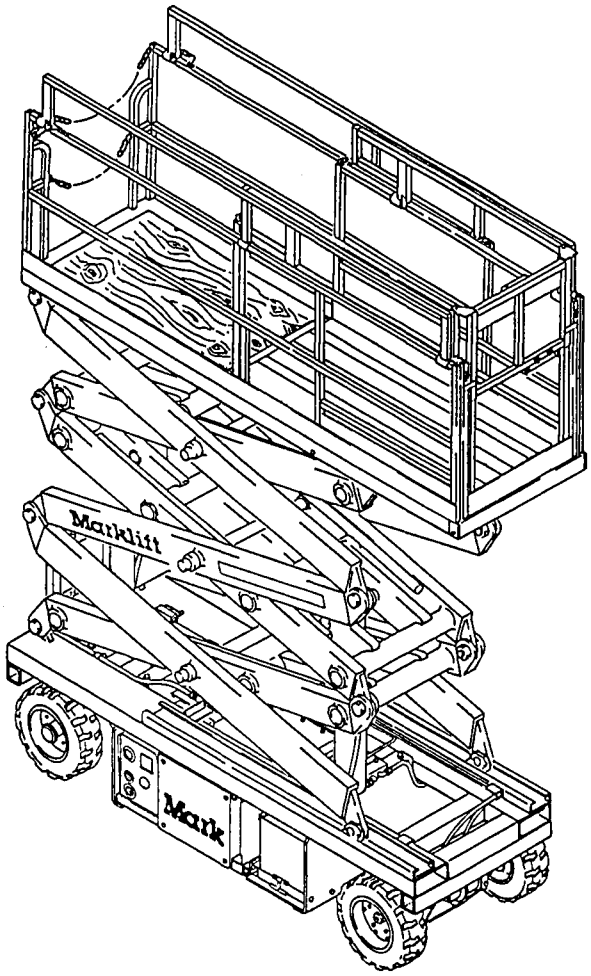
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED SCISSOR

OPERATION MAINTENANCE AND PARTS MANUAL



THIS TECHNICAL MANUAL APPLIES TO THE M20ESEP MODEL

Mark Industries

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Mark Industries

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The purpose of this manual is to provide the customer with operation, 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 functions are outlined in the **INSPECTION AND CHECKOUT** instructions in the operation section of this manual.

Description	Model
	M20E/SEP
Height –	
Working (maximum)	26' (7.92m)
Platform (maximum)	20' (6.09m)
Platform (minimum)	42.25" (107m)
Length (overall)	96" (2.43m)
Width (overall)	30" (.76m)
Platform –	
Dimenions (inside)	28.5"X93.5"
Safety Rail Height	42" (1.07m)
Toeplate Height	4" (.15m)
Load Capacity (evenly distributed)	750lbs (340kg)
Wheel Track	25"(.64m)
Wheel Base	67.75" (1.72m)
Turning Radius (inside)	7'-7" (2.31m)
Low	1.3 mph (2.09 km/hr)
High	2.5 mph (4.02 km/hr)
High Speed cut-out	7' (2.13m)
Lift/Lower Speed (maximum load)	53/23 seconds
Power System	24VDC
Battery Voltage	6VDC (series)
Capacities	
Battery	250 amp/hr (4)
Hydraulic Tank	13 gal. (45.45L)
Battery Charger	40 amps
Tire Size	4x8 solid
Shipping Weight	3550lbs (1606kg)
Shipping cube	135cu. ft. (3.82 m^3)

MANUFACTURERS' LIMITED WARRANTY

MARK INDUSTRIES makes no warranty, express or implied, on any product manufactured or sold by MARK INDUSTRIES except for the following limited warranty against defects 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 six (6) months 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 of 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 of any product) manufactured by MARK INDUSTRIES which, within six (6) months 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 the 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, express or implied, in addition to this limited warranty. **This limited warranty is exclusive and in lieu of all other warranties, express 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 and electrical components are specifically excluded from this limited warranty.

Mark Industries

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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.

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, 24, 25, 26, 32, 33).

		YES	NO
1.	Platform capacity decal _____ . lbs.	☐	☐
2.	All warning, caution and emergency decals installed	☐	☐
3.	Emergency descent valve functions properly	☐	☐
4.	Operation instructions properly installed	☐	☐
5.	Operation and safety handbook received	☐	☐
6.	Electrical schematic received	☐	☐
7.	All controls (aerial & ground) are identified and operate correctly	☐	☐
8.	Stop switches operate properly (aerial & ground)	☐	☐
9.	Platform guard rails, secure and undamaged	☐	☐
10.	Platform access gate works properly	☐	☐
11.	Horn and beacon operate properly (optional)	☐	☐
12.	Brakes adjusted and operate correctly	☐	☐
13.	Circuit breakers operate properly	☐	☐
14.	All Hydraulic cylinders free of gas	☐	☐
15.	All hydraulic cylinder rods free of paint or scratches	☐	☐
16.	Hydraulic pump free of leaks	☐	☐
17.	Hydraulic hoses and fittings free of leaks	☐	☐
18.	Hydraulic oil level	☐	☐
19.	Hydraulic tank and fittings free of leaks	☐	☐
20.	Drive motors free of leaks	☐	☐
21.	Battery water level	☐	☐
22.	Coolant hoses and fittings free of leaks	☐	☐
23.	Electric radiator fan operates properly	☐	☐
24.	System pressure _____. PSI	☐	☐
25.	Pilot pressure _____. PSI	☐	☐
26.	Tire pressure _____ . PSI	☐	☐
27.	Manual overrides operate properly	☐	☐
28.	Muffler is tight and free of leaks	☐	☐
29.	All electrical connections tight	☐	☐
30.	Manifold valve and fittings free of leaks	☐	☐
31.	110V generator operates properly (optional)	☐	☐
32.	Wheel lug nuts torqued to _____ . lbs	☐	☐
—Internal Combustion Units—			
33.	Engine _____ .R.P.M	☐	☐
34.	Engine coolant (radiator) level	☐	☐
35.	Fuel tank and fitting free of leaks	☐	☐
36.	Engine oil level	☐	☐
37.	Engine oil filter free of leaks	☐	☐
38.	Engine alternator functions properly	☐	☐

MODEL	SERIAL NUMBER
INSPECTOR	OPTIONS

REV.

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 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.)

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 scissor 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 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."**

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.

DO NOT LIFT FROM THIS END

2041

LOAD CAPACITY **750** LBS.
(EVENLY DISTRIBUTED LOAD)

2024

WARNING

DO NOT WORK UNDERNEATH THIS LIFT UNLESS IT IS MECHANICALLY LOCKED.

SEE SERVICE MANUAL FOR LOCATION AND USE OF MECHANICAL LOCKS

2016

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

2014

WARNING: LIGHT INDICATES UNSTABLE CONDITION

PLATFORM WILL LOWER AUTOMATICALLY

2015

GUARD RAILS ARE FOR YOUR SAFETY

CAUTION DO NOT REMOVE **CAUTION**

OPERATING THIS MACHINE WITHOUT GUARD RAILS COULD RESULT IN DEATH OR SERIOUS INJURY

31100

ATTACH SAFETY CHAINS BEFORE RAISING PLATFORM

11064

GENERAL DECALS
M20E/SEP

DECAL P/N	DECAL DESCRIPTION M20E/SEP	ASSEMBLY(LOCATION)	QTY
67639	Decal Set	All Standard Decals	1
2002	Forklift Boot	Final Assy	2
2003	Battery Water Level	Final Assy	1
2014	Caution, High Voltage	Aerial Control Panel	1
2016	Caution - Do not work Underneath	Final Assy	2
2017	Hydraulic System Fluid	Final Assy	2
2041	Do Not Lift From This End	Final Assy	1
20661	ANSI 92 Plate	Final Assy	1
31259	**MARKLIFT**	Final Assy	2
182737	Operation Instructions	Final Assy	1
11064	Attach Safety Chains Before	Final Assy	1
130606	Freewheeling valve	Final Assy	1
130820	Operation & Safety Handbook	Final Assy	1
32368	M-Series	Final Assy	1
130596	A PRODUCT OF MARK IND	Final Assy	2
130505	Ground Control Box	Ground Control Box	1
2023	Load Capacity 750 lbs.	Final Assy	2
20660	Nameplate, ID	Finally Assy	1
181720	M20E/SEP	Final Assy	1
182718	Aerial Coontrol Box	Aerial Control Panel	1
130796	Horn & Fuel	Aerial Control Panel	1

UNLOADING

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

When a loading dock is unavailable and a forklift must be used, make sure that the forklift used has forks sufficiently long for the forklift boots at the front of the unit. **Do Not** attempt to lift the machine from the side.

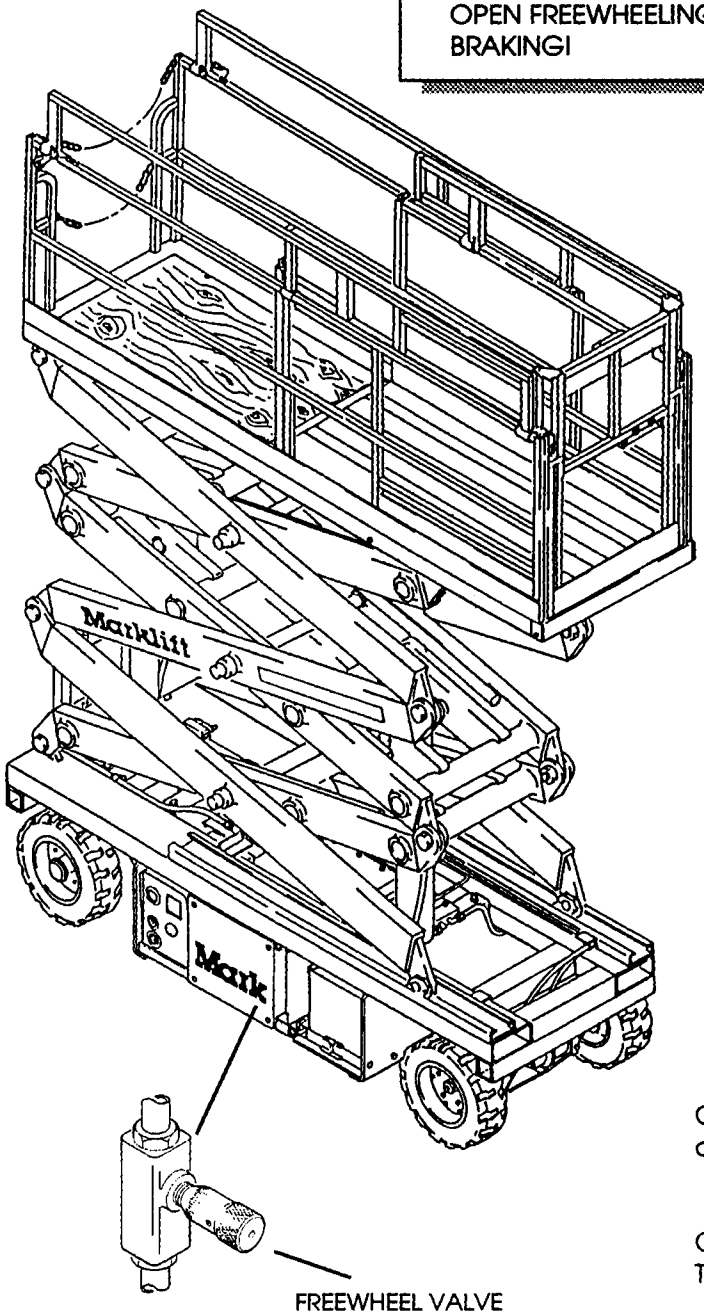
TRANSPORTING

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.) 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 set the brakes back into the normal mode.

When securing the MARKLIFT to the truck, put the chains or straps through the tiedown brackets only. **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.

CAUTION: MAKE SURE THE UNIT IS ON A LEVEL SURFACE BEFORE ATTEMPTING TO FREEWHEEL THE MARKLIFT. USE CAUTION WHEN BRAKES ARE DISENGAGED. ALWAYS REMEMBER TO OPEN FREEWHEELING VALVE TO RESTORE BRAKING!



Close valve to disengage brakes and freewheel. Turn clockwise.

Open valve to restore brakes. Turn counter clockwise.

M20E/SEP

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

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

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

3. Check battery for 1200 ± 50 reading on the hydrometer. Charge the battery if its reading is below 1100. If batteries require water, fill to proper level **AFTER** charging.

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

5. Check hoses for leaks.

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

1. STARTING

Turn power switch at ground control station to "ON". Position selector switch to "AERIAL". Enter the platform, **make sure the platform entry bar, gate, or chain is attached securely after entering the platform.** Pull open the red emergency stop switch cover located on the top right of the aerial control box. Turn on power switch to activate aerial controls and warning devices.

2. DRIVE

Forward and reverse drive is done from the aerial control box only. The **MARKLIFT** is equipped with a high and low speed for both forward and reverse drive. Rotate the drive knob forward for forward, low or high speed. Rotate the knob reverse for reverse, low or high speed. There is also an automatic creep speed, which will cut in whenever the platform is raised over one half of its rated height.

3. STEERING

A. Standard Toggle Switch

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.

B. Proportional Controller (Optional)

Use the thumb rocker switch on top of the drive controller. Pushing to the left causes the front wheels to turn left. Pushing the switch to the right causes the front wheels to turn to the right.

For best operation, place thumb over the controller knob and wrap fingers loosely around the locking stem. Apply a downward pressure with the thumb, while the index finger lifts the locking stem. Once the stem is disengaged and moved forward or reverse,

the pressure on the thumb may be relaxed because the locking stem has engaged the cam and cannot drop into the locking position until the lever or handle is returned to the center position.

4. RAISE PLATFORM

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

To operate from the aerial control box, 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 scissor 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 disable the scissor functions whenever the **MARKLIFT** is in an unsafe out-of-level position.

An unsafe out-of-level situation is sensed by the slope sensor 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, "Lift: UP/DOWN will not operate but the drive and steer functions will. The platform will lower automatically if not extended. Should the warning signals come on, maneuver the **MARKLIFT** until it is on a safe operating surface and all functions will be restored.

6. FREEWHEELING

In order to move the machine for loading, unloading and positioning, the **MARKLIFT** may be free wheeled for very short distances at no greater than 5 mph. **WHEN PREPARING FOR FREEWHEELING, MAKE SURE THE MACHINE IS ON A LEVEL SURFACE!**

The brake is disengaged by closing the freewheeling valve and driving the machine. Use caution when the brakes are disengaged. **ALWAYS REMEMBER TO OPEN FREEWHEELING VALVE TO RESTORE BRAKING.**

7. 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).

8. EXTENDING PLATFORM

The MARKLIFT M20E/SEP may be manually extended from the aerial platform. Pull out the safety lock pins then push the platform outward until it is fully extended. Place the safety lock pins back in the holes to secure the platform. When the platform is extended, the unit is automatically placed into low speed drive. If the slope sensor device is activated, the manually extended platform will not descend without using the "Descent Override."

All operators of the **MARKLIFT** should be instructed by trained operators. The new operators should spend at least 30 minutes practicing and becoming familiar with operating the scissor. He should begin by raising the scissor approximately 5 feet off the ground. The operator will soon find that gradual starts and stops are easy to perform.

For proportional controller, gradually raise the scissor higher, and drive the **MARKLIFT** until maximum height is reached. Remember that the proportional signal from the controller to the valve is controlled by the operator. There is approximately 3 degrees of "dead" motion on each side of the controller center position.

EMERGENCY DESCENT

If the operator has the platform extended and needs to descend, push down and hold the "Emergency Down" switch, then push the "Lift" switch down.

Use caution when lowering the extended platform. Remember to **check below the platform before using the emergency down switch**, to avoid damage to anything underneath.

IMPORTANT: The aerial start switch must be set at the "ON" position in order for the emergency hydraulics to function. Emergency functions also apply to the ground control station.
The following preventive maintenance information is intended as a general guide. Please refer to the vendor section of this manual for detailed information on the engine, battery, etc.

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, wire connections etc.
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.
6. Check for and correct any hydraulic leaks.
7. Check for and correct any structural damage.
8. Check overall performance.
9. Check for wear onelectrical 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.
4. Grease steering linkage.

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.

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 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, check the schematic, (see the SCHEMATIC chapter 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., then even if you have a proper electrical current to the coil or relay, some 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 switch other electrical devices.

2. HYDRAULIC

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

B. Directional valves (outriggers, steering, and drive) have two opposed electrical coils with a moveable spool between the coils.

C. One way valves (lift, descent,and dump) are normally open and are closed to prevent passage of fluid when electrically energized.

TROUBLE SHOOTING CHECKLIST

DRIVE MOTOR

1. Will not run.

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

2. Can't get high speed.

   Refer to your local service facility.

3. Dies under load.

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

DRIVE

A. Make sure hydraulic system is up to recommended pressure.
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

1. Functions will not operate from aerial control console.

   A. Check "Aerial/Ground" selector switch.
   B. Check for loose wire in aerial junction box.
   C. Solenoid dump valve.

2. Functions will not operate from ground control box.

   A. Check position of "Aerial/Ground" box selector switch.
   B. Solenoid dump valve.
   C. Pilot valve pressure.
   D. Refer to your local service facility.

HYDRAULIC FLUID TABLE

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°

Mark Industries

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			Front end assembly		
Choke(gas units)			Tire pressure		
Engine RPM (gas units)			Tire condition		
Charging system			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	Comments
F = Filled R = Repaired C = Checked A = Adjusted X = Needs repair	

MARKLIFT SERVICE MAINTENANCE CHECKLIST

MODEL NUMBER _____ SERIAL NUMBER _____ DATE SOLD _____

DATE IN SERVICE _____ OPTIONS _____ WARRANTY PERIOD _____

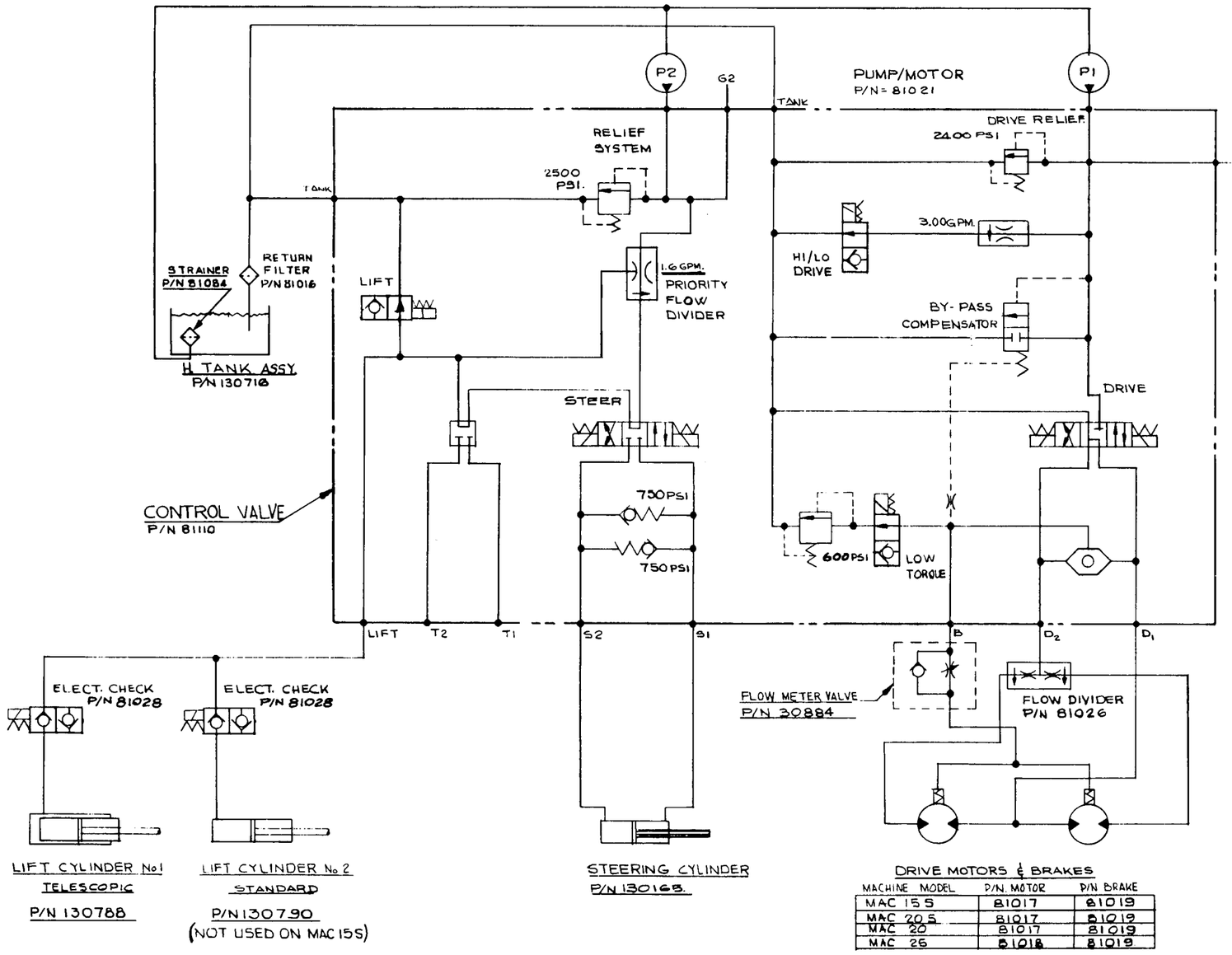
APPLIES TO MODELS WITH ENGINES ONLY

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

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

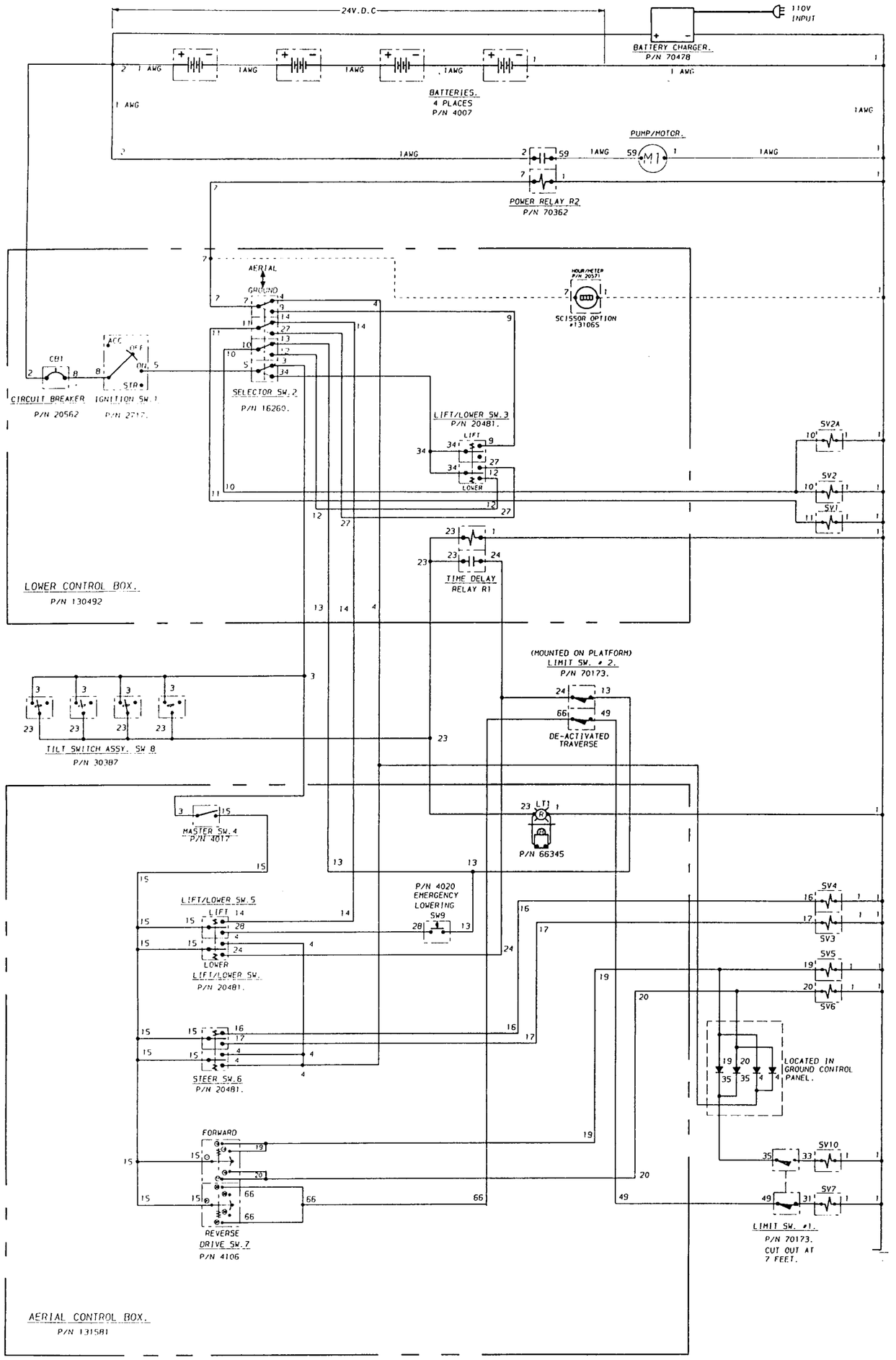
DATE	REMARKS	DATE	REMARKS	AGENCY

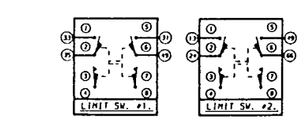
REV.

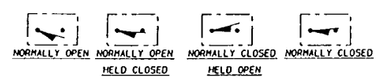


DRIVE MOTORS & BRAKES

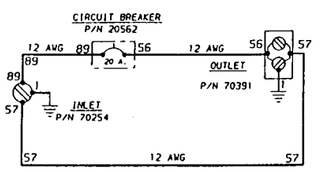
MACHINE MODEL	P/N. MOTOR	P/N BRAKE
MAC 15 S	81017	81019
MAC 20 S	81017	81019
MAC 20	81017	81019
MAC 26	81018	81019







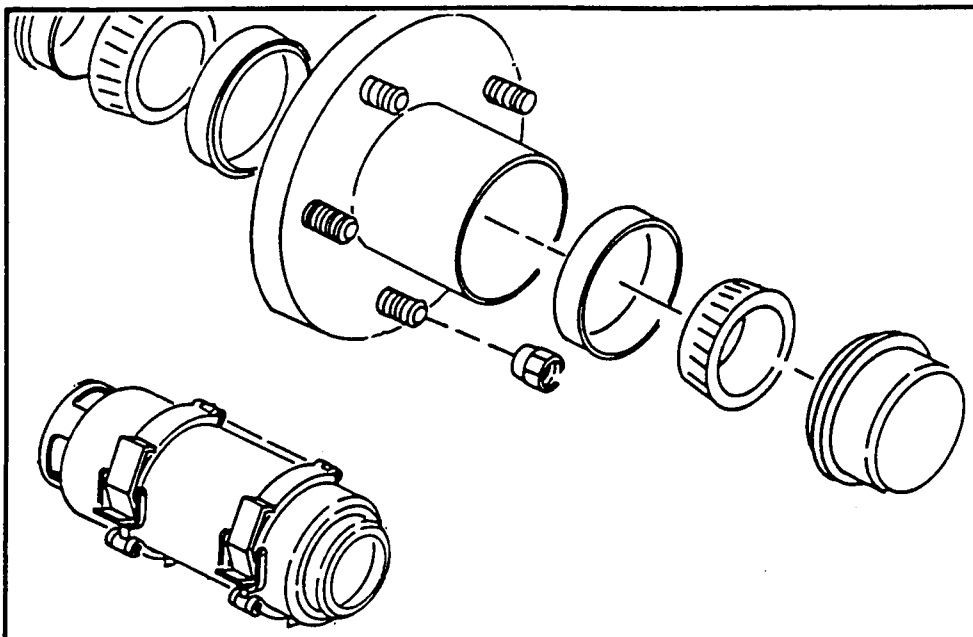
LEGEND FOR LIMIT SWITCHES.

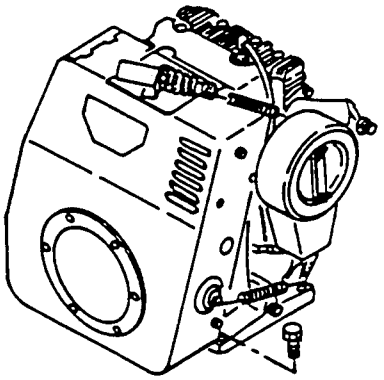


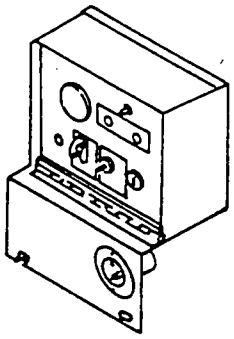
110 A.C. WIRING.

NOTES:

1. TO CONNECT GROUND CONTROL AND AERIAL CONTROL USE ARM CABLE P/N 130337.
2. USE 6A. 1000V. DIODE P/N 70479.
3. WIRING SHOWN IN STOWED POSITION.
4. IDENTIFY EACH WIRE BY NUMBER FLAG AT BOTH ENDS. WRAPPING COMPLETELY AROUND.







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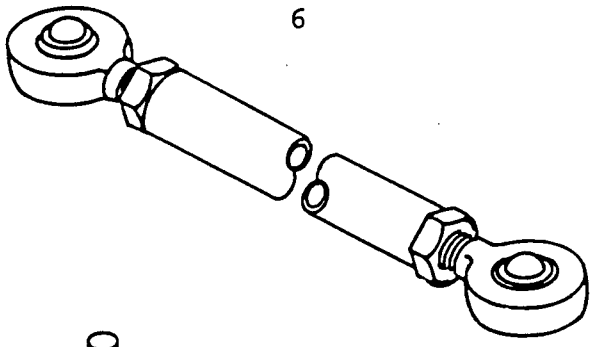

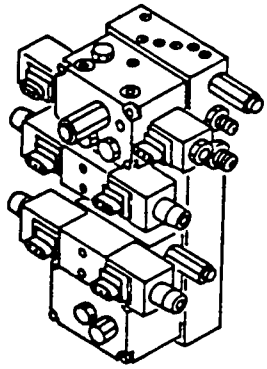

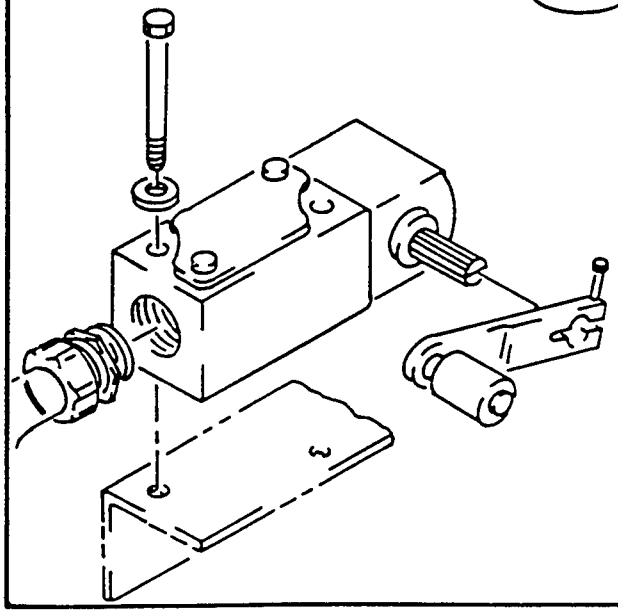

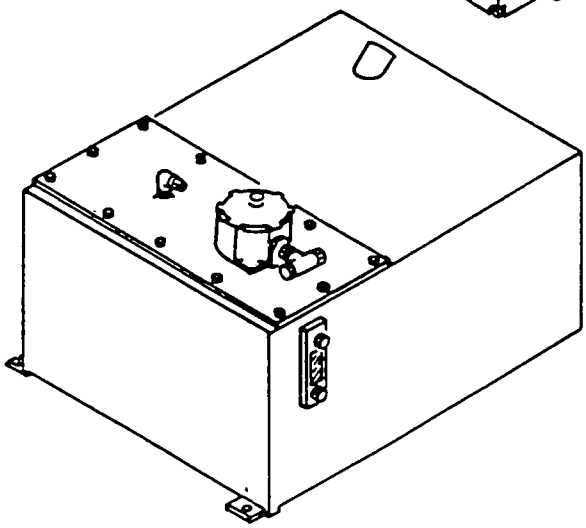

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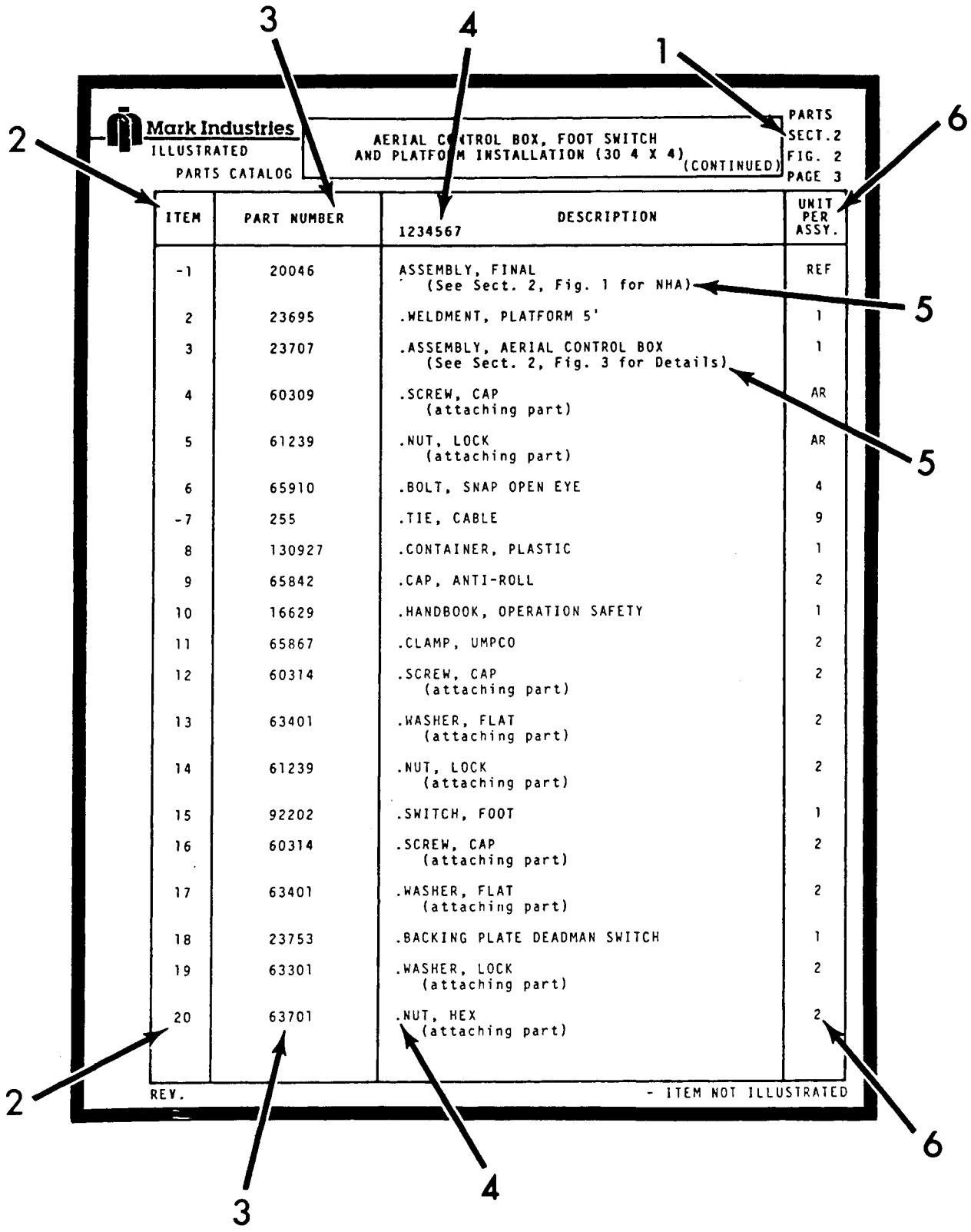


Mark Industries
ILLUSTRATED
PARTS CATALOG

AERIAL CONTROL BOX, FOOT SWITCH AND PLATFORM INSTALLATION (30 4 X 4) (CONTINUED)

PARTS SECT. 2
FIG. 2
PAGE 3

ITEM	PART NUMBER	1234567 DESCRIPTION	UNIT PER ASSY.
-1	20046	ASSEMBLY, FINAL (See Sect. 2, Fig. 1 for NHA)	REF
2	23695	.WELDMENT, PLATFORM 5'	1
3	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	1
4	60309	.SCREW, CAP (attaching part)	AR
5	61239	.NUT, LOCK (attaching part)	AR
6	65910	.BOLT, SNAP OPEN EYE	4
-7	255	.TIE, CABLE	9
8	130927	.CONTAINER, PLASTIC	1
9	65842	.CAP, ANTI-ROLL	2
10	16629	.HANDBOOK, OPERATION SAFETY	1
11	65867	.CLAMP, UMPCO	2
12	60314	.SCREW, CAP (attaching part)	2
13	63401	.WASHER, FLAT (attaching part)	2
14	61239	.NUT, LOCK (attaching part)	2
15	92202	.SWITCH, FOOT	1
16	60314	.SCREW, CAP (attaching part)	2
17	63401	.WASHER, FLAT (attaching part)	2
18	23753	.BACKING PLATE DEADMAN SWITCH	1
19	63301	.WASHER, LOCK (attaching part)	2
20	63701	.NUT, HEX (attaching part)	2

REV. - ITEM NOT ILLUSTRATED

1. This area refers to the corresponding illustration.

   1) **Chapter** should be divided with General, Operation, Maintenance, Schematics, Parts, Vendor and Service Bulletins.

