IMTCO
600 Crane

June 1976

FEBRUARY, 1977 2200 ND

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INTRODUCTION

This manual is provided to acquaint you with the operation of your IMTCO 600 series truck mounted, articulating hydraulic crane and supply you with the information necessary for proper equipment maintenance.

The service life, performance and efficiency of the unit depends upon close adherence to operation and service procedures described in this manual. Operators of this unit and those responsible for service should thoroughly familiarize themselves with these maintenance instructions.

If information is required which is beyond the scope of this manual, please contact your IMTCO distributor or the IMTCO Customer Service Department.

When placing parts orders or requesting assistance please refer to the information below.

TO BE COMPLETED BY DEALER

Chassis Information

Make_____ Model_____ Serial No._____

Transmission Model_____ Serial No._____

P.T.O. Ratio_____ Make_____

Crane and Pump Information

Crane Serial No._____ Model_____ Selector Valve_____

Pump Make_____ Model_____ Serial No._____

Accessories and Options_____

_____

_____

WARRANTY

IOWA MOLD TOOLING CO., INC. WARRANTS NEW MACHINERY AND EQUIPMENT, SO FAR AS THE SAME IS OF ITS OWN MANUFACTURE, AGAINST DEFECTS IN MATERIAL AND WORKMANSHIP UNDER NORMAL USE AI FROM DATE (OF IOWA MOLD ITED, HOWE\ NTH PRO-R TS OWN MANUF E OF START] HIPMENT OF MA(HE TIME IT WAS SHIPPED, PROVIDED THE PURCHASER HAS GIVEN IOWA MOLD TOOLING CO., INC. IMMEDIATE WRITTEN NOTICE UPON THE DISCOVERY OF SUCH DEFECT. IOWA MOLD TOOLING CO., INC. SHALL HAVE THE OPTION OF REQUIRING THE RETURN OF THE DEFECTIVE MATERIAL (TRANSPORTATION PREPAID) TO ESTABLISH THE CLAIM.

LIMITED WARRANTY
APRIL 1, 1977

Products manufactured by Iowa Mold Tooling Co., Inc. are warranted to be free from defects in material and workmanship, under proper use, application and maintenance in accordance with IMTCO's written recommendations, instructions and specifications, for a period of ninety (90) days from the date of shipment to the end user. IMTCO's obligation under this warranty is limited to, and the sole remedy for any such defect shall be the repair or replacement (at IMTCO's option) of unaltered parts returned to IMTCO, freight prepaid, and proven to have such defect, provided such defect occurs within the 90 day warranty period and is reported within fourteen (14) days of its occurrence.

This is the only authorized IMTCO warranty and is in lieu of all other express or implied warranties or representations, including any implied warranties of merchantability or fitness, or of any other obligations on the part of IMTCO. Warranty claims must be submitted and shall be processed in accordance with IMTCO's established warranty claim procedure. In no event will IMTCO be liable for business interruptions, loss of sales and/or profits, personal injury, costs of delay or for any other special, indirect, incidental or consequential losses, costs or damages.

IMTCO

IOWA MOLD TOOLING CO., INC.
500 HIGHWAY 18 WEST
GARNER, IOWA 50438, U.S.A.

OPERATION INFORMATION

CRANE IDENTIFICATION

Every IMTCO crane has an identification placard of the type shown below attached to its mast assembly. When ordering parts, communicating warranty information or referring to unit in correspondence always include the assigned serial and model numbers. All inquiries should be addressed to Iowa Mold Tooling Co., Inc. Garner, Iowa 50438 or telephone (515) 923-2827.

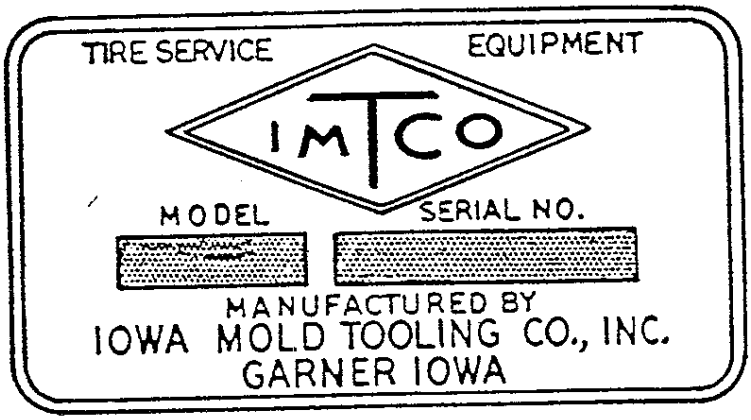


Fig. A-1

CONTROL INFORMATION

VEHICLE CONTROLS

POWER TAKE-OFF MANUAL SHIFT CONTROL: Transmission mounted, manual PTO's are usually installed with the shifting control knob located near the steering column. To engage the PTO the knob is pulled out. To disengage the PTO the knob is pushed in.

NOTE: In order to shift the PTO in either direction the truck transmission must be in neutral and clutch depressed.

HAND BRAKE: Prior to unit operation the vehicle hand brake should be securely set.

C A U T I O N
Power Take-Off should always be disengaged before driving the vehicle.

UNIT CONTROLS

The unit is equipped with dual control stations, one at each side of the vehicle. All controls have placards which indicate operating direction for the crane function desired. A hand throttle control is located at the driver's side only and provides engine speed control.

Some units will be provided with a triple dual selector valve which removes outrigger control handles from main control bank and allows for optional equipment installation. Due to optional equipment considerations, controls can vary in placement and/or location but operation is basically as follows:

MAIN BOOM: Push lever to lower and pull lever to raise.

SECONDARY BOOM: Push lever to lower and pull lever to raise.

EXTENSION BOOM: Push lever to extend and pull lever to retract.

ROTATION: Pull lever for counterclock-wise motion and push lever for clock-wise rotation.

STABILIZERS: Push lever to extend and pull lever to retract.

HAND THROTTLE: Rotate knob counterclock-wise to increase speed and rotate clock-wise or push to lower engine speed to idle.

C A U T I O N
Prior to operating the crane, stabilizers must be lowered to a firm footing. The main boom must be raised to allow adequate clearance before any other crane function can be initiated.

600 CRANE GROUP

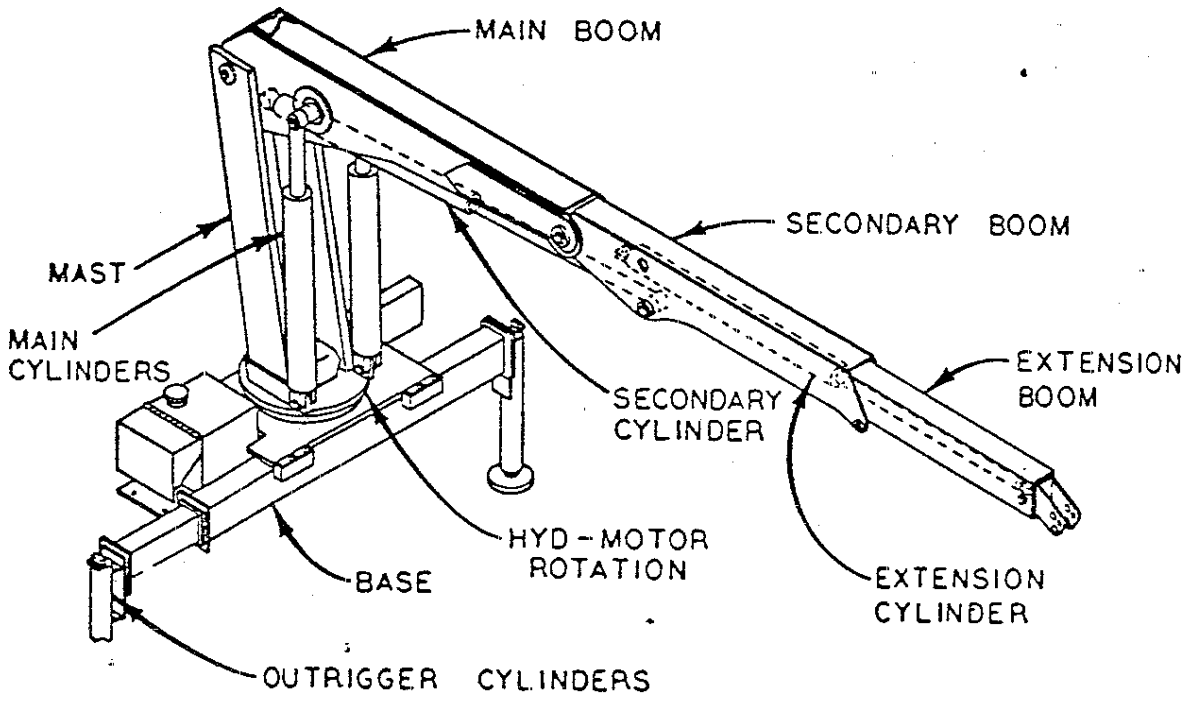


Fig. A-2

OPERATING INSTRUCTIONS

The IMTCO 600 crane is relatively simple to operate. However, prior to any work at job sites, the operator should thoroughly familiarize himself with the control operations, load limitations, prescribed operating procedures and safety precautions applicable to the unit. In addition, simulated job operations should be performed by the operator before putting the unit to a work task. The operator's understanding of emergency measure execution is essential; he should be prepared to take remedial action at any time.

SAFETY FACTORS

Three important factors in the safe operation of the unit are a competent operator, mechanical soundness of the unit and absolute assurance that the unit is not loaded to exceed its maximum specified capacities. The safety precautions contained in this section should be read carefully and observed at all times during unit operation.

LOAD LIMITS

The IMTCO 600 crane is designed to give satisfactory service if operated within maximum allowable load specifications stated on the unit's capacity placard. Potentially serious safety hazards and shortened service life of the unit can be the results of overloading.

The capacity placard should be studied before lifting operations are carried out. Exceeding stated load limit for a given radius can cause tipping or structural failure.

Warranty of unit will be void on any part of the unit subjected to misuse due to overloading, abuse or lack of maintenance. No warranty - verbal, written or implied - other than the official published IMTCO new machinery and equipment warranty will be valid with this unit.

EQUIPMENT INSPECTION

Before operating the unit always perform the safety checks outlined below. These procedures are vital to the detection of equipment malfunction and damage which may be potential safety hazards.

1. STRUCTURAL SOUNDNESS. Inspect unit for damaged members and loose nuts or bolts.

2. HYDRAULIC OIL SUPPLY. Check oil level in hydraulic reservoir and fill to dipstick " full" mark if it is low.

3. LEAKAGE. Examine all visible hydraulic hoses for frays and blisters. Look for signs of lubricating or hydraulic oil leakage.

4. CONTROLS. Make short test for proper control operation.

5. REPAIRS. Before putting the unit into service correct all observed defects and malfunctions.

This equipment check should be performed before every operation and as a periodic preventive maintenance procedure.

WORK STATION POSITIONING

The optimum location for the working unit is on firm, level and dry pavement or ground in close job proximity. Overhead obstructions on the work side of the unit should be avoided as much as possible.

Wheel chocks should be used when parking unit on a slope. If parking on curbed roadway, turn front wheels toward curb. At work site the vehicle should be parked with the grade. When across grade parking is necessary, restricted operation will be required to compensate for increased tipping risk due to the shortened fulcrum point of stabilizers.

POWER LINE PROXIMITY

Except where the electrical distribution and transmission lines have been de-energized and visibly grounded at point of work, or where insulating barriers not a part of or an attachment to the crane have been erected to prevent physical contact with the lines, cranes shall be operated proximate to, under, over, by, or near power lines only in accordance with the following:

1. For lines rated 50 kV or below, minimum clearance between the lines and any part of the crane or load shall be 10 feet.

2. For lines rated over 50 kV, minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each 1 kV over 50 kV, or use twice the length of the line insulator but never less than 10 feet.

3. In transit with no load and boom lowered the clearance shall be a minimum of four feet.

4. It is recommended that a person be designated to observe the clearance and give timely warning for all operations where it is difficult for the operator to maintain the desired clearance by visual means.

In addition to the above mentioned safety measures, the operator must take into account sag, sway and deflection factors in allowing for proper clearances.

BEGINNING OPERATION

To initiate unit operation:

1. Choose a unit operating location with two factors considered. The vehicle position should permit, if possible, total task performance without repositioning and the terrain should be firm, dry and level for proper stabilization throughout the operation.

2. Securely set the truck hand brake and set any auxiliary device, if supplied. Adjacent to curbing, turn front wheels in to further secure the vehicle. Wheel chocks should be firmly placed.

3. Shift truck into neutral, keep clutch depressed if transmission is mechanical and pull out the power take-off knob to engage the system.

4. Accelerate engine to proper operating speed using the unit hand throttle control.

5. Allow the system to idle at operating speed with all controls at neutral until the hydraulic system reaches operating temperature. Hydraulic reservoir should be warm to touch.

6. Outriggers should be extended until firm ground contact is made. Do not hold controls open to point of jacking action. When stabilizing the unit on soft ground bearing pads should be used to retard sinking and provide blocks to insure firm contact when operating on sloping terrain. Correct all defects in stabilization system before continuing.

W A R N I N G
Do not operate crane until the vehicle is firmly stabilized.

7. Several precautions should be taken in actuating the hydraulic controls on the unit. Before actual work begins put each control through one complete test cycle. To prevent shock loading no control operation should begin with a full open position. Sudden stops and starts stress equipment unduly and can shorten equipment life. When maximum speed is desired controls should be actuated slowly and acceleration achieved smoothly.

ENGINE SPEED-REGULATION

The speed of the hydraulic pump dictates the speed of the operating unit. In order for the unit to function at speeds stated in the specifications the pump must operate at optimum speed.

To determine the engine speed required for operation, the pump requirement-optimum - is divided by engine to PTO ratio of the truck. When the engine to

PTO ratio is not known, this information may be obtained from a local IMTCO dealer of distributor or Iowa Mold Tooling Co., Inc. direct. To find the ratio it will be necessary to know the PTO and transmission model numbers as well as the make, model and year of the truck. When this information is obtained, compute the proper engine speed as shown in the following examples:

$\frac{\text{Required Pump Speed (RPM)}}{\text{Engine to PTO Ratio (\%)}} =$ Required Engine Speed (RPM)		
PUMP SIZE	RECOMMENDED PTO RATIO	
13 GPM	70% to 100%	$\frac{\text{Optimum Speed (1500 RPM)}}{\text{100\% (1.00)}} = 1500$ RPM
17 GPM	60% to 70%	$\frac{\text{Otimum Speed (1100 RPM)}}{\text{70\% (.70)}} = 1575$ RPM
24 GPM	40% to 60%	$\frac{\text{Optimum Speed (800 RPM)}}{\text{55\% (.55)}} = 1350$ RPM

Efficient operation of the unit is dependent upon proper pump speed. When operation is too slow always check the pump speed when diagnosing the cause. An electric tachometer with accurate calibration may be used to check engine speed.

LOAD LIFTING

Capacity placards are located on unit mainframe near the operator stations. The structural capacities and permissible radii of operation stated on these placards should be carefully studied and strictly adhered to during equipment operation.

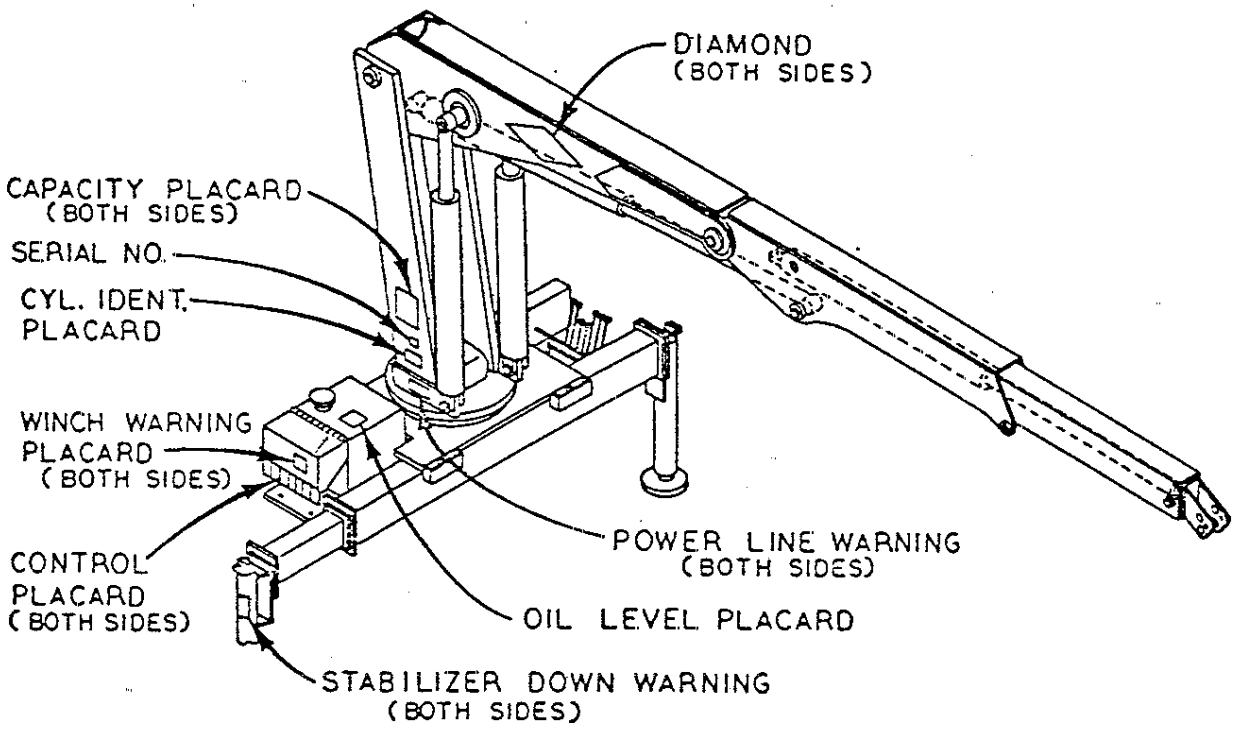
NOTE: Capacity placards are specifically located for close proximity to the operator. This is to assure ready reference in determining when a load can or cannot be handled.

Load limit information given on the capacity chart is formulated on 85% of tipping if:

1. The unit has been correctly installed on a factory approved truck.
2. A satisfactory stability test has been performed.

3. The intended operation is to be carried out on level, solid footing with proper outrigger placement.

It should be understood that each stated capacity is directly related to the radius of a given operation. The radius is measured from center of rotation to load line on the horizontal plane.



PLACARD PLACEMENT
Fig. A-3

STABILITY RATINGS

Capacity ratings project unit stability to no more than 85% of tipping provided:

1. The vehicle on which the unit is mounted complies with factory specifications.

2. Factory installation instructions are adhered to when unit is mounted on vehicle.

3. Counter weight sufficient to supplement vehicle weight has been installed and meets factory requirements.

4. Tire inflation pressures meet requirements stipulated in "Tire Inflation Table."

LOAD CAPACITY CHART

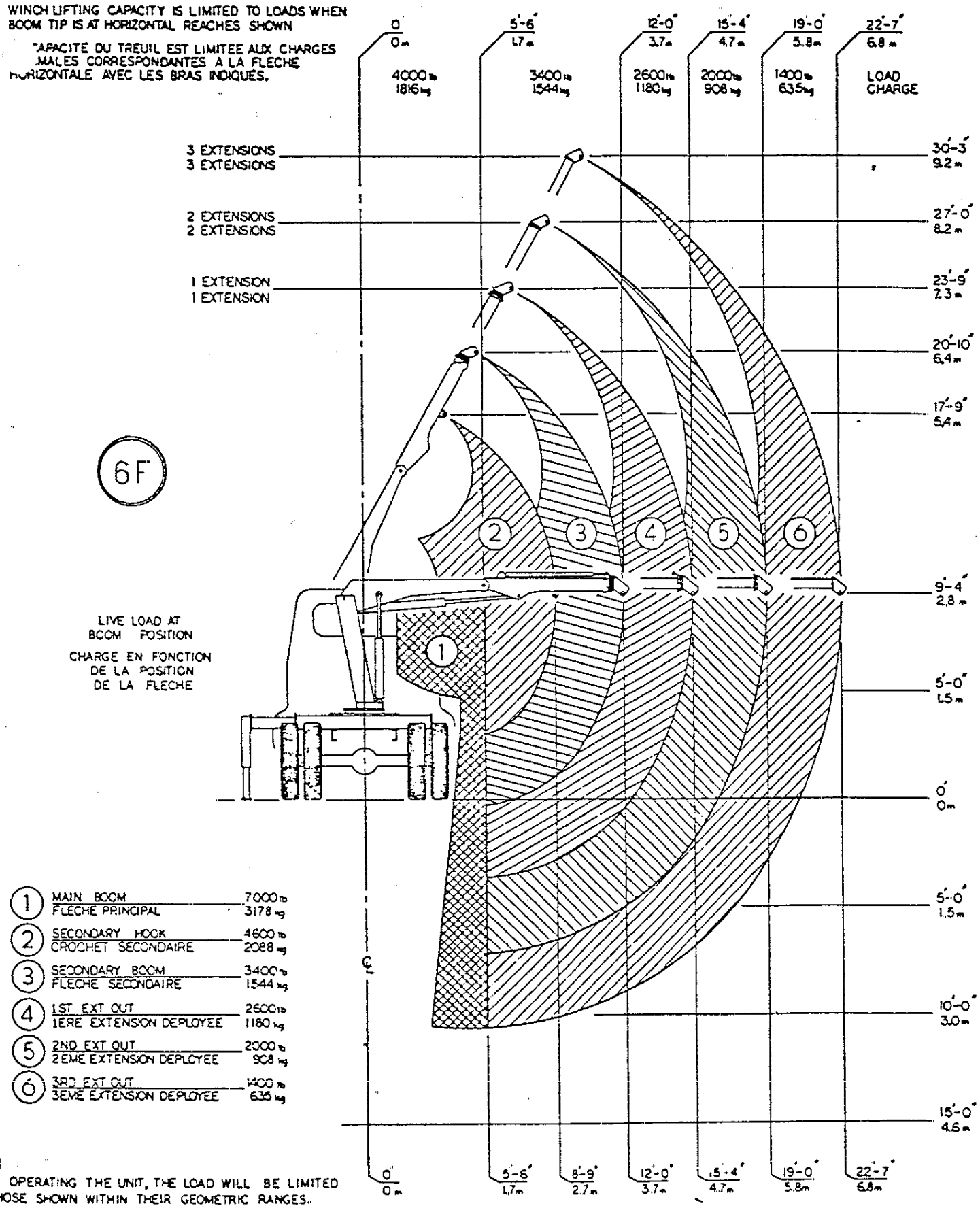


Fig. A-4

5. The outriggers are in use, making proper contact with firm level footing.

The "Load Capacity Chart" ratings depend upon compliance with the curb weights coupled with truck size. Adherence to minimum chassis specifications and/or requirements is necessary to obtain and maintain safe stabilization.

STABILITY CHART

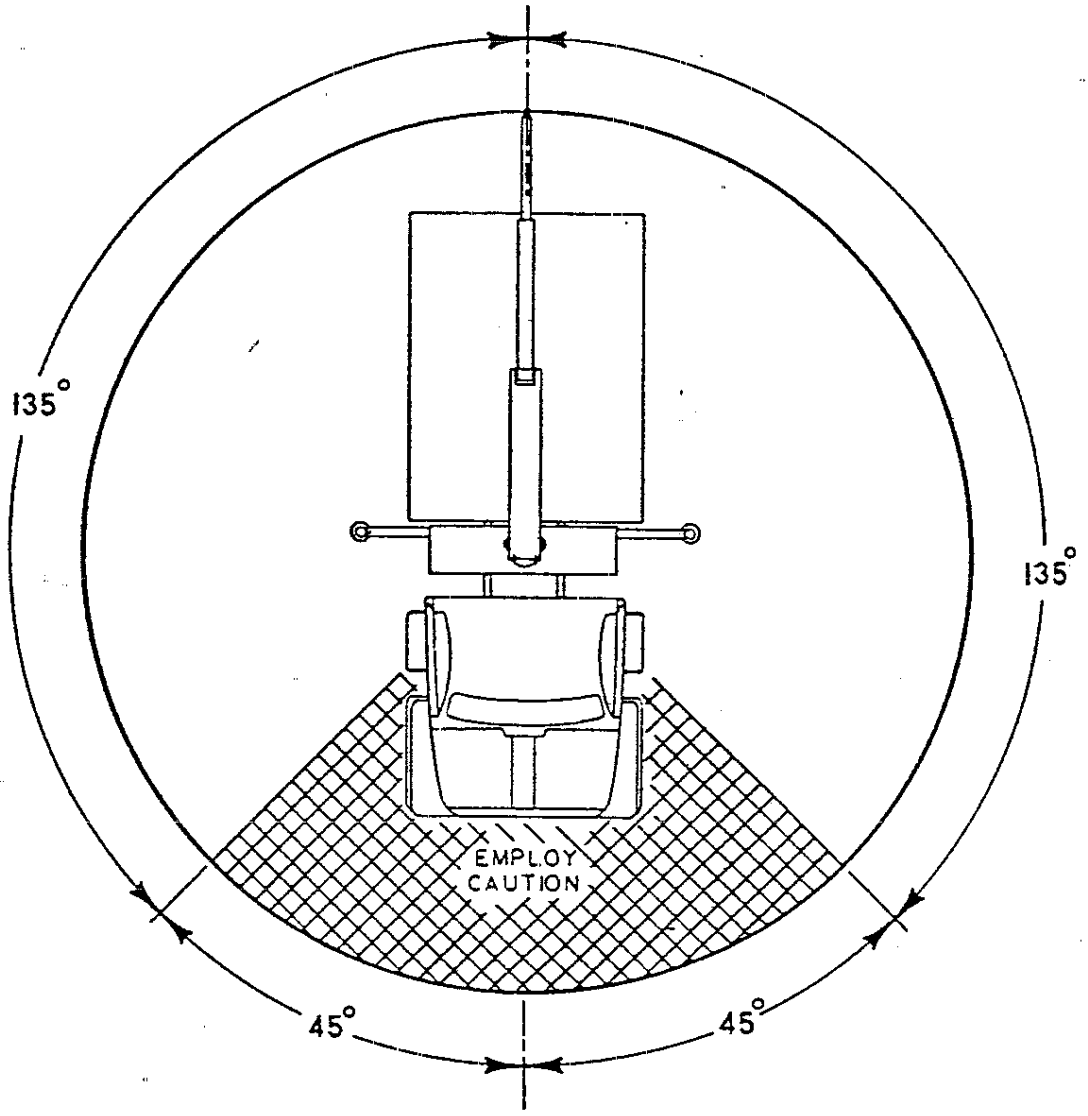


Fig. A-5

WARNING
The mimimum curb weights shown do not insure the unit will be stable. Actual stability ratings will be obtained from the initial start up and testing procedures.

