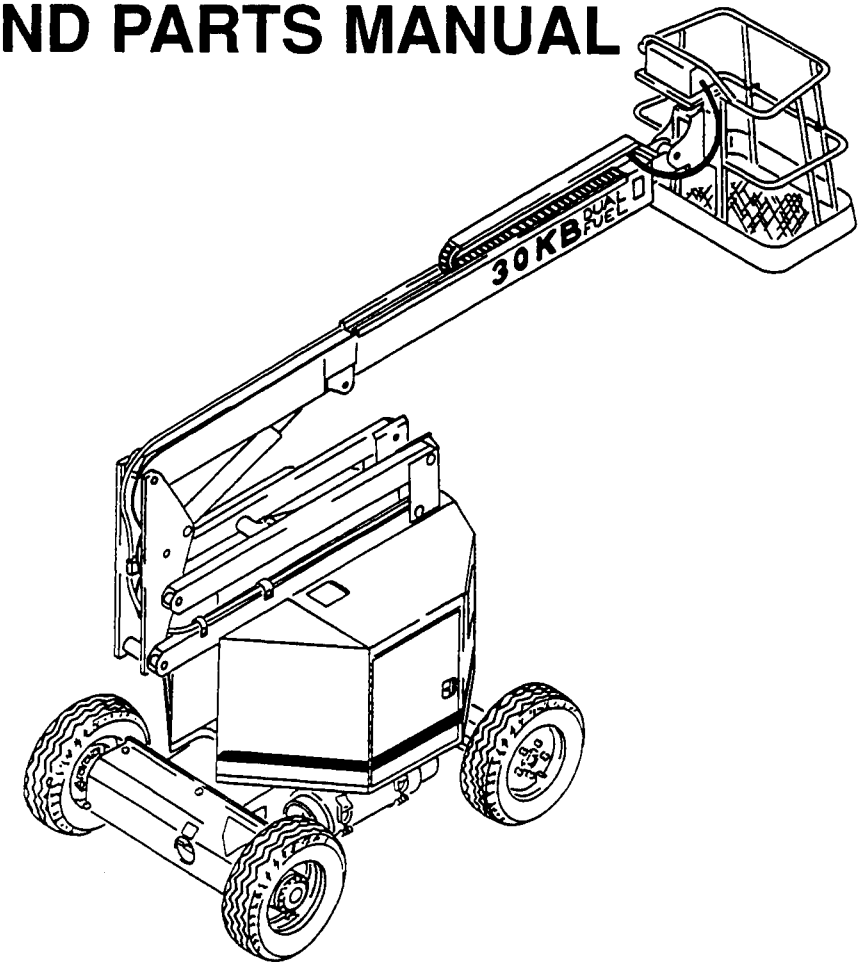
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED KNUCKLEBOOM OPERATION MAINTENANCE AND PARTS MANUAL



Model: 30KBDF

FIRST EDITION: January 1990

Mark Industries

P.O. Box 2255
Brea, California 92622
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17303

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SERVICE BULLETINS

The purpose of this manual is to provide the customer with operation, safety, maintenance and parts information that will enhance the reliable performance of the **MARKLIFT.** Schematic and vendor information is also furnished. If additional information is needed, we urge the customer to contact the local dealer. If this is impossible, please contact the Mark Industries Cusstomer Service Department at (714) 879-6275.

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

The model capacity, pressure settings and serial number can be found on the ID plate mounted on the rear of the frame assembly.The serial number should be used when ordering parts. This will help our parts department give prompt and accurate service.

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

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

Description	Model
	30KBDF
Height –	
Working (maximum)	36'9" (11.20m)
Platform (maximum)	30'9" (9.37m)
Length (stowed)	16'3" (4.95m)
Width	5'9" (1.75m)
Platform dimensions	30"x 48"x 42"
	(.76m x 1.22m x 1.07m)
Horizontal reach	
(center of turret)	22'6" (6.86m)
(clear reach)	19'0" (5.90m)
Load Capacity (unrestricted)	500 lbs. (226.8kg)
Wheel Base	6'0" (1.83m)
Wheel Track	5'0" (1.50m)
Turning Radius (inside)	6'8" (2.03m)
(outside)	13'0" (3.96m)
Power source	29HP Wisconsin (dual fuel)
Hydraulic reservoir capacity	20 gal. (75.71 L)
Tires	P235/60 RX14 (monofilled)
Weight	10,200 lbs. (4627 kg)
Shipping cube	630 cu. ft. (17.84 m^3)
Height (stowed)	6'7" (2.01m)
Turret rotation	350° noncontinuous
Turret tailswing	zero
Travel speed	0-3 mph (0-4.82 km/hr)
Controls	fully proportional

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

MANUFACTURERS' LIMITED WARRANTY

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

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

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

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

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

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

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

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

Mark Industries

P. O. Box 2255, Brea, CA 92622-2255
714-879-6275 800-448-MARK
TELEX 194402 FAX 1-714-879-8884

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.

KNUCKLE BOOM 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, 33,39,40,41,42).

		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	☐	☐
39.	Turret rotation gear box oil level _____.	☐	☐
40.	Turret ring gear bolts torqued to _____ Ft. lbs	☐	☐
41.	Drive wheel, torque hub oil level _____.	☐	☐
42.	Retraction cable tension _____ Ft. lbs	☐	☐

MODEL	SERIAL NUMBER
INSPECTOR	OPTIONS

CAUTION:	Due to the width of the **Marklift** compared to the overall width of the trailer, extreme caution must be taken when loading and unloading the unit.

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

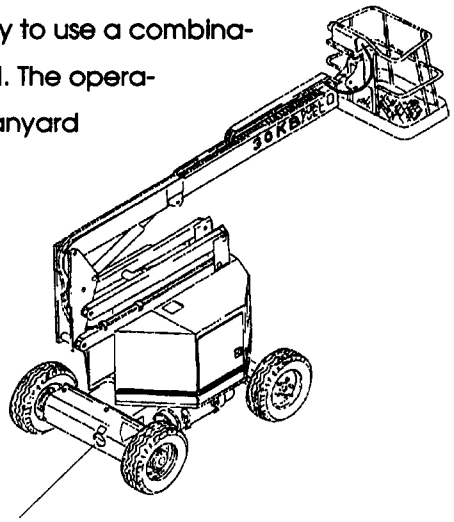


Figure 1: Parking Brake Control Valve

1. Make sure that the parking brake is set for immedi ate braking by opening the parking brake control valve. (See figure 1.)

2. Raise the boom to release the limit in order to achieve the lowest travel speed. Use **LOW DRIVE** at all times when loading and unloading.

LOADING

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

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

3. Exercise great care while driving and steering the unit up the ramp. Use low drive speed and keep all slack out pf the winch cable. If the ramp is too steep for the unit to climb, the winch will pull the unit up. **You must keep the drive function engaged while winching, otherwise the brakes will prevent the machine from rolling.**

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

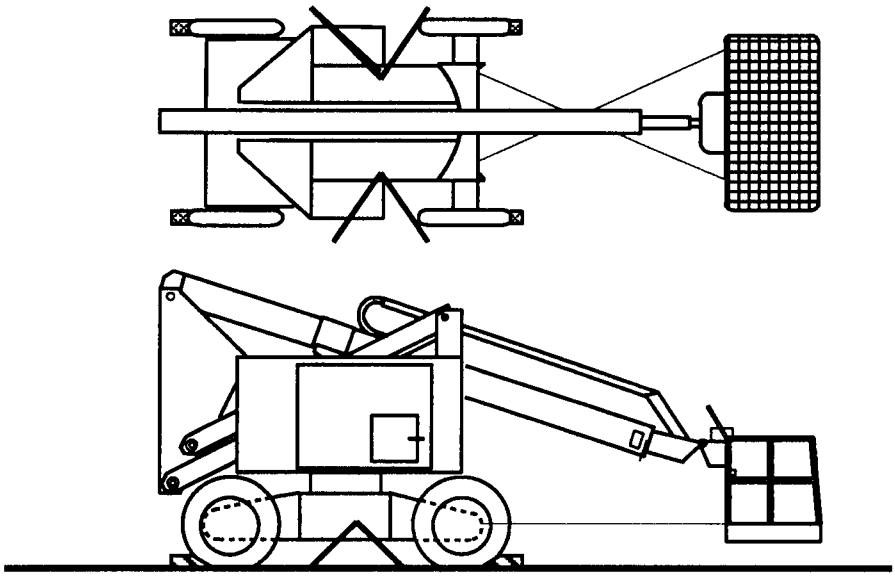


Figure 2: Securing the MARKLIFT to the platform

UNLOADING

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

2. Select the low drive speed on the platform control console.

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

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

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

5. Re-adjust the boom parking brakes so that they apply immediately after the dynamic brakes stop the unit. The procedure for re-adjusting the parking brakes is as follows: First, close the needle valve completely. Open the valve 1/8 turn then place the unit on a flat surface, approximately 10 feet long. Position the boom slightly below horizontal and

completely retract the boom. Select "High" drive speed at the platform console. Drive the MARKLIFT approximately 15 feet with the controller handle in maximum position. Release the controller while the wheel is next to a visual marker on the ground. A good slowing and braking distance would be 3 feet measured from the marker to the center line of the same wheel after the unit has completely stopped. Adjust the needle valve on the parking brakes to achieve this distance. Repeat this procedure, driving in both di rections until the MARKLIFT comes to a complete stop within 18" to 24". The deceleration valves have been set at the factory and should not be adjusted again without first con sulting the MARK INDUSTRIES Customer Service Engineering Department. It is best to completely open the needle valve if the unit is to be used in a facility that has very steep slopes or inclines. Warning: Do not drive on uneven, sloping or soft terrain that sets the unit in an out-of-level condition.

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

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

2. Check hydraulic oil level.

3. Check engine oil level.

4. Fill the fuel tank. Use regular gasoline or switch to propane.

5. Check battery for 1200 ± 50 reading on the hydrometer. Charge the battery if the reading is below 1100. (See Battery Maintenance).

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

7. Position selector switch to ground then operate switches to make sure all are functioning.

8. Make sure the brakes will hold the unit on an incline.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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 basket 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.

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."**

Information for Units Containing Lead Counterweights

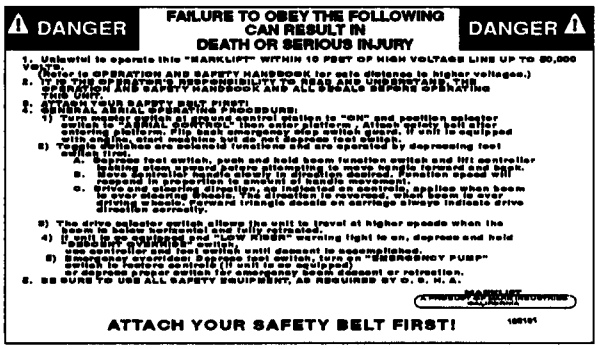
If your MARKLIFT has lead counterweights, please refer to OSHA 29 CFR 1910.1025 for requirements concerning occupational exposure to lead. It is your responsibility to obtain the regulations that pertain to lead usage for your place of employment and for the protection of your employees.

If you are unable to obtain said regulations, you may contact Mark Industries directly for assistance at (714) 879-6275. You may also contact Mark Industries for a copy of the Materiel Safety Data Sheet for Lead.

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

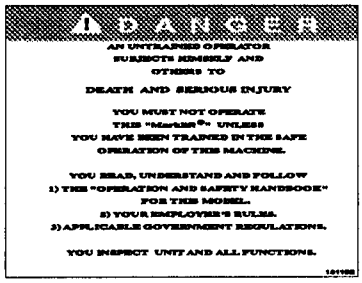
> It is the primary responsibility of the user and operator to be thoroughly knowledgeable of all decal information, definition and location.

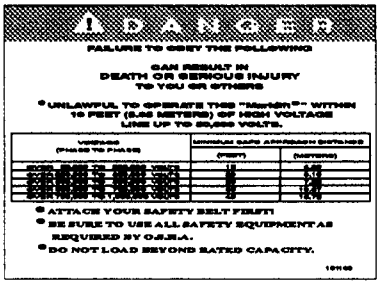
The following page illustrates a chart in which decals for the **MARKLIFT** can be replaced if the existing decal(s) is worn-out, torn, or illegible.

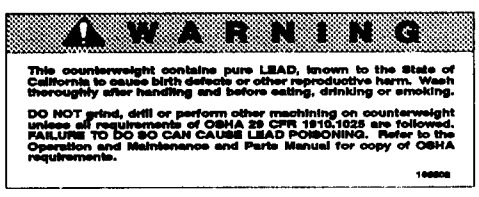


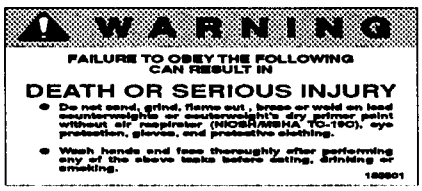


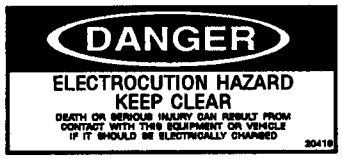


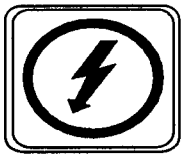














GENERAL DECALS
30KBDF

DECAL P/N	DECAL DESCRIPTION 30KBDF	ASSEMBLY	QTY
67400	Decal Set	All Standard Decals	1
140595	Tie Down Diagram	Final Assembly	2
20462	Forward Arrow Aft	Final Assembly	1
20896	Brake	Final Assembly	1
182101	Danger & Aerial Operation Instructions	Upper Control Panel	1
20412	Blue Stripe Round Ends	Final Assembly	2
20419	Danger Keep Clear	Final Assembly	2
181102	Danger Do Not Operate Unless...	Final Assembly	2
2022	Load Capacity 500 lbs.	Final Assembly	2
140496	Hand Pump	Final Assembly	1
140495	Emergency	Final Assembly	1
31259	Marklift	Final Assembly	2
20411	Blue Stripe Square End	Final Assembly	6
130596	A Product of Mark Industries	Final Assembly	2
22175	Caution Monofilled Tires Only	Final Assembly	12
20410	Logo Mark Industries	Final Assembly	1
2017	Hydraulic System Fluid	Final Assembly	1
20461	Forward Arrow	Final Assembly	1
22386	"D" Ring Attach Safety Belt	Final Assembly	2
130820	Operation & Safety Handbook	Final Assembly	1
181103	Danger Obey the Following...	Final Assembly	2
140420	"Dual Fuel"	Final Assembly	2
2004	Vapor Tank Only	Final Assembly	1
21237	Grease Fitting	Final Assembly	8
2020	Gasoline or Petrol	Final Assembly	2
20879	Dipstick	Final Assembly	1
20661	Plate, ANSI A92	Final Assembly	1
20660	Nameplate, Identification	Final Assembly	1
181901	MARKLIFT	Final Assembly	2
182716	Ground Control	Lower Control Panel	1
185702	Circuit Breaker 110 VAC	Final Assembly	1

STARTING

The **MARKLIFT** can be started from either the ground control or aerial control panel. Using the ignition key, turn the master switch to "ON".

Aerial Control

1. Position the selector switch (on the ground control panel) to "AERIAL" then enter the aerial platform. Attach safety belt after entering the platform

2. Select fuel, Propane or Gasoline, with the three-position switch on the aerial control box. The "OFF" position allows for adjustments when switching from one fuel to the other.

3. Set the "DRIVE" switch to "HIGH" or "LOW". Use the "LOW" setting if the unit is on an incline and "HIGH" if greater speed is required on a level surface.

Ground Control

1. Set selector switch to "GROUND".

2. Select fuel and set the "DRIVE" switch to "HIGH" or "LOW". Check the ammeter at the bottom of the panel to make sure it shows a positive charge.

Drive

The **MARKLIFT** can be driven only from the aerial control platform. The unit may be driven with the boom and turret in various positions.

1. While pressing the footswitch, operate the drive control lever on the right side of the panel to move the **MARKLIFT** forward or reverse. The directional arrow decals on each end of the base indicate drive direction.

2. Gradually increase speed, limiting travel speed according to conditions of the terrain.

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

STEERING

1. The **MARKLIFT** may be steered from the aerial control only. Make right and left turns by pressing the the footswitch and turning the steering switch right or left. Avoid oversteering. The steering angle will remain in the last powered position until repositioned by the operator.

2. Do Not continue to steer in the same direction after the steering cylinder has reached its extreme stroke.

BOOM

Boom functions are operated by toggle switches located on the left side of the panel. Push and hold the desired operation, depress the footswitch, then lift the controller locking stem upward and push forward or backward.

TURRET ROTATION

Turret rotation is grouped with the boom controls and is operated in the same manner. The turret may be rotated 350° noncontinuously. When rotated, the "FORWARD" indicating decals on the base of the unit provide reference for the drive direction and platform orientation.

If the turret is rotated 180°, the steering and drive orientation will also be reversed.

EMERGENCY GROUND CONTROL

1. On the ground control panel, select the boom and turret functions and activate switches in the desired directions.

2. To operate the handpump:

   A. Make sure that the master switch is still turned on.

   B. Set slector switch to "Ground".

   C. Push the Emergency Stop/Start switch to "STOP".

   D. Open door at the right of the ground control panel; the handpump is on the right side of the compartment. Move the handle of the handpump forward and backward or up and down, while holding the selected function switch with the left hand, until the desired position is attained.

SHUTDOWN

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

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

3. Turn the master switch to "OFF" and remove the ignition key.

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

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

DAILY (Before use on each work shift)

1. Make sure that operation and safety decals are in place and readable.
2. Check the water level in the battery.
3. Check for loose or worn hardware.
4. Check fuel level.
5. Make sure the operating controls perform correctly.
6. Check for and correct any structural damage.
7. Check for and correct any hydraulic leaks.
8. Check for wear on cables and hoses.

WEEKLY

1. Check the condition of the tires. Make sure they are free of serious cuts or defects.
2. Check that operation and safety decals are in place and readable.
3. Check for proper brake operation.
4. Make sure the battery is fully charged.
5. Clean the 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 on cables and hoses.
10. Check the air cleaner.
11. Check for proper hydraulic and engine oil level.

MONTHLY (for first 50 hours)

1. Check and lubricate, if necessary. (See lubrication instructions.)
2. Check battery condition.
3. Change the hydraulic oil return filter.
4. Grease ring gear and rotation gear box worm gear.
5. Grease steering linkage.
6. Check and and clean engine intake air cleaner.
7. Change engine oil filter.
8. Check torque hub oil filter.

EVERY YEAR

1. Re-pack all wheel bearings.
2. Change the hydraulic oil.
3. Change the hydraulic oil return filter.
4. Check the torque hub oil level.
5. Check the ring gear bolts for proper torque.
6. Change or clean air filter.

MARKLIFT SELF-PROPELLED BOOM
MODEL 30KBDF

1. Type — EP 90

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

2. Oil Temperature

   Continuous — 160° F
   Intermittent — 200° F

3. Oil Change

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

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

4. Oil Fill Level

   Unit mounted horizontal — half full.

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

Battery Fill Instructions

Water or Acid Loss to Batteries

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

Checking the Water Level

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

Materials and Equipment Required

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

Filling the Battery

Gas and diesel powered machines have alternators that keep the batteries fully charged. For these units, add water to the level indicator.

Avoid Battery Hazards !

- Batteries produce flammable and explosive gasses. Keep arcs, sparks, flames and lighted tabacco away from batteries.
- Battery acid will damage eyes or skin on contact. Always wear a face shield during battery maintenance to avoid acid in eyes. Also wear rubber gloves and protective clothing to keep acid off skin.
- Never check the battery by placing a metal object across the posts. Serious burns or an explosion can result.
- Charge batteries only in a well ventilated area.

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

TEMPERATURE/SPECIFIC GRAVITY CORRECTION TABLE FOR BATTERIES

ACTUAL HYDROMETER READING AT ACTUAL TEMPERATURE°

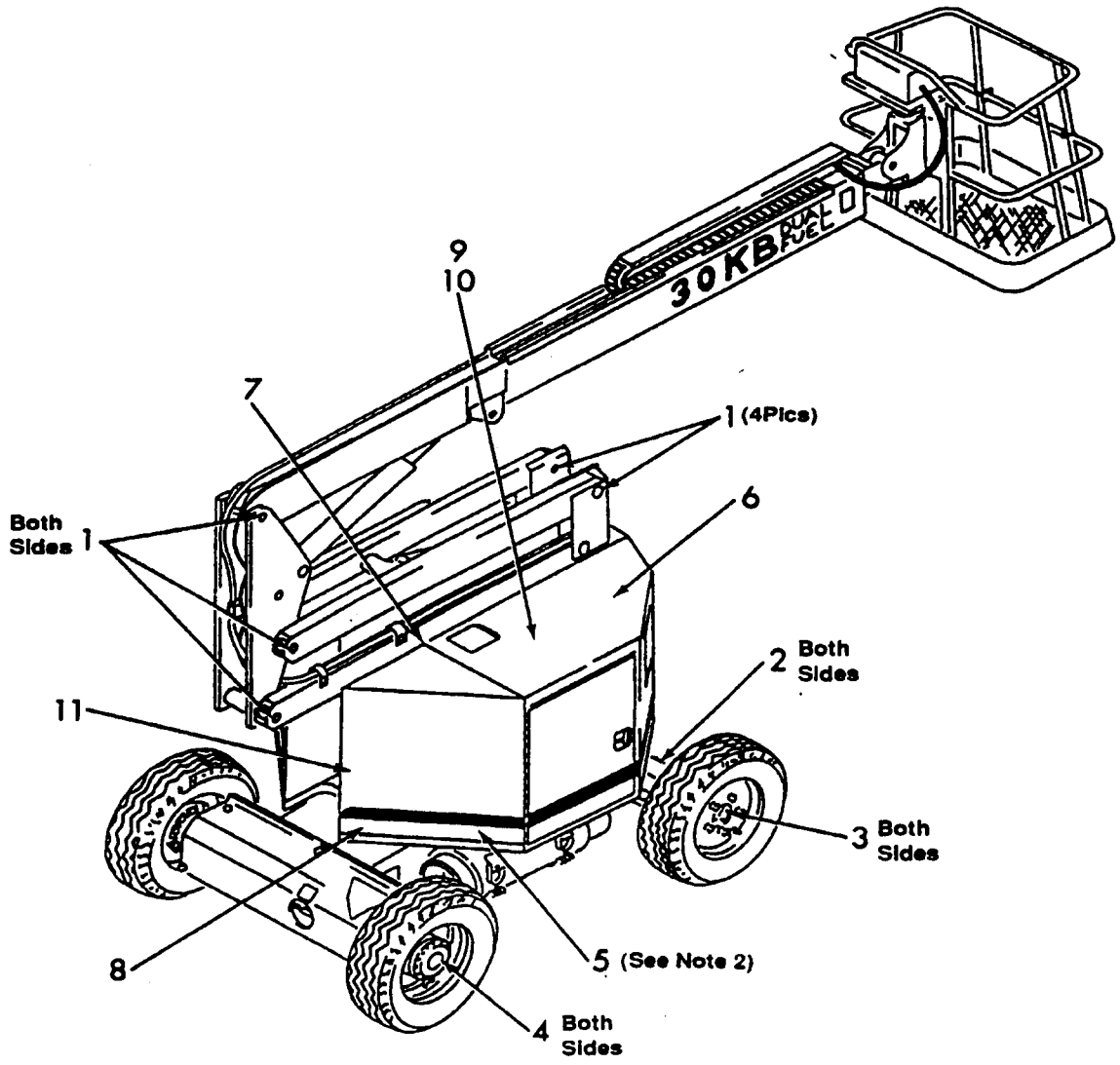
80°F (27°C)	0°F (-18°C)	-10°F (-23°C)	-20°F (-29°C)	-30°F (-34°C)	-45°F (-43°C)	-65°F (-54°C)	Approx. State of Charge In%
1.280	1.312	1.316	1.320	1.324	1.330	1.338	100
1.250	1.282	1.286	1.290	1.294	1.300	1.308	75
1.220	1.252	1.256	1.260	1.264	1.270	1.278	50
1.190	1.222	1.226	1.230	1.234	1.240	1.248	25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

Specific Gravity

Corrected to 80°F (17°C)	Freezing Temperature	
1,280	-90°F	-68°C
1.250	-62°F	-52°C
1.200	-16°F	-27°C
1.150	+ 5°F	-15°C
1.000	+19°F	- 7°C

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

Lubrication Instruction
Model 30KBDF



LUBRICATION CHART

ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
1.	Pivot Pin	Grease-Mobil (VA6L36AG)	Monthly
2.	Steering Yoke King Pins	Grease-Mobil (VA6L36AG)	Monthly
3.	Wheel Bearings	Grease-Mobil (VA6L36AG)	Yearly
4.	Torque Hub	Gear Oil SAE 90	Yearly
5.	Rig Gear	Grease- Mobil (VA6L36AG)	Monthly
6.	Hydraulic Return Line Filter Element	21245	100 Hours
7.	Engine Oil	SAE 30	See MFG. Operating Instructions
8.	Oil Filter	Recommended Element	See MFG. Operating Instructions
8a.	Governor	SAE 30	See MFG. Operating Instructions
9.	Hydraulic Oil	ATF Dexron II	Yearly
10.	Inlet Strainer	Clean	Yearly
11.	Fuel Filter	MARK Part No. 160061	100 Hours

Note:

1. Lower riser arms pivot pin lube fittings are located behind the radiator inlet cover (L.H. side turret) and fuel tank (R.H. side turret).
2. Lubricate entire radius of turntable bearing by rotating turret in 20° increments until one full rotation (360°) has been completed.
3. Check coolant level at coolant recovery tank DO NOT open radiator cap if engine has been operated less than one hour previously.

Protecting Engines for Winter

To protect the cylinders, pistons, rings and valves from rusting and sticking, a half and half mixture of kerosene and good gas engine oil should be injected into the intake manifold while the engine is warm and running at moderate speed. Use one ounce per cylinder or enough so that a heavy bluish smoke will appear at the exhaust. The ignition switch should then be shut off and the engine stopped. This fogging will give a coating of oil on the above mentioned parts protecting them from the atmosphere.

If possible, store the machine inside a building. If there is no available building, the engine should be protected from the weather by a proper covering.

HYDRAULIC SYSTEM

The following information will help the mechanic troubleshoot and make adjustments to the hydraulic system. It is the mechanic's responsibility to read and understand the given information.

The **MARKLIFT** employs the latest components in mobile hydraulic equipment. The hydraulic circuit contains 2 two-stage engine driven hydraulic pumps. One stage is for the drive function only, the other stage is for the steer and boom functions. The drive stage of the pump supplies the drive manifold. The drive manifold contains a bypass compensator, a load sense shuttle, a relief valve, and a proportional control valve. The bypass compensator acts as a dump alve, returning all of the drive pump output back to the hydraulic tank when the pump is running and the proportional drive valve is not energized. As the drive controller is moved, flow is automatically diverted proportionally from the tank to the drive motors. The relief valve insures that the pressure will not exceed the drive system requirement and damage the drive motor.

Manifold Relief Valve

The manifold pressure relief valve insures that the manifold pressure does not exceed the maximum pressure rating for the pump.

Dump Valve

The dump valve allows all of the flow from the secondary stage pump to free flow back to the hydraulic tank. The dump valve closes to pressurize the manifold when any function is activated. This provides fuel economy, over-all efficiency and minimizes oil heat build up.

Directional Control Valve

The directional control valves for the steer and rotation functions provide flow in the proper direction upon demand.

Three Way Valves

The three way valves provide flow to the function when electrically activated. They are normally closed in design allowing the function to be connected to tank in a neutral or de-energized condition.

Crossover Relief Valves

The crossover relief valves for the rotation function limit the pressure which limits the force of the boom rotation function. This reduces the possibility of damage to the boom if rotated into an obstacle.

Over-center Valves

The over-center valves in the slave leveling circuit provide protection to the circuit from over pressure when the slave leveling cylinder is bottomed out and the boom is being lifted or lowered (the movement of the boom drives the master cylinder which would cause the pressure to rise to the over-center relief setting).

Electrical System

The **MARKLIFT** electrical system is very straight forward and easy to troubleshoot because of it's simplicity. There are two major junction boxes which also serve as the ground and aerial control consoles. The source for the electrical system is a 12 volt battery with a negative ground. All electrical components operate directly from the source through either switches or a proportional controller.

The ground control console houses the necessary switches for starting and stopping the engine; a selector switch for isolating either the ground or aerial control consoles, and the required toggle switches for moving the boom. The ground control console also contains a keyed ignition/start switch, as well as an engine stop switch and ammeter. When the selector switch is placed in the aerial position, the electrical source is routed to the aerial control junction box. The intent of the footswitch is to provide an additional safety interlock in the control circuit to produce foot as well as hand movement by the operator, thereby requiring maximum operator attention. The function of the footswitch only completes the electrical circuit to the aerial control console. **The footswitch is not directly connected to the drive braking system.**

The aerial control console is equipped with two controllers and all switches necessary to operate the boom functions, as well as drive and steer. It also contains a start/stop switch. Your **MARKLIFT** is equipped with a proportional control valve for turret rotation and the drive function. The aerial control console contains electrical controllers complete with manual lockout rotation for the drive function. The controllers are spring-centered and are designed to produce a variable output signal to the control valve. The output signal is directly proportional to the handle movement on the controller. The valve is electrically coupled to the controller and responds only to the signal level transmitted to it by the operator.

The operator must learn how to move the controller slowly to obtain a smooth transition from start up to wide open and back to neutral.

The **MARKLIFT** boom unit has additional safety systems for driving. When the unit is driven with the boom raised above horizontal, the unit is automatically shifted into low speed. This is accomplished through a limit switch sensing the altitude of the boom. wired to the

controller "HI/Lo" circuitry. This prevents the controller from supplying maximum rated electrical output to the proportional valve whereby reduced speed is obtained when the boom is raised above horizontal.

ENGINE

1. Unit will not start or run.

   A. Check ground control box circuit breaker.
   B. Check for low battery reading.
   C. Check for fouled spark plugs.
   D. check fuel selector to see if it is in the gas or propane position.
   E. Check for closed fuel shut-off valve.
   F. Check for water in gas tank.
   G. Check engine points.
   H. Refer to your local service facility.

2. Unit dies under load.

   A. Check carburetor air/fuel mixture.
   B. Check hydraulic pressure.
   C. Check RPM to make sure setting is not too low.
   D. Refer to your local service facility.

3. Engine will not go into "HI" speed.

   A. Check the aerial HI/Lo selector switch.
   B. Check the throttle solenoid valve.
   C. Check the linkage on the hydraulic or electric throttle.
   D. Refer to your local service facility.

4. Unit will not idle.

   A. Check the aerial HI/Lo selector switch.
   B. Check the throttle solenoid valve.
   C. Refer to your local service facility.

HYDRAULIC 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.

HYDRAULIC PUMP

Pump producing excessive noise.

A. Check hydraulic oil level (sight gauge on tank.)
B. Check oil. (See hydraulic fluid table.)
C. Check suction hose from tank to pump for kinks.
D. Check reservoir hydraulic oil level gauge.
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 footswitch continuity.
C. Check for loose wire in aerial control box.
D. Refer to your local service facility.

2. Functions will not operate from ground control box.

A. Check position of "Aerial/Ground" box selector switch.
B. Check the flow control needle supply pressure to the solenoid valve.
C. Refer to your local service facility.

Drive

Low torque drive.

A. Makee sure hydraulic system is up to recommended pressure.
B. Check for extended or raised boom.
C. Refer to your local service facility.

BRAKES

No brakes or low pressure.

A. Check brake delay valve.
B. Refer to your local service facility.

EQUIPMENT MAINTENANCE RECORD

MODEL	SERIAL NUMBER
DATE	EQUIPMENT NUMBER
LOCATION	MECHANIC

ITEM	CODE	COMMENTS	ITEM	CODE	COMMENTS
Engine oil			Safety cut-outs		
Engine oil filter			Bushings		
Air filter			Rollers		
Fuel filter			Wear pad		
Tune-up			Front end assembly		
Choke			Tire pressure		
Engine RPM			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		
Relays			Literature		
Wire connections			Options		

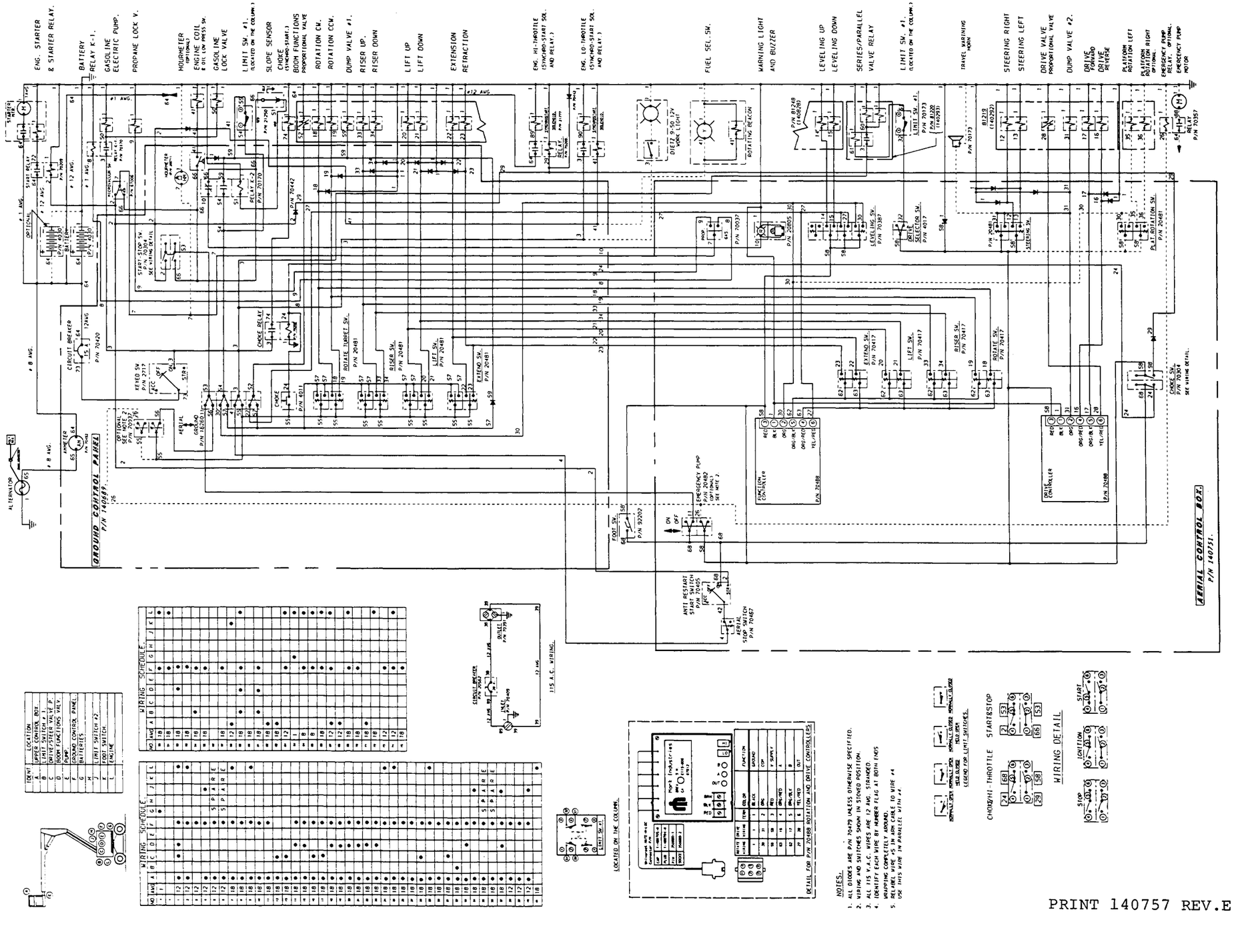
Code

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

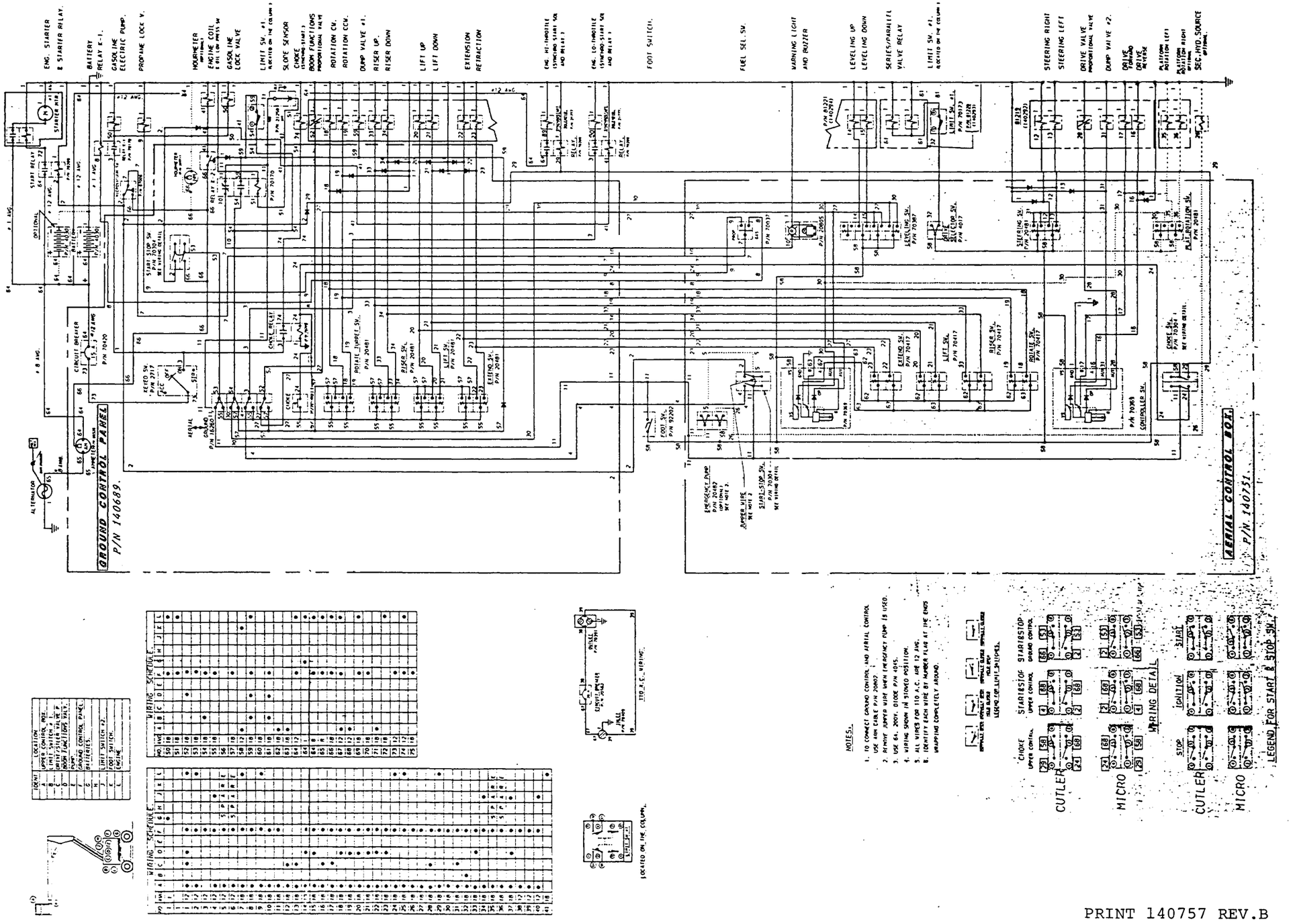
Comments

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

ELECTRICAL SCHEMATIC (30 KBDF)
(SINCE APRIL 1989)

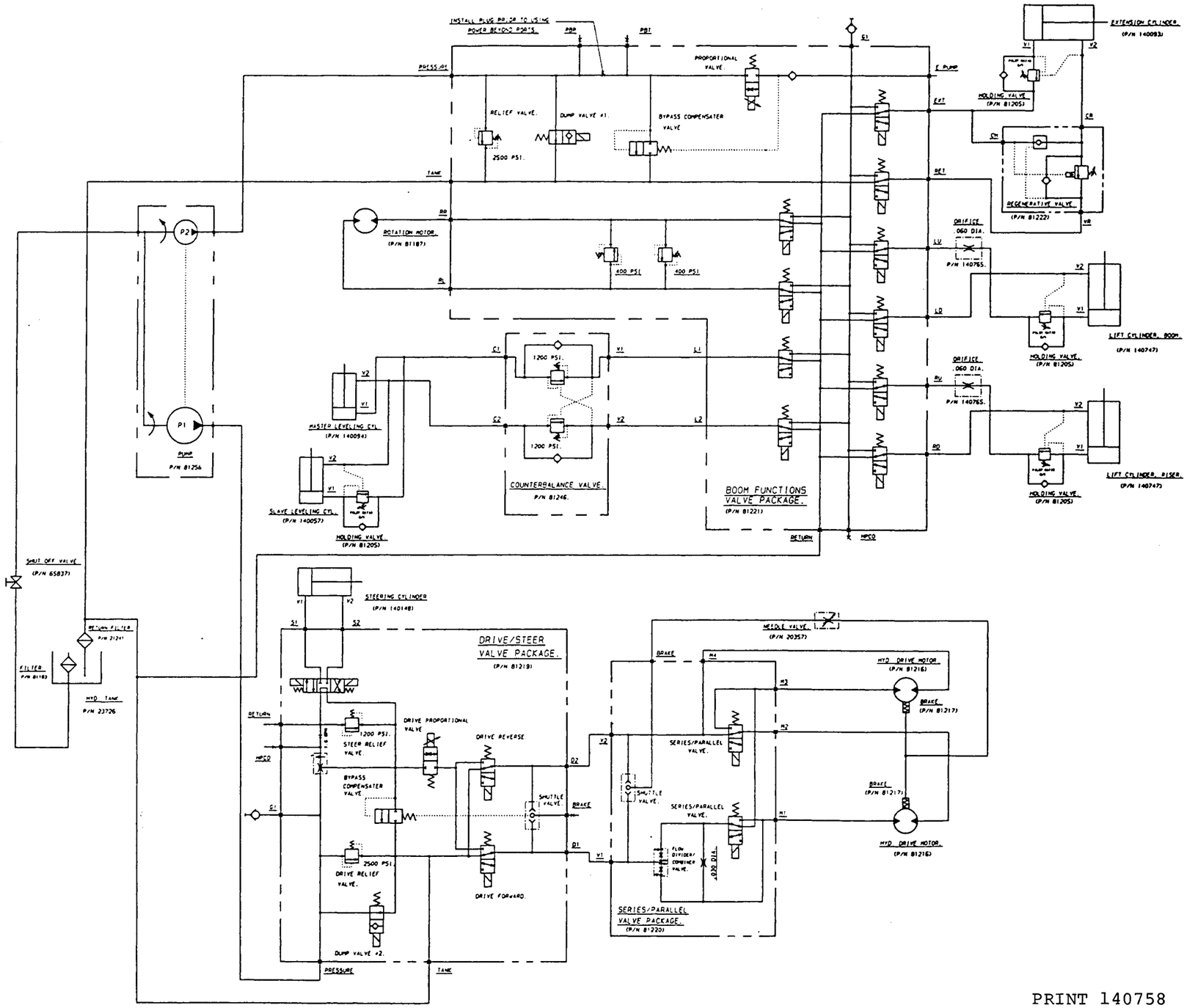


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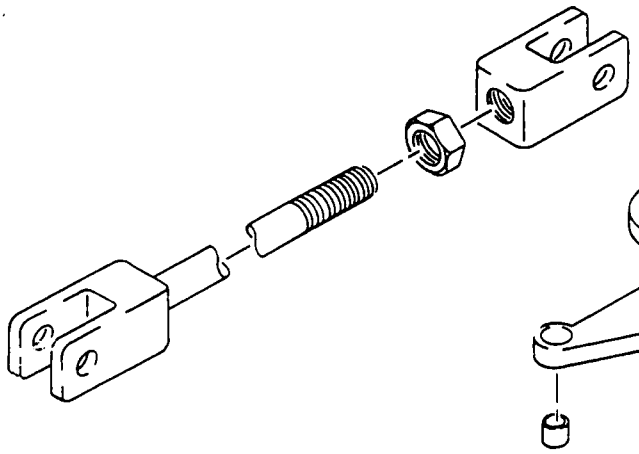


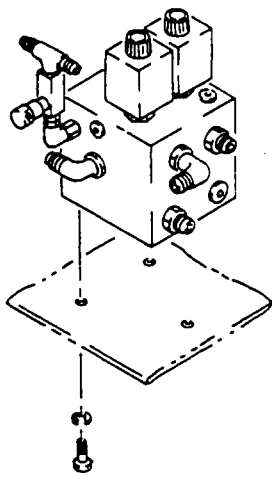
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HYDRAULIC SCHEMATIC (30 KBDF)



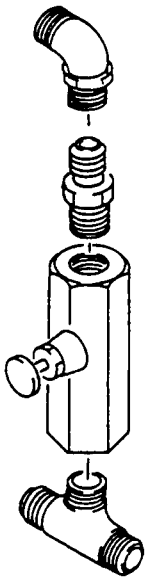
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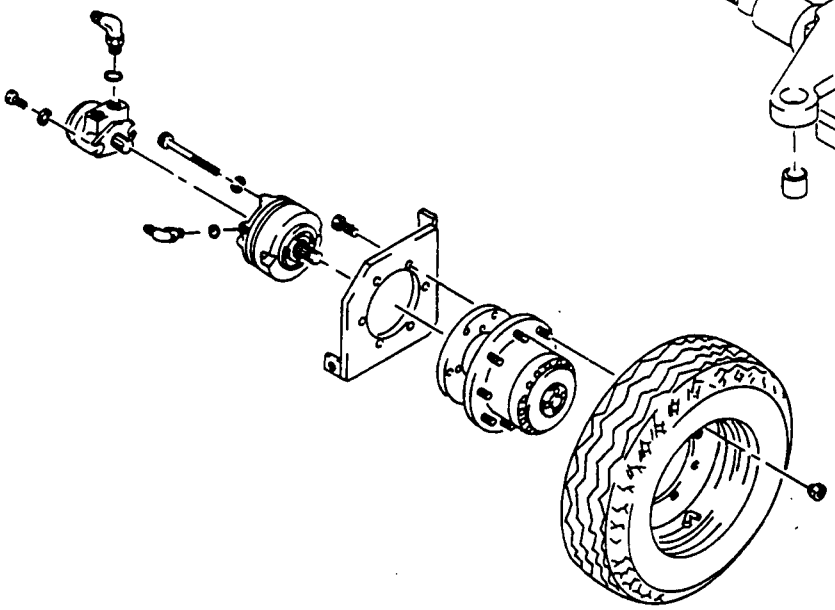


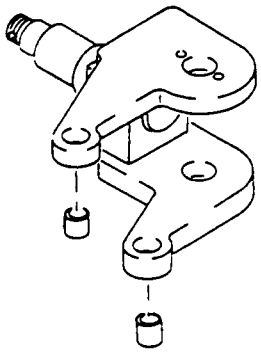


THIS SECTION 1 CONTAINS THE FOLLOWING MATTER:

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







SECTION 1 THE MARKLIFT PARTS CATALOG

PAGE NO.	TITLE
1	TABLE OF CONTENTS
3	NOTICE TO USERS
4	HOW TO USE THE PARTS CATALOG
6	HOW TO ORDER PARTS

SECTION 2 CONTAINS:

FIG. NO.	TITLE
1	FINAL ASSEMBLY (30 KBDF)
2	DECAL SET (30 KBDF)
3	LOWER CONTROL PANEL ASSEMBLY (30 KBDF)
4	HYDRAULIC HOSE INSTALLATION (30 KBDF)

SECTION 3 CONTAINS:

FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY (30 KBDF)
2	LEFT HAND SPINDLE & YOKE ASSEMBLY (30 KBDF)
3	RIGHT HAND SPINDLE & YOKE ASSEMBLY (30 KBDF)
4	HUB ASSEMBLY (30 KBDF)
5	WHEEL ASSEMBLY (30 KBDF)
6	STEERING CYLINDER ASSEMBLY (30 KBDF)
7	STEERING TIE ROD ASSEMBLY (30 KBDF)
8	DRIVE MOTOR (30 KBDF)
9	FRONT AXLE WHEEL ASSEMBLY (30 KBDF)
10	SERIES PARALLEL VALVE ASSEMBLY (30 KBDF)

SECTION 4 CONTAINS:

FIG. NO.	TITLE
1	TURRET ASSEMBLY (30 KBDF)
2	BOOM LIFT CYLINDER SUB-ASSEMBLY (30 KBDF)
3	REGENERATIVE VALVE SUB-ASSEMBLY (30 KBDF)
4	RISER ARM CYLINDER ASSEMBLY (30 KBDF)
5	RISER ARM ASSEMBLY (30 KBDF)
6	MASTER CYLINDER SUB-ASSEMBLY (30 KBDF)

SECTION 4 TURRET ASSEMBLY (CONT'D)

FIG. NO.	TITLE
7	FUEL TANK ASSEMBLY (30 KBDF)
8	HYDRAULIC TANK ASSEMBLY (30 KBDF)
9	ROTATION GEARBOX/BRACKET ASSEMBLY (30 KBDF)
10	PROPORTIONAL DRIVE/STEER VALVE ASSEMBLY (30 KBDF)
11	BOOM FUNCTION VALVE ASSEMBLY (30 KBDF)
12	EMERGENCY PUMP ASSEMBLY (30 KBDF)
13	ENGINE & PUMP ASSEMBLY (30 KBDF)
14	FUEL SYSTEM ASSEMBLY (30 KBDF)
15	SHEET METAL KIT (30 KBDF)

SECTION 5 CONTAINS:

FIG. NO.	TITLE
1	BOOM ASSEMBLY (30 KBDF)
2	INNER BOOM SUB-ASSEMBLY (30 KBDF)
3	EXTENSION CYLINDER SUB-ASSEMBLY (30 KBDF)
4	SLAVE CYLINDER SUB-ASSEMBLY (30 KBDF)

SECTION 6 CONTAINS:

FIG. NO.	TITLE
1	PLATFORM ASSEMBLY (30 KBDF)
2	MANUAL ROTATOR (SENCE LATE 1989)
2A	MANUAL ROTATOR (UNTILL LATE 1989)
3	AERIAL CONTROL BOX ASSY. (SENCE APRIL 1989)
3A	AERIAL CONTROL BOX ASSY. (UNTILL APRIL 1989)

SECTION 7 CONTAINS:

FIG. NO.	TITLE
1	ALL FUNCTION AUXILLARY POWER (30 KBDF)
2	2 HEAD LIGHTS & 2 REAR RED LIGHTS (30 KBDF)
3	SPARK ARRESTOR MUFFLER (30 KBDF)
4	LIFTING LUG (30 KBDF)
5	PLATFORM POWERED ROTATOR (30 KBDF)

SECTION 7 OPTIONS (CONT'D)

FIG.NO.	TITLE
6	2000W GENERATOR (30 KBDF)
7	12 VOLT PLATFORM WORK LIGHT (30 KBDF)
8	ROTATING AMBER BEACON (30 KBDF)
9	ALL MOTION ALARM (30 KBDF)
10	HOURMETER (30 KBDF)
11	½" HYDRAULIC LINE TO PLATFORM (30 KBDF)
12	½" AIR LINE TO PLATFORM (30 KBDF)
13	ADDITIONAL LP TANK (30 KBDF)
14	TRAVEL WARNING HORN (30 KBDF)
15	LIGHTS (30 KBDF)

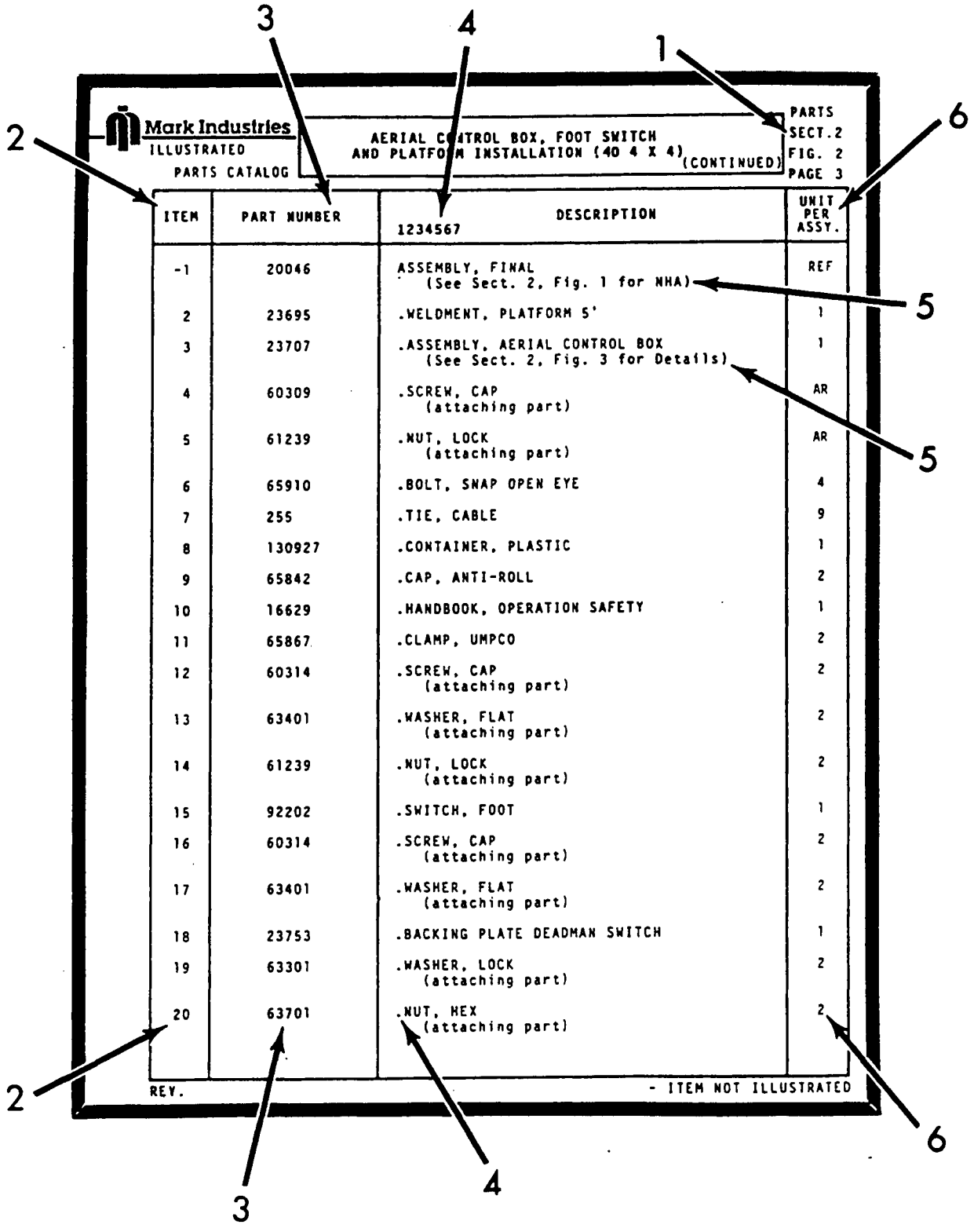
DISCLAIMER

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

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

NOTICE

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



Mark Industries
ILLUSTRATED
PARTS CATALOG

AERIAL CONTROL BOX, FOOT SWITCH AND PLATFORM INSTALLATION (40 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, -5, 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

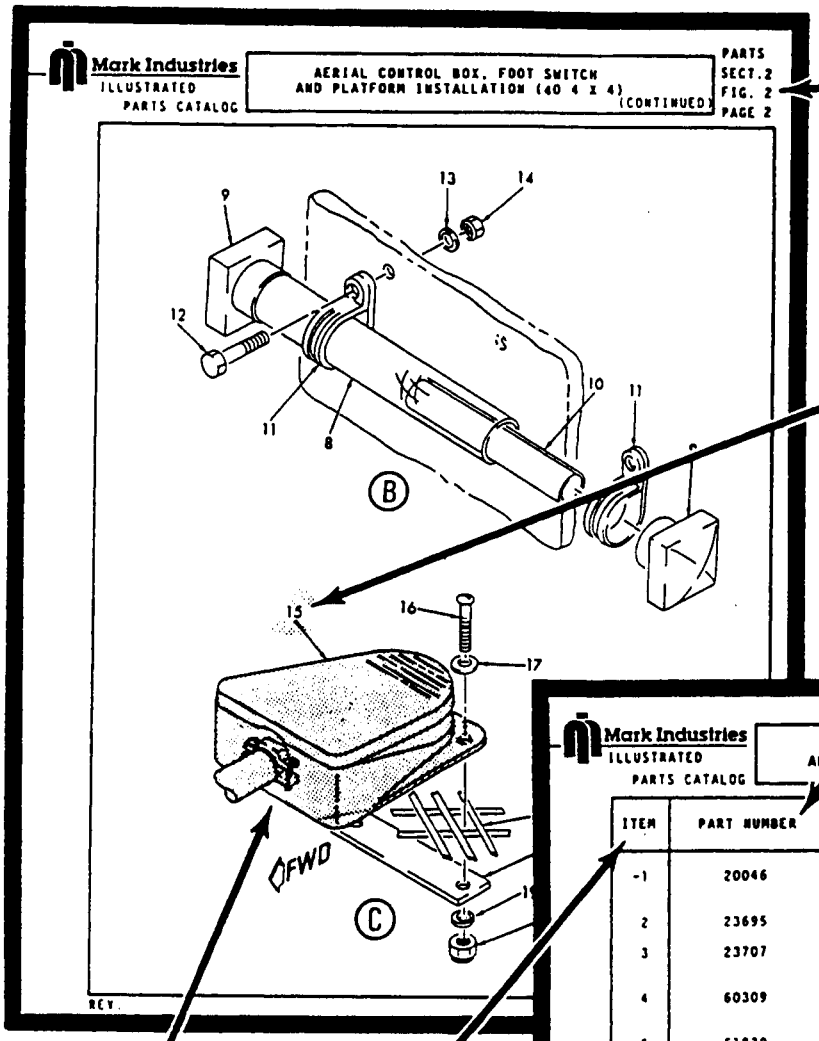
5. **NHA** (Next Higher Assembly) and **DETAILS** - Section and Figure reference catalog location indicates where the installation or assembly is listed under NHA and where illustrated for more detailed breakdown.

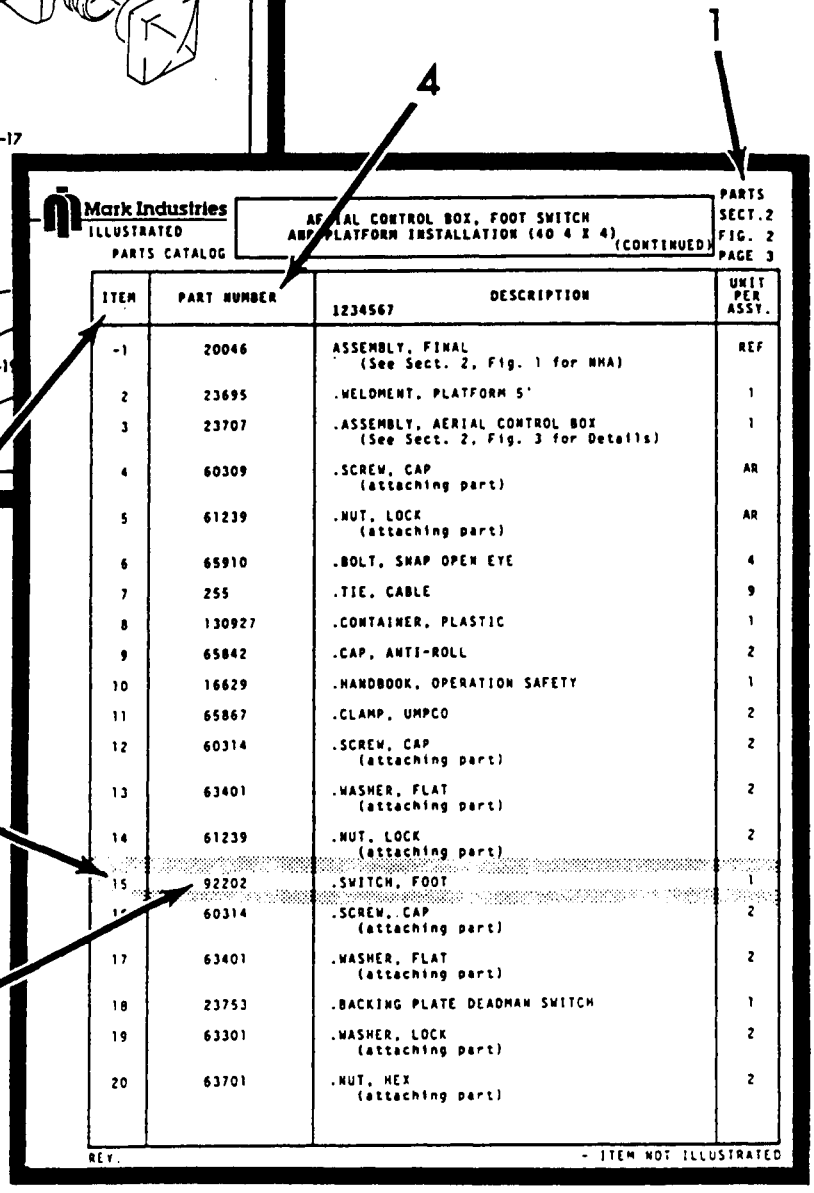
6. **UNIT PER ASSEMBLY** - Entries are as follows:

   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.





