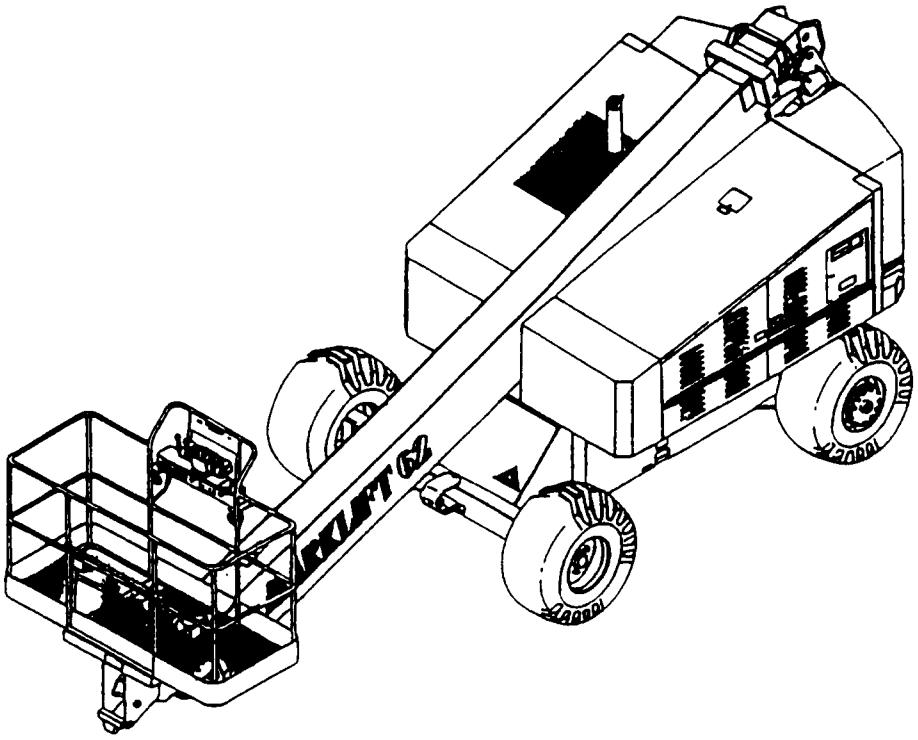
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED BOOM OPERATION MAINTENANCE AND PARTS MANUAL



MODEL 62 4X2

FIRST EDITION: August 1980

REV. 6: July 1990

Mark Industries

106 12th Street S.E.
Waverly, Iowa 50677-9466
TEL. (319) 352-3920, FAX (319) 352-5727

17111

This manual contains important information pertaining to the use and maintenance of the Marklift. A copy of the manual is provided by Mark Industries to the original purchaser * of the machine and must be made readily available to persons performing maintenance and inspection. **THIS MANUAL MUST ACCOMPANY THE MACHINE AT THE TIME OF ANY SUBSEQUENT SALE.**

Apart from the material contained in this manual, Mark Industries may send out service bulletins that pertain to this machine. These bulletins are sent to the original purchaser * of the Marklift. If you have purchased the Marklift from an authorized Marklift Dealer, you will be contacted by the dealer to perform any service that may be required per the bulletin. Since the bulletins may pertain to important safety matters, you are requested to notify your local Marklift dealer of any subsequent sale and keep him updated as to the ownership. Please provide the name of a responsible contact to whom they can direct correspondence.

If you feel you have not been provided all applicable service bulletins by the seller of the machine, copies of a volume of service bulletins for a series of years may be purchased through your local Marklift dealer. If you have trouble locating a Marklift dealer you may call Mark Industries at the phone number given below. You will be directed to the dealer closest to you.

1-800-736-MARK (Outside California)
1-714-879-6275 (California)
Ask for the Customer Service Engineering Department when calling.

It is recommended that the owner of the Marklift maintain copies of all service bulletins and maintenance records.

For your future reference write down the name, address and phone number of the Marklift dealer closest to you:

Name: _____
Address: _____
Phone: _____

* Dealer or distributor who originally purchased the machine from Mark Industries or other parties who purchased the machine from Mark Industries.

REGULATIONS PERTAINING TO YOUR MARKLIFT

There are certain OSHA, ANSI and other governmental regulations that apply to the design, manufacture, maintenance and use of this equipment. You must keep a copy of the regulations and follow their requirements. You can obtain a copy of the OSHA regulations from your local OSHA office and a copy of the ANSI regulations from the following address:

American National Standards Institute
Attention: Sales Department
1430 Broadway
New York, NY 10018

Copies of other regulations can be obtained by contacting the local office of the agency publishing the regulation.

NOTICE TO USERS REGARDING REPORTING OF INCIDENTS INVOLVING THE Marklift

Should this Marklift be involved in an incident, please inform the nearest Marklift dealer immediately.

If you are not able to locate the dealer, you may call Mark Industries at the phone numbers given below:

(714) 879-MARK

(800) 736-MARK (Outside California only.)

OPERATOR TRAINING TIPS

Following are some suggestions on how to provide proper training to all operators of the Marklift. The operators must be adequately trained in accordance with the requirements of the manufacturer, OSHA, ANSI and other agencies regulating such equipment.

1. Have the operator read the Operation & Safety Handbook.

2. Show the operator important parts and features of the machine and how to use/ operate them. Some important components/features that must be pointed out and explained are:

   (1) Controls
   (2) Warnings
   (3) Decals
   (4) Maximum capacity
   (5) Safety features of the machine
   (6) Emergency Lowering
   (7) Use of stabilizers (If included)
   (8) What to do in emergencies
   (9) Hazards that must be avoided

3. Safety videos for the type of machine that will be used, if available, may be shown.
4. Give the operator a demonstration i.e. operate the machine while he watches.

5. Have the operator operate the machine while you supervise and instruct him in proper operation.

6. Have the operator acknowledge the fact that he has received training by signing a copy of the operators statement in the Operation and Safety Handbook.

NOTE:
See ANSI, OSHA and other applicable standards for operator training requirements.

TABLE OF CONTENTS

GENERAL

Introduction 1

Specifications 2

New Equipment Condition Report 3

Warranty 4

Warranty Registration 5

Loading/Unloading Procedures 6-7
- Figure 1: Park Brake Control Valve
- Figure 2: Loading onto The Truck
- Figure 3: Securing the Marklift

Inspection and Checkout 9

Marklift Safety 11
- Division of Industrial Safety 13
- Decals 16
  - General Decal Listing 17
  - Warning, Caution, Danger, and Emergency Decals 18

OPERATIONS

Towing Instructions 1

General Operating Instructions 2-6
- Starting
- Drive
- Steering
- Lift/Lower
- Extending/Retracting
- Turret Rotation
- Platform Tilt
- Platform Rotation
- Warning light and Buzzer
- Stopping

MAINTENANCE

Preventive Maintenance 1

Recommended Service Instructions 3

Battery Maintenance 5-6
- Battery Fill Instructions .....
- Avoid Battery Hazards .....
- Battery Hydrometer Reading .....

Cold Weather Protection 7

Torque Hub Lubrication 8

Retraction Cable Tensioning Instructions 9

Troubleshooting 10
- Troubleshooting Checklist 14

Hydraulic Fluid Table 16

Recommended Spare Parts List 17

SCHEMATICS

Electrical Schematic (Wisconsin Gas) 1

Electrical Schematic (Nissan Gas) 3

Electrical Schematic (Deutz Diesel) 5

Hydraulic Schematic 7

PARTS

Marklift Parts Catalog ..... Section 1

Final Assembly ..... Section 2

Carriage Assembly ..... Section 3

Turret Assembly ..... Section 4

Boom Assembly ..... Section 5

Options ..... Section 6

VENDOR

Wisconsin Engine ..... Section 1

Torque Hydraulic Motor ..... Section 2

Minipak ..... Section 3

Nissan Diesel Engine ..... Section 4

Deutz Engine ..... Section 5

Eaton Hydraulic Motor ..... Section 6

Mico Disc Brake ..... Section 7

Torque Hub ..... Section 8

Nissan Industrial Engine ..... Section 9

Brake ..... Section 10

Helac Pivot Rotary Actuators ..... Section 11

Fairfield Torque Hub ..... Section 12

Description	Model
	62 4X2
Height	
Working (maximum)	68'4" (20.83m)*
Platform (maximum)	62'4" (19.0m)**
Lowered (minimum)	8'3" (2.51m)
Load capacity (unrestricted)	800 lbs (363 kg)
Platform dimensions	71" x 30" x 40" (1.8m x 76m x 1.01m)
Horizontal reach (maximum)	48'9" (14.86m)
Length (minimum)	23'4" (7.11m)
Width (maximum)	7'11" (2.41m)
Wheel base	8' (2.44m)
Wheel track	6'8" (2.03m)
Turret tailswing	7'3" (2.21m)
Turret rotation	360° continuous
Travel speed (proportional)	0-3 mph (0-4.8 km/h)
Controls	Proportional and solenoid
Turning radius (inside)	12' (3.65m)
Tires	15 x 19.5 12 ply rating
Power source	37 hp Wisconsin, gasoline (air cooled)
Fuel tank capacity	30 gal. (113.5 l)
Hydraulic system	Load sensing and pressure compensating
Hydraulic reservoir capacity	40 gal. (151.4 l)
Boom elevation	+75° above horizontal -20° below horizontal
Weight	24,000 lbs. (10,886 kg)
Shipping cube	1490 cu. ft. (42.17 m^3)

*Optional platform rotation decreases platform capacity to 700lbs.

**24'2" (7.36m) with platform rotation

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

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

		YES	NO	NA
1.	Platform capacity decal _____. lbs.	☐	☐	☐
2.	All warning, caution and emergency decals installed	☐	☐	☐
3.	Operation instructions properly installed	☐	☐	☐
4.	Operation and safety handbook received	☐	☐	☐
5.	All controls (aerial & ground) are identified and operate correctly	☐	☐	☐
6.	Stop switches operate properly (aerial & ground)	☐	☐	☐
7.	Platform guard rails and other hardware, secure and undamaged	☐	☐	☐
8.	Platform access gate works properly	☐	☐	☐
9.	Horn and beacon operate properly	☐	☐	☐
10.	110V generator operates properly	☐	☐	☐
11.	Brakes adjusted and operate correctly	☐	☐	☐
12.	Circuit breakers operate properly	☐	☐	☐
13.	All hydraulic cylinders free of leaks	☐	☐	☐
14.	All hydraulic cylinder rods free of paint or scratches	☐	☐	☐
15.	Hydraulic pump free of leaks	☐	☐	☐
16.	Hydraulic hoses and fittings tight	☐	☐	☐
17.	Hydraulic oil to proper level	☐	☐	☐
18.	Hydraulic tank and fittings free of leaks	☐	☐	☐
19.	Drive motors free of leaks	☐	☐	☐
20.	Wheel lug nuts torqued to _____. Ft. lbs	☐	☐	☐
21.	Battery water level _____.	☐	☐	☐
22.	Manual overrides operate properly	☐	☐	☐
23.	All electrical connections tight	☐	☐	☐
24.	Valve manifold and fittings free of leaks	☐	☐	☐
25.	Emergency descent valve functions properly	☐	☐	☐
26.	System pressure (PSI) P1 _____ P2 _____.	☐	☐	☐
27.	Stand-by pressure _____. PSI	☐	☐	☐
28.	Tire pressure _____ PSI	☐	☐	☐
29.	Drive wheel, torque hub oil level _____.	☐	☐	☐
30.	Engine R.P.M at idle _____ at high throttle _____.	☐	☐	☐
31.	Turret rotation gear box oil level _____.	☐	☐	☐
32	Turret ring gear bolts torqued to _____ Ft. lbs	☐	☐	☐
33.	Base ring gear bolts torqued to _____ Ft. lbs	☐	☐	☐
34.	Engine coolant (radiator) to proper level	☐	☐	☐
35.	Coolant hoses and fittings free of leaks	☐	☐	☐
36.	Electric radiator fan operates properly	☐	☐	☐
37.	Fuel tank and fitting free of leaks	☐	☐	☐
38.	Muffler is tight and free of leaks	☐	☐	☐
39.	Engine oil to proper level	☐	☐	☐
40.	Engine oil filter free of leaks	☐	☐	☐
41.	Engine alternator functions properly	☐	☐	☐
42.	Retraction cable tension _____ Ft. lbs	☐	☐	☐

MODEL
SERIAL NUMBER
INSPECTOR

OPTIONS

MANUFACTURERS' LIMITED WARRANTY

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

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

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

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

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

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

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

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

Warranty effective as of 2/90

Mark Industries

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

714-879-6275 800-448-MARK

TELEX 194402 FAX 1-714-879-8884

WARRANTY REGISTRATION

Purchaser/Dealer:

Company Name:

Address:

Telephone:

Date shipped (from invoice):

Date shipment received:

Date unit put into service:

Unit will be placed in rental fleet:

Unit will be sold:

Unit will be used for:

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

Comments: _____

Inspection completed by: Title:

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

IMPORTANT:	Due to the width of the Marklifts and the overall width of the transport vehicle, **extreme caution must be taken when loading and unloading.**

When loading and unloading Marklifts onto a transport vehicle, 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.**

1. Make sure that the parking brake is set to start braking immediately by fully opening the parking brake control severity valve.

2. If the unit has a High/Low drive speed option, it must be in **LOW DRIVE** at all times when loading and unloading.

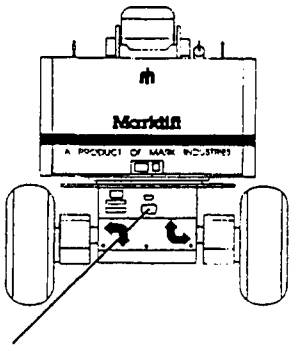


Figure 1: Parking Brake Control Valve

LOADING

1. With the transport vehicle on level ground, align the tires of the Marklift with the back end of the transport vehicle.

2. Attach the winch cable to the boom at the drive wheel end of the base through the tow or lift eyes if provided. (See Figure 2.)

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

4. When the unit is on the truck and its weight has been properly distributed, tie the boom down as shown in Figure 3 of this instruction.

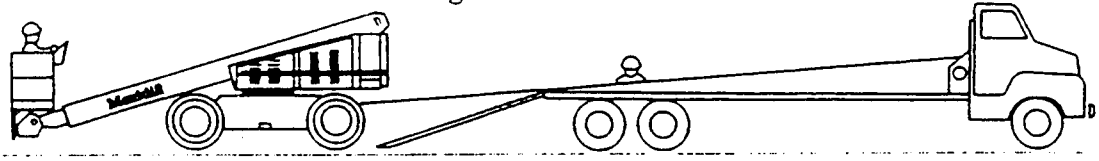


Figure 2: Loading the Marklift onto the truck

Note: Secure the platform to the carriage and tie the Marklift to the truck as shown.

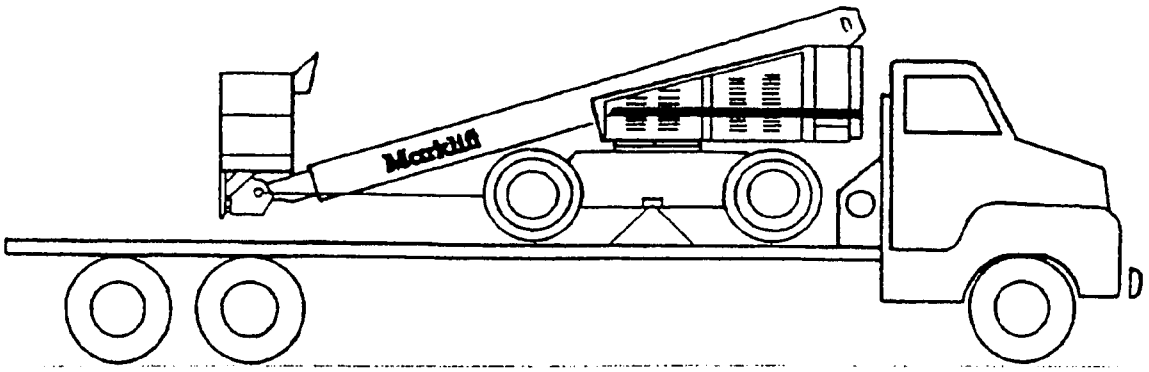


Figure 3: Securing the Marklift to the Platform

UNLOADING

1. With the transport vehicle on level ground, disconnect the tie-downs from the Marklift and make sure that the winch cable is still properly attached to the boom.

2. Select the low drive speed.

3. Use great care while driving and steering the unit off the transport vehicle. Keep all slackout 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 if the unit descends too fast.

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

5. Readjust 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

approximately 1/8 turn then place the unit on a flat, level surface, about 10' wide x 30' long. Position the boom slightly below horizontal and completely retract. Select "High" throttle at the platform console. Drive the Marklift with the controller handle in the "full on" (maximum) position, approximately 15 feet, letting go of the controller when the wheel is next to a visual marker on the ground. A good deceleration and braking distance would be slightly less than 3 feet measured from the marker to the center line of the same wheel after the unit has completely stopped. Adjust the valve on the parking brakes to reach this position. Repeat this procedure, driving in both directions until the Marklift comes to a complete stop within approximately three feet.

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

Before Operating The Marklift, Review The Followiing Procedures:

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 unleaded gasoline or switch to propane.

5. Check battery for a specificty reading of1.200 ± 50 reading on the hydrometer. Charge battery if reading is below 1.100 (see Battery Maintenance).

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

7. Position the ground/aerial selector switch to "Ground" then start the unit and operate the function switches, moving as follows: Boom UP/DOWN, rotation RIGHT/LEFT, and extend OUT/IN. Check for any leaks.

8. After the ground control functions have been checked-out, position the selector switch to "Aerial" for operation at work platform. After entering the platform, depress the footswitch before using any control function switches. This increases engine RPM (if throttle HIGH-LOW selector is positioned to High) and electrically completes the circuit to the controls.

9. Your Marklift is equipped with proportional controls, including drive. When using any proportional function, depress the footswitch, raise the controller locking device, if provided, then gradually move the controller in the desired direction. The controller handle is spring-centered and will return to the "off" position when released.

10. The normal travel or drive configuration is with the boom located over the steering wheels. This provides the best weight distribution for maximum traction. If the boom is rotated 180° the drive and steer decals read in reverse therefore the operator must reverse the drive and steer functions in order to continue in the forward direction. The arrow type decals on each end of the base will show the direction correctly, regardless of the turret's position.

11. Brake adjustments may be made by turning the parking brake severity control. This valve is merely a time delay for applying the brakes. With the valve completely open, the time delay for applying the brakes is minimum. Set the delay valve to stop the machine in approximately three feet on level ground while driving in high speed.

The Marklift conforms to specified **ANSI & OSHA** requirements, it is the responsibility of the owner to instruct the operators about safety requirements made not only by Mark Industries, but by the various safety boards in your area, as well as requirements set forth by **ANSI & OSHA.**

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. **Every operator of the Marklift must read, understand and follow the safety rules set forth herein.**

1. Inspect the machine periodically as specified in the Inspection and Checkout, and the Preventive Maintenance sections and as required by ANSI, OSHA, local safety boards and the owner. All unsafe items must be corrected by a qualified serviceperson 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 load evenly over platform floor area.

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

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

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

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

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

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

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

13. Under no circumstances should horseplay be tolerated on the Marklift.

14. **Do Not** operate boom functions on more than a 5° front to rear or side to side out-of-level condition.

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

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

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

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

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

20. **Do Not** jump start other vehicles using the Marklift battery.

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

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 acci dental contact with said high-voltage lines has been effectively guarded against.

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

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

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

TABLE X

Required clearances from Overhead High-Voltage Lines

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

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

Article 86. Provisions for Preventing Accidents

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

(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.

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	-	750,000	16
over	750,000	-	1,000,000	20

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

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

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

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

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

Observe all danger, warning, caution and emergency decals at the various locations on the Marklift in order to take timely preventive and corrective actions.

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

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

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

- Danger (Indicated in red):
  Immediate hazards which **Will** result in severe personal injury or death.

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

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

P/N	DESCRIPTION 62 4X2	LOCATION	QTY
66603	Decal Set	All Standard Decal	1
20460	Ground Control Console	Ground Control Box	1
20413	Engine Choke	Ground Control Box	1
22571	Aerial Control Switches	Aerial Control Box	1
20444	5° Slope	Aerial Control Box	1
21236	Marklift Boom	Final Assembly	2
20409	Standard Pedestal (Marklift)	Final Assembly	1
20410	Logo Mark Industries	Final Assembly	1
20411	Blue Stripe (Square End)	Final Assembly	6
20412	Blue Stripe (Round End)	Final Assembly	1
20556	Load Capacity 800 lbs.	Final Assembly	1
181103	Danger obey the following...	Final Assembly	2
181102	Danger Do Not Operate	Final Assembly	2
20419	Danger Keep Clear	Final Assembly	3
20461	Forward Arrow	Final Assembly	1
20462	Forward Arrow Aft	Final Assembly	1
20495	Emergency Ground Controls	Final Assembly	1
20896	Brake	Final Assembly	1
22386	"D" Ring Attach Safety Belt	Final Assembly	2
21235	Emergency Descent (Valve Type)	Final Assembly	1
20508	Transportation	Final Assembly	2
21227	62	Final Assembly	2
2017	Hydraulic System Fluid	Final Assembly	2
2020	Gasoline or Petrol	Final Assembly	2
20859	Caution Aerial Operating Instructions	Final Assembly	1
20860	General Checkout & Operating Instructions	Final Assembly	1
21237	Grease Fitting	Final Assembly	3
20420	Tire Pressure 75 PSI	Final Assembly	2
20660	Identification Nameplate	Final Assembly	1
2003	Battery Water Level	Final Assembly	1
20661	ANSI Plate A92	Final Assembly	1

ATTACH SAFETY BELT

22386

LOAD CAPACITY 800 LBS.
(EVENLY DISTRIBUTED LOAD)

20556

2020

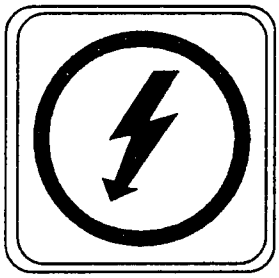
GASOLINE OR PETROL

DANGER

ELECTROCUTION HAZARD
KEEP CLEAR

DEATH OR SERIOUS INJURY CAN RESULT FROM CONTACT WITH THIS EQUIPMENT OR VEHICLE IF IT SHOULD BE ELECTRICALLY CHARGED

20419



! DANGER

AN UNTRAINED OPERATOR
SUBJECTS HIMSELF AND
OTHERS TO

DEATH AND SERIOUS INJURY

YOU MUST NOT OPERATE
THIS "Marklift®" UNLESS
YOU HAVE BEEN TRAINED IN THE SAFE
OPERATION OF THIS MACHINE.

YOU READ, UNDERSTAND AND FOLLOW
1) THE "OPERATION AND SAFETY HANDBOOK"
FOR THIS MODEL.
2) YOUR EMPLOYER'S RULES.
3) APPLICABLE GOVERNMENT REGULATIONS.

YOU INSPECT UNIT AND ALL FUNCTIONS.

! DANGER

FAILURE TO OBEY THE FOLLOWING

CAN RESULT IN
DEATH OR SERIOUS INJURY
TO YOU OR OTHERS

• UNLAWFUL TO OPERATE THIS "Marklift®" WITHIN 10 FEET (3.05 METERS) OF HIGH VOLTAGE LINE UP TO 50,000 VOLTS.

VOLTAGE (PHASE TO PHASE)	MINIMUM SAFE APPROACH DISTANCE (FEET)	(METERS)
OVER 50,000 TO 200,000 VOLTS	15	4.60
OVER 200,000 TO 350,000 VOLTS	20	6.10
OVER 350,000 TO 500,000 VOLTS	25	7.62
OVER 500,000 TO 750,000 VOLTS	35	10.67
OVER 750,000 TO 1,000,000 VOLTS	45	13.72

• ATTACH YOUR SAFETY BELT FIRST!
• BE SURE TO USE ALL SAFETY EQUIPMENT AS REQUIRED BY O.S.H.A.
• DO NOT LOAD BEYOND RATED CAPACITY.

The Marklift may be towed for a distance no greater than one (1) mile at a speed not to exceed 8 MPH. These instructions are for units equipped with a towing package.

To tow the Marklift:

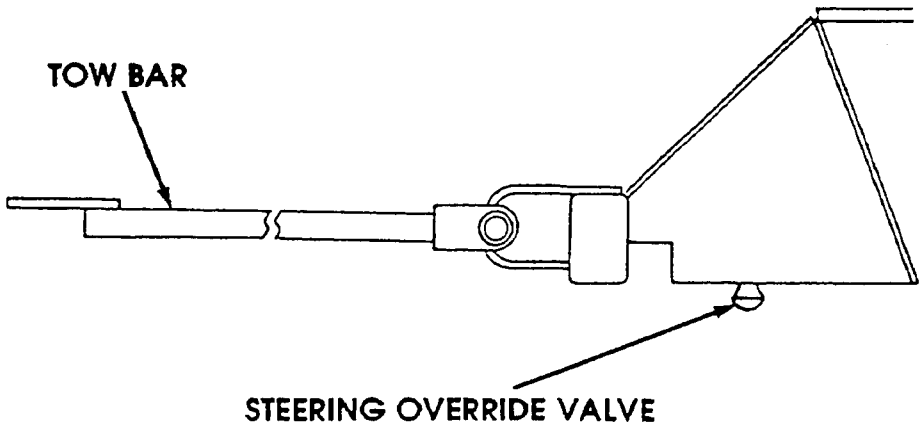
1. Attach the tow bar from the Marklift to the towing vehicle.

2. The torque hub **must** be disengaged.

   To disengage the torque hub, reverse the disconnect cap. The knob on the cap disengages the drive hub input shaft. **The brakes are also disengaged.**

Caution:	**Do not disengage torque hubs unless unit is parked on level ground and the wheels are blocked.**

3. Pull down the manual steering override valve handle.



Caution: Brakes are disengaged.

Caution: Do not tow faster than 8 miles per hour.

These instructions do not propose to be all inclusive, nor to supplement or replace other additional safety and/or precautionary measures covering usual or unusual conditions. If these instructions conflict in any way with the state, local or federal statute or regulations, said statute or regulations shall supersede these instructions, and it shall be the responsibility of each user to comply therewith, and inform Mark Industries of the variances.

The following are applicable excerpts from the federal register, title 29, chapter XVII, O.S.H.A - 1926.556.

"EXTENSIBLE AND ARTICULATING BOOM PLATFORMS"

1. Lift controls shall be tested each day, prior to use, to determine that such controls are in safe and working condition.

2. Only authorized persons shall operate an aerial lift.

3. Belting off to an adjacent pole, structure, or equipment while working from an aerial lift shall not be permitted.

4. Employees shall always stand firmly on the floor of the basket, and shall not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.

5. A body belt shall be worn and a lanyard attached to the boom or basket when working from an aerial lift.

6. Boom and basket load limits specified by the manufacturer shall not be exceeded.

7. Articulating boom and extensible boom platforms, primarily designed as personnel carriers, shall have both platform (upper) and lower controls. Upper controls shall be in or beside the platform within easy reach of the operator. Lower controls shall provide for overriding the upper controls. Controls shall be plainly marked as to their function. Lower level controls shall not be operated unless permission has been obtained from the employee in the lift, except in case of emergency.

8. Climbers shall not be worn while performing work from aerial lift.

9. Before moving an aerial lift for travel, the boom(s) shall be inspected to see that it is properly cradled.

It shall be the responsibility of all Marklift operators to read and act according to the following operating instructions. The purpose of these instructions is to promote safety and a better understanding of the functions of the Marklift self-propelled boom.

DUAL FUEL SYSTEM

The 62 4x2 Marklift is equipped with a dual fuel system which allows the operator to select gasoline or propane operation. The 3-position selector switch, located on the aerial control console, energizes solenoid valves which close one fuel line and open the other.

1. **STARTING**

The engine should be started with propane. The propane system bypasses the fuel pump and carburetor bowl and supplies fuel directly into the carburetor for quick starting. If the engine has been running on propane and an attempt is made to start the machine using gasoline, more than normal cranking is required for the fuel pump to fill the lines and carburetor bowl with gasoline. This will result in some battery drainage.

Turn the master switch at the ground control station to "ON". Position the selector switch to "Aerial". Enter the platform and **attach safety belt**. Turn the start lever lever to the start position, **do not** depress the footswitch, when the engine starts, release the switch. Note: if the engine fails to start and the switch has been released, it will be necessary to turn the switch to the "Off" position before attempting to turn to the "Start" position again.

Switching From Propane to Gasoline

With the engine running, step on the deadman footswitch and position the throttle switch to "HI" speed. Switch the fuel selector switch to gasoline. The engine will begin to stall as the carburetor bowl starts filling with gasoline. Switch back to propane until the engine resumes high speed. Switch back and forth from propane to gasoline until the engine is running smoothly on gasoline. (**Do not stop at "OFF" position**.)

Switching From Gasoline to Propane

With the engine running, step on the footswitch and position the throttle switch to "HI". Set the fuel selector to "OFF". The engine will continue to run as it uses fuel from the carburetor bowl. When the engine begins to stall, allow it to run several seconds and then switch to propane. Switch the throttle to "LOW" and release the footswitch. Let the engine idle for 20-30 seconds to completely burn up any remaining gasoline in the fuel bowl.

2. **FOOTSWITCH**

The footswitch is not **an accelerator. The operation of the footswitch only completes the electrical circuit to the aerial control console and engine throttle. The footswitch is not directly connected to the drive braking system. Operate the footswitch by placing the the foot inside the footswitch cover and gradually pressing down on the pedal.**

If aerial controls are being operated, remove foot from footswitch to disengage controls in an emergency.

3. **DRIVE**

Forward and reverse drive is operable from the aerial control box only. For the drive to function, push the drive controller in the desired direction while simultaneously depressing the footswitch. If the boom is rotated 180°, the drive and steer decals read in reverse. The operator must reverse the drive and steer functions in order to continue in the same direction. The arrow type decals on each end of the base will show the correct direction regardless of the turret's position.

4. **STEERING**

The steering function is incorporated in the drive controller. Depress the footswitch and push the steering controller to the left or right to turn the wheels.

5. **LIFT/LOWER**

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

To operate from the aerial control box, position the selector switch to the "Aerial" position. Raise or lower the platform by operating the "Lift/Lower" controller while depressing the footswitch.

6. **EXTENDING/RETRACTING**

Extend or retract the boom from the ground control station by pushing the toggle switch in the direction desired.

To extend or retract the boom from the aerial control station, place the selector switch to the aerial position then lift up on the lock in the handle and push the Retract/Extend controller forward to retract or pull it back to extend.

7. **TURRET ROTATION**

The turret may be rotated from either the ground control or aerial control stations. Use the toggle switch at the ground control station or the controllers at the aerial control station to rotate the turret in the desired direction.The turret may be rotated 360° continuously.

8. **PLATFORM TILT**

The platform may be tilted forward or backward. Use the toggle switch at the aerial control station to tilt the platform.

9. **PLATFORM ROTATION**

The platform may be rotated to the right or left from the aerial control station. Use the toggle switch to rotate the platform in the desired direction.

10. **WARNING LIGHT AND BUZZER**

As a special safety feature, the Marklift is equipped with an "out-of-level" sensor that will disable the boom functions whenever the Marklift is in an unsafe out-of-level position. An unsafe out-of-level condition is sensed by the level sensor when the machine is tilted at an angle greater than 5° front to rear or side to side.

The unsafe condition is indicated by a red warning light and buzzer, located on the top center of the aerial control box. When the warning light and buzzer are on, Lift/Lower, Extend/Retract, and Turret Rotation will not operate but the drive and steer functions will. Should the warning signals come on, maneuver

the Marklift until it is on a safe, level operating surface and all functions will be restored.

10. **ENGINE STOP**

In case of an emergency, push the red "Stop" button to sstop all functions and the engine. The buttons are located on the aerial and the ground control stations. The engine may also be stopped by rotating the engine start switch to the "Off" position. The fuel selector switch need not be moved to the "OFF" position.The engine may be restarted with the ignition switch. Before starting from the ground control console, check the fuel selector switch on the aerial console for proper fuel source.

In Case of an Engine Failure Emergency. All boom hydraulic functions are operable with the emergency pump running. From the aerial platform, position the emergency pump switch to "ON". This will start the emergency pump. Continue normal operation by depressing the footswitch and moving the controllers switches in the desired direction of motion.

IMPORTANT: The aerial start switch must be set at the "ON" position in order for the emergency hydraulics to function. Emergency functions also apply to the ground control station.

The following preventive maintenance information is intended as a general guide. In addition to the maintenance information provided below, the machine must be inspected and maintained as required by ANSI, OSHA, local safety boards and owners. 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 hydraulic leaks.
7. Check for and correct any structural damage.
8. Check for wear on cables and hoses.
9. Check the condition of the tires. Make sure they are free of serious cuts or defects.
10. Check for proper brake operation.

WEEKLY

1. Include all items indicated in daily check.
2. Make sure the battery is fully charged.
3. Clean unit by removing all dirt, oil, and grease. The machine may be washed with soap and water. Stay clear of all electrical panels and enclosures.

4. Check overall performance.

5. Check the air cleaner.

6. Check for proper hydraulic and engine oil level.

MONTHLY (and first 50 hours)

1. Include all items in weekly check.

2. Check and lubricate, if necessary. (See Recommended Service Instructions.)

3. Change the hydraulic oil return filter.

4. Grease ring gear, and rotation gear box worm gear (if applicable).

5. Grease steering linkage.

6. Change engine oil filter.

7. Check boom operating cables for proper tension.

EVERY SIX MONTHS (100 hours)

1. Include all items in monthly check.

2. Check and lubricate, if necessary. (See Recommended Service Instructions)

3. Change pilot filter element. (See Recommended Service Instructions.)

EVERY YEAR

1. Include all items in bi-annual check.

2. Re-pack all wheel bearings.

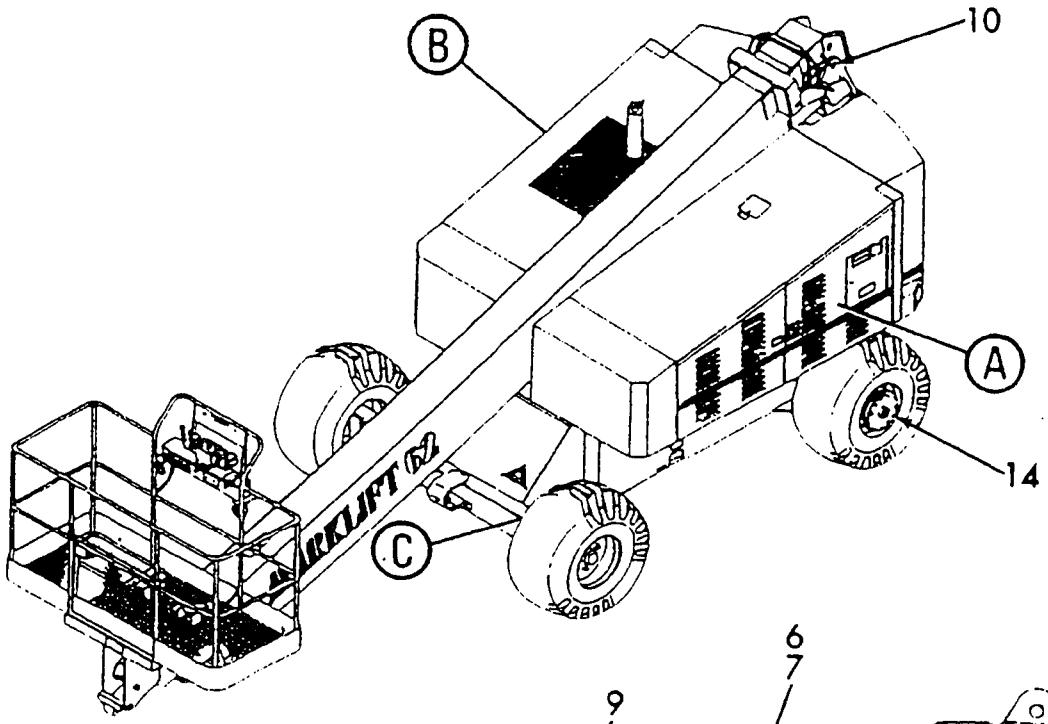
3. Change the hydraulic oil.

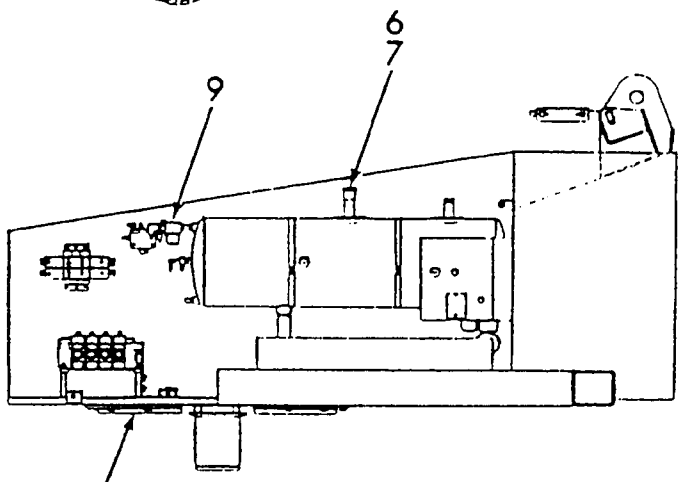
4. Check the torque hub oil level.

Recommended Service Instructions
62 4X2

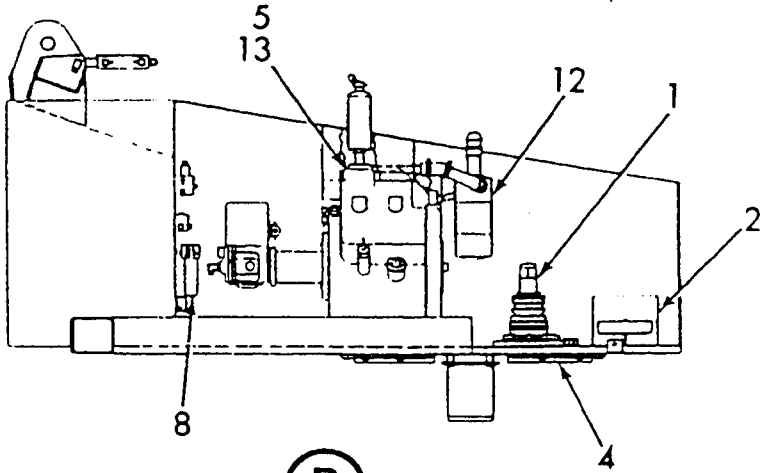
Item	Description*	Lubricant	Service/Frequency
1.	Rotation gear box	Gear oil SAE EP 90	Check/Monthly
2.	Battery		Check/Weekly
3.	Tie Rod Pin	Mobilcote type-s	Lubricate/Monthly
4.	Ring Gear	(4) Zerks rotate gear while greasing	Lubricate/Monthly
5.	Engine	See manufacturer's instructions	See manf. instructions
6.	Hydraulic Fluid	See Hydraulic Fluid Table	Check/Daily Replace/Yearly
7.	Hydraulic Tank Strainer		Clean/Yearly
8.	Pilot Filter		Replace/100 hours
9.	Return Line Filter		Replace/100 hrs.
10.	Main Boom Pivot Pin	Mobilcote Type-S	Lubricate/Monthly
11.	Steering Yoke King Pins	Mobilcote Type-S	Lubricate/Monthly
12.	Air Filter	Change according to filter manf. recommendations	Inspect/weekly or as conditions dictate
13.	Fuel Filter		Replace/100 hrs.
14.	Torque Hubs	Gear Oil 90	Check Monthly

*See the following page for locations.

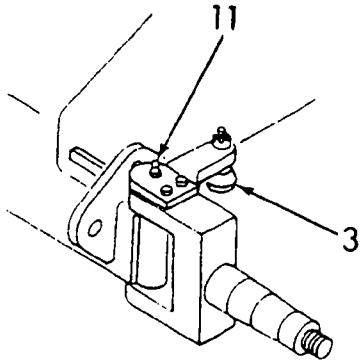




A



B



C

Battery Fill Instructions

Water or Acid Loss to Batteries

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

Checking the Water Level

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

Materials and Equipment Required

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

Filling the Battery

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 electric arcs, sparks, flames and lighted tobacco 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 electrochemical 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.

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.

Marklift Self-Propelled Boom
62 4x2

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

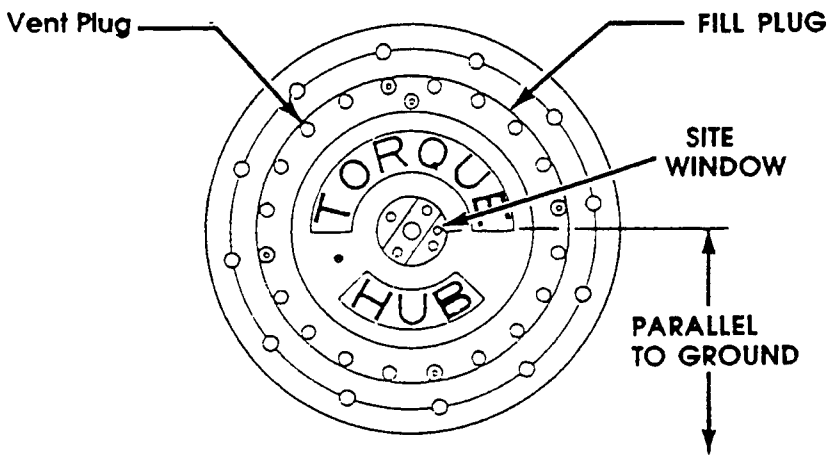
   Initial — After 50 hours or 50,000 revolutions of operation. Preferable in a loaded condition.

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

4. Oil Fill Level

   Remove fill plug
   Remove vent plug
   Pour oil into fill plug
   Fill to half-full.

Fill at slow pace, to allow air to escape.



Marklift Self-Propelled Boom
62 4x2

1. Elevate the boom until approximately horizontal above ground.

2. Extend the boom out approximately 1 to 3 feet.

3. It is necessary to have a crow's foot wrench or a special deep well socket.

4. Set torque wrench at 15.0 foot pounds.

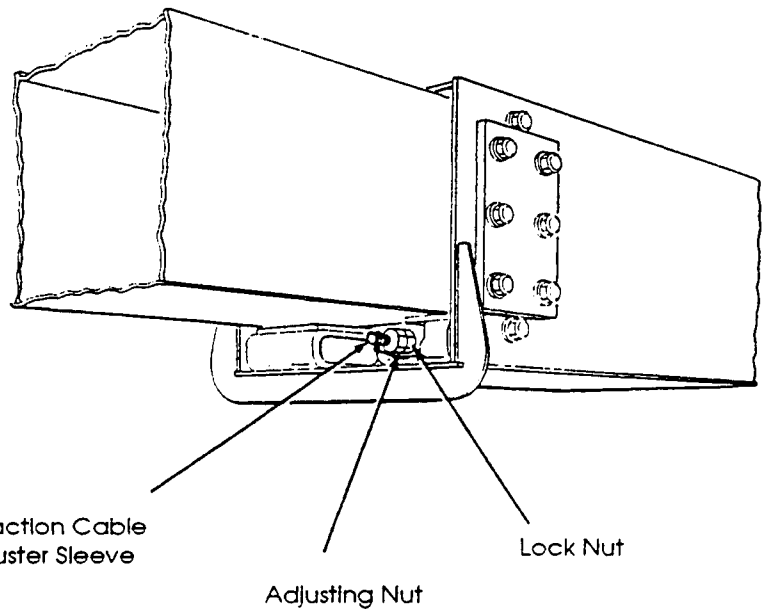
5. Apply a few drops of oil or hydraulic fluid to the cable stud threads and nuts.

6. Loosen lock nut.

7. Tighten the adjusting nut until a torque of 15.0 foot pounds is registered.

8. Continue to extend the boom at one foot increments and torque the adjusting nut until the torque wrench registers ("releases") at 15.0 foot pounds. (The adjusting nut no longer turns on the adjuster sleeve.)

9. Tighten the lock nut when cable tensioning is completed.



Proportional Control Valve Operation

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 proportional control valve is comprised of four valve "segments" which provide individual control for each proportional function; drive (forward and reverse), boom (lift/lower and extend/retract), and turret rotation (right/left).

Flow from the hydraulic pump enters the valve at the inlet port of the inlet manifold and is introduced at the directional control spool of each valve segment across a "flow compensator valve". However, since no flow occurs across the valve spool until a function is operated, an internal passage inside the valve segment generates a pressure signal to the flow compensator causing it to be seated. Simultaneously, flow enters a parallel passage where it is directed across a 40 micron wire mesh screen or strainer, and encounters the "pilot relief valve". A proportionate amount of this flow is returned to the tank across the valve, thus generating a pilot pressure signal which is then supplied to the pilot valves.

The "pilot valves" are electromechanical valves which respond to a command signal generated by the electrical controller at the control station. Inside the pilot valve there is a plunger (which responds to the magnetic field generated by the valve coil whenever the controller is operated), a concave seat and a metering rod or needle. Operating the controller causes the plunger inside the pilot valve to lift off the concave seat which permits the seat to "snap" up off the metering rod or needle. This permits pilot flow to pass across an orifice in the valve seat (which is blocked by the metering rod when it is in contact with the seat), and through the pilot valve. This metered flow is directed through the valve segment into a "control" passage for the directional control spool. Connected to the control passage is a tank return passage, pilot flow passing through the pilot valve is returned back to tank across a flow disc installed in the passage. This disc has a small orifice which meters the flow that is returned back to tank.

The rate at which the pilot valve opens and closes (the plunger releases the concave valve seat to permit it to lift up off the metering rod) determines the rate of flow

through the pilot valve and into the control passage. As long as the valve is opened and closed at a minimum specific rate, the rate of flow into the control circuit is equal to the rate of flow which can be returned to tank across the flow disc in the tank return passage. Consequently there is no increase in pressure in the control passage. However as the controller is moved farther "on", the rate that the plunger releases the concave inlet disc increases. This permits a greater volume of oil to pass across the valve and into the pilot valve body. This increased flow generates a pressure signal in the control passage (since only a finite amount of flow can be returned to tank across the flow disc at the base of the pilot valve in the tank return passage). This pressure signal is applied against the directional control spool and causes the spool to be "shifted" opposing a spring which normally maintains the spool in its centered state.

As the directional control spool is shifted off center, inlet flow from the pump is metered across tapered "lands" on the control spool and directed out the V1 or V2 ports, to the selected function. As the directional control spool shifts, a pressure drop occurs at the supply passage of the spool and results in a pressure "differential" across the flow compensator valve, this pressure difference causes the valve to open and regulates oil passed to the directional control spool based upon the difference in pressure created by the rate of flow out to the function being operated and the rate of flow being supplied by the pump. As flow out to the desired function encounters resistance, an internal passage parallel to the supply ports (V1 and V2) directs the corresponding pressure signal against a shuttle ball (located in the valve segment), which is connected in parallel to the other valve segments. This pressure signal is diverted by the shuttle ball out to the load sense port of the proportional control valve, where it is transmitted to the pump and instructs the pump to meet the flow requirements of the function being operated.

The speed at which the function operates is controlled by the metering effect across the valve spool (amount of shift determines the rate of flow), which is controlled by the operating rate (opening and closing) of the pilot valve. The load sense circuit is configured so that the pump receives the signal from whichever function has the highest flow requirement, even when multiple functions are selected.

Please see the Vendor Chapter for additional information about the proportional control valve and its operation.

Electrical System

The Marklift electrical system is very straight forward and easy to trouble shoot 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 typically operate directly from the source through either switches or a proportional controller.

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

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

B. Keep in mind, if you **DO NOT** have a good ground to a valve coil, relay, etc., even if you have proper electrical current to the coil or relay, the item will not function properly.

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

D. The basic purpose of a relay is to remotely switch other electrical devices.

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 console, 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, ammeter, and fuel gauge. When the selector switch is placed in the aerial position, the electrical source is routed to the aerial control box. The intent of the footswitch is to provide an additional safety interlock in the control circuit to require foot as well as hand move-

ment by the operator, thereby requiring maximum operator attention. The operation of the footswitch only completes the electrical circuit to the aerial control console and engine throttle. The footswitch is not directly connected to the drive braking system.

The aerial control console is equipped with controllers and switches to operate all of the boom functions. It also contains a start/stop and an emergency pump switch. Your Marklift is equipped with a proportional control valve. The aerial control console contains electrical controllers for operation of these functions. The controller is spring-centered and is designed to produce a variable output signal to the control valve. The output signal is directly proportional to the handle movement of 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 smoothly 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 extended or raised above horizontal, the unit is automatically shifted into low speed. This is accomplished through two limit switches sensing the altitude and extension positions of the boom, wired in series to a valve which supplies a hydraulic signal to the variable displacement drive motors.

Engine

1. **Engine 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 authorized service facility.

2. **Engine dies under load.**

   A. Check carburetor air/fuel mixture.
   B. Check hydraulic pressure.
   C. Refer to your local authorized service facility.

3. **Engine will not go into "HI" throttle.**

   A. Check the aerial HI/LO speed selector switch.
   B. Check the high speed solenoid valve.
   C. Refer to your local authorized service facility.

4. **Engine will not idle.**

   A. Check the carburetor.
   B. Check the throttle solenoid valve.
   C. Refer to your local authorized service facility.

Hydraulic Drive Motor

Hydraulic drive motor turns wheel while unloaded, but slows down or stops when load is applied.

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

Hydraulic Pump

Pump producing excessive noise.

A. Check hydraulic oil level (sight gauge on tank.)
B. Check suction hose from tank to pump for kinks.
C. Refer to your local authorized service facility.

Lift

1. Lift will not operate from aerial control console.

A. Check position of Aerial/Ground selector switch.
B. Check footswitch continuity.
C. Check for loose wire in aerial control box.
D. Refer to your local authorized service facility.

2. Lift will not operate from ground control box.

A. Check position of Aerial/Ground box selector switch.
B. Check the Aerial/Ground selector relay.
C. Refer to your local authorized service facility.

Drive

Low torque drive.

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

Brakes

No brakes.

A. Check the drive hub disengagement caps.
B. Check brake delay valve.
C. Refer to your local authorized service facility.

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

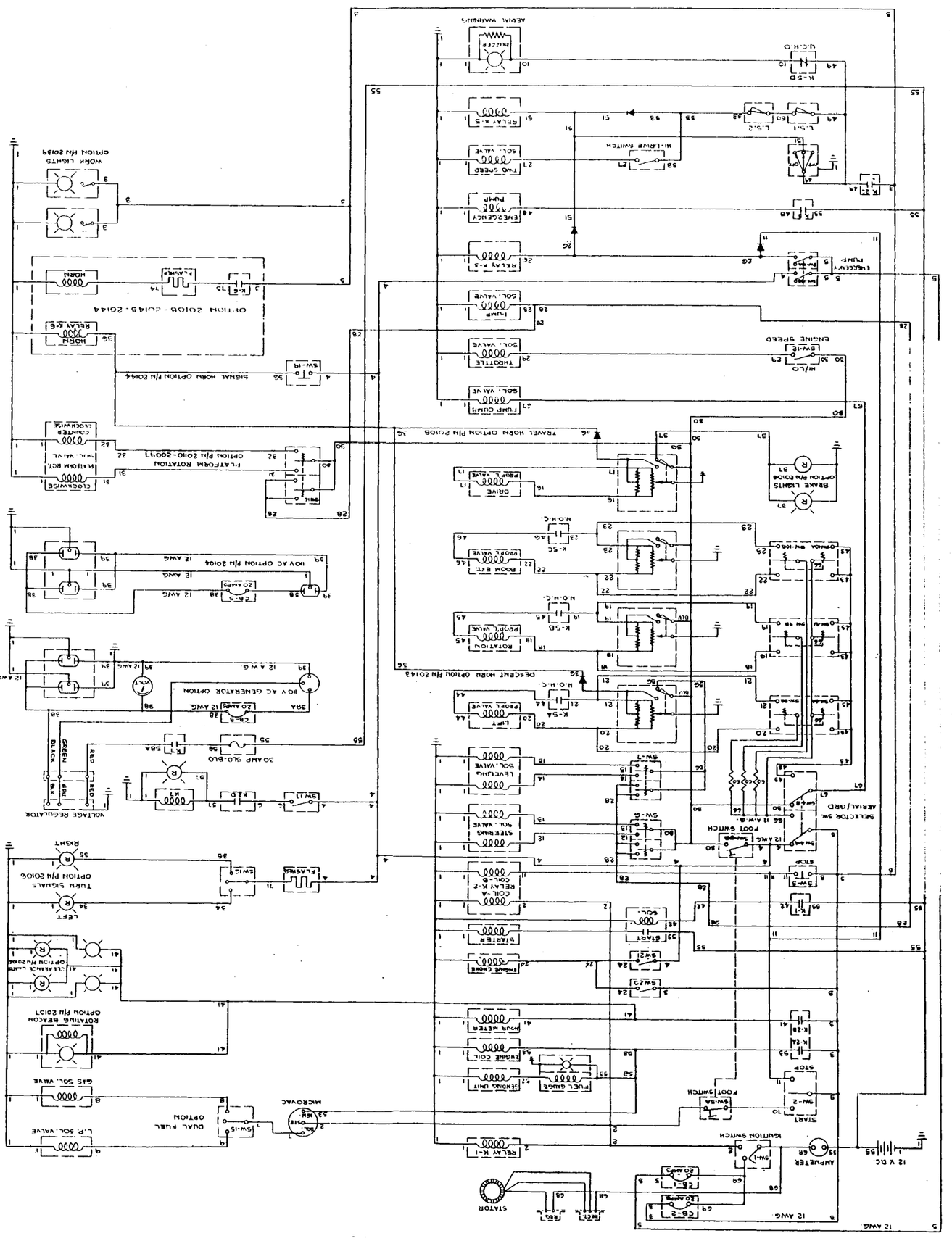
MODEL: 62 4X2

PART NO.	QTY.	DESCRIPTION
81007	4	Element Pilot Filter
21245	4	Element Return Filter
20030	2	Seal Kit (Steering Cylinder)
20031	2	Seal Kit (Slave Cylinder)
20032	2	Seal Kit (Master Cylinder)
20033	2	Seal Kit (Lift Cylinder)
20034	2	Seal Kit (Extension Cylinder)
20035	2	Seal Kit (Shift Cylinder)
20036	2	Seal Kit (Rotation Cylinder)
20562	2	Circuit Breaker
20481	2	Toggle Switch
20482	2	Toggle Switch
20580	2	Potentiometer Assembly
20581	2	Controller Lever Lock
20466	2	Pilot Valve
66603	2	Decal Set

SCHEMATIC	PAGE
	1

TITLE	ELECTRICAL SCHEMATIC
MODEL	62 4X2 CAS
NOTES	20070 REV. C

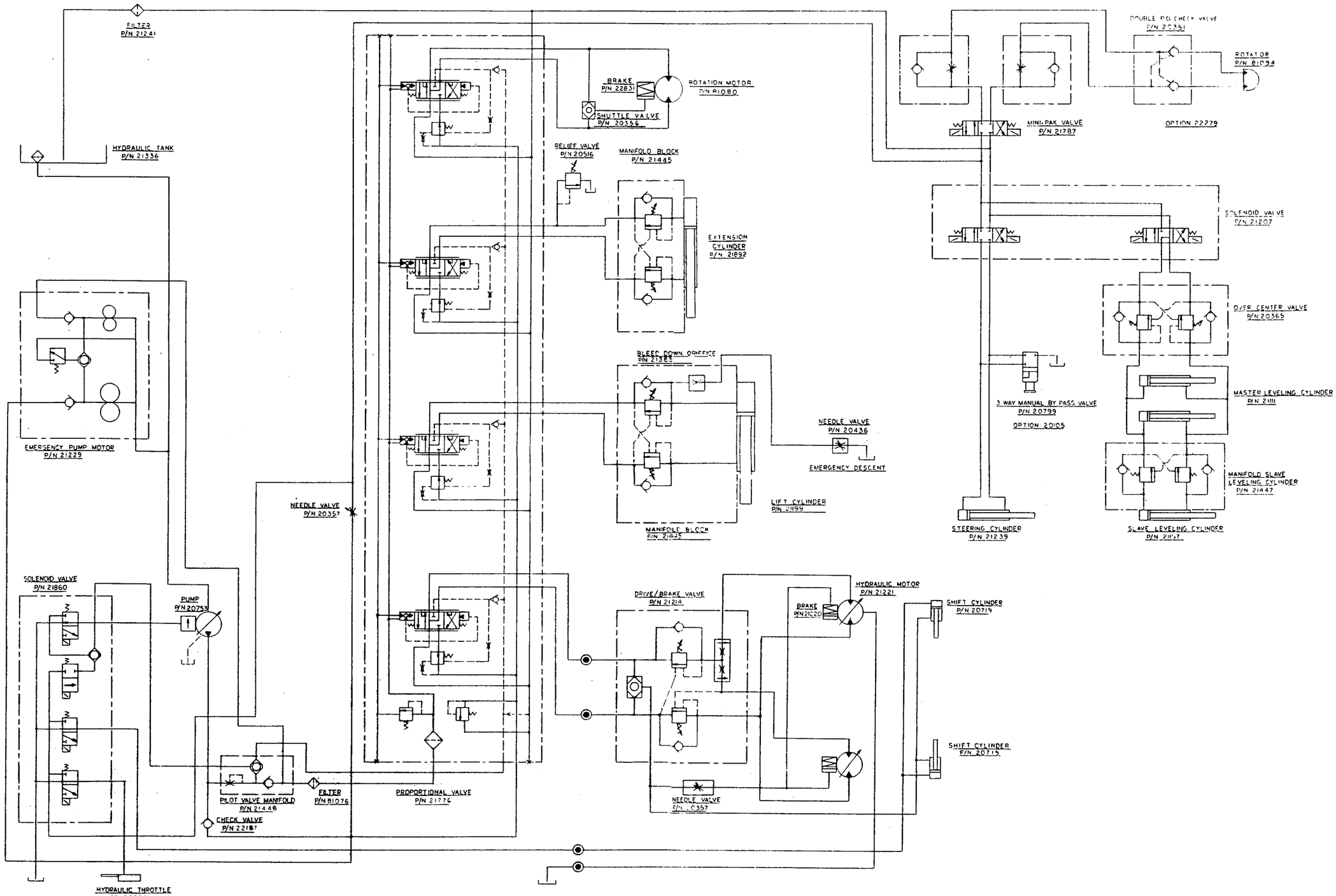
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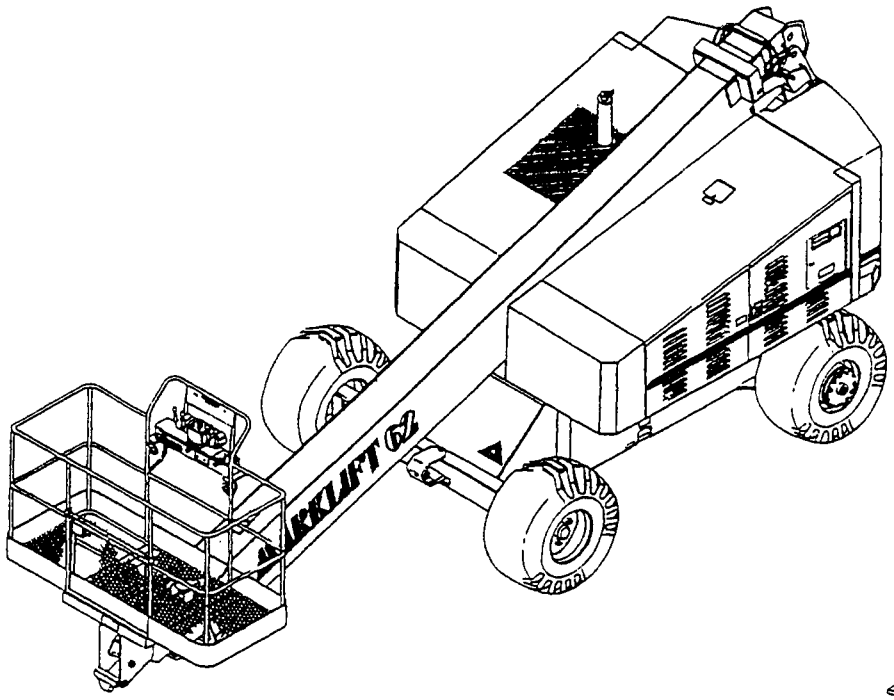
TITLE	HYDRAULIC SCHEMATIC
MODEL	62 4X2 STANDARD
NOTES	21057 REV. B

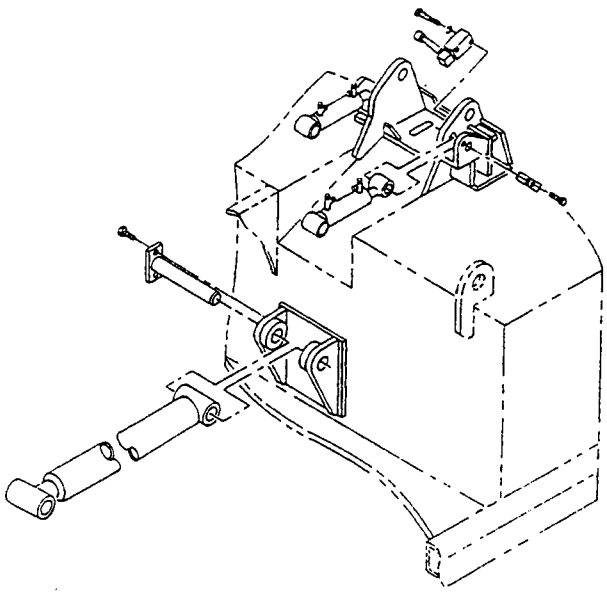
SCHEMATIC PAGE 2

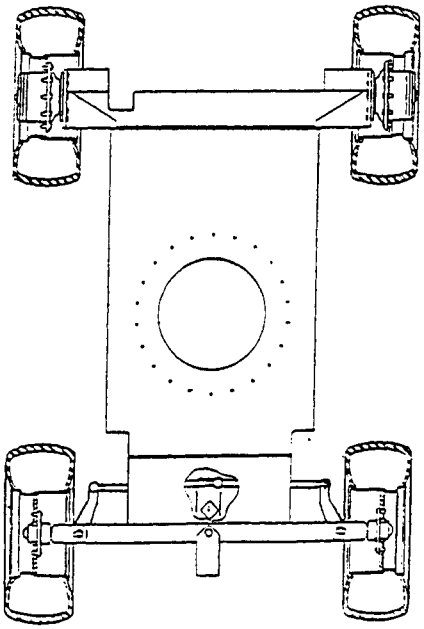


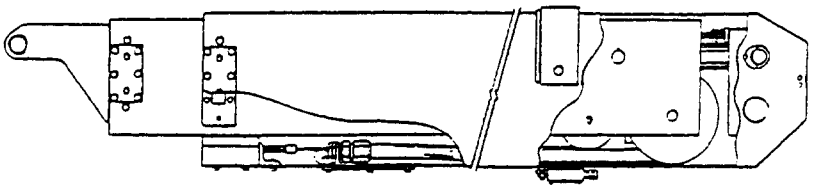
SECTION 1 CONTAINS:

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









DISCLAIMER

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

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

NOTICE

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

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

SECTION 2	FINAL ASSEMBLY
FIG. NO.	TITLE
1	FINAL ASSEMBLY
2	DECAL SET
3	SHEET METAL KIT (UNTIL EARLY 1984)
3A	SHEET METAL KIT (SINCE EARLY 1984)
4	AERIAL CONTROL CONSOLE ASSEMBLY
5	FOOTSWITCH ASSEMBLY (UNTIL MID 1985)
5A	FOOTSWITCH ASSEMBLY (SINCE MID 1985)
6	HYDRAULIC HOSE DIAGRAM (UNTIL LATE 1984)
6A	HYDRAULIC HOSE DIAGRAM (SINCE LATE 1984)

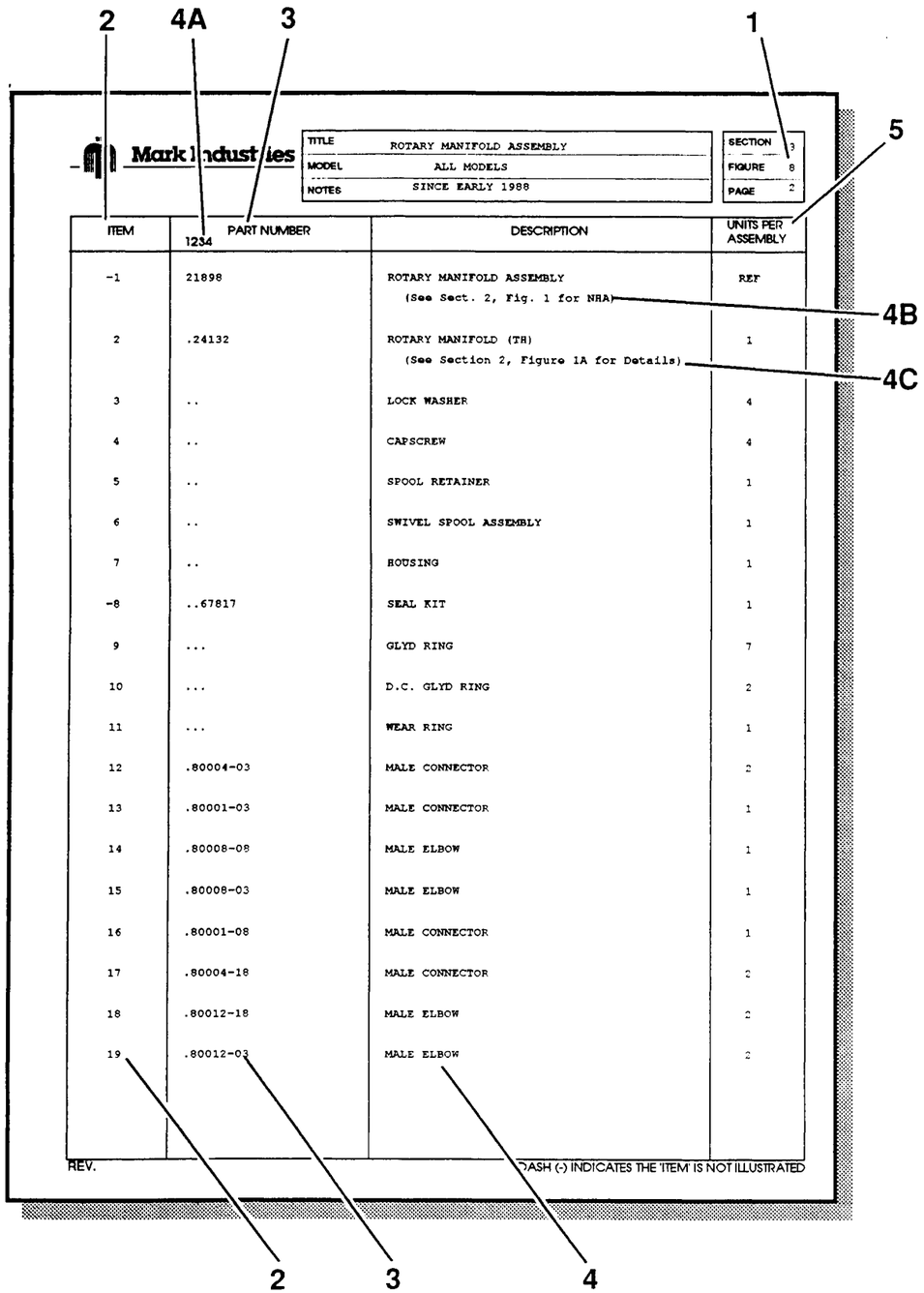
SECTION 3	CARRIAGE ASSEMBLY
FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY (UNTIL JAN. 1982)
1A	CARRIAGE ASSEMBLY (SINCE JAN. 1982)
2	HUB & YOKE ASSEMBLY (R.H.)
2A	HUB & YOKE ASSEMBLY (L.H.)
3	TORQUE HUB
4	STEERING CYLINDER (UNTIL EARLY 1982)
4A	STEERING CYLINDER ASSEMBLY (SINCE JAN. 1982)
5	BRAKE ASSEMBLY (UNTIL EARLY 1986)
5A	BRAKE ASSEMBLY (SINCE EARLY 1986)
6	DRIVE/BRAKE VALVE ASSEMBLY
7	SHIFT CYLINDER ASSEMBLY (EARLY VERSION)
7A	SHIFT CYLINDER ASSEMBLY (LATER VERSION)
8	MOTOR (EXTERNAL SHIFT)(UNTIL MID 1987)
8A	MOTOR (INTERNAL SHIFT)(SINCE MID 1987)

SECTION 4	TURRET ASSEMBLY
FIG. NO.	TITLE
1	TURRET ASSEMBLY (UNTIL EARLY 1985)
1A	TURRET ASSEMBLY (SINCE EARLY 1985)
2	ENGINE & PUMP ASSEMBLY
3	LIFT CYLINDER ASSEMBLY (UNTIL MID 1981)
3A	LIFT CYLINDER ASSEMBLY (SINCE MID 1981)
4	FUEL TANK ASSEMBLY
5	ROTATION GEARBOX ASSEMBLY (UNTIL EARLY 1985)
5A	ROTATION GEARBOX ASSEMBLY (SINCE EARLY 1985)
6	ROTATION GEARBOX (HT)
6A	ROTATION GEARBOX (BR)
7	TORQUE HUB (ROTATION GEARBOX; SINCE EARLY 1985)
8	GROUND CONTROL BOX ASSEMBLY
9	PROPORTIONAL VALVE ASSEMBLY
10	MINIPAK ASSEMBLY (WITHOUT PLATFORM ROTATION)
10A	MINIPAK ASSEMBLY (WITH PLATFORM ROTATION)
11	SOLENOID VALVE ASSEMBLY (UNTIL LATE 1981)
11A	SOLENOID VALVE ASSEMBLY (LATE 1981 TO LATE 1986)
11B	SOLENOID VALVE ASSEMBLY (FROM LATE 1986)
12	PILOT VALVE MANIFOLD ASSEMBLY
13	PILOT FILTER ASSEMBLY (UNTIL LATE 1985)
13A	PILOT FILTER ASSEMBLY (SINCE LATE 1985)
14	HYDRAULIC TANK ASSEMBLY
15	MASTER LEVELING CYLINDER ASSEMBLY
16	ROTARY MANIFOLD ASSEMBLY (UNTIL EARLY 1983)
16A	ROTARY MANIFOLD ASSEMBLY (SINCE EARLY 1983)
17	BATTERY CABLE KIT

SECTION 5	BOOM ASSEMBLY
FIG. NO.	TITLE
1	FINAL BOOM ASSEMBLY (UNTIL LATE 1984)
1A	FINAL BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)
1B	FINAL BOOM ASSEMBLY (SINCE MID 1986)
2	INTERMEDIATE BOOM ASSEMBLY (UNTIL LATE 1984)
2A	INTERMEDIATE BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)

SECTION 5	BOOM ASSEMBLY (CONT'D)
FIG. NO.	TITLE
2B	INTERMEDIATE BOOM ASSEMBLY (SINCE MID 1986)
3	INNER BOOM ASSEMBLY (UNTIL LATE 1984)
3A	INNER BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)
3B	INNER BOOM ASSEMBLY (SINCE MID 1986)
4	SLAVE LEVELING CYLINDER ASSEMBLY (UNTIL MID 1981)
4A	SLAVE LEVELING CYLINDER ASSEMBLY (SINCE MID 1981)
5	BOOM EXTENSION CYLINDER ASSEMBLY (UNTIL LATE 1981)
5A	BOOM EXTENSION CYLINDER ASSEMBLY (FROM LATE 1981 TO MID 1986)
5B	BOOM EXTENSION CYLINDER ASSEMBLY (SINCE MID 1986)

SECTION 6	OPTIONS	
FIG. NO.	TITLE	PART NO.
1	HEADLIGHTS OPTION	20078
2	CLEARANCE, STOP, & TURNING LIGHTS OPTION	20079
3	TOWING KIT OPTION	20081
4	RAISED PLATFORM ROTATION OPTION (TOP MOUNT)	20097
5	MINIPAK SUB-ASSEMBLY (PART OF PLATFORM ROTATION OPTION)	21713
6	110 VAC RECEPTACLE OPTION (GROUND & AERIAL CONSOLES)	20104
7	ROTATING AMBER BEACON OPTION	20107
8	12 VDC PLATFORM WORKLIGHT OPTION	20139
9	2.5 KW GENERATOR OPTION (WISCONSIN VG4D)	20159
10	DUAL FUEL OPTION (WISCONSIN VG4D)	20163
11	PLATFORM ROTATION ASSEMBLY OPTION (FRONT MOUNT)	22841
12	PLATFORM ROTATION ASSEMBLY OPTION (TOP MOUNT)	22847



1. The Parts Chapter Pagination.

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

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

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

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

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

4. Elements of the **Description**.

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

      Figure Description

      1 2 3 4

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

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

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

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

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

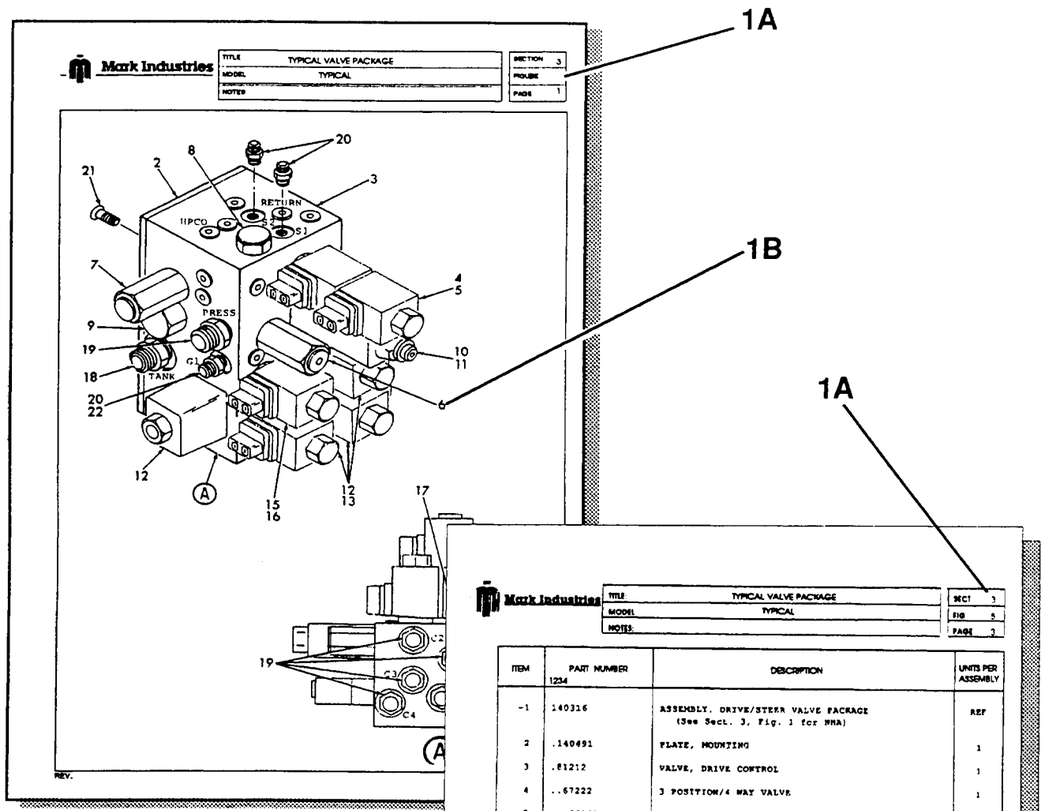
   C. **DETAILS** corresponds to the Section and Figure to be referred to for a more detailed breakdown of this item.

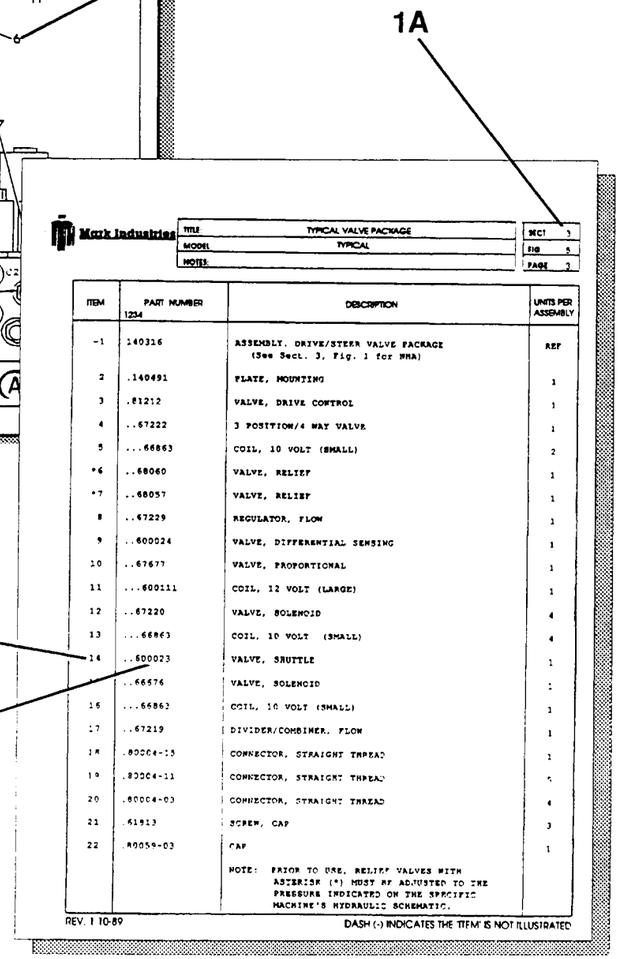
5. **UNITS PER ASSEMBLY** entries are as follows:

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

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

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





ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSEMBLY
-1	.140316	ASSEMBLY, DRIVE/STEER VALVE PACKAGE (See Sect. 3, Fig. 1 for NHA)	REF
2	.140491	PLATE, MOUNTING	1
3	.81212	VALVE, DRIVE CONTROL	1
4	..67222	3 POSITION/4 WAY VALVE	1
5	...66863	COIL, 10 VOLT (SMALL)	2
*6	..68060	VALVE, RELIEF	1
*7	..68057	VALVE, RELIEF	1
8	..67229	REGULATOR, FLOW	1
9	..600024	VALVE, DIFFERENTIAL SENSING	1
10	..67677	VALVE, PROPORTIONAL	1
11	...600111	COIL, 12 VOLT (LARGE)	1
12	..67220	VALVE, SOLENOID	4
13	...66863	COIL, 10 VOLT (SMALL)	4
14	..600023	VALVE, SHUTTLE	1
[illegible]	..66676	VALVE, SOLENOID	1
16	...66863	COIL, 10 VOLT (SMALL)	1
17	..67219	DIVIDER/COMBINER, FLOW	1
18	.80004-15	CONNECTOR, STRAIGHT THREAD	1
19	.80004-11	CONNECTOR, STRAIGHT THREAD	5
20	.80004-03	CONNECTOR, STRAIGHT THREAD	4
21	.61913	SCREW, CAP	3
22	.80059-03	CAP	1
		NOTE: PRIOR TO USE, RELIEF VALVES WITH ASTERISK (*) MUST BE ADJUSTED TO THE PRESSURE INDICATED ON THE SPECIFIC MACHINE'S HYDRAULIC SCHEMATIC.	

REV. 1 10-89 DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

1. Finding the Mark Industries Part Number.

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

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

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

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

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

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

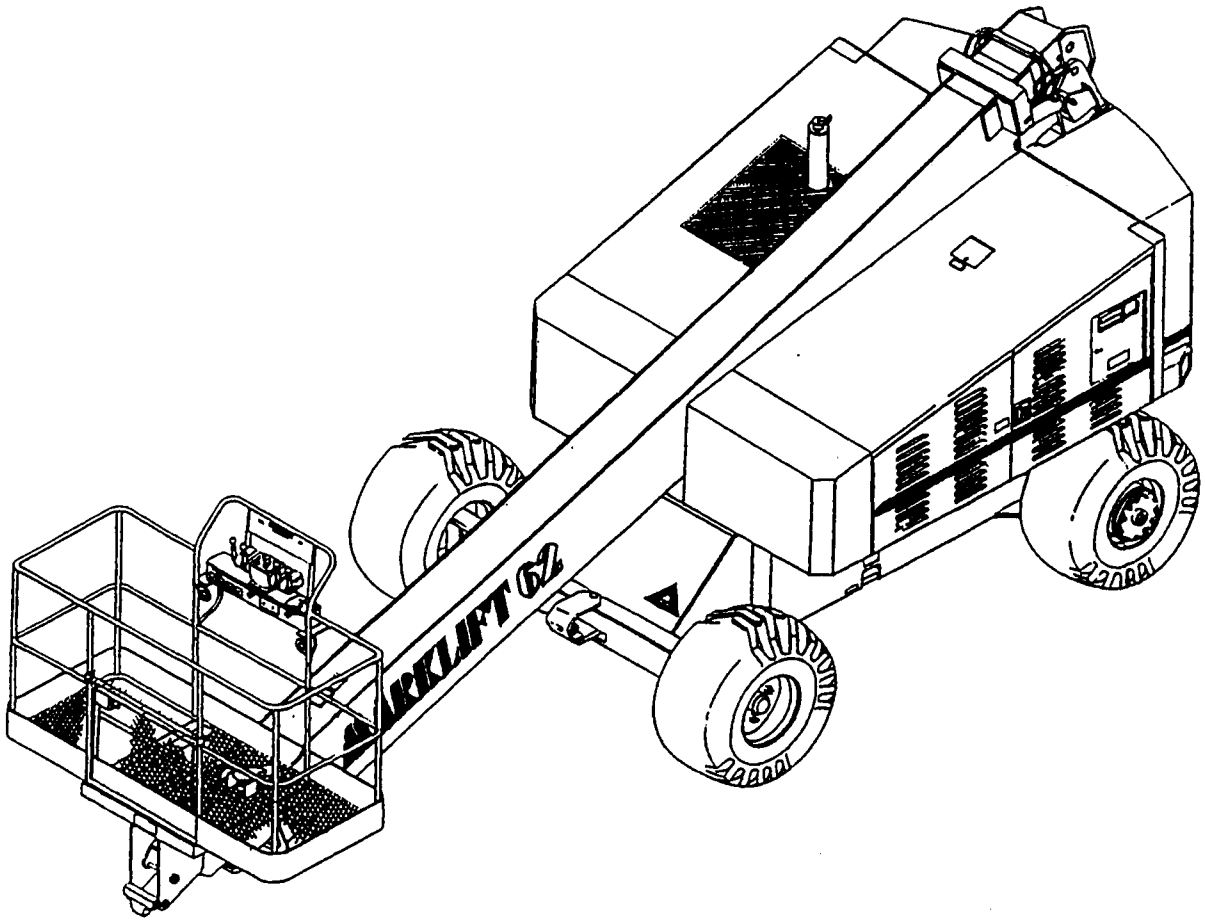
   B. By Phone: (714) 879-MARK

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

MARK INDUSTRIES
205 South Puente Street
Brea, CA 92621

SECTION 2 CONTAINS:

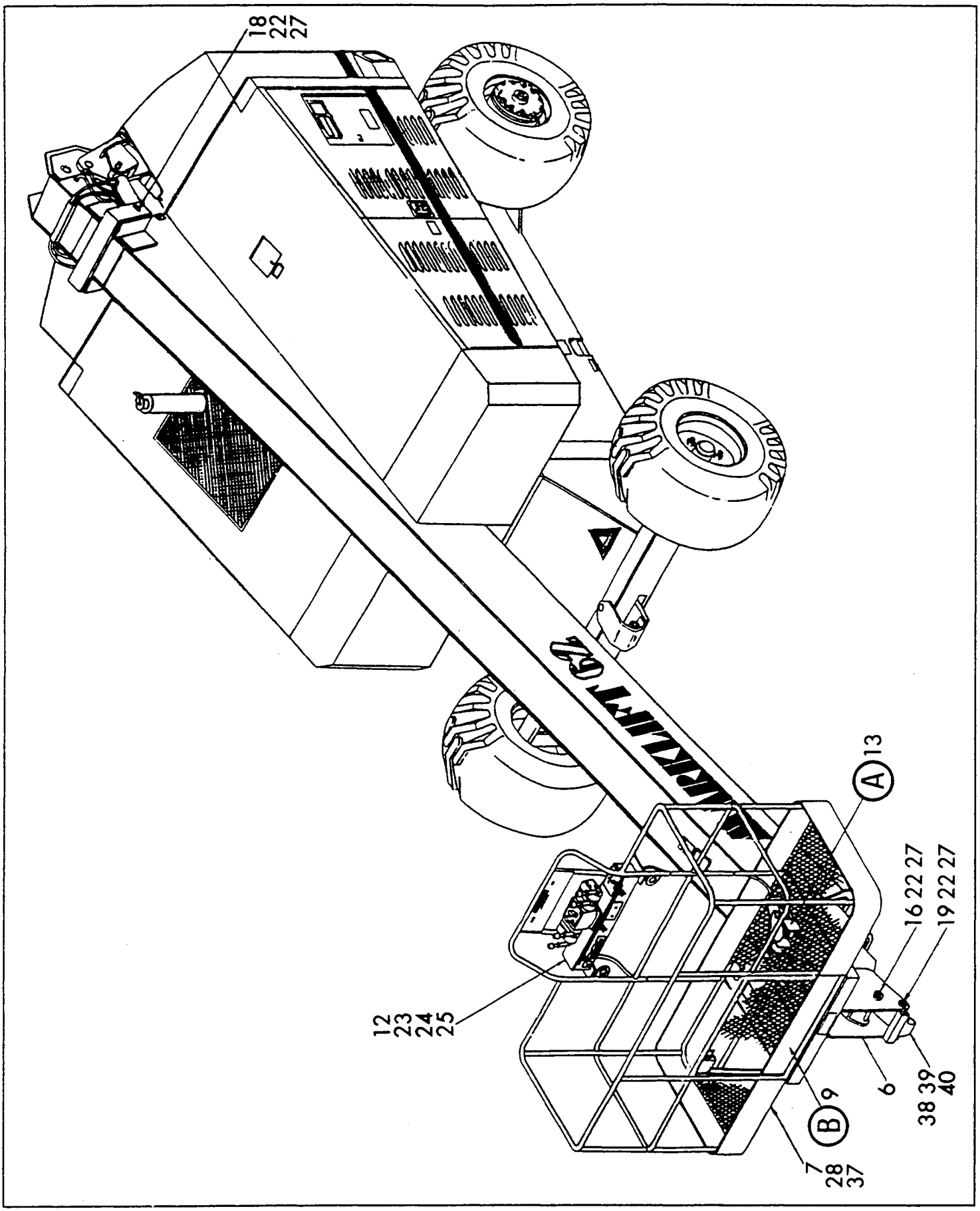
FIG. NO.	TITLE
1	FINAL ASSEMBLY
2	DECAL SET
3	SHEET METAL KIT (UNTIL EARLY 1984)
3A	SHEET METAL KIT (SINCE EARLY 1984)
4	AERIAL CONTROL CONSOLE ASSEMBLY
5	FOOTSWITCH ASSEMBLY (UNTIL MID 1985)
5A	FOOTSWITCH ASSEMBLY (SINCE MID 1985)
6	HYDRAULIC HOSE DIAGRAM (UNTIL LATE 1984)
6A	HYDRAULIC HOSE DIAGRAM (SINCE LATE 1984)

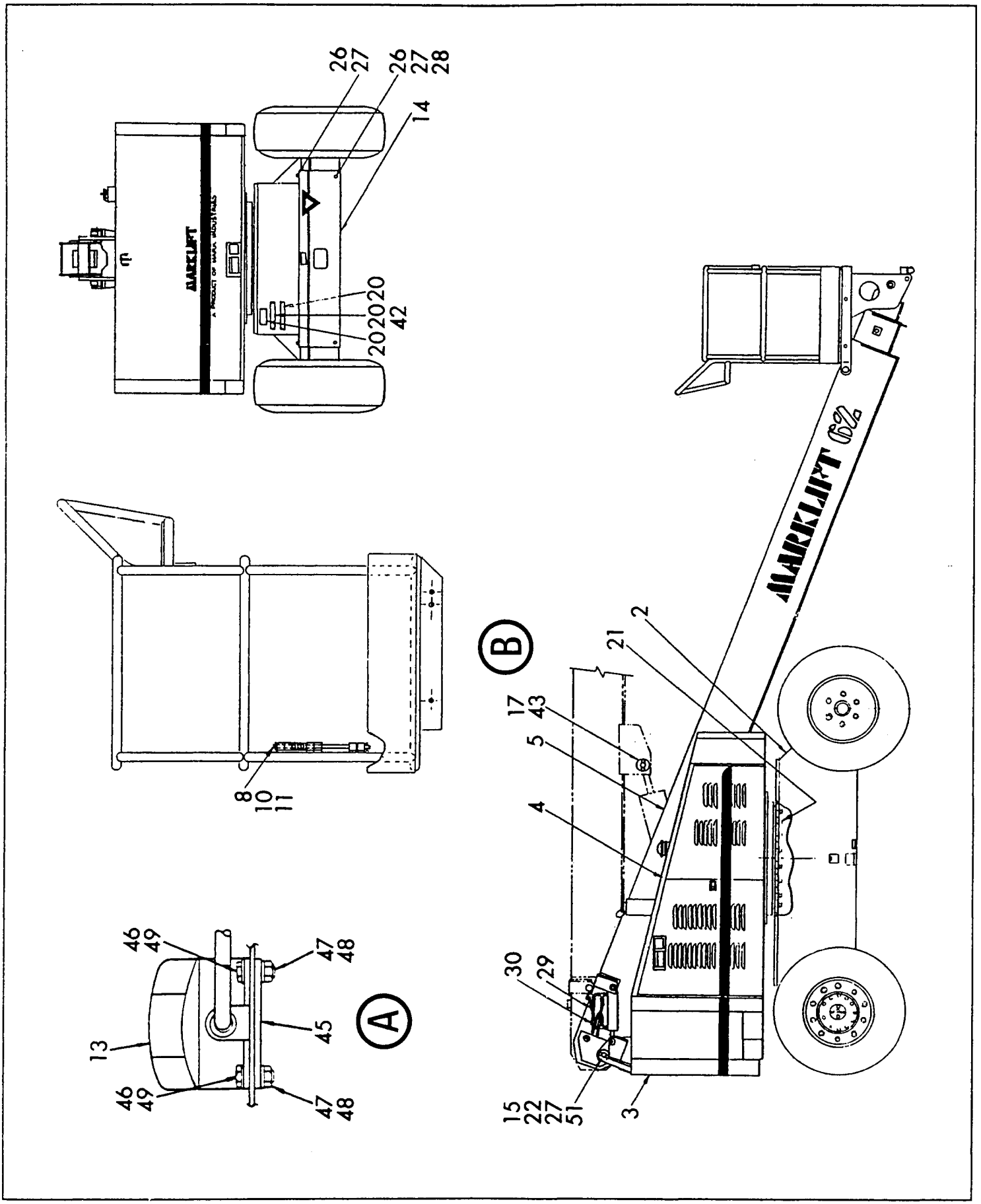


Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	2
FIGURE	1
PAGE	1




26
27
26
27
28
14
20
20
20
42
MARKLIFT
8
10
11
B
17
43
5
4
21
2
MARKLIFT 62
30
29
15
22
27
51
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46
49
47
48
13
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Mark Industries

TITLE	FINAL ASSEMBLY
MODEL	62 4X2
NOTES	

SECT.	2
FIG.	1
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20007	ASSEMBLY, FINAL	REF
2	.21497	ASSEMBLY, CARRIAGE (SINCE JAN. 1982) (See Sect. 3, Fig. 1A for Details)	1
2	.21050	ASSEMBLY, CARRIAGE (UNTIL JAN. 1982) (See Sect. 3, Fig. 1 for Details)	1
3	.21050	ASSEMBLY, TURRET (UNTIL EARLY 1985) (See Sect. 4, Fig. 1 for Details)	1
3	.21940	ASSEMBLY, TURRET (SINCE EARLY 1985) (See Sect. 4, Fig. 1A for Details)	1
4	.21224	KIT, SHEET METAL (UNTIL EARLY 1984) (See Sect. 2, Fig. 3 for Details)	1
4	.22618	KIT, SHEET METAL (SINCE EARLY 1984) (See Sect. 2, Fig. 3A for Details)	1
5	.21052	ASSEMBLY, FINAL BOOM (UNTIL LATE 1984) (See Sect. 5, Fig. 1 for Details)	1
5	.22700	ASSEMBLY, FINAL BOOM (FROM MID 1984 TO MID 1986) (See Sect. 5, Fig. 1A for Details)	1
5	.23062	ASSEMBLY, FINAL BOOM (SINCE MID 1986) (See Sect. 5, Fig. 1B for Details)	1
6	.20535	WELDMENT, FORK	1
7	.20538	WELDMENT, PLATFORM (6 FOOT)	1
8	..21928	ASSEMBLY, HINGE	1
9	..20540	GATE, SWING	1
10	..60603	SCREW, CAP	6
11	..64301	PIN, COTTER	1
12	.21090	ASSEMBLY, AERIAL CONTROL CONSOLE (See Sect. 2, Fig. 4 for Details)	1
13	.20480	ASSEMBLY, FOOTSWITCH (See Sect. 2, Fig. 5 & 5A for Details)	1
14	.21341	COVER, DRIVE	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
15	.23198	PIN, BOOM PIVOT	1
16	.20457	PIN, BOOM TO FORK PIVOT	1
17	.23511	PIN, LIFT CYLINDER	1
18	.21334	PIN, MASTER LEVELING CYLINDER	2
19	.20261	PIN, LEVELING CYLINDER	1
20	.63653	RIVET, POP	12
21	.60609	SCREW, CAP	22
22	.60607	SCREW, CAP	6
23	.60309	SCREW, CAP	2
24	.60701	NUT, HEX	2
25	.63301	WASHER, LOCK	2
26	.60325	SCREW, CAP	6
27	.63303	WASHER, LOCK	12
28	.61302	NUT, HEX	6
29	.2617	HOSE	2 FT
30	.2594	ELBOW, SWIVEL	4
-31	.16608	PAINT, WHITE WATERBASE	10 GAL
-32	.65112	PAINT, TANK WHITE	1 GAL
-33	.65114	GASOLINE, REGULAR	5 GAL
-34	.21055	DIAGRAM, HYDRAULIC HOSE (UNTIL LATE 1984) (See Sect. 2, Fig. 6 for Details)	1
-34	.21938	DIAGRAM, HYDRAULIC HOSE (SINCE LATE 1984) (See Sect. 2, Fig. 6A for Details)	1
-35	.20070	SCHEMATIC, ELECTRIC (See Schematic Chapter for Details)	1
-36	.21057	SCHEMATIC, HYDRAULIC (See Schematic Chapter for Details)	1

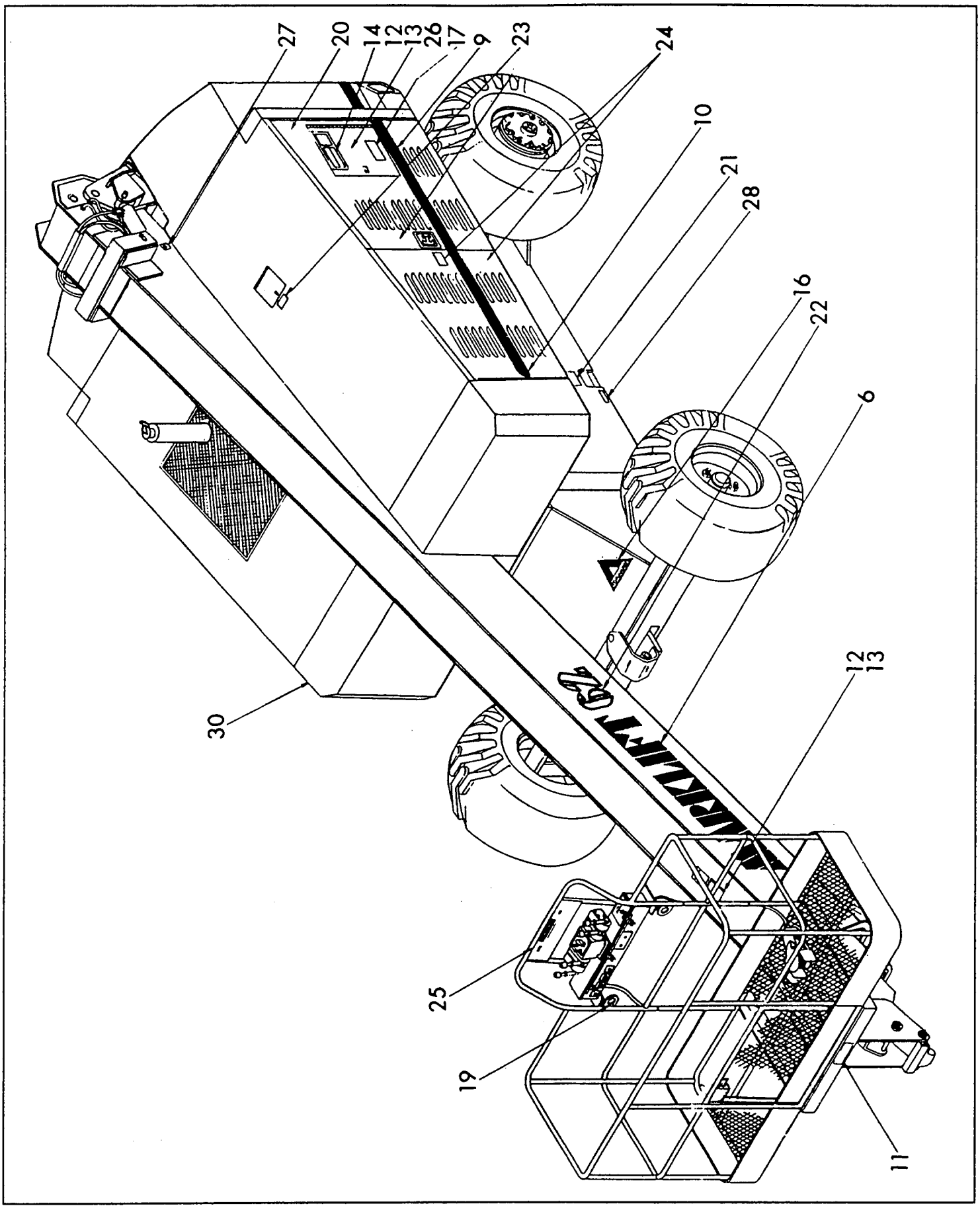
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
37	.60515	SCREW, CAP	4
38	.60307	SCREW, CAP	2
39	.61318	NUT, LOCK	2
40	.20552	BUMPER, PLATFORM	1
-41	.65116	OIL, HYDRAULIC	45 GAL
42	.20662	PLATE, PATENT NUMBER	1
43	.61813	SCREW, CAP	2
-44	.16609	PAINT, BLUE WATERBASE	1 GAL
45	.22742	PLATE, DEADMAN SWITCH BACKING	1
46	.60346	SCREW, CAP	2
47	.60702	NUT, HEX	2
48	.63302	WASHER, LOCK	2
49	.63402	WASHER, FLAT	2
-50	.66603	SET, DECAL (See Sect. 2, Fig. 2 for Details)	1
51	.26460	TUBE, ROUND	1

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	DECAL SET
MODEL	62 4X2
NOTES	GAS

SECTION	2
FIGURE	2
PAGE	1



Mark Industries

TITLE	DECAL SET
MODEL	62 4X2
NOTES	GAS

SECT.	2
FIG.	2
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	66603	SET, DECAL (GAS) (See Sect. 2, Fig. 1 for NHA)	REF
2	.20460	DECAL, GROUND CONTROL CONSOLE (See Ground Control Box for Details)	1
3	.20413	DECAL, ENGINE CHOKE (See Ground Control Box for Details)	1
4	.22571	DECAL, AERIAL CONTROL SWITCHES (See Aerial Control Box for Details)	1
5	.20444	DECAL, 5 DEGREE SLOPE (See Aerial Control Box for Details)	1
6	.21236	DECAL, MARKLIFT BOOM	2
7	.20409	DECAL, STANDARD PEDESTAL	1
8	.20410	DECAL, LOGO MARK INDUSTRIES	1
9	.20411	DECAL, BLUE STRIPE (SQUARE END)	6
10	.20412	DECAL, BLUE STRIPE (ROUND END)	1
11	.20556	DECAL, LOAD CAPACITY 800 LBS.	1
12	.181103	DECAL, DANGER OBEY THE FOLLOWING...	2
13	.181102	DECAL, DANGER DO NOT OPERATE UNLESS...	2
14	.20419	DECAL, DANGER KEEP CLEAR	3
15	.20461	DECAL, FORWARD ARROW	1
16	.20462	DECAL, FORWARD ARROW AFT	1
17	.20495	DECAL, EMERGENCY GROUND CONTROLS	1
18	.20896	DECAL, BRAKE	1
19	.22386	DECAL, "D" RING ATTACH SAFETY BELT	2
20	.21235	DECAL, EMERGENCY DESCENT (VALVE TYPE)	1
21	.20508	DECAL, TRANSPORTATION	2
22	.21227	DECAL, 62	2
23	.2017	DECAL, HYDRAULIC SYSTEM FLUID	2