CONVENTIONAL CAB

Stability rating for an IMTCO 600 crane mounted on a conventional chassis with a 175" (444.5 cm) wheel base and a 102" (259 cm) cab-to-axle dimension shown below. These specifications will provide complete 360° rotation stability based upon 85% tipping factor without capacity chart restrictions. Required axle weights are as follows:

Front Axle	(2313 kgs)	5,100 lbs.
Rear Axle	(2449 kgs)	5,400 lbs.
Total Weight	(4762 kgs)	10,500 lbs.

OPERATION SHUT DOWN

Proper shut down procedure is:

1. Stow the crane in folded position, boom within mast behind cab.
2. Retract the outriggers.
3. Disengage the power take-off prior to travel.
4. Disengage throttle control if applicable.

SPECIFICATIONS & OPERATING CHARACTERISTICS

600 SPECIFICATIONS & OPERATING CHARACTERISTICS

		615	619	623
REACH - (From Centerline Rot.)	(4.7 m)(5.8 m)(6.8m)	15'-4"	19'-0"	22'-7"
EXTENSION----------	(1.02 m)(1.07 m)(1.07m)	40"	+42"	+42"
LIFTING HEIGHT----------	(7.3 m)(8.2 m)(9.1 m)	23'-9"	27'-0"	30'-3"
WEIGHT OF CRANE----------	(1111 kgs)(1134 kgs)(1161 kgs)	2450#	2500#	2560#
OUTRIGGER SPAN----------	(2.4 m Std)(3.3 m Opt)	(7'-8" Std)(10'-8" Opt.)		
OPTIMUM PUMP CAPACITY----	(34.1 liters/min)	9 US/min.		
OIL RESERVOIR CAPACITY----	(41.6 liters)	11 US		
MOUNTING SPACE REQ'D-------	(66.3 cm)	26"		
STORAGE HEIGHT----------	(3 m)(or 1.9 m above frame)	9'-8" or 74" above frame		

(Based on 39" (99.1 cm) truck frame height and allowing 6" (15.2cm) space behind cab.)

DESIGN FACTORS

Materials ----------	3/1
Pins & Hydraulics ----------	4/1

PERFORMANCE CHARACTERISTICS

ROTATION (350°) ----------	59 Sec.
MAIN BOOM ELEVATION (-47° to +64°)----------	21 Sec.
SECONDARY BOOM ELEVATION (125°)----------	15 Sec.
EXTENSION----------	6 Sec.
OUTRIGGER EXTENSION----------	6 Sec.

LIFTING CAPACITY

(From Centerline Rotation)

(1.7 m)	5'-6" ----------	3178 kg ----------	7,000#
(2.7 m)	8'-9" ----------	2088 kg ----------	4,600#
(3.7 m)	12'-0" ----------	1544 kg ----------	3,400#
(4.7 m)	15'-4" ----------	1180 kg ----------	2,600#
(5.8 m)	19'-0" ----------	908 kg ----------	2,000#
(6.8 m)	22'-7" ----------	625 kg ----------	1,400#

HYDRAULIC SYSTEM

Open centered, full pressure system that requires 9 GPM (34.1 liters) optimum oil flow @2300 psi (161.7 kgs/sq.cm.) Six spool stack type control valve with optional dual operational handles that can be located at both sides for convenient operation. System includes hydraulic oil reservoir, suction line filter, pump, control valve, return line filter.

POWER SOURCE

Integral mounted hydraulic pump and PTO application. Other standard power sources may be utilized.

HOLDING VALVES

The holding sides of all cylinders are equipped with intergral mounted holding and/or counter-balance valves to prevent sudden cylinder collapse in case of hose or other hydraulic failure. The extension, main, secondary and outriggers have positive pilot operated valves that will open only upon command.

CYLINDERS

MAIN	(8.9 cm)	3½" Bore	(80 cm)	31½"	Stroke
SECONDARY	(11.4 cm)	4½" Bore	(95.3 cm)	37½"	Stroke
EXTENSION	(6.4 cm)	2½" Bore	(101.6 cm)	40"	Stroke
OUTRIGGERS	(7.6 cm)	3" Bore	(45.7 cm)	18"	Stroke

ROTATION SYSTEM

Turntable bearing powered with a high torque hydraulic motor through a gear reducer assembly.

MINIMUM CHASSIS SPECIFICATIONS

Body Style

Wheel Base	(419.1 cm to 444.5 cm)	165" to 175"	(342.9 cm)	135"
Cab to Axle	(259.1 cm)	102"	(274.3 cm)	108"
Frame Section Modulus	(314.7 cc)	19.2 cu.in.	(314.7 cc)	19.2 cu. in.
R B M	(7966 kgs/m)	691,000 in. lbs.	(7966 kgs/m)	691,000 in. lbs.
Front Axle	(2721.6 kgs)	6,000 lbs.	(2721.6 kgs)	6,000 lbs.
Rear Axle	(6804 kgs)	15,000 lbs.	(6804 kgs)	15,000 lbs.
Transmission		4 Speed		4 Speed

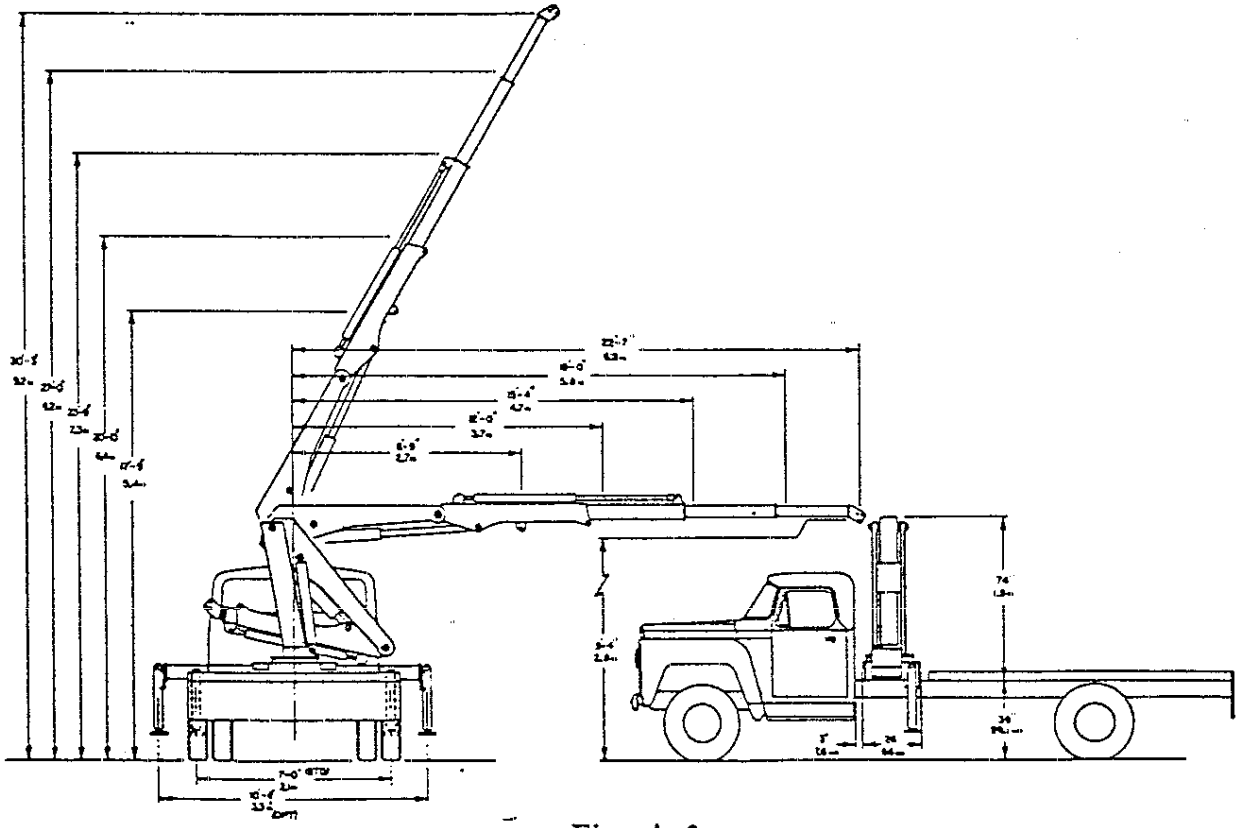


Fig. A-6

In addition to these specifications, heavy duty electrical and cooling systems and dual rear wheels are required. It is recommended that the vehicle be equipped with an electric engine tachometer, auxiliary brake lock, power steering and a five speed, in lieu of four speed, transmission.

REMOTE CONTROL OPTION

As a standard option, remote control is furnished with manual controls for the outriggers and electrical over hydraulic control for the four crane boom functions. Refer to Electrical Schematic, Fig. B-8, page 2-9 and general parts list Fig. C-24, page 3-40. The hydraulic schematic is shown in Fig. C-22, page 3-34.

Another variation of the remote control includes complete outrigger and boom manual controls and crane boom electrical remote controls. Refer to Fig. C-23, page 3-38 for this application hydraulic schematic. The electric schematic is similar to that mentioned above.

Both control types, as discussed above, allow for the winch option to be controlled remotely and this application is shown as integral to individual schematics. The electrical control is an On-Off type and cannot be metered or feathered.

WINCH OPTION

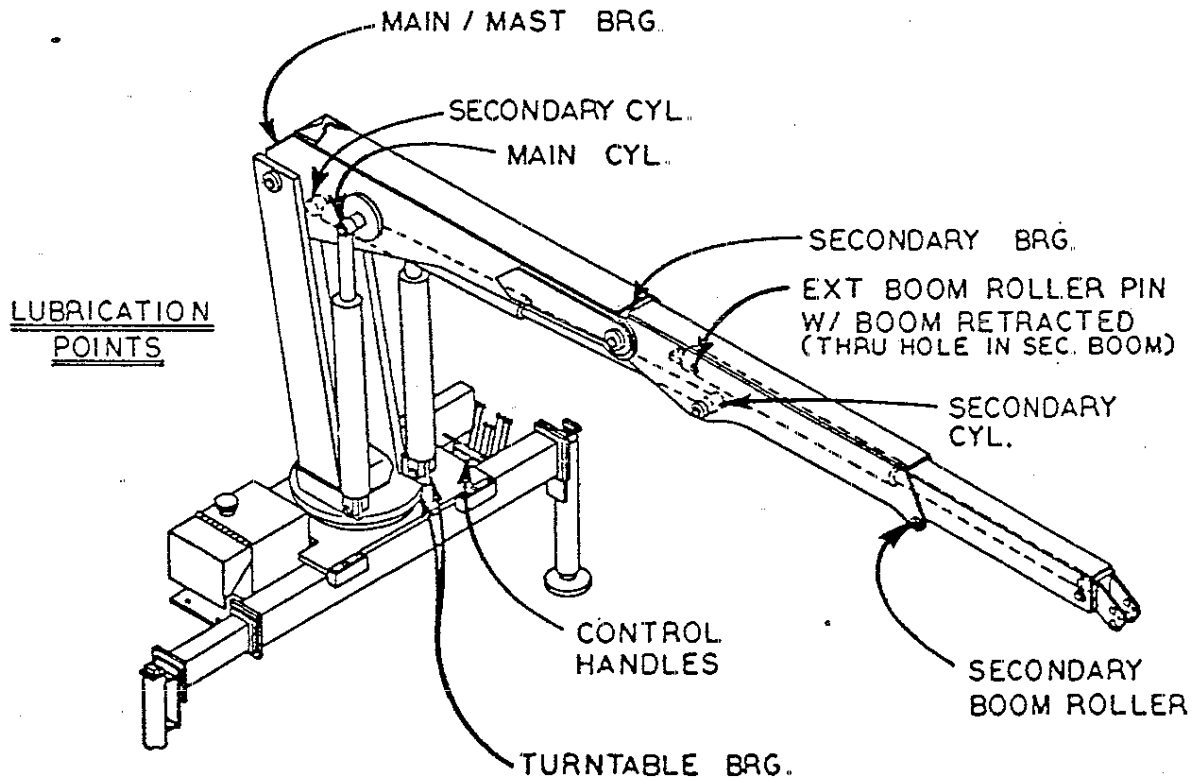
The 4000 lb. (1816 kg) bare drum pull is supplied by a hydraulic powered winch mounted to underside of secondary boom. The parts as shown in Fig. C-20, page 3-28 are supplied with the standard kit. The hydraulic schematics are shown as options on pages 3-32 through 3-39. Parts for winch gear box are shown in Fig. C-14, page 3-17.

MAINTENANCE

Proper maintenance on a regular schedule is essential to keep your unit operating at peak efficiency. This section outlines required maintenance information and necessary service intervals. Personnel responsible for care of the unit should familiarize themselves with the frequency and type of lubrication and maintenance operations to be performed.

LUBRICATION

Maintaining the proper lubrication schedule will vary with climatic conditions and use frequency. The lubrication chart is intended to serve as a schedule for a normal work load and moderate weather variance. Periods of heavy use would shorten service intervals.



LUBRICATION CHART
Fig. B-1

LUBRICATION CHART			
APPLICATION POINT	LUBRICATION PRODUCT	APPLICATION MEANS	INTERVAL
TURN TABLE BEARING	Shell Alvania 2EP or Shell Retinax "A" or equivalent	Hand grease gun or pneumatic pressure gun	Monthly
MAIN CYLINDER			
MAIN & SECONDARY BOOM PINS			
EXTENSION BOOM ROLLERS			
SECONDARY CYLINDER			
POWER TAKE-OFF OR TRANSMISSION	EP 90 Gear oil	Fill to check plug	Monthly

HYDRAULIC SYSTEM

OIL SELECTION: Minimum viscosity specifications for hydraulic oil to be used in the IMTCO 600 crane are given in the table provided in this section. Any major oil company can supply products which meet these requirements.

Oils selected by user for this class of equipment, in addition to meeting viscosity specifications, should have the following additives:

1. Antifoam inhibitors
2. Antioxidant inhibitors
3. Rust resistant additives
4. Antiwear additives

OIL SPECIFICATIONS: The chart on the following page states oil specifications for a full range of operating temperatures encountered in the temperate zones. Arctic conditions present special requirements which are not in the scope of this chart and must be given individual analysis. Consult your oil supplier for the proper fluids for working under these severe conditions. In addition, electric hydraulic oil reservoir heaters are available to improve operations at extremely low temperatures.

HYDRAULIC OIL SPECIFICATIONS				
Ambient Temperature Range, °F	0-90	Below 32	32-90	Above 90
Max. Pour Point, °F	-30	-25	+10	+10
Max. Viscosity, SSU @ 0°F	4000	4000	-	-
Min. Viscosity, SSU @ 100°F	140-195	100-130	150-200	200-315
Min. Viscosity, SSU @ 210°F	48	41	43	47
Min. Viscosity Index	139	90	90	90

HYDRAULIC OIL DETERIORATION

Contamination by entry of solvents, water and dust or other abrasives will cause deterioration of the system's hydraulic oil. Sustained presence of these impurities will result in premature breakdown in antifoam, lubrication, anti-rust and viscosity properties. An increase in the oil oxidation rate will result from water and operation at high temperatures (above 180°F). Oxidation produces varnish forming materials and sludge in the oil.

The hydraulic system which is operated on a sustained basis with contaminated or broken down oil will be subject to an increased component wear rate which can significantly shorten the efficient unit life.

Periodically the hydraulic oil in the system should have a sample drawn off and its condition checked for break down. To check oil quality:

1. Place oil sample in clean glass.

2. Smell oil to detect a burnt or rancid odor.

3. Visually examine the sample for a cloudy or dark color.

4. After a standing period of several minutes, inspect sample for water which will settle to the bottom of glass if present. Water can result from a system leak or condensation due to temperature extremes.

When any condition described above is observed, the system should be purged and filled with new oil.

The hydraulic oil should be changed in the reservoir and complete system:

1. After every 800 hours of operation or every six months, which ever occurs first.
2. After pump or other major hydraulic component failure.

HYDRAULIC SYSTEM PURGING

Purging the hydraulic system requires a new oil supply sufficient to completely fill the reservoir, lines, cylinders and extra allowance for loss during the procedure. To minimize oil loss during this process, operate the truck engine at low speed.

In purging, new oil is supplied to the pump pressure line and an escape flow is provided for old oil from the reservoir return line.

Two operators will be required, one to operate the controls and another to regulate pump flow, during the following procedure:

WARNING
During this operation do not allow reservoir level to drop below 1/3 capacity.

1. Initiate drainage by locating unit in an area which provides solid, level footing and space to accomodate full operating range of crane.

2. Extend outriggers out and down to full stroke. Move crane to maximum, extended, horizontal position on either side. Kill engine.

3. Disengage PTO, drain hydraulic oil reservoir, remove suction line filter and drain hoses. Disconnect pressure hoses from pump, drain and reassemble. Install new cartridge and reassemble filter.

NOTE: Mode of waste disposal is left to the discretion of service personnel in this discussion of system drainage.

4. Remove reservoir return line and direct this flow into a sump or waste container. Plug drain port on reservoir and refill with new oil.

NOTE: Personnel should thoroughly familiarize themselves with the following steps and be prepared to perform them in uninterupted sequence or stop engine at the end of each function. If this is not done, excessive new oil waste will occur.

5. Start truck engine and engage PTO. Rotate the crane 90° of travel horizontally, retract extension boom, elevate main boom to full height and lower secondary boom to lowest position.

6. Rotate crane toward rear center of vehicle, raise outriggers and kill engine.

7. All components of the system should now be purged. Replace return line filter cartridge and reinstall return line on reservoir.

8. Check oil level and add oil to " full " mark if needed.

HYDRAULIC COMPONENTS

FILTER REPLACEMENT

This unit's hydraulic system contains two filters: a 25 micron suction line filter to strain out large contaminating particles and a 10 micron return line filter for removal of smaller particles. To avoid residue accumulation in the reservoir and protect hydraulic components - valves, pump, cylinders, etc. - these filters must be serviced on a regular basis.

The filters should be replaced after the first 50 hours of new unit operation and approximately every 200 service hours thereafter. In addition to this service schedule, the suction line filter is equipped with a danger coded vacuum gauge. This gauge should be checked daily when operating unit. If it reads 8 inches of mercury pull, the suction line filter must be replaced to be effective. When the suction line filter requires changing, the return line filter should also be replaced.

To change filter cartridges:

1. Shut gate valve and remove filter cartridges.

2. Replace with new cartridges insuring proper rubber seal seating and tightening as much as possible with both hands.

3. Open gate valve and test system for leaks.

WARNING
Pump failure can result if shut-off valve is left closed.

RETURN FILTER

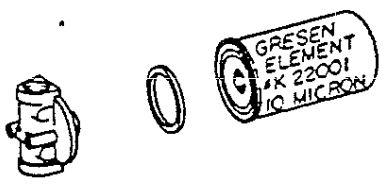


Fig. B-2

SUCTION FILTER

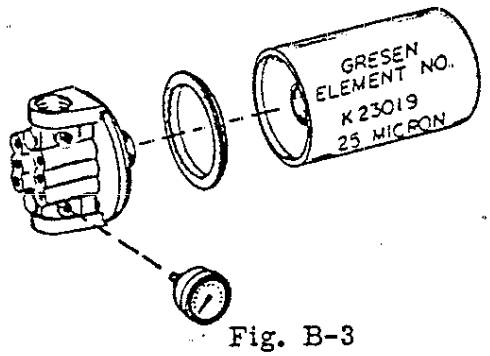


Fig. B-3

HOLDING VALVES

The main, secondary, extension and outrigger cylinders are all equipped with locking holding valves. The function of these valves is to insure against extensive damage due to load release in the event of hydraulic hose or other down stream component failure.

These valves, as supplied, are of a nonadjustable, nonserviceable type. Little reason exists for failure of this type valve but if valve malfunction is suspected, it may be checked in the procedure outlined below:

1. Place crane in a fully supported mode. Do this either by lowering secondary, main and extension booms until their respective cylinders are completely bottomed out or fully support suspected member by an overhead crane or other lifting device.

2. Be prepared for reasonable oil drainage from cylinder in question.

3. Remove the six Allen head valve mounting cap screws.

4. Lift holding valve off taking care not to loosen O-ring seals and introduce dirt to cylinder base.

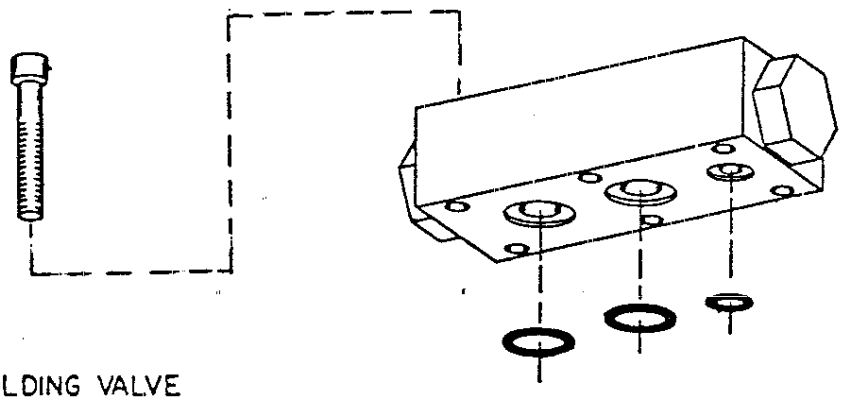
5. Check smallest end port for dirt plug and remove if necessary.

6. Using small screw driver carefully test actuate plunger through center port. If plunger is free, the valve should be operable.

7. Install new valve if it is required.

8. If old valve is to remain in use, reinstall taking care to insure O-ring seals are placed properly and are dirt free. Also be sure small pilot port is located at rod end of cylinder.

9. Tighten six mounting bolts evenly.



HOLDING VALVE

Fig. B-4

VALVE PORT ORIFICES

Fig. B-5 shows a valve port orifice which may be installed on the cylinder base side of the main control valve. The purpose is to slow descent of crane under load. Back pressure is maintained preventing erratic holding valve action. It is mounted with slot side of plate located upward in the control valve. Orifice size is usually 1/16" to 3/32" and is used in main, secondary, and extension cylinders' base side.

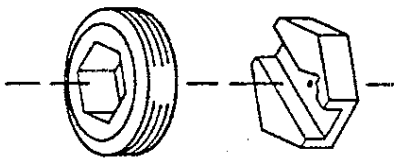


Fig. B-5

RELIEF VALVE ADJUSTMENT

The 600 crane hydraulic system is set to operate at 2350 to 2400 psi with an optimum oil flow of 9 gallons per minute. If unit pressure is below specifications noted, the following procedure is recommended:

1. Engage PTO and set engine speed at rate required to provide 13 gallons per minute.

2. Read pressure on gauge located at main control valve.

3. If low, shut off engine and remove relief plug. Install one 0.010 inch shim which will provide a 125 psi increase.

4. Reinstall relief valve plug and start engine. If pressure has not increased by the stated 125 psi increment, the malfunction indicates pump slippage.

5. If 125 psi increment is achieved, add shims required to bring pressure up to the required 2350 psi minimum.

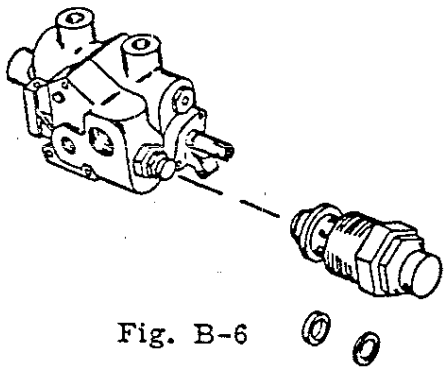
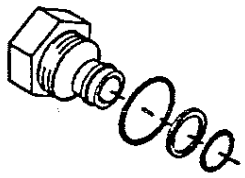


Fig. B-6

POWER BEYOND PLUG

Hydraulic power for an auxiliary function can be obtained by insertion of a power beyond plug as shown below: Remove items #4 and #5 shown in fugure C-12, page 3-12. Install plug taking care that two gasket seals are in place or function pressure will be lost. Install high pressure hose to auxiliary function control valve. Order P/N - 73023.



POWER BEYOND ADAPTER

Fig. B-7

HYDRAULIC SCHEMATIC

Several hydraulic schematics are shown in the PARTS section, pages 3-31 through 3-39. Refer to the application that illustrates your unit and its options.

ELECTRICAL SCHEMATIC

Shown in Fig. B-8 is the Remote Control Electrical Schematic. Included is the winch option which should be ignored if not applicable.