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

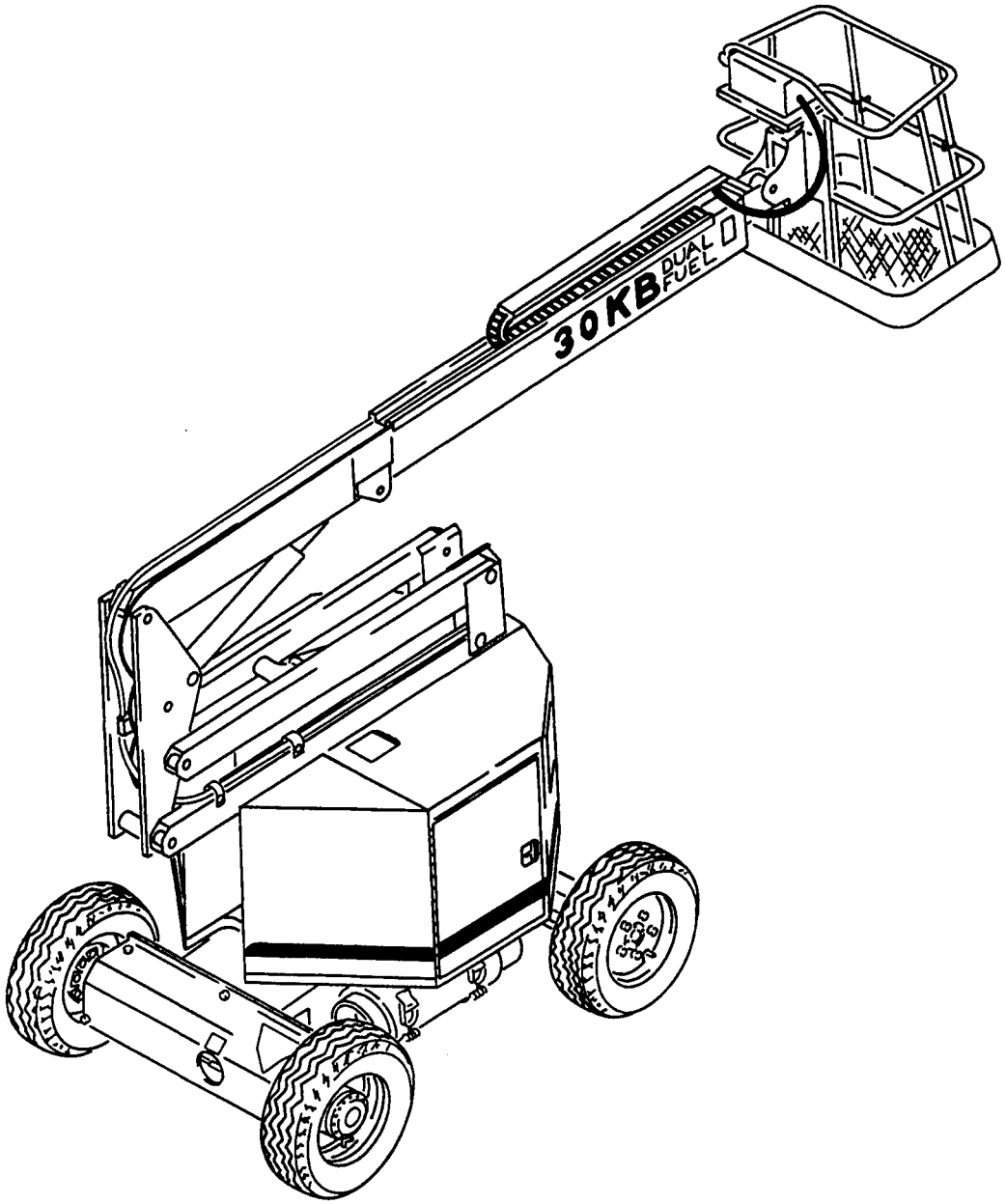
A. By **FAX**: **(714) 879-8884**

B. By Phone: (714) 879-MARK

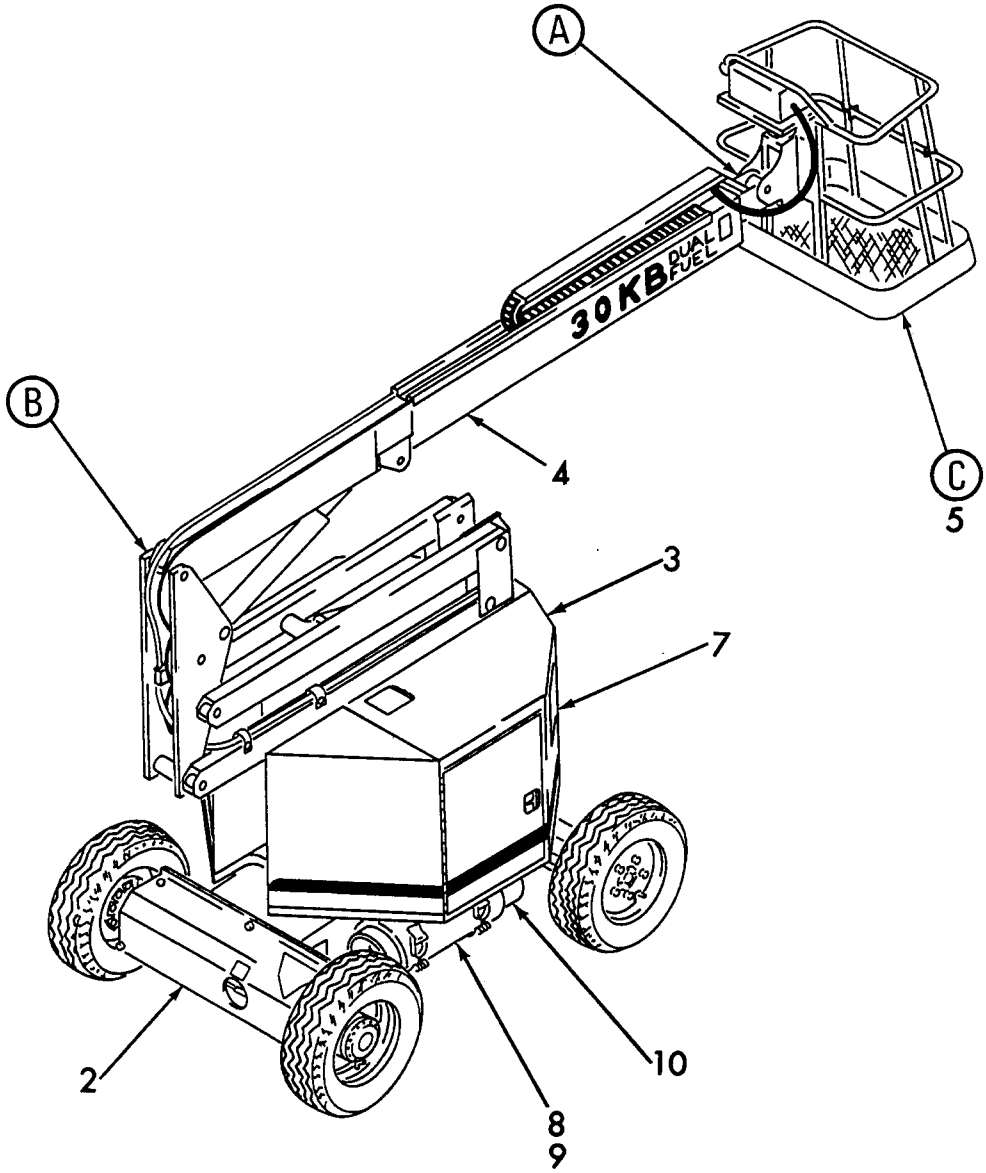
C. By Mail: MARK INDUSTRIES
ATTENTION: PARTS DEPARTMENT
P.O. BOX 2225
BREA, CA. 92622

SECTION 2 CONTAINS:

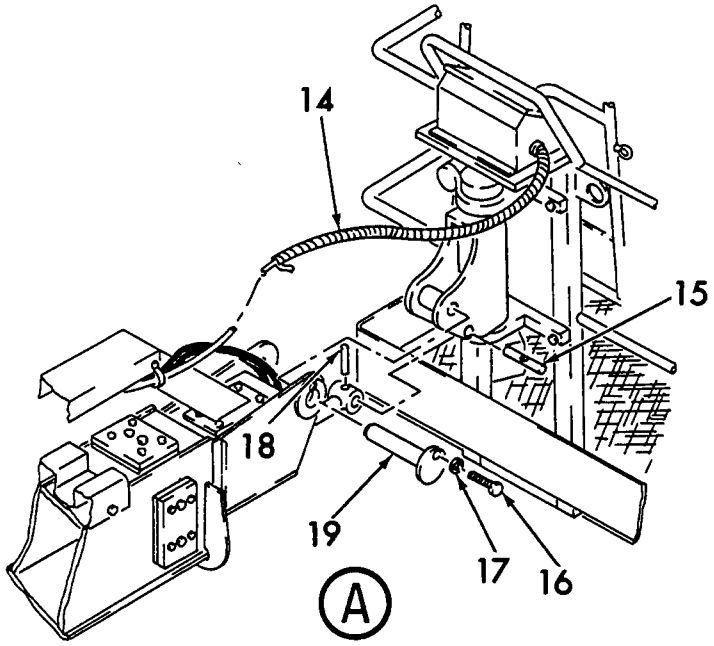
FIG. NO.	TITLE
1	FINAL ASSEMBLY (30 KBDF)
2	DECAL SET (30 KBDF)
3	LOWER CONTROL PANEL ASSEMBLY (30 KBDF)
4	HYDRAULIC HOSE INSTALLATION (30 KBDF)

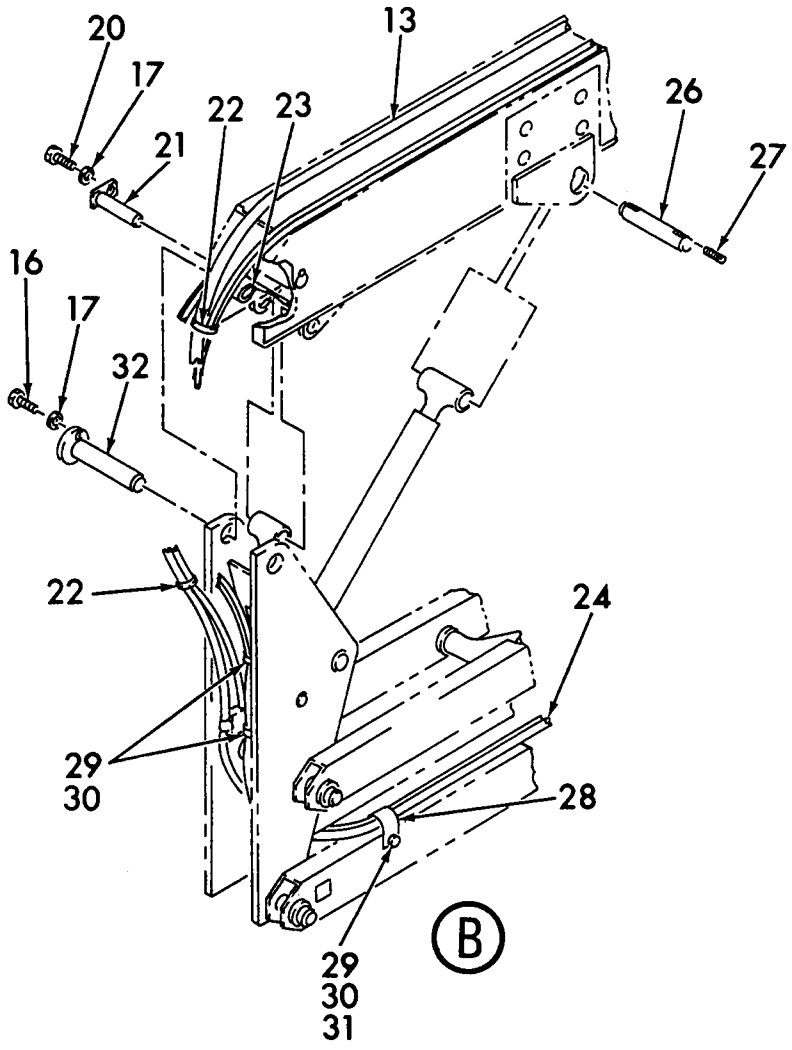


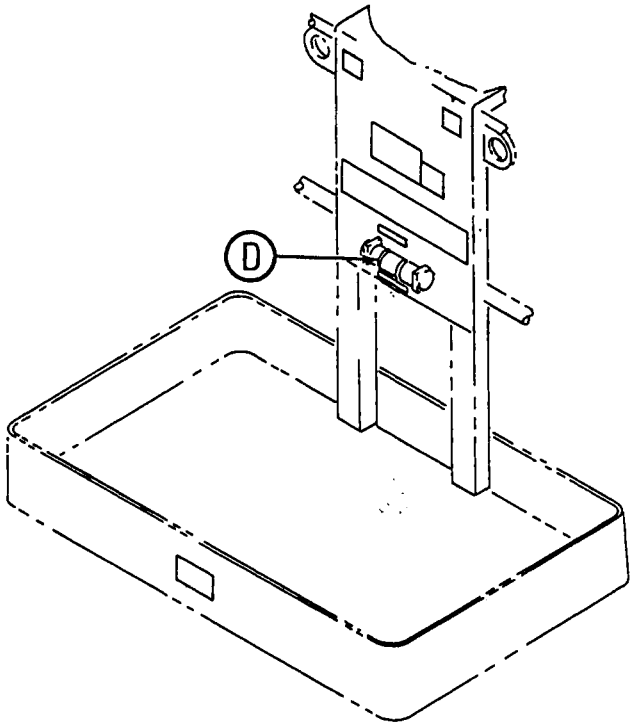
FINAL ASSEMBLY (30 KBDF)



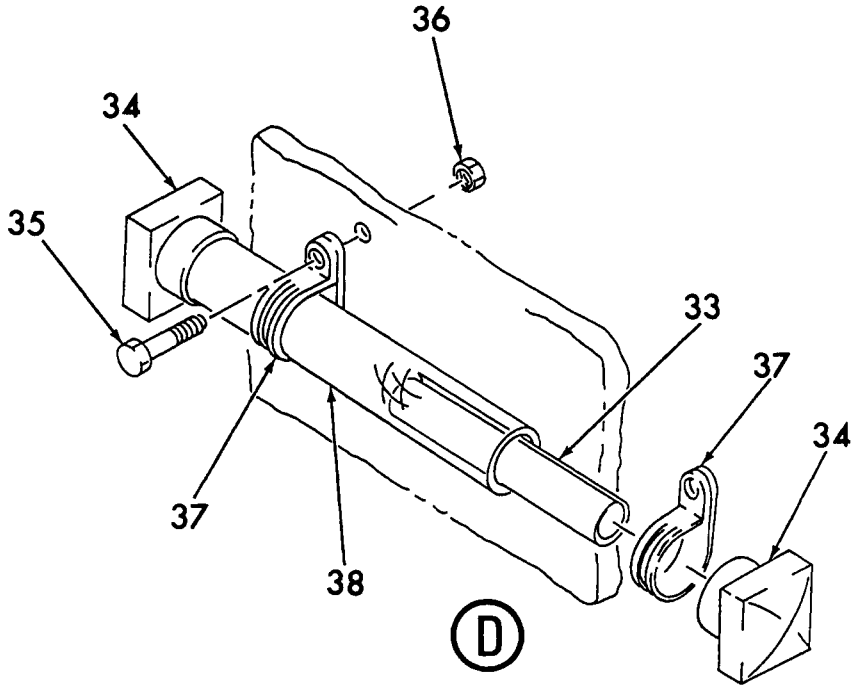
FINAL ASSEMBLY (30 KBDF)







C



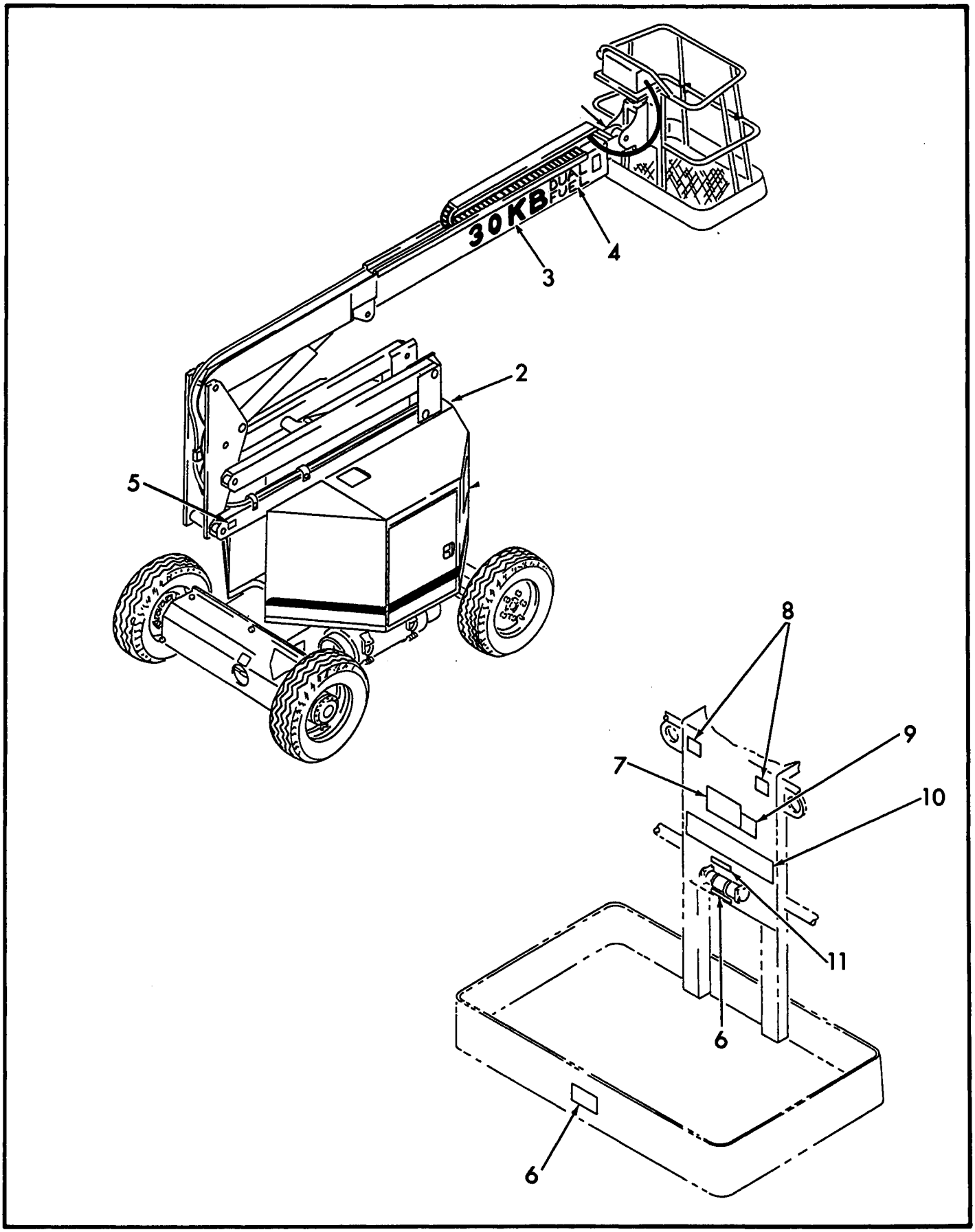
FINAL ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140003	ASSEMBLY, FINAL	REF
2	140640	.ASSEMBLY, CARRIAGE (See Sect. 3, Fig. 1 for Details)	1
3	140641	.ASSEMBLY, TURRET (See Sect. 4, Fig. 1 for Details)	1
4	140118	.ASSEMBLY, FINAL BOOM (See Sect. 5, Fig. 1 for Details)	1
5	140647	.ASSEMBLY, PLATFORM (See Sect. 6, Fig. 1 for Details)	1
6	67400	.SET, DECAL (See Sect. 2, Fig. 2 for Details)	1
7	140689	.PANEL, LOWER CONTROL (See Sect. 2, Fig. 3 for Details)	1
8	65141	.NIPPLE	1
9	32517	.ASSEMBLY, PROPANE HOSE	1
10	65937	.TANK, PROPANE	1
-11	65135	.PROPANE (10 GAL.)	1
-12	60645	.SCREW, CAP	24
13	20802	.CABLE, CONDUCTOR (50 FT.)	1
14	65322	.COIL, PROTECTIVE (5 FT.)	1
15	64209	.PIN, ROLL	1
16	60343	.SCREW, CAP	2
17	63319	.WASHER, LOCK	3
18	140436	.PIN, ROTATOR	1
19	140437	.PIN, SLAVE CYLINDER ROTATOR	1
20	60325	.SCREW, CAP	1
21	140431	.PIN, MASTER CYLINDER BOOM	1
22	256	.TIE, CABLE	50
23	27289	.TUBE, ROUND	1

- ITEM NOT ILLUSTRATED

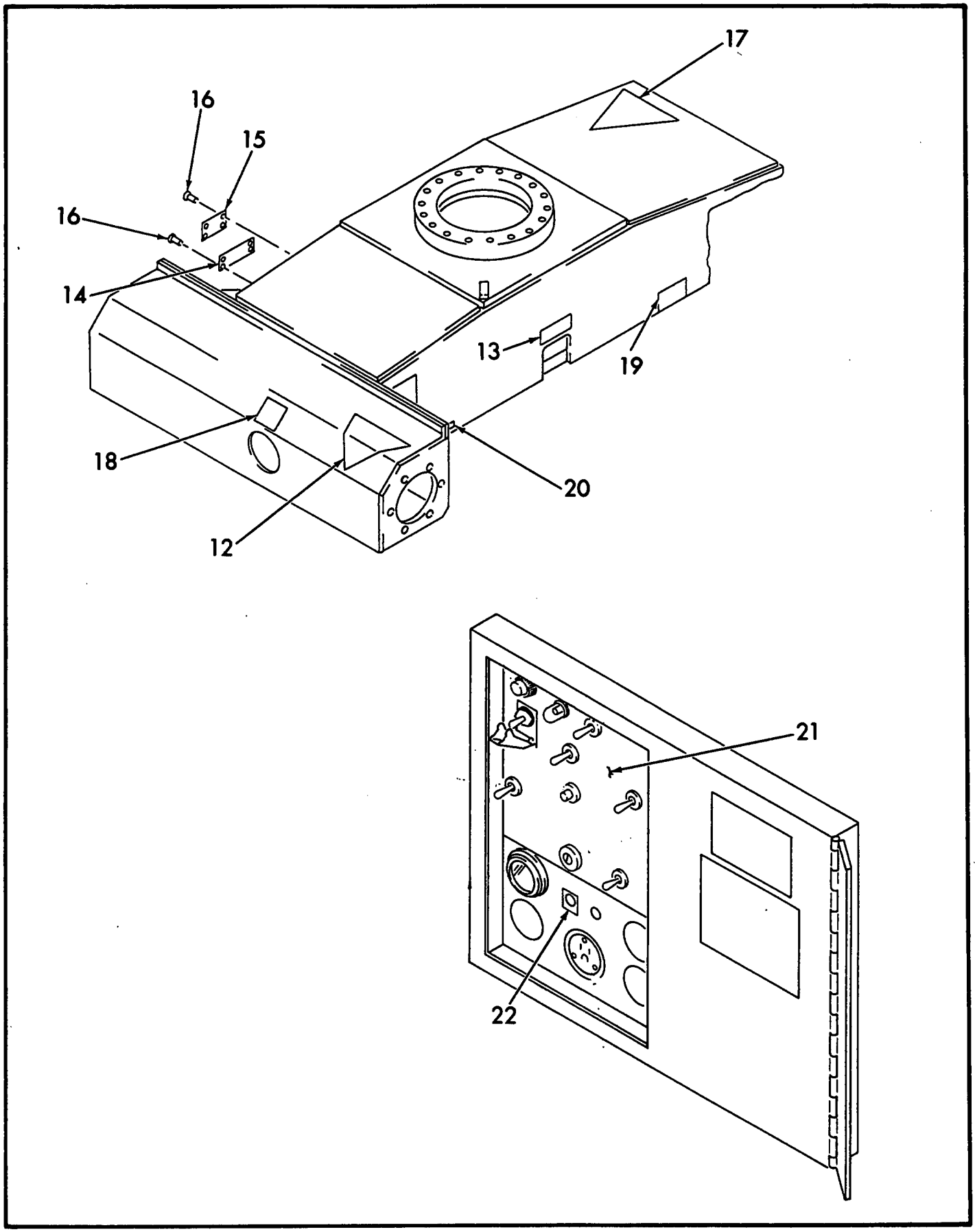
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	2568-35	.HOSE, HYDRAULIC (35 FT.)	2
-25	140761	.DIAGRAM, HOSE KIT (See Sect. 2, Fig. 4 for Details)	1
26	140489	.PIN, ROD END BOOM LIFT CYLINDER	1
27	62234	.SCREW, SET	1
28	140602	.ASSEMBLY, ARM CABLE CLAMP	6
29	60353	.SCREW, CAP	8
30	63301	.WASHER, LOCK	8
31	63433	.WASHER, FLAT	6
32	140601	.PIN, BOOM LIFT	1
33	17408	.HANDBOOK, OPERATION & SAFETY	1
34	65842	.CAP, ANTI-ROLL	2
35	60315	.SCREW, CAP	2
36	60711	.NUT, LOCK	2
37	65867	.CLAMP	10
38	130927	.CONTAINER, PLASTIC	1
-39	62702	.SCREW, MACHINE	2
-40	140757	•SCHEMATIC, ELECTRICAL (See Schematic Chapter for Details)	1
-41	140758	•SCHEMATIC, HYDRAULIC (See Schematic Chapter for Details)	1

DECAL SET (30 KBDF)

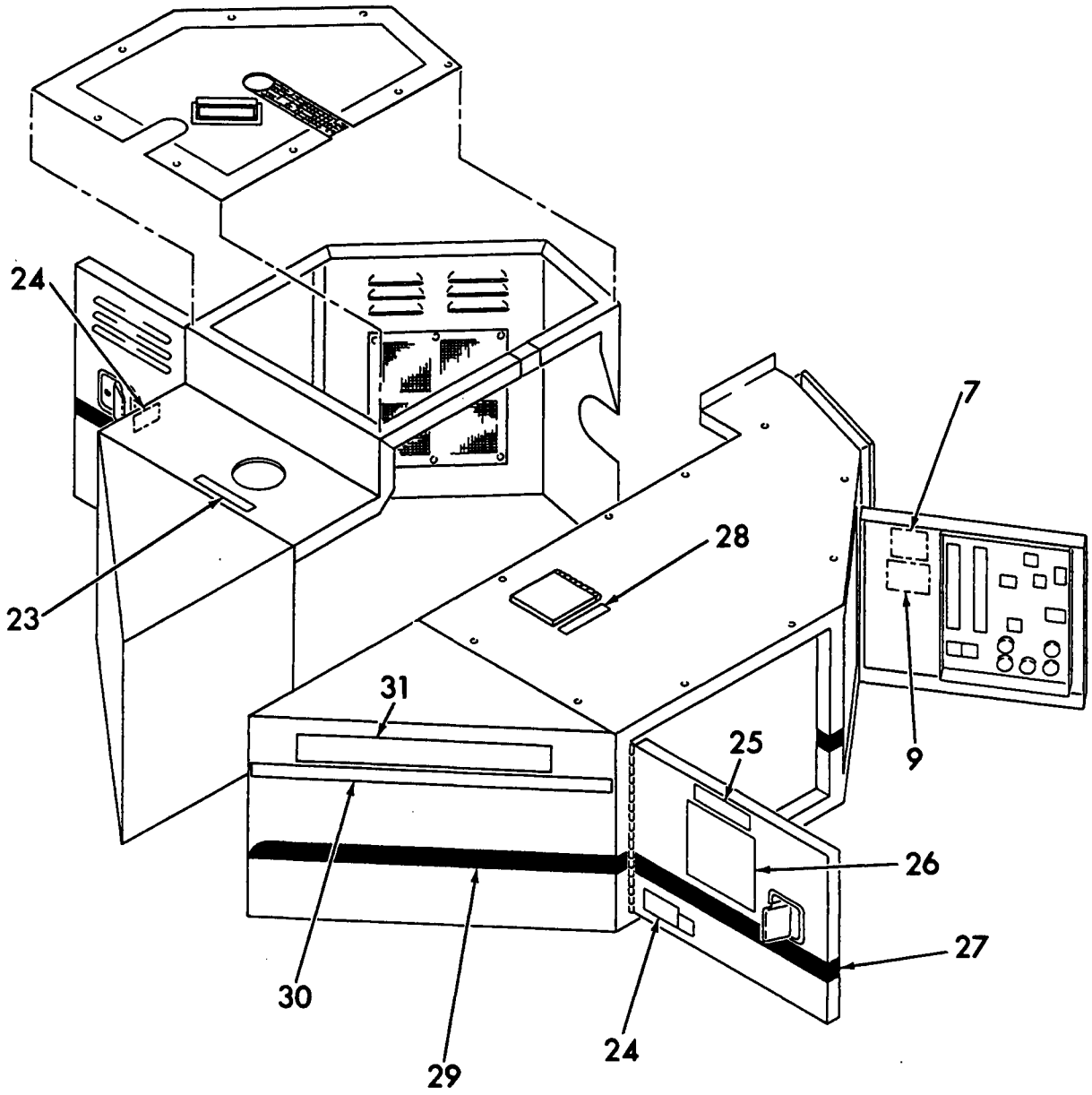


REV.

DECAL SET (30 KBDF)



DECAL SET (30 KBDF)



DECAL SET (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	67400	SET, DECAL	REF
2	20410	.DECAL, LOGO MARK INDUSTRIES	1
3	181901	.DECAL, MARKLIFT 30 KBDF	2
4	140420	.DECAL, DUAL FUEL	2
5	21237	.DECAL, GREASE FITTING	8
6	2022	.DECAL, LOAD CAPACITY 500 LBS.	2
7	181103	.DECAL, DANGER OBEY THE FOLLOWING...	2
8	22386	.DECAL, "D" RING ATTACH SAFETY BELT	2
9	181102	.DECAL, DANGER DO NOT OPERATE UNLESS...	2
10	182101	.DECAL, DANGER & AERIAL OPERATION INST.	1
11	130820	.DECAL, OPERATION & SAFETY HANDBOOK	1
12	20462	.DECAL, FORWARD ARROW FRONT	1
13	140595	.DECAL, TIE DOWN DIAGRAM	2
14	20661	.PLATE, ANSI A92	1
15	20660	.NAMEPLATE, IDENTIFICATION	1
-16	63654	.RIVET, POP	8
17	20461	.DECAL, FORWARD ARROW AFT	1
18	20896	.DECAL, BRAKE	1
19	2004	.DECAL, VAPOR TANK ONLY	1
20	22175	.DECAL, CAUTION MONOFILLED TIRES ONLY	12
21	182716	.DECAL, GROUND CONTROL	1
22	185702	.DECAL, CIRCUIT BREAKER 110 VAC	1
23	2020	.DECAL, GASOLINE OR PETROL	2
24	20419	.DECAL, DANGER KEEP CLEAR	2
25	140469	.DECAL, HAND PUMP	1
26	140495	.DECAL, EMERGENCY	1

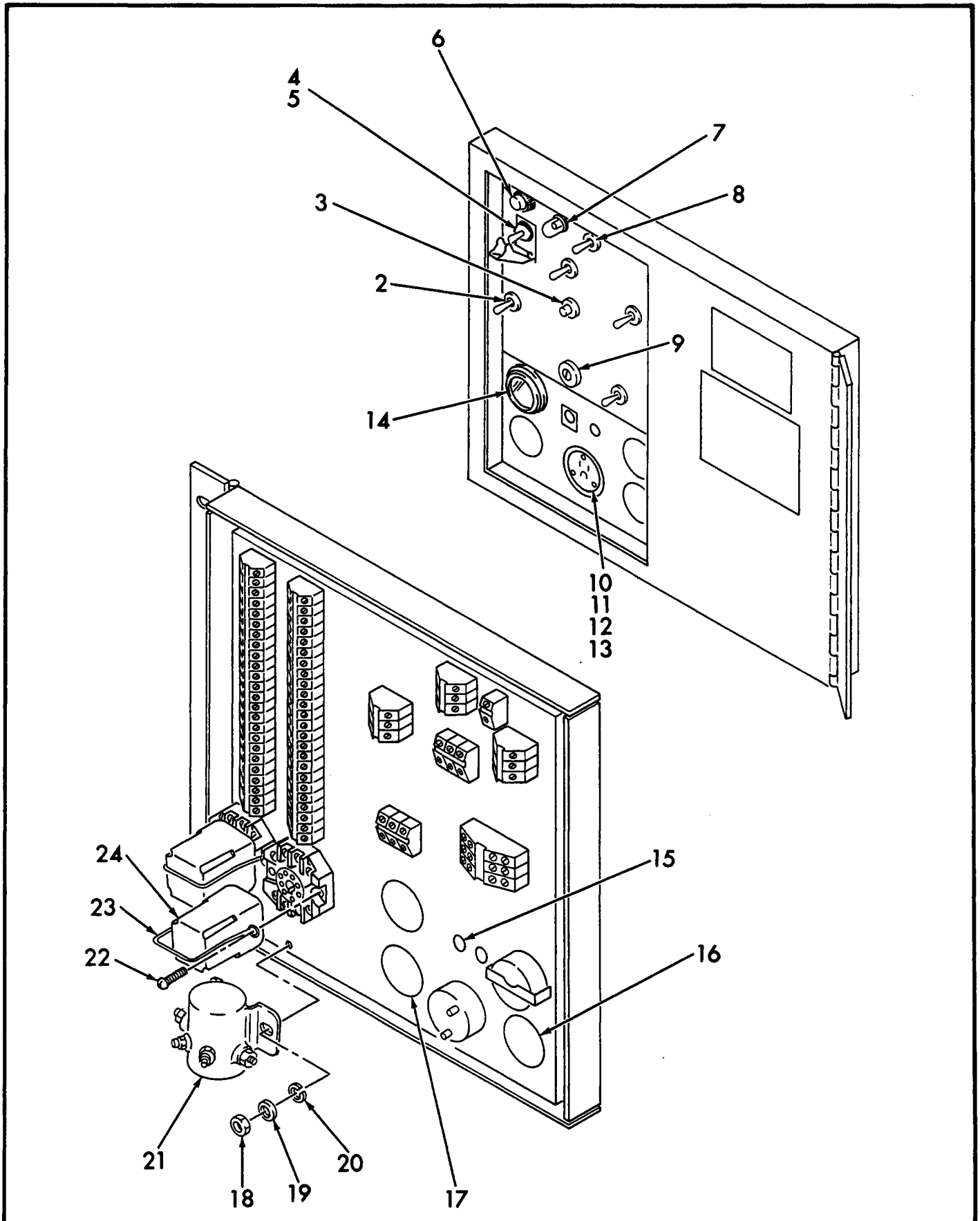
- ITEM NOT ILLUSTRATED

DECAL SET (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	20411	.DECAL, BLUE STRIPE SQUARE END	6
28	2017	.DECAL, HYDRAULIC SYSTEM FLUID	1
29	20412	.DECAL, BLUE STRIPE ROUND ENDS	2
30	130596	.DECAL, A PRODUCT OF MARK INDUSTRIES	2
31	31259	.DECAL, MARKLIFT	2
-32	20879	.DECAL, DIPSTICK	1

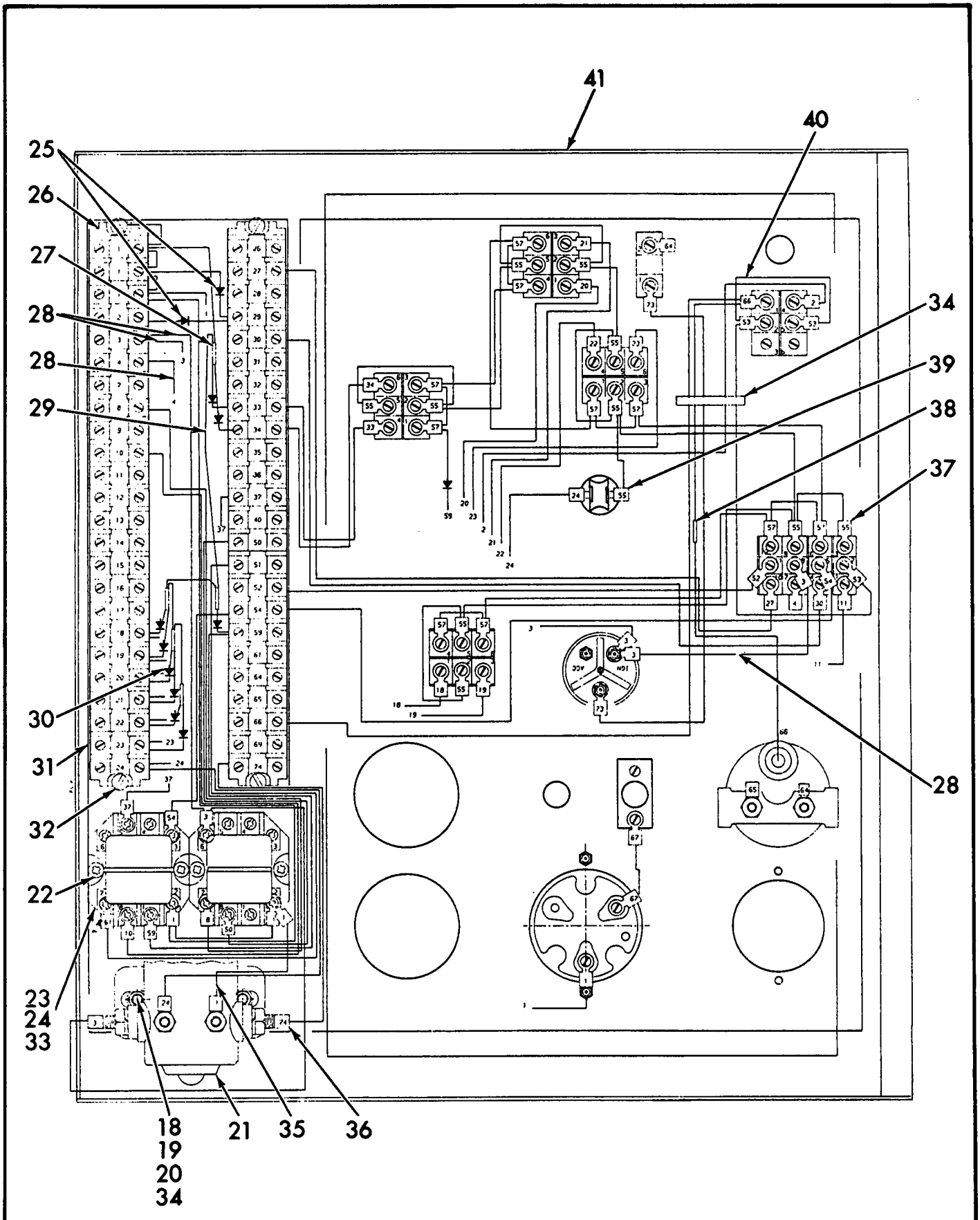
- ITEM NOT ILLUSTRATED

LOWER CONTROL PANEL ASSEMBLY (30 KBDF)



REV.

LOWER CONTROL PANEL ASSEMBLY (30 KBDF)



LOWER CONTROL PANEL ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140689	ASSEMBLY, LOWER CONTROL PANEL	REF
2	16260	.SWITCH, TOGGLE	1
3	4011	.SWITCH, PUSH BUTTON	1
4	70304	.SWITCH, TOGGLE	1
5	70303	.SWITCH, GUARD	1
6	775	.PLUG, HOLE	1
7	20562	.BREAKER, CIRCUIT	2
8	20481	.SWITCH, TOGGLE	4
9	2717	.SWITCH, IGNITION	1
10	62609	.SCREW, MACHINE	2
11	70409	.INLET, FLANGE	1
12	61501	.NUT, HEX	2
13	63311	.WASHER, LOCK	2
14	20994	.AMMETER	1
15	65240	.PLUG	1
16	65243	.PLUG	1
17	65244	.PLUG	1
18	60701	.NUT, HEX	2
19	63401	.WASHER, FLAT	2
20	63301	.WASHER, LOCK	2
21	70209	.SOLENOID	1
22	61721	.SCREW, CAP	4
23	30215	.CLIP RELAY, HOLD DOWN	2
24	70170	.RELAY	2
25	70442	.DIODE	2
26	117-A	.BLOCK END, TERMINAL	2

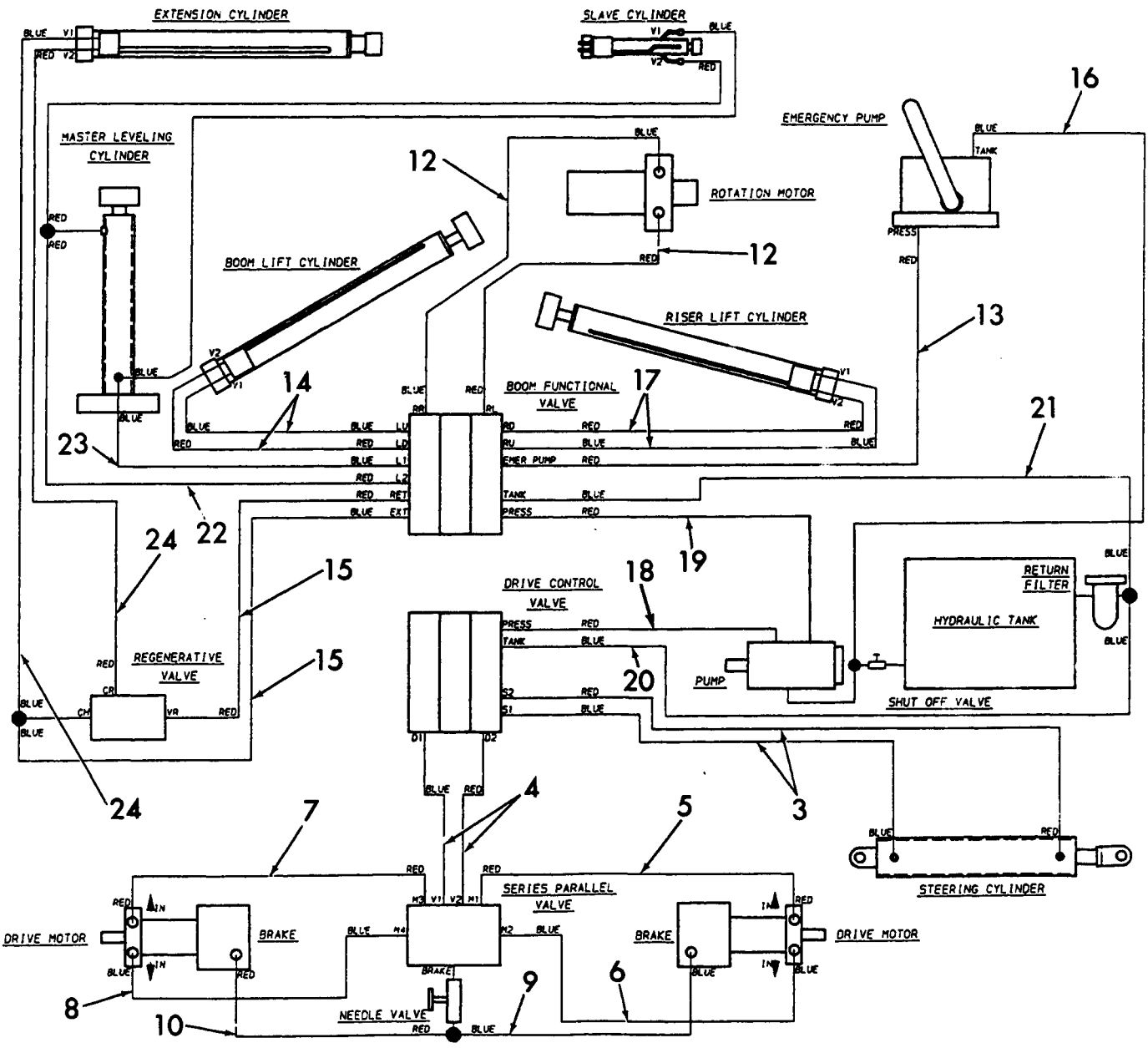
- ITEM NOT ILLUSTRATED

LOWER CONTROL PANEL ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	70162	.CONNECTOR, BUTT	1
28	2991	.WIRE	4
29	70008	.WIRE	4
30	4045	.DIODE	10
31	4027	.TERMINAL, BLOCK	48
32	61731	.SCREW, CAP	6
33	784-A	.RELAY, SOCKET	2
34	60342	.SCREW, CAP	2
35	70098	.WIRE	6
36	70255	.RING, CONNECTOR	2
37	117-C	.RING, CONNECTOR	62
38	117-D	.BUTT, CONNECTOR	5
39	117-E	.TERMINAL, PUSH-ON	2
40	2990	.WIRE	45
41	140792	.PANEL, LOWER CONTROL	1
-42	256	.TIE, CABLE	30

- ITEM NOT ILLUSTRATED

HYDRAULIC HOSE INSTALLATION (30 KBDF)



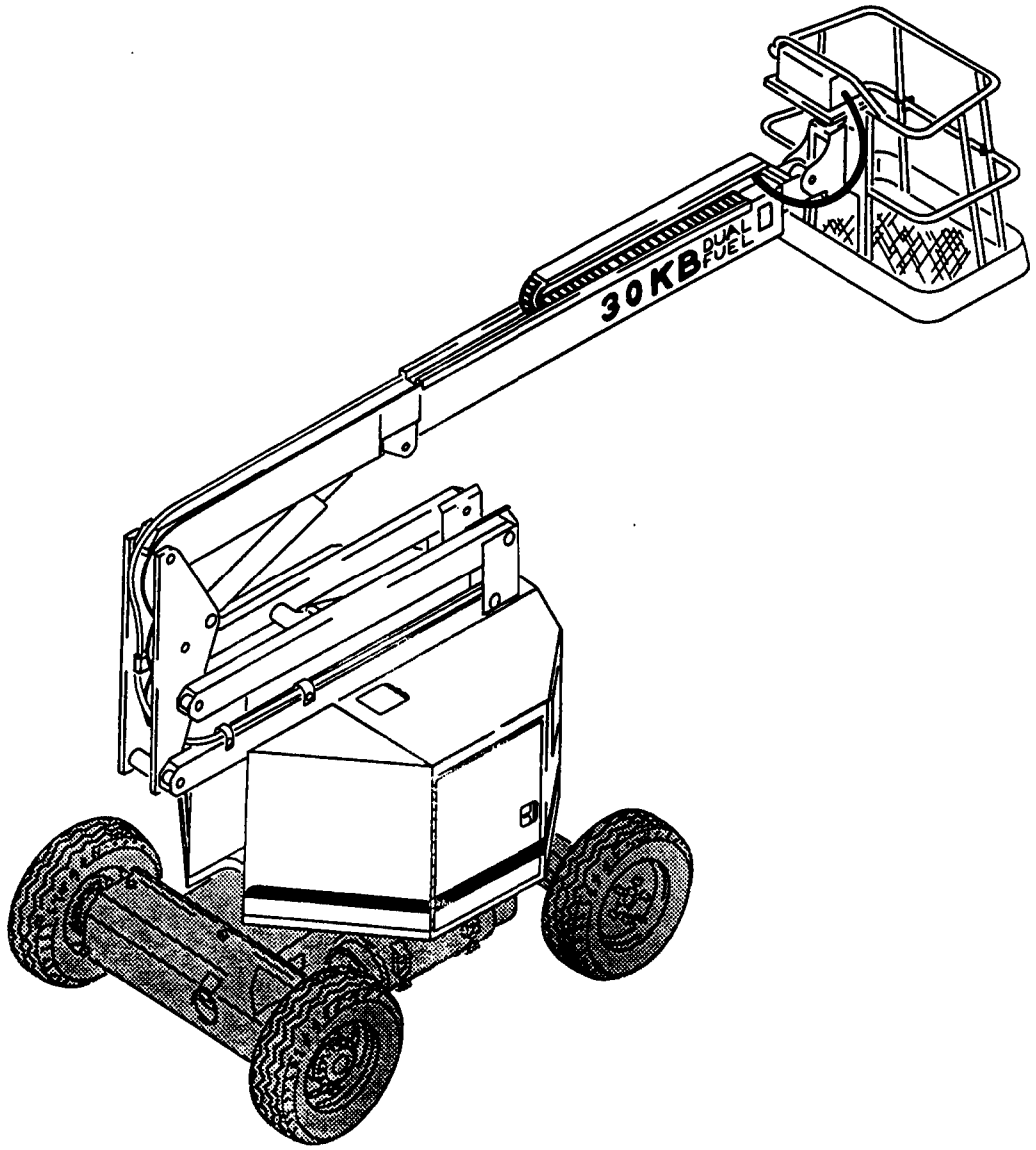
HYDRAULIC HOSE INSTALLATION (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140761	DIAGRAM, HOSE KIT	REF
-2		."A" HOSE KIT	REF
3	13213-04-1300	.ASSEMBLY, HOSE	2
4	13213-10-1300	.ASSEMBLY, HOSE	2
5	13212-08-0144	.ASSEMBLY, HOSE	1
6	13212-08-0120	.ASSEMBLY, HOSE	1
7	13213-08-0296	.ASSEMBLY, HOSE	1
8	13210-08-0250	.ASSEMBLY, HOSE	1
9	13210-04-0174	.ASSEMBLY, HOSE	1
10	13210-04-0244	.ASSEMBLY, HOSE	1
-11		."B" HOSE KIT	REF
12	13212-06-0310	.ASSEMBLY, HOSE	2
13	13213-04-0270	.ASSEMBLY, HOSE	1
14	13212-06-1730	.ASSEMBLY, HOSE	2
15	13212-06-1640	.ASSEMBLY, HOSE	2
16	13210-04-0160	.ASSEMBLY, HOSE	1
17	13212-06-0820	.ASSEMBLY, HOSE	2
18	13212-10-0510	.ASSEMBLY, HOSE	1
19	13213-08-0381	.ASSEMBLY, HOSE	1
20	13210-12-0330	.ASSEMBLY, HOSE	1
21	13213-10-0320	.ASSEMBLY, HOSE	1
22	13212-04-1810	.ASSEMBLY, HOSE	1
23	13212-04-1710	.ASSEMBLY, HOSE	1
24	13210-06-0380	.ASSEMBLY, HOSE	2

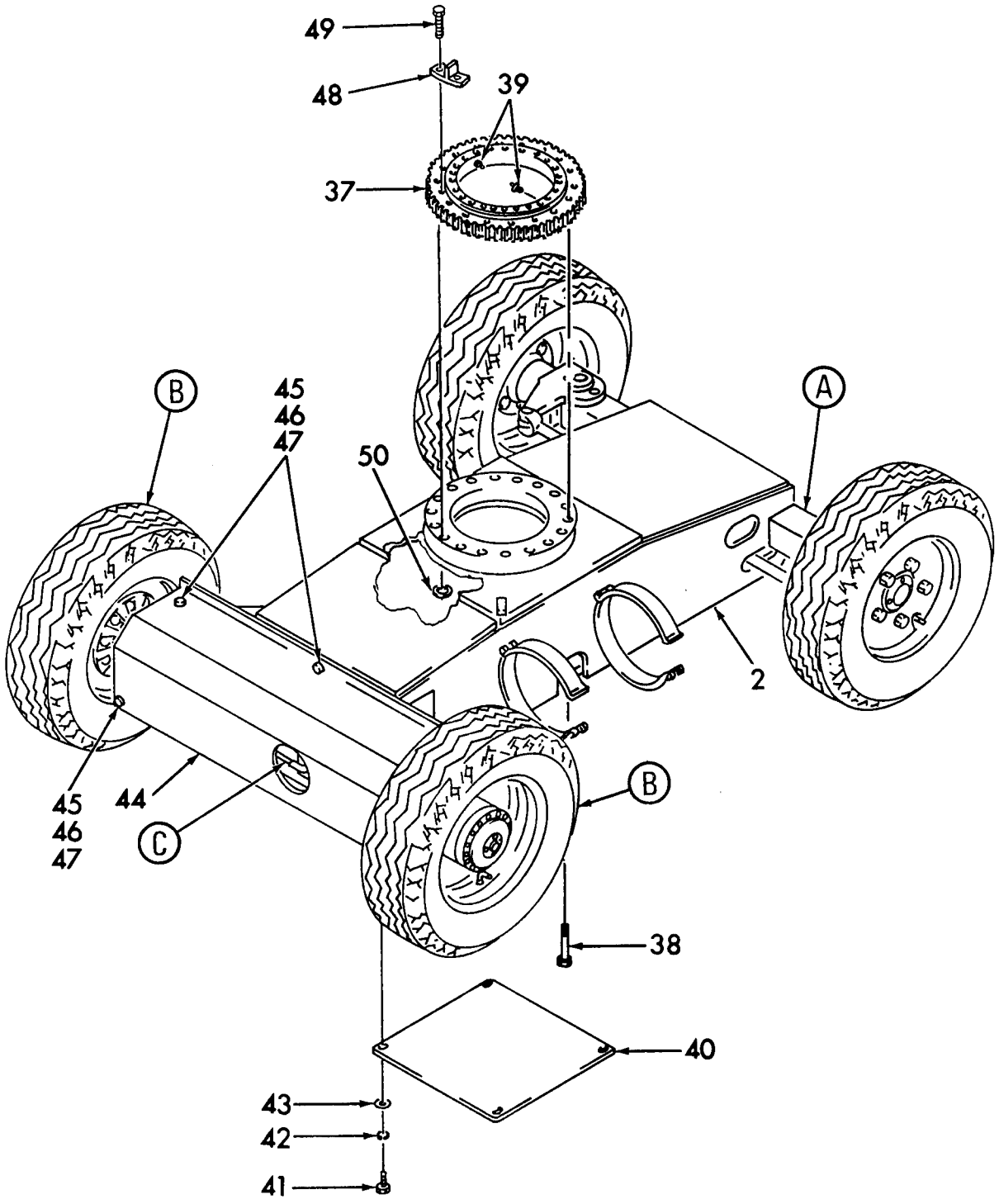
- ITEM NOT ILLUSTRATED

SECTION 3 CONTAINS:

FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY (30 KBDF)
2	LEFT HAND SPINDLE & YOKE ASSEMBLY (30 KBDF)
3	RIGHT HAND SPINDLE & YOKE ASSEMBLY (30 KBDF)
4	HUB ASSEMBLY (30 KBDF)
5	WHEEL ASSEMBLY (30 KBDF)
6	STEERING CYLINDER ASSEMBLY (30 KBDF)
7	STEERING TIE ROD ASSEMBLY (30 KBDF)
8	DRIVE MOTOR (30 KBDF)
9	FRONT AXLE WHEEL ASSEMBLY (30 KBDF)
10	SERIES PARALLEL VALVE ASSEMBLY (30 KBDF)

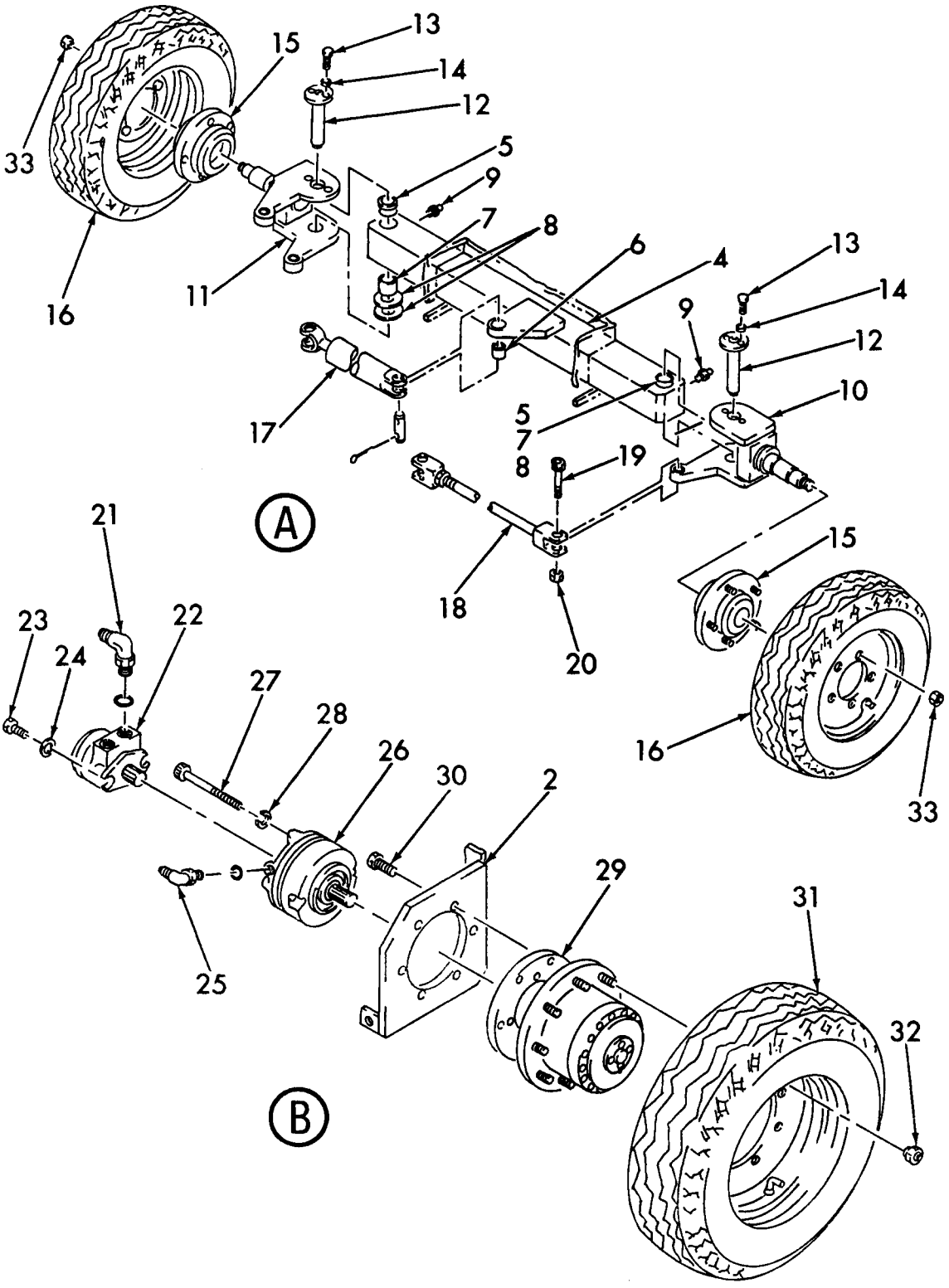


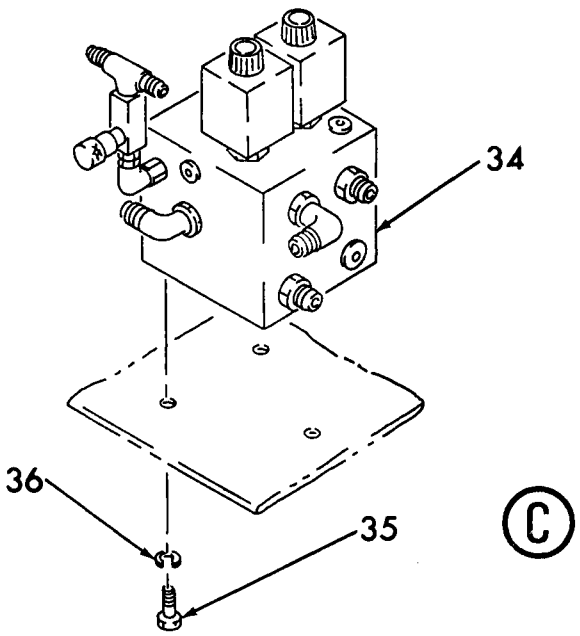
CARRIAGE ASSEMBLY (30 KBDF)



REV.

CARRIAGE ASSEMBLY (30 KBDF)





ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140640	ASSEMBLY, CARRIAGE (See Sect. 2, Fig. 1 for NHA)	REF
2	140346	.WELDMENT, CARRIAGE	1
3	140039	..MACHINING, STEERING AXLE	1
4	140038	...WELDMENT, STEERING AXLE	1
5	64910	...BUSHING, FLANGED	2
6	2265	...BEARING, SLEEVE	1
7	64934	...BEARING, SLEEVE	2
8	65952	.WASHER, THRUST	4
9	65103	.FITTING, GREASE	2
10	140329	.ASSEMBLY, L.H. SPINDLE AND YOKE (See Sect. 3, Fig. 2 for Details)	1

CARRIAGE ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
11	140328	.ASSEMBLY, R.H. SPINDLE AND YOKE (See Sect. 3, Fig. 3 for Details)	1
12	140338	.PIN, KING	2
13	60338	.SCREW, CAP (attaching part)	4
14	63302	.WASHER, LOCK (attaching part)	4
15	140089	.ASSEMBLY, HUB (See Sect. 3, Fig. 4 for Details)	2
16	140682	.ASSEMBLY, WHEEL (See Sect. 3, Fig. 5 for Details)	2
17	140291	.ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 6 for Details)	1
18	140237	.ASSEMBLY, STEERING TIE ROD (See Sect. 3, Fig. 7 for Details)	1
19	65966	.SCREW, SHOULDER (attaching part)	2
20	61236	.NUT, LOCK (attaching part)	2
21	80012-13	.ELBOW	4
22	81216	.MOTOR, DRIVE (See Sect. 3, Fig. 8 for Details)	2
23	60610	.SCREW, CAP (attaching part)	4
24	63405	.WASHER, FLAT (attaching part)	4
25	80012-03	.ELBOW	2
26	81217	.BRAKE, MICO (See Vendor Sect. for more Information)	2
27	65969	.SCREW, CAP (attaching part)	4
28	63305	.WASHER, LOCK (attaching part)	4
29	81218	.HUB, TORQUE (See Vendor Sect. for more Information)	2
30	60604	.SCREW, CAP	12
31	140683	.ASSEMBLY, FRONT AXLE WHEEL (See Sect. 3, Fig. 9 for Details)	2

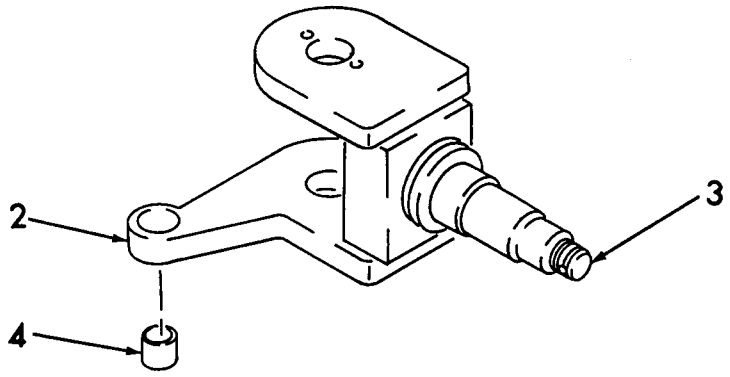
- ITEM NOT ILLUSTRATED

CARRIAGE ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
32	65945	.NUT, CONICAL F.C.	18
33	65117	.NUT, BALL	10
34	140293	.ASSEMBLY, SERIES PARALLEL VALVE (See Sect. 3, Fig. 10 for Details)	1
35	60343	.SCREW, CAP (attaching part)	3
36	63319	.WASHER, LOCK (attaching part)	3
37	23722	.GEAR, RING	1
38	60546	.SCREW, CAP (attaching part)	18
39	65103	.FITTING, GREASE	2
40	140472	.PLATE, CARRIAGE BOTTOM COVER	1
41	60353	.SCREW, CAP (attaching part)	4
42	63401	.WASHER, LOCK (attaching part)	4
43	63301	.WASHER, FLAT (attaching part)	4
44	140438	.COVER	1
45	60353	.SCREW, CAP (attaching part)	5
46	63401	.WASHER, FLAT (attaching part)	5
47	63301	.WASHER, LOCK (attaching part)	5
48	140515	.WELDMENT, ROTATION STOP	1
49	60606	.SCREW, CAP (attaching part)	2
50	63423	.WASHER, FLAT	4
-51	140778	.PROCEDURE, INSTALLATION	1
-52	65106	.OIL, GEAR	2 QT.

- ITEM NOT ILLUSTRATED

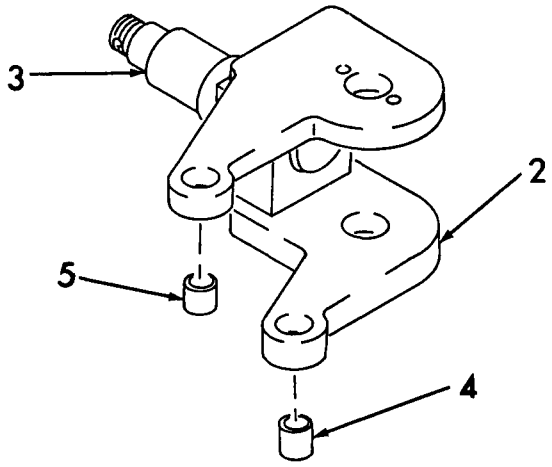
LEFT HAND SPINDLE AND YOKE ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140329	ASSEMBLY, L.H. SPINDLE AND YOKE (See Sect. 3, Fig. 1 or 2 for NHA)	REF
2	140327	.MACHINING, L.H. STEERING YOKE	1
3	140312	.SPINDLE	1
4	2265	.BEARING, SLEEVE	1

REV.

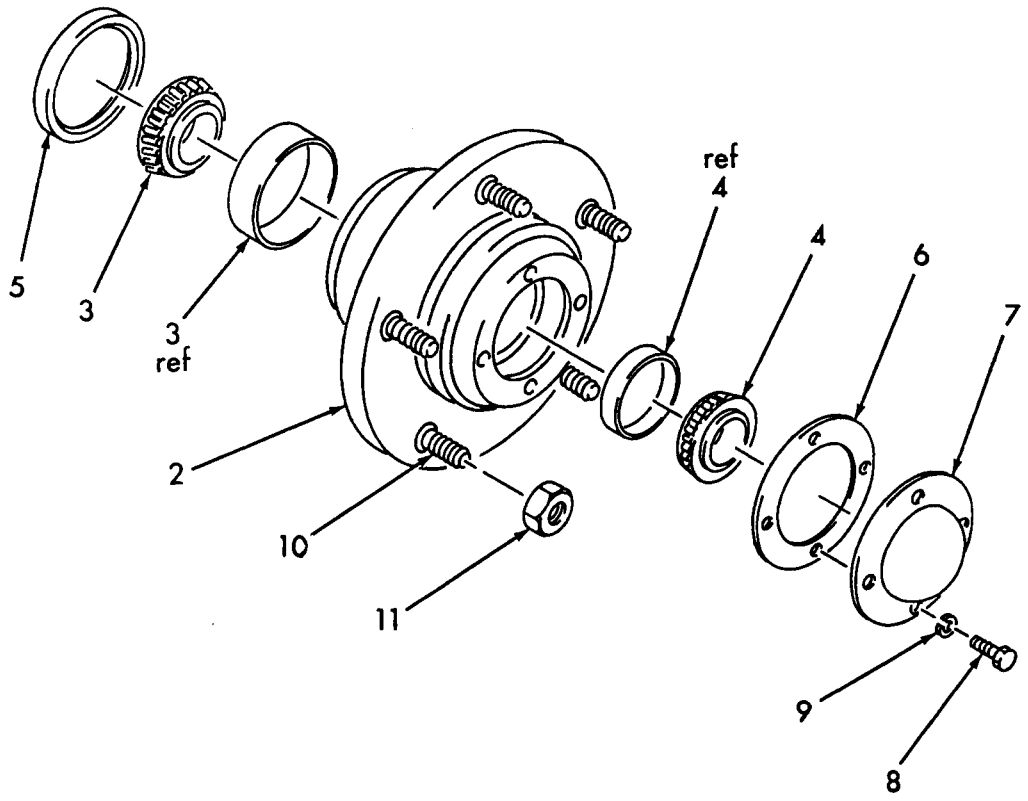
RIGHT HAND SPINDLE AND YOKE ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140328	ASSEMBLY, R.H. SPINDLE AND YOKE (See Sect. 3, Fig. 1 or 2 for NHA)	REF
2	140326	.MACHINING, R.H. STEERING YOKE	1
3	140312	.SPINDLE	1
4	2265	.BEARING, SLEEVE	1
5	64935	.BEARING, SLEEVE	1

REV.

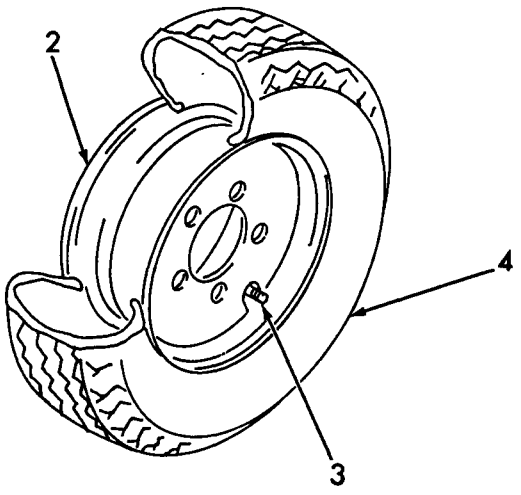
HUB ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140089	ASSEMBLY, HUB (See Sect. 3, Fig. 1 or 2 for NHA)	REF
2	67141	.SUB-ASSEMBLY, HUB	1
3	67140	.CONE, INNER BEARING	1
4	67139	.CONE, OUTER BEARING	1
5	67137	.SEAL, GREASE	1
6	67136	.GASKET	1
7	67135	.CAP, GREASE	1
8	67143	.BOLT, HEX HEAD (attaching part)	4
9	67144	.WASHER, LOCK (attaching part)	4
10	65943	.BOLT, WHEEL	5
11	67138	.NUT, WHEEL	5

REV.

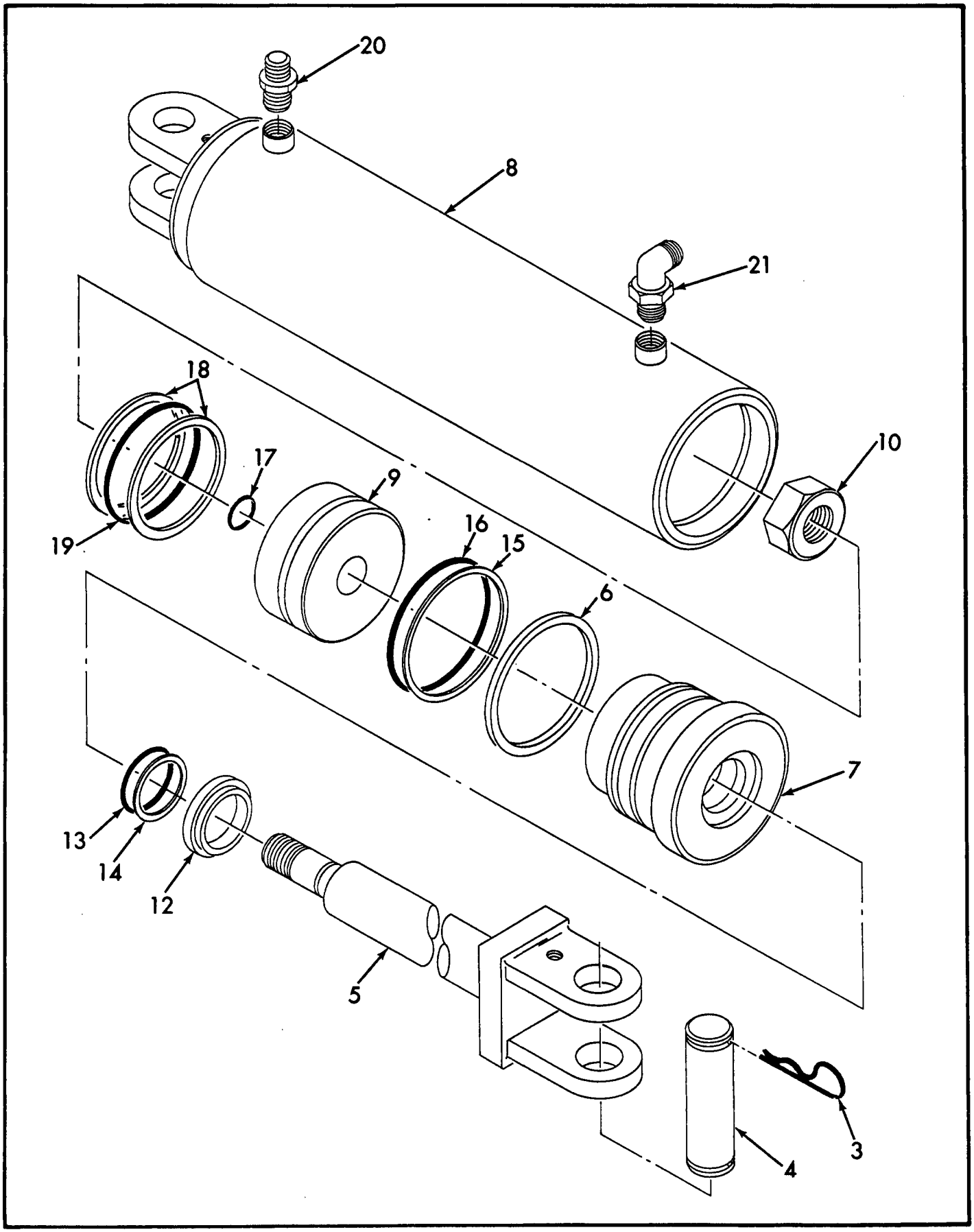
WHEEL ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140682	ASSEMBLY, WHEEL STEERING (See Sect. 3, Fig. 1 or 2 for NHA)	REF
2	140654	.WHEEL STEERING	1
3	2252	.VALVE	1
4	30357	.TIRE	1

REV.

