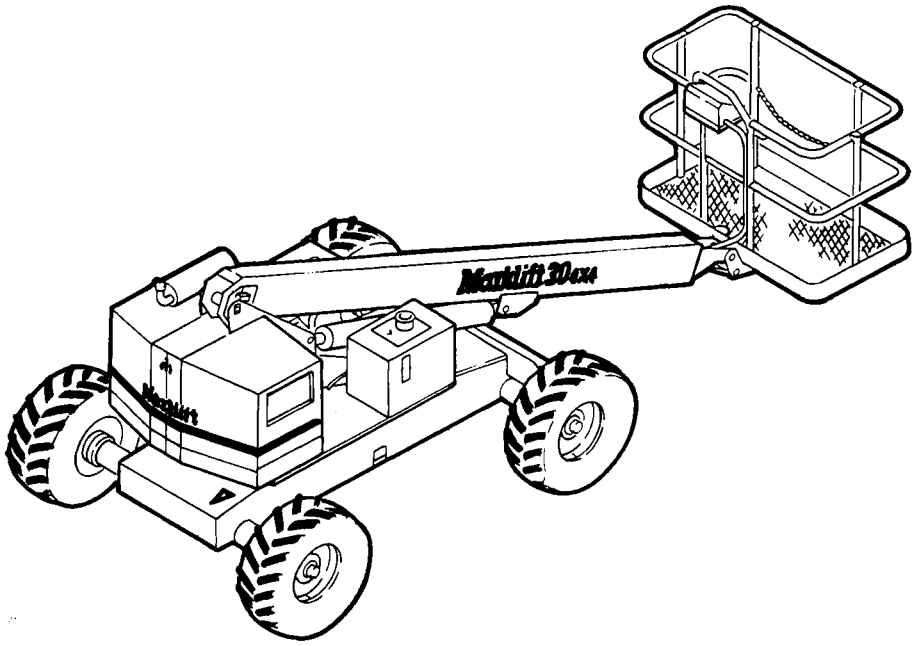
Marklift®

OPERATION MAINTENANCE AND PARTS MANUAL



SELF-PROPELLED BOOM FOUR WHEEL DRIVE (MODEL 30 4X4)

FIRST EDITION - AUGUST 1987

17104

The Marklifts.
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THIS **MARKLIFT** SELF PROPELLED BOOM MODEL **30 4 X 4** OPERATION MAINTENANCE AND PARTS MANUAL IS DESIGNED AS

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SERVICE BULLETINS

The purpose of this manual is to provide the customer with operation maintenance and parts information that will enhance the reliable performance of the **MARKLIFT.** Schematic and vendor information is also furnished.

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

The model capacity, pressure settings and serial number can be found on the ID Plate mounted on the rear of the base.

The serial number should be used when ordering parts. This will help our parts department in giving prompt and accurate service.

If additional information or service is needed, we urge the customer to contact his local dealer. If this is not possible, please get in touch with the **MARK INDUSTRIES** Service Department.

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

SPECIFICATIONS (30 4 X 4)

DESCRIPTION		ENGLISH	METRIC
HEIGHT	MAXIMUM WORKING	35'9"	10.9 m
	MAXIMUM PLATFORM	29'9"	9.07 m
	STOWED	6'4"	1.93 m
LOAD CAPACITY (UNRESTRICTED)		500 LBS.	226.8 Kg
MAXIMUM WIDTH		6'9"	2.06 m
MINIMUM LENGTH		19'10"	6.05 m
WHEEL BASE		7'4"	2.24 m
WHEEL TRACK		5'8"	1.73 m
INSIDE TURNING RADIUS		11'6"	3.51 m
TIRES		29 X 12.5 - 15 NHS	SUPER TERRA-GRIP
TURRET ROTATION		360°	
TURRET TAILSWING BEYOND TIRES		13"	0.33 m
GASOLINE ENGINE (AIR COOLED)		WISCONSIN 25 HP	
DRIVE MOTORS		4 MOTORS 4 WHEEL DRIVE	
PROPORTIONAL TRAVEL SPEED		0-2.3 MPH	0-3.7 Km PH
FUEL TANK CAPACITY		20 GA	78 L
CONTROLS		PROPORTIONAL DRIVE, ALL OTHERS SOLENOID	
HYDRAULIC SYSTEM		TANDEM GEAR PUMPS WITH HIGH/LOW FLOW	
HYDRAULIC OPERATING PRESSURE	DRIVE	2800 PSI	196.9 Kg/Sq Cm
	SOLENOID	2000 PSI	140.7 Kg/Sq Cm
HORIZONTAL REACH		23'7"	7.19 m
PLATFORM DIMENSIONS		30" X 60" X 42"	0.76 X 1.52 X 1.07 m
BOOM ELEVATION		+ 75° ABOVE AND - 20° BELOW HORIZONTAL	
WEIGHT		8240 LBS.	3,738 Kg
SHIPPING CUBE		837 CU. FT.	23.7 m^3

MANUFACTURERS' LIMITED WARRANTY

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

Mark Industries warrants the products manufactured by Mark Industries to be free from defects in material and workmanship under normal use and service for a period of six (6) months from the date of shipment. This limited warranty does not extend to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark industries. The warranty, if any, with respect to any product of another manufacturer or to any part, component, accessory or attachment not manufactured by Mark Industries is limited to the warranty, if any extended to mark Industries by the manufacturer of the other product, part, component, accessory or attachment.

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

The sole obligation and liability of Mark Industries under this limited warranty (and the exclusive remedy for any purchaser, owner or user of Mark Industries products) is limited to the repair or replacement, at the option of Mark Industries, of any product (or any part or parts of any product) manufactured by Mark Industries which, within six (6) months from the date of shipment, shall have been returned to the mark Industries facility in Carson, 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 descrtiption of the alleged defect, the date of the purchase and proof of the purchase and purchase date must accompany the returned product (or any part or parts of any product). Any product (or any part or parts of any product) determined by Mark Industries to be defective will be repaired or replaced, at the option of Mark Industries, free of charge, f.o.b. Carson, California. No credit will be given for any allegedly defective product (or any part or parts of any product) not returned to Mark Industries.

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

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

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

Mark Industries
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WARRANTY REGISTRATION

PURCHASER

_____

COMPANY NAME

_____

ADDRESS

_____

_____

TELEPHONE NUMBER

_____

DATE SHIPMENT RECEIVED

UNIT WILL BE USED _____

_____

DATE OF INVOICE

UNIT WILL BE SOLD _____

_____

DATE UNIT PUT INTO SERVICE

_____

INSPECTION	_____	GEN'L MAINTENANCE	_____	PAINTING/SANDBLAST	_____
MINING	_____	HEATING/AIR COND.	_____	STEEL FABRICATION	_____
WELDING	_____	CARPENTRY	_____	RIGGING	_____
CONSTRUCTION	_____	PLUMBING	_____	ROOFING	_____
SCAFFOLDING	_____	ELECTRICAL	_____	GLAZING	_____
MECHANICAL	_____	SPRINKLER	_____	OTHER	_____

_____

COMMENTS:

_____

_____

_____

_____

_____

_____

INSPECTION COMPLETED BY:

WARRANTY WILL BE VOID UNLESS THIS INSPECTION REPORT IS POSTMARKED TO MARK INDUSTRIES NOT MORE THAN 14 DAYS FROM DATE SHIPMENT RECEIVED.

NEW EQUIPMENT CONDITION REPORT

		YES	NO
1.	PLATFORM CAPACITY DECAL _____ LBS.	☐	☐
2.	ALL WARNING, CAUTION & EMERGENCY DECALS INSTALLED	☐	☐
3.	EMERGENCY DESCENT VALVE FUNCTIONS PROPERLY	☐	☐
4.	OPERATION INSTRUCTIONS PROPERLY INSTALLED	☐	☐
5.	OPERATION & SAFETY HANDBOOK RECEIVED	☐	☐
6.	ELECTRICAL SCHEMATIC RECEIVED	☐	☐
7.	ALL CONTROLS (AERIAL & GROUND) ARE IDENTIFIED AND OPERATE CORRECTLY	☐	☐
8.	STOP SWITCHES OPERATE PROPERLY (AERIAL & GROUND)	☐	☐
9.	PLATFORM GUARD RAILS, SECURE AND UNDAMAGED	☐	☐
10.	PLATFORM ACCESS GATE WORKS PROPERLY	☐	☐
11.	HORN AND BEACON OPERATE PROPERLY (OPTIONAL)	☐	☐
12.	BRAKES ADJUSTED AND OPERATE CORRECTLY	☐	☐
13.	CIRCUIT BREAKERS OPERATE PROPERLY	☐	☐
14.	ENGINE R.P.M. _____	☐	☐
15.	ALL HYDRAULIC CYLINDERS FREE OF LEAKS	☐	☐
16.	ALL HYDRAULIC CYLINDER RODS FREE OF PAINT OR SCRATCHES	☐	☐
17.	HYDRAULIC PUMP FREE OF LEAKS	☐	☐
18.	HYDRAULIC HOSES & FITTINGS TIGHT	☐	☐
19.	HYDRAULIC OIL LEVEL _____	☐	☐
20.	HYDRAULIC TANK & FITTINGS FREE OF LEAKS	☐	☐
21.	DRIVE MOTORS FREE OF LEAKS	☐	☐
22.	TURRET ROTATION GEAR BOX OIL LEVEL _____	☐	☐
23.	TURRET RING GEAR BOLTS TORQUED TO _____ FT. LBS.	☐	☐
24.	WHEEL LUG NUTS TORQUED TO _____ FT. LBS.	☐	☐
25.	BATTERY WATER LEVEL _____	☐	☐
26.	ENGINE COOLANT (RADIATOR) LEVEL _____	☐	☐
27.	COOLANT HOSES & FITTINGS FREE OF LEAKS	☐	☐
28.	ELECTRIC RADIATOR FAN OPERATES PROPERLY	☐	☐
29.	TIRE PRESSURE _____ PSI	☐	☐
30.	SYSTEM PRESSURE _____ PSIG	☐	☐
31.	PILOT PRESSURE _____ PSIG	☐	☐
32.	FUEL TANK & FITTINGS FREE OF LEAKS	☐	☐
33.	MANUAL OVERRIDES OPERATE PROPERLY	☐	☐
34.	MUFFLER TIGHT AND FREE OF LEAKS	☐	☐
35.	ENGINE OIL LEVEL _____	☐	☐
36.	ENGINE OIL FILTER, FREE OF LEAKS	☐	☐
37.	ALL ELECTRICAL CONNECTIONS TIGHT	☐	☐
38.	ENGINE ALTERNATOR FUNCTIONS PROPERLY	☐	☐
39.	VALVE MANIFOLD & FITTINGS, FREE OF LEAKS	☐	☐
40.	DRIVE WHEEL, TORQUE HUB OIL LEVEL _____	☐	☐
41.	RETRACTION CABLE TENSION _____ FT. LBS.	☐	☐
42.	110V GENERATOR OPERATES PROPERLY (OPTIONAL)	☐	☐

MODEL NUMBER _____ SERIAL NUMBER _____

INSPECTOR _____ OPTIONS _____

The **MARKLIFT** self-propelled boom model **30 4 X 4** has the following available options and accessories. (See Chapter Parts Section 6 for illustrated parts breakdown)

PART NUMBER	DESCRIPTION
23309	WORK PLATFORM ROTATOR FRONT MOUNT
23310	DUAL FUEL
23311	CONTINUOUS TURRET ROTATION
23312	SHEET METAL COWLING
23313	OVERHEAD GUARD ENGINE COVER
23314	GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE
23315	LIFTING LUGS
23316	HOUR METER
23317	SAND TIRES
	TRAVEL WARNING HORN
	ALL MOTION ALARM
	ROTATION AMBER BEACON
	SAFETY LIGHT PACKAGE
	12V PLATFORM WORK LIGHT
	AIRLINE TO PLATFORM
	HYDRAULIC LINE TO PLATFORM
	SPARK ARRESTOR MUFFLER
	CATALYTIC CONVERTER
	2000 WATT GENERATOR

MANUFACTURER'S AUTHORIZED LOADING/UNLOADING PROCEDURE FOR ALL **MARKLIFT** SELF PROPELLED BOOMS.

FIGURE 1 Tilt - Type Trucks

Loading and unloading on a tilt truck requires a combination of winching and driving in low drive. This means either one man to operate the winch while a second man operates the boom or the winch control must be provided with an extension cord or a remote control.

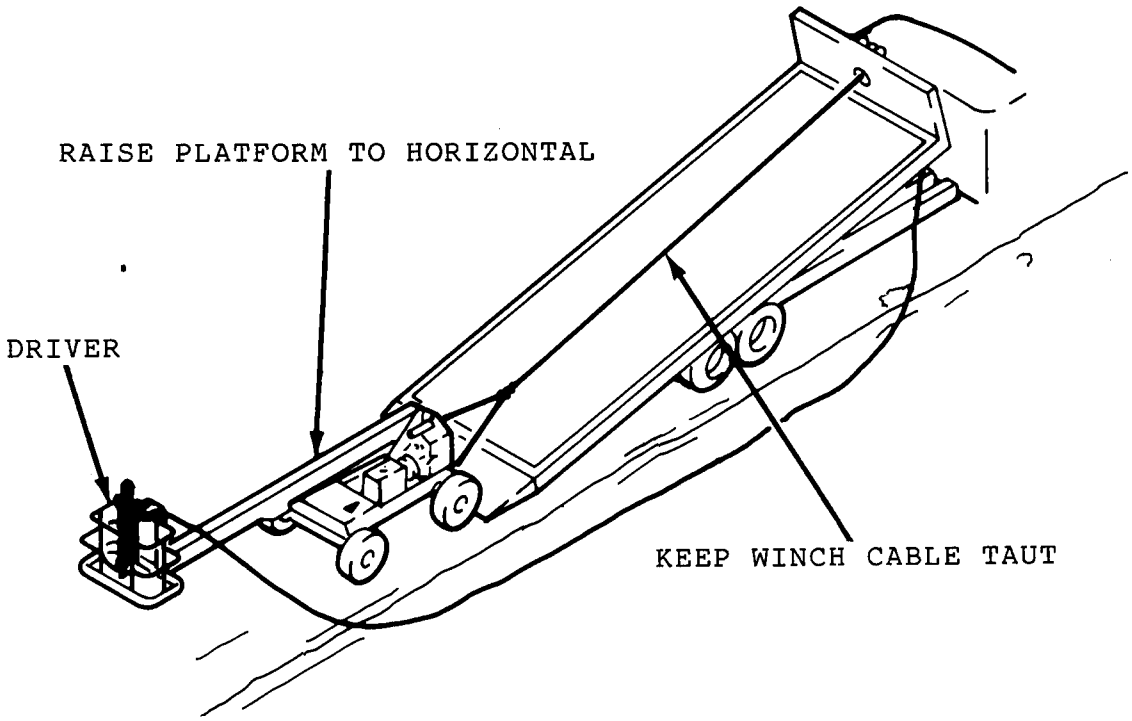
LOADING

1. The truck must be fitted with adequate winch to handle 8,240 lbs.

2. Align the boom with the steering wheels away from the trailer and the platform in a horizontal or slightly higher position.

3. Insure that the parking brake is set to activate immediately. This is accomplished by opening flow control valve.

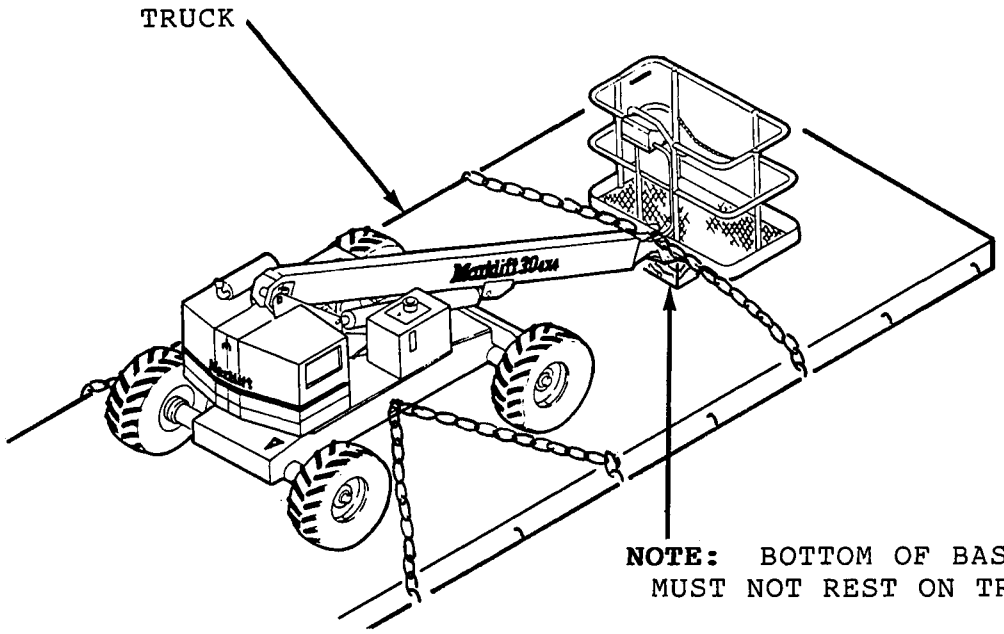
4. Select low drive at the aerial control box.



Attach winch cable to the boom at the drive wheel end of the base through the twin pad-eyes as shown.

5. When the boom is on the truck in position for proper weight distribution, it is chained down in the manner illustrated by the drawings below.

6. When the boom is on the truck in position for proper weight distribution, it is chained down in the manner illustrated by the drawings below.



UNLOADING

1. Release the hold down chains and remove the block under the basket end of the boom arm. Lift the boom arm to horizontal or slightly above the horizontal position.

2. Insure that the winch cable is in a taut position and then lower the truck bed.

3. Allow the boom to gradually roll down the truck bed by winching out.

4. When the boom is completely on level ground, remove the winch cable from the boom.

5. Boom is now ready for normal operation.

FIGURE 2

FLATBED WITH HYDRAULIC LIFT/LOWER REAR PORTION

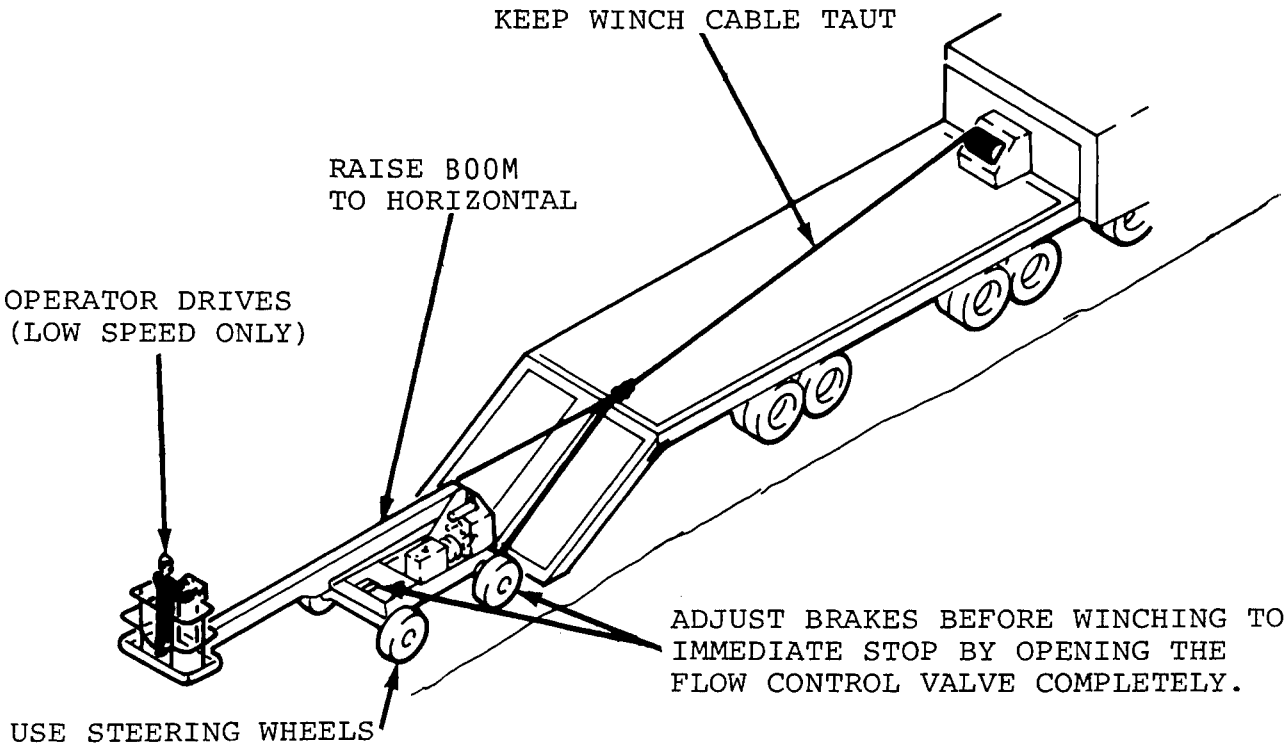
Flatbed Regular

> **IMPORTANT:** Due to the width of the booms and the overall width of the flatbed trailer...extreme caution must be used when loading or unloading.

In loading/unloading booms on flatbed trailers, a combination of winching and driving the boom in low drive speed must be utilized.

1. Insure that the parking brake is set to activate immediately. This is accomplished by opening the flow control valve

2. If the unit has the high/low drive option, it must be in **LOW DRIVE** at all times when loading/unloading.



LOADING

* 2 man operation — 1 man to operate winch
1 man to drive boom

* 1 man operation — Winch unit must be fitted with an extension cord or remote control for the control box.

1. With the trailer on level ground, align the boom with the back end of the trailer.

2. Attach winch cable as described in FIGURE 1 of this instruction.

3. Using great care while driving and steering the boom up the ramp in low drive, keep all slack out of the winch cable. (If the ramp is too steep of a grade for the boom to climb, the winch will pull the unit up.) You must keep drive function engaged while winching or the brakes will stop the machine from rolling.

4. When the boom is in the position for the proper weight distribution for transporting, tie down to the trailer using the procedure described in FIGURE 1 of this instruction.

NOTE: Immediate full reversal of controller handle when driving will automatically change the direction of drive and will not stall the engine, even if attempted on a ramp. This procedure is not recommended as standard reversing of drive or any other function, but may be used in emergency situations without damage to the unit.

UNLOADING

1. With the trailer on level ground, disconnect the tie-downs from the boom and insure that the winch cable is still properly attached to the boom.

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

3. Using great care while driving and steering the boom off the trailer, keep all slack out of the winch cable.

> **WARNING:** Do not allow slack in the winch cable when descending the ramp, due to the possibility of snapping the cable if the unit descends too fast in drive.

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

5. Re-adjust the boom parking brakes to energize immediately after the dynamic brakes stop the unit. Procedure is as follows:

First close needle valve completely, open 1/8 turn, then place unit on flat surface, about 10' wide x 30' long. Position boom slightly below horizontal and completely retract. Select "High" drive speed and "High" throttle at the platform console. Drive **MARKLIFT** with controller handle in maximum position, approximately 15 feet letting go of the controller as one wheel is adjacent to a visual marker on the ground. A suitable deceleration and braking distance would be 3' measured from the marker to the center line of same wheel when unit has completely stopped. Adjust needle valve on parking brakes to achieve this dimension. Repeat above procedure, driving in both directions until **MARKLIFT** completely stops within the 18" to 24".

The deceleration valves have been set at the factory and should not be readjusted without first consulting **MARK INDUSTRIES** Field Service Department.

It is advisable to completely open the needle valve if the unit is to be used in a facility with severe ramps or inclines. However, very abrupt stops will be experienced with the unit driving on flat surfaces when drive controller is rapidly returned to the neutral position.

BEFORE OPERATING THE **MARKLIFT**, REVIEW THE FOLLOWING:

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 oil level in the engine.

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

4. Fill fuel tank - use regular gasoline only or switch to propane.

5. Check battery for 1200 $\pm$ 50 reading on hydrometer. Charge battery if reading is below 1100.

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

7. The ground control panel is accessible by opening the turret cover opposite the engine side of the machine.

8. Start engine. Allow engine to warm up.

9. After initial warm-up of gasoline engine, press engine stop button making sure stop circuit is operational. The ignition switch may be left in the "ON" position indefinitely if engine stop button has been pressed, without fear of burning distributor points. However, should engine stall, the operator must push the stop button or turn off ignition switch to prevent current path to coil.

10. Position selector switch to ground then operate switches, moving as follows: Boom UP/DOWN, rotation RIGHT/LEFT, and extend OUT/IN. Check for hose leaks.

11. After check-out of ground control functions, position selector switch to AERIAL for operation at work platform. After entering platform, depress foot switch before using any control function switches. This increases engine RPM (if throttle HIGH-LOW selector is positioned to high) and electrically completes circuit to controls.

Your **MARKLIFT** is equipped with a proportional drive control. When using the proportional drive function, press foot switch, raise controller locking device, then gradually move controller in direction selected. The controller handle is spring-centered and self locking to prevent accidental operation. Familiarize yourself with the operation of the controller until you are able to start and stop the drive function in forward and reverse, obtaining a gradual, smooth start and stop.

12. The travel or drive configuration is with the boom over 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. The forward triangle decals on each end of the base will show drive direction correctly, regardless of turret position.

13. Brake adjustments may be made by turning a small needle valve. (See chapter parts, section 3, figure 7). 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 driving in high speed.

NOTES: See Chapter General page 8 reduced copy of NEW EQUIPMENT CONDITION REPORT that is sent with each machine.

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

1. 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.

2. The operation of any new and unfamiliar equipment can be hazardous in the hands of untrained operators. 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. Never exceed manufacturer's recommended platform load capacity.

4. Although the **MARKLIFT** conforms to specified **ANSI & OSHA** requirements, it is the responsibility of the owner to instruct the operators with 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.**

5. The **MARKLIFT** is a non-insulated personnel carrier and **must not** be operated within 10 feet of a 50,000 volt line. (See page 10 & 11 articles.)

6. Remember, the load capacity of the **MARKLIFT** is total combined weight of personnel and tools, fixtures, accessories, etc.

7. Always distribute load evenly over platform floor area.

8. The **MARKLIFT** platform is equipped with safety belt rings. A body belt for **each person must be worn attached** with lanyard to anchor points provided.

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

10. Under no circumstances should horseplay be tolerated.

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

12. **DO NOT** lean over platform guard railings to perform work.

13. **DO NOT** use ladders or scaffolding on the platform to obtain greater height.

14. **DO NOT** raise or lower boom into protuding objects.

15. **DO NOT** drive carriage or platform into stationary objects.

16. **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.

17. **DO NOT** alter equipment in any fashion.

18. **DO NOT** override any hydraulic, mechanical, or electrical safety devices.

19. **DO NOT** drive on uneven, sloping or soft terrain, unless the boom is fully retracted and raised just above horizontal.

20. **DO NOT** drive with any part of the boom or platform touching the ground.

21. **DO NOT** operate boom functions on more than a 5^{o} out-of-plumb condition.

22. **DO NOT** work on platform if your physical condition is such that you feel dizzy or unsteady in any way.

23. **DO NOT** jump start other vehicles using **MARKLIFT** battery.

TITLE 8 DIVISION OF INDUSTRIAL SAFETY 358.38.113
(Register 73, No. 30--7-28-73)

Article 86. Provisions for Preventing Accidents

Article 86. Provisions for Preventing Accidents Due to Proximity to Overhead Lines

2946. Provisions for Preventing Accidents Due to Proximity to Overhead lines. (a) General. No person, firm, or corporation, or agent of same, shall require or permit any employee to perform any function in proximity to energized high-voltage lines; to enter upon any land, building, or other premises and thereto engage in any excavation, demolition, construction, repair, or other operation; or to erect, install, operate, or store in or upon such premises any tools, machinery, equipment, materials, or structures (including scaffolding, house moving, well drilling, pile driving, or hoisting equipment) unless and until danger from accidental contact with said high-voltage lines has been effectively guarded against.

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

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

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

Table X
Required Clearances from Overhead High-Voltage Lines

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

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

Article 86. Provisions for Preventing Accidents

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

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

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

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

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

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

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

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

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

A working knowledge of the hydraulic system facilitates trouble shooting and adjustments by a mechanic. Therefore the information below, although general, will provide the mechanic with such knowledge.

The **MARKLIFT** employs the latest components in mobile hydraulic equipment. The hydraulic circuit contains an engine driven two stage gear pump, one stage for the drive function only, the other stage for the steer and boom functions. The drive stage of the pump supplies the drive manifold. The drive manifold contains a by-pass compensator, a load sense shuttle, a relief valve, and a proportional control valve. the by-pass compensator is controlled by the load sense shuttle. The by-pass compensator delivers the required flow and pressure to the proportional control valve and by-passes the un-required flow back to the hydraulic tank. This provides maximum efficiency and minimum oil heat. The relief valve insures that the pressure will not exceed the drive requirement. The proportional control valve spool is pilot driven. The steer and boom function manifold contains the following:

1. A manifold pressure relief valve.
2. A dump valve.
3. Two directional control valves (for steer and rotation functions).

4. Six three way valves (two each for, left, extension and platform leveling).
5. Two crossover relief valves (for the rotation function).
6. An extension relief valve.
7. Two overcenter valves (for the slave leveling function).

The manifold pressure relief valve insures that the manifold pressure does not exceed requirements.

The dump valve allows all of the flow from the steer and boom function stage of the pumps to free flow back to the hydraulic tank when steer and boom functions are not activated. The dump valve closes to pressurize the manifold when a steer or boom function is activated. This provides fuel economy overall efficiency and minimizes oil heat build up.

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

The three way valves provide flow to the function when activated and are open to tank from function port when not activated.

The cross over relief valves for the rotation function limit the pressure which limits the force of the boom rotation function. This limits the possibility of damage when the boom is rotated into an obstacle.

The extension relief valve limits the force of the extension cylinder when it is being extended. This provides protection from damage to the extension cylinder when the boom is extended into an obstacle or when the extension cylinder is fully extended and bottomed out.

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

THE MARKLIFT ELECTRICAL SYSTEM

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

The ground control console houses the necessary switches for starting and stopping the engine - a selector switch for isolating either the ground or aerial control console, and the required toggle switches for moving the boom. The ground 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 junction box. The intent of the footswitch is to provide an additional safety interlock in the control circuit to produce foot as well as hand movement by the operator, thereby requiring maximum operator attention. The function of the footswitch only completes the electrical circuit to the aerial control console and engine throttle. The footswitch is in no way, directly connected to the drive braking system.

Engine start and stop functions are independent of the selector switch, making them operable any time the ignition switch is on.

The aerial control console is equipped with a controller and all switches necessary to operat4 the boom functions, as well as drive and steer. It also contains a start/stop and an emergency pump switch. Your **MARKLIFT** is equipped with a proportional control valve for the drive function. The aerial control console contains an electrical controller complete with a manual lockout, for the drive function. 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 on the controller. The valve is electrically coupled to the controller and responds only to the signal level transmitted to it by the operator.

The operator must learn how to move the controller slowly to obtain a smooth, erratic-free 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 the low speed range. This is accomplished through two limit switches sensing the attitude and extension positions of the boom, wired in series to a relay which connects the controller signal to a variable resistor (or potentiometer) that is connected to ground and is parrallel to the solenoid coil. This drains off some of the drive signal, limiting the speed when the machine is extended or raised above horizontal.

The level sensor prevents any operation of the boom controls at 5^{o} or more out of level. When the unit is driven to a slope of less than 5^{o}, the buzzer and light go off and the boom controls become operable.

MARKLIFT Boom units equipped with a dual fuel system allow the operator to select gasoline or propane operation, with a 3-position selector switch located on the aerial control console. The selector switch energizes solenoid valves, which close one fuel line and open the other.

ENGINE 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 run on propane and starting is done with gasoline, more than normal cranking and battery drainage is required for the fuel pump to fill the lines and carburetor bowl with gasoline.

ENGINE STOPPING

The engine is stopped by pushing the red **"STOP"** button on the ground or aerial console. The fuel selector switch need **not be moved** to the **"OFF"** position; the engine may be restarted with the ignition switch or aerial start button. Before starting from ground console, check fuel selector switch on aerial console for proper fuel source.

SWITCHING FROM PROPANE TO GASOLINE

With the engine running, step on the deadman footswitch and position the throttle switch to **"HIGH"** speed. Switch fuel selector 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 **(DO NOT STOP AT "OFF" POSITION)** until the engine is running smoothly on gasoline.

SWITCHING FROM GASOLINE TO PROPANE

With the engine running, step on the deadman footswitch and position the throttle switch to **"HIGH"** speed. Switch 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 throttle to **"LOW"** and release footswitch. Let the engine idle for 20-30 seconds to completely burn up any remaining gasoline in the bowl..

It shall be the responsibility of all **MARKLIFT** operators to read and comply with the following operating instructions. These instructions are designed to promote safety and a better understanding of the functions of the **MARKLIFT** self-propelled boom.

It is recommended that the **MARKLIFT** be moved into an area-free of any overhead obstructions on a flat, level surface with no hazardous irregularities or accumulation of debris.

1. STARTING

A) GROUND CONTROL

The only functions that can be operated from the ground control station are: On/off, raise/lower, rotate turret and extend/retract boom. To start, position selector switch to ground control, turn key to start position, (using manual choke button if necessary) when the engine starts, release key. The **MARKLIFT** is now operational.

B) AERIAL CONTROL

Turn power switch at ground control station to "on". Position selector switch to "aerial". Enter the platform **ATTACHING SAFETY CHAIN AFTER ENTERING.** Pull up the red emergency stop switch cover located on the top right of the aerial control box. Pull down the toggle switch to the start position (using the manual choke button if necessary) when engine starts, release toggle switch. The **MARKLIFT** is now operational.

2. DRIVE

Forward and reverse drive is achieved from the aerial control box only. The **MARKLIFT** is equipped with a high and low throttle variance (toggle switch located on aerial control box - bottom right). For the drive to function, the operator must use both the forward/reverse controller knob and the footswitch.

NOTE: As a safety feature, the HI throttle will not function if the boom is fifteen degrees above horizontal or if the boom is extended.

3. STEERING

Steering the **MARKLIFT** is achieved by pressing the foot-switch and operating the steering toggle switch, depending on the direction to pursue, left or right. The steering toggle switch is a momentary switch that self centers itself to the "off" position. However, the steering wheels will resume in the last andle of direction until the switch is again used to re-maneuver the direction of the **MARKLIFT.**

4. LIFT/LOWER

To raise or lower the boom from the ground control, push the toggle switch up or down.

NOTE: Selector switch must be in the ground control position.

To operate from the aerial control box position selector switch to "aerial" and operate the lift/lower toggle switch. The lift and lower switch is a self centering momentary switch that, when released, the boom will remain stationary.

5. EXTENDING/RETRACTING

The boom extension/retraction toggle switch is located on the face of the ground control station and on the aerial control box. The boom may be extended forward or reverse, retracted by pushing the toggle switch in the direction desired. This switch also has a self centering momentary function.

6. WARNING LIGHT AND BUZZER

As a safety feature, the **MARKLIFT** is equipped with an "out of level" sensor that will cut-out the boom functions whenever the **MARKLIFT** is in an unsafe out-of-level situation.

An unsafe out-of-level situation is sensed by the level sensor when the machine is tilted 5^{0} or more in any direction.

The unsafe condition is indicated by a red warning light and buzzer located on the top center of the aerial control box. When this warning light and buzzer is on, lift/lower, extend/retract, and turret rotation will not operate while the drive and steer functions will. Should this warning occur, maneuver the **MARKLIFT** until it is on a safe operating surface and all functions are restored.

GENERAL CHECKOUT AND OPERATING INSTRUCTIONS

	GENERAL CHECK OUT LIST	DAILY	WEEKLY	MONTHLY
1.	CHECK FUEL & HYDRAULIC TANK LEVELS	X		
2.	CHECK ENGINE OIL LEVEL	X		
3.	CHECK BATTERY WATER LEVEL	X		
4.	CHECK FOR ANY LOOSE OR WORN HARDWARE	X		
5.	CHECK CRITICAL WELD AREAS FOR CRACKS	X		
6.	CHECK TIRE PRESSURES (IF APPLICABLE)	X		
7.	CHECK FOR ANY HYDRAULIC LEAKS & CORRECT		X	
8.	CHECK FOR ANY STRUCTURAL DAMAGE & CORRECT		X	
9.	CHECK OVERALL PERFORMANCE OF MACHINE		X	
10.	CHECK & CLEAN ENGINE INTAKE AIR FILTER		X	
11.	CHECK FOR WEAR ON CABLES & HOSES		X	
12.	GREASE* STEERING LINKAGE			X
13.	GREASE* TURRET ROTATION GEAR BOX			X
14.	GREASE* RING GEAR			X

* REFER TO OPERATION AND MAINTENANCE INSTRUCTION MANUAL FOR TYPE OF LUBRICANTS.

OPERATE THE MARKLIFT IN FOLLOWING MANNER FROM GROUND CONTROL BOX.

1. TURN IGNITION SWITCH TO START.
2. ALLOW ENGINE TO IDLE AT LEAST ONE MINUTE.
3. MAKE SURE AMMETER INDICATES "CHARGE".
4. POSITION AERIAL/GROUND SELECTOR SWITCH TO GROUND.
5. OPERATE ALL THREE BOOM FUNCTIONS MOMENTARILY IN BOTH DIRECTIONS MAKING SURE THE UNIT RESPONDS ACCORDINGLY.
6. POSITION SELECTOR SWITCH TO AERIAL AND ENTER WORK PLATFORM.

The operator should familiarize himself with the drive by raising the boom approximately 5 feet off the ground before driving the **MARKLIFT.**

The controller knob has a self centering safety feature. For best operation, place thumb over controller knob and wrap fingers loosely around locking stem. Now, rest the heel of the hand on the controller housing and apply a downward pressure with the thumb, making the index finger lift the locking stem. Once the stem is disengaged and moved forward or reverse, the pressure on the thumb may be relaxed because the locking stem has engaged the cam and cannot drop into the locking position until the lever or handle is returned to the center position.

Gradually raise the boom higher, and drive the **MARKLIFT** again until you reach maximum height. Remember, at all times, that the proportional signal from the controller to the valve is controlled by the operator. There is approximately 3 degrees of "dead" motion each side of the controller center position.

You will soon find that gradual starts and stops are easy to perform.

After the operator has been instructed by a trained operator and has spent 30 minutes practicing, he should be capable of smoothly starting and stopping the **MARKLIFT** on all proportional functions.

In an engine failure emergency, all boom hydraulic functions are operable with the emergency pump running. From the aerial platform, position emergency pump switch to "ON". This will start the emergency pump. Continue normal operation by pressing the foot switch and moving the toggle switches in the desired direction of motion.

Important; Aerial start switch must be on the "ON" position for the emergency hydraulics to function. Emergency function also applies to the ground control station.

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 supercede 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.

"Extendible and articulating boom platforms"

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

(ii) Only authorized persons shall operate an aerial lift.

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

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

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

(vi) Boom and basket load limits specified by the manufacturer shall not be exceeded.

(vii) Not applicable.

(viii) Not applicable.

(ix) Articulating boom and extendible 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 over-riding 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.

(x) Climbers shall not be worn while performing work from aerial lift.

(xi) Not applicable.

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

This preventative maintenance information is intended as a general guide, refer to vendor section in this manual for detailed information on engine, battery, etc.

Mark Industries recommends the following items be checked:

DAILY

1. Operation and safety decals in place and legible.
2. Check gas & hydraulic tank levels.
3. Check engine oil level.
4. Check battery water level.
5. Check for loose or worn hardware.

WEEKLY

1. Check tire condition (free of serious cuts or defects)
2. Check & clean engine intake air cleaner.
3. Operation and safety decals in place and legible.
4. Proper brake operation.
5. Record hour meter reading.
6. Clean unit by removing all dirt, oil, and grease. Machine may be washed with soap and water.
7. Check for hydraulic leaks and correct.
8. Check for structural damage and correct.
9. Check overall performance.
10. Check for wear on cables and hoses.

MONTHLY (or first 50 hours)

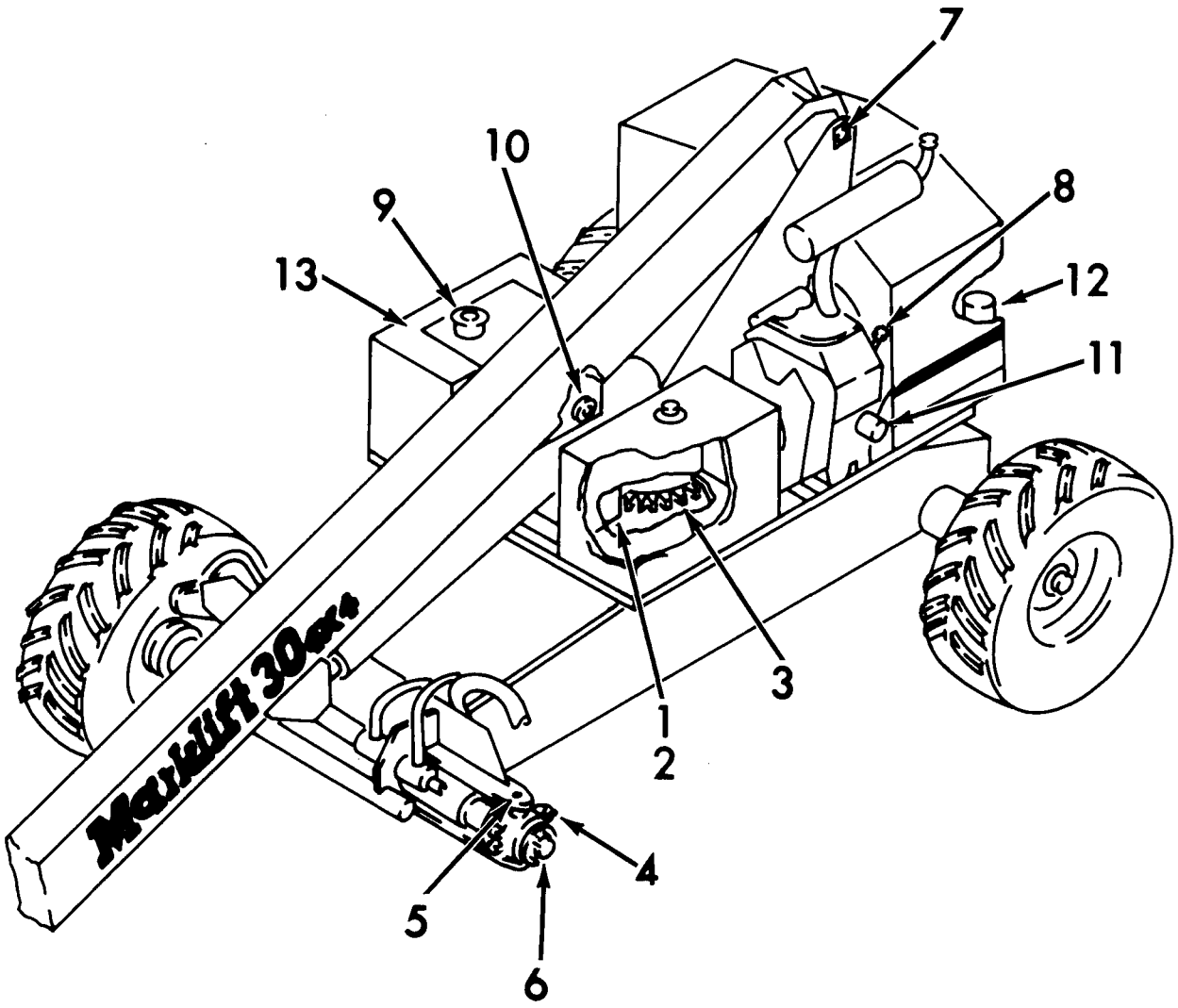
1. Check and lube, if necessary. (See lubrication instructions).
2. Check battery condition.
3. Change engine oil & filter.
4. Change hydraulic oil return filter.
5. Check ring gear bolts in turret and base for correct torque.
   15/16 bolts - 175 ft. lbs. lubricated
   3/4 bolts - 87 ft. lbs. lubricated
6. Check oil level, turret rotation gear box.
7. Grease ring gear.
8. Grease steering linkage.
9. Check & clean engine intake air cleaner.

EVERY SIX MONTHS (or 100 hours)

1. Check and lube, if necessary. (See lubrication instructions).
2. Change pilot filter element. (See lubrication instructions).
3. Change engine oil filter.
4. Change hydraulic oil return filter.

EVERY YEAR

1. Repack all wheel bearings.
2. Change hydraulic oil.
3. Check torque hub oil level.
4. Check ring gear bolts in turret and base, for correct torque.
5. Change hydraulic oil return filter.
6. Change pilot line filter.


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11
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Merlift 30ex4

ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
1	ROTATION GEAR BOX GEARING	GEAR OIL SAE 90	MONTHLY
2	ROTATION GEAR BOX BEARINGS	GREASE-MOBIL VA6L36AG OR EQUIVALENT	MONTHLY
3	RING GEAR	GREASE-MOBIL (2) ZERK FITTINGS ROTATE GEAR WHILE GREASING	MONTHLY
4	TIE ROD PIN	REASE - MOBIL VA6L36AG	MONTHLY
5	STEERING YOKE KING PINS	GREASE-MOBIL VA6L36AG OR EQUIVALENT	MONTHLY
6	WHEEL BEARINGS	GREASE-MOBIL VA6L36AG	YEARLY
7	BOOM PIVOT PIN	GREASE-MOBIL VA6L36AG OR EQUIVALENT	MONTHLY
8	ENGINE	SAE 30	SEE WISCONSIN OPERATING INSTRUCTIONS
9	RETURN LINE FILTER ELEMENT-81182		REPLACE EVERY 100 HRS.
10	SUCTION FILTER ELEMENT-81183		REPLACE EVERY 100 HRS.
11	ENGINE OIL FILTER	(SEE VENDOR)	REPLACE EVERY 100 HRS.
12	ENGINE AIR FILTER	(SEE VENDOR)	REPLACE EVERY 100 HRS.
13	HYDRAULIC FLUID	SEE PAGE 05	YEARLY

EQUIVALENT BEARING GREASE

UNION - UNOBA EP-2

SHELL - ALVINIA EP-2

MILESTONE			HYDRAULIC FLUID TABLE			
OIL COMPANY			CHEVRON	GULF	SHELL	UNION
BRAND NAME			ATF DEXRON II	ATF DEXRON II	DONAX-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°

ENGINE

1. Will not start or run.

   A. Check ground control box circuit breaker.
   B. Make sure fuel shut-off valve is open.
   C. Fuel selector should be in the "gasoline" position.
   D. Check for low battery
   E. Check for fouled spark plugs.
   F. Check for water in gas tank.
   G. Check engine points.
   H. Refer to your local service facility.

2. No high speed.

   A. Check aerial HIGH/LOW throttle switch.
   B. Check throttle solenoid valve.
   C. Refer to your local service facility.

3. No idle.

   A. Check aerial HIGH-LOW throttle switch.
   B. Check throttle solenoid valve.
   C. Refer to your local service facility.

4. Dies under load.

   A. Check governor setting.
   B. Check carburetor air/fuel mixture.
   C. Refer to your local service facility.

HYDRAULIC WHEEL DRIVE MOTOR

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

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

HYDRAULIC PUMP

1. Pump producing excessive noise.

   A. Check suction hose from tank to pump for kinks.
   B. Check hydraulic oil level (sight gauge on tank.)
   C. Check suction line fittings for tightness.
   D. Check oil. SEE PAGE 4 FLUID TABLE
   E. Refer to your local service facility.

LIFT

1. No functions operate from aerial control console.

   A. Check aerial/ground selector switch.
   B. Check foot switch continuity.
   C. Check for loose wire in aerial junction box.
   D. Check pilot valve pressure.
   E. Solenoid dump valve.

2. No functions operate from ground control box.

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

3. Functions too slow or too fast.

   A. Check pilot valve control pressure.
   B. Check flow control valve to solenoid valves.
   C. Refer to your local service facility.

DRIVE

   A. Make sure hydraulic system is up to recommended pressure.
   B. Check pilot valve control pressure.
   C. Refer to your local service facility.

SERVICE TOOLS

1. Volt/OHM meter.
2. Hydraulic pressure gauge (0-3000 PSI)
3. Battery hydrometer.
4. Photo tachometer.
5. Standard mechanics hand tools.
6. Cable tensioning tool MI #20053.
7. Radiator pressure tester.

Either excessive overcharge or moderate undercharge can shorten battery life.

With proper attention to water level and charging time, compared to hydrometer reading, 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	1.196	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

REV.

MODEL:_____ SER. NO.:_____ DATE SOLD _____

DATE IN SERVICE _____ OPTIONS _____ WARRANTY PERIOD _____

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

DATE	W.O.	MECH.	HR METER	PREVENTIVE MAINT.												ELECTRICAL						HYDRAULIC								FUEL			STEER				TIRE		MAJ.	MISC.				
				OIL CHANGE	OIL FILTER	AIR CLEANER	HYDRAULIC OIL CHANGE	HYDRAULIC OIL FILTER	WHEEL BEARING PACK	DRIVE MOTOR	PUMP MOTOR	ELECTRICAL CONTROLS	TRANS & DIFF OIL CHG	TUNE UP SPARK PLUGS	GENERATOR	VOLTAGE REGULATOR	BATTERY	STARTER	POINTS AND CONDENSER	HYDRAULIC SYSTEM	LEV CYL	LIFT CYL SEALS	HYD CONTROL VALVE	HYD PUMP	ROTARY MANIFOLD	LIFT ROLLERS	HYD HOSES	FUEL SYS	CARBURATOR	FUEL PUMP	STEERING	STEERING HOSES	STEER GEAR	STEER CYL	DRIVE TIRE	STEER TIRE	ENGINE O/H	DRIVE AXLE O/H	BRAKES				

DATE	REMARKS	DATE	REMARKS	AGENCY

MAINTENANCE CHECK LIST

MARKLIFT SERVICE MAINTENANCE RECORD

MODEL: _____ SERIAL NO. _____

DATE: _____ EQUIP. NO. _____

LOCATION: _____ MECHANIC: _____

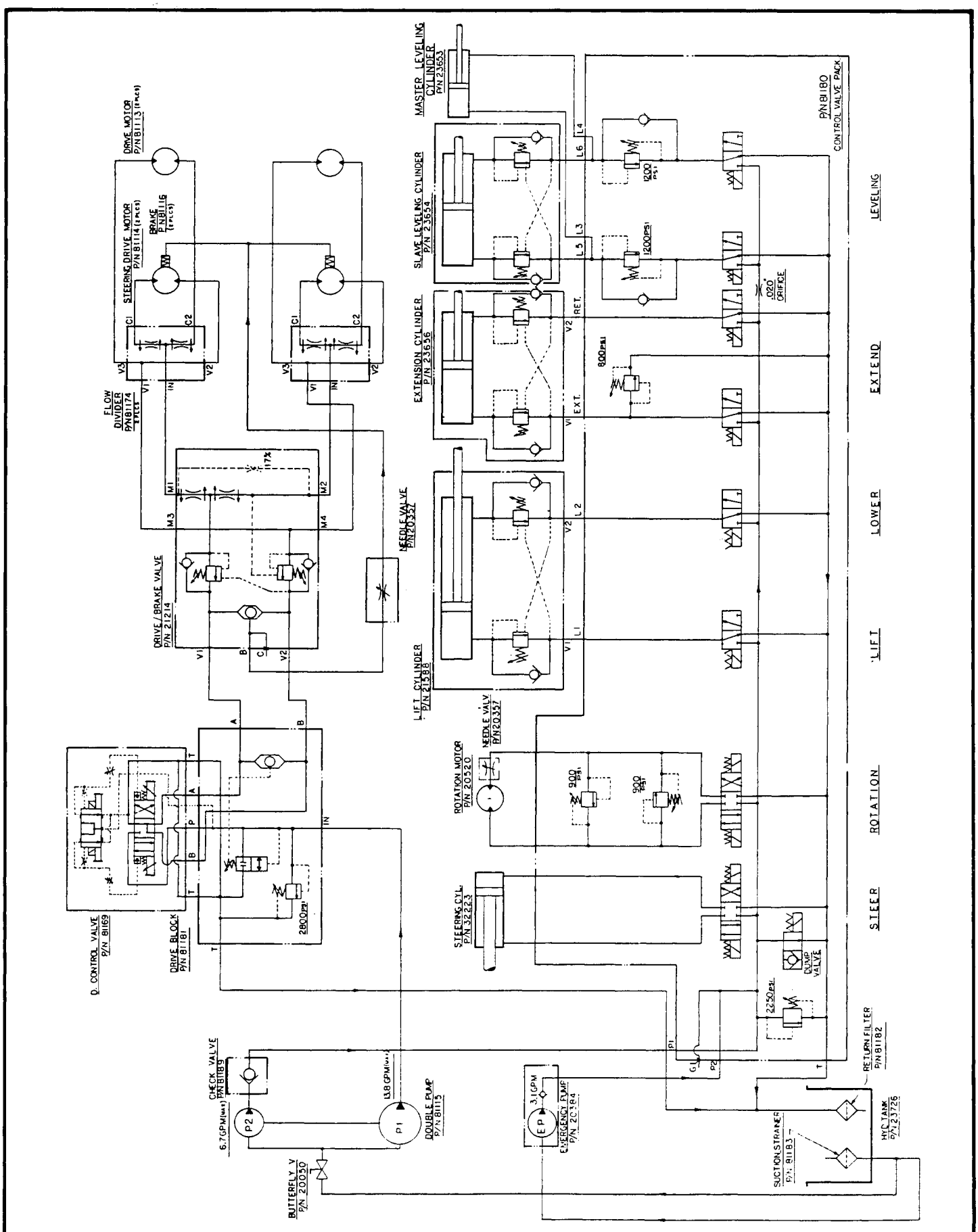
ITEM	CODE	COMMENTS	ITEM	CODE	COMMENTS
ENGINE OIL			SAFETY CUT-OUTS		
ENGINE OIL FILTER			BUSHINGS		
AIR FILTER			ROLLERS		
FUEL FILTER			WEAR PAD		
TUNE-UP			FRONT END ASSY.		
CHOKE			TIRE PRESSURE		
ENGINE RPM			TIRE CONDITION		
CHARGINE SYSTEM			WHEEL NUTS		
FUEL SYSTEM LPG-GAS			WHEEL BEARING		
BATTERIES			NUTS & BOLTS		
BATTERY TERMINALS			GUARD RAILS		
MOTOR BRUSHES			LUBRICATION		
HYDRAULIC FLUID			WARNING DECALS		
HYD. OIL FILTER			OPERATION INSTRUCTIONS		
HYDRAULIC SYSTEMS			GENERAL DECALS		
HYDRAULIC PRESSURE			PAINT		
HYDRAULIC HOSES			ALL OPERATIONS		
CYLINDERS			LIFT		
DRIVE MOTORS			STEERING		
BRAKES			FORWARD DRIVE		
EMERGENCY LOWERING VALVE			REVERSE DRIVE		
AERIAL CONTROL BOX			TILT SWITCHES		
GROUND CONTROL BOX			FUEL LEVEL		
RELAYS			LITERATURE		
WIRE CONNECTIONS			OPTIONS		

CODE

F - FILLED
R - REPAIRED
C - CHECKED
A - ADJUSTED
X - NEEDS REPAIR

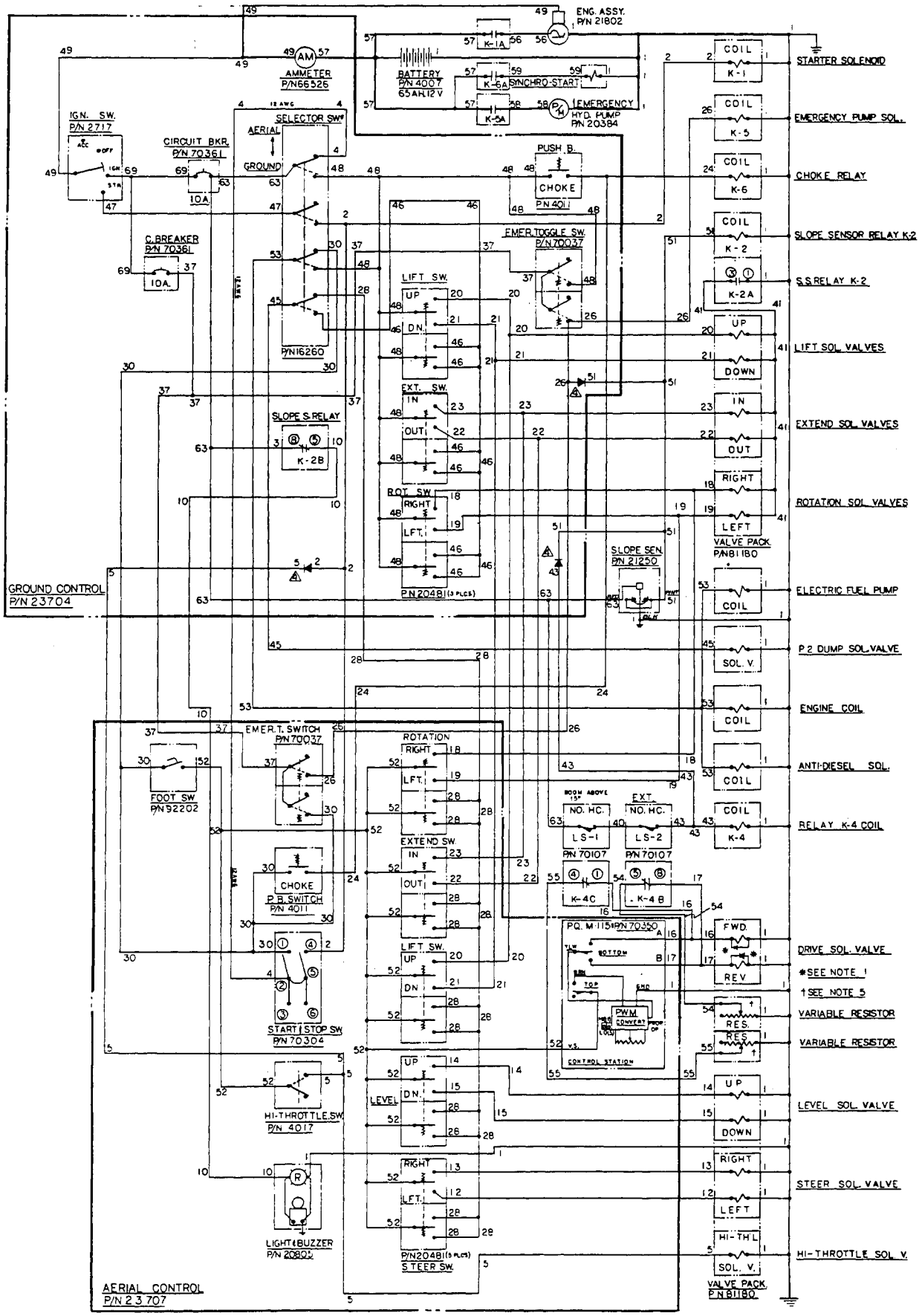
OTHER COMMENTS:

HYDRAULIC SCHEMATIC (30 4 X 4)



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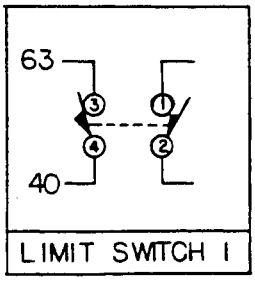
ELECTRICAL SCHEMATIC (30 4 X 4)



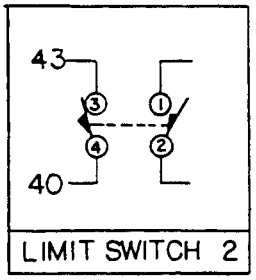
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NOTES:

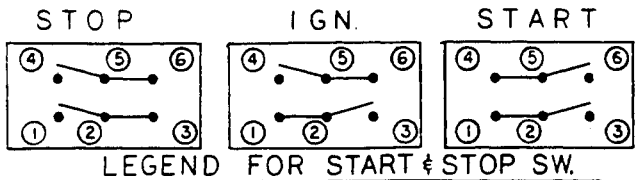
1. USE 1AMP./400V. MINIMUM DIODE.
2. TO CONNECT GROUND CONTROL AND AERIAL CONTROL USE ARM CABLE P/N 20802.
3. ALL WIRES BE 18 AWG. UNLESS OTHER - WISE SPECIFIED.
4. USE 6 A. 200V. DIODE P/N 4045.
5. VARIABLE RESISTORS HAVE TO BE ADJUSTED AT 3.8 Ω ± .1.



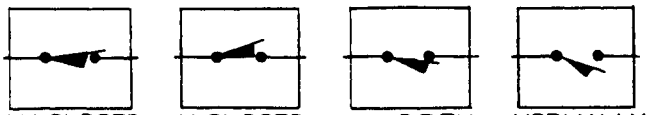
P/N 70107
LOCATED AT THE TURRET, 15°



P/N 70107
LOCATED ON THE BOOM



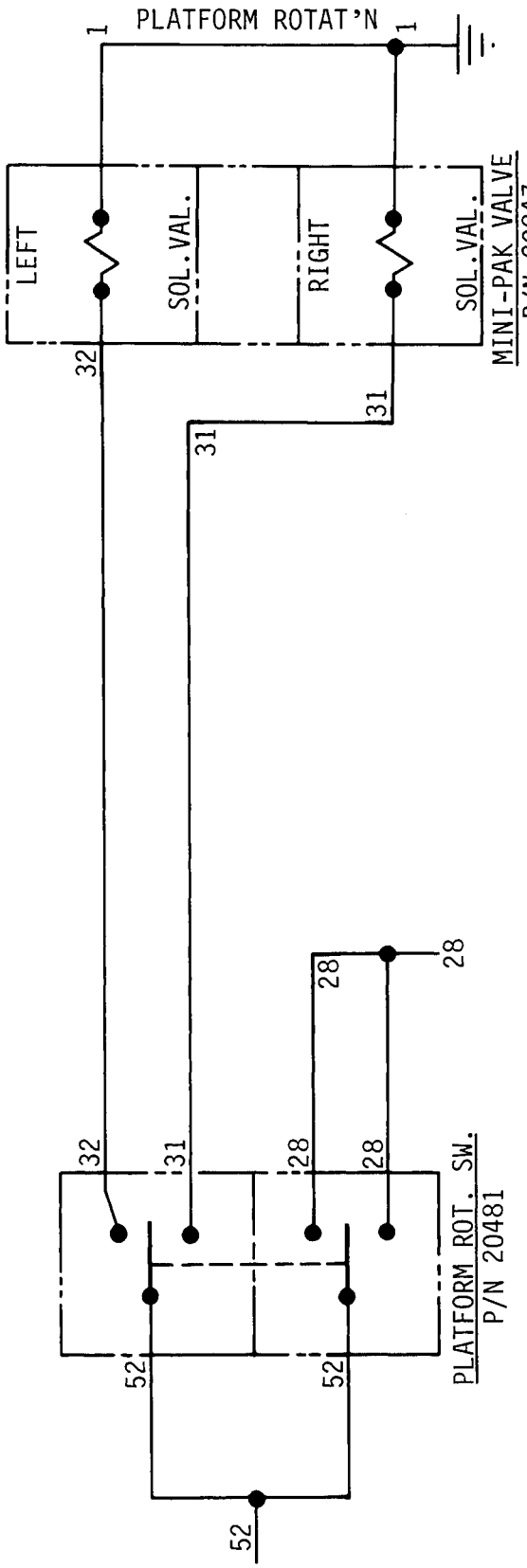
LEGEND FOR START & STOP SW.



NORMALLY CLOSED | N. CLOSED. HELD OPEN | N. OPEN. HELD CLOSED | NORMALLY OPEN.

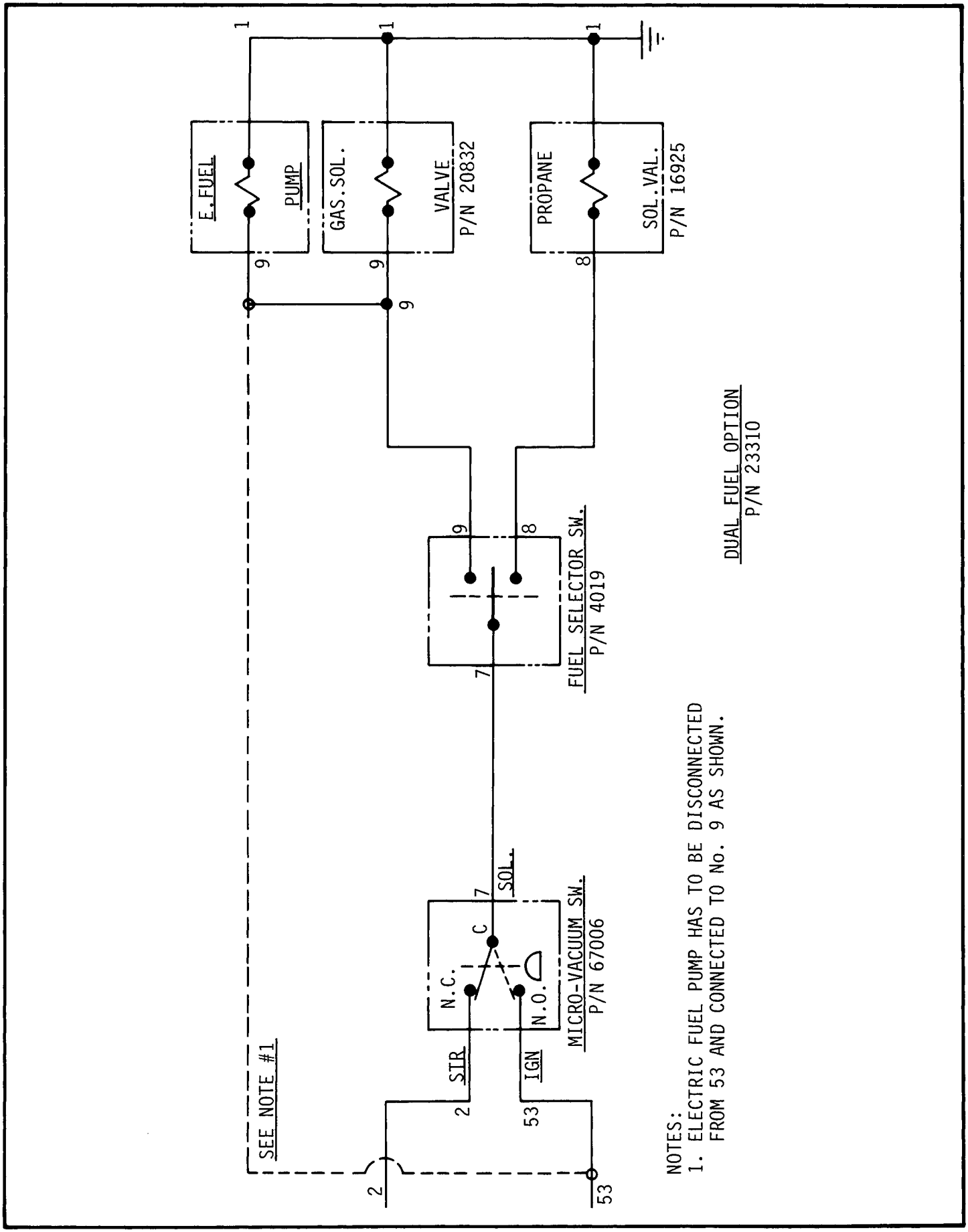
LEGEND FOR LIMIT SWITCHES

ELECTRIC SCHEMATIC (PLATFORM ROTATION)

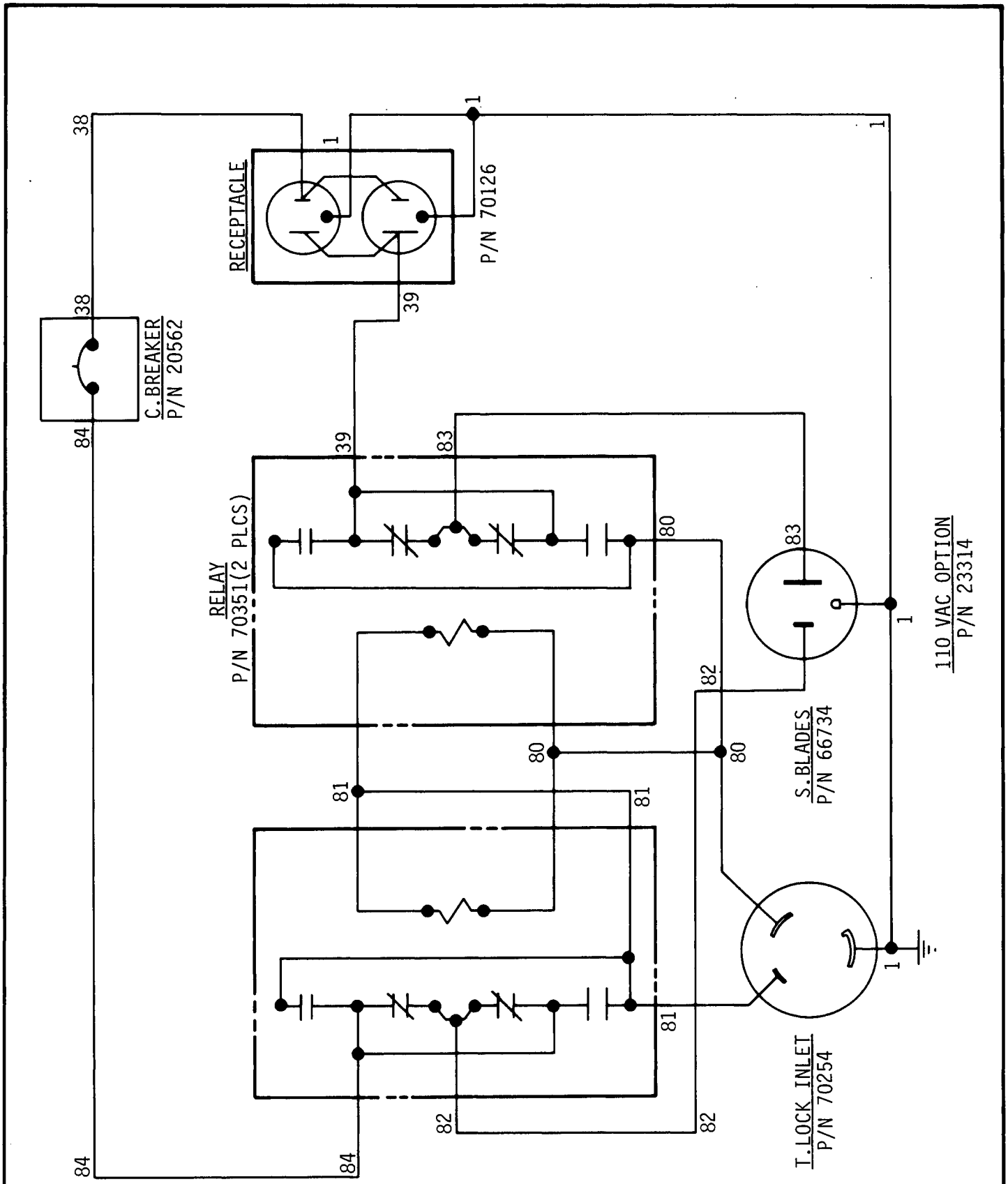


PLATFORM ROTATION OPTION
P/N 23309

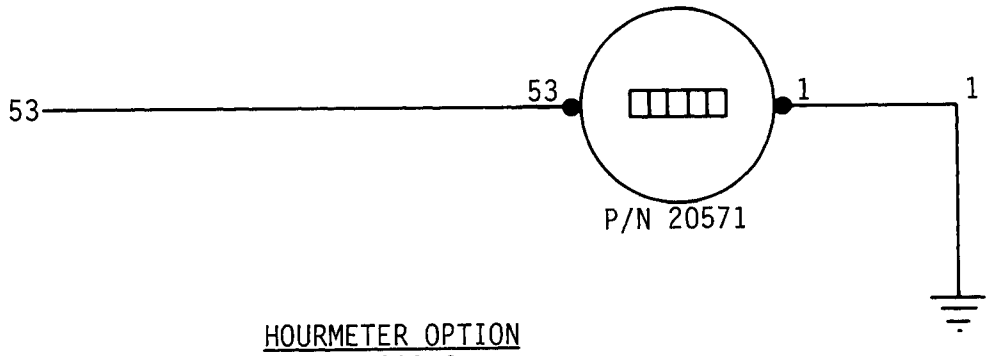
ELECTRIC SCHEMATIC (DUAL FUEL)



ELECTRIC SCHEMATIC (110 VAC)



ELECTRIC SCHEMATIC (HOURMETER)



HOURMETER OPTION
P/N 23316

THIS PARTS CATALOG IS DESIGNED AS:

SECTION 1 MARKLIFT PARTS CATALOG

FIGURE 1 HOW TO ORDER PARTS

FIGURE 2 HOW TO USE PARTS CATALOG

SECTION 2 MARKLIFT 30 4 X 4

FIGURE 1 FINAL ASSEMBLY

FIGURE 2 AERIAL CONTROL BOX, PLATFORM AND FOOT SWITCH INSTALLATION

FIGURE 3 AERIAL CONTROL BOX ASSEMBLY

FIGURE 4 DECAL INSTALLATION

FIGURE 5 HYDRAULIC HOSE INSTALLATION

SECTION 3 CARRIAGE ASSEMBLY

FIGURE 1 CARRIAGE ASSEMBLY

FIGURE 2 TIE ROD ASSEMBLY

FIGURE 3 STEERING CYLINDER ASSEMBLY

FIGURE 4 MOTOR BRAKE ASSEMBLY

FIGURE 5 DRIVE MOTOR ASSEMBLY

FIGURE 6 FLOW DIVIDER ASSEMBLY

FIGURE 7 DRIVE BRAKE VALVE ASSEMBLY

SECTION 4 TURRET ASSEMBLY

FIGURE 1 TURRET ASSEMBLY

FIGURE 2 ENGINE AND PUMP ASSEMBLY

FIGURE 3 FUEL TANK ASSEMBLY

FIGURE 4 HYDRAULIC TANK ASSEMBLY

FIGURE 5 MASTER LEVELING CYLINDER ASSEMBLY

FIGURE 6 LIFT CYLINDER ASSEMBLY

FIGURE 7 ROTATION GEAR BOX ASSEMBLY

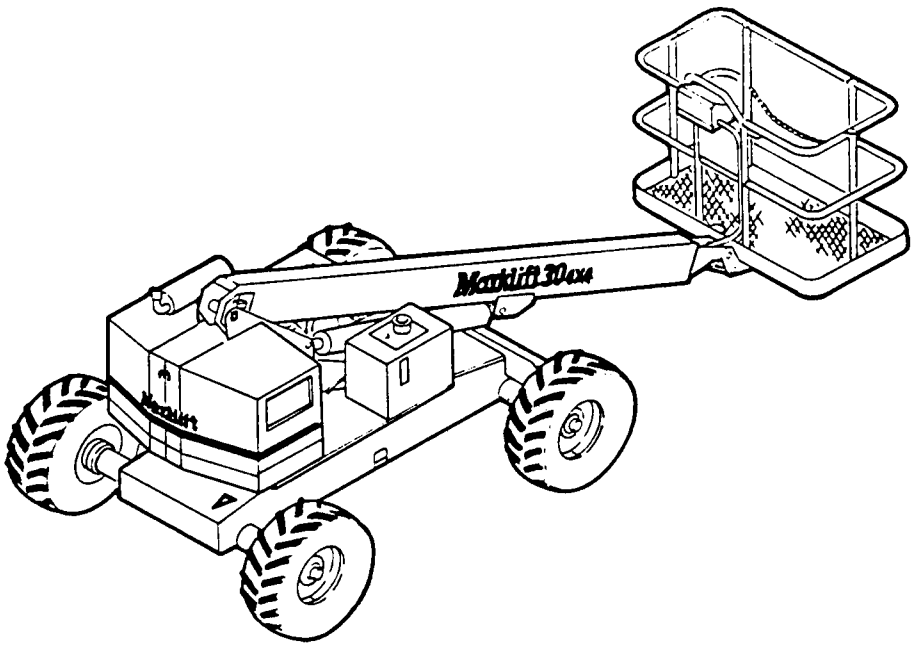
FIGURE 8 EMERGENCY PUMP AND MOTOR ASSEMBLY

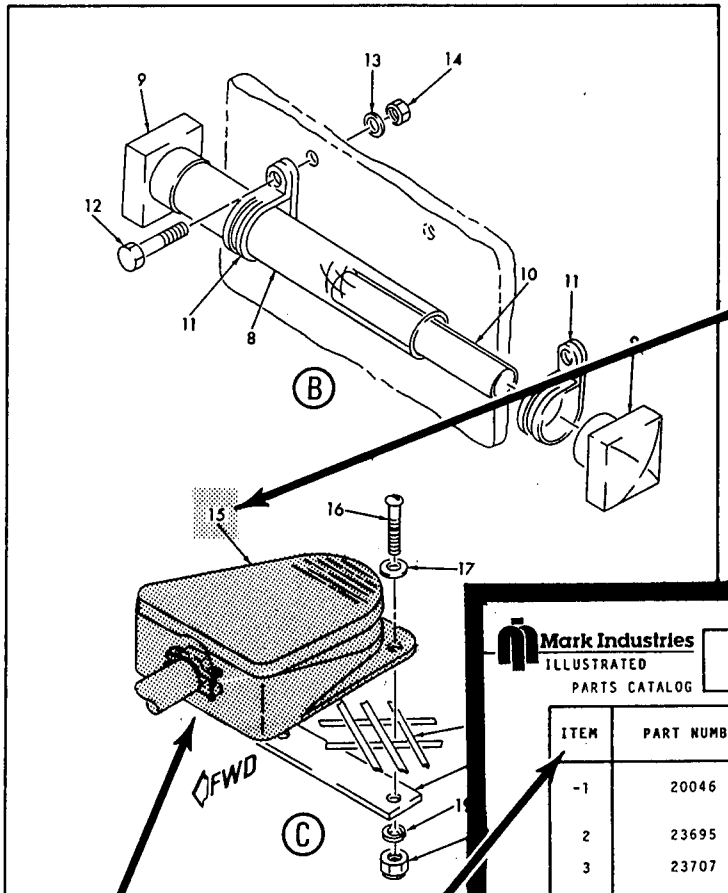
FIGURE 9 DRIVE BLOCK ASSEMBLY

FIGURE 10 CONTROL VALVE ASSEMBLY

FIGURE 11 LOWER CONTROL PANEL ASSEMBLY

SECTION 5 BOOM ASSEMBLY
FIGURE 1 FINAL BOOM ASSEMBLY
FIGURE 2 INNER BOOM ASSEMBLY
FIGURE 3 SLAVE LEVELING CYLINDER ASSEMBLY
FIGURE 4 EXTENSION CYLINDER ASSEMBLY
SECTION 6 OPTIONAL ASSEMBLIES
FIGURE 1 OPTIONAL ASSEMBLIES
FIGURE 2 WORK PLATFORM ROTATOR FRONT MOUNT
FIGURE 3 DUAL FUEL
FIGURE 4 CONTINUOUS TURRET ROTATION
FIGURE 5A SHEET METAL COWLING (BEF. JUL. '87)
FIGURE 5B SHEET METAL COWLING (AFT. JUL. '87)
FIGURE 6 ENGINE COVER
FIGURE 7 GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE
FIGURE 8 LIFTING LUGS
FIGURE 9 HOURMETER





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

REV.

