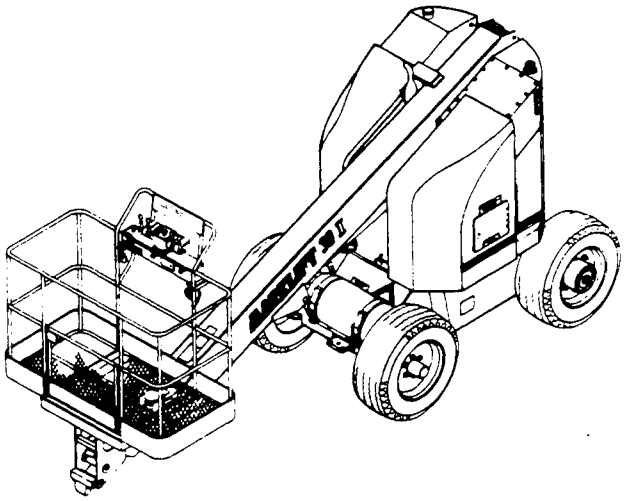
The Marklifts.®

A Product of Mark Industries

SELF-PROPELLED BOOM (MODEL 30 I & 32)



OPERATION MAINTENANCE AND PARTS MANUAL

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Mark Industries

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(MODEL 30I & 32)
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SERVICE BULLETINS

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)
OPERATION MAINTENANCE AND PARTS MANUAL

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 USAGE OF THIS MACHINE MAY RESULT IN SERIOUS PERSONNEL INJURY. 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 carriage.

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 final minor adjustments and inspections must be made prior to putting the unit in service. These functions are outlined in the inspection and checkout instructions in the operation section of this manual.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I)

DESCRIPTION	ENGLISH	METRIC
HEIGHT	30'	9.14 m
WORKING (MAXIMUM)	36'	10.97 m
PLATFORM (MAXIMUM) . . .	30'	9.14 m
LOWERED (MINIMUM)	6'11"	2.11 m
WIDTH	5'	152.4 m
LENGTH (MINIMUM)	16'2"	4.92 m
LIFT CAPACITY . . . . . (UNRESTRICTED)	500 LBS.*	226.78 kg
WHEEL BASE	5'	1.52 m
WHEEL TRACK	4'4"	1.32 m
TURNING RADIUS (INSIDE). .	12'0"	3.66 m
TURRET ROTATION	CONTINUOUS	
TURRET TAILSWING	WITHIN FRAME WIDTH	
ENGINE, GASOLINE/LP . . . . (DUAL FUEL)	20 HP ONAN (AIR COOLED)	
TRAVEL SPEED . . . . . (PROPORTIONAL)	0 TO 2.0 MPH	0 TO 3.2 km/hr
CONTROLS	4 PROPORTIONAL (DRIVE, ROTATION, ELEVATION, EXTENSION) 2 SOLENOID (STEERING, PLATFORM TILT)	
HYDRAULIC OPERATING PRESSURE	1750 PSI MAX.	123.0 kg/sq.cm
TIRES (MONOFILLED)	8 PLY RATING: 10-16.5 LT HIGHWAY	

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I)

DESCRIPTION	ENGLISH	METRIC
HORIZONTAL REACH (MAXIMUM)	21'	6.40 m
BOOM ELEVATION	+75° ABOVE HORIZONTAL -20° BELOW HORIZONTAL	
FUEL RESERVOIR CAPACITY	13 GAL.	49.21 l
HYDRAULIC RESERVOIR CAPACITY	28 GAL.	106. l
WEIGHT	11,670 LBS.	5293 kg
SHIPPING CUBE	560 CU. FT.	15.85 cu. m
PLATFORM DIMENSIONS	59" X 30" X 40" HIGH	1.50 m X .76 m X 1.01 m

NOTE: *OPTIONAL ROTATING WORK PLATFORM DECREASES UNRESTRICTED LIFT CAPACITY TO 450 LBS.

MARKLIFT SELF-PROPELLED BOOM

(MODEL 32)

DESCRIPTION		ENGLISH	METRIC
HEIGHT		32'	9.75 m
WORKING (MAXIMUM)		38'	11.58 m
PLATFORM (MAXIMUM)		32'	9.75 m
LOWERED (MINIMUM)		7'1'	2.16 m
WIDTH (MAXIMUM)		5'9"	1.75 m
LENGTH (MINIMUM)		15'3"	4.64 m
LIFT CAPACITY . . . . . (UNRESTRICTED)		600 LBS.*	272.13 kg
WHEEL BASE		5'9"	1.75 m
WHEEL TRACK		4'4"	1.32 m
TURNING RADIUS (INSIDE). .		12'0"	3.66 m
TURRET ROTATION		CONTINUOUS	
TURRET TAILSWING		10.5 BEYOND FRAME WIDTH	.26 m
ENGINE-GASOLINE . . . . . (AIR COOLED)		20 HP ONAN	
TRAVEL SPEED . . . . . (PROPORTIONAL)		0 TO 1.5 MPH	0 TO 2.4 km/hr
CONTROLS		4 PROPORTIONAL (DRIVE, ROTATION, ELEVATION, EXTENSION) 2 SOLENOID (STEERING, PLATFORM TILT)	
HYDRAULIC OPERATING PRESSURE		1750 PSI MAX.	
TIRES		PNEUMATIC 6-PLY RATING:	
	FRONT	11L 15SL MAXI. TRAC.	
	REAR	29 X 12.00-15NHS TERRA GRIP	

MARKLIFT SELF-PROPELLED BOOM

(MODEL 32)

DESCRIPTION	ENGLISH	METRIC
HORIZONTAL REACH (MAXIMUM)	22'3"	6.78 m
BOOM ELEVATION	+75° ABOVE HORIZONTAL -20° BELOW HORIZONTAL	
FUEL RESERVOIR CAPACITY	13 GAL.	49.20 l
HYDRAULIC RESERVOIR CAPACITY	28 GAL.	106 l
WEIGHT	11,410 LBS.	5175 kg
SHIPPING CUBE	696 CU. FT.	19.7 cu. m
PLATFORM DIMENSIONS	59" X 30" X 40"	1.50 m X 76 m X 1.02 m

NOTE: *OPTIONAL 5' ROTATING PLATFORM DOES NOT DECREASE LIFT CAPACITY.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

OPTION	TITLE
20104	GROUND AND AERIAL 110 VAC RECEPTACLE
20106	CLEARANCE, STOP AND TURNING LIGHTS
20107	ROTATING BEACON
20108	TRAVEL HORN
20110	PLATFORM ROTATION
20097	RAISED PLATFORM ROTATION
20112	LIFTING LUGS
20113	SPECIAL PAINT
20131	5 FT. PLATFORM
20132	8 FT. PLATFORM
20133	12 FT. PLATFORM
20134	4 FT. PLATFORM
20138	SPARK ARRESTER MUFFLER
20139	12 V PLATFORM WORK LIGHT
20140	AIR LINE TO PLATFORM (OUTSIDE BOOM)
20141	HYDRAULIC LINE TO PLATFORM
20142	PIPE HANDLING ATTACHMENT
20143	DESCENT HORN
20147	FIBERGLASS BASKET

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

OPTION	TITLE
20164	HEADLIGHTS - TAIL LIGHTS
20165	PLATFORM GROUND SENSOR
20168	PLATFORM HAND GUARDS
20169	AERIAL CONTROL PANEL LIGHTS
20170	AIR LINE TO PLATFORM (INSIDE BOOM)

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)
OPERATION MAINTENANCE AND PARTS MANUAL

REV. DATE	PAGE NUMBERS	REV. DATE	PAGE NUMBERS	REV. DATE	PAGE NUMBERS	REV. DATE	PAGE NUMBERS
REV.1 11-83	FRONT TITLE PAGE	REV.2	FRONT TITLE PAGE				
	CONTENTS vii,viii		viii PARTS INDEX				
	OPS.16,17,18 MAINT.43		70.4,70.5 70.6,73.4				
	PARTS INDEX 1,11,111		73.5,73.6 75.4,75.5				
	1,2,3,4 4.1,4.2		75.6,75.7 78.2				
	4.3,4.4 5,6,7,8						
	10,11.1 11.2,11.3						
	13,14.1 14.2,14.3						
	17,18,21 THRU 34						
	37,40,41 43,46,47						
	48,49,50 51,55,56						
	57,58.1 61,63,64						
	65,66,67 67.1,67.2						
	67.3,67.4 68,69,70						
	70.1,70.2 70.3,72						
	73.1,73.2 73.3,74						
	75,75.1 75.2,75.3						
	77,78,78.1 79,79.1						
	80,80.1 80.2,82						
	88,90 THRU 104						

MANUFACTURERS' LIMITED WARRANTY

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

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

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

The sole obligation and liability of MARK INDUSTRIES under this limited warranty (and the exclusive remedy for any purchaser, owner or user of MARK INDUSTRIES products) is limited to the repair or replacement, at the option of MARK INDUSTRIES, of any product (or any part or parts of any product) manufactured by MARK INDUSTRIES which, within six (6) months from the date of shipment, shall have been returned to the MARK INDUSTRIES facility in Brea, California (or any other location within the United States as shall be designated by MARK INDUSTRIES), at no expense to MARK INDUSTRIES, and demonstrated to the satisfaction of MARK INDUSTRIES as being defective in material or workmanship.

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

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

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

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

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

This is a reduced copy of the actual report that is sent with each Machine.

NEW EQUIPMENT CONDITION REPORT

(WARRANTY REGISTRATION)

BOOMS	YES	NO
1 CAPACITY DECAL IS _____		
2 ALL APPLICABLE WARNING DECALS ARE INSTALLED		
3 EMERGENCY DESCENT VALVE FUNCTIONS PROPERLY		
4 OPERATORS INSTRUCTIONS ARE PROPERLY INSTALLED		
5 OPERATORS GUIDE RECEIVED		
6 ELECTRIC SCHEMATIC RECEIVED		
7 ALL CONTROLS (UPPER & LOWER) ARE IDENTIFIED & OPERATE PROPERLY		
8 STOP SWITCHES OPERATE PROPERLY (UPPER & LOWER)		
9 CONDITION OF PLATFORM GUARD RAILS		
10 BASKET ACCESS GATE WORKS PROPERLY		
11 HORN/BEACON OPERATE PROPERLY (OPTIONAL)		
12 BRAKES ARE ADJUSTED AND OPERATE PROPERLY		
13 CIRCUIT BREAKERS OPERATE PROPERLY		
14 ENGINE RPM'S ARE _____ RPM'S		
15 ALL HYDRAULIC CYLINDERS ARE FREE OF LEAKS		
16 ALL HYDRAULIC CYLINDER RODS ARE FREE OF PAINT/SCRATCHES		
17 110V GENERATOR OPERATES PROPERLY (OPTIONAL)		
18 HYDRAULIC PUMP IS FREE OF LEAKS		
19 DRIVE MOTORS ARE FREE OF LEAKS		
20 ROTATION GEAR BOX OIL LEVEL IS _____		
21 ROTATION RING GEAR BOLTS (UNDERCARRIAGE) ARE TORQUED AT _____ FT. LBS.		
22 LUG NUTS ON WHEELS ARE TORQUED AT _____ FT. LBS.		
23 BATTERY FLUID LEVEL IS FULL		
24 HYDRAULIC HOSES & FITTINGS ARE TIGHT & FREE OF LEAKS		
25 AIR PRESSURE IN TIRES IS _____ PSI		
26 HYDRAULIC OIL LEVEL IS _____		
27 SYSTEM PRESSURE IS _____ PSIG		
28 PILOT PRESSURE IS _____ PSIG		
29 FUEL TANK AND FITTINGS ARE FREE OF LEAKS		
30 HYDRAULIC TANK AND FITTINGS FREE OF LEAKS		
31 MANUAL OVERRIDES OPERATE PROPERLY		
32 MUFFLER TIGHT AND FREE OF LEAKS		
33 ENGINE OIL LEVEL IS FULL		
34 ENGINE OIL FILTER IS FREE OF LEAKS		
35 ALL ELECTRICAL CONNECTIONS ARE TIGHT		
36 ENGINE ALTERNATOR FUNCTIONING PROPERLY		
37 VALVE MANIFOLD & FITTINGS ARE FREE OF LEAKS		
38 PROPER OIL LEVEL IN DRIVE WHEEL TORQUE HUB		
39 CABLE TENSION _____		

SCISSORS	YES	NO
1 CAPACITY DECAL IS _____		
2 ALL APPLICABLE WARNING DECALS ARE INSTALLED		
3 EMERGENCY DESCENT VALVE FUNCTIONS PROPERLY		
4 OPERATORS INSTRUCTIONS ARE PROPERLY INSTALLED		
5 OPERATORS GUIDE RECEIVED		
6 ELECTRICAL SCHEMATIC RECEIVED		
7 ALL CONTROLS (UPPER & LOWER) ARE IDENTIFIED AND OPERATE PROPERLY		
8 PLATFORM GUARD RAILS IN GOOD CONDITION AND ATTACHMENT BOLTS INCLUDED		
9 PLATFORM ACCESS GATE WORKS PROPERLY		
10 HORN/BEACON OPERATES PROPERLY (OPTIONAL)		
11 BRAKES (IF INSTALLED) OPERATE PROPERLY		
12 CIRCUIT BREAKER OPERATES PROPERLY		
13 ENGINE RPM'S ARE _____ RPM'S		
14 SCISSOR ARM SHAFT COLLARS ARE IN PLACE AND ARE TIGHT		
15 LIFT CYLINDER IS FREE OF LEAKS		
16 110V INVERTER OPERATES PROPERLY (OPTIONAL)		
17 110V GENERATOR OPERATES PROPERLY (OPTIONAL)		
18 HYDRAULIC PUMP IS FREE OF LEAKS		
19 SYSTEM PRESSURE IS SET AT _____ PSIG		
20 DRIVE MOTORS ARE FREE OF LEAKS		
21 DRIVE GEAR BOX OIL LEVEL (SRT MODELS)		
22 ALL NUTS & BOLTS ARE TIGHT		
23 (2) WHEEL NUTS ARE TORQUED AT ____ FT. LBS.		
24 LUG NUTS ON THE WHEELS ARE ___ FT. LBS		
25 BATTERY FLUID LEVEL IS CORRECT		
26 HYDRAULIC HOSES AND FITTINGS ARE FREE OF LEAKS		
27 AIR PRESSURE IN TIRES _____ PSI		
28 HYDRAULIC OIL LEVEL _____		
29 FUEL TANK & FITTINGS ARE FREE OF LEAKS		
30 HYDRAULIC OIL TANK & FITTINGS ARE FREE OF LEAKS		
31 STEERING CYLINDER IS FREE OF LEAKS		
32 MANUAL OVERRIDE ON VALVES OPERATE PROPERLY		
33 MUFFLER TIGHT & FREE OF LEAKS		
34 ENGINE OIL LEVEL FULL		
35 ENGINE OIL FILTER FREE OF LEAKS		
36 ALL ELECTRICAL CONNECTIONS ARE TIGHT		
37 ENGINE ALTERNATOR FUNCTIONS PROPERLY		
38 CHARGER FUNCTIONS PROPERLY (ELECT. MACH.)		
39 VALVE MANIFOLD & FITTINGS ARE FREE OF LEAKS		

MODEL NUMBER _____ SERIAL NUMBER _____

OPTIONS _____

INSPECTOR # _____

PURCHASER

_____
COMPANY NAME

_____
ADDRESS

_____
CITY STATE ZIP CODE

( )_____
AREA CODE TELEHONE NUMBER

DATE OF INVOICE _____ DATE SHIPMENT RECEIVED _____

DATE UNIT PUT INTO SERVICE _____

☐ UNIT WILL BE USED IN RENTAL FLEET

☐ UNIT WILL BE SOLD; THE INITIAL WORK APPLICATION WILL BE:

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

COMMENTS:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

INSPECTION COMPLETED BY: _____
(Please print legibly)

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

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

SECTION I

Tilt - Type Trucks (Any loading or unloading application other than horizontal)

IMPORTANT: All loading/unloading procedures onto and from TILT-TYPE TRUCKS, MUST NOT BE DRIVEN

LOADING

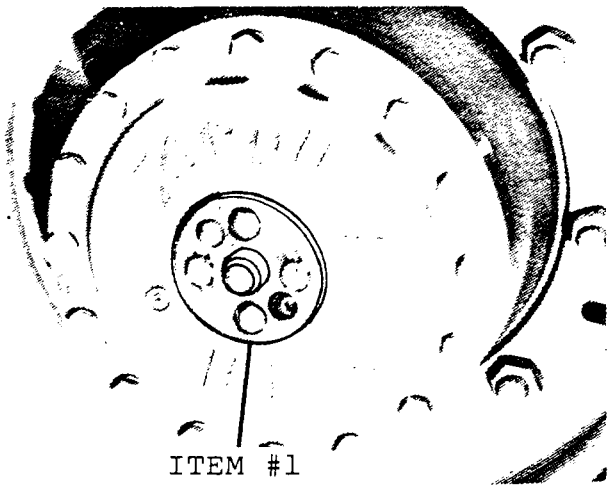
1. The truck must be fitted with adequate winch to handle the weight of equipment you are going to load/unload.

BOOM	GROSS VEHICLE WEIGHT
21	7600 lbs.
30L	11,170 lbs.
30RT	10,910 lbs.
30STD	11,420 lbs.
30I	11,670 lbs.
32	11,410 lbs.
40STD	14,680 lbs.
40RT	15,400 lbs.
42	15,000 lbs.
62	24,000 lbs.

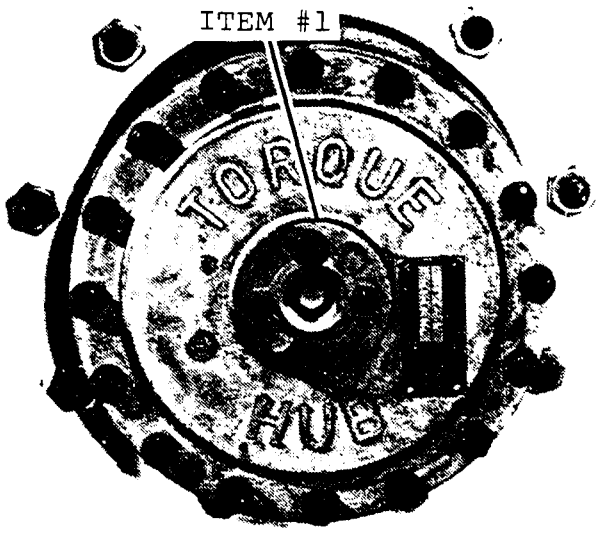
2. Align the boom with the steering wheels toward the trailer, and the basket in the horizontal or slightly above position.

3. Torque hubs must be disengaged for loading/unloading.

   * To disengage the torque hub, reverse the disconnect cap (Item #1). (The knob on the cap disengages the drive hub input shaft.)



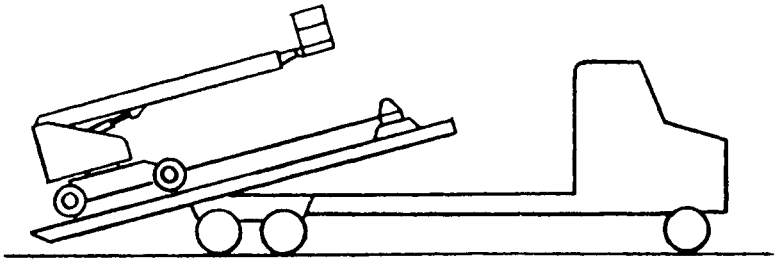
HUB ENGAGED

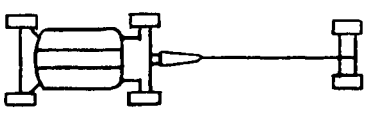


HUB DISENGAGED

CAUTION: BRAKES ARE ALSO AUTOMATICALLY DISENGAGED AT THIS TIME.

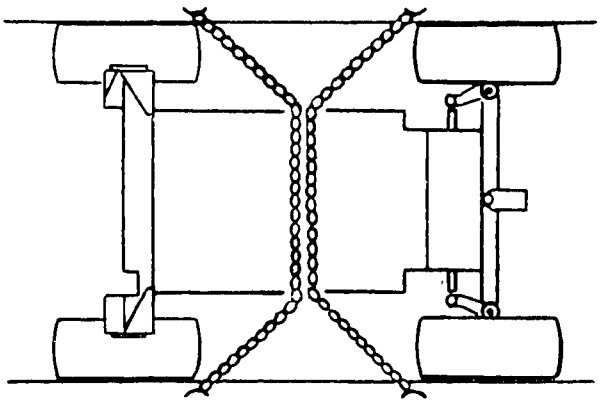
4. Attach the winch cable to the boom at the steering end on the center steering arm as shown.

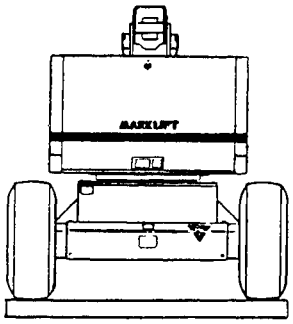


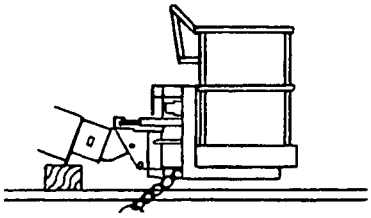


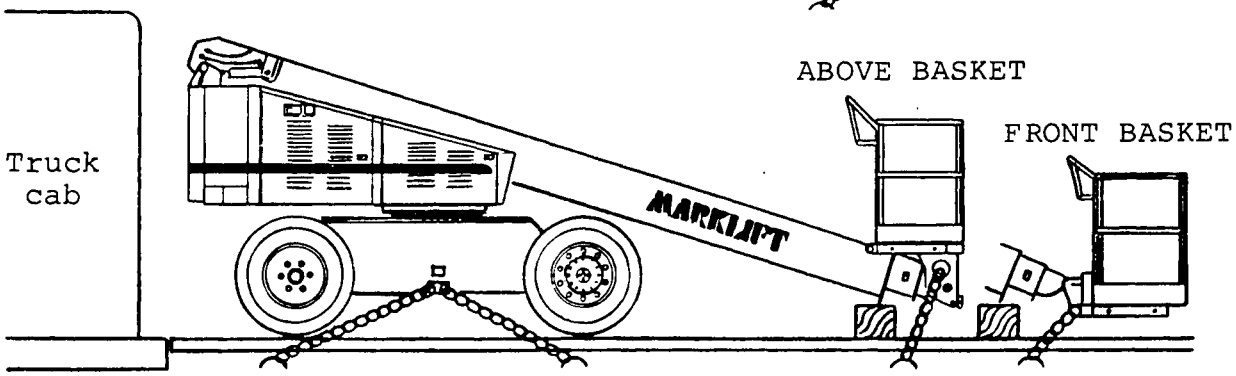
5. When truck bed is locked back into the horizontal position, rotate the boom 180° to a position where the counter weight is over the steering wheels. (This position would place the counterweight closest to the truck cab.)

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.









NOTE: Bottom of basket fork must not rest on truck bed.

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 taught 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, engage the torque hubs and remove the winch cable from the boom.

5. Boom is now ready for normal operation.

SECTION II

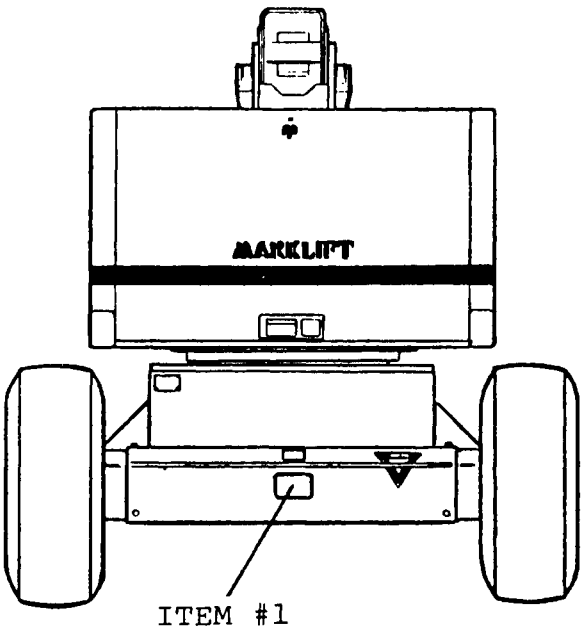
FLATBED WITH HYDRAULIC LIFT/LOWER REAR PORTION

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 (Item #1)



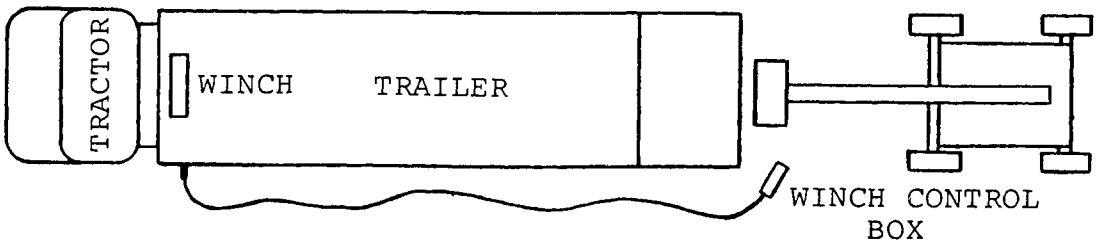
2. If the unit has the high/low drive option, it must be in low drive at all times when loading/unloading.

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 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 section I 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 boom is positioned approximately halfway forward on the trailer, rotate boom 180° to a position where the counterweight is over the steering wheels. (This position would place the counterweight closest to the truck cab.)

5. When the boom is in the position for the proper weight distribution for transporting, tie down to the trailer using the procedure described in section I 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:

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 18" 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.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

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. Check tire pressure.

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 L.P. Use diesel fuel when unit is diesel.

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

6. Check hydraulic valve panel for loose hardware and broken fittings or tubing.

7. The ground control panel is accessible by opening the door in 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 the engine points. However, should the engine stall, the operator must either push the stop button or turn off ignition switch to prevent current path to coil.

10. Position selector switch to ground and 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. Depress foot switch prior to moving any control function switches. This increases engine RPM (if throttle HI/LO selector is positioned in HI), and electrically completes circuit to controls.

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

12. THE TRAVEL OR DRIVE CONFIGURATION IS WITH THE STEERING WHEELS UNDER THE BOOM. 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 DECALS ATTACHED TO EACH END OF THE CARRIAGE ASSEMBLY WILL HELP ORIENT THE OPERATOR TO THE CONTROL CONSOLE.

13. Brake adjustments may be made by turning a small needle valve. (parts page 21, item 7). The valve is merely a time delay for applying the brakes. With the valve completely open, the time delay for applying the brakes is at a minimum. Set the delay valve to stop the machine in approximately three feet on level ground driving in high speed.

NOTE: See forematter page X reduced copy of New Equipment Condition Report that is sent with each machine.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

Every operator of the MARKLIFT must know, 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 be familiar with 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 the 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 14 & 15 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 with the safety strap attached.

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. Report any misuse of equipment to the proper personnel.

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 protruding 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 and/or miscellaneous boxes. If required to store such items, they must be situated in such a way as to prevent walking and tripping over such items.

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, as this is hazardous and must be avoided. The MARKLIFT must not be operated on more than a 5 degree out-of-plumb condition.

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

21. DO NOT jump start other vehicles using MARKLIFT battery.

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."

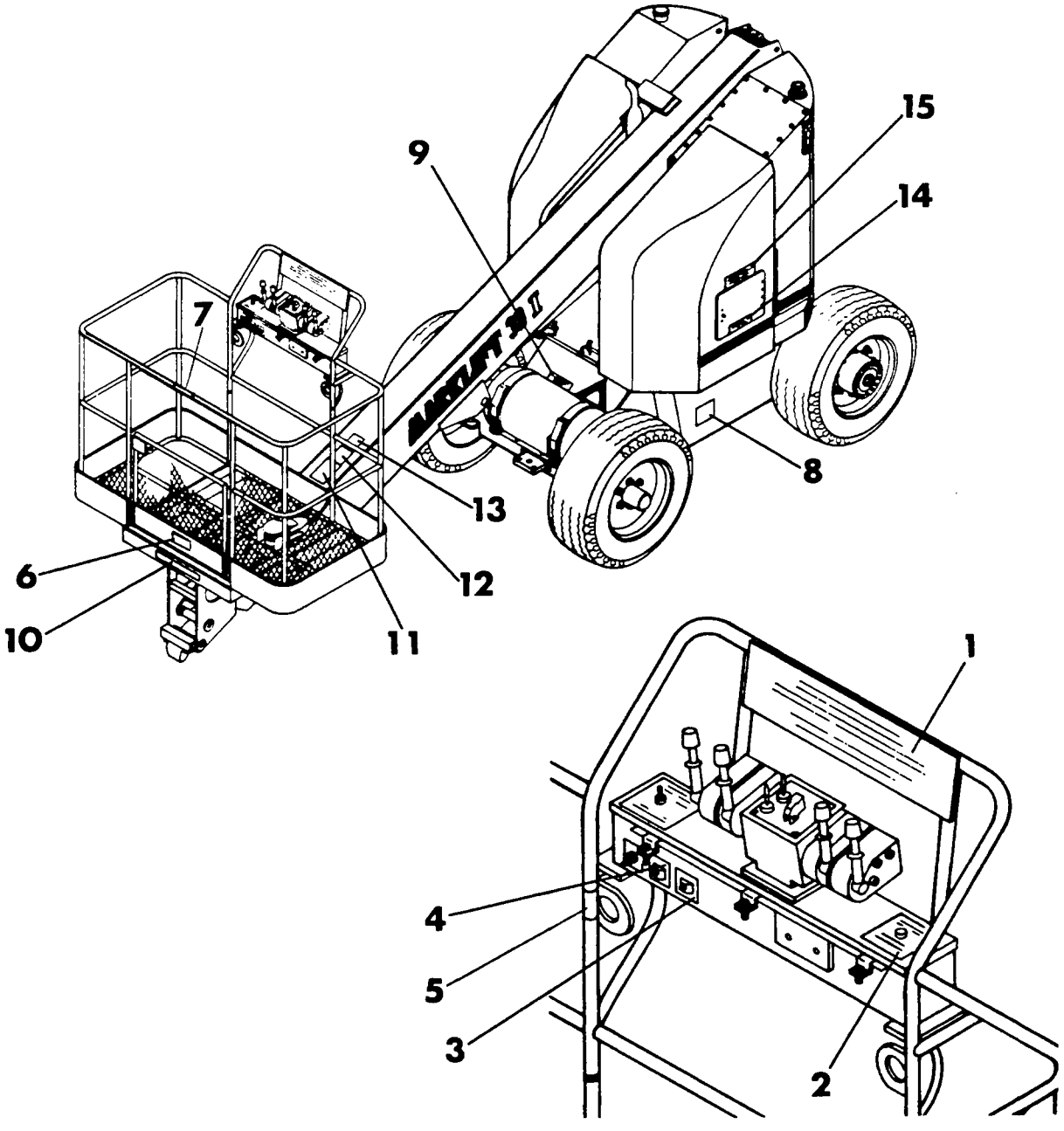
In addition to the above wording, the following statement in small lettering shall be provided on the warning sign: "For Minimum Clearances of High-Voltage Lines In Excess of 50,000 Volts, See Article 86, Title 8, High-Voltage Electrical Safety Orders."

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

Be completely familiar with all warning and caution decals that are posted on the unit.

Keep in mind to be alert and use common sense and judgement in responding to dangerous situations and conditions that might develop during unit operation.



1

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!

20859

2

CAUTION

LIGHT INDICATES AN UNSAFE OUT OF LEVEL OPERATING CONDITION

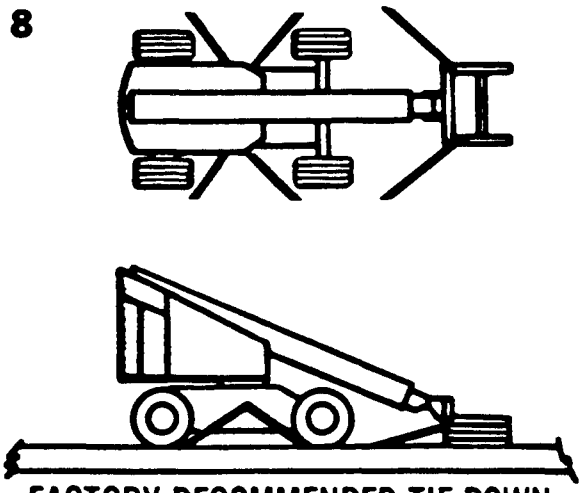
BOOM FUNCTIONS ARE INOPERATIVE WHEN LIGHT IS ON

●

CONTROLS WILL BE RESTORED WHEN UNIT IS DRIVEN TO A SAFE LEVEL CONDITION

20444

8



FACTORY RECOMMENDED TIE DOWN TRANSPORTING DIAGRAM 20508

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

2014

7

4

THROTTLE
HI
LO

EMERGENCY DESCENT

PUSH TO LOWER BOOM

20406

9

USE VAPOR TANK ONLY

6

LOAD CAPACITY 500 LBS.
(EVENLY DISTRIBUTED LOAD)

2022

5

ATTACH SAFETY BELT

3

EMERGENCY RETRACTION

PUSH TO RETRACT BOOM

20407

10

ATTACH YOUR SAFETY BELT FIRST!

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

22365

11

DANGER

YOU MUST NOT OPERATE THIS MACHINE UNLESS YOU ARE QUALIFIED BY TRAINING AND EXPERIENCE IN THE SAFE OPERATION OF THIS MACHINE.

TRAINING INCLUDES COMPLETE KNOWLEDGE OF YOUR EMPLOYER'S WORK RULES, ALL GOVERNMENTAL REGULATIONS, AND MANUFACTURER'S OPERATOR AND SAFETY MANUALS RELATIVE TO THIS MACHINE'S SAFE USE.

AN UNTRAINED OPERATOR SUBJECTS HIMSELF AND OTHERS TO DEATH OR SERIOUS INJURY.

20417

12

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

13

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

ONE EACH OF DECALS11,12&13
ARE ALSO LOCATED INSIDE GROUND
CONTROL BOX ACCESS DOOR

14

OPEN COVER FOR
EMERGENCY GROUND CONTROLS
20495

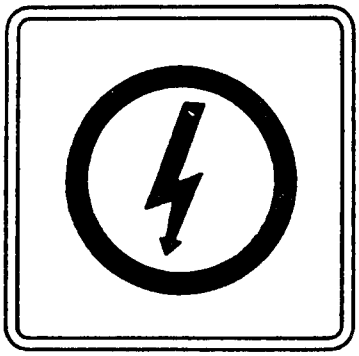
15

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



DECAL 15
IS ALSO
LOCATED
FARSIDE

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

A working knowledge of the hydraulic system facilitates trouble shooting or 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 variable displacement piston pump combined with proportional control valves.

Both the pump and control valves are pressure compensated and load sensing, resulting in a highly efficient controllable system utilizing less energy to drive, thus reducing fuel consumption.

The compensator has been pre-set at 1750 PSI to "DESTROKE" the pump. The pump compensator also receives a load sending signal shuttled from each proportional control valve directly connected to cylinder load ports. Consequently the direct Boom loads are transmitted back to the pump so the pump only delivers enough flow and pressure to satisfy the cylinder, depending on command from the control valve orifice.

The load sensing system is automatically removed from the hydraulic circuit during the engine start operations so as not to create excessive starter drag.

The throttle is activated hydraulically directly from the pump high pressure discharge, through a solenoid valve. The throttle solenoid valve is energized through a selector switch in the platform, wired in series with the foot switch.

The proportional control valves require a small flow and pressure signal constantly while the engine is running. This supply is tapped off the high pressure pump discharge through a fixed pressure compensated orifice. This low pressure and flow system is connected directly to the proportional control valve after being filtered, and acts on the first stage pilot of the control valve.

A satisfactory pilot line pressure is maintained constantly at 350 psi $\pm$ 25 psi. A capped port has been provided for a test gauge.

Two directional solenoid valves are provided in the circuit for steering and platform leveling override. The operator has no metering capabilities with the use of these valves since they are fully opened or closed.

The hydraulic oil is filtered on the return line from the control valves to the tank. The element can be easily replaced. Allow the engine to idle 2 minutes after changing any filter elements. This enables filter cans to completely fill automatically.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

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 proportional controllers.

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, hour gauge, 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, in no way, is directly connected to the drive braking system.

Engine start and stop are independently wired around the selector switch, making them operable any time the master switch or ignition switch is on.

The aerial control console is equipped with all controllers and switches necessary to operate 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 proportional control valves for all boom functions. The aerial control console contains electrical controllers complete with manual lockouts. The controllers are spring-centered and are designed to produce a variable output signal to the control valve. The output signal is directly proportional to the handle movement on the controller. The valve is electrically coupled to the controller and responds only to the signal level transmitted to it by the operator.

The operator must learn how to move the controller slowly to obtain a smooth, 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 parallel to the solenoid valves which selects HI & LO speed.

A level sensor is also automatically engaged through the same limit switches in a series circuit and will activate a warning buzzer and light if the unit is 5^{o} or more out of level.

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.

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 SELF-PROPELLED BOOM

(MODEL 30I & 32)

MARKLIFT Boom units equipped with a dual fuel system allow the operator to remotely 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.
Prior to 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 "HI" speed. Switch fuel selector to gasoline. The engine will begin to stall as the carburetor

SWITCHING FROM PROPANE TO GASOLINE

bowl starts filling with gasoline. Switch back to propane until the engine resumes high speed. Switch back and forth from LPG 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 "HI" 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.

MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)

It shall be the responsibility of all users of the MARKLIFT to read and comply with the following operating instructions. They are designed to promote safety and a better understanding of the operation of the self-propelled aerial platform.

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.

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.

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.

The operator should familiarize himself with the drive by raising the Boom approximately 5 feet off the ground prior to driving the unit. He will soon find that gradual starts and stops are relatively easy to perform. Gradually raise the Boom higher, and drive unit again until maximum height is established. Remember, at all times, that the proportional signal from the controller to the valve is controlled by the operator. There is approximtely 3 degrees of "dead" motion each side of the controller NEUTRAL position.

The best operation position can be achieved by placing the thumb over the knob of the controller and wrapping the fingers loosely around the locking stem. Now, rest the heel of the hand on the controller housing and apply a downward motion with the thumb, making the index finger lift the locking stem. Once the controller is disengaged and moved foreward or reverse, the pressure on the thumb may be omitted 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.

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

The emergency pump/motor is a new safety feature that has been available since Sept. 1980. Although at a reduced speed, all hydraulic functions are operable with the emergency pump running. From the work platform, position emergency pump switch to "ON" position. This will "KILL" the engine and permit the emergency pump to run. Standard operation procedure then resumes by depressing the foot switch and moving controller handles or toggle switches in the desired direction of motion.

The MARKLIFT is designed to be towed in plant, only, and NOT to exceed 10 mph. The towing kit is available from the factory as on option. Towing the MARKLIFT can be accomplished by locking out the plantary drive hubs, and hydraulic steering. (see page 31)

When hubs are disengaged, there are no wheel brakes. Care should be taken to disengage on flat level ground and all precautions taken to prevent accidents.

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

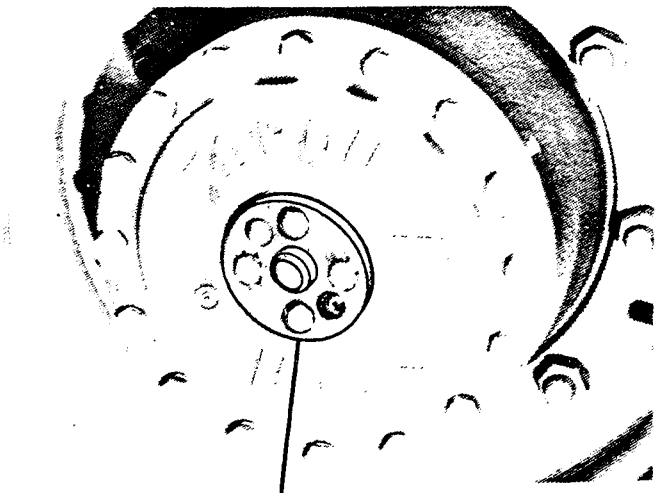
TORQUE HUB MUST BE DISENGAGED FOR TOWING.

MAXIMUM TOWING SPEED IS 10 mph.

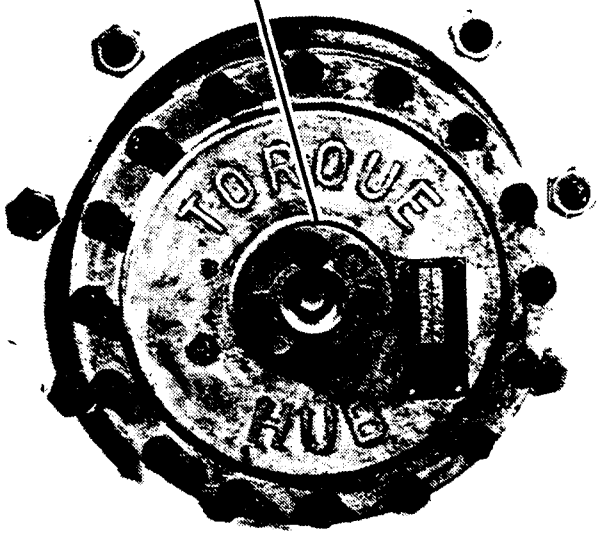
TO DISENGAGE TORQUE HUB, REVERSE THE DISCONNECT CAP. THE KNOB ON THE CAP DISENGAGES THE DRIVE HUB INPUT SHAFT.

CAUTION: BRAKES ARE ALSO DISENGAGED!

HUB ENGAGED



DISCONNECT CAP



HUB DISENGAGED

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

This preventative maintenance information is intended as a general guide which may be expanded by the owners normal maintenance program.

Mark Industries recommends the following items be checked:

WEEKLY

1. Clean unit by removing oil and grease with thinner. Machine may be washed with soap and water.
2. Operation and safety decals in place and legible.
3. Tire pressure at 35 P.S.I.
4. Tire condition (free of serious cuts or defects)
5. Proper engine oil level.
6. Proper hydraulic oil level.
7. Air cleaner.
8. Battery electrolyte level.
9. Battery fully charged.
10. Fuel level, daily.
11. Check and lube, if necessary. (See page 36)
12. Engine RPM should be
    WISC. - 1800 low
    2400 high
    LISTER - 2000 low
    2600 high
13. Proper brake operation.
14. Record hour meter reading.

MONTHLY, OR FIRST 50 HOURS

1. Check and lube, if necessary.
2. Check condition of battery.
3. Change engine oil filter.
4. Change hydraulic return oil filter.
5. Check ring gear bolt for torque - 175 ft. lbs. Turret, 85 ft. lbs. Torque values are with lubrication.
6. Check torque hub oil level. (See page 39)
7. Check air cleaner.
8. Check oil level, rotation gear box.
9. Check retraction cables for proper tension. (See page 34)

SIX MONTHS, OR 100 HOURS

1. Check and lube, if necessary.
2. Change low pressure filter element. (Item 9, page 37)
3. Change engine oil filter.
4. Change hydraulic return line filter element. (Item 10, page 37)

ANNUALLY

1. Replack all wheel bearings.
2. Change hydraulic oil.
3. Check Torque hub oil level.
4. Check ring gear bolts for Torque - 175 ft.lbs.

   Turret, 85 ft. lbs. base. (Torque values are with lubrication.
5. Change hydraulic return line filter.
6. Change pilot line filter.

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

Torquing the nut applies tension to the retraction cable which in turn, tensions or preloads the retraction housings. This assures a full 180 degree contact of both housings around the large retraction housing pullies.

1. Elevate boom approximately 7 feet above ground.

2. Extend boom arm out approximately 3 to 4 feet.

3. On MARKLIFT units with holding valve directly behind the boom extension cylinder, movement will be necessary to provide access to tensioning stud as follows:

   A. Remove and cap both hydraulic hoses on the bottom side of valve.

   B. Remove cap screws (2) which anchor holding valve bracket to outer boom.

   C. Lift holding valve upward and to the right side of outer boom to allow wrench access to retraction cable tensioning nut.

4. Set torque wrench at 15 inch pounds.

5. Apply a few drops of machine or hydraulic oil to the cable stud threads on each side of 5/16-18 nut.

6. If stud threads are rusted or corroded, it may be necessary to turn torquing nut a few turns (2 or 3) in both directions to clean threads before torquing.

7. Back out on jam nut from torque nut.

8. Insert two 5/16-18 nuts on stud end and jam together, if stud end is not ground down to facilitate holding without damaging threads. This provides a means of preventing stud from turning during torquing operation.

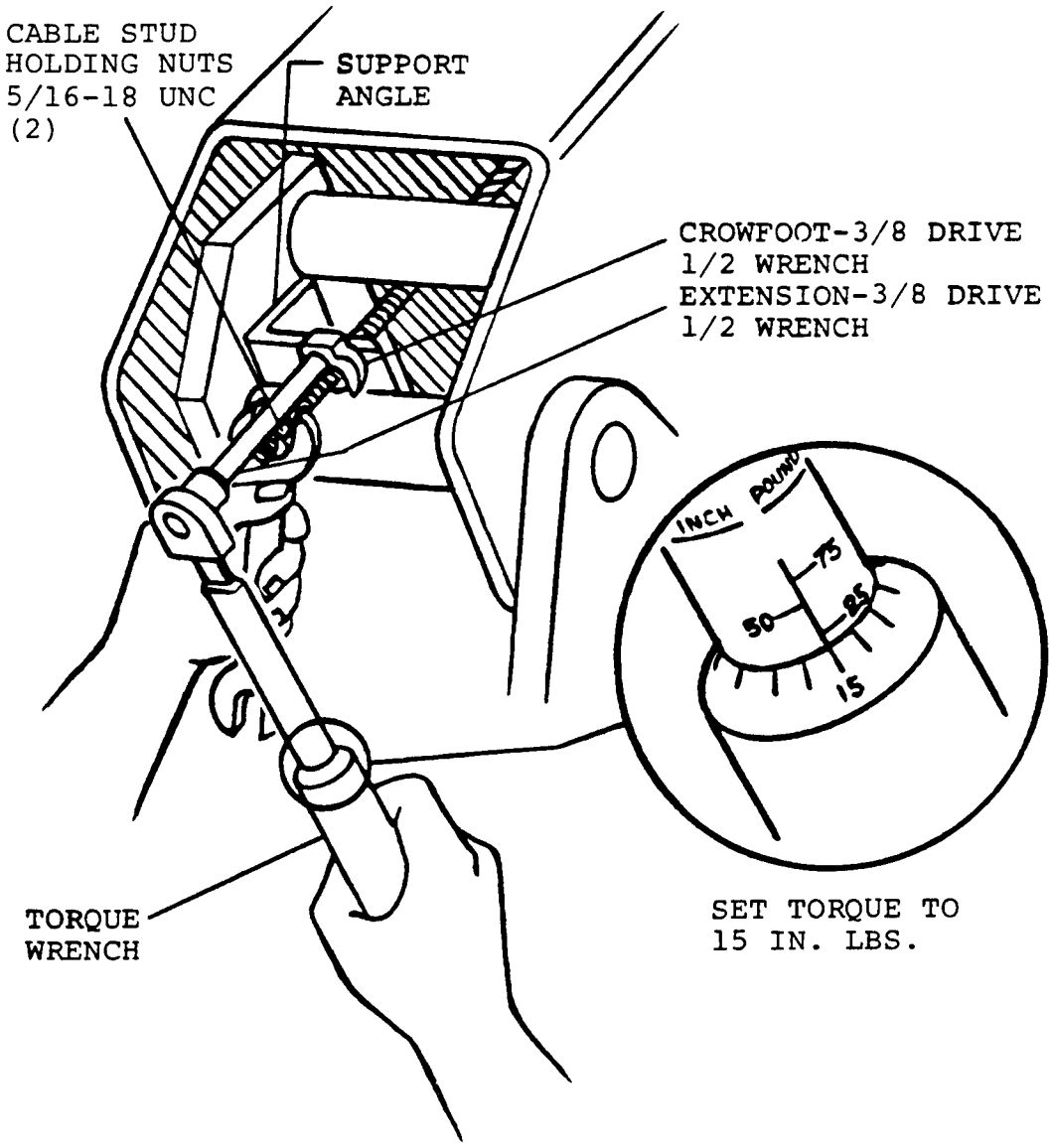
9. Attach crowfoot to 5/16 nut and rotate torque wrench clockwise. If the wrench "clicks" before nut turns, do not attempt to further tighten nut.

10. Make certain, however, that cable stud is not binding on support angle or that nut has "bottomed out" on thread.

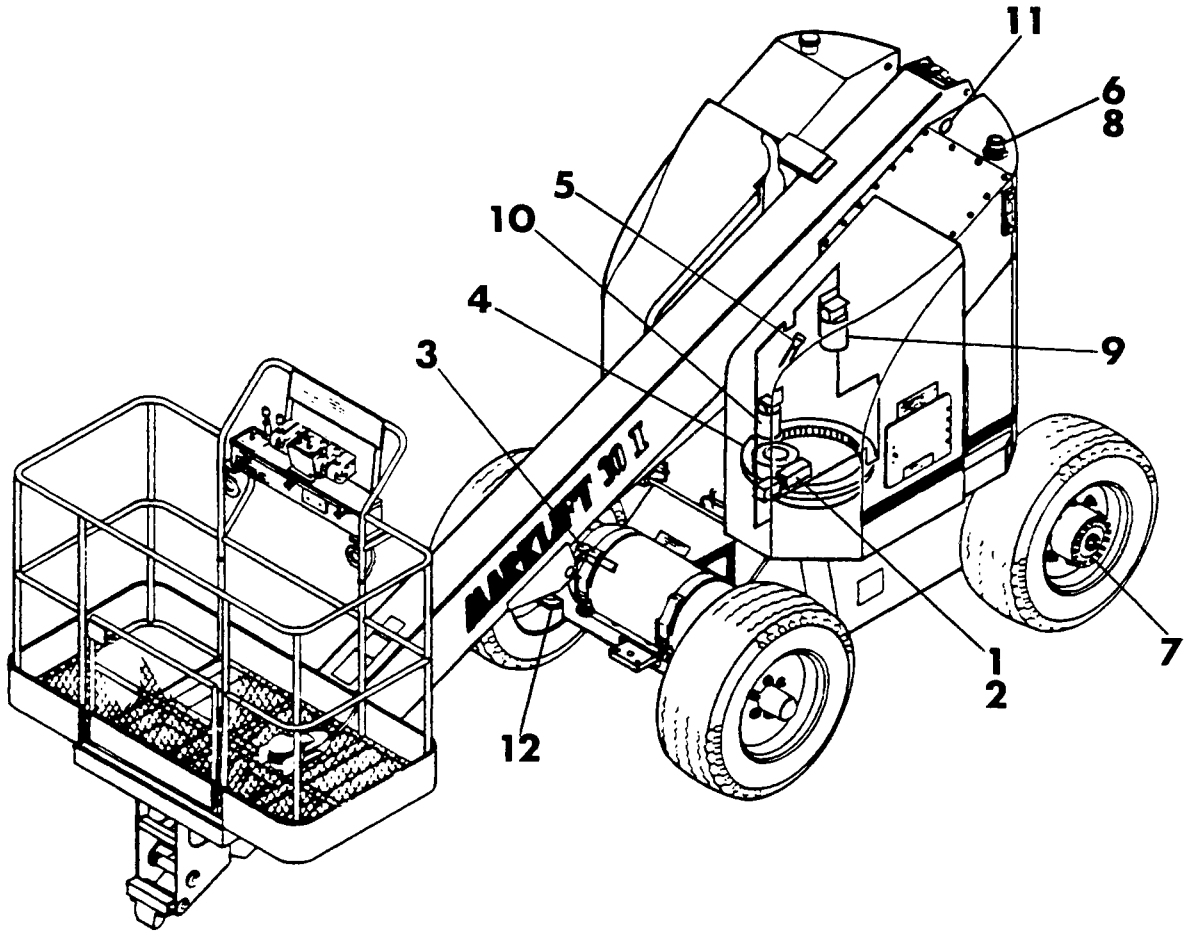
11. Continue to tighten nut until proper torque is established at 15 inch pounds.

12. Run jam nut down against torquing nut.

13. Reinstall extension holding valve if it was removed for tensioning.



MARKLIFT SELF-PROPELLED BOOM
(MODEL 30I & 32)



ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
1	ROTATION GEAR BOX GEARING	GEAR OIL SAE 90	MONTHLY
2	ROTATION GEAR BOX BEARINGS	MOBILCOTE TYPE-S GEAR GREASE OR EQUIVALENT	MONTHLY
3	TIE ROD PIN	MOBILCOTE TYPE-S GEAR GREASE	MONTHLY
4	RING GEAR	MOBILCOTE TYPE-S GEAR GREASE(4) ZERKS-ROTATE GEAR WHILE GREASING	MONTHLY

ITEM	DESCRIPTION	LUBRICANT	FREQUENCY
5	ENGINE	SAE 30	SEE ONAN OR WISCONSIN OPERATING INSTRUCTIONS IN VENDOR SECTION
6	HYDRAULIC FLUID	SEE PAGE 38	YEARLY
7	TORQUE HUB	SEE PAGE 39	YEARLY
8	HYDRAULIC TANK STRAINER		CLEAN YEARLY
9	LOW PRESSURE FILTER ELEMENT-20472		REPLACE EVERY 100 HOURS
10	RETURN LINE FILTER ELEMENT-20477		REPLACE EVERY 100 HOURS
11	MAIN BOOM PIVOT PIN	MOBILCOTE TYPE-S GEAR GREASE	MONTHLY
12	STEERING YOKE KING PINS	MOBILCOTE TYPE-S GEAR GREASE	MONTHLY

EQUIVALENT BEARING GREASE

UNION - UNOBA EP-2

SHELL - ALVINIA EP-2

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

OIL COMPANY	CHEVRON	GULF	SHELL	UNION
Brand Name	ATF Dexron 11	ATF Dexron 11	Donax-T6	ATF Dexron
Viscosity - SUS @ 100°F	187.4	195	200	200
SUS @ 210°F	49.2	50.4	50	52.3
Viscosity Index Typical	153°	155°	160°	172°
Flash Point °F	400°	405°	390°	395°
Pour Point °F	-40°	-50°	-50°	-45°

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

1. TYPE - EP 90

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

2. OIL TEMPERATURE

   Continous - 160°F
   Intermittent - 200°F

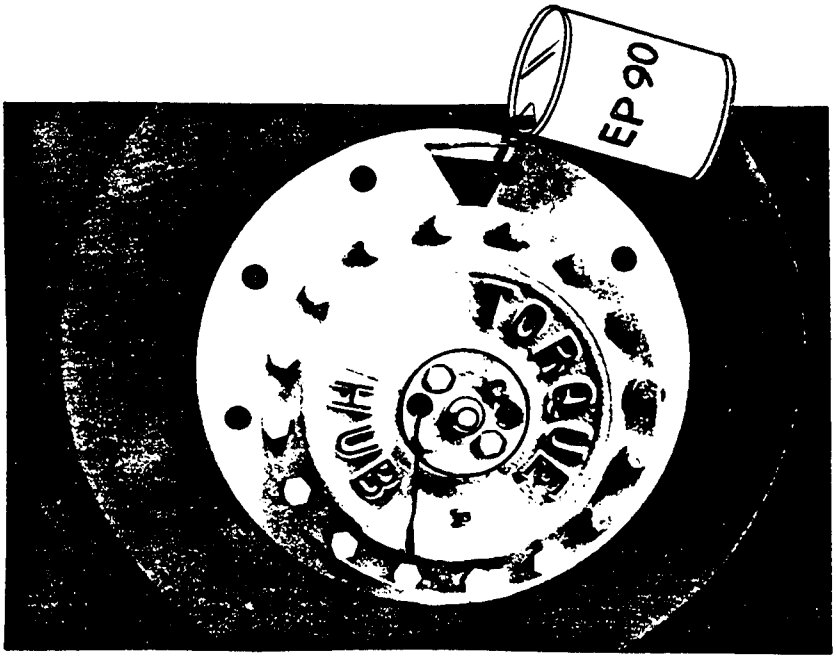
3. OIL CHANGE

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

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

4. OIL FILL LEVEL

   Unit mounted horizontal - half-full.



MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

ENGINE

1. Will not start or run.

   A. Check ground control box ciruit breaker.
   B. Check for opened fuel shut-off valve.
   C. Check fuel selector to see if it is in L.P. 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 HI/LO selector switch.
   B. Check throttle solenoid valve.
   C. Refer to your local service facility.

3. No idle.

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

4. Dies under load.

   A. Check governor setting.

   B. Check carburator air/fuel mixture

   C. Rever 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. Refer to your local service facility.

2. No functions operate from ground control box.

   A. Check position of aerial/ground box selector switch.

   B. Check pilot valve pressure.

   C. 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.

BRAKES

1. No brakes or slow pressure.
   - A. Check drive hub disengagement caps.
   - B. Check brake delay valve.
   - C. Refer to your local service facility.

DRIVE

1. Low torque drive.
   - A. Check high pressure.
   - B. Check pilot valve control pressure.
   - C. Refer to your local service facility.

HYDRAULIC MOTOR

1. Turns wheel while unloaded, but slows down or stops when load is applied.
   - A. Check planetary wheel drive to be sure engaging disc is NOT positioned in free wheeling.
   - B. Check high pressure hydraulic port with 3000 PSI gauge.
   - C. 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 reservoir hydraulic oil level gauge.
   - C. Check suction line fittings for tightness.
   - D. Check oil. USE ATF DEXRON II ONLY.
   - E. Refer to your local service facility.

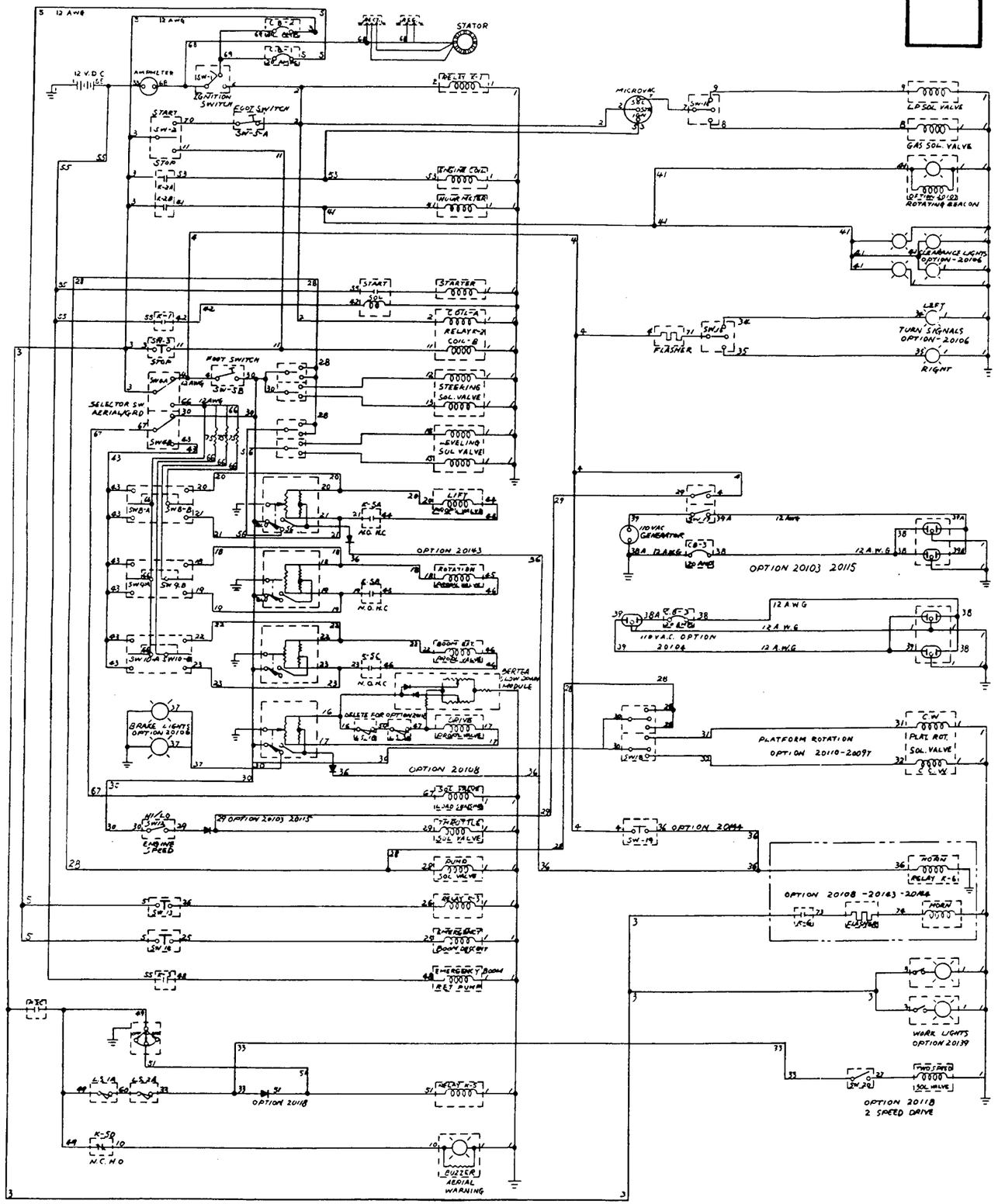
MARKLIFT SELF-PROPELLED BOOM

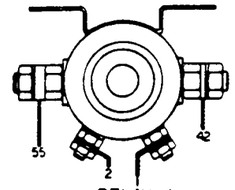
(MODELS 30I & 32)

ITEM	PART NO.	DESCRIPTION
1.	20472	Low pressure filter element.
2.	20477	Return line filter element.
3.	20125	Steering cylinder seal kit for 20206 cylinder.
4.	66228	Slave leveling cylinder seal kit.
5.	20128	Master leveling cylinder seal kit.
6.	66257	Lift cylinder seal kit.
7.	66250	Boom extension cylinder seal kit. (Model 30I).
8.	66251	Boom extension cylinder seal kit. (Model 32).
9.	66041	2-speed shift cylinder seal kit.
10.	66255	Platform rotation cylinder seal kit.
11.	20562	Ground control box circuit breaker.
12.	20481	Ground control box toggle switch.
13.	20482	Ground control box toggle switch.
14.	20580	Aerial control box potentiometer assembly.
15.	20581	Aerial controller lock-out.

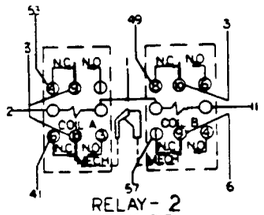
SERVICE TOOLS

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

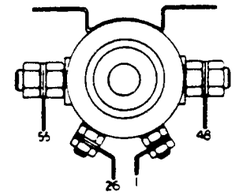




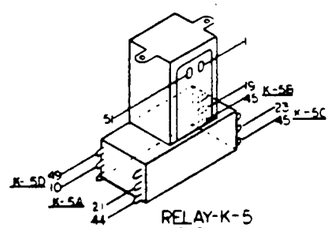
RELAY - 1
POWER RELAY
P/N 24059 COLE HERSEE



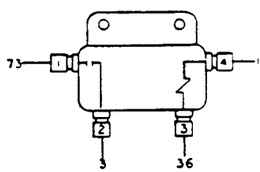
RELAY - 2
LATCHING TYPE
P/N KB 17DG POTTER-BRUMFIELD



RELAY-3
POWER RELAY
P/N 24059 COLE HERSEE

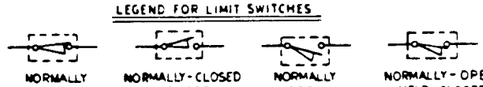


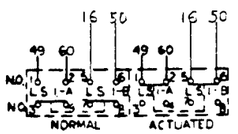
RELAY-K-5
T-BAR



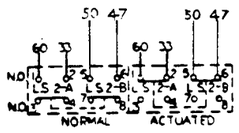
RELAY - 6
P/N D-1768 DELCO-REMY
P N 16262

LEGEND FOR LIMIT SWITCHES



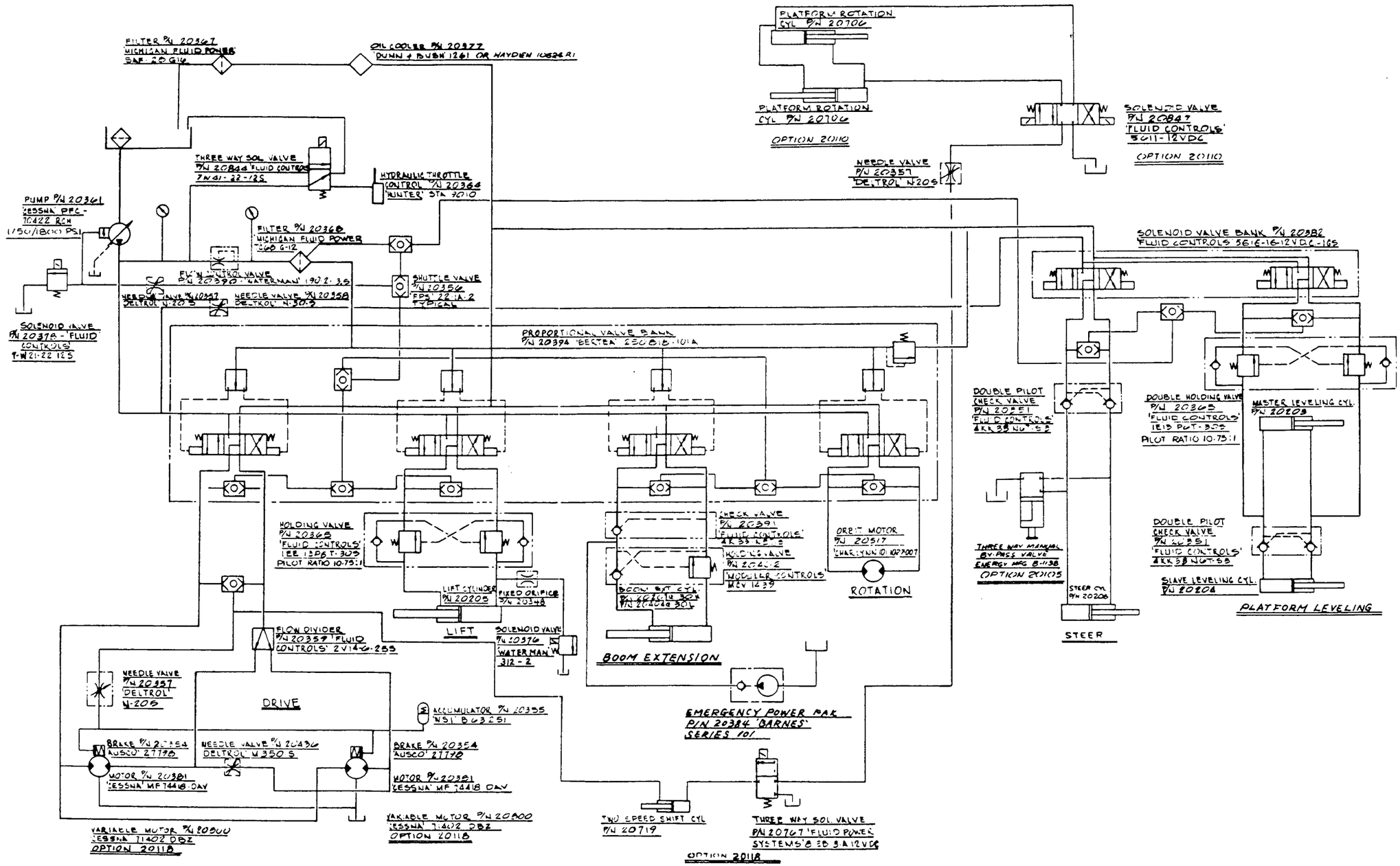


LIMIT SWITCH NO 1

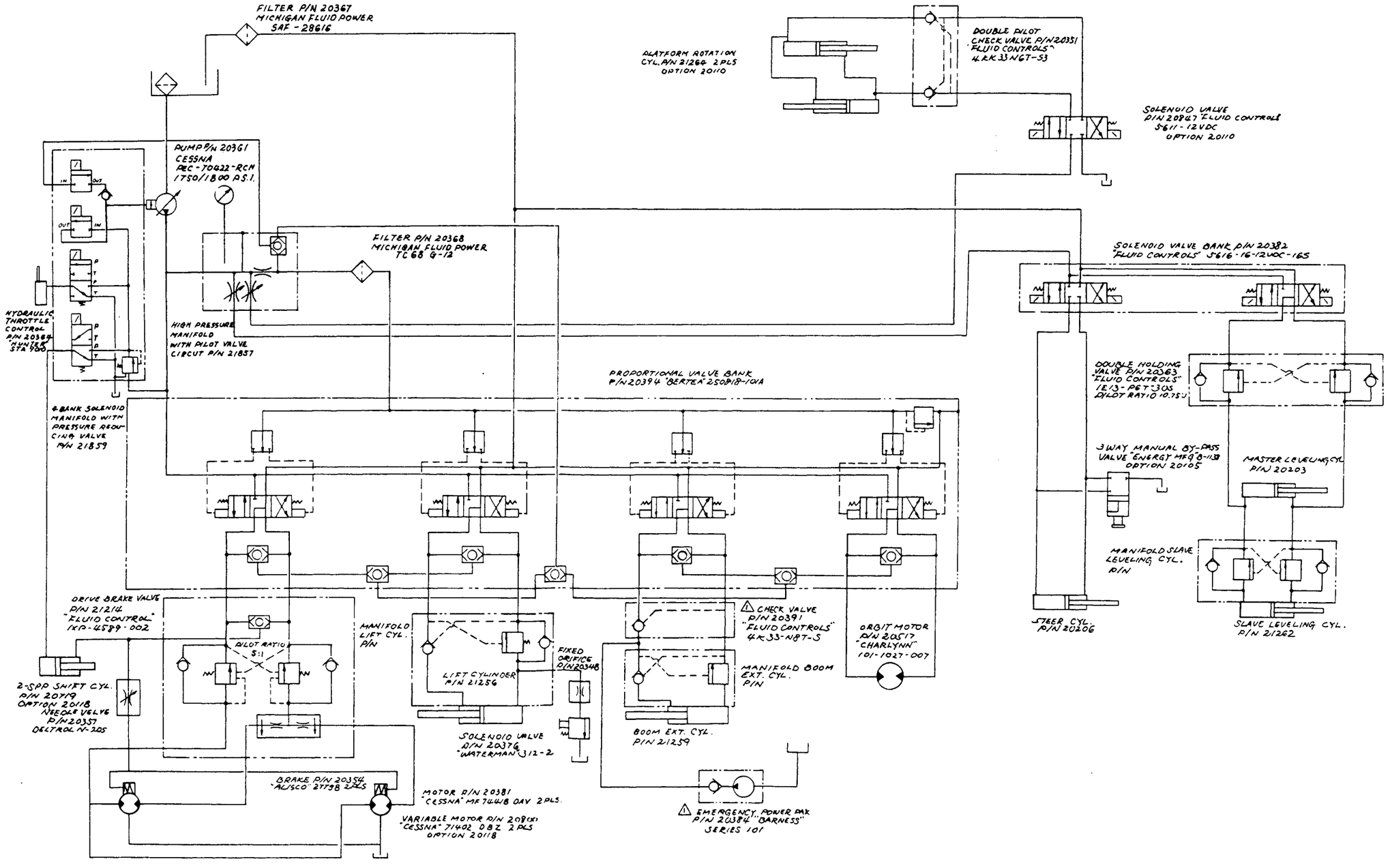


LIMIT SWITCH NO 2

DWG NO. 20067


FILTER P/N 20367
MICHIGAN FLUID POWER
SAE-20 G16
OIL COOLER P/N 20377
DUNN & BUSH 1261 OR HAYDEN 10626 R1
THREE WAY SOL VALVE
P/N 20844 'FLUID CONTROLS'
3W41-22-12S
HYDRAULIC THROTTLE CONTROL P/N 20364 'HUNTER' STA 7010
PUMP P/N 20361
'CESSNA' PFC-7622 R2H
1750/1800 PSI
FILTER P/N 20368
MICHIGAN FLUID POWER
300 G-12
FLOW CONTROL VALVE
P/N 20390 'WATERMAN' 190 2-3.5
SHUTTLE VALVE
P/N 20356
FDA 22-1A-2
TYPICAL
NEEDLE VALVE P/N 20358
DELTROL N-50-3
SOLENOID VALVE
P/N 20374 - 'FLUID CONTROLS'
3W21-22 12S
PROPORTIONAL VALVE BANK
P/N 20394 'BERTEA' 250 S1B-101A
HOLDING VALVE
P/N 20365
'FLUID CONTROLS'
TEE 13 DB T-305
PILOT RATIO 10-75:1
LIFT CYLINDER
P/N 20205
FIXED ORIFICE
P/N 20348
LIFT
FLOW DIVIDER
P/N 20357 'FLUID CONTROLS' 2V14-0.25S
SOLENOID VALVE
P/N 20376
'WATERMAN' 3/2-2
NEEDLE VALVE
P/N 20357
'DELTROL'
N-205
DRIVE
ACCUMULATOR P/N 20335
'NST' B 03 251
BRAKE P/N 20354
'AUSCO' 27798
NEEDLE VALVE P/N 20436
DELTROL N 350 S
BRAKE P/N 20354
'AUSCO' 27778
MOTOR P/N 20381
'CESSNA' MF 7441B DAV
MOTOR P/N 20381
'CESSNA' MF 7441B DAV
VARIABLE MOTOR P/N 20800
'CESSNA' 7140Z DBZ
OPTION 2011B
VARIABLE MOTOR P/N 20800
'CESSNA' 7140Z DBZ
OPTION 2011B
CHECK VALVE
P/N 20391
'FLUID CONTROLS'
4RR 3B NG-3
HOLDING VALVE
P/N 20364
'MODULAR CONTROLS'
MCV 1239
BOOM EXT CYL
P/N 20340 TO 30"
P/N 20340 30"
BOOM EXTENSION
ORBIT MOTOR
P/N 20517
'CHARLYNN' 10-1007
ROTATION
EMERGENCY POWER PAK
P/N 20384 'BARNES'
SERIES 101
TWO SPEED SHIFT CYL
P/N 20719
THREE WAY SOL VALVE
P/N 20767 'FLUID POWER SYSTEMS' B 3D 3-A 12 VDC
OPTION 2011B
PLATFORM ROTATION CYL P/N 20706
PLATFORM ROTATION CYL P/N 20706
OPTION 20110
NEEDLE VALVE
P/N 20357
DELTROL N205
SOLENOID VALVE
P/N 20847
'FLUID CONTROLS'
3C11-12VDC
OPTION 20110
SOLENOID VALVE BANK P/N 20382
FLUID CONTROLS 3E16-16-12VDC-10S
DOUBLE PILOT CHECK VALVE
P/N 20251
'FLUID CONTROLS'
4RR 3B NG-3
THREE WAY MANUAL BY-PASS VALVE
ENERGY MFG B-1138
OPTION 20105
STEER
STEER CYL P/N 20206
DOUBLE HOLDING VALVE
P/N 20365
'FLUID CONTROLS'
TEIB PGT-305
PILOT RATIO 10-75:1
MASTER LEVELING CYL
P/N 20203
DOUBLE PILOT CHECK VALVE
P/N 20251
'FLUID CONTROLS'
4RR 3B NG-3
SLAVE LEVELING CYL.
P/N 20204
PLATFORM LEVELING

DWG. NO. 20465


FILTER P/N 20367
MICHIGAN FLUID POWER
SAF - 28616
PUMP P/N 20361
CESSNA
REC - 70422 - RCN
1750/1800 R.S.I.
FILTER P/N 20368
MICHIGAN FLUID POWER
TC68 G-12
HYDRAULIC THROTTLE CONTROL P/N 20388 "HUNTER" STA 900
HIGH PRESSURE MANIFOLD WITH PILOT VALVE CIRCUIT P/N 21857
6 BANK SOLENOID MANIFOLD WITH PRESSURE REDUCING VALVE P/N 21859
PROPORTIONAL VALVE BANK P/N 20394 "BERTEA" 250818-10A
PLATFORM ROTATION CYL. P/N 21266 2 PLS OPTION 20110
DOUBLE PILOT CHECK VALVE P/N 20351 "FLUID CONTROLS" 4 RK 33 NGT-S3
SOLENOID VALVE P/N 20847 "FLUID CONTROLS" S611 - 12VDC OPTION 20110
SOLENOID VALVE BANK P/N 20382 "FLUID CONTROLS" S616-16-12VDC-16S
DOUBLE HOLDING VALVE P/N 20363 "FLUID CONTROLS" 1E13-PBT30S PILOT RATIO 10.75:1
3 WAY MANUAL BY-PASS VALVE "ENERGY MFG" B-113 OPTION 20105
MASTER LEVELING CYL P/N 20203
MANIFOLD SLAVE LEVELING CYL. P/N
STEER CYL P/N 20206
SLAVE LEVELING CYL. P/N 21262
DRIVE BRAKE VALVE P/N 21214 "FLUID CONTROL" 1XP-4589-002
PILOT RATIO 5:1
2-SPD SHIFT CYL. P/N 20719 OPTION 20118 NEEDLE VELVE P/N 20357 DELTROL N-20S
MANIFOLD LIFT CYL. P/N
LIFT CYLINDER P/N 21256
FIXED ORIFICE P/N 20348
SOLENOID VALVE P/N 20376 "WATERMAN" 3/2-2
BOOM EXT. CYL. P/N 21259
MANIFOLD BOOM EXT. CYL. P/N
CHECK VALVE P/N 20391 "FLUID CONTROLS" 4K-33-NBT-S
ORBIT MOTOR P/N 20517 "CHARLYNN" 101-1027-007
BRAKE P/N 20354 "ALISCO" 27798 2 PLS
MOTOR P/N 20381 "CESSNA" MF 74418 DAV 2 PLS.
VARIABLE MOTOR P/N 2098(X) "CESSNA" 71402 DBZ 2 PLS OPTION 20118
EMERGENCY POWER PAK P/N 20384 "DARNESS" SERIES 101

DWG. NO. 20072

MARKLIFT SELF-PROPELLED BOOM

(MODEL 30I & 32)

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20	HYDRAULIC TANK ASSEMBLY (30I) (32)	55
21	MASTER LEVELING CYLINDER ASSEMBLY (30I) (32)	56
22	MASTER LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION BOOM)	57
23	ROTARY MANIFOLD ASSEMBLY (30I) (32)	58
23A	ROTARY MANIFOLD ASSEMBLY (30I) (32) (MARCH 1983)	58.1
24	FIBERGLASS COVER ASSEMBLY-ENGINE SIDE (30I)	59
24A	FIBERGLASS COVER ASSEMBLY-CONTROL SIDE (30I)	61
24B	FIBERGLASS COVER ASSEMBLY-ENGINE SIDE (32)	62
24C	FIBERGLASS COVER ASSEMBLY-CONTROL SIDE (32)	63
25	AERIAL CONTROL CONSOLE ASSEMBLY (30I) (32)	64
25A	AERIAL CONTROL STATION ASSEMBLY	67.1
26	FINAL BOOM ASSEMBLY (30I) (2 SECTION)	68
26.1	FINAL BOOM ASSEMBLY (30I) (3 SECTION)	70.1
26.2	FINAL BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)	70.4
26A	FINAL BOOM ASSEMBLY (32)	71
26B	INTERMEDIATE BOOM ASSEMBLY (30I) (3 SECTION)	73.1
26C	INTERMEDIATE BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)	73.4
27	INNER BOOM ASSEMBLY (30I) (2 SECTION)	74
27.1	INNER BOOM ASSEMBLY (30I) (3 SECTION)	75.1
27.2	INNER BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)	75.4
27.3	MARK TRACK ASSEMBLY (30I) (3 SECTION)	75.7
27A	INNER BOOM ASSEMBLY (32)	76
28	SLAVE LEVELING CYLINDER ASSEMBLY (30I) (32)	78
28A	SLAVE LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION BOOM)	78.1
28B	SLAVE LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION) (NEW P/N)	78.2
29	SLAVE LEVELING CYLINDER (30I) (32)	79

FIG. NO.	TITLE	PAGE
29A	SLAVE LEVELING CYLINDER (30I)(3 SECTION BOOM) .	79.1
30	BOOM EXTENSION CYLINDER (30I) (2 SECTION) . . .	80
30.1	BOOM EXTENSION CYLINDER ASSEMBLY (30I) (3 SECTION)	80.1
30.2	BOOM EXTENSION CYLINDER (30I) (3 SECTION) . . .	80.2
30A	BOOM EXTENSION CYLINDER (32)	81
31	FOOT SWITCH ASSEMBLY (30I) (32)	82
32	HYDRAULIC HOSE KIT (30I)	83
33	HYDRAULIC HOSE KIT (32)	86
	OPTIONS	
34	GROUND & AERIAL 110 VAC RECEPTACLE	89
35	CLEARANCE, STOP AND TURNING LIGHTS	90
36	ROTATING BEACON INSTALLATION	92
37	RAISED PLATFORM ROTATION	93
38	12 VOLT PLATFORM WORKLIGHT	97
39	FORK GROUND SENSOR	98
40	PLATFORM ROTATION CYLINDER	100
41	DIESEL ST2-A ENGINE (32)	101

NOTE: 1. ALL PART NUMBERS LISTED IN THE FOLLOWING "PART NUMBER" COLUMNS ARE MARK INDUSTRIES NUMBERS.

