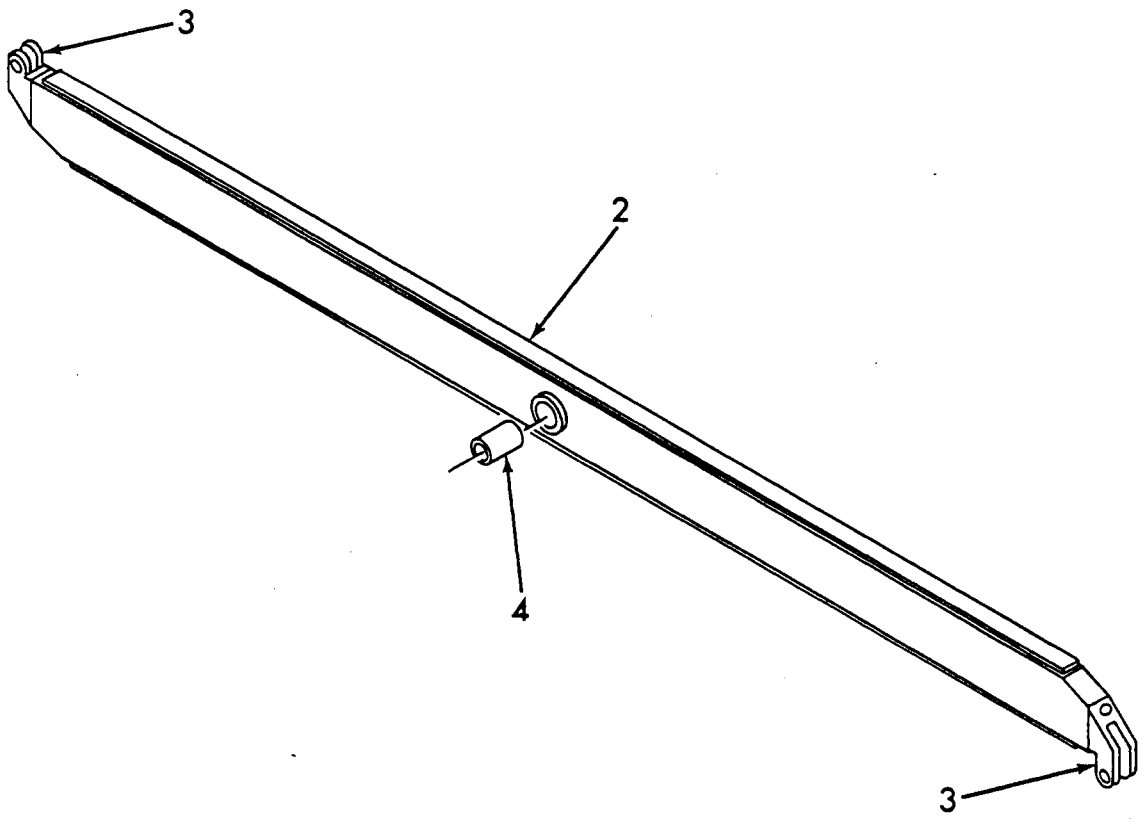
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30158	MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1 for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30155	.SHORT FEMALE EAR	2
4	30207	.BUSHING	1

REV.

Mark Industries

TITLE	MIDDLE OUTER ARM ASSEMBLY
MODEL	LS36E
NOTES	

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FIGURE	3A
PAGE	1



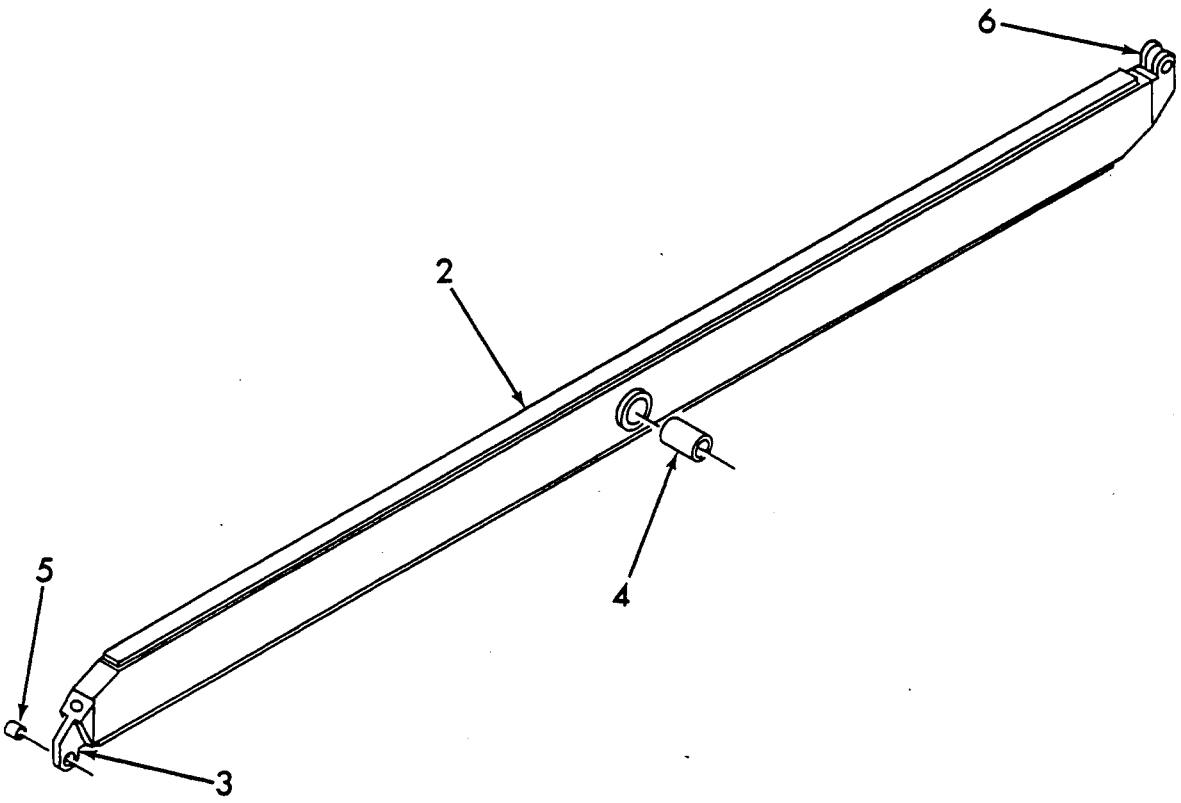
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30346	MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30155	.SHORT FEMALE EAR	2
4	30207	.BUSHING	1

REV.

Mark Industries

TITLE	MIDDLE OUTER ARM ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	3B
PAGE	1



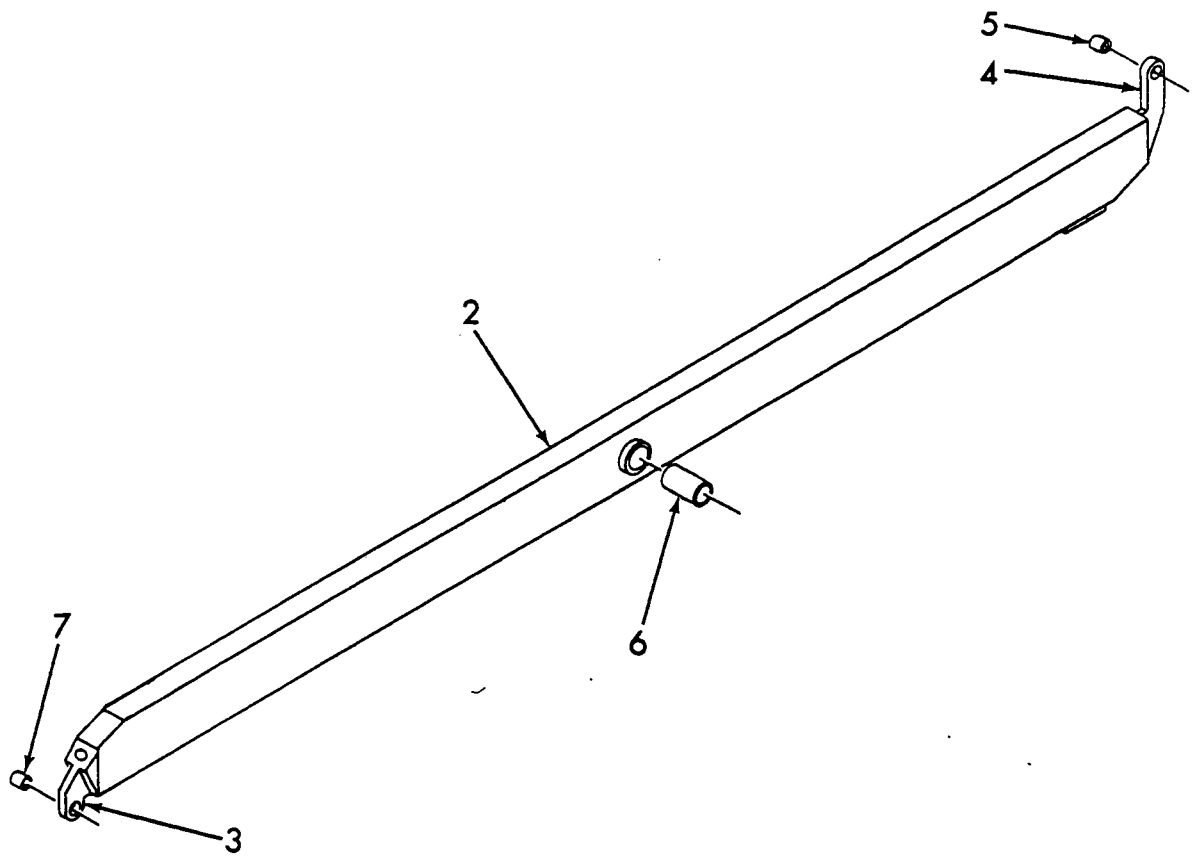
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30157	MIDDLE OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30154	.SHORT MALE EAR	1
4	30207	.BUSHING	1
5	30635	.BUSHING	1
6	30155	.FEMALE EAR	1

REV.

Mark Industries

TITLE	UPPER OUTER ARM ASSEMBLY
MODEL	LS30E
NOTES	

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FIGURE	4
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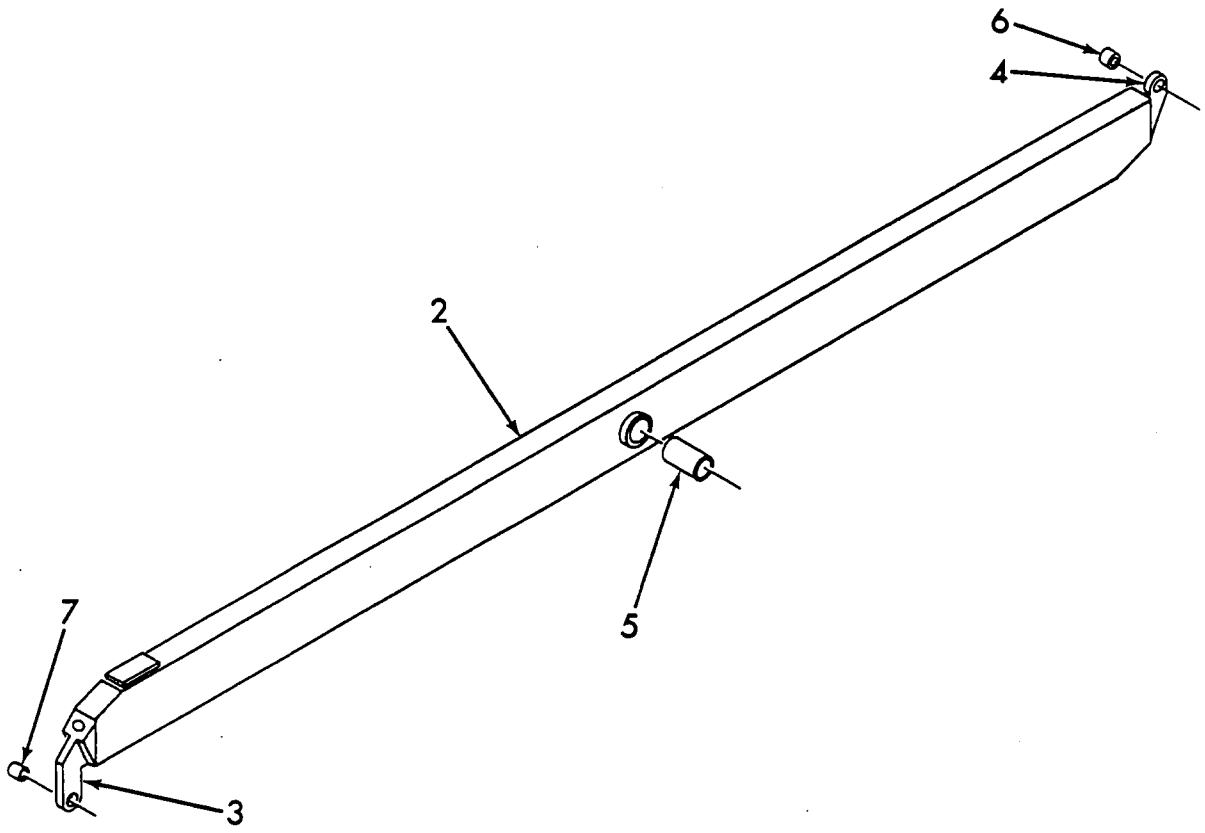
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30159	UPPER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1 for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30154	.SHORT MALE EAR	1
4	30152	.LONG MALE EAR	1
5	30186	.BUSHING	1
6	30207	.BUSHING	1
7	30635	.BUSHING	1

REV.

Mark Industries

TITLE	UPPER OUTER ARM ASSEMBLY
MODEL	LS36E
NOTES	

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FIGURE	4A
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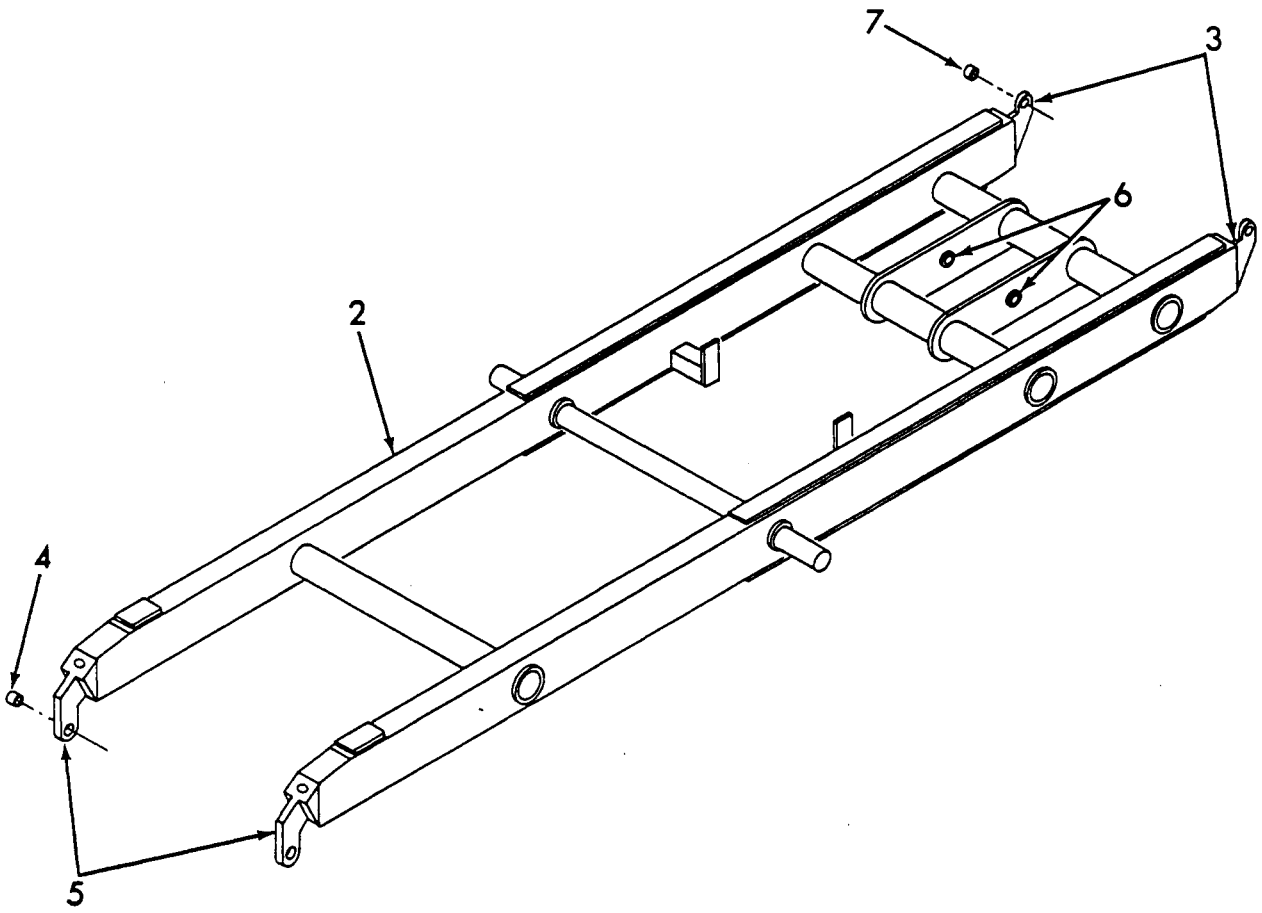
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30225	UPPER OUTER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30175	.OUTER ARM FABRICATION	1
3	30152	.LONG MALE EAR	1
4	30154	.SHORT MALE EAR	1
5	30207	.BUSHING	1
6	30635	.BUSHING	1
7	30186	.BUSHING	1

REV.

Mark Industries

TITLE	LOWER INNER ARM ASSEMBLY
MODEL	LS30E
NOTES	

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FIGURE	5
PAGE	1



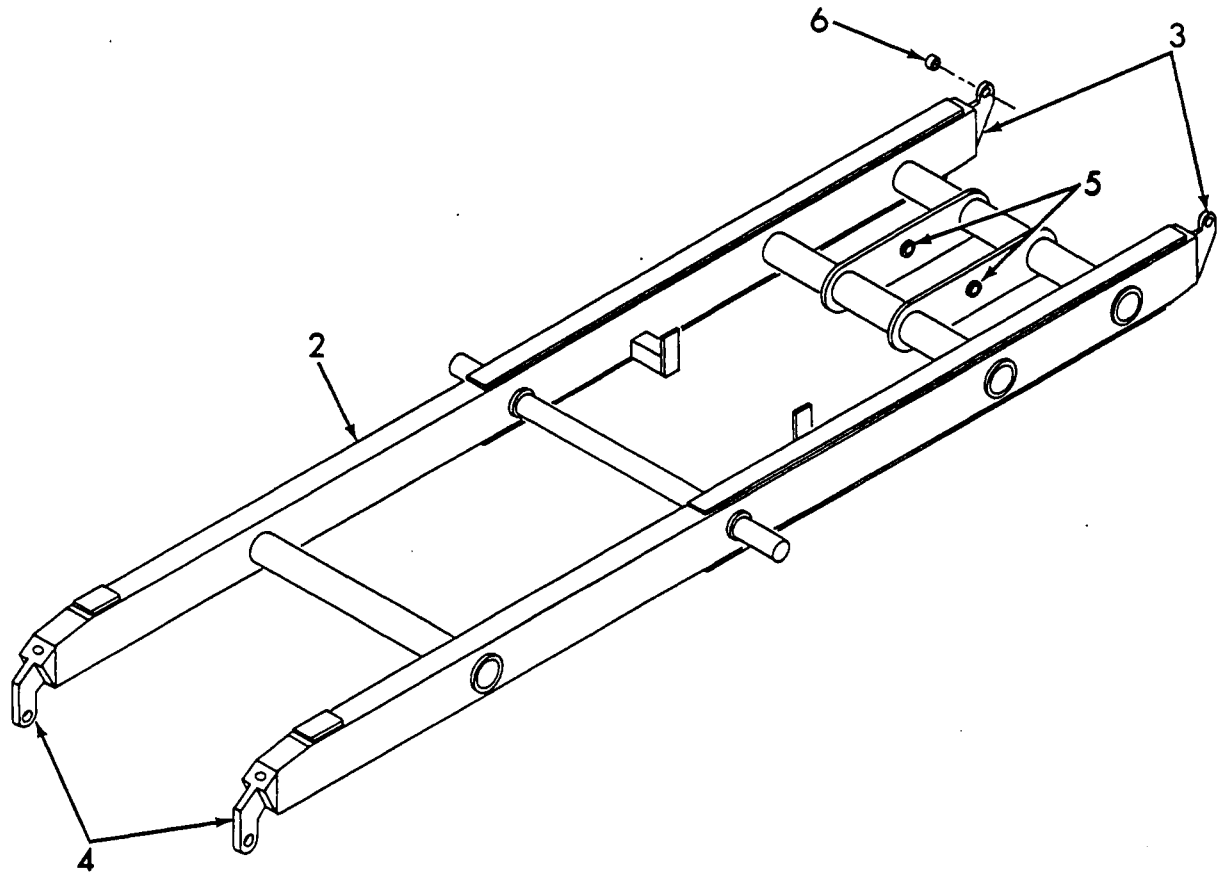
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30181	LOWER INNER ARM ASSEMBLY (See Sect. 4, Fig. 1 for NHA)	REF
2	30461	.INNER ARM LOWER FABRICATION	2
3	30154	.SHORT MALE EAR	2
4	30186	.BUSHING	2
5	30152	.LONG MALE PIVOT EAR	2
6	80200	.BUSHING	2
7	30635	.BUSHING	2

REV.

Mark Industries

TITLE	LOWER INNER ARM ASSEMBLY
MODEL	LS36E
NOTES	

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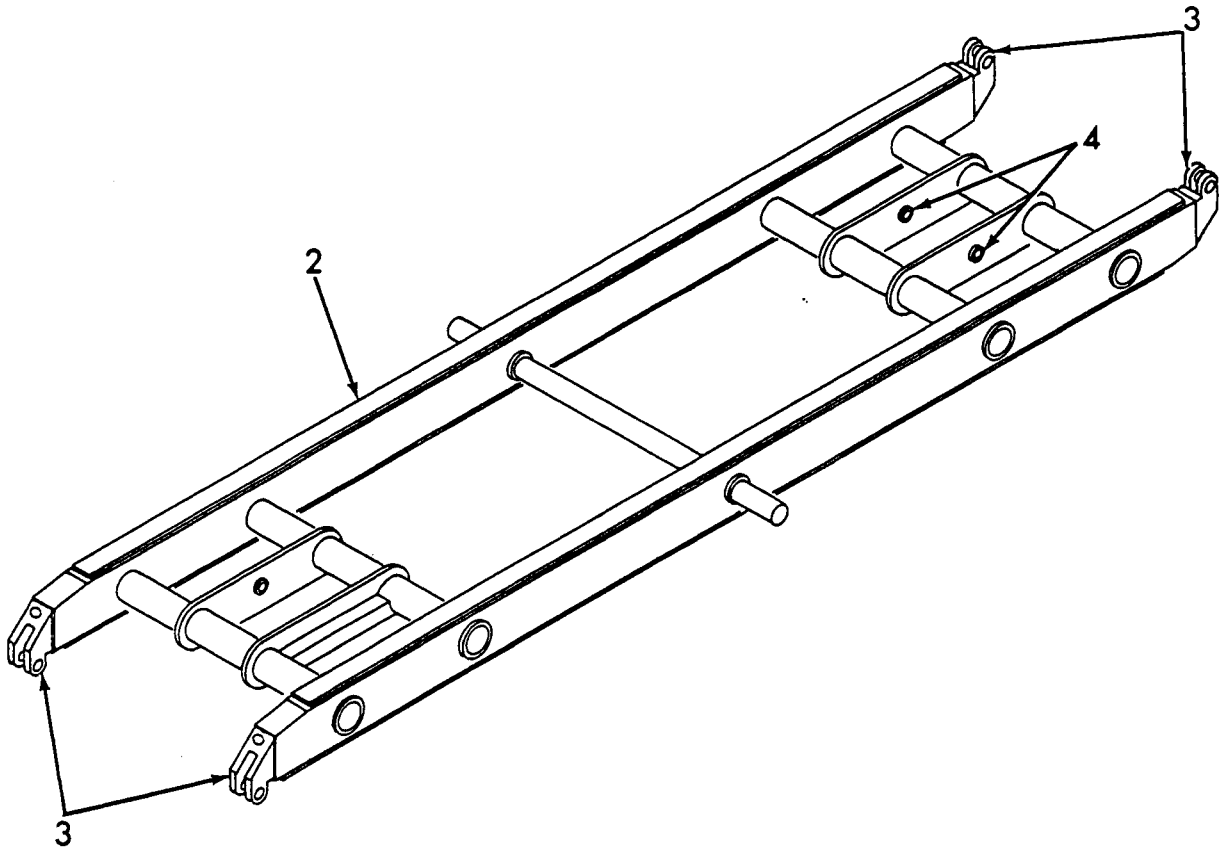
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32747	LOWER INNER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30461	.INNER ARM LOWER FABRICATION	2
3	30154	.SHORT MALE EAR	2
4	30153	.LONG MALE PIVOT EAR	2
5	30200	.BUSHING	2
6	30635	.BUSHING	2

REV.

Mark Industries

TITLE	MIDDLE INNER ARM ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIGURE	6
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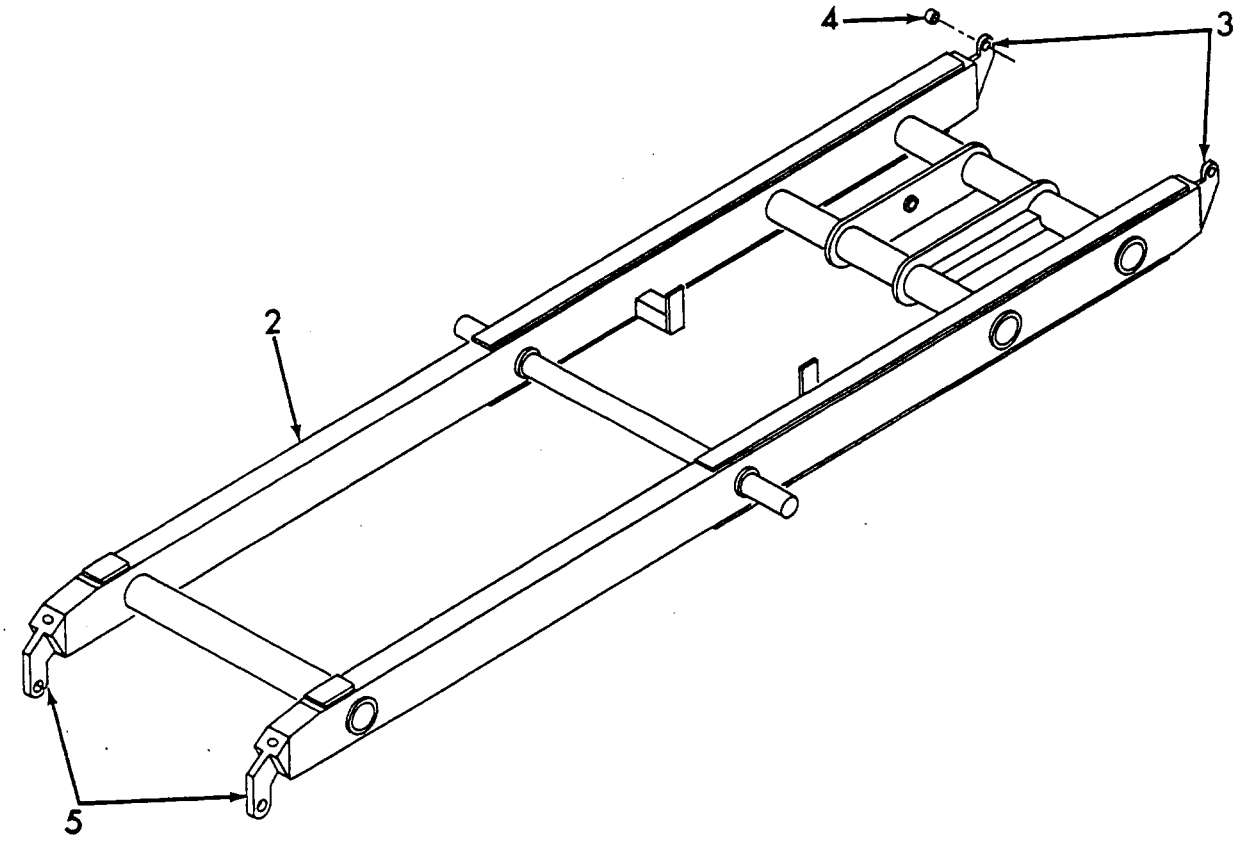
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30182	MIDDLE INNER ARM ASSEMBLY	REF
2	30177	.INNER ARM FABRICATION	2
3	30155	.FEMALE EAR	4
4	30200	.BUSHING	2

REV.

