PETTIBONE

NATIONAL IRON COMPANY
50TH AVENUE WEST AND RAMSEY STREET
DULUTH, MINNESOTA 55807

NICO

MANUAL

FOR

OPERATION, MAINTENANCE

AND

REPAIR INSTRUCTIONS

MODEL 100 TK-LSPC

50 TON CRANE

VOLUME I

PETTIBONE CORPORATION
4700 WEST DIVISION STREET • CHICAGO, ILLINOIS 60651 • 312/772-9300

FOREWORD

This Parts Book and Maintenance Manual contains complete description and detailed information regarding Replacement Parts and the Operation and Maintenance of PETTIBONE Equipment. Although long life and dependability are built into PETTIBONE Equipment, satisfactory performance depends upon intelligent maintenance and a thorough understanding of the various parts that make the complete unit.

Before maintenance operations are attempted, a thorough study of this manual is recommended.

■

MODIFICATIONS

Slight modifications in design as dictated by field experience or desire to improve the unit, or changes of materials due to inability to procure those originally specified may become necessary. Such changes in design will be obvious and, wherever possible, parts or assemblies will be interchangeable with the original design.

■

ILLUSTRATIONS

The illustrations in this manual are intended to show typical construction of the various parts. In some instances the shapes or details of the parts illustrated may not exactly represent their actual appearance; however, they will serve to show the servicing methods explained or help to identify parts performing the same functions.

Printed in U. S. A.

VOL. I

TECHNICAL MANUAL

OPERATION, MAINTENANCE

AND

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MODEL 100 TK-LSPC

50 TON CRANE

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NATIONAL IRON DIVISION
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SUPERSTRUCTURE OPERATORS AND SERVICE INSTRUCTIONS

PETTIBONE CORPORATION

4700 West Division Street • Chicago, Illinois 60651 • Phone: (Area 312) 772-9300

To Honor Our Warranty This Delivery Report Must Be Completely Filled Out and Returned To:

NATIONAL IRON COMPANY

50th Avenue West and Ramsey Street • Duluth, Minnesota 55807
Phone: (Area 218) 624-4863

CUSTOMER COPY

DELIVERY REPORT

IMPORTANT

A separate report must be made for each machine

Delivery Date_____

We report delivery of:_____

NAME OF MACHINE _____ MODEL NO._____ SERIAL NO._____

Sold To_____
Name of Customer

Permanent Address is_____
Town State

Street and Number_____

Delivery Point (Nearest Town)_____

- ☐ Inspected machine and checked for damage and shortage.
- ☐ Checked all gear cases for proper amount of grease and for correct viscosity of lubricant necessary for area and temperatures.
- ☐ Checked engine crank case and radiators.
- ☐ Started engine and checked over carefully for any misadjustments.
- ☐ Explained operation, greasing and maintenance procedures — Emphasized the major service points and periods.
- ☐ Explained service manuals and parts lists and delivered all manuals to owner.
- ☐ Explained that clutches, chains, belts and other moving parts might require several adjustments during break-in period and periodic checks and adjustments later.
- ☐ List any damage or shortages. (Use other side if necessary). Give us all pertinent information as well as the name of carrier with whom you filed claim — if a claim with carrier was filed.

The above machine was demonstrated and properly serviced and delivery is hereby accepted.

Purchaser's Signature_____

Title_____

Distributor's Name _____

Distributor's Address _____

Distribution Serviceman _____

To be made in DUPLICATE. Send ORIGINAL COPY to NATIONAL IRON COMPANY.

Form No. 698

PETTIBONE CORPORATION

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Form No. 698

STANDARD WARRANTY

THE PETTIBONE CORPORATION WARRANTS ITS HYDRAULIC CRANE PRODUCTS AGAINST DEFECTIVE MATERIAL AND/OR WORKMANSHIP FOR A PERIOD OF 6 (SIX) MONTHS OR 1,000 (ONE THOUSAND) HOURS OF OPERATION, WHICHEVER OCCURS FIRST, AFTER SUCH PRODUCTS ARE PLACED IN OPERATION, SUBJECT TO NORMAL USE AND SERVICE. THE CORPORATION'S SOLE LIABILITY SHALL BE LIMITED TO REPLACEMENT OF DEFECTIVE PARTS F.O.B. FACTORY. IF ANY MATERIAL IS FOUND TO BE DEFECTIVE WITHIN THE WARRANTY PERIOD SPECIFIED ABOVE, IMMEDIATE WRITTEN NOTIFICATION OF SAID DEFECT MUST BE MADE TO THE DISTRIBUTOR FROM WHOM THE MACHINE WAS PURCHASED OR TO THE CORPORATION. THE COST OF ANY LABOR, EXPENSES AND/OR DOWNTIME INCURRED BY SUCH DEFECTIVE PARTS ARE EXCLUDED. THE CORPORATION RESERVES THE RIGHT TO DEMAND THE RETURN OF SUCH PARTS FOR INSPECTION. TRANSPORTATION AND ALL OTHER CHARGES ARE TO BE PREPAID BY THE CUSTOMER.

THE CORPORATION RESERVES THE RIGHT TO MAKE ANY CHANGE IN DESIGN OR OTHERWISE MODIFY THE PRODUCT WITHOUT OBLIGATION TO INCORPORATE THESE CHANGES IN ANY PRODUCT PREVIOUSLY SOLD OR DELIVERED.

THE CORPORATION MAKES NO WARRANTY IN RESPECT TO TIRES, ENGINES, IGNITION APPARATUS, HORN, LIGHTS, STARTING DEVICES AND OTHER TRADE ACCESSORIES, SINCE THESE ARE WARRANTED SEPARATELY BY THEIR RESPECTIVE MANUFACTURERS.

PETTIBONE "100" TRUCK KRANE

OPERATING PROCEDURES

INTRODUCTION

BEFORE OPERATING A TRUCK KRANE, FAMILIARIZE YOURSELF WITH THE CONTROLS AND INSTRUCMENT PANEL. A CAREFUL OPERATOR IS THE BEST INSURANCE AGAINST ACCIDENTS TO THE CRANE OR PERSONS WORKING AROUND THE UNIT. BEFORE STARTING ENGINE, BE SURE ALL SHIFTING CONTROLS ARE IN NEUTRAL BEFORE PRESSING THE STARTING BUTTON. CARE SHOULD BE USED DURING THE FIRST FEW DAYS OF OPERATION TO INSURE THAT EVERY-THING IS WORKING SATISFACTORILY. WATCH PARTICULARLY FOR EXCESSIVE TEMPERATURE IN ENGINE, GEAR BOXES, ETC.

THE MANNER IN WHICH THE TRUCK KRANE IS OPERATED AND CARED FOR DURING THE FIRST 100 WORKING HOURS DETERMINES ITS FUTURE LIFE, FREEDOM FROM UNNECESSARY TROUBLES AND DELAYS, ETC. THE DUTY OF EVERY OPERATOR PLACED IN CHARGE OF A TRUCK KRANE IS TO STRICTLY ADHERE TO INSTRUCTIONS RECEIVED WHEN THE MACHINE IS DELIVERED AND TO THE INSTRUCTIONS IN THIS BOOK.

LUBRICATION AND MAINTENANCE — PROPER LUBRICATION AND MAINTENANCE ARE ESSENTIAL TO SATISFACTORY PERFORMANCE. FOLLOW THE "LUBRICATION POINTS" AND TRUCK KRANE MAINTENANCE INSTRUCTIONS TO BE FOUND IN THIS MANUAL.

DIRT IS YOUR WORST ENEMY — BEFORE REMOVING INSPECTION COVERS, PLUGS, ETC., FROM ANY PART OF THE TRUCK KRANE, THOROUGHLY CLEAN ALL DIRT AWAY FROM SAME. KEEP OIL AND GREASE CONTAINERS CLEAN AND WELL COVERED WHEN NOT IN USE. DO NOT ALLOW DUST TO ACCUMULATE IN THEM. KEEP ALL BREATHER CAPS IN PLACE, EXCEPT WHEN SERVICING.

MACHINE SET UP

AFTER ARRIVAL AT THE JOB SITE AND THE TRUCK HAS BEEN SPOTTED AT ITS LIFTING LOCATION, SHUT OFF THE ENGINE. LEAVING THE ENGINE SHUT OFF CABLE IN ITS "OFF" POSITION, PULL THE TWO PUMP GEAR CASE ENGAGEMENT CABLE LEVER. IN ORDER FOR THE GEARS TO MESH PROPERLY, IT SOMETIMES IS NECESSARY TO "JOG" THE STARTER. AFTER THE GEARS ARE PROPERLY MESHED, PUSH THE ENGINE SHUT OFF CABLE AND ENGINE IS READY FOR RUNNING. THIS NOW WILL ENGAGE THE FOUR HYDRAULIC PUMPS WHICH SUPPLY THE OIL TO ALL OF THE FUNCTIONS OF THE KRANE. "NOTE - AT NO TIME SHOULD THIS GEARCASE BE ENGAGED WHILE TRAVELING ON THE HIGHWAY".

THE OUTRIGGERS CAN NOW BE SET BY EITHER MANUALLY MOVING THE CONTROLS ON THE CARRIER OR OPERATING THE ELECTRIC CONTROLS IN THE UPPER CAB. THE KRANE SHOULD BE LEVELED BY USING THE CIRCULAR LEVELS MOUNTED ON THE CARRIER NEAR THE FRONT OUTRIGGERS. FOR THE BEST OPERATION, THE KRANE SHOULD BE RAISED ON THE OUTRIGGERS UNTIL THE REAR AND FRONT TANDEM TIRES ARE APPROXIMATELY 1/2" OFF THE GROUND. THIS ALLOWS THE MACHINE'S CENTER OF GRAVITY TO REMAIN AS LOW AS POSSIBLE AND REDUCES UNNECESSARY STRESS IN THE VERTICAL OUTRIGGER CYLINDER RODS.

MACHINE OPERATION

BY PUSHING THE LEVER IN THE UPPER CAB MARKED "WINCH", THE HOOK BLOCK WILL LOWER SLIGHTIY, ALLOWING THE HOOK TO BE DISENGAGED FROM ITS TRAVELING POSITION AND ALLOW THE BLOCK TO SWING FREE. RELEASE THE HOUSE-LOCK LEVER WHICH IS IMMEDICATELY TO THE RIGHT AND REAR OF THE OPERATOR'S SEAT. THIS DISENGAGES THE AIRCRAFT TYPE BRAKE WHICH HAS HELD THE SLEWING DRIVE IN A RIGID POSITION FOR ROAD TRAVEL (THIS SHOULD ALWAYS BE SET BEFORE THE KRANE IS ROADED FOR ANY APPRECIABLE DISTANCE). FOR THE MOST EFFICIENT OPERATION AND IN ORDER TO MAINTAIN SUFFICIENT OIL AND PRESSURE TO PROPERLY ACTUATE THE OPERATING VALVES AND COMPONENTS, THE EINGINE SHOULD OPERATE AT 1200 RPM OR ABOVE. FEATHERING OF THE OPERATING VALVES IS PREFERRED RATHER THAN CONTROLLING THE VARIOUS SPEEDS BY THE FOOT THROTTLE. THIS MAKES FOR MUCH SMOOTHER OPERATING AND ASSURES THE OPERATOR THAT THERE IS SUFFICIENT POWER AVAIAIBLE AT HIS FINGERTIPS AT ALL TIMES. WHEN EXTENDING THE TELESCOPING SECTIONS, THEY SHOULD BE EXTENDED NEAR EQUALLY, EXCEPT THAT IT IS ALWAYS PREFERRED THAT THE HEAVIER SECTION LEAD SLIGHTLY, WHEREVER POSSIBLE. IT IS SEIDOM PRACTICAL TO EVER HAVE ONE SECTION FULLY EXTENDED AND THE OTHER FULLY RETRACTED AS THIS POSITION EXERTS THE GREATEST FORCE ON THE BOOM SECTIONS. WHEN THESE CROWN SECTIONS ARE BEING EXTENDED, BE PARTICULARLY CAREFUL THAT THE MAIN WINCH IS PLAYING OUT CABLE AT THE SAME TIME, AS THIS WILL AVOID THE POSSIBILITY OF THE CROWD SECTIONS EXTENDING TOO FAST AND DOUBLING THE BLOCK AT THE BOOM POINT WHICH WILL RESULT IN A SNAPPED CABLE AND POSSIBLY BOOM DAMAGE. IN A SHORT PERIOD OF TIME IT WILL BECOME SECOND NATURE FOR AN OPERATOR TO ACQUIRE THE FEEL NECESSARY SO THIS SITUATION CAN NOT OCCUR.

FIGURE 1 ILLUSTRATES THE POSITIONING OF THE KRANE CONTROLS.

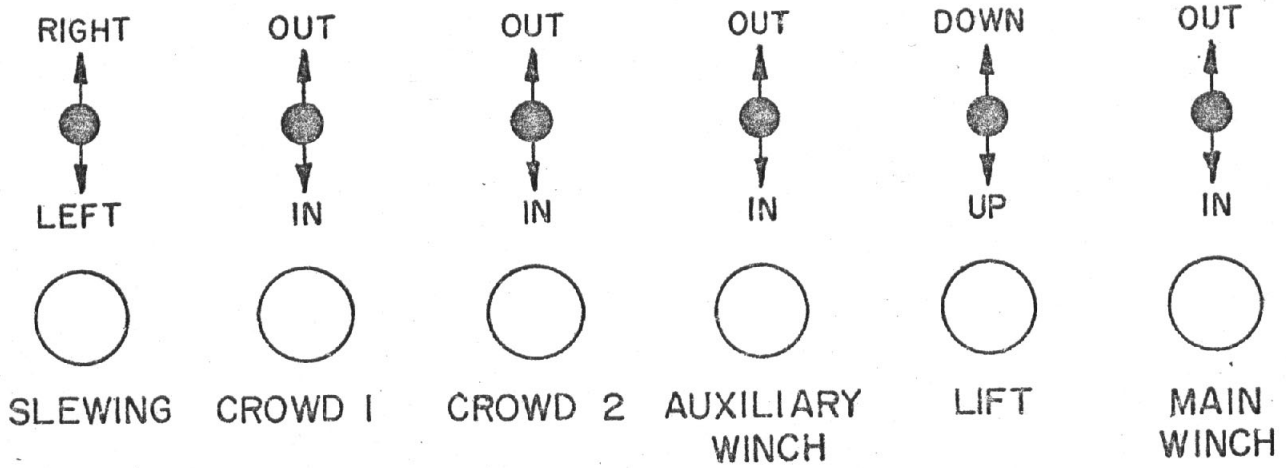

FIGURE 1

THE LIFTING CHART SUPPLIED WITH THIS UNIT IS BASED ON 85% OF TIPPING EXCEPT IN THE POSITION OVER THE REAR. AT NO TIME ATTEMPT TO LIFT MORE THAT THE WEIGHTS RECOMMENDED ON THE CHART. THE WEIGHT OF ALL LOAD HANDLING DEVICES SUCH AS; HOOK BLOCK, CHAINS, ETC., ARE CONSIDERED PART OF THE LOAD AND MUST BE ADDED WHEN WEIGHTS ARE CALCULATED. SINGLE LINE CAPACITY FOR THE MAIN WINCH IS 16,000 POUNDS. FOR HIGHER CAPACITIES, USE MULTIPLE REEVING OF YOUR BLOCK UP TO 8 PARTS OF LINE WHICH WILL BE ADEQUATE FOR 90,000 POUNDS.

THE KRANE FEATURES A FREE SWING CONTROL WITH A HYDRAULIC FOOT OPERATED BRAKE. THE BRAKE IS EQUIPPED WITH A MANUAL LOCK VALVE FOR HOLDING THE SWING POSITION.

ADDITIONAL CONTROLS LOCATED IN THE KRANE OPERATOR'S CAB INCLUDE THE FOLLOWING:

1. CARRIER ENGINE START AND STOP.
2. ALL OUTRIGGER FUNCTIONS.
3. AUXILIARY FOOT CONTROL FOR BOOM ELEVATION.

UNDER NO CONDITIONS SHOULD THE KRANE BE SUBJECTED TO EXCESSIVE SIDE LOADS (I.E. LOCKING THE SWING BRAKE AND WINCHING FROM THE SIDE).

THE JIB BOOM LOAD CAPACITY IS BASED ON SINGLE PART LINE OPERATION. USE OF A TWO-PART LINE IS PROHIBITED. WHEN JIB BOOM IS IN WORKING POSITION, REDUCE THE LOAD CHART CAPACITY BY 1,000 POUNDS FOR MAIN BOOM LOADS.

CAUTION: THE JIB ANGLE SHOULD NEVER EXCEED 7½ DEGREES IN RESPECT TO THE MAIN BOOM. THE PENDANT LINES ARE FURNISHED AT PREDETERMINED LENGTHS. THESE LENGTHS WILL ALLOW A 7½ DEGREE MAXIMUM JIB ANGLE WHEN THE OFFSET LINK IS INCLUDED, WHEN USING THE 32' JIB EITHER 5' OR 28' EXTENSION.

WHEN USING 32' JIB AND 24' JIB, AN OFFSET OF 15° TO 30° CAN BE ACHIEVED WITH OFFSET LINKS.

JIB & PENDANT LINE CHART

BOOM	JIBS	PENDANT LINES	LENGTHS
4 SECTION	32' SWINGAWAY & 24' JIB	FRONT 101-067	22'-4-1/8"
		REAR 101-068	30'-4-3/8"
3 SECTION	32' SWINGAWAY & 24' JIB	FRONT 101-067	22'-4-1/8"
		REAR 101-068	30'-4-3/8"
3 SECTION	28' EXTENSION & 32' SWINGAWAY	FRONT 100-717-1	58'-2-1/2"
		REAR 100-717-2	30'-5"
3 SECTION	5' EXTENSION & 32' SWINGAWAY	FRONT 100-836	35'-7-5/8"
		REAR 100-717-2	30'-5"

COLD WEATHER OPERATION

VISCOSITY OF A HYDRAULIC FLUID IS THE MEASURE OF ITS INTERNAL FRICTION OR RESISTANCE TO FLOW.

THE STANDARD METHOD OF DESIGNATION IS THE SSU, SAYBOLT SECONDS UNIVERSAL, WHICH IS THE ACTUAL CLOCKED NUMBER OF SECONDS FOR A MEASURED AMOUNT OF FLUID TO DRAIN THROUGH A SMALL ORIFICE AT A GIVEN TEMPERATURE.

THE UPPER CRITICAL VISCOSITY IS 75 SSU NEEDED TO SAFELY SEAL AND LUBRICATE THE PUMP. (VICKERS VANE SAYS 60 SSU OK)

THE LOWER CRITICAL VISCOSITY IS 4,000 SSU. THIS IS ALSO CALLED THE PUMP-ABILITY FACTOR. BELOW THIS TEMPERATURE OIL WILL NOT FILL THE PUMP AND SERIOUS CAVITATION (HAMMER) AND DESTRUCTIVE WEAR BEGINS.

WHEN THE OIL VISCOSITY IS BELOW 4,000 SSU, EXTREME CARE SHOULD BE USED IN STARTING AND WARMING THE HYDRAULIC FLUID TO A SAFE TEMPERATURE. A METHOD (SHORT OF ACTUAL APPLICATION OF HEAT) RECOMMENDED BY MOBILE EQUIPMENT MANUFACTURERS IS AS FOLLOWS:

1. JOG PUMP; ON 5 SECONDS - OFF 20 SECONDS (TEN TIMES) THEN ON 20 SECONDS, OFF 20 SECONDS (ABOUT 5 TIMES). IDLE SYSTEM A FEW SECONDS.

2. RUN PUMP AT ½ SPEED (ABOUT 800 TO 1000 RPM) AND PULL BACK ON ONE OF THE CROWD CYLINDER CONTROLS AND STALL IT THUS BLOWING OIL THRU THE PRESSURE RELIEF VALVE. RELIEVE PRESSURE 10 SECONDS OF EACH MINUTE.

3. OIL PASSING THRU THE RELIEF VALVE DOES NO USEFUL WORK AND PICKS UP 8½ DEGREES OF WARMTH PER 1000 POUNDS OF PRESSURE DROP. (APPROXIMATELY TEN MINUTES)

WHEN THE OIL VISCOSITY IS BELOW 20,000 SSU, WARM TANK (UP ABOUT 40 DEGREES) BEFORE STARTING PUMP, THEN FOLLOW STEPS ABOVE.

THE AVERAGE LIGHT HYDRAULIC FLUID HAS ABOUT THE PROPERTIES OF A 10W OIL (EXCEPT LITTLE OR NO DETERGENT) AND HAS A 4,000 SSU OR PUMPABILITY TEMPERATURE OF ABOUT 0 TO 20 DEGREES, AND A HIGH TEMPERATURE LUBRICITY FACTOR OF ABOUT 150 TO 175 DEGREES DEPENDING ON THE VISCOSITY INDEX.

PETTIBONE
100 TK-LS

HYDRAULIC TRUCK KRANE

PETTIBONE 100 TK-LS RATED LIFTING CAPACITIES
OUTRIGGERS FULLY EXTENDED—OVER SIDE AND REAR

RADIUS IN FEET	BOOM LENGTH				90' Boom + 22' Ext.	90'Boom + 32' Fly	111' Boom + 32' Fly
	37' BOOM	50' BOOM	62' BOOM	90' BOOM	111' BOOM	122' BOOM	143' BOOM
10	100,000						
12	95,000	66,000					
15	75,000	59,000	45,000				
20	60,000	48,000	40,000				
25	40,000	39,000	35,000	28,000	20,000	15,000	
30	28,000	28,000	27,000	24,000	18,000	15,000	
35		19,700	19,700	19,700	15,500	14,000	7,500
40		14,800	15,000	15,000	13,500	12,500	7,500
45			12,000	12,000	11,800	11,500	7,500
50			9,400	9,400	10,500	10,500	7,000
55			7,200	7,200	9,500	9,500	6,500
60				6,200	8,100	8,500	6,000
65				5,000	6,500	6,900	5,500
70				3,800	5,300	5,900	5,000
75				2,800	4,400	4,900	4,500
80				1,900	3,500	3,800	4,000
85				1,000	2,800	3,000	3,400
90					2,000	2,300	2,700
95					1,500	1,800	2,100
100					1,000	1,300	1,400
105					500	500	1,000

AREA ABOVE HEAVY LINE DENOTES STRUCTURAL STRENGTH

AREA BELOW HEAVY LINE DENOTES 85% OF TIPPING

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100 TK-LS

HYDRAULIC TRUCK KRANE

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10	100,000						
12	95,000	66,000					
15	75,000	59,000	45,000				
20	60,000	48,000	40,000				
25	40,000	39,000	35,000	28,000	20,000	15,000	
30	28,000	28,000	28,500	24,000	18,000	15,000	
35		21,000	21,500	19,700	15,500	14,000	7,500
40		17,000	17,500	15,000	13,000	12,500	7,500
45			13,500	14,000	11,800	11,500	7,500
50			11,000	11,500	10,500	10,500	7,000
55			8,500	9,500	9,500	9,500	6,500
60				7,500	8,500	8,500	6,000
65				6,000	7,500	8,000	5.500
70				4,500	6,500	6,500	5,000
75				3,500	5,400	5,500	4,500
80				2,500	4,300	4,700	4,000
85				1,600	3,700	4,000	3,700
90					3,000	3,500	3,400
95					2,200	2,700	3,200
100					1,600	2,100	2,700
105					1,000	1,600	2,100
110						1,000	1,700
115							1,400
120							1,000

ALL CAPACITIES SHOWN OVER REAR ARE BASED ON STRUCTURAL STRENGTH

ANTI-TWO BLOCK DEVICE

GENERAL:

The main function of this anti-two block device is to prohibit the hook block from coming in contact with the sheaves in the boom. This will keep the hook block from two-blocking and thereby eliminating the possibility of damaging either the sheaves or the cable. This system is on both the main and auxiliary winches.

OPERATION:

a. This system contains a boom mounted Micro switch, cable reel and a solenoid operated hydraulic dump valve.

b. When the hook block comes to within a specified distance from the sheaves, approximately 24", it will trip a weight, which in turn will activate the Micro switch. The Micro switch then sends an electrical impulse to the solenoid operated dump valve which is normally closed. The electrical impulse opens the spool and reroutes the oil directly to the hydraulic reservoir.

c. This dump valve will deactivate the main and auxiliary winch in the up position, the crowd 1 and crowd 2 in the extend position and the boom lift cylinders in the down position.

d. To return the crane to a safe operating condition, simply reverse the operation that put the crane in the unsafe position. If you were raising the winch when it activated the dump system, lower the winch to deactivate it. This same procedure also applies to the crowds and the lift.