Mark Industries

TITLE	DECAL SET
MODEL	62 4X2
NOTES	GAS

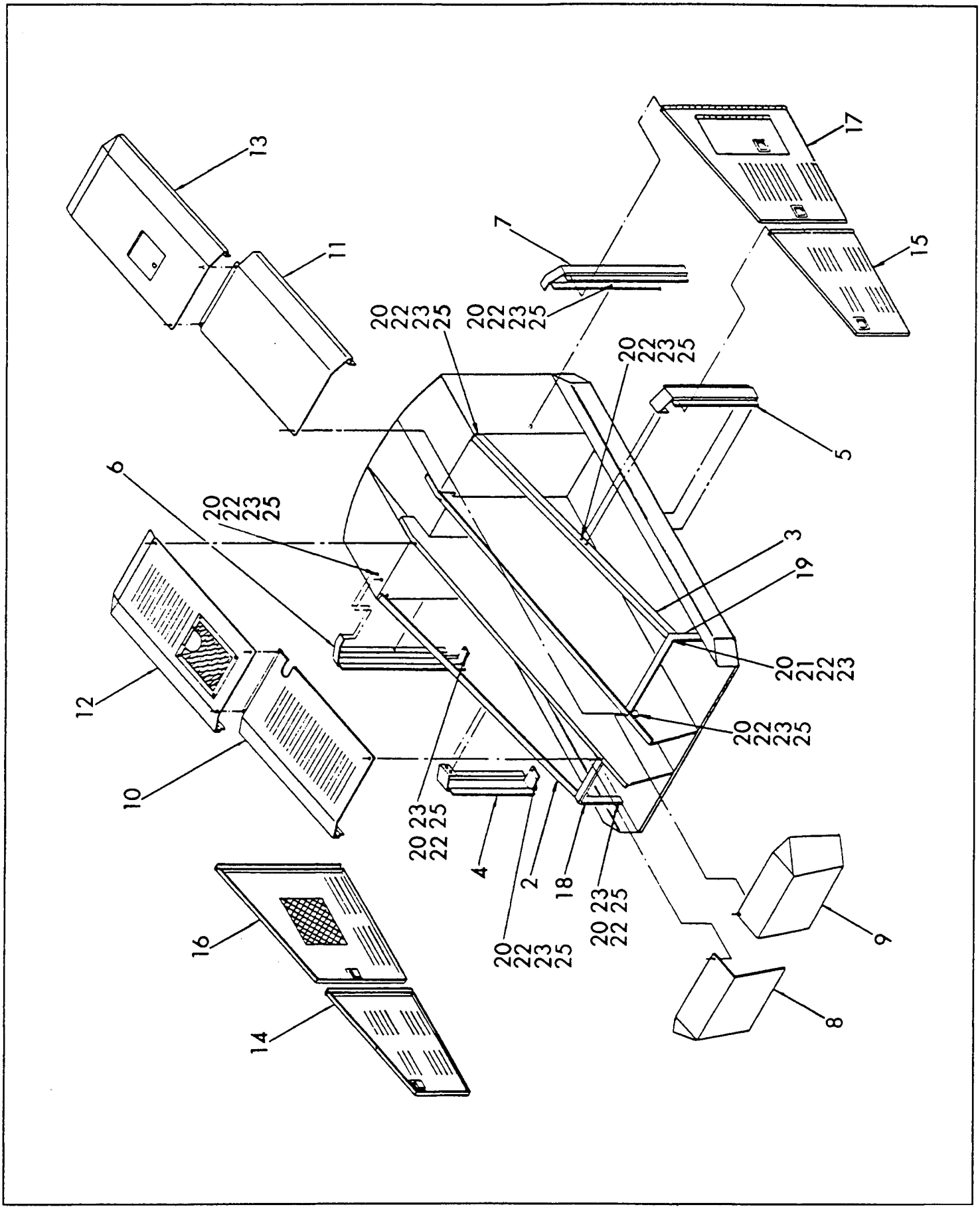
SECT.	2
FIG.	2
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
24	.2020	DECAL, GASOLINE OR PETROL	2
25	.20859	DECAL, CAUTION AERIAL OPERATING INSTRUCTIONS	1
26	.20860	DECAL, GENERAL CHECKOUT & OPERATING...	1
27	.21237	DECAL, GREASE FITTING	3
28	.20420	DECAL, TIRE PRESSURE 75 PSI	2
29	.20660	MANEPLATE, IDENTIFICATION	1
30	.2003	DECAL, BATTERY WATER LEVEL (ON BATTERY)	1
31	.20661	PLATE, ANSI A92	1

Mark Industries

TITLE	SHEET METAL KIT
MODEL	62 4X2
NOTES	UNTIL EARLY 1984

SECTION	2
FIGURE	3
PAGE	1



Mark Industries

TITLE	SHEET METAL KIT
MODEL	62 4X2
NOTES	UNTIL EARLY 1984

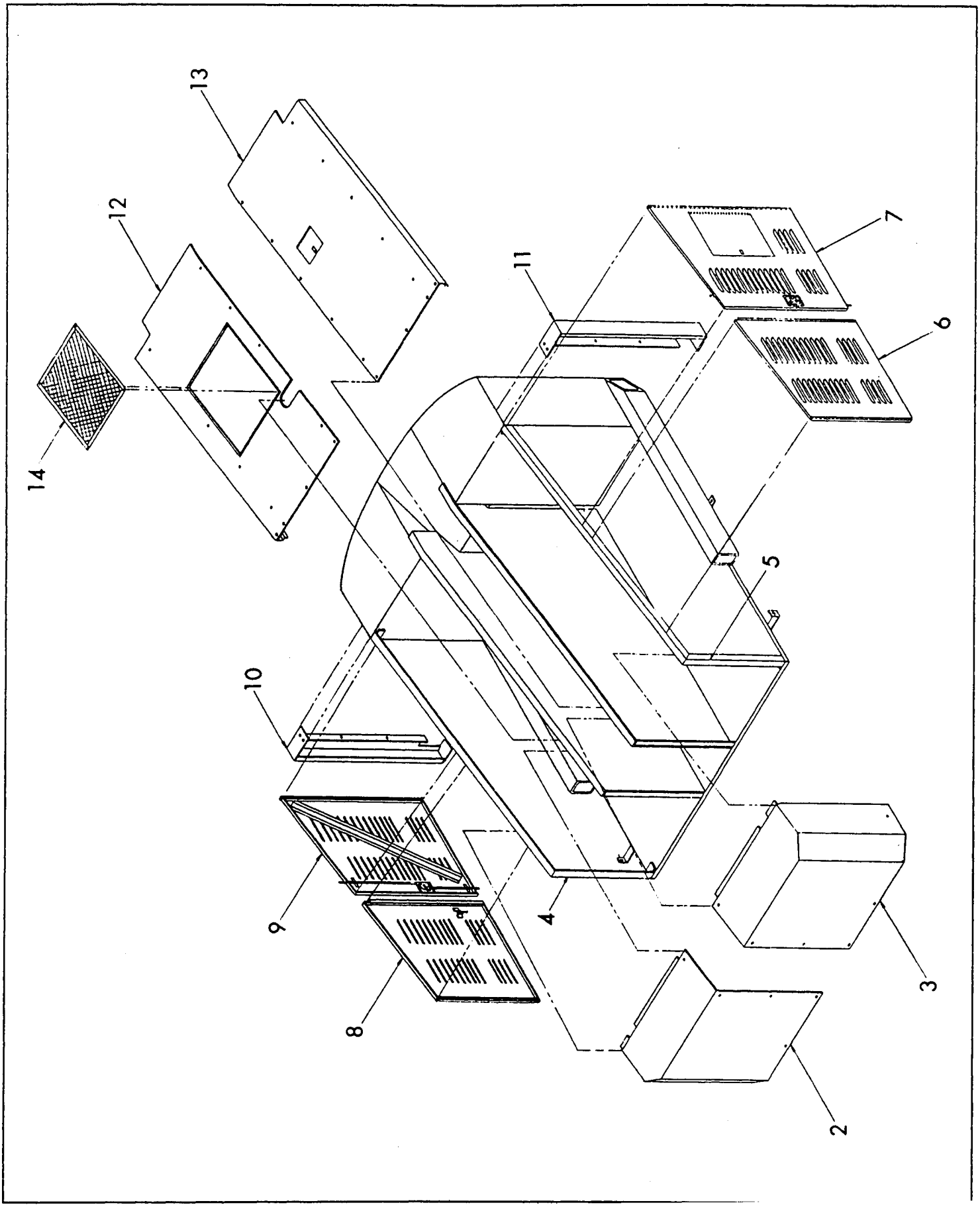
SECT.	2
FIG.	3
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21224	KIT, SHEET METAL (See Sect. 2, Fig. 1 for NHA)	REF
2	.21362	RAIL, LEFT FRAME	1
3	.21363	RAIL, RIGHT FRAME	1
4	.21364	SUPPORT, LEFT MID	1
5	.21365	SUPPORT, RIGHT MID	1
6	.21366	SUPPORT, LEFT FRONT	1
7	.21367	SUPPORT, RIGHT FRONT	1
8	.21368	NOSEPIECE, LEFT	1
9	.21369	NOSEPIECE, RIGHT	1
10	.21370	COVER, LEFT MID	1
11	.21371	COVER, RIGHT MID	1
12	.21396	COVER, LEFT FRONT	1
13	.21373	COVER, RIGHT FRONT	1
14	.21374	DOOR, LEFT REAR	1
15	.21375	DOOR, RIGHT REAR	1
16	.21393	DOOR, LEFT FRONT	1
17	.21377	DOOR, RIGHT FRONT	1
18	.21378	SUPPORT, LEFT REAR	1
19	.21379	SUPPORT, RIGHT REAR	1
20	.60343	SCREW, CAP	34
21	.60703	NUT, HEX	4
22	.63403	WASHER, FLAT	34
23	.63303	WASHER, LOCK	34
24	.61902	SCREW, CAP	52
25	.61313	NUT, LOCK	28

Mark Industries

TITLE	SHEET METAL KIT
MODEL	62 4X2
NOTES	SINCE EARLY 1984

SECTION	2
FIGURE	3A
PAGE	1



Mark Industries

TITLE	SHEET METAL KIT
MODEL	62 4X2
NOTES	SINCE EARLY 1984

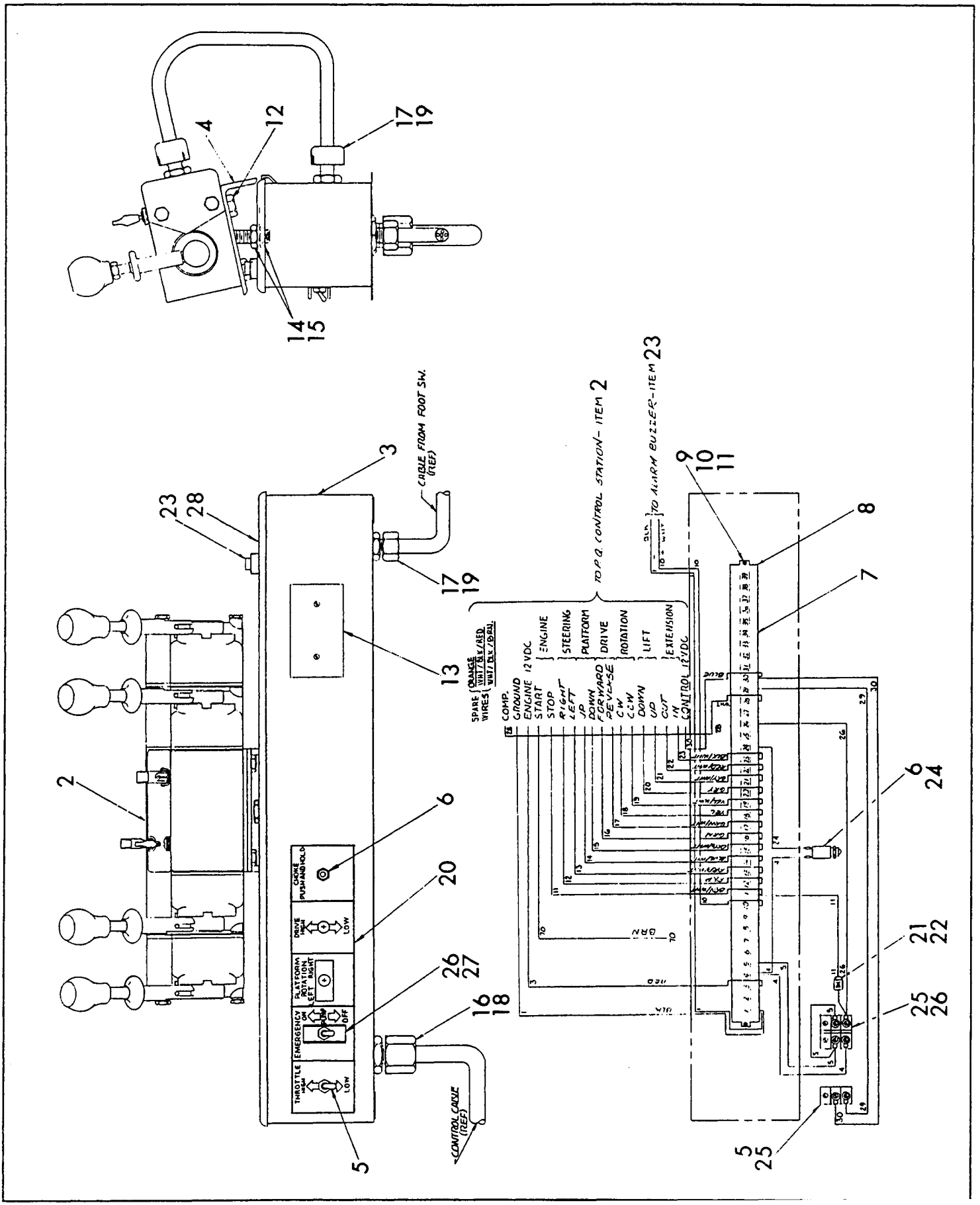
SECT.	2
FIG.	3A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22618	KIT, SHEET METAL (See Sect. 2, Fig. 1 for NHA)	REF
2	.22630	COVER, LEFT NOSE	1
3	.22631	COVER, RIGHT NOSE	1
4	.22659	SUPPORT, LEFT	1
5	.22660	SUPPORT, RIGHT	1
6	.22628	DOOR, RIGHT REAR	1
7	.22629	DOOR, RIGHT FRONT	1
8	.22627	DOOR, LEFT REAR	1
9	.22626	DOOR, LEFT FRONT	1
10	.22661	SUPPORT, LEFT FRONT	1
11	.22662	SUPPORT, RIGHT FRONT	1
12	.22633	COVER, LEFT TOP	1
13	.22632	COVER, RIGHT TOP	1
14	.22634	SCREEN, EXPANDED METAL	1

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	2
FIGURE	4
PAGE	1



Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	62 4X2
NOTES	

SECT.	2
FIG.	4
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21090	ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 1 for NHA)	REF
2	.22109	STATION, AERIAL CONTROL	1
3	.20311	MACHINING, AERIAL CONTROL BOX	1
4	.20217	BRACKET, CONTROLLER'S MOUNTING	1
5	.4017	SWITCH, TOGGLE	1
6	.4011	SWITCH, PUSH BUTTON	1
7	.4027	BLOCK, TERMINAL	39
8	.117-A	BLOCK, TERMINAL	1
9	.62624	SCREW, MACHINE	5
10	.61501	NUT, HEX	5
11	.63311	WASHER, LOCK	5
12	.60633	SCREW, CAP	4
13	.902	PLATE, COVER	1
14	.60702	NUT, HEX	4
15	.63302	WASHER, LOCK	4
16	.16215	RELIEF, STRAIN	1
17	.2806	RELIEF, STRAIN	2
18	.16105	NUT, LOCK	1
19	.2808	NUT, LOCK	2
20	.22571	DECAL, AERIAL CONTROL SWITCH	1
21	.4045	DIODE (1000V/6A)	1
22	.877	CONNECTOR, BUTT	1
23	.20805	BUZZER, ALARM	1
24	.117-E	TERMINAL, PUSH	2
25	.2859	RING, TONGUE	8

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

Mark Industries

TITLE	AERIAL CONTROL BOX ASSEMBLY
MODEL	62 4X2
NOTES	

SECT.	2
FIG.	4
PAGE	3

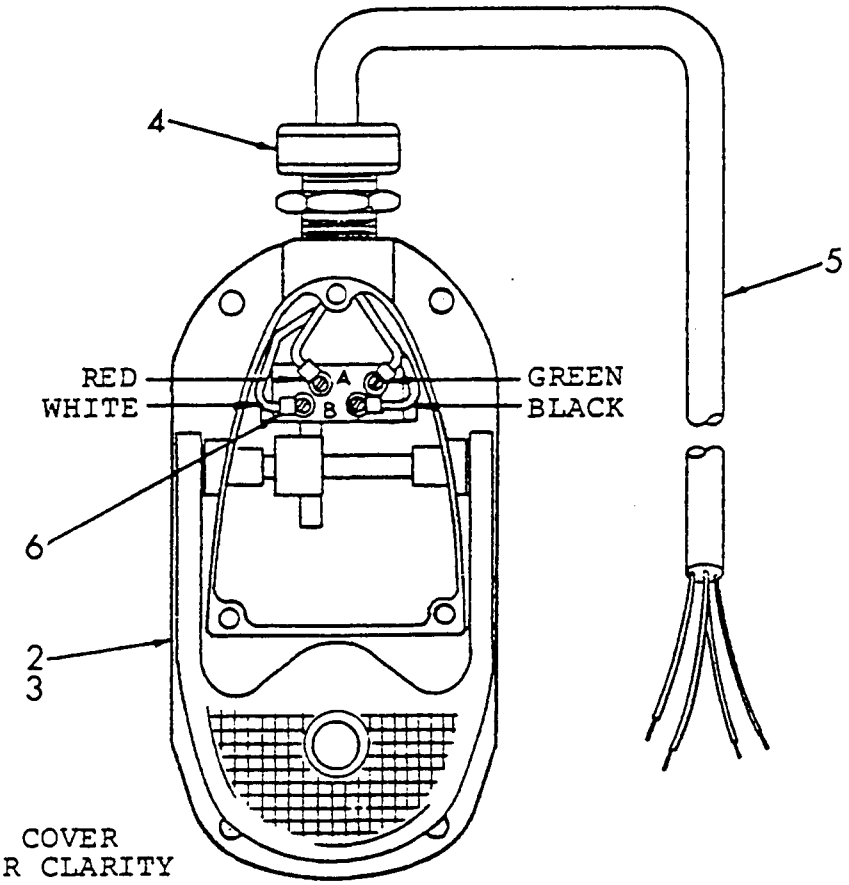
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.70037	SWITCH, TOGGLE	1
27	.20884	GUARD, SWITCH	1
28	.20444	DECAL, 5 DEGREE SLOPE	1

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	FOOTSWITCH ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL MID 1985

SECTION	2
FIGURE	5
PAGE	1



NOTE:
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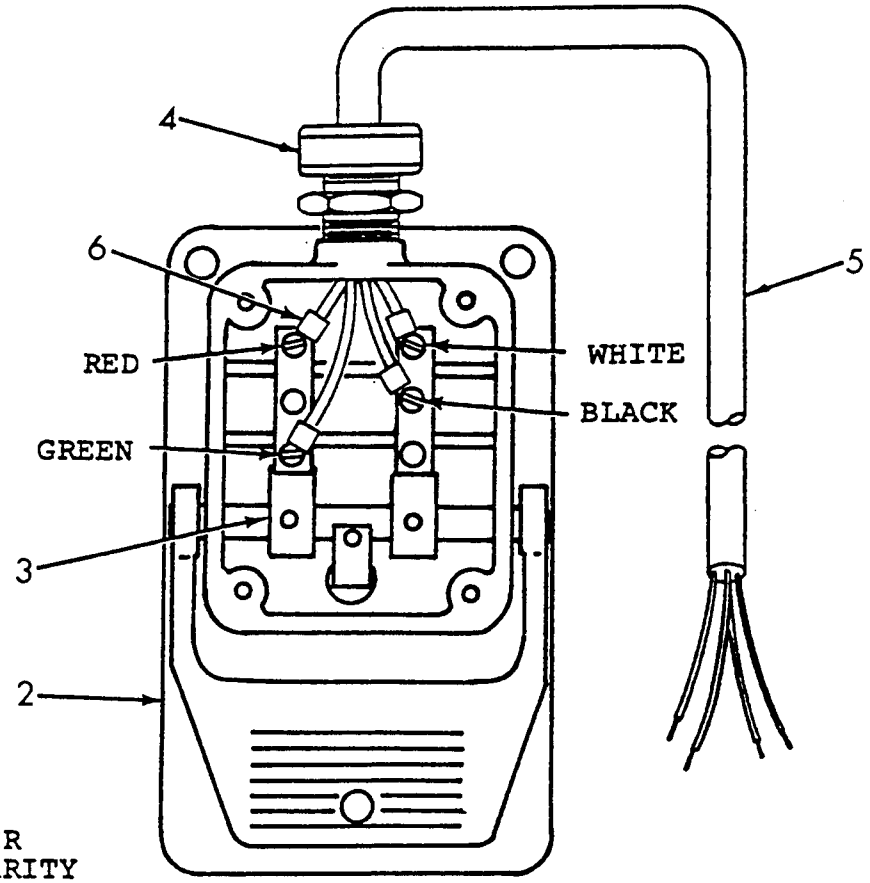
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20480	ASSEMBLY, FOOTSWITCH (See Sect. 2, Fig. 1 for NHA)	REF
2	.20379	FOOTSWITCH	1
3	..66185	MICROSWITCH (4 TERMINAL)	1
4	.2531	RELIEF, STRAIN	1
5	.2912	CABLE, CONDUCTOR	5 FT
6	.876	RING, TERMINAL	4

REV

Mark Industries

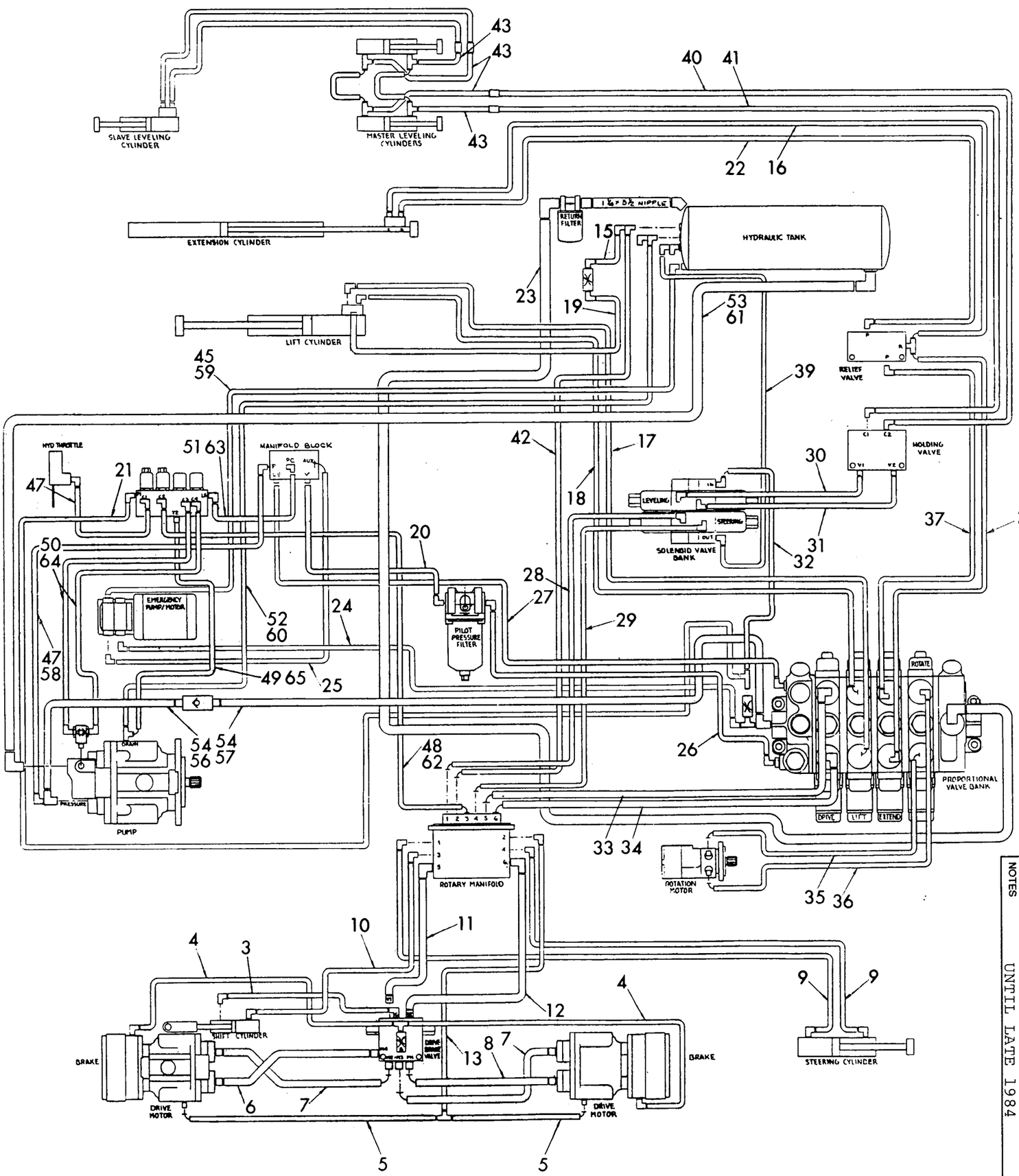
TITLE	FOOTSWITCH ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1985

SECTION	2
FIGURE	5A
PAGE	1



NOTE:
SHOWN WITH COVER
REMOVED FOR CLARITY

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20480	ASSEMBLY, FOOTSWITCH (See Sect. 2, Fig. 1 for NHA)	REF
2	.70212	FOOTSWITCH	1
3	..66336	MICROSWITCH (3 TERMINAL)	2
4	.2531	RELIEF, STRAIN	1
5	.2912	CABLE, CONDUCTOR	5
6	.876	RING, TERMINAL	4



Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECTION	2
FIGURE	6
PAGE	1

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	2
FIG.	6
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21055	DIAGRAM, HYDRAULIC HOSE (See Sect. 2, Fig. 1 for NHA)	REF
-2	.21055 KIT-A	KIT, HOSE (BASE)	1
3	..13210-04-0230	ASSEMBLY, HOSE	1
4	..13213-04-0340	ASSEMBLY, HOSE	2
5	..13213-06-0270	ASSEMBLY, HOSE	2
6	..13220-12-0204	ASSEMBLY, HOSE	1
7	..13223-12-0240	ASSEMBLY, HOSE	2
8	..13223-12-0260	ASSEMBLY, HOSE	1
9	..13210-04-0600	ASSEMBLY, HOSE	2
10	..13210-04-0700	ASSEMBLY, HOSE	1
11	..13220-12-0540	ASSEMBLY, HOSE	1
12	..13220-12-0560	ASSEMBLY, HOSE	1
13	..13210-06-0650	ASSEMBLY, HOSE	1
-14	.21055 KIT-B	KIT, HOSE (TURRET)	1
15	..13210-04-0900	ASSEMBLY, HOSE	1
16	..13210-08-0950	ASSEMBLY, HOSE	1
1	..13212-08-1260	ASSEMBLY, HOSE	1
18	..13213-08-1190	ASSEMBLY, HOSE	1
19	..13210-04-0600	ASSEMBLY, HOSE	1
20	..13210-06-0900	ASSEMBLY, HOSE	1
21	..13213-06-0960	ASSEMBLY, HOSE	1
22	..13210-08-0920	ASSEMBLY, HOSE	1
23	..13203-16-0700	ASSEMBLY, HOSE	1
24	..13210-06-0550	ASSEMBLY, HOSE	1
25	..13213-06-0780	ASSEMBLY, HOSE	1

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

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	2
FIG.	6
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	..13213-06-0660	ASSEMBLY, HOSE	1
27	..13210-04-0380	ASSEMBLY, HOSE	1
28	..13213-04-0360	ASSEMBLY, HOSE	1
29	..13213-04-0300	ASSEMBLY, HOSE	1
30	..13213-04-0110	ASSEMBLY, HOSE	1
31	..13213-04-0120	ASSEMLBY, HOSE	1
32	..13213-06-0290	ASSEMBLY, HOSE	1
33	..13214-12-0340	ASSEMBLY, HOSE	1
34	..13215-12-0440	ASSEMBLY, HOSE	1
35	..13215-08-0590	ASSEMBLY, HOSE	1
36	..13213-08-0570	ASSEMBLY, HOSE	1
37	..13213-08-0250	ASSEMBLY, HOSE	1
38	..13212-08-0310	ASSEMBLY, HOSE	1
39	..13213-06-0610	ASSEMBLY, HOSE	1
40	..13210-04-0940	ASSEMBLY, HOSE	1
41	..13210-04-0960	ASSEMBLY, HOSE	1
42	..13213-06-0390	ASSEMBLY, HOSE	1
43	..13213-04-0150	ASSEMBLY, HOSE	4
-44	.21055 KIT-C	KIT, HOSE (GAS MODELS ONLY)	1
45	..13205-12-0850	ASSEMBLY, HOSE	1
46	..13210-04-0960	ASSEMBLY, HOSE	1
47	..13210-06-0900	ASSEMBLY, HOSE	1
48	..13213-04-1050	ASSEMBLY, HOSE	1
49	..13213-06-0220	ASSEMBLY, HOSE	1
50	..13210-04-0140	ASSEMBLY, HOSE	2

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	2
FIG.	6
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
51	..13210-04-1050	ASSEMBLY, HOSE	1
52	..13210-06-0900	ASSEMBLY, HOSE	1
53	..13203-20-0340	ASSEMBLY, HOSE	1
54	..13220-16-0320	ASSEMBLY, HOSE	2
-55	.21055 KIT-D	KIT, HOSE (DIESEL MODELS ONLY)	1
56	..13220-16-0130	ASSEMBLY, HOSE	1
57	..13220-16-0180	ASSEMBLY, HOSE	1
58	..13213-06-0500	ASSEMBLY, HOSE	1
59	..13213-12-1050	ASSEMBLY, HOSE	1
60	..13210-06-1200	ASSEMBLY, HOSE	1
61	..13203-20-0760	ASSEMBLY, HOSE	1
62	..13213-04-0410	ASSEMBLY, HOSE	1
63	..13210-04-0600	ASSEMBLY, HOSE	1
64	..13210-04-0190	ASSEMBLY, HOSE	2
65	..13213-06-0350	ASSEMBLY, HOSE	1

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	SINCE LATE 1984

SECTION	2
FIGURE	6A
PAGE	1

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	SINCE LATE 1984

SECT.	2
FIG.	6A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21938	DIAGRAM, HYDRAULIC HOSE (See Sect. 2, Fig. 1 for NHA)	REF
-2	.21938 KIT-A	DIAGRAM, HYDRAULIC HOSE (BASE)	1
3	..13213-04-0340	ASSEMBLY, HOSE	2
4	..13213-06-0270	ASSEMBLY, HOSE	2
5	..13220-12-0204	ASSEMBLY, HOSE	1
6	..13223-12-0240	ASSEMBLY, HOSE	2
7	..13223-12-0224	ASSEMBLY, HOSE	1
8	..13210-04-0600	ASSEMBLY, HOSE	2
9	..13210-04-0600	ASSEMBLY, HOSE	1
10	..13220-12-0540	ASSEMBLY, HOSE	1
11	..13220-12-0560	ASSEMBLY, HOSE	1
12	..13210-06-0650	ASSEMBLY, HOSE	1
13	..13213-04-0210	ASSEMBLY, HOSE	2
-14	.21938 KIT-B	DIAGRAM, HYDRAULIC HOSE (TURRET)	1
15	..13210-04-1050	ASSEMBLY, HOSE	2
16	..13210-08-1020	ASSEMBLY, HOSE	1
17	..13212-08-1260	ASSEMBLY, HOSE	1
18	..13213-08-1190	ASSEMBLY, HOSE	1
19	..13210-04-0600	ASSEMBLY, HOSE	1
20	..13213-04-0170	ASSEMBLY, HOSE	2
21	..13213-06-0280	ASSEMBLY, HOSE	1
22	..13213-09-0980	ASSEMBLY, HOSE	1
23	..13205-16-0220	ASSEMBLY, HOSE	1
24	..13213-12-0270	ASSEMBLY, HOSE	1
25	..13213-06-1310	ASSEMBLY, HOSE	1

Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM
MODEL	62 4X2
NOTES	SINCE LATE 1984

SECT.	2
FIG.	6A
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	..13212-12-0280	ASSEMBLY, HOSE	1
27	..13213-04-0180	ASSEMBLY, HOSE	1
28	..13213-06-0144	ASSEMBLY, HOSE	1
29	..13213-04-0190	ASSEMBLY, HOSE	1
30	..13213-04-0200	ASSEMBLY, HOSE	2
31	..13213-06-0290	ASSEMBLY, HOSE	1
32	..13213-12-0150	ASSEMBLY, HOSE	1
33	..13213-12-0230	ASSEMBLY, HOSE	1
34	..13212-08-0750	ASSEMBLY, HOSE	1
35	..13213-08-0740	ASSEMBLY, HOSE	1
36	..13213-08-0234	ASSEMBLY, HOSE	1
37	..13212-08-0264	ASSEMBLY, HOSE	1
38	..13213-06-0290	ASSEMBLY, HOSE	1
39	..13210-04-1030	ASSEMBLY, HOSE	1
40	..13213-04-0150	ASSEMBLY, HOSE	4
41	..13210-04-0750	ASSEMBLY, HOSE	1
42	..13213-06-0070	ASSEMBLY, HOSE	2
-43	.21938 KIT-C	DIAGRAM, HYDRAULIC HOSE (GAS MODELS ONLY)	1
44	..13210-06-1230	ASSEMBLY, HOSE	1
45	..13210-06-0550	ASSEMBLY, HOSE	1
46	..13210-04-1110	ASSEMBLY, HOSE	1
47	..13210-06-1110	ASSEMBLY, HOSE	1
48	..13213-06-0190	ASSEMBLY, HOSE	1
49	..13213-06-0380	ASSEMBLY, HOSE	1
50	..13210-06-0900	ASSEMBLY, HOSE	1

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

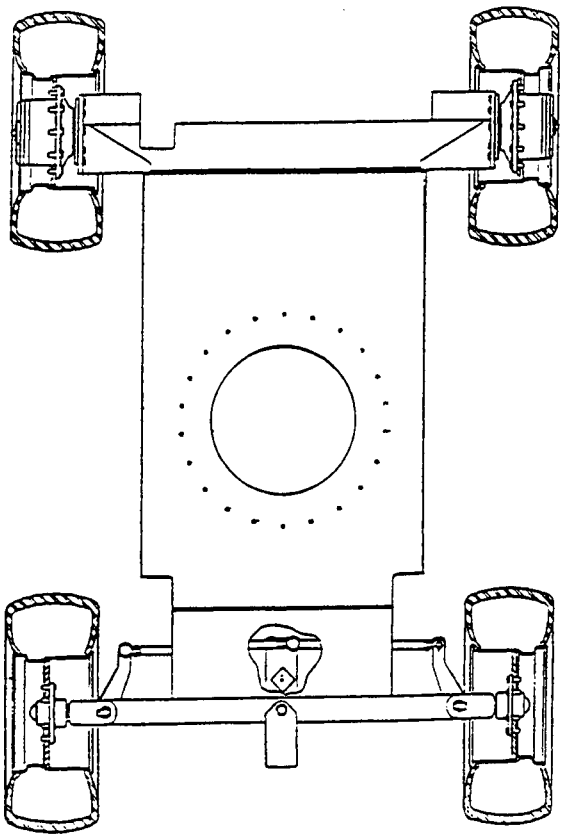
Mark Industries

TITLE	HYDRAULIC HOSE DIAGRAM	SECT. 2
MODEL	62 4X2	FIG. 6A
NOTES	SINCE LATE 1984	PAGE 4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
51	..13210-04-0140	ASSEMBLY, HOSE	1
52	..13203-12-0710	ASSEMBLY, HOSE	1
53	..13213-06-1320	ASSEMBLY, HOSE	1
54	..13210-04-1050	ASSEMBLY, HOSE	1
55	..13211-04-0160	ASSEMBLY, HOSE	1
56	..13210-16-0560	ASSEMBLY, HOSE	2
57	..13205-20-0400	ASSEMBLY, HOSE	1
58	..13213-04-1200	ASSEMBLY, HOSE	1
59	..13213-04-0160	ASSEMBLY, HOSE	1
-60	.21938 KIT-D	DIAGRAM, HYDRAULIC HOSE (DIESEL MODELS ONLY)	1
61	..13210-06-0690	ASSEMBLY, HOSE	1
62	..13210-06-1030	ASSEMBLY, HOSE	1
63	..13210-04-0870	ASSEMBLY, HOSE	1
64	..13213-06-0900	ASSEMBLY, HOSE	1
65	..13213-06-0160	ASSEMBLY, HOSE	1
66	..13213-06-0870	ASSEMBLY, HOSE	1
67	..13210-06-0710	ASSEMBLY, HOSE	1
68	..13213-04-0160	ASSEMBLY, HOSE	1
69	..13203-12-0710	ASSEMBLY, HOSE	1
70	..13210-06-0230	ASSEMBLY, HOSE	1
71	..13210-16-0260	ASSEMBLY, HOSE	1
72	..13210-04-0170	ASSEMBLY, HOSE	1
73	..13210-16-0410	ASSEMBLY, HOSE	1
74	..13203-20-0760	ASSEMBLY, HOSE	1
75	..13213-04-0620	ASSEMBLY, HOSE	1

SECTION 3 CONTAINS:

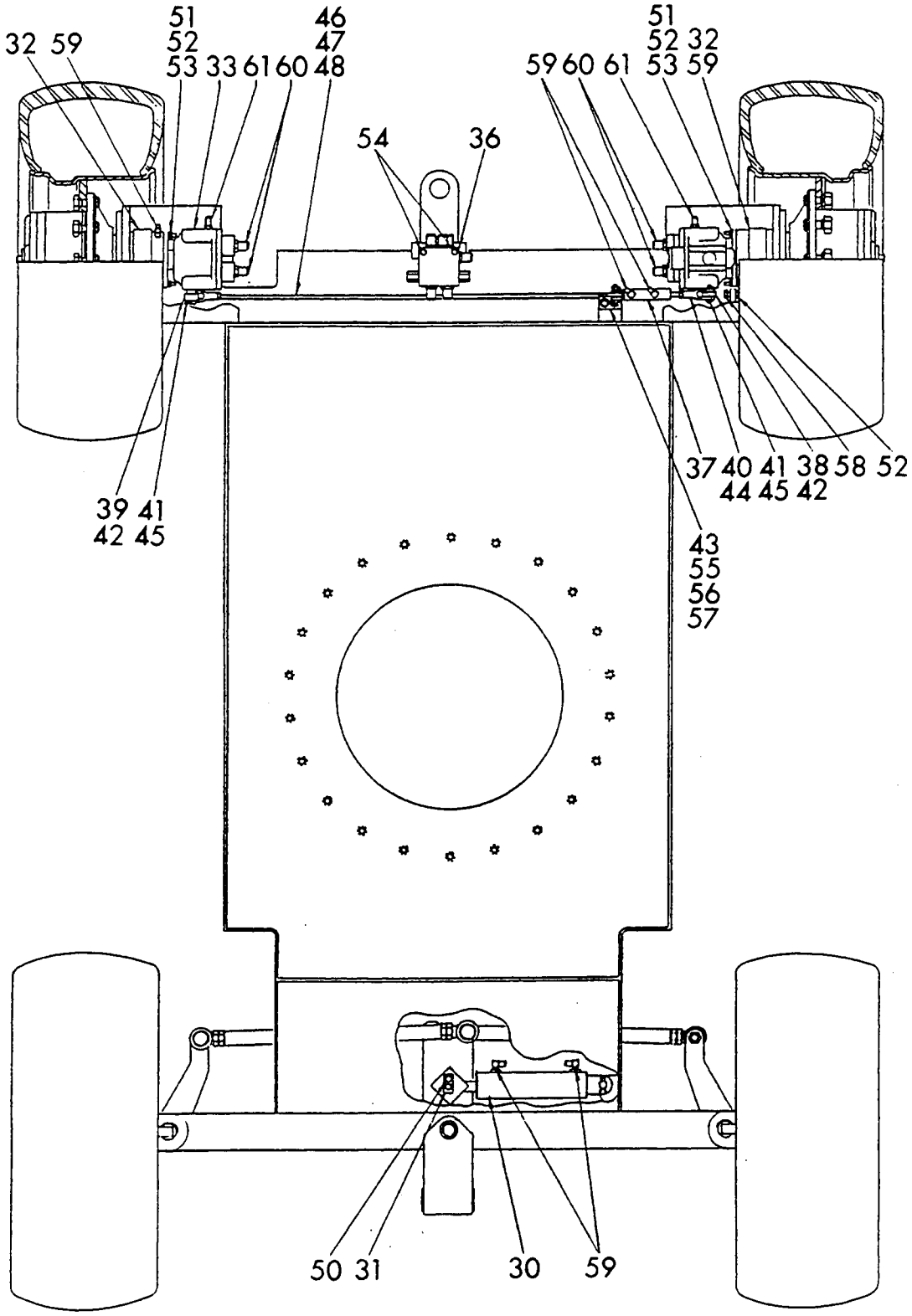
FIG. NO.	TITLE
1	CARRIAGE ASSEMBLY (UNTIL JAN. 1982)
1A	CARRIAGE ASSEMBLY (SINCE JAN. 1982)
2	HUB & YOKE ASSEMBLY (R.H.)
2A	HUB & YOKE ASSEMBLY (L.H.)
3	TORQUE HUB
4	STEERING CYLINDER (UNTIL EARLY 1982)
4A	STEERING CYLINDER ASSEMBLY (SINCE JAN. 1982)
5	BRAKE ASSEMBLY (UNTIL EARLY 1986)
5A	BRAKE ASSEMBLY (SINCE EARLY 1986)
6	DRIVE/BRAKE VALVE ASSEMBLY
7	SHIFT CYLINDER ASSEMBLY (EARLY VERSION)
7A	SHIFT CYLINDER ASSEMBLY (LATER VERSION)
8	MOTOR (EXTERNAL SHIFT)(UNTIL MID 1987)
8A	MOTOR (INTERNAL SHIFT)(SINCE MID 1987)



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL JAN. 1982

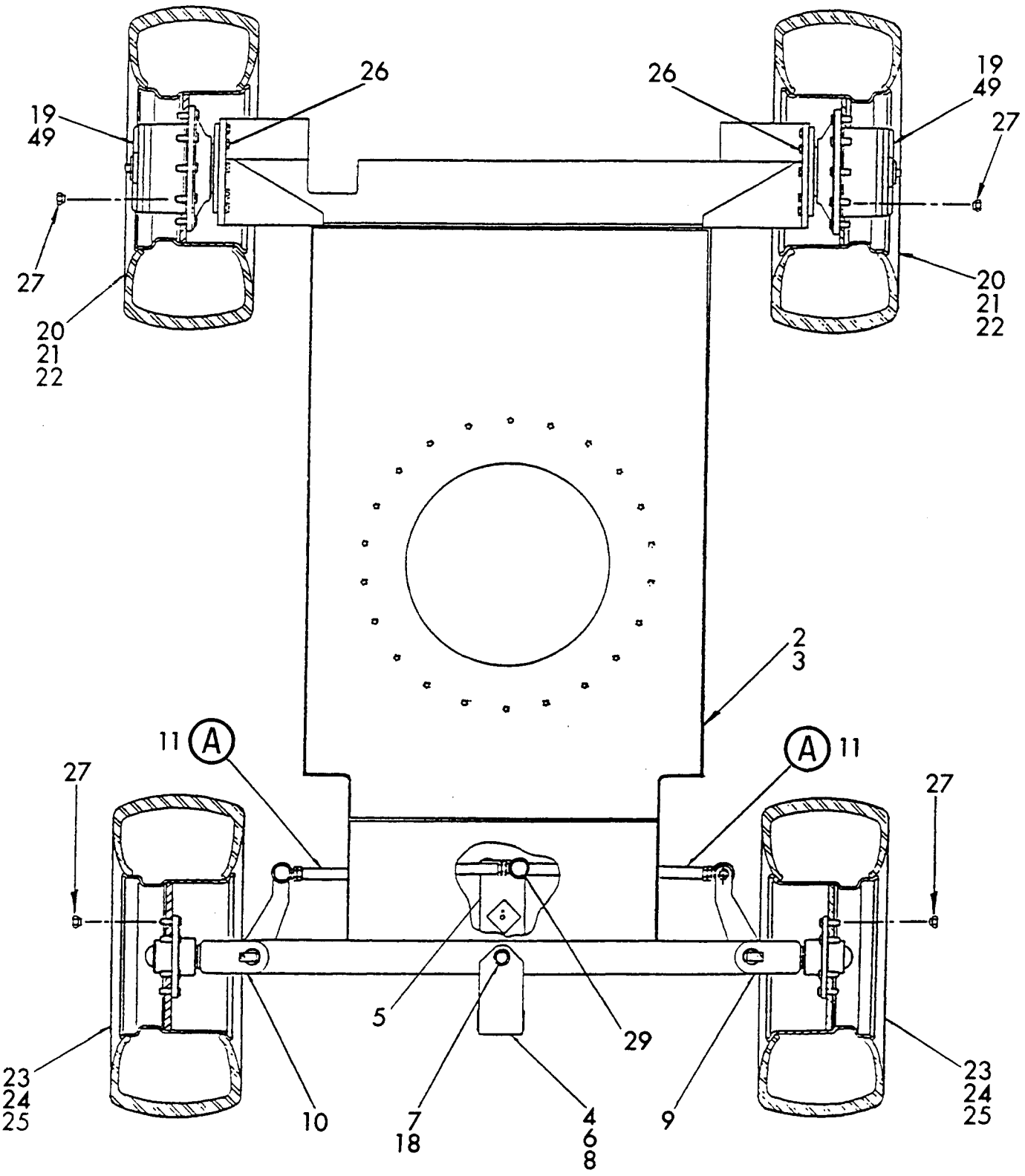
SECTION	3
FIGURE	1
PAGE	1



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL JAN. 1982

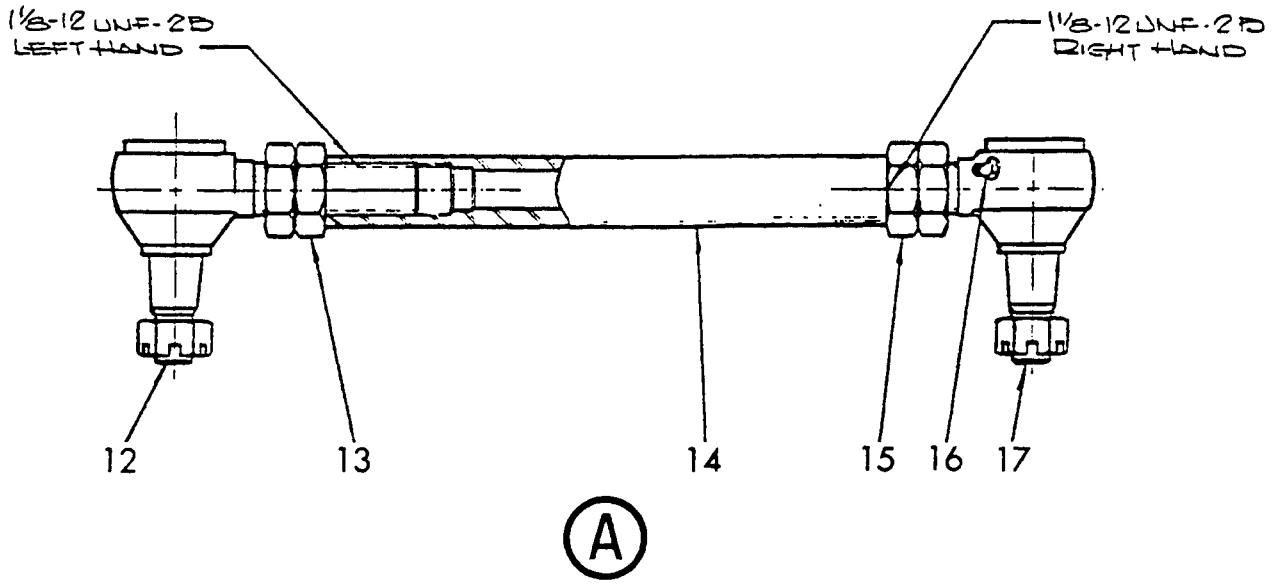
SECTION	3
FIGURE	1
PAGE	2



REV.

Mark Industries

TITLE	CARRIAGE ASSEMBLY	SECTION	3
MODEL	62 4X2	FIGURE	1
NOTES	UNTIL JAN. 1982	PAGE	3



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21050	ASSEMBLY, CARRIAGE (See Sect. 2, Fig. 1 for NHA)	REF
2	.21086	SUB-ASSEMBLY, CARRIAGE	1
3	..21100	WELDMENT, CARRIAGE	1
4	..21327	ASSEMBLY, STEERING ARM	1
5	...21299	ARM, STEERING	1
6	...21326	BRACKET, STEERING SUPPORT	1
7	...64901	BUSHING	2
8	...60601	SCREW, CAP	2
9	..21106	ASSEMBLY, HUB & YOKE (R.H.) (See Sect. 3, Fig. 2 for Details)	1
10	..21107	ASSEMBLY, HUB & YOKE (L.H.) (See Sect. 3, Fig. 2A for Details)	1
11	..21354	ASSEMBLY, TIE ROD	2

Mark Industries

TITLE	CARRIAGE ASSEMBLY	SECT.	3
MODEL	62 4X2	FIG.	1
NOTES	UNTIL JAN. 1982	PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
12	...20569	END, TIE ROD	2
13	...20567	NUT, JAM	4
14	..25071	TUBE	2
15	..20566	NUT, JAM	4
16	...65103	FITTING, GREASE	4
17	...20568	END, TIE ROD	2
18	..21328	PIN, MAIN STEERING	1
19	..21222	HUB, TORQUE (See Sect. 3, Fig. 3 for Detials)	2
20	..21204	ASSEMBLY, TIRE & WHEEL (DRIVE)	2
21	...21252	RIM	2
22	...21646	TIRE (NOTE TREAD DIRECTION)	2
23	..21205	ASSEMBLY, TIRE & WHEEL (STEER)	2
24	...21251	RIM	2
25	...21646	TIRE (NOTE TREAD DIRECTION)	2
26	..60604	SCREW, CAP	16
27	..65117	NUT, BALL	32
28	..60603	SCREW, CAP	2
29	..60804	NUT, HEX	1
30	.21756	CYLINDER, STEERING (See Sect. 3, Fig. 4 for Details)	1
31	.20796	PIN, STEERING CYLINDER	1
32	.22603	ASSEMBLY, BRAKE (See Sect. 3, Fig. 5 for Details)	2
33	.21221	MOTOR, HYDRAULIC (EXTERNAL SHIFT) (See Sect. 3, Fig. 8 for Details)	2
-34	..66607	KIT, SEAL	1

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

Mark Industries

TITLE	CARRIAGE ASSEMBLY	SECT. 3
MODEL	62 4X2	FIG. 1
NOTES	UNTIL JAN. 1982	PAGE 5

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-35	...67868	SEAL, SHAFT	1
36	.21082	ASSEMBLY, DRIVE/BRAKE VALVE (See Sect. 3, Fig. 6 for Details)	1
37	.20719	CYLINDER, SHIFT (See Sect. 3, Fig. 7 for Details)	1
38	.20737	BELL, CRANK (EXTERNAL SHIFT)	1
39	.20738	LEVER, ACTUATOR	1
40	.20789	CLEVIS, SHIFTING (EXTERNAL SHIFT)	1
41	.20795	PIN, SHIFTING (TIE ROD)	4
42	.64201	PIN, ROLL	2
43	.20814	BRACKET, MOUNTING (EXTERNAL SHIFT)	1
44	.60901	NIT, JAM	1
45	.64301	PIN, COTTER	8
46	.21329	ASSEMBLY, SHIFT ROD	1
47	..21352	ROD, SHIFTING (EXTERNAL SHIFT)	1
48	..20789	CLEVIS, SHIFTING (EXTERNAL SHIFT)	2
49	.65106	OIL, GEAR (90 WT.)	1 QT
50	.60603	SCREW, CAP	1
51	.63601	STUD	4
52	.60705	NUT, HEX	5
53	.63305	WASHER, LOCK	4
54	.60364	SCREW, CAP	2
55	.63303	WASHER, LOCK	4
56	.60343	SCREW, CAP	2
57	.63403	WASHER, FLAT	2
58	.60375	SCREW, CAP	1

Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL JAN. 1982

SECT.	3
FIG.	1
PAGE	6

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
59	.80012-03	ELBOW, SAE	6
60	.80004-18	CONNECTOR, SAE	4
61	.80004-08	CONNECTOR, STRAIGHT THREAD	2

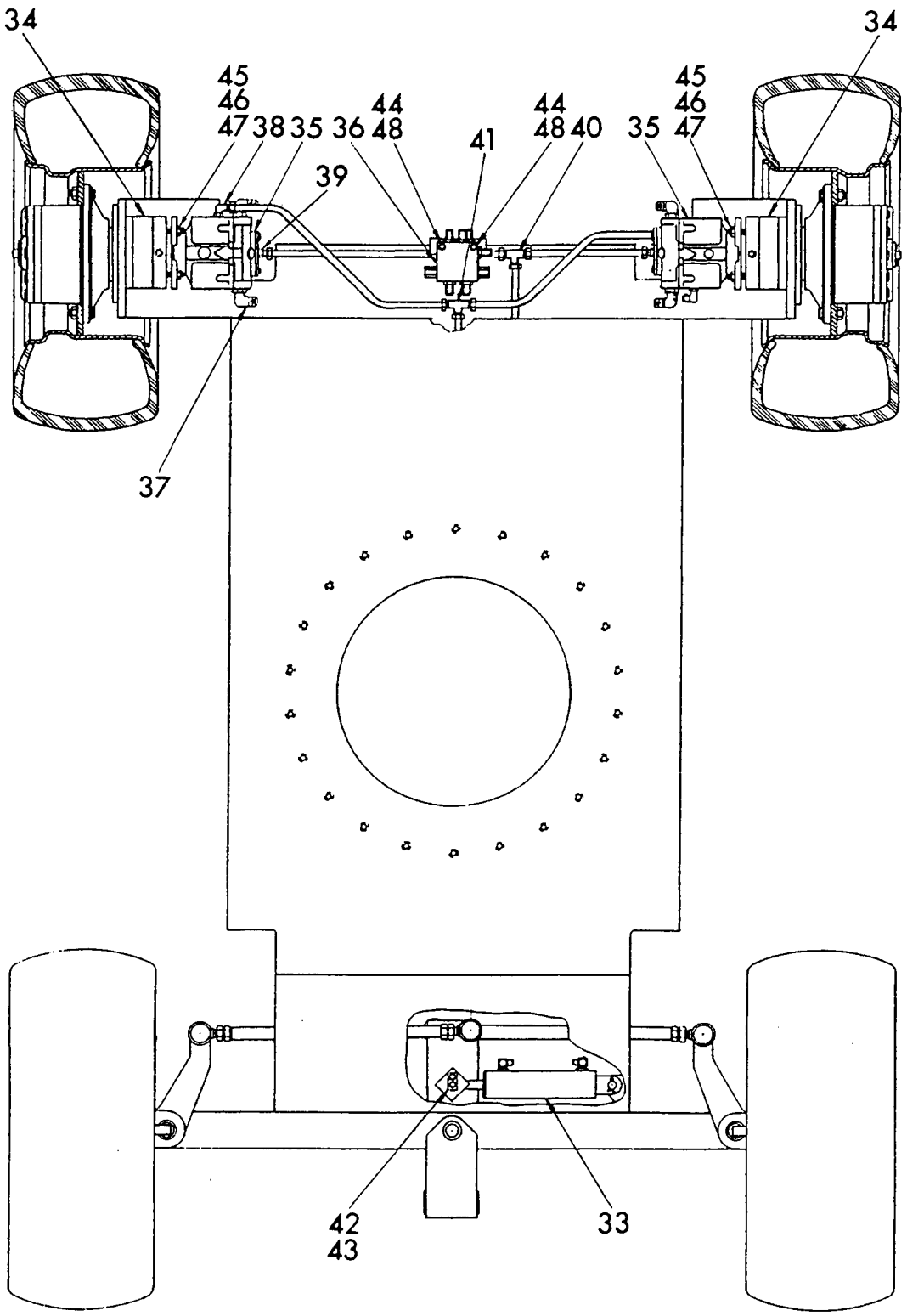
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DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	SINCE JAN. 1982

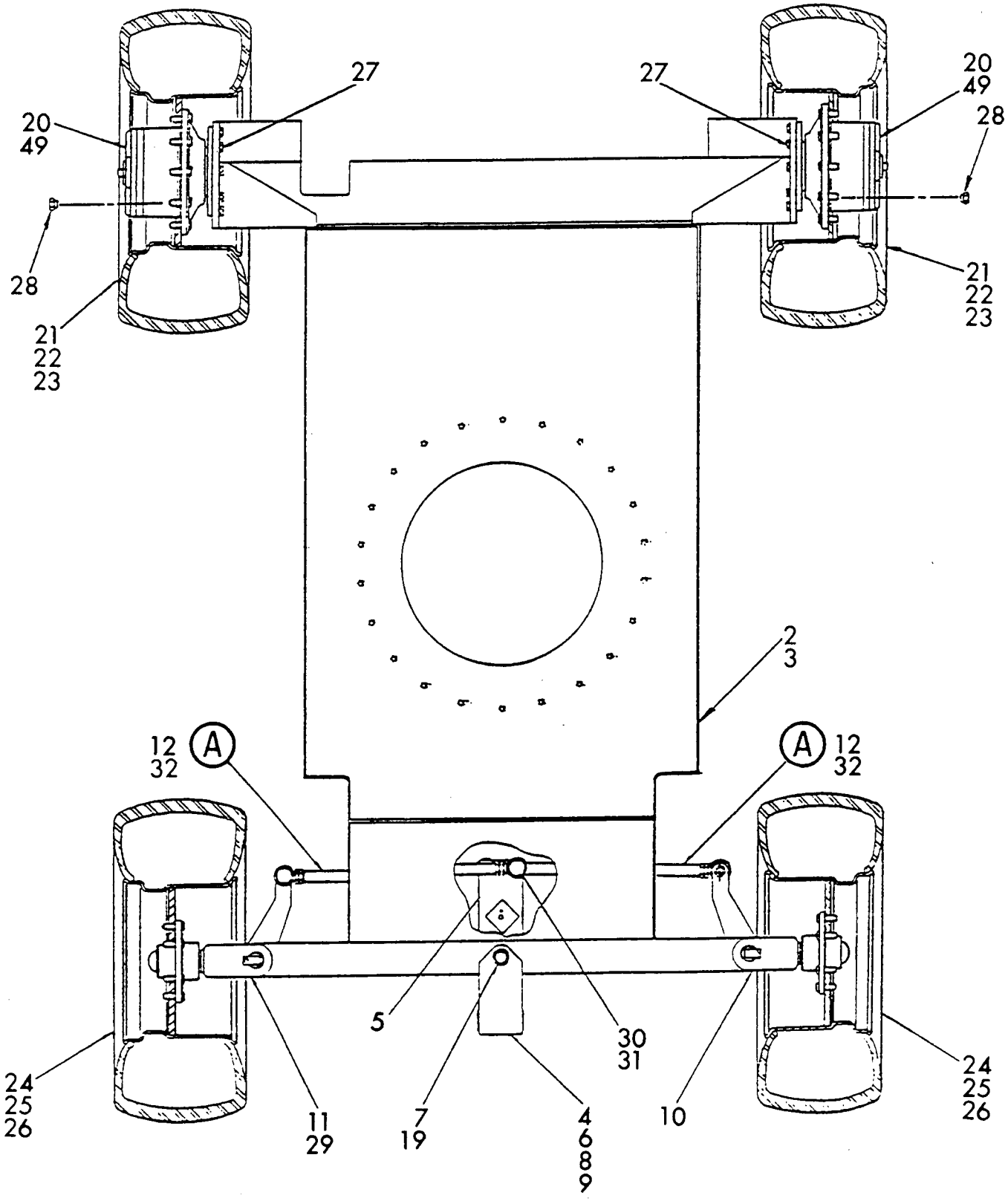
SECTION	3
FIGURE	1A
PAGE	1



Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	SINCE JAN. 1982

SECTION	3
FIGURE	1A
PAGE	2

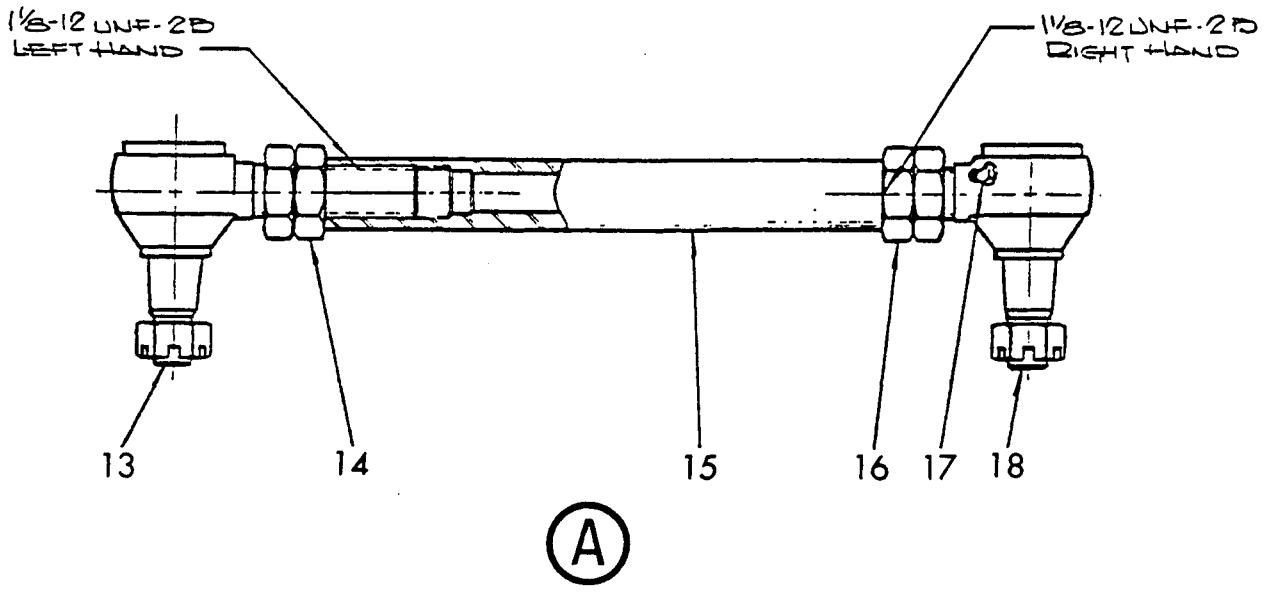


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Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	SINCE JAN. 1982

SECTION	3
FIGURE	1A
PAGE	3



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21497	ASSEMBLY, CARRIAGE (See Sect. 2, Fig. 1 for NHA)	REF
2	.21498	SUB-ASSEMBLY, CARRIAGE	1
3	..21100	WELDMENT, CARRIAGE	1
4	..21289	ASSEMBLY, STEERING ARM	1
5	...21299	ARM, STEERING	1
6	...21326	BRACKET, STEERING SUPPORT	1
7	...23152	BEARING, SLEEVE	2
8	...60506	SCREW, CAP	2
9	...61304	NUT, LOCK	2
10	..21106	ASSEMBLY, HUB & YOKE (R.H.) (See Sect. 3, Fig. 2 for Details)	1
11	..21107	ASSEMBLY, HUB & YOKE (L.H.) (See Sect. 3, Fig. 2A for Details)	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
12	..21354	ASSEMBLY, TIE ROD	2
13	...20569	END, TIE ROD	2
14	...20567	NUT, JAM	4
15	...25071	TUBE	2
16	...20566	NUT, JAM	4
17	...65103	FITTING, GREASE	4
18	...20568	END, TIE ROD	2
19	..21328	PIN, MAIN STEERING	1
20	..21222	HUB, TORQUE (See Sect. 3, Fig. 3 for Details)	2
21	..21204	ASSEMBLY, TIRE & WHEEL (DRIVE)	2
22	...21252	RIM	2
23	...21646	TIRE (NOTE TREAD DIRECTION)	2
24	..21205	ASSEMBLY, TIRE & WHEEL (STEER)	2
25	...21251	RIM	2
26	...21646	TIRE (NOTE TREAD DIRECTION)	2
27	..60604	SCREW, CAP	16
28	..65117	NUT, BALL	20
29	..60603	SCREW, CAP	2
30	..16101	NUT, LOCK	2
31	..63432	WASHER, FLAT	2
32	..64310	PIN, COTTER	4
33	.21663	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 4A for Details)	1
34	.22603	ASSEMBLY, BRAKE (See Sect. 3, Fig. 5 for Details)	2
35	.21672	ASSEMBLY, MOTOR (UNTIL MID 1987)	2

Mark Industries

TITLE	CARRIAGE ASSEMBLY
MODEL	62 4X2
NOTES	SINCE JAN. 1982

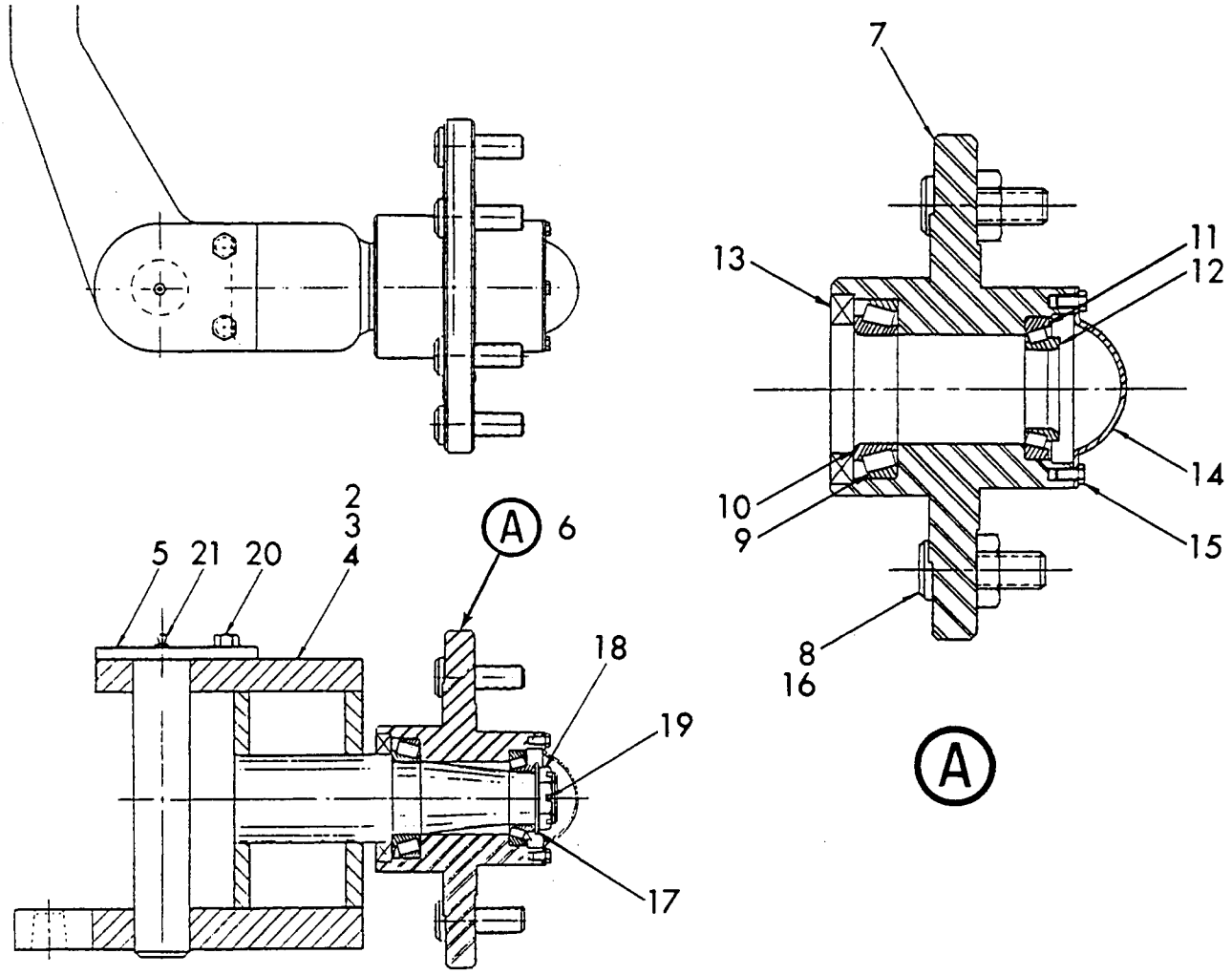
SECT.	3
FIG.	1A
PAGE	5

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
35	.23526	MOTOR (INTERNAL SHIFT) (See Sect. 3, Fig. 8A for Details)	2
36	.21082	ASSEMBLY, DRIVE/BRAKE VALVE (See Sect. 3, Fig. 6 for Details)	1
37	.80012-21	ELBOW, STRAIGHT THREAD	4
38	.80012-10	ELBOW, STRAIGHT THREAD	2
39	.80004-03	CONNECTOR, STRAIGHT THREAD	2
40	.80031-03	TEE	1
41	.80031-05	TEE	1
42	.21298	PIN, STEERING CYLINDER	1
43	.60607	SCREW, CAP	1
44	.63302	WASHER, LOCK	2
45	.63633	STUD	8
46	.60705	NUT, HEX	8
47	.63305	WASHER, LOCK	8
48	.60362	SCREW, CAP	2
49	.65106	OIL, GEAR (90 WT.)	1 QT

Mark Industries

TITLE	HUB & YOKE ASSEMBLY (R.H.)
MODEL	62 4X2
NOTES	

SECTION	3
FIGURE	2
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21106	ASSEMBLY, HUB & YOKE (R.H.) (See Sect. 3, Fig. 1 for NHA)	REF
2	.21120	WELDMENT, YOKE/SPINDLE (R.H.)	1
3	..21118	YOKE, STEERING	1
4	..21127	MACHINING, SPINDLE	1
5	.21344	PIN, KING	1
6	.21791	ASSEMBLY, HUB	1
7	..21792	MACHINING, STEERING HUB	1
8	..65351	BOLT, WHEEL	6

Mark Industries

TITLE	HUB & YOKE ASSEMBLY (R.H.)	SECT.	3
MODEL	62 4X2	FIG.	2
NOTES		PAGE	2

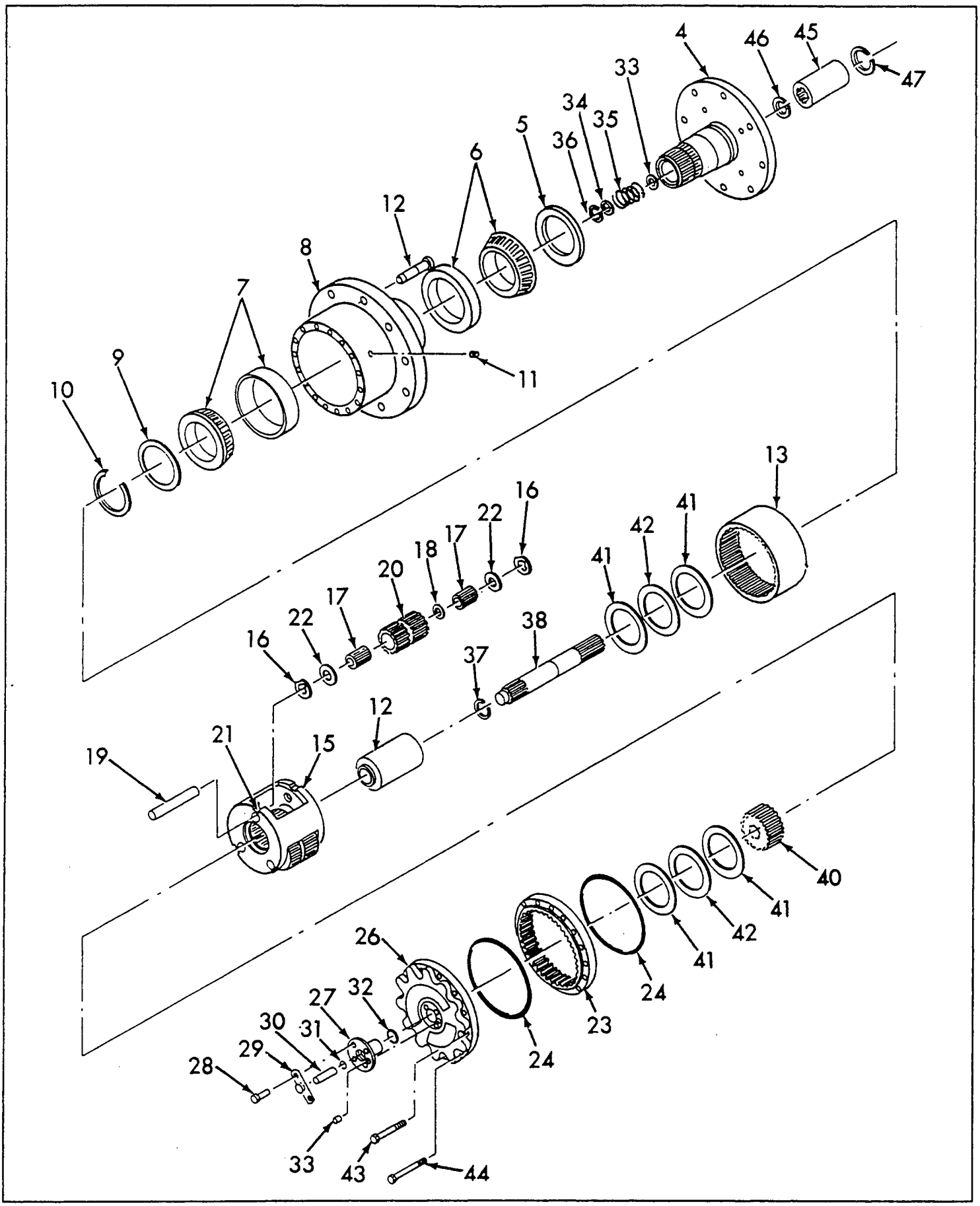
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
9	..21795	CUP, INNER	1
10	..21794	CONE, INNER	1
11	..65054	CUP, OUTER	1
12	..21796	CONE, OUTER	1
13	..21798	SEAL, GREASE	1
14	..21799	CAP, DUST	1
15	..60309	SCREW, CAP	4
16	..65117	NUT, BALL	6
17	.22497	RETAINER, BEARING	1
18	.61004	NUT, JAM	1
19	.16244	PIN, COTTER	1
20	.60618	SCREW, CAP	2
21	.65103	FITTING, GREASE	1

DASH (.) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	TORQUE HUB
MODEL	62 4X2
NOTES	

SECTION	3
FIGURE	3
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21222	HUB, TORQUE (See Sect. 3, Fig. 1 for NHA) (See Vendor Chapter for Details)	REF
-2	.67870	KIT, SEAL	1
-3	.	SUB-ASSEMBLY, HUB/SPINDLE	1
4	..67875	SPINDLE	1
*5	..66399	SEAL	1
6	..600435	KIT, BEARING	1
7	..600536	KIT, BEARING	1
8	..	HUB	1
9	..67903	SPACER	1
*10	..66516	RING, RETAINING	1
11	..	PLUG	2
12	..67884	STUD	10
13	.	GEAR, INTERNAL	1
14	.	ASSEMBLY, CARRIER	1
15	..66429	CARRIER	1
16	..66430	WASHER	6
17	..66423	ROLLER, NEEDLE	84
18	..67904	SPACER	3
19	..66431	SHAFT, PLANET	3
20	..66432	GEAR, CLUSTER	3
21	..	PIN, ROLL	3
22	..66434	WASHER	6
23	.	GEAR, RING	1
		NOTE: ASTERISK (*) INDICATES THE ITEM IS INCLUDED IN THE SEAL KIT.	

Mark Industries

TITLE	TORQUE HUB
MODEL	62 4X2
NOTES	

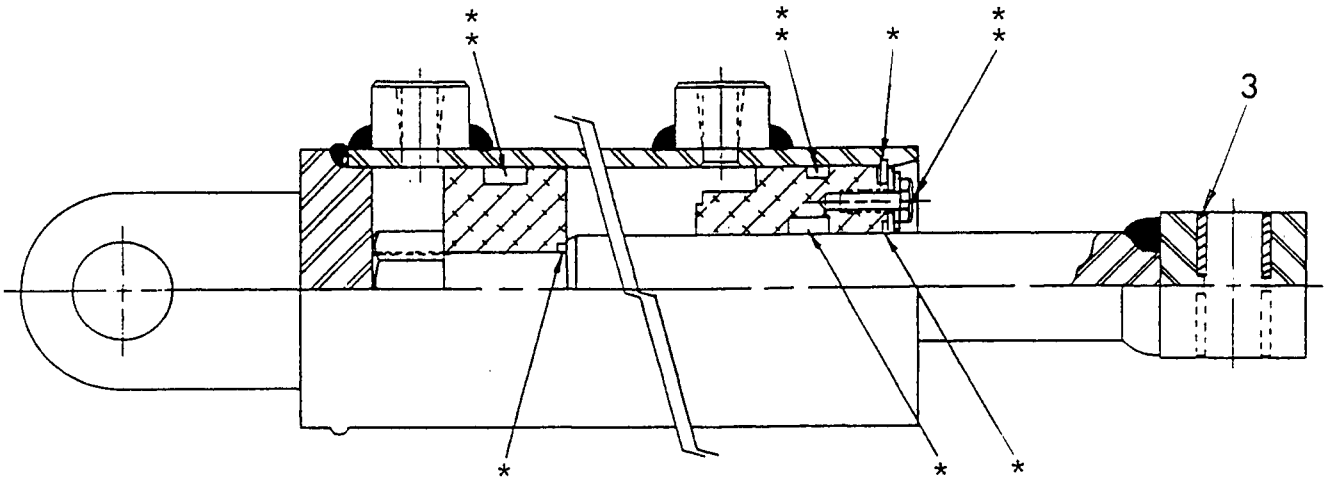
SECT.	3
FIG.	3
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
*24	.66397	O-RING	2
25	.	ASSEMBLY, COVER	1
26	..66724	COVER	1
27	..66341	CAP, COVER	1
28	..67928	BOLT	4
29	..66115	CAP, DISCONNECT	1
30	..66230	ROD, DISCONNECT	1
*31	..	O-RING	1
*32	..	O-RING	1
33	..	PLUG, PIPE	1
34	.67892	WASHER	2
35	.	SPRING	1
36	.66524	RING, RETAINING	1
37	.67889	RING, RETAINING	1
38	.	SHAFT, INPUT	1
39	.67905	SPACER	1
40	.	GEAR, INPUT	1
*41	.	WASHER	4
*42	.	BEARING	2
43	.67929	BOLT	8
44	.67930	BOLT	4
45	.67880	COUPLING	1
46	.67890	RING, RETAINING	1
47	.67891	RING, RETAINING	1
		NOTE: ASTERISK (*) INDICATES THE ITEM IS INCLUDED IN THE SEAL KIT.	

Mark Industries

TITLE	STEERING CYLINDER
MODEL	62 4X2
NOTES	UNTIL EARLY 1982

SECTION	3
FIGURE	4
PAGE	1



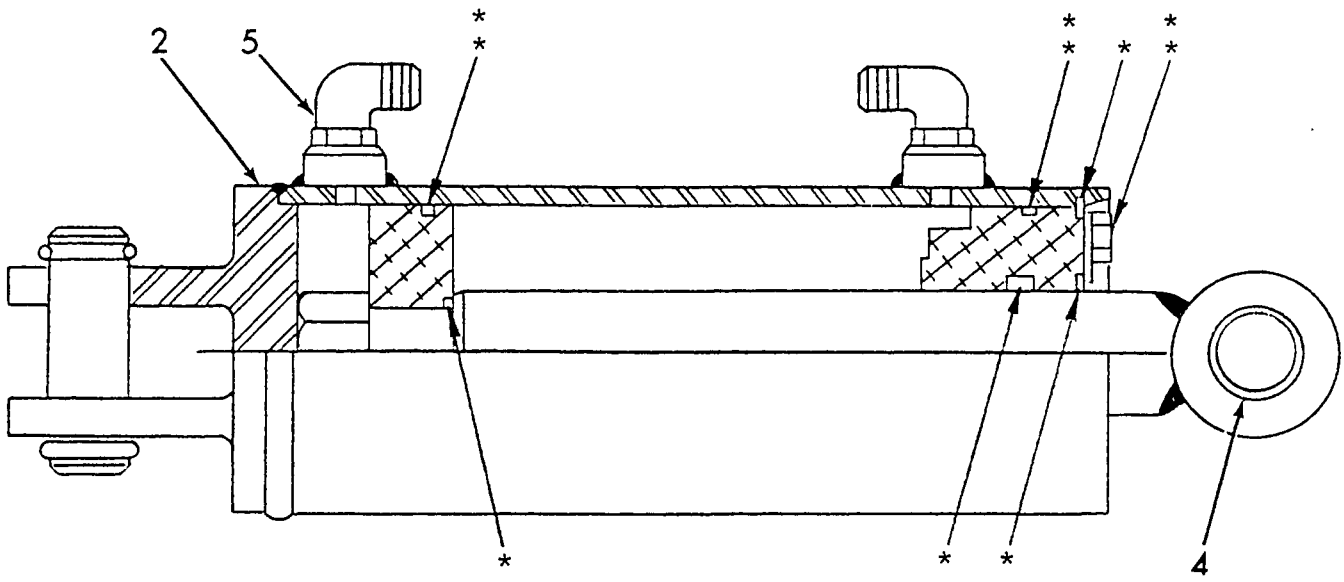
NOTE 1: DUE TO VENDOR/MFG. REVISIONS; WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21756	CYLINDER, STEERING (SE) (See Sect. 3, Fig. 1 for NHA) NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	REF
-2	.66226	KIT, SEAL (SE) NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	1
3	.67191	BUSHING (SE)	2

Mark Industries

TITLE	STEERING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE JAN. 1982

SECTION	3
FIGURE	4A
PAGE	1



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

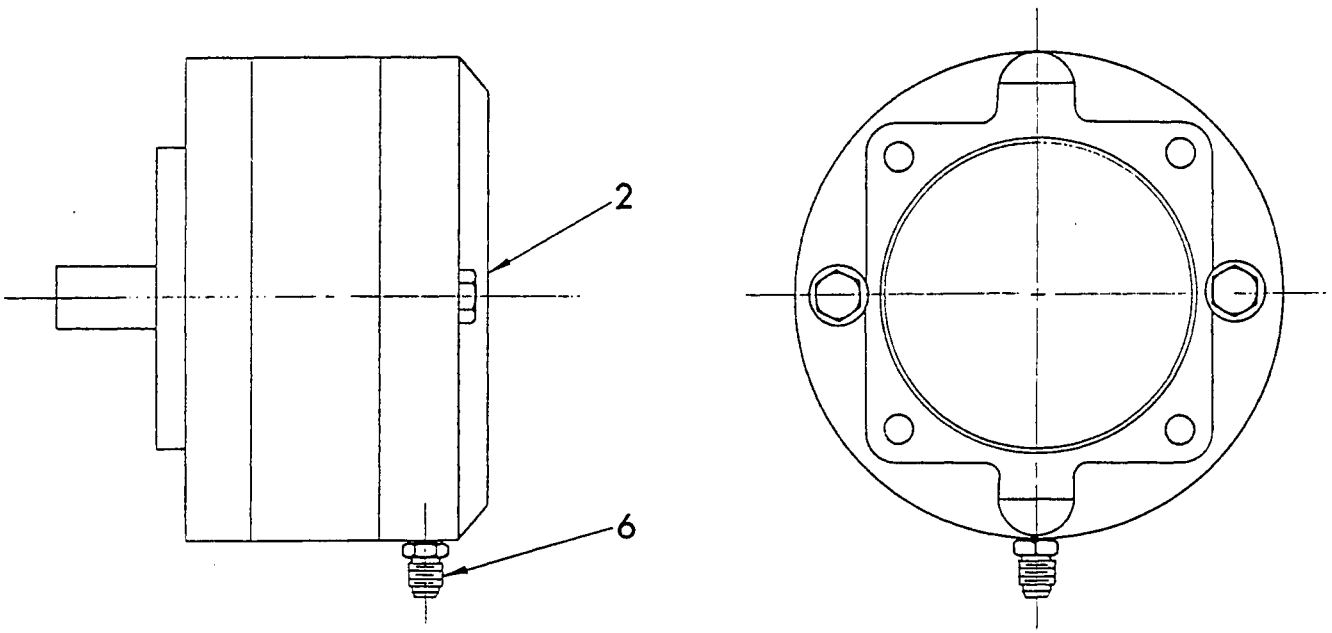
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21663	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 1A for NHA)	REF
2	.21239	CYLINDER, STEERING	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66041	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	..66485	BUSHING (SE)	2
5	.80012-03	ELBOW, STRAIGHT THREAD	2

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Mark Industries

TITLE	BRAKE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1986

SECTION	3
FIGURE	5
PAGE	1

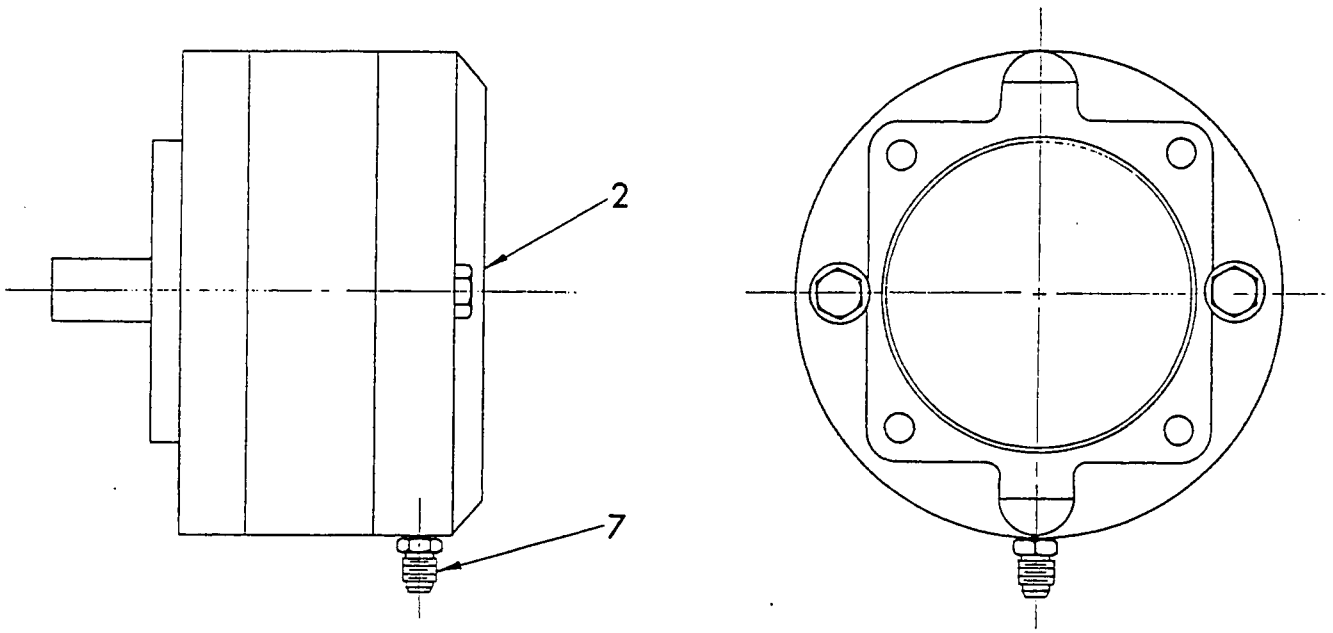


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22603	ASSEMBLY, BRAKE (See Sect. 3, Fig. 1 for NHA)	REF
2	.21220	BRAKE (AUSCO MODEL 27933) (See Vendor Chapter for Details)	1
-3	..66715	KIT, SEAL & GASKET	1
-4	..600416	KIT, STACK	1
-5	..600417	KIT, BEARING	1
6	.80004-03	CONNECTOR, STRAIGHT THREAD	1

Mark Industries

TITLE	BRAKE ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1986

SECTION	3
FIGURE	5A
PAGE	1



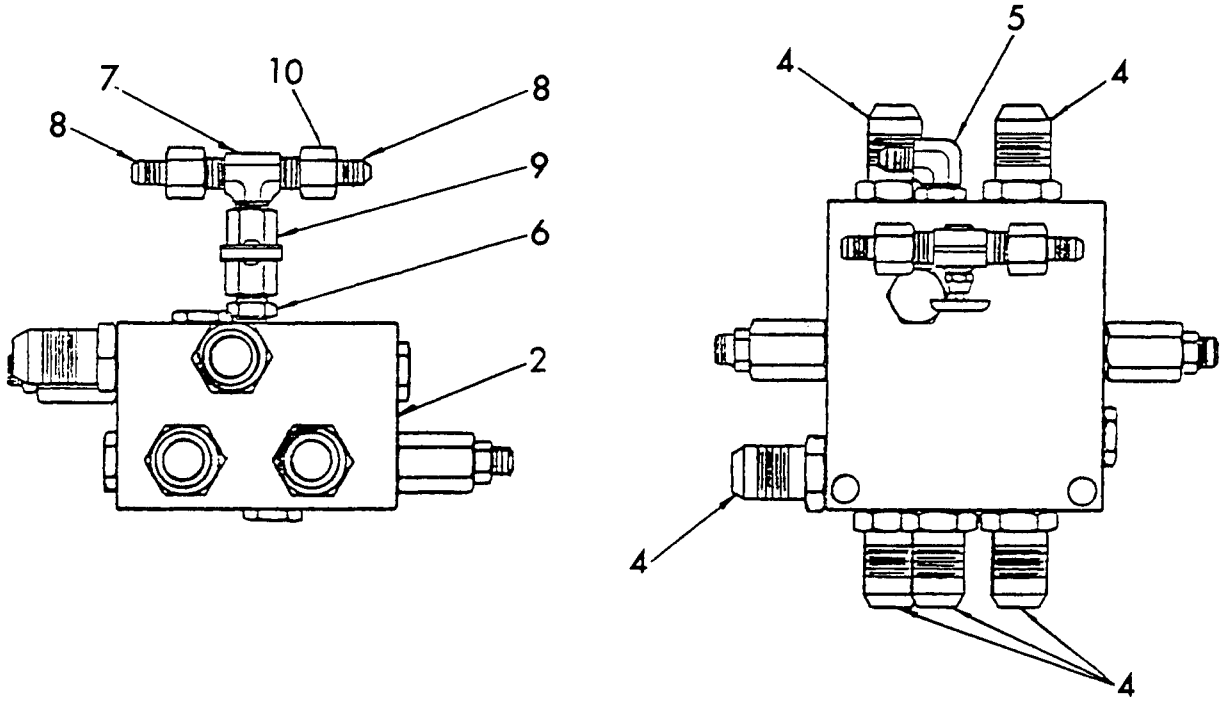
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22603	ASSEMBLY, BRAKE (See Sect. 3, Fig. 1 for NHA)	REF
2	.21220	BRAKE (MICO) (See Vendor Chapter for Details)	1
-3	..66972	KIT, SEAL	1
-4	..67643	KIT, LINING	1
-5	..67656	KIT, BEARING	1
-6	..67649	KIT, SPRING	1
7	.80004-03	CONNECTOR, STRAIGHT THREAD	1

REV.