Mark Industries

TITLE	UPPER INNER ARM ASSEMBLY
MODEL	LS30E
NOTES	

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FIGURE	7
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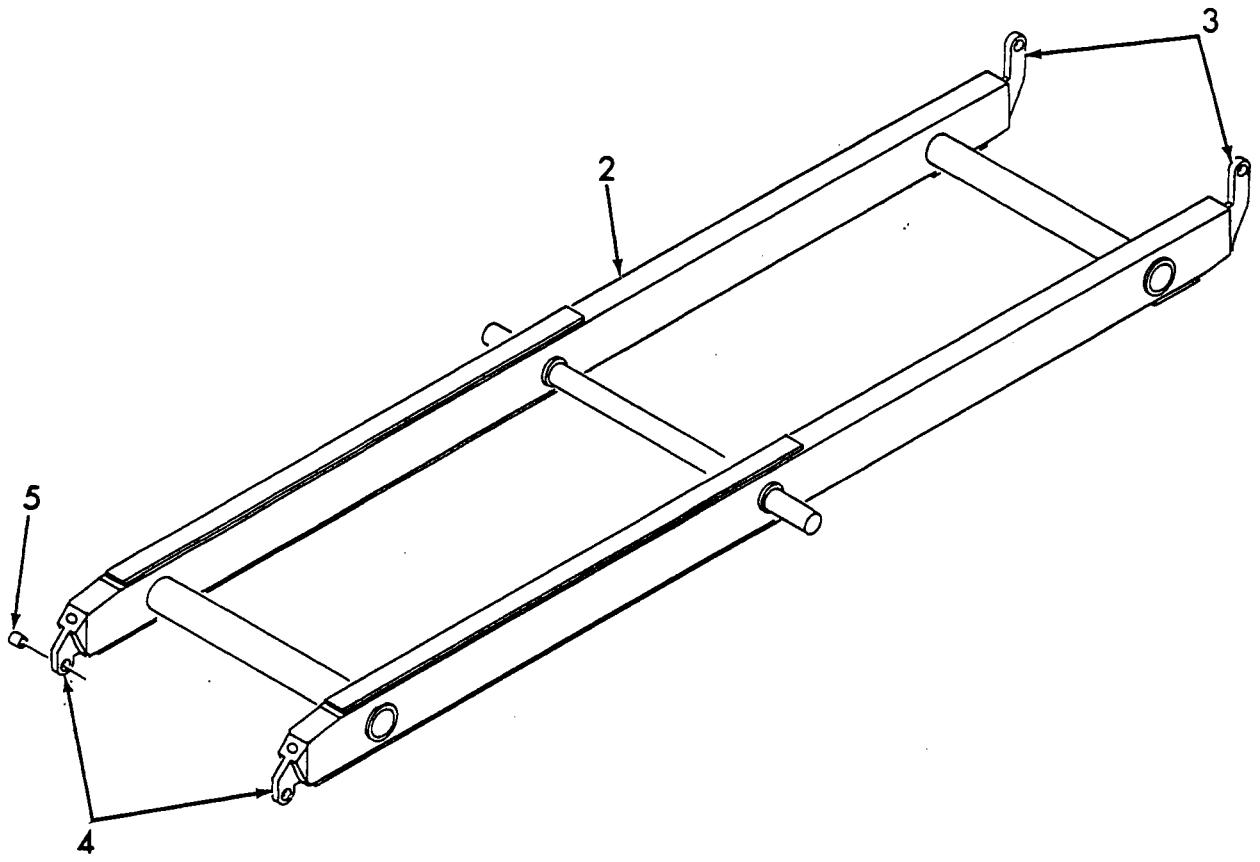
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30183	UPPER INNER ARM ASSEMBLY (See Sect. 4, Fig. 1 for NHA)	REF
2	30176	.UPPER & LOWER INNER ARM FABRICATION	2
3	30154	.SHORT MALE EAR	2
4	30635	.BUSHING	2
5	30153	.LONG MALE ROLLER EAR	2

REV.

Mark Industries

TITLE	UPPER INNER ARM ASSEMBLY
MODEL	LS36E
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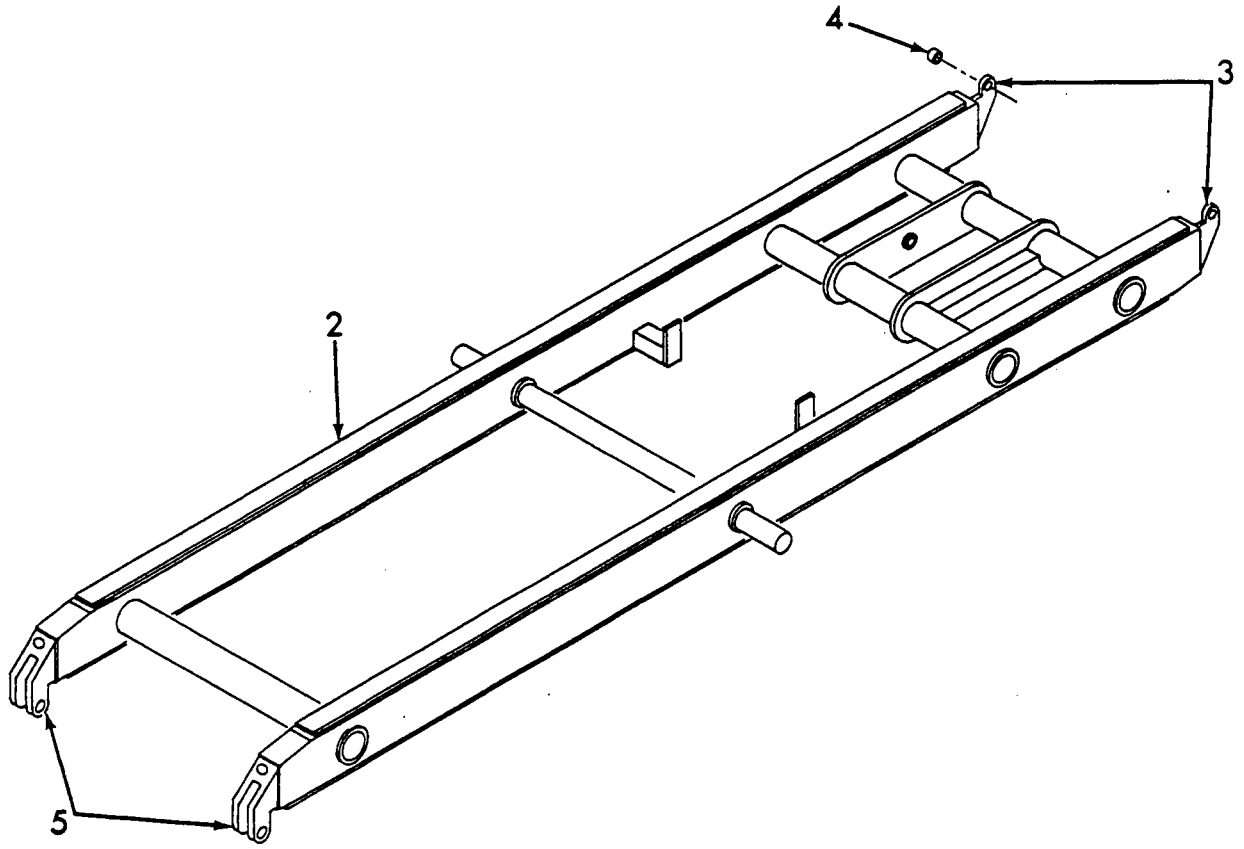
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30185	UPPER INNER ARM ASSEMBLY (See Sect. 4, Fig. 1A for NHA)	REF
2	30178	.UPPER INNER ARM FABRICATION	2
3	30153	.LONG MALE EAR	2
4	30154	.MALE EAR	2
5	30635	.BUSHING	2

REV.

Mark Industries

TITLE	UPPER MIDDLE INNER ARM ASSEMBLY
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	8
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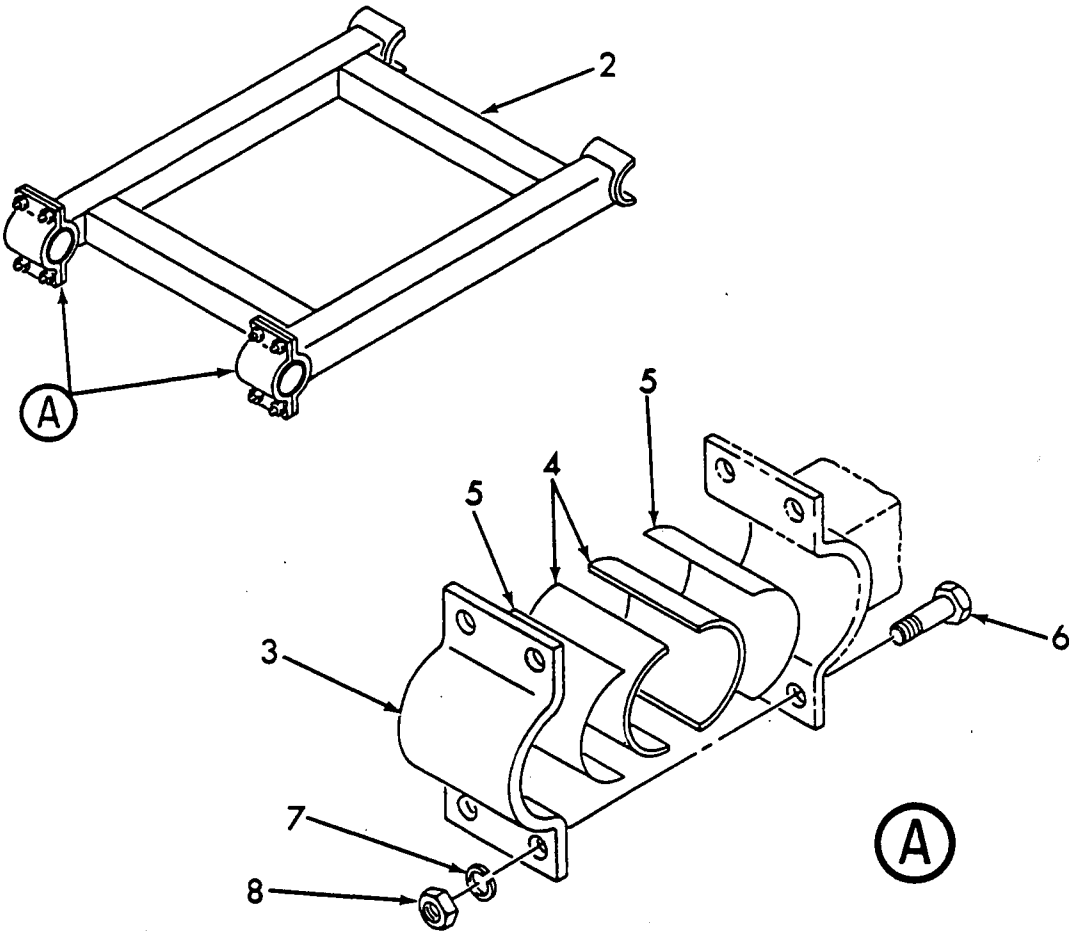
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30184	UPPER MIDDLE INNER ARM ASSEMBLY	REF
2	30176	.UPPER & LOWER INNER ARM FABRICATION	2
3	30154	.SHORT MALE EAR	2
4	30635	.BUSHING	2
5	30155	.FEMALE EAR	2

REV.

Mark Industries

TITLE	INNER ARM SUPPORT ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

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FIGURE	9
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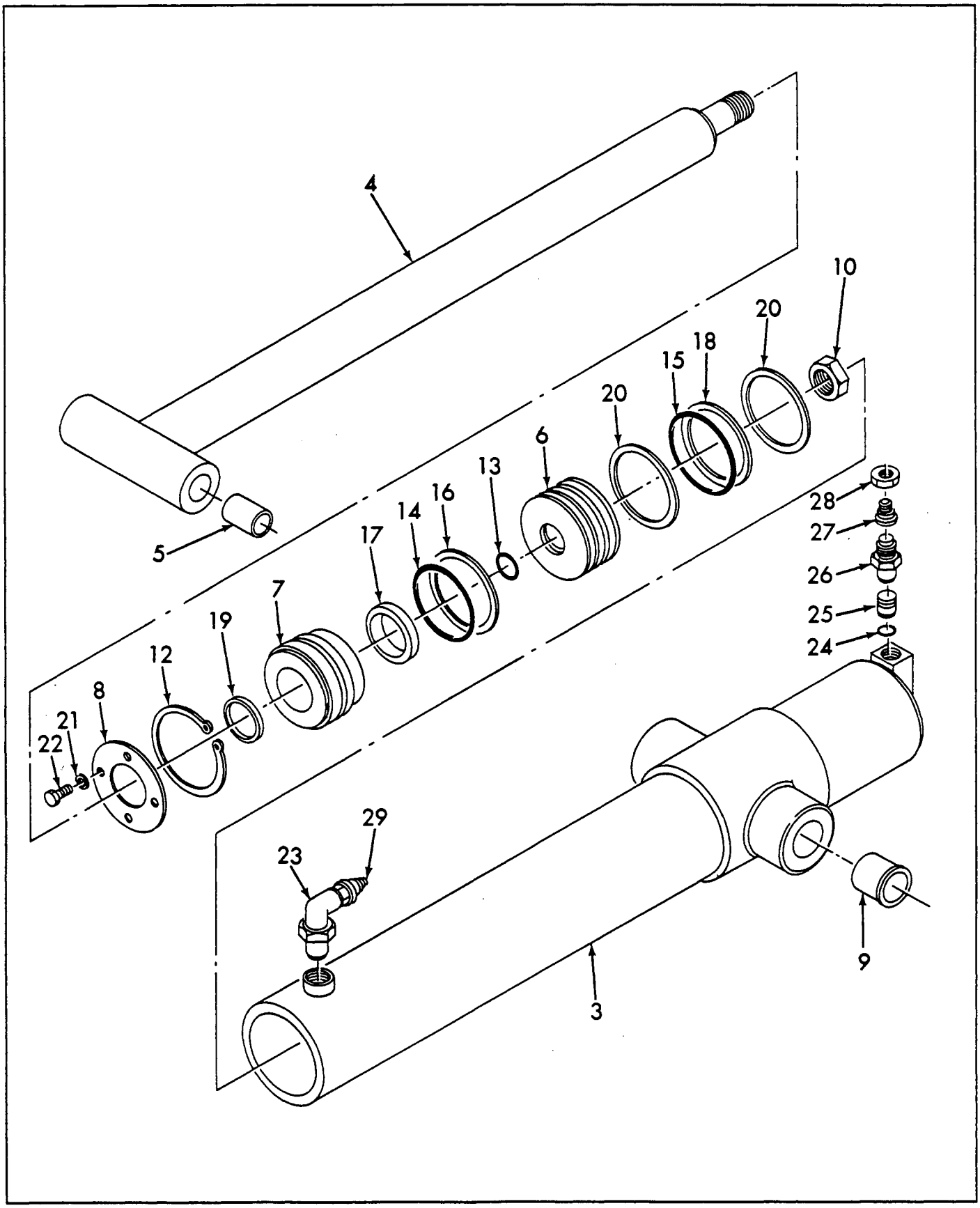
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30338	INNER ARM SUPPORT ASSEMBLY (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	30808	.INNER ARM SUPPORT WELDMENT	1
3	30335	.INNER ARM SUPPORT CLAMP	2
4	65792	.SPRING RUBBER CLAMP	4
5	65192	.ADHESIVE	AR
6	60343	.CAP SCREW	8
7	63303	.LOCK WASHER	8
8	60703	.NUT	8

REV.

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	10
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REV.

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS30E
NOTES	

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FIG.	10
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30326	MAIN LIFT CYLINDER ASSEMBLY (FRONT) (See Sect. 4, Fig. 1 for NHA)	REF
-2	30191	.CYLINDER	1
3		..BARREL ASSEMBLY	1
4		..ROD ASSEMBLY	1
5		..ROD BUSHING	2
6		..PISTON	1
7		..HEAD	1
8		..RETAINER PLATE	1
9	64910	..TRUNNION BUSHING	2
10		..NUT	1
-11	66962	..SEAL KIT (STEEL PISTON RINGS)(SHOWN)	1
	66017	SEAL KIT (POLY PAK)	1
	66018	SEAL KIT (HCI)(7/81-3/87 INTERMITTENTLY)	1
12		...SNAP RING	1
13		...O-RING	1
14		...O-RING	1
15		...O-RING	1
16		...BACK-UP RING	1
17		...ROD SEAL	1
18		...SHAMBAN SEAL	1
19		...ROD WIPER	1
20		...WEAR RING	2
21		...LOCK WASHER	4
22		...CAP SCREW	4
23	80012-09	.STRAIGHT THREAD ELBOW	1
24	880	.O-RING	1

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS30E
NOTES	

SECT.	4
FIG.	10
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ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
25	32583	.CHECK VALVE	1
26	80004-14	.STRAIGHT THREAD CONNECTOR	1
27	80056-03	.TUBE END REDUCER	1
28	80060-06	.NUT	1
29	2468	.HOSE FITTING	1

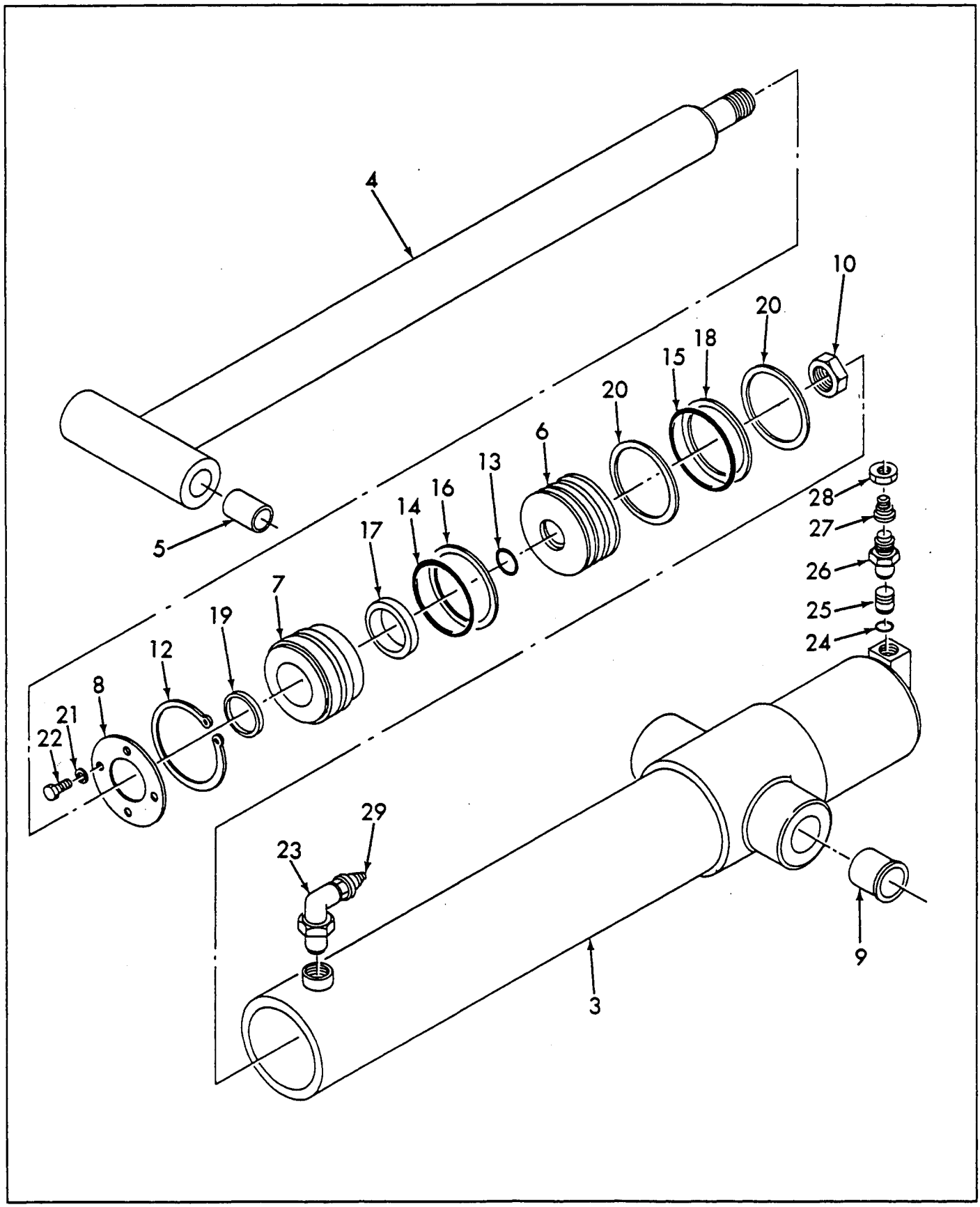
REV.

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

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)
MODEL	LS30E
NOTES	

SECTION	4
FIGURE	10A
PAGE	1



REV.

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)	SECT. 4
MODEL	LS30E	FIG. 10A
NOTES		PAGE 2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30325	MAIN LIFT CYLINDER ASSEMBLY (REAR) (See Sect. 4, Fig. 1 for NHA)	REF
-2	30192	.CYLINDER	1
3		..BARREL ASSEMBLY	1
4		..ROD ASSEMBLY	1
5		..ROD BUSHING	2
6		..PISTON	1
7		..HEAD	1
8		..RETAINING PLATE	1
9	64910	..TRUNNION BUSHING	2
10		..NUT	1
-11	66962	..SEAL KIT (STEEL PISTON RINGS)(SHOWN)	1
	66017	SEAL KIT (POLY PAK)	1
	66018	SEAL KIT (HCI)(7/81-3/87 INTERMITTENTLY)	1
12		...SNAP RING	1
13		...O-RING	1
14		...O-RING	1
15		...O-RING	1
16		...BACK-UP RING	1
17		...ROD SEAL	1
18		...SHAMBAN SEAL	1
19		...ROD WIPER	1
20		...WEAR RING	2
21		...LOCK WASHER	4
22		...CAP SCREW	4
23	80012-09	.STRAIGHT THREAD ELBOW	1
24	880	.O-RING	1

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)
MODEL	LS30E
NOTES	

SECT.	4
FIG.	10A
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
25	32583	.CHECK VALVE	1
26	80004-14	.STRAIGHT THREAD CONNECTOR	1
27	80056-03	.TUBE END REDUCER	1
28	80060-06	.NUT	1
29	2468	.HOSE FITTING	1

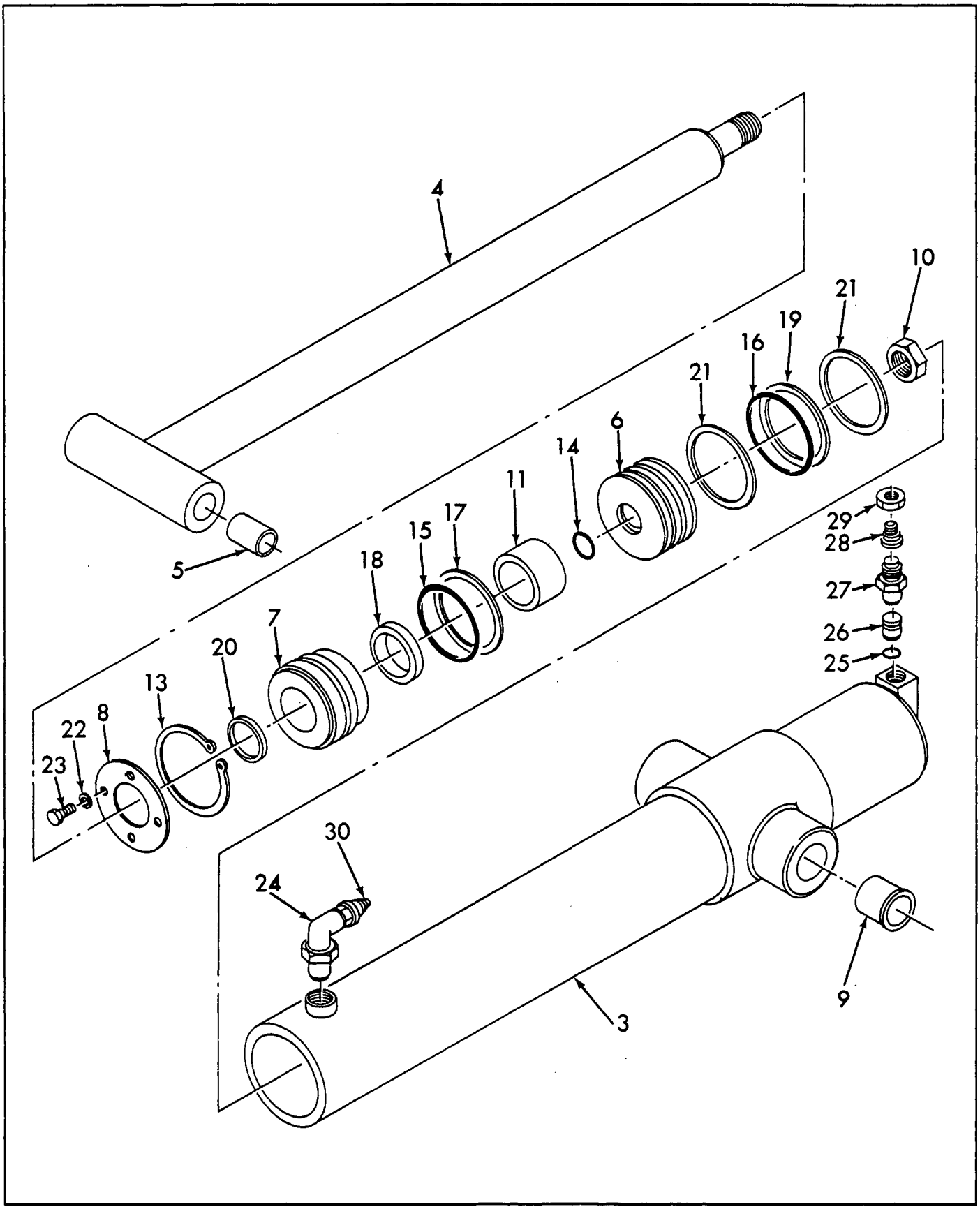
REV.

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

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	10B
PAGE	1



REV.