   2) **Section and Figure** belong to Parts Chapter only. Please check page of contents and each Section in Parts Chapter.

   3) Page numbers are followed for chapter or section, and figure.

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 such as -1, -7, etc.)

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

4. The **Indenture System** used in the detail parts list of this catalog shows the relationship of one part to another. For a given item, the number of indentures depicts the relationship of the item to the associated installation, next higher assembly, or components of the item as follows:

   1 2 3 4 5 6 7

   Installation
   . Detail parts for installation
   . Assembly
   . Attaching parts for Assembly
   . . Detail parts for Assembly
   . . Sub-Assembly
   . . Attaching parts for Sub-Assembly
   . . . Detail parts for Sub-Assembly
   . . . Sub-Sub-Assembly
   . . . Attaching parts for Sub-Sub-Assembly
   . . . . Detail parts for Sub-Sub-Assembly
   . . . . Sub-Sub-Sub-Assembly

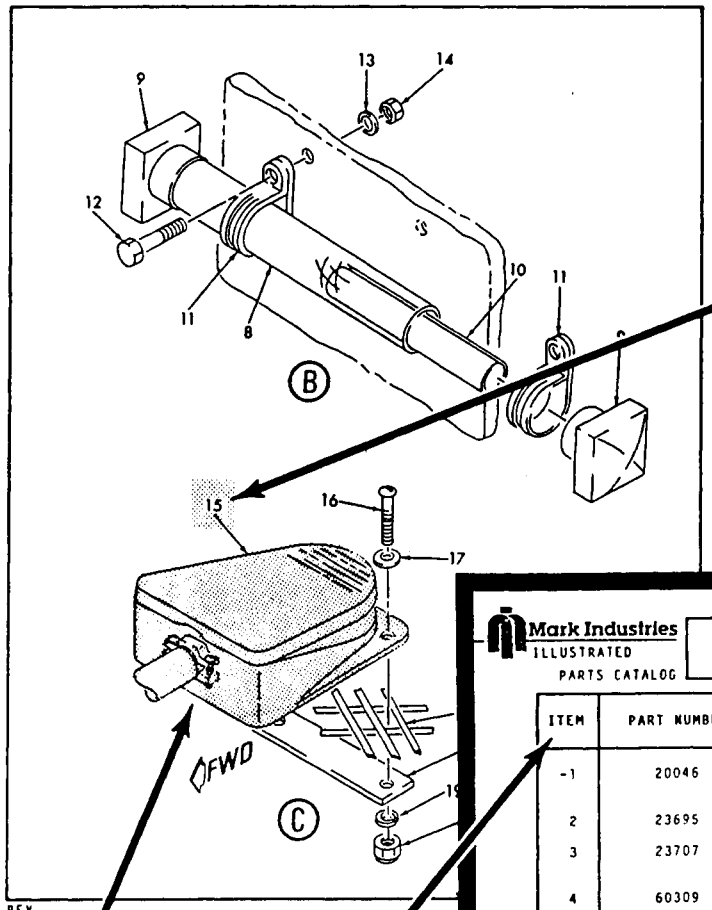
5. **NHA** (Next Higher Assembly) and **DETAILS** - Section and Figure reference catalog location indicates where the installation or assembly is listed under NHA and where illustrated for more detailed breakdown.

6. **UNIT PER ASSEMBLY** - Entries are as follows:

   1) **"REF"** indicates the item is listed previously in the NHA and then again in this figure.

   2) **"AR"** indicates the part is used in a quantity "As Required."

   3) **A number** entry indicates the quantity of the part used in its next higher application.



REV.

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	20046	ASSEMBLY, FINAL (See Sect. 2, Fig. 1 for NHA)	REF
2	23695	.WELDMENT, PLATFORM 5'	1
3	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	1
4	60309	.SCREW, CAP (attaching part)	AR
5	61239	.NUT, LOCK (attaching part)	AR
6	65910	.BOLT, SNAP OPEN EYE	4
7	255	.TIE, CABLE	9
8	130927	.CONTAINER, PLASTIC	1
9	65842	.CAP, ANTI-ROLL	2
10	16629	.HANDBOOK, OPERATION SAFETY	1
11	65867	.CLAMP, UMPCO	2
12	60314	.SCREW, CAP (attaching part)	2
13	63401	.WASHER, FLAT (attaching part)	2
14	61239	.NUT, LOCK (attaching part)	2
15	92202	.SWITCH, FOOT	1
16	60314	.SCREW, CAP (attaching part)	2
17	63401	.WASHER, FLAT (attaching part)	2
18	23753	.BACKING PLATE DEADMAN SWITCH	1
19	63301	.WASHER, LOCK (attaching part)	2
20	63701	.NUT, HEX (attaching part)	2

REV.

- ITEM NOT ILLUSTRATED

1. PART NUMBER

STEP 1. Locate Section and Figure number within the table of contents and each Section page.

STEP 2. Match your required part with the illustration page.

STEP 3. Refer to the item number on the detail part list page.

STEP 4. Part number is located in the part number column. Order by using that part number.

2. TO ORDER:

By Phone: Service Department

(800) 448-MARK

or

(714) 879-MARK

By Fax: (714) 879-8884

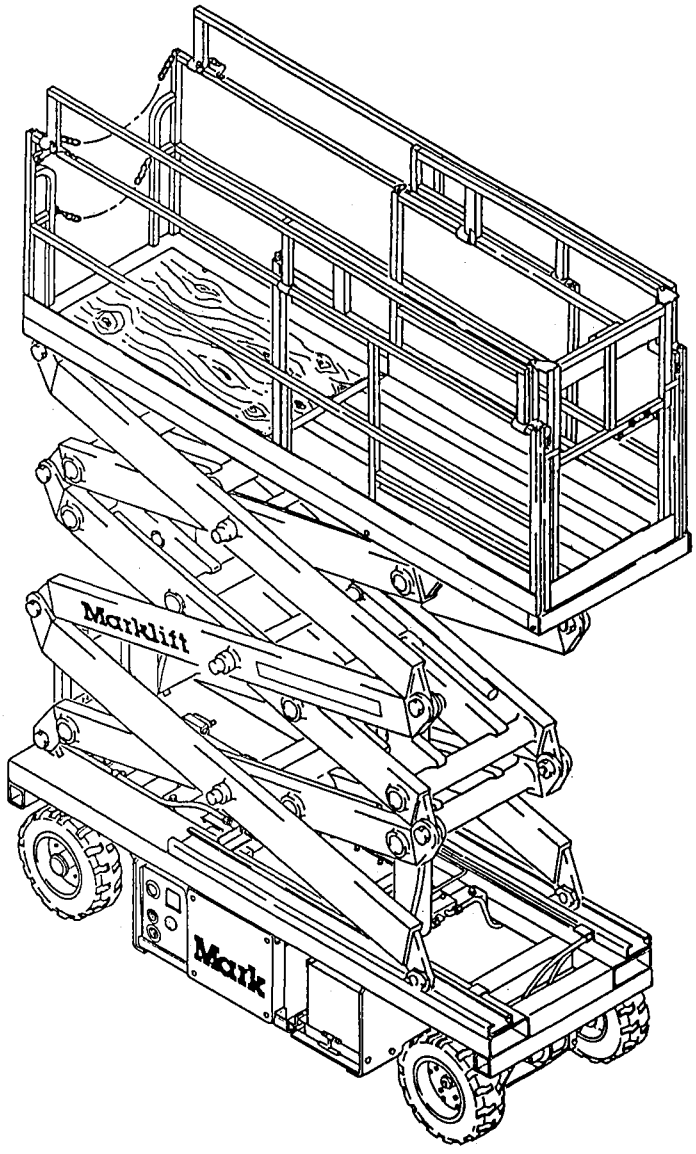
By Mail: Attention Service Department

MARK INDUSTRIES
Post Office Box 2255
Brea, California 92622

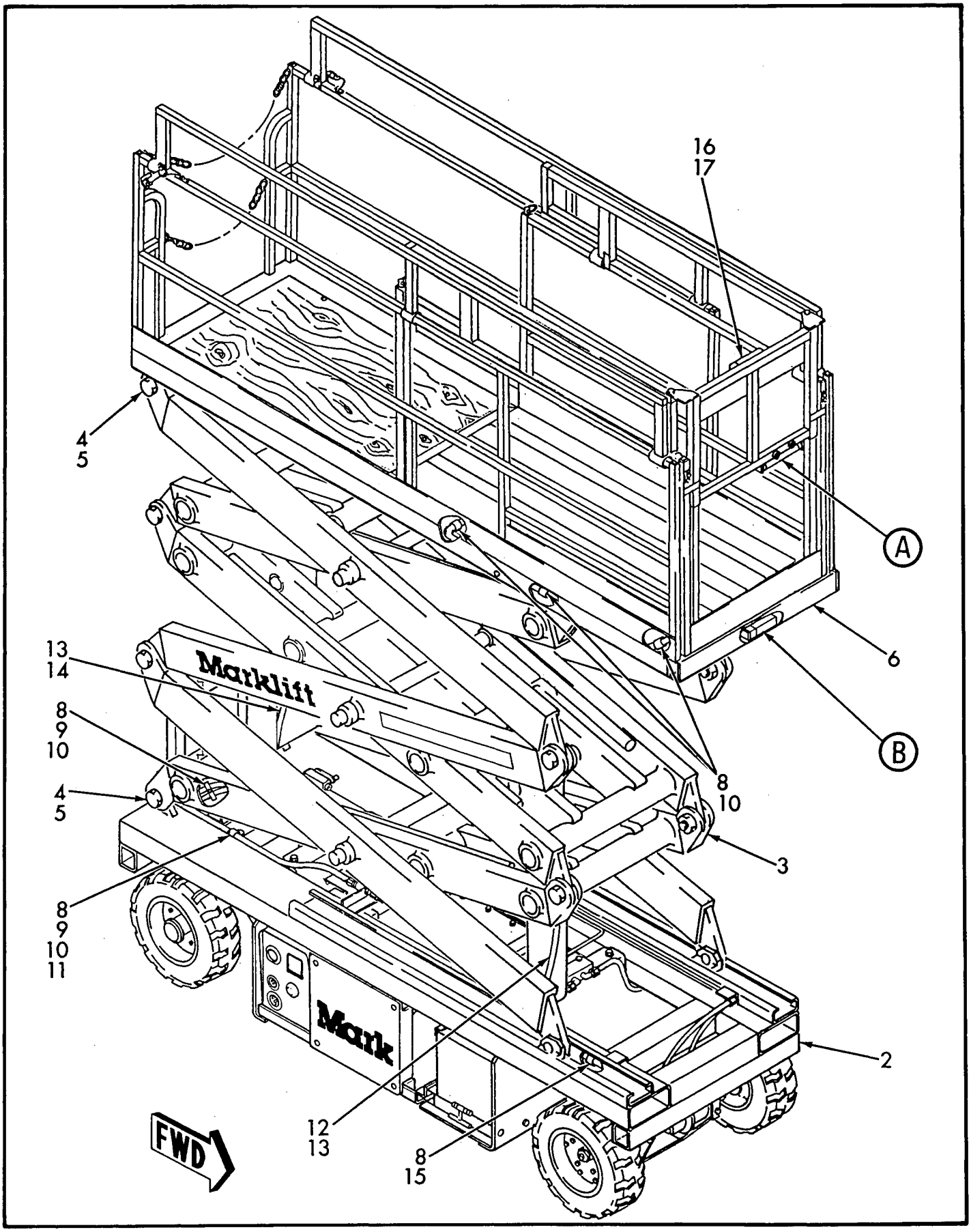
MARK INDUSTRIES
P.O. Box 2255
Brea, California 92622
205 South Puente Street, Brea, California 92621
(714)879-6275, FAX (714)879-8885

THIS SECTION 2 CONTAINS THE FOLLOWING FIGURES:

FIG. NO.	TITLE
1	FINAL ASSEMBLY
2	DECAL SET
3	HYDRAULIC HOSE DIAGRAM
4	HYDRAULIC TUBE DIAGRAM
5	UPPER CONTROL BOX ASSEMBLY



FINAL ASSEMBLY (M20ESEP)



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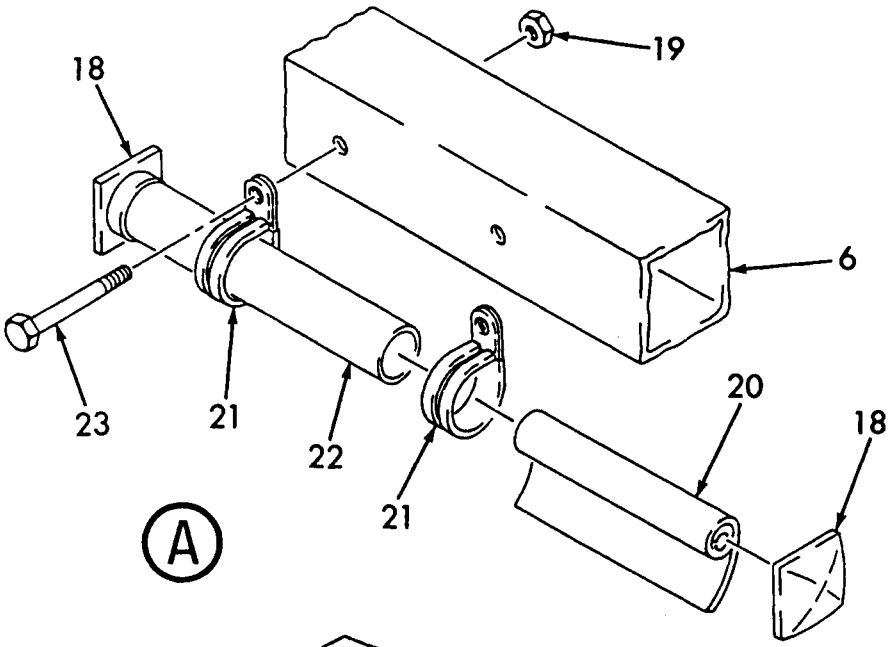
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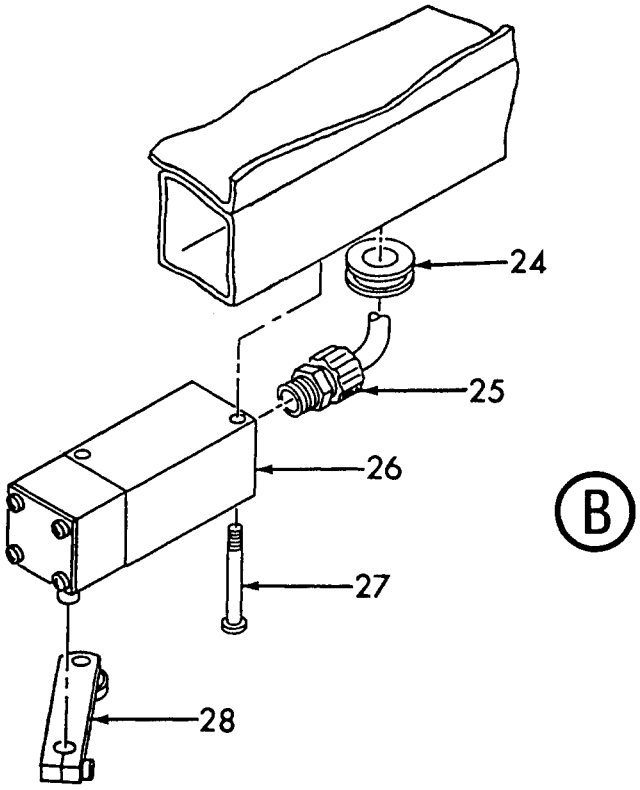
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B

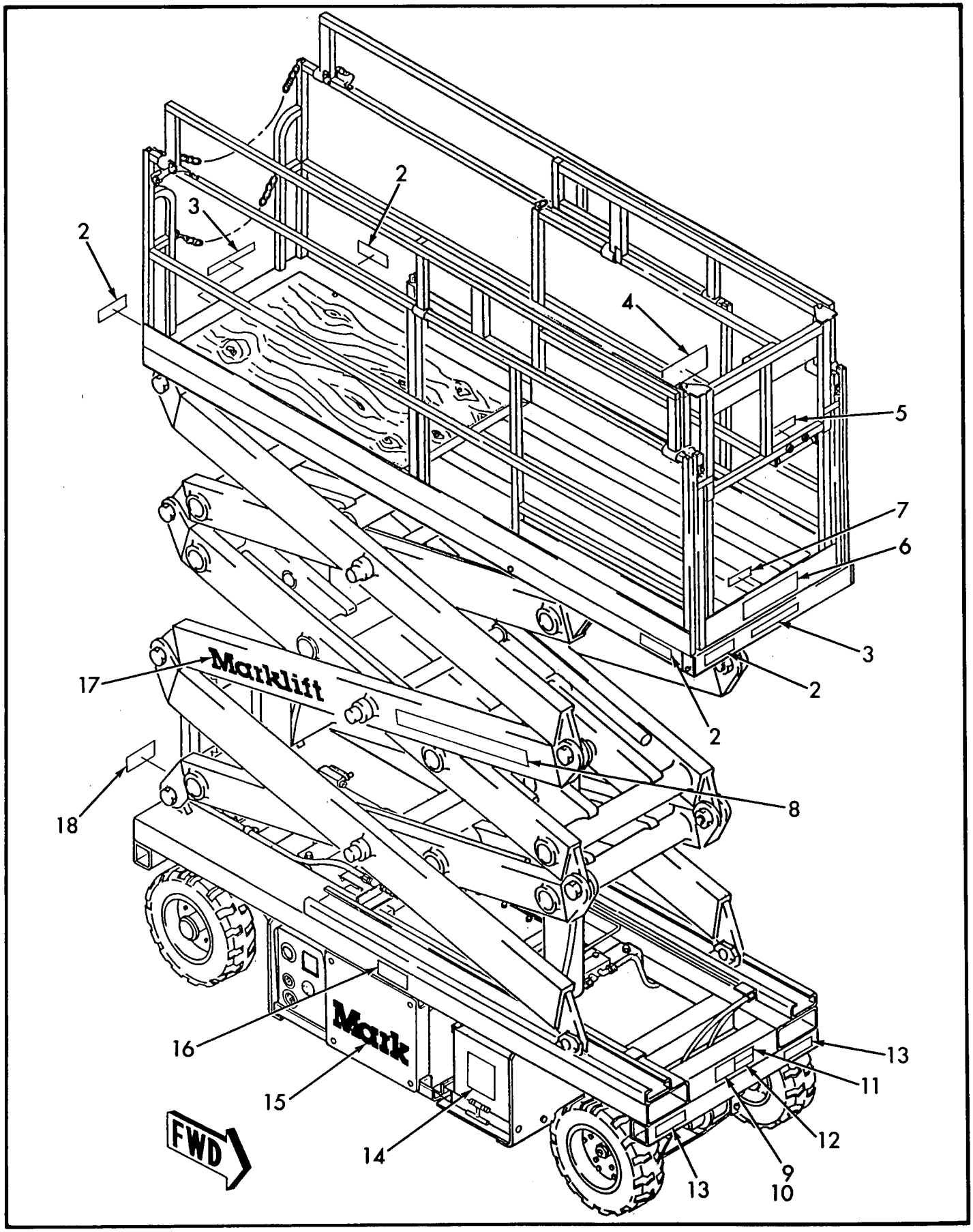
FINAL ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130033	ASSEMBLY, FINAL	REF
2	131302	.ASSEMBLY, FRAME (See Sect. 3, Fig. 1 for Details)	1
3	130615	.ASSEMBLY, SCISSOR (See Sect. 4, Fig. 1 for Details)	1
4	130696	.BOLT, EAR PIVOT (attaching part)	4
5	61249	.NUT, HEX LOCK (attaching part)	4
6	131172	.ASSEMBLY, SLIDE OUT PLATFORM (See Sect. 5, Fig. 1 for Details)	1
-7	67639	.KIT, DECAL (See Sect. 2, Fig. 2 for Details)	1
-8	63654	.RIVET, POP	11
9	16268	.CLAMP, CABLE (RIGHT SIDE)	4
10	65655	.CLAMP, CUSHIONED (LEFT SIDE)	8
11	765	.CLAMP, RUBBER (LEFT SIDE)	1
12	2568-15	.HOSE, HYDRAULIC	1
13	2562	.ELBOW, 37° SWIVEL	4
14	2568-25	.HOSE, HYDRAULIC	1
15	65787	.CLAMP, CUSHIONED	2
16	131581	.ASSEMBLY, UPPER CONTROL BOX (See Sect. 2, Fig. 5 for Details)	1
17	60342	.SCREW, HEX HEAD CAP (attaching part)	4
18	65842	.CAP, ANTI-ROLL	2
19	60711	.NUT, LOCK (attaching part)	2
20	130422	.HANDBOOK, OPERATORS	1
21	65867	.CLAMP	2
22	130927	.CONTAINER, PLASTIC	1
23	60315	.SCREW, HEX HEAD CAP (attaching part)	2

- ITEM NOT ILLUSTRATED

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	70016	.GROMMET	1
25	2806	.STRAIN RELIEF	1
26	70173	.SWITCH, LIMIT	1
27	62620	.SCREW, MACHINE (attaching part)	2
28	70235	.LEVER, LIMIT SWITCH	1
-29	256	.TIE, CABLE	AR
-30	255	.TIE, CABLE	AR
-31	65116	.OIL, HYDRAULIC (13 GAL)	AR
-32	130769	.DIAGRAM, HYDRAULIC HOSE (See Sect. 2, Fig. 3 for Details)	1
-33	130770	.DIAGRAM, HYDRAULIC TUBE	1
-34	130773	.SCHEMATIC, HYDRAULIC	1
-35	131584	.SCHEMATIC, ELECTRICAL (See Schematic Section)	1
-36	65389	.PAINT, BLUE WATER BASE	AR
-37	16608	.PAINT, WHITE WATER BASE	AR
-38	65368	.KRYLON, NO. 1910 TRUE BLUE	1
-39	2673	.PAINT, WHITE KIT KOTE NO. 1221	1
-40	130337-55	.CABLE, CONDUCTOR	1

DECAL SET (M20ESEP)



DECAL SET (M20ESEP)

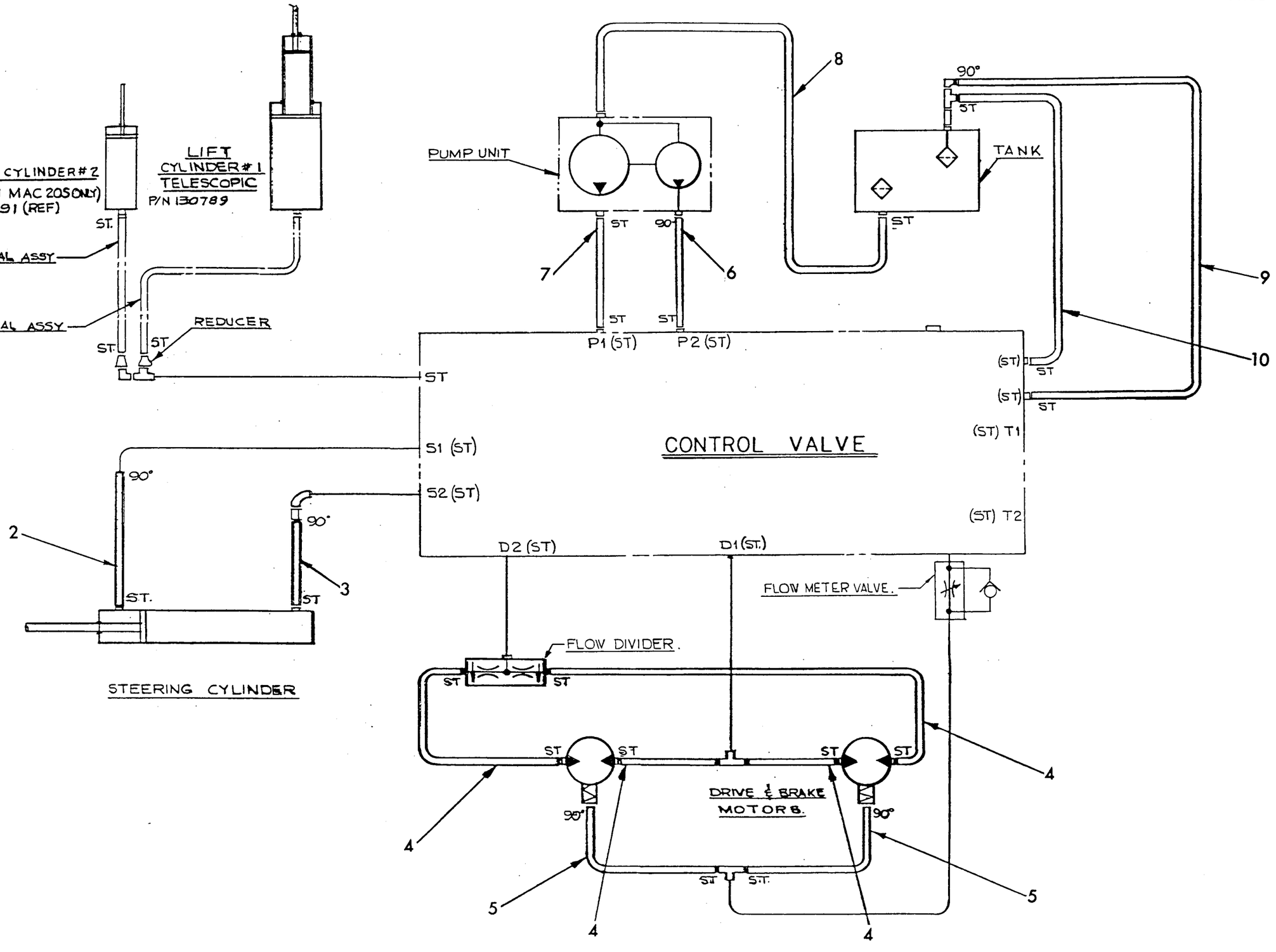
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	67639	SET, DECAL (See Sect. 2, Fig. 1 for NHA)	REF
2	2023	.DECAL, LOAD CAPACITY 750 LBS.	4
3	31109	.DECAL, CAUTION DO NOT REMOVE SCISSOR GUARD RAILS	2
4	130801	.DECAL, OPERATION INSTRUCTIONS	1
5	130820	.DECAL, OPERATION AND SAFETY HANDBOOK	1
6	32368	.DECAL, M-SERIES	1
7	11064	.DECAL, SAFETY CHAIN	1
8	130596	.DECAL-A PRODUCT OF MARK INDUSTRIES	2
9	20660	.PLATE, IDENTIFICATION	1
10	375	.RIVET, POP	12
11	30520	.PLATE, PATENT NUMBER	1
12	20661	.PLATE, ANSI A-92	1
13	2002	.DECAL, FORKLIFT BOOT	2
14	2003	.DECAL, BATTERY WATER LEVEL	2
15	130938	.DECAL, MARK	2
16	2016	.DECAL, DO NOT WORK UNDER	2
17	31259	.DECAL, MARKLIFT	2
18	2041	.DECAL, DO NOT LIFT	1
-19	2017	.DECAL, HYDRAULIC SYSTEM (LOCATED ON TOP OF HYDRAULIC TANK IN BELLY PAN)	1
-20	130606	.DECAL, FREE WHEELING (LOCATED NEAR VALVE PACKAGE IN BELLY PAN)	1
-21	31280	.DECAL, AERIAL CONTROL PANEL (See Sect. 2, Fig. 5 for Details)	1
-22	185707	.DECAL, POWER TO PLATFORM (See Sect. 3, Fig. 11 for Details)	1

- ITEM NOT ILLUSTRATED

DECAL SET (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-23	130505	.DECAL, GROUND CONTROL BOX (See Sect. 3, Fig. 11 for Details)	1
-24	2014	.DECAL, CAUTION HIGH VOLTAGE LINES (Located Above Operation Instruction Decal in Platform)	1

- ITEM NOT ILLUSTRATED


LIFT CYLINDER#2
(USED ON MAC 20SONLY)
P/N 130791 (REF)
LIFT CYLINDER#1 TELESCOPIC
P/N 130789
ST.
SEE FINAL ASSY
SEE FINAL ASSY
REDUCER
ST
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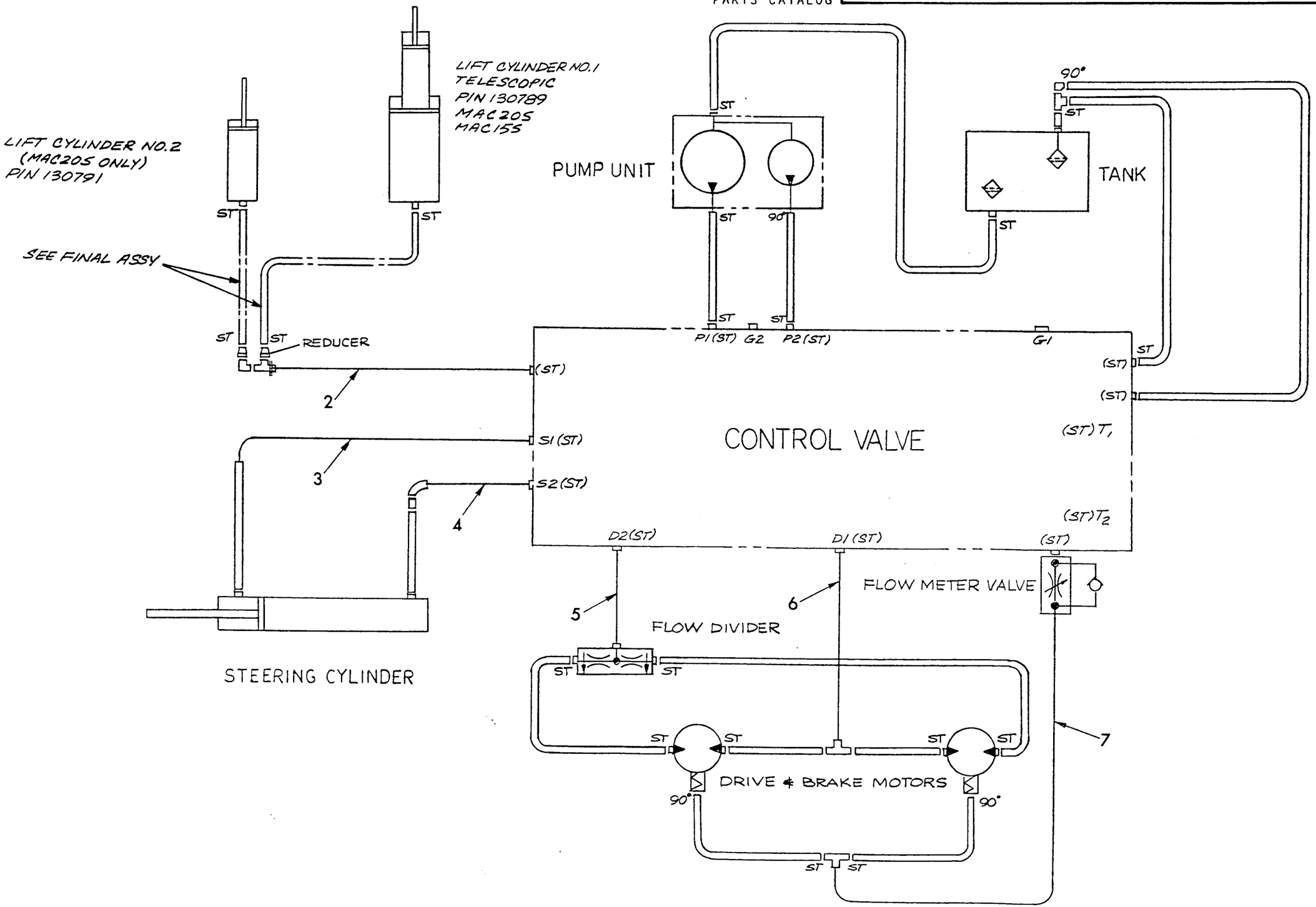
ST
ST
S1 (ST)
S2 (ST)
90°
90°
2
3
STEERING CYLINDER
PUMP UNIT
8
90°
ST
TANK
ST
ST
90°
7
6
ST
ST
P1 (ST)
P2 (ST)
9
10
(ST)
ST
(ST)
ST
(ST) T1
CONTROL VALVE
(ST) T2
D2 (ST)
D1 (ST.)
FLOW METER VALVE.
FLOW DIVIDER.
ST
ST
ST
ST
ST
ST
DRIVE & BRAKE MOTORS.
90°
90°
4
4
5
5
4
4
ST
ST
ST
ST

HYDRAULIC HOSE DIAGRAM (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130769	DIAGRAM, HYDRAULIC HOSE (See Sect. 2, Fig. 1 for NHA)	REF
2	13213-04-0130	.ASSEMBLY, HOSE	1
3	13213-04-0180	.ASSEMBLY, HOSE	1
4	13210-08-0264	.ASSEMBLY, HOSE	4
5	13213-04-0310	.ASSEMBLY, HOSE	2
6	13213-08-0210	.ASSEMBLY, HOSE	1
7	13210-08-0204	.ASSEMBLY, HOSE	1
8	13205-12-0260	.ASSEMBLY, HOSE	1
9	13203-08-0130	.ASSEMBLY, HOSE	1
10	13205-08-0110	.ASSEMBLY, HOSE	1

- ITEM NOT ILLUSTRATED

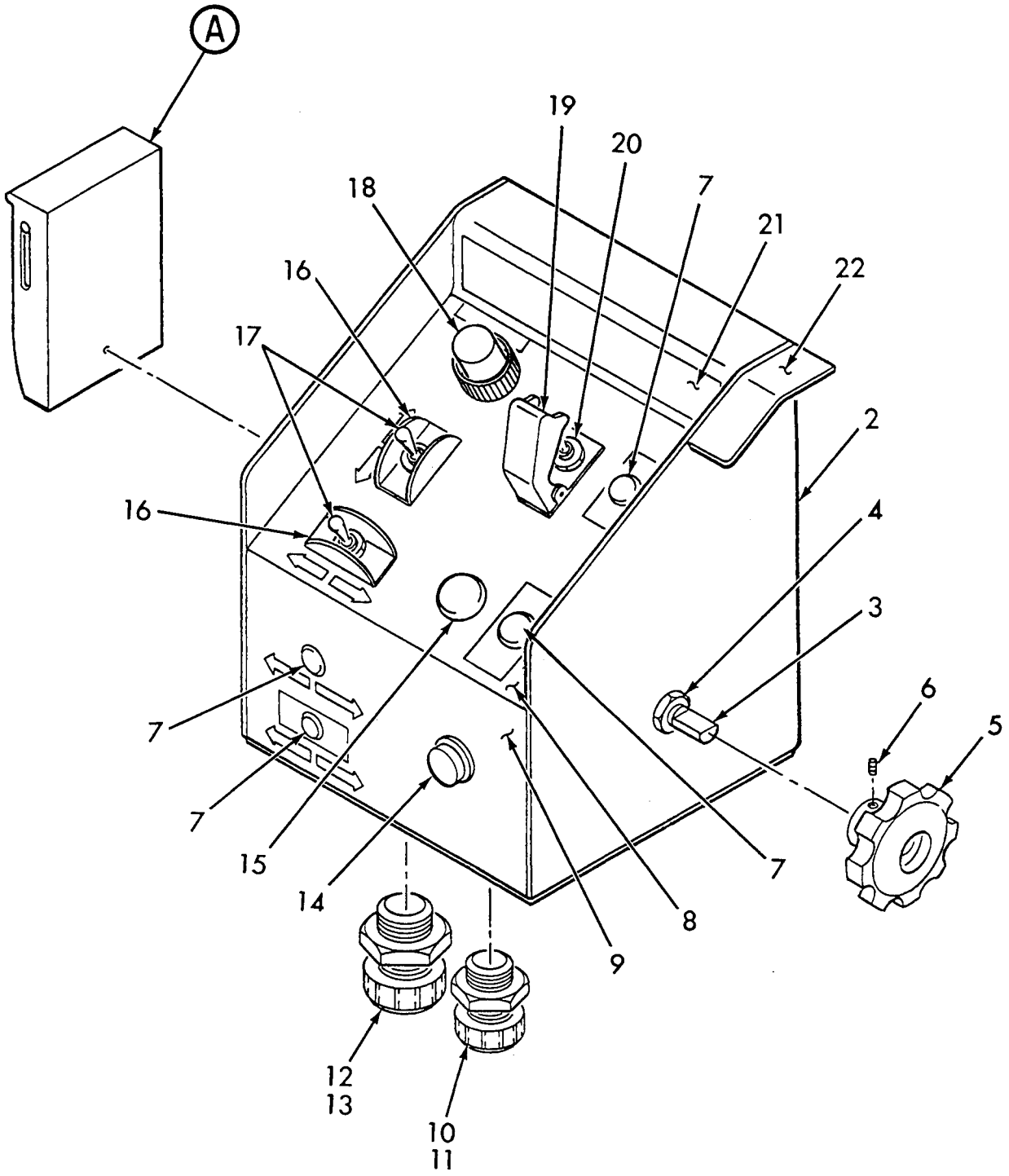

LIFT CYLINDER NO.1
TELESCOPIC
P/N 130789
MAC20S
MAC15S
LIFT CYLINDER NO.2
(MAC20S ONLY)
P/N 130791
SEE FINAL ASSY
ST
REDUCER
2
3
4
S1 (ST)
S2 (ST)
STEERING CYLINDER
PUMP UNIT
90°
P1 (ST)
G2
P2 (ST)
G1
TANK
CONTROL VALVE
(ST) T1
(ST) T2
D2 (ST)
D1 (ST)
(ST)
5
6
7
FLOW DIVIDER
FLOW METER VALVE
DRIVE & BRAKE MOTORS