STEERING CYLINDER ASSEMBLY (30 KBDF)
TH (SINCE SEPT. 1989)

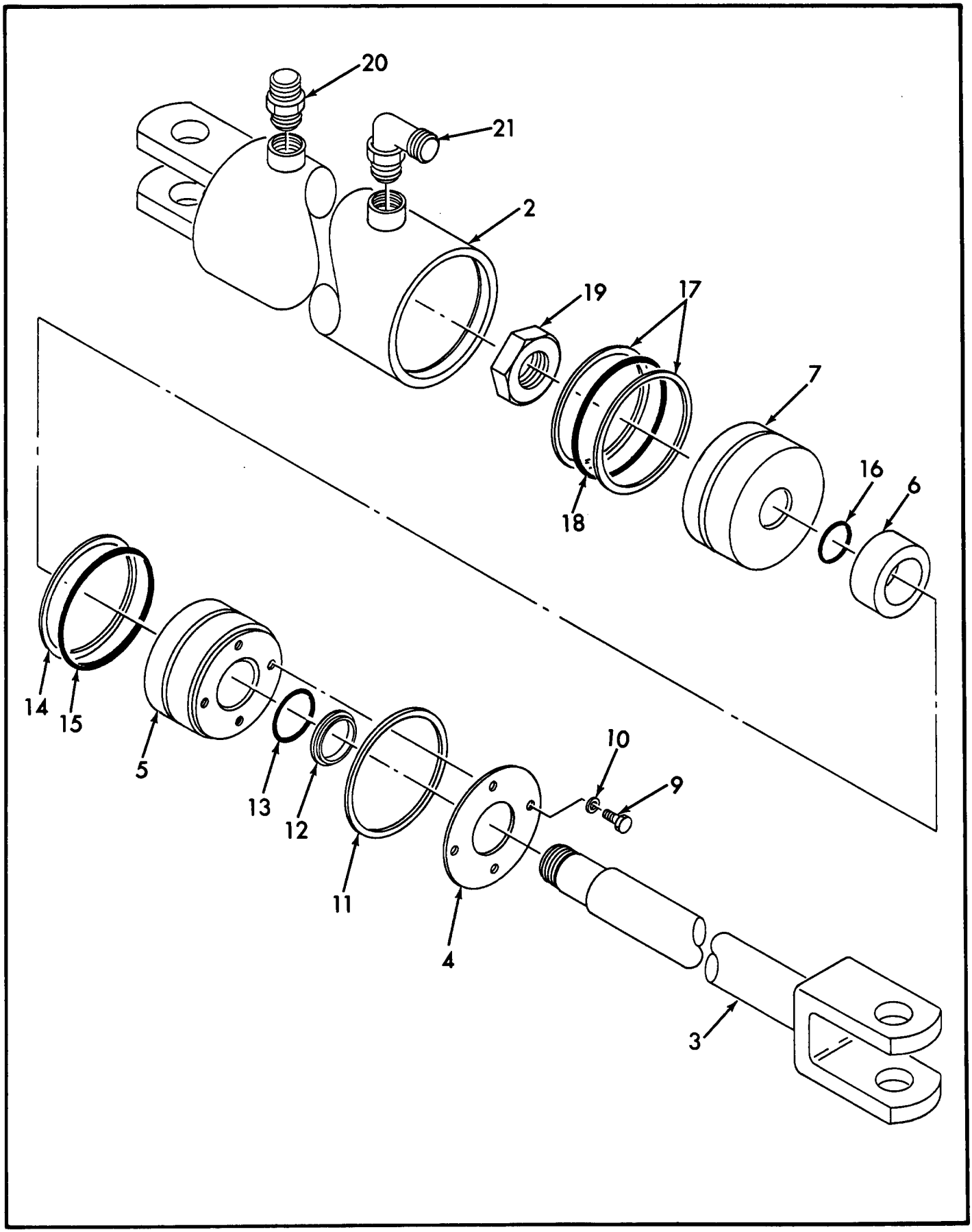


REV.

STEERING CYLINDER ASSEMBLY (30 KBDF)
TH (SINCE SEPT. 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140291	ASSEMBLY, STEERING CYLINDER	REF
2	140059	.CYLINDER, STEERING (TH)	1
3	68006	..PIN, CUP	4
4	68005	..PIN, CLEVIS	2
5	600038	..ROD	1
6	600035	..RING, RETAINING	1
7	600036	..HEAD	1
8	600039	..BARREL	1
9	600037	..PISTON	1
10	600034	..LOCK NUT	1
-11	600033	..KIT, SEAL	1
12		...WIPER, ROD	1
13		...RING, ROD BACK-UP	1
14		...O-RING, ROD	1
15		...RING, HEAD BACK-UP	1
16		...O-RING, HEAD	1
17		...O-RING	1
18		...RING, PISTON BACK-UP	2
19		...O-RING, PISTON	1
20	80004-03	.CONNECTOR, STRAIGHT THREAD	1
21	80012-03	.ELBOW, STRAIGHT THREAD	1

STEERING CYLINDER ASSEMBLY (30 KBDF)
SE (UNTIL SEPT. 1989)



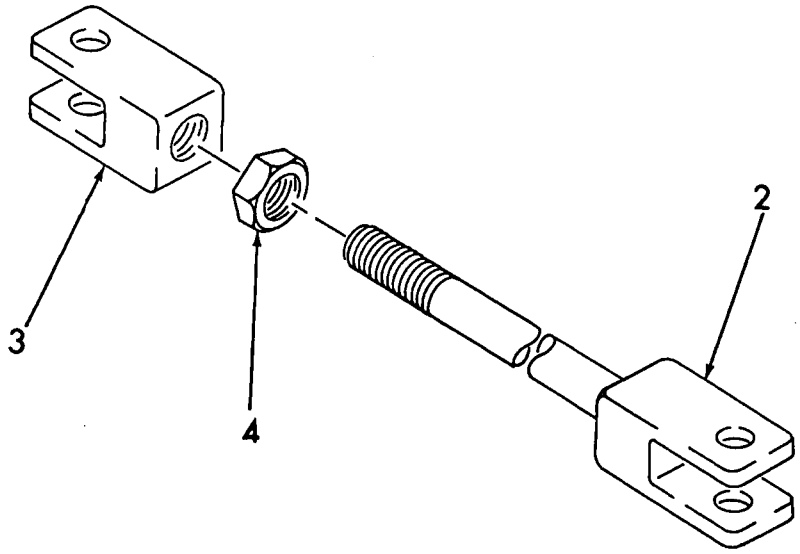
REV.

STEERING CYLINDER ASSEMBLY (30 KBDF)
SE (UNTIL SEPT. 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140291	ASSEMBLY, STEERING CYLINDER	REF
2	140059	.CYLINDER, STEERING (SE)	1
3	67193	..ROD	1
4		..PLATE, RETAINER	1
5	67195	..HEAD	1
6		..TUBE, STOP	1
7	67194	..PISTON	1
-8	66861	..KIT, SEAL	1
9		...SCREW, CAP	4
10		...LOCK WASHER	4
11		...RING, SNAP	1
12		...WIPER, ROD	1
13		...O-RING	1
14		...RING, HEAD BACK-UP	1
15		...O-RING, HEAD	1
16		...O-RING	1
17		...RING, PISTON BACK-UP	2
18		...O-RING, PISTON	1
19		...NUT	1
20	80004-03	.CONNECTOR, STRAIGHT THREAD	1
21	80012-03	.ELBOW, STRAIGHT THREAD	1

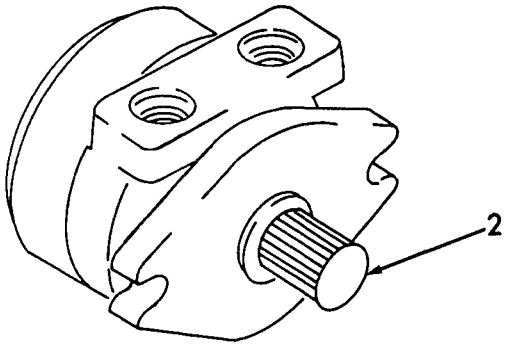
- ITEM NOT ILLUSTRATED

STEERING TIE ROD ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140237	ASSEMBLY, STEERING TIE ROD (See Sect. 3, Fig. 1 or 2 for NHA)	REF
2	140273	.WELDMENT, STEERING TIE ROD	1
3	140270	.YOKE, ADJUSTING TIE ROD	1
4	60902	.NUT, JAM	1

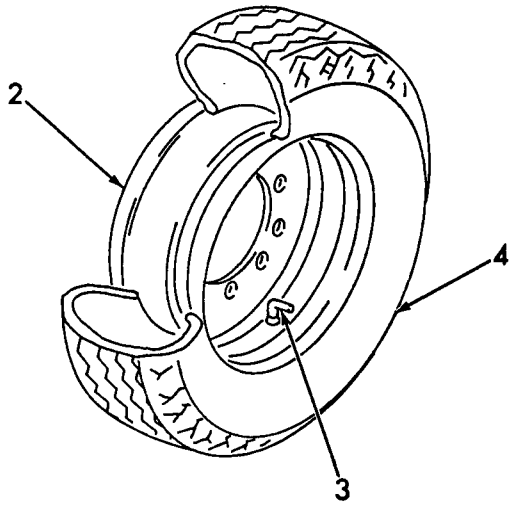
DRIVE MOTOR (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	81216	MOTOR, DRIVE (See Sect. 3, Fig. 1 for NHA) (See Vendor Chap. for more Information)	REF
2	67356	..SHAFT, OUTPUT	1
-3	67357	..KIT, SEAL	1

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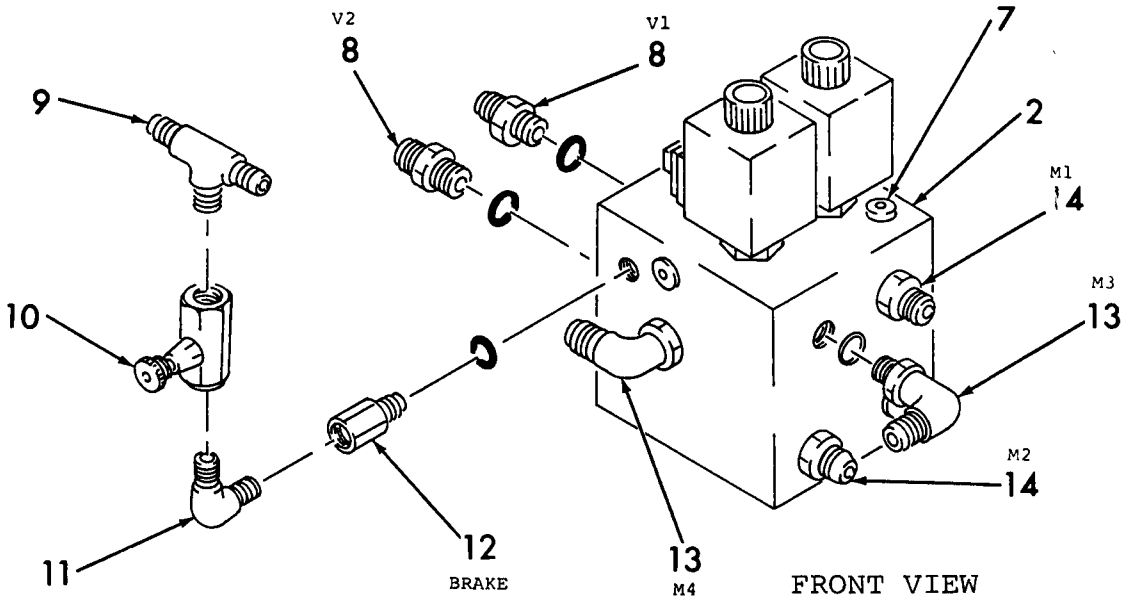
FRONT AXLE WHEEL ASSEMBLY (30 KBDF)



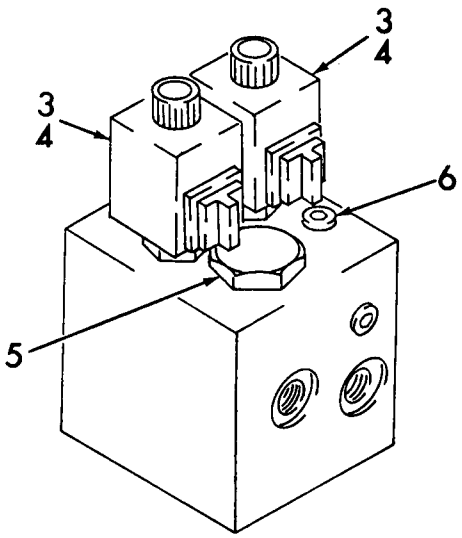
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140683	ASSEMBLY, FRONT AXLE WHEEL (See Sect. 3, Fig. 1 for NHA)	REF
2	140655	.WHEEL	1
3	2252	.VALVE	1
4	30357	.TIRE	1

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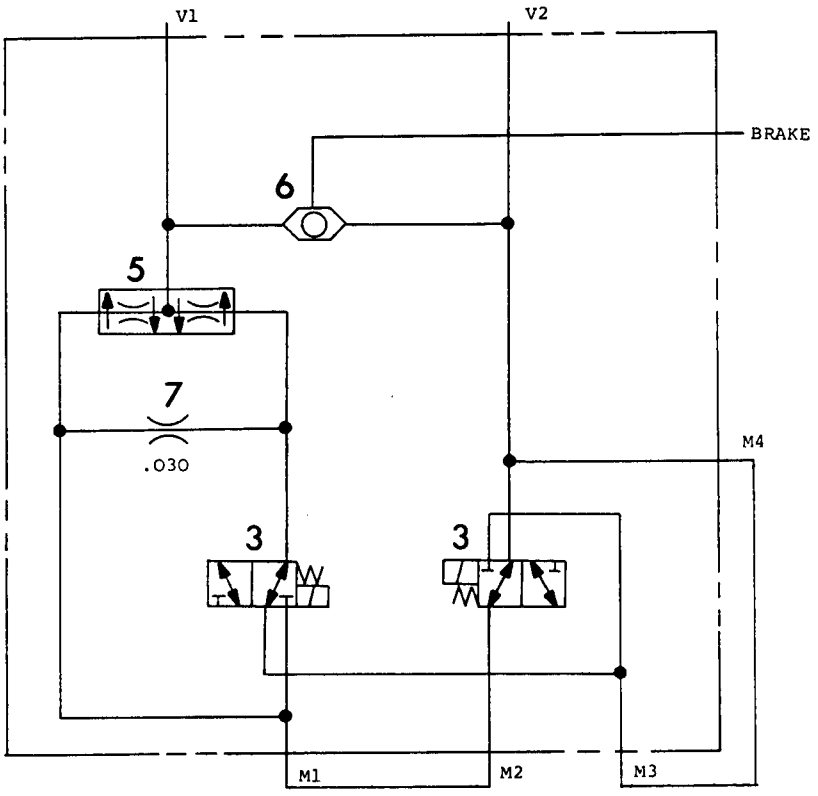
SERIES PARALLEL VALVE ASSEMBLY (30 KBDF)



FRONT VIEW



REAR VIEW



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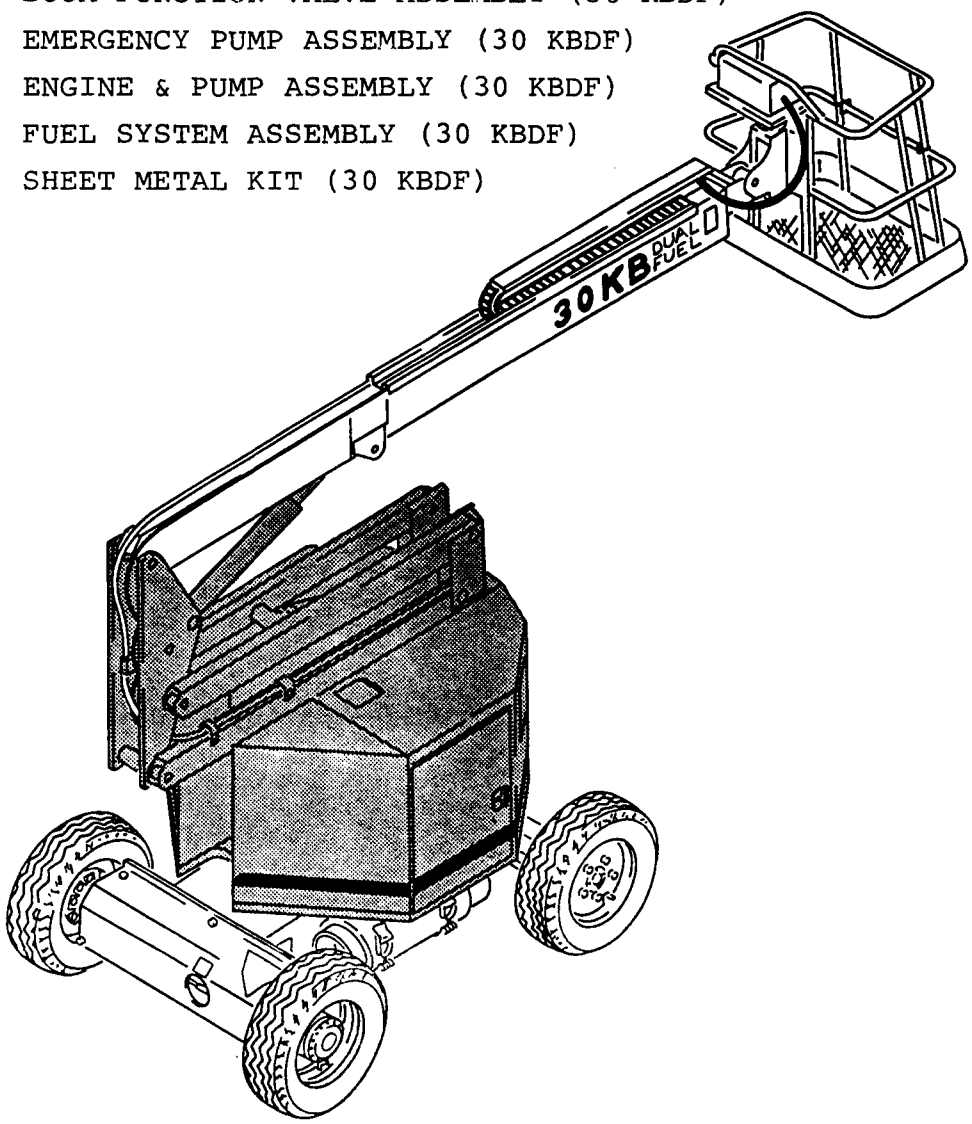
SERIES PARALLEL VALVE ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140293	ASSEMBLY, SERIES PARALLEL VALVE	REF
2	81220	.VALVE, SERIES PARALLEL	1
3	67221	..VALVE, SOLENOID	2
4	66914	...COIL (12 VOLT)	1
5	67228	..DIVIDER/COMBINER, FLOW	1
6	600023	..VALVE, SHUTTLE	1
-7		..ORIFICE	1
8	80004-15	.CONNECTOR, STRAIGHT THREAD	2
9	80034-04	.TEE, MALE BRANCH	1
10	20357	.VALVE, NEEDLE	1
11	80022-03	.ELBOW, MALE PIPE	1
12	51903	.ADAPTER, PIPE FEMALE	1
13	80012-13	.ELBOW, STRAIGHT THREAD	2
14	80004-13	.CONNECTOR, STRAIGHT THREAD	2

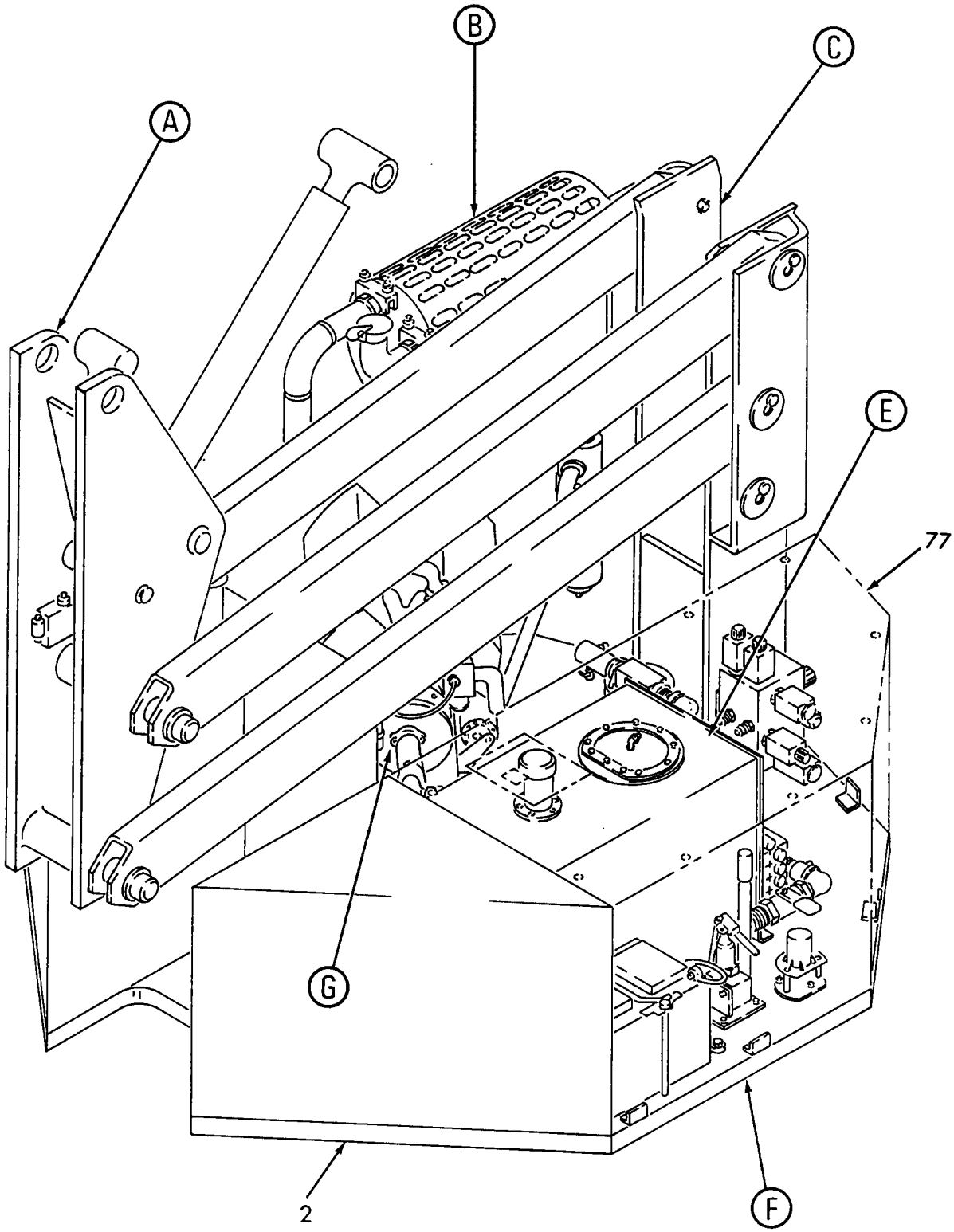
- ITEM NOT ILLUSTRATED

SECTION 4 CONTAINS:

FIG. NO.	TITLE
1	TURRET ASSEMBLY (30 KBDF)
2	BOOM LIFT CYLINDER SUB-ASSEMBLY (30 KBDF)
3	REGENERATIVE VALVE SUB-ASSEMBLY (30 KBDF)
4	RISER ARM CYLINDER ASSEMBLY (30 KBDF)
5	RISER ARM ASSEMBLY (30 KBDF)
6	MASTER CYLINDER SUB-ASSEMBLY (30 KBDF)
7	FUEL TANK ASSEMBLY (30 KBDF)
8	HYDRAULIC TANK ASSEMBLY (30 KBDF)
9	ROTATION GEARBOX/BRACKET ASSEMBLY (30 KBDF)
10	PROPORTIONAL DRIVE/STEER VALVE ASSEMBLY (30 KBDF)
11	BOOM FUNCTION VALVE ASSEMBLY (30 KBDF)
12	EMERGENCY PUMP ASSEMBLY (30 KBDF)
13	ENGINE & PUMP ASSEMBLY (30 KBDF)
14	FUEL SYSTEM ASSEMBLY (30 KBDF)
15	SHEET METAL KIT (30 KBDF)

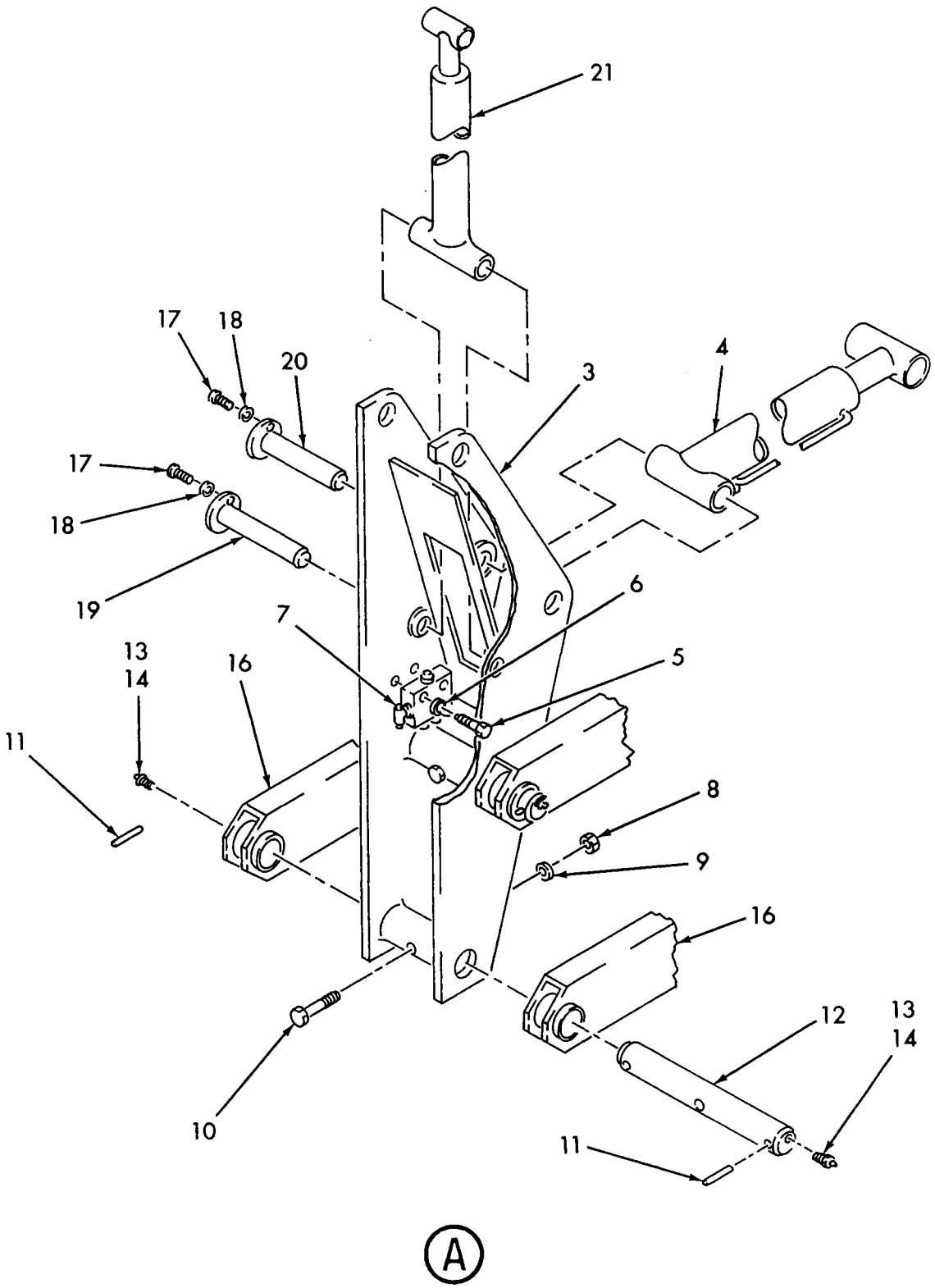


TURRET ASSEMBLY (30 KBDF)

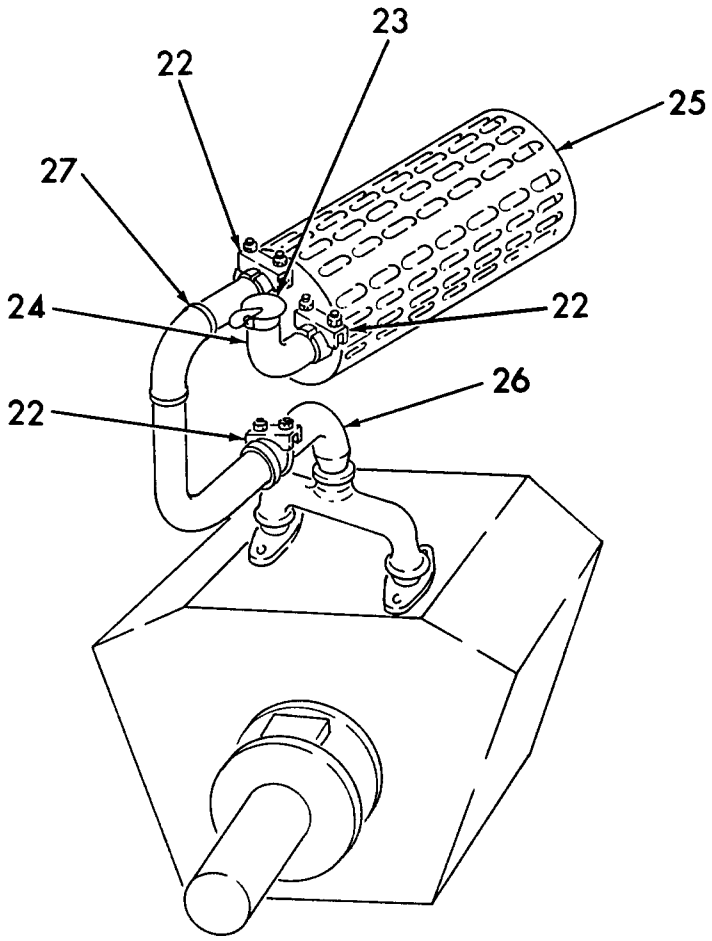


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TURRET ASSEMBLY (30 KBDF)

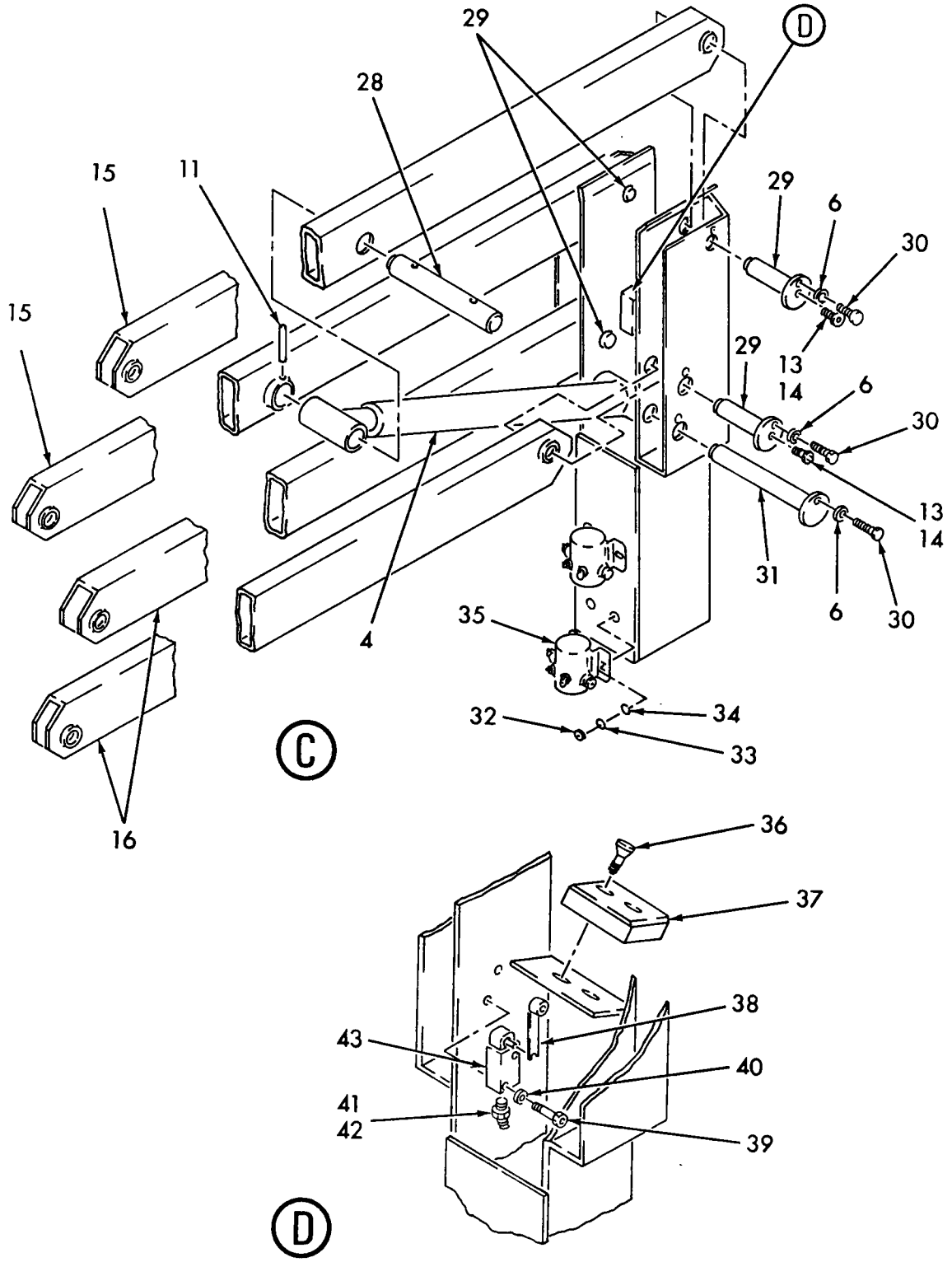


TURRET ASSEMBLY (30 KBDF)

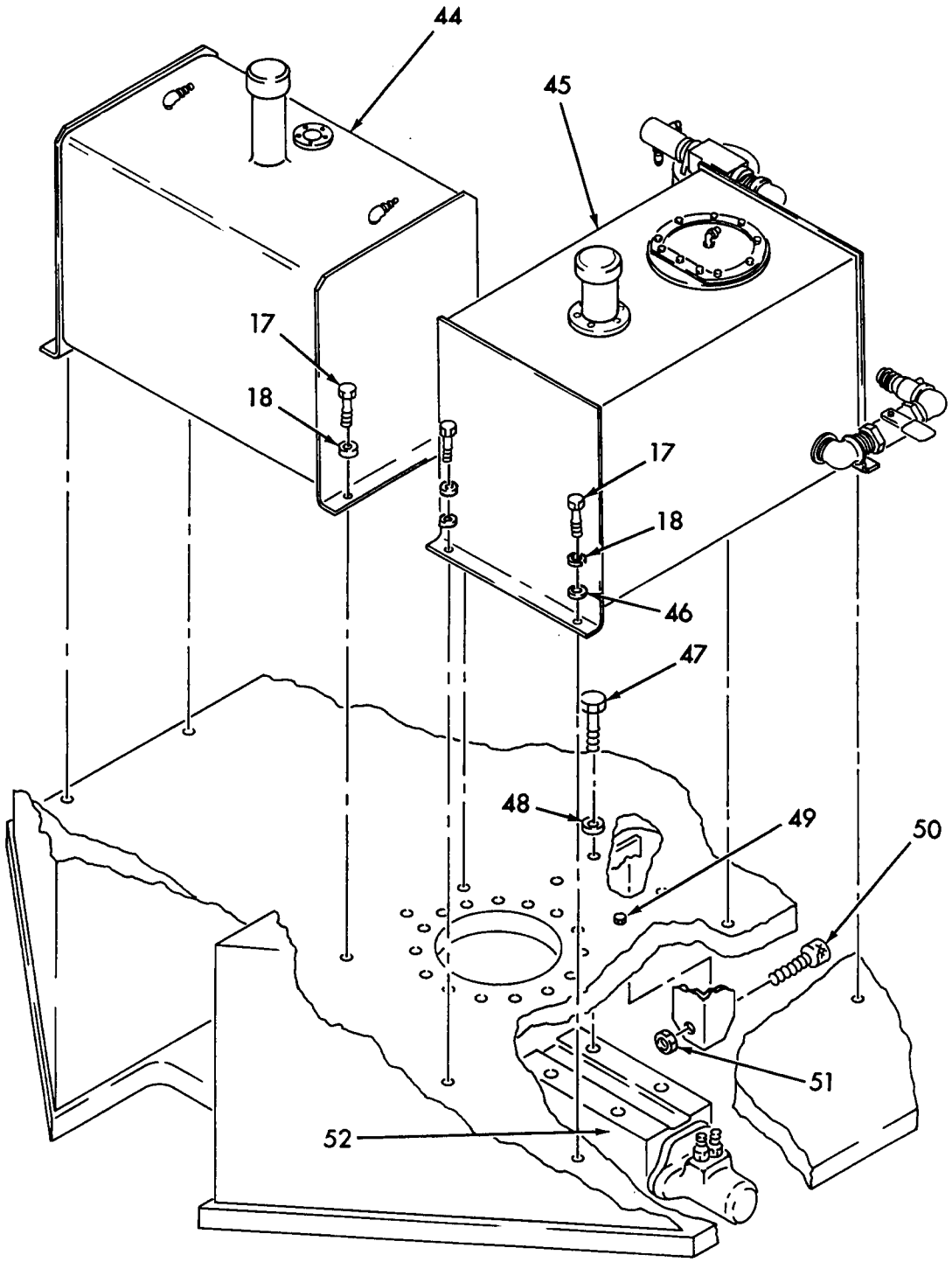


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TURRET ASSEMBLY (30 KBDF)

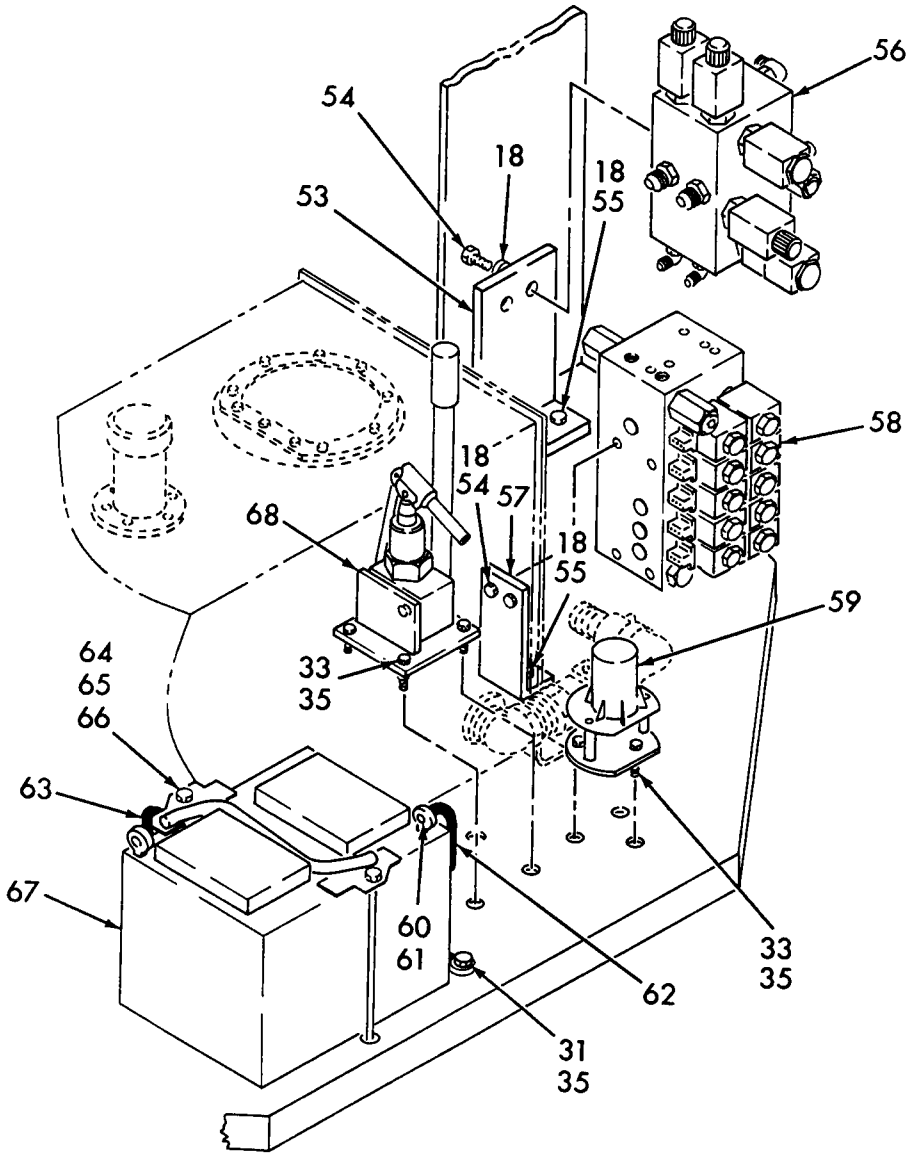


TURRET ASSEMBLY (30 KBDF)



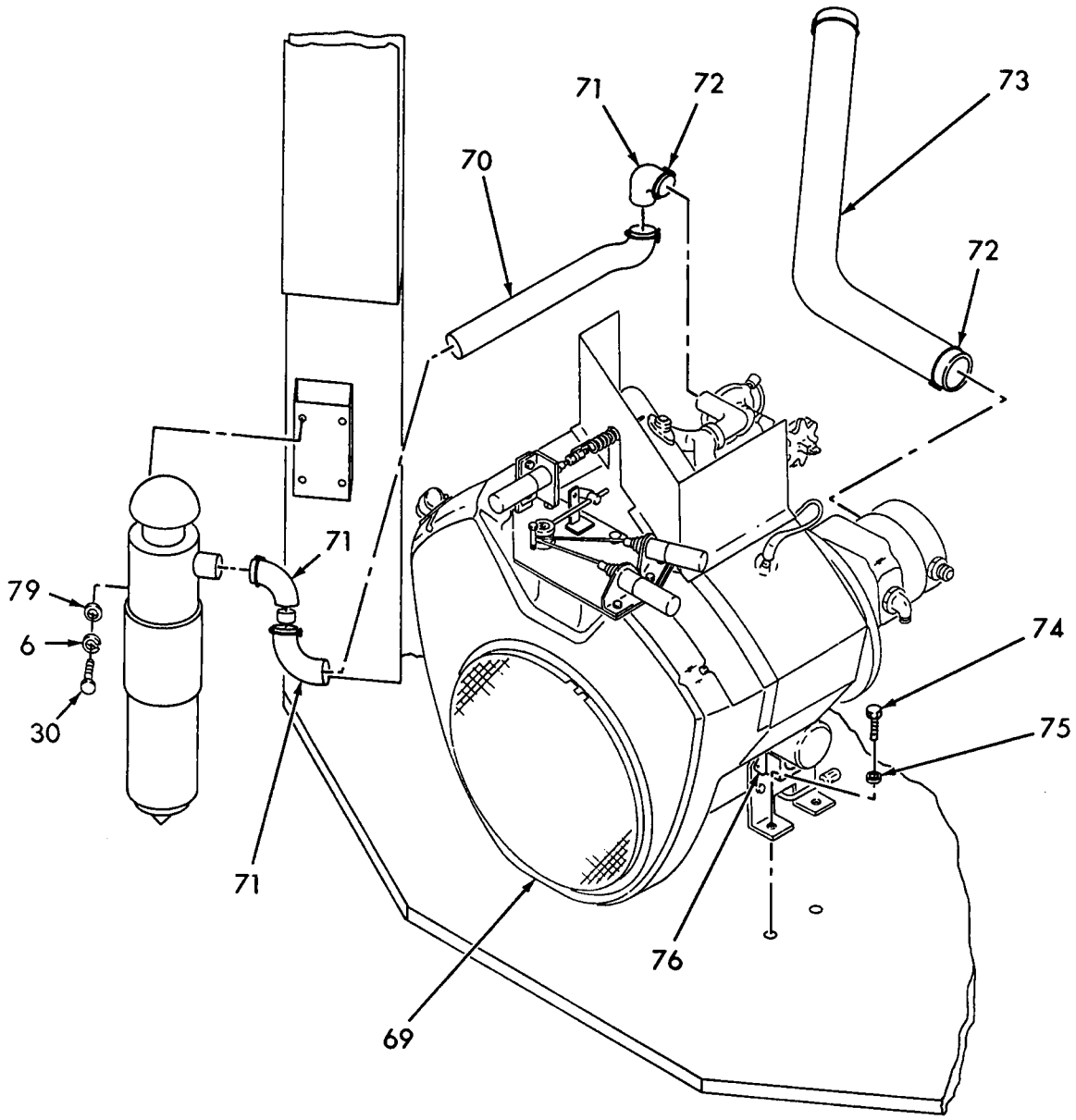
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F

TURRET ASSEMBLY (30 KBDF)



G

TURRET ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140641	ASSEMBLY, TURRET (See Sect. 2, Fig. 1 for NHA)	REF
2	140690	.WELDMENT, TURRET	1
3	140140	.MACHINING, RISER	1
4	140169	.SUB-ASSEMBLY, BOOM LIFT CYLINDER (See Sect. 4, Fig. 2 for Details)	2
5	60360	.SCREW, CAP	2
6	63302	.WASHER, LOCK	17
7	140532	.SUB-ASSEMBLY, REGENERATIVE VALVE (See Sect. 4, Fig. 3 for Details)	1
8	61305	.NUT, LOCK	2
9	90565	.WASHER, FLAT	10
10	60388	.SCREW, CAP	2
11	64216	.PIN, ROLL	6
12	140469	.PIN, ARM RISER	2
13	65103	.FITTING, GREASE	8
14	65366	.CAP, GREASE	8
15	140390	.ASSEMBLY, CYLINDER RISER ARM (See Sect. 4, Fig. 4 for Details)	2
16	140391	.ASSEMBLY, RISER ARM (See Sect. 4, Fig. 5 for Details)	2
17	60325	.SCREW, CAP	12
18	63319	.WASHER, LOCK	12
19	140427	.PIN, MASTER CYLINDER RISER	1
20	140601	.PIN, BOOM LIFT	1
21	140062	.SUB-ASSEMBLY, MASTER CYLINDER (See Sect. 4, Fig. 6 for Details)	1
22	16230	.CLAMP, MUFFLER	3
23	21288	.CAP, MUFFLER RAIN	1

- ITEM NOT ILLUSTRATED

TURRET ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
24	23546	.ELBOW, EXHAUST	1
25	65751	.MUFFLER	1
26	140767	.PIPE, EXHAUST	1
27	140768	.CONNECTER, EXHAUST	1
28	140471	.PIN, ARM/CYLINDER	1
29	140455	.PIN, RISER ARM	4
30	60322	.SCREW, CAP	14
31	140454	.PIN, RISER LIFT CYLINDER (CAP END)	1
32	60342	.SCREW, CAP	19
33	63433	.WASHER, FLAT	38
34	63301	.WASHER, LOCK	11
35	70209	.SOLENOID	2
36	61831	.SCREW, CAP	2
37	140463	.PAD, BOOM REST	1
38	70206	.LEVER, OPERATING	1
39	62708	.SCREW, MACHINE	2
40	63313	.WASHER, LOCK	4
41	2912	.CABLE, CONDUCTOR	8
42	2806	.VALVE, STRAIN RELIEF	1
43	70173	.SWITCH, LIMITING	1
44	140762	.ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 7 for Details)	1
45	140740	.ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 8 for Details)	1
46	63428	.WASHER, FLAT	4
47	60621	.SCREW, CAP	3
48	63423	.WASHER, FLAT	3

- ITEM NOT ILLUSTRATED

TURRET ASSEMBLY (30 KBDF)

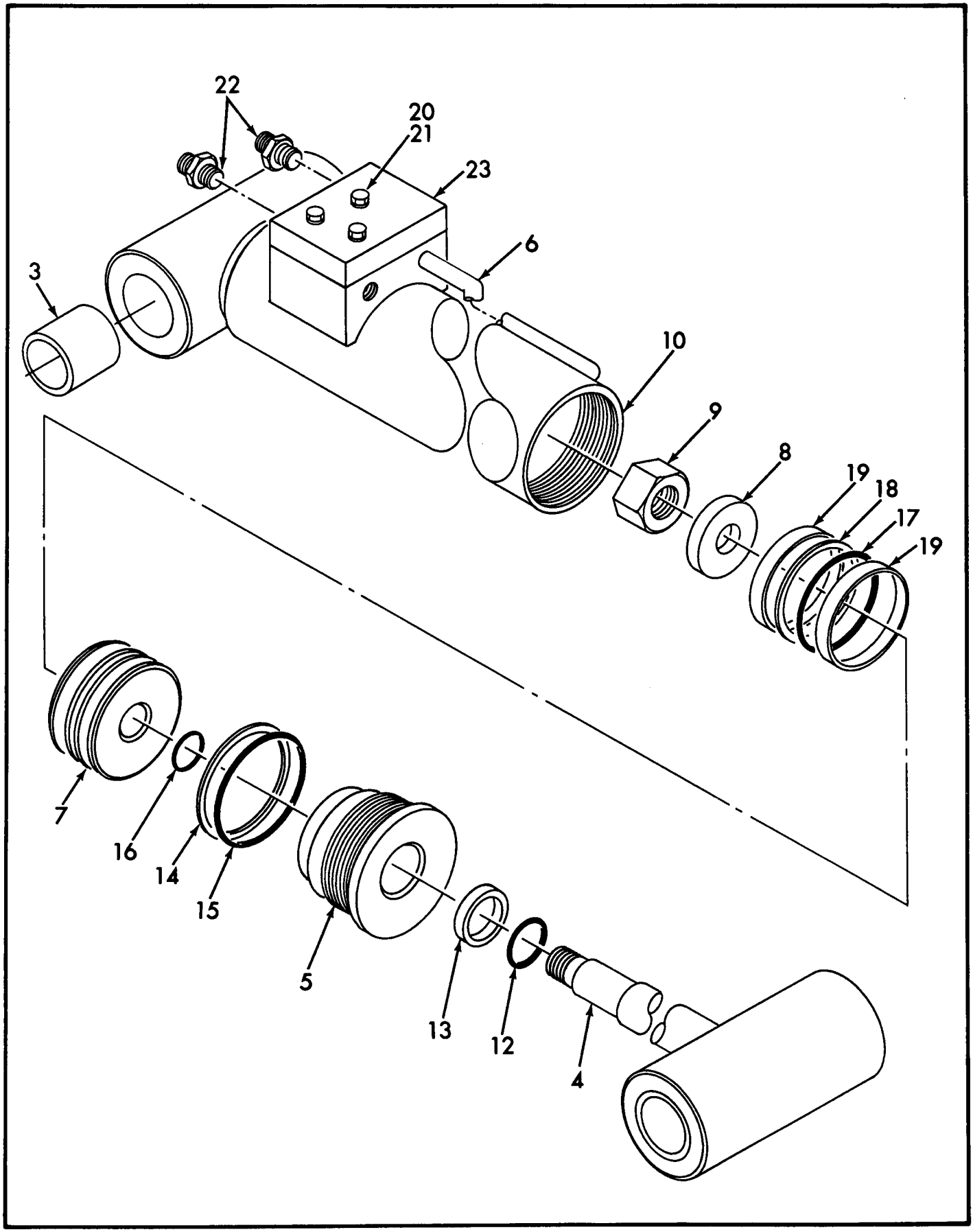
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
49	62118	.SCREW, SHOULDER	1
50	62222	.SCREW, SET	1
51	60707	.NUT, JAM	1
52	140753	.ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 9 for Details)	1
53	140635	.WELDMENT, MOUNTING BRACKET	1
54	60343	.SCREW, CAP	7
55	60331	.SCREW, CAP	4
56	140763	.ASSEMBLY, PROPORTIONAL DRIVE/STEER VALVE (See Sect. 4, Fig. 10 for Details)	1
57	140771	.WELDMENT, MANIFOLD MOUNTING BRACKET	1
58	140828	.ASSEMBLY, BOOM FUNCTION VALVE (See Sect. 4, Fig. 11 for Details)	1
59	21250	.SENSOR, SLOPE	1
60	63205	.SCREW, CAP	2
61	60702	.NUT, HEX	2
62	13226-0760	.ASSEMBLY, BATTERY CABLE	1
63	13226-0240	.ASSEMBLY, BATTERY CABLE	1
64	61246	.NUT, HEX	2
65	65108	.BOLT, HOLD DOWN	2
66	20375	.CLAMP, BATTERY	1
67	4030	.BATTERY (See Vendor Chap. for more Information)	1
68	140806	.ASSEMBLY, EMERGENCY PUMP (See Sect. 4, Fig. 12 for Details)	1
69	140737	.ASSEMBLY, ENGINE & PUMP (See Sect. 4, Fig. 13 for Details)	1
70	27846	.TUBE, ROUND	1
71	160095	.REDUCER, ELBOW	3

TURRET ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
72	55	.CLAMP, HOSE	7
73	140790	.HOSE, HYDRAULIC SUCTION	1
74	60516	.SCREW, CAP	4
75	63501	.WASHER, FLAT	4
76	140794	.ASSEMBLY, FUEL SYSTEM (See Sect. 4, Fig. 14 for Details)	1
77	140688	.KIT, SHEET METAL (See Sect. 4, Fig. 15 for Details)	1
-78	61921	.SCREW, CAP	34
79	63402	.WASHER, FLAT	4

- ITEM NOT ILLUSTRATED

BOOM LIFT CYLINDER (30 KBDF)
(SINCE JUNE 1988)



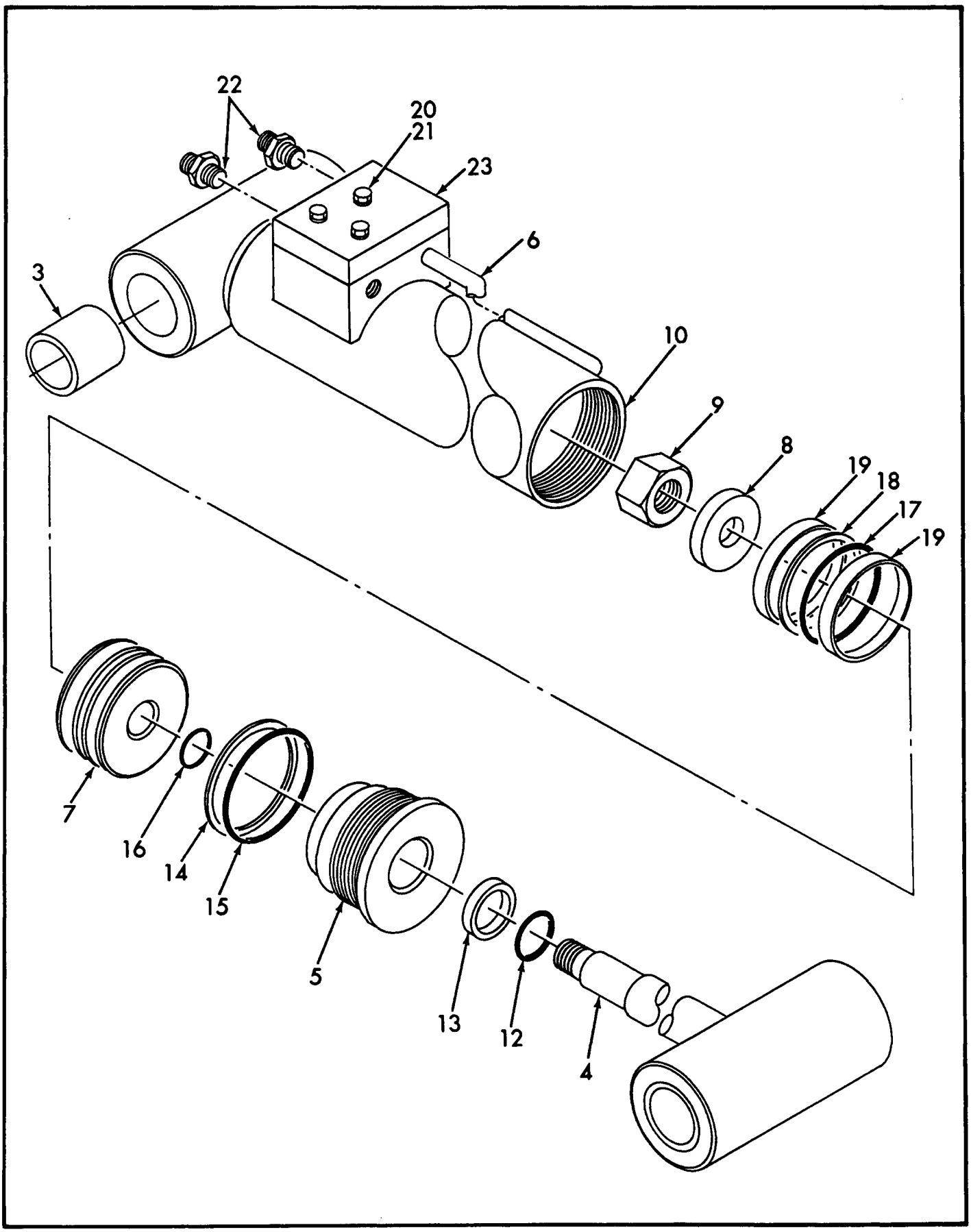
REV.

BOOM LIFT CYLINDER ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140169	ASSEMBLY, BOOM LIFT CYLINDER	REF
2	140747	.CYLINDER, LIFT (SE)	1
3	67180	..BUSHING	4
4	67200	..ROD	1
5	600029	..HEAD	1
6		..LINE, FLUID	1
7	600030	..PISTON	1
8		..SPACER	1
9		..NUT	1
10	67199	..BARREL	1
-11	67148	..KIT, SEAL	1
12		...WIPER, ROD	1
13		...SEAL, ROD	1
14		...RING, HEAD BACK-UP	1
15		...O-RING, HEAD	1
16		...O-RING	1
17		...O-RING, PISTON	1
18		...RING, SLYD	1
19		...RING, WEAR	2
20	60319	.SCREW, CAP	3
21	63301	.LOCK WASHER	3
22	80004-08	.CONNECTOR, STRAIGHT THREAD	2
23	81205	.VALVE, HOLDING	1

- ITEM NOT ILLUSTRATED

BOOM LIFT CYLINDER ASSEMBLY (30 KBDF)
(UNTIL JUNE 1988)



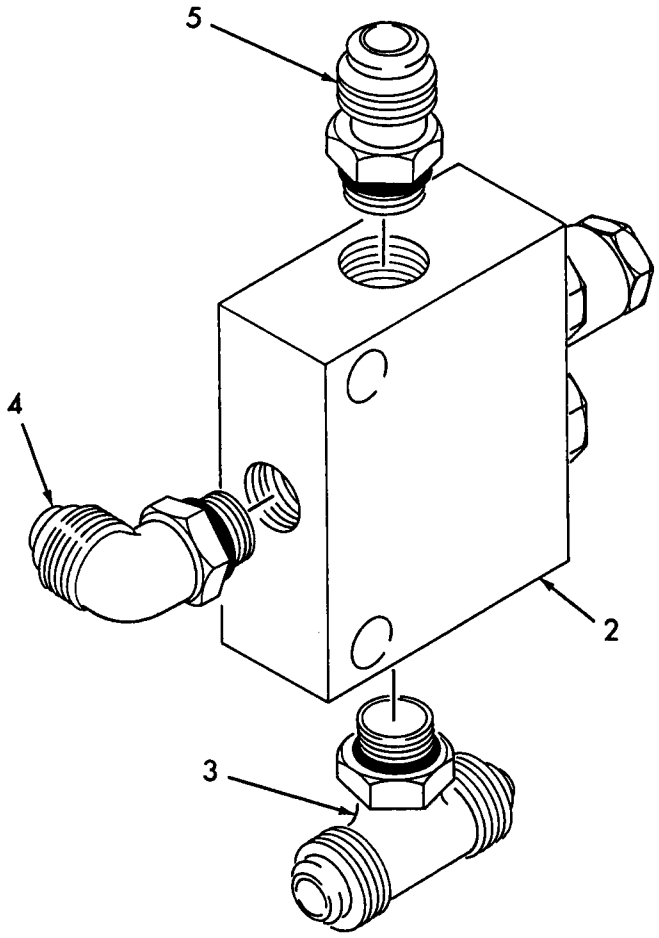
REV.

BOOM LIFT CYLINDER ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140169	ASSEMBLY, BOOM LIFT CYLINDER	REF
2	140092	.CYLINDER, LIFT (SE)	1
3	67180	..BUSHING	4
4	67200	..ROD	1
5	67202	..HEAD	1
6		..LINE, FLUID	1
7	67201	..PISTON	1
8		..SPACER	1
9		..NUT	1
10	67199	..BARREL	1
-11	67148	...KIT, SEAL	1
12		..WIPER, ROD	1
13		...SEAL, ROD	1
14		...RING, HEAD BACK-UP	1
15		...O-RING, HEAD	1
16		...O-RING	1
17		...O-RING, PISTON	1
18		...RING, SLYD	1
19		...RING, WEAR	2
20	60319	.SCREW, CAP	3
21	63301	.LOCK WASHER	3
22	80004-08	.CONNECTOR, STRAIGHT THREAD	2
23	81205	.VALVE, HOLDING	1

- ITEM NOT ILLUSTRATED

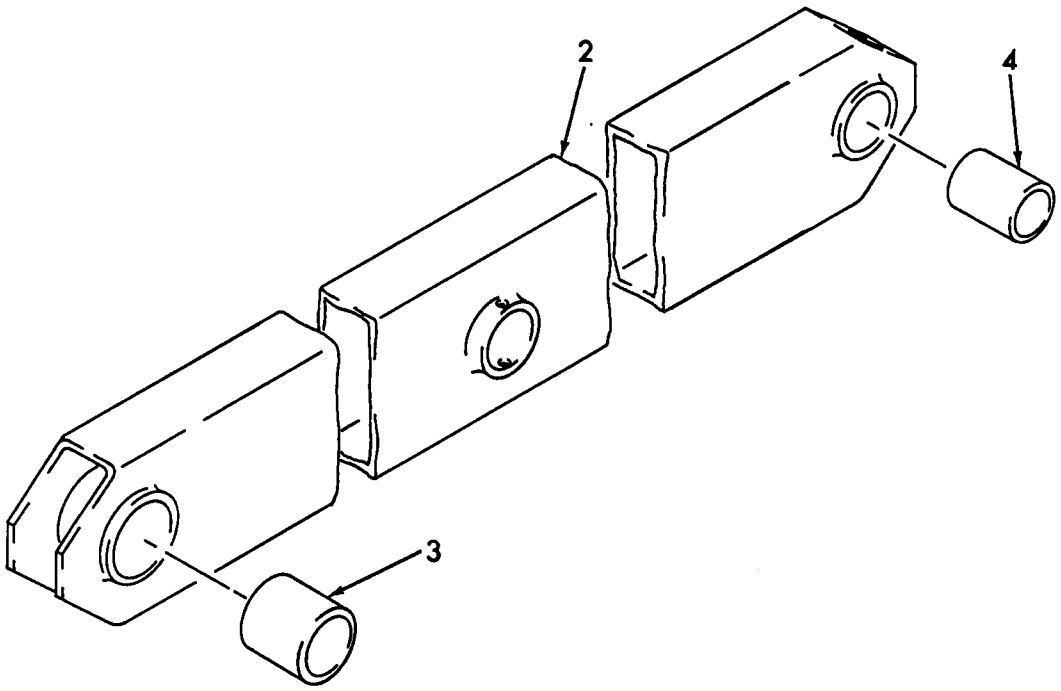
REGENERATIVE VALVE SUB-ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140532	SUB-ASSEMBLY, REGENERATIVE VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	81222	.VALVE, REGENERATIVE	1
3	80036-10	.TEE BRANCH, STRAIGHT	1
4	80012-10	.ELBOW, STRAIGHT THREAD	1
5	80004-10	.CONNECTOR, STRAIGHT THREAD	1

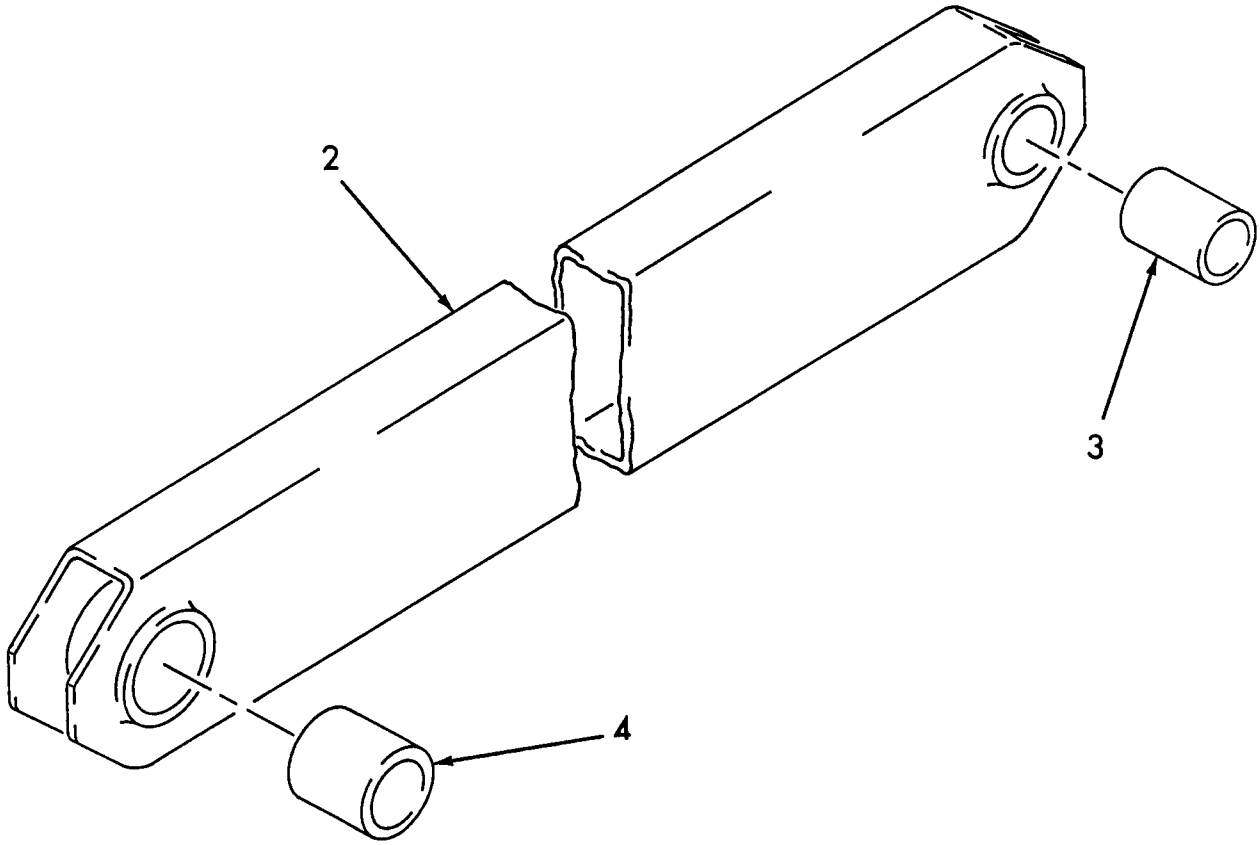
REV.