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS36E
NOTES	

SECT.	4
FIG.	10B
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30328	MAIN LIFT CYLINDER ASSEMBLY (FRONT) (See Sect. 4, Fig. 1A for NHA)	REF
-2	30193	.CYLINDER	1
3		..BARREL ASSEMBLY	1
4		..ROD ASSEMBLY	1
5		..ROD BUSHING	2
6		..PISTON	1
7		..HEAD	1
8		..RETAINER PLATE	1
9	64910	..TRUNNION BUSHING	2
10		..NUT	1
11		..STOP TUBE	1
-12	66962 66017 66018	..SEAL KIT (STEEL PISTON RINGS) (SHOWN) SEAL KIT (POLY PAK) SEAL KIT (HCI) (7/81-3/87 INTERMITTENTLY)	1 1 1
13		...SNAP RING	1
14		...O-RING	1
15		...O-RING	1
16		...O-RING	1
17		...BACK-UP RING	1
18		...ROD SEAL	1
19		...SHAMBAN SEAL	1
20		...ROD WIPER	1
21		...WEAR RING	2
22		...LOCK WASHER	4
23		...CAP SCREW	4
24	80012-09	.STRAIGHT THREAD ELBOW	1

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (FRONT)
MODEL	LS36E
NOTES	

SECT.	4
FIG.	10B
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
25	880	.O-RING	1
26	32576	.CHECK VALVE	1
27	80004-14	.STRAIGHT THREAD CONNECTOR	1
28	80056-03	.TUBE END REDUCER	1
29	80060-06	.NUT	1
30	2468	.HOSE FITTING	1

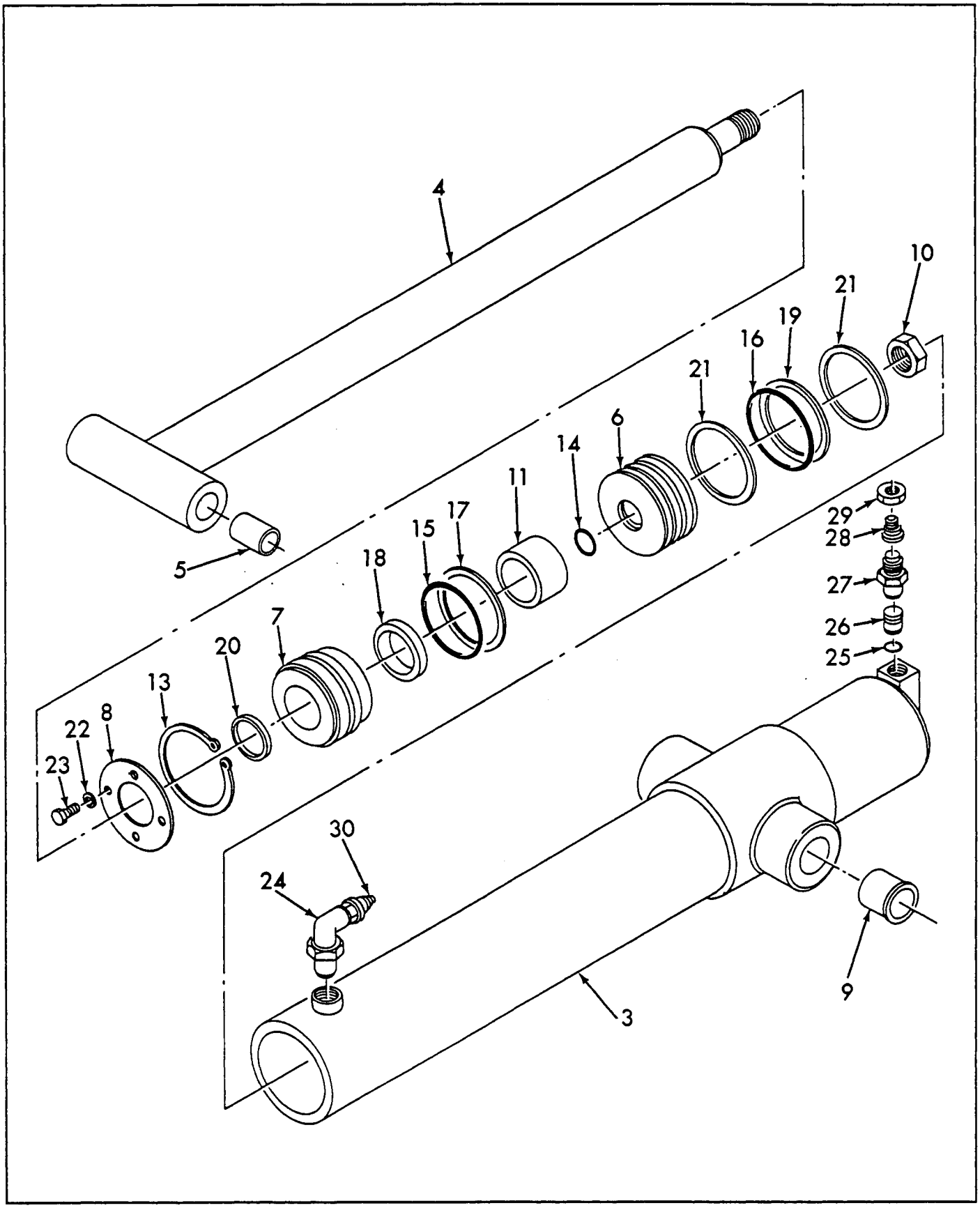
REV.

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

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)
MODEL	LS36E
NOTES	

SECTION	4
FIGURE	10C
PAGE	1



REV.

Mark Industries

TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)
MODEL	LS36E
NOTES	

SECT.	4
FIG.	10C
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	30327	MAIN LIFT CYLINDER ASSEMBLY (FRONT) (See Sect. 4, Fig. 1A for NHA)	REF
-2	30194	.CYLINDER	1
3		..BARREL ASSEMBLY	1
4		..ROD ASSEMBLY	1
5		..ROD BUSHING	2
6		..PISTON	1
7		..HEAD	1
8		..RETAINER PLATE	1
9	64910	..TRUNNION BUSHING	2
10		..NUT	1
11		..STOP TUBE	1
-12	66962 66017 66018	..SEAL KIT (STEEL PISTON RINGS)(SHOWN) SEAL KIT (POLY PAK) SEAL KIT (HCI)(7/81-3/87 INTERMITTENTLY)	1 1 1
13		...SNAP RING	1
14		...O-RING	1
15		...O-RING	1
16		...O-RING	1
17		...BACK-UP RING	1
18		...ROD SEAL	1
19		...SHAMBAN SEAL	1
20		...ROD WIPER	1
21		...WEAR RING	2
22		...LOCK WASHER	4
23		...CAP SCREW	4
24	80012-09	.STRAIGHT THREAD ELBOW	1

Mark Industries

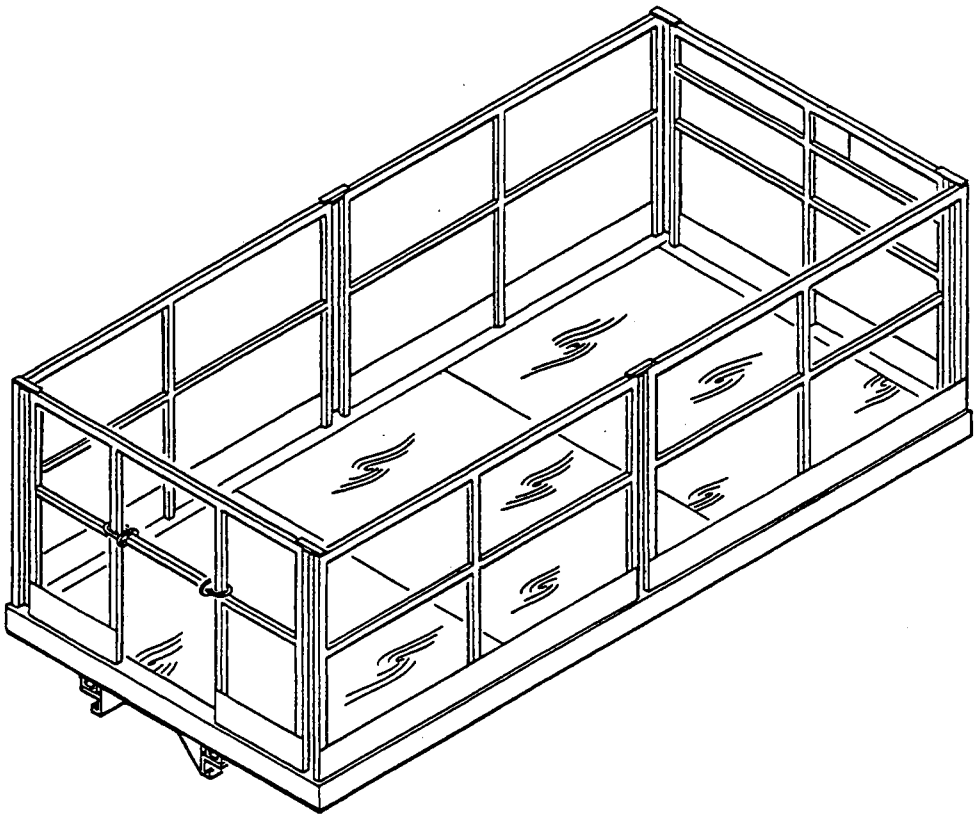
TITLE	MAIN LIFT CYLINDER ASSEMBLY (REAR)
MODEL	LS36E
NOTES	

SECT.	4
FIG.	10C
PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
25	880	.O-RING	1
26	32576	.CHECK VALVE	1
27	80004-14	.STRAIGHT THREAD CONNECTOR	1
28	80056-03	.TUBE END REDUCER	1
29	80060-06	.NUT	1
30	2468	.HOSE FITTING	1

SECTION 5 CONTAINS:

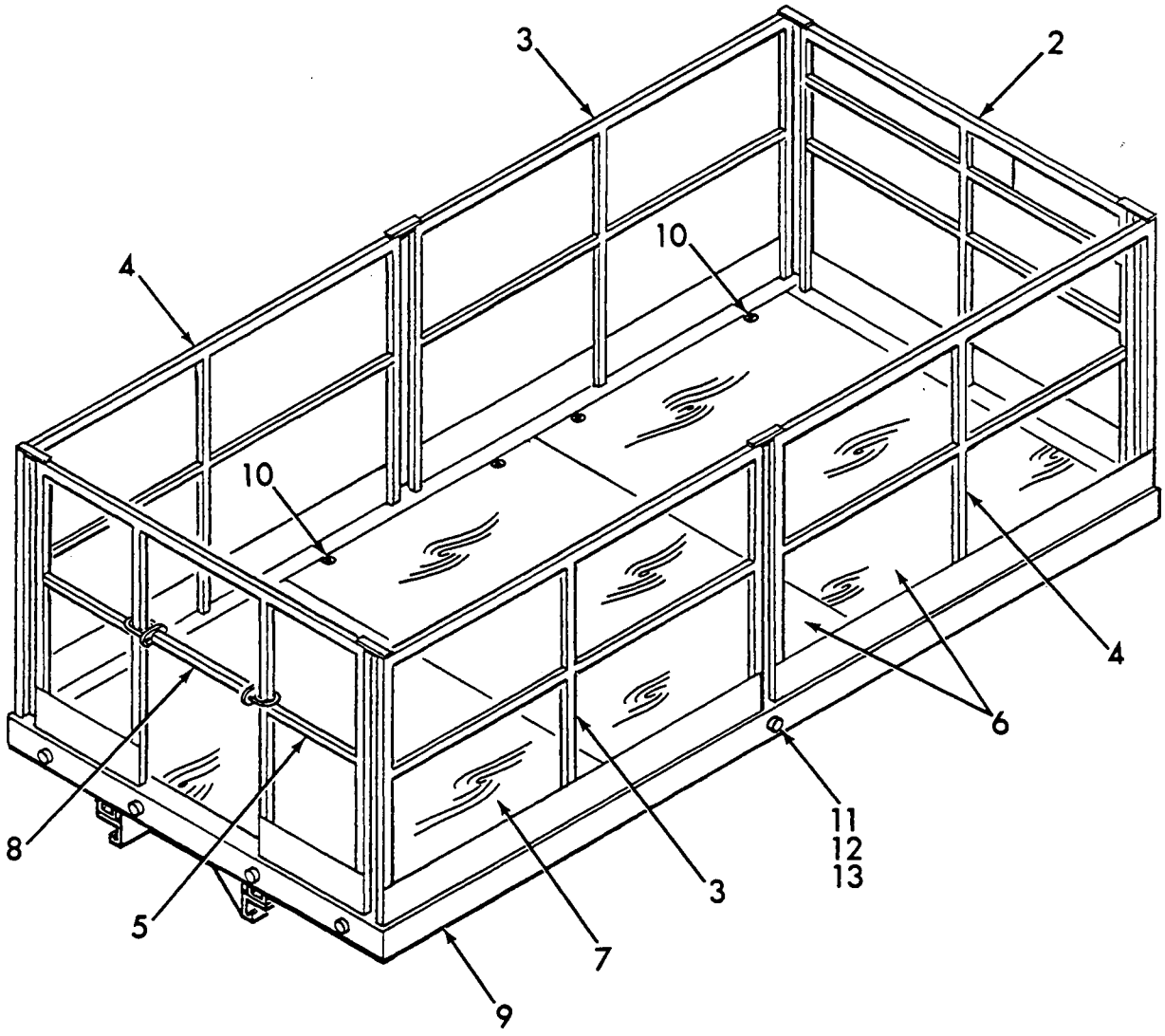
FIG. NO.	TITLE
1	DECK ASSEMBLY (LS30E & LS36E)
2	SLIDE BAR ASSEMBLY (LS30E & LS36E)



Mark Industries

TITLE	DECK ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	5
FIGURE	1
PAGE	1



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Mark Industries

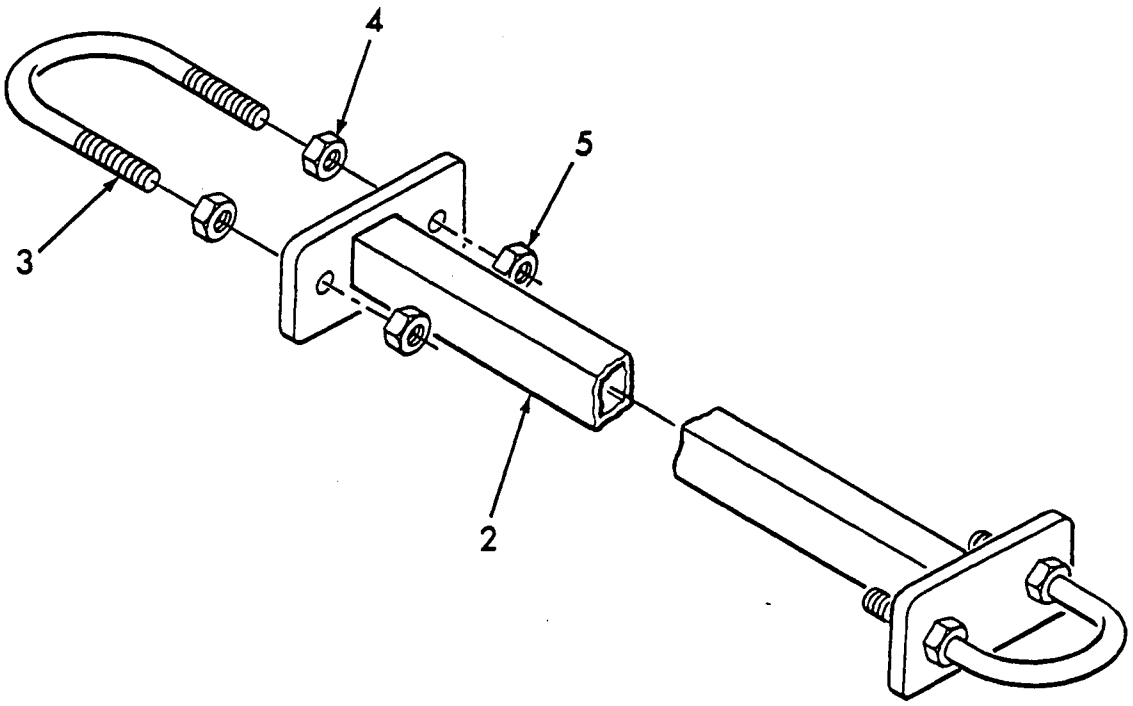
TITLE	DECK ASSEMBLY	SECT.	5
MODEL	LS30E & LS36E	FIG.	1
NOTES		PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32184	DECK ASSEMBLY (See Sect. 2, Fig. 1 or 1A for NHA)	REF
2	32042	.FRONT GUARD RAIL ASSEMBLY	1
3	32176	.SIDE GUARD RAIL ASSEMBLY	2
4	32177	.SIDE GUARD RAIL ASSEMBLY	2
5	32765	.REAR GUARD RAIL	1
6	30643	.PLYWOOD FLOOR	2
7	31117	.PLYWOOD FLOOR	1
8	32741	.SLIDE BAR ASSEMBLY (See Sect. 5, Fig. 2 for Details)	1
9	32183	.DECK WELDMENT ASSEMBLY	1
10	61708	.FLAT HEAD SELF TAPPING SCREW	18
11	60352	.CAP SCREW	9
12	63301	.LOCK WASHER	9
13	60701	.NUT	9

Mark Industries

TITLE	SLIDE BAR ASSEMBLY
MODEL	LS30E & LS36E
NOTES	

SECTION	5
FIGURE	2
PAGE	1

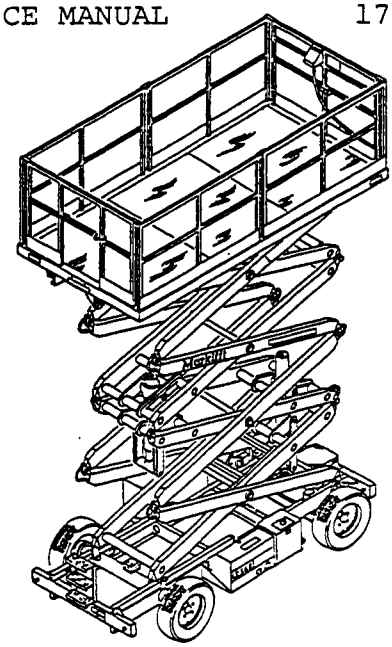


ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32741	SLIDE BAR ASSEMBLY (See Sect. 5, Fig. 1 for NHA)	REF
2	32740	.SLIDE BAR WELDMENT	1
3	160017	.U-BOLT	2
4	61318	.LOCK NUT	4
5	60703	.NUT	4

REV.

SECTION 6 CONTAINS:

FIG. NO.	TITLE	PART NO. (LS30E)	PART NO. (LS36E)
1	TRAVEL WARNING HORN	30408	30408
2	ALL MOTION ALARM	131900	131900
3	HOURMETER	131065	131065
4	ROTATING BEACON	32907	32907
5	12 VOLT PLATFORM WORK LIGHT	131928	131928
6	SWING GATE	32044	32044
7	REMOTE DRIVE KIT	131916	131916
8	FEMALE PLUG ONLY FOR REMOTE DRIVE	70267	70267
9	LANYARD/CONTROL BOX ONLY FOR REMOTE DRIVE KIT	130911	130911
10	PROPORTIONAL DRIVE CONTROLS	32927	32927
11	SOLID STATE SLOPE SENSOR	131908	131908
12	HYDRAULIC STABILIZERS	32921	32921
13	LIFTING LUGS	31010	31010
14	AUTOMATIC BATTERY CHARGER (DOMESTIC)	70228	70228
15	AUTOMATIC BATTERY CHARGER (INTERNATIONAL)	70435	70435
	PARTS & SERVICE MANUAL	17202	17202



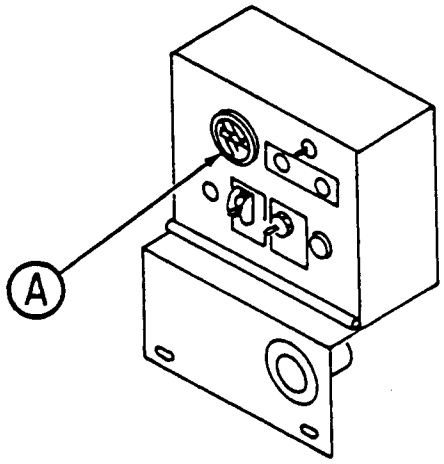
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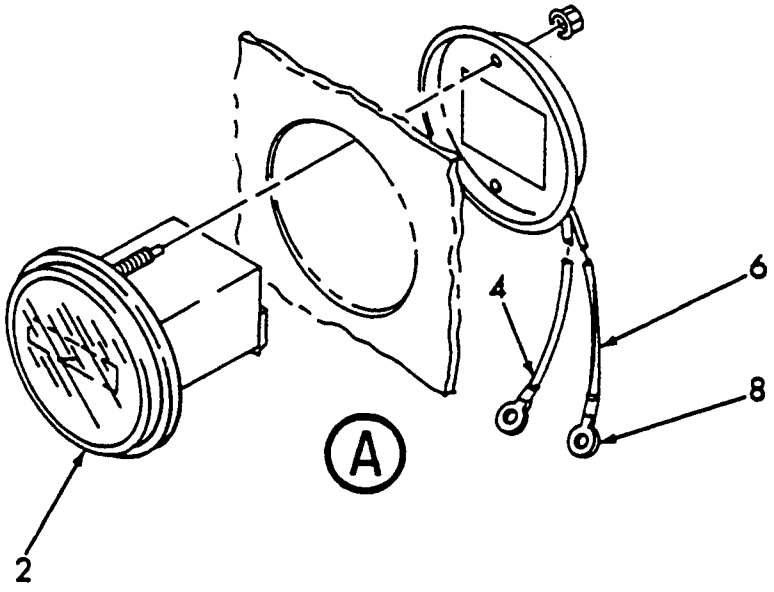
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Mark Industries

TITLE	HOURMETER
MODEL	
NOTES	

SECTION	6
FIGURE	3
PAGE	1





REV.

Mark Industries

TITLE	HOURMETER	SECT.	6
MODEL		FIG.	3
NOTES		PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	131065	HOURMETER	REF
2	20571	.HOURMETER	1
3	70232	.WHITE WIRE (1.5 FT)	AR
4	70008	.YELLOW/GREEN WIRE (1.5 FT)	AR
5	117-C	.CONNECTOR RING	2

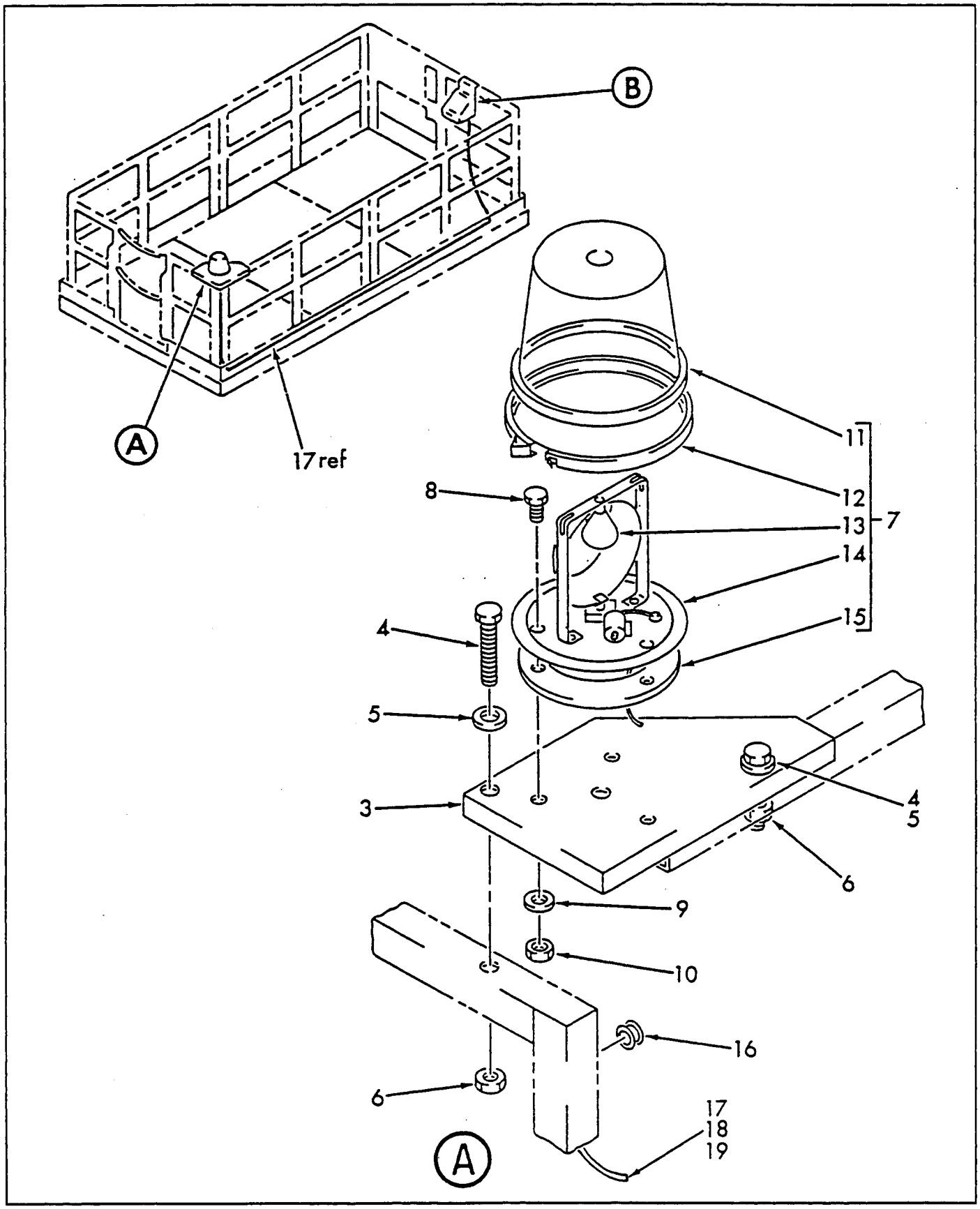
REV.

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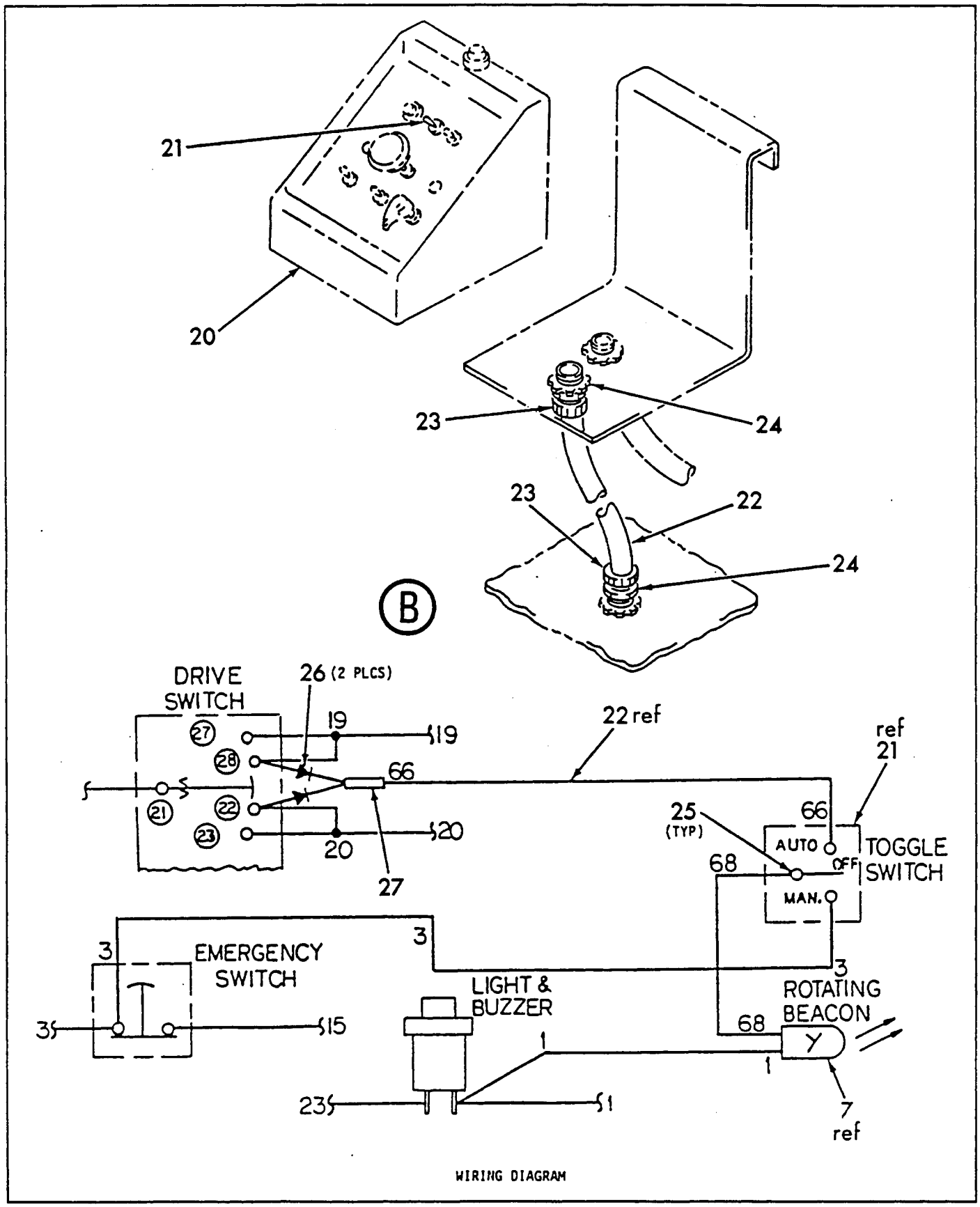
Mark Industries

TITLE	ROTATING BEACON
MODEL	
NOTES	

SECTION	6
FIGURE	4
PAGE	1



REV.



WIRING DIAGRAM

REV.