PLUG PIN NO.	WIRE COLOR	WIRE NO.
1	BLACK / ORANGE	16
2	BLACK / GREEN	15
3	BLACK / RED	14
4	BLACK / WHITE	13
5	WHITE / GREEN	12
6	RED / BLUE	11
7	RED / BLACK	10
8	WHITE / RED	8
9	WHITE / BLACK	7
10	BLACK / BLUE	9
11	WHITE	2
12	RED	4
13	GREEN	5
14	ORANGE	6
15	WHITE / BLUE	3
16	BLACK	1

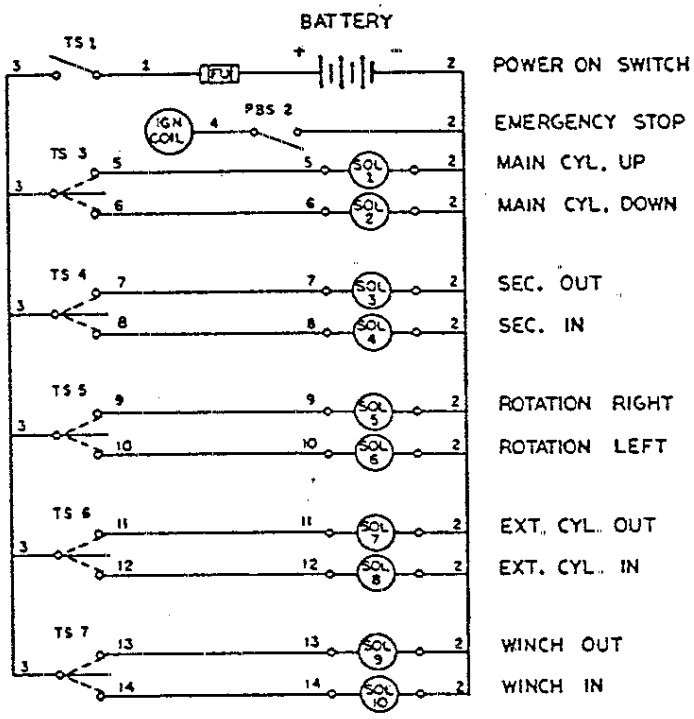


Fig. B-8

PREVENTIVE MAINTINANCE

The following inspection check list is designed to assist you in keeping the vehicle and crane unit in safe operating condition. Items which apply to the unit should be checked before unit operation and the carrying vehicle should be inspected before moving the equipment.

VEHICLE CHECK LIST				
Item	Description	Frequency		
		Daily	Weekly	Monthly
Battery	Inspect for correct fluid level. In hot, dry weather increase inspection frequency.		X	X
Engine Oil	Check for proper level. Make sure oil level on dipstick is above "add oil" mark.	X		
Brakes (Service & Parking)	Operate both systems to assure positive, efficient functioning.	X		
Radiator	Inspect coolant level. Check for antifreeze protection in cold weather.	X		
Safety Equipment Warning Signals & Lights	Inspect all devices and lights for proper operation.	X		
Suspension	Inspect for broken or weak springs.	X		
Tires & Wheels	Inspect tires for bruises, cuts and proper inflation. Check for loose wheel stud nuts, mud lumps or stones between dual wheels and bent wheels.	X		
UNIT CHECK LIST				
Walk Around Inspection	Visually inspect unit on all sides for hydraulic leaks, loose parts and obvious damage to external structural members.	X		

Item	Description	Frequency		
		Daily	Weekly	Monthly
Cylinders	Check securing pins on cylinders and booms for proper installation. Check for proper installation of bolts securing outrigger cylinders.			X
Hydraulic Hoses & Fittings	Inspect hose surfaces and metal end coupling junctions for oil leakage. Check outer hose coverings for blistering, excessive wear or flattening.	X		
Hydraulic Reservoir	With all cylinders retracted check fluid level in reservoir.	X		
Load Hook	Check load hook pin for proper installation. Inspect hook twist exceeding 10 degrees from normal opening. Check for throat opening spread exceeding 15 percent of normal.	X		
Mounting Bolts	Inspect and check torque. Permissible torque range requires 280-460 ft. lbs.			X
Oil Leaks	Inspect all valves and cylinders for signs of leakage.			X
Power Take-Off	Check for sufficient transmission lubrication. Check security of mounting bolts, leakage and correct alignment.		X	
Rotation System	Check for excessive back lash (play) in horizontal rotational stops. Normal variation at the mast location is not to exceed 1/8-3/16 inch. Check gear mesh & bolt torque of turntable bearing and gear box.		X	
Structural Damage	Inspect all structural members for broken welds or fatique cracks. Check booms for structural defects such as bends, weld cracks or dents.			X

Item	Description	Frequency		
		Daily	Weekly	Monthly
Holding Valve	Conduct a holding test with loaded boom to assure proper operation of pilot actuated holding valve on main, secondary and extension.		X	

REGULAR INSPECTION

Every three months or more often when equipment is subjected to heavy use, the following inspections should be performed in addition to the preceeding routing preventive maintenance outline.

MAIN AND SECONDARY BOOMS

1. Check structural defects evidenced in weld cracks, dents, or bends.

2. Check boom rollers for wear.

3. Check main and secondary boom cylinder pins for proper installation and worn pivot pin bushings.

MAINFRAME

1. Check control valve and all other fittings for oil leaks and tightness.

2. Check all roll pins and lock rings on main pin assemblies for proper installation.

3. Check torque on all unit mounting bolts to range of 280-460 ft. lbs.

4. Check for loose bolts, fatique cracks or corroded structural members.

MAST AND ROTATION SYSTEM

1. Check mast housing for cracks.

2. Check for proper rotation function by making several start-stop operations. Maximum allowable free-play at mast front should be 1/8" to 3/16".

3. Check for proper gear mesh in turntable bearing. Check motor and gear mounting bolts for tightness.

HYDRAULIC SYSTEM

1. Cylinders

   A. Check rods for damage such as scarring, nicks, dents and rust on out of service units.

   B. Check for leaks at weld joints and rod seals. Check for drift indicating leakage around piston.

   C. Check cylinder barrel for dents.

2. Hydraulic Pump

   A. Check for leaks at shaft seal and section joints.

   B. Check for drop in operating speed.

   C. Check hydraulic oil for excessive heating.

   D. Check bolts and fasteners for tightness and note unusual vibrations or noise.

3. Hydraulic Control Valves

   A. Check spools for sticking and failure to return to neutral position. Inspect for leaks at joints and spools.

   B. Inspect valve housing for cracks.

   C. Make sure relief valve reaches correct pressure setting.

UNDERDRIVE AND PUMP

1. Inspect for proper transmission gear to PTO engagement.

2. When supplied, inspect drive line U-joints for securing cap screw tightness and adequate lubrication.

3. Check mounting bolts on pump and PTO for tightness.

TROUBLE SHOOTING

The following chart is designed for quick reference in diagnosing on the job malfunctions. Care has been taken to list the possible causes in the most likely order of occurrence.

Malfunction	Possible Defect
Controls fail to respond	1. The PTO is not engaged. 2. Hydraulic oil supply is low. 3. Hydraulic pressure line is ruptured. 4. Suction line shutoff valve is obstructed. 5. Hydraulic Pump is faulty. 6. Relief valve is set incorrectly.
Operation slow down	1. Hydraulic oil supply is low. 2. Hydraulic pump is operating at a reduced speed. 3. Relief valve is set too low. 4. Pump or cylinder is worn. 5. Pump is slipping due to excessive oil temperature. This is a factor which will increase with worn components. 6. Filters are dirty. 7. Valve spools are inoperative. 8. Obstruction has occurred in boom holding valve.
Rotation control slowed or erratic	1. Internal port orifices are clogged. 2. Pinion gear out of mesh or bearing worn. 3. Possible motor failure.

Malfunction	Possible Defect
Boom drifts when loaded and controls neutralized.	1. Hydraulic oil is bypassing at piston seal. 2. Main, secondary or extension cylinder holding valves are defective or contaminated.
Unusual noise in operation.	1. Cavitation is occurring due to low hydraulic oil supply. 2. Loading is excessive. 3. Restriction or collapse of suction lines has occurred. 4. Bypass settings on relief valve are too low. 5. Relief valve is damaged. 6. Valve closure is obstructed due to particle accumulation.
Outriggers fail to retract.	1. Control valve spool is inoperative. 2. Cylinder or check valve is defective. 3. Hydraulic lines are restricted or ruptured.
Outriggers yield or drift.	1. Hydraulic lines are ruptured. 2. Internal bypass is occurring in cylinders.
Boom jumps or bounces when lowered under load.	1. Check cylinder base side port of control valve and install orifice. See page 2-7.

PARTS

CYLINDER IDENTIFICATION

Every IMTCO 600 Crane has a cylinder identification tag as shown in Fig. C-1 attached to the mast assembly.

The numbers stamped will begin with the letters IM or SD. Parts lists for both types are included in this section. Be sure to specify in any parts request a complete letter-number sequence to insure correct identification.

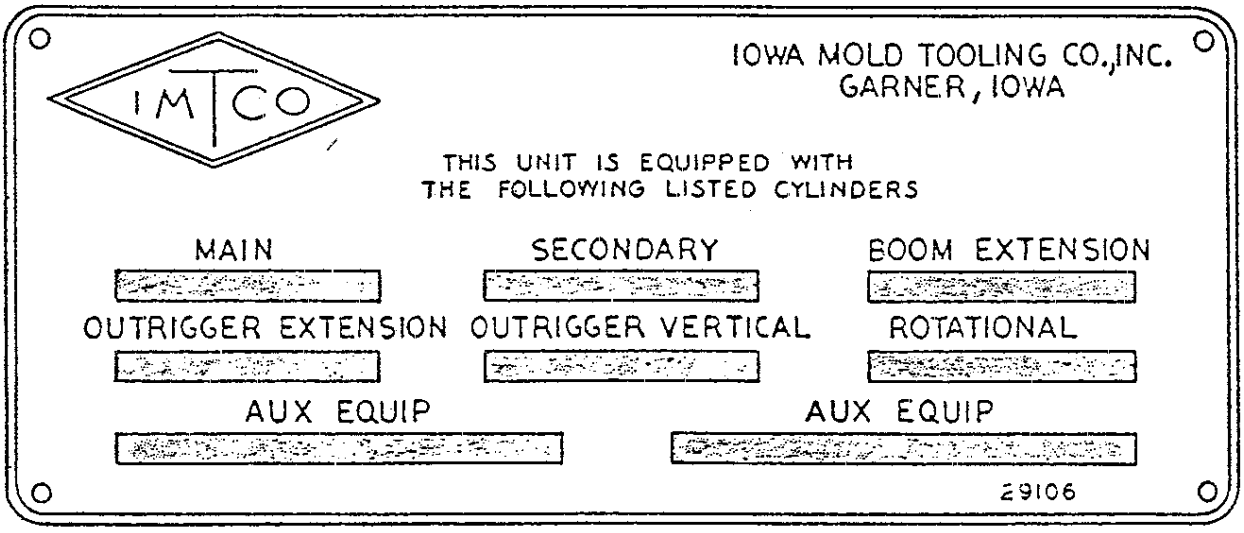


Fig. C-1

WARNING
Employ extreme care when replacing any main cylinder for the following reasons: 1. Early models have 30" (76.2 cm) stroke. 2. Most recent models have 31½" (80 cm) stroke and employ a bolt-on type holding valve. No two types of cylinders can be used in conjunction with one another without serious damage resulting.

IM STYLE

IMTCO P/N 3B099510

MAIN CYLINDER

Bore - 3½" Stroke - 31½" Rod Dia. - 2" Pin Size, Base End - 1½"

Pin Size, Rod End - 1½" c-c Closed - 44 3/4"

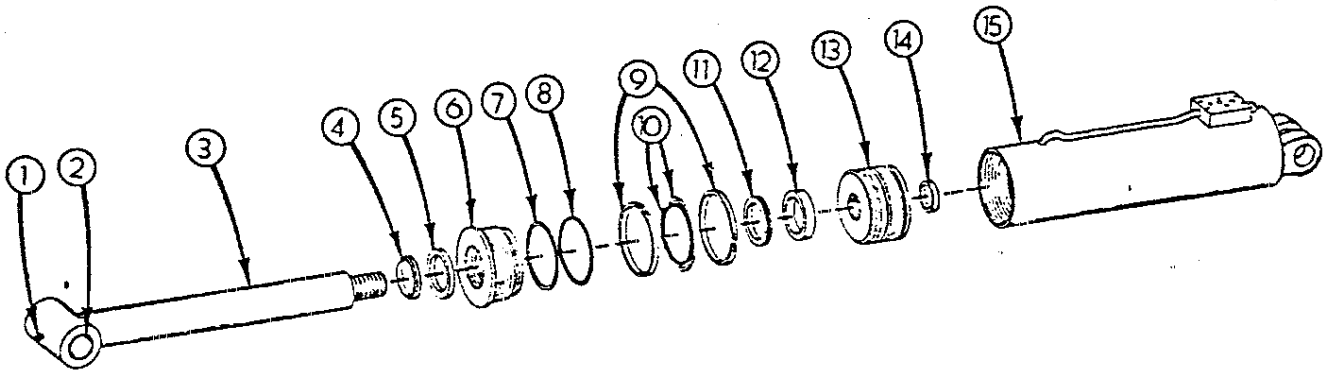


Fig. C-2

Ref. No.	IMTCO P/N	Description
1	72053506	Zerk
2	7BF81015	Bushing (2 Req'd)
3	4G099510	Rod Assy
4	7R14P020	Rod Wiper
5	7R546020	Rod Seal, Dynamic
6	6H035020	Head
7	7Q10P338	Back-Up Ring
8	7Q07X338	Head Static Seal
9	7T65I035	Piston Ring
10	7T66P035	Sirvon Ring, Dynamic Psn. Seal
	7Q07X151	Psn. O-Ring, Companion
11	6A025020	Wafer Lok
12	6C300020	Stop Tube
13	6I035125	Piston
14	7T61N125	Seal Lok
15	4B099510	Case Assy
	9C141620	Seal Kit (Not Shown)

IM STYLE

IMTCO P/N 3C103512

SECONDARY CYLINDER"

Bore - 4½" Stroke - 37½" Rod Dia. - 3" Pin Size, Base End - 1½"

Pin Size, Rod End - 1½" c-c Closed - 52 3/4"

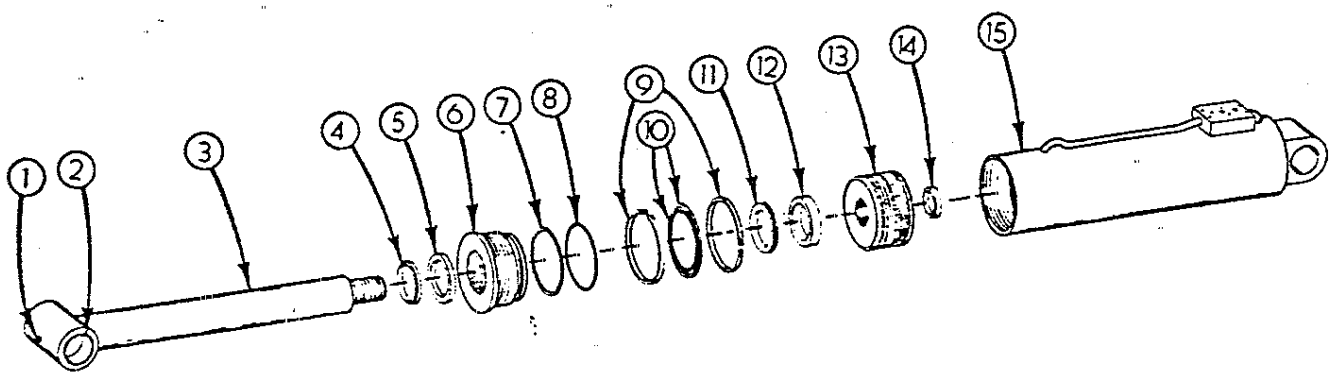


Fig. C-3

Ref. No.	IMTCO P/N	Description
1	72053506	Zerk
2	7BF81215	Bushing (2 Req'd)
3	4G103511	Rod Assy
4	7R14P030	Rod Wiper
5	7R546030	Rod Seal, Dynamic
6	6H045030	Head
7	7Q10P346	Back-Up Ring
8	7R546030	Head Static Seal
9	7T65I045	Piston Ring
10	7T66P045	Sirvon Ring, Dynamic Psn. Seal
	7Q07X155	Psn. O-Ring, Companion
11	6A025030	Wafer Lok
12	6C300030	Stop Tube
13	6I045143	Piston
14	7T61N143	Seal Lok
15	4C103511	Case Assy
	9C182423	Seal Kit (Not Shown)

IM STYLE

IMTCO P/N 3B105511

EXTENSION CYLINDER

Bore - 2½" Stroke - 40" Rod Dia. - 1½" Pin Size, Base End - 1"

Pin Size, Rod End - 1" c-c Closed - 58½"

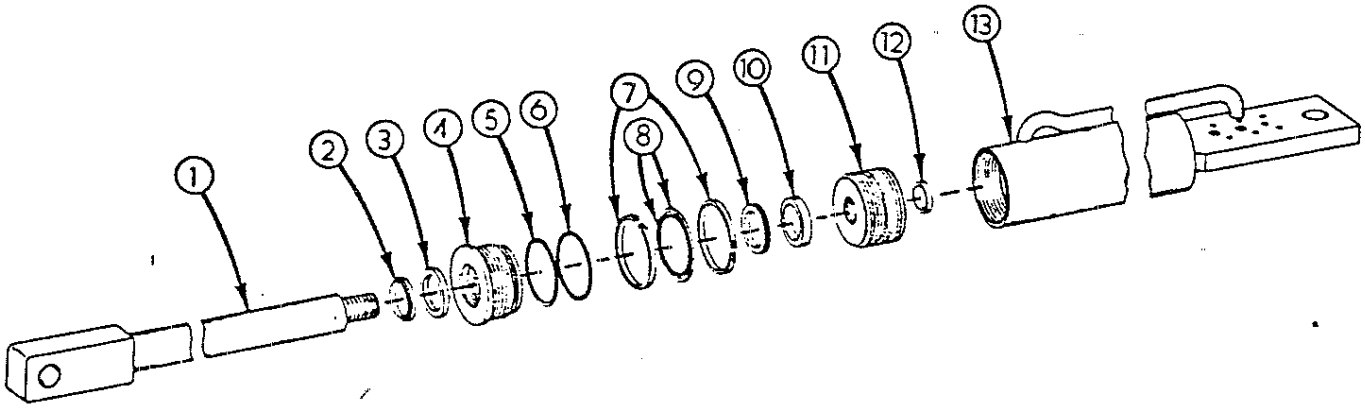


Fig. C-4

Ref. No.	IMTCO P/N	Description
1	4G105510	Rod Assy
2	7R14P015	Rod Wiper
3	7R546015	Rod Seal, Dynamic
4	6H025015	Head
5	7Q10P228	Back-Up Ring
6	7Q07X228	Head Static Seal
7	_____	Piston Ring
8	7T66P025	Sirvon Ring, Dynamic Psn. Seal
	7Q07X137	Psn. O-Ring, Companion
9	6A025015	Wafer Lok
10	6C075015	Stop Tube (3 Req'd)
11	6I025087	Piston
12	7T61N087	Seal Lok
13	4B105510	Case Assy
	9B101214	Seal Kit (Not Shown)

IM STYLE

IMTCO P/N 3B108512

STANDARD OUTRIGGER CYLINDER

Bore - 3" Stroke - 18" Rod Dia. - 2" c-c Closed - 30 3/4"

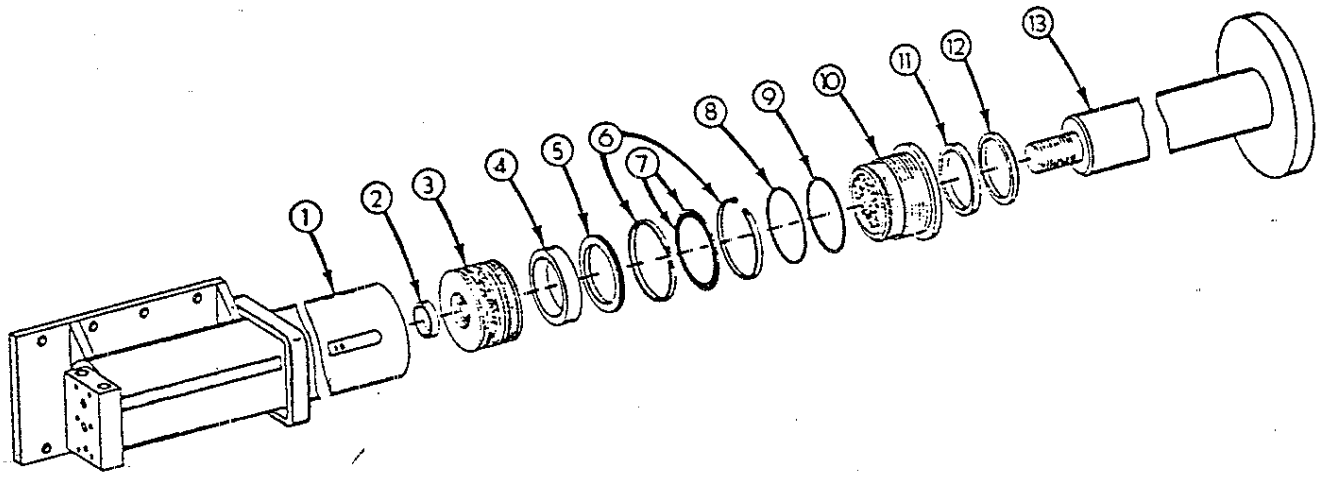


Fig. C-5

Ref. No.	IMTCO P/N	Description
1	4B108510	Case Assy
2	7T61N106	Seal Lok
3	6I030106	Piston
4	6C300020	Stop Tube
5	6A025020	Wafer Lok
6	7T65I030	Piston Ring
7	7T66P030	Sirvon Ring, Dynamic Psn. Seal
	7Q07X145	Psn. O-Ring, Companion
8	7Q07X334	Head Static Seal
9	7Q10P334	Back-Up Ring, Static
10	6H030020	Head
11	7R546020	Rod Seal, Dynamic
12	7R14P020	Rod Wiper
13	4G108510	Rod Assy
	9C121617	Seal Kit (Not Shown)

IM STYLE

IMTCO P/N 3B231413

OUTRIGGER CYLINDER

Bore - 4" Stroke - 21½" Rod Dia. - 3" c-c Closed - 30 3/8"

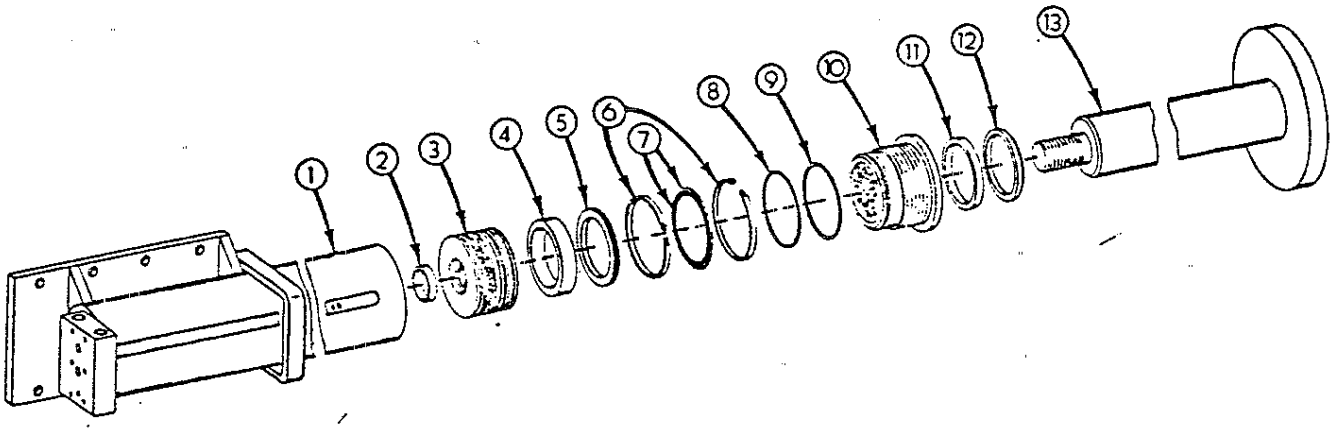


Fig. C-6

Ref. No.	IMTCO P/N	Description
1	4B231410	Case Assy
2	7T61N143	Seal Lok
3	6I040143	Piston
4	6C075030	Stop Tube
5	6A025030	Wafer Lok
6	7T65I040	Piston Ring
7	7T66P040	Sirvon Ring, Dynamic Psn. Seal
	7Q07X153	Psn. O-Ring, Companion
8	7Q07X342	Head Static Seal
9	7Q10P342	Back-Up Ring, Static
10	6H040030	Head
11	7R546030	Rod Seal, Dynamic
12	7R14P030	Rod Wiper
13	4G231410	Rod Assy
	9C162423	Seal Kit (Not Shown)

SD STYLE

IMTCO P/N 3BM12643

MAIN CYLINDER

Bore 3½" Stroke - 30" Rod Dia. - 2" Pin Size - 1½"

c-c Closed - 44 3/4"

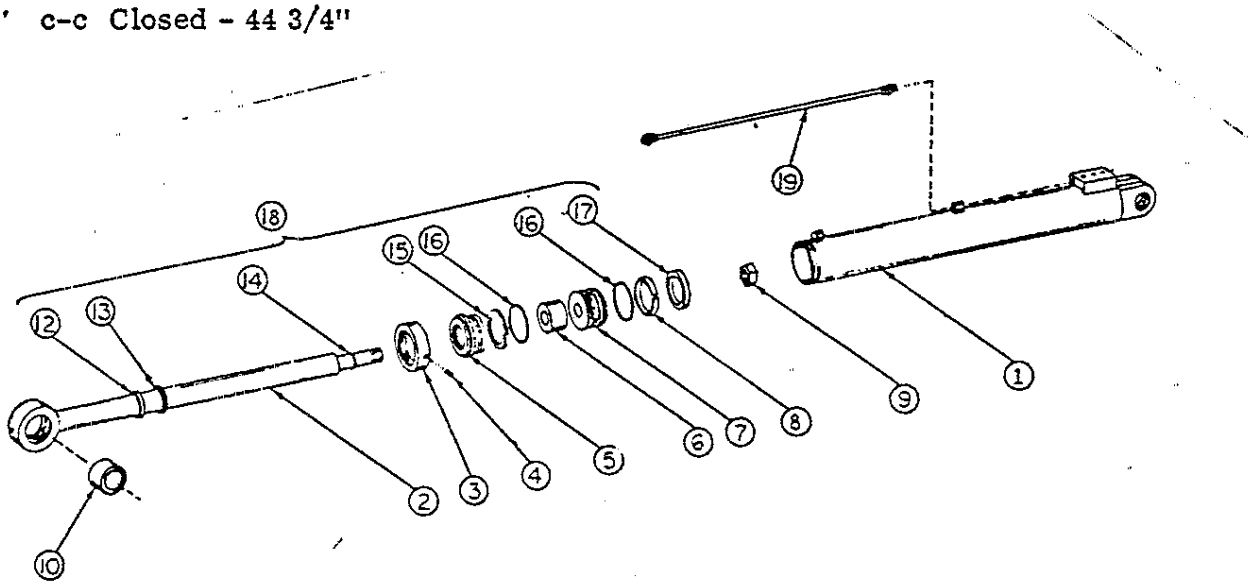


Fig. C-7

Ref. No.	IMTCO P/N	Description
1	4BM12643	Case Assy
2	4GM12643	Rod Assy
3	6DM12643	Gland Nut
4	72060556	Set Screw
5	6HM12643	Head
6	6CM12643	Stop Tube
7	6IM12643	Piston
8	7T2N4035	Wear Ring
9	6NM12643	1½" Nut
10	6BM12643	Bearing
12	7R14P020	Rod Wiper
13	7R336020	Rod Seal
14	7Q07X125	O-Ring
15	7Q10P338	Back-Up Ring
16	7Q07X338	O-Ring
17	7R346030	Seal
18	9CM12643	Seal Kit
19	4PM12643	Pipe Assy