- ITEM NOT ILLUSTRATED

1. **PART NUMBER**

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

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

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

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

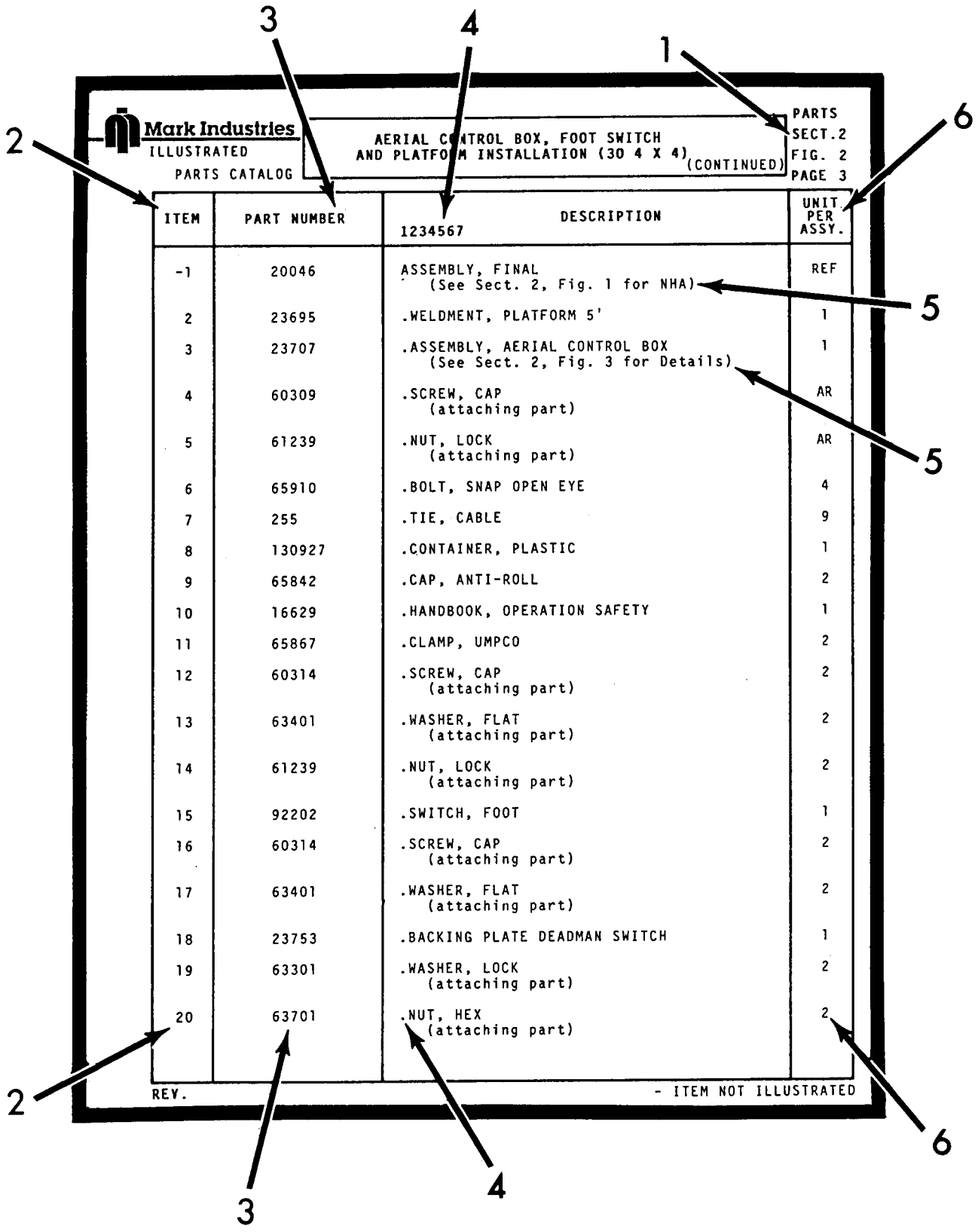
2. **TO ORDER:**

   By phone: Service Department

   (800) 421-1826
   or
   (213) 639-9700

   By mail: Attention Service Department

   MARK INDUSTRIES
   Post Office Box 720
   Long Beach, CA 90801



Mark Industries
ILLUSTRATED
PARTS CATALOG

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

PARTS
SECT.2
FIG. 2
PAGE 3

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

REV.

- ITEM NOT ILLUSTRATED

1. This area refers to the corresponding illustration.

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

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

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

2. The **Item Number** corresponds to the item number shown for the part in the illustration. (Parts with item numbers preceded by a dash are not illustrated such as -1, -5, etc.)

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

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

   1 2 3 4 5 6 7

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

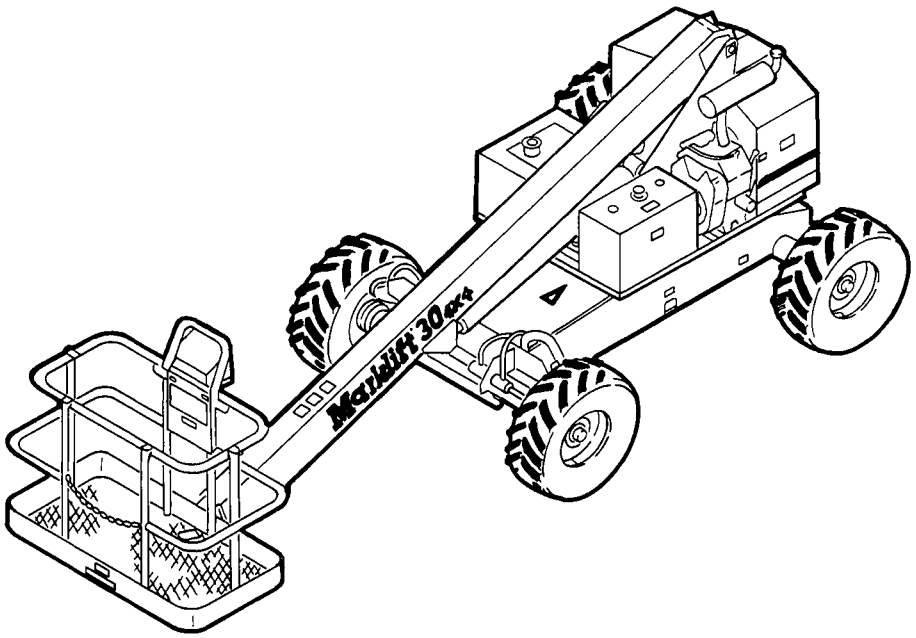
5. **NHA** (Next Higher Assembly) and **DETAILS** - Section and Figure reference catalog location indicates where the installation or assembly is listed under NHA and where illustrated for more detailed breakdown.

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

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

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

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



THIS SECTION 2 IS ILLUSTRATED AS:

FIGURE 1. FINAL ASSEMBLY

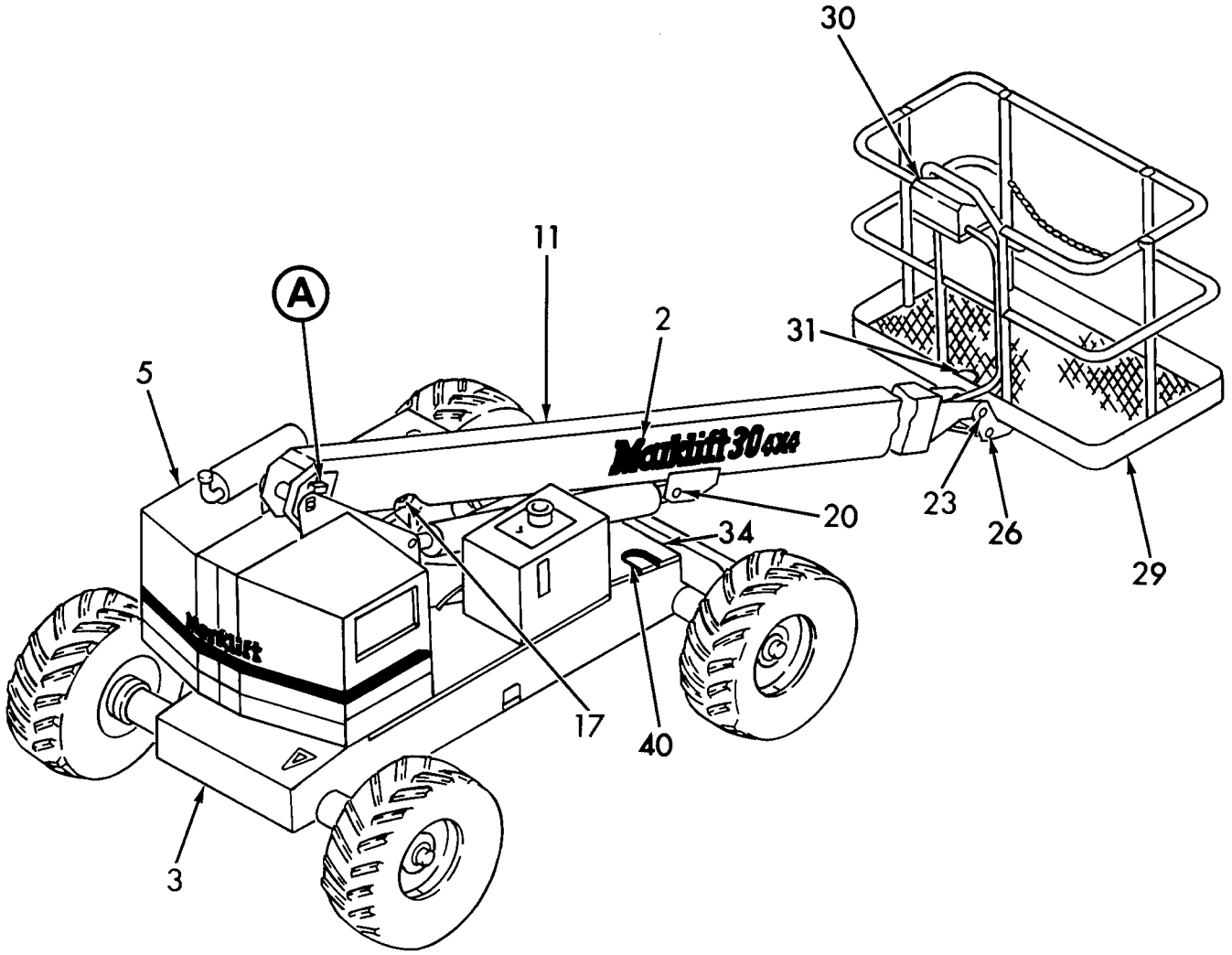
FIGURE 2. AERIAL CONTROL BOX, PLATFORM AND FOOT SWITCH INSTALLATION

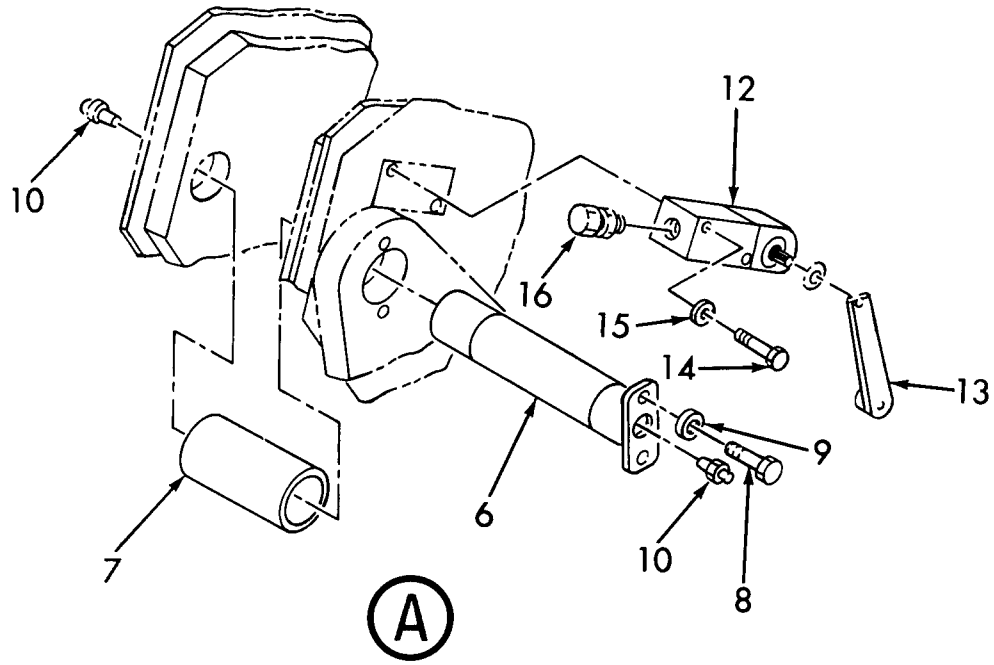
FIGURE 3. AERIAL CONTROL BOX ASSEMBLY

FIGURE 4. DECAL INSTALLATION

FIGURE 5. HYDRAULIC HOSE INSTALLATION

FINAL ASSEMBLY (30 4 X 4)





REV.

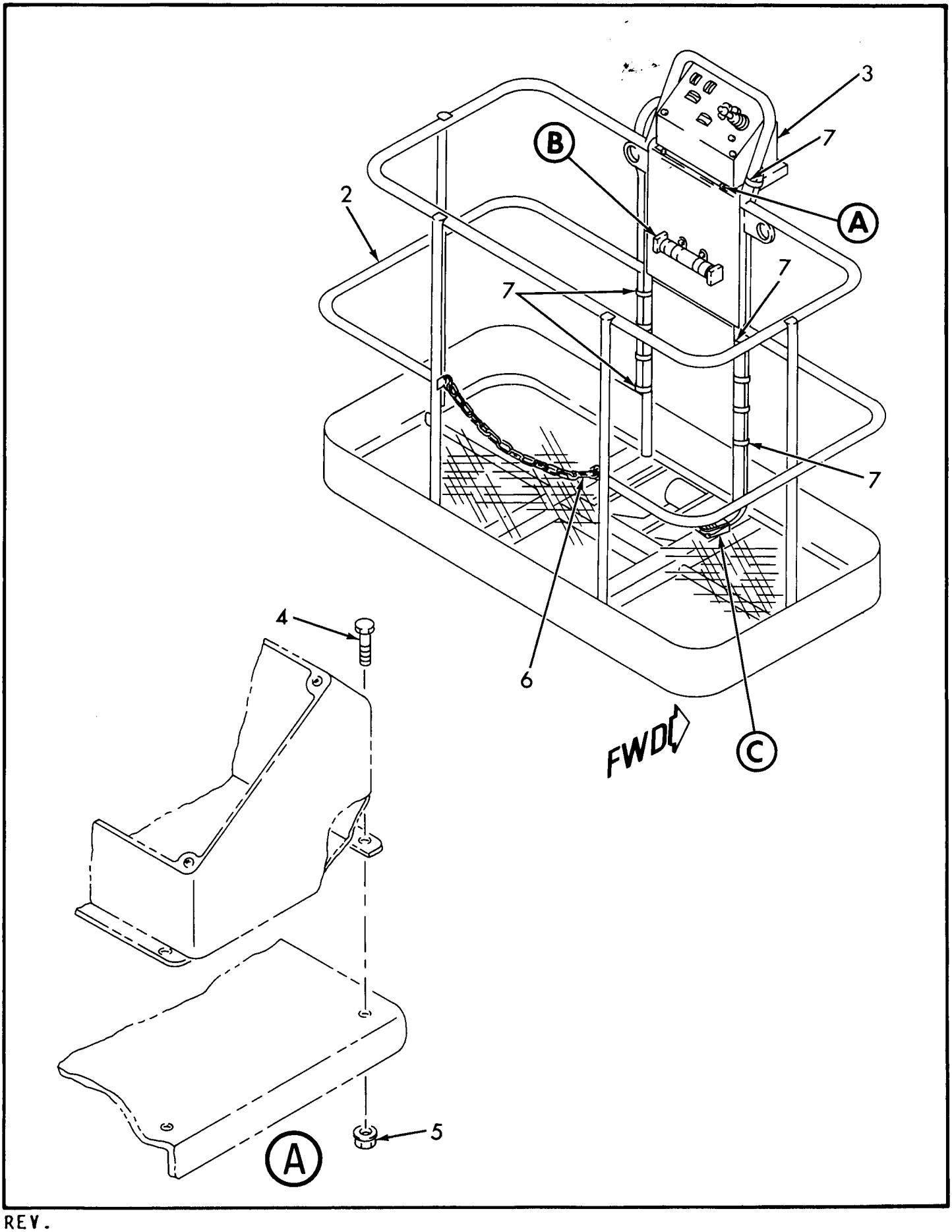
FINAL ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	20046	ASSEMBLY, FINAL	REF
2	67031	.KIT, DECAL (See Sect. 2, Fig. 4 for Details)	1
3	23667	.ASSEMBLY, CARRIAGE (See Sect. 3, Fig. 1 for Details)	1
4	60546	.SCREW, CAP (attaching part)	18
5	23689	.ASSEMBLY, TURRET (See Sect. 4, Fig. 1 for Details)	1
6	23777	.PIN	1
7	26454	.TUBE, ROUND	1
8	62009	.SCREW, CAP (attaching part)	2
9	63303	.WASHER, LOCK (attaching part)	2
10	65103	.FITTING, GREASE	2
11	23660	.ASSEMBLY, FINAL BOOM (See Sect. 5, Fig. 1 for Details)	1
12	70107	.SWITCH, LIMIT	1
13	70032	.LEVER, OPERATING	1
14	62615	.SCREW, CAP (attaching part)	2
15	63313	.WASHER, LOCK (attaching part)	2
16	2806	.RELIEF, STRAIN	1
17	23685	.PIN	1
-18	60539	.SCREW, CAP (attaching part)	1
-19	63319	.WASHER, LOCK (attaching part)	1
20	23509	.PIN	1
-21	60539	.SCREW, CAP (attaching part)	1
-22	63303	.WASHER, LOCK (attaching part)	1
23	20457	.PIN	1

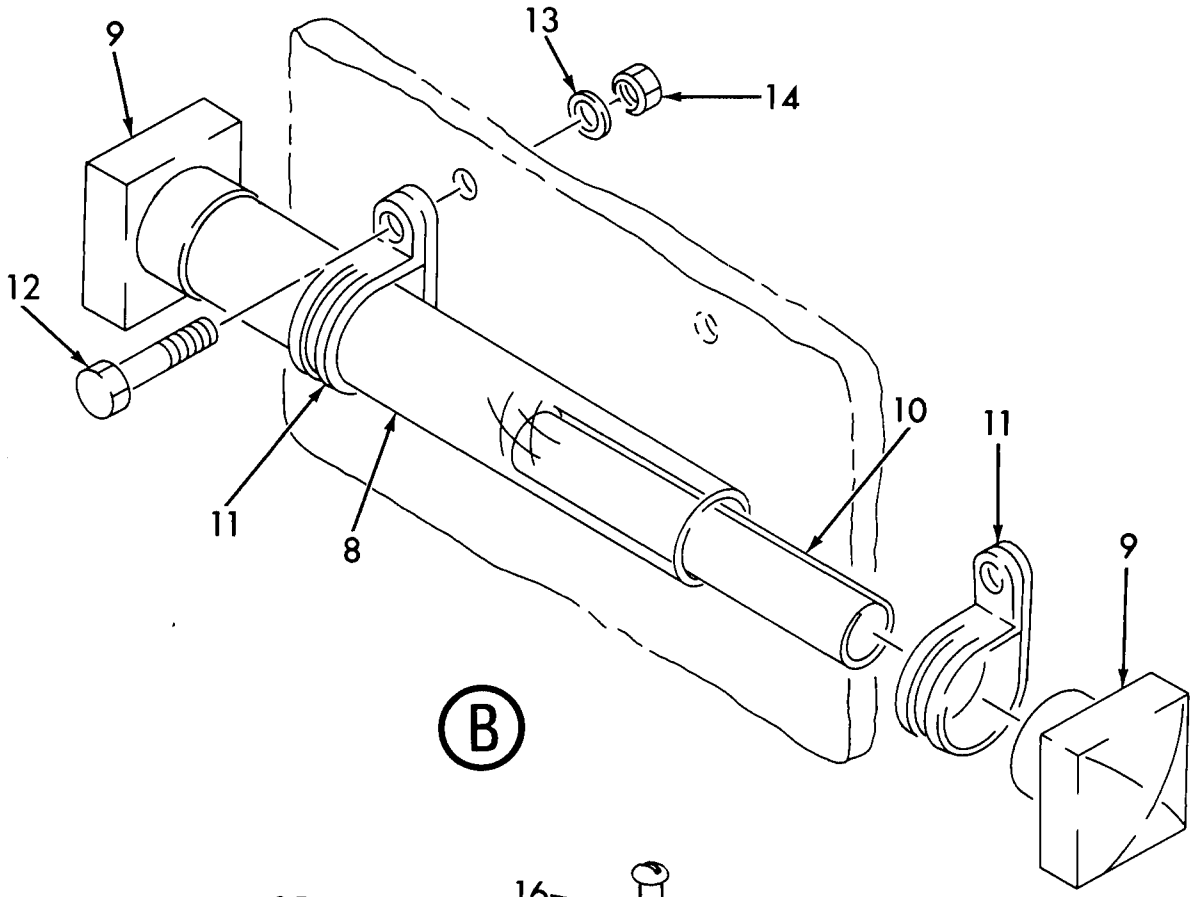
- ITEM NOT ILLUSTRATED

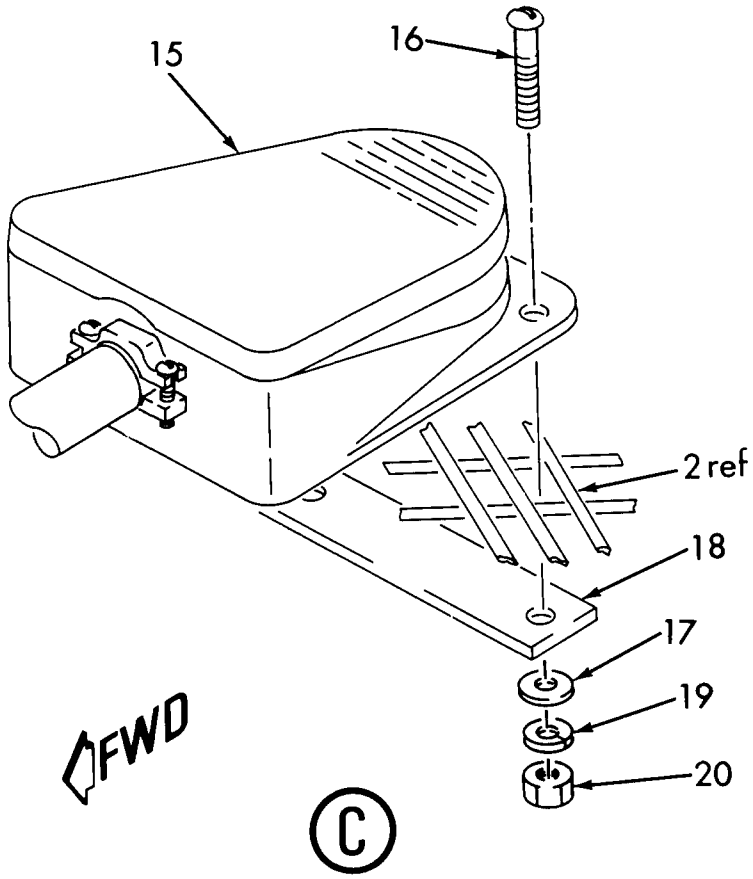
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-24	60539	.SCREW, CAP (attaching part)	1
-25	63303	.WASHER, LOCK (attaching part)	1
26	20457	.PIN	1
-27	60539	.SCREW, CAP (attaching part)	1
-28	63303	.WASHER, LOCK (attaching part)	1
29	23695	.WELDMENT, PLATFORM 5' (See Sect. 2, Fig. 2 for Details)	1
30	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	1
31	92202	.SWITCH, FOOT	1
-32	65114	.GAS, REGULAR	REF
-33	65116	.FLUID, HYDRAULIC	REF
34	23692	.COVER, FRAME	1
-35	60553	.SCREW, CAP (attaching part)	4
-36	63302	.WASHER, LOCK (attaching part)	4
-37	23745	.DIAGRAM, HOSE HYDRAULIC (See Sect. 2, Fig. 5 for Details)	1
-38	23716	.SCHEMATIC, HYDRAULIC (See Chap. Schematic for Details)	REF
-39	23717	.SCHEMATIC, ELECTRICAL (See Chap. Schematic for Details)	REF
40	65915	.EXTRUSION RUBBER	2

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



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



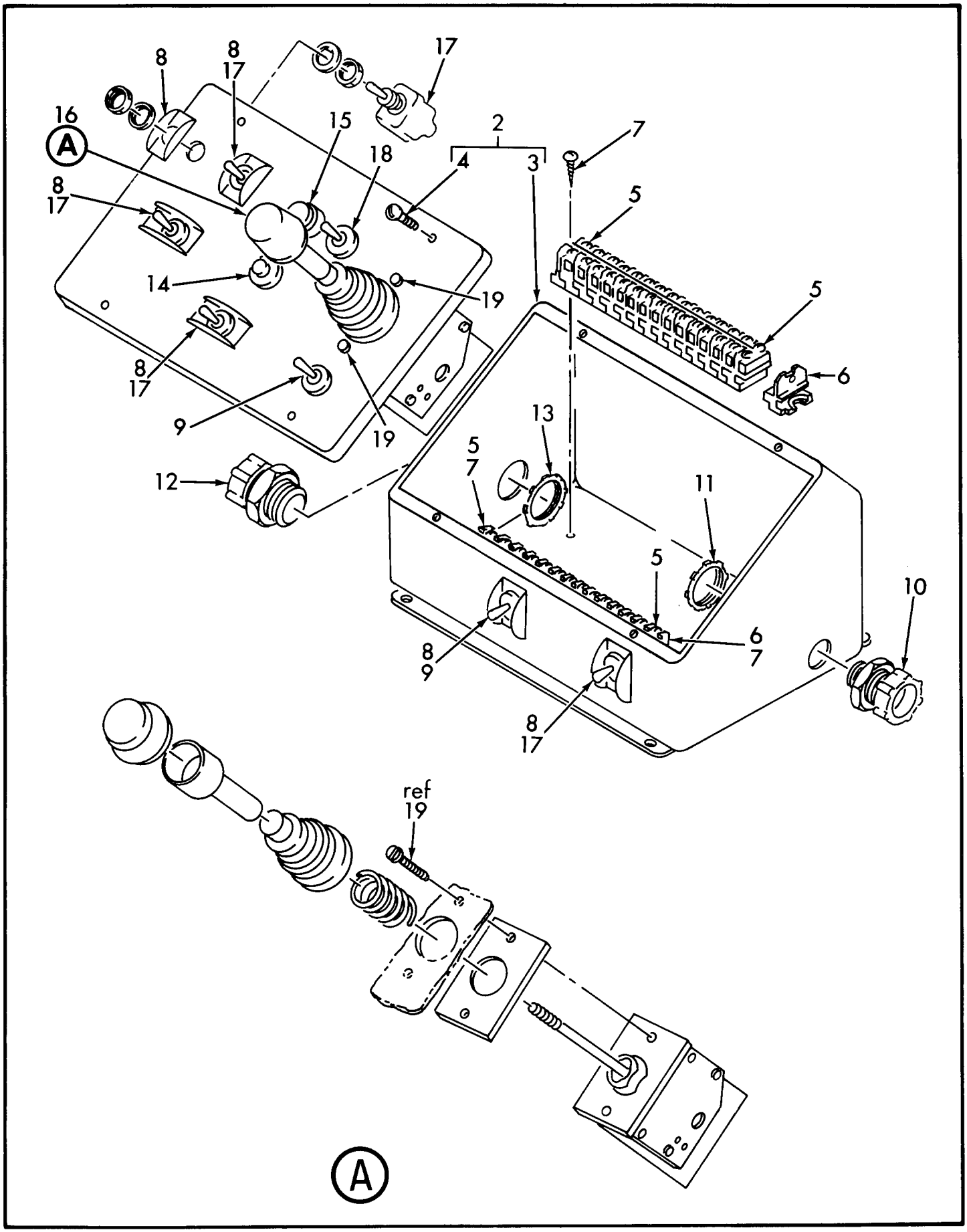


AERIAL CONTROL BOX, FOOT SWITCH AND PLATFORM INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	20046	ASSEMBLY, FINAL (See Sect. 2, Fig. 1 for NHA)	REF
2	23695	.WELDMENT, PLATFORM 5'	1
3	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	1
4	60309	.SCREW, CAP (attaching part)	4
5	61239	.NUT, LOCK (attaching part)	4
6	65910	.BOLT, SNAP OPEN EYE	4
7	255	.TIE, CABLE	9
8	130927	.CONTAINER, PLASTIC	1
9	65842	.CAP, ANTI-ROLL	2
10	16629	.HANDBOOK, OPERATION SAFETY	1
11	65867	.CLAMP, UMPCO	2
12	60314	.SCREW, CAP (attaching part)	2
13	63401	.WASHER, FLAT (attaching part)	2
14	61239	.NUT, LOCK (attaching part)	2
15	92202	.SWITCH, FOOT	1
16	62702	.SCREW, CAP (attaching part)	2
17	63413	.WASHER, FLAT (attaching part)	2
18	23753	.BACKING PLATE, DEADMAN SWITCH	1
19	63313	.WASHER, LOCK (attaching part)	2
20	60802	.NUT, HEX (attaching part)	2

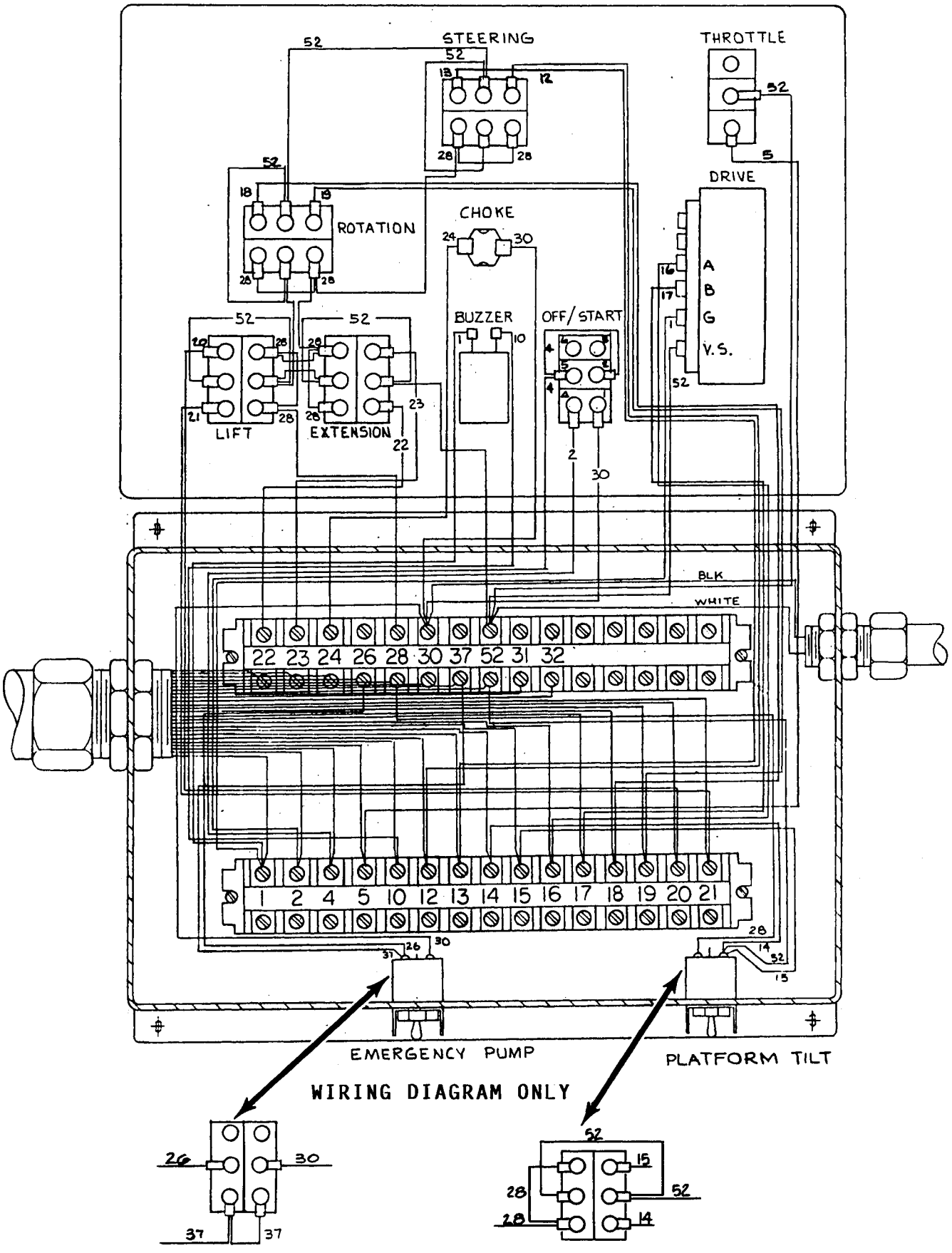
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AERIAL CONTROL BOX ASSEMBLY (30 4 X 4)



REV.

AERIAL CONTROL BOX ASSEMBLY (30 4 X 4) (CONTINUED)



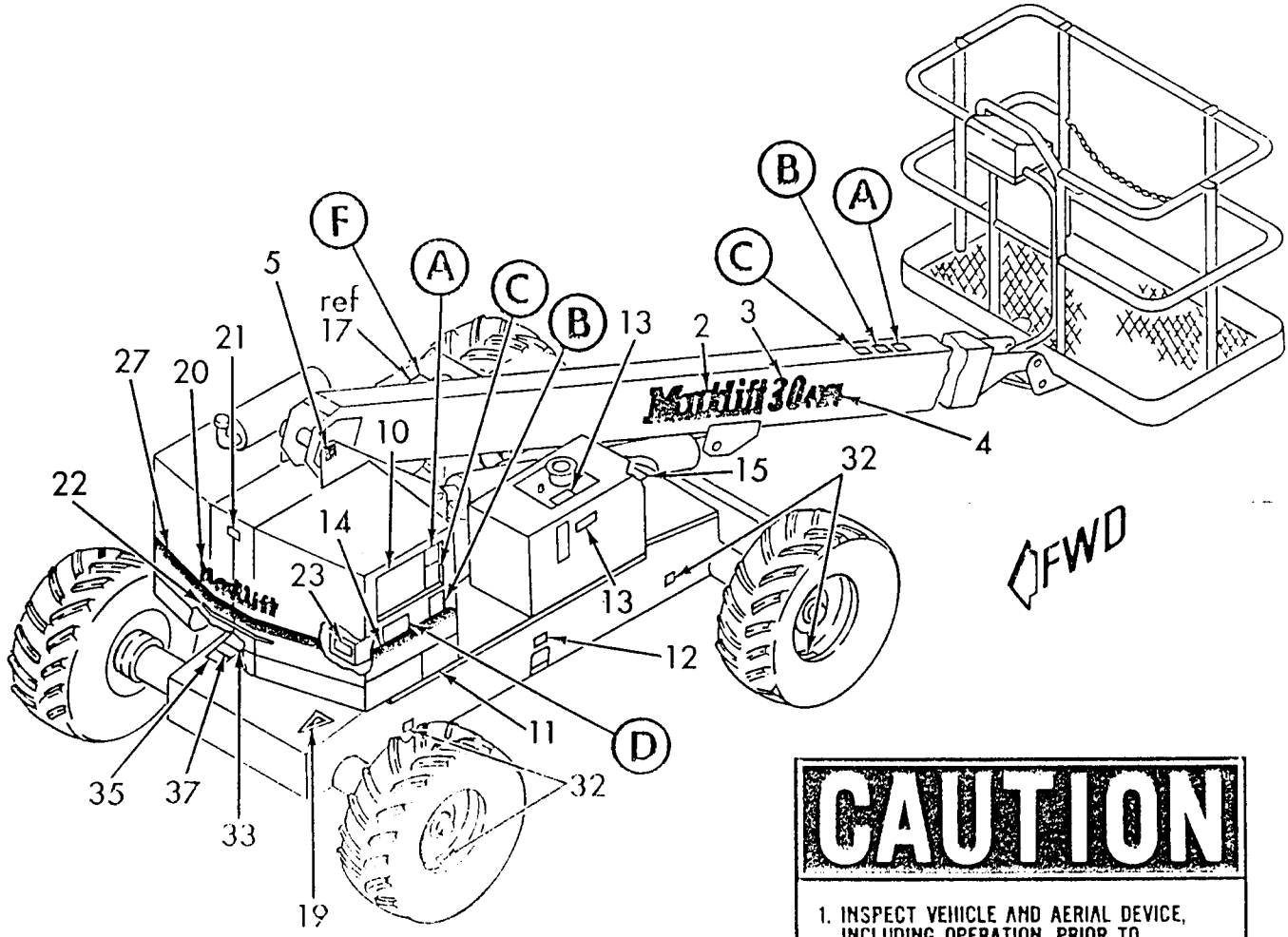
REV.

AERIAL CONTROL BOX ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23707	ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 2 for NHA)	REF
2	23702	.MACHINING, UPPER CONTROL PANEL	1
3	70343	..ENCLOSURE	1
4		..SCREW	4
5	4027	.BLOCK, TERMINAL	30
6	117-A	.END, TERMINAL BLOCK	2
7	61726	.SCREW, SELF TAPPING	4
8	20884	.GUARD, SWITCH	6
9	4017	.KIT, TOGGLE SWITCH	2
10	2806	.RELIEF, STRAIN	1
11	2808	.NUT, LOCK	1
12	16215	.RELIEF, STRAIN	1
13	16105	.NUT, LOCK	1
14	4011	.KIT, PUSH BUTTON SWITCH	1
15	20805	.KIT, ALARM BUZZER	1
16	70350	.KIT, AERIAL CONTROL STATION	1
17	20481	.KIT, TOGGLE SWITCH	5
18	70304	.KIT, TOGGLE SWITCH	1
19	62703	.SCREW, MACHINE	2
-20		.DIAGRAM, WIRING	REF

- ITEM NOT ILLUSTRATED

DECAL INSTALLATION (30 4 X 4)



CAUTION

1. INSPECT VEHICLE AND AERIAL DEVICE, INCLUDING OPERATION, PRIOR TO USE, DAILY.
2. FOR STATIONARY OPERATION VEHICLE MUST BE SECURELY PARKED AND STABILIZED FOR THE WORK TO BE PERFORMED BEFORE AERIAL DEVICE IS OPERATED.
3. OUTRIGGERS WHEN REQUIRED MUST BE ON SOLID FOOTING.
4. OPERATORS SHALL WEAR A BODY BELT, AND ATTACH WITH A LANYARD TO BOOM OR PLATFORM.
5. OPERATE ALL CONTROLS SLOWLY FOR SMOOTH PLATFORM MOTION.
6. DO NOT LOAD BEYOND RATED CAPACITY.

20416

6

(A)

(B)

7

REV.

DANGER

ELECTROCUTION HAZARD

THIS MACHINE IS NOT INSULATED

MAINTAIN SAFE CLEARANCES FROM ELECTRICAL POWER LINES AND APPARATUS, YOU MUST ALLOW FOR PLATFORM SWAY, ROCK, OR SAG

THIS AERIAL DEVICE DOES NOT PROVIDE PROTECTION FROM CONTACT WITH OR PROXIMITY TO AN ELECTRICALLY CHARGED CONDUCTOR.

DEATH OR SERIOUS INJURY WILL RESULT FROM SUCH CONTACT OR INADEQUATE CLEARANCE. 20418

8

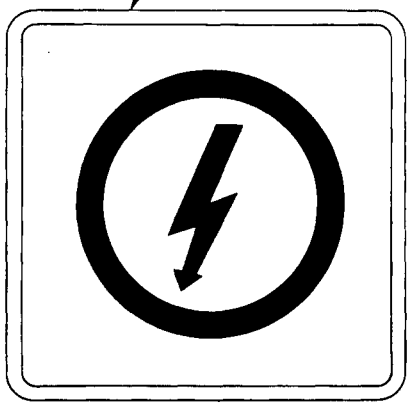
C

9

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



D

CAUTION

UNLAWFUL TO OPERATE THIS EQUIPMENT WITHIN 10 FEET OF HIGH VOLTAGE LINES UP TO 50,000 VOLTS
REFER TO OPERATING HANDBOOK FOR SAFE DISTANCE AT HIGHER VOLTAGES

CAUTION

STANDARD AERIAL OPERATING PROCEDURE

1. WITH MASTER SWITCH AT GROUND CONTROL STATION TO 'ON' AND SELECTOR SWITCH TO 'AERIAL' ENTER PLATFORM. ATTACH YOUR SAFETY BELT FIRST. THEN START MACHINE. (DO NOT DEPRESS FOOT SWITCH WHEN ATTEMPTING TO START MACHINE)
2. TOGGLE SWITCHES ARE SOLENOID FUNCTIONS AND ARE OPERATED BY DEPRESSING FOOT SWITCH FIRST.

OPERATE ALL PROPORTIONAL FUNCTIONS IN THE FOLLOWING MANNER

A. DEPRESS FOOT SWITCH AND LIFT CONTROLLER LOCKING STEM UPWARD, BEFORE ATTEMPTING TO MOVE HANDLE FORWARD OR BACK.
B. MOVE CONTROLLER HANDLE SLOWLY IN DIRECTION DESIRED. FUNCTION SPEED WILL RESPOND IN PROPORTION TO AMOUNT OF HANDLE MOVEMENT.

DRIVE AND STEERING DIRECTION, AS INDICATED ON CONTROLS, APPLIES WHEN BOOM IS OVER STEERING WHEELS. THE DIRECTION IS REVERSED, WHEN BOOM IS OVER NON-STEERING WHEELS. (FORWARD TRIANGLE DECALS, ON BASE, ALWAYS INDICATE DRIVE DIRECTION CORRECTLY)

3. THE DRIVE SELECTOR SWITCH, ALLOWS THE MARKLIFT TO TRAVEL AT HIGHER SPEEDS, WHEN THE BOOM IS BELOW HORIZONTAL AND FULLY RETRACTED.

EMERGENCY OVERRIDES

DEPRESS FOOT SWITCH, THEN TURN ON EMERGENCY PUMP TO RESTORE CONTROLS. (IF UNIT IS SO EQUIPPED) OR — DEPRESS PROPER SWITCH FOR EMERGENCY BOOM DESCENT OR RETRACTION.

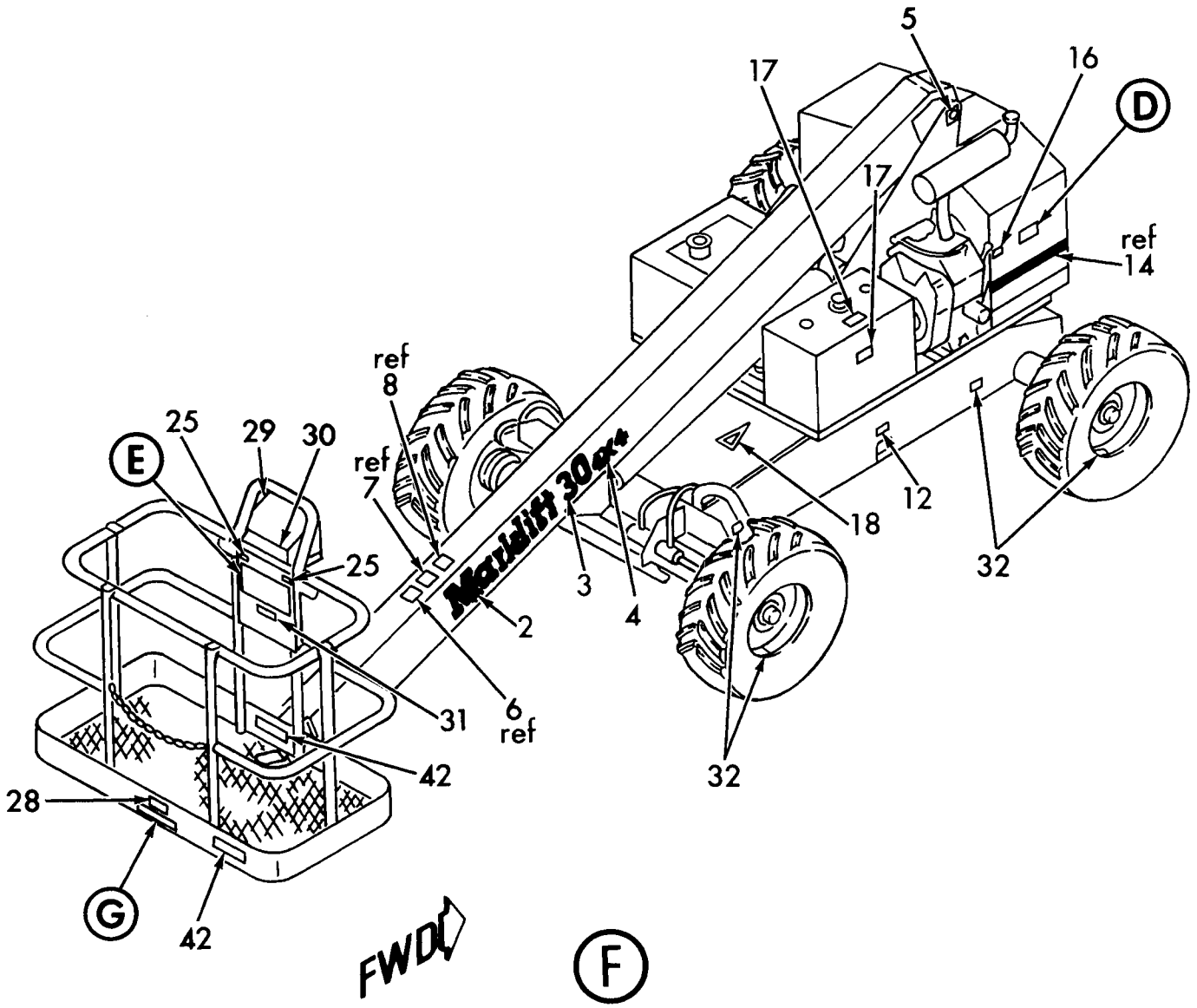
IT IS THE OPERATOR'S RESPONSIBILITY TO READ AND UNDERSTAND, THE OPERATION & SAFETY HANDBOOK AND ALL DECALS BEFORE USING THIS MACHINE!

MARK INDUSTRIES

20859

E

24



ATTACH YOUR SAFETY BELT FIRST!

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

22385

26

G

DECAL INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	67031	KIT, DECAL (See Sect. 2, Fig. 1 for NHA)	REF
2	20408	.DECAL, **"MARKLIFT"**	2
3	20871	.DECAL, 30 EBII	2
4	22740 ?	.DECAL, ~~4 X 4~~	2
5	21237	.DECAL, GREASE FITTING	2
6	20416	.DECAL, CAUTION	2
7	~~20417~~ 18102	.DECAL, DANGER DO NOT OPERATE	2
8	20418 18103	.DECAL, DANGER ElecTrocuTion	2
9	20419	.DECAL, DANGER Keep Clear	2
10	23721	.DECAL, GROUND CONTROL CONSOLE	1
11	20860	.DECAL, GENERAL CHECKOUT AND OPERATION INSTRUCTIONS	1
12	20508	.DECAL, FACTORY RECOMMENDED TIE DOWN TRANSPORTING DIAGRAM	2
13	2017	.DECAL, THE HYDRAULIC SYSTEM OF THIS MACHINE IS DESIGNED TO USE G.M. TRANSMISSION FLUID TYPE "B" WITH DEXTRON	2
14	20412	.DECAL, ROUND END STRIPE	1
15	20896	.DECAL, OPEN FOR FASTER BRAKING	1
16	20879	.DECAL, DIP STICK	1
17	2020	.DECAL, GASOLINE OR PETROL	1
18	20461	.DECAL, FORWARD ARROW	1
19	20462	.DECAL, AFT FORWARD ARROW	1
20	20409	.DECAL, **"MARKLIFT"** PEDESTAL	1
21	20410	.DECAL, **"MARK INDUSTRIES"** LOGO	1
22	~~23195~~	.DECAL, **"A PRODUCT OF MARK INDUSTRIES"**	1

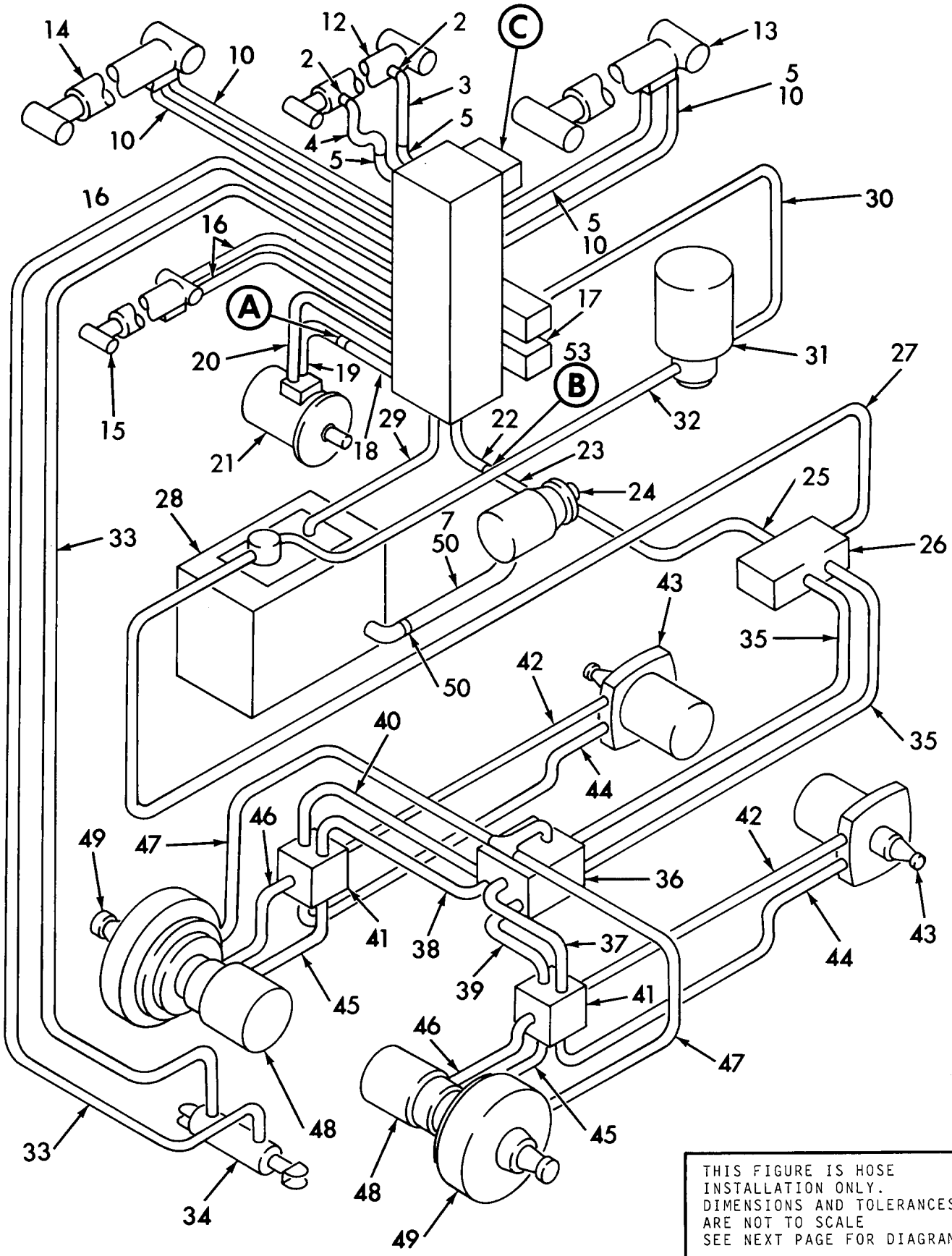
- ITEM NOT ILLUSTRATED

DECAL INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	2003	.DECAL, IMPORTANT - CHECK BATTERY WATER LEVEL AT LEAST ONCE A WEEK	1
24	20859	.DECAL, CAUTION	1
25	22386	.DECAL, ATTACH SAFETY BELT	2
26	22385	.DECAL, CAUTION	1
27	20411	.DECAL, SQUARE ENDS STRIPE	1
28	2022	.DECAL, LOAD CAPACITY 500 LBS (EVENLY DISTRIBUTED LOAD)	1
29	23665	.DECAL, BOOM AERIAL CONTROL CONSOLE	1
30	23666	.DECAL, BOOM AERIAL CONTROL SWITCHES	1
31	130820	.DECAL, OPERATION AND SAFETY HANDBOOK	1
32	22959	.DECAL, TIRE PRESSURE 50 PSI	8
33	20660	.PLATE, IDENTIFICATION	1
-34	63653	.RIVET, POP (attaching part)	4
35	20661	.PLATE, THIS MACHINE HAS BEEN CONSTRUCTED IN ACCORDANCE WITH APPLICABLE PORTION OF ANSI A92	1
-36	63653	.RIVET, POP (attaching part)	4
37	20662	.PLATE, PATENT NUMBER	1
-38	63653	.RIVET, POP (attaching part)	4
-39	16608	.PAINT, WATER BASE WHITE	AR
-40	16609	.PAINT, WATER BASE BLUE	AR
-41	65112	.PAINT, CARBOLINE TANK WHITE	AR
42	11064	.DECAL, ATTACH SAFETY CHAINS BEFORE RAISING PLATFORM	2

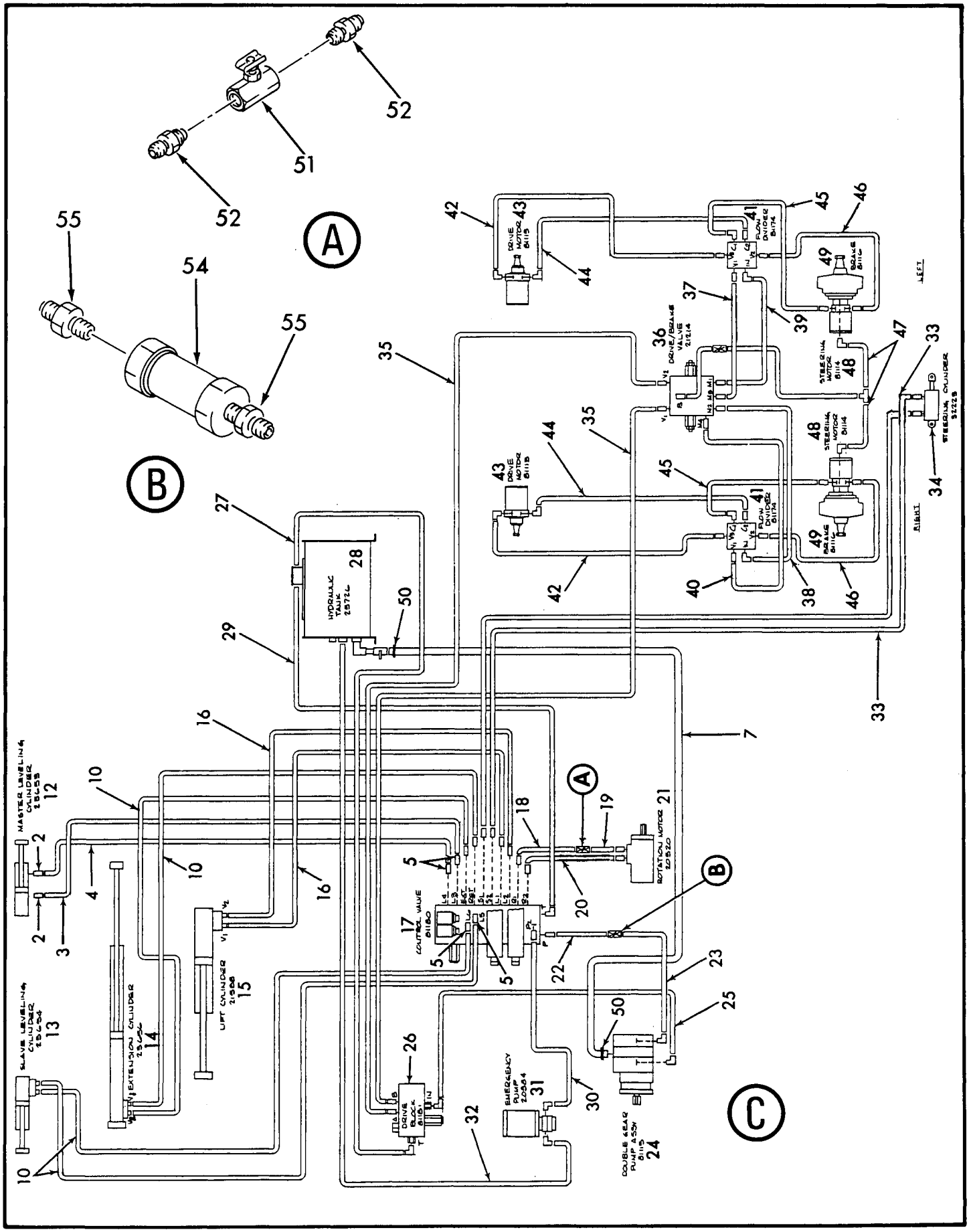
- ITEM NOT ILLUSTRATED

HYDRAULIC HOSE INSTALLATION (30 4 X 4)



THIS FIGURE IS HOSE INSTALLATION ONLY.
DIMENSIONS AND TOLERANCES ARE NOT TO SCALE
SEE NEXT PAGE FOR DIAGRAM

HYDRAULIC HOSE INSTALLATION (30 4 X 4)
(CONTINUED)



HYDRAULIC HOSE INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	20046	ASSEMBLY, FINAL (See Sect. 2, Fig. 1 for NHA)	REF
2	2562	.FITTING, STRAIGHT SWIVEL HOSE	2
3	2568-0250	.HOSE, HYDRAULIC	1
4	2568-0430	.HOSE, HYDRAULIC	1
5	2594	.ELBOW, SWIVEL	4
6	81188	..HOSE, SUCTION	1
-8	23660	.ASSEMBLY, FINAL BOOM (See Sect. 5, Fig. 1 for Details)	REF
-9	23661	..ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 2 for Details)	REF
10	2568-0732	...HOSE, HYDRAULIC	4
-11	23745	.INSTALLATION, HYDRAULIC HOSE	1
12	23653	..CYLINDER, MASTER LEVELING	REF
13	23654	..CYLINDER, SLAVE LEVELING	REF
14	23656	..CYLINDER, EXTENSION	REF
15	21588	..CYLINDER, LIFT	REF
16	13211-06-0800	..ASSEMBLY, HOSE	2
17	81180	..VALVE, CONTROL	REF
18	13210-06-0280	..ASSEMBLY, HOSE	1
19	13213-06-0280	..ASSEMBLY, HOSE	1
20	13210-06-0530	..ASSEMBLY, HOSE	1
21	20520	..MOTOR, ROTATION	REF
22	13213-08-0100	..ASSEMBLY, HOSE	1
23	13213-08-0064	..ASSEMBLY, HOSE	1
24	81185	..ASSEMBLY, DOUBLE GEAR PUMP	REF

- ITEM NOT ILLUSTRATED

HYDRAULIC HOSE INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	13212-10-0370	..ASSEMBLY, HOSE	1
26	81181	..BLOCK, DRIVE	REF
27	13210-10-0870	..ASSEMBLY, HOSE	1
28	23726	..TANK, HYDRAULIC	REF
29	13210-12-0750	..ASSEMBLY, HOSE	1
30	13213-08-0280	..ASSEMBLY, HOSE	1
31	20384	..PUMP, EMERGENCY	REF
32	13213-08-0750	..ASSEMBLY, HOSE	1
33	13211-04-1720	..ASSEMBLY, HOSE	2
34	32223	..CYLINDER, STEERING	REF
35	13213-10-1510	..ASSEMBLY, HOSE	2
36	21214	..VALVE, DRIVE AND BRAKE	REF
37	13214-10-0180	..ASSEMBLY, HOSE 90°	1
38	13214-10-0180	..ASSEMBLY, HOSE 180°	1
39	13214-10-0150	..ASSEMBLY, HOSE	2
40	13210-10-0120	..ASSEMBLY, HOSE	1
41	81174	..DIVIDER, FLOW	REF
42	13213-08-0900	..ASSEMBLY, HOSE	2
43	81113	..MOTOR, DRIVE	REF
44	13210-08-0880	..ASSEMBLY, HOSE	2
45	13213-08-0430	..ASSEMBLY, HOSE	2
46	13213-08-0390	..ASSEMBLY, HOSE	2
47	13213-04-0500	..ASSEMBLY, HOSE	2
48	81114	..MOTOR, STEERING	REF
49	81116	..ASSEMBLY, BRAKE	REF

- ITEM NOT ILLUSTRATED

HYDRAULIC HOSE INSTALLATION (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
50	55	.CLAMP, HOSE	2
51	20357	.VALVE, NEEDLE	1
52	80001-08	.CONNECTOR, MALE	2
53	23743	.ASSEMBLY, CHECK VALVE IN-LINE	1
54	81189	..VALVE, CHECK	1
55	80001-14	..CONNECTOR, MALE	1

- ITEM NOT ILLUSTRATED

THIS SECTION 3 IS ILLUSTRATED AS

FIGURE 1 CARRIAGE ASSEMBLY

FIGURE 2 TIE ROD ASSEMBLY

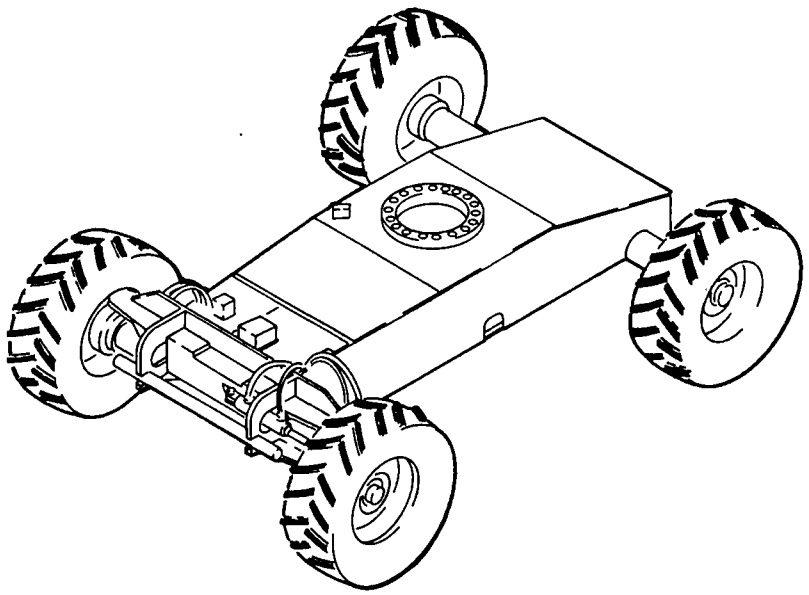
FIGURE 3 STEERING CYLINDER ASSEMBLY

FIGURE 4 MOTOR BRAKE ASSEMBLY

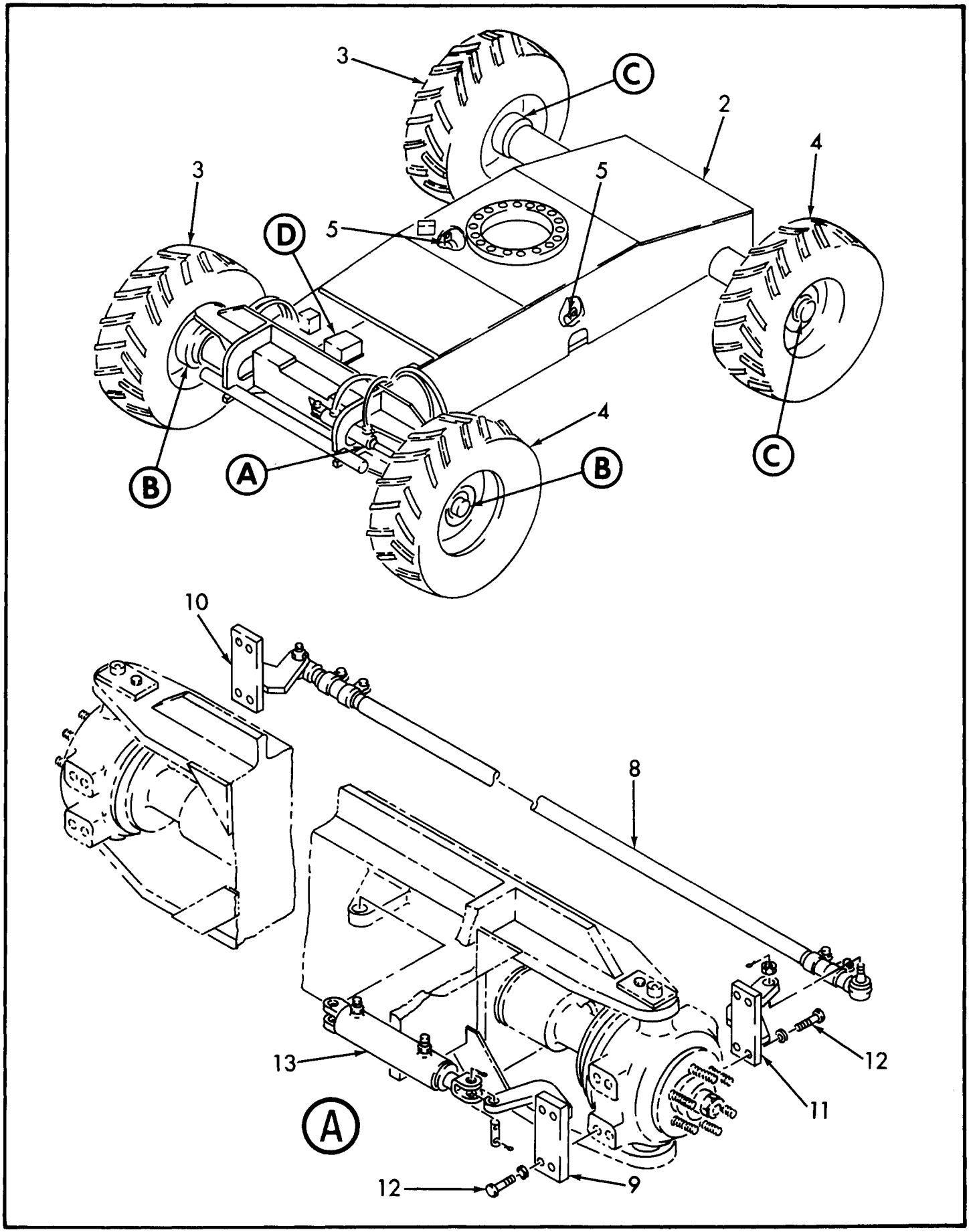
FIGURE 5 DRIVE MOTOR ASSEMBLY

FIGURE 6 FLOW DIVIDER ASSEMBLY

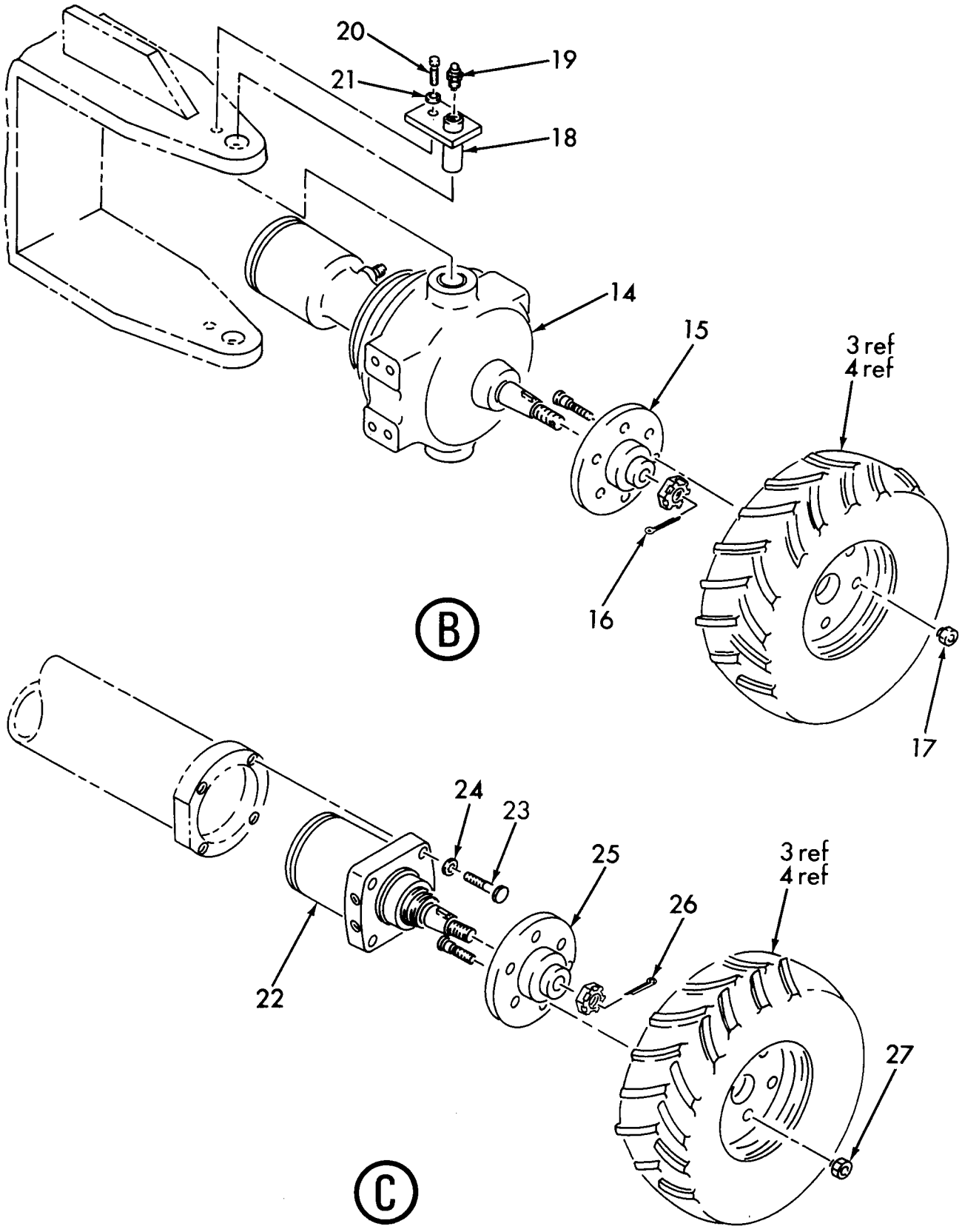
FIGURE 7 DRIVE BRAKE VALVE ASSEMBLY

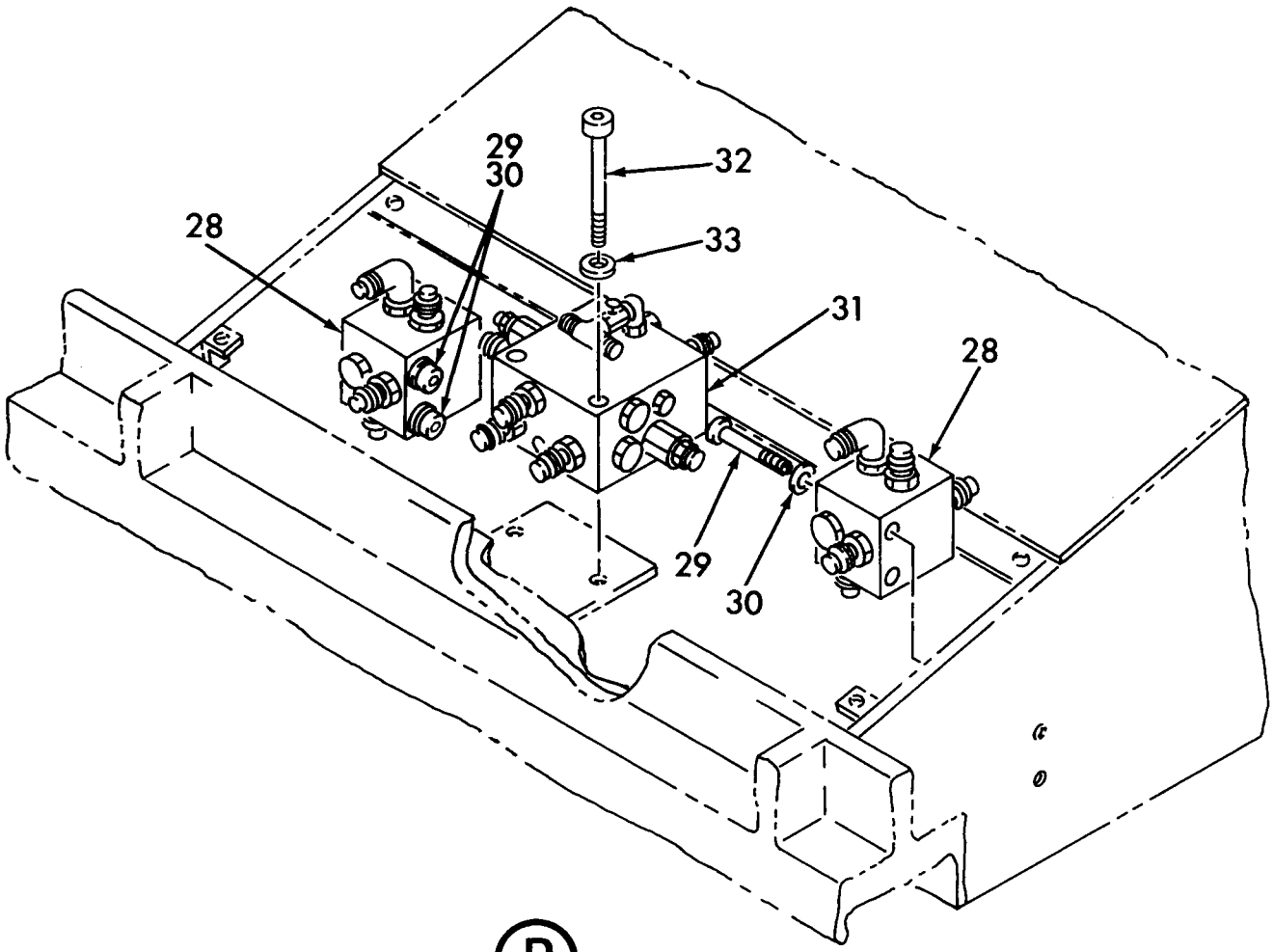


CARRIAGE ASSEMBLY (30 4 X 4)



CARRIAGE ASSEMBLY (30 4 X 4) (CONTINUED)