Mark Industries

TITLE	ROTATING BEACON	SECT.	6
MODEL		FIG.	4
NOTES		PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	32907	ROTATING BEACON ASSEMBLY	REF
-2	32184	.DECK ASSEMBLY	1
3	11068	.BEACON MOUNTING BRACKET	1
4	60319	.CAP SCREW	2
5	63401	.FLAT WASHER	2
6	60711	.LOCK NUT	2
7	20586	.ROTATING BEACON	1
8	60396	.CAP SCREW	3
9	63413	.FLAT WASHER	3
10	61247	.LOCK NUT	3
11		..CAP	1
12		..CLAMP	1
13		..BULB	1
14		..BODY	1
15		..GASKET	1
16	729	.BUSHING	1
17	70036	.CABLE (16 FT)	AR
18	66356	.FEMALE TERMINAL	2
19	66357	.MALE TERMINAL	2
20	32408	.UPPER CONTROL BOX	REF
21	4019	.TOGGLE SWITCH	1
22	70232	.WIRE (4 FT)	AR
23	2807	.STRAIN RELIEF	2
24	2808	.LOCK NUT	2
25	117-C	.RING CONNECTOR	5

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
26	4045	.DIODE	2
27	70069	.BUTT CONNECTOR	1

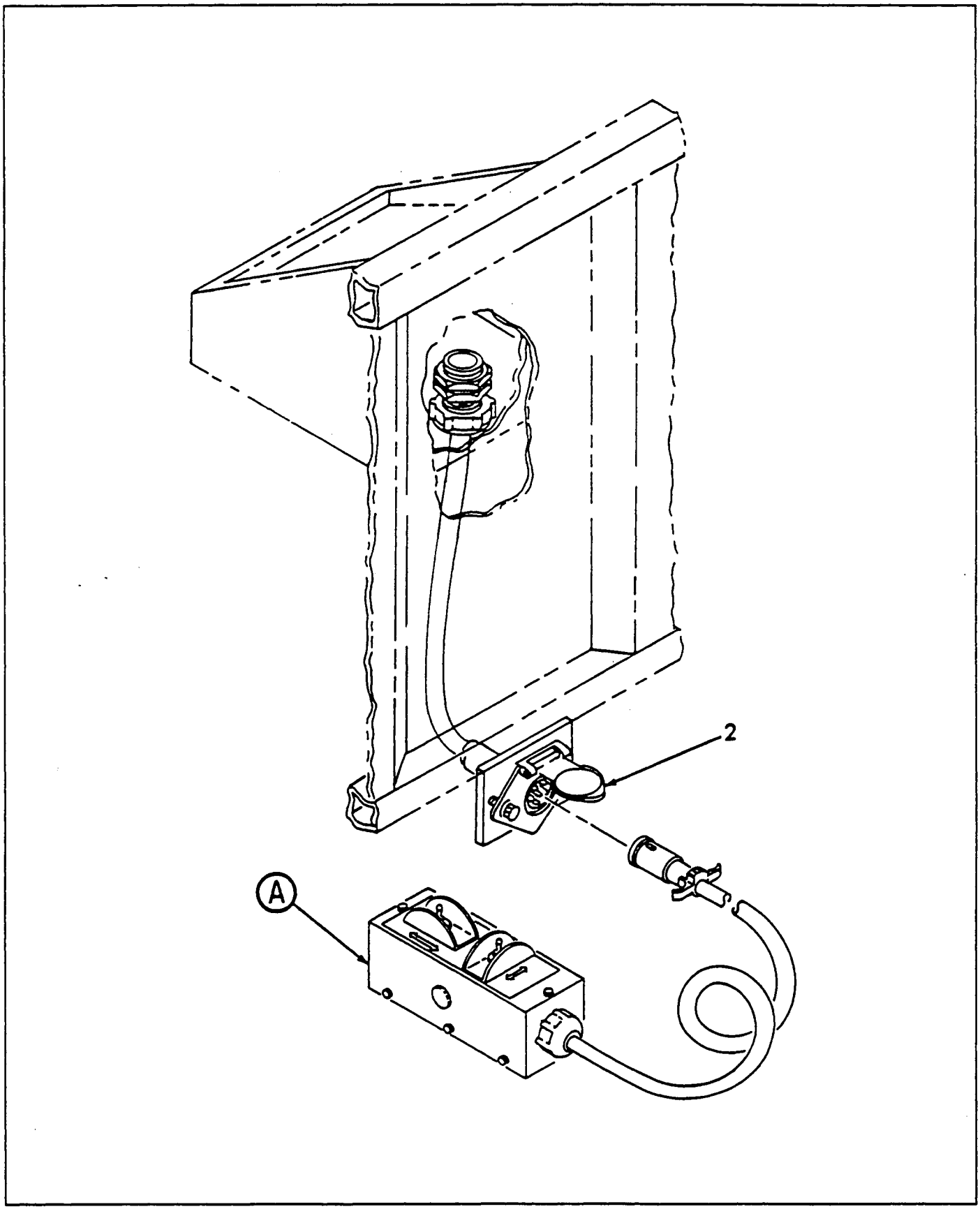
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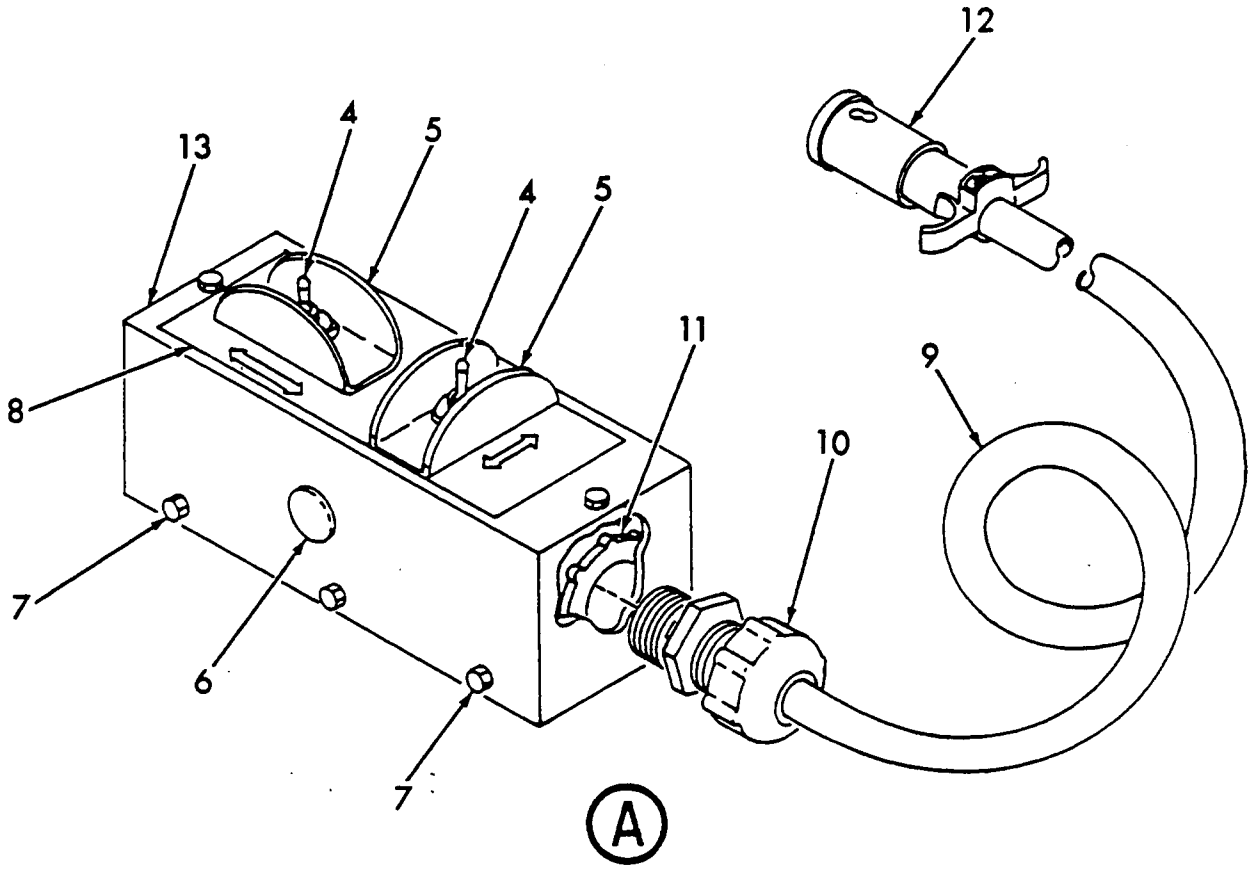
Mark Industries

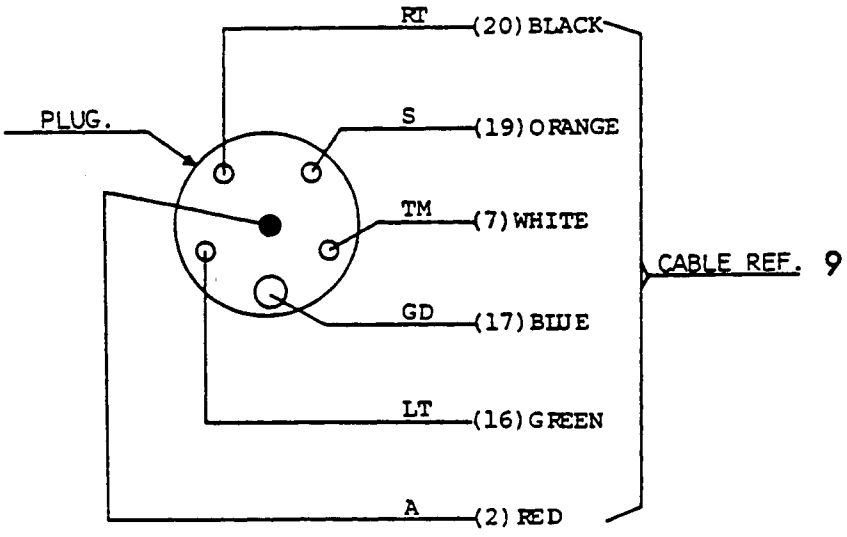
TITLE	REMOTE DRIVE KIT
MODEL	
NOTES	

SECTION	6
FIGURE	7
PAGE	1



REV.





PLUG WIRING DIAGRAM

Mark Industries

TITLE	REMOTE DRIVE KIT	SECT.	6
MODEL		FIG.	7
NOTES		PAGE	3

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	131916	REMOTE DRIVE KIT	REF
2	131940	.FEMALE REMOTE DRIVE & STEER PLUG	1
-3	130911	.REMOTE DRIVE LANYARD/CONTROL ASSEMBLY	1
4	20481	..TOGGLE SWITCH	2
5	20884	..SWITCH GUARD	2
6	771	..WHITE PLUG	1
7	61726	..SELF TAPPING SCREW	8
8	130906	..R. CONTROL DRIVE & STEER DECAL	1
9	130902-08	..CONDUCTOR CABLE	1
10	70281	..STRAIN RELIEF	1
11	2808	..LOCK NUT	1
12	70266	..PLUG (6-POLE)	1
13	130901	..ELECTRICAL ASSEMBLY	1

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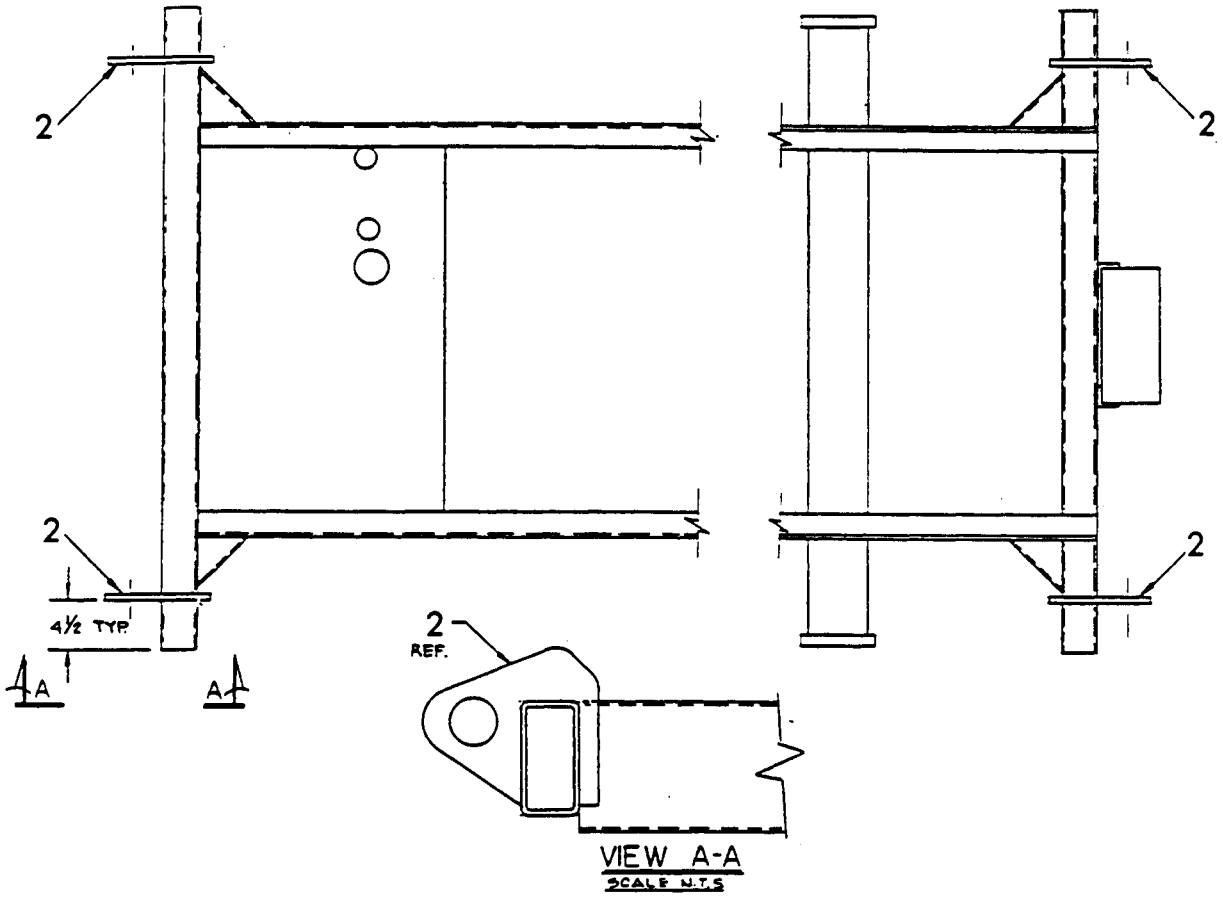
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Mark Industries

TITLE	LIFTING LUGS
MODEL	
NOTES	

SECTION	6
FIGURE	13
PAGE	1

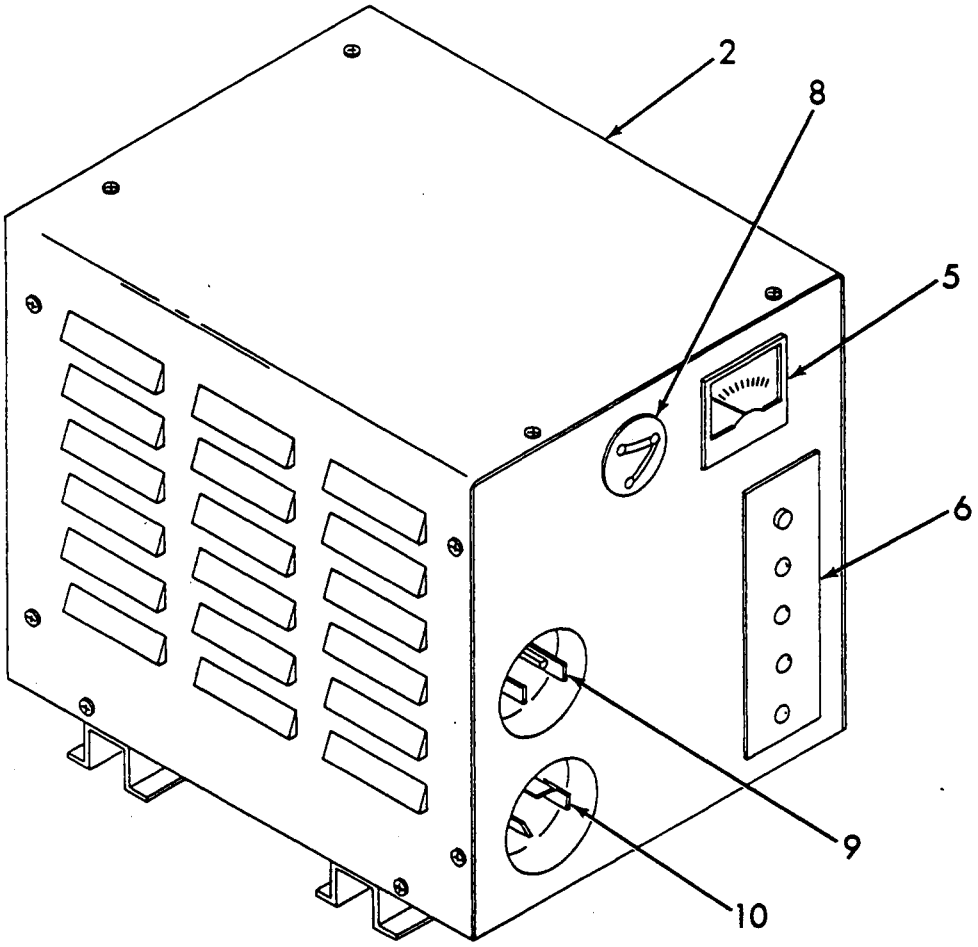


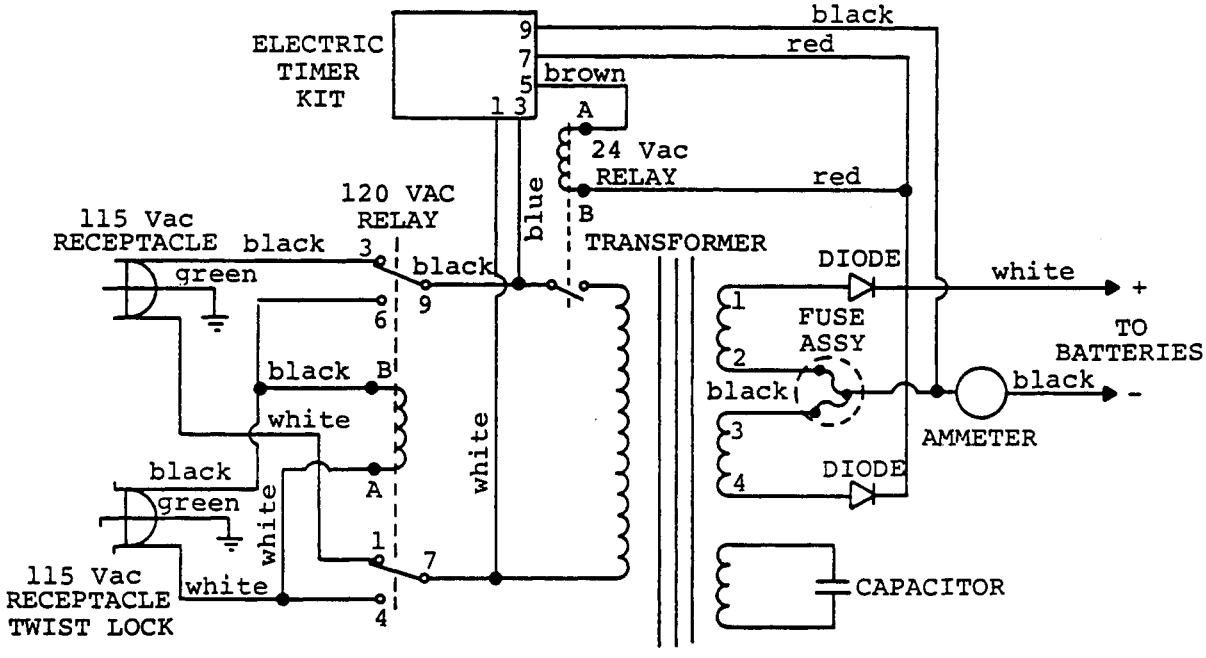
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	31010	LIFTING LUGS	REF
2	30920	.LIFTING LUG	4

REV.

Mark Industries

TITLE AUTOMATIC BATTERY CHARGER (DOMESTIC)	SECTION 6
MODEL	FIGURE 14
NOTES 115 VAC, 60 HZ/24 VDC 30 AMP	PAGE 1





REV.

Mark Industries

TITLE	AUTOMATIC BATTERY CHARGER (DOMESTIC)
MODEL	
NOTES	115 VAC, 60 HZ/24 VDC 30 AMP

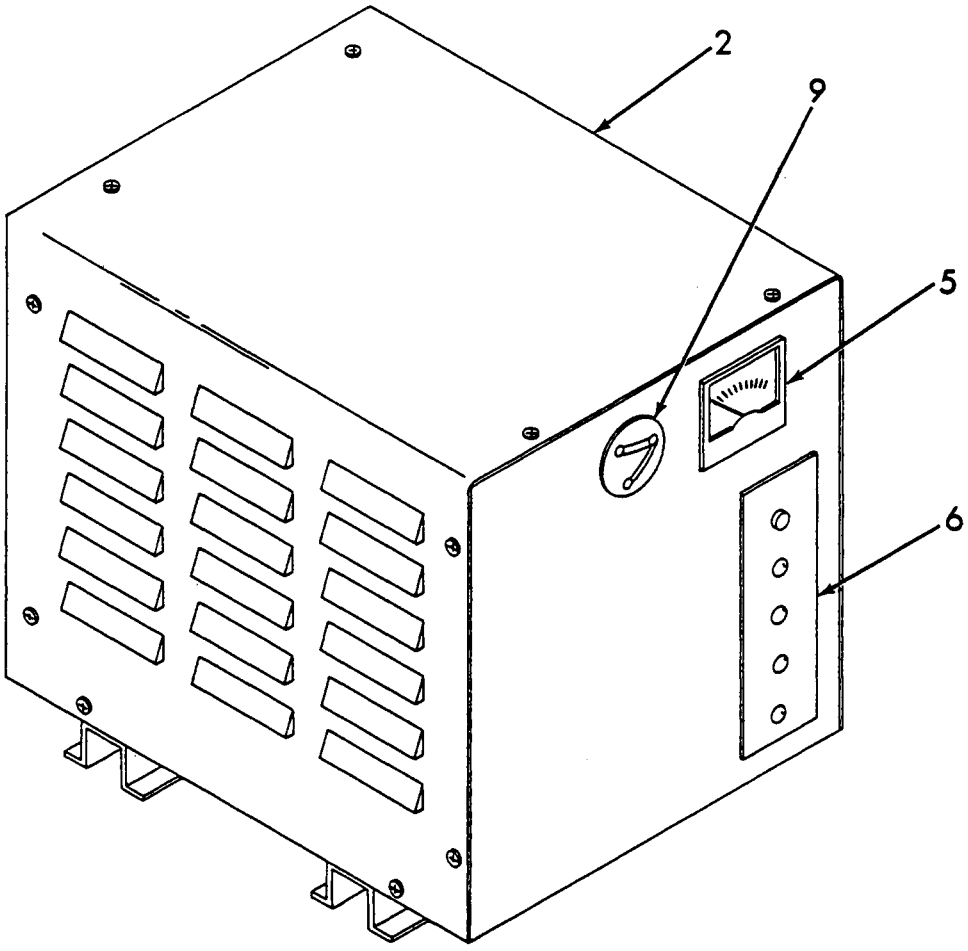
SECT.	6
FIG.	14
PAGE	2

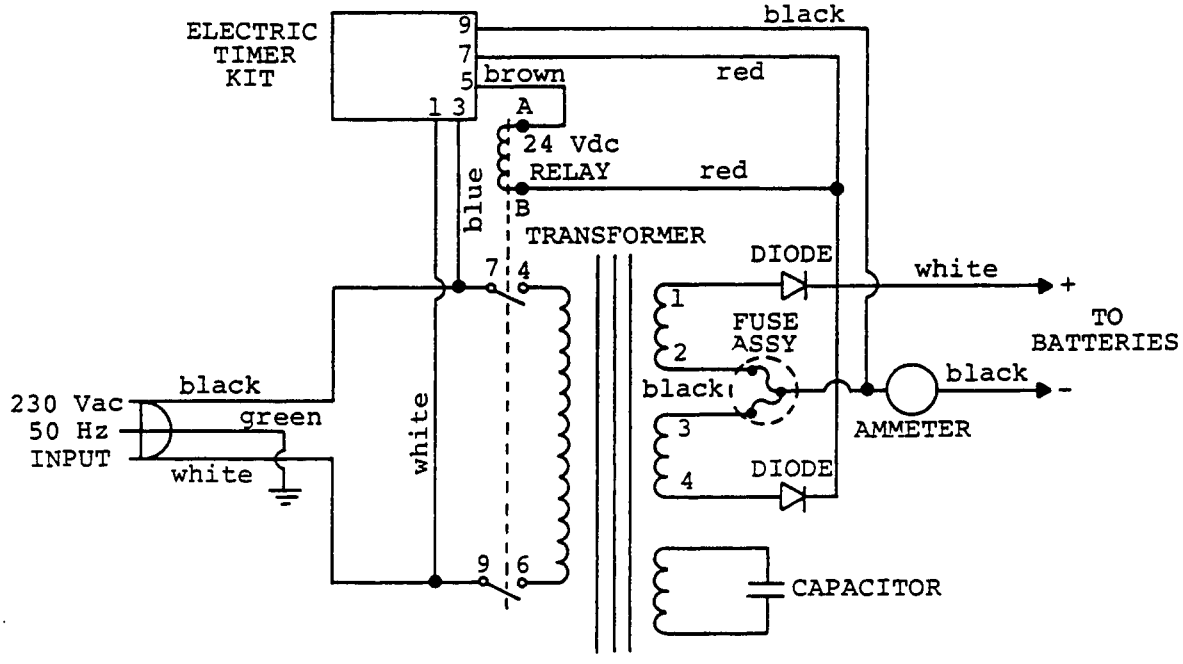
ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	70228	AUTOMATIC BATTERY CHARGER	REF
2		.CASE ASSEMBLY	1
-3	67978	.TRANSFORMER ASSEMBLY	1
-4	66731	.DIODE ASSEMBLY	2
5	66747	.AMMETER	1
6	66725	.ELECTRONIC TIMER KIT	1
-7	66750	.CAPACITOR	1
8	66727	.FUSE ASSEMBLY	1
9	66734	.STRAIGHT BLADE RECEPTACLE	1
10	66736	.TWIST LOCK RECEPTACLE	1
-11	66729	.24 VDC RELAY	1
-12	66728	.120 VAC RELAY	1

Mark Industries

TITLE	AUTOMATIC BATTERY CHARGER
MODEL	(INTERNATIONAL)
NOTES	230 VAC, 50HZ/24 VDC 30 AMP

SECTION	6
FIGURE	15
PAGE	1





REV.

Mark Industries

TITLE	AUTOMATIC BATTERY CHARGER (INTERNATIONAL)
MODEL	
NOTES	230 VAC, 50HZ/24 VDC 30 AMP

SECT.	6
FIG.	15
PAGE	2

ITEM	PART NUMBER	DESCRIPTION 1234	UNITS PER ASSY
-1	70435	AUTOMATIC BATTERY CHARGER	REF
2		.CASE ASSEMBLY	1
-3	67973	.TRANSFORMER ASSEMBLY	1
-4	66731	.DIODE ASSEMBLY	2
5	66747	.AMMETER	1
6	67975	.ELECTRONIC TIMER KIT	1
-7	66750	.CAPACITOR	1
-8		.24 VDC RELAY	1
9	66727	.FUSE	1

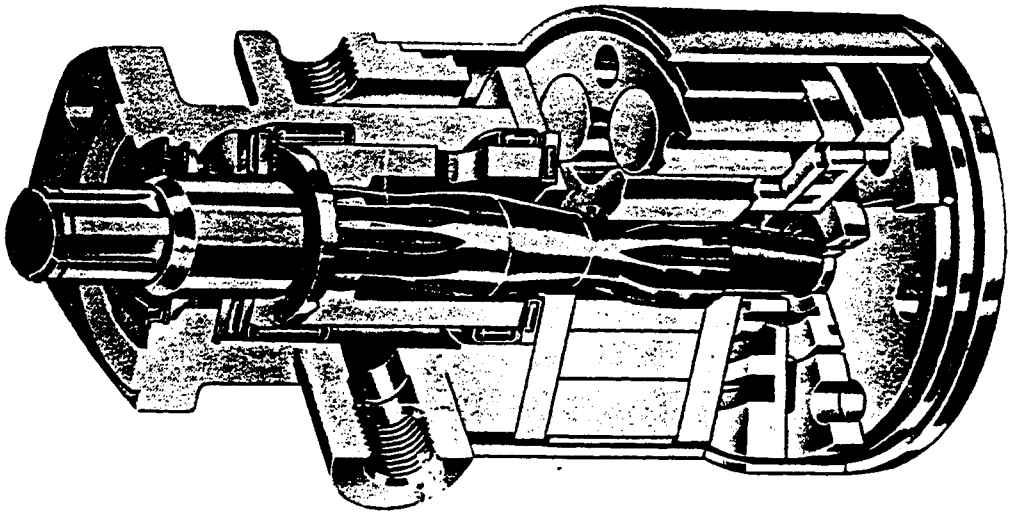
SECTION 7 CONTAINS:

PAGE NO.	TITLE
1	TRW ROSS GEAR DRIVE MOTOR - P/N 81165
13	TRW ROSS GEAR DRIVE MOTOR - P/N 81272
41	MICO DISC BRAKE - P/N 81117
47	TROJAN BATTERY
51	ANPAT MANUAL BATTERY CHARGER - P/N 4006
57	LESTER MANUAL BATTERY CHARGER - P/N 70430
62	LESTER AUTOMATIC BATTERY CHARGER - P/N 70228
68	LESTER AUTOMATIC BATTERY CHARGER - P/N 70435

TRW

Torqmotor™

Series Service Procedure



TRW Ross Gear Division

REV.