RISER ARM CYLINDER ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140390	ASSEMBLY, CYLINDER RISER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	140106	.WELDMENT, RISER ARM	1
3	140389	.BUSHING, RISER	1
4	140388	.BUSHING, COLUMN	1

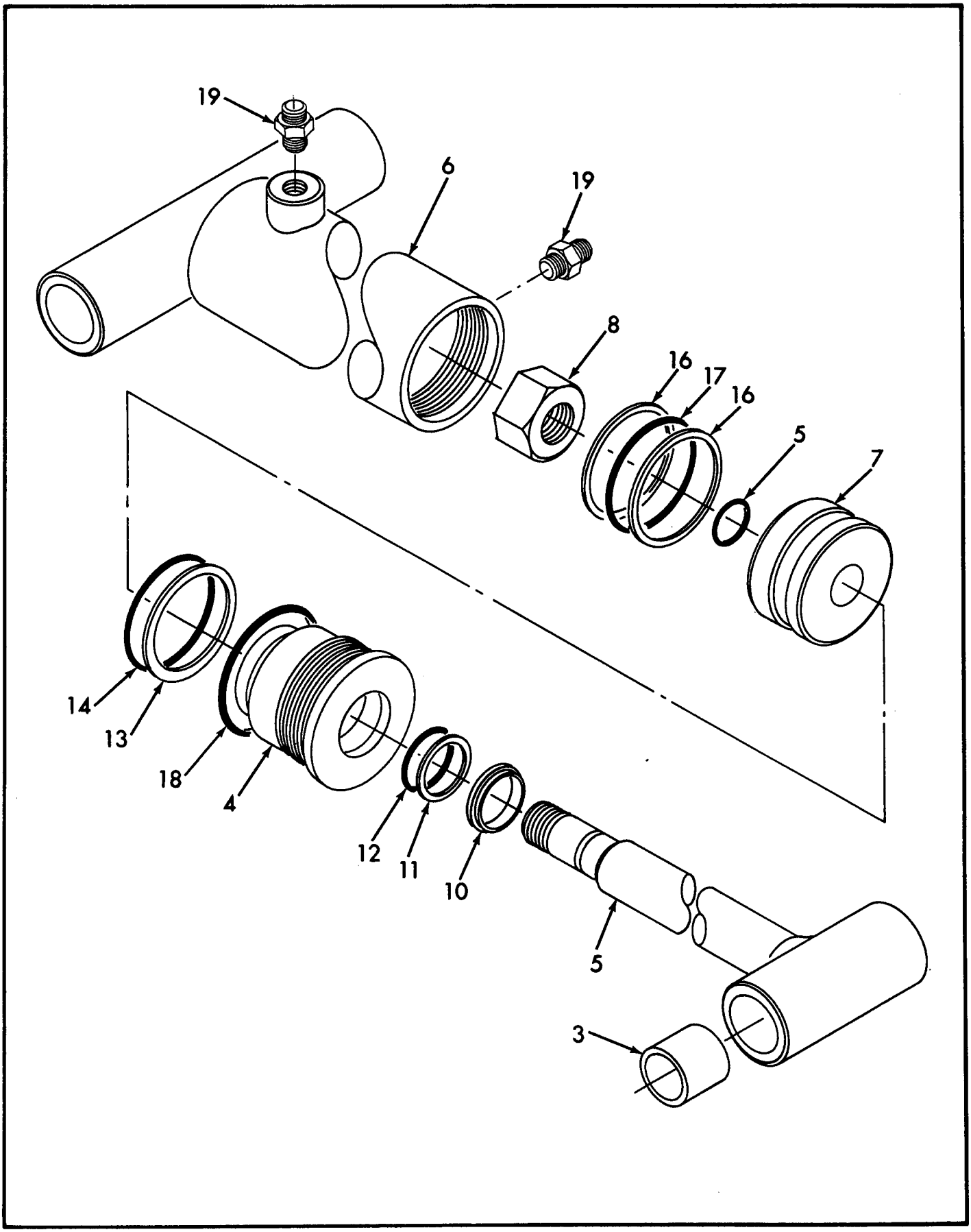
RISER ARM ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140391	ASSEMBLY, RISER ARM (See Sect. 4, Fig. 1 for NHA)	REF
2	140101	.ARM, RISER	1
3	140389	.BUSHING, RISER	1
4	140388	.BUSHING, COLUMN	1

REV.

MASTER CYLINDER ASSEMBLY (30 KBDF)
(SINCE MAY 1989)



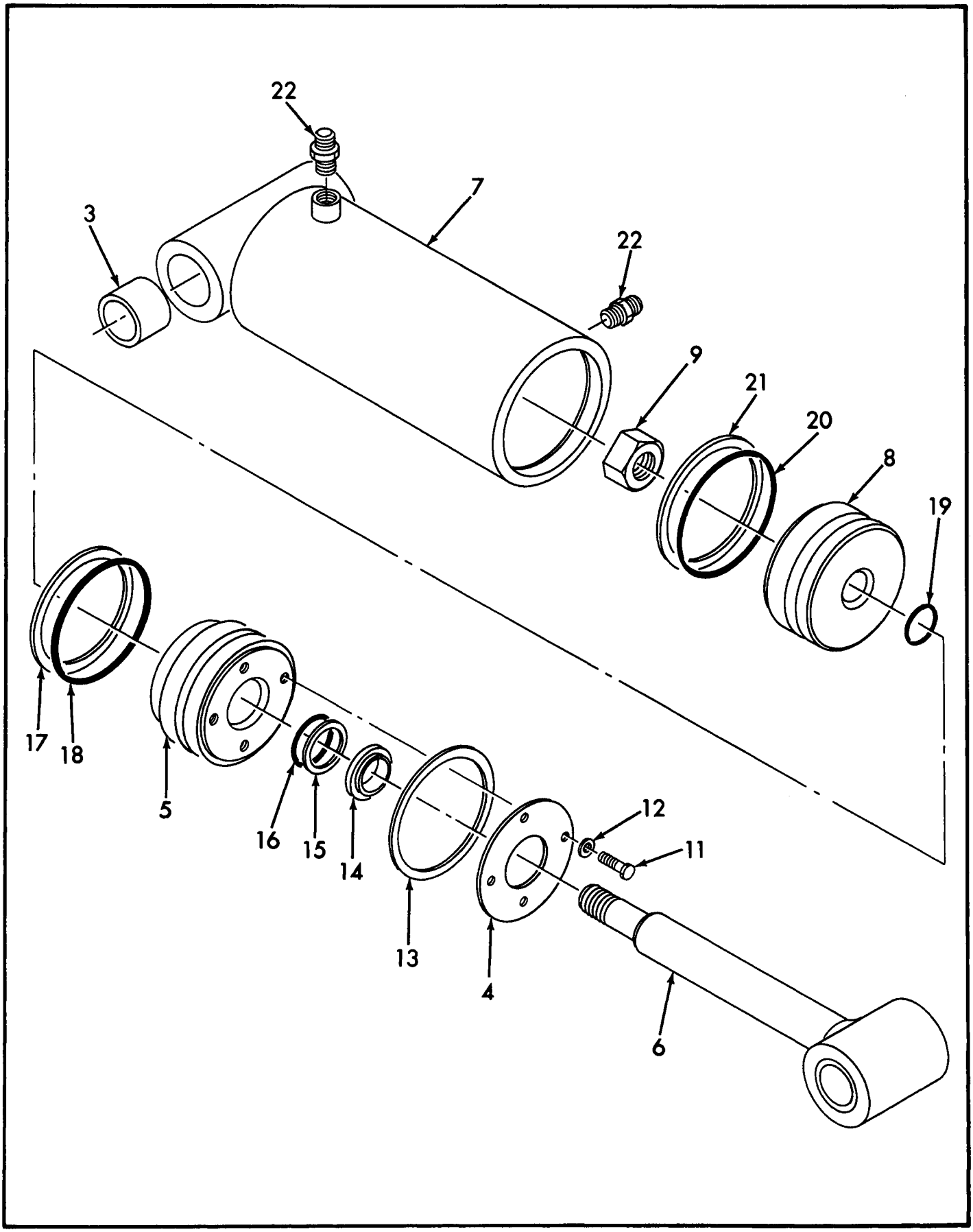
REV.

MASTER CYLINDER ASSEMBLY (30 KBDF)
(SINCE MAY 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140947	ASSEMBLY, MASTER CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
-2	140896	.CYLINDER MASTER (TH)	1
3	67999	..BUSHING	4
4	68000	..HEAD	1
5	67996	..ROD	1
6	67995	..ASSEMBLY, BARREL	1
7	68001	..PISTON	1
8	67998	..NUT	1
-9	67997	..KIT, SEAL	1
10		...WIPER, ROD	1
11		...ROD, B/U RING	1
12		...ROD, O-RING	1
13		...RING, HEAD B/U	1
14		...O-RING, HEAD	1
15		...O-RING	1
16		...RING, PISTON B/U	2
17		...O-RING, PISTON	1
18		...O-RING	1
19	80036-03	.TEE, STRAIGHT THREAD BRANCH	2

- ITEM NOT ILLUSTRATED

MASTER CYLINDER ASSEMBLY (30 KBDF) (UNTIL MAY 1989)



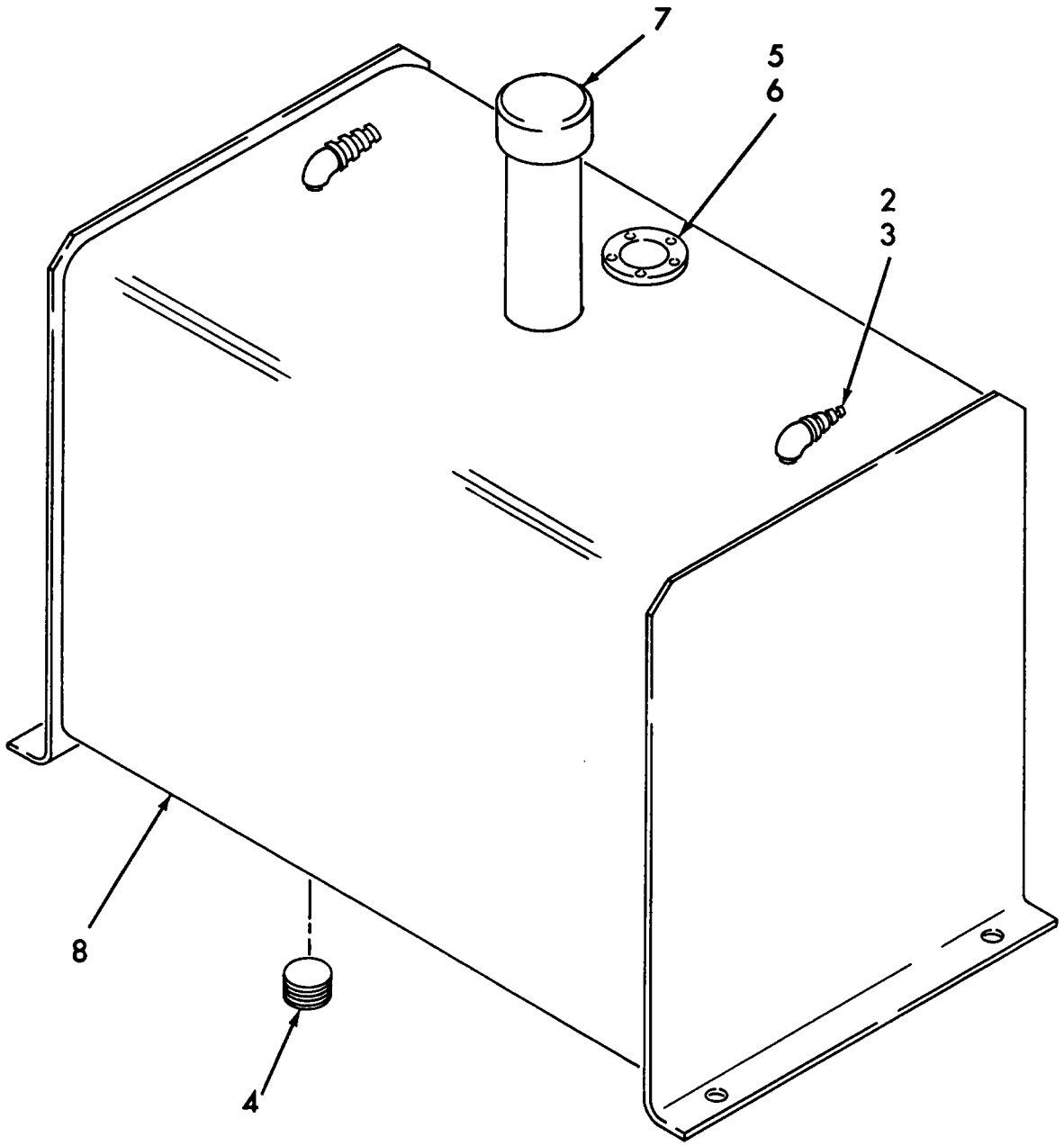
REV.

MASTER CYLINDER ASSEMBLY (30 KBDF)
(UNTIL MAY 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140062	ASSEMBLY, MASTER CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
-2	140094	.CYLINDER, MASTER (SE)	1
3	67191	..BUSHING	4
4		..PLATE, RETAINER	1
5	67190	..HEAD	1
6	67208	..ROD	1
7	67207	..BARREL	1
8	67189	..PISTON	1
9		..NUT	1
-10	67130	..KIT, SEAL	1
11		...SCREW, ALLEN HEAD	4
12		...WASHER, LOCK	4
13		...RING, SNAP	1
14		...WIPER, ROD	1
15		...RING, ROD B/U	1
16		...O-RING, ROD	1
17		...RING, HEAD B/U	2
18		...O-RING, HEAD	1
19		...O-RING	1
20		...O-RING, PISTON	1
21		...RING, PISTON B/U	1
22	80036-03	.TEE, STRAIGHT THREAD	2

- ITEM NOT ILLUSTRATED

FUEL TANK ASSEMBLY (30 KBDF)

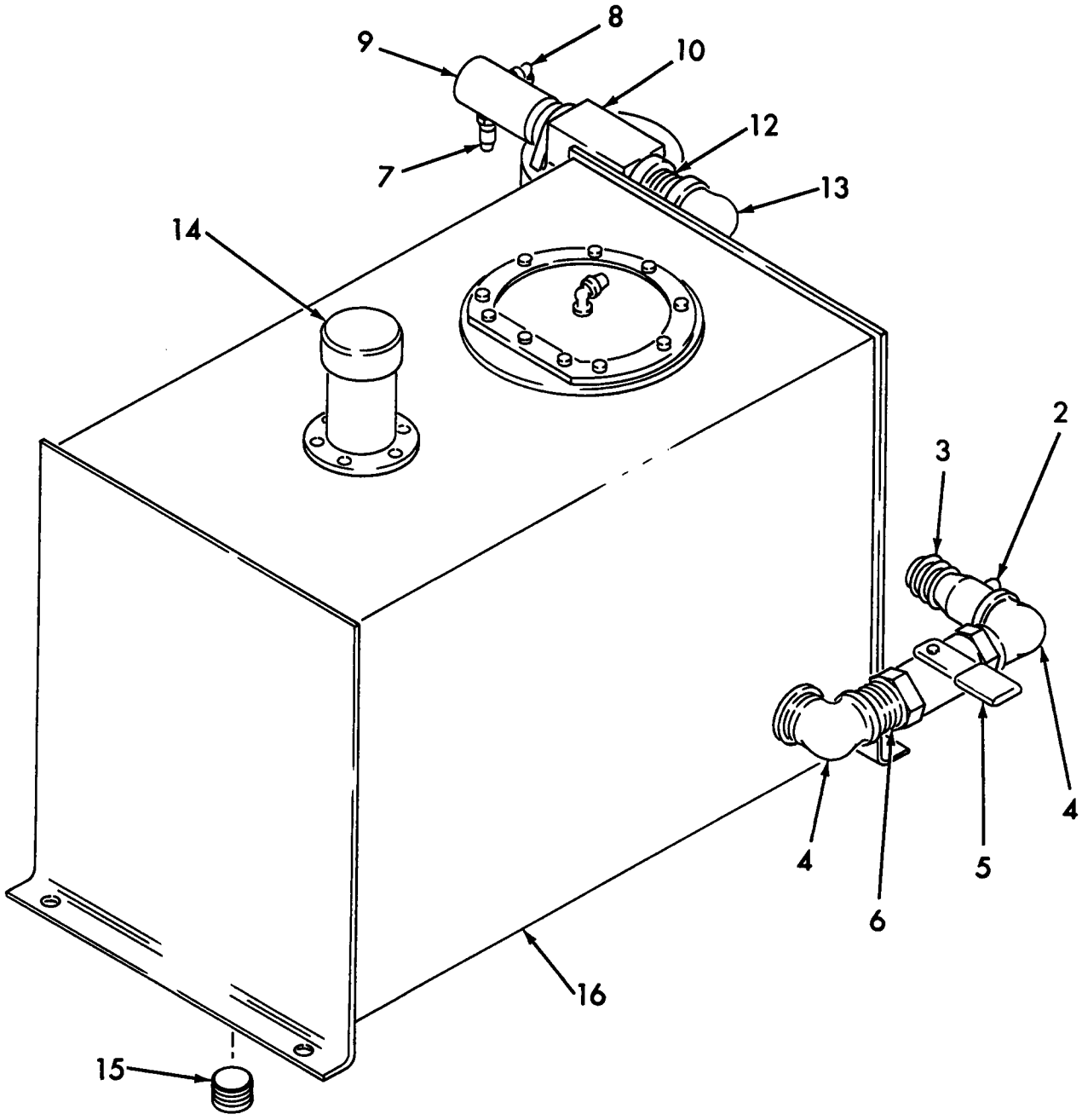


REV.

FUEL TANK ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140762	ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 1 for NHA)	REF
2	240	.FITTING, HOSE BARB	2
3	80021-03	.ELBOW, STREET	2
4	80048-05	.PLUG, HOLLOW HEX	1
5	65908	.SCREW, THREAD CUTTING	5
6	81186	.GAUGE, MAGNETIC LIQUID LEVEL	1
7	67959	.CAP,VENTED GAS	1
8	23732	.TANK, FUEL	1

HYDRAULIC TANK ASSEMBLY (30 KBDF)

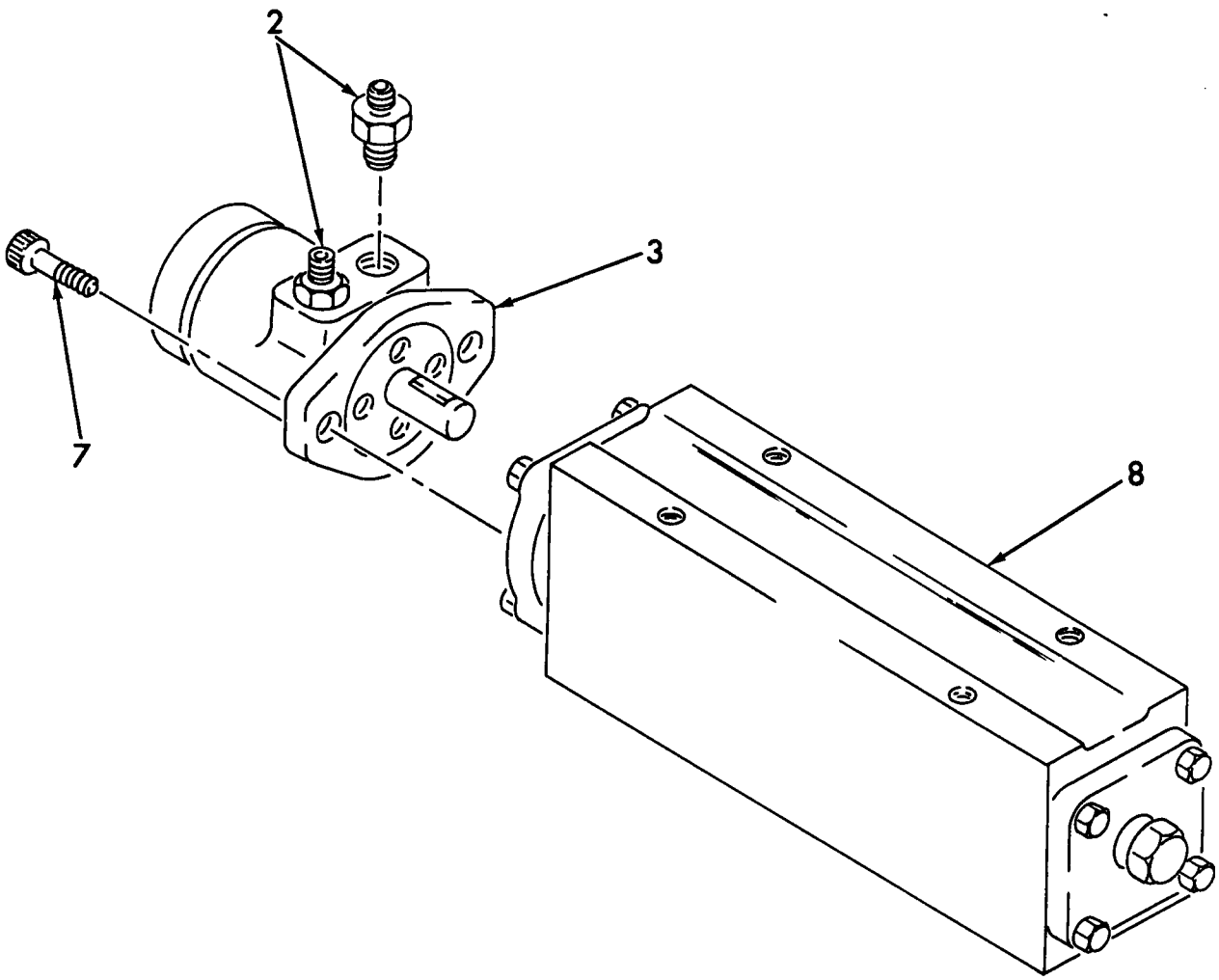


REV.

HYDRAULIC TANK ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140740	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 1 for NHA)	REF
2	80008-04	.ELBOW, MALE	1
3	140760	.WELDMENT, NIPPLE	1
4	52307	.ELBOW, STREET	2
5	20050	.VALVE, BUTTERFLY	1
6	16553	.NIPPLE	1
7	80001-20	.CONNECTOR, MALE	1
8	80008-16	.ELBOW, MALE	1
9	23922	.ADAPTER, HYDRAULIC TANK RETURN	1
10	21241	.FILTER, RETURN	1
11	21245	..ELEMENT, FILTER	1
12	65864	.NIPPLE	1
13	16503	.ELBOW, STREET	1
14	81185	.BREATHER, FILLER	1
15	80048-05	.PLUG, HOLLOW HEX	1
16	23728	.SUB-ASSEMBLY, HYDRAULIC TANK	1

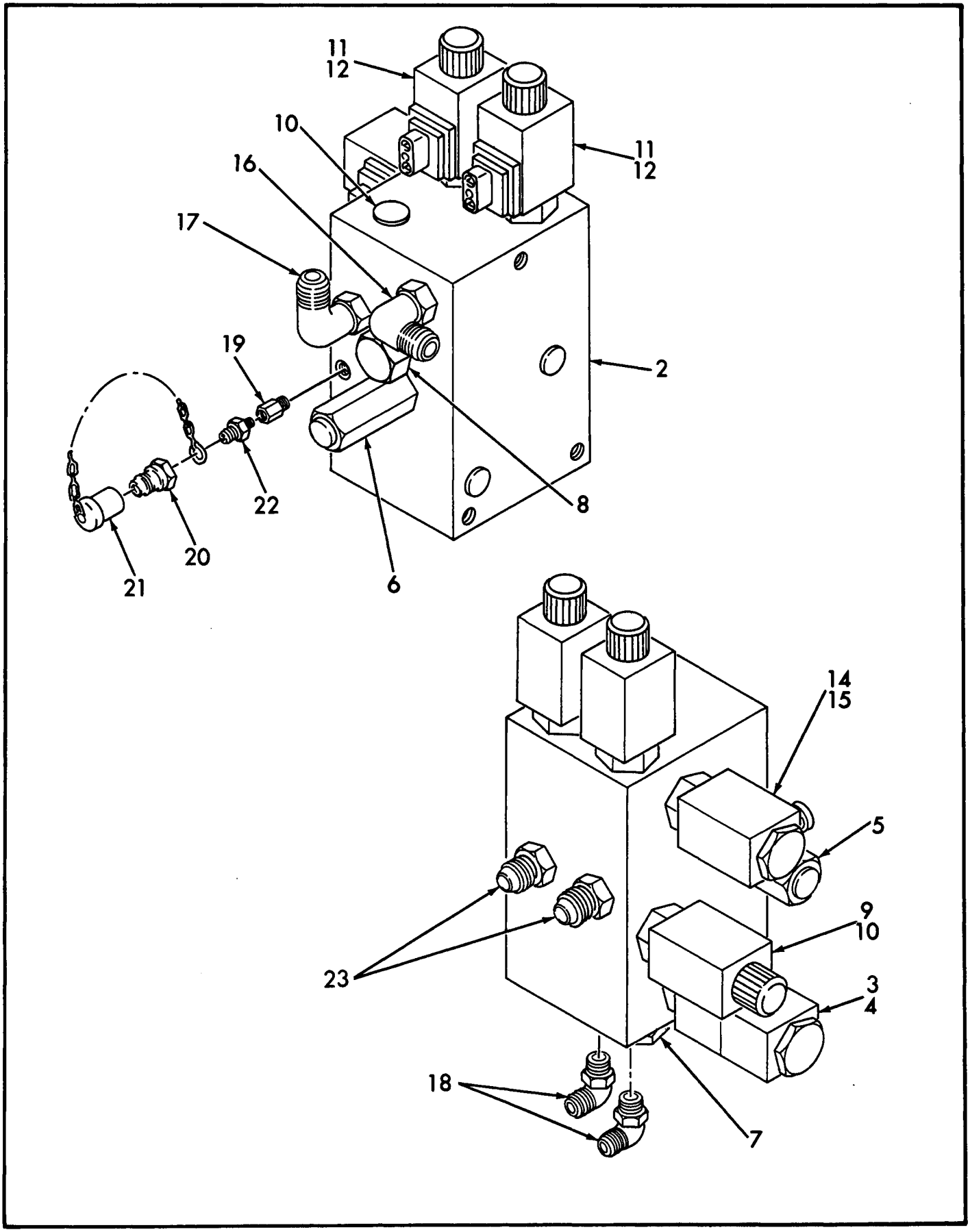
ROTATION GEARBOX/BRACKET ASSEMBLY (30 KBDF)



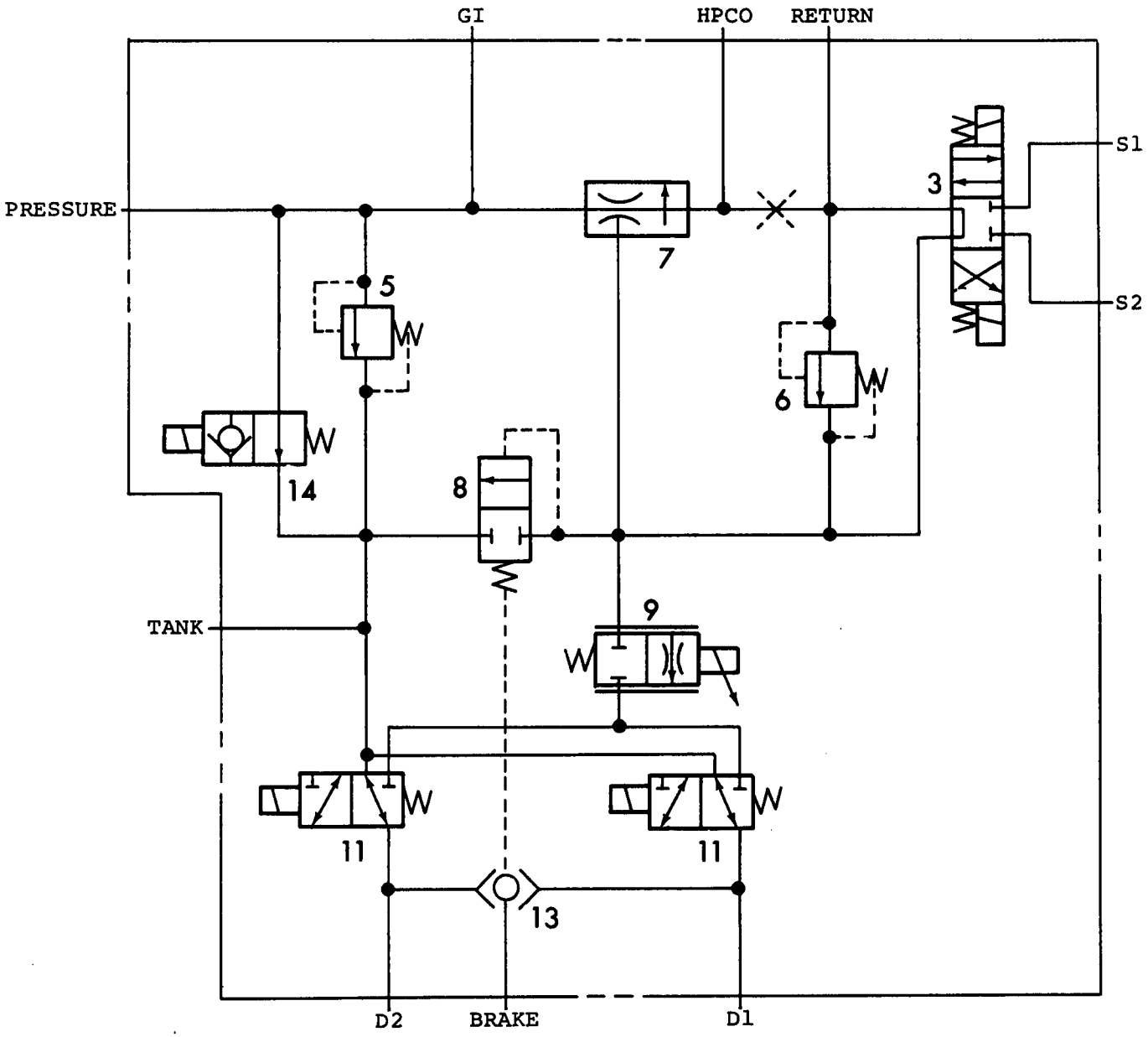
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140753	ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 1 for NHA)	REF
2	80004-10	.CONNECTOR, STRAIGHT THREAD	2
3	81187	.ASSEMBLY, HYDRAULIC MOTOR (See Vendor Chap. for more Information)	1
-4	67688	..KIT, SEAL	1
-5	67691	..LINK, DRIVE	1
-6	67698	..SHAFT, COUPLING	1
7	62011	.SCREW, CAP	2
8	23736	.ASSEMBLY, WORM GEAR	1

REV.

PROPORTIONAL DRIVE/STEER VALVE ASSEMBLY (30 KBDF)



REV.


GI
HPCO
RETURN
S1
S2
PRESSURE
3
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8
9
TANK
11
11
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D2
BRAKE
D1

PROPORTIONAL DRIVE/STEER VALVE ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140763	ASSEMBLY, PROPORTIONAL DRIVE/STEER VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	81219	.VALVE, DRIVE/STEER	1
-3	600025	..KIT, SEAL (COMPLETE VALVE PACKAGE)	1
4	67223	..VALVE, 3 POSITION - 4 WAY	2
5	66914	...COIL (12 VOLT)	2
*6	68060	..VALVE, RELIEF	1
*7	68057	..VALVE, RELIEF	1
8	67229	..REGULATOR, FLOW	1
9	600024	..VALVE, DIFFERENTIAL SENSING	1
10	67345	..SOLENOID, PROPORTIONAL	1
11		...COIL (12 VOLT)	1
12	67221	..VALVE, SOLENOID	2
13	66913	...COIL (12 VOLT)	1
14	600023	..VALVE, SHUTTLE	1
15	66920	..VALVE, SOLENOID	1
16	66914	...COIL	1
17	80012-18	.ELBOW, STRAIGHT THREAD	1
18	80012-15	.ELBOW, STRAIGHT THREAD	1
19	80012-03	.ELBOW, STRAIGHT THREAD	2
20	51903	.ADAPTER, FEMALE PIPE	1
21	2527	.COUPLING, QUICK DISCONNECT	1
22	845	.CAP, QUICK DISCONNECT	1
		NOTE: PRIOR TO USE, ITEMS WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE LISTED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

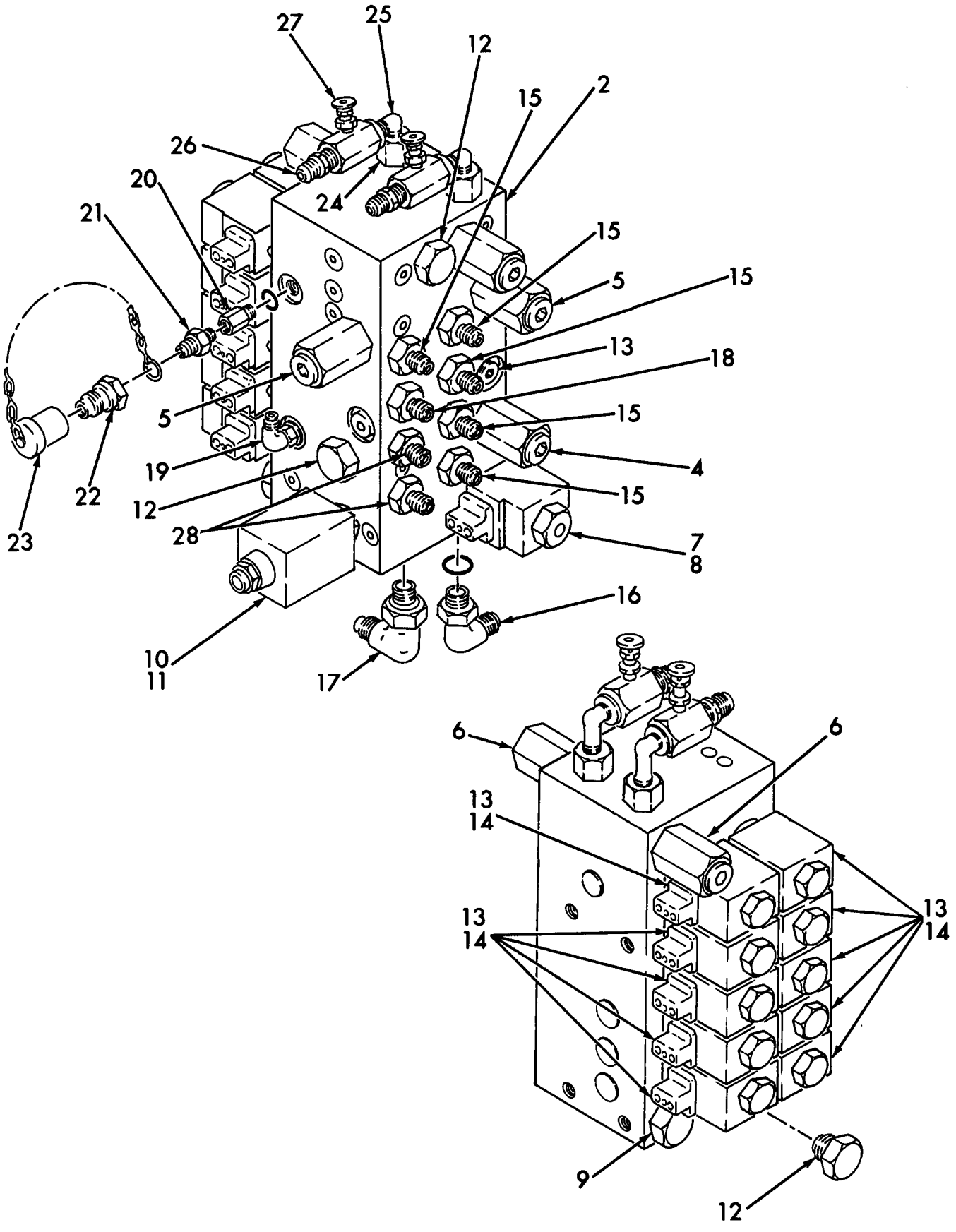
- ITEM NOT ILLUSTRATED

PROPORTIONAL DRIVE/STEER VALVE ASSEMBLY (30 KBDF)

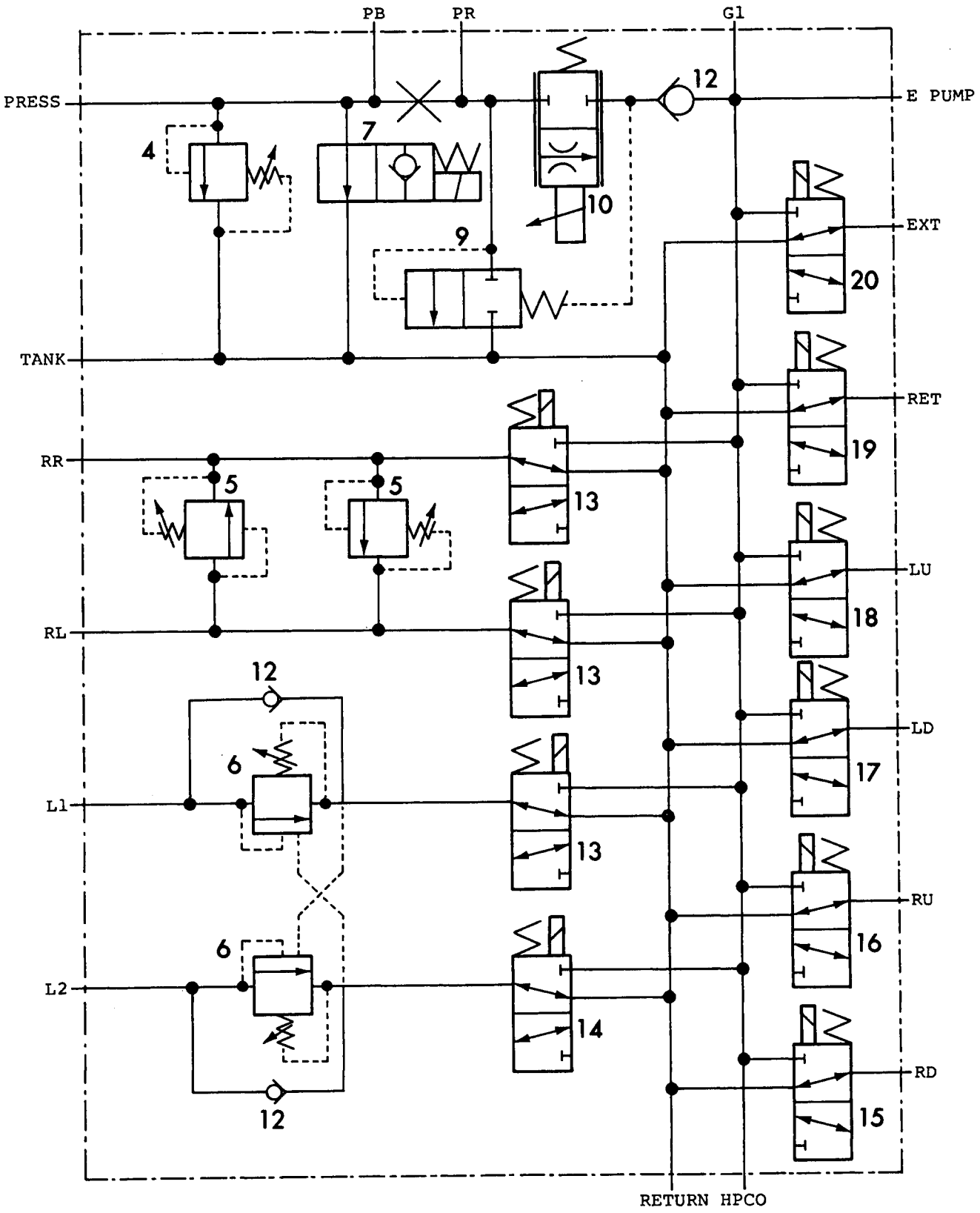
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	80052-03	.NIPPLE, PIPE	1
24	80004-15	.CONNECTOR, STRAIGHT THREAD	2

- ITEM NOT ILLUSTRATED

BOOM FUNCTION VALVE ASSEMBLY (30 KBDF) (FROM EARLY 1989)



BOOM FUNCTION VALVE ASSEMBLY (30 KBDF)
(FROM EARLY 1989)



BOOM FUNCTION VALVE ASSEMBLY (30 KBDF)
(FROM EARLY 1989)

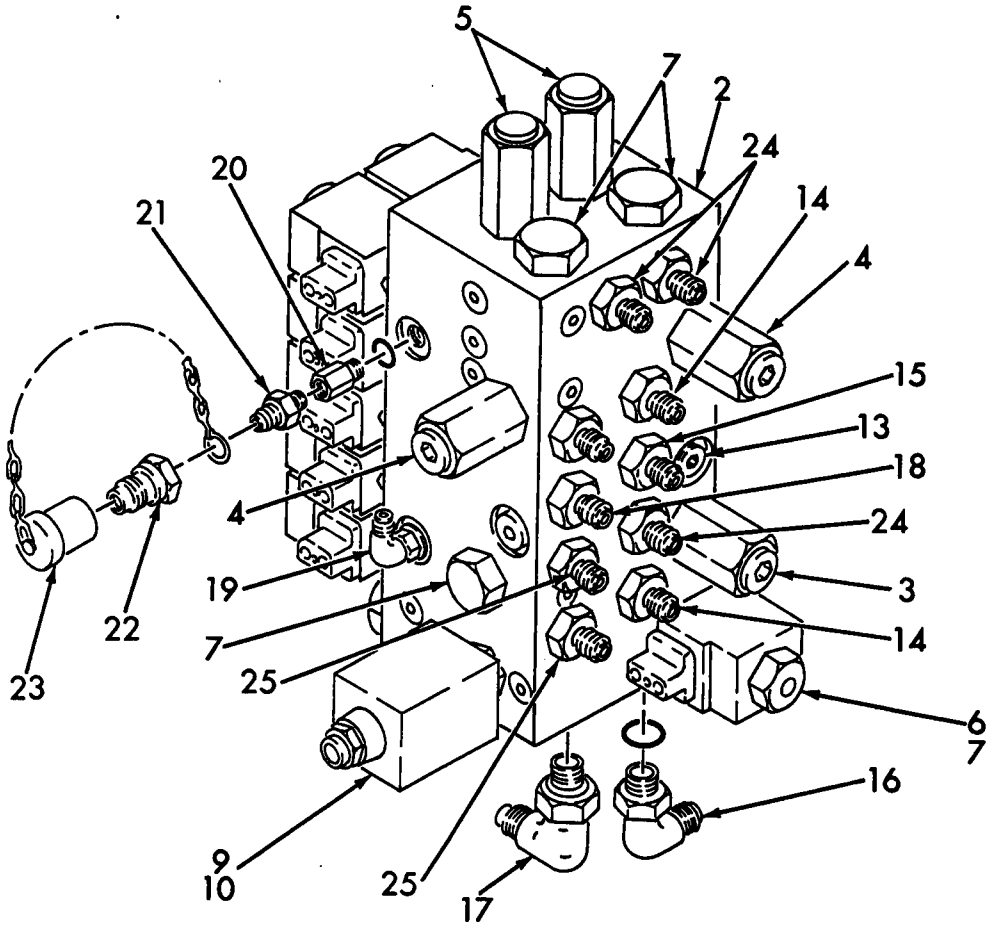
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140828	ASSEMBLY, BOOM FUNCTION VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	81248	.VALVE, BOOM FUNCTION CONTROL	1
-3	600026	..KIT, SEAL (COMPLETE VALVE PACKAGE)	1
*4	68060	..VALVE, RELIEF	1
*5	67218	..VALVE, RELIEF	2
*6	68057	..VALVE, RELIEF	2
7	66920	..VALVE, SOLENOID	1
8	66914	...COIL (12 VOLT)	1
9	67338	..VALVE, DIFFERENTIAL SENSING	1
10	600027	..SOLENOID, PROPORTIONAL	1
11		...COIL (PROPORTIONAL, 12 VOLT)	1
12	66674	..VALVE, CHECK	3
13	66923	..VALVE, SOLENOID	10
14	66914	...COIL (12 VOLT)	10
15	80004-08	.CONNECTOR, STRAIGHT THREAD	5
16	80012-12	.ELBOW, STRAIGHT THREAD	1
17	80012-15	.ELBOW, STRAIGHT THREAD	1
18	80004-09	.CONNECTOR, STRAIGHT THREAD	1
19	80012-03	.ELBOW, STRAIGHT THREAD	1
20	51903	.ADAPTER, FEMALE PIPE	1
21	80052-03	.NIPPLE, PIPE	1
22	2527	.COUPLING, QUICK DISCONNECT	1
		NOTE: PRIOR TO USE, ITEMS WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE LISTED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

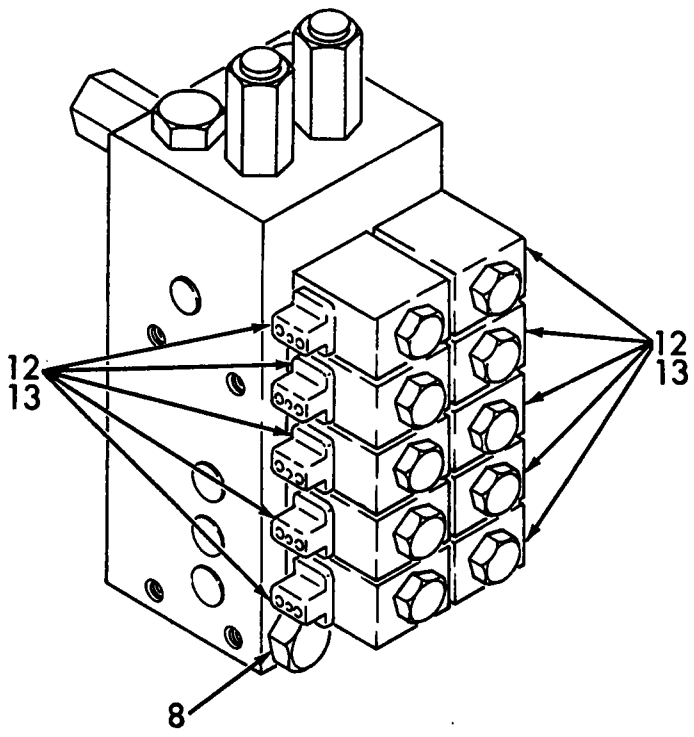
- ITEM NOT ILLUSTRATED

BOOM FUNCTION VALVE ASSEMBLY (30 KBDF)
(FROM EARLY 1989)

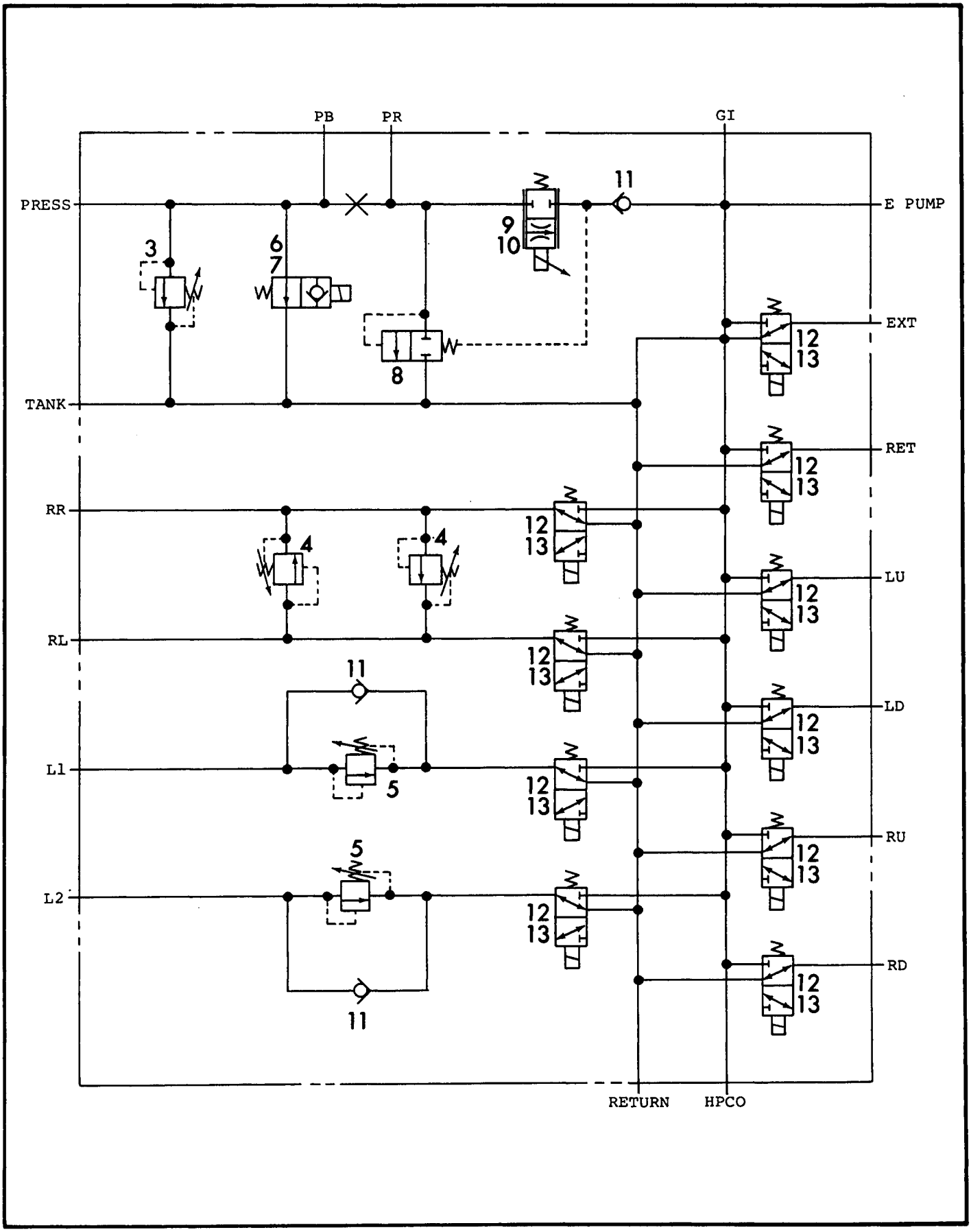
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	845	.CAP, QUICK DISCONNECT	1
24	80063-01	.ADAPTER, FEMALE PIPE	2
25	80022-04	.ELBOW, MALE	2
26	80001-04	.CONNECTOR, MALE	2
27	20357	.VALVE, NEEDLE	2
28	140765	.CONNECTOR, MODIFIED STRAIGHT THREAD	2

FUNCTIONAL BOOM VALVE ASSEMBLY (30 KBDF)
(TO EARLY 1989)





FUNCTIONAL BOOM VALVE ASSEMBLY (30 KBDF)
(TO EARLY 1989)



BOOM FUNCTION CONTROL VALVE ASSEMBLY (30 KBDF)
(TO EARLY 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140789	ASSEMBLY, BOOM FUNCTION CONTROL VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	81221	.VALVE, BOOM FUNCTION CONTROL	1
*3	68060	..VALVE, RELIEF	1
*4	67218	..VALVE, RELIEF	2
*5	68056	..VALVE, RELIEF	2
6	66920	..VALVE, SOLENOID	1
7	66914	...COIL (12 VOLT)	1
8	67338	..VALVE, DIFFERENTIAL SENSING	1
9	600027	..SOLENOID, PROPORTIONAL	1
10		...COIL (PROPORTIONAL, 12 VOLT)	1
11	66674	..VALVE, CHECK	3
12	66923	..VALVE, SOLENOID	10
13	66914	...COIL (12 VOLT)	1
14	80004-08	.CONNECTOR, STRAIGHT THREAD	3
15	80004-12	.CONNECTOR, STRAIGHT THREAD	1
16	80012-12	.ELBOW, STRAIGHT THREAD	1
17	80012-15	.ELBOW, STRAIGHT THREAD	1
18	80004-11	.CONNECTOR, STRAIGHT THREAD	1
19	80012-03	.ELBOW, STRAIGHT THREAD	1
20	51903	.ADAPTER, FEMALE PIPE	1
21	80052-03	.NIPPLE, PIPE	1
22	2527	.COUPLING, QUICK DISCONNECT	1
		NOTE: PRIOR TO USE, ITEMS WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE LISTED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

- ITEM NOT ILLUSTRATED

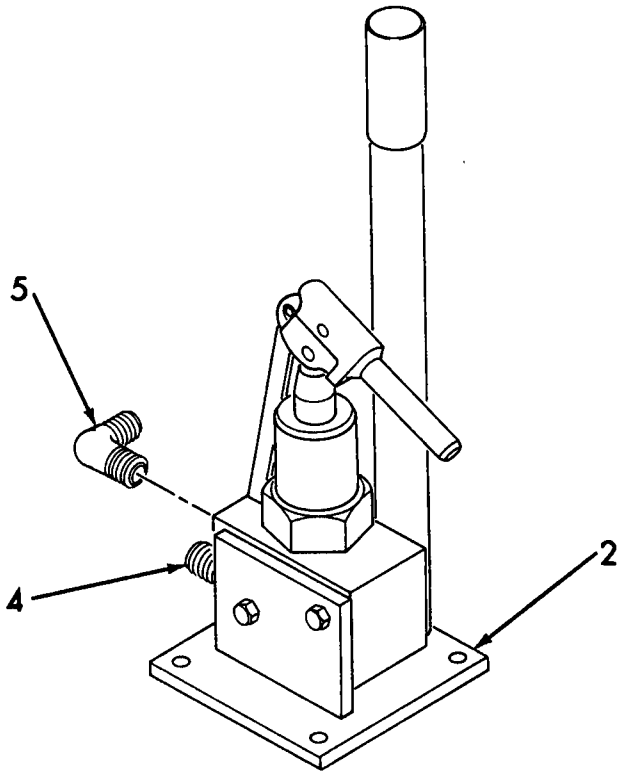
BOOM FUNCTION CONTROL VALVE ASSEMBLY (30 KBDF)
(TO EARLY 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	845	.CAP, QUICK DISCONNECT	1
24	80004-05	.CONNECTOR, STRAIGHT THREAD	3
25	140765	.CONNECTOR, MODIFIED STRAIGHT THREAD	2

REV.

- ITEM NOT ILLUSTRATED

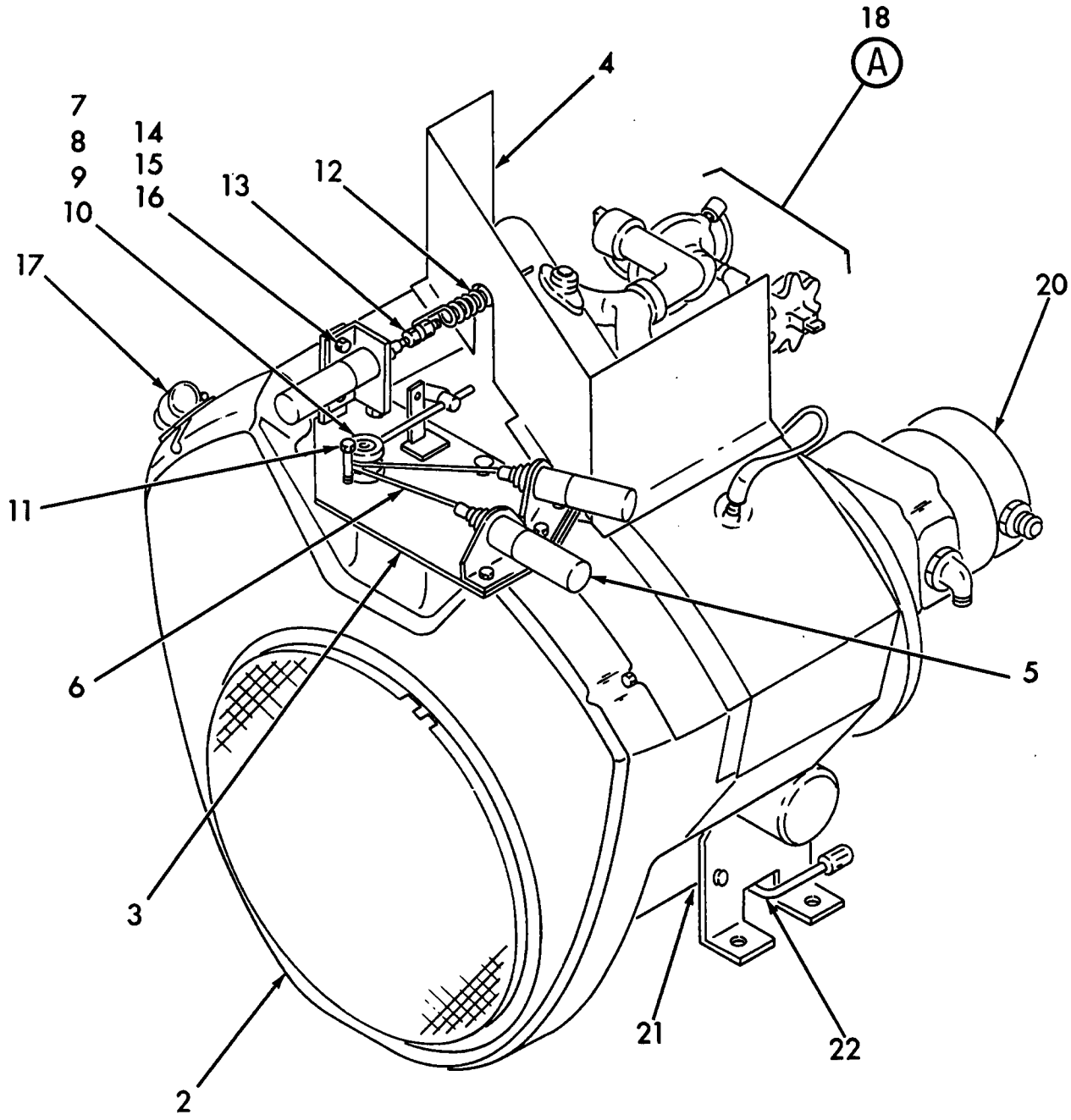
EMERGENCY PUMP ASSEMBLY (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140806	ASSEMBLY, EMERGENCY PUMP (See Sect. 4, Fig. 13 for NHA)	REF
2	81281	.PUMP, EMERGENCY	1
-3	60031	..KIT, SEAL	1
4	80001-04	.CONNECTOR	1
5	80008-04	.ELBOW	1

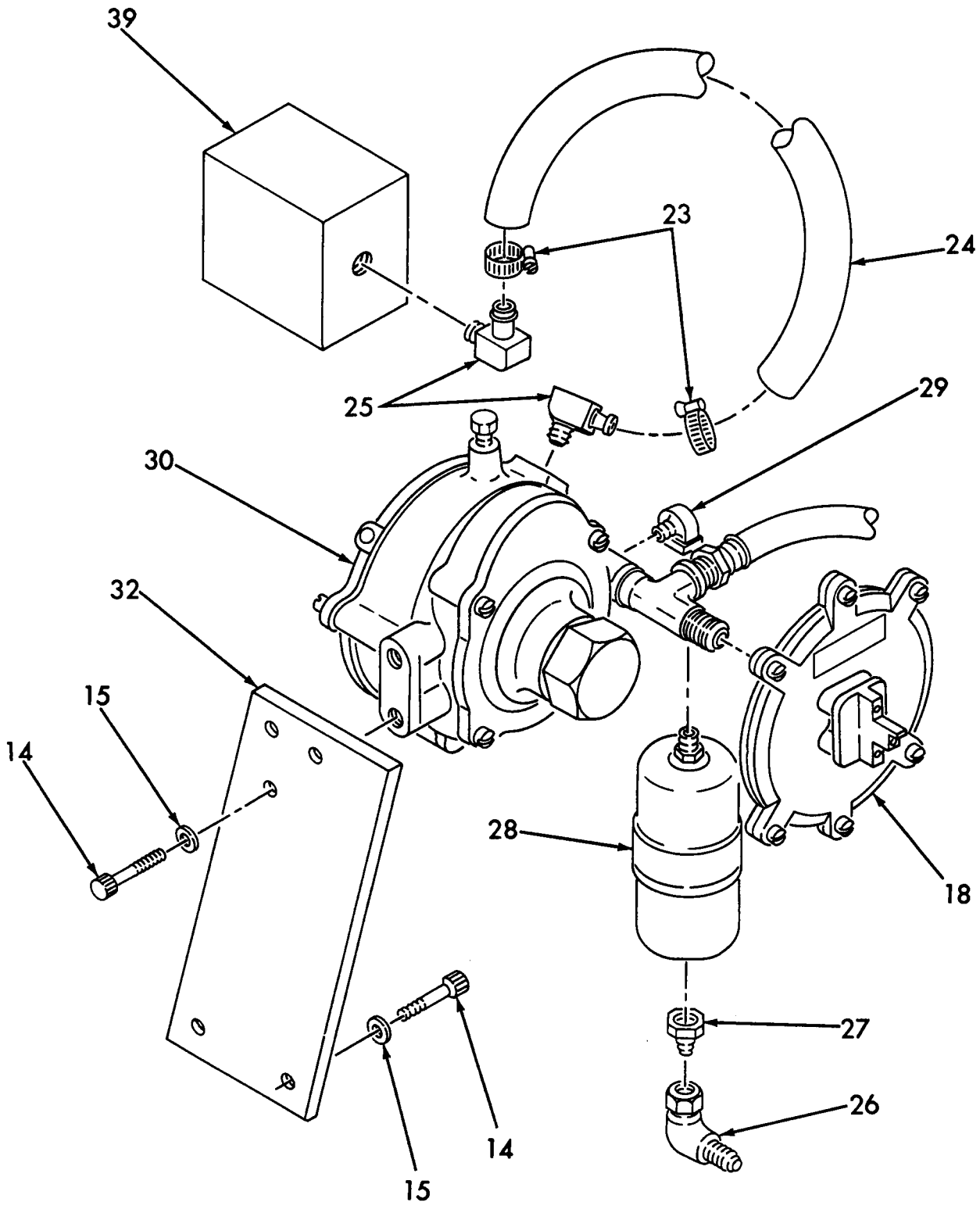
REV.

ENGINE & PUMP ASSEMBLY (30 KBDF)



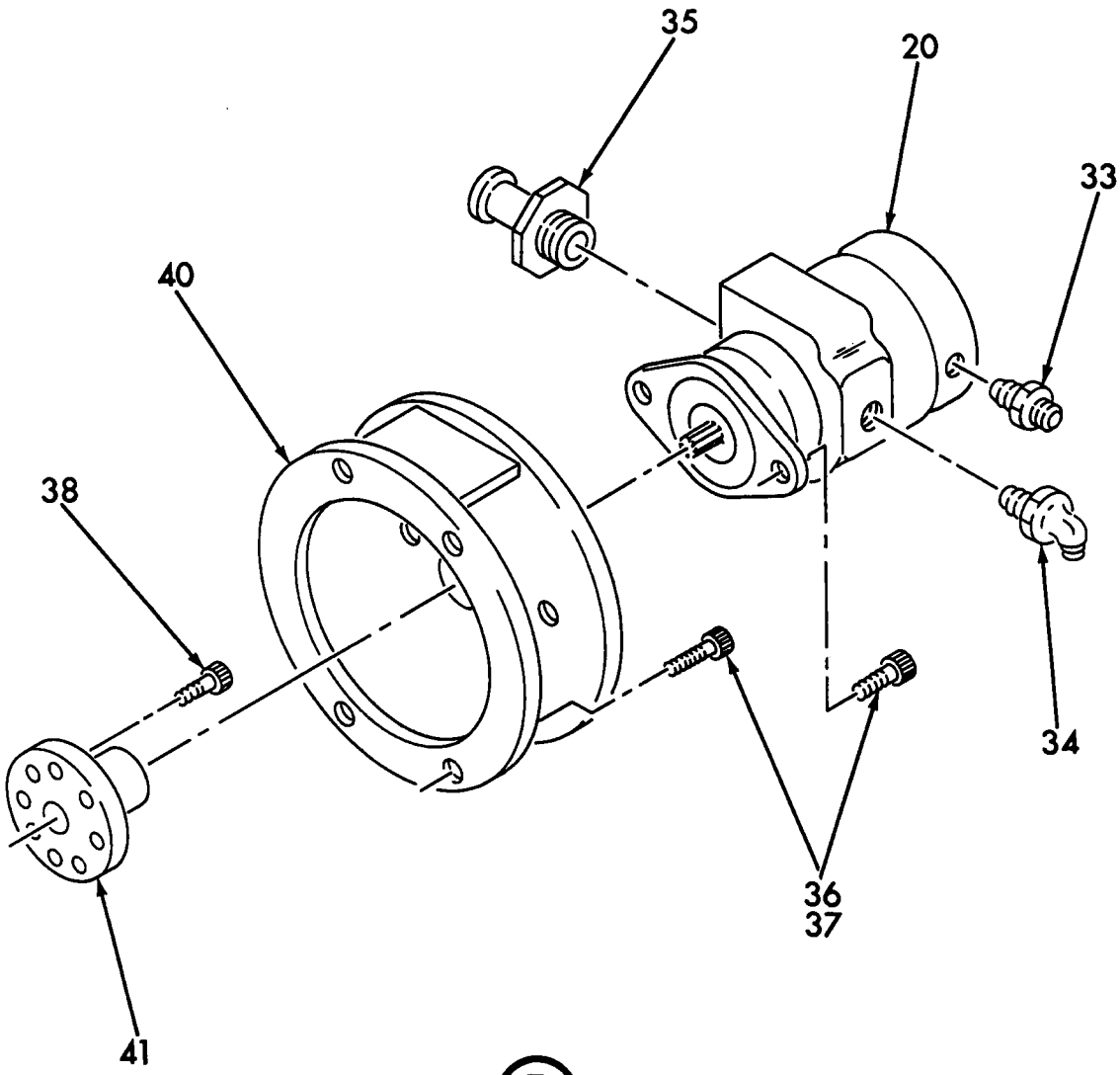
REV.

ENGINE & PUMP ASSEMBLY (30 KBDF)



REV.

ENGINE & PUMP ASSEMBLY (30 KBDF)



REV.