SAFE LOAD CONTROL DEVICE

GENERAL:

The main function of this safe load device is to prohibit the overloading of the crane by stopping the boom hoist in a lowering direction when the maximum safe load radius combination is reached. This system is designed to be used in conjuntion with the certified nuclear load, which is the handling of the Titan II Missile and its components.

OPERATION:

a. This system contains a weather proof boom angle switch box, an operator's signal box, a pendulum type boom angle indicator, a hydraulic dump valve and an on-off actuating switch.

b. Before attempting to operate the crane to lift the missile components, the following procedure must be followed:

(1) With the boom in the rest position, open up the boom angle switch box and set the boom up knob to 80° and the boom down knob to 63°.

(2) Switch the safe load actuating switch to the off position.

(3) Raise the boom and swing over side of machine to extend manual section as per Chapter 1, Section B, Page 1-9.

(4) Raise the boom until the needle on the boom angle indicator reads 55°.

(5) Switch the safe load actuating switch to the on position. This will actuate the alarm and the dump system, which will prevent lowering the boom.

(6) Raise the boom until the alarm has stopped.

(7) The boom should now be at 63°.

(8) Crowd out the two sections giving you maximum boom length.

(9) The boom should now be at the proper angle and radius to lift the Titan II Missile components.

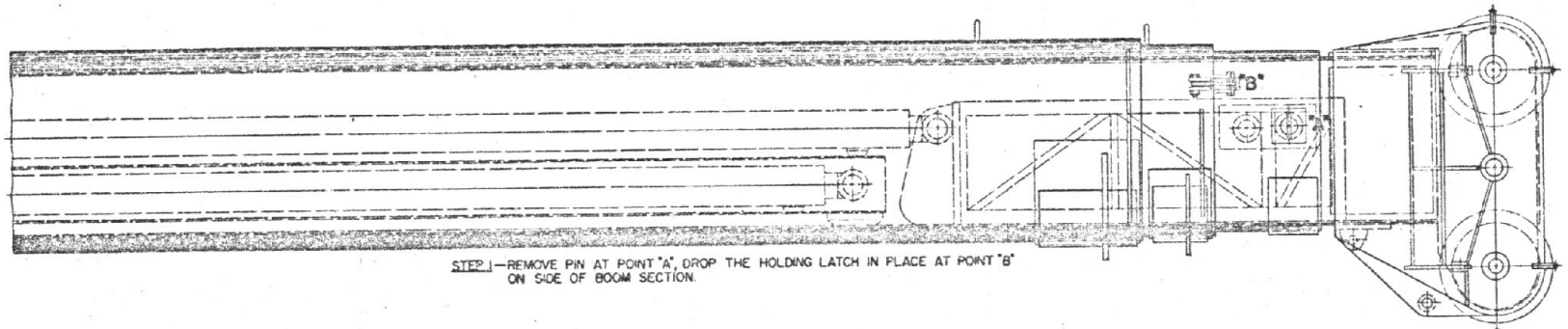
(10) To lower the boom, retract the two hydraulic sections completely and switch the safe load actuating switch to the off position.

(11) The boom can now be lowered without actuating the alarm or the hydraulic dump system.

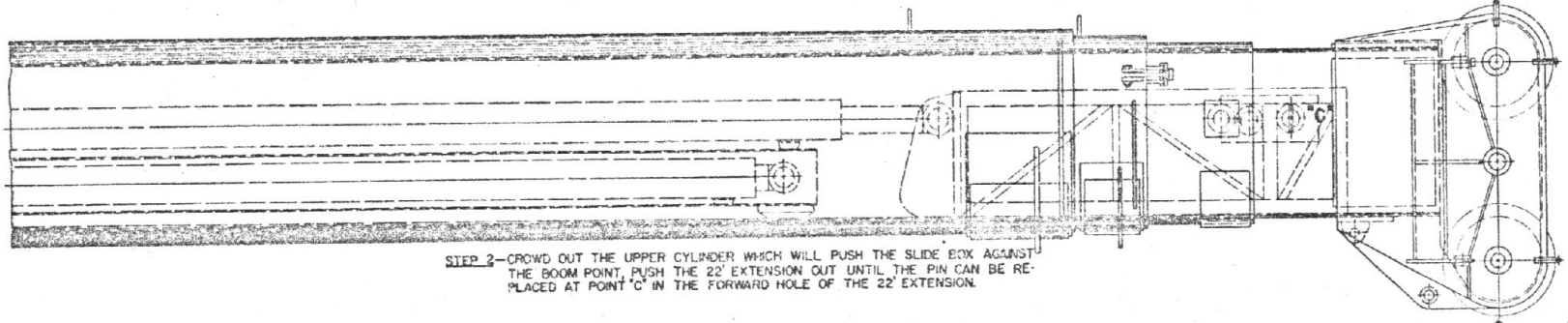
c. The dump system is activated by an electrical impulse coming from the operator's signal box when the boom reaches 63°. This electrical impulse energizes the solenoid controlled dump valve which is normally closed. This opens the spool and directs the oil directly to the hydraulic reservoir. This does not disrupt the boom raising operation. Raising the boom past the unsafe condition will deactivate the electrical impulse and close the spool in the dump valve and thereby directing the flow of oil back to the relief valve controlling the boom lifting operation.

d. It must also be noted that this hydraulic dump valve is also used in conjunction with the anti-two block device on the winches. This is explained in the next Section.

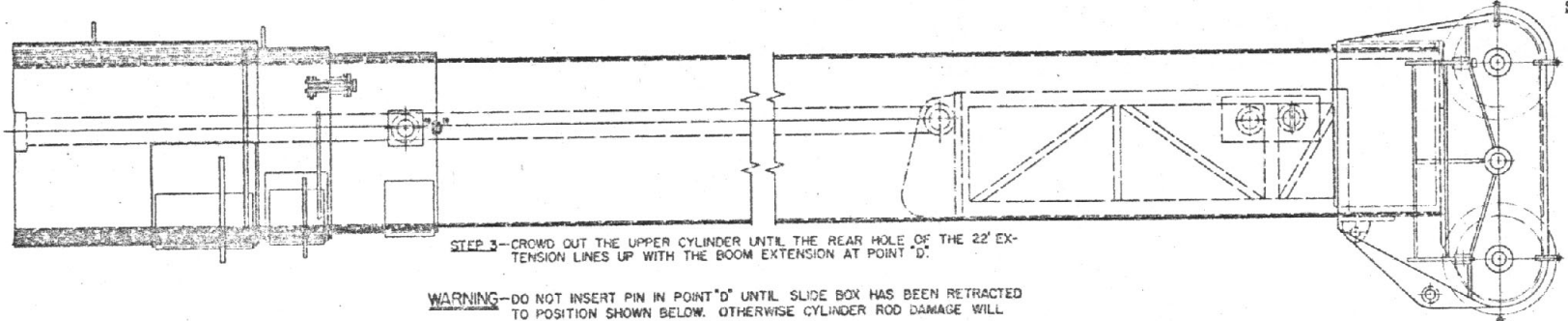
100 TK-LS
DIRECTIONS FOR OPERATION OF SLIDING BOX FOR EXTENDING 22' EXTENSION HYDRAULICALLY
D-201-292



STEP 1—REMOVE PIN AT POINT "A", DROP THE HOLDING LATCH IN PLACE AT POINT "B" ON SIDE OF BOOM SECTION.

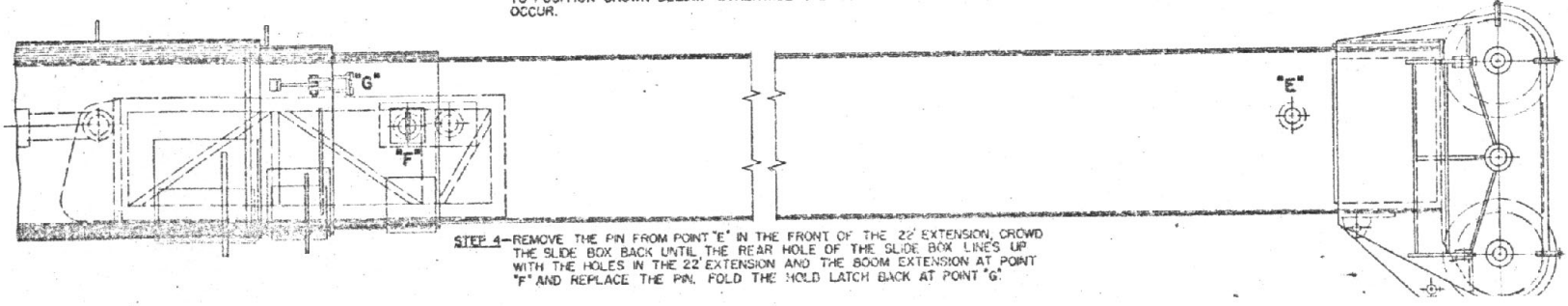


STEP 2—CROWD OUT THE UPPER CYLINDER WHICH WILL PUSH THE SLIDE BOX AGAINST THE BOOM POINT, PUSH THE 22' EXTENSION OUT UNTIL THE PIN CAN BE REPLACED AT POINT "C" IN THE FORWARD HOLE OF THE 22' EXTENSION.



STEP 3—CROWD OUT THE UPPER CYLINDER UNTIL THE REAR HOLE OF THE 22' EXTENSION LINES UP WITH THE BOOM EXTENSION AT POINT "D".

WARNING—DO NOT INSERT PIN IN POINT "D" UNTIL SLIDE BOX HAS BEEN RETRACTED TO POSITION SHOWN BELOW. OTHERWISE CYLINDER ROD DAMAGE WILL OCCUR.



STEP 4—REMOVE THE PIN FROM POINT "E" IN THE FRONT OF THE 22' EXTENSION, CROWD THE SLIDE BOX BACK UNTIL THE REAR HOLE OF THE SLIDE BOX LINES UP WITH THE HOLES IN THE 22' EXTENSION AND THE BOOM EXTENSION AT POINT "F" AND REPLACE THE PIN. FOLD THE HOLD LATCH BACK AT POINT "G".

STEP 5—RETRACTING THE 22' EXTENSION CAN BE DONE BY TWO-BLOCKING THE HOOK BLOCK AND WINCHING IT IN OR HYDRAULICALLY USING THE REVERSE OF STEPS 1 TO 4. WHICHEVER METHOD IS USED IT MUST BE CERTAIN THE SLIDE BOX AND THE CYLINDER ARE IN THE FULLY RETRACTED POSITION.

SERVICE AND MAINTENANCE FOR MODEL 100 TRUCK KRANE

GENERAL STARTING PRACTICE:

1. WHEN THE MACHINE IS FIRST RECEIVED, INSPECT IT VERY CAREFULLY FOR LOOSE BOLTS OR DAMAGE THAT MIGHT HAVE OCCURRED IN TRANSIT. ASSEMBLE ANY LOOSE ITEMS THAT MAY HAVE BEEN SHIPPED CRATED. (SOME ITEMS ARE SHIPPED IN A SEPARATE CRATE TO PREVENT LOSS IN SHIPMENT)

2. CHECK THE OIL LEVEL IN THE FOLLOWING TO SPECIFICATIONS OUTLINED IN THE LUBRICATION CHART:

   A. CARRIER ENGINE CRANKCASE. (REFER TO MANUFACTURER'S MANUAL)

   B. TRANSMISSION, CONVERTER, AND AXLES. (REFER TO MANUFACTURER'S MANUAL)

   C. HYDRAULIC OIL TANK. (REFER TO LUBRICATION CHART)

3. CHECK THE COOLING SYSTEM OF THE ENGINE TO BE SURE THAT THE RADIATOR IS FULL AND THAT THE DRAIN COCK ON THE RADIATOR AND BLOCK IS CLOSED.

   WHEN TEMPERATURES REACH 32° F OR BELOW, OR THERE IS DANGER OF WATER FREEZING IN THE COOLING SYSTEMS, USE A KNOWN RELIABLE BRAND OF PERMANENT ANTI-FREEZE SOLUTION AND ADD IT TO THE RADIATOR ACCORDING TO THE MANUFACTURER'S DIRECTIONS.

4. CHECK TO DETERMINE THAT ALL DRAIN PLUGS, DRAIN COCKS, FILTER OPENINGS, FUEL LINES, OIL LINES, AND COOLING SYSTEM CONNECTIONS ARE TIGHT AND DO NOT LEAK.

5. CONNECT BATTERY CABLES. (WHEN SHIPMENT IS MADE BY RAIL THE CABLES ARE DISCONNECTED). INSPECT TO INSURE THAT THE BATTERY IS NOT DISCHARGED AND THAT THE LIQUID IS AT PROPER LEVEL. ALSO CHECK ALL BATTERY CONNECTIONS TO INSURE THAT NONE ARE LOOSE OR CORRODED.

6. CHECK TIRE PRESSURE AGAINST THAT RECOMMENDED ON THE LUBRICATION CHART. BE SURE VALVE CAPS ARE IN PLACE TO PREVENT DIRT, MOISTURE AND FOREIGN MATERIAL FROM DAMAGING THE VALVE CORE.

7. GREASE ALL LUBRICATION POINTS OF THE ENTIRE UNIT. REFER TO THE LUBRICATION CHART AS A GUIDE.

100 TK-LS LIFTING CAPACITY AND SAFETY INSTRUCTIONS

1. RATED LIFTING CAPACITIES ARE THE MAXIMUM LOADS COVERED BY THE MANUFACTURER'S WARRANTY WITH THE MACHINE STANDING ON FIRM, UNIFORM AND LEVEL SURFACE, WITH OUTRIGGERS FULLY EXTENDED AND LOCKED DOWN, AND WITH 5,000 LBS COUNTERWEIGHT ATTACHED TO UPPER AND FULLY EXTENDED.

2. AT RADII WHERE NO RATINGS ARE SHOWN ON CHART, OPERATION IS NOT INTENDED OR APPROVED.

3. RADIUS OF LOAD IS THE HORIZONTAL DISTANCE FROM A PROJECTION OF AXIS OF ROTATION BEFORE LOADING, TO THE CENTER OF VERTICAL HOIST LINE OR TACKLE WITH LOAD APPLIED.

4. THE WEIGHT OF ALL AUXILIARY HANDLING DEVICES SUCH AS HOIST BLOCKS, HOOKS AND SLINGS IS CONSIDERED AS PART OF THE LOAD.

5. PRACTICAL WORKING LOADS SHALL BE ESTABLISHED BY THE USER AND DEPEND ON SUPPORTING SURFACE, WIND, PROPER OPERATING SPEEDS AND, IN GENERAL, CAREFUL AND COMPETENT OPERATION.

6. WHEN USING JIBS WITH EXTENDED BOOMS, THE MAIN BOOM LOAD CHART MUST NOT BE EXCEEDED.

7. WHEN USING 32' SWING BACK FLY, REDUCE CAPACITY OVER MAIN BOOM BY 3,000 LBS. WHEN USING 60' JIB, & 56' JIB, REDUCE CAPACITY OVER MAIN BOOM BY 4,000 LBS. JIB AND FLY CAPACITIES ARE PASED ON SINGLE LINE OPERATION. USE OF TWO PART LINE VOIDS WARRANTY.

8. MAXIMUM BOOM LENGTH FOR PURPOSE OF ERECTING JIBS IS 59'.

9. THE WINCHES ON THIS MACHINE ARE EQUIPPED WITH AUTOMATIC (FAIL-SAFE) SPRING SET, HYDRAULIC RELEASED BRAKES.

10. THE HYDRAULIC POWERED BOOM SECTIONS ARE INDEPENDENTLY OPERATED WITH THE FIRST SECTION EXTENDING 25'-9" AND THE SECOND EXTENDING 27'-3". POWER TELESCOPING BOOM SECTIONS MUST BE EXTENDED AND RETRACTED EQUALLY. THE MAXIMUM LOAD WHICH MAY BE TELESCOPED IS LIMITED BY HYDRAULIC PRESSURE, BOOM ANGLE AND BOOM LUBRICATION. IT IS SAFE TO ATTEMPT TO TELESCOPE ANY LOAD WITHIN THE LIMITS OF THE LOAD CHART.

11. HANDLING OF PERSONNEL FROM THE BOOM IS NOT AUTHORIZED.

12. FOR CLAM-SHELL OR CONCRETE BUCKET OPERATIONS, WEIGHT OF BUCKET AND LOAD MUST NOT EXCEED 90% OF RATED LIFTING CAPACITY.

13. LOAD HANDLING DEVICES SHOULD BE KEPT A MINIMUM OF 12" BELOW THE BOOM POINT WHEN LOWERING OR EXTENDING BOOM TO PREVENT TWO-BLOCKING.

100 TK-IS LIFTING CAPACITY AND SAFETY INSTRUCTIONS (CONTINUED)

14. WITH CERTAIN BOOM AND HOIST TACKLE COMBINATIONS, MAXIMUM CAPACITIES MAY NOT BE OBTAINABLE WITH STANDARD ROPE LENGTHS.

15. WITH CERTAIN BOOM AND LOAD COMBINATIONS, RAISING OF LOAD WITH BOOM LIFT CYLINDERS MAY NOT BE POSSIBLE. OPERATIONAL SAFETY IS NOT AFFECTED BY THIS CONDITION.

CABLE CAPACITY (POUNDS)	
NO OF PARTS OF LINE	3/4"-6 x 19 IWRC
1	15,900
2	30,000
3	44,000
4	58,000
5	72,000
6	85,000
7	100,000
8	100,000

SERVICE INSTRUCTIONS

IT IS OF UTMOST IMPORTANCE THAT THE ENTIRE HYDRAULIC SYSTEM BE KEPT CLEAN AND FREE FROM DIRT, GRIT, WATER, AIR OR ACIDS AT ALL TIMES. PERIODIC DRAINING, CLEANING AND REFILLING WITH NEW OIL IS RECOMMENDED TO INSURE PROPER PERFORMANCE AND SERVICE.

ALL OPENINGS IN THE HYDRAULIC CIRCUIT MUST BE PROPERLY CAPPED IF COMPONENT UNITS ARE REMOVED. THESE UNITS SHOULD ALSO BE CAPPED OR PLUGGED TO PROTECT THEM FROM ENTRY OF FOREIGN MATTER.

IT IS NECESSARY TO CHANGE HYDRAULIC FLUID EVERY 500 WORKING HOURS FOR DUSTY ATMOSPHERE OPERATION. ONE THOUSAND WORKING HOURS ARE RECOMMENDED UNDER NORMAL CONDITIONS.

SERVICE AND CLEAN THE HYDRAULIC SYSTEM OIL FILTERS AT EACH OIL CHANGE.

QUITE OFTEN A NEW OIL WILL HAVE A LINT-LIKE MATERIAL, WHICH WHEN PRESENT IN THE OIL WILL PLUG OIL FILTERS. FOR THIS REASON, THE FILTERS SHOULD BE CHECKED DURING THE FIRST 25 HOURS OF OPERATION AFTER ANY CONSIDERABLE QUANTITY OF OIL HAS BEEN ADDED TO THE HYDRAULIC SYSTEM.

WHEN HYDRAULIC FLUID IS ADDED TO REPLENISH THE SYSTEM, ALWAYS POUR IT THROUGH A MICRON FILTER. IF SUCH A FILTER IS NOT AVAILABLE, USE A FUNNEL WITH A FINE WIRE SCREEN (200 MESH OR BETTER).

IT IS IMPORTANT THAT OIL BE CLEAN AND FREE OF ALL SUBSTANCES THAT WILL CAUSE IMPROPER OPERATION OF THE PUMPS AND MOTORS AND EXCESSIVE WEAR OF THEIR PARTS. FOR THIS REASON, CLOTH SHOULD NEVER BE USED TO FILTER HYDRAULIC FLUID AS THERE IS ALWAYS DANGER OF ADDING LINT TO THE OIL.

WHEN DRAINING THE HYDRAULIC SYSTEM ALWAYS DRAIN THE SYSTEM AFTER WORKING THE MACHINE, BECAUSE THE OIL WILL BE WARM AND FLOW FREELY, WHICH IS NEEDED TO CARRY ALL THE DIRT AND SLUDGE WITH IT.

REFER TO THE LUBRICATION CHART FOR INFORMATION PERTAINING TO THE ABOVE SUBJECT AND OTHER SPECIAL INFORMATION.

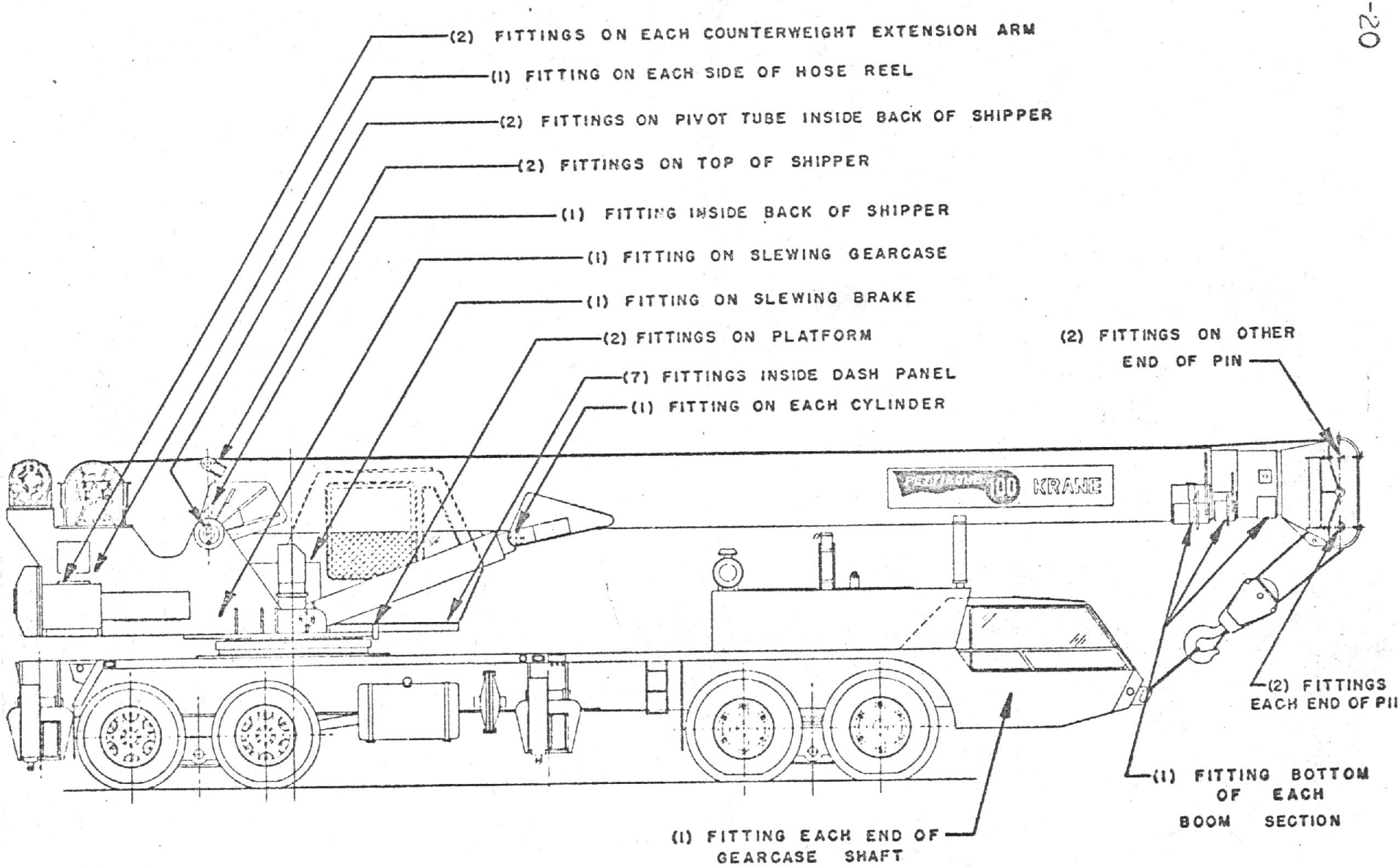
LUBRICATION AND SPECIAL INFORMATION CHART

DESCRIPTION	CAPACITY	TYPE OF LUBRICATION	REMARKS
TRUCK CARRIER (ALL COMPONENT PARTS SEE MFG'S MANUAL)			
HYDRAULIC OIL RESERVOIR AND SYSTEM	8 x 4 CARRIER 150 GALLONS	TEXACO RANDO HD-A (SEE HYDRAULIC LUBRICATION SHEET)	SEE SERVICE INSTRUCTIONS FOR REQUIRED CHANGER.
SLEWING GEAR CASE	12-3/4 PTS.	TEXACO MEROPA #3	CHANGE EVERY 1000 HRS.
MAIN WINCH	SEE MAIN WINCH SERVICE MANUAL		
TWO PUMP GEAR CASE	4 PTS.	TEXACO #90 GEAR LUBE (MULTI-PURPOSE)	CHANGE EVERY 1000 HRS.
AUXILIARY WINCH	SEE AUX WINCH SERVICE MANUAL		
DENISON MOTORS		SELF LUBRICATING	
VICKERS PUMPS		SELF LUBRICATING	
TURNTABLE ASSEMBLY		GREASE - EXTREME PRESSURE	GREASE EVERY 40 HRS.
SUMP OIL FILTERS	500 SQ. IN. FILTERING AREA 100 GPM.	FILTERS FOR HYDRAULIC CIRCUIT	SERVICE AND CLEAN AT EACH HYDRAULIC OIL CHANGE.
BATTERY	AS NEEDED	WATER	KEEP CONNECTIONS PROPERLY CLEAN AND TIGHT.