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.

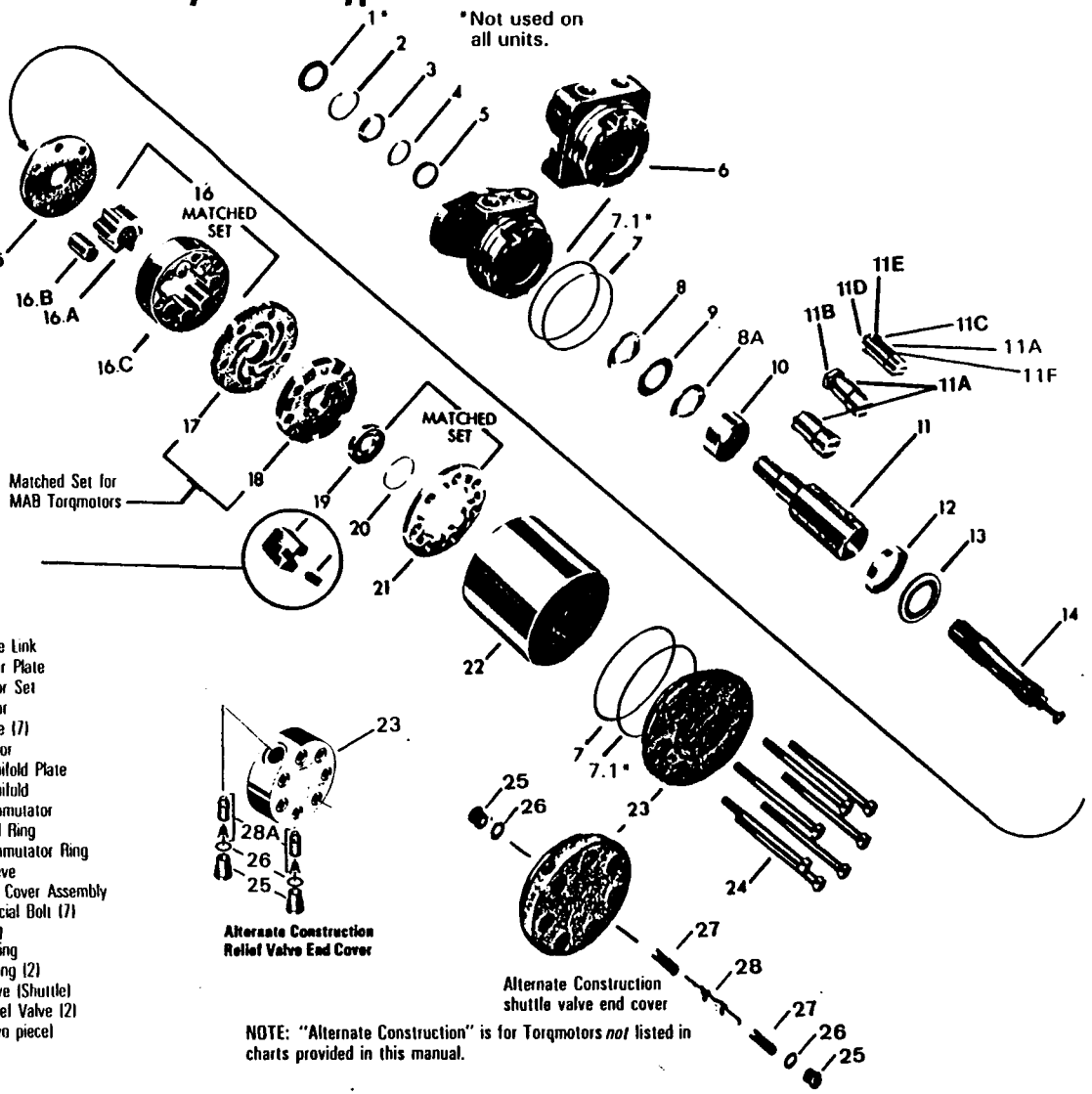
Visually check other components to see if they are loosely mounted, show signs of leaks, or other damage or wear.

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).

Exploded Assembly View—Typical



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

Mark Industries

TITLE	TRW ROSS GEAR DRIVE MOTOR
MODEL	
NOTES	P/N 81165

SECTION	7
PAGE	3

Troubleshooting Checklist

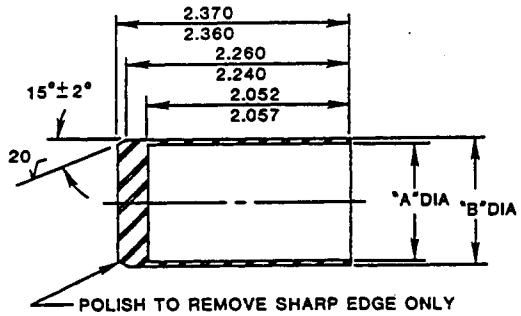
Trouble	Cause	Remedy
Oil Leakage	1. Hose fittings loose, worn or damaged	Check & replace damaged fittings or "O" Rings. Torque to manufacturers specifications.
	2. Oil seal rings (7) deteriorated by excess heat	Replace oil seal rings by disassembling Torqmotor™ unit.
	3. Special bolt (24) loose or its 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.

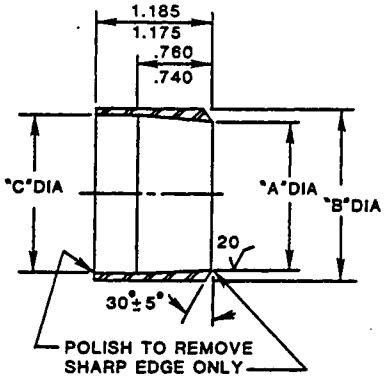
Seal Installation Tools



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

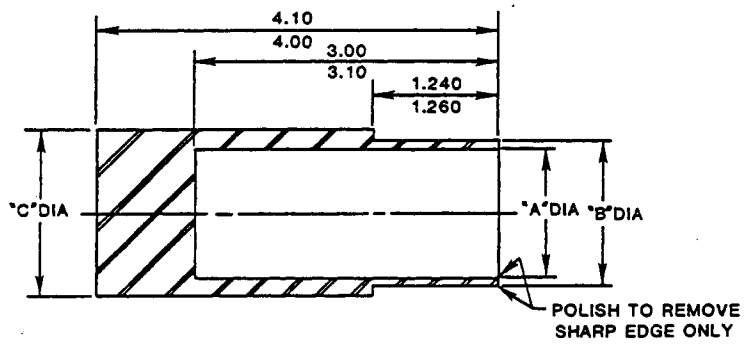
Seal Thimble
Figure 1.



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	40.46	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.

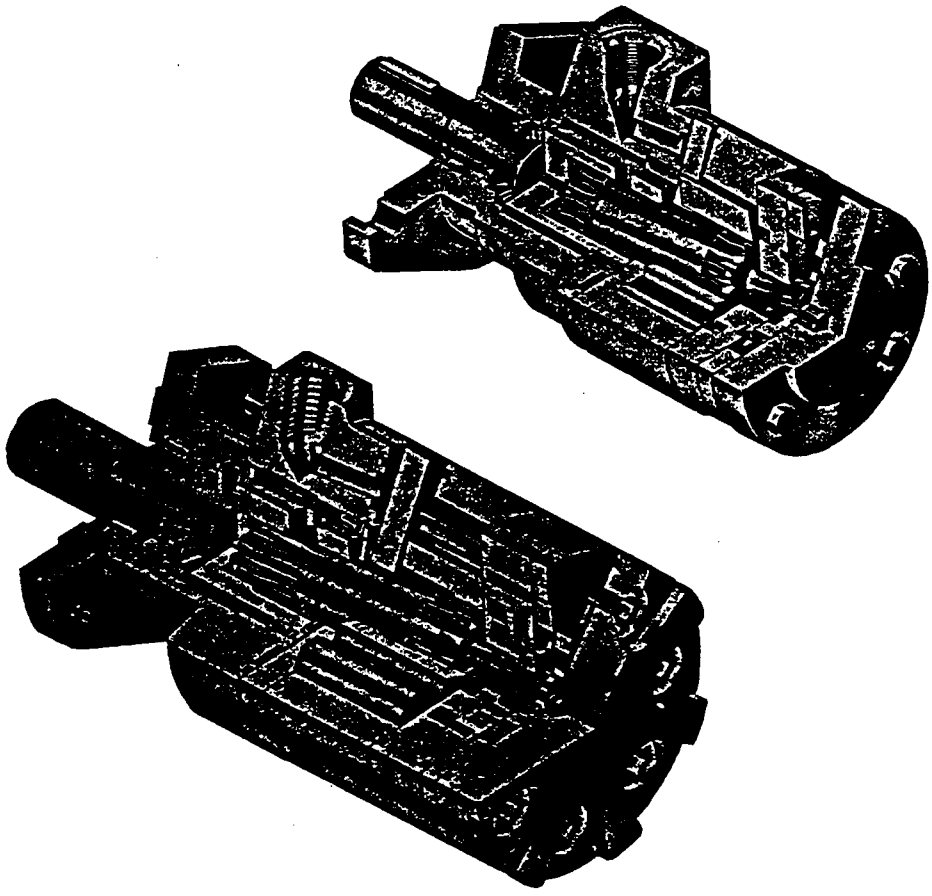
If inspection or testing reveals evidence of abnormal wear or damage to the Torqmotor unit or if you encounter circumstances not covered in the Manual, STOP — CONSULT THE EQUIPMENT MANUFACTURER'S SERVICE MANUAL AND WARRANTY. DO NOT TRY TO REPAIR OR SERVICE A TORQMOTOR UNIT WHICH HAS BEEN DAMAGED OR INCLUDES 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.

TRW

Torqmotor™

ME Series Service Procedure



TRW Ross Gear Division

REV.

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™

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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.

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.

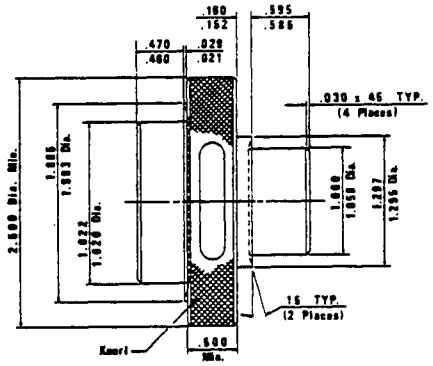
Clean corrosion resistant grease. Recommended grease is E/M Lubricant #K-70M, Ross Gear Specification #045236

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

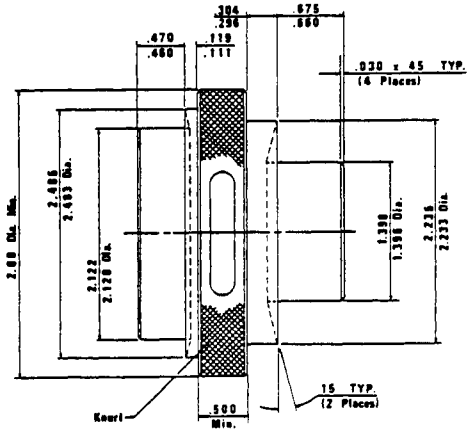
CAUTION: Mixing greases that have different bases can be detrimental to bearing life.

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

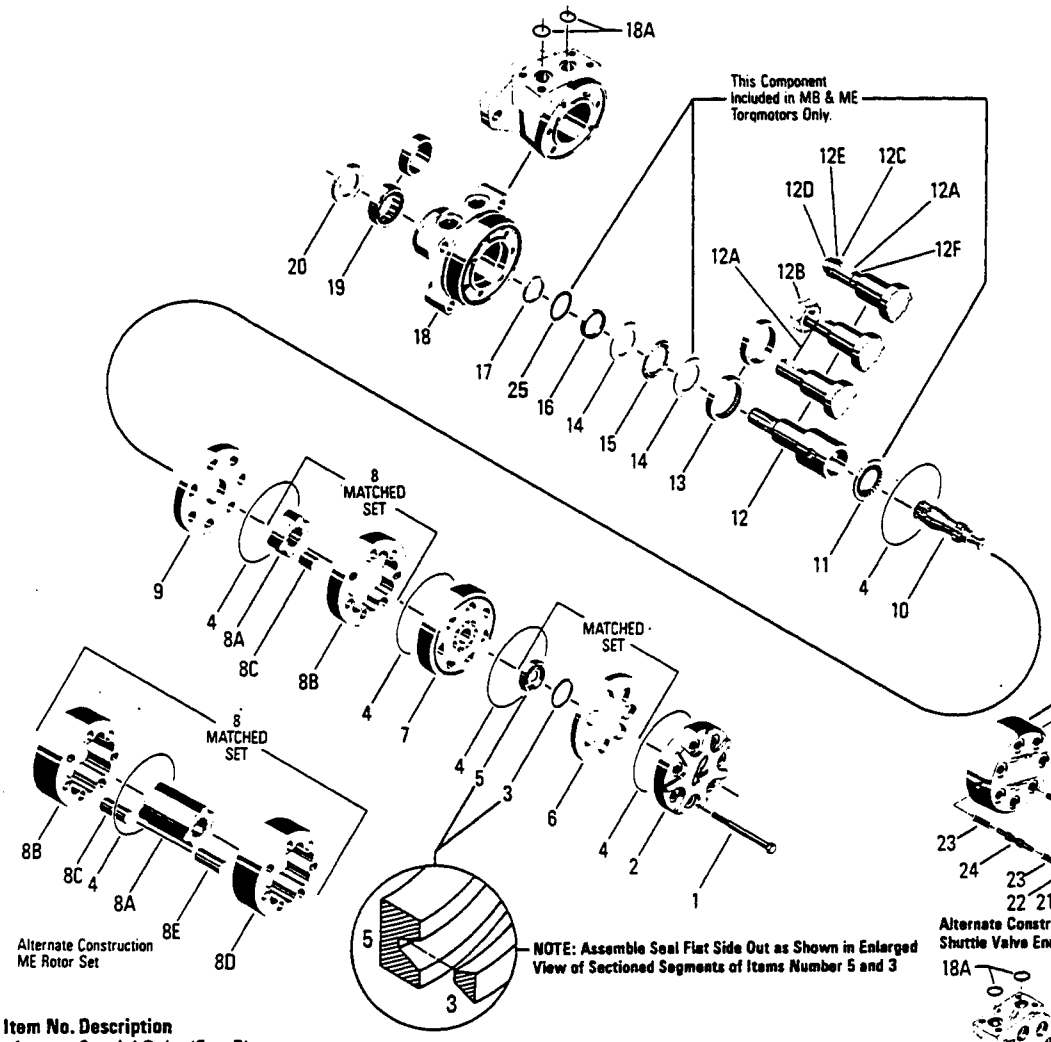


(Fabricate if considered necessary)
FIGURE 2—MB & ME

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.

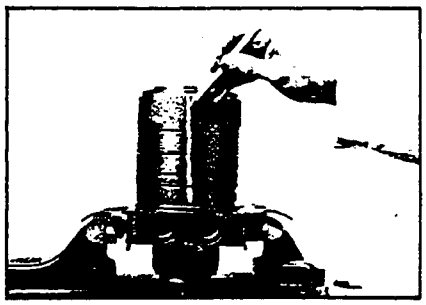


Figure 3

WARNING

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

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.

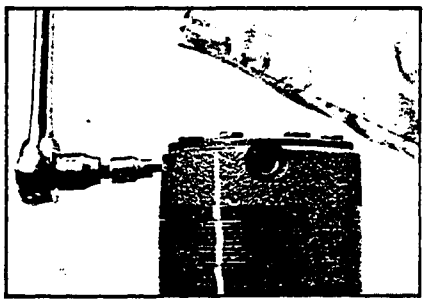


Figure 4

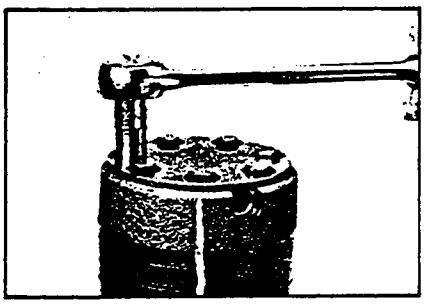


Figure 5

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.

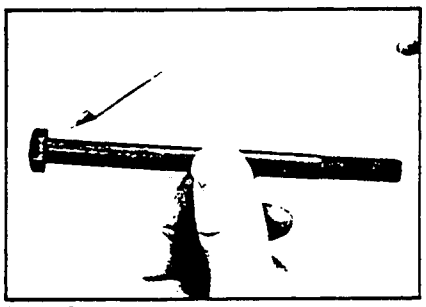


Figure 6

remove end cover & inspect bolts

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

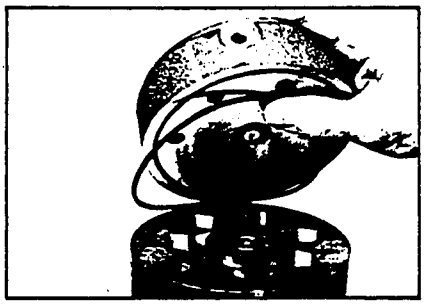


Figure 7

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.

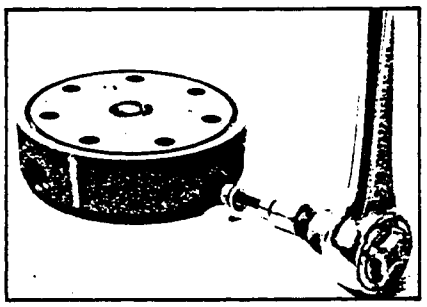


Figure 8

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.

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.

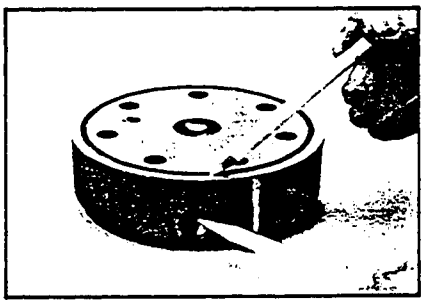


Figure 9

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.

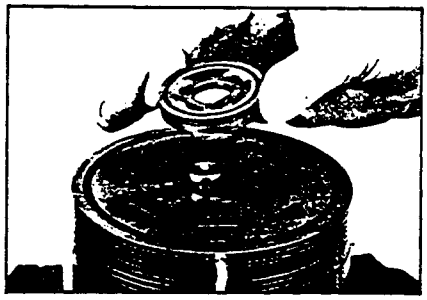


Figure 11

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.

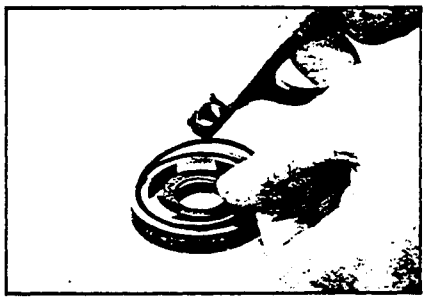


Figure 12

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.

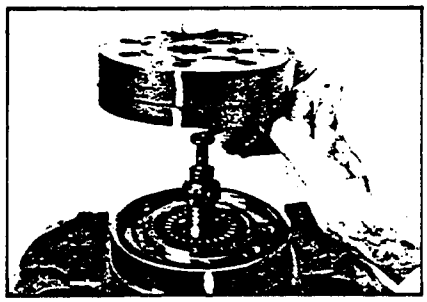


Figure 14

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.

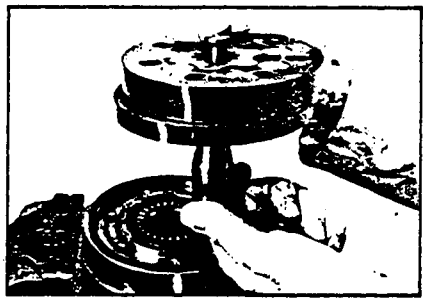


Figure 15

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.

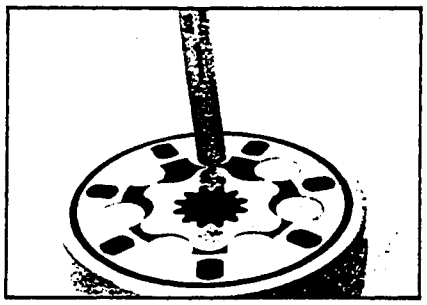


Figure 16

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).

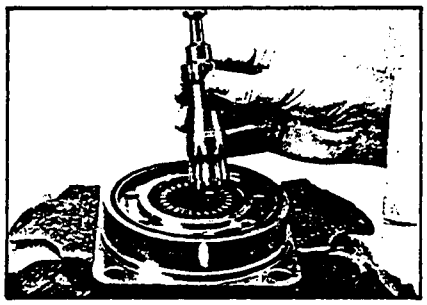


Figure 17

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).

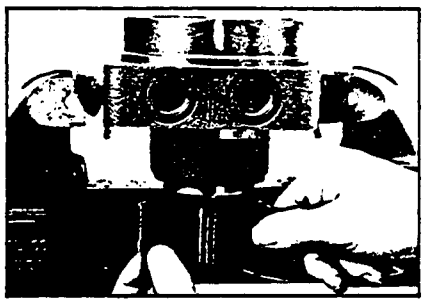


Figure 19

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.

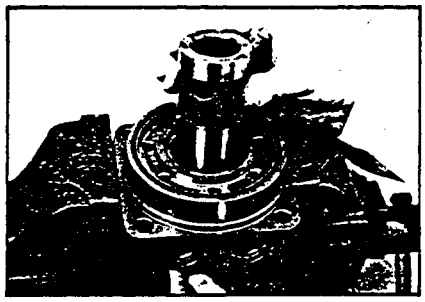


Figure 20

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.

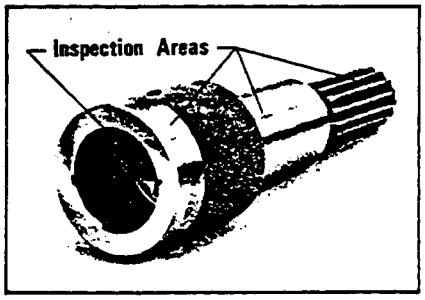


Figure 21

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.

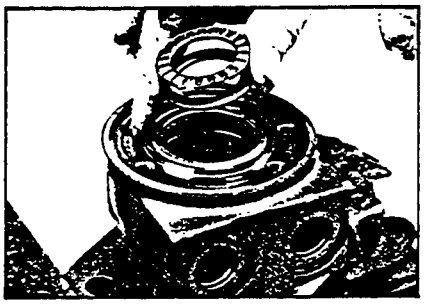


Figure 22

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.

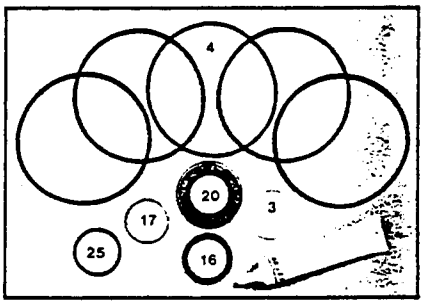
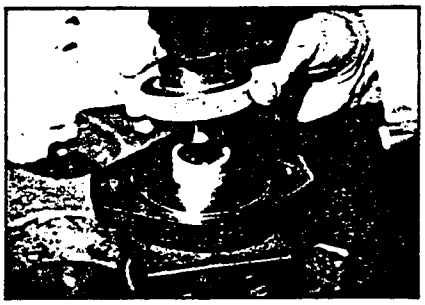


Figure 32 MB, ME seal kit

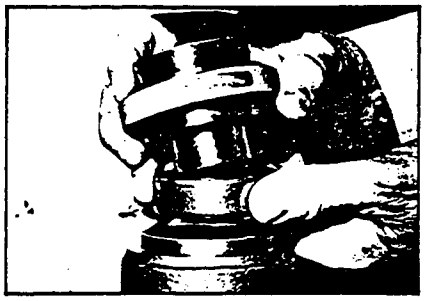
press in outer bearing/bushing

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.

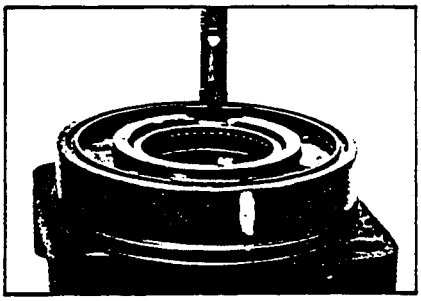


Figure 35

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.

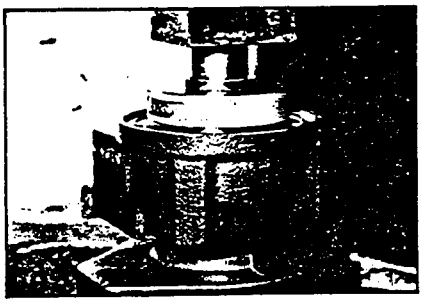


Figure 36

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.

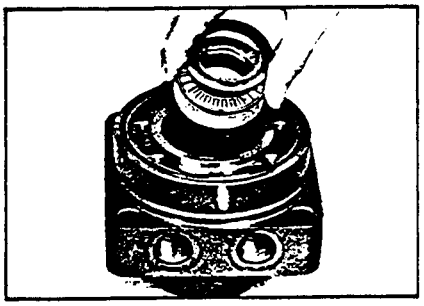


Figure 38

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

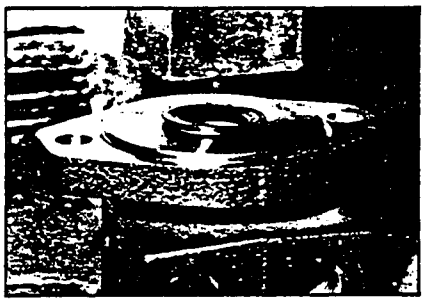


Figure 40

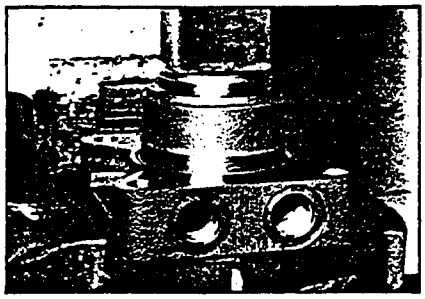


Figure 41

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.

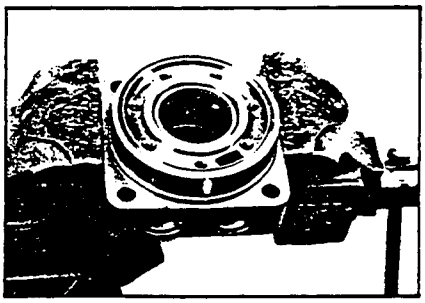


Figure 42

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.