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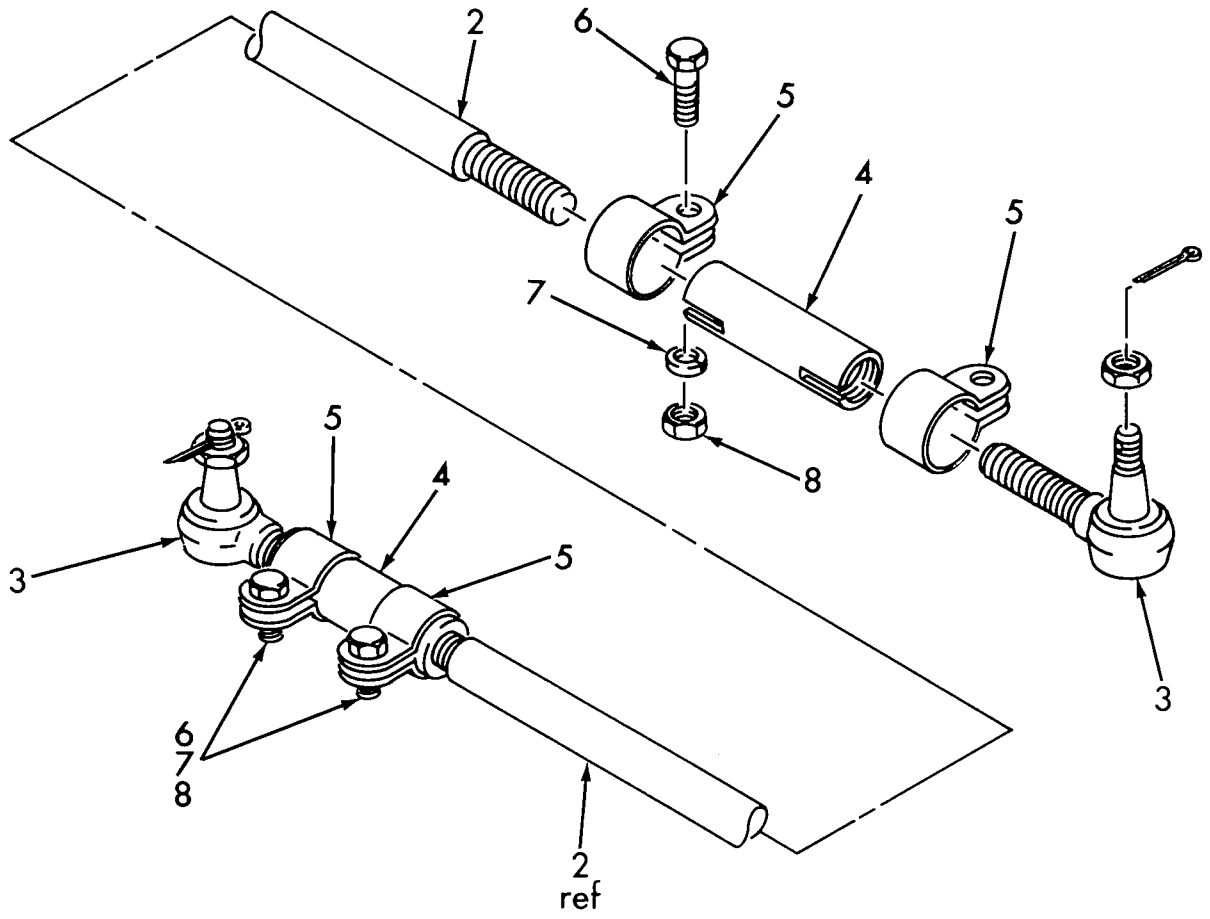
CARRIAGE ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23667	ASSEMBLY, CARRIAGE (See Sect. 1, Fig. 1 for NHA)	REF
2	23668	.WELDMENT, CARRIAGE	1
3	32166	.ASSEMBLY, TIRE & WHEEL (L.H.)	2
4	32259	.ASSEMBLY, TIRE & WHEEL (R.H.)	2
5	65867	.CLAMP	2
-6	60353	.SCREW, CAP (attaching part)	2
-7	63302	.WASHER, LOCK (attaching part)	2
8	32213	.ASSEMBLY, TIE ROD (See Sect. 3, Fig. 2 for Details)	1
9	32222	.BRACKET, STEERING CYLINDER	1
10	32170	.ARM, STEERING (R.H.)	1
11	32194	.ARM, STEERING (L.H.)	1
12	60370	.SCREW, CAP (attaching part)	12
13	32246	.ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 3 for Details)	1
14	23768	.ASSEMBLY, MOTOR BRAKE (See Sect. 3, Fig. 4 for Details)	2
15	32167	.HUB, DRIVE	2
16	64310	.PIN, COTTER	2
17	61316	.NUT, WHEEL	12
18	32243	.WELDMENT, KING PIN	4
19	65103	.GREASE FITTING	4
20	60322	.SCREW, CAP (attaching part)	4
21	63302	.WASHER, LOCK (attaching part)	4
22	32272	.ASSEMBLY, DRIVE MOTOR (REAR) (See Sect. 3, Fig. 5 for Details)	2
23	60512	.SCREW, CAP	8
24	63305	.WASHER, LOCK	8

- ITEM NOT ILLUSTRATED

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	32167	.HUB, DRIVE	2
26	64310	.PIN, COTTER	2
27	61316	.NUT, WHEEL	12
28	23698	.ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 6 for Details)	2
29	60377	.SCREW, CAP (attaching part)	4
30	63301	.WASHER, LOCK (attaching part)	4
31	23756	.ASSEMBLY, DRIVE BRAKE VALVE (See Sect. 3, Fig. 7 for Details)	1
32	60362	.SCREW, CAP (attaching part)	2
33	63302	.WASHER, LOCK (attaching part)	2

TIE ROD ASSEMBLY (30 4 X 4)

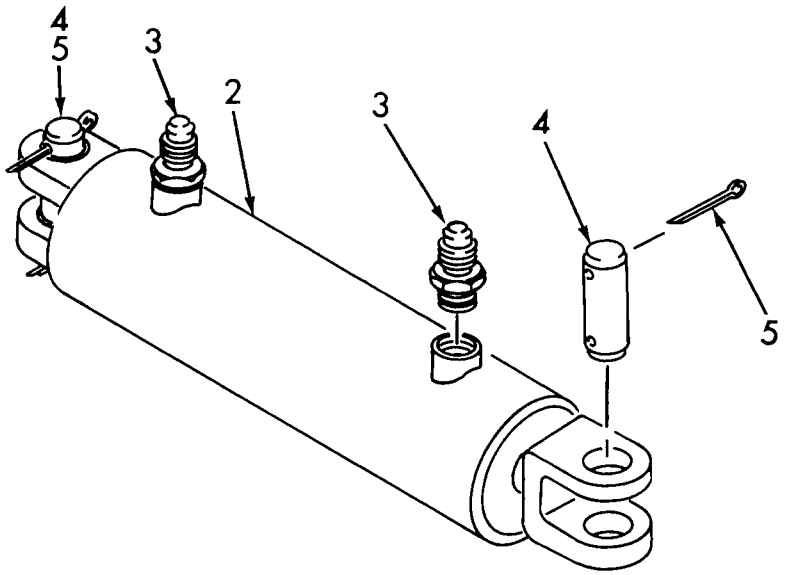


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	32213	ASSEMBLY, TIE ROD (See Sect. 3, Fig. 1 for NHA)	REF
2	32158	.TIE ROD	1
3	66037	.TIE ROD END (L.H.)	2
4	32212	.TURN BUCKLE	2
5	66239	.CLAMP	4
6	60415	.SCREW, CAP (attaching part)	4
7	63303	.WASHER, LOCK (attaching part)	4
8	60803	.NUT, HEX (attaching part)	4

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- ITEM NOT ILLUSTRATED

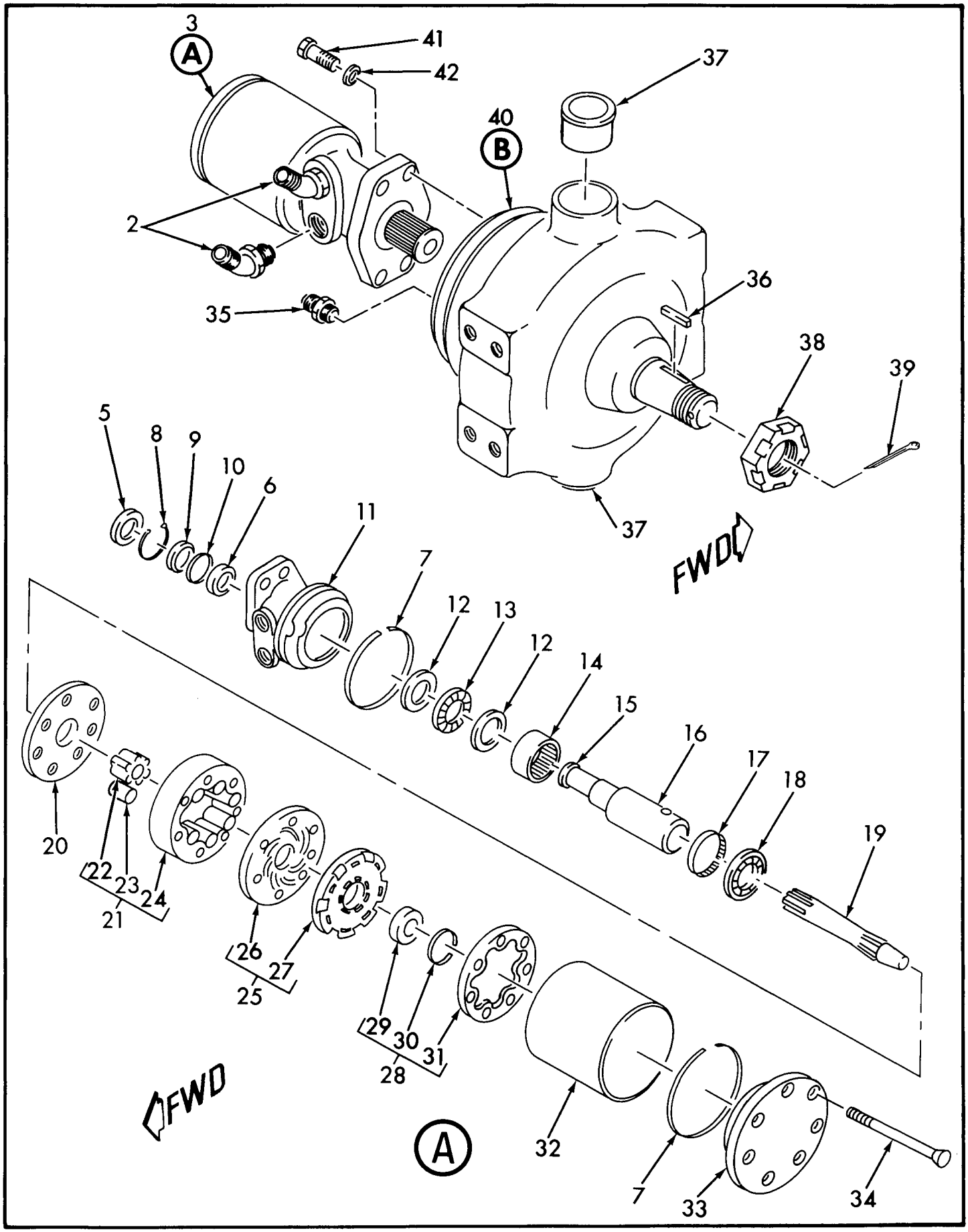
STEERING CYLINDER ASSEMBLY (30 4 X 4)

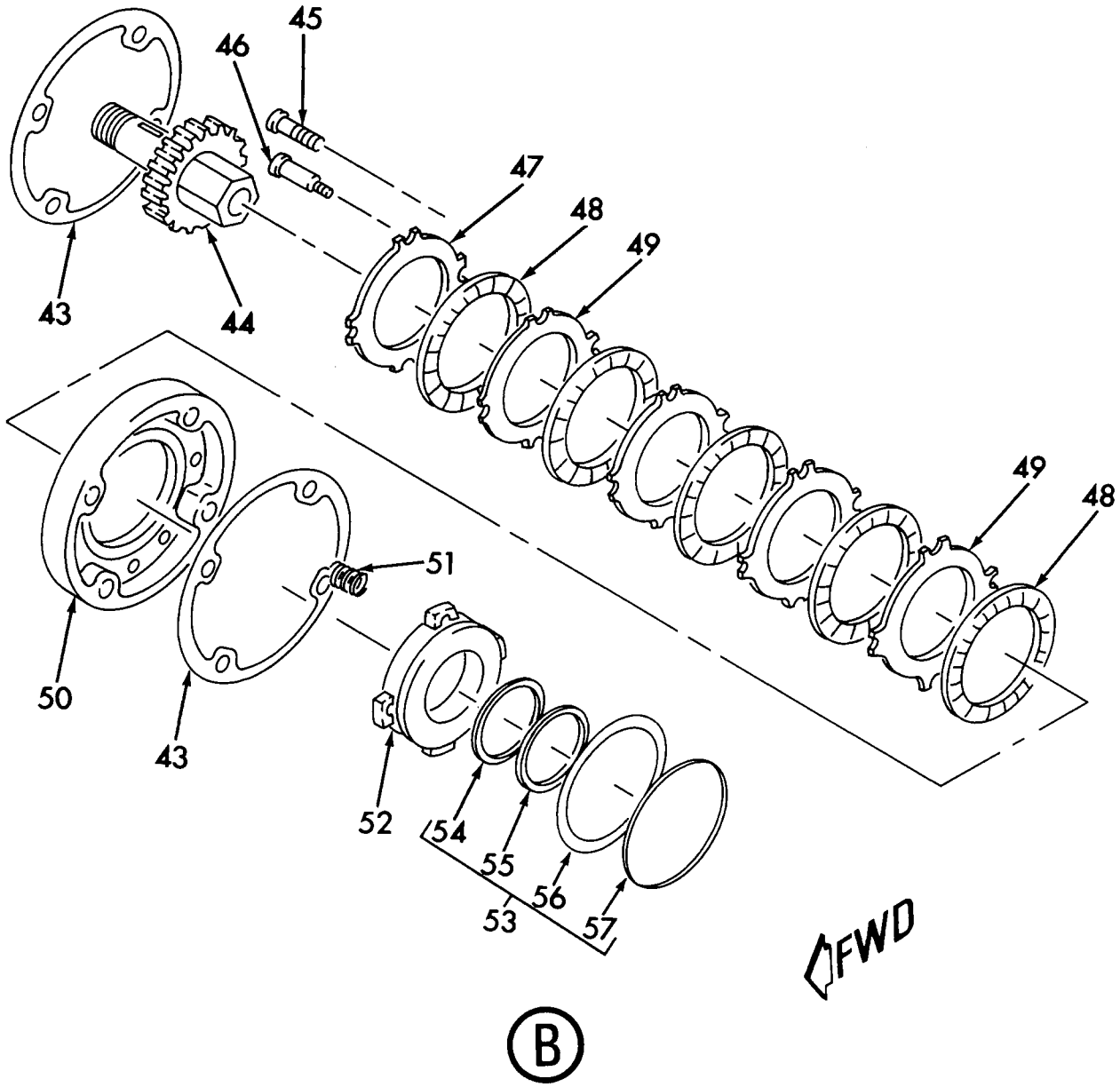


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	32246	ASSEMBLY, STEERING CYLINDER (See Sect. 3, Fig. 1 for NHA)	REF
2	32223	.CYLINDER, STEERING	1
3	80004-03	.CONNECTOR, STRAIGHT THREAD	2
4		.PIN	2
5		.PIN, COTTER	4

- ITEM NOT ILLUSTRATED

MOTOR BRAKE ASSEMBLY (30 4 X 4)




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MOTOR BRAKE ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23768	ASSEMBLY, MOTOR-BRAKE (See Sect. 3, Fig. 1 for NHA)	REF
2	80018-13	.CONNECTOR, STRAIGHT THREAD	2
3	81114	.ASSEMBLY, DRIVE MOTOR	1
-4	3036-A	..KIT, SEAL	1
5		...SEAL	1
6		...SEAL	1
7		...RING, SEAL	2
8		..RING, RETAINER	1
9		..WASHER, BACK-UP	1
10		..WASHER	1
11		..HOUSING	1
12		..WASHER, THRUST	2
13		..BEARING, THRUST	1
14		..BEARING	1
15		..WASHER	1
16		..SHAFT, COUPLING	1
17		..BEARING	1
18		..BEARING, THRUST	1
19		..LINK, DRIVE	1
20		..PLATE, WEAR	1
21		..SET, ROTOR	1
22		...ROTOR	1
23		...VALVE	7
24		...STATOR	1
25		..SET, MANIFOLD (FOR MAB TORQMOTORS)	1

- ITEM NOT ILLUSTRATED

MOTOR BRAKE ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26		...PLATE, MANIFOLD	1
27		...MANIFOLD	1
28		..SET, COMMUTATOR	1
29		...COMMUTATOR	1
30		...RING, SEAL	1
31		...RING, COMMUTATOR	1
32		..SLEEVE	1
33		..ASSEMBLY, END COVER	1
34		..BOLT, SPECIAL	7
35	80004-03	.CONNECTOR, STRAIGHT THREAD	1
36	67037	.KEY, WOODRUFF	1
37	67036	.BUSHING	2
38	67035	.NUT	1
39	64310	.PIN, COTTER	1
40	81116	.ASSEMBLY, BRAKE	1
41	60529	.SCREW, CAP (attaching part)	4
42	63305	.WASHER, LOCK (attaching part)	4
43		..GASKET, CASE	2
44	67034	..ASSEMBLY, SPLINE SHAFT	1
45		..SCREWS, SOCKET HEAD CAP (ASSEMBLY BOLTS)	4
46		..BOLTS, SOCKET HEAD SHOULDER (TENSION PINS)	4
47		..DISC, PRIMARY	1
48		..DISCS, ROTOR	5
49		..DISCS, STATOR	4
50		..PLATE, SPRING	1
51		..SPRINGS	8

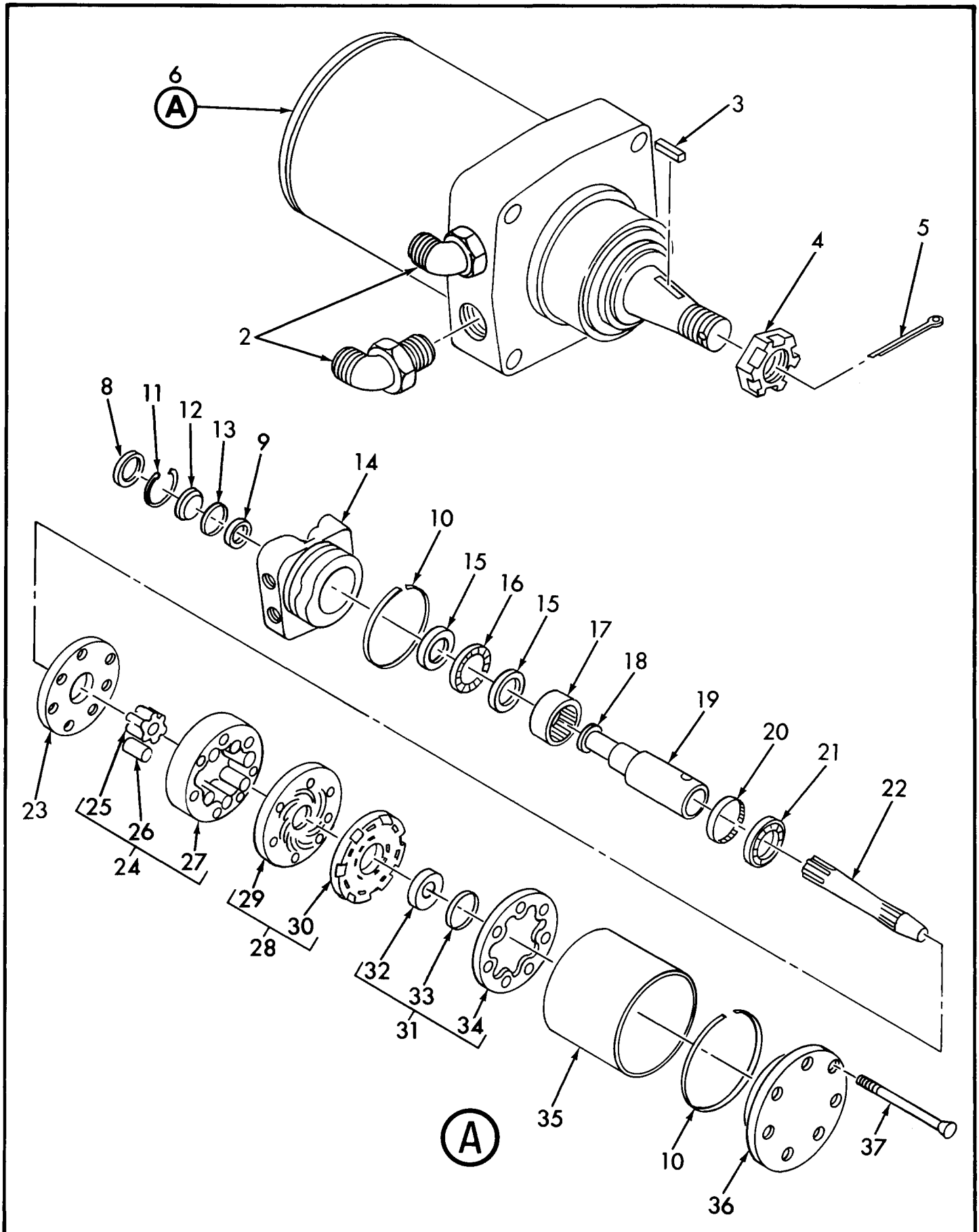
- ITEM NOT ILLUSTRATED

MOTOR BRAKE ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
52		..PISTON	1
53	66971	..KIT, SEAL	1
54		...RING, BACK-UP	1
55		...O-RING	1
56		...RING, BACK-UP	1
57		...O-RING	1

- ITEM NOT ILLUSTRATED

DRIVE MOTOR ASSEMBLY (30 4 X 4)



DRIVE MOTOR ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	32272	ASSEMBLY, DRIVE MOTOR (See Sect. 3, Fig. 1 for NHA)	REF
2	80012-13	.ELBOW, STRAIGHT THREAD	2
3		.KEY, WOODRUFF	1
4		.NUT	1
5		.PIN, COTTER	1
6	81113	.ASSEMBLY, DRIVE MOTOR (REAR)	1
-7	66162	..KIT, SEAL	1
8		...SEAL	
9		...SEAL	1
10		...RING, SEAL	2
11		...RING, RETAINING	1
12		..WASHER, BACK-UP	1
13		..WASHER	
14		..HOUSING	1
15		..WASHER, THRUST	2
16		..BEARING, THRUST	1
17		..BEARING	1
18		..WASHER	1
19		..SHAFT, COUPLING	1
20		..BEARING	1
21		..BEARING, THRUST	1
22		..LINK, DRIVE	1
23		..PLATE, WEAR	1
24		..SET, ROTOR	1
25		...ROTOR	1
26		...VANE	7

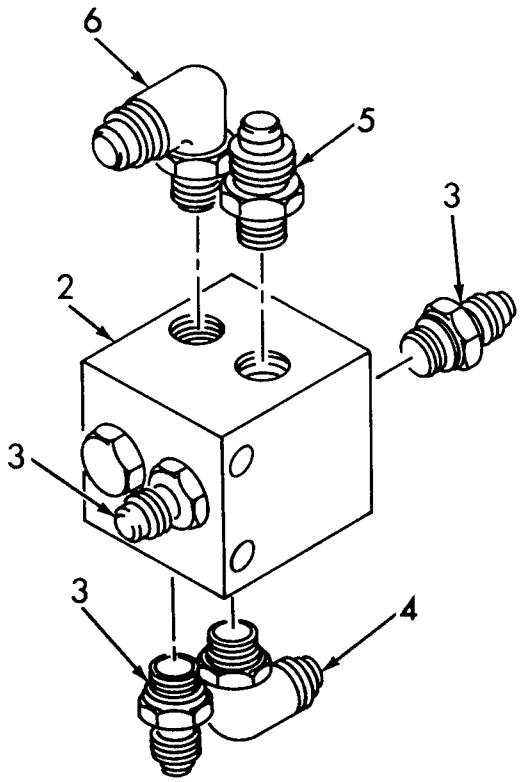
- ITEM NOT ILLUSTRATED

DRIVE MOTOR ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27		...STATOR	1
28		..SET, MANIFOLD	1
29		...PLATE,MANIFOLD	1
30		...MANIFOLD	1
31		..SET, COMMUTATOR	1
32		...COMMUTATOR	1
33		...RING, SEAL	1
34		...RING, COMMUTATOR	1
35		..SLEEVE	1
36		..ASSEMBLY, END COVER	1
37		..BOLT, SPECIAL	7

- ITEM NOT ILLUSTRATED

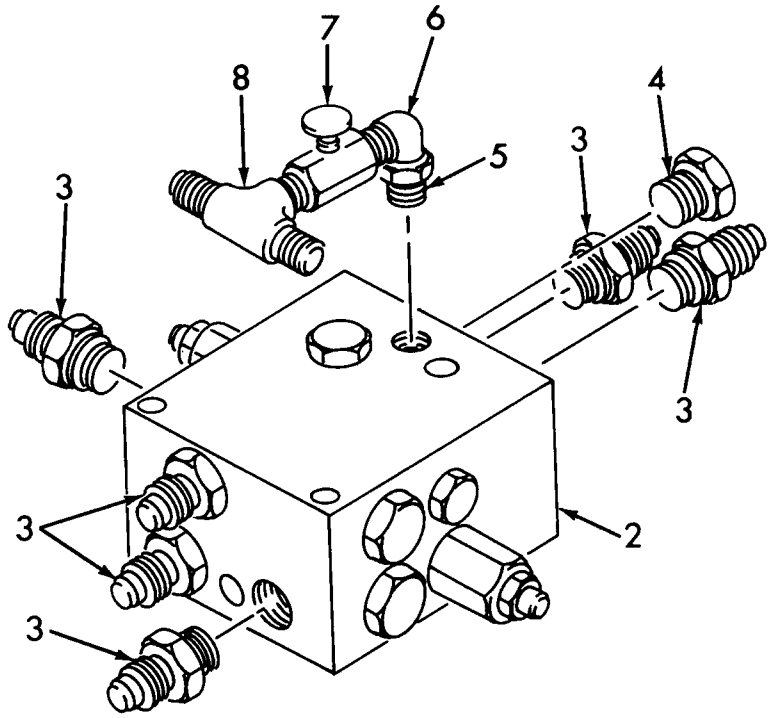
FLOW DIVIDER ASSEMBLY (30 4 X 4)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23698	ASSEMBLY, FLOW DIVIDER (See Sect. 3, Fig. 1 for NHA)	REF
2	81174	.VALVE, FLOW DIVIDER	1
3	80004-11	.CONNECTOR, STRAIGHT THREAD	3
4	80012-11	.ELBOW STRAIGHT THREAD	1
5	80004-15	.CONNECTOR, STRAIGHT THREAD	1
6	80012-15	.ELBOW, STRAIGHT THREAD	1

- ITEM NOT ILLUSTRATED

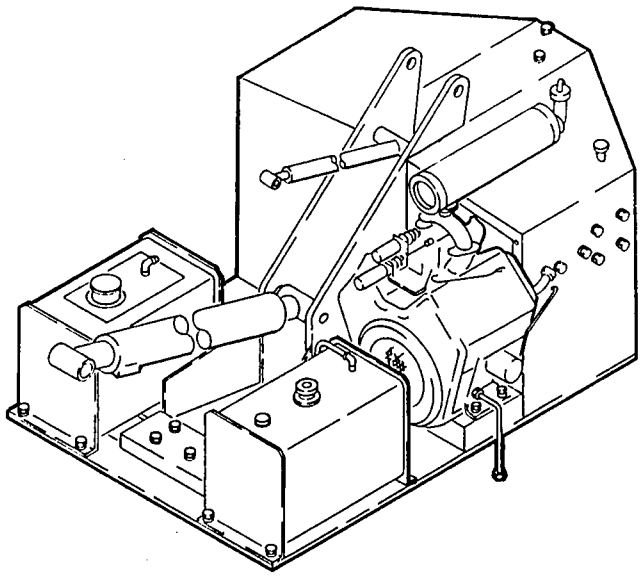
DRIVE/BRAKE VALVE ASSEMBLY (30 4 X 4)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23756	ASSEMBLY, DRIVE BRAKE VALVE (See Sect. 3, Fig. 1 for NHA)	REF
2	21214	.VALVE, DRIVE-BRAKE	1
3	80004-16	.CONNECTOR, STRAIGHT THREAD	6
4	80050-05	.PLUG, HEX HEAD STRAIGHT THREAD	1
5	80052-04	.NIPPLE, PIPE	1
6	80021-03	.ELBOW, STREET	1
7	20357	.VALVE, NEEDLE	1
8	80034-04	.TEE, MALE BRANCH	1

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- ITEM NOT ILLUSTRATED



THIS SECTION 4 IS ILLUSTRATED AS

FIGURE 1 TURRET ASSEMBLY

FIGURE 2 ENGINE AND PUMP ASSEMBLY

FIGURE 3 FUEL TANK ASSEMBLY

FIGURE 4 HYDRAULIC TANK ASSEMBLY

FIGURE 5 MASTER LEVELING CYLINDER ASSEMBLY

FIGURE 6 LIFT CYLINDER ASSEMBLY

FIGURE 7 ROTATION GEAR BOX ASSEMBLY

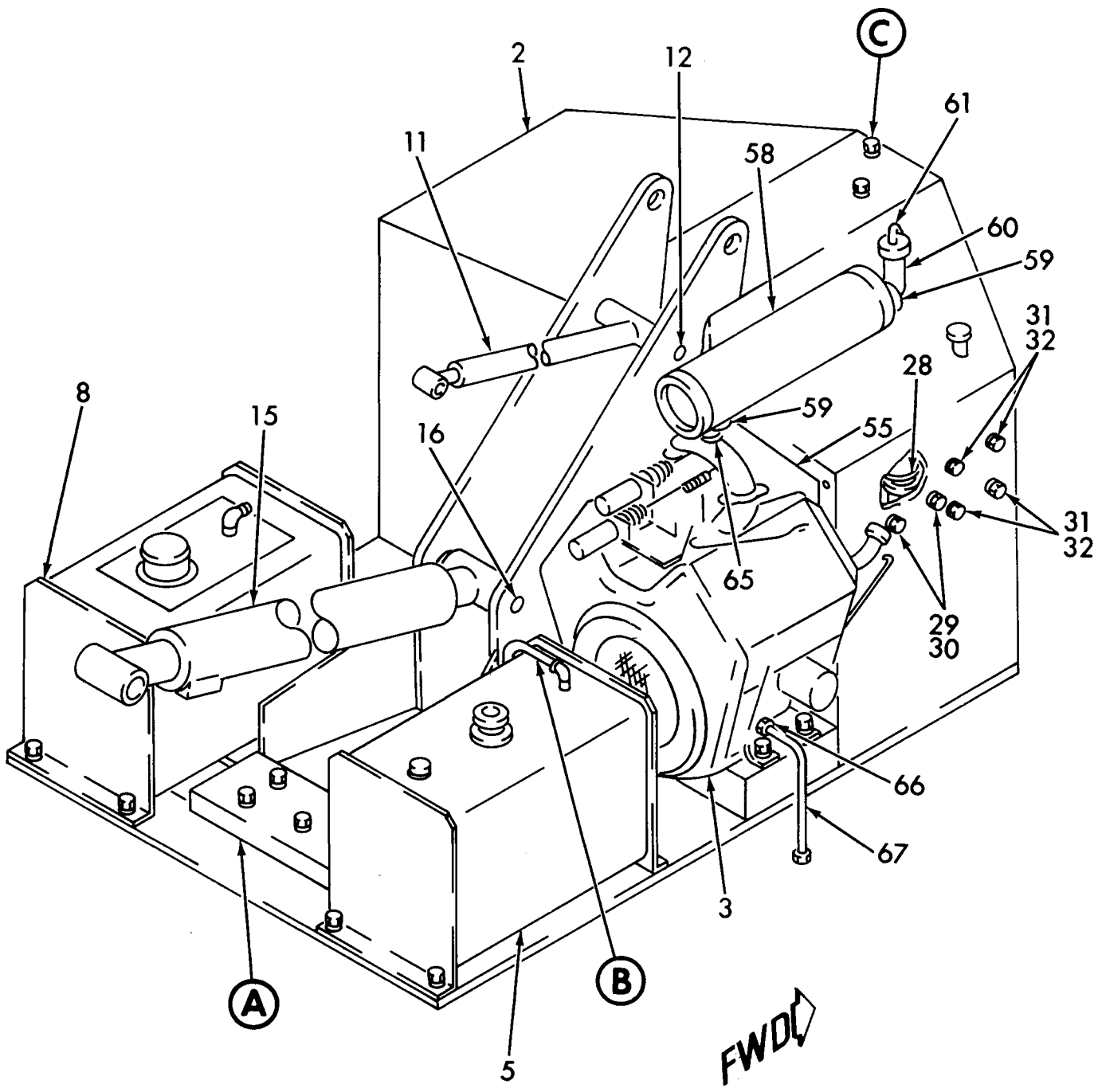
FIGURE 8 EMERGENCY PUMP AND MOTOR ASSEMBLY

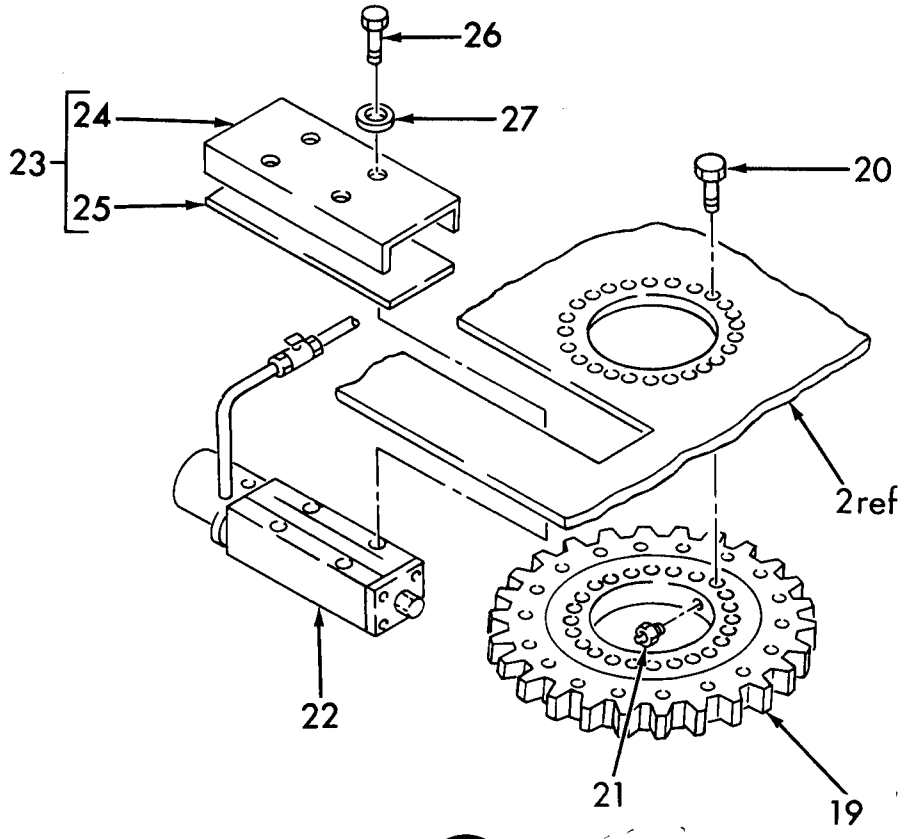
FIGURE 9 DRIVE BLOCK ASSEMBLY

FIGURE 10 LOWER CONTROL PANEL ASSEMBLY

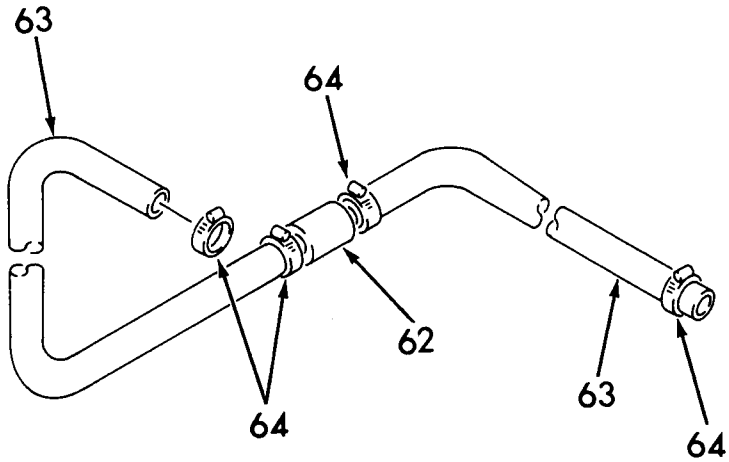
FIGURE 11 CONTROL VALVE ASSEMBLY

TURRET ASSEMBLY (30 4 X 4)

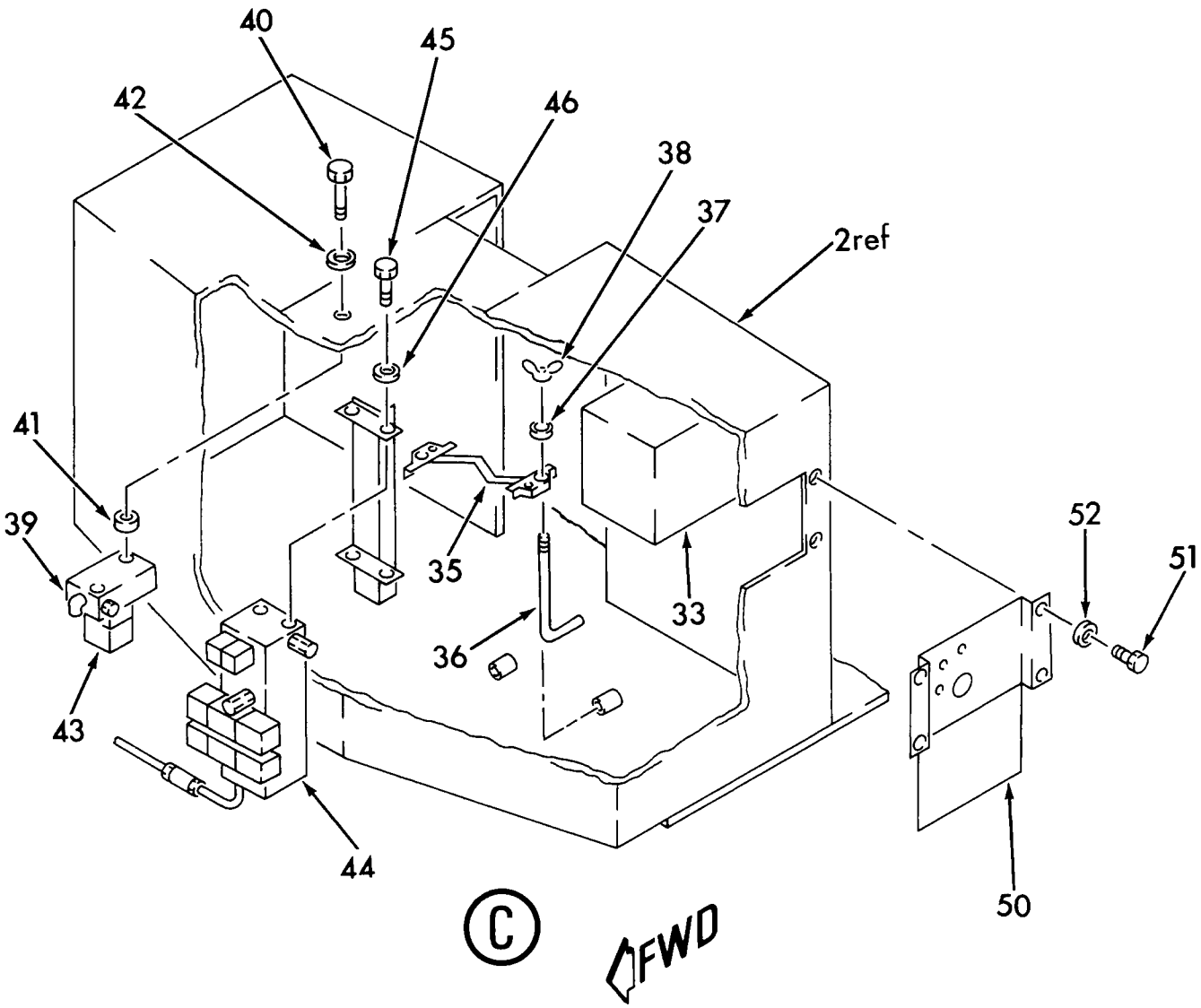




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TURRET ASSEMBLY (30 4 X 4) (CONTINUED)

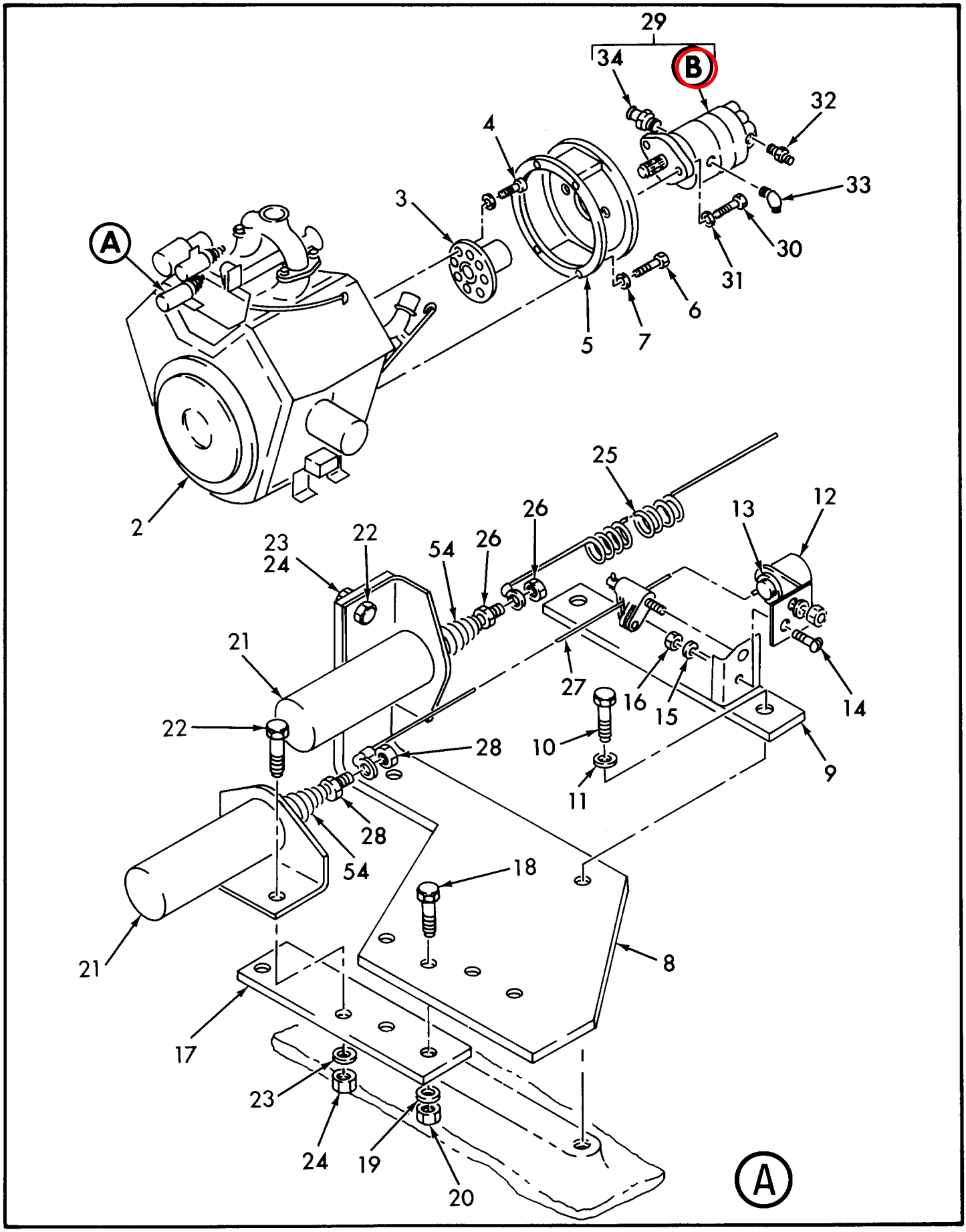
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23689	ASSEMBLY, TURRET (See Sect. 2, Fig. 1 for NHA)	REF
2	23681	.WELDMENT, TURRET	1
3	23739	.ASSEMBLY, ENGINE AND PUMP (See Sect. 4, Fig. 2 for Details)	1
-4	60610	.SCREW, CAP (attaching part)	4
5	23734	.ASSEMBLY, FUEL TANK (See Sect. 4, Fig 3 for Details)	1
-6	60395	.SCREW, CAP (attaching part)	4
-7	63319	.WASHER, LOCK (attaching part)	4
8	23731	.ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 4 for Details)	1
-9	60395	.SCREW, CAP (attaching part)	4
-10	63319	.WASHER, LOCK (attaching part)	4
11	23664	.ASSEMBLY, MASTER LEVELING CYLINDER (See Sect. 4, Fig. 5 for Details)	1
12	23686	.PIN	1
-13	60542	.SCREW, CAP (attaching part)	1
-14	63303	.WASHER, LOCK (attaching part)	1
15	23787	.ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 6 for Details)	1
16	23684	.PIN	1
-17	60542	.SCREW, CAP (attaching part)	1
-18	63303	.WASHER, LOCK (attaching part)	1
19	23722	.GEAR, RING	1
20	60347	..SCREW, CAP (attaching part)	24
21	65103	.FITTING, GREASE	2
22	23694	.ASSEMBLY, ROTATION GEAR BOX (See Sect. 4, Fig. 7 for Details)	1

- ITEM NOT ILLUSTRATED

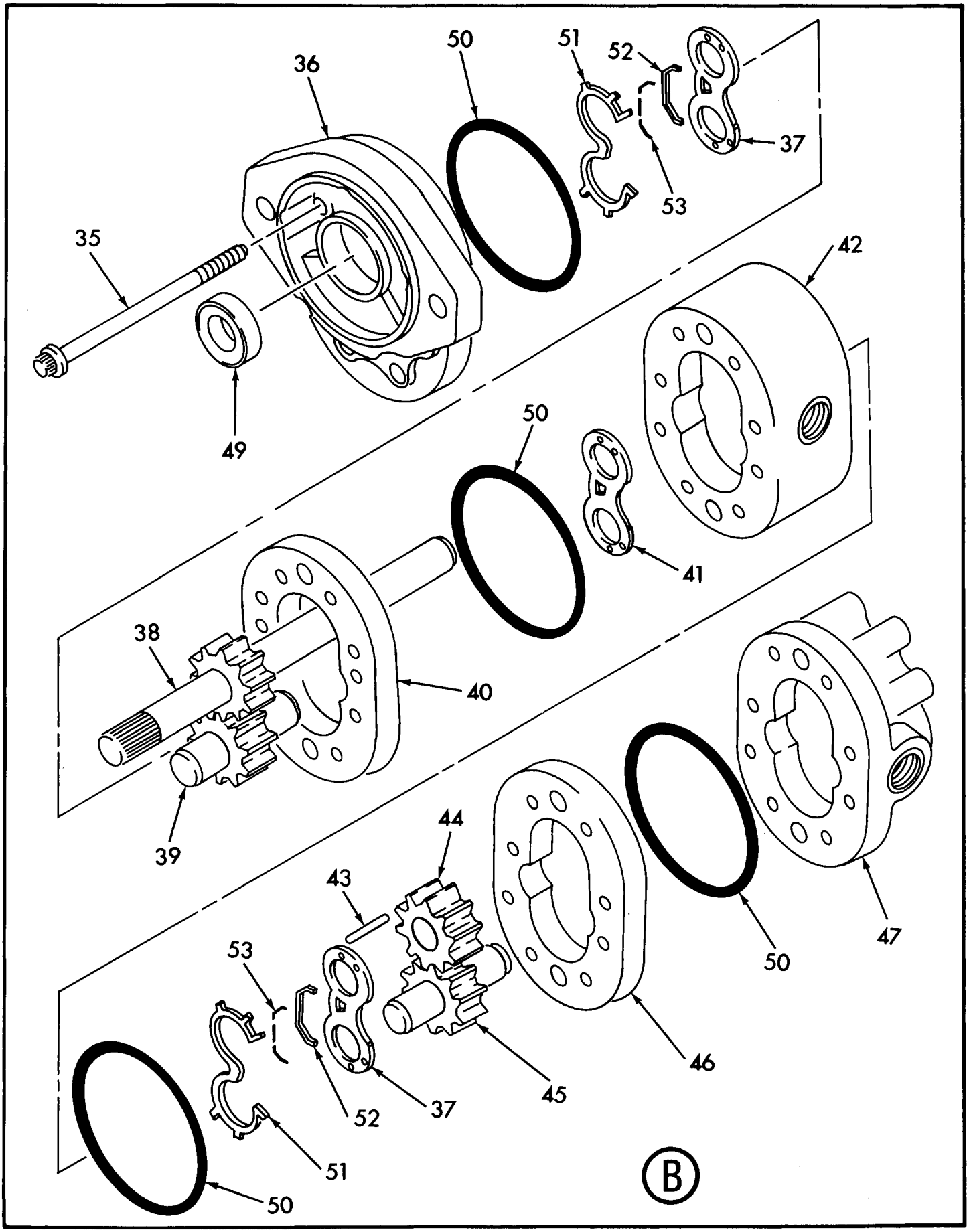
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
23	23693	.WELDMENT, ROTATION MOUNTING BRACKET	1
24	23639	..CHANNEL	1
25	26641	..BAR, FLAT	1
26	60548	.SCREW, CAP (attaching part)	4
27	63407	.WASHER, FLAT (attaching part)	4
28	23742	.ASSEMBLY, EMERGENCY PUMP AND MOTOR (See Sect. 4, Fig. 8 for Details)	1
29	60325	.SCREW, CAP (attaching part)	2
30	63319	.WASHER, LOCK (attaching part)	2
31	60338	.SCREW, CAP	4
32	63302	.WASHER, LOCK	4
33	4030	.BATTERY	1
-34	23740	.KIT, BATTERY CABLE	1
35	20375	.CLAMP	1
36	65798	.BOLT, ANCHOR (attaching part)	2
37	63319	.WASHER, LOCK (attaching part)	2
38	65125	.NUT, WING (attaching part)	2
39	23724	.ASSEMBLY, DRIVE BLOCK (See Sect. 4, Fig. 9 for Details)	1
40	60341	.SCREW, CAP (attaching part)	2
41	26701	.TUBE, ROUND (attaching part)	2
42	63301	.WASHER, LOCK (attaching part)	2
43	81169	.CONTROL VALVE, DIRECTIONAL	1
44	23723	.ASSEMBLY, CONTROL VALVE (See Sect. 4, Fig. 11 for Details)	1
45	60307	.SCREW, CAP (attaching part)	4
46	63302	.WASHER, LOCK (attaching part)	4
-47	23743	.ASSEMBLY, CHECK VALVE IN LINE	1

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-48	81189	..VALVE, CHECK	1
-49	80001-14	..CONNECTOR, MALE	2
50	23704	.ASSEMBLY, LOWER CONTROL PANEL (See Sect. 4, Fig. 10 for Details)	1
51	60353	.SCREW, CAP (attaching part)	4
52	63301	.WASHER, LOCK (attaching part)	4
-53	20357	.VALVE, NEEDLE	1
-54	80001-08	.CONNECTOR, MALE	2
55	23744	.BAFFLE, ENGINE SIDE	1
-56	60353	.SCREW, CAP (attaching part)	4
-57	63301	.WASHER, LOCK (attaching part)	4
58	65772	.MUFFLER	1
59	65791	.CLAMP, MUFFLER	2
60	65337	.ELBOW	1
61	21288	.CAP, RAIN	1
62	160	.FILTER, FUEL	1
63	160-B-0220	.HOSE	2
64	161-A	.CLAMP	4
65	23776	.WELDMENT, EXHAUST TUBE	1
66	80001-10	.CONNECTOR, MALE	1
67	23775	.DRAIN LINE, OIL	1

ENGINE AND PUMP ASSEMBLY (30 4 X 4)



ENGINE AND PUMP ASSEMBLY (30 4 X 4) (CONTINUED)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23739	ASSEMBLY, ENGINE AND PUMP (See Sect. 4, Fig. 1 for Details)	REF
2	21802	.ASSEMBLY, GASOLINE ENGINE (See Vendor Chapter for Details)	1
3	32217	.SHAFT, STUB	1
4	60625	.SCREW, CAP	8
5	32219	.ADAPTER, PUMP	1
6	60630	.SCREW, CAP (attaching part)	4
7	63304	.WASHER, LOCK (attaching part)	4
8	22521	.BRACKET, MOUNTING SOLENOID VALVE AND HYDRAULIC THROTTLE	1
9	22663	.BRACKET, DASH POT	1
10	60322	.SCREW, CAP (attaching part)	2
11	63302	.WASHER, LOCK (attaching part)	2
12	65511	.DASH POT	1
13	61232	.NUT, THIN FLEX (attaching part)	1
14	62703	.SCREW, MACHINE (attaching part)	1
15	63313	.WASHER, LOCK	1
16	60802	.NUT, HEX (attaching part)	1
17	23778	.BRACKET, MOUNTING SYNCHRO START	1
18	60309	.SCREW, CAP (attaching part)	2
19	63301	.WASHER, LOCK (attaching part)	2
20	60701	.NUT, HEX (attaching part)	2
21	21777	.SYNCHRO, START	2
22	60309	.SCREW, CAP (attaching part)	4
23	63301	.WASHER, LOCK (attaching part)	4
24	60701	.NUT , HEX (attaching part)	4
25	65199	.SPRING, UNIVERSAL THROTTLE	1

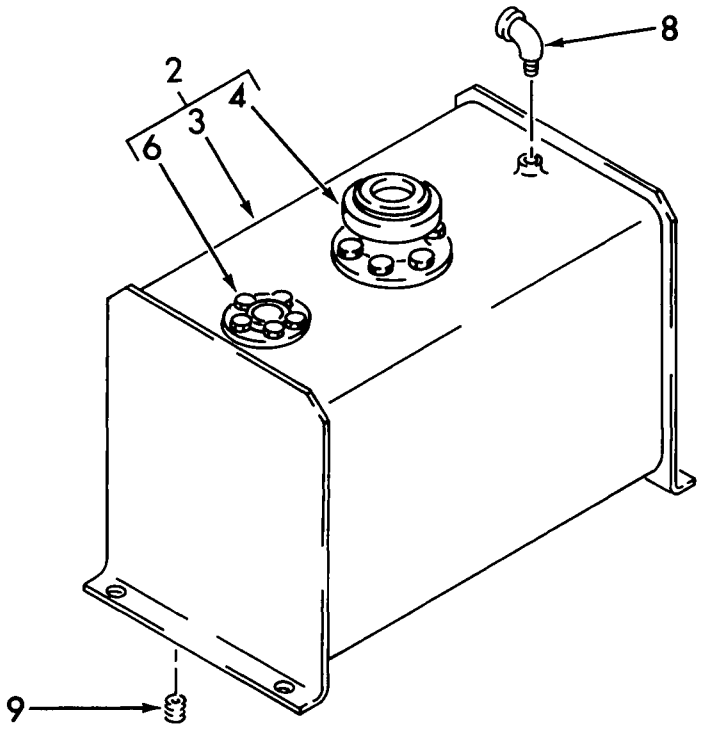
ENGINE AND PUMP ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	60805	.NUT, HEX	2
27	65913	.ASSEMBLY, CABLE	1
28	60805	.NUT, HEX	2
29	81115	.ASSEMBLY, DOUBLE GEAR PUMP	1
30	60630	.SCREW, CAP (attaching part)	2
31		.WASHER, LOCK (attaching part)	2
32	80004-13	.CONNECTOR, STRAIGHT	1
33	80012-15	.ELBOW, STRAIGHT THREAD	1
34	66995	..FITTING, FLOW	1
35		..CAP, SCREW	8
36	66989	..ASSEMBLY, FRONT PLATE	1
37		..WEAR, PLATE	2
38	66994	..ASSEMBLY, SPLINE DRIVE GEAR	1
39	66991	..ASSEMBLY, IDLER GEAR	1
40		..ASSEMBLY, FRONT BODY	1
41		..PLATE, OPTIONAL THRUST	1
42	66992	..ASSEMBLY, ADAPTOR PLATE	1
43	66990	..KEY, ROUND	1
44	66993	..GEAR, SLIP FIT	1
45	66996	..ASSEMBLY, IDLER GEAR	1
46	66998	..ASSEMBLY, REAR BODY	1
47	66988	..ASSEMBLY, BACK PLATE	1
-48		..KIT, SEAL	1
49		...SEAL, SHAFT	1
50		...O-RING	4
51		...GASKET, BACK-UP	2

- ITEM NOT ILLUSTRATED

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
52		...SEAL, BEARING	2
53		...O-RING, MOLDED	2
54	66966	.SPRING	2

FUEL TANK ASSEMBLY (30 4 X 4)

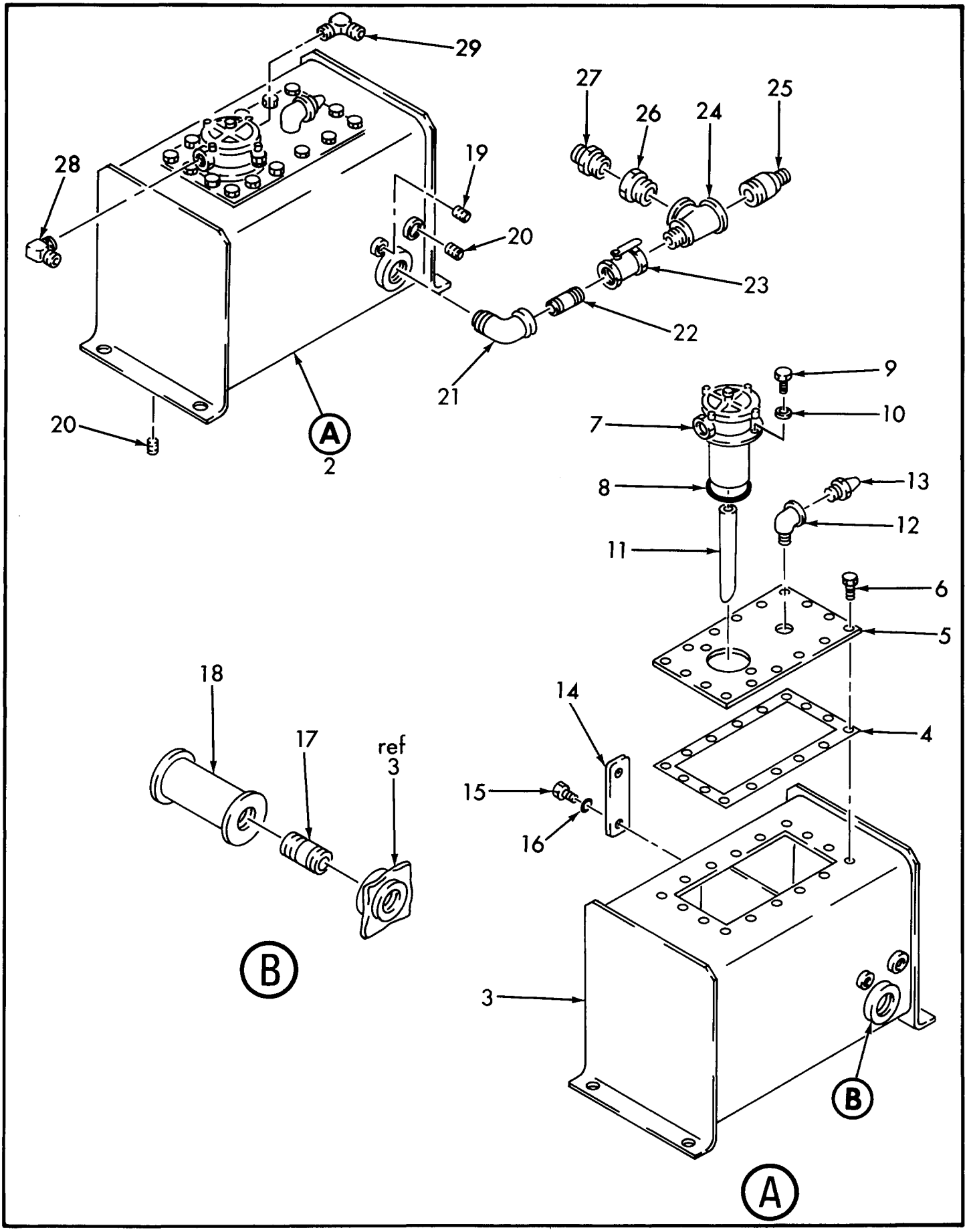


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23734	ASSEMBLY, FUEL TANK (See Sect. 4, Fig. 1 for NHA)	REF
2	23733	.SUB-ASSEMBLY, FUEL TANK	1
3	23732	..TANK, FUEL	1
4	81185	..BREATHER, FILLER	1
-5		..SCREW, SELF TAPPING (attaching part)	6
6	81186	..GAUGE, MAGNETIC LIQUID LEVEL	1
-7	65908	..SCREW, THREAD CUTTING (attaching part)	5
8	80021-03	.ELBOW STREET	1
9	80048-05	.PLUG, HOLLOW HEX	1

REV.

- ITEM NOT ILLUSTRATED

HYDRAULIC TANK ASSEMBLY (30 4 X 4)



REV.

HYDRAULIC TANK ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23731	ASSEMBLY, HYDRAULIC TANK (See Sect. 4, Fig. 1 for NHA)	REF
2	23728	.SUB-ASSEMBLY, HYDRAULIC TANK	1
3	23726	..TANK, HYDRAULIC	1
4	23729	..GASKET, COVER	1
5	23730	..PLATE, COVER	1
6	65907	..SCREW, THREAD (attaching part)	16
7	81182	..RETURN FILTER, TANK IMMERSED	1
-7A	67124	...ELEMENT, FILTER	1
8		..O-RING	1
9	60501	..SCREW, CAP (attaching part)	2
10	63301	..WASHER, LOCK (attaching part)	2
11	35022	..TUBE, ROUND	1
12	80021-03	..ELBOW, STREET	1
13	65213	..BREATHER	1
14	81184	..GAGE, FLUID LEVEL	1
15		...SCREW, CAP	2
16		...O-RING	2
17	16553	..NIPPLE	1
18	81183	..FILTER, SUCTION	1
19	80048-04	.PLUG, HOLLOW HEXAGON	1
20	80048-05	.PLUG, HOLLOW HEXAGON	2
21	52307	.ELBOW, STREET	1
22	16553	.NIPPLE	1
23	20050	.VALVE, BUTTERFLY	1
24	55100	.TEE, STREET	1

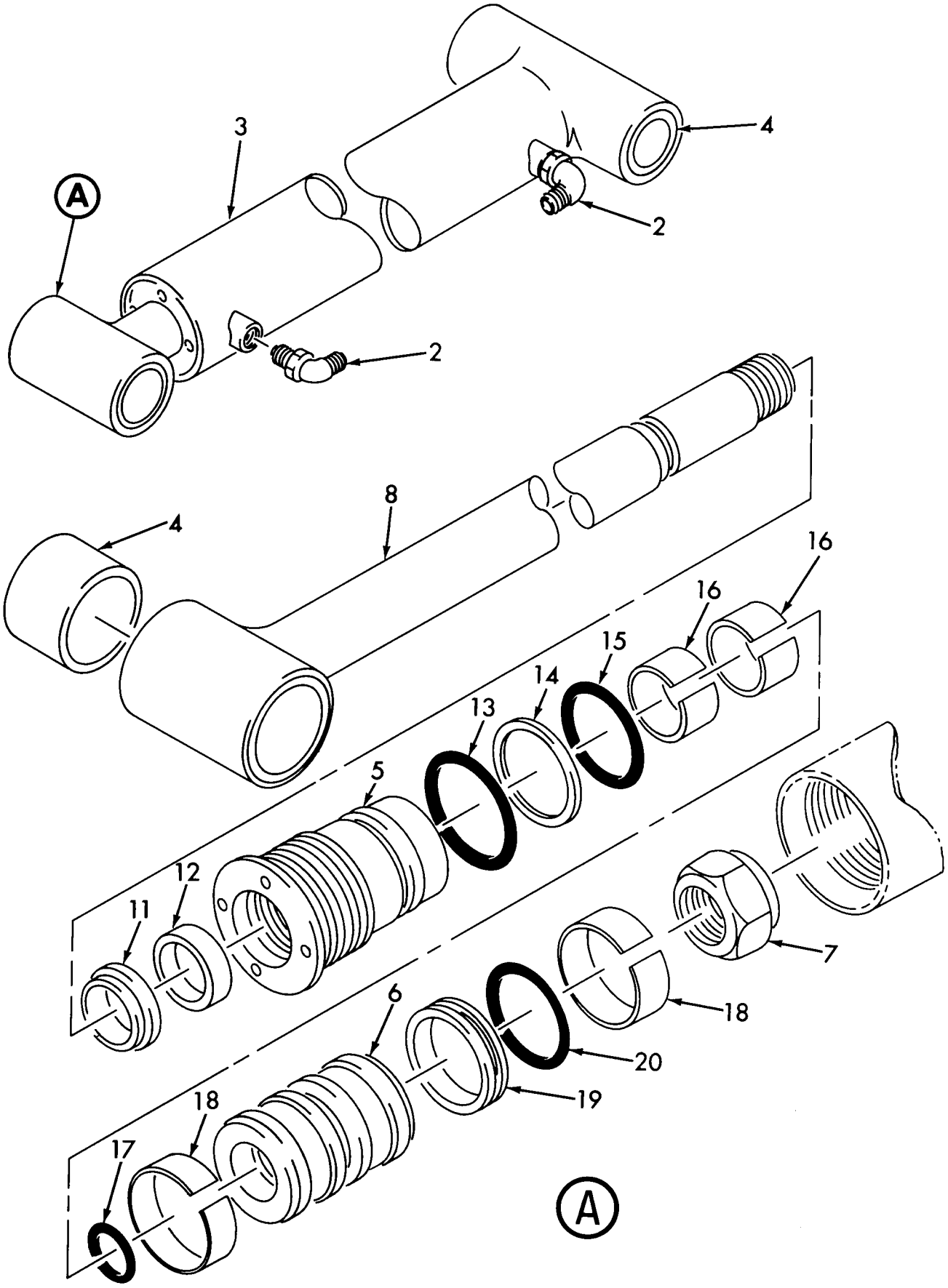
- ITEM NOT ILLUSTRATED

HYDRAULIC TANK ASSEMBLY (30 4 X 4)
(CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	65831	.NIPPLE, COMBINATION	1
26	53800	.REDUCER, PIPE	1
27	80001-15	.CONNECTOR, MALE	1
28	80008-18	.ELBOW, MALE	1
29	80008-21	.ELBOW, MALE	1

- ITEM NOT ILLUSTRATED

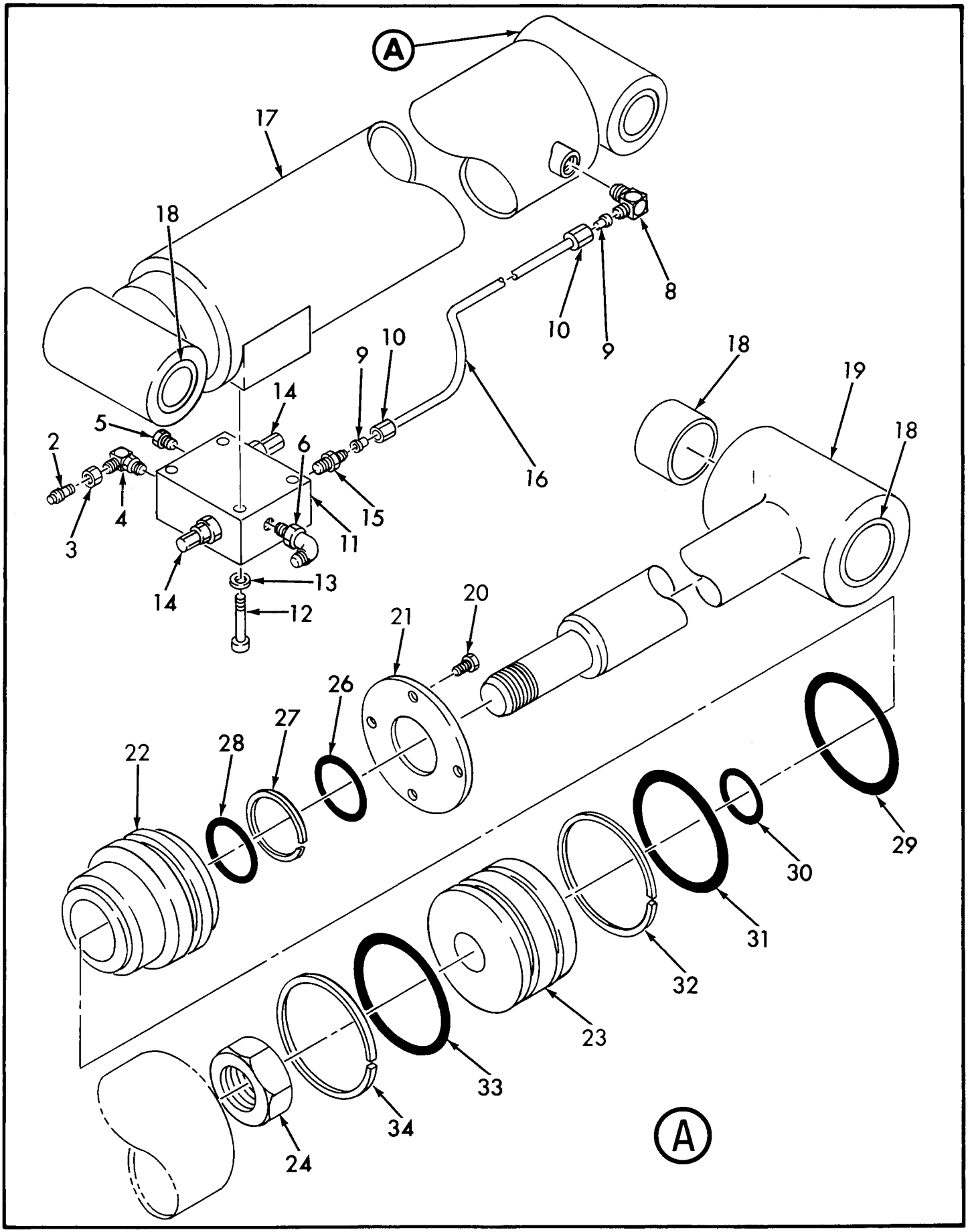
MASTER LEVELING CYLINDER ASSEMBLY (30 4 X 4)



MASTER LEVELING CYLINDER ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23664	ASSEMBLY, MASTER LEVELING CYLINDER (See Sect. 4, Fig. 1 for NHA)	REF
2	80012-03	.ELBOW, STRAIGHT THREAD	2
3	23653	.CYLINDER, MASTER LEVELING	1
4	67123	.BUSHING	4
5		.NUT, GLAND	1
6		.PISTON	1
7		.NUT, LOCK	1
8		.ROD	1
-9		.BARREL	1
-10	67052	.KIT, SEAL	1
11		..WIPER, ROD	1
12		..SEAL, ROD, POLYPAK	1
13		..O-RING	1
14		..RING, BACK-UP	1
15		..O-RING	1
16		..BEARING, WEAR	2
17		..O-RING	1
18		..RING, WEAR (GLASS/NYLON)	2
19		..SEAL, A Q (SQUARE)	1
20		..O-RING	1

LIFT CYLINDER ASSEMBLY (30 4 X 4)



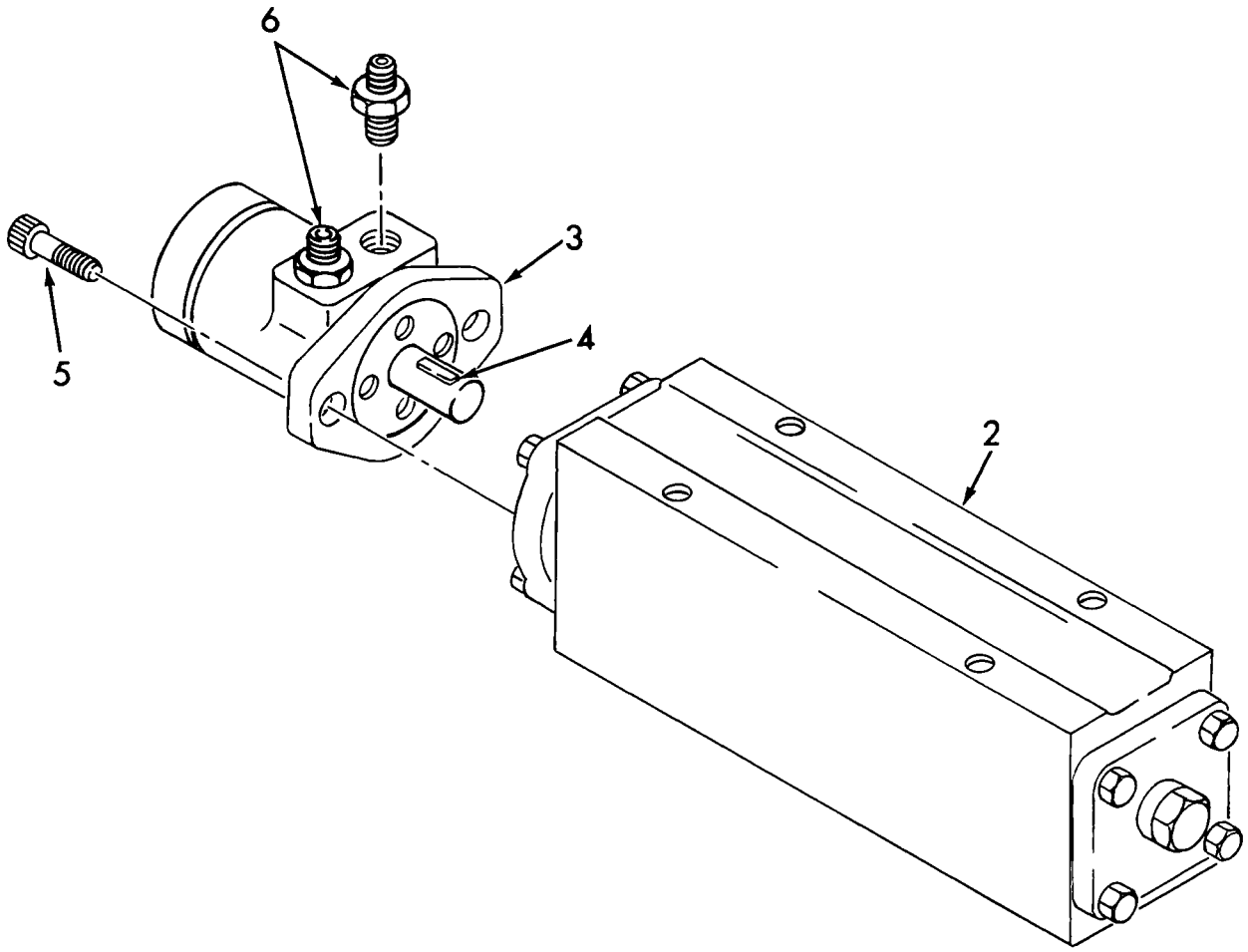
LIFT CYLINDER ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23787	ASSEMBLY, LIFT CYLINDER (See Sect. 4, Fig. 1 for NHA)	
2	20348	.ORIFICE, BLEED DOWN	1
3	80060-05	.NUT	1
4	50900	.ELBOW	1
5	80050-03	.PLUG	1
6	80012-11	.ELBOW	1
7	21769	.SUB-ASSEMBLY, LIFT CYLINDER	1
8	80012-09	..ELBOW	1
9	80062-05	..SLEEVE	2
10	80060-05	..NUT	2
11	21445	..BOOM VALVE BLOCK CYLINDER	1
12	61943	..SCREW, CAP (attaching part)	4
13	63302	..WASHER, LOCK (attaching part)	4
14	81006	..CARTRIDGE, OVERCENTER	2
15	80004-09	..CONNECTOR	1
16	26361	..TUBING, HYDRAULIC	1
17	21588	..CYLINDER, LIFT	1
18	67121	..BUSHING, D.U.	4
19		..ROD	1
20		..SCREW, CAP	4
21		..CAP	1
22		..HEAD	1
23		..PISTON	1
24		..NUT, LOCK	1
-25	66895	..KIT, SEAL	1
26		...O-RING	1

- ITEM NOT ILLUSTRATED

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27		...RING, WEAR	1
28		...O-RING	1
29		...O-RING	1
30		...O-RING	1
31		...O-RING	1
32		...RING, WEAR	1
33		...O-RING	1
34		...RING, WEAR	1

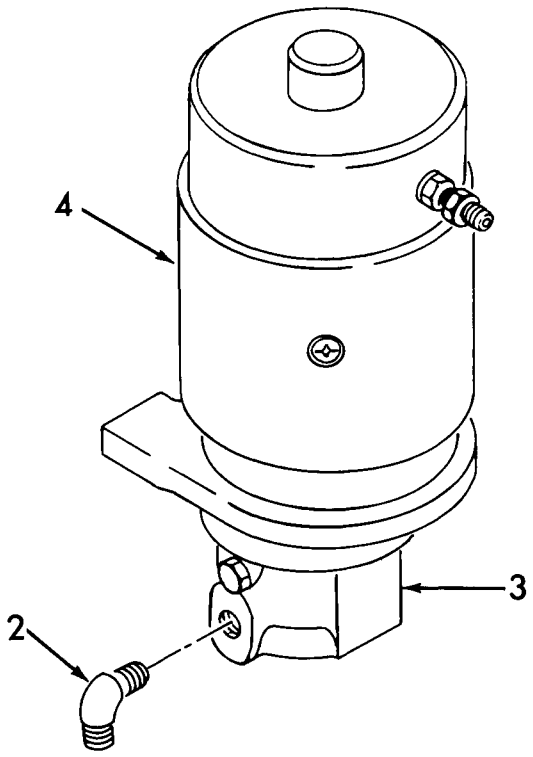
ROTATION GEAR BOX ASSEMBLY (30 4 X 4)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23694	ASSEMBLY, ROTATION GEAR BOX (See Sect. 4, Fig. 1 for NHA)	REF
2	23736	.ASSEMBLY, WORM GEAR	1
3	20520	.MOTOR, ORBIT	1
4		.KEY, WOODRUFF	1
5	62011	.SCREW, CAP (attaching part)	2
6	80001-11	.CONNECTOR, MALE	2

- ITEM NOT ILLUSTRATED

EMERGENCY PUMP AND MOTOR ASSEMBLY (30 4 X 4)

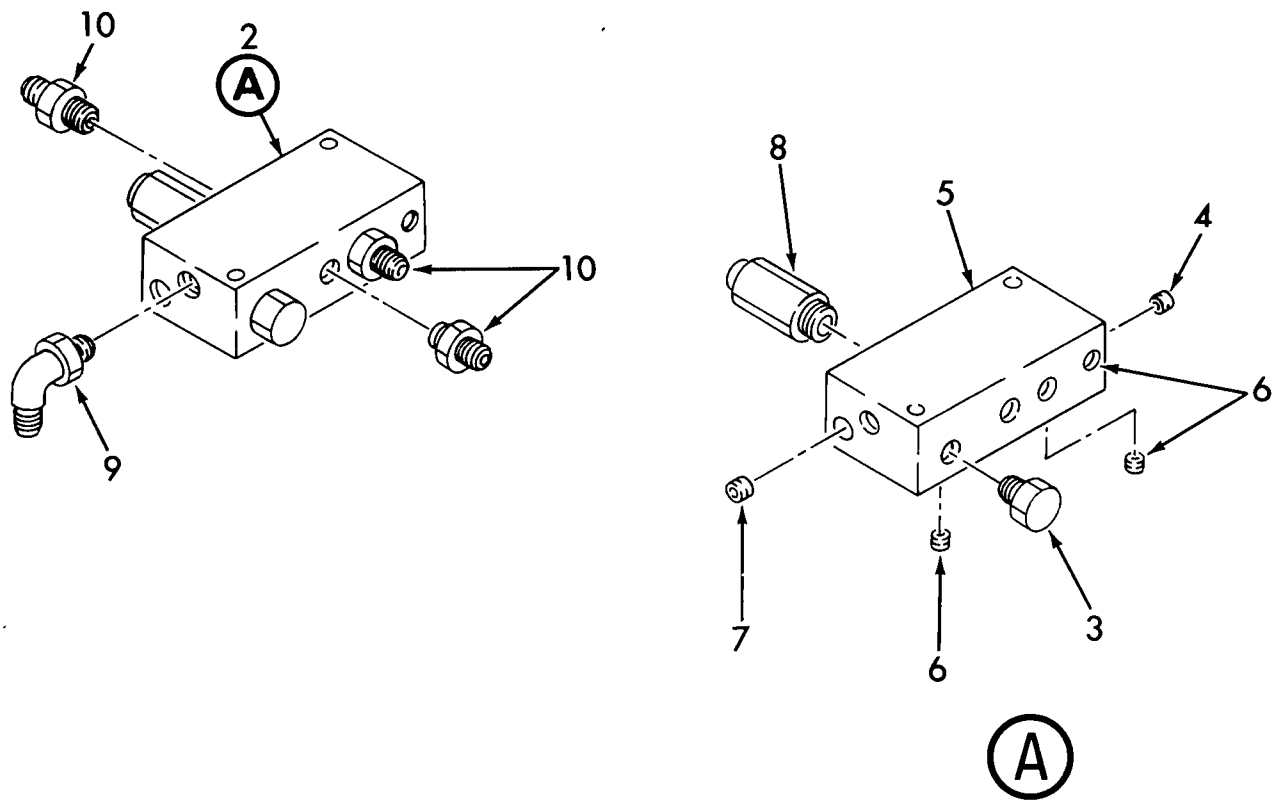


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23742	ASSEMBLY, EMERGENCY PUMP AND MOTOR (See Sect. 4, Fig. 1 for NHA)	REF
2	80008-13	.ELBOW, MALE	2
3	20384	.PUMP, EMERGENCY RETRACTION 101-1/4"	1
4		.MOTOR	1

REV.