LUBRICATION AND SPECIAL INFORMATION CHART

Description	Capacity	Type of Lubrication	Remarks
Tire Pressure	75 lbs.	None	Keep tire pressure up to give longer tire life.
Shipper, Boom & Extension		Grease - pressure	Grease every 40 hours

NOTE: All grease fittings use LUBRIPLATE #630-AA from FISKE BROTHERS REFINING COMPANY.



100 TK-LS LUBRICATION

RECOMMENDED MOBILE CRANE PERIODIC SAFETY INSPECTION RECORD

MANUFACTURE:	MODEL:	SERIAL NO:	CRANE NO:	MILEAGE:	HOURS:

CARRIER ITEM	INSPECTION CODE	DIAGNOSIS	SATIS-FACTORY	ADJUST	REPAIR
(INSIDE) PARKING BRAKE	D				
OIL PRESSURE	D				
AIR PRESSURE	D				
LOW AIR WARNING DEVICE	D				
TELLTAIL LIGHTS & BUZZERS	D				
HORN	D				
WINDSHIELD WIPER	D				
HEATER DEFROST	D				
MIRRORS	D				
STEERING WHEEL (EXCESS PLAY)	D				
ALL LIGHT SWITCHS	D				
ALL GLASS	D				
FIRE EXTINGUISHER	D				
FUSES	P				
(OUTSIDE) HEADLIGHTS	D				
CLEARANCE LIGHTS	D				
TURN SIGNALS & 4 WAY FLASHERS	D				
WINDSHIELD WIPER BLADES	D				
LUGS, TIRES & WHEELS	D				
FUEL TANK & CAP	D				
OUTRIGGER CONTROLS	D				
TAIL & STOP LIGHTS	D				
SIDE MARKER LIGHTS	D				
RADIATOR	D				
THERMOSTAT & HOSES	P				
DRIVE BELTS	D				
AIR COMPRESSOR	D				
AIR GOVERNOR	D				
AIR TANKS, LINES	D				
MUFFLER	P				
EXHAUST & TAIL PIPES	P				
CLUTCH	P				
TRANSMISSION	P				
REAR AXLE	P				
AIR-HYDRAULIC SYSTEM	D				
STEERING GEAR & CONTROLS	D				
SPRINGS & SHACKLES	P				
CRANE SUPERSTRUCTURE ITEMS					
ALL CONTROL MECHANISMS	D				
SWING	D				
LOAD RATING CHARTS & DECALS	D				
HOISTS	D				
TELESCOPE BOOM	D				
AUXILIARY WINCH	D				
MAIN WINCH	D				
BRAKES	D				
LIMIT SWITCHES	D				
BOOM ANGLE INDICATOR	D				
SIGNAL HORN	D				
GLASS	D				
WINDSHIELD WIPER	D				
OUTRIGGER CONTROLS	D				
HEATER & DEFROSTER	D				
HYDRAULIC FLUID	D				
WIRE ROPE	D				
SHEAVES, GUARDS	D				
BLOCKS & HOOKS	D				
BOOM	D				
JIB BACK STOPS	P				
OVERALL CLEANLINESS	D				
AUTO. BOOM KICK-OUT	D				
NUTS, BOLTS, RIVETS	M				
WEDGE SOCKETS	D				
MACHINERY GUARDS	P				
COUNTERWEIGHT HOOKS & BOLTS	W				

D- DAILY

W- WEEKLY

M- MONTHLY

P- PERIODICALLY

NOTICE

TURNTABLE BEARING BOLTS SHOULD BE CHECKED FOR TIGHTNESS AFTER THE FIRST 40 HOURS OF OPERATION AND EVERY 800 HOURS THEREAFTER.

NOTE

TIGHTEN BOLTS TO 1,200 FT/LB TORQUE.

NOTICE

IT IS RECOMMENDED THIS MACHINE NOT BE STEAM CLEANED FOR A PERIOD OF THREE MONTHS FROM DATE OF DELIVERY. THIS WILL ALLOW THE PAINT SUFFICIENT TIME TO AGE.

General

The krane hydraulic system consists of the hydraulic pump, drive motors, actuating cylinders, boom lift and boom extension cylinders (upper and lower), reservoir, filters, valves, lines, and fittings. Filters and valves will be serviced according to Vicker's Service Manuals included in this book covering each of these units. Pumps and drive motor will be serviced according to Denison's Service Manuals included in this book covering each of these units. It is of utmost importance that the entire hydraulic system be kept claean and free from dirt, grit, water, air or acids at all times. Periodic draining, cleaning and refilling with new oil is recommended to insure proper performance and service.

All openings in the hydraulic circuit must be properly capped if component units are removed. These units should also be capped or plugged to protect them from entry of foreign matter.

It is necessary to change hydraulic fluid every 500 working hours for dusty atmosphere operation. 1000 working hours are recommended under normal conditions. Service and clean the hydraulic system oil filters at each oil change. Quite often a new oil will have a lint-like material, which when present in the oil will plug oil filters. For this reason, the filters should be checked during the first 25 hours of operation after any considerable quantity of oil has been added to the hydraulic system.

Krane Hydraulic Pump

The krane hydraulic pump is a high-volume, high-pressure unit mounted on the lower side of the carrier frame and driven by a universal drive shaft off crank shaft pulley at front of engine. The pump supplies the fluid power required for all krane operations. For service and maintenance on this pump see Denison's Service Manual.

Hydraulic Motors - Swing

The hydraulic motors on winch and swing are M1E series vane type and for service and maintenance on motors see Denison's Service Manual included in this book.

Hydraulic Reservoir

Mountied on R. H. front fender of carrier.

Return Line Filters on Hydraulic Reservoirs

Filter elements should be replaced initially after 50 hours of operation and at least every 500 hours thereafter, under ordinary operating conditions. However, there can be a wide variation in the length of service periods and only experience can dictate how long the period must be for a particular application. A good preventative program should include regular filter element changes.

Before servicing the filter, the hydraulic system must be shut down and the filter and surrounding piping wiped clean. The filter body and element are removed together by screwing out the hold down bolt. The inside of the body should be wiped clean before installing the new element.

A new body gasket should be installed at this time. This gasket is included with the filter element in new filter element kit.

Multiple Unit Valves

For all operations are Vicker's CM2 units and are located in console in cab to front of operator. See Vicker's Service Manual.

ND TESTING PROCEDURES FOR CONTROL VALVES

2500 P.S.I.

2000 P.S.I.

2500 P.S.I.

2500 P.S.I.

2000 P.S.I.

375 TO 425 P.S.I.

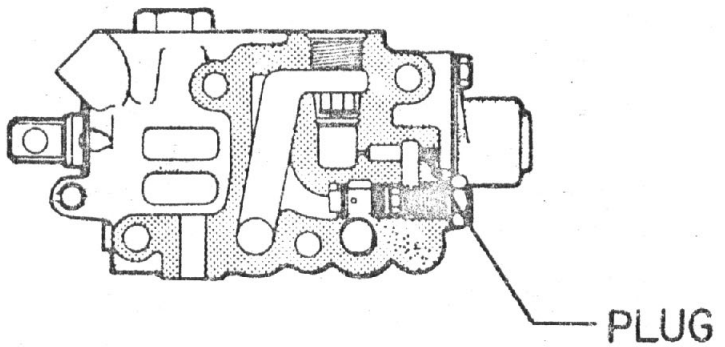
TING ON THE MODEL 30 DESIGN VICKERS
OCEDURE SHOULD BE FOLLOWED. REMOVE
UG, WHICH IS LOCATED DIRECTLY ABOVE
E DRAWING BELOW. INSTALL A PRESSURE
GAUGE AND TEST AS LISTED BELOW:

1. FOR THE #1 CROWD CONTROL AND THE SLEWING CONTROL VALVE #100-079, CROWD OUT THE BOOM SECTION, 2ND SECTION, AND HOLD IN THE STALLED POSITION WHILE CHECKING GAUGE.

2. FOR THE #2 CROWD CONTROL AND THE MAIN WINCH VALVE, #100-643 CROWD OUT THE BOOM EXTENSION SECTION, 3RD SECTION, AND HOLD IN THE STALLED POSITION WHILE CHECKING GAUGE.

3. FOR THE BOOM LIFT CONTROL AND THE AUXILIARY WINCH CONTROL VALVE, 100-642, LIFT THE BOOM SECTIONS UP TO 75° AND HOLD IN THE STALLED POSITION WHILE CHECKING GAUGE.

4. FOR THE PRIMARY WINCH CONTROL VALVE, #100-641, ATTACH A WEIGHT TO THE PRIMARY WINCH LINE, WHICH EXCEEDS THE SINGLE LINE PULL, AND CHECK THE GAUGE.



SPERRY RAND

VICKERS® OIL RECOMMENDATIONS FOR MOBILE HYDRAULIC SYSTEMS

THE OIL IN A HYDRAULIC SYSTEM SERVES AS THE POWER TRANSMISSION MEDIUM. IT IS ALSO THE SYSTEM'S LUBRICANT AND COOLANT. SELECTION OF THE PROPER OIL IS A REQUIREMENT FOR SATISFACTORY SYSTEM PERFORMANCE AND LIFE.

TWO IMPORTANT FACTORS IN SELECTING AN OIL FOR USE IN MOBILE HYDRAULIC SYSTEMS ARE:

1. ANTIWEAR ADDITIVES - The oil selected must contain the necessary additives to insure high antiwear characteristics.
2. VISCOSITY - The oil selected must have proper viscosity to maintain an adequate lubricating film at system operating temperature.

SUITABLE TYPES OF OIL FOR USE IN MOBILE HYDRAULIC SYSTEMS ARE:

1. CRANKCASE OIL meeting performance classification, letter designations, SC, SD or SE of SAE J183. Note that one oil may meet one or more of these classifications.
2. ANTIWEAR TYPE HYDRAULIC OIL - There is no common designation for oils of this type. However, they are produced by all major oil suppliers and provide the antiwear qualities of the above designated crankcase oils.
3. CERTAIN OTHER TYPES OF PETROLEUM OILS are suitable for Mobile hydraulic service if they meet the following provisions:
   (A) Contain the type and content of antiwear additives found in the above designated crankcase oils or have passed pump tests similar to those used in developing the antiwear type hydraulic oils.
   (B) Meet the viscosity recommendations shown in the following table.
   (C) Have sufficient chemical stability for Mobile hydraulic system service.

THE FOLLOWING TABLE SHOWS OIL-VISCOSITY RECOMMENDATIONS FOR USE WITH VICKERS EQUIPMENT IN MOBILE HYDRAULIC SYSTEMS:

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE (MIN.* TO MAX.)	SAE VISCOSITY DESIGNATION
*** -10° F. to 130° F. (-23° C. to 54° C.)	5W 5W-20 5W-30
0° F. to 180° F. (-18° C. to 83° C.)	10W
0° F. to 210° F. (-18° C. to 99° C.)	10W-30**
50° F. to 210° F. (10° C. to 99° C.)	20-20W

*Ambient Start-Up Temperature
**See Paragraph on Viscosity Index
***See Paragraph on Arctic Conditions

OPERATING TEMPERATURES - The temperatures shown in table are cold start-up to maximum operating. Suitable start-up procedures must be followed to insure adequate lubrication during system warm-up.

ARCTIC CONDITIONS - Arctic condtions represent a specialized field when extensive use is made of heating equipment before starting. If necessary, this and judicious use of the following recommendations may be used:

1. SAE 5W or SAE 5W-20 oil, in line with the viscosity guidelines shown in the table.
2. Oils especially developed for use in arctic conditions such as synthetic hydrocarbons, esters, or mixtures of the two.
3. Dilution of SAE 10W oil with maximum of 20% kerosene or low temperature diesel fuel is permissible. However, dilution of the special oils (see 2 above) should not be attempted unless the supplier and Vickers concur. The addition of the dilutant will not necessarily improve the cold cranking and may have an adverse affect on the performance of the oils in (2) above.

During cold start-up, avoid high speed operation of hydraulic system components until the system is warmed up to provide adequate lubrication.

Operating temperature should be closely monitored to avoid exceeding a temperature of 130° F. (54° C) with any of these light weight or diluted oils.

OTHER FACTORS IN SELECTING AN OIL ARE:

1. VISCOSITY - Viscosity is the measure of fluidity. In addition to dynamic lubricating properties, oil must have sufficient body to provide adequate sealing effect between working parts of pumps, valves, cylinders and motors, but not enough to cause pump cavitation or sluggish valve action. Optimum operating viscosity of the oil should be between 16 cSt (80 SSU) and 40 cSt (180 SSU).
2. VISCOSITY INDEX - Viscosity index reflects the way viscosity changes with temperature. The smaller the viscosity change, the higher the viscosity index. The viscosity index of hydraulic system oil should not be less than 90. Multiple viscosity oils, such as SAE 10W-30, incorporate additives to improve viscosity index (polymer thickened). Oils of this type generally exhibit both temporary and permanent decrease in viscosity due to the oil shear encountered in the operating hydraulic system. The actual viscosity can, therefore, be far less in the operating hydraulic system than what is shown in normal oil data. Accordingly, when such oils are selected, it is desirable to use those with high shear stability to insure that viscosity remains within recommended limits.
3. ADDITIVES - Research has developed a number of additive agents which materially improve various characteristics of oil for hydraulic systems. These additives are selected to reduce wear, increase chemical stability, inhibit corrosion and depress the pour point. The most desirable oils for hydraulic service contain higher amounts of antiwear compounding.
4. CHEMICAL STABILITY - Oxidative and thermal stability are essential characteristics of oils for Mobile Hydraulic systems. The combination of base stocks and additives should be stable during the expected lifetime of the oil when exposed to the environment of these systems.

SPECIAL REQUIREMENTS

Where special considerations indicate a need to depart from the recommended oils or operating conditions, see your Vickers representative.

CLEANLINESS

Thorough precautions should always be observed to insure that the hydraulic system is clean:

A. Clean (flush) entire system to remove paint, metal chips, welding shot, etc.
B. Filter each change of oil to prevent introduction of contaminant into the system.
C. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during the life of the system.
D. Provide continuous protection of system from entry of airborne contamination, by sealing the system and/or by proper filtration of the air.
E. During usage, proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over emphasized.
F. Aeration - thorough precautions should be taken, by proper system and reservoir design, to insure that the aeration of the oil will be kept to a minimum.

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INSTRUCTIONS FOR RIGGING AND REPLACEMENT OF WIRE ROPE

a. General - It is the purpose of this section to discuss the proper methods of rigging and replacing of wire rope to increase the life and receive better service through proper handling. When given reasonable treatment, wire rope is about the toughest and most durable steel product made. The contents of this section will be of help to obtain longer life and better service from wire rope.

b. Checking Groove Diameter

(1) Before new wire rope is placed in service, it is important to inspect the grooves in sheaves and the surfaces of guide rollers and drums. New rope is larger in diameter than the old rope it replaces. Grooves in sheaves will tend to wear to the smaller diameter of the old rope. Surfaces of drums of rollers may become grooved with score marks due to pickup of foreign particles on the wire rope.

(2) Check grooves in sheaves to be sure new wire rope will not be pinched, and bind the strands, which will cause excessive abrasion and rope-fatigue, leading to rapid deterioration of the rope. Replace sheaves if necessary.

c. Unreeling Wire Rope

(1) To unreel wire rope from a heavy reel, a shaft should be placed through the center of the reel and the reel lifted by means of jacks, so that the reel is clear of the floor and will revolve easily. Then one man, holding the end of the rope, walks straight ahead, while a second man regulates the speed of the turning reel by holding a wood block against the flange to act as a brake. Care should be taken so that slack will not get into the turns on the reel and bend around the shaft. If this happens and a kink is formed, the rope is ruined at that point.

(2) When the rope is run onto the winch drum, it shoud bend in the same way it did when coming off the reel. Otherwise, a reverse bend is caused. When unreeling wire rope from the reel to rewind on the winch drum, the rope should be unwound from the top of the full reel to the top of the winch drum. Unreeling the rope in this way will eliminate any possibility of causing a reverse bend. See Figure 1.

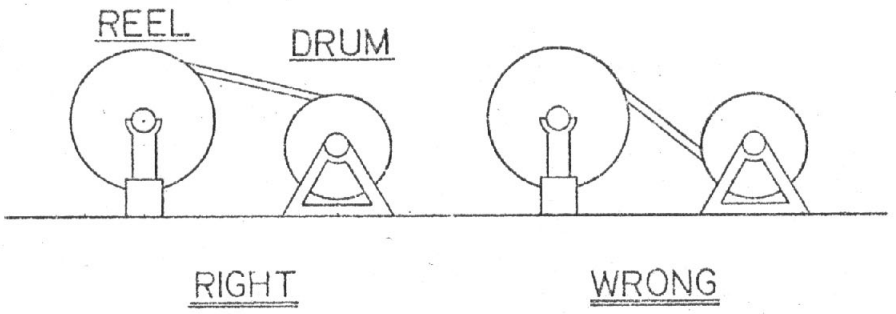
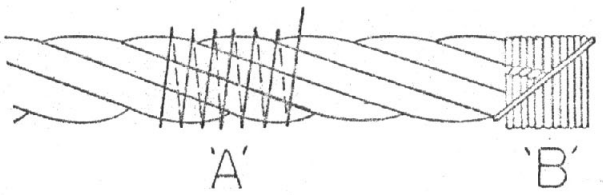


Figure 1. Unreeling wire rope.

d. Seizing Wire Rope Ends

(1) One important operation in handling wire rope is proper seizing of the rope ends. If this operation is not handled properly the structure of the rope is damaged. If improperly seized the ends become distorted and flatened, and the strands loosen, not only at the ends but back within the rope. Later, when the rope is put in tension by work, the load is distributed to the strand unevenly, shortening the life of the rope.

(2) The approved method is shown in Figure 2.



At A the turns are spread apart to show method of applying them. Completed is shown at B.

Figure 2. Seizing

(3) The two ends are twisted together in the approximate center of the seizing. A soft wire of annealed-iron grade shoud be used. The approximate diameter of seizing should be .080. The length of seizing should never be less than the diameter of the rope, and should preferably be longer. Length of seizing for 9/16 diameter wire rope should be (1) inch. Seize rope before cutting to desired length from the reel.

(4) Thread wire rope up through sheaves in boom point, then back to the winch drum. Push the wire rope through the small end of cavity in the drum. Loop wire around wedge and point end of rope back in the direction of the boom point. The end of the rope should extend beyond the small end of the wedge approximately two inches.

NOTE

CHECK, AFTER WEDGE AND ROPE ARE SEATED IN THE TAPERED CAVITY, THAT THE END OF THE ROPE DOES NOT PROJECT OUT OF THE SMALL END OF THE CAVITY SUFFICIENT ENOUGH TO INTERFERE WITH THE SPOOLING OF THE ROPE ON THE DRUM. THE ROPE AND WEDGE SHOULD BE TAPPED INTO THE CAVITY WITH A HARD WOOD BLOCK SHAPED TO THE CONTOUR OF THE ROPE WRAPPED AROUND THE WEDGE.

e. Applying Wire Rope Clips

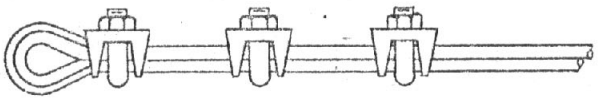


Figure 3. U-Bolt Wire Clips

(1) The correct method of attaching U-bolt wire clips to rope ends is shown in Figure 3. The base of the clip bears the live end of the rope, while the "U" of the bolt presses against the dead end.

(2) The clips are usually spaced about six rope diameters apart to give adequate holding power.

(3) Before the rope is placed under tension, the nuts on the clips should be tightened. It is advisable to tighten them again after the load is on the rope to take care of any reduction in the rope's diameter caused by the weight or tension of the load.

(4) A wire rope thimble should be used in the loop eye to prevent kinking when wire rope clips are used. For 9/16 diameter rope, three clips should be used spaced $3\frac{1}{2}$ inches apart.

f. Standard Reeving

(1) There are various ways to reeve wire rope. The application would dictate the way it should be reeved. The diagram and instructions listed in this section is the recommended rigging for the standard four sheave boom point and four sheave hook block for standard crane operation.

(2) The wire rope (2, Figure 4) leaves the winch from the top (1).

(3) Over sheave (3) and around sheave (7, 4, 8, 5, 9, 6, and 10) in this order and dead end on the boom point at (11).