Mark Industries

TITLE	DRIVE/BRAKE VALVE ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	3
FIGURE	6
PAGE	1

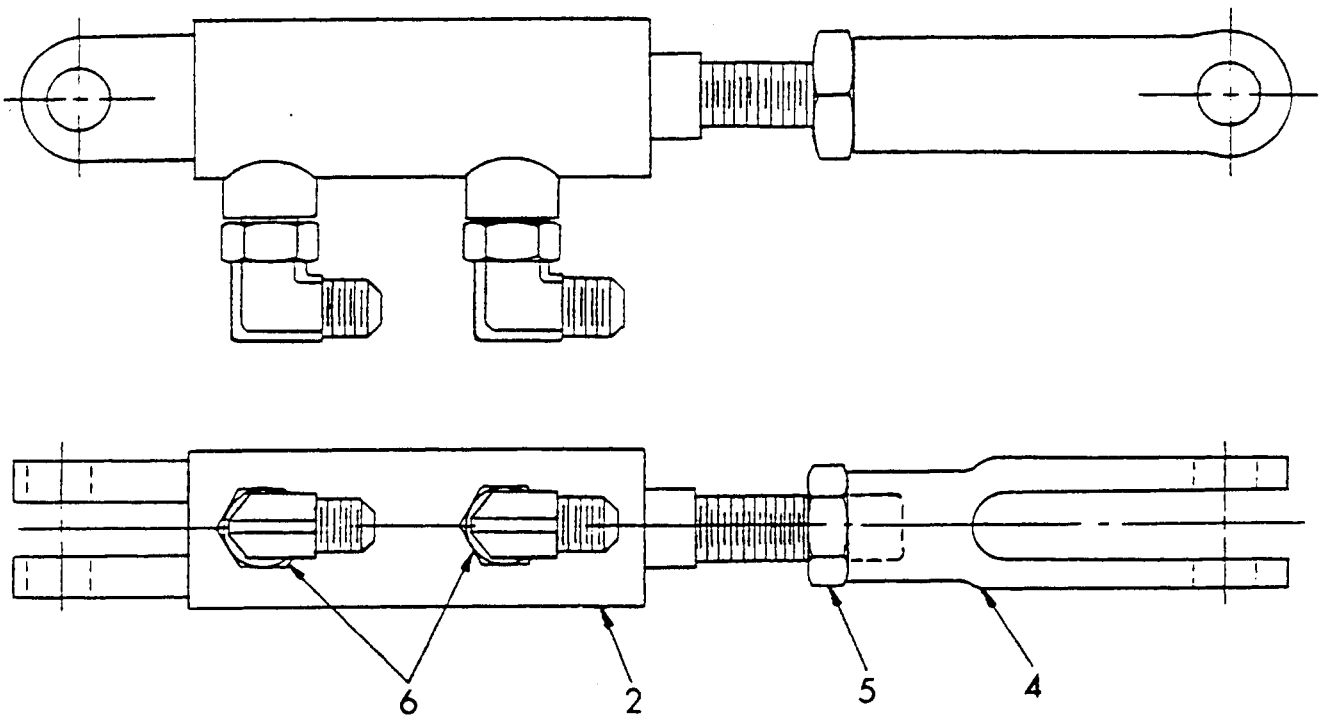


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21082	ASSEMBLY, DRIVE/BRAKE VALVE (See Sect. 3, Fig. 1 or 1A for NHA)	REF
2	.21214	VALVE, DRIVE/BRAKE	1
-3	..600316	KIT, SEAL	1
4	.80004-19	CONNECTOR, STRAIGHT THREAD	6
5	.80012-03	ELBOW, STRAIGHT THREAD	1
6	.80052-04	NIPPLE, PIPE	1
7	.80034-08	TEE, MALE	1
8	.80056-01	REDUCER, TUBE END	2
9	.20357	VALVE, NEEDLE	1
10	.80060-05	NUT	2

Mark Industries

TITLE	SHIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	EARLY VERSION

SECTION	3
FIGURE	7
PAGE	1



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

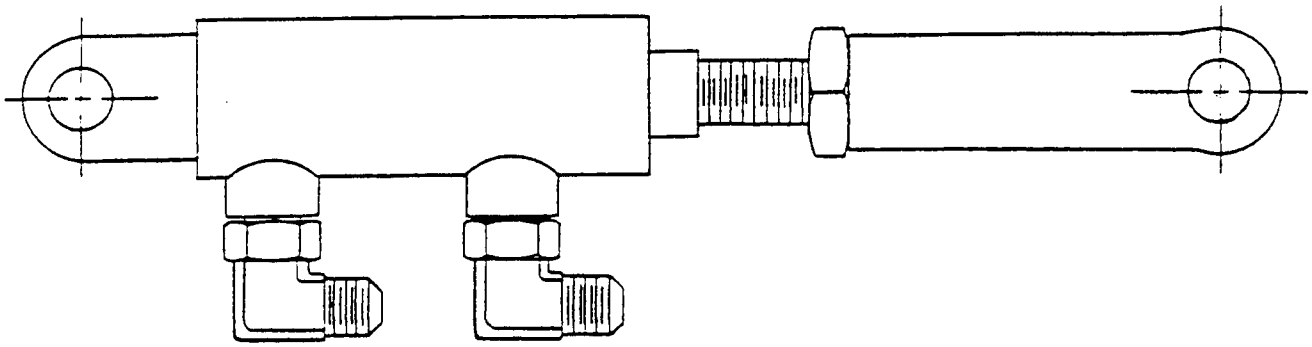
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22604	ASSEMBLY, SHIFT CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	.20719	CYLINDER, SHIFT (SE)	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66042	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	.20789	CLEVIS, SHIFT	1
5	.60901	NUT, JAM	1
6	.80012-03	ELBOW, STRAIGHT THREAD	2

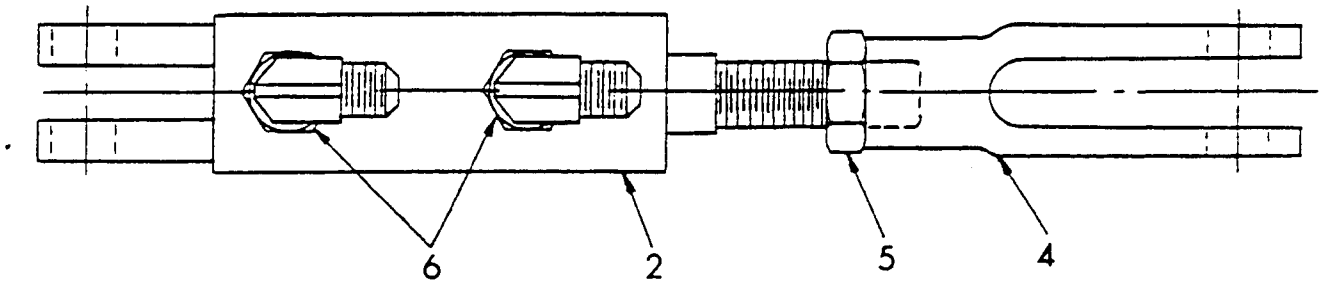
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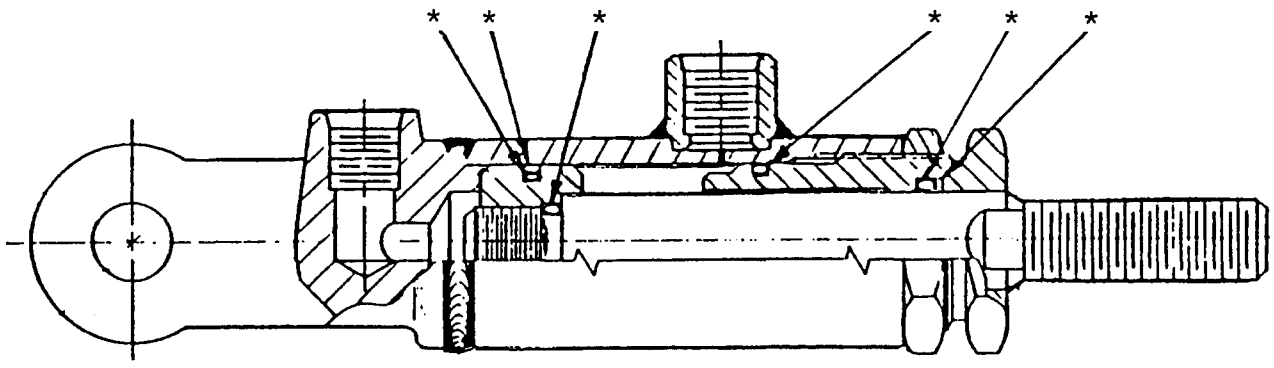
Mark Industries

TITLE	SHIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	LATER VERSION

SECTION	3
FIGURE	7A
PAGE	1







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

Mark Industries

TITLE	SHIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	LATER VERSION

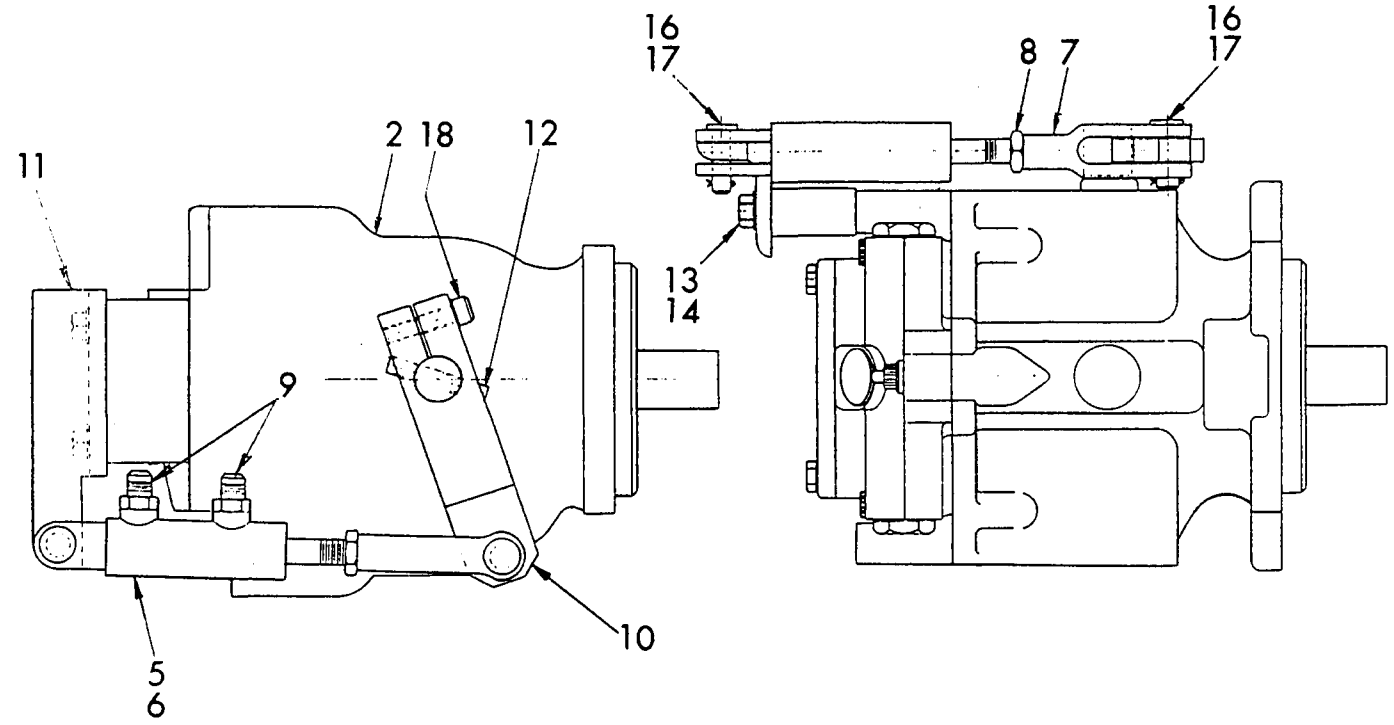
SECTION	3
FIGURE	7A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22604	ASSEMBLY, SHIFT CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	.20719	CYLINDER, SHIFT (C/E)	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66793	KIT, SEAL (C/E)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	.20789	CLEVIS, SHIFT	1
5	.60901	NUT, JAM	1
6	.80012-03	ELBOW, STRAIGHT THREAD	2

Mark Industries

TITLE	MOTOR ASSEMBLY (EXTERNAL SHIFT)
MODEL	62 4X2
NOTES	UNTIL MID 1987

SECTION	3
FIGURE	8
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21672	ASSEMBLY, MOTOR (EXTERNAL SHIFT) (See Sect. 3, Fig. 1 for NHA)	REF
2	.21221	MOTOR (See Vendor Chapter for Details)	1
-3	..66607	KIT, SEAL	1
-4	...67868	SEAL, SHAFT	1
5	.21660	ASSEMBLY, SHIFT CYLINDER	1
6	..20719	CYLINDER, SHIFT (See Sect. 3, Fig. 7 for Details)	1
7	..20789	CLEVIS, SHIFTING	1
8	..60901	NUT, JAM	1
9	..80004-03	CONNECTOR, STRAIGHT THREAD	2
10	.23221	LEVER, ACTUATOR	1
11	.21658	BRACKET, SHIFT CYLINDER	1
12	.64218	PIN, ROLL	1

Mark Industries

TITLE	MOTOR ASSEMBLY (EXTERNAL SHIFT)
MODEL	62 4X2
NOTES	UNTIL MID 1987

SECT.	3
FIG.	8
PAGE	2

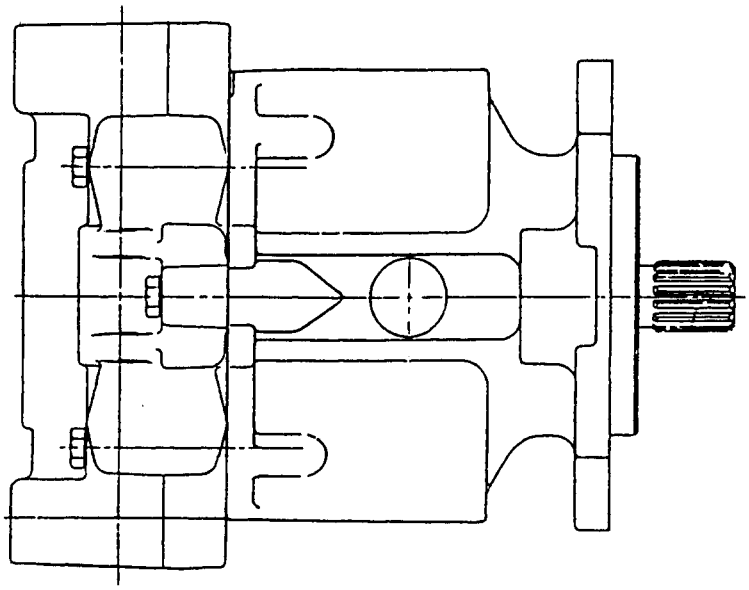
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
13	.60524	SCREW, CAP	2
14	.63304	WASHER, LOCK	2
15	.63303	WASHER, LOCK	1
16	.64106	PIN, CLEVIS	2
17	.64301	PIN, COTTER	2
18	.61903	SCREW, CAP	1

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

Mark Industries

TITLE	MOTOR (INTERNAL SHIFT)
MODEL	62 4X2
NOTES	SINCE MID 1987

SECTION	3
FIGURE	8A
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	23526	MOTOR (INTERNAL SHIFT) (See Sect. 3, Fig. 1A for NHA) (See Vendor Chapter for Details)	REF
-2	.67632	KIT, SEAL	1
-3	..67868	SEAL, SHAFT	1

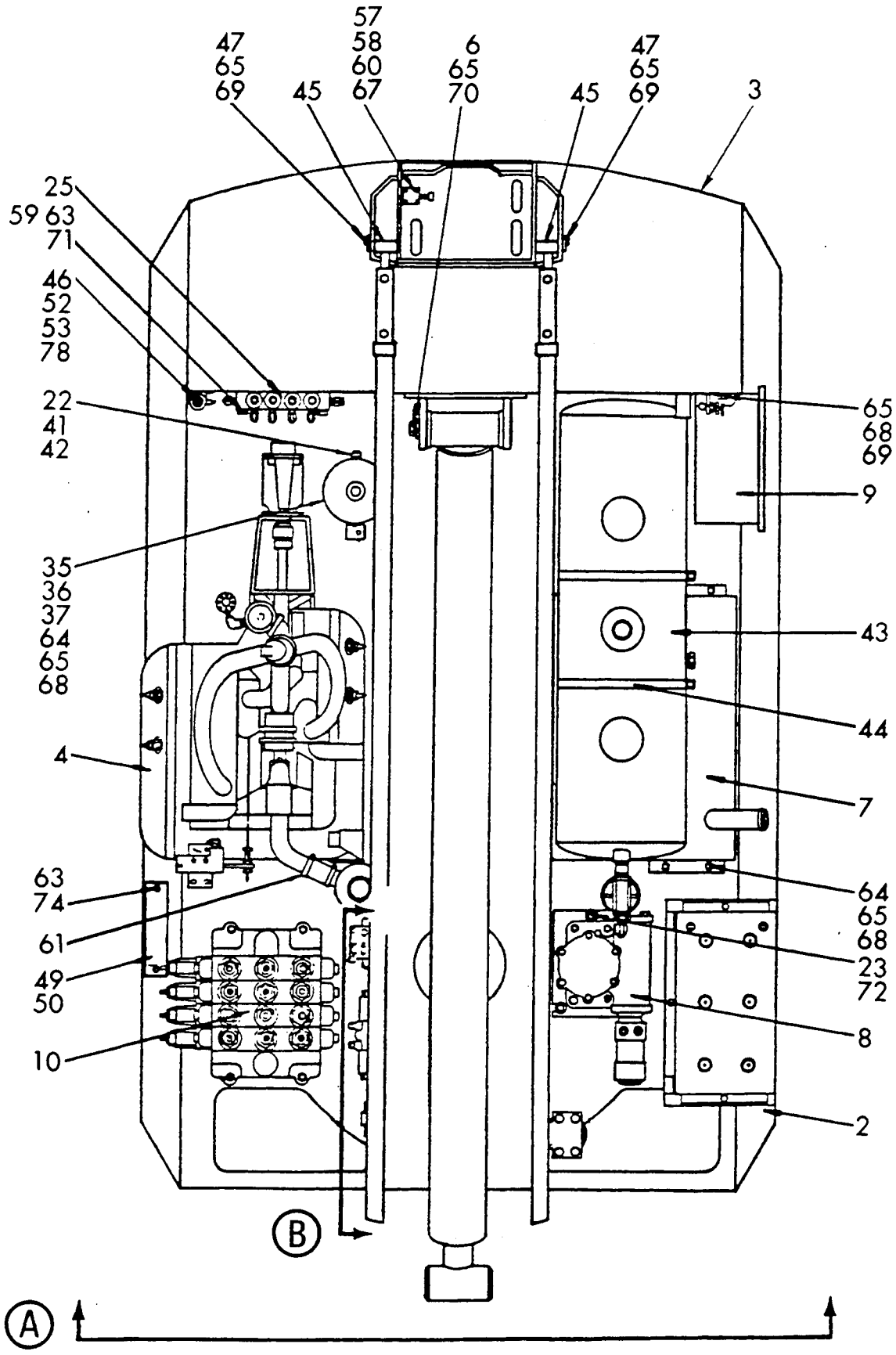
SECTION 4 CONTAINS:

FIG. NO.	TITLE
1	TURRET ASSEMBLY (UNTIL EARLY 1985)
1A	TURRET ASSEMBLY (SINCE EARLY 1985)
2	ENGINE & PUMP ASSEMBLY
3	LIFT CYLINDER ASSEMBLY (UNTIL MID 1981)
3A	LIFT CYLINDER ASSEMBLY (SINCE MID 1981)
4	FUEL TANK ASSEMBLY
5	ROTATION GEARBOX ASSEMBLY (UNTIL EARLY 1985)
5A	ROTATION GEARBOX ASSEMBLY (SINCE EARLY 1985)
6	ROTATION GEARBOX (HT)
6A	ROTATION GEARBOX (BR)
7	TORQUE HUB (ROTATION GEARBOX; SINCE EARLY 1985)
8	GROUND CONTROL BOX ASSEMBLY
9	PROPORTIONAL VALVE ASSEMBLY
10	MINIPAK ASSEMBLY (WITHOUT PLATFORM ROTATION)
10A	MINIPAK ASSEMBLY (WITH PLATFORM ROTATION)
11	SOLENOID VALVE ASSEMBLY (UNTIL LATE 1981)
11A	SOLENOID VALVE ASSEMBLY (LATE 1981 TO LATE 1986)
11B	SOLENOID VALVE ASSEMBLY (FROM LATE 1986)
12	PILOT VALVE MANIFOLD ASSEMBLY
13	PILOT FILTER ASSEMBLY (UNTIL LATE 1985)
13A	PILOT FILTER ASSEMBLY (SINCE LATE 1985)
14	HYDRAULIC TANK ASSEMBLY
15	MASTER LEVELING CYLINDER ASSEMBLY
16	ROTARY MANIFOLD ASSEMBLY (UNTIL EARLY 1983)
16A	ROTARY MANIFOLD ASSEMBLY (SINCE EARLY 1983)
17	BATTERY CABLE KIT

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1985

SECTION	4
FIGURE	1
PAGE	1

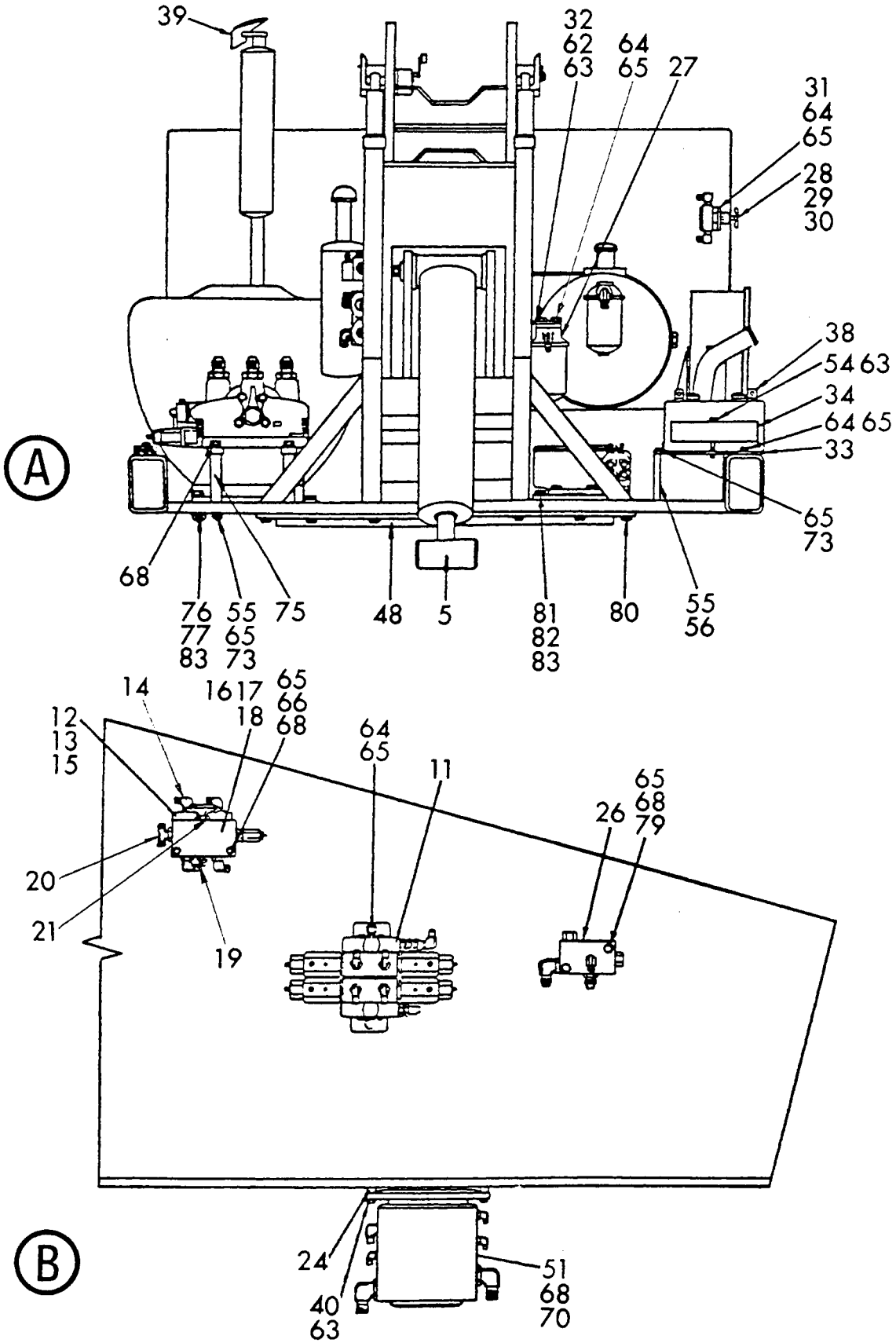


REV.

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1985

SECTION	4
FIGURE	1
PAGE	2



REV.

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1985

SECT.	4
FIG.	1
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21051	ASSEMBLY, TURRET (See Sect. 2, Fig. 1 for NHA)	REF
2	.21104	WELDMENT, TURRET	1
3	..21105	WELDMENT, PEDESTAL	1
4	.21083	ASSEMBLY, ENGINE & PUMP (See Sect. 4, Fig. 2 for Details)	1
5	.21894	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 3A for Details)	1
6	.21330	PIN, LIFT CYLINDER	1
7	.21076	ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 4 for Details)	1
8	.21078	ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 5 for Details)	1
9	.21703	ASSEMBLY, GROUND CONTROL BOX (See Sect. 4, Fig. 8 for Details)	1
10	.22519	ASSEMBLY, PROPORTIONAL VALVE (See Sect. 4, Fig. 9 for Details)	1
11	.21088	ASSEMBLY, MINIPAK (See Sect. 4, Fig. 10 for Details)	1
12	.21584	ASSEMBLY, DUAL OVERCENTER VALVE	1
13	..20365	VALVE, DUAL OVERCENTER	1
14	..80012-05	ELBOW, STRAIGHT THREAD	2
15	..80004-05	CONNECTOR, STRAIGHT THREAD	2
16	.22144	ASSEMBLY, RELIEF VALVE	1
17	..20564	REWORK, RELIEF VALVE	1
18	...20516	VALVE, RELIEF	1
19	..80004-11	CONNECTOR, STRAIGHT THREAD	1
20	..80036-11	TEE, STRAIGHT THREAD	1
21	..80012-11	ELBOW, STRAIGHT THREAD	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
22	.80012-08	ELBOW, STRAIGHT THREAD	1
23	.63503	WASHER, FLAT	1
24	.20445	SPACER, MANIFOLD	4
25	.21692	ASSEMBLY, SOLENOID VALVE (See Sect. 4, Fig. 11A for Details)	1
26	.21472	ASSEMBLY, PILOT VALVE MANIFOLD (See Sect. 4, Fig. 12 for Details)	1
27	.22146	ASSEMBLY, PILOT FILTER (See Sect. 4, Fig. 13 for Details)	1
28	.22189	ASSEMBLY, EMERGENCY DESCENT VALVE	1
29	..20436	VALVE, NEEDLE	1
30	..51103	ELBOW, MALE	2
31	.21279	BRACKET, EMERGENCY DESCENT VALVE	1
32	.20333	BRACKET, PRESSURE LINE FILTER	1
33	.21284	TRAY, BATTERY	1
34	.21286	BRACKET, BATTERY	2
35	.21229	PUMP/MOTOR, EMERGENCY	1
36	..66781	PUMP	1
37	..66783	MOTOR	1
38	.21244	BATTERY	1
39	.21288	CAP, MUFFLER RAIN	1
40	.60330	SCREW, CAP	4
41	.80004-19	CONNECTOR, STRAIGHT THREAD	1
42	.80004-08	CONNECTOR, STRAIGHT THREAD	1
43	.21937	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 14 for Details)	1
44	.21387	BRACKET, HYDRAULIC TANK	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
45	.21084	ASSEMBLY, MASTER LEVELING CYLINDER (See Sect. 4, Fig. 15 for Details)	2
46	.60309	SCREW, CAP	2
47	.21337	PIN, MASTER LEVELING CYLINDER	2
48	.21200	RING, SLEWING	1
49	.21217	STRIP, TERMINAL	1
50	.21386	COVER, TERMINAL STRIP	1
51	.20793 .22495	ASSEMBLY, ROTARY MANIFOLD (UNTIL EARLY 1983) ASSEMBLY, ROTARY MANIFOLD (SINCE EARLY 1983) (See Sect. 4, Fig. 16 & 16A for Details)	1 1
52	.63301	WASHER, LOCK	2
53	.70209	SOLENOID	1
54	.60307	SCREW, CAP	2
55	.63619	ROD, THREADED	5
56	.25314	TUBE, ROUND	1 FT
57	.70107	SWITCH, LIMIT	1
58	.70032	LEVER, OPERATING	1
59	.63402	WASHER, FLAT	2
60	.62704	SCREW, MACHINE	2
61	.16288	CLAMP, HOSE	2
62	.60322	SCREW, CAP	2
63	.63302	WASHER, LOCK	12
64	.60343	SCREW, CAP	16
65	.63303	WASHER, LOCK	39
66	.60356	SCREW, CAP	2
67	.63313	WASHER, LOCK	2
68	.63403	WASHER, FLAT	21

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1985

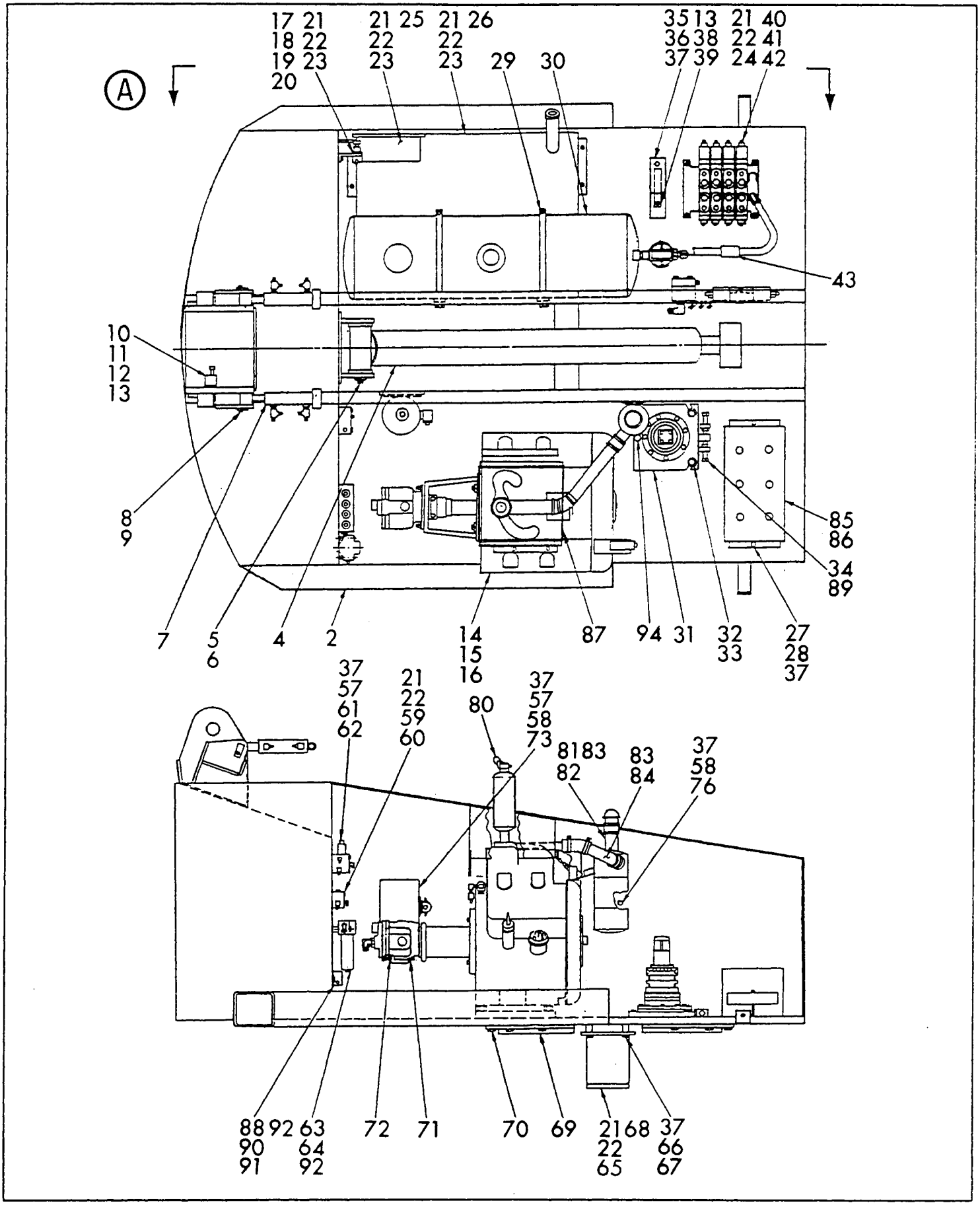
SECT.	4
FIG.	1
PAGE	6

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
69	.60607	SCREW, CAP	5
70	.60612	SCREW, CAP	4
71	.60339	SCREW, CAP	2
72	.60601	SCREW, CAP	1
73	.60703	NUT, HEX	10
74	.60355	SCREW, CAP	2
75	.25324	TUBE, ROUND	4
76	.60614	SCREW, CAP	4
77	.61301	NUT, LOCK	4
78	.63401	WASHER, FLAT	2
79	.60317	SCREW, CAP	2
80	.60604	SCREW, CAP	16
81	.21696	WASHER, GEARBOX	1
82	.60609	SCREW, CAP	1
83	.63501	WASHER, FLAT	5

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

SECTION	4
FIGURE	1A
PAGE	1

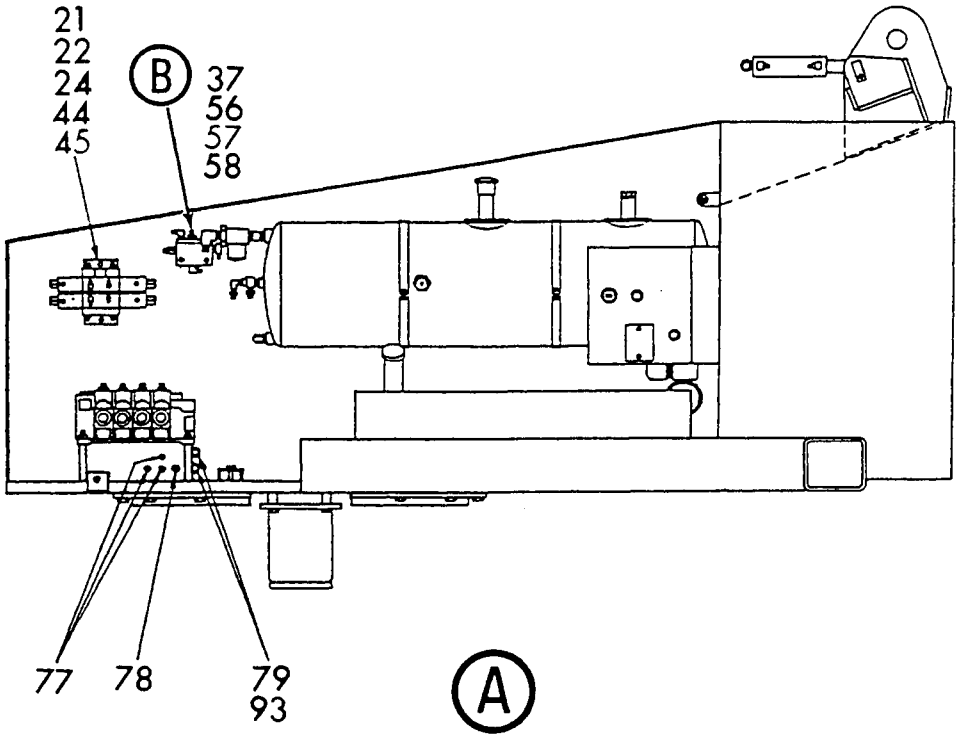


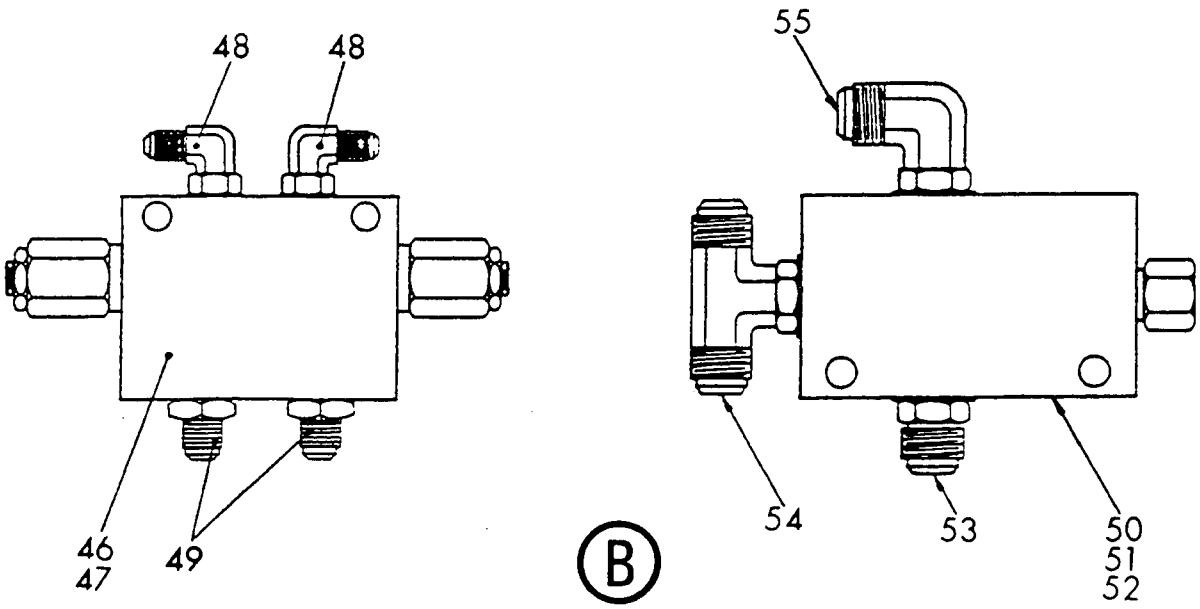
REV.

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

SECTION	4
FIGURE	1A
PAGE	2





REV.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21940	ASSEMBLY, TURRET (See Sect. 2, Fig. 1A for NHA)	REF
2	.22616	WELDMENT, TURRET	1
3	..22612	WELDMENT, PEDESTAL	1
4	.21894	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 3A for Details)	1
5	.21330	PIN, LIFT CYLINDER	1
6	.60618	SCREW, CAP	2
7	.21084	ASSEMBLY, MASTER LEVELING CYLINDER (See Sect. 4, Fig. 15 for Details)	2
8	.21337	PIN, MASTER LEVELING CYLINDER	2
9	.60607	SCREW, CAP	2
10	.70107	SWITCH, LIMIT	1
11	.70031	SWITCH, LEVER	1
12	.62704	SCREW, MACHINE	2
13	.63313	WASHER, LOCK	4
14	.21083	ASSEMBLY, ENGINE & PUMP (See Sect. 4, Fig. 2 for Details)	1
15	.60635	SCREW, CAP	4
16	.60715	NUT, LOCK	4
17	.22189	ASSEMBLY, EMERGENCY DESCENT VALVE	4
18	..20436	VALVE, NEEDLE	4
19	..51103	ELBOW, MALE	8
20	.21279	BRACKET, MOUNTING	1
21	.63403	WASHER, FLAT	12
22	.63303	WASHER, LOCK	12
23	.60325	SCREW, CAP	5

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
24	.60703	NUT	6
25	.21703	ASSEMBLY, GROUND CONTROL BOX (See Sect. 4, Fig. 8 for Details)	1
26	.21076	ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 4 for Details)	1
27	.21286	BRACKET, BATTERY HOLD DOWN	2
28	.60316	SCREW, CAP	2
29	.21387	BRACKET, HYDRAULIC TANK	2
30	.21937	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 14 for Details)	1
31	.21972	ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 5A for Details)	1
32	.60637	SCREW, CAP	2
33	.22169	WASHER, ROTATION GEARBOX	2
34	.62222	SCREW, SET	2
35	.21386	COVER, TERMINAL STRIP	1
36	.60323	SCREW, CAP	2
37	.63302	WASHER, LOCK	18
38	.21217	STRIP, TERMINAL	1
39	.62620	SCREW, MACHINE	2
40	.22519	ASSEMBLY, PROPORTIONAL VALVE (See Sect. 4, Fig. 9 for Details)	1
41	.25324	TUBE, ROUND	4
42	.63619	ROD, THREADED	4
43	.22187	VALVE, CHECK IN-LINE	1
44	.21088	ASSEMBLY, MINIPAK (See Sect. 4, Fig. 10 for Details)	1
45	.60343	SCREW, CAP	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
46	.21584	ASSEMBLY, DUAL OVERCENTER VALVE	1
47	..20365	VALVE, DUAL OVERCENTER	1
48	..80012-05	ELBOW, STRAIGHT THREAD	2
49	.80004-05	CONNECTOR, STRAIGHT THREAD	2
50	.22144	ASSEMBLY, RELIEF VALVE	1
51	..20564	REWORK, RELIEF VALVE	1
52	..20516	VALVE, RELIEF	1
53	..80004-11	CONNECTOR, STRAIGHT THREAD	1
54	..80036-11	TEE, STRAIGHT THREAD	1
55	..80012-11	ELBOW, STRAIGHT THREAD	1
56	.60316	SCREW, CAP	2
57	.63402	WASHER, FLAT	2
58	.60702	NUT, HEX	6
59	.21472	ASSEMBLY, PILOT VALVE MANIFOLD (See Sect. 4, Fig. 12 for Details)	1
60	.60317	SCREW, CAP	2
61	.21692	ASSEMBLY, SOLENOID VALVE (See Sect. 4, Fig. 11B for Details)	1
62	.60339	SCREW, CAP	2
63	.60377	SCREW, CAP	2
64	.22963	ASSEMBLY, PILOT FILTER (See Sect. 4, Fig. 13A for Details)	1
65	.60612	SCREW, CAP	2
66	.20445	SPACER, MANIFOLD	4
67	.60511	SCREW, CAP	4
68	.22495	ASSEMBLY, ROTARY MANIFOLD (See Sect. 4, Fig. 16A for Details)	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
69	.21200	RING, SLEWING	1
70	.60604	SCREW, CAP	16
71	.80004-08	CONNECTOR, STRAIGHT THREAD	2
72	.80004-18	CONNECTOR, STRAIGHT THREAD	1
73	.21229	PUMP/MOTOR, EMERGENCY	1
74	..66781	PUMP	1
75	..66783	MOTOR	1
76	.60338	SCREW, CAP	4
77	.80017-03	UNION	3
78	.80017-05	UNION, ELBOW	1
79	.80011-08	UNION, ELBOW	2
80	.21288	CAP, RAIN MUFFLER	1
81	.26015	TUBE	1
82	.65561	HOSE, RUBBER	1
83	.16288	CLAMP, HOSE	4
84	.26014	TUBE	1
85	.21244	BATTERY	1
86	.20673	KIT, BATTERY CABLE (See Sect. 4, Fig. 17 for Details)	1
87	.21956	CHIMNEY	1
88	.70201	RELAY	1
89	.60910	NUT, JAM	2
90	.60353	SCREW, CAP	2
91	.63301	WASHER, LOCK	2
92	.63401	WASHER, FLAT	4

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

SECT.	4
FIG.	1A
PAGE	7

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
93	.65352	WASHER, LOCK	2
94	.60601	SCREW, CAP	1

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

Mark Industries

TITLE	TURRET ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

SECT.	4
FIG.	1A
PAGE	7

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
93	.65352	WASHER, LOCK	2
94	.60601	SCREW, CAP	1

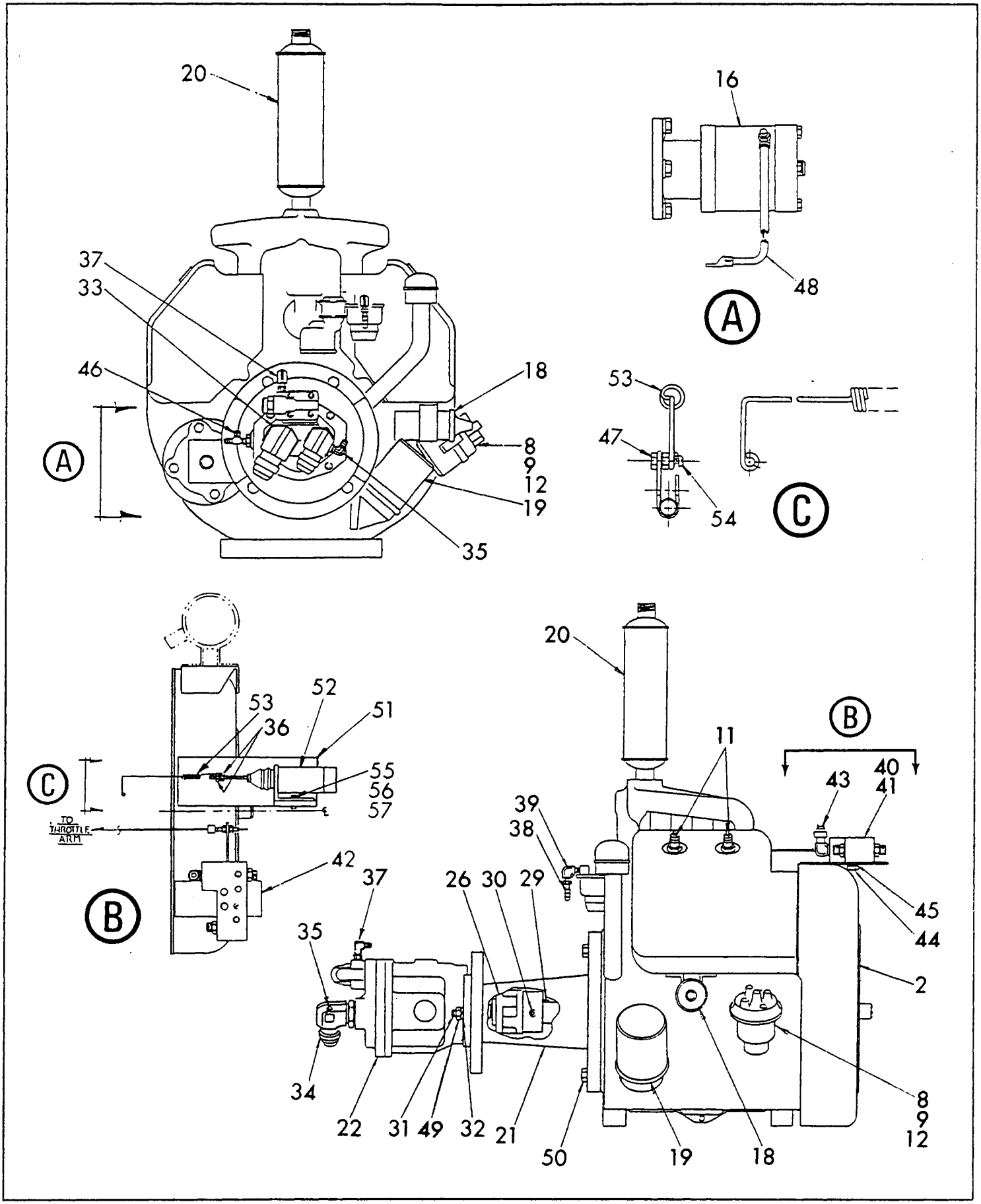
REV.

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

Mark Industries

TITLE	ENGINE & PUMP ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	2
PAGE	1



REV.

Mark Industries

TITLE	ENGINE & PUMP ASSEMBLY
MODEL	62 4X2
NOTES	

SECT.	4
FIG.	2
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21083	ASSEMBLY, ENGINE & PUMP (See Sect. 4, Fig. 1 for NHA)	REF
2	.21215	ENGINE (WISCONSIN VG4D) (See Vendor Chapter for Details)	1
-3	..67252	GASKET, OIL PAN	1
-4	..67253	SEAL, CRANK SHAFT	1
-5	..67255	COVER, VALVE INSPECTION	2
-6	..67257	CARBURETOR	1
-7	...67258	KIT, CARBURETOR REPAIR	1
8	..67259	CAP, DISTRIBUTOR	1
9	..67260	ROTOR, DISTRIBUTOR	1
-10	..67261	POINTS	1
11	..67262	PLUG, SPARK	4
12	..67263	DISTRIBUTOR	1
-13	..67264	PUMP, FUEL	1
-14	...67298	KIT, FUEL PUMP REPAIR	1
-15	..67265	GASKET, FUEL PUMP	1
16	..67266	STARTER	1
-17	..67267	SET, IGNITION WIRE	1
18	..67268	COIL	1
19	..65299	FILTER, OIL	1
20	..21246	MUFFLER	1
21	.21389	MACHINING, PUMP ADAPTER	1
22	.20753	PUMP (See Vendor Chapter for Details)	1
-23	..600163	KIT, SEAL	1
-24	...66741	SEAL, SHAFT	1

Mark Industries

TITLE	ENGINE & PUMP ASSEMBLY	SECT. 4
MODEL	62 4X2	FIG. 2
NOTES		PAGE 3

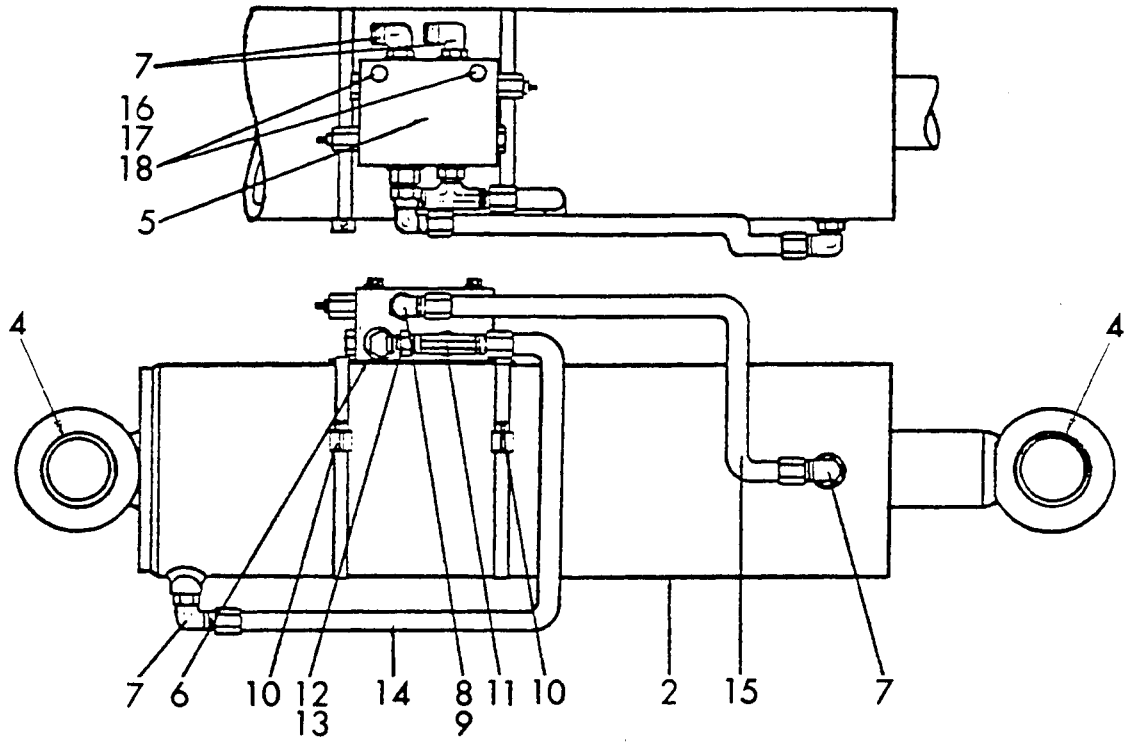
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-25	..21757	ASSEMBLY, COMPENSATOR	1
26	.21306	COUPLING, ENGINE/PUMP	1
-27	..20930	SPIDER, RUBBER	1
-28	..62201	SCREW, SET	2
29	.25005	KEYSTOCK	1
30	.62201	SCREW, SET	2
31	.63613	STUD	2
32	.63305	WASHER, LOCK	2
33	.80012-28	ELBOW, STRAIGHT THREAD	1
34	.21635	ELBOW, MODIFIED STRAIGHT THREAD	1
35	.80008-08	ELBOW, MALE	1
36	.60805	NUT, HEX	2
37	.80012-03	ELBOW, STRAIGHT THREAD	1
38	.240	HOSE, BARB	1
39	.16500	ELBOW, STREET	1
40	.20364	THROTTLE, HYDRAULIC	1
41	..66719	SPRING, LEAF	1
42	.20811	BRACKET, THROTTLE MOUNTING	1
43	.80012-04	ELBOW, STRAIGHT THREAD	1
44	.60404	SCREW, CAP	2
45	.63302	WASHER, LOCK	2
46	.80033-08	TEE, STRAIGHT THREAD	1
47	.61501	NUT, HEX	2
48	.4103-48	ASSEMBLY, CABLE	1
49	.60705	NUT, HEX	2

Mark Industries

TITLE	ENGINE & PUMP ASSEMBLY
MODEL	62 4X2
NOTES	

SECT.	4
FIG.	2
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
50	.60604	SCREW, CAP	4
51	.21097	BRACKET, SYNCHRO START	1
52	.21777	SOLENOID	1
53	.65199	SPRING, THROTTLE	1
54	.62609	SCREW, MACHINE	1
55	.60353	SCREW, CAP	2
56	.63301	WASHER, LOCK	2
57	.60701	NUT, HEX	2



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

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21075	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	.21112	CYLINDER, LIFT	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66043	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	..67672	BUSHING	4
5	.21223	VALVE, HOLDING	1
6	.20210	PLATE, HOLDING VALVE MOUNTING	1

Mark Industries

TITLE	LIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL MID 1981

SECT.	4
FIG.	3
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
7	.80012-11	ELBOW, SWIVEL	4
8	.80004-11	CONNECTOR	5
9	.80015-06	ELBOW, SWIVEL	1
10	.24166	STRAP	2
11	.80035-11	TEE	1
12	.80060-06	NUT	1
13	.21385	ORIFICE, BLEED DOWN	1
14	.20628	ASSEMBLY, TUBING	1
15	.20627	ASSEMBLY, TUBING	1
16	.60344	SCREW, CAP	2
17	.63303	WASHER, LOCK	2
18	.63428	WASHER, FLAT	2

REV.

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	LIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1981

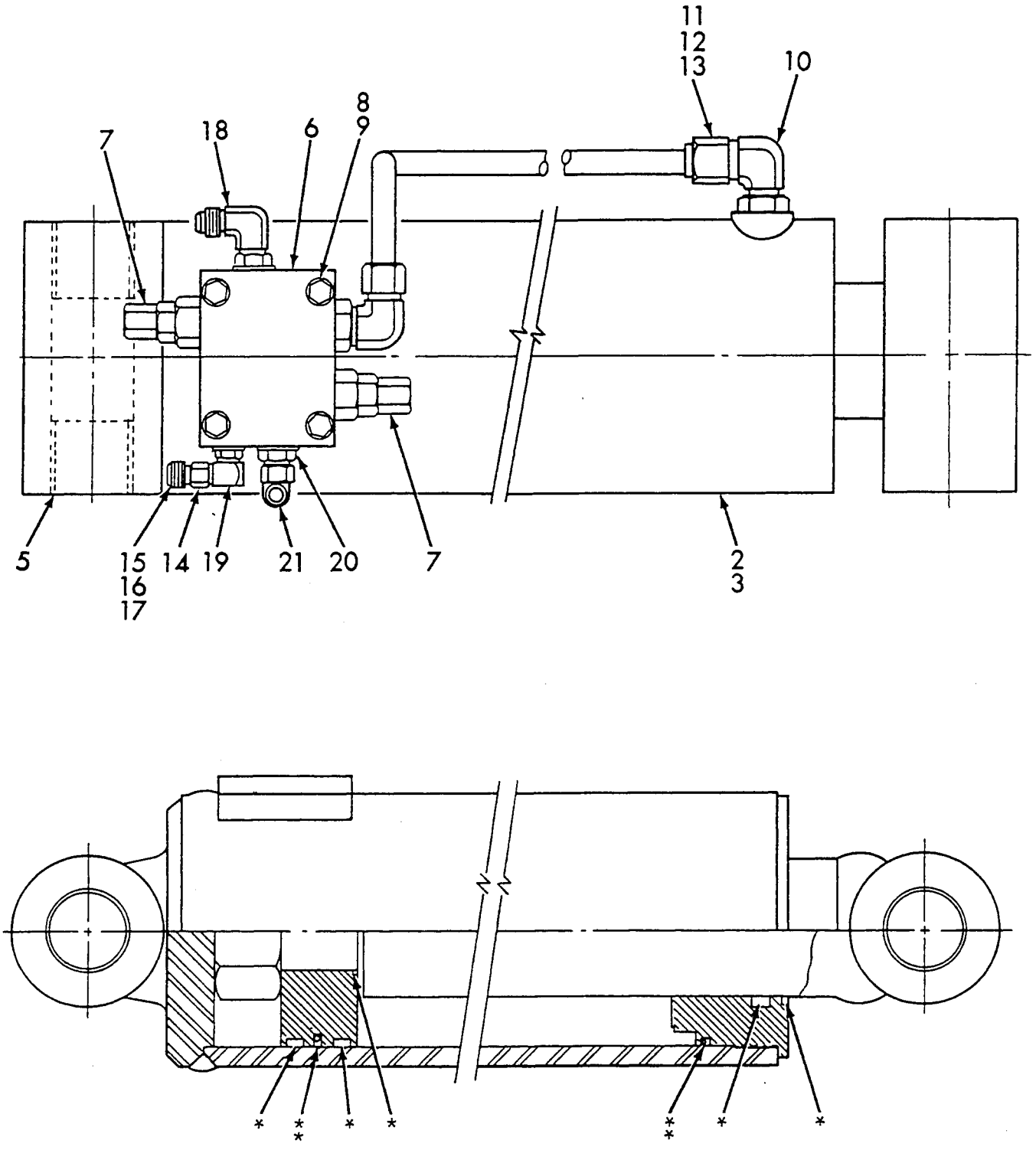
SECT.	4
FIG.	3A
PAGE	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21894	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1A for NHA)	REF
2	.21257	SUB-ASSEMBLY, LIFT CYLINDER (SE)	1
3	..21199	CYLINDER, LIFT	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-4	...66043	KIT, SEAL (SE: WITH POLYPAK; NOT SHOWN)	1
	...66721	KIT, SEAL (SE: WITH STEEL PISTON RINGS)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
5	...67672	BUSHING	4
6	..21445	BLOCK, VALVE	1
7	..81006	CARTRIDGE, OVERCENTER	2
8	..61943	SCREW, CAP	4
9	..63302	WASHER, LOCK	4
10	..80012-11	ELBOW, STRAIGHT THREAD	2
11	..80062-06	SLEEVE	2
12	..26372	TUBING, HYDRAULIC	1
13	..80060-06	NUT	2
14	.80060-05	NUT	1
15	.20348	ORIFICE, BLEED DOWN	1
16	..80056-01	REDUCER, TUBE END	1
17	..62202	SCREW, SET	1
18	.80012-11	ELBOW, STRAIGHT THREAD	1
19	.50900	ELBOW, STRAIGHT THREAD	1
20	.80004-11	CONNECTOR, STRAIGHT THREAD	1
21	.80015-06	ELBOW, SWIVEL NUT	1

Mark Industries

TITLE	LIFT CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1981

SECTION	4
FIGURE	3A
PAGE	1



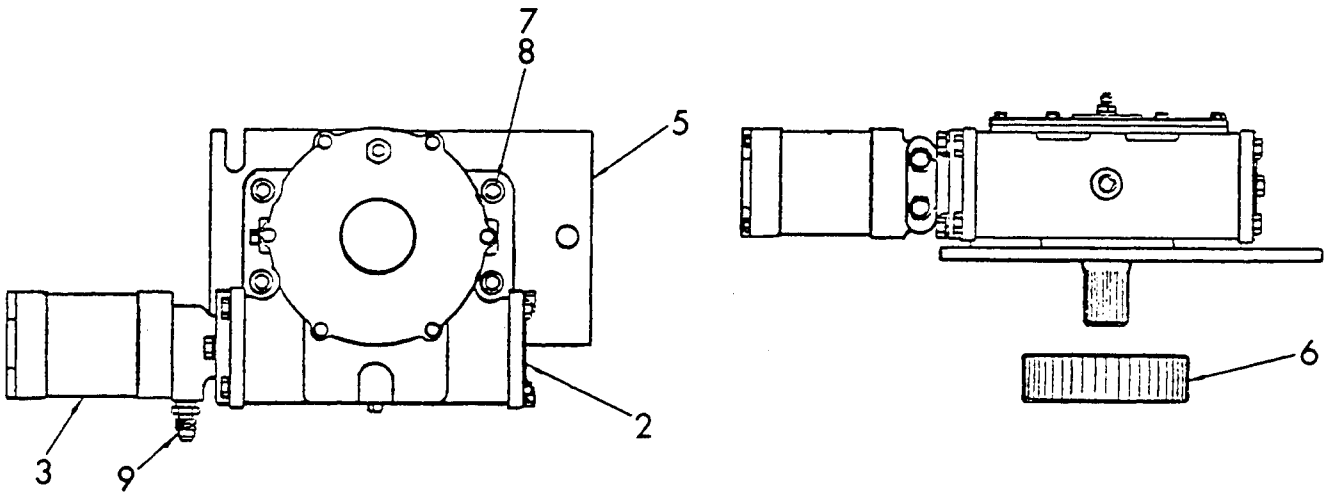
NOTE 1: DUE TO VENDOR/MFG. REVISIONS;
WHEN POSSIBLE, PROVIDE ALL NUMBERS
FROM THE CYLINDER I.D. TAG.

REV.

Mark Industries

TITLE	ROTATION GEARBOX ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1985

SECTION	4
FIGURE	5
PAGE	1



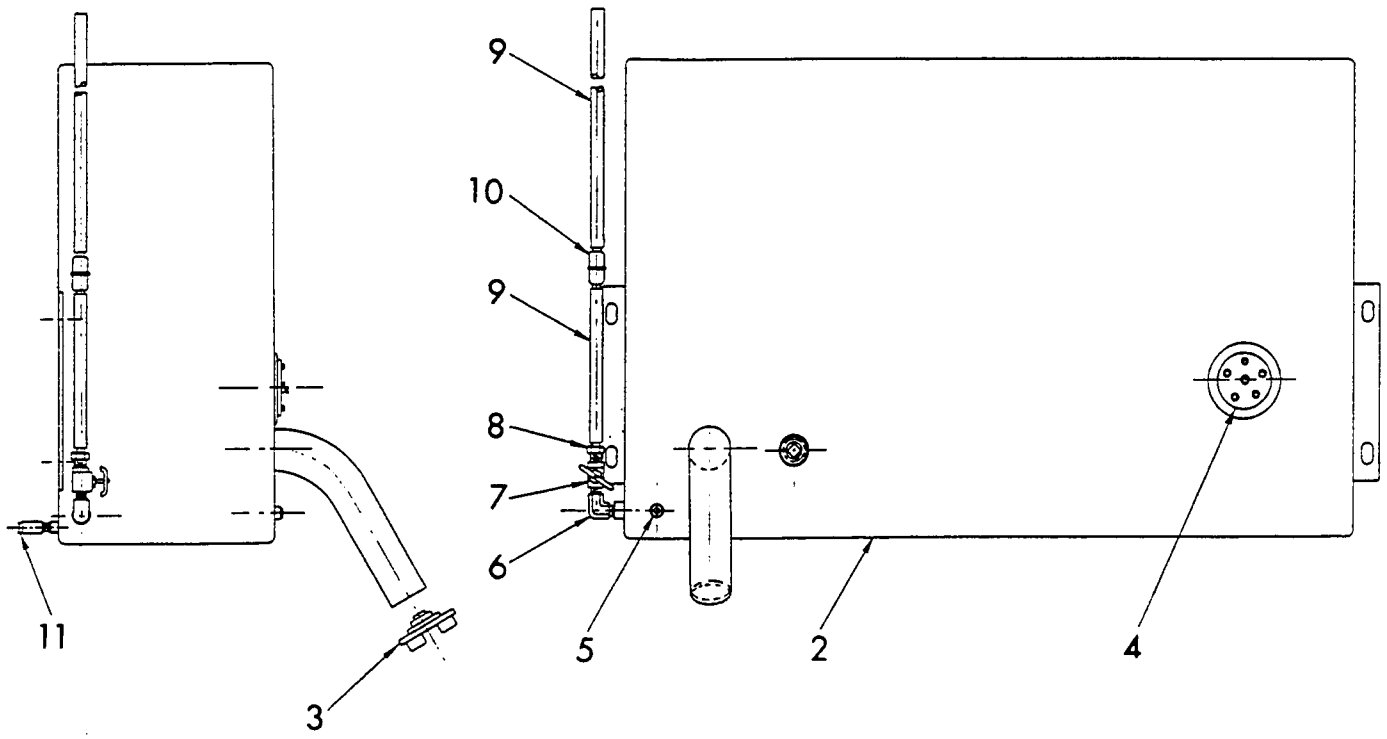
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21078	ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 1 for NHA)	REF
2	.20726	GEARBOX, ROTATION (HT OR BR) (See Sect. 4, Fig. 6 or 6A for Details)	1
3	.20520	MOTOR, ORBIT	1
-4	..16967	KIT, SEAL	1
5	.20736	SUBPLATE, GEARBOX	1
6	.21201	PINION	1
7	.61901	SCREW, CAP	4
8	.63306	WASHER, LOCK	4
9	.80001-12	CONNECTOR, MALE	2

REV.

Mark Industries

TITLE	FUEL TANK ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	4
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21076	ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 1 for NHA)	REF
2	.21335	TANK, FUEL	1
3	..65272	CAP, GAS	1
4	..20041	UNIT, SENDING	1
5	.80048-03	PLUG, HOLLOW	1
6	.80021-03	ELBOW, STREET	1
7	.12000	VALVE, NEEDLE	1
8	.2589	HOSE, FITTING	1
9	.160202	HOSE, FUEL	11.5 FT
10	.160	FILTER, FUEL	1
11	.53902	PLUG, PIPE	1

REV.

Mark Industries

TITLE	ROTATION GEARBOX ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

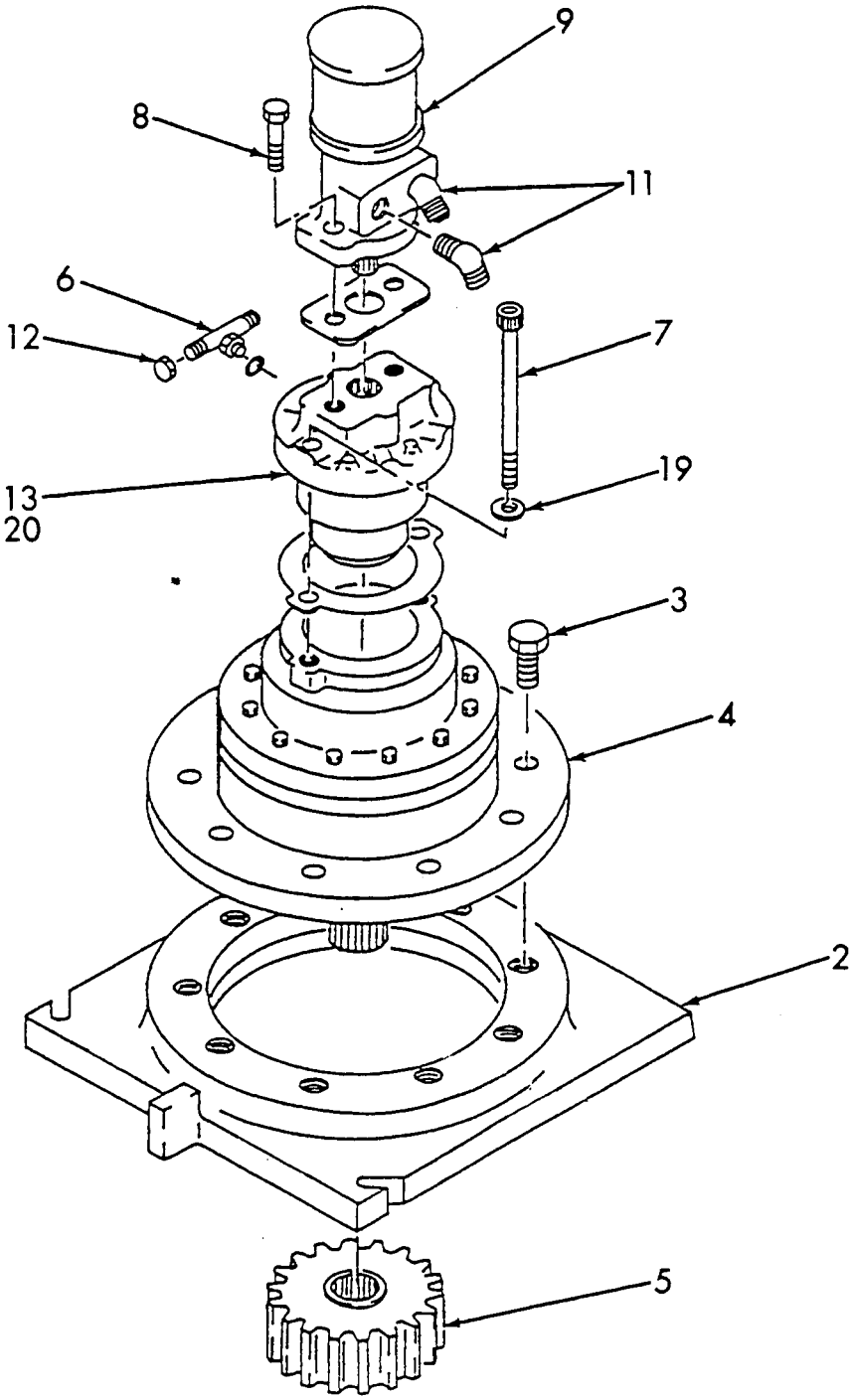
SECT.	4
FIG.	5A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21972	ASSEMBLY, ROTATION GEARBOX (See Sect. 4, Fig. 1A for NHA)	REF
2	.22997	WELDMENT, MOUNTING PLATE	1
3	.60602	SCREW, CAP	9
4	.22830	HUB, TORQUE (See Sect. 4, Fig. 7 for Details)	1
5	.21974	PINION	1
6	.80036-03	TEE, BRANCH STRAIGHT THREAD	1
7	.61940	SCREW, CAP	2
8	.60622	SCREW, CAP	2
9	.81080	MOTOR, HYDRAULIC (TRW: SINCE MID 1985) (See Vendor Chapter for Details)	1
-10	..66965	KIT, SEAL (FOR 81080)	1
11	.80018-13	ELBOW, STRAIGHT THREAD	2
12	.80059-03	CAP	1
13	.22831	BRAKE (See Vendor Chapter for Details)	1
-14	..67150	KIT, SEAL	1
-15	..67644	KIT, LINING	1
-16	..67657	KIT, BEARING	1
-17	..67650	KIT, SPRING	1
-18	..67660	PISTON, BRAKE	1
19	.63305	WASHER, LOCK	2
20	.66846	GASKET	1

Mark Industries

TITLE	ROTATION GEARBOX ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1985

SECTION	4
FIGURE	5A
PAGE	1



REV.

Mark Industries

TITLE	ROTATION GEARBOX	SECT. 4
MODEL	62 4X2	FIG. 6A
NOTES	BR	PAGE 3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.	VALVE, RELIEF	1
27	.	REDUCER	1
28	.	PLUG, PIPE	2
29	.	PLUG	1
30	.	COUPLING, BRAKE	1
31	.	SHAFT, BRAKE	1
32	.	COVER, BRAKE	1
33	.	PLATE, BRAKE END	1
34	.	DISC, FRICTION	2
35	.	ROTOR, BRAKE	1
36	.	PLATE, PRESSURE	1
37	.	ASSEMBLY, SPRING	1
38	.	KEY, WOODRUFF	2
39	.	NUT, BRAKE ADJUSTMENT	1
40	.66551	COUPLING, MOTOR	1
41	.	ADAPTER, MOTOR	1
42	.	PIN, DOWEL	2
43	.	O-RING	1
44	.	GASKET	1
45	.	GASKET, MOTOR	1
46	.	SCREW, CAP	2
47	.	WASHER, LOCK	2

Mark Industries

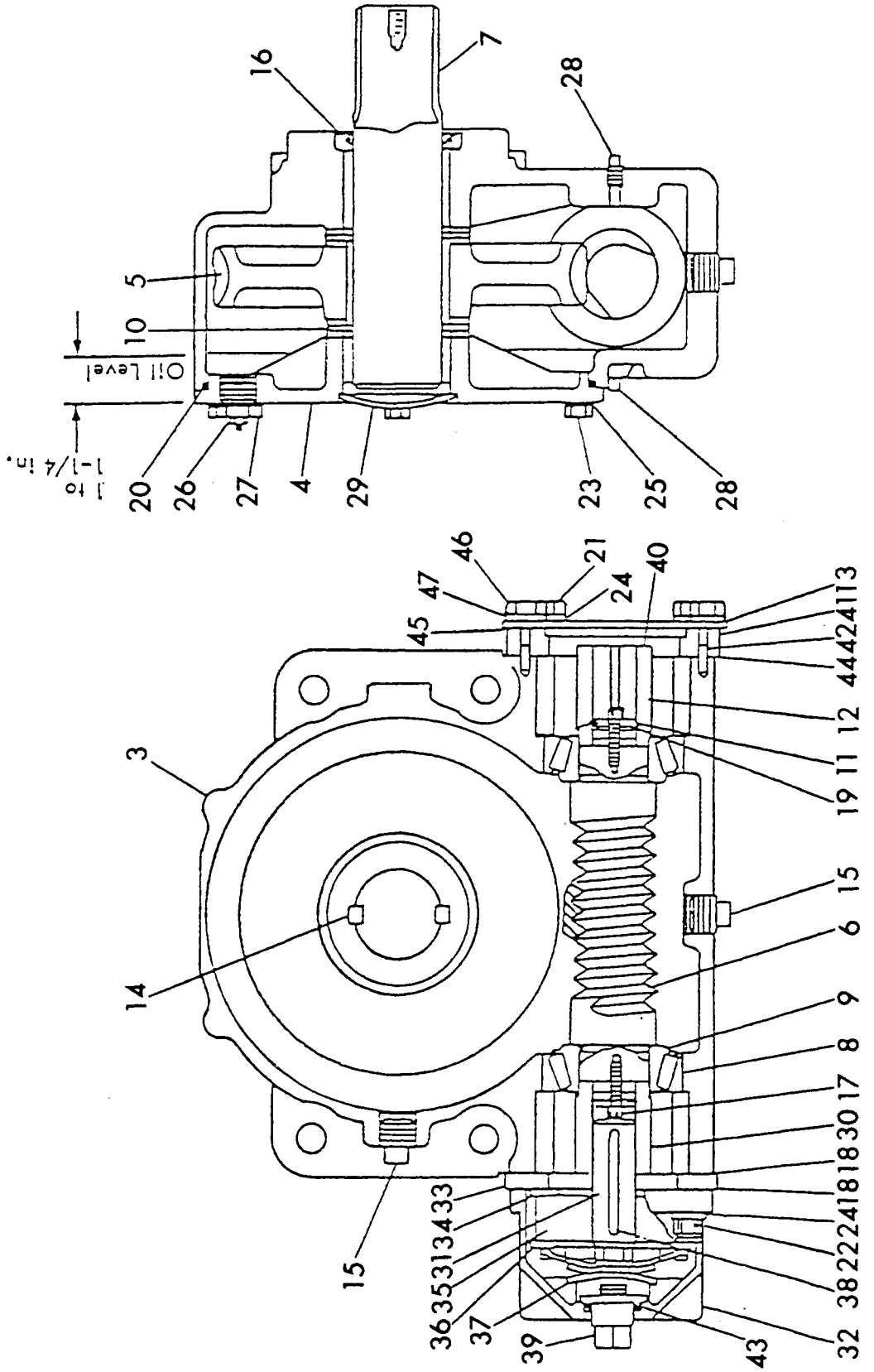
TITLE	ROTATION GEARBOX	SECT. 4
MODEL	62 4X2	FIG. 6A
NOTES	BR	PAGE 2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20726	GEARBOX, ROTATION (BR) (See Sect. 4, Fig. 5 for NHA)	REF
-2	.66172	KIT, SEAL REPAIR	1
3	.66176	HOUSING, WORM ASSEMBLY	1
4	.66177	COVER, HOUSING	1
5	.66403	GEAR, WORM	1
6	.	WORM (RH)	1
7	.66404	SHAFT, OUTPUT	1
8	.	CUP, BEARING	2
9	.	CONE, BEARING	2
10	.	RING, THRUST	2
11	.	RETAINER	2
12	.	SPACER, BEARING	2
13	.	SHIELD, DUST	1
14	.66758	KEY	2
15	.	PLUG, PIPE	2
16	.66249	SHAFT, SEAL	1
17	.	SCREW, CAP	2
18	.	GASKET	2
19	.	RING, SNAP	2
20	.	O-RING	1
21	.	SCREW, CAP	4
22	.	SCREW, CAP	4
23	.	SCREW, CAP	6
24	.	WASHER, LOCK	8
25	.	WASHER, LOCK	6

Mark Industries

TITLE	ROTATION GEARBOX
MODEL	62 4X2
NOTES	BR

SECTION	4
FIGURE	6A
PAGE	1



Mark Industries

TITLE	ROTATION GEARBOX
MODEL	62 4X2
NOTES	HT

SECT.	4
FIG.	6
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-26	.67066	BREATHER	1
-27	.	ADAPTER	1
28	.67067	PLUG, LEVEL	1
29	.67097	CIRCUP	1
30	.67099	WASHER	1
31	.67100	SCREW	1
32	.66772	COUPLING	1
33	.67068	WASHER, THRUST	2
34	.	GASKET, MOTOR	1
35	.67091	BOLT	2
-36	.67057	BUSHING	4

REV.

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

Mark Industries

TITLE	ROTATION GEARBOX
MODEL	62 4X2
NOTES	HT

SECT.	4
FIG.	6
PAGE	2

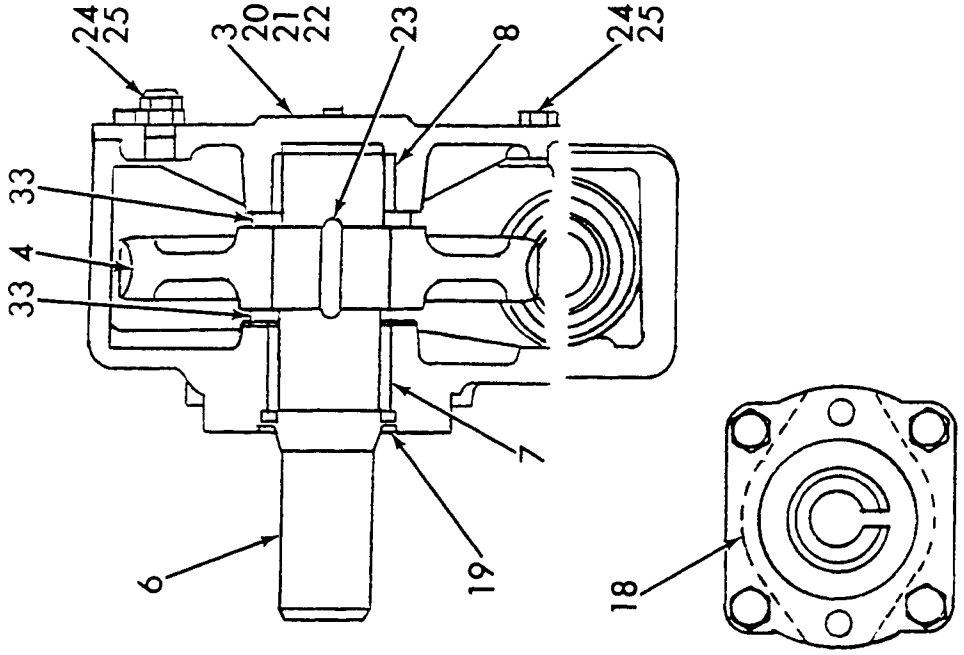
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20726	GEARBOX, ROTATION (HT) (See Sect. 4, Fig. 5 for NHA)	REF
2	.66754	CASE, GEARBOX	1
3	.66798	LID, GEARBOX	1
4	.66753	WHEEL, WORM	1
5	.67058	WORM	1
6	.66511	SHAFT, OUTPUT	1
7	.	BUSHING, CASE	1
8	.	BUSHING, LID	1
9	.67092	BEARING	2
10	.67059	CAP, CLOSED BEARING	1
11	.66785	CAP, MOTOR BEARING	1
12	.67062	SHIM, WORM BEARING	AR
13	.67063	SHIM, WORM BEARING	AR
14	.67064	SHIM, WORM BEARING	AR
15	.67065	GASKET	2
16	.67060	BOLT, HEX	8
17	.	WASHER, LOCK	8
18	.67093	PLATE, COVER	1
19	.	SEAL, OIL	1
20	.67095	SHIM, GEARBOX LID	AR
21	.67094	SHIM, GEARBOX LID	AR
22	.67096	SHIM, GEARBOX LID	AR
23	.66758	KEY	2
24	.67061	SCREW, HEX	6
25	.	WASHER, NYLITE	6

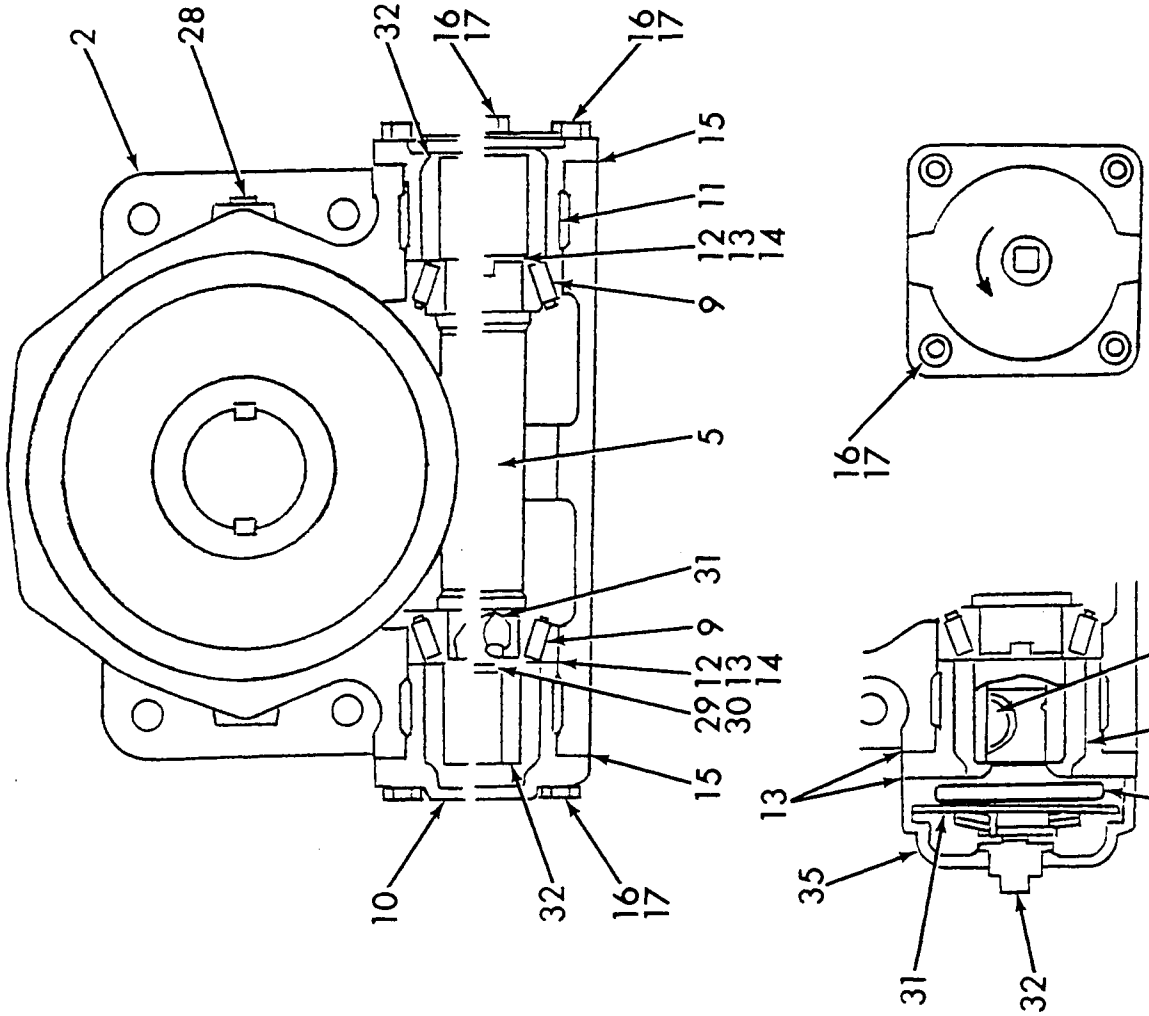
DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	ROTATION GEARBOX
MODEL	62 4X2
NOTES	HT

SECTION	4
FIGURE	6
PAGE	1



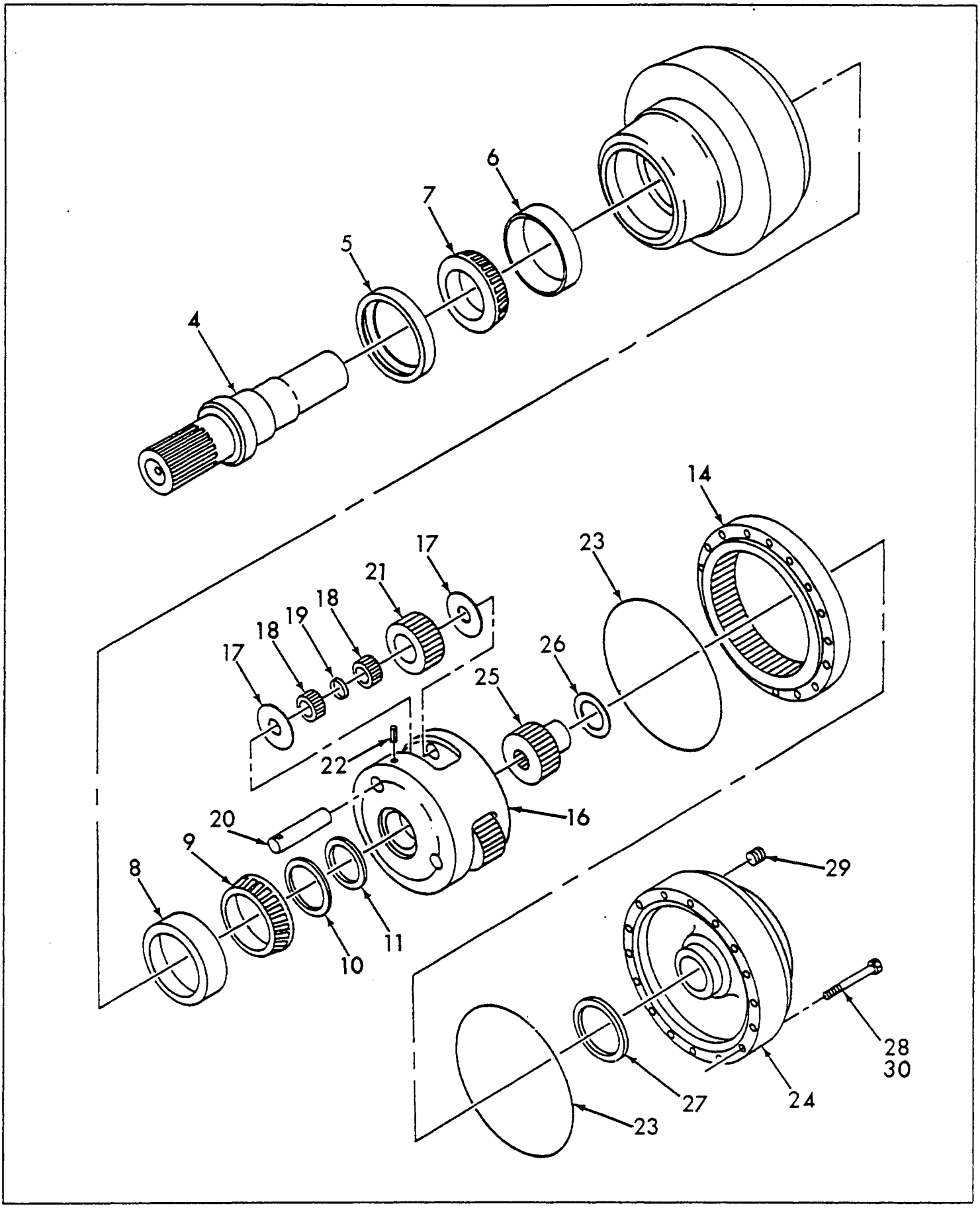


REV.

Mark Industries

TITLE	TORQUE HUB
MODEL	62 4X2
NOTES	ROTATION GEARBOX, SINCE EARLY 1985

SECTION	4
FIGURE	7
PAGE	1



REV.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22830	HUB, TORQUE (See Sect. 4, Fig. 5A for NHA) (See Vendor Chapter for Details)	REF
-2	.600220	KIT, SEAL	1
-3	.	SUB-ASSEMBLY, HUB/SPINDLE	1
4	..67877	SHAFT, OUTPUT	1
*5	..	SEAL	1
6	..67917	CUP, BEARING	1
7	..67924	CONE, BEARING	1
8	..67915	CUP, BEARING	1
9	..67923	CONE, BEARING	1
10	..67911	SPACER	1
*11	..	RING, RETAINING	1
-12	..	PLUG, PIPE	3
-13	..	PLUG, PIPE	1
14	.	GEAR, RING	1
-15	.	SUB-ASSEMBLY, CARRIER	1
16	..	CARRIER	1
17	..67898	WASHER, THRUST	6
18	..67918	ROLLER, NEEDLE	96
19	..67907	SPACER	3
20	..	SHAFT, PLANET	3
21	..	GEAR, PLANET	3
-22	..	PIN, ROLL	3
*23	.	O-RING	2
		NOTE: ASTERISK (*) INDICATES THE ITEM IS INCLUDED IN THE SEAL KIT.	

Mark Industries

TITLE	TORQUE HUB
MODEL	62 4X2
NOTES	ROTATION GEARBOX, SINCE EARLY 1985

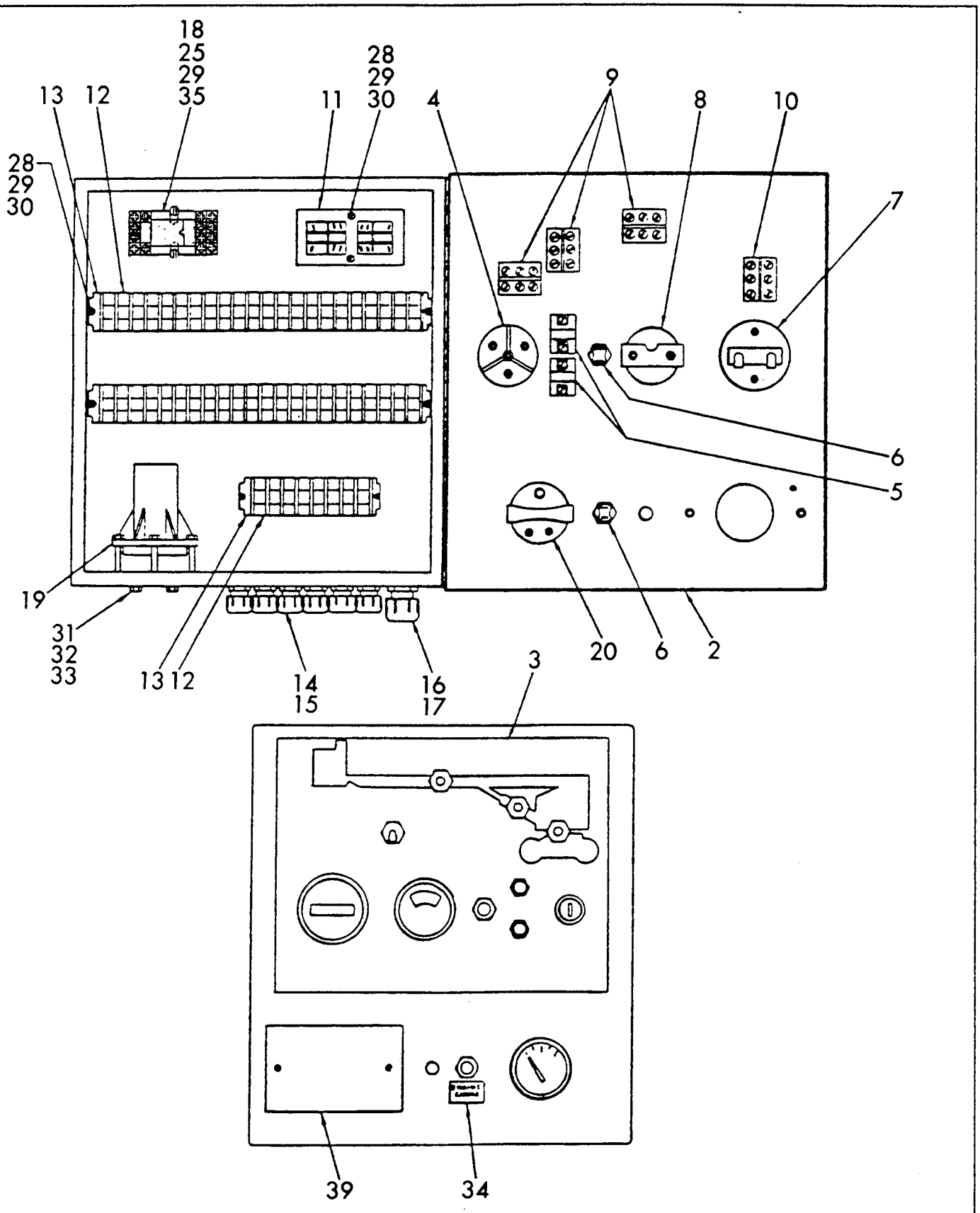
SECT.	4
FIG.	7
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
24	.	COVER	1
25	.67882	GEAR, INPUT	1
26	.67899	WASHER, THRUST	1
*27	.	WASHER, THRUST	1
28	.66427	BOLT	8
29	.	PLUG, PIPE	1
30	.66426	BOLT, SHOULDER	4
		NOTE: ASTERISK (*) INDICATES THE ITEM IS INCLUDED IN THE SEAL KIT.	