- ITEM NOT ILLUSTRATED

DRIVE BLOCK ASSEMBLY (30 4 X 4)

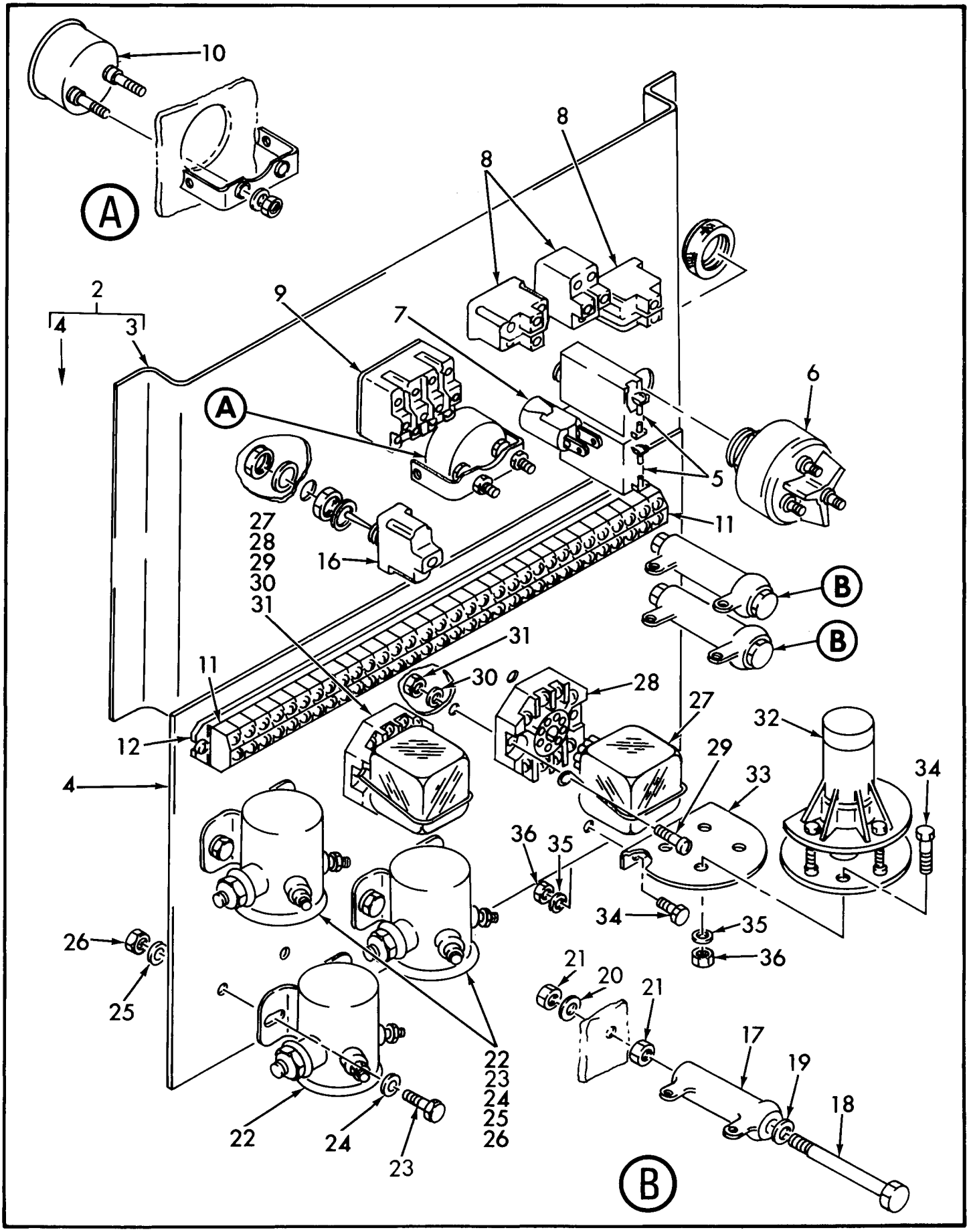


NOTE: see MT31G & MT40G manual P/N 17217, Sec 3 Fig 21 Pg 1 for complete directional control valve assembly

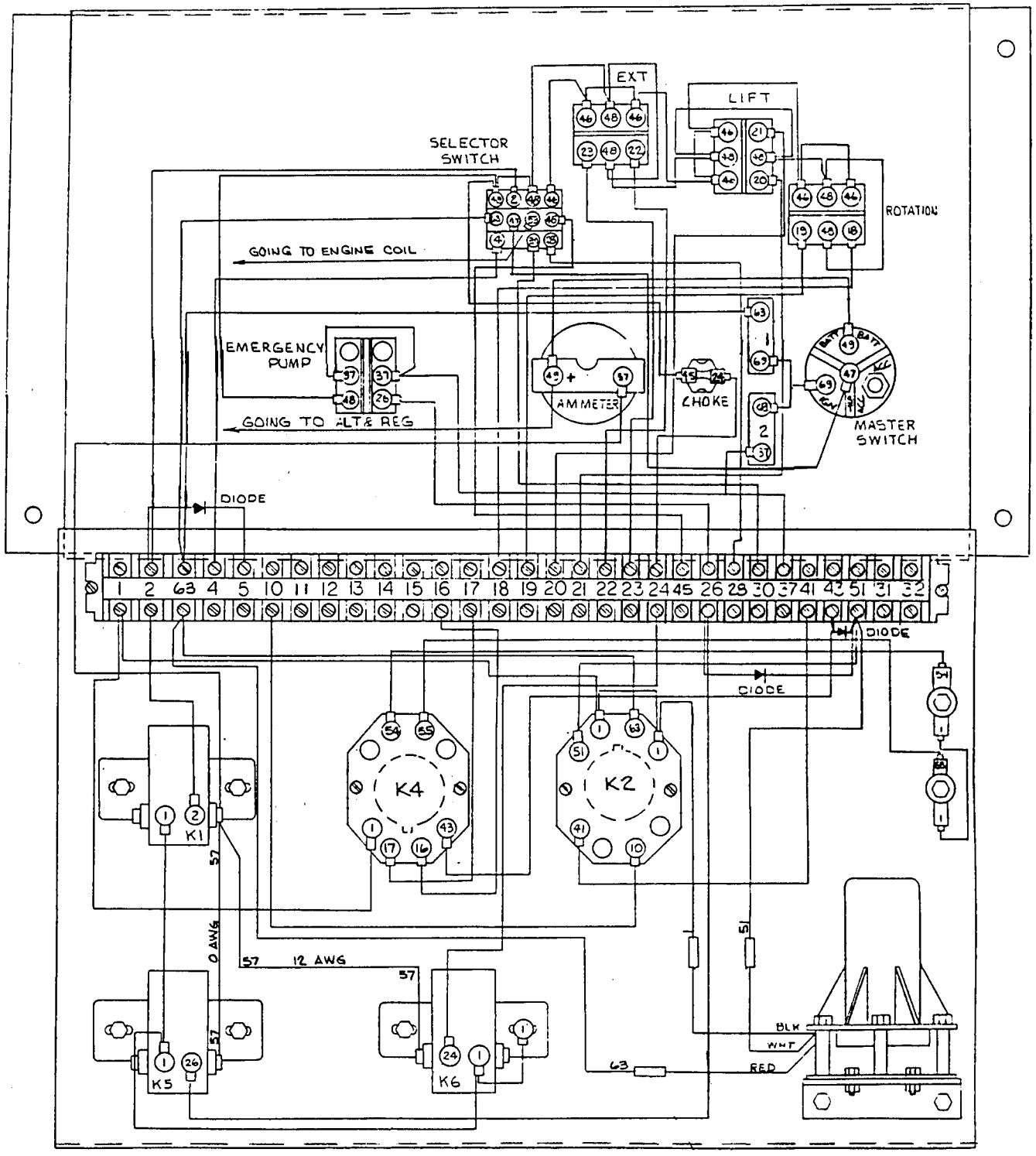
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23724	ASSEMBLY, DRIVE BLOCK (See Sect. 4, Fig. 1 for NHA)	REF
2	81181	.SUB-ASSEMBLY, DRIVE BLOCK	1
3		..VALVE, DIFF. SENSING	1
4		..VALVE, MINI SHUTTLE	1
5		..BODY	1
6		..PLUG, #2 SAE	5
7		..PLUG, #6 SAE	1
8		..TABLE, A	1
9	80012-16	.ELBOW, STRAIGHT THREAD	1
10	80004-16	.CONNECTOR, STRAIGHT THREAD	3

- ITEM NOT ILLUSTRATED

LOWER CONTROL PANEL ASSEMBLY (30 4 X 4)



LOWER CONTROL PANEL ASSEMBLY (30 4 X 4) (CONTINUED)



WIRING DIAGRAM ONLY

REV.

LOWER CONTROL PANEL ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23704	ASSEMBLY, LOWER CONTROL PANEL (See Section 4, Fig. 1 for NHA)	REF
2	23701	.PANEL, LOWER CONTROL	1
3	26644	..SHEET	1
4	26645	..SHEET	1
5	70361	.BREAKER, CIRCUIT	2
6	2717	.SWITCH, IGNITION	1
7	4011	.SWITCH PUSH BUTTON	1
8	20481	.SWITCH, TOGGLE	3
9	16260	.SWITCH, TOGGLE	1
10	20572	.AMMETER	1
11	4027	.BLOCK, TERMINAL	30
12	117-A	.END, TERMINAL BLOCK	1
-13	62636	.SCREW, MACHINE (attaching part)	3
-14	61532	.NUT, HEX (attaching part)	3
-15	63312	.WASHER, LOCK (attaching part)	3
16	70291	.SWITCH, TOGGLE	1
17	70358	.RESISTOR, VARIABLE	2
18	60341	.SCREW, CAP (attaching part)	2
19	63401	.WASHER, FLAT (attaching part)	2
20	63301	.WASHER, LOCK (attaching part)	2
21	63701	.NUT, HEX (attaching part)	4
22	70209	.SOLENOID, 12 VDC	3
23	60342	.SCREW, CAP (attaching part)	6
24	63401	.WASHER, FLAT (attaching part)	6
25	63301	.WASHER, LOCK (attaching part)	6
26	63701	.NUT, HEX (attaching part)	6

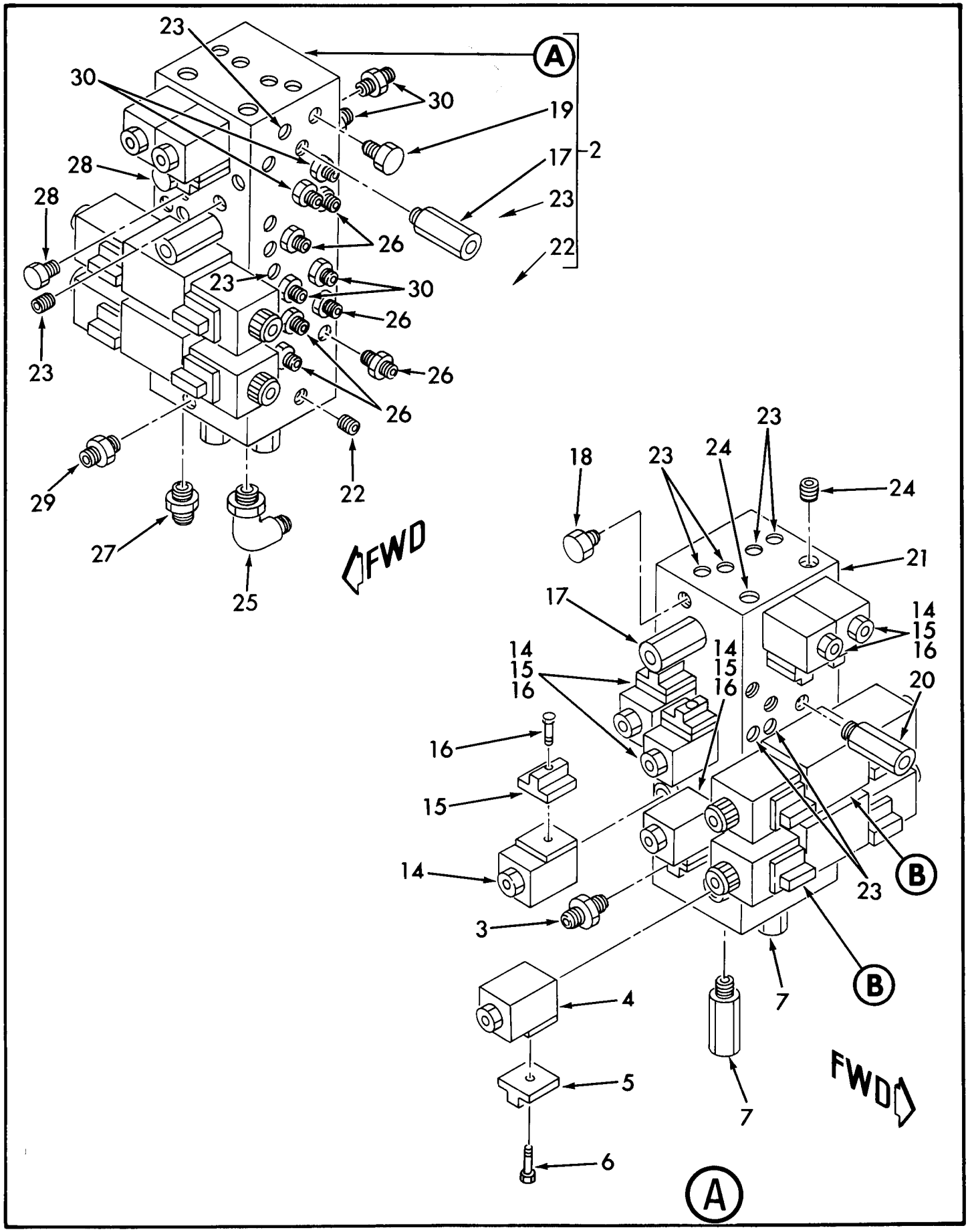
- ITEM NOT ILLUSTRATED

LOWER CONTROL PANEL ASSEMBLY (30 4 X 4) (CONTINUED)

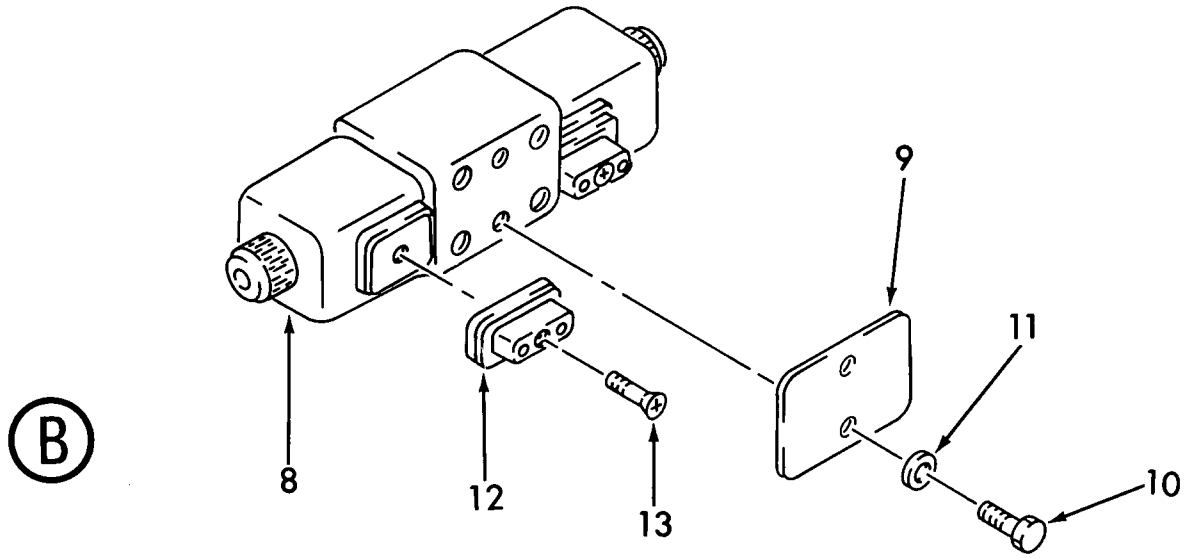
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	70170	.RELAY	2
28	784-A	.SOCKET, 8-PIN OCTAL	2
29	62636	.SCREW, MACHINE (attaching part)	4
30	63312	.WASHER, LOCK (attaching part)	4
31	61532	.NUT, HEX (attaching part)	4
32	21250	.SENSOR, SLOPE	1
33	23754	.BRACKET, SLOPE SENSOR	1
34	60342	.SCREW, CAP (attaching part)	6
35	63301	.WASHER, LOCK (attaching part)	6
36	63701	.NUT, HEX (attaching part)	6
-37	117-C	.RING, CONNECTOR	60
-38	117-F	.RELIEF, STRAIN	2
-39	4045	.DIODE	5
-40		.DIAGRAM, WIRING	REF

- ITEM NOT ILLUSTRATED

VALVE CONTROL ASSEMBLY (30 4 X 4)



VALVE CONTROL ASSEMBLY (30 4 X 4) (CONTINUED)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23723	ASSEMBLY, VALVE CONTROL (See Sect. 4, Fig. 1 for NHA)	REF
2	81180	.VALVE, CONTROL	1
3		..VALVE, RELIEF	1
4		..SOLENOID, N.O. POPPET	1
5		..COVER, SPADE	1
6		..SCREW, (attaching part)	1
7		..VALVE, RELIEF	2
8		..VALVE, DO1	2
9		..PLATE, COVER	2
10		..SCREW, CAP (attaching part)	4
11		..WASHER, LOCK (attaching part)	4

- ITEM NOT ILLUSTRATED

VALVE CONTROL ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
12		..COVER, SPADE	4
13		..SCREW, (attaching part)	4
14		..SOLENOID, 2 POSITION 3 WAY	6
15		..COVER, SPADE	6
16		..SCREW (attaching part)	6
17		..VALVE, CHECK	2
18		..VALVE, RELIEF	1
19		..VALVE, RELIEF	1
20		..VALVE, RELIEF	1
21		..BODY	1
22		..PLUG, #2 SAE O-RING	5
23		..PLUG, #4 SAE O-RING	22
24		..PLUG, #6 SAE O-RING	2
25	80012-18	.ELBOW, STRAIGHT THREAD	1
26	80004-08	.CONNECTOR, STRAIGHT THREAD	6
27	80004-11	.CONNECTOR, STRAIGHT THREAD	1
28	80050-03	.PLUG, STRAIGHT THREAD	2
29	80004-12	.CONNECTOR, STRAIGHT THREAD	1
30	80004-05	.CONNECTOR, STRAIGHT THREAD	6

- ITEM NOT ILLUSTRATED

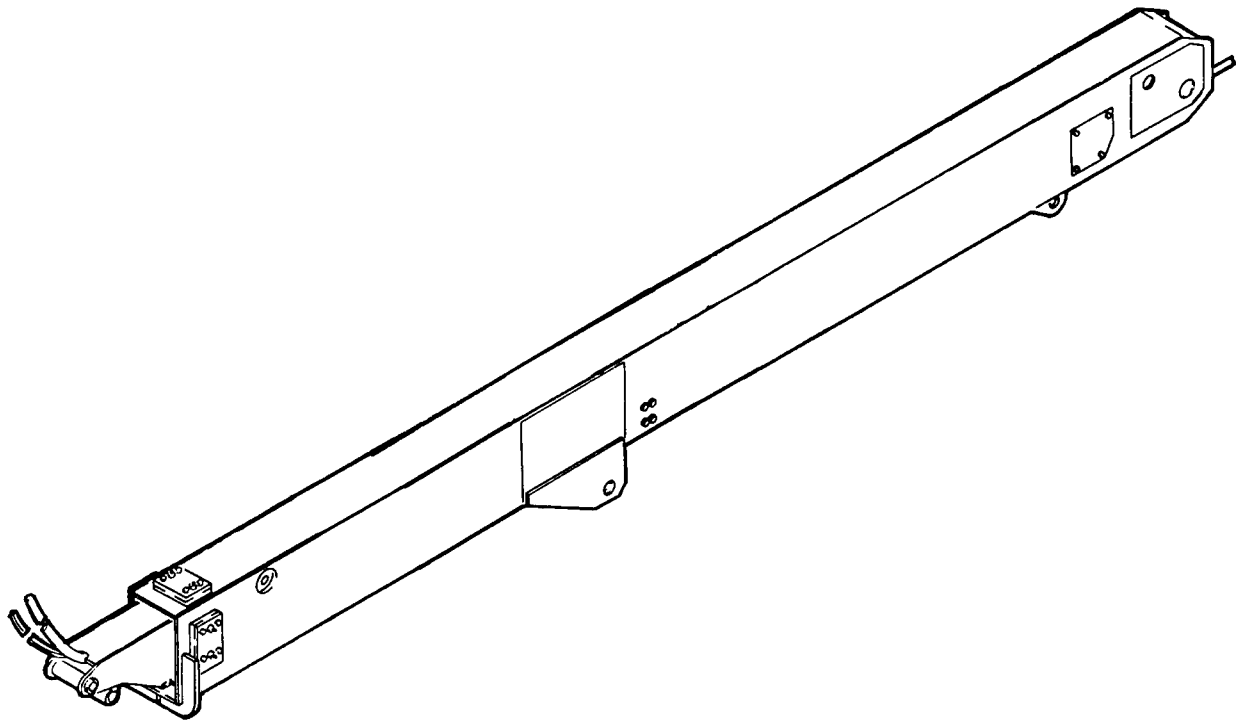
THIS SECTION 5 IS ILLUSTRATED AS

FIGURE 1 FINAL BOOM ASSEMBLY

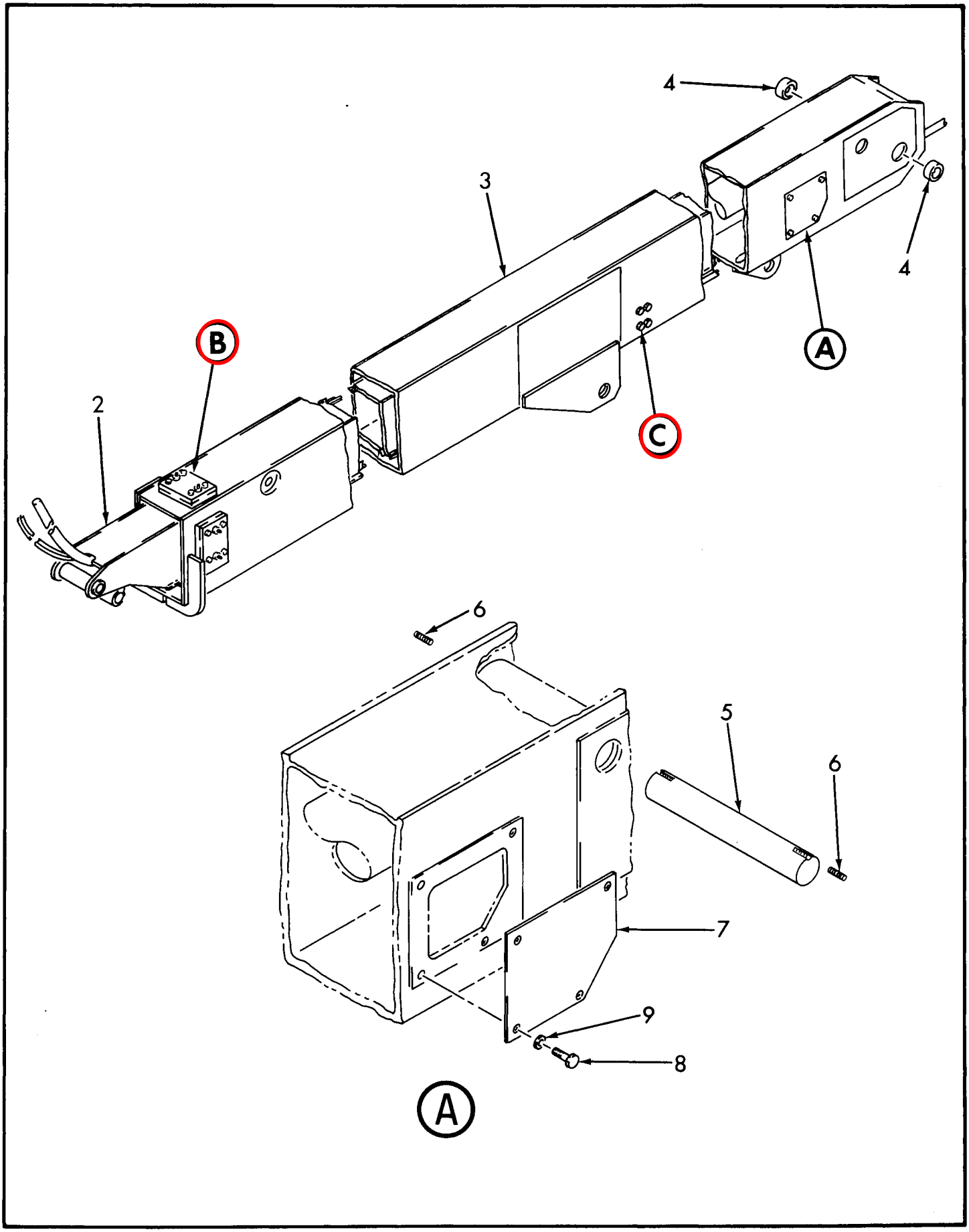
FIGURE 2 INNER BOOM ASSEMBLY

FIGURE 3 SLAVE LEVELING CYLINDER ASSEMBLY

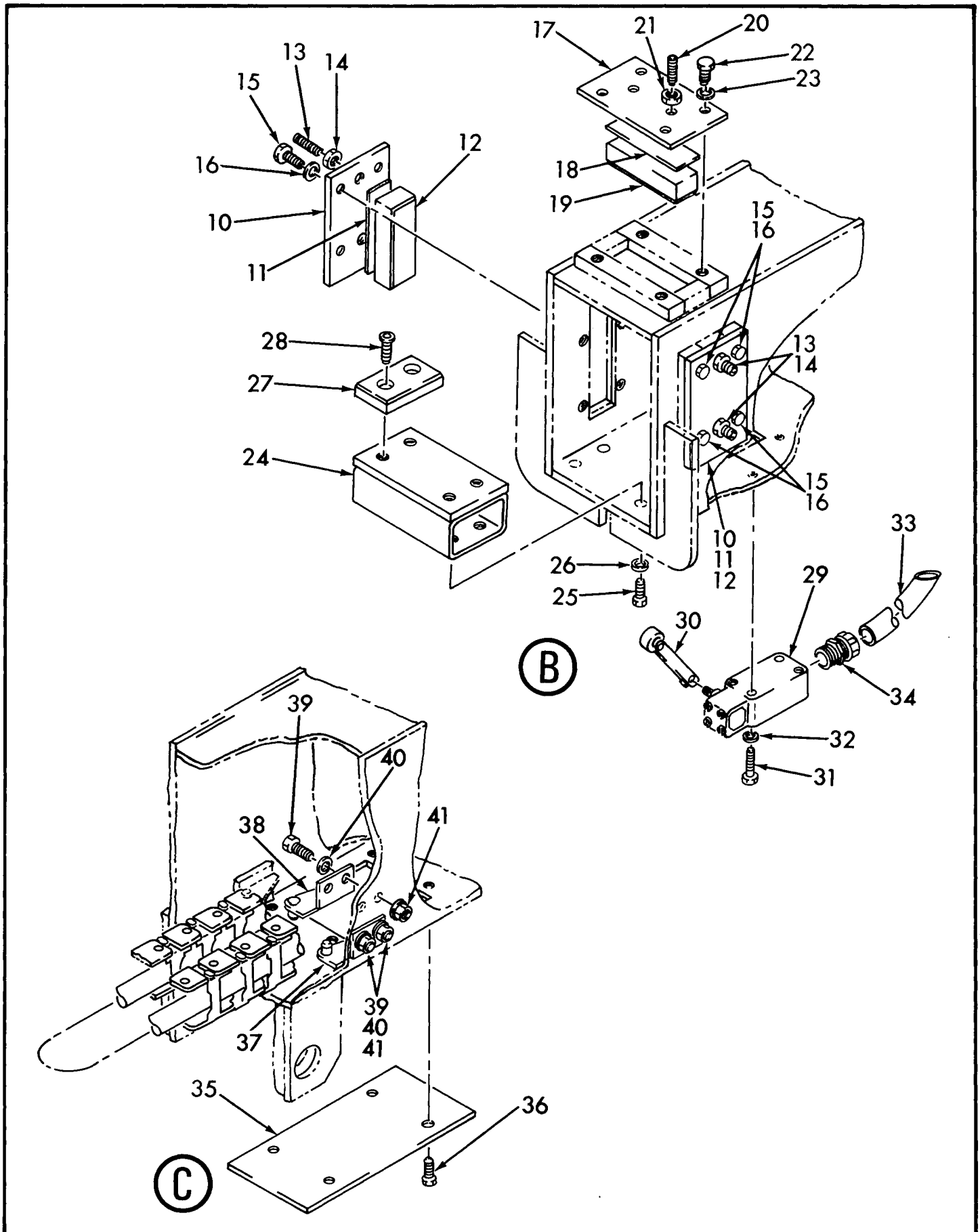
FIGURE 4 EXTENSION CYLINDER ASSEMBLY



FINAL BOOM ASSEMBLY (30 4 X 4)



FINAL BOOM ASSEMBLY (30 4 X 4)
(CONTINUED)



FINAL BOOM ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23660	ASSEMBLY, FINAL BOOM (See Sect. 2, Fig. 1 for NHA)	REF
2	23661	.ASSEMBLY INNER BOOM (See Sect. 5, Fig. 2 for Details)	1
3	23652	.MACHINING, OUTER BOOM	1
4	21782	..BUSHING	2
5	23163	.PIN, EXTENSION CYLINDER	1
6	62203	.SCREW, SET (attaching part)	2
7	23515	.COVER, DOUBLER PLATE	1
8	60324	.SCREW, CAP (attaching part)	4
9	63302	.WASHER, LOCK (attaching part)	4
10	23158	.COVER, PRESSURE PAD	2
11	22372	.PLATE, PAD PRESSURE	2
12	23160	.PAD, WEAR	2
13	62204	.SCREW, SET (attaching part)	4
14	61101	.NUT, JAM (attaching part)	4
15	60338	.SCREW, CAP (attaching part)	8
16	63302	.WASHER, LOCK (attaching part)	8
17	23159	.COVER, PRESSURE PAD	1
18	23164	.PLATE, PAD PRESSURE	1
19	23165	.PAD, WEAR	1
20	62204	.SCREW, SET (attaching part)	2
21	61101	.NUT, JAM (attaching part)	2
22	60338	.SCREW, CAP (attaching part)	4
23	63302	.WASHER, LOCK (attaching part)	4
24	23161	.BRACKET, BOOM END	1
25	60325	.SCREW, CAP (attaching part)	4
26	63303	.WASHER, LOCK (attaching part)	4

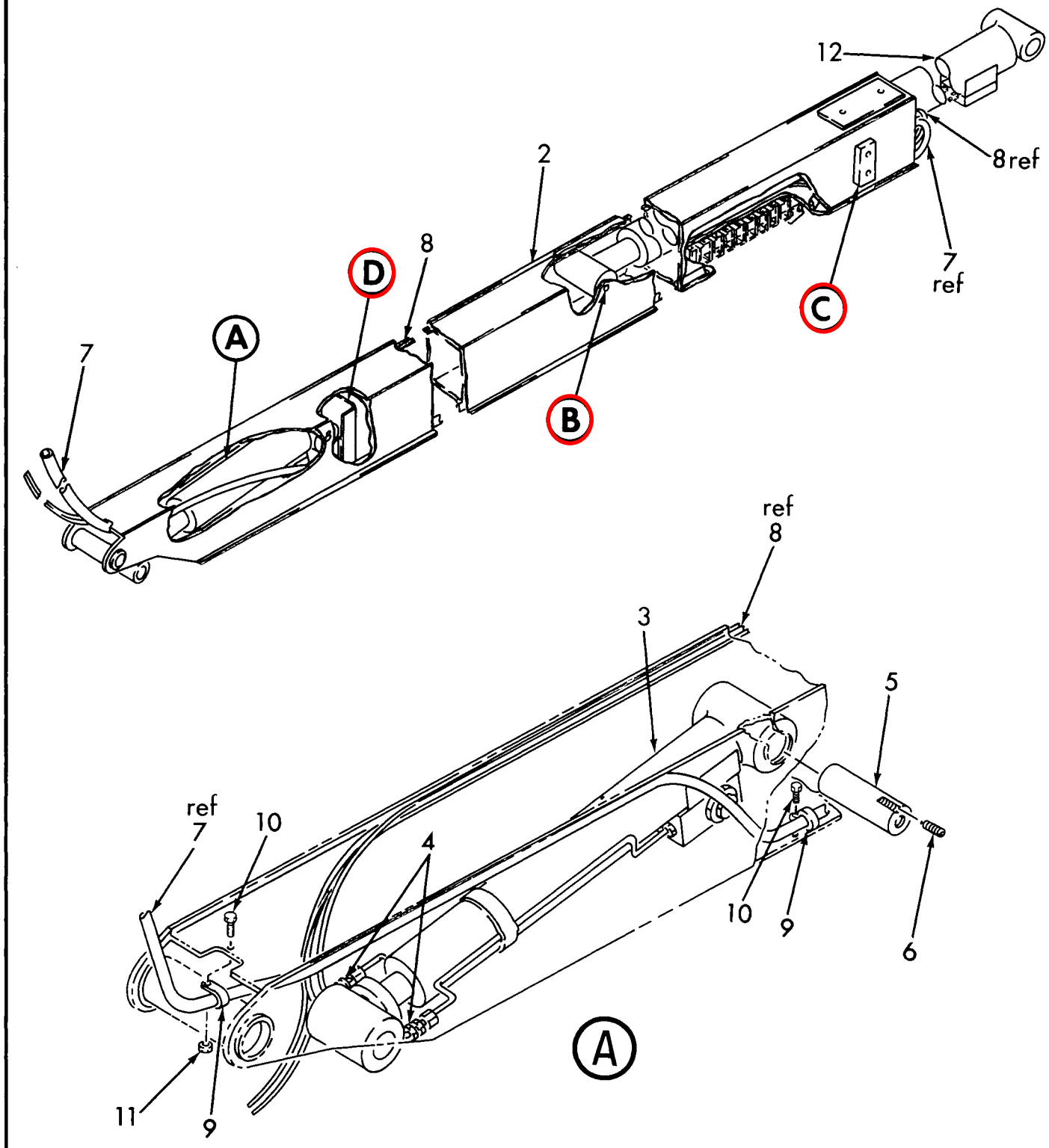
- ITEM NOT ILLUSTRATED

FINAL BOOM ASSEMBLY (30 4 X 4)
(CONTINUED)

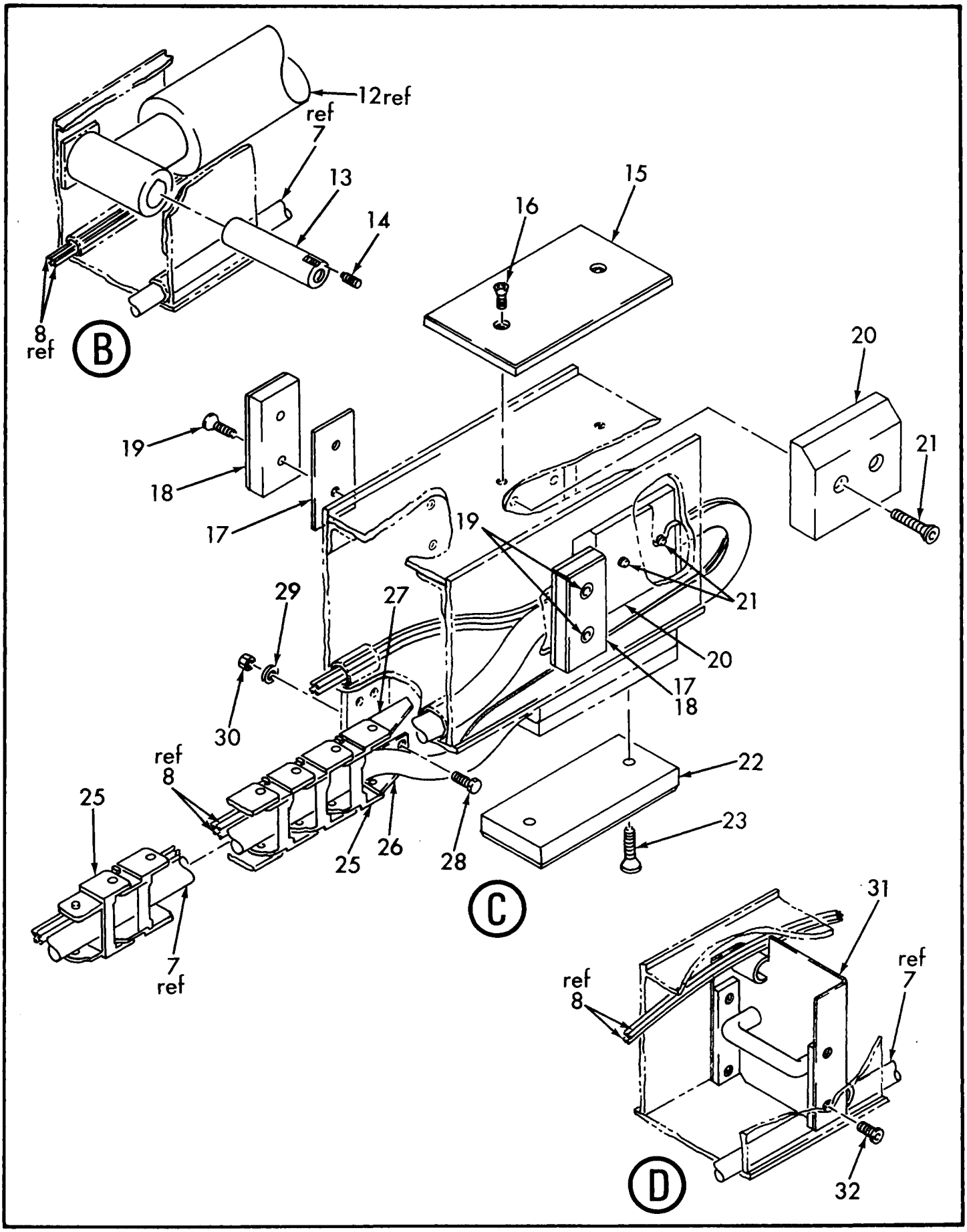
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27	23162	.PAD, WEAR	2
28	61805	.SCREW, CAP (attaching part)	4
29	70107	.SWITCH, LIMIT	1
30	70148	.ARM, LEVER	1
31	62615	.SCREW, MACHINE (attaching part)	2
32	63313	.WASHER, LOCK (attaching part)	2
33	2768-270	.CABLE, ELECTRICAL	1
34	2806	.RELIEF, STRAIN	1
35	22373	.COVER, ACCESS	1
36	60322	.SCREW, CAP (attaching part)	4
37	22585	.BRACKET, MOUNTING STATIONARY (RH)	1
38	22586	.BRACKET, MOUNTING STATIONARY (LH)	1
39	60501	.SCREW, CAP (attaching part)	4
40	63401	.WASHER, FLAT (attaching part)	4
41	61312	.NUT, LOCK (attaching part)	4

- ITEM NOT ILLUSTRATED

INNER BOOM ASSEMBLY (30 4 X 4)



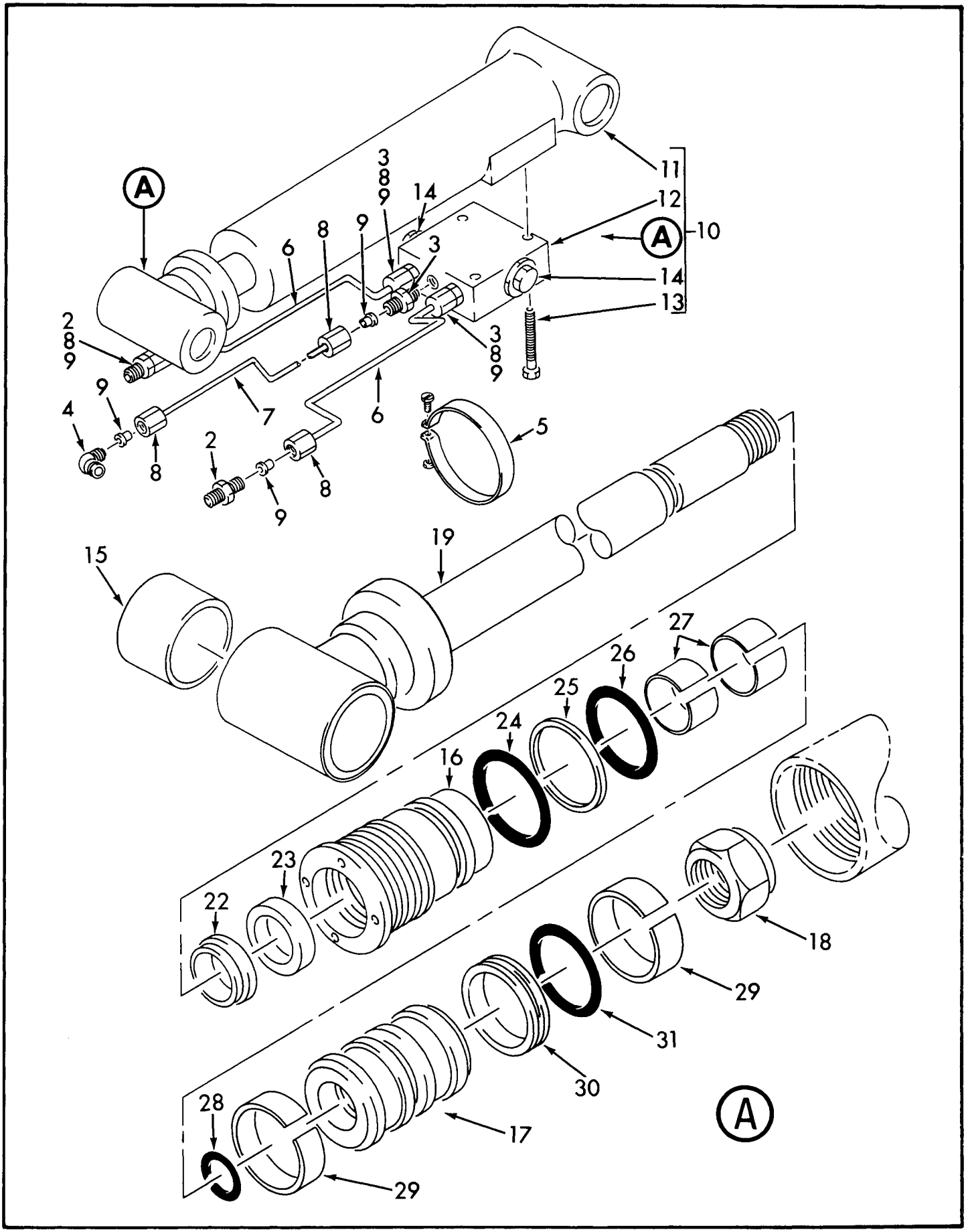
INNER BOOM ASSEMBLY (30 4 X 4) (CONTINUED)



ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23661	ASSEMBLY, INNER BOOM (See Sect. 5, Fig. 1 for NHA)	REF
2	23092	.MACHINING, INNER BOOM	1
3	23662	.ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 3 for Details)	1
4	65133	.FITTING, SWIVEL HOSE	2
5	23084	.PIN, SLAVE LEVELING CYLINDER	1
6	62203	.SCREW, SET (attaching part)	1
7	20802-744	.CABLE, ELECTRICAL	1
8	2568-732	.HOSE, HYDRAULIC	4
9	16268	.CLAMP, RUBBER	2
10	60309	.SCREW, CAP (attaching part)	2
11	60711	.NUT, HEX (attaching part)	1
12	23680	.ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 4 for Details)	1
13	23156	.PIN, EXTENSION CYLINDER	1
14	62203	.SCREW, SET (attaching part)	1
15	23157	.PAD, WEAR	1
16	61822	.SCREW, CAP (attaching part)	2
17	21278	.SHIM, WEAR PAD	2
18	22567	.PAD, WEAR	2
19	61801	.SCREW, CAP (attaching part)	4
20	23677	.PAD, WEAR	2
21	61802	.SCREW, CAP (attaching part)	4
22	23150	.PAD, WEAR	1
23	61805	.SCREW, CAP (attaching part)	2
-24	23703	.ASSEMBLY, MARK TRACK	1
25	21933	..TRACK, MARK	42

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
26	22587	.BRACKET, MOUNTING MOVABLE (R.H.)	1
27	22588	.BRACKET, MOUNTING MOVABLE (L.H.)	1
28	60501	.SCREW, CAP (attaching part)	4
29	63401	.WASHER, FLAT (attaching part)	4
30	61312	.NUT, LOCK (attaching part)	4
31	23166	.WELDMENT, BULKHEAD PLATE	1
32	61822	.SCREW, CAP (attaching part)	4

SLAVE LEVELING CYLINDER ASSEMBLY (30 4 X 4)



REV.

SLAVE LEVELING CYLINDER ASSEMBLY (30 4 X 4) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23662	ASSEMBLY, SLAVE LEVELING CYLINDER (See Sect. 5, Fig. 2 for NHA)	REF
2	80042-03	.UNION	2
3	80004-03	.CONNECTOR, STRAIGHT THREAD	3
4	80012-03	.ELBOW, STRAIGHT THREAD	1
5	16206	.STRAP	1
6	26646	.TUBE, HYDRAULIC	2
7	26647	.TUBE, HYDRAULIC	1
8	80060-03	.NUT	6
9	80062-03	.SLEEVE	6
10	23655	.SUB-ASSEMBLY, SLAVE LEVELING CYLINDER	1
11	23654	..CYLINDER, SLAVE LEVELING	1
12	21447	..BLOCK, MANIFOLD	1
13	61903	..SCREW, CAP (attaching part)	3
14	21267	..CARTRIDGE, OVER-CENTER	2
15	67123	..BUSHING,	4
16		..NUT, GLAND	1
17		..PISTON	1
18		..NUT, LOCK	1
19		..ROD	1
-20		..BARREL	1
-21	67051	..KIT SEAL	1
22		...WIPER, ROD	1
23		...SEAL, ROD POLYPAK	1
24		...O-RING	1
25		...RING, BACK-UP	1
26		...O-RING	1

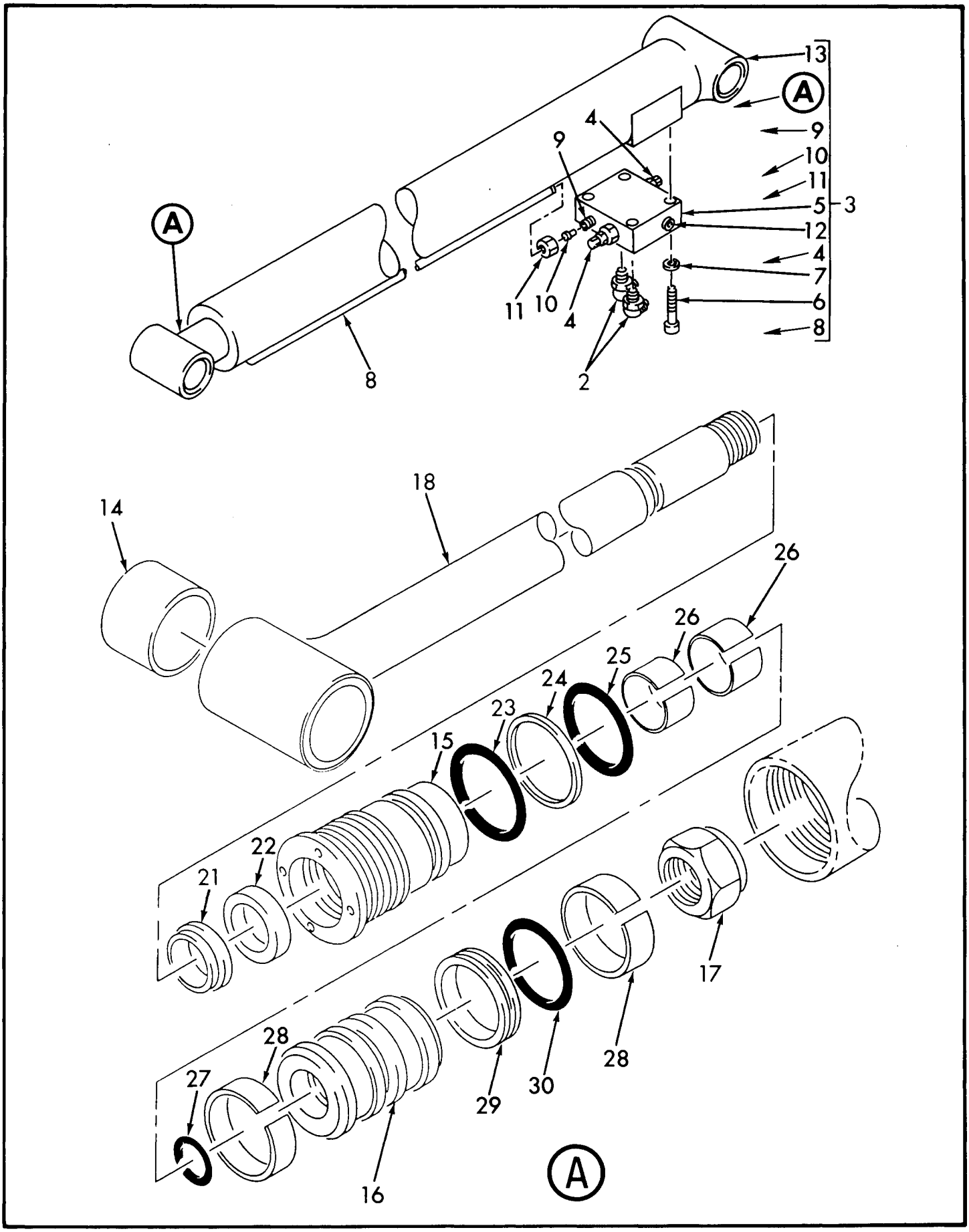
- ITEM NOT ILLUSTRATED

SLAVE LEVELING CYLINDER ASSEMBLY (30 4 X 4)
(CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27		...BEARING, WEAR	2
28		...O-RING	1
29		...RING, WEAR (GLASS/NYLON)	2
30		...SEAL, A.Q. (SQUARE)	1
31		...O-RING	1

- ITEM NOT ILLUSTRATED

EXTENSION CYLINDER ASSEMBLY (30 4 X 4)



EXTENSION CYLINDER ASSEMBLY (30 4 X 4) (CONTINUED)

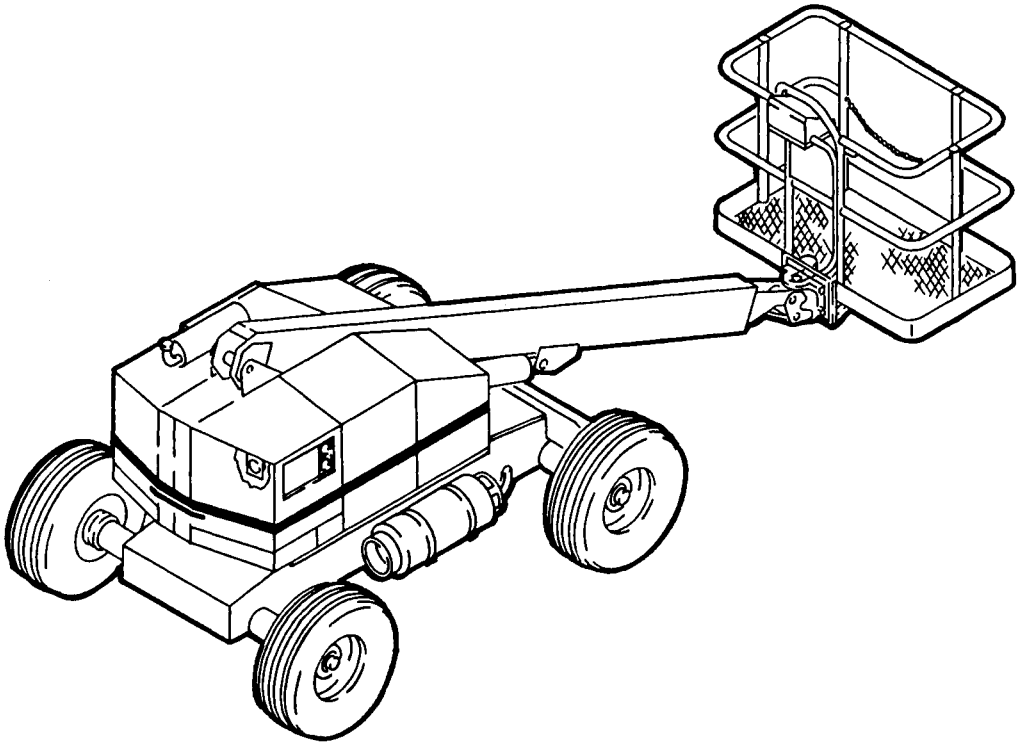
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23680	ASSEMBLY, EXTENSION CYLINDER (See Sect. 5, Fig. 2 for NHA)	REF
2	80012-11	.ELBOW, STRAIGHT THREAD	2
3	23657	.SUB-ASSEMBLY, EXTENSION CYLINDER	1
4	81006	..CARTRIDGE, OVER CENTER	2
5	22820	..BLOCK MANIFOLD	1
6	61947	..SCREW, CAP (attaching part)	4
7	63302	..WASHER, LOCK (attaching part)	4
8	26298	..TUBE, HYDRAULIC	1
9	80004-11	..CONNECTOR, STRAIGHT THREAD	1
10	80062-06	..SLEEVE	1
11	80060-06	..NUT	1
12	80051-03	..PLUG	1
13	23656	..CYLINDER, BOOM EXTENSION	1
14	67122	..BUSHING	4
15		..NUT, GLAND	1
16		..PISTON	1
17		..NUT, LOCK	1
18		..ROD	1
-19		..BARREL	1
-20	67050	..KIT, SEAL	1
21		...WIPER, ROD	1
22		...SEAL, ROD POLYPAK	1
23		...O-RING	1
24		...RING, BACK-UP	1
25		...O-RING	1
26		...BEARING, WEAR	2

- ITEM NOT ILLUSTRATED

EXTENSION CYLINDER ASSEMBLY (30 4 X 4) (CONTINUED)

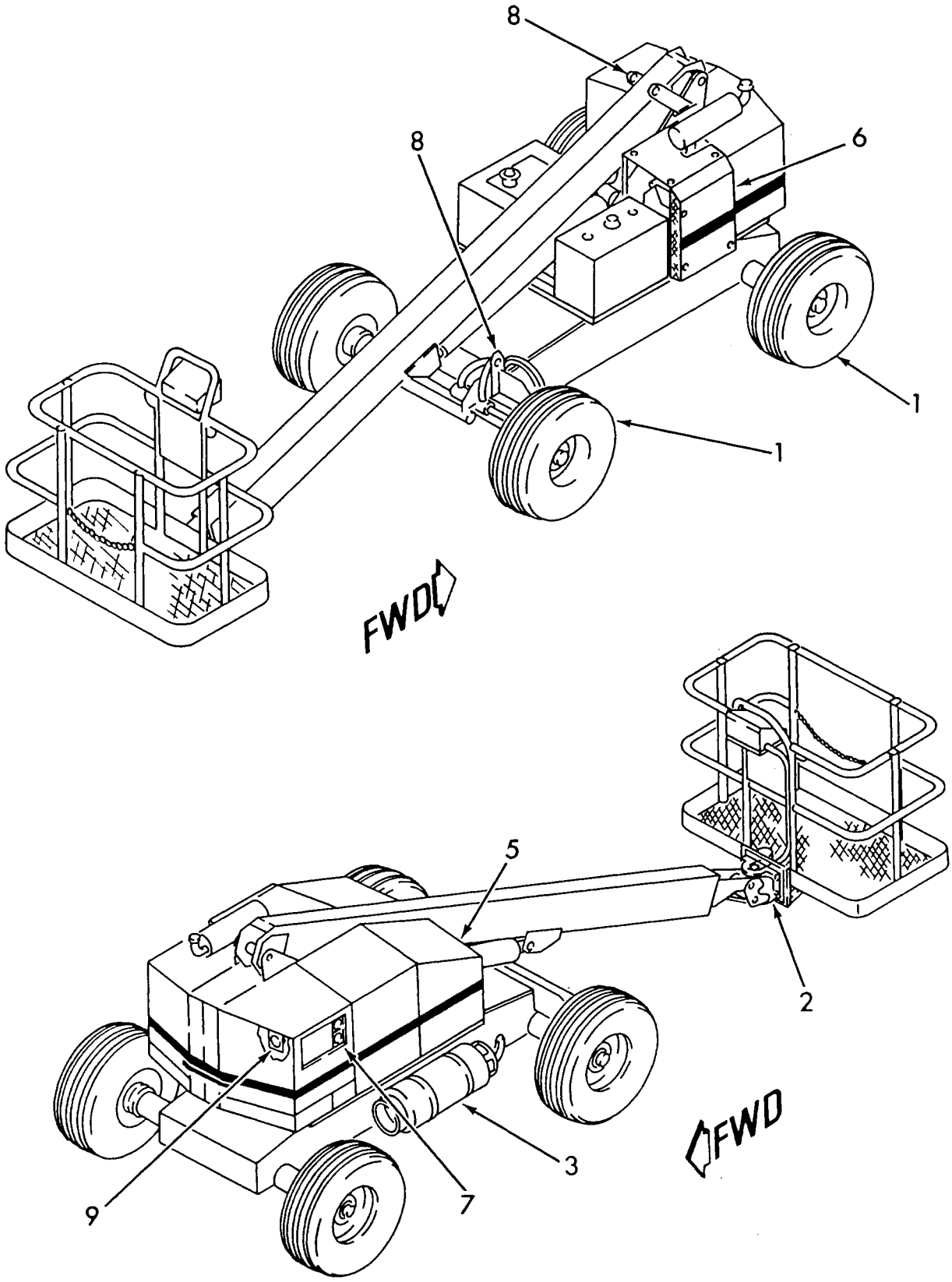
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
27		...O-RING	1
28		...RING, WEAR	2
29		...SEAL, A.Q. SQUARE	1
30		...O-RING	1

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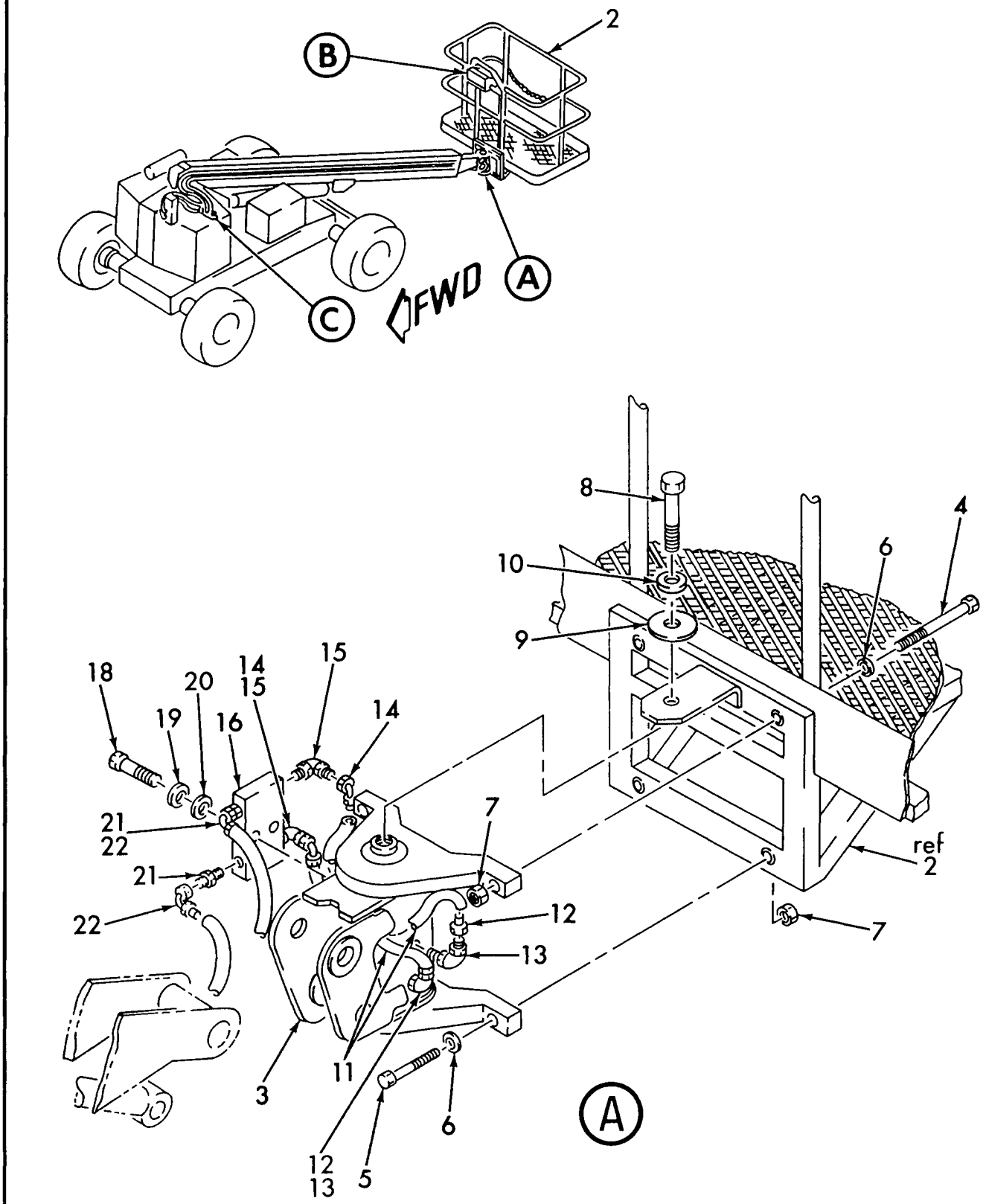
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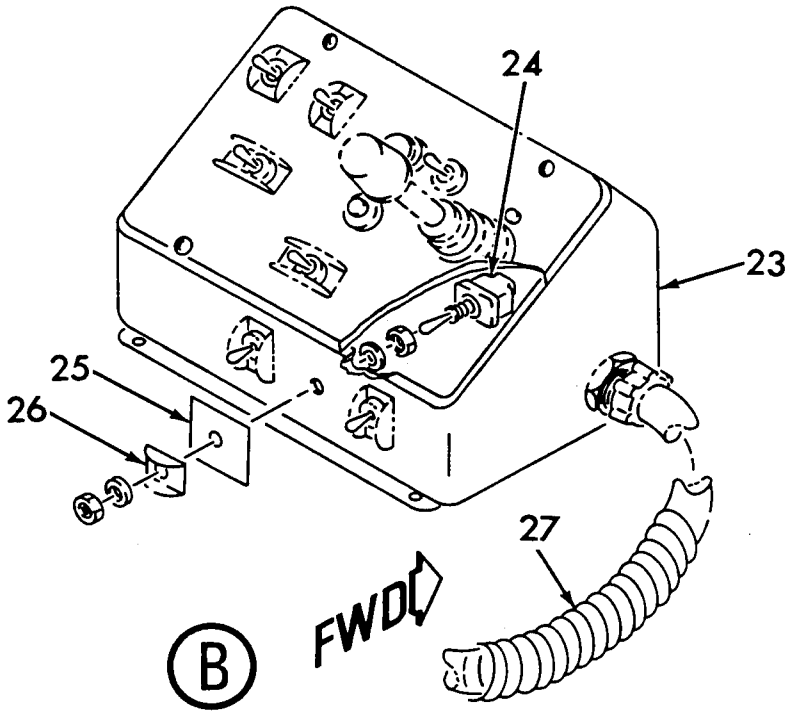
FIGURE 1 OPTIONAL ASSEMBLIES
FIGURE 2 WORK PLATFORM ROTATOR FRONT MOUNT
FIGURE 3 DUAL FUEL
FIGURE 4 CONTINUOUS TURRET ROTATION
FIGURE 5A SHEET METAL COWLING (BEF. JUL. 87)
FIGURE 5B SHEET METAL COWLING (AFT. JUL. 87)
FIGURE 6 ENGINE COVER
FIGURE 7 GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE
FIGURE 8 LIFTING LUGS
FIGURE 9 HOURMETER

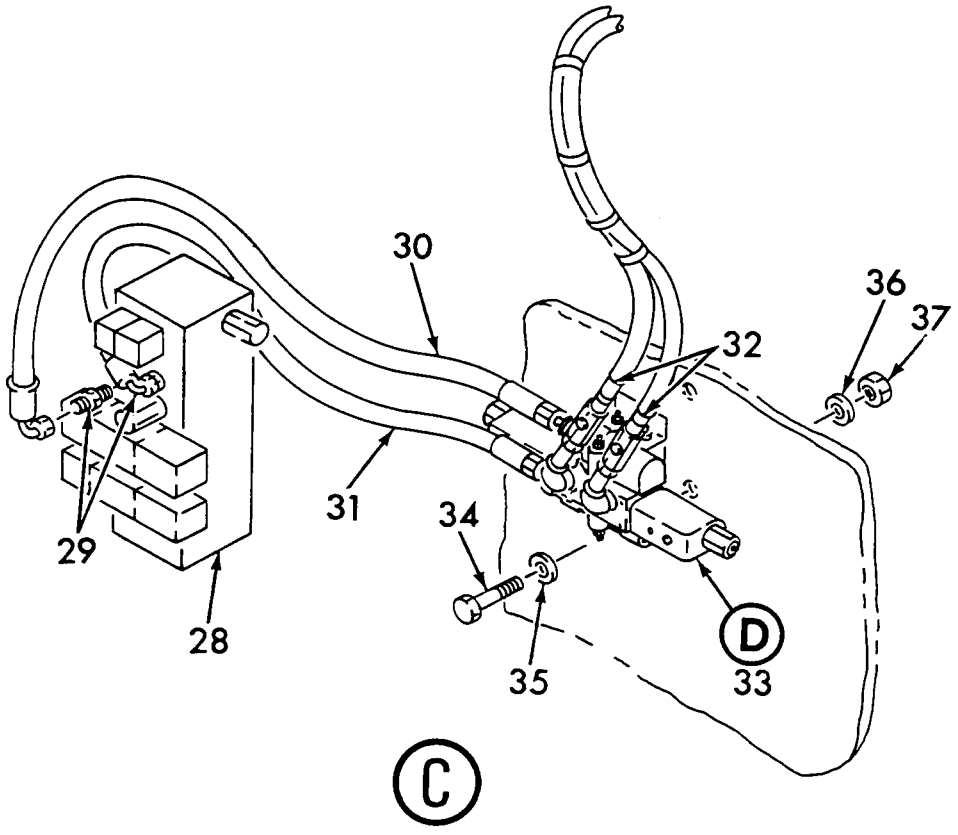

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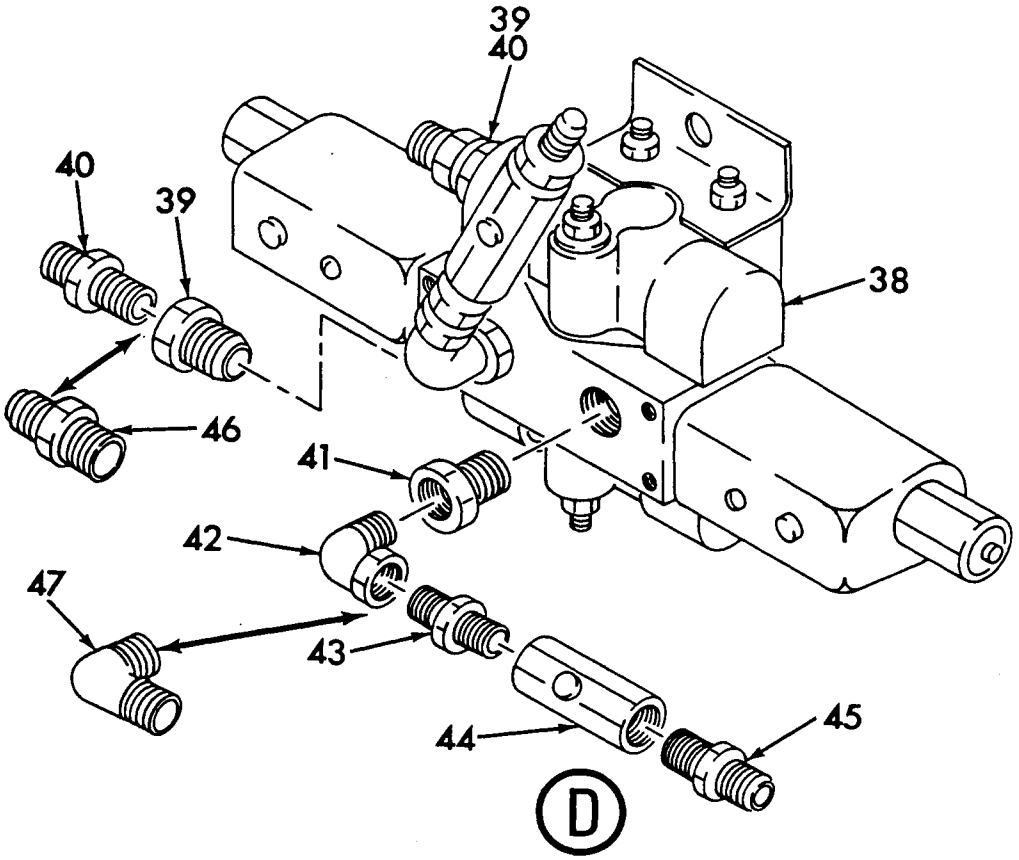
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
1	23317	OPTION, SAND TIRES	1
2	23309	OPTION, WORK PLATFORM ROTATOR FRONT MOUNT (See Sect. 6, Fig. 2 for Details)	1
3	23310	OPTION, DUAL FUEL (See Sect. 6, Fig. 3 for Details)	1
-4	23311	OPTION, CONTINUOUS TURRET ROTATION (See Sect. 6, Fig. 4 for Details)	1
5	23312	OPTION, SHEET METAL COWLING (BEF. JUL. '87) (See Sect. 6, Fig. 5A for Details)	1
-5A	23323	OPTION, SHEET METAL COWLING (AFT. JUL. '87) (See Sect. 6, Fig. 5B for Details)	1
6	23313	OPTION, ENGINE COVER (See Sect. 6, Fig. 6 for Details)	1
7	23314	OPTION, GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE (See Sect. 6, Fig. 7 for Details)	1
8	23315	OPTION, LIFTING LUGS (See Sect. 6, Fig. 8 for Details)	1
9	23316	OPTION, HOUR METER (See Sect. 6, Fig. 9 for Details)	1

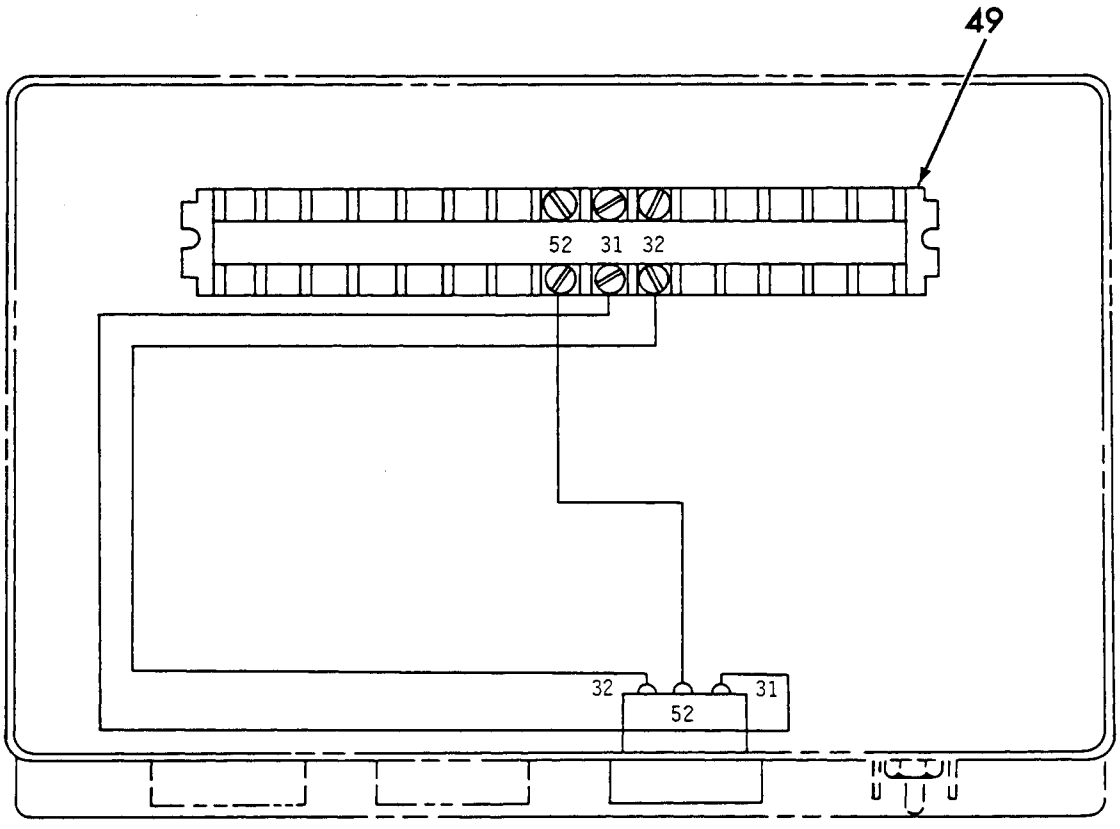
WORK PLATFORM ROTATOR FRONT MOUNT




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WIRING DIAGRAM

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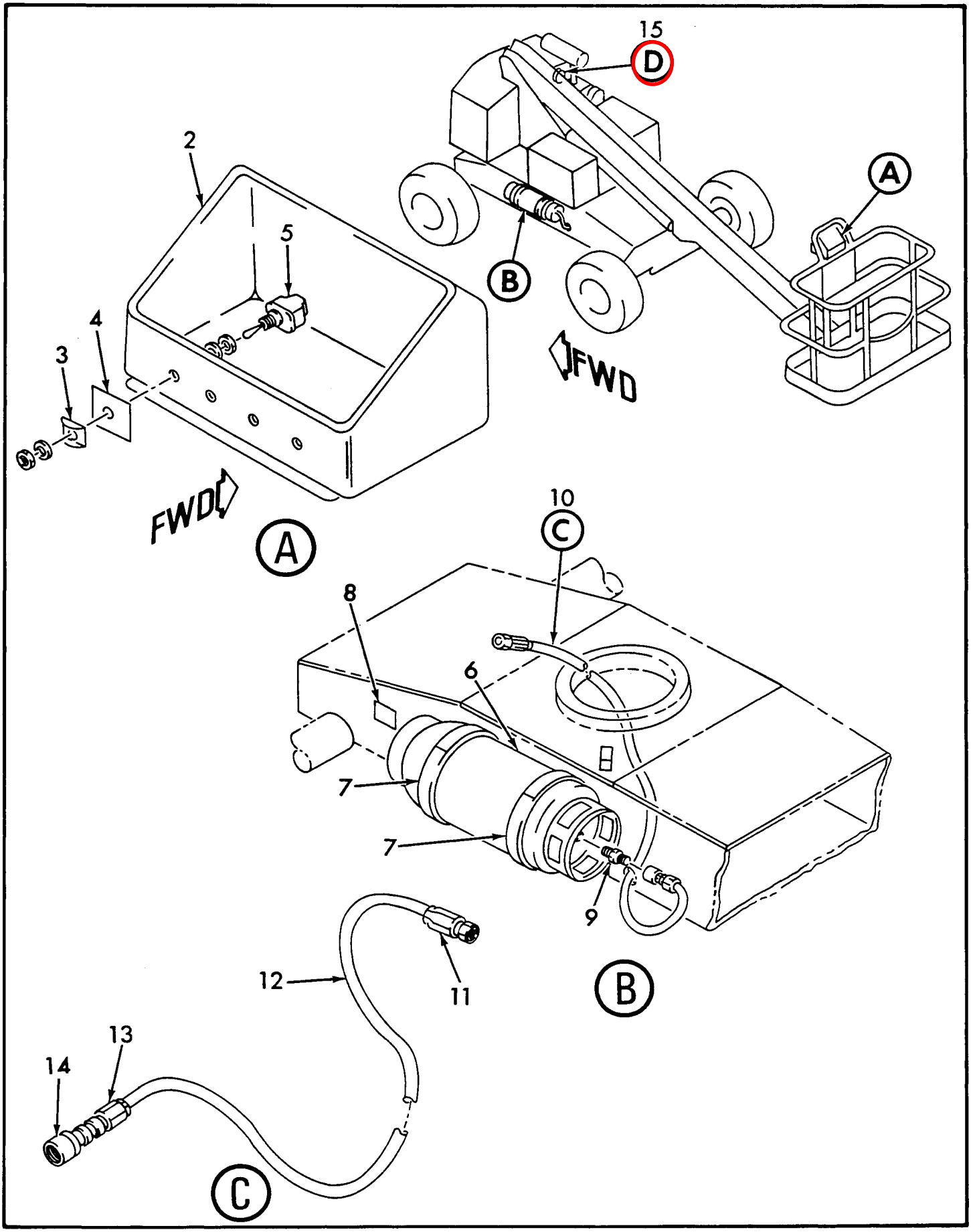
WORK PLATFORM ROTATOR FRONT MOUNT (CONTINUED)