SD STYLE

IMTCO P/N 3CM12517

SECONDARY CYLINDER

Bore - 4½" Stroke - 37¼" Rod Dia. - 2 3/4" Pin Size - 1½"

c-c Closed - 52 3/4"

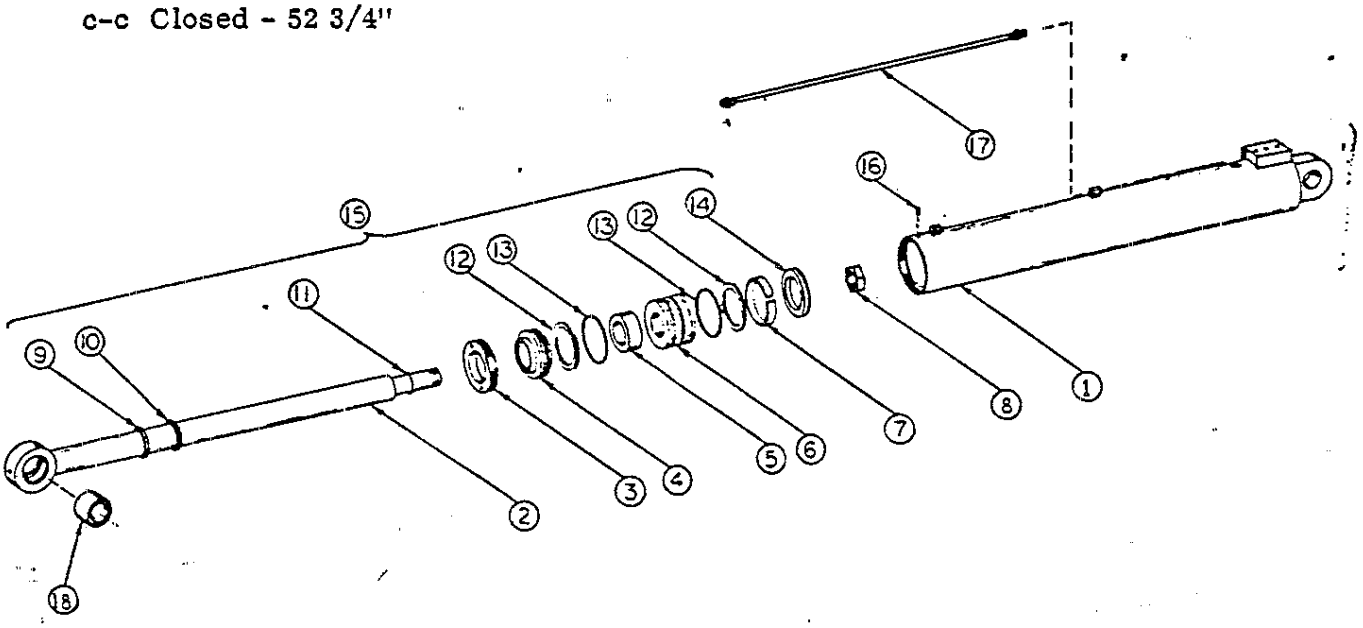


Fig. C-8

Ref. No.	IMTCO P/N	Description
1	4CM12517	Case Assy
2	4GM12517	Rod Assy
3	6DM12517	Gland Nut
4	6HM12517	Head
5	6CM12517	Stop Tube
6	6IM12517	Piston
7	7T2N4045	Wear Ring
8	6NM12643	1½" Nut
9	7R14P275	Rod Wiper
10	7R546027	Rod Seal
11	7Q07X129	O-Ring
12	7Q10P346	Back-Up Ring
13	7Q07X346	O-Ring
14	7R336041	Seal
15	9CM12517	Seal Kit
16	72060556	Set Screw
17	4PM12517	Pipe Assy
18	6BM12643	Bearing

SD STYLE

IMTCO P/N 3BM12671

EXTENSION CYLINDER

Bore - 2 3/8" Stroke - 40" Rod Dia. - 1 3/8" Pin Size - 3/4"

c-c Closed - 58½"

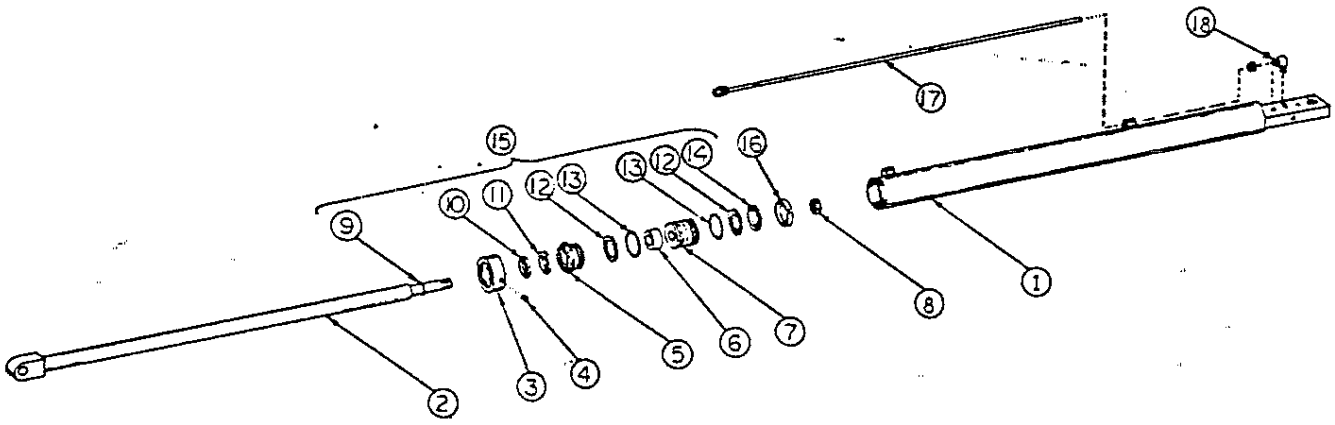


Fig. C-9

Ref. No.	IMTCO P/N	Description
1	4BM12671	Case Assy
2	4GM12671	Rod Assy
3	6DM12671	Gland Nut
4	72060556	Set Screw
5	6HM12671	Head
6	6CM12671	Stop Tube
7	6IM12671	Piston
8	6NM12671	1" Nut
9	7Q07X020	O-Ring
10	7R12I013	Rod Wiper
11	7R324013	Rod Seal
12	7Q10P227	Back-Up Ring
13	7Q07X227	O-Ring
14	7R336020	Seal
15	9CM12671	Seal Kit
16	7T2N4023	Wear Ring
17	4PM12671	Pipe Assy
18	72053515	3/8" Male Elbow

SD STYLE

IMTCO P/N 3BM12633 LH
3BM12634 RH

LH & RH OUTRIGGER CYLINDER

Bore - 3" Stroke - 18" Rod Dia. - 2¼" c-c Closed - 31½"

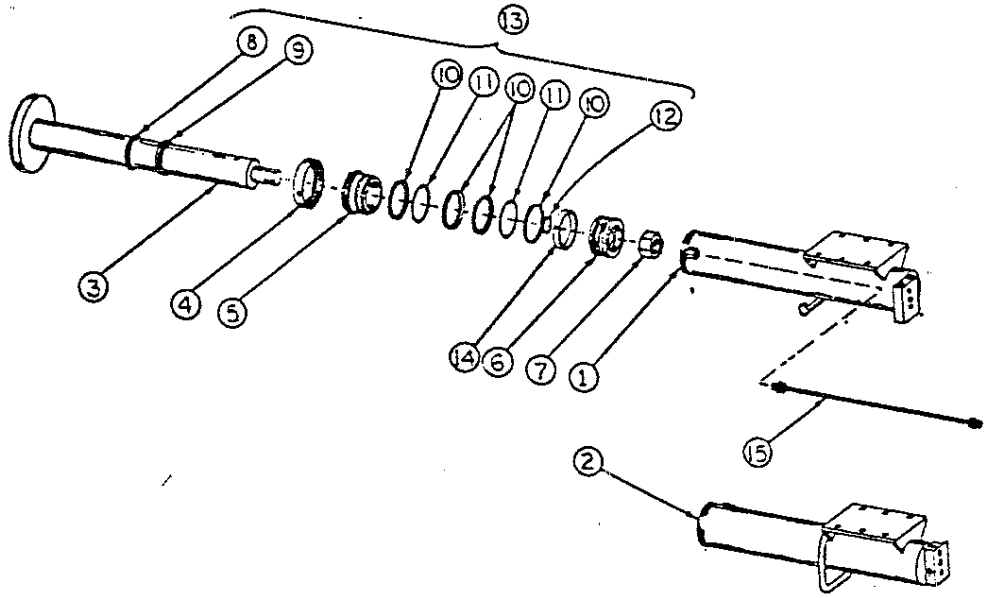


Fig. C-10

Ref. No.	IMTCO P/N	Description
1	4BM12633	LH Case Assy
2	4BM12634	RH Case Assy
3	4GM12634	Rod Assy
4	6DM12634	Gland Nut
4A	72060556	Set Screw
5	6HM12634	Head
6	6IM12634	Piston
7	6NM12643	1½" Nut
8	7R14P225	Rod Wiper
9	7R336022	Rod Seal
10	7Q10P334	Back-Up Ring
11	7Q07X334	O-Ring
12	7Q07X125	O-Ring
13	9CM12634	Seal Kit
14	7T2N4030	Wear Ring
15	4PM12634	Pipe Assy

SD STYLE

IMTCO P/N 3BM12627 LH
3BM12628 RH

OUTRIGGER CYLINDER, LH & RH

Bore - 4" Stroke - 21½" Rod Dia. - 3" c-c Closed - 31¼-31½"

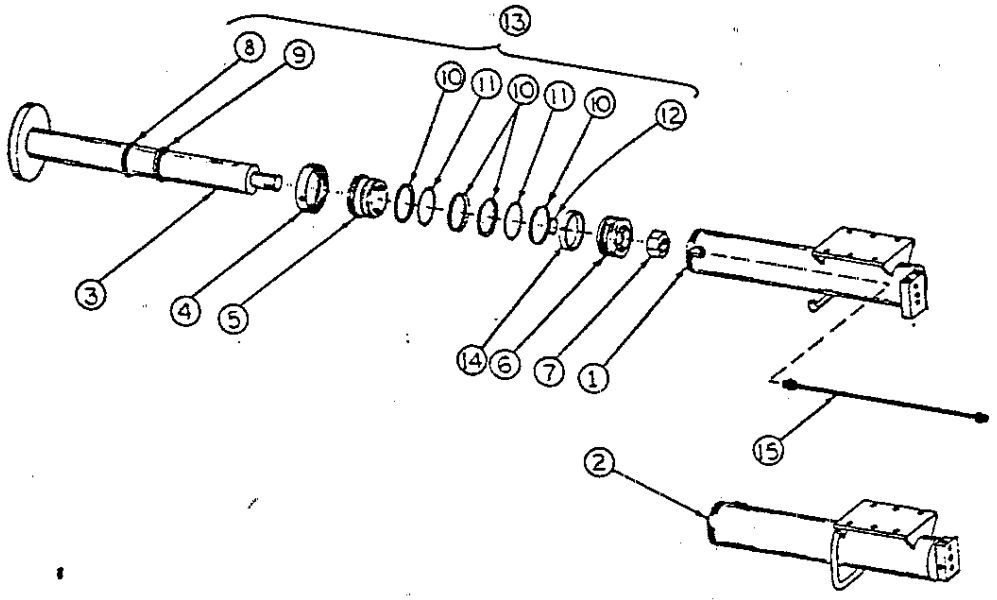


Fig. C-11

Ref. No.	IMTCO P/N	Description
1	4BM12627	LH Case Assy
2	4BM12628	RH Case Assy
3	4GM12628	Rod Assy
4	6DM12628	Gland Nut
4A	72060556	Set Screw
5	6HM12628	Head
6	6IM12628	Piston
7	6NM12643	1½" Nut
8	7R14P030	Wiper
9	7R336030	Seal
10	7Q10P342	Back-Up Ring
11	7Q07X342	O-Ring
12	7Q07X218	O-Ring
13	9CM12628	Seal Kit
14	7T2N4040	Piston Wear Ring
15	4PM12628	Pipe Assy

GRESEN CONTROL VALVE

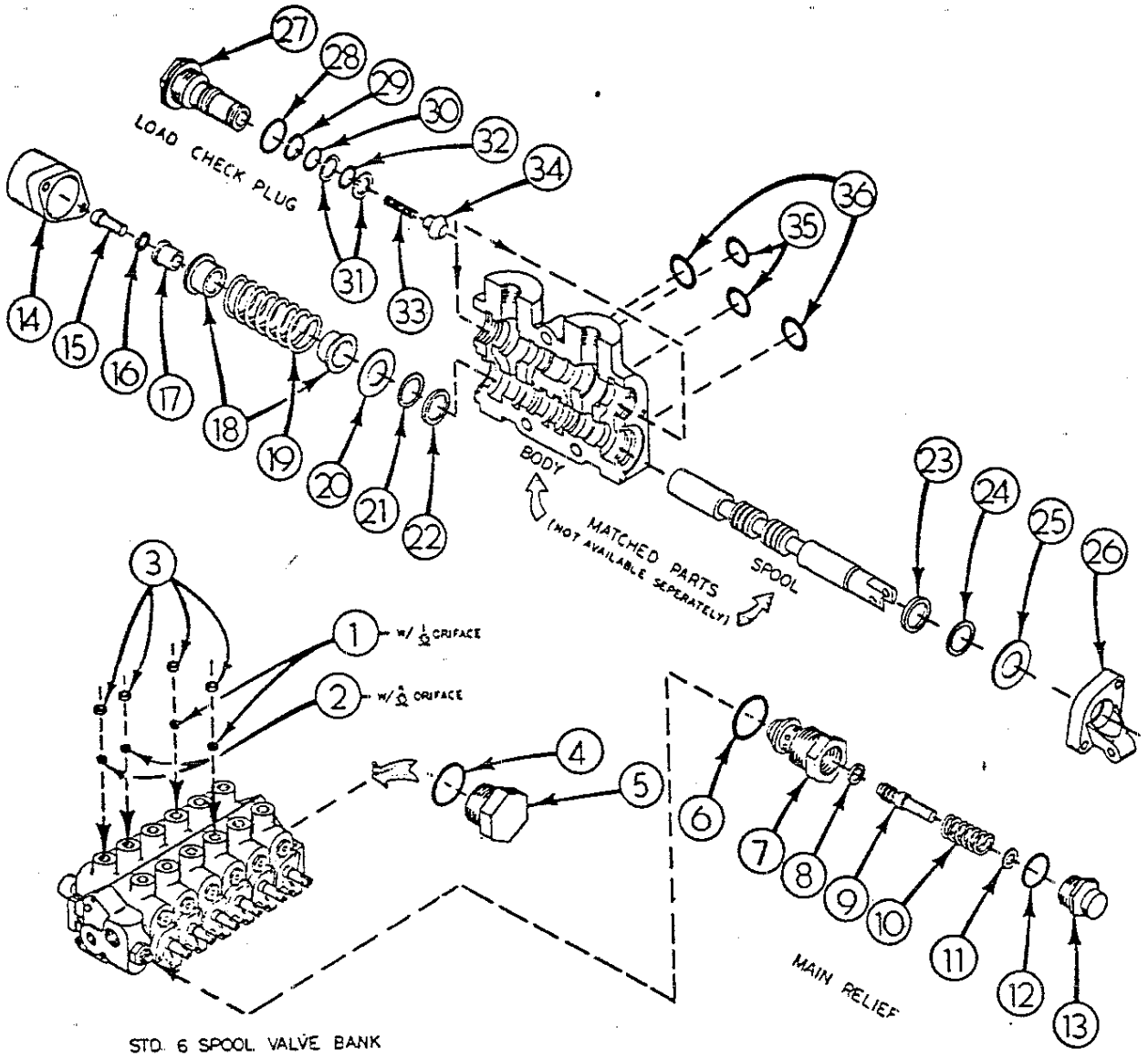


Fig. C-12

GRESEN CONTROL VALVE PARTS LIST

REF. NO.	IMTCO P/N	DESCRIPTION
1	73014691	1/32" Orifice
2	73014693	5/32" Orifice
3	73014692	Orifice Retainer
4	76039083	Seal, O-Ring
5	73014593	Std. Outlet Conversion Plug
6	76039082	Seal, O-Ring
7	73029056	Body
8	73034020	Ring, Piston
9	73014617	Poppet, Relief
10	73014588	Spring, 2201-3000 PSI Crack
11	73014618	Shim, .040"
	73014619	Shim, .020"
	73014620	Shim, .010"
12	76039070	Seal, O-Ring
13	73024101	Cap, Relief
14	73029051	Bonnet
15	72060831	Screw, Fill Hd. 5/16 x 3/4
16	72063055	Lock Washer
17	73014597	Collar, Spool
18	73014606	Collar, Spring
19	73014589	Spring, Return
20	73014591	Retainer, Plate Washer
21	73034022	Washer, Back-Up
22	76039087	Seal, Spool
23	76039087	Seal, Spool
24	73034022	Washer, Back-Up
25	73014591	Retainer, Plate Washer
26	73029053	Bracket, Die Cast
27	73029047	Plug, Lift Check
28	76039070	Seal, O-Ring
29	73014616	Washer, Back-Up Outer
30	76039071	Seal, O-Ring, Outer
31	73034019	Washer, Back-Up, Inner
32	76039072	Seal, O-Ring
33	73014587	Spring, Lift Check
34	73014602	Poppet, Lift Check
35	76039226	O-Ring
36	76039223	O-Ring

BASE ASSEMBLY WITH GEAR TRAIN ROTATION, COMPLETE

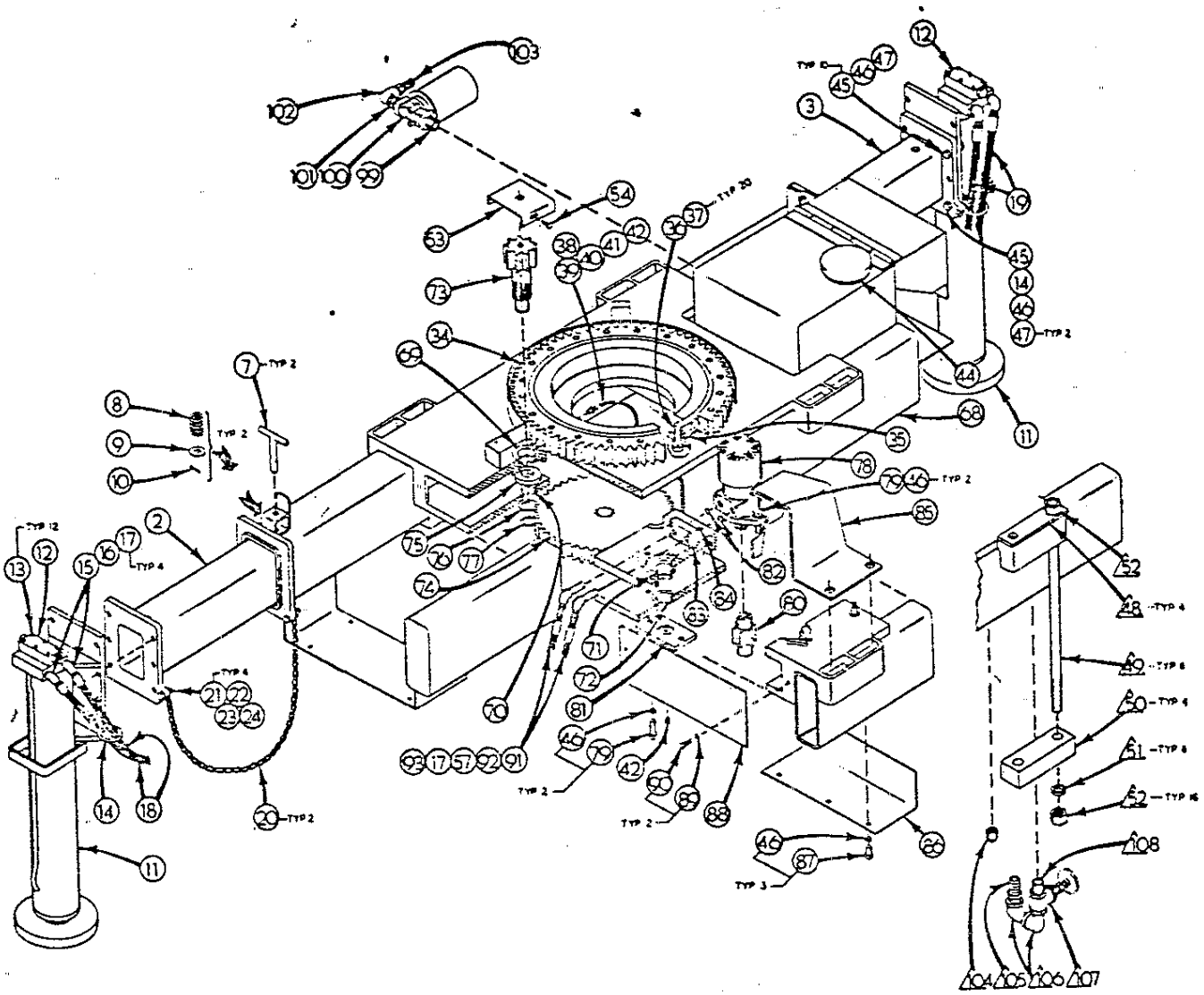


Fig. C-13

BASE ASSEMBLY WITH GEAR TRAIN ROTATION, COMPLETE

IMTCO P/N 41070047

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
2	52070052	O.R. Arm - RH	1
3	52070051	O.R. Arm - LH	1
7	52070138	Pin	2
8	60010351	Spring	2
9	72063007	5/8" Washer	2
10	72066185	5/32 x 1" Cotter Pin	2
11	3B108512 **	Outrigger Cylinder, 3" Bore	2
12	73054004	Holding Valve	2
13	72060710	$\frac{1}{4}$-20 x 1 3/4 Soc HD Cap Screw	12
14	52070140	Hose Holder	2
15	72053563	3/8 - 45° St. Elbow	4
16	72053642	3/8"M / 3/8"F Pipe Swivel	4
17	72531155	3/8" Swage Hose Fitting	4
18	60035123	3/8" Hose 120" Lg.	2
19	60035118	3/8" Hose 72" Lg.	2
20	60010239	Chain	2
21	72060047	3/8-16 x $1\frac{1}{4}$" Cap Screw	4
22	72063003	3/8" Washer	4
23	72063051	3/8" Lock Washer	4
24	72062002	3/8-16 Nut	4
34	71056001	Turn Table Gear-Bearing	1
35	60101760	Spacer	1
36	72060151	5/8-11 x 2 Gr 8 Cap Screw	20
37	72066427	Hardened Spring Lock Washer	20
38	72531826	1/4-1/8 Reducer Bushing	1
39	73073101	Grease Fitting Extension Hose	1
40	72063003	3/8" Wrt Washer	1
41	72053301	1/8" Pipe Coupling	1
42	72053508	1/8" Zerk	1
43	73024133	Fill Screen (Not Shown)	1
44	73014671	Fill Cap	1
45	72060095	$\frac{1}{2}$-13 x 2 Gr 8 Cap Screw	12
46	72063053	1/2" Lock Washer	16
47	72062004	$\frac{1}{2}$-13 Hex Nut	12
48	60101864 *	Plate	4
49	71014051 *	Stud	8
50	60010354 *	Clamp Block	4
51	72063058 *	1" Lock Washer	8
52	72062009 *	1" - 8 Hex Nut	16
53	60010235	Cover	1
54	72060833	5/16-18 Self Tapping Cap Screw	2
57	72053642	3/8"M / 3/8"F Pipe Swivel	2
68	51070048	Base Assy Gear Train Rotation (Incls. 69, 70, 71, 72 & 80)	1

BASE ASSEMBLY WITH GEAR TRAIN ROTATION, COMPLETE

IMTCO P/N 41070047

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
69	60024118	Bushing	1
70	60020081	Bushing	1
71	60024120	Bushing	1
72	60024121	Bushing	1
73	71056010	Pinion Gear	1
74	71056012	Intermediate Gear	1
75	60010843	Spacer	1
76	72063035	1¼-10 Ga Machy Washer	1
77	72066084	Retaining Ring 5100-125	1
78	73051004	Hydraulic Motor	1
79	72060092	½-13 x 1¼ Cap Screw	4
80	71056011	Drive Gear	1
81	60010844	Plate	1
82	76039196	O-Ring	2
83	60101481A	Adaptor	1
84	72060734	5/16-18 x 1½ Soc Hd Cap Screw	4
85	52070699	Guard	1
86	60101881C	Gear Guard	1
87	72060091	½-13 x 1 Cap Screw	3
88	60101882	Cover Plate	1
89	72063050	5/16" Lock Washer	2
90	72060023	5/16-18 x 3/4 Cap Screw	2
91	72053051	3/8 x 2 Pipe Nipple	2
92	72531100	3/8" - 45° Elbow	2
93	60035086	3/8" Hose 54" Lg.	2
99	72053141	3/4" Close Nipple	1
100	73052000	Return Filter	1
101	72531833	3/4 - 1/2 Reducer Bushing	1
102	72531133	½-90° St. Elbow	1
103	72053457	½" Barbed Nipple	1
104	73052001	3/4" NPT Magnetic Plug	1
105	72531549 *	1" Steel Barbed Nipple	1
106	72053286 *	1" - 90° Blk St. Elbow	2
107	73054001 *	1" Gate Valve	1
108	72053185 *	1" Close Nipple	1

NOTE: * These parts are included in Installation Kit.