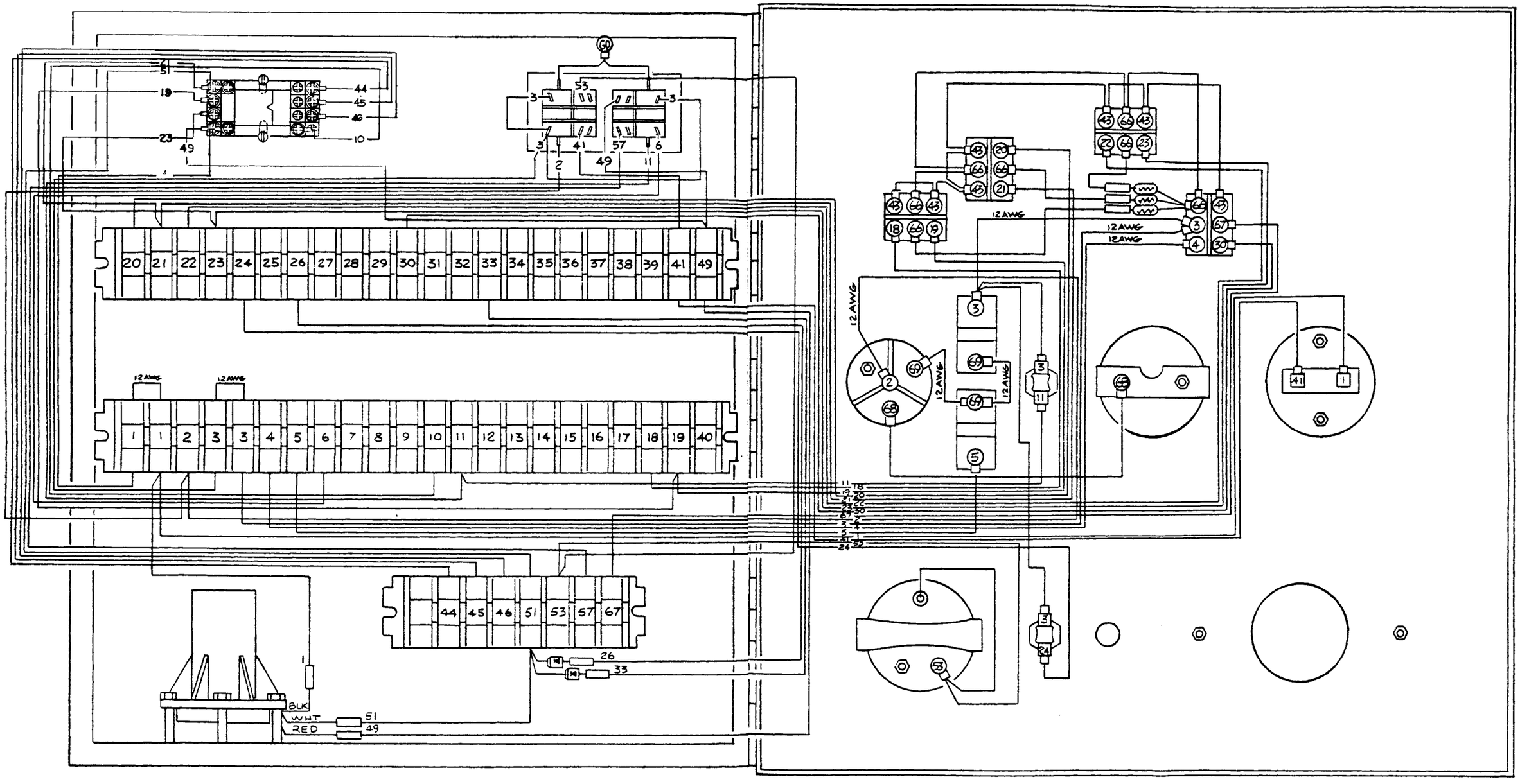
Mark Industries

TITLE	GROUND CONTROL BOX ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	8
PAGE	1



COVER



WIRING DIAGRAM LEGEND

- ITEM 21
- ITEM 22
- ITEM 23
- ITEM 24
- ITEM 38
- ITEM 26
- ITEM 27
- ITEM 36

Mark Industries

TITLE	GROUND CONTROL BOX ASSEMBLY	SECT.	4
MODEL	62 4X2	FIG.	8
NOTES		PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21703	ASSEMBLY, GROUND CONTROL BOX (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.20977	MACHINING, ELECTRICAL ENCLOSURE	1
3	.20460	DECAL, GROUND CONTROL CONSOLE	1
4	.2717	SWITCH, IGNITION	1
5	.20562	BREAKER, CIRCUIT	2
6	.4011	SWITCH, PUSH BUTTON	2
7	.20571	HOURMETER	1
8	.20572	AMMETER	1
9	.20481	SWITCH, TOGGLE	3
10	.20482	SWITCH, TOGGLE	1
11	.20573	RELAY, LATCHING	1
12	.4027	BLOCK, TERMINAL	52
13	.117-A	BLOCK, TERMINAL	3
14	.2806	RELIEF, STRAIN	6
15	.2808	NUT, LOCK	6
16	.2807	RELIEF, STRAIN	1
17	.2809	NUT, LOCK	1
18	.70213	RELAY, SQUARE	1
19	.21250	SENSOR, SLOPE	1
20	.21219	GAUGE, FUEL	1
21	.4045	DIODE	2
22	.70142	RESISTOR	3
23	.117-D	CONNECTOR, BUTT	8
24	.117-E	TERMINAL, PUSH	6
25	.70214	RELAY, BASE	1

DASH (-) INDICATES THE ITEM IS A PART OR ASSEMBLY

Mark Industries

TITLE	GROUND CONTROL BOX ASSEMBLY
MODEL	62 4X2
NOTES	

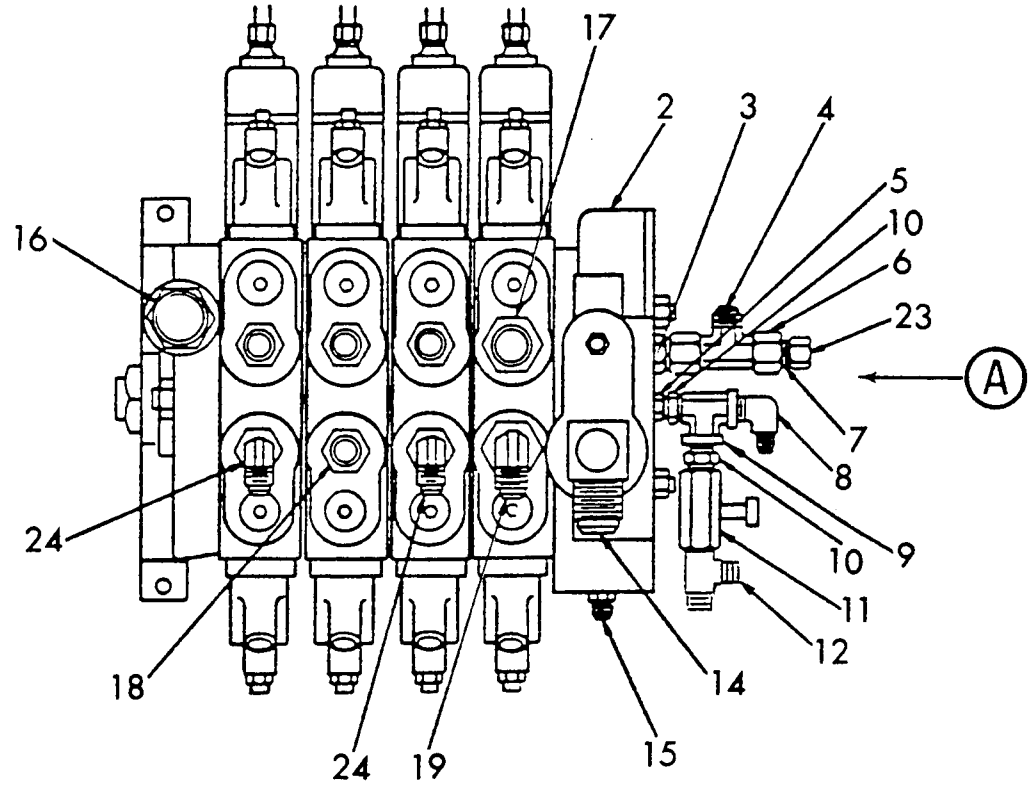
SECT.	4
FIG.	8
PAGE	4

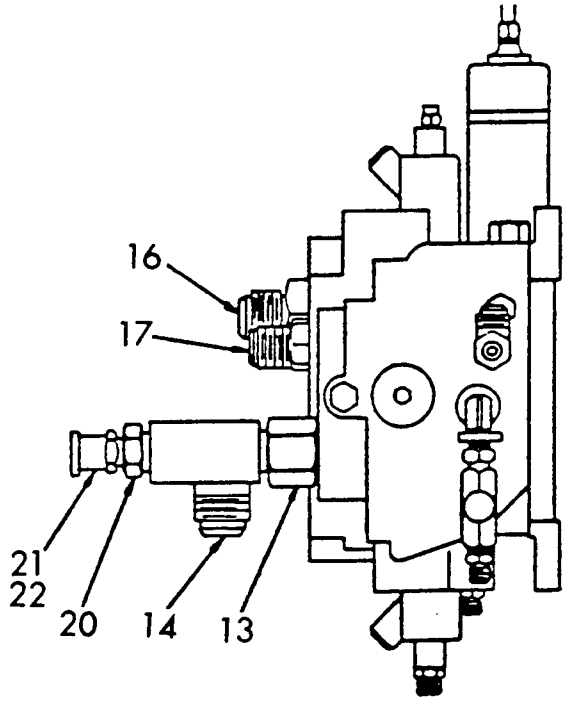
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.2859	RING, TONGUE	25
27	.876	TERMINAL, RING	10
28	.62609	SCREW, MACHINE	12
29	.63311	WASHER, LOCK	14
30	.61501	NUT, HEX	12
31	.60325	SCREW, CAP	4
32	.63303	WASHER, LOCK	4
33	.60703	NUT, HEX	4
34	.20413	DECAL, ENGINE CHOKE	1
35	.62630	SCREW, MACHINE	2
36	.70147	CAPACITOR, ELECTROLYTE	1
37	.117-CC	CONNECTOR, FEMALE	2
38	.70029	CONNECTOR	2
39	.902	PLATE, COVER	1

Mark Industries

TITLE	PROPORTIONAL VALVE ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	9
PAGE	1





A

Mark Industries

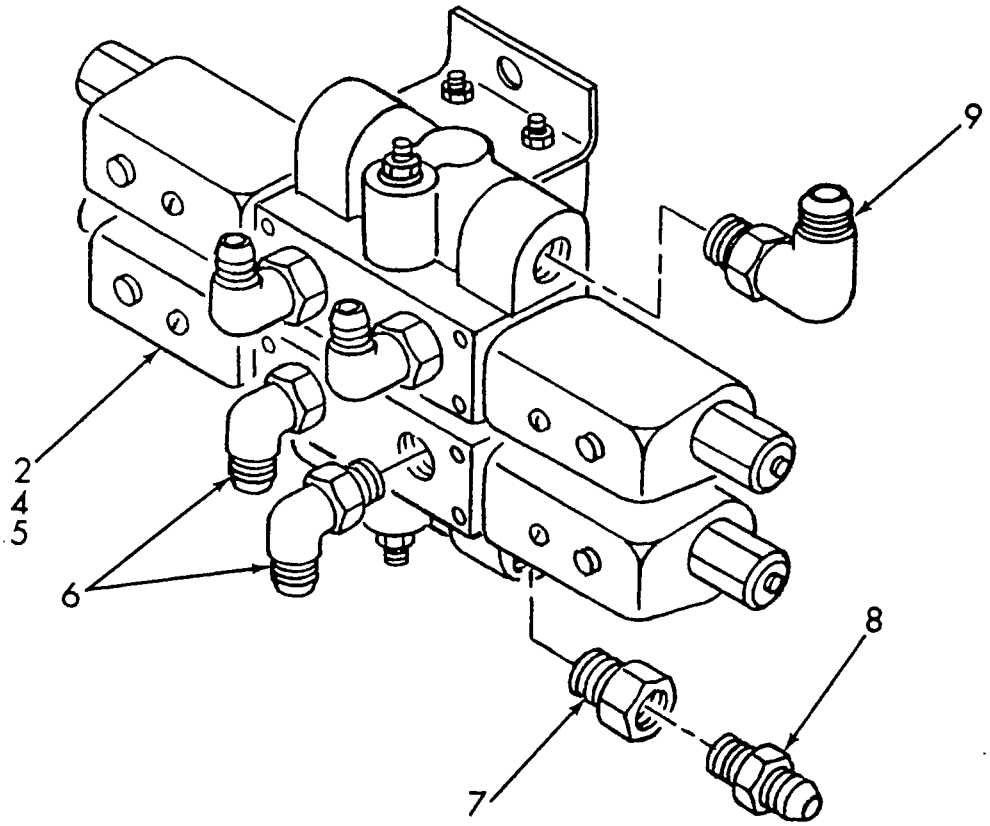
TITLE	PROPORTIONAL VALVE ASSEMBLY	SECT.	4
MODEL	62 4X2	FIG.	9
NOTES		PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22519	ASSEMBLY, PROPORTIONAL VALVE (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.21776	VALVE, CONTROL (See Vendor Chapter for Details)	1
3	.80004-09	CONNECTOR, STRAIGHT THREAD	1
4	.80028-05	TEE, SWIVEL NUT	1
5	.80058-03	REDUCER	1
6	.80060-05	NUT	1
7	.80056-01	REDUCER, TUBE END	1
8	.80008-08	ELBOW, MALE	1
9	.80039-04	TEE, FEMALE	1
10	.80052-04	NIPPLE, PIPE	2
11	.20357	VALVE, NEEDLE	1
12	.80037-08	TEE, MALE	1
13	.80063-15	ADAPTER, FEMALE	1
14	.55300	TEE	1
15	.80004-03	CONNECTOR, STRAIGHT THREAD	1
16	.80004-24	CONNECTOR, STRAIGHT THREAD	1
17	.80004-18	CONNECTOR, STRAIGHT THREAD	1
18	.80004-14	CONNECTOR, STRAIGHT THREAD	4
19	.80012-18	ELBOW, STRAIGHT THREAD	1
20	.54709	NIPPLE, REDUCING	1
21	.2527	COUPLING, QUICK DISCONNECT	1
22	.845	CAP, QUICK DISCONNECT	1
23	.80059-03	CAP	1
24	.80012-14	ELBOW, STRAIGHT THREAD	2

Mark Industries

TITLE	MINIPAK ASSEMBLY
MODEL	62 4X2
NOTES	WITHOUT PLATFORM ROTATION

SECTION	4
FIGURE	10
PAGE	1

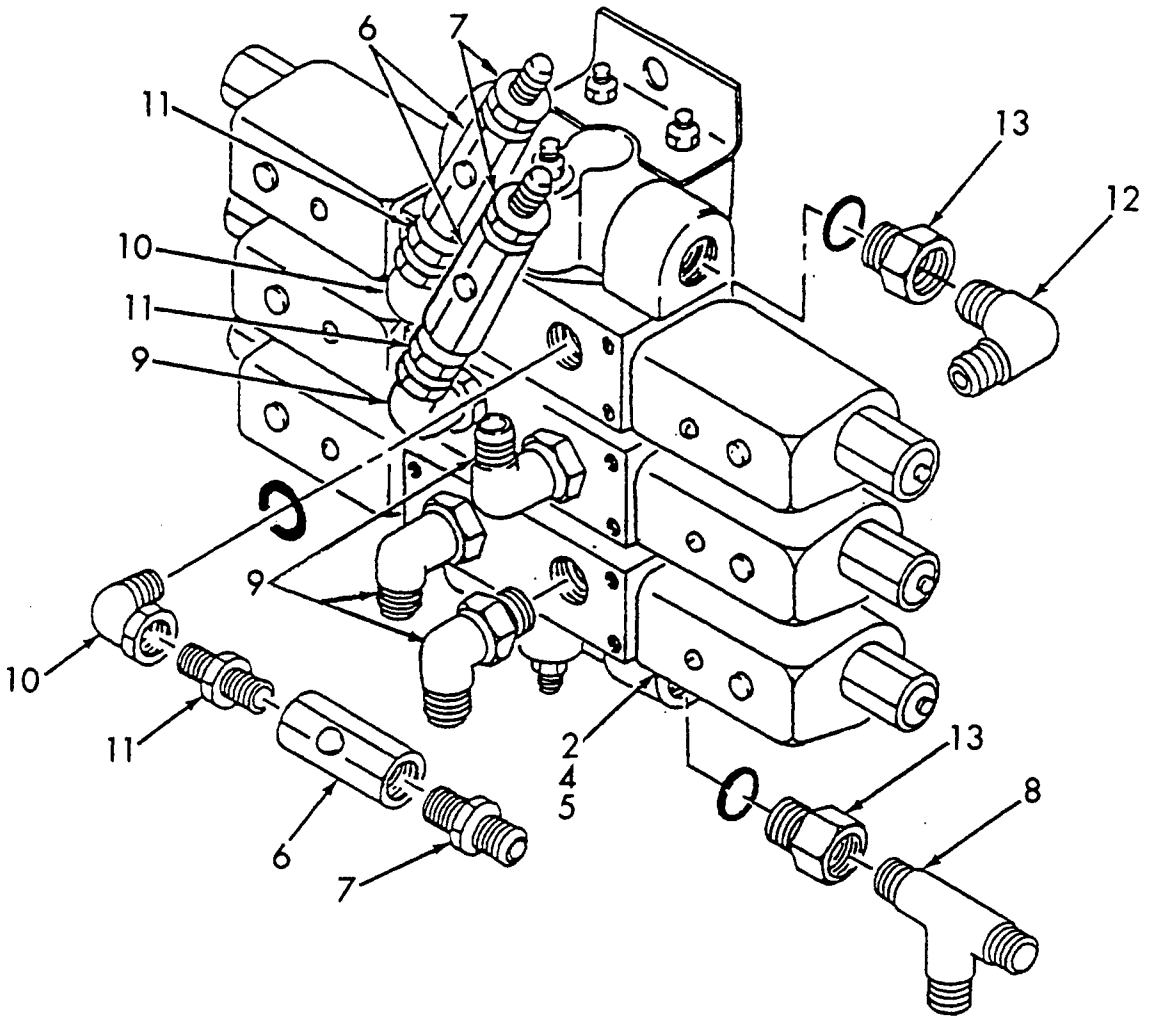


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21088	ASSEMBLY, MINIPAK (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.21207	VALVE, SOLENOID	1
-3	..67825	KIT, SEAL (COMPLETE VALVE PACKAGE)	1
4	..67958	CARTRIDGE (ONLY)	4
5	..16953	COIL (ONLY)	4
6	.80012-05	ELBOW, STRAIGHT THREAD	4
7	.80063-01	ADAPTER, FEMALE	1
8	.80001-08	CONNECTOR, MALE	1
9	.80012-08	ELBOW, STRAIGHT THREAD	1

Mark Industries

TITLE	MINIPAK ASSEMBLY
MODEL	62 4X2
NOTES	WITH PLATFORM ROTATION

SECTION	4
FIGURE	10A
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22607	ASSEMBLY, MINIPAK (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.21787	VALVE, SOLENOID (See Vendor Chapter for Details)	1
-3	..67825	KIT, SEAL (COMPLETE VALVE PACKAGE)	1
4	..67958	CARTRIDGE (ONLY)	6
5	..16953	COIL (ONLY)	6

Mark Industries

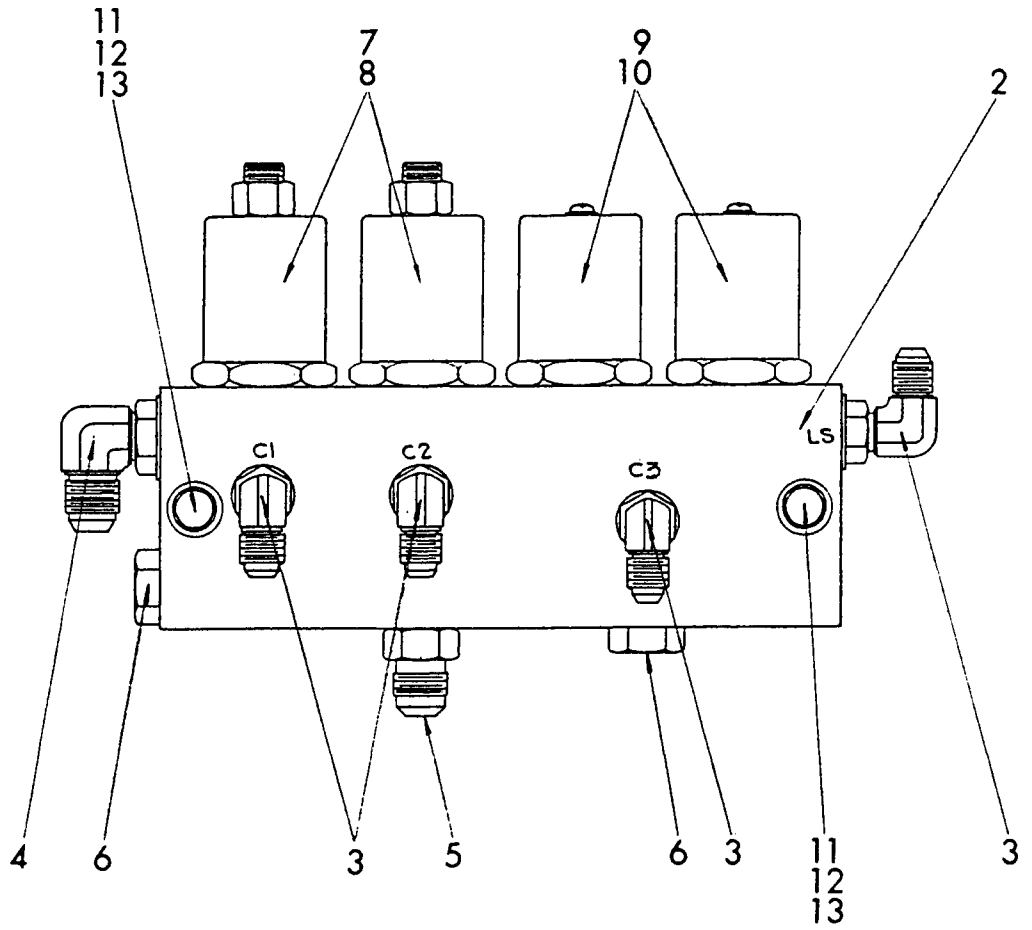
TITLE	MINIPAK ASSEMBLY	SECT.	4
MODEL	62 4X2	FIG.	10A
NOTES	WITH PLATFORM ROTATION	PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
6	.20370	VALVE, NEEDLE	3
7	.80001-04	CONNECTOR, MALE	3
8	.80037-08	TEE, MALE	1
9	.80012-05	ELBOW, STRAIGHT THREAD	4
10	.80021-03	ELBOW, STREET	2
11	.80052-04	NIPPLE, PIPE	2
12	.80008-08	ELBOW, MALE	1
13	.80063-01	ADAPTER, FEMALE PIPE	2

Mark Industries

TITLE	SOLENOID VALVE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1981

SECTION	4
FIGURE	11
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21089	ASSEMBLY, SOLENOID VALVE (See Sect. 4, Fig. 1 for NHA)	REF
2	.21384	BLOCK, MANIFOLD	1
3	.80012-03	ELBOW, STRAIGHT THREAD	3
4	.80012-09	ELBOW, STRAIGHT THREAD	1
5	.80004-08	CONNECTOR, STRAIGHT THREAD	1
6	.80050-05	PLUG, HEX HEAD	1
7	.21230	COIL AND CARTRIDGE	2
8	..67126	COIL (ONLY)	2
9	.21231	COIL AND CARTRIDGE	2

Mark Industries

TITLE	SOLENOID VALVE ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1981

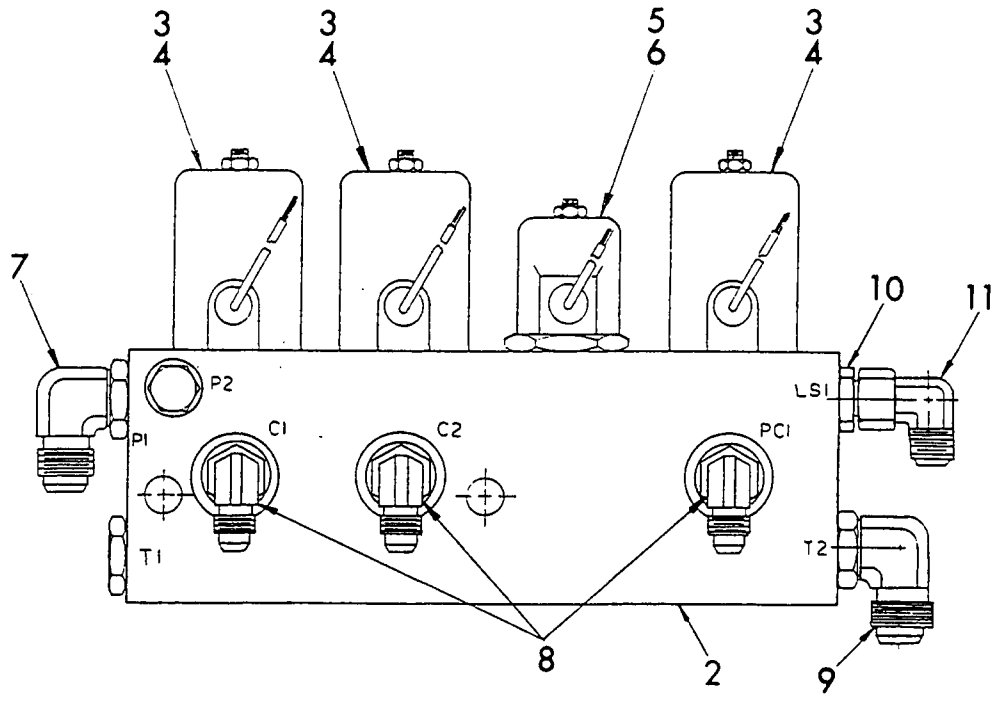
SECT.	4
FIG.	11
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
10	..67126	COIL (ONLY)	2
11	.60354	SCREW, CAP	2
12	.63307	WASHER, LOCK	2
13	.63403	WASHER, FLAT	2

Mark Industries

TITLE	SOLENOID VALVE ASSEMBLY
MODEL	62 4X2
NOTES	LATE 1981 TO LATE 1986

SECTION	4
FIGURE	11A
PAGE	1

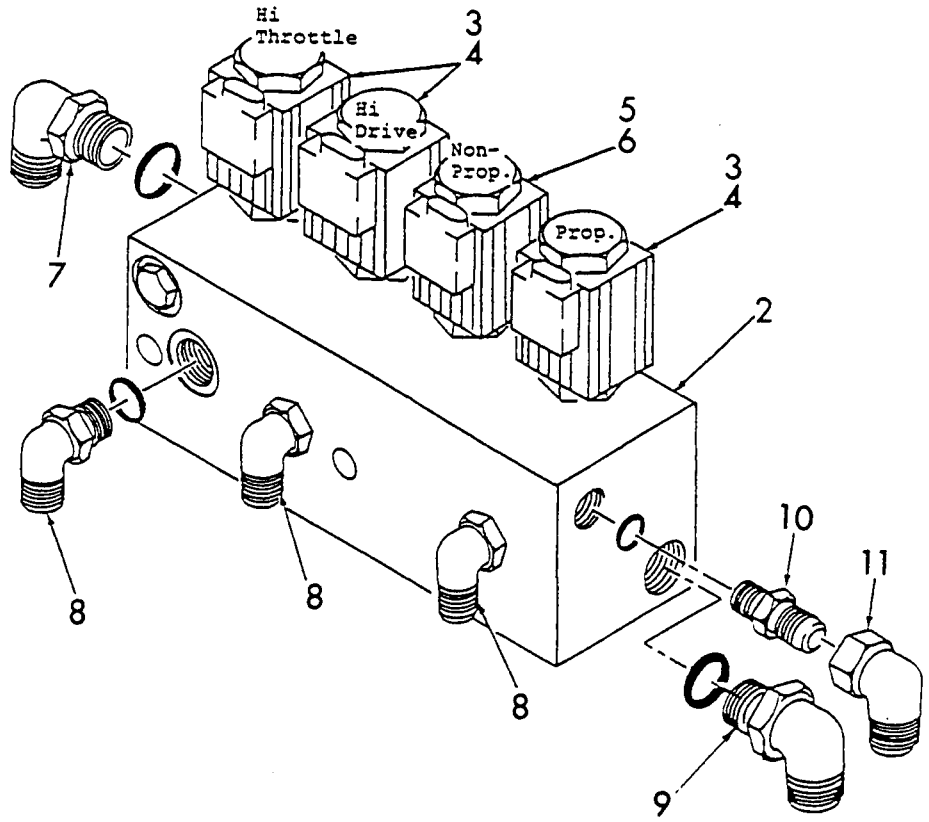


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21692	ASSEMBLY, SOLENOID VALVE (See Sect. 4, Fig. 1A for NHA)	REF
2	.21860	VALVE, SOLENOID	1
3	..66201	COIL, LARGE ROUND (ONLY)	3
4	..66245	CARTRIDGE, 3-WAY (ONLY)	3
5	..66202	COIL, SMALL ROUND (ONLY)	1
6	..66246	CARTRIDGE, 2-WAY (ONLY)	1
7	.50900	ELBOW, STRAIGHT THREAD	1
8	.80012-03	ELBOW, STRAIGHT THREAD	3
9	.80012-08	ELBOW, STRAIGHT THREAD	1
10	.80004-03	CONNECTOR, STRAIGHT THREAD	1
11	.80015-03	ELBOW, SWIVEL NUT	1

Mark Industries

TITLE	SOLENOID VALVE ASSEMBLY
MODEL	62 4X2
NOTES	FROM LATE 1986

SECTION	4
FIGURE	11B
PAGE	1



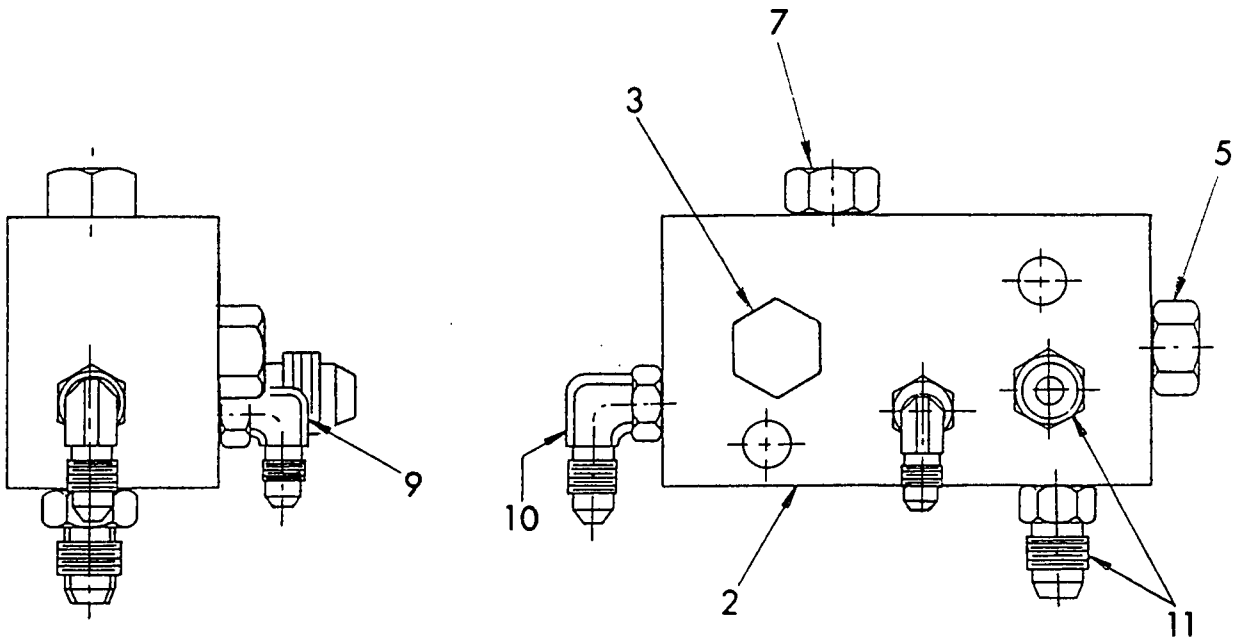
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21692	ASSEMBLY, SOLENOID VALVE (See Sect. 4, Fig. 1A for NHA)	REF
2	.21860	VALVE, SOLENOID	1
3	..66884	CARTRIDGE AND COIL (SQUARE)	3
4	...67249	COIL (ONLY)	3
5	..66883	CARTRIDGE AND COIL (SQUARE)	1
6	...67249	COIL (ONLY)	1
7	.50900	ELBOW, STRAIGHT THREAD	1
8	.80012-03	ELBOW, STRAIGHT THREAD	3
9	.80012-08	ELBOW, STRAIGHT THREAD	1
10	.80004-03	CONNECTOR, STRAIGHT THREAD	1
11	.80015-03	ELBOW, SWIVEL NUT	1

REV

Mark Industries

TITLE	PILOT VALVE MANIFOLD ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	12
PAGE	1

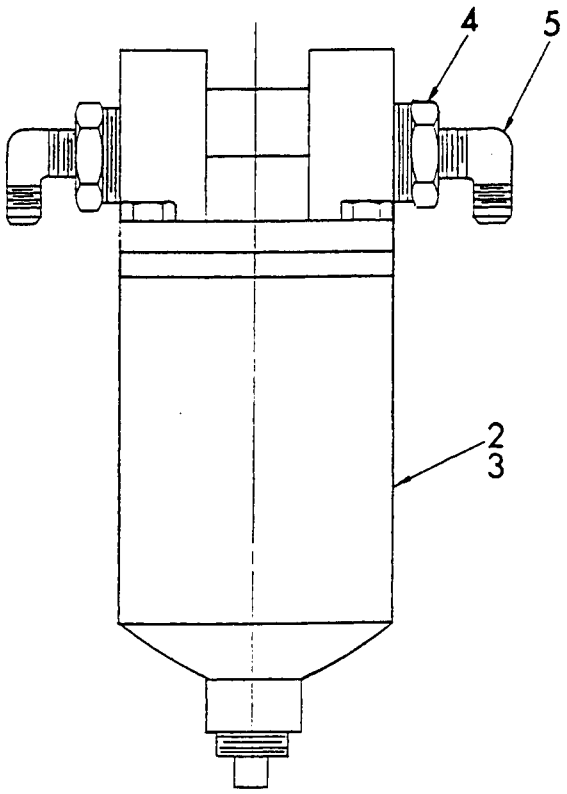


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21472	ASSEMBLY, PILOT VALVE MANIFOLD (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.21448	MANIFOLD, PILOT VALVE	1
3	..66906	CARTRIDGE, PRIORITY	1
-4	...67116	KIT, SEAL	1
5	..66907	CARTRIDGE, CHECK	1
-6	...67116	KIT, SEAL	1
7	..66908	CARTRIDGE, SHUTTLE	1
-8	...67117	KIT, SEAL	1
9	.80012-03	ELBOW, STRAIGHT THREAD	1
10	.80012-08	ELBOW, STRAIGHT THREAD	1
11	.80004-08	CONNECTOR, STRAIGHT THREAD	2

Mark Industries

TITLE	PILOT FILTER ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1985

SECTION	4
FIGURE	13
PAGE	1



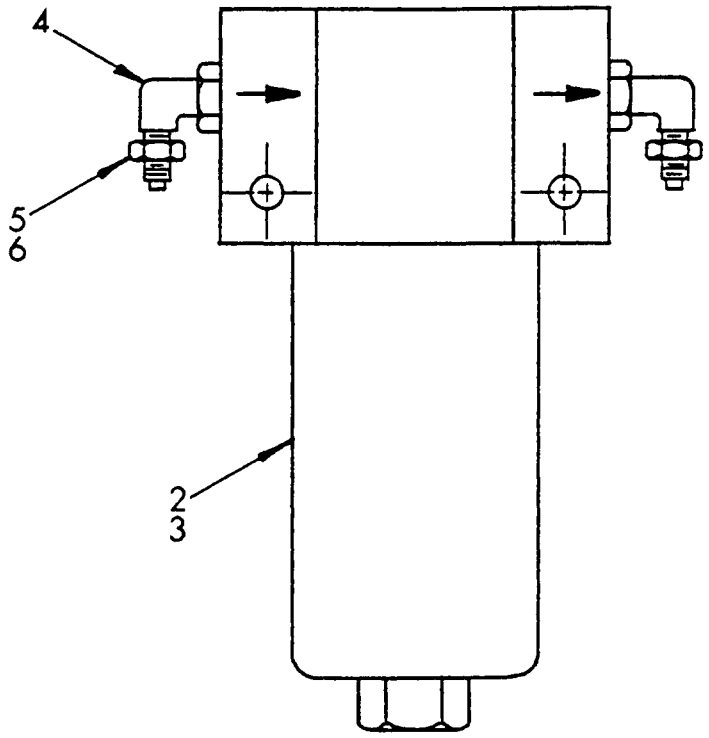
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22146	ASSEMBLY, PILOT FILTER (See Sect. 4, Fig. 1 for NHA)	REF
2	.20368	FILTER, LOW PRESSURE	1
3	..20472	ELEMENT, FILTER	1
4	.80057-11	REDUCER, PIPE THREAD	2
5	.80008-08	ELBOW, MALE	2

REV

Mark Industries

TITLE	PILOT FILTER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE LATE 1985

SECTION	4
FIGURE	13A
PAGE	1

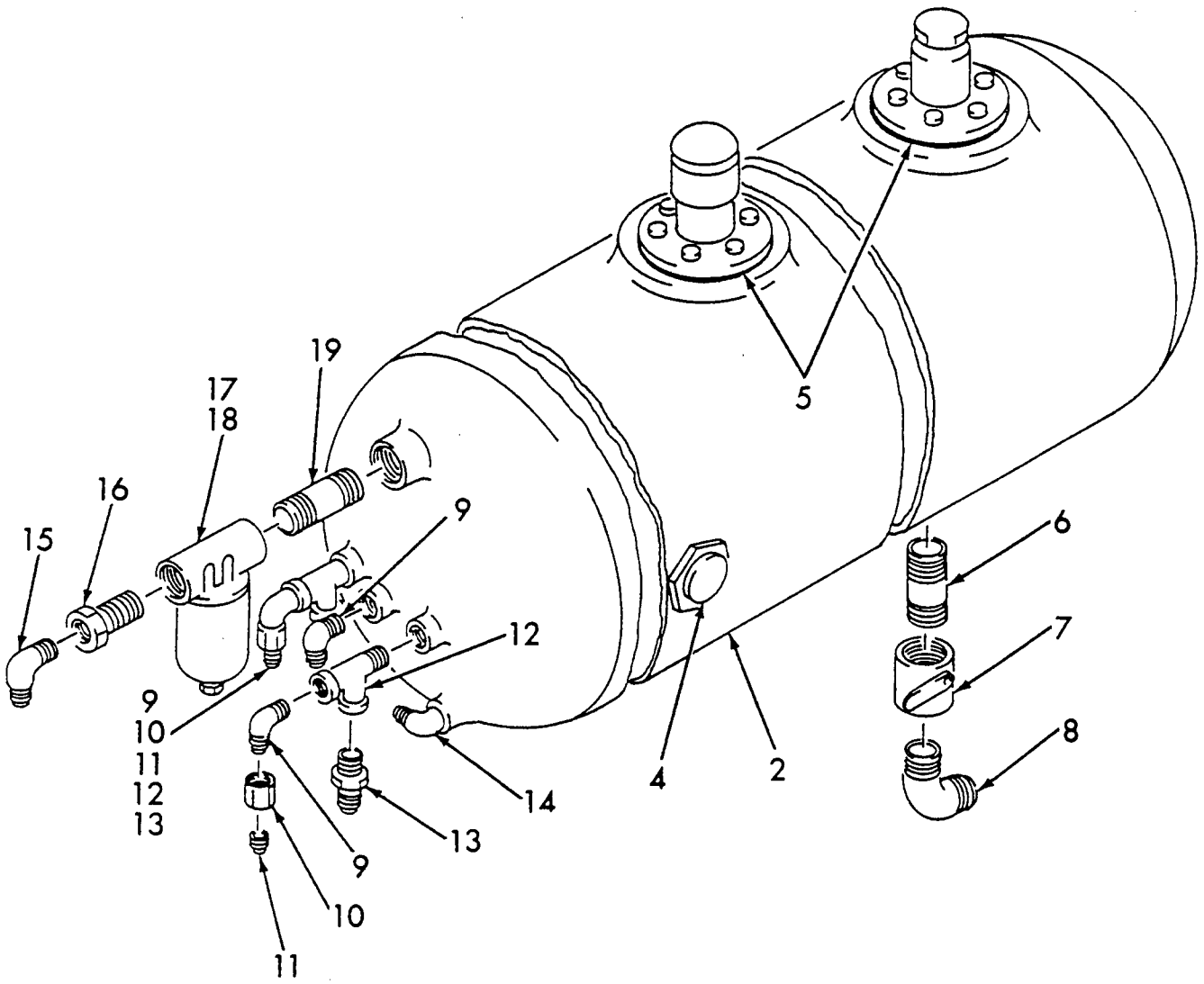


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22963	ASSEMBLY, PILOT FILTER (See Sect. 4, Fig. 1A for NHA)	REF
2	.81076	ASSEMBLY, FILTER	1
3	..81077	ELEMENT, FILTER	1
4	.80012-14	ELBOW, STRAIGHT THREAD	2
5	.80056-03	REDUCER, TUBE END	1
6	.80060-06	NUT	1

Mark Industries

TITLE	HYDRAULIC TANK ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	14
PAGE	1



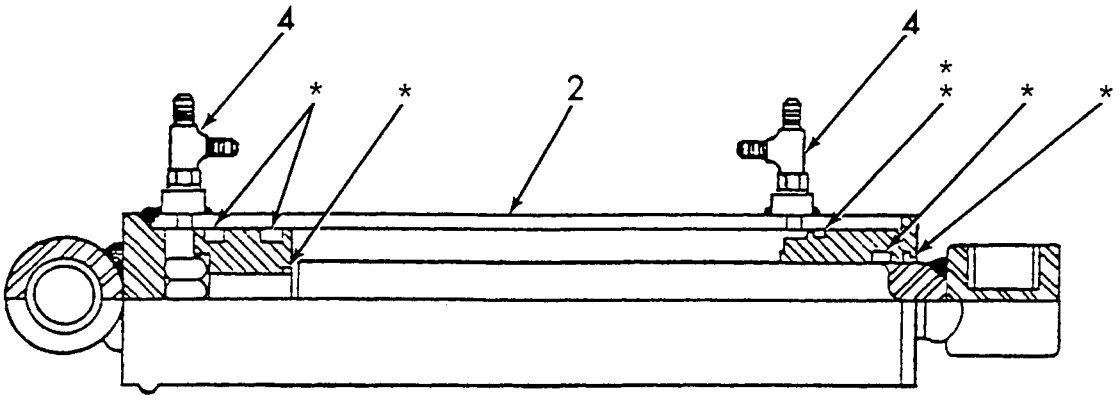
REV.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21937	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 1 or 1A for NHA)	REF
2	.21336	TANK, HYDRAULIC (41 GAL)	1
-3	..66335	FILTER, SUMP	1
4	..65130	GAUGE	1
5	..66247	GASKET	2
6	.16553	NIPPLE	1
7	.20050	VALVE, BUTTERFLY	1
8	.2551	ELBOW	1
9	.80008-10	ELBOW, MALE	3
10	.80060-05	NUT	2
11	.80056-01	REDUCER, TUBE END	2
12	.80041-06	TEE, STREET	2
13	.80001-10	CONNECTOR, MALE	2
14	.80008-20	ELBOW, MALE	1
15	.80008-23	ELBOW, MALE	1
16	.80057-20	REDUCER, PIPE THREAD	1
17	.21241	ASSEMBLY, FILTER	1
18	..21245	ELEMENT, FILTER	1
19	.16557	NIPPLE	1

Mark Industries

TITLE	MASTER LEVELING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	

SECTION	4
FIGURE	15
PAGE	1



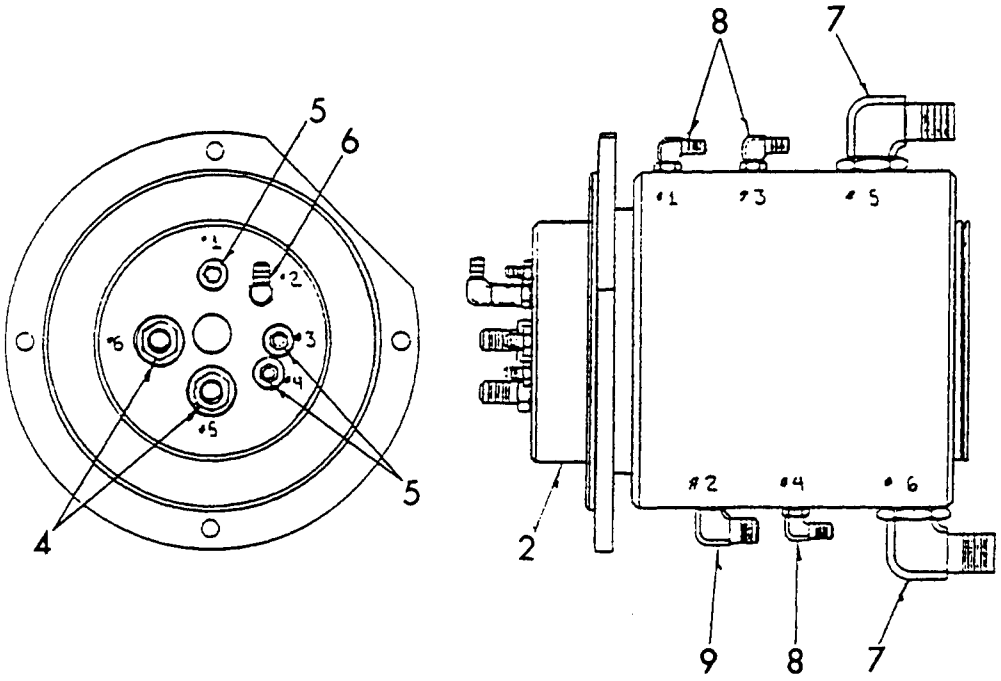
NOTE 1: DUE TO VENDOR/MFG. REVISIONS; WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21084	ASSEMBLY, MASTER LEVELING CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	.21111	CYLINDER, MASTER LEVELING (SE: SHOWN) (SINCE EARLY 1987: SOME CONCURRENT USE)	1
	.21111	CYLINDER, MASTER LEVELING (RA: NOT SHOWN) (UNTIL LATE 1987: SOME CONCURRENT USE)	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66044	KIT, SEAL (SE: SHOWN)	1
	..66651	KIT, SEAL (RA: NOT SHOWN)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	.80033-03	TEE, STRAIGHT THREAD	2

Mark Industries

TITLE	ROTARY MANIFOLD ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL EARLY 1983

SECTION	4
FIGURE	16
PAGE	1

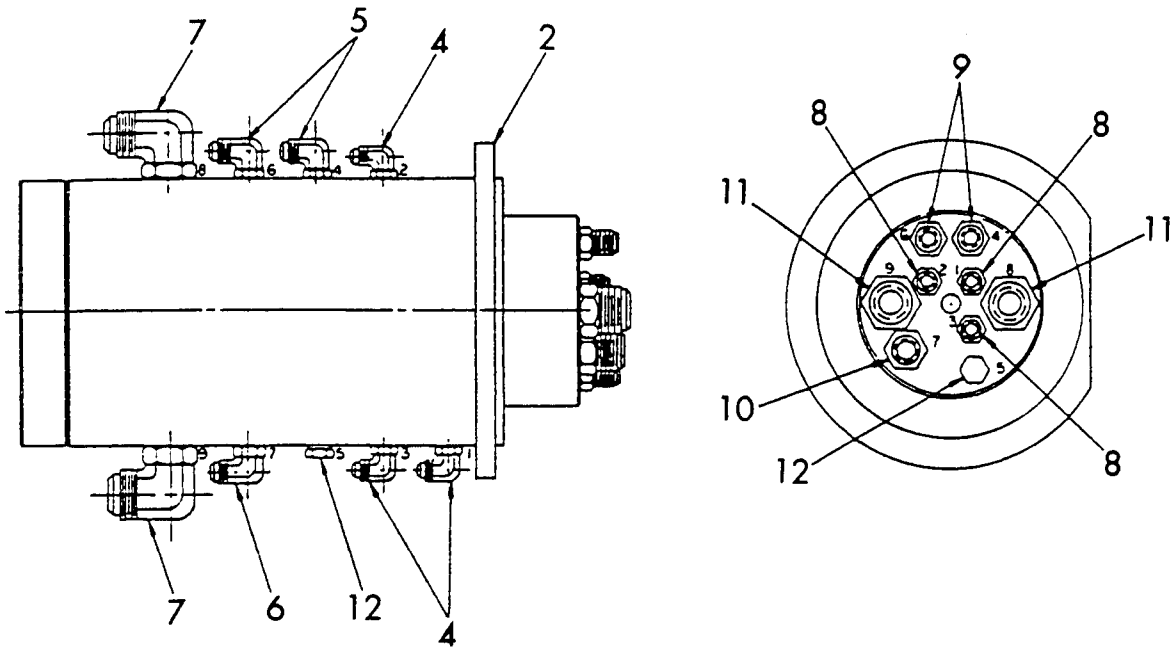


ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20793	ASSEMBLY, ROTARY MANIFOLD (See Sect. 4, Fig. 1 for NHA)	REF
2	.20324	MANIFOLD, ROTARY	1
-3	..20039	KIT, SEAL	1
4	.80004-18	CONNECTOR, STRAIGHT THREAD	2
5	.80004-03	CONNECTOR, STRAIGHT THREAD	3
6	.80013-08	ELBOW, MALE	1
7	.80012-18	ELBOW, STRAIGHT THREAD	2
8	.80012-03	ELBOW, STRAIGHT THREAD	3
9	.80008-08	ELBOW, MALE	1

Mark Industries

TITLE	ROTARY MANIFOLD ASSEMBLY
MODEL	62 4X2
NOTES	SINCE EARLY 1983

SECTION	4
FIGURE	16A
PAGE	1



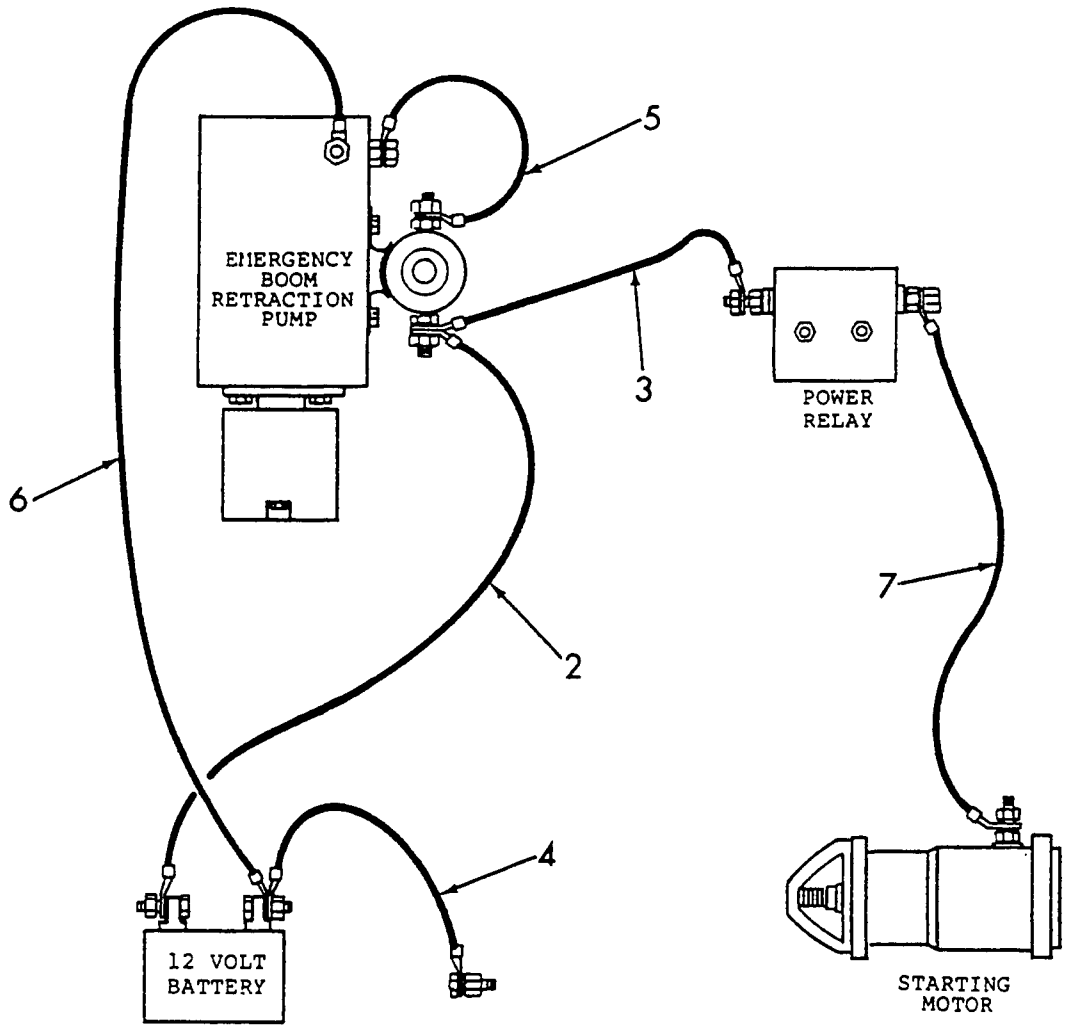
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22495	ASSEMBLY, ROTARY MANIFOLD (See Sect. 4, Fig. 1 for NHA)	REF
2	.22363	MANIFOLD, ROTARY	1
-3	..66562	KIT, SEAL	1
4	.80012-03	ELBOW	3
5	.80012-08	ELBOW	2
6	.80012-09	ELBOW	1
7	.80012-18	ELBOW	2
8	.80004-03	CONNECTOR	3
9	.80004-08	CONNECTOR	2
10	.80004-11	CONNECTOR	1
11	.80004-18	CONNECTOR	2
12	.80050-05	PLUG, HEX	2

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Mark Industries

TITLE	BATTERY CABLE KIT
MODEL	62 4X2
NOTES	

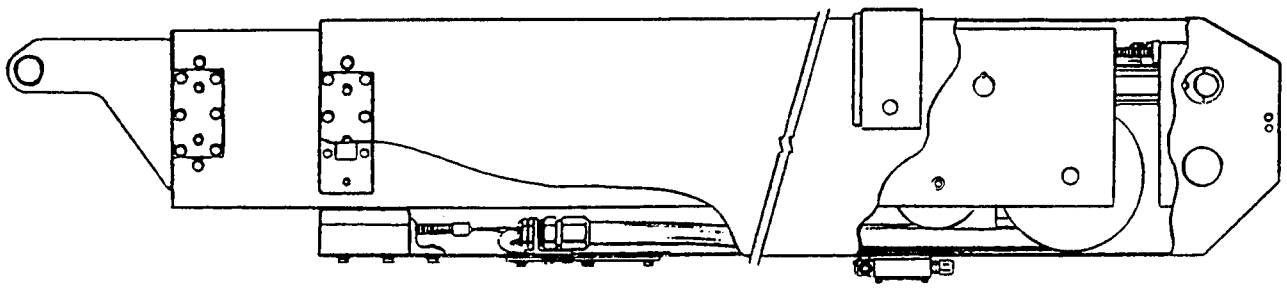
SECTION	4
FIGURE	17
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20673	KIT, BATTERY CABLE (See Sect. 4, Fig. 1A for NHA)	REF
2	.13226-1140	ASSEMBLY, ELECTRICAL CABLE	1
3	.13226-0480	ASSEMBLY, ELECTRICAL CABLE	1
4	.13226-0180	ASSEMBLY, ELECTRICAL CABLE	1
5	.13226-0090	ASSEMBLY, ELECTRICAL CABLE	1
6	.13226-1200	ASSEMBLY, ELECTRICAL CABLE	1
7	.13226-0600	ASSEMBLY, ELECTRICAL CABLE	1

SECTION 5 CONTAINS:

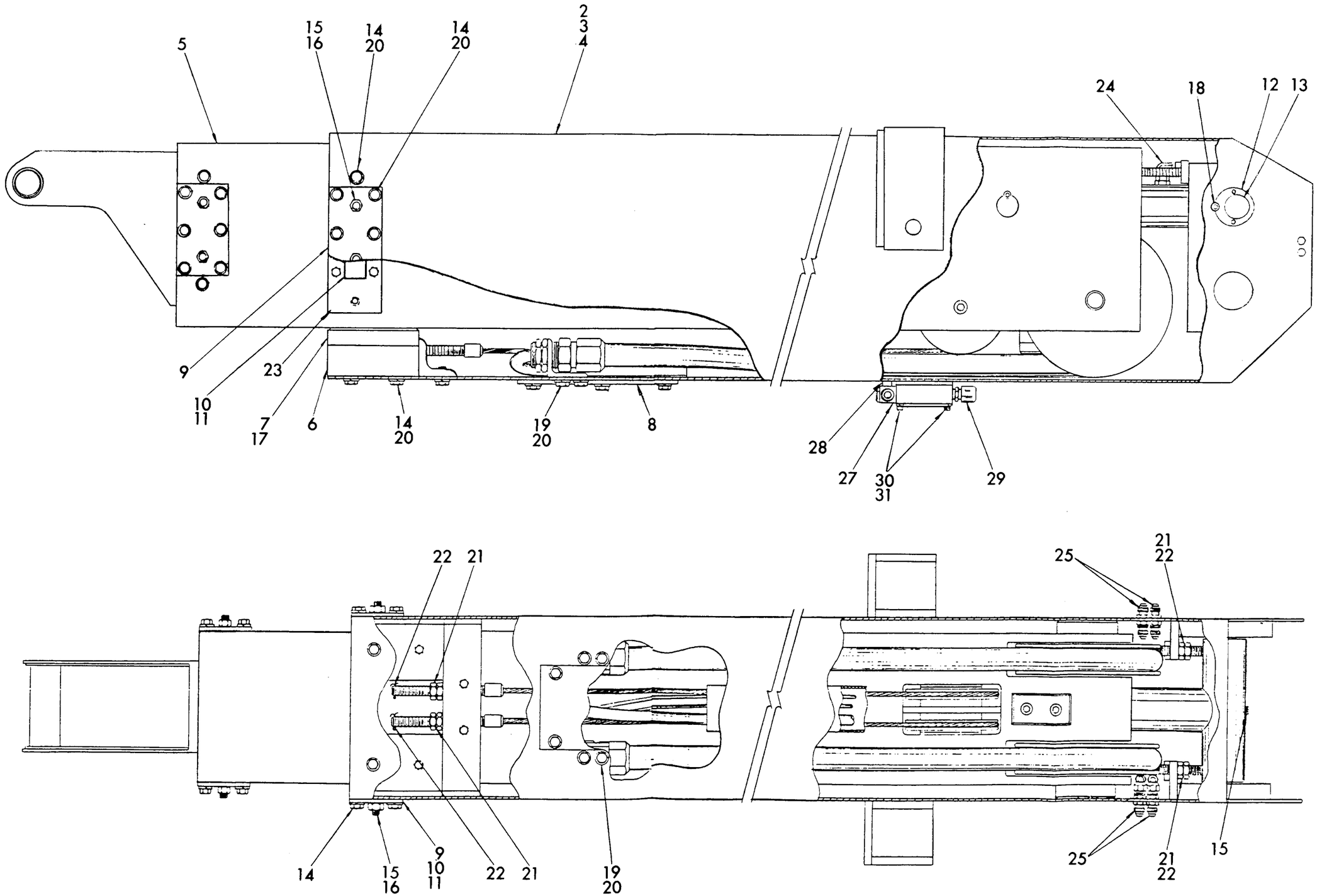
FIG. NO.	TITLE
1	FINAL BOOM ASSEMBLY (UNTIL LATE 1984)
1A	FINAL BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)
1B	FINAL BOOM ASSEMBLY (SINCE MID 1986)
2	INTERMEDIATE BOOM ASSEMBLY (UNTIL LATE 1984)
2A	INTERMEDIATE BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)
2B	INTERMEDIATE BOOM ASSEMBLY (SINCE MID 1986)
3	INNER BOOM ASSEMBLY (UNTIL LATE 1984)
3A	INNER BOOM ASSEMBLY (FROM MID 1984 TO MID 1986)
3B	INNER BOOM ASSEMBLY (SINCE MID 1986)
4	SLAVE LEVELING CYLINDER ASSEMBLY (UNTIL MID 1981)
4A	SLAVE LEVELING CYLINDER ASSEMBLY (SINCE MID 1981)
5	BOOM EXTENSION CYLINDER ASSEMBLY (UNTIL LATE 1981)
5A	BOOM EXTENSION CYLINDER ASSEMBLY (FROM LATE 1981 TO MID 1986)
5B	BOOM EXTENSION CYLINDER ASSEMBLY (SINCE MID 1986)



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	5
FIG.	1
PAGE	1



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	5
FIG.	1
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21052	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	.21101	MACHINING, OUTER BOOM	1
3	..21113	WELDMENT, OUTER BOOM	1
4	..21783	BUSHING	2
5	.21053	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 2 for Details)	1
6	.21310	BRACKET, BOOM END	1
7	.21311	PAD, WEAR	2
8	.21320	COVER, PLATE	1
9	.21321	COVER, WEAR PAD PLATE	2
10	.20453	PLATE, PAD PRESSURE	2
11	.21315	PAD, POLYETHYLENE WEAR	2
12	.21353	BUSHING, ECCENTRIC	2
13	.21340	PIN, ANCHOR	1
14	.60343	SCREW, CAP	22
15	.62204	SCREW, SET	5
16	.61101	NUT, HEX	4
17	.61806	SCREW, CAP	4
18	.62203	SCREW, SET	2
19	.60607	SCREW, CAP	4
20	.63303	WASHER, LOCK	26
21	.61102	NUT, HEX	8
22	.64301	PIN, COTTER	4
23	.21358	PAD, WEAR (RETAINER)	2
24	.80012-11	ELBOW, STRAIGHT THREAD	2

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

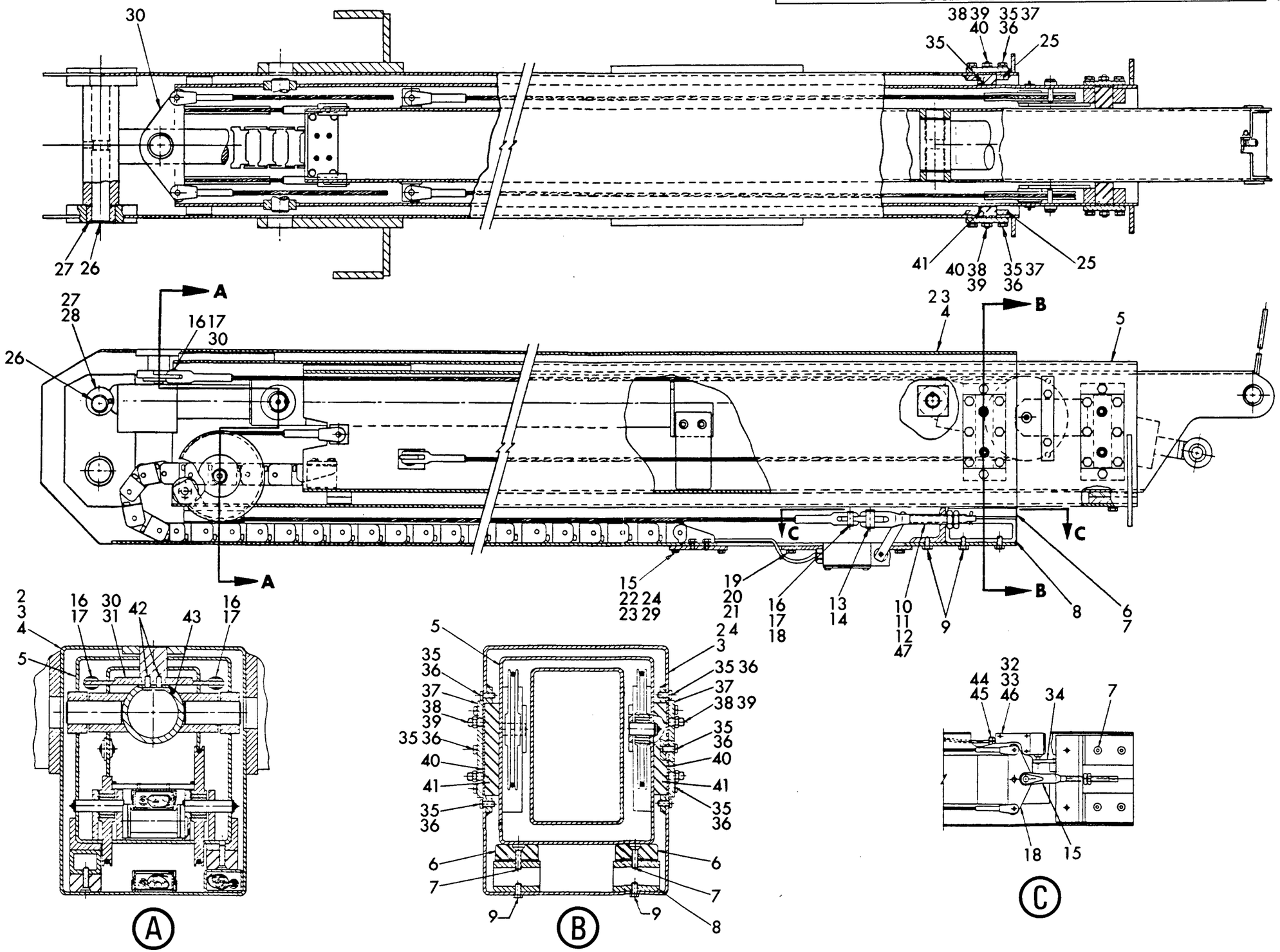
SECT.	5
FIG.	1
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.80045-03	UNION, BULKHEAD	4
26	.2594	ELBOW, SWIVEL	2
27	.70107	SWITCH, LIMIT	1
28	.70031	ACTUATOR, ARM	1
29	.2806	RELIEF, STRAIN	1
30	.61916	SCREW, CAP	2
31	.63313	WASHER, LOCK	2

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	1A
PAGE	1



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	1A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22700	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	.22694	MACHINING, OUTER BOOM	1
3	..22692	WELDMENT, OUTER BOOM	1
4	..21783	BUSHING, BOOM PIVOT	2
5	.22699	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 2A for Details)	1
6	.22696	PAD, WEAR	2
7	.61806	SCREW, CAP	4
8	.22706	BRACKET, BOOM END	1
9	.60607	SCREW, CAP	6
10	.22710	CLEVIS	1
11	.60910	NUT	2
12	.64301	PIN, COTTER	1
13	.22708	PIN	1
14	.65076	RING, SNAP	2
15	.63301	WASHER, LOCK	4
16	.22703	PIN	4
17	.65082	RING, SNAP	8
18	.22707	LEVER, RETRACTION	1
19	.60367	SCREW, CAP	6
20	.63302	WASHER, LOCK	6
21	.21320	COVER, PLATE	1
22	.60644	SCREW, CAP	4
23	.22586	BRACKET, MOUNTING STATIONARY (L.H.)	1
24	.22585	BRACKET, MOUNTING STATIONARY (R.H.)	1

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

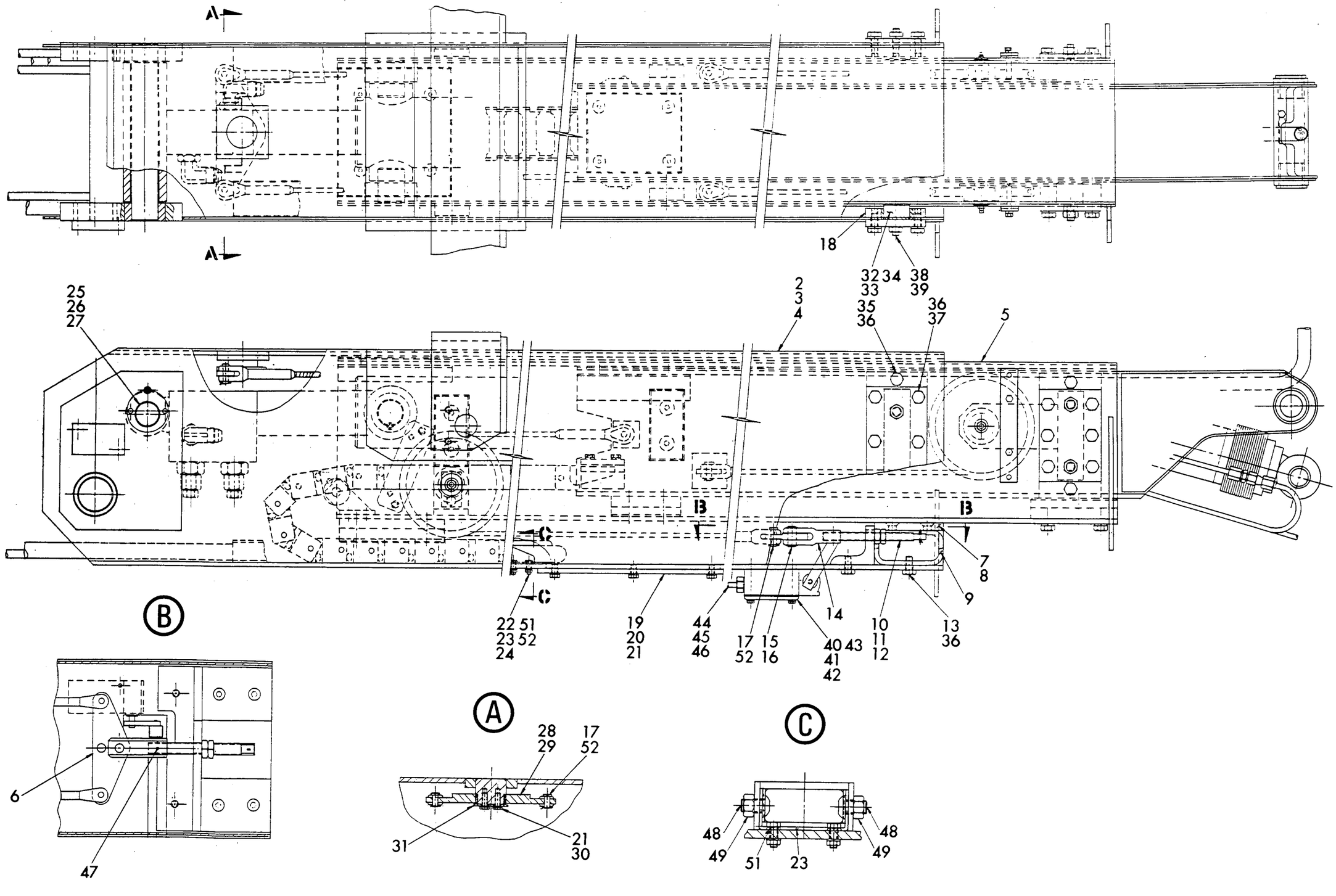
SECT.	5
FIG.	1A
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.21358	RETAINER, WEAR PAD	2
26	.21340	PIN, ANCHOR	1
27	.21353	BUSHING, ECCENTRIC	2
28	.62203	SCREW, SET	2
29	.60701	NUT	8
30	.22709	LEVER, EXTENSION CABLE	1
31	..64915	BUSHING	1
32	.62704	SCREW, MACHINE	2
33	.63313	WASHER, LOCK	2
34	.70148	ARM, LEVER SWITCH	1
35	.60325	SCREW, CAP	16
36	.63303	WASHER, LOCK	16
37	.21321	COVER, PLATE (WEAR PAD)	2
38	.62204	SCREW, SET	4
39	.61101	NUT, HEX	4
40	.20453	PAD, PRESSURE PLATE	2
41	.21315	PAD, WEAR	2
42	.60603	SCREW, CAP	2
43	.22593	RETAINER	1
44	.2806	RELIEF, STRAIN	1
45	.2768-385	CABLE, ELECTRICAL	1
46	.70107	SWITCH, LIMIT	1
47	.64301	PIN, COTTER	1

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	1B
PAGE	1



Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	1B
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	23062	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	.23055	MACHINING, OUTER BOOM	1
3	..23054	WELDMENT, OUTER BOOM	1
4	..21783	BUSHING	2
5	.23063	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 2B for Details)	1
6	.23210	LEVER, RETRACTION CABLE	1
7	.23208	PAD, WEAR	2
8	.61801	SCREW, CAP	4
9	.23212	BRACKET, BOOM END	1
10	.22594	SLEEVE, THREADED	1
11	.60801	NUT, HEX	2
12	.64301	PIN, COTTER	1
13	.60542	SCREW, CAP	4
14	.23269	TERMINAL, CABLE	1
15	.22548	PIN	1
16	.65081	RING, SNAP	2
17	.23544	PIN, CLEVIS	4
18	.21358	RETAINER, WEAR PAD	2
19	.21320	COVER, PLATE	1
20	.60367	SCREW, CAP	6
21	.63302	WASHER, LOCK	8
22	.60644	SCREW, CAP	4
23	.23894	BRACKET, STATIONARY	1
24	.63401	WASHER, FLAT	4

Mark Industries

TITLE	FINAL BOOM ASSEMBLY	SECT. 5
MODEL	62 4X2	FIG. 1B
NOTES	SINCE MID 1986	PAGE 3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.23213	PIN, EXTENSION CYLINDER	1
26	.21353	BUSHING, ECCENTRIC	2
27	.62203	SCREW, SET	2
28	.23209	LEVER, EXTENSION CABLE	1
29	..65475	BUSHING	1
30	.60533	SCREW, CAP	2
31	..22593	RETAINER	1
32	.23170	PAD, WEAR	2
33	.20453	PLATE, PAD PRESSURE	2
34	.21321	COVER, PLATE (WEAR PAD)	2
35	.60395	SCREW, CAP	4
36	.63303	WASHER, LOCK	20
37	.60343	SCREW, CAP	12
38	.62204	SCREW, SET	4
39	.61101	NUT, HEX	4
40	.70107	SWITCH, LIMIT	1
41	.62615	SCREW, MACHINE	2
42	.63313	WASHER, LOCK	2
43	.70148	ARM, LEVER SWITCH	1
44	.2806	RELIEF, STRAIN	1
45	.70036-385	CABLE, ELECTRICAL	1 FT
46	..70036	WIRE	32.1 FT
47	.64204	PIN, ROLL	1
48	.61931	SCREW, CAP	2
49	.61322	NUT, LOCK	2

Mark Industries

TITLE	FINAL BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	1B
PAGE	4

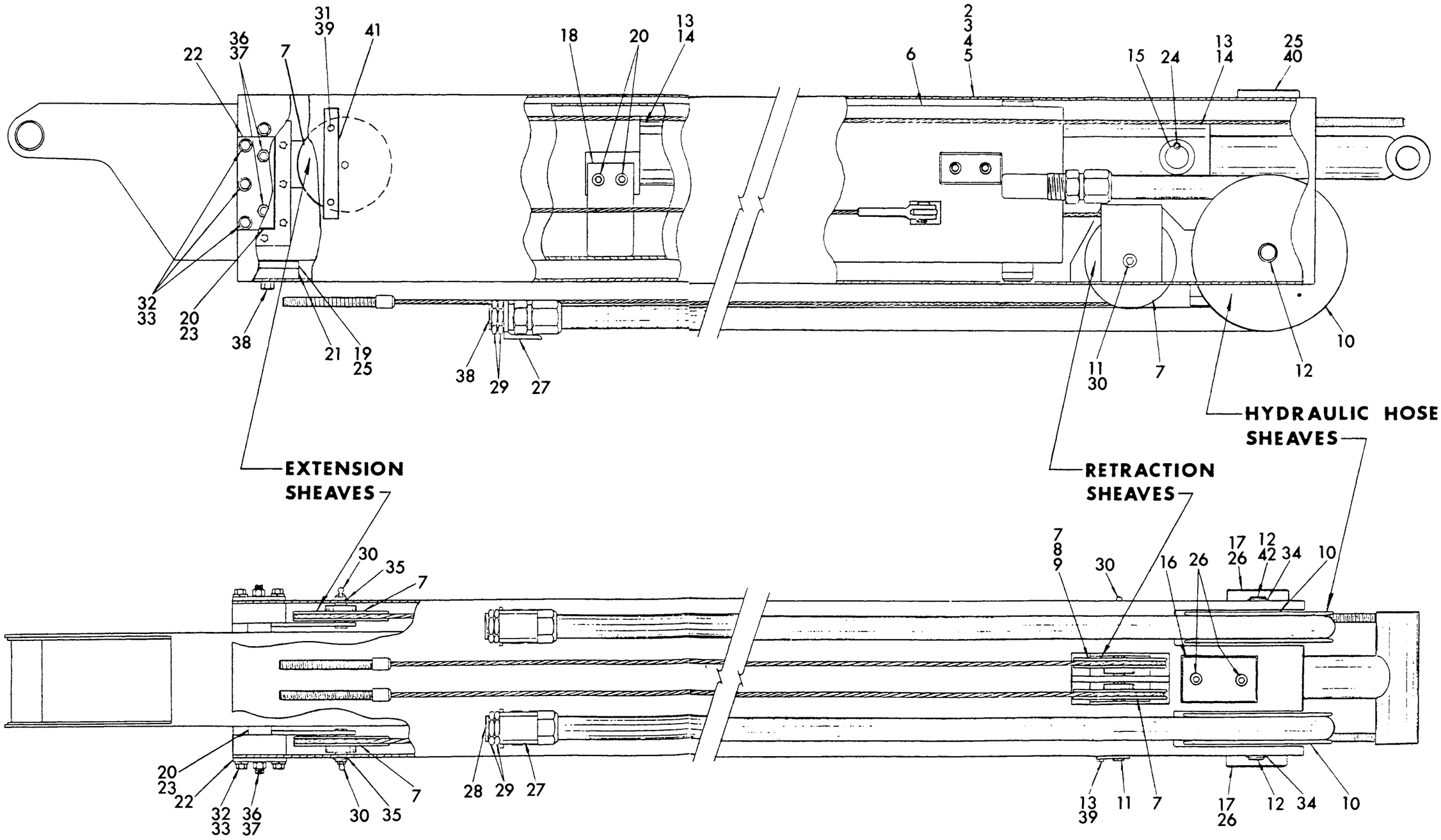
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-50	.60711	NUT, HEX	4
51	.60701	NUT, HEX	4
52	.64302	PIN, COTTER	4

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

Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	5
FIG.	2
PAGE	1



Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	5
FIG.	2
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21053	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 1 for NHA)	REF
2	.21102	MACHINING, INTERMEDIATE BOOM	1
3	..21114	WELDMENT, INTERMEDIATE BOOM	1
4	..60612	SCREW, CAP	4
5	..63303	WASHER, LOCK	4
6	.21054	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 3 for NHA)	1
7	.21303	ASSEMBLY, CABLE SHEAVE	4
8	..65062	BEARING	4
9	..65061	BEARING	4
10	.20247	SHEAVE, HOSE	2
11	.21302	SHEAVE, SHAFT CABLE	1
12	.21300	PIN, HOSE SHEAVE	1
13	.21213	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 5 for Details) (UNTIL LATE 1981)	1
14	.21893	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 5A for Details) (FROM LATE 1981 TO MID 1986)	1
15	.21338	PIN, TRUNNION	2
16	.20284	PAD, WEAR	1
17	.21317	PAD, WEAR	2
18	.21312	PAD, WEAR	2
19	.21391	PAD, WEAR	1
20	.21314	PAD, PRESSURE	2
21	.21343	PLATE, WEAR PAD SUPPORT	1
22	.21321	PLATE, COVER	2

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

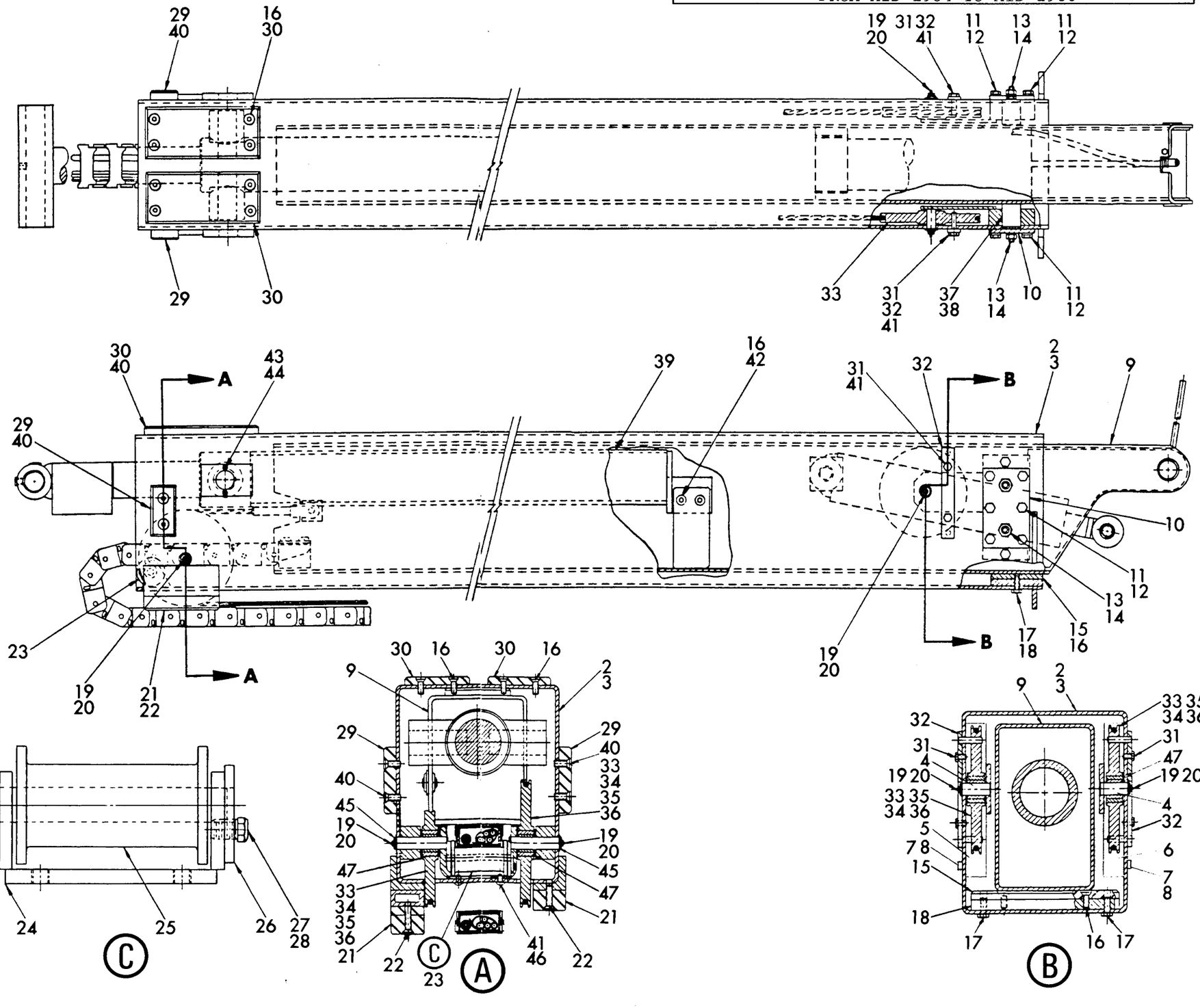
SECT.	5
FIG.	2
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
23	.20453	PLATE, PAD PRESSURE	2
24	.62203	SCREW, SET	2
25	.61801	SCREW, CAP	12
26	.61805	SCREW, CAP	6
27	.20298	BRACKET, RETRACTION HOSE	2
28	.20211	HOSE, ADAPTER	2
29	.80061-11	NUT, LOCK	4
30	.65103	FITTING, GREASE	3
31	.60627	SCREW, CAP	5
32	.60307	SCREW, CAP	12
33	.63303	WASHER, LOCK	12
34	.65075	RING, SNAP	2
35	.65076	RING, SNAP	2
36	.62204	SCREW, SET	4
37	.61101	NUT, HEX	4
38	.60613	SCREW, CAP	2
39	.63302	WASHER, LOCK	5
40	.21316	PAD, WEAR	2
41	.21287	WELDMENT, CABLE KEEPER	2
42	.25397	TUBE, ROUND	2

Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	2A
PAGE	1



Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	2A
PAGE	2

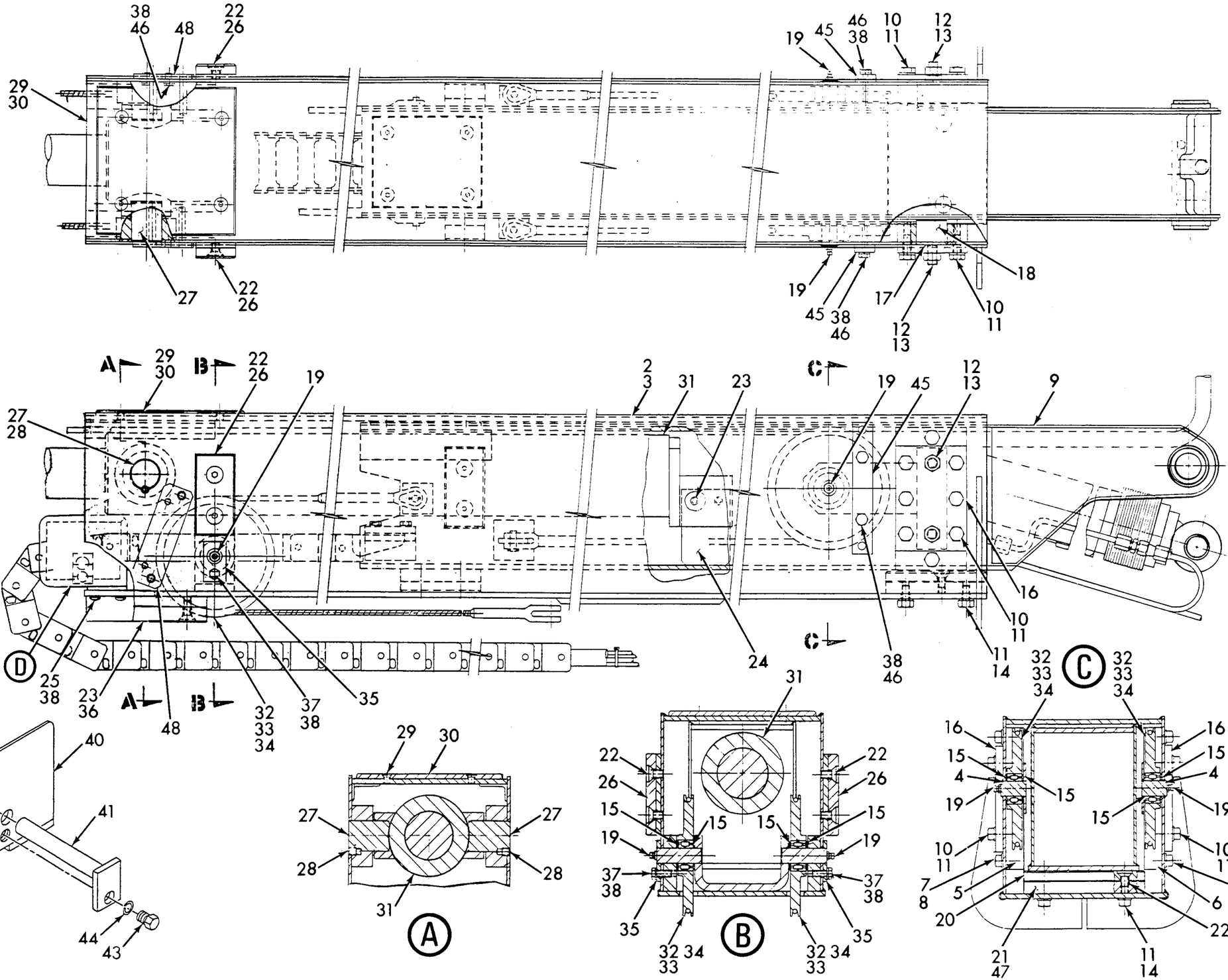
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22699	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 1A for NHA)	REF
2	.22689	MACHINING, INTERMEDIATE BOOM	1
3	..22688	WELDMENT, INTERMEDIATE BOOM	1
4	..21301	PIN, EXTENSION SHEAVE	2
5	..22691	BRACKET, SIDE WEAR PAD (L.H.)	1
6	..22690	BRACKET, SIDE WEAR PAD (R.H.)	1
7	..60612	SCREW, CAP	4
8	..63303	WASHER, LOCK	4
9	.22698	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 3A for Details)	1
10	.21321	PLATE, COVER (WEAR PAD)	2
11	.60307	SCREW, CAP	12
12	.63303	WASHER, LOCK	12
13	.61101	NUT, HEX	4
14	.62204	SCREW, SET	4
15	.21391	PAD, WEAR	1
16	.61801	SCREW, CAP	16
17	.60613	SCREW, CAP	2
18	.21343	PLATE, SUPPORT (WEAR PAD)	1
19	.65103	FITTING, GREASE	4
20	.65076	RING, SNAP	6
21	.22697	PAD, WEAR	2
22	.61802	SCREW, CAP	4
23	.22704	ASSEMBLY, PLASTITRAK SUPPORT ROLLER	1
24	..22715	WELDMENT, BRACKET	1

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	..22717	ROLLER, PLASTITRAK	1
26	..22716	PIN, ROLLER PLASTITRAK	1
27	..60527	SCREW, CAP	1
28	..63302	WASHER, LOCK	1
29	.21317	PAD, WEAR	2
30	.21316	PAD, WEAR	2
31	.60527	SCREW, CAP	4
32	.21287	WELDMENT, CABLE KEEPER	2
33	.22705	ASSEMBLY, CABLE SHEAVE	4
34	..25910	PLATE	4
35	..65062	BEARING	4
36	..65061	BEARING	4
37	.21314	PAD, PRESSURE	2
38	.20453	PLATE, PAD PRESSURE	2
39	.21893	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 5A for Details) (FROM LATE 1981 UNTIL MID 1986)	1
40	.61805	SCREW, CAP	4
41	.63302	WASHER, LOCK	8
42	.21312	PAD, WEAR	2
43	.21338	PIN, TRUNNION	2
44	.62203	SCREW, SET	2
45	.22729	PIN, SHEAVE	2
46	.61931	SCREW, CAP	4
47	.65534	WASHER, THRUST	8

Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	2B
PAGE	1



Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	2B
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	23063	ASSEMBLY, INTERMEDIATE BOOM (See Sect. 5, Fig. 1B for NHA)	REF
2	.23058	MACHINING, INTERMEDIATE BOOM	1
3	..23057	WELDMENT, INTERMEDIATE BOOM	1
4	..23014	PIN, EXTENSION SHEAVE	2
5	..23116	BRACKET, SIDE WEAR PAD (L.H.)	1
6	..23117	BRACKET, SIDE WEAR PAD (R.H.)	1
7	..60539	SCREW, CAP	4
8	..63303	WASHER, LOCK	4
9	.23064	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 3B for Details)	1
10	.60541	SCREW, CAP	12
11	.63303	WASHER, LOCK	16
12	.61101	NUT, HEX	4
13	.62204	SCREW, SET	4
14	.60325	SCREW, CAP	4
15	.65534	WASHER, THRUST	8
16	.21321	COVER, PLATE (WEAR PAD)	2
17	.20453	PLATE, PAD PRESSURE	2
18	.23200	PAD, WEAR	2
19	.65103	FITTING, GREASE	4
20	.23206	PAD, WEAR	1
21	.23207	SUPPORT, WEAR PAD	1
22	.61801	SCREW, CAP	6
23	.61805	SCREW, CAP	8
24	.23201	PAD, WEAR	2

Mark Industries

TITLE	INTERMEDIATE BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

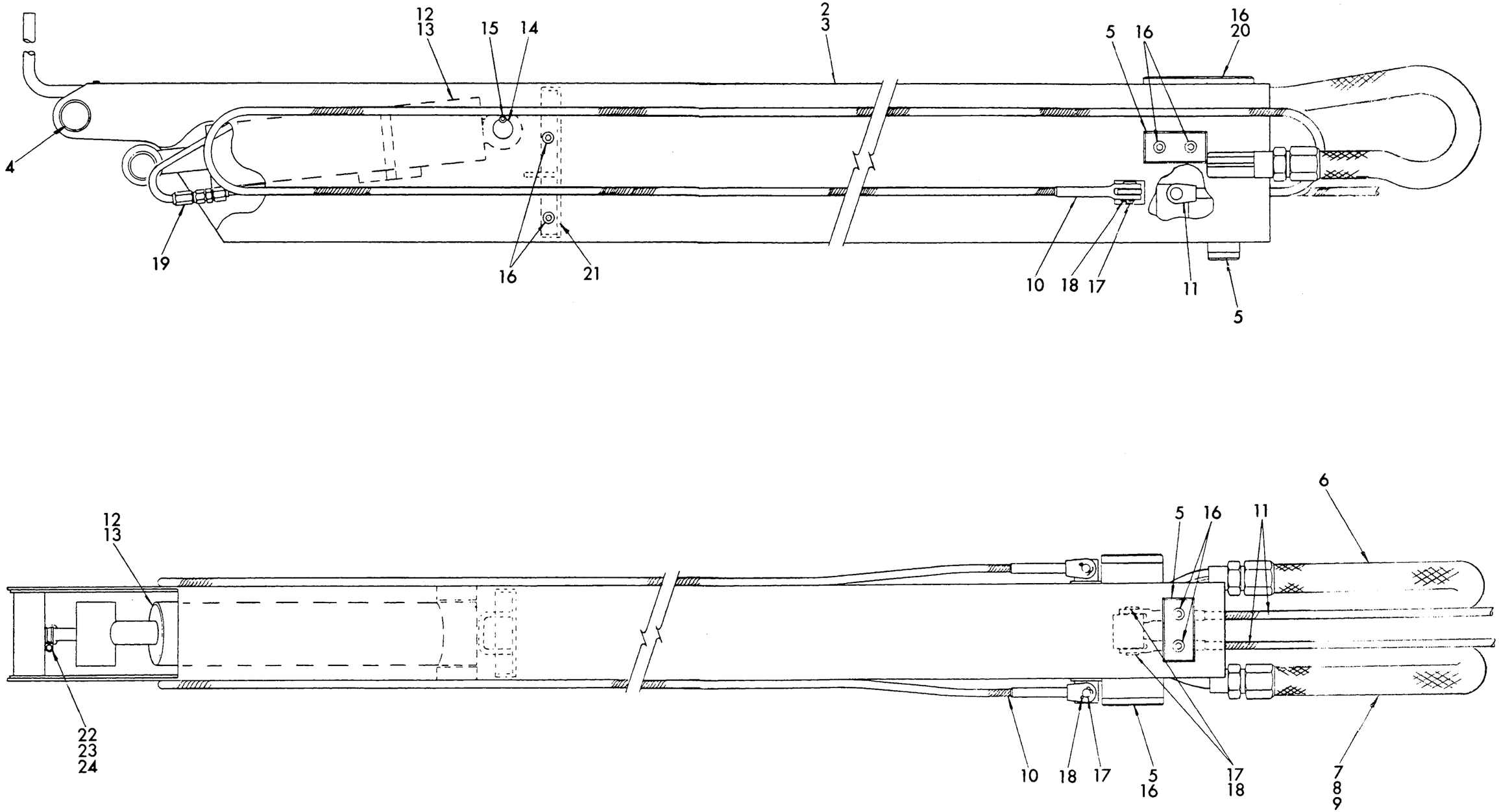
SECT.	5
FIG.	2B
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.61931	SCREW, CAP	4
26	.22567	PAD, WEAR	2
27	.23211	PIN, TRUNNION	2
28	.62203	SCREW, SET	2
29	.61822	SCREW, CAP	4
30	.23204	PAD, WEAR	1
31	.23188	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 5B for Details) (SINCE MID 1986)	1
32	.23543	ASSEMBLY, CABLE SHEAVE	4
33	..65064	ASSEMBLY, OUTER RING & ROLLER	4
34	..65063	RING, INNER	4
35	.23144	PIN, CABLE SHEAVE	2
36	.23202	PAD, WEAR	2
37	.60553	SCREW, CAP	2
38	.63302	WASHER, LOCK	14
39	.24510	ASSEMBLY, SUPPORT ROLLER PLASTITRAK	1
40	..24509	WELDMENT, ROLLER BRACKET	1
41	..22716	PIN, ROLLER PLASTITRAK	1
42	..24508	ROLLER, PLASTITRAK	1
43	..60324	SCREW, CAP	1
44	..63302	WASHER, LOCK	1
45	.23215	WELDMENT, CABLE KEEPER	2
46	.60527	SCREW, CAP	6
47	.23620	SHIM	1
48	.23710	KEEPER, CABLE	2

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

SECT.	5
FIG.	3
PAGE	1



Mark Industries

TITLE	INNER BOOM ASSEMBLY	SECT. 5
MODEL	62 4X2	FIG. 3
NOTES	UNTIL LATE 1984	PAGE 2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21054	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2 for NHA)	REF
-2	.21103	MACHINING, INNER BOOM	1
3	..21115	WELDMENT, INNER BOOM	1
4	..20582	BUSHING	2
5	.21313	PAD, WEAR	3
6	.21081	ASSEMBLY, HYDRAULIC HOSE	1
7	.21080	ASSEMBLY, CONTROL CABLE	1
8	..21324	HOUSING, RETRACTION	1
9	..20802	CABLE, 40 CONDUCTOR	95 FT
10	.21323	ASSEMBLY, EXTENSION CABLE	2
11	.21322	ASSEMBLY, RETRACTION CABLE	2
12	.21079	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 4 for Details) (UNTIL MID 1981)	1
13	.21094	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 4A for Details) (SINCE MID 1981)	1
14	.20262	PIN, LEVELING CYLINDER	1
15	.62203	SCREW, SET	2
16	.61801	SCREW, CAP	14
17	.21318	PIN, CLEVIS	4
18	.64302	PIN, COTTER	4
19	.2562	FITTING, STRAIGHT SWIVEL	2
20	.21391	PAD, WEAR (INNER & INTERMEDIATE)	1
21	.21350	PLATE, BULKHEAD	1
22	.16268	CLAMP, HOSE	1

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1984

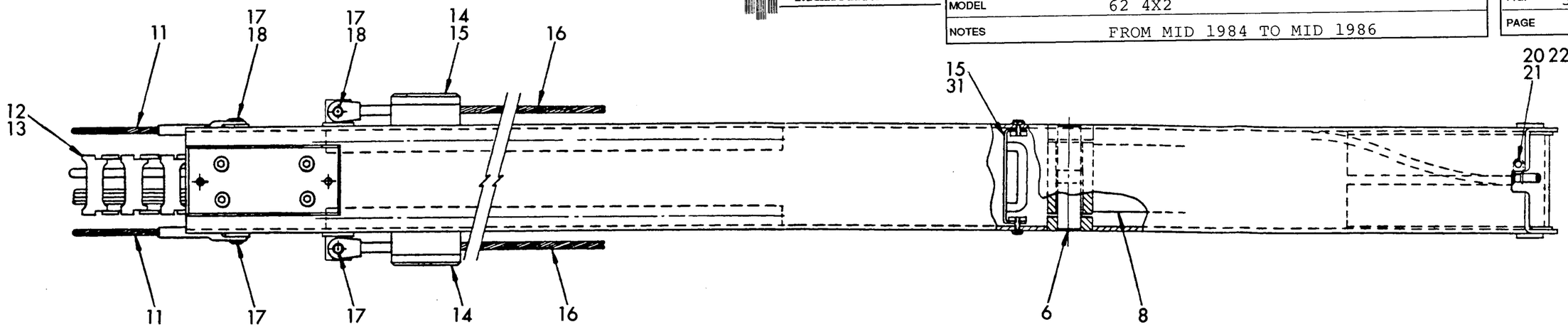
SECT.	5
FIG.	3
PAGE	3

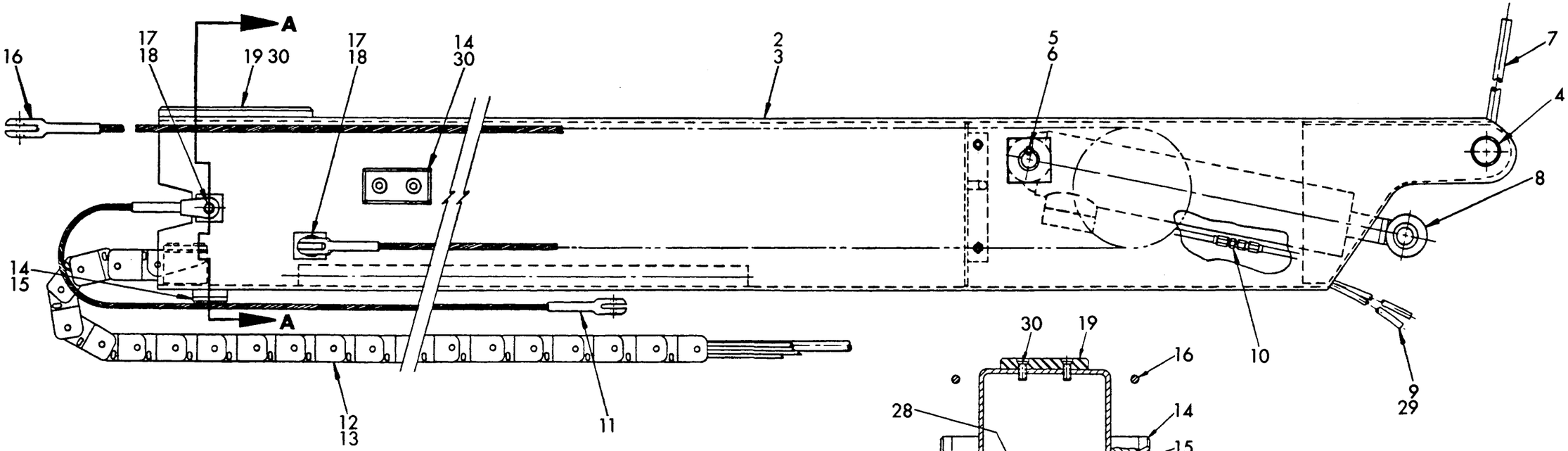
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
23	.60309	SCREW, CAP	1
24	.60701	NUT, HEX	1

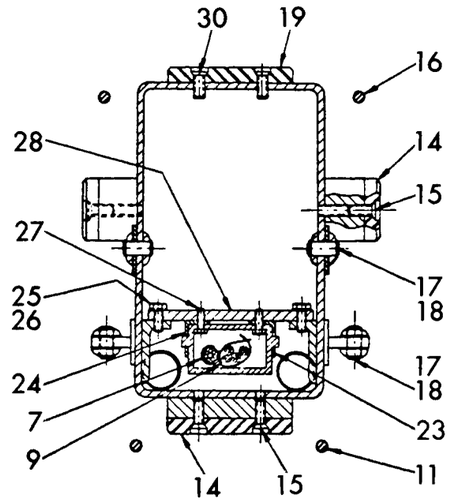
Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	3A
PAGE	1







Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

SECT.	5
FIG.	3A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22698	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2A for NHA)	REF
2	.22687	MACHINING, INNER BOOM	1
3	..22685	WELDMENT, INNER BOOM	1
4	..20582	BUSHING	2
5	.62203	SCREW, SET	1
6	.20262	PIN, LEVELING CYLINDER	1
7	.20802	CABLE, 40 CONDUCTOR	1 FT
8	.21094	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 4A for Details) (SINCE MID 1981)	1
9	.2568	HOSE	2 FT
10	.2562	FITTING, SWIVEL	2
11	.22701	CABLE, RETRACTION	2
12	.22695	ASSEMBLY, AMRK TRACK	1
13	..21933	TRACK, MARK	119
14	.21313	PAD, WEAR	3
15	.61801	SCREW, CAP	10
16	.22702	CABLE, EXTENSION	2
17	.22703	PIN, MARKLIFT	4
18	.65082	RING, SNAP	8
19	.21391	PAD, WEAR	1
20	.60309	SCREW, CAP	1
21	.60711	NUT, HEX	1
22	.16268	CLAMP, HOSE	1
23	.22588	BRACKET, MOUNTING MOVABLE (L.H.)	1
24	.22587	BRACKET, MOUNTING MOVABLE (R.H.)	1

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	FROM MID 1984 TO MID 1986

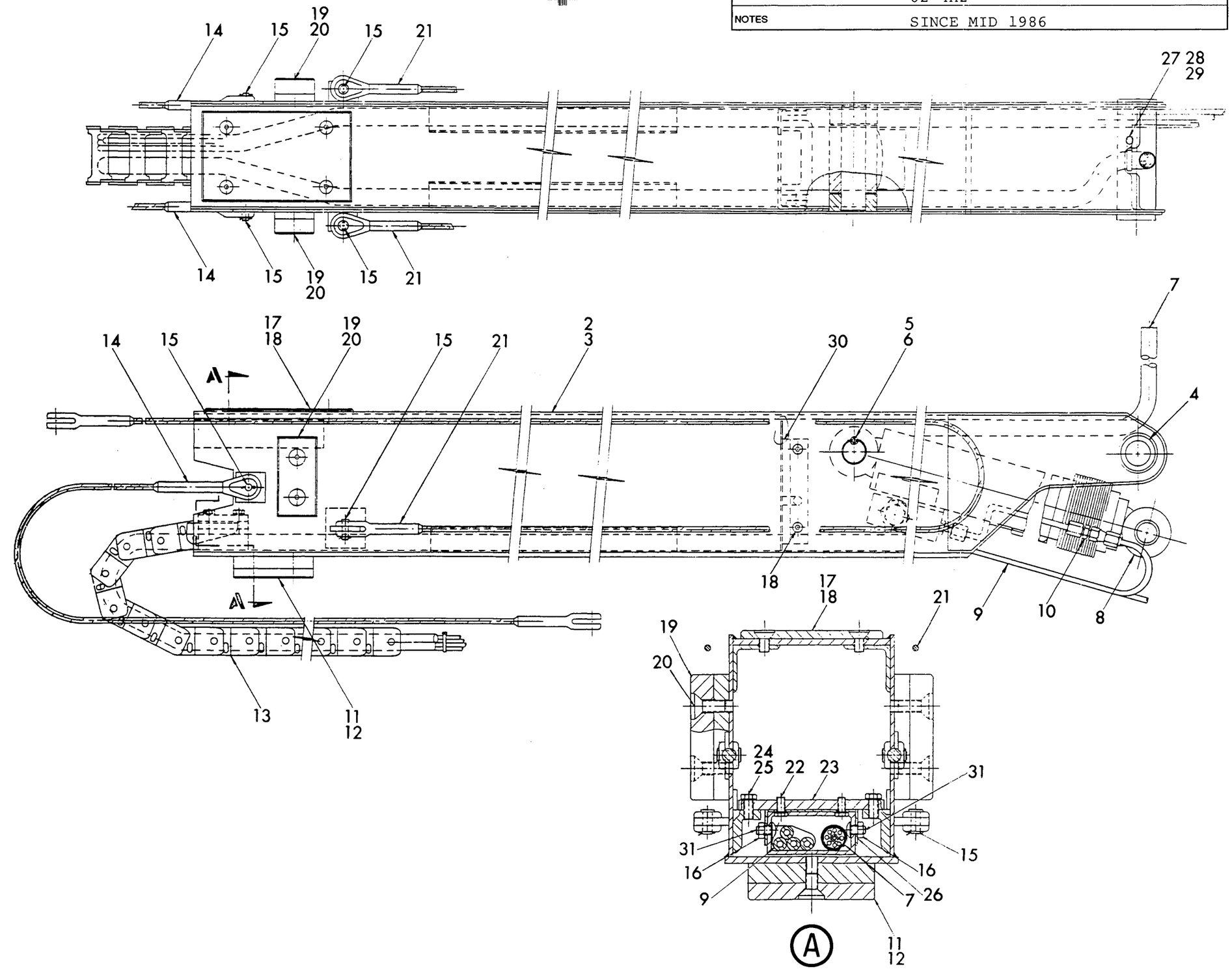
SECT.	5
FIG.	3A
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.60322	SCREW, CAP	4
26	.63302	WASHER, LOCK	4
27	.60633	SCREW, CAP	4
28	.22730	PLATE, MOUNTING PLASTITRAK	1
29	.2568	HOSE	2 FT
30	.61811	SCREW, CAP	4
31	.21350	PLATE, BULKHEAD	1

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	3B
PAGE	1



Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	3B
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	23064	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2B for NHA)	REF
2	.23061	MACHINING, INNER BOOM	1
3	..23060	WELDMENT, INNER BOOM	1
4	..20582	BUSHING	2
5	.62203	SCREW, SET	1
6	.23218	PIN, SLAVE LEVELING CYLINDER	1
7	.70528	CABLE, 40 CONDUCTOR	85 FT
8	.21094	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 4A for Details) (SINCE MID 1981)	1
9	.2568	HOSE, HYDRAULIC	4
10	.2562	FITTING, STRAIGHT SWIVEL	2
11	.23083	PAD, WEAR	1
12	.61827	SCREW, CAP	2
13	.23824	TRACK, POWER	119
14	.23217	CABLE, RETRACTION	2
15	.23544	PIN, CLEVIS	4
16	.61322	NUT, LOCK	2
17	.23203	PAD, WEAR	1
18	.61822	SCREW, CAP	8
19	.22569	PAD, WEAR	2
20	.61805	SCREW, CAP	4
21	.23216	CABLE, EXTENSION	2
22	.60543	SCREW, CAP	4
23	.22730	PLATE, MOUNTING PLASTITRAK	1
24	.60322	SCREW, CAP	4

Mark Industries

TITLE	INNER BOOM ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECT.	5
FIG.	3B
PAGE	2

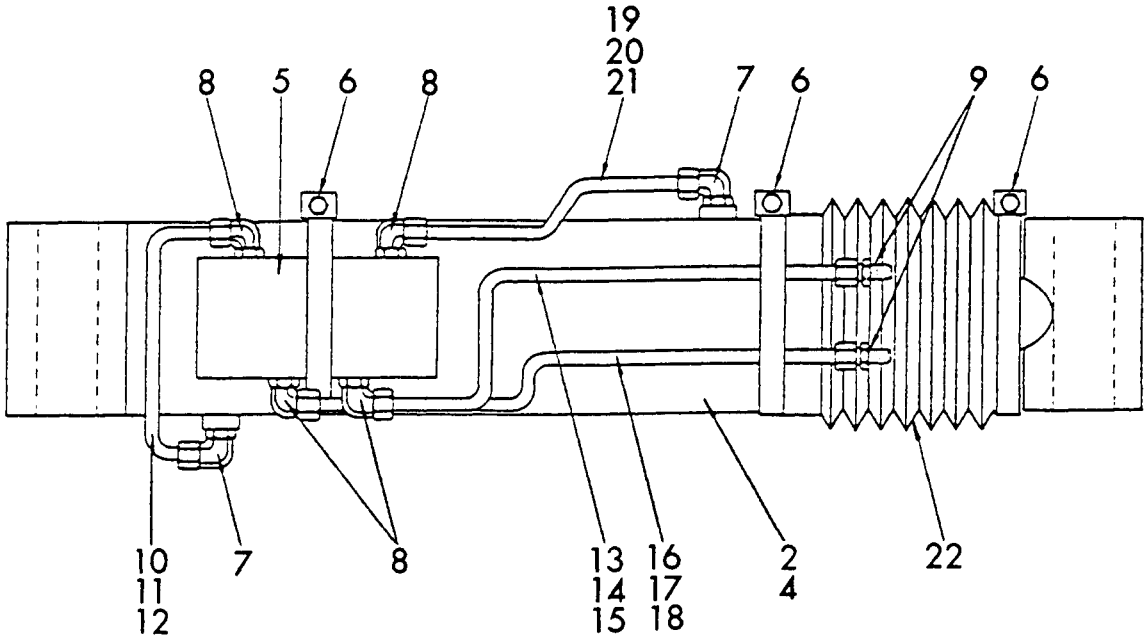
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.63302	WASHER, LOCK	4
26	.23895	BRACKET, MOVABLE PLASTITRAK	1
27	.60309	SCREW, CAP	1
28	.60711	NUT, HEX	1
29	.16268	CLAMP, HOSE	1
30	.23214	PLATE, BULKHEAD	1
31	.61931	SCREW, CAP	2

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

Mark Industries

TITLE	SLAVE LEVELING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL MID 1981

SECTION	5
FIGURE	4
PAGE	1



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

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21079	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 3 for NHA)	REF
2	.21110	CYLINDER, SLAVE LEVELING	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
-3	..66045	KIT, SEAL (SE)	1
4	..66468	BUSHING	4
5	.20351	VALVE, PILOT CHECK	1
6	.65111	STRAP	3
7	.80012-03	ELBOW	2
8	.80012-05	ELBOW	4

Mark Industries

TITLE	SLAVE LEVELING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL MID 1981

SECT.	5
FIG.	4
PAGE	2

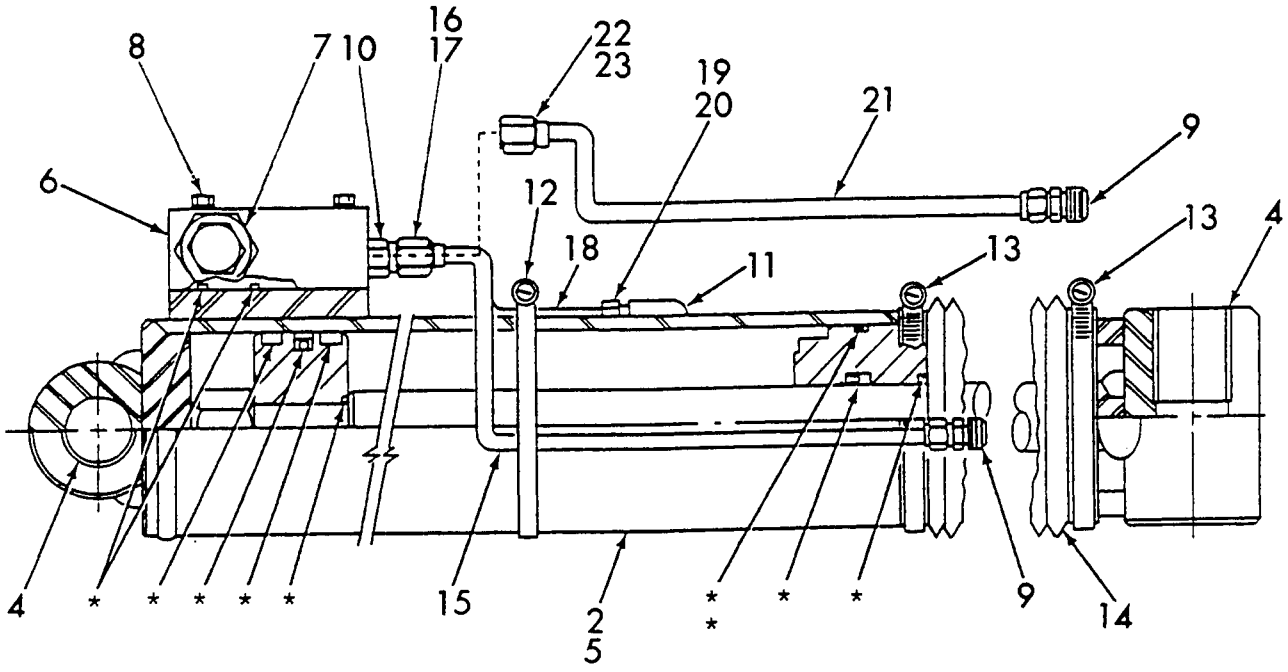
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
9	.80042-03	CONNECTOR	2
10	.20600	ASSEMBLY, TUBE	1
11	..2514	NUT	2
12	..2519	FERRULE	2
13	.20601	ASSEMBLY, TUBE	1
14	..2514	NUT	8
15	..2519	FERRULE	8
16	.20602	ASSEMBLY, TUBE	1
17	..2514	NUT	8
18	..2519	FERRULE	8
19	.20603	ASSEMBLY, TUBE	1
20	..2514	NUT	8
21	..2519	FERRULE	8
22	.21388	TUBING, CONVOLUTED	1

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

Mark Industries

TITLE	SLAVE LEVELING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1981

SECTION	5
FIGURE	4A
PAGE	1



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

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21094	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 3, 3A or 3B for NHA)	REF
2	.21263	SUB-ASSEMBLY, SLAVE LEVELING CYLINDER (SE)	1
-3	..66563	KIT, SEAL (RA: NOT SHOWN)	1
-3	..66045	KIT, SEAL (SE: W/POLYPAKS; NOT SHOWN)	1
-3	..67040	KIT, SEAL (SE: W/STEEL PISTON RINGS; SHOWN)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	..66468	BUSHING (SE ONLY)	1
5	..21197	CYLINDER, SLAVE LEVELING	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	

Mark Industries

TITLE	SLAVE LEVELING CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1981

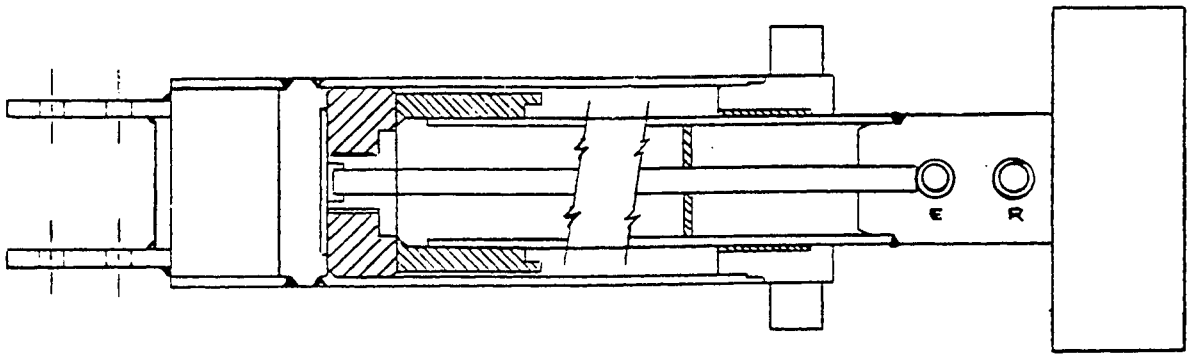
SECT.	5
FIG.	4A
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
6	..21447	MANIFOLD, SLAVE LEVELING CYLINDER	1
7	..21267	CARTRIDGE, OVERCENTER	2
8	..61903	SCREW, CAP	3
9	.80042-03	CONNECTOR, UNION	2
10	.80004-03	CONNECTOR, STRAIGHT THREAD	3
11	.80012-03	ELBOW, STRAIGHT THREAD	1
12	.65111	STRAP	1
13	.16318	CLAMP	2
14	.21388	TUBING, CONVOLUTED	1
15	.21094-8	ASSEMBLY, TUBE	1
16	..80062-03	SLEEVE	2
17	..80060-03	NUT	2
18	.21094-9	ASSEMBLY, TUBE	1
19	..80062-03	SLEEVE	2
20	..80060-03	NUT	2
21	.21094-10	ASSEMBLY, TUBE	1
22	..80062-03	SLEEVE	2
23	..80060-03	NUT	2

Mark Industries

TITLE	BOOM EXTENSION CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	UNTIL LATE 1981

SECTION	5
FIGURE	5
PAGE	1



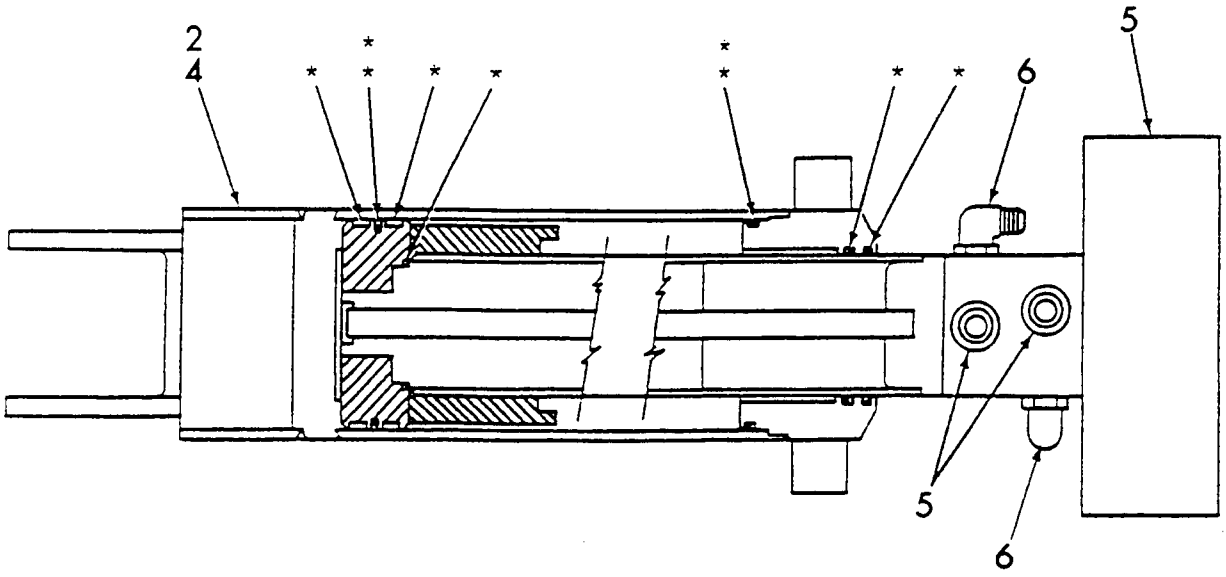
NOTE 1: DUE TO VENDOR/MFG. REVISIONS; WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21213	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 2 for NHA)	REF
-2	.66048	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	

Mark Industries

TITLE	BOOM EXTENSION CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	FROM LATE 1981 TO MID 1986

SECTION	5
FIGURE	5A
PAGE	1



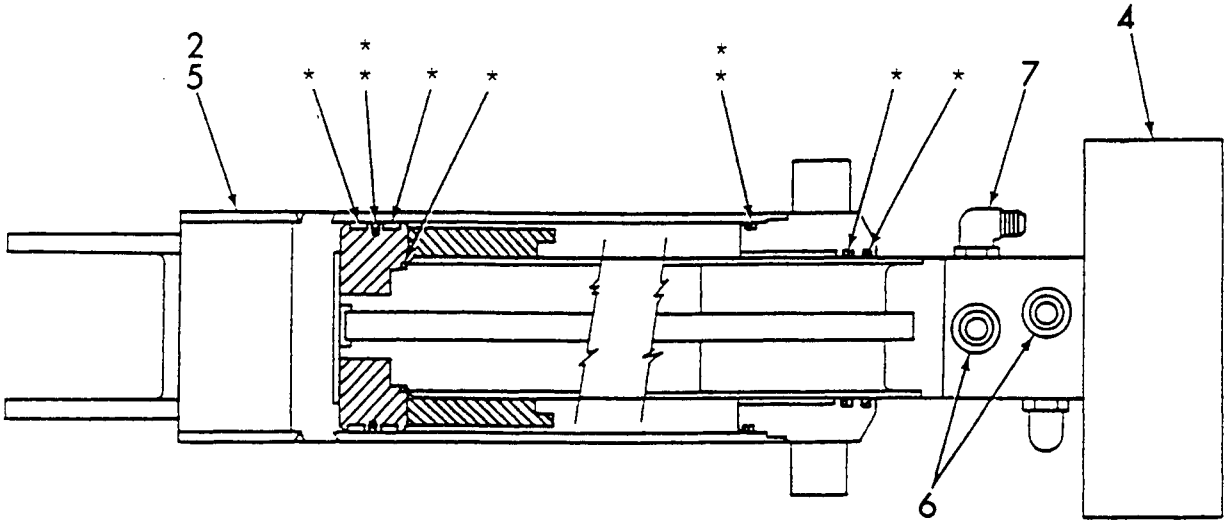
NOTE 1: DUE TO VENDOR/MFG. REVISIONS; WHEN POSSIBLE, PROVIDE ALL NUMBERS FROM THE CYLINDER I.D. TAG.