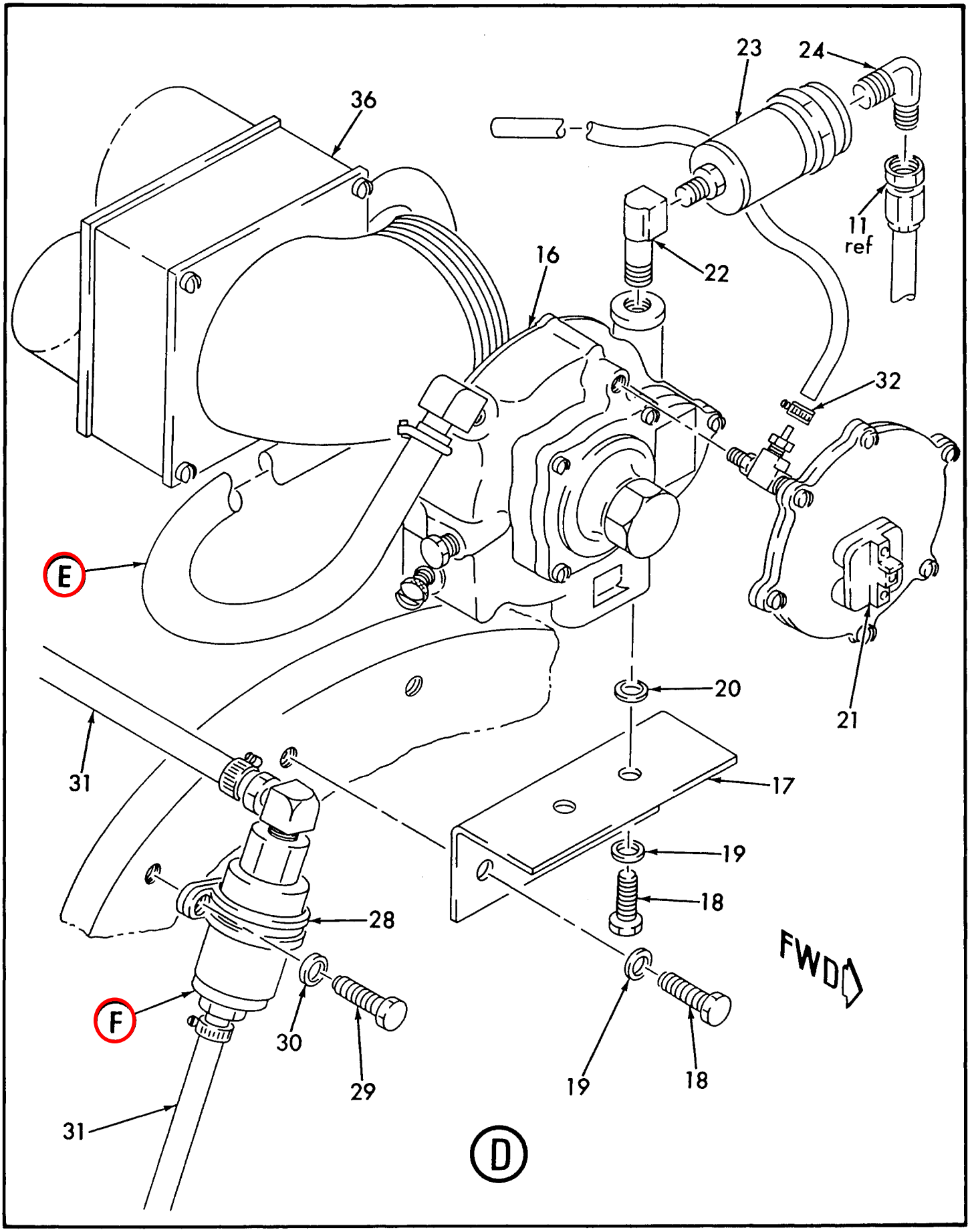
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23309	ROTATOR, FRONT MOUNT WORK PLATFORM (See Sect. 6, Fig. 1 for NHA)	REF
2	23755	.ROTATOR, FRONT MOUNT PLATFORM	1
3	81094	.ROTATOR, HELAC	1
4	60523	.SCREW, CAP (attaching part)	2
5	60549	.SCREW, CAP (attaching part)	2
6	63415	.WASHER, FLAT (attaching part)	4
7	61305	.NUT, LOCK (attaching part)	4
8	60516	.SCREW, CAP (attaching part)	1
9	23565	.WASHER (attaching part)	1
10	63305	.WASHER, LOCK (attaching part)	1
11	2568-0144	.HOSE, HYDRAULIC	2
12	2562	.FITTING, STRAIGHT SWIVEL HOSE	2
13	80012-03	.ELBOW, STRAIGHT THREAD	2
14	2594	.ELBOW, SWIVEL	2
15	80012-05	.ELBOW, STRAIGHT THREAD	2
16	20351	.VALVE, CHECK	1
-17	23197	.BRACKET, CHECK VALVE	1
18	60360	.SCREW, CAP (attaching part)	2
19	63302	.WASHER, LOCK (attaching part)	2
20	63402	.WASHER, FLAT (attaching part)	2
21	80004-05	.CONNECTOR, STRAIGHT THREAD	2
22	2594	.ELBOW, SWIVEL	2
23	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	REF
24	4021	.SWITCH, TOGGLE	1

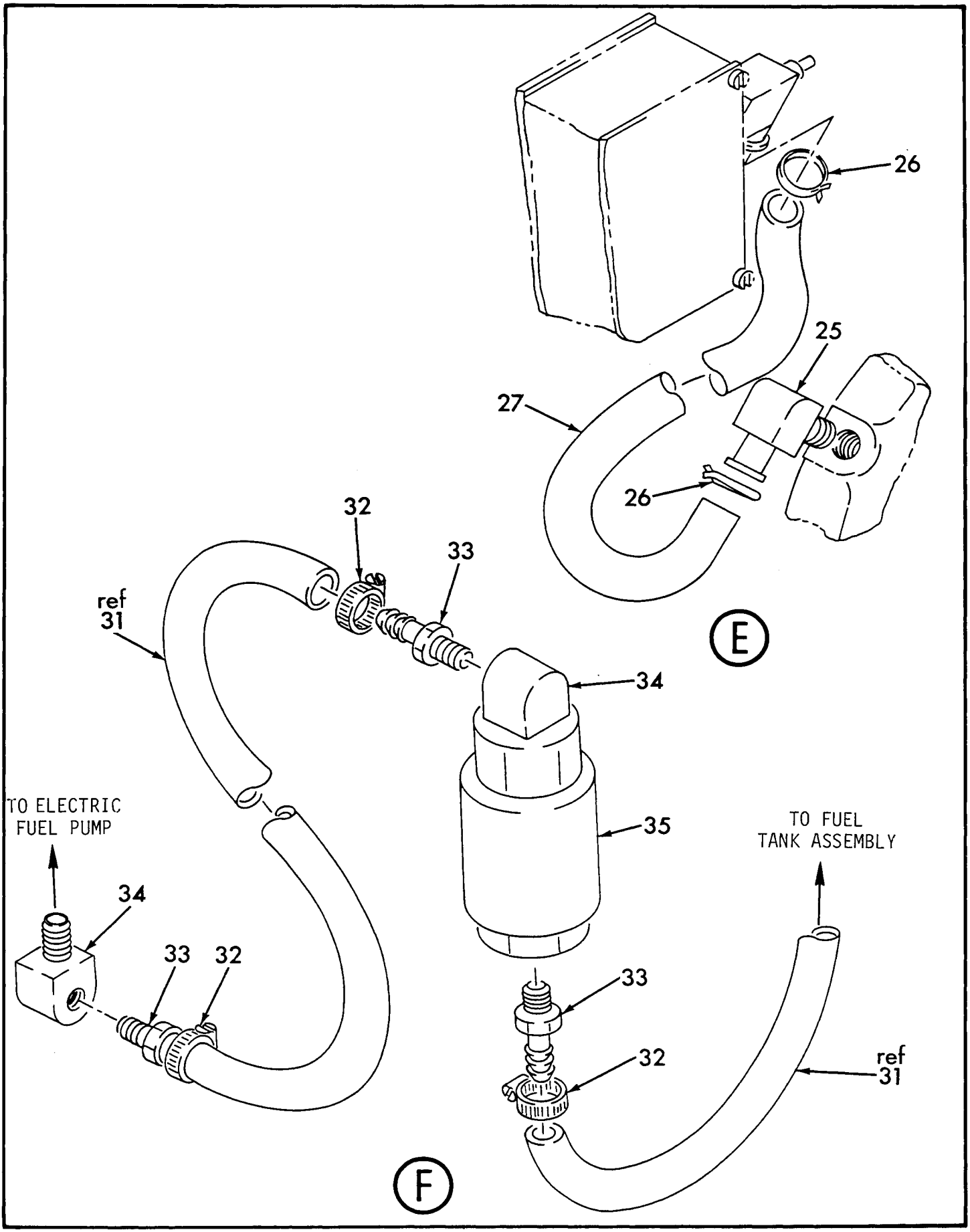
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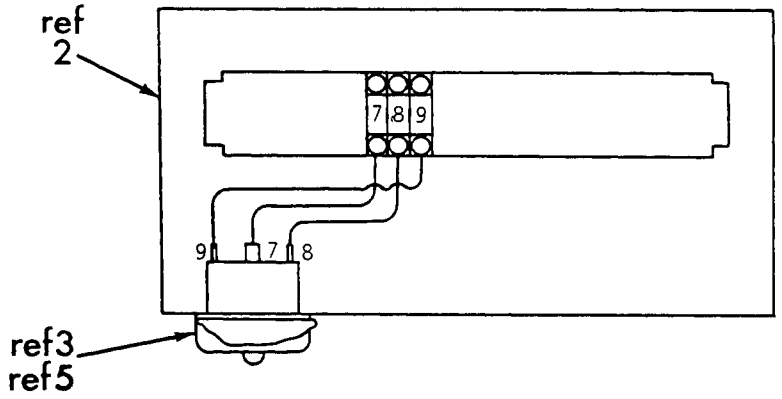
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	23666	.DECAL, BOOM	1
26	20884	.GUARD, SWITCH	1
27	65321-42	.SLEEVE, PLASTIC COIL	1
28	23723	.ASSEMBLY, VALVE CONTROL (See Sect. 4, Fig. 11 for Details)	REF
29	81078	.CONNECTOR, STRAIGHT THREAD	2
30	13213-06-0260	.ASSEMBLY, HOSE	1
31	13213-06-0280	.ASSEMBLY, HOSE	1
32	2562	.FITTING, STRAIGHT SWIVEL HOSE	2
33	23781	.ASSEMBLY, SOLENOID VALVE	1
34	60343	.SCREW, CAP (attaching part)	2
35	63403	.WASHER, FLAT (attaching part)	2
36	63319	.WASHER, LOCK (attaching part)	2
37	60703	.NUT, HEX (attaching part)	2
38	20847	..VALVE, SOLENOID	1
39	80063-01	..ADAPTER, FEMALE PIPE	2
40	80001-08	..CONNECTOR, MALE	2
41	80063-01	..ADAPTER, FEMALE PIPE	2
42	80021-03	..ELBOW, STREET	2
43	80052-04	..NIPPLE, PIPE	2
44	20370	..VALVE, NEEDLE	2
45	80001-04	..CONNECTOR, MALE	2
46	80004-08	..CONNECTOR, STRAIGHT THREAD (Optional to Items No. 39 and No. 40)	1
47	80022-04	..ELBOW, MALE PIPE (Optional to Items No. 42 and No. 43)	1
-48		.DIAGRAM, WIRING	REF
49	4027	.BLOCK, TERMINAL (See Sect. 2, Fig. 3 for Details)	REF

DUAL FUEL

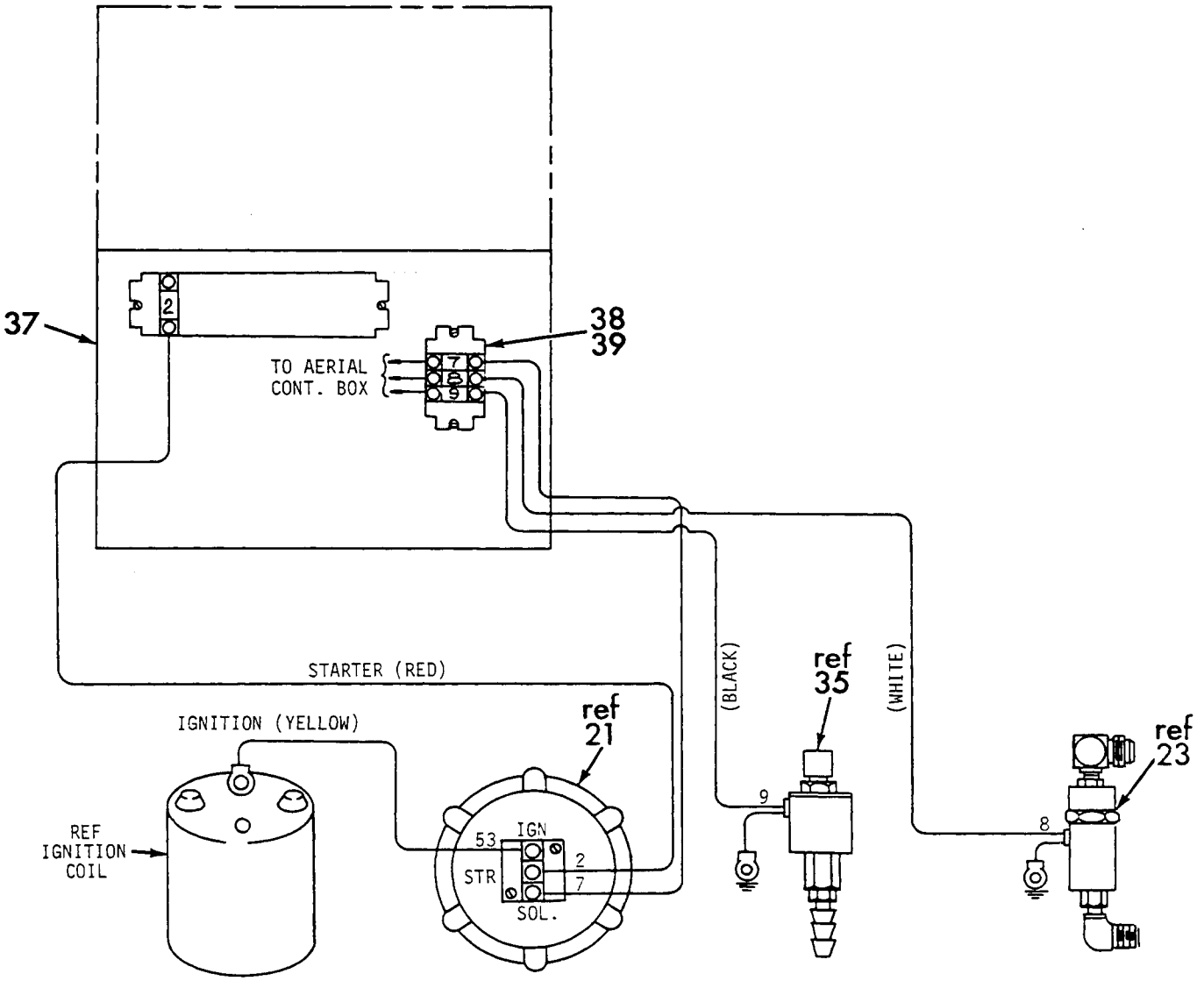



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WIRING DIAGRAM
AERIAL CONTROL BOX



WIRING DIAGRAM
GROUND CONTROL PANEL

DUAL FUEL (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23310	ASSEMBLY, DUAL FUEL (See Sect. 6, Fig. 1 for NHA)	REF
2	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	REF
3	20884	.GUARD, SWITCH	1
4	23783	.DECAL	1
5	4019	.SWITCH	1
6	486-C	.TANK, LPG	1
7	486-A	.BRACKET, TANK	2
8	2004	.DECAL	1
9	65142	.SOCKET, MALE	1
10	23786	.ASSEMBLY, PROPANE HOSE	1
11	16451	..FITTING	1
12	2616	..HOSE	10 FT.
13	16452	..FITTING	1
14	65141	..NIPPLE, FEMALE	1
15	23782	.KIT, DUAL FUEL	1
16	16921	..REGULATOR	1
17	32454	..BRACKET, DUAL FUEL	1
18	60309	..SCREW, CAP (attaching part)	4
19	63301	..WASHER, LOCK (attaching part)	4
20	63401	..WASHER, FLAT (attaching part)	2
21	16975	..KIT, MICROVAC	1
22	16519	..ELBOW, STREET	1
23	16925	..LOCK, PROPANE	1
24	80008-08	..ELBOW, MALE	1

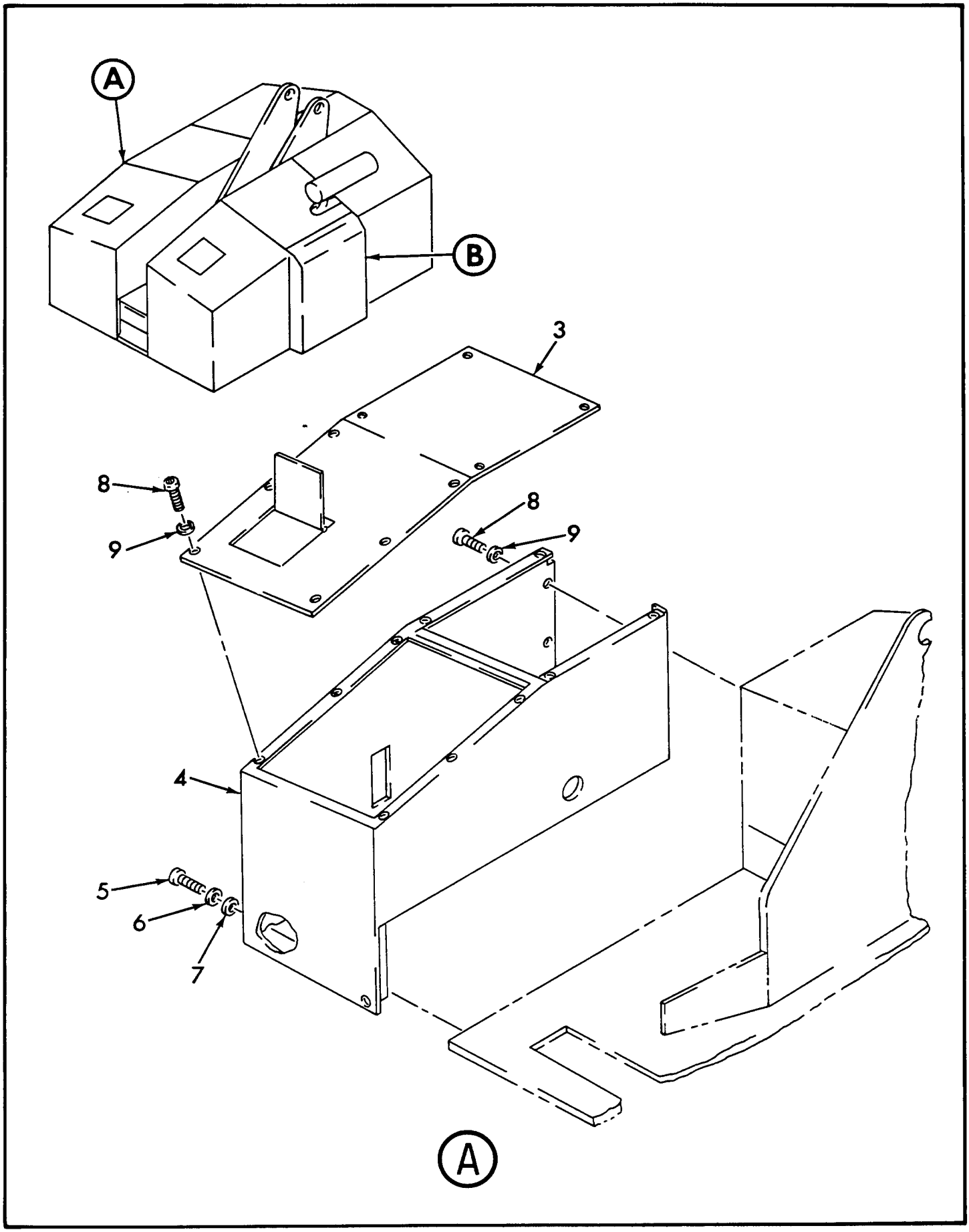
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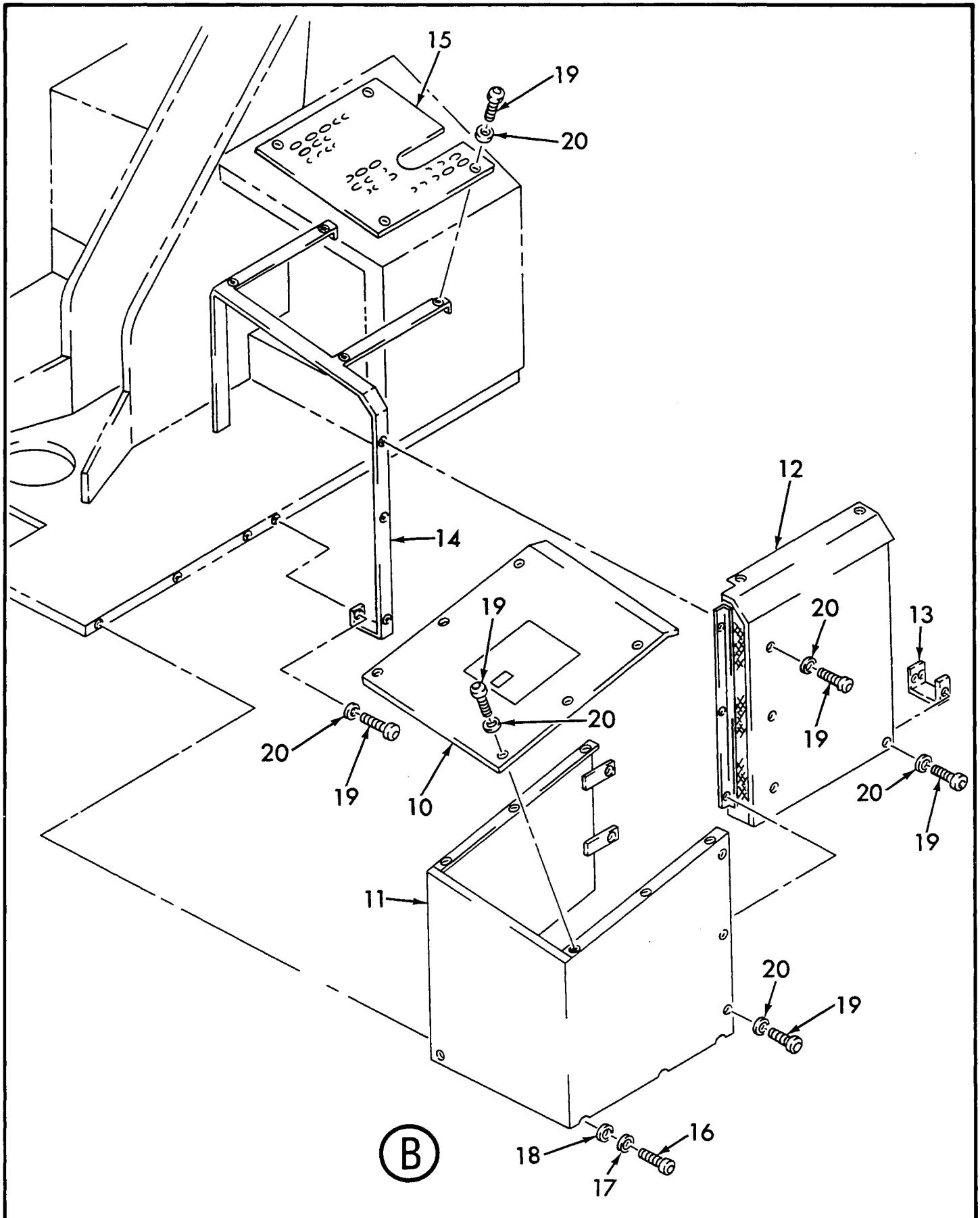
ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	65532	..HOSE, BARB	1
26	2713	..CLAMP, HOSE	2
27	65485-20	..HOSE	1
28	65867	..CLAMP	1
29	60309	..SCREW, CAP (attaching part)	1
30	63301	..WASHER, LOCK (attaching part)	1
31	160-B	..HOSE, FUEL	3.25 FT.
32	161-A	..CLAMP, HOSE	4
33	240	..HOSE, BARB	3
34	66196	..ELBOW, STREET	2
35	20832	..VALVE, FUEL SHUT-OFF	1
36	65510	..ADAPTER, CARBURETOR	1
37	26644	.SHEET, LOWER CONTROL PANEL (See Sect. 4, Fig. 10 for Details)	REF
38	4027	.BLOCK, TERMINAL	3
39	117-A	.CLOCK, TERMINAL END	1
-40	62636	.SCREW, MACHINE (attaching part)	2
-41	63312	.WASHER, LOCK (attaching part)	2
-42	61532	.NUT, HEX (attaching part)	2

CONTINUOUS TURRET ROTATION

THIS SECT. 6, FIG. 4 PART NUMBER 23311
CONTINUOUS TURRET ROTATION DRAWINGS
ARE NOT AVAILABLE THIS REVISION.

SHEET METAL COWLING (BEF. JUL. '87)



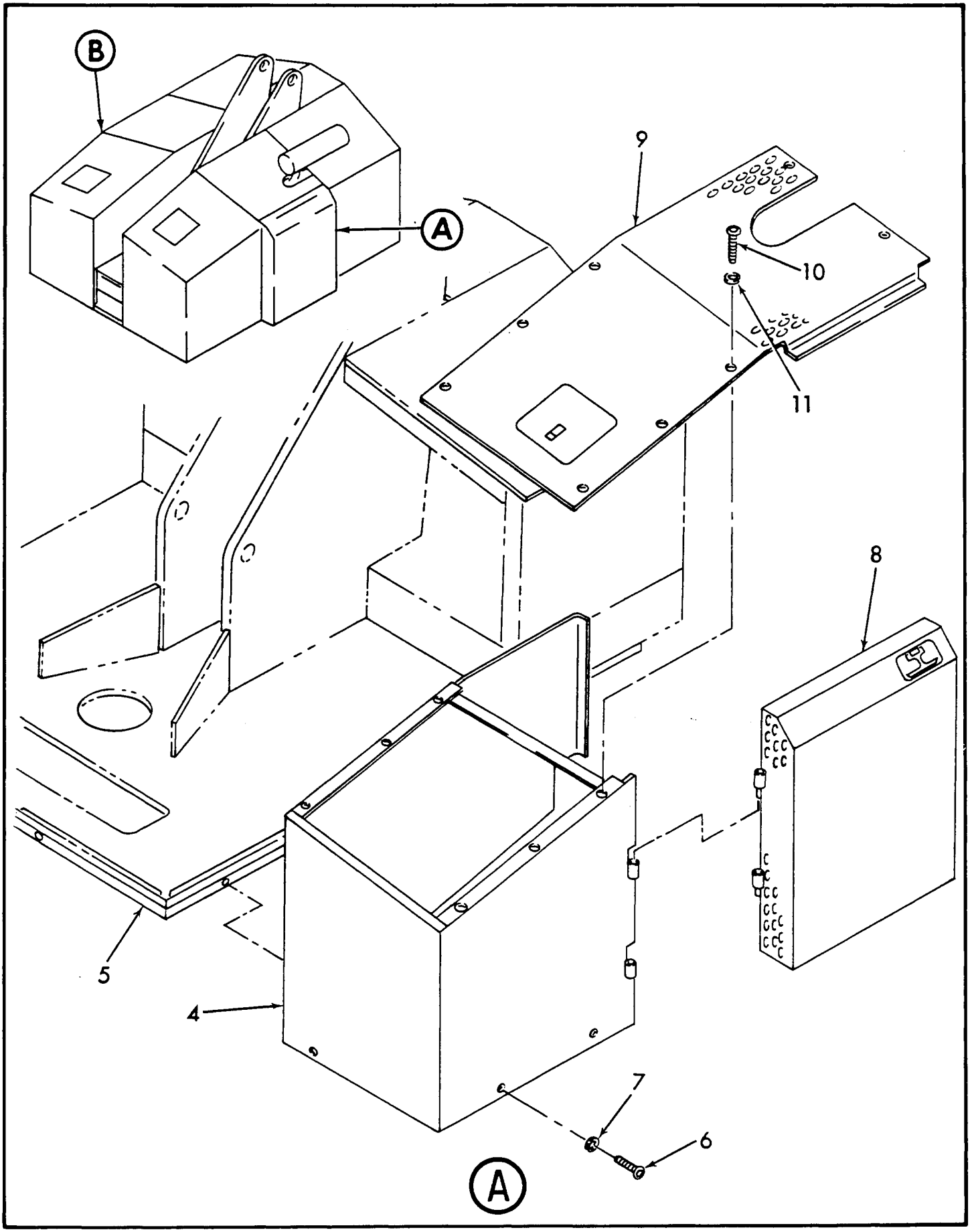

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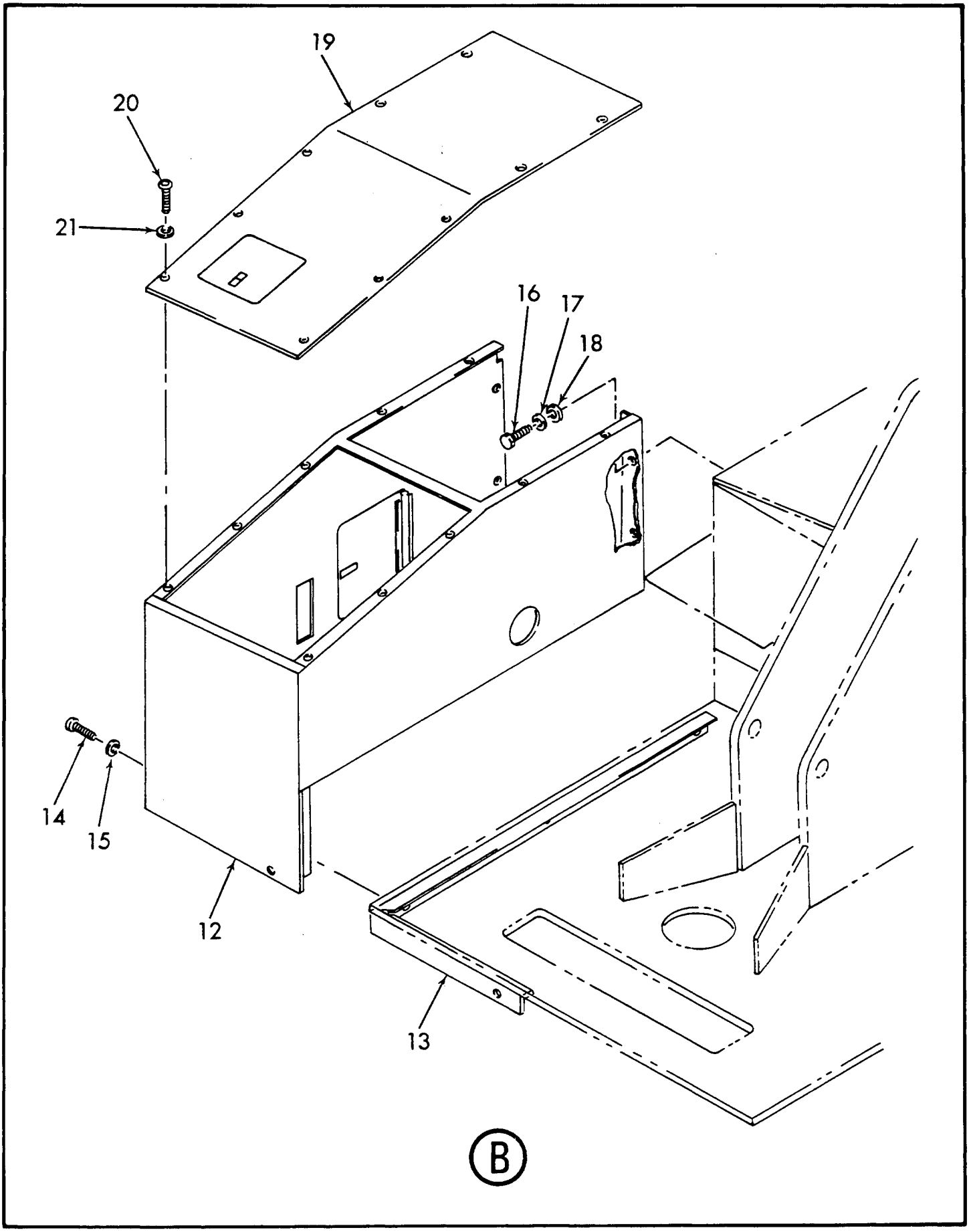
SHEET METAL COWLING (BEF. JUL. '87) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23312	ASSEMBLY, SHEET METAL COWLING (See Sect. 6, Fig. 1 for NHA)	REF
-2	23779	.KIT, SHEET METAL	REF
3	23758	..COVER, TOP LEFT	1
4	23757	..COVER, LEFT	1
5	60322	..SCREW, CAP (attaching part)	5
6	63302	..WASHER, LOCK (attaching part)	5
7	63402	..WASHER, FLAT (attaching part)	5
8	61902	..SCREW, CAP (attaching part)	16
9	63401	..WASHER, FLAT (attaching part)	16
10	23762	..COVER, TOP RIGHT	1
11	23761	..COVER, RIGHT	1
12	23766	..COVER, ENGINE	1
13	23765	..MOUNTING BRACKET, ENGINE COVER	1
14	23767	..SUPPORT, ENGINE COVER	1
15	23774	..COVER, TOP RIGHT REAR	1
16	60322	..SCREW, CAP (attaching part)	3
17	63302	..WASHER, LOCK (attaching part)	3
18	63402	..WASHER, FLAT (attaching part)	3
19	61902	..SCREW, CAP (attaching part)	28
20	63401	..WASHER, FLAT (attaching part)	28

- ITEM NOT ILLUSTRATED

SHEET METAL COWLING (AFT. JUL. '87)



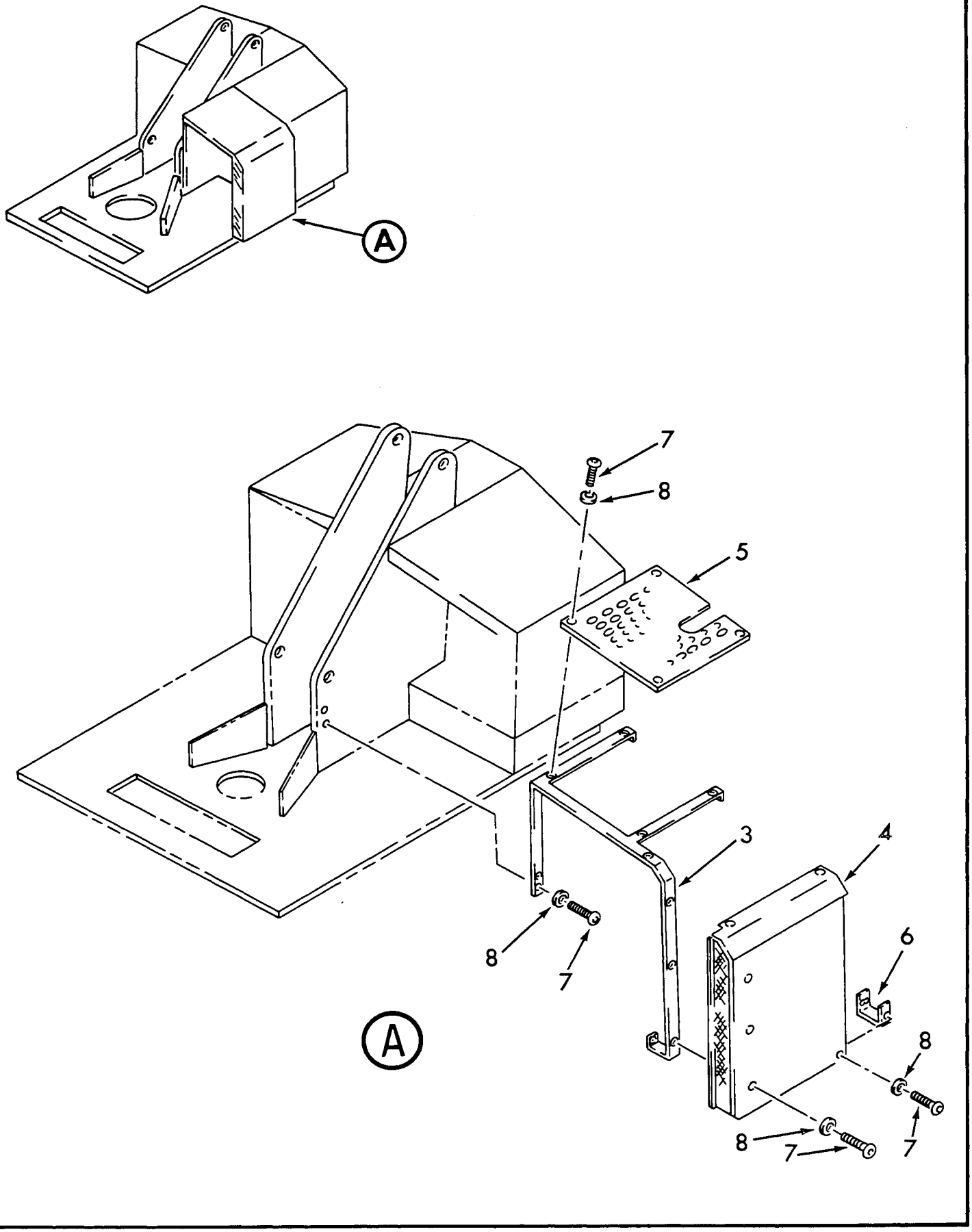

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SHEET METAL COWLING (AFT. JUL. '87) (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23323	ASSEMBLY, SHEET METAL COWLING (See Sect. 6, Fig. 1 for NHA)	REF
-2	23827	.INSTALLATION, SHEET METAL KIT	1
-3	23821	.KIT, SHEET METAL	1
4	23816	..COVER, RIGHT	1
5	23818	..ANGLE, MOUNTING	1
6	61902	..SCREW, CAP (attaching part)	3
7	63401	..WASHER, FLAT (attaching part)	3
8	23819	..COVER, ENGINE	1
9	23822	..COVER, TOP RIGHT	1
10	61902	..SCREW, CAP (attaching part)	8
11	63401	..WASHER, FLAT (attaching part)	8
12	23815	..COVER, LEFT	1
13	23814	..ANGLE, MOUNTING	1
14	61902	..SCREW, CAP (attaching part)	7
15	63401	..WASHER, FLAT (attaching part)	7
16	60322	..SCREW, CAP (attaching part)	2
17	63302	..WASHER, LOCK (attaching part)	2
18	63402	..WASHER, FLAT (attaching part)	2
19	23758	..COVER, TOP LEFT	1
20	61902	..SCREW, CAP (attaching part)	10
21	63401	..WASHER, FLAT (attaching part)	10

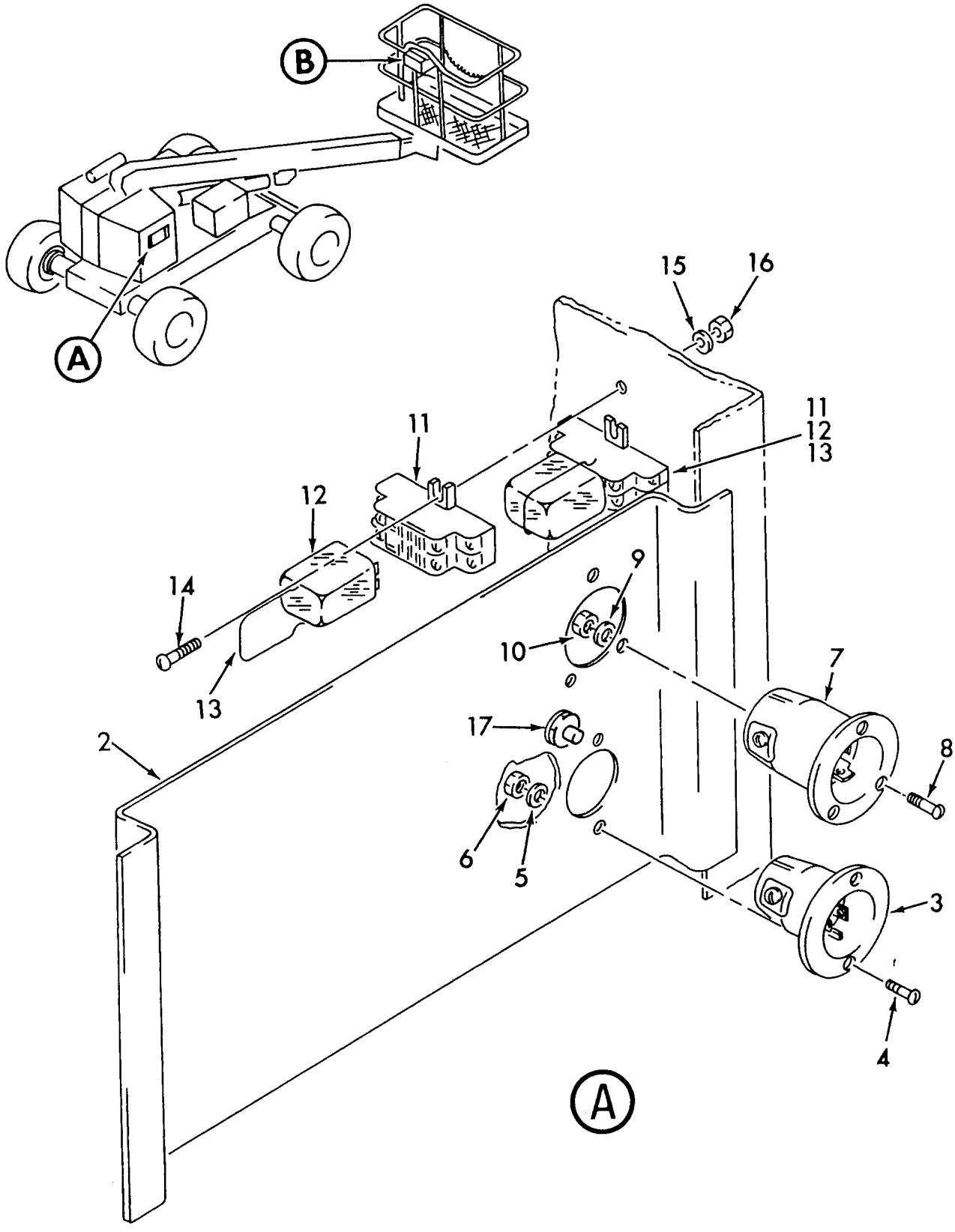
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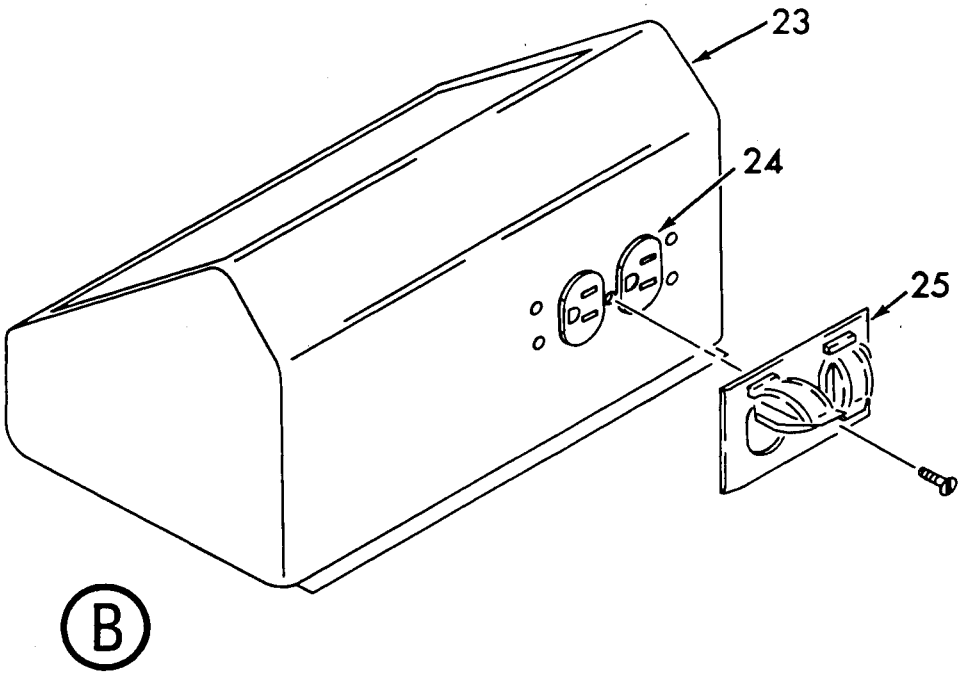
ENGINE COVER

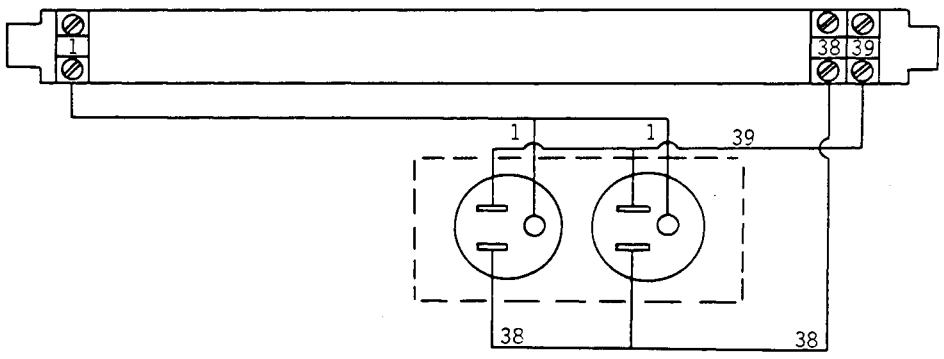


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23313	ASSEMBLY, ENGINE COVER (See Sect. 6, Fig. 1 for NHA)	REF
-2	23780	.KIT, ENGINE COVER	REF
3	23767	..SUPPORT, ENGINE COVER	1
4	23766	..COVER, ENGINE	1
5	23774	..COVER, TOP RIGHT REAR	1
6	23765	..BRACKET, ENGINE COVER MOUNTING	1
7	61902	..SCREW, CAP (attaching part)	17
8	63401	..WASHER, FLAT (attaching part)	17

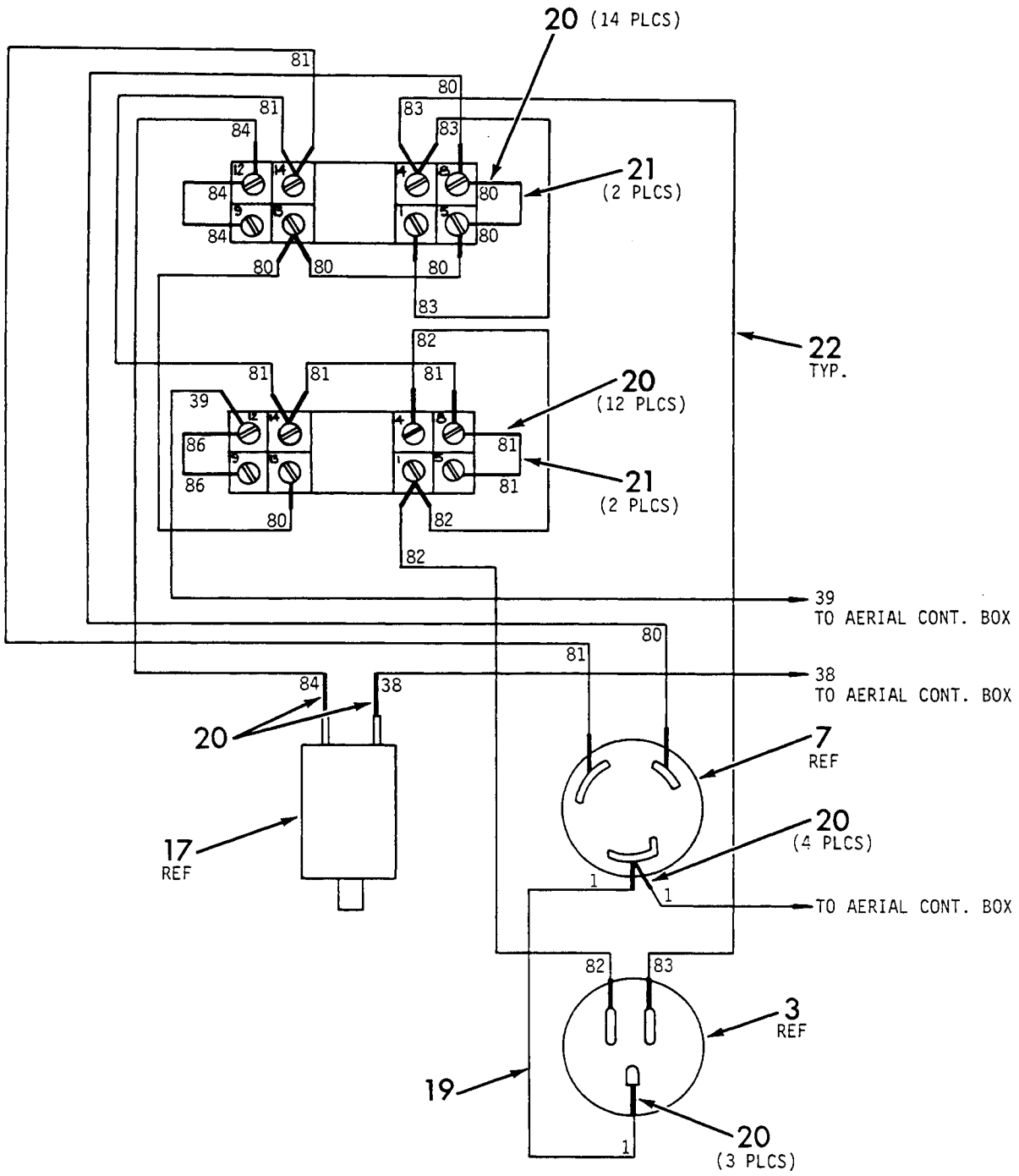
GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE







WIRING, AERIAL CONTROL BOX



WIRING, LOWER CONTROL PANEL

GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23314	ASSEMBLY, LOWER AND AERIAL 110 VAC WIRING AND RECEPTACLE (OPTION) (See Sect. 6, Fig. 1 for NHA)	REF
2	26644	.SHEET, LOWER CONTROL PANEL (See Sect. 4, Fig. 10 for Details)	REF
3	66734	.RECEPTACLE, STRAIGHT BLADE	1
4	62609	.SCREW, MACHINE (attaching part)	2
5	63311	.WASHER, LOCK (attaching part)	2
6	61501	.NUT, HEX (attaching part)	2
7	70254	.RECEPTACLE	1
8	62636	.SCREW, MACHINE (attaching part)	3
9	63312	.WASHER, LOCK (attaching part)	3
10	61502	.NUT, HEX (attaching part)	3
11	70352	.SOCKET, RELAY SCREW TERMINAL	2
12	70351	.RELAY, DP DT	2
13	70359	.SPRING, HOLD DOWN	2
14	62623	.SCREW, MACHINE (attaching part)	3
15	63312	.WASHER, LOCK (attaching part)	3
16	61502	.NUT, HEX	3
17	20562	.BREAKER, CIRCUIT	1
-18		.DIAGRAM, WIRING	REF
19	70098	.WIRE	1 FT.
20	117-C	.CONNECTOR, RING	35
21	70233	.WIRE	1 FT.
22	2991	.WIRE	4 FT.
23	23707	.ASSEMBLY, AERIAL CONTROL BOX (See Sect. 2, Fig. 3 for Details)	REF
24	70126	.RECEPTACLE, DUPLEX	1

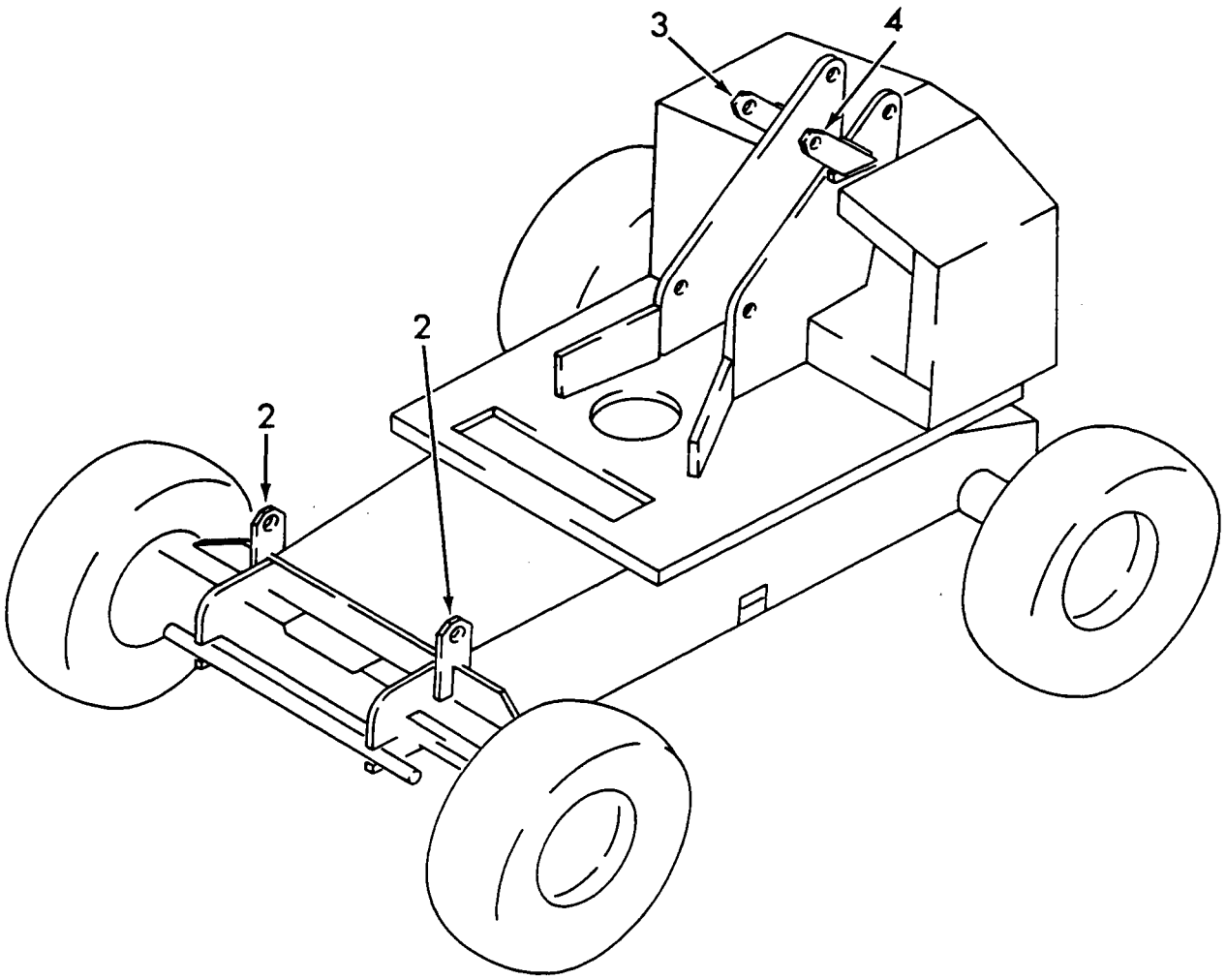
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GROUND AND AERIAL 110 VAC WIRING AND RECEPTACLE
(CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
25	288	.PLATE, SNAP COVER	1
-26		.DIAGRAM, WIRING AERIAL CONTROL BOX	REF

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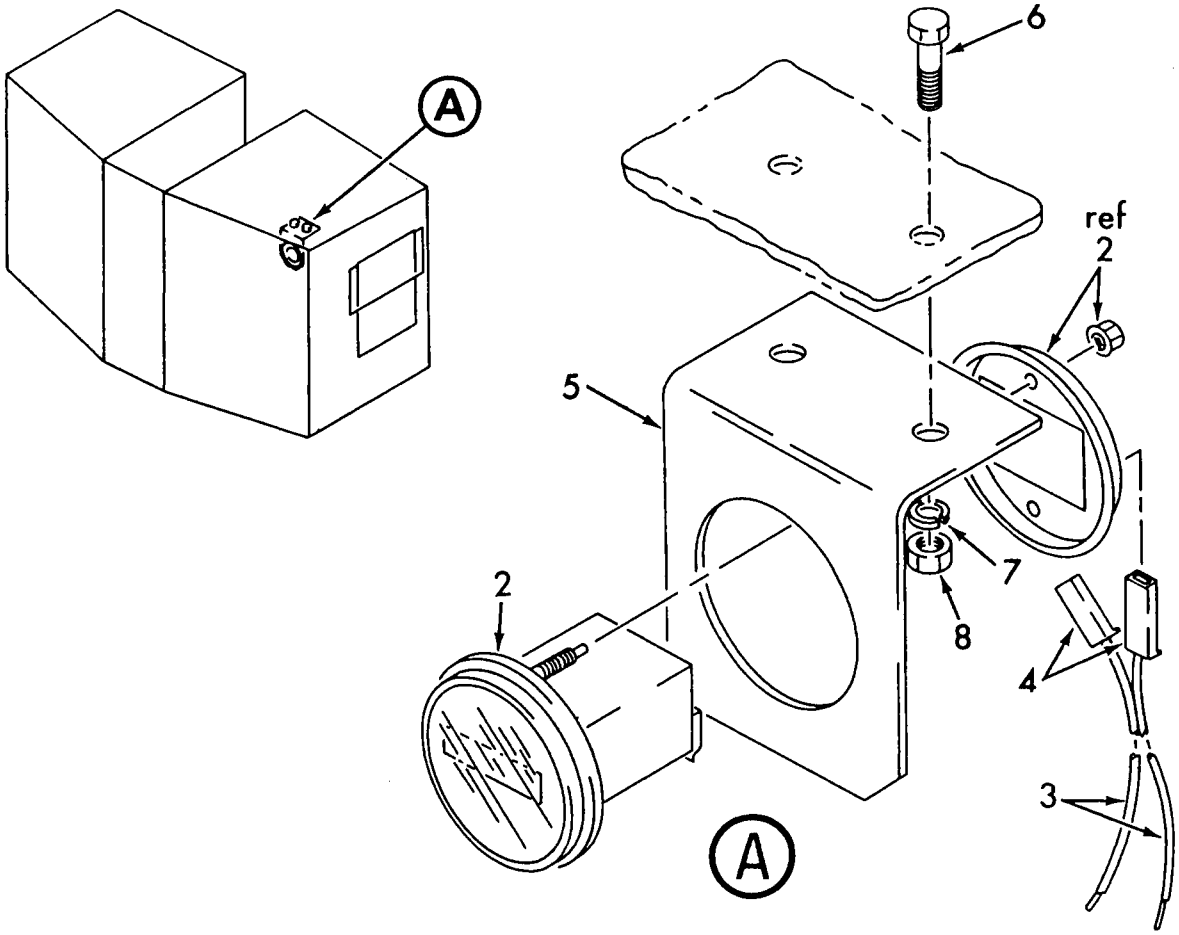
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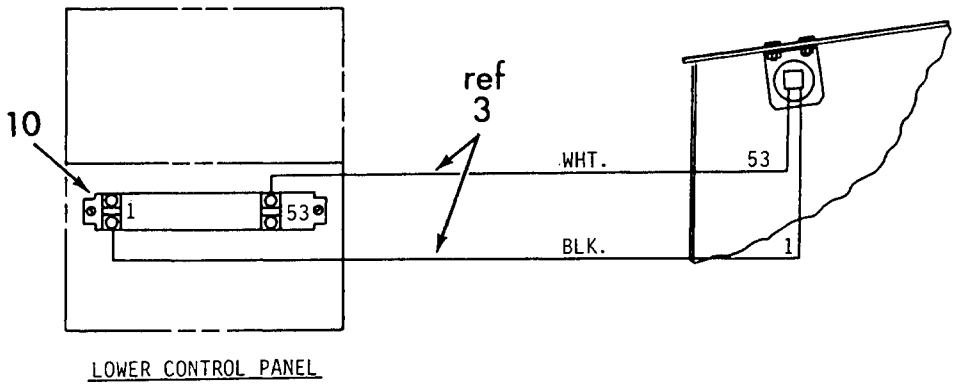


ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23315	ASSEMBLY, LUG LIFTING (OPTION) (See Sect. 6, Fig. 1 for NHA)	REF
2	23792	.LUG, CARRIAGE LIFTING	2
3	23793	.LUG, LEFT HAND TURRET LIFTING	1
4	23794	.LUG, RIGHT HAND TURRET LIFTING	1

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HOURMETER





LOWER CONTROL PANEL

WIRING DIAGRAM

REV.

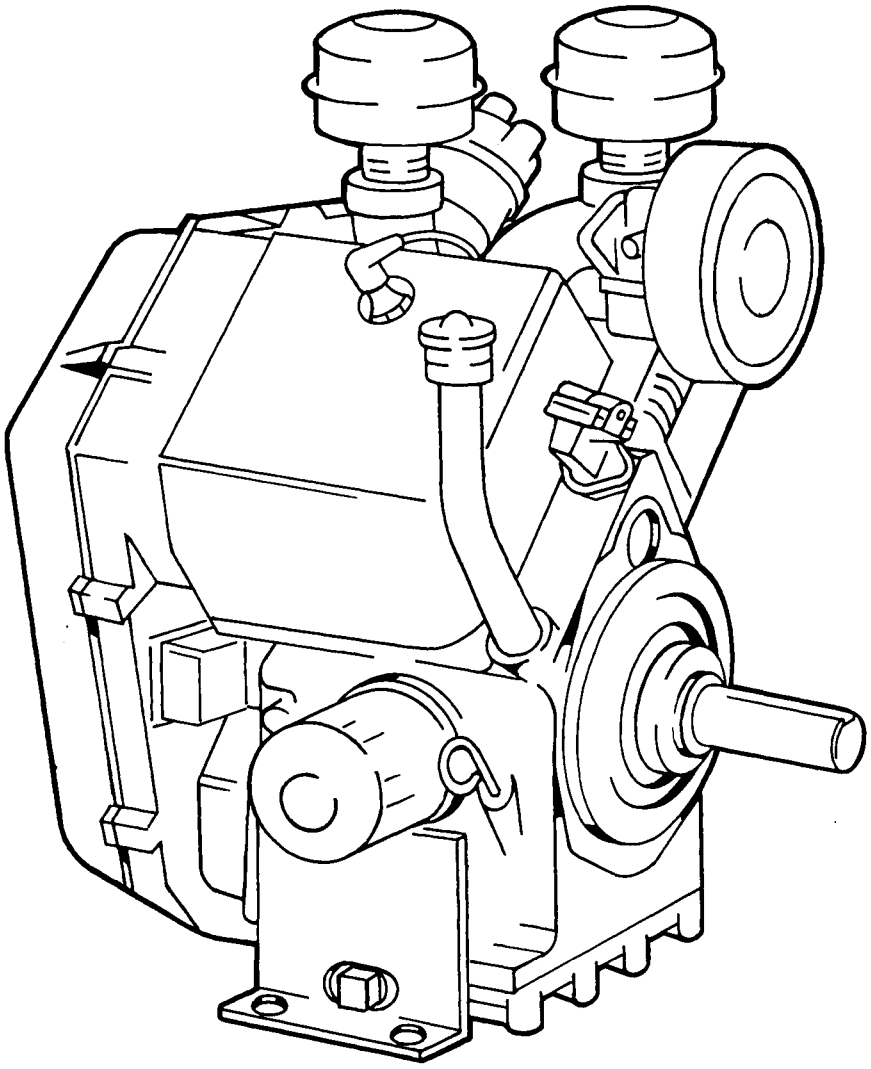
HOURMETER (CONTINUED)

ITEM	PART NUMBER	DESCRIPTION 1234567	UNIT PER ASSY.
-1	23316	ASSEMBLY, HOUR METER (OPTIONAL) (See Sect. , Fig. for NHA)	REF
2	20571	.METER, HOUR	1
3	2768-0360	.CABLE, ELECTRICAL	3 FT.
4	117-E	.TERMINAL, PUSH-ON	2
5	23737	.BRACKET, HOURMETER	1
6	60322	.SCREW, CAP (attaching part)	2
7	63302	.WASHER, LOCK (attaching part)	2
8	60702	.NUT, HEX (attaching part)	2
-9		.DIAGRAM, WIRING	REF
10	4027	.BLOCK, TERMINAL (See Sect. 4, Fig. 10 for Details)	REF

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REPAIR MANUAL

WISCONSIN ENGINE



gasoline
air cooled
2 cylinder

Model W2-1250

MAY BE USED FOR
MODELS W2-1230
AND W2-1235

TELEDYNE WISCONSIN MOTOR
MILWAUKEE, WISCONSIN 53219

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SPECIFICATIONS

MODELS W2-1230 and W2-1235

Bore ..... 3.75 in. (95.25 mm)
Stroke ..... 3.40 in. (86.36 mm)
Piston displacement ..... 75 cu. in. (1230 cc)
Compression ratio 6.8:1

Horsepower

Continuous duty operation is recommended at 80% of horsepower shown.

Engine rated performance is documented to Engine Test Code — S.A.E. J-1349.

Model W2-1230 .....25 hp at 3600 rpm
Model W2-1235 .....30 hp at 3600 rpm

Horsepower specified in the accompanying chart is for an atmospheric temperature of 77°F (25°C) at sea level and at a dry Barometric pressure of 29.31 inches (744.5 mm) of mercury.

For each inch (25.4 mm) lower the Barometric pressure drops, there will be a loss in horsepower of 3½%.

For each 10°F (5.5°C) temperature rise there will be a reduction in horsepower of 1%.

For each 1000 ft. (305 m) altitude above sea level there will be a reduction in horsepower of 3½%.

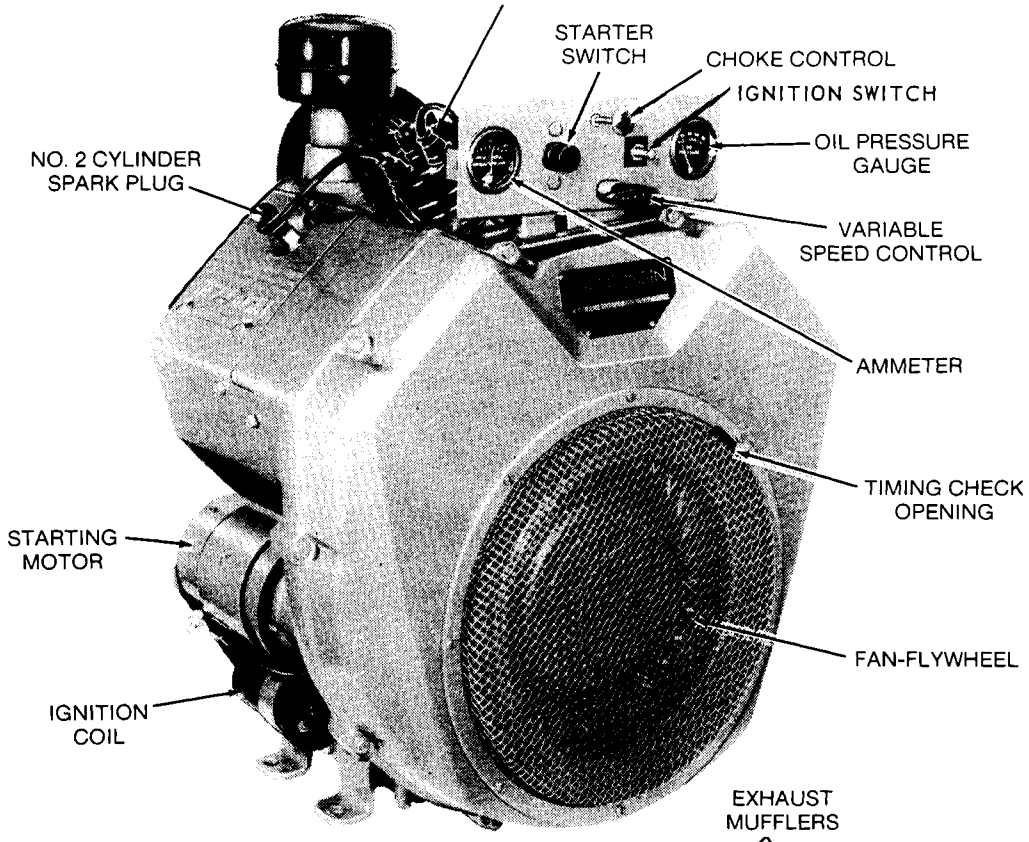
The friction in new engines cannot be reduced to the ultimate minimum during the regular block test, but engines are guaranteed to develop at least 85 per cent of maximum power when shipped from the factory. The power will increase as friction is reduced during the first few days of operation. The engine will develop at least 95% of maximum horsepower when friction is reduced to a minimum.

SAFETY PRECAUTIONS

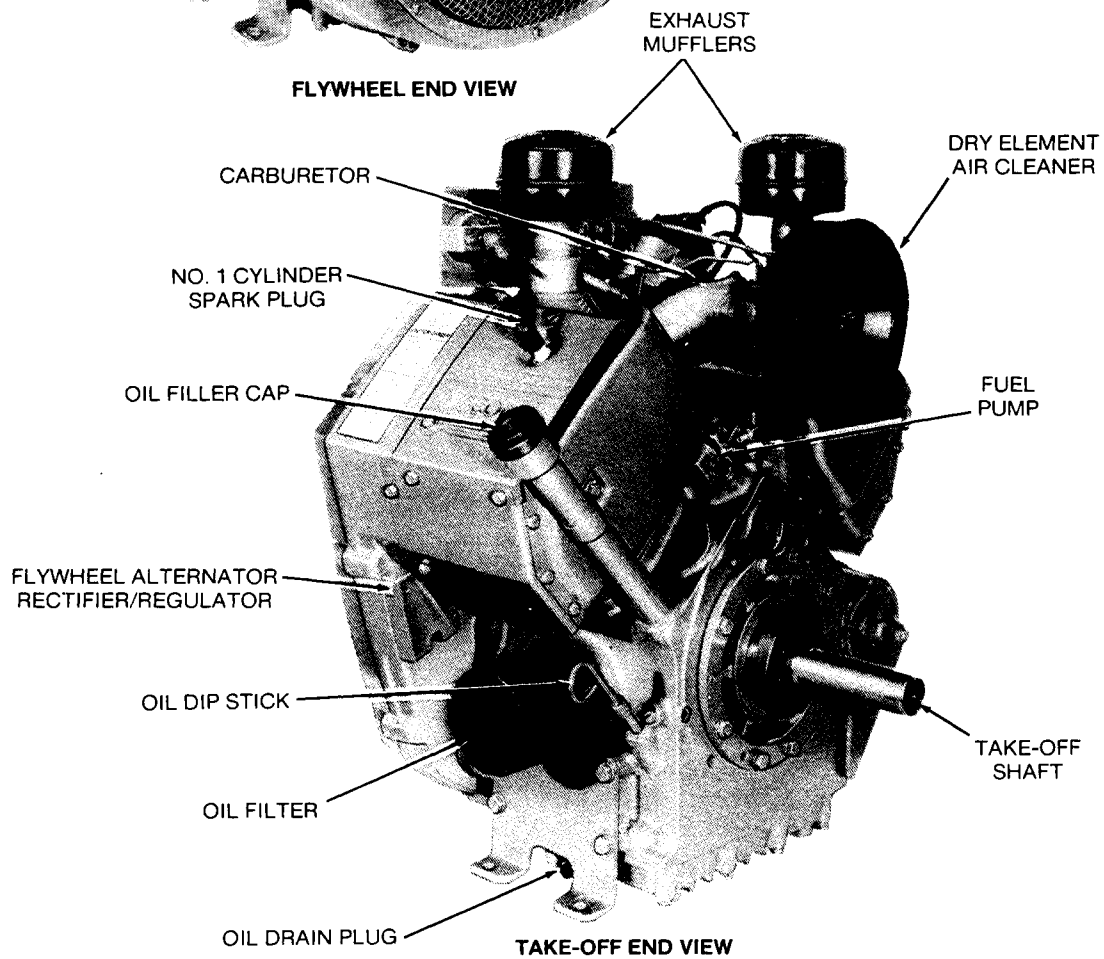
Careless use of the engine causes a high percentage of accidents. Avoid serious injury by being alert, use common sense and be safety minded. Observe the following precautions and carefully enforce them when operating your ***Wisconsin Engine.*** Read operating instructions thoroughly — Know how to stop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

⚠ This symbol indicates important safety messages throughout this Repair Manual — ***Read Them Carefully.***

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



FLYWHEEL END VIEW



TAKE-OFF END VIEW

Fig. 1

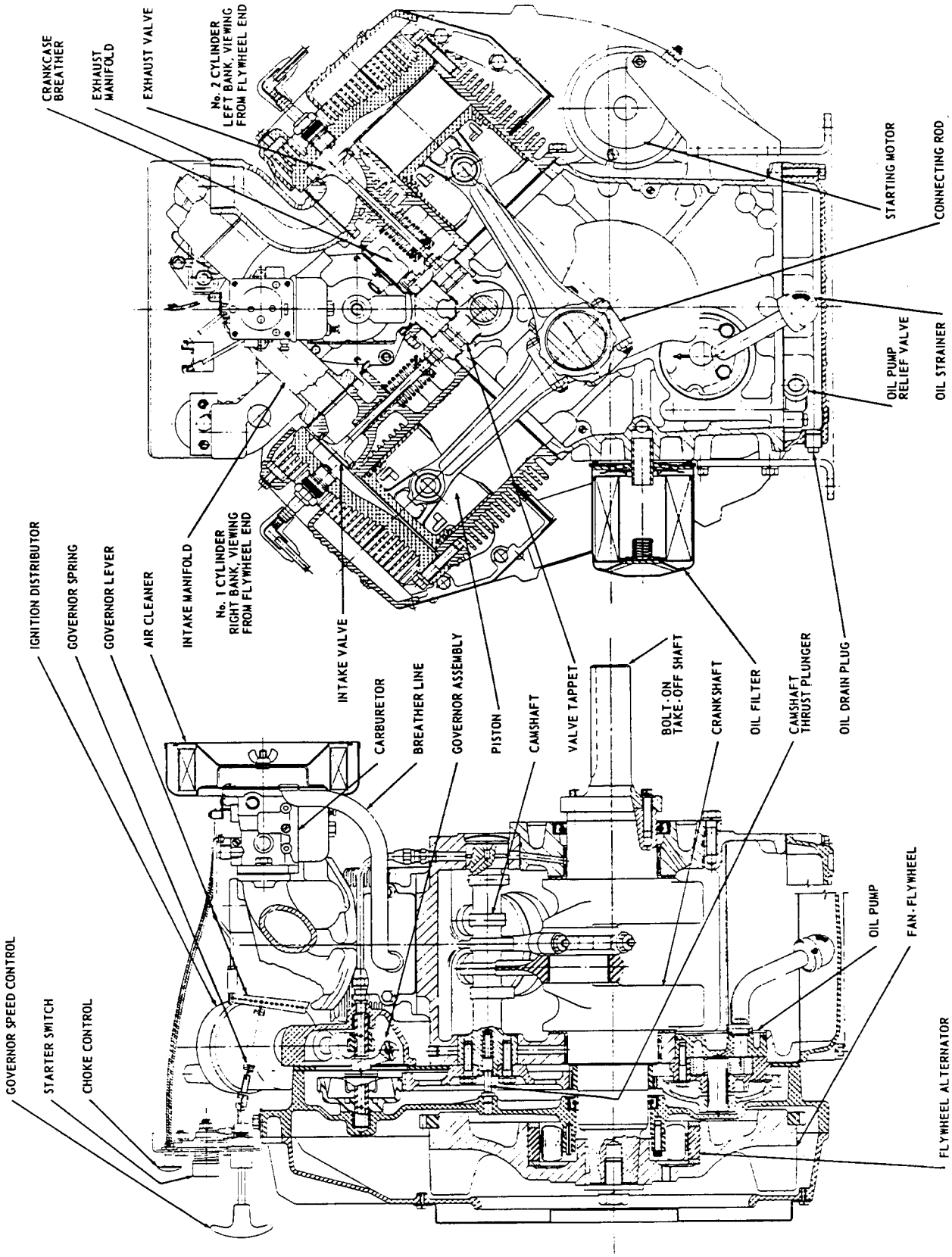


Fig. 2 ENGINE SECTIONAL VIEWS

GENERAL INFORMATION and DESIGN

Wisconsin engines are of the ***four cycle*** type, in which each of the four operations of ***intake, compression, expansion*** and ***exhaust*** requires 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, by a combination fan-flywheel encased in a cast aluminum shroud. The air is divided and directed by ducts and baffles to achieve maximum cooling efficiency.