2. ADDITIONAL OPTIONS ARE LISTED IN FORE-MATTER SECTION.

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FIGURE 1 - FINAL ASSEMBLY (30I) (2 SECTION BOOM)

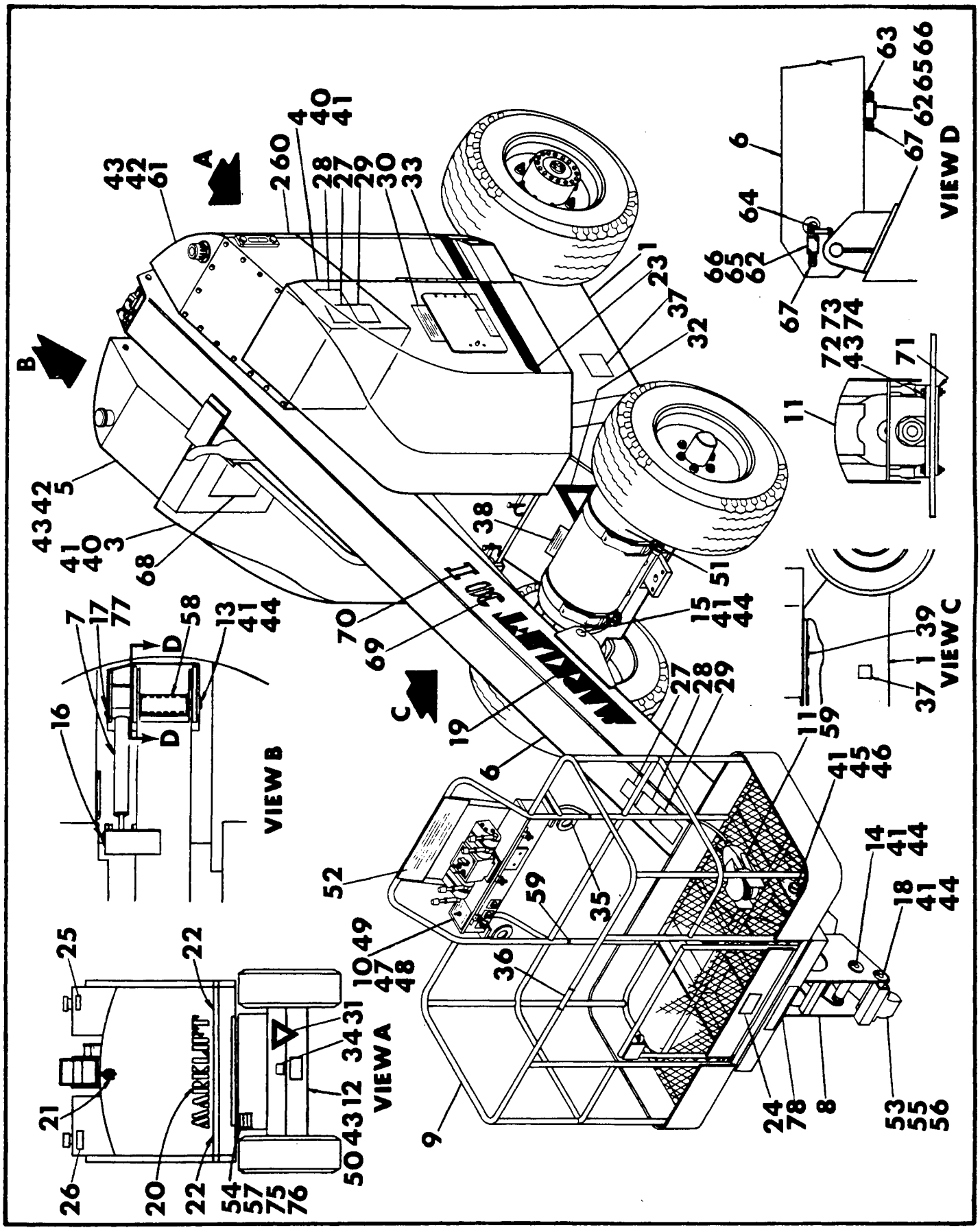


FIGURE 1 - FINAL ASSEMBLY (30I) (2 SECTION BOOM)

ITEM	PART NUMBER	DESCRIPTION	QTY
1-	20013	FINAL ASSEMBLY	1
-1	20179	CARRIAGE ASSEMBLY (SEE FIG. 2)	1
-2	20176	TURRET ASSEMBLY (SEE FIG. 9)	1
-3	20305	FIBERGLASS COVER - ENGINE SIDE (SEE FIG. 24)	1
-4	20651	FIBERGLASS COVER - CONTROL SIDE (SEE FIG. 24A)	1
-5	20476	FUEL TANK ASSEMBLY (SEE FIG. 13)	1
-6	20183	FINAL BOOM ASSEMBLY (SEE FIG. 26)	1
-7	20237	MASTER LEVELING CYLINDER ASSEMBLY (SEE FIG. 21)	1
-8	20535	FORK WELDMENT	1
-9	20537	PLATFORM WELDMENT	1
-10	20525	AERIAL CONTROL CONSOLE ASSEMBLY (SEE FIG. 25)	1
-11	20480	FOOT SWITCH ASSEMBLY (SEE FIG. 31)	1
-12	20458	DRIVE COVER	1
-13	21784	BOOM TO TURRET PIN	1
-14	20457	BOOM TO FORK PIN	1
-15	20259	LIFT CYLINDER TO BOOM PIN	1
-16	22491	MASTER LEVELING CYLINDER PIN - BLIND END	1
-17	22492	MASTER LEVELING CYLINDER PIN - ROD END	1
-18	20261	SLAVE CYLINDER TO FORK PIN	1
-19	20408	MARKLIFT BOOM DECAL	2
-20	20409	MARKLIFT PEDESTAL DECAL	1
-21	20410	MARK INDUSTRIES LOGO DECAL	1
-22	20411	STRIPE - SQUARE ENDS DECAL	3
-23	20412	STRIPE - ROUND ENDS DECAL	1
-24	2022	LOAD CAPACITY 500 LBS DECAL	1
-25	2020	GAS DECAL	1
-26	2017	HYDRAULIC FLUID DECAL	1
-27	20416	CAUTION DECAL	2
-28	20417	DANGER DO NOT OPERATE DECAL	2
-29	20418	DANGER ELECTRICAL HAZARD DECAL	2
-30	20419	DANGER KEEP CLEAR DECAL	2

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	20461	AHEAD FORWARD ARROW DECAL	1
-32	20462	AFT FORWARD ARROW DECAL	1
-33	20495	EMERGENCY GROUND CONTROLS DECAL	1
-34	20896	OPEN FOR FASTER BRAKING DECAL	1
-35	22386	ATTACH SAFETY BELT DECAL	2
-36	2014	UNLAWFUL TO OPERATE DECAL	1
-37	20508	TRANSPORTATION DECAL	2
-38	2004	USE VAPOR TANK ONLY DECAL	1
-39	60611	HEX HEAD CAP SCREW - 1/2-13 UNC X 1 3/4 BOWMALOK 41027	16
-40	60320	HEX HEAD CAP SCREW - 3/8-16 UNC X 1/2 (GR. 5)	8
-41	63303	SPLIT LOCKWASHER - 3/8	13
-42	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 (GR. 5)	6
-43	63302	SPLIT LOCKWASHER - 5/16	10
-44	60607	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 BOWMALOK 41012	5
-45	60515	HEX HEAD CAP SCREW - 3/8-16 UNC X 3 BOWMALLOY 36062	4
-46	61302	SELF LOCKING HEX NUT - 3/8-16 UNC BOWMA-GRIP 36782	4
-47	60123	HEX HEAD CAP SCREW - 1/4-20 UNC X 3/4	4
-48	63301	SPLIT LOCKWASHER - 1/4	4
-49	60701	HEX NUT - 1/4-20 UNC	4
-50	60324	HEX HEAD CAP SCREW - 5/16-18 UNC X 1/2	2
-51	486-C	L.P. TANK	1
-52	20859	AERIAL OPERATING INSTRUCTIONS DECAL	1
-53	20552	PLATFORM BUMPER	1
-54	20964	I.D. PLATE	1
-55	60122	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 1/2	2
-56	61318	LOCK NUT - 3/8-16 UNC	2
-57	63653	POP RIVET - 1/8 DIA. X 1/4	12
-58	20830	SPACER	1
-59	255	TIE WRAP	8
-60	20591	HYDRAULIC HOSE KIT (SEE FIG. 32)	1

ITEM	PART NUMBER	DESCRIPTION	QTY
-61	20474	HYDRAULIC TANK ASSEMBLY (SEE FIG. 20)	1
-62	70107	LIMIT SWITCH	2
-63	70031	LIMIT SWITCH ARM	1
-64	70032	LIMIT SWITCH ARM	1
-65	62610	ROUND SLOTTED HEAD CAP SCREW - NO. 12-24 UNC X 1 3/4	4
-66	63314	LOCKWASHER - NO. 12	4
-67	2806	STRAIN RELIEF	2
-68	20860	GROUND OPERATING INSTRUCTIONS DECAL	1
-69	20871	30 DECAL	2
-70	20998	I DECAL	2
-71	20663	FOOT SWITCH BACKING PLATE	1
-72	60346	HEX HEAD CAP SCREW - 5/16-18 UNC X 1 1/4	2
-73	60702	HEX NUT - 5/16-18 UNC	2
-74	63402	FLAT WASHER - 5/16	4
-75	20661	ANSI A92 PLATE	1
-76	20662	PATENT NUMBERS PLATE	1
-77	60613	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 BOWMALOK 41013	4
-78	22385	"CAUTION - ATTACH YOUR SAFETY BELT FIRST" DECAL	1

FIGURE 1.1 - FINAL ASSEMBLY (30I) (3 SECTION BOOM)

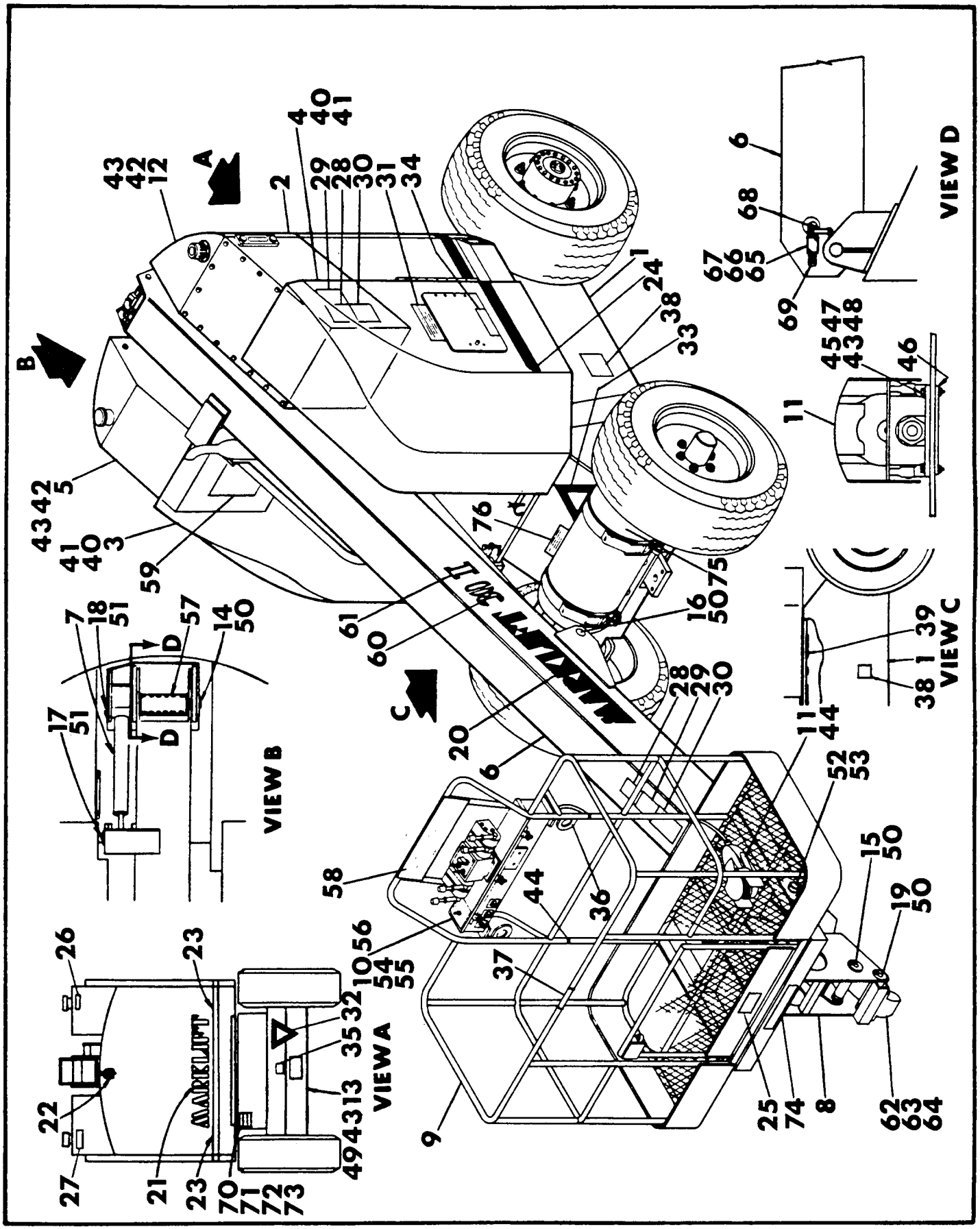


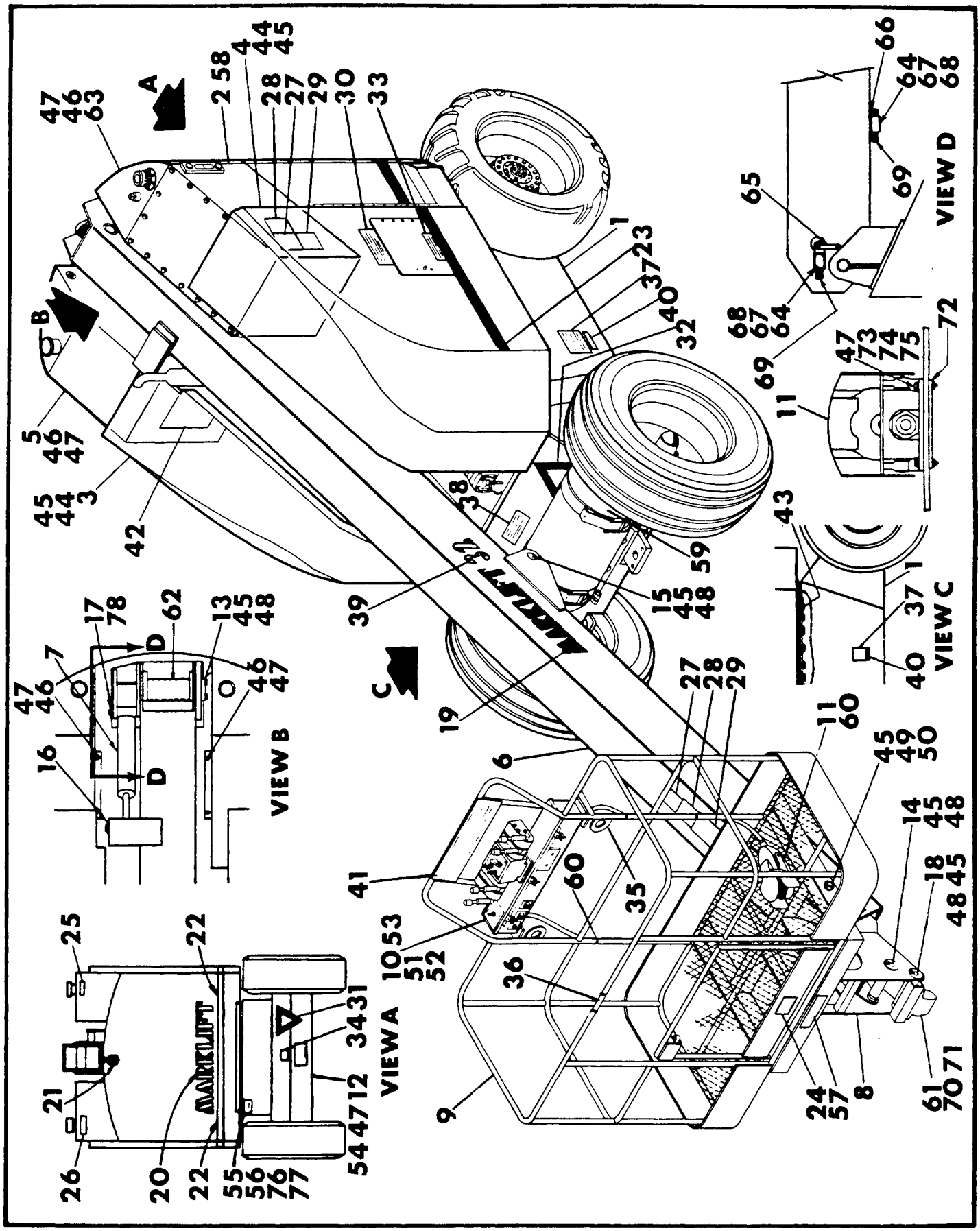
FIGURE 1.1 - FINAL ASSEMBLY (30I) (3 SECTION BOOM)

ITEM	PART NUMBER	DESCRIPTION	QTY
1-	20022	FINAL ASSEMBLY	1
-1	20179	CARRIAGE ASSEMBLY (SEE FIG. 2)	1
-2	20176	TURRET ASSEMBLY (SEE FIG. 9)	1
-3	20305	FIBERGLASS COVER - ENGINE SIDE (SEE FIG. 24)	1
-4	20651	FIBERGLASS COVER - CONTROL SIDE (SEE FIG. 24A)	1
-5	20476	FUEL TANK ASSEMBLY (SEE FIG. 13)	1
-6	22535	FINAL BOOM ASSEMBLY (SEE FIG. 26.1)	1
-7	22583	MASTER LEVELING CYLINDER ASSEMBLY (SEE FIG. 22)	1
-8	20535	FORK WELDMENT	1
-9	20537	PLATFORM WELDMENT	1
-10	20525	AERIAL CONTROL CONSOLE ASSEMBLY (SEE FIG. 25)	1
-11	20480	FOOT SWITCH ASSEMBLY (SEE FIG. 31)	1
-12	20474	HYDRAULIC TANK ASSEMBLY (SEE FIG. 20)	1
-13	20458	DRIVE COVER	1
-14	21784	BOOM TO TURRET PIN	1
-15	20457	BOOM TO FORK PIN	1
-16	20259	LIFT CYLINDER TO BOOM PIN	1
-17	22491	MASTER LEVELING CYLINDER PIN - BLIND END	
-18	22492	MASTER LEVELING CYLINDER PIN - ROD END	1
-19	20261	SLAVE CYLINDER TO FORK PIN	1
-20	20408	MARKLIFT BOOM DECAL	2
-21	20409	MARKLIFT PEDESTAL DECAL	1
-22	20410	MARK INDUSTRIES LOGO DECAL	1
-23	20411	STRIPE - SQUARE ENDS DECAL	3
-24	20412	STRIPE - ROUND ENDS DECAL	1
-25	2022	LOAD CAPACITY 500 LBS DECAL	1
-26	2020	GAS DECAL	1
-27	2017	HYDRAULIC FLUID DECAL	1
-28	20416	CAUTION DECAL	2
-29	20417	DANGER DO NOT OPERATE DECAL	2

ITEM	PART NUMBER	DESCRIPTION	QTY
-30	20418	DANGER ELECTRICAL HAZARD DECAL	2
-31	20419	DANGER KEEP CLEAR DECAL	2
-32	20461	AHEAD FORWARD ARROW DECAL	1
-33	20462	AFT FORWARD ARROW DECAL	1
-34	20495	EMERGENCY GROUND CONTROLS DECAL	1
-35	20896	OPEN FOR FASTER BRAKING DECAL	1
-36	22386	ATTACH SAFETY BELT DECAL	2
-37	2014	UNLAWFUL TO OPERATE DECAL	1
-38	20508	TRANSPORTATION DECAL	2
-39	60611	HEX HEAD CAP SCREW - 1/2-13 UNC X 1 3/4 BOWMALOK 41027	16
-40	60320	HEX HEAD CAP SCREW - 3/8-16 UNC X 1/2 (GR. 5)	8
-41	63303	SPLIT LOCKWASHER - 3/8	8
-42	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 (GR. 5)	8
-43	63302	SPLIT LOCKWASHER - 5/16	6
-44	255	TIE WRAP	8
-45	60702	HEX NUT - 5/16-18 UNC	2
-46	20663	FOOT SWITCH BACKING PLATE	1
-47	60346	HEX HEAD CAP SCREW - 5/16-18 UNC X 1 1/4 (GR. 5)	2
-48	63402	FLAT WASHER - 5/16	2
-49	60324	HEX HEAD CAP SCREW - 5/16-18 UNC X 1/2 (GR. 5)	2
-50	60607	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 BOWMALOK 41012	5
-51	60613	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 BOWMALOK 41013	4
-52	60515	HEX HEAD CAP SCREW - 3/8-16 UNC X 3 BOWMALLOY 36062	4
-53	61302	SELF-LOCKING HEX NUT - 3/8-16 UNC BOWMA-GRIP 36782	4
-54	60309	HEX HEAD CAP SCREW - 1/4-20 UNC X 3/4 (GR. 5)	4
-55	63301	SPLIT LOCKWASHER - 1/4	4

ITEM	PART NUMBER	DESCRIPTION	QTY
-56	60701	HEX NUT - 1/4-20 UNC	4
-57	20830	BOOM PIVOT PIN SPACER	1
-58	20859	AERIAL OPERATING INSTRUCTIONS DECAL	1
-59	20860	GROUND OPERATING INSTRUCTIONS DECAL	1
-60	20871	30 DECAL	2
-61	20998	I DECAL	2
-62	20552	PLATFORM BUMPER	1
-63	60307	HEX HEAD CAP SCREW - 3/8-16 UNC X 1/2 (GR. 5)	2
-64	61318	HEX HEAD LOCK NUT - 3/8-16 UNC	2
-65	70107	LIMIT SWITCH	1
-66	62615	SLOTTED ROUND HEAD MACHINE SCREW - NO. 10 - 32 UNF X 1 3/4	2
-67	63313	SPLIT LOCKWASHER - NO. 10	2
-68	70032	LIMIT SWITCH ARM	1
-69	2806	STRAIN RELIEF	1
-70	20662	PATENT NUMBERS PLATE	1
-71	20661	ANSI A92 PLATE	1
-72	20660	I.D. PLATE	1
-73	63653	POP RIVET - 1/8 DIA. X 1/4	12
-74	22385	"CAUTION - ATTACH YOUR SAFETY BELT FIRST" DECAL	1
-75	486-C	L.P. TANK	1
-76	2004	USE VAPOR TANK ONLY DECAL	1

FIGURE 1A-FINAL ASSEMBLY (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
1-	20002	FINAL ASSEMBLY	1
-1	20180	CARRIAGE ASSEMBLY (SEE FIG. 2A)	1
-2	20177	TURRET ASSEMBLY (SEE FIG. 9A)	1
-3	20195	FIBERGLASS COVER - ENGINE SIDE (SEE FIG. 24B)	1
-4	20652	FIBERGLASS COVER - CONTROL SIDE (SEE FIG. 24C)	1
-5	20476	FUEL TANK ASSEMBLY (SEE FIG. 13)	1
-6	20182	FINAL BOOM ASSEMBLY (SEE FIG. 26A)	1
-7	20237	MASTER LEVELING CYLINDER ASSEMBLY (SEE FIG. 21)	1
-8	20535	FORK WELDMENT	1
-9	20537	PLATFORM WELDMENT	1
-10	20525	AERIAL CONTROL CONSOLE ASSEMBLY (SEE FIG. 25)	1
-11	20480	FOOT SWITCH ASSEMBLY (SEE FIG. 31)	1
-12	20458	DRIVE COVER	1
-13	21784	BOOM TO TURRET PIN	1
-14	20457	BOOM TO FORK PIN	1
-15	20259	LIFT CYLINDER TO BOOM PIN	1
-16	22491	MASTER LEVELING CYLINDER PIN - BLIND END	1
-17	22492	MASTER LEVELING CYLINDER PIN - ROD END	1
-18	20261	SLAVE CYLINDER TO FORK PIN	1
-19	20408	MARKLIFT BOOM DECAL	2
-20	20409	MARKLIFT PEDESTAL DECAL	1
-21	20410	MARK INDUSTRIES LOGO DECAL	1
-22	20411	STRIPE - SQUARE ENDS DECAL	3
-23	20412	STRIPE - ROUND ENDS DECAL	1
-24	20575	LOAD CAPACITY 600 LBS DECAL	1
-25	2020	GAS DECAL	1
-26	2017	HYDRAULIC FLUID DECAL	1
-27	20416	CAUTION DECAL	2
-28	20417	DANGER DO NOT OPERATE DECAL	2
-29	20418	DANGER ELECTRICAL HAZARD DECAL	2
-30	20419	DANGER KEEP CLEAR DECAL	2

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	20461	AHEAD FORWARD ARROW DECAL	1
-32	20462	AFT FORWARD ARROW DECAL	1
-33	20495	EMERGENCY GROUND CONTROLS DECAL	1
-34	20896	OPEN FOR FASTER BRAKING DECAL	1
-35	22386	ATTACH SAFETY BELT DECAL	2
-36	2014	UNLAWFUL TO OPERATE DECAL	1
-37	20508	TRANSPORTATION DECAL	2
-38	2004	USE VAPOR TANK ONLY DECAL (OPTION)	1
-39	20980	32 DECAL	2
-40	20521	TIRE PRESSURE 35 PSI DECAL	2
-41	20859	AERIAL OPERATING INSTRUCTIONS DECAL	1
-42	20860	GROUND OPERATING INSTRUCTIONS DECAL	1
-43	60611	HEX HEAD CAP SCREW - 1/2-13 UNC X 1 3/4 BOWMALOK 41027	16
-44	60320	HEX HEAD CAP SCREW - 3/8-16 UNC X 1/2	8
-45	63303	SPLIT LOCKWASHER - 3/8	13
-46	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4	6
-47	63302	SPLIT LOCKWASHER - 5/16	10
-48	60607	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4- BOWMALOK 41012	5
-49	60515	HEX HEAD CAP SCREW - 3/8-16 UNC X 3- BOWMALLOY 36062	4
-50	61302	SELF-LOCKING HEX NUT - 3/8-16 UNC - BOWMA-GRIP 36782	4
-51	60123	HEX HEAD CAP SCREW - 1/4-20 UNC X 3/4	4
-52	63301	SPLIT LOCKWASHER - 1/4	4
-53	60701	HEX NUT - 1/4-20 UNC	4
-54	60324	HEX HEAD CAP SCREW - 5/16-18 UNC X 1/2	2
-55	20964	I.D. PLATE	1
-56	63653	POP RIVET - 1/8 DIA. X 1/4	12
-57	22385	"CAUTION - ATTACH YOUR SAFETY BELT FIRST" DECAL	1
-58	20592	HYDRAULIC HOSE KIT (SEE FIG. 33)	1
-59	486-C	L.P. TANK (OPTION)	1
-60	255	TIE WRAP	1

ITEM	PART NUMBER	DESCRIPTION	QTY
-61	20552	PLATFORM BUMPER	1
-62	20830	SPACER	1
-63	20474	HYDRAULIC TANK ASSEMBLY (SEE FIG. 20)	1
-64	70107	LIMIT SWITCH	2
-65	70032	LIMIT SWITCH ARM	1
-66	70031	LIMIT SWITCH ARM	1
-67	62610	ROUND SLOTTED HEAD CAP SCREW - NO. 12-24 UNC X 1 3/4	4
-68	63314	SPLIT LOCKWASHER - NO. 12	4
-69	2806	STRAIN RELIEF	2
-70	60122	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 1/2	2
-71	61318	LOCK NUT - 3/8-16 UNC	2
-72	20663	FOOT SWITCH BACKING PLATE	1
-73	60346	HEX HEAD CAP SCREW - 5/16-18 UNC X 1 1/4	2
-74	60702	HEX NUT - 5/16-18 UNC	2
-75	63402	FLAT WASHER - 5/16	4
-76	20661	ANSI A92 PLATE	1
-77	20662	PATENT NUMBERS PLATE	1
-78	60613	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 BOWMALOK 41013	4

FIGURE 2-CARRIAGE ASSEMBLY (30I)

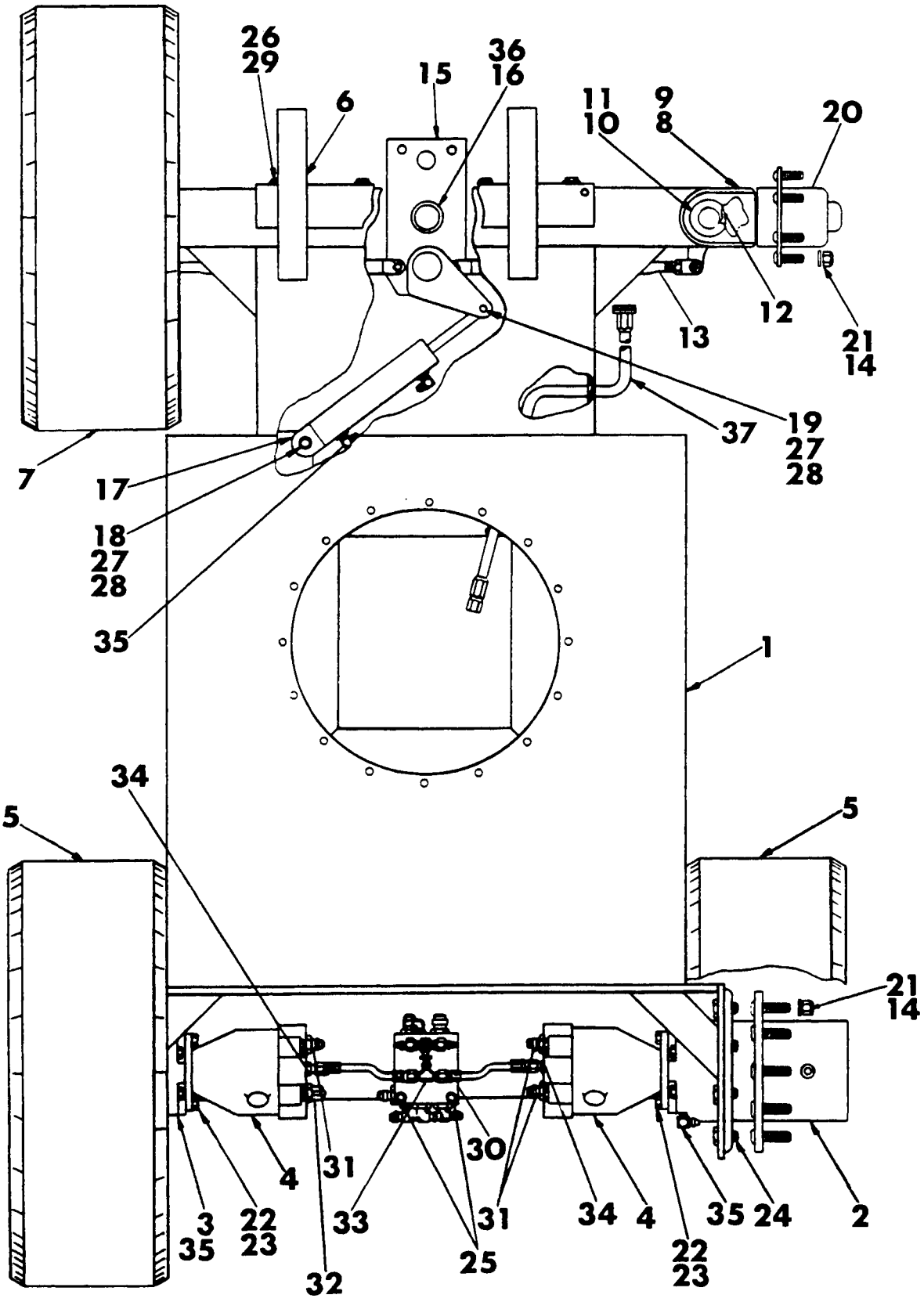


FIGURE 2-CARRIAGE ASSEMBLY (30I)

ITEM	PART NUMBER	DESCRIPTION	QTY
2-	20179	CARRIAGE ASSEMBLY	1
-1	20250	BASE WELDMENT	1
-2	20507	TORQUE HUB	2
-3	20354	BRAKE	2
-4	20352	MOTOR	2
-5	20421	DRIVE TIRE ASSEMBLY	2
-6	20843	LP TANK BRACKET	1
-7	20399	STEERING TIRE ASSEMBLY	2
-8	20560	STEERING YOKE ASSEMBLY (L.H.) (SEE FIG. 4A)	1
-9	20320	STEERING YOKE ASSEMBLY (R.H.) (SEE FIG. 4B)	1
-10	20321	KING PIN	2
-11	20323	THRUST WASHER	2
-12	377	ROLL PIN	2
-13	20316	TIE ROD ASSEMBLY (SEE FIG. 5)	2
-14	63501	FLAT WASHER-1/2-BOWMAN 36715 HD	30
-15	20222	STEERING ARM ASSEMBLY (SEE FIG. 3)	1
-16	20254	PIN-STEERING ARM CENTER	1
-17	20206	STEERING CYLINDER (SEE FIG. 6)	1
-18	20252	PIN-STEERING CYLINDER TO BASE	1
-19	20270	PIN-STEERING CYLINDER TO STEERING ARM	1
-20	20510	STEERING HUB ASSEMBLY (SEE FIG. 4)	2
-21	2924	LOCK NUT-1/2-20UNF BOWMAGRIP 36799	30
-22	60148	HEX HEAD CAPSCREW-1/2-13UNC X 6	4
-23	63305	SPLIT LOCKWASHER-1/2	4
-24	60606	CAPSCREW-5/8-11UNC X 1 1/4 BOWMALOK 41031-1	12
-25	60362	HEX HEAD CAPSCREW-5/16-18UNC X 3 1/2	2
-26	63303	SPLIT LOCKWASHER-3/8	4
-27	60631	CAPSCREW-1/4-20UNC X 5/8 BOWMALOK 41000-1	2
-28	63301	SPLIT LOCKWASHER-1/4	2
-29	60325	HEX HEAD CAPSCREW-3/8-16UNC X 3/4	4
-30	20912	DRIVE VALVE ASSEMBLY (SEE FIG. 7)	1

FIGURE 2-CARRIAGE ASSEMBLY (30I)

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	50823	STRAIGHT THREAD CONNECTOR	3
-32	2577	STRAIGHT THREAD ELBOW	1
-33	2421	UNION TEE	1
-34	2478	MALE CONNECTOR	2
-35	2532	STRAIGHT THREAD ELBOW	4
-36	60603	CAPSCREW-5/16-18UNC X 3/4 BOWMALOK 41006	2
-37		LPG FUEL HOSE ASSEMBLY (REF) (SUPPLIED WITH KIT 20512)	1

FIGURE 2.1 - CARRIAGE ASSEMBLY (30I)
(NOVEMBER 1983)

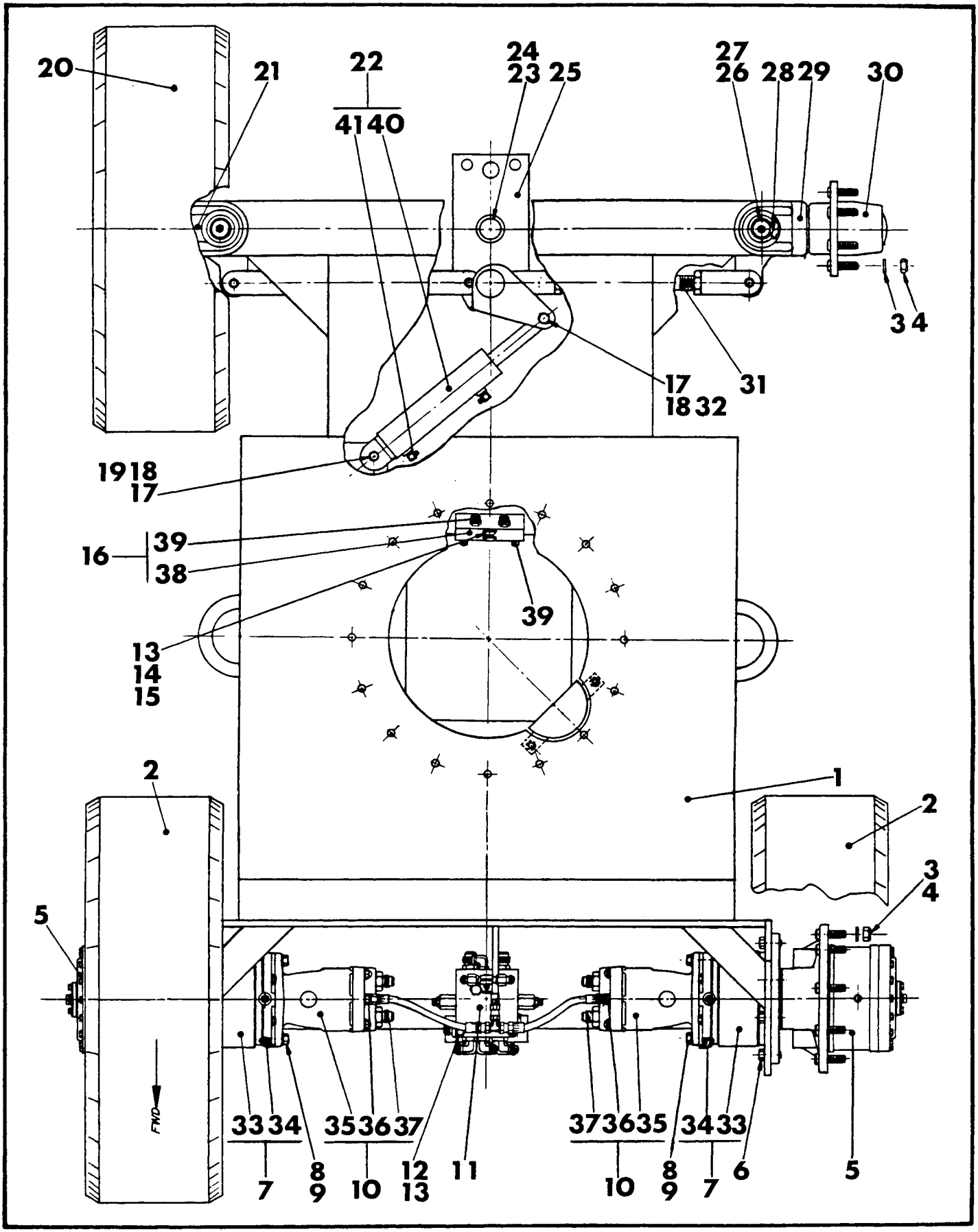


FIGURE 2.1 - CARRIAGE ASSEMBLY (30I)
(NOVEMBER 1983)

ITEM	PART NUMBER	DESCRIPTION	QTY
2-	20179	CARRIAGE ASSEMBLY	1
-1	20250	BASE WELDMENT	1
-2	20421	DRIVE TIRE ASSEMBLY	2
-3	63501	FLAT WASHER - 1/2 HEAVY DUTY	30
-4	61301	LOCK NUT - 1/2-20 UNF - BOWMAGRIP 36799	30
-5	20507	TORQUE HUB	2
-6	60606	HEX HEAD CAP SCREW - 5/8-11 UNC X 1 1/4 BOWMALOK 41031	12
-7	21668	BRAKE ASSEMBLY	2
-8	60348	HEX HEAD CAP SCREW - 1/2-13 UNC X 6	4
-9	63305	SPLIT LOCKWASHER - 1/2	4
-10	22507	MOTOR ASSEMBLY	2
-11	20912	DRIVE/BRAKE VALVE ASSEMBLY (SEE FIG. 7)	1
-12	60362	HEX HEAD CAP SCREW - 5/16-18 UNC X 3 1/2 (GR. 5)	2
-13	63302	SPLIT LOCKWASHER - 5/16	4
-14	60355	HEX HEAD CAP SCREW - 5/16-18 UNC X 2 1/2 (GR. 5)	2
-15	60708	HEX NUT - 5/16-18 UNC - CAD. PLATE	2
-16	22508	CHECK VALVE ASSEMBLY	1
-17	63301	SPLIT LOCKWASHER - 1/4	2
-18	60633	HEX HEAD CAP SCREW - 1/4-20 UNC X 1/2 BOWMALOK 41000	2
-19	20252	STEERING CYLINDER TO BASE PIN	1
-20	20399	STEERING TIRE ASSEMBLY	2
-21	20320	STEERING YOKE ASSEMBLY (R.H.) (SEE FIG. 4B)	1
-22	22506	STEERING CYLINDER ASSEMBLY	1
-23	20254	CENTER STEERING ARM PIN	1
-24	60603	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 BOWMALOK 41006	2
-25	20222	STEERING ARM WELDMENT	1
-26	20321	KING PIN	2
-27	20323	THRUST WASHER	2
-28	64206	ROLL PIN - 1/4 DIA. X 2 1/4	2

FIGURE 2.1 - CARRIAGE ASSEMBLY (30I)
(NOVEMBER 1983)

ITEM	PART NUMBER	DESCRIPTION	QTY
-29	20560	STEERING YOKE ASSEMBLY (L.H.) (SEE FIG. 4A)	1
-30	20510	STEERING HUB ASSEMBLY (SEE FIG. 4)	2
-31	20316	TIE ROD ASSEMBLY (SEE FIG. 5)	2
-32	20270	STEERING CYLINDER TO STEERING ARM PIN	1
-33	20354	BRAKE	1
-34	2532	STRAIGHT THREAD ELBOW	1
-35	20381	DRIVE MOTOR	1
-36	80001-10	MALE CONNECTOR	1
-37	80004-14	STRAIGHT THREAD CONNECTOR	2
-38	20351	CHECK VALVE	1
-39	80012-05	STRAIGHT THREAD ELBOW	4
-40	20206	STEERING CYLINDER (SEE FIG. 6)	1
-41	80012-03	STRAIGHT THREAD ELBOW	2

FIGURE 2A-CARRIAGE ASSEMBLY (32)

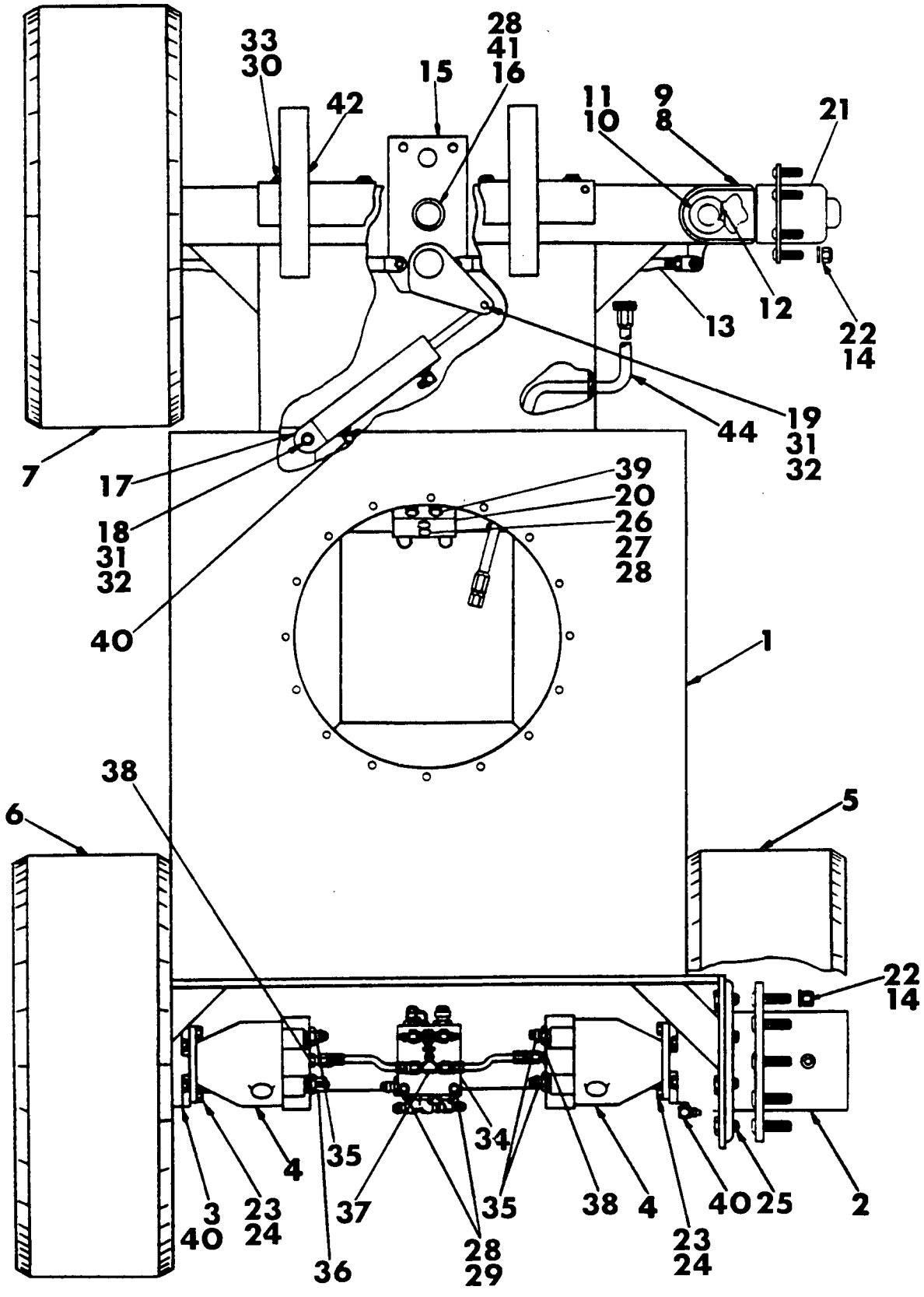


FIGURE 2A-CARRIAGE ASSEMBLY (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
2A-	20180	CARRIAGE ASSEMBLY	1
-1	20250	BASE WELDMENT	1
-2	20507	TORQUE HUB	2
-3	20354	BRAKE	2
-4	20381	MOTOR	2
-5	20397-1	DRIVE TIRE ASSEMBLY	1
-6	20397-2	DRIVE TIRE ASSEMBLY	1
-7	20399	STEERING TIRE ASSEMBLY	2
-8	20560	STEERING YOKE ASSEMBLY (L.H.) (SEE FIG. 4A)	1
-9	20320	STEERING YOKE ASSEMBLY (R.H.) (SEE FIG. 4B)	1
-10	20321	KING PIN	2
-11	20323	THRUST WASHER	2
-12	377	ROLL PIN	2
-13	20316	TIE ROD ASSEMBLY (SEE FIG. 5)	2
-14	63501	FLAT WASHER-1/2-BOWMAN 36715 HD	30
-15	20222	STEERING ARM ASSEMBLY (SEE FIG. 3)	1
-16	20254	PIN-STEERING ARM CENTER	1
-17	20206	STEERING CYLINDER (SEE FIG. 6)	1
-18	20252	PIN-STEERING CYLINDER TO BASE	1
-19	20270	PIN-STEERING CYLINDER TO STEERING ARM	1
-20	20351	CHECK VALVE	1
-21	20510	STEERING HUB ASSEMBLY (SEE FIG. 4)	2
-22	2924	LOCK NUT-1/2-20UNF BOWMAGRIP 36799	30
-23	60148	HEX HEAD CAPSCREW-1/2-13UNC X 6	4
-24	63305	SPLIT LOCKWASHER-1/2	4
-25	60606	CAPSCREW-5/8-11UNC X 1 1/4 BOWMALOK 41031-1	12
-26	60149	HEX HEAD CAPSCREW-5/16-18UNC X 2 1/2	2
-27	16103	HEX NUT-5/16-18UNC	2
-28	63303	SPLIT LOCKWASHER-5/16	6
-29	60362	HEX HEAD CAPSCREW-5/16-18UNC X 3 1/2	2
-30	63303	SPLIT LOCKWASHER-3/8	4

FIGURE 2A-CARRIAGE ASSEMBLY (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	60631	HEX HEAD CAPSCREW-1/4-20UNC X 5/8-BOWMALOK 41000-1	2
-32	63301	SPLIT LOCKWASHER-1/4	2
-33	60325	HEX HEAD CAPSCREW-3/8-16UNC X 3/4	4
-34	20912	DRIVE VALVE ASSEMBLY (SEE FIG. 7)	1
-35	50823	STRAIGHT THREAD CONNECTOR	3
-36	2577	STRAIGHT THREAD ELBOW	1
-37	2421	UNION TEE	1
-38	2478	MALE CONNECTOR	2
-39	2572	STRAIGHT THREAD ELBOW	4
-40	2532	STRAIGHT THREAD ELBOW	4
-41	60603	CAPSCREW-5/16-18UNC X 3/4 BOWMALOK 41006	2
-42	20843	LP TANK BRACKET	1
-43	2543	STRAIGHT THREAD CONNECTOR	1
-44		LP FUEL HOSE ASSEMBLY (REF) (SUPPLIED WITH KIT 20512)	1

FIGURE 2B - CARRIAGE ASSEMBLY (32)
(NOVEMBER 1983)

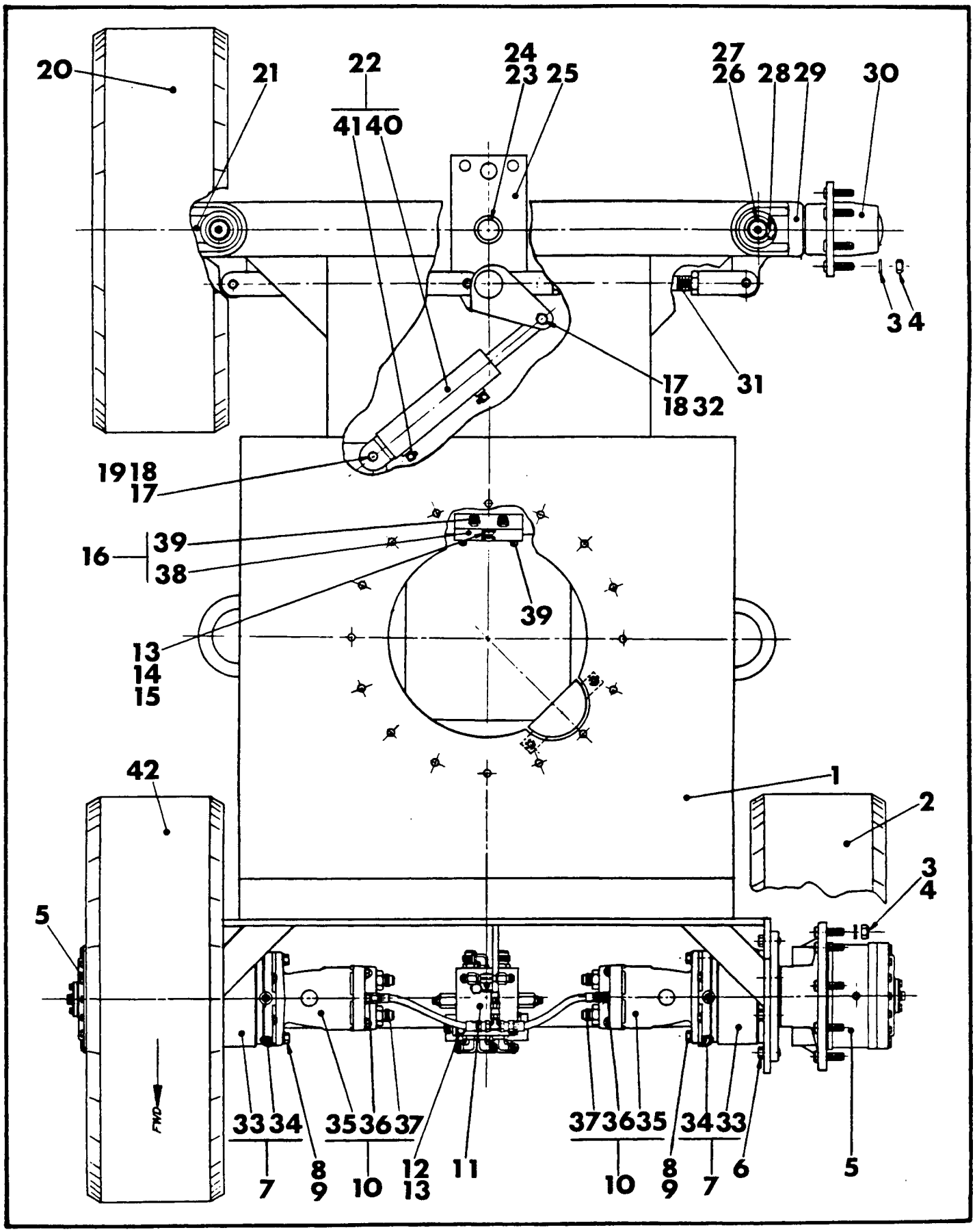


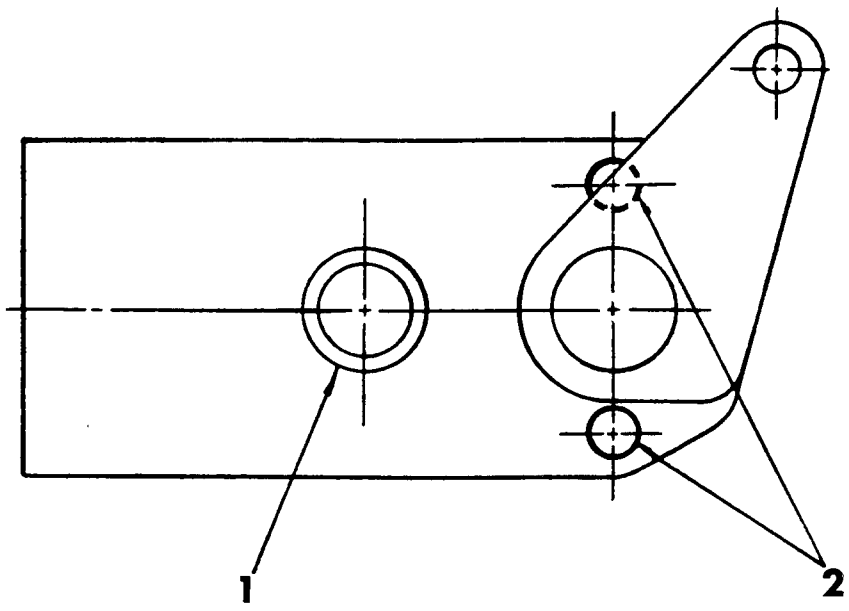
FIGURE 2B - CARRIAGE ASSEMBLY (32)
(NOVEMBER 1983)

ITEM	PART NUMBER	DESCRIPTION	QTY
2-	20180	CARRIAGE ASSEMBLY	1
-1	20250	BASE WELDMENT	1
-2	20715-1	DRIVE TIRE ASSEMBLY	1
-3	63501	FLAT WASHER - 1/2 HEAVY DUTY	30
-4	61301	LOCK NUT - 1/2-20 UNF - BOWMAGRIP 36799	30
-5	20507	TORQUE HUB	2
-6	60606	HEX HEAD CAP SCREW - 5/8-11 UNC X 1 1/4 BOWMALOK 41031	12
-7	21668	BRAKE ASSEMBLY	2
-8	60348	HEX HEAD CAP SCREW - 1/2-13 UNC X 6	4
-9	63305	SPLIT LOCKWASHER - 1/2	4
-10	22507	MOTOR ASSEMBLY	2
-11	20912	DRIVE/BRAKE VALVE ASSEMBLY (SEE FIG. 7)	1
-12	60362	HEX HEAD CAP SCREW - 5/16-18 UNC X 3 1/2 (GR. 5)	2
-13	63302	SPLIT LOCKWASHER - 5/16	4
-14	60355	HEX HEAD CAP SCREW - 5/16-18 UNC X 2 1/2 (GR. 5)	2
-15	60708	HEX NUT - 5/16-18 UNC - CAD. PLATE	2
-16	22508	CHECK VALVE ASSEMBLY	1
-17	63301	SPLIT LOCKWASHER - 1/4	2
-18	60633	HEX HEAD CAP SCREW - 1/4-20 UNC X 1/2 BOWMALOK 41000	2
-19	20252	STEERING CYLINDER TO BASE PIN	1
-20	20399	STEERING TIRE ASSEMBLY	2
-21	20714	STEERING YOKE ASSEMBLY (R.H.) (SEE FIG. 4B)	1
-22	22506	STEERING CYLINDER ASSEMBLY	1
-23	20254	CENTER STEERING ARM PIN	1
-24	60603	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 BOWMALOK 41006	2
-25	20222	STEERING ARM WELDMENT	1
-26	20321	KING PIN	2
-27	20323	THRUST WASHER	2
-28	64206	ROLL PIN - 1/4 DIA. X 2 1/4	2

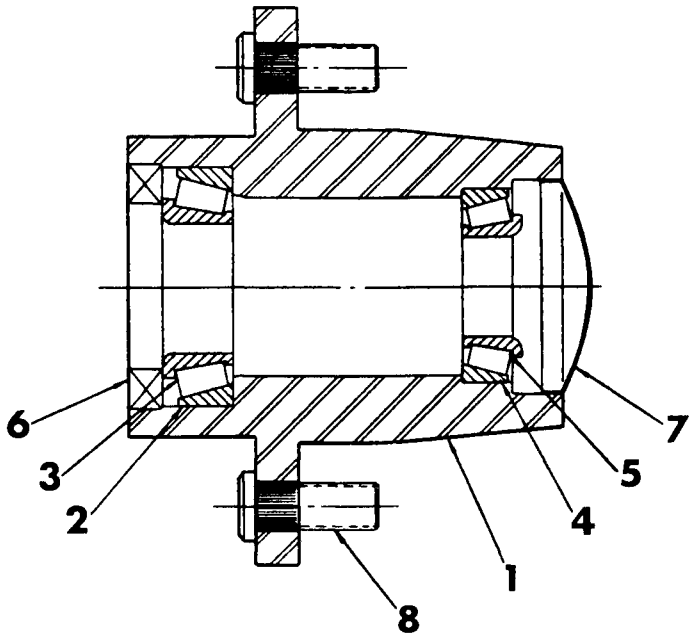
FIGURE 2B - CARRIAGE ASSEMBLY (32)
(NOVEMBER 1983)

ITEM	PART NUMBER	DESCRIPTION	QTY
-29	20560	STEERING YOKE ASSEMBLY (L.H.) (SEE FIG. 4A)	1
-30	20510	STEERING HUB ASSEMBLY (SEE FIG. 4)	2
-31	20316	TIE ROD ASSEMBLY (SEE FIG. 5)	2
-32	20270	STEERING CYLINDER TO STEERING ARM PIN	1
-33	20354	BRAKE	1
-34	2532	STRAIGHT THREAD ELBOW	1
-35	20381	DRIVE MOTOR	1
-36	80001-10	MALE CONNECTOR	1
-37	80004-14	STRAIGHT THREAD CONNECTOR	2
-38	20351	CHECK VALVE	1
-39	80012-05	STRAIGHT THREAD ELBOW	4
-40	20206	STEERING CYLINDER (SEE FIG. 6)	1
-41	80012-03	STRAIGHT THREAD ELBOW	2
-42	20715-2	DRIVE TIRE ASSEMBLY	1

FIGURE 3-STEERING ARM ASSEMBLY (30I) (32)

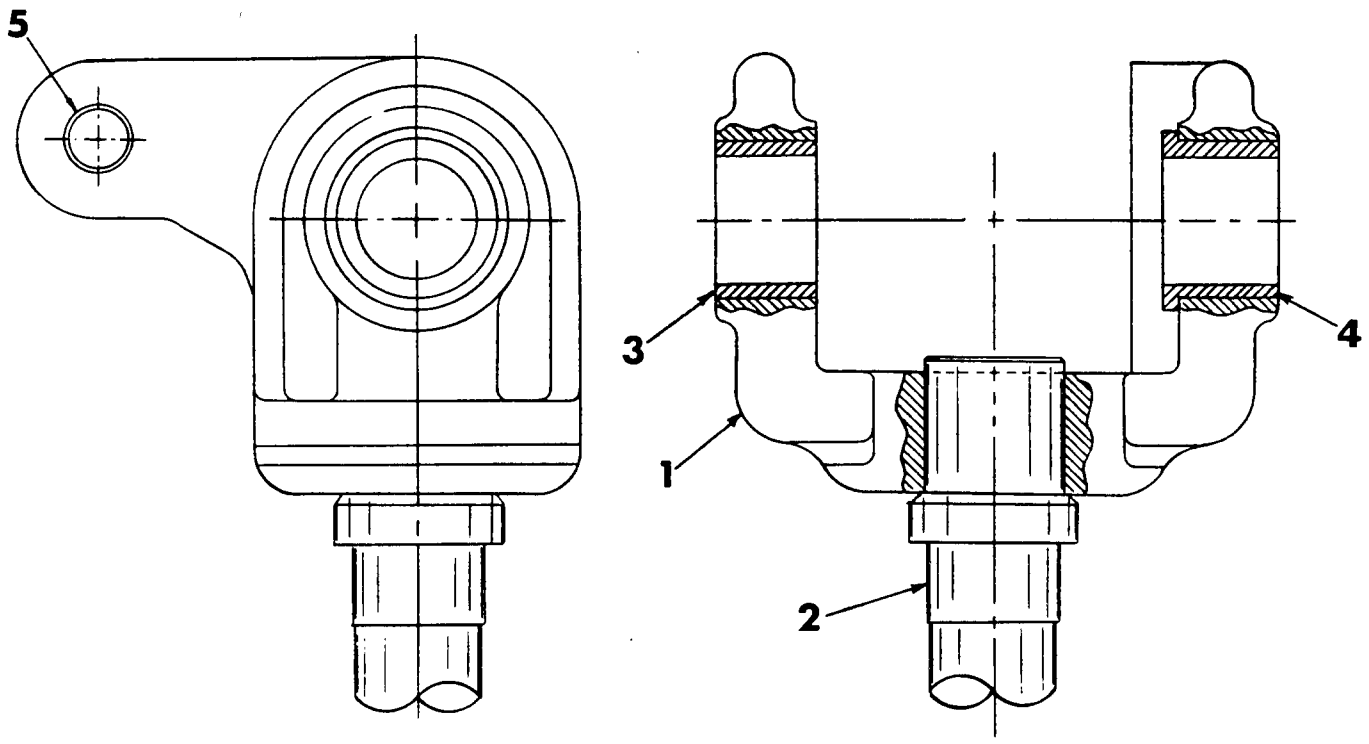


ITEM	PART NUMBER	DESCRIPTION	QTY
3-	20222	STEERING ARM ASSEMBLY	1
-1	64901	BUSHING	1
-2	64903	BUSHING	2



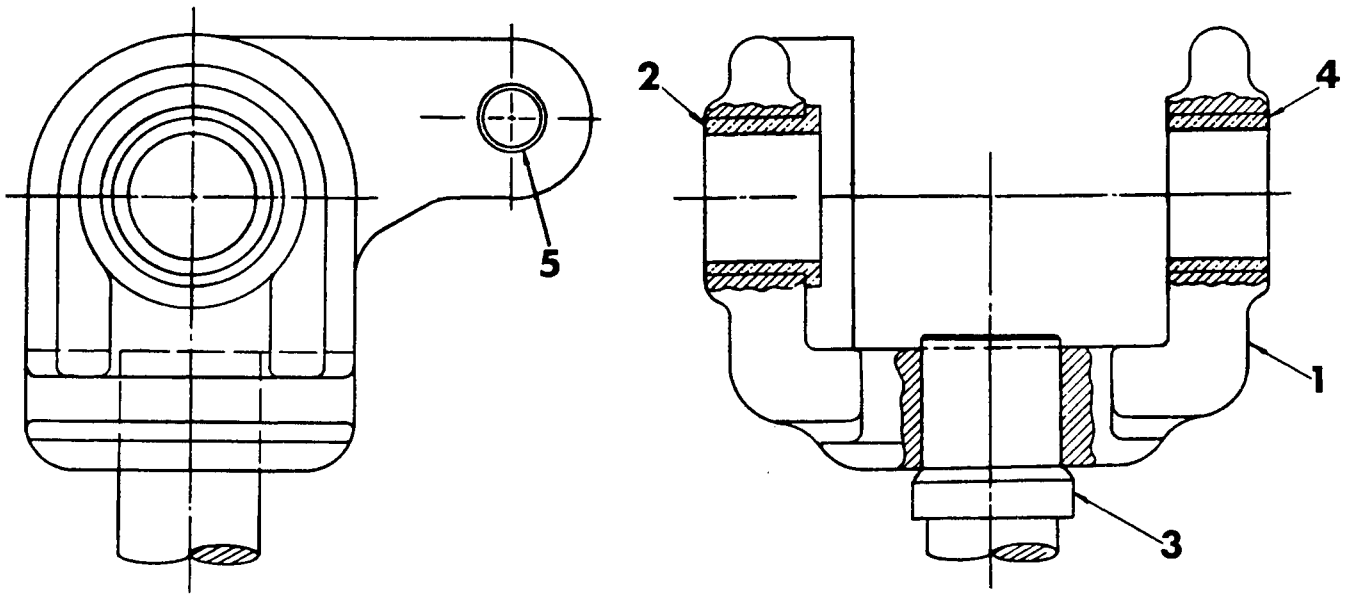
ITEM	PART NUMBER	DESCRIPTION	QTY
4-	20510	STEERING HUB ASSEMBLY	1
-1	20905	MACHINED HUB	1
-2	65054	INNER CUP	1
-3	65052	INNER CONE	1
-4	65053	OUTER CUP	1
-5	65051	OUTER CONE	1
-6	65102	GREASE SEAL	1
-7	65101	DUST CAP	1
-8	65105	STUD 1/2-20 X 1 1/2 HADCO 3071	6

FIGURE 4A - STEERING YOKE ASSEMBLY (L.H.) (30I) (32)



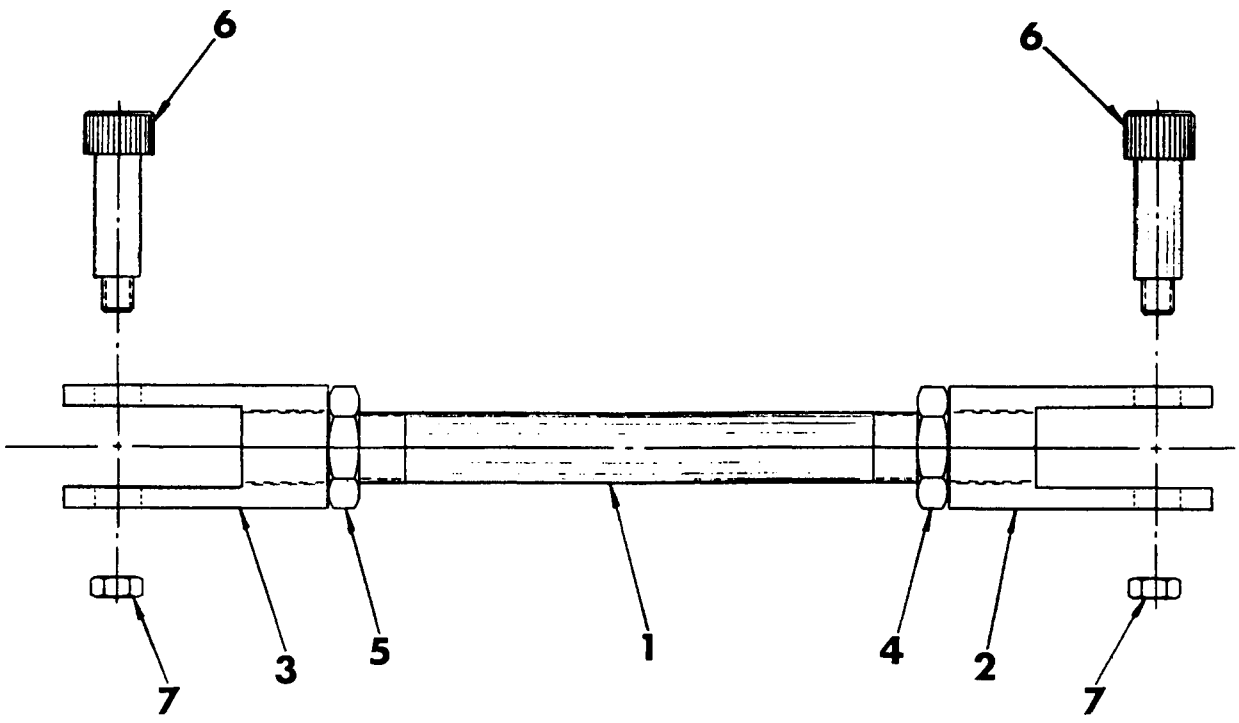
ITEM	PART NUMBER	DESCRIPTION	QTY
4A-	20560	STEERING YOKE ASSEMBLY	1
-1	20559	YOKE CASTING	1
-2	20511	SPINDLE ASSEMBLY	1
-3	20322	BUSHING	1
-4	30242	FLANGED BUSHING	1
-5	20932	BUSHING	1

FIGURE 4B - STEERING YOKE ASSEMBLY (R.H.) (30I) (32)



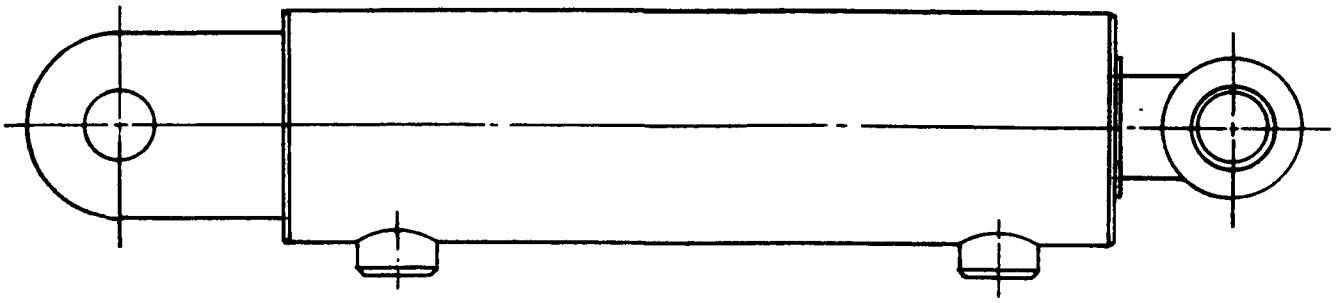
ITEM	PART NUMBER	DESCRIPTION	QTY
48-	20320	STEERING YOKE ASSEMBLY	1
-1	20319	YOKE CASTING	1
-2	30242	FLANGED BUSHING	1
-3	20511	SPINDLE ASSEMBLY	1
-4	20322	BUSHING	1
-5	20932	BUSHING	1

FIGURE 5-STEERING TIE ROD ASSEMBLY (30I) (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
5-	20316	STEERING TIE ROD ASSEMBLY	1
-1	20579	ROD	1
-2	20578-1	YOKE (R.H.)	1
-3	20578-2	YOKE (L.H.)	1
-4	60902	JAM NUT-1-14UNS (R.H.) THREAD	1
-5	60903	JAM NUT-1-14UNS (L.H.) THREAD	1
-6	62103	SHOULDER BOLT-3/4 DIA. X 2 HEX SOCKET HEAD-5/8-11UNC (GRADE 5)	2
-7	60706	HEX NUT-5/8-11UNC	2

FIGURE 6-STEERING CYLINDER (30I) (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
6-	20206	STEERING CYLINDER	1
-1	20125	SEAL KIT	1

FIGURE 7 - DRIVE/BRAKE VALVE ASSEMBLY (30I) (32)

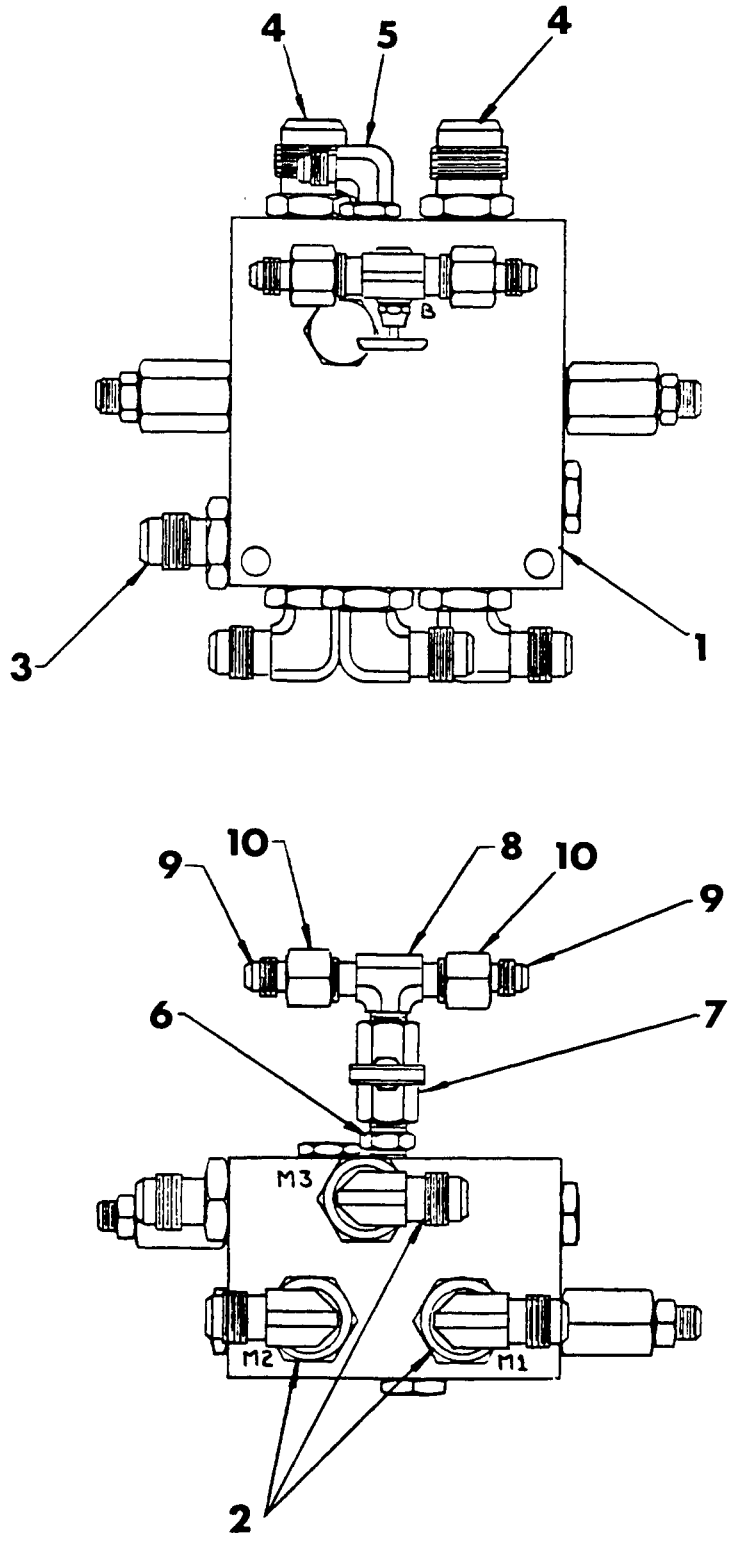
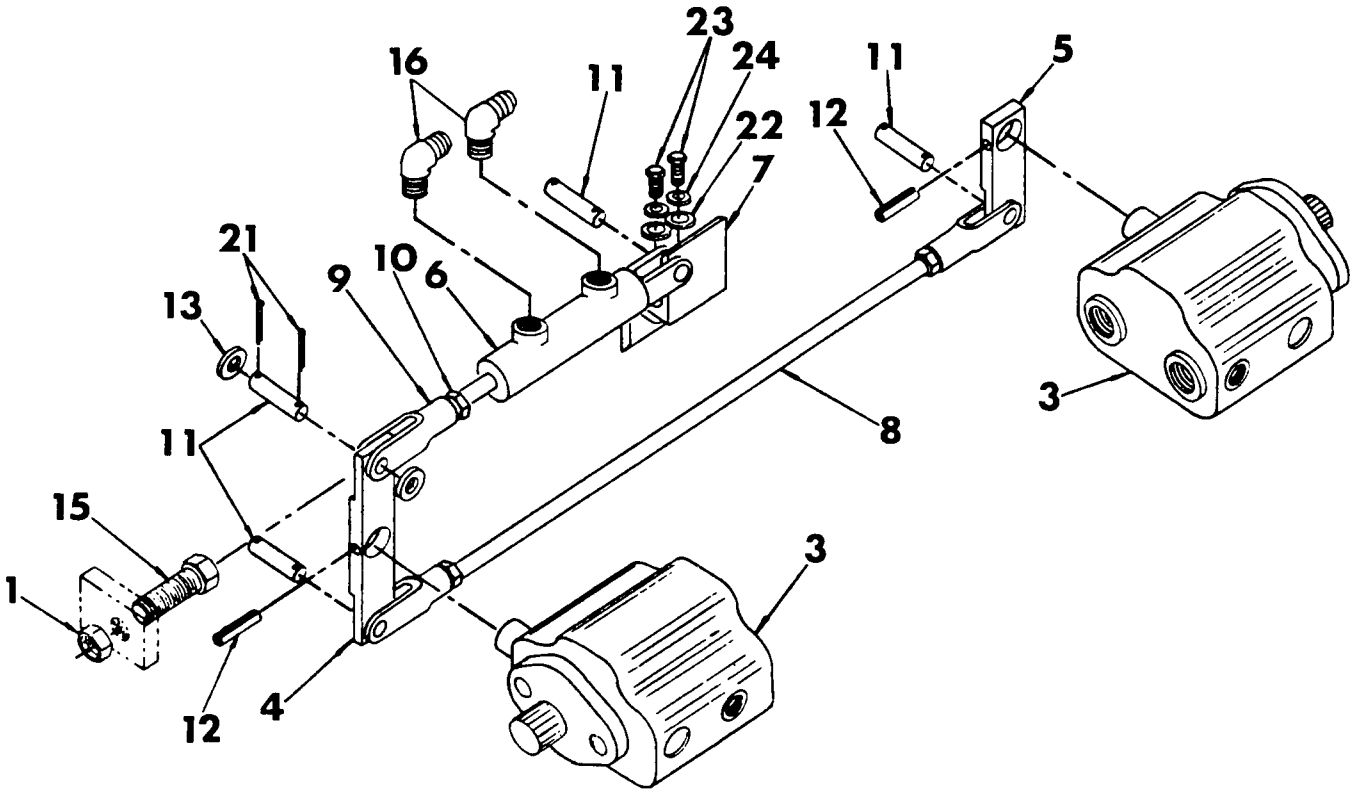
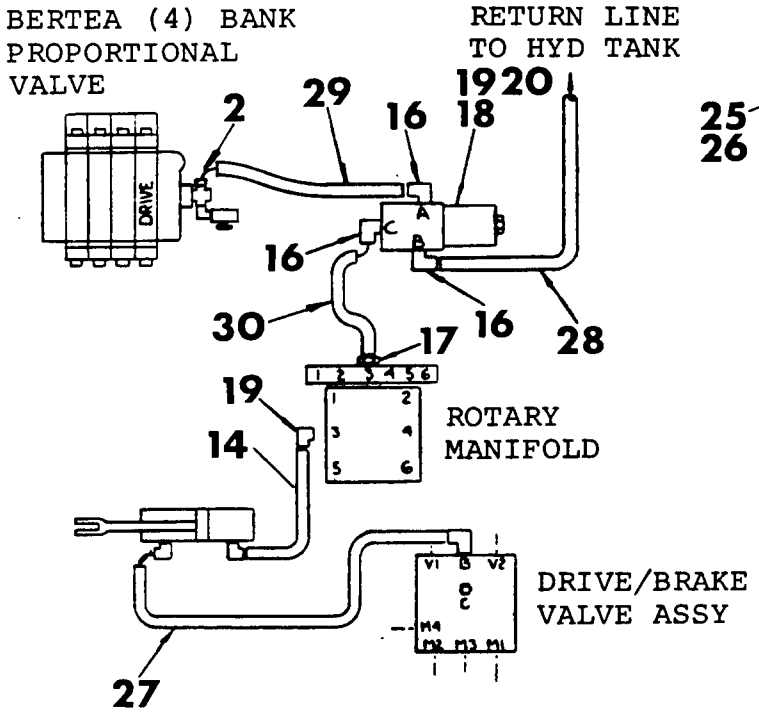