** #3B231413 Cylinder w/ 4" bore is optional.

4000 LB. WINCH ASSEMBLY

IMTCO P/N 71073027

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
1	72060731	5/16-18 x 3/4" Soc. HD Cap Screw	6
2	70014724	Gear Case Cover	1
3	76039262	.002" Cover Gasket, Red	AR
	76039263	.005" Cover Gasket, Blue	AR
	76039264	.010" Cover Gasket, Brown	AR
4	70055031	Brg. Cup, #LM29710	3
5	70055032	Brg. Cone, #LM29749	3
6	72060908	3/8-16 x 3/4" Nylok Set Screw Soc. HD	2
7	70056066	Bronze Worm Gear 27:1 Ratio	1
8	60014725	3/8 sq. x 1-7/16 Key	2
9	70014726	Shaft	1
10	70014727	Gear Case	1
11	72053413	3/8" NPT Pipe Plug	2
12	76039268	Oil Seal	1
13	70014728	End Housing	1
14	70055035	Brg. Sealmaster SL 23	1
15	72060907	Set Screw 5/16-24 x 1/4"	Ref.
16	70055033	Brg. Cup, #21212	1
17	70055034	Brg. Cone, #21075	1
18	70056067	Worm Shaft	1
19	70014729	Spacer	1
20	76039265	.002" Motor Gasket, Red	AR
	76039266	.005" Motor Gasket, Blue	AR
	76039267	.010" Motor Gasket, Brown	AR
21	72066283	Woodruff Key 1/4" x 1	1
22	73051020	D5G Char-Lynn Motor	1
23	72063052	7/16" Lock Washer	2
24	72060775	Socket HD Cap Screw	2

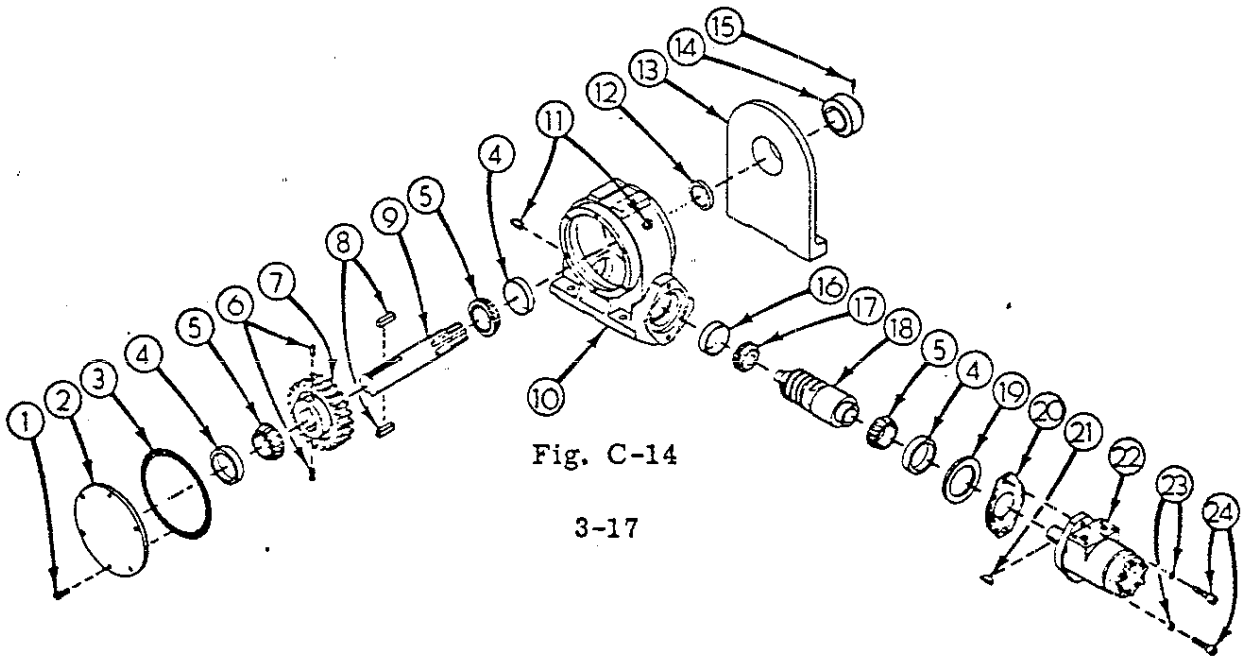


Fig. C-14

MAST ASSEMBLY, COMPLETE
AND MAIN BOOM ASSEMBLY, COMPLETE

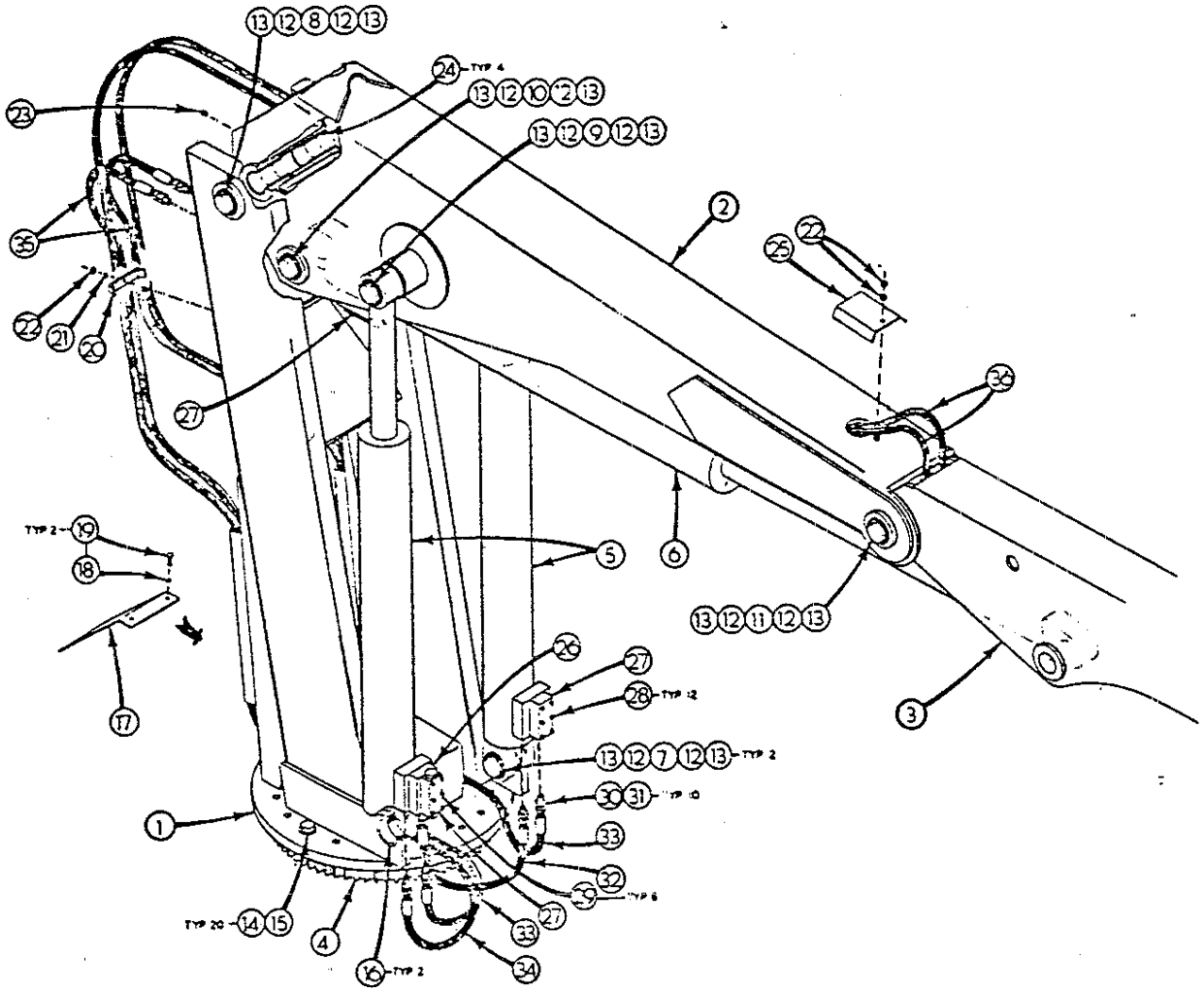


Fig. C-15

MAST ASSEMBLY, COMPLETE IMTCO P/N 41070345
AND MAIN BOOM ASSEMBLY, COMPLETE IMTCO P/N 41070346

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
1	52070365 *	Mast Assy	1
2	51070357	Main Boom Assy	1
3	51070625 **	Secondary Boom Assy	Ref.
4	71056001	Turn Table Gear-Bearing	Ref.
5	3B099510	Main Cylinder	2
6	3C103512	Secondary Cylinder	1
7	60010830	Pin	2
8	60010824	Pin, Main/Mast	1
9	60010822	Pin	1
10	60010005	Pin, Sec. Cylinder	1
11	60010821	Pin, Main/Secondary	1
12	72063037	1½ x 10 Ga Machy Washer	12
13	72066132	Retaining Ring 5160-150	12
14	72060151	5/8-11 x 2 Gr 8 Cap Screw	18
15	72066427	Hardened Spring Lock Washer	18
16	60020040	Bushing	2
17	60010302	Shield	1
18	72063050	5/16" Lock Washer	2
19	72060023	5/16-18 x 3/4" Cap Screw	2
20	60010118	Hose Clamp	1
21	72063051	3/8" Lock Washer	1
22	72062002	3/8-16 Hex Nut	1
23	72053508	1/8" NPT Zerk	1
24	7BF82020	Bushing	4
25	60010123	Cover	1
26	60025011	Cross Over Manifold	1
27	73054004	Holding Valve	3
28	72060710	¼-20 x 1 3/4 Soc HD Cap Screw	18
29	72060714	¼-20 x 2 3/4 Soc HD Cap Screw	6
30	72053642	3/8"M / 3/8"F Pipe Swivel	4
31	72031155	3/8" Swage Hose Fitting	10
32	60035120	3/8" Hose 22" Lg.	1
33	60035120	3/8" Hose 22" Lg.	2
34	60035132	3/8" Hose 64" Lg. (Cyl Base to VB)	1
35	60035121	3/8" Hose 132" Lg.	2
36	60035122	3/8" Hose 240" Lg.	2

NOTE: * Use 51070698 for models 619 & 623.
** Use 51070356 for models 619 & 623.

SECONDARY BOOM ASSEMBLY, COMPLETE

AND EXTENSION BOOM ASSEMBLY, COMPLETE

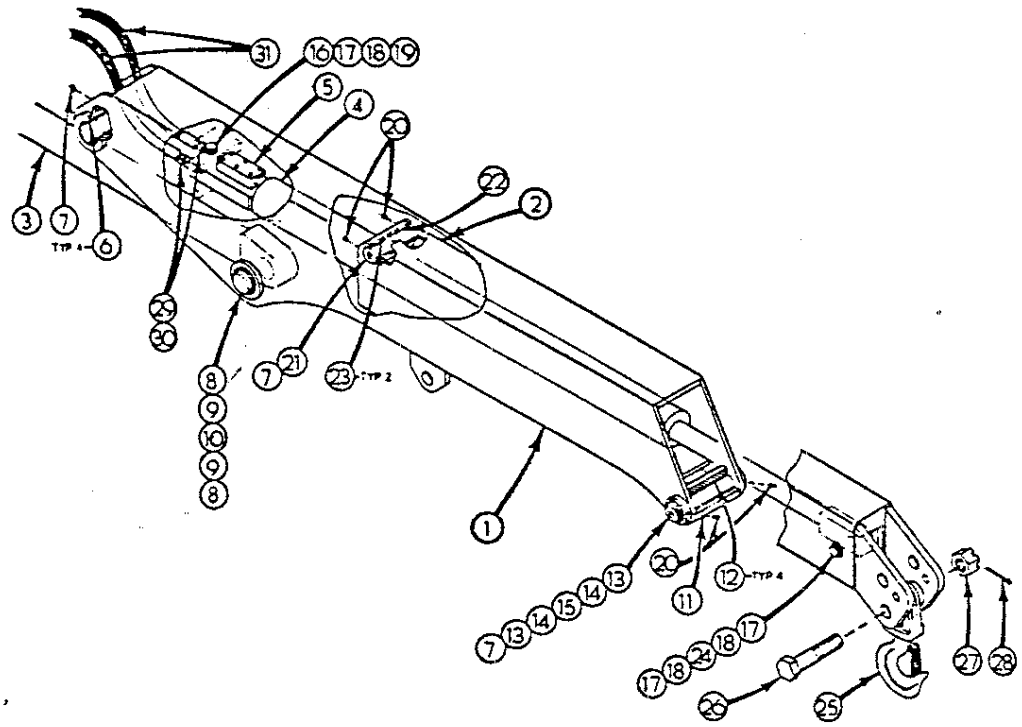


Fig. C-16

SECONDARY BOOM ASSEMBLY, COMPLETE — IMTCO P/N 41070347
AND EXTENSION BOOM ASSEMBLY, COMPLETE — IMTCO P/N 41070348
(Model 615)

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
1	51070625	Secondary Boom Assy	1
2	51070626	Extension Boom Assy	1
3	3C103512	Secondary Cylinder	Ref.
4	3B105511	Extension Cylinder	1
5	73054004	Holding Valve	1
6	7BF81220	Bushing	4
7	72053508	1/8" NPT Zerk	3
8	72066132	Retaining Ring 5160-150	2
9	72063037	1½" x 10 Ga Machy Washer	2
10	60101468	Pin	1
11	51010784	Roller	1
12	7BF80715	Bushing	4
13	72066132	Retaining Ring 5160-150	2
14	72063034	1" x 10 Ga Machy Washer	2
15	60010783	Pin, Sec. Roller	1
16	60101905	Pin, Ext. Cyl., Base End	1
17	72063034	1" x 10 Ga Machy Washer	3
18	72066125	Retaining Ring 5160-98	3
19	72066194	3/16 x 1½" Cotter Pin	1
20	72060832	5/16-18 x 3/4" Set Screw	4
21	60101045	Pin, Ext. Roller	1
22	60010172	Roller, Ext	1
23	60020037	Bushing	1
24	60101906	Pin, Ext. Cyl., Rod Eye	1
25	71073016	Hook Assembly	1
26	60102663	Bolt	1
27	72062082	1¼ - 7 Castellated Nut	1
28	72066197	3/16 x 2½" Cotter Pin	1
29	72053642	3/8" M / 3/8" F Pipe Swivel	2
30	72531155	3/8" Swage Hose Fitting	2
31	60035122	3/8" Hose 240" Lg.	2

SECONDARY BOOM ASSEMBLY, COMPLETE
AND EXTENSION BOOM ASSEMBLY, COMPLETE
(Model 619)

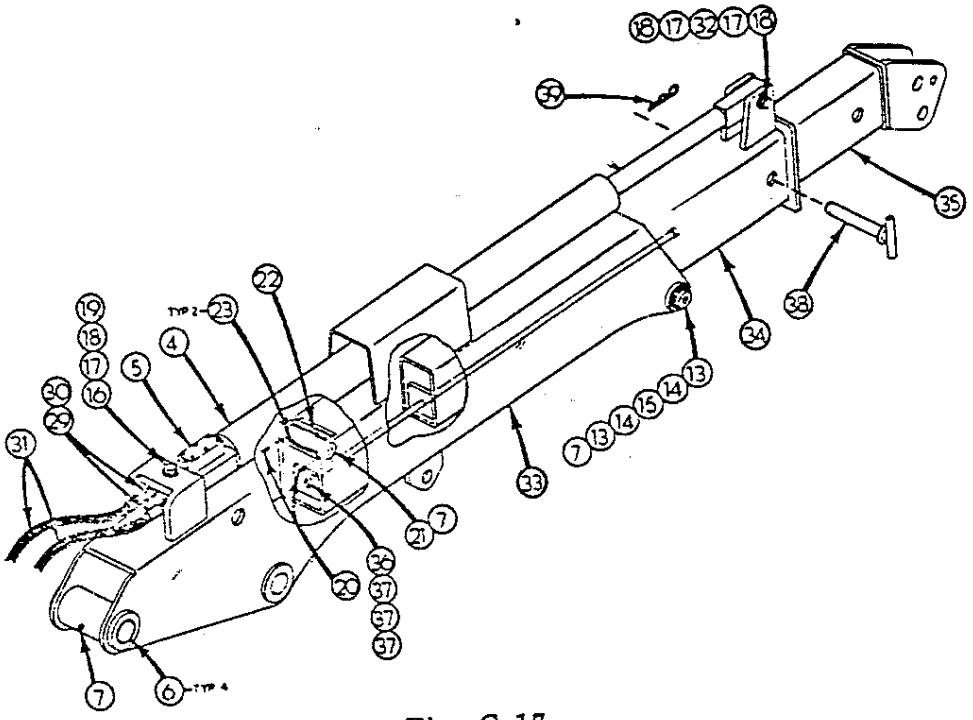


Fig. C-17

NOTE: To convert a Model 615 crane into a Model 619 crane, purchase the following parts:

1. One each of #16, 19, 21, 22, 32, 34, 35, 36, 38, and 39.
2. Two of # 23.
3. Three each of #17, 18 and 37.
4. Four of #20.
5. One each of Lower cylinder anchor assembly and boom support bracket.

It is necessary to weld the last two items onto the Secondary Boom; relocate the Extension Cylinder from inside to outside as illustrated, and install new booms.

SECONDARY BOOM ASSEMBLY, COMPLETE IMTCO P/N 41070350

AND EXTENSION BOOM ASSEMBLY, COMPLETE IMTCO P/N 41070351

(Model 619)

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
3	3C103512	Secondary Cylinder	Ref.
4	3B105511	Extension Cylinder	1
5	73054004	Holding Valve	1
6	7BF81220	Bushing	4
7	72053508	1/8" NPT Zerk	3
8	72066132	Retaining Ring 5160-150	2
9	72063037	1½" x 10 Ga Machy Washer	2
10	60101468	Pin	1
11	60010784	Roller	1
12	7BF80715	Bushing	4
13	72066132	Retaining Ring 5160-150	2
14	72063034	1" x 10 Ga Machy Washer	2
15	60010783	Pin, Sec. Roller	1
16	60101905	Pin, Ext. Cyl., Base End	1
17	72063034	1" x 10 Ga Machy Washer	3
18	72066125	Retaining Ring 5160-98	3
19	72066194	3/16 x 1½" Cotter Pin	1
20	72060332	5/16-18 x 3/4" Set Screw	4
21	60101045	Pin	1
22	60010172	Roller	1
23	60020037	Bushing	2
25	71073016	Hook Assy	1
26	60102663	Bolt	1
27	72062082	1¼ - 7 Castellated Nut	1
28	72066197	3/16 x 2½ Cotter Pin	1
29	72053642	3/8"M / 3/8"F Pipe Swivel	2
30	72531155	3/8" Swage Hose Fitting	2
31	60035122	3/8" Hose 240" Lg.	2
32	60101907	Pin, Ext. Cyl., Rod End	1
33	51070356	Secondary Boom Assy	1
34	51070353	1st Stage Extension Boom Assy	1
35	52070711	19' Stinger Assy	1
36	60010265	Stud	1
37	72062004	½" - 13 Hex Nut	3
38	52070152	Pin	1
39	72066145	3/16" Hairpin	1

SECONDARY BOOM ASSEMBLY, COMPLETE
AND EXTENSION BOOM ASSEMBLY, COMPLETE
(Model 623)

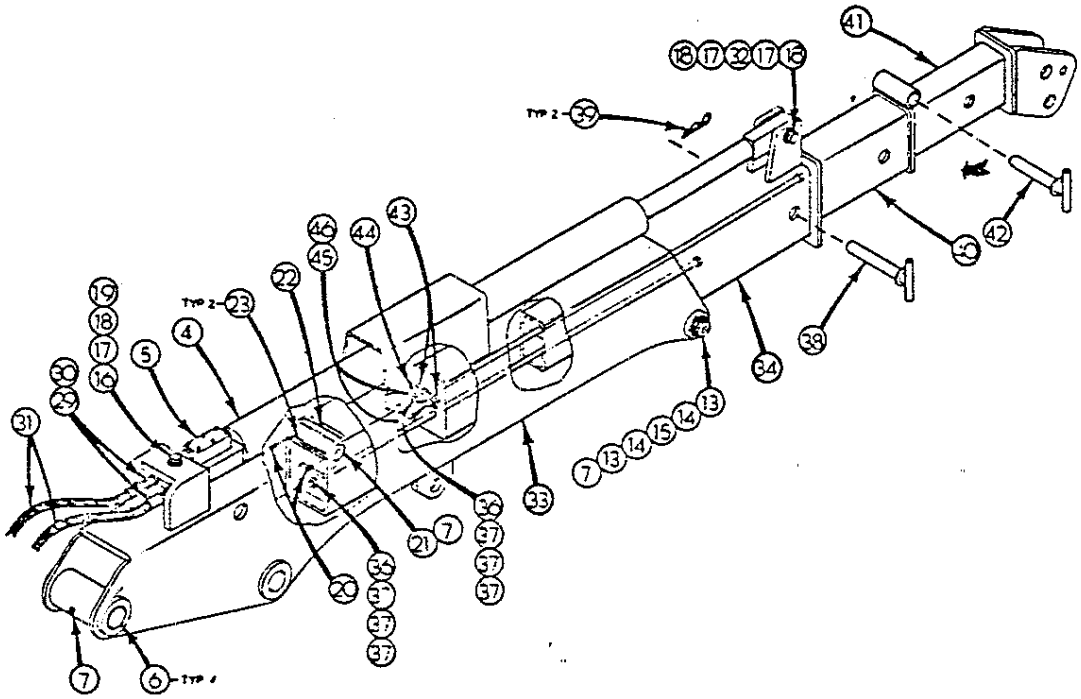


Fig. C-18

NOTE: To convert a Model 619 crane into a Model 623 crane, purchase the following parts:
1. One each of #39, 40, 41 and 42.

Remove Second Extension Boom and replace with the above listed parts.

To convert a Model 615 crane into a Model 623 crane, refer to page 3-22 for general information and purchase the following parts:
1. B/M page 3-25, items #16 through # 46 less items #29, 30 and 31.
2. One each of Lower Cylinder Anchor Assembly and Boom Support Bracket.