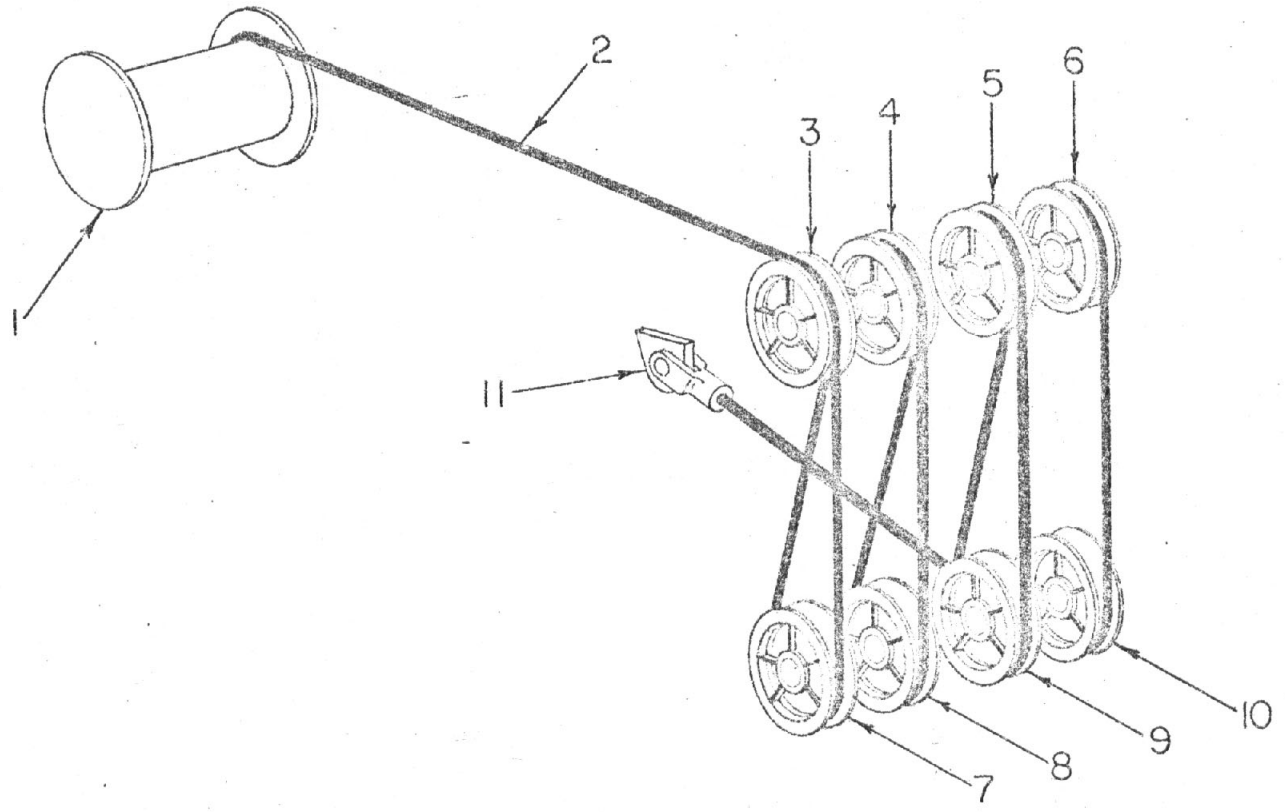
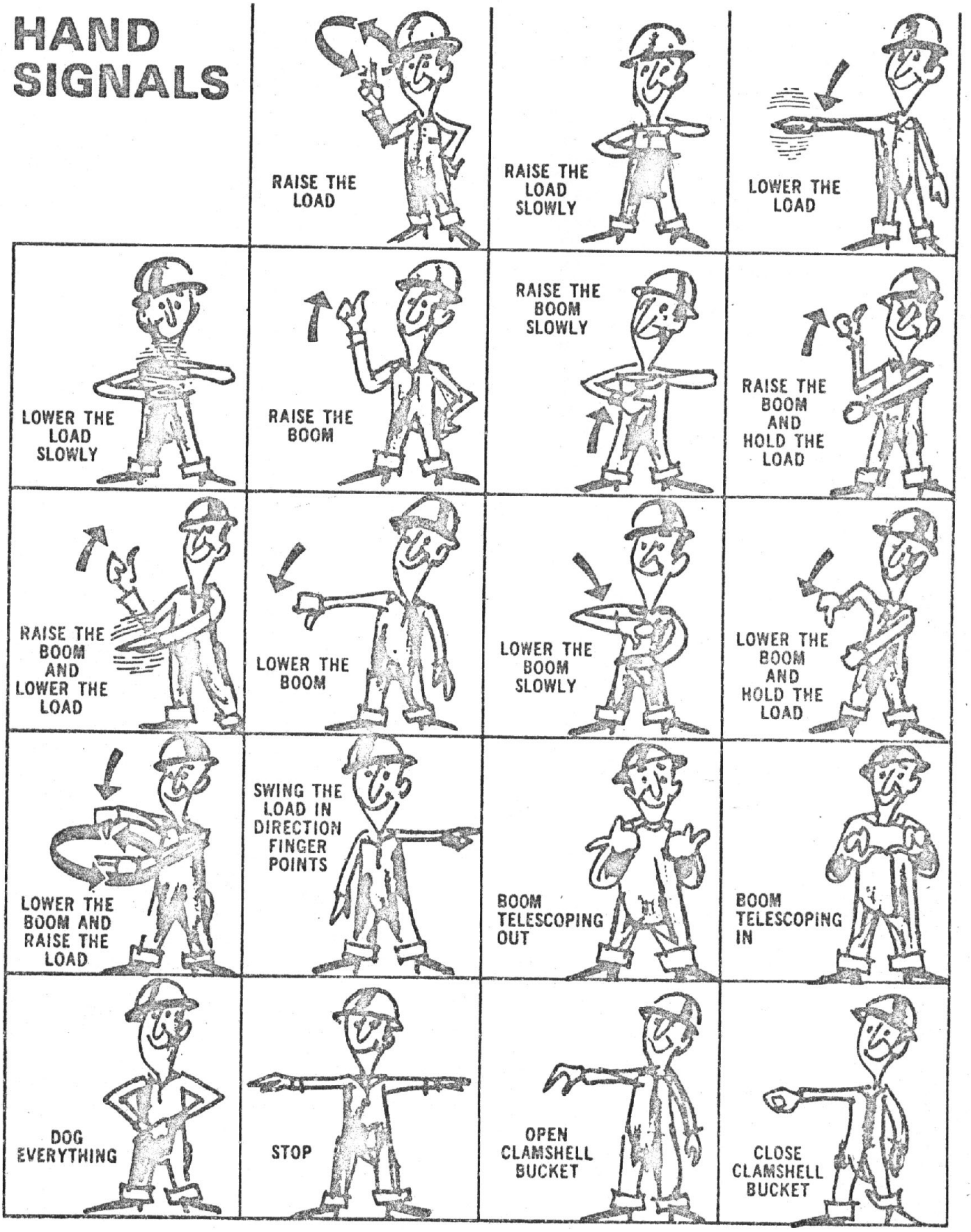
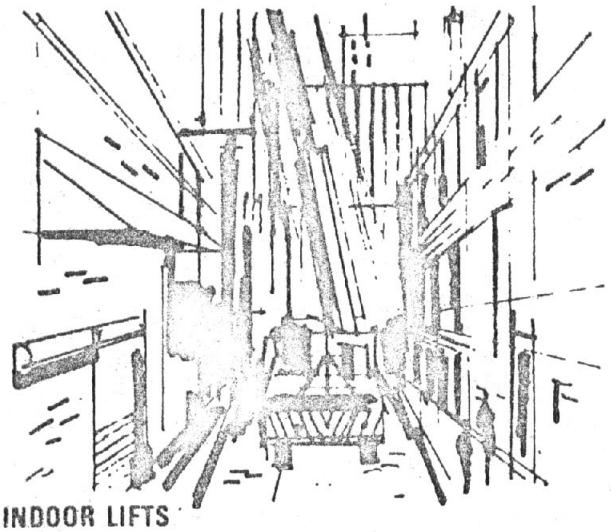


Figure 4. Standard reeving diagram

HAND SIGNALS





INDOOR LIFTS OR WORKING IN CLOSE QUARTERS

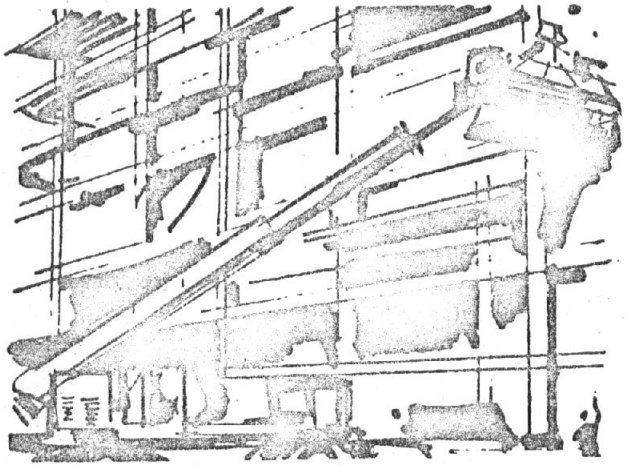
This is one of the main reasons you have a hydraulic crane. Its live boom gets into places stiff booms can't. By making good use of the boom telescoping and hoist actions, you will be able to perform your crane function anywhere your carrier can find space to stand.

1. We recommend a dry run, especially in areas where you are working which are really tight. Go through all the motions without a load, anticipating what actions you will take to make a safe pick and a smooth operation overall.

2. Check your load chart closely through all the angles and boom lengths the job requires.

3. A proper sling is essential.

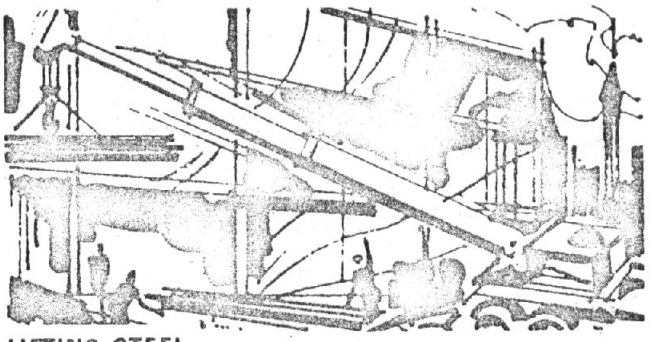
4. Make maximum use of tag lines as dictated by the indoor structure or other obstructions.



PLACING MACHINERY

1. Learn the weight of the machinery before the lift and determine its weight distribution.

2. Know how the piece of machinery will be positioned.

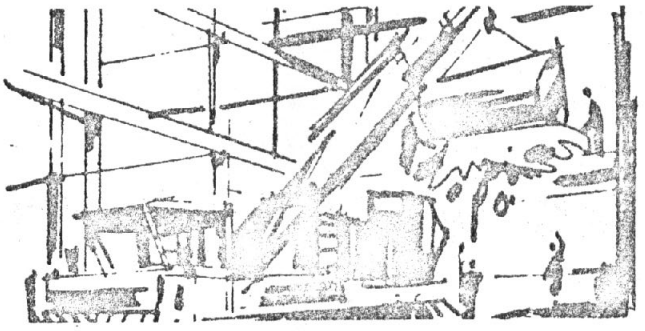


LIFTING STEEL

1. Secure proper slings and tag lines.

2. Always be sure sling is properly attached before lifting and completely released before moving boom away from the structure and personnel.

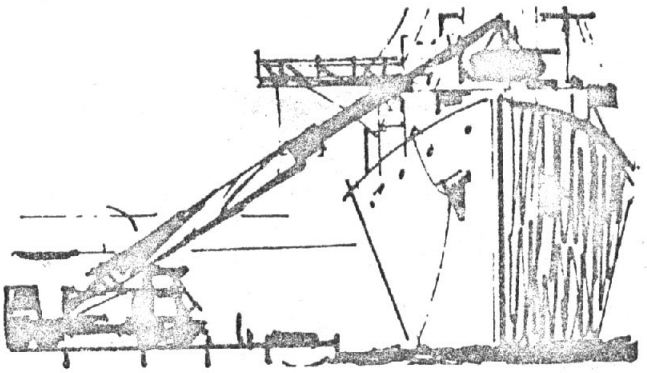
3. No matter how exciting it looks, NEVER allow personnel to ride a steel beam up to the structure.



POURING CONCRETE

1. Place machine as close to job as possible with a minimum of swing from truck to structure.

2. Take concrete bucket up to desired height after you swing to position of the lift.

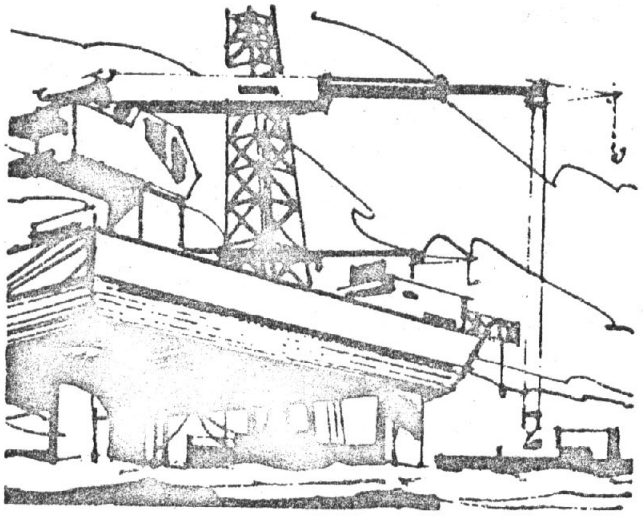


DOCK AND STEVEDORE OPERATIONS

1. Use proper sling and place machine for minimum swing.

2. Up to 3 men may be required to act as signalmen. One in the hold, one on the deck and one on the dock.

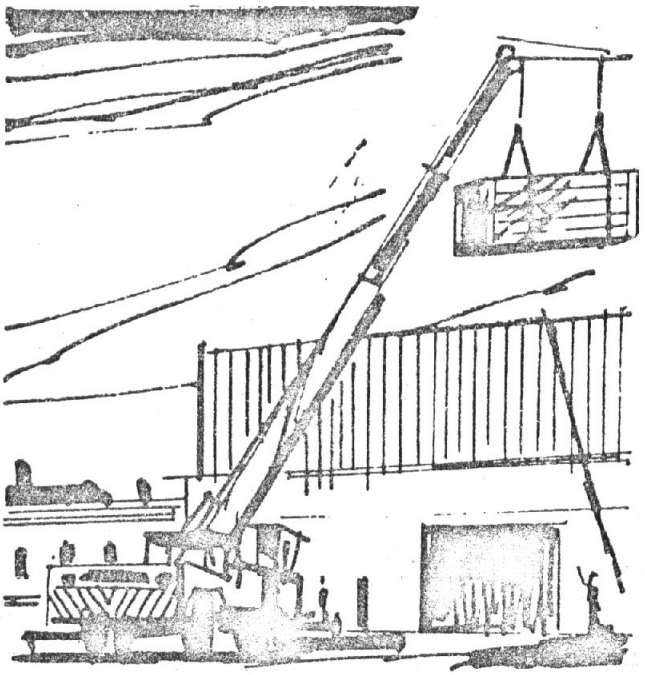
3. Suit your machine to the type of vessel and stock moved.



PEDESTAL CRANE

1. Always retract the boom and secure it as part of your shut down procedure.

2. If working near salt water, be sure to wash down the machine with fresh water frequently.

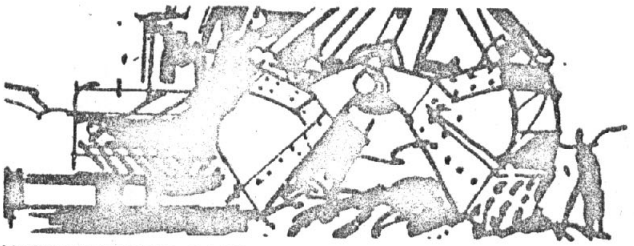


JIB AND FLY OPERATIONS

1. Both the jib and fly operations are used when added reach is required.

2. By using both winches, two kinds of production are possible. Heavy lifts can be handled by the main winch, while light ones are handled by the auxiliary winch, attached to the jib.

3. Both main winch and auxiliary winch can be used simultaneously when handling special equipment or setting pre-set concrete.



WORKING THE CLAMSHELL

1. At the start of the digging cycle the bucket rests on the material with the shells open.

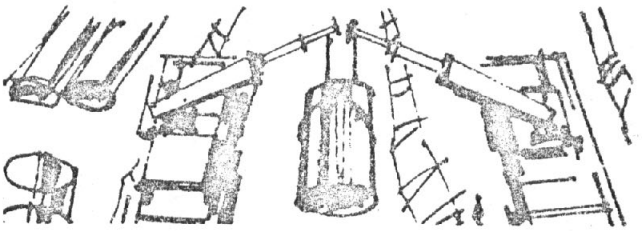
2. As the closing line wire rope is wound up on the drum, the shells are drawn together causing them to dig into the material.

3. The weight of the bucket, which is the only crowding action available, helps the bucket to penetrate the material.

4. Bucket is raised by holding and closing lines.

5. Swing to dumping point where the bucket is opened by releasing tension on the closing line.

6. Clamshells are used for digging vertical shafts and ditches, dredging, loading hoppers and trucks, and unloading gondola cars. It is designed to operate above, at, or below the ground line. It can excavate loose to medium material.



TEAMING UP TWO MACHINES

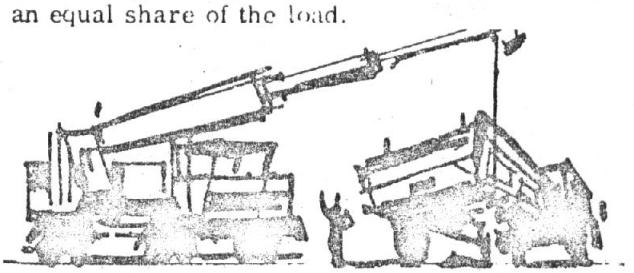
1. Suggested for loads which exceed one crane's capacity and unwieldy loads is using two machines.

2. Use one signalman only.

3. Coordinate plans for lift with both operators.

4. Know distribution of load to be lifted.

5. Arrange slings so that each machine takes an equal share of the load.



MAINTENANCE FUNCTIONS

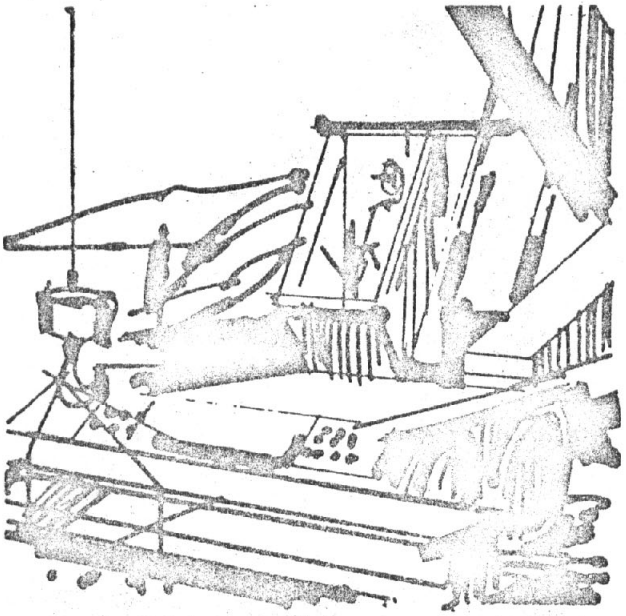
1. Maximum utilization of the crane is often possible in the field or indoors if it is used for maintenance of fleet equipment.

2. The crane provides hoist functions you can use on such jobs as lifting engines, chassis, etc.

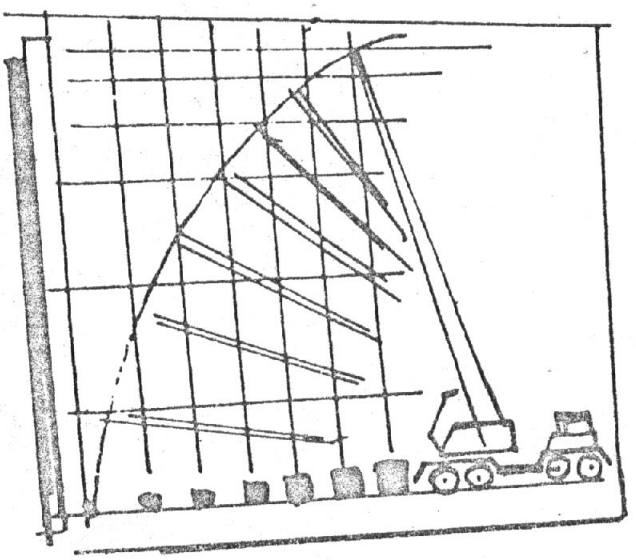
3. It is easy to see the rough terrain crane's application as a towing vehicle.

PART FIVE: SAFETY RULES ARE A MUST

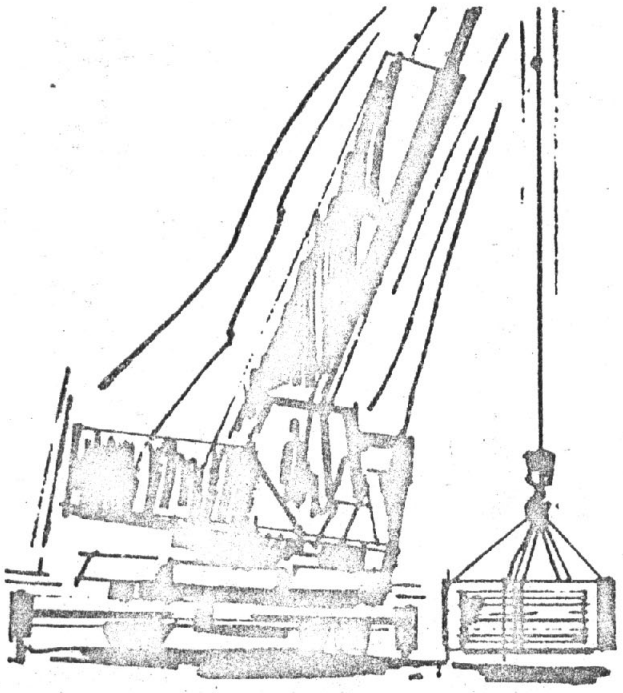
And plain common sense is the first and most important rule to follow for safe crane operation. Following are some areas of crane operation that could be harmful to you, or to people working around you, if common sense and simple safety rules are not followed.



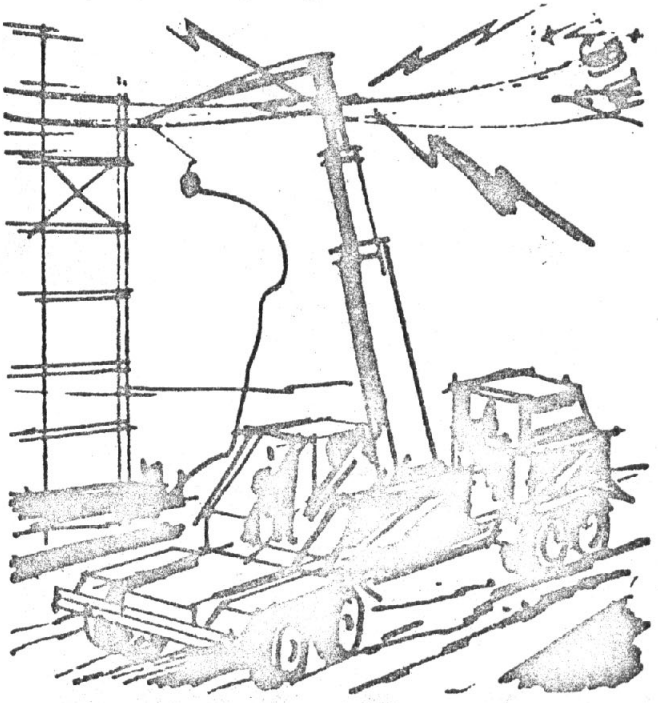
1 ALWAYS keep the load as near to the carrier and as close to the ground as possible.



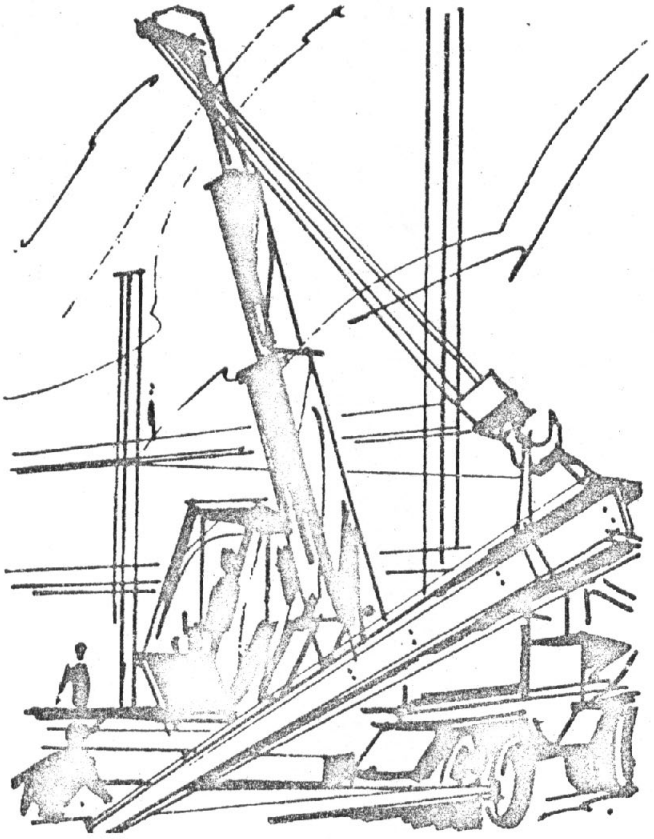
2 NEVER exceed the rated lift capacities shown on the load chart. ALWAYS determine the weight of the load and check the capacity chart to determine that the load can be lifted at the desired radius within the rated capacity of the machine.



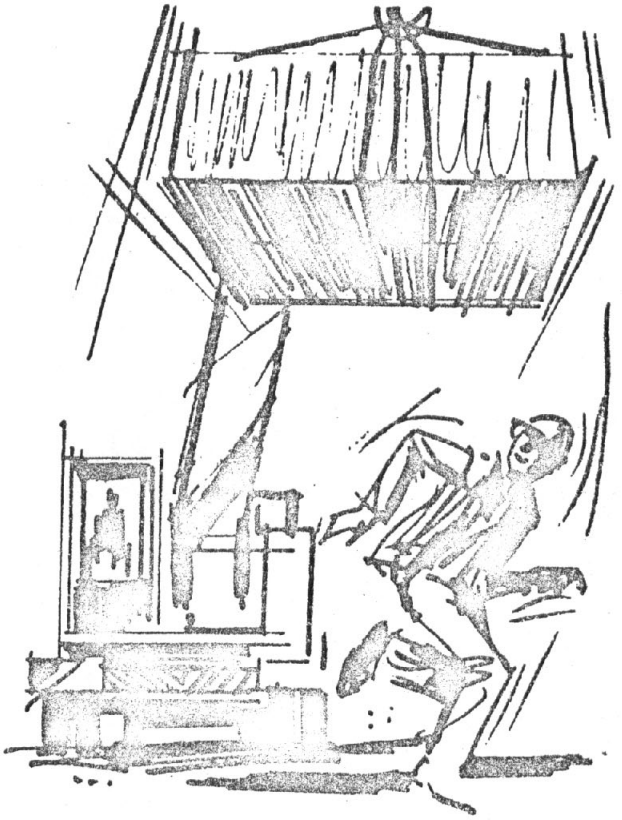
3 NEVER use stability of the machine to determine capacity. When you find out, it might be too late.