FIGURE 7 - DRIVE/BRAKE VALVE ASSEMBLY (30I) (32)

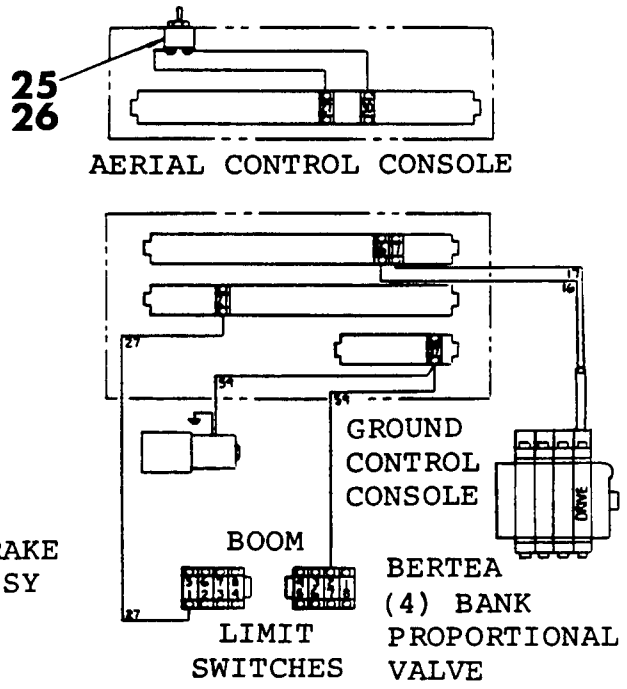
ITEM	PART NUMBER	DESCRIPTION	QTY
7-	20912	DRIVE/BRAKE VALVE ASSEMBLY	1
-1	21214	VALVE	1
-2	2523 (80012-11)	STRAIGHT THREAD ELBOW	3
-3	2542 (80004-11)	STRAIGHT THREAD CONNECTOR	1
-4	2544 (80004-19)	STRAIGHT THREAD CONNECTOR	2
-5	2532 (80012-03)	STRAIGHT THREAD ELBOW	1
-6	2475 (80052-04)	PIPE NIPPLE	1
-7	20357	NEEDLE VALVE (FOR BRAKE ADJUSTMENT)	1
-8	2490 (80034-08)	MALE BRANCH TEE	1
-9	2496 (80056-01)	TUBE END REDUCER	2
-10	80060-05	HEX NUT	2

FIGURE 8 - 2-SPEED DRIVE (OPTION) (30I) (32)





HYDRAULIC DIAGRAM

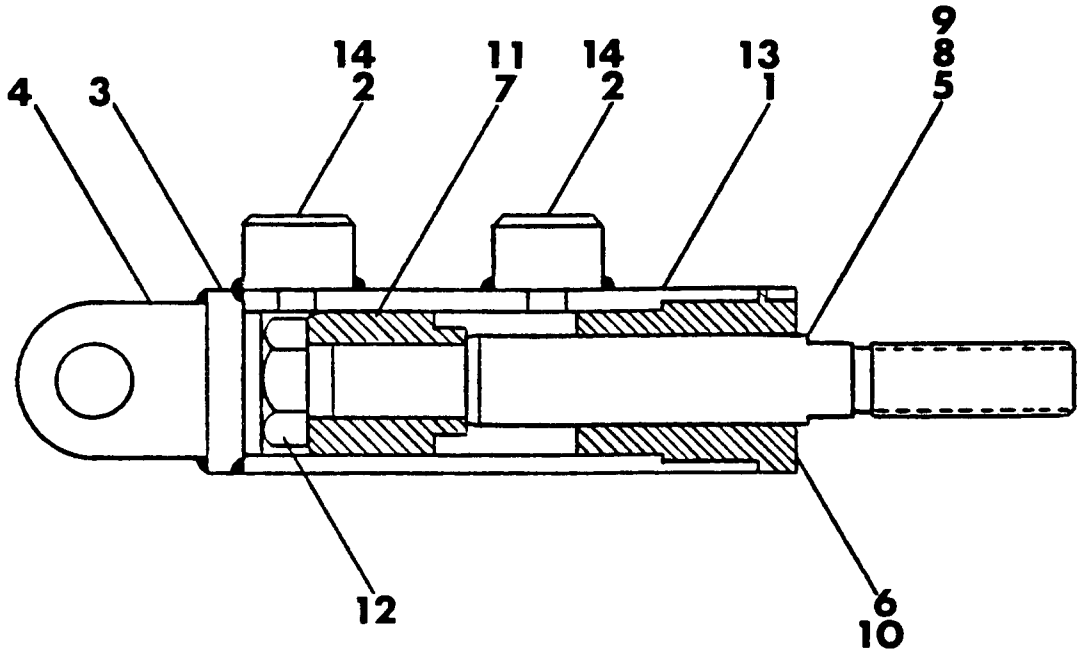


ELECTRICAL DIAGRAM

FIGURE 8 - 2-SPEED DRIVE (OPTION) (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
8-	20118	2-SPEED DRIVE	1
-1	60705	HEX NUT-1/2-13UNC	1
-2	2496	TUBE END REDUCER	1
-3	20800	VARIABLE MOTOR	2
-4	20737	BELL CRANK	1
-5	20738	LEVER ACTUATOR	1
-6	20719	2-SPEED SHIFT CYLINDER (SEE FIG. 8A)	1
-7	20814	CYLINDER MOUNTING BRACKET	1
-8	20583	TIE ROD ASSEMBLY	1
-9	20789	CLEVIS	1
-10	60901	JAM NUT-1/2-20UNF	1
-11	20795	CLEVIS PIN	4
-12	64201	ROLL PIN-3/8 DIA. X 2	2
-13	63405	FLAT WASHER-1/2	8
-14	*13210-04-0350	HOSE ASSEMBLY (REF)	1
-15	60375	HEX HEAD CAPSCREW-1/2-13UNC X 3	1
-16	2523	STRAIGHT THREAD ELBOW	6
-17	2581	STRAIGHT THREAD CONNECTOR	1
-18	20844	3 WAY SOLENOID VALVE	1
-19	25134	ROUND TUBING-3/8 O.D. X .065 WALL X 1/2	2
-20	60329	HEX HEAD CAPSCREW-5/16-18UNC X 2	2
-21	64301	COTTER PIN-1/8	8
-22	2835	FLAT WASHER-3/8	2
-23	60343	HEX HEAD CAPSCREW-3/8-16UNC X 1	2
-24	63303	LOCKWASHER-3/8	2
-25	4017	SWITCH	1
-26	20546	DECAL-"DRIVE HI-LOW"	1
-27	*13213-04-0120	HOSE ASSEMBLY (REF)	1
-28	*13210-04-0640	HOSE ASSEMBLY (REF)	1
-29	*13213-04-0350	HOSE ASSEMBLY (REF)	1
-30	*13213-04-0400	HOSE ASSEMBLY (REF)	1
		* PART OF 20917 HOSE KIT	

FIGURE 8A- 2-SPEED SHIFT CYLINDER (OPTION) (30I) (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
8A-	20719	2-SPEED SHIFT CYLINDER (SE)	1
-1		BARREL - SE00719	1
-2		PORT - 9885	2
-3		BASE - 16001	1
-4		CLEVIS EAR - 15155	2
-5		ROD - SE00719R	1
-6		TEE HEAD - 13110	1
-7		"U" PISTON - 14207	1
-8		ROD WIPER - 10605	1
-9		ROD SEAL - 10051	1
-10		HEAD SEAL - 10151	1
-11		PISTON SEAL - 10436	1
-12		HEX NUT - 11015	1
-13		MARK NAMEPLATE - 9303	1
-14		PORT PLUG - 9810	2
-15	66041	SEAL KIT - 25303	1

FIGURE 9 - TURRET ASSEMBLY (30I)

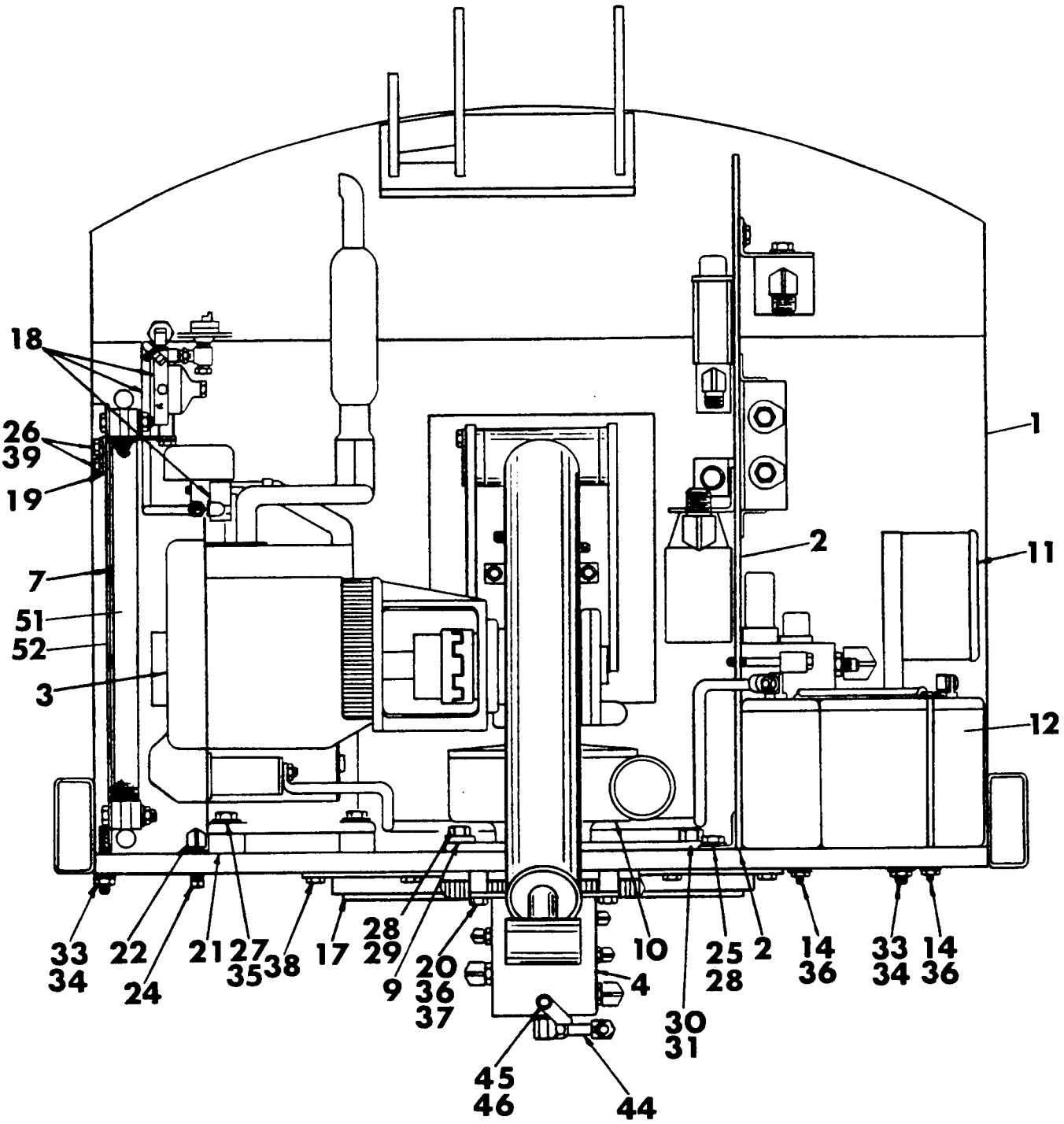


FIGURE 9 - TURRET ASSEMBLY (30I)

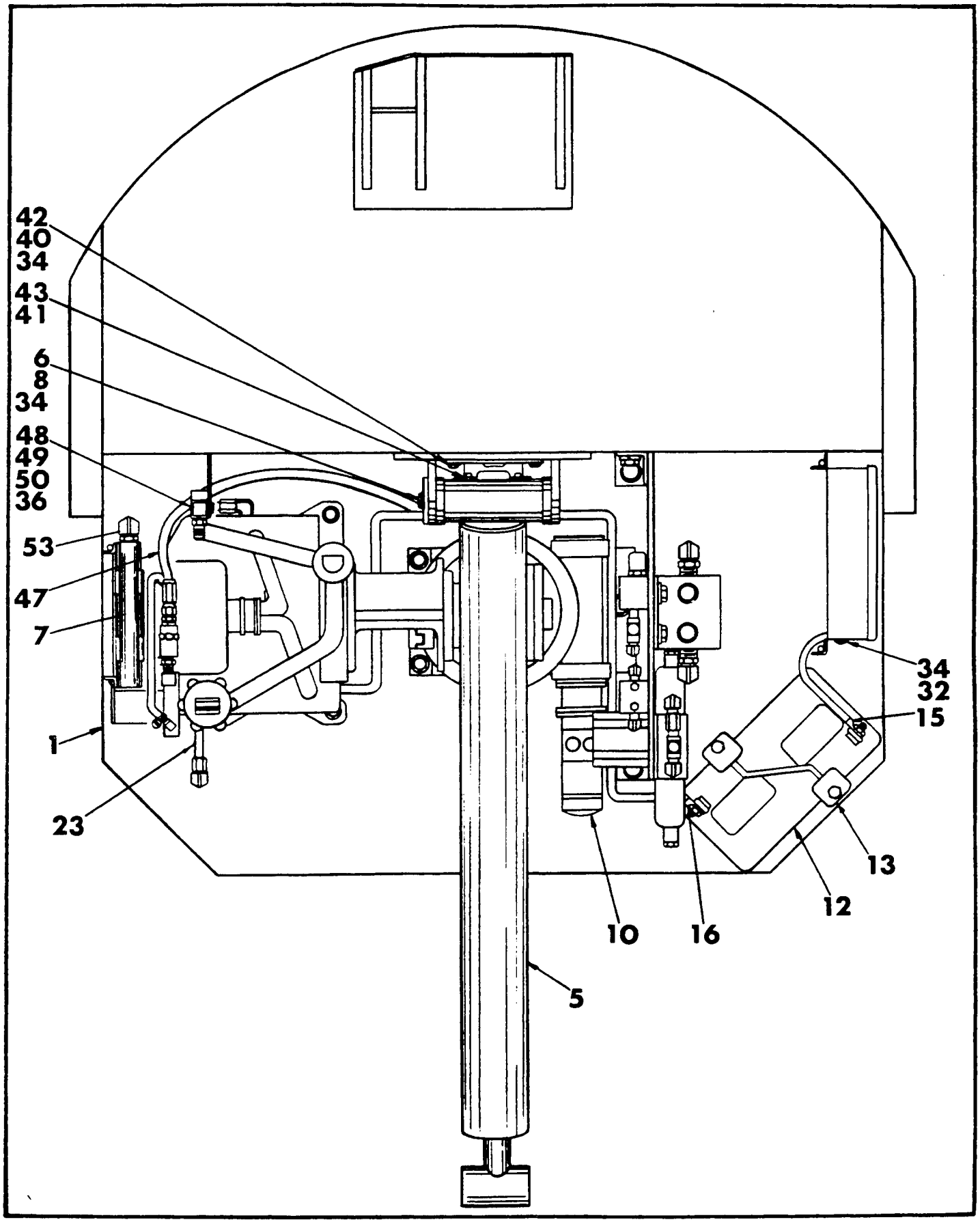


FIGURE 9 - TURRET ASSEMBLY (30I)

ITEM	PART NUMBER	DESCRIPTION	QTY
9-	20176	TURRET ASSEMBLY	1
-1	20232	TURRET WELDMENT	1
-2	20151	TURRET VALVE PLATE ASSEMBLY (SEE FIG. 9B)	1
-3	20314	ENGINE AND PUMP ASSEMBLY (SEE FIG. 10)	1
-4	20239 OR 21899	ROTARY MANIFOLD ASSEMBLY (SEE FIG. 23 OR 23A)	1
-5	21705	LIFT CYLINDER ASSEMBLY (SEE FIG. 11)	1
-6	20255	LIFT CYLINDER PIN	1
-7	20313	OIL COOLER ASSEMBLY	1
-8	60607	HEX HEAD CAPSCREW-3/8-16UNC X 3/4 BOWMALOK 41012	1
-9	20209	SPACER PLATE	1
-10	20490	ROTATION SPEED REDUCER ASSEMBLY (SEE FIG. 14)	1
-11	21813	GROUND CONTROL BOX ASSEMBLY (SEE FIG. 15)	1
-12	4030	BATTERY	1
-13	20375	HOLD DOWN BRACKET	1
-14	2653	HOLD DOWN BOLT	2
-15	20448	GROUND CABLE	1
-16	20447	POSITIVE CABLE	1
-17	20353	RING GEAR	1
-18	20512	DUAL FUEL KIT (SEE FIG. 17)	1
-19	20401	REGULATOR MOUNTING BRACKET	1
-20	20445	MANIFOLD SPACER	4
-21	20242	ENGINE MOUNT	4
-22	2456	MALE ELBOW	1
-23	20611	TUBE ASSEMBLY-3/8	1
-24	53901	PLUG	1
-25	60319	HEX HEAD CAPSCREW-1/4-20UNC X 1 3/4	3
-26	63301	SPLIT LOCKWASHER-1/4	7
-27	60602	HEX HEAD CAPSCREW-1/2-13UNC X 1 1/2-BOWMALOK 41026	4
-28	63305	SPLIT LOCKWASHER-1/2	5
-29	60609	HEX HEAD CAPSCREW-1/2-13UNC X 2-BOWMALOK 41028	2

FIGURE 9 - TURRET ASSEMBLY (30I)

ITEM		PART NUMBER	DESCRIPTION	QTY
-30		60601	HEX HEAD CAPSCREW-3/4-10UNC X 1 1/2-BOWMAN 41039	1
-31		63307	SPLIT LOCKWASHER-3/4	1
-32		60325	HEX HEAD CAPSCREW-3/8-16UNC X 3/4	1
-33		60703	HEX NUT-3/8-16UNC	4
-34		63303	SPLIT LOCKWASHER-3/8	10
-35		63415	FLAT WASHER-1/2-BOWMALLOY 36705	4
-36		63302	SPLIT LOCKWASHER-5/16	8
-37		60330	HEX HEAD CAPSCREW-5/18-18UNC X 2 3/4	4
-38		60606	5/8-11UNC X 1 1/4-BOWMALOK 41031-1	10
-39		60342	HEX HEAD CAPSCREW-1/4-20UNC X 5/8	2
-40		60320	HEX HEAD CAPSCREW-3/8-16UNC X 1/2	4
-41		2476	MALE CONNECTOR	2
-42		20334	PUMP MOUNTING BRACKET	1
-43		20384	PUMP/MOTOR	1
-44		20238	LP SWIVEL JOINT ASSEMBLY	1
-45		60612	HEX HEAD CAPSCREW (NEAR SIDE) 3/8-16UNC X 1 1/2 BOWMALOK 41015	1
-46		60613	HEX HEAD CAPSCREW (FAR SIDE) 3/8-16UNC X 1 BOWMALOK 41013	1
-47		20624	LP GAS HOSE	1
-48		20364	HYDRAULIC THROTTLE	1
-49		50843	STRAIGHT THREAD MALE CONNECTOR	1
-50		60404	HEX HEAD CAPSCREW-5/16-24UNF X 1	2
-51	*	20377	OIL COOLER	1
-52	*	20213	MOUNTING BRACKET	1
-53	*	2409	MALE ELBOW	2

* PART OF ITEM 7 20313 OIL COOLER ASSEMBLY

FIGURE 9A-TURRET ASSEMBLY (32)

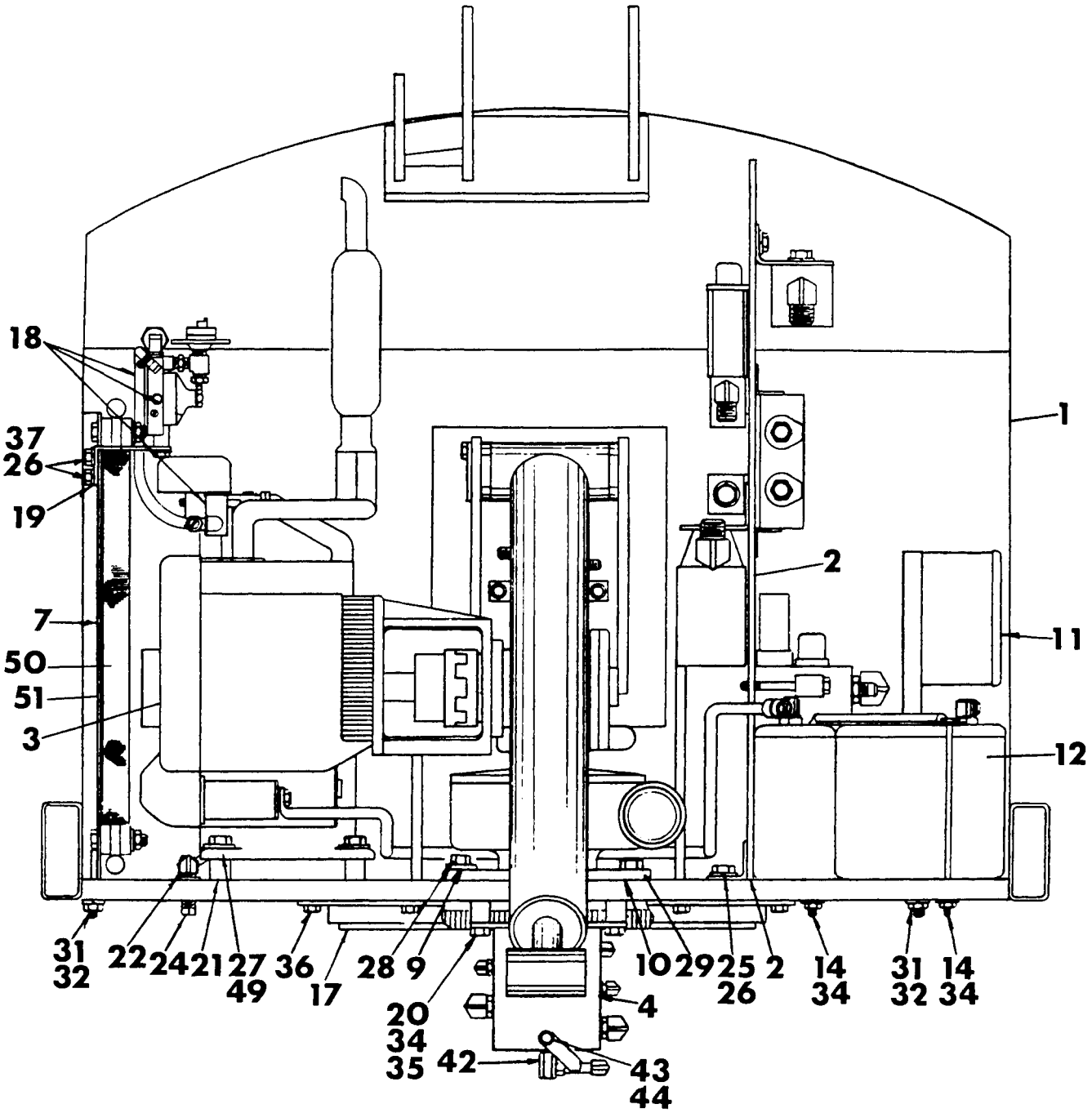


FIGURE 9A-TURRET ASSEMBLY (32)

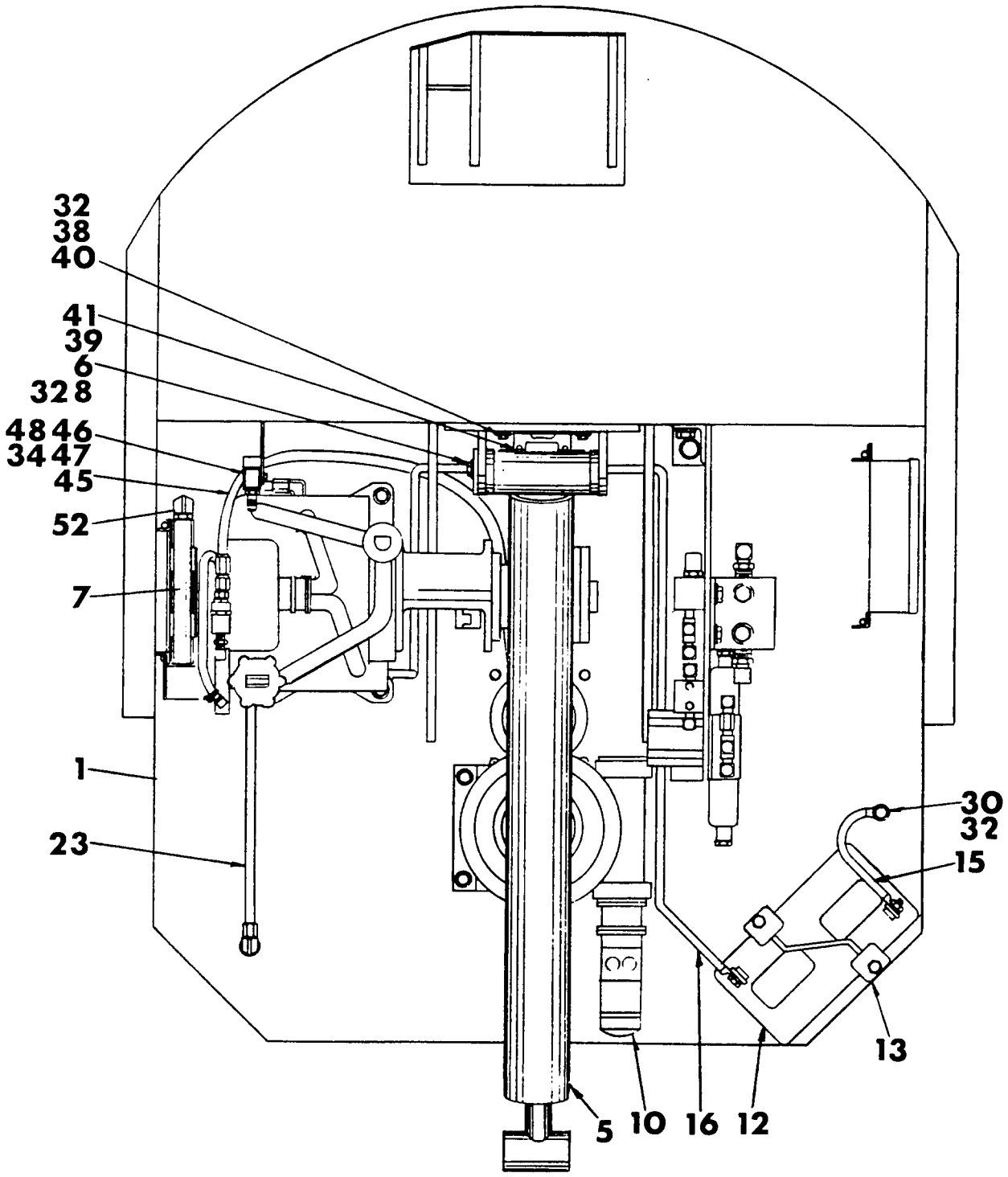


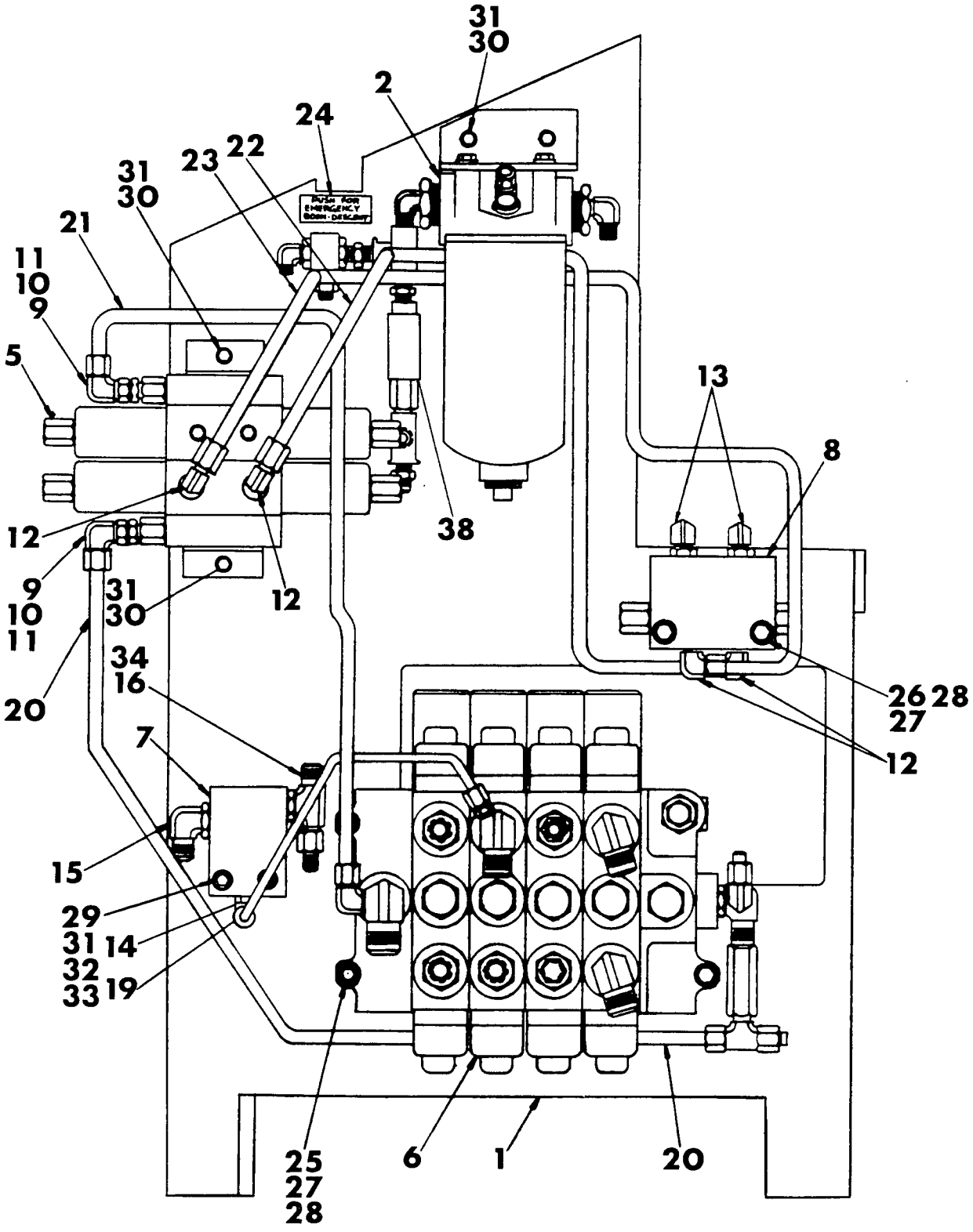
FIGURE 9A - TURRET ASSEMBLY (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
9A-	20177	TURRET ASSEMBLY	1
-1	20231	TURRET WELDMENT	1
-2	20151	TURRET VALVE PLATE ASSEMBLY (SEE FIG. 9B)	1
-3	20314	ENGINE AND PUMP ASSEMBLY (SEE FIG. 10)	1
-4	20239 OR 21899	ROTARY MANIFOLD ASSEMBLY (SEE FIG. 23 OR 23A)	1
-5	21705	LIFT CYLINDER ASSEMBLY (SEE FIG. 11)	1
-6	20255	LIFT CYLINDER PIN	1
-7	20313	OIL COOLER ASSEMBLY	1
-8	60607	HEX HEAD CAPSCREW-3/8-16UNC X 3/4-BOWMALOK 41012	1
-9	20209	SPACER PLATE	1
-10	20490	ROTATION SPEED REDUCER ASSEMBLY (SEE FIG. 14)	1
-11	21813	GROUND CONTROL BOX ASSEMBLY (SEE FIG. 15)	1
-12	4030	BATTERY	1
-13	20375	HOLD DOWN BRACKET	1
-14	2653	HOLD DOWN BOLT	2
-15	20448	GROUND CABLE	1
-16	20447	POSITIVE CABLE	1
-17	20353	RING GEAR	1
-18	20512	DUAL FUEL KIT (SEE FIG. 17)	1
-19	20401	REGULATOR MOUNTING BRACKET	1
-20	20445	MANIFOLD SPACER	4
-21	20242	ENGINE MOUNT	4
-22	2456	MALE ELBOW	1
-23	20611	TUBE ASSEMBLY - 3/8	1
-24	53901	PLUG	1
-25	60319	HEX HEAD CAPSCREW-1/4-20UNC X 1 3/4	3
-26	63301	SPLIT LOCKWASHER - 1/4	7
-27	60602	HEX HEAD CAPSCREW-1/2-12UNC X 1 1/2-BOWMALOK 41026	4

ITEM	PART NUMBER	DESCRIPTION	QTY
-28	60609	HEX HEAD CAPSCREW-1/2-13UNC X 2-BOWMALOK 41028	2
-29	60601	HEX HEAD CAPSCREW-3/4-10UNC X 1 1/2-BOWMAN 41039	1
-30	60325	HEX HEAD CAPSCREW-3/8-16UNC X 3/4	1
-31	60703	HEX NUT-3/8-16UNC	4
-32	63303	SPLIT LOCKWASHER - 3/8	10
-33	63415	FLAT WASHER-1/2 - BOWMALLOY 36705	3
-34	63302	SPLIT LOCKWASHER - 5/16	9
-35	60330	HEX HEAD CAPSCREW-5/18-UNC X 2 3/4	4
-36	60606	HEX HEAD CAPSCREW-5/8-11UNC X 1 1/4-BOWMALOK 41031-1	10
-37	60342	HEX HEAD CAPSCREW-1/4-20UNC X 5/8	2
-38	60320	HEX HEAD CAPSCREW-3/8-16UNC X 1/2	4
-39	2476	MALE CONNECTOR	2
-40	20334	PUMP MOUNTING BRACKET	1
-41	20384	PUMP/MOTOR	1
-42	20238	LP SWIVEL JOINT ASSEMBLY	1
-43	60612	HEX HEAD CAPSCREW (NEAR SIDE) 3/8-16UNC X 1 1/2 BOWMALOK 41015	1
-44	60613	HEX HEAD CAPSCREW (FAR SIDE) 3/8-16UNC X L BOWMALOK 41013	1
-45	20624	LP GAS HOSE	1
-46	20364	HYDRAULIC THROTTLE	1
-47	50843 (80004-4)	STRAIGHT THREAD MALE CONNECTOR	1
-48	60404	HEX HEAD CAPSCREW-5/16-24UNF X 1	1
-49	63415	FLAT WASHER-1/2- BOWMALLOY 36705	4
-50 *	20377	OIL COOLER	1
-51 *	20213	MOUNTING BRACKET	1
-52 *	2409	MALE ELBOW	2

* PART OF ITEM 7 20313 OIL COOLER ASSEMBLY

FIGURE 9B-TURRET VALVE PLATE ASSEMBLY (30I) (32)



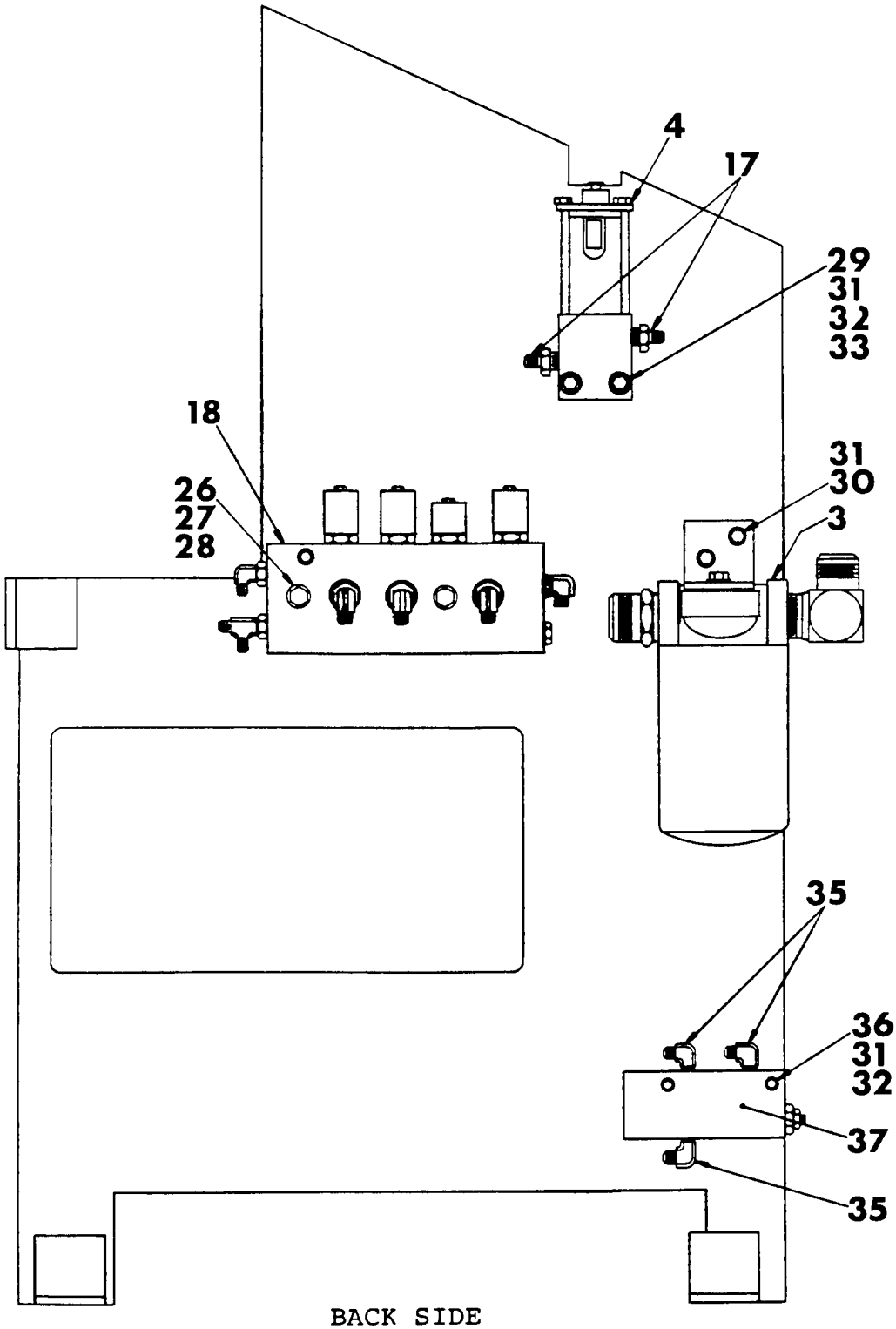
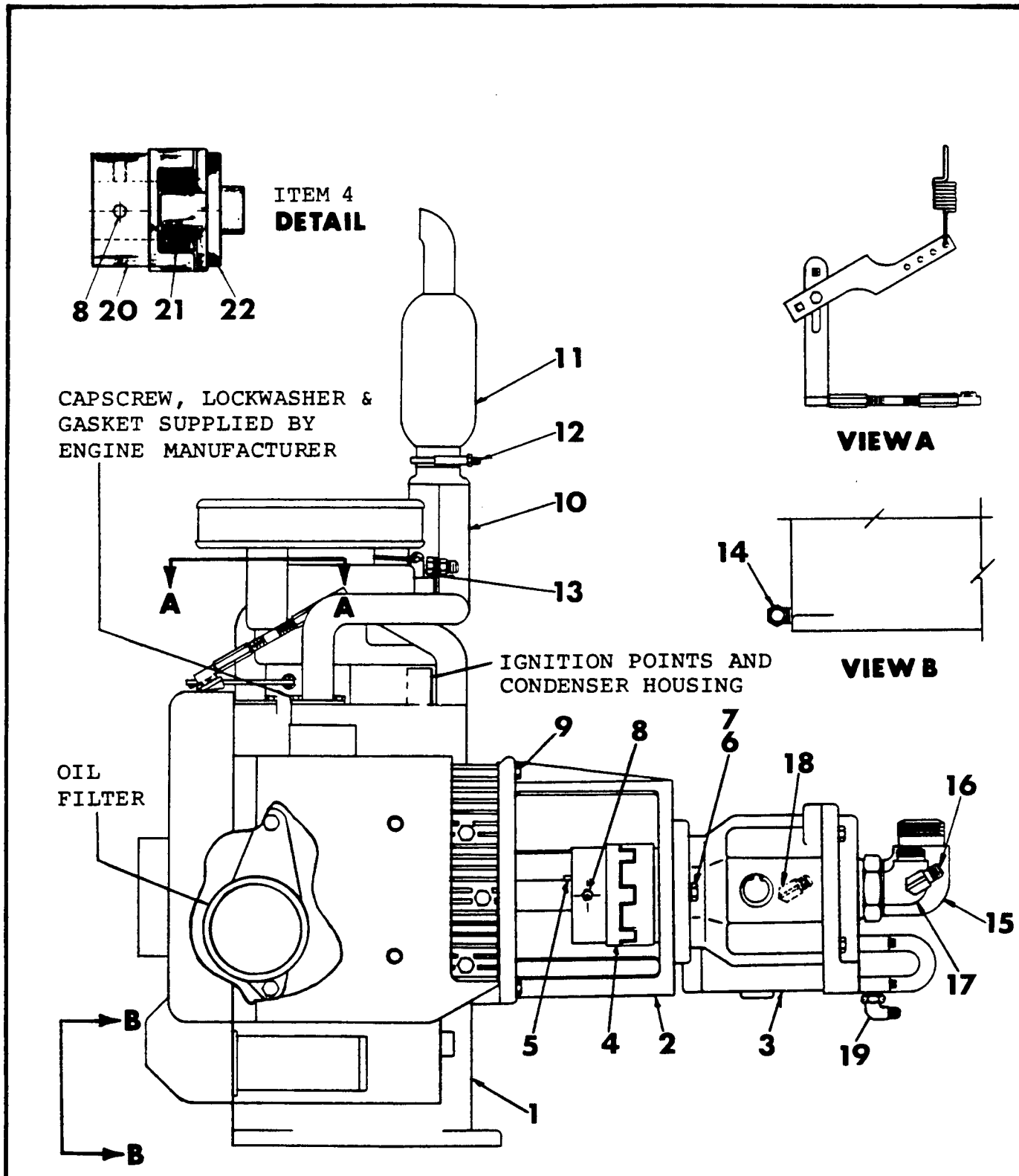

4
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32
37
35
BACK SIDE

FIGURE 9B-TURRET VALVE PLATE ASSEMBLY (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
9B-	20151	TURRET VALVE PLATE ASSEMBLY	1
-1	20318	VALVE MOUNTING PLATE	1
-2	20593	FILTER ASSEMBLY-LOW PRESSURE (SEE FIG. 19)	1
-3	20594	FILTER ASSEMBLY-RETURN LINE (SEE FIG. 19A)	1
-4	20376	SOLENOID VALVE	1
-5	21207	SOLENOID VALVE BANK	1
-6	20427	PROPORTIONAL VALVE ASSEMBLY (SEE FIG. 16)	1
-7	20391	CHECK VALVE	1
-8	20365	OVER CENTER VALVE	1
-9	2476	MALE CONNECTOR	2
-10	2498	O-RING BOSS ADAPTER	4
-11	2538	SWIVEL NUT ELBOW	2
-12	2447	STRAIGHT THREAD ELBOW	6
-13	2575	STRAIGHT THREAD ELBOW	2
-14	2532	STRAIGHT THREAD ELBOW	3
-15	2523	STRAIGHT THREAD ELBOW	1
-16	2546	STRAIGHT THREAD BRANCH TEE	1
-17	2435	MALE CONNECTOR	2
-18	21692	SOLENOID VALVE ASSEMBLY (SEE FIG. 18)	1
-19	20610	TUBE ASSEMBLY - 1/4	1
-20	20611	TUBE ASSEMBLY - 3/8	1
-21	20612	TUBE ASSEMBLY - 3/8	1
-22	20613	TUBE ASSEMBLY - 3/8	1
-23	20614	TUBE ASSEMBLY - 3/8	1
-24	20414	DECAL - EMERGENCY DESCENT	1
-25	60108	HEX HEAD CAPSCREW-5/16-18UNC X 4 1/2	3
-26	60151	HEX HEAD CAPSCREW-5/16-18UNC X 3	4
-27	63302	SPLIT LOCKWASHER - 5/16	9
-28	63402	FLAT WASHER - 5/16	7
-29	60113	HEX HEAD CAPSCREW-1/4-20UNC X 2 1/4	4
-30	60107	HEX HEAD CAPSCREW-1/4-20UNC X 5/8	6

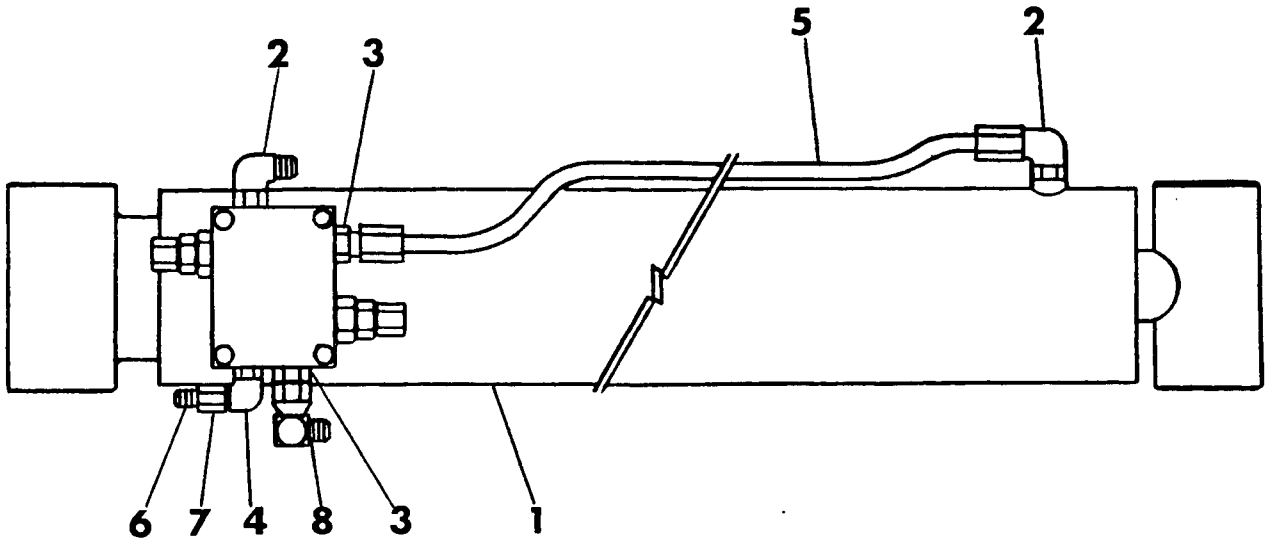
FIGURE 9B-TURRET VALVE PLATE ASSEMBLY (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	63301	SPLIT LOCKWASHER - 1/4	12
-32	63401	FLAT WASHER	4
-33	25078	ROUND TUBING	4
-34	2578	TUBE END REDUCER	1
-35	2435	MALE ELBOW	3
-36	60340	HEX HEAD CAPSCREW-1/4-20UNC X 2	2
-37	21734	PRESSURE REDUCER VALVE	1
-38	20390	FLOW CONTROL VALVE	1


ITEM 4
DETAIL
8 20 21 22
VIEW A
CAPSCREW, LOCKWASHER &
GASKET SUPPLIED BY
ENGINE MANUFACTURER
11
12
10
13
A
A
14
VIEW B
IGNITION POINTS AND
CONDENSER HOUSING
OIL
FILTER
9
8
7
6
18
16
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17
5
4
2
3
19
1
B
B

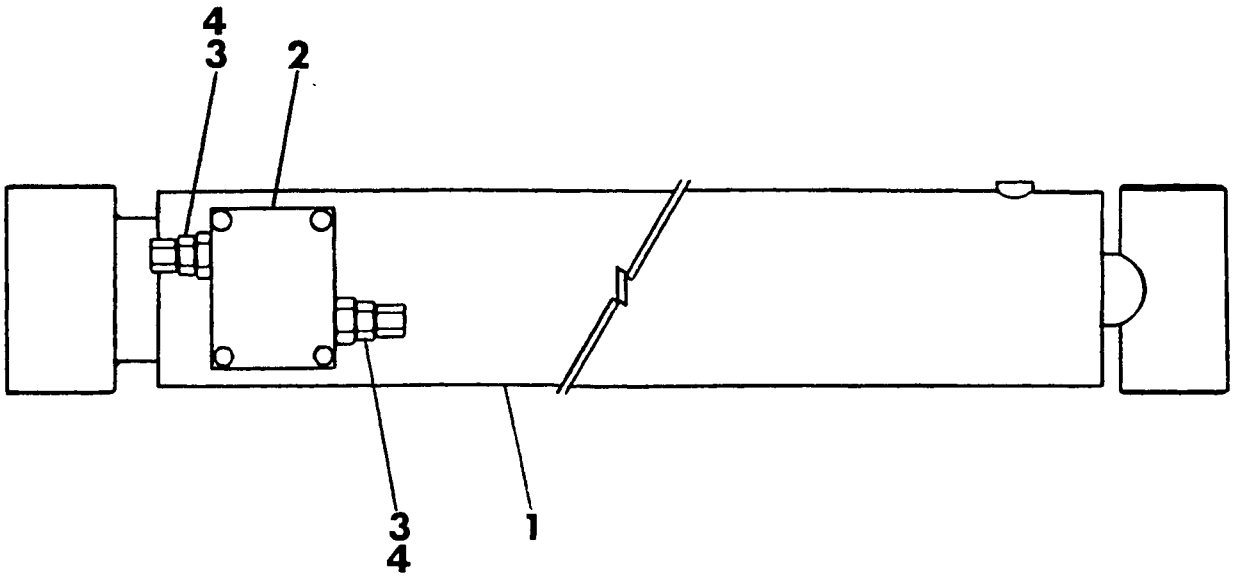
ITEM	PART NUMBER	DESCRIPTION	QTY
10-	20314	ENGINE & PUMP ASSEMBLY	1
-1	20506	ENGINE	1
-2	20328	PUMP ADAPTER	1
-3	20361	PUMP	1
-4	20198	COUPLING ASSEMBLY	1
-5	25005	KEYSTOCK-3/8 SQ. X 2	1
-6	60139	HEX HEAD CAPSCREW-1/2-13UNC X 1 1/2	2
-7	63305	SPLIT LOCKWASHER-1/2	2
-8	62207	HEX SOCKET HEAD SET SCREW-3/8-16UNC X 1/2	2
-9	60610	HEX HEAD CAPSCREW-1/2-13UNC X 1 - BOWMALOK 41024	4
-10	20424	EXHAUST MANIFOLD	1
-11	20300	EXHAUST MUFFLER	1
-12	65127	CLAMP	1
-13	20478	AUTOMATIC CHOKE ASSEMBLY	1
-14	2444	TUBE ELBOW	1
-15	2529	STRAIGHT THREAD ELBOW	1
-16	2435	MALE ELBOW	1
-17	20798	MODIFIED STRAIGHT THREAD ELBOW	1
-18	50901	STRAIGHT THREAD ELBOW	1
-19	2447	STRAIGHT THREAD ELBOW	1
-20	20927	HALF JAW COUPLING	1
-21	20930	RUBBER SPIDER	1
-22	20925	HALF JAW COUPLING	1

FIGURE 11-LIFT CYLINDER ASSEMBLY (30I) (32)



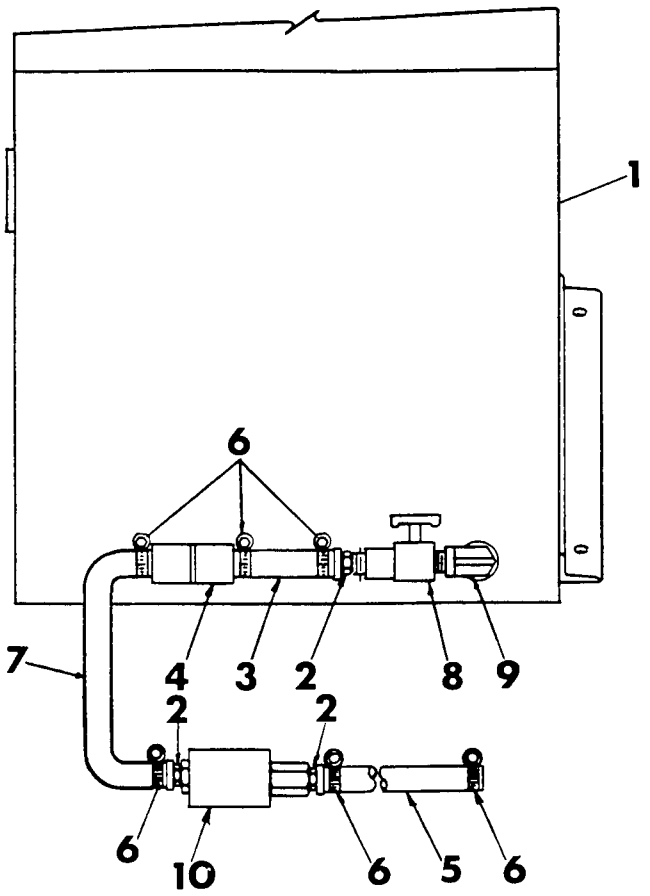
ITEM	PART NUMBER	DESCRIPTION	QTY
11-	21705	LIFT CYLINDER ASSEMBLY	1
-1	20968	LIFT CYLINDER (SEE FIG. 12)	1
-2	2523	STRAIGHT THREAD ELBOW	2
-3	2542	STRAIGHT THREAD CONNECTOR	2
-4	50900	STRAIGHT THREAD ELBOW	1
-5	20633	TUBE ASSEMBLY-1/2	1
-6	20348	BLEED DOWN ORIFICE	1
-7	2539	"B" NUT	1
-8	2538	90° SWIVEL NUT ELBOW	1

FIGURE 12-LIFT CYLINDER (30I) (32)



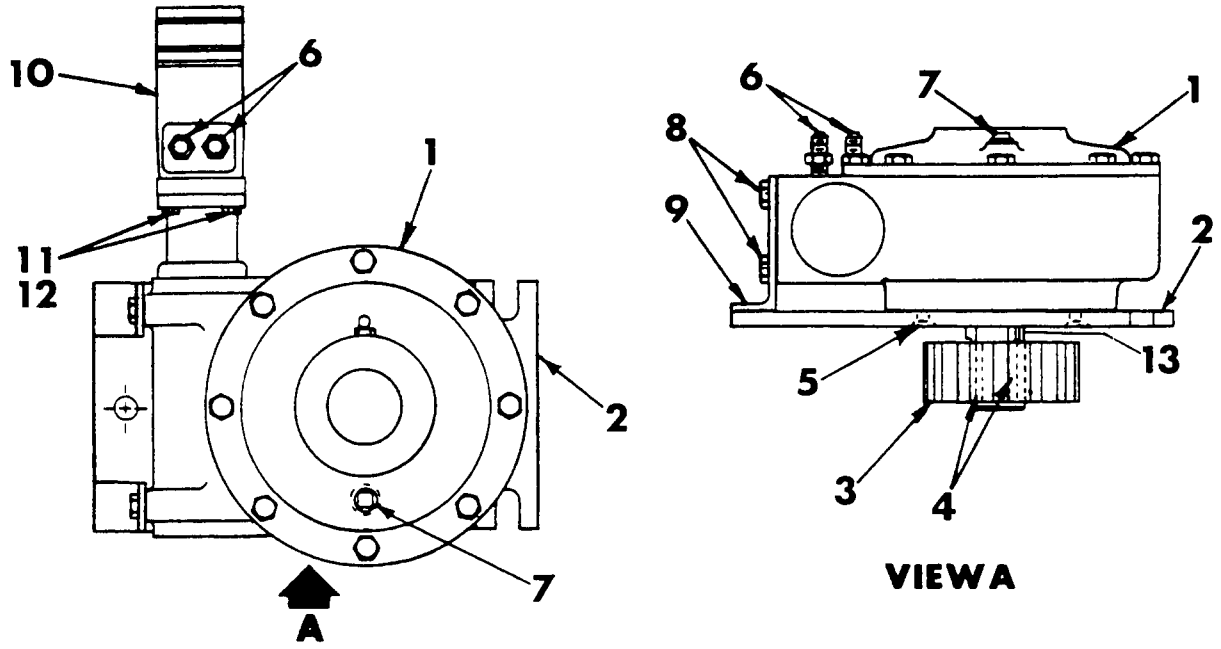
ITEM	PART NUMBER	DESCRIPTION	QTY
12-	20968	LIFT CYLINDER	1
-1	21198	CYLINDER	1
-2	21445	MANIFOLD BLOCK	1
-3	21265	OVER CENTER CARTRIDGE	2
-4		O-RING-HASKEL 568-123 (IF O.C. CARTRIDGE LEAKS)	2
-5	66165	SEAL KIT	1

FIGURE 13-FUEL TANK ASSEMBLY (30I) (32)



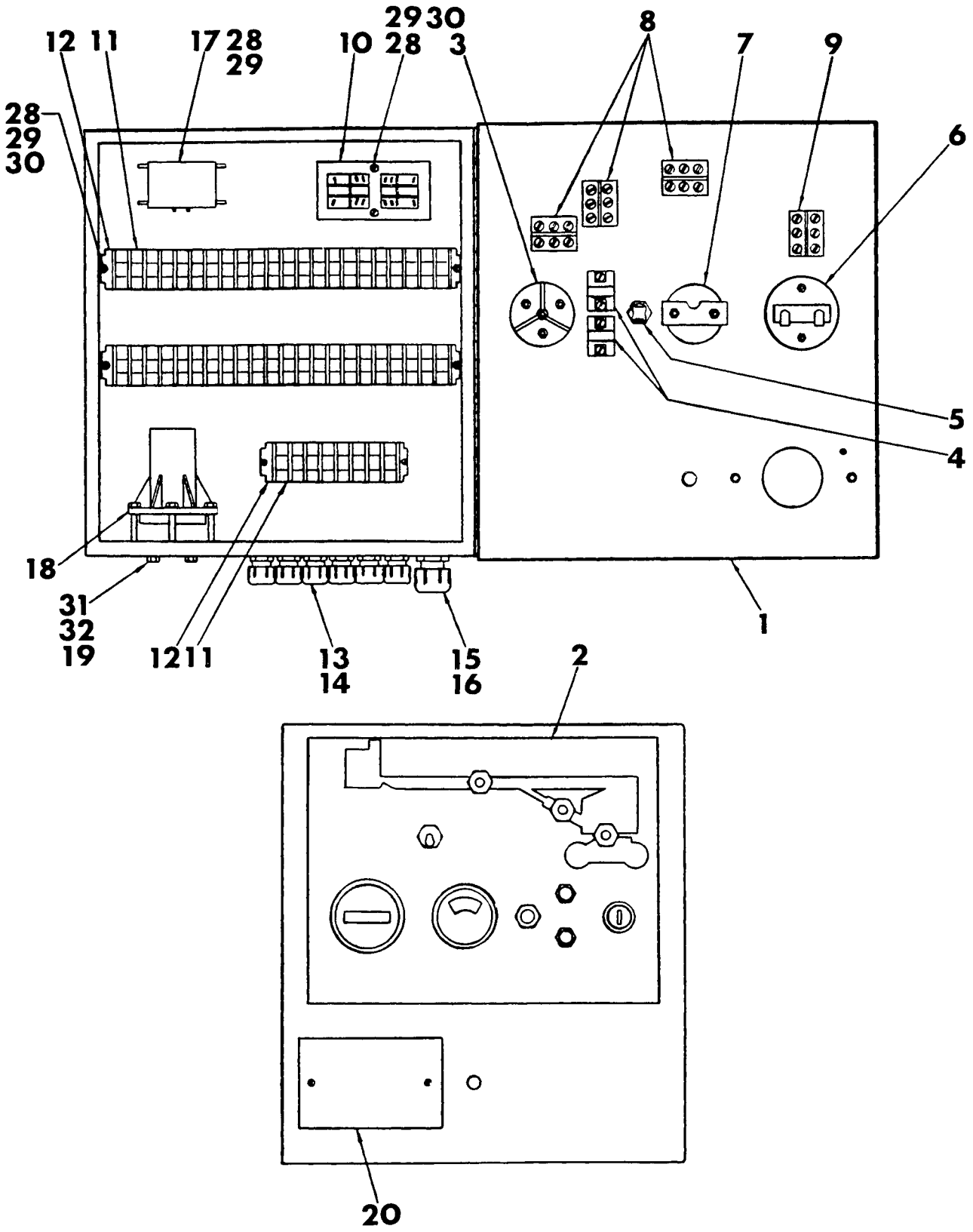
ITEM	PART NUMBER	DESCRIPTION	QTY
13-	20476	FUEL TANK ASSEMBLY	1
-1	20188	FUEL TANK	1
-2	2589	MALE CONNECTOR	3
-3	160B	HOSE - 2 1/2 LONG	1
-4	160	FUEL FILTER	1
-5	160B	HOSE - 16 LONG	1
-6	161B	HOSE CLAMP	8
-7	160B	HOSE - 8 LONG	1
-8	1200	SHUT OFF VALVE	1
-9	16501	STREET ELBOW	1
-10		LP LOCK OFF VALVE - PART OF 20512 DUAL FUEL KIT	1

FIGURE 14-ROTATION GEAR BOX ASSEMBLY (30I) (32)



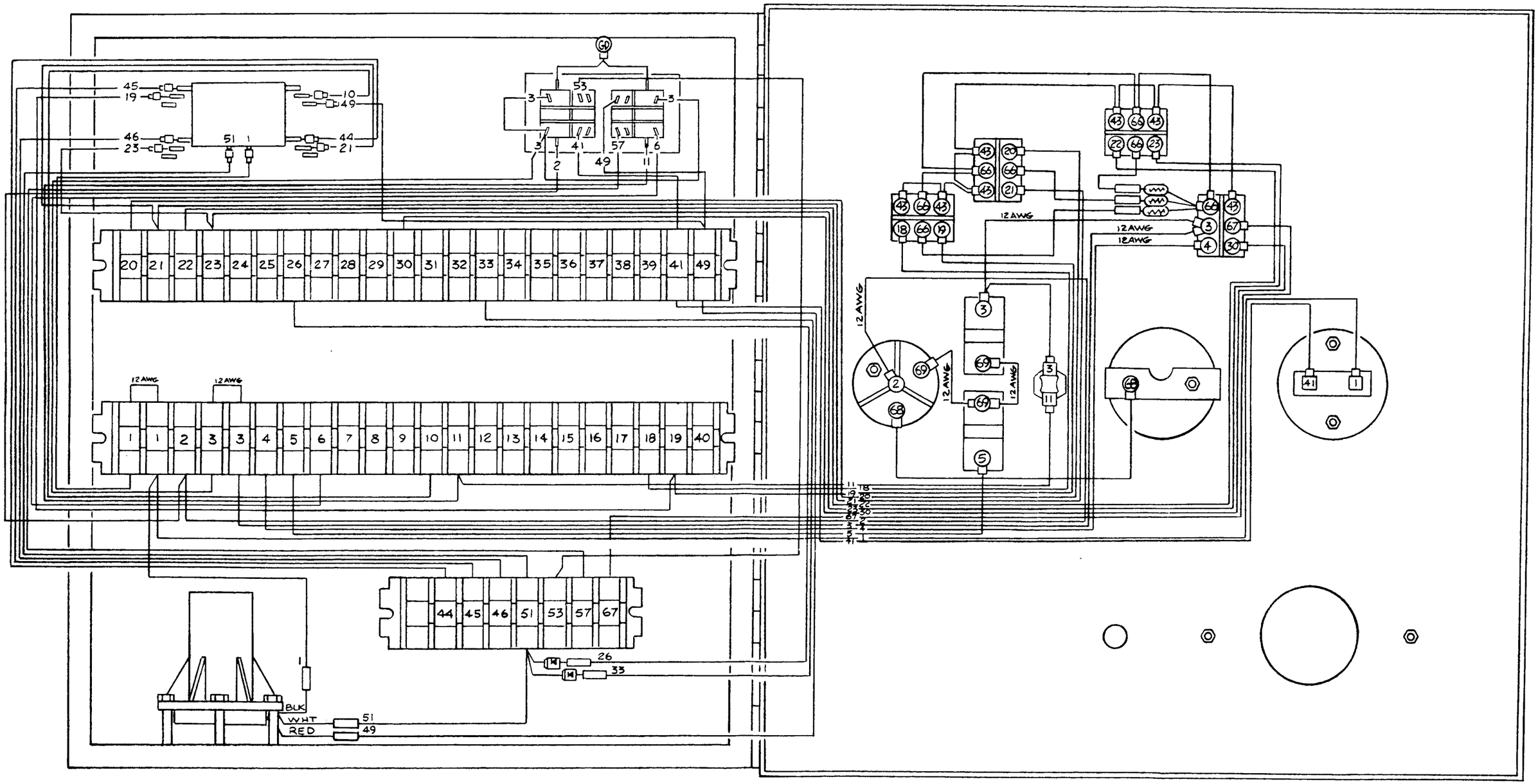
ITEM	PART NUMBER	DESCRIPTION	QTY
14-	20490	ROTATION GEAR BOX ASSEMBLY	1
-1	20362	ROTATION SPEED REDUCER	1
-2	20208	REDUCER SUB-PLATE	1
-3	20249	PINION GEAR	1
-4	20888	KEY	2
-5	61810	FLAT SOCKET HEAD CAPSCREW-1/2-13UNC X 1	5
-6	2480	MALE CONNECTOR	2
-7	2580	HOLLOW HEX PLUG	1
-8	60610	HEX HEAD CAPSCREW-1/2-13UNC X 1-BOWMALOK 41024	4
-9	20550	ANGLE	2
-10	20517	MOTOR	1
-11	60102	HEX HEAD CAPSCREW-3/8-16UNC X 1	4
-12	63303	SPLIT LOCKWASHER-3/8	4
-13	16938	OUTPUT SHAFT	1

FIGURE 15-GROUND CONTROL BOX ASSEMBLY (30I) (32)



COVER

FIGURE 15-GROUND CONTROL BOX ASSEMBLY (30I) (32)



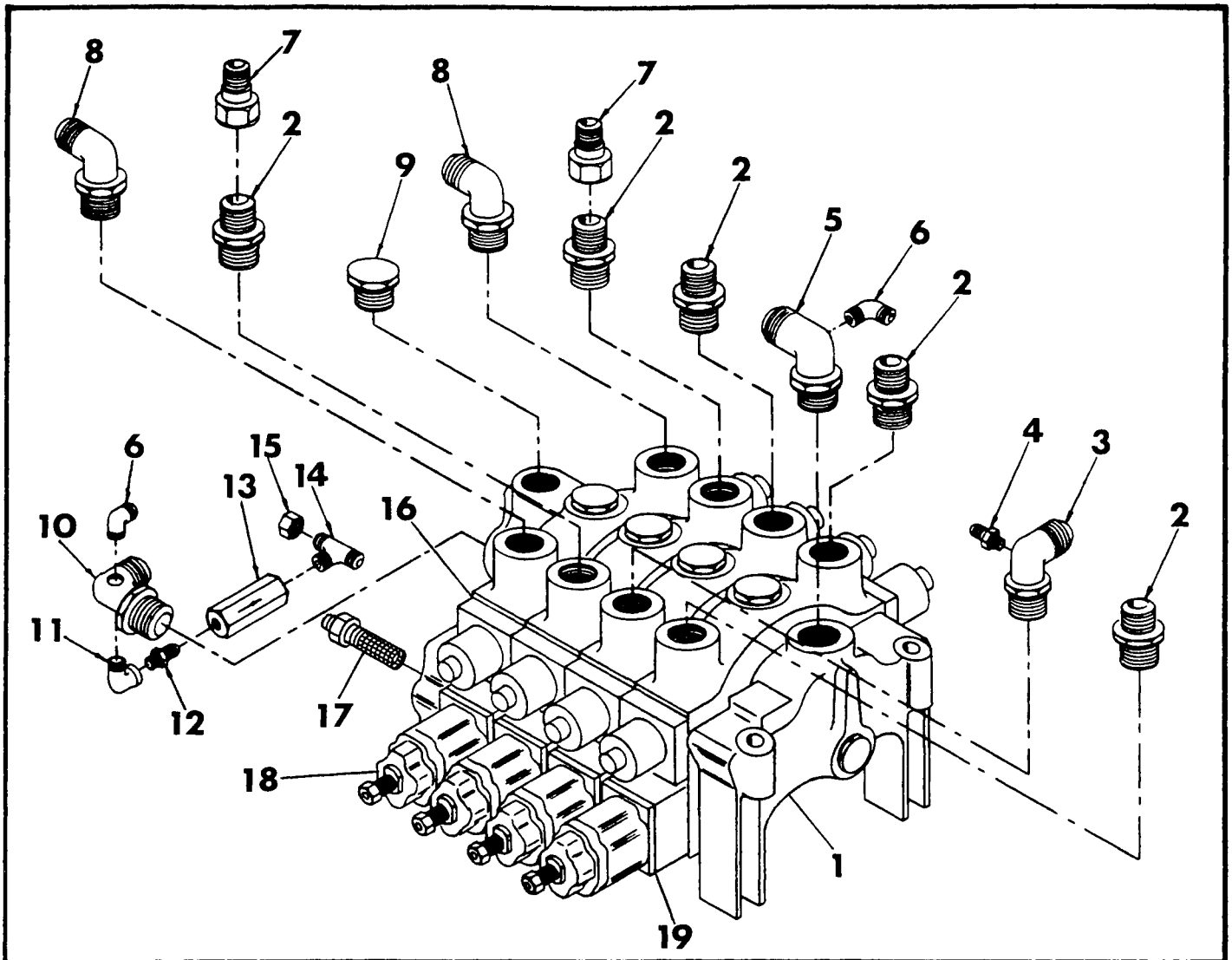
WIRING DIAGRAM LEGEND

- ITEM 21
- ITEM 22
- ITEM 23
- ITEM 24
- ITEM 25
- ITEM 26
- ITEM 27

FIGURE 15-GROUND CONTROL BOX ASSEMBLY (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
15-	21813	GROUND CONTROL BOX ASSEMBLY	1
-1	20977	ENCLOSURE	1
-2	20460	DECAL - COVER	1
-3	405	IGNITION SWITCH	1
-4	20562	CIRCUIT BREAKER	2
-5	4011	PUSH BUTTON SWITCH	1
-6	20571	HOUR METER	1
-7	20572	AMMETER	1
-8	20481	TOGGLE SWITCH	3
-9	20482	TOGGLE SWITCH	1
-10	20573	LATCHING RELAY	1
-11	4027	TERMINAL BLOCK	52
-12	117A	TERMINAL BLOCK END	3
-13	2806	STRAIN RELIEF	6
-14	2808	LOCK NUT	6
-15	2807	STRAIN RELIEF	1
-16	2809	LOCK NUT	1
-17	21253	RELAY T-BAR	1
-18	21250	SLOPE SENSOR	1
-19	60703	HEX NUT-3/8-16UNC	4
-20	902	COVER PLATE	1
-21	4045	DIODE	2
-22	70037	RESISTOR	3
-23	117D	BUTT CONNECTOR	8
-24	117E	PUSH ON TERMINAL	6
-25	496A	PUSH ON TERMINAL	8
-26	2859	RING TONGUE	25
-27	876	RING TONGUE	10
-28	62609	ROUND HEAD SLOTTED CAPSCREW NO. 6-32UNC X 1/2	14
-29	63311	LOCKWASHER - No. 6	14
-30	61501	HEX NUT - NO. 6-32UNC	12
-31	60116	HEX HEAD CAPSCREW - 3/8-16UNC X 3/4	4
-32	63303	LOCKWASHER - 3/8	4

FIGURE 16-PROPORTIONAL VALVE ASSEMBLY (30I) (32)

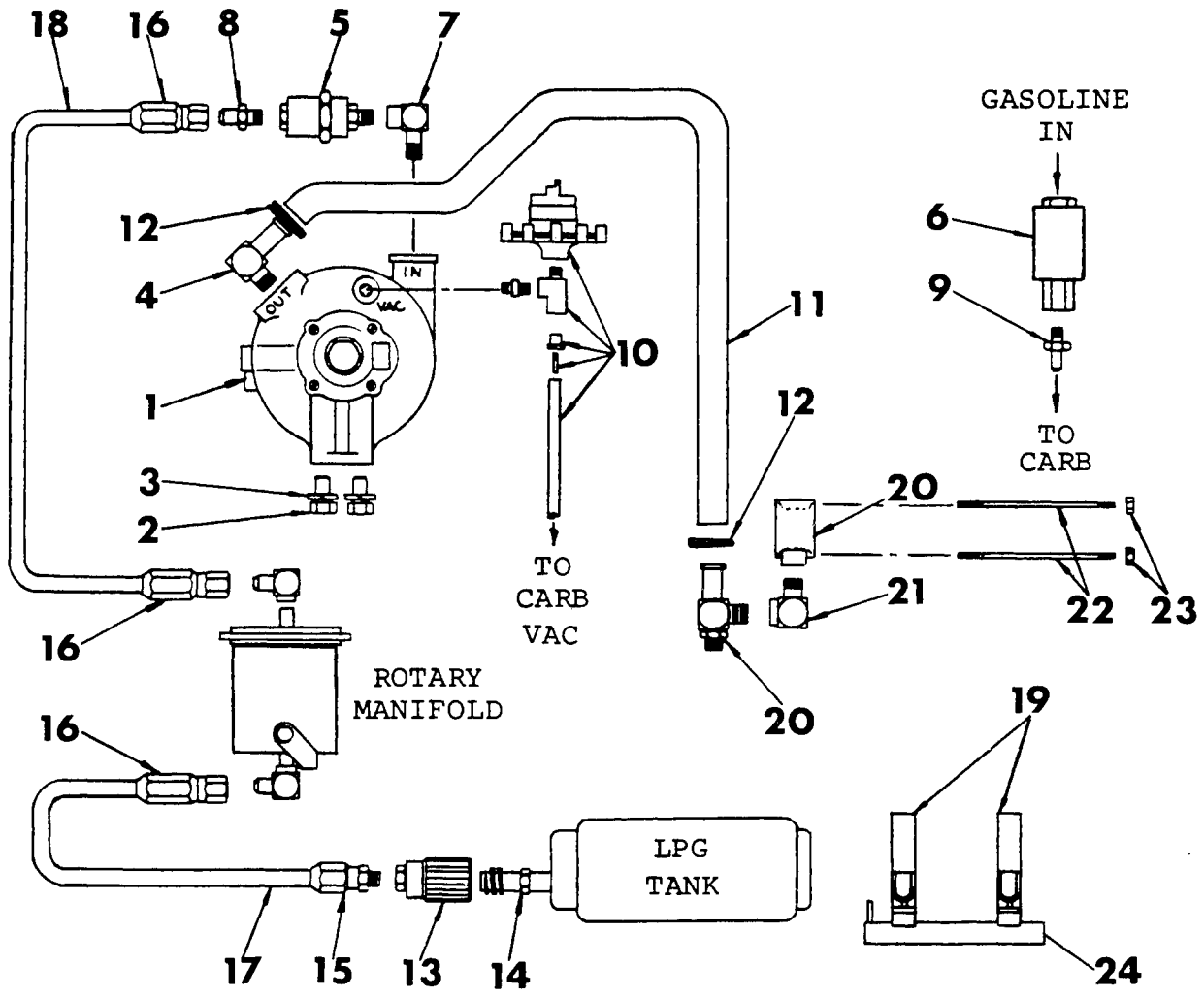


ITEM	PART NUMBER	DESCRIPTION	QTY
16-	20427	PROPORTIONAL VALVE ASSEMBLY	1
-1	20394	PROPORTIONAL VALVE	1
-2	780	STRAIGHT THREAD CONNECTOR	5
-3	20405	MODIFIED STRAIGHT THREAD ELBOW	1
-4	2414	MALE CONNECTOR	1
-5	20451	MODIFIED STRAIGHT THREAD ELBOW	1
-6	2448	MALE ELBOW	2
-7	2578	TUBE END REDUCER	2
-8	2577	STRAIGHT THREAD ELBOW	2
-9	2549	PLUG	1
-10	20456	MODIFIED STRAIGHT THREAD ELBOW	1

FIGURE 16-PROPORTIONAL VALVE ASSEMBLY (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
-11	2450	STREET ELBOW	1
-12	2475	PIPE NIPPLE	1
-13	20357	NEEDLE VALVE	1
-14	2490	MALE BRANCH TEE	1
-15	2412	CAP NUT	1
-16	16950	END CAP GASKET	4
-17	16951	BERTEA FILTER ASSEMBLY	1
-18	20466	PILOT VALVE	4
-19	16949	PILOT SECTION GASKET	4

FIGURE 17-DUAL FUEL KIT-ONAN ENGINE (30I) (32)