HYDRAULIC TUBE DIAGRAM (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130770	DIAGRAM, HYDRAULIC TUBE (See Sect. 2, Fig. 1 for NHA)	REF
2	130770-1	.ASSEMBLY, TUBE	1
3	130770-2	.ASSEMBLY, TUBE	1
4	130770-3	.ASSEMBLY, TUBE	1
5	130770-4	.ASSEMBLY, TUBE	1
6	130770-5	.ASSEMBLY, TUBE	1
7	130770-6	.ASSEMBLY, TUBE	1

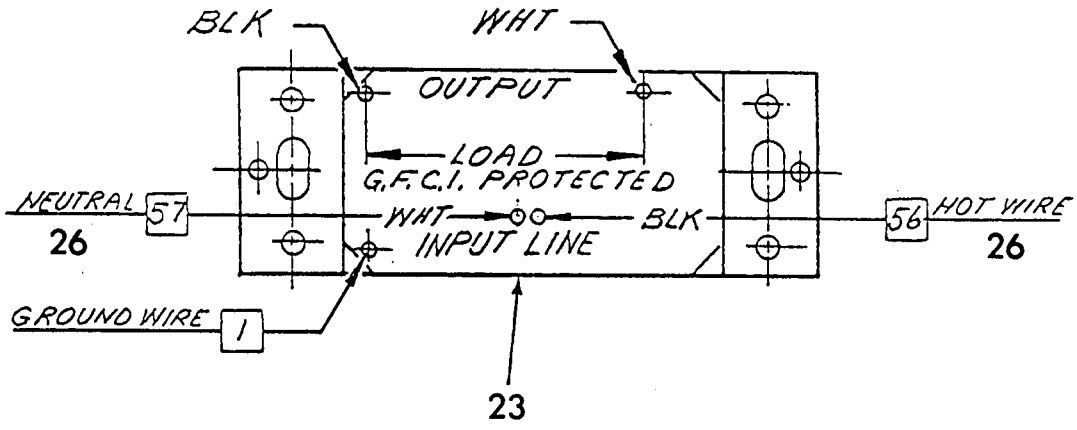
- ITEM NOT ILLUSTRATED

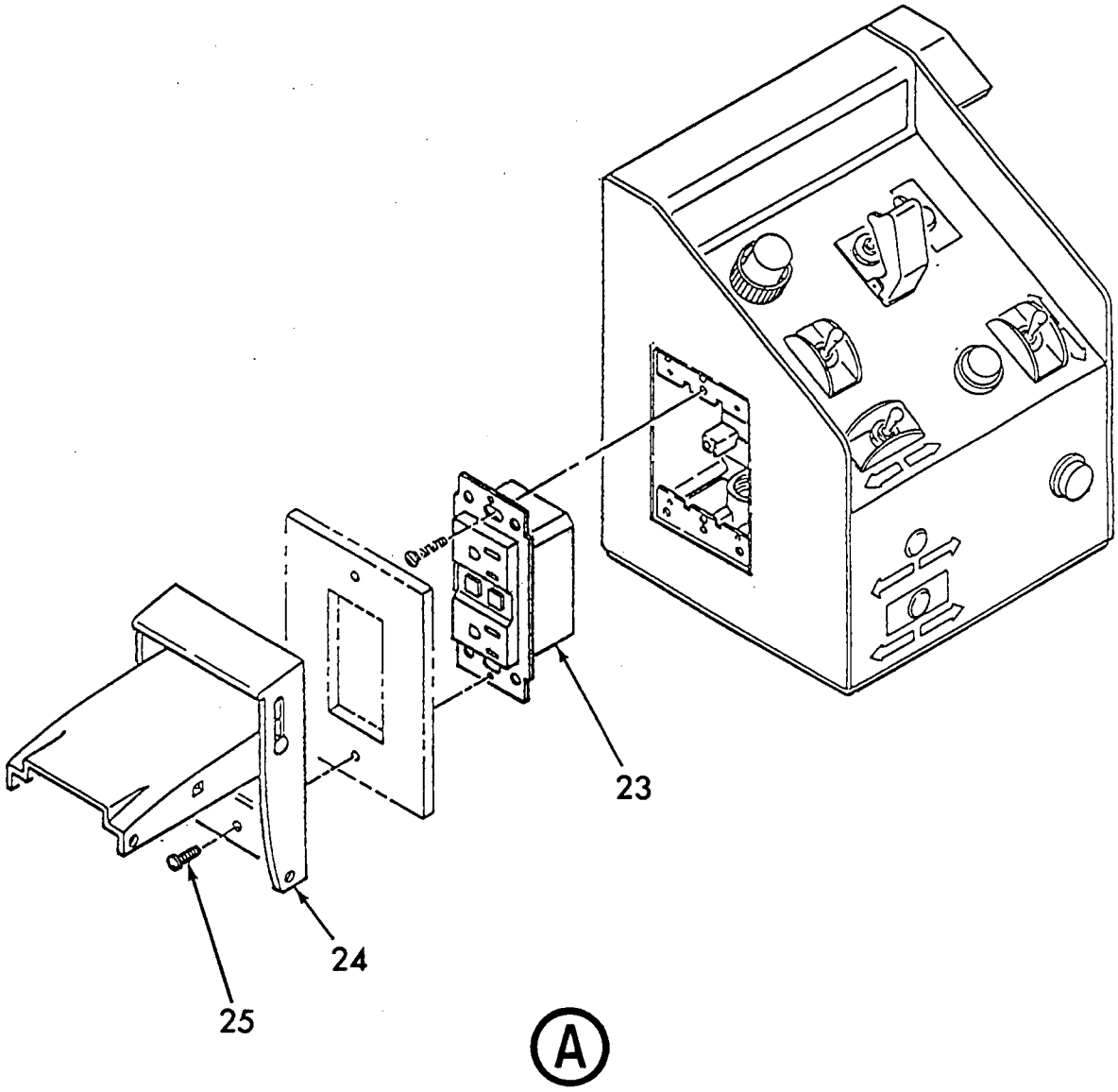
UPPER CONTROL BOX ASSEMBLY (M20ESEP)



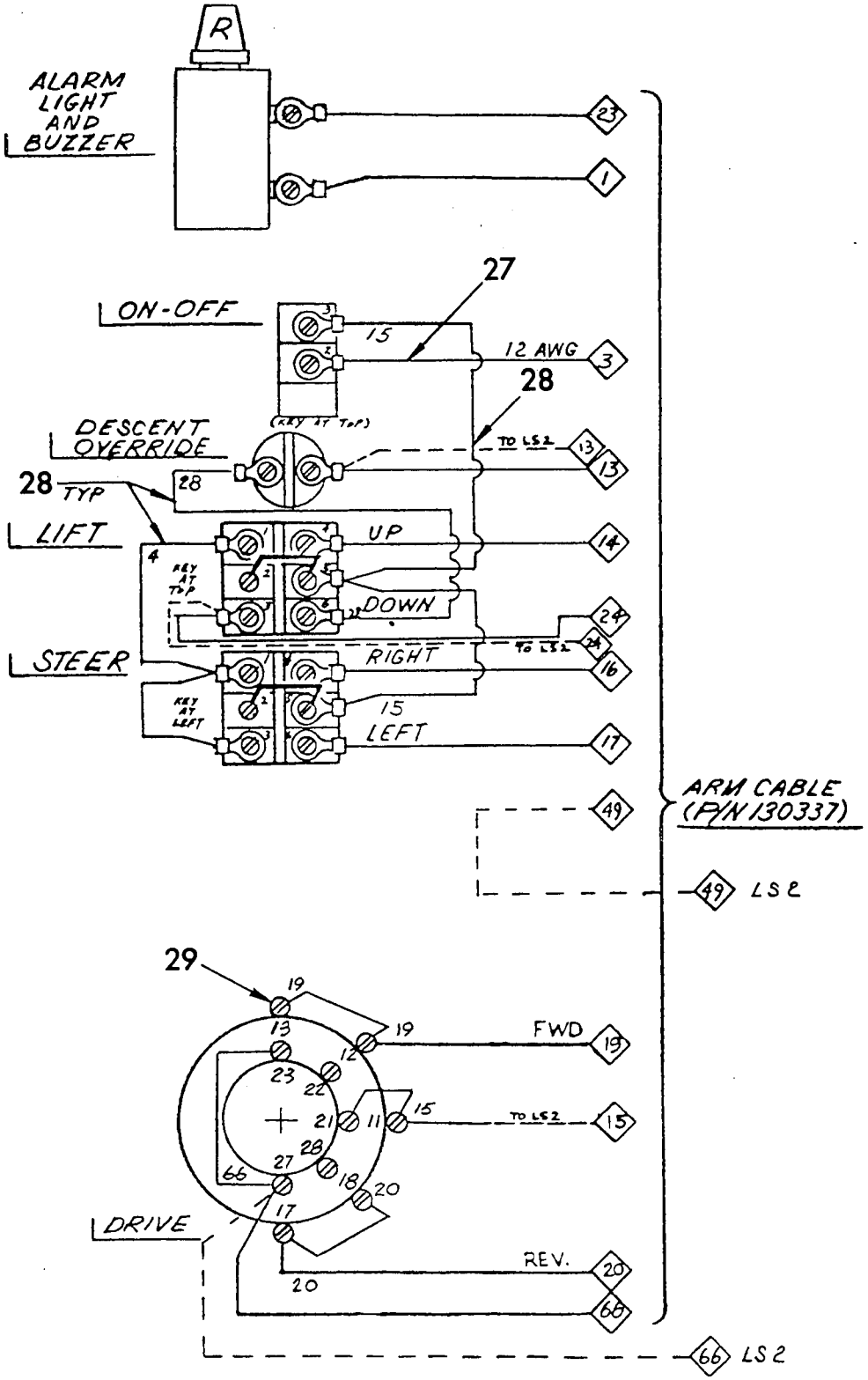
REV.

UPPER CONTROL BOX ASSEMBLY (M20ESEP)





REV.



ELECTRICAL DIAGRAM
(REFER TO ELECTRICAL SCHEMATIC DWG NO 131584)

UPPER CONTROL BOX ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131581	ASSEMBLY, UPPER CONTROL BOX (See Sect. 2, Fig. 1 for NHA)	REF
2	130781	.WELDMENT, UPPER CONTROL BOX	1
3	4106	.SWITCH, 5 POSITION DRIVE	1
4	65131	.NUT, RUBBER COATED	1
5	65753	.KNOB, FLUTED TORQUE	1
6	62209	.SCREW, SET	1
7	771	.PLUG, WHITE	4
8	182718	.DECAL, STEER	1
9	130796	.DECAL	1
10	2806	.RELIEF, STRAIN	1
11	2808	.NUT, LOCK	1
12	2807	.RELIEF, STRAIN	1
13	2809	.NUT, LOCK	1
14	4020	.BUTTON, PUSH	1
15	65241	.PLUG, WHITE	1
16	20884	.GUARD, SWITCH	2
17	20481	.SWITCH, TOGGLE	2
18	66345	.BUZZER, ALARM	1
19	70303	.GUARD, SWITCH	1
20	4017	.SWITCH, TOGGLE	1
21	2014	.DECAL, CAUTION	1
22	130782	.DECAL, DRIVE	1
23	70391	.RECEPTACLE	1
24	70392	.COVER, RECEPTACLE	1
25	63002	.SCREW, MACHINE	2

- ITEM NOT ILLUSTRATED

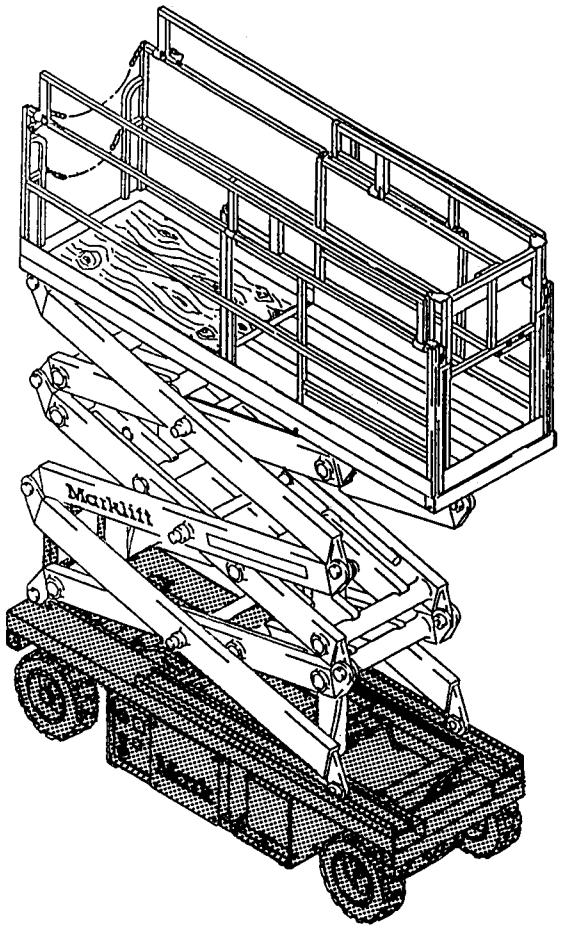
UPPER CONTROL BOX ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	70394	.CONNECTOR	4
27	2991	.WIRE, WHITE	1 FT.
28	70232	.WIRE, WHITE	4 FT.
29	16228	.RING, TERMINAL	4

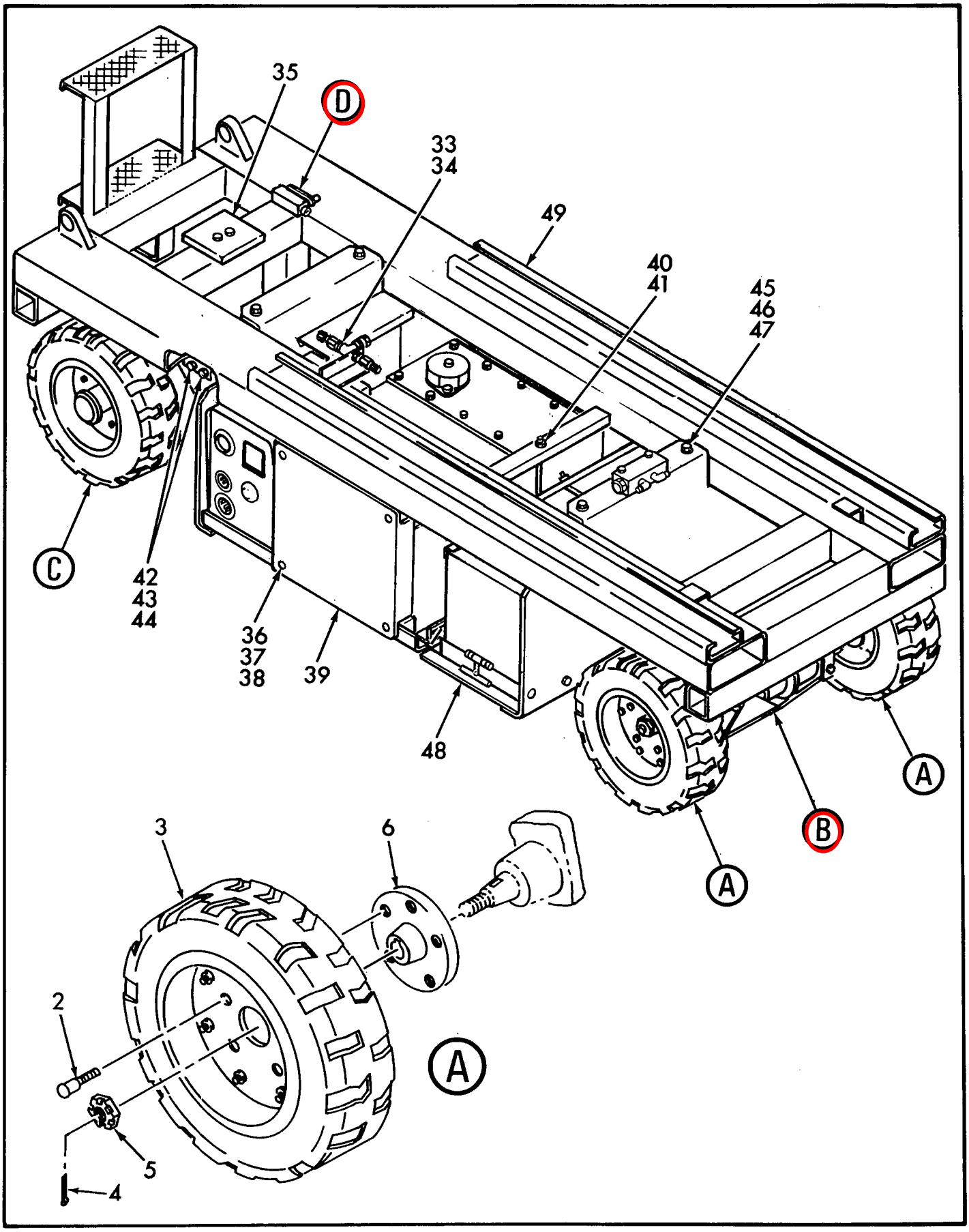
- ITEM NOT ILLUSTRATED

THIS SECTION 3 CONTAINS THE FOLLOWING FIGURES:

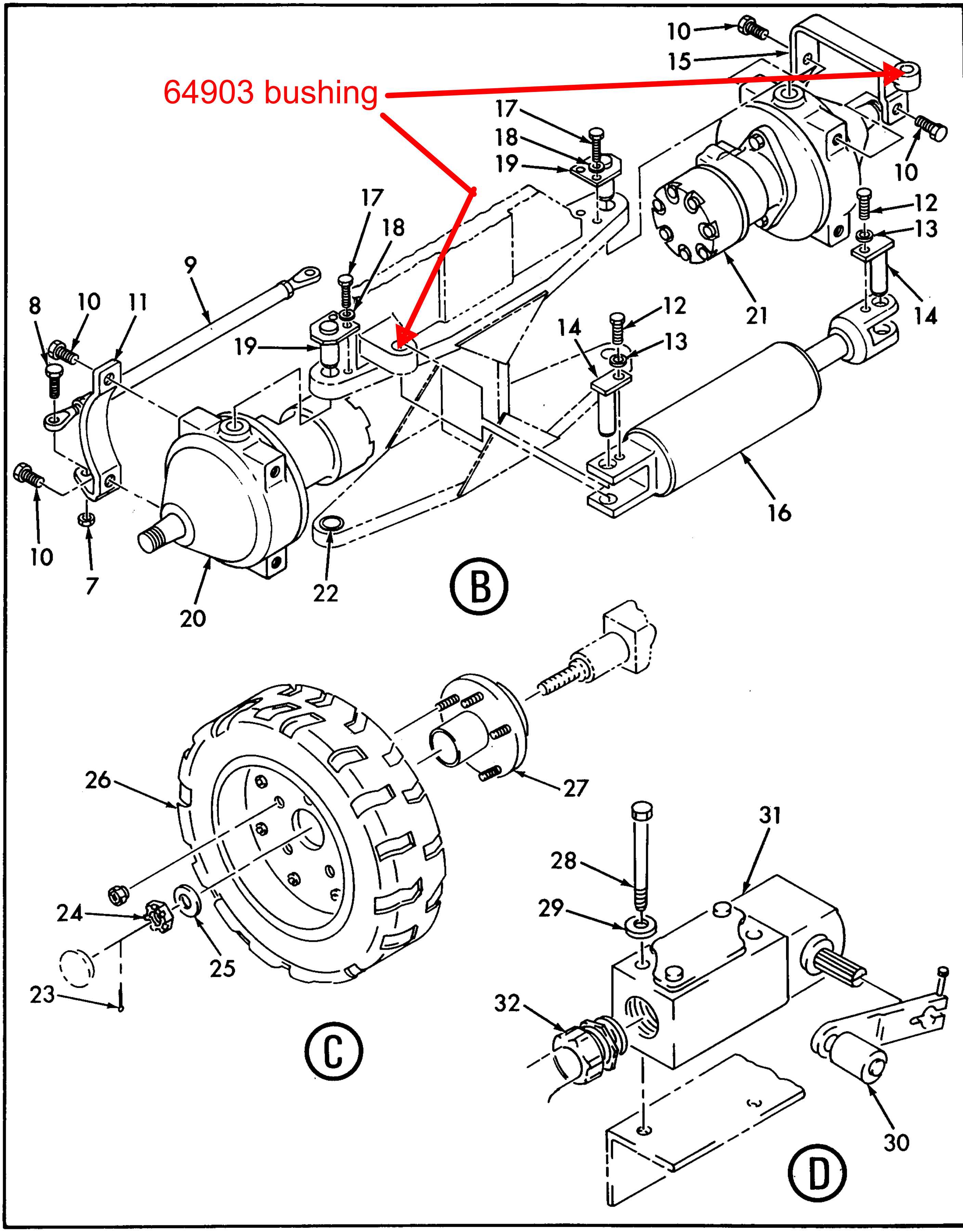
FIG. NO.	TITLE
1	FRAME ASSEMBLY
2	TIRE & WHEEL ASSEMBLY
3	TIE ROD ASSEMBLY
4	STEERING CYLINDER ASSEMBLY
5	DRIVE MOTOR BRAKE ASSEMBLY
6	HUB ASSEMBLY
7	TILT SWITCH ASSEMBLY
8	BELLY PAN ASSEMBLY
9	HYDRAULIC TANK ASSEMBLY
10	VALVE PACKAGE ASSEMBLY
11	GROUND CONTROL BOX ASSEMBLY
12	PUMP & MOTOR ASSEMBLY
13	FLOW DIVIDER ASSEMBLY



FRAME ASSEMBLY (M20ESEP)



REV.


64903 bushing
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D

FRAME ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131302	ASSEMBLY, FRAME (See Sect. 2, Fig. 1 for NHA)	REF
2	34044	.BOLT, CONE	10
3	130945	.ASSEMBLY, TIRE & WHEEL (See Sect. 3, Fig. 2 for Details)	2
4	64306	.PIN, COTTER	2
5	65174	.NUT, HEX, SLOTTED (attaching part)	2
6	31158	.MACHINING, DRIVE HUB	2
7	61242	.NUT, HEX, LOCKING (attaching part)	2
8	60393	.SCREW, HEX HEAD (attaching part)	2
9	130302	.ASSEMBLY, TIE ROD (See Sect. 3, Fig. 3 for Details)	1
10	60622	.SCREW, HEX HEAD	5
11	130394	.LEVER, STEERING R.H.	1
12	60353	.SCREW, HEX HEAD (attaching part)	2
13	63301	.WASHER, LOCK	2
14	20252	.PIN, STEERING CYLINDER ANCHOR	2
15	130393	.LEVER, STEERING L.H.	1
16	130237	.ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 4 for Details)	1
17	60338	.SCREW, HEX HEAD	8
18	63302	.WASHER, LOCK	8
19	131153	.PIN, STEERING	4
20	130442	.ASSEMBLY, DRIVE MOTOR BRAKE (R.H.) (See Sect. 3, Fig. 5 for Details)	1
21	130490	.ASSEMBLY, DRIVE MOTOR BRAKE (L.H.) (See Sect. 3, Fig. 5 for Details)	1
22	65658	.BEARING, THRUST	AR

- ITEM NOT ILLUSTRATED

FRAME ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	64306	.PIN, COTTER	2
24	60811	.NUT, HEX, SLOTTED	2
25	63409	.WASHER, FLAT	2
26	130945	.ASSEMBLY, TIRE & WHEEL (See Sect. 3, Fig. 2 for Details)	2
27	134	.ASSEMBLY, HUB (See Sect. 3, Fig. 6 for Details)	2
28	62615	.SCREW ROUND HEAD	2
29	63313	.WASHER, LOCK	2
30	70032	.LEVER, OPERATING	1
31	70173	.SWITCH, LIMIT	1
32	70288	.STRAIN, RELIEF	1
33	80032-05	.TEE, BULKHEAD	1
34	80056-01	.REDUCER, TUBE END	2
35	131077	.ASSEMBLY, TILT SWITCH (See Sect. 3, Fig. 7 for Details)	1
36	60342	_SCREW, HEX HEAD	8
37	63401	.WASHER, FLAT	8
38	63301	.WASHER, LOCK	8
39	130727	.COVER	2
40	61245	.NUT, SELFLOCKING	3
41	63669	.ROD, THREADED	1
42	60343	.SCREW, HEX HEAD	4
43	63319	.WASHER, LOCK	4
44	60703	.NUT, HEX	4
45	60311	.SCREW, HEX HEAD	4

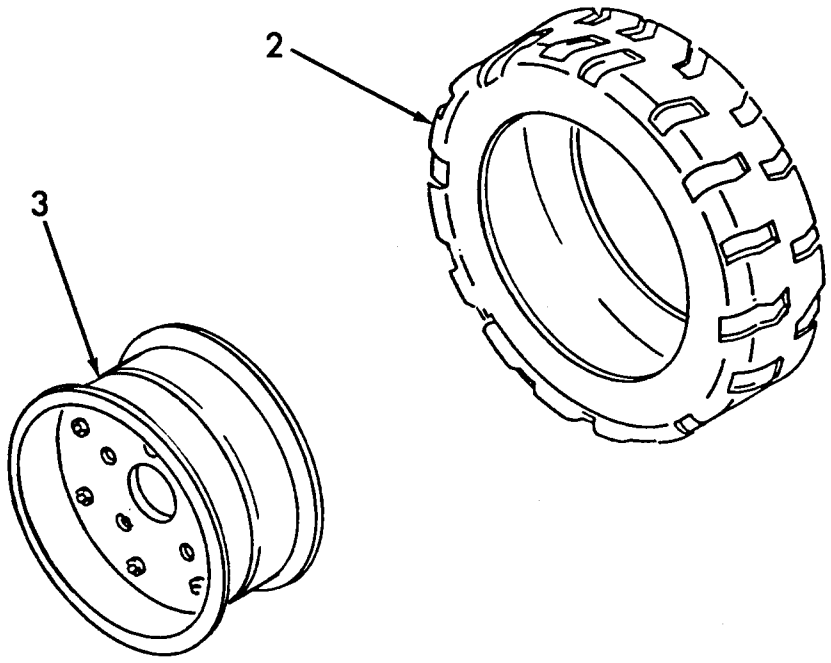
- ITEM NOT ILLUSTRATED

FRAME ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
46	63415	.WASHER, FLAT	8
47	61305	.NUT, LOCK	4
48	131301	.ASSEMBLY, BELLY PAN (See Sect. 3, Fig. 8 for Details)	1
49	130738	WELDMENT, FRAME	1

- ITEM NOT ILLUSTRATED

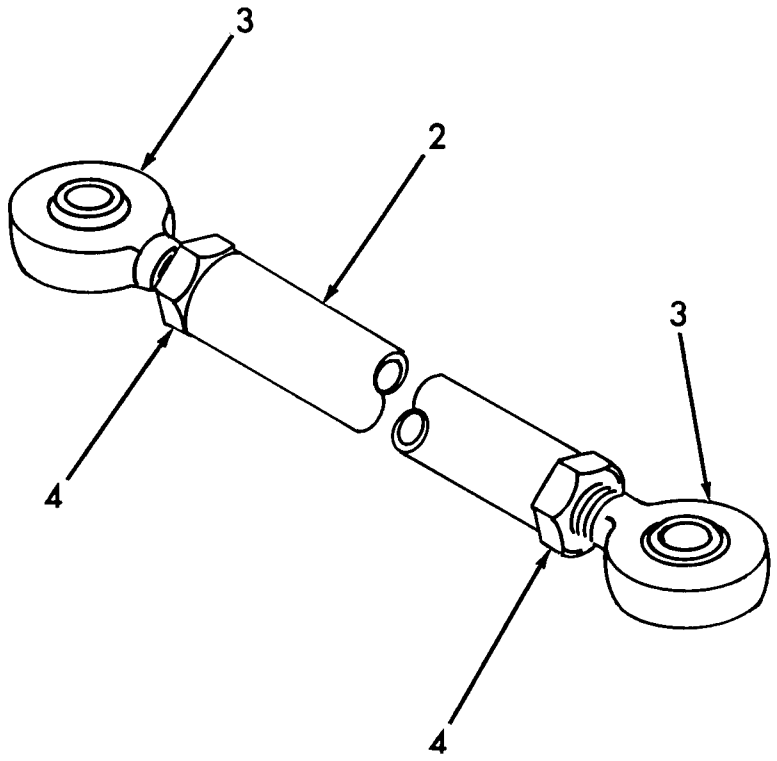
TIRE & WHEEL ASSEMBLY (M20ESEP)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130945	ASSEMBLY, TIRE & WHEEL (See Sect. 3, Fig. 1 for NHA)	REF
2	130946	.TIRE	1
3	30927	.WHEEL	1

REV.

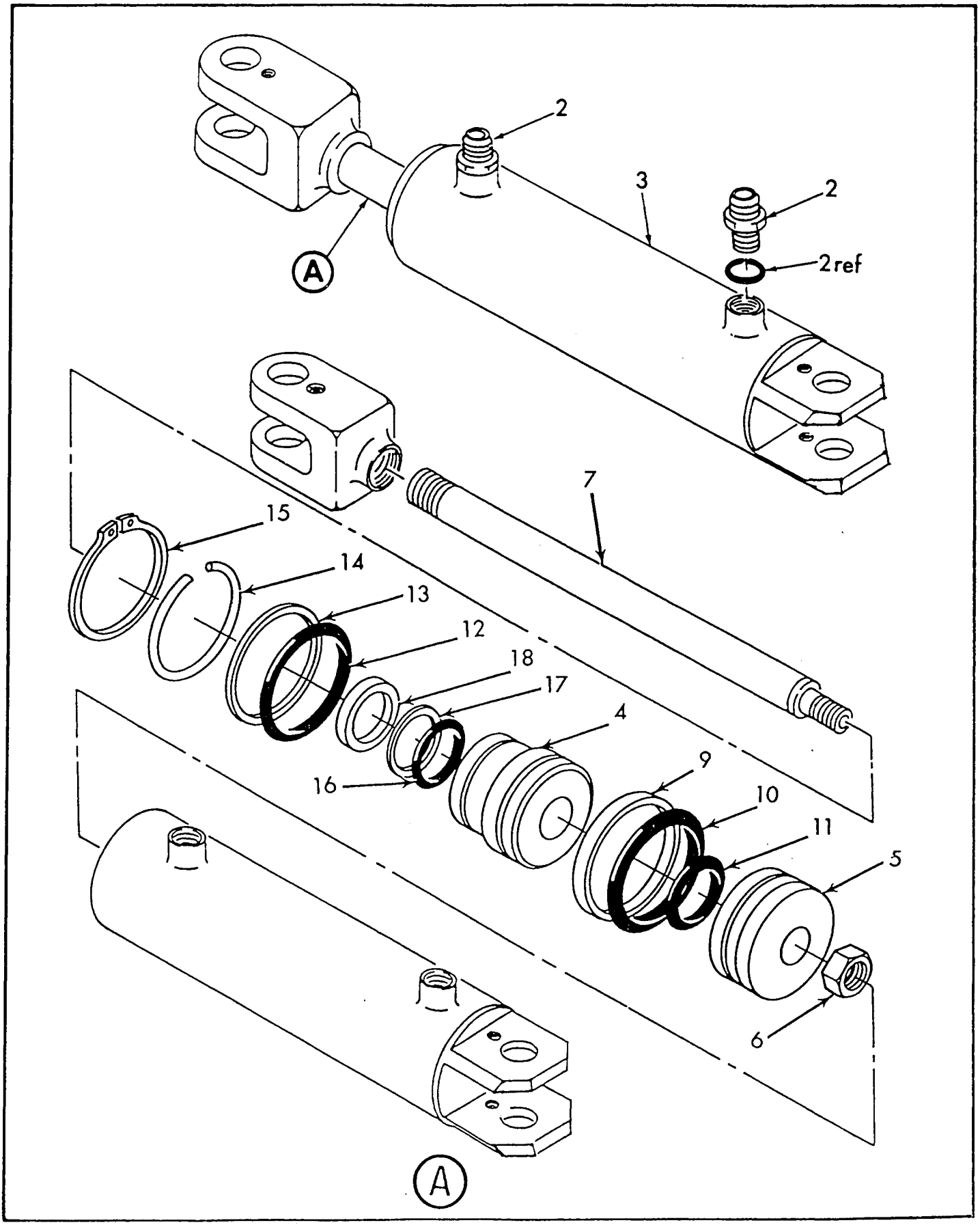
TIE ROD ASSEMBLY (M20ESEP)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130302	ASSEMBLY, TIE ROD (See Sect. 3, Fig. 1 for NHA)	REF
2	130303	.ROD, TIE	1
3	2274	.END, TIE ROD	2
4	60901	.NUT, JAM	2

REV.

STEERING CYLINDER ASSEMBLY (M20ESEP)



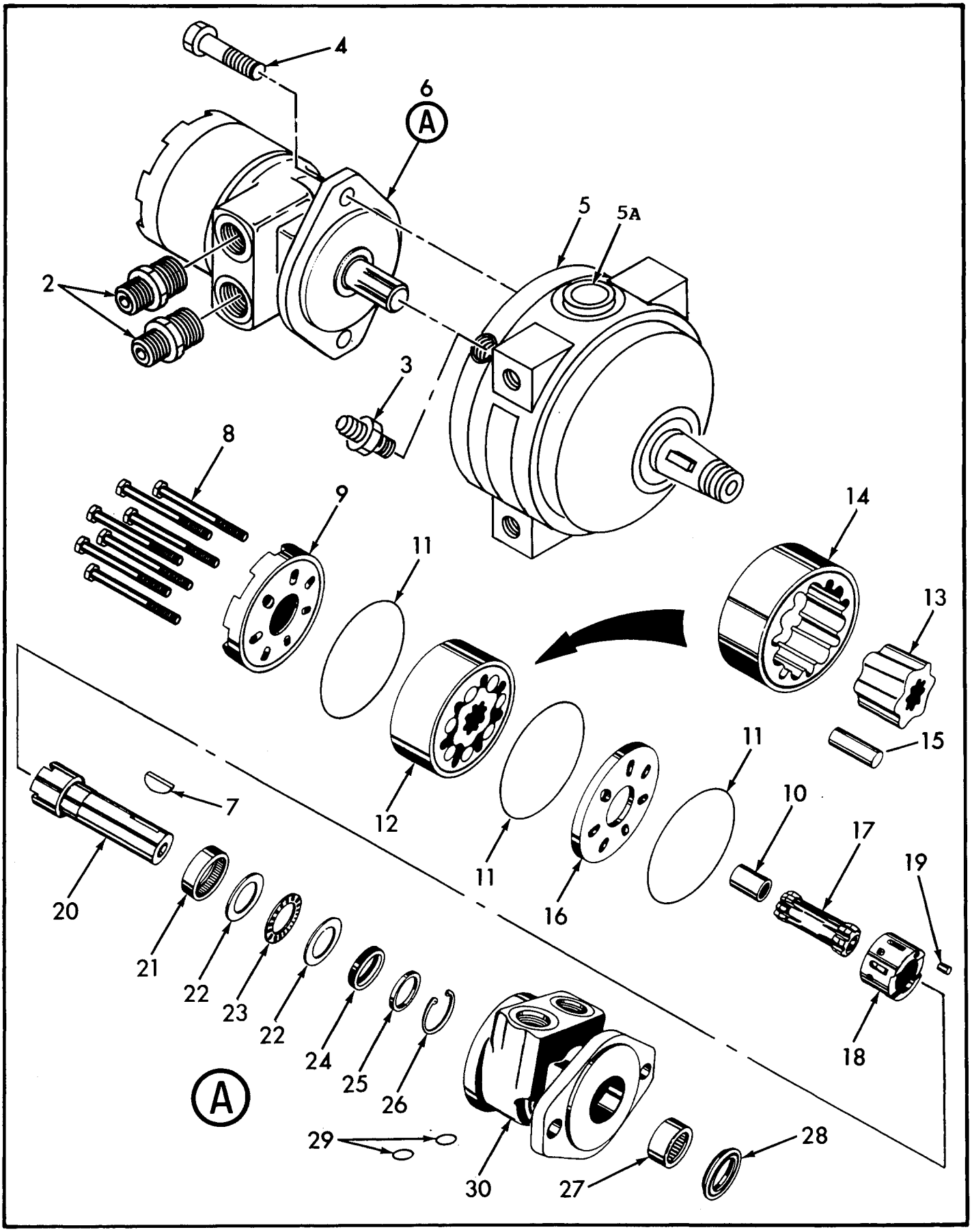
REV.

STEERING CYLINDER ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130237	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	80004-03	.ELBOW, STRAIGHT THREAD	2
3	130165	.CYLINDER, STEERING	1
4		..BEARING	1
5		..PISTON	1
6		..NUT, LOCK	1
7		..ROD, CHROME PLATED	1
-8	66640	..KIT, SEAL	1
9		...RING, SLIPPER	1
10		...O-RING	1
11		...O-RING	1
12		...O-RING	1
13		...WASHER, BACKUP	1
14		...RING, LOCK	1
15		...RING, RETAINING	1
16		...O-RING	1
17		...WASHER, BACKUP	1
18		...SEAL, WIPER	1

- ITEM NOT ILLUSTRATED

DRIVE MOTOR BRAKE ASSEMBLY (M20ESEP)



REV.