ENGINE & PUMP ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140737	ASSEMBLY, ENGINE & PUMP (See Sect. 4, Fig. 1 for NHA)	REF
2	24062	.ENGINE, GASOLINE (See Vendor Chap. for more Information)	1
3	140755	.BRACKET	1
4	140803	.SHIELD, HEAT	1
5	21777	.SOLENOID, SYNCHRO START	3
6	65913	.CABLE, ASSEMBLY	2
7	60703	.NUT, HEX	1
8	63319	.WASHER, LOCK	1
9	62101	.SCREW, SHOULDER	1
10	140756	.PULLEY	1
11	62001	.SCREW, CAP	1
12	65199	.SPRING, THROTTLE	1
13	60805	.NUT, HEX	6
14	60309	.SCREW, CAP	10
15	63301	.WASHER, LOCK	10
16	60701	.NUT, HEX	4
17	70209	.COIL, WITH ATTACHING PARTS	1
18	16975	.SWITCH, VACUUM SAFETY	1
19	16919	..KIT, REPAIR	1
20	81256	.PUMP, DOUBLE GEAR (See Sect. 4, Fig. 16 for Details) (See Vendor Chap. for more Information)	1
21	80001-10	.CONNECTOR, MALE	1
22	23775	.DRAIN LINE, OIL	1
23	2713	.CLAMP, HOSE	2
24	65485-24	.HOSE	1
25	65532	.AIRWAY HOSE, BARB	2

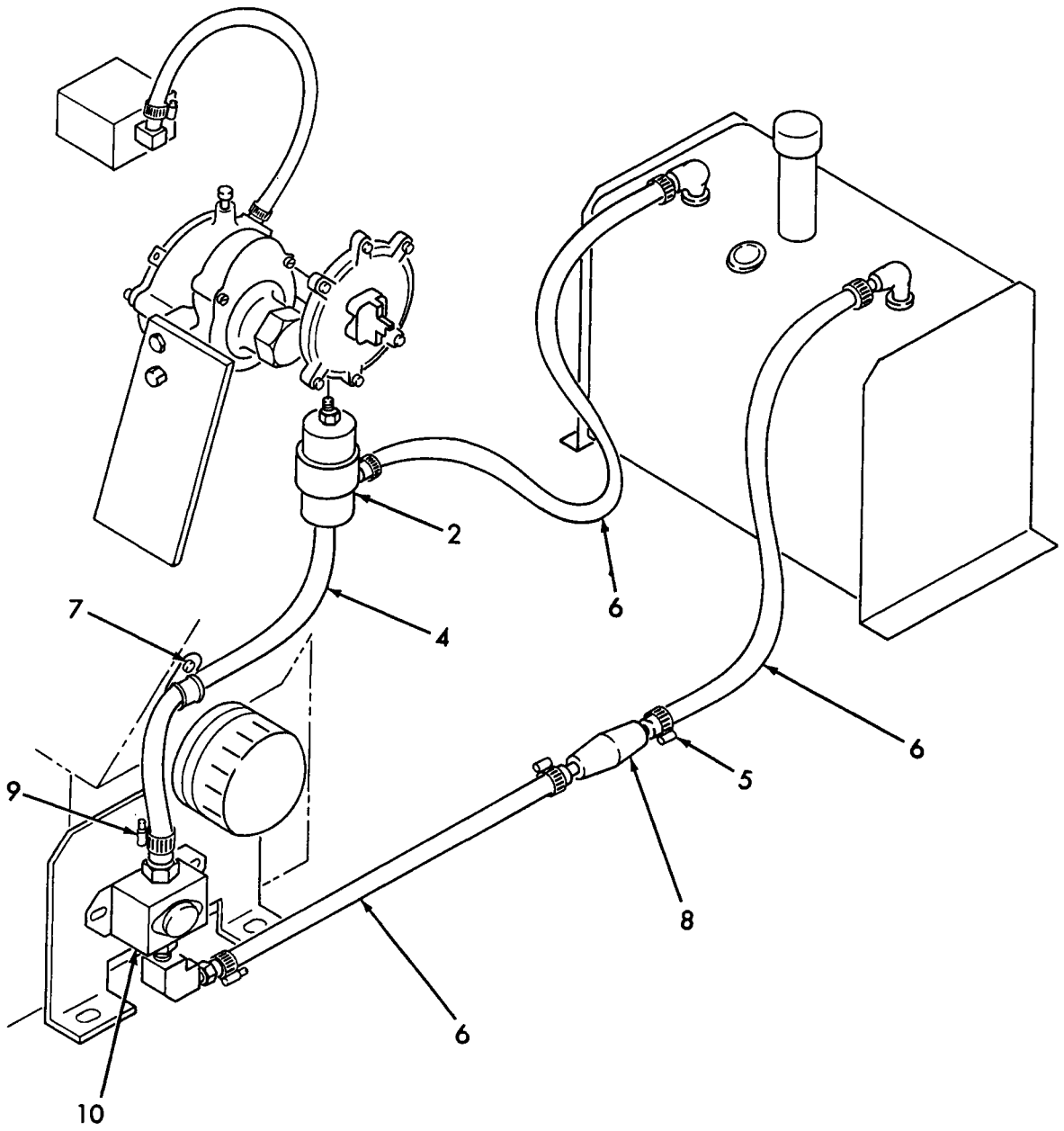
- ITEM NOT ILLUSTRATED

ENGINE & PUMP ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	80015-05	.ELBOW, SWIVEL NUT	1
27	80001-08	.CONNECTOR, MALE	1
28	16925	.LOCK, PROPANE FILTER FUEL	1
29	16519	.ELBOW, STREET	1
30	16921	.REGULATOR	1
-31	16965	..KIT, REPAIR (REGULATOR)	1
32	140634	.BRACKET, MOUNTING	1
33	80004-13	.CONNECTOR, STRAIGHT	1
34	80012-15	.ELBOW, STRAIGHT THREAD	1
35	81198	.INSERT, BEADED	1
36	60630	.SCREW, CAP	6
37	63304	.WASHER, LOCK	8
38	60625	.SCREW, CAP	8
39	160068	.ADAPTER, CARBURETOR	1
40	32219	.PUMP, ADAPTER	1
41	32217	.SHAFT, STUB	1
-42	67282	.STARTER	1
-43	67284	.FILTER, OIL	1

- ITEM NOT ILLUSTRATED

FUEL SYSTEM ASSEMBLY (30 KBDF)



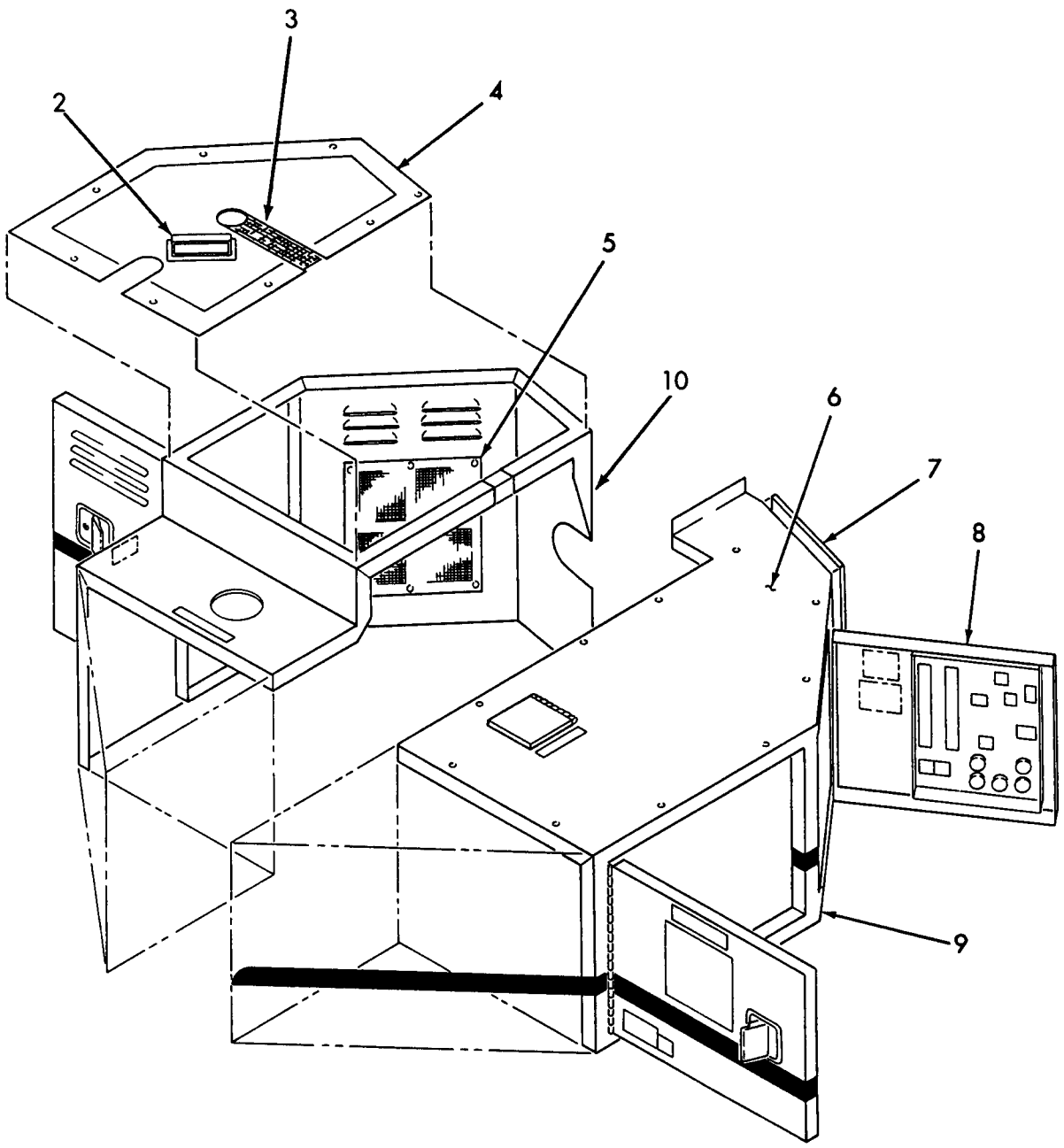
REV.

FUEL SYSTEM ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140794	ASSEMBLY, FUEL SYSTEM	REF
2	160061	.FILTER, FUEL	1
3	30355	.CLAMP, CUSHIONED	1
4	65227	.HOSE, FUEL	3 FT
5	161A	.CLAMP, HOSE	6
6	160-B	.HOSE, FUEL	5.3 FT
7	764	.CLAMP, CUSHIONED	1
8	160	.FILTER, FUEL	1
9	65157	.CLAMP, HOSE	4
10	70256	•PUMP, ELECTRIC FUEL	1

- ITEM NOT ILLUSTRATED

SHEET METAL KIT (30 KBDF)

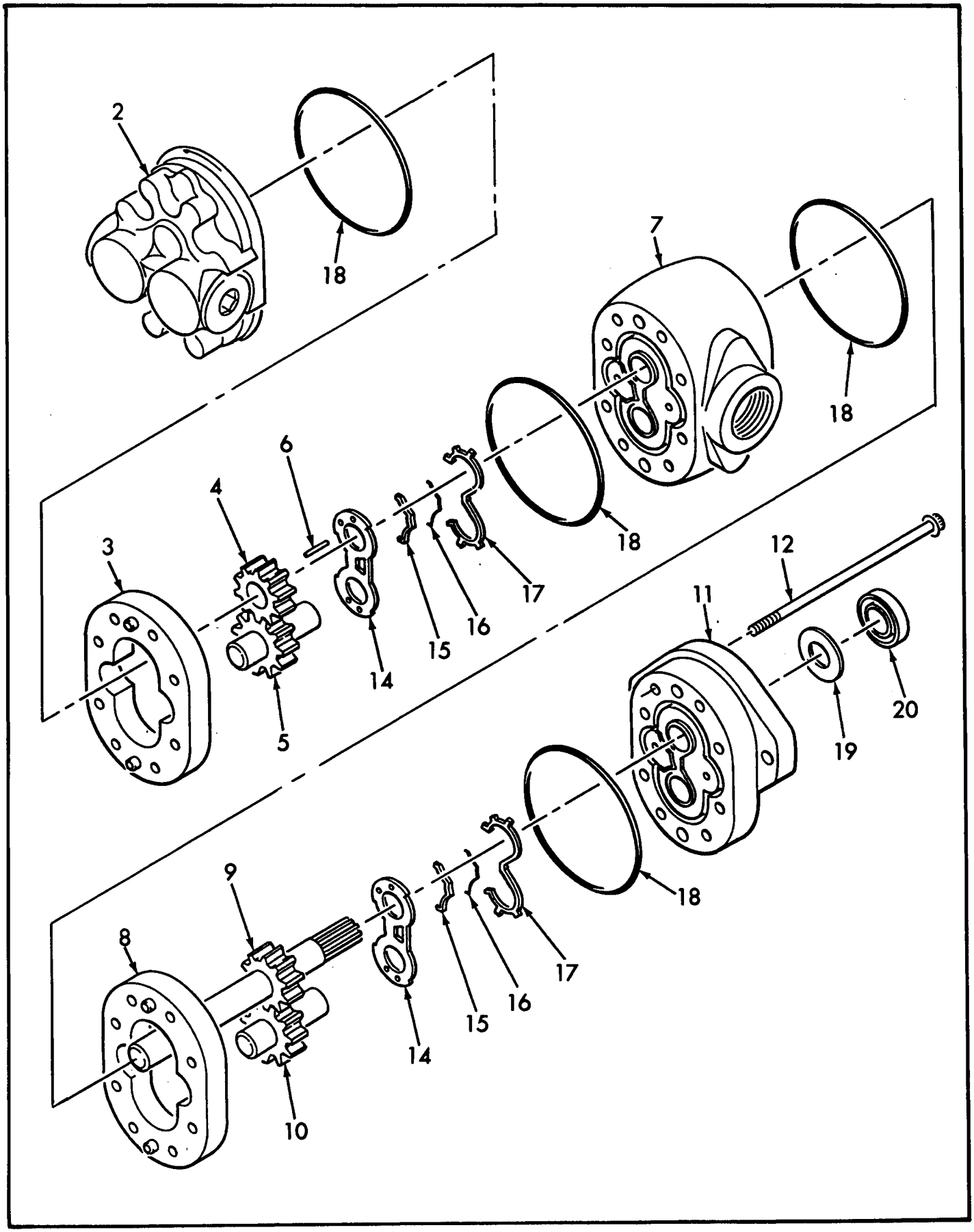


REV.

SHEET METAL KIT (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140688	KIT, SHEET METAL	REF
2	140820	.DUCT, EXHAUST	1
3	140821	.PANEL, EXHAUST	1
4	140797	.COVER, TOP-ENGINE SIDE	1
5	140822	.PANEL, INTAKE	1
6	140798	.COVER, TOP-HYDRAULIC SIDE	1
7	140823	.COVER, VALVE PACKAGE	1
8	140792	.PANEL, LOWER CONTROL	1
9	140796	.COVER, HYDRAULIC SIDE	1
10	140769	.COVER, ENGINE SIDE	1

DOUBLE GEAR PUMP ASSEMBLY (30 KBDF)



REV.

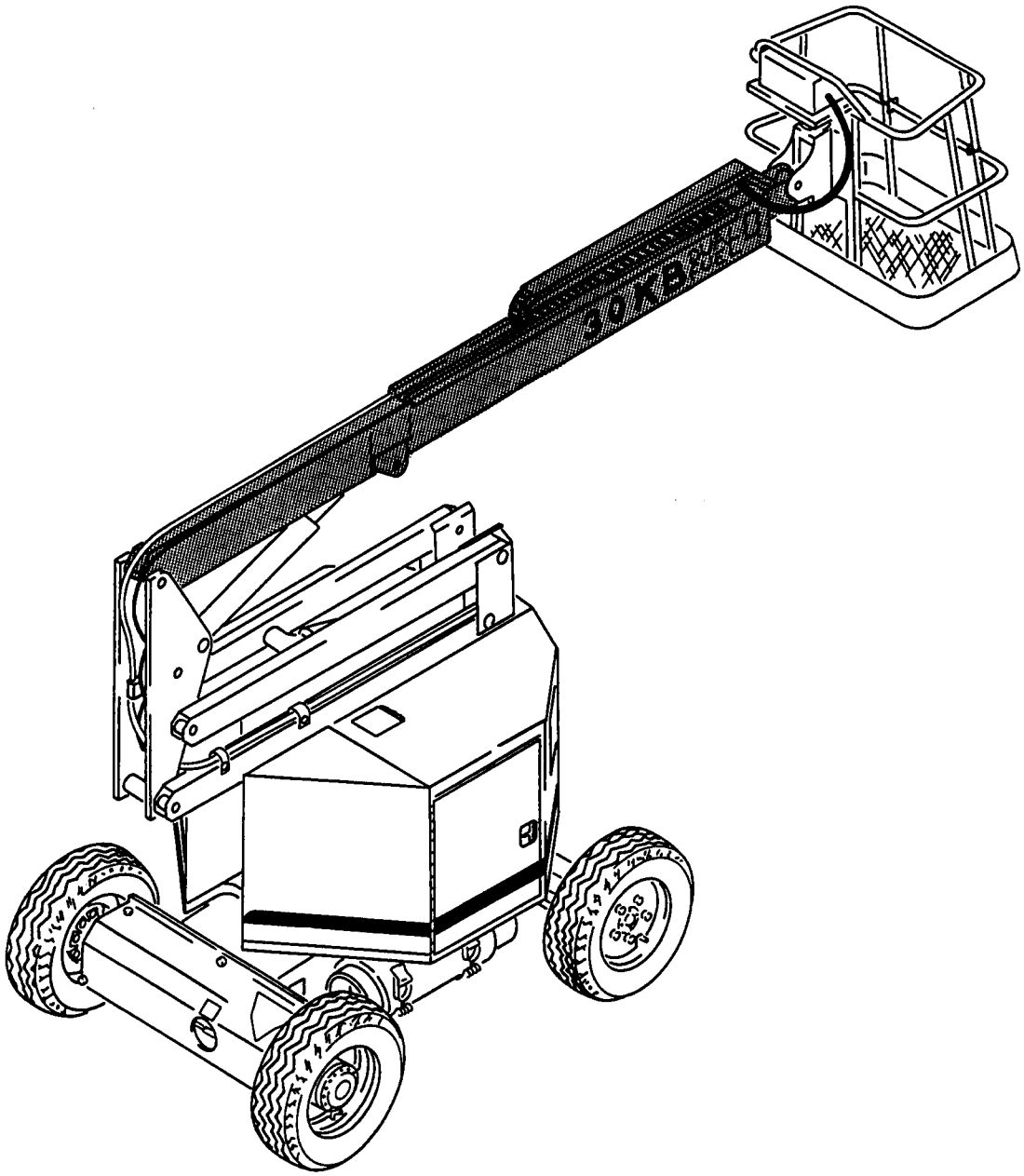
DOUBLE GEAR PUMP ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	81256	ASSEMBLY, DOUBLE GEAR PUMP (See Sect. 3, Fig. 11 for NHA) (See Vendor Chap. for more Information)	REF
2	67501	.ASSEMBLY, BACK PLATE	1
3		.BODY, REAR	1
4		.GEAR, SLIP FIT	1
5		.GEAR, REAR IDLER	1
6		.KEY, ROUND	1
7	67504	.PLATE, ADAPTER	1
8		.BODY, FRONT	1
9		.ASSEMBLY, SPLINE DRIVE GEAR	1
10		.GEAR, FRONT IDLER	1
11	67502	.ASSEMBLY, FRONT PLATE	1
12		.SCREW, CAP	8
-13	66869	.KIT, SEAL	1
14		..PLATE, WEAR	2
15		..SEAL, BEARING	2
16		..O-RING, MOLDED	2
17		..GASKET, BACK-UP	2
18		..O-RING	4
19		..WASHER	1
20		..SEAL, SHAFT	1

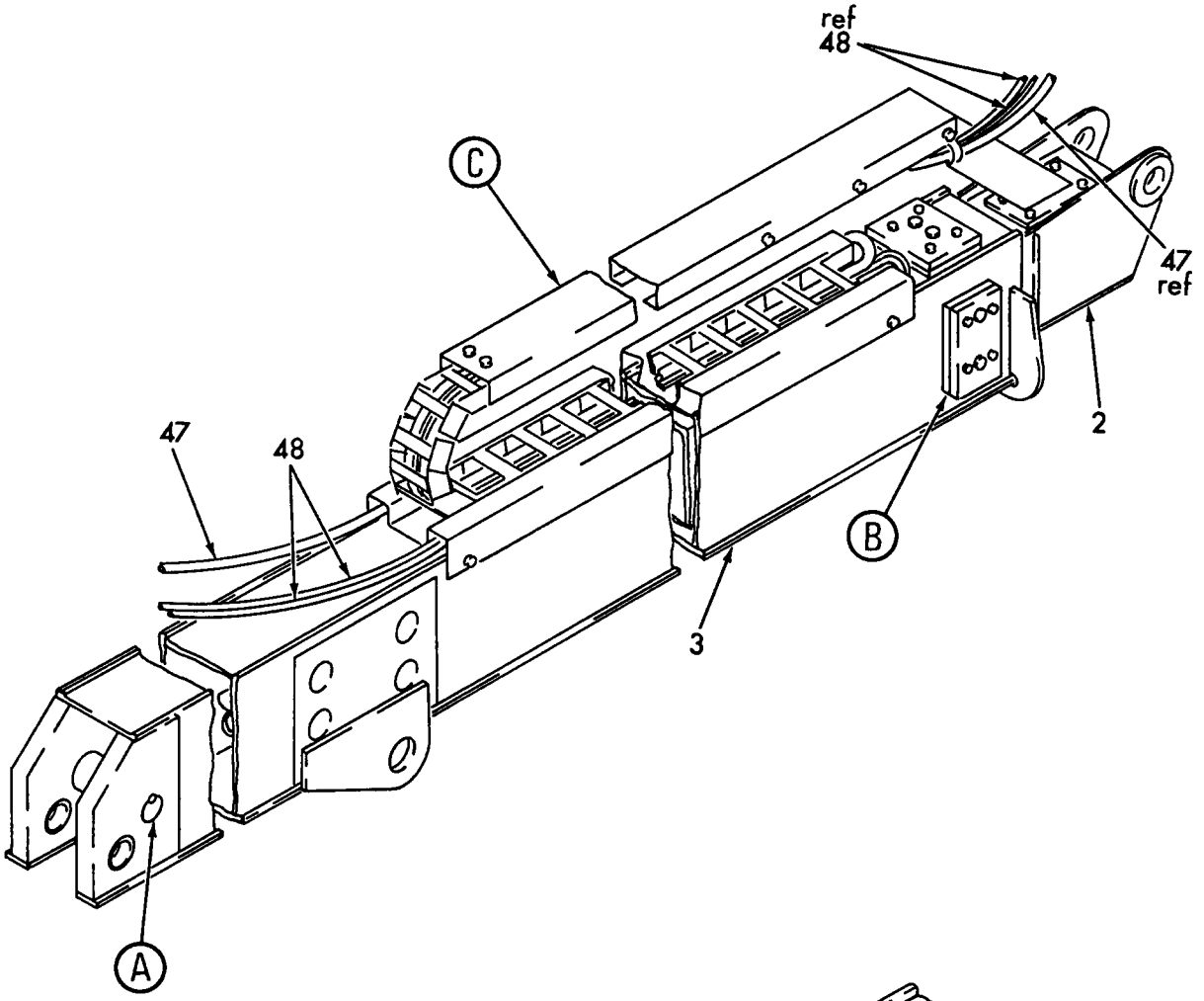
- ITEM NOT ILLUSTRATED

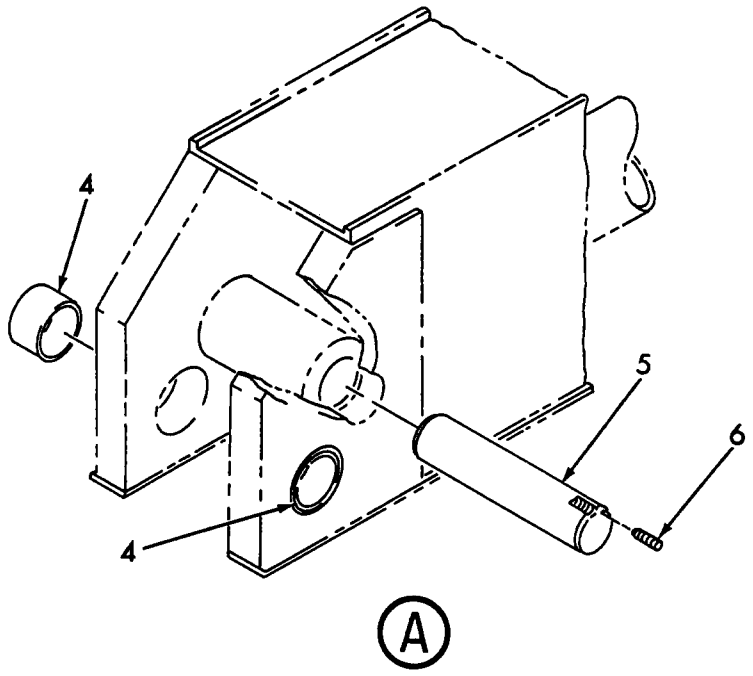
SECTION 5 CONTAINS:

FIG. NO.	TITLE
1	BOOM ASSEMBLY (30 KBDF)
2	INNER BOOM SUB-ASSEMBLY (30 KBDF)
3	EXTENSION CYLINDER SUB-ASSEMBLY (30 KBDF)
4	SLAVE CYLINDER SUB-ASSEMBLY (30 KBDF)



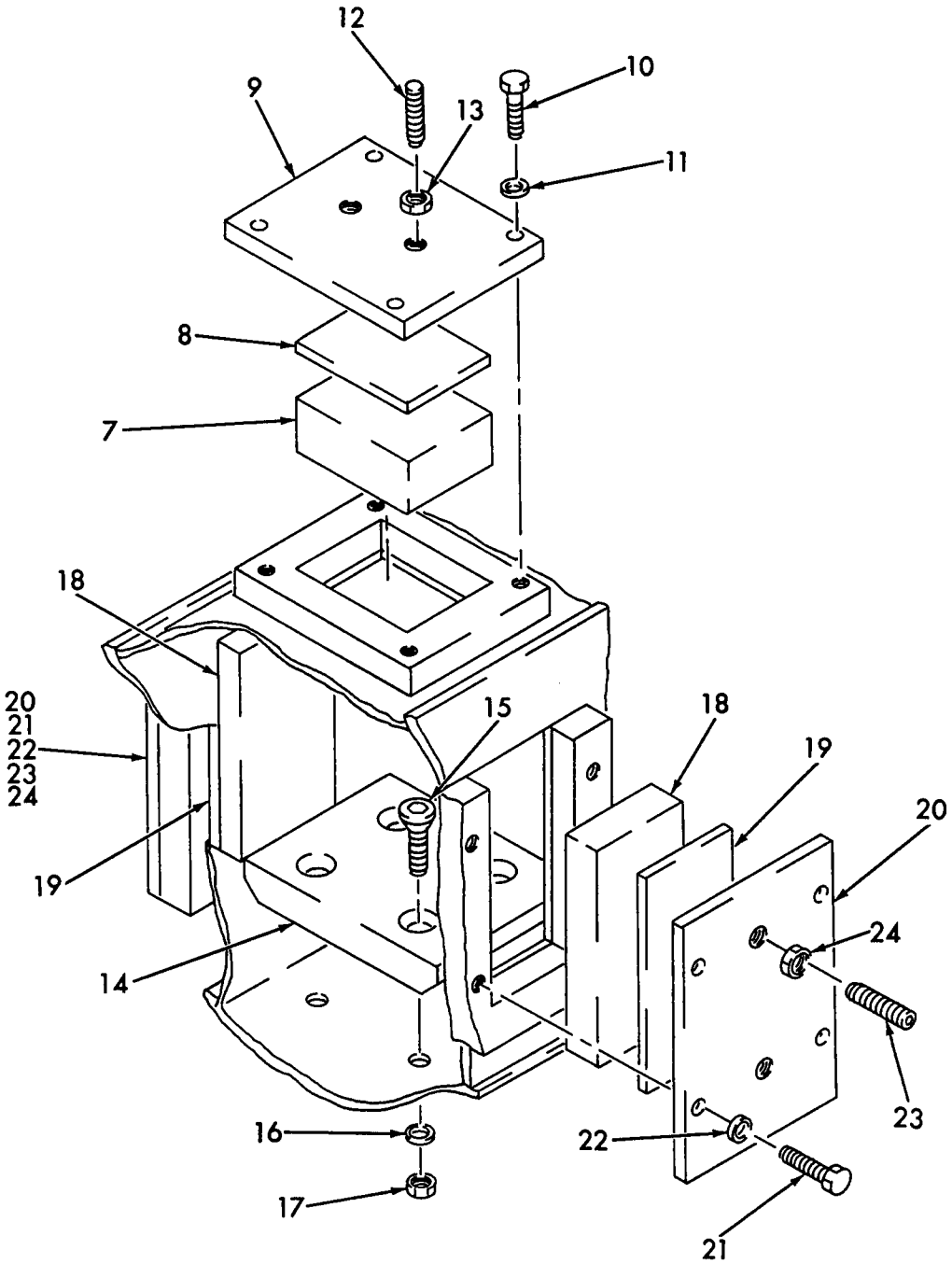
BOOM ASSEMBLY (30 KBDF)



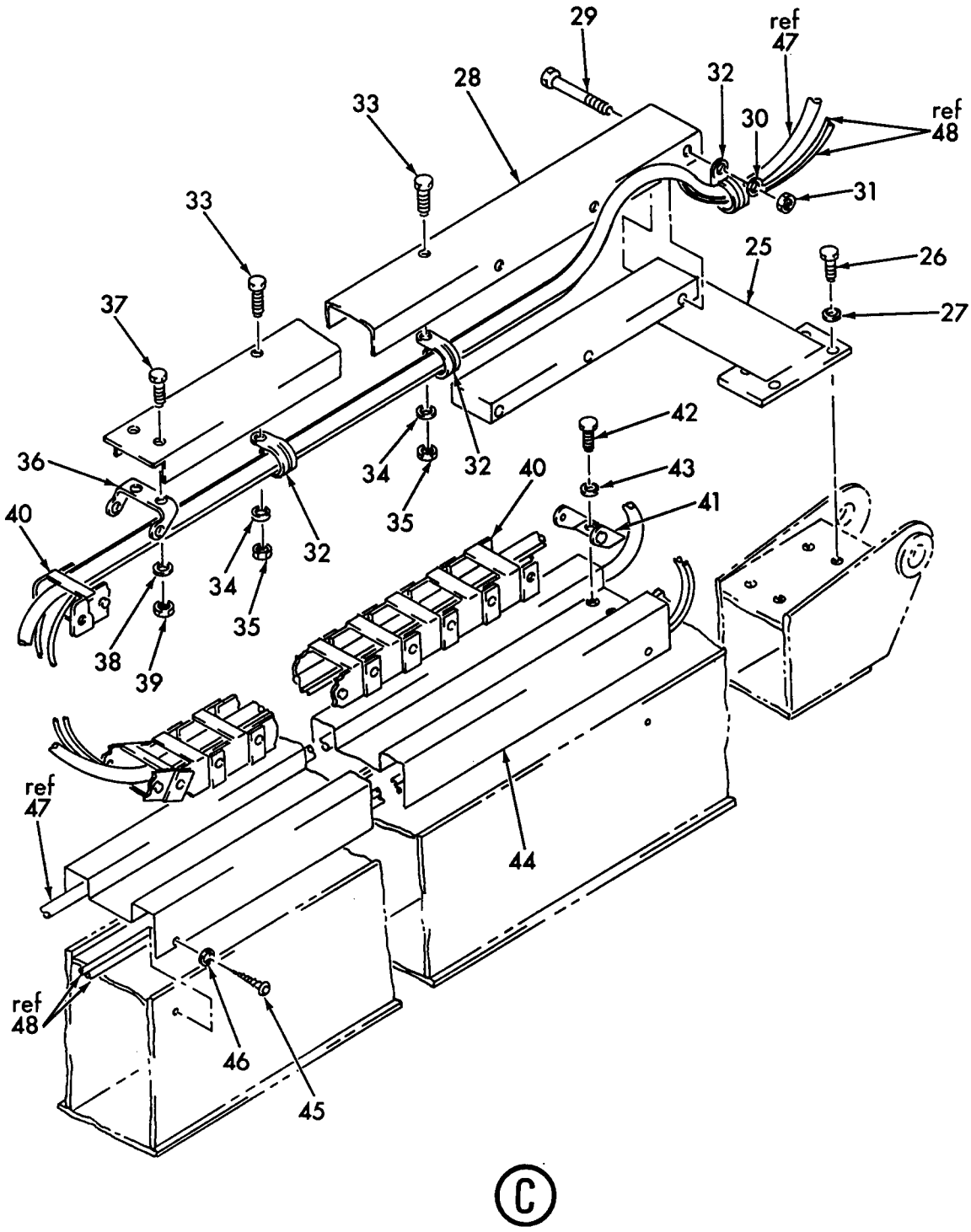


REV.

BOOM ASSEMBLY (30 KBDF)



BOOM ASSEMBLY (30 KBDF)



©

BOOM ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140118	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	140119	.SUB-ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2 for Details)	1
3	140098	.MACHINING, OUTER BOOM	1
4	140099	..BUSHING	2
5	140483	.PIN, EXTENSION CYLINDER CAP END	1
6	62234	.SCREW, SET	1
7	140405	.PAD, TOP WEAR	1
8	27250	.STRIP	1
9	140406	.PLATE, TOP COVER	1
10	60338	.SCREW, CAP	4
11	63302	.WASHER, LOCK	4
12	62210	.SCREW, SET	2
13	60901	.NUT, JAM	2
14	140396	.PAD, BOTTOM/OUTER BOOM WEAR	1
15	61821	.SCREW, CAP	4
16	63319	.WASHER, LOCK	4
17	60703	.NUT, HEX	4
18	140403	.PAD, SIDE WEAR	2
19	27247	.STRIP	2
20	140402	.PLATE, SIDE COVER	2
21	60338	.SCREW, CAP	8
22	63302	.WASHER, LOCK	8
23	62210	.SCREW, SET	4
24	60901	.NUT, JAM	4
25	140399	.WELDMENT, POWER TRACK BRACKET	1

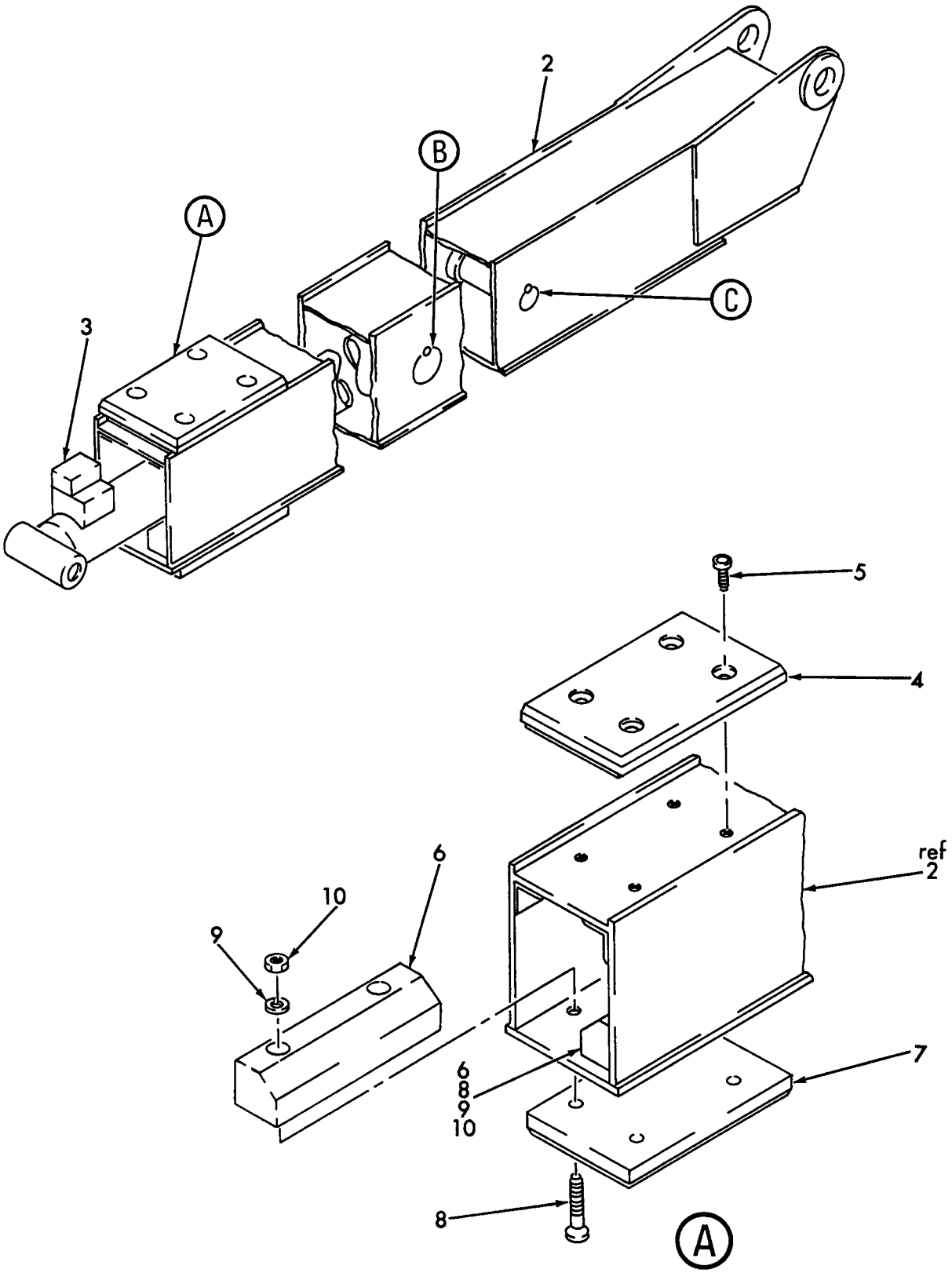
- ITEM NOT ILLUSTRATED

BOOM ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	60367	.SCREW, CAP	4
27	63302	.WASHER, LOCK	4
28	140342	.SUPPORT, POWER TRACK	1
29	60429	.SCREW, CAP	3
30	63429	.WASHER, LOCK	3
31	61322	.NUT, LOCK	3
32	65867	.CLAMP	3
33	60353	.SCREW, CAP	2
34	63433	.WASHER, FLAT	2
35	61227	.NUT, LOCK	2
36	23874	.BRACKET, MOVEABLE	1
37	60353	.SCREW, CAP	2
38	63433	.WASHER, FLAT	2
39	61227	.NUT, LOCK	2
40	23824	.TRACK, POWER	31
41	23875	.BRACKET, STATIONARY	1
42	60422	.SCREW, CAP	2
43	63433	.WASHER, FLAT	2
44	140201	.GUIDE, POWER TRACK	1
45	61729	.SCREW, MACHINE	4
46	63313	.WASHER, LOCK	4
47	20802	.CABLE, CONDUCTOR (50 FT.)	1
48	2568-35	.HOSE	2
-49	65395	.PLUG, SQUARE	2

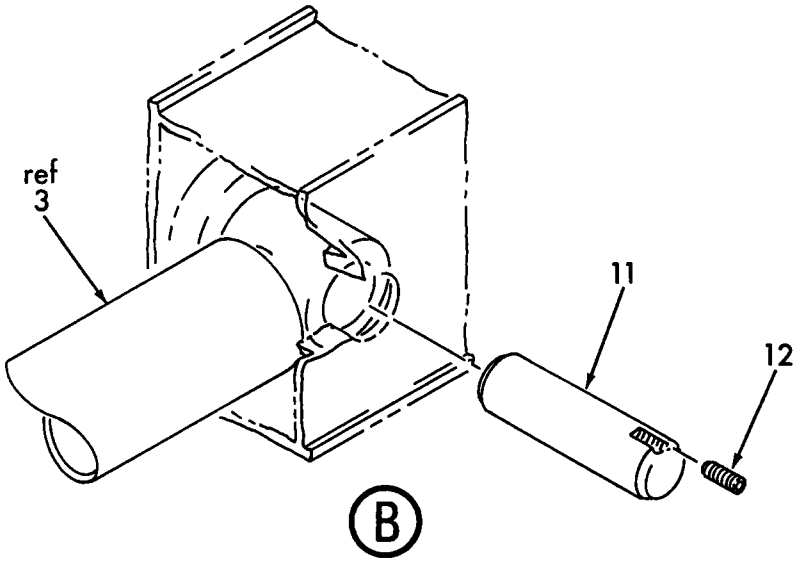
- ITEM NOT ILLUSTRATED

INNER BOOM SUB-ASSEMBLY (30 KBDF)

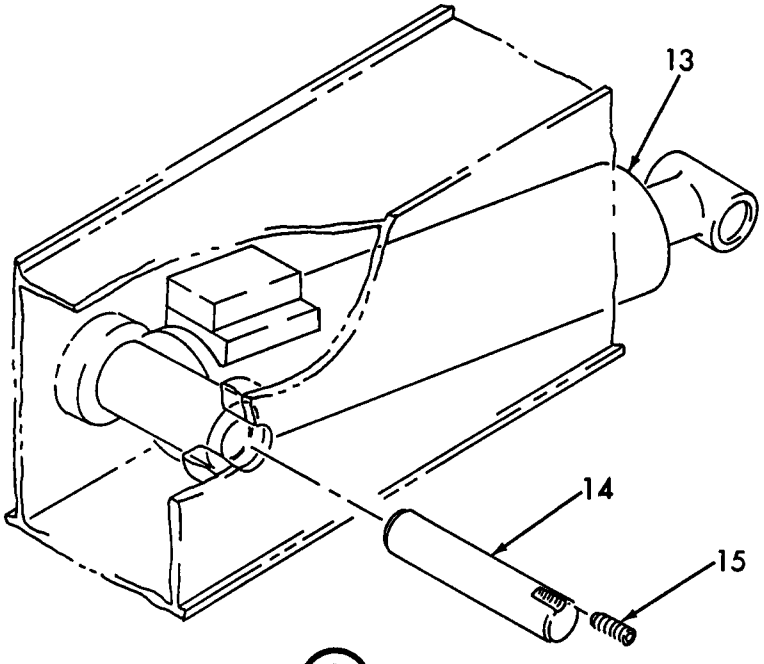


REV.

INNER BOOM SUB-ASSEMBLY (30 KBDF)



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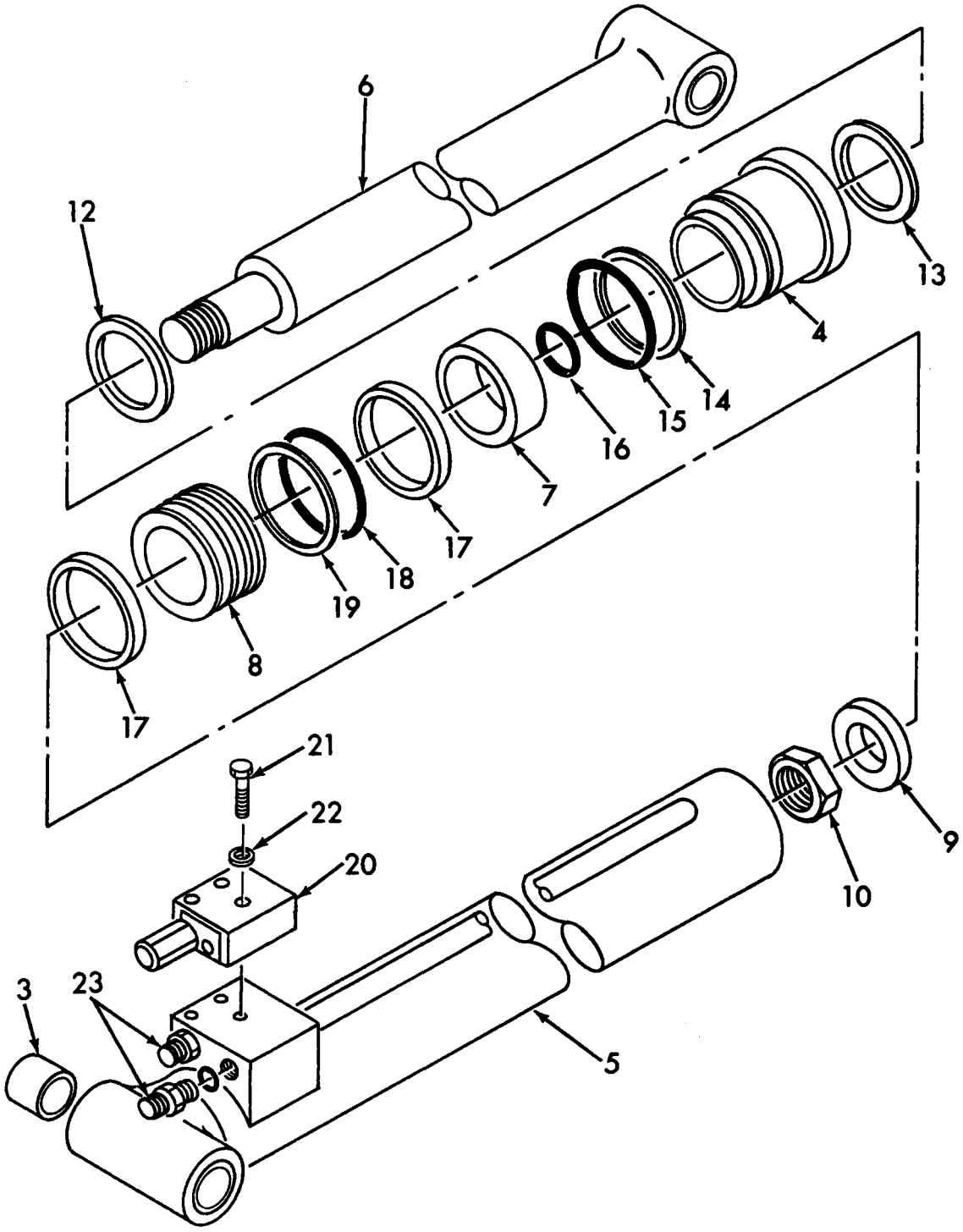
REV.

INNER BOOM SUB-ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140119	SUB-ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 1 for NHA)	REF
2	140095	.MACHINING, INNER BOOM	1
3	140170	.SUB-ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 3 for Details)	1
4	140414	.PAD, INNER BOOM TOP WEAR	1
5	61829	.SCREW, CAP	4
6	140413	.PAD, INNER BOOM SIDE WEAR	2
7	140412	.PAD, INNER BOOM BOTTOM WEAR	1
8	61832	.SCREW, CAP	4
9	63319	.WASHER, LOCK	4
10	61302	.NUT, HEX	4
11	140424	.PIN, ROD END EXTENSION CYLINDER	1
12	62234	.SCREW, SET	1
13	140058	.SUB-ASSEMBLY, SLAVE CYLINDER (See Sect. 5, Fig. 4 for Details)	1
14	140415	.PIN, CAP END SLAVE CYLINDER	1
15	62234	.SCREW, SET	1

- ITEM NOT ILLUSTRATED

EXTENSION CYLINDER SUB-ASSEMBLY (30 KBDF)

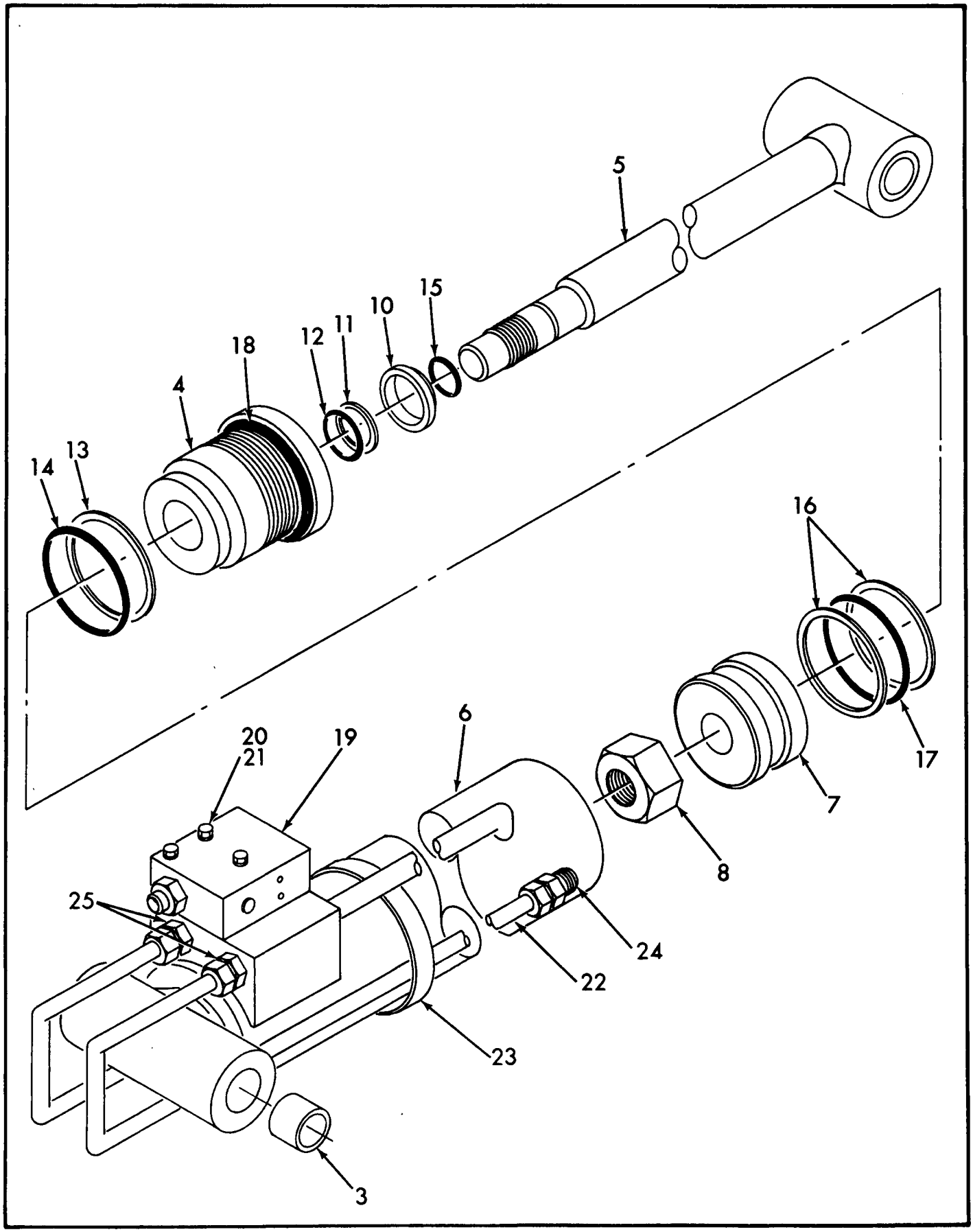


EXTENSION CYLINDER ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140170	ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 1 for NHA)	REF
-2	140093	.CYLINDER, EXTENSION (SE)	1
3	67180	..BUSHING	4
4	67206	..HEAD	1
5	67203	..ASSEMBLY, BARREL	1
6	67204	..ROD	1
7		..TUBE, STOP	1
8	67205	..PISTON	1
9		..SPACER	1
10		..NUT	1
-11	67128	..KIT, SEAL	1
12		...WIPER, ROD	1
13		...SEAL, ROD (POLYPAK)	1
14		...RING, HEAD B/U	1
15		...O-RING, HEAD	1
16		...O-RING	1
17		...RING, WEAR	2
18		...O-RING, PISTON	1
19		...RING, PISTON SLYD	1
20	81205	.VALVE, HOLDING	1
21	60319	.SCREW, CAP	3
22	63301	.WASHER, LOCK	3
23	80004-08	.CONNECTOR, STRAIGHT THREAD	2

- ITEM NOT ILLUSTRATED

SLAVE CYLINDER (30 KBDF)
(SINCE JUNE 1989)

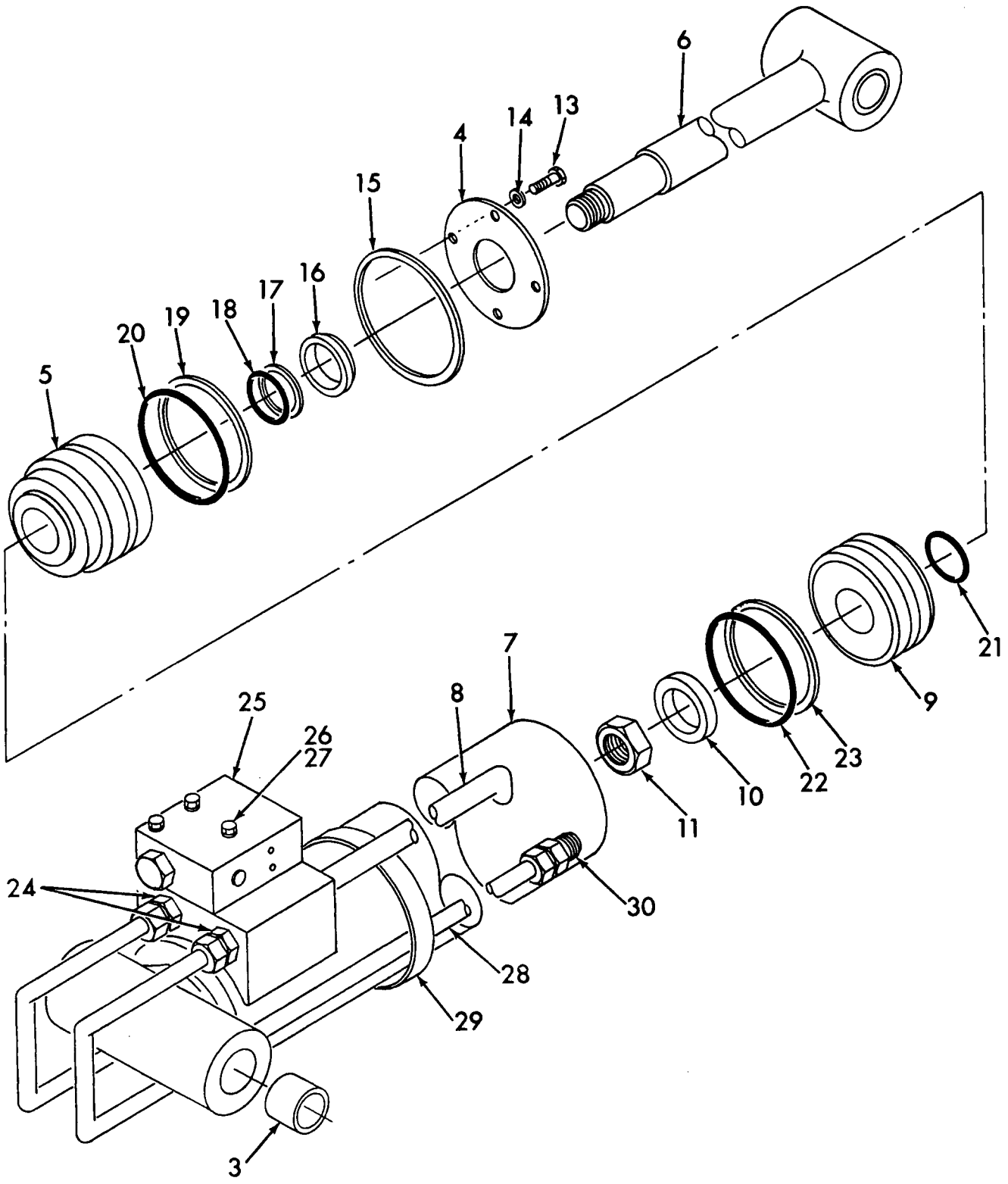


SLAVE CYLINDER ASSEMBLY (30 KBDF)
(SINCE JUNE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140946	ASSEMBLY, SLAVE CYLINDER (See Sect. 5, Fig. 1 for NHA)	REF
-2	140890	.CYLINDER, SLAVE (TH)	1
3	67999	..BUSHING	4
4	68000	..HEAD	1
5	68002	..ROD	1
6	68003	..ASSEMBLY, BARREL	1
7	68001	..PISTON	1
8	67998	..NUT	1
-9	67997	..KIT, SEAL	1
10		...WIPER, ROD	1
11		...RING, ROD B/U	1
12		...O-RING, ROD	1
13		...RING, HEAD B/U	1
14		...O-RING, HEAD	1
15		...O-RING	1
16		...RING, PISTON B/U	2
17		...O-RING, PISTON	1
18		...O-RING	1
19	81205	.VALVE, HOLDING	1
20	60319	.SCREW, HEX HEAD CAP	3
21	63301	.WASHER, LOCK	3
22	140058-6	.ASSEMBLY, TUBE	2
23	65111	.STRAP	1
24	80042-03	.CONNECTOR, UNION	2
25	80004-03	.CONNECTOR, STRAIGHT THREAD	2

- ITEM NOT ILLUSTRATED

SLAVE CYLINDER ASSEMBLY (30 KBDF)
(UNTIL JUNE 1989)



REV.

SLAVE CYLINDER ASSEMBLY (30 KBDF)
(UNTIL JUNE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140058	ASSEMBLY, SLAVE CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	140057	.CYLINDER, SLAVE	1
3	67191	..BUSHING	4
4		..PLATE, RETAINING	1
5	67190	..HEAD	1
6	67188	..ROD	1
7	67187	..BARREL	1
8		..LINE, FLUID	1
9	67189	..PISTON	1
10		..SPACER	1
11		..NUT	1
12	67130	..KIT, SEAL	1
13		...SCREW, ALLEN HEAD	4
14		...WASHER, LOCK	4
15		...RING, SNAP	1
16		...WIPER, ROD	1
17		...RING, BACK-UP	1
18		...O-RING	1
19		...RING, HEAD BACK-UP	2
20		...O-RING, HEAD	1
21		...O-RING	1
22		...O-RING, PISTON	1
23		...RING, PISTON BACK-UP	1
24	80004-03	.CONNECTOR, STRAIGHT THREAD	2
25	81205	.VALVE, HOLDING	1

- ITEM NOT ILLUSTRATED

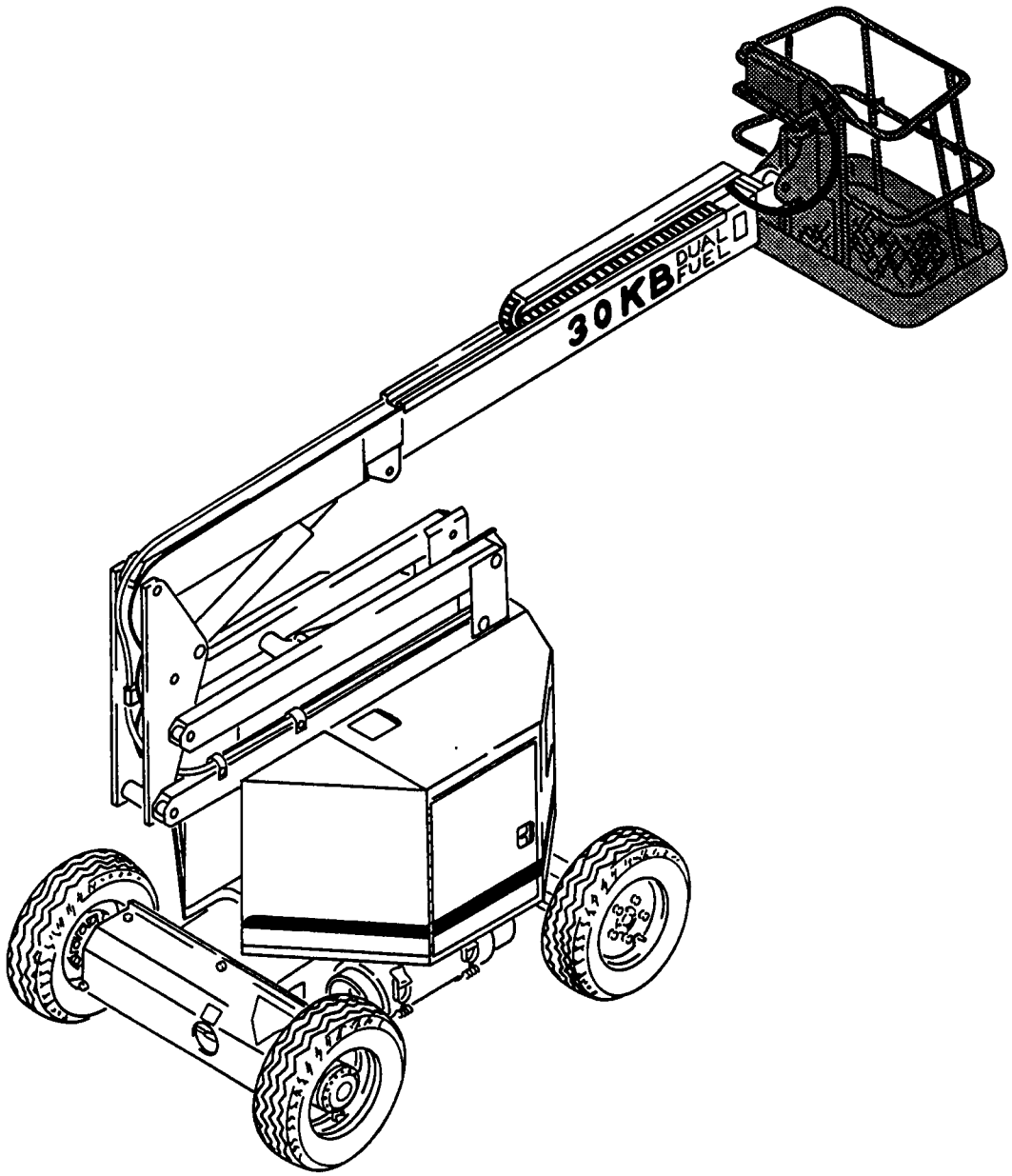
SLAVE CYLINDER ASSEMBLY (30 KBDF)
(UNTIL JUNE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	60319	.SCREW, CAP	3
27	63301	.WASHER, LOCK	3
28	140058-6	.ASSEMBLY, TUBE	2
29	65111	.STRAP	1
30	80042-03	.CONNECTOR, UNION	2

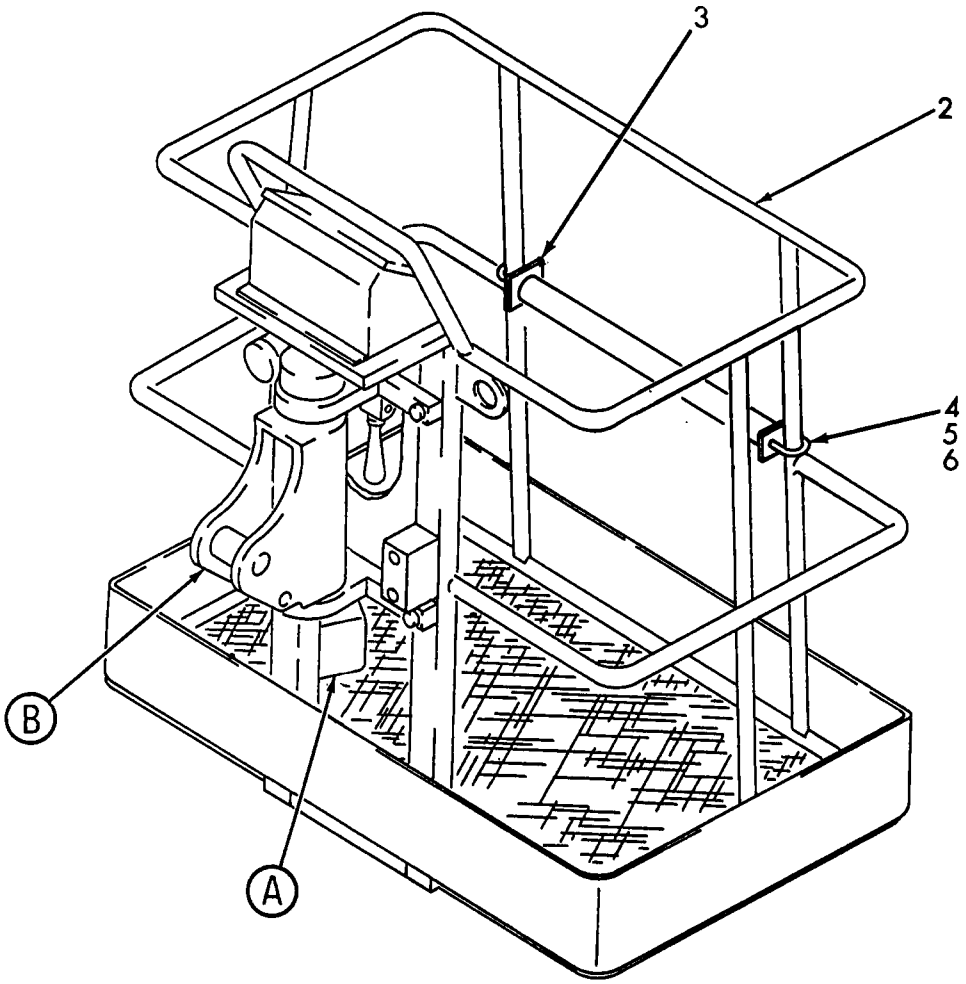
- ITEM NOT ILLUSTRATED

SECTION 6 CONTAINS:

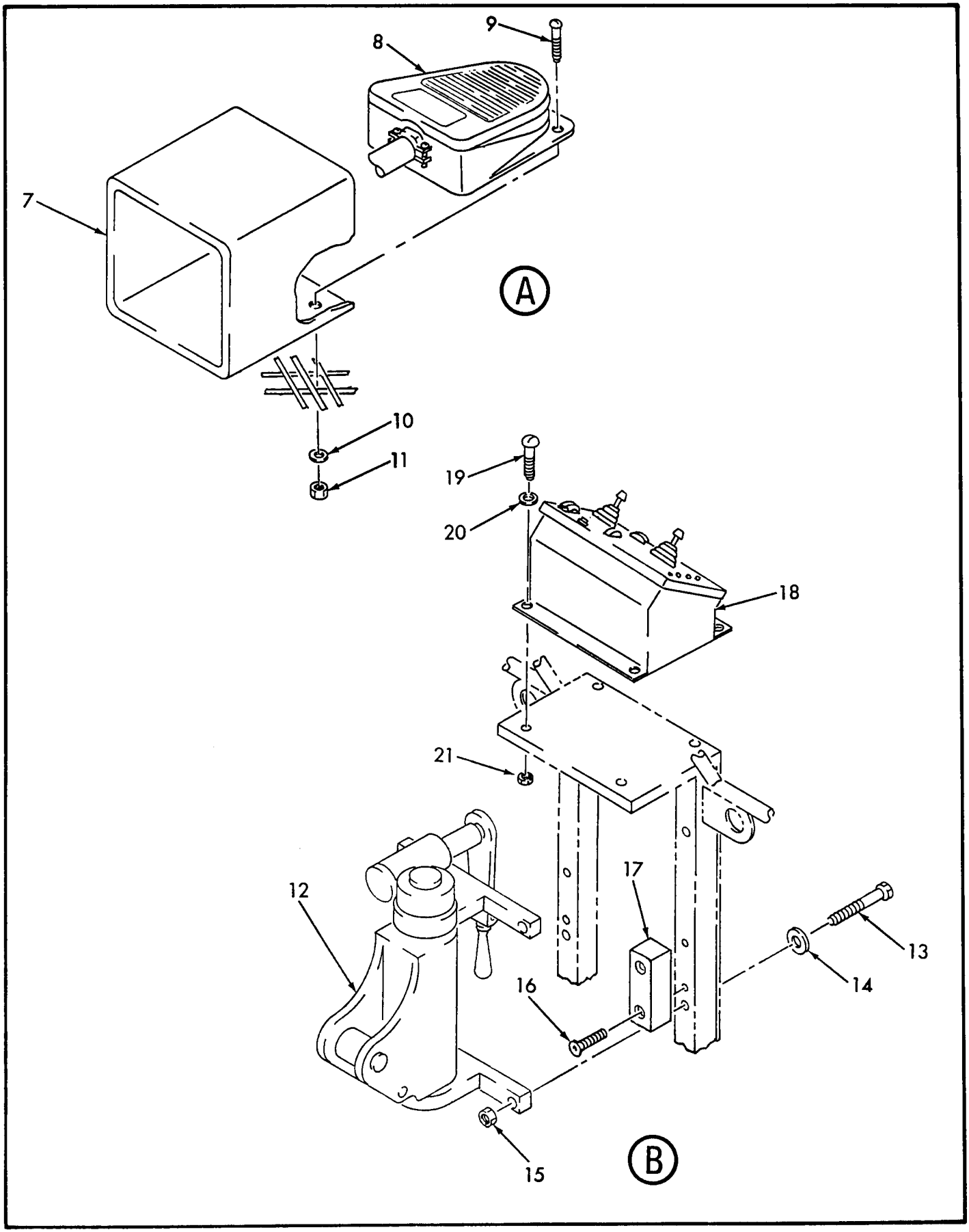
FIG. NO.	TITLE
1	PLATFORM ASSEMBLY (30 KBDF)
2	MANUAL ROTATOR (SENCE LATE 1989)
2A	MANUAL ROTATOR (UNTIL LATE 1989)
3	AERIAL CONTROL BOX ASSY. (SENCE APRIL 1989)
3A	AERIAL CONTROL BOX ASSY. (UNTIL APRIL 1989)



PLATFORM ASSEMBLY (30 KBDF)



PLATFORM ASSEMBLY (30 KBDF)

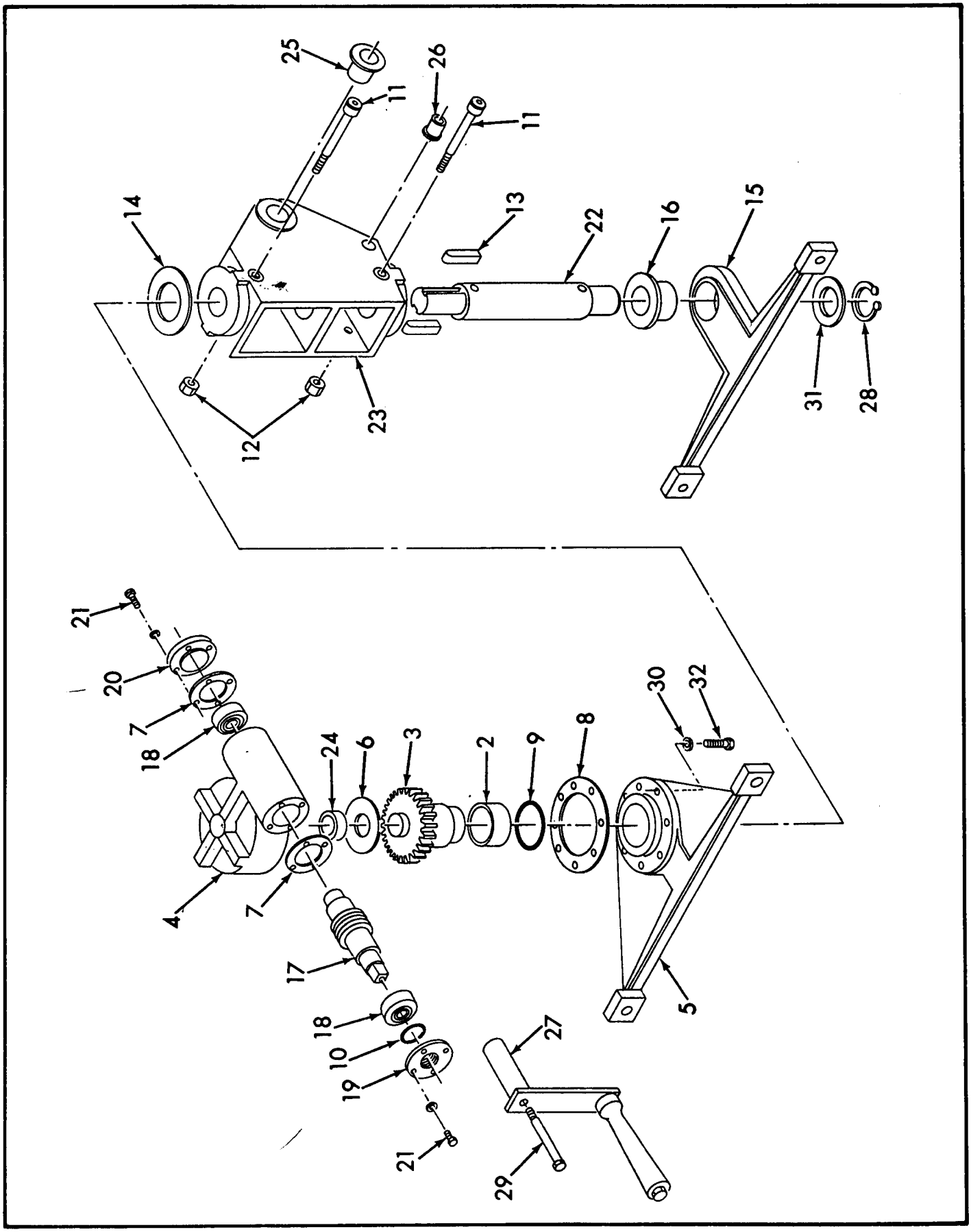


PLATFORM ASSEMBLY (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140647	ASSEMBLY, PLATFORM (See Sect. 2, Fig. 1 for NHA)	REF
2	140645	.WELDMENT, PLATFORM	1
3	141080	.WELDMENT, SLIDE BAR	1
4	61318	.NUT, LOCK	1
5	60703	.NUT, HEX	1
6	160017	.U-BOLT	1
7	23846	.COVER, FOOT SWITCH	1
8	92202	.SWITCH, FOOT	1
9	62714	.SCREW, MACHINE	2
10	63413	.WASHER, FLAT	2
11	61241	.NUT, LOCK	2
12	140684	.ROTATOR (See Sect. 6, Fig. 2 or 2A for Details)	1
13	60523	.SCREW, CAP	4
14	63415	.WASHER, FLAT	4
15	61242	.NUT, LOCK	4
16	61832	.SCREW, CAP	4
17	140473	.BUMPER	2
18	140751	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 6, Fig. 3 for Details)	1
19	62607	.SCREW, MACHINE	4
20	63413	.WASHER, FLAT	4
21	61241	.NUT, LOCK	4

- ITEM NOT ILLUSTRATED

MANUAL ROTATOR (30 KBDF)
(USED SINCE LATE 1989)



REV.