SECONDARY BOOM ASSEMBLY, COMPLETE IMTCO P/N 41070350
AND EXTENSION BOOM ASSEMBLY, COMPLETE IMTCO P/N 41070352
(Model 623)

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
3	3C103512	Secondary Cylinder	Ref.
4	3B105511	Extension Cylinder	1
5	73054004	Holding Valve	1
6	7BF81220	Bushing	4
7	72053508	1/8" NPT Zerk	3
8	72066132	Retaining Ring 5160-150	2
9	72063037	1½" x 10 Ga Machy Washer	2
10	60101468	Pin	1
11	60010784	Roller	1
12	7BF80715	Bushing	4
13	72066132	Retaining Ring 5160-150	2
14	72063034	1" x 10 Ga Machy Washer	2
15	60010783	Pin, Sec. Roller	1
16	60101905	Pin, Ext. Cyl., Base End	1
17	72063034	1" x 10 Ga Machy Washer	3
18	72066125	Retaining Ring 5160-98	3
19	72066194	3/16 x 1½ Cotter Pin	1
20	72060832	5/16-18 x 3/4 Set Screw	4
21	60101045	Pin, Ext. Roller	1
22	60010172	Roller	1
23	60020037	Bushing	2
25	71073016	Hook Assembly	1
26	60102663	Bolt	1
27	72062082	1¼ - 7 Castellated Nut	1
28	72066197	3/16 x 2½ Cotter Pin	1
29	72053642	3/8"M / 3/8"F Pipe Swivel	2
30	72531155	3/8" Swage Hose Fitting	2
31	60035122	3/8" Hose 240" Lg.	2
32	60101907	Pin, Ext. Cyl., Rod Eye	1
33	51070356	Secondary Boom Assy	1
34	51070353	1st Stage Extension Boom Assy	1
36	60010265	Stud	2
37	72062004	½-13 Hex Nut	6
38	52070152	Pin	1
39	72066145	3/16 Hair Pin	2
40	52070354	2nd Stage Extension Boom Assy	1
41	52070355	23' Stinger Assy	1
42	52070151	Pin	1
43	60010264	Spacer	1
44	60010263	Plate	1
45	72060047	3/8" - 16 x 1¼" Cap Screw	2
46	72063051	3/8" Lock Washer	2

CONTROL ASSEMBLY
(Standard 6 Spool System)

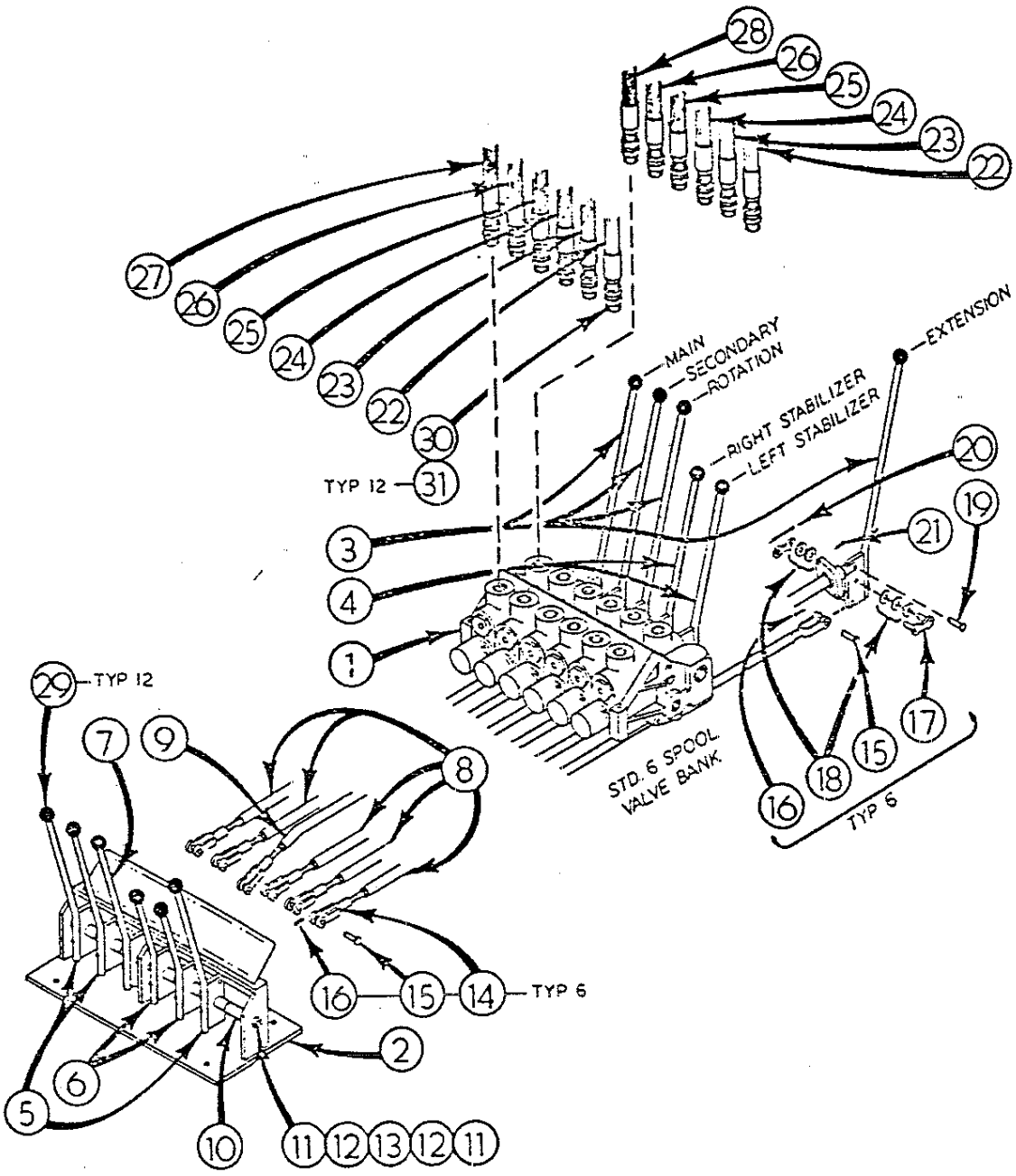


Fig. C-19

WINCH ASSEMBLY

IMTCO P/N 50070141

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
1	52701220	Secondary Boom Assy	1
2	52070626	Extension Boom Assy (Standard 615 Extension Shown)	1
3	60101327	Roller	1
4	60101328	Pin	1
5	72066132	Retaining Ring 5160-150	2
6	72063037	1½ x 10 Ga Machy Washer	2
7	60010118	Hose Clamp	1
8	72063051	3/8 " Lock Washer	1
9	72062002	3/8 -16 Hex Nut	1
10	72053508	1/8" NPT Zerk	2
11	60010868	Spacer	2
12	71073027	4000 lb. Winch	1
13	73051001	Hydraulic Motor	Ref.
14	52070302	Winch Drum	1
15	60010869	Stud	4
16	72060797	½-13 x 2½ Soc HD Cap Screw	2
17	72063053	½" Lock Washer	6
18	72062004	½-13 Hex Nut	4
19	60102663	Bolt	1
20	72062082	¼-7 Castellated Nut	1
21	72066197	3/16 x 2½ Cotter Pin	1
22	71073016	Hook Assembly	1
23	52070704	Sheave Yoke	1
24	52070705	Pin	1
25	72066145	3/16" Hairpin	1
26	60101504	Sheave	1
27	60024123	Bushing	1
28	72055005	Optional Roller Bearing	Ref.
29	60058010	Cable 3/8 IWRC x 55' Lg.	1
30	72058074	Cable Clamp	2
31	60011219	Down Haul Weight	1
32	52070851	Pin	1
33	72063034	1 x 10 Ga Machy Washer	1
34	72066197	3/16 x 1½ Cotter Pin	1
35	72058015	Wedge Socket	1
36	71073079	3 Ton Swivel Hook	1
37	73054006	Pilot Operated Check Valve	1
38	72532138	3/8 - 1/4 Reducer Bushing	1
39	72053563	1/4 - 45° St. Elbow	2
40	72053545	1/4" Male Connector	2
41	72053052	3/8" x 2½ Nipple	1
42	72531829	1/2 - 3/8 Reducer Bushing	2

WINCH ASSEMBLY

IMTCO P/N 50070141

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
43	72053723	3/8" Hex Nipple	1
44	72053611	3/8" Tee	1
45	72053642	3/8"M / 3/8"F Pipe Swivel	2
46	60101420	U Tube	1
47	72531155	3/8" Swage Hose Fitting	2
48	60035010	3/8" Hose 23½' Lg.	2
49	73054009	4-Way Tandem Valve	1
50	71039168	Decal-LH Control	1
51	52070168	Long Valve Lever	1
52	71039096	Black Ball Knob	2
53	72066337	Pin	1
54	72066336	Cotter Pin	1
55	52070165	Link	1
56	72066168	3/32" x 3/4" Cotter Pin	2
57	72066338	Pin	2
58	72063001	1/4" Washer	5
59	72058003	Connecting Link	1
60	76039228	O-Ring	2
61	76039226	O-Ring	2
62	73014603	LH Cover	Ref.
63	60014596	Stud	3
64	72062077	Nut	Ref.
65	72058002	Clevis	1
66	52070163	Long Control Lever	1
67	71039169	RH Control Decal	1
68	72531100	3/8" - 90° Elbow	1
69	72531132	3/8" - 90° St. Elbow	1
70	72060591	7/16-14 x 3/4 HH Set Screw	1
71	72063036	1½ x 14 Ga Machy Washer	1
72	7C918614	Bushing	4

STANDARD HYDRAULIC SCHEMATIC

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
1	3B099510		Main Cylinder	2
2	3C103512		Secondary Cylinder	1
3	73051001		Rotation Hydraulic Motor	1
4	3B108512	**	Outrigger Cylinder, 3" Bore	2
5	3B105511		Extension Cylinder	1
6	73054004		Holding Valve	5
7	60010710		Metering Block	1
8	60101481		Adapter	1
9	52701221		Reservoir (Part of Base Assy)	Ref.
10	73052000		Return Filter	1
11	73052007	*	Suction Filter	1
12	73051000	*	Pump (9 Gal Opt.)	1
13	73073011		CP 4-Way Gresen 6 Spool Valve Bank	1
14	60035120		3/8" x 22" Lg. Hose	2
15	60035120		3/8" x 22" Lg. Hose	1
16	60035119		3/8" x 54" Lg. Hose	1
17	60035132		3/8" x 64" Lg. Hose	2
18	60035121		3/8" x 132" Lg. Hose	2
19	60035119		3/8" x 54" Lg. Hose	2
20	60035118		3/8" x 72" Lg. Hose	2
21	60035123		3/8" x 120" Lg. Hose	2
22	60035122		3/8" x 240" Lg. Hose	2
23	72053642		3/8"M / 3/8"F Pipe Swivel	26
24	72531181		3/8" Swage Hose Fitting	30
25	72053412		1/4" Pipe Plug	1
26	72531830		1/2" - 1/4" Reducer Bushing	3
27	72531131		1/4" - 90° St. Elbow	2
28	72053641		1/4"M / 3/8"F Pipe Swivel	2
29	72053723		3/8"M / 3/8"M Hex Nipple	1
30	72531100		3/8" - 90° Elbow	1
31	72531132		3/8" - 90° St. Elbow	3
32	72053611		3/8" Tee	1
33	72052001		3/4" NPT Mag. Plug	1
34	72053049		3/4" Close Nipple	1
35	72531833		3/4" - 1/2" Reducer Bushing	2
36	72531133		1/2" - 90° St. Elbow	1
37	72053457		1/2" Barbed Nipple	2
38	72053185	*	1" Close Nipple	1
39	73054001	*	1" Gate Valve	1
40	72531549	*	1" Barbed Nipple	3
41	72053377	*	1¼ - 1" Reducer Bushing	2

STANDARD HYDRAULIC SCHEMATIC

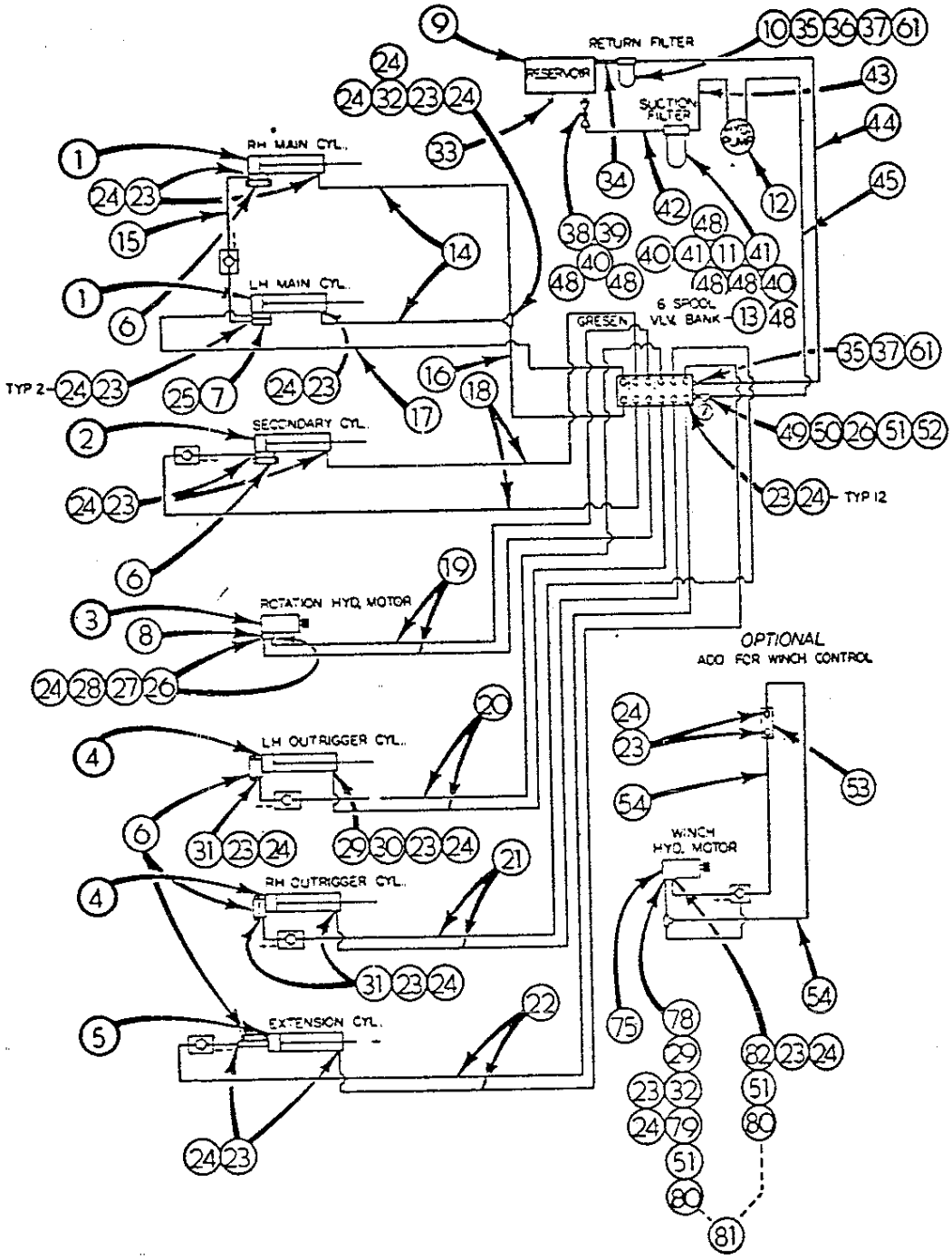


Fig. C-21

STANDARD HYDRAULIC SCHEMATIC

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
42	60039188	*	1" x AR Lg. Hose	1
43	60039188	*	1" x AR Lg. Hose	1
44	60039101	*	1/2" x AR Lg. Hose	1
45	60039101	*	1/2" x AR Lg. Hose	1
48	72066001	*	#24 Hose Clamp	6
49	72053725		1/2" Hex Nipple	1
50	72053612		1/2" Tee	1
51	72053533		1/4" - 45° St. Elbow	1
52	73054003		Pressure Gauge	1
61	72066000		#12 Hose Clamp	2

NOTE: * These parts are included in installation kit.
** A 4" Cylinder, P/N 3B231413 is optional.

WINCH OPTION FOR STANDARD HYDRAULIC SCHEMATIC

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
23	72053642	3/8" M / 3/8"F Pipe Swivel	4
24	72531181	3/8" Swage Hose Fitting	4
29	72053723	3/8"M / 3/8"F Hex Nipple	1
32	72053611	3/8" Tee	1
51	72053533	1/4" - 45° St. Elbow	2
53	73054009	CP 4-Way Gresen 1 Spool Tandem Valve	1
54	60035157	3/8" x 23½' Lg. Hose	2
75	73051020	Hydraulic Motor, Winch	1
78	72531829	1/2" - 3/8" Reducer Bushing	1
79	72532138	3/8" - 1/4" Reducer Bushing	1
80	72053545	1/4" x 3/8" Male Connector	2
81	60101420	U Tube	1
82	73054006	Pilot Operated Check Valve	1

HYDRAULIC SCHEMATIC WITH REMOTE CONTROL

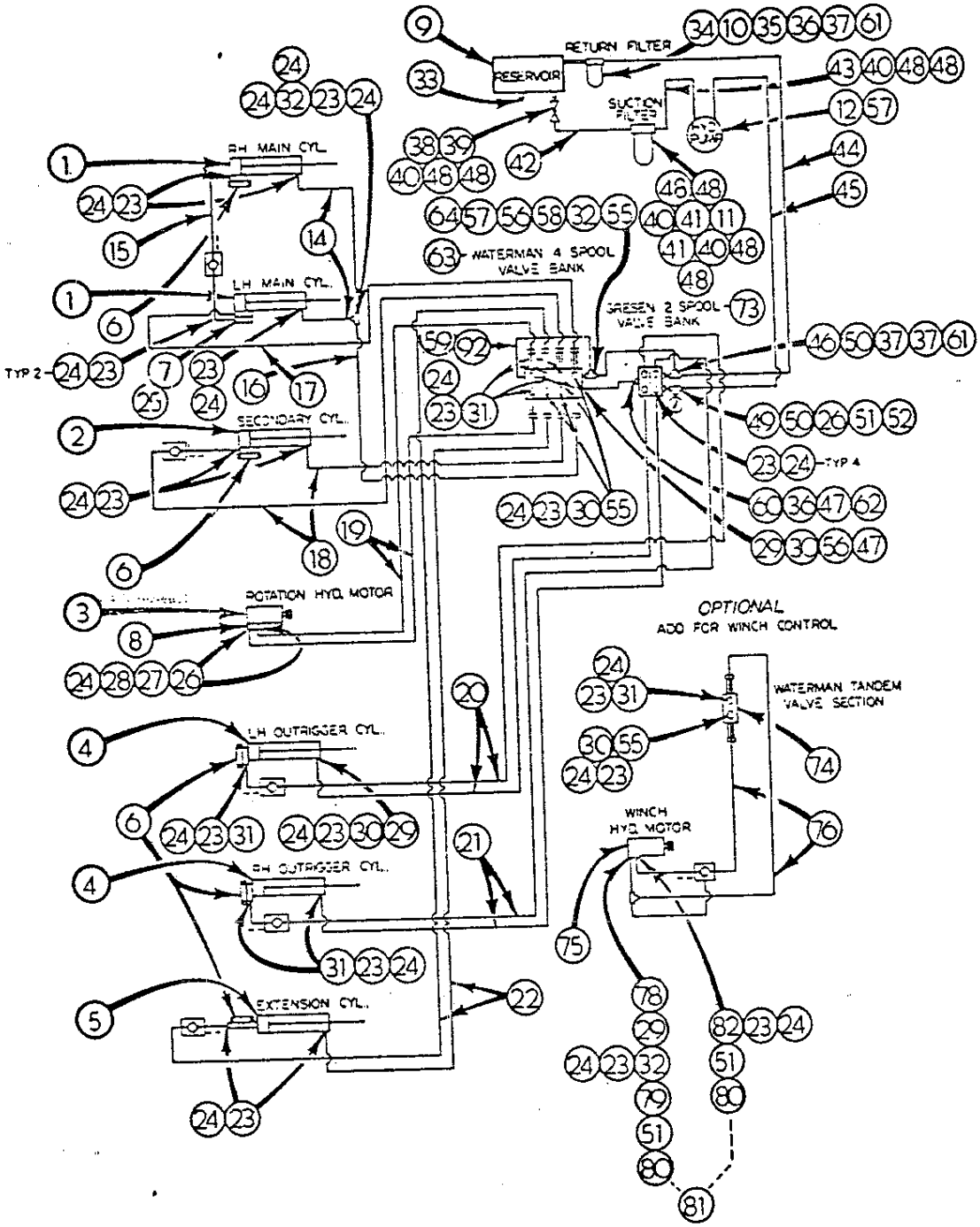


Fig. C-22

HYDRAULIC SCHEMATIC WITH REMOTE CONTROL

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
1	3B099510		Main Cylinder	2
2	3C103512		Secondary Cylinder	1
3	73051001		Rotation Hydraulic Motor	1
4	3B108512	**	Outrigger Cylinder, 3" Bore	2
5	3B105511		Extension Cylinder	1
6	73054004		Holding Valve	5
7	60010710		Metering Block	1
8	60101481		Adaptor	1
9	52701221		Reservoir (Part of Base Assy)	Ref.
10	73052000		Return Filter	1
11	73052007	*	Suction Filter	1
12	73051000	*	Pump (9 Gal. Opt.)	1
14	60035120		3/8" x 22" Lg. Hose	2
15	60035120		3/8" x 22" Lg. Hose	1
16	60035153		3/8" x 36" Lg. Hose	1
17	60035154		3/8" x 58" Lg. Hose	1
18	60035153		3/8" x 36" Lg. Hose	2
19	60035154		3/8" x 58" Lg. Hose	2
20	60035118		3/8" x 72" Lg. Hose	2
21	60035123		3/8" x 120" Lg. Hose	2
22	60035156		3/8" x 11' Lg. Hose	2
23	72053642		3/8"M / 3/8"F Pipe Swivel	26
24	72531181		3/8" Swage Hose Fitting	30
25	72053412		1/4" Pipe Plug	1
26	72531830		1/2" - 1/4" Reducer Bushing	3
27	72531131		1/4" - 90° St. Elbow	2
28	72053641		1/4"M / 3/8"F Pipe Swivel	2
29	72053723		3/8"M / 3/8"M Hex Nipple	2
30	72531100		3/8" - 90° Elbow	6
31	72531132		3/8" - 90° St. Elbow	7
32	72053611		3/8" Tee	2
33	72052001		3/4" NPT Mag. Plug	1
34	72053049		3/4" Close Nipple	1
35	72531833		3/4" - 1/2" Reducer Bushing	1
36	72531133		1/2" - 90° St. Elbow	2
37	72053457		1/2" Barbed Nipple	3
38	72053185	*	1" Close Nipple	1
39	73054001	*	1" Gate Valve	1
40	72531549	*	1" Barbed Nipple	4
41	72053377	*	1¼ - 1" Reducer Bushing	2
42	60039188	*	1" x AR Lg. Hose	1
43	60039188	*	1" x AR Lg. Hose	1
44	60039101	*	1/2" x AR Lg. Hose	1
45	60039101	*	1/2" x AR Lg. Hose	1

HYDRAULIC SCHEMATIC WITH REMOTE CONTROL

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
46	72053726		3/4" x 1/2" Hex Nipple	1
47	72531185		1/2" Swage Swivel Hose Fitting	2
48	72066001	*	#24 Hose Clamp	8
49	72053725		1/2" Hex Nipple	1
50	72053612		1/2" Tee	2
51	72053533		1/4" - 45° St. Elbow	1
52	73054003		Pressure Gauge	1
55	72053052		3/8" x 2½" Nipple	5
56	72053732		3/8"M / 1/2"F Adaptor	2
57	72531165		1/2" Swage Hose Fitting	2
58	72053516		3/8" x 3/8" Male Connector	1
59	72053515		3/8" x 3/8" Male Elbow	1
60	73073023		Power Beyond Adaptor	1
61	72066000		#12 Hose Clamp	2
62	60039158		1/2" x 7' Lg. Hose	1
63	73073094		Waterman 4 Spool Valve Bank	1
64	60039159		1/2" x 8' Lg. Hose	1
73	73073034		CP 4-Way Gresen 2 Spool Valve Bank	1
92	60102671		Tube	1

NOTE: * These parts are included in Installation Kit.
** A 4" Bore Cylinder, P/N 3B231413 is Optional.

WINCH OPTION FOR HYDRAULIC SCHEMATIC W/ REMOTE CONTROL

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
23	72053642	3/8"M / 3/8"F Pipe Swivel	4
24	72531181	3/8" Swage Hose Fitting	4
29	72053723	3/8"M / 3/8"M Hex Nipple	1
30	72531100	3/8" - 90° Elbow	1
31	72531132	3/8" - 90° St. Elbow	1
32	72053611	3/8" Tee	1
51	72053533	1/4" - 45° St. Elbow	2
55	72053052	3/8" x 2½" Nipple	1
74	73073105	Waterman 1 Spool Tandem Valve	1
75	73051020	Hydraulic Motor, Winch	1
76	60035155	3/8" x 14' Lg. Hose	2
78	72531829	1/2" - 3/8" Reducer Bushing	1
79	72532138	3/8" - 1/4" Reducer Bushing	1
80	72053545	1/4" x 3/8" Male Connector	2
81	60101420	U Tube	1
82	73054006	Pilot Operated Check Valve	1

HYDRAULIC SCHEMATIC WITH MANUAL AND REMOTE CONTROL

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
1	3B099510		Main Cylinder	2
2	3C103512		Secondary Cylinder	1
3	73051001		Rotation Hydraulic Motor .	1
4	3B108512	**	Outrigger Cylinder	2
5	3B105511		Extension Cylinder	1
6	73054004		Holding Valve	5
7	60010710		Metering Block	1
8	60101481		Adapter	1
9	52701221		Reservoir (Part of Base Assy)	Ref.
10	73052000		Return Filter	1
11	73052007	*	Suction Filter	1
12	73051000	*	Pump (9 Gal. Opt.)	1
13	73073011		CP 4-Way Gresen 6 Spool Valve Bank	1
14	60035120		3/8" x 22" Lg. Hose	2
15	60035120		3/8" x 22" Lg. Hose	1
16	60035153		3/8" x 36" Lg. Hose	1
17	60035154		3/8" x 58" Lg. Hose	1
18	60035153		3/8" x 36" Lg. Hose	2
19	60035154		3/8" x 58" Lg. Hose	2
20	60035118		3/8" x 72" Lg. Hose	2
21	60035123		3/8" x 120" Lg. Hose	2
22	60035156		3/8" x 11' Lg. Hose	2
23	72053642		3/8"M / 3/8"F Pipe Swivel	42
24	72531181		3/8" Swage Hose Fitting	46
25	72053412		1/4" Pipe Plug	1
26	72531830		1/2" - 1/4" Reducer Bushing	3
27	72531131		1/4" - 90° St. Elbow	2
28	72053641		1/4"M / 3/8"F Pipe Swivel	2
29	72053723		3/8"M / 3/8"M Hex Nipple	6
30	72531100		3/8" - 90° Elbow	2
31	72531132		3/8" - 90° St. Elbow	10
32	72053611		3/8" Tee	10
33	72052001		3/4" NPT Mag. Plug	1
34	72053049		3/4" Close Nipple	1
35	72531833		3/4" - 1/2" Reducer Bushing	1
36	72531133		1/2" - 90° St. Elbow	1
37	72053457		1/2" Barbed Nipple	2
38	72053185	*	1" Close Nipple	1
39	73054001	*	1" Gate Valve	1
40	72531549	*	1" Barbed Nipple	4
41	72053377	*	1¼" - 1" Reducer Bushing	2
42	60039188	*	1" x AR Lg. Hose	1
43	60039188	*	1" x AR Lg. Hose	1