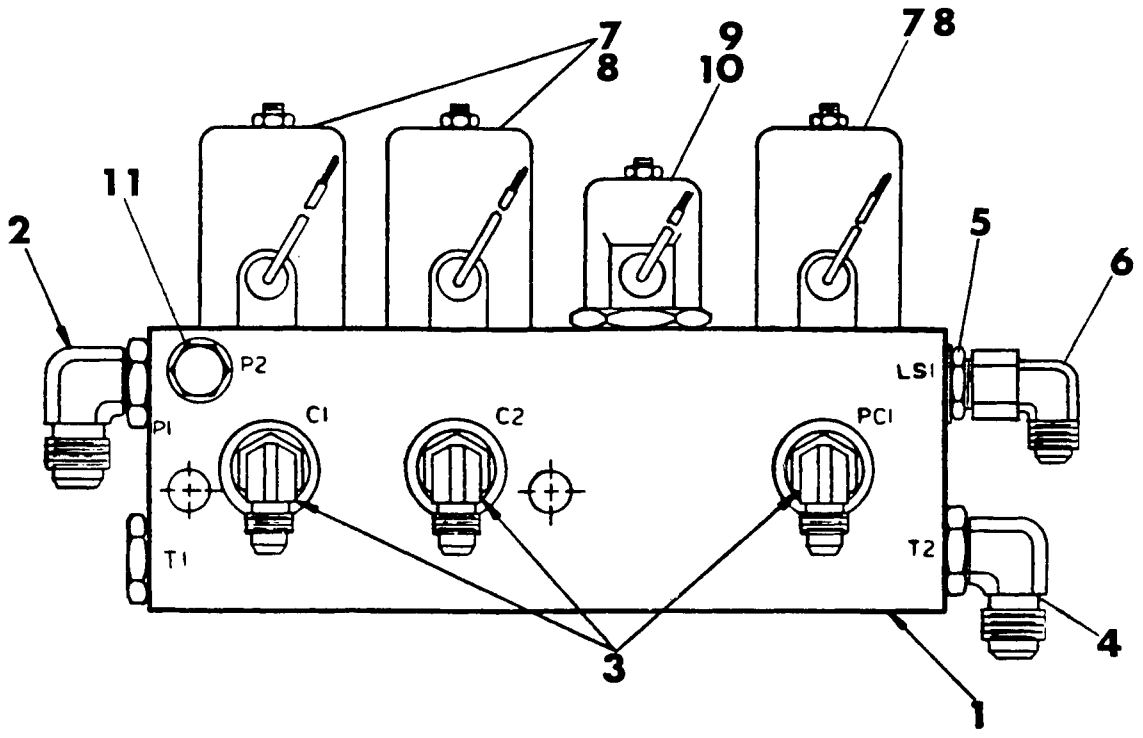


ITEM	PART NUMBER	DESCRIPTION	QTY
17-	20512	DUAL FUEL KIT-ONAN ENGINE	1
-1	16921	REGULATOR - 50E	1
-2	60107	CAPSCREW-462010-H-1/4 20 X 5/8	2
-3	63301	LOCKWASHER-W46-L-1/4	2
-4	66143	ELBOW-3H-305B-5/8 HOSE TO 3/8NPT	1
-5	16925	FILTERLOCK-FL-218 12V	1
-6	20832	VALVE-GT622 GASOLINE 6/12V	1
-7	16519	STREET ELBOW-3401 X 4 SPECIAL LONG-1/4NPT	1
-8		MALE CONNECTOR-48 X 6-3/8F X 1/4NPT	1
-9		MALE CONNECTOR-48 X 4-1/4F X 1/8NPT	1
-10	16923	VACUUM SAFETY SWITCH - 1501-PA	1

FIGURE 17-DUAL FUEL KIT-ONAN ENGINE (30I) (32)

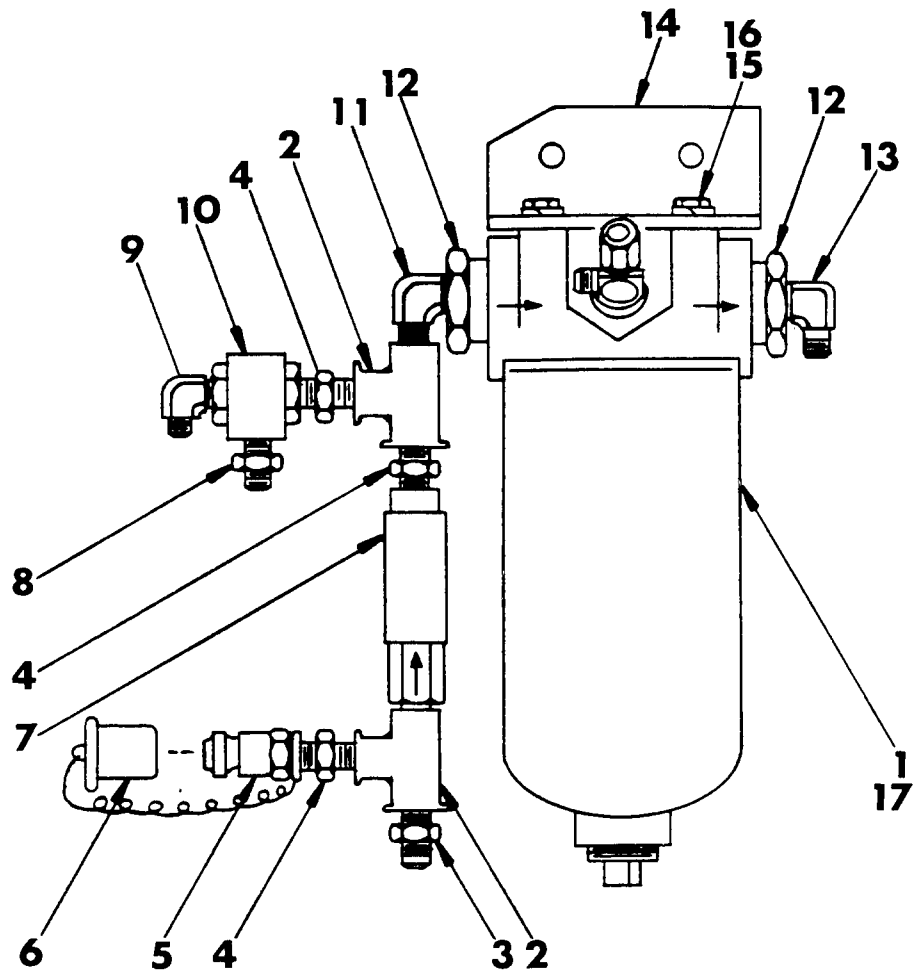
ITEM	PART NUMBER	DESCRIPTION	QTY
-11	66146	HOSE-H-703-WATER 5/8 I.D. X 2 FT.	1
-12	66147	HOSE CLAMP-CC115-5/16 O.D.	2
-13	16927	SOCKET-7141-F	1
-14	65142	NIPPLE-7141-M	1
-15	16425	HOSE FITTING-2F-238 5/16 HOSE X 1 1/4 NPT	1
-16	16451	HOSE FITTING-2F-237 5/16 HOSE X 3/8 SW. TUBE	3
-17	66149	HOSE-H-501UL-HP FUEL 5/16 I.D. X 5 FT.	1
-18	66149	HOSE-H-501UL-HP FUEL 5/16 I.D. X 4 FT.	1
-19	486-A	BRACKET-33 1/2LB ICC TANK (PAIR)	1
-20	16922	CARB. ADAPTER-1431A-26	1
-21		STREET ELBOW 3400 X 6 3/8NPT	1
-22		CARB. ADAPTER STUD 35-501	2
-23		LOCK NUT-N-1032-HTC	2
-24	20843	LP TANK BRACKET (REF)	1

FIGURE 18 - SOLENOID VALVE ASSEMBLY



ITEM	PART NUMBER	DESCRIPTION	QTY
18-	21692	SOLENOID VALVE ASSEMBLY	1
-1	21860	SOLENOID VALVE	1
-2	50900	STRAIGHT THREAD ELBOW	1
-3	80012-03	STRAIGHT THREAD ELBOW	3
-4	80012-08	STRAIGHT THREAD ELBOW	1
-5	80004-03	STRAIGHT THREAD CONNECTOR	1
-6	80015-03	SWIVEL NUT ELBOW	1
-7	66201	LARGE COIL	3
-8	66245	LARGE CARTRIDGE	3
-9	66202	SMALL COIL	1
-10	66246	SMALL CARTRIDGE	1
-11	53900	HOLLOW HEX PLUG	1

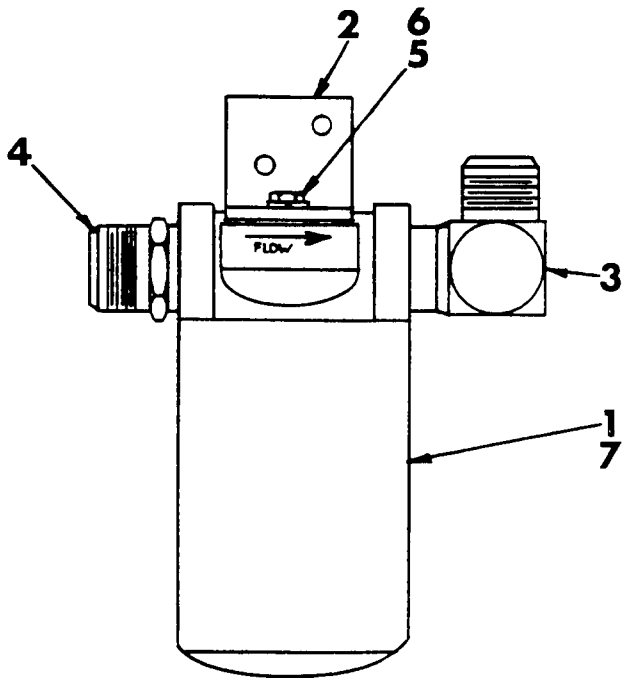
FIGURE 19-LOW PRESSURE FILTER ASSEMBLY (30I) (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
19-	20593	LOW PRESSURE FILTER ASSEMBLY	1
-1	20368	FILTER	1
-2	2420	STREET TEE	1
-3	2476	MALE CONNECTOR	1
-4	2475	PIPE NIPPLE	3
-5	2527	QUICK DISCONNECT COUPLING	1
-6	845	CAP	1
-7	20390	FLOW CONTROL VALVE	1
-8	2415	MALE CONNECTOR	1
-9	2435	MALE ELBOW	1
-10	20356	SHUTTLE VALVE	1
-11	2450	STREET ELBOW	1

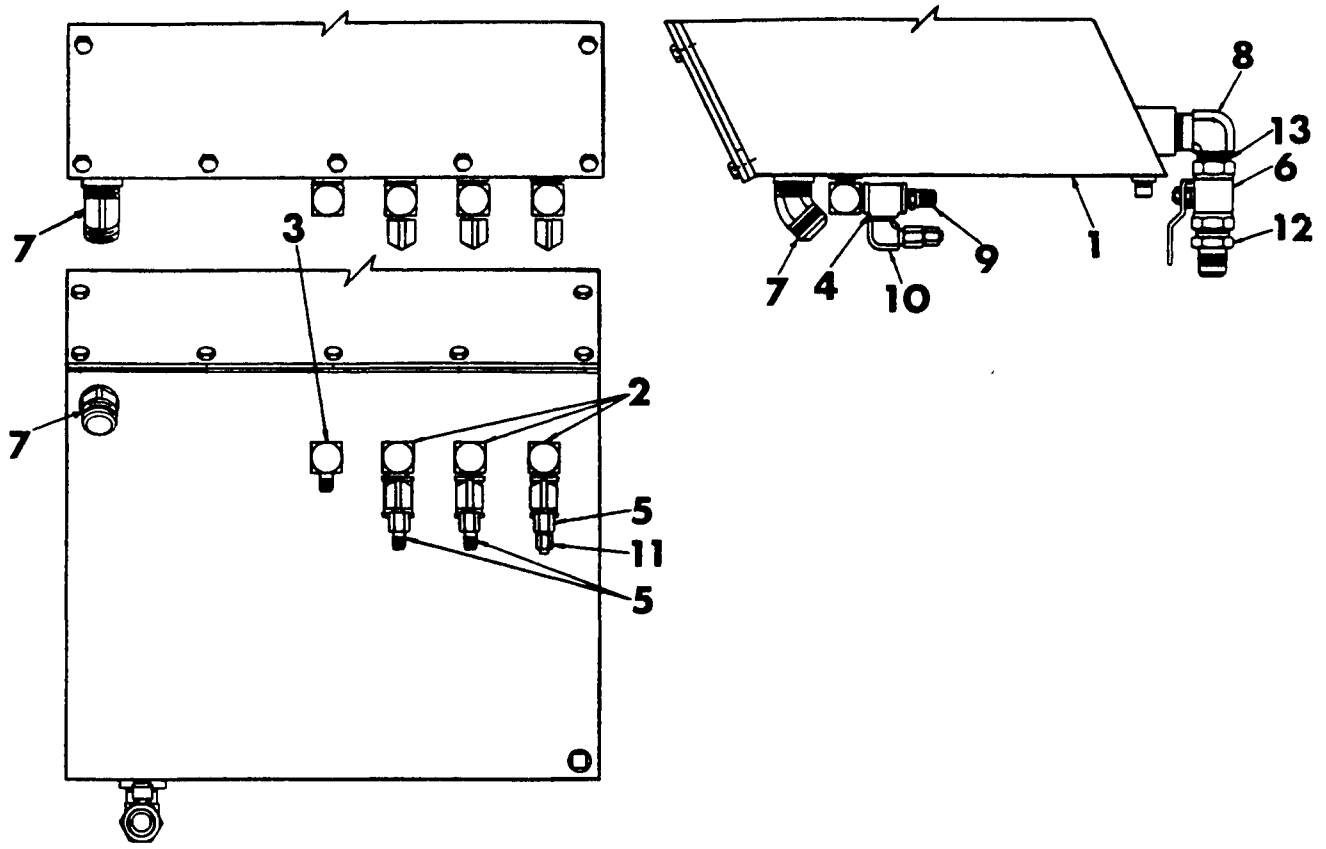
ITEM	PART NUMBER	DESCRIPTION	QTY
-12	2548	REDUCER	2
-13	2448	MALE ELBOW	1
-14	20333	FILTER BRACKET	1
-15	61701	SELF TAPPING HEX HEAD CAPSCREW-3/8-16UNC X 1/2	1
-16	63303	SPLIT LOCKWASHER - 3/8	1
-17	20472	FILTER ELEMENT	1

FIGURE 19A-RETURN LINE FILTER ASSEMBLY (30I) (32)



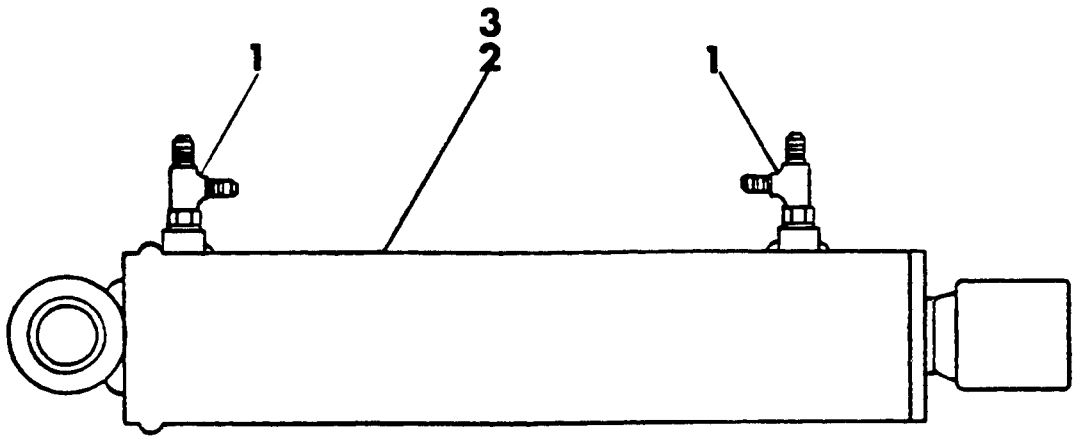
ITEM	PART NUMBER	DESCRIPTION	QTY
19A-	20594	RETURN LINE FILTER ASSEMBLY	1
-1	20367	FILTER	1
-2	20333	MOUNTING BRACKET	1
-3	2409	MALE ELBOW	1
-4	2574	MALE CONNECTOR	1
-5	60342	HEX HEAD CAPSCREW-1/4-20UNC X 5/8 (GR.5)	2
-6	63301	SPLIT LOCKWASHER - 1/4	2
-7	20477	FILTER ELEMENT	1

FIGURE 20-HYDRAULIC TANK ASSEMBLY (30I) (32)



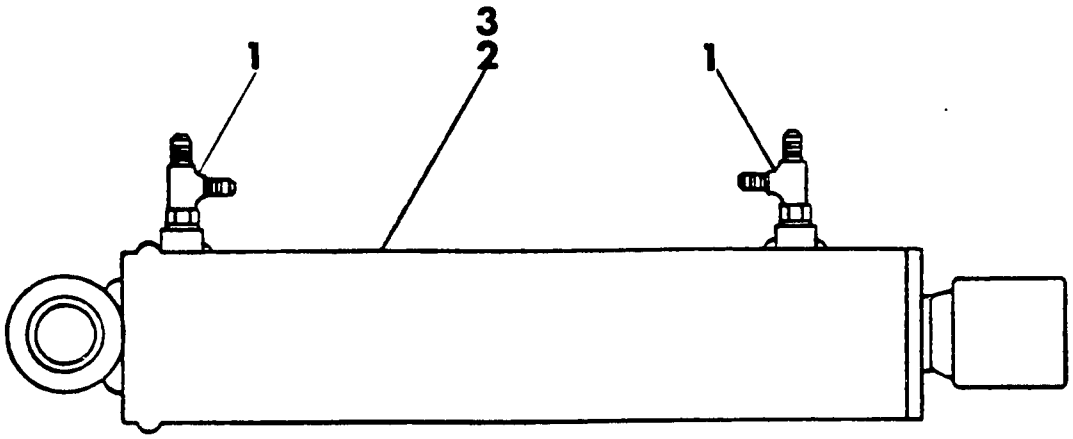
ITEM	PART NUMBER	DESCRIPTION	QTY
20-	20474	HYDRAULIC TANK ASSEMBLY	1
-1	20187	HYDRAULIC TANK	1
-2	2585	STREET ELBOW	3
-3	2584	MALE ELBOW	1
-4	2586	STREET TEE	3
-5	2496	TUBE END REDUCER	3
-6	65132	BUTTERFLY VALVE	1
-7	2583	MALE ELBOW 45°	1
-8	52307	STREET ELBOW	1
-9	2478	MALE CONNECTOR	3
-10	2449	MALE ELBOW	3
-11	2411	CAP NUT	1
-12	2814	MALE CONNECTOR	1
-13	54702	CLOSE NIPPLE	1

FIGURE 21-MASTER LEVELING CYLINDER ASSEMBLY (30I) (32)

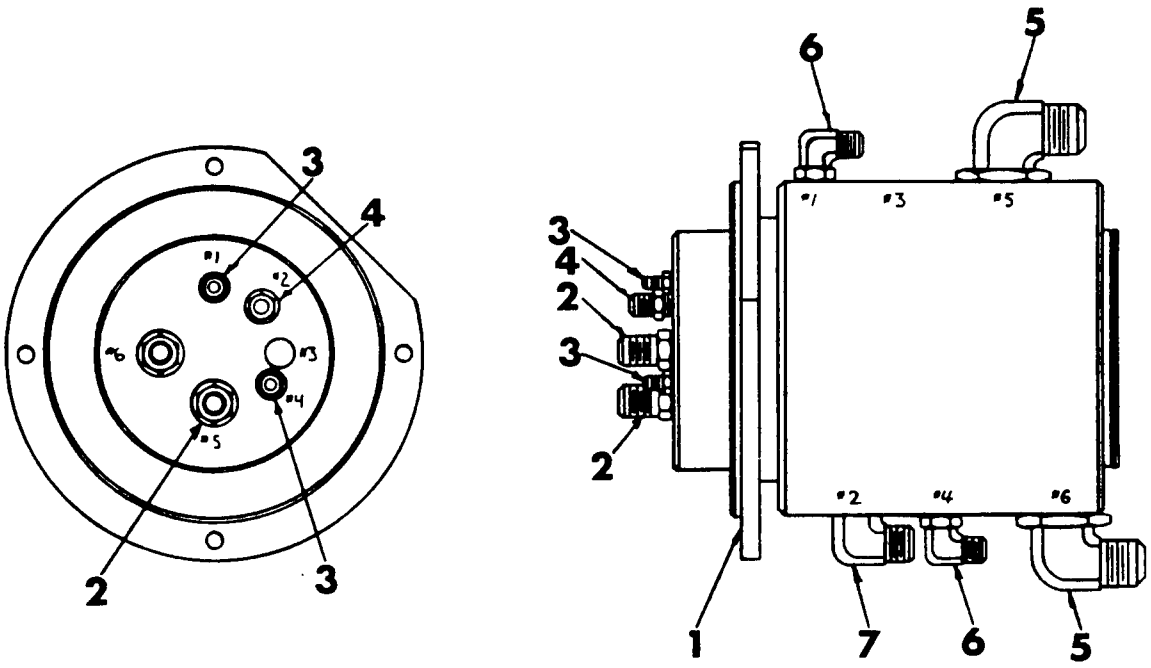


ITEM	PART NUMBER	DESCRIPTION	QTY
21-	20237	MASTER LEVELING CYLINDER ASSEMBLY	1
-1	80033-03	STRAIGHT THREAD RUN TEE	2
-2	20203	MASTER LEVELING CYLINDER	1
-3	20128	SEAL KIT	1

FIGURE 22 - MASTER LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION BOOM)

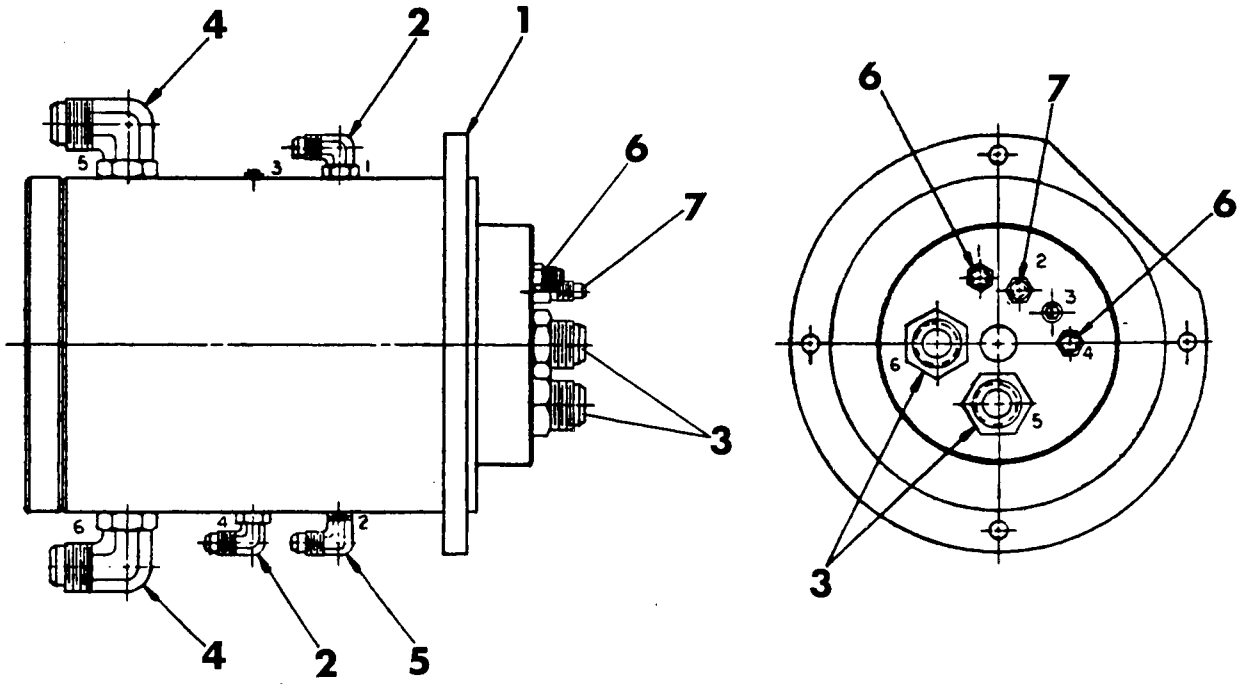


ITEM	PART NUMBER	DESCRIPTION	QTY
22-	22583	MASTER LEVELING CYLINDER ASSEMBLY	1
-1	80033-03	STRAIGHT THREAD RUN TEE	2
-2	22577	MASTER LEVELING CYLINDER (RA)	1
-3	66553	SEAL KIT	1

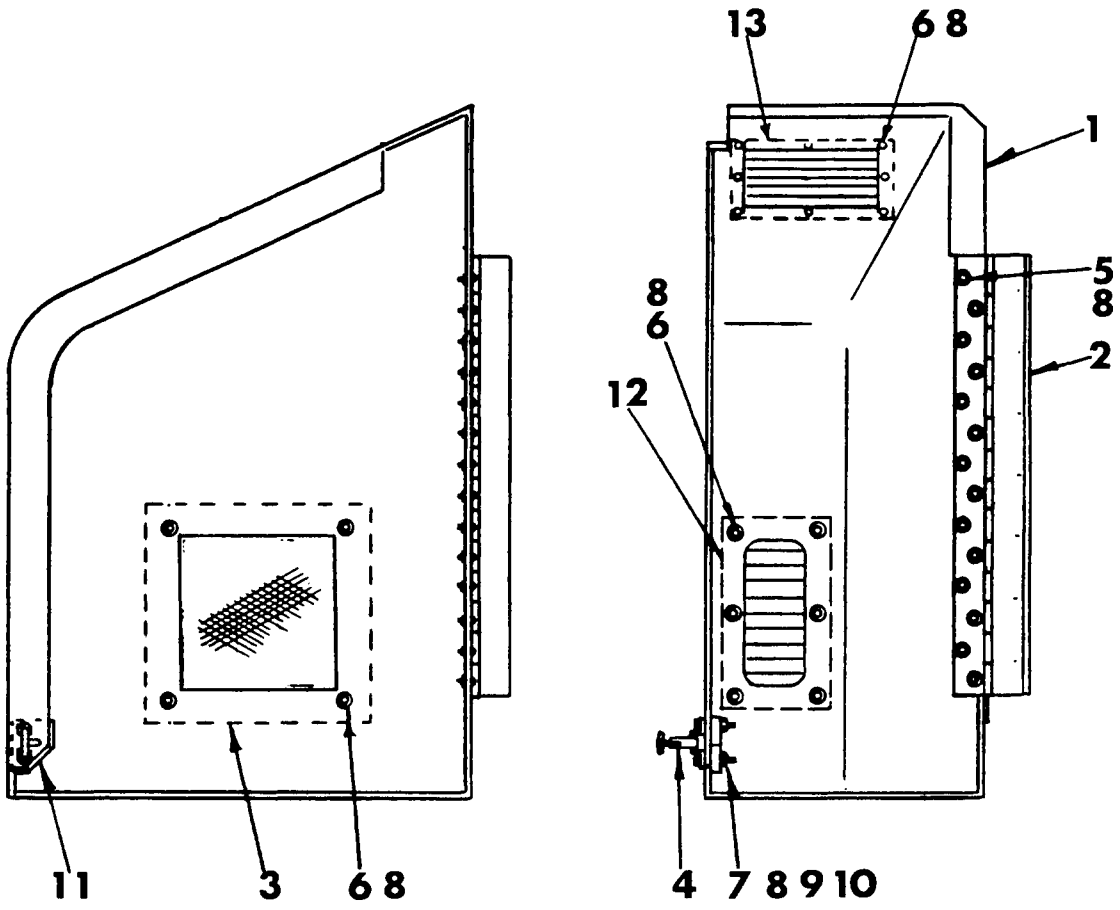


ITEM	PART NUMBER	DESCRIPTION	QTY
23-	20239	ROTARY MANIFOLD ASSEMBLY	1
-1	20324	HYDRAULIC ROTARY MANIFOLD	1
-2	2543	STRAIGHT THREAD CONNECTOR	2
-3	2581	STRAIGHT THREAD CONNECTOR	2
-4	2476	MALE CONNECTOR	1
-5	2524	STRAIGHT THREAD ELBOW	1
-6	2532	STRAIGHT THREAD ELBOW	2
-7	2448	MALE ELBOW	1

FIGURE 23A - ROTARY MANIFOLD ASSEMBLY (30I) (32) (MARCH 1983)



ITEM	PART NUMBER	DESCRIPTION	QTY
23A-	21899	ROTARY MANIFOLD ASSEMBLY	1
-1	21895	ROTARY MANIFOLD	1
-2	2532	STRAIGHT THREAD ELBOW	2
-3	2543	STRAIGHT THREAD CONNECTOR	2
-4	2524	STRAIGHT THREAD ELBOW	2
-5	2448	MALE ELBOW	1
-6	50801	STRAIGHT THREAD CONNECTOR	2
-7	2476	MALE CONNECTOR	1

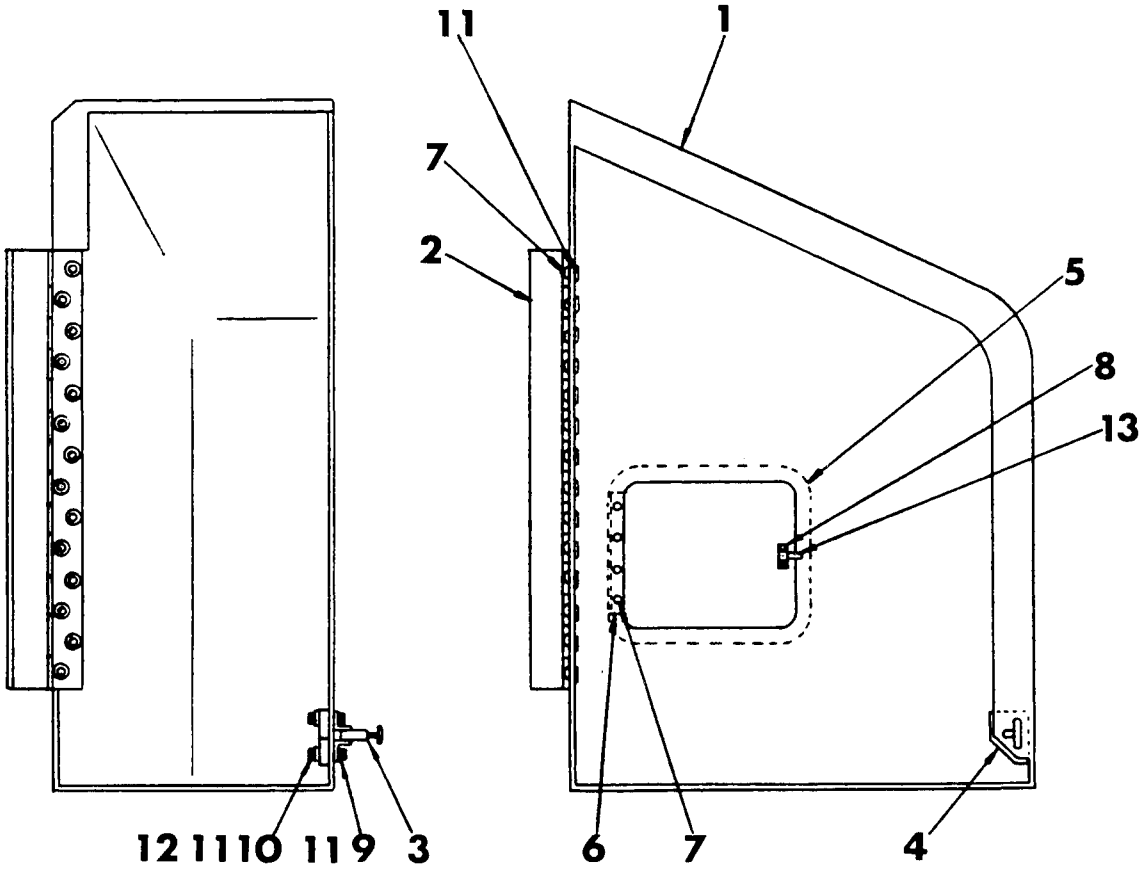


ITEM	PART NUMBER	DESCRIPTION	QTY
24-	20305	FIBERGLASS COVER ASSEMBLY-ENGINE SIDE	1
-1	20330	COVER	1
-2	20337	HINGE WELDMENT	1
-3	21695	EXPANDED METAL SCREEN	1
-4	65128	LATCH	1
-5	63651	RIVET-3/16 X 1/2	14
-6	63654	RIVET-3/16 X 3/8	18
-7	62716	ROUND SLOTTED HEAD BOLT NO. 10-24 X 1 1/2	2
-8	63413	FLAT WASHER-NO. 10	32
-9	63313	LOCK WASHER-NO. 10	2
-10	60709	HEX NUT-NO. 10-24	2
-11	20496	WEAR PAD	1

FIGURE 24-FIBERGLASS COVER ASSEMBLY-ENGINE SIDE (30I)

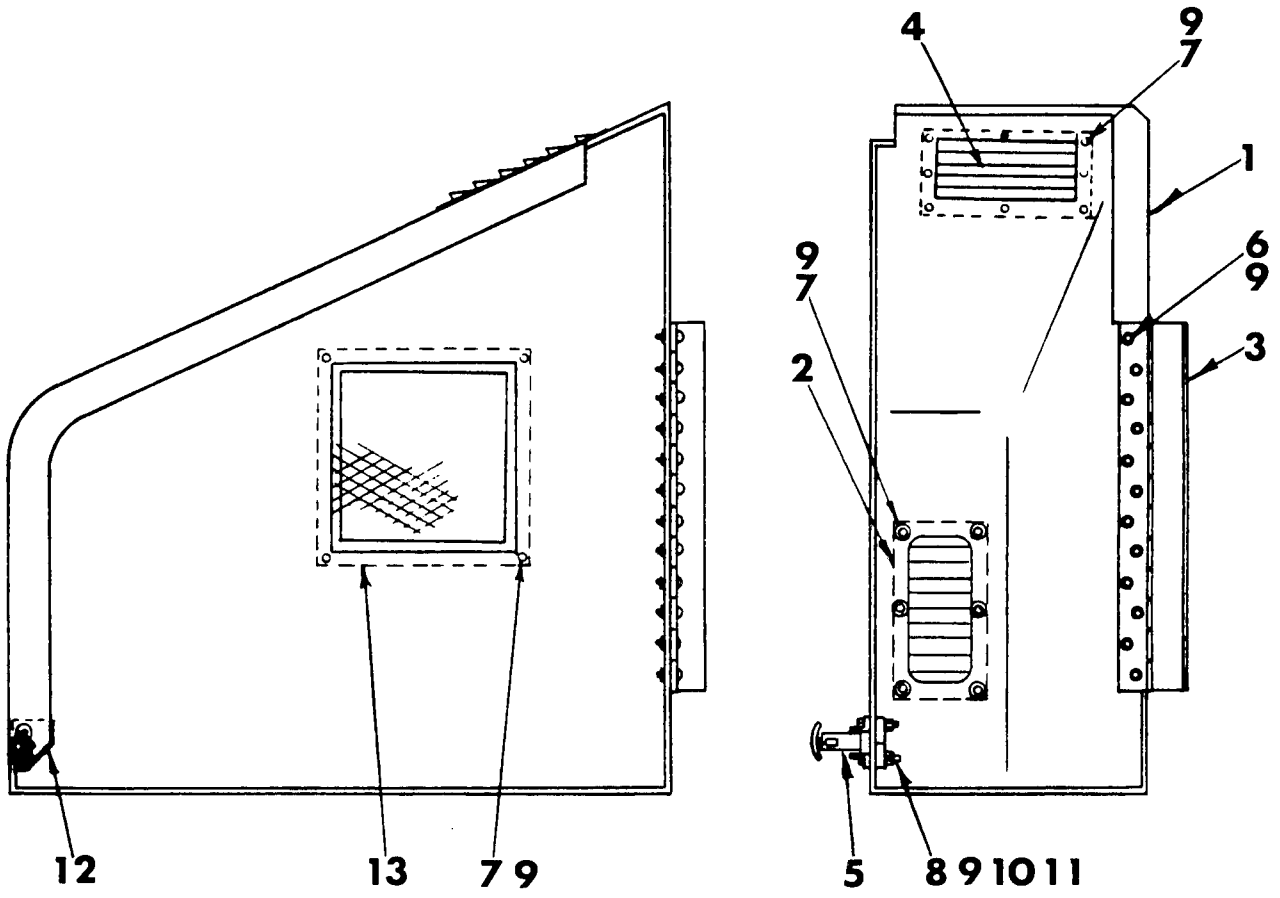
ITEM	PART NUMBER	DESCRIPTION	QTY
-12	20902	LOUVER	1
-13	20901	LOUVER	1

FIGURE 24A-FIBERGLASS COVER ASSEMBLY-CONTROL SIDE (30I)



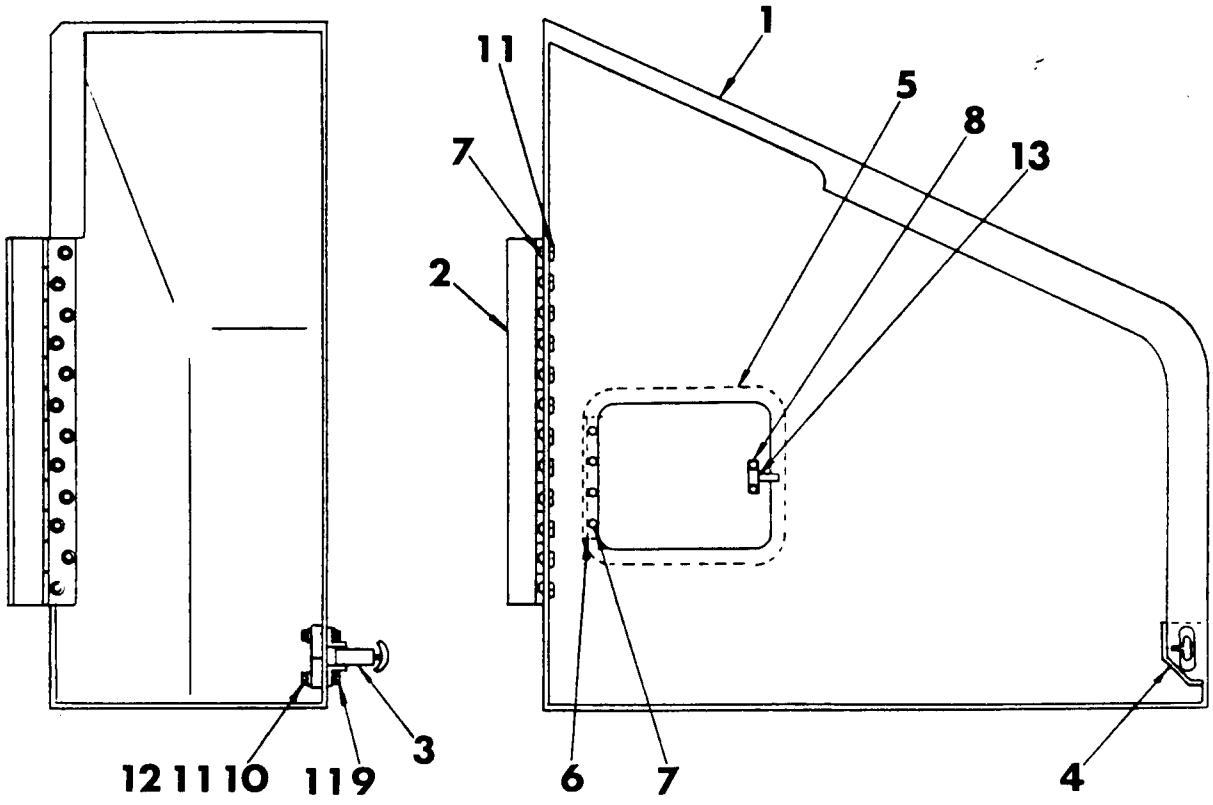
ITEM	PART NUMBER	DESCRIPTION	QTY
24A-	20651	FIBERGLASS COVER ASSEMBLY-CONTROL SIDE	1
-1	20497	COVER	1
-2	20337	HINGE WELDMENT	1
-3	65128	LATCH	1
-4	20496	WEAR PAD	1
-5	20826	ACCESS DOOR	1
-6	20829	HINGE	1
-7	63651	RIVET-3/16 X 1/2	22
-8	63652	RIVET-1/8 X 3/8	2
-9	62716	SLOTTED HEAD BOLT NO. 10-24UNC X 1 1/2	2
-10	60709	HEX NUT-NO. 10-24UNC	2
-11	63413	FLAT WASHER-NO. 10	18
-12	63313	LOCKWASHER-NO. 10	2
-13	65279	LATCH	1

FIGURE 24B-FIBERGLASS COVER ASSEMBLY-ENGINE SIDE (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
24B-	20195	FIBERGLASS COVER ASSEMBLY-ENGINE SIDE	1
-1	20331	FIBERGLASS COVER	1
-2	20902	LOUVER	1
-3	20537	HINGE WELDMENT	1
-4	20901	LOUVER	1
-5	65128	LATCH	1
-6	63651	POP RIVET-3/16 X 1/2	14
-7	63654	POP RIVET-3/16 X 3/8	18
-8	62716	ROUND SLOTTED HEAD BOLT-NO. 10-24 X 1 1/2	2
-9	63413	FLAT WASHER-NO. 10	36
-10	63313	LOCK WASHER-NO. 10	2
-11	60709	HEX NUT-NO. 10-24	2
-12	20496	WEAR PAD	1
-13	21695	EXPANDED SCREEN	1

FIGURE 24C-FIBERGLASS COVER ASSEMBLY-CONTROL SIDE (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
24C-	20652	FIBERGLASS COVER ASSEMBLY-CONTROL SIDE	1
-1	20498	COVER	1
-2	20337	HINGE WELDMENT	1
-3	65128	LATCH	1
-4	20496	WEAR PAD	1
-5	20826	ACCESS DOOR	1
-6	20829	HINGE	1
-7	63651	RIVET-3/16 X 1/2	22
-8	63652	RIVET-1/8 X 3/8	2
-9	62716	ROUND SLOTTED HEAD BOLT NO. 10-24UNC X 1 1/2	2
-10	60709	HEX NUT-NO. 10-24UNC	2
-11	63413	FLAT WASHER-NO. 10	18
-12	63313	LOCKWASHER-NO. 10	2
-13	65279	LATCH	1

FIGURE 25-AERIAL CONTROL CONSOLE ASSEMBLY (30I) (32)

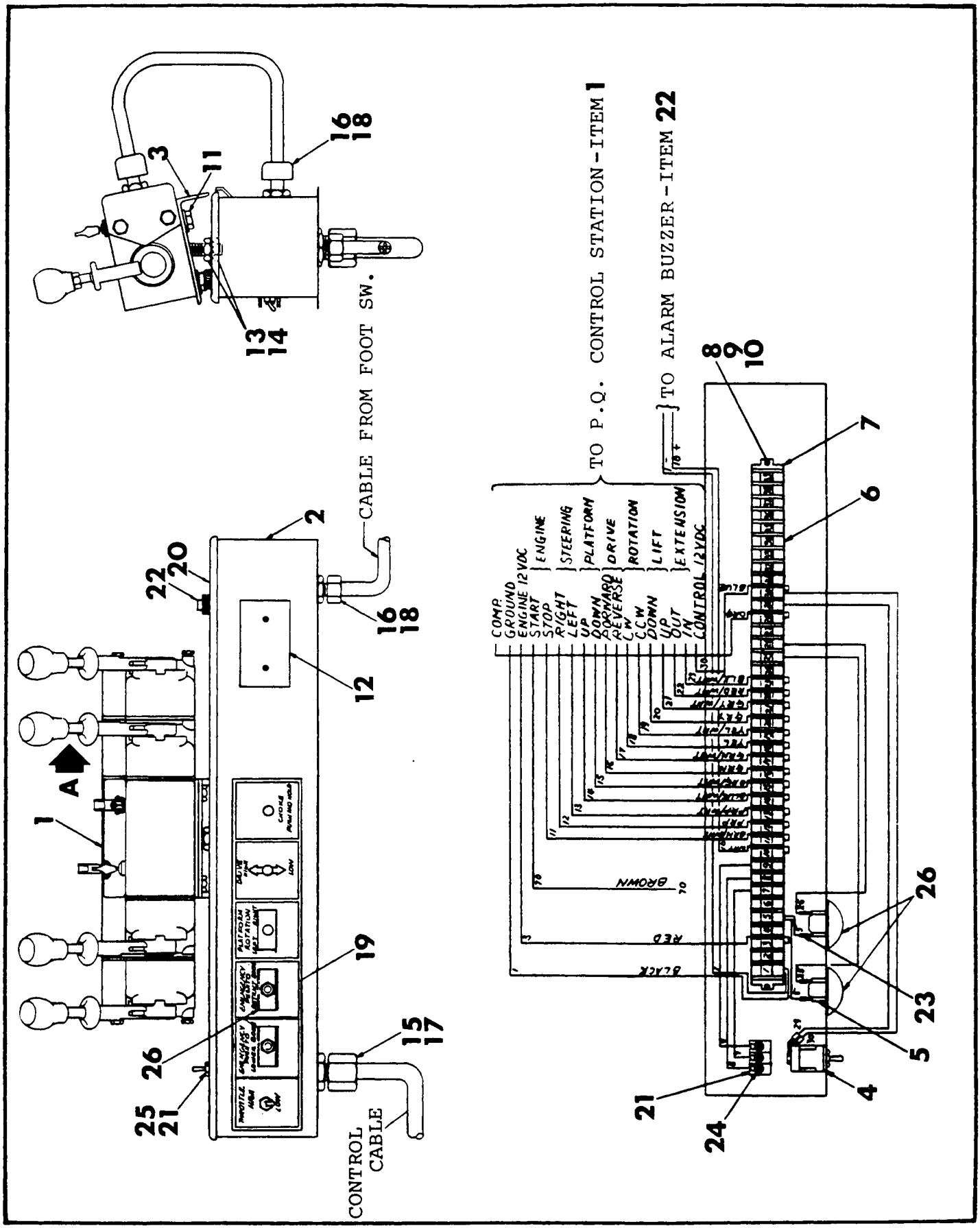
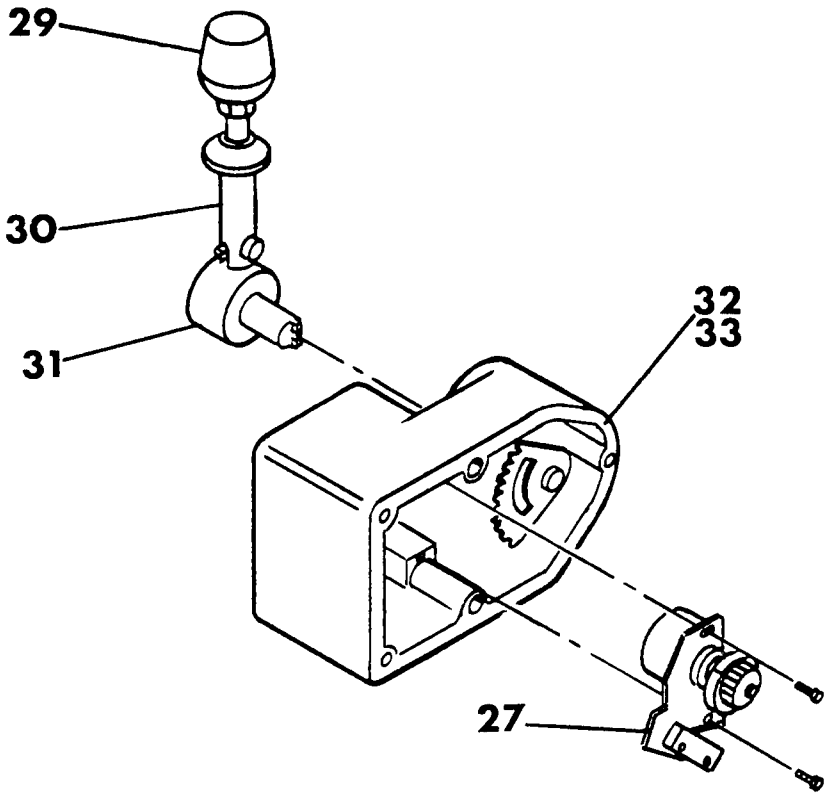


FIGURE 25-AERIAL CONTROL CONSOLE ASSEMBLY (30I) (32)



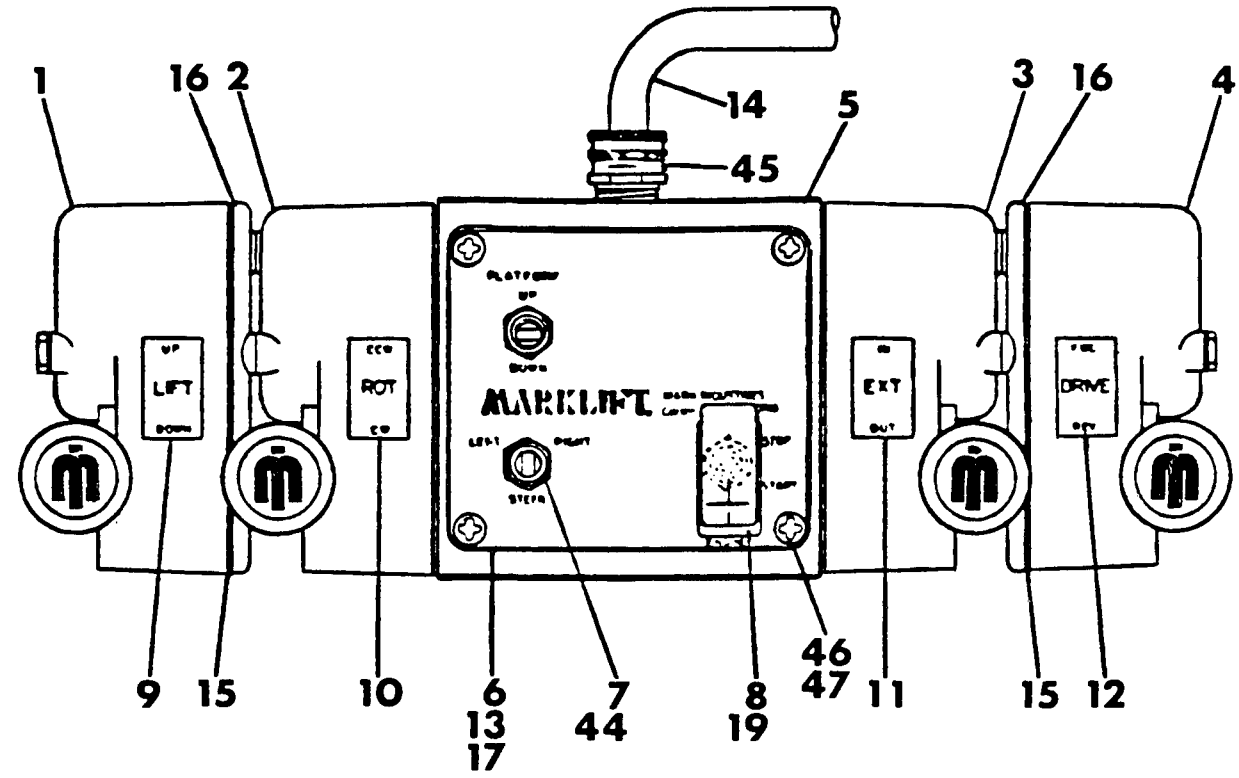
VIEW A

FIGURE 25-AERIAL CONTROL CONSOLE ASSEMBLY (30I) (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
25-	20525	AERIAL CONTROL CONSOLE ASSEMBLY	1
-1	20392	AERIAL CONTROL STATION (SEE FIG. 25A)	1
-2	20311	ENCLOSURE	1
-3	20217	CONTROLLER MOUNTING BRACKET	1
-4	4017	TOGGLE SWITCH	1
-5	4011	PUSH BUTTON SWITCH	2
-6	4027	TERMINAL BLOCK	39
-7	117A	TERMINAL BLOCK END	1
-8	62624	TRUSS HEAD CAPSCREW-NO. 6-32UNC X 3/8	5
-9	60710	HEX NUT-NO. 6-32UNC	5
-10	63311	LOCKWASHER-NO. 6	5
-11	60633	HEX HEAD CAPSCREW-1/4-20UNC X 1/2	4
-12	902	COVER PLATE	1
-13	60702	HEX NUT-5/16-18UNC	4
-14	63302	LOCKWASHER-5/16	4
-15	16215	STRAIN RELIEF	1
-16	2806	STRAIN RELIEF	2
-17	16105	LOCK NUT	1
-18	2808	LOCK NUT	2
-19	22572	DECAL- AERIAL CONTROL SWITCHES	1
-20	20444	DECAL- 5^{O} SLOPE BOOM INOPERATIVE	1
-21	4019	TOGGLE SWITCH	1
-22	20805	ALARM BUZZER	1
-23	117E	PUSH ON TERMINAL	4
-24	2859	RING TONGUE	7
-25	20543	DECAL-DUAL FUEL INSTALLATION	1
-26	20884	SWITCH GUARD	2
-27	20580	POTENTIOMETER ASSEMBLY	1
-28	902	COVER PLATE	1
-29	20479	KNOB	1
-30	20581	CONTROLLER LOCK-OUT	1
-31	20539	CONTROLLER HANDLE ASSEMBLY	1
-32	20597	GASKET	1

ITEM	PART NUMBER	DESCRIPTION	QTY
-33	20598	GASKET-CENTER COVER	1

FIGURE 25A - AERIAL CONTROL STATION ASSEMBLY



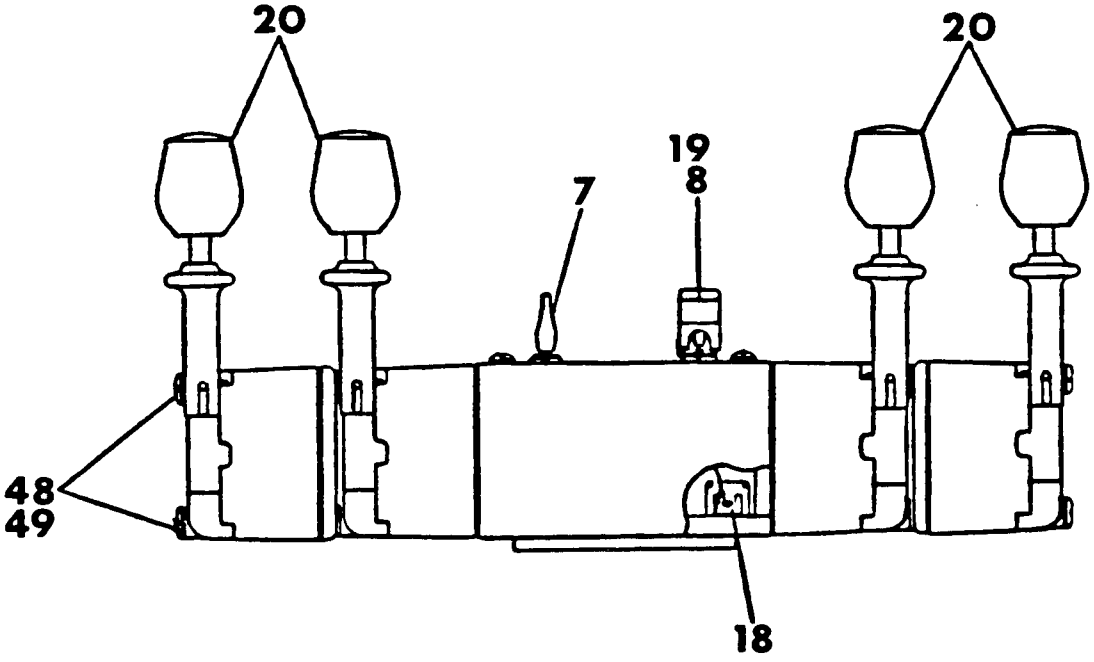
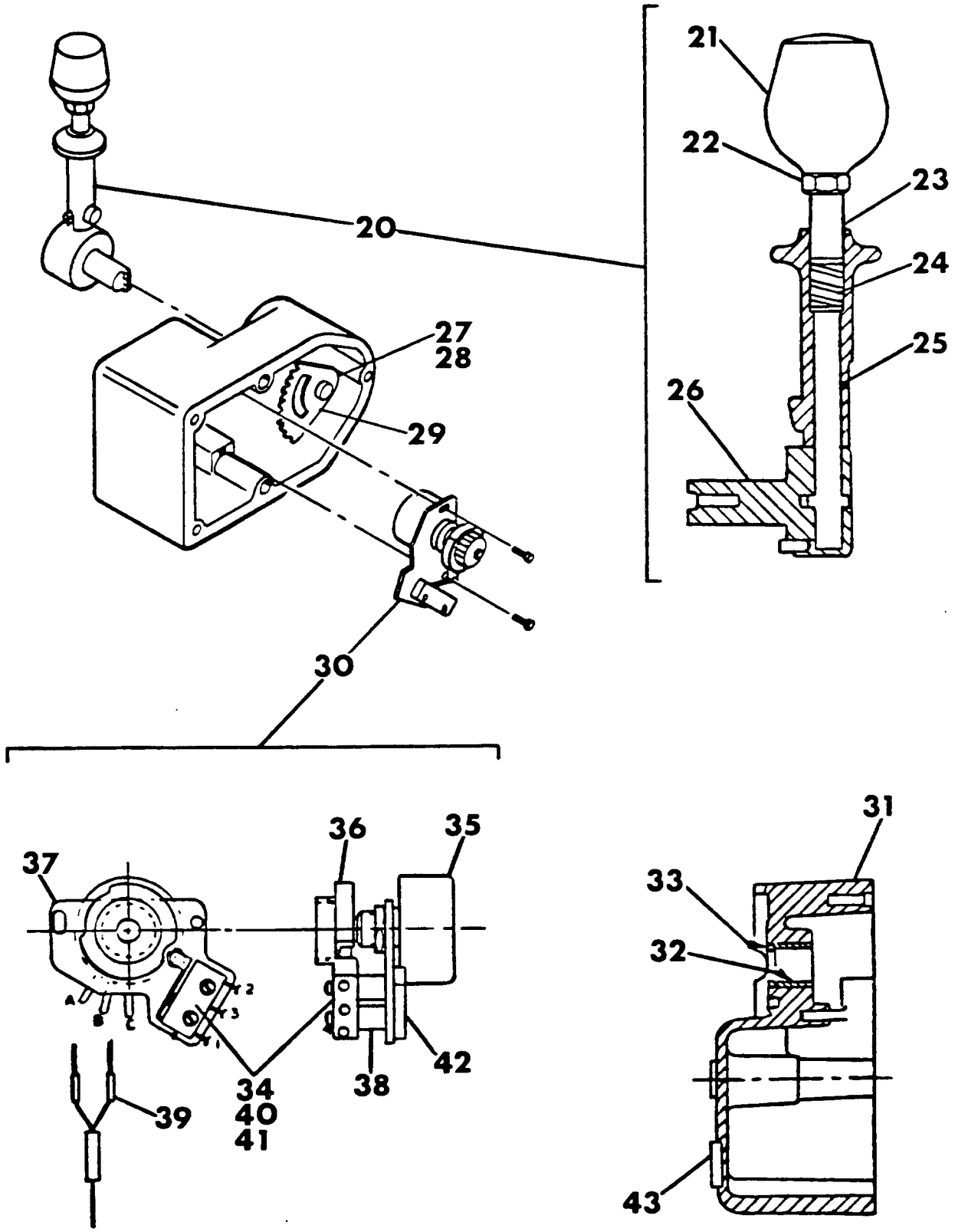


FIGURE 25A - AERIAL CONTROL STATION ASSEMBLY



REV.1 11-83	FIGURE 25A - AERIAL CONTROL STATION ASSEMBLY	67.3

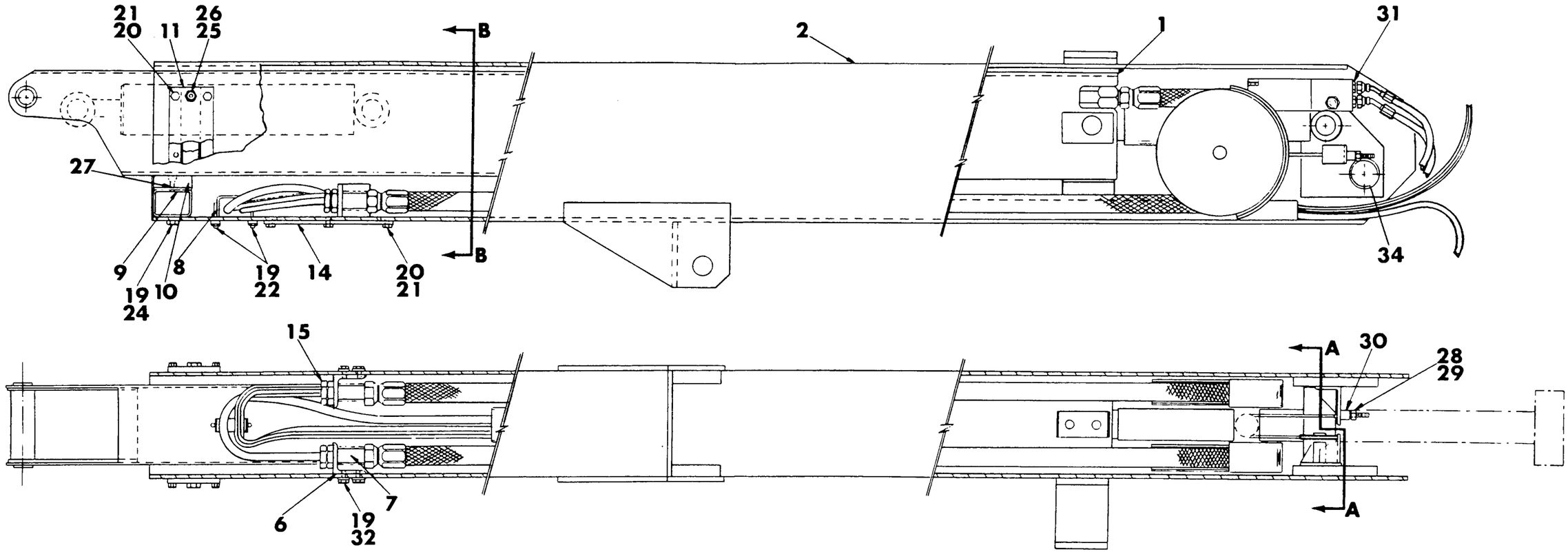
ITEM	PART NUMBER	DESCRIPTION	QTY
25A-	20392	AERIAL CONTROL STATION ASSEMBLY (PQ)	1
-1	2962	LIFT CONTROLLER ASSEMBLY	1
-2	2959	ROTATION CONTROLLER ASSEMBLY	1
-3	2960	EXTENSION CONTROLLER ASSEMBLY	1
-4	2963	DRIVE CONTROLLER ASSEMBLY	1
-5	16907	CENTER HOUSING	1
-6	16908	SWITCH MOUNTING PLATE	1
-7	20618	MOMENTARY SWITCH	2
-8	16912	SWITCH GUARD (RED)	1
-9	16901	LIFT METAL DECAL	1
-10	16910	ROTATION METAL DECAL	1
-11	16905	EXTENSION METAL DECAL	1
-12	16909	DRIVE METAL DECAL	1
-13	16913	SWITCH MOUNTING PLATE (USED ON S21 ONLY)	1
-14	16914	CONTROLLER CABLE	1
-15	20597	CONTROLLER HOUSING GASKET	4
-16	16900	CONTROLLER HOUSING COVER PLATE	2
-17	20598	SWITCH PLATE MOUNTING GASKET	1
-18	66161	TERMINAL STRIP	2
-19	4021	START/STOP SWITCH	1
-20	20539	CONTROLLER HANDLE ASSEMBLY	4
-21	20479	CONTROLLER KNOB W/LOGO	4
-22	60708	5/16" HEX NUT	4
-23	16916	SAFETY LOCK SPACER	4
-24	16915	SAFETY LOCK SPRING	4
-25	20581	SAFETY LOCK	4
-26	16903	CONTROLLER HANDLE	4
-27	16904	TORSION SPRING	4
-28	16917	TORSION SPRING SPACER	4
-29	16906	SELECTOR GEAR	4
-30	20580	POTENTIOMETER ASSEMBLY	4
-31	* 16902	CONTROLLER HOUSING	4
-32	66222	BUSHING-CONTROLLER HOUSING	4

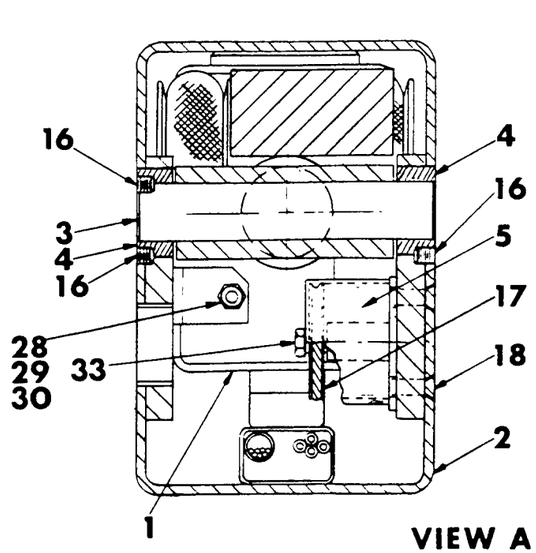
FIGURE 25A - AERIAL CONTROL STATION ASSEMBLY

ITEM	PART NUMBER	DESCRIPTION	QTY
-33	66223	O'RING-CONTROLLER HOUSING	4
-34	16918	MICROSWITCH	4
-35	66034	POTENTIOMETER ONLY	4
-36	66040	CAM & GEAR ASSEMBLY	4
-37	66489	SWITCH MOUNTING PLATE	4
-38	66490	NYLON SPACER	8
-39	66488	RESISTOR (82 OHM)	8
-40	66491	SWITCH MOUNTING SCREW	8
-41	66492	LOCK WASHER	8
-42	66493	SWITCH FASTENER PLATE	4
-43	66494	GROMMET	4
-44	66120	SWITCH DIODE (NOT USED)	4
-45	2806	STRAIN RELIEF	1
-46	66497	SCREW SWITCH PLATE	4
-47	66498	LOCK WASHER	4
-48	66496	CONTROLLER MOUNTING BOLT	4
-49	66495	SPACER MOUNTING BOLT	4

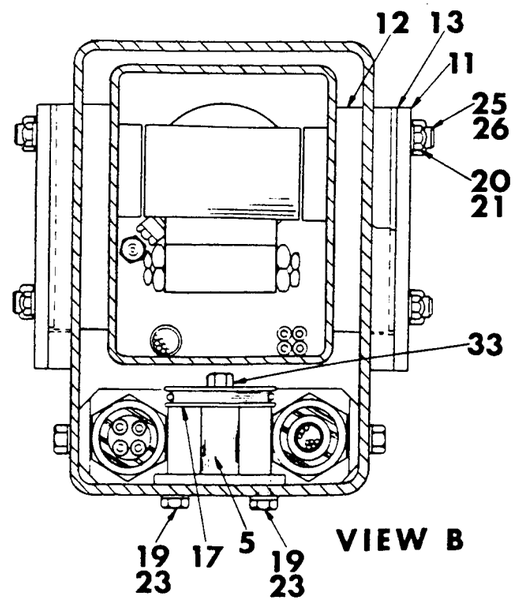
* NOTE:
SPECIFY INSIDE OR OUTSIDE HOUSING.

FIGURE 26 - FINAL BOOM ASSEMBLY (30I)
(2 SECTION)





VIEW A



VIEW B

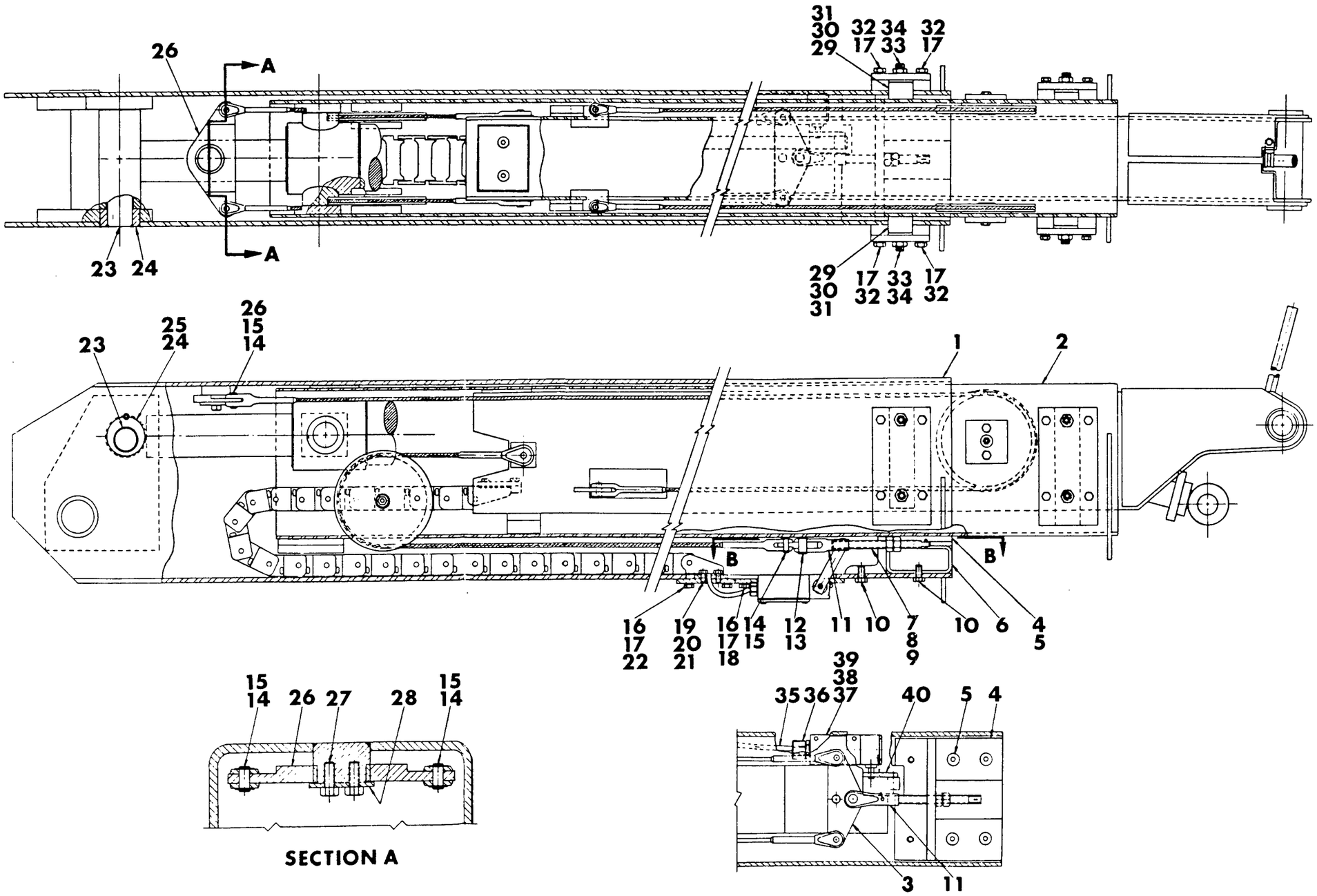
FIGURE 26 - FINAL BOOM ASSEMBLY (30I)
(2 SECTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
26-	20183	FINAL BOOM ASSEMBLY	1
-1	20433	INNER BOOM ASSEMBLY (SEE FIG. 27)	1
-2	20432	OUTER BOOM MACHINING	1
-3	20267	EXTENSION CYLINDER PIN	1
-4	20268	ECCENTRIC BUSHING	2
-5	20245	RETRACTION SHEAVE BRACKET	2
-6	20298	RETRACTION HOSE BRACKET	2
-7	20211	HOSE ADAPTER	2
-8	20277	HOLD DOWN BRACKET FOR HOSES	1
-9	20278	OUTER BOOM WEAR PAD BRACKET	1
-10	20284	WEAR PAD-OUTER BOOM	1
-11	20452	COVER FOR OUTER BOOM SIDE WEAR PAD	2
-12	20454	WEAR PAD-OUTER BOOM-SIDE	2
-13	20453	PAD PRESSURE PLATE	2
-14	20275	OUTER BOOM COVER PLATE	1
-15	2596	BULKHEAD LOCKNUT	4
-16	62203	HEX SOCKET HEAD SETSCREW-3/8-16UNC X 3/8	3
-17	20387	SHEAVE	2
-18	61802	HEX SOCKET FLAT HEAD CAPSCREW-3/8-24 UNF X 1 1/2	2
-19	63303	LOCKWASHER-3/8	10
-20	60114	HEX HEAD CAPSCREW-5/16-18UNC X 3/4	22
-21	63302	LOCKWASHER-5/16	18
-22	60703	HEX NUT-3/8-16UNC	2
-23	60202	HEX HEAD CAPSCREW-3/8-24UNC X 5/8	2
-24	60102	HEX HEAD CAPSCREW-3/8-16UNC X 1	2
-25	62204	HEX SOCKET HEAD SETSCREW-1/2-13UNC X 1	4
-26	61101	JAM HEX NUT-1/2-13UNC	4
-27	61804	HEX SOCKET FLAT HEAD CAPSCREW-3/8-16 UNC X 1	2
-28	63403	FLAT WASHER-3/8	1
-29	60703	HEX NUT-3/8-16UNC	2
-30	25053	ROUND TUBING-3/4	1

FIGURE 26 - FINAL BOOM ASSEMBLY (30I)
(2 SECTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
-31	2542	STRAIGHT THREAD CONNECTOR	2
-32	60607	HEX HEAD CAPSCREW-3/8-16UNC X 3/4-BOWMALOK 41012	4
-33	60608	HEX HEAD CAPSCREW-5/16-18UNC X 1 1/4-BOWMALOK 41008	2
-34	21782	BUSHING	2

FIGURE 26.1 - FINAL BOOM ASSEMBLY (30I) (3 SECTION)



SECTION A

SECTION B

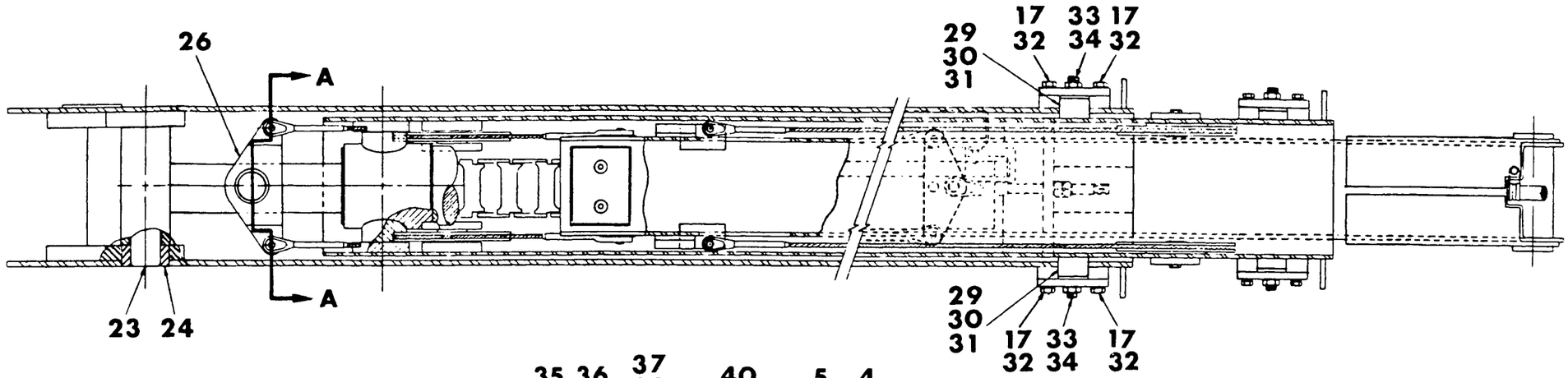
FIGURE 26.1 - FINAL BOOM ASSEMBLY (30I)
(3 SECTION)

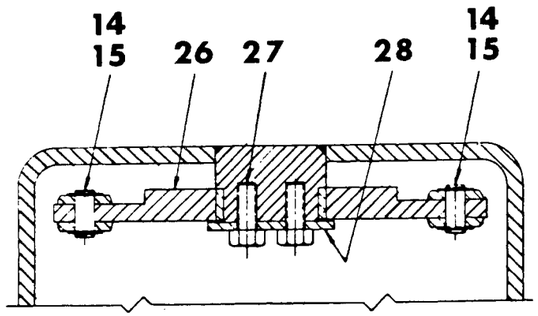
ITEM	PART NUMBER	DESCRIPTION	QTY
26.1-	22535	FINAL BOOM ASSEMBLY	1
-1	22538	OUTER BOOM MACHINING	1
-2	22536	INTERMEDIATE BOOM ASSEMBLY (SEE FIG. 26B)	1
-3	22549	RETRACTION CABLE LEVER	1
-4	22570	WEAR PAD	2
-5	61805	SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1	4
-6	22545	BOOM END BRACKET	1
-7	22594	THREADED SLEEVE	1
-8	60801	HEX NUT - 1/2-20 UNF	2
-9	64301	COTTER PIN - 1/8 DIA. X 1	1
-10	60607	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 BOWMALOK 41012	4
-11	65477	TERMINAL	1
-12	22548	PIN	1
-13	65081	SNAP RING	2
-14	22547	CABLE PIN	2
-15	65080	SNAP RING	8
-16	60367	HEX HEAD CAP SCREW - 5/16-18 UNC X 5/8 (GR. 5)	8
-17	63302	SPLIT LOCKWASHER - 5/16	16
-18	22563	ACCESS COVER	1
-19	60631	HEX HEAD CAP SCREW - 1/4-20 UNC X 5/8 BOWMALOK 41000-1	4
-20	22586	LEFT HAND STATIONARY MOUNTING BRACKET	1
-21	22585	RIGHT HAND STATIONARY MOUNTING BRACKET	1
-22	22541	PLASTITRAK BRACKET	1
-23	20267	BOOM EXTENSION CYLINDER PIN	1
-24	20268	ECCENTRIC BUSHING	2
-25	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	2
-26	22546	EXTENSION LEVER CABLE	1
-27	60603	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 BOWMALOK 41006	2

FIGURE 26.1 - FINAL BOOM ASSEMBLY (30I)
(3 SECTION)

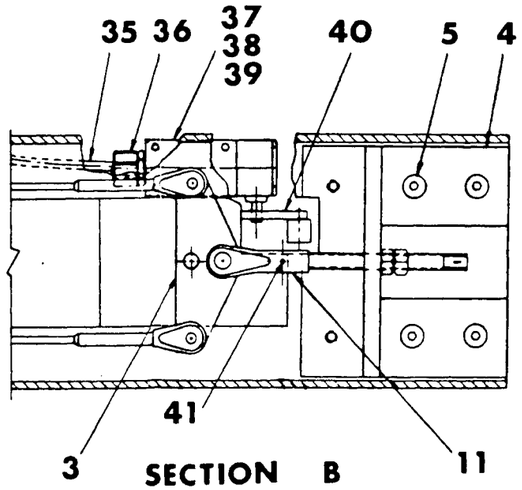
ITEM	PART NUMBER	DESCRIPTION	QTY
-28	22593	RETAINER	1
-29	22172	WEAR PAD	2

FIGURE 26.2 - FINAL BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)