MANUAL ROTATOR (30 KBDF)
(USED SINCE LATE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	24919	MANUAL ROTATOR	REF
2	68030	.BUSHING	1
3		.BULL GEAR	1
4	68032	.GEAR HOUSING	1
5	68034	.TOP ARM	1
6	68037	.THRUST WASHER	1
7	68038	.END CAP GASKET	1
8	68039	.GEAR BOX GASKET	1
9	68040	.O-RING	1
10	68041	.O-RING	1
11		.BOLT	2
12		.NUT	2
13		.KEY	2
14	68042	.THRUST WASHER	1
15		.BOTTOM ARM	1
16	68045	.FLANGED BUSHING	1
17		.WORM GEAR	1
18	68046	.ROLLER BEARING	2
19		.THRU SHAFT END CAP	1
20	68047	.END CAP	1
21		.BOLT	8
22		.MAIN PIN	1
23		.YOKE	1
24	68049	.BUSHING	1
25	68050	.FLANGED BUSHING	2
26	68051	.SLEEVE BUSHING	2

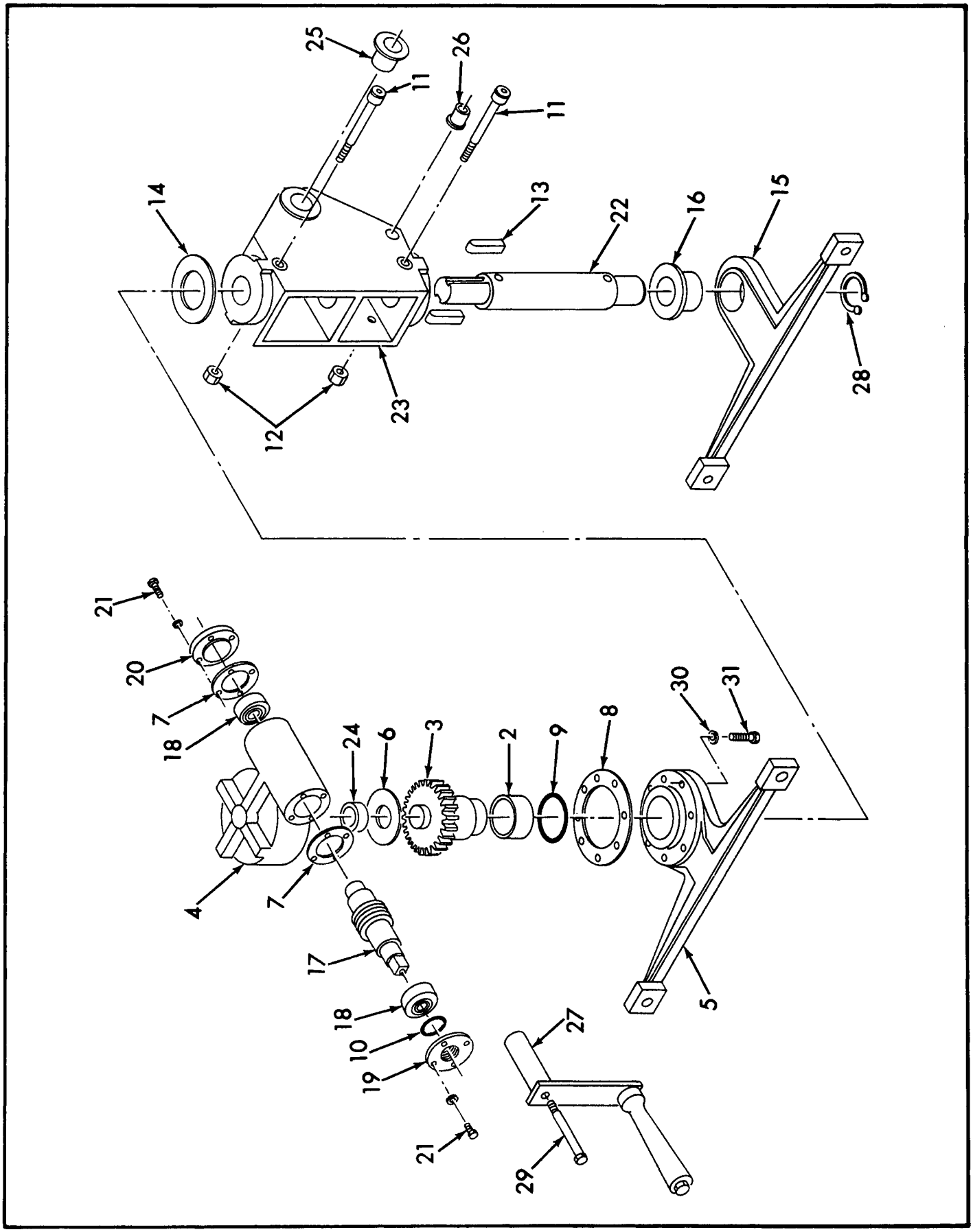
- ITEM NOT ILLUSTRATED

MANUAL ROTATOR (30 KBDF)
(USED SINCE LATE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	68052	.HAND CRANK	1
28	68054	.SNAP RING	1
29		.BOLT	1
30		.LOCK WASHER	8
31		.FLAT WASHER	1
32		.BOLT	8

- ITEM NOT ILLUSTRATED

MANUAL ROTATOR (30 KBDF)
(USED UNTIL LATE 1989)



MANUAL ROTATOR (30 KBDF)
(USED UNTIL LATE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140684	MANUAL ROTATOR	REF
2	68030	.BUSHING	1
3		.BULL GEAR	1
4	68032	.GEAR HOUSING	1
5	68035	.TOP ARM	1
6	68037	.THRUST WASHER	1
7	68038	.END CAP GASKET	2
8	68039	.GEARBOX GASKET	1
9	68040	.O-RING	1
10	68041	.O-RING	1
11		.BOLT	2
12		.NUT	2
13		.KEY	2
14	68043	.THRUST WASHER	1
15		.BOTTOM ARM	1
16	68045	.FLANGED BUSHING	1
17		.WORM GEAR	1
18	68046	.ROLLER BEARING	2
19		.THRU SHAFT END CAP	1
20	68047	.END CAP	1
21		.BOLT	8
22		.MAIN PIN	1
23		.YOKE	1
24	68049	.BUSHING	1
25	68050	.FLANGED BUSHING	2
26	68051	.SLEEVE BUSHING	2

- ITEM NOT ILLUSTRATED

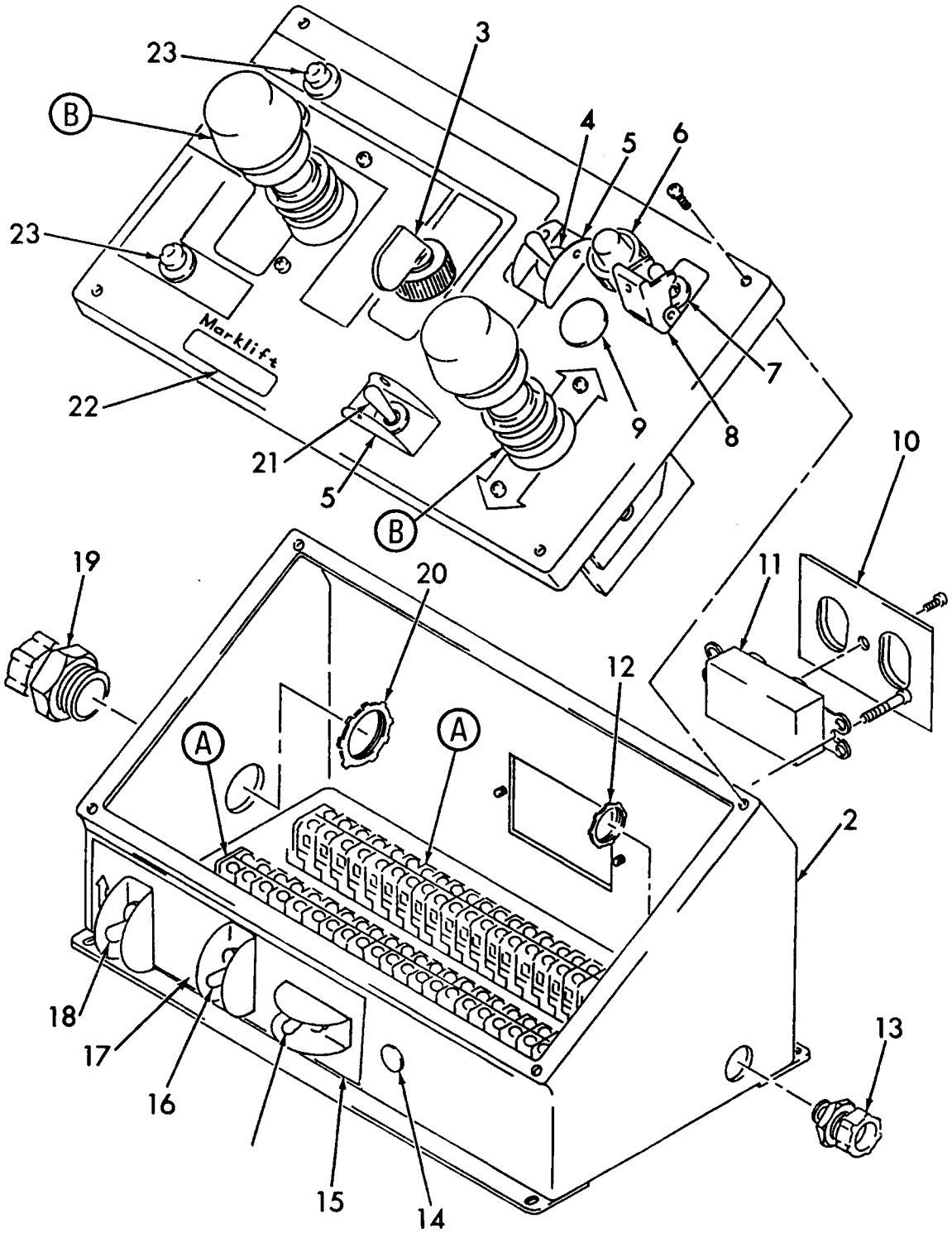
MANUAL ROTATOR (30 KBDF)
(USED UNTIL LATE 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	68052	.HAND CRANK	1
28	68054	.SNAP RING	1
29		.BOLT	1
30		.LOCK WASHER	8
31		.BOLT	8

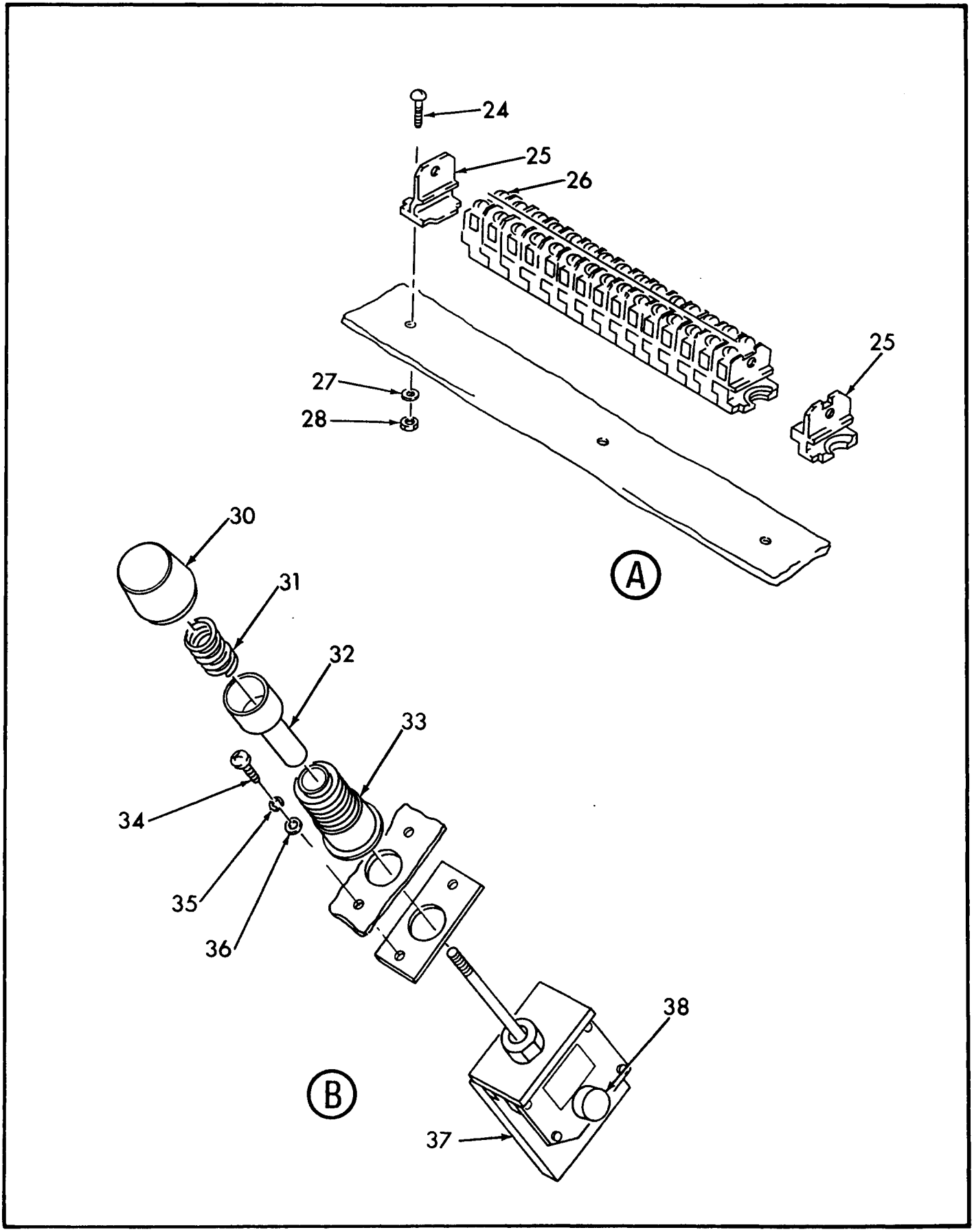
REV.

- ITEM NOT ILLUSTRATED

AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(SINCE APRIL 1989)

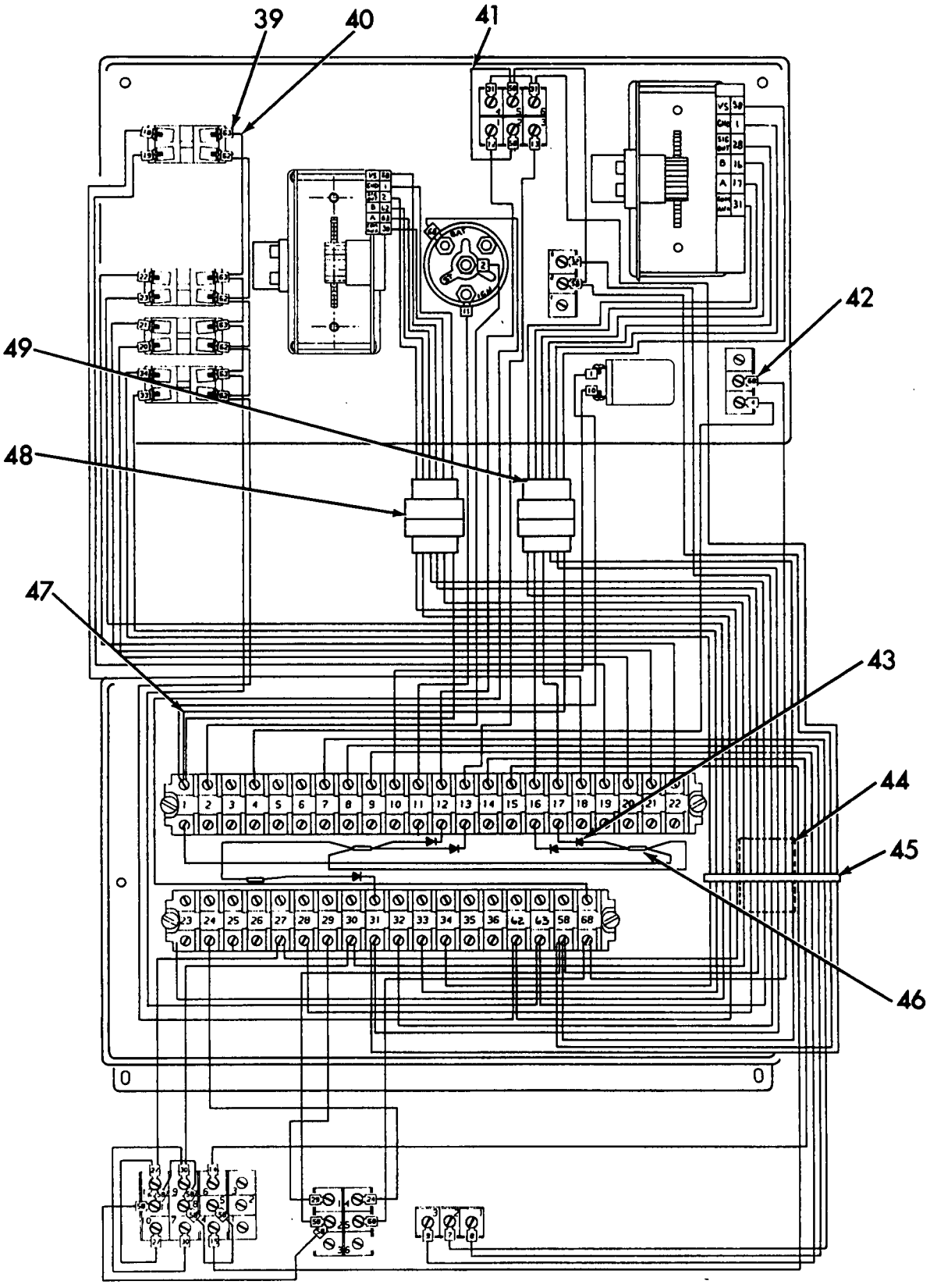


AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(SINCE APRIL 1989)



REV.

AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(SINCE APRIL 1989)



REV.

AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(SINCE APRIL 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	141107	ASSEMBLY, AERIAL CONTROL BOX WITH ANTI-RESTART SWITCH (See Sect. 6, Fig. 1 for NHA)	REF
2	141108	.MACHINING, AERIAL CONTROL BOX	1
3	70467	.SWITCH, IGNITION	1
4	4017	.SWITCH, TOGGLE	1
5	20884	.GUARD, SWITCH	5
6	20805	.ALARM, BUZZER	1
7	70467	.SWITCH, TOGGLE	1
8	70303	.GUARD, SWITCH	1
9	772	.PLUG	1
10	70392	.COVER, RECEPTICAL	1
11	70391	.RECEPTICAL, G.F.C.I.	1
12	2808	.NUT, LOCK	1
13	2806	.RELIEF, STRAIN	1
14	771	.PLUG	1
15	4019	.SWITCH	1
16	70304	.SWITCH, TOGGLE	1
17	182705	.DECAL, AERIAL CONTROL SWITCH	1
18	70383	.SWITCH, LEVELING	1
19	16215	.RELIEF, STRAIN	1
20	16105	.NUT, LOCK	1
21	20481	.SWITCH, TOGGLE	1
22	182729	.DECAL, UPPER CONTROL	1
23	70417	.SWITCH, TOGGLE	4
24	62612	.SCREW, CAP	6
25	117-A	.BLOCK, TERMINAL END	2

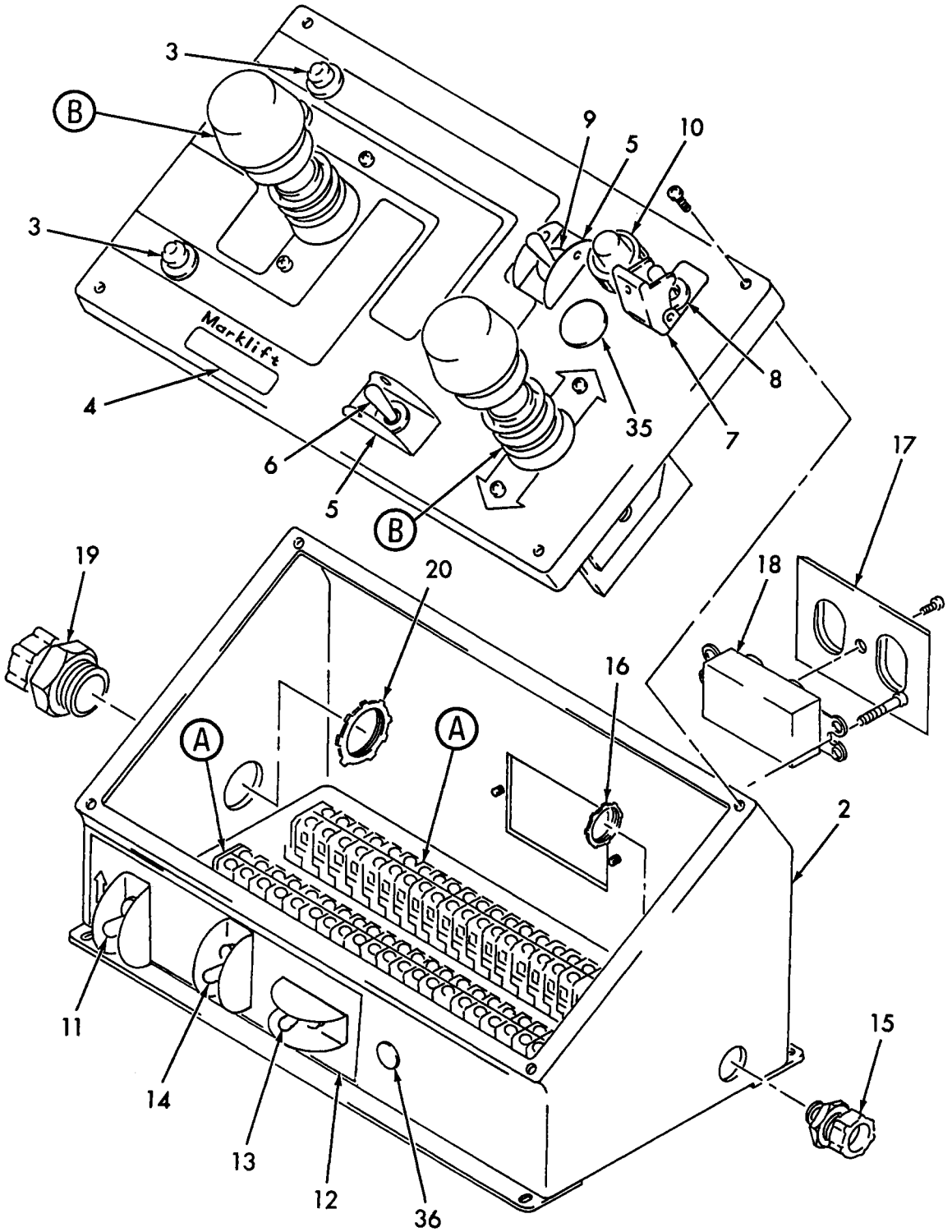
- ITEM NOT ILLUSTRATED

AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(SINCE APRIL 1989)

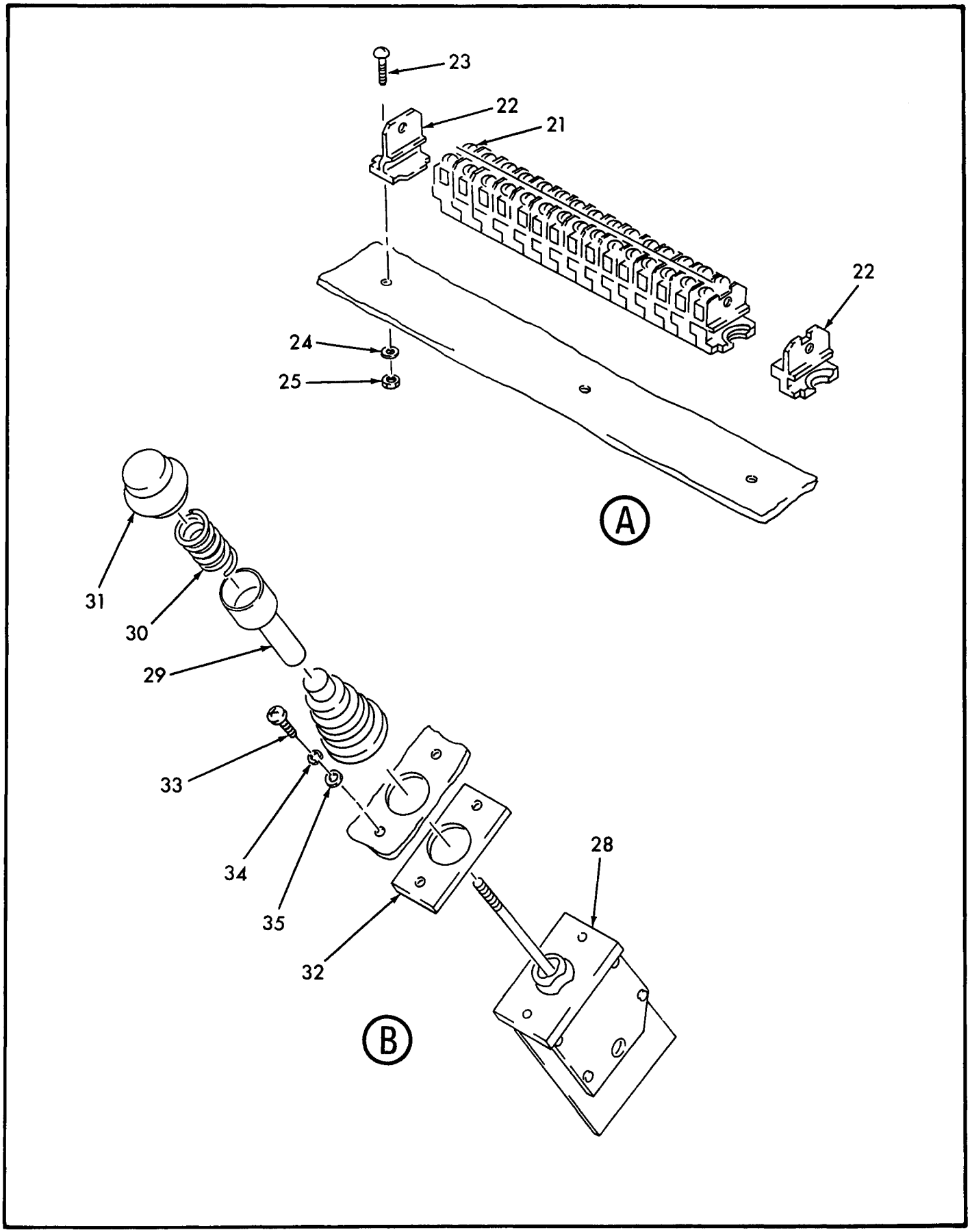
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	4027	.BLOCK, TERMINAL	40
27	63312	.WASHER, LOCK	6
28	61502	.SCREW, CAP	6
-29	70488	.CONTROLLER	2
30	600010	..KNOB, UPPER	1
31	600009	..SPRING, UPPER	1
32	600007	..ASSEMBLY, SLIDE LOCK & BOOT	1
33	600008	...BOOT	1
34	62703	..SCREW, CAP	2
35	63313	..WASHER, LOCK	2
36	63413	..WASHER, FLAT	2
37	27812	..BOARD, ENCAPSULATED CONTROLLER	1
38	600006	..POTENTIOMETER WITH WIRES	1
39	16213	.CONNECTOR	8
40	2990	.WIRE (WHITE 18 AWG STRANDED)	90
41	2991	.WIRE (WHITE CU12 19 STD)	10
42	117-C	.CONNECTOR, RING	41
43	70479	.DIODE	6
44	16241	.MOUNT	5
45	256	.TIE, CABLE	37
46	70162	.BUTT, TERMINAL	4
47	70098	.WIRE (YELLOW W/GREEN STRIPE 12 GAL 19CU)	5
48	141144	.ASSEMBLY, BOOM FUNCTION WIRE HARNESS	1
49	141162	.ASSEMBLY, DRIVE WIRE HARNESS	1
-50	117-D	.CONNECTOR, BUTT	2
-51	70394	.CONNECTOR, TWIST-ON WIRE	2

- ITEM NOT ILLUSTRATED

AERIAL CONTROL BOX ASSEMBLY (30 KBDF) (UNTIL APRIL 1989)

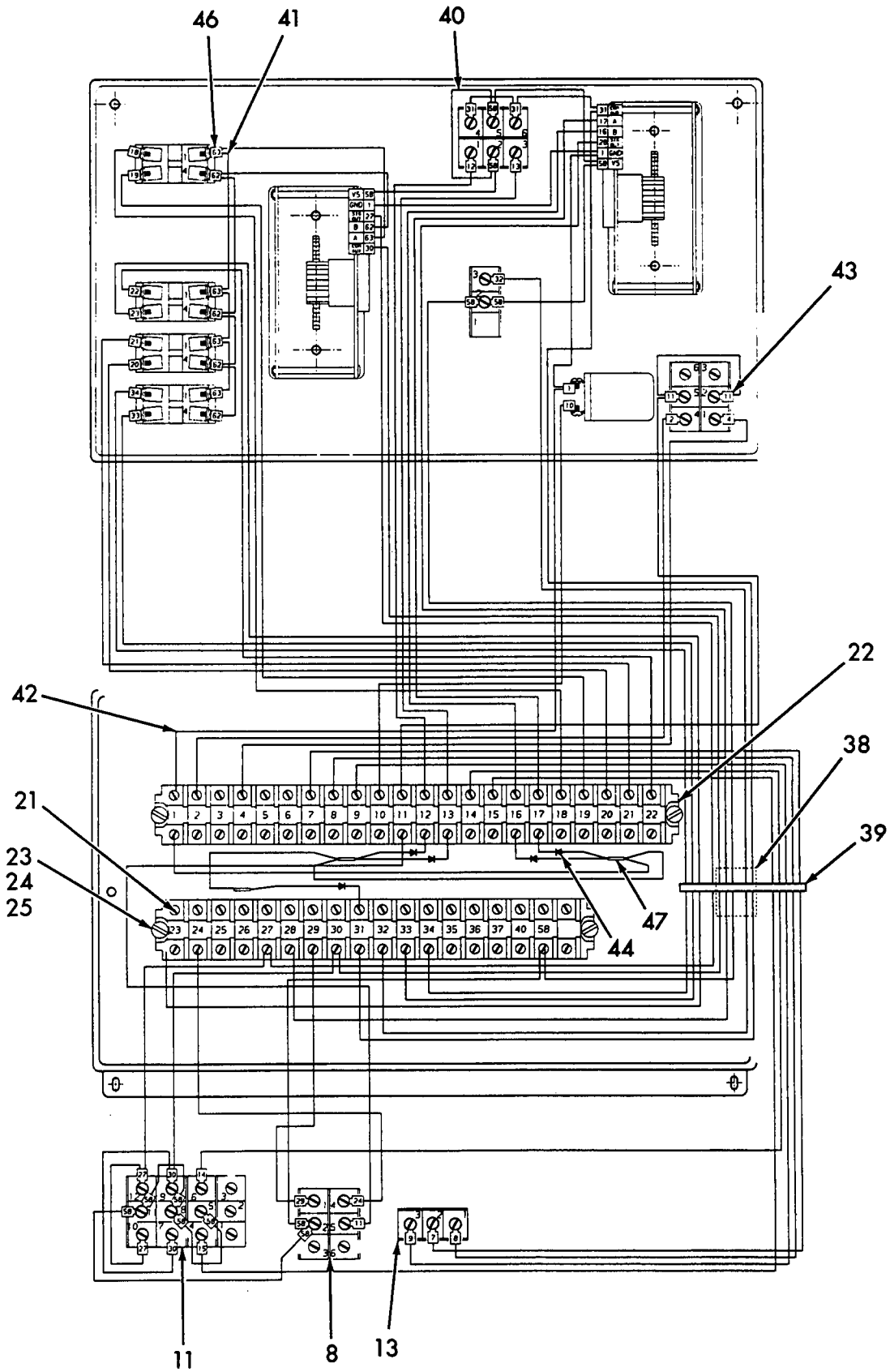


AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(UNTIL APRIL 1989)



REV.

AERIAL CONTROL BOX ASSEMBLY (30 KBDF) (UNTIL APRIL 1989)



AERIAL CONTROL BOX ASSEMBLY (30 KBDF) (UNTIL APRIL 1989)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140751	ASSEMBLY, AERIAL CONTROL BOX	REF
2	140315	.MACHINING, AERIAL CONTROL BOX	1
3	70417	.SWITCH, TOGGLE	4
4	140374	.DECAL, UPPER CONTROL	1
5	20884	.GUARD, SWITCH	5
6	20481	.SWITCH, TOGGLE	1
7	70303	.SWITCH, GUARD	1
8	70304	.SWITCH, TOGGLE	1
9	4017	.SWITCH, TOGGLE	2
10	20805	.ALARM, BUZZER	1
11	70383	.SWITCH, LEVELING	1
12	182705	.DECAL, AERIAL CONTROL SWITCH	1
13	4019	.SWITCH	1
14	70304	.SWITCH, TOGGLE	1
15	2806	.RELIEF, STRAIN	1
16	2808	.NUT, LOCK	1
17	70392	.COVER, RECEPTACLE	1
18	70391	.RECEPTACLE, G.F.C.I.	1
19	16215	.RELIEF, STRAIN	1
20	16105	.NUT, LOCK	1
21	4027	.BLOCK, TERMINAL	40
22	117-A	.BLOCK, TERMINAL END	2
23	62612	.SCREW, CAP	6
24	63312	.WASHER, LOCK	6
25	61502	.NUT, HEX	6
-26	70488	.CONTROLLER	2

- ITEM NOT ILLUSTRATED

AERIAL CONTROL BOX ASSEMBLY (30 KBDF)
(UNTIL APRIL 1989)

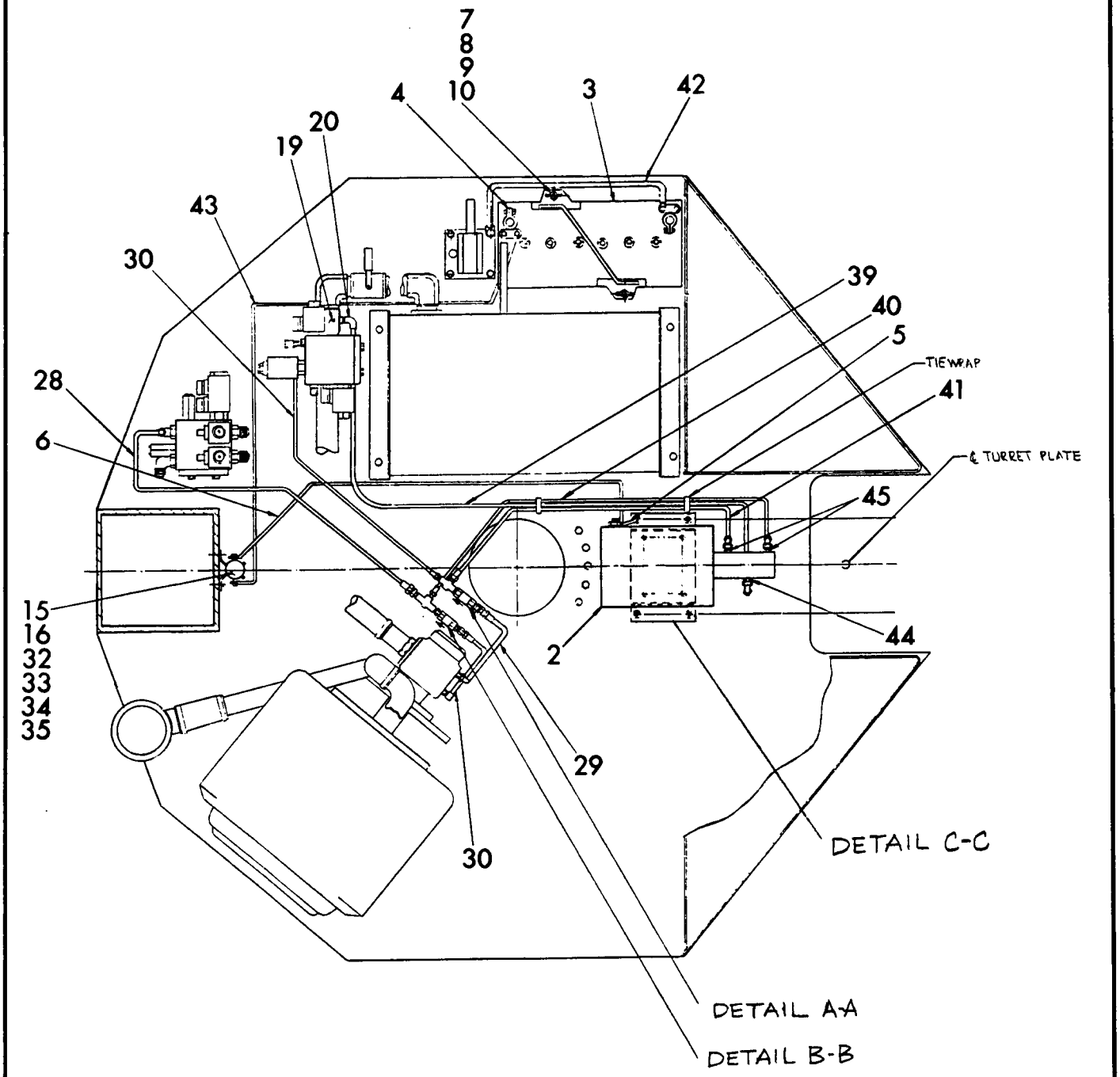
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	67386	..ASSEMBLY, ELECTRICAL	1
-28	67385	..ASSEMBLY, HOUSING & HANDLE	1
29	67371	..ASSEMBLY, SLIDE LOCK	1
30	67372	..SPRING, COMPRESSION	1
31	67373	..KNOB, UPPER (TAPPED)	1
32	67374	..GASKET	1
33	62703	..SCREW, CAP	4
34	63313	..WASHER, LOCK	4
35	63413	..WASHER, FLAT	4
36	771	.PLUG	1
37	772	.PLUG	1
38	16214	.MOUNT	5
39	256	.TIE, CABLE	37
40	2991	.WIRE	10
41	2990	.WIRE	90
42	70098	.WIRE	5
43	117-C	.CONNECTOR, RING	41
44	4045	.DIODE	5
-45	70394	.CONNECTOR, TWIST-ON WIRE	2
46	16213	.CONNECTOR	8
47	70162	.BUTT, TERMINAL	4

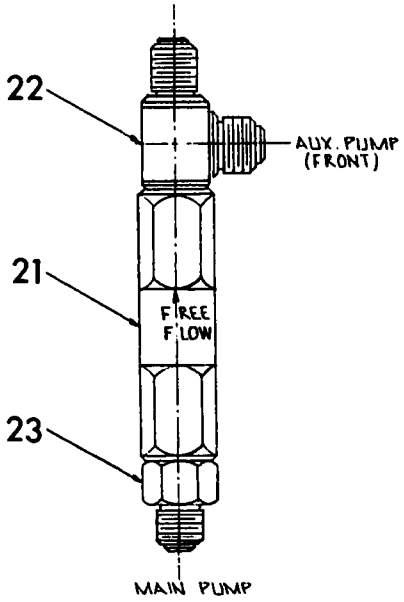
- ITEM NOT ILLUSTRATED

SECTION 7 CONTAINS:

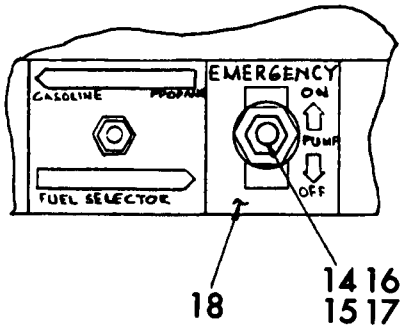
FIG. NO.	TITLE
1	ALL FUNCTION AUXILLARY POWER (30 KBDF)
2	2 HEAD LIGHTS & 2 REAR RED LIGHTS (30 KBDF)
3	SPARK ARRESTOR MUFFLER (30 KBDF)
4	LIFTING LUG (30 KBDF)
5	PLATFORM POWERED ROTATOR (30 KBDF)
6	2000W GENERATOR (30 KBDF)
7	12 VOLT PLATFORM WORK LIGHT (30 KBDF)
8	ROTATING AMBER BEACON (30 KBDF)
9	ALL MOTION ALARM (30 KBDF)
10	HOURMETER (30 KBDF)
11	½" HYDRAULIC LINE TO PLATFORM (30 KBDF)
12	½" AIR LINE TO PLATFORM (30 KBDF)
13	ADDITIONAL LP TANK (30 KBDF)
14	TRAVEL WARNING HORN (30 KBDF)
15	LIGHTS (30 KBDF)

ALL FUNCTION AUXILLARY POWER (30 KBDF)

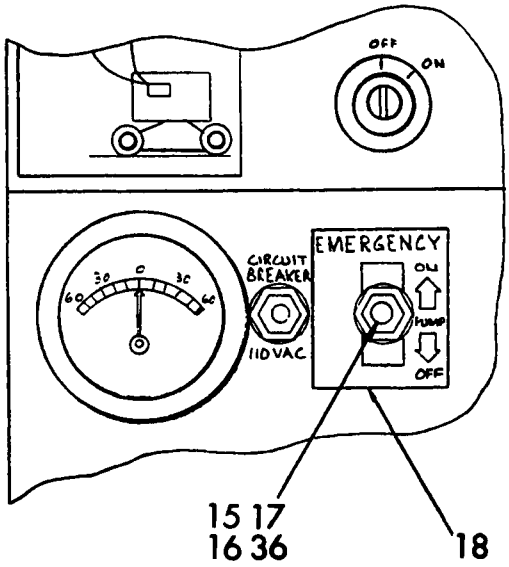




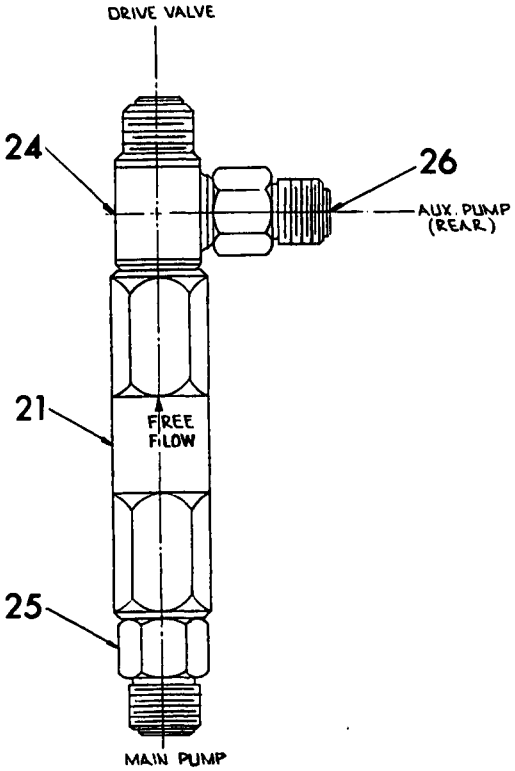
DETAIL A-A
(BOOM FUNCTION)



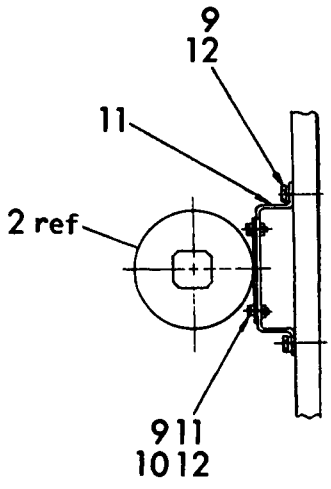
ASS'Y AERIAL CONTROL BOX



ASS'Y LOWER CONTROL PANEL



DETAIL B-B



DETAIL C-C

REV.

ALL FUNCTION AUXILLARY POWER (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140676	POWER, ALL FUNCTION AUXILLARY	REF
2	21229	.PUMP, EMERGENCY	1
3	70458	.BATTERY	1
4	160116	.BATTERY, TERMINAL	2
5	13226-0130	.ASSEMBLY, ELECTRICAL CABLE	1
6	13226-0550	.ASSEMBLY, ELECTRICAL CABLE	1
7	160125	.ROD, THREADED	2
8	61615	.NUT, WING	2
9	63302	.WASHER, LOCK	10
10	63402	.WASHER, FLAT	6
11	140861	.SUPPORT, EMERGENCY PUMP	1
12	60338	.SCREW, CAP	8
13	60702	.NUT, HEX	4
14	70037	.SWITCH, TOGGLE	1
15	2990	.WIRE	20 FT.
16	117-C	.RING, CONNECTOR	12
17	70303	.GUARD, SWITCH	2
18	182702	.DECAL, EMERGENCY PUMP	2
19	140856	.WELDMENT, SUCTION	1
20	80008-12	.ELBOW, MALE	1
21	81189	.VALVE, CHECK	2
22	80037-14	.TEE, MALE RUN	1
23	80001-14	.CONNECTOR, MALE	1
24	80037-16	.TEE, MALE RUN	1
25	80001-16	.CONNECTOR, MALE	1
26	80056-06	.REDUCER, TUBE END	1

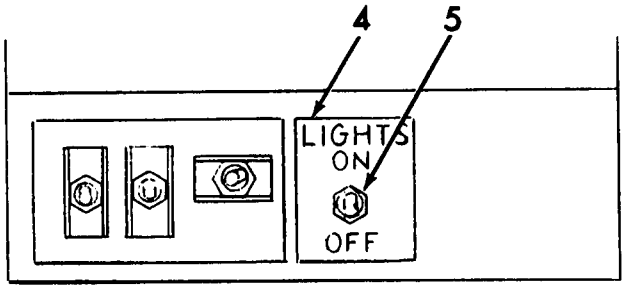
- ITEM NOT ILLUSTRATED

ALL FUNCTION AUXILLARY POWER (30 KBDF)

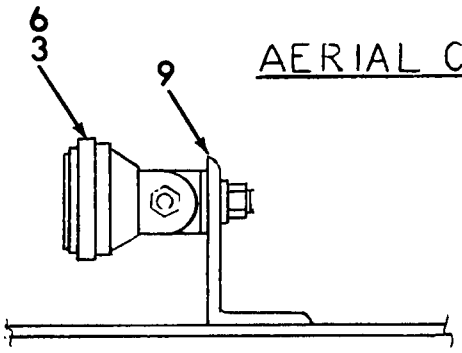
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	13212-10-0110	.ASSEMBLY, HOSE	1
28	13210-10-0400	.ASSEMBLY, HOSE	1
29	13213-08-0104	.ASSEMBLY, HOSE	1
30	13210-08-0380	.ASSEMBLY, HOSE	1
31	13213-08-065	.ASSEMBLY, HOSE	1
32	70209	.SOLENOID	1
33	60342	.SCREW, CAP	2
34	63401	.WASHER, FLAT	2
35	63301	.WASHER, LOCK	2
36	20482	.SWITCH, SELECTOR	2
37	2991	.WIRE	10 FT.
38	70008	.WIRE	10 FT.
39	13213-08-0620	.ASSEMBLY, HOSE	1
40	13213-08-0420	.ASSEMBLY, HOSE	1
41	13213-08-0300	.ASSEMBLY, HOSE	1
42	13226-0350	.ASSEMBLY, ELECTRICAL CABLE	1
43	13226-0720	.ASSEMBLY, ELECTRICAL CABLE	1
44	80001-15	.CONNECTOR, MALE	1
45	80004-12	.CONNECTOR, STRAIGHT THREAD	2

- ITEM NOT ILLUSTRATED

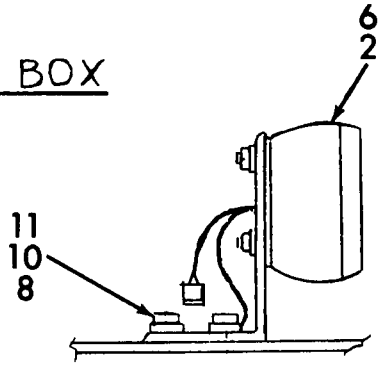
2 HEAD LIGHTS & 2 REAR RED LIGHTS (30 KBDF)



AERIAL CONTROL BOX



HEADLIGHT ASSY

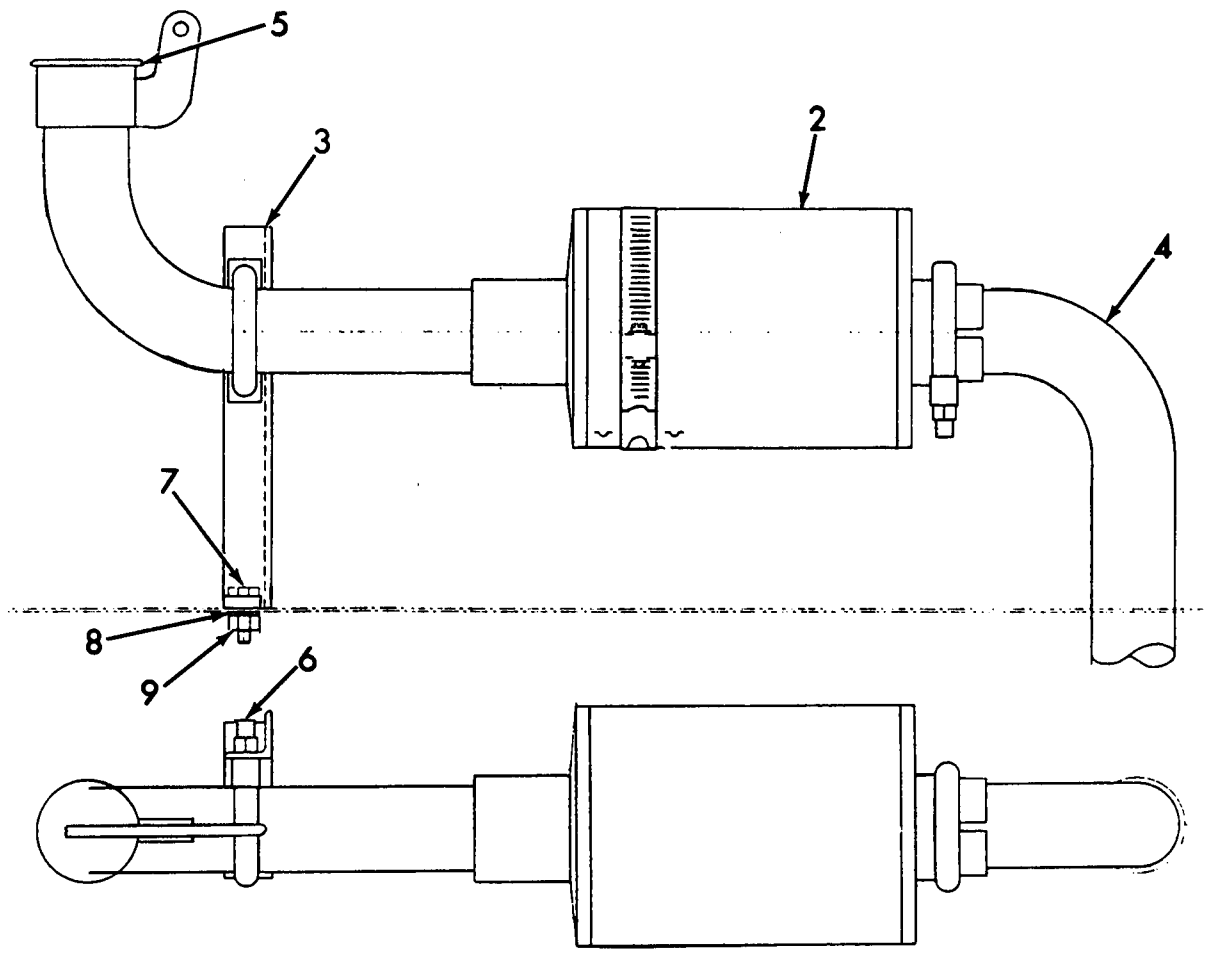


TAILLIGHT ASSY

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140662	2 HEAD LIGHTS & 2 REAR RED LIGHTS	REF
2	20972	.LIGHT, TAIL	2
3	20971	.LIGHT, HEAD	2
4	20509	.DECAL, LIGHTS	1
5	4017	.SWITCH, TOGGLE	1
6	70068	.CONNECTOR, BUTT	4
7	2991	.WIRE, WHITE (20 FT.)	1
8	140894	.BRACKET, TAIL LIGHT	2
9	140895	.BRACKET, HEAD LIGHT	2
10	60309	.SCREW, CAP	4
11	63301	.WASHER, LOCK	4

REV.

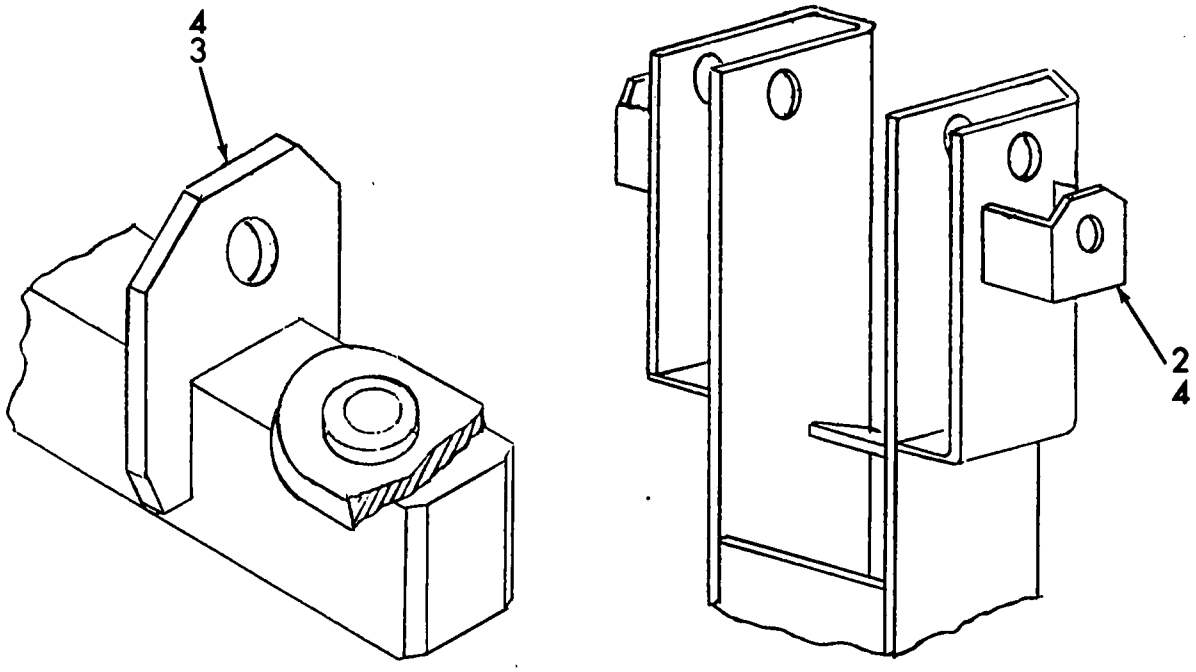
SPARK ARRESTOR MUFFLER (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140666	SPARK ARRESTOR MUFFLER	REF
2	140810	.WELDMENT, SPARK ARRESTOR	1
3	140812	.WELDMENT, BRACKET MUFFLER	1
4	140817	.WELDMENT, EXHAUST TUBE	1
5	21288	.CAP, MUFFLER RAIN	1
6	16230	.CLAMP, MUFFLER	1
7	60312	.SCREW, CAP	2
8	63301	.WASHER, LOCK	2
9	60701	.NUT, HEX	2

REV.

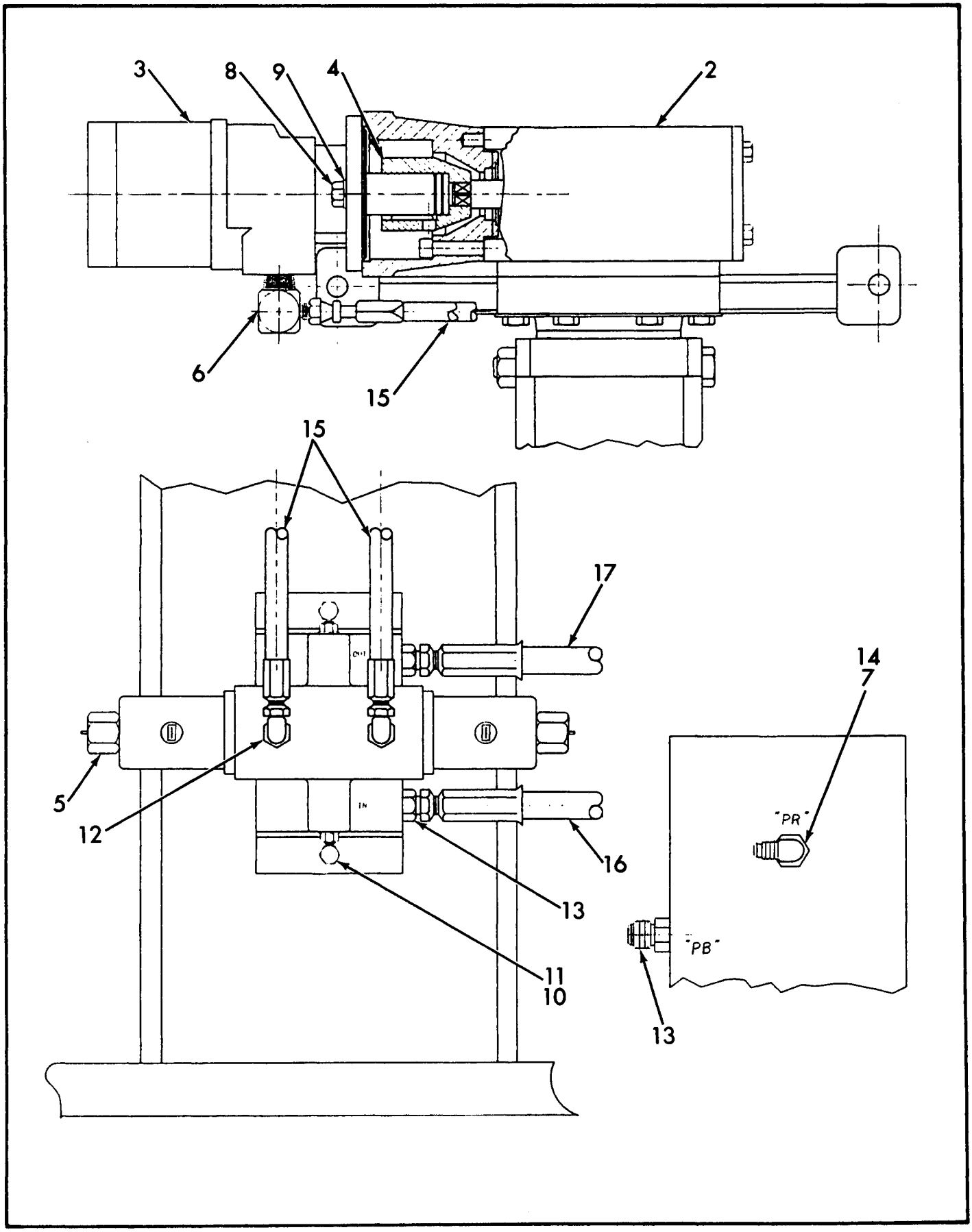
LIFTING LUG (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140907	LIFTING LUGS (30 KBDF)	REF
2	140644	.WELDMENT, LIFTING LUGS	2
3	21759	.LUG, LIFTING	2
4	181501	.DECAL	4

REV.