HYDRAULIC SCHEMATIC WITH MANUAL AND REMOTE CONTROL

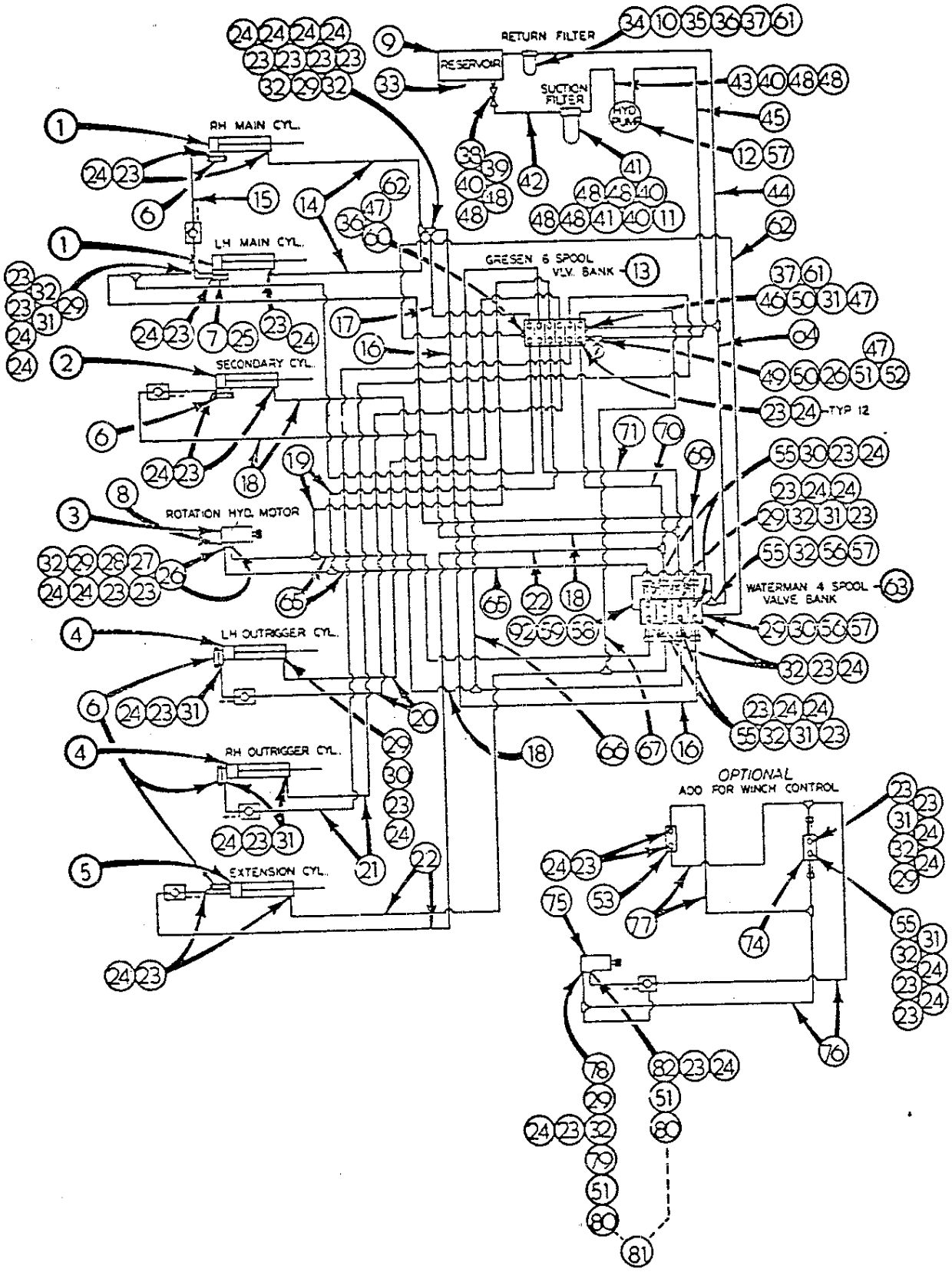


Fig. C-23

HYDRAULIC SCHEMATIC WITH MANUAL AND REMOTE CONTROL

REF. NO.	IMTCO P/N		DESCRIPTION	NO. REQ'D
44	60039101	*	1/2" x AR Lg. Hose	1
45	60039101	*	1/2" x AR Lg. Hose	1
46	72053726		3/4" - 1/2" Hex Nipple	1
47	72531185		1/2" Swage Swivel Hose Fitting	3
48	72066001	*	#24 Hose Clamp	8
49	72053725		1/2" Hex Nipple	2
50	72053612		1/2" Tee	2
51	72053533		1/4" - 45° St. Elbow	1
52	73054003		Pressure Gauge	1
55	72053052		3/8" x 2½" Nipple	5
56	72053732		3/8"M / 1/2"F Adapter	2
57	72531165		1/2" Swage Hose Fitting	3
58	72053516		3/8" x 3/8" Male Connector	1
59	72053515		3/8" x 3/8" M Elbow	1
60	73073023		Power Beyond Adapter	1
61	72066000		#12 Hose Clamp	2
62	60039158		1/2" x 7' Lg. Hose	1
63	73073094		Waterman 4 Spool Valve Bank	1
64	60039159		1/2" x 8' Lg. Hose	1
65	60035154		3/8" x 58" Lg. Hose	2
66	60035160		3/8" x 8'-6" Lg. Hose	1
67	60035160		3/8" x 8'-6" Lg. Hose	1
69	60035154		3/8" x 58" Lg. Hose	1
70	60035160		3/8" x 8'-6" Lg. Hose	1
71	60035160		3/8" x 8'-6" Lg. Hose	1
92	60102671		Tube	1

NOTE: * These parts are included in Installation Kit.
** A 4" Bore Cylinder, P/N 3B231413 is optional.

WINCH OPTION FOR MANUAL AND REMOTE CONTROL

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
23	72053642	3/8"M / 3/8"F Pipe Swivel	8
24	72531181	3/8" Swage Hose Fitting	8
29	72053723	3/8"M / 3/8"F Hex Nipple	2
31	72531132	3/8" - 90° St. Elbow	2
32	72053611	3/8" Tee	3
51	72053533	1/4" - 45° St. Elbow	2
53	73054009	CP 4-Way Gresen 1 Spool Tandem Valve	1
55	72053052	3/8" x 2½" Nipple	1
74	73073105	Waterman 1 Spool Tandem Valve	1
75	73051020	Hydraulic Motor, Winch	1
76	60035155	3/8" x 14' Lg. Hose	2
77	60039099	3/8" x AR Lg. Hose	2
78	72531829	1/2" - 3/8" Reducer Bushing	1
79	72532138	3/8" - 1/4" Reducer Bushing	1
80	72053545	1/4" x 3/8" Male Connector	2
81	60101420	U Tube	1
82	73054006	Pilot Operated Check Valve	1

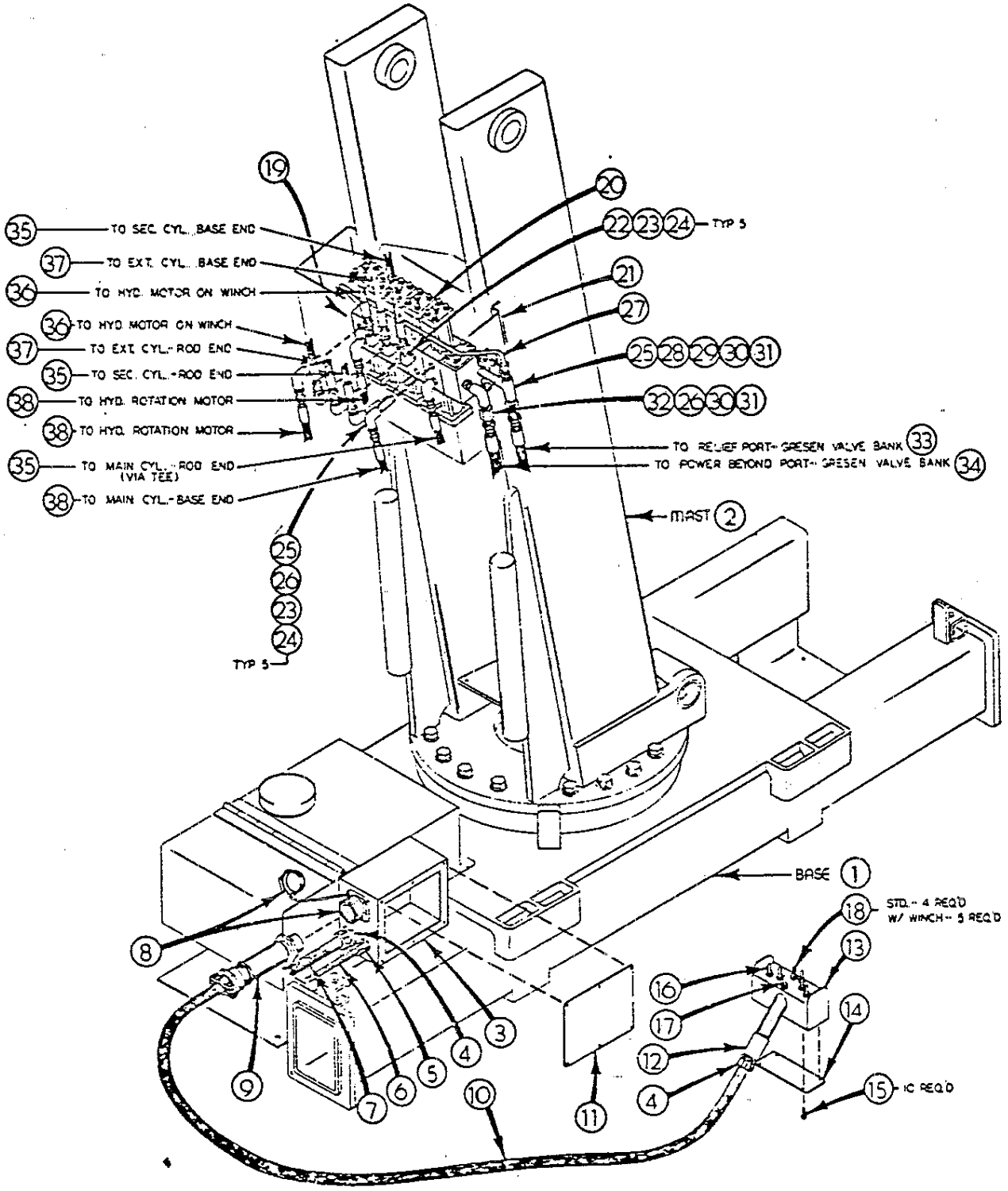

35 TO SEC. CYL., BASE END
37 TO EXT. CYL., BASE END
36 TO HYD. MOTOR ON WINCH
36 TO HYD. MOTOR ON WINCH
37 TO EXT. CYL.- ROD END
35 TO SEC. CYL.- ROD END
38 TO HYD. ROTATION MOTOR
38 TO HYD. ROTATION MOTOR
35 TO MAIN CYL.- ROD END (VIA TEE)
38 TO MAIN CYL.- BASE END
19
20
22 23 24 TYP 5
21
27
25 28 29 30 31
32 26 30 31
TO RELIEF PORT- GRESEN VALVE BANK 33
TO POWER BEYOND PORT- GRESEN VALVE BANK 34
MAST 2
25
26
23
24
TYP 5
BASE 1
18 STD.- 4 REQ'D W/ WINCH- 5 REQ'D
13
16
17
14
12
4
15 IC REQ'D
8
9
7
6
5
4
3
10
11

Fig. C-24

REMOTE CONTROL SYSTEM

REF. NO.	IMTCO P/N	DESCRIPTION	NO. REQ'D
1	52070048	Base Assy	Ref.
2	52070365	Mast Assy	Ref.
3	52070681	Electrical Cabinet Assy	1
4	77044017	1" Strain Relief Connector	2
5	77044018	1/2" Strain Relief Connector	1
6	77044039	#14-3 Wire	AR
7	77044035	16 Wire Cable 10' Lg.	1
8	77044040	Receptical W/ Cap	1
9	77044041	Male Plug	1
10	77044042	16 Wire Cable 35' Lg.	1
11	60101424	Cover	1
12	72053306	1" Coupling	1
13	52070674	Remote Control Handle Assy	1
14	60101416	Handle Cover	1
15	72061003	6 x $\frac{1}{2}$" Self Tapping Screw	10
16	77041004	Toggle Switch, Single Throw	1
17	77041005	Momentary Contact Switch	1
18	77041006	Toggle Switch, Double Throw	5
19	72053515	3/8" x 3/8" Male Elbow	1
20	73073094	Waterman 4 Spool Valve Bank (Std)	1
	73073095	Waterman 5 Spool Valve Bank (w/winch)	AR
21	52070921	Cover, Valve Bank	1
22	72531133	3/8" - 90° St. Elbow	5
23	72053642	3/8"M / 3/8"F Pipe Swivel	10
24	72531181	3/8" Swage Hose Fitting	10
25	72053052	3/8" x $2\frac{1}{2}$" Nipple	6
26	72531100	3/8" - 90° Elbow	6
27	60102671	Tube	1
28	72053611	3/8" Tee	1
29	72053516	3/8" x 3/8" Male Connector	1
30	72053732	3/8"M / 1/2" F Adaptor	2
31	72531185	1/2" Swage Swivel Hose Fitting	2
32	72053723	3/8"M / 3/8"M Hex Nipple	1
33	60035159	1/2" x 8' Lg. Hose	1
34	60035158	1/2" x 7' Lg. Hose	1
35	60035153	3/8" x 36" Lg. Hose	3
36	60035155	3/8" x 14' Lg. Hose	2
37	60035156	3/8" x 11' Lg. Hose	2
38	60035154	3/8" x 58" Lg. Hose	3

INSTALLATION

CHASSIS PREPARATION

1. Inspect carrier vehicle to assure compliance with listed requirements shown under "Minimum Chassis Requirements", page 1-13.
2. Chassis frame must be clear of all obstructions immediately behind the cab for 30" (76.2). Space will be available for gas tanks, etc., after crane is installed. Some modification of hanger brackets may be required.
3. Install PTO in accordance with manufacturer's instructions (see Fig. D-6 or Fig. D-7 pages 4-6 or 4-7).
4. Install pump, insure that correct rotation is employed. See Hydraulic Pump (Fig. D-8 page 4-8).
5. Replace transmission grease and check for leaks.
6. Install suction filter. Select location at a point approximately 20" (50.8 cm) behind cab and within 48" (122 cm) of PTO-Pump location. Filter must be below top of chassis frame and should be accessable for servicing.
7. If rivets protrude thru top of frame flange, install $\frac{1}{4}$" x 3" (0.64 cm x 7.6 cm) flat bar strip on top of frame flange to provide a flat mounting surface. Tack weld along edge of frame, do not weld across the flange.
8. Spray paint all unpainted steel surfaces.

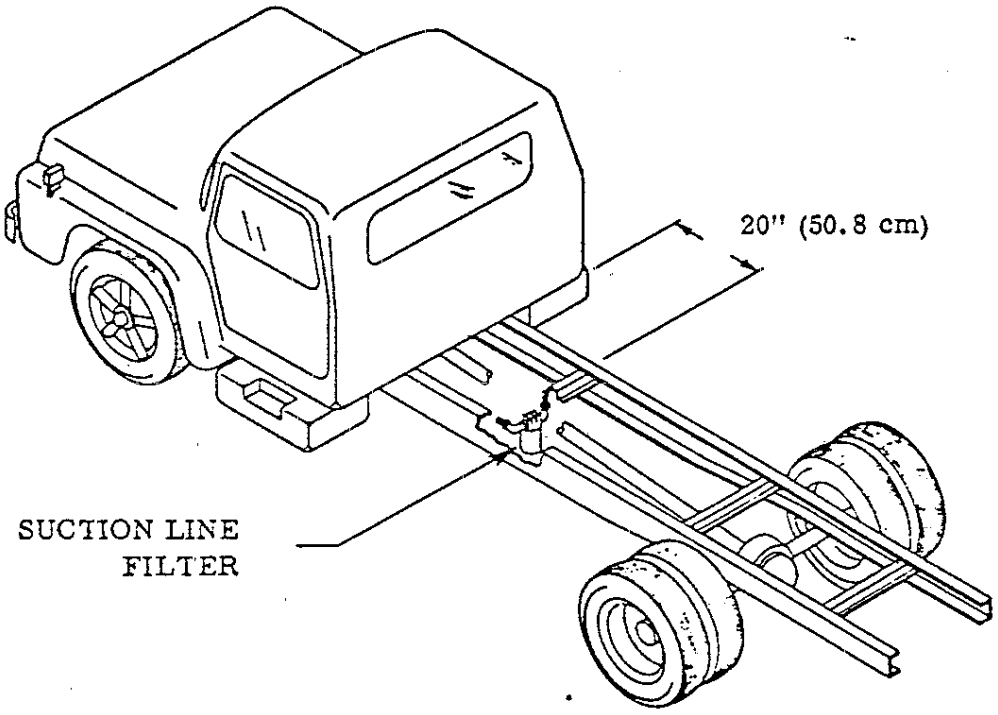


Fig. D-1

CHASSIS FRAME REINFORCEMENT

1. If chassis frame does not meet minimum section modulus or R B M requirements it must be fishplated.
2. Use the same material as in the frame.
3. Strip frame of all steps, tanks, etc. which are attached from the back of the front spring hanger to the front of the rear spring hanger.
4. Clamp 3/8" x 12" plate to both sides from a point directly behind the rear front spring hanger to a point directly in front of the foreward rear spring hanger. Use heavy duty C-clamps and secure the plates tightly to the frame.
5. Drill and reinstall all original bolts possible.
6. Weld fishplate and "L" reinforcing angles as shown below.

WARNING
Do not weld on high tensile frames. Bolt fishplate utilizing bolt pattern below. Use 3/4" - 8 NC Grade 6 or 8 bolts, hardened flat washers both sides and self locking nuts. Torque according to specifications on Torque Data page.

7. Paint fishplate and all welds black.

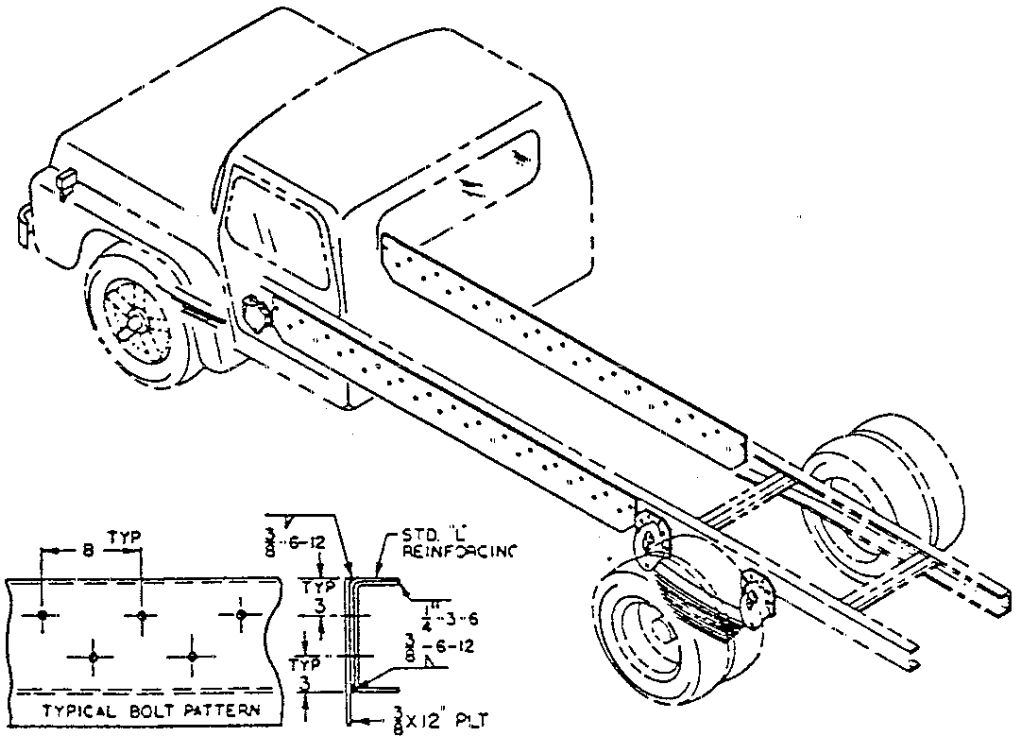
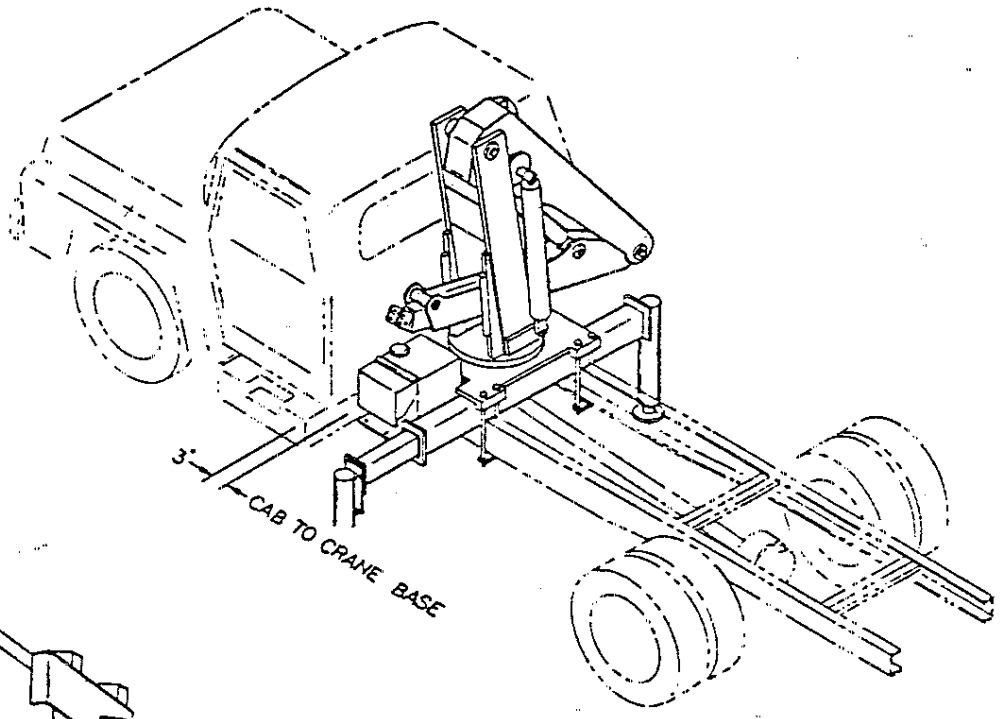


Fig. D-2

INSTALLING BASIC CRANE ASSEMBLY

1. Reinforce frame flanges by tack welding 4 each 3/8" x 3" (0.95 cm x 7.6 cm) flat bar strips vertically as shown below. Front pair should be centered approximately at a point 5" (12.7 cm) behind cab and another pair centered 28" (71 cm) behind those. These bars will prevent frame flange collapse.
2. Employ adequate lifting device; attach lifting hook to eye supplied on top of main boom. Raise crane, move chassis under and lower crane into desired location upon chassis. Check for front to rear alignment.
3. Install mounting bolts, clip bars, lockwashers, and nuts to secure crane to chassis. Torque all eight bolts to 660 ft. - lbs. or 91.3 kg/m.



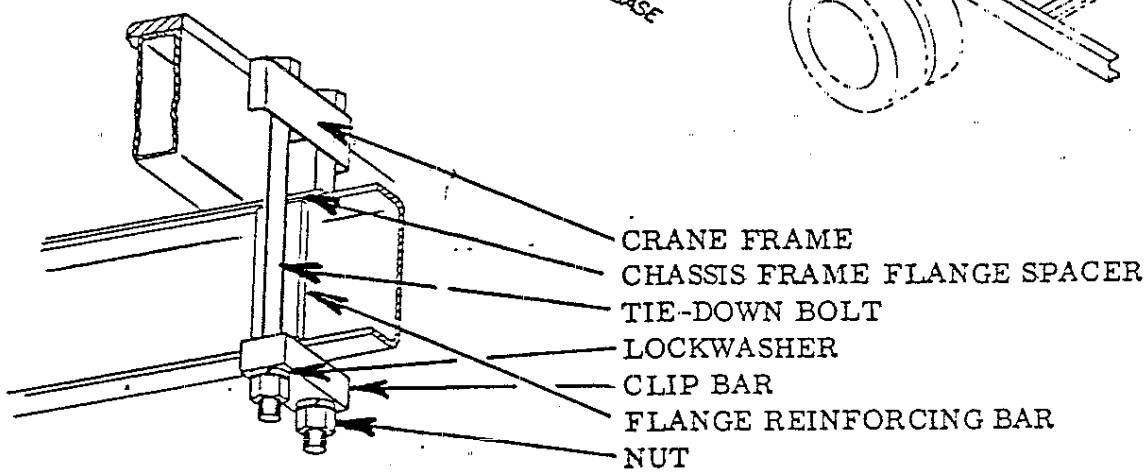


Fig. D-3

HYDRAULIC CONNECTIONS

1. Install suction hose between oil reservoir and filter.
2. Install suction hose between filter and pump.
3. Install pressure hose between pump and control valve input port.
4. All Fittings should be properly treated with a good sealant material and are to be adequately tightened to prevent leaks.
5. Open gate valve located at suction port on oil reservoir and fill tank with oil. See oil specifications on page 2-3.
6. Check unit for leaks.
7. Start engine, engage PTO and charge system with oil.
8. Check oil reservoir and refill as necessary.
9 Test unit in accordance to Structural and Stability Test form pages 4-9 & 4-10.
10. At the conclusion of test procedures, re-inspect and completely check all lubrication points. See Lubrication Chart page 2-2.
11. Make all final adjustments and corrections.
12. Paint unit as required.
13. Insure all operation placards are in place. See Fig. A-3, page 1-8.
14. Install Electrocution placards as shown below in Fig. D-4.

NOTE:	Electrocution Placards must be placed on front and rear, and both sides of vehicle.