DRIVE MOTOR BRAKE ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130490	ASSEMBLY, DRIVE MOTOR BRAKE (L.H.)	1
	130442	ASSEMBLY, DRIVE MOTOR BRAKE (R.H.) (See Sect. 3, Fig. 1 for NHA)	1
2	80004-13	.CONNECTOR, STRAIGHT THREAD	2
3	80004-03	.CONNECTOR, STRAIGHT THREAD	1
4	60610	.SCREW, CAP	2
5	81019	.BRAKE, MULTIPLE DISC	1
5A	66792	.BUSHING	2
6	81017	.MOTOR, HYDRAULIC WHEEL	1
7		.KEY, WOODRUFF	1
8		.BOLT, HEX HEAD	7
9		.COVER, END	1
10		.SPACER/WASHER	1
11		.SEAL, RING	3
12		.ASSEMBLY, ROTOR SET (Do Not Service Separately)	1
13		..ROTOR	1
14		..STATOR	1
15		..VANE	7
16		.WEAR PLATE	1
17		.DRIVE LINK	1
18		.COMMUTATOR (Matched with Housing) (Do Not Service Separately)	1
19		.DRIVE, PIN	1
20		.SHAFT, COUPLING	1
21		.BEARING, INNER	1
22		.WASHER, THRUST	2
23		.BEARING, THRUST	1

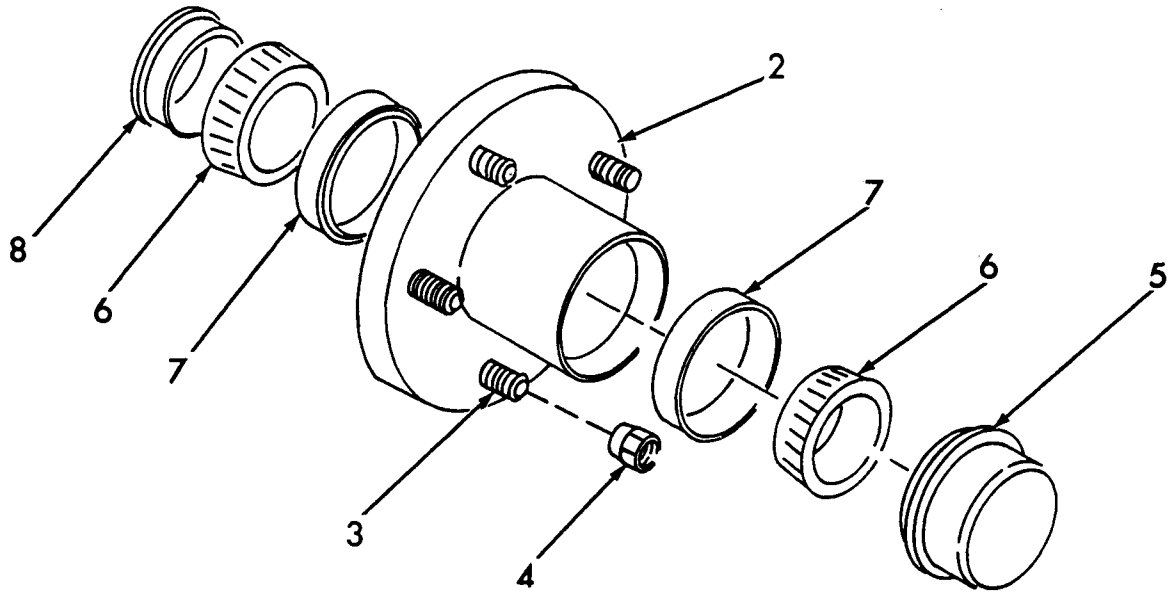
- ITEM NOT ILLUSTRATED

DRIVE MOTOR BRAKE ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24		.SEAL, INNER	1
25		.WASHER, BACKUP	1
26		.RING, RETAINING	1
27		.BEARING	1
28		.SEAL, DIRT & WATER	1
29		.O-RING	2
30		.HOUSING (Matched with COMMUTATOR) (Do Not Service Separately)	

- ITEM NOT ILLUSTRATED

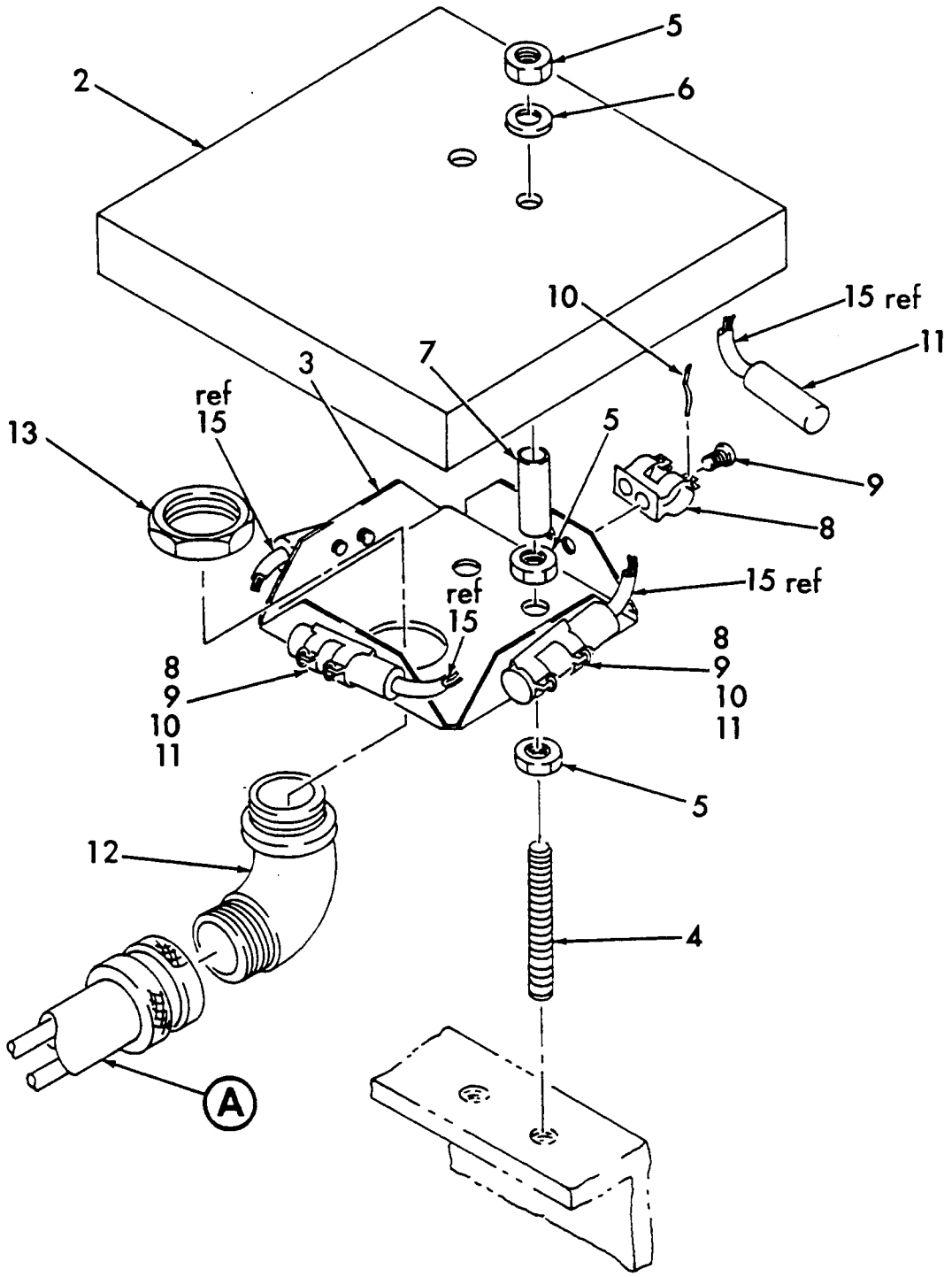
HUB ASSEMBLY (M20ESEP)

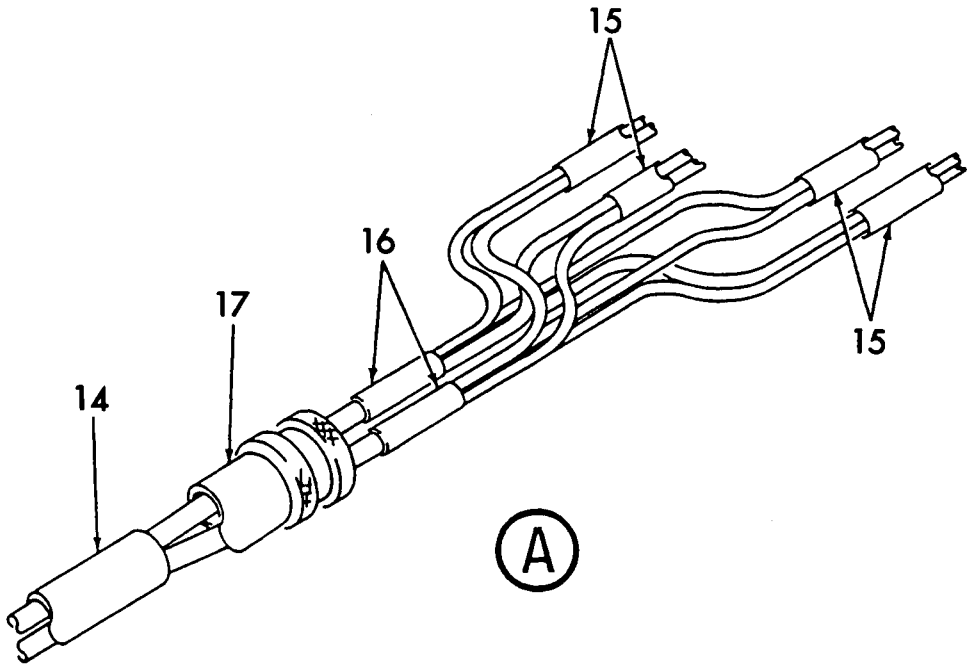


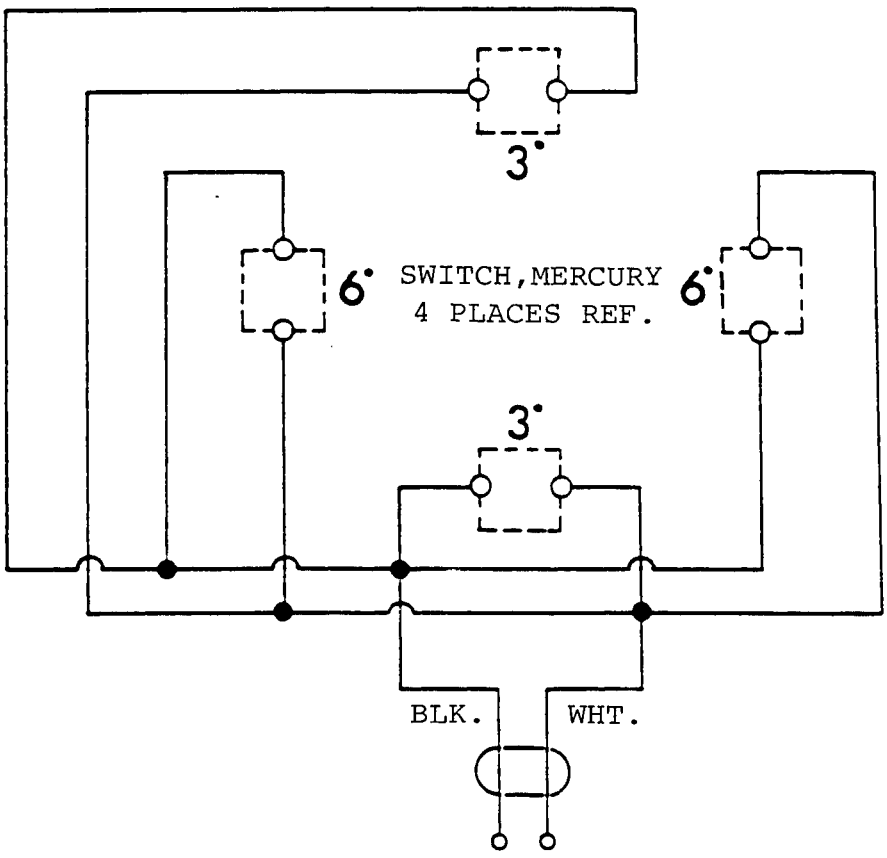
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	134	ASSEMBLY, HUB (See Sect. 3, Fig. 1 for NHA)	REF
2	65684	.HUB	1
3	65685	.BOLT, LUG (attaching part)	5
4	61316	.NUT, LUG (attaching part)	5
5	137	.CAP, DUST	1
6	65059	.BEARING	2
7	65686	.RACE, BEARING	2
8	66113	.SEAL	1

- ITEM NOT ILLUSTRATED

TILT SWITCH ASSEMBLY (M20ESEP)







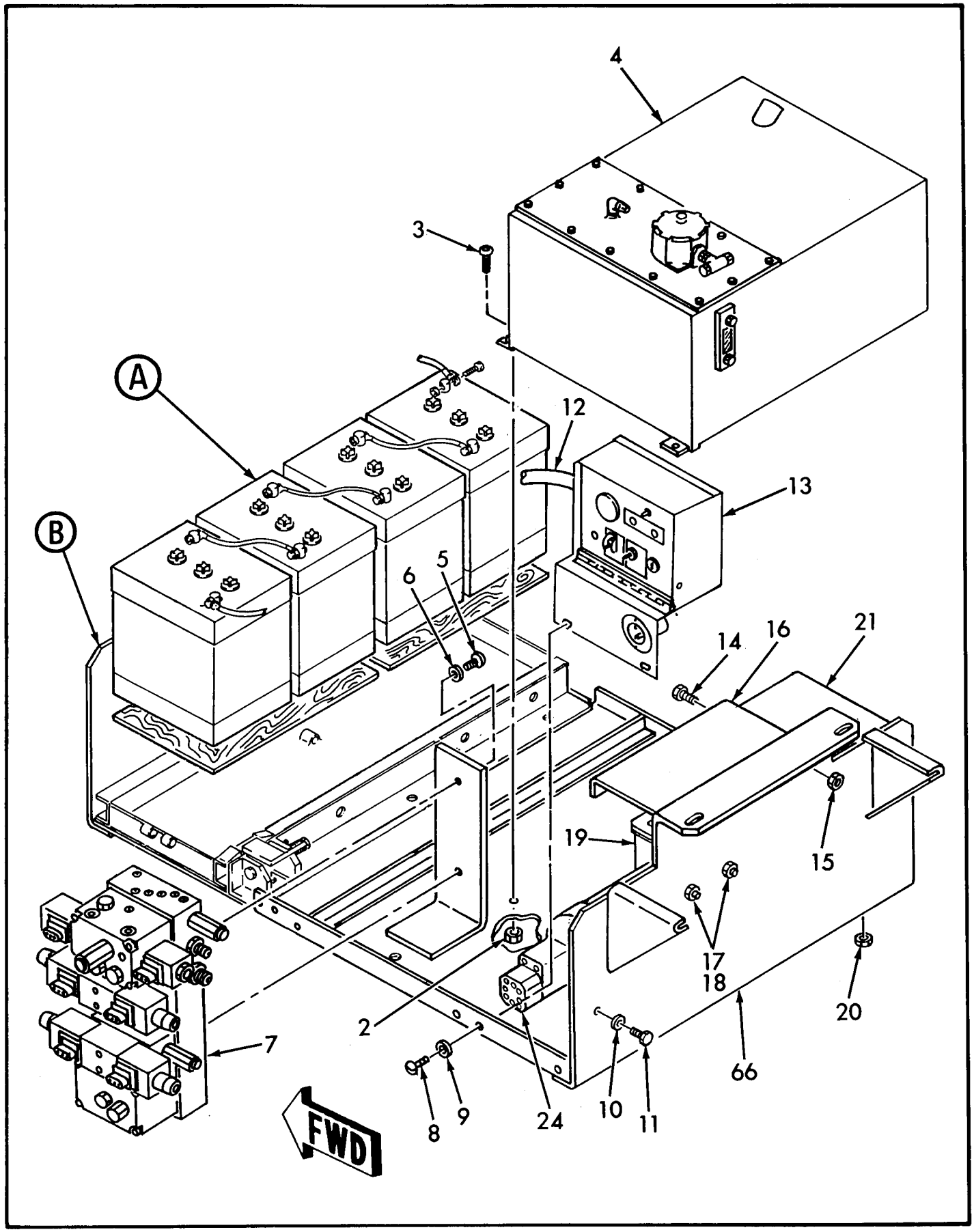
WIRING DIAGRAM

TILT SWITCH ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131077	ASSEMBLY, TILT SWITCH (See Sect. 3, Fig. 1 for NHA)	REF
2	30386	. COVER, TILT SWITCH	1
3	30385	. BRACKET, TILT SWITCH	1
4	63606	. ROD, THREADED (attaching part)	2
5	60701	. NUT (attaching part)	6
6	63301	. WASHER, LOCK (attaching part)	2
7	35715	. TUBE, ROUND (attaching part)	2
8	119-A	. BRACKET, SWITCH	4
9	62605	. SCREW, ROUND HEAD (attaching part)	8
10	70225	. WIRE, SAFETY	8
11	4014	. SWITCH, MERCURY	4
12	70226	. CONNECTOR, 90 DEGREE	1
13	61317	. NUT (attaching part)	1
14	70036	. WIRE (9 Ft.)	AR
15	65898	. TUBE, HEAT SHRINK	4
16	117-D	. CONNECTOR, BUTT	2
17	65899	. TUBE, HEAT SHRINK	1

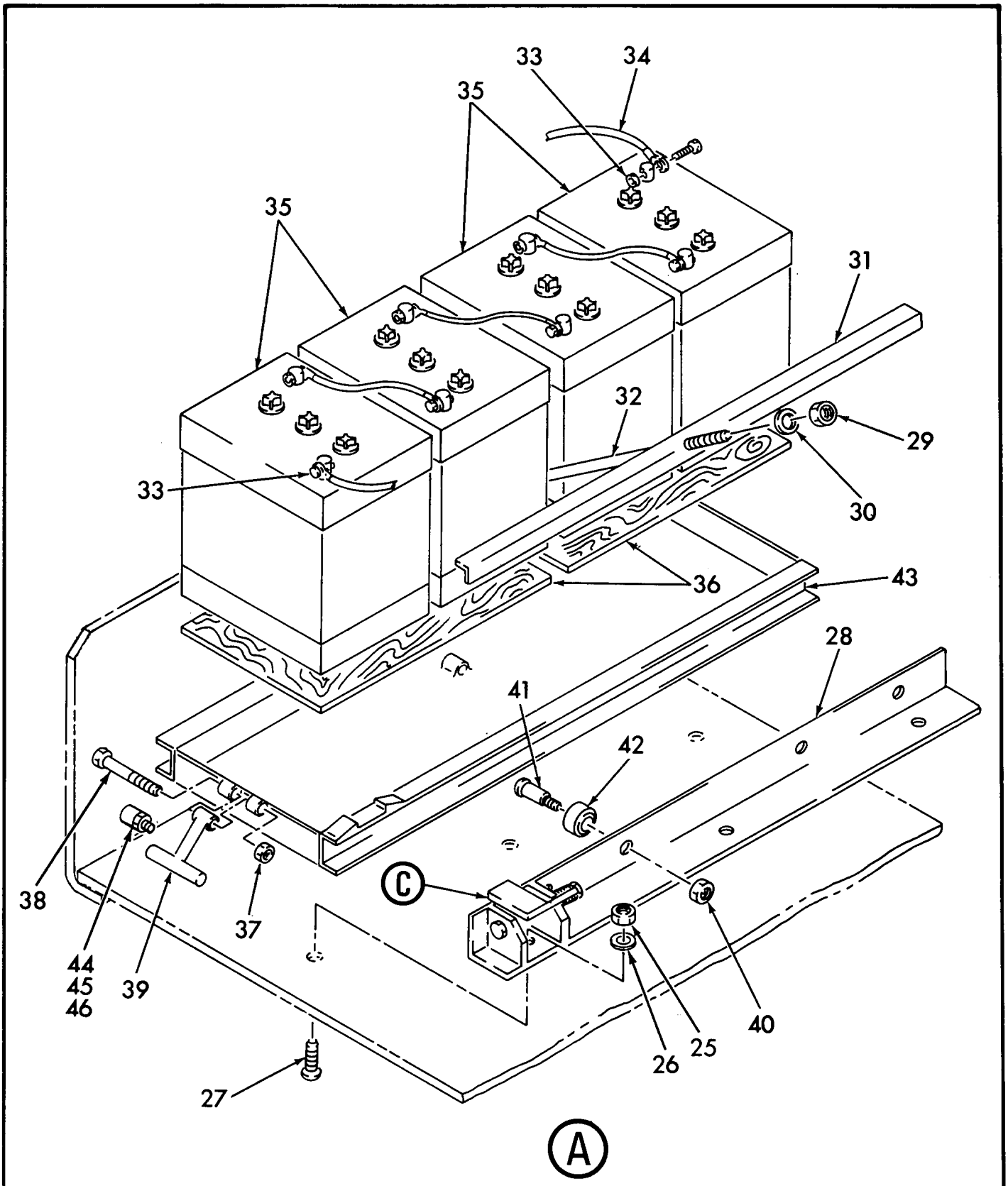
- ITEM NOT ILLUSTRATED

BELLY PAN ASSEMBLY (M20ESEP)



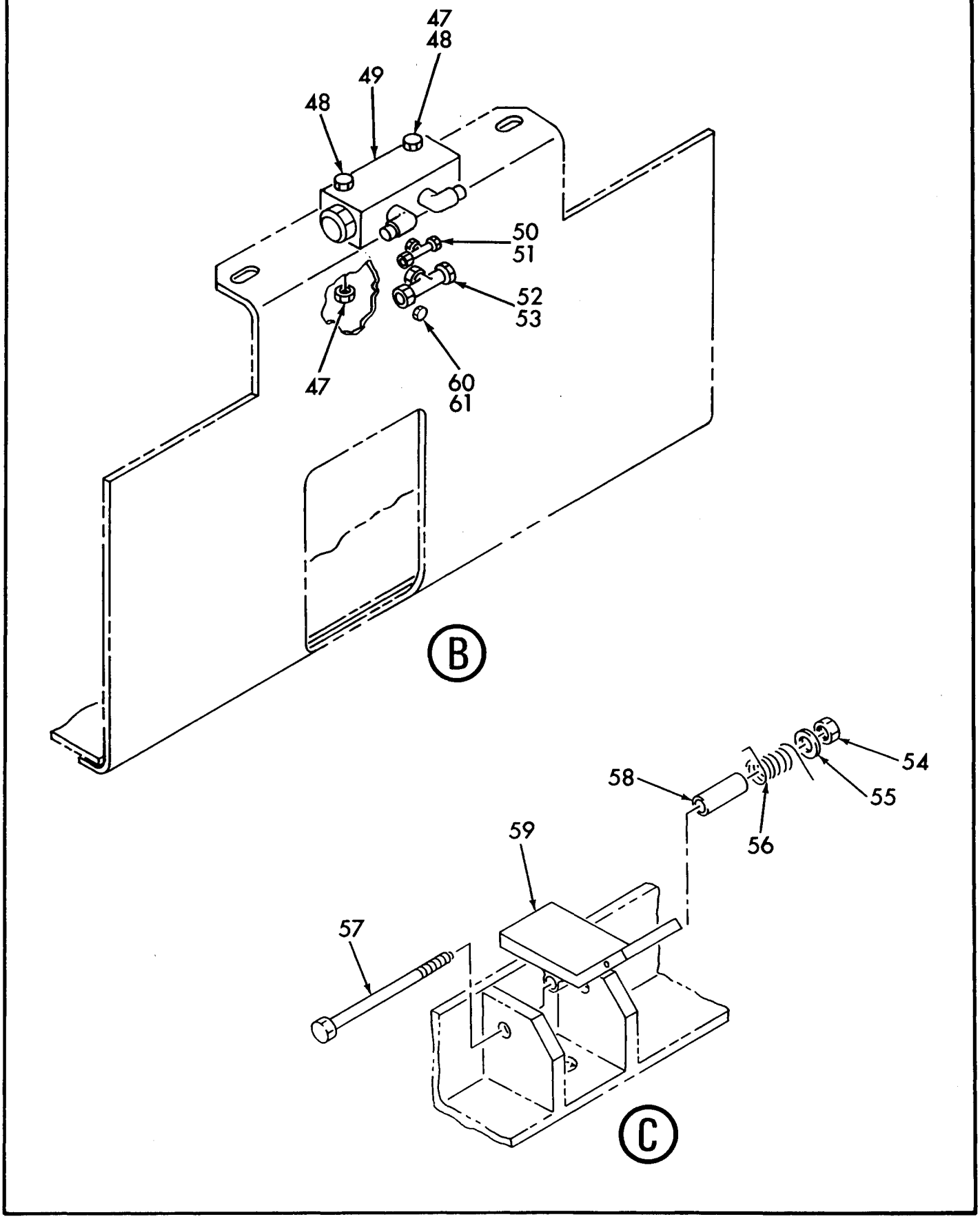
REV.

BELLY PAN ASSEMBLY (M20ESEP)



REV.

BELLY PAN ASSEMBLY (M20ESEP)



REV.

BELLY PAN ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131301	ASSEMBLY, BELLY PAN (See Sect. 3, Fig. 1 for NHA)	REF
2	61318	.NUT, HEX (attaching part)	3
3	61944	.SCREW, BUTTON HEAD SCOKET (attaching part)	3
4	130654	.ASSEMBLY, HYDRAULIC TANK (See Sect. 3, Fig. 9 for Details	1
5	60343	.SCREW, CAP (attaching part)	2
6	63319	.WASHER, LOCK (attaching part)	2
7	130767	.ASSEMBLY, VALVE PACKAGE (See Sect. 3, Fig. 10 for Details)	1
8	63359	.SCREW, CAP (attaching part)	2
9	63301	.WASHER, LOCK (attaching part)	2
10	60322	.SCREW, CAP	1
11	63302	.WASHER, LOCK	1
12	130600-07	.CABLE, CONDUCTOR	1
13	131199	.ASSEMBLY, GROUND CONTROL BOX (See Sect. 3, Fig. 11 for Details)	1
14	63359	.SCREW, CAP	2
15	61312	.NUT, LOCK	2
16	130797	.GUARD, TILT SENSOR	1
17	63359	.SCREW, CAP	2
18	61312	.NUT, LOCK	1
19	70362	.RELAY, POWER	1
20	61312	.NUT, LOCK	4
21	70321	.CHARGER, BATTERY	1
-22	61318	.NUT, HEX	2
-23	61944	.SCREW, BUTTON HEAD SOCKET	2

- ITEM NOT ILLUSTRATED

BELLY PAN ASSEMBLY (M20ESEP)

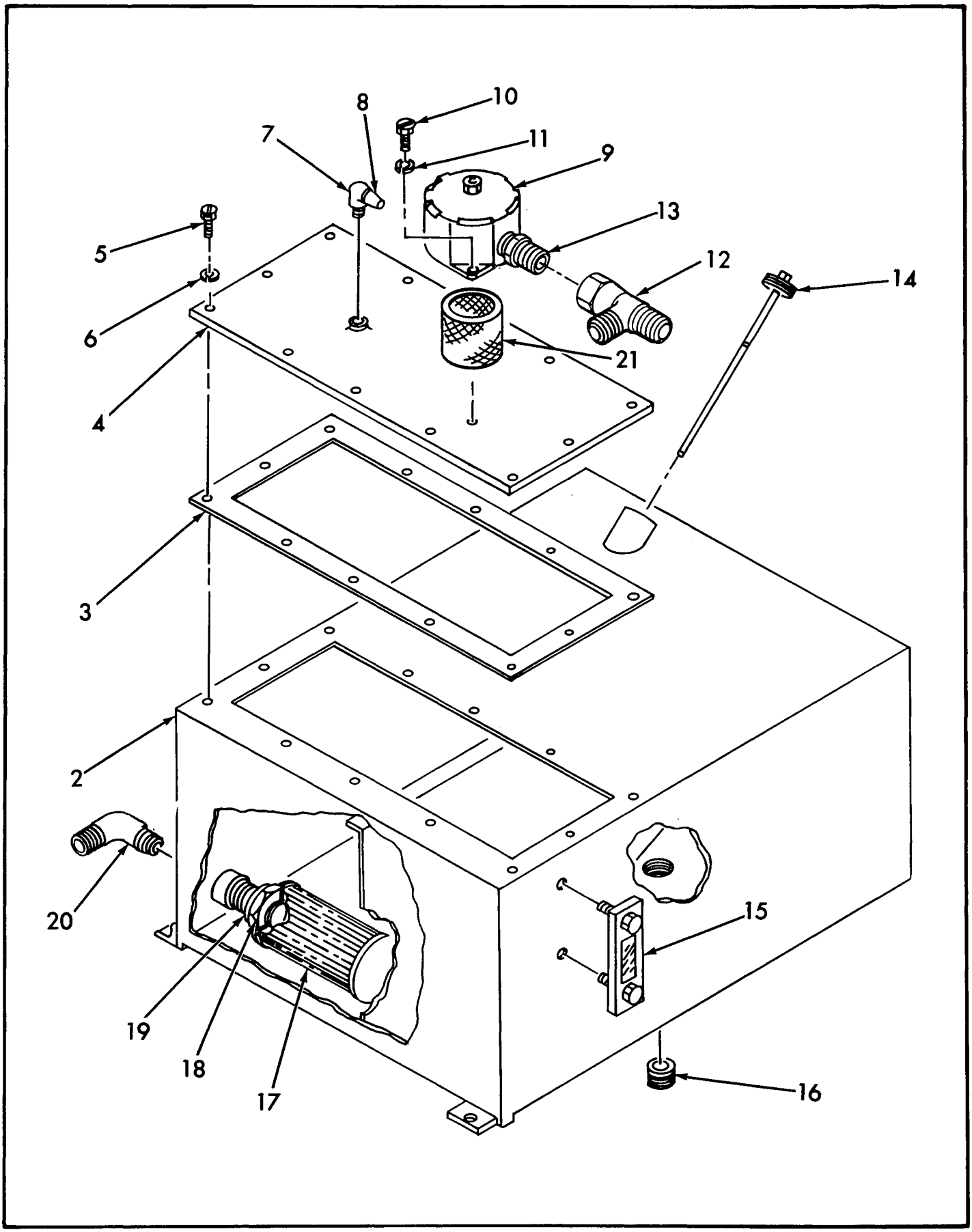
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	130300	.ASSEMBLY, PUMP & MOTOR (See Sect. 3, Fig. 12 for Details)	1
25	61318	.NUT, HEX	3
26	63403	.WASHER, FLAT	3
27	61944	.SCREW, BUTTON HEAD SOCKET	3
28	130798	.WELDMENT, BATTERY TRAY BRACKET	1
29	61302	.NUT, LOCK	1
30	63403	.WASHER, FLAT	1
31	130392	.HOLD DOWN, BATTERY	1
32	130733	.BOLT, HOLD DOWN	1
33	61246	.NUT, LOCK	8
34	130768	.KIT, BATTERY CABLE	1
35	4007	.BATTERY	4
36	65768	.PLYWOOD	2
37	61246	.NUT, LOCK	2
38	60339	.SCREW, CAP	2
39	130787	.WELDMENT, HANDLE	2
40	61318	.NUT, HEX	8
41	62101	.BOLT, SHOULDER	8
42	7073	.ROLLER, BATTERY TRAY	8
43	130725	.WELDMENT, BATTERY TRAY	1
44	61318	.NUT, HEX	2
45	36666	.TUBE, ROUND	2
46	62101	.SCREW, BUTTON HEAD SOCKET	2

BELLY PAN ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
47	61312	.NUT, LOCK	2
48	60340	.SCREW, CAP	2
49	130305	.ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 13 for Details)	1
50	80015-03	.ELBOW, SWIVEL NUT	1
51	80035-03	.TEE, UNIVERSAL	1
52	80015-06	.ELBOW, SWIVEL NUT	1
53	80035-06	.TEE, UNIVERSAL	1
54	61318	.NUT, HEX	1
55	63403	.WASHER, FLAT	1
56	130482	.SPRING, TORSION, R.H.	1
57	60344	.SCREW, CAP	1
58	36437	.TUBE, ROUND	1
59	130785	.WELDMENT, BELLY PAN LOCK	1
60	60324	.SCREW, CAP	1
61	65681	.WASHER, LOCK	1
-62	70270	.TERMINAL, RING	2
-63	66357	.TERMINAL, MALE	2
-64	66356	.TERMINAL, FEMALE	2
-65	70269	.WIRE, BLACK	10 FT
66	130762	.WELDMENT, BELLY PAN	1

- ITEM NOT ILLUSTRATED

HYDRAULIC TANK ASSEMBLY (M20ESEP)



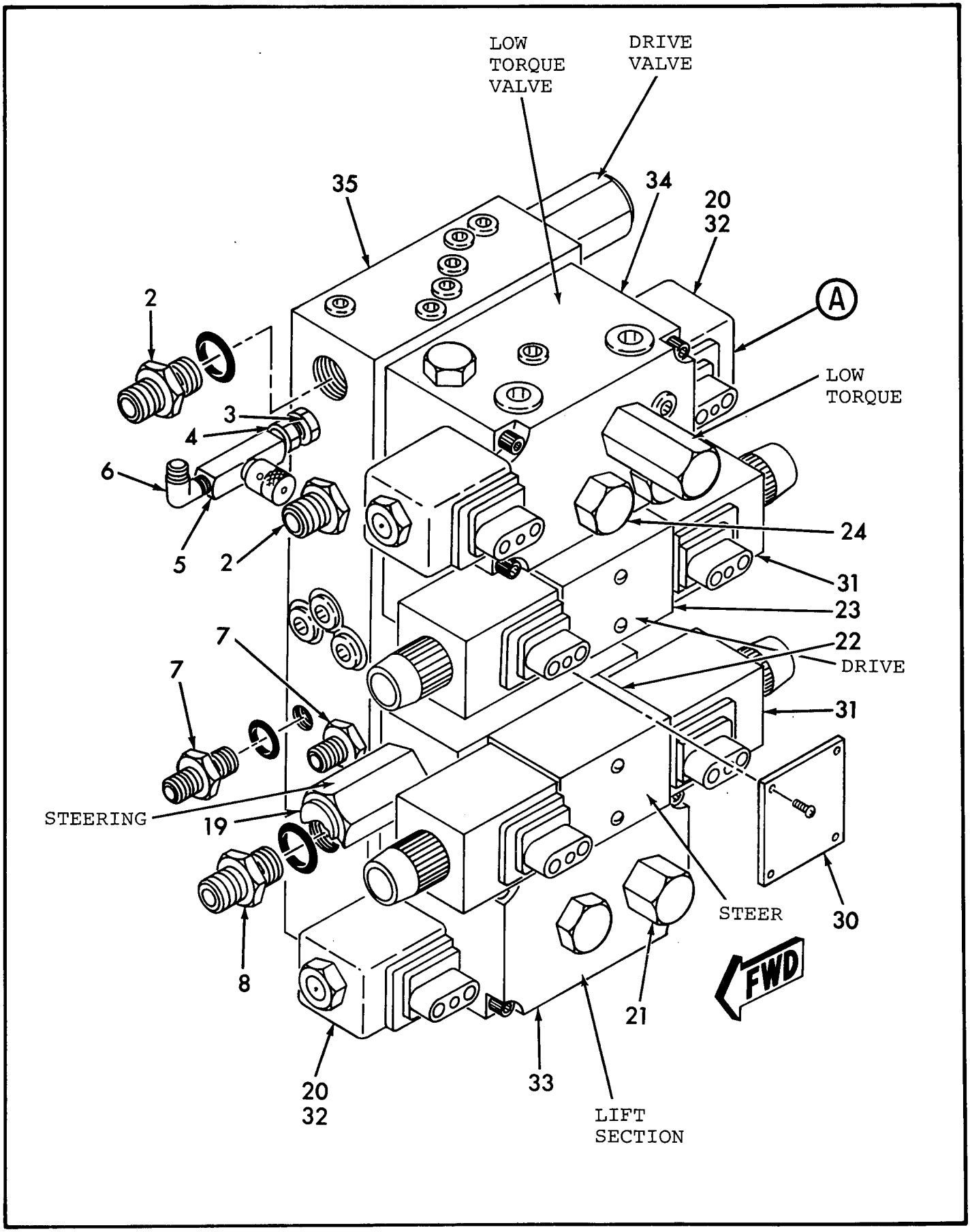
REV.