SECTION A



SECTION B

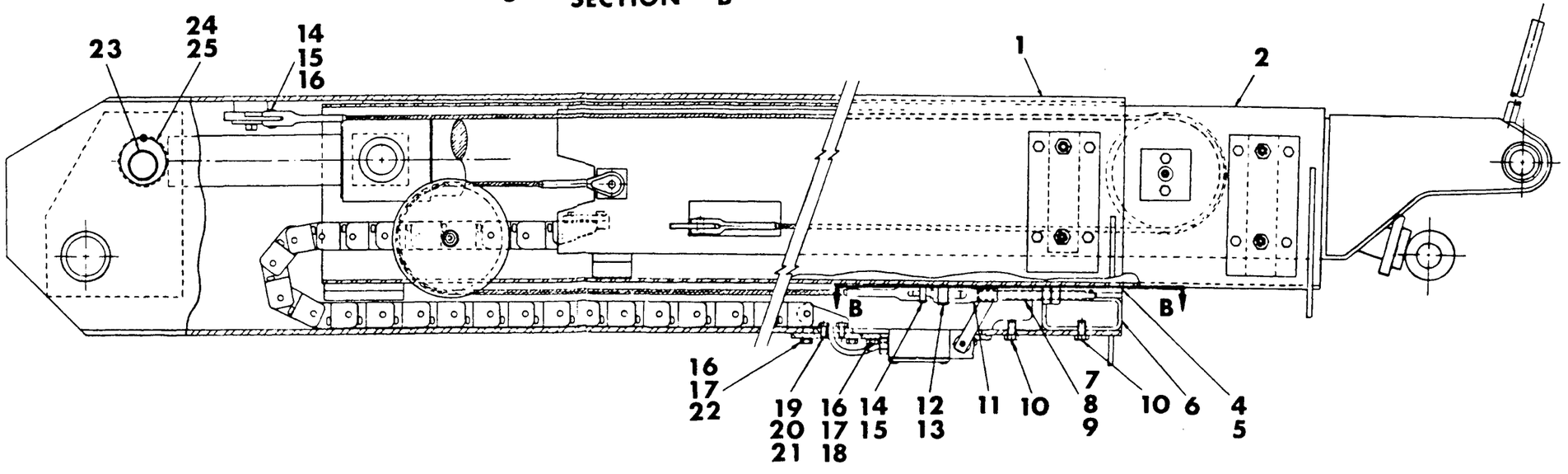
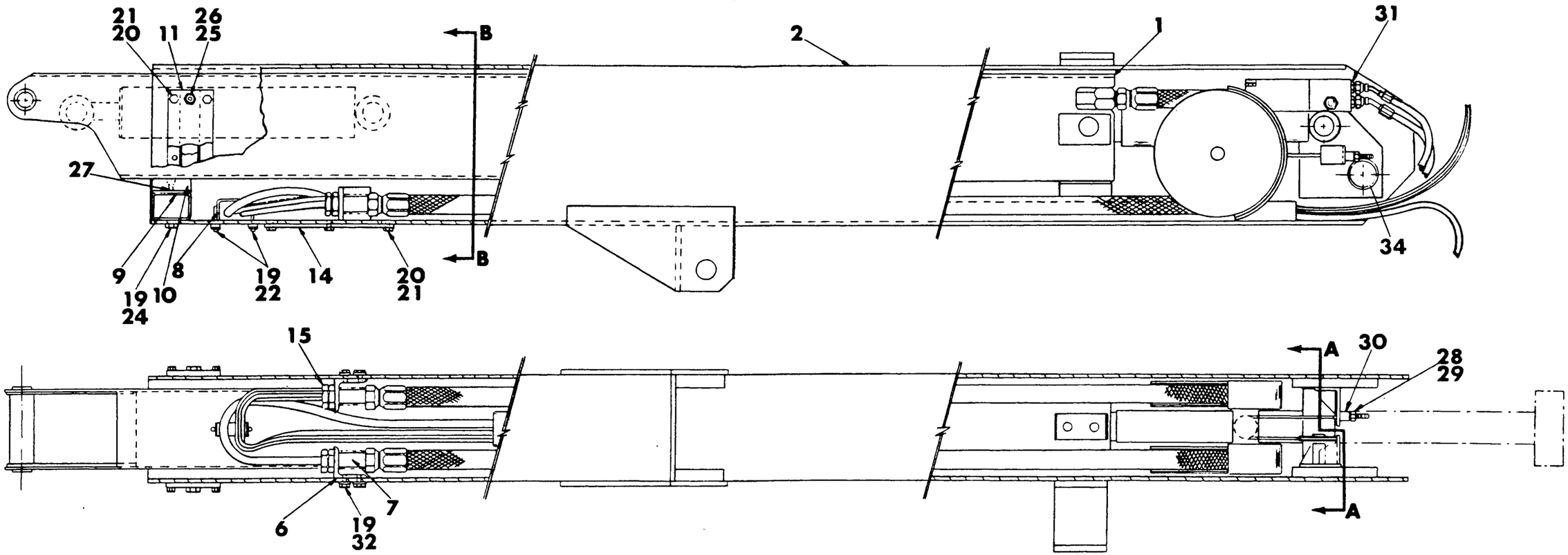


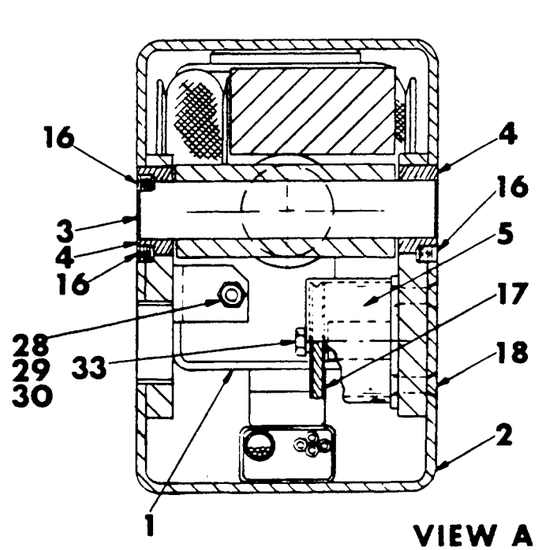
FIGURE 26.2 - FINAL BOOM ASSEMBLY (30I)
(3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
26.2-	22535	FINAL BOOM ASSEMBLY	1
-1	22538	OUTER BOOM MACHINING	1
-2	22536	INTERMEDIATE BOOM ASSEMBLY (SEE FIG. 26C)	1
-3	22549	RETRACTION CABLE LEVER	1
-4	22570	WEAR PAD	2
-5	61805	SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1	4
-6	22545	BOOM END BRACKET	1
-7	22594	THREADED SLEEVE	1
-8	60801	HEX NUT - 1/2-20 UNF	2
-9	64301	COTTER PIN - 1/8 DIA. X 1	1
-10	60607	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 BOWMALOK 41012	4
-11	65477	TERMINAL	1
-12	22548	PIN	1
-13	65081	SNAP RING	2
-14	22547	CABLE PIN	2
-15	65080	SNAP RING	8
-16	60367	HEX HEAD CAP SCREW - 5/16-18 UNC X 5/8 (GR. 5)	8
-17	63302	SPLIT LOCKWASHER - 5/16	16
-18	22563	ACCESS COVER	1
-19	60631	HEX HEAD CAP SCREW - 1/4-20 UNC X 5/8 BOWMALOK 41000-1	4
-20	22586	LEFT HAND STATIONARY MOUNTING BRACKET	1
-21	22585	RIGHT HAND STATIONARY MOUNTING BRACKET	1
-22	22541	PLASTITRAK BRACKET	1
-23	20267	BOOM EXTENSION CYLINDER PIN	1
-24	20268	ECCENTRIC BUSHING	2
-25	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	2
-26	22546	EXTENSION LEVER CABLE	1
-27	60603	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 BOWMALOK 41006	2
-28	22593	RETAINER	1
-29	22172	WEAR PAD	2

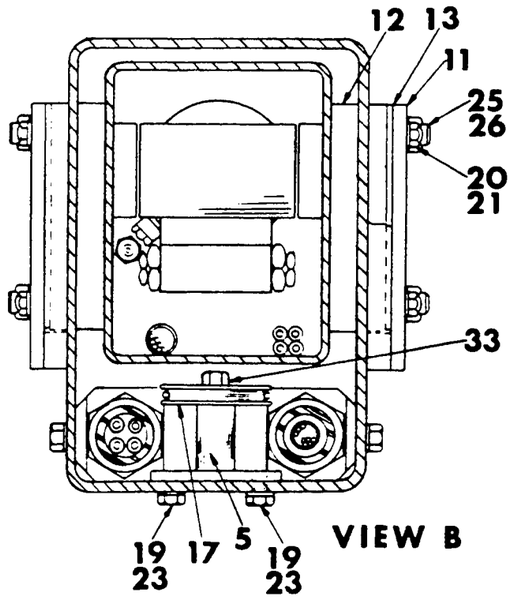
FIGURE 26.2 - FINAL BOOM ASSEMBLY (30I)
(3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
-30	20453	PRESSURE PLATE PAD	2
-31	20452	PRESSURE PAD COVER	2
-32	60338	HEX HEAD CAP SCREW - 5/16-18 UNC X 1 (GR. 5)	8
-33	62204	HEX SOCKET HEAD SET SCREW - 1/2-13 UNC X 1	4
-34	61101	HEX JAM NUT - 1/2-13 UNC	4
-35	70036-168	ELECTRICAL CABLE	1
-36	2806	STRAIN RELIEF	1
-37	70107	LIMIT SWITCH	1
-38	62615	ROUND HEAD SLOTTED MACHINE SCREW - NO. 10-32 UNF X 1 3/4	2
-39	63313	SPLIT LOCK WASHER - NO. 10	2
-40	70148	ARM LEVER	1
-41	64204	ROLL PIN - 1/8 DIA. X 1" LG.	1


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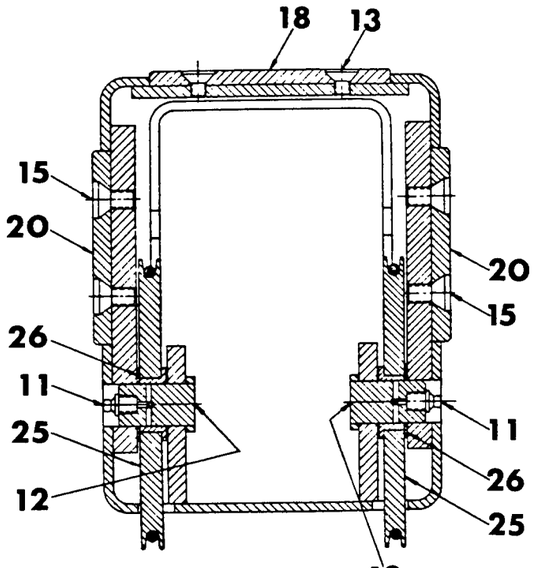
VIEW B

FIGURE 26A-FINAL BOOM ASSEMBLY (32)

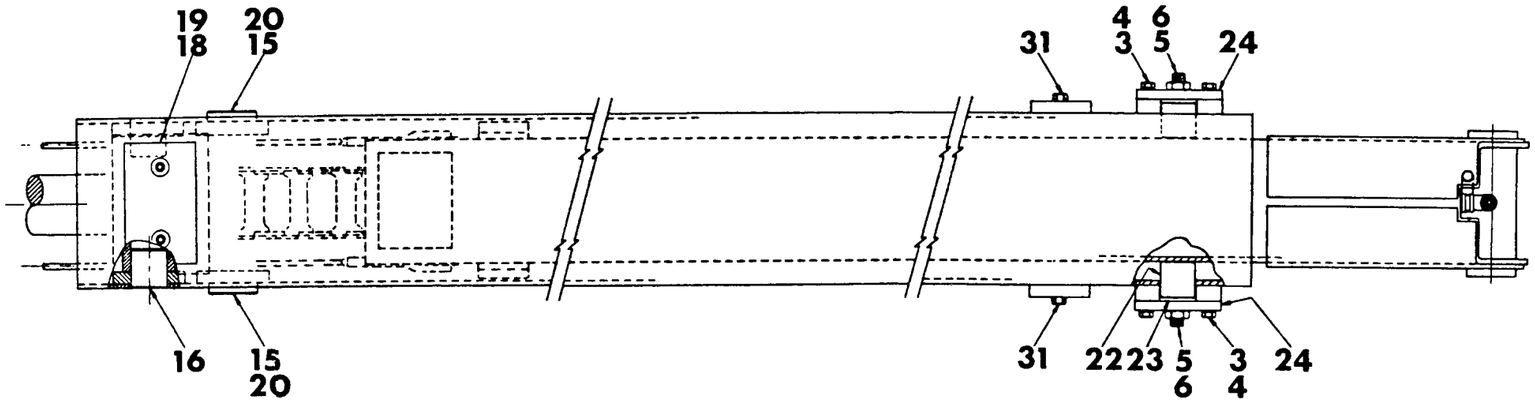
ITEM	PART NUMBER	DESCRIPTION	QTY
26A-	20182	FINAL BOOM ASSEMBLY	1
-1	20181	INNER BOOM ASSEMBLY (SEE FIG. 27)	1
-2	20219	OUTER BOOM MACHINING	1
-3	20267	EXTENSION CYLINDER PIN	1
-4	20268	ECCENTRIC BUSHING	2
-5	20245	RETRACTION SHEAVE BRACKET	2
-6	20298	RETRACTION HOSE BRACKET	2
-7	20211	HOSE ADAPTER	2
-8	20277	HOLD DOWN BRACKET FOR HOSES	1
-9	20278	OUTER BOOM WEAR PAD BRACKET	1
-10	20284	WEAR PAD-OUTER BOOM	1
-11	20452	COVER FOR OUTER BOOM SIDE WEAR PAD	2
-12	20454	WEAR PAD-OUTER BOOM-SIDE	2
-13	20453	PAD PRESSURE PLATE	2
-14	20275	OUTER BOOM COVER PLATE	1
-15	2596	BULKHEAD LOCKNUT	4
-16	62203	HEX SOCKET HEAD SETSCREW-3/8-16UNC X 3/8	3
-17	20387	SHEAVE	2
-18	61802	HEX SOCKET FLAT HEAD CAPSCREW-3/8-24 UNF X 1 1/2	2
-19	63303	LOCKWASHER-3/8	10
-20	60114	HEX HEAD CAPSCREW-5/16-18UNC X 3/4	18
-21	63302	LOCKWASHER-5/16	18
-22	60703	HEX NUT-3/8-16UNC	2
-23	60202	HEX HEAD CAPSCREW-3/8-24UNC X 5/8	2
-24	60102	HEX HEAD CAPSCREW-3/8-16UNC X 1	2
-25	62204	HEX SOCKET HEAD SETSCREW-1/2-13UNC X 1	4
-26	61101	JAM HEX NUT-1/2-13UNC	4
-27	61804	HEX SOCKET FLAT HEAD CAPSCREW-3/8-24 UNF X 1	2
-28	63403	FLAT WASHER-3/8	1
-29	60703	HEX NUT-3/8-16UNC	2
-30	25053	ROUND TUBING-3/4	1

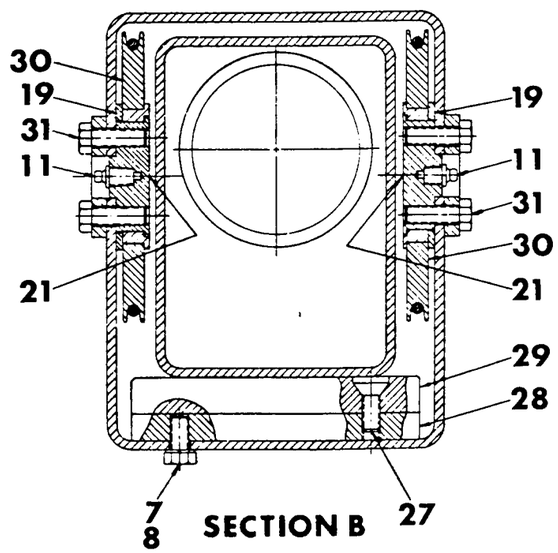
ITEM	PART NUMBER	DESCRIPTION	QTY
-31	2542	STRAIGHT THREAD CONNECTOR	2
-32	60607	HEX HEAD CAPSCREW-3/8-16UNC X 3/4-BOWMALOK 41012	4
-33	60608	HEX HEAD CAPSCREW-5/16-18UNC X 1 1/4-BOWMALOK 41008	2
-34	21782	BUSHING	2

FIGURE 26B - INTERMEDIATE BOOM ASSEMBLY (30I) (3 SECTION)



SECTION A





SECTION B

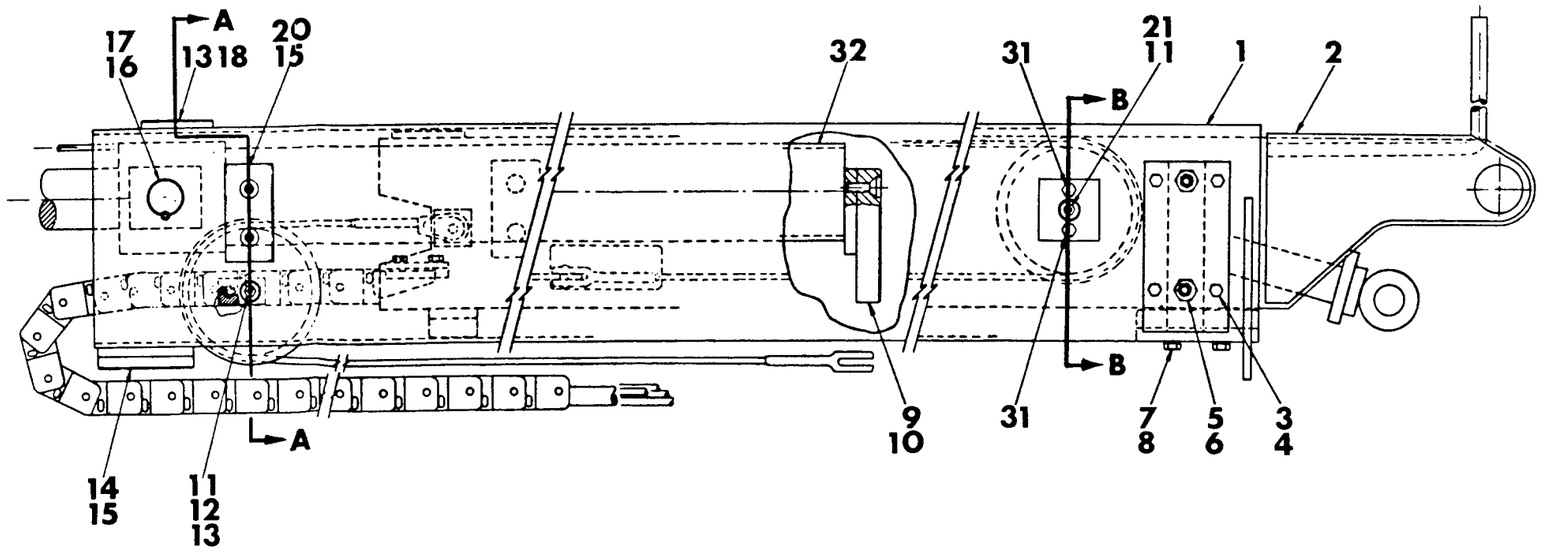


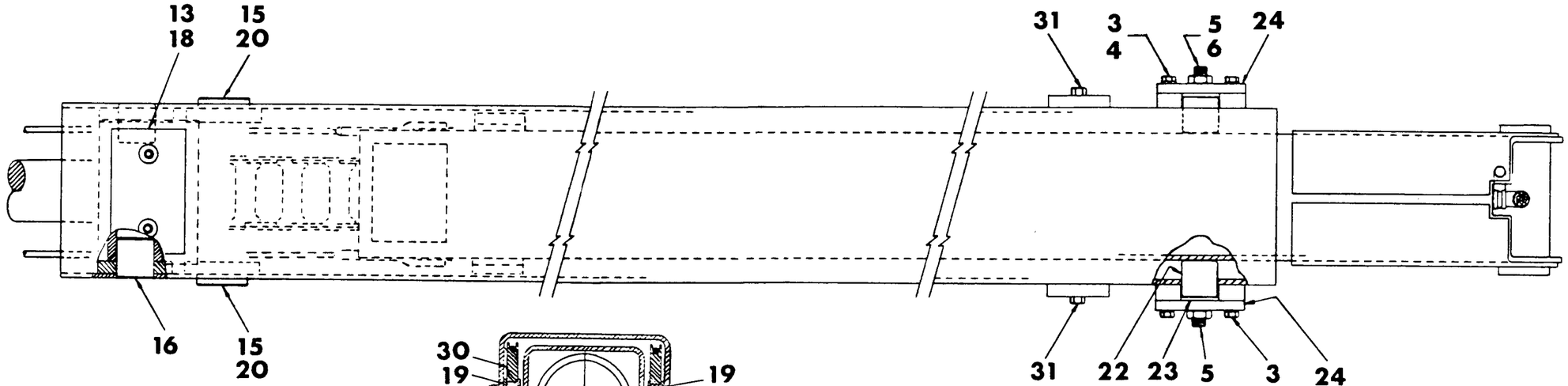
FIGURE 26B - INTERMEDIATE BOOM ASSEMBLY
(30I) (3 SECTION)

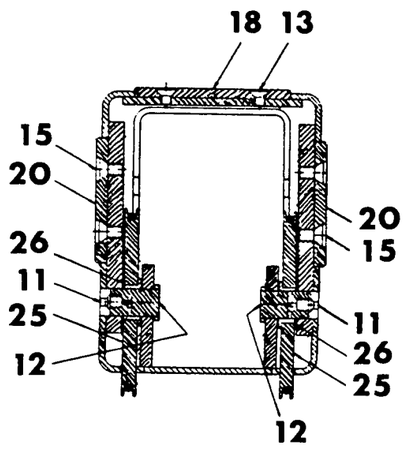
ITEM	PART NUMBER	DESCRIPTION	QTY
26B-	22536	INTERMEDIATE BOOM ASSEMBLY	1
-1	22527	INTERMEDIATE BOOM MACHINING	1
-2	22537	INNER BOOM ASSEMBLY (SEE FIG. 27.1)	1
-3	60338	HEX HEAD CAP SCREW - 5/16-18 UNC X 1	8
-4	63302	SPLIT LOCK WASHER - 5/16	8
-5	61101	JAM NUT - 1/2-13 UNC	4
-6	62204	SOCKET HEAD SET SCREW - 1/2-13 UNC X 1	4
-7	60325	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 (GR. 5)	4
-8	63303	SPLIT LOCK WASHER - 3/8	4
-9	22565	WEAR PAD	1
-10	61806	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF 1 1/4	2
-11	65103	GREASE FITTING - 1/8 NPT	4
-12	22543	CABLE SHEAVE PIN	2
-13	61822	FLAT SOCKET HEAD CAP SCREW - 5/16-24 UNF X 1/2	4
-14	22569	WEAR PAD	2
-15	61801	FLAT SOCKET HEAD CAP SCREW - 24 UNF X 3/4	8
-16	20266	TRUNNION PIN	2
-17	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	2
-18	22558	WEAR PAD	1
-19	22590	THRUST WASHER	2
-20	22561	WEAR PAD	2
-21	22544	CABLE SHEAVE PIN	2
-22	22562	WEAR PAD	2
-23	20453	PRESSURE PAD PLATE	2
-24	20452	PRESSURE PAD COVER	2
-25	22540	CABLE SHEAVE	2
-26	65476	THRUST WASHER	2
-27	61805	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1	2
-28	22564	WEAR PAD SUPPORT	1

FIGURE 26B - INTERMEDIATE BOOM ASSEMBLY
(30I) (3 SECTION)

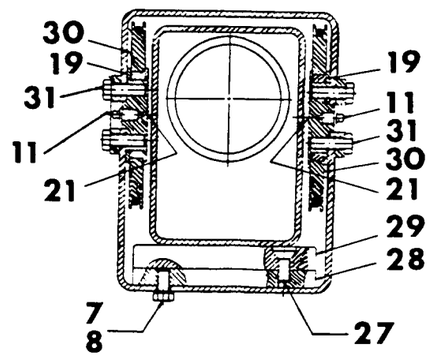
ITEM	PART NUMBER	DESCRIPTION	QTY
-29	22566	WEAR PAD	1
-30	22592	CABLE SHEAVE	2
-31	60643	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 1/8	4
-32	22582	BOOM EXTENSION CYLINDER ASSEMBLY (SEE FIG. 30.1)	1

FIGURE 26C - INTERMEDIATE BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)





SECTION A



SECTION B

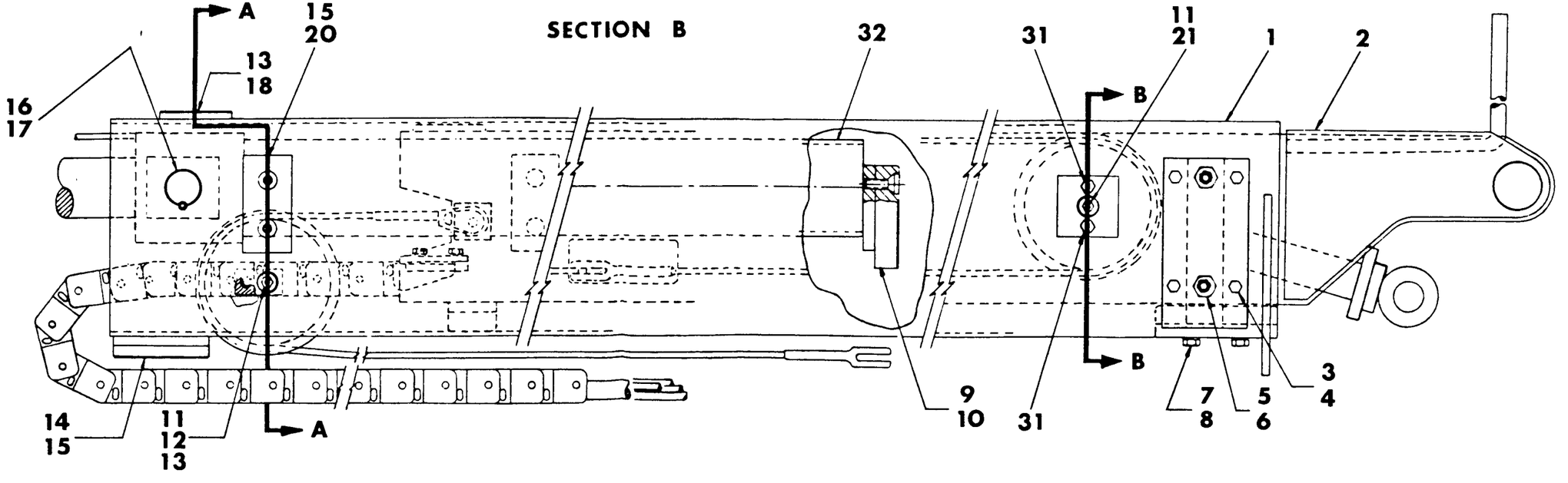


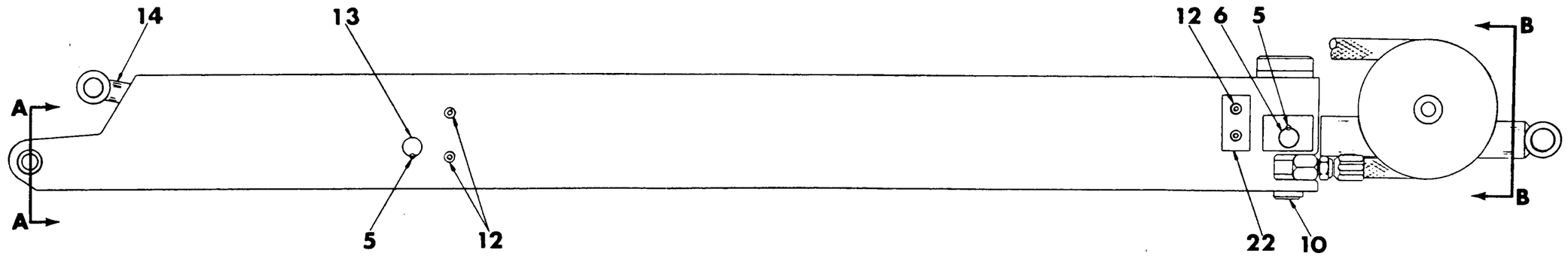
FIGURE 26C - INTERMEDIATE BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
26C-	22536	INTERMEDIATE BOOM ASSEMBLY	1
-1	22527	INTERMEDIATE BOOM MACHINING	1
-2	22537	INNER BOOM ASSEMBLY (SEE FIG. 27.2)	1
-3	60338	HEX HEAD CAP SCREW - 5/16-18 UNC X 1	8
-4	63302	SPLIT LOCK WASHER - 5/16	8
-5	61101	JAM NUT - 1/2-13 UNC	4
-6	62204	SOCKET HEAD SET SCREW - 1/2-13 UNC X 1	4
-7	60325	HEX HEAD CAP SCREW - 3/8-16 UNC X 3/4 (GR. 5)	4
-8	63303	SPLIT LOCK WASHER - 3/8	4
-9	22565	WEAR PAD	1
-10	61806	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF 1 1/4	2
-11	65103	GREASE FITTING - 1/8 NPT	4
-12	22543	CABLE SHEAVE PIN	2
-13	61822	FLAT SOCKET HEAD CAP SCREW - 5/16-24 UNF X 1/2	4
-14	22569	WEAR PAD	2
-15	61801	FLAT SOCKET HEAD CAP SCREW - 24 UNF X 3/4	8
-16	20266	TRUNNION PIN	2
-17	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	2
-18	22558	WEAR PAD	1
-19	22590	THRUST WASHER	2
-20	22561	WEAR PAD	2
-21	22544	CABLE SHEAVE PIN	2
-22	22562	WEAR PAD	2
-23	20453	PRESSURE PAD PLATE	2
-24	20452	PRESSURE PAD COVER	2
-25	22540	CABLE SHEAVE	2
-26	65476	THRUST WASHER	2
-27	61805	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1	2
-28	22564	WEAR PAD SUPPORT	1

FIGURE 26C - INTERMEDIATE BOOM ASSEMBLY (30I)
(3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
-29	22566	WEAR PAD	1
-30	22592	CABLE SHEAVE	2
-31	60643	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 1/8	4
-32	22582	BOOM EXTENSION CYLINDER ASSEMBLY (SEE FIG. 30.1)	1

FIGURE 27 - INNER BOOM ASSEMBLY (30I)
(2 SECTION)



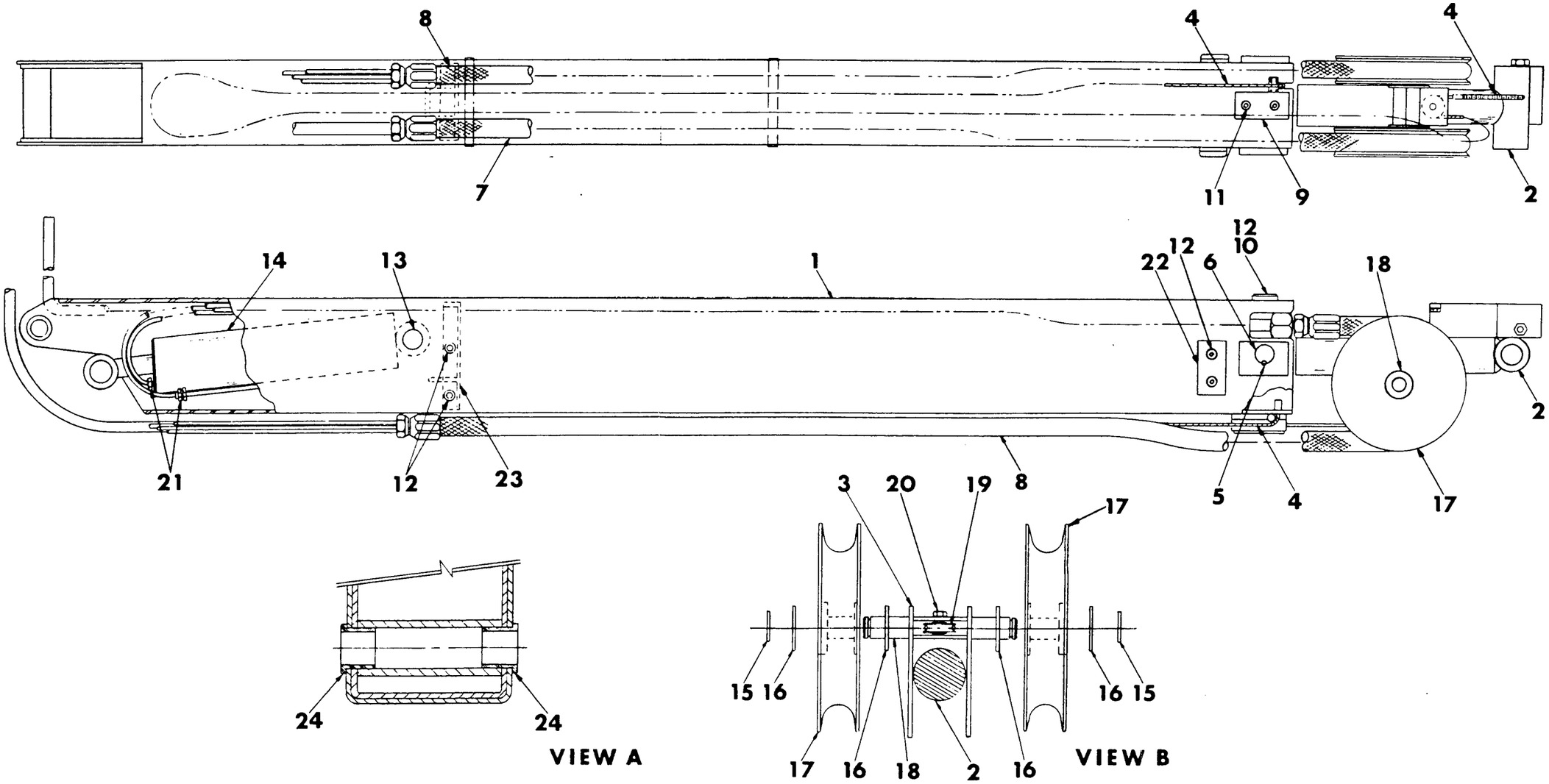
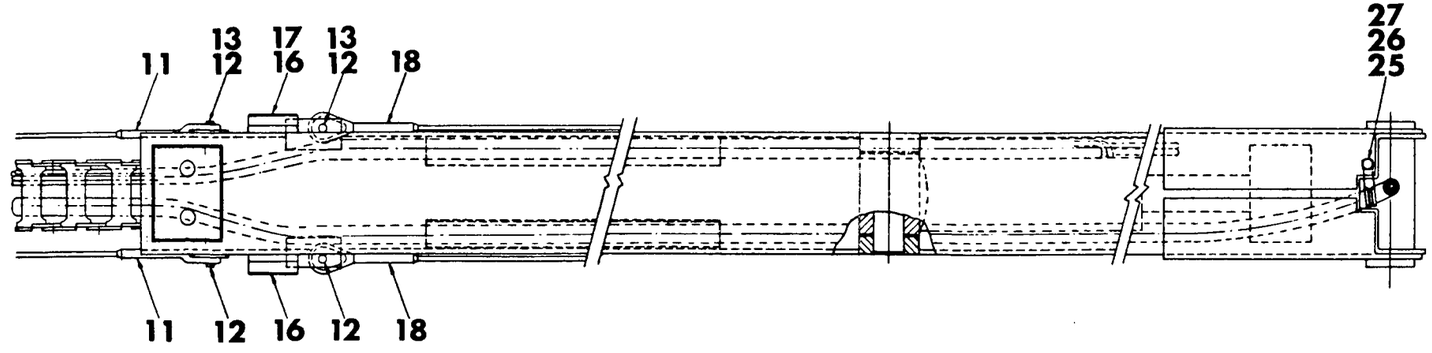
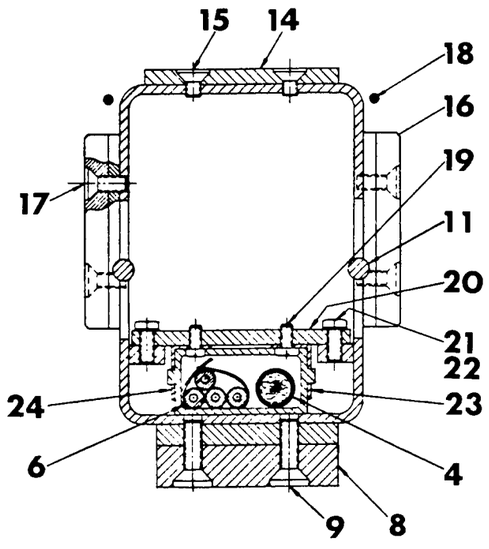


FIGURE 27 - INNER BOOM ASSEMBLY (30I) (2 SECTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
27-	20433	INNER BOOM ASSEMBLY	1
-1	20218	INNER BOOM MACHINING	1
-2	21258	BOOM EXTENSION CYLINDER (SEE FIG. 30)	1
-3	20297	SHEAVE BRACKET	1
-4	20428	RETRACTION CABLE ASSEMBLY	1
-5	62203	HEX SOCKET HEAD SET SCREW-3/8-16UNC X 3/8	3
-6	20266	TRUNNION PIN	2
-7	20431	ELECTRICAL HOSE ASSEMBLY	1
-8	20430	HYDRAULIC HOSE ASSEMBLY	1
-9	20281	WEAR PAD-BOTTOM	1
-10	20892	WEAR PAD-TOP	1
-11	61802	FLAT HEX SOCKET HEAD CAPSCREW-3/8-24UNF X 1 1/2	2
-12	61801	FLAT HEX SOCKET HEAD CAPSCREW-3/8-24UNF X 3/4	10
-13	20262	LEVELING CYLINDER PIN	1
-14	21711	SLAVE LEVELING CYLINDER ASSEMBLY (SEE FIG. 28)	1
-15	65075	SNAP RING	2
-16	63417	FLAT WASHER	4
-17	20247	SHEAVE-HYDRAULIC AND ELECTRICAL	2
-18	20265	SHEAVE PIN	1
-19	20388	CABLE SHEAVE	1
-20	60608	HEX HEAD CAPSCREW-5/16-18UNC X 1 1/4 BOWMALOK 41008	1
-21	65133	SWIVEL HOSE FITTING	2
-22	20280	WEAR PAD-SIDE	2
-23	20915	BULKHEAD PLATE	1
-24	20582	BUSHING	2

FIGURE 27.1 - INNER BOOM ASSEMBLY (30I) (3 SECTION)





SECTION A

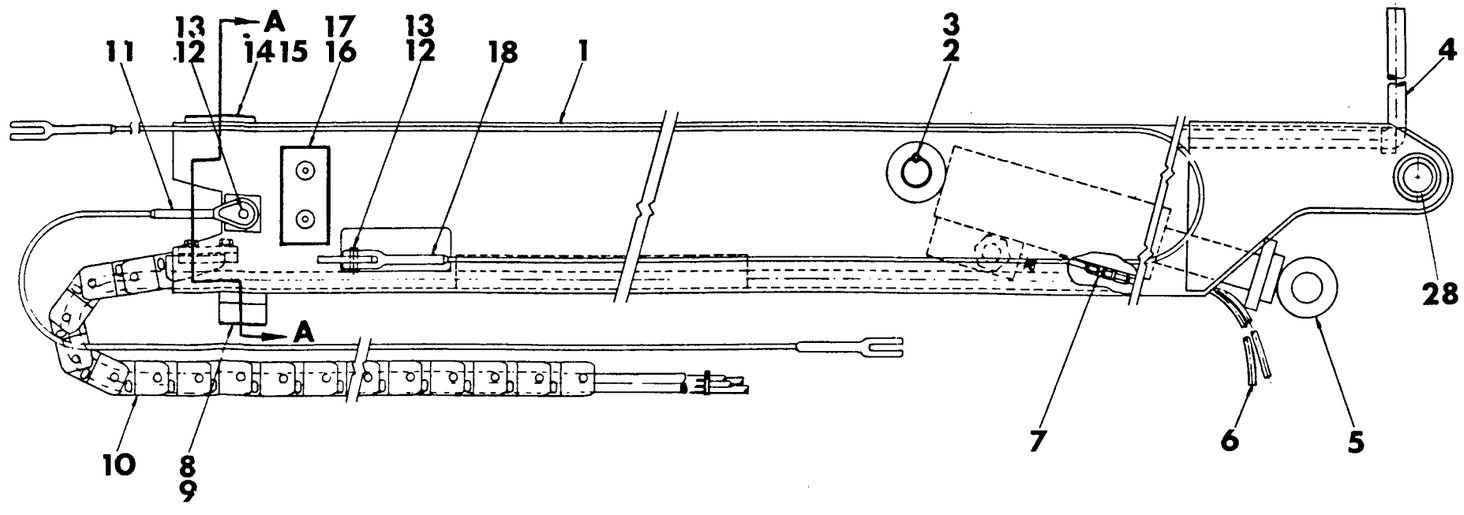


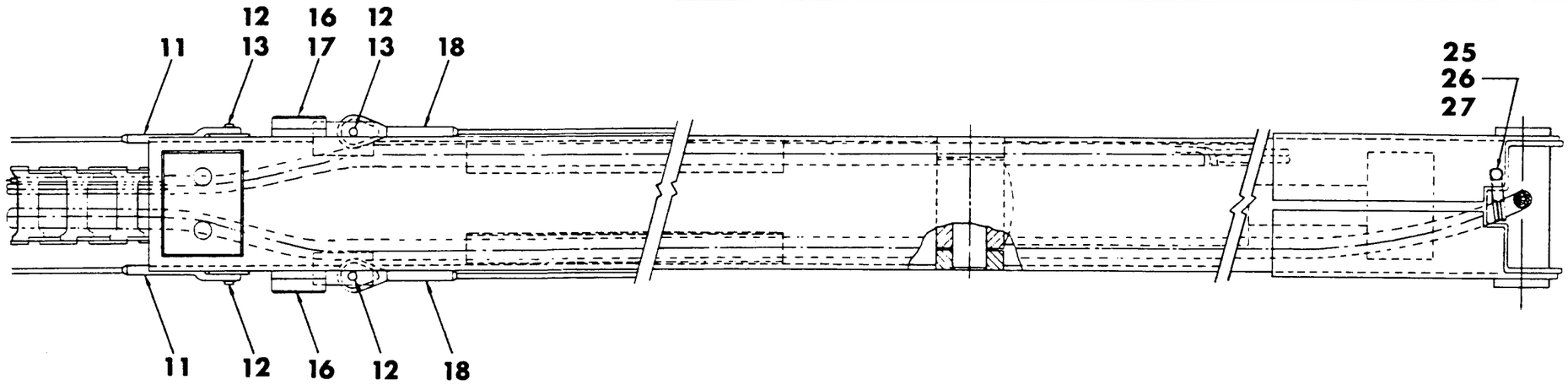
FIGURE 27.1 - INNER BOOM ASSEMBLY
(30I) (3 SECTION)

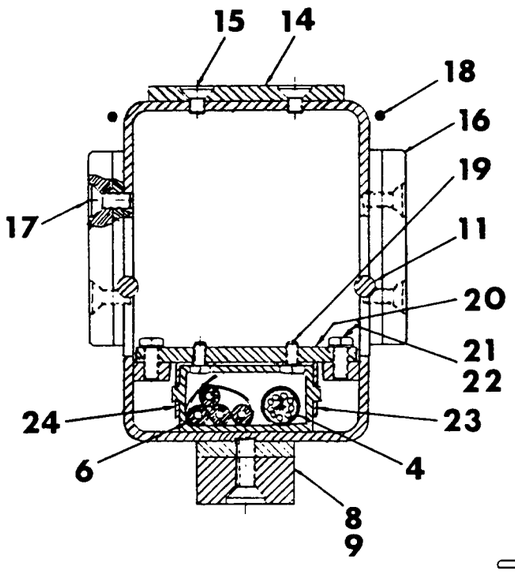
ITEM	PART NUMBER	DESCRIPTION	QTY
27.1-	22537	INNER BOOM ASSEMBLY	1
-1	22553	INNER BOOM MACHINING	1
-2	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	1
-3	22573	SLAVE LEVELING CYLINDER PIN	1
-4	20802	ELECTRICAL CABLE	1
-5	22584	SLAVE LEVELING CYLINDER ASSEMBLY (SEE FIG. 28A)	1
-6	2568	HYDRAULIC HOSE	1
-7	2562	STRAIGHT SWIVEL FITTING	2
-8	22568	WEAR PAD	1
-9	61806	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1 1/4	2
-10	22589	MARK TRACK ASSEMBLY	1
-11	22550	RETRACTION CABLE	2
-12	22547	CABLE PIN	4
-13	65080	SNAP RING	8
-14	22557	CABLE PIN	1
-15	61822	FLAT SOCKET HEAD CAP SCREW - 5/16-24 UNF X 1/2	2
-16	22567	WEAR PAD	2
-17	61801	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 3/4	4
-18	22551	CABLE EXTENSION	2
-19	60633	HEX HEAD CAP SCREW - 1/4-20 UNC X 1/2 BOWMALOK 41000	4
-20	22560	PLASTITRAK MOUNTING PLATE	1
-21	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 (GR. 5)	4
-22	63302	SPLIT LOCK WASHER - 5/16	4
-23	22588	LEFT HAND MOVABLE MOUNTING BRACKET	1
-24	22587	RIGHT HAND MOVABLE MOUNTING BRACKET	1
-25	60309	HEX HEAD CAP SCREW - 1/4-20 UNC X 3/4 (GR. 5)	1

FIGURE 27.1 - INNER BOOM ASSEMBLY
(30I) (3 SECTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
-26	60711	HEX NUT WITH NYLON INSERT - 1/4-20 UNC	1
-27	16268	RUBBER CLAMP	1
-28	20582	BUSHING	2

FIGURE 27.2 - INNER BOOM ASSEMBLY (30I) (3 SECTION) (MARK TRACK)





SECTION A

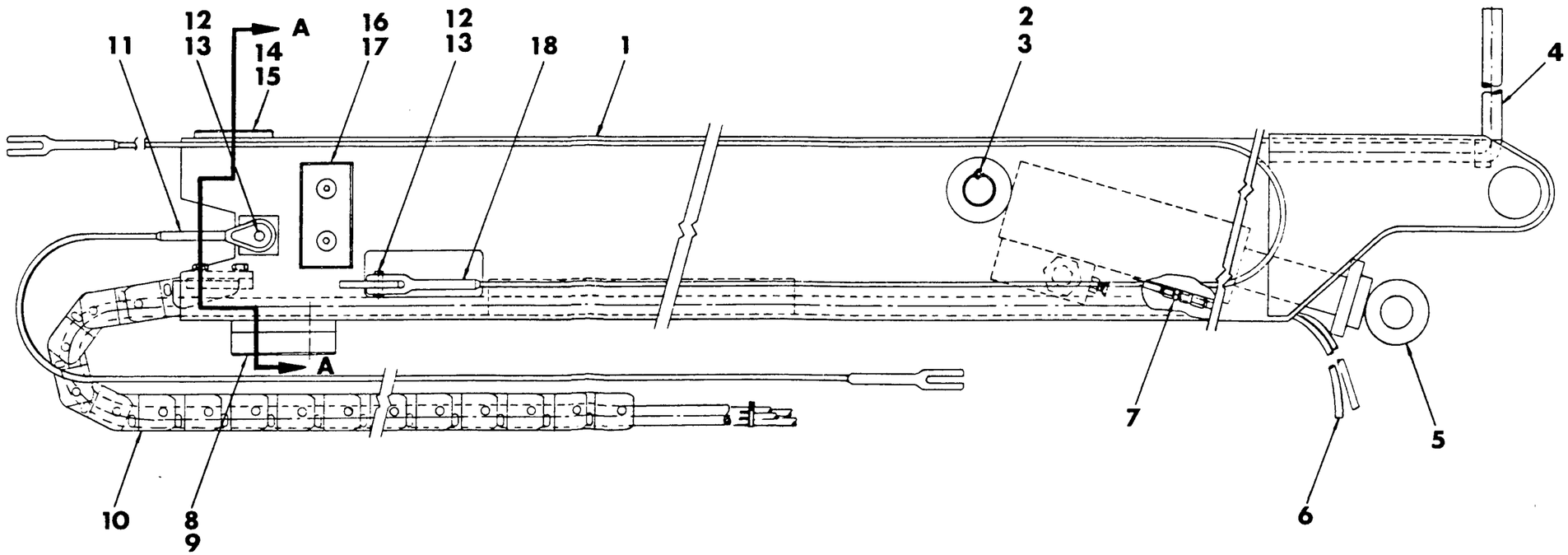


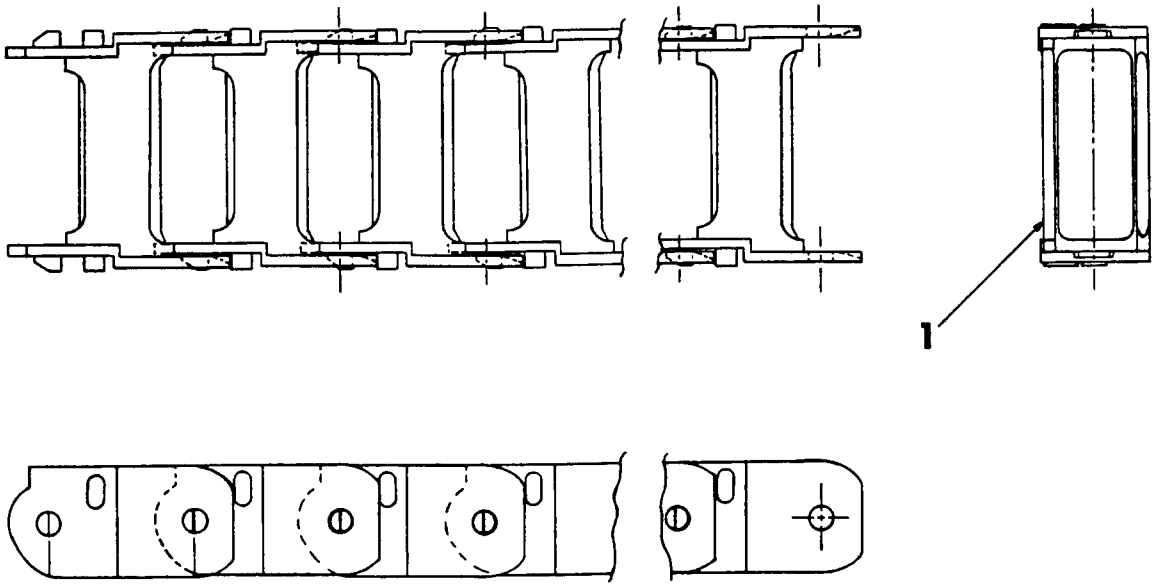
FIGURE 27.2 - INNER BOOM ASSEMBLY (30I)
(3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
27.2-	22537	INNER BOOM ASSEMBLY	1
-1	22553	INNER BOOM MACHINING	1
-2	62203	SOCKET HEAD SET SCREW - 3/8-16 UNC X 3/8	1
-3	22573	SLAVE LEVELING CYLINDER PIN	1
-4	20802	ELECTRICAL CABLE	1
-5	22584	SLAVE LEVELING CYLINDER ASSEMBLY (SEE FIG. 28B)	1
-6	2568	HYDRAULIC HOSE	1
-7	2562	STRAIGHT SWIVEL FITTING	2
-8	22568	WEAR PAD	1
-9	61806	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 1 1/4	2
-10	22589	MARK TRACK ASSEMBLY	1
-11	22550	RETRACTION CABLE	2
-12	22547	CABLE PIN	4
-13	65080	SNAP RING	8
-14	22557	CABLE PIN	1
-15	61822	FLAT SOCKET HEAD CAP SCREW - 5/16-24 UNF X 1/2	2
-16	22567	WEAR PAD	2
-17	61801	FLAT SOCKET HEAD CAP SCREW - 3/8-24 UNF X 3/4	4
-18	22551	CABLE EXTENSION	2
-19	60633	HEX HEAD CAP SCREW - 1/4-20 UNC X 1/2 BOWMALOK 41000	4
-20	22560	PLASTITRAK MOUNTING PLATE	1
-21	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 (GR. 5)	4
-22	63302	SPLIT LOCK WASHER - 5/16	4
-23	22588	LEFT HAND MOVABLE MOUNTING BRACKET	1
-24	22587	RIGHT HAND MOVABLE MOUNTING BRACKET	1
-25	60309	HEX HEAD CAP SCREW - 1/4-20 UNC X 3/4 (GR. 5)	1

FIGURE 27.2 - INNER BOOM ASSEMBLY (30I)
(3 SECTION) (MARK TRACK)

ITEM	PART NUMBER	DESCRIPTION	QTY
-26	60711	HEX NUT WITH NYLON INSERT - 1/4-20 UNC	1
-27	16268	RUBBER CLAMP	1

FIGURE 27.3 - MARK TRACK ASSEMBLY (30I) (3 SECTION)



ITEM	PART NUMBER	DESCRIPTION	QTY
27.3-	22589	MARK TRACK ASSEMBLY	1
-1	21933	MARK TRACK	56

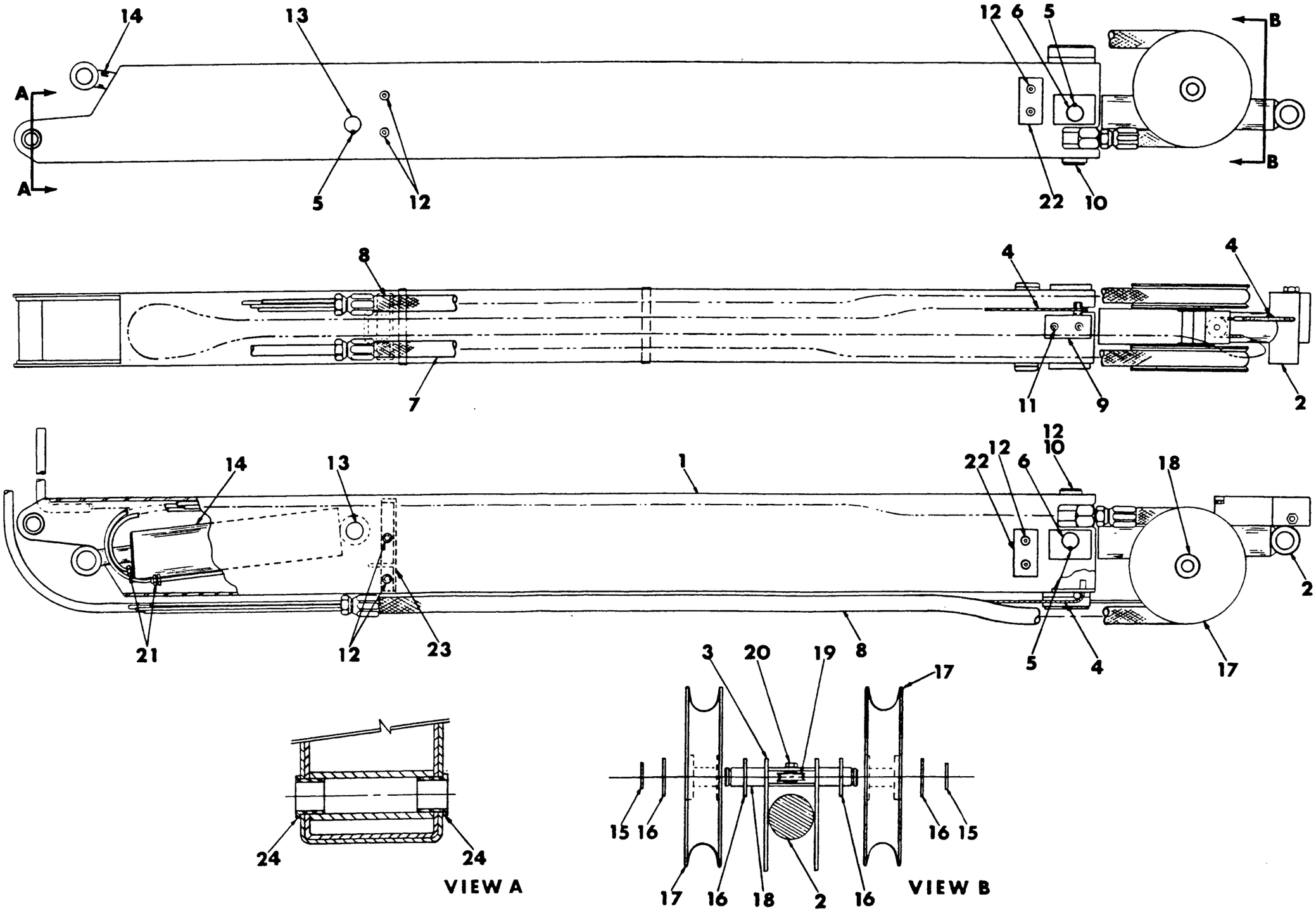
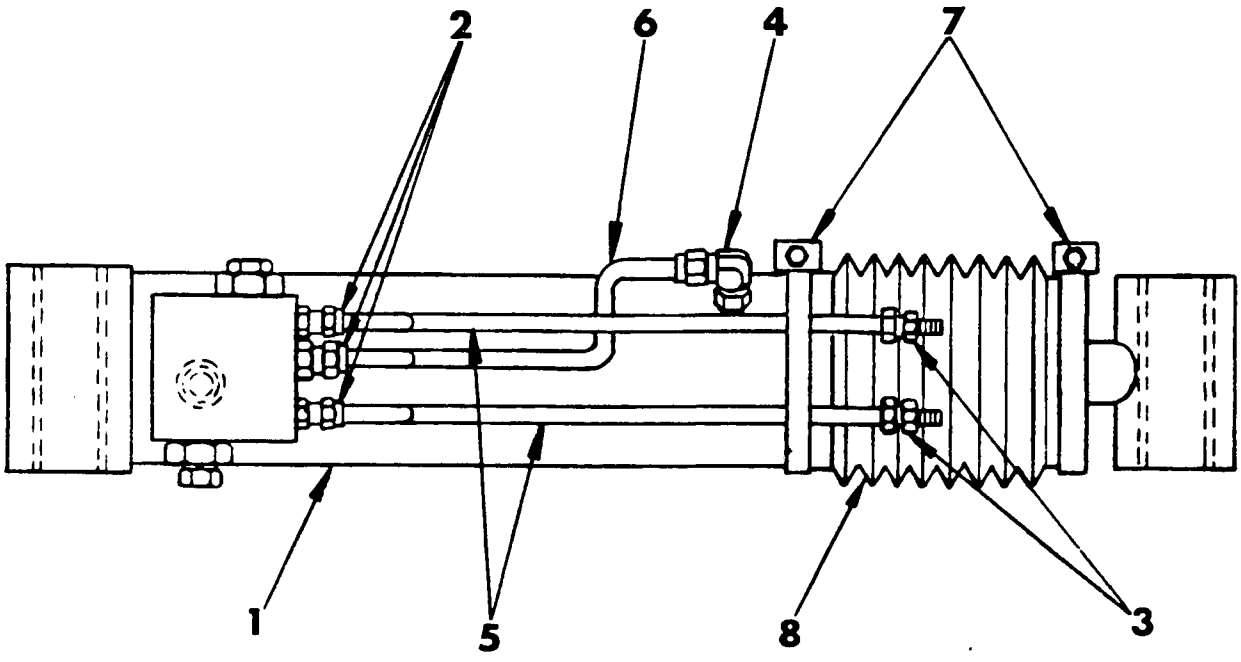

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VIEW B

FIGURE 27A-INNER BOOM ASSEMBLY (32)

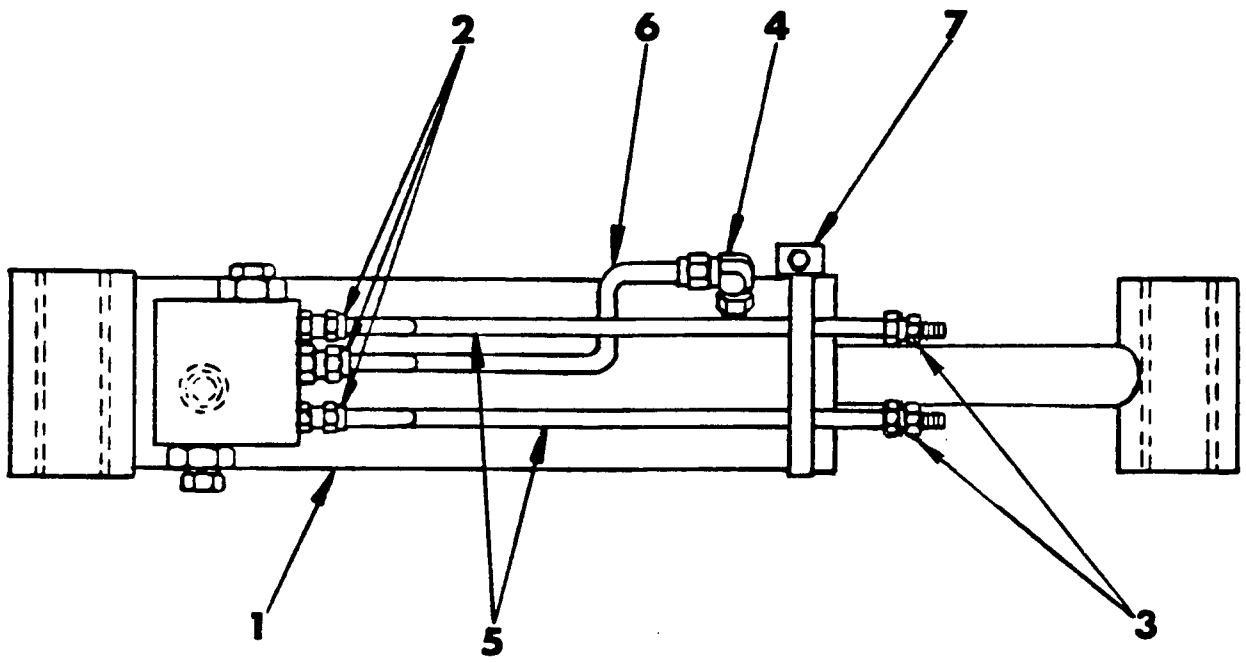
ITEM	PART NUMBER	DESCRIPTION	QTY
27A-	20181	INNER BOOM ASSEMBLY	1
-1	20218	INNER BOOM MACHINING	1
-2	21259	BOOM EXTENSION CYLINDER (SEE FIG. 30A)	1
-3	20297	SHEAVE BRACKET	1
-4	20309	RETRACTION CABLE ASSEMBLY	1
-5	62203	HEX SOCKET HEAD SET SCREW-3/8-16UNC X 3/8	3
-6	20266	TRUNNION PIN	2
-7	20327	ELECTRICAL HOSE ASSEMBLY	1
-8	20326	HYDRAULIC HOSE ASSEMBLY	1
-9	20281	WEAR PAD-BOTTOM	1
-10	20892	WEAR PAD-TOP	1
-11	61802	FLAT HEX SOCKET HEAD CAPSCREW-3/8-24UNF X 1 1/2	2
-12	61801	FLAT HEX SOCKET HEAD CAPSCREW-3/8-24UNF X 3/4	10
-13	20262	LEVELING CYLINDER PIN	1
-14	21711	SLAVE LEVELING CYLINDER ASSEMBLY (SEE FIG. 28)	1
-15	65075	SNAP RING	2
-16	63417	FLAT WASHER	4
-17	20247	SHEAVE-HYDRAULIC AND ELECTRICAL	2
-18	20265	SHEAVE PIN	1
-19	20388	CABLE SHEAVE	1
-20	60608	HEX HEAD CAPSCREW-5/16-18UNC X 1 1/4 BOWMALOK 41008	1
-21	65133	SWIVEL HOSE FITTING	2
-22	20280	WEAR PAD-SIDE	2
-23	20915	BULKHEAD PLATE	1
-24	20582	BUSHING	2

FIGURE 28 - SLAVE LEVELING CYLINDER ASSEMBLY (30I) (32)



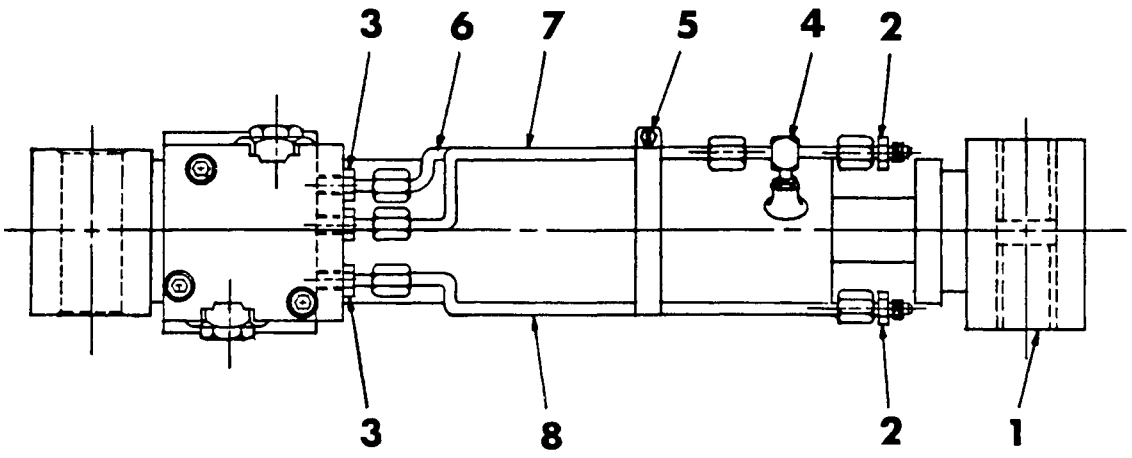
ITEM	PART NUMBER	DESCRIPTION	QTY
28-	21711	SLAVE LEVELING CYLINDER ASSEMBLY	1
-1	21262	SLAVE LEVELING CYLINDER (SEE FIG.29)	1
-2	2581	CONNECTOR	3
-3	2465	UNION CONNECTOR	2
-4	2532	90° ELBOW	1
-5	20631	TUBE ASSEMBLY - 1/4	2
-6	20632	TUBE ASSEMBLY - 1/4	1
-7	65111	STRAP	2
-8	21388	CONVOLUTED TUBING	1

FIGURE 28A - SLAVE LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION BOOM)



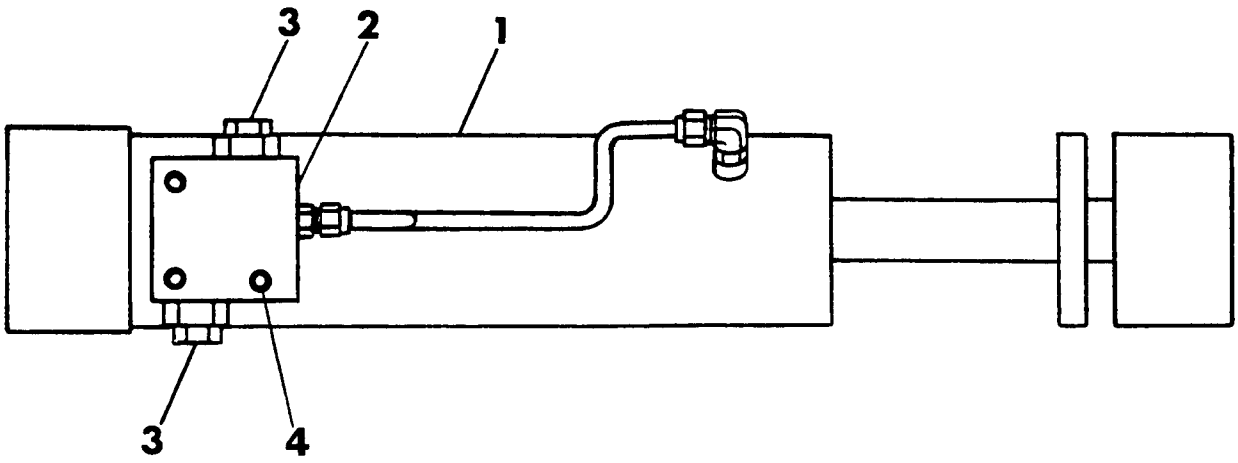
ITEM	PART NUMBER	DESCRIPTION	QTY
28A-	22584	SLAVE LEVELING CYLINDER ASSEMBLY	1
-1	22576	SLAVE LEVELING CYLINDER (SEE FIG.29A)	1
-2	2581	CONNECTOR	3
-3	2465	UNION CONNECTOR	2
-4	2532	90° ELBOW	1
-5	20631	TUBE ASSEMBLY - 1/4	2
-6	20632	TUBE ASSEMBLY - 1/4	1
-7	65111	STRAP	1

FIGURE 28B - SLAVE LEVELING CYLINDER ASSEMBLY (30I) (3 SECTION) (NEW P/N)



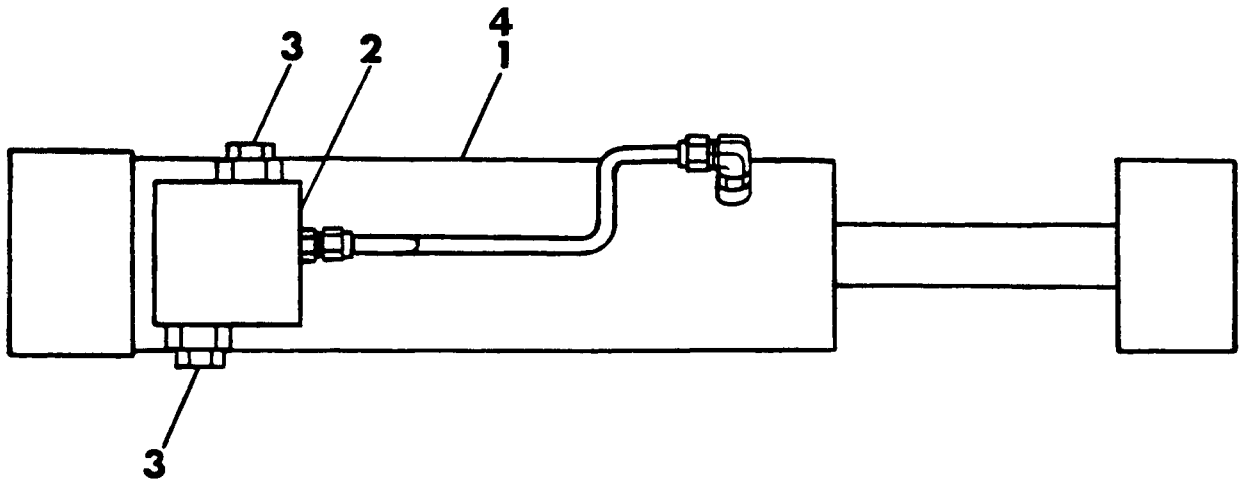
ITEM	PART NUMBER	DESCRIPTION	QTY
28B-	22584	SLAVE LEVELING CYLINDER ASSEMBLY	1
-1	22576	SLAVE LEVELING CYLINDER SUB-ASSEMBLY	1
-2	80042-03	UNION CONNECTOR	2
-3	80004-03	STRAIGHT THREAD CONNECTOR	3
-4	80012-03	STRAIGHT THREAD ELBOW	1
-5	16206	STRAP	1
-6	22584-6	TUBE ASSEMBLY - 1/4	1
-7	22584-7	TUBE ASSEMBLY - 1/4	1
-8	22584-8	TUBE ASSEMBLY - 1/4	1

FIGURE 29 - SLAVE LEVELING CYLINDER (30I) (32)



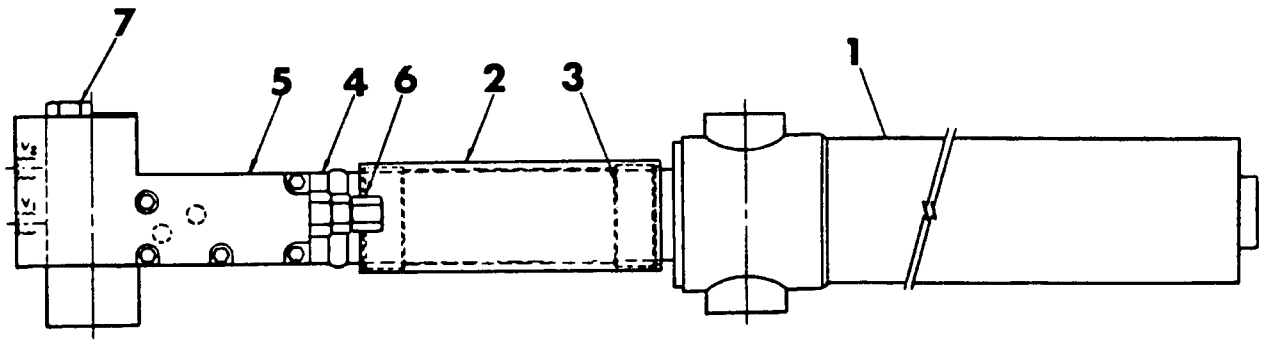
ITEM	PART NUMBER	DESCRIPTION	QTY
29-	21262	SLAVE LEVELING CYLINDER	1
-1	21274	CYLINDER	1
-2	21447	MANIFOLD BLOCK	1
-3	21267	OVER CENTER CARTRIDGE	2
-4	61903	SOCKET HEAD CAP SCREW - 3/8-16UNC X 1 1/2	3
-5	66228	SEAL KIT	1

FIGURE 29A - SLAVE LEVELING CYLINDER (30I) (3 SECTION BOOM)



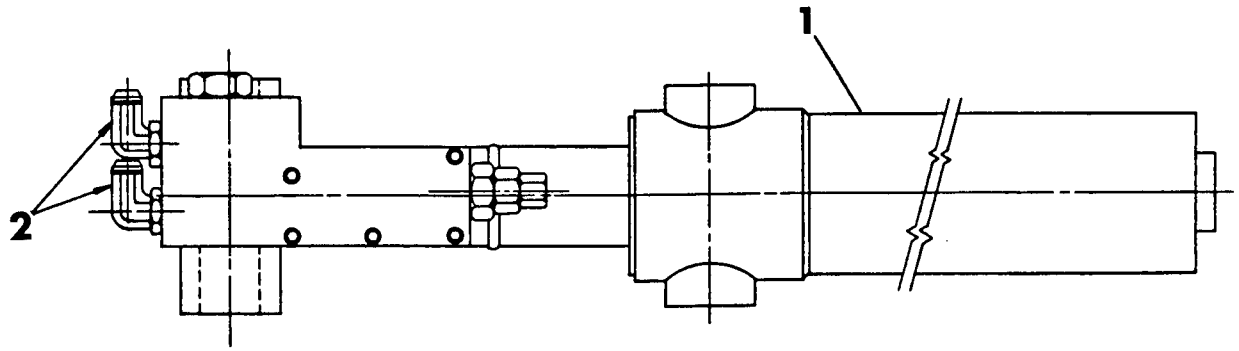
ITEM	PART NUMBER	DESCRIPTION	QTY
29A-	22576	SLAVE LEVELING CYLINDER (RA)	1
-1	22574	CYLINDER	1
-2	21447	MANIFOLD BLOCK	1
-3	21267	OVER CENTER CARTRIDGE	2
-4		SEAL KIT	1

FIGURE 30 - BOOM EXTENSION CYLINDER (30I)
(2 SECTION)



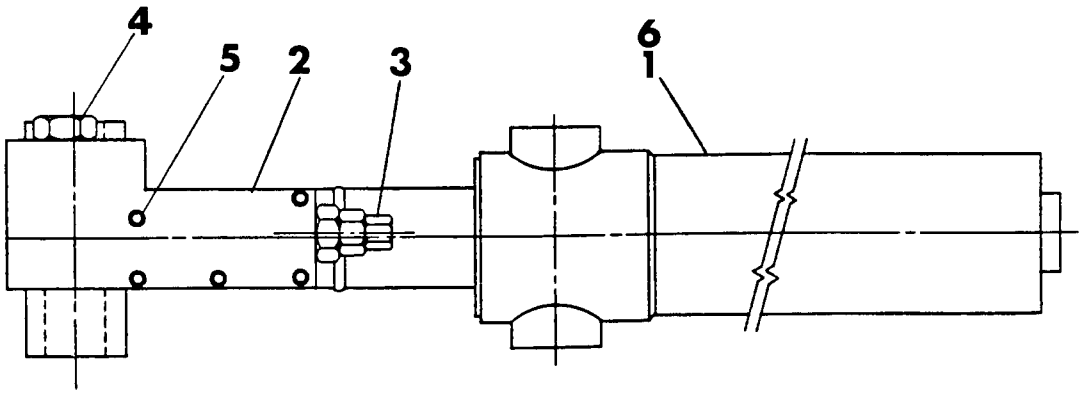
ITEM	PART NUMBER	DESCRIPTION	QTY
30-	21258	BOOM EXTENSION CYLINDER	1
-1	21270	CYLINDER	1
-2	20273	SLIDE WELDMENT	1
-3	20274	RETRACTOR BUSHING	2
-4	21446	ROD END	1
-5	21444	MANIFOLD BLOCK	1
-6	21265	OVER CENTER CARTRIDGE	1
-7	21266	P.O. CHECK CARTRIDGE	1
-8	66250	SEAL KIT	1

FIGURE 30.1 - BOOM EXTENSION CYLINDER ASSEMBLY (30I) (3 SECTION)



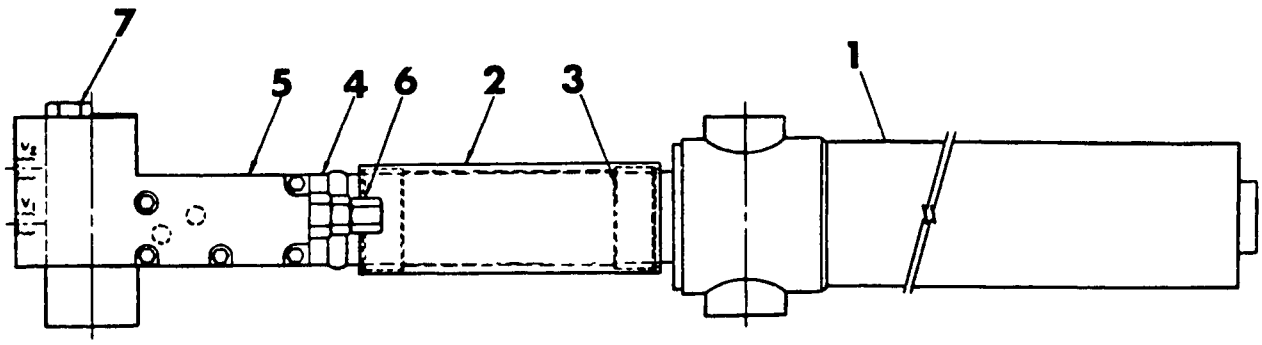
ITEM	PART NUMBER	DESCRIPTION	QTY
30.1-	22582	BOOM EXTENSION CYLINDER ASSEMBLY	1
-1	22581	BOOM EXTENSION CYLINDER (SEE FIG. 30.2)	1
-2	80012-11	STRAIGHT THREAD ELBOW	2

FIGURE 30.2 - BOOM EXTENSION CYLINDER (30I) (3 SECTION)



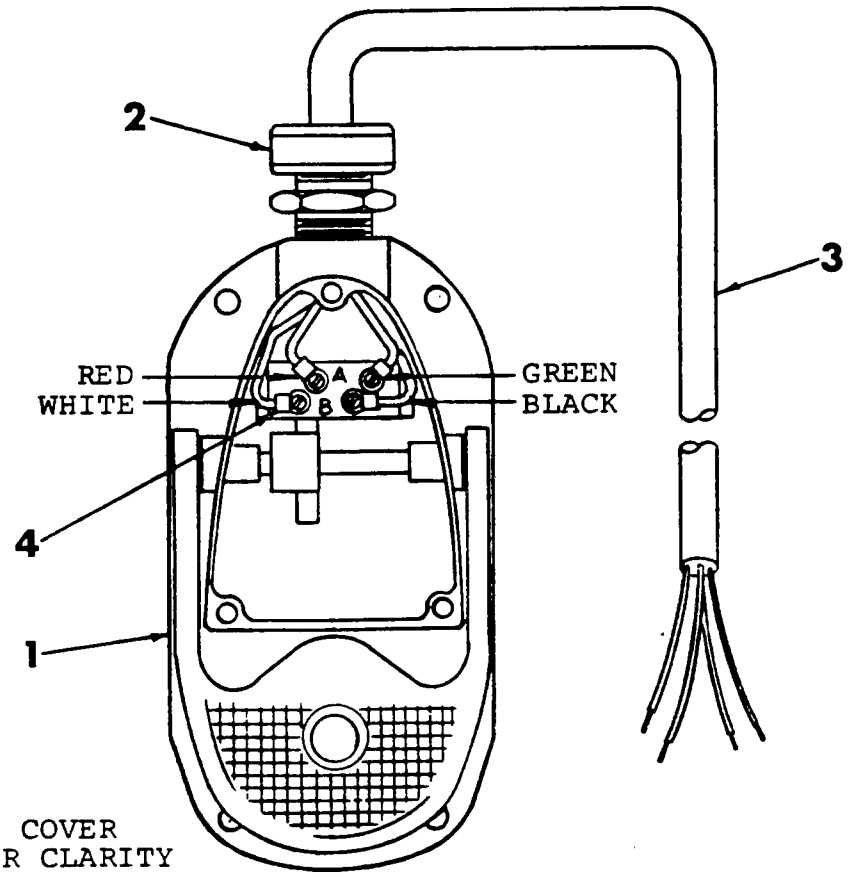
ITEM	PART NUMBER	DESCRIPTION	QTY
30.2-	22581	BOOM EXTENSION CYLINDER (RA)	1
-1	22578	CYLINDER	1
-2	21444	MANIFOLD BLOCK	1
-3	21580	OVER CENTER CARTRIDGE	1
-4	21266	PILOT CHECK VALVE CARTRIDGE	1
-5	61929	SOCKET HEAD CAP SCREW - 5/16-18 UNC X 2 3/4	5
-6		SEAL KIT	1