PLATFORM POWERED ROTATOR (30 KBDF)

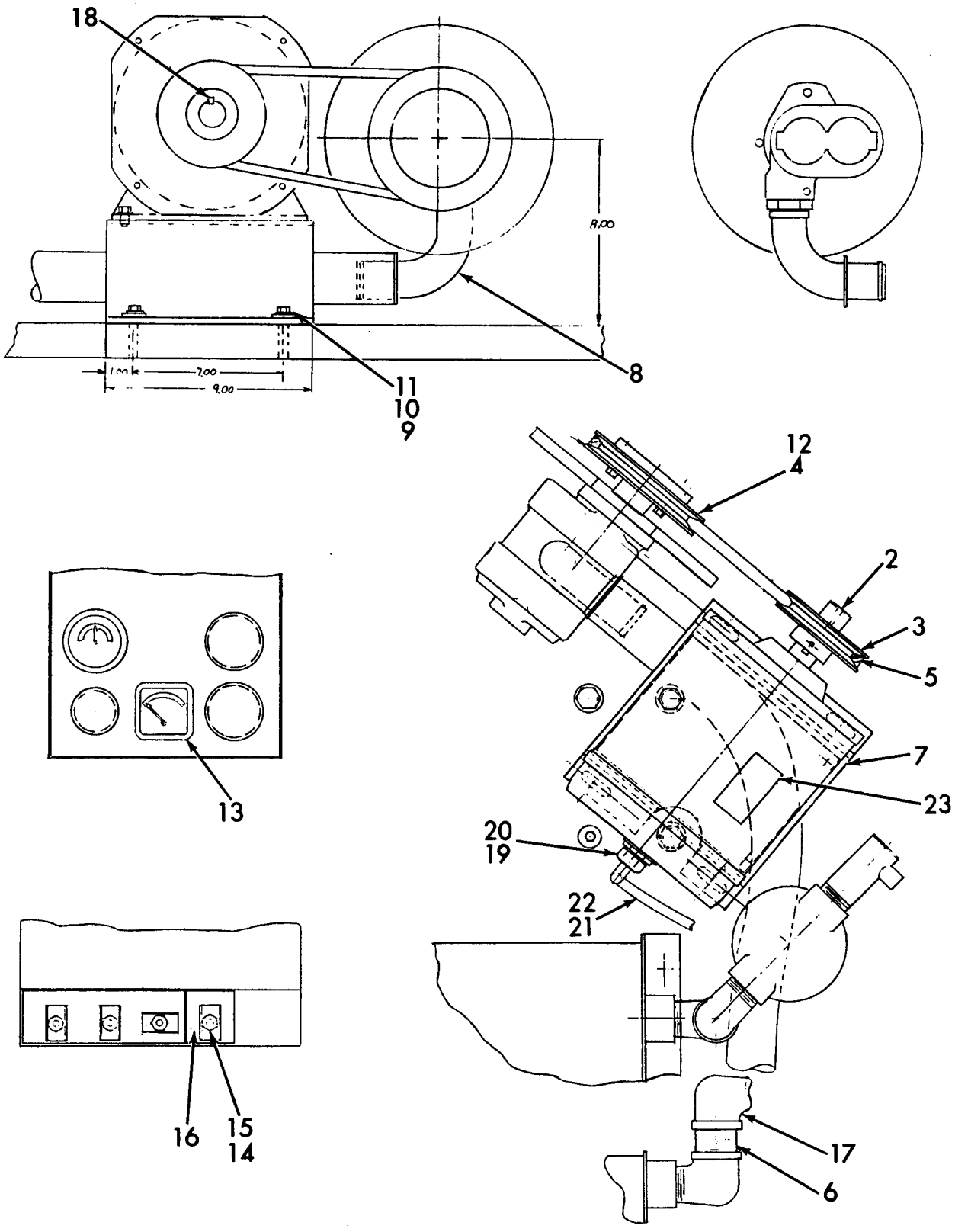


PLATFORM POWERED ROTATOR (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140022	PLATFORM POWERED ROTATOR	REF
2	141136	.SUB-ASSEMBLY, HYDRAULIC POWERED ROTATOR	1
3	81274	.MOTOR, HYDRAULIC	1
4	140819	.COUPLING, SHAFT	1
5	81239	.VALVE, WITH CROSSOVER RELIEF	1
6	80008-05	.ELBOW, MALE	2
7	80048-02	.PLUG, HOLLOW HEX	2
8	60308	.SCREW, CAP HEX HEAD	2
9	63305	.WASHER, LOCK	2
10	60352	.SCREW, CAP	2
11	62319	.WASHER, LOCK	2
12	80012-05	.ELBOW, STRAIGHT THREAD	2
13	80004-08	.CONNECTOR, STRAIGHT THREAD	3
14	80012-08	.ELBOW, STRAIGHT THREAD	1
15	13232-04-6000	.ASSEMBLY, HOSE	2
16	13213-06-0250	.ASSEMBLY, HOSE	1
17	13213-06-0200	.ASSEMBLY, HOSE	1

- ITEM NOT ILLUSTRATED

2000W GENERATOR (30 KBDF)

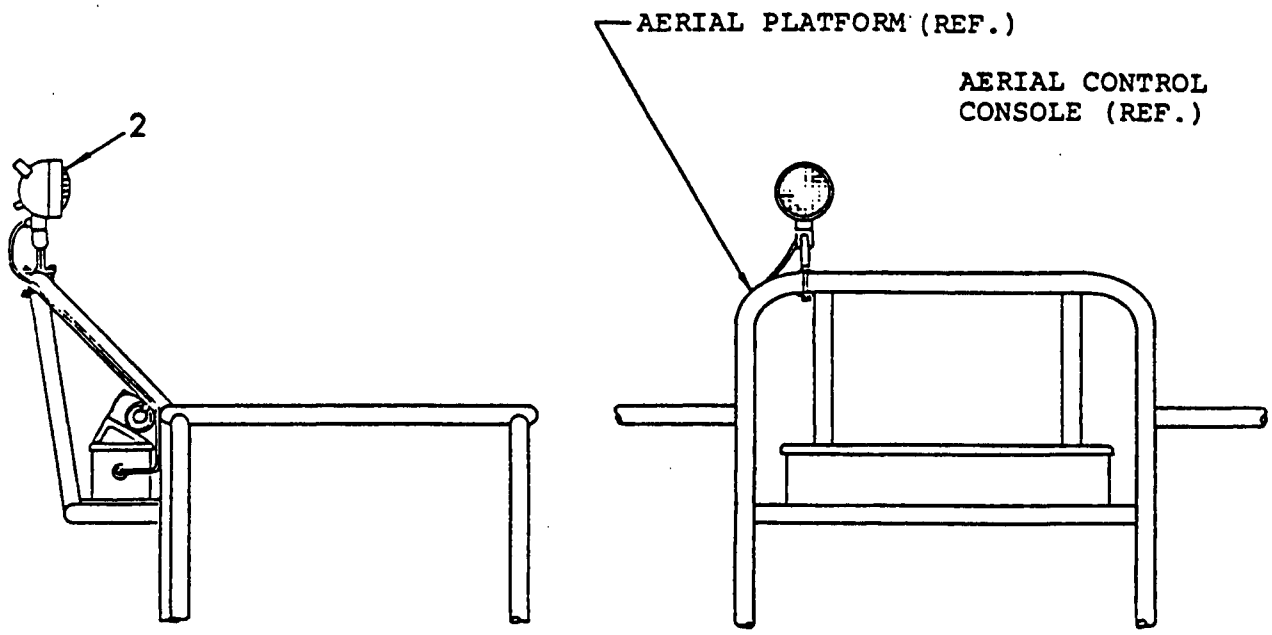


2000W GENERATOR (30 KBDF)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140667	2000W GENERATOR	REF
2	70464	.GENERATOR	1
3	160118	.PULLEY	1
4	32459	.STUB, SHAFT & PULLEY	1
5	160156	.BELT, "V"	1
6	16552	.NIPPLE, CLOSE	1
7	140910	.BRACKET, GENERATOR	1
8	81197	.ELBOW, TUBE	1
9	60343	.SCREW, CAP	8
10	63319	.WASHER, LOCK	8
11	63428	.WASHER, FLAT	8
12	60323	.SCREW, CAP	8
13	66480	.VOLT METER, A.C.	1
14	16260	.SWITCH, TOGGLE	1
15	20884	.GUARD, SWITCH	1
16	185717	.DECAL, 110 VAC	1
17	16503	.ELBOW, STREET	1
18	28114	.KEY, STOCK	1
19	63426	.WASHER, FLAT	2
20	2806	.STRAIN, RELIEF	1
21	2767	.WIRE, 12/2 (6 FT.)	1
22	70162	.BUTT, CONNECTOR	2
23	181502	.DECAL, GENERATOR	1

- ITEM NOT ILLUSTRATED

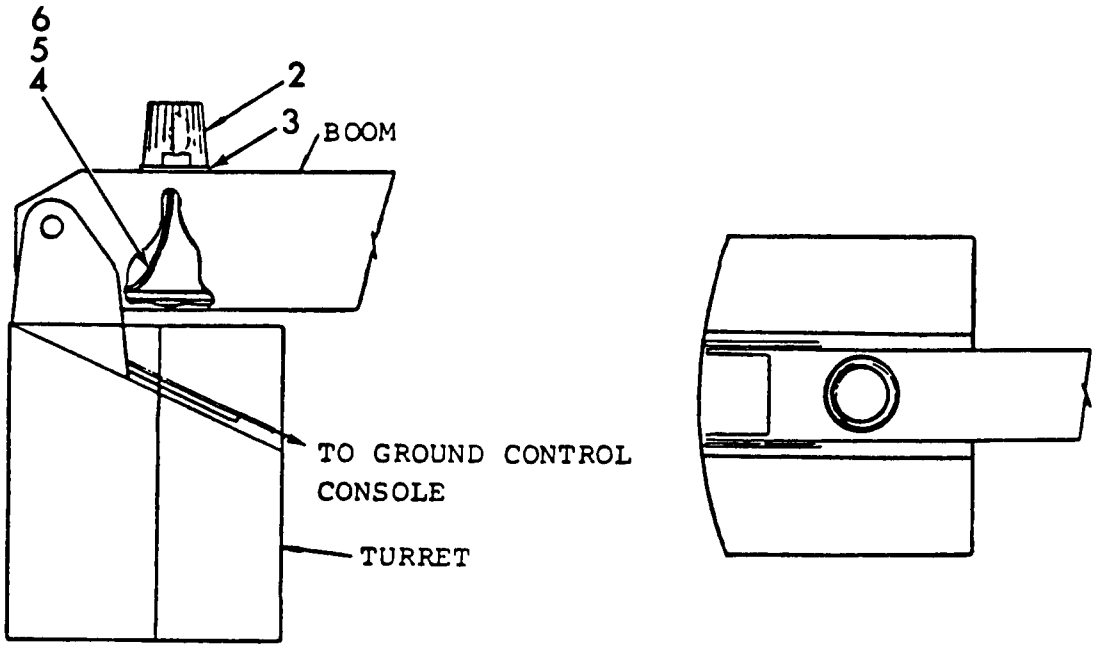
12 VOLT PLATFORM WORKLIGHT



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140664	.WORK LIGHT, 12V PLATFORM	REF
2	20862	.WORK LIGHT	1
-3	255	.TIE, CABLE	3

REV.

ROTATING AMBER BEACON (30 KBDF)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	140866	.ROTATING AMBER BEACON	REF
2	20863	.BEACON, ROTATING	1
3	140865	.WELDMENT, MOUNTING BRACKET	1
4	2768	.CABLE (20 FT.)	1
5	764	.CLAMP, CABLE	6
6	63657	.RIVET, POP	6

REV.

Drawing for **Option Assembly**
Part No. 140660 is not
available this edition

Drawing for **Option Assembly**
Part No. 140657 is not
available this edition

Drawing for **Option Assembly**
Part No. 140670 is not
available this edition

Drawing for **Option Assembly**
Part No. 140672 is not
available this edition

Drawing for **Option Assembly**
Part No. 140665 is not
available this edition

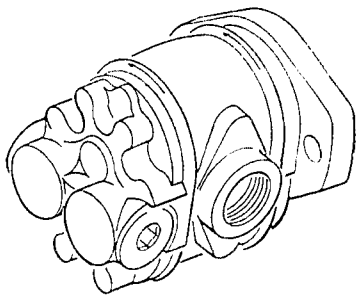
TRAVEL WARNING HORN (30 KBDF)

Drawing for **Option Assembly**
Part No. 140657 is not
available this edition

Drawing for **Option Assembly**
Part No. 140663 is not
available this edition

VENDORS (30 KBDF)

Parker



SECTION	TITLE
1	DRIVE MOTOR P/N 81216
2	BATTERY P/N 4030
3	HYDRAULIC MOTOR P/N 81187
4	GASOLINE ENGINE P/N 24062
5	DOUBLE GEAR PUMP P/N 81256

Torqmotor™



REV.

110 Series

REF: MARK P/N 81216 (30KBDF) (45KBDF)

Service and Parts List

High Torque, Low Speed Hydraulic Motor with Thru-Shaft Option

The 110 Series High Torque Low Speed (HTLS) hydraulic orbit motors are designed to provide long life while operating with limited radial load. Refer to catalog radial load limits. However, should maintenance be required, the instructions below should be used for disassembly, replacement of parts, cleaning and assembly.

Note: Prior to any motor disassembly, plug the open ports and clean all dirt from the outside of the motor. Prior to assembly lightly oil all seals, the rollers and the threaded bolt ends.

Part I—Installation Requirements

1. The motor may be mounted in any secure position.
2. If the system minimum downstream pressure exceeds 1000 psi on a continuous basis, the external case drain (9) should be vented to a low pressure area.
3. The standard motor seals are suitable for use with petroleum base oils. Consult the factory for use with other fluids.
4. A minimum of 25 micron filtration with B ratio of 2 is recommended.
5. For maximum system pressure refer to catalog.
6. Shaft may not turn freely after assembly. A short running break in period may be required.

Part II—Motor Disassembly

A. Disassembly of Cover Section of Motor

1. Remove the key (11) from the shaft if there is a key.
2. Mount the motor in a vise or other holding device with the shaft facing down.
3. Remove the eight 5/16-24 bolts (10). If motor has bolt washers, remove and discard them.
4. Remove the cover/bearing assembly (17) or (18) and the square ring (8).
5. Remove the IGR set components (6) starting with the outer locating ring and rollers. Note that the innermost IGR component and rotary valve (4) are retained on the shaft by the snap ring (7). Do **not** remove this snap ring.
6. Remove the two check valve balls (5). Note that the check balls may fall into the body tapped holes or into the body valve ports during disassembly. Be sure that the check balls are removed.
7. Remove the shaft (12) or (13), the IGR inner element, and the rotary valve (4) as one assembly.
8. With the shaft assembly removed from the body, inspect the IGR inner component, the rotary valve (4), and the shaft (12) or (13) for wear or other damage. The shaft should have smooth polished surfaces in the bearing and seal areas. If any of these components are damaged, the snap ring (7) must be removed and the appropriate components replaced. If the snap ring (7) is removed, **discard** it.
9. Check IGR tip clearance. Replace the IGR assembly if the clearance between the inner-most rolls and outer contour exceeds .010 inches.

B. Main Shaft Seal Replacement

1. If the motor body shaft seal has shown signs of leakage during operation, the quad ring seal (3) and back-up ring (2) must be replaced with the motor completely disassembled per Part II, Section A above.
2. The quad ring seal (3) and the back-up ring (2) can be removed using a dull pointed object such as a pencil point or the end of a paperclip. Do **not** use a sharp object such as a knife because the sealing surface in the body or cover can be damaged.
3. With the old quad ring seal and back-up ring removed, install a new back-up ring first and push it against the sealing surface toward the outside of the motor. The back-up ring can be seated with a dull object.
4. Next install the new quad ring seal on the inboard side of the back-up ring and push it against the back-up ring.
5. Lubricate the inside diameter of the quad ring and back-up ring with oil.

C. Thru Cover Shaft Seal Replacement

1. If the motor body thru cover shaft seal has shown signs of leakage during operation, the seals must be replaced with the motor completely disassembled per Part II, Section A above.
2. The lip seal (19) can be removed using a dull pointed object such as a pencil point or the end of a paperclip. Do **not** use a sharp object such as a knife because the sealing surface in the cover can be damaged. **Note:** models pre-January 1, 1986, Serial Number A6 and earlier, contain quad rings and back-up rings.

Parker

3. With the old seal removed, install the new lip seal into the bore with the rubber lips facing the inboard side (the flat seal back against the bore floor). **Note:** models pre-January 1986, Serial Number A6 and earlier, require quad rings and back-up rings as the replacement seals (see Note 3, page 3). Install the back-up ring into the cover bore and push it against the sealing surface toward the outside of the motor. Put the quad ring in next on the inboard side of the back-up ring and push it against the back-up ring.
4. Press the dust seal into the bore on the outboard side of the cover. Make sure that the rubber lips are facing the outside of the motor. The dust seal's back should be flush with the bottom of the bore.
5. Lubricate the inside diameter of the seals with oil.

Part III—Motor Assembly

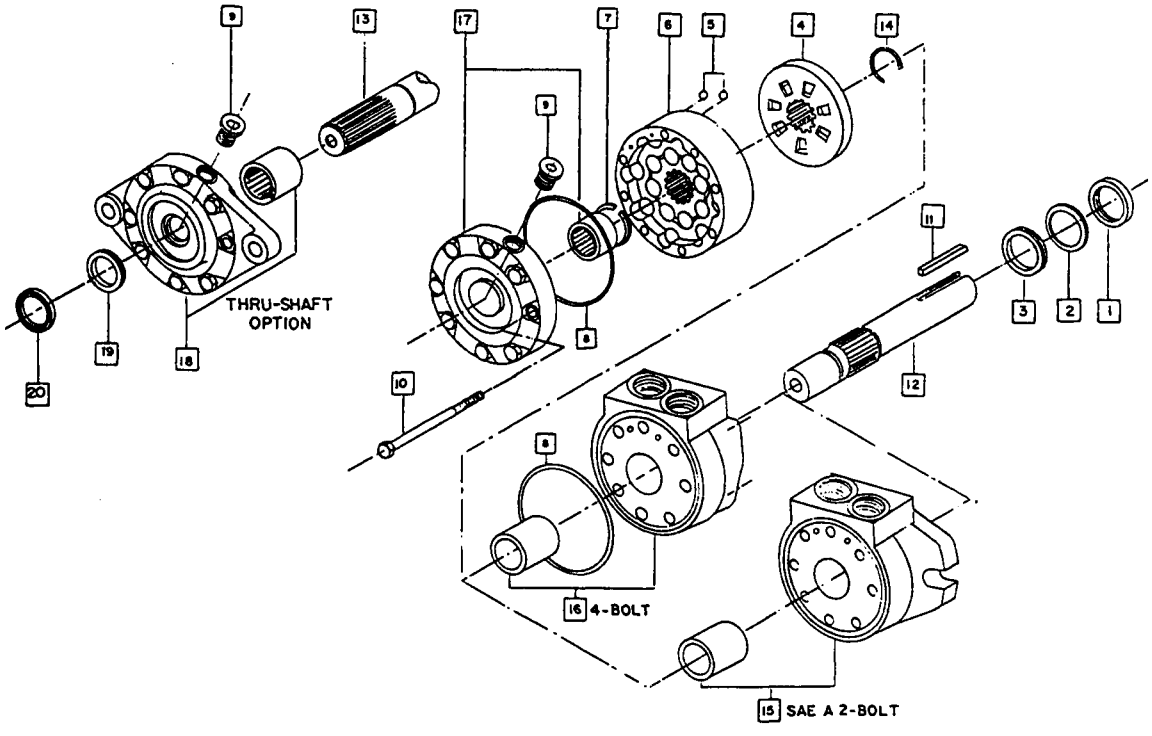
A. Shaft, IGR Inner, and Rotary Valve Assembly

1. If the shaft assembly has been disassembled intact according to Part II, Section A, step 7; proceed to Part III, Section B.
2. Place the rotary valve (4) on the shaft spline with the "T" shaped slots on first.
3. Next put the IGR inner member on the shaft spline with the semi-circular roll pockets between the rotary valve ports.
4. Now install the new snap ring (7) which holds the inner and valve on the shaft. Be sure not to over-extend the snap ring during assembly. The snap ring should be snug in the groove when finally assembled.

B. Assembly of Complete Motor

1. Prior to assembly, all parts must be cleaned with a suitable solvent and be free of nicks and burrs.
2. Mount the body with the pilot and bearing down in a vise or other holding mechanism.
3. Check the output shaft end for burrs and scratches, especially on a used keyed shaft. De-burr if necessary. The shaft end must be free of burrs because it slides through the quad ring and can cut it. Install the shaft assembly into the body.
4. Place the contour member of the IGR over the inner and insert the seven rolls into the inner pockets (larger in diameter than the eight rollers).
5. Lightly oil the square ring seal (8) and place in the body groove.
6. Place the check balls (5) over the two ⅛ inch diameter holes in the body. Be sure the check balls do not fall into the tapped holes.
7. Place the locating ring section (4.5 inch diameter) of the IGR (6) onto the body with the check ball holes facing downward over the balls. Align the eight bolt holes in the locating ring with the eight holes in the body. The holes align in only one position.

   Note: Be sure not to dislodge the body square ring seal while moving the locating ring.
8. Install the eight locating ring rollers into their pockets and oil lightly.
9. Place the other lightly oiled square ring seal (8) into the groove in the cover and place the cover over the shaft end and align the bolt holes.
10. If the motor had bolt washers, install the bolts with new washers, Part #1047. Install the eight bolts with lightly oiled thread ends into the bolt holes. Tighten diagonally to 15 lbs. ft. Turn the shaft by hand through several rotations. Increase the torque of each bolt by 5 lbs. ft. in a diagonal pattern. Turn the shaft by hand through several rotations. Repeat this procedure until the torque of each bolt has reached 27 lbs. ft.



THE 10 COMMANDMENTS OF GOOD BATTERY CARE

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

Watering Instructions

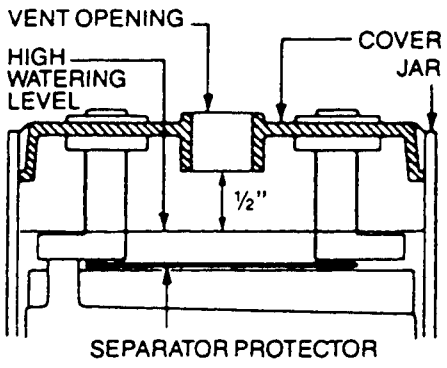
Approved Water

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

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

Proper Electrolyte Level

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



1. NEW BATTERY RECEIVAL AND INSTALLATION

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

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

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

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

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

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

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

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

2. MAINTENANCE- INSPECTION PROCEDURES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. CHARGING PROCEDURE

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

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

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

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

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

4. TROUBLE SHOOTING FOR WEAK OR BAD BATTERIES

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

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

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

3. Recharge the batteries as recommended by the manufacturer.

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

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

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

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

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

5. BATTERY REPLACEMENT

Defective Batteries (Premature Failures)

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

Worn Out Batteries

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

6. WINTER STORAGE OF WET BATTERIES

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

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

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

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

A PRIMER ON THE LEAD-ACID BATTERY

1. **Q.** WHAT IS A STORAGE BATTERY?

   A. A reservoir which may be used repeatedly for storing energy. Energy is put into it and removed from it in the form of electricity, but it is stored as chemical energy.

2. **Q.** WHAT ARE AMPERES?

   A. Units of quantity of electric current. The current forced through a resistance of one ohm by a pressure of one volt is one ampere.

3. **Q.** WHAT ARE VOLTS?

   A. Units of force or pressure of electric current. In an industrial truck, running speed, lifting speed and controller operations are dependent upon battery voltage. The voltage of a battery depends on the number of cells. Each lead-acid cell has 2 volts; a 6-cell battery has 12 volts and an 18-cell battery has 36 volts.

4. **Q.** WHAT ARE WATTS?

   A. The product of volts times amps. (Volume of electric current times pressure of electric current.) The total power is measured in watts.

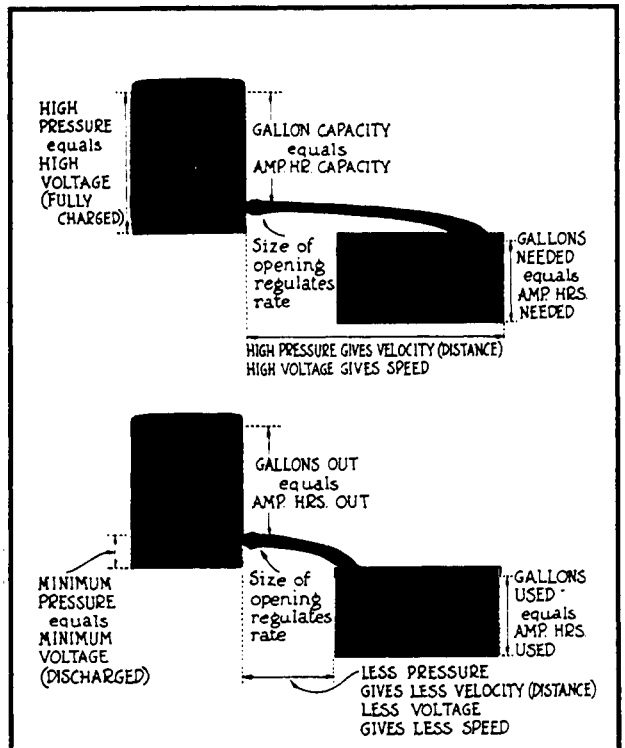
5. **Q.** WHAT IS AMPERE HOUR (A.H.) CAPACITY?

   A. Product of amps multiplied by time. It refers to the volume of electricity that can be drawn from a battery. Other things being equal*, higher ampere hour capacity batteries will run a truck longer than those with lower ampere hour capacities. A.H. capacity of a battery depends on the number and design of plates per cell.

   *"Other things" refers to number of cells in battery, truck resistance, truck motor, rate of discharge, etc.

6. **Q.** WHAT IS KILOWATT HOUR (K.W.H.) CAPACITY?

   A. A kilowatt is 1,000 watts. The kilowatt hour capacity is the total amount of power (volts x amps x hours divided by 1,000) that can be drawn from a battery. It is the watt or kilowatt which does the work—not amps alone.



Discharge of a storage battery is similar to the flow of water from one tank to another.

7. **Q.** HOW ARE BATTERIES RATED?

   A. Lead-acid batteries are rated at the six hour rate. For example: a 16 cell, 19 plate lead-acid battery will deliver a total of 765 ampere hours if it is discharged at a continuous rate of 127.5 amperes per hour for six hours.

8. **Q.** WHAT IS ELECTROLYTE?

   A. In lead-acid batteries, it is a mixture of sulfuric acid and water. The operation of the batteries is affected by the specific gravity, quantity, purity, etc. of the electrolyte within the cell.

9. **Q.** WHAT IS MEANT BY "SPECIFIC GRAVITY" OF BATTERY ELECTROLYTE?

   A. It is the weight of the sulfuric acid-water mixture compared to an equal volume of water. Pure water has a specific gravity of 1.000.

10. **Q.** WHAT EFFECT DOES MAXIMUM SPECIFIC GRAVITY HAVE ON A BATTERY?

    A. Experience has proved that the optimum specific gravity of a new lead-acid industrial truck battery is 1.265-1.285. If the maximum gravity of a new battery is higher than that, slightly more ampere hour capacity will result but battery life will be shortened.

11. **Q.** WHAT IS MEANT BY BATTERY LIFE?

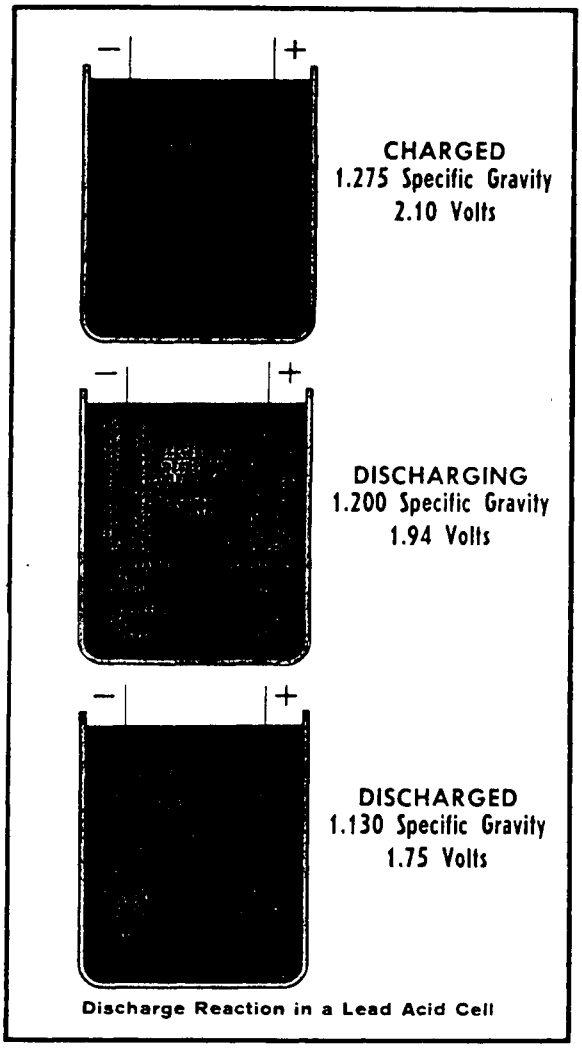
    A. Battery life normally refers to the number of times that a battery can be charged and discharged before it is no longer able to do a required day's work. One complete charge and one complete discharge is called a cycle. The number of complete cycles a battery will give depends on: 1) construction of the battery, 2) charging procedure, 3) maintenance, 4) operation.

12. **Q.** HOW DOES SPECIFIC GRAVITY VARY WITH DISCHARGE?

    A. This normal range of a lead-acid battery from full charge to full discharge is from 1.275 to 1.130. By the time the specific gravity gets down to 1.130 the rated capacity is usually out of the battery and a maximum amount of acid has combined with the active material on the plates. If discharge is frequently continued below the 1.130 point, battery life will be shortened.

13. **Q.** DOES VOLTAGE (FORCE OR PRESSURE) VARY AS THE BATTERY IS DISCHARGED?

    A. Yes, voltage drops as specific gravity of the electrolyte drops. A full charged lead-acid battery with a specific gravity of 1.275 has an average initial discharge cell voltage of 2.03 volts. It is considered to be fully discharged when the average cell voltage is 1.75. Since truck speed is dependent on battery voltage, the truck will go approximately 14% slower at the end of discharge than it did at beginning of discharge. This difference cannot be detected in the average operation.



Discharge Reaction in a Lead Acid Cell

14. **Q.** HOW DOES THE ELECTRICAL SIZE (K.W.H.) OF THE BATTERY AFFECT INDUSTRIAL TRUCK OPERATION?

    A. The work that can be done by an industrial truck is proportional to the total kilowatt hour capacity of the battery. A 16-cell, 19-plate lead-acid battery has a 23.57 kilowatt hour capacity. It will do approximately the same total amount of work as an 18-cell, 17-plate battery which is rated at 23.56 kilowatt hours, *if it is used in the same truck.*

Lead Industries Association
292 Madison Ave.
New York, New York 10017

Torqmotor™ MAG Design Features

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

Definitions

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

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

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

Patents

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

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Introduction

Service Manual for Model MAG

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

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

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

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

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

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

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

Troubleshooting Guide

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

Preparation

Make your troubleshooting easier by preparing as follows:

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

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

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

Preliminary Checks

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

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

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

Hydraulic Components

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

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

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

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

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

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

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

Troubleshooting Checklist

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

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

Tools and Materials Required for Servicing

MAG service manual

Clean, petroleum-based solvent

Emery paper

Vise with soft jaws

Air pressure source

Arbor press

Screw driver

Retaining ring pliers (internal)

Breaker bar

1/2 inch thin wall socket

Torque wrench - foot pounds or Newton meter

Adjustable crescent wrench or hose fitting wrenches

SAE 10W40 SE or SF oil

Special bearing mandrel (SEE FIGURE 1)

Feeler gage .005 inch (.13 mm)

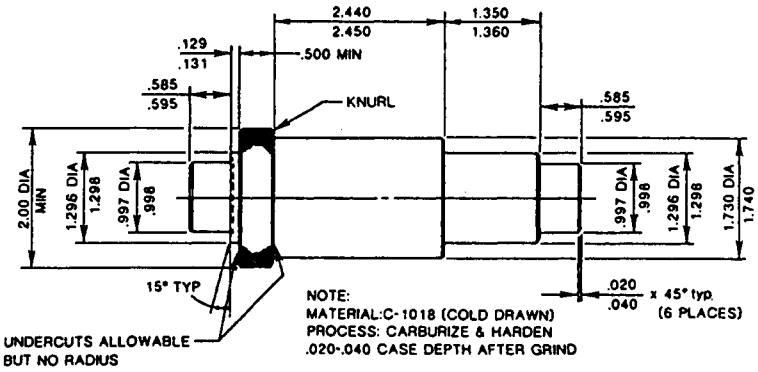
Clean corrosion resistant grease. Recommended grease is E/M Lubricant #K-70 Alternate compatible greases are:

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

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

CONVERSIONS

INCHES	mm	INCHES	mm
.020	.51	1.296	32.92
.040	1,02	1.298	32.97
.129	3.28	1.350	34.29
.131	3.33	1.360	34.54
.500	12.70	1.730	43.94
.585	14.86	1.740	44.20
.595	15.11	2.00	50.8
.997	25.32	2.440	61.98
.998	25.35	2.450	62.23

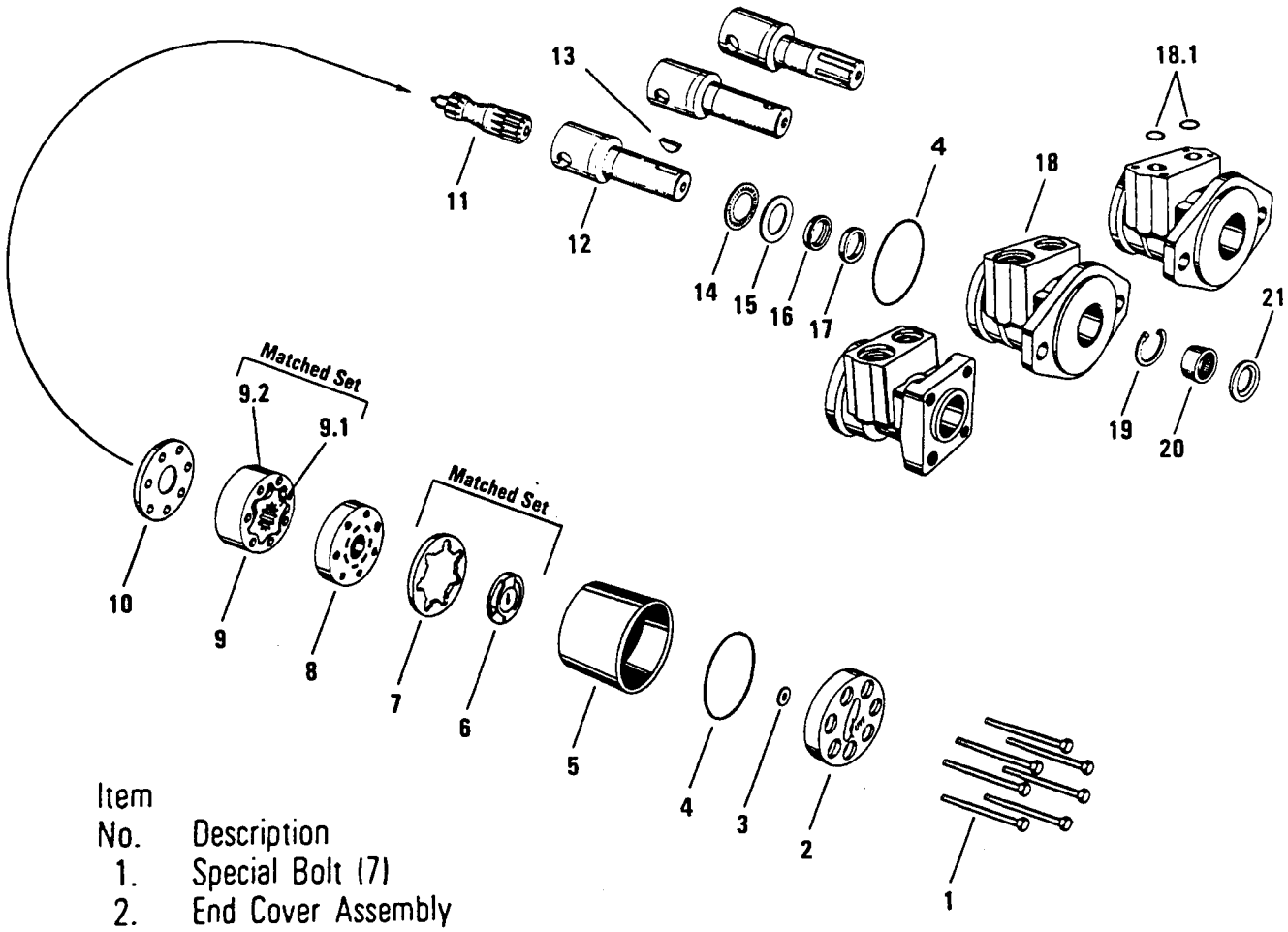


Bearing Mandrel (Fabricate if considered necessary)
Figure 1

Torque Chart

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

MAG Torqmotor™ Exploded Assembly View-Typical



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

MAG Torqmotor Exploded View

MAG: Disassembly and Inspection

(Preparation Before Disassembly)

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

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

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

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

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

Disassembly and Inspection

position Torqmotor™ in a vise

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

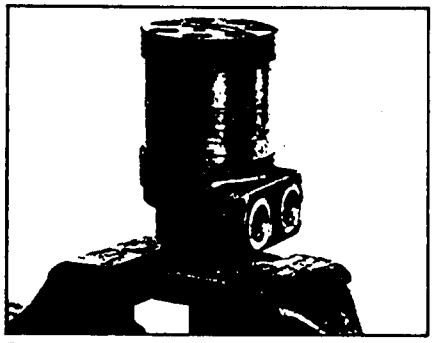


Figure 2

WARNING

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

remove special bolts & inspect bolts

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

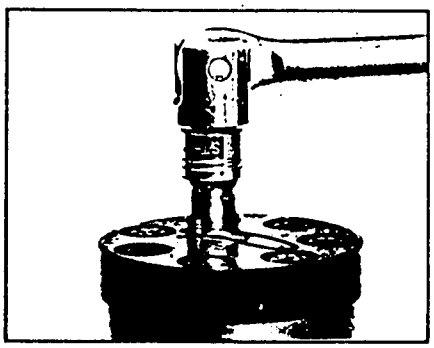


Figure 3

remove end cover & seal ring

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

NOTE

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

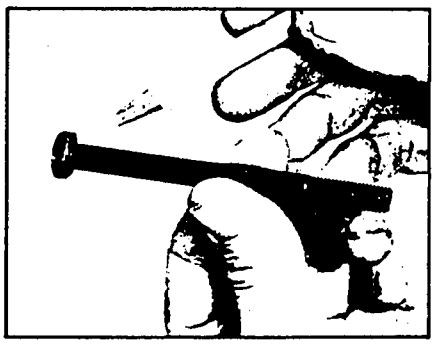


Figure 4

inspect end cover

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

NOTE

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

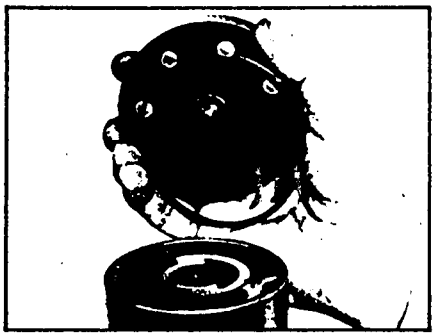


Figure 5

remove & inspect drive link washer

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

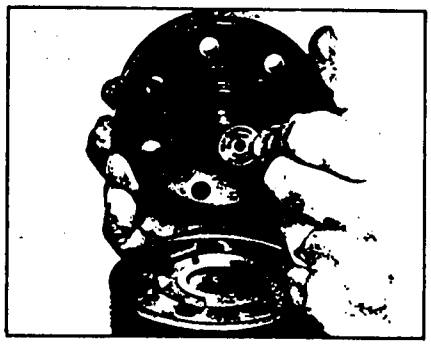


Figure 6

remove & inspect sleeve

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

NOTE

NOTE: Minor burrs can be removed.



Figure 7

remove & inspect commutator ring

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



Figure 8

remove & inspect commutator

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



Figure 9

remove manifold

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



Figure 10

remove & inspect rotor set

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

NOTE

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



Figure 11

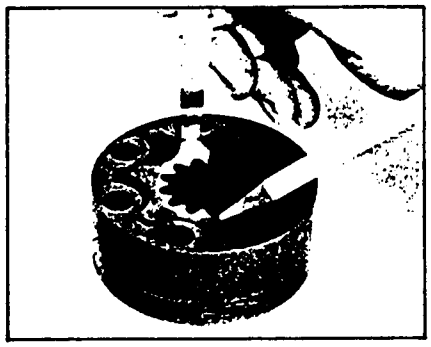


Figure 12

check rotor, stator clearance

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

remove & inpect spacer

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

NOTE

NOTE: A polished pattern from rotor rotation is normal.

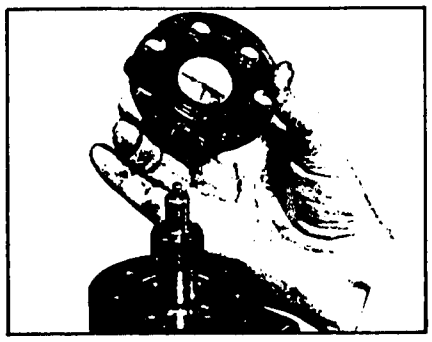


Figure 13

remove & inspect drive link

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

NOTE

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

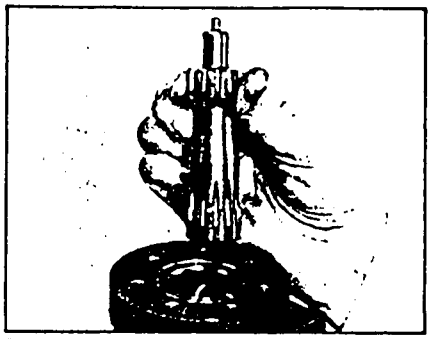


Figure 14

check coupling shaft for rust or corrosion

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

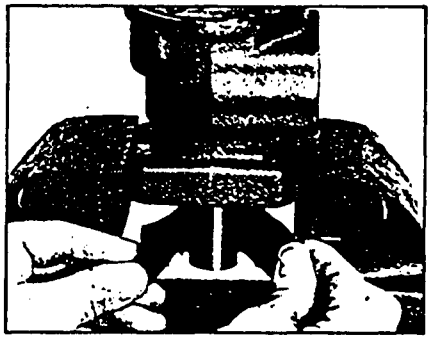


Figure 15

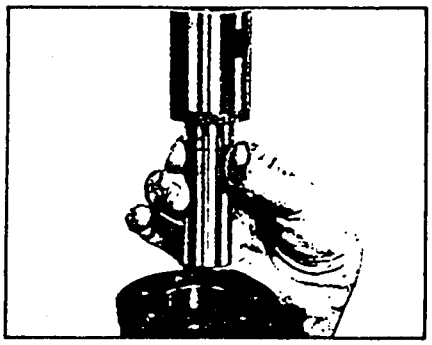


Figure 16

remove & inspect coupling shaft

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

NOTE

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

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



Figure 17

remove seal ring from housing

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

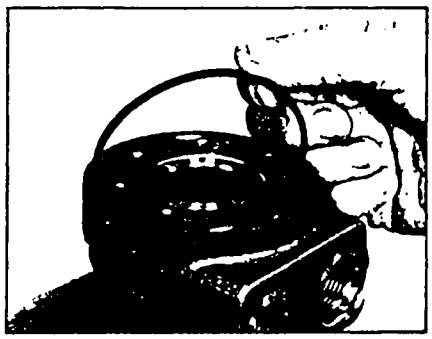


Figure 18

remove & inspect thrust bearing, washer

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

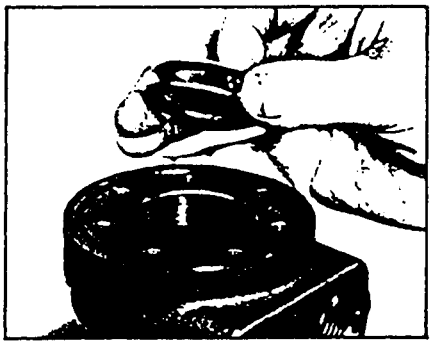


Figure 19

remove seal & spacer

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

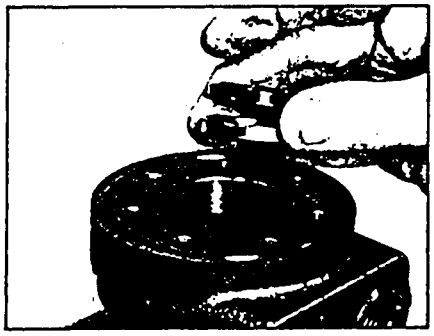


Figure 20

remove seal

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

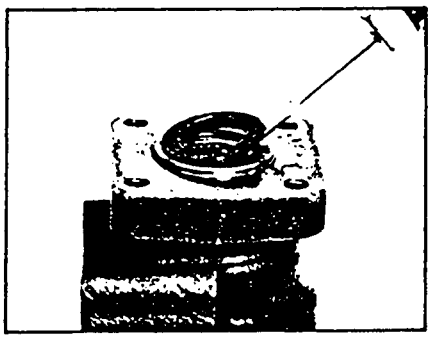


Figure 21

inspect housing assembly

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

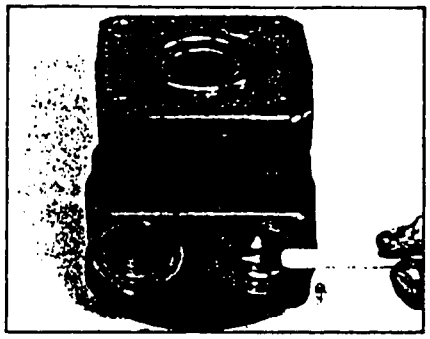


Figure 22

inspect housing bearing

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

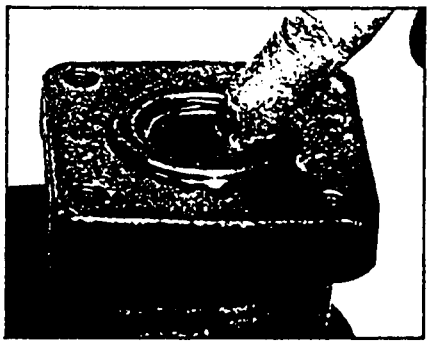


Figure 23

remove retaining ring & bearing

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

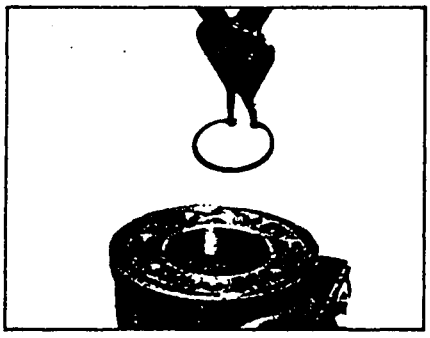


Figure 24

The MAG Torqmotor™ disassembly is now complete.

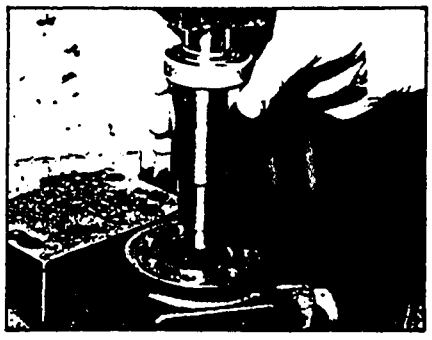


Figure 25

MAG Assembly

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

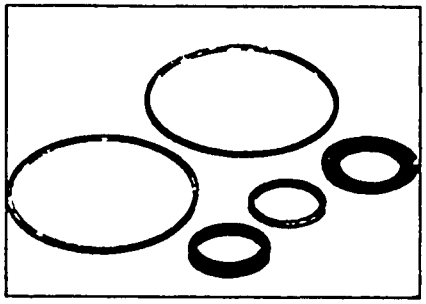


Figure 26

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

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

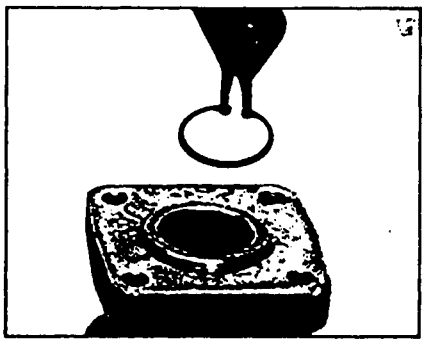


Figure 27

install retaining ring

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

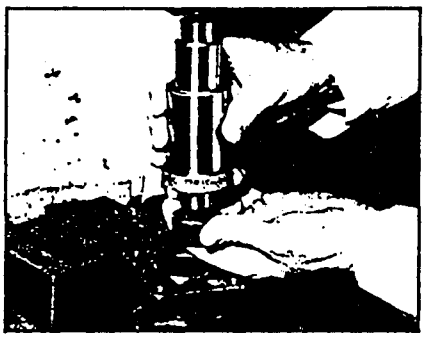


Figure 28

press in bearing

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

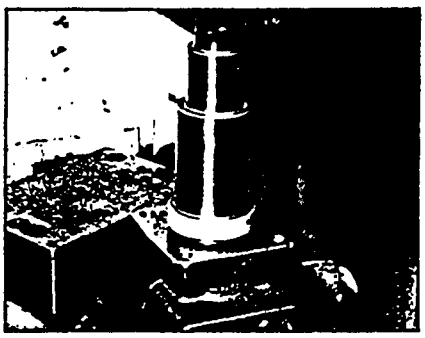


Figure 29

NOTE

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

CAUTION

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

CAUTION

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

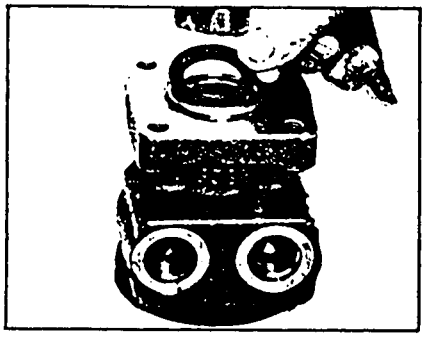


Figure 30

insert dirt & water seal

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

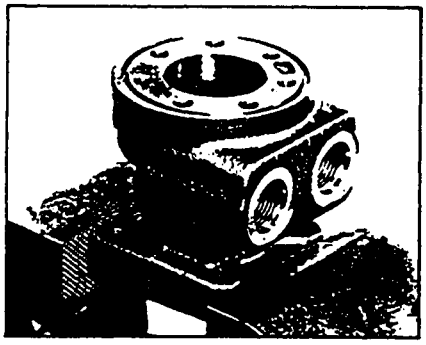


Figure 31

place housing assembly into vise

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

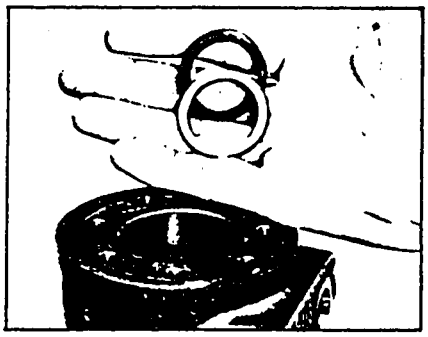


Figure 32

install backup washer & seal

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



Figure 33

install thrust washer & thrust bearing

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

install coupling shaft

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

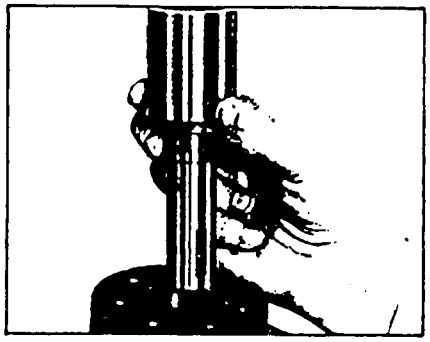


Figure 34

NOTE

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

insert seal ring

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

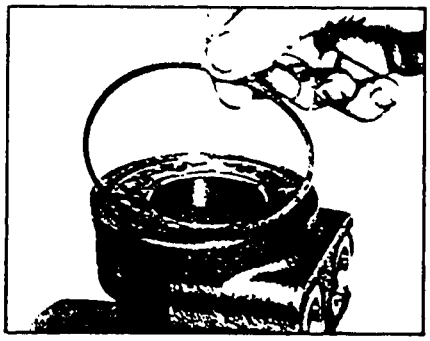


Figure 35

install drive link

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

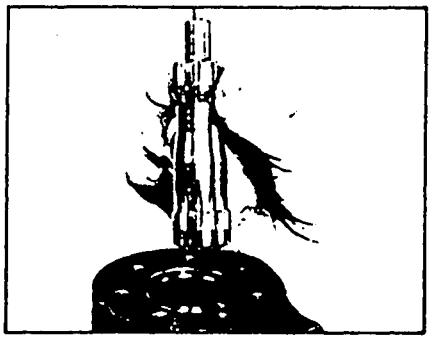


Figure 36

assemble spacer

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

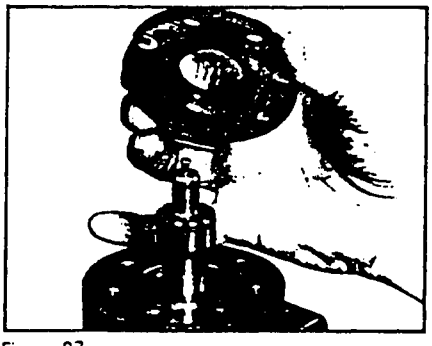


Figure 37

assemble rotor set

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

NOTE

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



Figure 38

assemble manifold

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

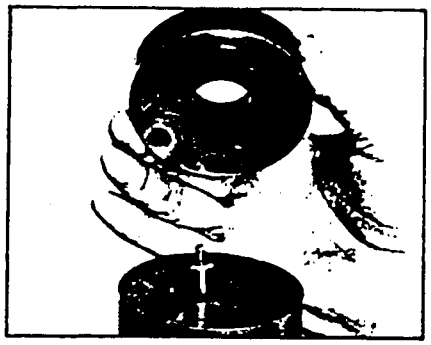


Figure 39

assemble commutator ring

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



Figure 40

assemble commutator

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

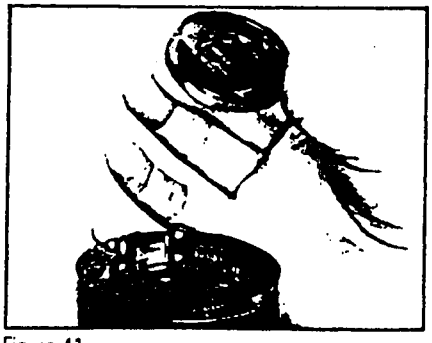


Figure 41

assemble sleeve

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

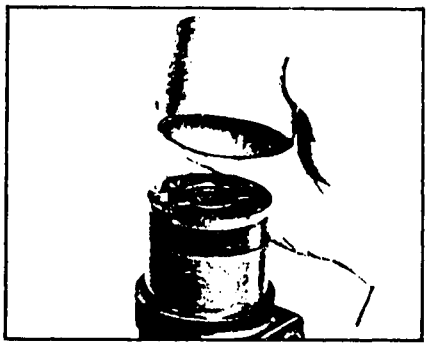


Figure 42

assemble washer

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

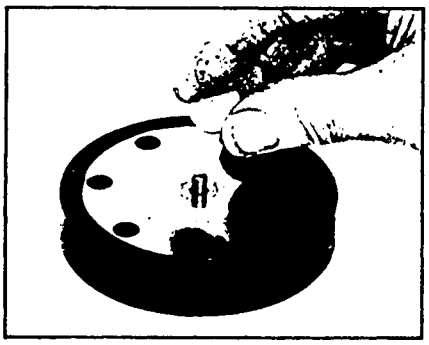


Figure 43

assemble seal ring

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

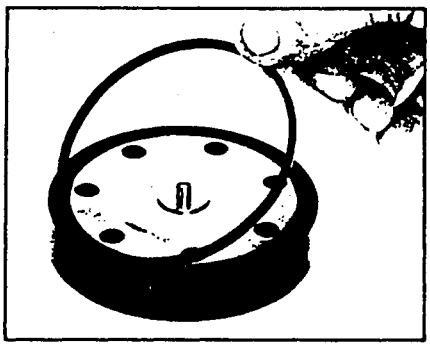


Figure 44

assemble end cover assembly

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



Figure 45

NOTE

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

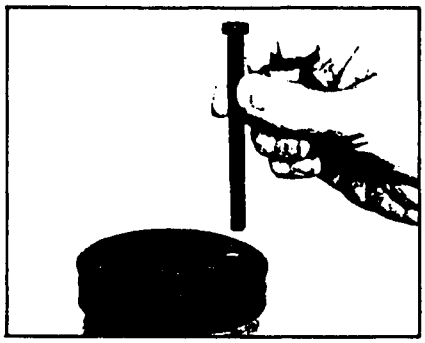


Figure 46

install and torque bolts

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

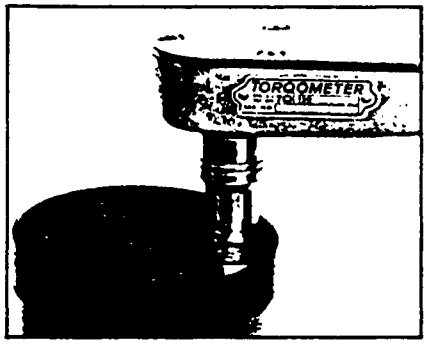


Figure 47

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

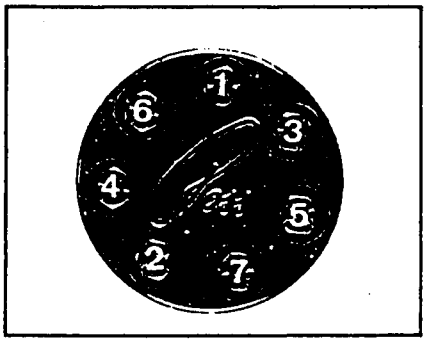


Figure 48

Final Checks

Final Checks

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

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

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

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

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

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

Tips for Maintaining the Torqmotor™ Hydraulic System

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

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

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

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

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

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

OPERATION GUIDE

WISCONSIN
Engine Model
W2-1250

TELEDYNE
TOTAL POWER

INTRODUCTION

USE FOR W2-1230 & W2-1235 ALSO

The **W2-1250** is a two cylinder, four cycle, Vee type, air cooled gasoline engine of the most advanced design, and is readily and efficiently adaptable to a great variety of customer requirements. This typical **Wisconsin** heavy-duty engine has full pressure lubrication with a full-flow type oil filter, and is capable of operating at a 30° angle in any direction.

COOLING is accomplished by a flow of air circulated around the cylinders and heads of the engine from a combination fan-flywheel encased in a metal shroud. The air is divided and directed by ducts and baffle plates to insure uniform cooling of all parts.

IMPORTANT

Never operate an engine with any part of the shrouding removed — this will retard air cooling and cause the engine to overheat.

Keep the air intake screen, and the cylinder and head fins free from dirt and chaff. Improper circulation of cooling air will cause engine to overheat and become damaged in a very short time.

BATTERY IGNITION (12 volt) distributor with automatic advance is furnished as standard equipment, and can be supported by an efficient **30 amp Flywheel Alternator** and unified Rectifier Regulator module, or a lower output 10 amp Flywheel Alternator.

ROTATION of the crankshaft is clockwise when viewing the flywheel or starting end of the engine. This gives counterclockwise rotation when viewing the power take-off end of the crankshaft. With a **Take-off Shaft** optionally available at flywheel end, full engine power can be taken from either end of crankshaft.

SPECIFICATIONS

Bore ..... **3.75 in. (95.25 mm)**

Stroke ..... **3.40 in. (86.36 mm)**

Piston Displacement ..... **75 cu. in. (1230 cc)**

BATTERY IGNITION (12 volt) .....
Distributor with automatic advance

BEARINGS, crankshaft main .....
Sleeve Type
1000 lb. thrust capacity
1000 lb. belt load

COMPRESSION RATIO 6.8:1

ROTATION .... Counterclockwise at T.O. end

CONNECTING ROD ..... Forged Steel
Automotive Shell Bearings

CRANKSHAFT ..... Ductile Iron

CYLINDER DESIGN..... L-head

GEAR TRAIN..... Helical Gears

STARTING MOTOR with Folo-Thru Bendix

VALVE GUIDES ..... Replaceable

VALVES and SEAT INSERTS .....
Hardened Exhaust
Exhaust Valve Rotators
Replaceable Inse

SAFETY PRECAUTIONS

Careless use of the engine causes a high percentage of accidents. Avoid serious injury by being alert, use common sense and be safety minded. Observe the following precautions and carefully enforce them when operating your ***Wisconsin Engine.*** Read operating instructions thoroughly — Know how to stop the engine in case of emergency.

⚠ This symbol indicates important safety messages throughout this operators guide — ***Read Them Carefully.***

- Engine should be operated only by qualified persons.
- Do not operate engine in a closed building unless the exhaust is piped outside. This exhaust contains carbon monoxide, a poisonous, odorless and invisible gas, which if breathed can cause serious illness and possible death.
- Keep exhaust connection tight and components in good condition; noise from a faulty exhaust system can also be harmful.
- Exhaust system parts get very hot — avoid touching these parts until engine has stopped and has sufficiently cooled.
- Never refuel a hot or running engine. Do not smoke while filling fuel tank or servicing fuel system.
- Always refuel slowly to avoid spillage.
- Make sure all fuel lines and connections are tight and in good condition.
- Handle batteries carefully; battery acid will burn skin and can cause blindness if it contacts the eyes.
- Avoid sparks near battery. Gas given off by battery is explosive.
- Keep engine and surrounding area clean and clear of trash.
- When starting engine, maintain a safe distance from moving parts of equipment. Be sure all rotating parts are secure and in good condition.
- Do not start engine with clutch engaged.
- Never run engine with governor linkage disconnected, or operate at speeds in excess of 3600 R.P.M. load.
- Never make adjustments on machinery while it is connected to the engine, without first disconnecting the ignition cables from the spark plugs. Turning the machinery over by hand during adjusting or cleaning might start the engine and machinery with it, causing serious injury to the operator.
- Never run engine while safety switches are disconnected, or protective screening is removed from unit.
- Do not leave engine running while lubricating, making adjustments or repairs unless specifically recommended.
- Never leave engine unattended while it is running.
- Keep hands, feet and clothing away from all moving parts.
- Mount a fire extinguisher close to the engine. Maintain extinguisher properly and be familiar with its use.
- Precaution is the best insurance against accidents.

STARTING and OPERATING INSTRUCTIONS

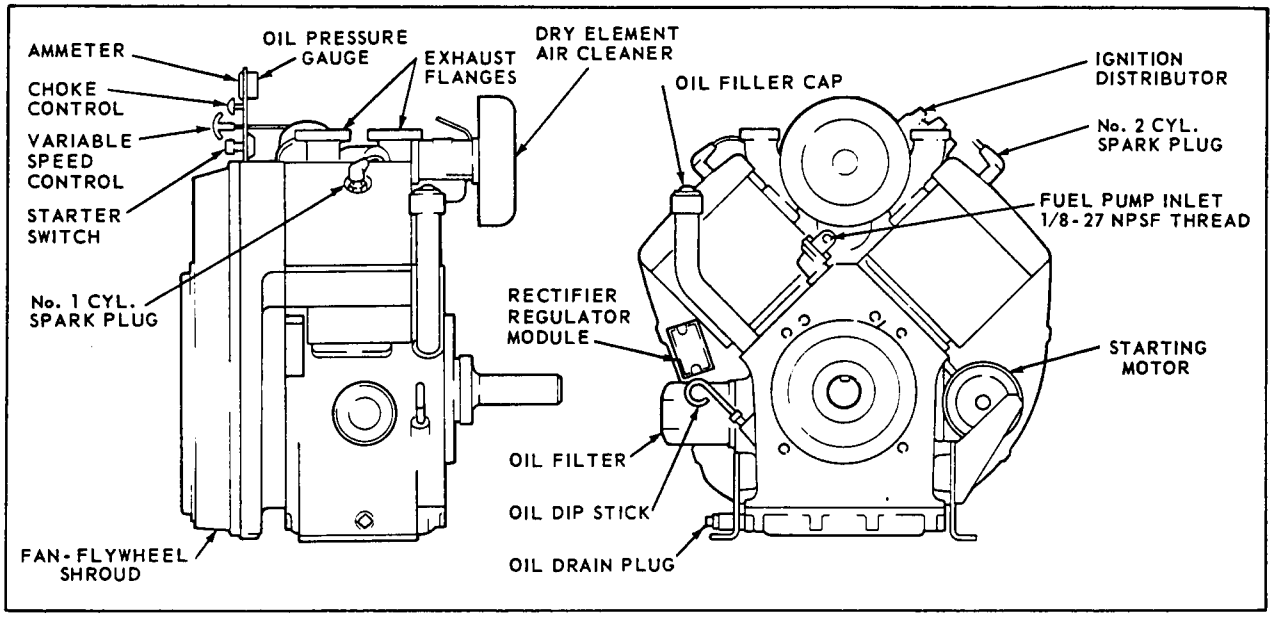


Fig. 1, REFERENCE VIEWS

IMPORTANT

Engine is shipped without oil. Fill Crankcase to proper level, and add oil to Clutch or Reduction gear units and Oil Bath Air Cleaner if furnished. Refer to Lubrication paragraphs, Oil Chart, and Air Cleaner Maintenance.

NEW ENGINE BREAK-IN

Proper **break-in** will lead to trouble-free operation and increased engine life. The factory test given to a new engine is not sufficient to establish the polished bearing surfaces which are so necessary for good performance and long engine life. There is no quickway to force the establishment of good bearing surfaces, and these can only be obtained by running a new engine carefully and under reduced speeds and loads for a short period of time as follows:

1/2 hour	1000-1200 rpm	No load
1 hour	50% rated rpm	25% load
1 hour	75% rated rpm	50% load
1 hour	100% rated rpm	75% load
5 minutes	Low idle	No load

For **break-in** of new engines, use same oil as recommended in oil chart.

BEFORE STARTING ENGINE

1. **FUEL**

Fill fuel tank with a reputable well known brand of **Regular Grade** gasoline. **Leaded** gasoline is preferred with an *Anti-knock Index of **87 minimum.** Unleaded regular gasoline may be used, although shorter valve life may be experienced.
Note: *minimum Motor octane number must be 82.

⚠ **Caution:** Refuel slowly to avoid spillage. Do not smoke when filling tank.

Be sure that vent hole in fuel tank cap is clean and free of any obstruction.

2. **LUBRICATION**

Fill crankcase base with the proper grade of engine oil as specified in **"Grade Of Oil"** chart. Fill through the oil filler tube opening to the level indicated by the **Full Mark** on **Dipstick.** Approximately 3-1/2 quarts are required in a new engine — 4 quarts with oil and filter change.

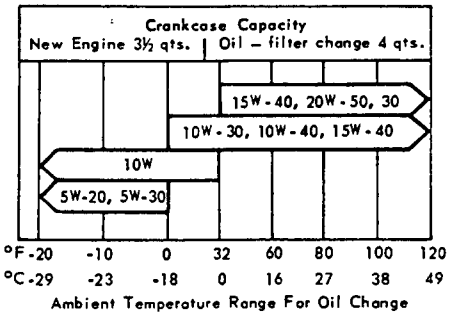
IMPORTANT

Do not overfill crankcase. **Do not** allow oil level to go below **Add** mark on dip stick.

Check oil level every 8 hours. One quart of oil is required to raise the oil level from **Add** to **Full** mark on dip stick.

Change oil every **100 hours** under normal operating conditions. In extreme dusty and extensive idling conditions, change oil at 50 hour intervals.