HYDRAULIC TANK ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130654	ASSEMBLY, HYDRAULIC TANK (See Sect. 3, Fig. 8 for NHA)	REF
2	130639	.WELDMENT, HYDRAULIC TANK	1
3	130644	.GASKET	1
4	130641	.COVER, TANK	1
5	60342	.SCREW, CAP (attaching part)	12
6	63301	.WASHER, LOCK (attaching part)	12
7	80021-03	.ELBOW, STREET	1
8	65213	.BREATHER	1
9	81016	.FILTER (UCC)	1
10	60342	.SCREW, CAP (attaching part)	2
11	63301	.WASHER, LOCK (attaching part)	2
12	80028-06	.TEE, SWIVEL NUT RUN	1
13	80001-14	.CONNECTOR, MALE	1
14	130230	.DIPSTICK	1
15	3018	.GAUGE, SIGHT	1
16	54200	.PLUG, MAGNETIC PIPE	1
17	81084	.STRAINER	1
18	80057-16	.REDUCER, PIPE THREAD	1
19	65749	.NIPPLE, CLOSE	
20	80008-20	.ELBOW, MALE	
21	66739	.ELEMENT, RETURN FILTER (UCC)	1

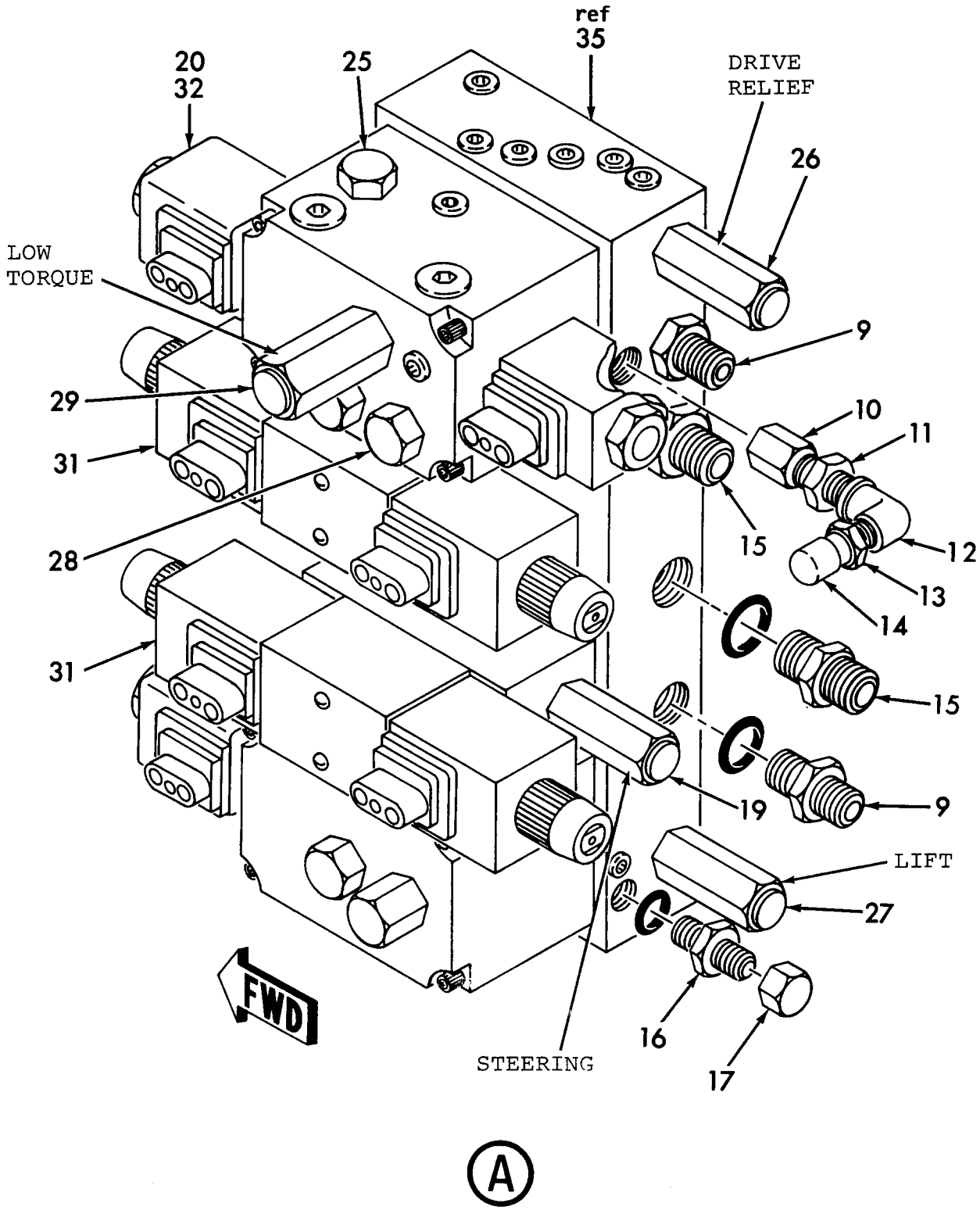
- ITEM NOT ILLUSTRATED

VALVE PACKAGE ASSEMBLY (M20ESEP)

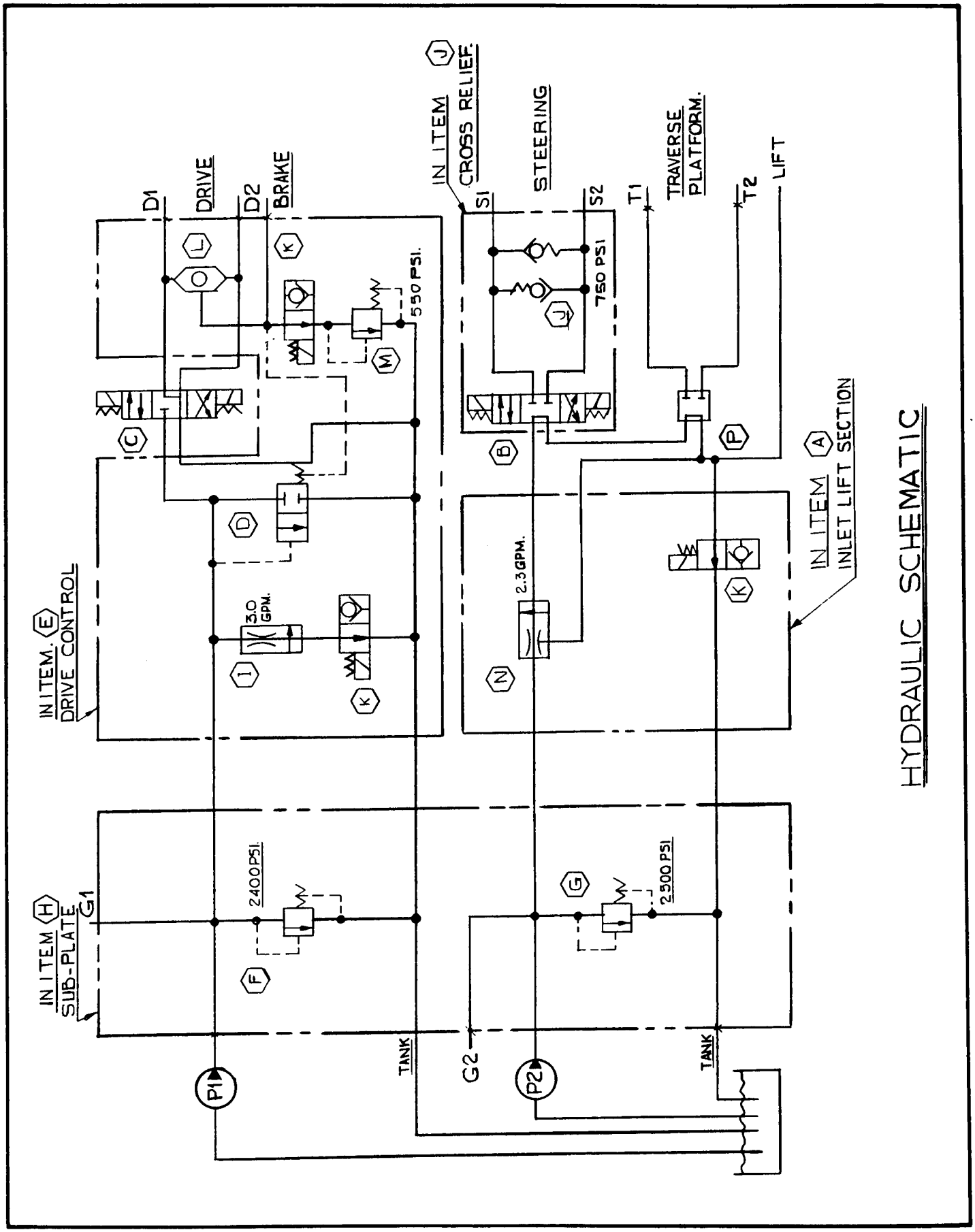


REV.

VALVE PACKAGE ASSEMBLY (M20ESEP)



VALVE PACKAGE ASSEMBLY (M20ESEP)



REV.

VALVE PACKAGE ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130767	ASSEMBLY, VALVE PACKAGE (See Sect. 3, Fig. 8 for NHA)	REF
2	80004-11	.CONNECTOR, STRAIGHT THREAD (D1, D2)	4
3	51903	.ADAPTER, FEMALE PIPE (Brake)	1
4	80052-02	.NIPPLE, PIPE	1
5	30884	.VALVE, NEEDLE (FREE WHEELING)	1
6	80008-03	.ELBOW, MALE	1
7	80004-03	.CONNECTOR, STRAIGHT THREAD (S1, S2)	2
8	80004-08	.CONNECTOR, STRAIGHT THREAD (Lift)	1
9	80004-12	.CONNECTOR, STRAIGHT THREAD (P1,P2)	2
10	51903	.ADAPTER, FEMALE PIPE (G1)	1
11	80052-03	.NIPPLE, PIPE	1
12	80021-03	.ELBOW, 90^0 STREET	1
13	2527	.COUPLING, QUICK DISCONNECT	1
14	845	.CAP, QUICK DISCONNECT	1
15	80004-11	.CONNECTOR, STRAIGHT THREAD	2
16	80004-03	.CONNECTOR, STRAIGHT THREAD	1
17	80059-03	.CAP	1
18	81110	.PACKAGE, VALVE	1
19	66926	..VALVE, RELIEF (Steering)	2
20	67026	..VALVE, 2 WAY N.O. SOLENOID	3
21	66677	.REGULATOR, COMBINATION FLOW (LIFT)	1
22	66925	..VALVE, DO1	1
23	66843	..VALVE, DO1	1

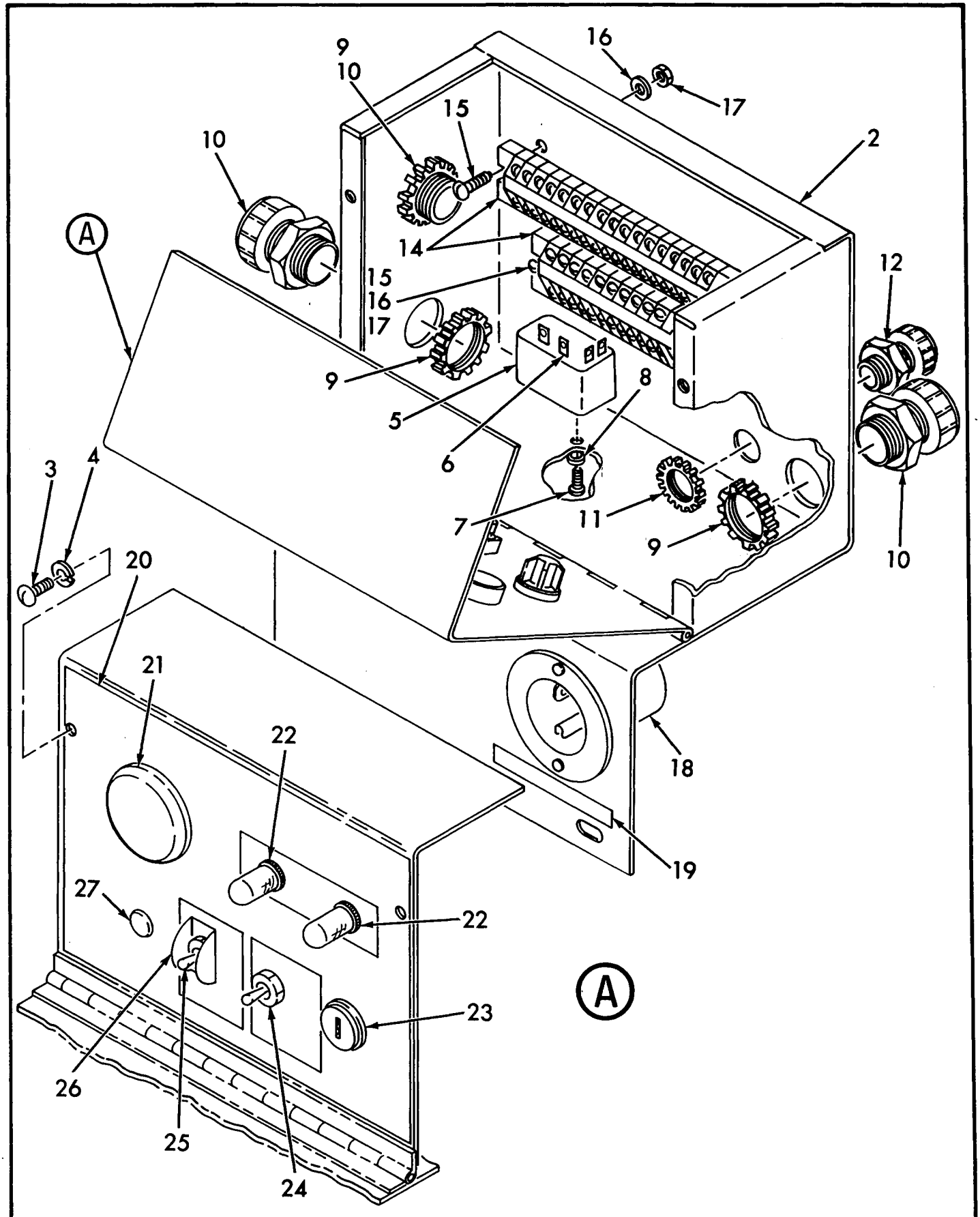
- ITEM NOT ILLUSTRATED

VALVE PACKAGE ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	67024	..VALVE, DIFFERENTIAL SENSING	1
25	66924	..VALVE, SHUTTLE (BRAKE)	1
26	66666	.VALVE, RELIEF (DRIVE)	1
27	66816	..VALVE, RELIEF (LIFT)	1
28	67025	..REGULATOR, FLOW (3.0)	1
29	67027	..VALVE, RELIEF (LOW TORQUE)	1
30	66929	..PLATE, COVER	1
31	66865	..COIL-DIRECTIONAL (20V)	4
32	67212	..COIL-CARTRIDGE	3
33	67023	..LIFT SECTION	1
34	66667	..VALVE, LOW TORQUE	1
35	66671	..SUB-PLATE	1

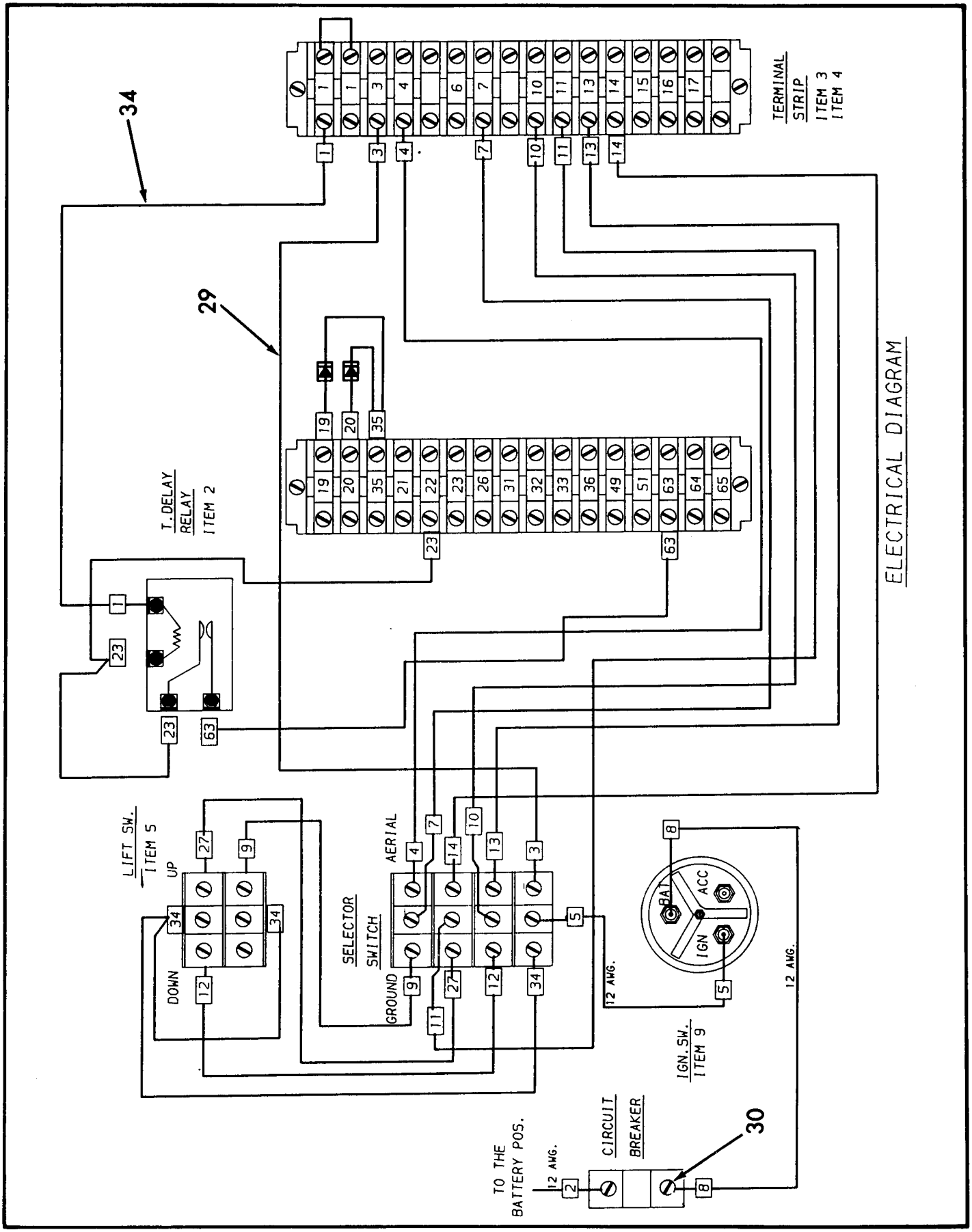
- ITEM NOT ILLUSTRATED

GROUND CONTROL BOX ASSEMBLY (M20ESEP)



REV.

GROUND CONTROL BOX ASSEMBLY (M20ESEP)



GROUND CONTROL BOX ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	13119	ASSEMBLY, GROUND CONTROL BOX (See Sect. 3, Fig. 8 for NHA)	REF
2	130390	.BOX, GROUND CONTROL	1
3	62612	.SCREW, CAP (attaching part)	2
4	63312	.WASHER, LOCK (attaching part)	2
5	70337	.RELAY, DELAY	1
6	496-A	.TERMINAL	4
7	61728	.SCREW (attaching part)	1
8	63322	.WASHER, LOCK (attaching part)	1
9	61115	.NUT, LOCK	3
10	2807	.RELIEF, STRAIN	3
11	2808	.NUT, LOCK	1
12	2806	.RELIEF, STRAIN	1
13	4027	.BLOCK, TERMINAL	32
14	117-A	.END, TERMINAL BLOCK	2
15	62612	.SCREW, CAP (attaching part)	4
16	63312	.WASHER, LOCK (attaching part)	4
17	61502	.NUT, HEX (attaching part)	4
18	70409	.INLET, FLANGE	1
19	185707	.DECAL, POWER TO PLATFORM	1
20	130505	.DECAL, GROUND CONTROL BOX	1
21	65244	.PLUG, HEYCO	1
22	20562	.BREAKER, CIRCUIT	2
23	2717	.SWITCH, IGNITION	1

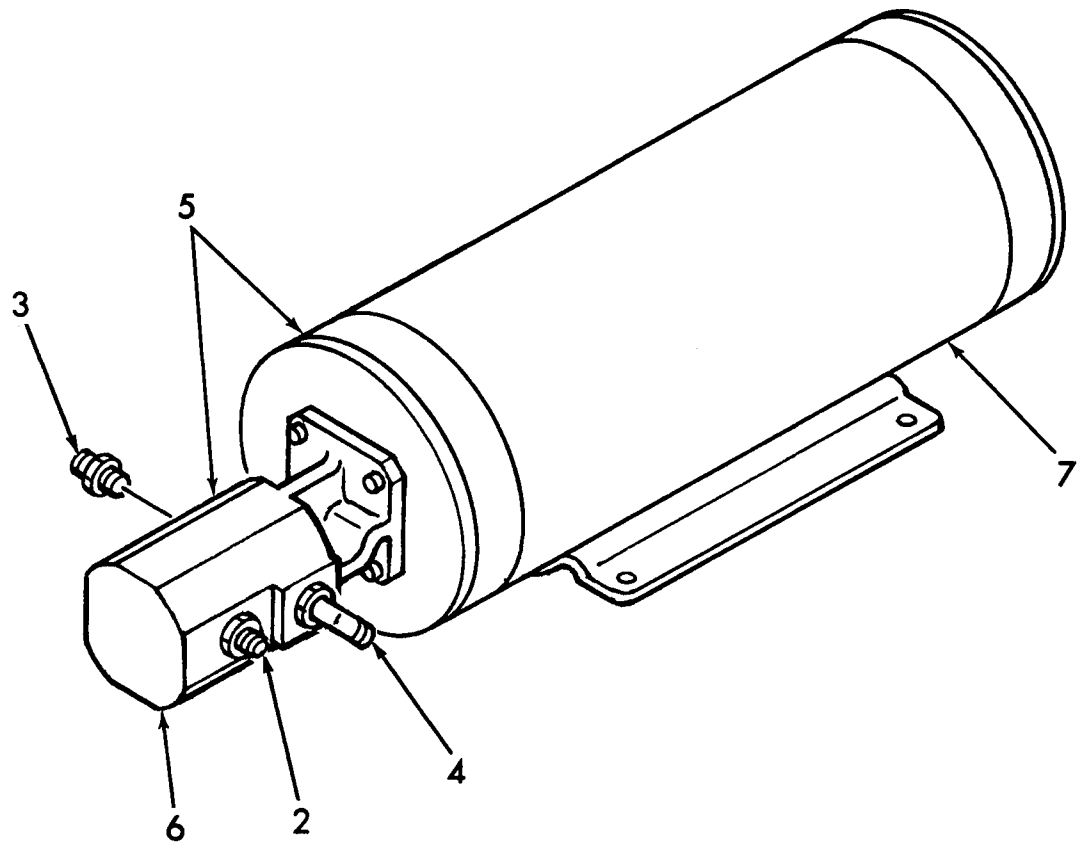
- ITEM NOT ILLUSTRATED

GROUND CONTROL BOX ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	16260	.SWITCH, TOGGLE	1
25	20481	.SWITCH, TOGGLE	1
26	20884	.GUARD, SWITCH	1
27	771	.PLUG, WHITE	1
-28	70068	.CONNECTOR, BUTT	1
29	70009	.WIRE (15 FT. RED)	1
30	117-C	.CONNECTOR, RING	33
-31	16213	.CONNECTOR	2
-32	70442	.DIODE	2
-33	70008	.WIRE (3FT. YELLOW/GREEN)	1
34	2991	.WIRE (1 FT. WHITE)	1

- ITEM NOT ILLUSTRATED

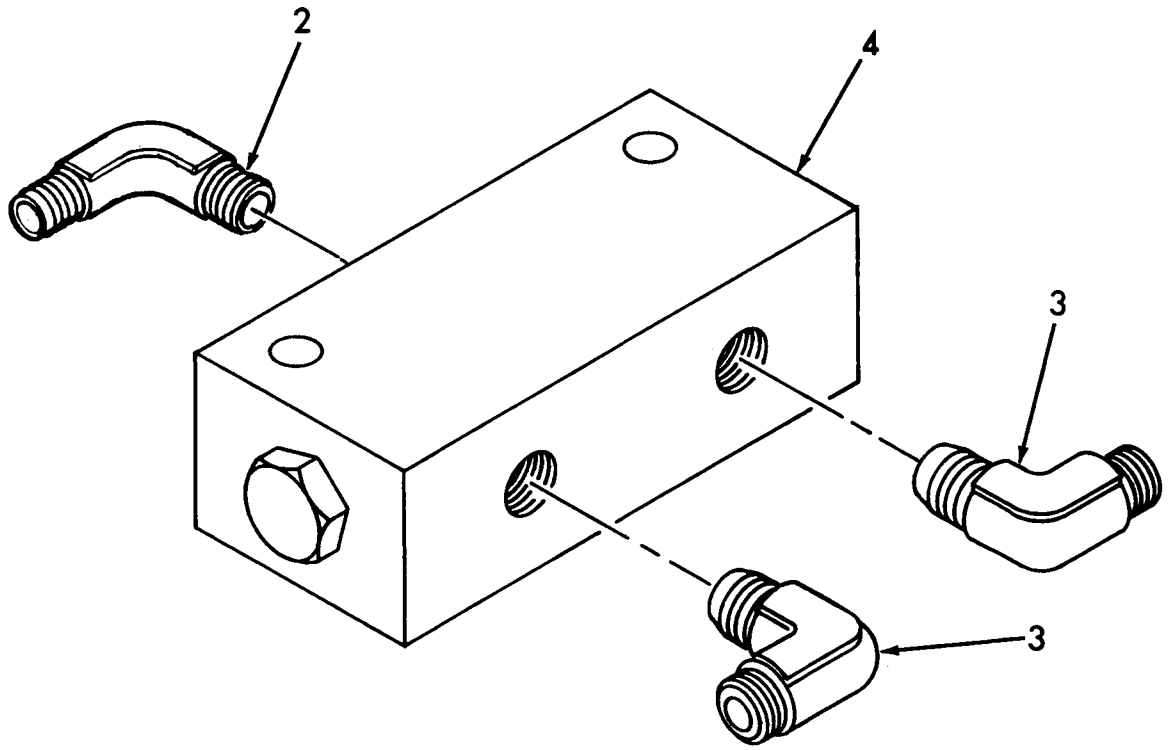
PUMP & MOTOR ASSEMBLY (M20ESEP)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130300	ASSEMBLY, PUMP & MOTOR (See Sect. 3, Fig. 8 for NHA)	REF
2	80001-15	.CONNECTOR, MALE	1
3	80001-20	.CONNECTOR MALE	1
4	80008-15	.ELBOW, MALE	1
5	81021	.PUMP & MOTOR, HYDRAULIC	1
6	81021-1	.PUMP	1
7	3015-2	.MOTOR	1
-8	2793	.BRUSHES	1

REV.

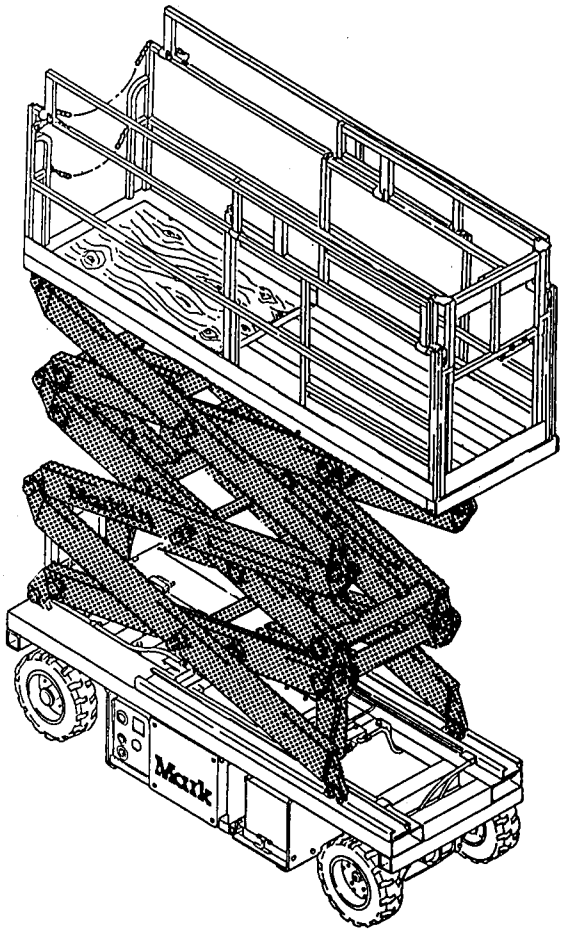
FLOW DIVIDER ASSEMBLY (M20ESEP)



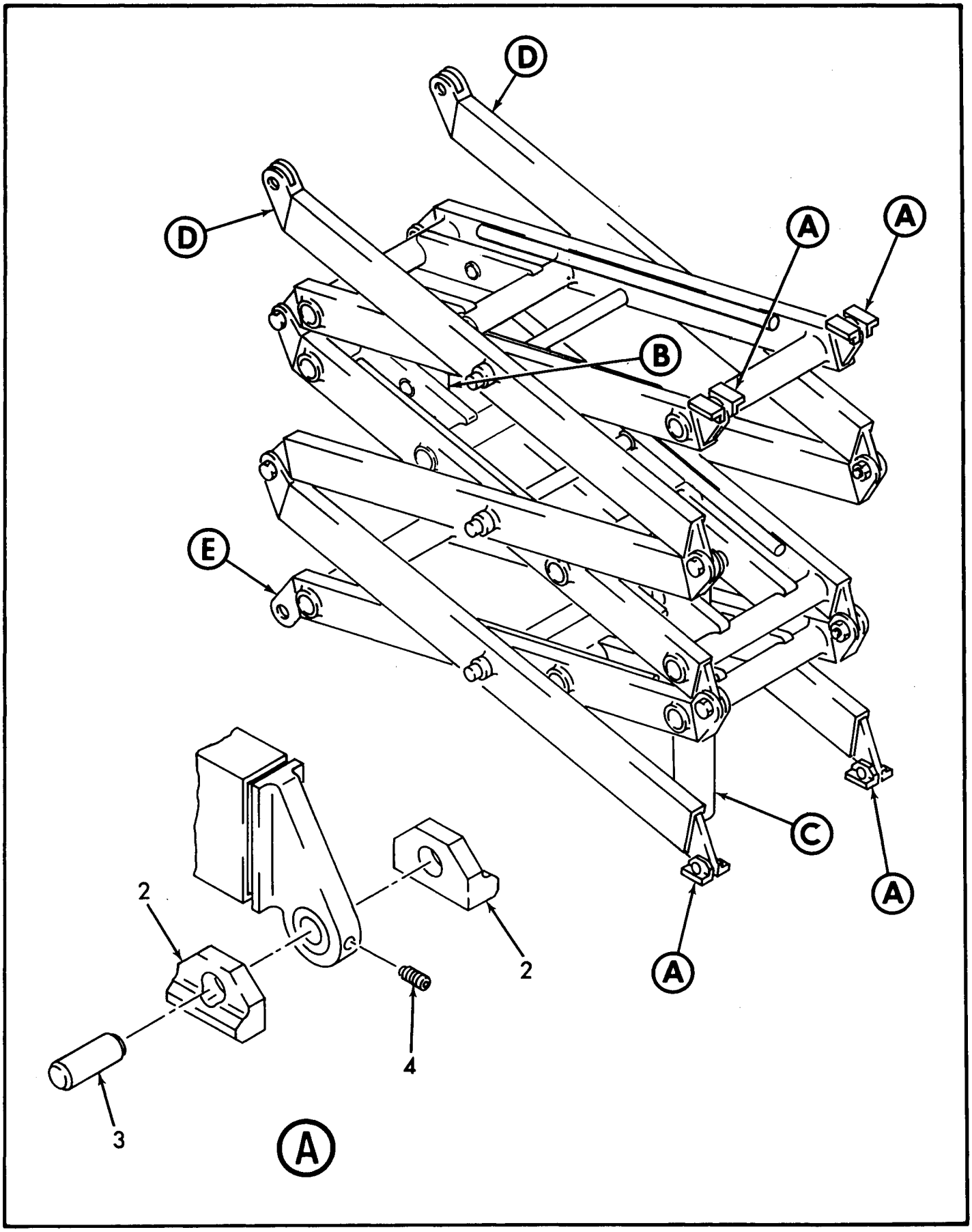
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130305	ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 8 for NHA)	REF
2	80008-14	.CONNECTOR, MALE	1
3	80008-12	.ELBOW, MALE	2
4	81026	.DIVIDER, FLOW	1

REV.

THIS SECTION 4 CONTAINS THE FOLLOWING FIGURES:

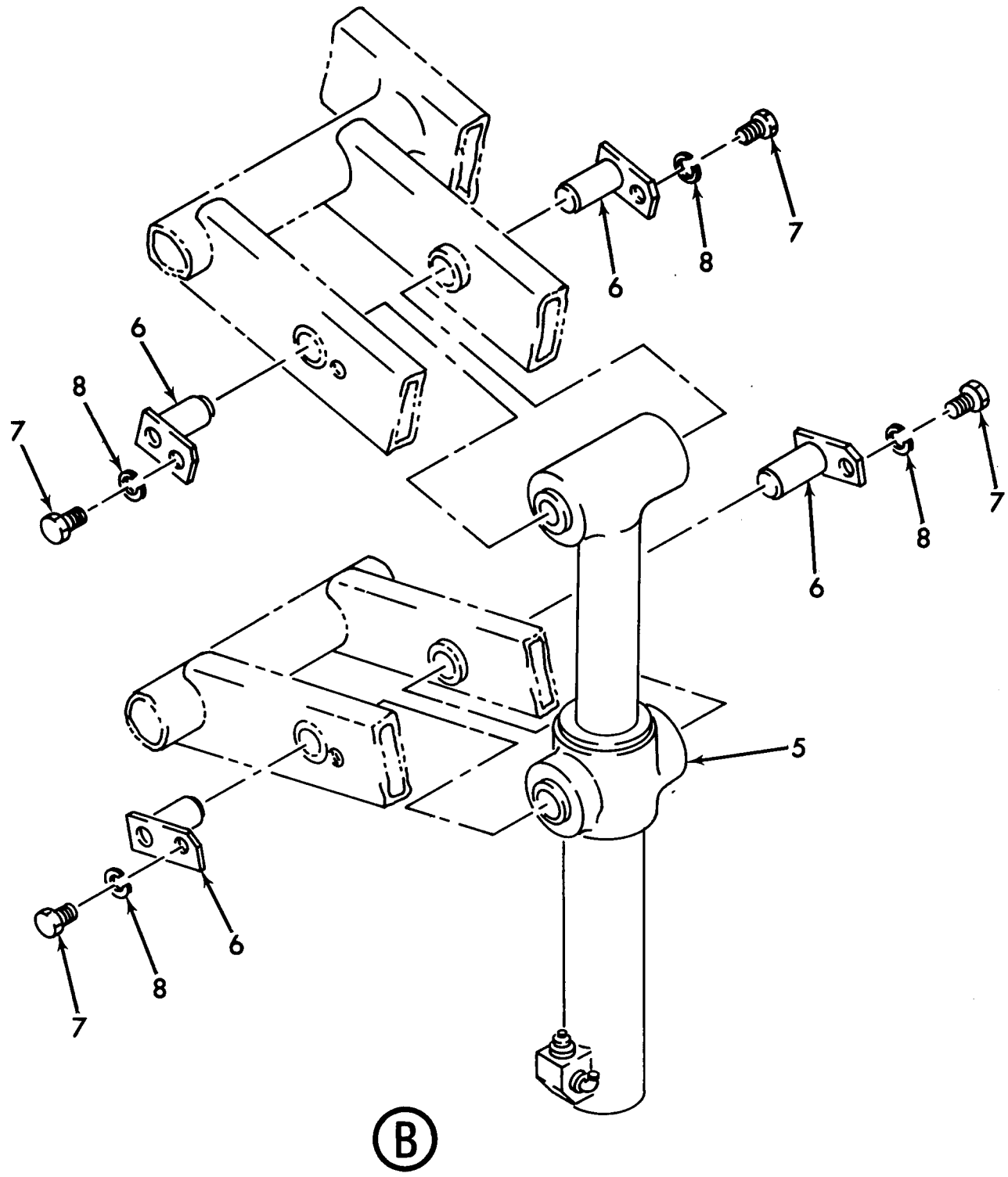


SCISSOR ASSEMBLY (M20ESEP)

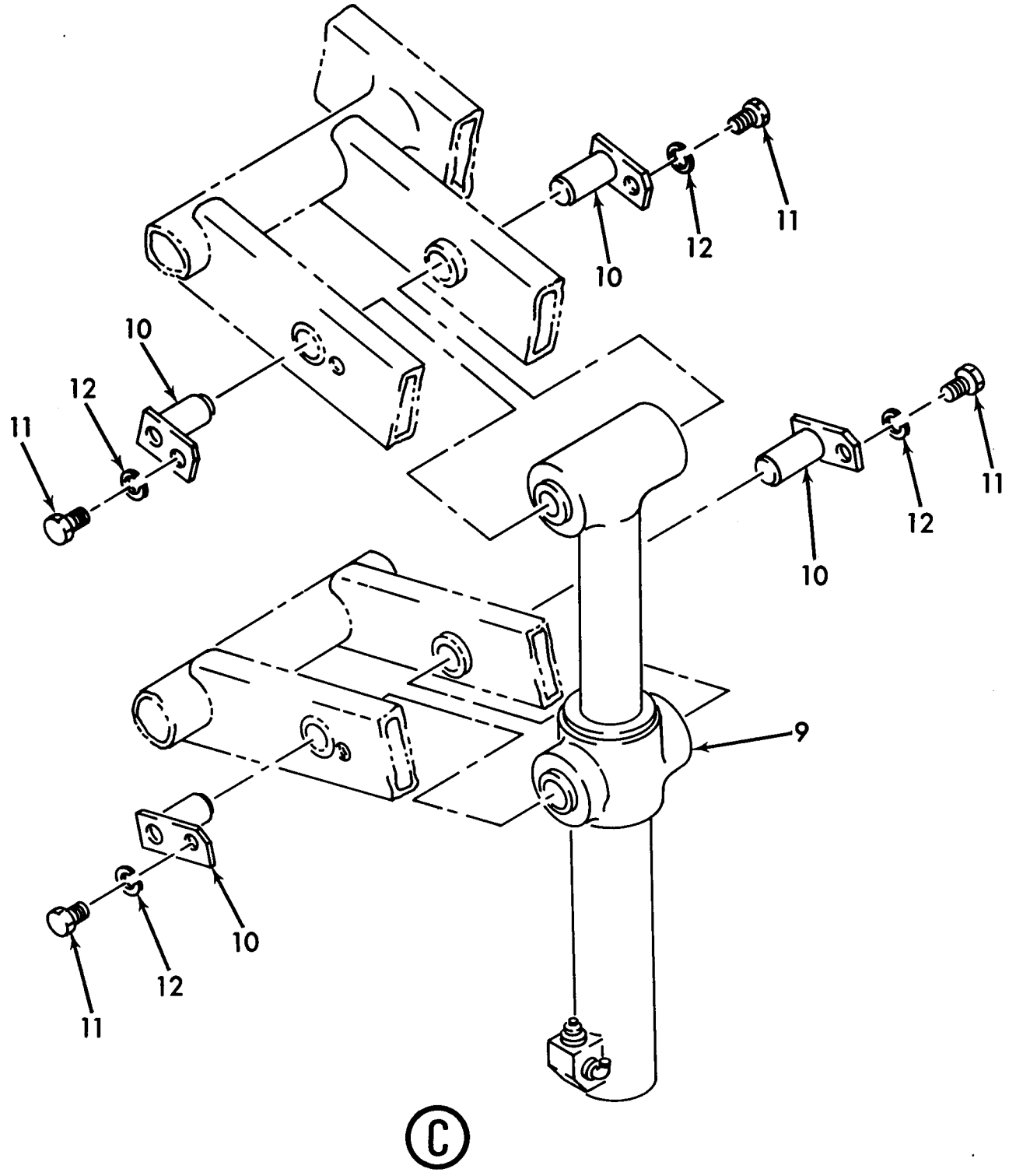


REV.