FIGURE 30A-BOOM EXTENSION CYLINDER (32)



ITEM	PART NUMBER	DESCRIPTION	QTY
30A-	21259	BOOM EXTENSION CYLINDER	1
-1	21271	CYLINDER	1
-2	20273	SLIDE WELDMENT	1
-3	20274	RETRACTOR BUSHING	2
-4	21446	ROD END	1
-5	21444	MANIFOLD BLOCK	1
-6	21265	OVER CENTER CARTRIDGE	1
-7	21266	P.O. CHECK CARTRIDGE	1
-8	66251	SEAL KIT	1

FIGURE 31 - FOOT SWITCH ASSEMBLY



NOTE:
SHOWN WITH COVER
REMOVED FOR CLARITY

ITEM	PART NUMBER	DESCRIPTION	QTY
31-	20480	FOOT SWITCH ASSEMBLY	1
-1	20379	FOOT SWITCH	1
-2	2531	STRAIN RELIEF	1
-3	2912	CABLE - 18/4 SJO OIL RESISTANT X 60'	1
-4	876	TERMINAL RING	1

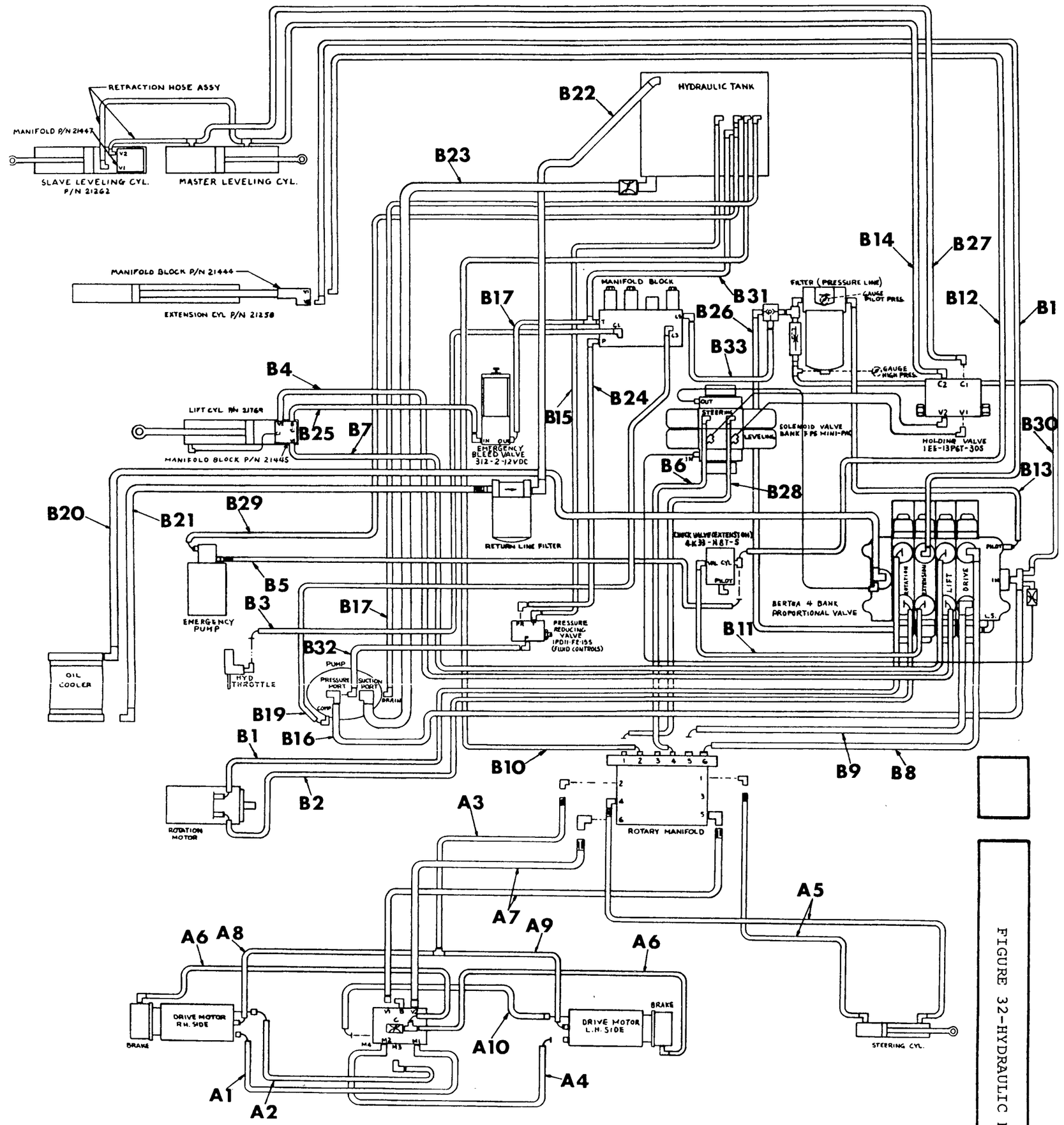


FIGURE 32-HYDRAULIC HOSE KIT (30I)

FIGURE 32-HYDRAULIC HOSE KIT (30I)

ITEM	PART NUMBER	DESCRIPTION	QTY
	NOTE:	KIT "A" - BASE KIT "B" - TURRET	
32-	20591	HYDRAULIC HOSE KIT	1
-A1	13213-8-0270	HOSE ASSEMBLY	1
-A2	13213-8-0200	" "	1
-A3	13210-6-0380	" "	1
-A4	13213-8-0260	" "	1
-A5	13210-4-0380	" "	2
-A6	13213-4-0190	" "	2
-A7	13210-12-0350	" "	2
-A8	13213-6-0100	" "	1
-A9	13213-6-0120	" "	1
-A10	13213-8-0180	" "	1
-B1	13214-8-0300	" "	1
-B2	13214-8-0280	" "	1
-B3	13213-4-0700	" "	1
-B4	13213-06-0580	" "	1
-B5	13213-6-0250	" "	1
-B6	13213-4-0430	" "	1
-B7	13213-06-0640	" "	1
-B8	13213-12-0240	" "	1
-B9	13213-12-0260	" "	1
-B10	13213-06-0640	" "	1
-B11	13213-8-0240	" "	1
-B12	13213-08-0860	" "	1
-B13	13213-6-0220	" "	1
-B14	13213-04-0700	" "	1
-B15	13210-04-0600	" "	1
-B16	13210-12-0370	" "	1
-B17	13213-04-0270	" "	1
-B18	13210-08-0860	" "	1
-B19	13211-04-0220	" "	1
-B20	13205-16-0740	" "	1
-B21	13205-16-0620	" "	1

FIGURE 32-HYDRAULIC HOSE KIT (30I)

ITEM	PART NUMBER	DESCRIPTION	QTY
-B22	13205-16-0240	HOSE ASSEMBLY	1
-B23	13203-20-0110	" "	1
-B24	13210-04-0270	" "	1
-B25	13210-4-0420	" "	1
-B26	13210-4-0370	" "	1
-B27	13213-4-0750	" "	1
-B28	13213-4-0470	" "	1
-B29	13213-6-0640	" "	1
-B30	13213-6-0220	" "	1
-B31	13213-04-0400	" "	1
-B32	13210-4-0170	" "	1
-B33	13210-4-0300	" "	1

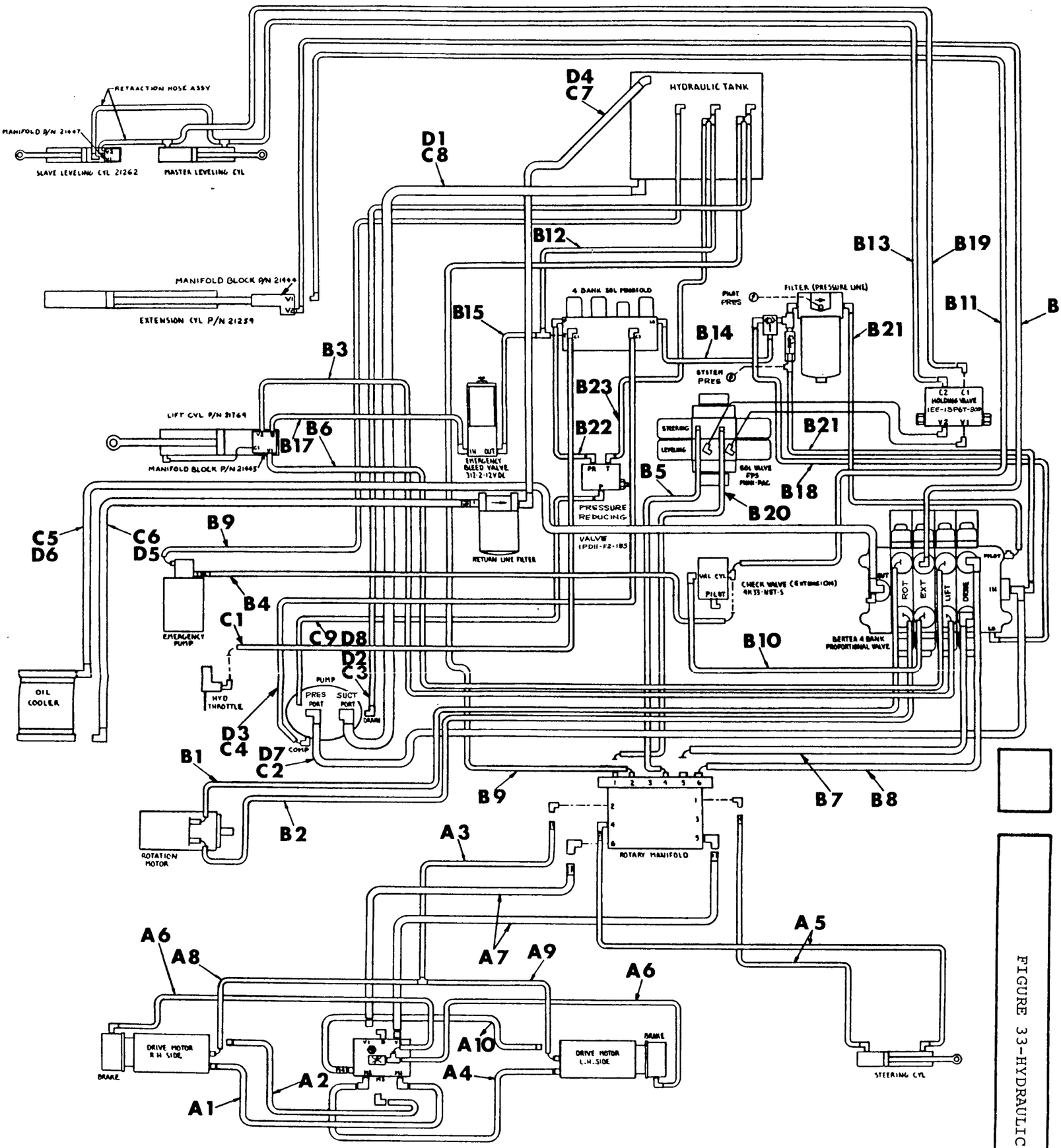


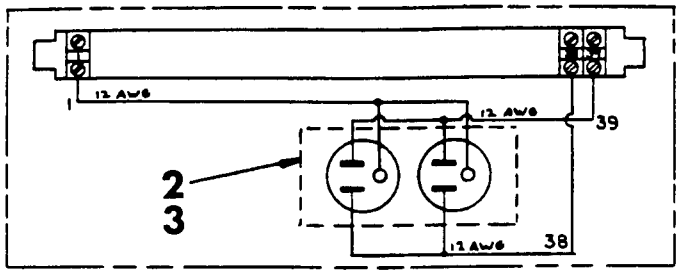
FIGURE 33-HYDRAULIC HOSE KIT (32)

FIGURE 33-HYDRAULIC HOSE KIT (32)

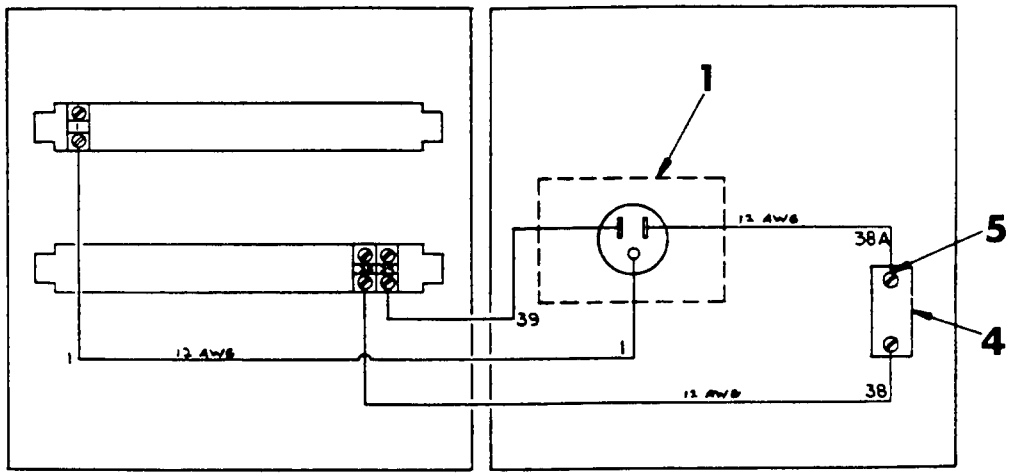
ITEM	PART NUMBER	DESCRIPTION	QTY
	NOTE:	KIT "A" - BASE KIT "B" - TURRET KIT "C" - GAS MODELS ONLY KIT "D" - DIESEL MODELS ONLY	
33-	20592	HYDRAULIC HOSE KIT	1
-A1	13213-08-0260	HOSE ASSEMBLY	1
-A2	13213-08-0270	" "	1
-A3	13210-06-0380	" "	1
-A4	13213-08-0200	" "	1
-A5	13210-04-0380	" "	2
-A6	13213-04-0190	" "	2
-A7	13210-12-0350	" "	2
-A8	13213-06-0100	" "	1
-A9	13213-06-0120	" "	1
-A10	13213-08-0180	" "	1
-B1	13214-08-0340	" "	1
-B2	13214-08-0280	" "	1
-B3	13213-06-0584	" "	1
-B4	13213-06-0250	" "	1
-B5	13213-04-0370	" "	1
-B6	13213-06-0640	" "	1
-B7	13213-12-0370	" "	1
-B8	13213-12-0410	" "	1
-B9	13213-06-0640	" "	2
-B10	13213-08-0240	" "	1
-B11	13213-08-0860	" "	1
-B12	13213-04-0300	" "	1
-B13	13213-04-0700	" "	1
-B14	13210-04-0284	" "	1
-B15	13213-04-0400	" "	1
-B16	13210-08-0860	" "	1
-B17	13210-04-0450	" "	1
-B18	13210-04-0400	" "	1
-B19	13213-04-0750	" "	1
-B20	13213-04-0410	" "	1

FIGURE 33-HYDRAULIC HOSE KIT (32)

ITEM	PART NUMBER	DESCRIPTION	QTY
-B21	13213-06-0230	HOSE ASSEMBLY	2
-B22	13210-04-0270	" "	1
-B23	13210-04-0600	" "	1
-C1	13213-04-0700	" "	1
-C2	13210-12-0370	" "	1
-C3	13210-06-0320	" "	1
-C4	13211-04-0220	" "	1
-C5	13205-16-0740	" "	1
-C6	13205-16-0620	" "	1
-C7	13205-16-0240	" "	1
-C8	13203-20-0110	" "	1
-C9	13210-04-0290	" "	1
-D1	13210-20-0500	" "	1
-D2	13210-06-0900	" "	1
-D3	13213-04-0560	" "	1
-D4	13205-16-0180	" "	1
-D5	13205-16-0350	" "	1
-D6	13205-16-0400	" "	1
-D7	13210-12-0544	" "	1
-D8	13213-04-0550	" "	1



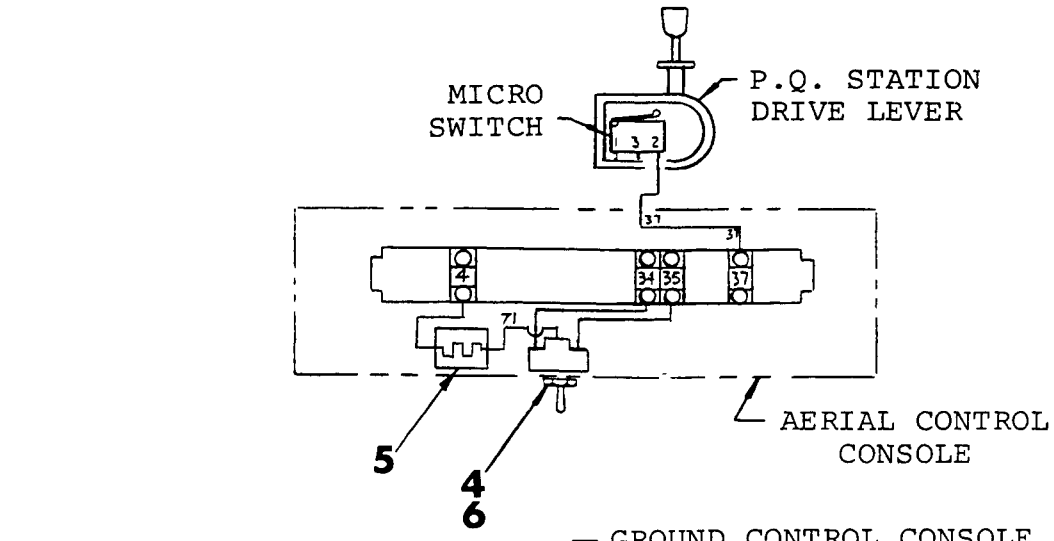
AERIAL CONTROL CONSOLE

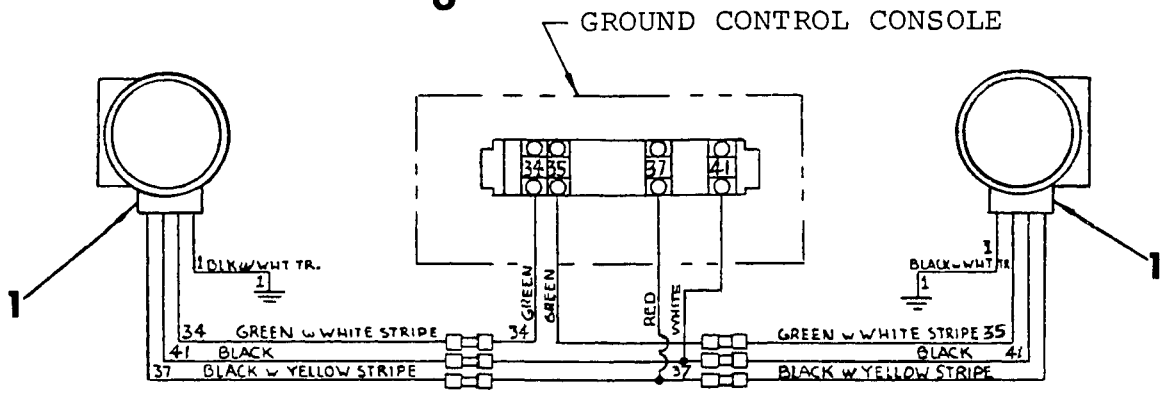


GROUND CONTROL CONSOLE

ITEM	PART NUMBER	DESCRIPTION	QTY
34-	20104	GROUND & AERIAL 110 VAC RECEPTACLE	1
-1	70119	COVER PLATE (WITH MALE RECEPTACLE)	1
-2	288	COVER PLATE	1
-3	70126	RECEPTACLE	1
-4	20562	CIRCUIT BREAKER	1
-5	2832	RING TONGUE CONNECTOR	7

FIGURE 35 -CLEARANCE, STOP AND TURNING LIGHTS (OPTION)





ELECTRICAL DIAGRAM

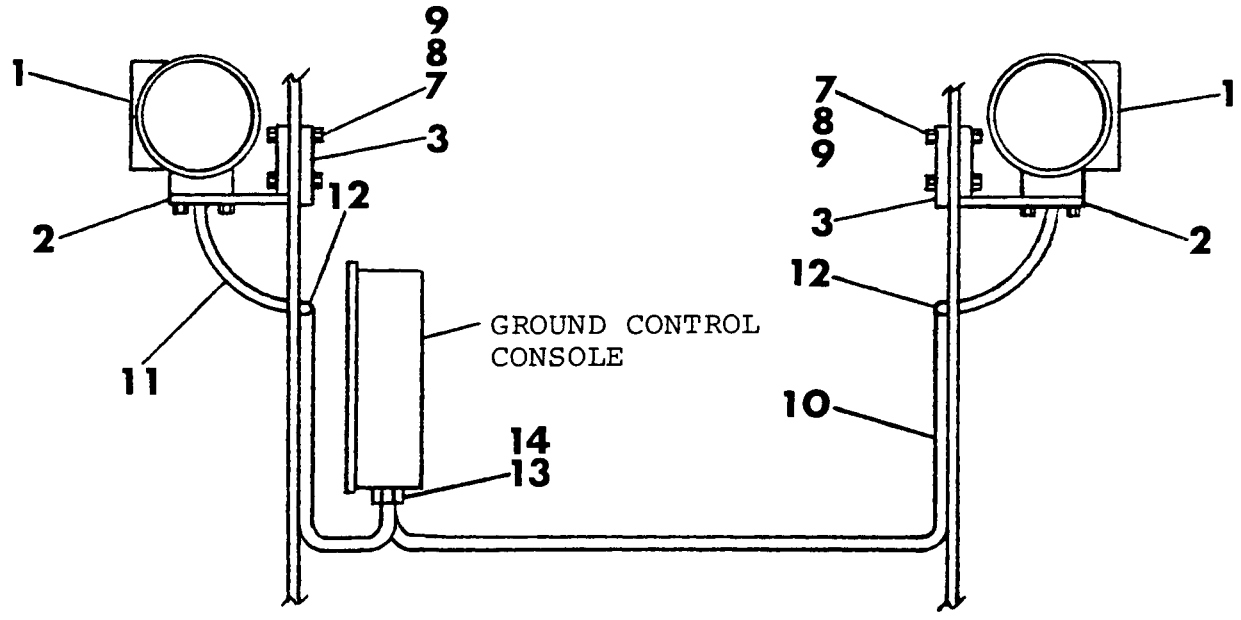
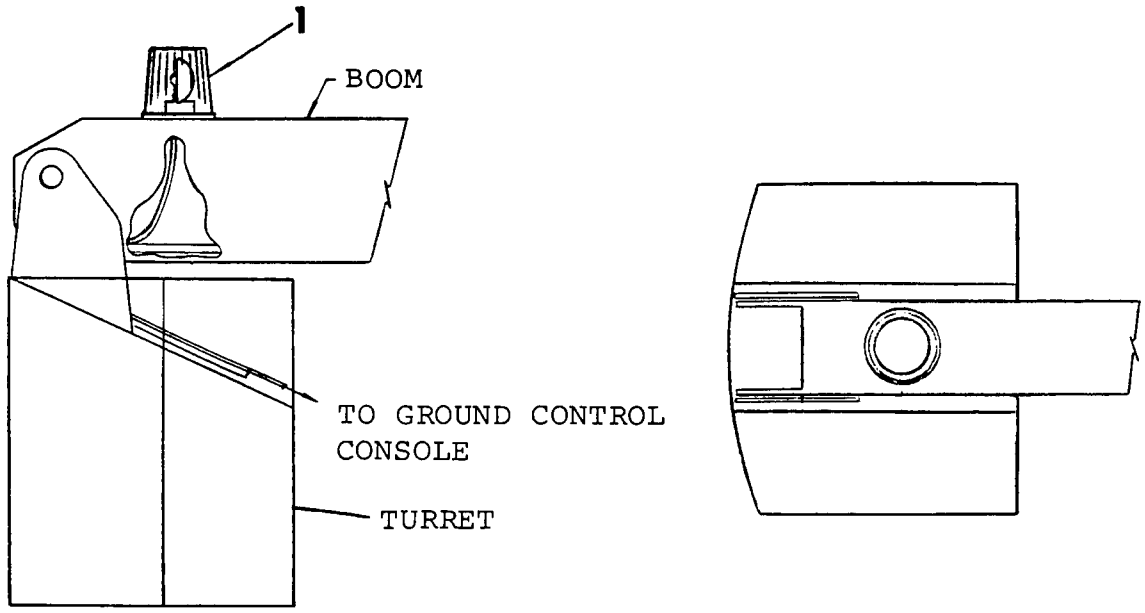


FIGURE 35 -CLEARANCE, STOP AND TURNING LIGHTS (OPTION)

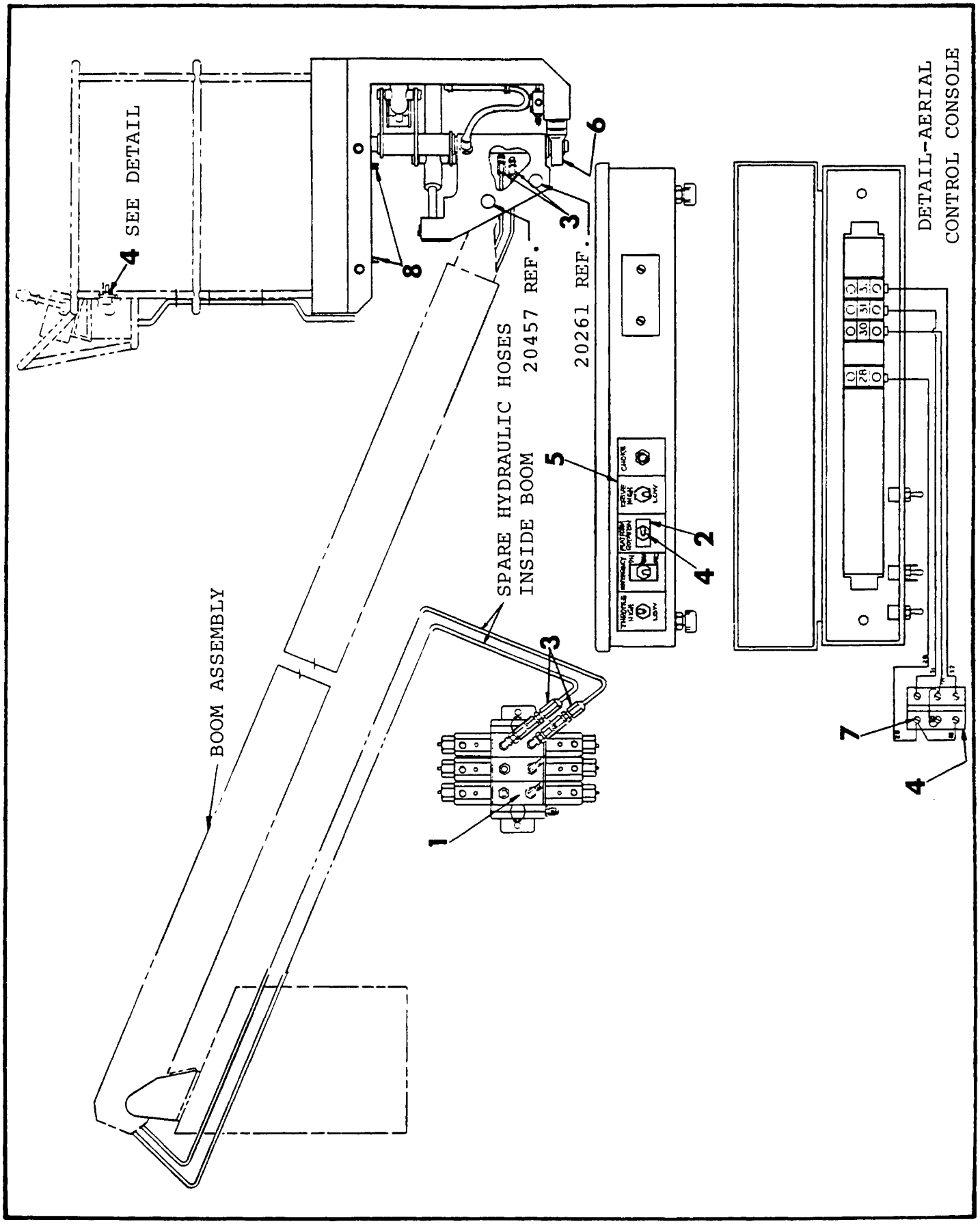
ITEM	PART NUMBER	DESCRIPTION	QTY
35-	20106	CLEARANCE, STOP AND TURNING LIGHTS	1
-1	20838	CLEARANCE LIGHT	2
-2	20864	MOUNTING BRACKET	2
-3	20865	BACK-UP PLATE	2
-4	4019	TOGGLE SWITCH - 8510K1	1
-5	448-A	FLASHER	2
-6	20866	TURN INDICATOR DECAL	1
-7	60331	HEX HEAD CAPSCREW--3/8-16UNC X 1 1/4	4
-8	60703	HEX NUT--3/8-16UNC	4
-9	63303	SPLIT LOCKWASHER--3/8	4
-10	2912	CABLE--18AWG 4 COND X 18	1
-11	2912	CABLE--18AWG 4 COND X 10	1
-12	117-D	BUTT CONNECTOR	8
-13	2806	STRAIN RELIEF	2
-14	2808	LOCK NUT	2

FIGURE 36 -ROTATING BEACON INSTALLATION (OPTION)



ITEM	PART NUMBER	DESCRIPTION	QTY
36 -	20107	ROTATING BEACON INSTALLATION	1
-1	20863	ROTATING BEACON -- YELLOW	1

FIGURE 37- RAISED PLATFORM ROTATION (OPTION)



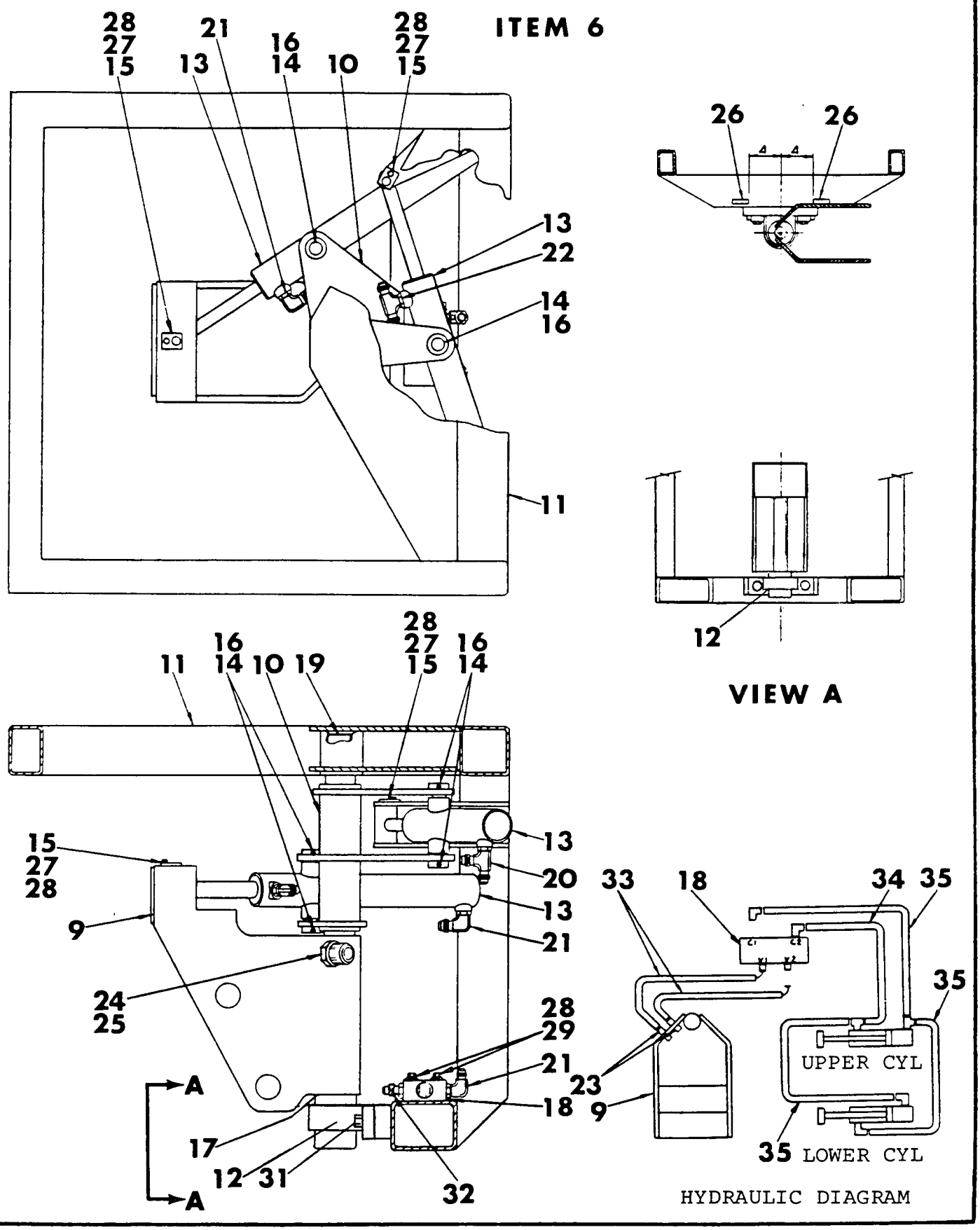

ITEM 6
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LOWER CYL
HYDRAULIC DIAGRAM

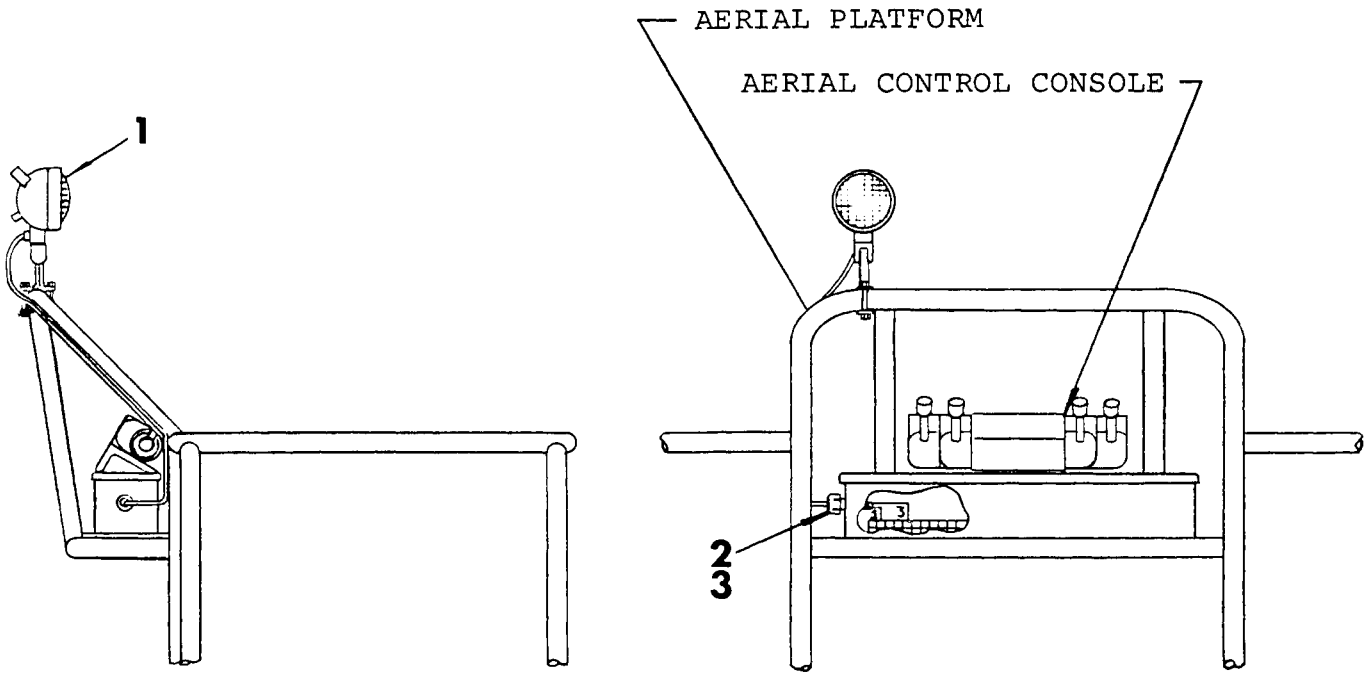
FIGURE 37- RAISED PLATFORM ROTATION (OPTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
37-	20097	PLATFORM ROTATION	1
-1	21713	MINI-PACK SUB ASSEMBLY	1
-2	20884	SWITCH GUARD	1
-3	2562	STRAIGHT SWIVEL HOSE FITTING	4
-4	4021	TOGGLE SWITCH	1
-5	22571	DECAL - AERIAL CONTROL SWITCHES	1
-6	20960	FORK ASSEMBLY	1
-7	117B	RING TONGUE	6
-8	16268	HOSE CLAMPS	4
-9	20818	LEVELING SKIRT	1
-10	20985	IDLER WELDMENT	1
-11	20997	FORK WELDMENT	1
-12	20848	PILLOW BLOCK	1
-13	21264	PLATFORM ROTATION CYLINDER (SEE FIG.41)	2
-14	20821	CYLINDER TRUNNION PIN	4
-15	20822	CYLINDER ROD PIN	2
-16	64215	ROLL PIN - 5/32 X 1 1/4	4
-17	20914	SPACER	1
-18	20351	DOUBLE P.O. CHECK VALVE	1
-19	20846	THRUST WASHER	1
-20	16400	RUN TEE	1
-21	2532	90° ELBOW	4
-22	2545	BRANCH TEE	1
-23	2502	BULKHEAD UNION	2
-24	30038	STRAIN RELIEF	1
-25	61120	CONDUIT NUT	1
-26	25253	KEYSTOCK - 1/2 SQ. X 2	2
-27	60391	HEX HEAD CAPSCREW - 5/16 - 18 UNC X 3/8	2
-28	63302	SPLIT LOCK WASHER - 5/16	4
-29	60329	HEX HEAD CAPSCREW - 5/16 - 18 UNC X 2	2
-30	65454	COLLAR	1
-31	60602	HEX HEAD CAPSCREW - 1/2 - 13 UNC X 1 1/2 BOWMALOK	2
-32	2581	STRAIGHT THREAD CONNECTOR	2

FIGURE 37- RAISED PLATFORM ROTATION (OPTION)

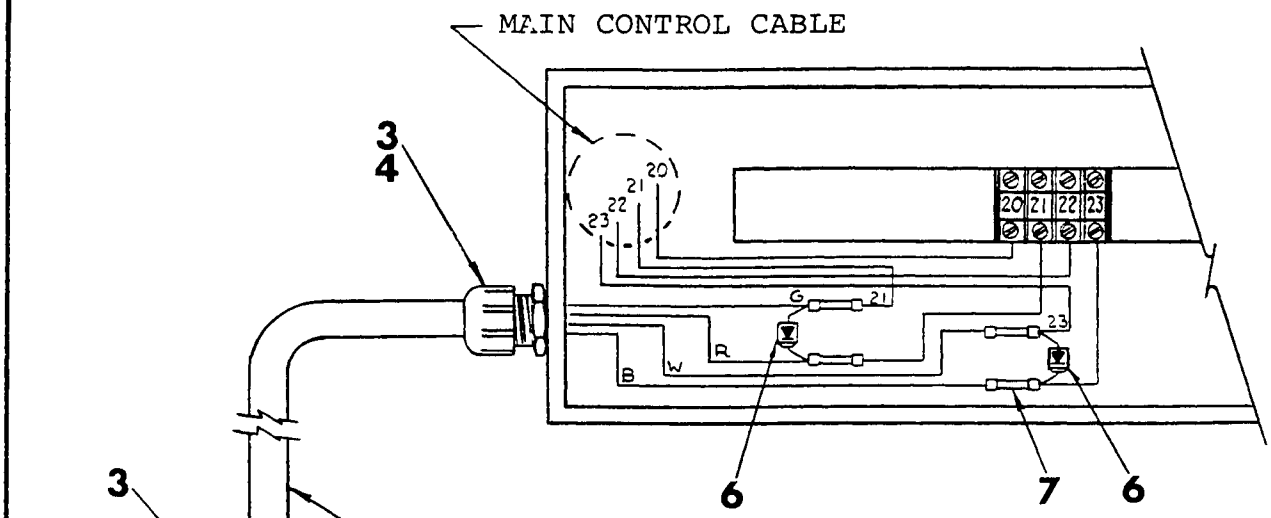
ITEM	PART NUMBER	DESCRIPTION	QTY
-33	13213-04-0200	HOSE ASSEMBLY	2
-34	13210-04-0240	HOSE ASSEMBLY	1
-35	13210-04-0220	HOSE ASSEMBLY	3

FIGURE 38-12 VOLT PLATFORM WORKLIGHT (OPTION)

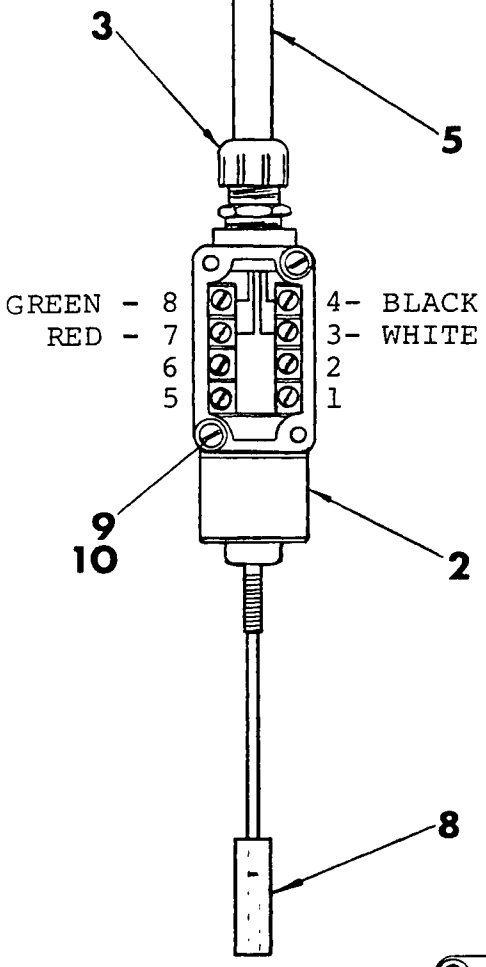


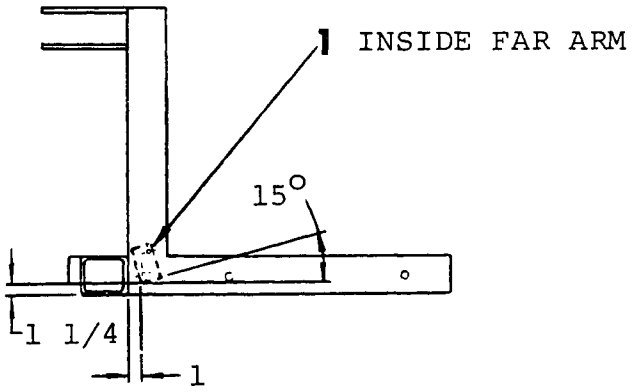
ITEM	PART NUMBER	DESCRIPTION	QTY
38-	20139	12V PLATFORM WORKLIGHT	1
-1	20862	WORKLIGHT	1
-2	2522	STRAIN RELIEF	1
-3	141	LOCK NUT	1

FIGURE 39-FORK GROUND SENSOR (OPTION)

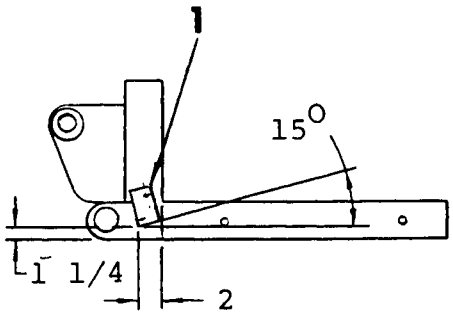


AERIAL CONTROL BOX

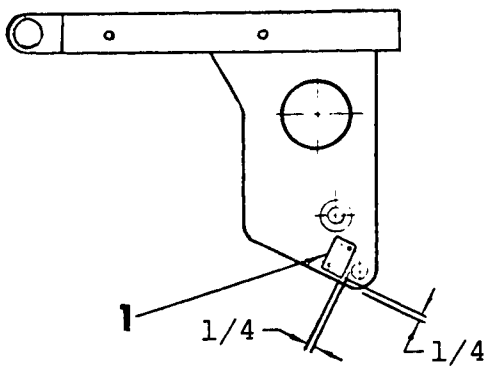




FORK WELDMENT 20819



FORK WELDMENT 20536

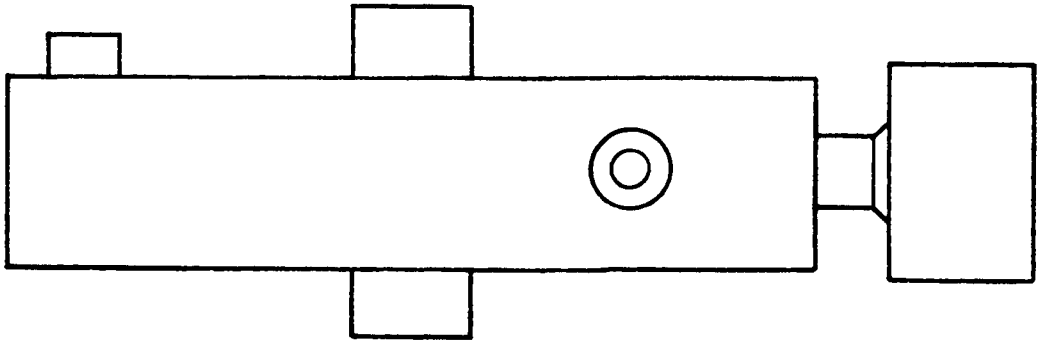


FORK WELDMENT 20535

FIGURE 39-FORK GROUND SENSOR (OPTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
39-	20164	FORK GROUND SENSOR	1
-1	20761	MOUNTING PLATE	1
-2	20919	LIMIT SWITCH	1
-3	2806	STRAIN RELIEF	1
-4	2808	LOCK NUT	1
-5	70019	CABLE--4 COND 18GA X 60	1
-6	4045	DIODE	2
-7	117D	BUTT CONNECTOR	4
-8		HOSE--3/16 ID X 2	1
-9		HEX HEAD CAPSCREW--10-32UNF X 2	2
-10	63310	SPLIT LOCKWASHER	2

FIGURE 40-PLATFORM ROTATION CYLINDER (OPTION)



ITEM	PART NUMBER	DESCRIPTION	QTY
40-	21264	PLATFORM ROTATION CYLINDER	1
-1	20042	SEAL KIT	1

FIGURE 41 - DIESEL ST2-A ENGINE (32) (OPTION)

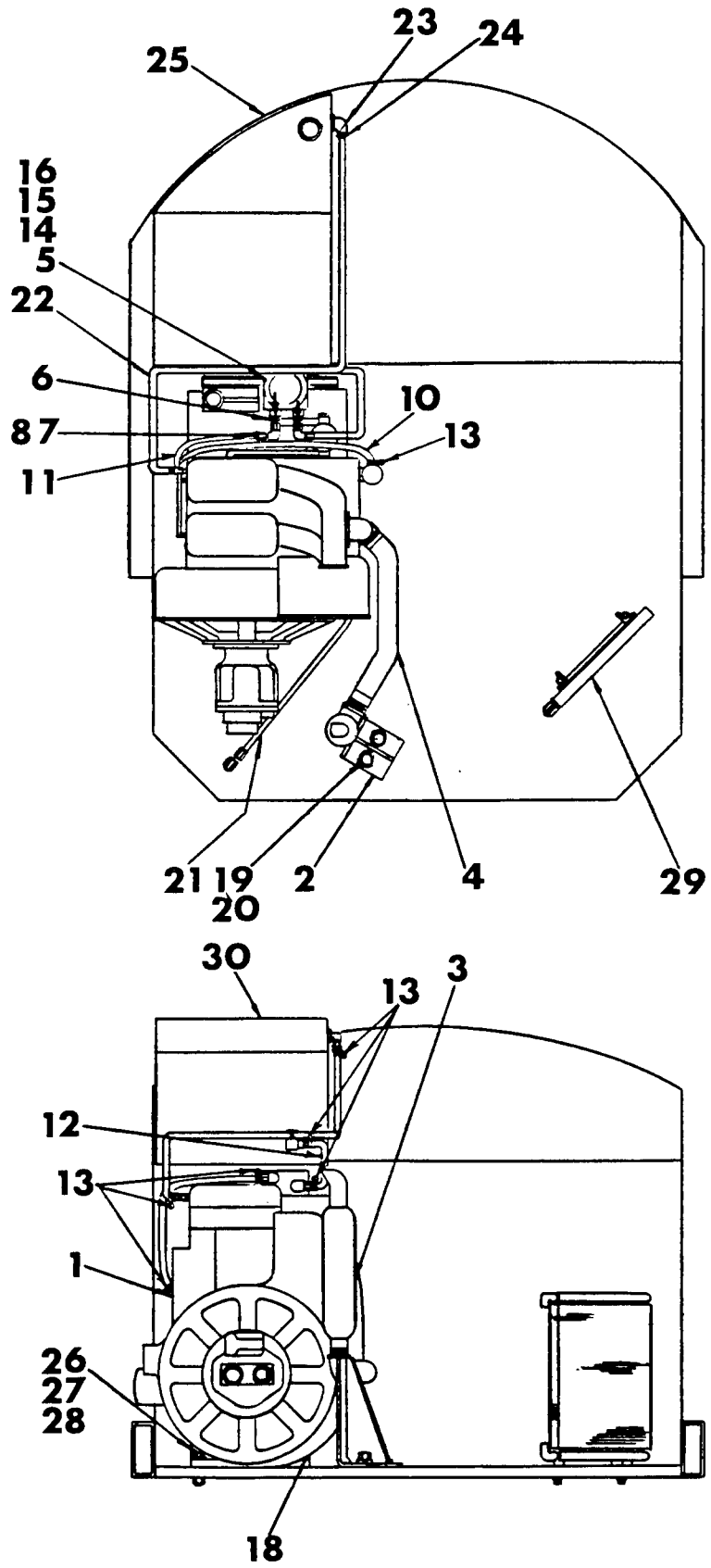
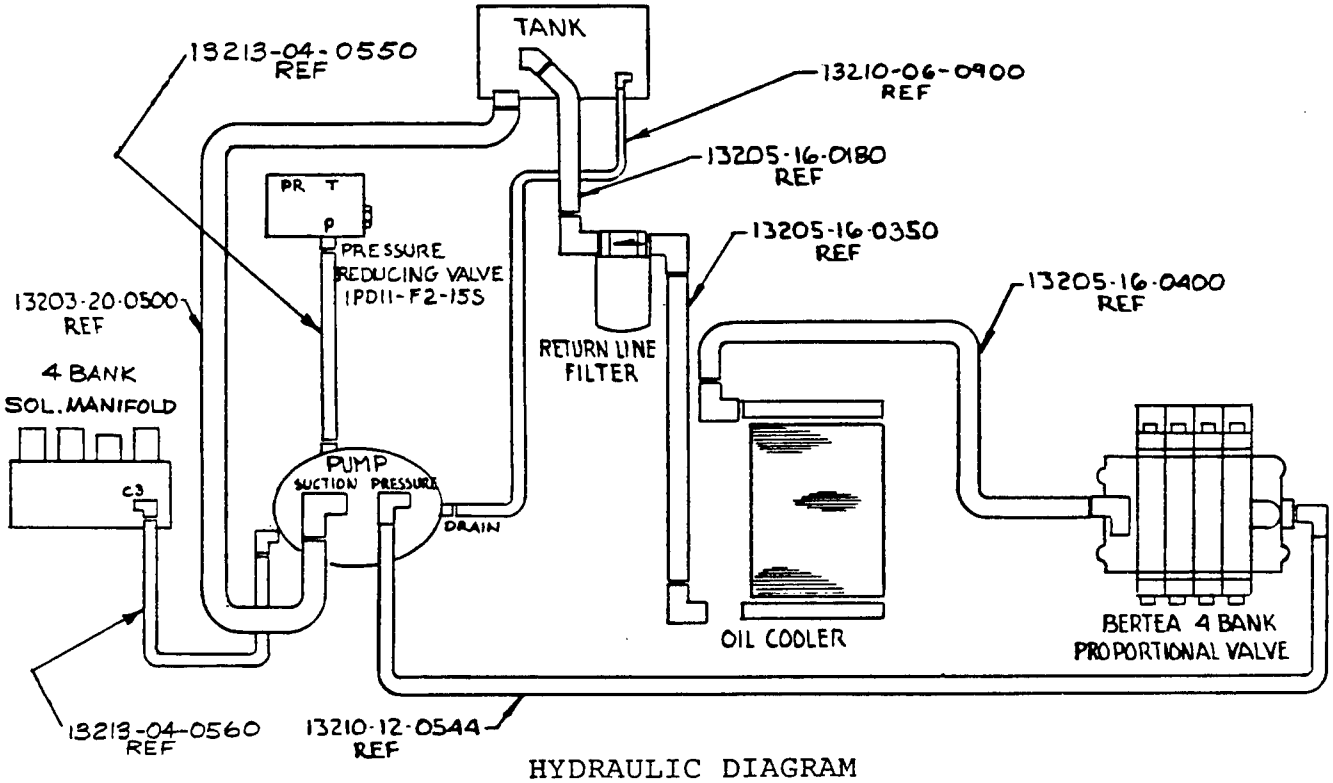
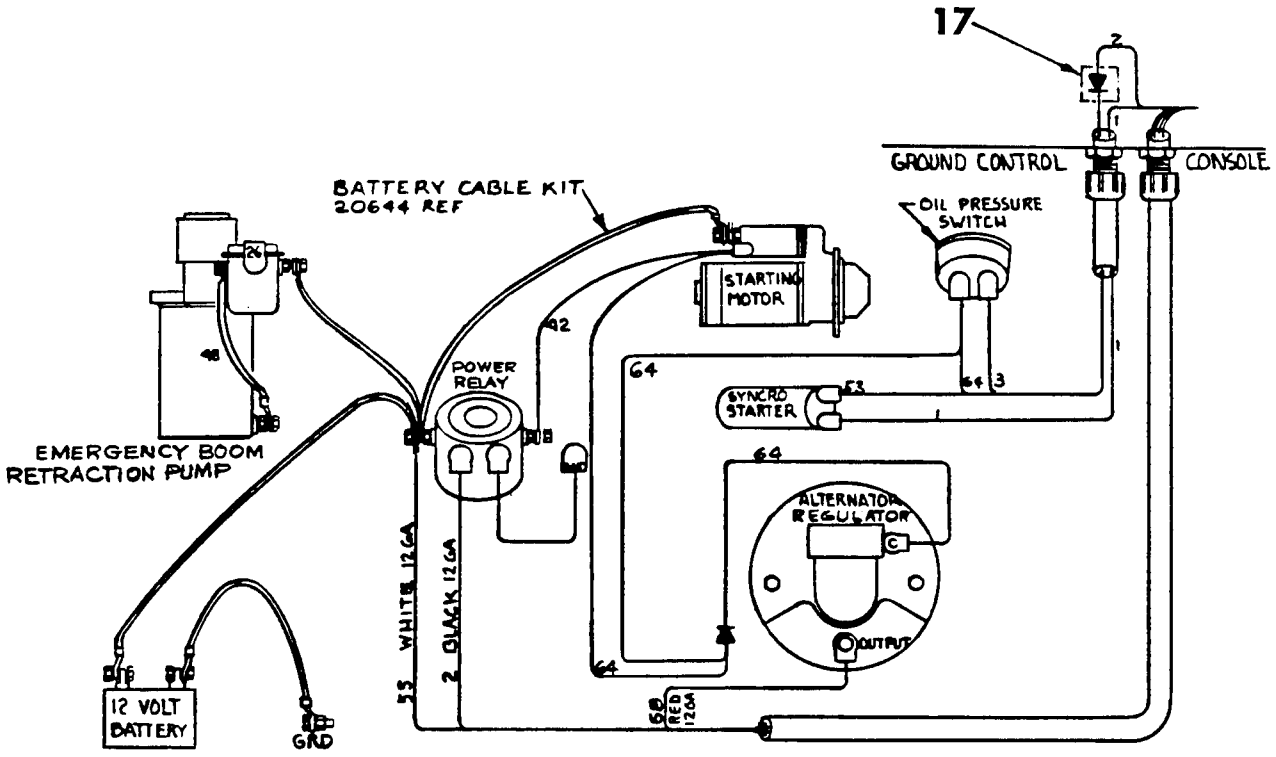


FIGURE 41 - DIESEL ST2-A ENGINE (32) (OPTION)



HYDRAULIC DIAGRAM

REF. HOSE KIT 20592-D



ELECRICAL DIAGRAM

FIGURE 41 - DIESEL ST2-A ENGINE (32) (OPTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
41-	20120	DIESEL ST2-A ENGINE	1
-1	20841	ENGINE ASSEMBLY	1
-2	20857	MUFFLER MOUNTING BRACKET	1
-3	20812	MUFFLER	1
-4	20835	FLEX HOSE ASSEMBLY	1
-5	20878	WATER SEPARATOR	1
-6	2476	MALE CONNECTOR	2
-7	2538	SWIVEL NUT ELBOW	2
-8	5491	HOSE FITTING	2
-9	20592	HOSE KIT "D"	1
-10	65276	HOSE	1
-11	65275	HOSE	1
-12	65274	HOSE	1
-13	65155	CLAMP	8
-14	63402	FLAT WASHER - 5/16	2
-15	60322	HEX HEAD CAP SCREW - 5/16-18 UNC X 3/4 (GR. 5)	2
-16	63302	SPLIT LOCK WASHER - 5/16	2
-17	4045	DIODE - 6 AMP	1
-18	60605	HEX HEAD CAP SCREW - 1/2-13 UNC X 2 1/2 BOWMALOK 41209	1
-19	60331	HEX HEAD CAP SCREW - 3/8-16 UNC X 1 1/4	2
-20	63303	SPLIT LOCK WASHER - 3/8	2
-21	20616	TUBE ASSEMBLY	1
-22	65273	HOSE	1
-23	52305	STREET ELBOW	1
-24	864	HOSE BARB	1
-25	2033	DECAL - DIESEL	1
-26	60614	HEX HEAD CAP SCREW - 1/2-20 UNF X 3 1/2 BOWMALLOY 36414	3
-27	61301	LOCK NUT - 1/2-20 UNF - BOWMAGRIP 36799	3
-28	63501	FLAT WASHER - 1/2 - BOWMAN 36715 HEAVY DUTY	3

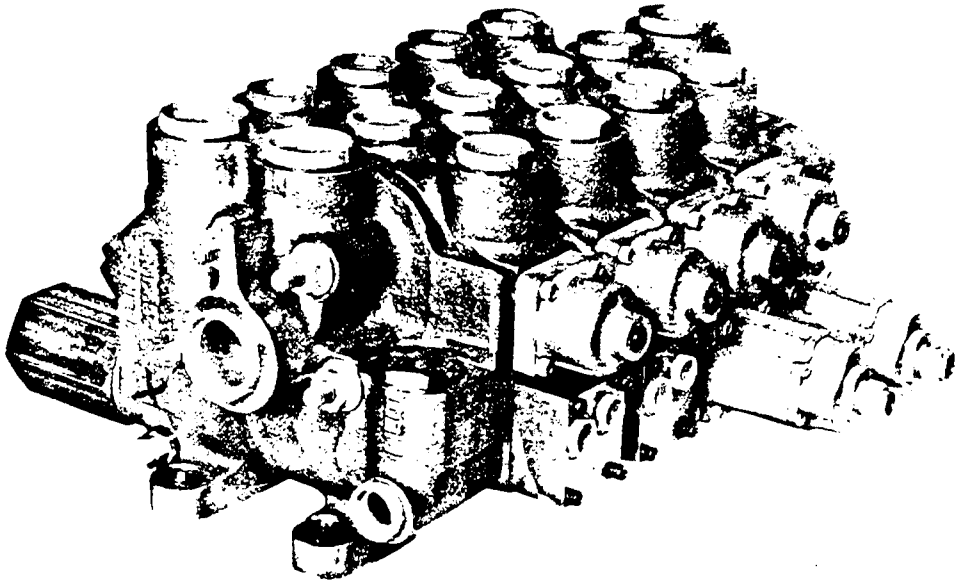
FIGURE 41 - DIESEL ST2-A ENGINE (32)
(OPTION)

ITEM	PART NUMBER	DESCRIPTION	QTY
-29	20313	OIL COOLER ASSEMBLY (REF.)	1
-30	20476	FUEL TANK ASSEMBLY (REF.)	1

JULY 1977

SERVICE MANUAL

LOAD SENSING PRESSURE COMPENSATING PROPORTIONAL DIRECTIONAL VALVE



MODEL NO. 269300

BERTEA / INDUSTRIAL PRODUCTS

S E R V I C E M A N U A L

MODEL 269300 SERIES

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FIGURE IDENTIFICATION

Figure #1 - Module Assembly

Figure #2 - Circuit Schematic

Figure #3 - Remote Electro-Hydraulic Control Schematic

Figure #4 - Remote Pilot Oil Control Schematic

Figure #5 - Dual Port Inlet Manifold

Figure #6 - Directional Valve Manifold

Figure #7 - Manual Override End Cap

Figure #8 - Single Port Inlet Manifold

Figure #9 - Basic Shuttle

Figure #10 - Adjustable Shuttle

Figure #11 - Purge Manifold Assembly

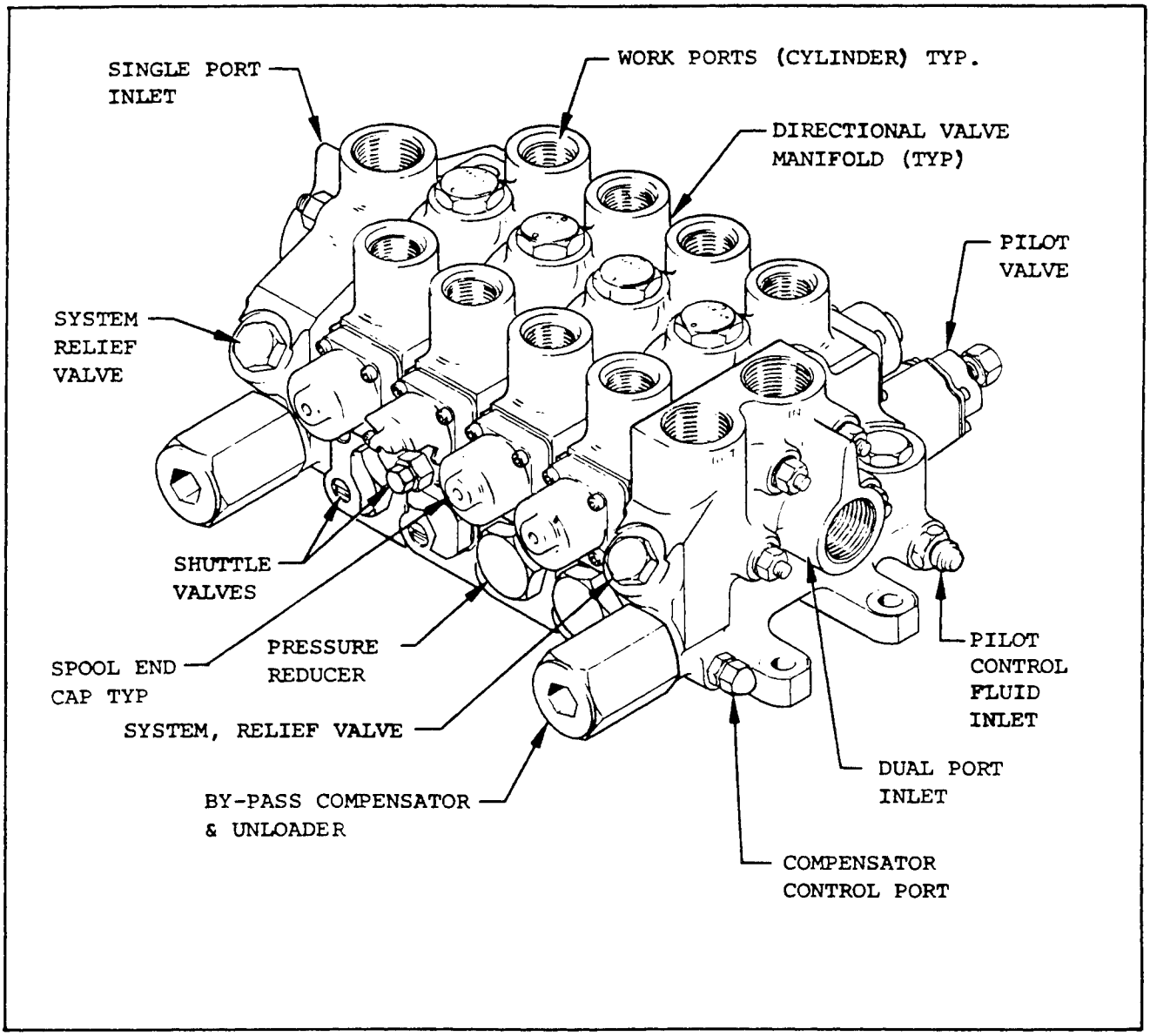
Figure #12 - Bertea Valve Installation

Figure #13 - Remote Purge System Schematic

Figure #14 - Installation Drawing 269300

Figure #15 - Pilot Valve Installation

BERTEA LOAD SENSING - PRESSURE COMPENSATING
PROPORTIONAL DIRECTIONAL VALVE



MODULE ASSEMBLY
FIGURE 1

I INTRODUCTION

The Bertea Load Sensing Pressure Compensating directional valve module, Figure #1, provides a means of sensing the highest "work cylinder port" pressure and then adjust a by-pass compensator or variable pump compensator to provide a pump pressure of 150 psi above this value.

Since the pump pressure is always held at only 150 psi above the highest load pressure, this system reduces the energy requirements

and heat generation. Additional features are provided; such as, unloading the pump to 50 psi when the valves are not in use; providing constant rate control for multiple function operation, and providing a single module for dual pump application.

In order to provide control of the directional valve spools under various system configurations and operating modes, the module is designed to contain two separate hydraulic circuits. The main power pump circuit is configured in the normal manner to provide power oil to the working cylinder ports. The control circuit used to position the directional valve spool is independent of the power oil circuit and operates at approximately 300 to 400 psi. This circuit separation, also, provides the capability to control the module from a remote location with electro hydraulic controls or by a remote pilot oil system with variable pressure capability.

The method used to port the Pressure Compensating Control Circuit to tank when not in use requires all directional valve spools to be open cylinder port configuration. Therefore, external controls will be required for load holding capability.

II SYSTEM DESCRIPTION

The Bertea pressure compensating valve module consists of (5) basic sub-systems as noted: (Ref: Figure 1)

A. The shuttle valves, within the spool sections, sense the highest cylinder port pressure within each spool section manifold assembly and, also, select the highest load pressure among all of the spool sections in the complete module, and port this signal to the by-pass compensator. These shuttles, also, connect the pressure compensation control circuit to tank thru the open cylinder port type directional valve spools.

B. The by-pass compensator, within the inlet manifold, is controlled by the highest load pressure and it will by-pass all excess pump flow at 150 psi above the highest load pressure.

C. The optional pressure reducer, within the spool section manifold, is controlled by the highest cylinder port pressure of that spool section and maintains 100 psi pressure drop across the directional valve spool regardless of supply pressure.

D. The directional valve spool directs and meters the fluid to the function as specified by the amount of spool travel from its neutral or shut off position. This travel is determined by the difference in pressure established in the two spool end caps by the external control source.

   Since the pressure reducer holds 100 psi pressure drop across this spool, then for any fixed spool position the flow to the

function thru the spool metering notch will be constant regardless of load. This provides constant rate for the function.

E. The remote control system determines the directional valve spool position by varying the pressure in each spool end cap. The two commonly used control systems are:

1) Remote pilot control oil ported to each end cap thru external tubing from a remote pressure reducing valve.

2) Electro-hydraulic pilot valves, manifold to the spool section, and controlled electrically from a remote location. This pilot valve obtains its pilot supply oil from the module and ports it to the spool end cap at various pressure levels proportional to the electrical command.

Figure 1 & 2 shows a typical 4 spool section module of the following configuration in sequence, starting with the dual port inlet:

Dual Port Inlet Manifold Assembly with a by-pass compensator, unloader, system relief valve and an optional pilot control circuit relief valve.

Directional Valve Manifold Assemblies with shuttles and pressure reducers.

Plugs in the pressure compensation control line and main pump line between directional valve manifold #3 and #4.

Directional Valve Manifold with one shuttle and a blank spool in the pressure reducer cavity.

Single Port Inlet Manifold Assembly with a by-pass compensator, unloader, and system relief valve.

This module is supplied by one 20 gpm pump ported into the dual port inlet for directional valves #1, #2, & #3, and one 30 gpm pump ported into the single port inlet for directional valve #4.

The remote control configuration can be electro-hydraulic using the Bertea pilot valve and electrical controllers or it can be the remote pilot oil system using lever operated pressure reducing valves to provide control oil from 0 to 200 psi into either spool end cap.

III OPERATION (Figure #2)

A. LOAD SENSING & PRESSURE COMPENSATING

When the system is not in use and the directional valve spools are in the center position, the pressure compensating (P.C.)

control circuit is connected to tank thru the shuttles and open cylinder port spools! Since this connects the large area of the unloading piston (Item 4) to tank allowing the piston to move away from the compensator and the spring to relax its preload; the pump output is by-passed to tank at 50 psi, rather than the 150 psi control level. This results in lower stand by heat generation.

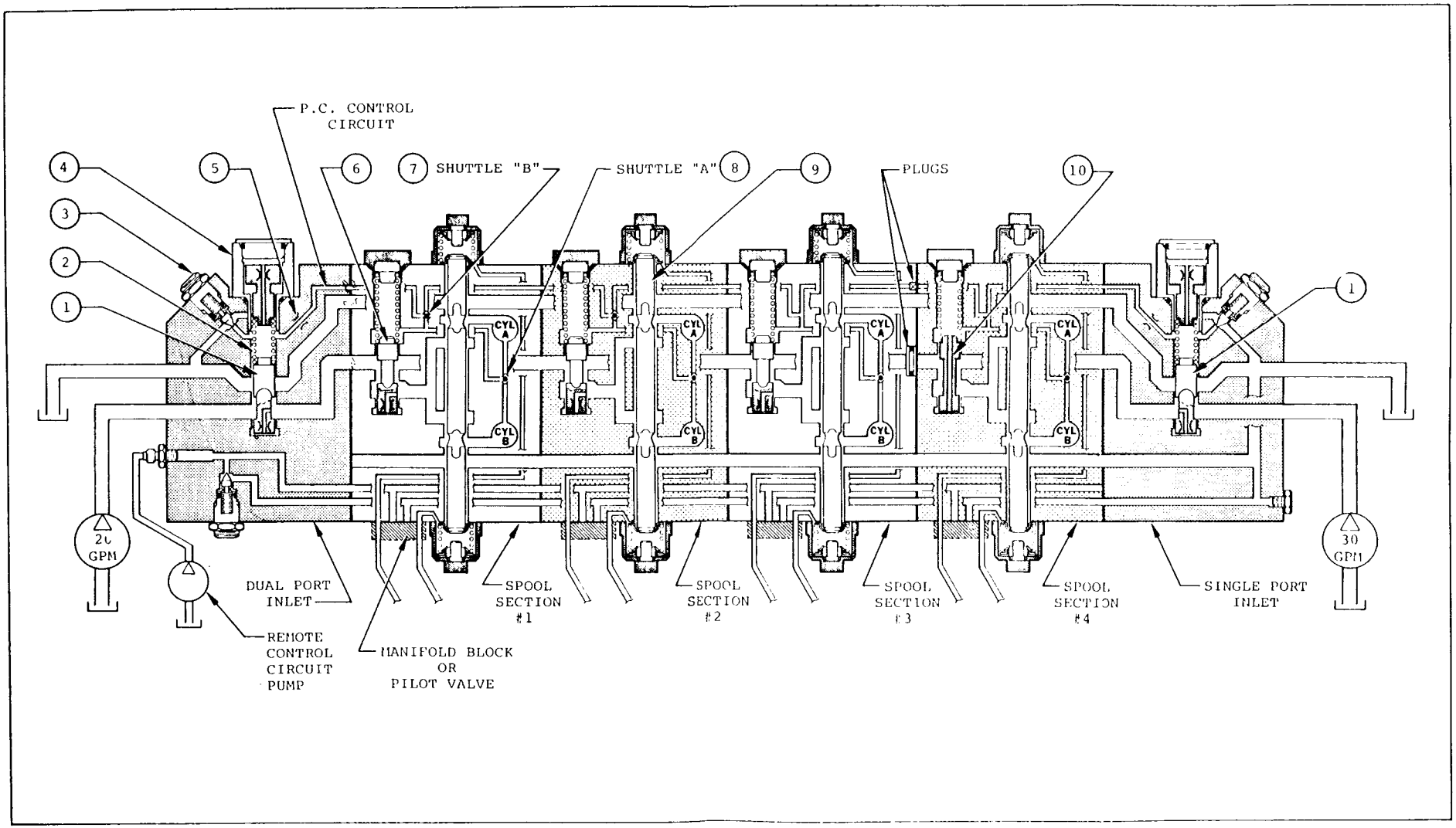
The directional valve spool (Item 9) is spring caged to the center position with a 19# preload. As the remote control system builds up a differential pressure across the spool - ie increases the pressure in one end cap and lowers the pressure in the other end cap - the spool will move out of center detent at about 40 psi differential pressure. Increasing the differential pressure will move the spool thru its 0.100 inch over lap length to the initial metering area and, also, with this movement, close off the open path across the spool from the cylinder port to the tank port. (Additional increase in differential pressure, up to 200 psi, will move the spool thru the metering notch area to full stroke of .350 travel and maximum flow.)

The shuttle system of spool section #1 is now connected to the cylinder load instead of the tank port. Shuttle "A" (Item 8 - Large Shuttle) senses this load pressure and passes it thru shuttle "B" (Item 7 - Small Shuttle) to the P.C. control circuit. This pressure moves the unloading piston (Item 4) into the operating position which preloads the spring (Item 2) to the 150 psi operating position.

The compensator spool (Item 1) will now vary the metering notch opening from pump supply to tank return, holding pump pressure at 150 psi above the cylinder port load pressure. If the directional valve spool #1 is set to flow 5 gpm, the remaining 15 gpm of the pump will be by-passed.

The pressure reducer spool (Item 6), also receives a load pressure signal from shuttle "A", and begins to reduce its meter notch area to hold a 100 psi pressure drop across the directional valve spool. It is this feature that provides constant flow regardless of changes in load pressure or pump pressure. Logically if only one spool section were to be used this reducer would not be required, since the by-pass compensator always holds the pump at 150 psi above the load.

Assume that the load pressure of directional valve spool #1 is 500 psi and the pump pressure is 150 psi higher or 650 psi! Then the directional valve spool, of section #3, is moved to operate its function at 7 gpm. The load pressure of #3 is 1500 psi.



LOAD SENSING - PRESSURE COMPENSATING
CIRCUIT SCHEMATIC
FIGURE 2

Shuttle "A" of spool section #3 senses this 1500 psi load and ports it to the pressure reducer (Item 6) of this spool section and, also, on to the P.C. control circuit. Shuttle "B" is omitted in this manifold since the P.C. circuit of #4 is blocked from this #3 spool section system.

This 1500 psi load signal is transmitted thru the "B" shuttles of the P.C. control circuit to the by-pass compensator which in turn increases pump pressure to 1650 psi. Now the pressure reducer (Item 6) of spool section #1 must operate to reduce the 1650 psi pump pressure to 600 psi in order to maintain the 100 psi differential across the directional valve spool and thus hold constant rate.

The system relief valve (Item 3) limits maximum pump pressure by bleeding off the P.C. control circuit at the pre-set level. The flow limiting orifice (Item 5) permits the small poppet of the relief valve to control the pressure level in the spring cavity of the compensator. This results in the pump output being by-passed to tank at relief setting.

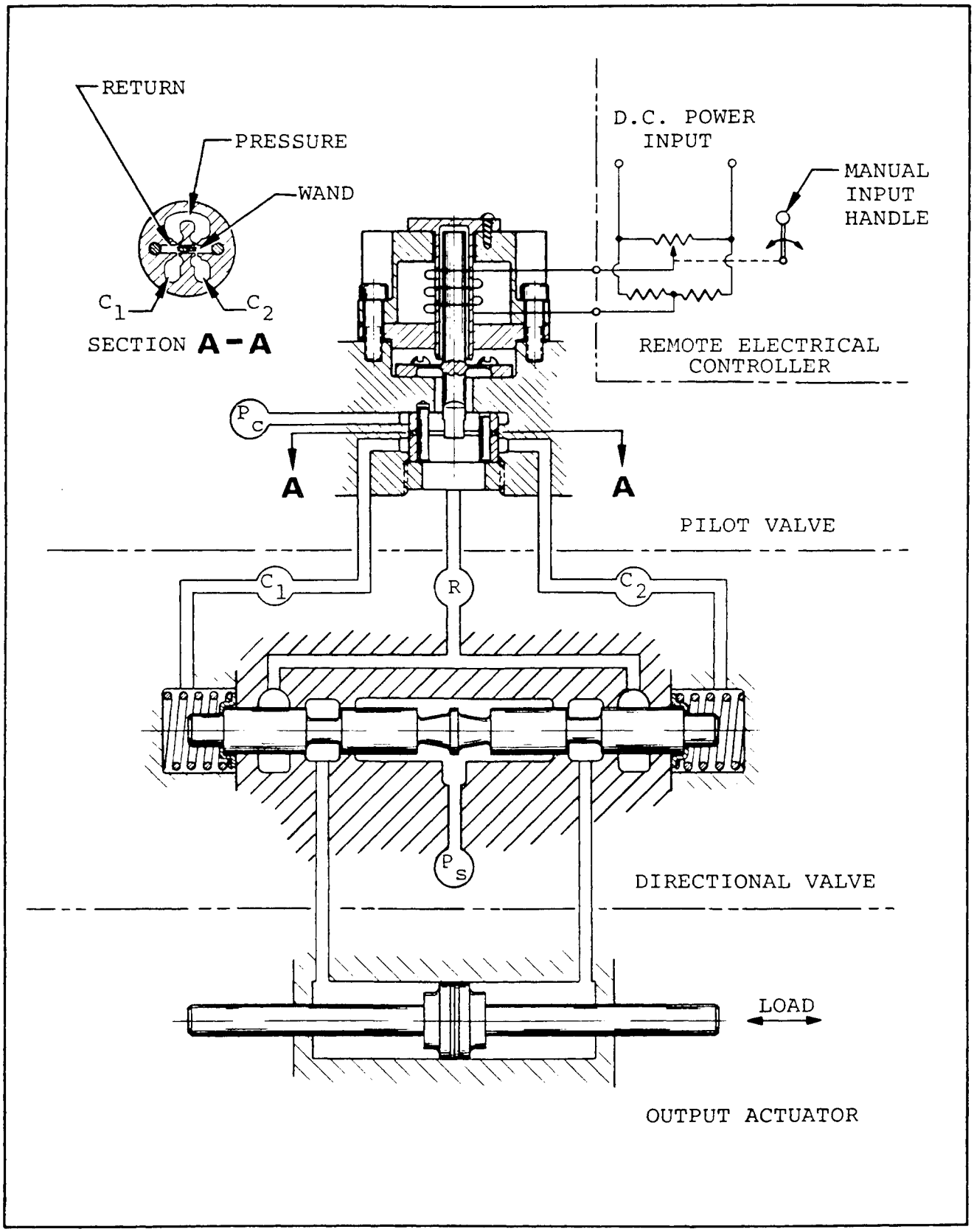
Since the 30 gpm pump supplies fluid to only spool section #4, it is not required to use a pressure reducer spool in the manifold, because the by-pass compensator (Item 1) of the single port inlet will hold 150 psi differential pressure across the directional valve spool. This 150 psi will maintain constant rate of the function for any directional valve spool position. A simple blocking spool (Item 10) is used in place of a pressure reducer spool.