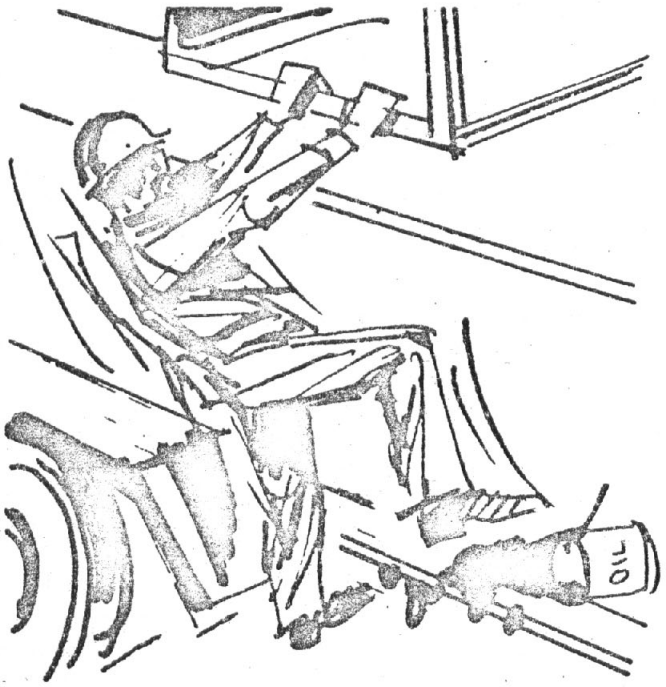
4 ALWAYS keep the boom and all parts of crane away from the electrical lines or equipment.



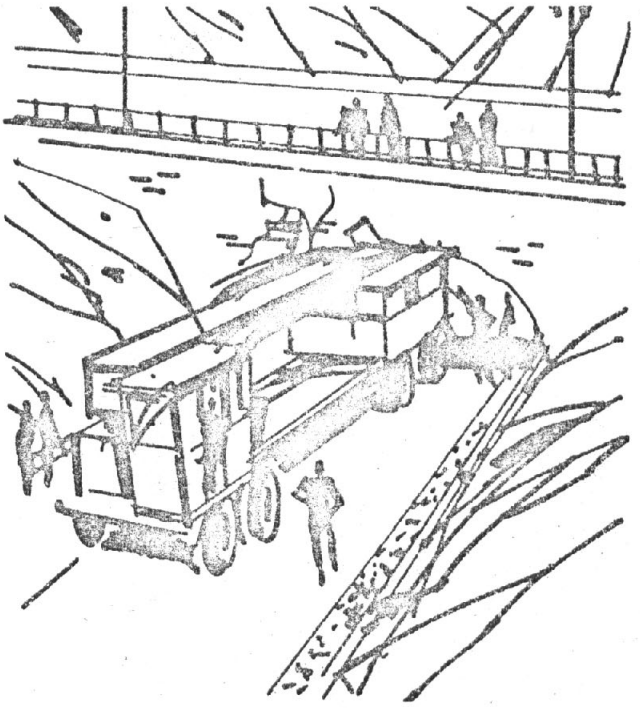
5 NEVER side-load the boom. It is for lifting only.



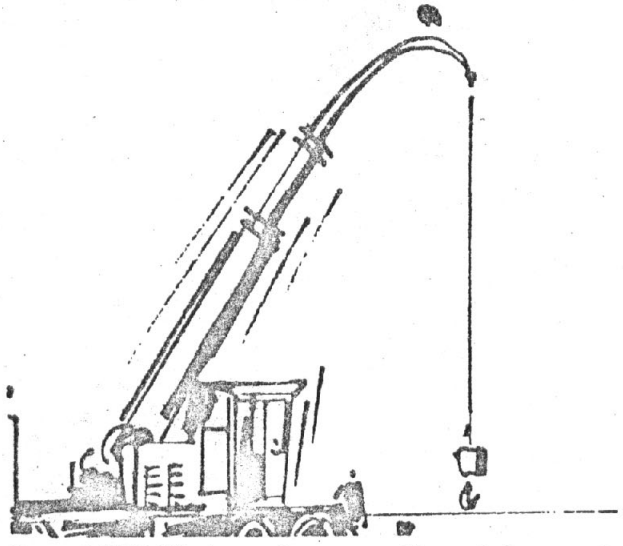
6 NEVER allow persons to stand or work under a load. Use tag lines for positioning loads.



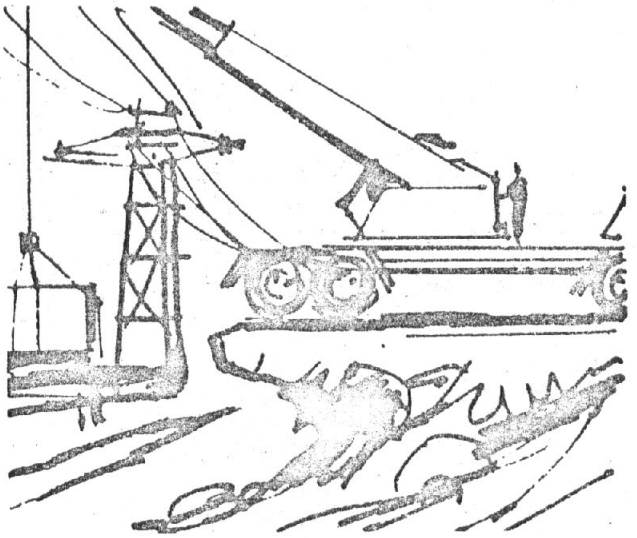
7 ALWAYS keep the machine clean and free from oil and grease at all times. Use the rule of two-hands at all times when climbing around the machine.



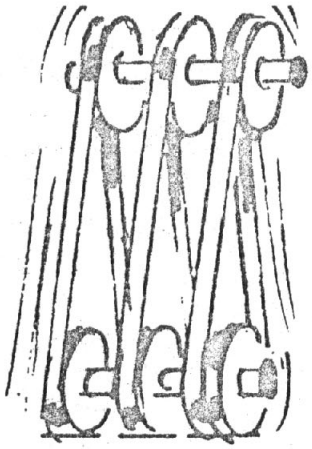
8 ALWAYS check height and width of clearances for traveling in your state. Check rated capacities of bridges. Check local restrictions covering axle weights.



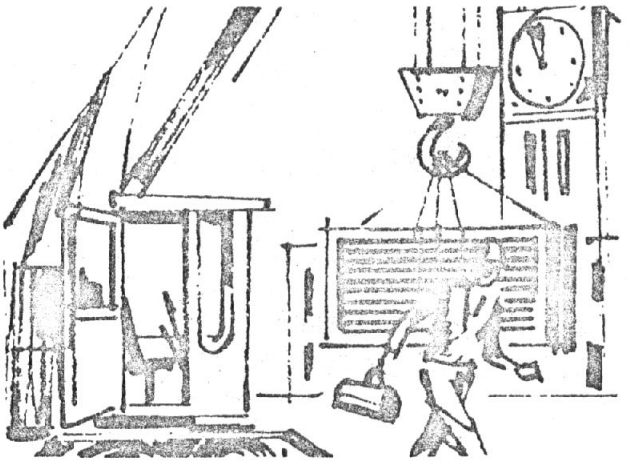
9 ALWAYS keep boom sections telescoped equally at all times for maximum boom strength. NEVER extend one section only leaving the other section retracted. Load charts are based on having equal boom sections.



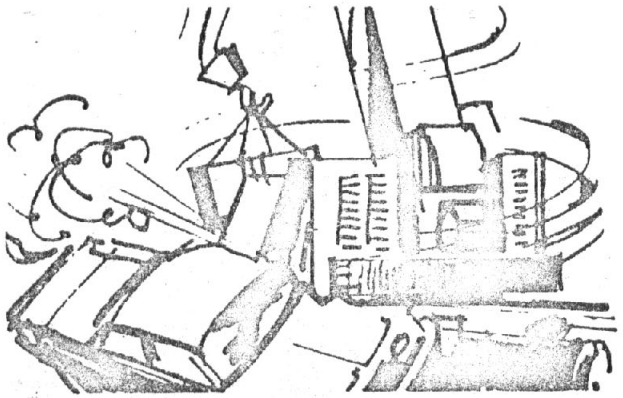
10 ALWAYS stay away from dangerous banks that might give away under you.



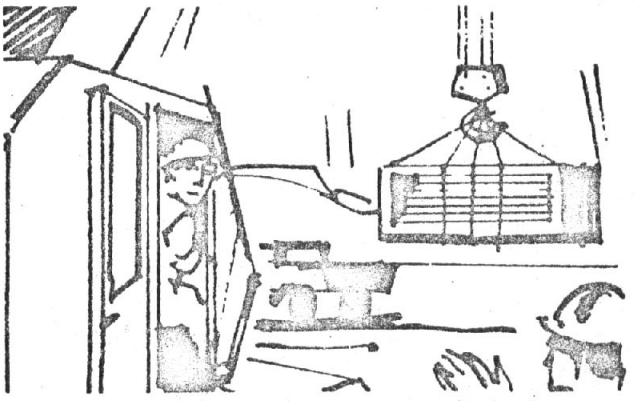
11 ALWAYS use sufficient parts of line for heavy lifts. DON'T take chances, use a good safety allowance.



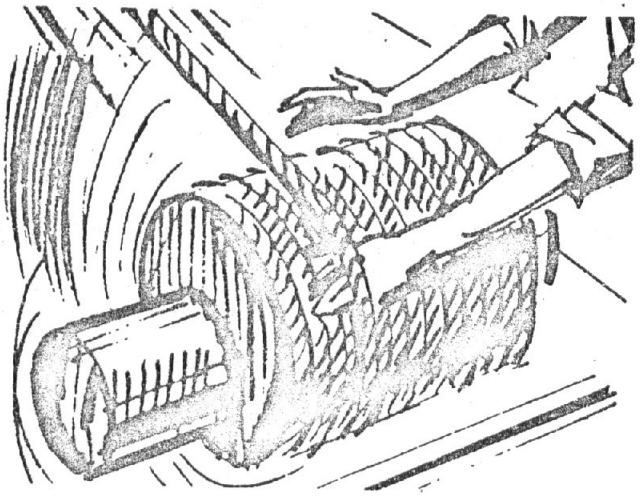
12 NEVER leave the machine with a load up in the air. If you must leave the crane place the load on the ground.



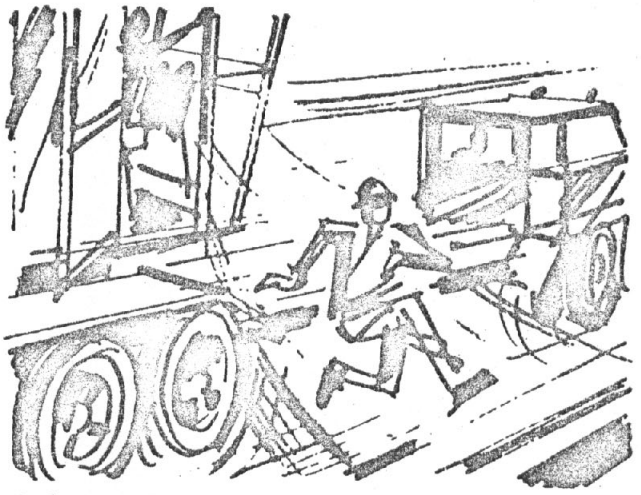
13 ALWAYS make sure you have enough clearance for tail swing of the upperstructure, especially if there are cars or people in the area.



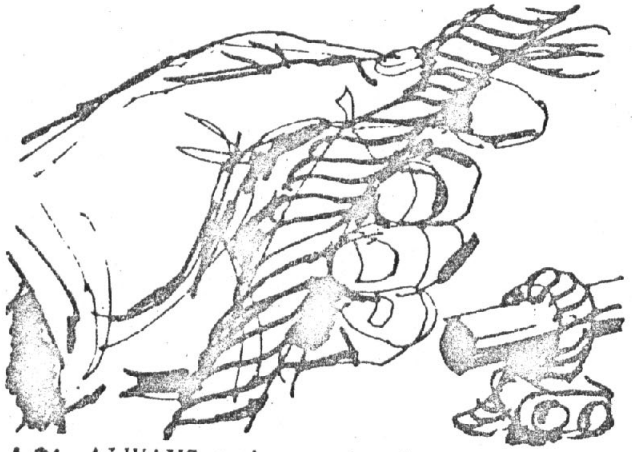
14 ALWAYS watch your load at all times. If you must look elsewhere, stop and hold the load still.



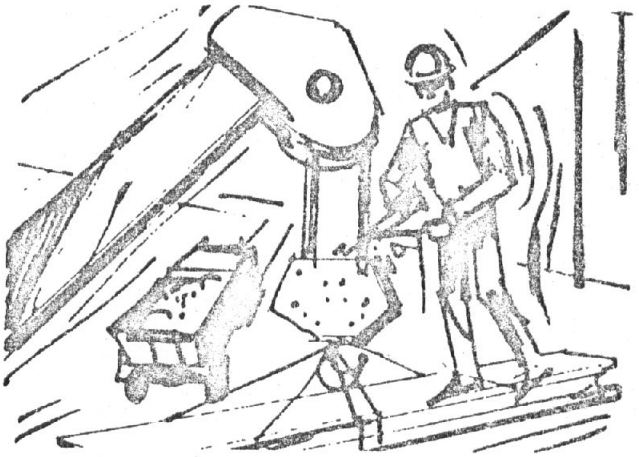
15 ALWAYS be careful to keep your hands away from cable drums, sheaves and pulleys. Replace all guards.



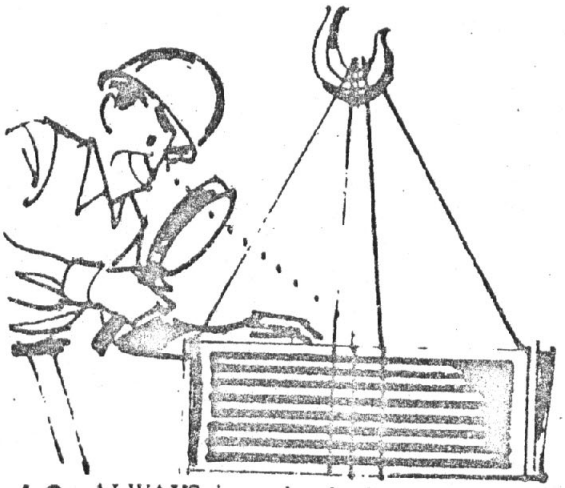
16 NEVER get on or off of a machine in motion.



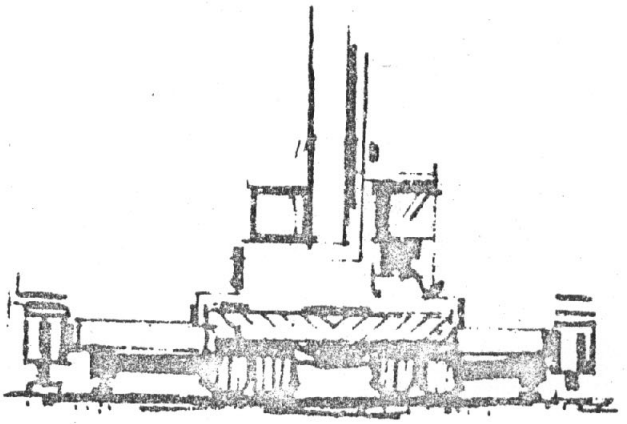
17 ALWAYS make regular inspections of the cables and replace worn, rusty or frayed cables. Inspect the cable clamps often.



18 ALWAYS stop the crane with load on the ground and boom supported while lubricating or adjusting.



19 ALWAYS have load slings checked before lifting. When in doubt, check them yourself.



20 ALWAYS set your outriggers firmly, keeping the machine level. Reset your outriggers frequently between heavy lifts.

Hydraulic Components Maintenance Instructions

PRIMARY CONTROL VALVE ASSEMBLY

1. DESCRIPTION

a. General--CM2 -20 Design Valves are made up of directional control valve sections mounted in banks and connected internally to common pressure and tank return passages. A valve bank usually consists of an inlet and operating (R*, F*, or K*), a number of operating sections (*) and an operating inlet and operating (*L or *E). Each operating section contains a sliding spool (For example B, C, D, or T Spool). In valve banks where only one operating section is required, an R* section is used with an L or E tank plate section.

b. Assembly and Construction--Figure 1 is a cross-sectional view showing the construction and assembly of a three-section valve. Each section normally contains a sliding spool with centering springs and a check valve. The inlet section also contains a relief valve assembly. Passages between the bodies connect each section to the common inlet and tank ports. Seal rings between the sections seal the connecting passages. Sections are held together by studs and nuts.

c. Detent Features--A spool detent assembly consists of a special end cap with a spring loaded plunger and a spool extension. The plunger engages in grooves of the spool extension to hold the spool in the desired position (See Figure 2).

2. INSPECTION AND MAINTENANCE

a. Service Tools--No special tools are required to service Vickers CM2 series multiple unit valves.

b. Inspection--Periodic inspection of spool operation, oil condition and pressure connections saves time-consuming breakdowns and unnecessary parts replacement.

(1) All hydraulic connections must be tight. Loose connections not only allow leakage but also permit air to be drawn into the system, resulting in noisy and erratic operation.

(2) Spools should return to neutral automatically when the control is released. The centering spring force is approximately 60 pounds. If more force is necessary, the spool may be binding or control linkage may be faulty.

(3) System filters and reservoir should be checked periodically for foreign particles. If excessive contamination is found, the system should be drained. The reservoir must be cleaned thoroughly before refilling.

c. Adding Fluid to the System--When hydraulic fluid is added to the system, it should be pumped through a 25 micron filter. If such a filter is not available, or practical to use in the field, a funnel with a fine wire screen (200 mesh or better) can be used.

NOTE

It is important that oil be clean and free of all substance which will cause improper operation and excessive wear of the pump or other hydraulic units in the system. Be sure to purge all air from the system.

d. Lubrication--Internal lubrication is provided by system oil.

e. Trouble Shooting--Table I lists the difficulties which may be experienced with the unit and hydraulic system. It indicates the cause and remedy for each of the troubles listed. It should always be remembered that pressure and delivery are factors which are usually dependent upon each other. Adequate pressure gage equipment and thorough understanding of the operation of the complete hydraulic system are essential to diagnose improper operation.

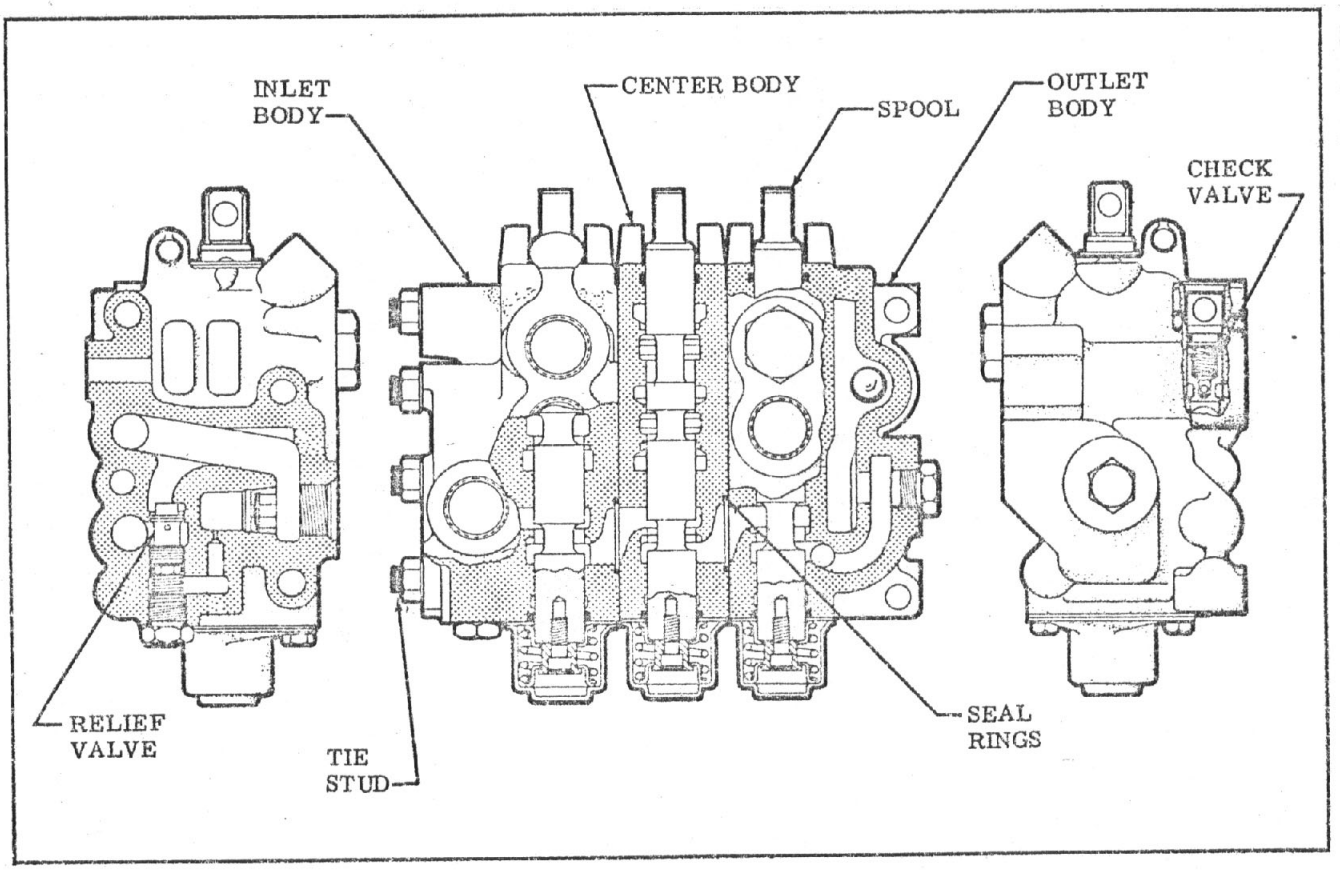


Figure 1

3. OVERHAUL

a. General--Refer to Vickers Overhaul Manual in the last section of this Manual.

TABLE I - TROUBLE, CAUSE AND REMEDY CHART

TROUBLE	PROBABLE CAUSE	REMEDY
Oil leaks at either end of spool.	Defective "O" rings in valve body.	Replace "O" rings.

TABLE I - TROUBLE, CAUSE AND REMEDY CHART (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Spring-centered spools do not return to neutral.	Broken springs.	Replace springs.
	Bent spool.	Replace with new section of same size and type.
	Foreign particles.	Clean system and valve.
	Misalignment of operating linkage.	Check linkage for binding condition.
	Valve bank improperly torqued.	Retorque nuts to specifie ratings.
Detent type spools will not stay in detent position.	Worn detent barrel.	Replace detent barrel.
	Weak or broken detent spring.	Replace detent spring.
No motion, slow or jerky action of hydraulic system.	Relief valve not properly set, or stuck in base and/or worn.	Repair, clean and re-adjust.
	Dirt or foreign particles lodged between relief valve control poppet and seat.	Disassemble, clean and reassemble.
	Valve body cracked inside.	Replace valve section.
	Spool not moved to full stroke.	Check travel.
No relief valve action (High Pressure)	Small particles of dirt plugging orifice in relief valve sub-assembly.	Remove relief valve and check hole. If blocked, clear hole.
	Relief Valve S.A. installed backwards.	Install properly.
Load will not hold.	Oil by-passing between spool and body.	Replace valve.
	Oil by-passing piston in cylinder.	Repair or replace cylinder.
	Spool not centered.	Refer to above spool remedies.
Load drops when spool is moved from neutral to a power position.	Dirt or foreign particles lodged between check valve poppet and seat.	Disassemble, clean and reassemble.