SCISSOR ASSEMBLY (M20ESEP)

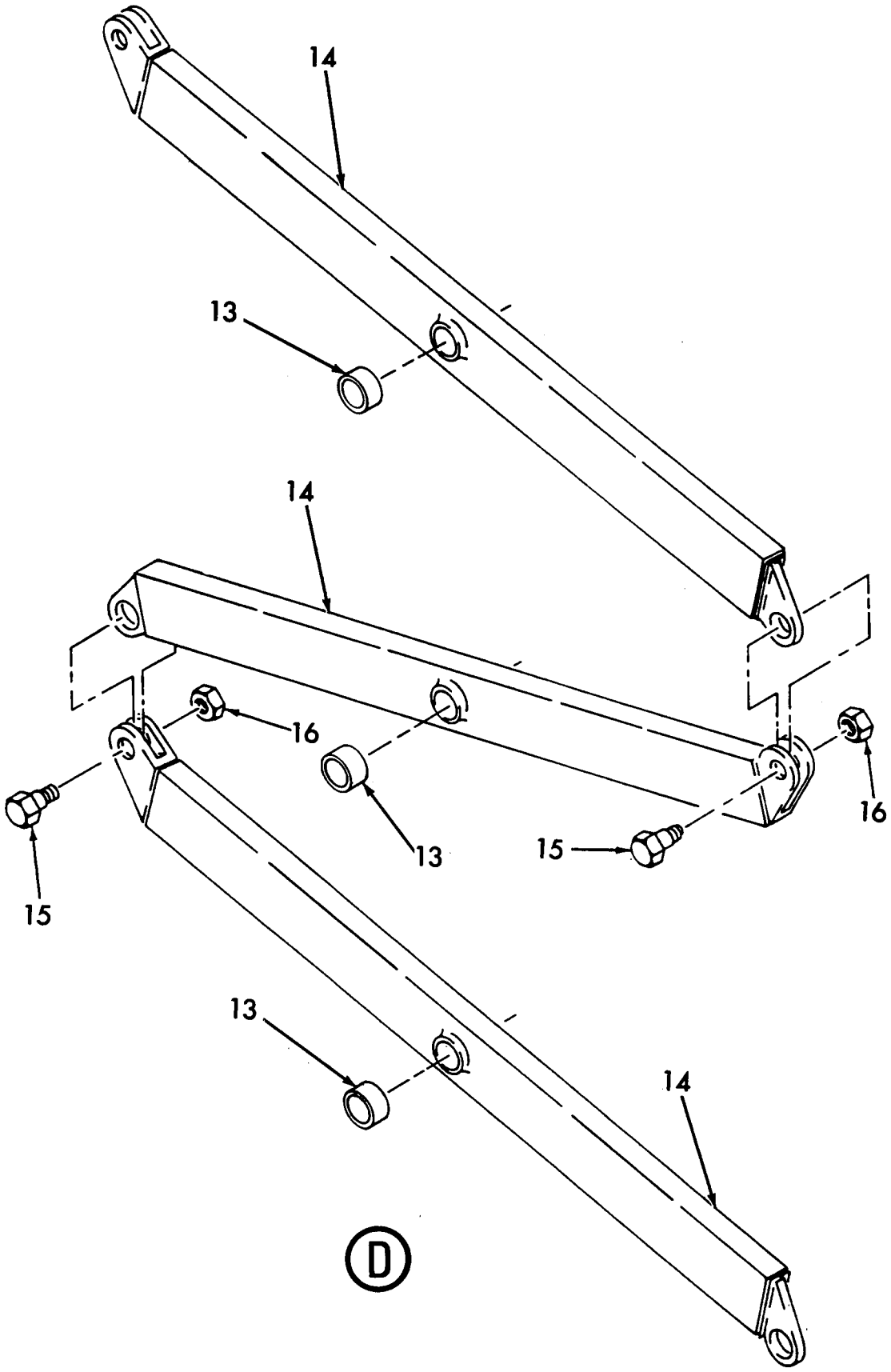


SCISSOR ASSEMBLY (M20ESEP)



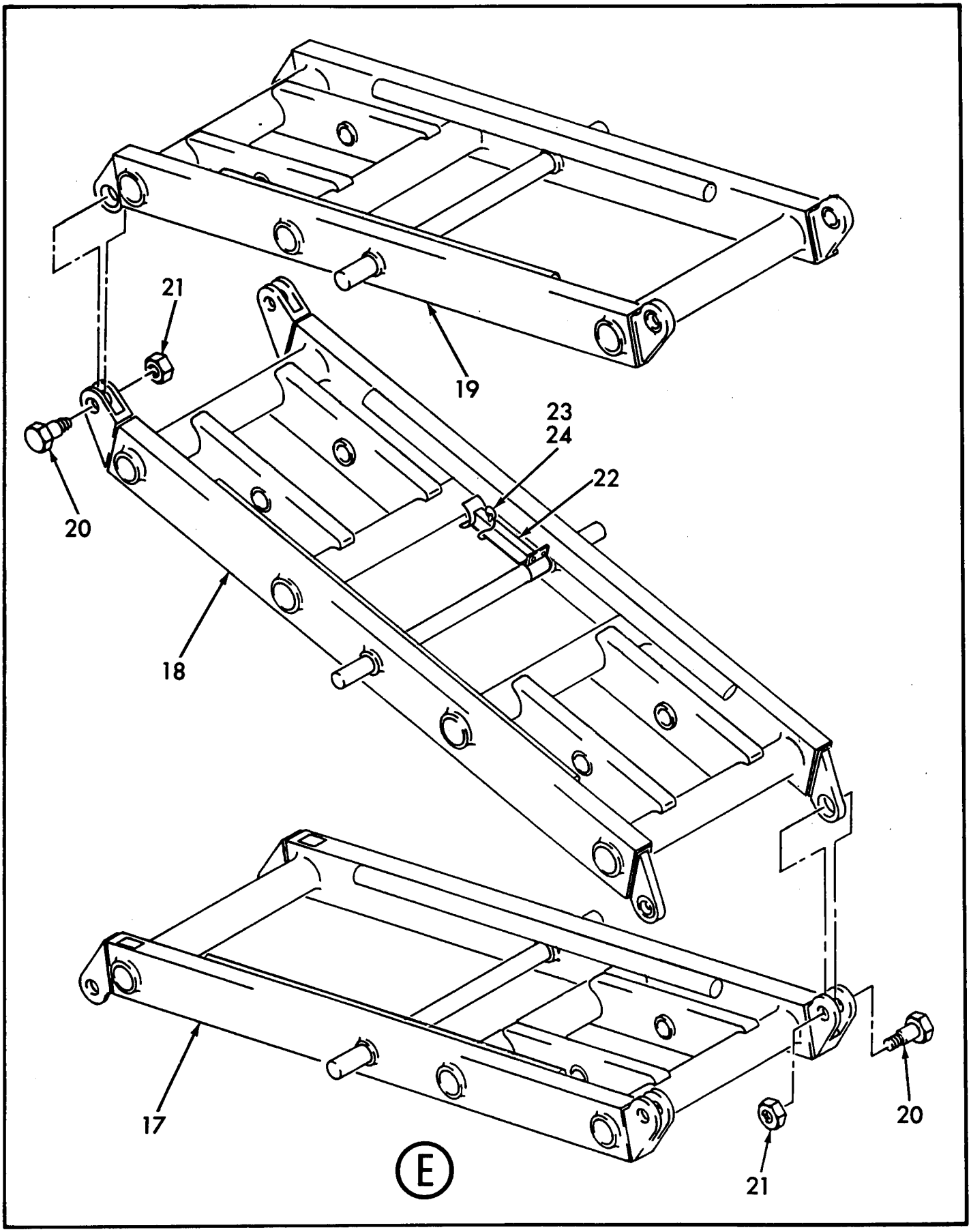
REV.

SCISSOR ASSEMBLY (M20ESEP)



REV.

SCISSOR ASSEMBLY (M20ESEP)



REV.

SCISSOR ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130615	ASSEMBLY, SCISSOR (See Sect. 2, Fig. 1 for NHA)	REF
2	130326	.PAD, WEAR	8
3	130327	.PIN, WEAR PAD	4
4	62201	.SCREW, SOCKET HEAD SET	4
5	130791	.ASSEMBLY, LIFT CYLINDER (SINGLE ACTING) (BEFORE JAN. 1989)	1
	131421	.ASSEMBLY, LIFT CYLINDER (SINGLE ACTING) (AFTER JAN. 1989) (See Sect. 4, Fig. 2 for Details)	2
6	130493	.PIN, TRUNNION	4
7	60533	.SCREW, HEX HEAD CAP	4
8	63302	.WASHER, SPLIT LOCK	4
9	130789	.ASSEMBLY, LIFT CYLINDER (TELESCOPIC) (BEFORE JAN. 1989) (See Sect. 4, Fig. 3 for Details)	1
10	130493	.PIN, TRUNNION	4
11	60533	.SCREW, HEX HEAD CAP	4
12	63302	.WASHER, SPLIT LOCK	4
13	65577	.COLLAR, SHAFT	6
14	130254	.ASSEMBLY, OUTER ARM SUPPORT (See Sect. 4, Fig. 5 for Details)	6
15	130696	.BOLT, EAR PIVOT	4
16	61249	.NUT, HEX	4
17	130262	.ASSEMBLY, INNER ARM (LOWER) (See Sect. 4, Fig. 6 for Details)	1
18	130268	.ASSEMBLY, INNER ARM (MIDDLE) (See Sect. 4, Fig. 7 for Details)	1
19	130272	.ASSEMBLY, INNER ARM (UPPER) (See Sect. 4, Fig. 8 for Details)	1
20	130696	.BOLT, EAR PIVOT	4

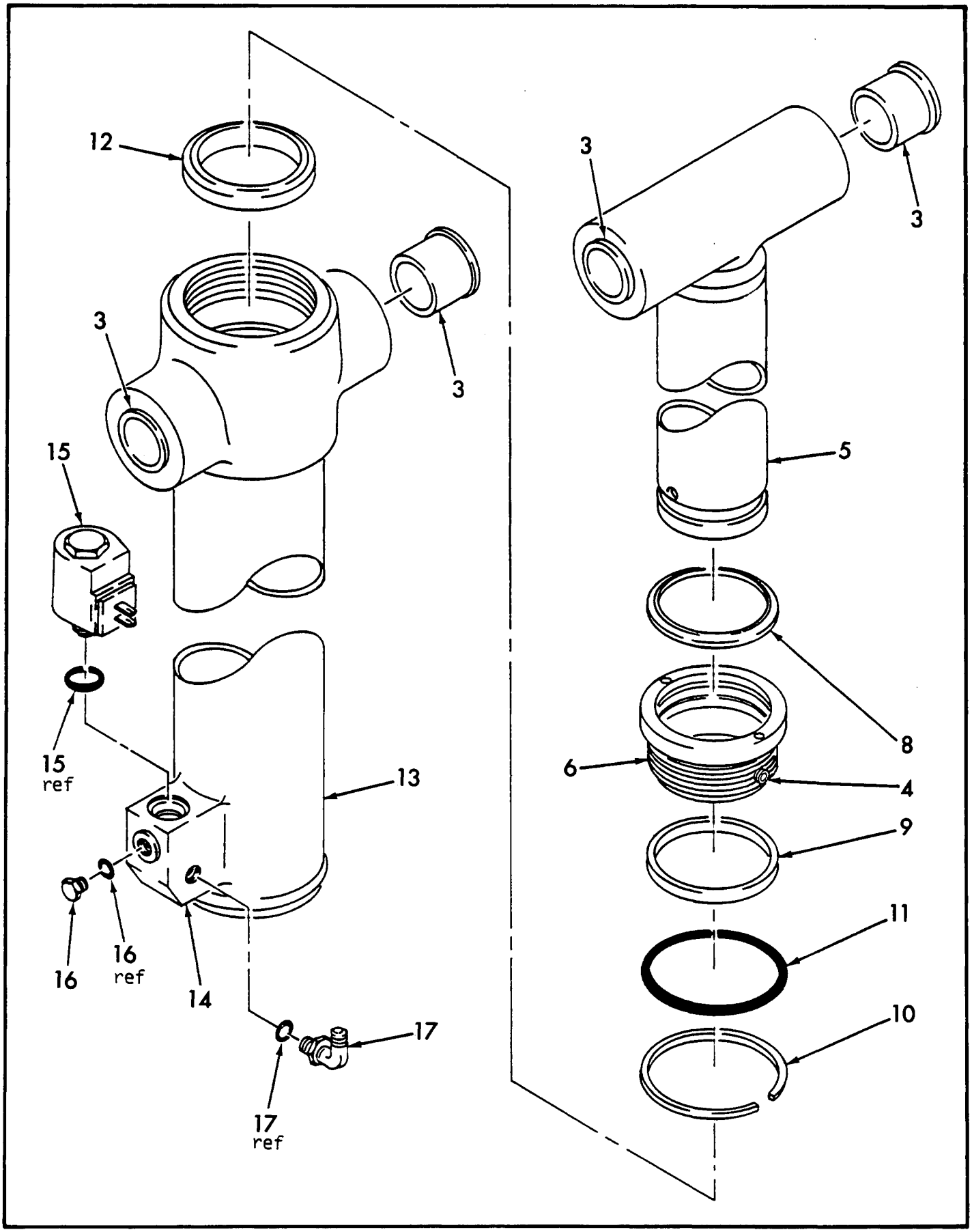
- ITEM NOT ILLUSTRATED

SCISSOR ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
21	61249	.NUT, HEX	4
22	130511	.ASSEMBLY, INNER ARM SUPPORT (See Sect. 4, Fig. 4 for Details)	1
23	12007	.PIN, BALL-LOC DETENT	1
24	375	.RIVET	1

- ITEM NOT ILLUSTRATED

LIFT CYLINDER ASSEMBLY (single acting) (BEFORE JAN. 1989)



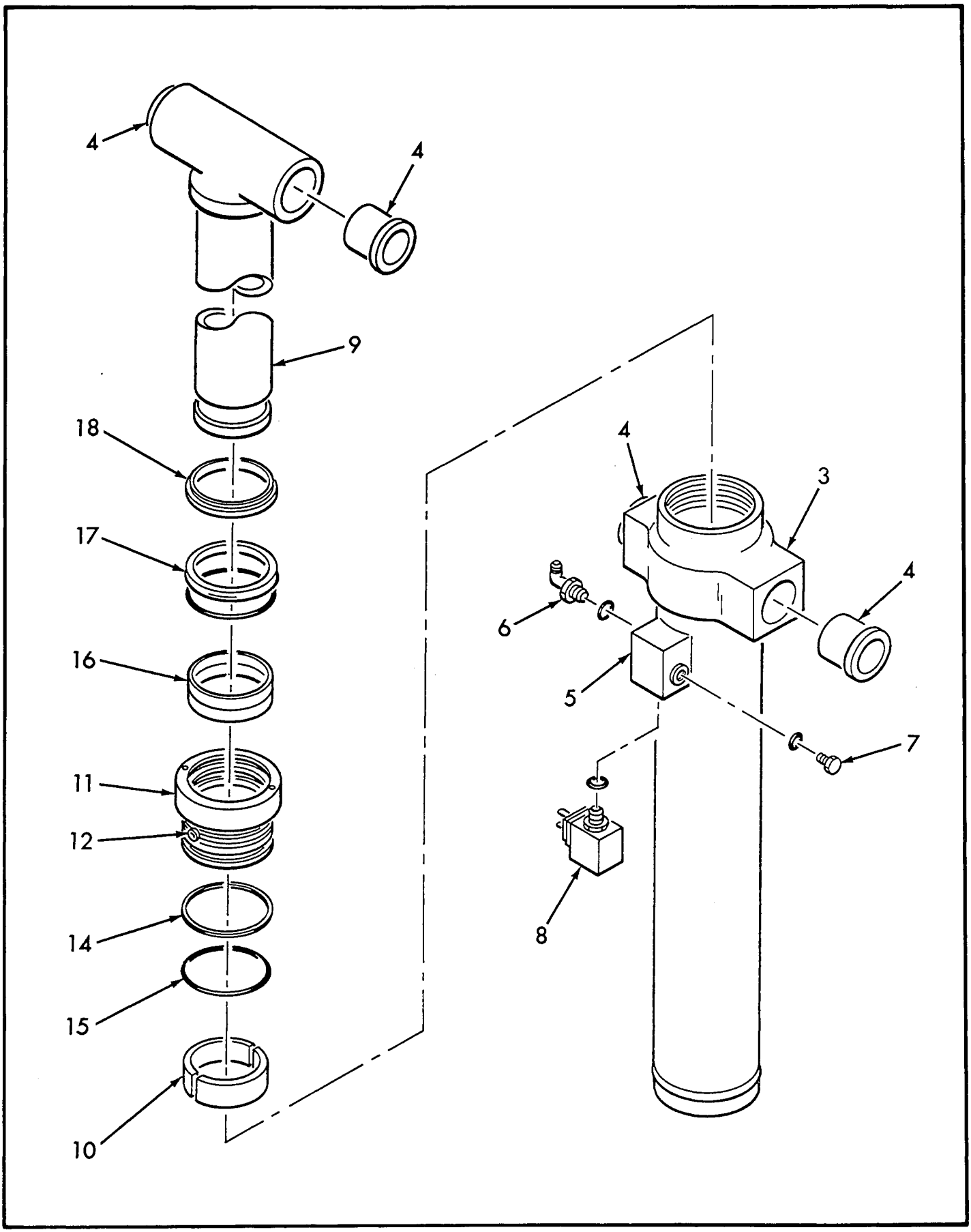
REV.

LIFT CYLINDER ASSEMBLY (single acting) (BEFORE JAN. 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130791	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
-2	130790	.CYLINDER, SINGLE ACTING LIFT	1
3	67036	..BUSHING, FLANGED BRONZE	4
4	30010	..PLUG, NYLON	1
5		..ROD	1
6		..NUT, ROD BEARING	1
-7	66822	..KIT, SEAL	1
8	30163	...WIPER, ROD	1
9	32127	...O-RING	1
10	30066	...RING, BACK-UP	1
11	30065	...SEAL, STATIC	1
12		..PISTON	1
13		..BODY	1
14		..VALVE, CHECK	1
15	81028	.VALVE, SOLENOID	1
16	80050-03	.PLUG, O-RING	1
17	80012-05	.ELBOW	1

- ITEM NOT ILLUSTRATED

LIFT CYLINDER ASSEMBLY (single acting) (AFTER JAN. 1989)



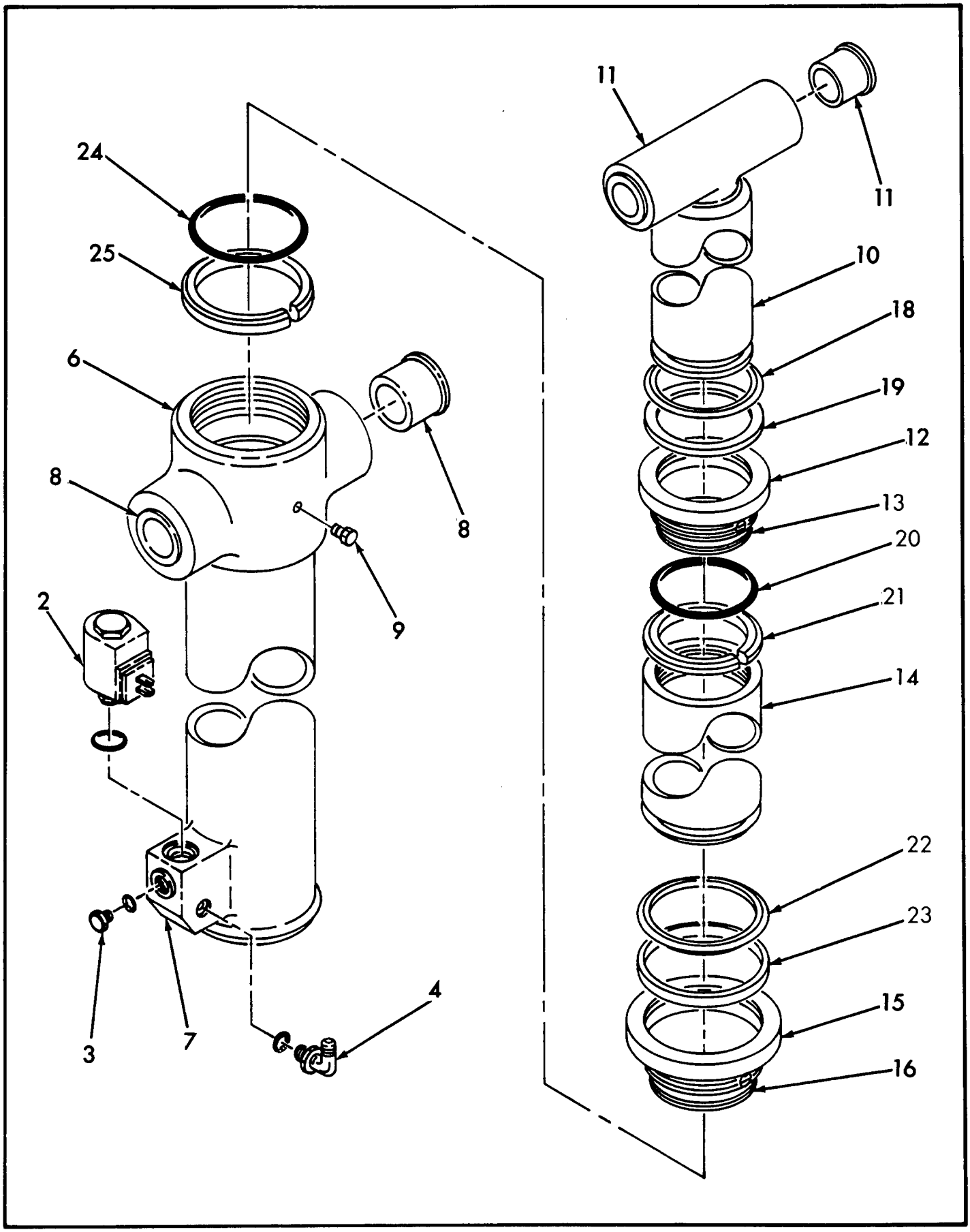
REV.

LIFT CYLINDER ASSEMBLY (single acting) (AFTER JAN. 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131421	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
-2	131411	.CYLINDER, LIFT	1
3	67828	..BARREL	1
4	67830	..BUSHING, FLANGED BRONZE	4
5		..VALVE, CHECK	1
6	80012-08	.ELBOW	1
7	80050-03	.PLUG, 'O' RING	1
8	81028	.SOLENOID, ELECTRIC CHECK	1
9	67829	..ROD	1
10	67831	..PISTON, SPLIT	1
11	67832	..GLAND	1
12		..PLUG, NYLON	4
-13	67676	..KIT, SEAL	1
14		...RING, BACK-UP	1
15		...'O' RING	1
16		...RING, WEAR	2
17		...U-CUP, LOADED ('O' RING)	1
18		...WIPER, ROD	1

- ITEM NOT ILLUSTRATED

LIFT CYLINDER ASSEMBLY (telescopic) (BEFORE JAN. 1989)



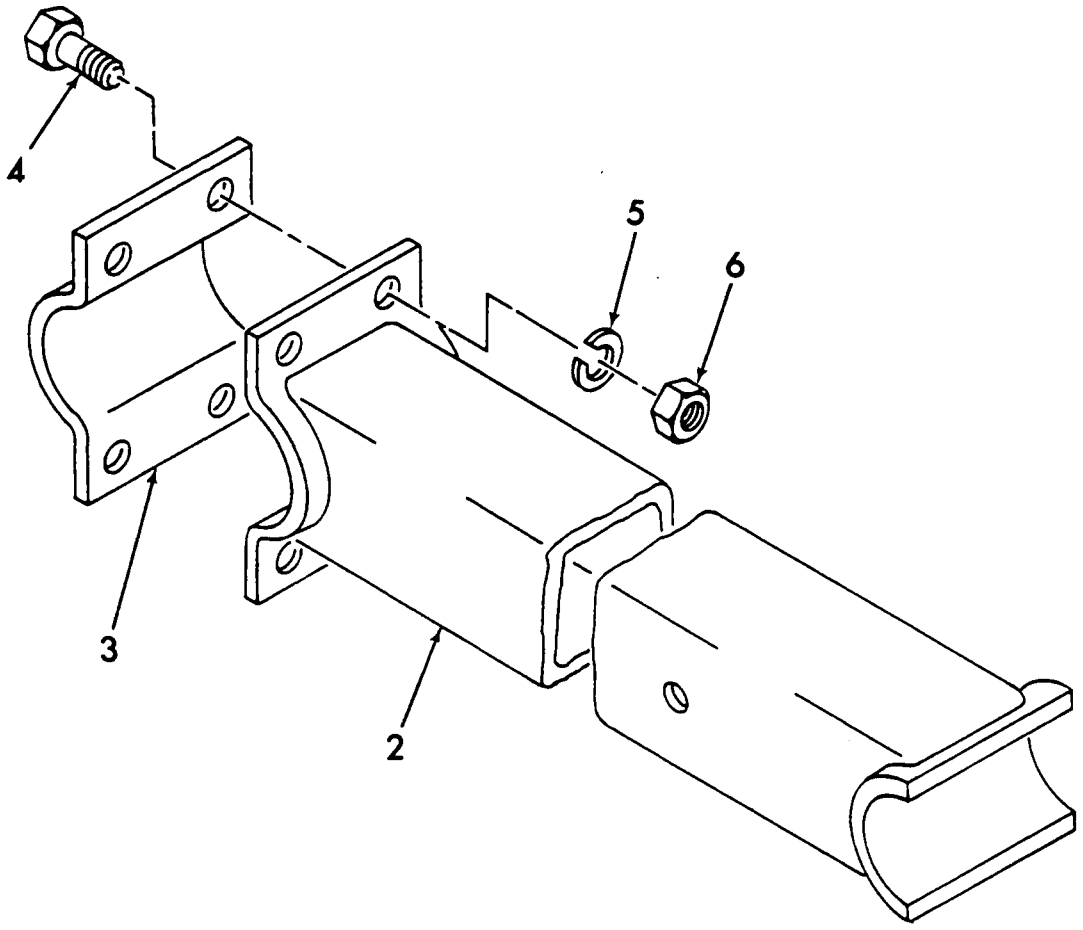
REV.

LIFT CYLINDER ASSEMBLY (telescopic)
(BEFORE JAN. 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130789	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	81028	.VALVE, SOLENOID	1
3	80050-03	.PLUG, O-RING	1
4	80012-05	.ELBOW	1
5	130788	.CYLINDER, TELESCOPIC LIFT	1
6		..BODY	1
7		..VALVE, CHECK	1
8		..BUSHING, FLANGED BRONZE	2
9	65214	..PLUG, VENT	1
10		..ROD, (3.50 DIA.)	1
11	67036	..BUSHING, FLANGED BRONZE	2
12		..NUT, ROD BEARING	1
13	30010	..PLUG, NYLON	1
14		..ROD, (4.50 DIA.)	1
15		..NUT, ROD BEARING	1
16		..PLUG, NYLON	1
17	66818	..KIT, SEAL	1
18	30163	...WIPER, A.N.	1
19	32252	...U-RING	1
20	30065	...O-RING	1
21		...RING, BACKUP	1
22	30148	...WIPER, A.N.	1
23	32128	...U-RING	1
24	30065	...O-RING	1
25		...RING, BACKUP	1

- ITEM NOT ILLUSTRATED

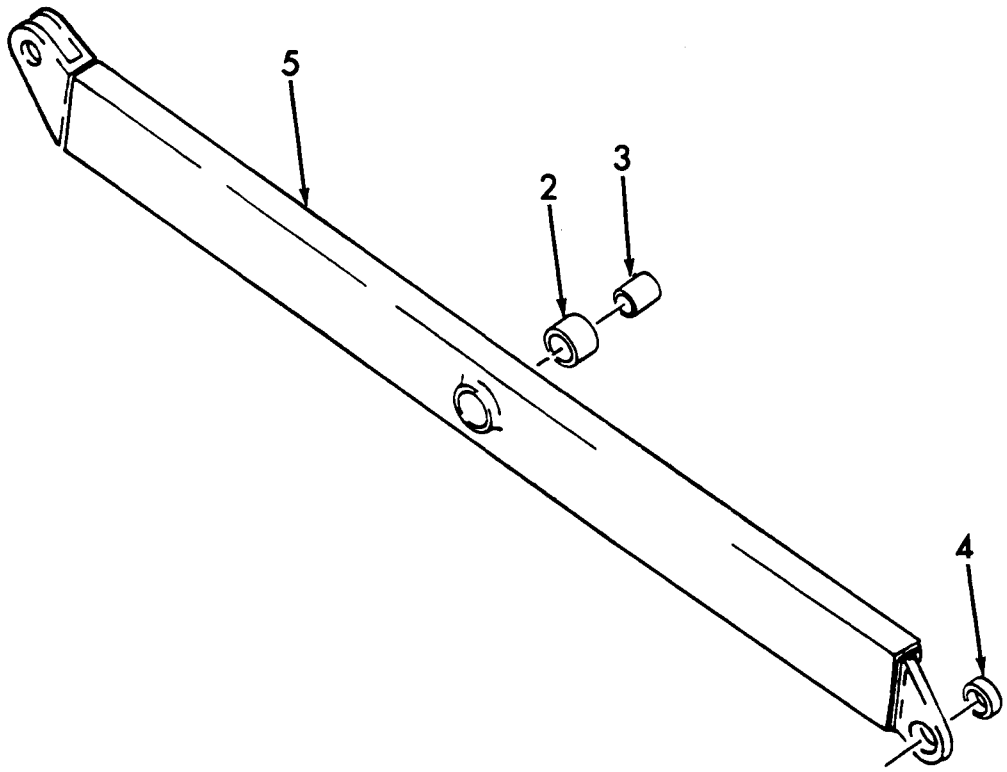
INNER ARM SUPPORT ASSEMBLY (M20ESEP)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130511	ASSEMBLY, INNER ARM SUPPORT (See Sect. 4, Fig. 1 for NHA)	REF
2	130512	. WELDMENT, INNER ARM SUPPORT	1
3	30693	. CLAMP, INNER ARM SUPPORT	1
4	60343	. SCREW, H.H.C. (attaching part)	4
5	63303	. WASHER, SLIT LOCK (attaching part)	4
6	60703	. NUT, HEX (attaching part)	4

REV.

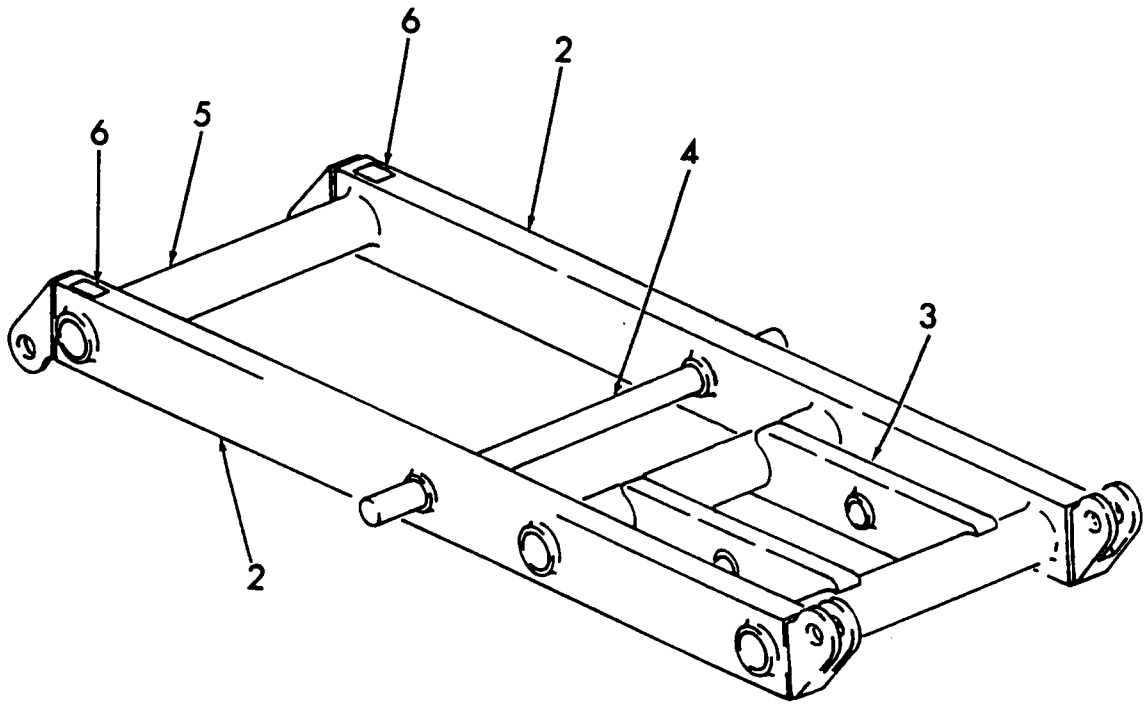
OUTER ARM SUPPORT ASSEMBLY (M20ESEP)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130254	ASSEMBLY, OUTER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130258	.SLEEVE	1
3	64922	.BUSHING	1
4	916	.BUSHING	1
5	130253	.MACHINING, ARM	1

REV.

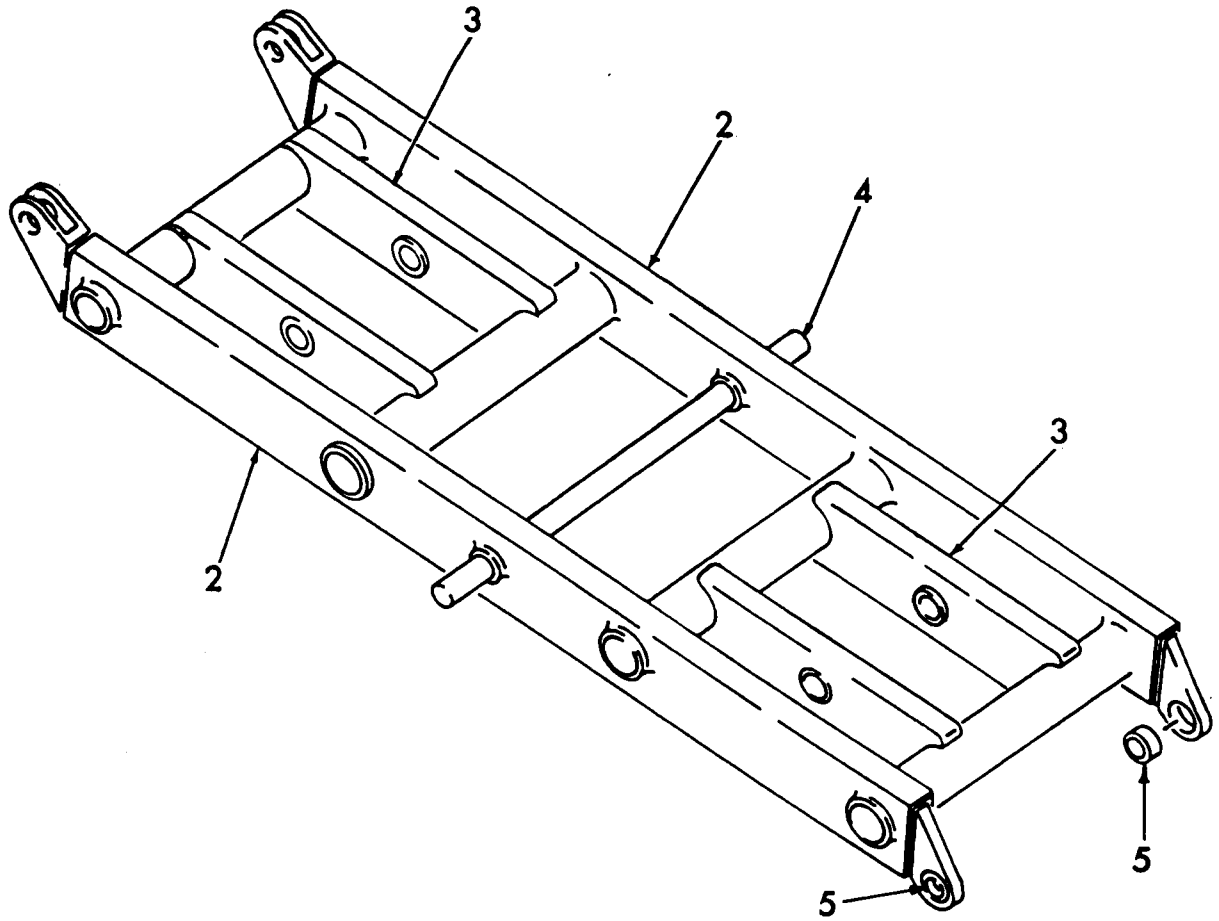
INNER ARM ASSEMBLY (lower)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130262	ASSEMBLY, INNER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130261	.SUB-ASSEMBLY, INNER ARM	2
3	130273	..SUPPORT, TRUNNION CYLINDER	1
4	130274	..SHAFT, CENTER	1
5	36046	..PIPE	1
6	35994	..BAR, FLAT	2

REV.