B. REMOTE CONTROL OF DIRECTIONAL VALVE SPOOL

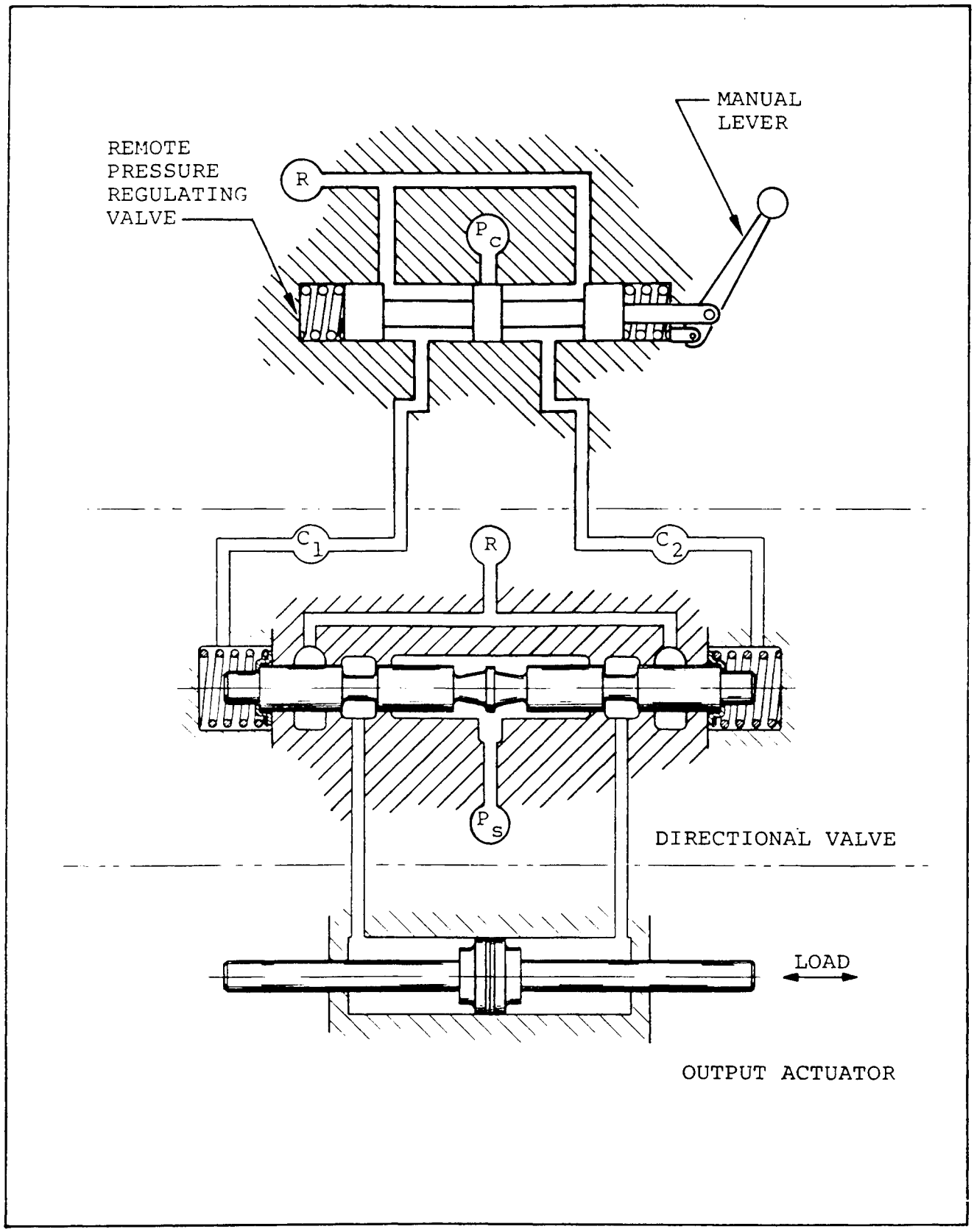
The two basic systems used to control the position of the directional valve spool, and thus control the speed or position of the function are (1) Electro-Hydraulic or (2) Remote Pilot Oil. Each system varies the differential pressure in the end caps to position the spool proportional to input command! Power system output flow will be provided from the cylinder port adjacent to the end cap with the highest pressure.

The Remote Electro-Hydraulic system uses the pilot valve and remote electrical controller as shown on figure 3. The operation starts with a manual input to the remote electrical controller that provides an output signal(0 to 3.6 volts) proportional to handle position. This signal is conducted to the pilot valve where it is converted to a differential control pressure by the movement of the jet diverter wand.

The pilot valve operates on a 300 psi differential pressure across its supply to tank ports and will provide a maximum differential output control pressure between its C_1 and C_2 output ports of 240 psi. (ie - minimum pressure recovery of 80%) Each pilot valve requires a continous flow of 0.5 to 0.6 gpm



REMOTE ELECTRO-HYDRAULIC CONTROL
FIGURE 3



REMOTE PILOT OIL CONTROL
FIGURE 4

at 300 psi differential pressure. An isolated source of control fluid is required as shown on figure 12!

A positive polarity of the red wire of the pilot valve coil will provide flow from the cylinder port adjacent to the pilot valve.

The Remote Pilot Oil Control system, Figure #4, starts with a remote pressure regulating valve that will provide an output pressure (0 to 200 psi) that is proportional to valve lever position. When the pressure regulating spool is in the neutral position, both control ports (C_1 and C_2) are connected to tank.

As the spool is moved with manual lever travel, the pressure will increase in the selected control port, overcoming the 19# directional valve spool spring detent. Additional pressure increase with the remote pressure regulating valve operation will position the directional valve spool in proportion to command.

An optional purge manifold assembly is discussed in section IV, and figure #11.

IV ASSEMBLY & SERVICE

The Bertea module is a stack type valve that permits the use of multiple spool sections and various options of controls in the inlets or directional valve manifolds.

Dual Port Inlet Manifold Assembly Figure #5

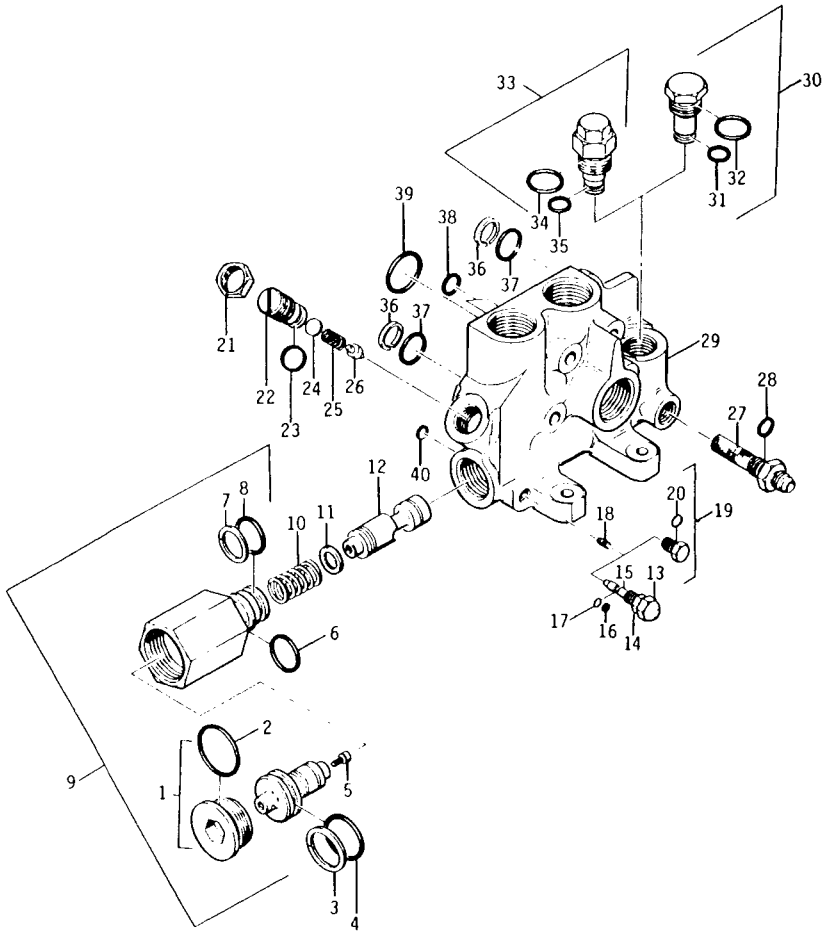
The dual port manifold assembly provides inlet porting for both the power fluid circuit and, also, the pilot valve control fluid circuit. The power fluid circuit contains both inlet and outlet porting, but the control fluid circuit is inlet porting only. The system relief valve (Item 21 thru 26) is adjustable up to 3000 psi. The orifice (Item 18) limits the flow into the compensator spring cavity, permitting the relief valve to limit system pressure by porting this fluid to tank.

The compensator unloader (Item 9) is a selected fit of the piston to the housing and, therefore, must be changed as an assembly.

When electro-hydraulic pilot valves are used for directional valve spool control, the dual port inlet should contain a pilot pressure relief valve (Item 33) to maintain the required 300 psi control pressure. All other inlets may use the optional port plug (Item 30).

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	269342-20	HEX. PLUG
2	1	3-920N552-90	"O" RING
3	1	261895-5	GLYD RING
4	1	2-122N674-70	"O" RING
5	1	269341-3	ORIFICE PLUG
6	1	3-916N552-90	"O" RING
7	1	8-922N300-90	BACKUP RING
8	1	2-022N674-70	"O" RING
9	1	269388-1	UNLOADER ASSY.
10	1	269337-1	SPRING
11	AS REQ'D	249899-11	SHIM
12	1	269336-1	SPOOL
13	1	3/8-24 UNF	ACORN NUT
14	1	5/8x1/4x3/8-24 UNF	HEX. NUT
15	1	269343-1	THROTTLE
16	1	MS28774-006	BACKUP RING
17	1	2-006N674-70	"O" RING
18	1	269374-1	ORIFICE PLUG
19	1	269376-3	HEX. HD. PLUG
20	1	3-903N552-90	"O" RING
21	1	1x5/16x3/4-16UNF	HEX. NUT
22	1	269316-1	PLUG
23	1	2-014N674-70	"O" RING
24	AS REQ'D	249899-12	SHIM
25	1	269318-1	SPRING
26	1	269317-1	POPPET
27	1	234950-1	FILTER
28	1	3-908N552-90	"O" RING
29	1	269307-1	INLET MANIFOLD
30	1	242925	PLUG ASSY.
31	1	3-912N552-90	"O" RING
32	1	2-014N674-70	"O" RING
33	1	231852-1	PILOT PRESS. RELIEF VALVE
34	1	3-912N552-90	"O" RING
35	1	2-014N674-70	"O" RING
△ 36	2	2-117N674-70	"O" RING
△ 37	2	24854-3	BACKUP RING
△ 38	2	2-112N674-70	"O" RING
△ 39	1	2-122N674-70	"O" RING
△ 40	1	2-107N674-70	"O" RING

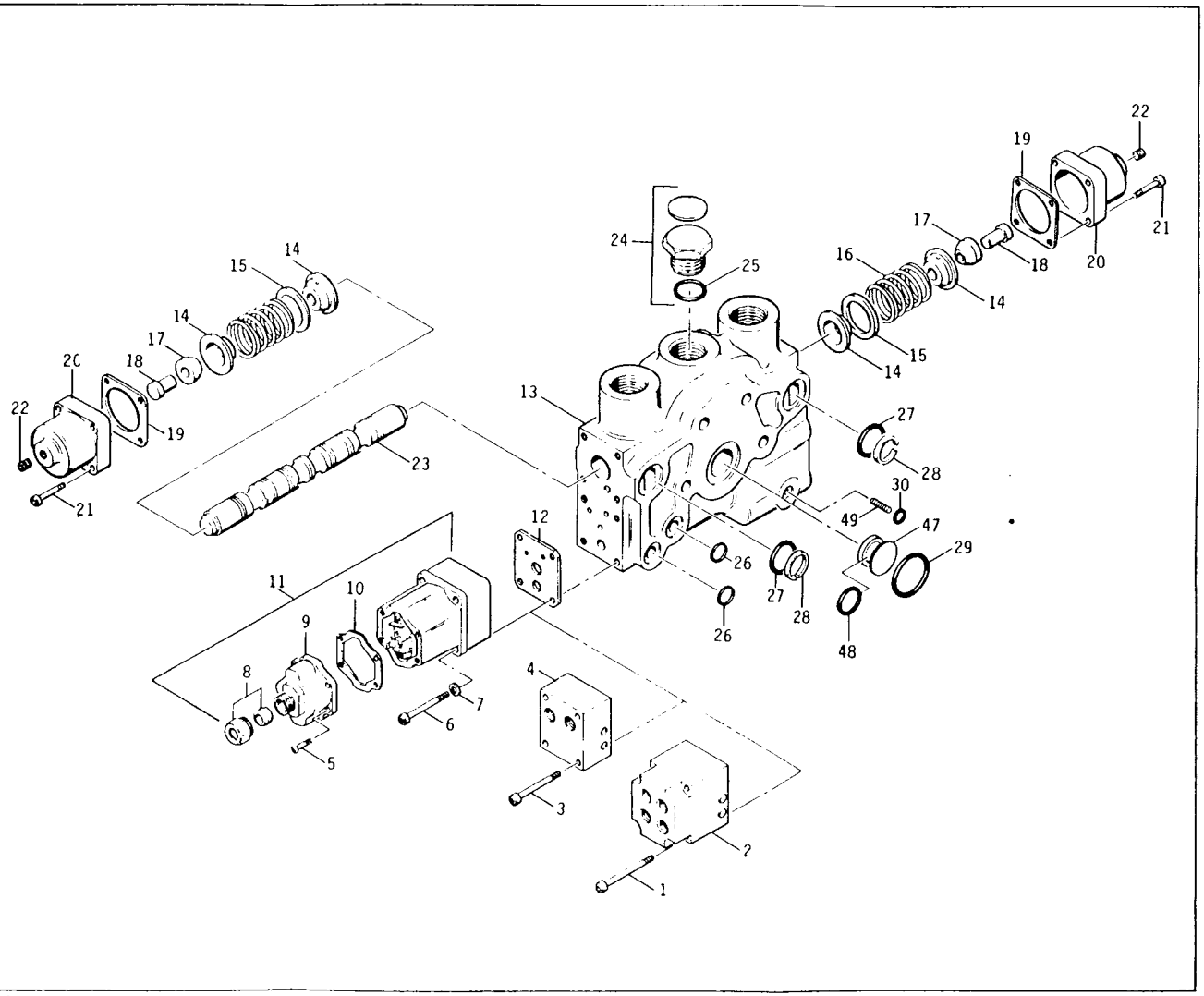
△ 269344-1 "O" RING KIT



DUAL PORT INLET MANIFOLD
FIGURE 5

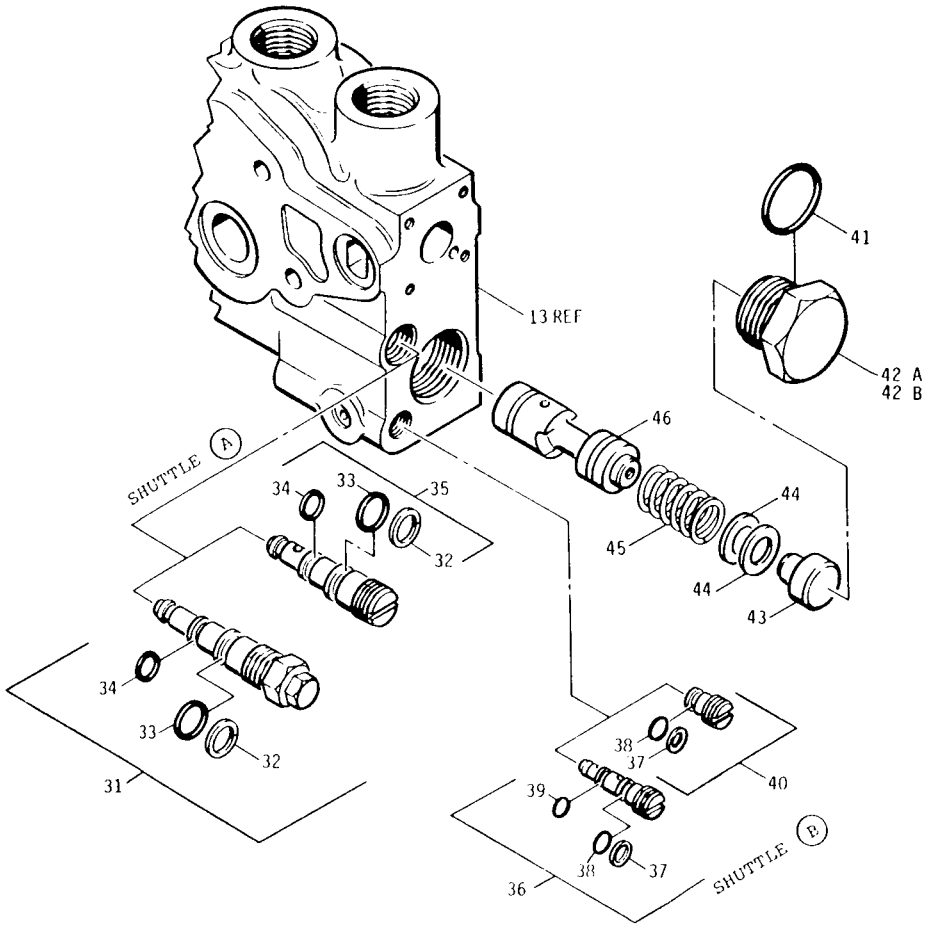
ITEM NO.	QTY	PART NUMBER	DESCRIPTION
1	4	10-24x1 3/4	SCREW-SOC. HEAD
2	1	269357-1	MANIFILD ASSY.-PURGE & SHUTTLE VALVE
3	4	10-24x1 1/2	SCREW-SOC. HEAD
4	1	269327-1	MANIFOLD ASSY.- PURGE CIRCUIT
5	4	#6-32x1/2	SCREW-PHILLIPS HD.
6	4	234980	SCREW-SOC. HEAD
7	4	234959	WASHER
8	1	249896	SEAL KIT
9	1	242933	COVER
10	1	242907	GASKET
11	1	234912	PILOT VALVE
12	1	225931-1	GASKET
13	1	269305-1	BODY
14	4	234927-1	SPRING GUIDE
15	2	234953-1	SHIM
16	2	231830-1	SPRING
17	2	234932-1	PIVOT
18	2	234931-1	PIN .350 SPOOL TRVL
		-3	PIN .300 SPOOL TRVL
		-9	PIN .250 SPOOL TRVL
19	2	225989-1	GASKET
20	2	269315-1	END CAP
21	8	#10-24x3/4	SCREW-SOC. HEAD
22	2	1/8-27 NPT	PLUG SOC. HEAD
23	1	AS REQ'D	SPOOL
24	1	261850-3	PLUG ASSY.
25	1	3-912N300-90	"O" RING
△ 26	2	2-112N674-70	"O" RING
△ 27	2	2-114N674-70	"O" RING
△ 28	2	248584-3	BACKUP RING
△ 29	1	2-122N674-70	"O" RING
△ 30	1	2-107N674-70	"O" RING

△ 269344-1 "O" RING KIT



DIRECTIONAL VALVE MANIFOLD (SHEET 1 OF 2)
FIGURE 6

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
31	1	269360-1	SHUTTLE BY-PASS VALVE ASSY.
32	1	8-014	BACKUP RING
33	1	2-014 N64-70	"O" RING
34	1	269370-012	"O" RING
35	1	269364-1	SHUTTLE VALVE ASSY. (1/4 BALL)
36	1	269330-1	SHUTTLE VALVE ASSY. (5/32 BALL)
37	1	8-010	BACKUP RING
38	1	2-010N64-70	"O" RING
39	1	269379-009	"O" RING
40	1	269359-1	PLUG ASSY. (SHUTTLE VALVE)
41	1	3-916N552-90	"O" RING
42a	1	269335-1	PLUG, PRESSURE REDUCER (USE WITH ITEM 35)
42B	1	269340-1	PLUG, PRESSURE REDUCER (USE WITH ITEM 31)
43	1	269347-1	RETAINER
44	2	249899-11	SHIM
45	1	269375-1	SPRING
46	1	269333-1	SPOOL-PRESSURE REDUCER
		269349-1	SPOOL-BLANK
47	1	269345-1	PLUG
48	1	2-115	O'RING
49	1	269394-1	PLUG



DIRECTIONAL VALVE MANIFOLD (SHEET 2 OF 2)
FIGURE 6

Directional Valve Manifold Assembly Figure #6

Each directional valve assembly consists of the directional valve spool (Item 23); a means to position the spool by either the electro-hydraulic pilot valve (Item 11) or a remote pilot oil system (Item 2 or 4); a shuttle to sense highest working cylinder port pressure (Item 31 or 35); and a shuttle (Item 36) to transmit the highest pressure with in the total module to the inlet compensator.

An optional pressure reducer spool (Item 46) is provided when constant rate for the function is required in multiple spool section stacks. When only single functions are operated at one time, a blank spool is provided in order to simplify the system.

The standard end cap (Item 20) with various length pins (Item 18) determine the maximum spool travel and hence the maximum flow rate for any specific spool. This selction of spool and pins provide field adjustment of desired function speeds.

The optional manual override assembly for a remote controlled spool is shown in Figure #7. This assembly will provide direct manual control of the spool in the event of a failure in the remote controller, the electrical power supply, or a malfunction of the pilot valve.

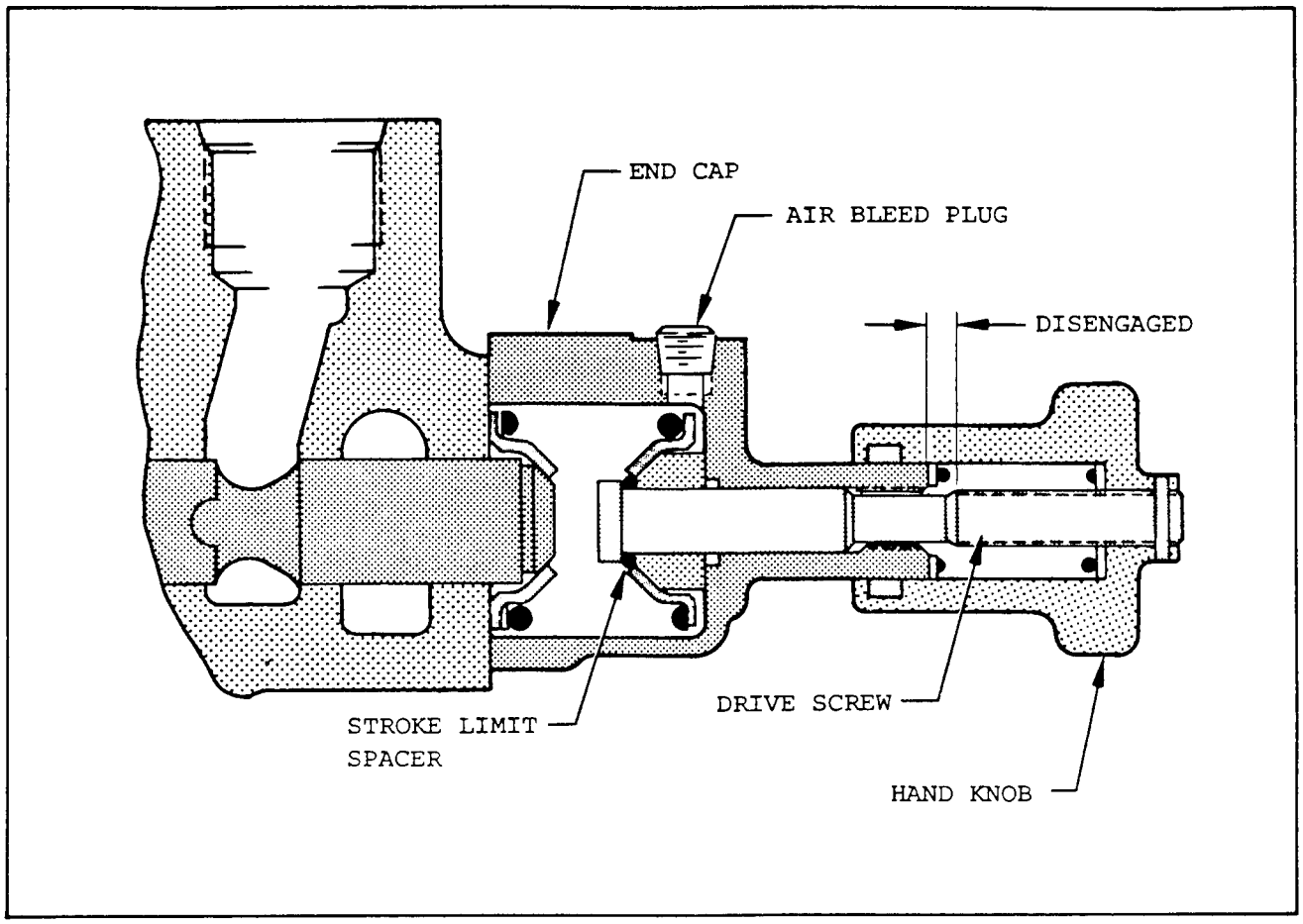
The hand knob is held in the thread disengaged position by a light spring to prevent inadvertent operation. Press the knob inward while rotating to engage the threads in the cap and the drive screw. Continued rotation clockwise will move the spool from center and will provide flow from the cylinder port adjacent to this end cap. The knob must be rotated outward and disengaged prior to operating the manual override on the opposite end cap.

A plug is provided, as shown, to bleed the air from each end cap after initial assembly and operation. Air trapped in the spool end cap will reduce the response of the valve assembly.

Single Port Inlet Manifold Assembly Figure #8

The single port manifold provides inlet porting for the power system fluid only. The tank return porting has an optional configuration of joining the pilot valve control fluid tank return, to the power fluid return for common porting to tank or separating the two return circuits for independent tank lines.

When the ¼ NPTF pipe plug (Item 29) is installed, it will block the pilot control return fluid from the power system tank line! With this configuration the pilot fluid must be connected to tank from port 28A. Without the ¼ NPTF plug installed, both fluid return circuits are common.



MANUAL OVERRIDE END CAP ASSEMBLY NO. 234955
FIGURE 7

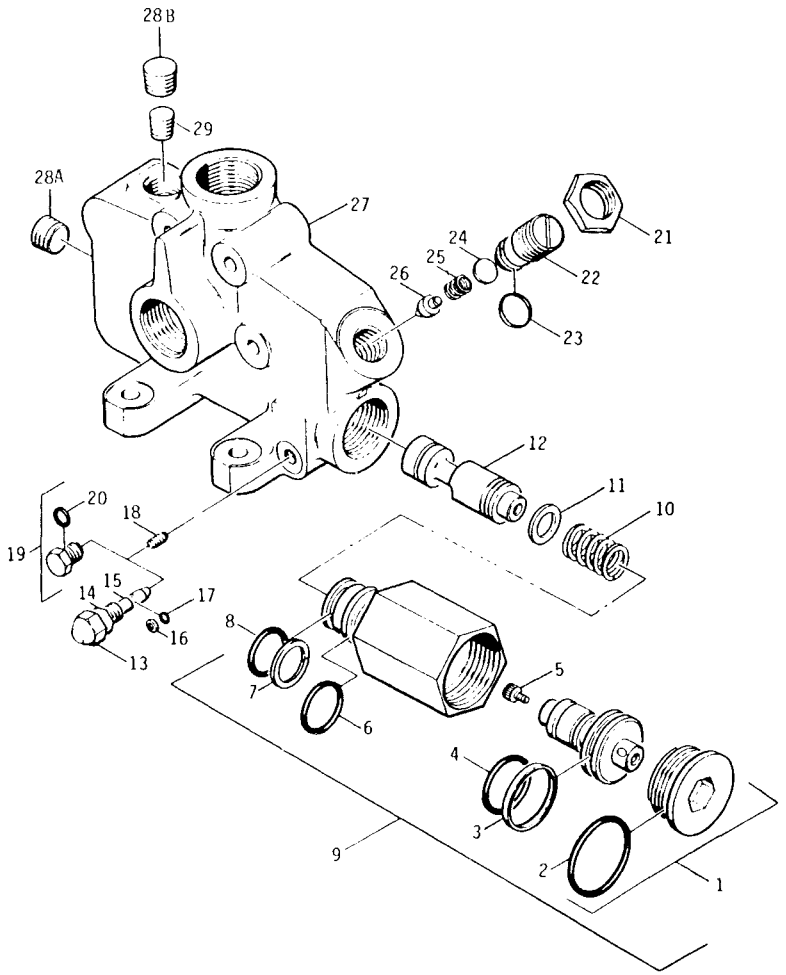
The system relief valve (21 thru 26) is adjustable up to 3000 psi. The orifice (Item 18) limits the flow into the compensator spring cavity, permitting the relief valve to limit system pressure by porting this fluid to tank.

The compensator unloader (Item 9) is a selected fit assembly of the piston to the housing and, therefore, must be changed as an assembly.

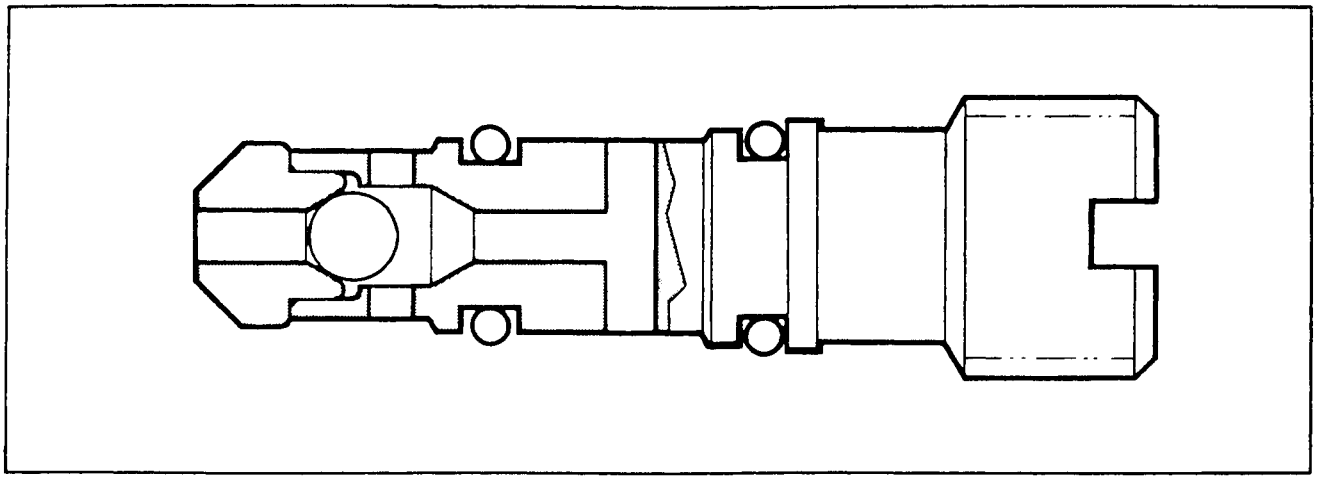
Pilot Valve Assembly

The electro-hydraulic pilot valve is a separate, replaceable assembly as shown on Figure #6 and #15. Each valve has 150 micron filter, installed beneath the roll pin that is used for installation orientation.

ITEM NO.	QTY.	PART NUMBER	DESCRIPTION
1	1	269342-20	HEX. PLUG
2	1	3-920N552-90	"O" RING
3	1	261895-5	GLYD RING
4	1	2-122N674-70	"O" RING
5	1	269341-3	ORIFICE PLUG
6	1	3-916N 552-90	"O" RING
7	1	8-022N300-90	BACKUP RING
8	1	2-022N784-70	"O" RING
9	1	269388-1	UNLOADER ASSY.
10	1	269337-I	SPRING
11	AS REQ'D	249899-11	SHIM
12	1	269336-1	SPOOL
13	1	3/8-24 UNF	ACORN NUT
14	1	5/8x1/4x3/8-24UNF	HEX. NUT
15	1	269343-1	THROTTLE
16	1	MS28774-006	BACKUP RING
17	1	2-006N674-70	"O" RING
18	1	269374-1	ORIFICE PLUG
19	1	269376-3	HEX. HD. PLUG
20	1	3-903N552-90	"O" RING
21	1	1"x5/16x3/4-16 UNF	HEX NUT
22	1	269316-1	PLUG
23	1	2-014N674-70	"O" RING
24	AS REQ'D	249899-12	SHIM
25	1	269318-1	SPRING
26	1	269317-1	POPPET
27	1	269310-1	OUTLET MANIFOLD
28	1	3/8-18 NPT	PIPE PLUG SOCKET HD.
29	AS REQ'D	1/4-18 NPT	PIPE PLUG SOCKET HD.



SINGLE PORT INLET MANIFOLD
FIGURE 8

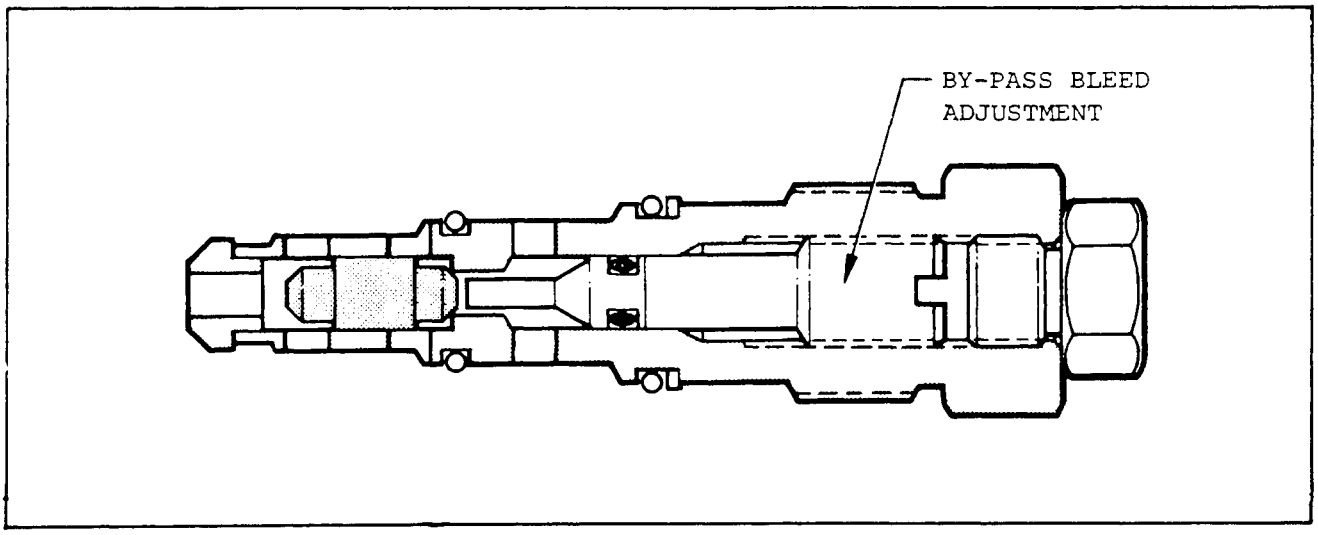


BASIC SHUTTLE
FIGURE 9

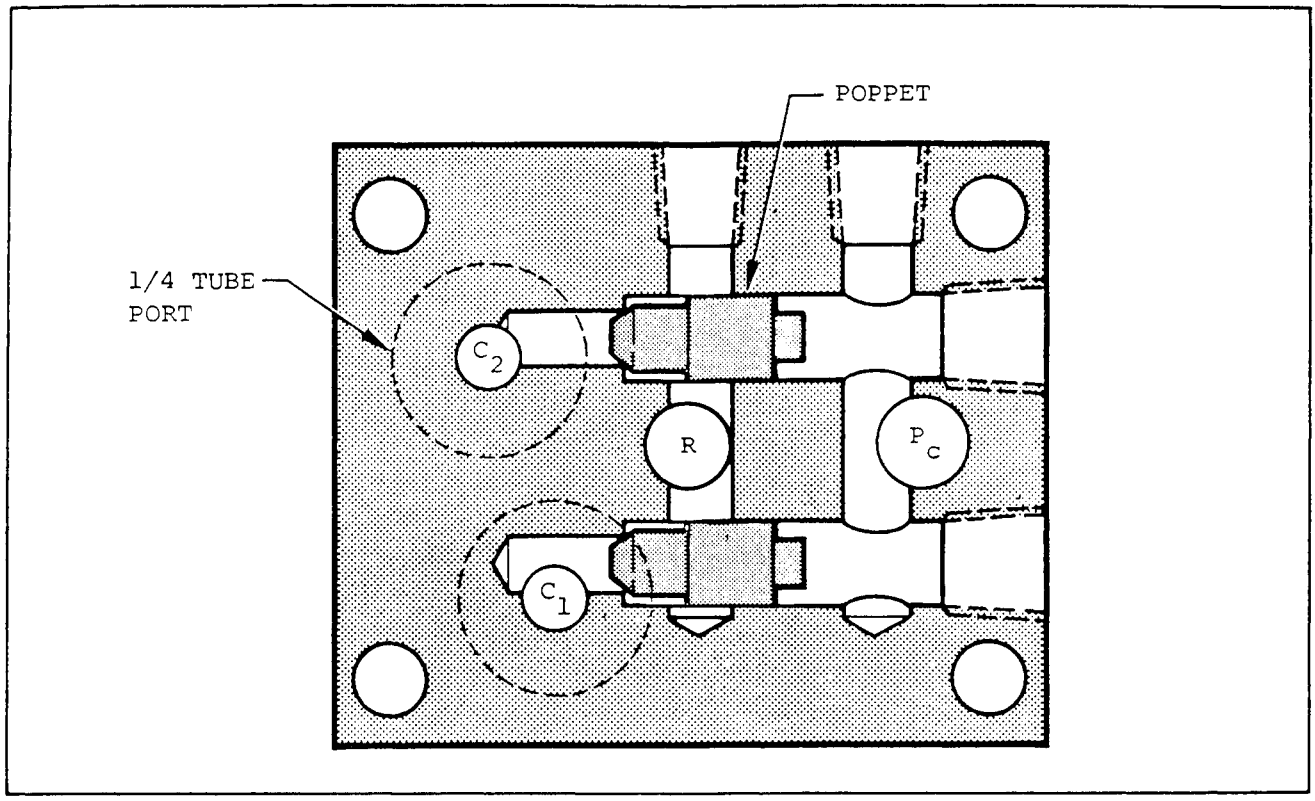
Shuttle Assemblies

Two types of shuttle assemblies are used in the P.C. control circuit. The basic shuttle shown in Figure #9, is a single ball unit that seals in either position. This type is the standard configuration for shuttle "B" (Ref: Figure #2), and is optional for shuttle "A" usage. There are no adjustments in this shuttle.

Figure #10 shows the second shuttle configuration used as shuttle "A", and it provides an adjustable by-pass bleed from cylinder port "B" to cylinder port "A", as shown on Figure #2. This is used to smooth the operation of a holding valve in a topping cylinder application. Therefore, cylinder port "B", which is adjacent to the pilot valve or purge manifold mounting face must be connected to lower the function.



ADJUSTABLE BY-PASS SHUTTLE
FIGURE 10



PURGE MANIFOLD ASSEMBLY
FIGURE 11

Purge Manifold Assembly

The purge manifold assembly, shown in Figure #11, provides the interface porting for the Remote Pilot Oil applications. The manifold is ported to receive control oil from the remote valve into the ¼" tube ports on the top surface, and, also, to provide porting into the directional valve spool section for C_1, C_2, R (return), and P_C (control pressure). This control pressure (P_C) is received internally from the inlet manifold and is not from the remote pressure reducer valve. The external circuit is shown on Figure #13.

When 200 psi pressure is applied at P_C, the poppets are held in the position shown, which isolates C_1 and C_2 from R (return). This is the normal operating configuration for the system.

In order to purge cold oil from the lines connecting the purge manifold to the remote pressure reducing valve, the P_C port is connected to tank. Now the 100 to 200 psi pressure in the control lines C_1 and C_2 will unseat the poppets, and the oil will flow into the return port (R), and back to tank.

V INSTALLATION

A. FILTRATION & HYDRAULIC SYSTEM PREPARATION

The life of any hydraulic system is sensitive to the cleanliness of the fluid stream. It is recommended that good cleaning and flushing procedures be followed in the assembly and test of the system.

The filtration configuration recommended for the Bertea system is shown on Figure #12. A power system filter of 10 micron rating is to be used either as a return line unit or a full flow high pressure filter on the power system pump discharge. The non by-pass filter for the pilot fluid line should be as large a flow rating as possible and of a 25 or 40 micron rating.

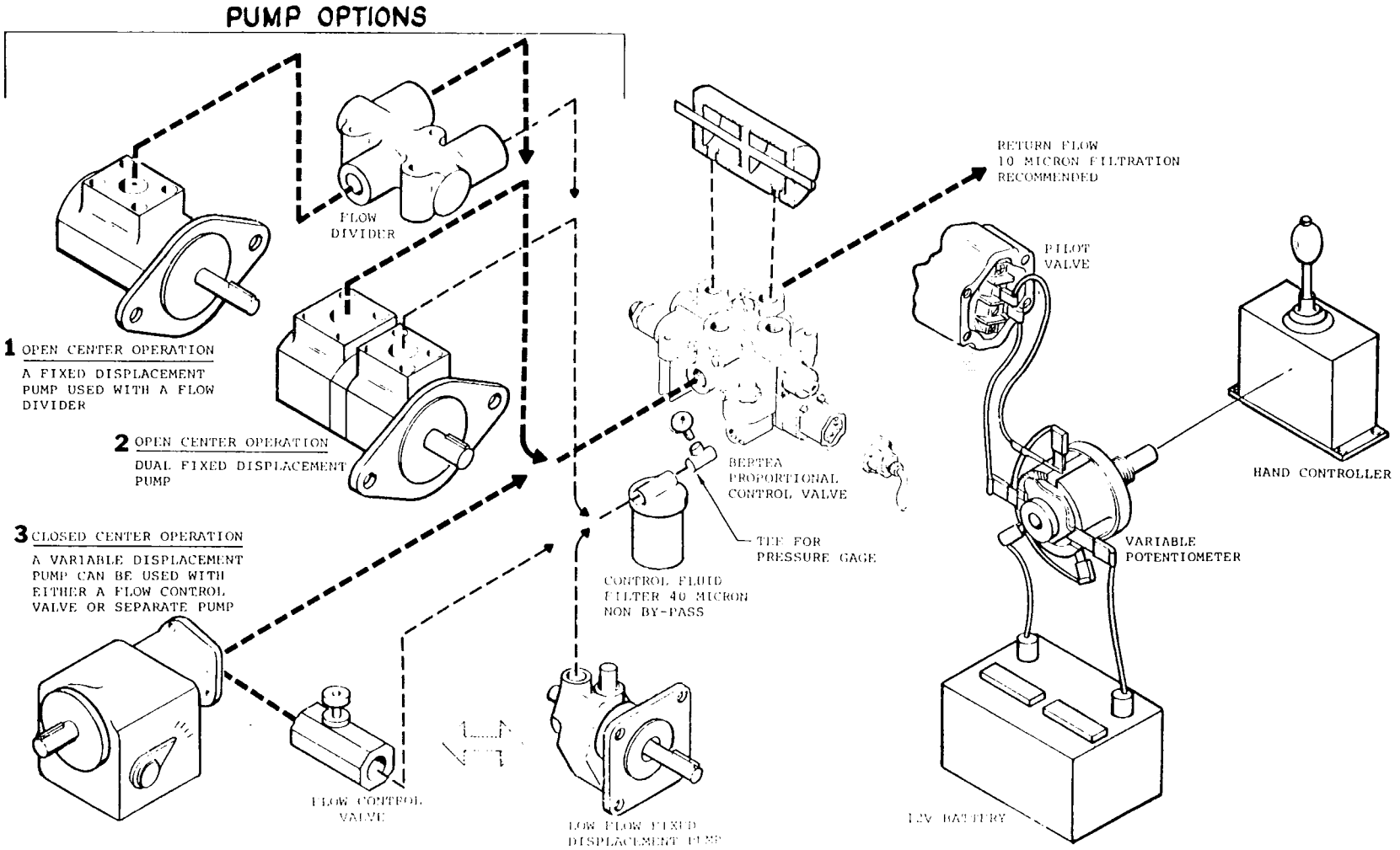
Since this pilot circuit is a constant flow, if the filter is the same micron size as the system filter, it will have a short life. The small tube type filter in the inlet manifold (234950, Figure #5) is 100 micron rating and is only intended for coarse material. Each pilot valve has a 150 micron filter on its inlet port as a protection while replacing units on a manifold.

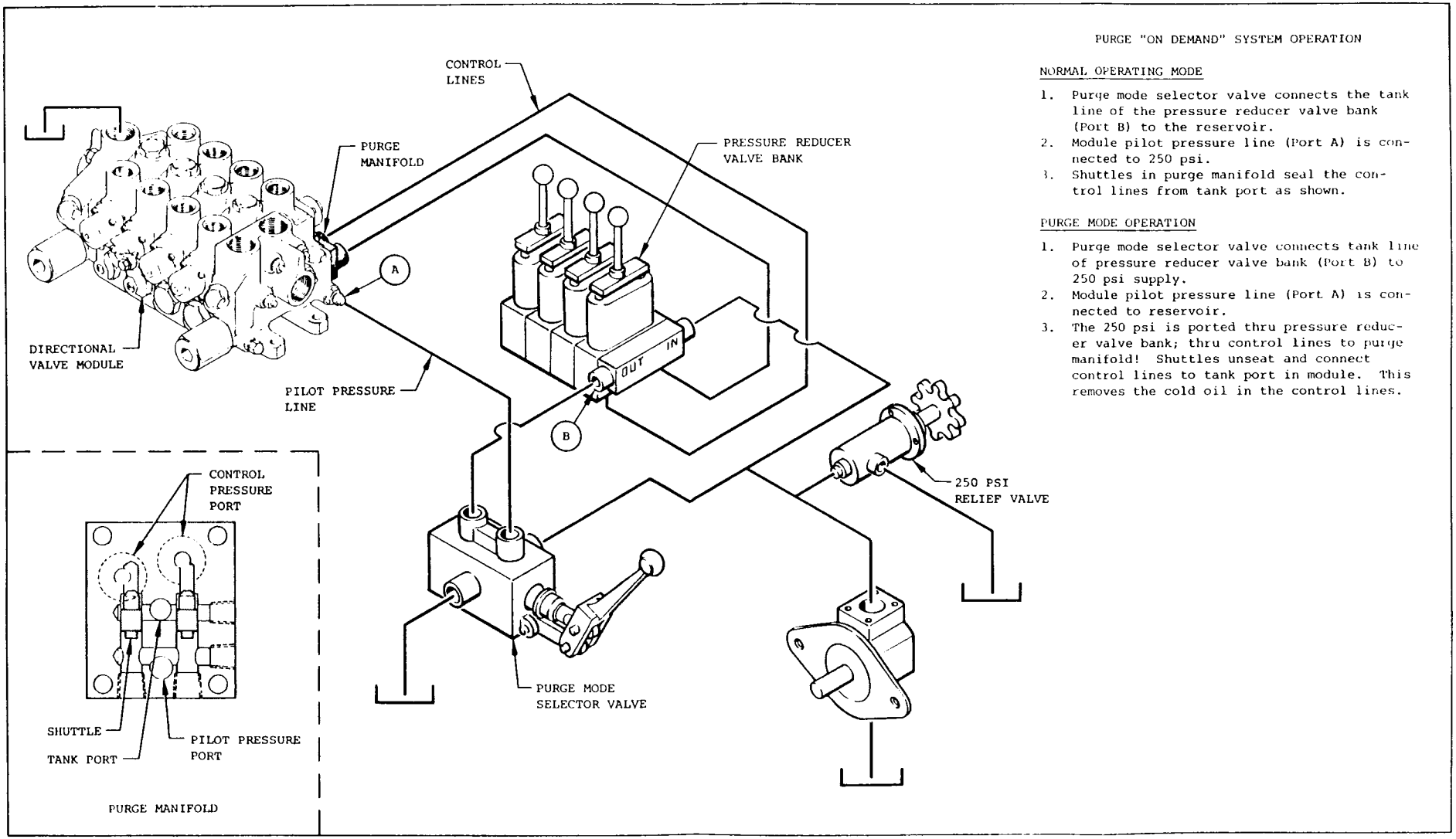
B. PILOT FLUID CIRCUIT

The separate pilot fluid circuit options, as shown on Figure #12 and #13, provide capability of controlling the directional valve spool under any operating mode.

When using electro-hydraulic pilot valves, (Ref: Figure #12), a differential pressure of 300 to 350 psi is required across the module. If the return line pressure is 50 psi, an inlet pressure of 350 psi would be required. Each standard pilot valve requires a continous flow of 0.5 to 0.6 gpm and the pilot pressure relief valve is set to flow 0.5 gpm at 300 psi Δp. Therefore, a (4) spool section module would require 4 x 0.5 gpm plus 1.0 gpm for the relief valve (plus flow tolerance) or 3 gpm total constant flow.

If a remote pilot oil system is used as shown on Figure #13, the method of obtaining the pilot oil can be the same, but the required flow rate and pressure will be lower. Since the manual pressure reducer valves are blocked center, they only flow oil when actuated. Therefore, a flow rate of 2 to 3 gpm is adequate for control and, also, for the purge mode. The required pressure is 250 psi.


PUMP OPTIONS
FLOW DIVIDER
1 OPEN CENTER OPERATION
A FIXED DISPLACEMENT PUMP USED WITH A FLOW DIVIDER
2 OPEN CENTER OPERATION
DUAL FIXED DISPLACEMENT PUMP
3 CLOSED CENTER OPERATION
A VARIABLE DISPLACEMENT PUMP CAN BE USED WITH EITHER A FLOW CONTROL VALVE OR SEPARATE PUMP
FLOW CONTROL VALVE
LOW FLOW FIXED DISPLACEMENT PUMP
CONTROL FLUID FILTER 40 MICRON NON BY-PASS
BERTEA PROPORTIONAL CONTROL VALVE
TEE FOR PRESSURE GAGE
RETURN FLOW 10 MICRON FILTRATION RECOMMENDED
PILOT VALVE
HAND CONTROLLER
VARIABLE POTENTIOMETER
12V BATTERY



REMOTE PURGE SYSTEM SCHEMATIC
FIGURE 13

PURGE "ON DEMAND" SYSTEM OPERATION

NORMAL OPERATING MODE

1. Purge mode selector valve connects the tank line of the pressure reducer valve bank (Port B) to the reservoir.
2. Module pilot pressure line (Port A) is connected to 250 psi.
3. Shuttles in purge manifold seal the control lines from tank port as shown.

PURGE MODE OPERATION

1. Purge mode selector valve connects tank line of pressure reducer valve bank (Port B) to 250 psi supply.
2. Module pilot pressure line (Port A) is connected to reservoir.
3. The 250 psi is ported thru pressure reducer valve bank; thru control lines to purge manifold! Shuttles unseat and connect control lines to tank port in module. This removes the cold oil in the control lines.

C. REMOTE PILOT OIL WITH PURGE OPTION

The remote pilot oil system uses manually operated pressure reducers to vary the control pressure in the directional valve spool end caps from 0 to 200 psi. Spool position is proportional to the differential pressure in the end caps.

The addition of a manually selected purge system that will flow oil from the pressure reducers, thru the control lines, then thru the purge manifold and into the tank return line of the module is, also, shown on Figure #13. This is a demand system that is energized by putting the selector valve in the purge mode. This applies pressure to port (B) and connects port (A) to tank and causes the purge flow as noted. Normal control operation is resumed when the lever is returned to the operating mode by connecting (B) to tank and control pressure to port (A).

D. MODULE INSTALLATION

The Bertea proportional control valve module can be mounted in any position or attitude, except in the case where in a severe shock load would be imposed parallel to the axis of movement of the directional valve spool. For example, with a scoop loader impacting into a material pile, the module should be installed with the spool axis 90° to the direction of impact.

Figure #14 shows the installation dimensions of the module. It should be noted that when using the electro-hydraulic pilot valves, the 1½" air gap should be maintained as shown.

VI START-UP AND TROUBLE SHOOTING (Figure #2)

PROBLEM — POSSIBLE CAUSES — REMEDY

A. Functions will not move and pump is at full system pressure.

1) Inlet and outlet plumbing are reversed.

a. Reverse plumbing.

2) Inlet spool is stuck.

a. Remove spool (1) and check for burrs, and/or foreign material.

B. Functions will not move and pump is at low press. (approximately 100 psi)

1) No pilot pressure to spool section spool.

   a. Apply pilot pressure ΔP across spool and to pilot inlet.

2) Small shuttle plugged.

   a. Clean shuttle (7).

3) Orifice in inlet plugged.

   a. Clean orifice (5).

C. First function speeds up when a second function is operated.

1) Small shuttle in first function is plugged.

   a. Clean shuttle (7).

2) Pressure reducer spool in first function is stuck.

   a. Remove spool (6) and check for burrs and/or foreign material.

D. Function operates in one direction only.

1) Large shuttle stuck.

   a. Clean shuttle (8).

2) Directional valve spool stuck.

   a. Remove spool (9) and check for burrs and/or foreign material.

3) Pilot pressure to spool section spool in one direction only.

   a. Check ΔP across spool in both directions: See paragraph 8 for remote pilot oil applications. See paragraph 9 for electro-hydraulic pilot valve applications.

E. Function continues to move with no input command.

1) Directional valve spool stuck.

   a. Remove spool (9) and check for burrs and/or foreign material.

2) Pilot pressure to spool section spool is unbalanced.

   a. Check ΔP across spool in both directions: See paragraph 8 for remote pilot oil applications. See paragraph 9 for electro-hydraulic pilot valve applications.

F. Can Not obtain full system pressure.

1) System relief valves adjusted too low.

a. Increase relief valve setting (3) by adjusting the cap clockwise.

2) Inlet control orifice plugged.

a. clean orifice (5).

3) Foreign material on relief valve seat.

a. Remove relief valve cap (3), spring, and poppet. Flush the cavity.

4) Damaged "o" ring on unloader.

a. Remove unloader body (4) and replace "o" ring.

G. By-pass pressure too high.

1) Excessive flow.

a. Reduce pump output.

2) Excessive return pressure.

a. Remove return line restriction.

3) Unloader piston stuck in the "in" position.

a. Remove unloader (4) and clean orifice.

4) Directional valve spool stuck.

a. Remove spool (9) and check for burrs and/or foreign material.

H. Remote Pilot Oil Applications

Control problems with remote pilot oil systems are usually caused by a mal-function of either the pressure reducer or purge manifold assembly.

Disconnect the control lines at the purge manifold and attach pressure gages to the lines. With the manual lever in the center position the pressure in the lines should be equal. Movement of the lever should increase the pressure proportionally in one line to at least 200 psi greater than the other line pressure. Opposite lever travel should reverse the pressure differential.

Stuck poppets in the purge manifold block normally occur in the sealed or non purge mode! This mal-function is demonstrated by a function operating in one direction when switching to the purge mode, but stopping when returning to the operating mode. Remove poppet and deburr or replace purge manifold assembly.

I. Electro-Hydraulic Pilot Valve Applications

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

Control problems are usually either electrical, hydraulic or mechanical!

Electrical problems are isolated by disconnecting the wires from the pilot valve to determine if the problem is caused by the remote electrical controller or the pilot valve.

Hydraulic control problems, such as poor feathering, can be caused by very high or very low differential pressure across the pilot valve. Hydraulic mal-function problems, such as unwanted motion or non operation, can be caused by contamination failures. Check the control system filter and the inlet manifold filter (Item 27, Figure #5) for plugging or failure. Replace the pilot valve with a spare unit or one from another function to check for a plugged valve.

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

VII SPECIFICATIONS

A. POWER OIL SYSTEM

Rated Flow - 30 gpm
Rated Pressure - 2500 psi
By-Pass Compensator - 150 psi setting
Pressure Reducer - 100 psi setting
Recommended Filtration - 10 micron

B. PILOT VALVE OIL SYSTEM

REQUIRED Pressure - 300 psi ΔP
REQUIRED Flow - 0.6 gpm per valve
Plus - 1.0 gpm for relief valve
REQUIRED Filtration - 40 micron

C. PORT SIZES

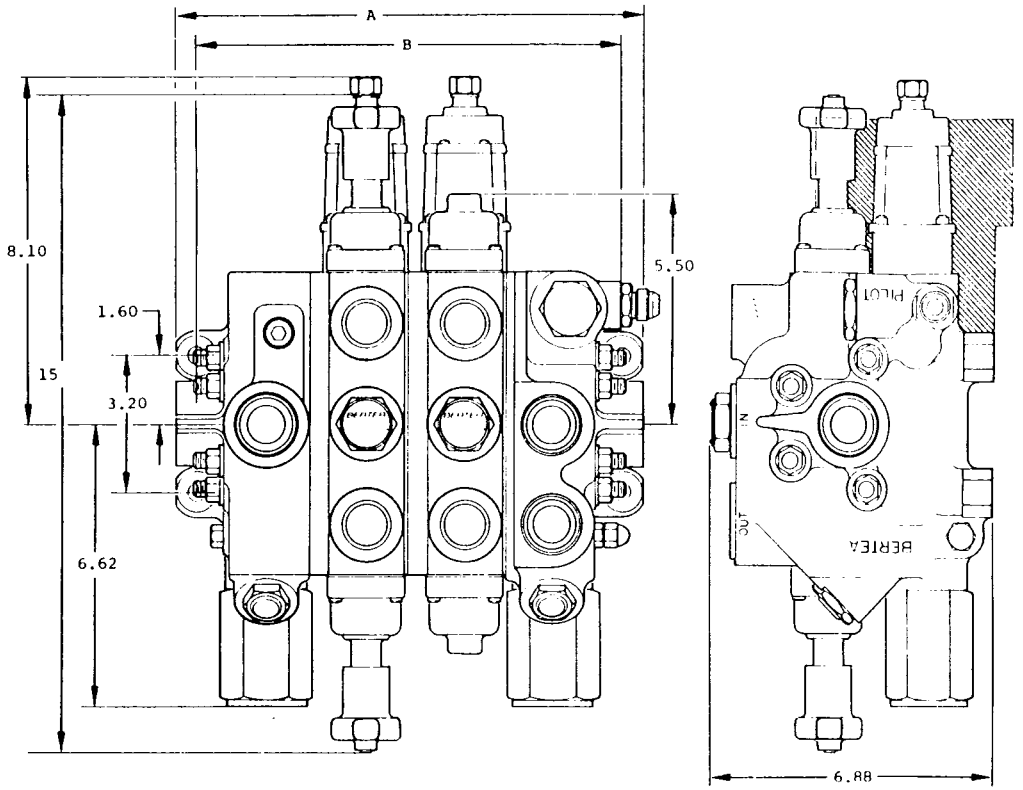
Inlet - 1 5/16-12 (1" Tube)
Cylinder - 1 1/16-12 (3/4" Tube)
Outlet - 1 5/16-12 (1" Tube)
Pilot Control - 3/8 Flared Tube Male
Purge Manifolds - 7/16-20 (1/4" Tube)

D. BOLT TORQUES

3/8-16 Clamping Studs	-	23 lb-ft Lube 30 lb-ft Dry
10-24 Screws	-	30 in lb Lube 40 in lb Dry

E. HYDRAULIC OIL

The recommended viscosity range is 50 to 4000 SSU which is typical for most pumps! Operating temperature range is -40°F to 200°F. Extreme cold weather operation will require fluids simular to automatic transmission fluids in order to minimize pump cavitation and excessive pressure loss in lines during start-up and initial warm-up.

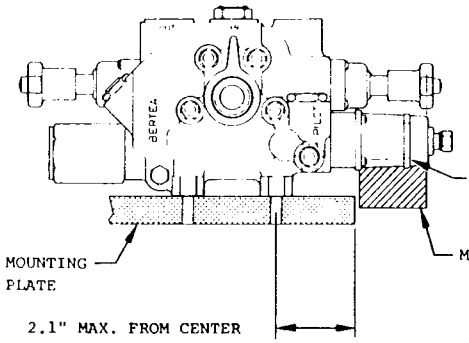


⚠ CAUTION: NO MAGNETIC METAL WITHIN 1.5 OF PILOT VALVE AS SHOWN.

NUMBER OF SPOOL SECTIONS	1	2	3	4	5	6
DIMENSION "A"	8.62	10.94	13.26	15.58	17.90	20.22
DIMENSION "B"	7.62	9.94	12.26	14.58	16.90	19.22
CLAMPING KIT P/N 269350 DASH NO.	-1	-2	-3	-4	-5	-6

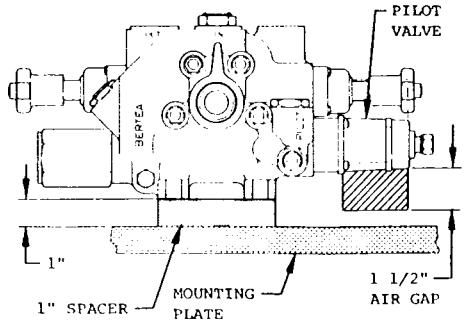
INSTALLATION
FIGURE 14

The pilot valve is mounted on the directional valve in a location to provide the easiest access for wiring and field replacement. This mounting configuration does present restraints when installing the complete valve module on a vehicle because of the permanent magnet in the pilot valve.
A large mass of magnetic metal adjacent to the magnet will offset the flux field and may cause a null shift in the valve. Therefore, the recommended mounting is shown in Figure 1 and 2 in order to provide at least 1-1/2 inches air gap beneath the magnet of the pilot valve.



If the mounting plate does not extend beneath the pilot valve, as shown, the module may be mounted directly to the plate.

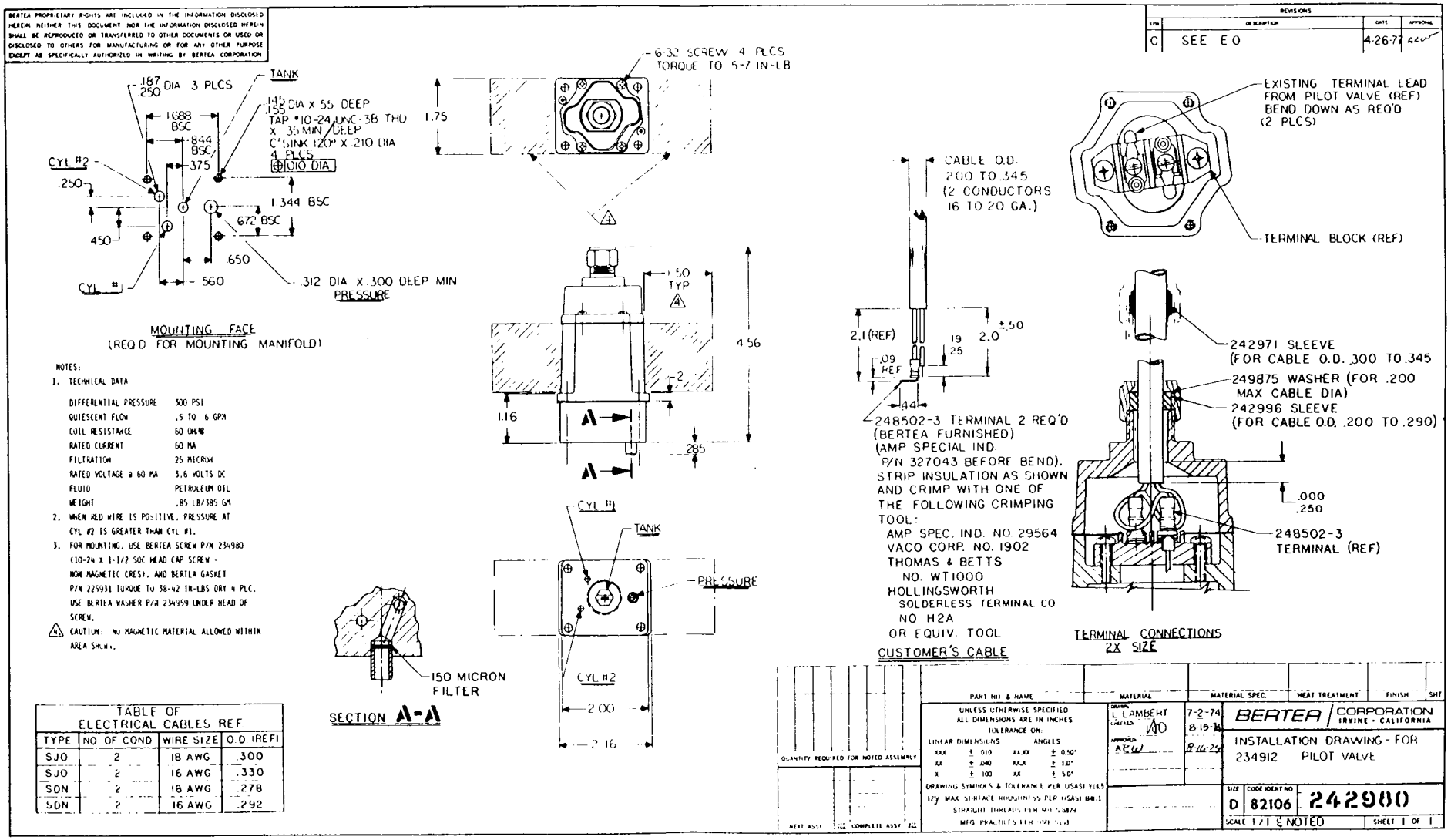
FIGURE 1



If the mounting plate extends underneath the pilot valve magnet the module must be raised at least one (1) inch in order to provide an air gap of 1-1/2 inch beneath the pilot valve.

FIGURE 2

26

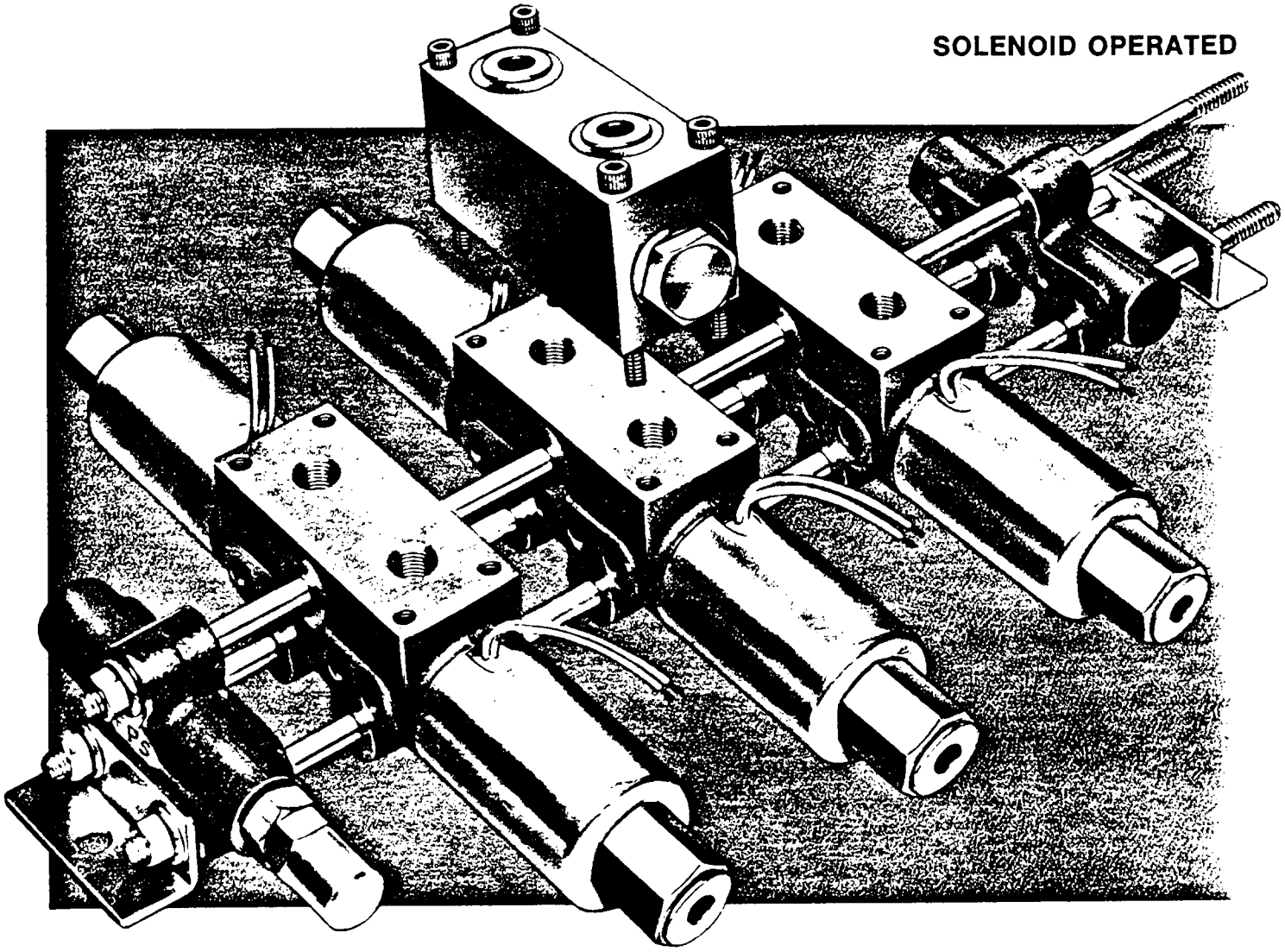


PILOT VALVE INSTALLATION
FIGURE 15

Bulletin No. 5-2360-4

mini-pak valves

SOLENOID OPERATED



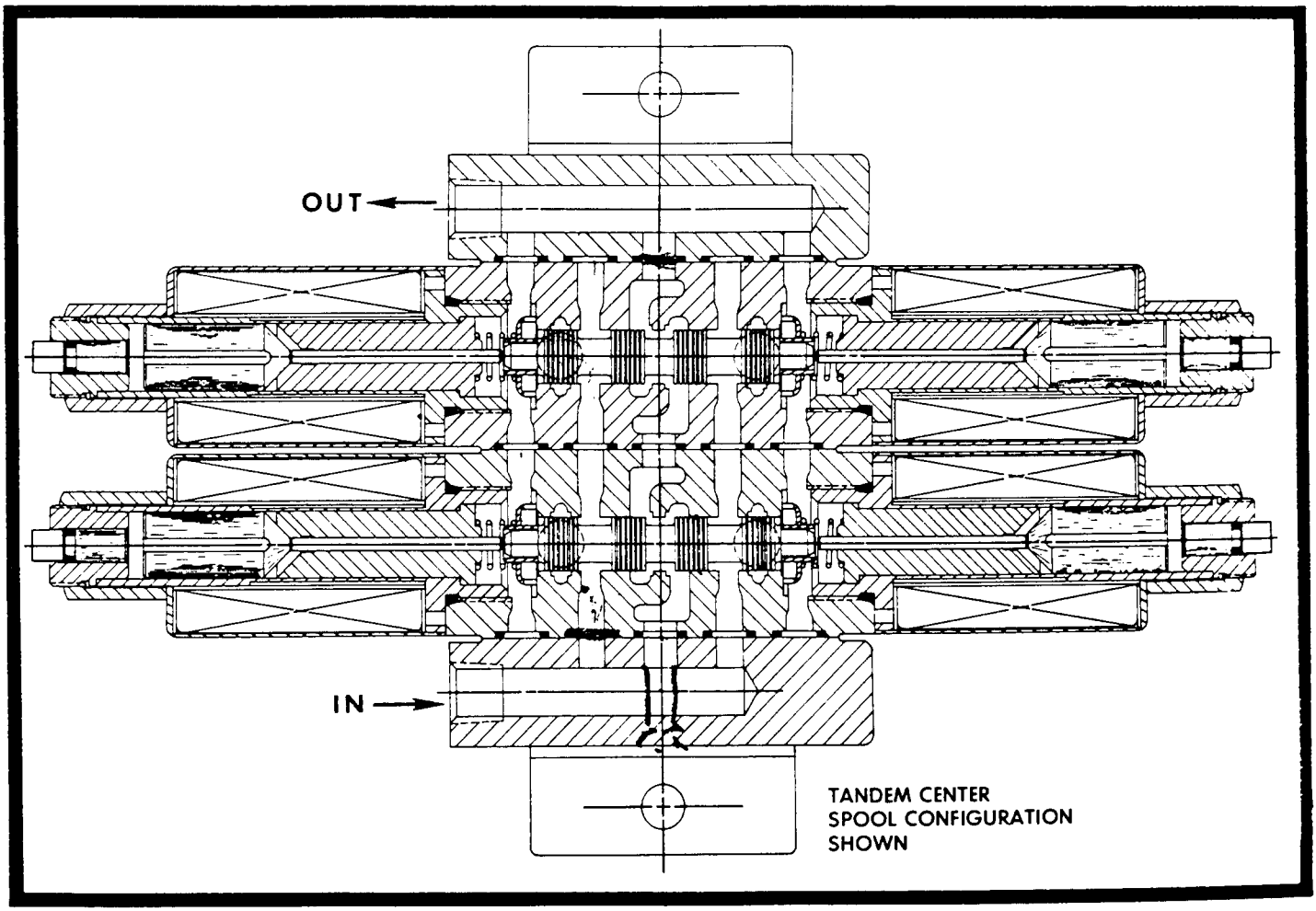
- maximum flow rate 19 L/min (5 gpm)
- working pressures to 207 BAR (3000 psi)
- direct solenoid operated — dc
- series-parallel circuit

AMBAC Industries Incorporated
FLUID POWER SYSTEMS DIVISION

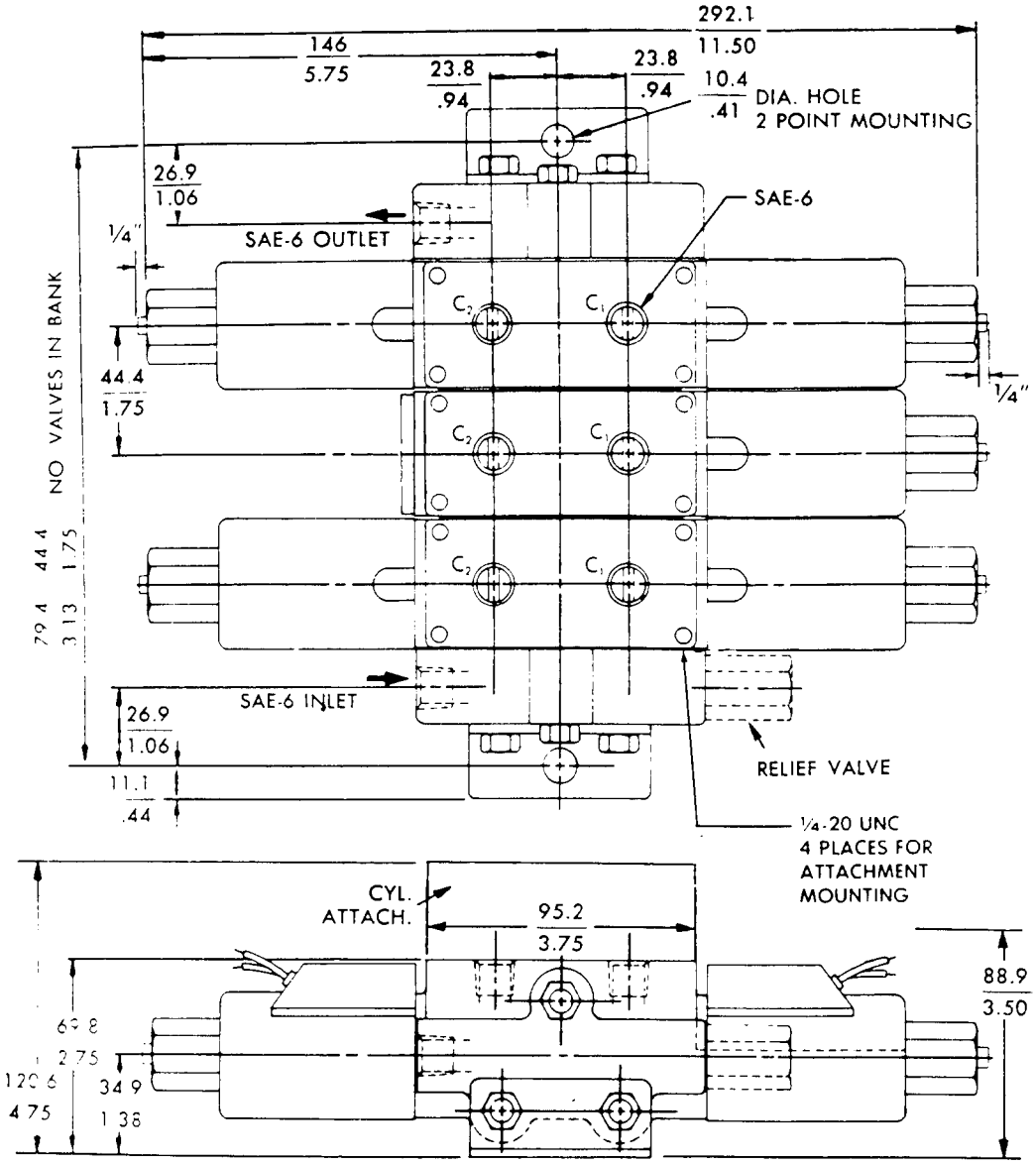
mini-pak
solenoid valve features

FPS MINI-PAK Solenoid Valves offer a new concept in valve assembly allowing greater circuit flexibility in less space than with conventional valves. This modular banking design concept eliminates costly fittings, potential leak points and simplifies factory and field installations. In addition to banking directional control valves, you can also stack the main system relief valve. Maximum flow rate 19L/MIN. (5 GPM.) Operating pressures to 207 BAR (3000 PSI.) Construction features include hardened steel spools, precision fit into a high strength alloy cast body. Solenoid actuator construction utilizes the proven wet plunger design. The series-parallel circuitry, within the valve, offers greater application flexibility.