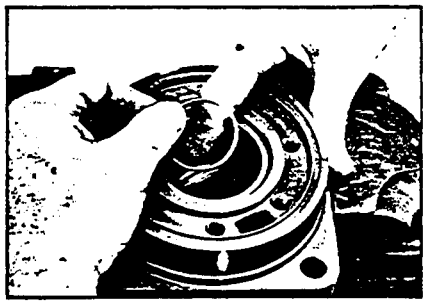


Figure 43

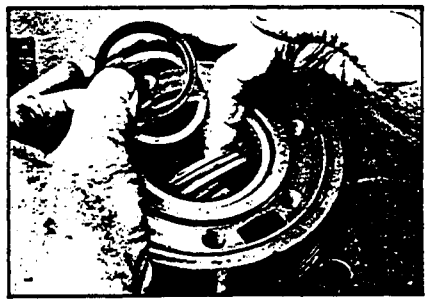


Figure 44

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).

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.

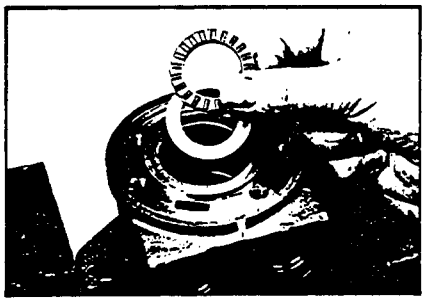


Figure 45

apply masking tape to shaft

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

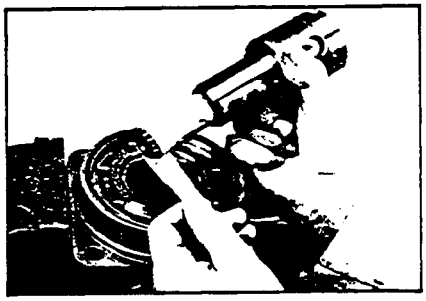


Figure 46

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.

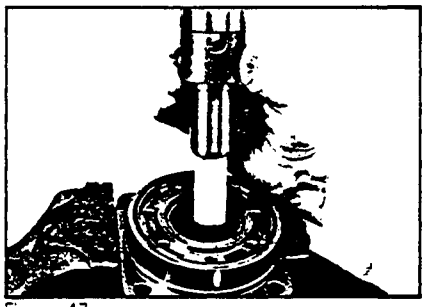


Figure 47

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.

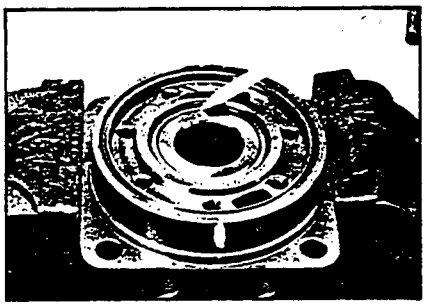


Figure 48

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.

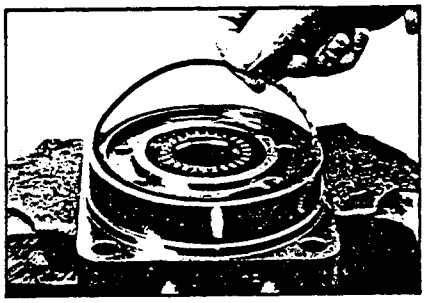


Figure 50

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.

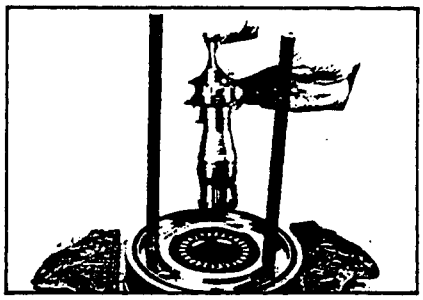


Figure 51

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.

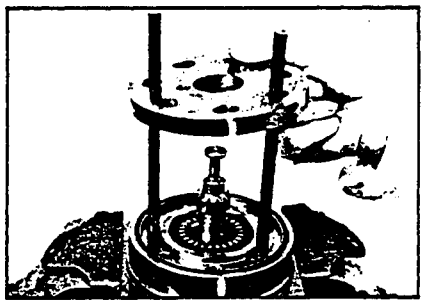


Figure 52

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.

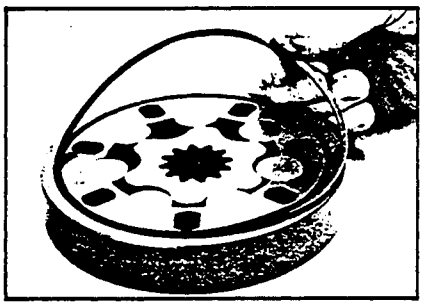


Figure 53

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).

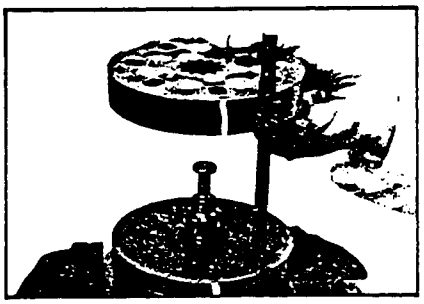


Figure 54

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.

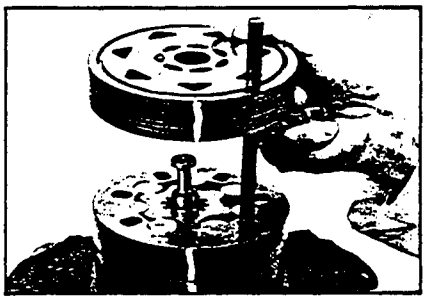


Figure 56

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.

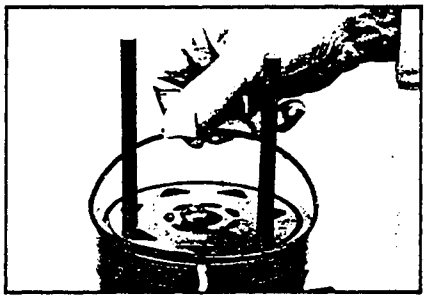


Figure 57

assemble commutator ring

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

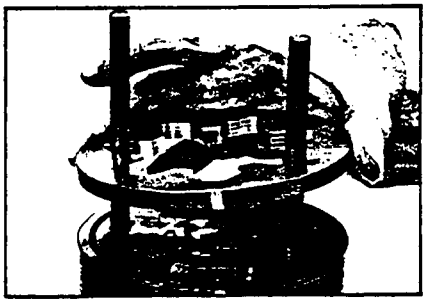


Figure 58

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.

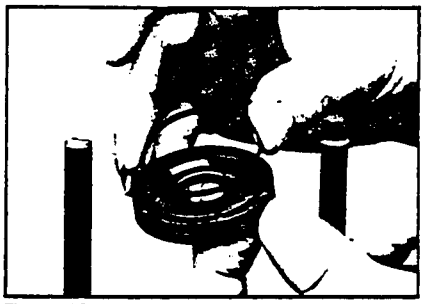


Figure 59

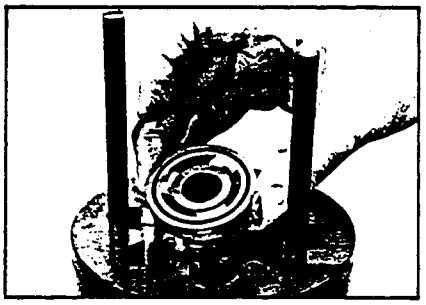


Figure 60

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.

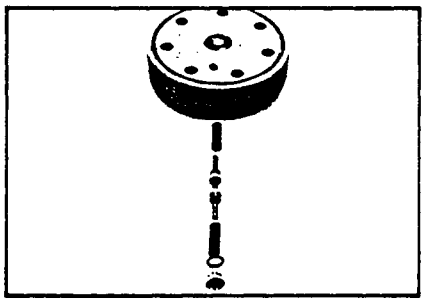


Figure 61

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.

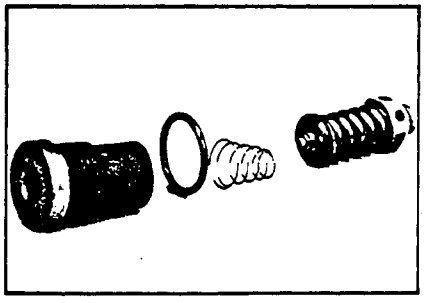


Figure 62

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.

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.

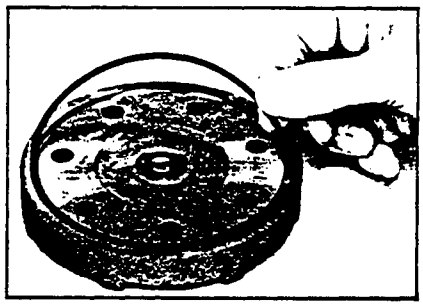


Figure 63

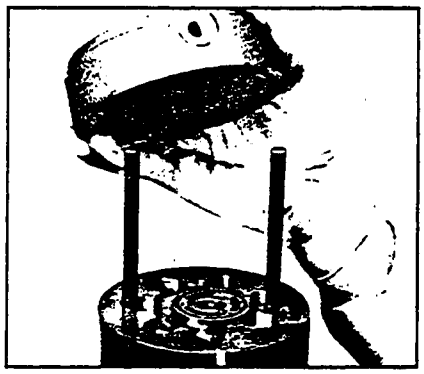


Figure 64

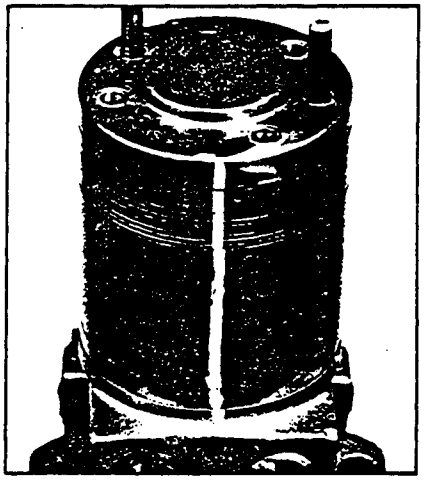


Figure 65

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.

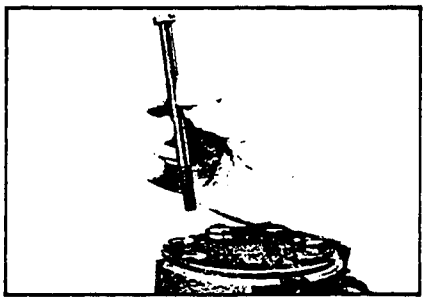


Figure 66

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.

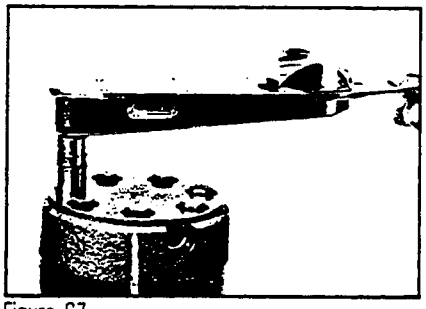


Figure 67

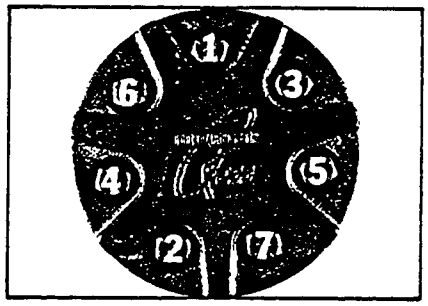


Figure 68

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.

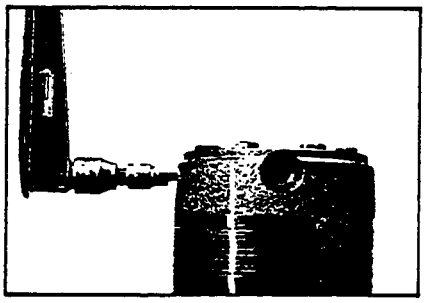


Figure 69

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.

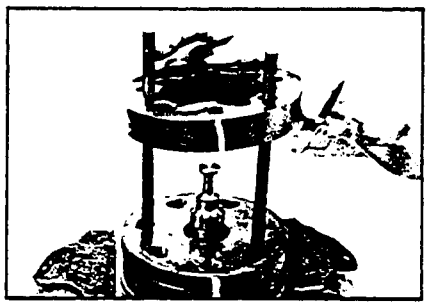


Figure 70

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.

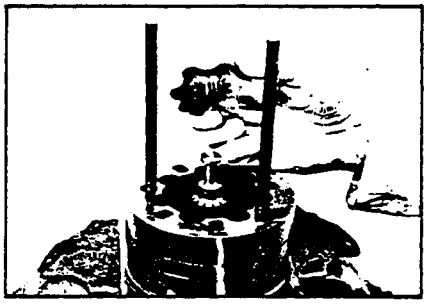


Figure 71

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.

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

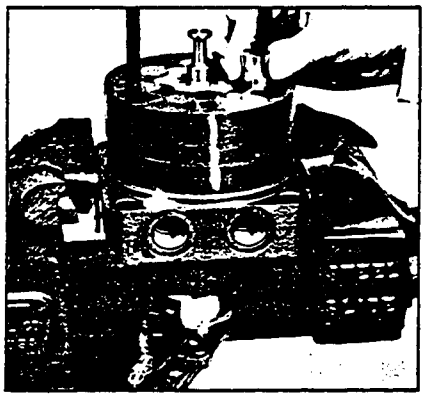


Figure 73

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 26 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.

Application Data ME Series

ME

Torqmotor Series		ME	09	12	15	18	21	29	33	48	58
Displacement	(in^3/rev)	English	8.6	12.1	14.6	17.7	20.6	29.0	32.6	48.1	58.0
	(cm^3/rev)	Metric	141	198	239	290	338	475	534	788	950
Pressure (PSI) (kg/cm^2)	Continuous (differential) 1, 3		3000	3000	3000	3000	3000	2000	2000	1500	1000
			210.9	210.9	210.9	210.9	210.9	140.6	140.6	105.5	70.3
	Intermittent (differential) 1, 3, 4		4000	4000	4000	4000	4000	3000	2500	2000	1500
			281.2	281.2	281.2	281.2	281.2	210.9	175.8	140.6	105.5
Torque (In-Lbs) (kg-m)	At continuous rated pressure and flow		3456	4699	5992	7061	8339	7313	8326	8737	6908
			39.82	54.14	69.04	81.35	96.08	84.25	95.93	100.66	79.59
	At intermittent rated pressure and continuous rated flow		4725	6434	8154	9619	11126	12013	10735	11789	10954
			54.44	74.13	93.94	101.82	128.18	138.40	123.68	135.82	126.20
	Minimum starting at continuous rated pressure		2667	3313	4930	5600	6529	6287	7104	7339	5733
			30.73	38.17	56.80	64.52	75.22	72.43	81.85	84.55	66.05
	Minimum starting at intermittent rated pressure		3495	3889	6491	7552	8987	9678	8974	9313	8544
			40.27	44.81	74.78	87.01	103.54	111.50	103.39	107.30	98.44
Flow (GPM) (liters/min)	Continuous		20	20	20	20	20	20	20	20	20
			76	76	76	76	76	76	76	76	76
	Maximum		25	25	25	25	25	30	30	30	30
			95	95	95	95	95	114	114	114	114
Speed (rpm)	At continuous rated flow & pressure		494	349	288	245	197	145	127	87	76
	At maximum flow and no load 2		670	479	395	336	279	236	212	141	118

Notes:

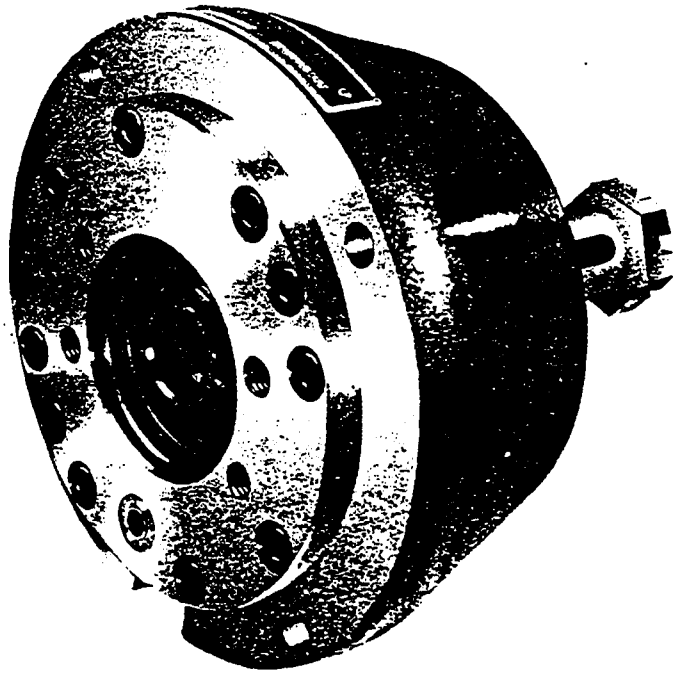
1. The maximum pressure at the motor inlet or outlet ports without regard to the continuous or intermittent pressure ratings is 4000 PSI (281.2 kg/cm^2).
2. For applications with rpm requirements in excess of the maximum rating contact your authorized Ross Gear representative.
3. Differential pressure is the difference between inlet and outlet port pressures.
4. Intermittent pressure applies to a maximum of 10% of every minute.
5. **Operating Temperature:** Recommended 0 to 200°F.
6. **Filtration:** Recommended nominal filtration is 20 to 50 micrometers.
7. Recommended fluid: 10W40 SE or SF API designation; 50 SUS minimum at maximum operating temperature; and .125% zinc antiwear by weight.

SY·TEC SERIES

MULTIPLE DISC BRAKE

(wheel mount)

SERVICE MANUAL



MICO INCORPORATED

MICO WEST O VISION

TYPICAL BRAKE

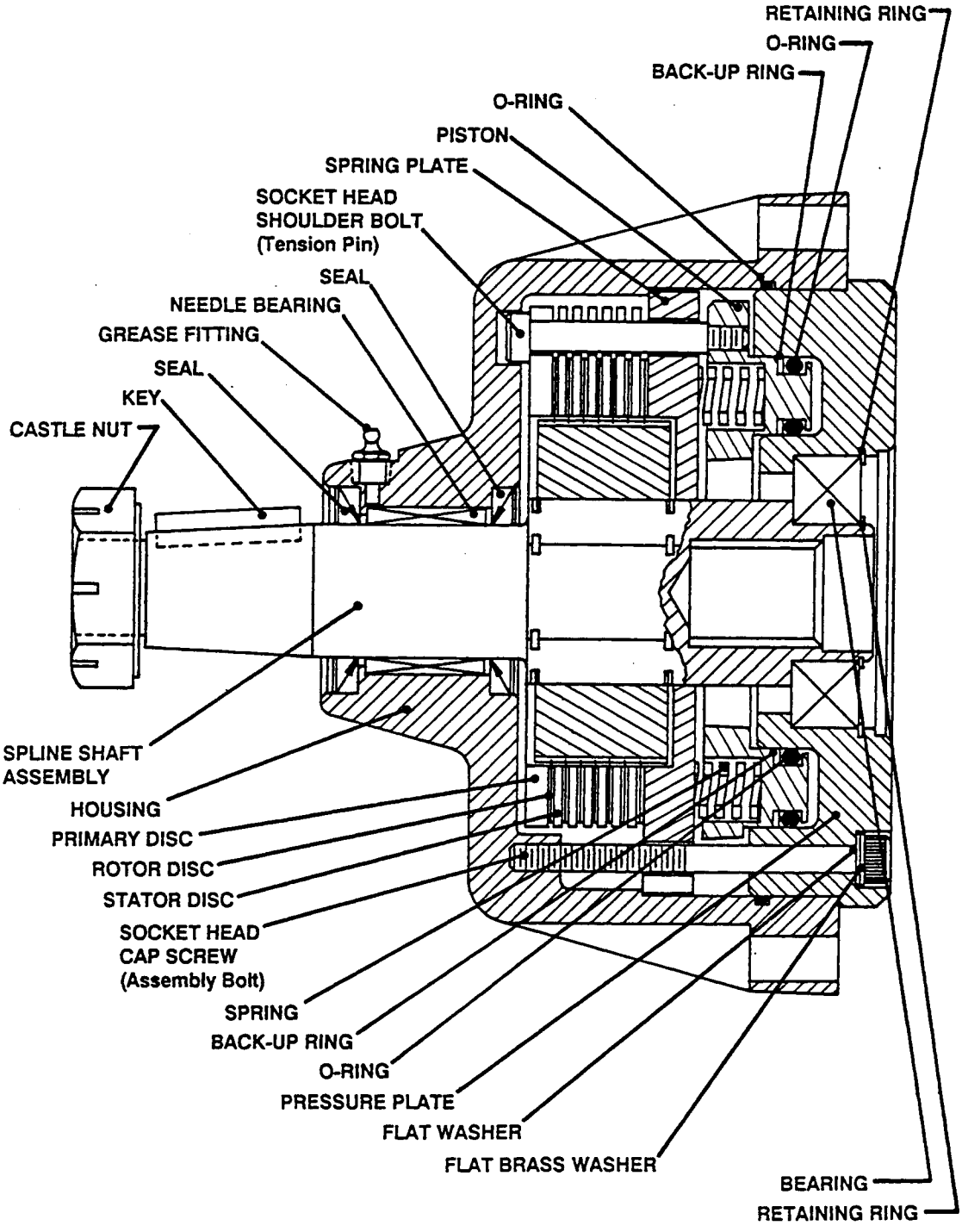


FIGURE 1

PRINCIPLES OF OPERATION

These brakes are spring-set, hydraulically released, multi-disc brakes used primarily for holding a vehicle in place when the hydraulic drive system is shut down or fails. Although the brakes are rated at 3000 psi, they only require 250 psi release pressure to make them function normally.

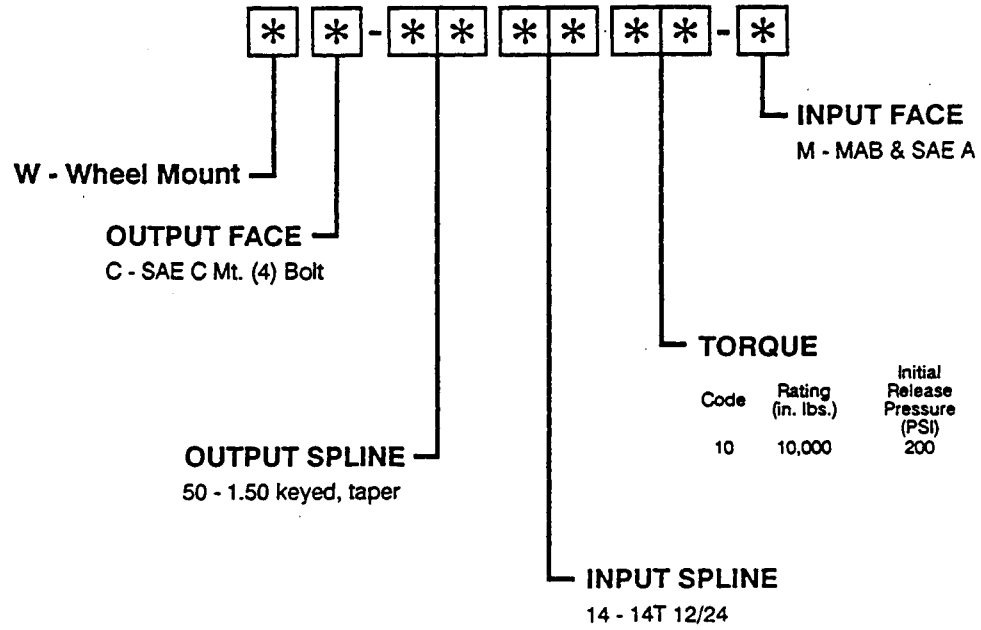
Any pressure on the brake's release piston will directly effect the level of torque.

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 build-up 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



Code	Rating (in. lbs.)	Initial Release Pressure (PSI)	Full Release Pressure (PSI)
10	10,000	200	250

DISASSEMBLY

1. Remove castle nut (26) and key (20) from output end of spline shaft assembly (19).
2. Remove ten socket head assembly bolts (4) and flat washers (5 & 6). Washers (5) are brass. A suitable holding fixture is useful to keep brake in position.
3. Tap output end of spline shaft assembly (19) with a soft mallet to separate housing (22) from internal parts assembly.
4. Remove o-ring (21) from housing (22).
5. Needle bearing (24) and seals (23 & 25) will remain in housing (22). Inspect parts for wear and remove only if necessary.
6. Remove retaining ring (1) from input end of spline shaft assembly (19).
7. Tap input end of spline shaft assembly (19) with a soft mallet to separate spline shaft from internal parts assembly.
8. Bearing (3) and retaining ring (2) will remain in pressure plate (7). Inspect for damage. Replace if necessary.
9. Remove four socket head shoulder bolts (18). A suitable holding fixture is useful to hold brake in position.

   CAUTION: **Do not remove shoulder bolts without first relieving spring force on lining stack. This can be accomplished in a press. Apply force on spring plate (14) thru center of stack.**
10. Remove primary disc (17), seven rotor discs (16) and six stator discs (15).
11. Remove spring plate (14).
12. Before removing springs (13), note pattern for reassembly purposes.
13. Separate piston (12) and pressure plate (7) by carefully exerting hydraulic pressure through brake release port on pressure plate.
14. Remove outside and inside o-rings (8 & 10) and outside and inside back-up rings (9 & 11) from piston (12).

    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 SYSTEM.

1. Use an alkaline wash to clean parts before assembly.
2. Install back-up rings (9 & 11) on piston (12) toward spring pockets.
3. Install o-rings (8 & 10) on piston (12). 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 (12) with type fluid found in the system. Carefully press piston into pressure plate (7). Be sure piston is aligned correctly at all times and that there are no extrusions. Press piston until it bottoms on pressure plate (7).
5. Install springs (13) according to pattern noted during disassembly. Different colored springs must be alternated.
6. Place spring plate (14) over springs (13).
7. Install stator discs (15) and rotor discs (16). Begin with a rotor disc (16) and alternate with stator discs (15).
8. Install primary disc (17).
9. Align discs and partially screw in four socket head shoulder bolts (18).

   NOTE: **Socket head shoulder bolts (18) should have Loctite applied. Place one or two drops of Loctite to threads.**

   Inspect for free movement of stack and check to see if spline shaft assembly (19) lines up with discs so it can fit through stack. Apply force against spring plate (14) thru center of lining stack to relieve spring force on plates. Torque shoulder bolts to 18 ft. lbs. and release pressure. A suitable holding fixture is useful to hold brake in position.
10. Install spline shaft assembly (19) through stack input end first and out pressure plate (7).
11. Install bearing (3) and retaining ring (2) in pressure plate (7). (If removed).
12. Install retaining ring (1) on input end of spline shaft assembly (19).
13. If seals (23 & 25) and needle bearing (24) were removed from housing (22) they must be installed. Note direction of both seals.
14. Install o-ring (21) in housing (22).
15. Install the internal parts assembly in housing (22) using ten socket head assembly bolts (4) and flat washers (5 & 6). Rotate pressure plate (7) as required to line up mounting holes.

    NOTE: **The ten socket head assembly bolts (4) should have Loctite applied. Place one or two drops of Loctite to the threads.**

    Washers (5) are brass and should be first on the bolts. Torque bolts to 35 - 40 ft. lbs.
16. Install castle nut (26) and key (20) on output end of spline shaft assembly (19).