DOUBLE VANED HYDRAULIC PUMP

1. DESCRIPTION

a. General

(1) Pumps in these series are used to develop hydraulic fluid flow for the operation of Mobile equipment. The positive displacement pumping cartridges are the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

(2) All units are designed so that the direction of rotation, pumping capacity and port positions can be readily changed to suit particular applications.

b. Assembly and Construction--The pump illustrated in cross-section in Figure 1 is representative of all double pumps in these series. The unit consists principally of six basic components: (A) an end cap, (B) "C" section unitized cartridge consisting of: rotor, vanes, van holding pins, cam ring, bearing and port plates, (C) a center housing, (D) "D" section unitized cartridge consisting of: rotor, vanes, van holding pins, cam ring, bearing and port plate (E) a shaft and bearing and (F) a mounting cap. As the rotor is driven by the driveshaft, the vanes develop fluid flow by carrying fluid around the elliptical ring contour. Fluid enters the cartridge through the inlet port in the center housing and is discharged through the pressure plates to the outlet ports.

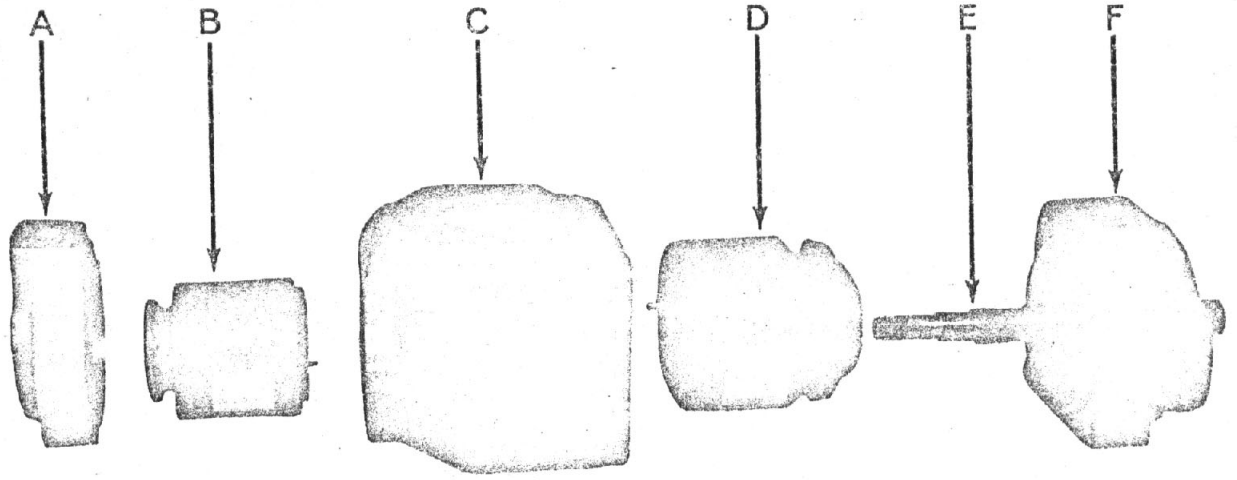


FIG. I

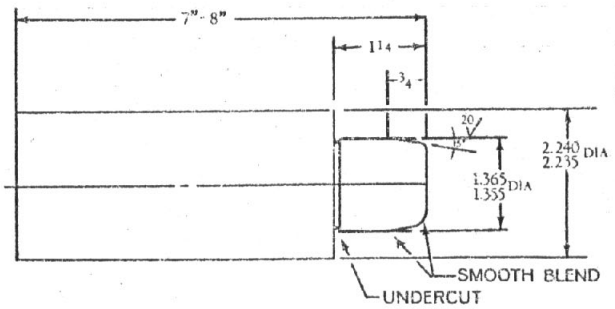


FIG. II

2. INSPECTION AND MAINTENANCE

a. Service Tools--No special tools, other than a shaft seal driver, are required to service these pumps. This driver should be used to assure installation of the shaft seal without damage. A length of tubular stock machined to proper dimension should be made up. (See Figure 2).

b. Inspection--Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly.

(1) All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the systems, resulting in noisy and/or erratic operation.

(2) Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaninants. If the fluid becomes contaminated the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

(3) Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

(4) A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper operation corrected.

c. Adding Fluid to the System--When hydraulic fluid is added to replenish the system, it shoud be poured through a fine wire screen - 200 mesh or finer.

NOTE

It is important that the fluid be clean and free of any substance which could cause improper operation of wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

d. Adjustments-No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

e. Lubrication-Internal lubrication is provided by the fluid flow in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

f. Troubleshooting

(1) Table II lists the common difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

(2) It should always be remembered that many apparent pump failures are actually the failures of other parts of the systems. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

3. OVERHAUL

a. General

Refer to Denison T5DC Installation, Operation, and Overhaul Instructions in the last section of this manual.

TABLE II - TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid.	Driven in wrong direction of rotation.	The drive direction must be reversed immediately to prevent seizure.
	Coupling or shaft sheared or disengaged.	Disassemble the pump and check the shaft and cartridge for damage. Replace the necessary parts.
	Fluid intake pipe in reservoir restricted.	Check all strainers and filters for dirt and sludge. Clean if necessary.
	Fluid intake pipe heavy to pick up prime.	Completely drain the system. Add new filtered fluid of the proper viscosity.
	Air leaks at the intake. Pump not priming.	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump.
	Relief valve stuck open. (Models with integral relief valve only)	Disassemble the pump and wash the valve in clean solvent. Return the valve to its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the lands or attempt to polish the bore. Wash all parts and reassemble the pump.

TABLE II - TROUBLESHOOTING (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid, continued	Vane(s)stuck in the rotor slot(s).	Disassemble the pump, Check for diret or metal chips. Clean the parts thoroughly and replace any damaged pieces. If necessary, flush the system and refill it with clean fluid.
Insufficient pressure build-up.	System relief valve set too low.	Use a pressure gauge to correctly adjust the relief valve.
	Worn parts causing internal leakage of pump delivery.	Replace pump cartridge.
Pump making noise	Pump intake partially blocked.	Service the intake strainers. Check the fluid condition and, if necessary, drain and flush the system. Refill with clean fluid.
	Air leaks at the intake or shaft seal. (oil in reservoir would be foamy)	Check the inlet connections and seal to determine where air is being drawn in. Tighten any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening.
	Pump drive speed too slow or too fast	Operate the pump at the recommended drive speed.
	coupling misalignment.	Check if the shaft seal, bearing or other parts have been damaged Replace any damaged parts. Realign the coupled shafts.

VANED HYDRAULIC POWER STEERING PUMP

1. DESCRIPTION

a. General

(1) Pumps in this series are used to develop hydraulic fluid flow for the operation of Mobile equipment. The positive displacement pumping cartridges are the rotary vane type with shaft side loads hydraulically balanced. The flow rate depends on the pump size and the speed at which it is driven.

(2) All units are designed so that the direction of rotation, pumping capacity and port position can be readily changed to suit particular applications.

b. Assembly and Construction--The V20 series pump illustrated in cutaway in Figure 1 is representative of all single pumps in this series. The unit consists principally of a proted body and cover, a drive shaft supported by two ball bearings, a pumping cartridge and a pressure plate. The components of the cartridge are an elliptical ring, a slotted rotor splined to the drive shaft and twelve vanes fitted to the rotor slots. As the rotor is driven by the driveshaft, the vanes generate fluid flow by carrying fluid around the elliptical ring coutour. Fluid enters the cartridge through the inlet port in the body and is discharged through the pressure plate to the outlet port in the cover.

c. Flow Control and Relief Valve--V20 pumps are available with an integral Flow Control and Relief Valve in the pump cover. This limits the fluid flow in the system to a maximum prescribed rate and prevents excessive pressure build-up. Fluid not required in the system is recirculated to tank.

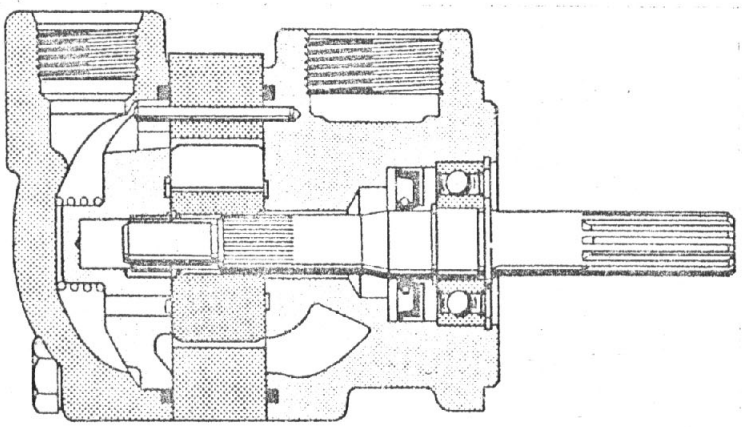


FIGURE 1

2. INSPECTION AND MAINTENANCE

a. Service Tools--No special tools are required to service these pumps.

b. Inspection--Periodic inspection of the fluid condition and tube or piping connections can save time-consuming breakdowns and unnecessary parts replacement. The following should be checked regularly.

(1) All hydraulic connections must be kept tight. A loose connection in a pressure line will permit the fluid to leak out. If the fluid level becomes so low as to uncover the inlet pipe opening in the reservoir, extensive damage to the pump can result. In suction or return lines, loose connections permit air to be drawn into the systems, resulting in noisy and/or erratic operations.

(2) Clean fluid is the best insurance for long service life. Therefore, the reservoir should be checked periodically for dirt or other contaminants. If the fluid becomes contaminated the system should be thoroughly drained and the reservoir cleaned before new fluid is added.

(3) Filter elements also should be checked and replaced periodically. A clogged filter element results in a higher pressure drop. This can force particles through the filter which would ordinarily be trapped, or can cause the by-pass to open, resulting in a partial or complete loss of filtration.

(4) A pump which is running excessively hot or noisy is a potential failure. Should a pump become noisy or overheated, the machine should be shut down immediately and the cause of improper opertion corrected.

c. Adding Fluid to the System--When hydraulic fluid is added to replenish the system, it should always be poured through a fine wire screen - 200 mess or finer.

NOTE

It is important that the fluid be clean and free of any substance which could cause improper operation or wear of the pump or other hydraulic units. Therefore, the use of cloth to strain the fluid should be avoided to prevent lint getting into the system.

d. Adjustments--No periodic adjustments are required, other than to maintain proper shaft alignment with the driving medium.

e. Lubrication--Internal lubrication is provided by the fluid in the system.

f. Troubleshooting

(1) Table I lists the common difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

(2) It should always be remembered that many apparent pump failures are actually the failures of other parts of the systems. The cause of improper operation is best diagnosed with adequate testing equipment and a thorough understanding of the complete hydraulic system.

3. OVERHAUL

a. General--Plug all removed units and cap all lines to prevent the entry of dirt into the system. During disassembly pay particular attention to identification of the parts, especially the cartridges, for correct assembly. Pump bearings are pressed in the bodies or on the shafts and should not be removed unless defective. Figure 1 can be referred to for the correct assembled relationship of the parts.

b. Disassembly

(1) Disassembly of Basic Pump--See Figure 2. If a mounting flange or foot bracket is used, remove it before dismantling the pump. Clamp the pump body in a vise (not too tightly), cover end up, and remove the four screws. Note the position of the cover port with respect to the body port before lifting off the cover and "O" ring.

(2) Remove the pressure plate and spring and note the position of the ring for correct reassembly. Lift off the ring and remove the locating pin. Separate the vanes from the rotor and remove the rotor from the shaft.

(3) Turn the pump body over and remove the shaft key and the snap ring which retains the outer bearing. Tap with a soft hammer on the splined end of the shaft to force the shaft out of the body. Support the bearing inner race and press the shaft out of the bearing. Pull the shaft seal out of the body with a suitable hooked tool and press out the inner bearing.

(4) Disassembly of Flow Control and Relief Valve Covers-See Figure 2. If a screen is used in the cover, remove the plug and pull out the screen. Do not remove the orifice plug unless it is necessary. Check whether there is a plug at each end of the relief valve bore. If the bore is blind, remove the plug and the snap ring to release the valve and spring as shown in the inset view, Figure 2. If the bore is through the cover, remove only the one plug to release the spring and valve. Leave the snap ring and the other plug in the cover.

TABLE I - TROUBLESHOOTING

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid	Driven in wrong direction of rotation.	The drive direction must be reversed immediately to prevent seizure.
	Coupling or shaft sheared or disengaged.	Disassemble the pump and check the shaft and cartridge for damage. Replace the necessary parts.
	Fluid intake pipe in reservoir restricted.	Check all strainers and filters for dirt and sludge. Clean if necessary.
	Fluid viscosity too heavy to pick up prime.	Completely drain the system. Add new filtered fluid of the proper viscosity.
	Air leaks at the intake. Pump not priming.	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. See that the fluid in the reservoir is above the intake pipe opening. Check the minimum drive speed which may be too slow to prime the pump.
	Relief valve stuck open. (Models with integral relief valve only.)	Disassemble the pump and wash the valve in clean solvent. Return the valve to its bore and check for any stickiness. A gritty feeling on the valve periphery can be polished with crocus cloth. Do not remove excess material, round off the edges of the lands or attempt to polish the bore. Wash all parts and reassemble the pump.

TABLE I - TROUBLESHOOTING (Continued)

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering fluid continued.	Vane(s) stuck in the rotor slot(s).	Disassemble the pump. Check for dirt or metal chips. Clean the parts thoroughly and replace any damaged pieces. If necessary, flush the system and refill it with clean fluid.
Insufficient pressure build-up	System relief valve set too low.	Use a pressure gauge to correctly adjust the relief valve.
	Worn parts causing internal leakage of pump delivery.	Replace pump cartridge.
Pump making noise	Pump intake partially blocked.	Service the intake strainers. Check the fluid condition and if necessary, drain and flush the system. Refill with clea fluid.
	Air leaks at the intake or shaft seal. (Oil in reservoir would be foamy)	Check the inlet connections and seal to determine where air is being drawn in. Tighte any loose connections and replace the seal if necessary. See that the fluid in the reservoir is above the intake pipe opening.
	Pump drive speed too slow or too fast.	Operate the pump at the recommended drive speed.
	Coupling misalignment.	Check if the shaft seal, bearing or other parts have been damaged. Replace any damaged parts. Realign the coupled shafts.

c. Inspection and Repair

(1) Discard the used shaft seal and all "O" rings. Wash the metal parts in mineral oil solvent, blow them dry with filtered compressed air and place them on a clean surface for inspection.

(2) Check the wearing surfaces of the body, pressure plate, ring and rotor for scoring and excessive wear. Remove light score marks by lapping. Replace any heavily scored or badly worn parts.

(3) Inspect the vanes for burrs, wear and excessive play in the rotor slots. Replace the rotor if the slots are worn.

(4) Check the bearings for wear and looseness. Rotate the bearings while applying pressure to check for pitted or cracked races.

(5) Inspect the oil seal mating surface on the shaft for scoring or wear. If marks on the shaft cannot be removed by light polishing, replace the shaft.

(6) Check the relief valve sub-assembly for free movement in the cover bore. Remove burrs from the valve by polishing, but do not round off the corners of the lands. Do not attempt to rework the valve bore, if the bore is damaged, replace the cover.

d. Reassembly

(1) Coat all parts with hydraulic fluid to facilitate assembly and provide initial lubrication. Use small amounts of petroleum jelly to hold "O" rings in place during assembly.

NOTE

During handling and shipping of the precision machined cartridge parts, it is possible th raise burrs on the sharp edges. All sharp edges on the parts of a new cartridge kit should be stoned prior to installation.

(2) Assembly of Flow Control Cover--See Figure 2. If the cover has a through bore, insert the valve in the bore, small land first. Then install the spring and pipe plug. For models with the blind bore, first install the spring, then the valve, with the hexagon head end first. Follow this with the snap ring (being certain it is firmly seated in the groove) and the pipe plug. Install the screen and the plug which retains it.

(3) Assembly of Pump--See Figure 2. Begin assembly by pressing the shaft into the front bearing while supporting the bearing inner race. Next, press the inner bearing into the body, using a driver which contacts the outer race only. Be certain both bearings are firmly seated.

NOTE

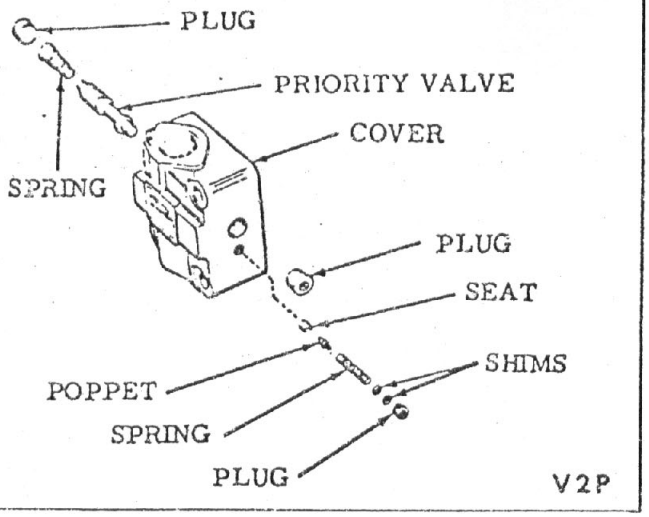
Before assembling the shaft seal, determine the correct position of the sealing lip. Double lip seals are assembled with the spring toward the pumping cartridge. Single lip seals have two pressure holes, which are assembled toward the shaft end of the pump.

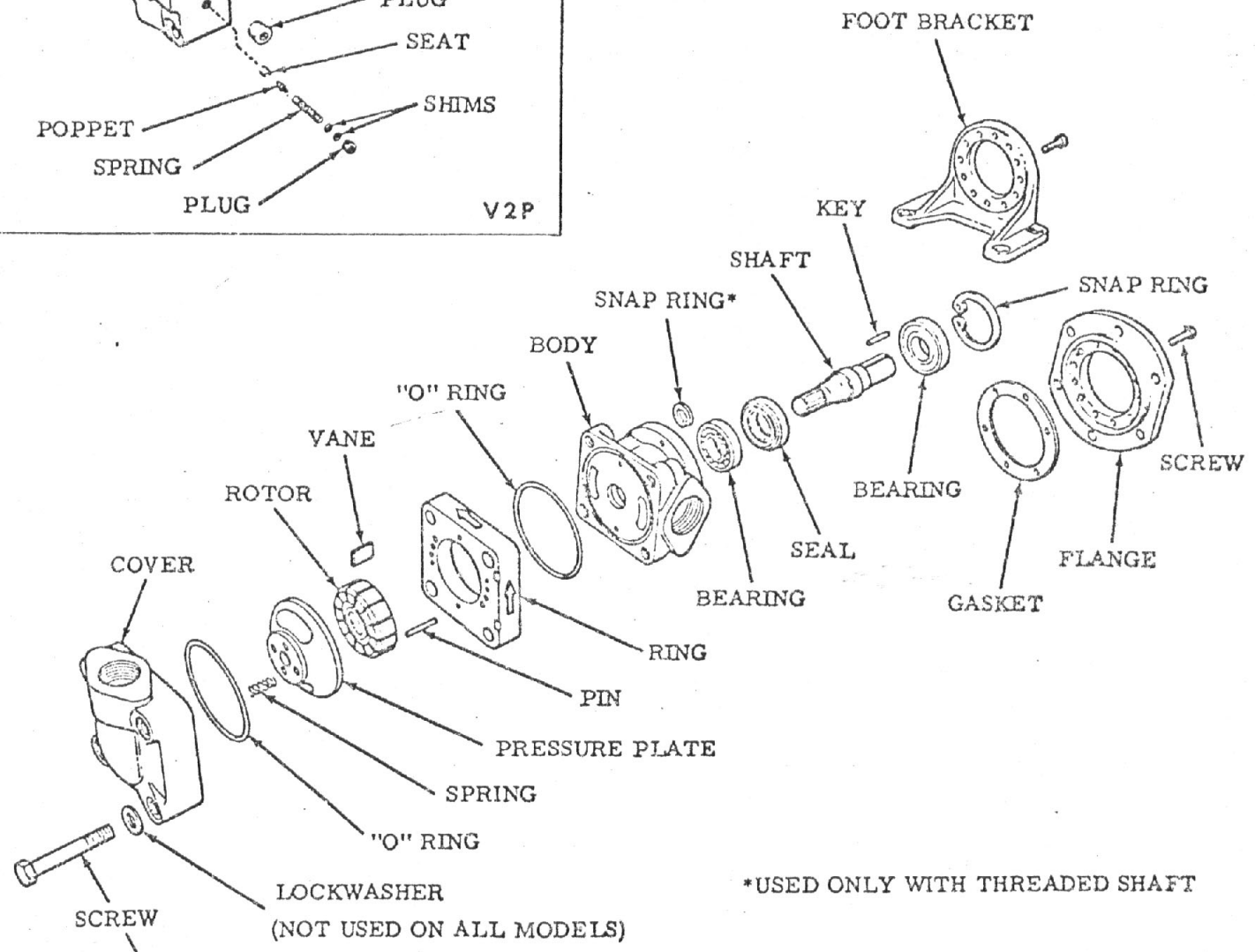
(a) Press the seal firmly in place and lubricate the lip with petroleum jelly or other grease compatible with the system fluid. Slide the drive shaft into the body until the bearing is seated. Tap lightly on the end of of the shaft if necessary. Install the snap ring.

(b) Install new "O" rings in the body and cover. Insert the ring locating pins in the body and assemble the ring so that the arrow on the perimeter points in the proper direction of rotation. Install the rotor on the shaft and insert the vanes in the rotor slots. Be certain the radius edges of the vanes are toward the cam ring

(c) Place the pressure plate on the locating pins and flat against the ring. Use a small amount of petroleum jelly or grease to stick the spring in the recess in the pressure plate. Carefully install the cover with the outlet port in the correct position. Tighten the cover screw to the torque shown in Figure 2. Turn the shaft through by hand to insure that there is no internal binding. Install the shaft key.

(d) Assemble the pump to its mounting flange or foot mounting. If a gasket is used, be certin it is flat to avoid misalignment of the shaft.





*USED ONLY WITH THREADED SHAFT

MODEL	TIGHTEN TO
V100	25± 3 ft. lbs.
V2, V200	70± 5 ft. lbs.
V300	100± 10 ft. lbs.
V400	150± 10 ft. lbs.
V500	250± 10 ft. lbs.

FLOW CONTROL VALVE

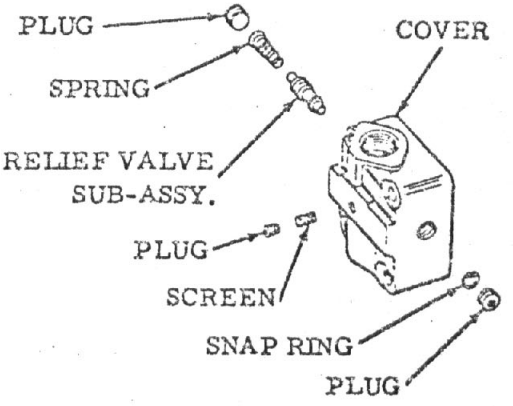


Figure 2

HYDRAULIC OIL FILTER

a. Removal

(1) Disconnect hydraulic lines and fittings from inlet and outlet ports of the oil filter.

(2) Remove capscrews and lockwashers which secure the filter head to the mounting bracket. Remove oil filter assembly.

b. Disassembly

(1) Loosen bolt (1, Figure 1) and separate head assembly from body. Discard gasket (6).

(2) Remove filter element (4) from body. Spring (3) must be pulled upward to disengage its lower turn from detent groove on bolt body. Spring (3), bolt (1), and washer (2) may now be removed from body (5).

(3) Remove snap ring (11), washer (10), spring (9), and poppet (8) from head (7). Removal is through the outlet port.

c. Cleaning--Clean all parts in an approved cleaning solvent and dry thoroughly.