- Stackable Valve Sections (Up to 5)
- New Circuit Versatility
- Series-Parallel Circuits
- Low Pressure Drop
- Low Current Consumption
- Direct Operated
- Manual Over-rides
- 7 Standard Spool Configurations
- Single or Double Solenoids
- Weather Resistant Solenoids, Continuous Duty at Rated Voltage
- DC Service
- Stackable Relief Valve
- Stackable Manual Sections When Installed Upstream of Solenoid Section
- Accessory Attachments Available



TANDEM CENTER
SPOOL CONFIGURATION
SHOWN

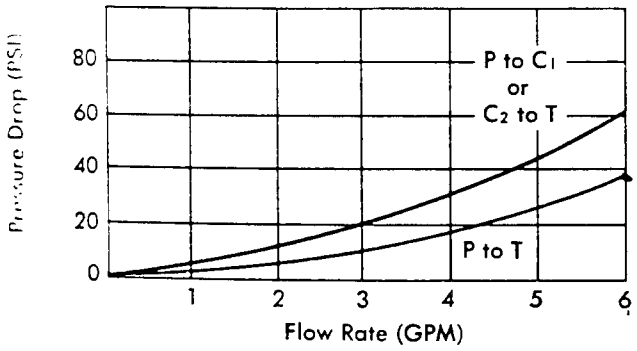


- Two position and Three Position Spools Available—Spool Types, Page 4.
- Rated Pressure 207 BAR (3000 PSI).
- Rated Oil Temperature 74°C (165°F).
- Available Voltages 12, 24 and 36 VDC.
- Current Draw 2.8 amp. @ 12 VDC @ 21°C (70°F).
- Can Be Mounted In Any Position.
- Weight 3.6 kg (8 lbs.) Per Section.
- Recommended 10 Micron Filtration.
- "O" RING SEAL BETWEEN SECTIONS INSURES LEAK-FREE OPERATION AND PROVIDES EASY FIELD CONVERSION FOR ADDITIONAL WORKING SECTIONS. TORQUE TO $\frac{\text{12 Newton meter}}{\text{110 IN. LBS}}$

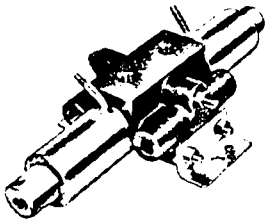
$\frac{\text{MM}}{\text{INCH}} = \text{MM/INCH.}$

FLOW L/MIN	PRESSURE DROP P-C_1, C_2-T BAR	PRESSURE DROP P-T BAR
10	1	0.5
20	3.5	2

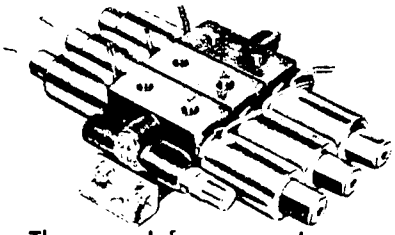
Pressure drop data for valve Model 56-10 (Tandem center 3 position 4-way, pressure to tank open — C_1 and C_2 blocked.) Maximum flow rate 19L/min (5 GPM). 150 SSU oil at 38°C (100°F).



Available options (consult factory).



Four-way, three position double solenoid valve.

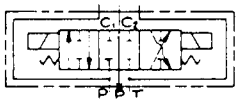
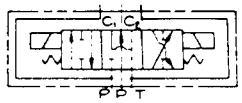
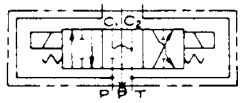
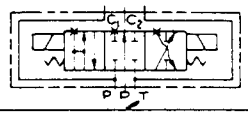
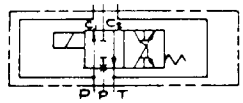
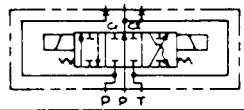


Three spool, four-way valve assembly with relief valve at inlet.



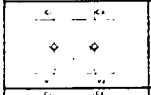
Three spool, four-way valve assembly with relief valve (Manual-Solenoid-Solenoid).

spool type (flow pattern) — TABLE I

	Valve Type	A.S.A. Symbol	Spool Des.
Standard Spools	Tandem Center Series — Parallel Circuit Cyl. Ports Blocked P-T Open		10
	Closed Center Parallel Circuit Cyl. Ports Blocked P-T Blocked		11
	Open Center Series — Parallel Circuit Cyl. Ports Open To Tank		14
	Closed Center Parallel Circuit Cyl. Ports Open To Tank		16
	Tandem Center Series — Parallel Circuit Cyl. Port Blocked P-T Open (Single Acting Cylinder)		17
	Motor Spool Parallel Circuit		25
	Tandem Center Series Circuit Cyl. Ports Blocked P-T Open		40

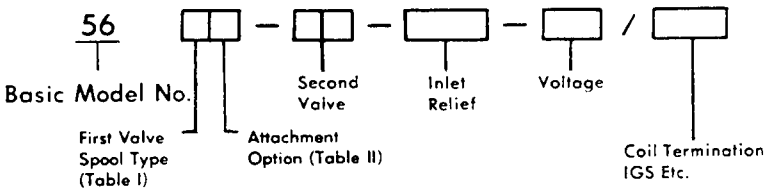
For spool configurations other than shown consult factory.

cylinder attachment valves — C_1C_2 — TABLE II

A.S.A. Symbol	Valve Type	Code	Description
	Lock Valve	A	Without Thermal Reliefs
		B	One Thermal Relief — 241 BAR (3500 PSI)
		C	Two Thermal Reliefs — 241 BAR (3500 PSI)
	Cross Over Relief	F	Specify Pressure Settings
	Pilot Operated Check	L	Without Thermal Reliefs
		Y	One Thermal Relief
		Z	Two Thermal Reliefs

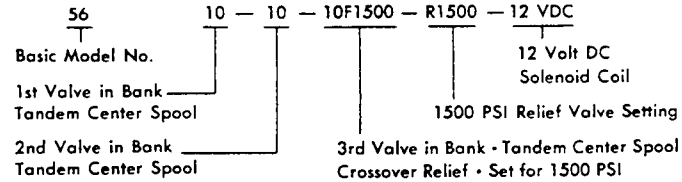
Code letter JJ indicates Palm Button Manual Override

ordering information



Attach. Provided Where Specified. All Sections Machined For Attachments.

example of three bank assembly

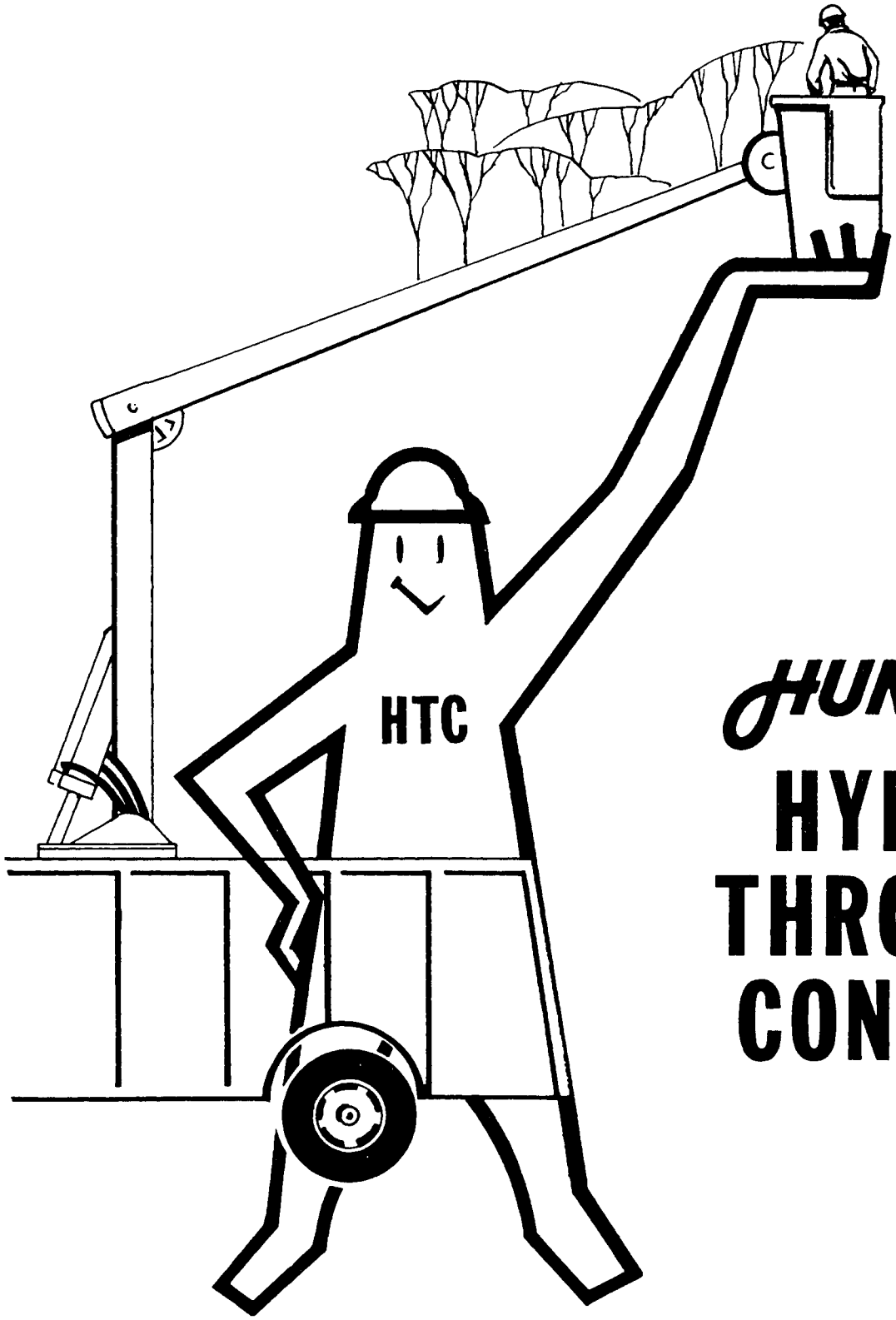


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FO-LC-5M-3 78

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INSTALLATION INSTRUCTIONS



HUNTER

HYDRO-THROTTLE CONTROL

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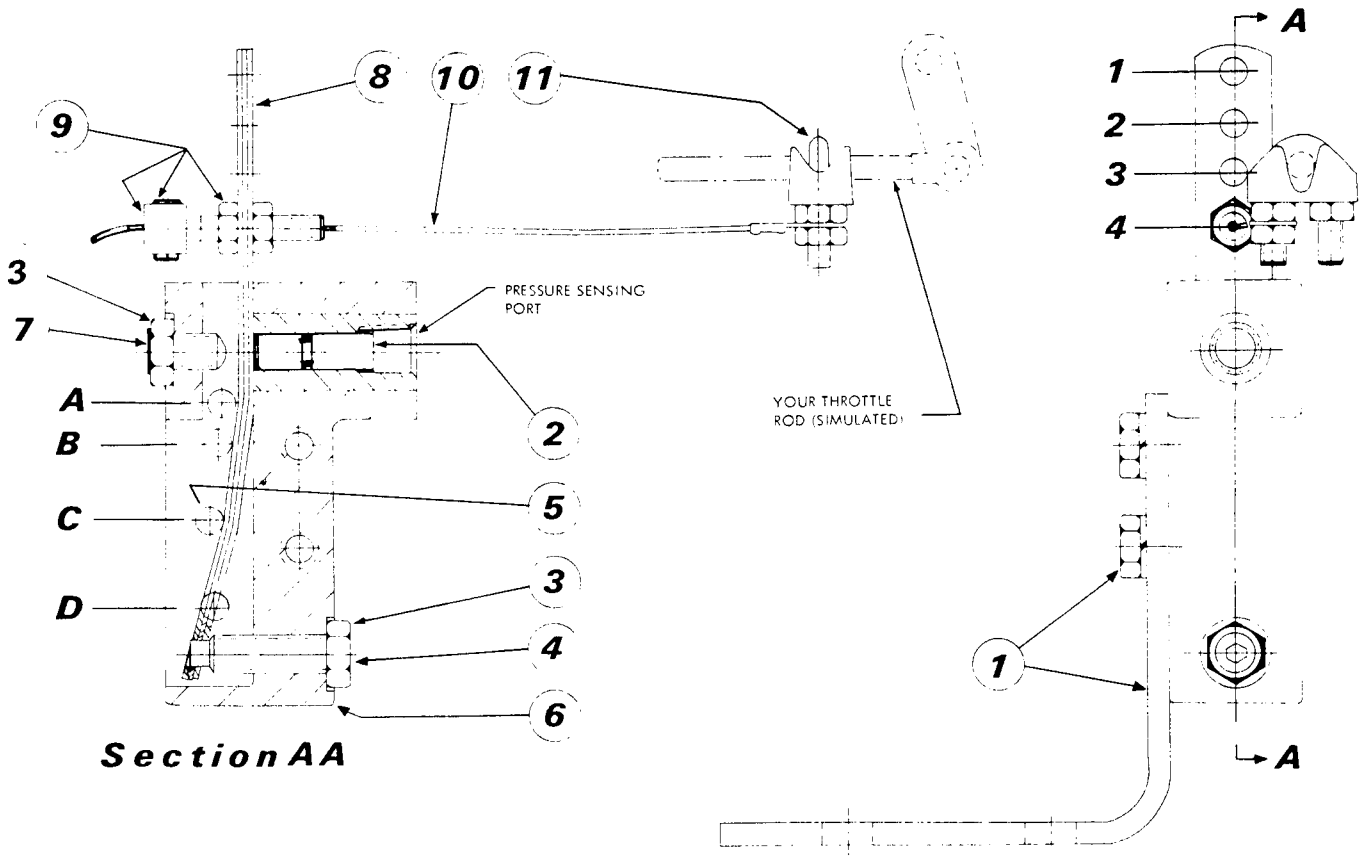
SEATTLE
Subsidiary of Muncie Parts Mfg. Co. Inc.
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Seattle, Wash. 98108 • Ph. (206) 763-2230

TOLEDO DIVISION
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PARTS LIST

SERIES 90 THROTTLE CONTROL



Model 1-9010

Item	Part No.	Description
1	2-8124	Bracket and Bolt Assembly
2	2-9002	Piston Assembly
3	5322	Nut, Jam 3/8 - 16
4	5050	Screw 3/8 - 16 x 1-1/4 Spring Tension Adjusting
5	9004	Screw, Fulcrum
6	2-9007	Housing and Liner Assembly
7	5049	Screw 3/8 - 16 x 3/4 Speed Adjusting
8	8118	Spring, Leaf (3 required)
9	1-170211	Rod, Actuating, with Nuts and Set Screws
10	2-170212	Cable Assembly
11	180960	Clamp

I. INSTALLATION OF THE THROTTLE CONTROL

A. Introduction

Refer to sketch shown with parts list, included on page 2.

One Throttle Control can operate an unlimited number of circuits, that are driven by the same pump discharge line in the hydraulic system.

The Throttle Control piston (2) senses the pump discharge line pressure. The pressure increases, and pulls the throttle open, when you operate a circuit to move a load. The pump by-passes, and allows the throttle to close when the valve circuit lever is returned to neutral.

The pressure must increase, above by-passing pressure, at least 15 PSI for each pound of throttle pull, plus the amount your by-passing pressure will vary, due to oil viscosity changes, over your oil operating temperature range.

Highly loaded circuits usually increase the pressure to a level far above the pump by-passing pressure, and produce a motivating force far beyond the minimum required to open the throttle.

Lightly loaded circuits, such as, when the boom is lowering, swing circuits, outriggers lowering, etc., produce the least pressure. The plumbing flow restrictions must be revised in these circuits if the load cannot increase the circuit pressure sufficiently above by-passing pressure to produce the motivating force needed to open the throttle.

The pressure will increase at a greater rate as the engine speed increases because the plumbing relating to the circuits usually contain greater restrictions. A lightly loaded circuit may then become operable at a higher engine speed, if it did not operate at idle.

The motivating force can be increased by revising your plumbing, downstream of the throttle control connection, as follows:

Restrict the plumbing relating to the circuits. (1) Add an orifice. (2) Reduce diameter and/or lengthen line size. (3) Add a two-way check valve with a heavier spring in the direction of flow. This will increase pressure more at idle speed where needed most. It, therefore, is the best type of restriction.

Decrease your by-passing pressure. (1) Remove "bottle necks", and elbows. (2) Increase diameter and/or shorten line size.

B. Mounting Bracket

One is furnished in the kit. Modify it to fit if necessary. Make the bracket rigid and mount it to your engine rather than another surface to prevent erratic operation due to flexing and/or movement.

Position the Throttle Control so the connecting cable is in line with the accelerator rod and pulls in the same direction.

C. Pressure Connection to Pump Discharge Line

Use a 1/4" minimum sized high pressure tube or hose.

Make the connection at the control valve inlet rather than the pump discharge so it will sense the lowest pressure. The pressure will then change by a smaller amount when the oil viscosity changes. The spring tension will also become more effective.

For cold climates, consider whether you need to add a heater to your reservoir and/or shut off valve in this pressure connection to prevent high speed operation of your hydraulic components with cold oil. An oil temperature sensing switch would make them automatic.

D. Engine Throttle Linkage Check

Start the engine. Engage PTO to load the idling engine with by-passing oil pressure. Try to reduce the engine throttle pull to a minimum. Make sure it is well oiled and in good repair. Check with the engine manufacturer whether the return spring load can be reduced if it appears to be excessive for its application.

When the engine has warmed up, make sure it is capable of returning to its proper idle speed after operating the accelerator. Make necessary adjustments now before the connecting cable is applied.

E. Cable Slack Adjustment

Refer to the sketch on page 2. Make sure the actuating rod (9) is still located in hole 4 as shipped.

Secure the clamp (11) to the throttle rod. Engage the cable (10) eyelet to one of the clamp studs. Thread the cable through the hole in the rod, remove almost all slack, and secure it with the set screws.

Finalize the cable slack adjustment with the nuts provided on the actuating rod (9). The cable should have some slack but not excessive. Check to make sure the engine returns to idle after operating the accelerator.

F. Adjusting Procedure

The spring rate is adjustable by moving the fulcrum screw (5) and changing the number of leaf springs (8). See table below for the possible variations. The spring rate increases as the variation number decreases. For instance, the table indicates the spring will be three (3) times stiffer with variation No. 2 than No. 3.

Variation Number	No. of Springs	Fulcrum Hole	Spring Tension			Actuating Rod Hole Location
			*Turns	*Pressure	Rate	
1	3	A	3	1100	11X	4
2	3	B	3	780	3X	4
3	3	C	2-1/2	640	Normal	4
4	2	C	2	370	3/4X	4
5	2	D	5/8	300	1/4X	4

* Note: Apply turns from when the screw (4) just begins to deflect the spring at zero load. Pressure is approximate when piston will begin to move.

The control was shipped with variation 3. Try it first. The adjusting procedure will direct you to another variation, if another is needed.

1. Disengage PTO. Turn in speed screw (7) until it touches spring (8). Then turn out one turn, temporarily, to limit stroke and prevent accidental racing of engine.

2. Engage PTO. Air bleed sensing line by cracking fitting at Throttle Control. Proceed after oil warms up to within normal operating temperature range.

3. Operate a highly loaded circuit valve lever. Bottom out a cylinder to obtain system relief valve pressure if this is easier. The throttle will open.

4. Make speed adjustment. Turn speed screw (7) in or out with the circuit loaded. Use the nut (3) to lock it when it regulates your desired speed. Move actuating rod from hole 4 to hole 3, only if the spring should stop on the housing instead of the screw.

5. Return lever to neutral. The throttle must close and the engine must return to idle. Check Trouble Shooting section, Part II, Section C. If unsuccessful, increase the spring rate, see table above. Repeat entire procedure.

F. Adjusting Procedure (Continued)

6. Determine which of the circuits produce the lowest pressure. Operate it and decide which of the following applies, paragraph 6a, 6b, or 6c.

a. Throttle Opens and Closes Properly From Idle

(1) Finalize engine speed screw (7) adjustment by alternately operating the lowest and the highest loaded circuits. Lock nut (3) securely.

(2) Operate and check all other circuits. They should operate because they are loaded between the highest and lowest circuits used for adjustments.

(3) Installation is now complete.

b. Throttle Does Not Open From Idle Speed, but Will at Higher Speed

Check if it will open at higher engine speeds.

(1) Operate a higher pressure circuit lever to open the throttle and bring the engine up to speed, then operate the lowest pressure circuit lever.

(2) If it stays open, after the higher pressure lever is returned, decide whether the required sequence of operation is acceptable. It usually is acceptable. It now contains the highest spring setting.

(3) If not acceptable, or if it did not stay open, proceed with step (c) below.

c. Throttle Will Not Open at All

Make spring tension adjustment. Proceed as follows:

(1) Disengage PTO. Turn out screw (4) until leaf spring (8) is loose. Then turn it in until the spring just begins to deflect and is at zero load.

(2) Engage PTO. The throttle will open.

(3) Turn screw (4) in gradually. Count turns, and record as "B", until the throttle just closes. Do not overshoot and leave the screw at this point. Note how the throttle closed. If it closed suddenly, increase the spring rate, see table above. Repeat adjustment from paragraph c (1).

6c. (Continued)

(4) Operate the lowest pressure circuit. The throttle must open. If it opened, proceed directly to step 5. Otherwise, choose between (a) and (b) below.

(a) If it did not open, the motivating force is below zero. Revise the plumbing to increase the amount the pressure will increase when the circuit is operated. See Section A.

(b) Operate the next higher loaded circuit, etc. until you find a circuit that does operate from idle. Use this circuit for the adjustments specified in paragraph 5 below. You will find out later whether the lower pressure circuits, that did not operate from idle, will become operable at a higher speed.

(5) Turn in on screw (4) in small increments equal to approximately 10% of the total turns given in the table above.

After each increment, operate the lowest pressure circuit lever from neutral to fully open the throttle, and then return it to neutral to fully close the throttle.

Wait for the engine to idle before repeating.

Count, and record as "C", the number of turns to exactly when the throttle no longer opens from idle.

Note: Increase the spring rate, see table above, if the total turns counted (B plus C), exceeds by more than 20% the number of turns noted in the table above.

Decrease your spring rate if you observed the throttle will no longer fully open.

Repeat adjustment from paragraph c(1), if spring rate was changed.

(6) Turn screw (4) out 1/8 turn or 1/4 times "C" turns whichever is greater to provide an operating margin between the lowest circuit pressure and the final spring tension.

(7) Check operation as per paragraph F6a or F6b. If the lighter loaded circuits do not operate, revise the plumbing to increase the amount the pressure will increase when these circuits are operated. See Section A.

II. TROUBLE SHOOTING HINTS

A. Problem: Engine Does Not Idle But Speeds Up When PTO Is Engaged

Probable Cause	Remedy
1. Control lever stuck open.	1. Return all valves to neutral.
2. Low leaf spring tension.	2. Repeat calibration.
3. Cold Oil.	3. Warm oil. Also check Part I, Section "C".

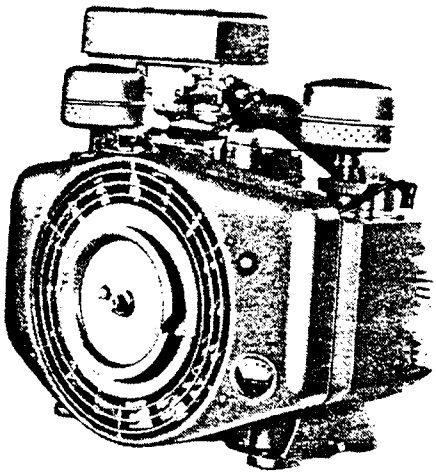
B. Problem: Engine Does Not Speed Up When Light Load Is Applied

Probable Cause	Remedy
1. PTO not engaged.	1. Engage PTO.
2. Air in sensing line.	2. Bleed line. Crack fitting at control.
3. Connecting cable.	3. Reduce slack to minimum.
4. Stops on speed screw.	4. Adjust screw.
5. Hot oil.	5. Allow oil to cool.
6. Your engine throttle linkage.	6. Oil and repair. Check manufacturer for lighter spring if it is excessive.
7. Circuit pressure is too low.	7. Revise plumbing to increase spread between your circuit and by-passing pressures. See Part I, Section "A".
8. Excessive leaf spring tension.	8. Repeat calibration.
9. Excessive leaf spring rate.	9. Reduce spring rate. See table in Part I, Section "F".

C. Problem: Engine Does Not Return To Idle After A Load Is Applied

Probable Cause	Remedy
1. Engine speed excessive.	1. Reset speed screw adjustment.
2. Your engine.	2. Make sure it can idle.
3. Connecting cable.	3. Check for slack.
4. Low leaf spring rate.	4. Increase spring rate. See table in Part I, Section "F".
5. Low leaf spring rate.	5. Repeat calibration.
6. Excessive by-passing pressure.	6. Remove "bottlenecks" or increase line size downstream of the control connection.

OPERATING AND MAINTENANCE INSTRUCTIONS



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ENGINE

ONAN 1400 73RD AVENUE N.E. • MINNEAPOLIS, MINNESOTA 55432
A DIVISION OF ONAN CORPORATION

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5-77
(SPEC J)

ENGINE SAFETY PRECAUTIONS

It is recommended that you read your engine manual and become thoroughly acquainted with your equipment before you start the engine.

WARNING **This symbol is used throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

Safety Codes

- All local, state and federal codes should be consulted and complied with.

General

- Provide appropriate fire extinguishers and install them in convenient locations. Use an extinguisher rated ABC by NFPA.
- Make sure that all fasteners on the engine are secure. Tighten supports and clamps, keep guards in position over fans, driving belts, etc.
- If it is necessary to make adjustments while the engine is running, use extreme caution when close to hot exhausts, moving parts, etc.

Protect Against Moving Parts

- Do not wear loose clothing in the vicinity of moving parts, such as PTO shafts, flywheels, blowers, couplings, fans, belts, etc.
- Keep your hands away from moving parts.

Batteries

- Before starting work on the engine, disconnect batteries to prevent inadvertent starting of the engine.
- DO NOT SMOKE while servicing batteries. Lead acid batteries give off a highly explosive hydrogen gas which can be ignited by flame, electrical arcing or by smoking.
- Verify battery polarity before connecting battery cables. Connect negative cable last.

Fuel System

- DO NOT fill fuel tanks while engine is running, unless tanks are outside engine compartment.
- DO NOT smoke or use an open flame in the vicinity of the engine or fuel tank. Internal combustion engine fuels are highly flammable.
- Fuel lines must be of steel piping, adequately secured, and free from leaks. Piping at the engine should be approved flexible line. Do not use copper piping on flexible lines as copper will work harden and become brittle enough to break.
- Be sure all fuel supplies have a positive shutoff valve.

Exhaust System

- Exhaust products of any internal combustion engine are toxic and can cause injury, or death if inhaled. All engine installations, especially those within a confine, should be equipped with an exhaust system to discharge gases to the atmosphere.
- Do not use exhaust gases to heat a compartment.
- Make sure that your exhaust system is free of leaks. Ensure that exhaust manifolds are secure and are not warped by bolts unevenly torqued.

Engine Exhaust Gas (Carbon Monoxide) is Deadly!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

Cooling System

- Coolants under pressure have a higher boiling point than water. DO NOT open a radiator pressure cap while the engine is running. Bleed the system pressure first.

Keep the Unit and Surrounding Area Clean

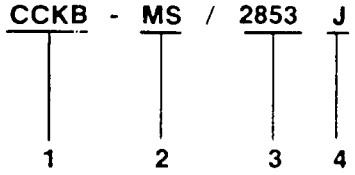
- Make sure that oily rags are not left on or near the engine.
- Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

GENERAL INFORMATION

ENGINE MODEL REFERENCE

Identify your model by referring to the MODEL and SPEC (specification) NO. as shown on the unit nameplate. Always use this number and the engine serial number when making reference to your engine.

How to interpret MODEL and SPEC NO.



1. Factory code for general identification purposes.
2. Specific Type:
   S - MANUAL STARTING
   MS - ELECTRIC STARTING
3. Factory code for optional equipment supplied.
4. Specification (Spec Letter) advances with factory production modification.

If your engine needs service or repair, contact an Onan Service Center. Trained mechanics will assure expert repair service on your Onan engine.

SPECIFICATIONS

Engine Design ..... Opposed two cylinder, four cycle, L head and air cooled
Bore ..... 3-¼ inch (82.55 mm)
Stroke ..... 3 inch (76.20 mm)
Displacement ..... 49.8 cu inch (816.22 cm^3)
H P. - Garden Tractor Service ..... 19-½ hp @ 3600 rpm; 20 hp max. @ 3900 rpm
Oil Capacity with Filter Change ... 4 qts. (3.78 lit)
Oil Capacity without Filter Change ..... 3-½ qts. (3.31 lit)

TUNE-UP SPECIFICATIONS

Spark Plug Gap (Gasoline) ..... .025 (0.69 mm)
Spark Plug Gap (LPG) ..... .018 (0.46 mm)
Breaker Point Gap ..... .020 (0.51 mm)
Valve Lash,
  Intake ..... .006 to .008 (0.152 to 0.203 mm)
  Exhaust ..... .015 to .017 (0.381 to 0.432 mm)
Ignition Timing:
  Standard Electric Start (Stopped or Running) ..... 20° BTC
  Manual Start with Spark Advance ..... 1° ATDC (Stopped)
    24° BTC (Running)
  Electric Start with Magneto and Spark Advance ..... 5° (Stopped)
    24° BTC (Running)

OUT-OF-SERVICE PROTECTION

Protect an engine that will be out-of-service for more than 30 days as follows:

1. Run engine until thoroughly warm (5 to 10 minutes).
2. Turn off fuel supply and run until engine stops.
3. Drain oil from oil base while still warm. Refill and attach a warning tag stating oil viscosity used.
4. Remove spark plugs. Pour one ounce (two tablespoons) of rust inhibitor (or SAE #50 oil) into the cylinders. Crank engine over a few times. Install spark plugs.
5. Service air cleaner.
6. Clean governor linkage and protect by wrapping with a clean cloth.
7. Plug exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
8. Wipe entire unit. Coat rustable parts with a light film of grease or oil.
9. Provide a suitable cover for the entire unit.
10. If battery is used, disconnect and follow standard battery storage procedure.

RUNNING REPLACEMENT PARTS

Oil Filter 122-0323
Air Filter 140-0636
Spark Plugs—Non-Resistor 167-0241
Spark Plugs—Resistor 167-0237
Breaker Points 160-0002
Condenser (Breaker Box) 312-0069
Coil 166-0535

WARNING

ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

PRE-START

BEFORE STARTING

Check the engine to make sure it has been filled with oil and fuel. The chart below lists oil and fuel recommendations.

Crankcase Oil: Fill the crankcase with a good quality oil that meets the API (American Petroleum Institute) service designation SE or SE/CC. Recommended oil numbers for expected ambient temperatures are as follows:

TEMPERATURE	GRADE
Below 0° F (18° C)	SAE 5W30
Below 32° F (0° C)	SAE 5W30 or 10W40
Above 32° F (0° C)	SAE 30

Fill to "Full" mark on dipstick.

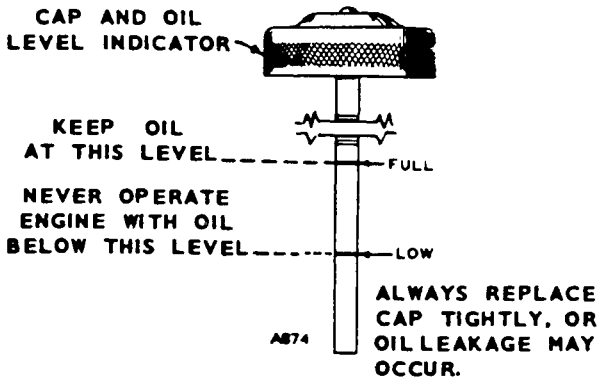
CAUTION **Do not overfill crankcase. Do not use service DS oil. Do not mix brands nor grades of motor oil.**

Refer to *Periodic Service* section for recommended oil change intervals.

Recommended Fuel: Use clean, fresh, non-leaded or regular grade, automotive gasoline. Do not use highly leaded premium types.

For new engines, the most satisfactory results are obtained by using nonleaded gasoline. For older engines that have previously used leaded gasoline, heads must be taken off and all lead deposits removed from engine before switching to nonleaded gasoline.

WARNING **Never check oil level while engine is running. Hot oil discharged from the engine could cause personal injury.**



CRANKCASE OIL FILL

CAUTION **If lead deposits are not removed from engine before switching from leaded to nonleaded gasoline, preignition could occur, causing severe damage to the engine.**

WARNING **Never fill the fuel tank when the engine is running. Gasoline could ignite, causing a serious injury.**

Inspection: Inspect the engine visually before starting. Check for loose or missing parts and any damage which may have occurred in shipment.

STARTING

If your engine has a START-RUN-STOP switch, press switch toggle to START, then release to RUN when engine starts. Press toggle to STOP, to stop engine.

1. Turn on ignition switch, pull the choke lever way out (for a cold engine) and push the start switch. When the engine starts, gradually push the choke lever in until the engine runs smoothly.
2. Black smoke from the exhaust and a rough running engine usually indicate over-choking.
3. To stop engine, turn ignition switch to off position.

OPERATION

BREAK-IN PROCEDURE

Controlled break-in with proper oil and a conscientiously applied maintenance program will help assure satisfactory service for many hours from your Onan engine.

Break-in or ideal fitting of all internal moving metal parts can best be achieved by maintaining proper cooling and correct lubrication during the running-in period. Run the engine at about half load for the first three hours with intermittent periods of full load to control engine break-in. Engine damage can be caused by using the wrong grade and weight of oil and high engine operating temperatures during break-in.

Check the oil level at least every five operating hours. Add oil to keep it at the proper level, but never overfill as overfilling may cause the oil to foam and enter the breather system.

HOT WEATHER OPERATION

When operating the engine in temperatures above 75° F (24° C) pay particular attention to the following items to prevent damage:

1. Keep the engine cooling fins clean and free of obstruction which would decrease air flow to and from the engine.
2. See that nothing obstructs air flow to and from the engine.
3. Ensure that you are using the proper grade and weight of oil for the temperature the engine is being used in. Check the oil level each time you fill the fuel tank.
4. Check the battery water level more frequently than every 50 hours which is recommended under normal conditions. High temperatures cause faster evaporation.

COLD WEATHER OPERATION

When the engine is being used in temperatures below 32° F (0° C), check the following items closely:

1. Use the correct grade and weight of oil for the temperature conditions. Change the oil only when the engine is warm. If an unexpected temperature drop occurs when the engine is filled with summer oil, move to a warm location until the oil will flow freely before starting the engine.
2. Use fresh fuel. Fill the fuel tank after each days use to protect against moisture condensation.
3. Keep battery in a well-charged condition.

MAINTENANCE

Oil Level: Check oil level at least every eight hours of operation. Check more frequently on a new or overhauled engine as oil consumption is higher until piston rings seat properly.

Oil Change: Change crankcase oil after the first 25 hours of operation; change every 50 hours after that. If operating in extremely dusty conditions, change oil more frequently.

Oil Filter (If Used): Replace oil filter every 100 hours; replace more often in dusty conditions. Tighten the filter finger-tight plus one quarter to one half turn. Be sure to replace rubber ring around filter.

Crankcase Breather: This engine uses a crankcase breather valve for maintaining crankcase vacuum. No maintenance is generally required. If the crankcase becomes pressurized as evidenced by oil leaks at the seals, clean the crankcase breather cap and valve assembly, and the breather tube baffle in suitable solvent. To remove breather cap and valve assembly, remove the breather hose clamp and breather tube clamp.

Moistened Foam Air Cleaner: This air cleaner consists of a synthetic sponge over a metal retainer. The base and cover are similar to those of the dry paper kind. Wash the sponge periodically, moisten in oil and squeeze dry.

Cooling System: Check and clean cooling fins at least every 50 hours. Remove any dust, dirt or oil which may have accumulated.

CAUTION **Plugged or clogged cooling fins can cause overheating and engine damage.**

Spark Plugs: Check, clean and reset spark plugs every 100 operating hours. Replace spark plugs that show signs of fouling or electrode erosion. Replace plugs every 250 operating hours.

Breaker Points: Check, clean and reset breaker points every 200 operating hours. Replace points if they are pitted or burned. See *ADJUSTMENT* section.

ADJUSTMENTS

CARBURETOR

The carburetor has an idle jet and a main jet. The idle jet which is adjustable, affects engine operation at low speed. The main jet usually affects operation under load (high speed). Under normal circumstances, factory carburetor adjustments should not be disturbed. If the idle adjustment has been disturbed, turn the needle (counterclockwise) off its seat 1 to 1-1/2 turns to permit starting the engine, then readjust as follows:

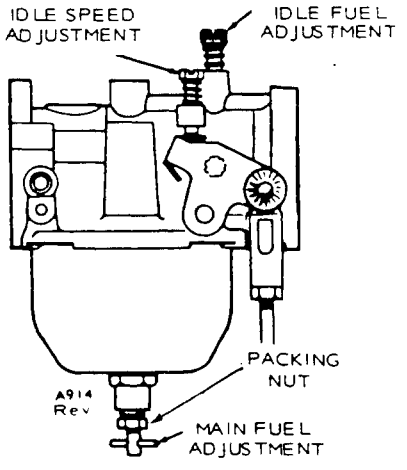
Carburetor Idle Adjustment

1. Allow the engine to run at least 10 minutes to warm it up.
2. Move engine speed control to SLOW position. The engine should run at about 1300 rpm.
3. Turn the idle needle out (counterclockwise) until engine begins to slow down or run unevenly. Remember this position.
4. Turn needle in (clockwise) past the position where the engine runs smoothly until it begins to slow down or run unevenly.

CAUTION **Do not force the needle against its seat; doing so will damage it.**

5. Back the needle out to a position approximately halfway between the two positions. This should provide a smooth running idle.

CAUTION **Loosen the packing nut before making main fuel adjustment and then tighten the nut to a snug fit after the adjustment has been made. This procedure makes it easier to use the carburetor adjusting tool and prevents fuel leaks around the packing nut. Fuel leaks cause hard starting because the float level becomes lower than normal.**



CARBURETOR

CARBURETOR ADJUSTMENTS

Carburetor Main (Load) Adjustment

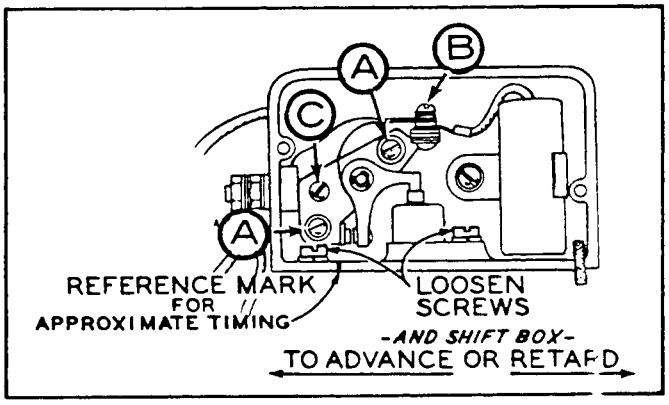
If engine runs unevenly at half or full load due to faulty carburetion, the main adjusting needle needs readjustment. For initial start-up, turn main adjustment 1 to 1-1/2 turns (counterclockwise) off its seat.

1. Start engine and allow it to warm up.
2. Push in on the governor mechanism to slow the unit down to about 400-500 rpm.
3. Set idle adjustment so engine runs smoothly.
4. Release governor mechanism to allow engine to accelerate. If engine accelerates evenly and without hesitation, main adjustment is correct. If not, turn needle outward about 1/2 turn and again slow the engine down and release the mechanism. Continue until the engine accelerates evenly and without hesitation after releasing the governor.
5. If engine tends to hunt (alternate increase and decrease of speed), open the main adjusting needle a little more. Do not open more than 1/2 turn beyond the maximum power point.

BREAKER POINTS

To maintain maximum efficiency from the engine, check condition of the breaker points every 200 hours of operation. Proceed as follows:

1. Remove the two screws and the cover on the breaker box.
2. Remove both spark plugs so engine can be easily rotated by hand. If plugs have not been changed within the last 100 hours, clean and regap or replace them with new ones after setting the breaker points.
3. Remove the two mounting screws (A) and pull the points out of the box just far enough so screw (B) can be removed. Replace points with a new set (if needed) but do not completely tighten mounting screws (A).
4. Rotate the engine clockwise (facing flywheel) by hand until TC mark on gear cover aligns with TC mark on flywheel. Turn screw (C) until point gap measures .020" (0.508 mm) with a flat thickness gauge.
5. Tighten mounting screws and recheck gap.



BREAKER POINT ADJUSTMENT

PERIODIC SERVICE GUIDE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The following schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check the condition of the crankcase oil, the filters, cooling fins, etc. frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest Onan Service Center.

PERIODIC MAINTENANCE SCHEDULE

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS					
	8	50	100	200	400	1000
Inspect Engine Generally	x[3]					
Check Oil Level	x					
Service Air Cleaner		x[1]				
Change Crankcase Oil		x[1]				
Check Battery Electrolyte Level		x				
Clean Cooling Fins		x				
Clean and Regap Spark Plugs (Replace at 250 hours)			x			
Replace Oil Filter			x[1]			
Clean Breather Valve				x		
Check Breaker Points				x		
Replace Air Cleaner Element				x[1]		
Check Valve Clearance					x[2]	
Remove Carbon and Lead Deposits					x[2]	
Inspect Valves, Grind If Necessary						x[2]
Complete Reconditioning (If Required)						x[2]

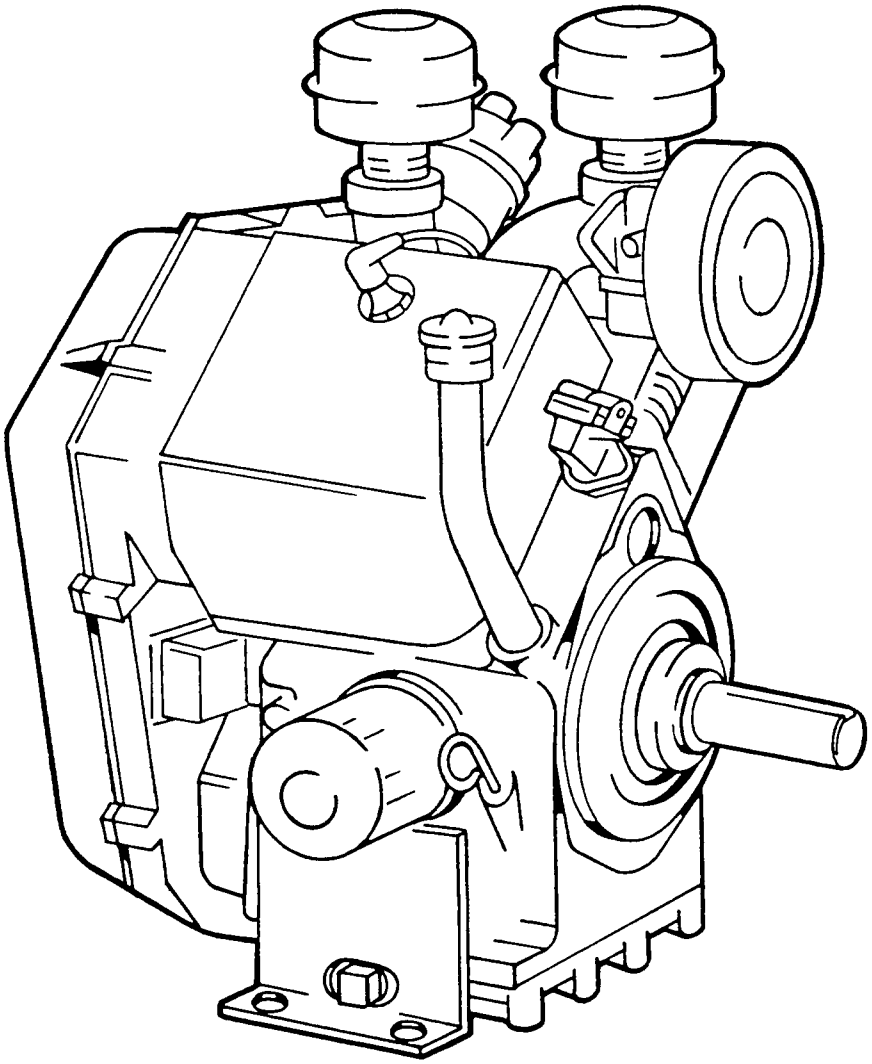
x[1] - Perform more often in extremely dusty conditions.
x[2] - For detailed maintenance, contact an Onan Service Center.
x[3] - Check for fuel leaks, exhaust leaks, etc.

FOR MAJOR SERVICE AND OVERHAUL CONTACT YOUR NEAREST ONAN SERVICE CENTER.

OPERATION GUIDE

ISSUE MM-395

WISCONSIN ENGINE



gasoline
air cooled
2 cylinder

Model W2-1230

TELEDYNE WISCONSIN MOTOR
MILWAUKEE, WISCONSIN 53219

INTRODUCTION

The Model W2-1230 is a two cylinder, four cycle, Vee type, air cooled gasoline engine of the most advanced design, and is readily and efficiently adaptable to a great variety of customer requirements. This typical **Wisconsin** heavy-duty engine has full pressure lubrication with a full-flow oil filter, and is capable of operating at a 30° angle in any direction.

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

IMPORTANT

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

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

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

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

SPECIFICATIONS

Bore ..... 3.75 inch
Stroke ..... 3.40 inch
Piston Displacement - cu. in. 75.0
cu. cm. 1230.0

Horsepower - 1600 R.P.M. 15.0
1800 R.P.M. 17.5
2000 R.P.M. 19.5
2200 R.P.M. 21.0
2400 R.P.M. 22.0
2600 R.P.M. 23.0
2800 R.P.M. 23.6
3000 R.P.M. 24.0
3200 R.P.M. 24.5
3400 R.P.M. 24.8
3600 R.P.M. 25.0

Engine rated performance is documented to Engine Test Code — SAE J-245. Continuous duty operation is recommended at 85% of horsepower shown.

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% of maximum power when shipped from the factory. Power will increase, as friction is reduced, after a few days of operation. The engine will develop at least 95% of power when friction is reduced to a minimum.

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

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

COMPRESSION RATIO 6.8:1

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

CRANKSHAFT ..... Ductile Iron

CYLINDER DESIGN ..... L-head

GEAR TRAIN ..... Helical Gears

ROTATION .... Counter-clockwise at T.O. end

STARTING MOTOR with Folo-Thru Bendix

TORQUE, maximum .. 51 ft. lbs. at 2000 r.p.m.

VALVE GUIDES ..... Replaceable

VALVES and SEAT INSERTS .....
Hardened exhaust
Exhaust Valve Rotators
Replaceable Inserts

SAFETY PRECAUTIONS

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

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

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

STARTING and OPERATING INSTRUCTIONS Model W2-1230

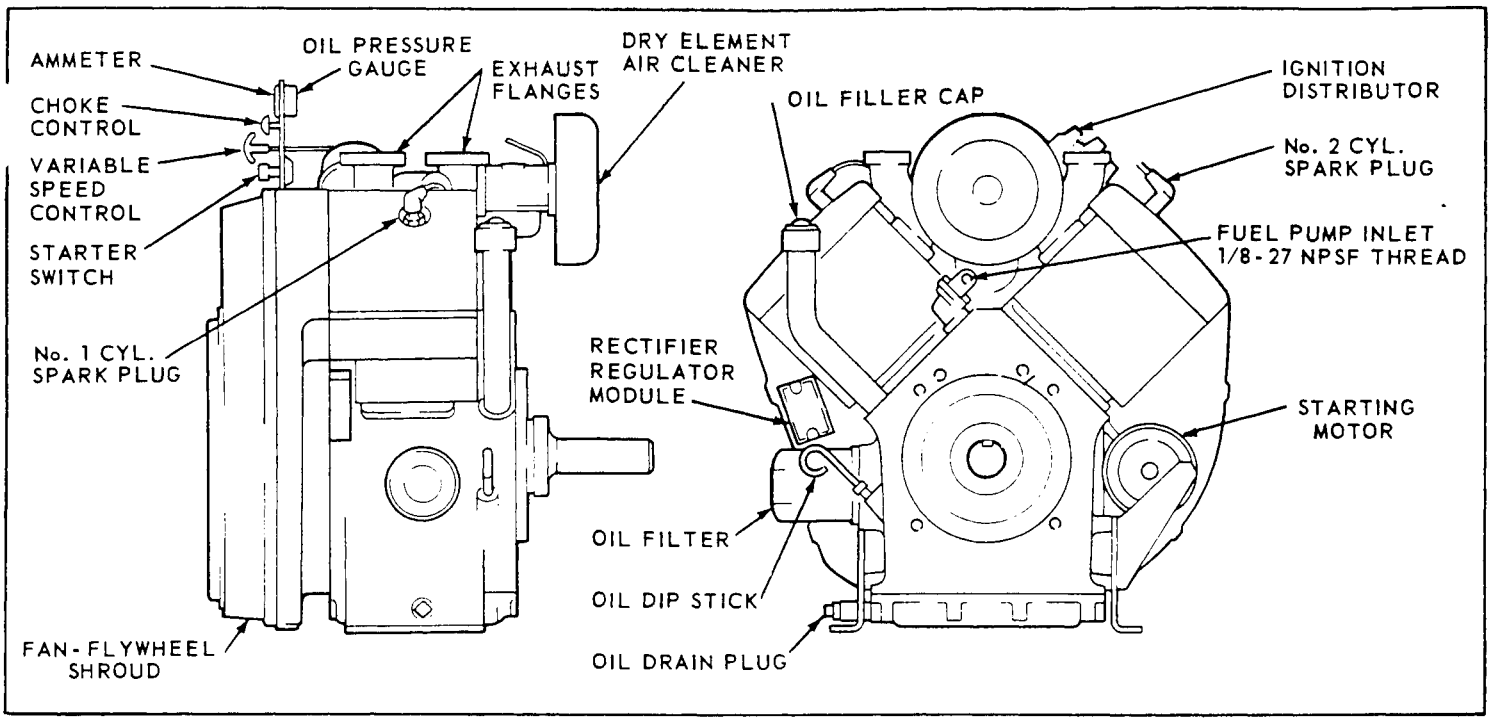


Fig. 1, REFERENCE VIEWS

IMPORTANT

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

NEW ENGINE BREAK-IN

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

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

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

BEFORE STARTING ENGINE

1. **FUEL**

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

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

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

2. **LUBRICATION**

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

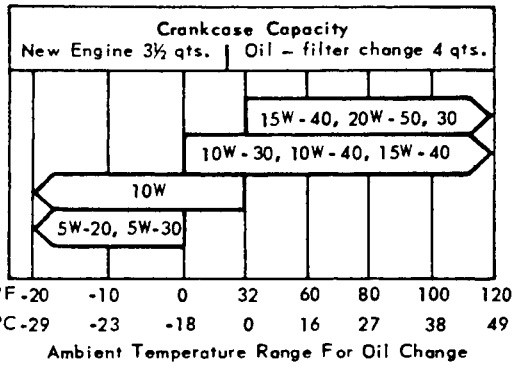
IMPORTANT

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

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

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

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



Ambient Temperature Range For Oil Change

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

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

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

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

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

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

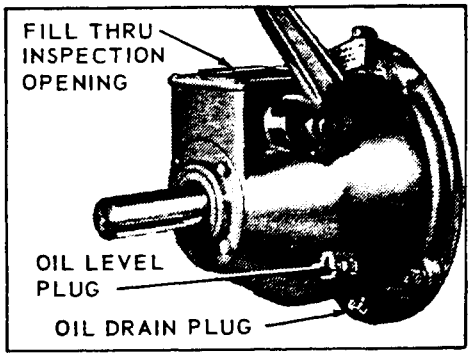


Fig. 2, CLUTCH LUBRICATION

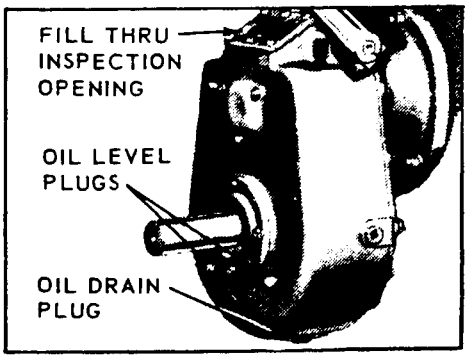


Fig. 3, CLUTCH RED. LUBRICATION

ELECTRICAL SYSTEM

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

Battery is not furnished by Teledyne Wisconsin Motor.

ALTERNATOR

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

IMPORTANT

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

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

PRECAUTIONS to be exercised in the use of Alternators:

1. **Do not** reverse battery connections. Negative battery terminal must be grounded. Reverse polarity will damage rectifier-regulator.
2. Connect booster batteries — positive to positive and negative to negative.
3. **Do not** ground any wires from stator or module which terminate at connectors.

   Do not operate engine with battery disconnected from system.
5. Disconnect at least one battery lead if a battery charger is used.

STARTING

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

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

STARTING PROCEDURE, Fig. 5

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

IMPORTANT

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

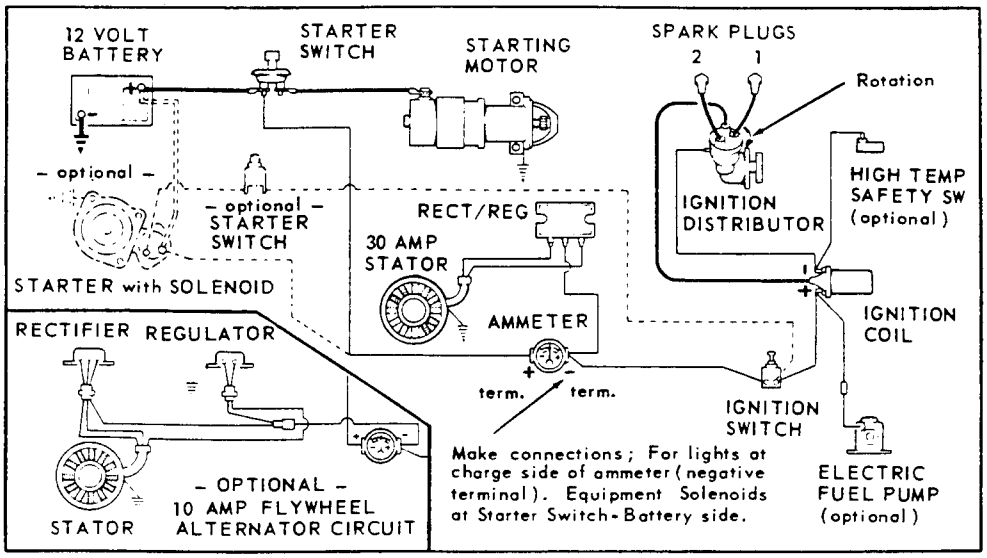


Fig. 4, ELECTRICAL SYSTEM with FLYWHEEL ALTERNATOR

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

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

WARM-UP

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

TO STOP ENGINE

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

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

OIL PRESSURE

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

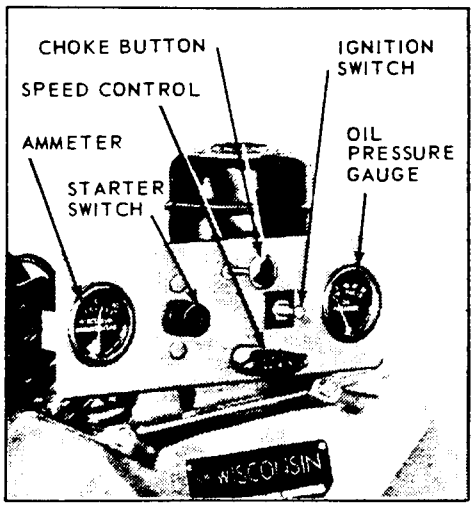


Fig. 5, CONTROL PANEL

MAINTENANCE

AIR CLEANERS

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

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

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

DRY TYPE AIR CLEANER, Fig. 6

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

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

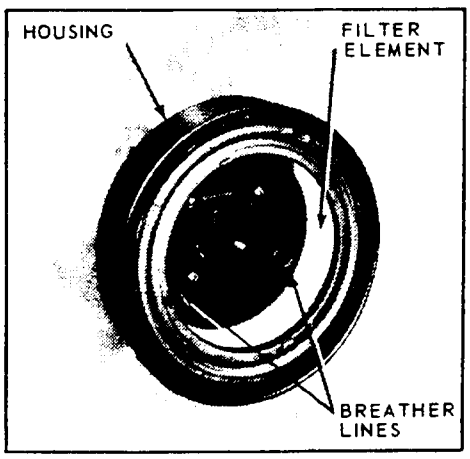


Fig. 6, DRY ELEMENT AIR CLEANER

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

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

HEAVY DUTY AIR CLEANERS, Fig. 7

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

DRY TYPE HEAVY DUTY AIR CLEANER

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

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

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

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

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

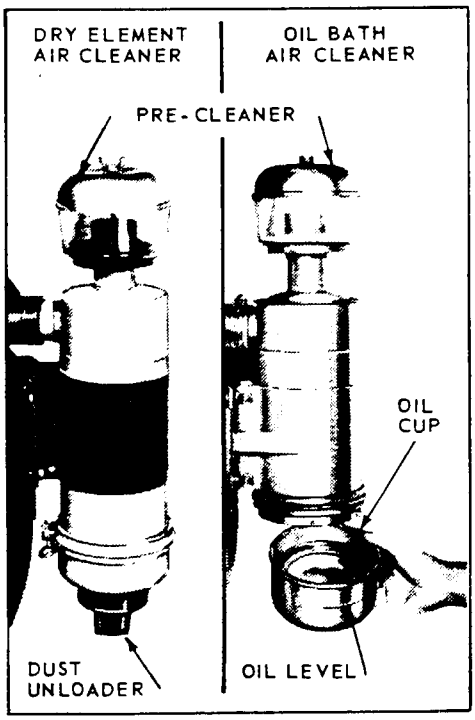


Fig. 7, HEAVY DUTY AIR CLEANERS

OIL BATH HEAVY DUTY AIR CLEANER

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

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

IMPORTANT

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

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

PRE-CLEANER

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

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

CRANKCASE BREATHER, Fig. 8

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

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

IMPORTANT

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

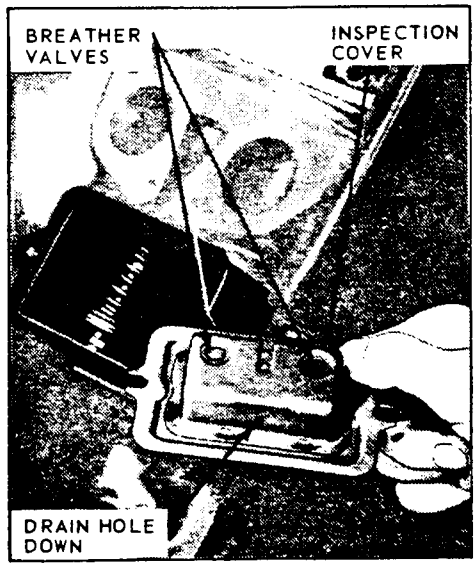


Fig. 8, CRANKCASE BREATHER

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

Every 100 Hours; Inspect breather lines.

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

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

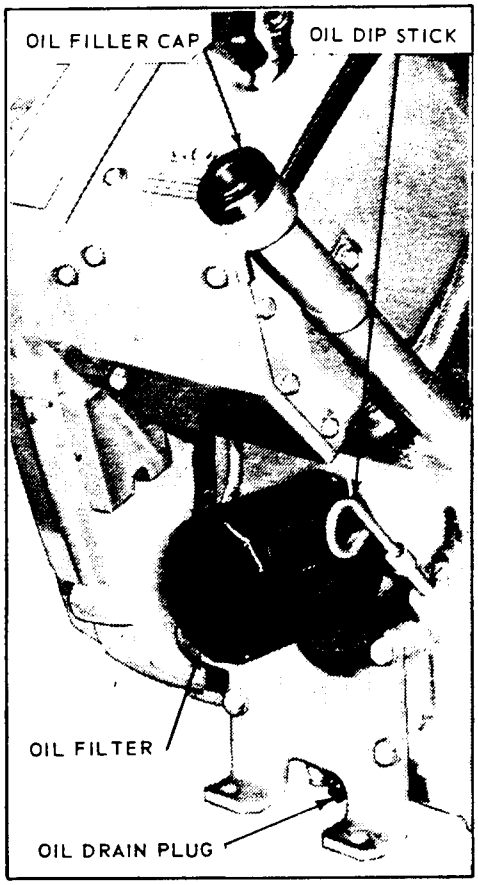


Fig. 9, LUBRICATION

CRANKCASE OIL, Fig. 9

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

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

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

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

IMPORTANT

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

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

OIL FILTER, Fig. 9

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

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

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

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

FUEL FILTER, Fig. 10

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

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

IGNITION DISTRIBUTOR, Fig. 13

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

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

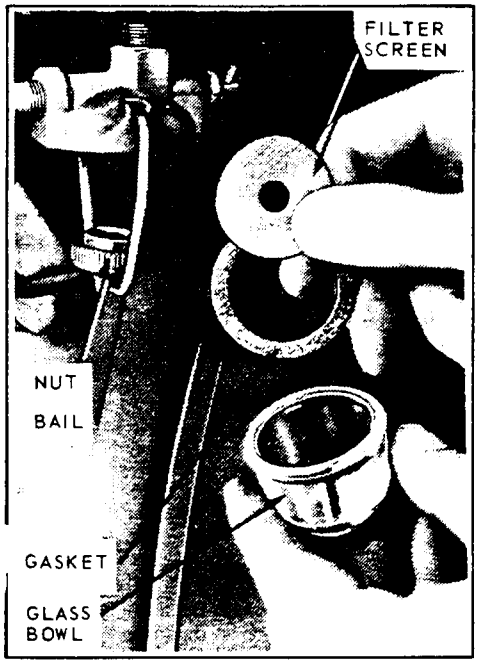


Fig. 10, FUEL FILTER

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

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

SPARK PLUGS, Fig. 11

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

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

Spark plug gap - 0.030 inch

Replacement plugs must be of the correct heat range, like Champion No. D-16J, AC No. C86 Commercial, (Wisconsin YD-6). Thread size is 18 mm. In reassembly tighten spark plugs, **28 to 34 foot pounds torque (dry).**

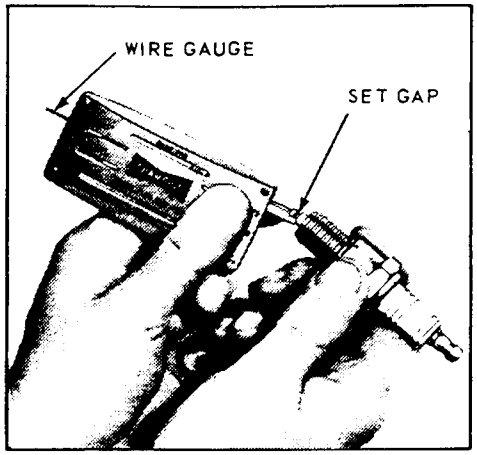


Fig. 11, SPARK PLUG

STARTING MOTOR, Fig. 12

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

In extreme dust and dirt conditions it may be necessary to occasionally remove the 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. 12

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

IMPORTANT

Do not operate engine with damaged or badly dented shrouding.

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

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

ADJUSTMENTS

CARBURETOR, Fig. 16

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

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

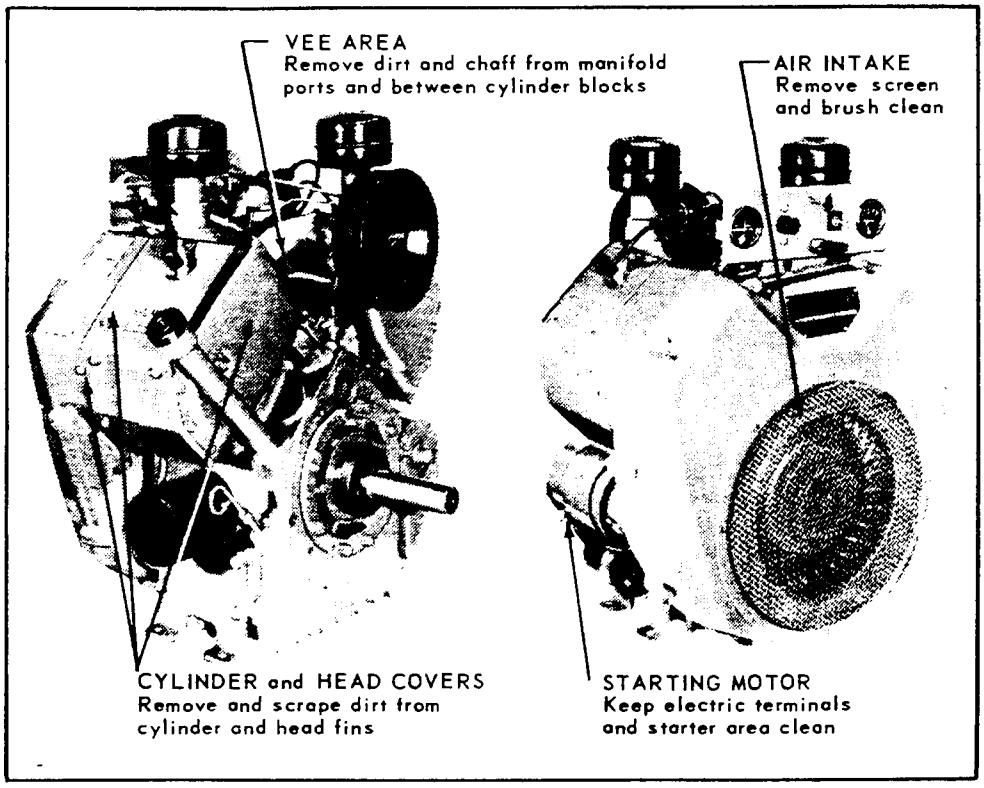


Fig. 12, KEEP ENGINE CLEAN

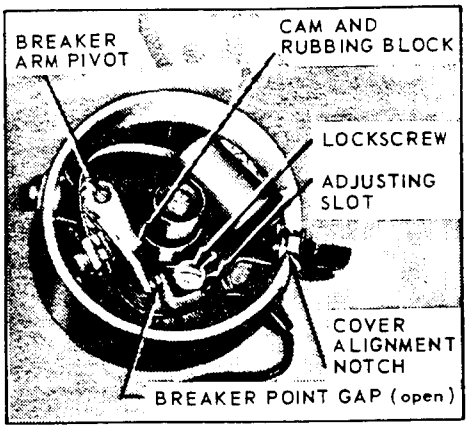


Fig. 13, DISTRIBUTOR BREAKER POINTS

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

DISTRIBUTOR BREAKER POINTS, Fig. 13

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 place a feeler gauge between the points. Insert the end of a screwdriver into to the **Adjusting Slot** on the breaker plate. Open or close the points by moving the point bracket until a slight drag is felt when sliding the feeler gauge from between the points. Tighten lockscrew and recheck point gap.

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

VALVE TAPPET ADJUSTMENT, Fig. 14

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

Intake - .007 inch Exhaust - .020 inch

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

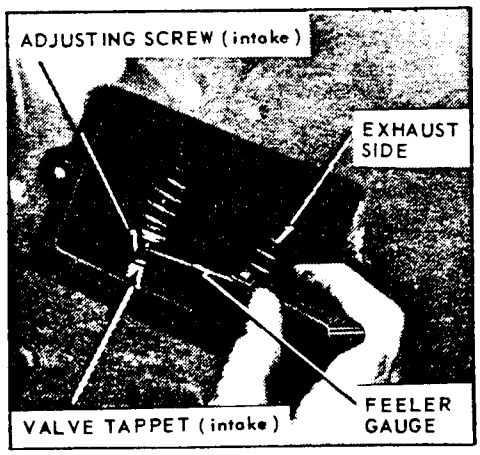


Fig. 14, VALVE TAPPET ADJUSTMENT

TIMING

FIRING ORDER

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

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

DISTRIBUTOR

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

SPARK ADVANCE

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

TIMING MARKS

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

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

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

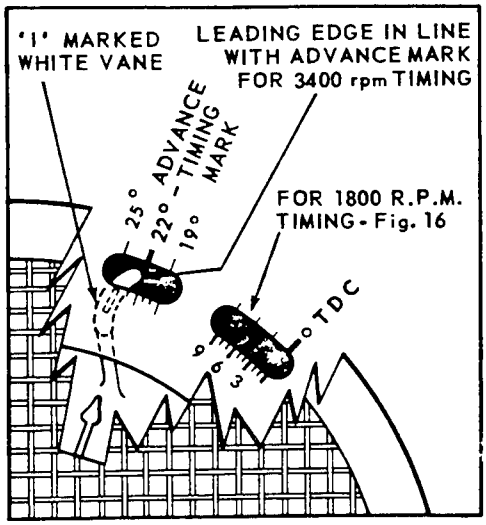


Fig. 15, SPARK ADVANCE VARIABLE HIGH SPEED

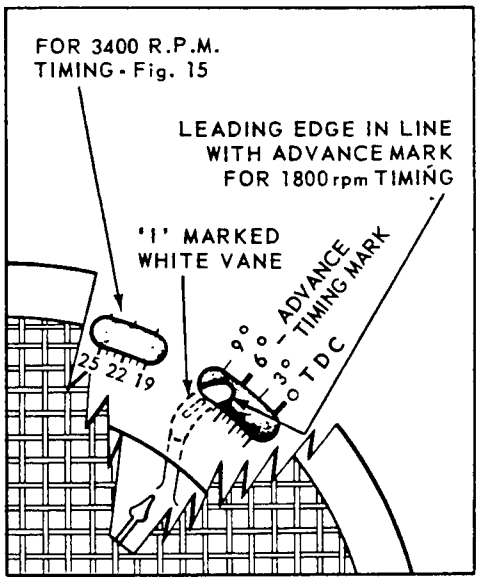


Fig. 16, SPARK ADVANCE FIXED LOW SPEED

TIMING CHECK AND ADJUSTMENT

IMPORTANT

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

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

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

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

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

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

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

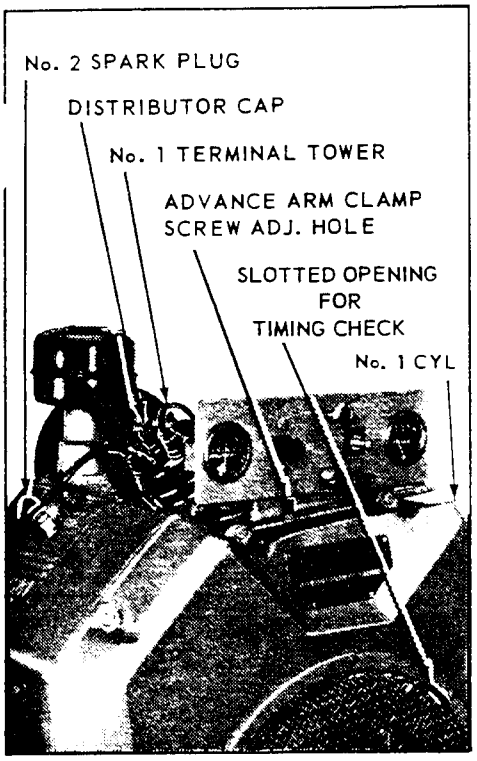


Fig. 17

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

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

IMPORANT

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

For engines where the governor is set to operate at 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. 18.**

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

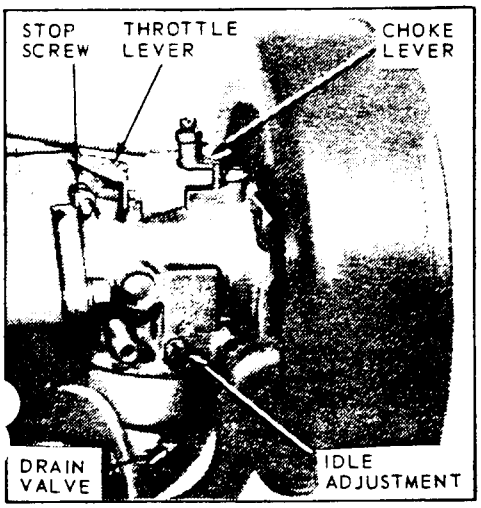


Fig. 18, CARBURETOR ADJUSTMENT

CLUTCH ADJUSTMENT

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

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

CLUTCH, Fig. 19

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

CLUTCH REDUCTION, Fig. 20

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

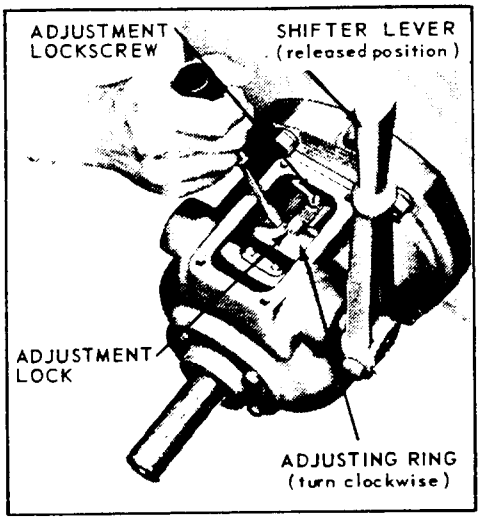


Fig. 19, CLUTCH ADJUSTMENT

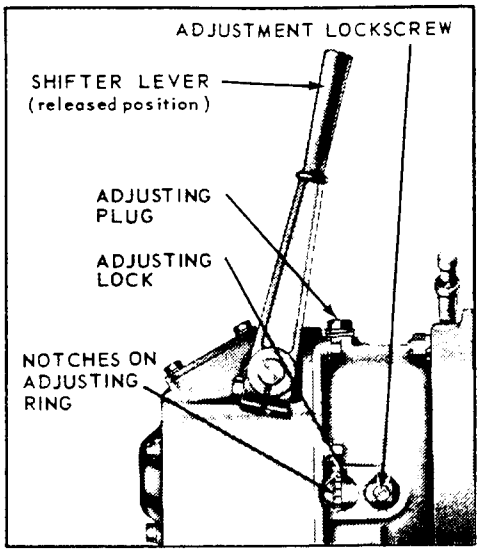


Fig. 20, CLUTCH REDUCTION ADJUSTMENT

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

TROUBLE SHOOTING

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

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

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

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

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

FUEL MIXTURE

No fuel in tank or fuel valve closed.

Plugged vent hole in fuel tank cap.

Fuel line clogged.

Fuel pump diaphragm worn or punctured.

Carburetor not choked sufficiently, especially if engine is cold.

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

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

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

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

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

COMPRESSION

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

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

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

Valve stuck open. Piston rings stuck or worn.

Valves adjusted with insufficient clearance.

IGNITION

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

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

Broken or frayed ignition wires.

Spark plug insulator broken.

Spark plugs wet or dirty.

Spark plug gap incorrect.

Condensation on spark plug electrodes.

Breaker point gap incorrect.

Breaker points pitted or fused.

Breaker arm sticking.

Condenser leaking or grounded.

Spark timing wrong.

Weak battery. Faulty ignition coil.

ENGINE MISSES

Spark plug gap incorrect.

Worn, leaking or loose ignition cables.

Weak spark. See "Ignition" test for spark.

Loose connections at ignition cables.

Breaker points pitted or worn.

Water in gasoline. Sticky valves.

Poor compression. See "Compression."

ENGINE STOPS

Fuel tank empty.

Water, dirt or gum in gasoline.

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

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

Air vent hole in fuel tank cap plugged.

Ignition troubles. See "Ignition."

OVERHEATING

Crankcase oil supply low.

Ignition timing wrong.

Low grade of gasoline.

Engine overloaded.

Restricted cooling air circulation.

Part of air shroud removed from engine.

Dirt between cooling fins.

Intake screen clogged with dirt.

Restricted exhaust.

ENGINE SURGES OR GALLOPS

Carburetor flooded.

Governor spring hooked into wrong hole.

Governor rod incorrectly adjusted.

ENGINE KNOCKS

Poor grade gasoline or of low octane rating.

Operating under heavy load at low speed.

Loose or burnt out rod bearings.

Spark advanced too far.

Worn or loose piston pin.

Carbon or lead deposits in cylinder head.

BACKFIRES THROUGH CARBURETOR

Water or dirt gasoline.

Engine cold.

Poor grade of gasoline.

Sticky inlet valves.

Overheated valves.

Spark plug heat range incorrect (too hot).

Hot carbon particles in engine.

HIGH OIL PRESSURE

Oil pressure gauge defective.

Oil too heavy.

Faulty relief valve.

Clogged pressure line.

LOW or NO OIL PRESSURE

Oil pressure gauge defective.

Clogged oil lines or leaky connections.

Crankcase oil supply low.

Faulty relief valve.

Faulty oil pump.

Oil pump intake screen clogged.

Oil too thin (diluted or wrong grade).

Worn rod or crankshaft bearings.

For Your Record

MODEL	
SPEC NO.	
SERIAL NO.	

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

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

cut along dotted line - mail in envelope

return to
TELEDYNE WISCONSIN MOTOR
PRODUCT SUPPORT CENTER
1910 SO. 53 RD STREET
MILWAUKEE, WISCONSIN 53219

Dear Customer:

If you would like to receive a free copy of a list of Authorized Teledyne Wisconsin Motor DISTRIBUTORS and SERVICE CENTERS in your area, please complete the following:

NAME _____

STREET _____

CITY _____ STATE _____ ZIP _____

ENGINE MODEL _____ SERIAL NO. _____

ENGINE MAINTENANCE SCHEDULE	Daily	Weekly or 50 hrs.	100 hrs.	250 hrs.
CHECK OIL LEVEL. Add to full mark - Do not overfill.	●			
CHECK AIR CLEANER. Shake out accumulated dirt from dry element.	●			
CLEAN AIR INTAKE SCREEN. Clean cooling fins if necessary.	●			
CLEAN AIR FILTER ELEMENT. Replacement Element LO 194 A		●		
CHANGE CRANKCASE OIL. Use grade and classification of oil recommended. In adverse conditions change oil every 50 hours of operation.			●	
REPLACE OIL FILTER every oil change. Replacement Filter RV 51			●	
INSPECT CRANKCASE BREATHER SYSTEM. Clean if necessary.			●	
DISTRIBUTOR CAM. Apply 1 or 2 drops of light oil (10W) to felt in cam sleeve and 1 drop to breaker arm pivot.				●
INSPECT SPARK PLUGS and BREAKER POINTS. Replace if necessary and regap. (Spark Plugs .030 inch) (Breaker gap .020 inch) Replacement Spark Plugs YD 6				●
INSPECT FUEL FILTER. Clean filter screen or strainer in fuel tank.				●
INSPECT COOLING SYSTEM. Remove shrouding and scrape off dirt from between fins, around cylinder, head and from shrouding.				●
INSPECT STARTING MOTOR. Check for loose mounting and cable connections.				●

ENGINE STORAGE

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

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

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

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

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

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

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

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.

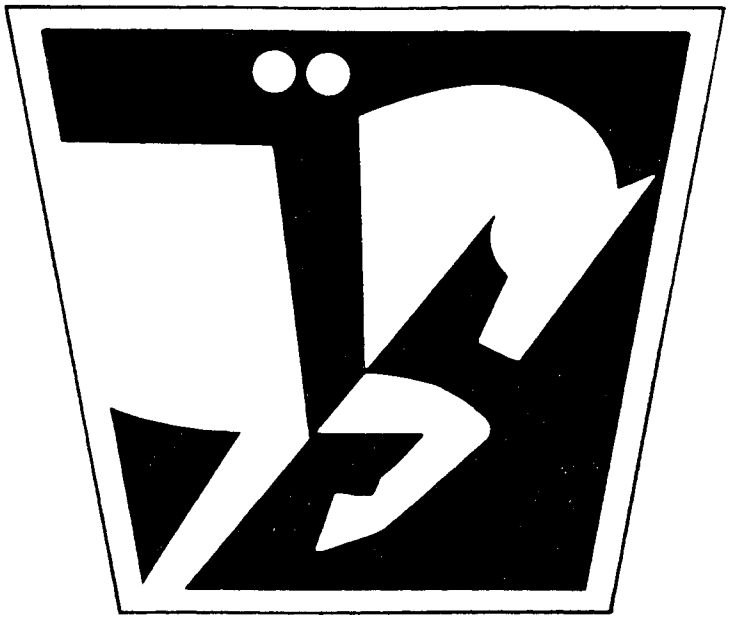
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TELEDYNE WISCONSIN MOTOR

MILWAUKEE, WISCONSIN 53219

FOR SERVICE and PARTS — contact your nearest Teledyne Wisconsin Motor Distributor or Service Center

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WISCONSIN ENGINES

SINCE 1909

TELEDYNE WISCONSIN MOTOR

1910 South 53rd Street, Milwaukee, Wisconsin 53219

Printed in U.S.A.

SERVICE BULLETINS

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

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