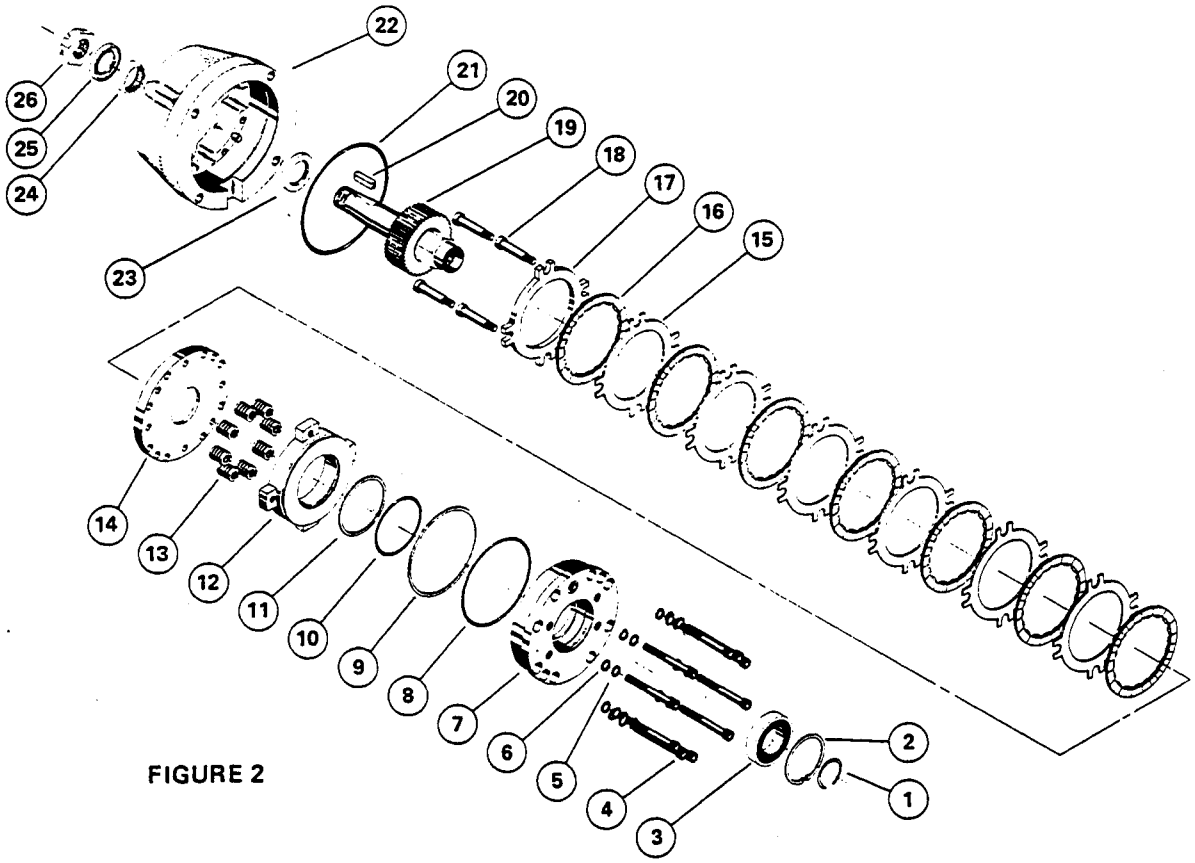


FIGURE 2

PARTS LISTS

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	RETAINING RING	14	SPRING PLATE
2	RETAINING RING	15	STATOR DISCS (6)
3	BEARING	16	ROTOR DISCS (7)
4	SOCKET HEAD CAP SCREWS (10) (Assembly Bolts)	17	PRIMARY DISC
5	FLAT BRASS WASHERS (10)	18	SOCKET HEAD SHOULDER BOLTS (4) (Tension Pins)
6	FLAT WASHERS (10)	19	SPLINE SHAFT ASSEMBLY
7	PRESSURE PLATE	20	KEY
8	O-RING	21	O-RING
9	BACK-UP RING	22	HOUSING
10	O-RING	23	SEAL
11	BACK-UP RING	24	NEEDLE BEARING
12	PISTON	25	SEAL
13	SPRINGS (8)	26	CASTLE NUT

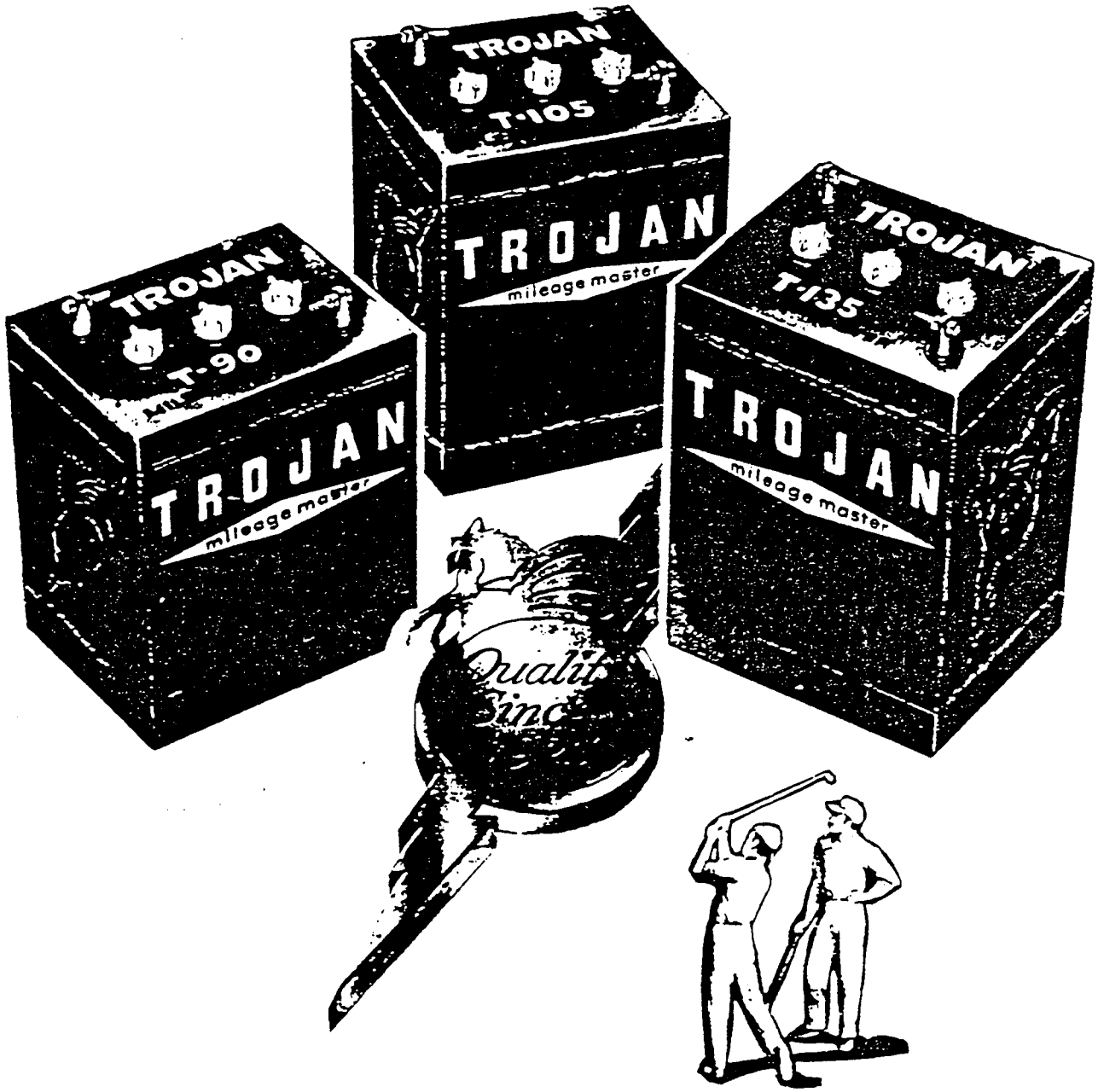
BLEEDING

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 brake's 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.	
	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

TROJAN MILEAGE MASTER BATTERIES



TROJAN BATTERY COMPANY

12380 CLARK STREET • SANTA FE SPRINGS, CA 90670

(213) 946-8381 • (714) 521-8215 Toll Free (Outside Calif.) (800) 423-6569 (Excluding Alaska and Hawaii)

proper care and maintenance of electric vehicle

1. NEW BATTERY RECEIVAL AND INSTALLATION

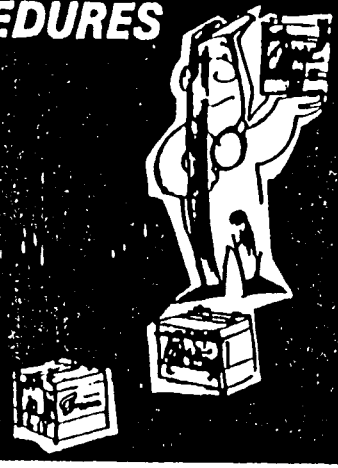


1. Always inspect incoming shipments of batteries for damage. Look for and pay particular attention for damage to or wet spots on the shipping cartons, examine those batteries for signs of breakage.
2. If damaged batteries are found secure acknowledgment of the damage from the carrier's representative 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 (.078).
   b. Remove vent caps and water batteries preferably 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 ⅛ 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 "Trouble Shooting" 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 or 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 golf, 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 1.260 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 service 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 trouble shooting procedures to determine the condition of the batteries.

TROJAN MILEAGE MASTER BATTERIES

GROUP NUMBER	TYPE	VOLTS	REF. 20 HOUR RATE A.H.	75 AMPS TO 5.25 VOLTS AT 80° F MINUTES	OVERALL DIMENSIONS LENGTH	WIDTH	*HEIGHT	WEIGHT
GC-2	T-90	6	185	90	10-3/8	7-1/8	10-3/4	56
GC-2H	T-105	6	217	105	10-3/8	7-1/8	10-3/4	61
GC-2H	T-135	6	244	135	10-3/8	7-1/16	11-1/2	72

OTHER SPECIAL BATTERIES AVAILABLE FOR ELECTRIC VEHICLES.

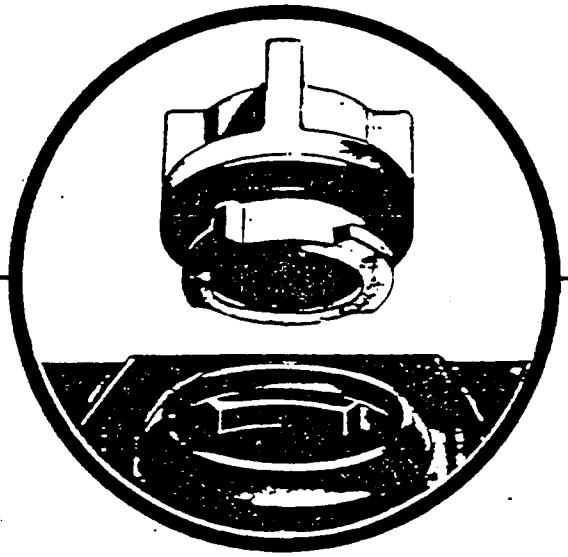
*TYPE OR TERMINAL WILL VARY HEIGHT SLIGHTLY

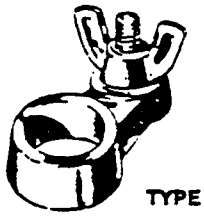
TROJAN "MILEAGE MASTER" TYPES FEATURE QUARTER-TURN VENT CAPS REDUCING SERVICE TIME 75%



TYPE AP

STRAIGHT POST



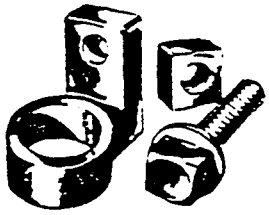


TYPE WT

WING NUT TERMINAL
3/16 or 5/16 Stud

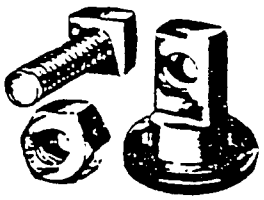
TYPE LT

ANGLE TERMINAL
5/16 Lead coated bolt



TYPE UT

UNIVERSAL TERMINAL



ALL BATTERIES COME WITH UNIVERSAL TERMINALS
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ANPAT MANUAL BATTERY CHARGER(S)
P/N 4006 & 63

INTRODUCTION

This handbook describes the installation, operation, trouble shooting, and repair of the ANPAT Series L portable and built-in battery chargers. These units are self-contained, fully automatic, ruggedized, commercial battery chargers, designed for operation on the normal electrical service. The output of the Series L charger is regulated by use of a resonance transformer. The built-in model is permanently mounted on the battery powered vehicle.

SPECIFICATIONS

INPUT POWER	115 Volts; 60 Hz
OUTPUT VOLTAGE	12 or 24 volts, DC
OUTPUT CURRENT	40 Amp
OUTPUT MONITOR	Ammeter
OUTPUT CONTROL	12 or 24 hour Automatic Timer
TRANSFORMER PROTECTION	D-C output fuses
PERSONNEL PROTECTION	Grounded cabinet (3rd wire)

INSPECTION AND INSTALLATION

Inspect the exterior of the shipping container for visual signs of rough handling during shipment.

Remove the charger from the shipping container and inspect the exterior of the unit for damage (broken glass, cracked knobs, etc.). CLAIMS FOR SHIPPING DAMAGE SHOULD BE FILED WITH THE CARRIER.

Install the charger on any suitable working surface so that there is free access to the front (control) panel and at least six (6) inches of free clearance on each side. There should be at least two (2) inches of clearance on the top of the charger. (The charger may be suspended overhead by the handle.) The clearance is required to allow proper flow of air through the side and top louvers for cooling.

There must be a separately fused, three-wire, single-phase, 115 volt, power receptacle sufficient rating (see A-C Amp in table on back page) within reach of the AC input cord of the charger.

OPERATING INSTRUCTION

1. Connect the AC plug to a suitable power receptacle.
2. Connect the DC plug to the battery receptacle (permanently connected on built-in models).

NOTE

Check the output plug for the correct polarity. The WHITE or RED lead must be connected to the POSITIVE terminal. The BLACK lead must be connected to the NEGATIVE terminal.

3. Turn the charger ON by setting the timer to the desired charging time (See Charging Time Chart).
4. Verify that the OUTPUT METER indicates a charging current. (If it does not, see TROUBLE SHOOTING SECTION.)
5. The timer control will turn off the charger (positive turn-off feature) at the completion of the charge cycle.
6. Disconnect the battery from the charger (on built-in model disconnect the AC cord).
7. Using a hydrometer, verify that the battery has been properly charged.

TROUBLE SHOOTING & REPAIR INSTRUCTIONS

LOW OR NO CHARGING CURRENT

1. Verify that the battery being charged has no open or dead cells. Check jumper cables between batteries for tight and clean connections, and also verify that the battery is not already fully charged.
2. Check the output fuses of the charger.
3. Verify that the AC receptacle has power by plugging in an electrical appliance.
4. Turn the charger ON and verify that the transformer hums. If no hum is heard, proceed with step 4.1.
   - 4.1 Remove the cabinet cover to gain access to the interior of the charger.
   - 4.2 On larger chargers furnished with a power relay (see wiring diagram) verify that the relay accuates when charger is turned on. If relay does not close, check continuity across relay coil. Also check for burned or damaged relay contacts.
   - 4.3 Disconnect the transformer primary leads from the timer assembly or power relay. Check for continuity between the primary input leads of the transformer on the terminal board. If no continuity is found, replace the transformer. If continuity is found proceed as follows:
   - 4.4 With the timer switch ON, check for continuity across the switch. If the switch is open with the timer on, replace the timer assembly.
   - 4.5 If all of the foregoing checks indicate continuity, but the transformer does not hum, check for loose or broken leads between the AC plug, timer assembly, and terminal board.
5. If the transformer hums, proceed as follows:
   - 5.1 Check the output fuses to insure they are good. Inspect the fuse holders for damage or a blackened appearance. (If the fuse holder is blackened it indicates oxidation and should be replaced.)
   - 5.2 Remove the cabinet cover to gain access to the interior of the charger.
   - 5.3 Disconnect the capacitor or capacitors for the following test:
   - 5.4 Remove one of the output fuses. With the timer switch OFF, check for continuity across the DC output, connecting the continuity indicator first in one direction and then in the other. The indicator should show an open in one direction and continuity in the other.
   - 5.5 Repeat step 5.4 interchanging the condition of the two output fuses.

5.6 If the indications obtained in steps 5.4 and 5.5 are normal, the secondary of the transformer is shorted, land it should be replaced. If a short is measured in both directions in either step 5.4 or 5.5 are open, then the diode or transformer secondary may be open.

5.7 To isolate the defective part with one of the output fuses installed, lcheck for continuity between its fuse holder and both terminals of the output ammeter. If continuity exists between the fuse holder and one of the meter terminals but not lthe other, the meter and the shunt are defective and must be replaced.

5.8 If continuity exists, repeat step 5.7 by interchanging fuses and connecting the continuity meter to the other fuse holder.

5.9 If continuity does not exist in either step 5.7 or 5.8, the transformer secondary may be open. Check for continuity directly across the transformer secondary with both output fuses removed.

5.10 If all indications to this point are normal, test the entire DC output circuitry for continuity by progressing from the +DC output terminal to the -DC terminal in incremental test sections, checking for open circuits and poor connections.

5.11 Test the resonance transformer for continuity between test points (3) and (4). If open replace transformer.

5.12 Test the resonance transformer under operating conditions by making the voltage measurements noted in the schematic diagram. Replace the transformer if these voltages are not normal.

5.13 Remove one lead from capacitor. Check across capacitor for continuity. If continuity exists, replace capacitor.

AC LINE FUSES BLOW

6. With unit unplugged and timer turned ON, check for continuity between each input prong of the AC plug and the ground prong. If all indications are open, the transformer or timer is shorted. Operate the timer with the transformer disconnected to isolate the faulty item. If continuity is found, a short circuit exists and must be found and removed.
7. Verify that the circuit under charge is not shorted by disconnecting the charger and operating it disconnected.
8. If fuses continue to blow, test the charger as per steps 5.1 through 5.13.

TIMER DOES NOT TURN UNIT OFF

9. Indicates that timer motor or switch is faulty. Replace timer assembly.

CHARGING TIME CHART

The following chart provides useful information for determining the minimum charging time needed to restore a battery to a full charge condition. In addition to normal charging, the cells of the batteries should be equalized twice each month. This is done by charging the batteries an additional seven (7) hours after a normal charge cycle. The current indications of the ammeter will be low during cell equalization.

Specific Gravity Reading	Condition of Battery	Hours Needed* to Charge
1100	fully discharged	12
1125	10% charged	10
1150	20% charged	8
1175	30% charged	7
1200	60% charged	4
1225	75% charged	2
1250	95% charged	1/2
1260	fully charged	0

*Charging time will vary with the AH capacity of the battery.

INSPECTION OF BATTERIES AND ASSOCIATED CIRCUITS

An inspection of batteries and associated circuits is required often to assure that the batteries are capable of being fully charged. This inspection requires the use of a single-cell voltmeter, a hydrometer and a continuity tester.

1. Verify that all connections within the unit to be charged are clean and tight.
2. Check each battery for loose terminal posts.
3. Test for continuity between all battery terminals and the charging receptacle.
4. Verify that the top of each battery is free of moisture, grease and acid films which may cause a current leakage.
5. Test each individual cell in each battery after recharging with the hydrometer to verify that all specific gravity readings are within 10 points of one another.
6. Using the hydrometer, pull out acid from a cell and then vigorously expel the acid back into the cell to cause a violent stirring action. Immediately draw out another sample of acid and visually inspect it to see if it contains a brownish sediment (indicates positive plates are deteriorated).

IMPORTANT FACTS ON BATTERIES AND CHARGERS

Do not discard a good battery as being defective because its specific gravity does not show an increase immediately upon applying a charge. Many good batteries require a charging period as long as three (3) hours before they show any increase in the specific gravity.

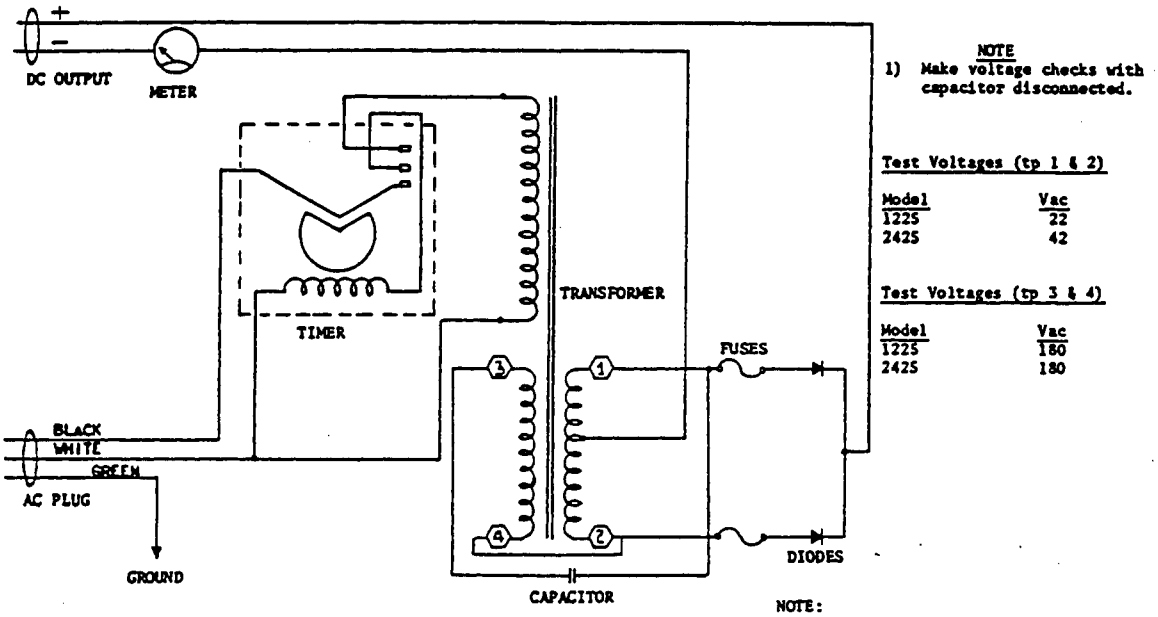
Do not charge a battery if the electrolyte temperature could rise above 120°F. This could damage both battery and charger. As a rule of thumb, the electrolyte temperature during normal charging is about 25°F above the local air temperature.

Voltage testing methods without fully charging or made while charging have no relationship to battery defectiveness.

Failure to keep the battery electrolyte to the proper level will result in a crumbling (abnormal sulfation) of the plates and cause failure of the battery. Distilled water must be added to the battery regularly to make up for the loss due to evaporation, especially during periods of high charging rates. Add water only to fully charged batteries.

Both overcharging and undercharging can cause a premature failure of a battery. Overcharging destroys the positive plates. Consistent undercharging causes a buckling of the plates.

Wiring Diagram Models 1225L, 2425L and 3625L
(Separate appropriate diagram is furnished for other models)



NOTE

1) Make voltage checks with capacitor disconnected.

Test Voltages (tp 1&2)		Test Voltages (tp 3 & 4)	
Model	Vac	Model	Vac
1240	20±1	1240	185±10%
2440	42±2	2440	245±10%

Model	AC Volts	AC Amp	Battery* Amp Hours	DC Volts	DC Amp
1240L	115	5	170/250	12	40
2440L	115	12	170/250	24	40

*Higher capacity batteries may be charged if longer than 12 hours recharge time is available. Some units are furnished with 24 hr. timers for this purpose.

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.

OWNERS MANUAL

AUTOMATIC BATTERY CHARGER

P/N 70228

INPUT: 115 VAC, 60 HZ.
OUTPUT: 24 VDC, 30 AMP.

CAUTION

THIS CHARGER IS INTENDED FOR THE CHARGING OF A 12 CELL (24V) LEAD ACID STORAGE BATTERY ONLY. USE OF THIS CHARGER ON ANY OTHER BATTERY COULD CAUSE DAMAGE TO THE BATTERY AND/OR TO THE CHARGER.

THIS MANUAL CONTAINS VITAL INFORMATION FOR THE SAFE USE AND EFFICIENT OPERATION OF THE BATTERY CHARGER. CAREFULLY READ THIS MANUAL BEFORE USING CHARGER, AND RETAIN FOR FUTURE REFERENCE. FAILURE TO ADHERE TO INSTRUCTIONS COULD RESULT IN SERIOUS BODILY INJURY OR PROPERTY DAMAGE. ALL REPAIRS SHOULD BE MADE BY QUALIFIED PERSONNEL ONLY.

CAUTION

DO NOT EXPOSE CHARGER TO WATER, MOISTURE, CLEANING AGENTS OR POWER WASH.

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CHARGER OPERATION

1. CHARGER INSTALLATION: MOUNT THE CHARGER IN THE VEHICLE AND CONNECT THE CHARGER POSITIVE (WHITE) DC CORD LEAD TO THE POSITIVE BATTERY TERMINAL AND CONNECT THE CHARGER NEGATIVE (BLACK) DC CORD LEAD TO THE NEGATIVE BATTERY TERMINAL.

2. ELECTRICAL SUPPLY: THIS CHARGER MUST BE OPERATED FROM A PROPERLY GROUNDED 115 VOLT, 60 HZ AC OUTLET ONLY.

3. CHARGER OPERATION:

   A. STARTING THE CHARGER, INSERT THE AC PLUG INTO THE APPROPRIATE CHARGER AC RECEPTACLE. THE CHARGER WILL START WHEN THE AC PLUG IS INSERTED.

   B. MONITOR METERS: THE AMMETER SHOULD INDICATE AN INITIAL CHARGE RATE OF APPROXIMATELY 30 AMPS. THE CHARGE RATE WILL GRADUALLY TAPER TO A FINISH RATE OF FROM 2 TO 10 AMPS.

   C. MONITOR LIGHTS (LIGHT EMITTING DIODES - L.E.D.):

      (1) THE GREEN "AC POWER ON" LIGHT SHOULD GLOW AT ALL TIMES WHEN THE AC CORD IS PLUGGED INTO A "LIVE"

115 VAC 60 HZ OUTLET AND THE DC CORD IS CONNECTED TO THE BATTERY.

NOTE: THE GREEN LIGHT, DUE TO THE CHARACTERISTICS OF THE L.E.D., MAY NOT BE HIGHLY VISIBLE WHEN THE CHARGER IS LOCATED IN A BRIGHTLY LIGHTED AREA.

(2) THE RED LIGHT "CHARGE ON/COMPLETE" SHOULD BLINK WHEN THE CHARGE STARTS AND REMAIN BLINKING UNTIL THE CHARGE IS COMPLETED. WHEN THE CHARGE IS COMPLETE THE LIGHT WILL STOP BLINKING AND GLOW CONTINUOUSLY. IF THE RED LIGHT IS "OFF", NOT GLOWING OR BLINKING, THEN A POSSIBLE PROBLEM EXISTS.

(3) THE YELLOW LIGHT "AC INTERRUPT" WHEN GLOWING INDICATES THAT THE 115 VAC POWER SOURCE HAS BEEN INTERRUPTED WHILE THE CHARGE WAS IN PROGRESS. ALL LIGHTS WILL BE OFF DURING THE ABSENCE OF THE AC POWER.

NOTE: IF THE CHARGE IS TERMINATED BY UNPLUGGING THE AC CORD OR IF THE "AC INTERRUPT" LIGHT IS GLOWING WHEN THE AC CORD IS UNPLUGGED, THE STOP/RESTART SWITCH MUST BE MOMENTARILY ENGAGED PRIOR TO THE NEXT CHARGE TO PREVENT THE "AC INTERRUPT" LIGHT FROM GLOWING WHEN THE NEXT CHARGE IS STARTED.

(4) THE ORANGE LIGHT "CHECK BATTERY" INDICATES ONE OF THE FOLLOWING TWO CONDITIONS: THAT THE BATTTERIES ARE NOT BEING CHARGED BEFORE THE PRESET MAXIMUM TIME HAS ELAPSED, OR THE BATTERY POTENTIAL OF 2.35 VOLTS/CELL HAS NOT BEEN REACHED IN THE COURSE OF THE CHARGE. THIS LIGHT SHOULD NOT GLOW UNDER NORMAL CIRCUMSTANCES. IF THE ORANGE LIGHT GLOWS AFTER THE CHARGE IS TERMINATED, CHECK THE BATTERY FOR WEAK CELLS.

D. CHARGE TERMINATION: THE CHARGER AUTOMATICALLY TERMINATES THE CHARGE WHEN THE BATTERIES ARE FULLY CHARGED OR WHEN THE PRESET MAXIMUM TIME HAS ELAPSED OR IF THE BATTERY POTENTIAL AFTER REACHING 2.16 VOLT/CELL STOPS INCREASING FOR A TIME PERIOD OF 80 MINUTES BEFORE REACHING 2.35 VOLTS/CELL. THE CHARGE MAY ALSO BE TERMINATED MANUALLY BY MOMENTARILY ENGAGING THE STOP/RESTART SWITCH. IF THE SWITCH IS DEPRESSED BEFORE (SIX) 6 MINUTES OF CHARGE TIME HAS ELAPSED OR IF THE BATTERY VOLTAGE IS BELOW 2.35 VOLT/CELL THE FAULT LIGHT WILL GLOW. IF VOLTAGE IS HIGHER THAN 2.35, THE COMPLETE LIGHT WILL GLOW. THE PRESET MAXIMUM CHARGE TIME IS TWENTY (20) HOURS.

CAUTION

DO NOT DISCONNECT THE DC CORD FROM THE VEHICLE DURING CHARGE. IF THE BATTERY MUST BE DISCONNECTED, STOP CHARGER WITH THE STOP/RESTART SWITCH, THEN UNPLUG AC CORD.