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

Keep the cylinder and head fins free from dirt and chaff. Improper circulation of cooling air will cause engine to overheat.

CARBURETOR

The proper combustible mixture of gasoline and air is furnished by a calaberated carburetor, with a fixed main metering jet, that provides correct fuel to air ratios for all speeds and loads.

IGNITION SYSTEM

The spark for ignition of the fuel mixture is directed from the coil to the spark plugs, at the proper time, by ***Battery ignition*** (12 volt) ***Distributor***. The distributor is mounted to the governor housing and is easily accessible for timing.

CHARGING SYSTEM

10 amp or 30 amp Flywheel Alternator Circuits are furnished as optional equipment. Stub shaft drive at flywheel end is also available for an automotive type belt driven alternator. Battery is not furnished by Teledyne Wisconsin Motor.

LUBRICATION SYSTEM, Fig. 11

A Gerotor type oil pump provides pressurized lubrication through passages in the crankcase and crankshaft to the main bearings, connecting rods and camshaft bearings. Oil expelled from these areas forms a mist which lubricates the cylinder walls, valves and tappets. An external oil line from above the camshaft provides lubrication to the governor and gear train. All of the circulated oil passes through a ***full-flow*** oil filter.

GOVERNOR

A mechanical flyweight type governor maintains engine speed by varying the throttle opening to suit the load imposed upon the engine. Options available are either a ***fixed speed*** governor, a ***variable speed control*** to regulate the governed speed of the engine, or an ***idle control***.

ROTATION

The rotation of the crankshaft is clockwise when viewing the flywheel or cranking end of the engine. This gives ***counterclockwise rotation*** when viewing the power take-off end of the crankshaft. The flywheel end of the engine is designated the ***front end***, and the power take-off end, the ***rear end*** of the engine.

Full power take-off from the flywheel end of engine is also optionally available.

BEFORE STARTING ENGINE

1. FUEL

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

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

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

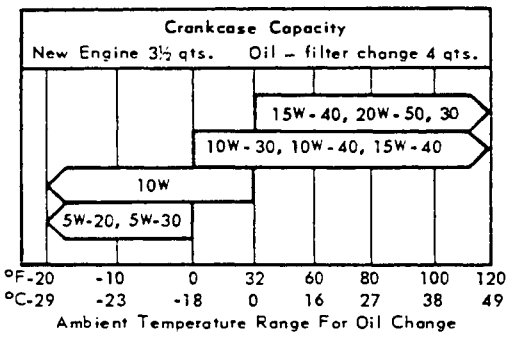
2. LUBRICATION

Fill crankcase base with the proper grade of engine oil as specified in ***"Grade Of Oil"*** chart. Fill through the oil filler tube opening to the level indicated by the ***Full Mark*** on ***Dipstick***. Approximately 3½ quarts are required in a new engine — 4 quarts with oil and filter change.

IMPORTANT

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

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



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

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

With reference to *Fig. 3* and *Fig. 4*, 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.

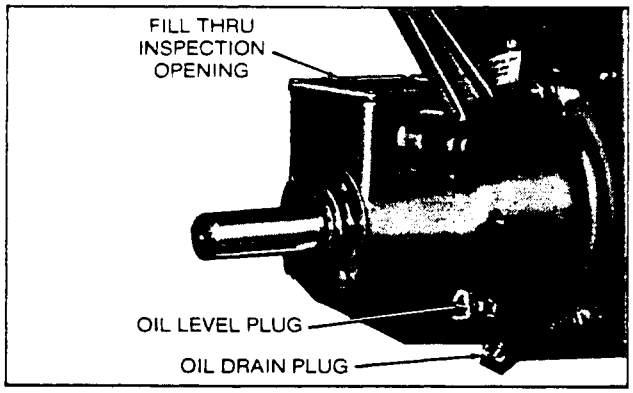


Fig. 3

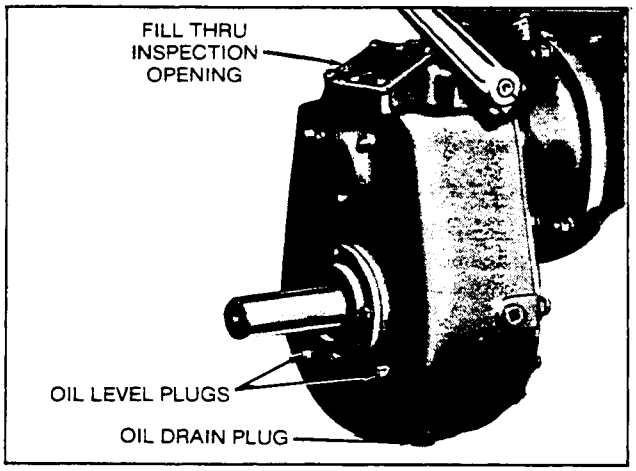


Fig. 4

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

STARTING

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

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

STARTING PROCEDURE, Fig. 5

1. Check crankcase oil level and gasoline supply. Open fuel shut-off valve in fuel strainer or tank.
2. Disengage clutch, if furnished.
3. Pull variable speed control 'T' handle out about halfway and lock in place. With a two speed (idle control), start in full load position — idle after engine starts.
4. Close choke by pulling choke button to extreme out position.
5. Pull out ignition switch button, tag reads ***'To Stop Push In'***.
6. Depress starter switch to start engine.

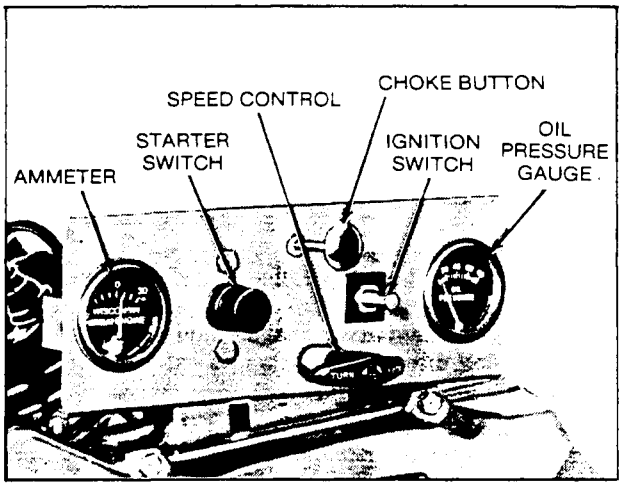


Fig. 5 CONTROL PANEL

IMPORTANT

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

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

If flooding should occur, open choke fully by pushing choke button in and continue cranking. Less choking is necessary in warm weather or when engine is warm, than when cold.

WARM-UP

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

Caution: Racing an engine by disconnecting the governor, or by doing anything to interfere with the governor controlled engine speed, ***is extremely dangerous.***

The governor is provided as a means for controlling the engine speed to suit the load applied, and also as a safety measure to guard against excessive speeds, which not only overstrain all working parts, but which might cause wrecking of the engine and possible injury to bystanders.

TO STOP ENGINE

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

If the engine has been running hard and is hot, do not stop it abruptly from full load, but remove the load and allow engine to run idle at 1000 to 1200 R.P.M. for three to five minutes. This will reduce the internal temperature of the engine much faster, minimize valve warping, and of course the external temperature, including the manifold and carburetor will also reduce faster, due to air circulation

from the flywheel. Thus, the problems of ***vapor lock*** and ***dieseling***, or ***run-on***, will also be minimized by this continued practice.

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 on remote or side mounted air cleaners.

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

DRY TYPE AIR CLEANER, Fig. 6

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

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

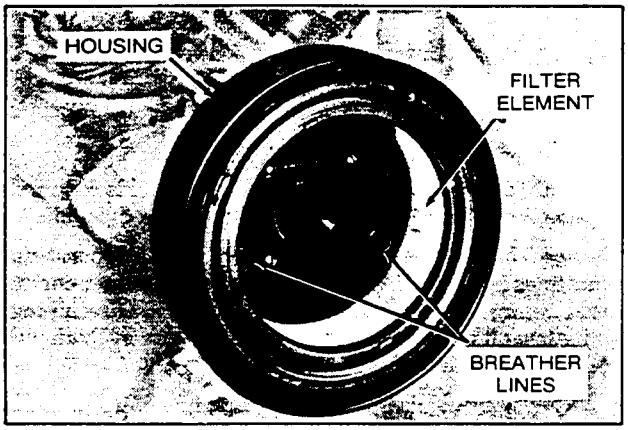


Fig. 6 DRY ELEMENT AIR CLEANER

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

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

HEAVY DUTY AIR CLEANERS, Fig. 7

Dry element, or oil bath heavy duty type air cleaners are optionally used, and are mounted either to the left hand side of the engine, or to the customer equipment structure.

DRY TYPE Heavy Duty Air Cleaner

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

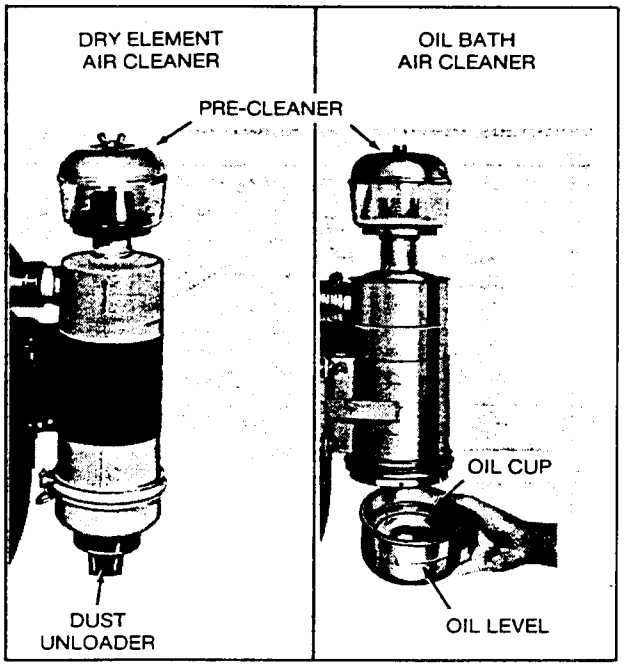


Fig. 7 HEAVY DUTY AIR CLEANERS

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

After ten washings or one year of service, replace cartridge. New cartridges are available at all ***Wisconsin Distributors*** and ***Service Centers***.

OIL BATH Heavy Duty Air Cleaner

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

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

IMPORTANT

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

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

PRE-CLEANER

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

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

BREATHER SYSTEM, Fig. 8, Fig. 9

The crankcase is ventilated by means of a closed breather system, controlled by ***Reed Type Breather Valves***. The breather valve is an integral part of each of the two valve chamber inspection covers, as illustrated in Fig. 9.

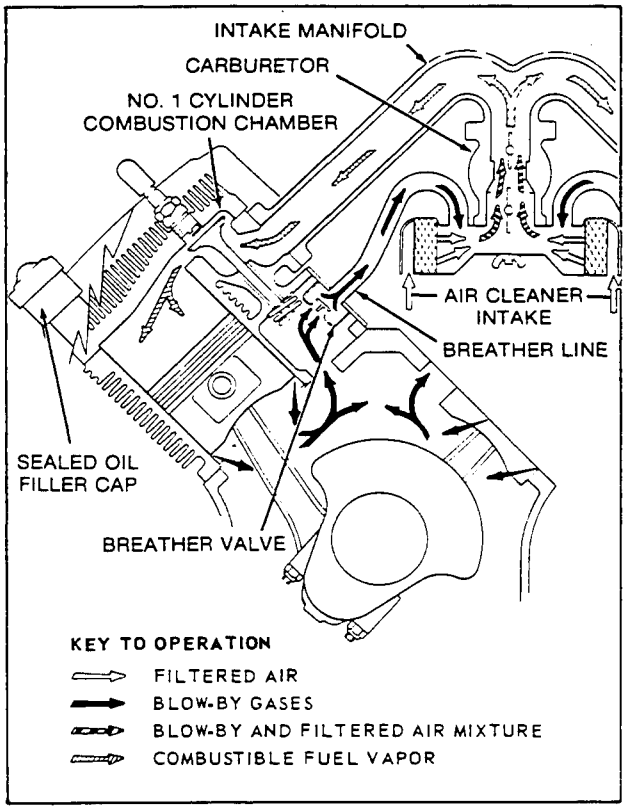


Fig. 8

Oil and fuel vapors (blow-by) in the crankcase is released through the breather valves to the air cleaner, carburetor and intake manifold, where it is mixed with fresh fuel vapor and burned in the combustion chamber. See Fig. 8.

IMPORTANT

It is necessary that the breather valves be kept clean and operable, and the breather lines free of any obstruction. The operation of the breather valves is also important in maintaining a partial vacuum in the crankcase to prevent oil leaks at seal and gasket surfaces.

Every 100 Hours; Inspect breather lines for breaks or obstruction.

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

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

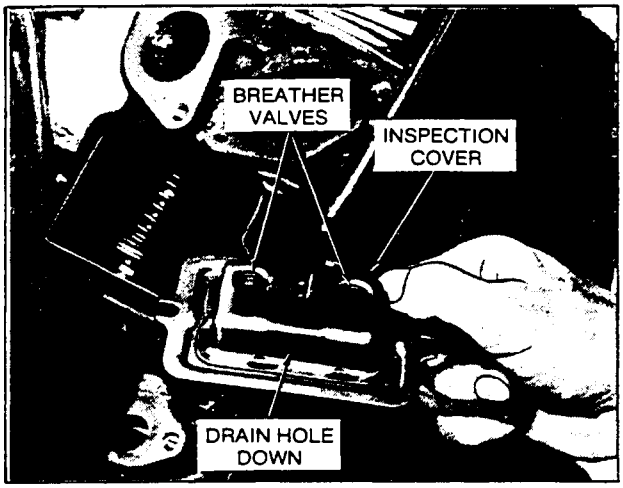


Fig. 9 BREATHER VALVE

CRANKCASE OIL, Fig. 10

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

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

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

IMPORTANT

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

Refer to ***Recommended Grades of Oil chart***, Page 5, for type and quantity of oil to be used.

OIL FILTER, Fig. 10, Fig. 11

Under ordinary conditions, all of the engine oil is circulated through a ***full-flow*** 25 micron oil filter. But, when the filter element becomes extremely dirty, the oil bypasses the filter material through a relief valve within the oil filter. As a result, there is no variation in oil pressure to indicate that the oil filter is clogged and requires replace-

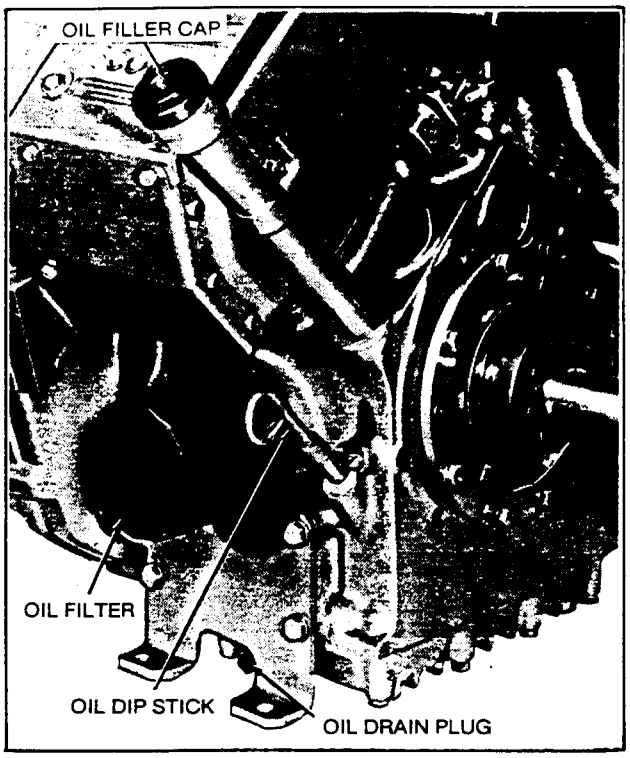


Fig. 10

ment. Because clean oil is so essential for the friction free operation of all bearing surfaces, it is very important that the oil filter be changed at the recommended interval.

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

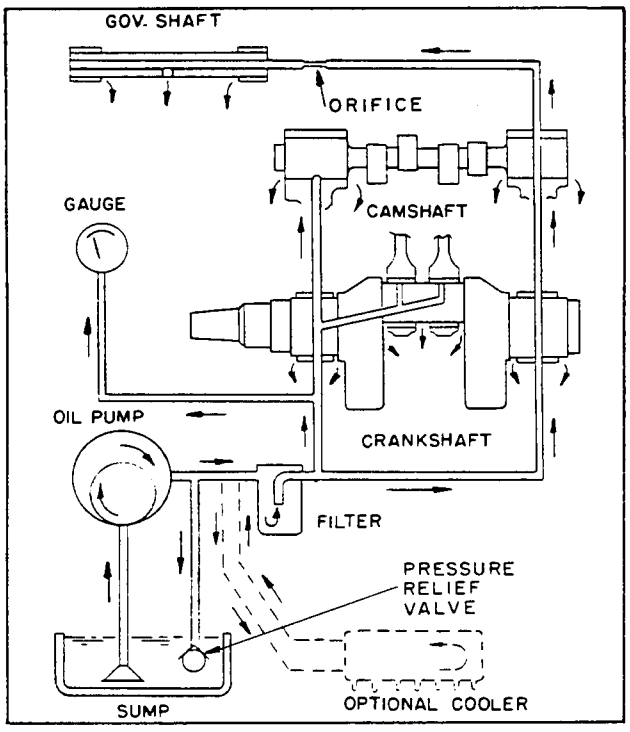


Fig. 11 LUBRICATION SYSTEM

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

When reassembling new filter, add a film of clean oil to the face of the base gasket. Turn filter to a snug fit, then ½ turn more. ***Do not overtighten.***

OIL PRESSURE, Fig. 11

Oil pressure is controlled by a non-adjustable relief valve mounted in the crankcase below the oil pump. With engine oil hot, gauge pressure will be from 30 to 50 p.s.i. at engine speeds of 1600 to 3600 r.p.m. If pressure falls below 15 p.s.i., refer to ***'trouble shooting'***, page 23, for possible causes.

FUEL FILTER, Fig. 12

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

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

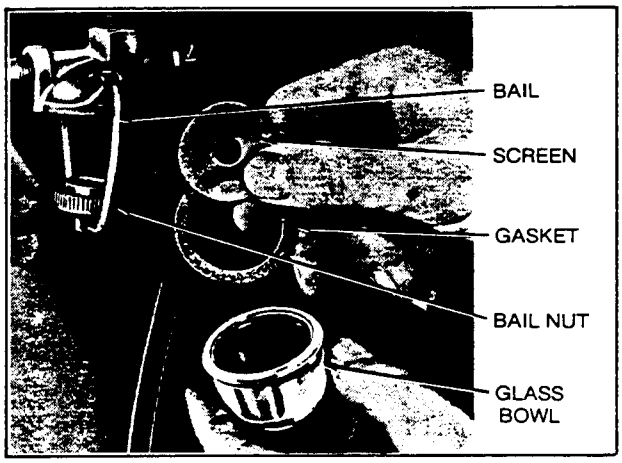


Fig. 12

IGNITION DISTRIBUTOR, Fig. 18

Check for faulty and loose fitting wires, for cracks in distributor cover, and for corroded or burned terminals.

Every 250 Hours; apply 1 drop of light engine oil (10W) to 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.

Inspect condition of breaker points for cleaning, adjustment or replacement.

SPARK PLUGS, Fig. 13

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

NOTE: Beginning with engine serial number 5996538, model W2-1230 is equipped with 14 mm spark plugs, Champion N6 (std.), or RN6 (resistor type), in place of 18 mm spark plugs (Champion D-16J). The 14 mm spark plugs always were original equipment on engine model W2-1235.

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

Spark plug gap — 0.035 inch (std. 14 mm)
0.030 inch (resistor type)
0.030 inch (18 mm plug)

Replacement plugs must be of the same heat range as those removed. ***In reassembly***; tighten spark plugs ***18*** to ***22 foot pounds torque*** (dry).

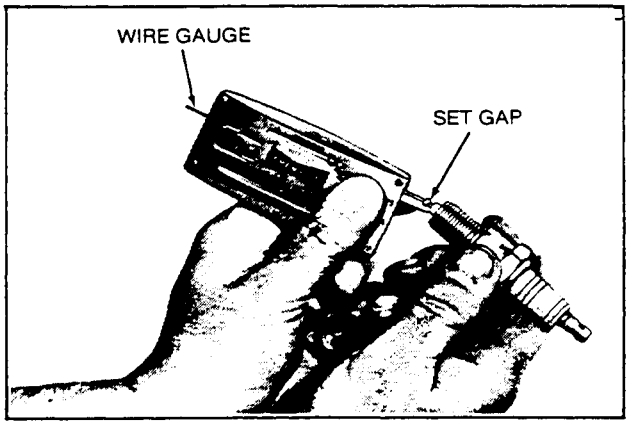


Fig. 13 SPARK PLUG

STARTING MOTOR, Fig. 1

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 drive — if necessary lubricate with powdered graphite.

KEEP ENGINE CLEAN, Fig. 14

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

IMPORTANT

Do not operate engine with damaged or badly dented shrouding.

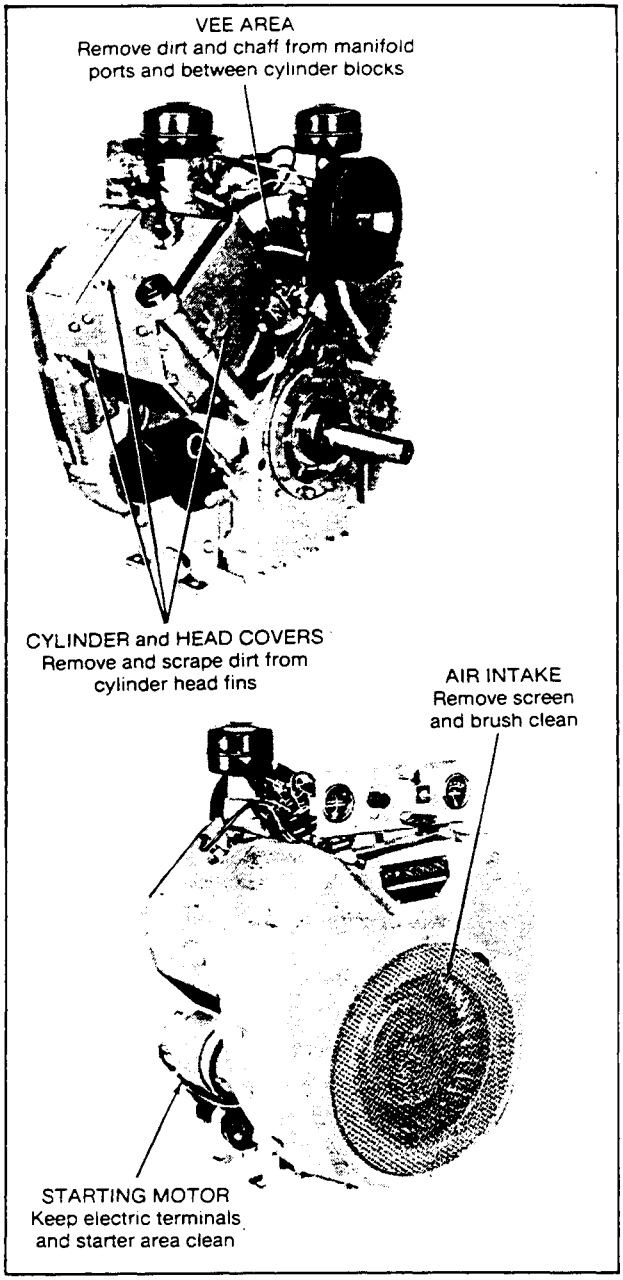


Fig. 14

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

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

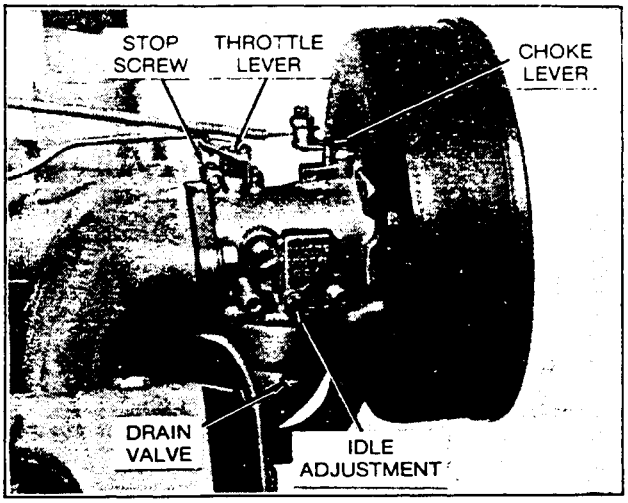


Fig. 15 CARBURETOR ADJUSTMENT

ADJUSTMENTS

CARBURETOR, Fig. 15

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

Refer to *'CARBURETOR'* section, *Page 46*, for further Adjustment and Repair Information.

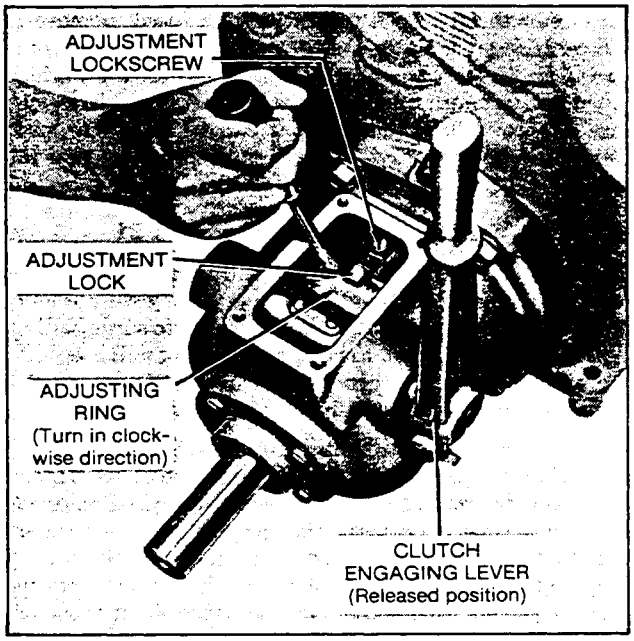


Fig. 16

CLUTCH ADJUSTMENT, Fig. 16

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

Turn engine over; by means of a 15/16 inch socket wrench fitted to the flywheel retainer screw, until clutch ***adjustment lock*** is visible through the inspection opening. Loosen ***adjustment lockscrew*** one full turn. Keep clutch from turning by securing the crankshaft at flywheel end. Then, by means of a screwdriver, turn ***adjusting ring*** one notch at a time in a clockwise direction, until a very firm pressure (100 ft. lbs. torque), is required to snap the clutch into engaged position by means of the clutch shifter lever. Securely tighten adjustment lockscrew. Assemble the inspection plate, being sure the gasket fits properly and is not broken.

CLUTCH REDUCTION ADJUSTMENT, Fig. 17

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

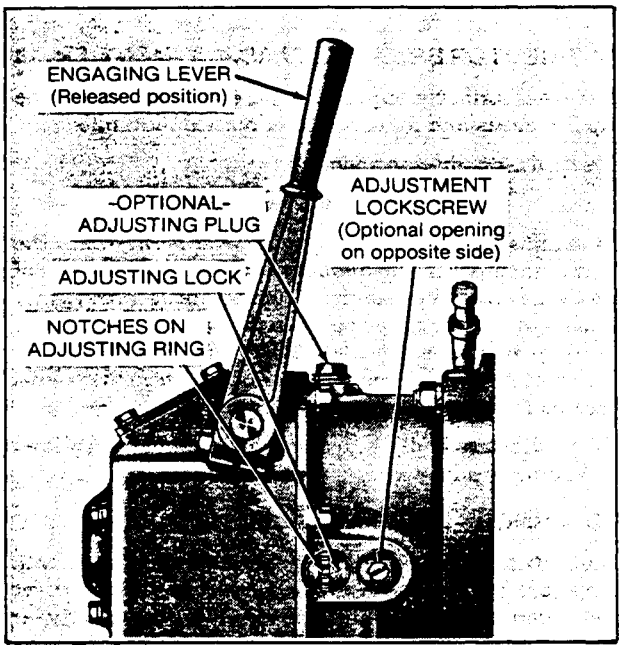


Fig. 17

Remove the two pipe plugs on the side of the housing (if not accessible, use the two optional taps). Disengage the clutch and turn engine over slowly with socket wrench until the ***adjustment lockscrew*** is visible through the pipe plug opening nearest to the engine. Loosen ***lockscrew*** one full turn, or enough to relieve the tension of the lock against the notches on the ***adjusting ring***. Then, turn engine over slightly to expose the ***notches*** on ***adjusting ring***. Keep engine crankshaft from turning, while through

the adjacent pipe plug opening, turn the ***adjusting ring*** with a screwdriver, one notch at a time in a clockwise direction (viewing from take-off end), until a very firm pressure (100 ft. lbs. torque), is required to snap the clutch into engaged position by means of the clutch shifter lever. Tighten adjustment lockscrew and install pipe plugs when adjustment is completed.

Automotive Type Clutch should be adjusted per manufacturer's instruction on inspection plate attached to clutch housing.

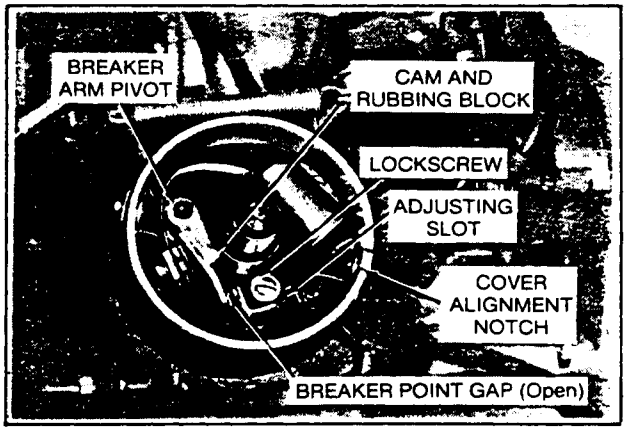


Fig. 18 DISTRIBUTOR BREAKER POINTS

DISTRIBUTOR BRK'R. POINT ADJUSTMENT, Fig. 18

Remove distributor cap, rotor and dust cover. Examine cap for cracks and for corroded or burned terminals.

The breaker point gap should be:

.020 inch at full separation

To readjust point gap, turn engine over slowly until the distributor breaker arm ***Rubbing Block*** is on a high point of the ***Cam***. Loosen the stationary contact ***Lockscrew*** slightly and insert a feeler gauge between the points. By means of a screwdriver, turn ***Adjusting Screw*** until a slight drag is felt when sliding the feeler gauge from between the points. Tighten lockscrew and recheck point gap.

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

GOVERNOR — OPERATION, Fig. 19

The centrifugal flyweight type governor rotates on a shaft, supported by bearings in the upper part of the gear cover and governor housing, and is driven off the camshaft gear at ***crankshaft speed***. The governor shaft and housing also provide an integral drive for the Battery Ignition Distributor.

Four sintered iron flyweights are contained in pockets of the governor drive gear. The toe end of the flyweights bear against a thrust sleeve and bearing assembly that moves back and forth as the flyweights move in and out. The motion of the thrust sleeve and bearing is transmitted to the governor lever which in turn is linked to the carburetor throttle lever.

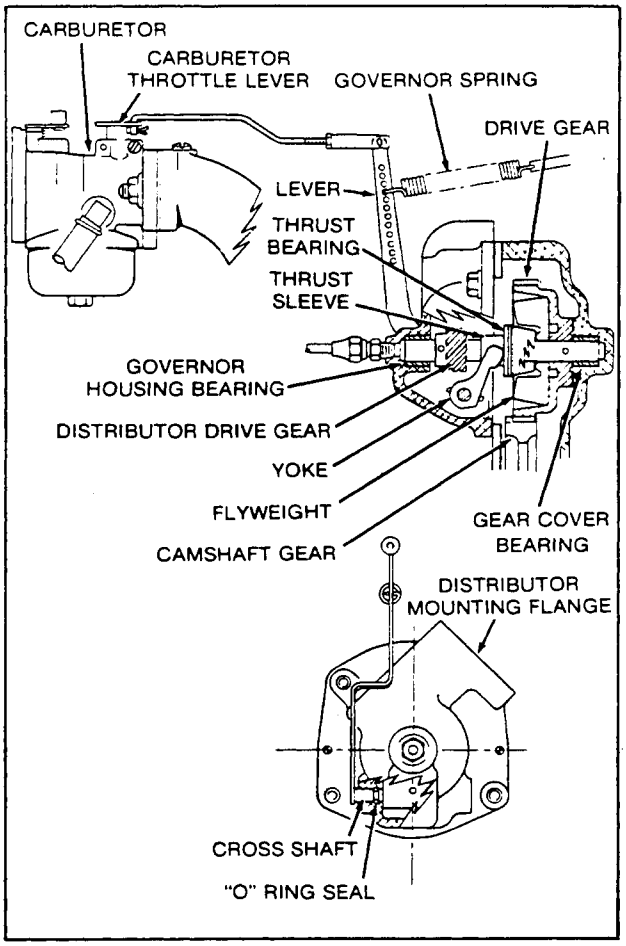


Fig. 19

A spring connected to the governor lever tends to hold the governor flyweights to their ***inner*** position, also to hold the carburetor throttle open. As the engine speed increases, the centrifugal force in the flyweights acts against the spring and closes the throttle to a point where the engine speed will be maintained practically constant under varying load conditions. This speed can be varied to suit conditions by adjusting the governor spring tension to suit.

GOVERNOR ADJUSTMENT, Fig. 20, Fig. 21

The throttle rod connection to the carburetor must be very carefully adjusted for length, otherwise the governor will not function properly and cause the engine to surge badly. With the engine at rest, the governor spring will keep the flyweights ***in***, and the throttle rod must be of such length as to hold the carburetor throttle wide open at that point.

With reference to Fig. 20, disconnect the ***throttle rod*** from the carburetor, and loosen the ***locknut*** at the ***connector*** on the ***governor lever***. Place the governor lever in a ***stopped position*** against the governor housing, and the carburetor throttle lever in the ***wide open*** position, in same direction as governor lever. With both levers in this position, screw the throttle rod into the connector until the 90° bent end of

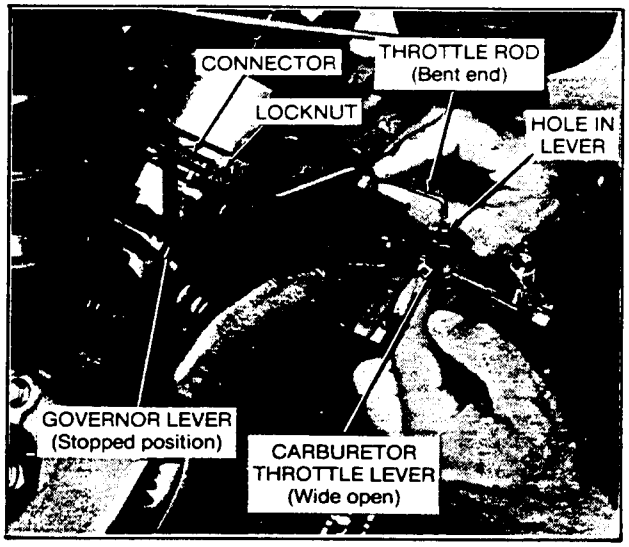
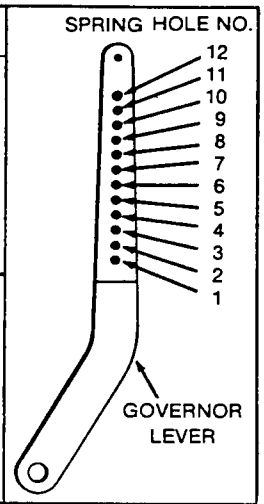


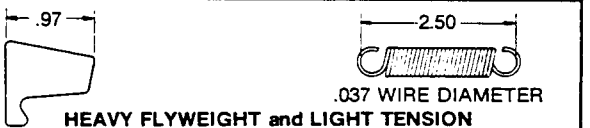
Fig. 20

Load R.P.M.	No Load R.P.M.	Hole No.	Spring	Fly-Weight
1600	1650	5	Light	
1700	1770	5		
1800	1880	6		
1900	2000	7		
2000	2420	2		Heavy
2100	2450	2		
2200	2475	2		
2300	2550	2		
2400	2620	2		
2500	2700	2		
2600	2770	2	Std.	
2700	2850	3		
2800	2925	4		
2900	3050	4		
3000	3130	5		
3100	3200	5		Std.
3200	3300	6		
3300	3410	6		
3400	3520	7		
3500	3630	9		
3600	3740	11		





— STANDARD —
FLYWEIGHT and GOVERNOR SPRING



HEAVY FLYWEIGHT and LIGHT TENSION
GOVERNOR SPRING
(for Generator Set)

Fig. 21

the rod will register with the hole in the carburetor throttle lever. Then, screw throttle rod ***in one more turn*** to shorten linkage slightly. Tighten throttle rod locknut and assemble cotter pin to carburetor end of throttle rod.

NOTE: Heavy flyweight governor with a light tension spring is used in place of standard, when minimum overrun is required, i.e., generator set.

The governor lever is furnished with 12 holes, as shown in *Fig. 21,* for attaching the governor spring. It is very important that the spring is hooked into the proper hole to suit the speed at which the engine is to be operated. The Governor Lever Chart, *Fig. 21,* shows the ***full load*** and ***no load*** speeds of the engine and the hole corresponding thereto. Note that the ***full load*** speed is less than the ***no load*** speed and this must be taken into consideration when readjusting the governor. As an example; if the engine is to be operated at ***3200*** revolutions per minute under load, the spring should be hooked into the ***6th*** hole in the governor lever, and the spring tension adjusted to run ***3300 r.p.m.*** at ***no load.*** When load is applied, the engine will run at approximately ***3200 r.p.m.***

⚠ ***Caution: Do not*** operate engine above 3600 r.p.m. load. ***Do not*** operate with governor disconnected.

GOVERNOR-SPRING TENSION ADJUSTMENT, Fig. 22

With engine running and warmed up, use a tachometer or revolution counter against crankshaft to observe the engine r.p.m. while adjusting the governor spring tension.

Variable Speed Control:

Pull *'T'* handle control outward and turn clockwise to lock in place when desired operating speed is obtained. Move ***collar*** on speed control rod to a ***stop position*** against ***threaded ferrule*** and lock in place with ***allen set screw.***

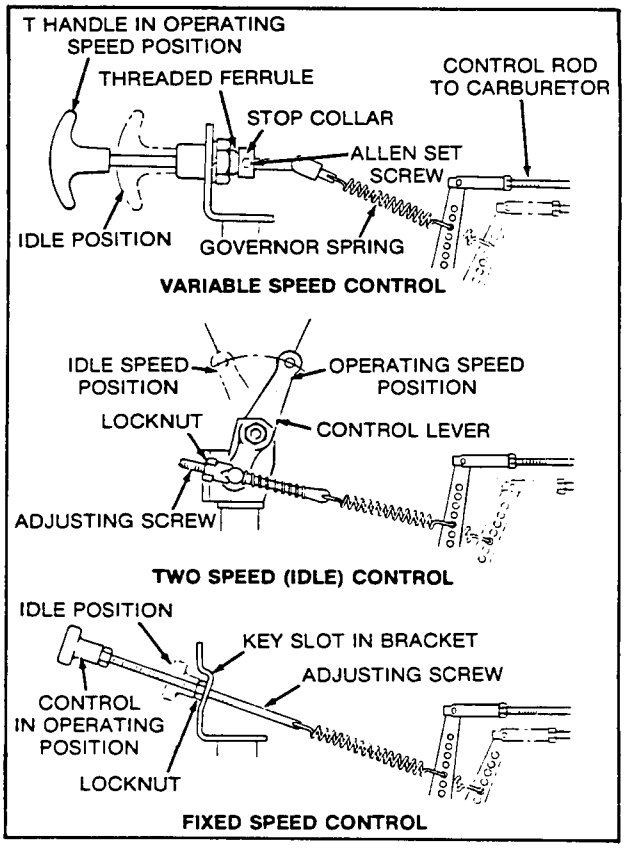


Fig. 22

Two Speed (Idle), or Fixed Speed Control

Place ***control*** in operating speed position. Turn ***adjusting screw locknut,*** to obtain desired No Load operating

r.p.m. — clockwise to increase speed, counterclockwise to decrease speed.

VALVE TAPPET ADJUSTMENT, Fig. 23

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

Intake — .007 inch Exhaust — .020 inch

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

For ease in adjusting the tappets, disconnect the oil line to governor housing, and remove the intake manifold.

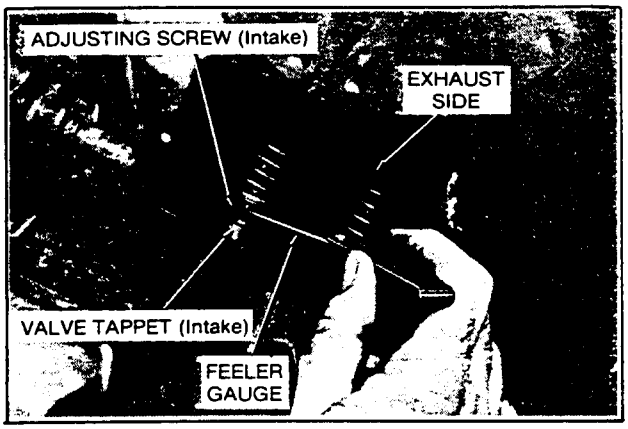


Fig. 23 VALVE TAPPET ADJUSTMENT

TIMING

FIRING ORDER

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

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

NOTE: This differs from other Wisconsin Vee type engines where the No. 1 cylinder is in the left hand cylinder bank, nearest to the flywheel.

DISTRIBUTOR

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

DISTRIBUTOR TIMING PROCEDURE, Fig's. 24, 25, 26, 27, 28

⚠ ***Caution:*** Disconnect battery leads to engine, to prevent engine from accidently starting.

IMPORTANT

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

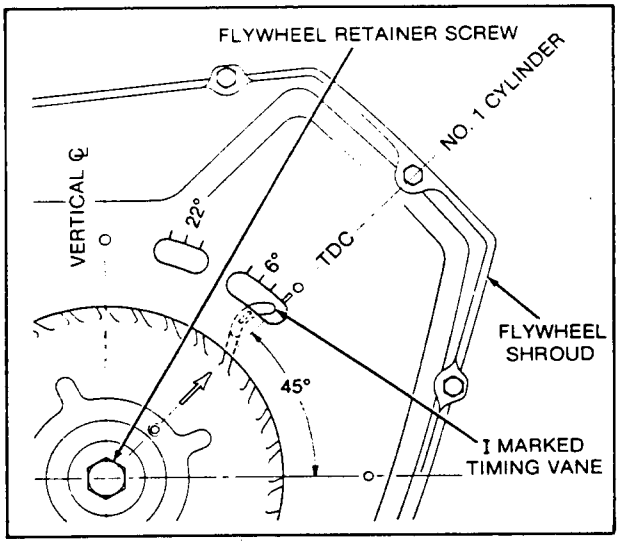


Fig. 24

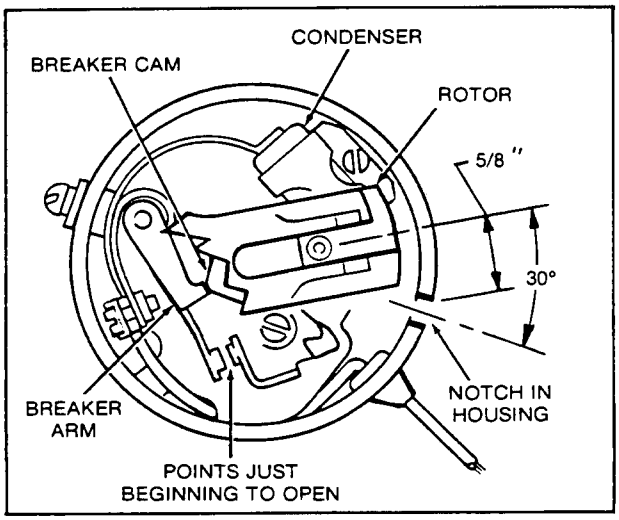


Fig. 25

Distributor Breaker Point Adjustment paragraphs, Page 12, before timing distributor to engine.

DISTRIBUTOR MOUNTING

Assuming the distributor was removed from the engine; take off the screen over the flywheel air intake opening. This will more clearly expose the timing marks on flywheel shroud, and also the flywheel T.D.C. ***Timing Vane*** located by an ***Arrow*** and identified through the timing opening by a vertical *(I)* cast depression on the top of the vane, see Fig. 24. Next, remove spark plug from No. 1 cylinder, on right hand side of engine. By means of a 15/16 inch socket wrench fitted to the flywheel retainer screw, turn the engine over slowly, and at the same time hold a finger or thumb over the spark plug hole to determine the compression stroke.

Upon reaching the compression stroke, continue turning flywheel until the ***vertical mark (I)*** on the top of the ***Timing Vane*** is in line with ***T.D.C. mark*** on the flywheel shroud. The No. 1 piston is now on top dead center with timing marks positioned as illustrated in Fig. 24. Reassemble spark plug.

NOTE: At this time, paint the ***'I' mark*** on the timing vane ***white***, so that it will be clearly visible for checking with a ***Timing Light.***

With the No. 1 piston now on ***TDC*** and on compression stroke, take off cap, rotor and dust shield from distributor and mount to adapter housing in the following manner:

1. With reference to Fig. 25, place ***rotor*** on distributor shaft and turn shaft clockwise until center of ***rotor contact*** is about 5/8" from ***outer edge of notch*** in distributor housing, or about 30° from center of notch. A ***slight resistance*** will be felt as the breaker cam contacts the breaker arm.
2. With ***advance arm*** in place and tightened to adapter housing, assemble distributor to adapter with ***rotor*** pointing in an approximate ***3 o'clock position***, which would place the ***notch*** in housing and ***No. 1 terminal*** in about a ***4 o'clock position***, see Fig. 26. It may be necessary to rotate shaft slightly by means of the rotor to mesh distributor gear with governor accessory drive gear.
3. With the ***distributor clamp screw*** loose, turn the distributor body slightly in a clockwise direction until the breaker points are firmly closed. Then turn the distributor body in a counterclockwise direction until the ***breaker points*** are just ***beginning to open.*** At this point a slight resistance can be felt as the breaker point cam strikes the breaker point arm.

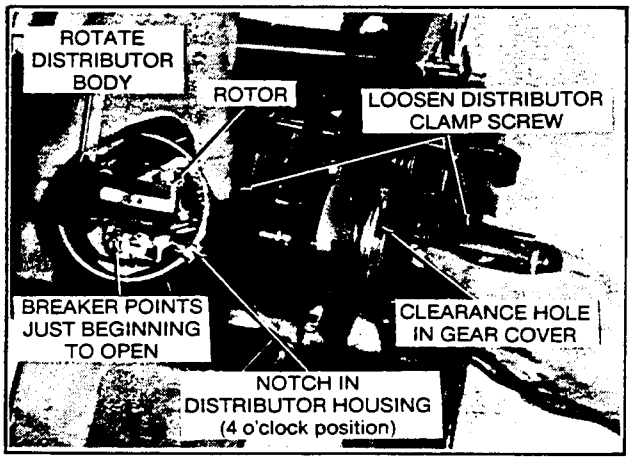


Fig. 26

4. Tighten ***advance arm clamp screw*** through hole in gear cover. Number 1 cylinder is now ready to fire in the retarded position.
5. Assemble dust cover and distributor cap. Connect ignition wires from distributor to spark plugs and coil per Fig. 27 and wiring diagram Fig. 30.

If care is exercised in the preceding instructions, the spark timing should be accurate enough for satisfactory starting, however, ***checking spark advance*** with a Timing Light, as described in the following ***'Timing Check'*** paragraphs, is necessary.

SPARK ADVANCE

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

TIMING MARKS

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

1. ***For timing variable high speed engines to 22° at 3400 r.p.m.,*** refer to Fig. 28 which illustrates 25°, 22°, 19° and T.D.C. timing marks. A ***cast arrow*** identifies the ***"I" marked*** flywheel vane that is visible through the opening at the 22° mark.
2. ***For fixed speed engines,*** particularly those operating at ***1800 r.p.m.,*** refer to Fig. 28A which illustrates 9°, 6°, 3° and T.D.C. timing marks. The ***cast arrow*** identifies the ***"I" marked*** flywheel vane that is visible through the opening at the ***6° mark.***

NOTE: Read ****Important Note*** on Page 16, with reference to Fig. 15 on Page 11, for adjusting engine speed to 1800 r.p.m. for 6° advance timing.

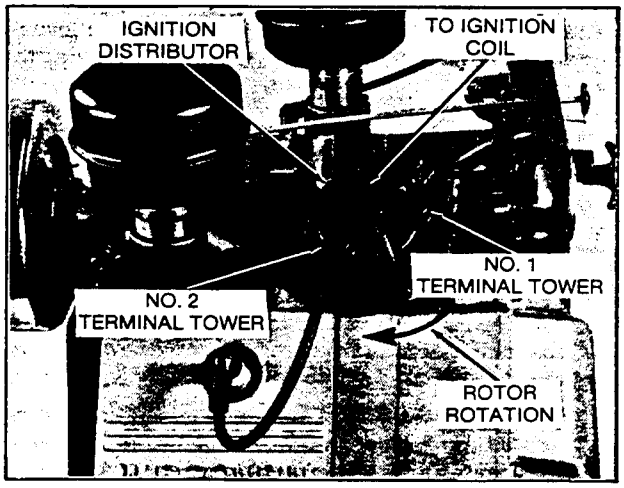


Fig. 27

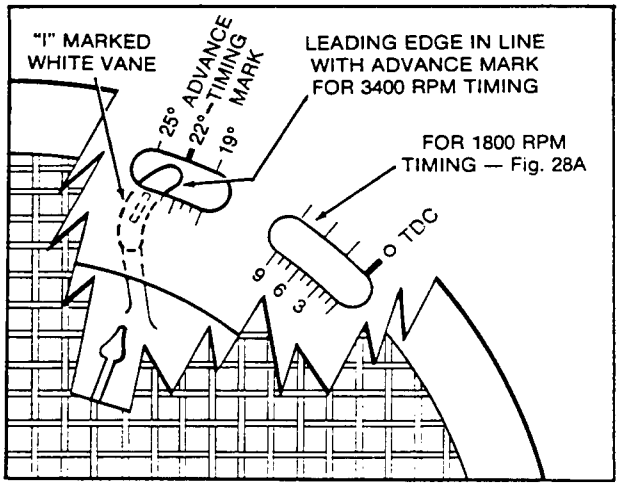


Fig. 28 SPARK ADVANCE VARIABLE HIGH SPEED

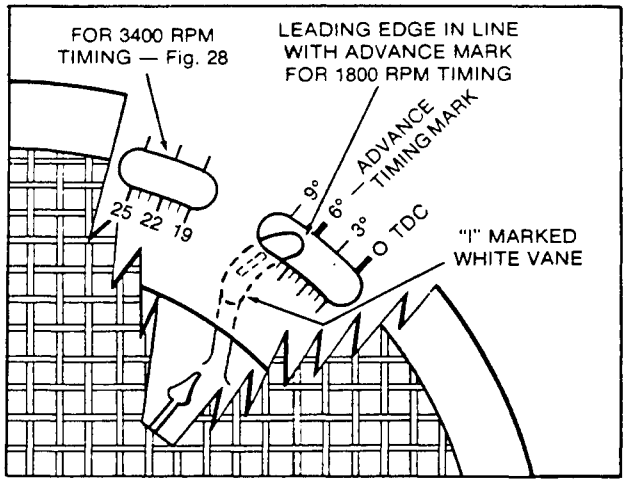


Fig. 28A SPARK ADVANCE FIXED LOW SPEED

TIMING CHECK AND ADJUSTMENT

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

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

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

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

1. With reference to Fig. 29, connect the inductive clamp of a conventional automotive type ***Timing Light*** to the ***No. 1*** spark plug cable. Clip the red marked clamp of the timing light to the battery positive terminal, and the black marked clip to ground.
2. With reference to Figs. 28, 29, and the engine operating at ***3400 r.p.m.,*** allow the flash from the timing light to illuminate the ***"I" whitened*** flywheel vane. At the time of the flash the ***leading edge*** of the vane should line up with the ***22° Timing Mark*** on the flywheel shroud.

2a. For fixed ***low speed*** applications, operate the engine at ***1800 r.p.m.*** and allow the flash from the timing light to illuminate the ***"I" whitened*** flywheel vane. At the time of the flash the leading edge of the vane should line up with the ***6° Timing Mark*** on flywheel shroud, as illustrated in Fig. 28A.

3. If timing is incorrect, loosen the advance arm ***clamp screw*** at the base of the distributor. A screwdriver clearance hole is provided in the flywheel shroud as shown in Fig. 26.

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

*IMPORTANT

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

For engines where the governor is set to operate at speeds other than 1800 r.p.m., a tachometer will have to be used, and the speed adjusted to 1800 r.p.m. in the following manner, and with reference to Fig. 15.

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

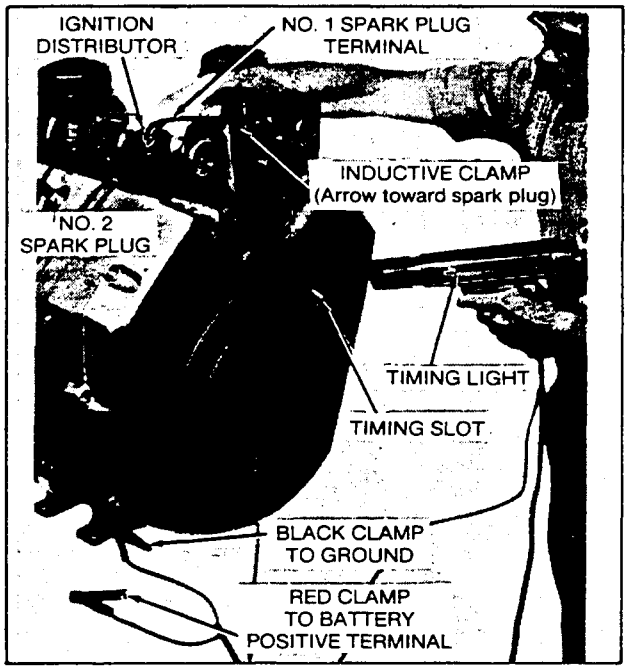


Fig. 29

ELECTRICAL EQUIPMENT

The ***12 volt*** Battery Ignition Distributor with Coil and Starting Motor, Fig. 30, are standard equipment. Options include: 30 amp or 10 amp Flywheel Alternator, Electric Fuel Pump, Instrument Panel, High-Temperature Safety Switch and Solenoid Starting. ***Battery is not furnished by Teledyne Wisconsin Motor.***

⚠ ***Caution:*** Stop engine when checking battery terminals or electrical connections. High voltage in starter and ignition cables will cause shock if touched with bare hands.

FLYWHEEL ALTERNATOR, Fig. 31, Fig. 31A

This flywheel alternator is of the permanent magnet type and has ***no brushes, commutator, belts*** or ***adjustments***. A series of coils (stator) is mounted to the engine gear cover,

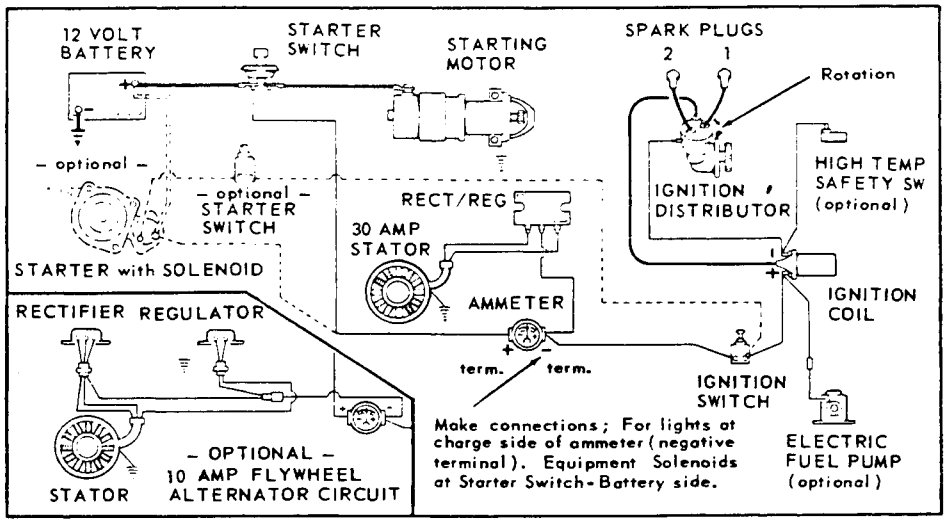


Fig. 30 WIRING DIAGRAM ELECTRICAL SYSTEM WITH FLYWHEEL ALTERNATOR

and the magnetic flux is provided by a permanent magnet in the flywheel which rotates around these stationary coils.

IMPORTANT

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

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

Both ***10 amp*** and ***30 amp Flywheel 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 30 amp circuit. Also, the 30 amp system has a ***single unit Rectifier/Regulator*** mounted to a cavity on the right hand side of the gear cover. The 10 amp system has ***separate Rectifier/Regulator modules*** mounted to a cover in the same location.

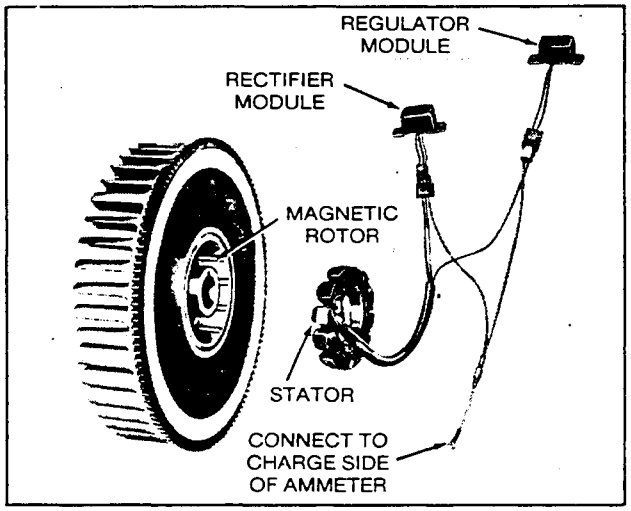


Fig. 31 10 AMP FLYWHEEL ALTERNATOR

IMPORTANT

While welding is being done on equipment or machinery

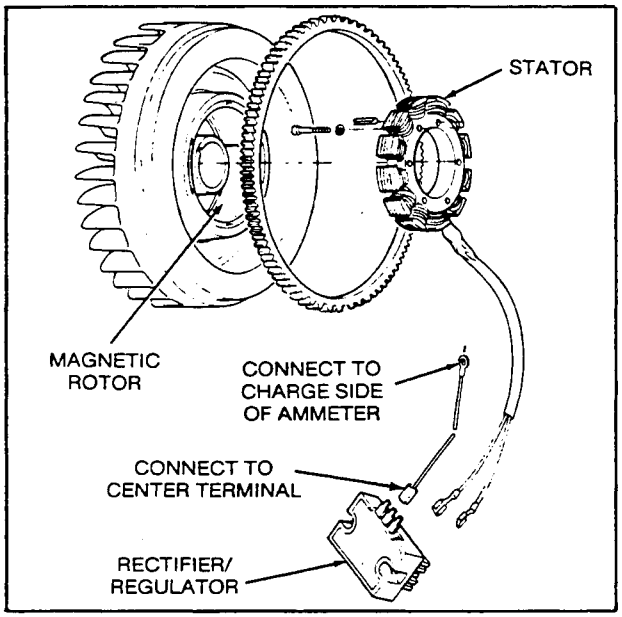


Fig. 31A 30 AMP FLYWHEEL ALTERNATOR

equipped with a Wisconsin engine, furnished with a flywheel alternator, disconnect battery completely from the electrical circuit (remove cables from positive and negative terminals of battery). This is a precautionary measure, since high electric current and voltage may appear during the welding process and damage the regulator.

PRECAUTIONS to be exercised in the use of both 10 amp and 30 amp Flywheel Alternators.

1. ***Do not*** reverse battery connections. Negative battery terminal must be grounded. Reverse polarity will damage rectifier.
2. Connect booster batteries — positive to positive and negative to negative.
3. ***Do not*** ground any wires from stator or modules which terminate at connectors.
4. ***Do not*** operate engine with battery disconnected, or disconnect the alternator output lead while the alter-

nator is operating, as damping effect of the battery will be lost. The voltage will rise to an extreme value and permanent damage to the regulator may occur.

5. Disconnect ground battery lead if a battery charger is used.
6. ***Do not*** polarize the Rectifier/Regulator.

WIRING CIRCUITS, Fig. 30, 31, 31A

These are ***negative ground circuits***. Connect ground strap from negative post of battery to starting motor flange, or good clean grounding surface on engine.

10 Amp System, Fig. 31

The *fool-proof* type connectors are used to prevent incorrect wiring from the stator to the rectifier and regulator modules. To disconnect plugs, squeeze outer ends of recepticle and pull apart.

The rectifier is insulated from ground, but the stator and regulator module are grounded to the engine through their mounting surface. The regulator module therefore should not be removed and mounted at some remote location.

30 Amp System, Fig. 31A

The single module ***rectifier/regulator*** is grounded through its mounting surface. Ease in making wire connections is provided by spade type terminals.

The two lead wires from the stator are connected to ***either*** of the two ***outer terminals*** on the regulator/rectifier. The ***center terminal*** on the regulator/rectifier ***must*** be connected to the ***negative terminal*** on the ammeter.

FLYWHEEL ALTERNATOR SERVICE PROCEDURE:

PRELIMINARY TESTS

1. ***Visual Inspection*** should be made to eliminate conditions that may be interpreted as a defective alternator. Examine leads for broken or loose connections, and make sure modules are securely mounted. The ***regulator module*** must be mounted to a metal surface for grounding purposes, (Test 5.0) for 10 amp alternator system.

   The ***rectifier module***, although insulated electrically from ground, should be securely mounted for heat dissipation. The mounting surfaces must be clean and free of contaminants, oil, grease, etc.

   The rectifier/regulator module for the 30 amp system is cooled by air circulation through body fins which extend into the flywheel air shroud. ***Do not*** allow fins to get clogged with dirt.

2. ***Check Battery.*** Use a Automotive battery in good condition, fully charged and with clean, tight terminal connections.
3. ***Check Ammeter.*** Be certain the ammeter is functioning correctly. Amperage output is regulated by engine speed. The rated ***amperage*** output is

Maximum RPM	10 AMP System	30 AMP System
3600	10 amps	30 amps

When assured that the problem is with the alternator, follow the tests outlined in *'Trouble Shooting'*.

TROUBLE SHOOTING

FLYWHEEL ALTERNATOR
12 VOLT — 10 AMP and 30 AMP Systems

Trouble Shooting Procedure is a guide showing methods of testing the charging components. The following chart of ***Tests 1.0*** to ***4.3*** are with the ***engine running***, and substituting known good components in place of suspected faulty components. ***Static Tests 5.0*** through ***7.2***, following the ***Running Tests***, are more conclusive but some tests require special Wisconsin Test Lights.

RUNNING TESTS

Problem: Battery Overcharge	Possible Cause & Remedy
Test 1.0 Engine ***not*** running check battery with DC Voltmeter.	
1.1 If voltage is greater than 13.5 volts	1.1 Place 12 volt light bulb or carbon pile across battery to reduce voltage to below 13.5 volts.
1.2 With engine running at full RPM, check battery voltage with ***DC Voltmeter.***	
1.3 If the charge increases beyond 13.5 volts.	1.3 ***For 10 amp circuit*** Faulty Regulator. Replace, — static check regulator per Test No. 5.1. for 10 amp system. ***For 30 amp system*** Faulty Rectifier/Regulator. Replace
1.4 If the charge remains under 13.5 volts.	1.4 Alternator functioning properly. Check battery condition.

Problem: Low/No Charge	Possible Cause & Remedy
Test 2.0 Proceed with Test 1.0 and 1.1. It is necessary to slightly discharge battery to make system work.	
2.1 With engine running at full RPM, check battery voltage with DC Voltmeter.	
2.2 If the charge rate increases —	2.2 Alternator functioning properly. Battery was fully charged.
For 10 amp system	
2.3 If system does not charge.	2.3 Operate engine with regulator disconnected (continue with Test 2.4).
2.4 If charge rate increased with regulator disconnected.	2.4 Regulator was at fault. Replace regulator module, — static check regulator per Test No. 5.1.
2.5 If the charge rate does not increase with regulator disconnected.	2.5 Regulator is not at fault ***Check Rectifier*** per Test 3.0, 3.1 or static check per Test 6.0.
For 30 amp system	
2.6 If system does not charge.	2.6 Temporarily substitute another Rectifier/Regulator. Be sure to ground case to engine.
2.7 If charge rate increases with substitute Rectifier/ Regulator.	2.7 Rectifier/Regulator at fault — replace.
2.8 If no charge.	2.8 Rectifier/Regulator not at fault — check stator per Test 4.2.

Problem: Low/No Charge	Possible Cause & Remedy
Test 3.0 Test conditions and procedure the same as 1.0 and 1.1. It is necessary to slightly discharge battery to make system work.	
3.1 Plug ***new Rectifier in*** system. Run engine at full RPM.	
For 10 amp system only	
3.2 If the charge rate increases with new rectifier in system.	3.2 Rectifier module at fault. Permanently install new rectifier module.
3.3 If the charge rate does not increase with new Rectifier —	3.3 Rectifier not at fault. ***Check Stator*** per Test 4.0.

Problem: Low/No Charge	Possible Cause & Remedy
For 10 amp system	
Test 4.0 With engine stopped, unplug all connectors between modules and stator. Start engine and run at 2400 RPM. ***With AC voltmeter*** check voltage between each of the black stator leads and ground.	
4.1 If one of the two voltages is zero or they are over 10% apart. —	4.1 The stator is defective and should be replaced. Static check stator per Tests 7.0, 7.1, 7.2.
For 30 amp system	
4.2 With engine stopped, unplug both AC leads at Rectifier/Regulator. Connect AC voltmeter to leads from stator. Start engine and check voltage.	4.2

Open Circuit AC Voltage	
RPM	Volts ± 10%
3600	50
3200	44
2800	39
2400	33
2000	28
1600	22

4.3 If AC voltage does not increase with engine speed.	4.3 The stator is defective and should be replaced.

FLYWHEEL ALTERNATOR COMPONENTS

STATIC TESTS

The following test equipment is required:

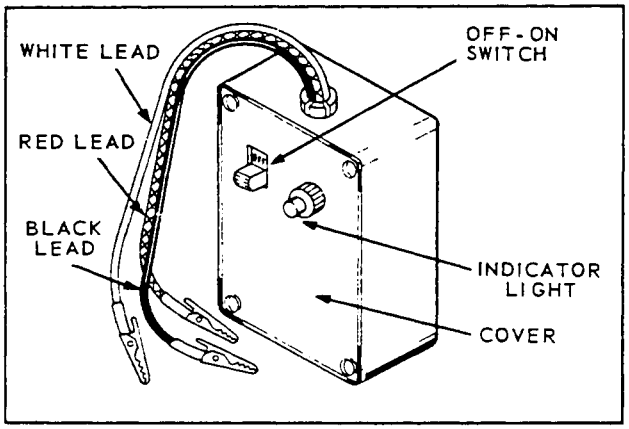


Fig. 32, DF83 ANALYZER

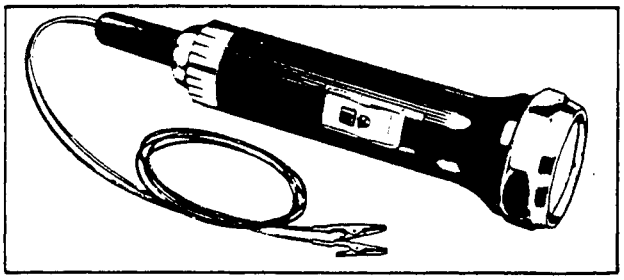


Fig. 32A, DF81 FLASHLITE TESTER

DF 83 Analyzer — Wisconsin Part, *Fig. 32.*
DF 81 Flashlite Tester — Wisconsin Part, *Fig. 32A.*
VOLT-OHM-MILLIAMMETER Simpson 260 or equal.

The DF 83 Analyzer was developed for testing the solid state ignition and flywheel alternator components as furnished on ***Wisconsin*** engines. It is very efficiently and economically powered by four transistor radio type 9 volt batteries. The DF 81 Flashlite Tester is used primarily for checking continuity.

REGULATOR TESTS (10 Amp System)

Test 5.0 REGULATOR GROUND

The YJ 60 Regulator module must be mounted to a metal surface for grounding purposes. Check for continuity with a VOM (R x 1 scale) or test light.

TESTER RED LEAD	TESTER BLACK LEAD	RESULT
To Regulator Body	To Ground	DF 83 - Light On DF 81 - Light On VOM - Continuity

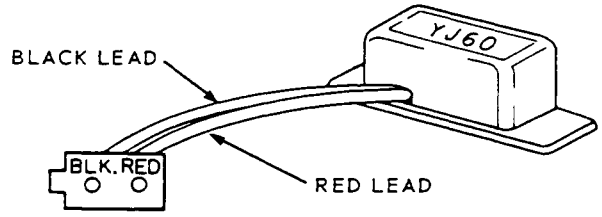
Test 5.1 REGULATOR STATIC CHECK

This test is an alternative or in addition to running tests 2.3 and 2.4 (omitting regulator). The ***DF 83*** Analyzer is used.

YJ 60 REGULATOR

NOTE: Module is ***defective*** if light indication ***is not as shown.***

TEST NO.	ANALYZER RED LEAD TO:	ANALYZER BLACK LEAD TO:	ANALYZER WHITE LEAD TO:	LIGHT INDICATION
1	Module Base Plate	Module Red Lead	–	OFF
2	Module Red Lead	Module Base Plate	–	OFF
3	Module Red Lead	Module Base Plate	Module Black Lead Then Remove	On And Remain On



RECTIFIER TESTS (10 Amp System)

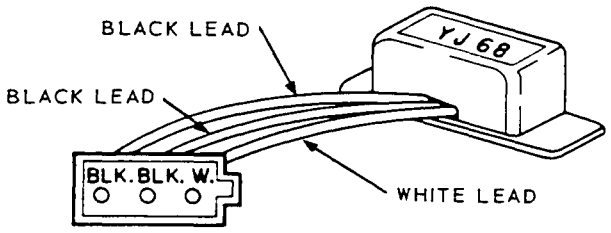
Test 6.0 RECTIFIER STATIC CHECK

The diodes in the Rectifier module can be checked with any continuity device such as the DF 83 analyzer, DF 81 Flashlite or VOM. Since various testing devices will differ in their operation, it should be noted in the following three Rectifier test charts that the results in tests 1 and 2 should always be opposite to the results of tests 3 and 4.

YJ 68 RECTIFIER (using DF 83 Analyzer)

Module is defective if light indication is not as shown.

TEST NO.	ANALYZER RED LEAD TO:	ANALYZER BLACK LEAD TO:	ANALYZER WHITE LEAD TO:	LIGHT INDICATION
1	Module White Lead	Either Module Black Lead	–	OFF
2	Module White Lead	Other Module Black Lead	–	OFF
3	Either Module Black Lead	Module White Lead	–	ON
4	Other Module Black Lead	Module White Lead	–	ON



YJ 68 RECTIFIER (using DF 81 Flashlite)

TEST NO.	TESTER RED LEAD TO:	TESTER BLACK LEAD TO:	LIGHT INDICATION
1	Module White Lead	Either Module Black Lead	ON
2	Module White Lead	Other Module Black Lead	ON
3	Either Module Black Lead	Module White Lead	OFF
4	Other Module Black Lead	Module White Lead	OFF

YJ 68 RECTIFIER (using VOM equipment)

Note: Continuity shall be in one direction only. If readings are not as indicated, replace module.

TEST NO.	VOM RED LEAD TO:	VOM BLACK LEAD TO:	METER INDICATION
1	Module White Lead	Either Module Black Lead	No Continuity
2	Module White Lead	Other Module Black Lead	No Continuity
3	Either Module Black Lead	Module White Lead	Continuity
4	Other Module Black Lead	Module White Lead	Continuity

RECTIFIER/REGULATOR TESTS (30 Amp System)

NOTE: Static check of Rectifier/Regulator module is not available — direct substitution is the only means of checking. Follow engine running test procedures beginning with Test No. 2.0 and for 30 amp system.

STATOR TESTS

YB 81 10 amp STATOR YB 84 30 amp STATOR



The continuity tests for stators is not a 100% method of checking. However, if the stator fails the continuity tests, it is definitely defective. If it passes the tests but all other components have also checked out O.K., the stator may be the defective part of the system and should be replaced. Test can be made with Stator on engine.

Test 7.0 STATOR GROUND

Like the Regulator, the YB 81 and YB 84 Stators must be grounded. Stator ground can be checked with any type continuity device.

TEST NO.	TESTER RED LEAD	TESTER BLACK LEAD	RESULT
1	To Stator Black Lead	To Ground	DF 83 - Light On DF 81 - Light On VOM - Continuity
2	To Other Black Lead	To Ground	

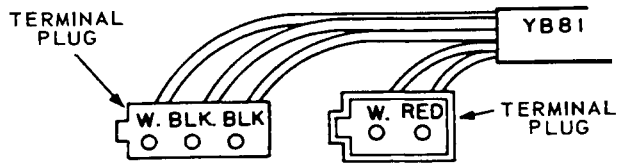
Test 7.1 STATOR CONTINUITY

This test should be performed after 7.0 stator ground test. Use continuity equipment such as DF 81 Flashlite or VOM. ***Results other than specified indicate a defective stator.***

TEST NO.	TESTER RED LEAD	TESTER BLACK LEAD	RESULT
1	To Ground	To Stator Red Lead	DF 81 - Light On VOM - Continuity
2	To Ground	To Stator Black Lead	
3	To Ground	To Other Black Lead	

Test 7.2 CONTINUITY with DF 83 Analyzer (applies to 10 amp system only)

TEST NO.	ANALYZER RED LEAD TO:	ANALYZER BLACK LEAD TO:	ANALYZER WHITE LEAD TO:	LIGHT INDICATION
1	Stator Black Lead	Ground	–	On
2	Stator Other Black Lead	Ground	–	On
3	Ground	Stator Red Lead	–	On
4	Ground	Stator Black Lead	–	On
5	Ground	Stator Other Black Lead	–	On



For 30 amp system

1. Connect analyzer Red and Black leads to stator leads — Light "ON."
2. From either stator lead to ground — Light "OFF."

If light indication is other than shown, for either 10 amp or 30 amp systems, stator is defective. If stator checks out good, perform voltage test 7.3.

Test 7.3 STATOR RUNNING VOLTAGE For 10 amp system

With the engine stopped, unplug all connectors between modules and stator. Start the engine and run at operating speed. Perform the following tests with an AC voltmeter:

TEST NO.	METER RED LEAD	METER BLACK LEAD	STATOR DEFECTIVE IF:
1	To Stator Black Lead	To Ground	Either Reading is 0 or Readings Vary more than 10%
2	To Other Stator Black Lead	To Ground	

For 30 amp system refer to test 4.2.

HIGH TEMPERATURE SAFETY SWITCH, Fig. 33

As a safety precaution against overheating, engines are optionally equipped with a high temperature switch mounted to the cylinder head opposite the ***No. 1*** spark plug toward take-off end. ***Do not*** locate switch at any other location.

When cylinder head temperature becomes critically high, the safety switch will automatically stop the engine by shorting out the ignition system. A waiting period of ***5 to 10 minutes*** will be required before the switch has cooled off sufficiently to re-start the engine. An overheated engine will score the cylinder walls, burn out connecting rod and crankshaft bearings, also warp pistons and valves. The cause of the overheating condition will have to be remedied before the engine is re-started. *See **Engine Overheats** paragraph in Troubles, Causes and Remedies section.*

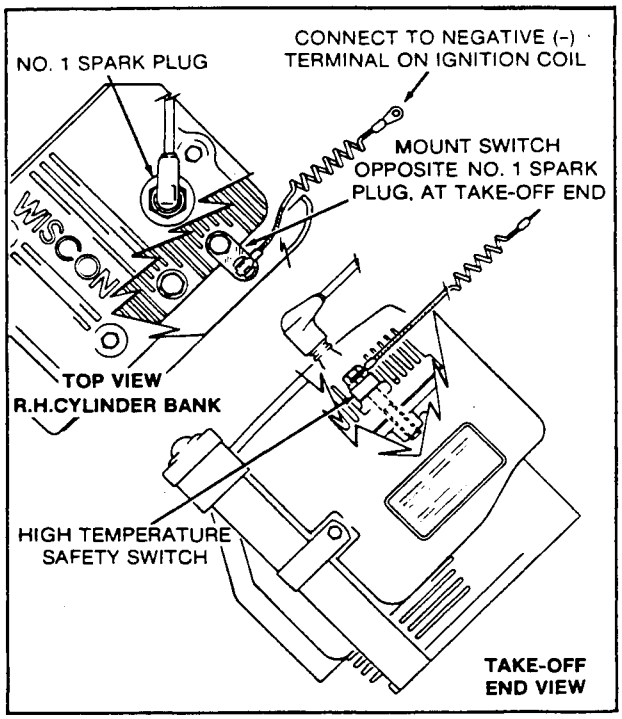


Fig. 33

ENGINE TROUBLES CAUSES AND REMEDIES

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

1. ***A proper fuel mixture*** in the cylinder.
2. ***Good compression*** in the cylinder.
3. ***Good spark, properly timed,*** to ignite the mixture.