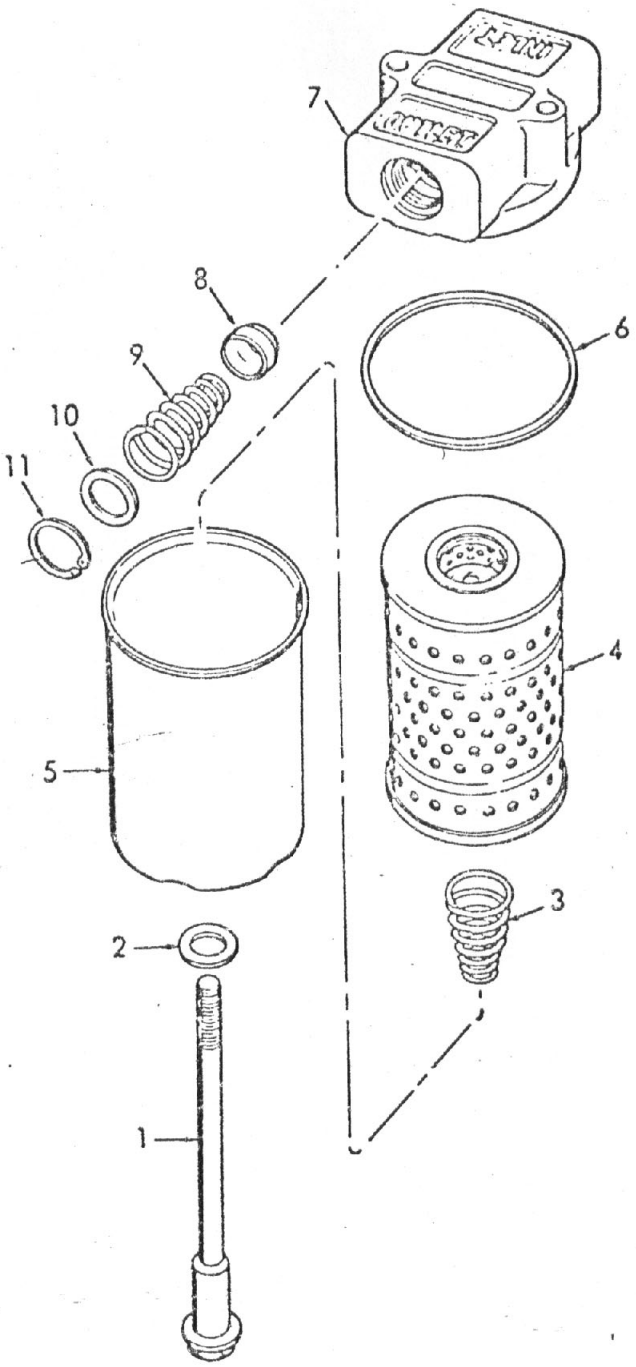
d. Reassembly

(1) Reassemble in reverse of disassembly instructions, installing a new gasket (6) and filter element (4).

(2) Be sure that smallest turn of spring (3) seats in groove of bolt (1).

(3) Tighten bolt (1) to 30-35 ft. lbs. torque.

e. Installation--Install filter assembly in reverse of removal instructions.



1. Bolt
2. Washer
3. Spring
4. Element
5. Body
6. Gasket
7. Head
8. Poppet
9. Spring
10. Washer
11. Snap Ring

Figure 1. Hydraulic Oil Filter.

HYDRAULIC LINES AND FITTINGS

a. The hydraulic lines will require minimum maintenance. Occasional inspection of the complete arrangement must be made for leakage. Replacement is required only when a part has become frayed, cracked, deteriorated, bent or threads are damaged. Replace hoses with the correct replacement part as some hoses are of the high pressure type. Replace tubing with the correct replacement to insure the type tubing will withstand the pressures within the system. All connections must be tight and free from leaks.

b. When removing any hydrulic lines or fittings, tag each part with its location and mating parts noted to insure proper reinstallation or replacement.

c. Piping Leaks:

The basic causes of fluid system leakage are:

1. Human error.
2. Lack of cuality control.
3. Poor protection of components in handling.
4. Difficult if not impossible to reach fitting connections.
5. Lack of education.

CAUSES:	CURE:
1. Connector not tight	Tighten
2. Cracked port or connector	Check for cracks and replace defective parts
3. Galled threads (torn threads)	Inspect and replace if necessary
4. Damaged threads, nicks, cuts, etc.	Replace if damaged
5. Contaminated threads, dirt, chips, etc.	Clean and inspect
6. Heat expansion of female threads	Retighten while hot
7. Too tight, causing thread distortion	Check, replace

TROUBLE SHOOTING CHART

GENERAL

PROBLEM	SOLUTION
NO HYDRAULIC PRESSURE OR FLOW	1. Check hydraulic oil tank level. 2. Check both pumps for engagement. 3. Check suction lines for a pin hole or collapsed hose. 4. Check pumps for damage. 5. Refer to Vickers pump trouble shooting.
ENGINE WILL NOT START	1. Check transmission selector, should be in neutral. 2. If emergency engine shut-down knob has been pulled engine can be started only after latch on engine air shut-down housing has been reset. 3. Check ground at batteries. 4. Trace wiring using wiring diagrams. 5. Check engine fuel rack air cylinder and solenoid. 6. Refer to engine trouble shooting. Refer to series 53 Service Manual Form 6SE201 (Rev. 7/72).

PROBLEM	DRIVE TRAIN SOLUTION
NOISY DRIVE LINE	1. Check assembly of slip joints. Replace if necessary. 2. Check for worn universal joints, replace if necessary. 3. Inspect drive shaft assembly for yokes out of phase. 4. Check shafts for out of balance, replace defective shafts.

PROBLEM	ELECTRICAL SOLUTION
BATTERIES	1. Check battery solution and add if needed. 2. Check for short in battery cells. 3. Alternator belt is loose or slipping, adjust belt tension. 4. Check voltage regulator setting, adjust regulator if needed. 5. Inspect and test wiring for short circuits.

PROBLEM	AIR SYSTEM SOLUTION
AIR SYSTEM WILL NOT MAINTAIN AIR PRESSURE	1. Inspect system for leaks and correct. 2. Compressor is malfunctioning, refer to air compressor trouble shooting. 3. Check governor for malfunction and replace if necessary. 4. Check for clogged air intake strainer at compressor.

PROBLEM	HYDRAULIC SYSTEM SOLUTION
SLUGGISH OPERATIONS, OR EXCESSIVE PUMP NOISE	1. Check hydraulic tank oil level, and fill to proper level. 2. Drain oil tank and inspect strainers in bottom of sump tank and clean with compressed air. Fill system with fresh oil. 3. Hydraulic pumps may be worn. Refer to pump trouble shooting. 4. Inspect oil suction hoses from tank to pumps. Tighten clamps and fittings, Check suction hoses if hoses are chafed or worn through, replace them. 5. Inspect entire hydraulic system for leaks or collapsed hoses.

TROUBLE SHOOTING CHART (Cont.)

PROBLEM	SOLUTION
CRANES EQUIPPED WITH A TWO BLOCK ACTUATOR	
BOOM WILL NOT LOWER BOOM WILL NOT EXTEND WINCH WILL NOT RAISE LOAD	1. Micro switch on boom point is not making contact with actuator arm. Micro switch defective. 2. Hydraulic dump valve is not energized. Actuate manual valve over-ride to check for proper valve function. Valve is normally open. If valve functions properly, check boom point micro switch for contact, and then check wiring from boom point to to dump valve.
NO SLEWING OPERATON	1. Check pump working pressure and flow. 2. Refer to Denison Control valve trouble shooting.
NO CROWD OPERATION	1. Check pump working pressure and flow. 2. Check two block actuator assembly and electrical system. 3. Check crowd cylinder for bypass 4. Refer to Vickers control valve trouble shooting. 5. Check double over-center valve.
BOOM WILL NOT RETRACT	1. Check over-center check valve. Valve is located on crowd-out hose. It is free flow in crowd-out direction and check on the retract side. Pilot pressure opens valve to retract boom. Remove ¼ inch pilot hose and fittings. Check screen in valve body for foreign elements. Clean and replace screen, fittings, and hose. 2. Refer to Vickers Control valve trouble shooting.
NO BOOM LIFT OPERATION	1. Check pump working pressure and flow. 2. Check lift cylinders for bypass. 3. Refer to Vickers' control valve trouble shooting.

PROBLEM	SOLUTION
NO BOOM LOWER OPERATION	1. Check two-block actuator assembly and electrical system. 2. Check over-center valve on clevis end of cylinder tube. Valve is free-flow raising boom, and pilot operated checked lowering boom. Remove 3/8 inch pilot hose and fittings. Check screen in both valve bodies for foreign elements. Clean and replace screens, fittings, and hoses. 3. Refer to Vickers' control valve trouble shooting.
NO STEERING OR STEERING NOT SYNCHRONIZED	1. Check steering pump working pressure and flow. 2. Check steer selector valve, 3. Check steering cylinders for bypass.
OUTRIGGERS DO NOT FUNCTION	1. Check pump working pressure and flow. 2. Balance speed of front and rear outriggers by adjusting flow regulator with engine running at maximum RPM. 3. Operate outrigger control valves manually to determine if problem is hydraulic or electric–air related. If problem is hydraulic check the following: A) Check pump working pressure and flow. B) If vertical outrigger cylinder operates in one direction and not the opposite, check outrigger double pilot operated check valve for foreign material. If problem is electric–air related check the following: A) Check outrigger switches and wiring for continuity. B) C) Check outrigger air solenoid banks. Solenoids are normally closed and air is pressure regulated to 45 PSI. Check air cylinders for bypass.

PROBLEM	SOLUTION
TRANSMISSION DOES NOT SHIFT	1. Check wiring from transmission selector to air shift solenoids. 2. Check air pressure-minimum of 45 PSI required. 3. Check air shift cylinders and piping.
NO FOOT BRAKE CONTROL	1. Check foot brake treadle valve. Air should expel momentarily when pedal is released. 2. Check air pilot hoses at relay valves, no air pressure should be in these hoses until brake pedal is actuated. 3. Check total brake system for leaks and tighten if necessary.
NO MAIN WINCH CONTROL	1. Check pump working pressure and flow. 2. Check two-block actuator assembly and its electrical system. 3. Refer to winch trouble shooting. 4. Refer to Vickers control valve trouble shooting.

MECHANICAL COMPONENTS: Periodically inspect all mechanical and fabricated components for proper alignment, wear pattern, ease of operation and secure mounting. Tighten and/or replace any defective hardware. Repair or replace any defective components.

TROUBLE SHOOTING HYDRAULICS:

SYMPTOM	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING OIL	Pump driven in wrong direction of rotation.	Must be reversed immediately to prevent seizure. Check direction of drive rotation against proper pump rotation.
	Pump drive shaft coupling sheared (direct drive).	Remove pump from accessory mounting pad and determine damage to pump. Replace needed parts. Check input speed to determine whether it is higher than recommended. Check relief valve setting.
	Fluid intake pipe in reservoir blocked or oil viscosity too high to pick up prime.	Drain complete system. Add new fluid of proper viscosity. Check all filters for dirt and sludge. Follow filling procedures.
	Air leaks at intake-pump not priming.	Circuit must be tested at input connection. Determine where air is being drawn into line connections and tighten. Check minimum drive speed which may be too slow to prime the pump.
	Oil below pump intake opening in reservoir.	Add oil to reservoir as required. Follow recommended filling procedures.
INSUFFICIENT PRESSURE BUILD-UP IN THE SYSTEM	System relief valve set too low.	Set relief valve properly using pressure gauge.
	Dirt in relief valve – relief valve sticking.	Remove relief valve from unit. Flush thoroughly and check for free operation.
	Sludge and dirt in unit.	Flush and clean system thoroughly. Disassemble and inspect for wedged dirt or sludge. Clean thoroughly and reassemble.
	Valving surfaces scored by abrasive matter.	Replace all scored or worn parts.
	Leak in hydraulic system connections or cylinders.	Check for source of leaks. Tighten connections as required. Replace worn seals, gaskets or parts that may be causing leakage.
	Fan Drive belt slippage.	Adjust and tighten belt for recommended tension.
PUMP MAKING NOISE	Partially clogged intake line or strainer.	Pump must receive intake oil freely or cavitation will result. Drain system and clean intake line. Replace strainer element as required.
	Air leaks at pump intake line joints or pump shaft packing.	Test by pouring oil on joints and around drive shaft. Listen for change in operation. Tighten joints affected and replace pump drive shaft packing or oil seal according to service instructions.
	Coupling misalignment	Realign. Replace oil seal if it has been damaged by the shaft misalignment.
	Tank air vent plugged.	Remove air breather cap. Flush and clean air filter.
	Sludge and dirt in pump.	Disassemble and inspect for wedged dirt or sludge. Clean thoroughly and reassemble.
	Alternator drive belt too tight.	Adjust belt for recommended tension. If necessary, replace worn bearings
	Oil viscosity too high.	Change to specified oil.
	System tubing or rubber inlet hose pinched.	Inspect hose or tubing at pinched area to determine possible damage. Replace tubing always. Replace rubber hose if cut, torn or deformed.

MECHANICAL COMPONENTS: Periodically inspect all mechanical and fabricated components for proper alignment, wear pattern, ease of operation and secure mounting. Tighten and/or replace any defective hardware. Repair or replace any defective components.

TROUBLE SHOOTING HYDRAULICS:

SYMPTOM	PROBABLE CAUSE	REMEDY
PUMP NOT DELIVERING OIL	Pump driven in wrong direction of rotation.	Must be reversed immediately to prevent seizure. Check direction of drive rotation against proper pump rotation.
	Pump drive shaft coupling sheared (direct drive).	Remove pump from accessory mounting pad and determine damage to pump. Replace needed parts. Check input speed to determine whether it is higher than recommended. Check relief valve setting.
	Fluid intake pipe in reservoir blocked or oil viscosity too high to pick up prime.	Drain complete system. Add new fluid of proper viscosity. Check all filters for dirt and sludge. Follow filling procedures.
	Air leaks at intake-pump not priming.	Circuit must be tested at input connection. Determine where air is being drawn into line connections and tighten. Check minimum drive speed which may be too slow to prime the pump.
	Oil below pump intake opening in reservoir.	Add oil to reservoir as required. Follow recommended filling procedures.
INSUFFICIENT PRESSURE BUILD-UP IN THE SYSTEM	System relief valve set too low.	Set relief valve properly using pressure gauge.
	Dirt in relief valve – relief valve sticking.	Remove relief valve from unit. Flush thoroughly and check for free operation.
	Sludge and dirt in unit.	Flush and clean system thoroughly. Disassemble and inspect for wedged dirt or sludge. Clean thoroughly and reassemble.
	Valving surfaces scored by abrasive matter.	Replace all scored or worn parts.
	Leak in hydraulic system connections or cylinders.	Check for source of leaks. Tighten connections as required. Replace worn seals, gaskets or parts that may be causing leakage.
	Fan Drive belt slippage.	Adjust and tighten belt for recommended tension.
PUMP MAKING NOISE	Partially clogged intake line or strainer.	Pump must receive intake oil freely or cavitation will result. Drain system and clean intake line. Replace strainer element as required.
	Air leaks at pump intake line joints or pump shaft packing.	Test by pouring oil on joints and around drive shaft. Listen for change in operation. Tighten joints affected and replace pump drive shaft packing or oil seal according to service instructions.
	Coupling misalignment	Realign. Replace oil seal if it has been damaged by the shaft misalignment.
	Tank air vent plugged.	Remove air breather cap. Flush and clean air filter.
	Sludge and dirt in pump.	Disassemble and inspect for wedged dirt or sludge. Clean thoroughly and reassemble.
	Alternator drive belt too tight.	Adjust belt for recommended tension. If necessary, replace worn bearings
	Oil viscosity too high.	Change to specified oil.
	System tubing or rubber inlet hose pinched.	Inspect hose or tubing at pinched area to determine possible damage. Replace tubing always. Replace rubber hose if cut, torn or deformed.

EXTERNAL LEAKAGE	Shaft oil seal worn or damaged.	Replace shaft oil seal. Check pump alignment.
	Damaged gasket.	Replace damaged part.
	Valve spool oil seal worn or damaged.	Replace plunger oil seal. Check spool for scoring.
	Loose bolts.	Tighten to correct torque.
VALVE SPOOL STICKY OR SLUGGISH	Dirt between operating spool and body.	Disassemble and inspect for foreign matter. Clean and polish thoroughly or replace scored parts.
	Broken valve spring.	Replace spring.
	Mounting bolts distorting valve body.	This may occur where the mounting pad is uneven or does not offer sufficient support for the valve. Remove bolts and shim corners as necessary to relieve distortion. Re-tighten to recommended torque.
	Binding control linkage.	Adjust linkage to permit free action and to allow valve spool to center in neutral position.
EXCESSIVE OIL TEMPERATURE	Unit operated improperly.	Do not hold operating spool in the extreme "IN" or "OUT" position after the work load has reached its movement limits. Do not "exercise" the work load rapidly or continuously for a long period of time. Observe recommended limits for operating speed and pressure.
	Valve spool held off center by manual control levers and linkage.	Adjust linkage to permit valve spool to center in neutral position.
	Valve spool binding.	Disassemble and clean. Correct or replace scored parts.
CYLINDER INOPERATIVE OR SLUGGISH	Rod packing too tight.	Adjust packing nut.
	Cylinder misalignment.	Align cylinder and check connecting parts.
	Scored cylinder or piston.	Rework or replace scored parts.

TROUBLE SHOOTING POWER STEERING
HARD STEERING

	CAUSE	REMEDY
1.	Sticky relief valve or improper setting.	Check relief valve for function and setting.
2.	Improper steering valve adjustment.	Adjust thrust bearings on either side of valve.
3.	Spool in steering valve sticking or spool in flow divider sticking.	Inspect valve. Clean and flush system to remove dirt.
4.	Insufficient pump pressure.	Check pump.
5.	Valve or cylinder lines incorrectly installed.	Check plumbing for correct installation.
7.	Loss of hydraulic oil due to leaks or damaged lines.	Check oil level. If low, check for leaks or damage.
8.	Broken piston or piston rings.	Replace .
9.	Lack of steering gear lubricant.	Add lube to proper level.
10.	Stud adjusted too tightly in cam groove.	Adjust.
11.	Wheel tube bent or sprung.	Replace bent parts and correct column alignment.
12.	Improper steering wheel alignment.	Align.
13.	Low tire pressure.	Inflate to proper level.

LOST MOTION, SHIMMY OR WOBBLE

CAUSE	REMEDY
1. Valve out of adjustment.	Adjust.
2. Excessive backlash of stud in cam.	Tighten wheel nut.
3. Steering wheel loose on wheel tube.	Tighten lever shaft nut.
4. Pitman arm loose on lever-shaft.	Adjust.
5. Loose ball socket connections.	Adjust.

NOISE

1. Low fluid level.	Check for leaks, refill to level.
2. Air in system.	Check all connections and bleed systems.
3. Dirt and sludge in pump.	Drain system and clean.
4. Pump worn.	Replace.
5. Weakened pressure relief valve spring.	Replace spring.

HOW TO ASSEMBLE CONE-DRIVE GEARS
Continued

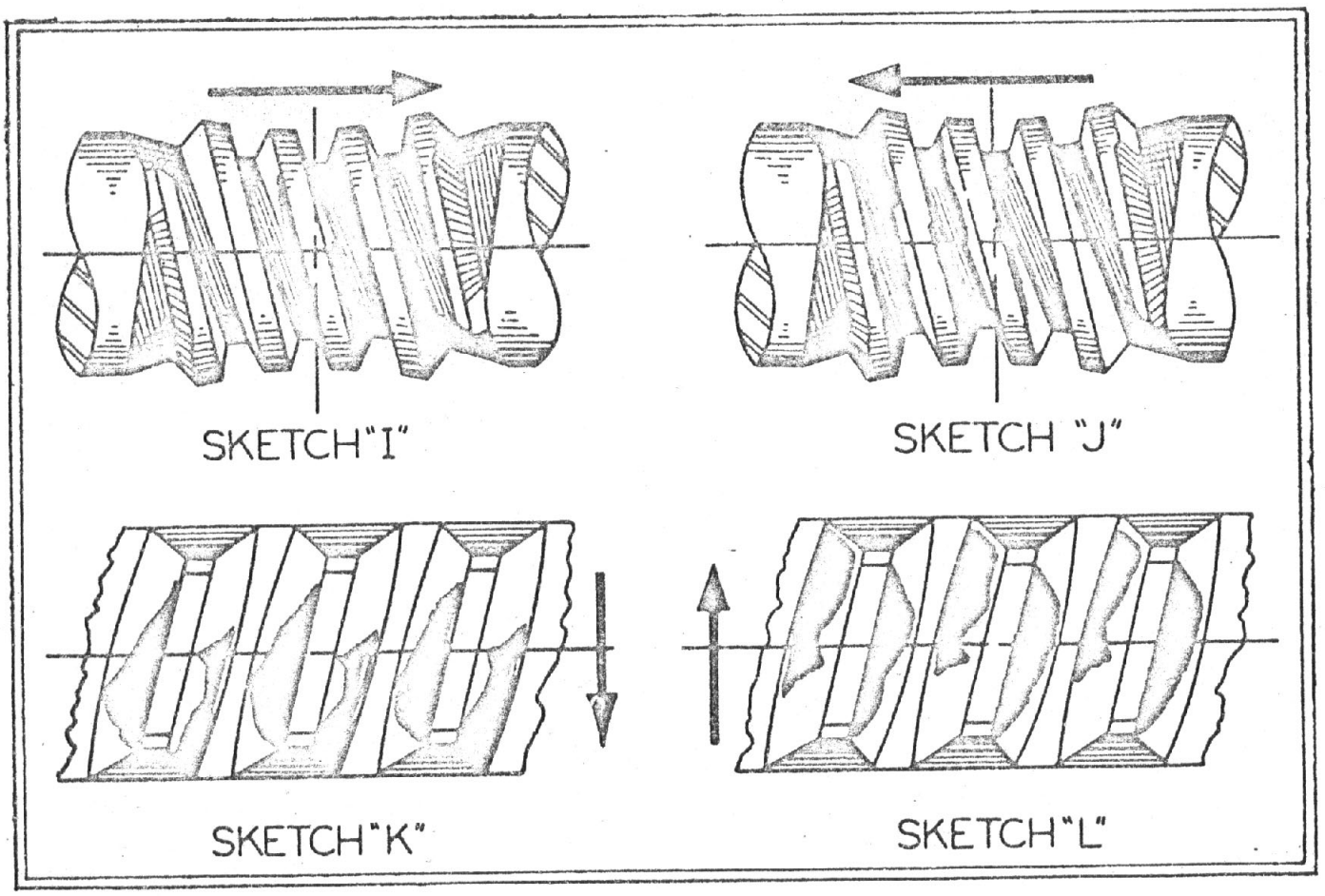
If the drive is not correctly aligned, any one of a combination of the contacts illustrated in Sketches I, J, K, L, M, N, O or P may be obtained. If the contact secured indicates considerable out-of-alignment, the housing and parts should be rechecked as per assembly instructions.

If the contact shows that the alignment is off only a slight amount it may be adjusted by removing or adding an estimated amount from or to the shims. This is done in the following manner:

If bearing contact is similar to that in sketch:

"I" or "J" – The worm is out of end position. Move it endwise in the direction indicated by the arrows (see sketch "a" for correct contact pattern).

"K" or "L" – The gear is out of side position. Move gear sidewise in the direction indicated by the arrows (see sketch "b" for correct contact pattern).



HOW TO ASSEMBLE CONE-DRIVE GEARS

HIGH RATIO UNITS

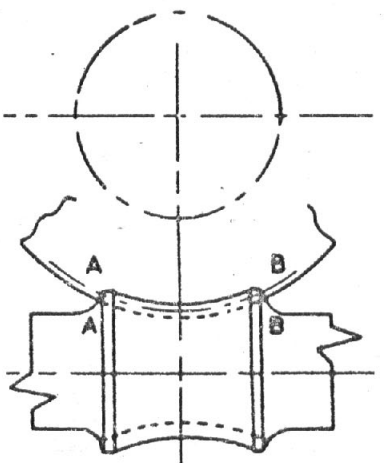
NOTE: When worm and gear are both symmetrical about their centerlines, caution should be exercised in assembling them in the housing to see that the letters "A" and "B" stamped on the gear coincide with the same letters on the worm shoulders as shown in Sketch "a-1".

After the worm and gear have been assembled in the housing to their correct relative dimensions as previously described, the assembly may be checked as follows:

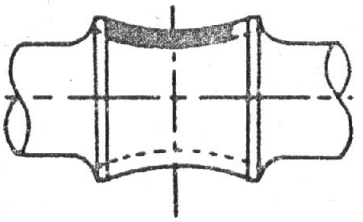
Brush a light even coat of Prussian Blue or Red Lead on the whole worm thread portion. Rotate the worm against a light retarding load on the gear shaft until a clear contact pattern is obtained on the worm threads and on the gear teeth. If the gear set is properly aligned, the contact should be approximately the same as shown by the shaded portion in sketches "a" and "b".

The type of bearing "M" and "N" in sketch "b", in conventional worm and straight type worm gearing, would normally be called a "cross" bearing. In the case of Cone-Drive gearing, however, it is caused by the ends of the worm threads being relieved slightly.

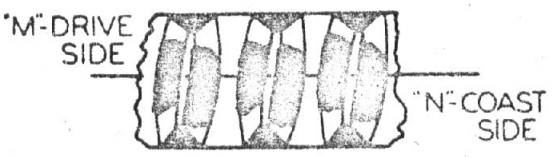
After a short run under full load, the worm will seat itself and show a bearing contact for the full width of the gear and the full length of the pinion thread.