RECOMMENDED SAE VISCOSITY GRADES
Use Oil Designation as Service SE or SF



Ambient Temperature Range For Oil Change

If engine is used at near maximum performance, it is recommended that a single-viscosity oil of SE Quality be used either grade SAE 30 or SAE 10W.

Proven synthetic oils give superior service in air cooled gasoline engines and can be used, but the recommended oil change interval remains at 100 hours.

3. **CLUTCH-GEAR RED. LUBRICATION**

With reference to Fig. 2 and Fig. 3, fill clutch and gear reduction units to the height of the oil level plug opening — Use same grade oil as used in engine crankcase. Add sufficient oil between changes to keep oil up to the level plug opening.

Change Oil in Clutch and Reduction Units at least every 500 hours of operation.

NOTE: Automotive Dry Plate Clutch and Clutch Reduction assemblies should be lubricated per instructions on inspection plate on clutch housing.

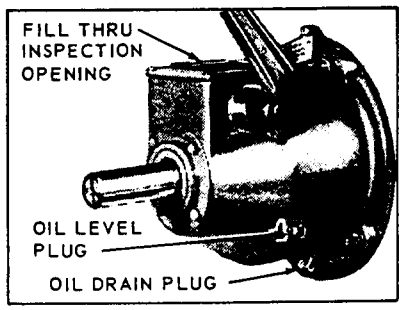


Fig. 2, CLUTCH LUBRICATION

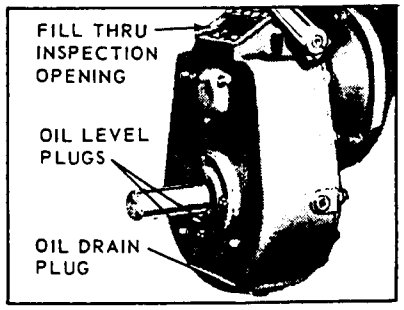


Fig. 3, CLUTCH RED. LUBRICATION

ELECTRICAL SYSTEM

12 Volt Battery Ignition Distributor, Coil and heavy duty Starting Motor are standard equipment. Options include: 10 amp or 30 amp Flywheel Alternator, Instrument Panel, Solenoid Starting, High-Temperature Safety Switch and electric Fuel Pump.

Battery is not furnished by Teledyne Wisconsin Motor.

ALTERNATOR

The **12 volt - 30 amp** Flywheel Alternator system consists of a **Magnetic Rotor, Stator** and **Rectifier-Regulator** module. No adjustments are required. The alternator is wired into the electrical circuit as illustrated in Fig. 4.

IMPORTANT

This is a **Negative Ground** system. Charging components will be damaged if grounded wrong in connecting or jumping batteries.

Caution: Handle battery carefully to prevent acid burns. Avoid sparks near battery — gas given off by battery is explosive.

PRECAUTIONS to be exercised in the use of Alternators:

1. **Do not** reverse battery connections. Negative battery terminal must be grounded. Reverse polarity will damage rectifier-regulator.
2. Connect booster batteries — positive to positive and negative to negative.
3. **Do not** ground any wires from stator or module which terminate at connectors.
4. **Do not** operate engine with battery disconnected from system.
5. Disconnect at least one battery lead if a battery charger is used.

STARTING

Caution: Maintain a safe distance from moving parts of equipment. Know how to stop the engine quickly in case of emergency.

Caution: Do not operate engine in a closed building unless it is properly ventilated.

STARTING PROCEDURE, Fig. 5

1. Check crankcase oil level and gasoline supply. Open fuel shut-off valve in fuel strainer or tank.
2. Disengage clutch, if furnished.
3. Pull variable speed control **"T"** handle out about half-way and lock in place. With a two speed (idle control) start in full load position — idle after engine starts.
4. Close choke by pulling choke button to extreme out position.
5. Pull out ignition switch button, tag reads **"To Stop Push In."**
6. Depress starter switch to start engine.

IMPORTANT

Do not crank engine for more than 30 seconds at a time. If engine fails to start, wait about 2 minutes between cranking periods to prevent starter from over-heating.

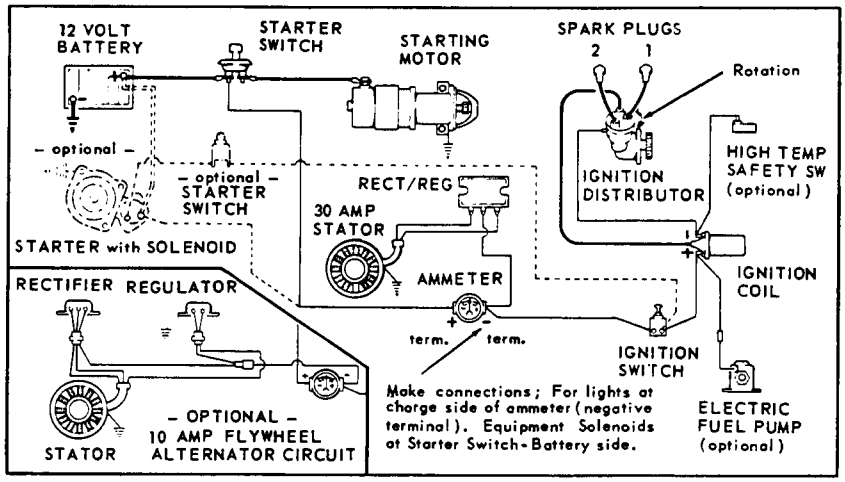


Fig. 4, ELECTRICAL SYSTEM with FLYWHEEL ALTERNATOR

7. After engine starts, push choke button in as required for smooth running.

   Less choking is necessary in warm weather or when engine is warm, than when cold. Should flooding occur, open choke fully and continue cranking.

WARM-UP

After engine starts, allow it to warm up a few minutes before applying load. **Do not race or gun engine** to hurry WARM-UP. The proper oil film on various surfaces of the pistons, cylinders, bearings, etc., cannot be established until the oil has warmed up and become sufficiently fluid.

TO STOP ENGINE

Depress ignition switch button, tag reads **"To Stop Push In."**

If engine has been running hard and is hot, do not stop it abruptly from full load. Cool the engine by removing the load and allowing the engine to run idle (1000 to 1200 R.P.M.), for 3 to 5 minutes.

OIL PRESSURE

Oil pressure is controlled by a non-adjustable relief valve mounted in the crankcase below the oil pump. With engine oil hot, gauge pressure will be from 30 to 50 P.S.I. at engine speeds of 1600 to 3600 r.p.m. If pressure falls below 15 P.S.I., refer to **"Trouble Shooting"** for possible causes.

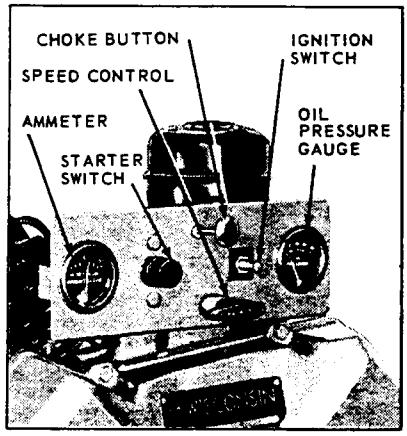


Fig. 5, CONTROL PANEL

MAINTENANCE

AIR CLEANERS

The air cleaner is an essential accessory, filtering the air entering the carburetor and preventing abrasive dirt from entering the engine and wearing out valves and piston rings in a very short time.

The air cleaner must be serviced frequently, depending on the dust conditions in which the engine is operated. Check connections for leaks or breaks and replace all broken or damaged hose clamps on remote or side mounted air cleaners.

Excessive smoke or loss of power are good indications that the air cleaner requires attention.

DRY TYPE AIR CLEANER, Fig. 6

The dry element air cleaner mounted directly to the carburetor is Standard equipment on this model engine. **Do not** oil element, and **Do not** use gasoline or kerosene for cleaning.

Service Daily; or twice a day if engine is operating in very dusty conditions. Remove element and shake out the accumulated dust and dirt. Wipe out dirt from inside cover and from housing.

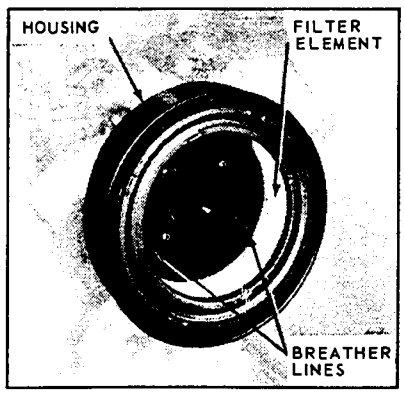


Fig. 6, DRY ELEMENT AIR CLEANER

Once Each Week; The filtering cartridge should be taken out and rinsed under a faucet with cold water, then wash by repeated dippings for several minutes in a solution of lukewarm water and a mild, **Non-sudsing** detergent. Rinse in cold water from the inside out, and allow to dry overnight before installing in air cleaner. In cold weather, protect element from freezing until dry.

After five washings or one year of service, which ever comes first, replace the cartridge element. New filter elements are available from all Teledyne Wisconsin Motor Distributors and Service Centers.

HEAVY DUTY AIR CLEANERS, Fig. 7

Dry Element or Oil Bath heavy duty type air cleaners are optionally used, and are mounted either to the side of the engine, or to the equipment structure.

DRY TYPE HEAVY DUTY AIR CLEANER

Service Daily; squeeze rubber dust unloader once or twice a day to check for possible obstruction. If engine is operating in very dusty conditions, remove cartridge and shake out the accumulated dust and dirt.

Wipe out dirt from inside housing and bowl, after removing baffle and dumping out dust.

Once Each Week; The filtering cartridge should be taken out and rinsed under a faucet with cold water, then wash by repeated dippings for several minutes in a solution of lukewarm water and a mild, **Non-sudsing** detergent. Rinse in cold water from the inside out, and allow to dry overnight before re-installing. In cold weather, protect element from freezing until dry.

Do Not Use Gasoline, Kerosene or Solvent For Cleaning — Do Not Oil Element.

After ten washings or one year of service, which ever comes first, replace cartridge element — available from your nearest Teledyne Wisconsin Motor Distributor or Service Center.

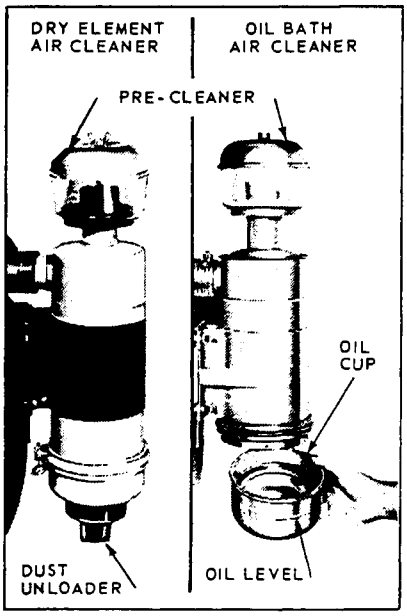


Fig. 7, HEAVY DUTY AIR CLEANERS

OIL BATH HEAVY DUTY AIR CLEANER

Service Daily; or twice a day if engine is operating in very dusty conditions. **Once each week;** in comparatively clean conditions.

Remove oil cup from bottom of air cleaner and clean thoroughly. Add the same grade of oil, as used in the engine crankcase, to the **Level Line** indicated on the oil cup.

IMPORTANT

Operating the engine under dusty conditions without oil in the air cleaner or with dirty oil, may wear out cylinders, pistons, rings and bearings in just a few days time.

Once a Year; or oftener if conditions are severe, the air cleaner should be removed from the engine and the element, which is not removable, should be washed in a solvent to clean out accumulated dust and dirt.

PRE-CLEANER

The optionally furnished collector type pre-cleaner, mounted to the top of the air cleaner as illustrated in Fig. 7, removes the larger dirt and dust particles before the air reaches the main air cleaner.

Clean bowl regularly of accumulated dust and dirt. **Do not put oil or water in pre-cleaner, this must be kept dry.**

CRANKCASE BREATHER, Fig. 8

The crankcase is ventilated by means of a closed breather system, controlled by **reed type breather valves.** The breather valve is an integral part of each of the two valve chamber inspection covers.

Oil and fuel vapors **(blow-by)** in the crankcase are released through the breather valves to the air cleaner, carburetor and intake manifold, where it is mixed with fresh fuel vapor and burned in the combustion chamber.

IMPORTANT

It is necessary that the breather valves be kept clean and operable, and the breather lines free of obstruction.

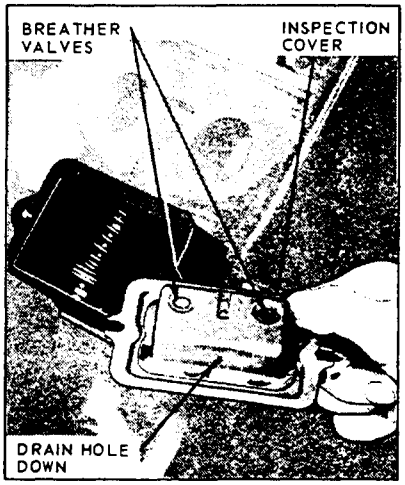


Fig. 8, CRANKCASE BREATHER

The operation of the breather valves is also important in maintaining a partial vacuum in the crankcase to prevent oil leaks at seal and gasket surfaces.

Every 100 Hours; Inspect breather lines.

Every 250 Hours; Remove inspection covers and clean breather valves with a solvent.

⚠ **Caution:** Do not use gasoline, naptha, or benzine. They are highly flammable.

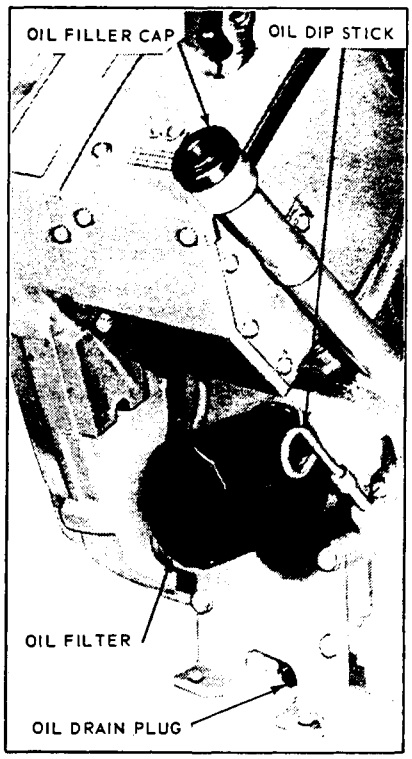


Fig. 9, LUBRICATION

CRANKCASE OIL, Fig. 9

Check Oil Level Every 8 Hours. One quart of oil is required to raise the oil level from **Add** to **Full** mark on dipstick.

Change Oil Every 100 Hours under normal operating conditions. In extreme dusty and extensive idling conditions, change oil at 50 hour intervals. Remove drain plug and allow oil to drain into a suitable container. Drain oil while engine is hot — it will flow more freely.

⚠ **Caution:** Wear gloves when removing drain plug from a hot engine.

Crankcase capacity	3-1/2 Quarts
With Oil Filter Change	4 Quarts

IMPORTANT

Do not overfill crankcase. **Do not** allow oil level to go below **Add** mark on dipstick.

Refer to **Recommended Grades of Oil** chart, page 1, for classification and grade of oil to be used.

OIL FILTER, Fig. 9

Under ordinary conditions all of the engine oil is circulated through a **full-flow Micro-Fine** oil filter. But, when the filter element becomes extremely dirty, the oil by-passes the filter material through a relief valve within the oil filter. As a result, there is no variation in oil pressure to indicate that the oil filter is clogged and requires replacement. Because clean oil is so essential for the friction free operation of all bearing surfaces, it is very important that the oil filter be changed at the recommended interval.

Every 100 hours of operation, or at every oil change, replace oil filter.

For replacement, use only a Wisconsin **Micro-Fine** oil filter, specifically designed for this model engine.

When reassembling new filter, add a film of oil to the face of the base gasket. Turn filter to a snug fit, then 1/2 turn more — **Do not over-tighten.**

FUEL FILTER, Fig. 10

It is very important that the fuel be filtered to prevent sediment, dirt and water from entering the carburetor and causing trouble or even complete stoppage of the engine. A glass bowl fuel filter should be connected into the fuel system between the tank and fuel pump, see Fig. 10.

Inspect glass filter bowl daily, and clean if dirt or water are visible. To remove sediment bowl, loosen nut below glass bowl and swing bail to one side. Twist bowl as it is being removed to prevent gasket from sticking to bowl and breaking. Clean screen and bowl thoroughly — replace gasket if it is damaged or hardened.

IGNITION DISTRIBUTOR, Fig. 13

Check for faulty and loose fitting wires, and for cracks in distributor cover.

Every 250 Hours: apply 1 drop of light engine oil (10W), to the breaker arm pivot.



Fig. 10, FUEL FILTER

Every 250 Hours; add a small amount of high melting point grease to the breaker arm rubbing block.

Avoid Excessive Lubrication. Oil on the contact points will cause them to burn.

SPARK PLUGS, Fig. 11

Incorrect gap, fouled or worn spark plug electrodes, will have an adverse affect on engine operation.

Every 250 Hours: remove spark plugs — clean, regap or replace if necessary.

Spark plug gap - 0.035 inch (Standard)
- 0.030 inch (Resistor plug)

Replacement plugs must be of the correct heat range, like Champion No. N6 (Wisconsin YD369, Standard), or RN6 (YD369A, Resistor plug). Thread size is 14 mm. In reassembly tighten spark plugs **18** to **22 foot pounds torque (dry)**.

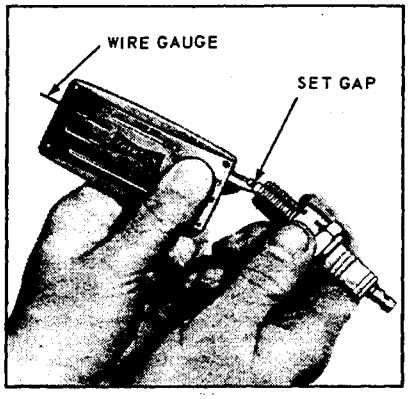


Fig. 11, SPARK PLUG

STARTING MOTOR, Fig. 12

No maintenance is required other than keeping the outside of the starting motor clean, and periodic inspection for insecure mounting and loose or corroded cable connections.

In extreme dust and dirt conditions it may be necessary to occasionally remove the started from the engine and clean the Bendix by brushing with Kerosene. **Do not oil Bendix** drive — if necessary lubricate with powdered graphite.

KEEP ENGINE CLEAN, Fig. 12

This engine is cooled by blasts of air which must be allowed to circulate all around the cylinders and cylinder heads to properly cool the engine and thereby keep it in good running condition. If **dust, dirt or chaff is allowed to collect in the cylinder shrouding or in the V between the cylinders,** it will retard the flow of air and cause the engine to overheat. Keep **flywheel screen** clean, so as not to restrict the intake of cooling air.

IMPORTANT

Do not operate engine with damaged or badly dented shrouding.

Do not operate engine with any part of the shrouding removed.

Do not allow warm air to recirculate back through the cooling system.

ADJUSTMENTS

CARBURETOR, Fig. 18.

The carburetor **Main Metering Jet** is of the fixed type and therefore no adjustment is necessary

The correct amount of throttle plate opening for the proper low idle speed is obtained by means of the **Throttle Stop Screw.** However, this is set at

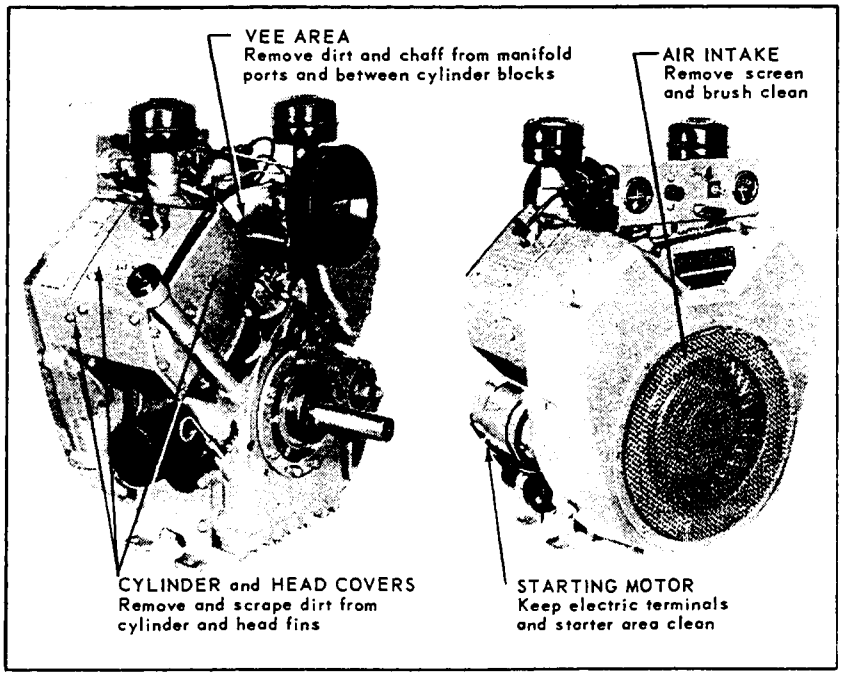


Fig. 12, KEEP ENGINE CLEAN

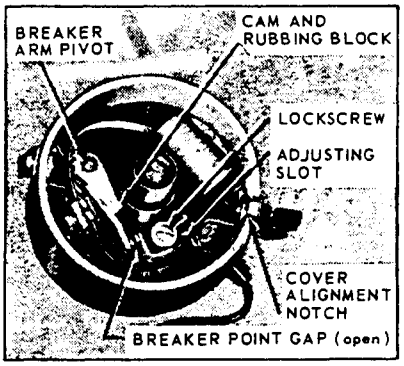


Fig. 13, DISTRIBUTOR BREAKER POINTS

the factory so that no immediate adjustment is necessary. The **Idle Adjustment** is for smooth low speed operation and this adjustment, if necessary, must be made with the engine running at idle speed (throttle valve closed). Initial setting is approximately **1 turn open.**

NO ADJUSTMENT REQUIRED ON SOLID STATE IGN
BREAKER POINT ADJUSTMENT, Fig. 13
BREAKER POINT GAP – .020 IN.

To readjust point gap, turn engine over slowly until the distributor breaker arm **Rubbing Block** is on a high point of the **Cam.** Loosen the stationary contact **Lockscrew** slightly and place a feeler gauge between the points. Insert the end of a screwdriver into to the **Adjusting Slot** on the breaker plate. Open or close the points by moving the point bracket until a slight drag is felt when sliding the feeler gauge from between the points. Tighten lockscrew and recheck point gap.

Points that are badly pitted or worn should be replaced and properly adjusted.

VALVE TAPPET ADJUSTMENT, Fig. 14

With the tappets in their **lowest position** (valves completely closed) and **engine cold,** the clearance between valve stem and tappet adjusting screw should be:

Intake - .007 inch Exhaust - .020 inch

The **intake valve** is to the **left** in the cylinder block, facing the valve chamber opening. The **exhaust valve** is to the **right.** Place a feeler gauge of proper clearance thickness between valve stem and tappet screw. Adjust clearance by means of two 1/2 - 7/16 inch tappet wrenches.

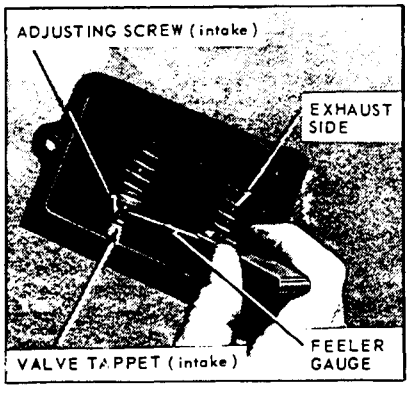


Fig. 14, VALVE TAPPET ADJUSTMENT

TIMING

FIRING ORDER

The firing interval (crankshaft degrees), between No. 1 cylinder and No. 2 is 270° — from No. 2 cylinder to No. 1, 450°.

The **No. 1 cylinder** is on the **Right Hand Side,** when viewed from flywheel end of engine. No. 2 cylinder is on the left hand side, nearest to the flywheel.

DISTRIBUTOR

The distributor is of the mechanical advance type and it is driven off an engine speed governor shaft through a pair of 2:1 ratio gears. Thus, the distributor operates at **one-half** engine speed in a **clockwise direction,** when viewed from above.

SPARK ADVANCE

The running spark advance is 6° before Top Dead Center (T.D.C.) at 1800 r.p.m., with the distributor **fully advanced** to **22°** before T.D.C. at **3400 r.p.m.** Engines are properly adjusted at the factory for accurate timing and peak dependable performance for the complete operating range of speeds from 1600 through 3600 r.p.m. Future timing can be checked and adjusted in the following manner:

TIMING MARKS

Two timing slots are provided on the right hand side of the front face of flywheel shroud:

1. **For timing variable high speed engines to 22° at 3400 r.p.m.,** refer to Fig. 15 which illustrates 25°, 22°, 19° and T.D.C. timing marks. A **cast arrow** identifies the **"I" marked** flywheel vane that is visible through the opening at the 22° mark.
2. **For fixed speed engines,** particularly those operating at **1800 r.p.m.,** refer to Fig. 16 which illustrates 9°, 6°, 3° and T.D.C. timing marks. The **cast arrow** identifies the **"I" marked** flywheel vane that is visible through the opening at the **6° mark.**

NOTE: Read **Important Note** with reference to Fig. 18 on page 6, for adjusting engine speed to 1800 r.p.m. for 6° advance timing.

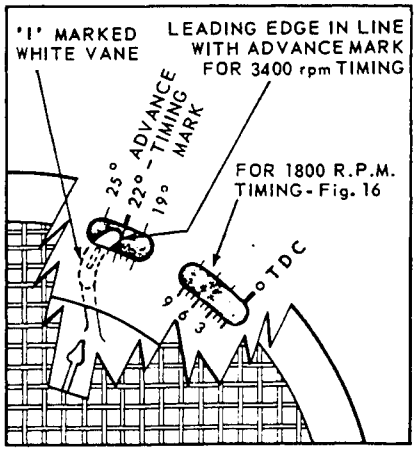


Fig. 15, SPARK ADVANCE VARIABLE HIGH SPEED

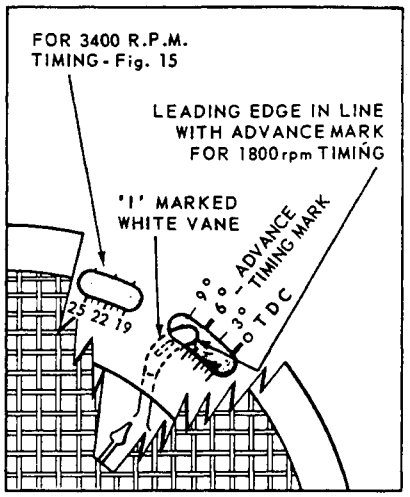


Fig. 16, SPARK ADVANCE FIXED LOW SPEED

TIMING CHECK AND ADJUSTMENT

IMPORTANT

It is necessary that the distributor breaker point gap be **.020 inch,** because any change in gap opening will affect the ignition advance. Check and adjust if necessary, per Distributor Breaker Point Adjustment paragraphs, before timing.

A **slotted opening** is provided on the rim of the flywheel screen so that timing can be checked without removing the screen.

Caution: Do not operate engine with screen removed from front face of shroud.

NOTE: Paint the **"I" marked** flywheel vane **white,** so that it will be clearly visible for checking with a **Timing Light.**

1. With reference to Fig. 17, insert a small screwdriver into the No. 1 terminal tower on the distributor cap, making contact with the spark plug wire terminal. Connect the red terminal clip, from a conventional automotive type **Timing Light,** to the metal portion of the screwdriver. One of the other two timing light wires is connected to the battery, and the other to the ground.

2. With reference to Fig. 15 and the engine operating at **3400 r.p.m.,** allow the flash from the timing light to illuminate the **"I" whitened** flywheel vane. At the time of the flash the **leading edge** of the vane should line up with the **22° Timing Mark** on the flywheel shroud.

2a. For fixed **low speed** applications, operate the engine at **1800 r.p.m.** and allow the flash from the timing light to illuminate the **"I" whitened** flywheel vane. At the time of the flash the leading edge of the vane should line up with the **6° Timing Mark** on flywheel shroud, as illustrated in Fig. 16.

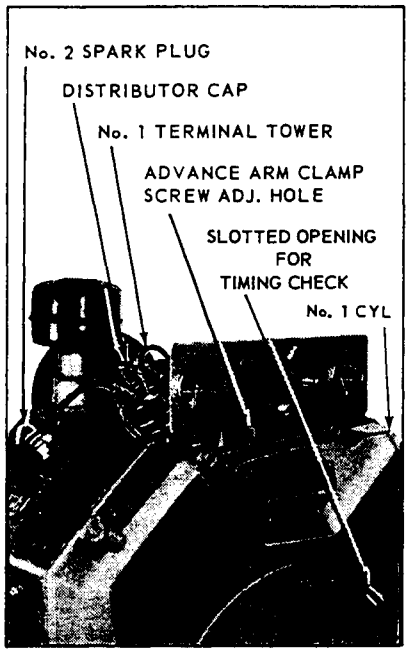


Fig. 17

3. If timing is incorrect, loosen the advance arm **clamp screw** at the base of the distributor. A screwdriver clearance hole is provided in the flywheel shroud as shown in Fig. 17.

   With the engine again running at timing speed turn the distributor body **very slightly** clockwise or counterclockwise as required, until **white vane** and **Timing Mark** do match up. Securely tighten clamp screw when satisfactory timing is accomplished.

IMPORANT

On fixed low speed applications timing should be adjusted to 6° before T.D.C. at 1800 r.p.m.

For engines where the governor is set to operate at low **fixed speed** other than 1800 r.p.m., a tachometer will have to be used, and the speed set at 1800 r.p.m. in the following manner, and with reference to **Fig. 18.**

1. Run engine at idle speed, **1000 r.p.m.**
2. Turn **Stop Screw** on carburetor throttle lever clockwise until engine speed reaches **1800 r.p.m.**
3. Proceed to check and adjust timing starting with paragraph 2a, page 5.
4. After timing is accomplished, turn stop screw on carburetor throttle lever counterclockwise until original idle speed of **1000 r.p.m.** is obtained.

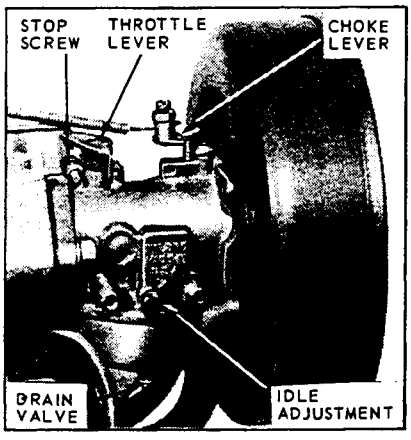


Fig. 18, CARBURETOR ADJUSTMENT

CLUTCH ADJUSTMENT

The clutch is an optional accessory furnished either as a power take-off unit, or a clutch reduction assembly.

If the clutch begins to slip, it should be readjusted to prevent it from becoming overheated and damaged. First, remove inspection plate to expose the **adjusting ring.** Release clutch by pushing **shifter lever forward** (toward engine).

CLUTCH, Fig. 19

Turn engine over until clutch **adjustment lock** is visible through the inspection opening. Loosen **adjustment lockscrew** one full turn. Keep clutch from turning by securing the crankshaft at flywheel end. Then, by means of a screwdriver, turn **adjusting ring** one notch at a time in a clockwise direction, until a very firm pressure (100 foot pounds torque) is required to snap the clutch into engaged position by means of the clutch shifter lever. Securely tighten adjustment lockscrew.

CLUTCH REDUCTION, Fig. 20

The clutch in the clutch reduction unit is the same as used in the power take-off unit and is adjusted through **two pipe tap openings;** one for the **adjustment lockscrew** and the other for turning the **adjusting ring.** There are **four adjusting plugs** in the housing to provide a means of adjusting the clutch regardless of what position the unit is mounted in.

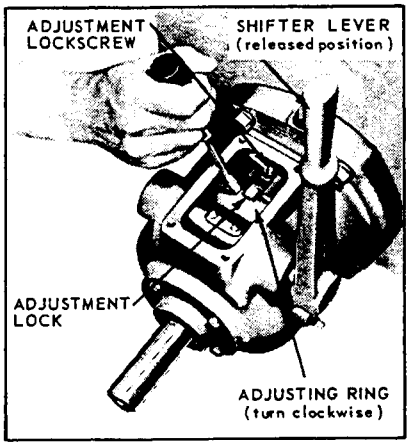


Fig. 19, CLUTCH ADJUSTMENT

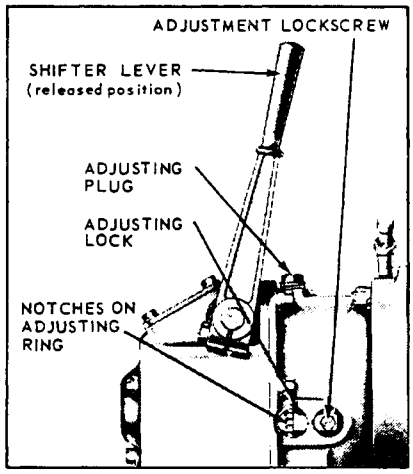


Fig. 20, CLUTCH REDUCTION ADJUSTMENT

Automotive Type Clutch should be adjusted per instructions on inspection plate attached to the clutch housing.

TROUBLE SHOOTING

The three prime requisites essential to starting and maintaining satisfactory operation of internal combustion engines are:

1. A **Proper Fuel Mixture** in the cylinder.
2. **Good compression** in the cylinder.
3. **Good Spark, Properly Timed,** to ignite the mixture.

If all three of these conditions do not exist the engine cannot be started.

As a guide to locating some of the difficulties in starting, **causes** are listed under the three main headings of:

Fuel Mixture, Compression, and **Ignition.**

FUEL MIXTURE

No fuel in tank or fuel valve closed.

Plugged vent hole in fuel tank cap.

Fuel line clogged.

Fuel pump diaphragm worn or punctured.

Carburetor not choked sufficiently, especially if engine is cold.

Water, dirt, or gum in gasoline interfering with free flow of fuel to carburetor.

Poor grade, stale or out-of-season gasoline.

Carburetor flooded, caused by too much choking especially if engine is hot.

Dirt or gum holding float needle valve in carburetor open. This condition would be indicated if fuel continues to drip from carburetor with engine standing idle.

Carburetor out of adjustment. Restricted (dirty) air cleaner.

COMPRESSION

Cylinders dry due to engine having been out of use. Pour one fluid ounce of crankcase oil through spark plug holes.

Loose or broken spark plug. A hissing noise will be heard in cranking due to escaping gas mixture on compression stroke.

Damaged cylinder head gasket or loose cylinder head. This will likewise cause hissing noise on compression stroke.

Valve stuck open. Piston rings stuck or worn.

Valves adjusted with insufficient clearance.

IGNITION

Test for spark by removing spark plugs and observe spark at plug gap while turning engine over. No spark or weak spark may be attributed to the following:

Ignition wires loose or disconnected at spark plug, distributor or coil.

Broken or frayed ignition wires.

Spark plug insulator broken.

Spark plugs wet or dirty.

Spark plug gap incorrect.

Condensation on spark plug electrodes.

Breaker point gap incorrect.

Breaker points pitted or fused.

Breaker arm sticking.

Condenser leaking or grounded.

Spark timing wrong.

Weak battery. Faulty ignition coil.

ENGINE MISSES

Spark plug gap incorrect.

Worn, leaking or loose ignition cables.

Weak spark. See "Ignition" test for spark.

Loose connections at ignition cables.

Breaker points pitted or worn.

Water in gasoline. Sticky valves.

Poor compression. See "Compression."

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

Gasoline vaporized in fuel lines, due to excessive heat around engine (Vapor Lock).

Vapor lock in fuel lines due to using winter gas (too volatile) in hot weather.

Air vent hole in fuel tank cap plugged.

Ignition troubles. See "Ignition."

OVERHEATING

Crankcase oil supply low.

Ignition timing wrong.

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins.

Intake screen clogged with dirt.

Restricted exhaust.

ENGINE SURGES OR GALLOPS

Carburetor flooded.

Governor spring hooked into wrong hole.

Governor rod incorrectly adjusted.

ENGINE KNOCKS

Poor grade gasoline or of low octane rating.

Operating under heavy load at low speed.

Loose or burnt out rod bearings.

Spark advanced too far.

Worn or loose piston pin.

Carbon or lead deposits in cylinder head.

BACKFIRES THROUGH CARBURETOR

Water or dirt gasoline.

Engine cold.

Poor grade of gasoline.

Sticky inlet valves.

Overheated valves.

Spark plug heat range incorrect (too hot).

Hot carbon particles in engine.

HIGH OIL PRESSURE

Oil pressure gauge defective.

Oil too heavy.

Faulty relief valve.

Clogged pressure line.

LOW or NO OIL PRESSURE

Oil pressure gauge defective.

Clogged oil lines or leaky connections.

Crankcase oil supply low.

Faulty relief valve.

Faulty oil pump.

Oil pump intake screen clogged.

Oil too thin (diluted or wrong grade).

Worn rod or crankshaft bearings.

For Your Record

MODEL	
SPEC NO.	
SERIAL NO.	

Copy the above from the Engine Name Plate. The Model, Spec No. and Serial No. must be given when requesting specific engine information and when ordering Service Replacement Parts.

Individual REPAIR and SERVICE PARTS CATALOGS available from all Wisconsin Distributors.

ENGINE MAINTENANCE SCHEDULE	Daily	Weekly or 50 hrs.	100 hrs.	250 hrs.
CHECK OIL LEVEL. Add to full mark — Do not overfill.	●			
CHECK AIR CLEANER. Shake out accumulated dirt from dry element.	●			
CLEAN AIR INTAKE SCREEN. Clean cooling fins if necessary.	●			
CLEAN AIR FILTER ELEMENT. Replacement Element LO 194 A		●		
CHANGE CRANKCASE OIL. Use grade and classification of oil recommended. In adverse conditions change oil every 50 hours of operation.			●	
REPLACE OIL FILTER every oil change. Replacement Filter RV 51			●	
INSPECT CRANKCASE BREATHER SYSTEM. Clean if necessary.			●	
DISTRIBUTOR. Apply 1 drop of light oil (10W) to breaker arm pivot.				●
INSPECT SPARK PLUGS and BREAKER POINTS. Replace if necessary and regap. (Spark Plugs .035 inch Std. — .030 inch Resistor Plug). (Breaker gap .020 inch)				●
INSPECT FUEL FILTER. Clean filter screen or strainer in fuel tank.				●
INSPECT COOLING SYSTEM. Remove shrouding and scrape off dirt from between fins, around cylinder, head and from shrouding.				●
INSPECT STARTING MOTOR. Check for loose mounting and cable connections.				●

ENGINE STORAGE

To protect the cylinders, pistons, rings and valves and keep them from rusting and sticking, a half-and-half mixture of kerosene and good "gasoline engine" oil (the same kind of oil as used in the crankcase of the engine), should be injected into the ***pipe tap*** opening on the ***intake manifold*** while the engine is warm and running at moderate speed. About a quarter of a pint is necessary, or enough so that a heavy bluish smoke will appear at the exhaust. The ignition switch should then be shut off and the engine stopped. This fogging operation will leave a coating of oil on the above mentioned parts, protecting them from the atmosphere.

Drain crankcase oil while engine is warm. Drain fuel lines, carburetor, fuel pump and tank, to prevent lead and gum sediment from interfering with future operation.

⚠ **Caution:** Gasoline fumes from gradual evaporation is a dangerous fire hazard.

The outside of the engine, including the cooling fins on the cylinder block and head, should be thoroughly cleaned of all dirt and other deposits. All exposed unpainted metal parts should be coated with grease or heavy oil.

Before starting the engine, after the storage period, remove crankcase drain plug so that any condensation which may have collected may be drained, before new crankcase oil is added. It is advisable to remove the engine oil pan and scrub off all sediment which may have collected there. Use a new gasket when reassembling the oil pan.

Use new spark plugs at the beginning of the operating interval, especially if the engine has given considerable service.

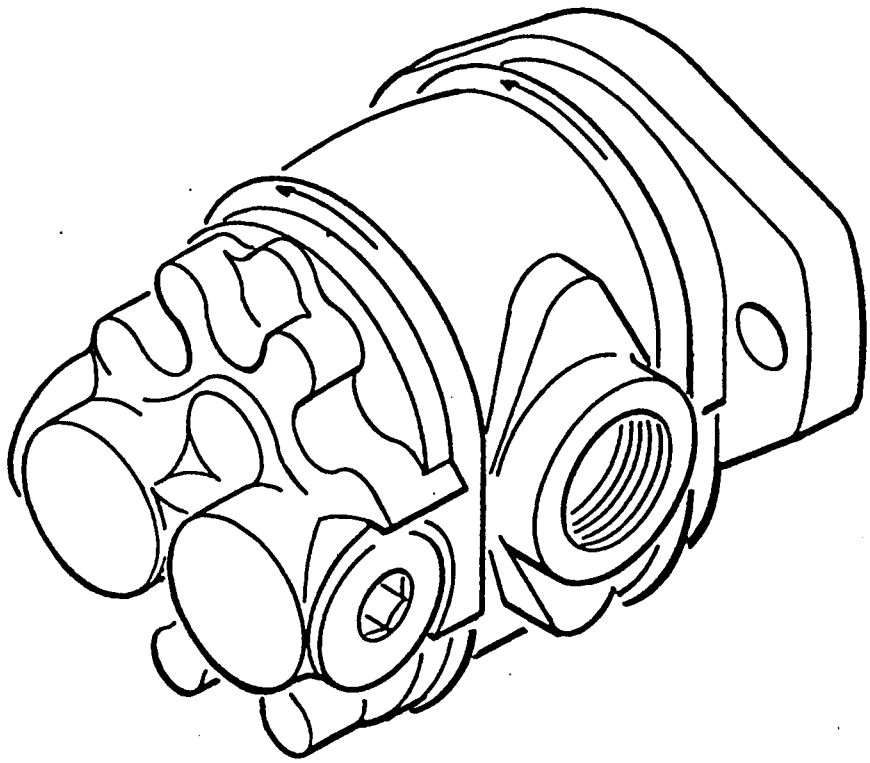
It is highly recommended that machines be stored inside a building through the winter. If this is not possible, the engine should be protected from snow and ice by a proper covering.

SERVICE AND PARTS
AVAILABLE FROM YOUR AUTHORIZED
TELEDYNE TOTAL POWER SERVICE CENTER

Headquarters
3409 Democrat Road
P. O. Box 181160
Memphis, Tennessee 38181-1160
Phone: (901) 365-3600
TELEX: 462-1058 (ITT)
CALL TOLL FREE 1-800-932-2858

European Office
Rue Joseph Deflandre, 13
B4920 Chaudfontaine (Liege)
Belgium
Phone: (32) (41) 67 53 20
TELEX: 42361 TDY TP B

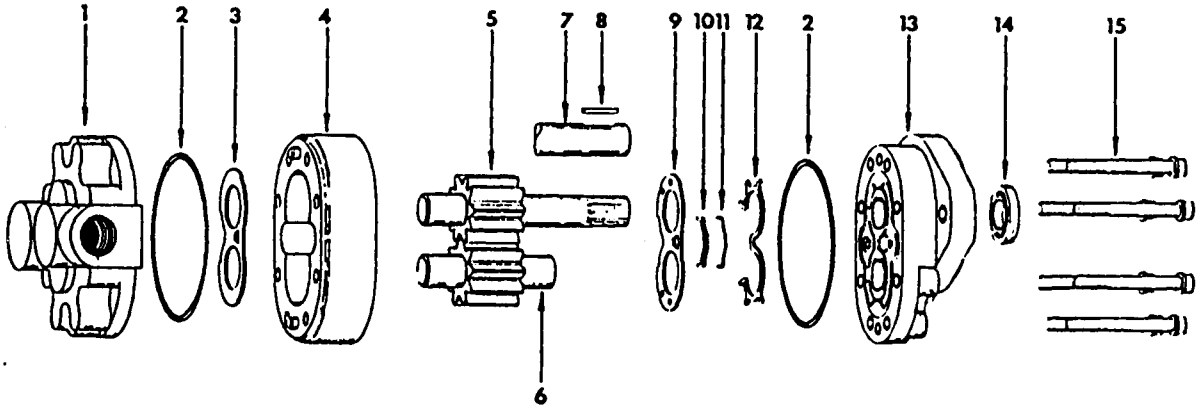
Service Manual



Model 25300 High Pressure Gear Pump

Inspection/Servicing

SINGLE PUMP



PARTS LIST

REF. NO.	DESCRIPTION	REQ'D. PER ASSY.	REF. NO.	DESCRIPTION	REQ'D. PER ASSY.
1	Back plate assembly	1	9	Wear plate	1
2	O-ring	2	10	Bearing seal	1
3	Optional thrust plate	1	11	Molded o-ring	1
4	Body	1	12	Back-up gasket	1
5	Spline drive gear assy.	1	13	Front plate assy.	1
6	Idler gear assy.	1	14	Shaft seal	1
7	Keyed drive gear assy.	1	15	Cap screw	8
8	Key	1			

Note: For pumps with Flow Divider, Flow Control or Relief Valve backplates refer to page 7.

DISASSEMBLY

1. Remove key (8) from drive shaft if keyed drive gear assembly (7) is used.
2. Thoroughly clean outside of pump.
3. Use sharp tool to mark across front plate, body and backplate. This will assure proper reassembly.
4. Clamp pump in vise, shaft up.
5. Remove cap screws (15) eight each.
6. Remove pump from vise, hold pump in hands and bump shaft against wooden block to separate front plate (13) from back plate (1). Body (4) will remain with either front plate or backplate.
7. If backplate was removed first, remove optional thrust plate (3) from body gear pockets (4). If the front plate was removed first, remove wear plate (9) from body gear pockets (4).
8. Remove drive gear assembly (5) or (7) and idler gear assembly (6) from body (4).
9. To separate body (4) from the plate it remains with, place drive gear assembly (5) or (7) in bushing and tap protruding end with plastic hammer or rawhide mallet.
10. Remove o-ring (2) from front plate (13) and backplate (1).
11. Remove back-up gasket (12) from front plate (13) by prying with a sharp tool.
12. Remove bearing seal (10) from front plate (13) by prying with a sharp tool.
13. Remove molded o-ring (11) from front plate (13).
14. Remove shaft seal (14) from front plate (13) by prying with a screwdriver.

INSPECT PARTS FOR WEAR

GENERAL

1. Clean and dry all parts.
2. Remove all nicks and burrs from all parts with emery cloth.

GEAR ASSEMBLY

1. Check drive shaft spline for twisted or broken teeth or check keyed drive shaft for broken or chipped keyway.
2. Inspect both the drive gear and idler gear shafts at bushing points and seal area for rough surfaces and excessive wear.
3. If shaft measures less than .748 in bushing area, the gear assembly should be replaced. (one gear assembly may be replaced separately; shafts and gears are available as assemblies only.)
4. Inspect gear face for scoring and excessive wear.
5. If gear width is below the following figures — the gear assembly should be replaced.

Pump Disp.	.50	.66	.84	1.02	1.20	1.37	1.54	1.69	1.87
Gear Width	.384	.510	.636	.762	.888	1.014	1.140	1.266	1.392

6. Be sure snap rings are in grooves on either side of drive and idler gears.
7. If edge of gear teeth are sharp, break edge with emery cloth.

FRONT AND BACKPLATE

1. Oil groove in bushings in both front plate and backplate should be in line with dowel pin holes and 180° apart. This positions the oil grooves closest to respective dowel pin holes.
2. If I.D. of bushings in front plate or backplate exceed .755 front or backplate should be replaced. (Bushings are not available as separate items.)
3. Bushings in front plate should be flush with face of front plate.
4. If optional thrust plate is not used, check for scoring on face of backplate. If wear exceeds .0015, backplate should be replaced.

BODY

1. Check inside gear pockets for excessive scoring or wear.
2. Body should be replaced if I.D. of gear pockets exceeds 1.713.

GENERAL INFORMATION

It is important that the relationship of the backplate, thrust plate, body, wear plate and front plate is correct. You will note two half moon cavities in the body which must face away from the front plate. Note: The smaller half moon port cavity must be on the pressure side of the pump. Side of thrust plate and wear plate with mid section cut out must be on suction side of pump. Suction side of backplate is always side with larger port boss.

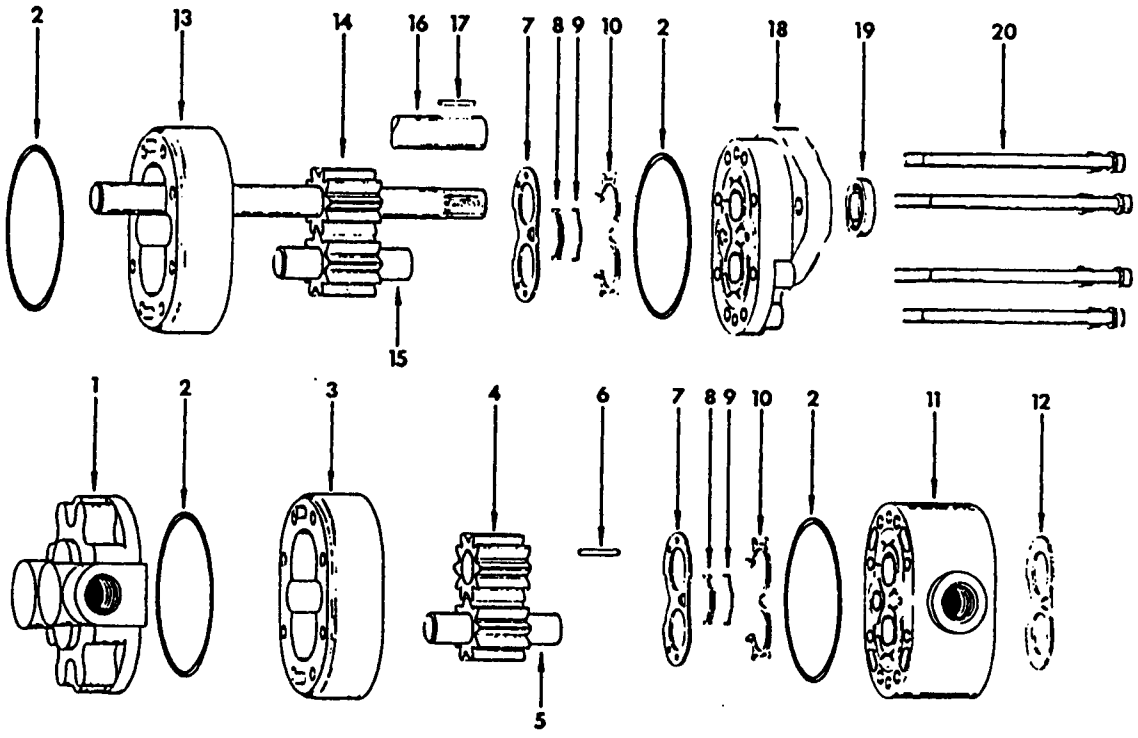
REASSEMBLY

1. The optional thrust plate, wear plate, bearing seal, molded o-ring, back-up gasket, shaft seal and o-rings should be replaced as new parts.
2. Install o-ring (2) in groove of front plate (13).
3. Tuck back-up gasket (12) into groove in front plate (13) with open part of "V" section down.
4. Place molded o-ring (11) in groove in front plate. Place bearing seal (10) over molded o-ring — groove side down.
5. Apply a thin coat of heavy grease to both milled faces of body. Slip body onto front plate — half moon port cavities in body must face away from front plate.

   Note: The small half moon port cavity must be on the pressure side of pump.
6. Place wear plate (9) on top of back-up gasket with bronze face up. The side with the mid section cut away must be on suction side of pump. (Be sure to note difference between wear plate (9) and optional thrust plate (3).
7. Dip gear assemblies into oil and slip into front plate bushings.
8. Install optional thrust plate (3) — bronze face toward gears. The side with mid section cut out must be on suction side of pump. Thrust plate must fit inside gear pockets.
9. Install o-ring (2) in groove in backplate (1).
10. Slide backplate (1) over gear shafts until dowel pins are engaged.
11. Install bolts (15). Tighten evenly to 25/28 ft. lbs. torque.
12. Liberally oil shaft seal (14) and carefully work over drive shaft being careful not to cut rubber sealing lip.
13. Place 1-5/16" O.D. sleeve over shaft and press in shaft seal (14) until flush with front surface of front plate.
14. Install key (8) on keyed shaft (7).

Note: Refer to Trouble Shooting and Start-up Procedure on page 6.

DOUBLE PUMP



PARTS LIST

REF. NO.	DESCRIPTION	REQ'D. PER ASSY.	REF. NO.	DESCRIPTION	REQ'D. PER ASSY.
1	Back plate assembly	1	11	Adapter plate	1
2	O-ring	4	12	Optional thrust plate	1
3	Rear body	1	13	Front body	1
4	Gear (slip fit)	1	14	Spline drive gear assy.	1
5	Idler gear assy. (rear)	1	15	Idler gear assy. (front)	1
6	Round key	1	16	Keyed drive gear assy.	1
7	Wear plate	2	17	Key	1
8	Bearing seal	2	18	Front plate assy.	1
9	Molded o-ring	2	19	Shaft seal	1
10	Back-up gasket	2	20	Cap screw	8

Note: For pumps with Flow Divider, Flow Control or Relief Valve backplates refer to page 7.

DISASSEMBLY

1. Remove key (17) if keyed drive gear assembly (16) is used.
2. Clean outside of pump thoroughly.
3. Use sharp tool to scribe a mark across all sections of the pump. This will assure proper reassembly.
4. Clamp pump in vise, shaft up and remove cap screws (20) eight each.
5. Remove pump from vise, hold pump in hands and bump shaft against wooden block to separate front pump sections. Body (13) will remain with either front plate (18) or adapter plate (11).
6. Remove idler gear (15) from either front plate or adapter plate.
7. Remove backplate (1) from body (3) by tapping on backplate with plastic hammer or rawhide mallet.
8. Remove idler gear (5), slip fit gear (4) and key (6). Remove drive gear assembly (14 or 16) from adapter plate. Remove optional thrust plate (12) from adaptor plate (11).
9. Place drive gear assembly in bushing and tap protruding end with plastic hammer or rawhide mallet to remove bodies (3) or (13) from plates they remained with.
10. Remove wear plate (7) from front plate (18).
11. Remove wear plate (7) from adapter plate (11).
12. Remove o-rings (2) from front plate (18), adapter plate (11), and backplate (1).
13. Remove back-up gasket (10), bearing seal (8) and molded o-ring (9) from front plate (18) and adapter plate (11) by prying out with a sharp tool.
14. Remove shaft seal (19) from front plate (18) by prying with a screwdriver.

INSPECT PARTS FOR WEAR

GENERAL

1. Clean and dry all parts.
2. Remove nicks and burrs from all parts with emery cloth.

GEAR ASSEMBLY

1. Check drive shaft spline (14) for twisted or broken teeth or check keyed drive shaft (16) for broken or chipped keyway. Check for broken keyway in shaft where slip fit gear is installed for double pump.
2. Inspect both the drive gear and idler gear shafts at bushing points and seal area for rough surfaces and excessive wear.
3. If shaft measures less than .748 in bushing area, the gear assembly should be replaced. (One gear assembly may be replaced separately; shafts and gears are available as assemblies only. The slip fit gear is available separately).
4. Inspect gear face for scoring and excessive wear.
5. If gear widths are below the following figures the gear assembly should be replaced.

Pump Disp.	.50	.66	.84	1.02	1.20	1.37	1.54	1.69	1.87
Gear Width	.384	.510	.636	.762	.888	1.014	1.140	1.266	1.392

6. Be sure retaining rings are in grooves on either side of drive and idler gears.
7. If edge of gear teeth are sharp, break edge with emery cloth.

FRONT PLATE, BACKPLATE & ADAPTER PLATE

1. Oil gooves in bushing in both front plate, backplate and adapter plate should be in line with dowel pin holes and 180° apart. This positions the oil grooves closest to the respective dowel pin holes.
2. If I.D. of bushings in front plate, backplate or adapter plate exceed .755 the front plate, backplate, or adapter plate should be replaced. (Bushings are not available as separate items).
3. Bushings in front plate and back-up gasket side of adapter plate should be flush with face.
4. If optional thrust plates are not used check for scoring on face of backplate and adapter plate. If wear exceeds .0015 backplate or adapter plate should be replaced.

BODY

1. Check inside gear pockets for excessive scoring or wear.
2. Body should be replaced if I.D. of gear pockets exceed 1.713.

GENERAL INFORMATION

It is important that relationship of the backplate, body, wear plate and front plate is correct. You will note two half moon cavities in the body which must face away from the front plate. Note: The smaller half moon port cavity must be on the pressure side of the pump. Side of thrust plate and wear plate with mid section cut out must be on suction side of pump. Suction side of backplate is always side with larger port boss.

REASSEMBLY

1. Optional thrust plate, wear plates, bearing seals, molded o-rings, back-up gaskets, shaft seal and o-rings should be replaced as new parts.
2. Install o-rings (2) in groove of front plate (18), adapter plate (11), and backplate (1) with a small amount of grease to hold in place.
3. Tuck back-up gasket (10) in front plate (18) and adapter plate (11) with open part of "V" section down.
4. Place molded o-ring (9) in groove in front plate and adapter plate. Place bearing seal (8) over molded o-ring, groove side down.
5. Apply a thin coat of heavy grease to both milled faces of body. Slip body onto front plate-half moon port cavities in body must face away from front plate. Note: The small half moon port cavity must be on the pressure side of pump.
6. Place wear plate (7) on top of back-up gasket with bronze face up. The side with the mid section cut away must be on suction side of pump.
7. Dip drive gear assembly (14 or 16) and idler gear assembly (15) into oil. Slip both gear assemblies into gear pocket of body and into front plate bushings.
8. Install optional thrust plate (12) into body (13) bronze face toward gears with mid section cut away towards suction side of pump.
9. Install adapter plate (11) in place on front body (13). Check positioning mark on all sections of pump.
10. Install second body (3) onto adapter plate (11) and install wear plate (7).
11. Install key (6) in slot of drive gear assembly shaft (14 or 16). Dip slip fit gear (4) in oil and slip on shaft and into gear pocket of body. Check key for proper location.
12. Dip idler gear (5) in oil and install in gear pocket of body (3).
13. Position backplate (1) over shafts until dowel pins in body are engaged.
14. Install cap screws (20). Tighten evenly to 25/28 ft. lbs. torque.
15. Work shaft seal (19) over drive gear shaft, being careful to not cut rubber sealing lip. (Oil seal liberally before installing). Place 1-5/16 O.D. sleeve over shaft and press in shaft seal (19) until flush with front surface of front plate.
16. Install key (17) on keyed shaft (16).

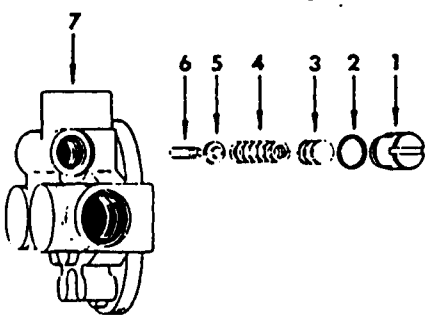
PLACING PUMP BACK INTO SERVICE

1. If shop test stand is available, the following procedure for testing rebuilt pumps is recommended:
   - A. Mount pump on test stand making sure that the proper level of clean oil is available in the reservoir. Check suction line for leaks and obstructions.
   - B. Start pump and run for three minutes at zero pressure.
   - C. Intermittently load pump to 500 P.S.I. for three minutes.
   - D. Intermittently load pump to 1000 P.S.I. for three minutes.
   - E. Intermittently load pump to 2000 P.S.I. for three minutes.
   - F. Remove pump from test stand and check for freeness of drive shaft. Check for leaks.
2. If shop test stand is not available, the following procedure for testing rebuilt pumps is recommended:
   - A. Mount pump on equipment and run pump at 1/2 engine speed at zero pressure.
   - B. By operating control valve build pressure intermittently for three minutes.
   - C. Increase engine speed to full throttle and build pressure intermittently for three minutes.
   - D. Idle engine and check for leaks.

SINGLE OR DOUBLE PUMP TROUBLE SHOOTING

PUMP TROUBLE	PROBABLE CAUSE	REMEDY
1. Noisy pump caused by cavitation.	a. Oil too heavy. b. Oil filter plugged. c. Suction line plugged or too small.	a. Change to proper viscosity b. Clean filters. c. Clean line and check for size.
2. Oil heating	a. Oil supply low. b. Contaminated oil. c. Setting of relief valve too high or too low. d. Oil in system too light.	a. Fill reservoir. b. Drain reservoir and refill with clean oil. c. Set to correct pressure. d. Drain reservoir and refill with proper viscosity oil.
3. Shaft seal leakage	a. Worn shaft seal. b. Worn shaft in seal area c. Broken bearing seal or back-up gasket d. Bushings out of position. e. Excessive internal wear.	a. Replace shaft seal. b. Replace drive shaft c. If replacing the shaft and shaft seal does not stop seal leakage, the pump should be disassembled and checked for items 3, c. & d. d. Disassemble pump and replace front plate. e. Disassemble pump inspect parts and replace as needed.
4. Foaming oil	a. Low oil level. b. Air leaking into suction line. c. Wrong kind of oil.	a. Fill reservoir. b. Tighten fittings. c. Drain and fill reservoir with non-foaming oil.

RELIEF VALVE BACKPLATE



PARTS LIST

REF. NO.	DESCRIPTION	REQ'D. PER ASSY.
1	Slotted plug	1
2	O-ring	1
3	Shims	As Reqd
4	Spring, Relief Valve	1
5	Plug Seat	1
6	Seat	1
7	Backplate	1

DISASSEMBLY

1. Use slotted socket and remove relief valve plug (1), shims (3), spring (4), plug seat (5) and seat (6) from backplate (7).

Note: Do not remove internal relief valve cartridge assembly. Cartridge assembly has been set to a predetermined depth with locktite applied.

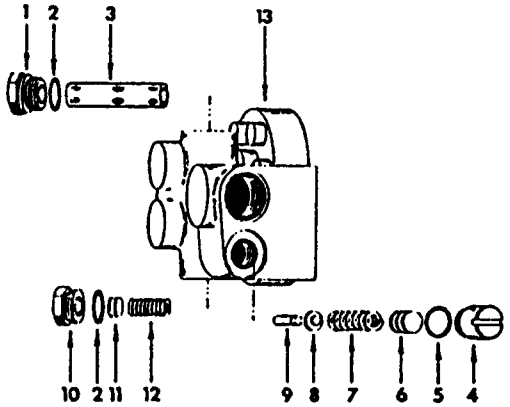
INSPECTION

1. Clean and dry all parts.
2. The o-rings need not be inspected as they should be replaced as new items.
3. Remove all nicks and burrs from all parts with emery cloth.
4. Oil grooves in bushings should be in line with dowel pin holes and 180 degrees apart. This positions the oil grooves closest to the respective pin holes.
5. If I.D. of bushings in backplate exceed .755, the backplate should be replaced. (Bushings are not available as separate items).
6. If optional thrust plate is not used, check for scoring on face of backplate. If wear exceeds .0015, backplate should be replaced.
7. Check shims (3) for wear.
8. Check spring (4) for weakness or breakage.
9. Wash backplate in clean solvent, direct compressed air into relief valve cavity in backplate to dry relief valve cartridge assembly. The procedure removes any trapped contamination.

REASSEMBLY

1. Install relief valve parts in backplate (7), seat (6), plug seat (5), spring (4), same number of shims (3), new o-ring (2) on plug (1) and torque plug to 21 to 24 ft. lbs.

FLOW DIVIDER/FLOW CONTROL BACKPLATE



PARTS LIST

REF. NO.	DESCRIPTION	REQ'D. PER ASSY.
1	Hex Plug	1
2	O-ring	2
3	Flow Divider Spool	1
4	Slotted Plug	1
5	O-ring	1
6	Shims	As Req'd
7	Spring, Relief Valve	1
8	Plug Seat	1
9	Seat	1
10	Hex Plug	1
11	Shims	As Req'd
12	Spring, Flow Divider	1
13	Backplate	1

DISASSEMBLY

1. Use slotted socket and remove relief valve plug (4), shims (6), spring (7), plug seat (8) and seat (9) from backplate (13).
   Note: Do not remove internal relief valve cartridge assembly. Cartridge assembly has been set to a predetermined depth with locktite applied.
2. Remove plug (1), spool (3), plug (10), shims (11) and spring (12) from backplate (13).

INSPECTION

1. Clean and dry all parts.
2. The o-rings need not be inspected as they should be replaced as new items.
3. Remove all nicks and burrs from all parts with emery cloth.
4. Oil grooves in bushings should be in line with dowel pin holes and 180 degrees apart. This positions the oil grooves closest to the respective pin holes.
5. If I.D. of bushings in backplate exceed .755 the backplate should be replaced. (Bushings are not available as separate items).
6. If optional thrust plate is not used, check for scoring on face of backplate. If wear exceeds .0015, backplate should be replaced.
7. Inspect backplate spool bore for scoring or contamination.
8. Inspect spool O.D. for scratches, it should be smooth and free of nicks and burrs. Spool should slide freely inside backplate bore.
9. Check shims (6) and (11) for wear.
10. Check springs (7) and (12) for weakness or breakage.
11. Wash backplate in clean solvent, direct compressed air into relief valve cavity in backplate to dry relief valve cartridge assembly. The procedure removes any trapped contamination.

REASSEMBLY

1. Install relief valve parts in backplate (13), seat (9), plug seat (8), spring (7), same number of shims (6), new o-ring (5) on plug (4) and torque plug (4) to 21 to 24 ft. lbs.
2. Install flow divider parts in backplate (13) spool (3), spring (12), same number of shims (11), new o-rings (2) on plugs (1) and (10) and torque plugs (1) and (10) to 27 to 30 ft. lbs.

FLOW DIVIDER/FLOW CONTROL TROUBLE SHOOTING

FLOW DIVIDER TROUBLE	PROBABLE CAUSES	REMEDY
1. External leakage.	a. Spool plug o-ring. b. Relief valve plug o-ring.	a. Remove spool plug and replace o-ring. b. Remove relief valve plug and replace o-ring.
2. Low priority pressure.	a. Low relief valve setting.	a. Replace weak or broken spring. b. Shim as required. c. Replace backplate assy.
3. Low priority flow.	a. Relief valve open or leaking. b. Scratched machined sealing surface in relief valve. (Either in seat or poppet within cartridge) c. Contaminant lodged in relief valve. d. Missing spring shims. e. Weak Spool spring.	a. Replace weak or broken spring. b. Replace parts as required. c. Clean relief valve cavity. d. Add shims as required. e. Replace spool spring.
4. No priority flow.	a. Broken spool spring. b. Orifice inside spool plugged.	a. Replace spool spring. b. Check for contaminant lodged in orifice.
5. No secondary flow.	a. Spool sticking.	a. Remove and clean spool bore.
6. Low secondary flow.	a. Pump flow degradation due to wear.	a. Check pump for worn parts and replace.

SERVICE BULLETINS

As we make improvements to the **MARKLIFTS**, we like to supply you, the customer, with updated information which applies to your machine.

This section is provided as a place to store Service Bulletins as you receive them from MARK INDUSTRIES.