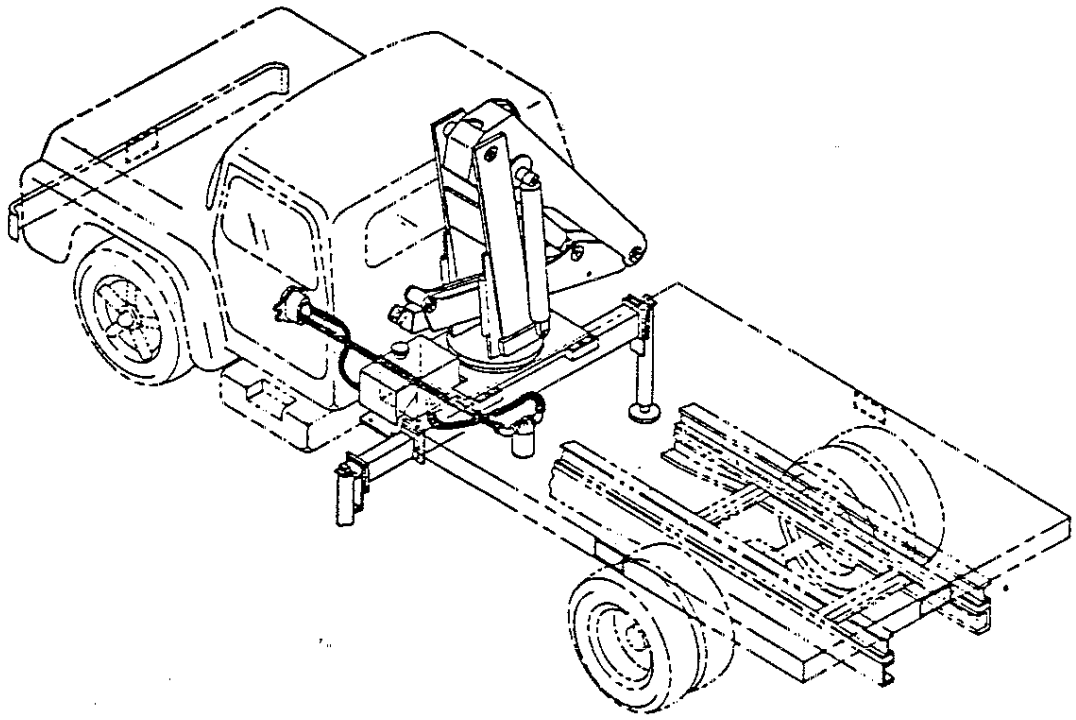


Fig. D-4

OPTIONAL WINCH INSTALLATION

The winch option is usually completely installed at the factory. If so no additional installation work is required. If however, the winch is to be added to an in service unit, the kit will consist of materials as shown in Fig. C-20, page 3-28 and is installed as follows:

1. Weld boom side plates in position as shown with top flanges level with lower side of secondary boom.
2. Bolt winch to bracket, Item #3, and then bolt bracket to boom member. Insure motor is to right hand side of boom.
3. Add control valve section and cross-over control rod. Torque control valve bolts to 25 to 30 in./lbs. Check to insure free valve spool movement.
4. Route hoses from valve to winch motor and add control valve placard.
5. Operate winch, check for leaks.
6. Install wire rope, downhaul weight, and hook assembly. Overwind rope as shown in the Figure.
7. Test winch. Speed will be approximately 15 ft. (4.6 m) per min. and 4,000 pounds (1814 kgs) pull on the bare drum.

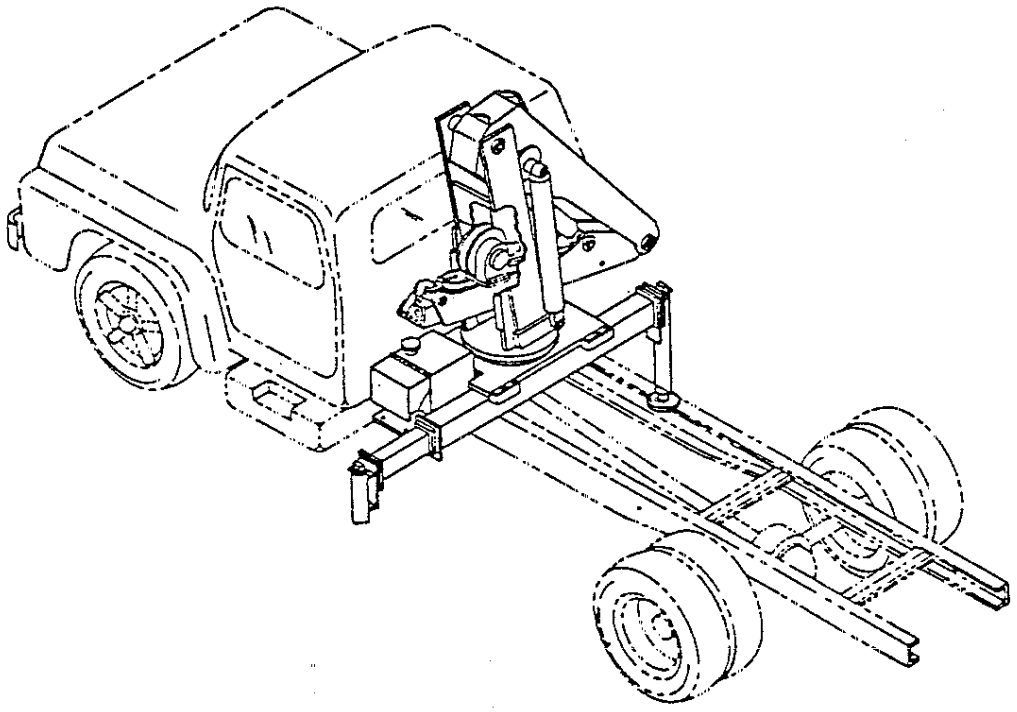


Fig. D-5

POWER TAKE-OFF INSTALLATION

Power take-off manufacturers provide installation specifications pertinent to individual products. These specifications should be adhered to when installing a PTO. The following steps are a guide in this application:

1. Drain transmission oil into a clean container for reuse if vehicle is new. If vehicle is used dispose of the oil.

2. Temporarily install PTO with proper gaskets and only two studs. Check backlash for a maximum allowance of 1/32" to 1/16".

3. Remove PTO, apply Perma-Tex to gaskets, install remaining studs, PTO, bronze seal washers and nuts. Make sure all nuts are tightened evenly and securely. Recheck backlash.

4. Install operation cable to suit conditions.

5. Replace transmission oil.

NOTE: The application shown is the one normally employed by IMTCO. If a driveline is utilized, employ standard practices pertinent to that application.

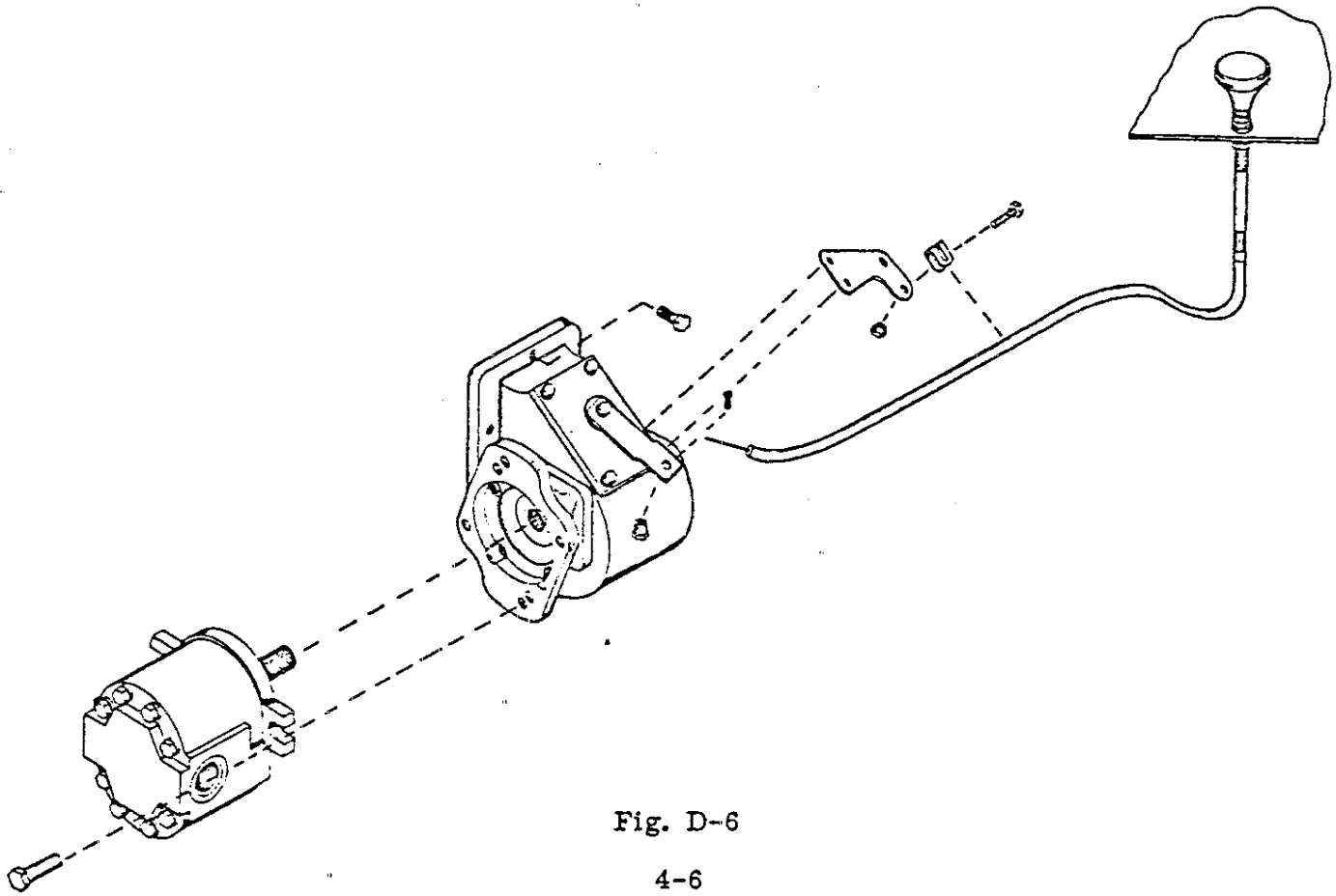


Fig. D-6

DRIVELINE POWER APPLICATION

The pump can be driven as shown below as an optional method to that shown on the previous page. The following steps are a guide in this application.

1. Install PTO as discussed on page 4-6.
2. Loosely bolt pump mounting bracket Item "A" to adjustable bracket Item "B".
3. The adjustable bracket is to be bolted to chassis frame at a point that will provide that the driveline will not exceed 48" (122 cm) and the joint angle will not be greater than 8°.
4. Check pump rotation, see page 4-8, and install pump, pump end yoke and the PTO end yoke.
5. Size, cut, and weld driveline at choosen length. Insure driveline balance. Allow 1" (2.54 cm) in slip yoke.
6. Install driveline, lock set screws, and lubricate joints.
7. Insure all mounting bolts are tight.

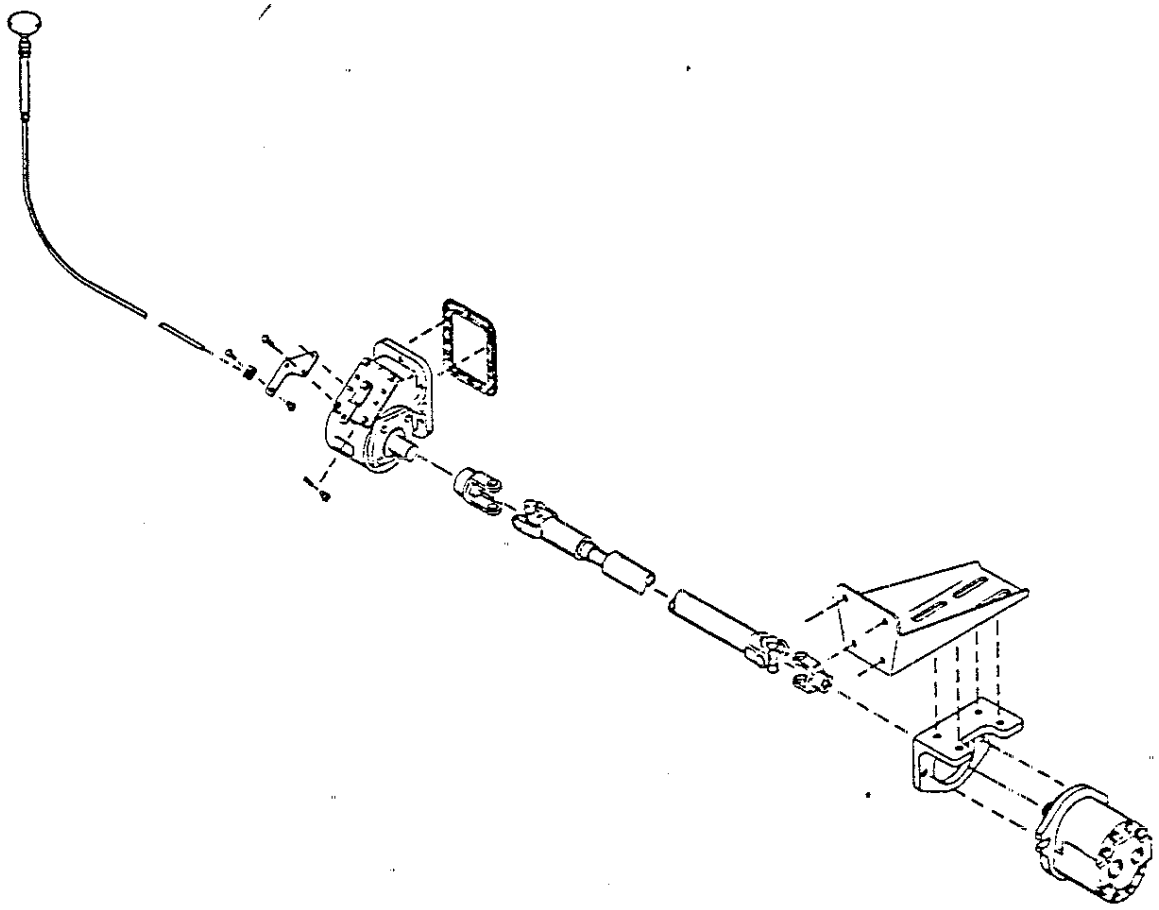


Fig. D-7

HYDRAULIC PUMP

Shown below is a parts breakdown for the pump used to power the 600 series crane. We do not recommend that this pump be rebuilt in case of failure. It should be replaced with a new pump. If, however, you elect to repair the pump, parts are numbered and IMTCO will supply replacement parts if requested. In making a parts order please refer to pump model number on your unit and the item number in the pump parts list.

When installing the pump it may be necessary, in an emergency, to reverse its rotation. It is not recommended practice, but if necessary the following procedure may be used:

1. Remove bolts shown as Item #6.
2. Back off Item #5.
3. Remove Items #4, 3, and 2.
4. Remove Item #1 and rotate 180° side to side. Do not turn over fore to aft.
5. Insure seal on Item #1 is in place and properly fitted to its slot.
6. Replace Items #1, 2, 3, and 4.
7. Rotate Item #5 so that large fitting #7 is opposite side as originally located.
8. Replace bolts, Item #6, and torque from 28 to 32 ft./lbs.
9. Pump is now ready to install.

NOTE: If, when the pump is engaged, it will not hold its pressure at 2300 psi and falls as low as 1500 - 1600 psi, the seal in Item #1 is misplaced and will require correction or replacement.

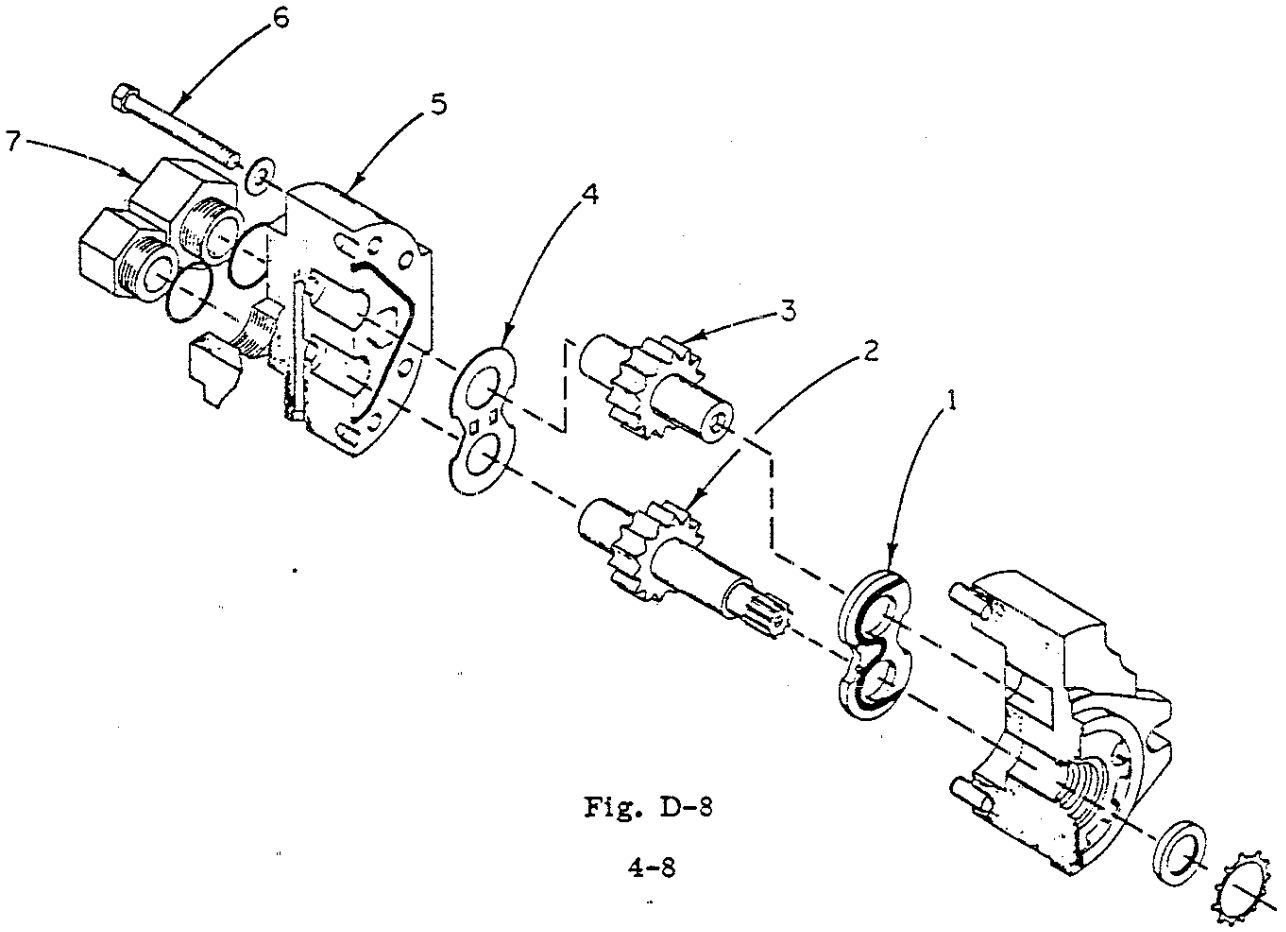


Fig. D-8

3) With full rated load - 2600# (1180 kgs) @ 15'-4" (4.7 m) - and booms at 30° above horizontal position check holding valves, shut engine off and open control valves, one at a time, starting with secondary down, main down, extension at retract and outrigger down. No function drift should occur.

4) Restart engine extend & retract extension boom five times for proper operation.

5) Raise and lower secondary boom five times.

6) Raise and lower main boom five times.

7) Check stability by lowering the rated load - 2600# (1180 kgs) @ 15'-4" (4.7 m) to a low practical position. Rotate crane very slowly while constantly observing vehicle wheels for contact with ground.

a) Note % rated load stability
b) Position of stability (360° or portion thereof)

8) If unit is stable, rotate complete cycle five times.

9) Time unit functions for speed, record & compare with these shown in ( ) below:

Extension----------	6 Sec.	Rotation----------	59 Sec.
Main----------	21 Sec.	Outriggers----------	6 Sec.
Secondary----------	15 Sec.		

10) Give unit final inspection, note & correct deficiencies.

DEALER OR INSTALLATION AGENT

I HAVE TESTED THIS UNIT AS DESCRIBED ABOVE & HEREBY RELEASE IT FOR SERVICE

DATE_____ S/N_____

NAME_____

STRUCTURAL AND STABILITY TEST FORM
600 CRANE

CHASSIS INFORMATION

Make_____Model_____Serial Number_____

W/B_____C/A_____Transmission_____

GAWR-FRT_____GAWR-Rear_____GVWR_____

PTO Model_____PTO %_____

Pump Model_____Pump Rotation_____

Unit Model_____Unit Serial Number_____

Order Number_____Date_____

Prior to placing unit into service the following test must be performed.

INSPECTION & TEST CHECK

A) Power Take-Off/shifting cable for efficient operation

B) PTO mounting bolts

C) Transmission grease

D) Underdrive hoses for brakes

E) Routing of hoses - no kinks, muffler or tail pipe contact

F) All pins and retainer parts

G) Mounting bolts for tightness

H) Lubricate all necessary lube points - check chart

I) Fill oil reservoir

J) Shut off valve open

OPERATING TEST

1) Slowly operate unit through all motions. Check hoses, cylinders, and all structural parts for proper operation.

2) Check placards to insure correctness.

TORQUE DATA

GRADE BOLT	SAE GRADE 1 OR 2	SAE GRADE 5	SAE GRADE 6	SAE GRADE 8
MARKING				
DEFINITION	INDETERMINATE QUALITY	MINIMUM COMMERCIAL QUALITY	MEDIUM COMMERCIAL QUALITY	BEST COMMERCIAL QUALITY
MATERIAL	LOW CARBON STEEL	MEDIUM CARBON STEEL TEMPERED	MEDIUM CARBON STEEL Q & T	MED. CARBON ALLOY STEEL Q & T
MIN. TENSILE STRENGTH	64 000 P.S.I. 44 998 400 kgs/sq m	105 000 P.S.I. 73 825 500 kgs/sq m	133 000 P.S.I. 93 512 300 kgs/sq m	150 000 P.S.I. 105 465 000 kgs/sq m

BOLT SIZE		RECOMMENDED TORQUE VALUES							
FRAC.	mm	FT. LBS.	kg-m	FT. LBS.	kg-m	FT. LBS.	kg-m	FT. LBS.	kg-m
1/4	6.35	5	.69	7	.96	10	1.38	10.5	1.45
5/16	7.92	9	1.24	14	1.93	19	2.62	22	3.04
3/8	9.52	15	2.07	25	3.45	34	4.7	37	5.11
7/16	11.09	24	3.31	60	8.29	55	7.6	60	8.29
1/2	12.7	37	5.11	60	8.29	85	11.75	92	12.72
9/16	14.27	53	7.32	88	12.17	120	16.59	132	18.25
5/8	15.87	74	10.23	120	16.59	167	23	180	24.89
3/4	19.05	120	16.59	200	27.66	280	38.72	296	40.93
7/8	22.22	190	26.27	302	41.76	440	60.85	473	65.41
1"	25.4	282	39	466	64.45	660	91.27	714	98.74

Fig. D-9

In using the torque data in the chart above the following rules should be observed:

1. Manufacturers' particular specifications should be consulted when provided.

2. When multiple tapered tooth (shakeproof) are employed, the torque should be increased by 20%.

3. All torque measurement values are given in foot-pounds.

4. The information in the chart is pertinent to lightly lubricated course and fine thread fasteners.

5. To convert measurement to inch pounds multiply by 12.

TIRE INFLATION CHART

Definite tire inflation pressures are established for each tire size depending upon the load imposed on the tires. For greater stability, riding comfort and prolonged tire life, tires should be inflated for the loads carried. The "Load and Inflation Table" shown below indicates the proper inflation pressures.

TIRE LOAD AND INFLATION TABLES

Tire and Rim Association Standard Tire Loads At Various Inflation Pressures
Load Range Letters and Corresponding Ply Rating-(D=8 ply, E=10 ply, F=12 ply and G=14 pl

SINGLE TIRES FOR TRUCKS IN HIGHWAY SERVICE

TIRE SIZE	LOAD RANGE	TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES										
		50	55	60	65	70	75	80	85	90	95	100
7.00-20	D	2100	2260	2390	2530	2670	2790					
7.00-20	E	2100	2260	2390	2530	2670	2920	3030	3150			
7.50-20	D	2360	2530	2680	2840	2990	3140					
7.50-20	E	2360	2530	2680	2840	2990	3140	3270	3410	3530		
8.25-20	E	2800	3010	3190	3370	3560	3730	3890	4050			
8.25-20	F	2800	3010	3190	3370	3560	3730	3890	4050	4210	4350	4500
9.00-20	E		3560	3770	4000	4210	4410	4610				
9.00-20	F		3560	3770	4000	4210	4410	4610	4790	4970	5150	
10.00-20	F			4290	4530	4770	4990	5220	5430			
10.00-20	G			4290	4530	4770	4990	5220	5430	5640	5840	6040
11.00-20	F			4670	4940	5200	5450	5690	5920			
11.00-20	G			4670	4940	5200	5450	5690	5920	6140	6370	6590
11.00-22	F			4960	5240	5520	5790	6040	6290			
11.00-22	G			4960	5240	5520	5790	6040	6290	6530	6770	7000

DUAL TIRES FOR TRUCKS IN HIGHWAY SERVICE

TIRE SIZE	LOAD RANGE	TIRE LOAD LIMITS AT VARIOUS INFLATION PRESSURES										
		40	45	50	55	60	65	70	75	80	85	90
7.00-20	D	1840	1980	2100	2220	2340	2450					
7.00-20	E	1840	1980	2100	2220	2340	2450	2560	2660	2760		
7.50-20	D	2070	2220	2350	2490	2620	2750					
7.50-20	E	2070	2220	2350	2490	2620	2750	2870	2990	3100		
8.25-20	E	2460	2640	2800	2960	3120	3270	3410	3550			
8.25-20	F	2460	2640	2800	2960	3120	3270	3410	3550	3690	3820	3950
9.00-20	E		3120	3310	3510	3690	3870	4040				
9.00-20	F		3120	3310	3510	3690	3870	4040	4200	4360	5420	
10.00-20	F			3760	3970	4180	4380	4580	4760			
10.00-20	G			3760	3970	4180	4380	4580	4760	4950	5120	5300
11.00-20	F			4100	4330	4560	4780	4990	5190			
11.00-20	G			4100	4330	4560	4780	4990	5190	5390	5590	5780
11.00-22	F			4350	4600	4840	5080	5300	5520			
11.00-22	G			4350	4600	4840	5080	5300	5520	5730	5940	6140