If all three of these conditions do not exist, the engine cannot be started. There are other factors which will contribute to hard starting; such as, too heavy a load for the engine to turn over at a low starting speed, a long exhaust pipe with high back pressure, etc. These conditions may affect the starting but do not indicate that the engine is improperly adjusted.

As a guide to locating starting difficulties which might arise, the following causes are listed under the three headings: ***Fuel Mixture, Compression,*** and ***Ignition.***

In each case, the causes of trouble are given in the order in which they are most apt to occur. If the remedy is apparent, no further remedies are suggested.

Starting Difficulties

FUEL MIXTURE

No fuel in tank or fuel shut-off valve closed.

Plugged vent hole in fuel tank cap.

Faulty fuel pump. Diaphragm in pump worn or punctured.

Carburetor not choked sufficiently, especially if engine is cold.

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

Poor grade or stale gasoline that will not vaporize sufficiently to form the proper fuel mixture.

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

Dirt or gum holding float needle valve in carburetor open. This condition would be indicated if fuel continues to drip from carburetor with engine standing idle. Often tapping the float chamber of the carburetor very lightly with the handle of a screwdriver or similar tool will remedy this trouble.

Restricted or dirty air cleaner.

Faulty carburetor — requires overhaul.

To test for clogged fuel line, loosen fuel line nut at carburetor slightly. If line is open, fuel should drip out at loosened nut.

COMPRESSION

⚠ ***Caution:*** Disconnect spark plug wires to prevent engine from accidentally starting.

If the engine has proper compression, considerable resistance will be encountered on the compression stroke when turning engine crankshaft over slowly by hand. If resistance is not encountered compression is faulty.

Restore Compression to an engine that has been out of operation for a period of time, in which the oil has drained off the cylinders, by removing the spark plugs and pour about a fluid ounce of crankcase oil through the spark plug hole in each cylinder. Turn engine crankshaft over several times to distribute the oil over the cylinder walls, then reassemble spark plugs and compression should be satisfactory.

Compression Check using a commercial compression test gauge; T.W.M. does not consider it practical to publish a p.s.i. compression figure because of the variables involved; engine condition, method of testing, and rpm of test. Our recommendation is that whatever gauge test is performed, a variation of more than 10 p.s.i. between cylinders would indicate leaking rings, valves or any of the following:

Valve stuck open due to carbon and gum on valve stem, or leaking valve seat, *see 'Valves', Page 35.*

Valve tappets adjusted with insufficient clearance under valve stems. *See 'Valve Tappets,' Page 14.*

Piston rings worn, broken, or stuck in piston due to carbon accumulation. *See 'Connecting Rods and Pistons', Page 31.*

Loose spark plugs or broken spark plug. In this case a hissing noise will be heard when cranking engine, 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.

IGNITION

Check Distributor *'Ignition spark'* per instructions on *Page 23.* No spark or weak spark may be attributed to the following:

Ignition cable loose or disconnected at coil, distributor or magneto, or spark plugs.

Broken or frayed ignition wires.

Spark plug insulator broken.

Spark plugs wet or dirty.

Spark plug gap incorrect. *See Page 10.*

Condensation on spark plug electrodes.

Breaker point gap incorrect. *See Page 12.*

Breaker points pitted or fused.

Breaker arm sticking.

Condenser leaking or grounded.

Spark timing wrong. *See Page 16.*

Weak battery. Faulty ignition coil.

ENGINE MISSES

Spark plug gap incorrect. *See Page 10.*

Worn, leaking or loose ignition cables.

Weak spark or no spark in one of the cylinders. *See 'Ignition',* test for spark, *Page 23.*

Loose connections at ignition cables.

Breaker points pitted or worn.

Water in gasoline.

Poor compression. *See 'Compression', Page 22.*

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', Page 6.*

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

Air vent hole in fuel tank cap plugged.

Engine scored or stuck due to lack of oil.

Ignition troubles. *See 'Ignition', Page 22.*

ENGINE OVERHEATS

Crankcase oil supply low. Replenish immediately.

Ignition spark timed wrong. *See 'Timing', Page 14.*

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins on cylinder or head.

Intake screen clogged with dirt.

Engine operated in confined space where cooling air is continually recirculated.

Carbon in engine.

Dirty or incorrect grade of crankcase oil.

Restricted exhaust.

Engine operated while detonating due to low octane gasoline or heavy load at low speed.

ENGINE SURGES OR GALLOPS

Carburetor flooding.

Governor spring hooked into wrong hole in lever. *See 'Governor Adjustment', Page 12.*

Governor spring tension incorrectly adjusted.

Governor or throttle linkage binding, worn or disconnected.

ENGINE KNOCKS

Poor grade of gasoline or of low octane rating.

Engine operating under heavy load at low speed.

Carbon or lead deposits in cylinder head.

Spark advanced too far. *See 'Timing', Page 14.*

Loose or burnt out connecting rod bearing.

Engine overheated due to causes under previous heading.

Worn or loose piston pin.

ENGINE BACKFIRES THROUGH CARBURETOR

Water or dirt in gasoline.

Engine cold.

Poor grade of gasoline.

Sticky inlet valves.

Overheated valves.

Spark plug heat range incorrect (too hot).

Hot carbon particles in engine.

HIGH OIL PRESSURE

Oil pressure gauge defective.

Oil too heavy.

Faulty relief valve.

Clogged pressure line.

LOW or NO OIL PRESSURE

Oil pressure gauge defective.

Oil line to gauge clogged up.

Crankcase oil supply low.

Faulty oil pump.
- Gears worn or broken.
- Cover worn.
- Loose cover.
- Body worn.

Faulty relief valve.

Clogged or leaky oil line connections.

Strainer screen clogged up.

Oil too thin due to dilution or too light of grade used.

Worn rod bearings, or main bearings.

IGNITION SPARK

If difficulty is experienced in starting the engine or if engine misses firing, the strength of the ignition spark should be tested as follows: ***Disconnect*** the No. 1 and No. 2 spark plug cables from distributor towers. Leave the cable from the center tower to the coil in place. Insert a stiff piece of wire or metal rod into one of the sockets. Use an insulated pliers and hold cable terminal of that tower about 1/8 inch from the stiff wire or rod. Then, with the ignition switch on, turn the engine over by depressing the starter button and watch for a spark to discharge during the cranking cycle.

⚠ ***Caution:*** There is high voltage in ignition cables. Hold with insulated pliers to prevent receiving an electric shock.

Repeat this check with the other ignition cable. A good spark from each of the towers will eliminate the ignition coil and distributor as the source of trouble. If there is a weak spark, or no spark at all, check ***breaker point gap, condenser*** and ***ignition coil.***

ENGINE DISASSEMBLY and REASSEMBLY

OVERHAUL

An engine overhaul shall be deemed necessary if at least one of the following occur:

1. A ***10%*** loss in horsepower.
2. Oil consumption of ***one quart*** or more every 12 hours of operation.
3. A major engine part failure.

Under normal operating conditions and with scheduled maintenance, a suggested period between ***overhaul;***

2000 Hours: For ***intermittent load*** applications using 65 to 85% of horsepower at 1500 to 3600 r.p.m.

1500 Hours: For ***continuous load*** applications using 85 to 95% of horsepower at 2400 to 3600 r.p.m.

SAFETY NOTICE

Correct repair and adjustment are very important for safe and reliable engine operation. It is impossible to evaluate and advise of all the conceivable ways in which service work should be done, or of the unsafe consequences of each

way. Use common sense and satisfy yourself that what you are doing will not jeopardize your safety, the safety of others, or cause damage to the engine.

⚠ *Caution:*

1. Engine repairs should be made only by an experienced mechanic.
2. Wear safety glasses and safety shoes.
3. Do not clean parts with gasoline — use a commercial petroleum solvent, or 'degreaser', according to instructions.
4. When using air pressure for cleaning, wear safety glasses and protective clothing.
5. Keep work area clean of spilled fuel and oil.
6. Store oily rags in a fireproof container.
7. Do not smoke in work area or where batteries are stored.
8. Comply with recommended torque valves when tightening screws and nuts.
9. Replacement screws must be of equal or better grade of steel.

PREPARATION and SUGGESTIONS

Clean the engine before attempting to repair it. Remove as much dirt and grime as possible before removing any parts. This will make the repair job much cleaner and reduce the possibility of getting harmful dirt particles inside the engine.

Provide a well lighted working area with enough space for parts and tools to be spread out. A work stand is essential for holding the engine securely while removing or tightening parts.

When disassembling the engine, lay the parts out in the order that they were removed. Have several boxes available so that parts belonging to certain groups can be kept together. Tag parts if there is a possibility of confusion.

It is suggested that reference also be made to engine PARTS MANUAL for reassembly. The exploded illustrations will help in identifying parts, show the components of individual assembly groups and presents a visual order of reassembly.

Drain Oil From Crankcase Before Disassembly

All parts should be thoroughly cleaned and inspected for possible replacement. ***Use new gaskets, crankshaft oil seals*** and ***'o' ring seals*** in reassembly and lubricate all bearing surfaces.

TOOL REQUIREMENTS

Other than the conventional socket wrenches, screwdrivers, pliers, hammer, etc., the following tools may also be required.

Compressor, piston ring.

Dial Indicators.

Driver, insert (Wisconsin DF 69).

Driver, valve guide (Wisconsin DF 72).

Expander, piston ring.

Micrometers.

Oil Seal and Bearing Tool Kit (Wis. TW1001) Fig. 34.

Puller, flywheel.

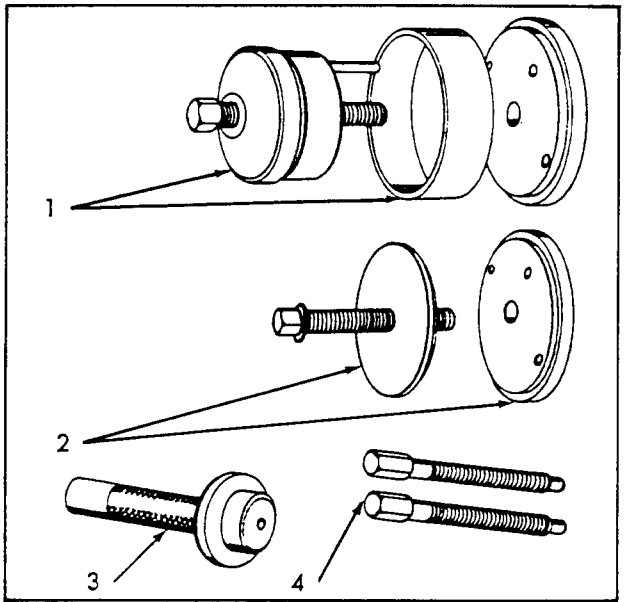
Puller, insert (Wisconsin DF 66A).

Puller, idler shaft (Wisconsin DF 67).

Torque wrench (0-75 in. lbs.).

Torque wrench (0-50 ft. lbs.).

Valve spring compressor.



1	**CRANKSHAFT MAIN BEARING TOOL:** Used to install and remove main bearings. Aligns oil holes of bearings with oil passages in crankcase.
2	**CRANKSHAFT SEAL INSTALLER:** Used to install crankshaft oil seal in bearing retainer (take off end).
3	**SEAL DRIVER:** Used to install crankshaft oil seal in gear cover.
4	**FORCING SCREWS:** Used to remove main bearing retainer plate from crankcase.

Fig. 34 SERVICE TOOL KIT TW1001

DISASSEMBLY and REASSEMBLY PROCEDURES

With the disassembly operations, instructions on reassembly are also given, as often it will not be necessary to disassemble the entire engine. If it is desired to disassemble the entire engine, the reassembly instructions can be looked up under the headings of the various parts.

ACCESSORIES

Remove ***clutch*** or ***clutch reduction*** unit if engine is equipped with either of these accessories.

AIR CLEANER, if mounted to left hand side of engine; disconnect breather lines and loosen adapter elbow at carburetor. Remove complete air cleaner and bracket assembly from side of cylinder shroud.

CONTROL PANEL can be removed to prevent being damaged. Disconnect: ignition wires, choke wire at carburetor, oil pressure line to gauge and variable speed control if furnished.

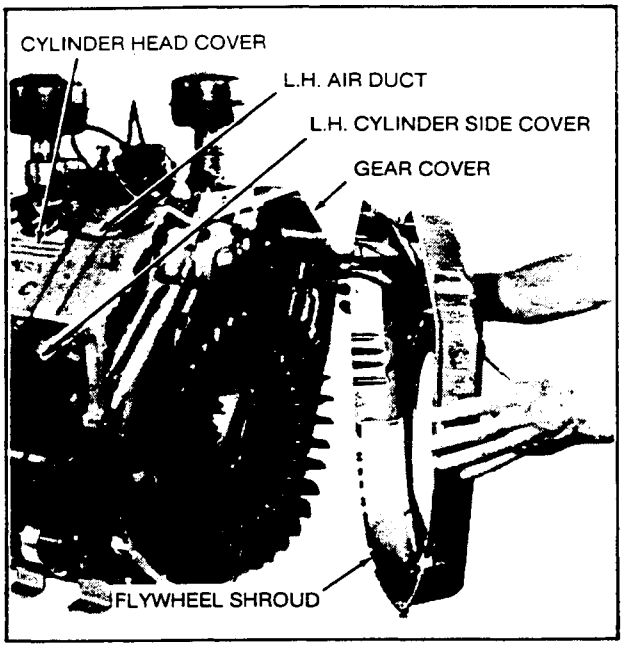


Fig. 35

FLYWHEEL SHROUD, Fig. 35

Remove eight pan head screws and take off screen from front face of flywheel shroud. Remove ten hex head screws and take off flywheel shroud.

In Reassembly; tighten flywheel shroud to gear cover screws ***48 inch lbs. torque.***

POWER TAKE-OFF STUB SHAFT, Fig. 36

The stub shaft mounted to the back-end of the crankshaft must be removed if main bearing plate or crankshaft is to be disassembled. Use a 5/16 inch 12 point socket wrench to remove the eight mounting screws.

The stub shaft mounting holes are equally spaced, so scribe crankshaft with a ***locating mark*** on hub of stub shaft if it is an installation requirement that the keyway in the stub shaft be mounted in the same position it was removed from.

In Reassembly; tighten the 12 point capscrews alternately to ***24 ft. lbs. torque.*** Keep flywheel from turning by applying a 15/16 inch wrench to the flywheel retainer screw while tightening stub shaft capscrews.

FLYWHEEL, Fig. 37

By means of a 15/16 inch offset box wrench, loosen flywheel screw by striking the handle of wrench a sharp blow with a soft hammer. Remove retainer screw with washers and keep nearby for use after flywheel is taken off.

⚠ ***Caution:*** Wear safety glasses when using a hammer to loosen flywheel retainer screw and for all other phases of overhaul where eye injuries are possible.

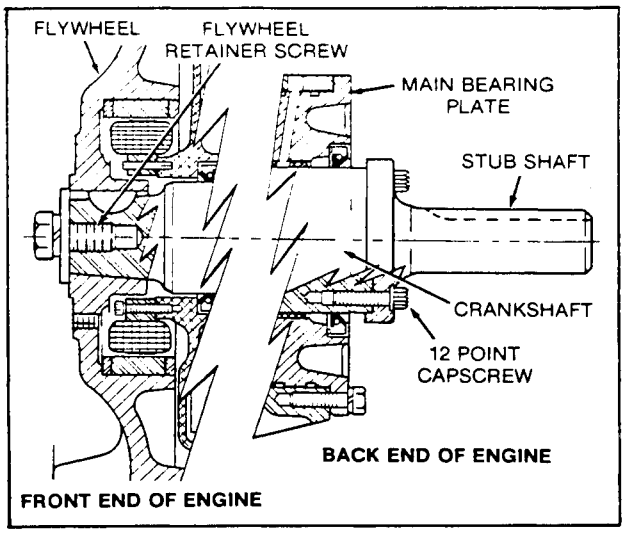


Fig. 36

The flywheel is mounted to a taper on the crankshaft and is further secured in place by a Woodruff key. The flywheel is provided with at least two 5/16-18 tapped holes on a 3-3/4 inch bolt circle for removal by means of a wheel puller as illustrated in Fig. 37.

Important: Avoid striking end of crankshaft with a hammer to loosen flywheel from taper — damage to the retainer screw threads and crankshaft could result.

Important: Carefully remove and reassemble flywheel so as not to damage flywheel alternator rotor and stator.

⚠ ***Caution:*** Handle flywheel with care — check condition of cooling fins. Operating an engine with damaged or broken off fins will damage the engine and could seriously injure the operator or bystanders.

NOTE: The flywheel retainer screw can be put back into the end of the crankshaft and used with a 15/16 inch socket wrench to turn crankshaft during overhaul procedures.

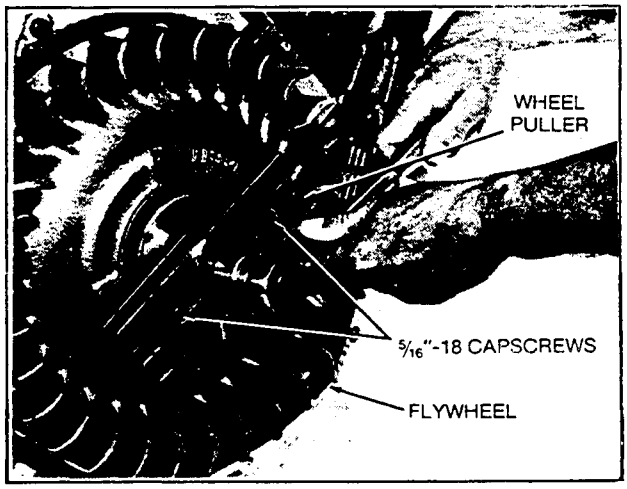


Fig. 37

In Reassembly; be sure the Woodruff key is in position on the shaft and that the keyway in the flywheel is lined up accurately with the key. After mounting; seat flywheel on crankshaft taper by slipping a piece of pipe over the end of the crankshaft and against the hub of the flywheel, and striking the end of the pipe a sharp blow with a hammer.

Mount plain washer, lockwasher and retainer screw — tighten to ***115 ft. lbs. torque.***

FLYWHEEL RING GEAR, Fig. 38

If ring gear is damaged, it can be removed by sawing partway through the ring gear, then breaking it using a hammer and chisel.

In Reassembly; oven heat new ring gear 380° to 400°F for 30 to 40 minutes. ***Do not heat with a torch.***

When properly heated, ring will fall into place on flywheel (chamfer on inside of ring toward flywheel). If necessary, tap into place with a hammer, but ***work fast.*** If ring gear shrinks to the flywheel before it is properly in place, it will have to be removed and replaced with another new ring gear.

INTAKE MANIFOLD and CARBURETOR, Fig. 39

Disconnect fuel line at carburetor, breather lines at air cleaner, and unhook throttle rod from carburetor lever. By removing 4 capscrews and lockwashers, complete air cleaner, carburetor and intake manifold can be removed from cylinder blocks as a complete unit.

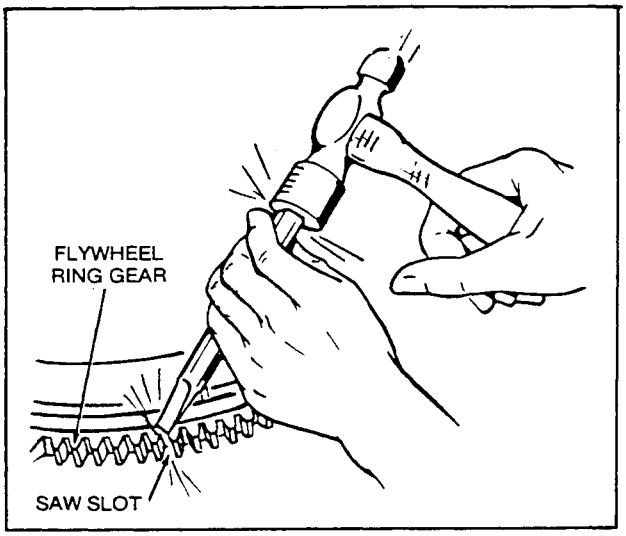


Fig. 38 RING GEAR REMOVAL

In Reassembly; if cylinder blocks were removed — spacing between intake port flanges of both cylinder blocks must be accurate to provide a secure fit to the intake manifold flanges. Use manifold as a gauge when tightening cylinder blocks to crankcase — refer to Fig. 65, Page 35.

With gaskets in place, mount and tighten manifold screws ***alternately,*** from one side to the other, to ***18 ft. lbs. torque.***

Refer to Accessories in rear section of manual for Carburetor Repair. Tighten carburetor to manifold locknuts to ***24 ft. lbs. torque.***

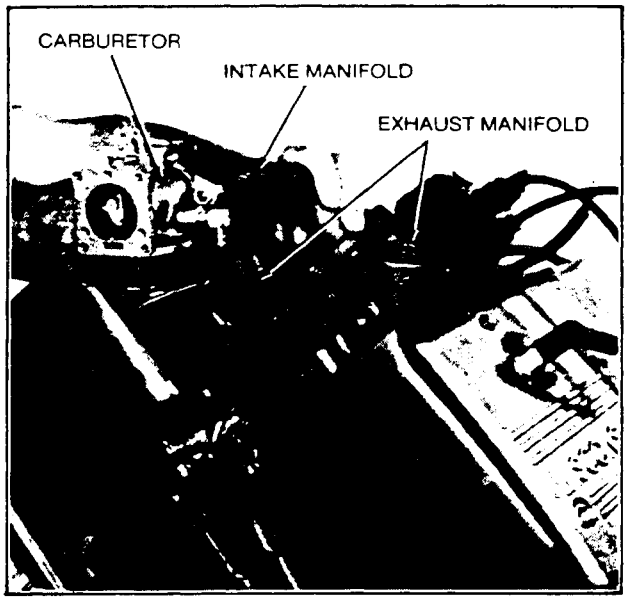


Fig. 39

EXHAUST MANIFOLDS, Fig. 39

Remove the twin exhaust manifolds, or if optional single branch exhaust system was furnished — this can be removed as a complete unit.

In Reassembly; with gaskets in place, tighten manifold to cylinder block flange screws to ***18 ft. lbs. torque.*** The optional single exhaust manifold branch is mounted to the twin side branches and tightened to ***31 ft. lbs. torque.***

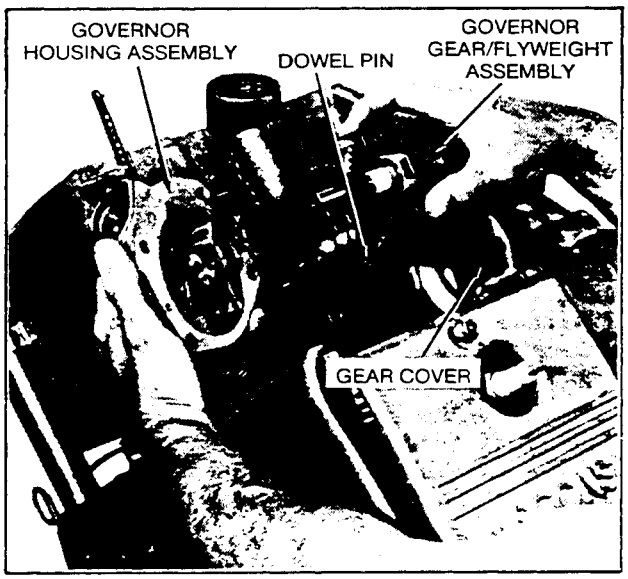


Fig. 40

GOVERNOR and DISTRIBUTOR, Figs. 40, 41, 42

Remove breather lines from valve chambers, and disconnect ignition wires at spark plugs and coil. Take out

distributor advance arm mounting screw and remove distributor. Loosen governor oil line at crankcase and take out the 4 governor housing capscrews and lockwashers from inside of the gear cover. Pull housing free from dowel pins, then twist slightly to disengage governor gear from cam gear. Remove governor housing and gear/flyweight assemblies from gear cover, see *Fig. 40.*

In Reassembly; clean and lubricate all bearing surfaces. Replace parts that are damaged or if there is excessive wear, *see Chart, Fig. 41 and Governor Illustration, Fig. 42.* Mount distributor per *Timing Instructions, Page 14.*

With housing gasket in place on spacer plate, mount governor assembly (less distributor), carefully engaging governor gear with camshaft gear, and aligning holes in

GOVERNOR— CLEARANCE and WEAR LIMITS (inches)

Description	Original Dimension	Clearance	Wear Limit
Cross Shaft Diameter	.309/.310		.002
Cross Shaft Hole dia. in Housing	.312/.313	.002/.004	.002
Gear Shaft Diameter	.5000/.4996		.002
Gear Shaft Bearing I.D.	.501/.502	.0024/.0010	.002
Thrust Sleeve I.D.	.503/.505	.0030/.0054	.003

Fig. 41

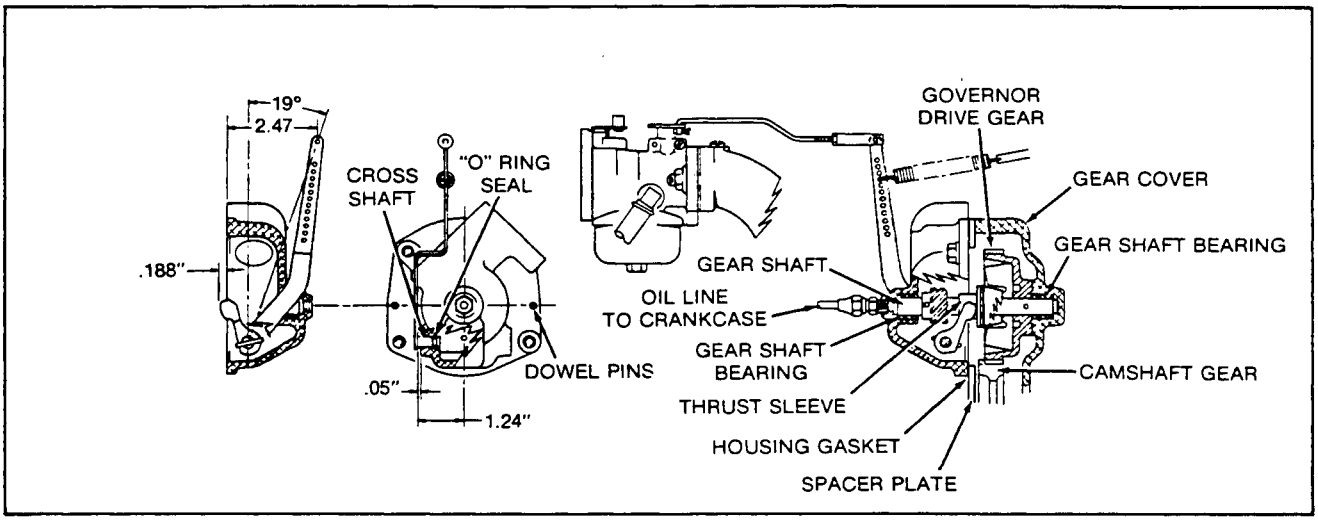


Fig. 42

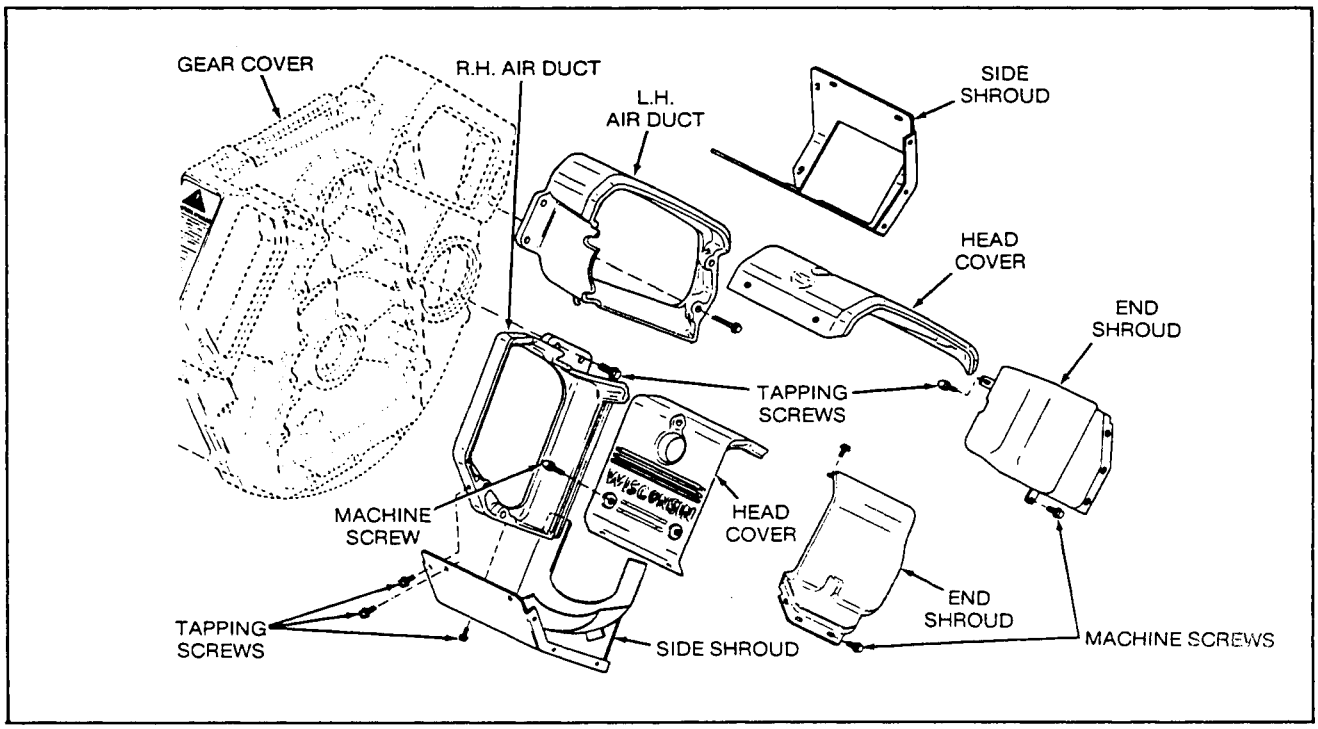


Fig. 43

governor housing with dowel pins in gear cover. Tighten housing mounting screws to ***84 inch lbs. torque***, then connect oil line to crankcase.

Mount ignition distributor to governor housing per ***'Timing Procedure'***, Page 14, Figures 23, 24, 25, 26.

AIR SHROUDING, Fig. 43

Remove shrouding in the following sequence, noting that some of the mounting screws are hex head machine thread with an attached external lockwasher, and others are self-tapping thread with a hex washer head.

1. Cylinder end shrouds and oil filler tube support strap.
2. Cylinder side shrouds.
3. Cylinder head covers.
4. Air duct from right hand side. Air duct on left hand side can remain attached to the gear cover.

In Reassembly; tighten machine thread screws to ***108 inch lbs. torque***, and the self-tapping thread screws to ***48 inch lbs. torque.***

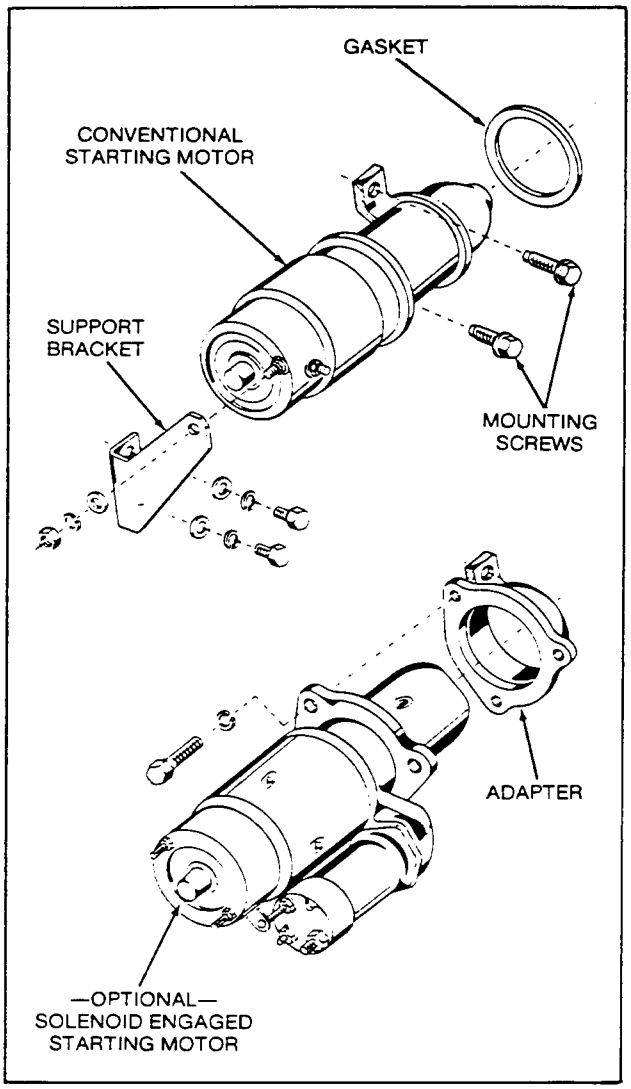


Fig. 44

STARTING MOTOR, Fig. 44

The ***conventional type*** standard starting motor is *"Inertia Engaged"*, with a *FOLO-THRU* bendix to protect against damages caused by false starts.

Optionally furnished is a "Solenoid Engaged" starting motor containing an overrunning clutch type drive that provides positive engagement. The ***Solenoid Starting Motor*** is mounted to an adapter attached to the engine gear cover, and is removed and reassembled in the same manner as the conventional starting motor.

First remove the ignition coil, which is usually mounted to the engine support below the starting motor. Disconnect starter cable, then loosen and remove nut and washers from starting motor to support bracket. Take off support bracket after removing the 2 mounting screws and washers.

Caution: Starting motor is not held in place by a pilot flange — ***hold starter firmly*** while removing mounting screws. By means of a 9/16 inch socket wrench, take out the 2 capscrews that support starting motor to gear cover.

In Reassembly; thoroughly clean terminals and exterior of motor body. Clean bendix with Kerosene — ***Do not*** oil bendix — if necessary, lubricate with powdered graphite.

When remounting starter, be sure flange gasket is in place. Its purpose is to prevent dirt and moisture from entering into the gear cover and starter bendix. Tighten starter to gear cover screws to ***144 inch lbs. torque — Do not*** overtorque — screw threads are in aluminum material. Tighten bracket and support screws and nut to ***108 inch lbs. torque.***

CYLINDER HEADS and SPARK PLUGS, Fig. 45

Caution: Beginning with engine serial No. 5996538 the cylinder head was changed to accommodate a 14 mm spark plug in place of an 18 mm plug. If a cylinder head using an 18 mm plug is to be replaced with a new head, both heads must be changed using 14 mm spark plugs. ***Do not*** use cylinder heads with two different spark plug sizes on the same engine. Refer to Page 10 for spark plug part numbers and gap setting.

Remove spark plug, three studs, five capscrews and washers from each of the two cylinder heads. Take off heads and discard head gaskets. Clean carbon from the combustion chamber and dirt from between cooling fins. Check cylinder head mounting face for distortion — if ***warpage*** is evident, replace head. The cylinder head should be flat within .005 inch.

In Reassembly; mount new gaskets with gasket face in either direction. Apply a mixture of graphite and oil to the threads of the mounting screws and studs to prevent them from rusting tight against the cylinder block. Screw the studs for attaching the cylinder head covers in their correct location on cylinder heads. Then, tighten the studs and screws to ***36 ft. lbs. torque***, in the sequence shown in *Fig 45*. After engine is ***run-in***, retorque to ***36 ft. lbs.***

Hi-temp Safety Switch, optionally furnished, is mounted to the cylinder head opposite the No. 1 spark plug, at take-off end. Switch must be remounted in this same location or it will not function properly. See Fig. 33.

Spark plugs can be left out temporarily for ease in turning engine over for remainder of assembly and for timing adjustments. When mounting spark plugs, tighten ***18 to 22 ft. lbs. torque*** (dry).

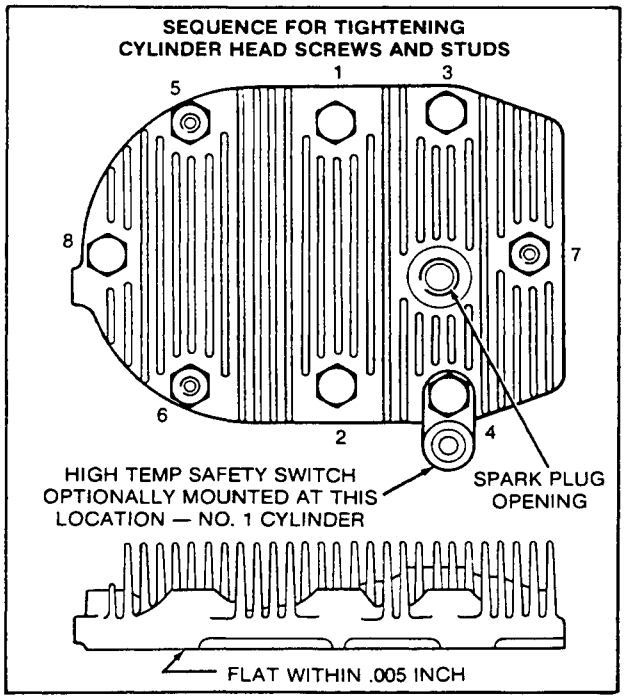


Fig. 45

FLYWHEEL ALTERNATOR — STATOR, Fig. 46

Stator can be left on gear cover and removed as a complete unit as illustrated in *Fig. 47*. If stator is to be replaced because of malfunction, first remove the four #10-32 screws by means of a 5/32 inch Allen wrench. Then, place a pry bar alternately in the area behind the two stator dowel pins, and pry stator mounting surface loose. Then, take off stator wire cavity cover from gear cover, disconnect wire from rectifier/regulator module terminals — remove stator assembly.

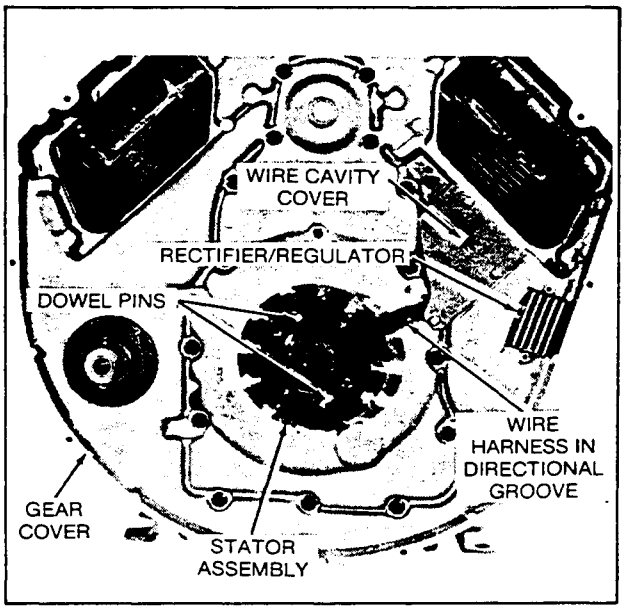


Fig. 46

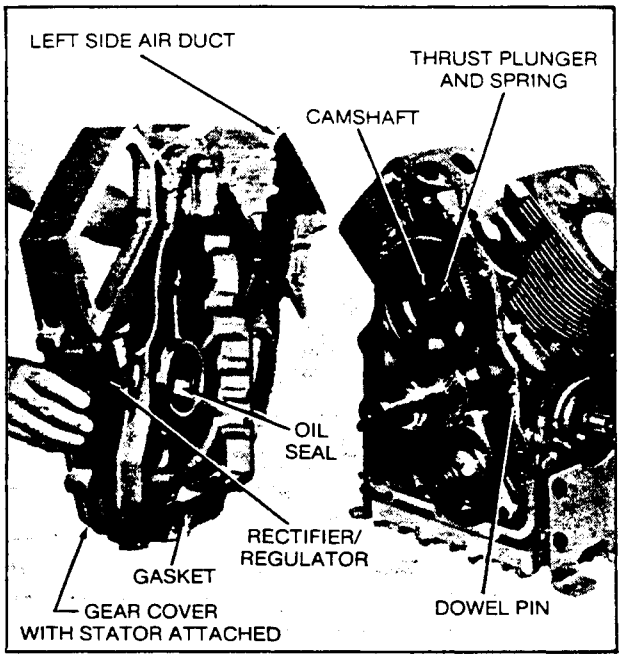


Fig. 47

In Reassembly of new stator, point wire harness in line with directional groove in gear cover, place stator mounting surface over dowel pins and gently tap in place. Apply #242 ***Loctite*** to the four #10-32 screw threads and tighten to ***18 inch lbs. torque.*** Connect wire harness to rectifier/regulator module and remount wire cavity cover.

GEAR COVER, Fig's. 47, 48, 49

Disassemble air duct from gear cover on right hand side by removing four hex head screws. Air duct on left hand side can remain attached to gear cover.

Remove eleven 5/16"-18 x 2" long capscrews and lockwashers that mount the gear cover to crankcase. With the rectifier/regulator disconnected from the stator, pull gear cover free from crankcase dowel pins.

Remove thrust plunger and spring from end of camshaft to prevent them from falling out and being lost.

With reference to Fig. 49, check condition of governor shaft bearing and oil seal. Crankshaft oil seals are included as part of the engine gasket set and should be replaced if engine is rebuilt. The oil seal is assembled to the gear cover with the ***lip pointing inward*** toward the engine crankshaft gear, see Fig. 49.

Install Gear Cover Oil Seal as illustrated in *Fig. 48*, by using seal driver tool #208200 contained in TW1001 Tool Kit.

1. Slide oil seal onto driver with open lip toward the tool. ***Note:*** This is opposite of the main bearing plate oil seal.
2. While supporting and cushioning the gear cover assembly, place the oil seal and driver into the gear cover recess.

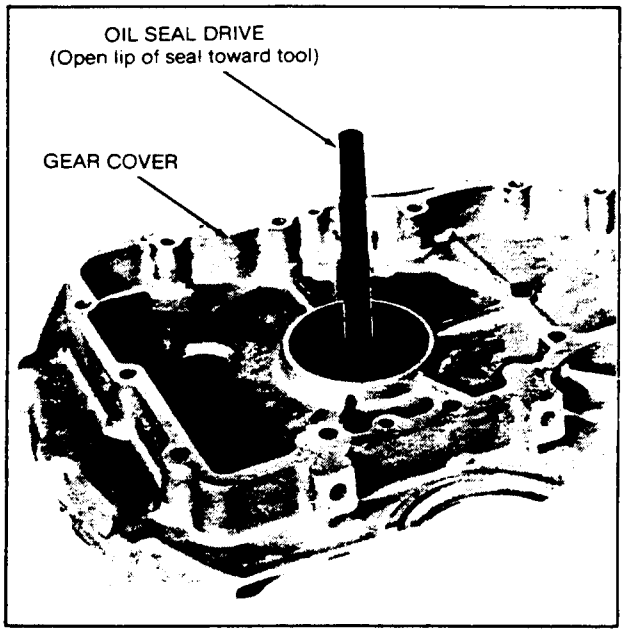


Fig. 48

3. Squarely hit the seal driver with a hammer until the seal is fully seated in the gear cover.

The governor shaft to bearing clearance is .001 to .0024 inch. When the clearance becomes .0044 inch, replace bearing and, or shaft.

In Reassembly; insert thrust plunger and spring into end of camshaft. Mount gasket to spacer plate face, using a thin coat of oil or grease to hold it in place. Assemble gear cover being careful not to damage or fold lip of oil seal when contacting shoulder on crankshaft. Engage crankcase dowel pins and lightly tap gear cover in place. Assemble the 11 capscrews and lockwashers, tighten to ***18 ft. lbs. torque.***

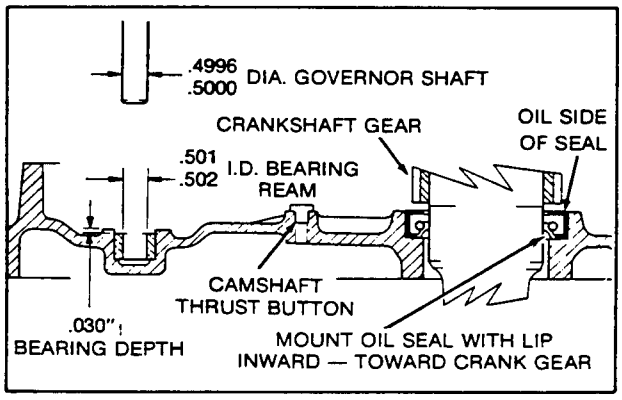


Fig. 49

GEAR TRAIN, Fig. 50

With the removal of gear cover, the gear train will be exposed as shown in *Fig. 50.* Remove camshaft thrust plunger and spring to prevent their being lost.

Future reference can be made to *Fig. 50* when assembling crankshaft and camshaft, as accurate location of the timing marks is essential for proper engine operation.

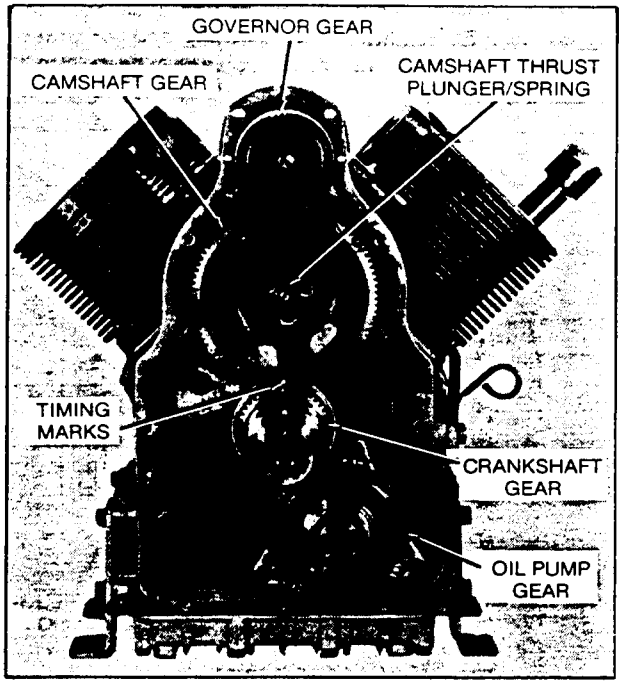


Fig. 50

OIL PAN, Fig. 51

Invert engine to a position where the bottom of the crankcase will be accessible. Take off oil pan and gasket, using a 1/2 inch socket wrench to remove 12 capscrews and lockwashers.

In Reassembly; use a new oil pan gasket, and mount oil pan with oil drain to either side — oil filter side is standard. Use Perma-tex on screw threads and tighten to ***18 ft. lbs. torque.***

OIL PUMP, Fig's. 51, 52, 53

Remove 3 capscrews and lockwashers through the openings in the oil pump drive gear at the gear cover face of the crankcase. The complete oil pump assembly can then be pushed out from inside the crankcase.

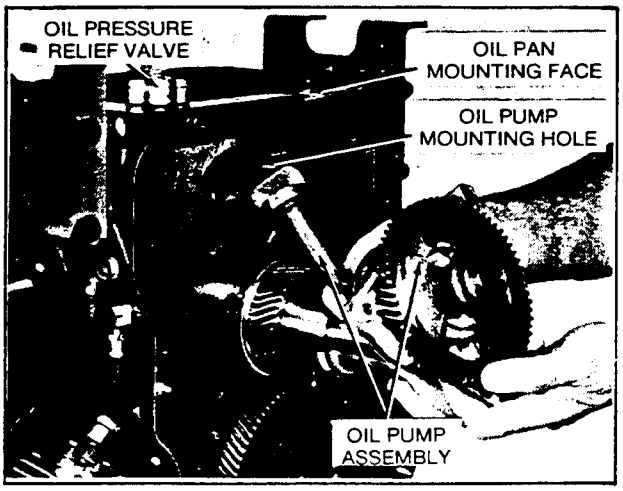


Fig. 51

Oil pump disassembly; is required for inspection and cleaning if faulty pump operation is suspected. The cover and pick-up tube assembly can be removed by taking out the pump mounting screws through openings in the drive gear. A puller is required to remove drive gear from shaft. Wash all parts in a cleaning solvent and dry with compressed air.

Replace oil pump or related parts if any of the following conditions exist.

1. Cracks or excessive wear in pump body.
2. Excessive wear or damage to gears. (Gears are replaced as a matched set.)

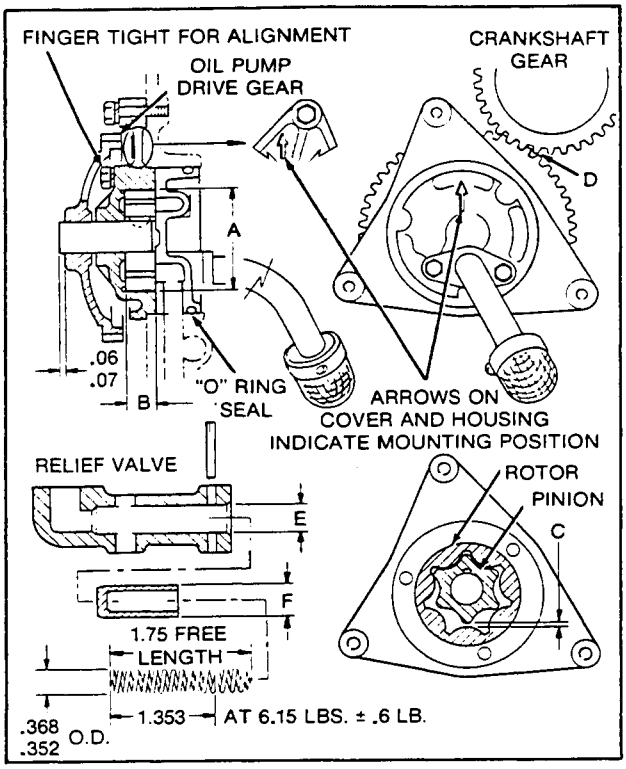


Fig. 52 OIL PUMP

OIL PUMP— CLEARANCE and WEAR LIMITS (inches)

	Description	Original Dimension	Clearance	Wear Limit
A	Pump Housing I.D.	2.2555/2.2575	.0055/.0105	.003
	Rotor O. Dia.	2.2500/2.2470		
B	Pump Housing Depth	.6905/.6925	.003/.006	.002
	Rotor Width	.6875/.6865		
C	Rotor Tip Clearance		.004/.006	.003
D	Backlash-Pump Gear to Crankshaft Gear		.003/.006	
E	Relief Valve Body I.D.	.4375/.4385	.0015/.0030	.001
F	Piston O. Dia.	.4360/.4355		

Fig. 53

3. Drive shaft loose in pump body.
4. Wear in cover that allows oil to leak past the face of rotor and pinion.
5. Damage to oil pick-up tube or screen.

Refer to *Fig. 53* for size, clearance and wear limits of oil pump parts.

Relief Valve; for oil pump pressure, is mounted to the bottom of the crankcase, as illustrated in *Fig 51*. Remove, clean and inspect for faulty operation. Refer to *Fig. 53* for relief valve clearance and wear limits.

In Reassembly; press drive gear onto shaft before mounting cover, and per dimensions in *Fig. 52*. ***Note:*** Thoroughly oil pinion and rotor gears as a pump prime for initial starting.

Mount housing and cover with cast ***arrow pointing upward.*** Tighten cover screws only ***fingertight*** to allow for alignment of cover and body assembly to crankcase.

Place a new 'O' ring seal on cover. Push oil pump into crankcase bore, being sure that body is aligned with cover, and shoulders firmly against crankcase face. Check to be sure that ***arrows*** on cover, and on the opposite side of body, are pointing in the same ***upward direction, see Fig. 52.***

Tighten cover mounting screws and pick-up tube screws to ***48 inch lbs. torque,*** and body flange screws to crankcase, ***108 inch lbs. torque.***

Spin oil pump drive gear counterclockwise to check for free movement of internal gears.

PISTONS and CONNECTING RODS

REMOVAL

Rotate crankshaft to bring connecting rod down to a convenient position for removal of cap. By means of a 9/16 inch socket wrench, loosen and remove locknuts from connecting rod bolts. By tapping the end of the bolts lightly, the connecting rod cap will break loose from the bolts. Tape or cap ends of connecting rod bolts to prevent them from scratching cylinder walls and crank pins when removing.

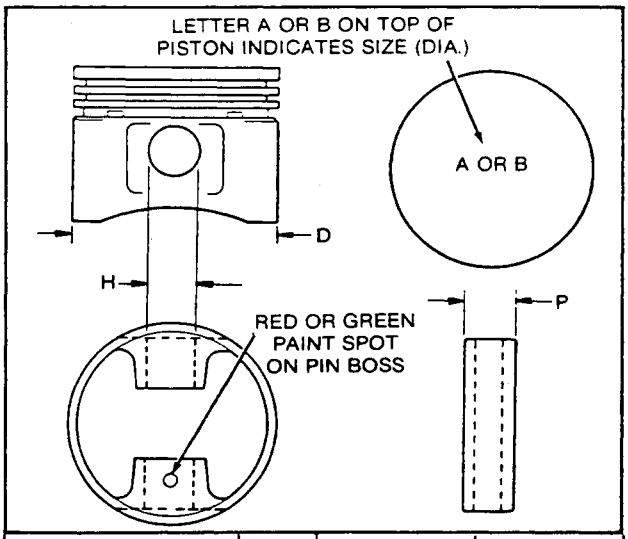
Scrape off all carbon deposits that might interfere with removal of pistons from upper end of cylinder. Turn crankshaft until piston is at top, then push connecting rod and piston assembly upward and out through top of cylinder. Be careful not to scrape rod against crank pin and cylinder wall. Place caps on rods immediately so that they will not be mismatched in reassembly. ***Note:*** Tag connecting rod and piston assemblies so that they can be reassembled into the same cylinder that they were removed from.

Replace connecting rods that are damaged. Check for twisted or bent rods, and inspect for nicks and cracks.

DISASSEMBLY

Piston Pin should be removed using a hydraulic press. The pin is a select clearance fit to the piston, and an interference press fit to the connecting rod. ***Do not*** interchange piston pins. Pistons are matched with pins to obtain a clearance of .0005 to .0008 inch. ***Pins are not serviced separately. For Service Replacement;*** pin is furnished with

piston and ***color coded*** Red and Green to match corresponding color spot on piston pin boss in piston, *see Fig. 54.*



	Description		Size (inches)	Clearance
D	Piston Diameter at Skirt Thrust Faces	A	3.7465/3.7470	.0035/.0025
		B	3.7471/3.7475	.0034/.0026
H	Piston Pin Hole Dia. in Piston	Red	.87530/.87515	
		Green	.87515/.87500	
P	Piston Pin Diameter	Red	.8746/.8745	.00080/.00055
		Green	.8745/.8744	.00075/.00050

Fig. 54

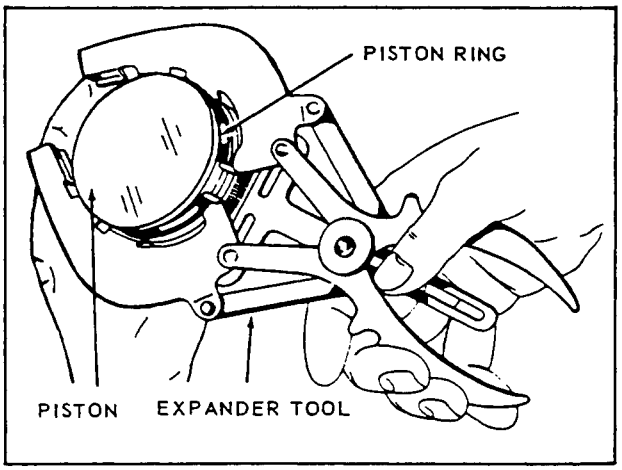


Fig. 55

Piston Rings; if they are to be replaced, should be removed by means of a ring expander, *see Fig. 55*, so as not to damage piston.

Pistons; should be thoroughly cleaned of carbon and varnish accumulations using a cleaning solvent, ***do not use a wire brush.*** Clean oil ring slots and oil holes in piston pin bosses.

Check for cracked or worn ring lands, scuffed or cracked skirt or pin holes and eroded areas at top of piston. Replace pistons that are damaged or show excessive wear.

PISTON, RING, ROD CLEARANCES and WEAR LIMITS (inches)

Cylinder Bore	A	3.7500/3.7495	
	B	3.7505/3.7501	
Cyl. Out of Round		.0005	
Cyl. Taper		.003	
Piston Dia. at Bottom of Skirt, Thrust Faces	A	3.7465/3.7470	
	B	3.7471/3.7475	
Piston to Cylinder at Piston Skirt Thrust Face		**Clearance**	**Wear Limits**
	A	.0035/.0025	.003
	B	.0034/.0026	.003
Piston Ring Gap		.010/.020	.005
Piston Ring Side Clearance in Grooves	Top Ring	.002/.004	.002
	Scraper Ring	.002/.004	.002
	Oil Ring	.0015/.0035	.002
Piston Pin to Connecting Rod-Small End (1500 lb. min. for assembly)		.0006/.0015 Tight	
Piston Pin to Piston	Red	.00080/.00055	.001
	Green	.00075/.00050	.001
Connecting Rod to Crank Pin – Side Clearance		.009/.018	.005
Connecting Rod **Shell Bearing** to Crank Pin Dia. (Vertical)		.0011/.0036	.003

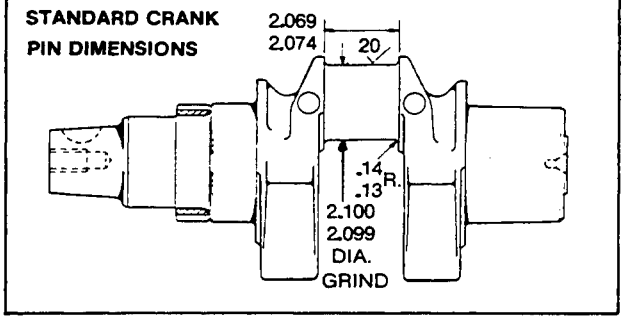


Fig. 56

REASSEMBLY/PISTONS and CONNECTING RODS

Shell Bearings must be correctly mounted to the connecting rod ***in reassembly.*** The cap should be mounted to the rod so that the ***locating lug*** of both bearing halves are on the same side as illustrated in *Fig. 57.* Spread a film of oil on back of shell bearing before mounting to help hold them in place during assembly. Refer to chart, *Fig. 56,* for clearance between bearing and crank pin.

The precision shell bearings do not utilize shims for adjustment. Check crank pin for out-of-round or taper, then use a commercial ***Plastic Gage*** to check clearance between crank pin and rod bearing. If clearance is excessive — .010 and .020 inch undersize shell bearings are available for reconditioned crank pins.

Piston skirt is ***cam-ground*** to an elliptical contour. Clearance between the piston and cylinder must be determined from the center of the thrust face at the bottom of the piston skirt. Refer to Chart, *Fig. 56*, for proper clearance. The thrust face on the piston are the wide section of the piston, 90° from the axis of the piston pin hole, on both sides of the piston.

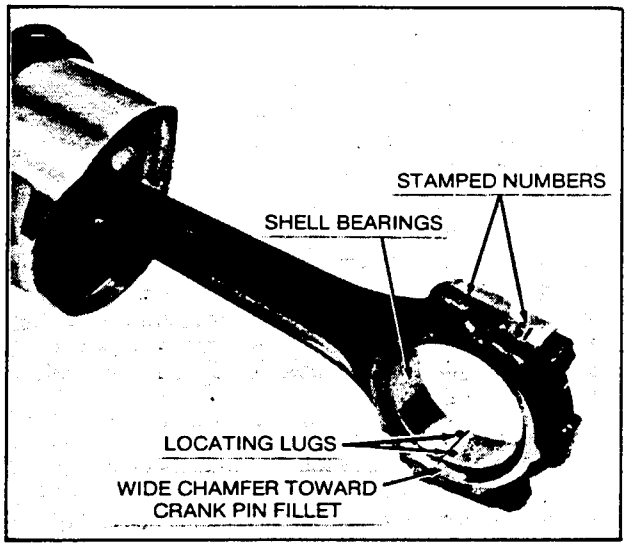


Fig. 57

IMPORTANT

When measuring pistons, pins and cylinder bores, it is important that these parts be at room temperature. If any parts are hotter or colder than the others, improper fitting will result.

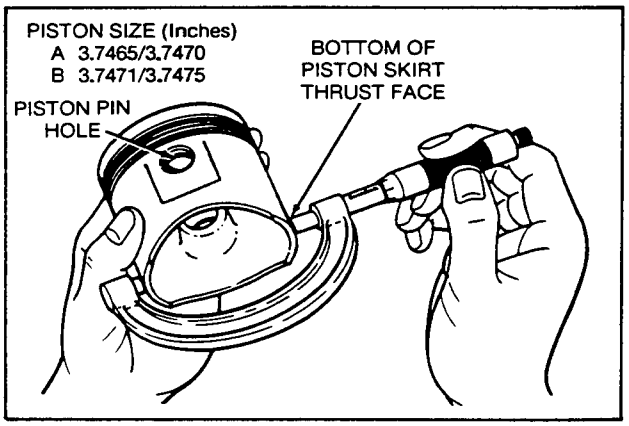


Fig. 58

With reference to *Fig. 58*, measure piston at bottom of piston skirt thrust faces, 90° from pin hole. For service, standard pistons are marked on top in ***A*** and ***B*** sizes, as illustrated. For reboring, .010, .020 and .030 inch oversize pistons are also available.

Piston Pin is a press fit into the connecting rod. Lubricate pin hole in piston and rod — use a hydraulic press to facilitate assembly of pin. Properly support piston to prevent skirt from being crushed. Press pin into a depth of about .015 inch below outer surface of piston, using a minimum force of 1500 lbs. to obtain functional pin operation. See *Fig. 62*.

Optionally; a rod heater can be used to induction heat and expand pin hole in connecting rod so that piston pin can be hand pressed in place.

Caution: Do not use a torch for heating — connecting rod might warp.

Piston Ring gap and side clearance should be checked before installing onto piston.

With reference to *Fig. 59*, insert ring into cylinder bore below ring travel. Square ring in bore by pushing it in position with head of piston. The ring gap as measured with a feeler gauge should be .010 to .020 inches for each of the three rings. With new rings, incorrect gap usually indicates wrong size rings. It should not be necessary to alter gap by filing ends of new rings.

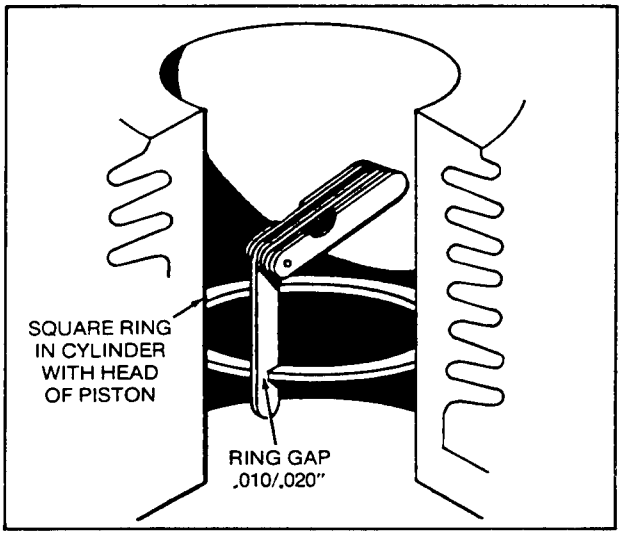


Fig. 59 RING GAP

Side Clearance of the compression, scraper and oil rings, should be measured before installing rings on piston. The clearances indicated in *Fig. 60* are with new piston and rings. If clearance is more than .002 inch over the high limit with new rings and original piston, replace piston assembly.

PISTON RINGS, Fig's. 59, 60, 61, 62

If a ring expander tool, *Fig. 55*, is not available, install rings by placing the open end of ring on piston first, as shown in *Fig. 61*. Spread ring only far enough to slip over piston and into correct groove, being careful not to distort ring. Install bottom ring first and work toward the head of the piston, installing top ring last. The word ***'TOP'*** on compression and scraper rings indicates direction of ring placement on piston.

Note: Be sure Expander Ring is in place in 3rd groove before mounting oil control ring.

The outer diameter of the compression ring is ***chrome plated***. Mount scraper ring with scraper edge down,

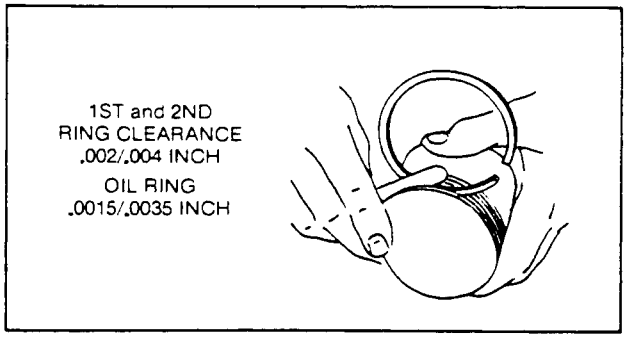


Fig. 60 RING SIDE CLEARANCE

otherwise oil pumping and excessive oil consumption will result. Refer to *Fig. 62* for the correct placement of piston rings.

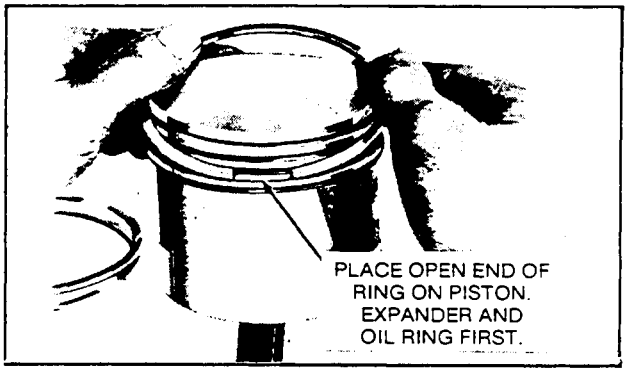


Fig. 61

Connecting Rod/Piston Assemblies should be put back into the same cylinder bore from which they were removed. Stagger the piston ring gaps as follows:

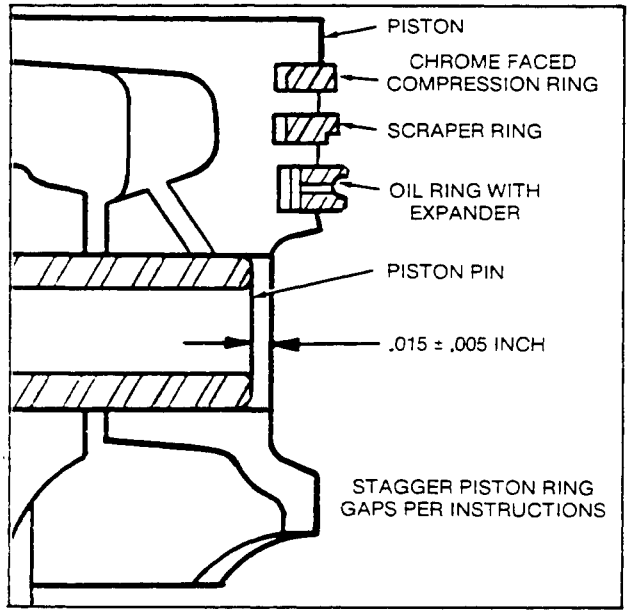


Fig. 62

1. 180° between top and 2nd ring.
2. 90°, oil ring expander from 2nd ring.
3. 90°, oil ring from expander, and at least 30° from top and 2nd ring gaps.

Lubricate rings, pistons, cylinder walls and crank pin with SAE 30 grade oil.

IMPORTANT

Assemble with rod bearing parallel to crank pin, and chamfer in bearing bore away from vertical center of crank pin. The large outer vertical flat surfaces of both rods are facing each other when rods are attached to crank pin as illustrated in Fig's. 63 and 64.

Tape or cap ends of connecting rod bolts to prevent them from scratching cylinder walls and crank pins when assembling. Use an automotive ring compressor over piston and insert rod into cylinder from cylinder head end. Use the wooden handle end of hammer and gently tap piston into cylinder until the connecting rod bearing contacts the crank pin.

Note: Identical numbers are stamped on one side of the bearing end of connecting rod and its corresponding cap, *see Fig. 63.* These numbers must be on the same side of each individual rod when mounted in engine. This is for identification and correct assembly. The numbers for No. 1 cylinder rod are on a side opposite those of No. 2.

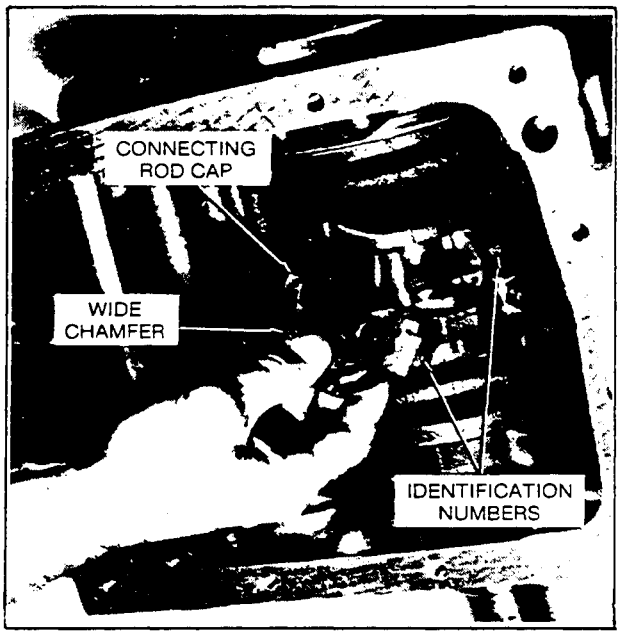


Fig. 63

Install ***new locknuts*** on connecting rod bolts and tighten to ***36 ft. lbs. torque.*** Total ***side clearance*** of both rods to the crankshaft is .009 to .018 inches. Evenly distributed this is approximately .003 to .006 inch between the two rods and to each side of the crank pin cheeks. If there is no clearance to either of the sides, then one of the rods is incorrectly mounted, *see Fig. 64.*

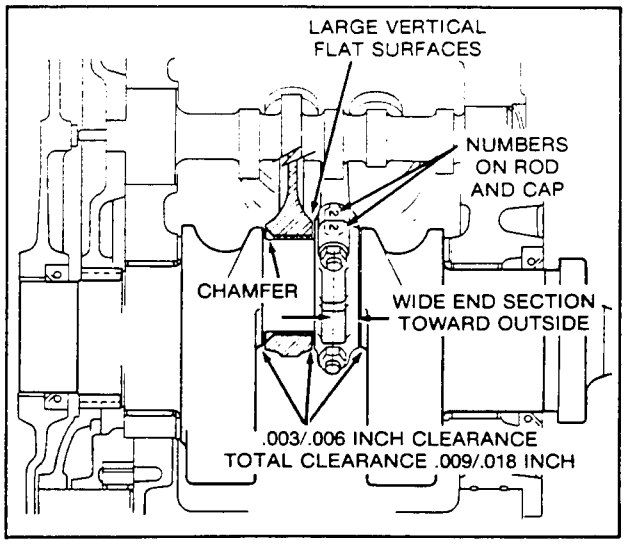


Fig. 64 CONNECTING ROD ASSEMBLY

FUEL PUMP, Fig. 65

The mechanical fuel pump illustrated in *Fig. 65* is standard equipment on these models of engines. The pump is driven off the camshaft — has a lift of 4 feet, and static pressure of 1 to 1½ lbs. above the outlet port when engine is operating at 1800 rpm.

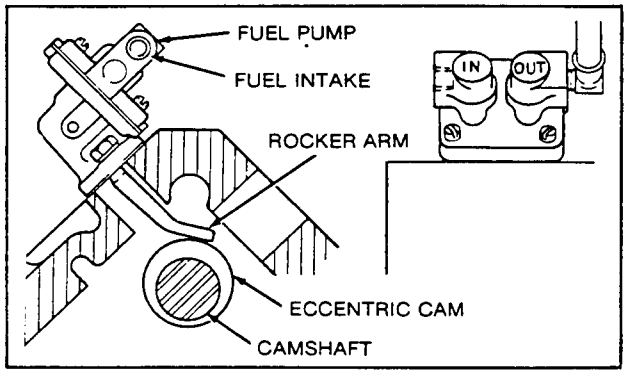


Fig. 65 FUEL PUMP

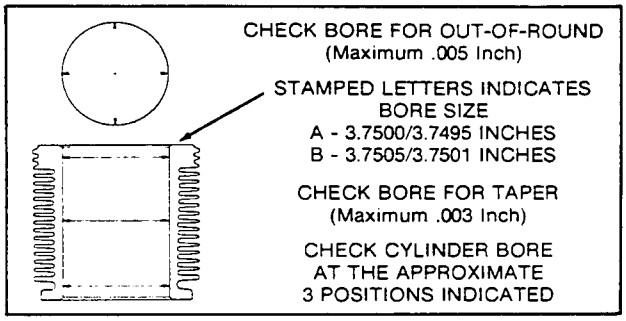


Fig. 66

After 500 hours of operation the efficiency of the pump may decrease. Check for rocker arm or cam wear, and inspect diaphragm for possible replacement. Refer to *Repair Instructions* in *Accessories Section* for further information.

Electric Fuel Pump rated at 2 to 3.5 *psi* at zero delivery is optionally available in place of mechanical pump. The pump is wired into the circuit per wiring diagram, *Fig. 30*.

CYLINDER BLOCKS, Fig's. 66, 67

Clean all dirt and foreign deposits from between the cylinder fins and manifold ports.

The cylinder blocks do not have to be removed unless the cylinder bore is scored, out-of-round, or worn oversize more than ***0.005*** inch. The standard cylinder bore sizes are as follows (inches):

A 3.7500/3.7495 dia.
B 3.7505/3.7501 dia.

For service replacement, cylinder blocks are stamped ***A*** and ***B***, on top between bore and valve ports, for selection with A and B marked pistons.

Cylinder blocks can be rebored and fitted with pistons and ring of .010", .020" and .030" oversize. It is recommended that this work be done by an authorized Teledyne Wisconsin Motor Distributor or Service Center.

In Reassembly; spacing and parallel alignment between intake port flanges of both cylinder blocks must be accurate enough to provide a secure fit to the intake manifold.

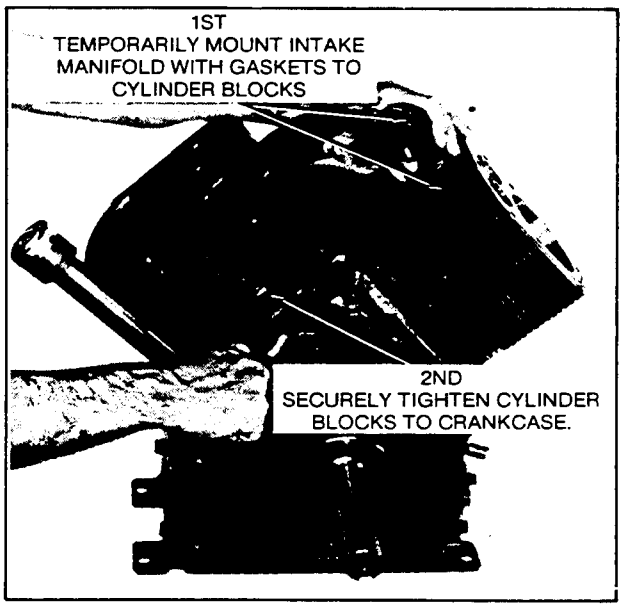


Fig. 67

With reference to *Fig. 67*, use manifold and gaskets as a gauge. Hand tighten manifold to cylinder block screws for alignment, then tighten the four cylinder block holddown nuts to ***47 ft. lbs. torque***. Tighten the cap screw in valve spring compartment to ***31 ft. lbs. torque***.

After securely mounting both cylinder blocks, remove manifold and gaskets for convenience in tappet adjustment and further parts assembly in the valley area.

VALVES and SEAT INSERTS

Take off the combination valve inspection cover and

breather assemblies from cylinder blocks. Insert a rag in the opening at the bottom of valve chamber so the retainer locks do not fall into the engine crankcase. By means of a standard automotive valve spring compressor as illustrated in *Fig. 68*, remove retainer locks. Release compressor tension lever and remove seat, spring and valve. Follow the same procedure for the other valves.

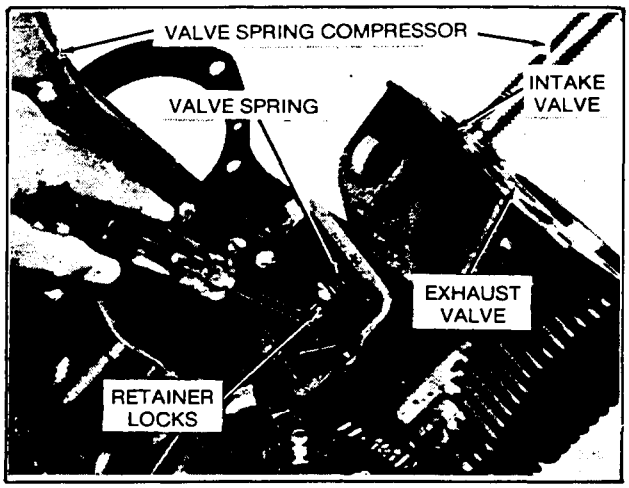


Fig. 68

Clean all parts, as well as the cylinder ports and guides, of all carbon and gum deposits. Tag each reusable valve so that they will be put back into the same guide they were removed from, in reassembly. Replace valves that are badly burned, pitted or warped.