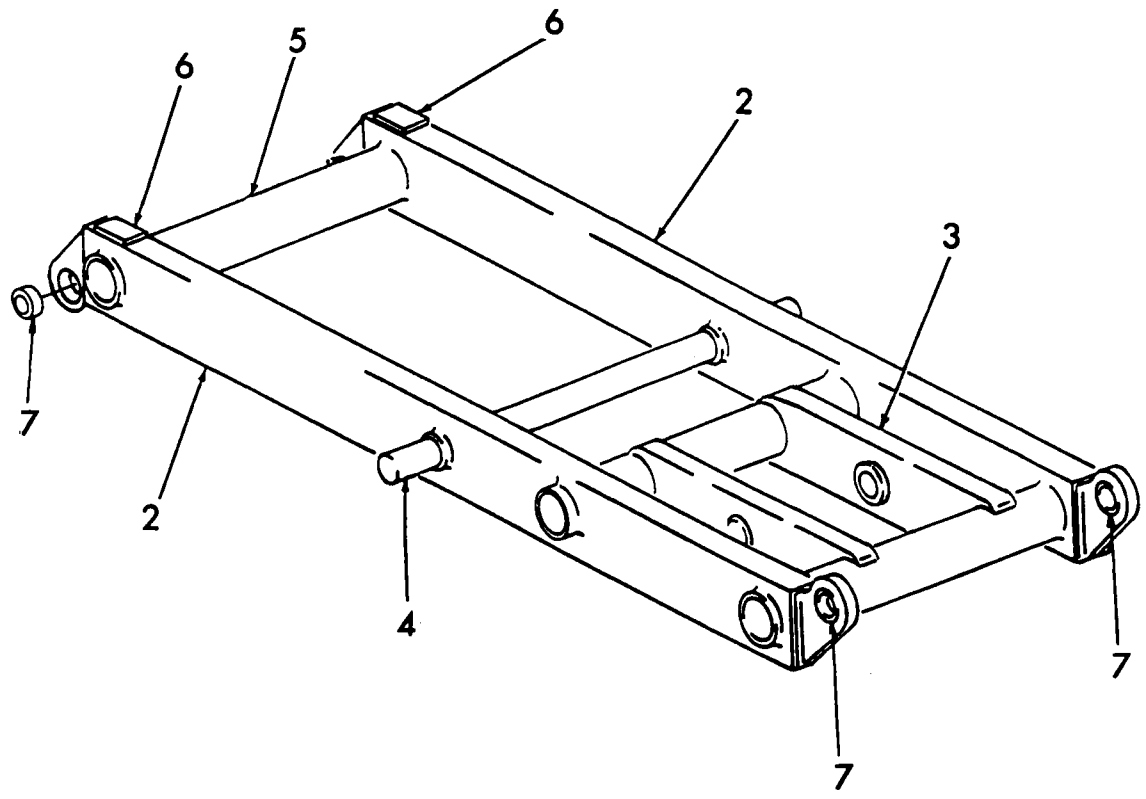
INNER ARM ASSEMBLY (middle)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130268	ASSEMBLY, INNER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130267	.SUB-ASSEMBLY, INNER ARM	2
3	130273	..SUPPORT, TRUNNION CYLINDER	2
4	130274	..SHAFT, CENTER	1
5	916	..BUSHING	2

REV.

INNER ARM ASSEMBLY (upper)

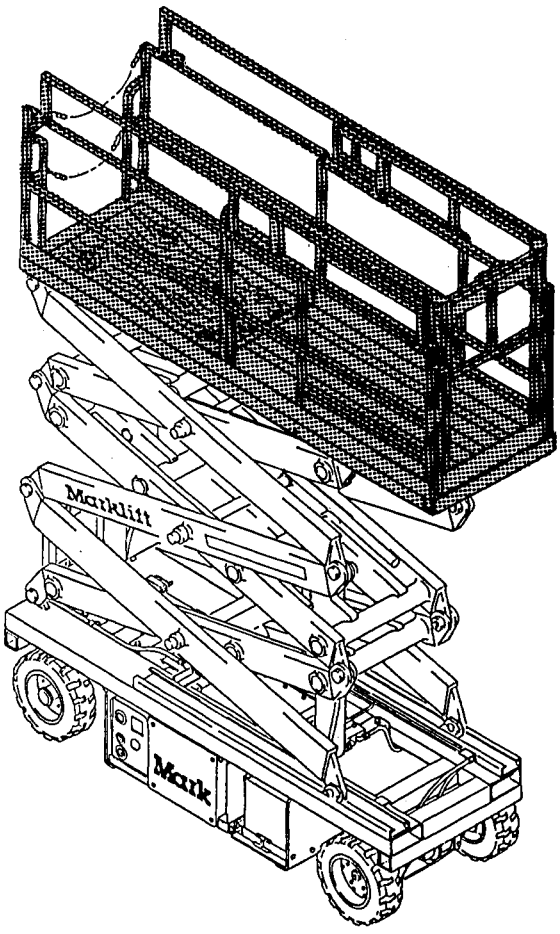


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	130272	ASSEMBLY, INNER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	130271	.SUB-ASSEMBLY, INNER ARM	2
3	130273	..SUPPORT, TRUNNION CYLINDER	1
4	130274	..SHAFT, CENTER	1
5	36046	..PIPE	1
6	35994	..BAR, FLAT	2
7	916	..BUSHING	4

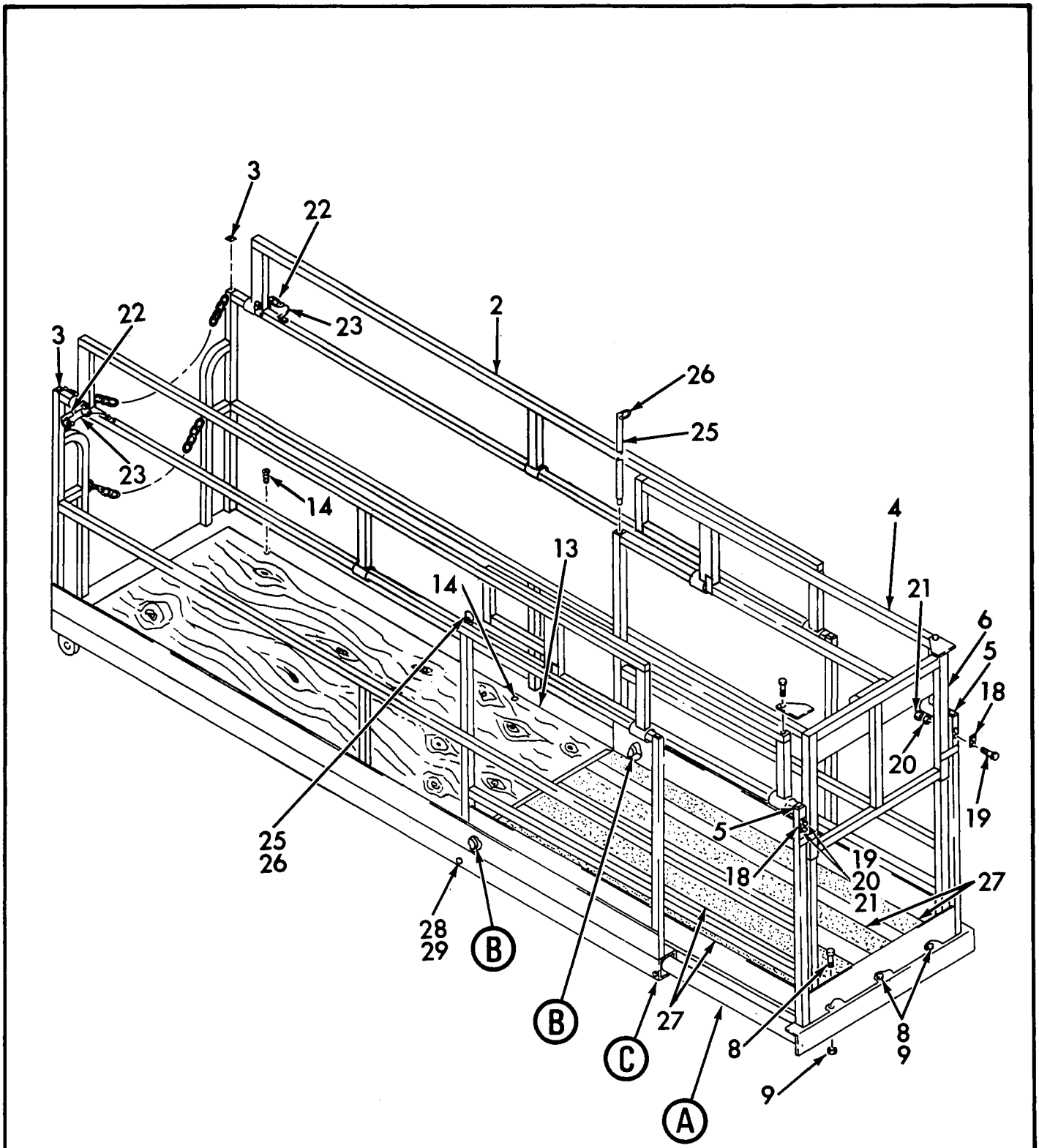
REV.

THIS SECTION 5 CONTAINS THE FOLLOWING FIGURE:

FIG. NO.	TITLE
1	PLATFORM ASSEMBLY

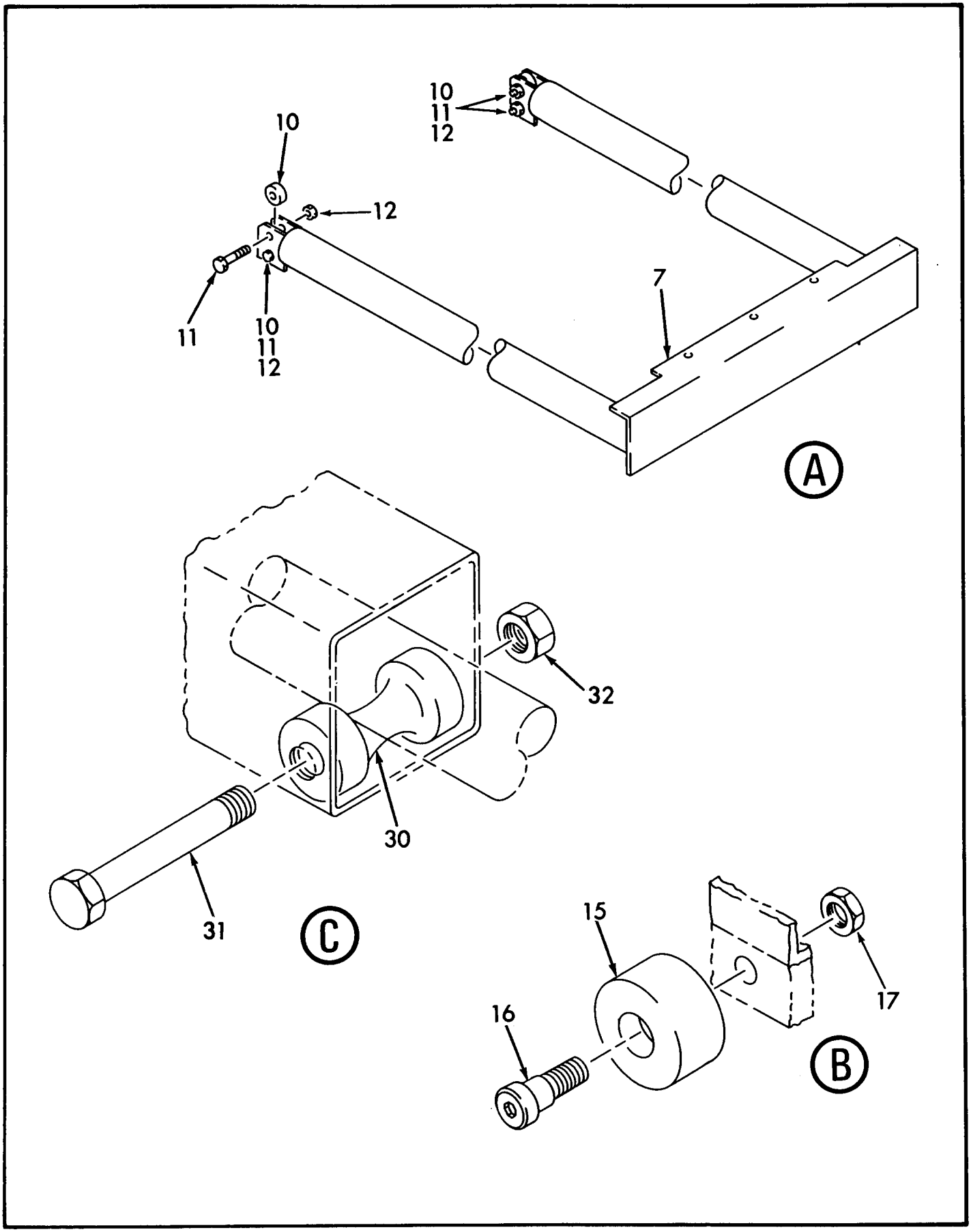


PLATFORM ASSEMBLY (M20ESEP)



REV.

PLATFORM ASSEMBLY (M20ESEP)



PLATFORM ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131172	ASSEMBLY, PLATFORM SLIDE OUT (See Sect. 2, Fig. 1 for NHA)	REF
2	131170	. WELDMENT, PLATFORM	1
3	91541	. PLUG, CAP	2
4	131173	. WELDMENT, PLATFORM SLIDE OUT	1
5	91541	. PLUG, CAP	2
6	131004	. RAIL, FRONT GUARD	1
7	130891	. WELDMENT, SLIDE	1
8	60325	. SCREW, CAP (attaching part)	3
9	61318	. NUT, LOCK (attaching part)	3
10	131028	. ROLLER, REAR	4
11	60370	. SCREW, CAP (attaching part)	4
12	61305	. NUT, HEX (attaching part)	4
13	131175	. FLOOR, PLYWOOD	1
14	61713	. SCREW, SELF-TAPPING CAP (attaching part)	6
15	31161	. ROLLER, PLATFORM SLIDE OUT	2
16	62101	. SCREW, SHOULDER (attaching part)	2
17	61318	. NUT, LOCK (attaching part)	2
18	130926	. PLATE, LOCK	2
19	60360	. SCREW, CAP (attaching part)	4
20	63302	. WASHER, LOCK (attaching part)	4
21	60702	. NUT, HEX (attaching part)	4
22	65124	. PIN, BALL-LOK	2
23	65669	. ASSEMBLY, LANDYARD	2
-24	63651	. RIVET, POP (attaching part)	2

- ITEM NOT ILLUSTRATED

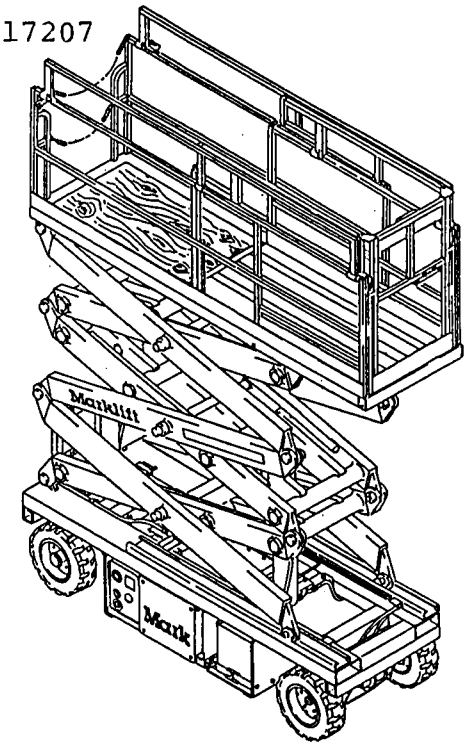
PLATFORM ASSEMBLY (M20ESEP)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	130825	. WELDMENT, LOCK PIN	2
26	65687	. SPLIT, RING	2
27	131035	. SURFACING, ANTI-SLIP	4
28	60388	. SCREW, CAP (attaching part)	2
29	61305	. NUT, HEX (attaching part)	2
30	131023	. GUIDE, ROLLER	2
31	90564	. SCREW, CAP	2
32	61305	. NUT, HEX	2

- ITEM NOT ILLUSTRATED

THIS SECTION 6 CONTAINS THE FOLLOWING FIGURES:

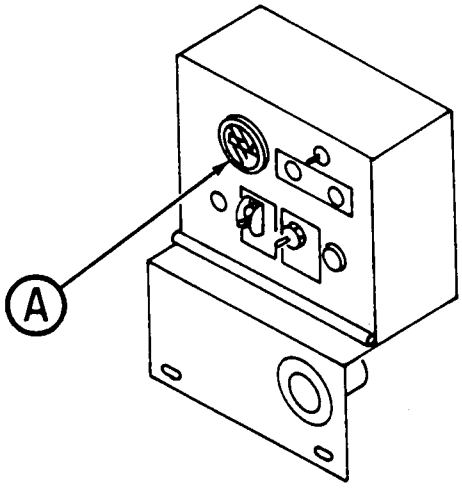
FIG. NO.	TITLE	PART NO.
1	TRAVEL WARNING HORN	131901
2	ALL MOTION ALARM	131900
3	HOUR METER	131065
4	ROTATING AMBER BEACON	130921
5	24 VOLT PLATFORM WORKLIGHT	131904
6	SWING GATE	131929
7	REMOTE DRIVE KIT	131916
8	REMOTE PLUG ONLY FOR REMOTE DRIVE	131956
9	LANYARD/CONTROL BOX ONLY FOR REMOTE DRIVE	130911
10	PROPOTIONAL DRIVE CONTROLS	130919
11	SOLID STATE SLOPE SENSOR IN LIEU OF STANDARD	131908
12	SOLID STATE DELUXE CHARGER IN LIEU OF STANDARD	70228
13	SLIDE OUT BELLY PAN	130924
14	TUV PACKAGE	131926
15	NON-MARKING TIRES 4.00 x 8	131945
	PARTS AND SERVICE MANUAL	17207

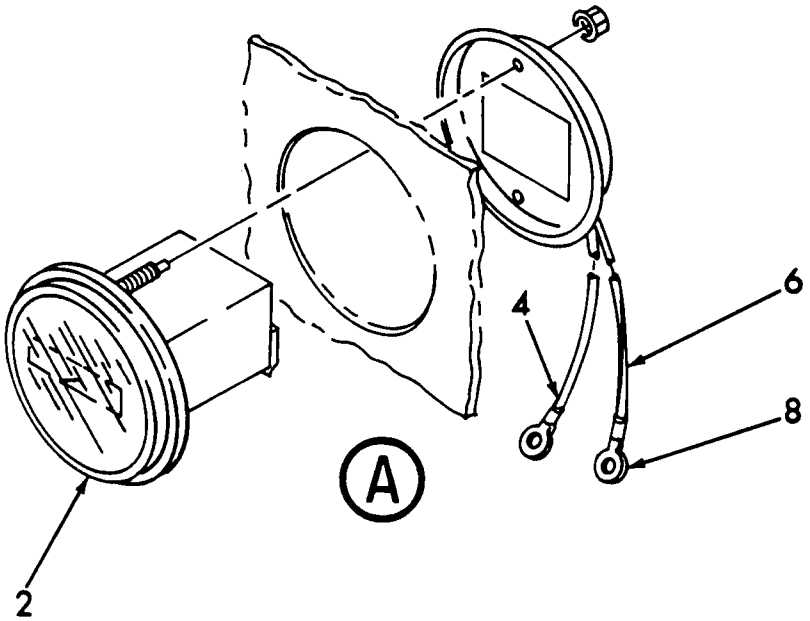


TRAVEL WARNING HORN

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131901
IS NOT AVAILABLE THIS EDITION

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131900
IS NOT AVAILABLE THIS EDITION


A


6
4
8
A
2

HOURMETER

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131065	HOURMETER	REF
2	20571	.HOURMETER	1
4	70232	.WIRE, WHITE 1.5 FEET	AR
6	70008	.WIRE, YELLOW/GREEN 1.5 FEET	AR
8	117-C	.RING, CONNECTOR	2

- ITEM NOT ILLUSTRATED

ROTATING AMBER BEACON

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 130921
IS NOT AVAILABLE THIS EDITION

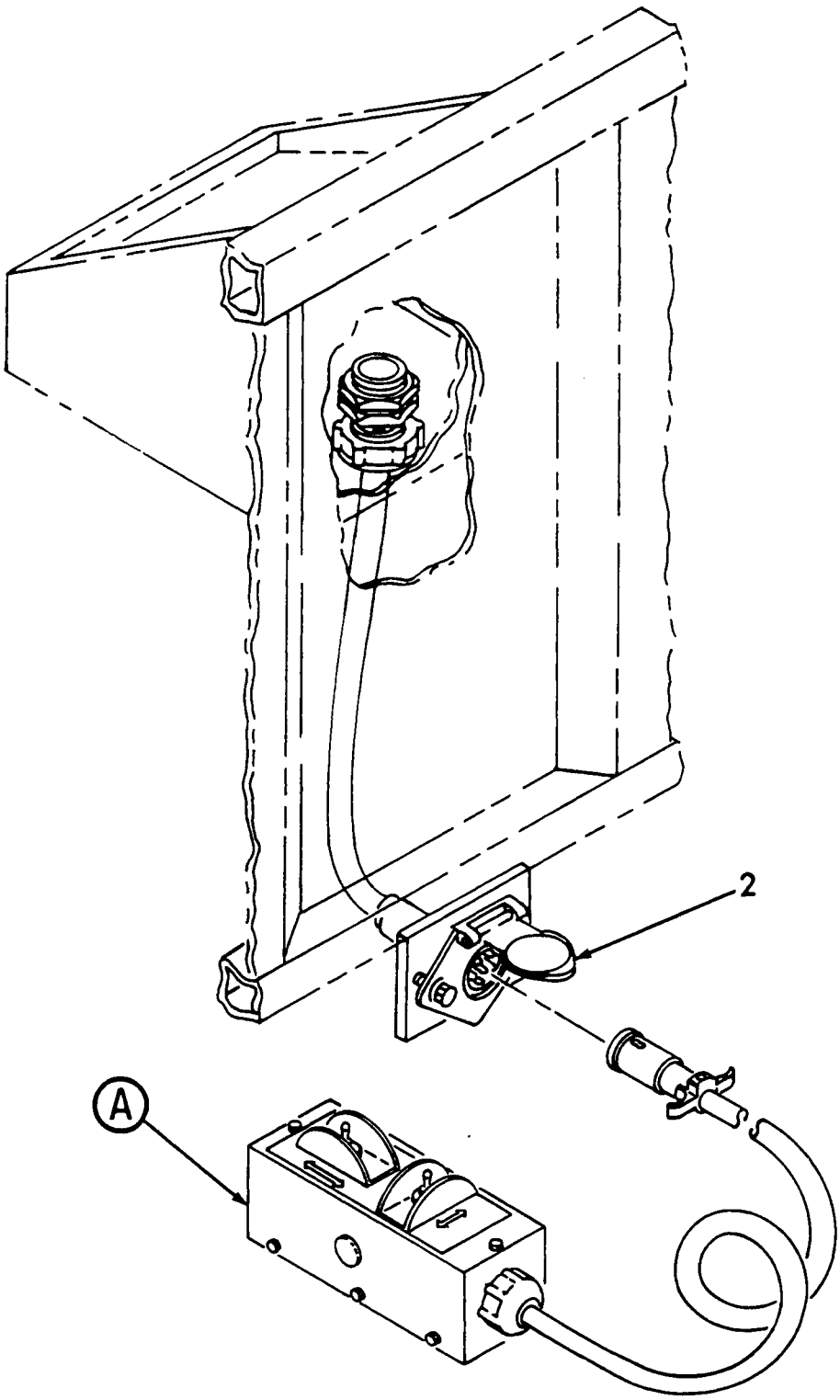
24 VOLT PLATFORM WORKLIGHT

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131904
IS NOT AVAILABLE THIS EDITION

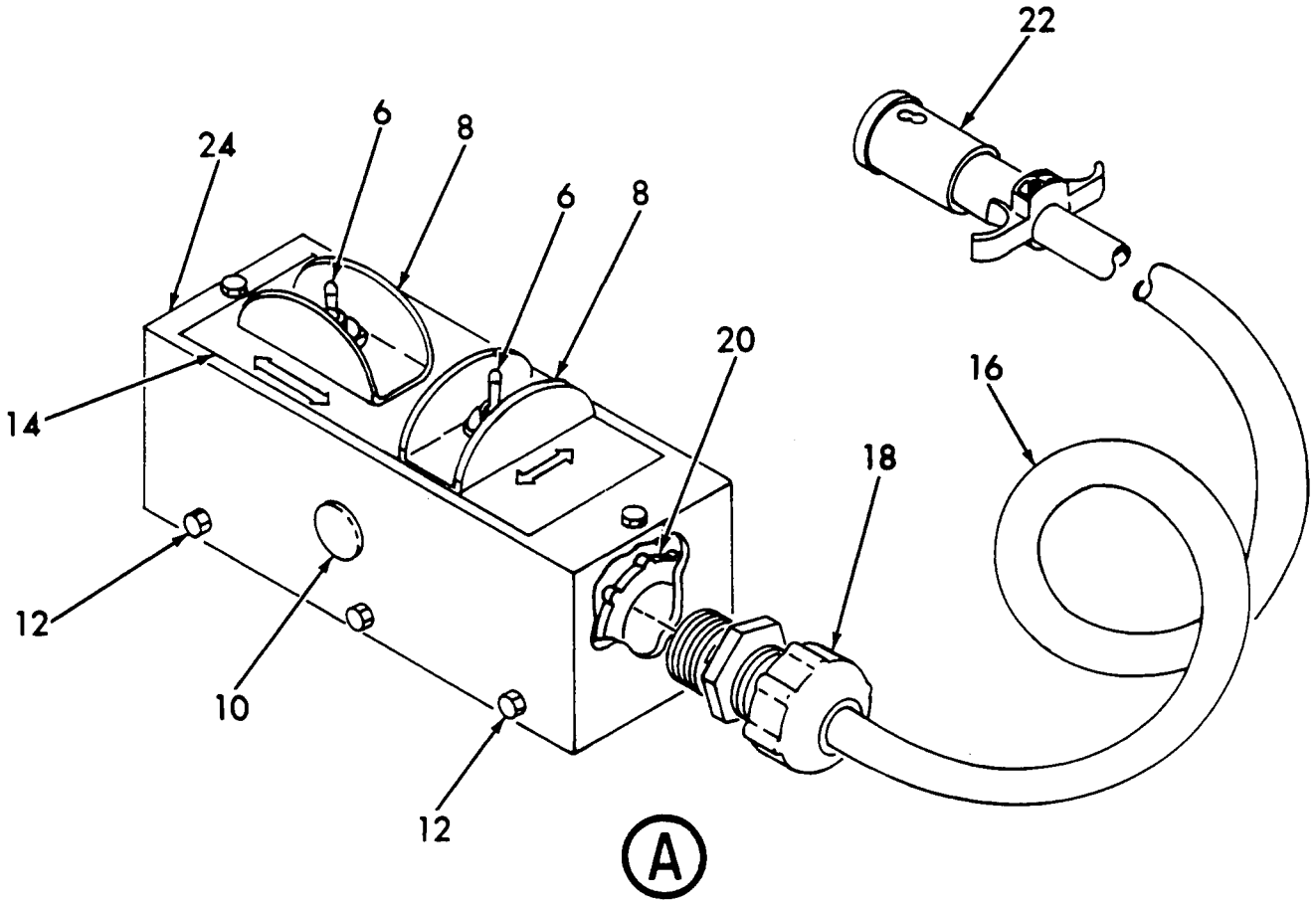
SWING GATE

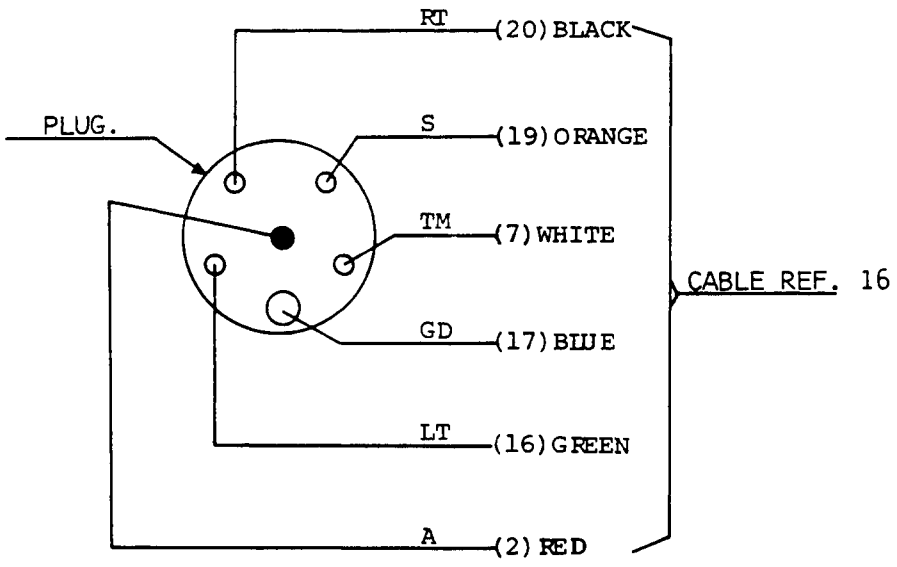
THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131929
IS NOT AVAILABLE THIS EDITION

REMOTE DRIVE KIT



REV.





PLUG WIRING DIAGRAM

REMOTE DRIVE KIT

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	131916	KIT, REMOTE DRIVE	REF
2	131940	.PLUG, FEMALE REMOTE DRIVE & STEER	1
-4	130911	.ASSEMBLY, REMOTE DRIVE LANYARD/CONTROL	1
6	20481	..SWITCH, TOGGLE	2
8	20884	..GUARD, SWITCH	2
10	771	..PLUG, WHITE	1
12	61726	..SCREW, SELF TAPPING	8
14	130906	..DECAL, R. CONTROL DRIVE & STEER	1
16	130902-08	..CABLE, CONDUCTOR	1
18	70281	..RELIEF, STRAIN	1
20	2808	..NUT, LOCK	1
22	70266	..PLUG, (6-POLE)	1
24	130901	..ASSEMBLY, ELECTRICAL	1

- ITEM NOT ILLUSTRATED

FEMALE PLUG ONLY FOR REMOTE DRIVE

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131956
IS NOT AVAILABLE THIS EDITION

LANYARD/CONTROL BOX
ONLY FOR REMOTE DRIVE

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 130911
IS NOT AVAILABLE THIS EDITION

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 130919
IS NOT AVAILABLE THIS EDITION

SOLID STATE SLOPE SENSOR
IN LIEU OF STANDARD

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131908
IS NOT AVAILABLE THIS EDITION

SOLID STATE DELUXE CHARGER
IN LIEU OF STANDARD

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 70228
IS NOT AVAILABLE THIS EDITION

SLIDE OUT BELLY PAN

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 130924
IS NOT AVAILABLE THIS EDITION

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131926
IS NOT AVAILABLE THIS EDITION

NON-MARKING TIRES 4.00x8

THIS SECTION 6 - OPTION ASSEMBLY
PRINT NO. 131945
IS NOT AVAILABLE THIS EDITION

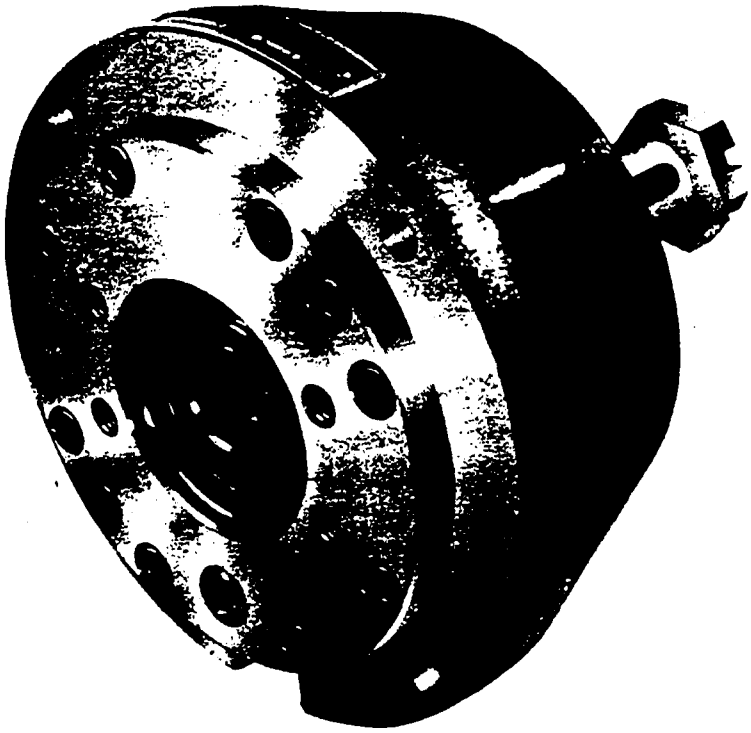
THIS SECTION 7 CONTAINS THE FOLLOWING VENDOR DATA:

SY·TEC SERIES

MULTIPLE DISC BRAKE

(wheel mount)

SERVICE MANUAL mico



mico INCORPORATED
mico WEST / SY·TEC

MICO, INC.
1911 Lee Blvd., P.O. Box 2118, No. Mankato, MN U.S.A. 56002-2118
Phone. (507) 625-6426 / TELEX 910-565-2444

MICO WEST / SY•TEC
701 East Francis St., P.O. Box 9058, Ontario, CA U.S.A. 91762-9058
Phone. (714) 947-4077 / TELEX 510-600-0132

TYPICAL BRAKE

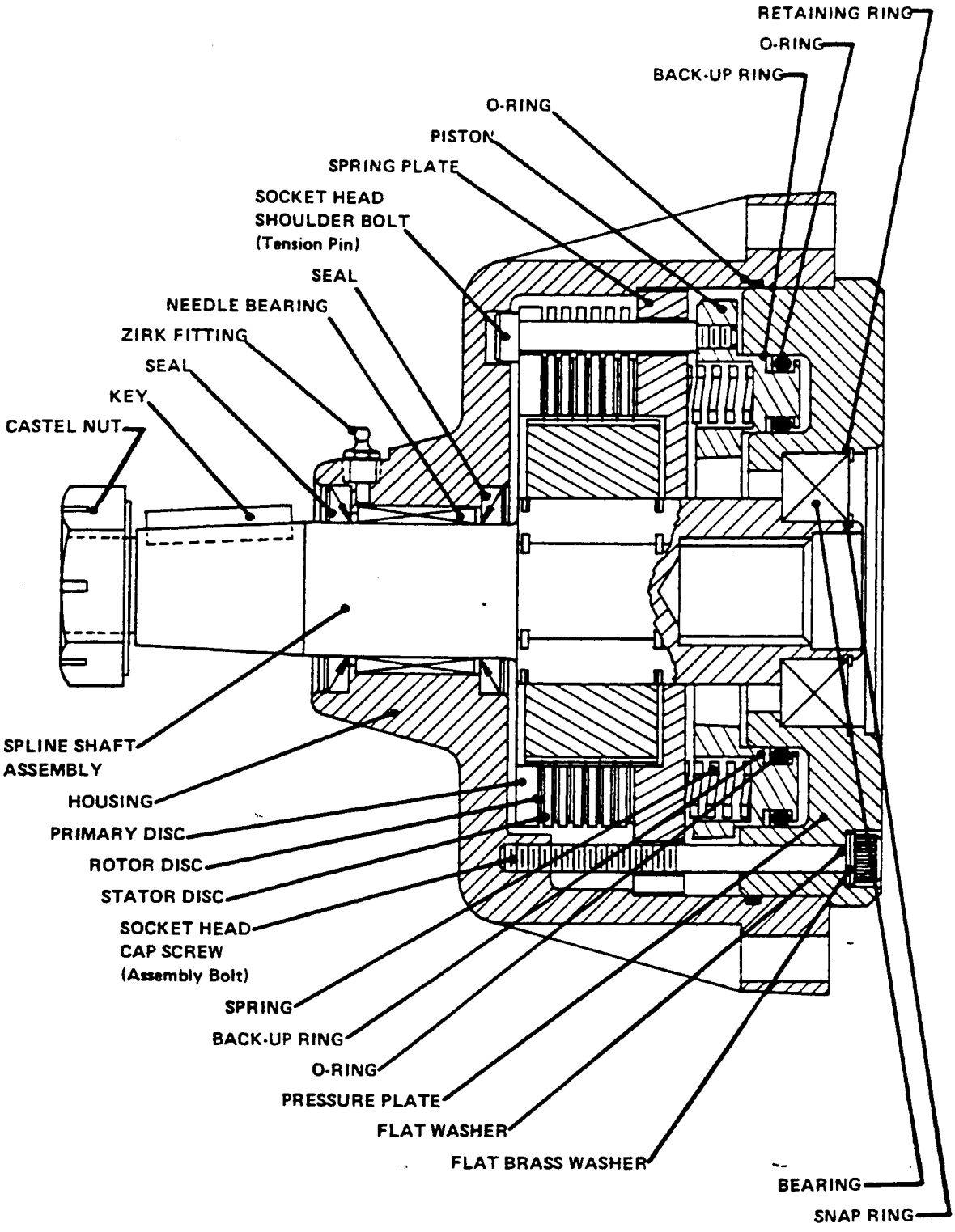


FIGURE 1

PRINCIPLES OF OPERATION

These brakes are spring-set, hydraulically released, multi-disc brakes. They are used primarily for holding loads, vehicles, conveyors, etc. in place when the hydraulic drive system is shut down or fails. Although the brakes are rated at 3,000 psi, they only require from 100 psi to 220 psi to make them function normally. The exact pressure required for operation is dependent upon the number of springs used to generate the torque necessary to hold the designed load. Thus, a brake with a full compliment of springs, will generate the highest level of torque and require approximately 220 psi to fully release the brake and provide adequate running clearance for the individual discs. A brake with 1/2 of the full spring compliment will have 1/2 as much torque and will require only 100 psi to fully release the brake. Consult catalog to choose the torque which best suits your design parameters.