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21893	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 2A for NHA)	REF
2	.21261	SUB-ASSEMBLY, BOOM EXTENSION CYLINDER (SE)	1
-3	...66363	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	..21892	CYLINDER, BOOM EXTENSION	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS AVAILABLE ON A SPECIAL ORDER BASIS.	
5	..81006	CARTRIDGE, OVERCENTER	2
6	.80012-11	ELBOW, STRAIGHT THREAD	2

Mark Industries

TITLE	BOOM EXTENSION CYLINDER ASSEMBLY
MODEL	62 4X2
NOTES	SINCE MID 1986

SECTION	5
FIGURE	5B
PAGE	1



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

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	23188	ASSEMBLY, BOOM EXTENSION CYLINDER (See Sect. 5, Fig. 2B for NHA)	REF
2	.23189	SUB-ASSEMBLY, BOOM EXTENSION CYLINDER (SE)	1
-3	...66363	KIT, SEAL (SE)	1
		NOTE 3: THE SEAL KIT INCLUDES ITEMS SHOWN WITH AN ASTERISK (*).	
4	...67948	BUSHING	2
5	..23190	CYLINDER, BOOM EXTENSION	1
		NOTE 2: INTERNAL SERVICE REPLACEMENT PARTS ABAILABLE ON A SPECIAL ORDER BASIS.	
6	..81006	CARTRIDGE, OVERCENTER	2
7	.80012-11	ELBOW, STRAIGHT THREAD	2

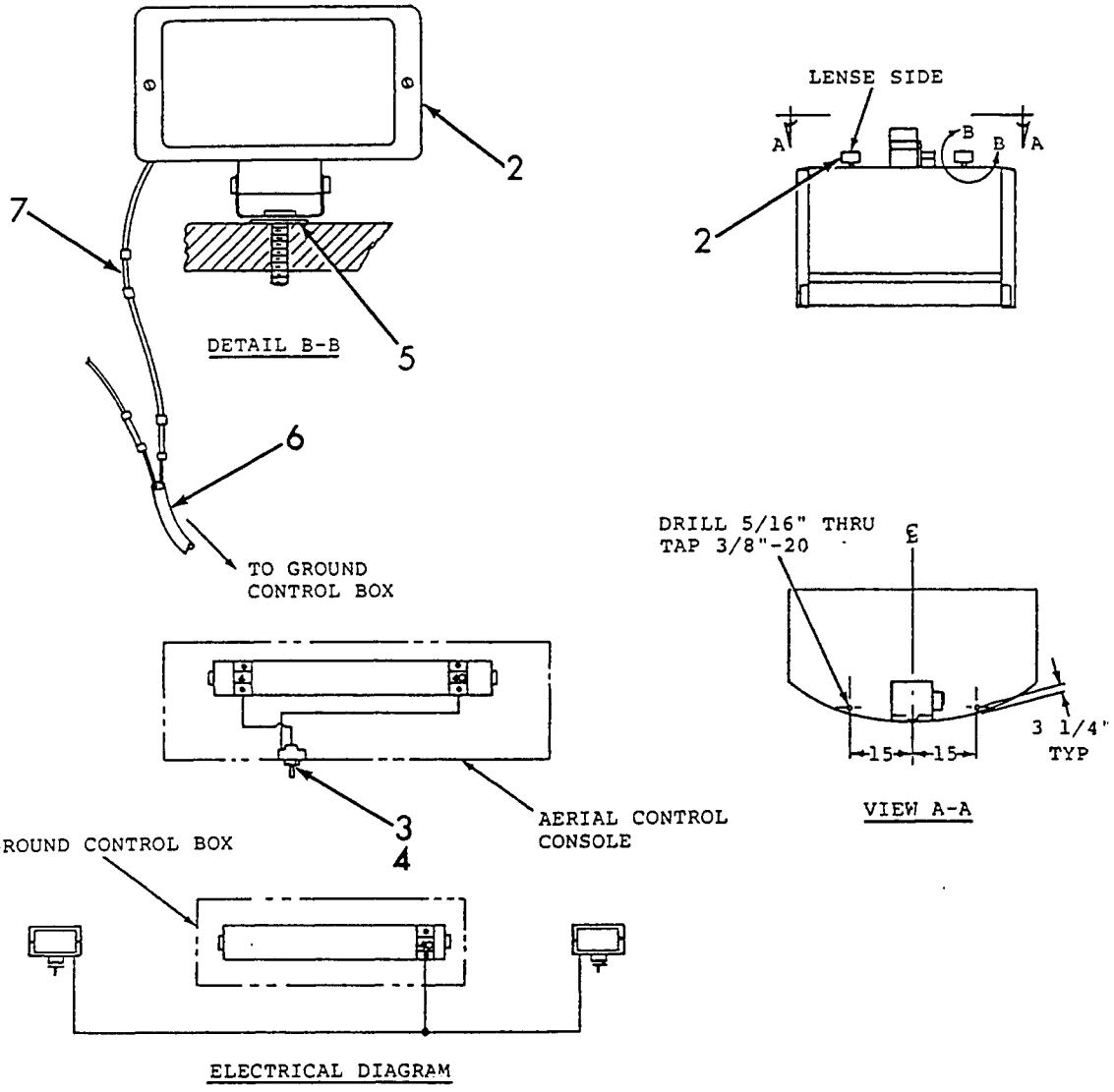
SECTION 6 CONTAINS:

FIG. NO.	TITLE	PART NO.
1	HEADLIGHTS OPTION	20078
2	CLEARANCE, STOP, & TURNING LIGHTS OPTION	20079
3	TOWING KIT OPTION	20081
4	RAISED PLATFORM ROTATION OPTION (TOP MOUNT)	20097
5	MINIPAK SUB-ASSEMBLY (PART OF PLATFORM ROTATION OPTION)	21713
6	110 VAC RECEPTACLE OPTION (GROUND & AERIAL CONSOLES)	20104
7	ROTATING AMBER BEACON OPTION	20107
8	12 VDC PLATFORM WORKLIGHT OPTION	20139
9	2.5 KW GENERATOR OPTION (WISCONSIN VG4D)	20159
10	DUAL FUEL OPTION (WISCONSIN VG4D)	20163
11	PLATFORM ROTATION ASSEMBLY OPTION (FRONT MOUNT)	22841
12	PLATFORM ROTATION ASSEMBLY OPTION (TOP MOUNT)	22847

Mark Industries

TITLE	HEADLIGHTS OPTION
MODEL	62 4X2
NOTES	

SECTION	6
FIGURE	1
PAGE	1



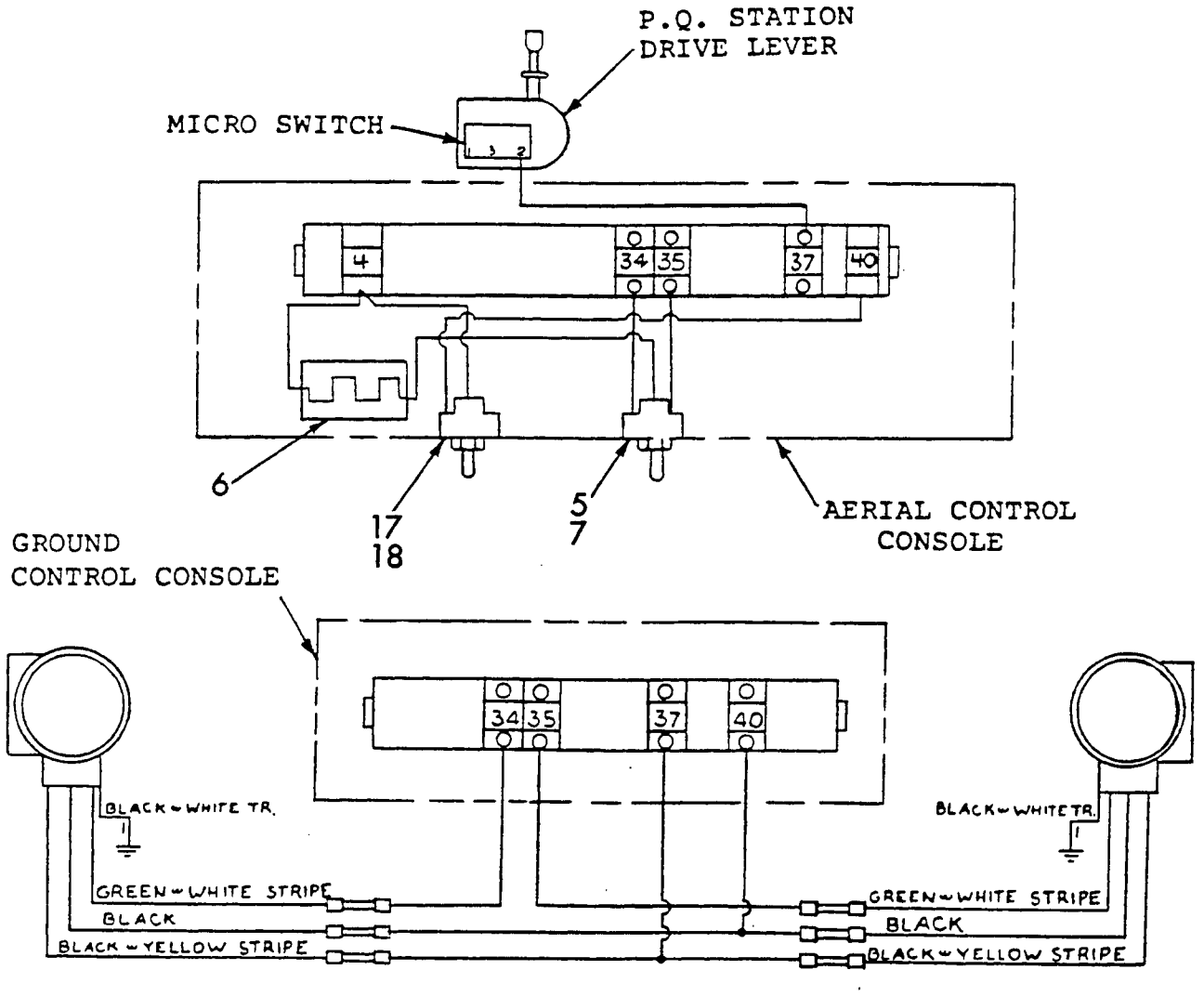
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20078	OPTION, HEADLIGHTS	REF
2	.20971	HEADLIGHT	2
3	.4017	SWITCH, TOGGLE	1
4	.20509	DECAL, LIGHTS	1
5	.63403	WASHER, FLAT	1
6	.2991	WIRE, WHITE	6 FT
7	.117-D	CONNECTOR, BUTT	4

REV

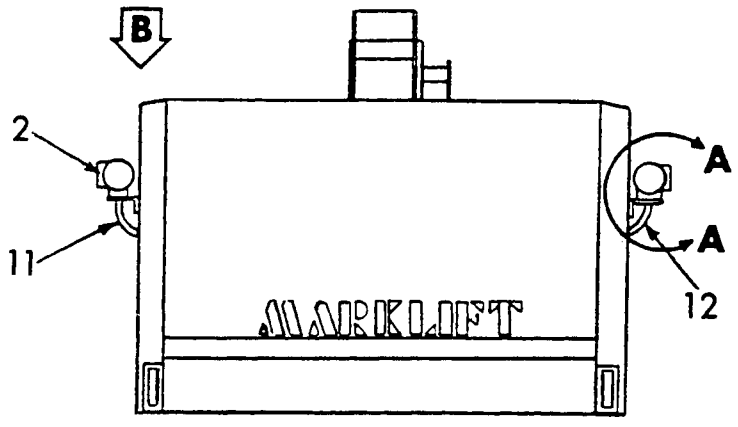
Mark Industries

TITLE	CLEARANCE, STOP, & TURNING LIGHTS OPTION
MODEL	62 4X2
NOTES	WITH ON/OFF SWITCH

SECT.	6
FIG.	2
PAGE	1



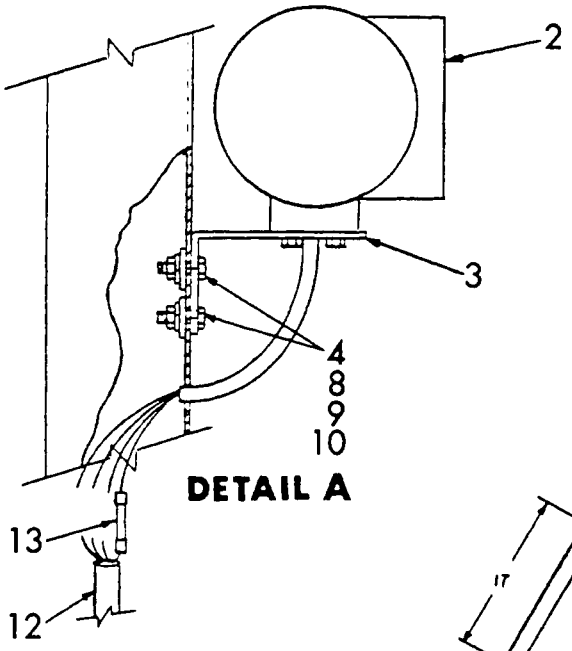
ELECTRICAL DIAGRAM



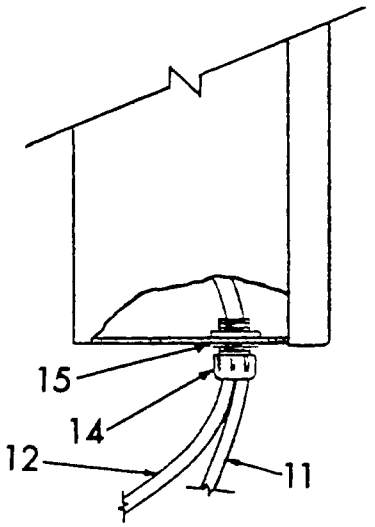
Mark Industries

TITLE	CLEARANCE, STOP, & TURNING LIGHTS OPTION
MODEL	62 4X2
NOTES	WITH ON/OFF SWITCH

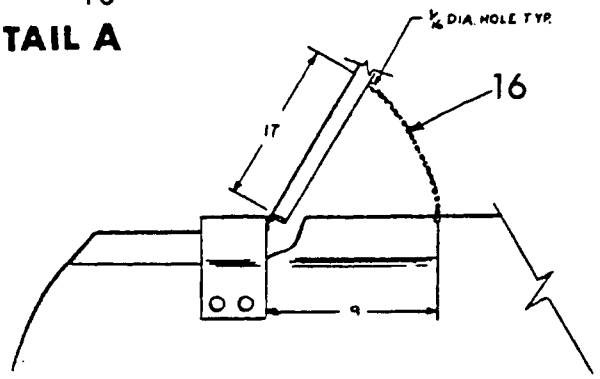
SECT.	6
FIG.	2
PAGE	2



DETAIL A



GROUND CONTROL BOX



VIEW B

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20079	OPTION, CLEARANCE, STOP, & TURNING LIGHTS	REF
2	.20838	LIGHT, CLEARANCE	2
3	.20864	BRACKET, CLEARANCE LIGHTS MOUNTING	2
4	.63403	WASHER, FLAT	4
5	.4019	SWITCH	1
6	.448-A	FLASHER, 12 VOLT	1
7	.20866	DECAL, TURN INDICATOR	1
8	.60331	SCREW, CAP	4
9	.60703	NUT, HEX	4
10	.63303	WASHER, LOCK	4

REV.

Mark Industries

TITLE	CLEARANCE, STOP, & TURNING LIGHTS OPTION
MODEL	62 4X2
NOTES	WITH ON/OFF SWITCH

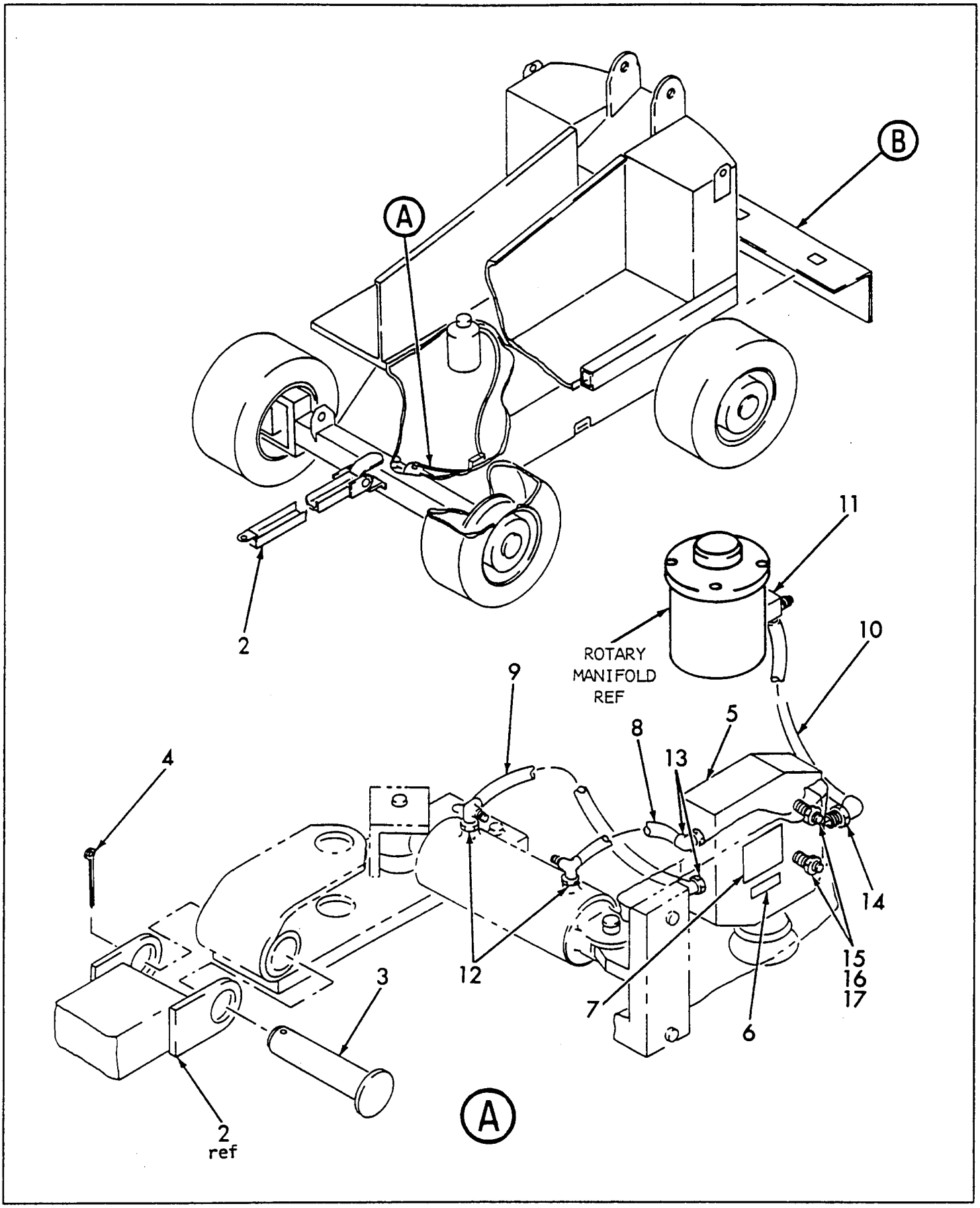
SECT.	6
FIG.	2
PAGE	3

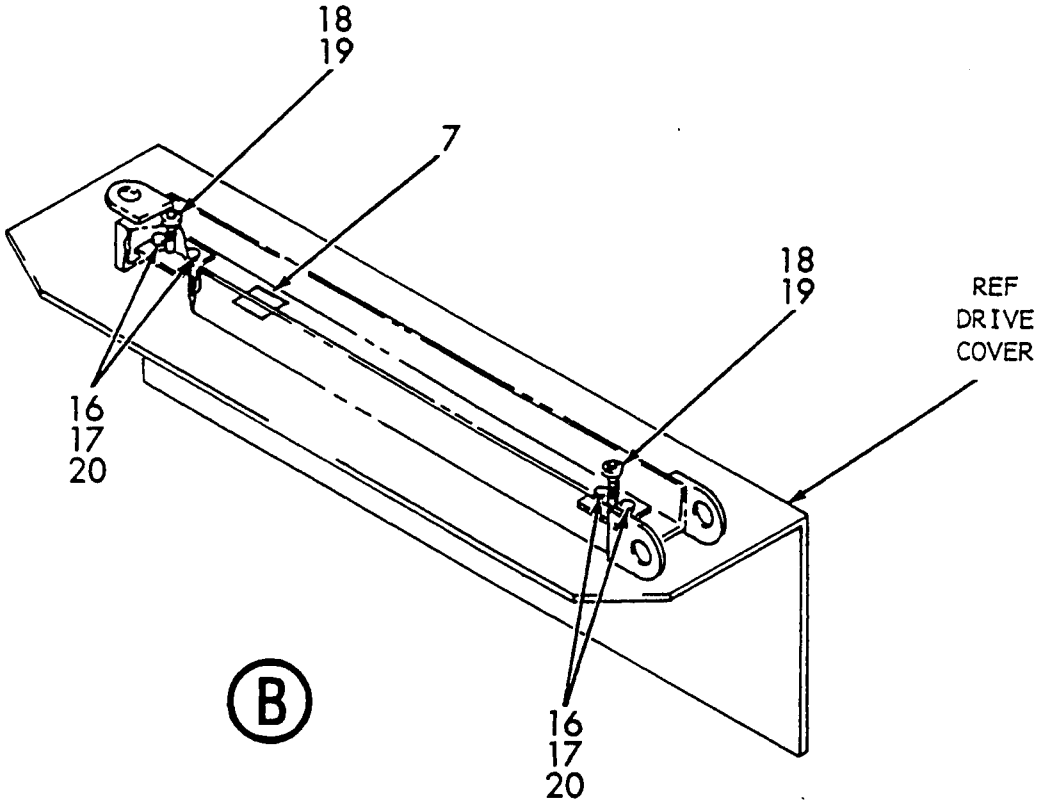
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
11	.2912	CABLE, CONDUCTOR (18 AWG)	2 FT
12	.2912	CABLE, CONDUCTOR (18 AWG)	10 FT
13	.117-D	CONNECTOR, BUTT	8
14	.2806	RELIEF, STRAIN	2
15	.2808	NUT, LOCK	2
16	.3-B	CHAIN	AR
17	.4017	SWITCH, TOGGLE	1
18	.20509	DECAL, LIGHTS	1

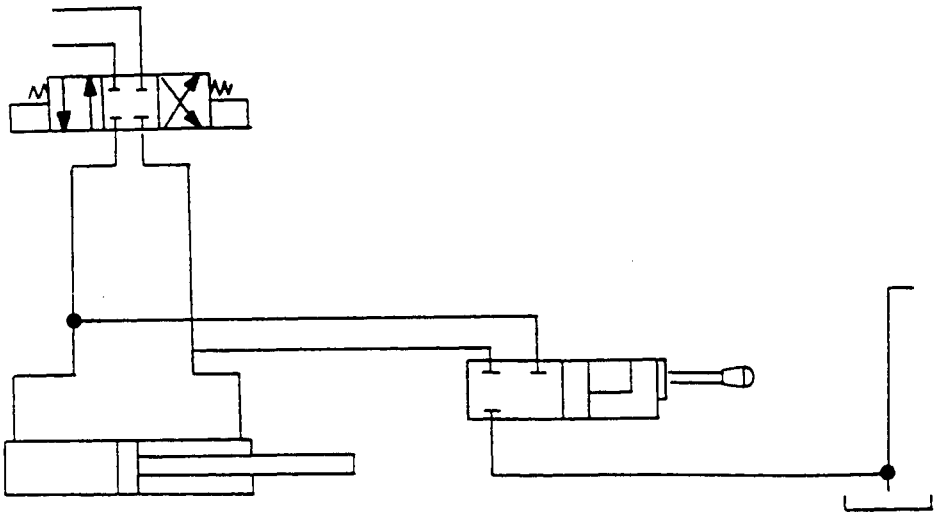
Mark Industries

TITLE	TOWING KIT OPTION
MODEL	62 4X2
NOTES	

SECTION	6
FIGURE	3
PAGE	1







HYDRAULIC SCHEMATIC

Mark Industries

TITLE	TOWING KIT OPTION
MODEL	62 4X2
NOTES	

SECT.	6
FIG.	3
PAGE	3

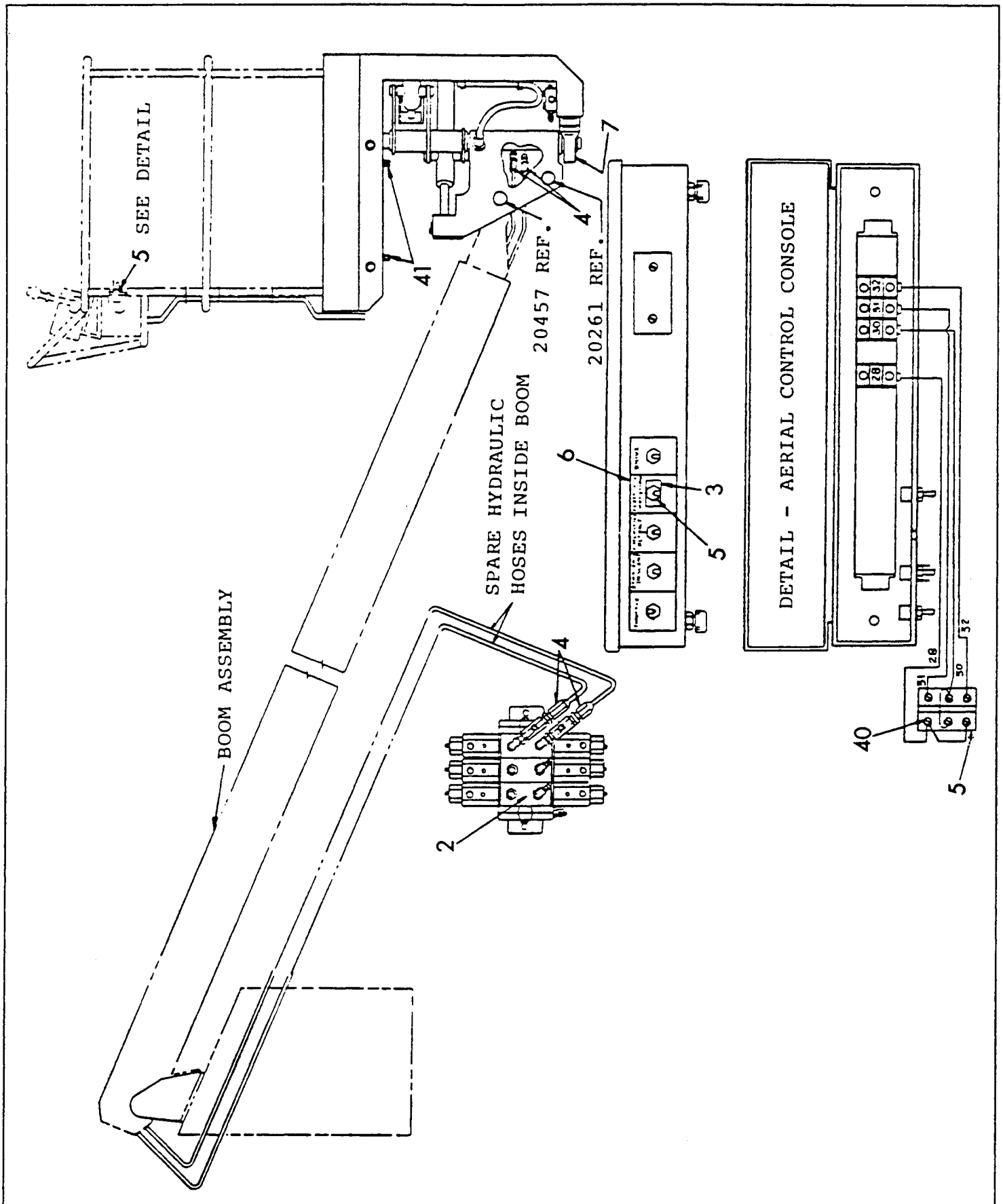
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20081	OPTION, TOWING KIT	REF
2	.20425	BAR, DRAW (TOW)	1
3	.20426	PIN	1
4	.64314	PIN, COTTER	1
5	.20799	VALVE, BYPASS	1
6	.20492	DECAL, STEER OVERRIDE VALVE	1
7	.20491	DECAL, TOWING INSTRUCTIONS	2
8	.13210-04-0220	ASSEMBLY, HOSE	1
9	.13210-04-0300	ASSEMBLY, HOSE	1
10	.13210-06-0800	ASSEMBLY, HOSE	1
11	.2425	TEE, MALE	1
12	.53200	TEE, STRAIGHT THREAD	2
13	.2584	ELBOW, MALE	2
14	.2443	ELBOW, MALE	1
15	.60317	SCREW, CAP	2
16	.60703	NUT, HEX	6
17	.63303	WASHER, LOCK	6
18	.20837	STUD, FLANGED	2
19	.60705	NUT, HEX	2
20	.60343	SCREW, CAP	4

DASH (-) INDICATES THE ITEM IS NOT ILLUSTRATED

Mark Industries

TITLE	RAISED PLATFORM ROTATION OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

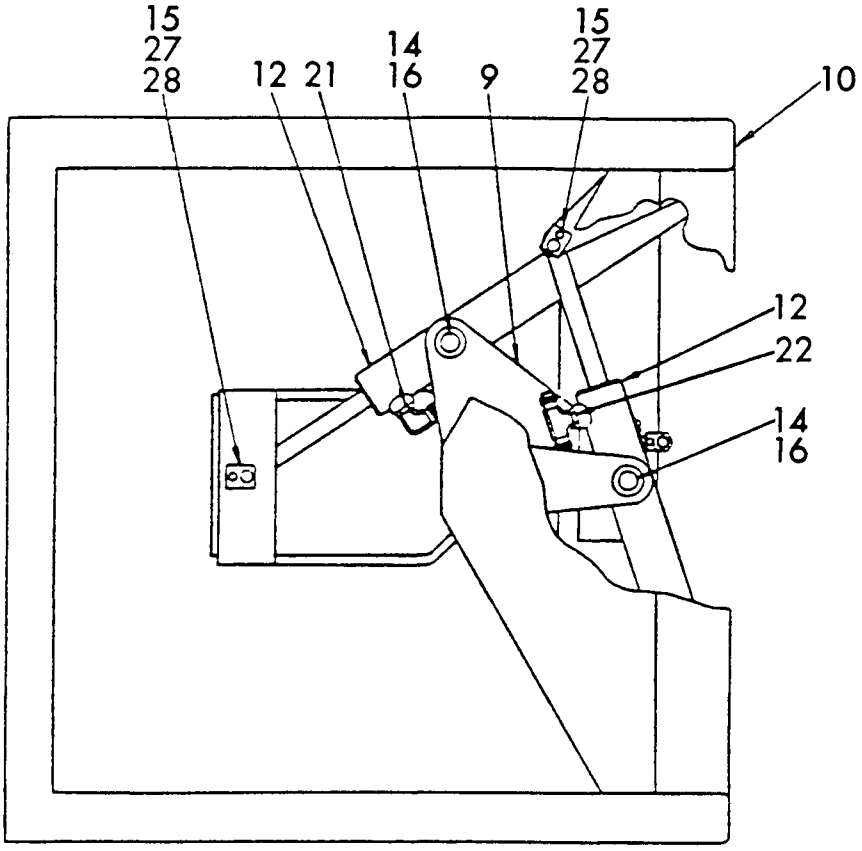
SECTION	6
FIGURE	4
PAGE	1

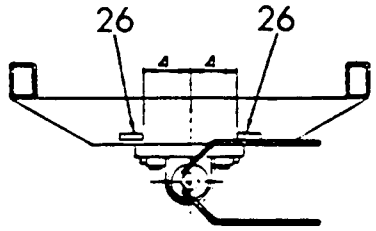


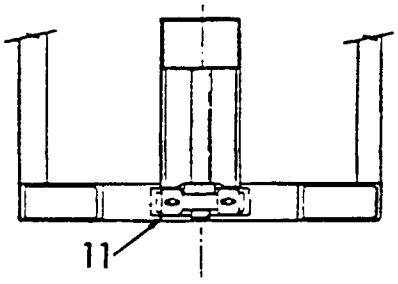
Mark Industries

TITLE	RAISED PLATFORM ROTATION OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

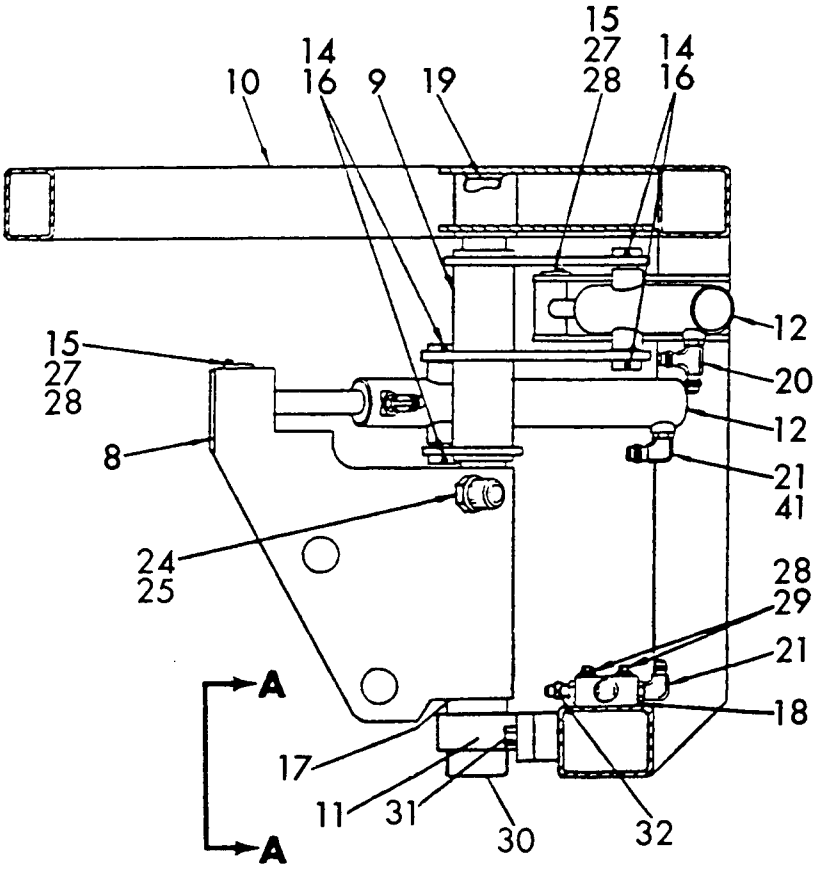
SECTION	6
FIGURE	4
PAGE	2

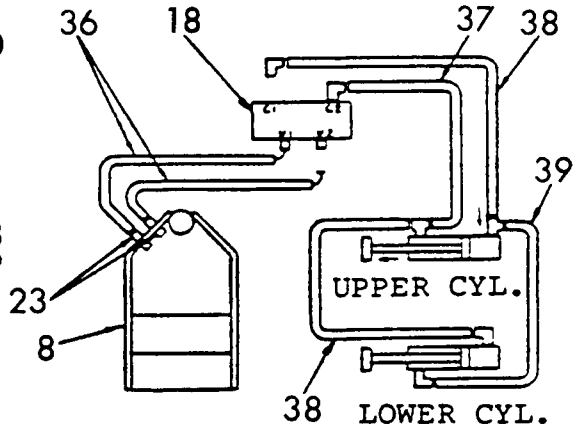






VIEW A





HYDRAULIC DIAGRAM

Mark Industries

TITLE	RAISED PLATFORM ROTATION OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

SECT.	6
FIG.	4
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20097	OPTION, RAISED PLATFORM ROTATION	REF
2	.21713	SUB-ASSEMBLY, MINIPAK (See Sect. 6, Fig. 5 for Details)	1
3	.20884	GUARD, SWITCH	1
4	.2562	FITTING, SWIVEL	4
5	.4021	SWITCH, TOGGLE	1
6	.22571	DECAL, AERIAL CONTROL SWITCH	1
-7	.20960	ASSEMBLY, PLATFORM ROTATION (ATOP BOOM)	1
8	..20818	WELDMENT, LEVELING SKIRT	1
9	..20985	WELDMENT, IDLER	1
10	..20997	WELDMENT, FORK	1
11	..22481	BLOCK, PILLOW	1
12	..21264	CYLINDER, PLATFORM ROTATION	2
-13	...20042	KIT, SEAL (SE)	1
-13	...66568	KIT, SEAL (RA)	1
14	..20821	PIN, CYLINDER TRUNNION	4
15	..20822	PIN, CYLINDER ROD	2
16	..64215	PIN, ROLL	4
17	..20914	SPACER, PLATFORM ROTATION	1
18	..20351	VALVE, CHECK	1
19	..20846	WASHER, THRUST	1
20	..80033-08	TEE, STRAIGHT THREAD	1
21	..80012-05	ELBOW, STRAIGHT THREAD	5
22	..80036-03	TEE, STRAIGHT THREAD	1
23	..80045-03	UNION	2
24	..30038	RELIEF, STRAIN	1

Mark Industries

TITLE	RAISED PLATFORM ROTATION OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

SECT.	6
FIG.	4
PAGE	4

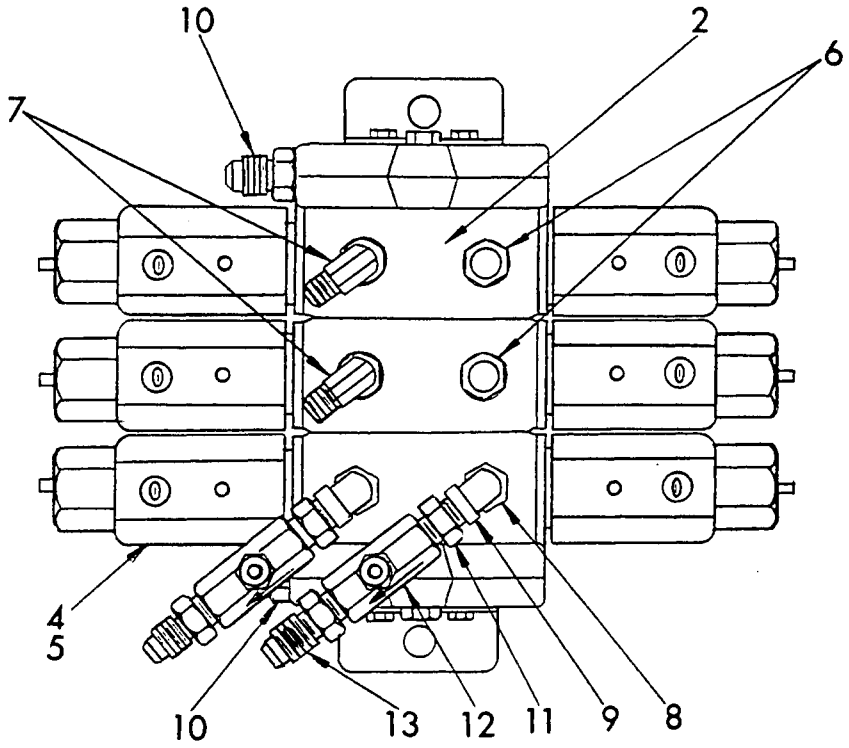
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	..61120	NUT	1
26	..25253	KEY	2
27	..60391	SCREW, CAP	2
28	..63302	WASHER, LOCK	4
29	..60329	SCREW, CAP	2
30	..65454	COLLAR, SHAFT	1
31	..60602	SCREW, CAP	2
32	..80004-03	CONNECTOR, STRAIGHT THREAD	2
33	..80028-03	TEE, SWIVEL NUT	1
34	..80056-01	REDUCER, TUBE END	2
-35	..80060-05	NUT	2
36	..13213-04-0200	ASSEMBLY, HOSE	2
37	..13210-04-0240	ASSEMBLY, HOSE	1
38	..13210-04-0220	ASSEMBLY, HOSE	2
39	..13213-04-0280	ASSEMBLY, HOSE	1
40	.117-B	CONNECTOR	6
41	.16268	CLAMP, HOSE	4

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

Mark Industries

TITLE	MINIPAK SUB-ASSEMBLY
MODEL	62 4X2
NOTES	PART OF PLATFORM ROTATION OPTION

SECTION	6
FIGURE	5
PAGE	1



ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	21713	SUB-ASSEMBLY, MINIPAK (See Sect. 6, Fig. 4 for NHA)	REF
2	.21787	VALVE, MINIPAK (3 BANK) (See Vendor Chapter for Details)	1
-3	..67825	KIT, SEAL (COMPLETE VALVE PACKAGE)	1
4	..67958	CARTRIDGE (ONLY)	6
5	..16953	COIL (ONLY)	6
6	.2608	CONNECTOR	2
7	.2572	ELBOW, SAE	2
8	.80063-01	ADAPTER, PIPE	2
9	.2450	ELBOW, STREET	2
10	.2474	CONNECTOR, STRAIGHT THREAD	2

REV

Mark Industries

TITLE	MINIPAK SUB-ASSEMBLY
MODEL	62 4X2
NOTES	PART OF PLATFORM ROTATION OPTION

SECT.	6
FIG.	5
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
11	.2475	NIPPLE, PIPE	2
12	.20370	VALVE, NEEDLE	2
13	.2415	CONNECTOR, MALE	2

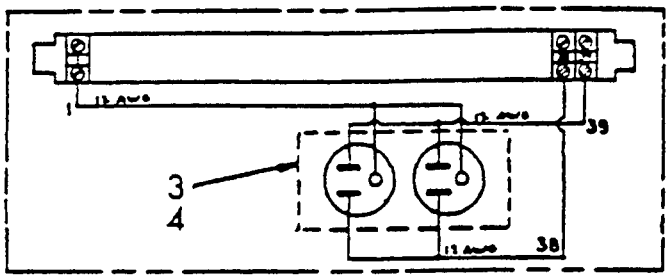
REV.

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

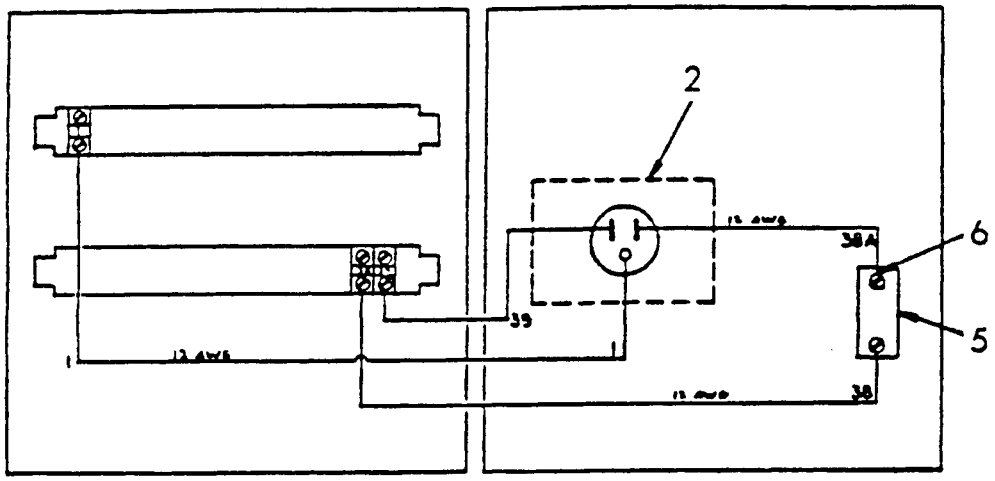
Mark Industries

TITLE	110 VAC RECEPTACLE OPTION
MODEL	62 4X2
NOTES	GROUND & AERIAL CONSOLES

SECTION	6
FIGURE	6
PAGE	1



AERIAL CONTROL CONSOLE



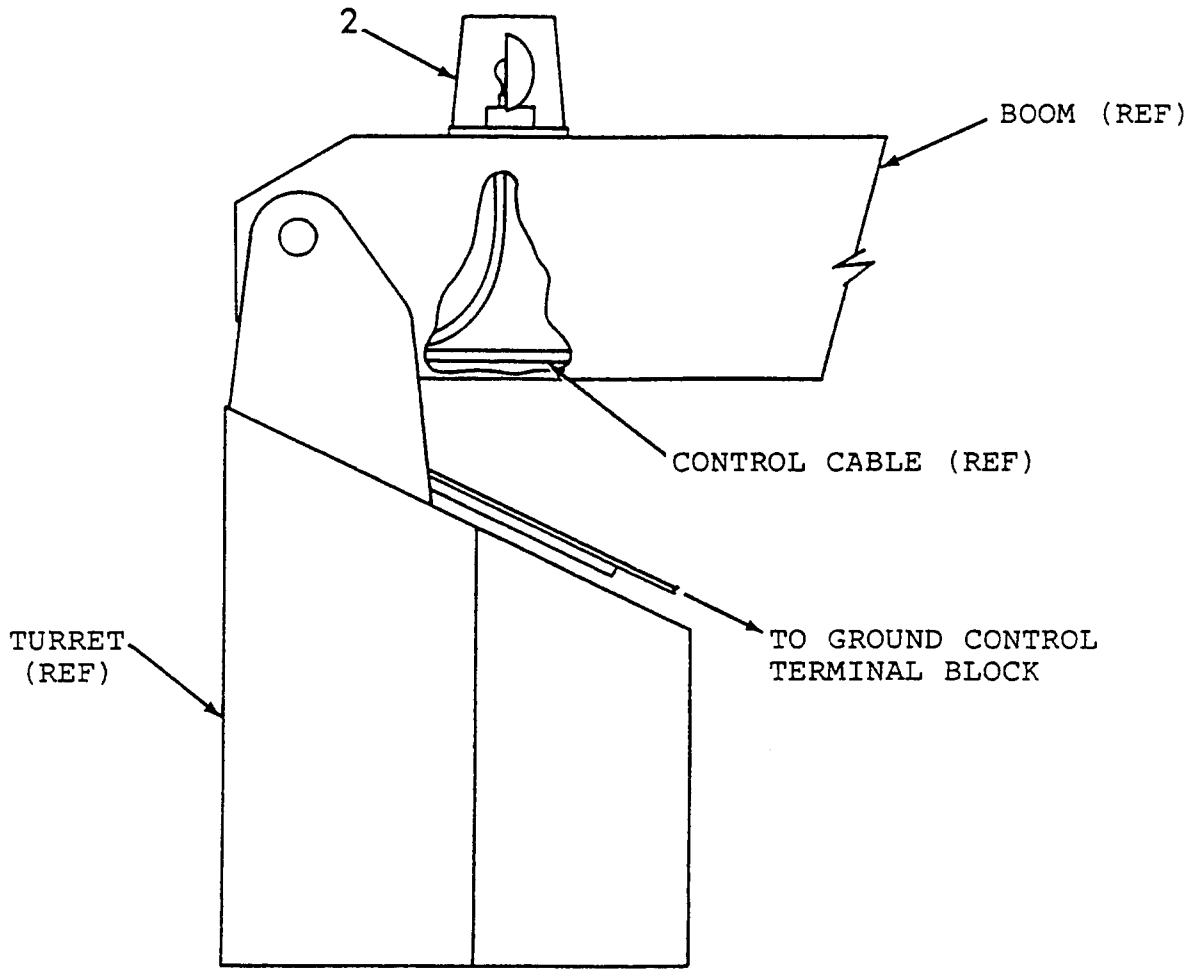
GROUND CONTROL CONSOLE

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20104	OPTION, 110 VAC RECEPTACLE	REF
2	.70119	RECEPTACLE (AND COVER PLATE)	1
3	.288	PLATE, COVER	1
4	.70126	RECEPTACLE, DUPLEX	1
5	.20562	BREAKER, CIRCUIT	1
6	.2832	CONNECTOR	7

Mark Industries

TITLE	ROTATING AMBER BEACON OPTION
MODEL	62 4X2
NOTES	

SECTION	6
FIGURE	7
PAGE	1



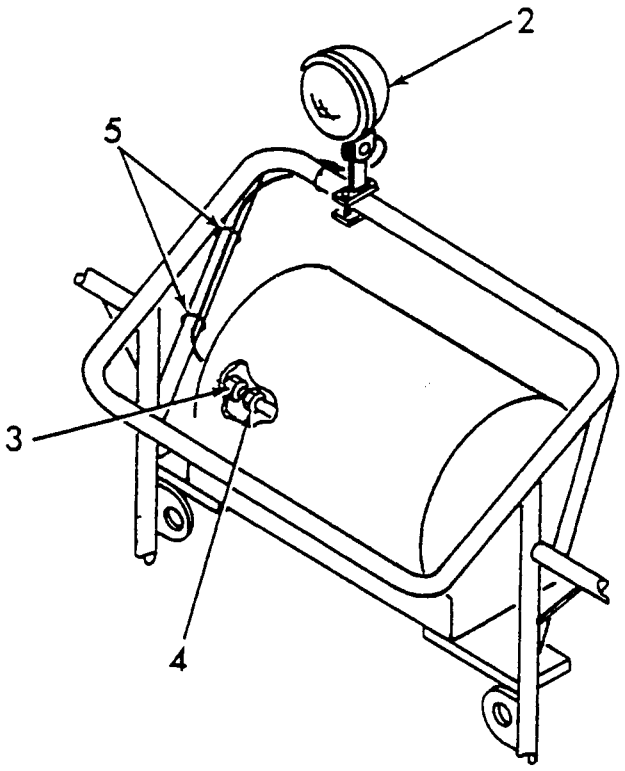
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20107	OPTION, ROTATING AMBER BEACON	REF
2	.20863	BEACON (WITH SWITCH)	1

REV.

Mark Industries

TITLE	12 VDC PLATFORM WORKLIGHT OPTION
MODEL	62 4X2
NOTES	

SECTION	6
FIGURE	8
PAGE	1

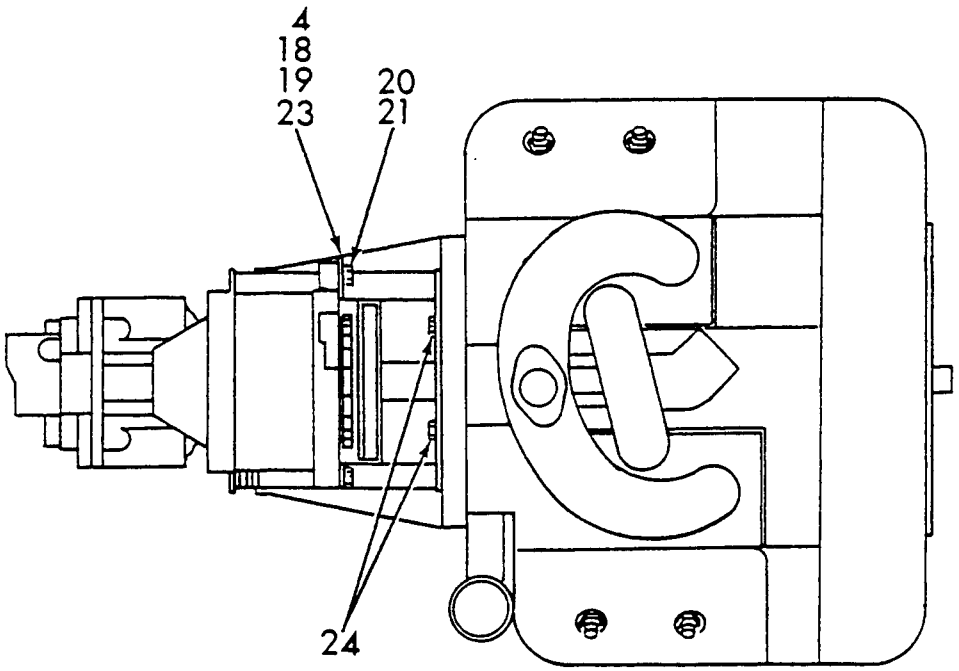


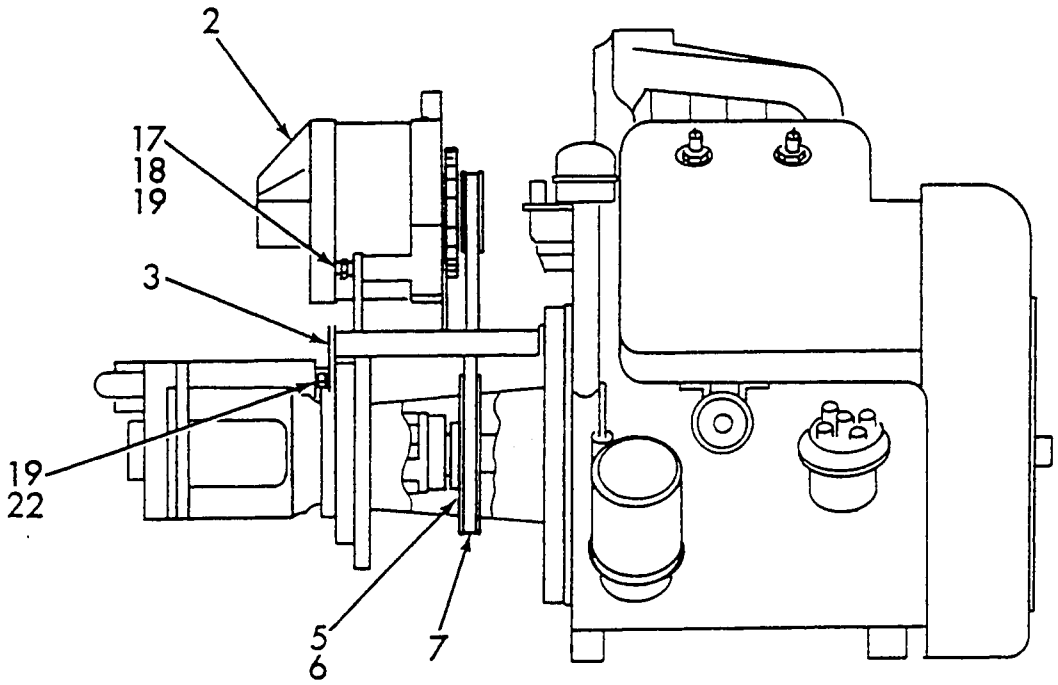
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20139	OPTION, 12 VDC PLATFORM WORKLIGHT	REF
2	.20862	WORKLIGHT	1
3	.2806	RELIEF, STRAIN	1
4	.2808	NUT, LOCK	1
5	.255	TIE, CABLE	5

Mark Industries

TITLE	2.5 KW GENERATOR OPTION
MODEL	62 4X2
NOTES	WISCONSIN VG4D

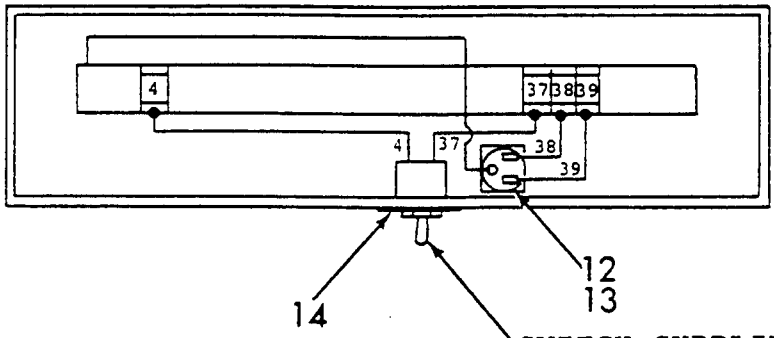
SECTION	6
FIGURE	9
PAGE	1

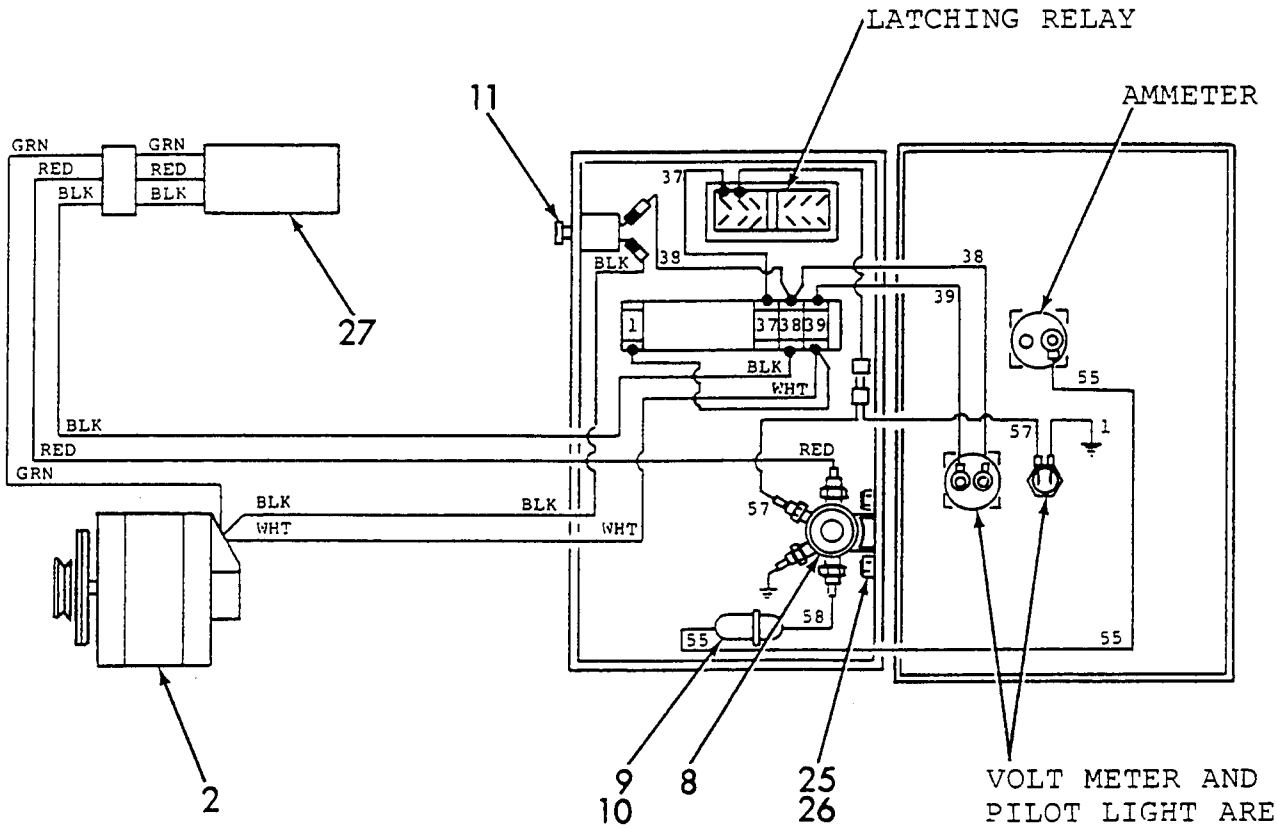




ENGINE ASSEMBLY

AERIAL CONTROL CONSOLE





GROUND CONTROL CONSOLE

Mark Industries

TITLE	2.5 KW GENERATOR OPTION
MODEL	62 4X2
NOTES	WISCONSIN VG4D

SECT.	6
FIG.	9
PAGE	3

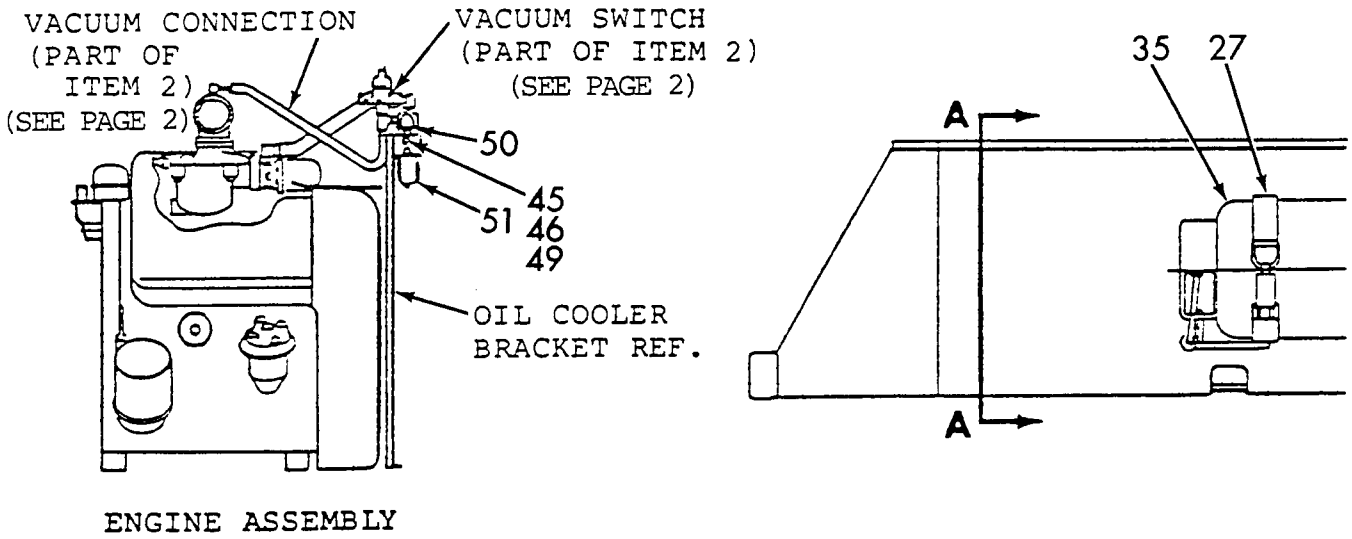
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20159	OPTION, 2.5 KW GENERATOR	REF
2	.20907	GENERATOR (ALTERNATOR)	1
3	.21381	BRACKET, GENERATOR	1
4	.20900	TENSIONER, GENERATOR BELT	1
5	.65001	SHEAVE, TAPER-LOK	1
6	.65005	BUSHING	1
7	.65019	V-BELT, GENERATOR	1
8	.70209	RELAY	1
9	.16337	HOLDER, FUSE	1
10	.16310	FUSE (30 AMP SLO-BLO)	1
11	.20562	BREAKER, CIRCUIT	1
12	.70126	RECEPTACLE, DUPLEX	1
13	.288	PLATE, COVER	1
14	.185717	DECAL, 110 VAC	1
-15	.2806	RELIEF, STRAIN	1
-16	.2808	NUT, LOCK	1
17	.60347	SCREW, CAP	1
18	.60703	NUT, HEX	2
19	.63303	WASHER, LOCK	4
20	.60338	SCREW, CAP	1
21	.63302	WASHER, LOCK	1
22	.60325	SCREW, CAP	2
23	.60343	SCREW, CAP	1
24	.60624	SCREW, CAP	2
25	.60150	SCREW, CAP	2

Mark Industries

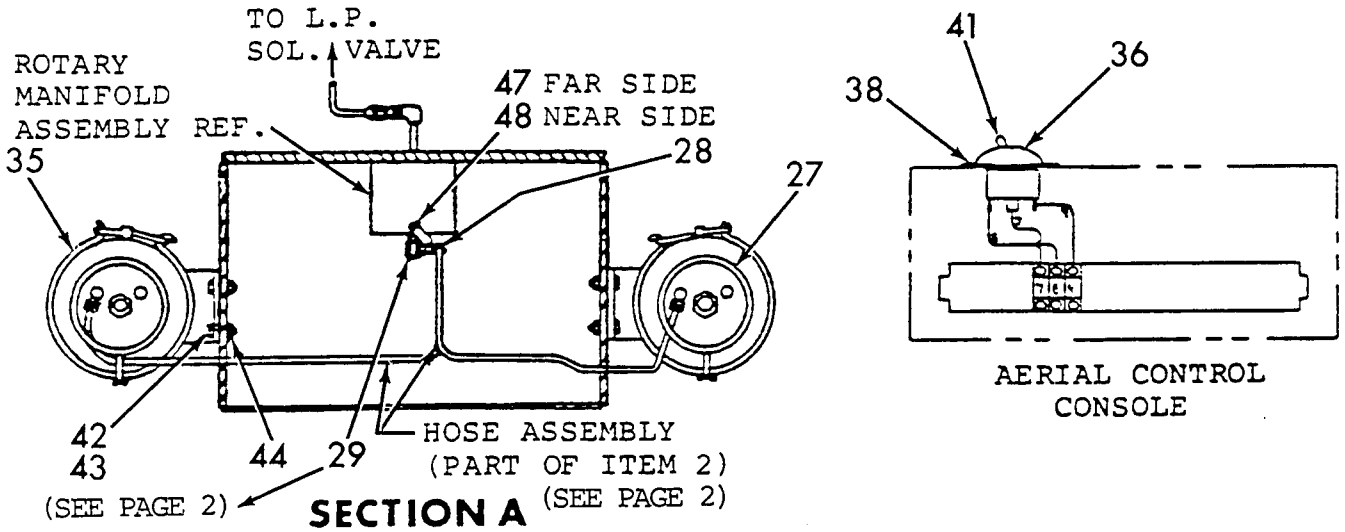
TITLE	2.5 KW GENERATOR OPTION
MODEL	62 4X2
NOTES	WISCONSIN VG4D

SECT.	6
FIG.	9
PAGE	4

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	.60701	NUT, HEX	2
27	.20986	REGULATOR, VOLTAGE	1

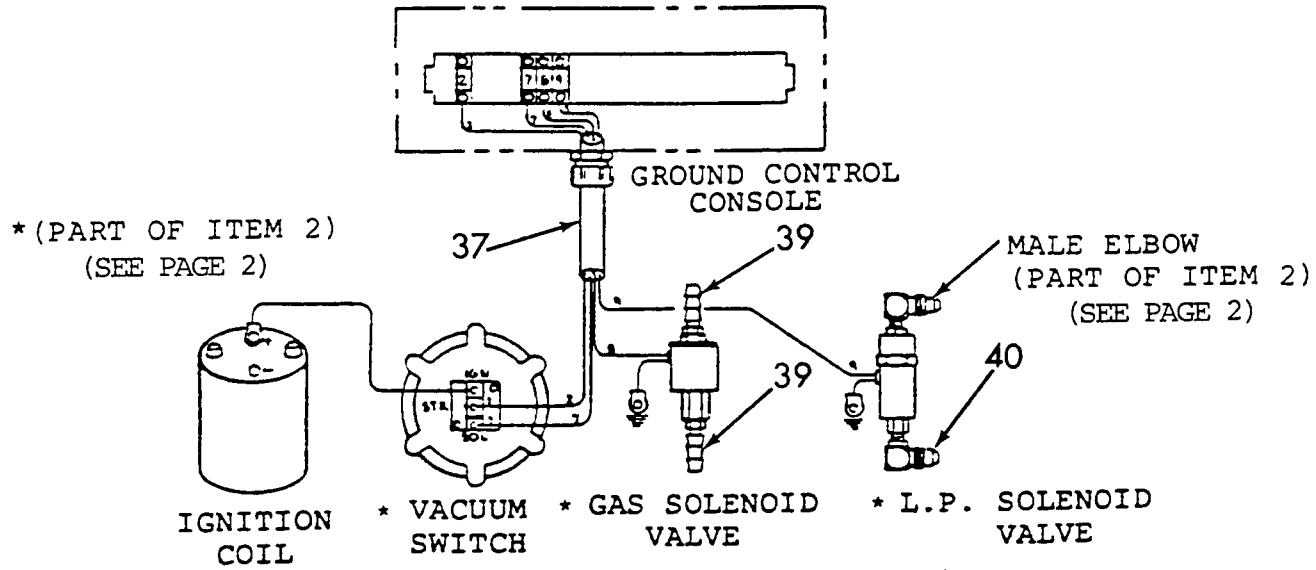


ENGINE ASSEMBLY



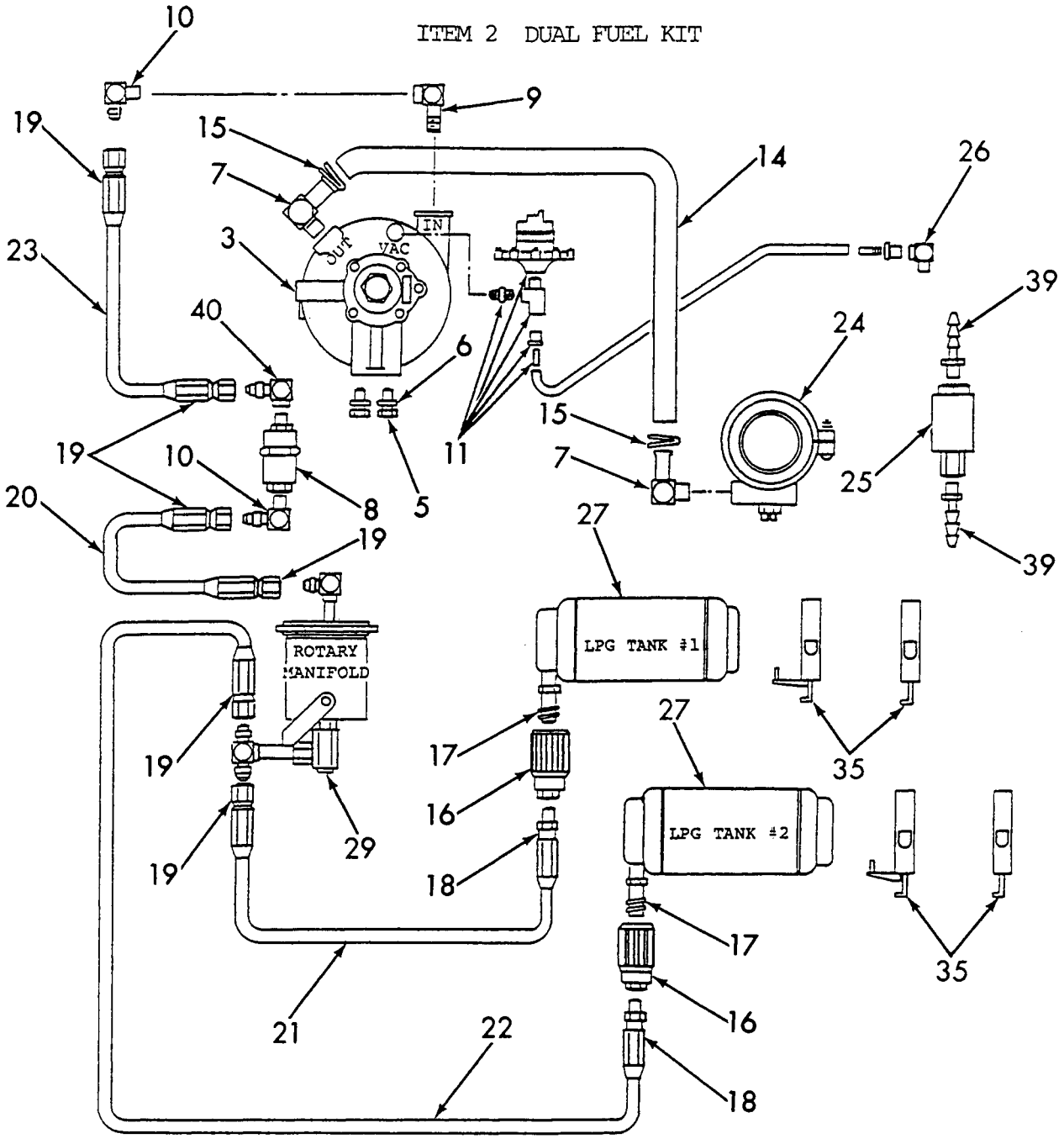
SECTION A

AERIAL CONTROL CONSOLE

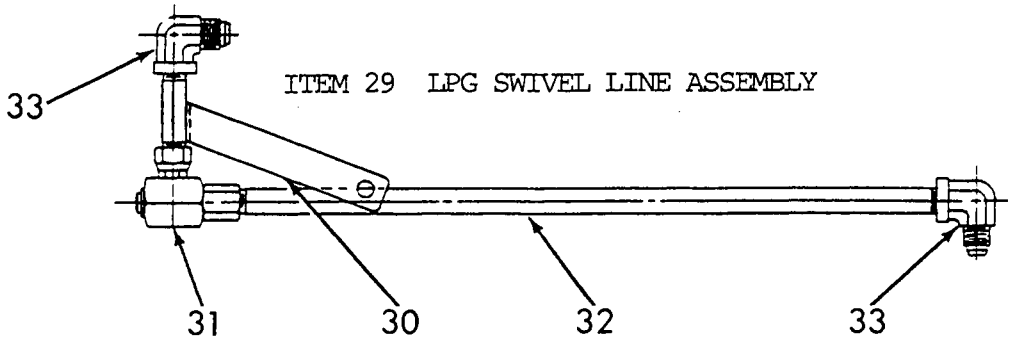


ELECTRICAL DIAGRAM

ITEM 2 DUAL FUEL KIT



ITEM 29 LPG SWIVEL LINE ASSEMBLY



Mark Industries

TITLE	DUAL FUEL OPTION	SECT. 6
MODEL	62 4X2	FIG. 10
NOTES	WISCONSIN VG4D	PAGE 3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	20163	OPTION, DUAL FUEL	REF
2	.21240	KIT, DUAL FUEL	1
3	..16921	REGULATOR, 50E	1
-4	...16965	KIT, REGULATOR REPAIR	1
5	..60107	SCREW, CAP	2
6	..63301	WASHER, LOCK	2
7	..66143	ELBOW	2
8	..67779	LOCK FILTER (FL218-12V)	1
9	..16519	ELBOW, STREET	1
10	..66144	ELBOW, MALE	2
11	..16975	KIT, MICROVAC	1
12	...16923	SWITCH, VACUUM SAFETY	1
-13	16919	KIT, VACUUM SAFETY SWITCH REPAIR	1
14	..66146	HOSE, WATER	2 FT
15	..66147	CLAMP, HOSE	2
16	..65142	SOCKET	2
17	..65141	NIPPLE	2
18	..16452	FITTING, HOSE	2
19	..16451	FITTING, HOSE	6
20	..66149	HOSE (H-50I UL HP FUEL 5/16 ID)	5 FT
21	..66149	HOSE (H-50I UL HP FUEL 5/16 ID)	4 FT
22	..66149	HOSE (H-50I UL HP FUEL 5/16 ID)	4 FT
23	..66149	HOSE (H-50I UL HP FUEL)	3 FT
24	..16322	ADAPTER, CARBURETOR (1770-S/32)	1
25	..20832	VALVE (GT-622)	1

REV.

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

Mark Industries

TITLE	DUAL FUEL OPTION
MODEL	62 4X2
NOTES	WISCONSIN VG4D

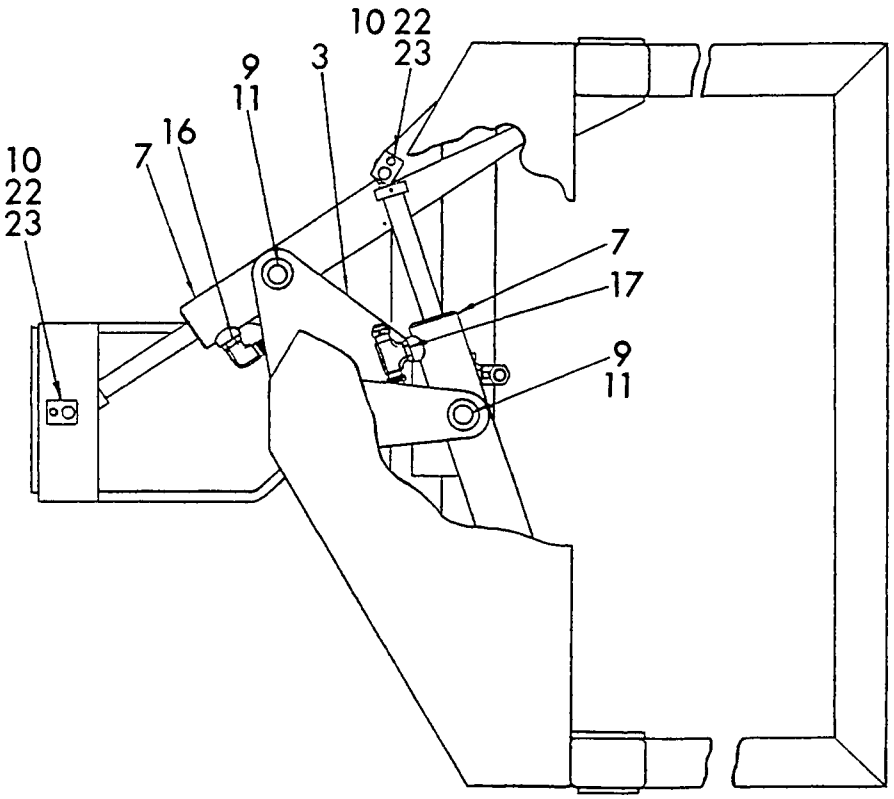
SECT.	6
FIG.	10
PAGE	4

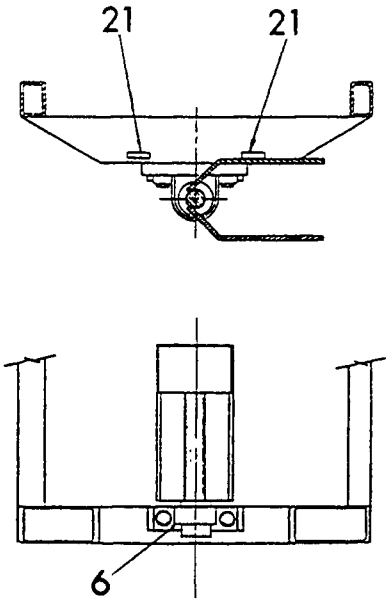
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
26	..66196	ELBOW, STREET	1
27	.486-C	TANK, LPG	2
28	.80029-07	TEE, FEMALE	1
29	.21897	ASSEMBLY, LPG SWIVEL LINE	1
30	..21896	BRACKET, LPG SWIVEL LINE	1
31	..20815	JOINT, LPG LINE SWIVEL	1
32	..65391	NIPPLE, PIPE	1
33	..16506	ELBOW	1
-34	..	TEE	1
35	.486-A	BRACKET, TANK	2
36	.20884	GUARD, SWITCH	1
37	.2912	CABLE, CONDUCTOR (18 AWG)	15 FT
38	.20543	DECAL, DUAL FUEL SELECTOR & INSTRUCTIONS	1
39	.65209	BARB, HOSE	2
40	.80009-07	ELBOW, FEMALE	1
41	.4019	SWITCH, SP 3P	1
42	.63303	WASHER, LOCK	8
43	.60307	SCREW, CAP	8
44	.60703	NUT, HEX	8
45	.60312	SCREW, CAP	2
46	.60701	NUT, HEX	2
47	.60612	SCREW, CAP	1
48	.60613	SCREW, CAP	1
49	.63401	WASHER, FLAT	4
50	.80001-08	CONNECTOR, MALE	1
51	.20886	BRACKET, THROTTLE REWORK	1

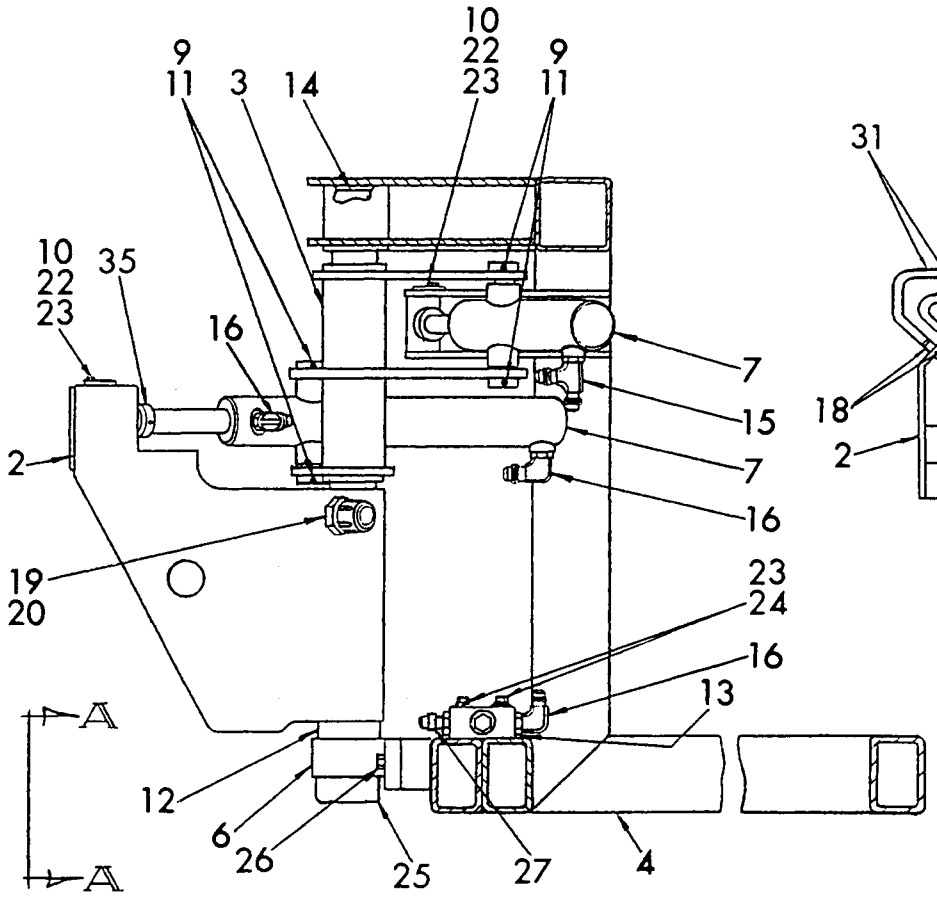
Mark Industries

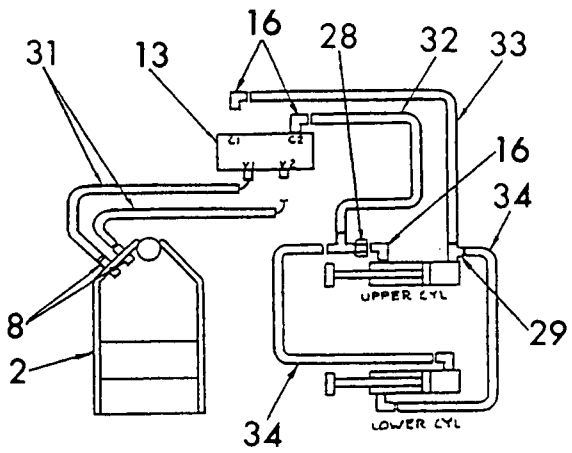
TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	FRONT MOUNT

SECTION	6
FIGURE	11
PAGE	1









HYDRAULIC DIAGRAM

REV.

Mark Industries

TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	FRONT MOUNT

SECT.	6
FIG.	11
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22841	OPTION, PLATFORM ROTATION ASSEMBLY	REF
2	.20818	WELDMENT, LEVELING SKIRT	1
3	.20985	WELDMENT, IDLER	1
4	.21990	WELDMENT, FORK	1
5	..64927	BUSHING	1
6	.22481	BLOCK, PILLOW	1
7	.21264	CYLINDER, PLATFORM ROTATION	2
-8	..20042	KIT, SEAL (SE)	1
-8	..66568	KIT, SEAL (RA)	1
9	.20821	PIN, CYLINDER TRUNNION	4
10	.20822	PIN, CYLINDER ROD	2
11	.64215	PIN, ROLL	4
12	.20914	SPACER, PLATFORM ROTATION	1
13	.20351	VALVE, CHECK	1
14	.20846	WASHER, THRUST	1
15	.80033-08	TEE, STRAIGHT THREAD	1
16	.80012-05	ELBOW, STRAIGHT THREAD	5
17	.80036-03	TEE, BRANCH STRAIGHT THREAD	1
18	.80045-03	UNION, BULKHEAD	2
19	.30038	RELIEF, STRAIN	1
20	.61120	NUT	1
21	.26058	BAR	2
22	.60391	SCREW, CAP	2
23	.63302	WASHER, LOCK	4
24	.60329	SCREW, CAP	2

Mark Industries

TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	FRONT MOUNT

SECT.	6
FIG.	11
PAGE	3

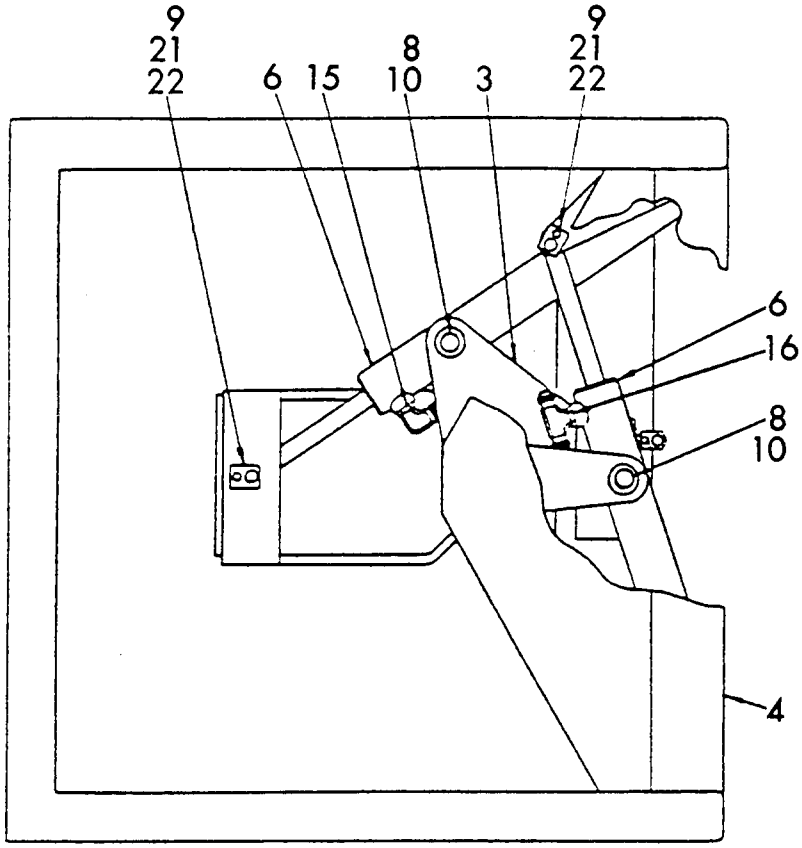
ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.65454	COLLAR, SHAFT	1
26	.60602	SCREW, CAP	2
27	.80004-03	CONNECTOR, STRAIGHT THREAD	2
28	.80028-03	TEE, SWIVEL NUT	1
29	.80056-01	REDUCER, TUBE END	2
-30	.80060-05	NUT	2
31	.13213-04-0200	ASSEMBLY, HOSE	2
32	.13210-04-0240	ASSEMBLY, HOSE	1
33	.13210-04-0280	ASSEMBLY, HOSE	1
34	.13213-04-0280	ASSEMBLY, HOSE	2
35	.65627	COLLAR (TWO PIECE STEEL)	2

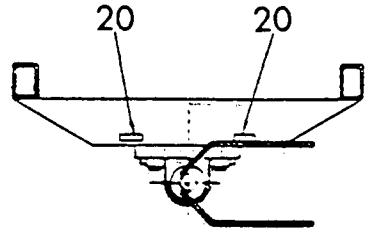
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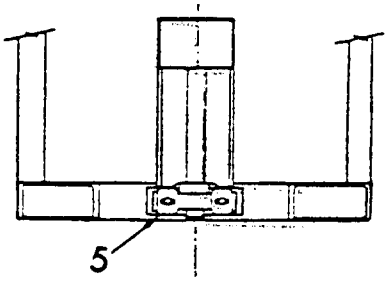
Mark Industries

TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

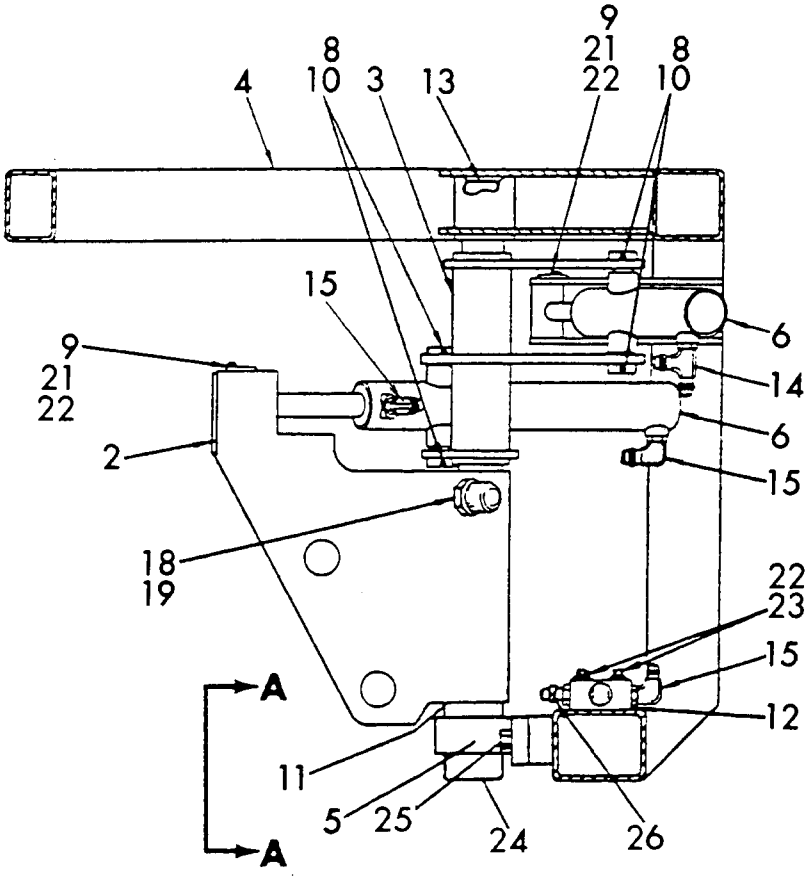
SECTION	6
FIGURE	12
PAGE	1

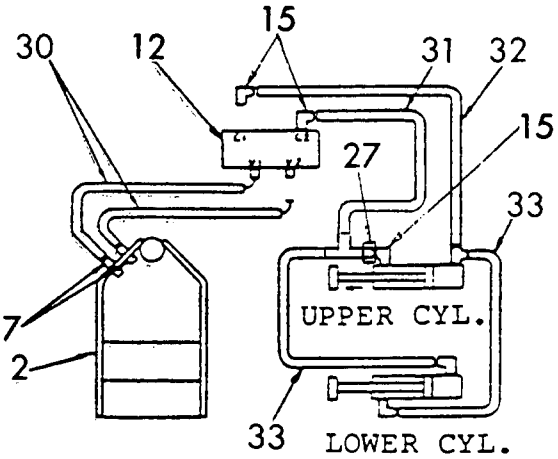






VIEW A





HYDRAULIC DIAGRAM

Mark Industries

TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

SECT.	6
FIG.	12
PAGE	2

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
-1	22847	OPTION, PLATFORM ROTATION ASSEMBLY	REF
2	.20818	WELDMENT, LEVELING SKIRT	1
3	.20985	WELDMENT, IDLER	1
4	.22846	WELDMENT, FORK	1
5	.22481	BLOCK, PILLOW	1
6	.21264	CYLINDER, PLATFORM ROTATION	2
-7	..20042	KIT, SEAL (SE)	1
-7	..66568	KIT, SEAL (RA)	1
8	.20821	PIN, CYLINDER TRUNNION	4
9	.20822	PIN, CYLINDER ROD	2
10	.64215	PIN, ROLL	4
11	.20914	SPACER, PLATFORM ROTATION	1
12	.20351	VALVE, CHECK	1
13	.20846	WASHER, THRUST	1
14	.80033-08	TEE, STRAIGHT THREAD	1
15	.80012-03	ELBOW, STRAIGHT THREAD	5
16	.80036-03	TEE, STRAIGHT THREAD	1
17	.80045-03	UNION, BULKHEAD	2
18	.30038	RELIEF, STRAIN	1
19	.61120	NUT	1
20	.26058	BAR, FLAT	2
21	.60391	SCREW, CAP	2
22	.63302	WASHER, LOCK	4
23	.60329	SCREW, CAP	2
24	.65454	COLLAR, SHAFT	1

Mark Industries

TITLE	PLATFORM ROTATION ASSEMBLY OPTION
MODEL	62 4X2
NOTES	TOP MOUNT

SECT.	6
FIG.	12
PAGE	3

ITEM	PART NUMBER 1234	DESCRIPTION	UNITS PER ASSY
25	.60602	SCREW, CAP	2
26	.80004-03	CONNECTOR, STRAIGHT THREAD	2
27	.80028-03	TEE, RUN SWIVEL	1
-28	.80056-01	REDUCER, TUBE END	2
-29	.80060-05	NUT	2
30	.13213-04-0200	ASSEMBLY, HOSE	2
31	.13210-04-0240	ASSEMBLY, HOSE	1
32	.13210-04-0280	ASSEMBLY, HOSE	1
33	.13213-04-0280	ASSEMBLY, HOSE	2

Mark Industries

TITLE	VENDOR CHAPTER
MODEL	62 4X2
NOTES	

VENDOR CHAPTER CONTAINS:

SECTION	DESCRIPTION	PART NO.
1	WISCONSIN VG4D ENGINE	21215
2	BERTEA REMOTE CONTROL VALVE	21776
3	PAUL MONROE MINIPAK	21787
4	EATON PUMP	20753
5	AUSCO BRAKE	21220
6	TRW TORQMOTOR	81080
7	MICO BRAKE	21220
8	EATON 71503-DAB MOTOR	21221
9	SIC TORQUE HUB	22830
10	MICO BRAKE	22831
11	EATON 71593-DAA MOTOR	23526
12	FAIRFIELD TORQUE HUB	21222

Mark Industries

TITLE	VENDOR CHAPTER
MODEL	62 4X2
NOTES	NOTICE TO USER

VENDOR CHAPTER DISCLAIMER

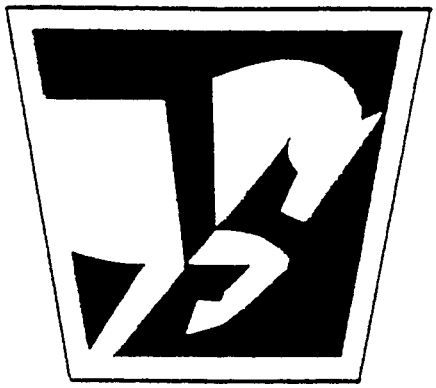
INFORMATION PROVIDED IN THIS VENDOR CHAPTER IS BEING FORWARDED AS A COURTESY. ***MARK INDUSTRIES*** IS NOT RESPONSIBLE FOR THE ACCURACY OF THE INFOMATION PROVIDED HEREIN.