Valve springs that are weak will spoil a good overhaul if they are not replaced. With reference to *Fig. 69*, check free length, compression strength and if both ends are parallel. Replace springs that are not within ***5 lbs.*** of the amount shown, when compressed to length when ***valve is open.*** Discard springs that show evidence of rust, and if they are not within 1/16 inch of being square.

In Reassembly; Mount valve springs with the damper coils against the cylinder block.

NOTE: Both ends of spring are ground square with 1.5 ***damper coils*** on one end only.

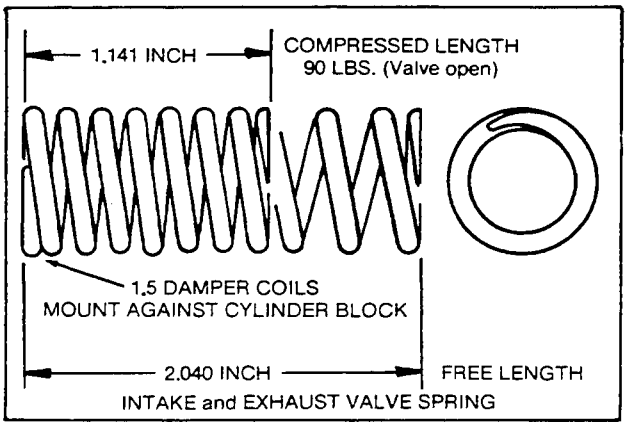


Fig. 69

Valve Rotators are furnished on the ***exhaust valves*** in place of the conventional valve seat. On some applications rotators are also furnished on the ***intake valves***. The same valve spring is used with or without valve rotator. The action of the rotator is to rotate the valve slightly each time the valve opens, helps prevent sticky valves and will impart a wiping action between the valve face and valve seat, thereby preventing the build-up of foreign deposits. Valve rotation will also avoid prolonged exposure of any one sector of the valve face to a local hot spot on the seat which will result in lower and more uniform valve face-seat temperatures. Clean and inspect operation of rotators — replace if faulty.

Seat Inserts for both intake and exhaust valves can be removed when replacement becomes necessary by means of a Wisconsin ***DF 68A*** insert puller, *See Fig. 70.* Maximum recommended seat width for replacement is .087 inches, *See Fig. 71.* The intake and exhaust seat inserts are identical in size, but the materials are different. The exhaust seat inserts are of a special ***long life*** heat resistant steel. For mounting seat inserts use Wisconsin ***DF 69*** insert driver.

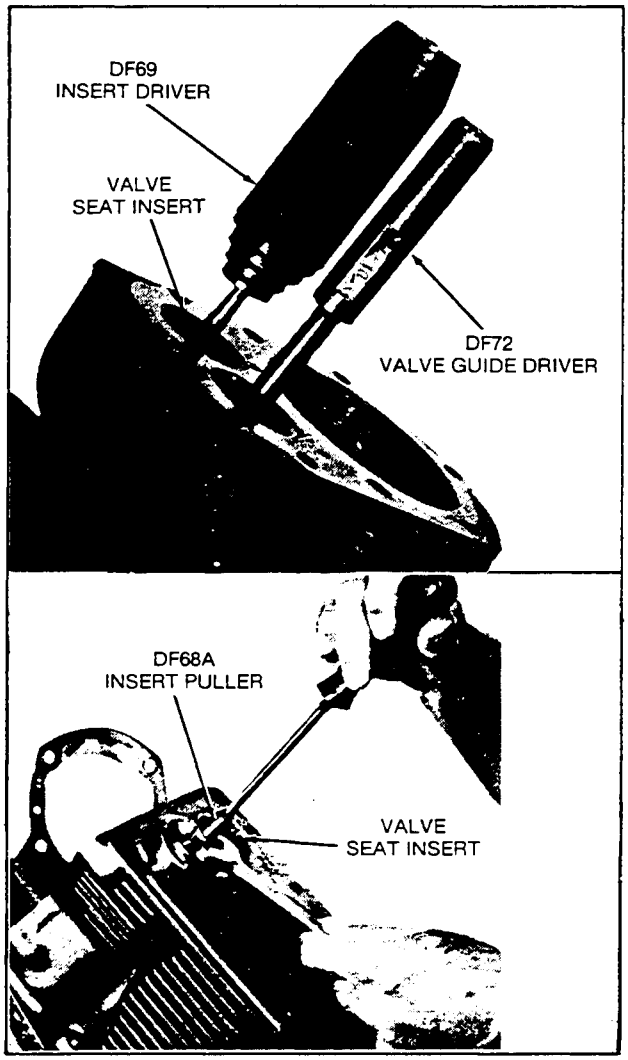
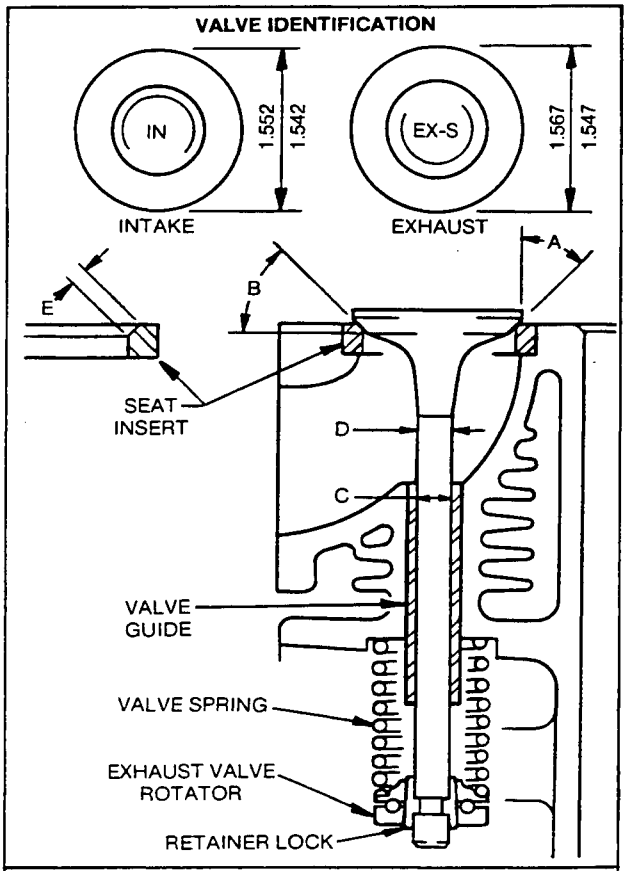


Fig. 70

Before grinding valves, inspect valve guides for possible replacement. Refer to *Valve Guide* paragraph. The valve face is ground at 45° to the vertical center line of the valve stem and the valve seat insert should also be ground at a 45° angle. ***After grinding,*** lap valves in place until a uniform ring will show entirely around the face of the valve. Clean valves and wash block thoroughly with a hot solution of soap and water. Wipe cylinder walls with clean lint free rags and light engine oil, especially if cylinders were rebored and honed.



SPECIFICATIONS ARE FOR BOTH INTAKE AND EXHAUST		
A - Valve Face Angle	45°	
B - Seat Insert Angle	45°	
C - Guide Inside Diameter	.312/.313"	
D - Valve Stem Diameter	**Clearance**	**Wear Limit**
Intake - .310/.311"	.001/.003"	.002"
Exhaust - Lock End .308/.309"	.003/.005"	.002"
Head End .308/.307"	.004/.006"	
E - Valve Insert Face	**Width** .057/.072"	**Max.** .087"

Fig. 71 VALVE and SEAT SPECIFICATIONS

Valves are approximately identical in size, but the material specifications are considerably different. The exhaust valves have a special ***long life*** heat resistant steel seat face, and is identified by the cast letters ***EX-S*** on the head. The intake valve has ***IN*** cast on the face and is to the left in the cylinder block — the exhaust valve is to the right. *See Fig's. 68 and 71.*

Valve guides in the cylinder block are easily replaceable by use of Wisconsin ***DF 72 driver tool.***

In Reassembly; mount guides as illustrated in *Fig. 71.* Maximum allowable clearance between valve stem and guide is .005 inch for intake valve, and .007 inch for exhaust valve. The inside diameter of the unassembled valve guide is .313/.314 inch. When pressed into the cylinder block, using DF-72 driver tool, the inside diameter should compress to an operating diameter of .312/.313 inches — ***If necessary ream to obtain the proper I.D.***

CAMSHAFT and VALVE TAPPETS

The valve tappets are cylindrical shaped and can be taken out from the top of the crankcase before the camshaft is removed. Tag tappets so that they can be reassembled back into the same holes that they were removed from. Camshaft and gear assembly can be taken out as a complete unit from the gear cover end of the crankcase as illustrated in *Fig. 72.*

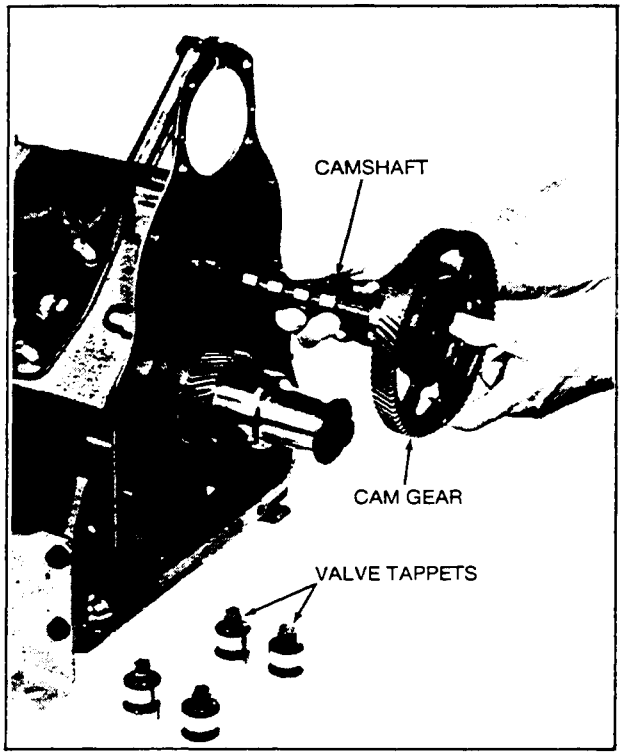


Fig. 72

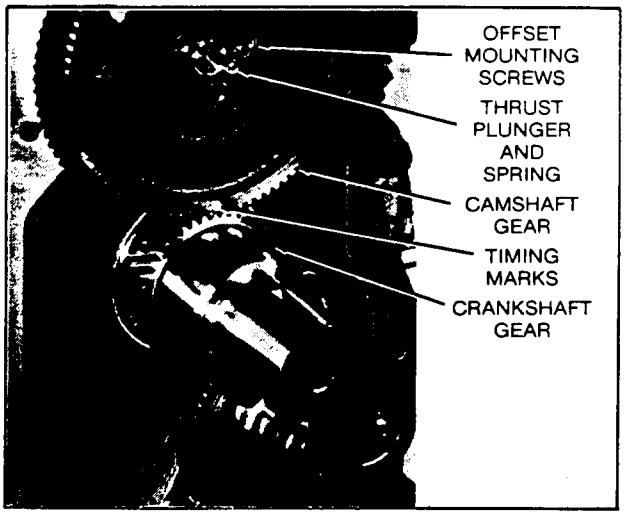


Fig. 73

In Reassembly; check tappets, camshaft and gear for damage or excessive wear, replace if necessary. Refer to clearance and wear limits chart, *Fig. 74*. Check cam gear teeth backlash with a dial indicator as illustrated in *Fig. 75*. The backlash should not be less than .003 inch nor more than .006 inch.

Camshaft Gear can be removed if necessary by taking out the three mounting screws and applying a gear puller. ***In Reassembly;*** align the gear mounting holes with the camshaft tapped holes (offset spacing for accurate mounting). Thread mounting screws, with lockwashers, in place and alternately turn them down to draw cam gear in place on camshaft. Tighten screws to ***18 ft. lbs. torque.***

Timing Mark (drill point) in space between gear teeth on cam gear must match up with a similar ***marked gear tooth*** on crankshaft gear for accurate timing. Assemble accordingly and per *Fig. 73* illustration.

CAMSHAFT and VALVE TAPPETS CLEARANCE and WEAR LIMITS (inches)

Description		Original Dimension	Clearance	Wear Limit
Tappet Diameter		1.1247/1.1237	.0003/.0021	.001
Tappet Hole Diameter in Crankcase		1.1258/1.1250		
Camshaft Bearing Diameter-Small End		1.4980/1.4974	.0002/.0036	.002
Bearing Hole Diameter in Crankcase-Small End		1.501/1.500 (Fig. 80)		
Camshaft Bearing Diameter-Large End		2.0600/2.0593	.0025/.0044	.002
Bearing Hole Dia. in Crankcase-Large End		2.0637/2.0625 (Fig. 80)		
Cam Lift In. and Exh.	W2-1230	.331		±.005
	W2-1235	.370		
Tappet Screw Adjustment Torque 35 in. lbs. min.				

Fig. 74

Tappet Adjustment should be made after the cylinder block assemblies are in place, and before manifolding is mounted.

The clearance between valve stem and tappet adjusting screw should be:

Intake - .007 inch ***Exhaust - .020 inch***

Refer to page 13 and Fig. 23 for valve tappet adjustment procedure.

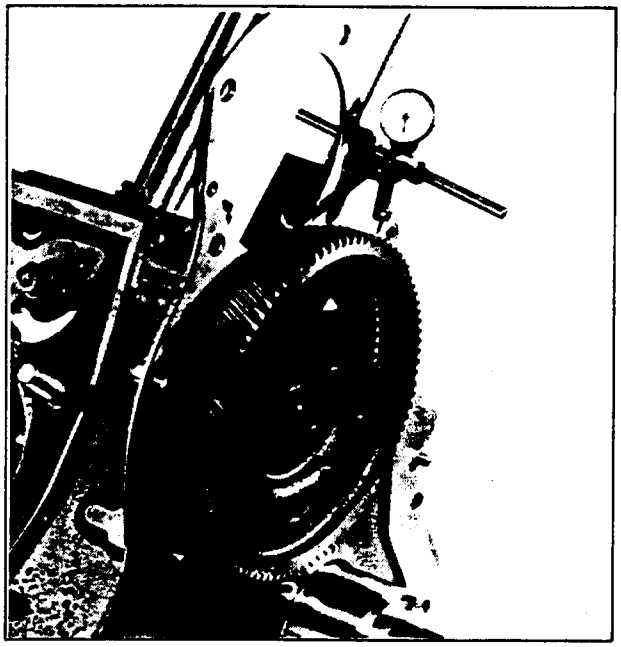


Fig. 75 CHECKING CAMSHAFT GEAR BACKLASH

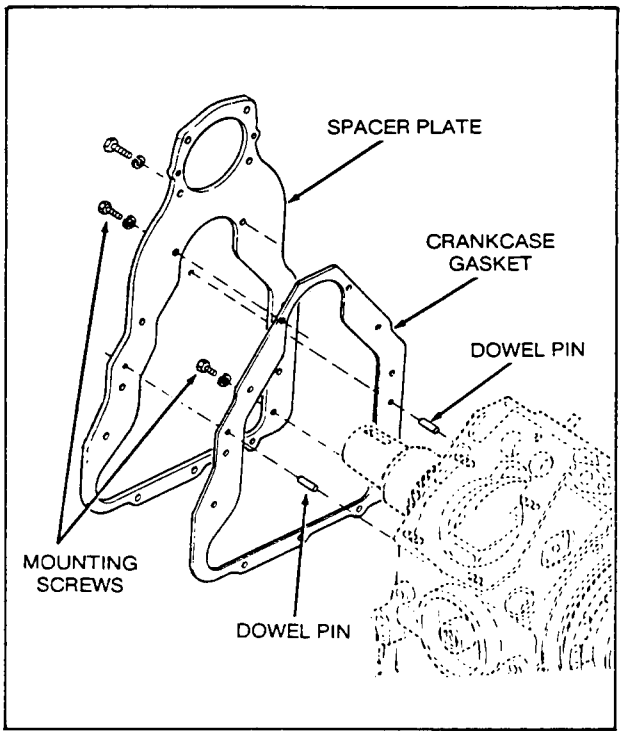


Fig. 76

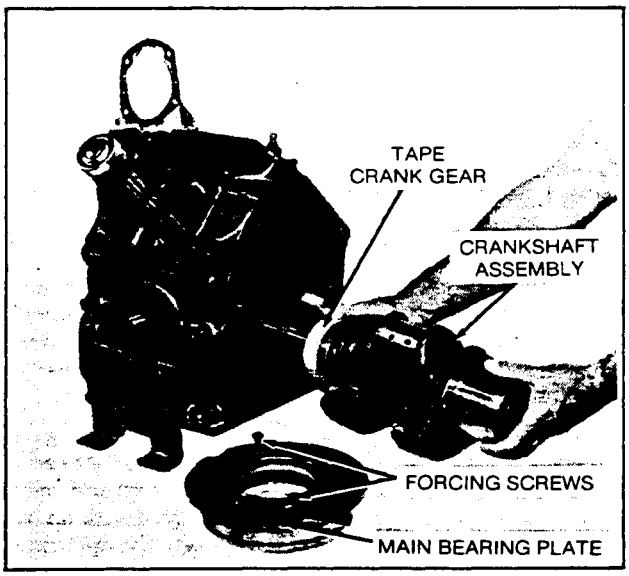


Fig. 77

SPACER PLATE, Fig. 76

If it is necessary to remove or replace the spacer plate; it is fastened to the crankcase with three capscrews, two at the cam gear location, and one in the lower left hand side.

In Reassembly; use a new gasket and hold in place on crankcase with a few dabs of grease. Tighten mounting screws to ***18 ft. lbs. torque.***

MAIN BEARING PLATE — Removal, Fig. 77

The power take-off shaft mounted to the rear end of the crankshaft must be removed before taking off the main bearing plate. Refer to *Fig. 36, page 25,* for stub shaft disassembly and reassembly procedures.

The bearing plate is doweled to the crankcase for bearing alignment. After removing the eight mounting screws and lockwashers, thread a 5/16"-18 x 1½" long capscrew into the two tapped holes in the face of the bearing plate. Alternately tighten them to loosen bearing plate from dowel pins. Take off main bearing plate along with crankshaft shims (if any), and thrust bearing. Check main bearing and thrust bearing for scuffing or excessive wear, see chart *Fig. 80.*

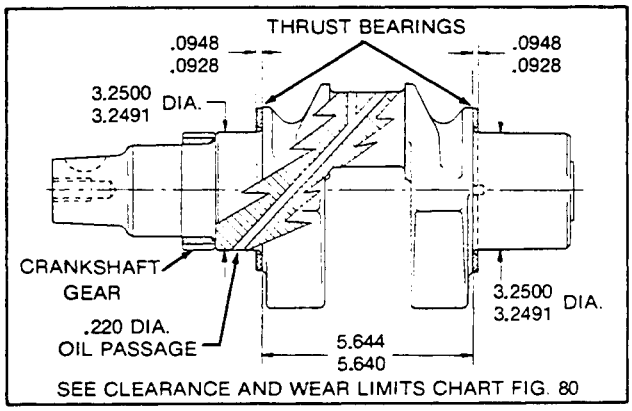


Fig. 78

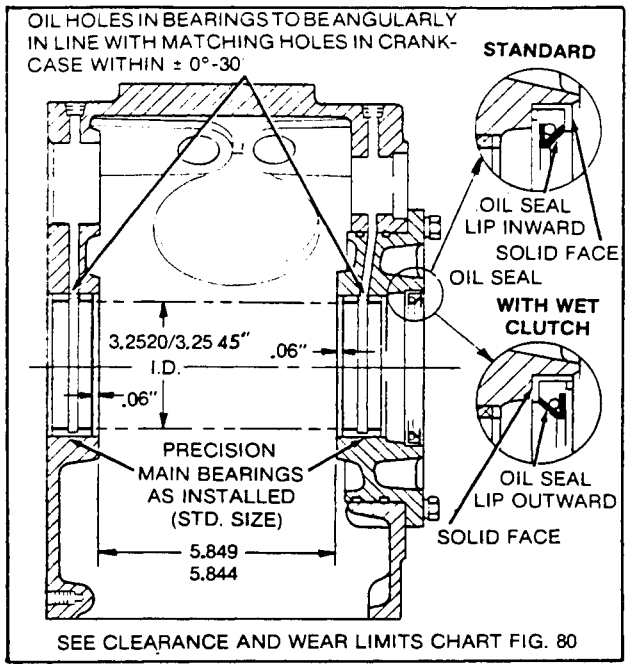


Fig. 79

CRANKSHAFT — Removal, Fig's. 77, 78

Wrap tape around crank gear teeth, and then remove crankshaft from crankcase being very careful not to damage main bearing in crankcase. Inspect connecting rod bearings per *Fig. 56, page 32,* and main bearings per *Fig. 79.* Clean out oil passages at main bearing, up and through to crank pin.

Remove thrust bearing from inside crankcase, inspect for scuffing or excessive wear.

CRANKCASE, Fig. 79

Clean out all oil passages to camshaft and main bearings. Check ***camshaft*** bearings for excessive wear per chart *Fig. 74* and illustration *Fig. 82.* Inspect ***main bearings*** in crankcase and bearing plate for wear and alignment per *Fig. 79* and specification chart *Fig. 80.*

For Service Replacement; standard size and .005 inch undersize bearings are available. These precision bearings do not require any machining after bearings are pressed in place.

IMPORTANT: The two oil holes in the main bearings must be aligned with the oil passages in crankcase and main bearing plate to within ±0°-30'.

The *Main Bearing Tool* included in *Kit TW1001* (Ref. 1, Fig. 34), is used to conveniently remove and install main bearings in both crankcase and main bearing plate.

Because the alignment of the main bearings is critical, the crankcase and main bearing plate for production engines are sub-assembled and the holes for the main bearings are line bored for accuracy. For ***service replacement of crankcase***, a matched production engine bearing plate and crankcase complete with bearings is furnished.

To replace main bearing plate only, a semi-finished bearing plate can be furnished for ***line-boring*** with an existing crankcase, if machining facilities of this type are available. Oil seal counter-bore and pilot diameter machining are also required, and oversize dowel pins must be used. Refer to ***Main Bearing Plate*** paragraphs on *page 39*.

BEARING PLATE/CRANKCASE MAIN BEARING CLEARANCE and WEAR LIMITS (inches)

Description	Original Dimension	Clearance	Wear Limit
Crankshaft Main Bearing Diameter	3.2500/3.2491	.002/.005	.001
Crankcase Main Bearing Diameter	3.2520/3.2541		
Crankshaft Thrust Surface Length	5.644/5.640		
Crankcase/Thrust Brg. Surface Length	5.654/5.663	.010/.023	
*Available Shim Sizes to Obtain Proper Clearance (End Play)	.004/.006 and .010/.012	.005/.012 End Play	

Fig. 80

CRANKSHAFT/GEAR — Reassembly, Fig. 81

To replace crank gear — drill and chisel to split gear, being careful not to damage oil seal or main bearing surfaces on crankshaft. Scribe a mark on the crankshaft, not more than 9/16 inch long, from end of oil seal surface, and in line with center of flywheel keyway in shaft. ***Do not*** scribe into area where oil seal lips contact crankshaft — remove any scribe burrs.

Press new gear onto shaft, chamfer end forward, with the vertical centerline of any ***tooth exactly in line with scribe mark*** on oil seal surface and vertical centerline of engine crank pin. Add a prick punch ***Timing Mark*** to base of tooth face on vertical centerline, *see Fig. 81*.

IMPORTANT

Marked gear tooth must be in line with vertical centerline of crank pin to within .020 inch, or valve timing will be inaccurate for satisfactory engine operation.

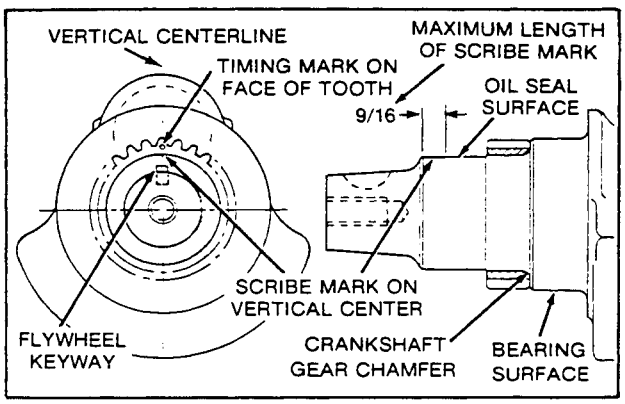


Fig. 81 CRANKSHAFT GEAR ASSEMBLY

Mount flywheel end thrust bearing with tabs inserted into retainer holes in crankcase. Apply oil to thrust bearing and crankshaft main bearing surfaces.

Wrap outside of crank gear teeth with tape, and then assemble crankshaft to crankcase through main bearing plate opening, being careful not to damage crankcase bearing, or scratch oil seal surface on crankshaft.

MAIN BEARING PLATE — Reassembly

Note: Finished bearing plates are not available for service replacement because of bearing alignment. Semi-finished bearing plates, which can be mounted to an existing crankcase and ***line-bored***, are available. See ***New Bearing Plate*** instructions following the next two paragraphs.

The main bearing plate oil seal and sleeve bearing, if replaced, are mounted per illustration *Fig. 79. **Oil Seal*** is normally assembled (standard), with ***lip inward*** and solid face toward the outside. On engines equipped with an oil operated clutch, the oil seal is reversed, with the lip facing outward. The same standard size and .005 inch undersize bearings used in the crankcase are also used in the main bearing plate. No machining is required after bearings are pressed in place.

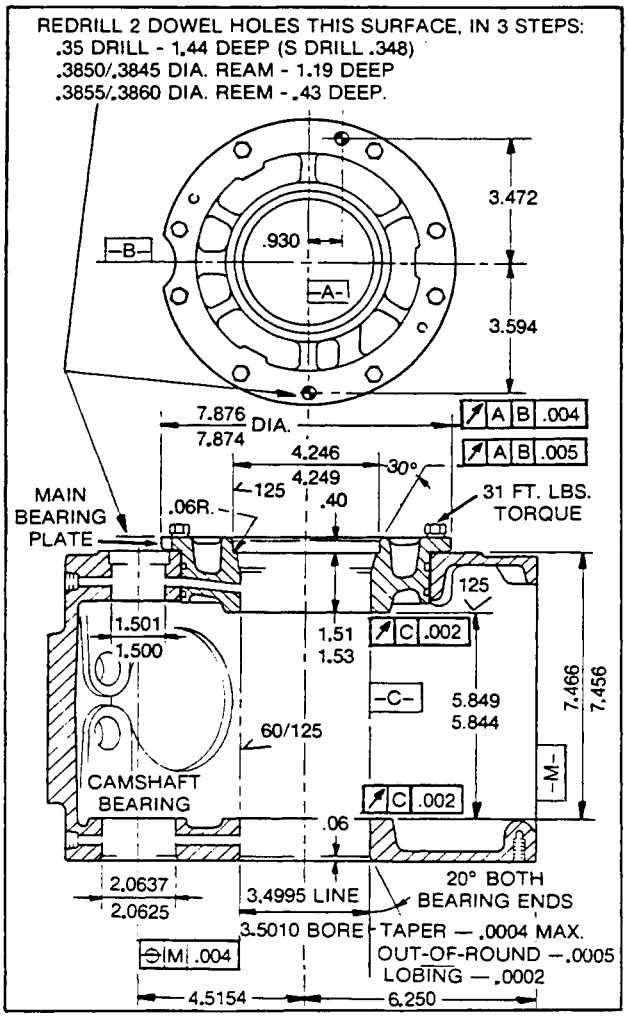


Fig. 82

***Service Tool Kit** TW 1001* (Fig. 34) contains tools for conveniently removing and installing main bearing and oil seal in the main bearing plate.

Temporarily mount bearing plate with shims (if used), and thrust bearing attached, but leave the two 'o' ring seals off. Torque mounting screws to ***31 ft. lbs.*** and proceed with *Crankshaft End Play* instructions.

New Bearing Plate (furnished semi-finished), used with an existing crankcase will have to be line-bored so that bearings are in complete alignment. With reference to *Fig. 82*:

1. Align the 2 drilled holes in semi-finished bearing plate with current reamed dowel holes in crankcase — mount bearing plate to case, less 'o' ring seals and shaft oil seal. Torque mounting screws to ***31 ft. lbs.***
2. Redrill the 2 dowel holes in three steps as follows (in inches):
   .35 dia. drill — 1.44 deep (S drill .348 dia.)
   .3850/.3845 dia. ream — 1.19 deep
   .3855/.3860 dia. ream — .43 deep
3. Tap two new PA-475 service dowel pins in place (.3853/.3851 dia. x 1¼ long).
4. Line-bore bearing plate with crankcase.
   3.4995/3.5010" Diameter.

Taper, hour glass or barrel	.0004" max.
Out-of-round	.0005" max.
Lobing	.0002" max.

5. Machine inside thrust face of bearing plate, counterbore for oil seal, and turn outside pilot diameter per dimensions shown in *Fig. 82*.
6. Clean crankcase/bearing plate and press in place the appropriate size main bearings and oil seal per *Fig. 79*. Check bearing alignment.
7. Remove bearing plate from crankcase. Add thrust bearings and assemble the crankshaft into crankcase. Remount bearing plate, less 'o' ring seals, and proceed to ***check end play***.

Crankshaft End Play is .005 to .012 inch with the engine at normal room temperature. Adjustment is made by the addition or removal of steel shims between the crankshaft thrust bearing and main bearing plate.

With reference to *Fig. 83*, check and adjust end play in the following manner.

1. Rap crankshaft from take-off end with a soft hammer so that crankshaft will shoulder against main bearing at gear cover end.
2. Rap crankshaft in the opposite end (from gear cover end) to seat against main bearing at take-off end.
3. Attach a Dial Indicator to the crankcase at the take-off end, and against the end of the crankshaft. Set dial at 0.
4. With a pry bar, wedge crankshaft toward gear cover end of crankcase — the movement of the crankshaft will register as end play on the indicator dial. Confirm the end play figures by repeating this sequence several times.

The end play adjustment shims are of two thicknesses —.010 to .012 inch and .004 to .006 inch. If end play is ***more than .012 inch***, add a corresponding thickness of shim —***less than .005 inch*** end play, remove shim.

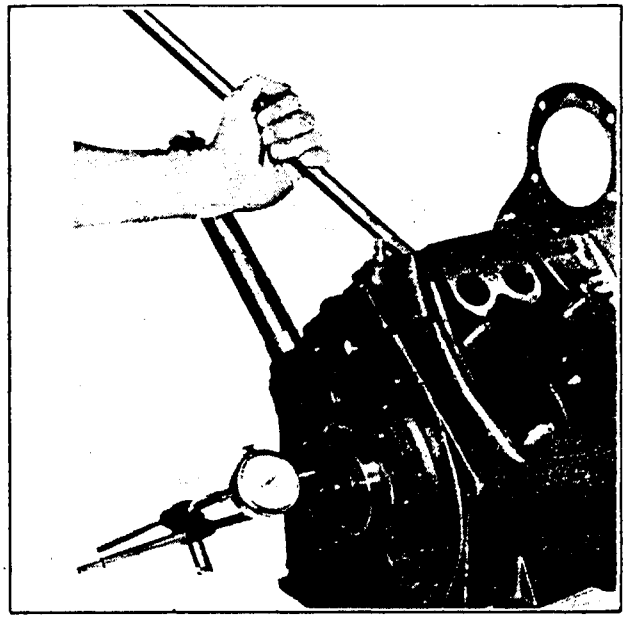


Fig. 83

After end play is finalized, remove bearing plate one more time and mount two new ***'o' ring oil seals*** to the outer body diameter. Gently tap bearing plate over the dowel pins to the crankcase face, being careful not to damage the 'o' ring seals and crankshaft oil seal. Mount capscrews with lockwashers and tighten to ***31 ft. lbs. torque.***

TESTING REBUILT ENGINE

An engine that has been rebuilt with new main bearings, connecting rod shell bearings and having cylinders re-bored or replaced, and fitted with new pistons, rings and valves, should go through a thorough "run-in" period before any load is applied to it.

The engine should be started and allowed to run for about one-half hour at about 1200 to 1400 R.P.M. without load. The R.P.M. should then be increased to engine operating speed, still without load, for an additional three and one-half to four hours.

The proper "running-in" of the engine will help to establish polished bearing surfaces and proper clearances between the friction areas of the newly replaced parts.

MARK INDUSTRIES
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Post Office Box 720, Long Beach, CA 90801

ENGINE STORAGE

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

Drain crankcase oil while engine is warm.

Drain fuel lines, carburetor, fuel pump and tank, to prevent lead and gum sediment from interfering with future operation. Gasoline fumes from gradual evaporation is a dangerous ***fire hazard***.

The air cleaner and filter element should be thoroughly cleaned. Tape or otherwise seal off the exhaust and air cleaner openings for the duration of storage.

The outside of the engine, including the cool cylinder block and head, should be thoroug all dirt and other deposits. All exposed un parts should be coated with grease or heav

Before starting the engine, after the storage crankcase drain plug so that any conde may have collected may be drained, before oil is added. It is advisable to remove the base and scrub off all sediment which may there. Use a new gasket when reassembli base. Replace oil filter and fill crankcase with the recommended grade of lubricating

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

It is highly recommended that machines be building through the winter. If this is not poss should be protected from snow and ice by a p

ENGINE MAINTENANCE SCHEDULE	Page Ref.	Daily	Weekly or 50 hrs.	100 hrs.	250 h
CHECK OIL LEVEL. Add to full mark - Do not overfill.	5	●			
CHECK AIR CLEANER. Shake out accumulated dirt from dry element cleaner - Maintain oil level in oil bath type cleaner.	7	●			
CLEAN AIR INTAKE SCREEN. Clean cooling fins if necessary.	10	●			
CLEAN AIR FILTER ELEMENT. Dry Element and Oil Bath types.	7		●		
CHANGE CRANKCASE OIL. Use grade and classification of oil recommended. In adverse conditions change oil every 50 hours of operation.	8			●	
REPLACE OIL FILTER every oil change.	8			●	
INSPECT CRANKCASE BREATHER SYSTEM. Clean if necessary.	8			●	
CHECK COMPRESSION. Pressure should not vary more than 10 p.s.i. between cylinders. Remove head - clean out carbon deposits. Reseat valves if necessary	22				●
INSPECT SPARK PLUGS and BREAKER POINTS. Replace if necessary and regap to specification.	10 12				●
INSPECT FUEL FILTER. Clean filter screen and glass bowl.	9				●
LUBRICATE DISTRIBUTOR breaker arm pivot.	9				●
INSPECT COOLING SYSTEM. Remove shrouding and scrape off dirt from between fins, around cylinders and from shrouding.	10				●
INSPECT STARTING MOTOR. Check for loose mounting and cable connections.	10				●
CHANGE OIL IN CLUTCH and REDUCTION GEAR HOUSINGS.	5,6				

CLEARANCE and WEAR LIMITS (Inches) for Models W2-1230 and W2-1235

Description		Tolerance	Wear Limit
Cylinder Bore	A size 3.7500 3.7495		.005
	B size 3.7505 3.7501		
	Out of round	.0005	
	Taper	.003	
Cylinder Head	Flatness	.005	
Pistons	A size at skirt 3.7470 3.7465		.002
	B size at skirt 3.7475 3.7471		
	Clearance to bore	.0025 .0035	.003
Piston Pins	Red-dia. of pin .8746 .8745		Clearance .0005 .0008
	Green-dia. of pin .8745 .8744		
	Red-bore in piston .87530 .87515		Wear limit .001
	Green-bore in piston .87515 .87500		
	Piston pin to con. rod	.0006/.0015 tight	
Piston Rings side clearance in grooves	Top ring	.002/.004	.002
	Scraper ring	.002/.004	.002
	Oil ring	.0015/.0035	.002
	Ring gap	.010/.020	.005
Connecting Rods	Bearing to crank pin	.0011/.0036	.003
	Side clearance	.009/.018	.005
	Bore centers	7.559/7.555	—
	Bore align. (parallel)	.002	.004
Crankshaft	Crank pin diameter	2.100/2.099	.002
	Crank pin width	2.074/2.069	.003
	Main bearing dia.	3.2500/3.2491	.001
	Bearings parallel	.0002	.0004
	End play	.005/.012	Adj.
Crankcase	Main bearing I.D.	3.2541/3.2520	
	Clearance to crankshaft	.002/.005	.001
	Camshaft brg.-large	2.0637/2.0625	
	Camshaft brg.-small	1.501/1.500	
	Bearings out of round	.0005	
Camshaft	Bearing dia.-large	2.0600/2.0593	
	Clearance to case bore	.0025/.0044	.002
	Bearing dia.-small	1.4980/1.4970	
	Clearance to case bore	.0020/.0036	.002
	Cam lift W2-1230	.331	±.005
	Cam lift W2-1235	.370	

Description		Tolerance	Wear Limit
Governor	Gear shaft dia.	.5000/.4996	.002
	Shaft bearing I.D.	.501/.502	.002
	Clearance, shaft/brg.	.0010/.0024	.003
	Cross shaft dia.	.310/.309	.002
	Shaft bearing I.D.	.312/.313	.002
	Clearance, shaft/brg.	.002/.004	.003
	Thrust sleeve I.D.	.503/.505	.003
	Clearance to shaft	.0030/.0054	.006
Oil Pump	Pump housing I.D.	2.2555/2.2575	.002
	Rotor outside dia.	2.2500/2.2470	.002
	Clearance, rotor/hsg.	.0055/.0105	.003
	Pump housing depth	.6905/.6925	.002
	Rotor width	.6875/.6865	.001
	Clearance, rotor width	.003/.006	.002
	Clearance, rotor tip	.004/.006	.003
Tappets	Tappet diameter	1.1247/1.1237	.0005
	Bore in crankcase	1.1250/1.1258	.0005
	Clearance, tappet/bore	.0003/.0021	.001
	Valve stem to tappet clearance	IN. .007 EX. .020	Adj.
Valves	Valve guide I.D.	.312/.313	
	Stem dia.-INTAKE	.311/.310	
	Stem clearance, IN.	.001/.003	.002
	Stem diameter-EXH. lock end	.308/.309	
	Stem diameter-EXH. head end	.307/.308	
	EXH.-Stem clearance Lock end Head end	 .003/.005 .004/.006	.002
	Valve/Seat angle	45°	
	Insert face width	.057/.072	.015
	Valve spring	1.141 at 90 lbs.	-5 lbs.
Ignition	Distributor Breaker point gap	.020	Adj.
	Running spark advance B.T.D.C.	6° at 1800 rpm 22° at 3400 rpm	Adj.
	Spark plug gap Regular	.035	Adj.
	Spark plug gap Resistor	.030	

TORQUE SPECIFICATIONS FOR MACHINE HARDWARE
For Engine Models W2-1230 and W2-1235
Torque Values — Maximum Foot Pounds (Dry)

Wisconsin Part Number	Size Capscrew Unless Specified	Qty.	Application	Torque Foot Pounds
XB 114	#10-32 x 1¼ (socket head)	4	Alternator Stator to Gear Cover	1.5
XD 157	¼-20 x ½	4	Breather Cover Assembly to Cylinder Block	9
		8	Cylinder End Cover to Cylinder Cover	9
XD 188	¼-20 x ⅜ (self-tapping)	2	End Cover to Cylinder Head Cover	4
XD 180	¼-20 x ½ (self-tapping)	8	Cylinder Cover to Air Duct and Cylinder Head	4
XD 14	¼-20 x ⅝	1	Coil to Engine Support	9
XD 6	¼-20 x ¾	2	Starting Motor Bracket to Crankcase	9
		2	Fuel Pump to Crankcase	9
		2	Oil Pump Pick Up Tube to Cover	4
XD 184	¼-20 x ¾ (self-tapping)	10	Flywheel Shroud to Gear Cover	4
XD 186	¼-20 x ⅞	6	Cylinder Head Cover to Special Studs	9
XD 7	¼-20 x 1	3	Oil Pump to Crankcase	9
XD 8	¼-20 x 1¼	2	Oil Pump Relief Valve to Crankcase	9
XD 152	¼-20 x 1⅜	3	Oil Pump Cover to Body	4
PD 77	¼-20 Nut	1	Starting Motor Bracket to Starting Motor Stud	9
XD 15 B	⅝-18 x ¾	3	Spacer Plate to Crankcase	18
XD 181	⅝-18 x ¾ (self-tapping)	4	Air Duct to Gear Cover	7
		2	Instrument Panel Mounting	7
XD 19	⅝-18 x 1¼	3	Camshaft Gear to Camshaft	18
		6	Intake and Exhaust Manifolds to Cylinder Block	18
XD 182	⅝-18 x 1¼ (self-tapping)	4	Air Duct to Gear Cover	7
XB 116	⅝-18 x 1¼ (12 point drive)	8	Crankshaft Extension (stub shaft)	24
XD 22	⅝-18 x 1¾	12	Oil Pan to Crankcase	18
XD 23	⅝-18 x 2	9	Gear Cover to Crankcase	18
		2	Spacer to Gear Cover	18
XD 140	⅝-18 x 2¼	4	Governor Housing to Gear Cover	7
		2	Exhaust Manifold to Cylinder	18
PD 256	⅝-24 Nut (tensilock)	2	Carburetor to Intake Manifold	24
XD 27 A	⅜-16 x 1	8	Engine Supports to Crankcase	31
XD 29	⅜-16 x 1¼	8	Bearing Plate to Crankcase	31
		2	Cylinder Block Hold Down	31
		6	Optional Single Outlet Exhaust Manifold	31
XD 185	⅜-16 x 1¼ (self-tapping)	2	Starting Motor to Gear Cover	12
XD 31	⅜-16 x 1¾	10	Cylinder Head to Cylinder Block	36
PC 638	⅜-16 Stud	6	Cylinder Head to Cylinder Block	36
PD 247	⅜-24 Nut	4	Connecting Rod	36
PD 12	7/16-20 Nut	8	Cylinder Block Hold Down	47
XD 51	⅝-11 x 1¼	1	Flywheel to Crankshaft	115
YD 369 YD 369 A	M14 x 1.25	2	Spark Plug to Cylinder Head	18-22

ACCESSORIES

OPERATION and SERVICE INSTRUCTION

CARBURETOR

FUEL PUMP

Major repairs of Industrial Clutches, Transmissions, Ignition Distributor and Starting Motor require special tools and testing equipment. It is suggested that these repairs be done at either a Teledyne Wisconsin Motor Distributor, or the Accessory Manufacturer's dealer.

CARBURETOR OPERATION, REPAIR and SERVICE PARTS

WISCONSIN No. L118 WALBRO LHM-43 For Engine Model W2-1235
WISCONSIN No. L119 WALBRO LMH-44 For Engine Model W2-1230

NOTE: For obsolete L115 (LMH-34) refer to page 48.

OPERATION, Fig. 1

Fuel from supply tank flows to **float valve seat** (1), through **fuel valve** (2) and into **fuel bowl** (3). As the level in fuel bowl increases, the **float** (4) rises, shutting off fuel supply by forcing **fuel valve** (2) into seat. As fuel is being used, the float lowers and allows additional fuel to enter bowl through the fuel valve.

Fuel from the bowl enters the **main fuel jet** (5), then through and up to the **main nozzle** (7). At full throttle, fuel passes through **main nozzle** (7) where it is mixed with air from **nozzle air bleed** (8) and enters into **venturi** (9). At low idle speeds, fuel flows through the **idle jet** (10), up the **idle channel** (11), around **idle adjustment** (12) and into the **emulsion chamber** (13), where it is mixed with air entering the **idle air vent** (14). This air-fuel mixture then enters the throttle bore of carburetor through the outer **idle hole** (15). As the throttle is gradually opened, the inner hole starts to feed the throttle bore, and assists the **main nozzle** (7) in taking over the full throttle range.

When starting, the **choke valve** is closed and the **throttle valve** (16) is opened causing an abnormally high suction on both idle and main systems, thus providing a rich mixture for starting.

CARBURETOR TROUBLES — CAUSES AND REMEDIES

Dirt is the major cause of field service carburetor problems. An adequate Fuel Filter must be used between the tank and carburetor, and should be serviced frequently. Service Air Filter daily — Keep carburetor and linkage free of dirt.

FUEL LEAKS FROM CARBURETOR

Float level too high: See Fig. 2 and Float Setting Instructions page 47.

Dirt under inlet needle valve: Remove inlet valve, clean seat by rinsing in mild solvent or clean fuel, blow off with compressed air.

Bowl vent plugged: Remove bowl and blow thru body vent hole with compressed air.

Collapsed float, caused by blowing assembled carburetor with compressed air: Replace float.

Carburetor gummed from storage - float stuck: Remove fuel bowl and clean.

ENGINE SMOKES AND RUNS RICH

Dirty air filter: Clean per instructions.

Improper adjustment: Set Idle Needle 1 turn open from seat. Refer to Adjustment Instruction, page 47.

Bowl retainer gasket leaks: Tighten securely, or replace.

Air bleed in carburetor plugged: Remove fuel bowl and idle needle. Clean thoroughly with compressed air.

ENGINE RUNS LEAN

Improper adjustment: Set Idle Needle 1 turn open from seat. Refer to Adjustment Instructions, page 47.

Idle holes plugged. Dirt in fuel delivery channels: Remove fuel bowl and idle needle. Clean thoroughly with compressed air.

Low fuel level: See Fig. 2 and Float Setting Instructions, page 47.

Fuel filter plugged: Remove and clean.

ENGINE STARTS HARD

Improper adjustment: Set Idle Needle 1 turn open from seat. Refer to Adjustment Instructions, page 47.

No fuel in carburetor: Check carburetor drain valve. Clean tank, filter and carburetor. Check fuel lines for obstructions, and test fuel pump.

Choke valve not closing: Check linkage for proper travel.

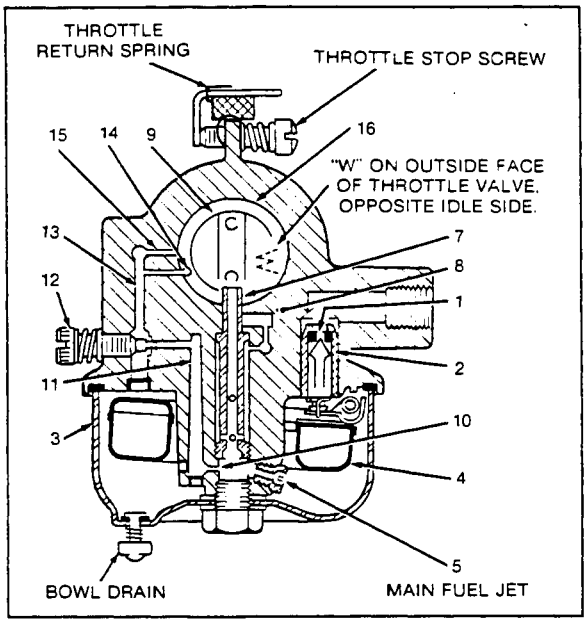


Fig. 1

GOVERNOR SURGE

Governor sticking: Check linkage for binding.

Throttle shaft and valve binding: Remove and replace shaft if worn. Clean carburetor body and reassemble throttle shaft.

DISASSEMBLY

Before disassembling: Clean outside of carburetor from all foreign material.

CAUTION: When cleaning a completely assembled carburetor, **do not** blow with compressed air, you may collapse the float.

DO NOT soak or boil carburetor or body in chemical solutions. Idle channel is permanently sealed — solution will seep in and cause corrosion. Use a mild solvent, fuel oil or kerosene.

Disassemble parts in the following sequence: Refer to exploded view, page 47.

1. Bowl retainer screw .... (4)
2. Retainer gasket ..... (5)
3. Fuel bowl ..... (2)
4. Fuel bowl gasket ..... (3)
5. Float shaft ..... (7)
6. Float and spring ..... (6, 8)
7. Fuel valve-spring ..... (9)
8. Idle needle assembly . (11)
9. Throttle stop screw ... (13)
10. Choke valve screws .. (18)
11. Choke valve ..... (22)
12. Choke shaft ..... (19)
13. Throttle valve screws . (18)
14. Throttle valve ..... (17)
15. Throttle shaft ..... (14)
16. Throttle shaft seal .... (16)
17. Throttle return spring (15)

Viton seat for fuel valve can be replaced if necessary. Pull out by means of a small hook on the end of a wire paper clip.

Clean throttle shaft seal in fuel oil or kerosene and dry. Re-oil with No. 30 weight oil or equivalent.

REASSEMBLY

Wash all other parts with carburetor cleaning solvent and blow off with compressed air.

Install choke shaft and valve. Mount valve with **part number** toward the outside with the valve in a closed position.

Mount throttle valve, with letter "**W**" on valve facing outward and opposite idle side of carburetor. Make certain valve plate does not bind when opening and closing throttle. Be sure that return spring tension holds throttle valve closed.

Viton fuel valve seat; press firmly in place with groove end toward seat hole.

Tighten **main fuel jet** (25) to 12-16 inch pounds torque and **Bowl Screw (4), to 30-35 inch pounds.**

FLOAT SETTING, Fig. 2

Mount all other parts in reverse order of disassembly. Hook fuel valve spring under float adjustment tab, and float support spring as illustrated in fig. 2. Float should be .030/.070 inch from top of body casting rim — bend adjustment tab to raise or lower fuel level — **Float drop should be ± .060 inch from end of nozzle boss.**

ADJUSTMENTS, Fig. 3

Turn **Idle speed screw** (13) in, until throttle valve is slightly open. With engine warmed up and running, turn adjusting screw in or out as required to obtain desired low idle speed (1000 to 1200 r.p.m.).

The **Idle adjusting needle** (11) should be seated lightly (clockwise), then backed out **1 ± 1/8 turns** as a preliminary setting. With engine warmed up and running at about 1200 R.P.M., fine tune idle mixture for smooth steady running.

The **Main Metering Jet** (25) for high speed operation is **fixed** (not adjustable).

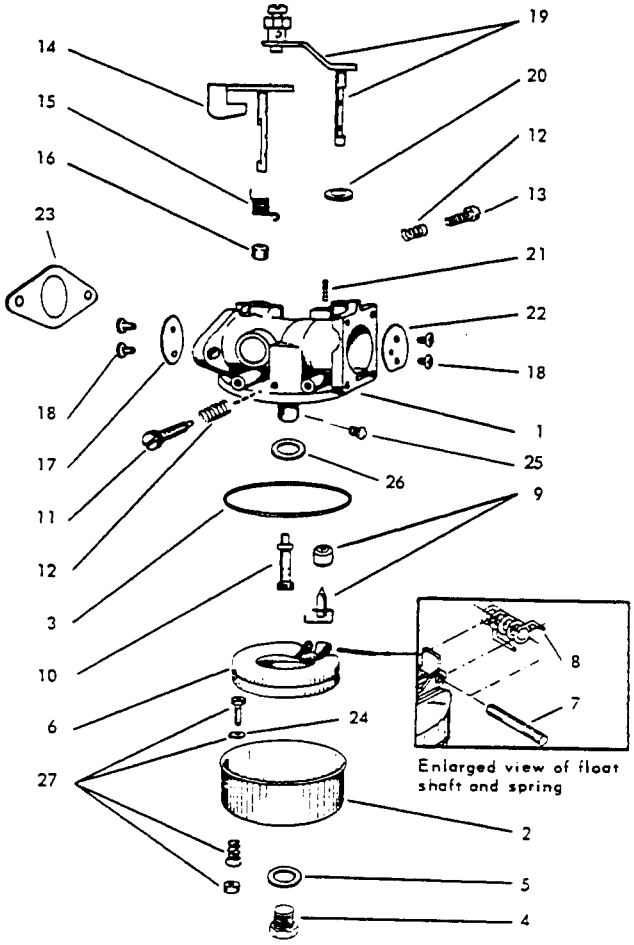


Fig. 3, EXPLODED VIEW

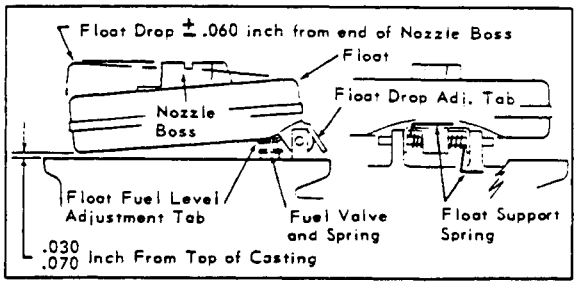


Fig. 2, FLOAT SETTING

ADJUSTABLE MAIN JET for high altitude operation is available for service.

Part No. ***83-100-540***

Includes: (1) Fiber washer
(1) Adjustable needle assembly

Remove and discard gasket (5) and screw (4). Replace with 83-100-540 Adjustable Needle Assembly.

SERVICE PARTS LIST

Wisconsin Part No's. L 118 (LMH-43) and L 119 (LMH-44).
Parts are identical for both carburetors except where noted.

Item No.	Part Number	Description	Qty.
1		**THROTTLE BODY** (not served)	1
2	83-20-513	**FUEL BOWL** with drain assembly ..	1
3	*	**GASKET** - fuel bowl	1
4	83-96-155	**SCREW** - fuel bowl retainer	1
5	*	**GASKET** - fuel bowl retainer (outer)	1
6	83-75-502	**FLOAT** - assembly	1
7	†	**SHAFT** - float	1
8	†	**SPRING** - float support	1
9	†	**FUEL VALVE** and **VITON SEAT**	1
10	83-86-244	**NOZZLE** - main, for L118	1
	83-86-261	**NOZZLE** - main, for L119	1
11	†	**NEEDLE** - idle	1
12	†	**SPRING** - idle needle, and stop (1 in Kit)	2
13	83-96-18	**SCREW** - throttle stop, 10-32 x 5/8 Fill. hd.	1
14	83-30-887	**THROTTLE SHAFT** assy — incl. items 15, 16	1
15	83-98-240	**SPRING** - throttle return	1
16	83-156-18	**SEAL** - throttle shaft	1
17	83-34-18	**VALVE** - throttle	1
18	83-96-263	**SCREW** - throttle and choke valve No. 4-40 x 3/16 Pan head	4
19	83-40-796	**CHOKE SHAFT** - assembly with swivel	1
20	83-156-21	**SEAL** - choke shaft	1
21	83-98-13	**SPRING** - choke stop	1
22	83-62-50	**VALVE** - choke, ...	1
23	*	**GASKET** - flange	1
24	*	**GASKET** - bowl drain	1
25	83-114-0740†	**JET** - main fuel, for L118 (LQ57) ...	1
	83-114-0700†	**JET** - main fuel, for L119 (LQ58) ...	1
26	*	**GASKET** - fuel bowl to body (inner)	1
27	83-154-503	**KIT** - bowl drain	1
	Q51†	**GASKET SET** (also included in Repair Kit)	
		*Parts included in Q51 Gasket Set.	
	LQ57	**REPAIR KIT**, for L118	1
	LQ58	**REPAIR KIT**, for L119	1
		†Parts included in Repair Kit.	

CARBURETOR OPERATION, REPAIR and SERVICE PARTS

WISCONSIN No. L 115 WALBRO No. LMH-34 For Engine Model W2-1230

(OBSOLETE) Replaced by L 119, interchangeable as a complete unit.

CAUTION: Do not remove nozzle (Ref. 10) from carburetor, unless replacing it with a new **service nozzle** — idle holes will not line up. Tighten 15 to 20 inch pounds torque. Use a proper fitted tool to prevent damage to slot in nozzle head.

Mount throttle valve, with letter **"W"** on valve facing outward and opposite idle side of carburetor. Make certain valve plate does not bind when opening and closing throttle. Be sure that return spring tension holds throttle valve closed.

Viton fuel valve seat; press firmly in place with groove end toward seat hole.

Tighten **main fuel jet** (4), to 35 inch pounds torque.

FLOAT SETTING, Fig. 2

Mount all other parts in reverse order of disassembly. Hook fuel valve spring under float adjustment tab, and float support spring as illustrated in fig. 2. Float should be .030/.070 inch from top of body casting rim — bend adjustment tab to raise or lower fuel level.

ADJUSTMENTS, Fig. 3

Turn **Idle speed screw** (13) in, until throttle valve is slightly open. With engine warmed up and running, turn adjusting screw in or out as required to obtain desired low idle speed (1000 to 1200 r.p.m.).

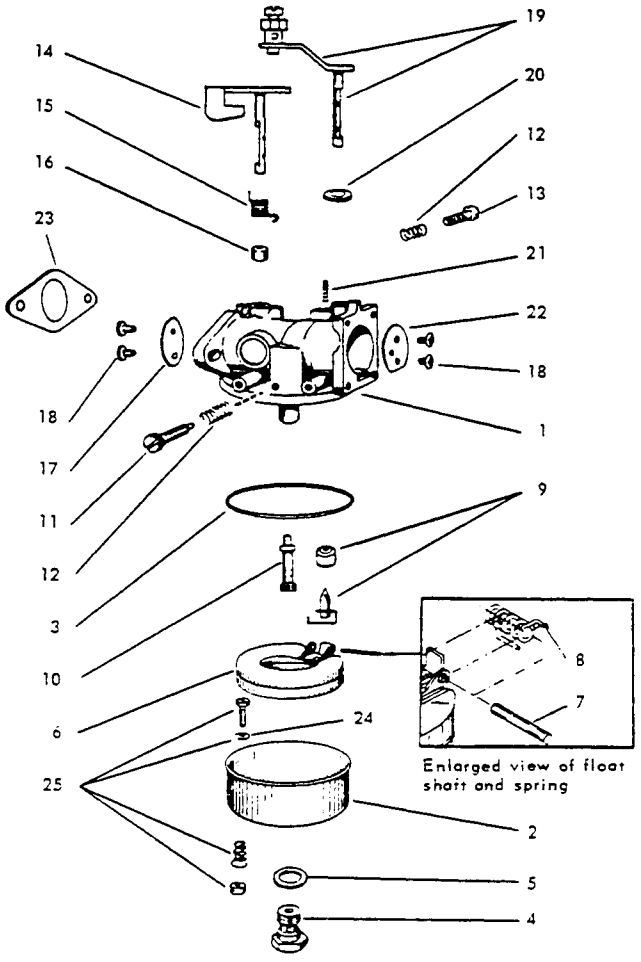


Fig. 3, EXPLODED VIEW

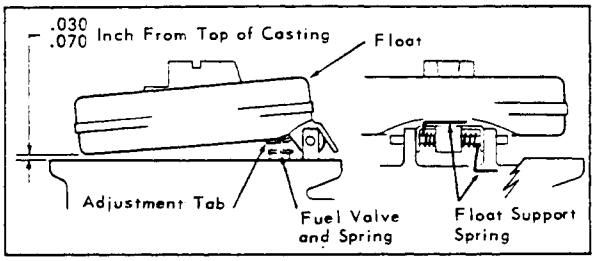


Fig. 2, FLOAT SETTING

The **Idle adjusting needle** (11) should be seated lightly (clockwise), then backed out **1 ± 1/8 turn** as a preliminary setting. With engine warmed up and running at about 1200 R.P.M., fine tune idle mixture for smooth steady running.

The **Main Metering Jet** (4), for high speed operation is **fixed** (not adjustable).

SERVICE PARTS LIST

	WISCONSIN PART NO. L 115	WLBRO PART NO. LMH-34

Item No.	Part Number	Description	Qty.
1		**THROTTLE BODY** (not serviced)	1
2	83-20-513	**FUEL BOWL** with drain assembly	1
3	*	**GASKET** — fuel bowl	1
4	83-112-666†	**MAIN FUEL JET** (.066)	1
5	*	**GASKET** — main jet, bowl retainer	1
6	83-75-502	**FLOAT** — assembly	1
7	†	**SHAFT** — float	1
8	†	**SPRING** — float support	1
9	†	**FUEL VALVE** and **VITON SEAT**	1
10	83-86-174	**NOZZLE** — main (service)	1
11	†	**NEEDLE** — idle	1
12	†	**SPRING** — idle needle, and stop (1 in Kit)	2
13	83-96-18	**SCREW** — throttle stop, 10-32 × [illegible] Fill. hd	1
14	83-30-887	**THROTTLE SHAFT** assy — Incl. Items 15, 16	1
15	83-98-240	**SPRING** — throttle return	1
16	83-156-18	**SEAL** — throttle shaft	1
17	83-34-18	**VALVE** — throttle	1
18	83-96-263	**SCREW** — throttle and choke valve No. 6-32 × 3/16 Pan head	4
19	83-40-796	**CHOKE SHAFT** — assembly with swivel	1
20	83-156-21	**SEAL** — choke shaft	1
21	83-98-13	**SPRING** — choke stop	1
22	83-62-70	**VALVE** — choke	*
23	*	**GASKET** — flange	1
24	*	**GASKET** — bowl drain	1
25	83-154-503	**KIT** — bowl drain	1
	† Q 50	**GASKET SET** (also included in Repair Kit) * Parts included in Q 50 Gasket Set.	
	LQ 56	**REPAIR KIT** † Parts included in LQ 56 Repair Kit.	

LP-62 series FUEL PUMP

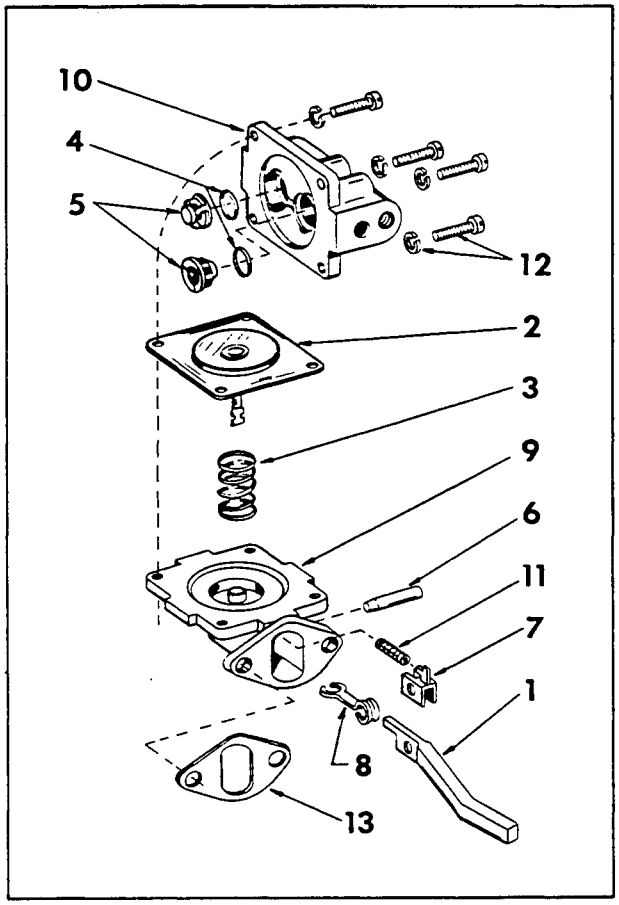
REPAIR INSTRUCTIONS

For single and two cylinder engine models

PART NO.	ENGINE USED ON
LP 62 A	THD, TJD
LP 62 B	ACN, BKN, AENL
LP 62 C	MTHD
LP 62 D	AGND
LP 62 E	S-7D
LP 62 F	S-10D, S-12D, S-14D
LP 62 G	S-8D, TRA-10D, TRA-12D
LP 62 A4	W2-1230, W2-1235

The fuel pump, like all other parts of the engine, is subject to wear and you will find that any time after 500 hours of use, its efficiency will gradually decrease. This is indictated by the engines faltering at high speeds or when heavy loads are suddenly applied. The pump can easily be restored to its normal efficiency by the installation of a **Wisconsin LQ-51** Diaphragm Kit.

1. Disconnect fuel lines from pump and remove fuel strainer if mounted to pump. Remove fuel pump from engine housing by taking out the two mounting screws.
2. File a groove across a point at the union of castings (9 and 10). This is a positive location of the fuel INLET and OUTLET positions when reassembling. Remove four head to bracket screws (12) and remove fuel head (10).
3. Turn fuel head (10) over, remove and discard both valve assemblies, noting their positions.
4. Clean fuel head thoroughly with kerosene or diesel fuel and a fine wire brush.



5. Hold fuel head (10), with diaphragm surface up, place two valve gaskets (4) into covities where valves were removed. Press valve assemblies (5) in evenly without distortion, and stake in place.
6. Set fuel head assembly aside and proceed to rebuild lower diaphragm section.
7. Insert the end of a small screw driver into the coils of rocker arm spring (11), remove and save.
8. Hold mounting bracket (9) in the left hand, with the rocker arm toward your body and the thumb nail on the end of link (8). With the heel of right hand on diaphragm (2), compress the diaphragm spring (3), and at the same time turn in a clockwise direction 90°. This will unhook the diaphragm from link (8) so it can be removed.
9. Clean the mounting bracket (9) with kerosene or diesel fuel and a fine wire brush.
10. Place the new diaphragm operating spring (3) into bracket (9). Repeat in reverse order paragraph eight, using the new diaphragm. Replace rocker arm spring (11) removed in paragraph seven.
11. Mount this assembly back on the engine in the position from which it was removed, using the new flange gasket (13), which is the last piece of the repair kit.
12. Crank the engine over to a position where the diaphragm (2) is laying flat on the mounting bracket (9). Place the fuel head (10) back in position so that the indicating marks of step one are in line, and start the four head screws approximately three turns. Again, crank the engine over to a position where diaphragm (2) is pulled down into mounting bracket (9) to its lowest position. Securely tighten the four head screws (12).
13. Mount fuel strainer to fuel pump, if applicable, and connect fuel lines.

NOTE: The **LQ-51 Diaphragm Kit** and the parts included there-in, which are identified by an asterisk (*), are the only parts of the fuel pump available for service.

Ref. No.	Description	No. Req.
1	ROCKER ARM	1
* 2	DIAPHRAGM ASSEMBLY	1
* 3	DIAPHRAGM SPRING	1
* 4	VALVE GASKETS	2
* 5	VALVE and CAGE ASSEMBLY	2
6	PIN for rocker arm	1
7	SPRING CLIP for rocker arm	1
8	LINK for diaphragm spring	1
9	MOUNTING BRACKET	1
10	FUEL HEAD	1
11	SPRING for rocker arm	1
12	SCREW and WASHER for head mounting	4
*13	GASKET for mounting flange	1

INSTALLATION INSTRUCTIONS (Solid State Ignition)

PRE-INSTALLATION CHECKS

1. Visually inspect plug wires, coil wire, distributor cap and rotor. Replace any components that show deterioration. It is especially important that the cap and plug wires be in good condition if a high output coil is used.
2. Check for loose or poor connections in ignition circuit. Check battery terminals for corrosion and loose connections.
3. Check battery voltage with engine off. It should be in the area of 12 to 14 volts.
4. The following procedure applies only to those installations where an external ballast resistor or resistance wire is used in the primary ignition circuit. Using a jumper wire, or clip lead, connect the minus (−) side of the coil to ground. Turn the ignition switch on. Read the voltage from the positive (+) side of the coil to ground. This voltage must not be less than 6.0 volts. If it is less than 6.0 volts the red or white wire from the module will have to be connected to the ignition switch side of the ballast resistor (Point A in Figure 2).

NOTE: In most circuits that use an external ballast resistor, this resistor is bypassed during starting putting the full battery voltage to the positive (+) terminal of the coil. ***In those cases where an external ballast resistor is used and it is not bypassed during starting, the red or white wire from the module will have to be connected to the ignition switch side of the ballast resistor (Point A in Figure 2) regardless of the voltage read at the positive (+) terminal of the ignition coil in the procedure above.*** In all cases the black wire remains connected to the minus (−) side of the ignition coil.

1. Make sure ignition switch is off. For added safety disconnect negative terminal from battery.
2. Remove distributor cap and gasket from distributor (1). Leave high voltage wires connected in the distributor cap.
3. Check side play in top distributor bearing. Excessive side play will cause erratic performance and must be corrected before installing IGNITOR.
4. Install adapter plate (5) in the same holes where the points were located. Using the flat head screw (6) provided, secure the adapter plate. ***DO NOT TIGHTEN.*** The Pan Head screw (7) is to hold the ground strap and the adapter plate. Leave both screws snug, not tight.
5. Install wire harness. For part number MIC0065600 the wire must be laced back under the breaker plate. Figure (1). For part number MIC0065650, the wires are to be looped around the inside diameter of the Distributor. In both cases, the grommet is to be inserted in the slot (8) in the distributor case. The wire length inside the distributor can be adjusted by pulling one wire at a time through the grommet.

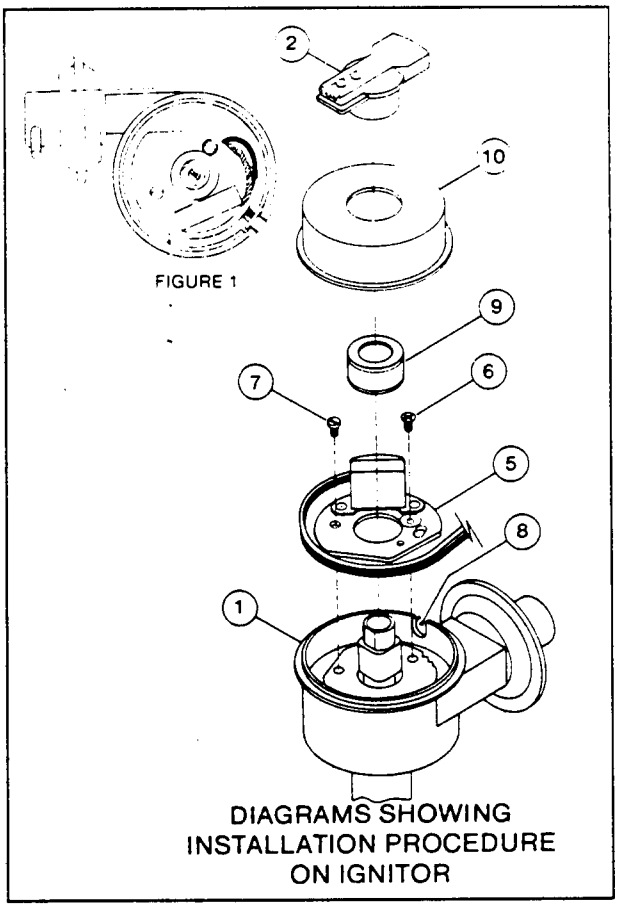


Fig. 1

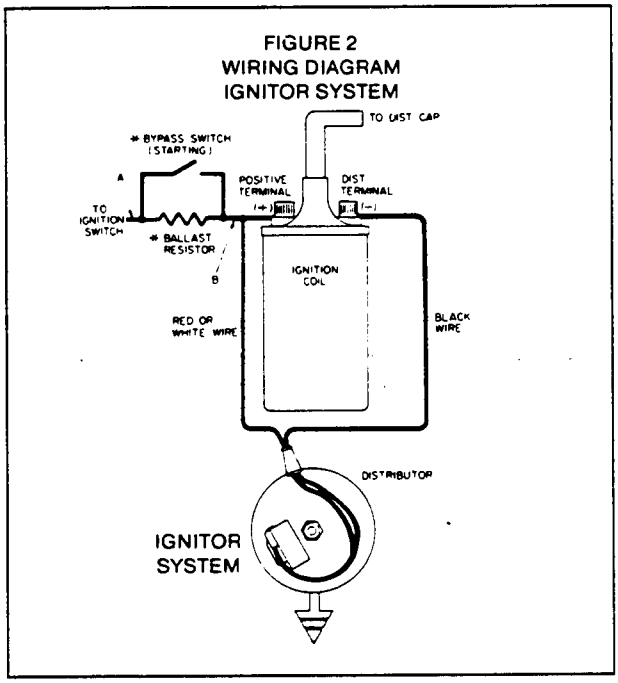


Fig. 2

6. Install IGNITOR magnet sleeve (9) over cam on distributor shaft. Locate on cam and press firmly into position. NOTE: Sleeve fits tightly over cam. It may be necessary to use the rotor to press over cam (rotate it until a slight locating position can be felt) before pressing it into place. Press all the way on until fully seated.

7. With magnet sleeve installed, adjust gap between magnet sleeve and module. This is done by pulling the module away from magnet sleeve. A gap of .015" to .030" is desirable. ***Make sure IGNITOR module does not hit magnet sleeve.*** Once gap is correct, tighten the two screws.

8. Install dust cap (10) making sure step in dust cover is locked into detent in distributor where wire harness goes through housing wall (8) and reinstall rotor (2).

9. Replace distributor cap and gasket. Make sure all high voltage wires are securely seated.

10. Connect the black wire to the distributor (−) side of the ignition coil. For installations that do not use a primary ballast resistor, connect the white wire to the ignition (+) side of the ignition coil. For installations that use a primary ballast resistor, it is preferable to connect the white wire to the ignition switch side of the resistor, rather than to the ignition (+) side of the coil. For installations that use a primary ballast resistor, AND THIS RESISTOR IS NOT BY-PASSED DURING STARTING, the white wire must be connected to the ignition switch side of the ballast resistor.

11. The engine can now be started. Let the engine run for a few minutes and then set the timing in the conventional manner. It will be worth the time to set the timing exactly, as it will never have to be reset.

TESTING

If the vehicle will not start after installation or vehicle quits after starting, the following test may be done to check the system.

1. Connect the positive (+) lead of a voltmeter to the negative (−) side of the ignition coil. Connect the negative (−) lead of the voltmeter to ground. Set the voltmeter to DC volts on at least a 15 volt scale.
2. Disconnect the high voltage wire from the center of the distributor cap and ***ground*** it to the engine block or chassis.
3. Crank engine.
4. The voltmeter should fluctuate from a range of 1 to 2 volts to a range of 10 to 12 volts as the engine is cranked.
5. If the voltmeter does not fluctuate, one of the following problems exist:
   a. If the voltmeter shows a constant 0 reading, there is an open circuit somewhere in the primary ignition circuit.
   b. If the voltmeter shows a constant voltage in the 1.0 to 3.5 volts range, the power transistor is shorted out.
   c. If the voltmeter shows a constant voltage equal to the battery voltage, there is an open circuit in the Ignitor or the Hall cell is not operating.

FOREWORD

This Repair Manual includes operating instructions, maintenance, adjustments, disassembly and reassembly procedures for the basic engine and accessories. Application of this information will help to obtain maximum engine performance, keep repair costs to a minimum and add years of service to the life of your **Wisconsin** engine.

Because **Wisconsin** engines are used on so many different types of equipment, and built to such a variety of specifications, the illustrations and information contained may not exactly suit all applications, but are typical for this particular model. Also, continued engineering for the improvement of our product may reflect changes in your engine which may not have been included at the time of this publication.

Teledyne Wisconsin Motor stands behind its engines with a world-wide network of more than 2200 Engine Distributors and Service Centers in over 90 countries. Should there be a need for specific data relative to the service of your engine, contact your nearest Teledyne Wisconsin Motor Distributor or Service Center — he is listed in the Yellow Pages of the Telephone Directory under ENGINES — GASOLINE.

MODEL	
SPEC NO.	
SERIAL NO.	

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

MM-396 Parts Catalog should be used in conjunction with this Repair Manual. The exploded illustrations will help to identify parts and will present a visual order of reassembly.

IMPORTANT SAFETY NOTICE

Proper maintenance, adjustments and repair are very important for safety and reliable engine operation. It is impossible to evaluate and advise of all the conceivable ways in which service work should be done, or of the unsafe consequences of each way. Use common sense, and satisfy yourself that what you are doing will not jeopardize your safety, the safety of others, or damage to the engine.

Read instructions thoroughly before making any adjustments and repairs. Acquaint yourself with the parts and how they operate. When operating the engine, strictly follow the **Safety Precautions** on page 2, and any additional safety measures suggested by the manufacturer of the equipment the engine is used on.

Limited Engine Warranty

TELEDYNE WISCONSIN MOTOR, herein referred to as 'Teledyne Wisconsin , warrants each new Wisconsin 4-cycle air-cooled engine sold by Teledyne Wisconsin to be free from defects in material and workmanship, under normal use and service, for a period of one (1) year (except in the case of an engine used on any recreational type vehicle the period shall be ninety (90) days) after the date of delivery to the original retail purchaser, and Teledyne Wisconsin will, at its option, replace or repair, at one of Teledyne Wisconsin's factories, or at a point designated by Teledyne Wisconsin, any part or parts which shall appear to the satisfaction of Teledyne Wisconsin upon inspection at such point, to have been defective in material or workmanship. This warranty does not obligate Teledyne Wisconsin to bear any transportation charges in connection with the replacement or repair of defective parts.

This Warranty shall not apply to any engine which shall have been installed or used in a manner not recommended by Teledyne Wisconsin, nor to any engine which shall have been repaired, altered, used in any type of competition, nor operated other than within Teledyne Wisconsin Motor specified limits, neglected or used in any way which, in Teledyne Wisconsin's opinion, adversely affects its performance: nor to any engine in which parts not supplied or approved by Teledyne Wisconsin have been used: nor to any accessories installed on the engine where the accessory manufacturer has its own warranty: nor to normal maintenance services or replacement of normal service items.

Teledyne Wisconsin reserves the right to modify, alter, and improve any engine or parts without incurring any obligation to replace any engine or parts previously sold with such modified, altered, or improved engine or parts.

THIS WARRANTY, AND TELEDYNE WISCONSIN'S OBLIGATION HEREUNDER, IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE, AND ALL OTHER OBLIGATIONS OR LIABILITIES, INCLUDING SPECIAL OR CONSEQUENTIAL DAMAGES OR CONTINGENT LIABILITIES ARISING OUT OF THE FAILURE OF ANY ENGINE OR PART TO OPERATE PROPERLY. No person is authorized to give any other warranty or to assume any additional obligation on Teledyne Wisconsin's behalf unless made in writing and signed by an officer of Teledyne Wisconsin.

TELEDYNE WISCONSIN MOTOR
MILWAUKEE, WISCONSIN 53219

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