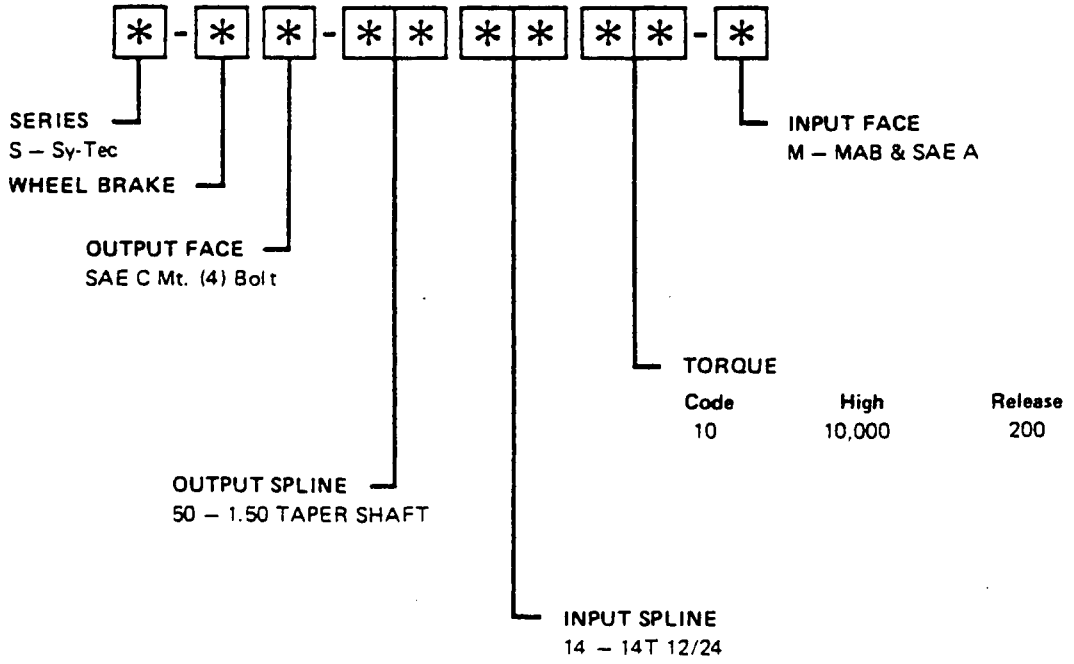
It is very important to remember that any pressure on the brake's release piston will directly effect the level of torque.

Two application examples:

1. The brake has a release pressure of 200 psi. The actuation pressure is provided by a charge pump. During certain phases of the machine's operation, the charge pump pressure dips from 200 psi to 100 psi. At 200 psi, the brake runs free (zero torque) but at 100 psi the brake will generate slightly less than half of its rated torque. The brake will drag — failure may occur. In this case, a brake should be selected which has a lower release pressure.
2. A brake has a release pressure of 200 psi. The system is set up to hold a load when a variable pump is shifted into neutral. Everything is running fine until the filter clogs, causing a 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



DISASSEMBLY

1. Remove castle nut (item 26) and key (item 20) from output end of spline shaft assembly (item 19).
2. Remove 10 socket head assembly bolts (item 4) and flat washers (items 5 & 6). Washers (item 5) are brass. A suitable holding fixture is useful to keep brake in position.
3. Tap output end of spline shaft assembly (item 19) with a soft mallet to separate housing (item 22) from internal parts assembly.
4. Remove o-ring (item 21) from housing (item 22).
5. Needle bearing (item 24) and seals (items 23 & 25) will remain in housing (item 22). Inspect parts for wear and remove only if necessary.
6. Remove snap ring (item 1) from input end of spine shaft assembly (item 19).
7. Tap input end of spline shaft assembly (item 19) with a soft mallet to separate spline shaft from internal parts assembly.
8. Bearing (item 3) and retaining ring (item 2) will remain in pressure plate (item 7). Remove both and inspect for wear.
9. Remove four socket head shoulder bolts (item 18). A suitable holding fixture is useful to hold brake in position.

   CAUTION: Do not remove shoulder bolts without pressurization of brake (approx. 200 psi) or damage may result.

10. Remove primary disc (item 17), seven rotor discs (items 16) and six stator discs (items 15).
11. Remove spring plate (item 14).
12. Before removing springs (items 13), note pattern for reassembly purposes.
13. Separate piston (item 12) and pressure plate (item 7) by carefully exerting hydraulic pressure through brake release port on pressure plate.
14. Remove outside and inside o-rings (items 8 & 10) and outside and inside back-up rings (items 9 & 11) from piston (item 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 (items 9 & 11) on piston (item 12) toward spring pockets.
3. Install o-rings (items 8 & 10) on piston (item 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 (item 12) with type fluid found in the system. Carefully press piston into pressure plate (item 7). Be sure piston is aligned correctly at all times and that there are no extrusions. Press piston until it bottoms on pressure plate (item 7).
5. Install springs (item 13) according to pattern noted during disassembly. Different colored springs must be alternated.
6. Place spring plate (item 14) over springs (item 13).
7. Install stator discs (item 15) and rotor discs (item 16). Begin with a rotor disc (item 16) and alternate with stator discs (item 15).
8. Install primary disc (item 17).
9. Align discs and partially screw in four socket head shoulder bolts (item 18).

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

   Inspect for free movement of stack and check to see if spline shaft assembly (item 19) lines up with discs so it can fit through stack. Pressurize brake release port (approx. 200 psi) to release discs. Torque shoulder bolts to 20 ft. lbs. and release pressure. A suitable holding fixture is useful to hold brake in position.
10. Install spline shaft assembly (item 19) through stack input end first and out pressure plate (item 7).
11. Install bearing (item 3) and retaining ring (item 2) in pressure plate (item 7).
12. Install snap ring (item 1) on input end of spline shaft assembly (item 19).
13. If seals (items 23 & 25) and needle bearing (item 24) were removed from housing (item 22) they must be installed. Note direction of both seals.
14. Install o-ring (item 21) in housing (item 22).
15. Install housing (item 22) with the internal parts assembly using 10 socket head assembly bolts (item 4) and flat washers (items 5 & 6).

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

    Washers (item 5) are brass and should be first on the bolts. Torque bolts to 45 ft. lbs.
16. Install castle nut (item 26) and key (item 20) on output end of spline shaft assembly (item 19).

FOR REPAIR KIT INFORMATION REFER TO PAGE 7

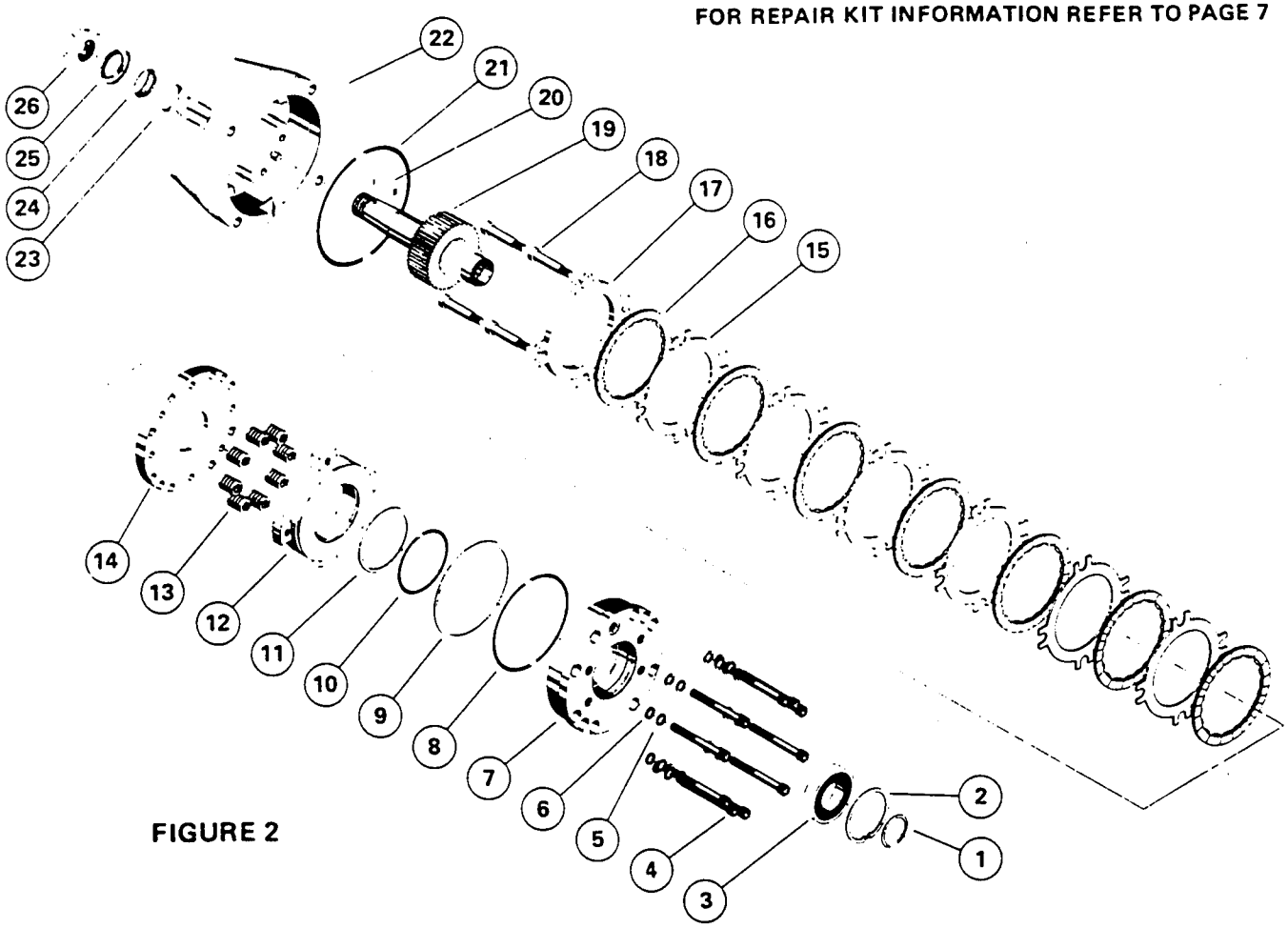


FIGURE 2

PARTS LIST

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

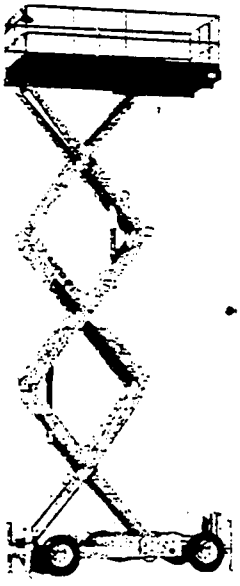
SERVICE DIAGNOSIS

PROBLEM	CAUSE	EXPLANATION	ACTION
Brake slips	A. Excessive pressure in hydraulic system	If there is back pressure in the brakes actuation line, the holding torque of the brakes is reduced.	Check filters, hose size, restrictions in other hydraulic components.
	B. Oil in brake if designed for dry use	Dry linings generate 66% more torque than linings saturated with oil. If the brake has oil in it, check the type of oil hydraulic or gearbox. 1. Gearbox oil 2. Hydraulic oil	Replace oil seal in brake Check motor seal Check piston seals Note: Internal components will need to be inspected, cleaned and replaced as required.
	C. Disc plates worn	The thickness of the disc stack sets the torque level. A thin stack reduces torque.	Check disc thickness
	D. Springs broken or have taken a permanent set	Broken or set springs can cause reduced torque - a rare occurrence	Check release pressure
Brake drags or runs hot	A. Low actuation pressure	The brake should be pressurized to minimum of 20 psi over the specified release pressure under normal operating conditions. Lower pressures will cause the brake to drag thus generating heat.	Place pressure gauge in bleed port & check pressure with system on
	B. Bearing failure	If the bearing should fail, a large amount of drag can be generated	Replace bearing
	C. Oil in brake	Excess fill of oil in sump condition thru wet brakes can cause the unit to run hot. Also excessive rpm in sump condition.	Drain oil and refill as specified for brakes Switch to flow thru cooling.
Brake will not release	A. Stuck valve or clogged	Brakes are designed to come on when system pressure drops below stated release pressure. If pressure cannot get to brake, the brake will not release.	Place pressure gauge in bleed port - check for adequate pressure - Replace defective line or component
	B. Bad o-rings	If release piston will not hold pressure, brake will not release.	
	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

REPAIR KITS

(Refer to Page 5 for item numbers)

NUMBER	DESCRIPTION	INCLUDES
12-501-026	O-ring and Back-up Ring Kit	Flat Brass Washers (items 5) Seals (items 23 & 25) O-rings (items 8, 10 & 21) Back-up Rings (items 9 & 11) Loctite
12-501-106	Lining Kit	Flat Brass Washers (items 5) O-ring (item 21) Primary Disc (item 17) Stator Discs (items 15) Rotor Discs (items 16) Loctite
12-501-108	Bearing Kit	Flat Brass Washers (items 5) O-ring (item 21) Seals (items 23 & 25) Bearings (items 3 & 24) Loctite
12-501-110	Spring Kit	Flat Brass Washers (items 5) O-ring (item 21) Springs (items 13) Loctite



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

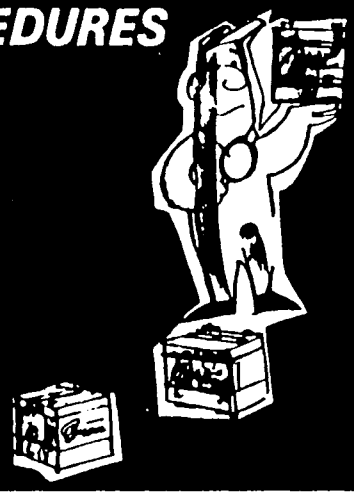
1. NEW BATTERY RECEIVAL AND INSTALLATION

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 (.075).
   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 ½ 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.

REV.

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.

Battery Council International

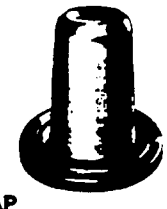
TROJAN MILEAGE MASTER BATTERIES

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.

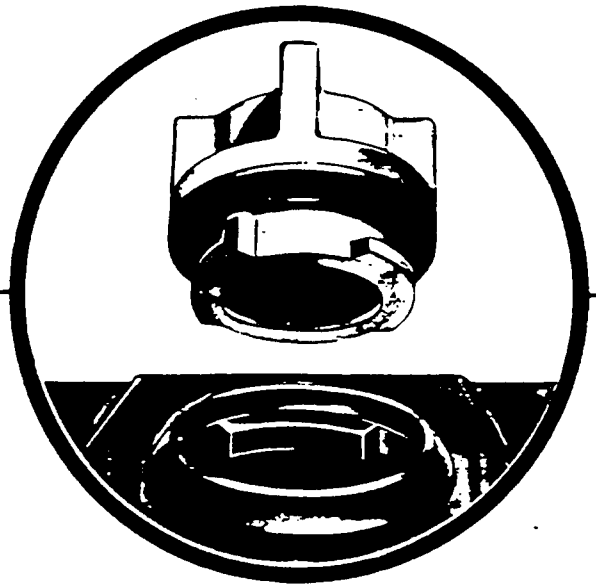
*TYPE OR TERMINAL WILL VARY HEIGHT SLIGHTLY

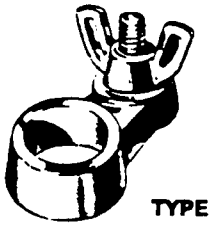
TROJAN "MILEAGE MASTER" TYPES FEATURE QUARTER-TURN VENT CAPS REDUCING SERVICE TIME 75%



TYPE AP

STRAIGHT POST



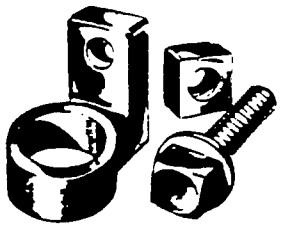


TYPE WT

WING NUT TERMINAL
3/16 or 5/16 Stud

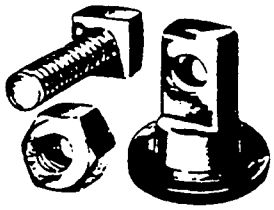
TYPE LT

ANGLE TERMINAL
5/16 Lead coated bolt



TYPE UT

UNIVERSAL TERMINAL



ALL BATTERIES COME WITH UNIVERSAL TERMINALS
UNLESS OTHERWISE SPECIFIED

DISTRIBUTED BY

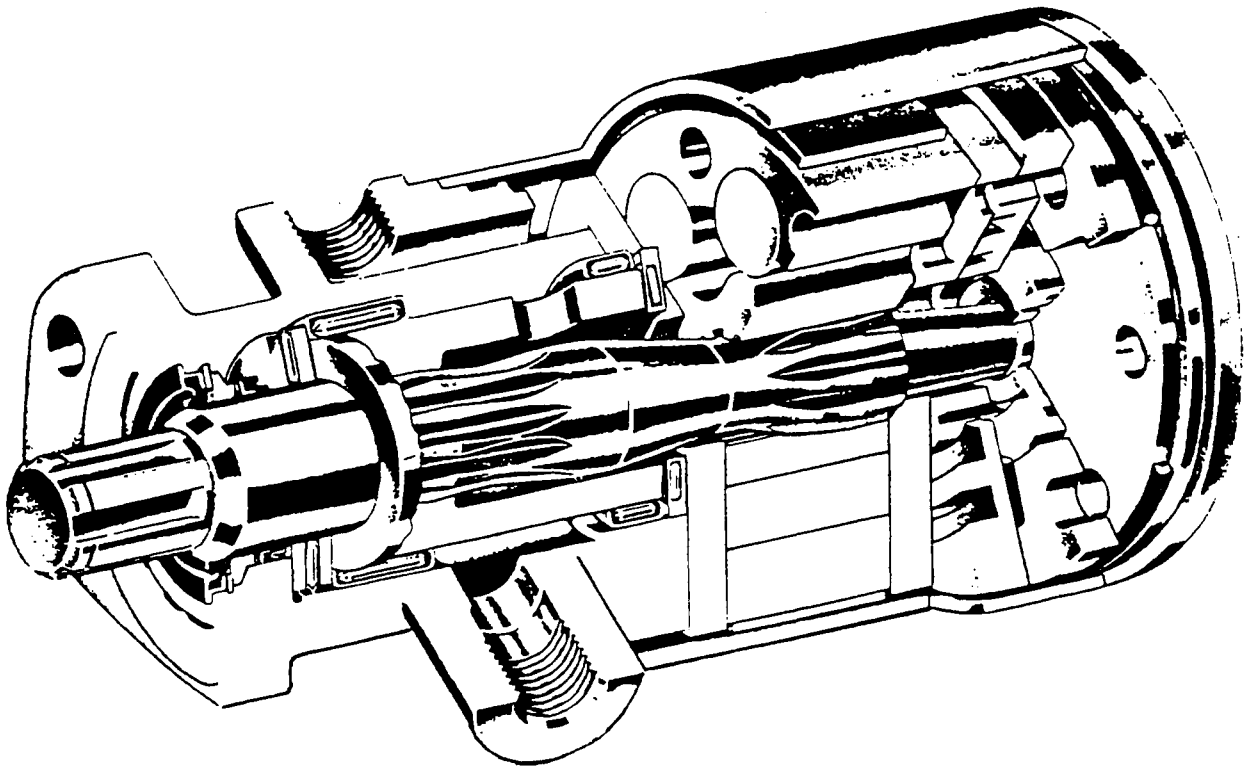
MARK INDUSTRIES

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)

TORQMOTOR®

SERVICE PROCEDURE

MAB SERIES



TRW®

ROSS GEAR DIVISION

LAFAYETTE, INDIANA 47902

The *MAB* TORQMOTOR

- Low Speed,
- High Torque
- Hydraulic Motor.

REV.

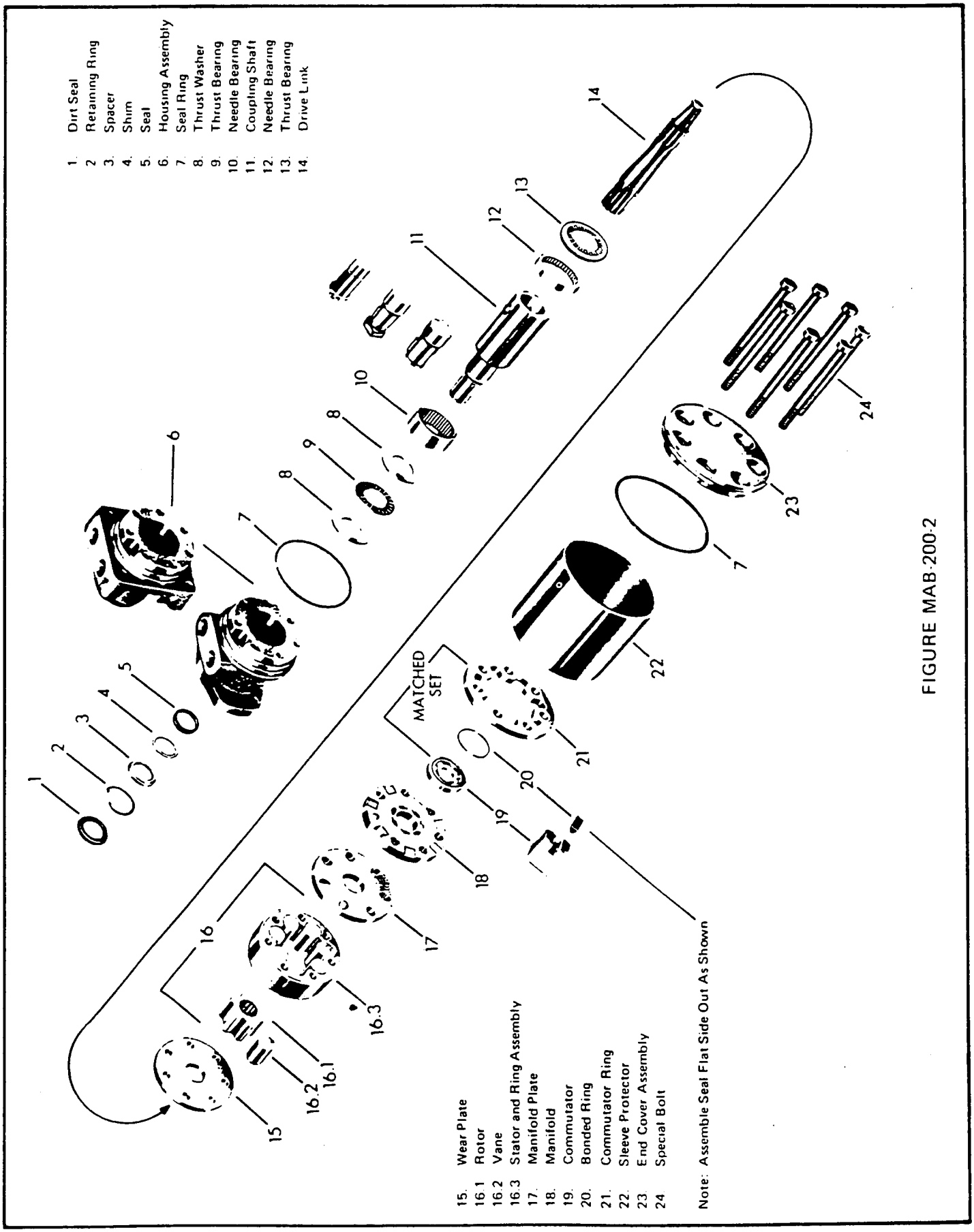


FIGURE MAB-200-2

REV.

SERVICE PROCEDURE

Preparation Before Disassembly

Remove port hole plugs before attempting to rotate shaft. Drain the motor assembly by turning the output shaft. Wash the complete motor in solvent and remove all particles of dirt from the exterior and blow dry before placing on work bench.

Clean Work Conditions

If it is necessary to disassemble the TORQMOTOR, make certain to use a clean work bench (a piece of clean wrapping paper makes an excellent and disposable top). The hands and tools of the repairman should be clean, and the operation should be carried out in a sheltered area free from drafts that may carry foreign material into the disassembled pieces. (Precision fits in the TORQMOTOR needs "white room" type care.)

Caution: Avoid wiping parts with a cloth, as lint and foreign particles may adhere to the working parts of the TORQMOTOR.

Handling

Care must be taken in handling the close fitting parts, as nicks and mutilations will result in serious damage.

REPLACEMENT OF HIGH PRESSURE SEAL (5) IN TORQMOTOR

(Reference Figure MAB-200-2)

1. Remove dirt seal (1) and retaining ring (2), if burr exists on retaining ring groove, remove with a scraping tool.
2. Set the motor with coupling shaft (11) down in a suitable clean can. Plug "A" port and connect "B" port to 120 psi air hose, or use a piston type hydraulic hand pump. Note: The air connection should be made with provisions for quick shut-off after the spacer (3), shim (4) and seal (5) have been ejected.
3. Apply clean grease to new seal (5) and assemble into housing assembly (6) with lip side inward.
4. Assemble shim (4), spacer (3) and retaining ring (2), be sure the rounded edge of the retaining ring is faced inward. Apply a small amount of clean grease to the back side of new dirt seal (1) and assemble into housing assembly (6).

TORQMOTOR DISASSEMBLY

(Reference Figure MAB-200-2)

1. In a vise, clamp down on the housing assembly (6) port bosses with the coupling shaft (11) pointed down.
2. Using wrench with a 12 point 9/16" socket, remove the seven special bolts (24) and place them on the work bench.
3. Remove the end cover assembly (23) and seal ring (7) by inserting screw driver between end cover assembly (23) and sleeve protector (22). Pry up end cover assembly (23) and lift from unit with seal ring (7) attached.
4. Remove seal ring (7) from end cover assembly (23) and discard.
5. Remove the commutator ring (21), commutator (19), bonded ring (20) and manifold (18) by using two of the special bolts (24) as a lifting tool, insert the two special bolts (24) into two holes and lift out the previously mentioned parts.
6. Remove bonded ring (20) from commutator (19) by using an air hose, blow air down into ring groove until bonded ring (20) is lifted out and discard.
7. Inspect manifold (18) for cracks and replace with new manifold if cracks are visible.
8. Remove manifold plate (17) by using the two special bolts (24) and method previously mentioned.
9. Remove rotor assembly (16), wear plate (15) and drive link (14) by using the two special bolts (24) and method previously mentioned.
10. Remove vanes (16.2) and rotor (16.1) from rotor assembly (16). Use caution not to drop these parts when handling.
11. Inspect rotor (16.1) outside lobes for pits and marks. If pits or wear marks are visible, discard rotor (16.1) and replace complete rotor assembly (16) with a new rotor assembly.
12. Remove thrust bearing (13).
13. Remove coupling shaft (11).
14. Remove sleeve protector (22) by inserting screw driver between sleeve protector (22) and housing assembly (6) and pry up. If rust exists on ends of sleeve protector (22), remove by sanding lightly.
15. Remove seal ring (7) from housing assembly (6) and discard.
16. Remove housing assembly (6) from vise, turn over and reclamp housing assembly in vise so that dirt seal (1) is pointed upward.
17. Remove dirt seal (1), retaining ring (2), spacer (3), shim (4) and seal (5) from housing assembly (6). Discard dirt seal (1) and seal (5). If burr exists on retaining ring groove, remove with a scraping tool.

18. Do not remove thrust washers (8), thrust bearing (9) and needle bearings (10) and (12) unless there is absolute evidence of damage. Needle bearings should be free to rotate and not show signs of surface breakdown. If needle bearing (10) requires replacement, use a 1.490 maximum diameter shaft and press out thrust washers (8), thrust bearing (9) and needle bearings (10) and (12). The housing assembly face should be placed on a block of wood during the pressing operation to protect it. Discard thrust washers, thrust bearing and needle bearings and replace with new parts as parts may have been damaged when being pressed out.

If needle bearing (12) needs replacement use a bearing puller to remove needle bearing, care should be taken to not damage the housing assembly (6) face with the bearing puller.

TOROMOTOR ASSEMBLY

(Reference Figure MAB-200-2)

Important: Before starting assembly, clean all parts with a clean petroleum base solvent and air dry. **Do not wipe dry with rags.** Be sure all dried paint lips have been removed from edges of lapped surfaces. Unless otherwise indicated, do not oil or grease parts before assembly. Note: Lubricate All Seals before assembly with SAE 10W-40 SD oil or clean grease.

1. In a vise, clamp down on the housing assembly (6) port bosses with the small bore end pointed up. Assemble new seal (5) with lip side inward, assemble shim (4), spacer (3) and retaining ring (2). Be sure the rounded edge of the retaining ring (2) is faced inward.

2. Apply a small amount of clean grease to the back side of new dirt seal (1) and assemble into housing assembly (6).

3. Remove housing assembly (6) from vise, turn over and reclamp in vise with large bore end up. (*** See Note.)

4. Apply "Scotch" tape around splines or keyway on coupling shaft (11) to prevent damaging seal (5). Assemble coupling shaft (11).

5. Assemble thrust bearing (13).

6. Assemble drive link (14).

7. Assemble wear plate (15).

8. Assemble rotor assembly (16) with counterbore in rotor (16.1) down.

9. Assemble manifold plate (17), manifold (18) and commutator ring (21).

10. Assemble commutator (19) and new bonded ring (20).

11. Assemble new seal rings (7) on housing assembly (6) and end cover assembly (23).

12. Apply a generous amount of "STP" to both ends on sleeve protector (22) and assemble over unit and onto unit and onto housing assembly (6). Make sure sleeve protector is setting in a non-cocked position.

13. Assemble end cover assembly (23) onto sleeve protector (22) in a non-cocked position.

14. Assemble seven special bolts (24) and screw in finger tight. Alternately and progressively tighten the seven special bolts to pull end cover assembly (23) and sleeve protector (22) down into place. (Torque the seven special bolts to 50 ± 5 ft. lbs.)

*** NOTE
If it was necessary to remove thrust washers (8), thrust bearing (9), needle bearing (10) and needle bearing (12), the following assembly procedure must be followed.

1. Assemble new thrust washer (8), new thrust bearing (9), new thrust washer (8) in this order into housing assembly (6).

2. Press in new needle bearing (10) with suitable tools to a 2.365 ± .030 dimension into housing assembly (6). Note: Bearing should indicate which side to press against.

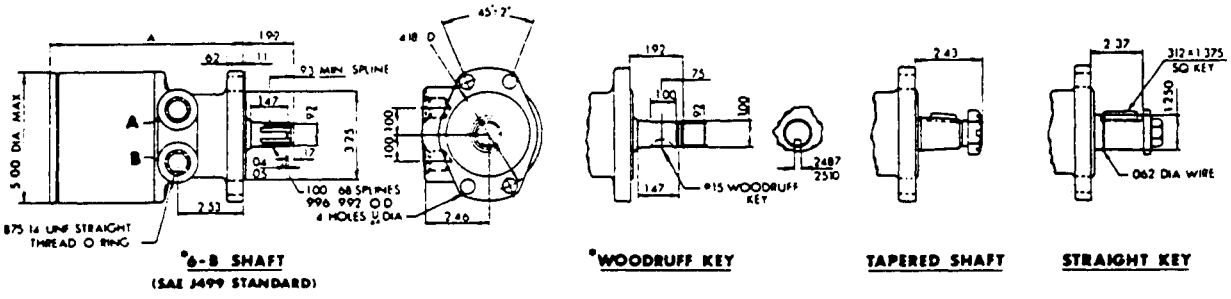
3. Press in new needle bearing (12) with suitable tools to a .18 ± .03 dimension into housing assembly (6). Note: Bearing should indicate which side to press against.

TROUBLE SHOOTING

Trouble	Cause	Remedy
Oil leakage	1. Hose fittings leaking	(a) Tighten fittings
		(b) Replace O ring in 7/8", 14 thread fitting
	2. Seal ring leak	(a) Replace seal ring by disassembling motor
	3. Special bolt leakage	(a) Tighten single bolt to 50 foot lbs.
	4. Faulty high pressure seal	Remove dirt seal, retaining ring and spacer. Blow out seal. Replace seal.
	5. Coupling shaft and high pressure seal	Replace coupling shaft and seal package.
High loss of speed, under load.	1. Lack of sufficient oil supply	(a) Adjust faulty pressure relief valve.
		(b) Repair worn pump.
		(c) Use correct oil for temperature of operation.
	2. High internal motor leakage.	(a) Replace worn rotor set with new rotor assembly
		(b) Replace worn commutator ring
		(c) Replace worn manifold
		(d) Replace worn wear plate.
Low mechanical efficiency or undue high pressure required to operate TORQMOTOR	1. Line blockage	(a) Replace blocked line.
	2. Internal Interference.	(a) Correct clearance of rotor set. (Replace rotor set)

PROVISIONING DATA

STANDARD MOUNT

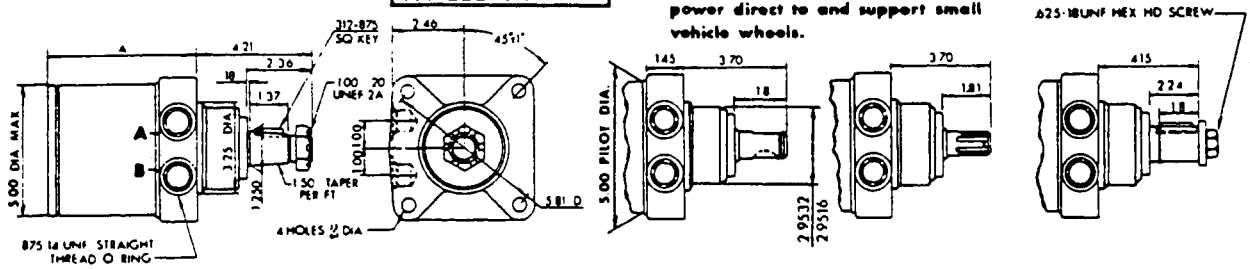


*6-B SHAFT (SAE J499 STANDARD) | *WOODRUFF KEY | TAPERED SHAFT | STRAIGHT KEY

WHEEL MOUNT

Use this design mounting when maximum side load is applied to the output shaft.

The Wheel Mount design (w/ 1-¼ taper output shaft) can be used to apply power direct to and support small vehicle wheels.



TAPERED SHAFT (SAE J501 STANDARD) | *WOODRUFF KEY | *6-B SHAFT | STRAIGHT KEY

*The 6-B Spline shaft and Woodruff Key shaft are machined for a WALDES TRUARC Snap Ring No 5100 100 (or equivalent)

MOTOR SERIES	DISPLACEMENT CU IN / REV	DIMENSION "A" STD MTG	DIMENSION "A" WHL MTG	APPROX RPM WITH 10 GPM NO LOAD	APPROX RPM WITH 10 GPM @1500 PSI	THEO. TORQUE IN LBS/100 PSI	IN LB TORQUE @ 1500 PSI STARTING	IN LB TORQUE @ 1500 PSI RUNNING
MAB 08	5.9	7.409	5.630	400	365	94	1,040	1,250
MAB 16	11.8	7.910	6.131	200	180	188	2,150	2,850
MAB 24	17.7	8.410	6.631	130	115	282	3,600	4,150
MAB 40	29.6	9.410	7.631	78	65	470	6,050	6,800

Dimensional Values Shown Are Reference

MAB TORQMOTOR

NOTE: System Relief Valve Setting from 2,000-3,000 PSI Require Prototyping and Evaluation by Sales Engineer.

SPECIFICATION & IDENTIFICATION TAG GUIDE

EXAMPLE: MAB 08 0 02

SERIES — MAB

ROTOR WIDTH IN $\frac{1}{16}$ 'S
- 08
- 16
- 24
- 40

MOUNTING & SHAFT
- 02 STD. MTG. 6-B SHAFT
- 03 WHL. MTG. TAPERED SHAFT
- 04 STD. MTG. TAPERED SHAFT
- 05 WHL. MTG. 6-B SHAFT
- 08 STD. MTG. WOODRUFF KEY
- 09 WHL. MTG. WOODRUFF KEY
- 10 STD. MTG. STRAIGHT KEY
- 11 WHL. MTG. STRAIGHT KEY

THIS CHAPTER HAS BEEN PROVIDED TO KEEP **MARK INDUSTRIES** SERVICE BULLETINS THAT APPLY TO THE IMPROVEMENT OF YOUR **MARKLIFT.**