STARTING and OPERATING INSTRUCTIONS

ISSUE MM-357

WISCONSIN

Air-Cooled Engines



Four Cylinder Engine Models

VH4D • VG4D • V-465D

TELEDYNE WISCONSIN MOTOR

WORLD'S FOREMOST SOURCE FOR HEAVY DUTY AIR COOLED ENGINES

INTRODUCTION

WISCONSIN heavy duty air cooled engines are of the most advanced design and are built in a modern factory, equipped with the latest machinery available. Only the best materials, most suitable for the particular part, are used. During production, every part is subjected to rigid inspection, as are also the completely assembled engines. After assembly, every engine is operated on its own power and all adjustments are carefully made so that each engine will be in perfect operating condition when it leaves the factory.

Teledyne Wisconsin Motor is backed by over 65 years of engineering experience in the design of internal-combustion engines for every conceivable type of service. The performance of these engines is proof of the long satisfactory service you too can expect from your engine.

Like all fine machinery, the engine must be given regular care and be operated in accordance with the instructions.

SPECIFICATIONS

MODEL VH4D

Bore	3¼"
Stroke	3¼"
Piston Displacement — cu. in.	107.7
Horsepower — 1400 R.P.M.	17.2
1600 R.P.M.	20.0
1800 R.P.M.	22.5
2000 R.P.M.	24.7
2200 R.P.M.	26.5
2400 R.P.M.	28.0
2600 R.P.M.	29.2
2800 R.P.M.	30.0

MODEL VG4D

Bore	3½"
Stroke	4 "
Piston Displacement — cu. in.	154
Horsepower — 1400 R.P.M.	25
1600 R.P.M.	29
1800 R.P.M.	32
2000 R.P.M.	34
2200 R.P.M.	36
2400 R.P.M.	37

MODEL V-465D

Bore	3¾"
Stroke	4 "
Piston Displacement — cu. in.	177
Horsepower — 1600 R.P.M.	41.6
1800 R.P.M.	47.5
2000 R.P.M.	52.4
2200 R.P.M.	56.7
2400 R.P.M.	60.0
2600 R.P.M.	63.0
2800 R.P.M.	64.5
3000 R.P.M.	65.9

Note: For continuous operation, allow 20% of horsepower shown, as a safety factor.

SAFETY PRECAUTIONS

- Never fill fuel tank while engine is running or hot: avoid the possibility of spilled fuel causing a fire.
- Always refuel slowly to avoid spillage.
- When starting engine, maintain a safe distance from moving parts of equipment.
- Do not start engine with clutch engaged.
- Do not spin hand crank when starting. Keep cranking components clean and free from conditions which might cause the crank jaw to bind and not release properly. Oil periodically to prevent rust.
- Never run engine with governor disconnected, or operate at load speeds in excess of: 2800 R.P.M. for model VH4D, 2400 R.P.M. for model VG4D and 3000 R.P.M. for model V-465D.
- 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 causes serious illness and possible death.
- Never make adjustments on machinery while it is connected to the engine without first removing 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.
- Precaution is the best insurance against accidents.

NEW ENGINE Instructions

• LUBRICATION

Operating without oil will ruin engine.

IMPORTANT

There is **NO OIL** in this unit.
Fill crankcase to proper oil level, also clutch or gear box if furnished, and oil bath air cleaner.

Refer to *GRADE OF OIL* chart (page 2) and fill with proper oil *before* starting engine.

• AIR CLEANER

Oil bath type — Add same grade oil as used in crankcase to the level line indicated on cleaner bowl. Maintain oil level or dirt will be drawn in and damage engine.

Dry element type, optional equipment – DO NOT OIL – Follow instructions on cleaner body.

• FUEL

Use 'REGULAR' grade gasoline. Engines built to operate on FUEL OIL, KEROSENE, L.P.G. or NATURAL GAS are so identified in the model designation. Refer to *'FUEL'* paragraphs of instructions. Buy fresh fuel. Do not use *out-of-season* gasoline.

• NEGATIVE GROUND CIRCUIT

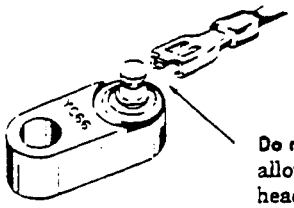
, if engine is equipped with STARTING MOTOR, DISTRIBUTOR IGNITION and FLYWHEEL ALTERNATOR, or GENERATOR.



GROUND ENGINE TO NEGATIVE TERMINAL ON BATTERY.

CAUTION: Be absolutely sure of proper connection or damage to the Alternator or Generator circuits will result.

• PREVENT OVERHEATING



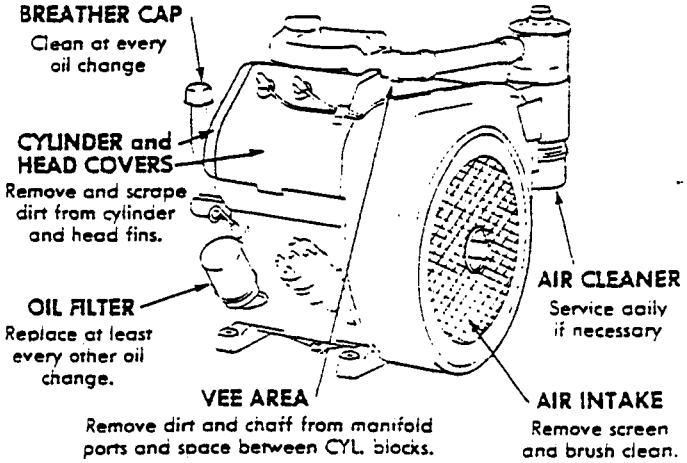
Temperature Safety Switch

Do not disconnect wire or allow terminal to touch head fins or shrouding.

Optional accessory mounted to cylinder head bolt near spark plug — *TO PROTECT ENGINE AGAINST OVERHEATING.* If engine stops, check first to see if engine is overheated. Other conditions may have caused the engine to stop. Clean air cleaner, air intake screen, fins, and check oil level, spark plugs and wiring. Let engine cool at least 10 minutes before restarting.

Keep Engine Clean

External dirt restricts cooling and internal dirt causes wear.



• 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 quick way 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. Run the engine for a half hour without load at low idle speed (1000 to 1200 R.P.M.). The speed should then be increased gradually, to engine operating r.p.m. still without load, for an additional two hours. If at all possible, operate the engine at light loads for a period totaling about eight hours, before maximum load is applied.

STARTING AND OPERATING INSTRUCTIONS

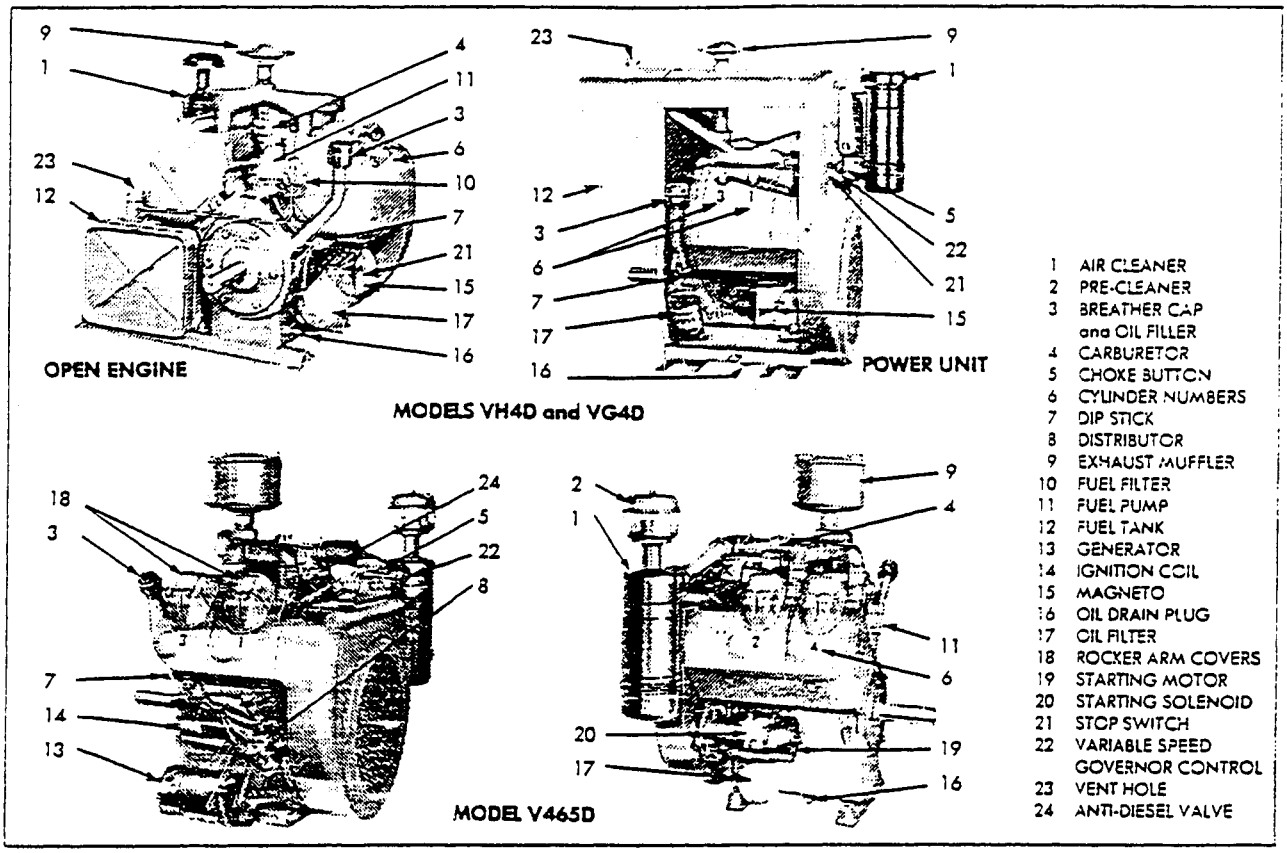


Fig. 1, REFERENCE VIEWS

GENERAL INFORMATION

These engines are of the four cycle type, in which each of the four operations of suction, compression, expansion and exhaust constitutes a complete stroke. This gives one power stroke per cylinder for each two revolutions of the crankshaft.

COOLING

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

NEVER OPERATE AN ENGINE WITH ANY PART OF THE SHROUDING REMOVED — this will retard air cooling.

IGNITION

The spark for ignition of the fuel mixture is furnished by a high tension magneto driven by the timing gears at crankshaft speed (models VH4D and VG4D).

Battery ignition (12 volt) distributor, is furnished in place of magneto on engines equipped with flywheel alternator, or as optional ignition (Std. on model V-465D).

ROTATION

The rotation of the crankshaft is clockwise when viewing from the flywheel or front end of the engine, and counterclockwise rotation of the power takeoff or rear end of the engine.

BEFORE STARTING NEW ENGINE

1. Fill tank with Regular grade gasoline.

   OIL BURNING engine has letter 'O' suffixed to model designation — use 35 minimum octane fuel oil.

   L.P.G. BURNING engine has letter 'G' added to model designation — use propane HD5.

   NATURAL GAS burning engines require a B.T.U. content of at least 1000.

2. Fill crankcase base with the proper grade of engine oil as specified in "GRADE OF OIL" chart. Fill through the breather tube opening to the level indicated by the FULL mark on DIPSTICK.

   For run-in of new engines, use same oil as recommended in GRADE OF OIL chart.

   Check crankcase oil level every 8 hours, change oil every 50 hours of operation.

   To change oil, remove drain plug from oil pan. Oil should be drained while engine is hot; it will flow more freely.

3. Clutch and gear reduction unit lubrication differs between the various engine models. All units operating in oil are furnished with oil filler, level and drain plugs, suitable for any take-off shaft position.

GRADE OF OIL

SEASON OR TEMPERATURE	GRADE OF OIL
Spring, Summer or Autumn +120°F to +40°F	SAE 30
Winter +40°F to +15°F +15°F to 0°F Below 0°F	SAE 20-20W SAE 10W SAE 5W-20
Use oils classified as Service MS, SDorSE	

Crankcase Capacity	VH4D	VG4D	V465D
New Engine	3½ qts.	4½ qts.	6 qts.
Oil and filter change	4 qts.	5 qts.	7qts.
Less — oil filter or filter change	3½ qts.	4½ qts.	6 qts.

Model VH4D, 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.

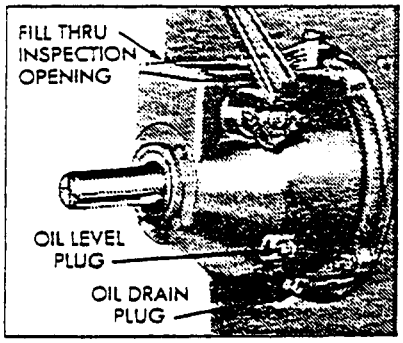


Fig. 2, VH4D
CLUTCH LUBRICATION

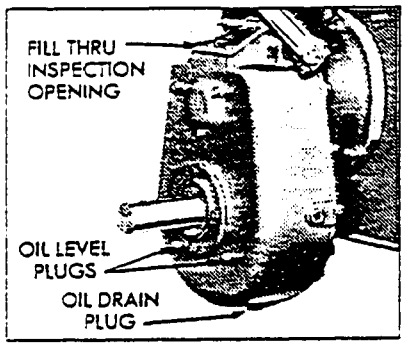


Fig. 3, VH4D
CLUTCH REDUCTION LUBRICATION

Models VG4D and V465, Fig. 4 and Fig. 5:

The clutch in both the power take-off and clutch reduction units is of the dry disc type, therefore NO OIL should be put into the clutch housing. Grease fittings are provided for periodic lubrication of the bearings. The HOUSING BEARING should be greased every 50 hours of operation, and the THROWOUT BEARING every day before starting. use Mobil Gargoyle grease 3RB No 3, Sinclair AF-1 grease, or equal.

The PILOT BEARING is sealed and requires no external lubrication.

The SHIFTER SHAFT should be lubricated periodically if external oil fittings are provided.

THE REDUCTION UNIT IS OPERATED IN OIL and the gear case oil level must be maintained to the oil DIPSTICK mark or PLUG opening, which ever is applicable. In ROCKFORD units use No. 30 S.A.E. crankcase oil. for TWIN DISC units use

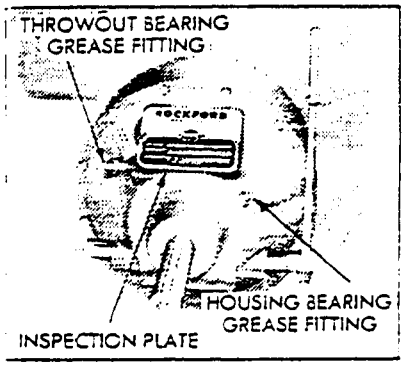


Fig. 4, VG4D, V465D
CLUTCH LUBRICATION

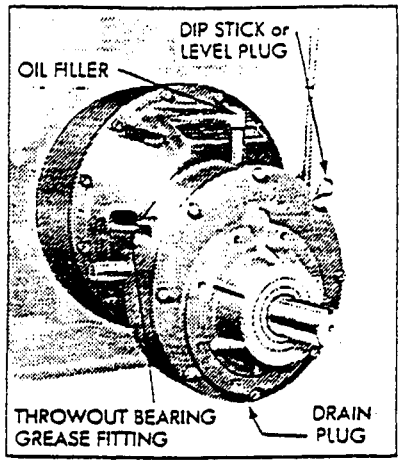


Fig. 5, VG4D, V465D
CLUTCH REDUCTION LUBRICATION

high grade transmission oil, S.A.E. No. 90 to No. 110 viscosity. Change oil every 500 hours of service, while unit is warm.

STARTING

With reference to Fig. 1: Engines enclosed in a sheet metal house are referred to as Power Units, whereas those without a house are called Open Engines.

Power Unit side doors should always be removed when operating.

STARTING PROCEDURE Fig.'s 6,7,8

1. Check crankcase oil level and gasoline supply. Open shut-off valve in fuel strainer.

   OIL BURNING engines must be started on gasoline and run for 2 or 3 minutes before switching to oil. Special instructions are available for starting L.P.G. and NATURAL GAS burning engines.

2. Disengage clutch, if furnished.

3. Prime new engine — if necessary, see Fig. 6. Hand primer lever at fuel pump (available option), should be worked back and forth until strainer bowl is full — then an additional 5 or 10 strokes to fill carburetor bowl. If primer does not function — turn crankshaft one complete revolution.

   Gravity feed (power units), and electric start engines do not require priming.

4. Set throttle about 1/2 open if variable speed governor control is furnished. With a two speed control, start in full load position — idle after engine starts.

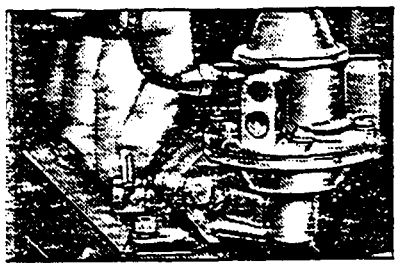


Fig. 6, FUEL PUMP PRIMER

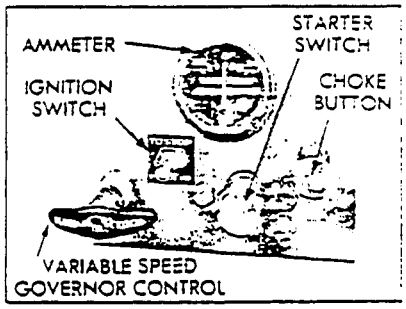


Fig. 7, VH4D, VG4D
CONTROL PANEL

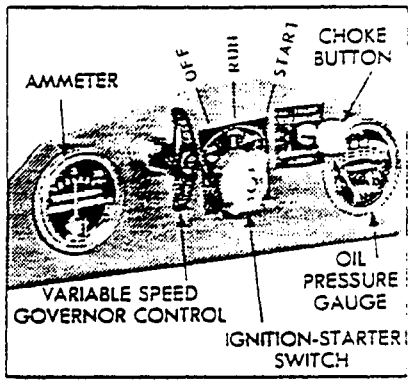


Fig. 8, V465D
CONTROL PANEL

Models VH4D and VG4D only, Fig. 7

5. Pull out ignition switch, if applicable (tag reads "TO STOP PUSH IN").

   Magneto ignition engines (less ignition switch), have a lever type ground switch on side of magneto which is always in the ON or running position, except when depressed for stopping.

5a. Close choke by pulling choke button to extreme out position.

5b. Turn engine over slowly one or two revolutions. CAUTION: Be sure that crank does not bind — apply oil to the crank jaw and crank nut extension for ease of engagement and release.

   Push choke control button in about halfway and then pull up rapidly on the starting crank. Do not attempt to spin the engine with the starting crank. If engine does not start on the first pull up of the crank, re-engage the crank and repeat the operation.

   With electric starting motor: depress starter switch button in place of hand cranking. See Fig. 7.

5c. After engine starts, push choke button in as required for smooth running. Choke should be completely open (button in), when engine is warmed up.

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

Model V465D only, Fig. 3

6. After setting throttle as per paragraph 4.
   Turn IGNITION-STARTING SWITCH to 'Start' position and at the same time pull out choke button only sufficient to start the engine.

6a. Release choke button to open position after engine starts, but rechoke if it tends to stop. EVEN A HOT ENGINE REQUIRES MOMENTARY CHOKING WHEN STARTING. When engine starts release switch to 'RUN' position.

If flooding should occur, continue cranking with the starting motor, but with the choke open (choke button in).

WARM-UP

If all conditions are right, engine will start promptly in one or two attempts. 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. Break-in new engine per instructions on page 1.

TO STOP ENGINE

Magneto ignition (open engines) have a lever type ground switch on the side of the magneto. DEPRESS AND HOLD DOWN UNTIL ENGINE STOPS. See Fig. 1, Ref. 21.

Power units and battery ignition, Fig. 7, are furnished with an ignition switch, "TO STOP PUSH IN".

Model V465D: turn IGNITION-STARTING SWITCH to OFF position. See Fig. 3.

If engine has been running hard and is hot, do not stop it abruptly from full load. Remove the load and allow the engine to run idle (1000 to 1200 R.P.M.), for 3 to 5 minutes. Air circulation from the flywheel will reduce the temperature of the engine much faster and minimize valve warping.

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 hose connections for leaks or breaks and replace all broken or damaged hose clamps.

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

OIL BATH AIR CLEANER, Fig. 9

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.

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.

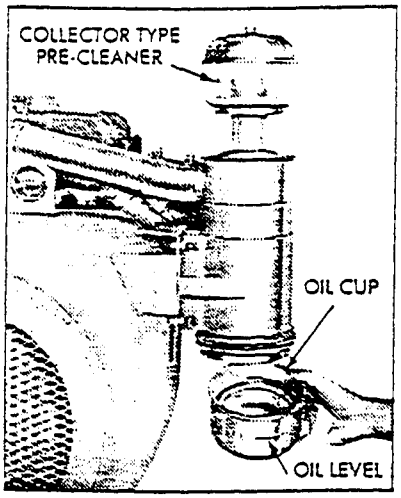


Fig. 9 OIL BATH AIR CLEANER

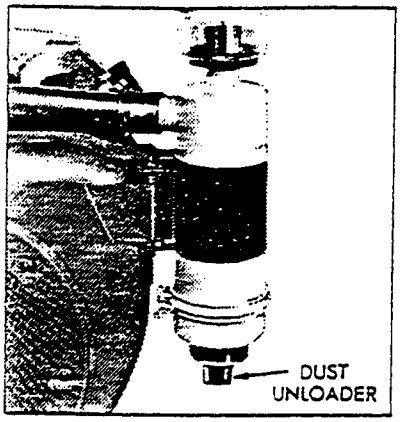


Fig. 10, DRY TYPE AIR CLEANER

DRY TYPE AIR CLEANER, Fig. 10

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 dirt (do not tap or strike element — it may become damaged). Wipe out dirt from inside cover 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 — DO NOT OIL ELEMENT.

After ten washings or one year of service, replace cartridge. New cartridges are available at your TELEDYNE WISCONSIN MOTOR Service Center.

PRE-CLEANER

The collector type pre-cleaner, mounted to the top of the air cleaner as illustrated in Fig. 9, 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 precleaner, this must be kept dry.

BREATHER CAP, Fig. 1, Ref.3

The crankcase is ventilated thru a breather cap mounted ot the top of the oil filler tube. At every oil change, it is recommended that the cap be cleaned by washing in kerosene.

DISTRIBUTOR, Fig. 1, Ref. 8

If engine is equipped with battery ignition distributor:

Every 250 hours of operation; add 3 to 5 drops of medium engine oil to the oiler on side of distributor base.

Every 250 hours, apply 3 to 5 drops of light engine oil (10W), to the felt in the top of the cam sleeve, and 1 or 2 drops to the breaker arm pivot.

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.

GENERATOR - Belt Driver, Fig. 1, Ref 13

Every 50 hours of operation; add 3 to 5 drops of medium engine oil into the oil cups at both ends of the generator.

FUEL FILTER, Fig. 11

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. The glass filter bowl should be inspected frequently, and cleaned if dirt or water are present.

To remove sediment bowl, loosen nut below bowl, swing bail to one side and twist bowl as it is being removed. Clean screen and bowl thoroughly — replace gasket if it is damaged or hardened.

OIL FILTER, Fig. 1, Ref. 17

A BY-PASS type oil filter is furnished on all Model VH4D and VG4D engines, except where the use of other accessories prevent mounting an oil filter.

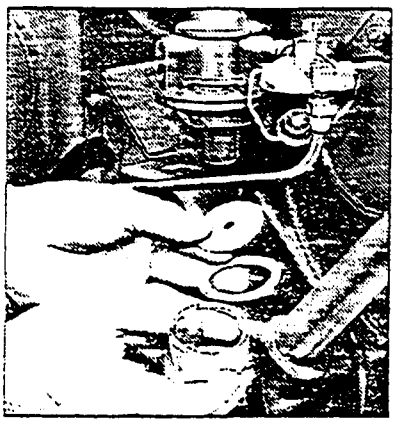


Fig. 11, FUEL FILTER

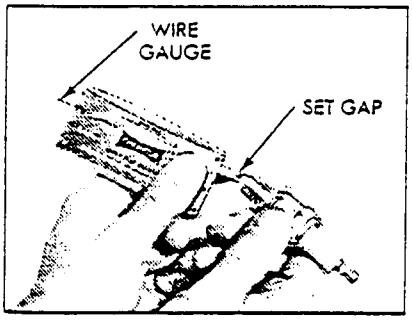


Fig. 12

A FULL-FLOW oil filter is furnished on model V465D engines as standard equipment. Since all of the circulated oil passes thru the filter, it is very important that it be serviced regularly.

The oil filtering cartridge should be replaced after EVERY OTHER OIL CHANGE. If operating conditions are extremely dusty, replace cartridge after every oil change. Use only Wisconsin Micro-Fine or Full-Flo oil filter cartridges from your nearby Teledyne Wisconsin Motor Service Center.

SPARK PLUGS, Fig. 12

Incorrect gap, fouled or worn spark plug electrodes, will have an adverse affect on engine operation. Remove spark plugs periodically — clean, regap or replace if necessary.

Spark plug gap - .030 inch.

Use new spark plugs at the beginning of a new season. Replacement plug must be of the correct heat range, equal to:

Model	Thread Size	Make
VH4D VG4D	18mm	Champion D-16J (Wisconsin YD-6)
V465D	14mm	Champion N-12Y Wisconsin YD-301

Torque spark plugs 25 to 30 foot pounds for Models VH4D, VG4D, and to 22 foot pounds for Model V465D.

STARTING MOTOR, Fig. 1, Ref. 19

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 starter from the engine and clean the Bendix by brushing with Kerosene. Do not oil Bendix.

ADJUSTMENTS

CARBURETOR

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 the factory

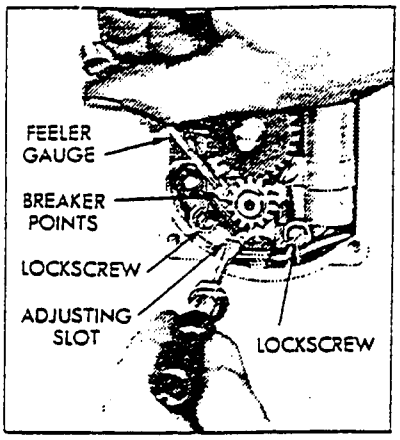


Fig. 13

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 carburetor throttle lever closed. Initial setting is approximately 1½ turns open.

MAGNETO BREAKER POINTS, Fig. 13

At least once each season or when ignition spark becomes weak, remove magneto end cover, inspect points and check gap opening. If there is evidence of pitting or pyramiding and it becomes necessary to resurface or replace points, it will also be necessary to readjust the gap clearance. The BREAKER POINT GAP should be:

.015 inch at full separation.

Turn engine crankshaft over until breaker points are at their maximum opening. Loosen the two lockscrews on breaker plate just enough so that plate can be moved. Place a 0.015 inch feeler gauge between points. Insert end of small screw driver into adjusting slot at bottom of breaker plate and open or close the contacts by moving plate until a slight drag is felt when sliding the feeler gauge from between the points. Tighten lockscrews and recheck point gap.

Before placing end cover on frame, clean contact surfaces, coat with gasket cement and mount new gasket. Assemble cover, rotor and end cap.

DISTRIBUTOR (Battery Ignition), Fig. 14

The breaker point gap should be:

.020 inch at full separation.

To readjust point gap, turn engine over by means of the hand crank until the distributor breaker arm RUBBING BLOCK is on a high point of the CAM. Loosen the stationary contact LOCKSCREW slightly and insert a feeler gauge between the points. By means of a screw driver, turn ADJUSTING SCREW until correct gap is obtained. Tighten lockscrew and recheck gap.

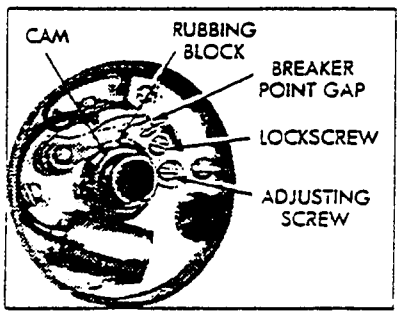


Fig. 14

Points that are badly pitted or worn should be replaced.

VALVE TAPPET ADJUSTMENT

Models VH4D, VG4D, Fig. 15

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

Inlet - .008" Exhaust - .016"

The inlet valves are to the inside of the cylinder block, the exhaust valves are toward the outside. Place feeler gauge between valve stem and tappet screw, and adjust clearance by means of two ½ inch tappet wrenches.

Model V465D, Fig. 16

The clearance between the valve and rocker arm, with the tappet in its lowest position (valve completely closed) and the engine cold.

Inlet - .008" Exhaust - .014"

The rocker arms can be identified as follows: When facing toward the side of the engine, the Exhaust Rocker Arm is to the right in the cylinder head and the inlet rocker arm to the left.

Measure clearance between the top of the valve and nose of rocker arm with a feeler

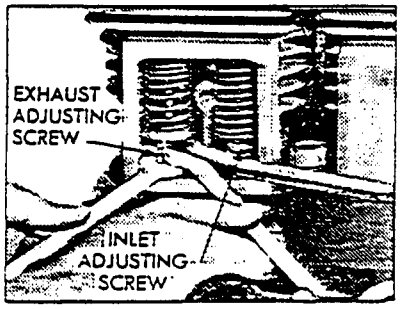


Fig. 15, VH4D, VG4D
VALVE TAPPET ADJUSTMENT

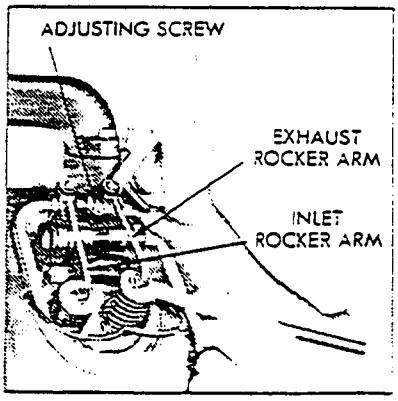


Fig. 16, V465D
VALVE TAPPET ADJUSTMENT

gauge as shown. By means of a ½ inch tappet wrench, turn the adjusting screw clockwise to decrease valve clearance and counter-clockwise to increase the clearance.

The sequence in which the tappets are adjusted is determined by the 1-3-4-2 firing order. Start by adjusting No. 1 inlet valve clearance first, then by just a short turn of the crank, No. 3 inlet can be adjusted. Return to No. 1 cylinder and adjust the exhaust clearance, then adjust the No. 3 exhaust.

The same procedure applies to the No. 2 and No. 4 bank of cylinders, starting with No. 4 inlet valve. Mark each rocker arm with chalk as adjustment is completed, to prevent repetition.

TIMING

FIRING ORDER

The firing order of the cylinders is 1-3-4-2, and the magneto or distributor rotor turns at one-half engine speed, as is the case with conventional 'In Line' engines.

The intervals between the firing of the cylinders is 180°. No. 1 cylinder is the one nearest to the flywheel in the left bank of cylinders, when viewed from the flywheel end of the engine. No. 3 cylinder is the other cylinder in this bank. No. 2 cylinder is the one nearest to the flywheel in the right bank of cylinders and No. 4 is the other cylinder in this bank. The cylinders are numbered on the head covers.

Note: When disconnecting ignition wires, mark cap, and tag wires for correct re-assembly.

TIMING CHECK, Fig. 17

The running spark advance for both magneto and battery ignition, is 23°, and timing must be checked with the engine running at 2000 R.P.M. or over.

Insert a small screw driver into the No. 1 terminal tower on the distributor cap, making contact with the ignition wire terminal. Connect the red terminal clip, from an automotive Timing Light to the metal part of the screw driver. Connect the other two wires of the timing light; one to the positive side of the battery, the other to ground. Chalk or paint the end of the 'X' marked vane of the flywheel, white. Then, with the engine operating at 2000 r.p.m. or over, allow the flash from the timing light to illuminate the white vane. At the time of the flash the leading edge of the vane should line up with the running spark advance timing hole in the front face of the flywheel shroud.

Note: Timing can be checked without removing flywheel shroud screen (Fig. 17 shows screen removed), by illuminating leading edge of white vane with timing light thru the ⅜" diameter hole in rim face of flywheel screen.

Timing Adjustment for either battery or magneto ignition: Refer to the INSTRUCTION and PARTS MANUAL of the specific engine model for adjustment procedure.

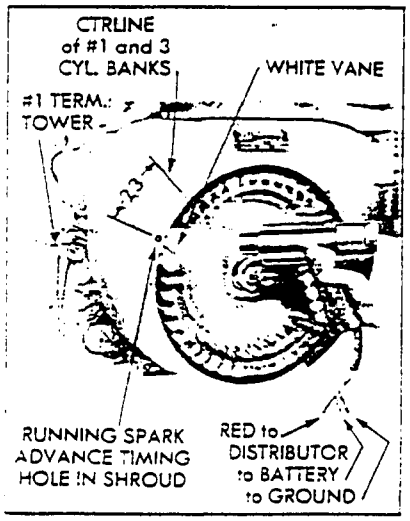


Fig. 17

CLUTCH ADJUSTMENT

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).

VH4D Clutch, Fig. 18

Turn engine over by means of the starting crank until clutch adjustment lock is visible thru the inspection opening. Loosen adjustment lockscrew one full turn. Keep clutch from turning by securing the crankshaft at cranking end. Then, by means of a screw driver, turn adjusting ring one notch at a time in a clockwise direction, until a very firm pressure is required when engaging the clutch shifter lever, and as the clutch snaps into engaged position. Securely tighten adjustment lockscrew.

VH4D CLUTCH REDUCTION, Fig. 19

The clutch in the clutch reduction unit is the same as used in the power take-off unit and is adjusted thru two pipe tap openings; one for the adjustment lockscrew and the other for turning the adjusting ring. If one of the taps is inaccessible, adjustment can be made thru just one opening by rotating clutch slightly after adjustment lockscrew is loosened. Follow adjustment procedures as outlined in preceding paragrapn.

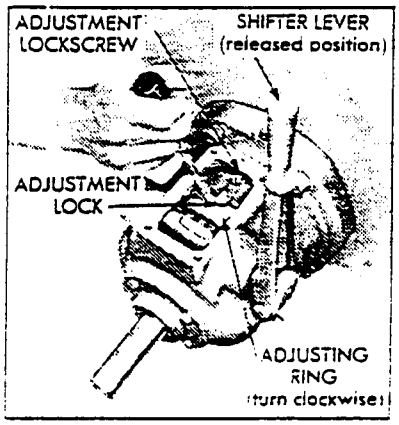


Fig. 18, VH4D
CLUTCH ADJUSTMENT

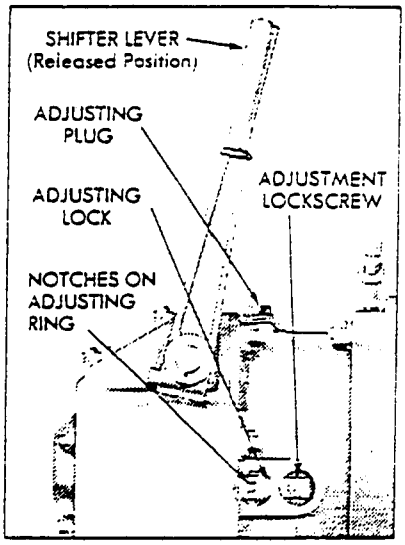


Fig. 19, VH4D
CLUTCH REDUCTION ADJUSTMENT

VG4D, V465D CLUTCH ADJUSTMENT

Rockford Clutch Fig. 20: After removing the inspection cover and disengaging clutch with the shifter lever, turn engine over by means of the hand crank, until the clutch adjustment lock is visible thru the inspection opening in the clutch housing. Prevent take-off shaft from turning by means of a drift punch wedged in place as shown. Then, loosen the lockscrew holding the adjustment lock in place. Insert a screwdriver in one of the notches and turn the adjusting ring, in a counter-clockwise direction, one notch at a time, until a very firm pressure is required to engage the clutch with the shifter lever. Tighten adjusting lockscrew and mount inspection cover.

TWIN DISC CLUTCH, Fig. 21: Pull adjusting lockpin out and insert a piece of 1/16" diameter wire into the hole on the side of the lockpin to keep pin in outer position. Turn the adjusting yoke in a clockwise direction

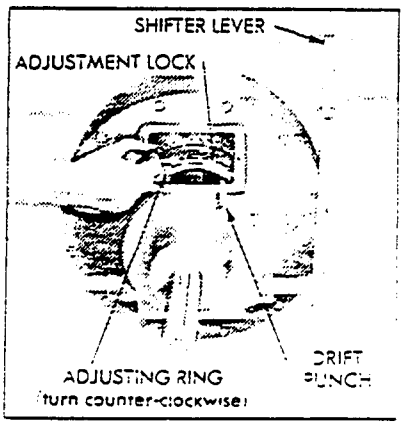


Fig. 20, VG4D, V465D
ROCKFORD CLUTCH ADJUSTMENT

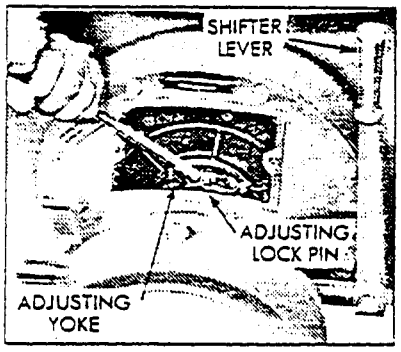


Fig. 21, VG4D, V465D
TWIN DISC CLUTCH ADJUSTMENT

as shown, or wedge a screw driver into the adjusting yoke and against the side of the inspection hole openings to keep the yoke from turning, then turn the take-off shaft counter-clockwise to adjust yoke enough so that the shifter lever requires a distinct pressure to engage. Remove wire from lockpin and turn adjusting yoke slightly, to allow lockpin to snap into hole in floating plate.

A new clutch generally requires several adjustments until the friction surfaces are worn in. Do Not let a new clutch slip, this will ruin the friction surfaces.

FLYWHEEL ALTERNATOR

Fig. 22 and Fig. 23

12 Volt - 10 Amp or 25 Amp Flywheel Alternator, consisting of a flywheel with Magnetic Rotor, Stator and Rectifier- Regulator modules, is optional equipment on models VH4D and VG4D-furnished when battery ignition is required. There are no brushes, commutator or belts to contend with and no adjustments are necessary.

Since the physical appearance of both 10 amp and 25 amp alternator systems are very similar, they can be distinguished from each other by the ammeter calibrations; 0 to 15 amps for the 10 amp circuit and 0 to 30 amps for the 25 amp circuit.

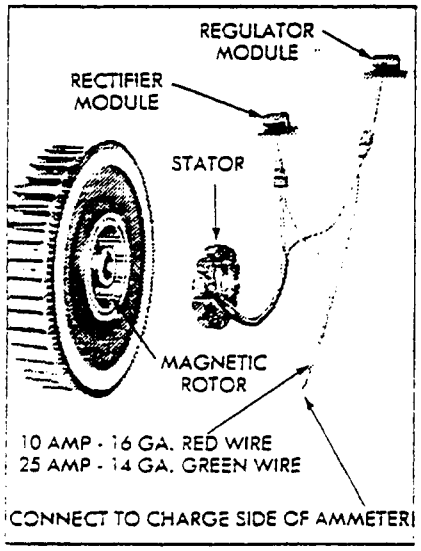


Fig. 22, FLYWHEEL ALTERNATOR

PRECAUTIONS to be exercised in the use of this flywheel alternator:

1. Do not reverse battery connections. This is a negative ground system only.
2. Connect booster batteries — positive to positive and negative to negative.
3. Do not polarize the alternator.
4. Do not ground any wires from stator or modules which terminate at connectors.
5. Do not operate engine with battery disconnected from system.
6. Disconnect at least one battery lead if a battery charger is used.

GENERATOR — WIRING CIRCUIT, Fig. 24

The model V465D engine is equipped with a 12 volt-17 amp generator in a negative ground electrical system. Do not reverse polarity-damage to both generator and regulator will occur. Engine will not operate with carburetor anti-diesel solenoid wire disconnected.

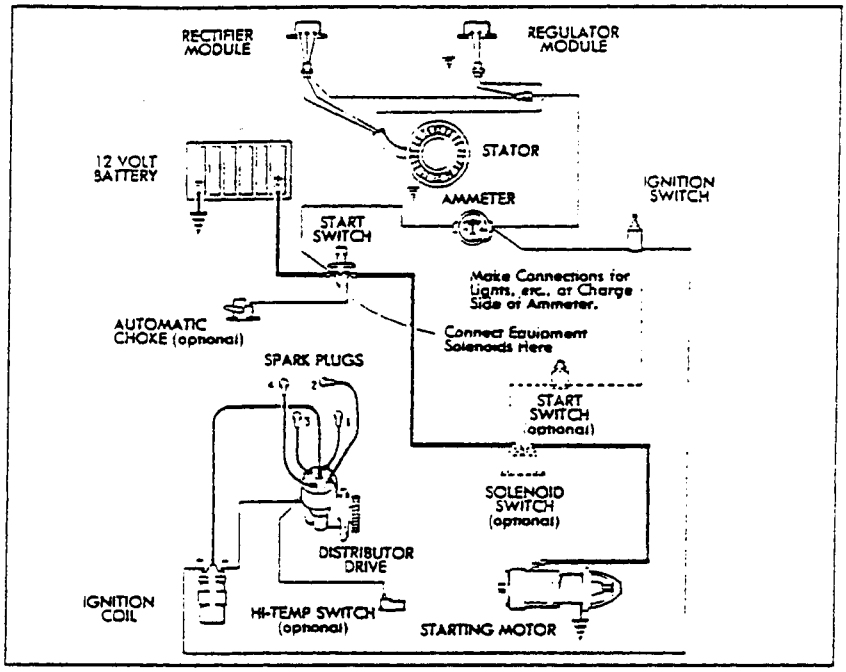


Fig. 23, WIRING DIAGRAM, Flywheel Alternator and Battery Ignition, Models VH4D, VG4D

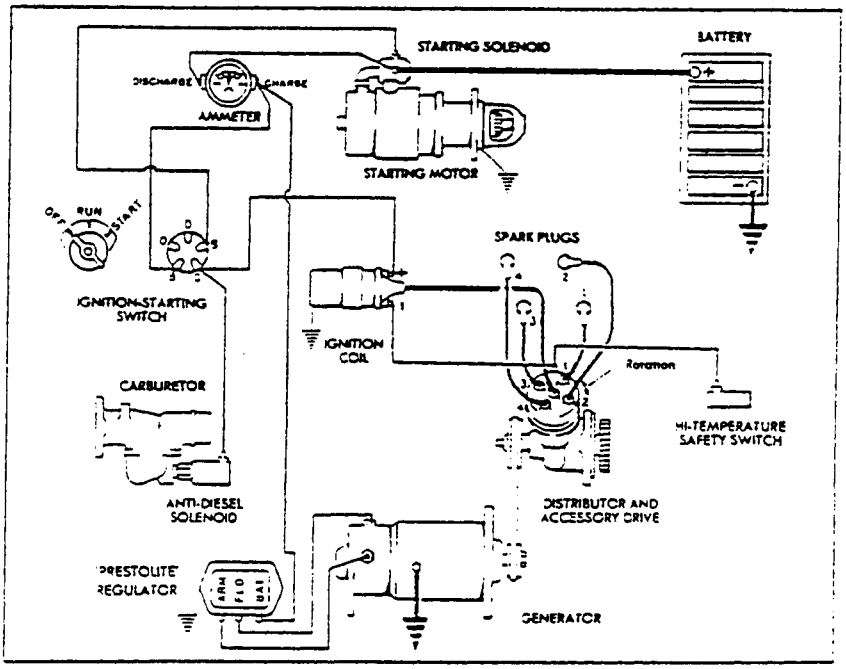


Fig. 24, WIRING DIAGRAM, Generator and Battery Ignition, Model V465D

TROUBLE SHOOTING

The three prime requisites essential to starting and maintaining sanstactory 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.

Anti-diesel solenoid valve at carburetor inoperative (model V465D).
Check for disconnected, loose or broken wire.

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.

Carburetor float needle valve stuck open. This condition would be indicated if fuel continues to drip from carburetor with engine standing idle.

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 magneto, 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.

Breaker points pitted or worn.

Water in gasoline.

Poor compression. See 'Compression'.

Sticky valves.

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

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

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 or rotating screen clogged with dirt.

Restricted exhaust.

ENGINE MAINTENANCE SCHEDULE	Page Ref.	Daily	Weekly or 50 hrs.	100 hrs.	250 hrs.	Seasonally or 500 hrs.
CHECK OIL LEVEL. Add to full mark - Do not overfill.	2	●				
CHECK AIR CLEANER. Shake out accumulated dirt from dry element cleaner - Maintain oil level in oil bath type cleaner.	4	●				
CLEAN AIR INTAKE SCREEN. Clean cooling fins if necessary.	1	●				
GREASE CLUTCH THROWOUT BEARING (VG4D, V465D).	3	●				
CHANGE CRANKCASE OIL.	2		●			
CLEAN AIR FILTER ELEMENT. DRY Element and OIL Bath types.	4		●			
CLEAN CRANKCASE BREATHER CAP.	4		●			
GREASE CLUTCH HOUSING BEARING (VG4D, V465D).	3		●			
REPLACE OIL FILTER. In adverse conditions replace every oil change.	4			●		
LUBRICATE DISTRIBUTOR SHAFT.	4				●	
CHECK COMPRESSION. Pressure should not vary more than 10 p.s.i. between cylinders. Remove head - clean out carbon deposits. Reseat valves if necessary.	-				●	
INSPECT SPARK PLUGS and BREAKER POINTS. Replace if necessary and regap to specification.	5				●	
INSPECT FUEL FILTER. Clean filter screen and glass bowl.	4				●	
LUBRICATE DISTRIBUTOR CAM and breaker arm pivot.	4				●	
INSPECT COOLING SYSTEM. Remove shrouding and scrape off dirt from between fins, around cylinders and from shrouding.	1				●	
INSPECT STARTING MOTOR. Check for loose mounting and cable connections.	5				●	
CHANGE OIL IN CLUTCH and REDUCTION GEAR HOUSINGS.	2					●

Bertea Industrial Division
July 1985

Service Manual Series VS30-700250

Remote Control
Proportional Directional Valve
Load Sense Circuits

Parker
Fluidpower

OPERATION

The Bertea proportional valve control system converts a low power electrical signal (0.25 watts) into a differential hydraulic control pressure which is used to position the directional valve spool.

The control for each spool section contains three basic components as shown on Figure #12.

1. A remote electrical controller that operates on 12 VDC and provides a 0-60 ma command that is proportional to lever position.

2. An electrohydraulic pilot valve to convert this 0 to 60 ma command into a 0-240 psi differential control pressure.

3. A directional valve module to control the volume and direction of the main power system flow.

The remote controller consists of a simple potentiometer and resistors wired into a bridge network in a manner to provide a plus or minus command related to the direction of lever movement from center. Also, to provide a proportional command related to lever position or degree of lever rotation. The controller is designed to provide single or multi station control for a single pilot valve. The controller operates on 12 VDC supply and provides a 0 to 60 ma output command.

The pilot valve is an electrohydraulic device that converts this 0 to 60 ma command into a 0-240 psi differential control pressure to be used to control the position of the directional valve spool. The configuration is a pressure recovery unit with approximately 80% recovery efficiency. This means that with a 300 psi drop across the pilot valve from supply to tank, it will provide a proportional differential control pressure of 0 to 240 psi between its output cylinder ports (C_1 & C_2). The cylinder ports (C_1 & C_2) are connected to the ends of the directional valve spool.

The fluid circuit of the pilot valve is based on two jets of fluid that are formed by the supply pressure of 300 psi being converted into velocity as the fluid escapes through the supply nozzles. These two jet streams, if not interrupted, will impact into the two receivers (C_1 & C_2) where the velocity is converted back into pressure.

The command voltage from the remote controller is passed through the coil of the pilot valve. This creates a magnetic field based on the polarity of the command signal. As the command signal, and therefore the magnetic field, increases the armature is deflected and pivots on the suspension member (Figure 3 and 4). This moves the diverter blade that is located between the two jet streams (Figure 5, 6, and 7). The direction of movement is dependent upon the polarity of the command, and the degree of movement upon the magnitude of the command.

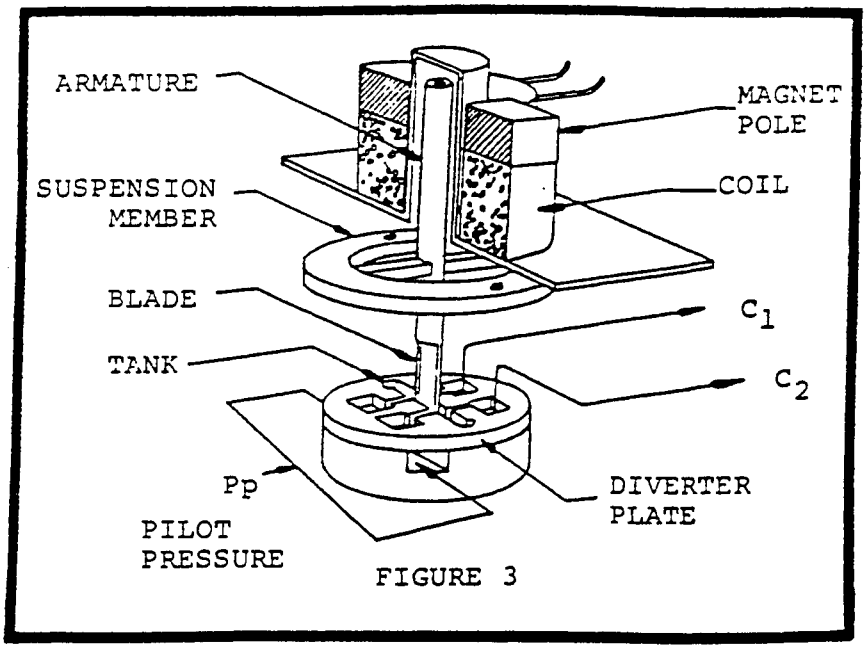


FIGURE 3

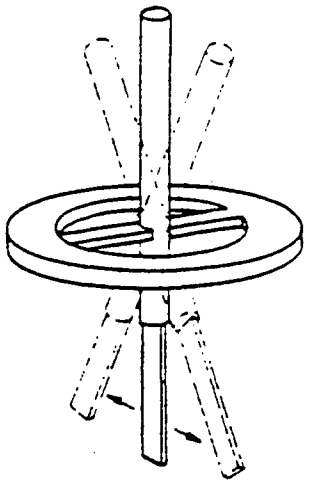


FIGURE 4
(Armature Motion)

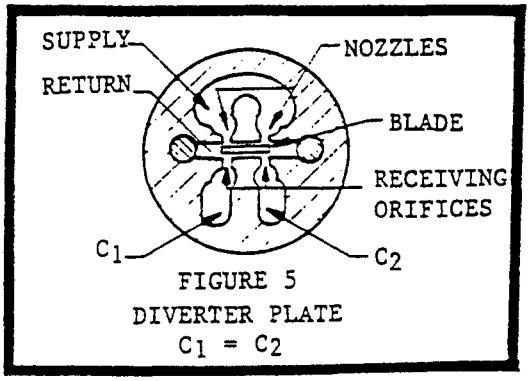


FIGURE 5
DIVERTER PLATE
$C_1 = C_2$

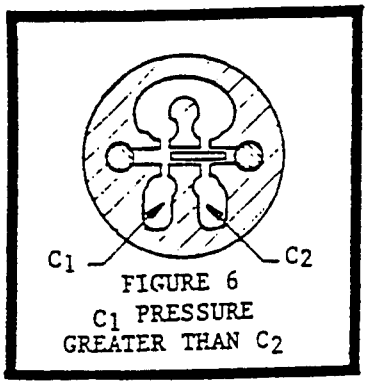


FIGURE 6
C_1 PRESSURE
GREATER THAN C_2

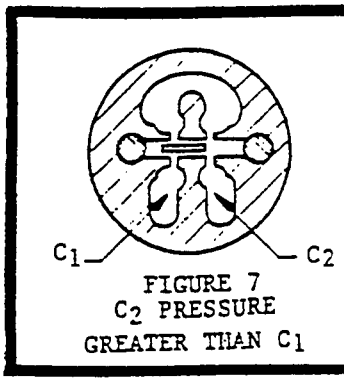


FIGURE 7
C_2 PRESSURE
GREATER THAN C_1

The center position of the blade (no command signal) partially interrupts both jets and is adjusted to provide equal pressure at C_1 and C_2 (Figure 5). This equal pressure is called the null of the valve. As the command signal is increased, the blade will interrupt one jet to a larger degree and reduce its interruption of the other jet. This generates a differential pressure between C_1 and C_2 that is proportional to input command. At maximum command, the blade completely blocks one jet and is free from the other jet.

The directional valve spool section is a modified 30 gpm, closed center, stack valve rated at 3000 psi operating pressure for a six spool section stack assembly. Each spool section is configured with high rate springs in each end cap that oppose spool movement in one direction only. Therefore, when the control pressure from the pilot valve C_1 and C_2 ports is ported to the end caps, the in-

crease in pressure in one end cap, onto the end of the spool is resisted by the spring on the oppoiste end.

As the differential pressure between C_1 and C_2 is increased by the pilot valve, in response to an increase in electrical command, the differential pressure across the spool increases, resulting in spool movement proportional to the spring rate versus pressure differential. The spool is 0.75" diameter and the springs have a 200 #/in rate. The failure modes of this configuration are safe since any loss of electrical command or control pressure results in the spool returned to the center position by a very high spring load.

The purpose of a load sensing pump is to provide variable flow and variable pressure in response to the working circuit requirements. Therefore, each spool section contains a load sense pressure pick-up circuit to be used to transmit the highest working pressure signal, in the module, to the load sense port of the pump. This pick-up port, in each spool section, is downstream of the metering notch on the directional valve spool and is isolated from both the pump supply and cylinder ports by the spool overlap when the spool is in the center position.

An additional feature provided in the spool section is a compensator spool (pressure reducing), Figure 9, that will maintain 100 psi drop across the metering notch of the directional valve spool. This is accomplished by porting controlled pressure to one end of the compensator spool and the load pressure to the other end with the spring load. This combination will provide a constant flow for any directional valve spool position, regardless of fluctuating load pressures or supply pressures. For example, the operation of a rotation function will not be affected when a lift function is added to the load demand.

The load sense logic circuit is configured to always provide the highest working pressure signal from the spool sections to be transmitted, thru the inlet section, to the load sense port of the pump. These pumps are designed to maintain an output pressure of 150 to 400 psi above the pressure signal at the load sense port. Therefore, as load pressures fluctuate, the pump pressure will always be higher by this delta pressure value.

The compensating feature in each spool section provides a pressure compensated flow control for each input command. The metering notch opening on the directional valve spool creates a fixed flow area related to spool movement. The compensator spool (i.e. - pressure reducer) varies the supply pressure to the notch, as the cylinder load varies, to always maintain a 100 psi drop across the notch. Therefore, changes in pump and/or load pressure will have minimal effect on the flow to the function. This permits simultaneous operation of multiple functions with supply from one pump.

In order to provide the desired control over as broad a flow range as possible, the spool configurations have four basic flow notches available. The ratings of 2.6, 6.5, 13 and 26 gpm are based on maximum spool stroke and 100 psi drop across the metering notch. Flows above 25 gpm require special notches.

An additional advantage of load sense systems is that the logic circuit can often be used to provide special control for specific functions. For example, single or multiple pressure limitation can be added to a function as shown on Figure 12 and as described under the installation section.

The stack valve module provides a separate hydraulic circuit for the power system fluid and a separate circuit for the pilot valve control fluid. The pilot valve control fluid circuit operates at 300 to 400 psi and at a flow related to the number of pilot valves in the stack requiring 0.6 gpm each. The advantage of this separate circuit is that it provides a means of filtering the important control system fluid at 25 micron independent of the power system fluid. In addition, it allows for a low pressure operation at 300 psi of the parasitic control system rather than at system pressure. Optional circuits to provide this flow are shown on Figure 12.

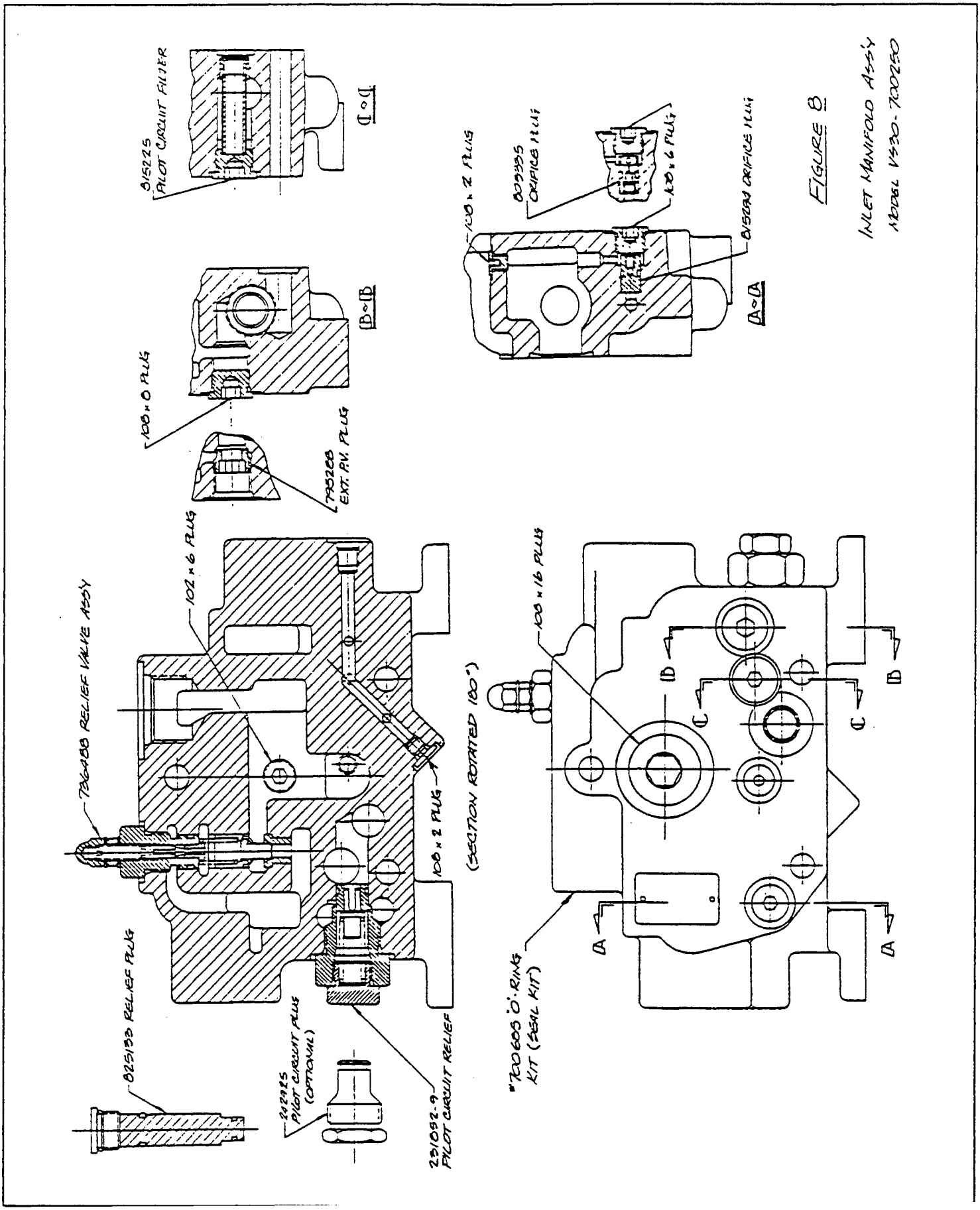
FILTRATION AND HYDRAULIC SYSTEM PREPARATION

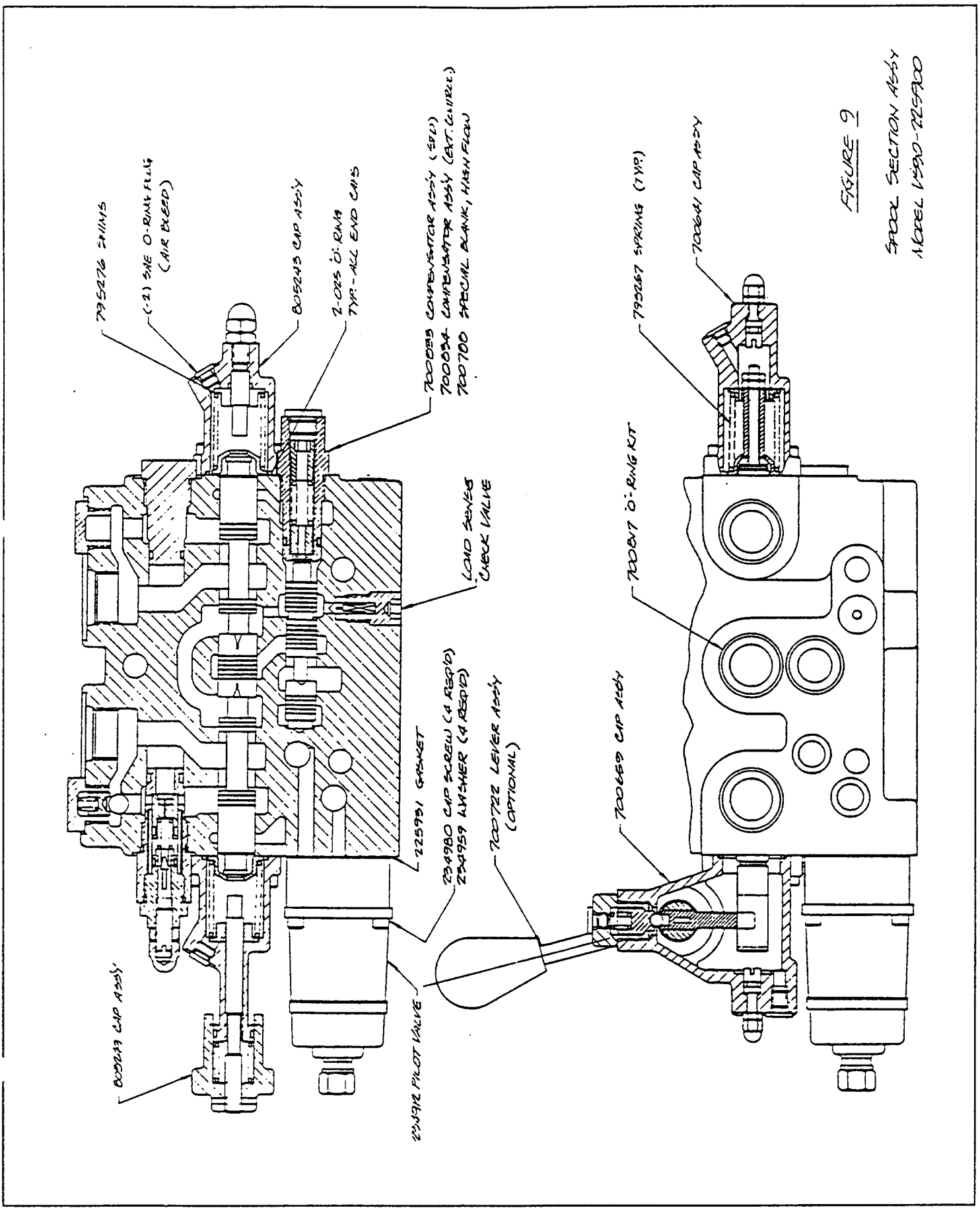
The life of any hydraulic system is sensitive to the cleanliness of the fluid stream. It is recommended that good cleaning and flushing procedures be followed in the assembly and test of the system. The purpose of separating the control pressure fluid from the main power circuit fluid as shown on Figure 12 is to assure continuous filtration of the fluid supply to the pilot valves.

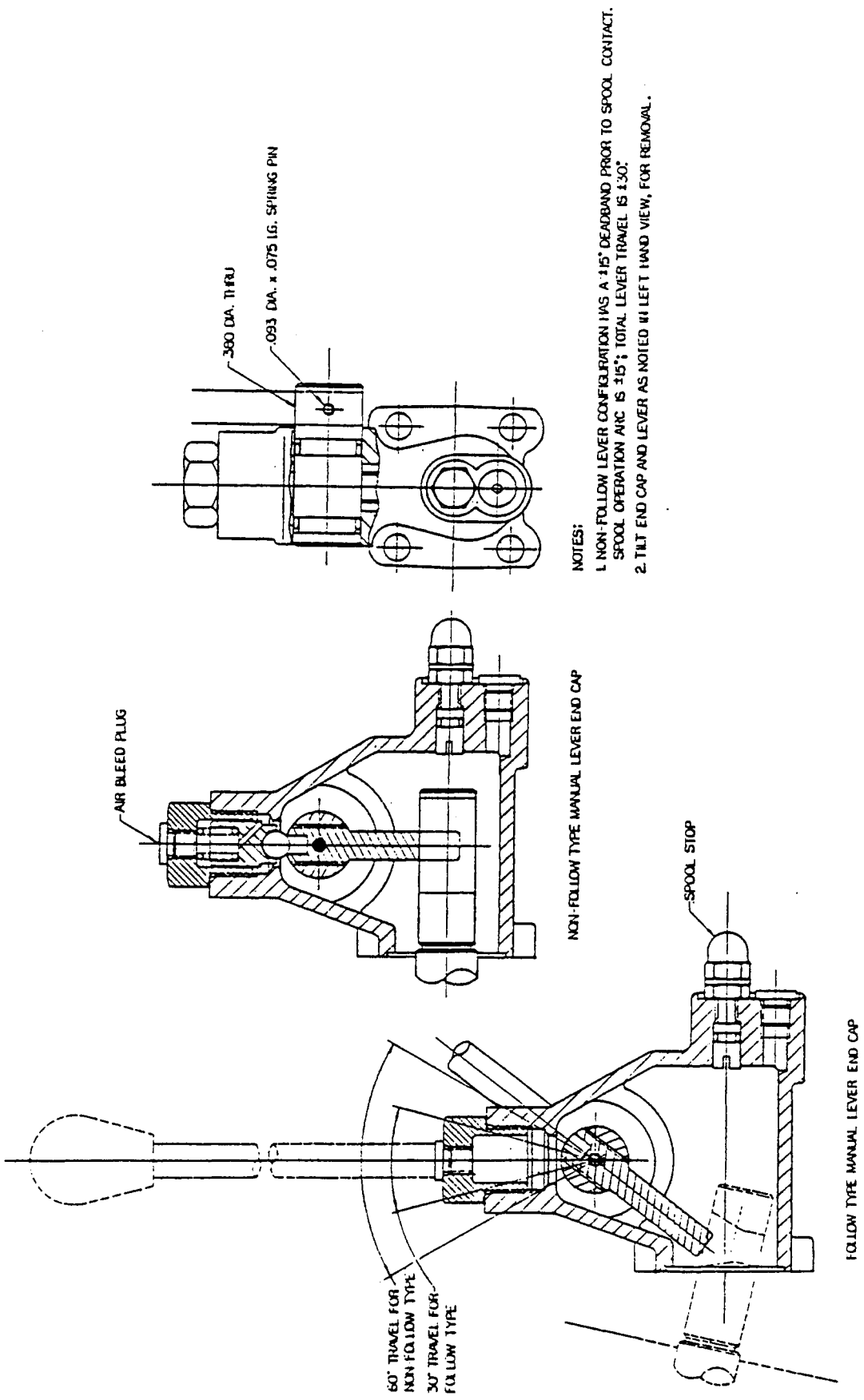
Although the minimum flow rate will be based on the number of pilot valves used, it is recommended that a filter as large as possible be used to insure long filter life.

The main power fluid circuit filtration should be 10 micron as shown on Figure 12. A suction strainer on the pump and magnetic tank unit are beneficial to filter life. A magnetic unit in the circuit is required to remove the very fine ferrous wear debris that typically is not removed by the standard filters. This debris not only acts as a lapping compound in the spool bore fit but also may be attracted into the magnetic field of the pilot valve resulting in sludge in the armature area.

A 100 micron strainer is installed into each inlet manifold (Figure 8) to provide second level protection in case of debris in tubing, etc.


INLET MANIFOLD ASS'Y
MODEL V330-700250
FIGURE 8
A-A
B-B
C-C
D-D
100 x 16 PLUG
(SECTION ROTATED 180°)
*700605 O-RING KIT (SEAL KIT)
100 x 2 PLUG
102 x 6 PLUG
736488 RELIEF VALVE ASS'Y
825153 RELIEF PLUG
242925 PILOT CIRCUIT PLUG (OPTIONAL)
25052-9 PILOT CIRCUIT RELIEF
100 x 8 PLUG
795268 EXT. RV. PLUG
815225 PILOT CIRCUIT FILTER
100 x 2 PLUG
803935 ORIFICE PLUG
100 x 6 PLUG
815284 ORIFICE PLUG


795276 PINS
(-2) SAE O-RING PLUG (AIR BLEED)
800243 CAP ASSY
2-025 O-RING TYP - ALL END CAPS
700055 COMPENSATOR ASSY (SAE)
700054 COMPENSATOR ASSY (EXT. CAVITY)
700700 SPECIAL BLANK, HIGH FLOW
LOAD SENSE CHECK VALVE
225931 GASKET
234980 CAP SCREW (4 REQD)
234959 WASHER (4 REQD)
700722 LEVER ASSY (OPTIONAL)
800243 CAP ASSY
23J91Z PILOT VALVE
795267 SPRING (TYP)
700641 CAP ASSY
700617 O-RING KIT
700669 CAP ASSY
FIGURE 9
SPOOL SECTION ASSY
MODEL V620-MSF600


.380 DIA. THRU
.093 DIA. x .075 LG. SPRING PIN
NOTES:
1. NON-FOLLOW LEVER CONFIGURATION HAS A 15° DEADBAND PRIOR TO SPOOL CONTACT. SPOOL OPERATION ARC IS ±15°; TOTAL LEVER TRAVEL IS ±30°
2. TILT END CAP AND LEVER AS NOTED IN LEFT HAND VIEW, FOR REMOVAL.
AIR BLEED PLUG
NON-FOLLOW TYPE MANUAL LEVER END CAP
SPOOL STOP
60° TRAVEL FOR NON-FOLLOW TYPE
30° TRAVEL FOR FOLLOW TYPE
FOLLOW TYPE MANUAL LEVER END CAP

The manual override assembly (805249) will provide direct manual control of the spool in the event of a failure in the remote control system. The hand knob is held in the thread disengaged position by a light spring to prevent inadvertent operation. Press the knob inward while rotating to engage the threads in the cap and drive screw. Continued rotation clockwise will provide flow from the cylinder port adjacent to this end cap.

A plug is provided, as shown, to bleed the air from each end cap after initial assembly and operation. Air trapped in the spool end cap will reduce the response of the valve assembly. The screw in the end of the cap provides an adjustable spool stop to limit maximum travel.

The manual lever end cap assembly (700659) with the single spring end cap assembly (700641) provides direct control of the spool with or without the pilot valve. The standard configuration is a non-follow type (Figure 10) which permits the pilot valve to move the spool without moving the lever. A $\pm$ 15° deadband is built into the assembly to provide this feature. The follow type provides direction connection to the spool.

Each load sensing spool section contains a spool compensator to maintain a 100 psi drop across the metering notch on the directional valve spool. The options in the compensator assembly include:

#700833 Standard Compensator

#700834 Compensator, External Control

#700788 Special Blank, High Flow

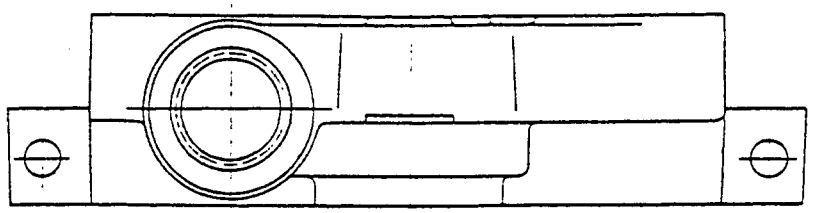
The 700834 External Control Compensator provides an external port from the spring cavity that can be used to control the load pressure of the spool section from an external source such as a relief valve. This is shown on Figure 12.

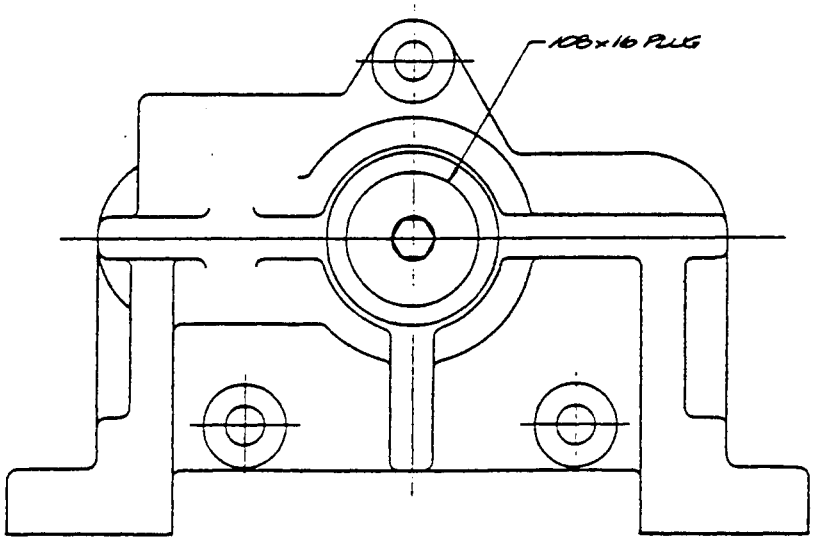
The 700788 Special Blank Compensator eliminates the compensation feature and is normally used for flows in excess of 30 gpm in order to minimize pressure drop.

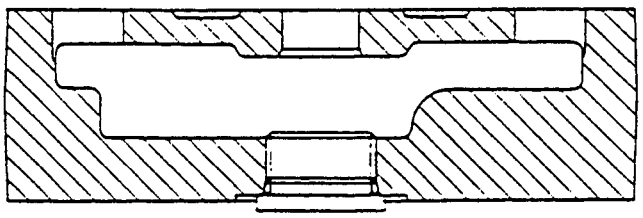
Each spool section contains a load sense circuit check valve to isolate individual spool sections from higher pressure that may be in the load sense logic circuit.

C. Outlet Manifold (Figure 11)

The outlet manifold provides the function of being the end section of the stack and provides connection to the tank. Either port may be used for the tank connection.







OUTLET ASS'Y
MODEL V530-700250

D. Pilot Valve (Figure 14)

The pilot valve ratings include the following:

Coil	60 ohm resistance
Operating Current	60 ma
Operating Voltage	3.6 volts
Maximum Current	100 ma
Required Flow	.55 to .65 gpm at 300 gpm differential

The correct mounting orientation of the pilot valve is determined by the locating pin in the pilot valve body. Care must be exercised to assure correct matching of the gasket between the two faces.

A positive polarity of the red wire of the pilot valve will provide flow from the cylinder port on the opposite side of the spool section from the pilot valve (Cylinder Port "B").

There are no external adjustments for the pilot valve nor mechanical connections to the spool. If a problem related to the pilot valve develops, the unit should be replaced and returned to the factory.

INSTALLATION (Figure 12)

This stack valve was designed for simple installation and easy field trouble shooting. All subassemblies are interchangeable and easily replaced. With electrohydraulic control systems, the most sensitive component is the pilot valve and therefore the installation of the module should consider the accessibility of the pilot valves for easy replacement.

The valves are not sensitive to attitude and may be installed in any reasonable manner on the vehicle. Caution should be exercised to avoid placing steel tubing or magnetic material within 1.5 inches of the pilot valve as shown in Figure 13. Magnetic material will affect the flux field of the pilot valve permanent magnet and may cause a shift in the valve null position.

The 231852 pilot pressure relief valve establishes the 300 psi differential pressure for the pilot valve circuit. Only one pilot pressure relief valve is required per vehicle and therefore when two or more modules are used, this port must be closed with a 231856 plug in the extra modules. Each pilot valve requires a continuous flow of .55 to .65 gpm at 300 psi ΔP. A four spool section installation would require four times .6 gpm plus 1.0 gpm for assurance or a 3.4 gpm supply.

LOAD SENSE PUMP

A pump that has less than 400 psi standby pressure will require a circuit that permits the pump to unload during standby and also provide pilot circuit pressure (300 psi) prior to movement of the directional valve spool. The use of a pilot circuit pressure sensing line connected thru a shuttle and a 3-way normally closed solenoid valve to the load sense port of the pump will provide this feature.

During standby, the valve is closed, allowing the pump control circuit to bleed down to tank pressure and unload the pump for standby. Moving the lever of a remote electrical controller will close a switch and energize the solenoid valve to the open position. The pump load sense control port is now connected to the pilot circuit pressure requirement (300 psi) and it will provide the flow and pressure to meet this demand.

When a directional valve spool is moved into a fluid metering position, it will connect the pump load sensing line to the cylinder port through the shuttle. The pump control system will now follow this higher pressure demand.

COMPENSATED PUMPS

Since a compensated pump typically holds a high pressure during standby, the pilot circuit always has adequate pressure for operation.

LOAD SENSE VALVE MODULE (VARIABLE PUMPS)

A typical (4) spool valve module is shown in Figure 12 with the inlet and outlet manifolds. Each spool section contains a load sensing circuit with a compensator to hold 100 psi differential across the metering notch of the directional valve spool. The check valve in the load sense line of each section provides control pressure isolation for that section.

An optional feature is available to provide external load pressure limitation for individual spool sections, as shown. For example, if one function requires a maximum continuous limitation of 1000 psi, a small relief valve, set at that pressure, can be installed on the optional external load control line. The maximum pressure of the other functions will be limited by the system relief valve or pump compensator setting.

If a dual pressure limitation is desired, a solenoid valve can be used on the external line as shown. One mode of operation would be limited by the system relief valve and the second mode by the relief valve on the external load control line. Logically, multiple relief valves can be used if required.

TROUBLE SHOOTING

The modular design of the valve provides simple field trouble shooting and service. The first step should be to isolate the problem to a specific component if possible. For example, change the remote controller leads from one pilot valve to another to check if the problem follows the remote controller.

The same procedure can then be used to check the pilot valves by interchanging two units. Care should be taken to avoid introducing dirt into the system when removing pilot valves.

The pilot valve converts an electrical input signal of 0 to 3.6 volts into a pressure unbalance across the directional valve spool. At the factory setting of 300 psi differential pressure across the pilot valve, the directional valve spool deadband will be a minimum of 20%. Increasing the differential pressure across the pilot valve will reduce the deadband significantly.

Control problems are usually either electrical, hydraulic, or mechanical.

ELECTRICAL PROBLEMS

1. Use a voltmeter to check for zero command and a maximum command of 3.6 volts. When controller lever is in the center position, the output command should be zero.

2. Disconnect the wires from the pilot valve with 300 psi at the pilot circuit. If function operates replace pilot valve.

HYDRAULIC PROBLEMS

A very important requirement in load sense circuits is that the load sense pump must provide at least 400 psi when the directional valve spool begins to move. This will assure a continuous 300 psi to the pilot circuit during the initial metering (see - Load Sense Pump on page 14).

1. Poor Metering Control

   This can be caused by the use of a directional valve spool with a metering notch that is too large. For example, a 30 gpm notch where a 8 gpm should be used.

   When the standby pump pressure is less than 400 psi, resulting in less than 300 psi pilot circuit pressure, the initial load sense signal from the cylinder port will cause both the pump and pilot circuit pressure to jump up. This results in additional spool movement for the same command.

TROUBLE SHOOTING CHART

POTENTIAL TROUBLE	PROBABLE CAUSE	REMEDY
Control valve does not respond to command.	1. Controller does not provide signal (60 ma max reqd).	1. Replace controller.
	2. Open wire in control cable.	2. Replace cable.
	3. Shorted Terminal connection.	3. Check for terminal end contacting case or poor clamping of wire ends on terminal strip.
	4. Failed pilot valve.	4. Replace pilot valve.
	5. Jammed spool.	5. Remove end cap and check spool freedom.
High null bias (Actuator drifts or hydraulic motor slowly rotates when controller returns to neutral).	1. Failed controller resulting in a command at neutral position.	1. Replace controller.
	2. Failed pilot valve.	2. Replace pilot valve.
	3. Sticking spool due to contamination.	3. Remove end cap and check spool freedom.
Low flow rate from cylinder port, motor turns slowly or cylinder moves slowly at maximum command.	Directional valve spool is not traveling far enough.	
	1. Caused by low pressure gain of pilot valve.	1. Check filter in the inlet section for plugging.
	2. Caused by low control pressure supply.	2. Replace pressure regulator if necessary.
	3. Plugged pilot valve.	3. Change pilot valve.
Poor response, function shuts off slowly when command is removed.	1. Restricted tank return line.	1. Check for restrictions in tank return line.
	2. Low spool spring preload.	2. Check for correct spring and shims in end caps.
	3. Sticking spool due to contamination.	3. Remove end cap and check spool freedom.
	4. Air in end caps.	4. Bleed air from end caps.

Slow response by the pump to increase output pressure above the working cylinder pressure will cause a jerk in the operation. This can be checked by comparing the pressure at a gauge in the load sense line with a gauge in the pump output line. These readings should maintain a constant differential during spool operation.

2. LOW FUNCTION SPEED

Low function speed at maximum command may be caused by low pump pressure differential over the working cylinder pressure. The pump pressure should be a minimum of 200 psi over the working cylinder pressure in order to accommodate the 100 psi drop across the spool metering notch plus other circuit losses.

If the pilot circuit pressure is low or if contamination is restricting the flow thru the filters or pilot valve, the control circuit may not generate enough pressure in the spool end cap to move the spool full stroke. Check for inlet filter contamination and/or replace the pilot valve.

3. NULL SHIFT

If the function continues to operate after removal of the input command the problem could be a null shift in the pilot valve or center position of the controller. Check the controller by removing the wires from the pilot valve with 300 psi in the pilot circuit. If the problem continues, remove the 300 psi in the pilot circuit while the main power circuit is still operating. If this stops the function, it would indicate that the pilot valve is providing output differential pressure without an input command (ie - null shift).

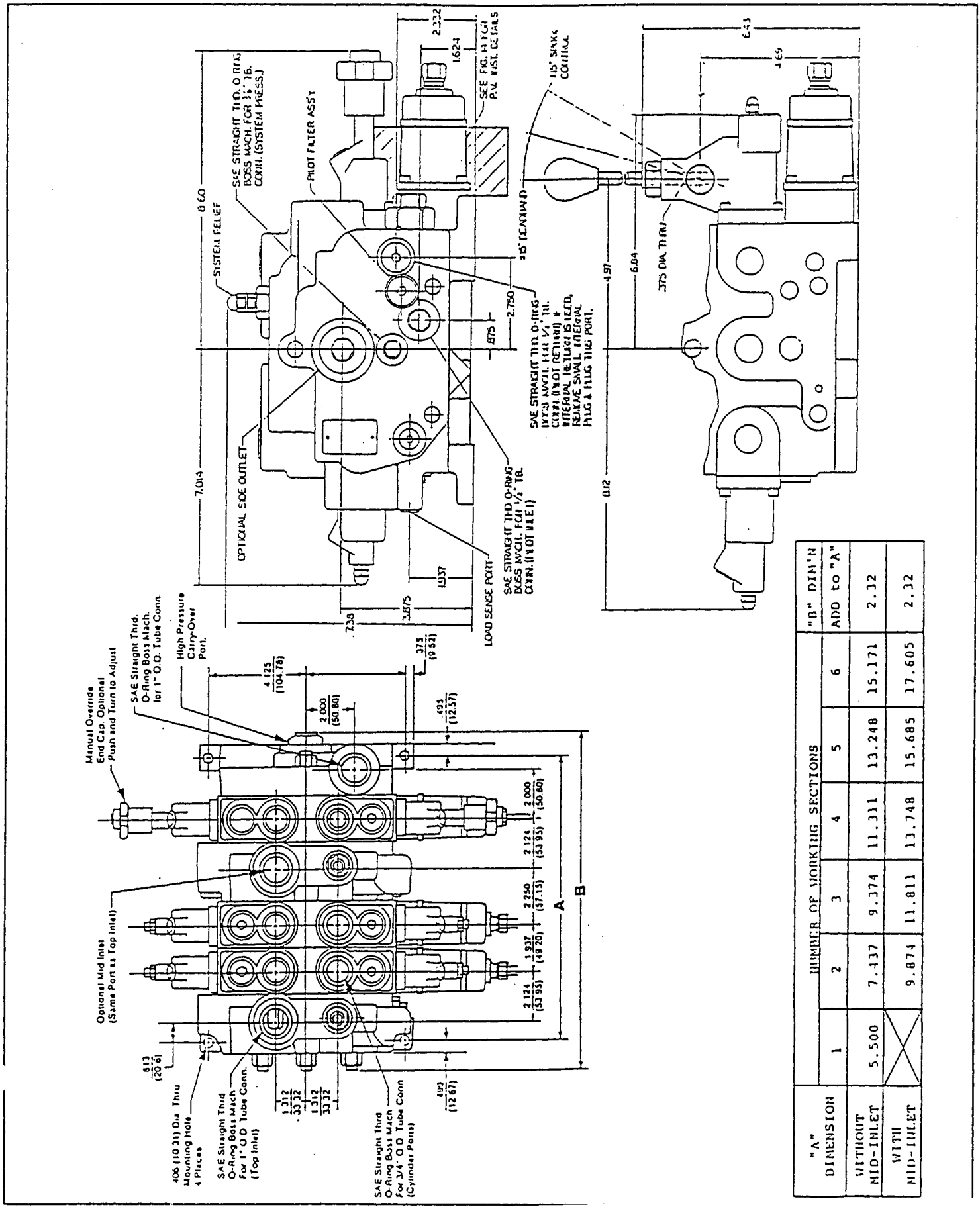
A null shift is quite often caused by contamination in the nozzles. These pilot valves are easily replaced and should be returned to Bertea for clean up. The control system filter and the filter in the inlet manifold should be checked for plugging or failure.

4. ENGINE START MOTION

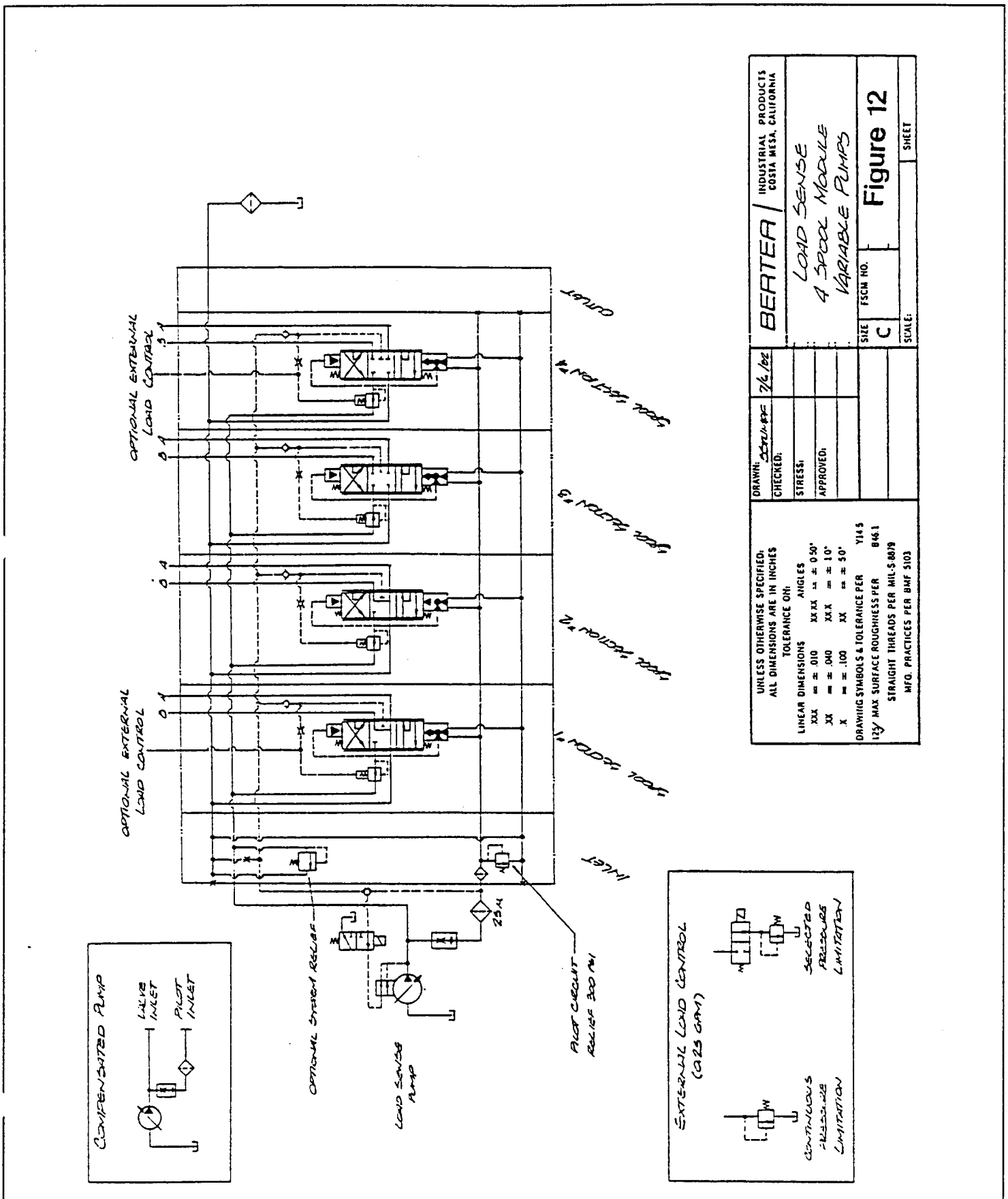
Unwanted motions that occur during engine start are usually caused by air in the spool end caps. Each cap has an air bleed plug that should be used while the pilot circuit is operating at 300 psi.

The electromechanical operation of the pilot valve can be checked by removing the valve and observing the motion of the end of the diverter blade while moving the remote control lever. The end of the blade is visible in the center slot of the gasket face of the valve.

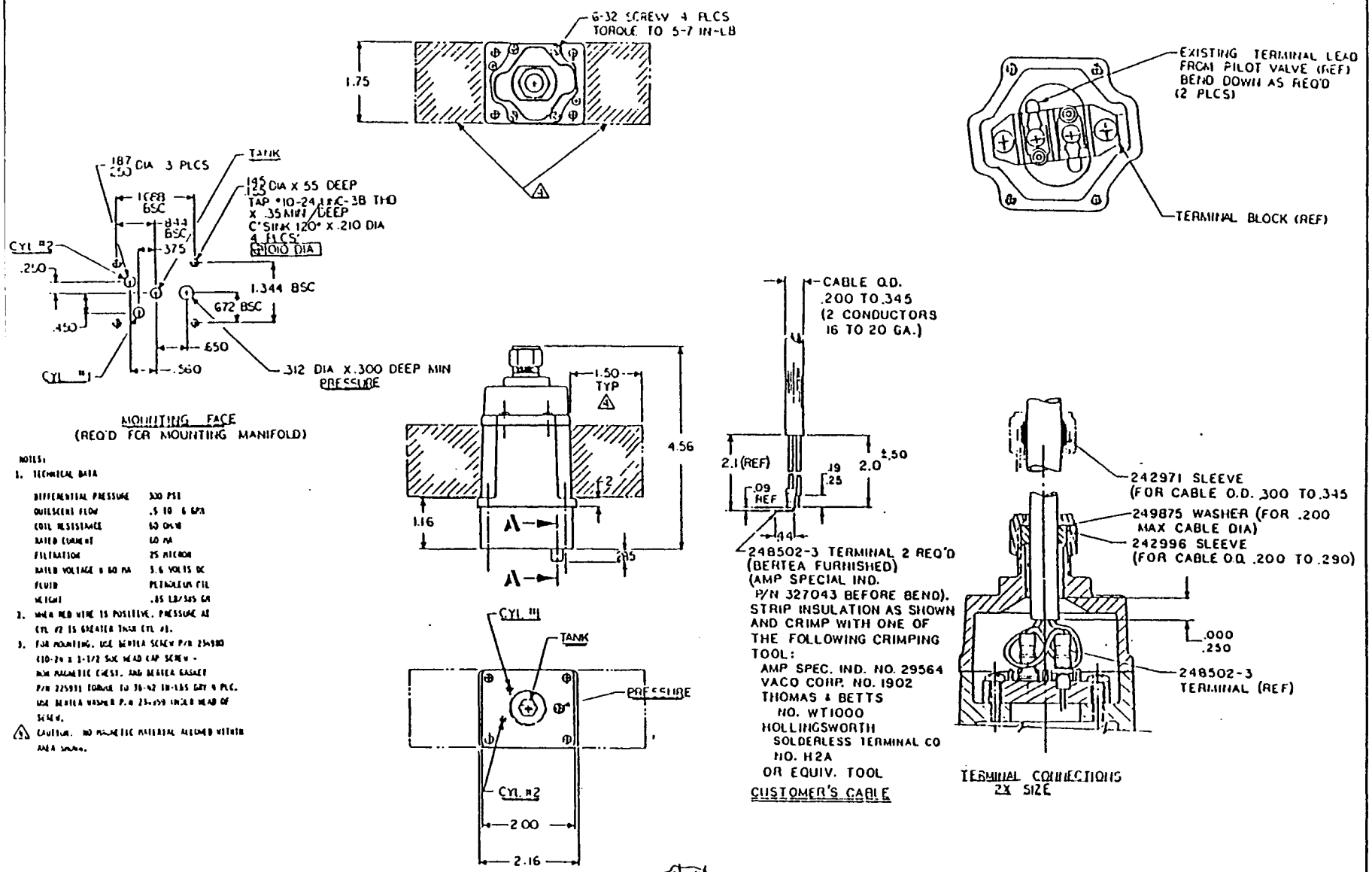
Mechanical failure, such as a broken part or mechanical null shift, can be checked by replacing the pilot valve.



"A" DIMENSION	NUMBER OF WORKING SECTIONS						"B" DIM'N
	1	2	3	4	5	6	ADD to "A"
WITHOUT MID-INLET	5.500	7.437	9.374	11.311	13.248	15.171	2.32
WITH MID-INLET	X	9.874	11.811	13.748	15.685	17.605	2.32


OUTLET
OPTIONAL EXTERNAL LOAD CONTROL
OPTIONAL EXTERNAL LOAD CONTROL
INLET
25 M
OPTIONAL SYSTEM RELIEF
LOAD SENSE PUMP
PILOT CIRCUIT RELIEF 300 PSI
COMPENSATED PUMP
VALVE INLET
PILOT INLET
EXTERNAL LOAD CONTROL (0.25 GPM)
CONTINUOUS PRESSURE LIMITATION
SELECTED PRESSURE LIMITATION
BERTEA | INDUSTRIAL PRODUCTS COSTA MESA, CALIFORNIA
LOAD SENSE 4 SPOOL MODULE VARIABLE PUMPS
Figure 12
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS ARE IN INCHES TOLERANCE ON:
LINEAR DIMENSIONS ANGLES
DRAWN:
CHECKED:
STRESS:
APPROVED:
SIZE C
FSCM NO.
SCALE:
SHEET
DRAWING SYMBOLS & TOLERANCE PER Y14.5
125 MAX SURFACE ROUGHNESS PER 846.1
STRAIGHT THREADS PER MIL-S-8879
MFG. PRACTICES PER BMF 5103

REV



NOTES:

1. TECHNICAL DATA

DIFFERENTIAL PRESSURE	300 PSI
QUIESCENT FLOW	.5 TO 6 GPM
COIL RESISTANCE	60 OHM
RATED CURRENT	60 MA
FILTRATION	25 MICRON
RATED VOLTAGE @ 60 MA	5.6 VOLTS DC
FLUID	PETROLEUM OIL
WEIGHT	.85 LB/365 GM

2. WHEN RED WIRE IS POSITIVE, PRESSURE AT CYL #2 IS GREATER THAN CYL #1.
3. FOR MOUNTING, USE BERTEA SCREW P/N 234980 (10-24 x 1-1/2 SOC HEAD CAP SCREW - NON MAGNETIC CRES), AND BERTEA GASKET P/N 225931 TORQUE TO 36-42 IN-LBS DRY 4 PLC. USE BERTEA WASHER P/N 234959 UNDER HEAD OF SCREW.
4. CAUTION: NO MAGNETIC MATERIAL ALLOWED WITHIN AREA SHOWN.