E. CHARGE TIME: THE TIME REQUIRED TO FULLY CHARGE THE BATTERIES WILL NORMALLY BE 8 TO 12 HOURS.

F. FULL CHARGE TEST: TO TEST FOR A FULL CHARGE ON A 24V BATTERY, RESTART THE CHARGER WITH THE STOP/RESTART SWITCH. IF THE BATTERY IS FULLY CHARGED, THE CHARGE RATE SHOULD DROP TO APPROXIMATELY 8 TO 15 AMPS WITHIN 10 TO 20 MINUTES. THE CHARGER WILL AUTOMATICALLY SHUT OFF WITHIN 45 TO 90 MINUTES OR IT MAY BE SHUT OFF WITH THE STOP/RESTART SWITCH.

G. AC POWER FAILURE: IF AN AC POWER FAILURE OCCURS DURING THE CHARGE, THE CHARGER WILL AUTOMATICALLY RESUME THE CHARGE WHEN THE AC POWER RETURNS. ALL CHARGER TIMING IS RESET TO ZERO TIME. THE "AC INTERRUPT" LIGHT WILL GLOW TO INDICATE THAT THE AC POWER HAS FAILED.

H. CHARGER RESTART: THE CHARGER MAY BE RESTARTED AFTER IT HAS SHUT OFF BY UNPLUGGING THE AC POWER CORD FOR A FEW SECONDS (3 TO 5 SECONDS) AND THEN PLUGGING THE CORD BACK IN. ALSO, THE CHARGER MAY BE RESTARTED BY MOMENTARILY ENGAGING (3 TO 5 SECONDS) THE STOP/RESTART SWITCH.

IF THE CHARGER AC CORD REMAINS CONNECTED TO THE 115 VAC 60 HZ AND THE DC CORD REMAINS CONNECTED TO THE BATTERIES AFTER THE CHARGER HAS FINISHED THE FIRST CHARGE, THE CHARGER WILL AUTOMATICALLY RESTART AFTER A PRESET NUMBER OF DAYS (24 HOUR PERIODS). THE CHARGE TIME (PROVIDED THE BATTERIES ARE UNLOADED) WILL NORMALLY BE 15 TO 90 MINUTES. THE CHARGER WILL AUTOMATICALLY SHUT OFF AND AGAIN TURN ON AFTER THE PRESET NUMBER OF DAYS. THIS CYCLE (CALLED A STORAGE MODE) WILL CONTINUE AS LONG AS THE CHARGER REMAINS CONNECTED TO THE AC POWER AND BATTERIES. THE PRESET NUMBER OF DAYS FOR TURN "ON" IS FOUR (4).

NOTE: THE ALLOWABLE MAXIMUM CHARGE TIME BEFORE SHUT OFF IS AUTOMATICALLY REDUCED IN THE STORAGE MODE TO PREVENT POSSIBLE OVERCHARGING OF THE BATTERIES. THE MAXIMUM CHARGE TIME IN THE STORAGE MODE IS THREE (3) HOURS.

IF AN AC POWER FAILURE OCCURS WHEN THE CHARGER IS IN THE STORAGE MODE THE CHARGER WILL START WHEN THE AC POWER RETURNS AND CONTINUE OPERATING IN THE STORAGE MODE.

IF THE BATTERY VOLTAGE DROPS TO APPROXIMATELY 21 VOLTS WHEN THE CHARGER IS "OFF" IN THE STORAGE MODE, THE CHARGER WILL AUTOMATICALLY RESTART WITHOUT WAITING FOR THE PRESET NUMBER OF DAYS TO ELAPSE. THE STORAGE MODE WILL CONTINUE AFTER THE BATTERIES ARE FULLY CHARGED.

TROUBLESHOOTING INSTRUCTIONS FOR CHARGER

THE FOLLOWING IS A LIST OF POSSIBLE PROBLEMS AND REMEDIES WHICH MIGHT OCCUR TO THE CHARGER.

THE VOM USED FOR MEASUREMENTS SHOULD HAVE A RESISTANCE OF 20,000 OHMS/VOLT DC, 5000 OHMS/VOLT AC OR GREATER.

IF A PROBLEM OCCURS IN THE CHARGER, DISCONNECT THE CHARGER

FROM THE 115 VAC OUTLET AND BATTERIES AND EXAMINE THE AC AND DC CORDS FOR DAMAGE OR LOOSE CONNECTIONS. AFTER THE COVER HAS BEEN REMOVED, EXAMINE THE INTERNAL PARTS AND CONNECTIONS FOR SIGNS OF DAMAGE OR LOOSE ELECTRICAL CONNECTIONS.

1. GREEN LIGHT (L.E.D.) DOES NOT GLOW AND CHARGER DOES NOT WORK WHEN CHARGER IS CONNECTED TO 115 VAC 60 HZ AND BATTERIES:

NOTE: IF THE CHARGER WORKS WHEN USING ONE OF THE AC RECEPTACLES ONLY, THEN THE AC RELAY SHOULD BE REPLACED.

CAUTION

USE EXTREME CARE WHEN WORKING INSIDE THE CHARGER WHEN IT IS CONNECTED TO THE 115 VAC LINE AND/OR THE BATTERIES IN ORDER TO PREVENT ELECTRICAL SHOCK OR TO PREVENT POSSIBLE DAMAGE TO THE PRINTED CIRCUIT BOARD COMPONENTS.

READ THE AC VOLTAGE BETWEEN PINS 1 AND 3 OF THE COMPU-TIME 4 PRINTED CIRCUIT BOARD EDGE CONNECTOR. THE VOLTAGE SHOULD BE THE SAME POTENTIAL AS THE 115 VAC POWER. IF THE VOLTAGE IS NOT PRESENT, CHECK FOR LOOSE ELECTRICAL CONNECTIONS. IF THE VOLTAGE IS CORRECT, THE P.C. BOARD IS FAULTY AND MUST BE REPLACED. READ THE PRECAUTIONS BELOW ON HANDLING P.C. BOARD BEFORE REMOVING THE BOARD FROM THE CHARGER.

2. GREEN "AC POWER ON" LIGHT GLOWS BUT CHARGER WILL NOT START OR STARTS BUT WILL NOT SHUT OFF WHEN CONNECTED TO THE 115 VAC AND THE BATTERY: THESE PROBLEMS COULD BE CAUSED BY THE P.C. BOARD AND THE FOLLOWING VOLTAGE MEASUREMENTS SHOULD DETERMINE IF THAT IS THE CASE.

   A. P1 VOLTAGE READINGS (P1 IS THE EDGE CONNECTOR OF THE P.C. BOARD), ALL VOLTAGE READINGS ARE REFERENCED TO PIN 9.

PIN	APPROXIMATE PIN VOLTAGE
7	SAME AS BATTERY VOLTAGE
5	CHARGER ON = LESS THAN 1 VDC CHARGER OFF = BATTERY VOLTAGE

IF ALL VOLTAGES ARE CORRECT, CHECK THE CONNECTOR TERMINALS TO BE SURE THEY ARE MAKING PROPER CONTACT WITH PINS. IF VOLTAGES ARE NOT CORRECT, REPLACE THE P.C. BOARD AND RETURN THE DEFECTIVE BOARD TO THE FACTORY FOR REPAIR.

CAUTION

BEFORE REMOVING THE P.C. BOARD, FIRST DISCONNECT THE CHARGER FROM THE 115 VAC AND BATTERIES. THEN REMOVE THE TWO MOUNTING SCREWS FROM THE FRONT PANEL AND REMOVE THE BOARD BY PULLING IT OUT THRU THE FRONT OF THE CHARGER. UNPLUG THE EDGE CONNECTOR.

DO NOT ATTEMPT TO REPLACE INDIVIDUAL COMPONENTS ON THE BOARD. DO NOT HANDLE THE BOARD ANY MORE THAN NECESSARY. SOME OF THE

COMPONENTS ON THE BOARD COULD BE DAMAGED BY STATIC ELECTRICITY. PLACE THE BOARD IN AN ANTI-STATIC BAG OR CARDBOARD BOX AND SHIP TO FACTORY.

TO INSTALL A NEW PRINTED CIRCUIT BOARD, REVERSE THE REMOVAL PROCEDURES DESCRIBED ABOVE.

IF THE PRINTED CIRCUIT BOARD IS NOT THE PROBLEM, CHECK THE RELAY TO SEE IF THE CONTACTS ARE CLOSING OR STICKING.

3. CHARGER OPERATES AT A REDUCED RATE OF CHARGE CURRENT AND/OR TRIPS AN AC POWER CIRCUIT BREAKER OR BLOWS DC FUSES: (A BLOWN DC FUSE WILL DISCOLOR THE BUBBLE WINDOW ON THE FUSE HOLDER. BEFORE CHANGING DC FUSE, CHECK BOTH DIODES FOR SHORTING CONDITION.)

   THE PROBLEM COULD BE A FAILED DIODE: DISCONNECT THE CHARGER FROM THE 115 VAC OUTLET AND BATTERIES AND CHECK CONTINUITY ACROSS THE DIODES WITH THE VOM. REMOVE THE TRANSFORMER LEADS FROM THE DIODES BEFORE READING CONTINUITY. IF A DIODE SHOWS APPROXIMATELY ZERO OHMS IN BOTH DIRECTIONS, IT IS SHORTED AND SHOULD BE REPLACED. IF A DIODE SHOWS AN OPEN CIRCUIT IN BOTH DIRECTIONS, IT IS OPEN AND SHOULD BE REPLACED.

   IF THE DIODES ARE OK, CONNECT THE TRANSFORMER LEADS BACK TO THE DIODES. RECONNECT THE CHARGER TO THE BATTERIES AND PLUG IN THE AC CORD TO THE 115 VAC OUTLET AND MAKE THE FOLLOWING VOLTAGE MEASUREMENTS.

DANGER: USE EXTREME CAUTION WHEN WORKING NEAR THE CAPACITOR.

PLACE METER LEADS ACROSS	*APPROXIMATE VOLTAGE READINGS	
	WITH CAPACITOR CONNECTED	WITH CAPACITOR DISCONNECTED
(1) AMMETER POST TO EACH DIODE ANODE (TRANSFORMER LEAD)	25-30 VAC	15-16 VAC
(2) AMMETER POST TO DIODE CATHODES (HEAT SINK)	27-31 VDC	26-31 VDC
(3) TRANSFORMER LEADS CONNECTED TO THE CAPACITOR	560-665 VAC	350 VAC

*NOTE: THESE READINGS WILL VARY AS SHOWN DEPENDING ON THE VOLTAGE OF THE BATTERIES AT THE TIME OF THE READING.

IF THE READINGS ARE THE SAME WITH THE CAPACITOR CONNECTED AS THEY ARE WITH THE CAPACITOR DISCONNECTED, THE CAPACITOR SHOULD BE REPLACED.

IF READING # (2) ONLY IS ABOUT ONE HALF OF THE VALUES SHOWN, A DIODE IS OPEN. RECHECK DIODE CONTINUITY AS WAS DONE ABOVE JUST PREVIOUS TO READING VOLTAGES.

IF THE VOLTAGES ARE STILL NOT CORRECT AND THE CAPACITOR AND DIODES ARE GOOD, THE TRANSFORMER MAY HAVE FAILED AND SHOULD BE REPLACED.

OWNERS MANUAL

AUTOMATIC BATTERY CHARGER

P/N 70435

INPUT: 230 VAC, 50 HZ.
OUTPUT: 24 VDC, 30 AMP.

CAUTION

THIS CHARGER IS INTENDED FOR THE CHARGING OF A 12 CELL (24V) LEAD ACID STORAGE BATTERY ONLY. USE OF THIS CHARGER ON ANY OTHER BATTERY COULD CAUSE DAMAGE TO THE BATTERY AND/OR TO THE CHARGER.

THIS MANUAL CONTAINS VITAL INFORMATION FOR THE SAFE USE AND EFFICIENT OPERATION OF THE BATTERY CHARGER. CAREFULLY READ THIS MANUAL BEFORE USING CHARGER, AND RETAIN FOR FUTURE REFERENCE. FAILURE TO ADHERE TO INSTRUCTIONS COULD RESULT IN SERIOUS BODILY INJURY OR PROPERTY DAMAGE. ALL REPAIRS SHOULD BE MADE BY QUALIFIED PERSONNEL ONLY.

CAUTION

DO NOT EXPOSE CHARGER TO WATER, MOISTURE, CLEANING AGENTS OR POWER WASH.

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CHARGER OPERATION

1. CHARGER INSTALLATION: MOUNT THE CHARGER IN THE VEHICLE AND CONNECT THE CHARGER POSITIVE (WHITE) DC CORD LEAD TO THE POSITIVE BATTERY TERMINAL AND CONNECT THE CHARGER NEGATIVE (BLACK) DC CORD LEAD TO THE NEGATIVE BATTERY TERMINAL.

2. ELECTRICAL SUPPLY: THIS CHARGER MUST BE OPERATED FROM A PROPERLY GROUNDED 230 VOLT, 50 HZ AC OUTLET ONLY.

3. CHARGER OPERATION:

   A. STARTING THE CHARGER, INSERT THE AC PLUG INTO THE APPROPRIATE CHARGER AC RECEPTACLE. THE CHARGER WILL START WHEN THE AC PLUG IS INSERTED.

   B. MONITOR METERS: THE AMMETER SHOULD INDICATE AN INITIAL CHARGE RATE OF APPROXIMATELY 30 AMPS. THE CHARGE RATE WILL GRADUALLY TAPER TO A FINISH RATE OF FROM 2 TO 10 AMPS.

   C. MONITOR LIGHTS (LIGHT EMITTING DIODES - L.E.D.):

      (1) THE GREEN "AC POWER ON" LIGHT SHOULD GLOW AT ALL TIMES WHEN THE AC CORD IS PLUGGED INTO A "LIVE"

230 VAC 50 HZ OUTLET AND THE DC CORD IS CONNECTED TO THE BATTERY.

NOTE: THE GREEN LIGHT, DUE TO THE CHARACTERISTICS OF THE L.E.D., MAY NOT BE HIGHLY VISIBLE WHEN THE CHARGER IS LOCATED IN A BRIGHTLY LIGHTED AREA.

(2) THE RED LIGHT "CHARGE ON/COMPLETE" SHOULD BLINK WHEN THE CHARGE STARTS AND REMAIN BLINKING UNTIL THE CHARGE IS COMPLETED. WHEN THE CHARGE IS COMPLETE THE LIGHT WILL STOP BLINKING AND GLOW CONTINUOUSLY. IF THE RED LIGHT IS "OFF", NOT GLOWING OR BLINKING, THEN A POSSIBLE PROBLEM EXISTS.

(3) THE YELLOW LIGHT "AC INTERRUPT" WHEN GLOWING INDICATES THAT THE 230 VAC POWER SOURCE HAS BEEN INTERRUPTED WHILE THE CHARGE WAS IN PROGRESS. ALL LIGHTS WILL BE OFF DURING THE ABSENCE OF THE AC POWER.

NOTE: IF THE CHARGE IS TERMINATED BY UNPLUGGING THE AC CORD OR IF THE "AC INTERRUPT" LIGHT IS GLOWING WHEN THE AC CORD IS UNPLUGGED, THE STOP/RESTART SWITCH MUST BE MOMENTARILY ENGAGED PRIOR TO THE NEXT CHARGE TO PREVENT THE "AC INTERRUPT" LIGHT FROM GLOWING WHEN THE NEXT CHARGE IS STARTED.

(4) THE ORANGE LIGHT "CHECK BATTERY" INDICATES ONE OF THE FOLLOWING TWO CONDITIONS: THAT THE BATTTERIES ARE NOT BEING CHARGED BEFORE THE PRESET MAXIMUM TIME HAS ELAPSED, OR THE BATTERY POTENTIAL OF 2.35 VOLTS/CELL HAS NOT BEEN REACHED IN THE COURSE OF THE CHARGE. THIS LIGHT SHOULD NOT GLOW UNDER NORMAL CIRCUMSTANCES. IF THE ORANGE LIGHT GLOWS AFTER THE CHARGE IS TERMINATED, CHECK THE BATTERY FOR WEAK CELLS.

D. CHARGE TERMINATION: THE CHARGER AUTOMATICALLY TERMINATES THE CHARGE WHEN THE BATTERIES ARE FULLY CHARGED OR WHEN THE PRESET MAXIMUM TIME HAS ELAPSED OR IF THE BATTERY POTENTIAL AFTER REACHING 2.16 VOLT/CELL STOPS INCREASING FOR A TIME PERIOD OF 80 MINUTES BEFORE REACHING 2.35 VOLTS/CELL. THE CHARGE MAY ALSO BE TERMINATED MANUALLY BY MOMENTARILY ENGAGING THE STOP/RESTART SWITCH. IF THE SWITCH IS DEPRESSED BEFORE (SIX) 6 MINUTES OF CHARGE TIME HAS ELAPSED OR IF THE BATTERY VOLTAGE IS BELOW 2.35 VOLT/CELL THE FAULT LIGHT WILL GLOW. IF VOLTAGE IS HIGHER THAN 2.35, THE COMPLETE LIGHT WILL GLOW. THE PRESET MAXIMUM CHARGE TIME IS TWENTY (20) HOURS.

CAUTION

DO NOT DISCONNECT THE DC CORD FROM THE VEHICLE DURING CHARGE. IF THE BATTERY MUST BE DISCONNECTED, STOP CHARGER WITH THE STOP/RESTART SWITCH, THEN UNPLUG AC CORD.

E. CHARGE TIME: THE TIME REQUIRED TO FULLY CHARGE THE BATTERIES WILL NORMALLY BE 8 TO 12 HOURS.

F. FULL CHARGE TEST: TO TEST FOR A FULL CHARGE ON A 24V BATTERY, RESTART THE CHARGER WITH THE STOP/RESTART SWITCH. IF THE BATTERY IS FULLY CHARGED, THE CHARGE RATE SHOULD DROP TO APPROXIMATELY 8 TO 15 AMPS WITHIN 10 TO 20 MINUTES. THE CHARGER WILL AUTOMATICALLY SHUT OFF WITHIN 45 TO 90 MINUTES OR IT MAY BE SHUT OFF WITH THE STOP/RESTART SWITCH.

G. AC POWER FAILURE: IF AN AC POWER FAILURE OCCURS DURING THE CHARGE, THE CHARGER WILL AUTOMATICALLY RESUME THE CHARGE WHEN THE AC POWER RETURNS. ALL CHARGER TIMING IS RESET TO ZERO TIME. THE "AC INTERRUPT" LIGHT WILL GLOW TO INDICATE THAT THE AC POWER HAS FAILED.

H. CHARGER RESTART: THE CHARGER MAY BE RESTARTED AFTER IT HAS SHUT OFF BY UNPLUGGING THE AC POWER CORD FOR A FEW SECONDS (3 TO 5 SECONDS) AND THEN PLUGGING THE CORD BACK IN. ALSO, THE CHARGER MAY BE RESTARTED BY MOMENTARILY ENGAGING (3 TO 5 SECONDS) THE STOP/RESTART SWITCH.

IF THE CHARGER AC CORD REMAINS CONNECTED TO THE 230 VAC 50 HZ AND THE DC CORD REMAINS CONNECTED TO THE BATTERIES AFTER THE CHARGER HAS FINISHED THE FIRST CHARGE, THE CHARGER WILL AUTOMATICALLY RESTART AFTER A PRESET NUMBER OF DAYS (24 HOUR PERIODS). THE CHARGE TIME (PROVIDED THE BATTERIES ARE UNLOADED) WILL NORMALLY BE 15 TO 90 MINUTES. THE CHARGER WILL AUTOMATICALLY SHUT OFF AND AGAIN TURN ON AFTER THE PRESET NUMBER OF DAYS. THIS CYCLE (CALLED A STORAGE MODE) WILL CONTINUE AS LONG AS THE CHARGER REMAINS CONNECTED TO THE AC POWER AND BATTERIES. THE PRESET NUMBER OF DAYS FOR TURN "ON" IS FOUR (4).

NOTE: THE ALLOWABLE MAXIMUM CHARGE TIME BEFORE SHUT OFF IS AUTOMATICALLY REDUCED IN THE STORAGE MODE TO PREVENT POSSIBLE OVERCHARGING OF THE BATTERIES. THE MAXIMUM CHARGE TIME IN THE STORAGE MODE IS THREE (3) HOURS.

IF AN AC POWER FAILURE OCCURS WHEN THE CHARGER IS IN THE STORAGE MODE THE CHARGER WILL START WHEN THE AC POWER RETURNS AND CONTINUE OPERATING IN THE STORAGE MODE.

IF THE BATTERY VOLTAGE DROPS TO APPROXIMATELY 21 VOLTS WHEN THE CHARGER IS "OFF" IN THE STORAGE MODE, THE CHARGER WILL AUTOMATICALLY RESTART WITHOUT WAITING FOR THE PRESET NUMBER OF DAYS TO ELAPSE. THE STORAGE MODE WILL CONTINUE AFTER THE BATTERIES ARE FULLY CHARGED.

TROUBLESHOOTING INSTRUCTIONS FOR CHARGER

THE FOLLOWING IS A LIST OF POSSIBLE PROBLEMS AND REMEDIES WHICH MIGHT OCCUR TO THE CHARGER.

THE VOM USED FOR MEASUREMENTS SHOULD HAVE A RESISTANCE OF 20,000 OHMS/VOLT DC, 5000 OHMS/VOLT AC OR GREATER.

IF A PROBLEM OCCURS IN THE CHARGER, DISCONNECT THE CHARGER

FROM THE 230 VAC OUTLET AND BATTERIES AND EXAMINE THE AC AND DC CORDS FOR DAMAGE OR LOOSE CONNECTIONS. AFTER THE COVER HAS BEEN REMOVED, EXAMINE THE INTERNAL PARTS AND CONNECTIONS FOR SIGNS OF DAMAGE OR LOOSE ELECTRICAL CONNECTIONS.

1. GREEN LIGHT (L.E.D.) DOES NOT GLOW AND CHARGER DOES NOT WORK WHEN CHARGER IS CONNECTED TO 230 VAC 50 HZ AND BATTERIES:

NOTE: IF THE CHARGER WORKS WHEN USING ONE OF THE AC RECEPTACLES ONLY, THEN THE AC RELAY SHOULD BE REPLACED.

CAUTION

USE EXTREME CARE WHEN WORKING INSIDE THE CHARGER WHEN IT IS CONNECTED TO THE 230 VAC LINE AND/OR THE BATTERIES IN ORDER TO PREVENT ELECTRICAL SHOCK OR TO PREVENT POSSIBLE DAMAGE TO THE PRINTED CIRCUIT BOARD COMPONENTS.

READ THE AC VOLTAGE BETWEEN PINS 1 AND 3 OF THE COMPU-TIME 4 PRINTED CIRCUIT BOARD EDGE CONNECTOR. THE VOLTAGE SHOULD BE THE SAME POTENTIAL AS THE 230 VAC POWER. IF THE VOLTAGE IS NOT PRESENT, CHECK FOR LOOSE ELECTRICAL CONNECTIONS. IF THE VOLTAGE IS CORRECT, THE P.C. BOARD IS FAULTY AND MUST BE REPLACED. READ THE PRECAUTIONS BELOW ON HANDLING P.C. BOARD BEFORE REMOVING THE BOARD FROM THE CHARGER.

2. GREEN "AC POWER ON" LIGHT GLOWS BUT CHARGER WILL NOT START OR STARTS BUT WILL NOT SHUT OFF WHEN CONNECTED TO THE 230 VAC AND THE BATTERY: THESE PROBLEMS COULD BE CAUSED BY THE P.C. BOARD AND THE FOLLOWING VOLTAGE MEASUREMENTS SHOULD DETERMINE IF THAT IS THE CASE.

   A. P1 VOLTAGE READINGS (P1 IS THE EDGE CONNECTOR OF THE P.C. BOARD), ALL VOLTAGE READINGS ARE REFERENCED TO PIN 9.

PIN	APPROXIMATE PIN VOLTAGE
7	SAME AS BATTERY VOLTAGE
5	CHARGER ON = LESS THAN 1 VDC CHARGER OFF = BATTERY VOLTAGE

IF ALL VOLTAGES ARE CORRECT, CHECK THE CONNECTOR TERMINALS TO BE SURE THEY ARE MAKING PROPER CONTACT WITH PINS. IF VOLTAGES ARE NOT CORRECT, REPLACE THE P.C. BOARD AND RETURN THE DEFECTIVE BOARD TO THE FACTORY FOR REPAIR.

CAUTION

BEFORE REMOVING THE P.C. BOARD, FIRST DISCONNECT THE CHARGER FROM THE 230 VAC AND BATTERIES. THEN REMOVE THE TWO MOUNTING SCREWS FROM THE FRONT PANEL AND REMOVE THE BOARD BY PULLING IT OUT THRU THE FRONT OF THE CHARGER. UNPLUG THE EDGE CONNECTOR.

DO NOT ATTEMPT TO REPLACE INDIVIDUAL COMPONENTS ON THE BOARD. DO NOT HANDLE THE BOARD ANY MORE THAN NECESSARY. SOME OF THE

COMPONENTS ON THE BOARD COULD BE DAMAGED BY STATIC ELECTRICITY. PLACE THE BOARD IN AN ANTI-STATIC BAG OR CARDBOARD BOX AND SHIP TO FACTORY.

TO INSTALL A NEW PRINTED CIRCUIT BOARD, REVERSE THE REMOVAL PROCEDURES DESCRIBED ABOVE.

IF THE PRINTED CIRCUIT BOARD IS NOT THE PROBLEM, CHECK THE RELAY TO SEE IF THE CONTACTS ARE CLOSING OR STICKING.

3. CHARGER OPERATES AT A REDUCED RATE OF CHARGE CURRENT AND/OR TRIPS AN AC POWER CIRCUIT BREAKER OR BLOWS DC FUSES: (A BLOWN DC FUSE WILL DISCOLOR THE BUBBLE WINDOW ON THE FUSE HOLDER. BEFORE CHANGING DC FUSE, CHECK BOTH DIODES FOR SHORTING CONDITION.)

   THE PROBLEM COULD BE A FAILED DIODE: DISCONNECT THE CHARGER FROM THE 230 VAC OUTLET AND BATTERIES AND CHECK CONTINUITY ACROSS THE DIODES WITH THE VOM. REMOVE THE TRANSFORMER LEADS FROM THE DIODES BEFORE READING CONTINUITY. IF A DIODE SHOWS APPROXIMATELY ZERO OHMS IN BOTH DIRECTIONS, IT IS SHORTED AND SHOULD BE REPLACED. IF A DIODE SHOWS AN OPEN CIRCUIT IN BOTH DIRECTIONS, IT IS OPEN AND SHOULD BE REPLACED.

   IF THE DIODES ARE OK, CONNECT THE TRANSFORMER LEADS BACK TO THE DIODES. RECONNECT THE CHARGER TO THE BATTERIES AND PLUG IN THE AC CORD TO THE 230 VAC OUTLET AND MAKE THE FOLLOWING VOLTAGE MEASUREMENTS.

DANGER: USE EXTREME CAUTION WHEN WORKING NEAR THE CAPACITOR.

PLACE METER LEADS ACROSS	*APPROXIMATE VOLTAGE READINGS	
	WITH CAPACITOR CONNECTED	WITH CAPACITOR DISCONNECTED
(1) AMMETER POST TO EACH DIODE ANODE (TRANSFORMER LEAD)	25-30 VAC	15-16 VAC
(2) AMMETER POST TO DIODE CATHODES (HEAT SINK)	27-31 VDC	26-31 VDC
(3) TRANSFORMER LEADS CONNECTED TO THE CAPACITOR	560-665 VAC	350 VAC

*NOTE: THESE READINGS WILL VARY AS SHOWN DEPENDING ON THE VOLTAGE OF THE BATTERIES AT THE TIME OF THE READING.

IF THE READINGS ARE THE SAME WITH THE CAPACITOR CONNECTED AS THEY ARE WITH THE CAPACITOR DISCONNECTED, THE CAPACITOR SHOULD BE REPLACED.

IF READING # (2) ONLY IS ABOUT ONE HALF OF THE VALUES SHOWN, A DIODE IS OPEN. RECHECK DIODE CONTINUITY AS WAS DONE ABOVE JUST PREVIOUS TO READING VOLTAGES.

IF THE VOLTAGES ARE STILL NOT CORRECT AND THE CAPACITOR AND DIODES ARE GOOD, THE TRANSFORMER MAY HAVE FAILED AND SHOULD BE REPLACED.

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