TABLE OF ELECTRICAL CABLES REF.

TYPE	NO OF COND	WIRE SIZE	O D (REF)
SJO	2	18 AWG	.300
SJO	2	16 AWG	.330
SDN	2	18 AWG	.278
SDN	2	16 AWG	.292

Bertea Industrial Division

INSTALLATION DRAWING - FOR
234912 PILOT VALVE

SIZE	CAGE CODE NO.	
D	82106	Figure 14

SHEET 1 OF 1 SHEETS

Mark Industries

TITLE	VENDOR CHAPTER
MODEL	62 4X2
NOTES	P/N 21776

VENDOR	SECT.
2	19

PAGE

MINIPAK DISASSEMBLY/ASSEMBLY INSTRUCTIONS

DISASSEMBLY: (See Figure)

NOTE: Before attempting to disassemble this or any other hydraulic component, prepare a **CLEAN** work area.

1. Remove coil nut (1) and slide coil (3) off tube (4).
2. Remove nuts (18), mounting bracket (17) and washer (16) from the inlet end of the valve bank.
3. Remove inlet (15), attachments (20) as necessary, and O-Rings.
4. Remove valve sections (14), one at a time, removing O-Rings (12) or (13) between each section. Remove only those sections to be repaired or replaced.
5. Use a 1 1/4" wrench to loosen tubes (4) from body.

CAUTION: Use proper tools to avoid damaging tube sub-assembly.

6. Remove tube sub-assembly by hand. Spring (8) and spring retainer (9) may fall from valve body.
7. Slide pin, plug, and plunger out of tube.

NOTE: Pin, plug, and plunger are a matched set. Do **NOT** mix parts.

8. Use a small punch to gently push manual override pin into tube until it is free and falls out.
9. If valve has manual override option "JJ", use a screwdriver inside the tube to hold pin (5) from turning while removing the palm button.
10. Repeat steps 5 through 8 to remove tubes on the opposite side of the valve.
11. Gently slide spool (14) from valve body. Make a note of its position in the valve body. Spool cannot be turned around. It must slide into the body in the same position it came out.

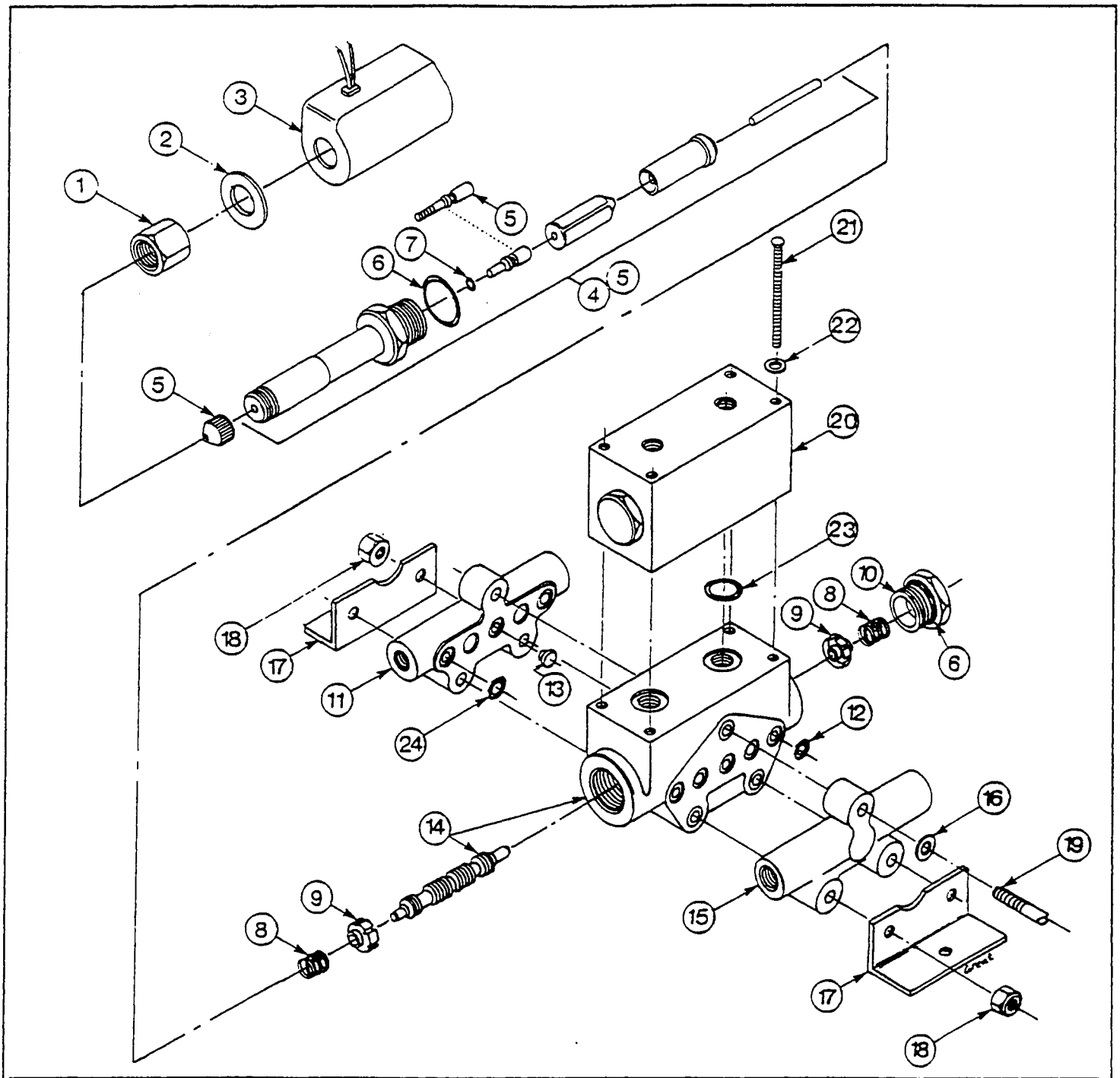
CAUTION: BODY AND SPOOL ARE A MATCHED SET. If either one is damaged, BOTH must be replaced.

12. Wash all parts in cleaning solvent and dry with air gun. Be sure to remove all traces of solvent.

ASSEMBLY:

NOTE: Before re-assembly, discard all used O-Rings.

1. All parts should be individually inspected to verify they are free from wear, burrs, nicks, scratches or any other defect that could cause poor performance.
2. Lubricate all system parts and O-Rings with clean system oil before assembly.
3. Lubricate spool (14) and valve body and carefully slide spool into body, making sure it is in the same position as when it was removed. Spool should slide freely in plug.
4. Install O-Ring (7) on manual override pin. Lubricate inside of tube where pin is installed. Carefully push pin into place. Install O-ring (6) on tube. Install plunger, plug and pin. Make sure that these parts are lubricated with oil. Pin should slide freely in plug.
5. Place spring retainer (9) onto spool with prongs towards spool. Place spring (8) over retainer and install tube subassembly into valve body by hand.
6. Repeat steps 4 and 5 for the opposite side of the valve.
7. For single solenoid sections, place O-ring (6) on plug (10), retainer (9) on spool with prongs towards spool and spring (8) over retainer. Tighten plug and/or tube subassembly to 100 in./lbs.
8. Install one nut (18) on each tie rod (19). Place two tie rods through the mounting bracket (17). Place one flat washer (16) on the third tie rod. Place outlet section (11) over the tie rods. An aid in banking sections is to place the mounting bracket in a vice or on the edge of a flat surface with the tie rods in a vertical positions. Place five O-rings (24). Install a valve section over the tie rods. Place the O-rings (12) on this section. Replace remaining sections as above.
9. Install inlet section (15). Place mounting bracket (17) over lower tie rods and install two nuts (18). Place a flat washer (16) over top tie rod only.
10. Torque tie rods in three steps of 50 in./lbs., 90 in/lbs. and finally 115 in./lbs.
    THIS IS VERY IMPORTANT! OVERTORQUEING WILL CAUSE BORE DISTORTION & MAY CAUSE SPOOL BINDING OR INCREASED LEAKAGE.
11. In order to set the relief, if installed, the complete valve must be placed on a test stand capable of flow from 1 to 5 GPM. Remove the cap over the adjustment screw and loosen the lock nut (see below). Set incoming pressure on test stand to desired valve setting and adjust screw in to increase relief setting or out to decrease relief setting. Setting is correct when .25 GPM flows out of valve at desired pressure.
12. If painting is required make sure all ports are plugged and electrical connections are masked.



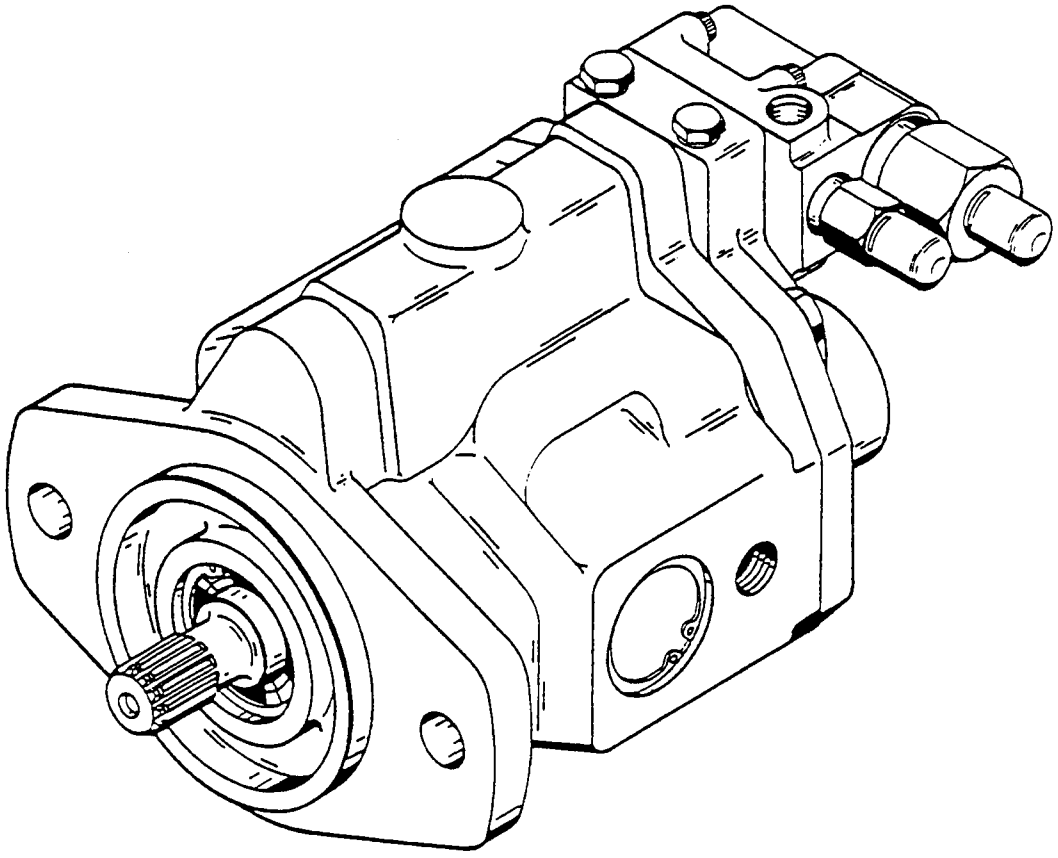
Parts List

Item	Description	Item	Description	Item	Description
1.	Nut	9.	Spring retainer	18.	Nut
2.	Nameplate	10.	Plug	19.	Tie rod
3.	Solenoid coil	11.	Outlet section	20.	Attachment (optional)
4.	Tube S/A (standard)	12.	O-ring (5)		
5.	Tube S/A (palm button)	13.	Closed center plug	21.	Bolt
6.	O-ring	14.	Body & spool	22.	Wasner
7.	O-ring	15.	Inlet section	23.	O-ring
		16.	Washer	24.	O-ring (5)

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Hydraulics
Division

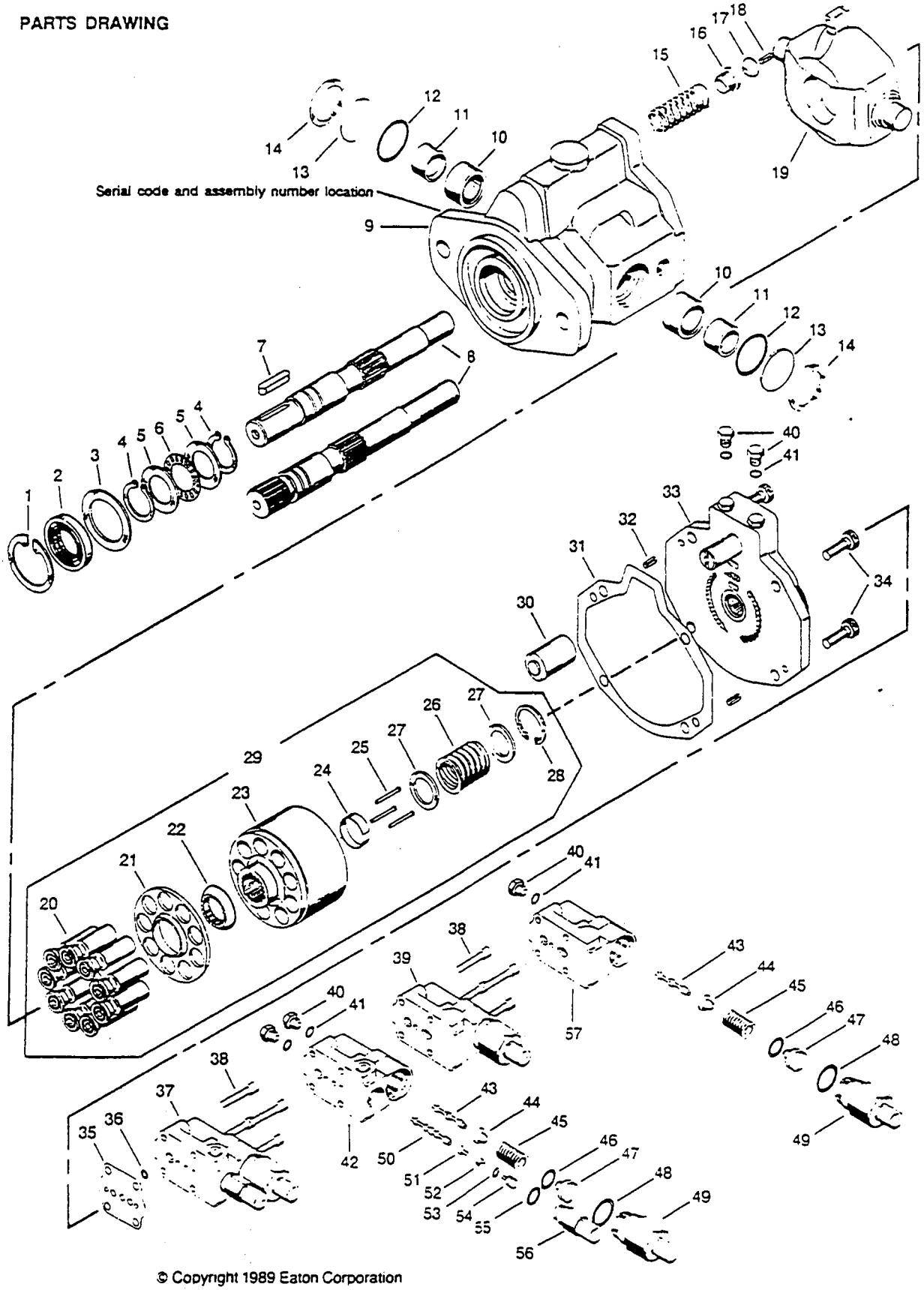
Repair Information

Model 70422 and 70423
Pressure, Pressure-Flow Compensated Piston Pump



EATON

PARTS DRAWING



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PARTS LIST

Item No.	Description	Quantity
1	Retaining ring	1
2	Shaft seal	1
3	Washer	1
4	Retaining ring	2
5	Thrust washer	2
6	Thrust bearing	1
7	Key	1
8	Drive shaft	1
9	Housing assembly	1
10	Needle bearing	2
11	Inner race	2
12	O-ring, 3/32 x 1-7/16 I.D.	2
13	Trunnion cover	2
14	Retaining ring	2
15	Camplate control spring	1
16	Spring collar	1
17	Pivot button	1
18	Roll pin	1
19	Camplate	1
20	Piston assembly	9
21	Spider	1
22	Spider pivot	1
23	Piston block	1
24	Pin keeper	1
25	Pin	3
26	Washer	2
27	Spring	1
28	Retaining ring	1
29	Rotating kit assembly	1
30	Control piston	1
31	Gasket	1
32	Roll pin	2
33	Backplate assembly	1
34	Cap screw	4
35	Gasket, compensator	1
36	O-ring, 1/16 x 1/4 I.D.	1
37	Compensator assy., pressure-flow	1
38	Allen head cap screw	4
39	Compensator assembly, pressure	1
40	Plug	4
41	O-ring, 1/16 x 19/64 I.D.	4
42	Compensator housing, pressure-flow	1
43	Spool, pressure compensator	1
44	Spring pivot cap	1
45	Spring, pressure compensator	1
46	O-ring, 3/32 x 9/16 I.D.	1
47	Spring follower, pressure	1
48	O-ring, 3/32 x 7/8 I.D.	1
49	Adjustment cap, pressure	1
50	Spool, flow compensator	1
51	Spring pivot	1
52	Spring, flow compensator	1
53	O-ring, 1/16 x 7/32 I.D.	1
54	Spring follower, flow	1
55	O-ring, 5/64 x 15/32 I.D.	1
56	Adjustment cap, flow	1
57	Compensator housing, pressure	1

Tools Required For Disassembly And Reassembly

- 3/16 Allen wrench
- 9/16 Socket
- 1-1/8 Open end wrench
- 11/16 Open end wrench
- O-ring pick
- Plastic or wooden mallet
- Internal and External Retaining Pliers (Straight, .070" tip)
- 3/8 I.D. x 1-1/8 O.D. Flat washer (2 ea.)
- 3/8 x 3-1/4 N.C. Cap screw (1 ea.)
- 3/8 N.C. Nut
- Screw driver (1/4 in. blade)
- Torque wrench (40 lb-ft [54 N-m] capacity)

REPAIR INFORMATION - Model 70422 and 70423

Cleanliness is extremely important when repairing these pumps. Work in a clean area. Before disconnecting the lines clean port area of pump. Disconnect hydraulic lines and remove pump assembly from vehicle and plug ports. Thoroughly clean the outside of pump. After cleaning, remove port plugs and drain oil.

DISASSEMBLY

ATTENTION: Removal of the adjusting screw covers from cap may void the warranty on this assembly.

1 Clamp the end of the drive shaft in a protected jaw vise with the body of the pump up and remove the four allen head screws (38) holding compensator (37).

2 Remove the compensator assembly (37 or 39), o-ring (36), and gasket (35).

3 Remove the four cap screws (34) from the backplate of the pump.

4 Place a screw driver in slots provided between housing and loosen backplate. Remove backplate (33) and gasket (31) from housing.

5 Remove the control piston (30) remaining on the backplate or in housing. Also remove plug (40) from backplate (33).

6 To remove rotating assembly (29) from housing, remove pump from vise and slide rotating assembly off shaft. Caution: pistons may not come out with piston block.

7 Remove pistons (20), spider (21), and spider pivot (22) from piston block (23).

8 The piston block assembly (23) need not be disassembled unless the internal pins (25) or spring (27) are damaged.

CAUTION: Use the following procedure if the spring is to be removed from the piston block. The spring (27) is highly compressed and the snap ring (28) should not be removed without compressing the spring (27).

The following parts will be needed to disassemble the piston block:
2 ea. 3/8 I.D. x 1-1/8 O.D. flat washer,
1 ea. 3/8 x 3-1/4 N.C. cap screw, and
1 ea. 3/8 N.C. nut.

Place one of the flat washers over the 3/8 x 3-1/4 cap screw and place this through the center of the piston block (23). Place the other washer over the cap screw and let it rest on the three pins. Screw the nut on and compress the spring inside the piston block. Use a pair of snap ring pliers and remove the internal snap ring (28). Remove the bolt and the two washers (26), three pins (25), and the internal pin keeper (24).

9 To free shaft seal and shaft, remove retaining ring (1).

10 Remove shaft (8) from housing (9) by tapping backplate end of shaft with a wooden or plastic mallet.

11 Remove shaft seal (2), washer (3), the two retaining rings (4), the two thrust washers (5), and bearing (6) from shaft.

12 To remove the camplate (19) from the housing, remove the two internal retaining rings (14) from the sides of the housing. Remove the two covers (13), the two o-rings (12), the two inner races (11), and the bearings (10). The camplate can now be moved over to one side and removed. The two camplate pivot bearings are a loose slip fit into the housing. Do not be concerned if they are not tight.

13 Remove the spring collar (16) and spring (15). Do not remove the button (17) and roll pin (18) unless they are worn or loose.

14 The pressure-flow compensator assembly (37) may be disassembled for cleaning and inspection.

ATTENTION: Removal of the adjusting screw covers from cap may void the warranty on this assembly.

15 Remove pressure adjustment cap (49) from compensator housing (37). Pressure spring follower (47) will remain in cap (49), pull follower from cap.

16 Remove flow adjustment cap (56) from compensator housing (37). Flow spring follower (54) will remain in cap (56). Pull follower from cap.

17 Remove springs (45 and 52) and spring pivots (44 and 51) from compensator housing.

18 Remove plugs (40), pressure compensator spool (43), and flow compensator spool (50) from compensator housing (37).

19 The shaft seal, all o-rings, and all gaskets should be removed and replaced with new items upon reassembly.

INSPECT PARTS FOR WEAR

1 Inspect the flat surface of the backplate (33), the finish on the piston block side should be smooth and free of grooves. The piston guide should be tight in the backplate. The needle bearing in the backplate should be free of excessive play and remain in the bearing cage. If the backplate has any of the wear characteristics outlined above, replace complete backplate assembly.

2 Inspect the piston block (23). The surface that contacts the backplate should be smooth and free of grooves.

3 The pistons (20) should move freely in the piston block bore. If they stick in the bore, examine the bore for scoring or contamination.

4 Examine the O.D. of the piston (20) for finish condition. They should not show wear or deep scratches. The shoes should be a snug fit on the ball end of the piston. The flat surface of the shoes should be flat, and smooth. **Do not lap piston shoes.**

5 Examine the spider (21). It should be flat, no cracks, and no signs of wear in the pivot area.

6 Examine the pivot (22). It should be smooth and show no signs of wear.

7 Inspect the camplate (19) for the condition of finish of the polished shoe surface. It should show no signs of scoring.

8 Inspect shaft (8) for wear in bearing and spline areas.

9 Inspect thrust bearing (6) and thrust washers (5) for wear.

10 Inspect the needle bearing in the housing assembly (9). If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the housing.

11 Inspect the compensator springs (45 and 52) for breakage or weakness.

12 Inspect the spools (43 and 50) for scoring.

13 It is not necessary to inspect the o-rings, retaining rings, gaskets, or shaft seal as they should be replaced as new items and are included in the seal repair kit available for this assembly.

REASSEMBLY

1 Clean all parts in suitable solvent; lubricate all critical moving parts before reassembly.

2 Install camplate control spring (15) and spring collar (16) in housing (9).

3 Insert camplate (19) into housing (9). Insert needle bearings (10) and bearing inner race (11) over the camplate arms and slide into housing (9). The numbered end of the bearing should face outward and the chamfered I.D. of the race should face inward.

4 Install new o-ring (12) around O.D. of camplate pivot bearing (10). Install trunnion covers (13) and secure with retaining rings (14).

5 Install retaining ring (4) on shaft (8). Install thrust washer (5), thrust bearing (6), and second thrust washer (5). Secure with second retaining ring (4).

6 Install shaft (8) in housing (9) and install washer (3), shaft seal (2), and retain with retaining ring (1). Make sure retaining ring is seated in the groove.

7 If piston block assembly was disassembled, compress the pin keeper (24), and install in the spline area of piston block. Install the three pins (25) with the head end to the inside of the block and install in the special grooves of the piston block spline.

8 Install the washer (26), spring (27), and second washer (26) in the piston block. Use the two 3/8 I.D. washers and the 3/8 x 3-1/4 cap screw to compress the spring and retain with retaining ring (28). Remove the 3/8 x 3-1/4 cap screw and the two washer.

9 Install the pivot (22), spider (21), and piston assemblies (20) in the piston block. Install this assembly in the housing assembly, the piston shoes must be in contact with the camplate. Be sure all the parts are in their proper position.

10 Clamp this assembly in a protected jaw vise with the open end of the housing (9) up.

11 Install new gasket (31).

12 Install control piston (30), and plug (40) with new o-ring onto backplate. Note roll pin (32) locations.

13 Install backplate (33) and retain with cap screws (34). Torque to 27 to 31 lb-ft [37 to 42 N-m].

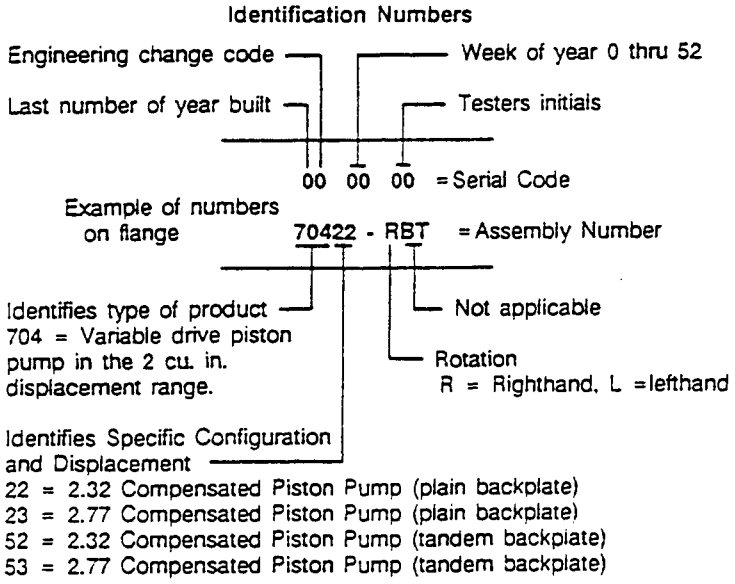
14 Place new o-ring (41) on plug (40). Install plug assembly (40),flow compensator spool (50), spring pivot (51), spring (52), flow spring follower (54) with new o-ring (53), and flow adjustment cap (56) with new o-ring (55) into compensator housing (42). Torque plug (40) 6 to 8 lb-ft [8 to 11 N-m] and torque flow adjustment cap (56) 10 to 12 lb-ft [14 to 16 N-m].

15 Place new o-ring (41) on plug (40). Install plug assembly (40), pressure compensator spool (43), spring pivot (44), spring (45), pressure spring follower (47) with new o-ring (46), and pressure adjustment cap (49) with new o-ring (48) into compensator housing (42). Torque plug (40) 6 to 8 lb-ft [8 to 10 N-m] and torque pressure adjustment cap (49) 35 to 40 lb-ft [47 to 54 N-m].

16 Install new gasket (35) and new o-ring (36), then install compensator assembly (37 or 39),and retain with four allen head cap screws (38) and torque to 10 to 12 lb-ft [14 to 16 N-m].

17 Plug ports to preserve cleanliness until installation on vehicle. (Refer to start up procedures.)

EACH ORDER MUST INCLUDE
THE FOLLOWING INFORMATION
1. Product Number
2. Date Code
3. Part Name
4. Part Number
5. Quantity of Parts



Start-Up Procedure

When initially starting a rebuilt load sensing system, it is extremely important that the start-up procedure be followed. It prevents the chance of damaging the pump which might occur if the system was not properly purged with oil before start-up.

1 After the pump has been properly installed onto the machine and all hydraulic connections have been made, check all fittings to make sure that they are tight.

2 Fill the pump housing at least 1/2 full with system oil that has been filtered through a 10 micron filter.

3 Fill the reservoir with an approved oil that has been filtered through a 10 micron filter. Leave the filler cap loose as a means of air that is trapped in the system.

4 Note on gasoline or L.P. engines: remove the coil wire and turn the engine over for 15 seconds. Diesel engines: shut off the fuel flow to the injectors and turn the engine over for 15 seconds. This procedure enables the pump to pick-up the oil before start-up. At this time disconnect the sensor line from the pump compensator and pull one of the valve spools while the engine is being turned over. This allows oil to flow through the sensor line, thus, removing any air in the sensor line. Reconnect the sensor line after a steady flow of oil is coming from the line.

5 Replace the coil wire or return the fuel flow to the injectors and start the engine. Run at low idle speed for one minute. The pump should immediately pick up oil and go into low pressure standby. If there is no indication of fill in 30 seconds, stop engine and determine the cause.

6 After the pump has stabilized in low pressure standby, operate the control valve and steering, if the system is equipped with one, to purge the system of air and to fill the cylinders with oil. Continue operating the system slowly with no load until it responds fully.

7 Check fluid level at the reservoir and refill if necessary to the proper level at the reservoir and refill if necessary to the proper level with an approved filtered oil.

8 Check all line connections for leaks tighten if necessary.

9 The machine is now ready to be put into operation.

10 Short hour filter changes are recommended for the first two changes after placing the machine back into operation. The first filter would be changed in 3-5 hours and the second at approximately 50 hours. Routine scheduled filter changes are recommended for maximum life of hydraulic system.

EATON
REPAIR INFORMATION
PRESSURE OR PRESSURE-FLOW
COMPENSATED PISTON PUMP
MODEL 70422 AND 70423
NO. 7-609

Trouble Shooting

Problem	Possible Cause	Correction
1 Noisy pump caused by cavitation.	A Oil too heavy. B Suction strainer or filter plugged. C Suction line plugged, too small, or too long.	A Change to proper viscosity. B Clean or replace. C Clean line and check for proper size and length.
2 Noisy pump caused by aeration.	A Oil supply low. B Air leaking into suction line. C Foaming oil.	A Fill reservoir. B Tighten fittings. C Drain reservoir and fill with non-foaming type oil.
3 Hydraulic system overheating.	A Oil supply low. B Oil in system too light. C Excessive internal leakage. D Aeration of oil.	A Fill reservoir. B Drain reservoir and refill with proper viscosity oil. C Disconnect case, drain line, measure leakage volume while pressurizing hydraulic system. Case drain flow should not exceed 3 G.P.M. if excessive, remove pump, disassemble and repair. D Tighten fittings.
4 System not developing adequate pressure.	A Excessive internal leakage. B Either compensator spool stuck open. C Either compensator spring weak or broken. D Loss of flow compensator signal.	A Refer to 3-c. B Disassemble compensator, inspect for stuck spool, clean or replace compensator assembly. C Disassemble compensator, inspect for weak or broken spring. Replace spring if necessary. D Check signal line connections, check for line obstruction, line damage and line size and length.
5 System not developing adequate flow.	A Excessive internal leakage. B Either compensator spool stuck open. C Either compensator spring weak or broken. D Pump cavitation. E Loss of flow compensation signal.	A Refer to 3-c. B Refer to 4-b. C Refer to 4-c. D Refer to 1-a,1-b,1-c. C Refer to 4-d.

Ausco
Model 27933

"C" Series
Fail Safe Brake

BRAKE FUNCTION

The Failsafe Brake is spring loaded to apply the brake. Hydraulic pressure is required to release or "hold off" the brake. Normal operation is to have the brake pressurized in the released position with the vehicle hydraulic system running. Any function which reduces the hydraulic system pressure below the release pressure of the brake, will cause a brake application.

The brake is designed to fit with a gear reducer and a hydraulic motor. The common mounting surfaces of the brake, the motor, and the gear reducer are machined to close tolerances and should be protected from damage during installation and removal.

INSTALLATION INSTRUCTIONS (Refer to Fig. 1)

1. Place the gasket onto the mounting face of the brake.
2. Place the brake shaft into the gear reducer with the brake bleeder screw in the vertical position, if possible.
3. Move the brake into position with gear reducer assuring proper gasket location. Align the mounting bolt holes by rotating the engaged brake into position. If this is not possible the brake may be rotated after pressure has been applied to the brake inlet. This will release the brake and allow it to be rotated into position.
4. Similarly place a gasket onto the flange of the motor.
5. Insert the shaft of the motor into the brake and push into position, assuring proper gasket location.
6. Insert four half-inch bolts or two 5/8 dia. bolts (Grade 5) thru the motor flange, the gasket, the brake, the second gasket, and into the threaded hole in the gear reducer mounting flange. Insure that the bolts are not too long so that they do not bottom out in the reducer before clamping.
7. Run bolts in alternately, to prevent binding, until snug. Then torque the bolts as follows: 1/2 in. dia: 75-85 lb-ft.; 5/8 in. dia: 135-165 lb-ft. Note: both shafts must slide together freely - DO NOT use bolts to force the unit together.
8. With motor and brake bolted into position, remove cap plug and connect "inlet" hydraulic line to brake. (If not dome for shaft alignment - step 3). Brake inlet is .250 tubing O.D., straight thread O-ring boss, (.438-20 UNF 2B Thd).
9. Bleed air from brake via bleeder screw.
   Note: Maximum pressure to brake is 3000 psi.

BRAKE DISASSEMBLY PROCEDURE: (Refer to Fig. 2)

1. With shaft protrusion downward, disassemble in the following order:
2. Bolts (23) alternately, Power Plate (19), O-ring (5), Rotating Discs (11), Springs (12), Stationary Discs (13), Primary Disc (10), Pins (9), Springs (6 & 7).
3. Further disassembly is not recommended and should not be attempted unless necessary for the replacement of specific parts, i.e., Seal (1), Snap Ring (2), Bearing (3) and Shaft (8) from Housing (4), if necessary: proceed as follows:

   a) Remove Seal (1): This will be ruined and must be replaced. **CAUTION: Be extra careful not to damage the adjacent bearing seal.**
   b) Remove Snap Ring (2), then Shaft (8) with Bearing (3) by lightly tapping the shaft with a plastic mallet.
   c) Remove shaft from bearing by supporting the inner race of the bearing and applying pressure the shaft.

4. Remove the Piston (14) from the Power Plate (19) by introducing low pressure air -15 psi- into the hydraulic inlet. Make sure piston is directed away from the operator. Remove O-rings (16 & 18) and Back-up Rings (15 & 17) from the Piston O.D. & I.D. grooves. Back-up Rings will be damaged and should not be removed if replacement is not planned. Remove Snap Ring (21). Bearing (22) may be removed by tapping lightly with a plastic mallet.
5. Pressure Relief Valve (27) can be removed and inspected to assure spring-loaded ball moves freely and is free of contamination.

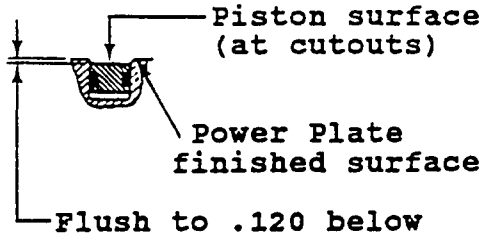
BRAKE REASSEMBLY PROCEDURE:

All parts must be thoroughly clean prior to reassembly!

Important: There may be more parts in a service kit than your brake requires. Check the parts list carefully for the exact quantity. In the case of springs, space the required quantity equally.

1. Worn O-rings and damaged or worn teflon back-up rings must be replaced prior to reassembly.
2. Cylinder(s) for the Power Plate, Piston and O-rings must be clean prior to assembly, and pre-lubed with system hydraulic fluid.
3. If replacement of Pressure Relief Valve (27) is necessary, install 1/2 to 3/4 turns beyond finger tight.
4. Assemble Piston (14) into Power Plate (19) using a shop press, being careful no to damage the O-rings or the Teflon Back-Up rings. Visually align the center of the cutouts in the Piston (14) with the Torque Pin (9) holes in the Power Plate (19).

Depth of piston installation into the power plate is critical. DO NOT exceed .120 depth or piston will cock, resulting in a complete loss of braking.

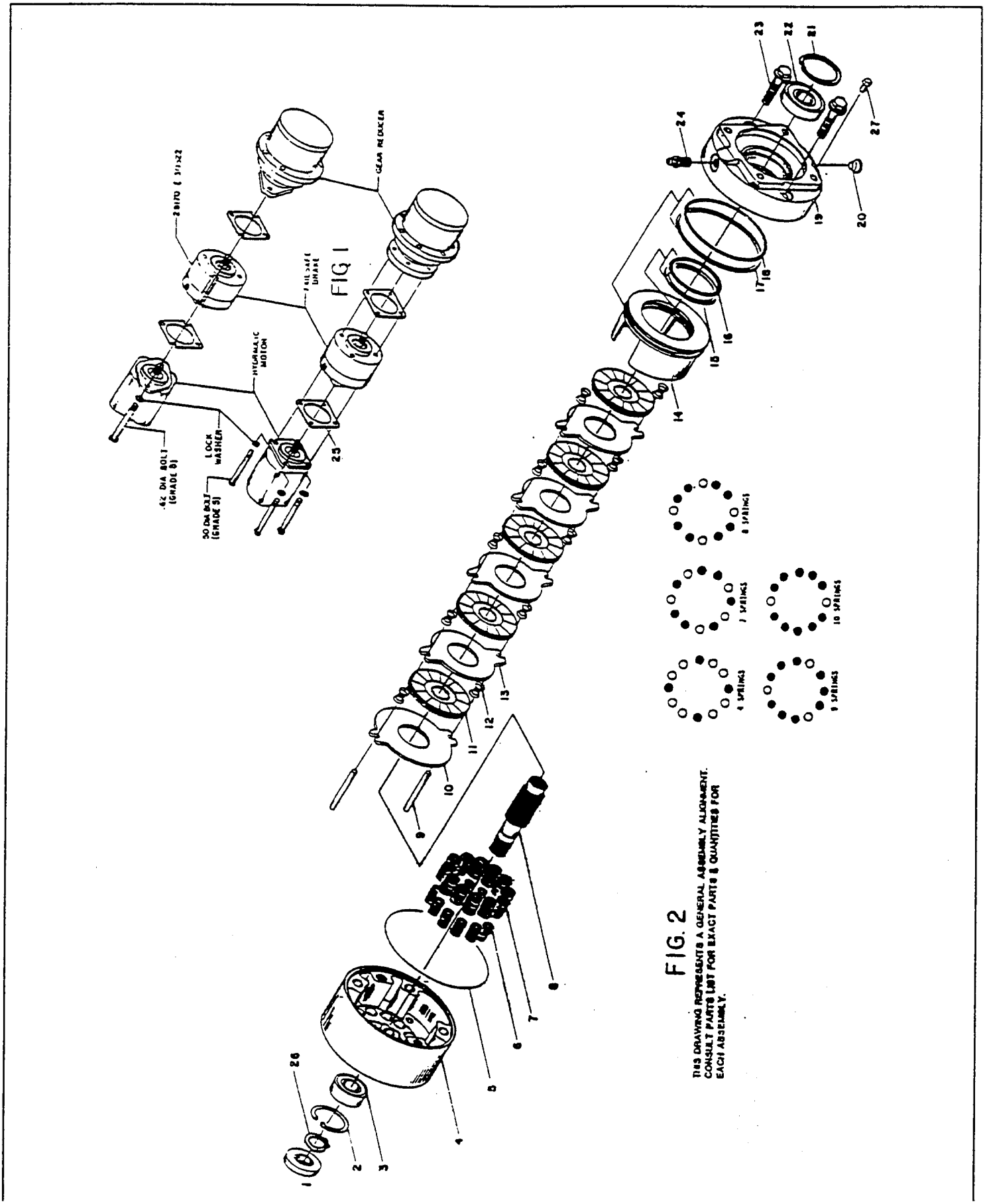


5. Rotating Discs must be clean and dry. There should be no oil on any lining material or mating surfaces of the Stationary Discs. Worn or heavily scored rotating discs must be replaced.
6. Install bolts (23). Tighten sequentially, one turn at a time, until Power Plate (19) is properly seated. Torque to 75-85 lb ft.

SERVICE KITS

The following kits are available as service items. All other parts may be ordered individually.

Description	M.I. P/N
O-ring & Gasket Kit (Consists of items 5,15,16,17,18,& 25)	66715
Stack Kit (Consists of items 6,7,9,10,11,12,& 13)	600416
Bearing Kit (Consists of items 1,2,3,21,22,& 26)	600417


FIG 1
FIG. 2
THIS DRAWING REPRESENTS A GENERAL ASSEMBLY ALIGNMENT. CONSULT PARTS LIST FOR EXACT PARTS & QUANTITIES FOR EACH ASSEMBLY.

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.

Table of Contents

	Page
Design Features Illustrated	1
Design Features	2
Definitions	2
Introduction	4
Trouble Shooting Guide	5
Trouble Shooting Check List	6
Tools & Material Required for Servicing	7
Bolt Torque	7
Exploded Assembly View Fold Out	8
Disassembly & Inspection	9
Assembly	16
Final Checks	22
Hydraulic Fluids	22
Filtration, Operating Temperature	22
Tips for Maintaining the System	23

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)

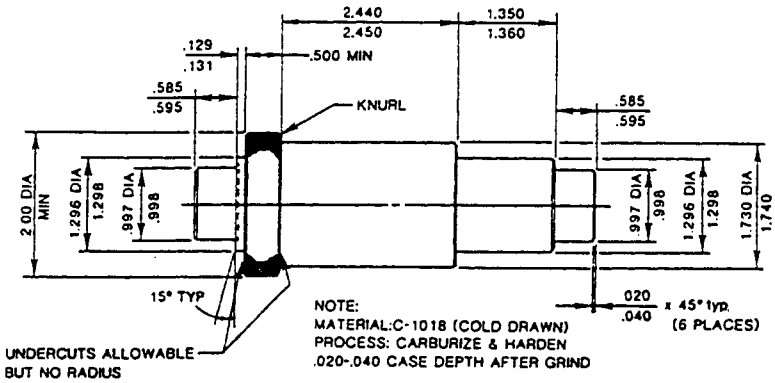
Clean corrosion resistant grease. Recommended grease is E/M Lubricant #K-70 Alternate compatible greases are:

- 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

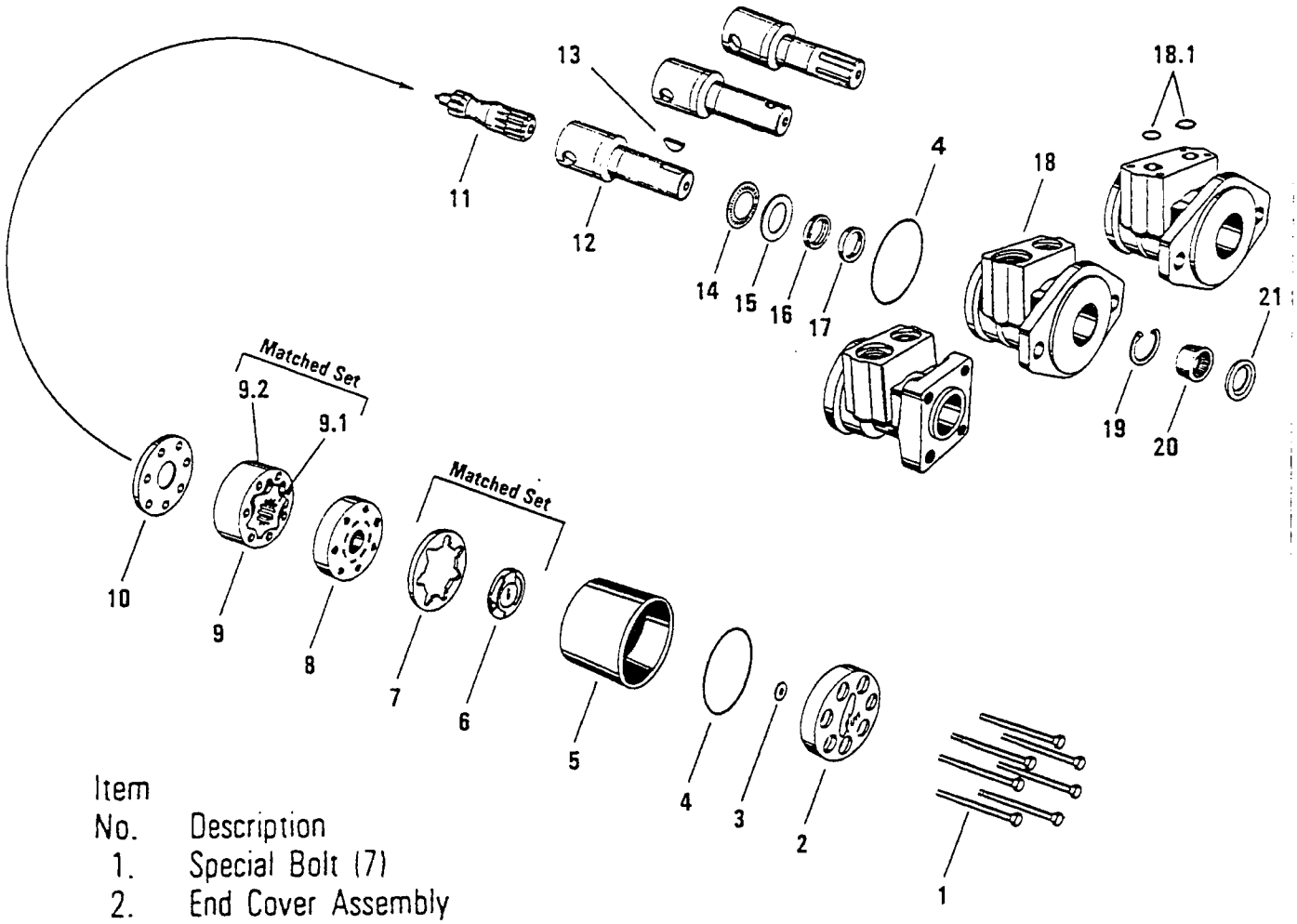


Bearing Mandrel (Fabricate if considered necessary)
Figure 1

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

MAG Torqmotor Exploded View

MAG: Disassembly and Inspection

(Preparation Before Disassembly)

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

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

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

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

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

Disassembly and Inspection

position Torqmotor™ in a vise

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

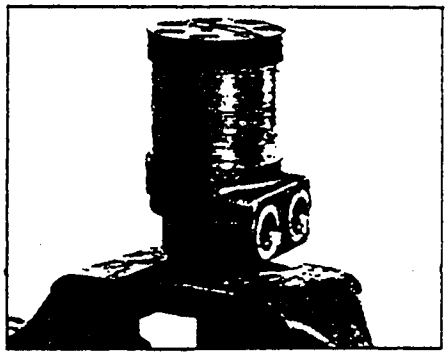


Figure 2

WARNING

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

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.

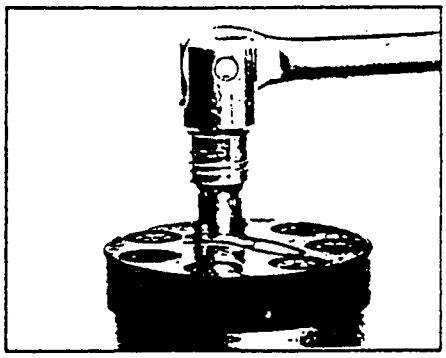


Figure 3

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.

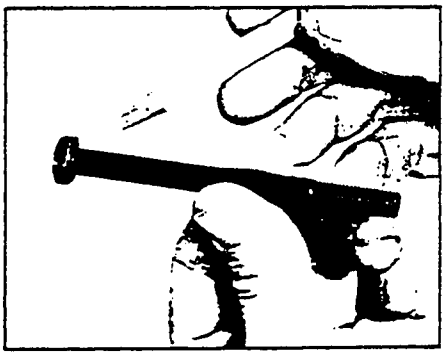


Figure 4

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.

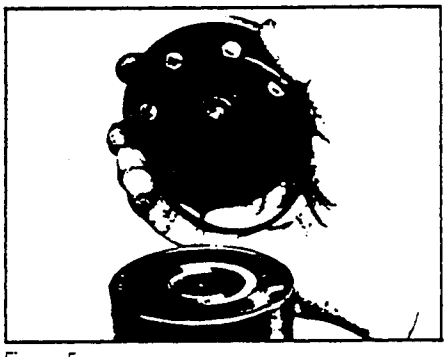


Figure 5

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.

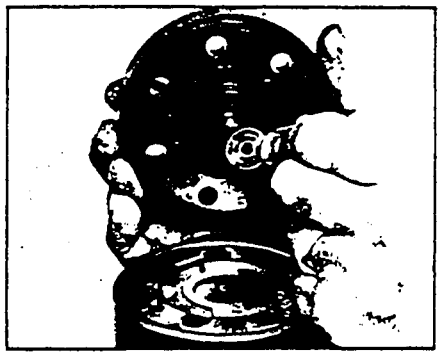


Figure 6

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.



Figure 7

NOTE

NOTE: Minor burrs can be removed.

remove & inspect commutator ring

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

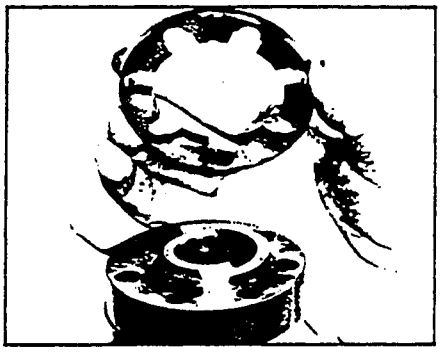


Figure 8

remove & inspect commutator

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



Figure 9

remove manifold

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



Figure 10

remove & inspect rotor set

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

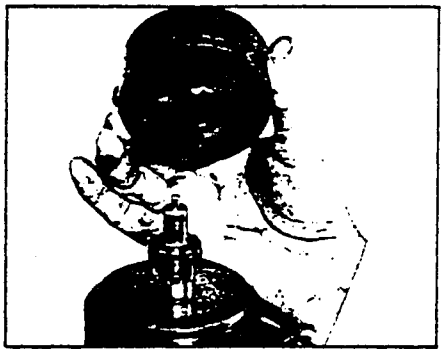


Figure 11

NOTE

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

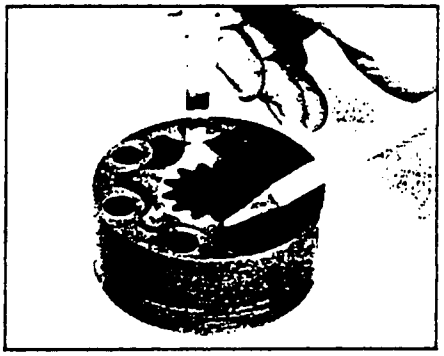


Figure 12

check rotor, stator clearance

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

remove & inpect spacer

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

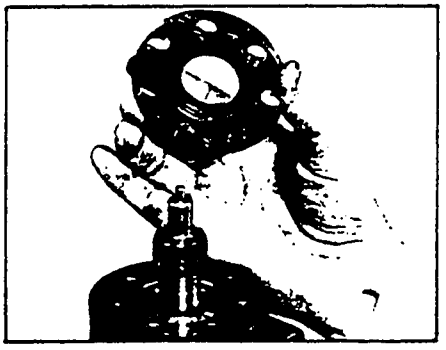


Figure 13

NOTE

NOTE: A polished pattern from rotor rotation is normal.

remove & inspect drive link

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

NOTE

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

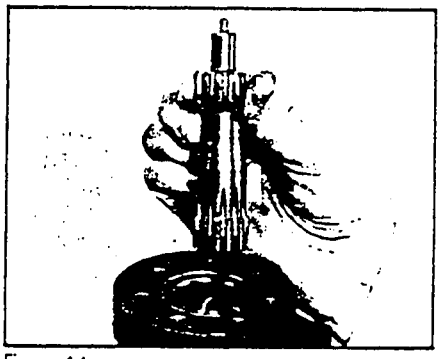


Figure 14

check coupling shaft for rust or corrosion

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

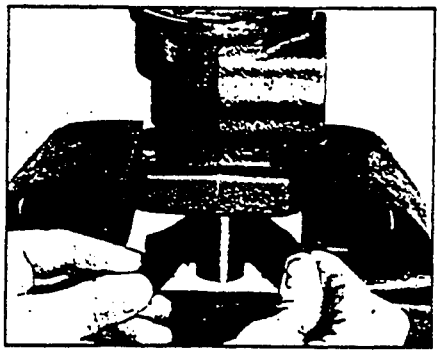


Figure 15

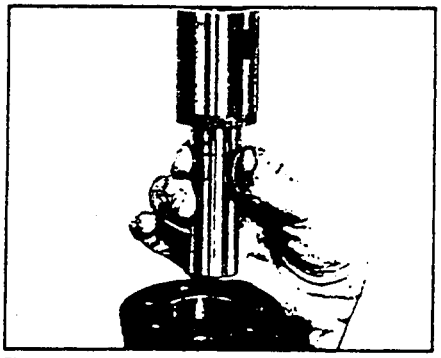


Figure 16

remove & inspect coupling shaft

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

NOTE

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

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

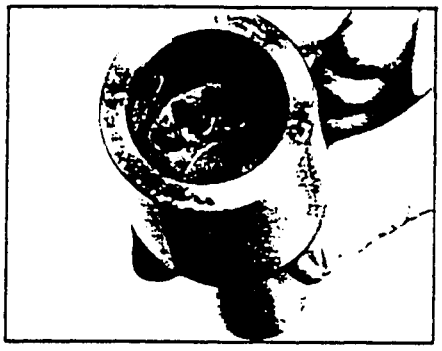


Figure 17

remove seal ring from housing

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

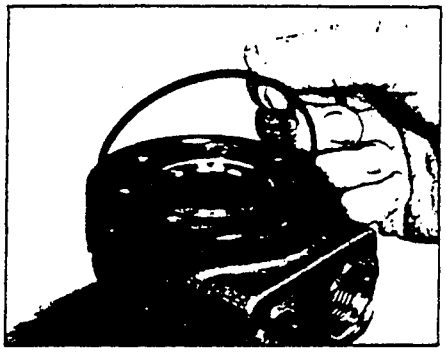


Figure 18

remove & inspect thrust bearing, washer

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

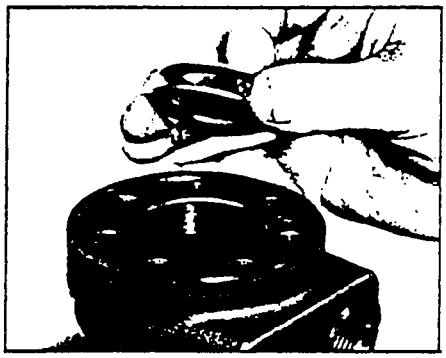


Figure 19

remove seal & spacer

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

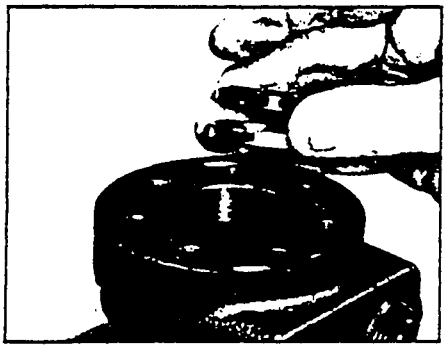


Figure 20

remove seal

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

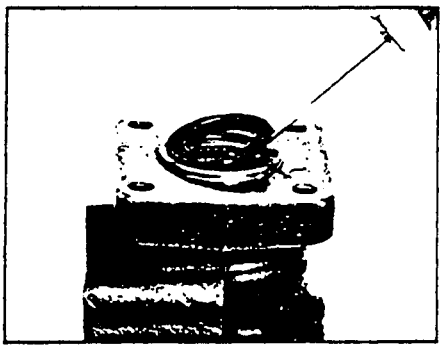


Figure 21

inspect housing assembly

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

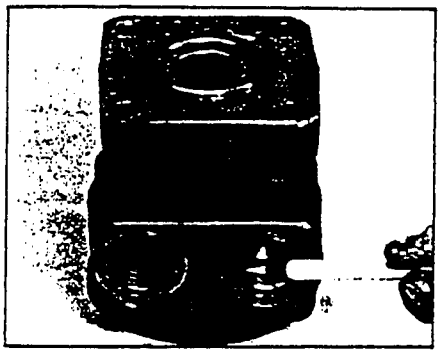


Figure 22

inspect housing bearing

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

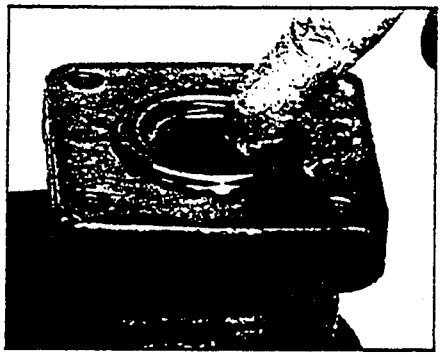


Figure 23

remove retaining ring & bearing

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

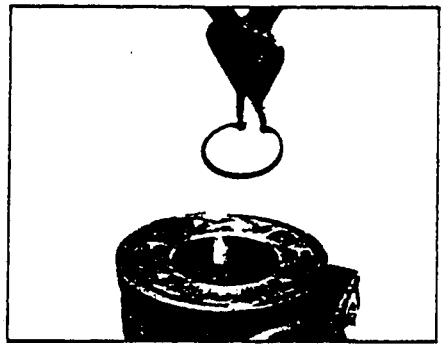


Figure 24

The MAG Torqmotor™ disassembly is now complete.

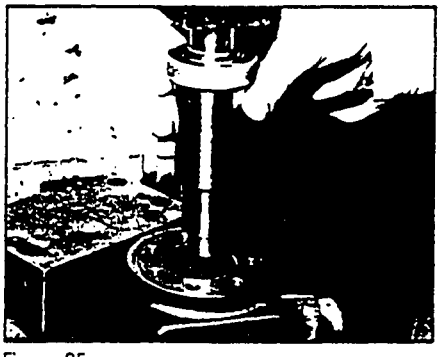


Figure 25

MAG Assembly

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

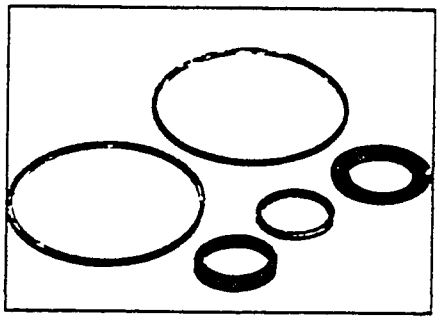


Figure 26

WARNING

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

WARNING

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

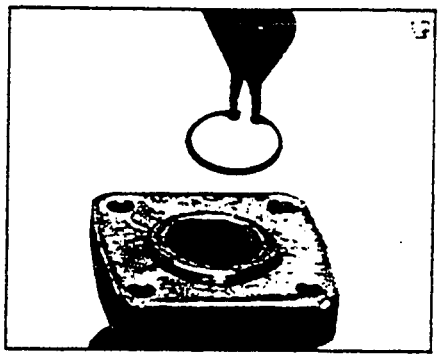


Figure 27

install retaining ring

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

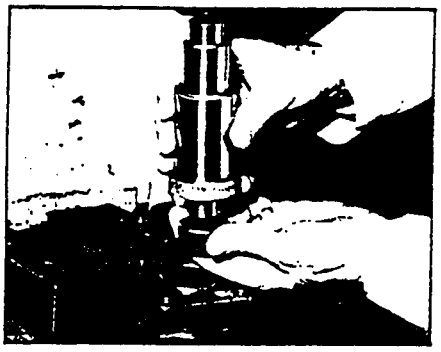


Figure 28

press in bearing

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

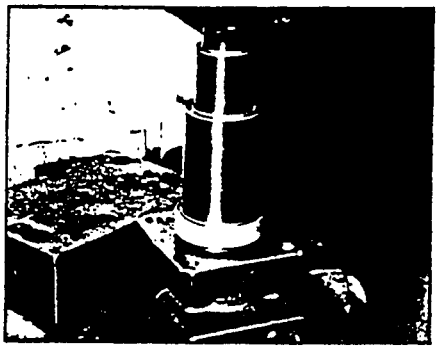


Figure 29

NOTE

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

CAUTION

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

CAUTION

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

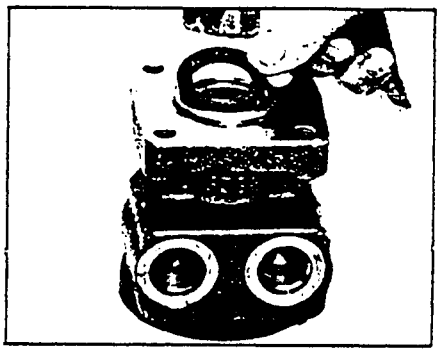


Figure 30

insert dirt & water seal

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

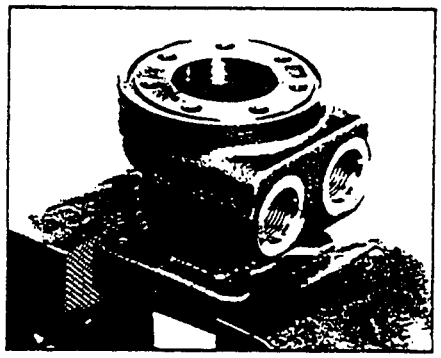


Figure 31

place housing assembly into vise

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

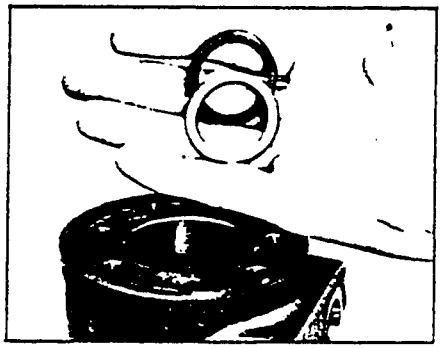


Figure 32

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.

install thrust washer & thrust bearing

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



Figure 33

install coupling shaft

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

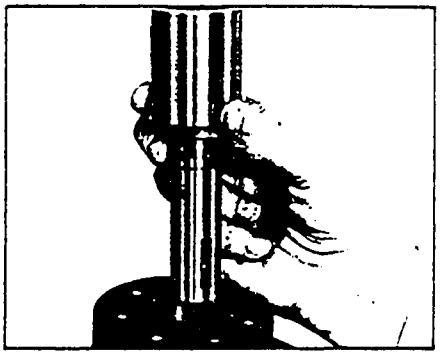


Figure 34

NOTE

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

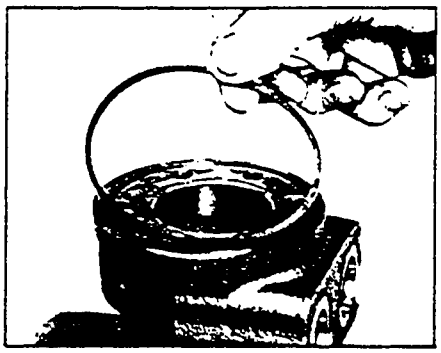


Figure 35

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.

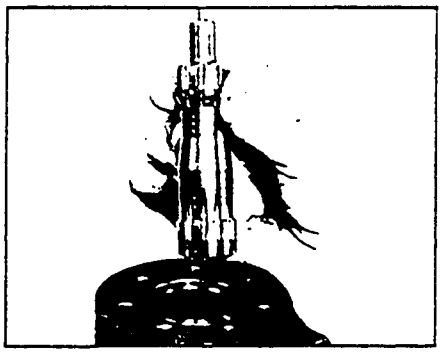


Figure 36

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.

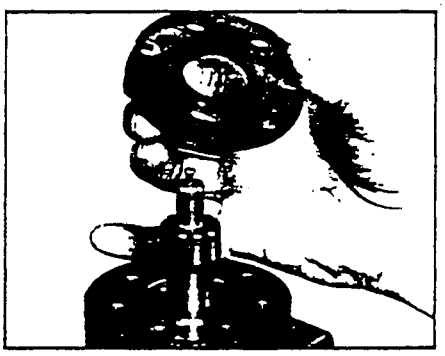


Figure 37

assemble spacer

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

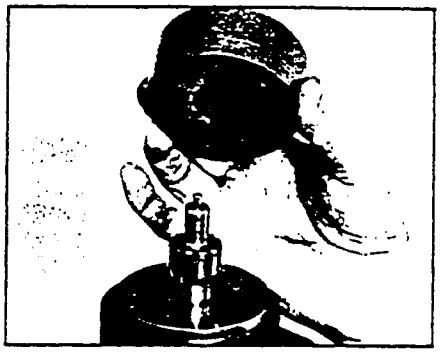


Figure 38

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.

assemble manifold

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

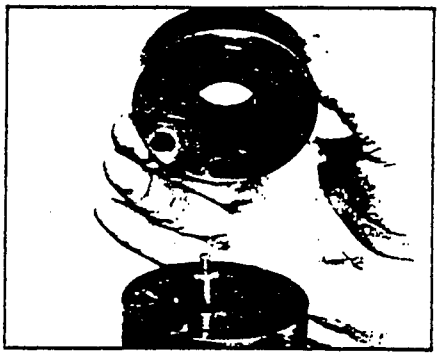


Figure 39

assemble commutator ring

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



Figure 40

assemble commutator

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

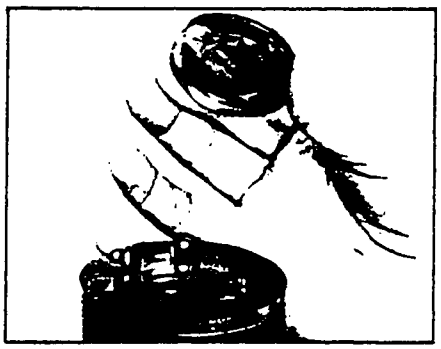


Figure 41

assemble sleeve

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



Figure 42

assemble washer

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

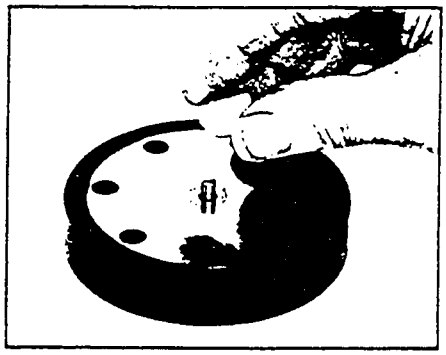


Figure 43

assemble seal ring

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



Figure 44

assemble end cover assembly

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



Figure 45

NOTE

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

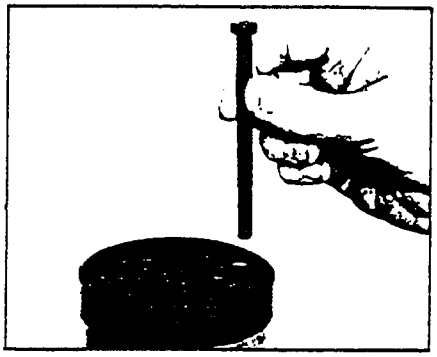


Figure 46

install and torque bolts

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

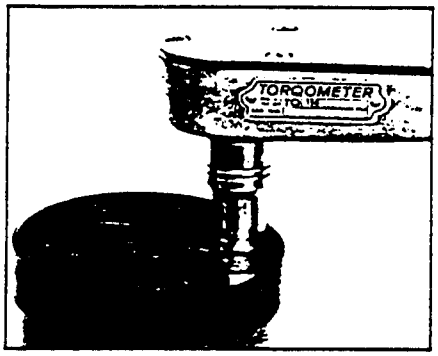


Figure 47

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

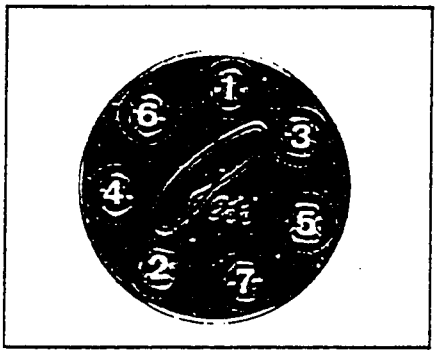


Figure 48

Final Checks

Final Checks

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

Hydraulic Fluid

Keep the hydraulic system filled with one of the following:

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

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

Filtration

Recommended filtration 20-50 micron.

Oil Temperature

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

Tips for Maintaining the Torqmotor™ Hydraulic System

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

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

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

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

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

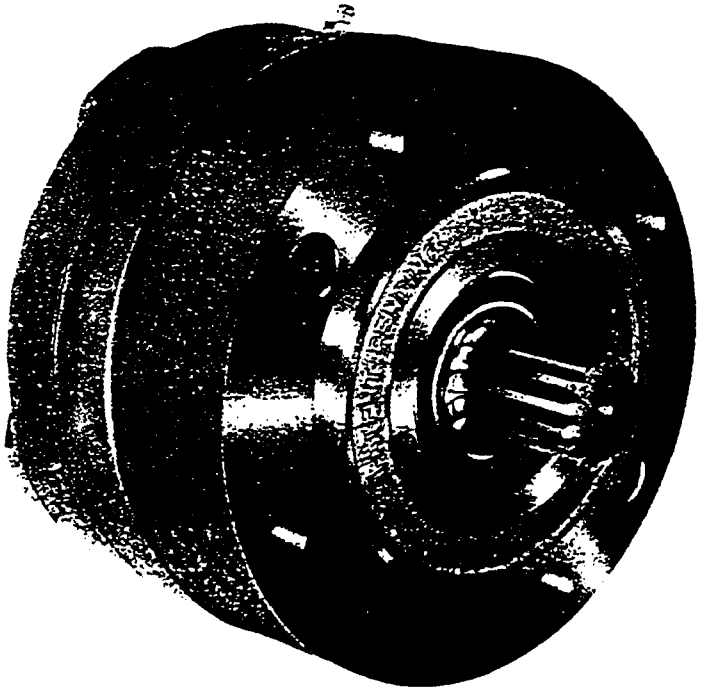
Ross Gear extends close technical cooperation and assistance. If problems occur which you cannot solve, please contact our Ross Service Department or local Ross approved Distributor. Our phone number and telex number and address are on the back cover of this manual.

SY·TEC SERIES

MULTIPLE DISC BRAKE

(dry design - SAE C size)

SERVICE MANUAL MICO



TYPICAL BRAKE

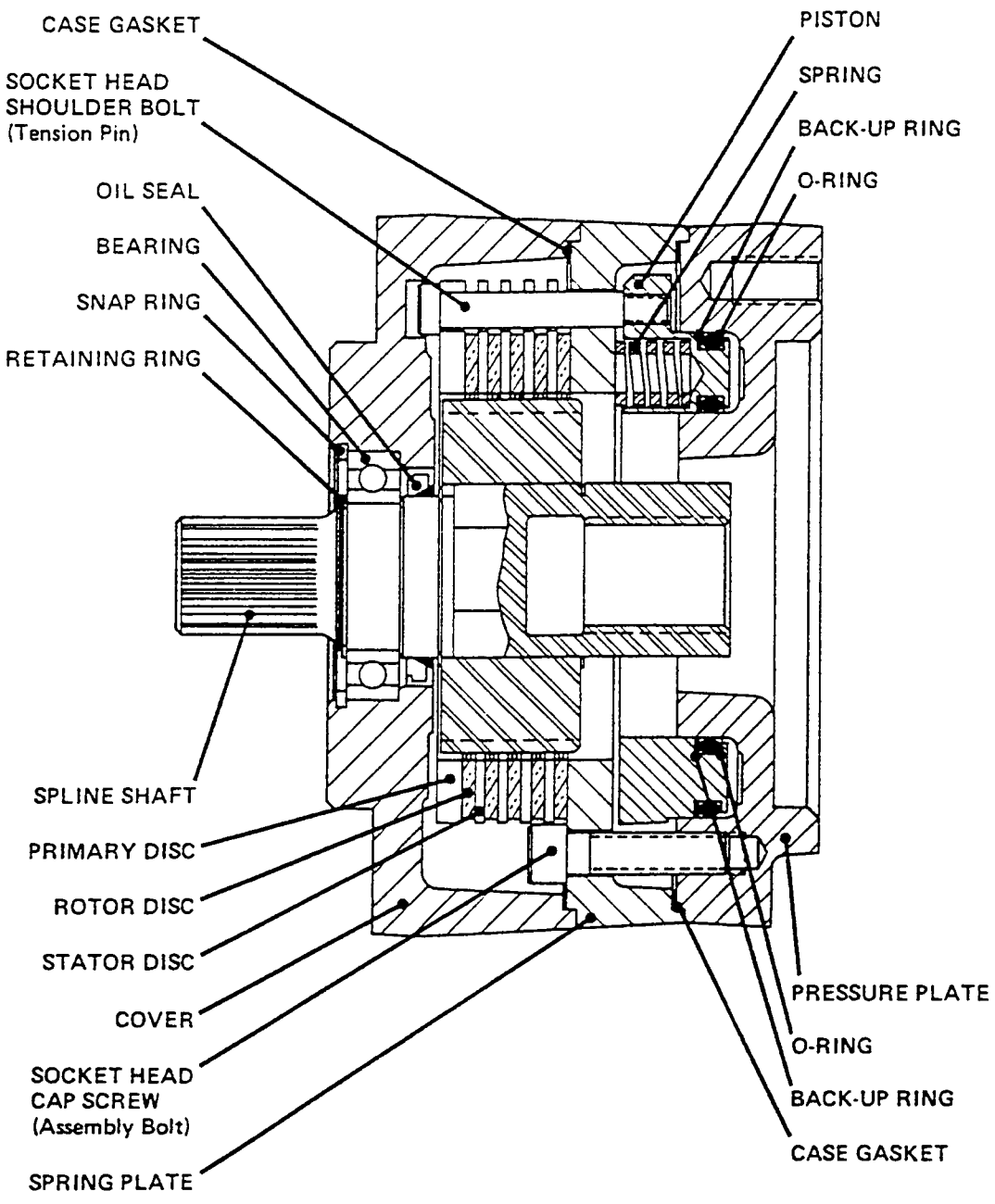


FIGURE 1

PRINCIPLES OF OPERATION

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

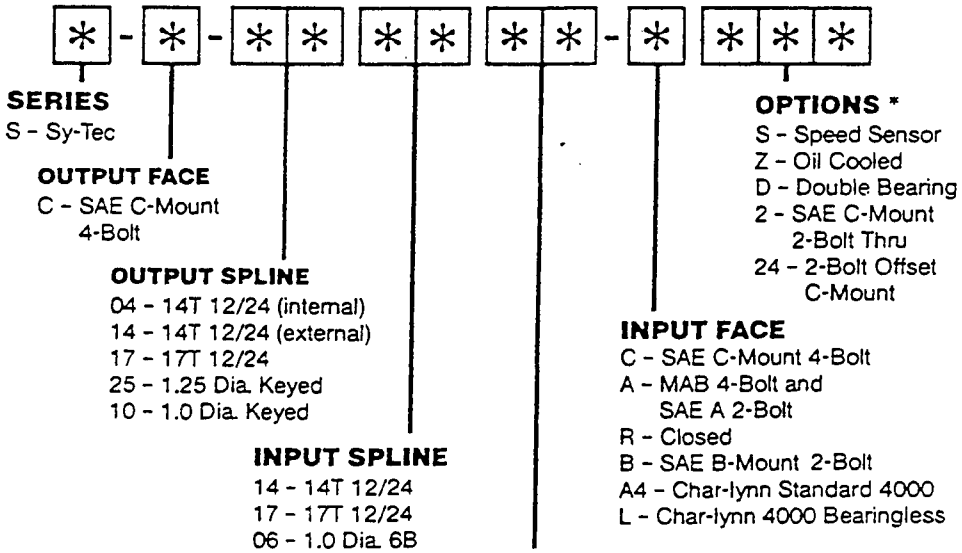
It is very important to remember that any pressure on the brake's release piston will directly effect the level of torque.

Two application examples.

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

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

DESCRIPTION OF MODEL NUMBERS



* (Available separately or in combination)

1 psi = .06895 bar

Code	Standard (In. lbs.)	High (In. lbs.)	Release Pressure (psi)	Full Release Pressure (psi)
12		12,000	200	230
98	9800		200	230
10		10,000	170	200
80	8000		170	200
85		8500	150	180
70	7000		150	180
66		6600	125	155
55	5500		125	155
54		5400	105	135
45	4500		105	135

Lower torques available on request

DISASSEMBLY

1. Remove 2 flat head assembly bolts (items 1). A suitable holding fixture is useful to keep brake in position.
2. Tap female end of spline shaft assembly (item 8) and spring plate (item 14) with soft mallet to separate cover. If sections will not separate, use a screwdriver to carefully pry sections apart.
3. Remove case gasket (item 7) from cover (item 6).
4. Remove retaining ring (item 2) from spline shaft assembly (item 8).
5. Remove spline shaft assembly (item 8) from cover (item 6) by tapping male end of spline shaft assembly with soft mallet.
6. Remove snap ring (item 3) from cover (item 6) and press out oil seal (item 5) and bearing (item 4) if required.
7. Remove four socket head shoulder bolts (items 10). A suitable holding fixture is useful to hold brake in position.

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

8. Remove primary disc (item 11), five rotor discs (items 12) and four stator discs (items 13).
9. Remove 2 socket head cap screws (items 9).
10. Remove spring plate (item 14).
11. Remove case gasket (item 7) from spring plate (item 14).
12. Before removing springs (items 15), note pattern for reassembly purposes.
13. Remove piston (item 16) by carefully exerting hydraulic pressure through brake release port on pressure plate (item 21).
14. Remove outside and inside o-rings (items 18 & 20) and outside and inside back-up rings (items 17 & 19) from piston (item 16).

    CAUTION: **Care must be taken so as not to scratch or mar piston.**

ASSEMBLY

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Press oil seal (item 5) into bore until it is flush with bearing shoulder. Open side of oil seal must face toward the front side of cover (item 6).
3. Press bearing (item 4) into position until it bottoms out on oil seal borestep.
4. Install snap ring (item 3) into cover (item 6).
5. Press spline shaft assembly (item 8) into bearing (item 4) until shaft bottoms on shaft shoulder. Bearing innner race must be supported during this operation.
6. Install retaining ring (item 2) on spline shaft assembly (item 8).
7. Install back-up rings (items 17 & 19) on piston (item 16) toward spring pockets.
8. Install o-rings (items 18 & 20) on piston (item 16). Be sure o-rings are flat and all twists removed.

   CAUTION: **Care must be taken so as not to scratch or mar piston.**

9. Lubricate piston (item 16) with type fluid used in the system. Carefully press piston into pressure plate (item 21). Be sure piston is aligned correctly at all times and that there are no extrusions. Press piston until it bottoms on pressure plate (item 21).
10. Install eight springs (item 15) according to pattern noted during disassembly. Different colored springs must be alternated.
11. Apply a bead of 3M-08001 adhesive on the spring plate (item 14), pressure plate (item 21) and cover (item 6) sealing surfaces. Affix case gaskets (item 7) to cover (item 6) and spring plate (item 14).
12. Place unit on a press. Using fixture, depress and install two socket head assembly bolts (item 9). SEE NOTE BELOW. Torque bolts to 40 ft. lbs. A suitable holding fixture is useful to hold brake in position.
13. Install stator discs (item 13) and rotor discs (item 12). Begin with a rotor disc (item 12) and alternate with stator discs (item 13).
14. Install primary disc (item 11).
15. Align discs and partially screw in four socket head shoulder bolts (item 10). SEE NOTE BELOW. Inspect for free movement of stack. Pressurize brake release port (approx. 200 psi) to release discs. Torque shoulder bolts to 20 ft. lbs. and release pressure. A suitable holding fixture is useful to hold brake in position.
16. Install cover (item 6) using flat head assembly bolts (item 1). SEE NOTE BELOW. Torque bolts to 45 ft. lbs.

NOTE: Bolts should have Loctite applied. Place one or two drops of Loctite to the threads.

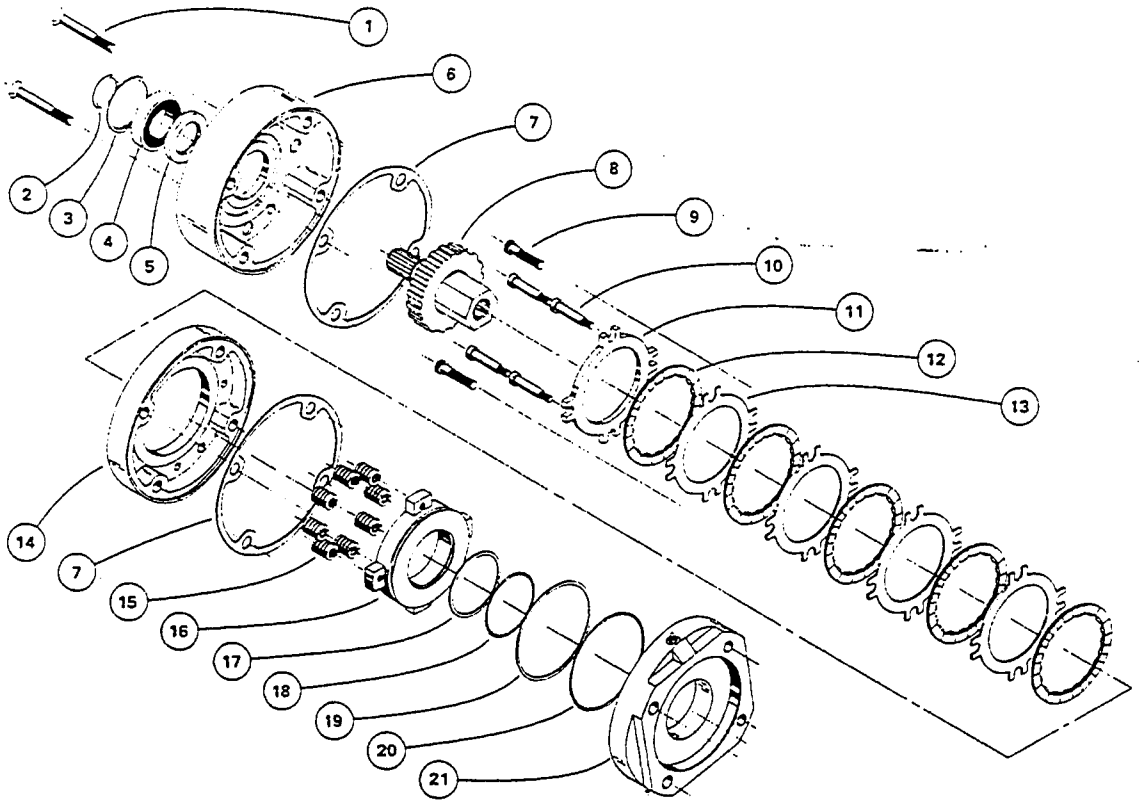


FIGURE 2

PARTS LIST

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

BLEEDING

1. Install brake in system and connect pressure lines.
2. Bleed pressure release section of brake by pressurizing side inlet port and allowing air to escape from top port. Pressure should not exceed 100 psi during bleeding.
3. Apply sufficient pressure to release brake and check for proper operation in system.

SERVICE DIAGNOSIS

(Numbers shown refer to Figure 2)

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

REPAIR KITS

NUMBER	DESCRIPTION	INCLUDES
66972	O-ring and Back-up Ring Kit	Case Gaskets (item 7) Face Gasket (not shown) Oil Seal (item 5) O-rings (items 18 & 20) Back-up Rings (items 17 & 19) Loc-tite
67643	Lining Kit	Case Gaskets (item 7) Face Gasket (not shown) Primary Disc (item 11) Stator Discs (item 13) Rotor Discs (item 12) Loc-tite
67656	Bearing Kit	Case Gaskets (item 7) Face Gasket (not shown) Bearing (item 4) Loc-tite
67649	Spring Kit	Case Gaskets (item 7) Face Gasket (not shown) Springs - red (item 15) Springs - blue (item 15) Loc-tite
N/A	High Torque Lining Kit	Case Gaskets (item 7) Face Gasket (not shown) Primary Disc (item 11) Stator Discs (item 13) Rotor Discs - thick (item 12) Rotor Discs - thin (item 12) Loc-tite

SERVICE INSTRUCTIONS
FOR THE CESSNA
71503-DAB PISTON MOTOR ASSEMBLY

DISASSEMBLY

1. Disconnect all control linkage and hydraulic lines. Remove motor assembly from vehicle.

2. Plug all ports and thoroughly clean outside of motor.

3. Clamp the end of the drive shaft in a protected jaw vise with the body of the motor up and remove the cover plate (36). Remove cap screws (37). Remove o-ring (35).

4. Remove the five cap screws (33) and one capscrew (34) from the backplate (30). Use a plastic mallet and tap the backplate assembly (30) to loosen it, then pull backplate up until it is free of shaft. Remove gasket (27).

5. Remove plugs (32) from backplate (30).

6. Remove motor from vise and remove rotating assembly (17) from motor housing (9).

7. If the pistons (18) did not come out with the piston block (21), remove them, the spider (19) and the spider pivot (20).

8. The piston block assembly (17) need not be disassembled unless the internal pins (23) or spring (25) are damaged.

   CAUTION:
   The following procedure should be used if the spring (25) is to be removed from the piston block assembly (17). The spring (25) is highly compressed and the snap ring (26) should not be removed without first compressing the spring.

   The following parts are used to disassemble the piston block assembly:
   - 2 each 1/2 flat washers with 1-3/8 O.D.
   - 1 each 5/8 flat washer with 1-3/4 O.D.
   - 1 each 1/2 X 4-1/2 N.C. cap screw
   - 1 each 1/2 N.C. nut

   Place one of the 1/2 flat washers over the 1/2 X 4-1/2 cap screw and place this through the center of the piston block. Place the 5/8 flat washer over the cap screw and let it rest on the three pins. Place the other 1/2 flat washer on the capscrew and screw nut on and compress the spring inside the piston block. Use a pair of snap ring pliers and remove the internal snap ring (26). Remove the nut, bolt and three washers. Remove spring (25), washer (24), three pins (23) and the internal pin keeper (22).

9. Remove snap ring (1) from housing (9). Press shaft (7) from housing and remove shaft seal (2) and washer (3).

10. Remove the two snap rings (4), thrust bearing (6), and two thrust washers (5) from the drive shaft (7).

11. To remove the camplate (16) from housing (9), remove the snap rings (1) from sides of the housing. Remove trunnion cover (13) and seal housing (15). Remove o-ring (12), inner race (11), and needle bearings (10). The camplate (16) can now be moved over to one side and removed. The camplate pivot bearings (10) are a loose slip fit into the housing. Do not be concerned if they are not tight.

12. Remove seal (14) from seal housing (15).

INSPECTION

1. Inspect flat surface of the backplate (30). The finish on the piston block side should be smooth and free of grooves. DO NOT LAP BACKPLATE WEAR SURFACE. The backplate should be replaced if it shows any of the wear characteristics outlined above. Inspect the needle bearing (29) in the backplate (30). If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the bearing.

2. Inspect the piston block (21). The wear surface that contacts the backplate should be smooth and free of grooves. DO NOT LAP PISTON BLOCK.

3. The pistons (18) should move freely in the piston block bores. If they are sticky in the bore, examine the bore for scoring or contamination.

4. Examine the O.D. of the pistons (18) for finish condition. They should not show wear or deep scratches. The shoes should be snug fit on the ball end of the pistons. The flat surfaces of the shoes should be flat and smooth. DO NOT LAP THE PISTON SHOES.

5. Examine the spider (19). It should be flat, no cracks and no signs of wear in the pivot area.

6. Examine the pivot (20). It should be smooth and show no signs of wear.

7. The camplate (16) should be inspected for the condition of the finish of the polished shoe surface. It should show no signs of scoring. Inspect the camplate pivot bearings (10). If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the bearing.

8. Inspect the drive shaft (7) for fretting in the bearing and spline areas.

9. Inspect the thrust bearing (6) and thrust washers (5) for wear.

10. Inspect the needle bearing (8) in the housing (9). If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the bearing.

REASSEMBLY

1. Clean all parts in a suitable solvent. Lubricate all critical moving parts before reassembly. If necessary, install new needle bearing (8) in housing (9) with numbered end of bearing outward.

2. Insert camplate (16) into housing (9). Insert needle bearings (10) and inner race (11). The chamfered I.D. of the race should be inward. Install o-ring (12), trunnion cover (13), seal (14) in seal housing (15), and install seal housing (15) onto trunnion. Retain with snap ring (1).

3. Install snap ring (4) on shaft (7). Install thrust washer (5), thrust bearing (6) and second thrust washer (5). Secure with second snap ring (4).

4. Install shaft in housing (9) and install washer (3), shaft seal (2) and retain with snap ring (1).

5. Compress pin keeper (22) and install in the spline of the piston block (21). Install the three pins (23) in the special grooves of the piston block spline.

6. Install washer (24) and spring (25) in the piston block (21). Use the 1/2 X 4-1/2 N.C. cap screw with the three flat washers to compress the spring (25) and retain with snap ring (26). Remove the 1/2 X 4-1/2 cap screw and the three washers.

7. Install the pivot (20), spider (19), and the piston assemblies (18) in the piston block (21). Install assembly in the housing assembly. The piston shoes must be in contact with the camplate. Be sure all the parts are in their proper position.

8. Clamp this assembly in a protected jaw vise with the open end of the housing up.

9. Install roll pins (28). Install new gasket (27).

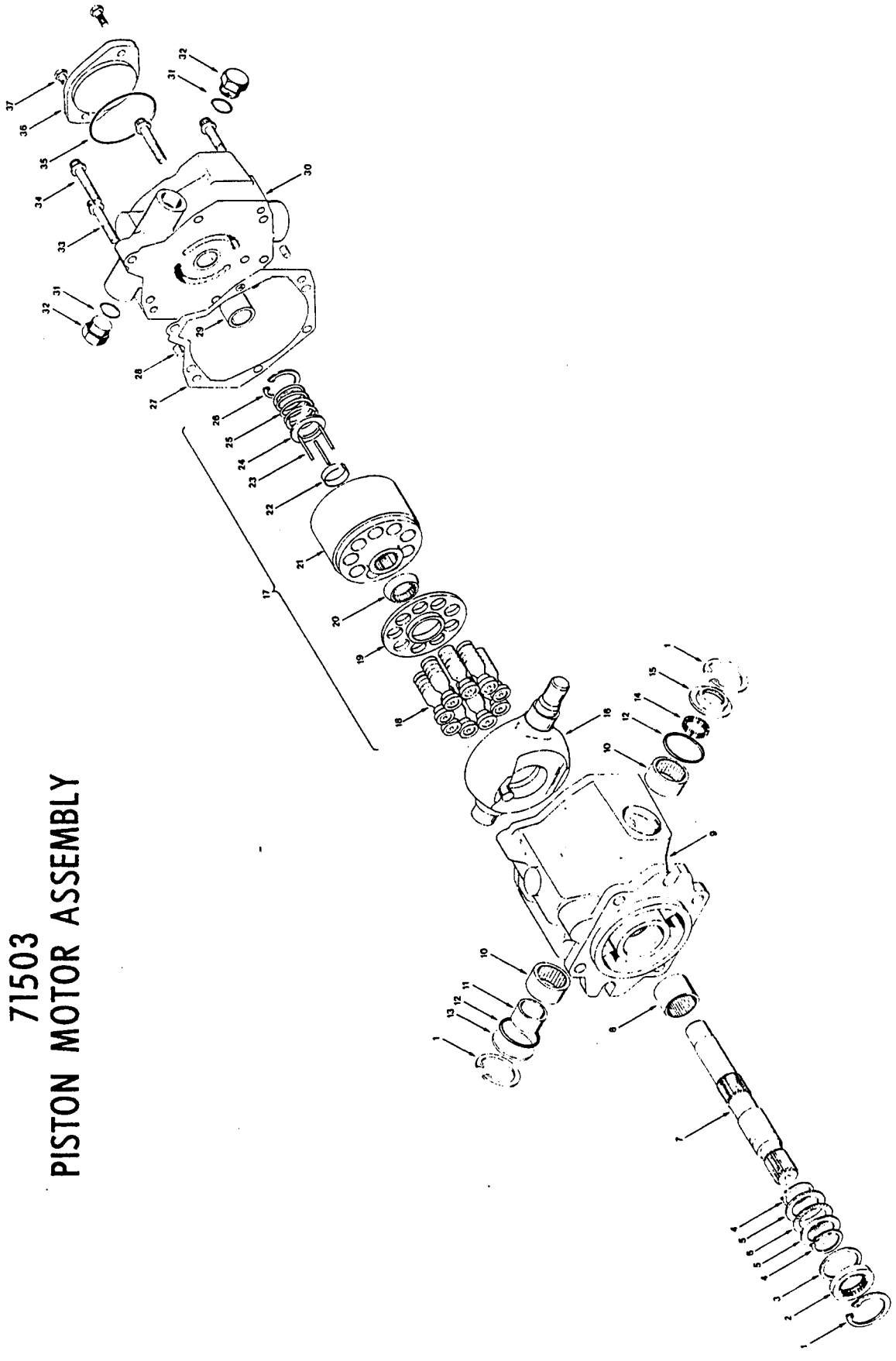
10. Install plugs (32) with new o-rings (31) into backplate (30) and torque to 55-60 ft. lbs.

11. Install backplate assembly (30). Install five cap screws (33) and one cap screw (34) and torque to 35-40 ft. lbs.

12. Install new o-ring (35) on cover plate (36). Install cover plate on backplate and retain with cap screws (37). Torque 27-31 ft. lbs.

PARTS LIST
FOR THE
71503-DAB

Ref. No.	Description
1	Retaining Ring
2	Shaft Seal
3	Washer
4	Retaining Ring
5	Thrust Race
6	Thrust Bearing
7	Drive Shaft
8	Bearing
9	Housing
10	Trunnion Bearing
11	Trunnion Race
12	O'ring
13	Trunnion Cover
14	Seal
15	Seal Housing
16	Camplate
17	Rotating Kit Assembly
18	Piston Assembly
19	Spider
20	Spider Pivot
21	Piston Block
22	Internal Pin Keeper
23	Loading Pin
24	Washer
25	Spring
26	Retaining Ring
27	Gasket
28	Dowel Pin
29	Bearing
30	Backplate
31	O'ring
32	Plug
33	Cap Screw
34	Cap Screw
35	O'ring
36	Cover Plate
37	Cap Screw



71503
PISTON MOTOR ASSEMBLY

TORQUE-HUB®

Final Drives

ASSEMBLY-DISASSEMBLY MANUAL

FOR THE

S1C

UNIT

INTRODUCTION

This manual is a step-by-step guide to assembly and disassembly of torque-hub units. It is designed for the customer or shop mechanic who is repairing a particular model of torque-hub final drive.

Users of this manual should note that each part mentioned is followed by an in-dentification number enclosed in parentheses. These part numbers may be referred to in the Parts List section of this manual and on the cross-sectional view of this unit.

Any specialized tools normally used to assemble this unit are noted in the assembly procedures and diagrammed in the tooling section. However, it is not mandatory that these tools be used in this unit's assembly. Bearing cups and cones can be pressed using a punch and hammer along their top edges. Seals can be pressed by laying a board flat on top of the seal and then hammering the board down until it meets the hub. Studs can be hammered into stud holes. Should you use these methods, be very careful not to damage parts when using a punch and/or hammer.

Users should familiarize themselves with the procedures for roll and leak testing and bolt tightening and torquing found on the following pages before getting started.

SAFETY

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn. Heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see the word CAUTION. This indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

ROLL and LEAK TESTING

Torque-hub units should always be roll and leak tested before disassembly and after assembly to make sure that the unit's gears and sealants are working properly. The following information briefly outlines what to look for when performing these tests.

The Roll Test

The purpose of a roll test is to determine if the unit's gears are rotating freely and properly. You should be able to rotate the gears in your unit by applying a constant force to the roll checker. If you feel more drag in the gears only at certain points, then the gears are not rolling freely and should be examined for improper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if the gears in your unit seem to roll hard as long as they roll with consistency.

The Leak Test

The purpose of a leak test is to make sure the unit is air tight. You can tell if your unit has a leak if the pressure gauge reading on your air checker starts to fall once the unit has been pressurized. Leaks will most likely occur at the main seal or wherever "O" rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where "O" rings or gaskets meet the exterior of the unit, then checking for air bubbles. If a leak is detected in a seal, "O" ring, or gasket, the part must be replaced.

TIGHTENING and TORQUING BOLTS

If an air impact wrench is used to tighten bolts, extreme care should be taken to insure that the bolts are not tightened beyond their specified torque. Never use an impact wrench to tighten shoulder bolts. All shoulder bolts should be tightened by hand.

The following steps describe how to tighten and torque bolts or socket head cap screws in a bolt circle.

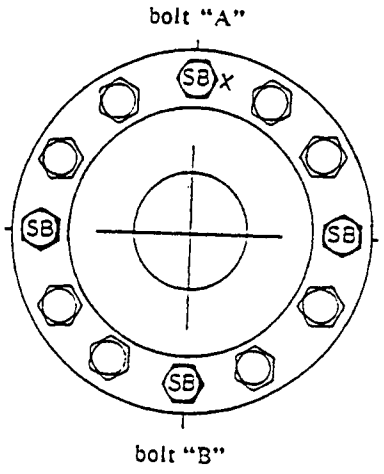
1. Tighten (but do not torque) bolt "A" until snug.

2. Go to the opposite side of the bolt circle and tighten bolt "B" until equally snug.

3. Continue around the bolt circle and tighten the remaining bolts.

4. Now use a torque wrench to apply the specified torque to bolt "A".

5. Continue around the bolt circle and apply an equal torque to the remaining bolts.



CONTENTS

Introduction, Safety I

Roll and Leak Testing I

Tightening and Torquing Bolts II

Main Disassembly 5

Carrier Disassembly 6

Carrier Sub-Assembly 7

Hub-Shaft Sub-Assembly 10

Main Assembly. 15

Tooling 20

Tool Prints 21

MAIN DISASSEMBLY

1. Remove the two pipe plugs (13) in cover (6) and drain the oil from the unit.

2. Loosen and remove the four shoulder bolts (14) and eight grade 8 bolts (12) from cover (6).

3. Remove cover (6) from hub (1G).

4. Remove "O" ring (5) from the counterbore in cover (6) and discard.

5. Remove thrust washer (11) from the counterbore in carrier housing (3A).

6. Remove input gear (9) from mesh with planet gears (3F).

CAUTION: Safety glasses should be worn during this step:
7. Using a punch, remove retaining ring (20) from the groove around the inside of input gear (9) and discard.

8. Lift carrier sub-assembly (3) out of hub (1G).

9. Lift ring gear (2) off of hub (1G).

10. Remove "O" ring (5) from the counterbore in hub (1G) and discard.

11. Remove the three pipe plugs (1J) from side of hub (1G).

12. Apply a preload to output shaft(1A) in order to remove retaining ring(1I). To do this, follow steps a-b:

a. Place bearing cone pressing tool (T-116407) on top of retaining ring (1I).

b. Apply pressure to the fixture using a hydraulic ram or by striking the fixture with a soft face hammer. Pressure should be applied until the hub rotates with difficulty.

CAUTION: Safety glasses should be worn during this step:
13. Using retaining ring pliers, remove retaining ring (1I) and discard.

14. Remove spacer (1H) from output shaft (1A).

15. Raise hub (1G) above your work surface and place a support underneath it in such a manner that output shaft (1A) will be able to fall through the bottom when pressed in next step.

16. Press output shaft (1A) out of hub (1G). The output shaft may come out with bearing cone (1D) and seal (1B) attached. If so, remove seal (1B) from output shaft and discard. Use a soft punch and hammer to remove bearing cone (1D) from the shaft. Be very careful not to strike the shaft when using the punch.

17. If seal (1B) and bearing cone (1D) remain in the hub, press the seal and bearing cone out using a bearing cone pressing tool (T-116407). Discard the seal.

18. Lift bearing cone (1F) out of hub (1G).

19. Stand hub(1G) on its small diameter end. Using a soft punch and hammer, remove bearing cup (1C) from the counterbore of hub (1G). Be very careful not to strike the counterbore when using the punch.

20. Turn hub (1G) over so that it rests on its large end. Using a soft punch and hammer, remove bearing cup (1E) from the counterbore of hub (1G). Be very careful not to strike the counterbore when using the punch.

21. At this point the main disassembly is complete.

CARRIER DISASSEMBLY

1. Locate roll pin (3G) which holds planet shaft (3E) in the carrier housing (3A).

2. Drive the roll pin (3G) down into planet shaft (3E) until it bottoms against the carrier housing. If the roll pin is not completely driven into the planet shaft, damage to the carrier could occur when the shaft is removed.

3. Remove planet shaft (3E) from carrier housing (3A). The two thrust washers (3B) and planet gear (3F) will slide off.

4. Place planet shaft (3E) in a vise and drive roll pin (3G) out through the roll pin hole.

5. Remove the needle rollers (3C) and spacer (3D) from inside planet gear (3F).

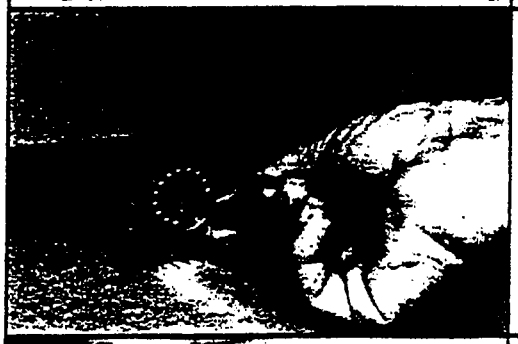
6. Repeat steps 1-5 to remove and disassemble the two remaining planet gears.

7. At this point the carrier disassembly is complete.

CARRIER SUB-ASSEMBLY



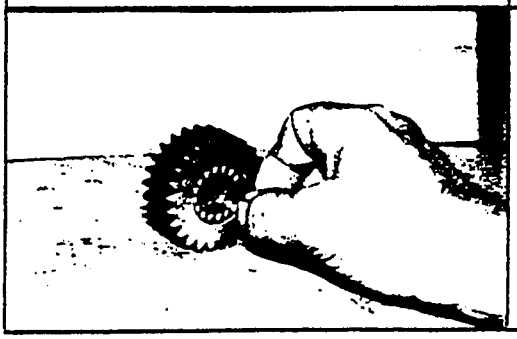
1. Apply grease to the inside of one **planet gear (3F).**



2. Line one half of **planet gear (2F)** with **16 needle rollers (3C).**

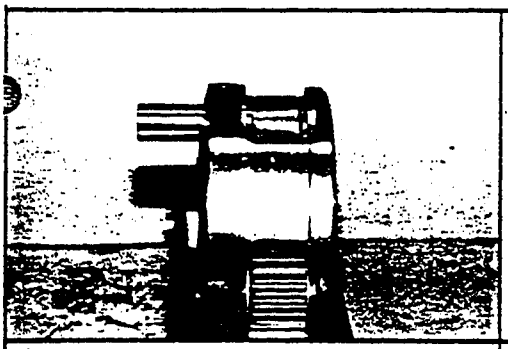


3. Place one **spacer (3D)** inside **planet gear (3F)** so that it rests on top of the **needle rollers (3C).**

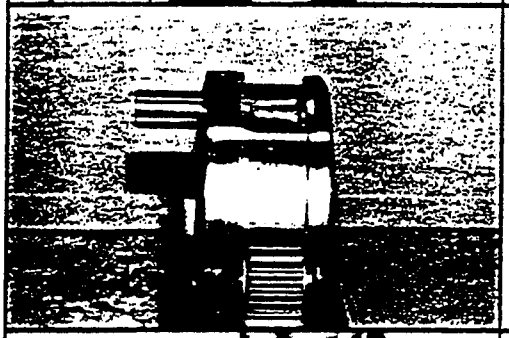


4. Line the remaining half of **planet gear (3F)** with 16 **needle rollers (3C).**

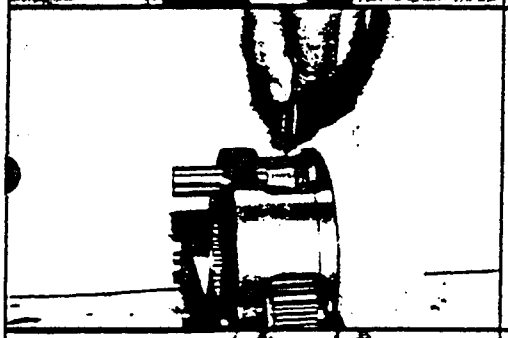
Carrier Sub-Assembly



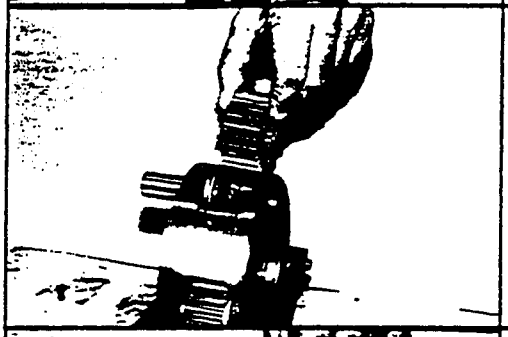
5. Stand carrier housing (3A) in an upright position.



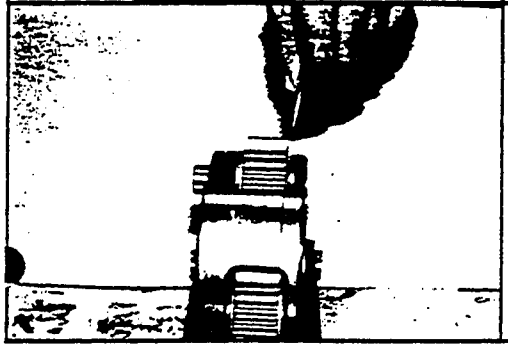
6. Insert a planet shaft (3E) into one of the planet shaft holes which also has a roll pin hole on carrier housing (3A). The end of the planet shaft that does not have the roll pin hole should be inserted into the carrier housing first.



7. Place one thrust washer (3B) onto the end of planet shaft (3E) which has been inserted through the planet shaft hole. Notice that the thrust washer has a tang on it: the tang should point straight down so as to fit within the space in the raised inside edge of the planet shaft hole.

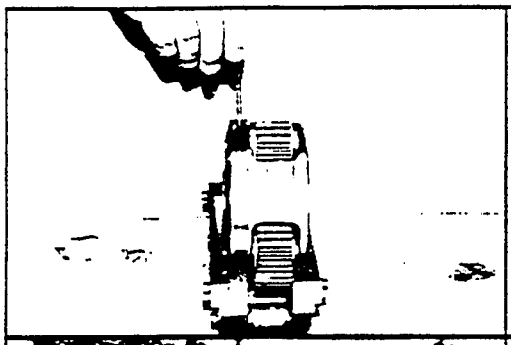


8. Following the thrust washer, place assembled planet gear (3F) onto planet shaft (3E).

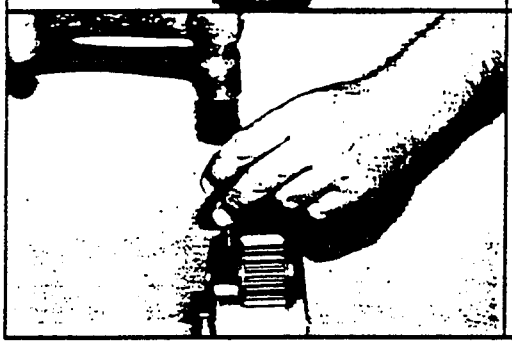


9. Following the planet gear, place one more thrust washer (3B) onto planet shaft (3E). Now insert planet shaft (3E) through the opposite planet shaft hole on carrier housing (3A).

Carrier Sub-Assembly



10. Use an alignment punch or similar tool to align the roll pin holes on the **carrier housing (3A)** and **planet shaft (3E)**.



11. Drive **roll pin (3G)** down into the aligned roll pin holes.

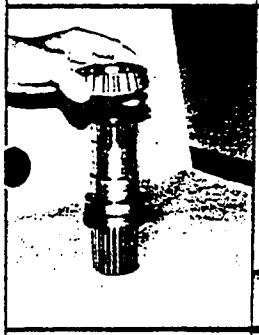
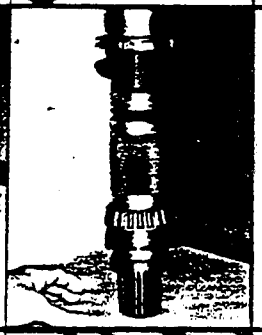
12. Repeat steps 1-11 to assemble and install the two remaining planet gears.

13. At this point the carrier sub-assembly is complete.

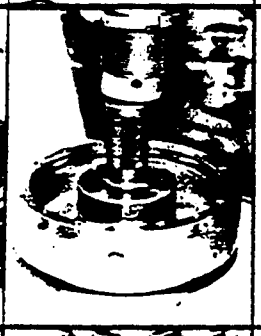
HUB-SHAFT SUB-ASSEMBLY




1. Oil **output shaft** (1A) and **bearing cone** (1D).

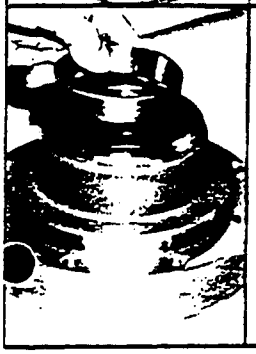



2. Using bearing cone pressing tool (T-116407), press **bearing cone** (1D) onto the end of **output shaft** (1A) that has the retaining ring groove.

3. Stand **hub** (1G) on its small end. Using bearing cup pressing tool (T-116412), press **bearing cup** (1E) down into **hub** (1G).

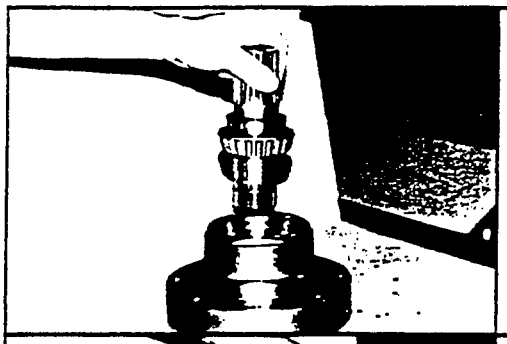
NOTE: Make sure that the cup sits square with the counterbore before pressing.



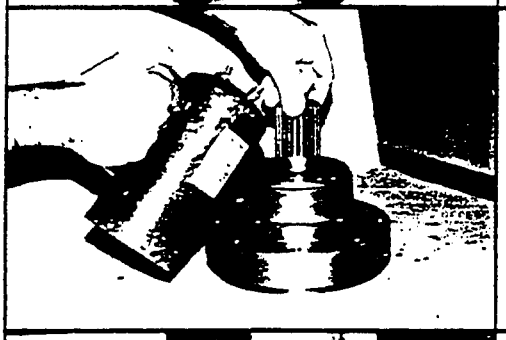

4. Turn **hub** (1G) over so that it rests on its large diameter end. Using bearing cup pressing tool (T-116412), press **bearing cup** (1C) into the small end of **hub** (1G).

NOTE: Make sure that the cup sits square with the counterbore before pressing.

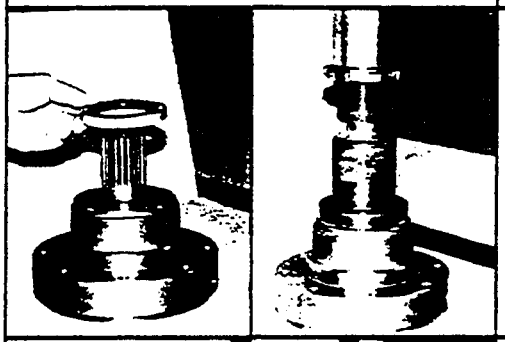
Hub-Shaft Sub-Assembly



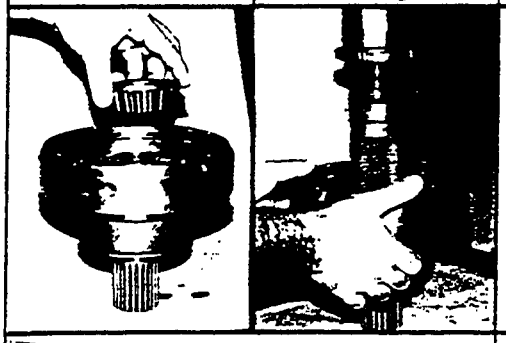
5. With **hub (1G)** still standing on its large end, place **output shaft (1A)** into **hub (1G)** so that the end of the shaft with the retaining ring groove points down.



6. Oil **output shaft (1A).**



7. Using seal pressing tool (T-116402), press **seal (1B)** into the counterbore in the small end of **hub (1G).** The closed face of the seal should be up.

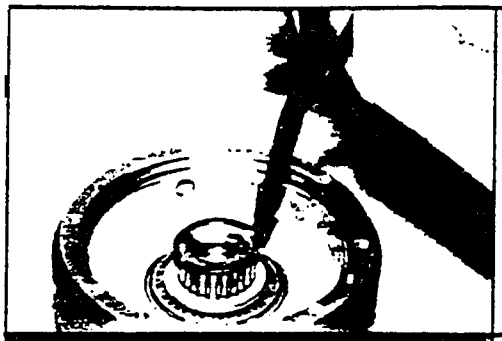


8. Turn **hub(1G)** over so that its small end points down. Using bearing cone pressing tool (T-116407), press bearing **cone (1F)** onto **output shaft (1A).** Rotate the hub while pressing the bearing. Stop pressing when the hub starts to resist rotating.

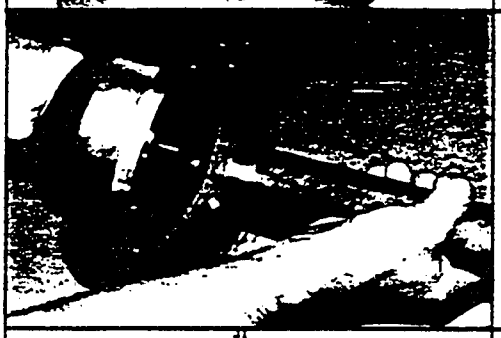


9. Place **spacer (1H)** onto **output shaft (1A)** so that it rests on top of bearing **cone (1F).**

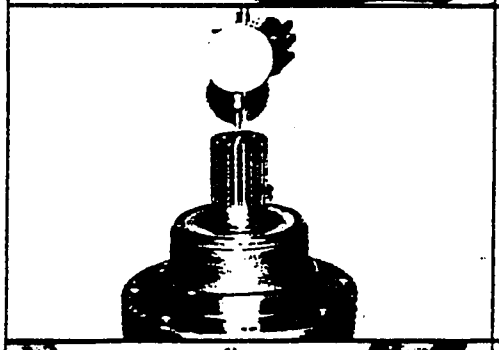
Hub-Shaft Sub-Assembly



CAUTION: Safety glasses should be worn during this step:
10. Using retaining ring pliers, place **retaining ring (1I)** into the groove on **output shaft (1A)**. Use a soft punch against the retaining ring to make sure that it is seated.

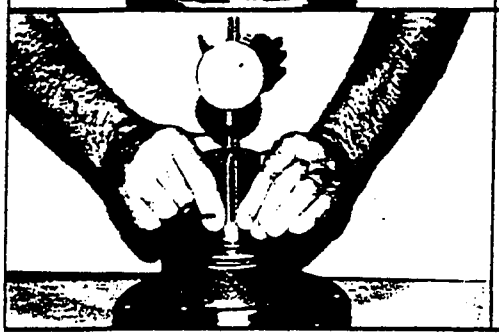


11. Hit the end of **output shaft (1A)** once or twice with a soft face hammer. Turn the shaft in both clockwise and counter clockwise directions while hitting. This will seat the bearing cone against the spacer and retaining ring, allowing necessary endplay in the hub-shaft sub-assembly.



12. Turn **hub (1G)** over so that it rests on its large end. Measure the endplay in the hub-shaft sub-assembly. To do this, follow steps a-c:

a. Mount a dial indicator on **hub (1G)**.Locate the dial rod on top of **output shaft (1A)**.

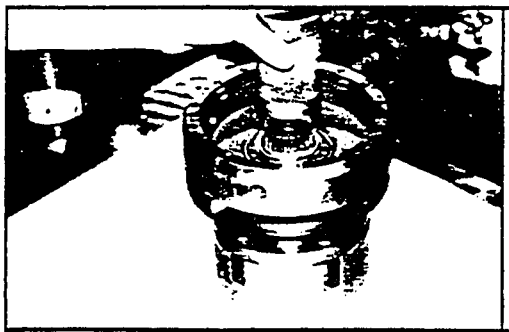


b. Lift up on the output shaft until the needle on the dial stops moving.

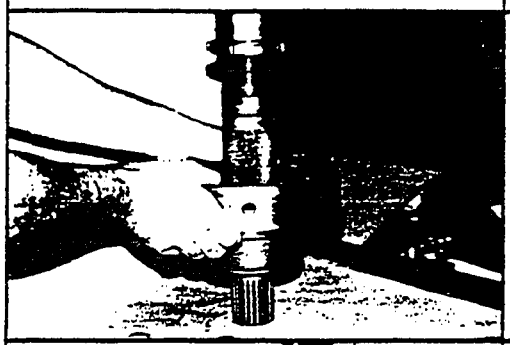
NOTE: Before doing step c, be aware that some applications of this unit may require an endplay of 0.000 in. to 0.003 in. If this is the case, installation of shims on **bearing cone (1F)** may be necessary to achieve this endplay. Contact your original equipment manufacturer (OEM) for the endplay information on your unit.

c. Read the dial. The reading on the dial should be no greater than 0.008 in.
- If the reading is less than 0.008 in., go to step 13.
- If the reading is above 0.008 in., continue to do steps d-h.

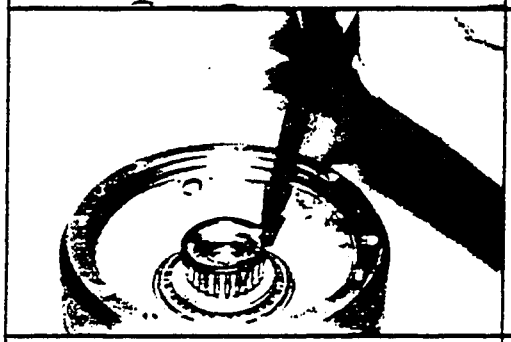
Hub-Shaft Sub-Assembly



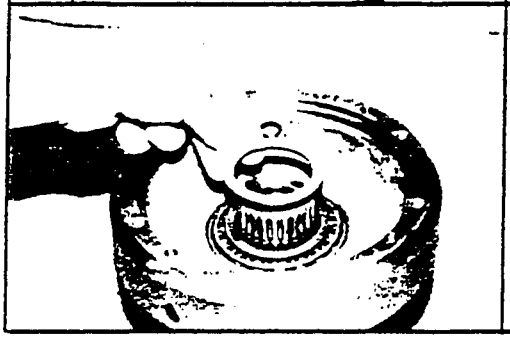
d. Place a bearing cone pressing tool (T-116407) on top of **retaining ring (1I)**.



e. Press the fixture with a hydraulic ram or by striking it with a soft face hammer. Pressure should be applied until the hub rotates with difficulty. This step is necessary in order to remove the preload against the retaining ring.



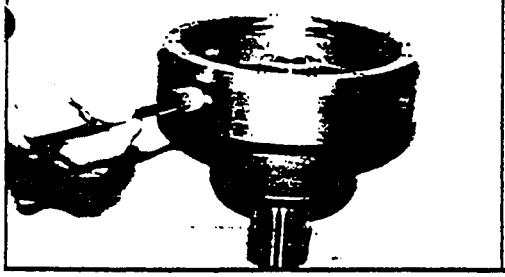
CAUTION: Safety glasses should be worn during this procedure.
f. Using retaining ring pliers, remove **retaining ring (1I)** and discard.
NOTE: Do not reuse the retaining ring.



g. Remove **spacer (1H)** and replace it on the output shaft with an SK91 spacer. This spacer is thicker and will reduce the endplay.

h. Repeat steps 8-12 to reassemble the shaft and remeasure the endplay.

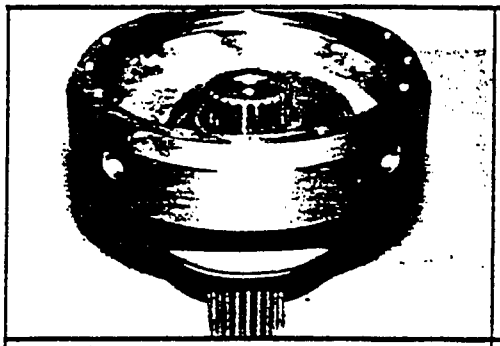
Hub-Shaft Sub-Assembly



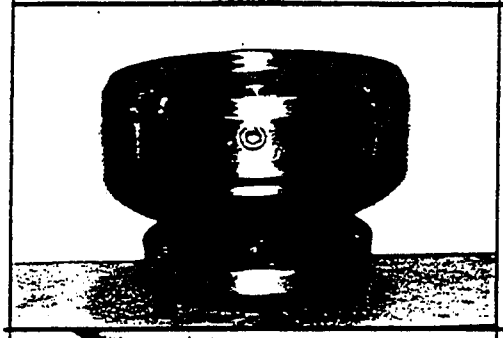
13. Apply a light coat of "Never-Seize" to the three pipe plugs (1J). Tighten pipe plugs (1J) into the three pipe plug holes on hub (1G).

14. At this point the hub-shaft sub-assembly is complete.

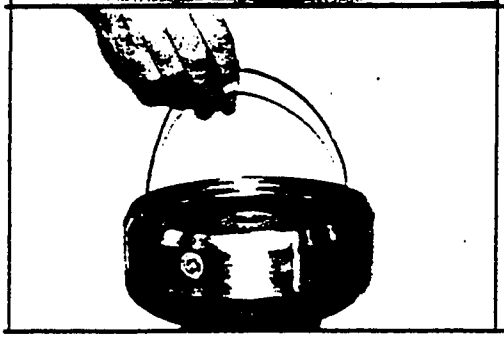
MAIN ASSEMBLY



1. Position hub (1G) on its output shaft (1A) so that the hub's small diameter end points down.



2. Mark the four shoulder bolt holes in hub (1G) with chalk or marker so that they can be aligned with the shoulder bolt holes in the ring gear (2) in a later step.

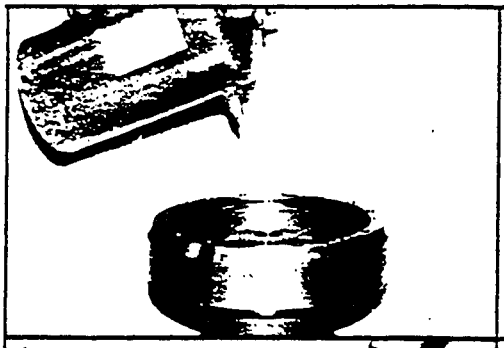


3. Grease "O" ring (5). Place "O" ring (5) into the counterbore of hub (1G).

CAUTION: Beware of sharp edges and burrs around the counterbore when installing the "O" ring.

NOTE: "O" rings may be stretched to fit the counterbore. If an "O" ring has been stretched too much, simply squeeze the "O" ring together bit by bit as you place it around the counterbore. It can be made to fit exactly.

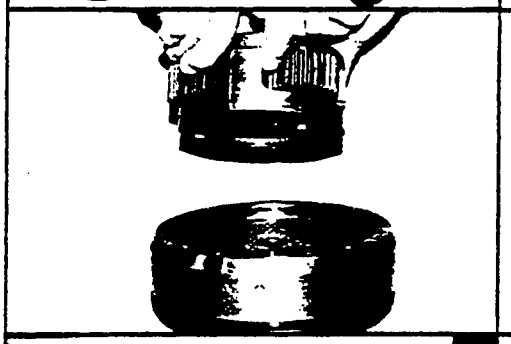
Main Assembly



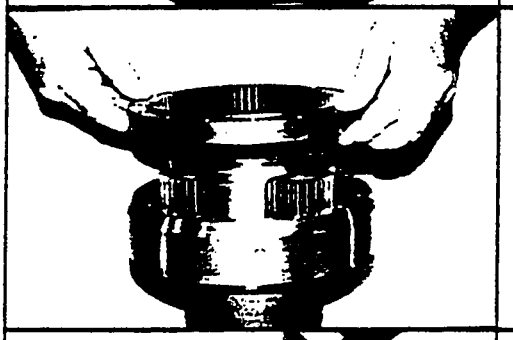
4. Oil all exposed surfaces inside hub (1G).



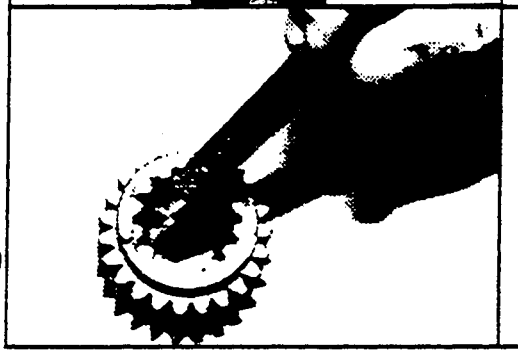
5. Oil carrier sub-assembly (3).



6. Place carrier sub-assembly (3), with spline connections down, into mesh with output shaft (1A).



7. Place ring gear (2), with squared shoulder side down, into mesh with the planet gears (3F) of the carrier sub-assembly. Make sure that the shoulder bolt hole that is marked with an "X" on the ring gear aligns with any one of the marked shoulder bolt holes on the hub. The "X" should be on the cover side the ring gear.



8. Start one half of retaining ring (20) into the groove inside input gear (9). Use a soft punch to press the remaining half of the retaining ring into the groove.

Main Assembly



9. Insert input gear (9), with large diameter end down, into mesh with planet gears (3F).



10. Place large thrust washer (11) over input gear (9) so that it rests on carrier housing (3A).



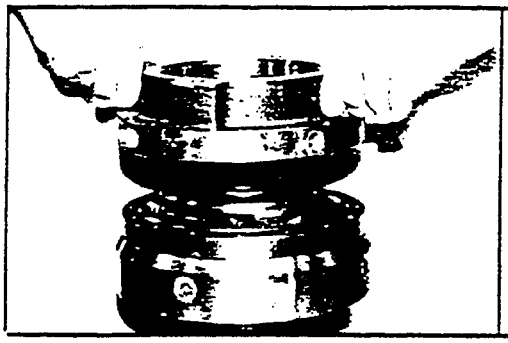
11. Oil all exposed surfaces inside hub (1G).



12. Grease "O" ring (5). Place "O" ring (5) into the counterbore of cover (6).

CAUTION: Beware of sharp edges and burrs around the counterbore when installing "O" ring.

NOTE: "O" rings may be stretched to fit counterbore. If an "O" ring has been stretched too much, simply squeeze the "O" ring together bit by bit as you place it around the counterbore. It can be made to fit exactly.



14. Place cover (6) on top of ring gear (2) so that the two pipe plug holes in the cover line up between the pipe plug holes in the hub as shown in Diagram 1: pipe plug timing.

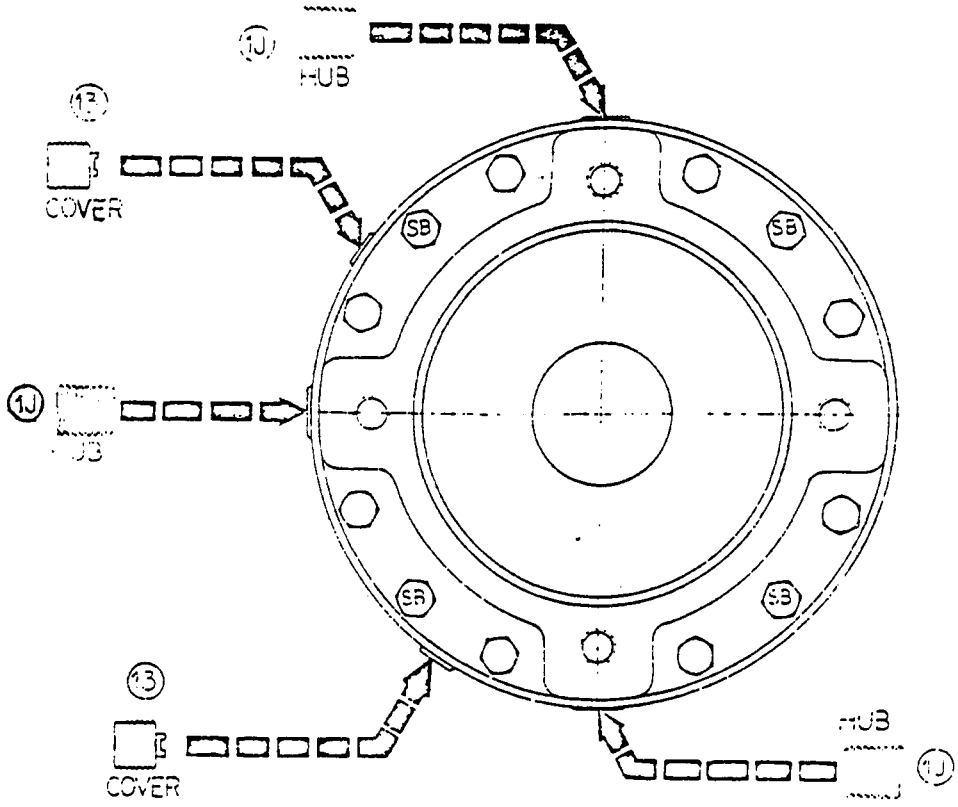
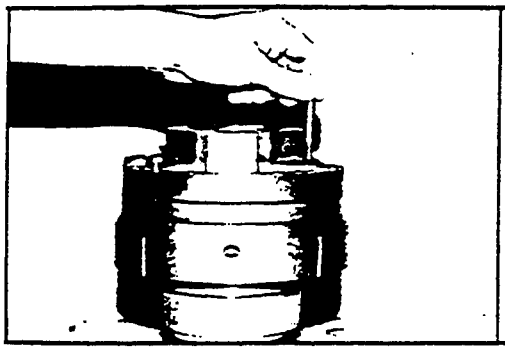
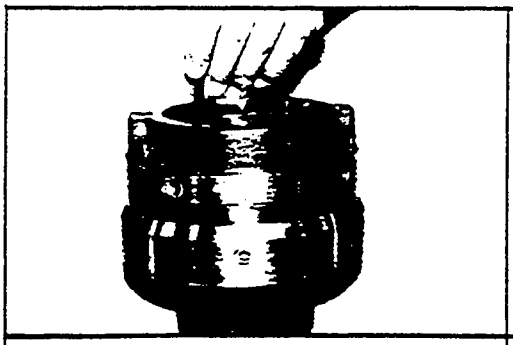


DIAGRAM 1: Pipe plug timing.



15. Place the four shoulder bolts (14) into the shoulder bolt holes marked on the hub and tighten.

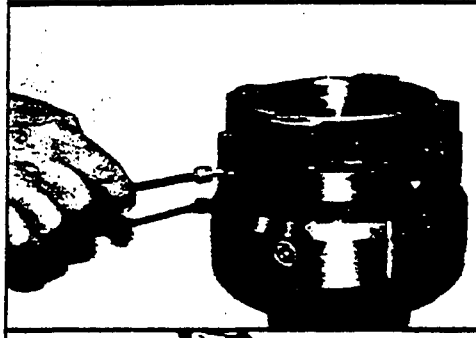
Main Assembly



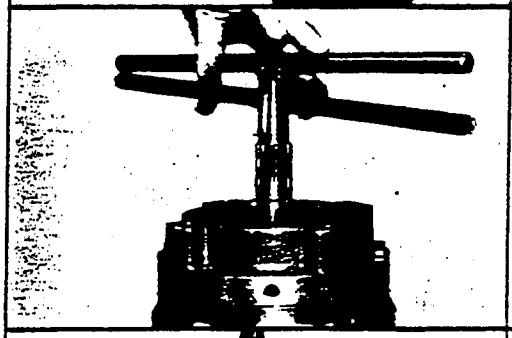
16. Place the eight grade 8 bolts (12) into the remaining bolt holes and tighten.



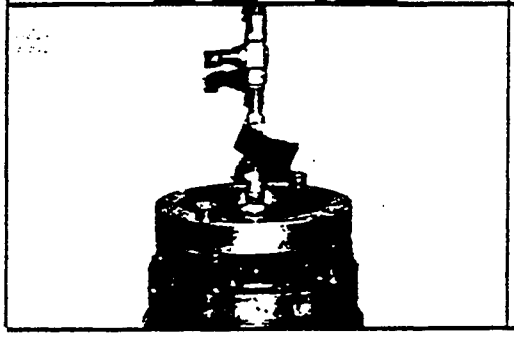
17. Apply 23-27 ft.-lbs. of torque to all bolts.



18. Apply a light coat of "Never-Seize" to both pipe plugs (13). Tighten pipe plugs (13) into the two pipe plug holes on cover (6).



19. Roll test the unit in both clockwise and counterclockwise directions. Perform the same number of turns as the ratio of the unit. The ratio is the last two digits of the model number found on the unit's ID tag. For example, unit S1C544S4 should be rolled 4 times in each direction.



20. Leak test the unit at a pressure of 5 psi for 2-3 minutes.

21. At this point the main assembly is complete.

TOOLING

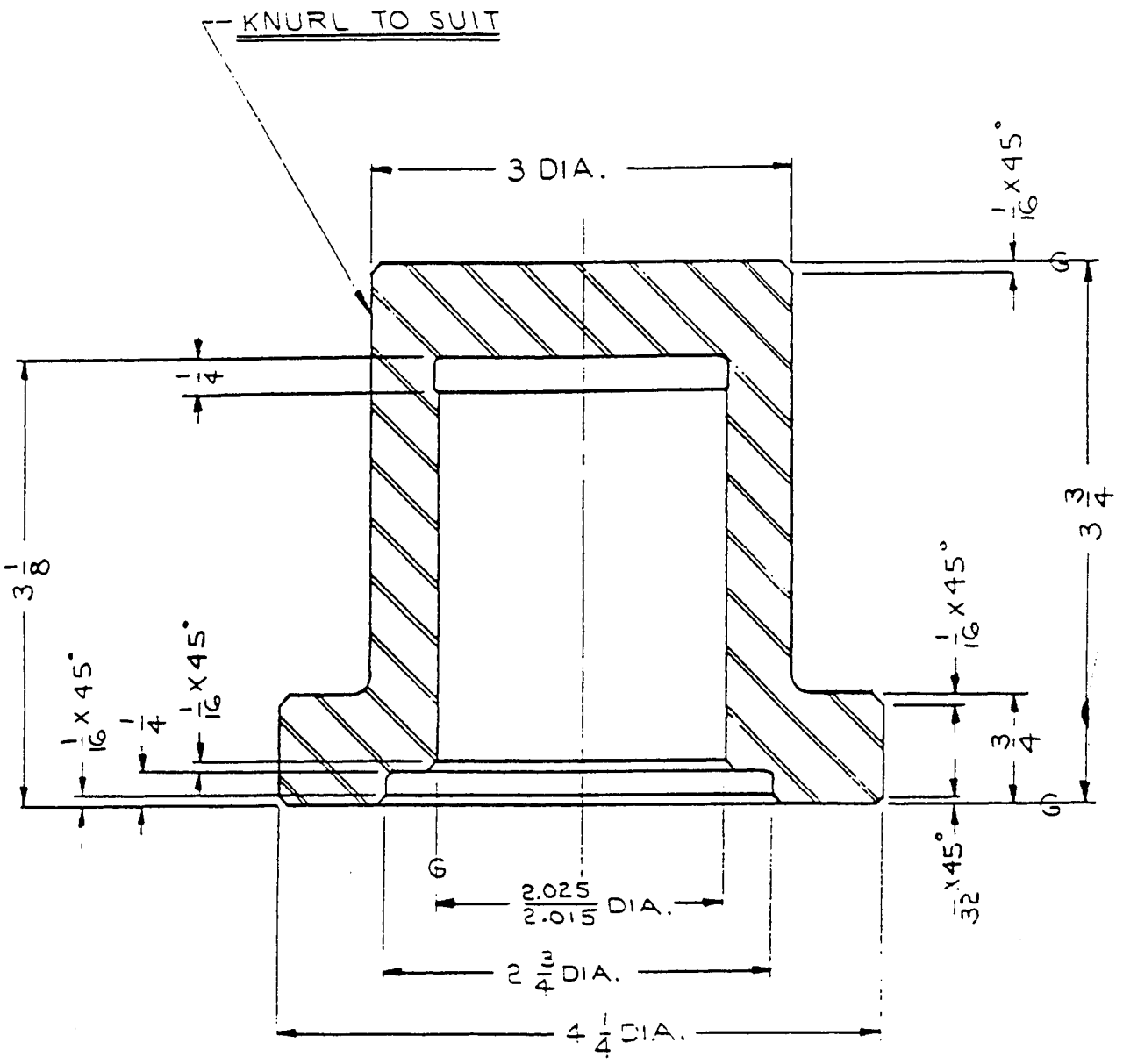
The following specialized tools are used in the assembly of this unit. The tool diagrams included in this manual are intended for the customer who may wish to have a tool made. All tools exist as one piece and must be made from mild steel. All dimensions are given in inches.

OPTIONAL: In order to improve tool life, tools may be carburized and hardened. If this is done, however, the tools must be ground on all surfaces labeled with a "G" on the tool diagram.

1.) T-116402
SEAL PRESSING FIXTURE for SEAL (1B)

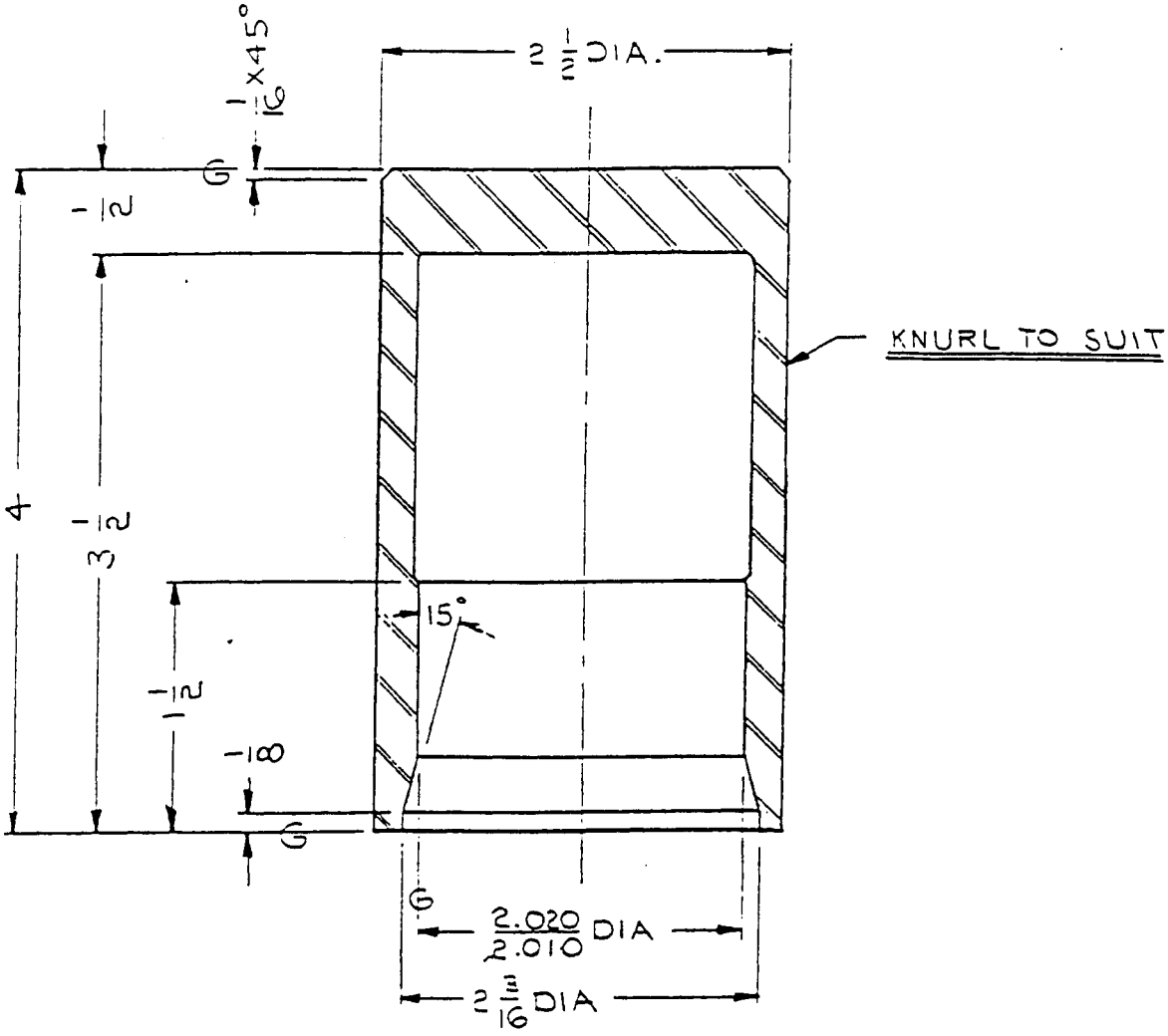
2.) T-116407
ASSEMBLY PRESSING TOOL for BEARING CONES (1D) and (1F)

3.) T-116412
ASSEMBLY PRESSING TOOL for BEARING CUPS (1C) and (1E)



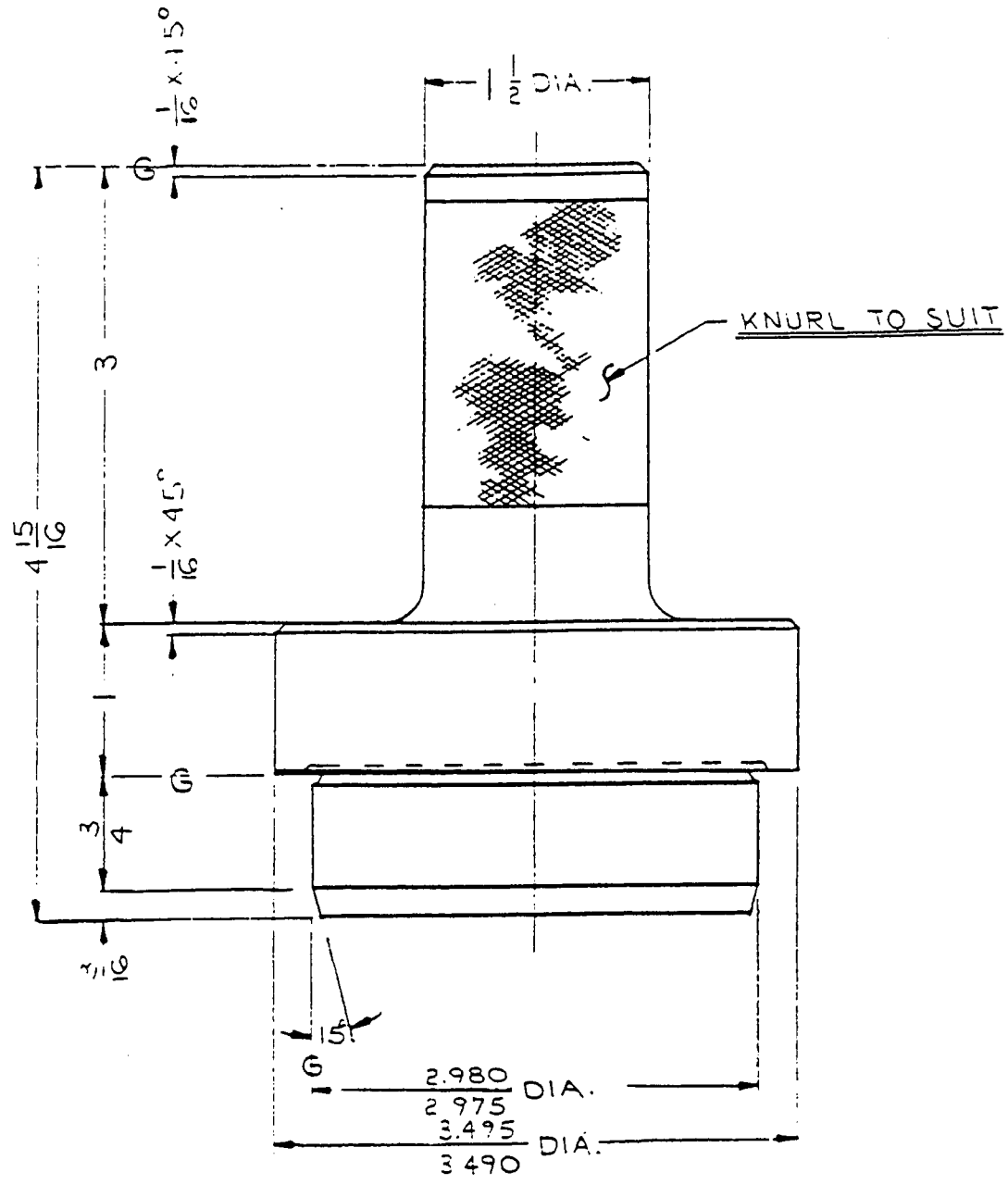
TOOL NO. T-116402

SEAL PRESSING FIXTURE
Used with seal(1B)



TOOL NO. T-116407

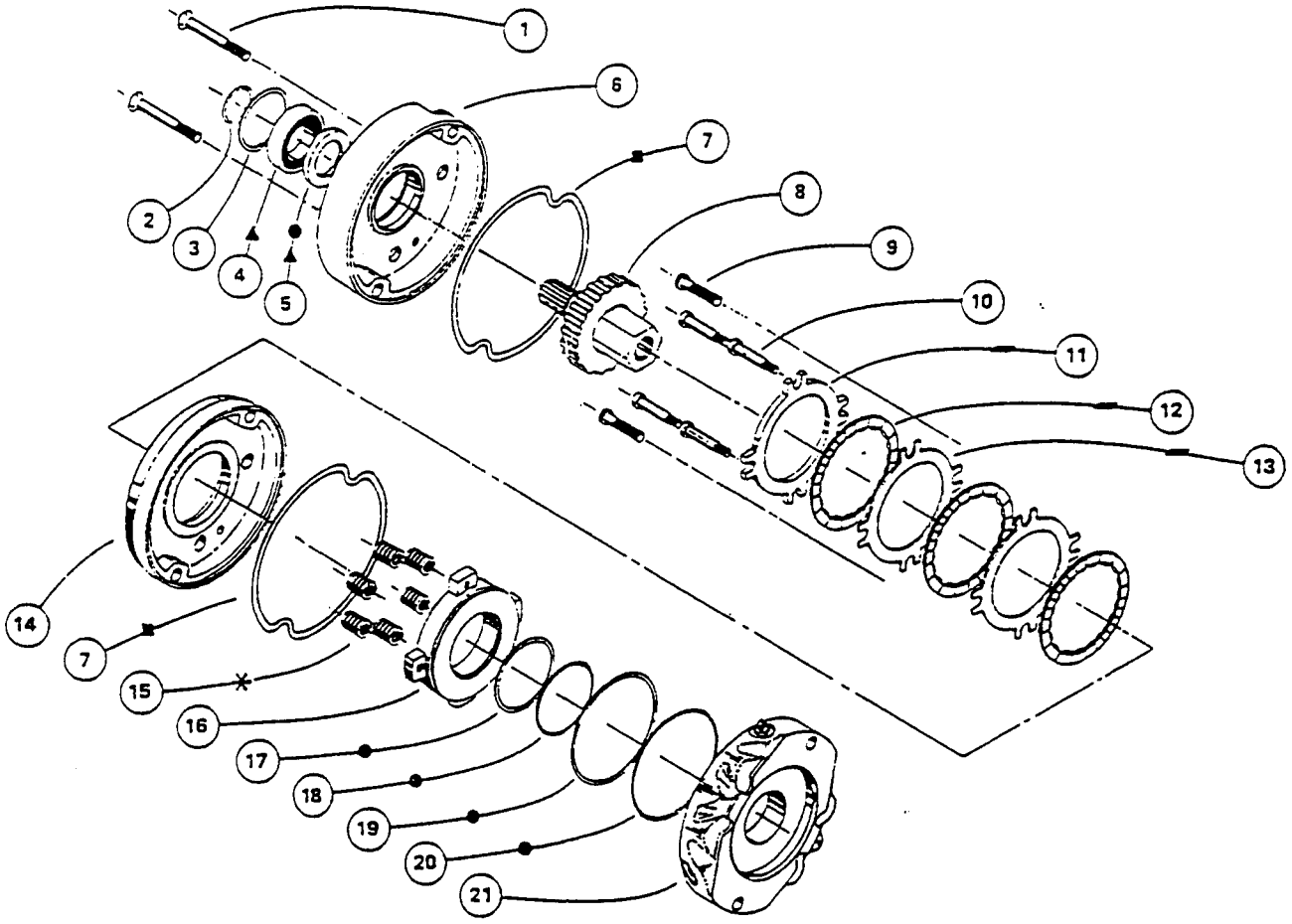
BEARING CONE PRESSING FIXTURE
Used with bearing cones(1D) and (1F)



TOOL NO. T-116412

BEARING CUP PRESSING FIXTURE
Used with bearing cups(1C) and (1E)

- ● Items included in O-ring and Back-up Ring Kit
- ▬ Items included in Lining Kit
- ▲ Items included in Bearing Kit
- ✳ Items included in Spring Kit
- ■ Items included in all Repair Kits listed above



PARTS LIST

ITEM	QTY.	DESCRIPTION
1	2	Flat Head Socket Cap Screws
2	1	Retaining Ring
3	1	Snap Ring
4	1	▲ Bearing
5	1	● ▲ Oil Seal
6	1	Cover Plate
7	2	■ Case Seals
8	1	Spline Shaft Assembly
	1	Shaft
	1	Outer Spline
	1	Retaining Ring
9	2	Socket Head Cap Screws (Assembly Bolt)
10	4	Socket Head Shoulder Bolts (Tension Pin)

ITEM	QTY.	DESCRIPTION
11	1	▬ Primary Disc
12	3	▬ Rotor Discs
13	2	▬ Stator Discs
14	1	Spring Plate
15	4	✳ Springs - Red
	2	✳ Springs - Blue
16	1	Piston
17	1	● Back-up Ring (I.D.)
18	1	● O-ring (I.D.)
19	1	● Back-up Ring (O.D.)
20	1	● O-ring (O.D.)
21	1	Pressure Plate

SERVICE INSTRUCTIONS
FOR THE
71593-DAA

DISASSEMBLY

1. Disconnect all hydraulic lines and remove motor assembly from vehicle.

2. Plug all ports and thoroughly clean outside of motor.

3. Clamp the end of the drive shaft in a protected jaw vise with body of the motor up.

4. Remove the six capscrews (33) and (34) from the back plate of the motor.

5. Use a plastic mallet and tap the back plate (32) to loosen it, then pull the back plate. Remove the gasket (28) and control piston (29).

6. Remove the motor from the vise and lay on bench to remove rotating assembly (22A) from motor housing.

7. Remove pistons (19), spider (20) and spider pivot (21) from piston block.

8. The piston block assembly need not be disassembled unless the internal pins (24) or spring (26) are damaged.

CAUTION:

The following procedure should be used in the disassembly of the piston block assembly.

Spring (26) is highly compressed and snap ring (27) should not be removed without first compressing spring (26).

The following parts are used to disassemble the piston block assembly.

2 each 1/2 flat washers with 1-3/8 OD
1 each 5/8 flat washer with 1-3/4 OD
1 each 1/2 X 4-1/2 NC capscrew
1 each 1/2 NC nut

Place one of the 1/2 flat washers over the 1/2 X 4-1/2 capscrew and place this through the center of the piston block. Place the 5/8 flat washer over the capscrew and let it rest on the three pins. Place the other 1/2 flat washer on the capscrew and screw nut on and compress the spring inside the piston block. Use a pair of snap ring pliers and remove the internal snap ring (27).

Remove the nut, bolt and three washers. Remove spring (26), washer (25), three pins (24) and the internal pin keeper (23).

9. Remove the snap ring (1), shaft seal (2) and washer (3) from front of housing (9).

10. Remove shaft (7) from housing.

11. Remove the two snap rings (4), bearing (6) and two thrust washers (5) from drive shaft.

12. To remove the camplate (18) from the housing, remove the two internal snap rings (1) from the sides of the housing. Remove the two covers (13), the two o-rings (12), the two inner races (11) and the bearings (10). The camplate can now be slid over to one side and removed. The two camplate pivot bearings are a loose slip fit into the housing - do not be concerned if they are not tight.

13. Remove the spring guide (15) and spring (14). Do not remove the button (16) and roll pin (17) unless they are worn or loose.

INSPECTION

1. Inspect the flat surface of the back plate (32), the finish on the piston block side should be smooth and free of grooves or metal build up. The back plate should be replaced if it shows any of the wear characteristics outlined above. The piston guide should be tight in the housing.

2. Inspect the piston block (22). The surface that contacts the back plate should be smooth and free of grooves or metal build up.

3. The pistons (19) should move freely in the piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.

4. Examine the OD of the pistons for finish condition. They should not show wear or deep scratches. The shoes should be snug fit on the ball end of the pistons. The flat surface of the shoes should be flat, smooth, and show no signs of metal build up. Do not lap piston shoes.

5. Examine the spider (20). It should be flat, no cracks and no signs of wear in the pivot area.

6. Examine the pivot (21). It should be smooth and show no signs of wear.

7. The camplate (18) should be inspected for the condition of the finish of the polished shoe surface. It should show no signs of scoring.

8. Inspect the shaft for fretting in the bearing and spline areas.

9. Inspect thrust bearing (6) and washers (5) for wear.

10. Inspect the needle bearing (8) in the housing assembly. If the needles are free of excessive play and remain in the bearing cage, there is no need to replace the bearing.

11. It is not necessary to inspect the o-rings, snap rings, gaskets, or shaft seal as they should be replaced as new items and are included in the seal repair kit available for this assembly.

REASSEMBLY

1. Clean all parts in suitable solvent, and lubricate all critical moving parts before reassembly. If necessary, install new needle bearings in the housing. The camplate pivot bearings (10) are slip fit, the shaft bearing (8) press fit. The shaft bearing should be installed with numbered end of the bearing outward.

2. Install spring (14), spring guide (15) in housing (9).

3. Insert camplate into housing (9). Insert the needle bearing (10) with numbered end inward and bearing inner race (11) over the camplate journals and slide into the housing. The numbered end of the race should face outward and the chamferred should be inward.

4. Install new o-ring (12) around OD of cam pivot bearings. Install trunnion covers (13) and secure with snap rings (1).

5. Install snap ring (4) on shaft (7). Install thrust washer (5), thrust bearing (6), and second thrust washer (5), secure with second snap ring.

6. Install shaft in housing and install washer (3), shaft seal (2) and retain with snap ring (1).

7. Compress the pin keeper (23) and install in the spline. Install the three pins (24) with head end to the inside of the block and install in the special grooves of the piston block spline.

8. Install the washer (25) and spring (26) in the piston block. Use the 11/2 X 4-1/2 NC capscrew with the three flat washers to compress the spring and retain with snap ring (27). Remove the 1/2 X 4-1/2 capscrew and the three washers.

9. Install the pivot (21), spider (20) and the piston assemblies (19) in the piston block. Install this assembly in the housing assembly, the piston shoes must be in contact with the camplate. Be sure all the parts are in their proper position.

10. Clamp spline end of drive shaft in a protected jaw vise with the open end of the housing up.

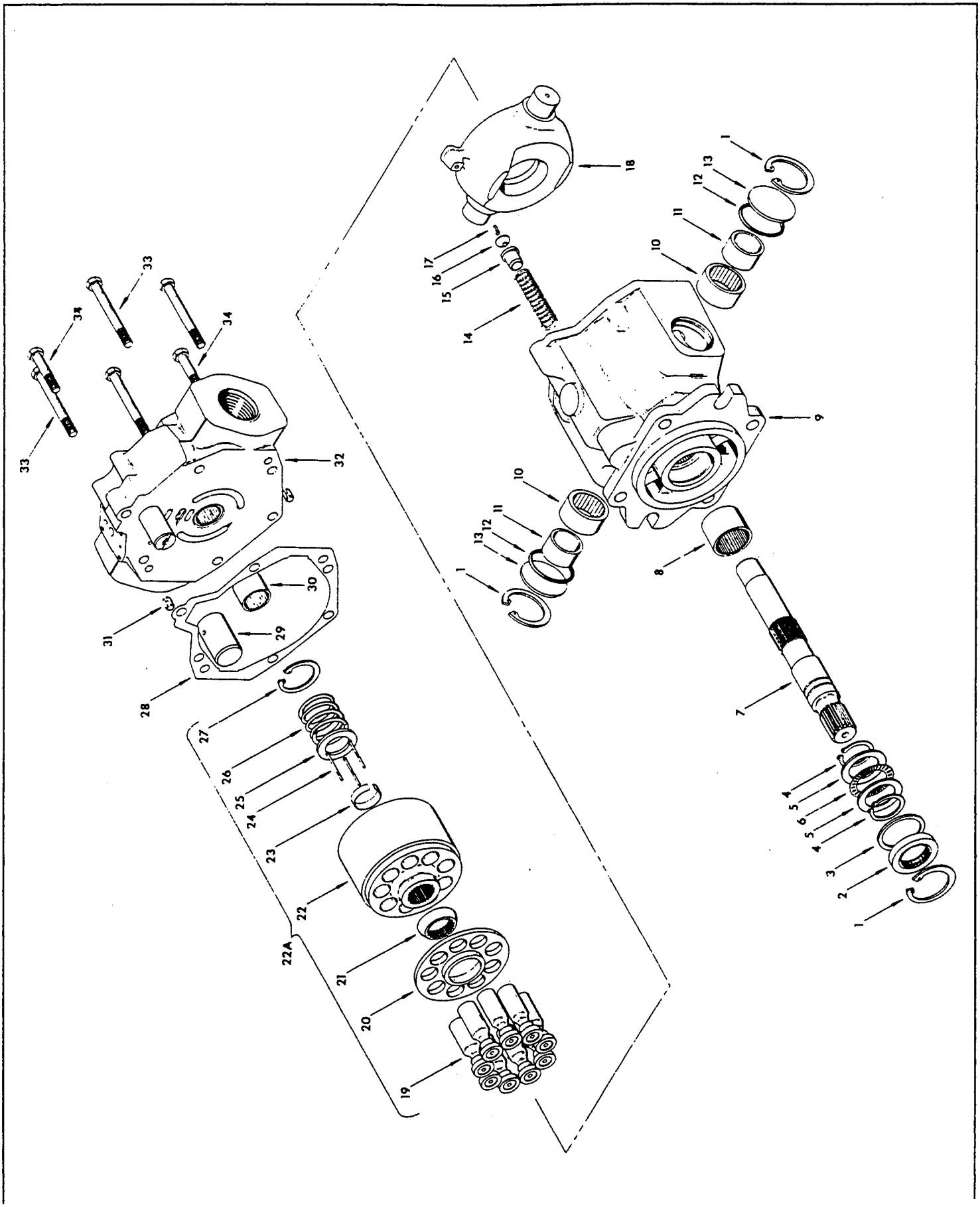
11. Install new gasket (28).

12. Install control piston (29) on back plate.

13. Install back plate (32). Install capscrews (33), (34) and torque to 35/40 ft. lbs.

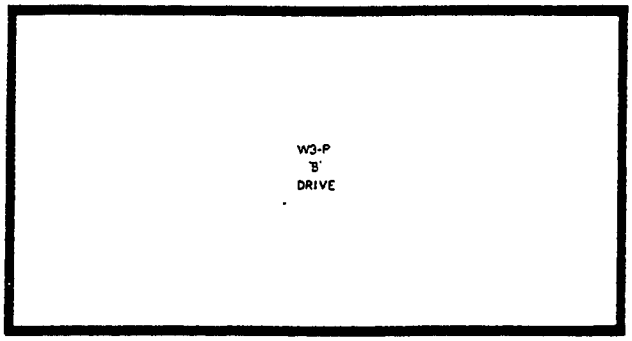
PARTS LIST
FOR THE
71593-DAA

REF. NO.	DESCRIPTION
1.	Snap ring
2.	Shaft seal
3.	Washer
4.	Snap ring
5.	Thrust race
6.	Thrust bearing
7.	Drive shaft
8.	Needle bearing
9.	Housing assembly
10.	Needle bearing
11.	Inner race
12.	O-ring
13.	Cover
14.	Spring
15.	Spring guide
16.	Spring button
17.	Roll pin
18.	Camplate
19.	Piston assembly
20.	Spider
21.	Spider pivot
22.	Piston block
22A.	Rotating assembly
23.	Pin keeper
24.	Pin
25.	Washer
26.	Spring
27.	Snap ring
28.	Gasket
29.	Control piston
30.	Needle bearing
31.	Roll pin
32.	Back plate assembly
33.	Capscrew
34.	Capscrew


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Torque-Hub® Final Drives

Service Manual



Fairfield

THE DRIVE PEOPLE

Introduction

This Service Manual is a step-by-step guide designed for the customer or shop mechanic who is servicing or repairing a particular model of Torque-Hub Final Drive. (The model covered by this copy of the Manual is specified on the Manual cover.)

Included are —

1. assembly and exploded view drawings
2. disassembly procedure
3. main assembly procedure (assuming all sub-assemblies to be intact)
4. sub-assembly procedures.

At the time of printing, this Manual was complete for the specific Torque-Hub model designated. However, Fairfield Manufacturing Co., Inc., reserves the right to update and improve its products at any time. All specifications and procedures are therefore subject to change without notice.

Safety

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn; heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see a caution symbol (⚠). This symbol indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

W3-P "B" Drive Disassembly Procedure

1. Loosen all 12 Cover Bolts and drain the oil from the unit.

2. Remove the 12 Cover Bolts and lift off the Cover Sub-Assembly. Discard the 'O' ring Seal from the Cover counterbore.

3. Lift out the Carrier Sub-Assembly and *Thrust Bearing Set. A Thrust Washer may stick inside the Cover.

4. Pry the Ring Gear loose and remove it. Discard the 'O' ring Seal from the Hub counterbore.

5. Remove the Input Shaft, Input Gear, and the Thrust Spacers that are on the Input Shaft.

6. Lift out the Internal Gear and Thrust *Bearing Set. A Thrust Washer may stick to the bottom of the Carrier.

7. Remove the Retaining Ring from the Spindle and discard; then lift the hub off the Spindle.
   Eye protection should be worn during Retaining Ring removal.

8. The inside Bearing Cone and the Bearing Shim can now be removed.

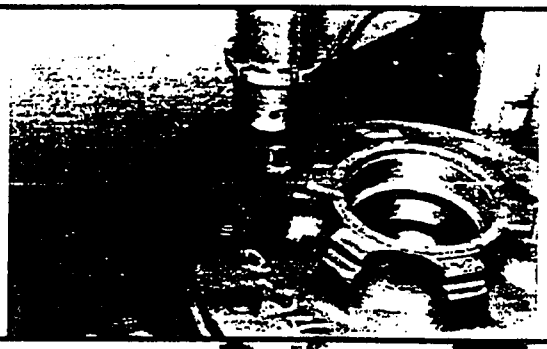
9. The Seal can be pried out of the Hub with a screw driver or pry bar. This will also allow the outside Bearing to be removed.

   Note: If bearing replacement is necessary, the Bearing Cups can be removed with a "slide hammer puller" or driven out with a punch

10. To remove the Cluster Gears from the Carrier, drive the anti-roll pin into the Planet Shaft of the Cluster Gear. After the Planet Shaft is removed the roll pin should be driven out of the Planet Shaft.

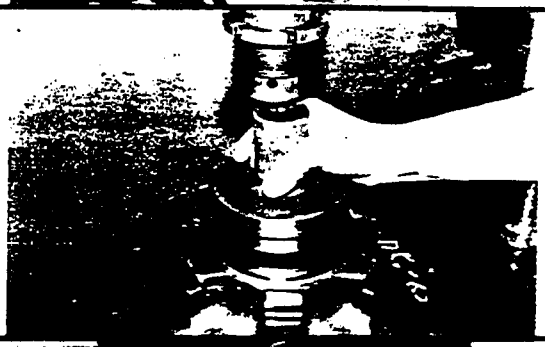
WARNING: When rebuilding the unit, the 'O' rings and Retaining Rings should always be replaced.

Main Assembly Procedure

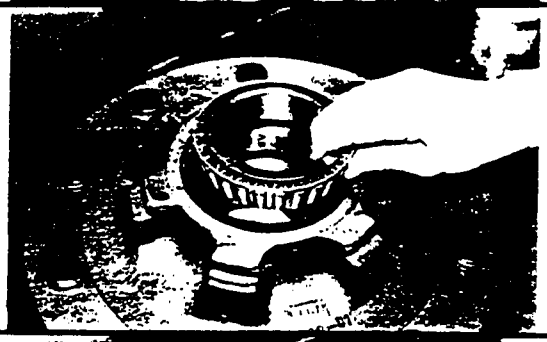


1. Using an arbor type press if available, (if not, a hammer may be used), install the wheel studs. The hub flange should be supported from the underside during this operation.

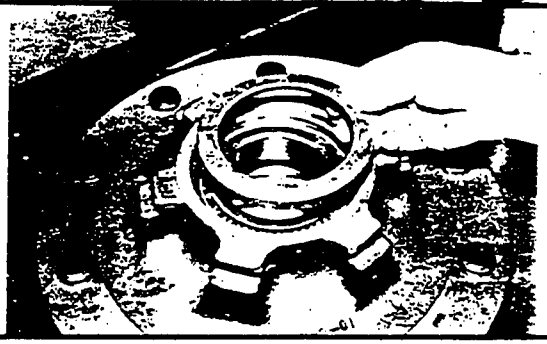
   Note: Wheel studs are optional.



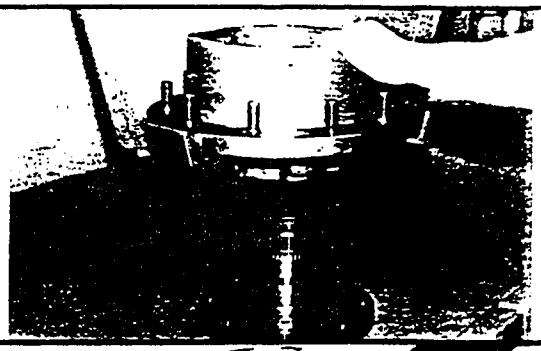
2. Using an arbor type press if available, press Bearing Cups with large inside diameters facing out, into Hub counterbores. Cup #JM716610 will go into small end of Hub, and Cup #JM515610 will go into large end of Hub.



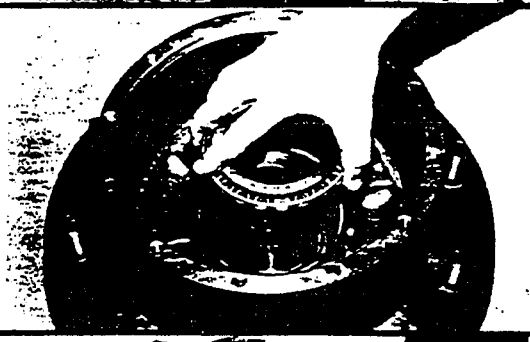
3. Place Bearing cone #JM716649 into Bearing Cup in small end of Hub.



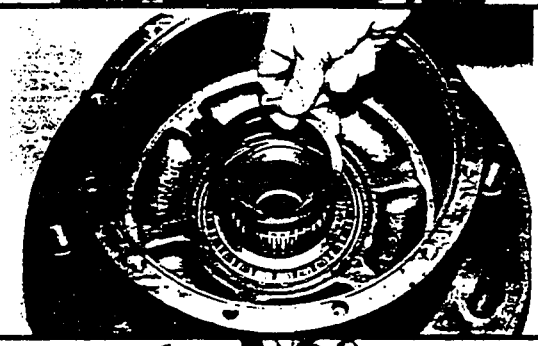
4. Press Seal into Hub counterbore with flat metal side facing in. Use a flat object to assure that Seal is pressed evenly and is flush with Hub face.



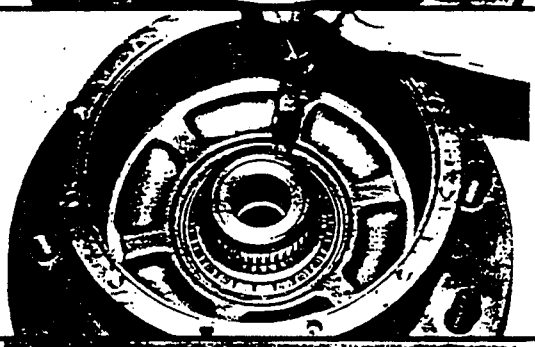
5 Lower Hub onto Spindle with large open end up



6. Place Bearing cone #JM515649 over end of Spindle and into Bearing Cone.

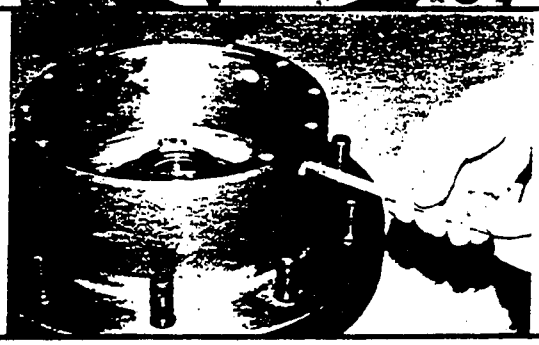


7. Place Bearing Shim over end of Spindle and against Bearing Cone.

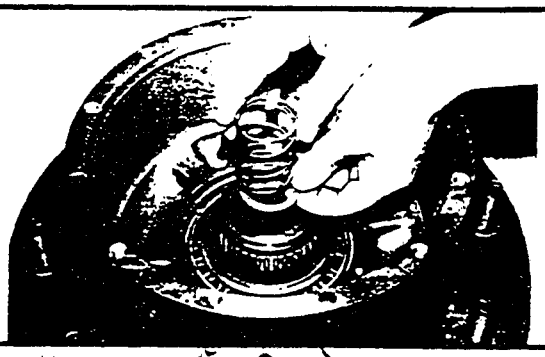


8. Secure Retaining Ring completely into Spindle groove and against Bearing Shim. Be sure that Retaining Ring is entirely in groove.

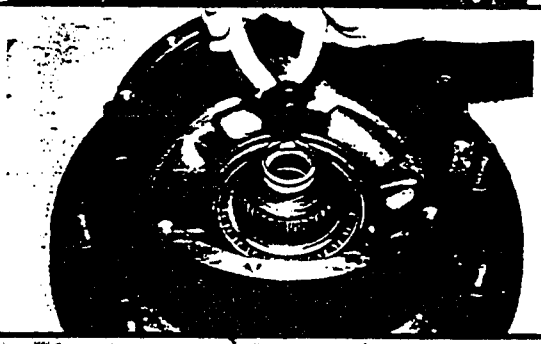
⚠ Eye protection should be worn during Retaining Ring installation.



9. The pipe plugs are installed in the Hub. The use of lub-seal is recommended on the pipe plug.

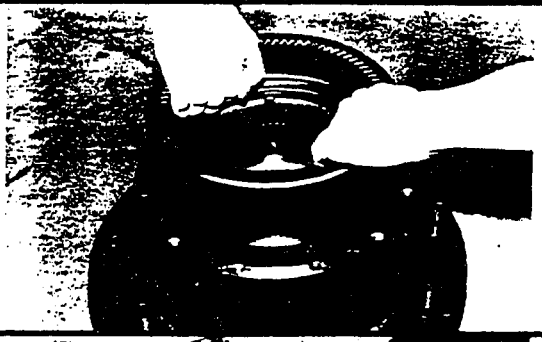


10 The disengage spacer and spring are installed into the co'bore of the Spindle.

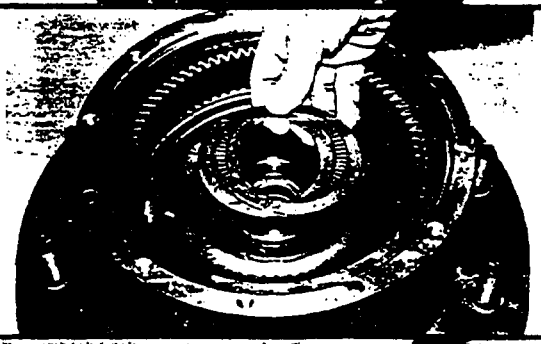


11. Another spacer and the correct Retaining Ring are installed into the Spindle co'bore and Retaining Ring groove provided.

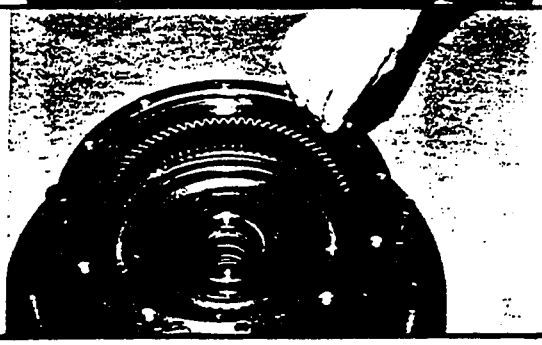
⚠ Eye protection should be worn during Retaining Ring installation.



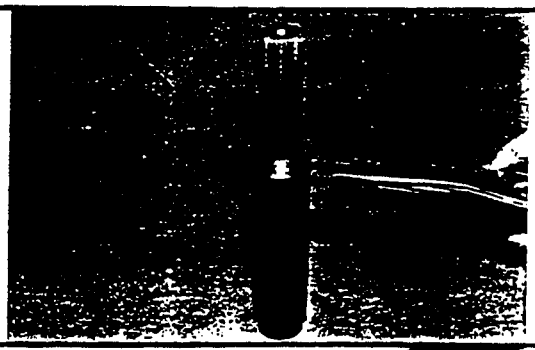
12. The internal gear is installed matching the Bore Spline the Spindle Spline.



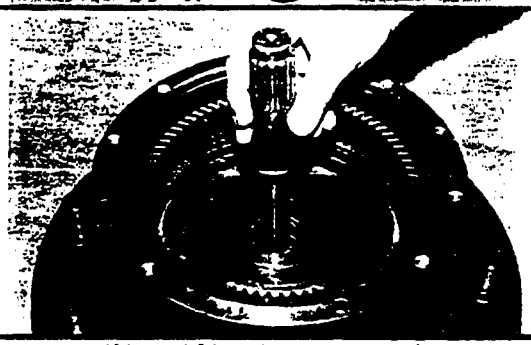
13. The thrust washer/thrust bearing set is installed on the portion of the Spindle which extends into the internal gear.



14. The O'Ring is placed into the counterbore provided in the Hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

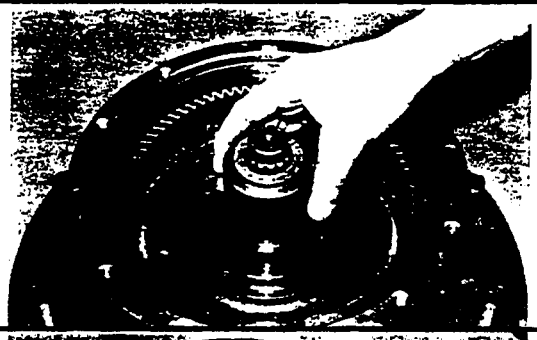


15. Install retaining ring into input shaft retaining ring groove.

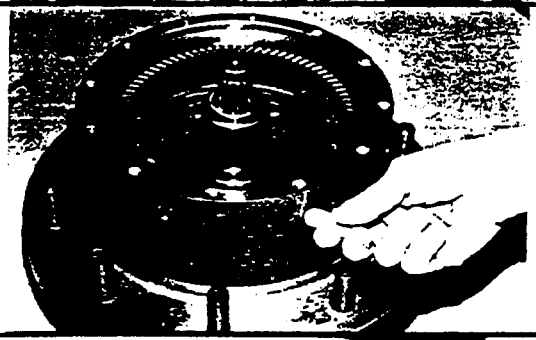


16. The input shaft is installed into the spindle.

    The action of the spring should be checked at this point.

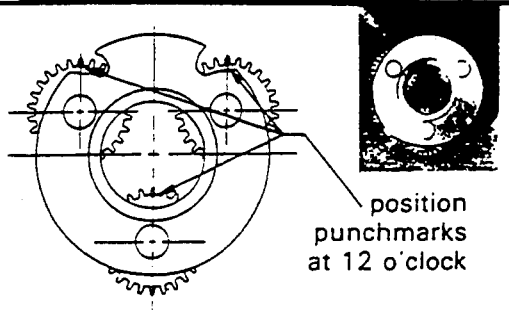


17. The thrust spacer is installed on the input shaft.

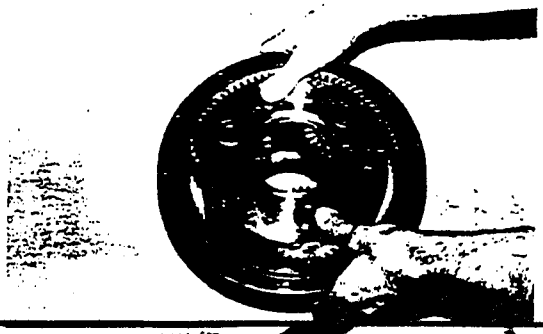


18. Locating the four counter reamed holes in the face of the hub, mark them for later identification.

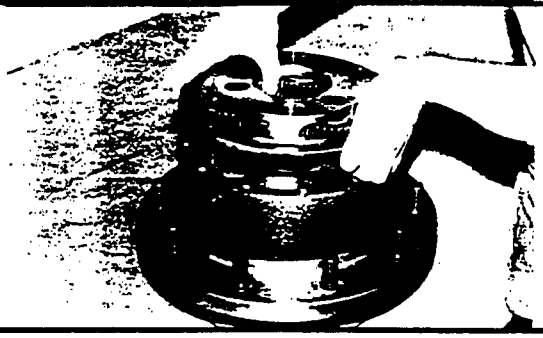
    These holes are reamed to accept the shoulder bolts.



19. Place Carrier Assembly on a flat surface with the large gears up and positioned as shown. Find the punch marked tooth on each large gear and locate at 12 o'clock (straight-up) from each planet pin. Marked tooth will be located just under the Carrier on upper two gears.

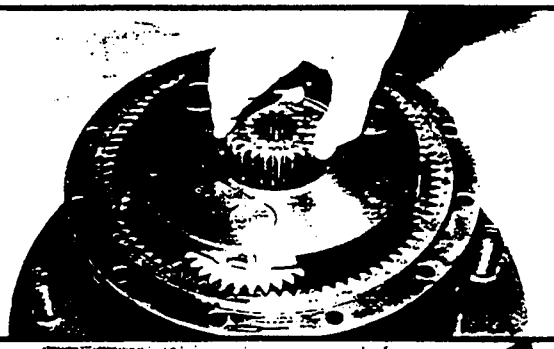


20. With shoulder side of Ring Gear facing down, place Ring Gear over (into mesh with) large gears. Be sure that punch marks remain in correct location during Ring Gear installation. The side of the Ring Gear with an "X" stamped on it should be up.

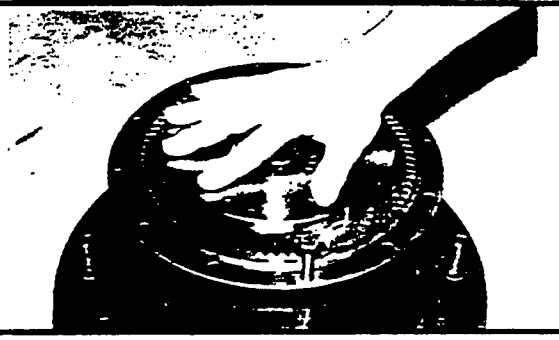


21. While holding Ring Gear and Cluster Gears in mesh, place small side of Cluster Gear into mesh with the Internal Gear. On the Ring Gear locate the hole marked "X" over one of the marked counterbored holes in Hub.

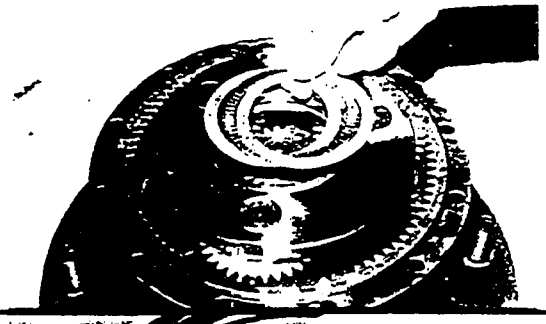
Note: If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.



22. The Input Gear is installed into this assembly meshing with the larger diameter Cluster Gear. The counterbored side of the Input Gear is installed down or to the inside of the unit.



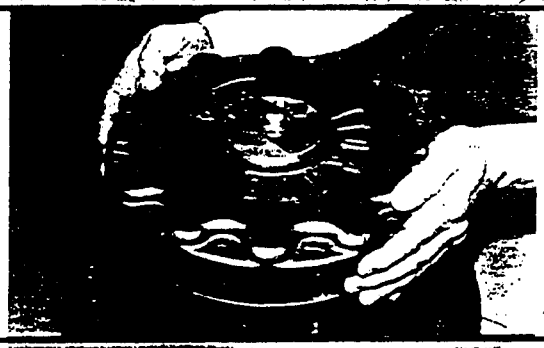
23. After inserting at least one shoulder bolt in the proper location, rotate the carrier. This is to check freedom of rotation and recheck timing.



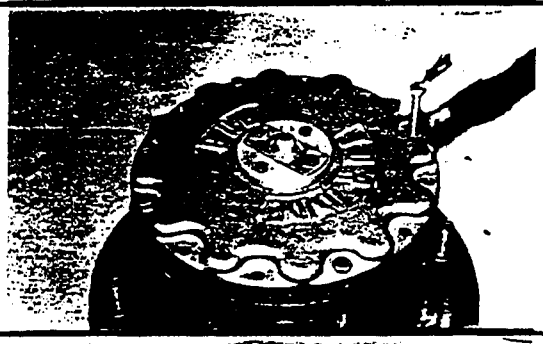
24 Another thrust washer/thrust bearing set is now installed into the counterbore in the face of the carrier.



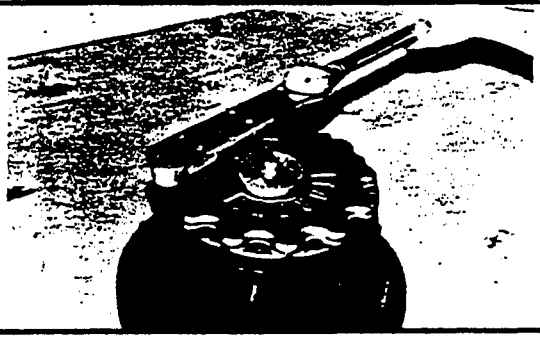
25. Place O'Ring into cover assembly counterbore. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.



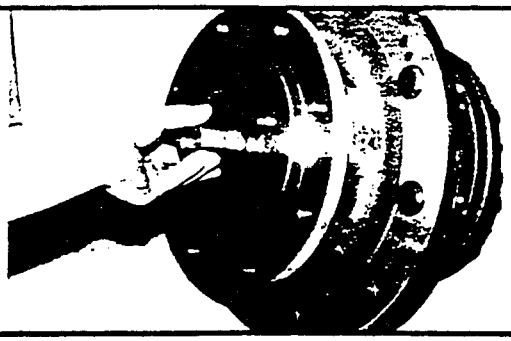
26. Place cover assembly on Ring Gear with oil level. check plug in cover located approximately 90° from oil fill plug in Hub.



27. Locate four shoulder bolts 90° apart into counterbored hole in Hub which were marked in step 17. Torque each bolt to 47 ft. lbs.



28. Install grade eight bolts into the remaining eight holes and torque all bolts to 47ft. lbs. Use the 180° to 90° method in torqueing all bolts.

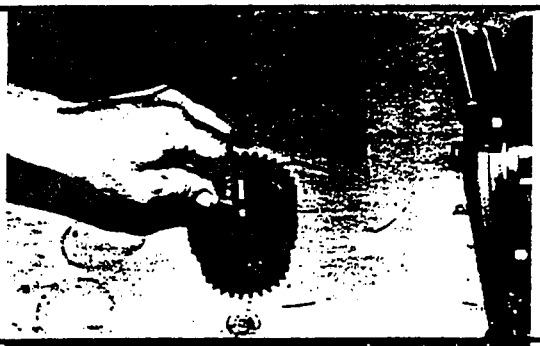


29. Place Coupling into the Spindle and onto the Input Shaft.

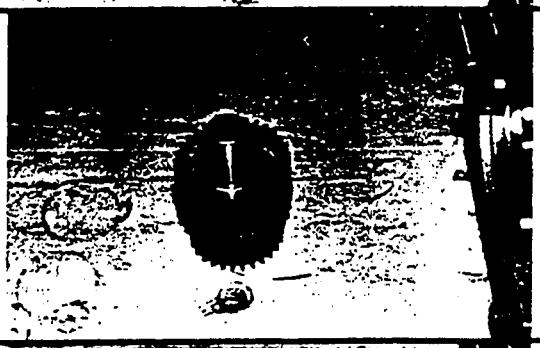
    Note: W3C units must have one external and one internal Snap Ring installed. All units with a "X" on the end of the model number must have two internal Snap Rings with a spacer between them installed in the Coupling.

This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation.

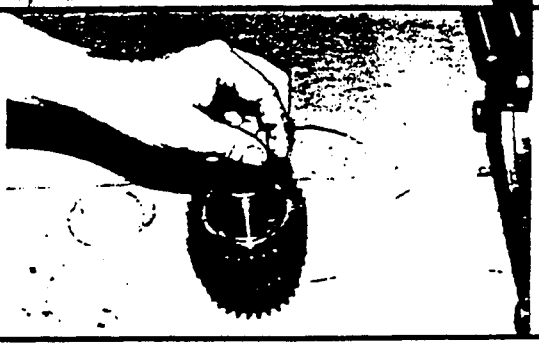
Carrier Sub-Assembly (Bronze Washers)



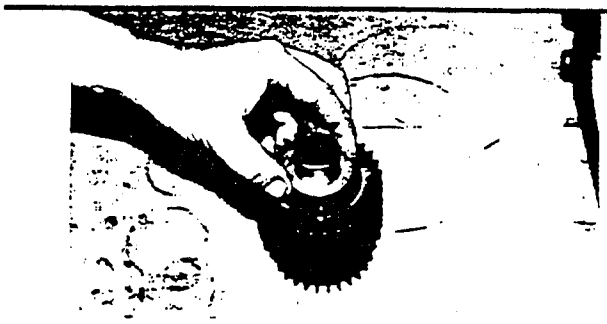
1. To aid in centering Planet Pin (3E) use an extra Spacer (3D) inserted into the bore of Cluster Gear (3F) which has been positioned on a flat surface, small diameter Cluster Gear down.



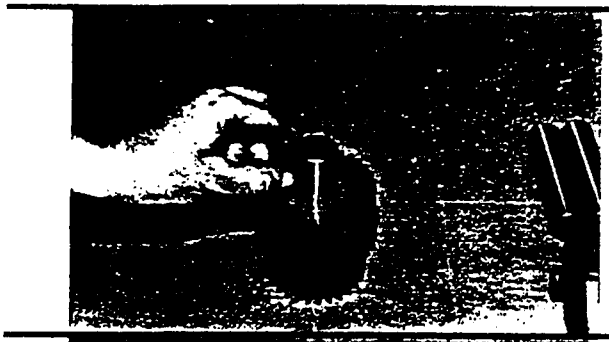
2. Position Planet Pin (3E) in the bore of Cluster Gear (3F) locating in Spacer (3D).



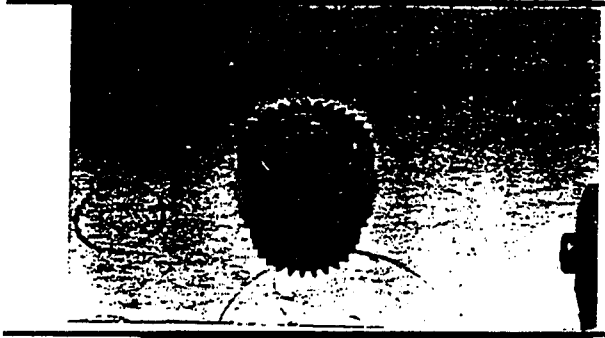
3. Install 14 Needle Rollers (3C) into lower half of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding Needle Rollers (3C).



4. Install Spacer (3D) onto Planet Pin (3E) locating on inboard end of Needle Rollers (3C).



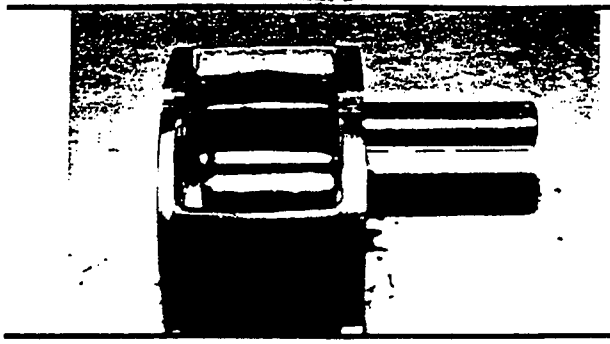
5. Install another 14 Needle Rollers (3C) into the remaining half of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding Needle Rollers (3C) in place once Planet Pin (3E) is removed.



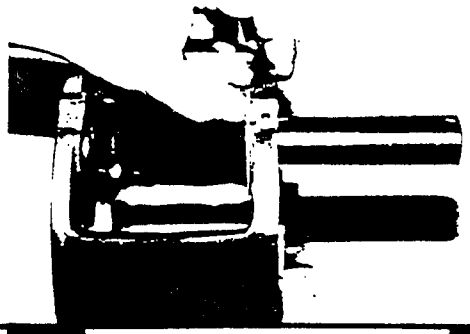
6. Planet Pin (3E) may be removed from the bore of Cluster Gear (3F).



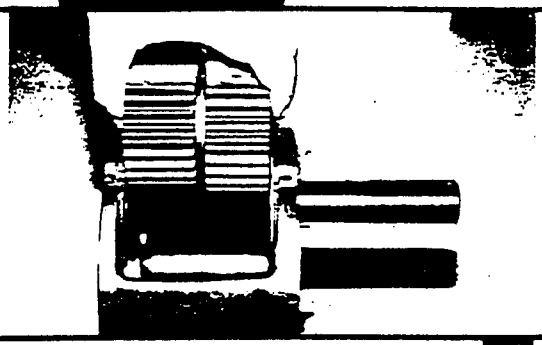
7. Thrust Washers (3H) are installed into the counterbores of each end of the Cluster Gear (3F). Care is to be taken to install the smooth side of Thrust Washer (3H) into the counterbore of Cluster Gear (3F).



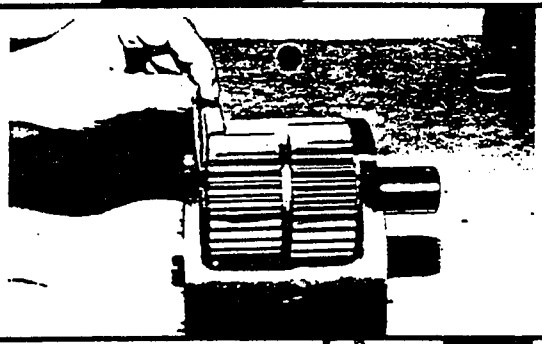
8. Insert Planet Pin (3E) into the Planet Pin hole of Carrier (3A) from the Roll Pin hole side. Care is to be taken to align Planet Pin (3E) with the chamfered end of the Roll Pin hole up. This chamfered hole is to assist in aligning the Roll Pin holes in the Carrier (3A) and Planet Pin (3E) as Roll Pin (3G) is tapped into location.



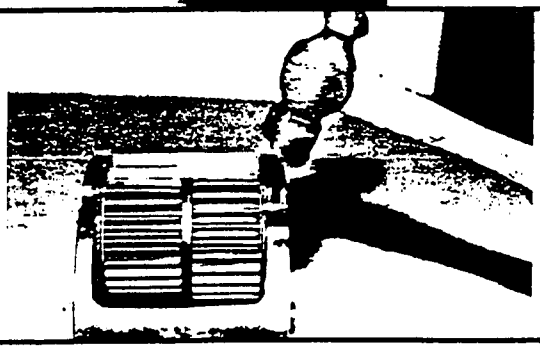
9. Using sufficient grease or petroleum jelly to assist in holding in position. Thrust Washer (3B) is installed onto Planet Pin (3E). Care is to be taken to install Thrust Washer (3B) with the tang positioned in the slot provided.



10. Cluster Gear (3F) with Thrust Washers (3H), Needle Rollers (3C) and Spacer (3D) installed is positioned into Carrier (3A) and aligned with Planet Pin (3E). Care is to be taken to insure Cluster Gear (3F) is installed with the large diameter end to the Roll Pin (3G) side of Carrier (3A).

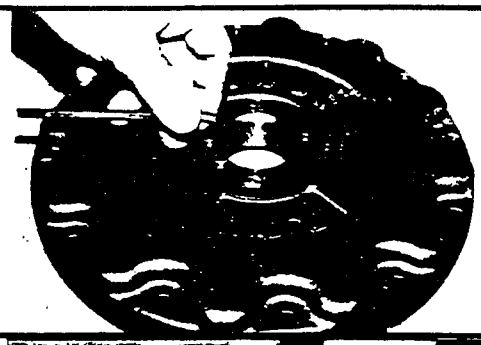


11. A second Thrust Washer (3B) is installed on the small diameter end of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding position as Planet Pin (3E) is fully extended through Carrie (3A).

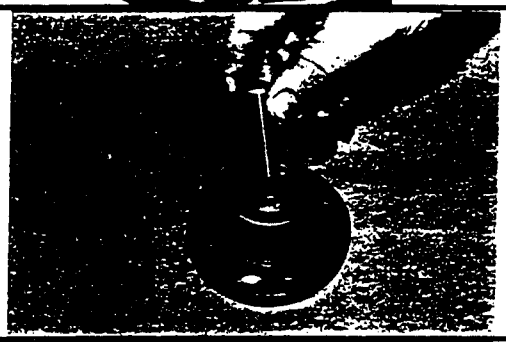


12. Upon checking alignment of the Roll Pin holes in Carrier (3A) and Planet Pin (3E), Roll Pin (3G) is tapped into location. Care is to be taken to insure that the external end of Roll Pin (3G) is below the outer diameter of Carrier (3A).

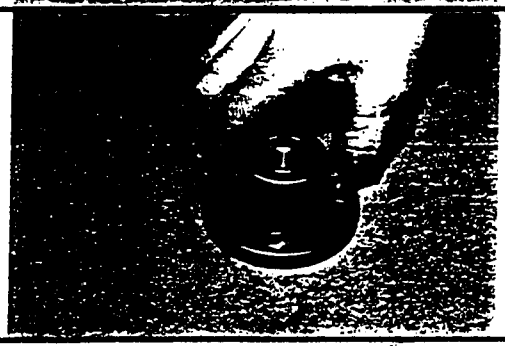
Cover Sub-Assembly



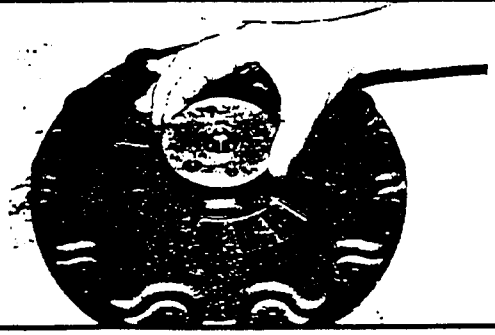
1. Screw Pipe Plug into Cover.



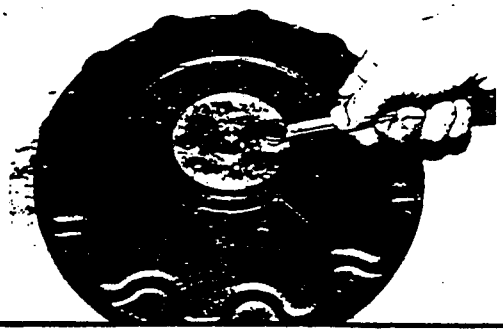
2. Place 'O' Ring into Cover Cap internal groove. The Disconnect Rd may be used to push 'O' Ring into groove. Rod will be held in place by friction from the 'O' Ring.



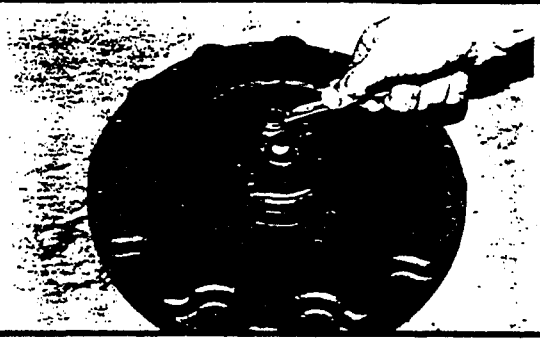
3. Slip 'O' Ring over Cover Cap and against face.



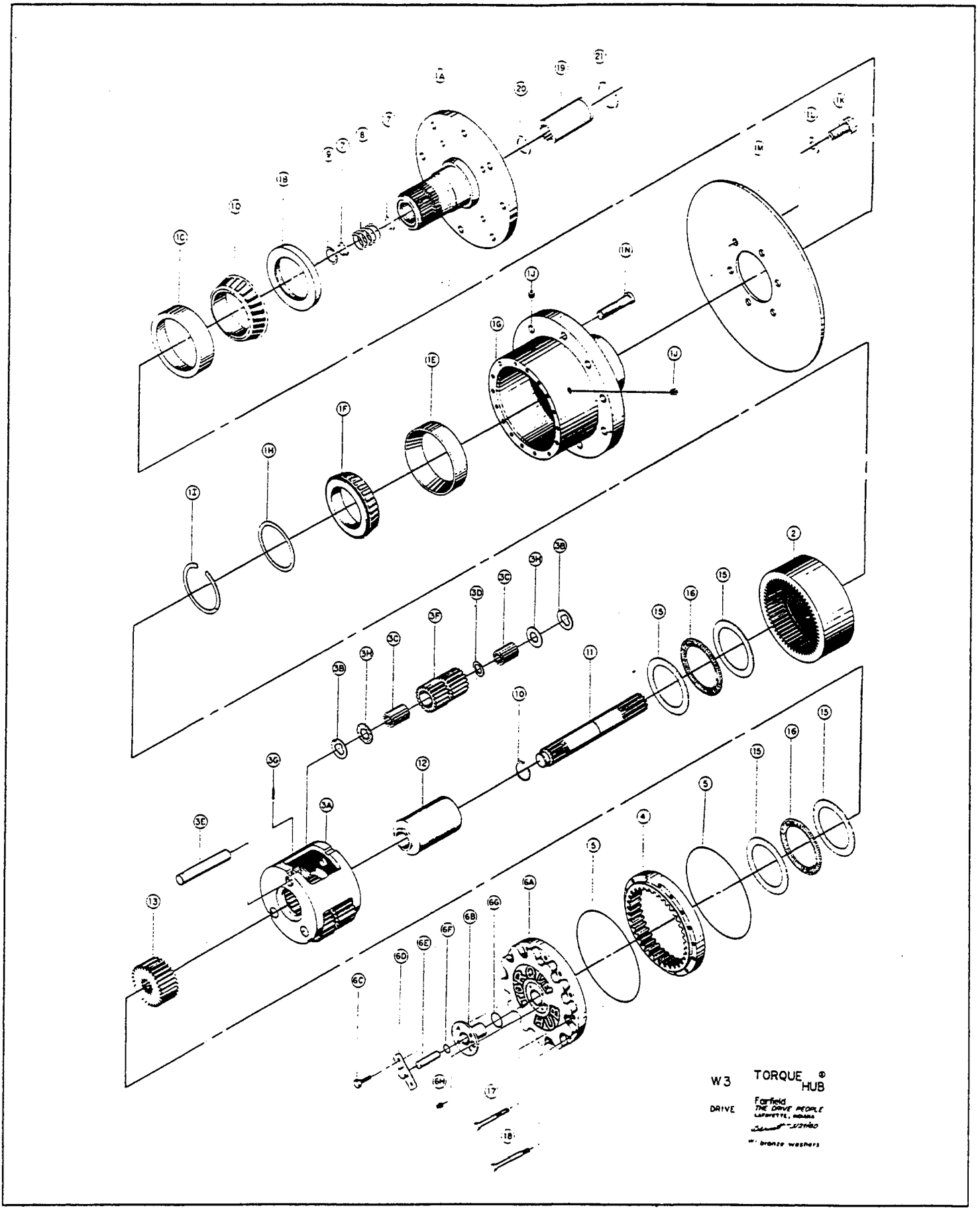
4. Place Cover Cap into Cover with large hole located over Pipe Plug.



5. Install two 1/4 × 20 × 3/4 bolts 180° apart and torque to 70 - 80 in. lbs.



6. Place disconnect cap over cover cap with nipple facing out and align with two open holes. Secure disconnect cap to cover with two 1/4 × 20 × 3/4 and 70 - 80 in. lbs.


W3 TORQUE HUB
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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.