SKETCH "a-1"

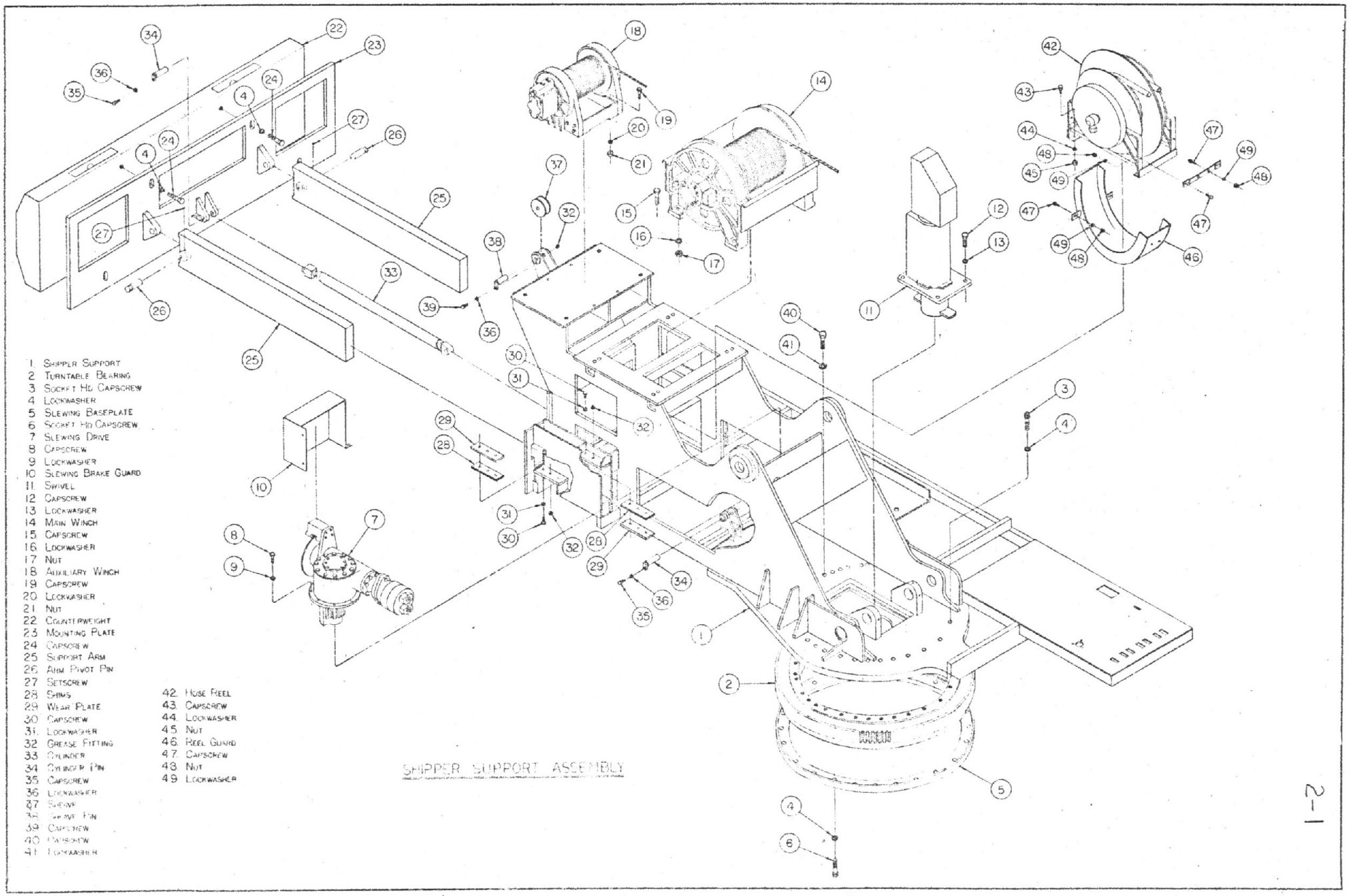


SKETCH "a"



SKETCH "b"

UPPER STRUCTURE AND RELATED COMPONENTS



1. Shipper Support
2. Turntable Bearing
3. Socket Hd Capscrew
4. Lockwasher
5. Slewing Baseplate
6. Socket Hd Capscrew
7. Slewing Drive
8. Capscrew
9. Lockwasher
10. Slewing Brake Guard
11. Swivel
12. Capscrew
13. Lockwasher
14. Main Winch
15. Capscrew
16. Lockwasher
17. Nut
18. Auxiliary Winch
19. Capscrew
20. Lockwasher
21. Nut
22. Counterweight
23. Mounting Plate
24. Capscrew
25. Support Arm
26. Arm Pivot Pin
27. Setscrew
28. Shims
29. Wear Plate
30. Capscrew
31. Lockwasher
32. Grease Fitting
33. Cylinder
34. Cylinder Pin
35. Capscrew
36. Lockwasher
37. Sheave
38. Sheave Pin
39. Capscrew
40. Capscrew
41. Lockwasher
42. Hose Reel
43. Capscrew
44. Lockwasher
45. Nut
46. Reel Guard
47. Capscrew
48. Nut
49. Lockwasher

SHIPPER SUPPORT ASSEMBLY

SHIPPER SUPPORT

a. Removal

(1) Following removal of shipper and boom assembly and lift cylinders, the krane superstructure can then be removed.

(2) Disconnect all hydraulic couplings leading to the krane and the electric leads to the collector ring.

(3) Attach wire rope sling to the superstructure.

(4) Turntable bearing & gear (2) is anchored to carrier thru base plate of carrier and bearing base plate (5) by socket head capscrews (6) and lockwashers (4). Bearing and gear (2) is anchored to shipper support weldment (1) by hex head capscrews (40), lockwashers (41), socket head capscrews (3) and lockwashers (4). Remove the capscrews (6) and lockwashers (4) and lift superstructure off carrier. Then gear (2) can be removed by taking off capscrews (40 & 3) and lockwashers (41 & 4).

b. Disassembly

(1) Remove capscrews (24) and lockwashers (4) and, using seperate krane, pull counterweight (22) off plate (23).

(2) Remove setscrews (27), pins (26), pin (34), capscrew (35) and lockwasher (36) and pull mounting plate (23) off shipper support.

(3) The counterweight support arms (25) can then be taken out of brackets.

(4) Remove capscrews (30) and lockwashers (31), then wear plate (29) and shims (28) can be removed.

(5) Remove cylinder pin (34), capscrew (35) and lockwasher (36). The cylinder can then be removed.

(6) Remove capscrew (19), nut (21) and lockwasher (20) then, using seperate krane, lift off auxiliary winch (18).

(7) Remove capscrew (15), nut (17) and lockwasher (16) then, using seperate krane, lift off main winch (14).

(8) Remove slewing brake guard (10), capscrew (8) and lockwasher (9). Lift out slewing drive (7) using a seperate krane.

(9) Remove capscrew (43), nut (45) and lockwasher (44). Then hose reel (42) can be taken out.

(10) Remove capscrew (47), nut (48) and lockwasher (49). Then take guard off hose reel.

(11) Remove capscrew (12) and lockwasher (13) then the swivel can be taken out.

(12) The rear sheave (37) can be taken off as follows: Remove capscrew (39) and lockwasher (36). This will release pin (38) for removal thus releasing sheave (37).

c. Assembly

(1) All parts should then be inspected for wear and replaced if so needed.

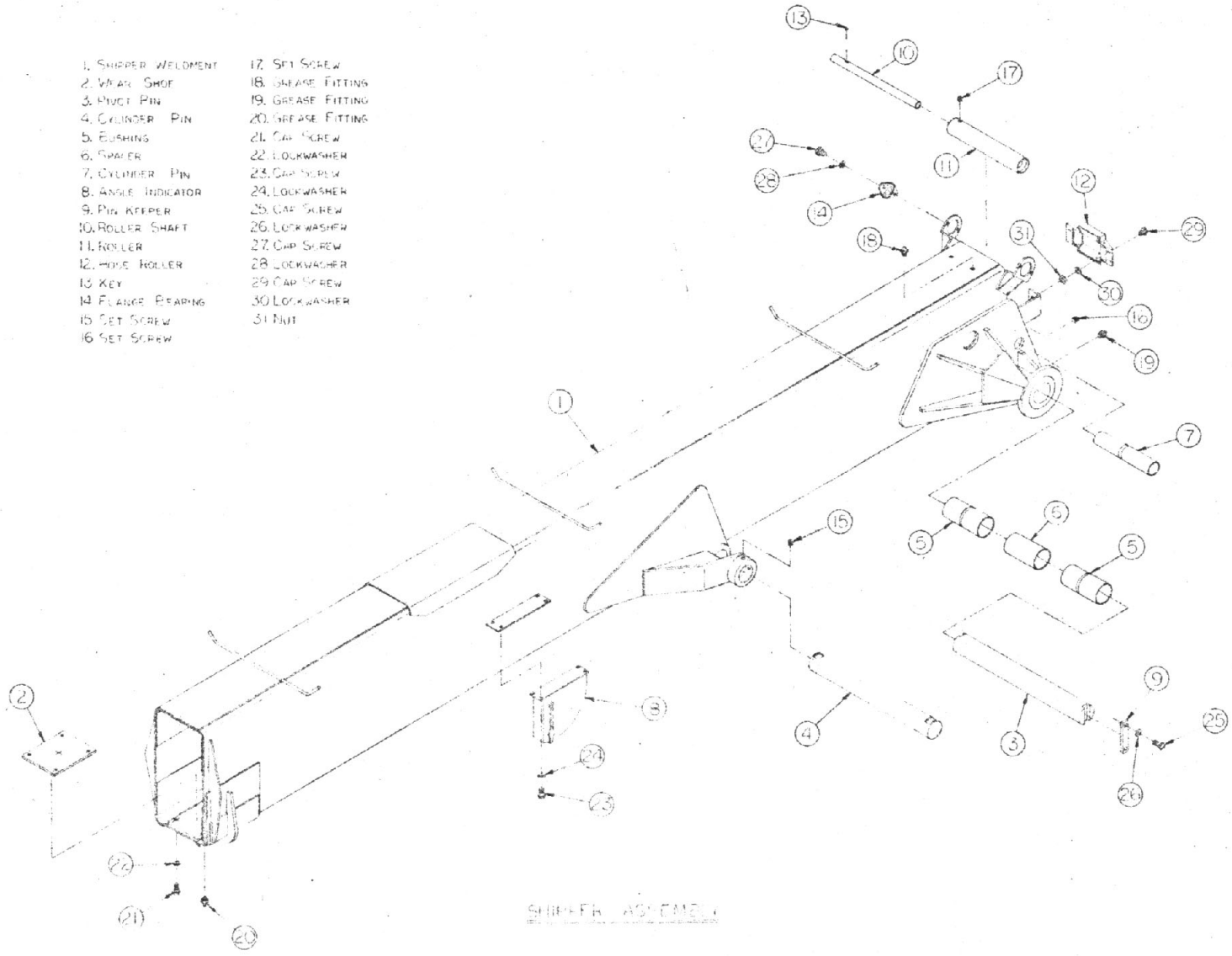
(2) Assemble complete upper in reverse order of disassembly.

(3) Install turntable bearing and gear (2) to shipper support (1) and anchor to carrier (bearing base plate - 5).

(4) Reconnect hydraulic couplings and electrical leads on krane.

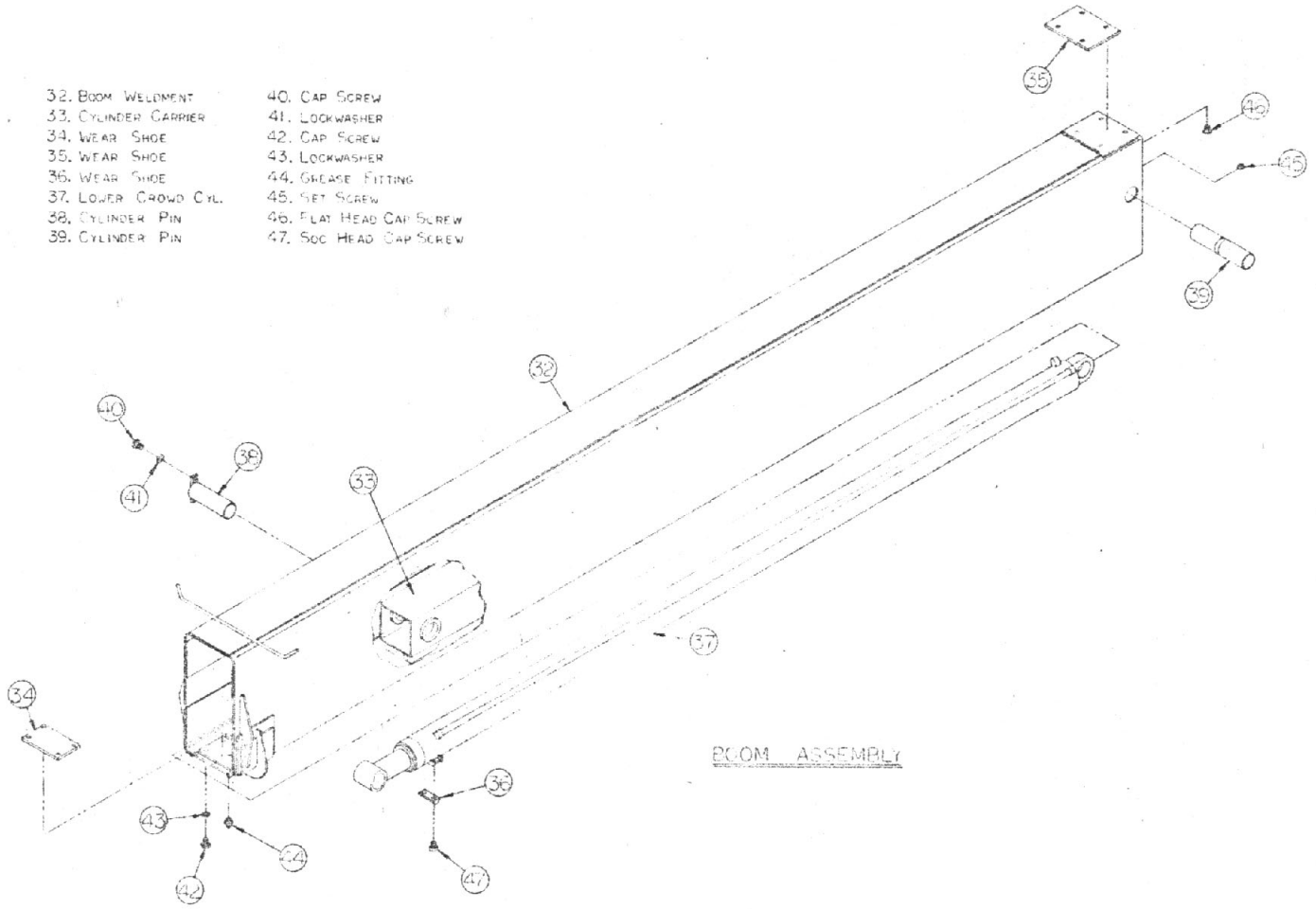
(5) Replace lift cylinders and the shipper and boom assembly - reconnect the crowd cylinder hoses and assembly is complete.

1. SHIPPER WELDMENT
2. WEAR SHOE
3. PIVOT PIN
4. CYLINDER PIN
5. BUSHING
6. SPACER
7. CYLINDER PIN
8. ANGLE INDICATOR
9. PIN KEEPER
10. ROLLER SHAFT
11. ROLLER
12. HOSE ROLLER
13. KEY
14. FLANGE BEARING
15. SET SCREW
16. SET SCREW
17. SET SCREW
18. GREASE FITTING
19. GREASE FITTING
20. GREASE FITTING
21. CAP SCREW
22. LOCKWASHER
23. CAP SCREW
24. LOCKWASHER
25. CAP SCREW
26. LOCKWASHER
27. CAP SCREW
28. LOCKWASHER
29. CAP SCREW
30. LOCKWASHER
31. NUT



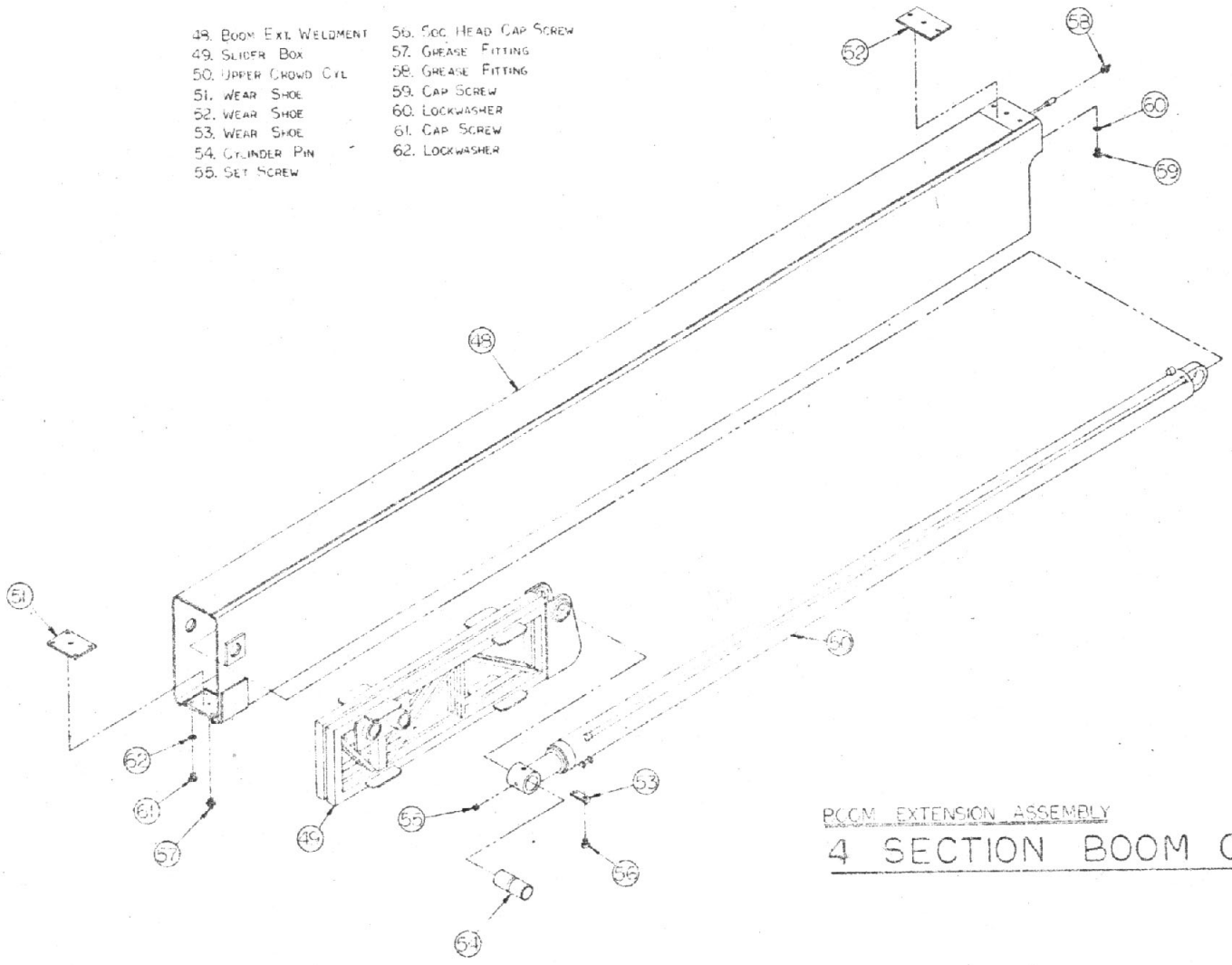
SHIPPER ASSEMBLY

32. Boom Weldment
33. Cylinder Carrier
34. Wear Shoe
35. Wear Shoe
36. Wear Shoe
37. Lower Crowd Cyl.
38. Cylinder Pin
39. Cylinder Pin
40. Cap Screw
41. Lockwasher
42. Cap Screw
43. Lockwasher
44. Grease Fitting
45. Set Screw
46. Flat Head Cap Screw
47. Soc Head Cap Screw



BOOM ASSEMBLY

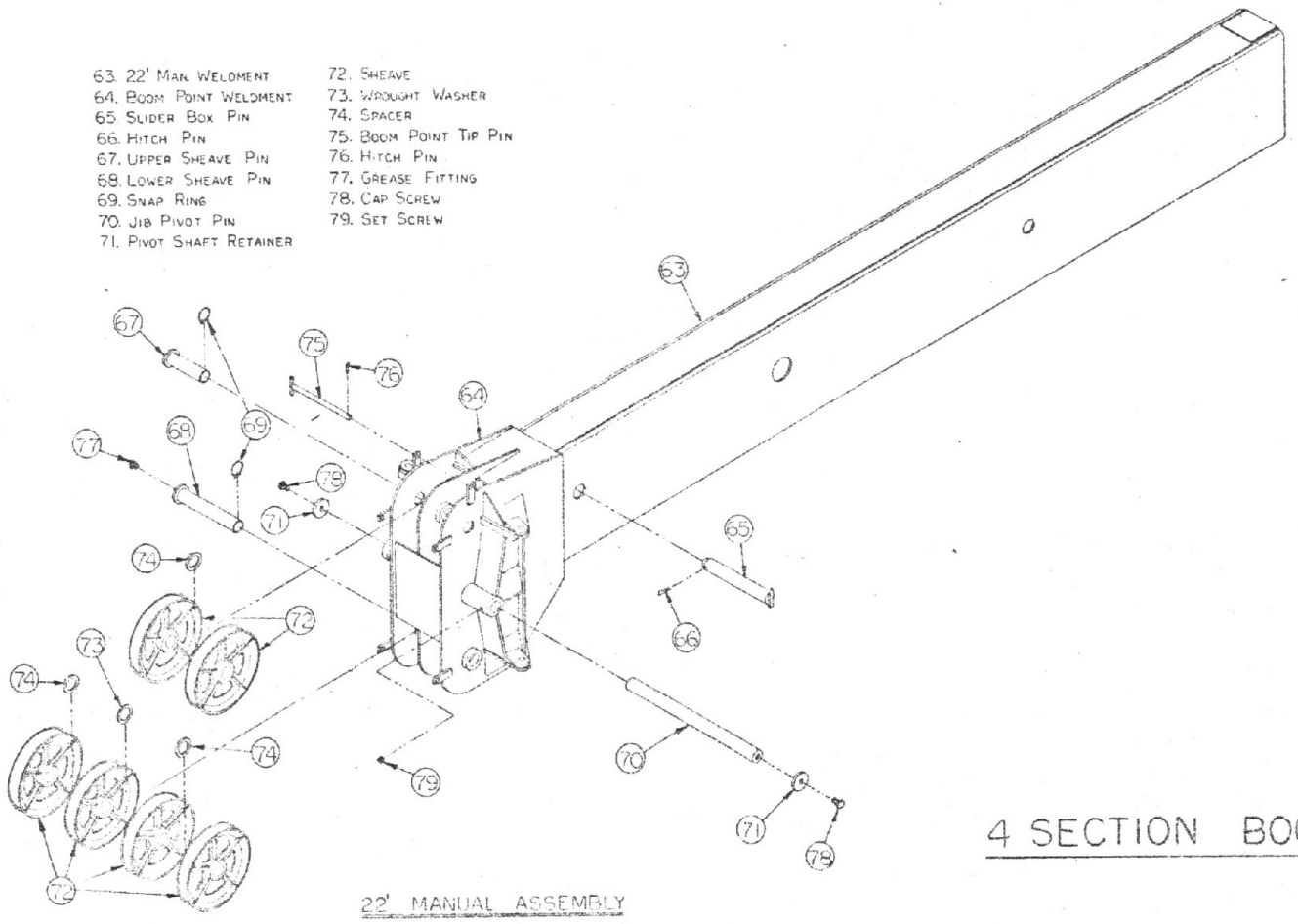
48. Boom Ext. Weldment
49. Slider Box
50. Upper Crowd Cyl.
51. Wear Shoe
52. Wear Shoe
53. Wear Shoe
54. Cylinder Pin
55. Set Screw
56. Soc. Head Cap Screw
57. Grease Fitting
58. Grease Fitting
59. Cap Screw
60. Lockwasher
61. Cap Screw
62. Lockwasher



PCCM EXTENSION ASSEMBLY

4 SECTION BOOM ONLY

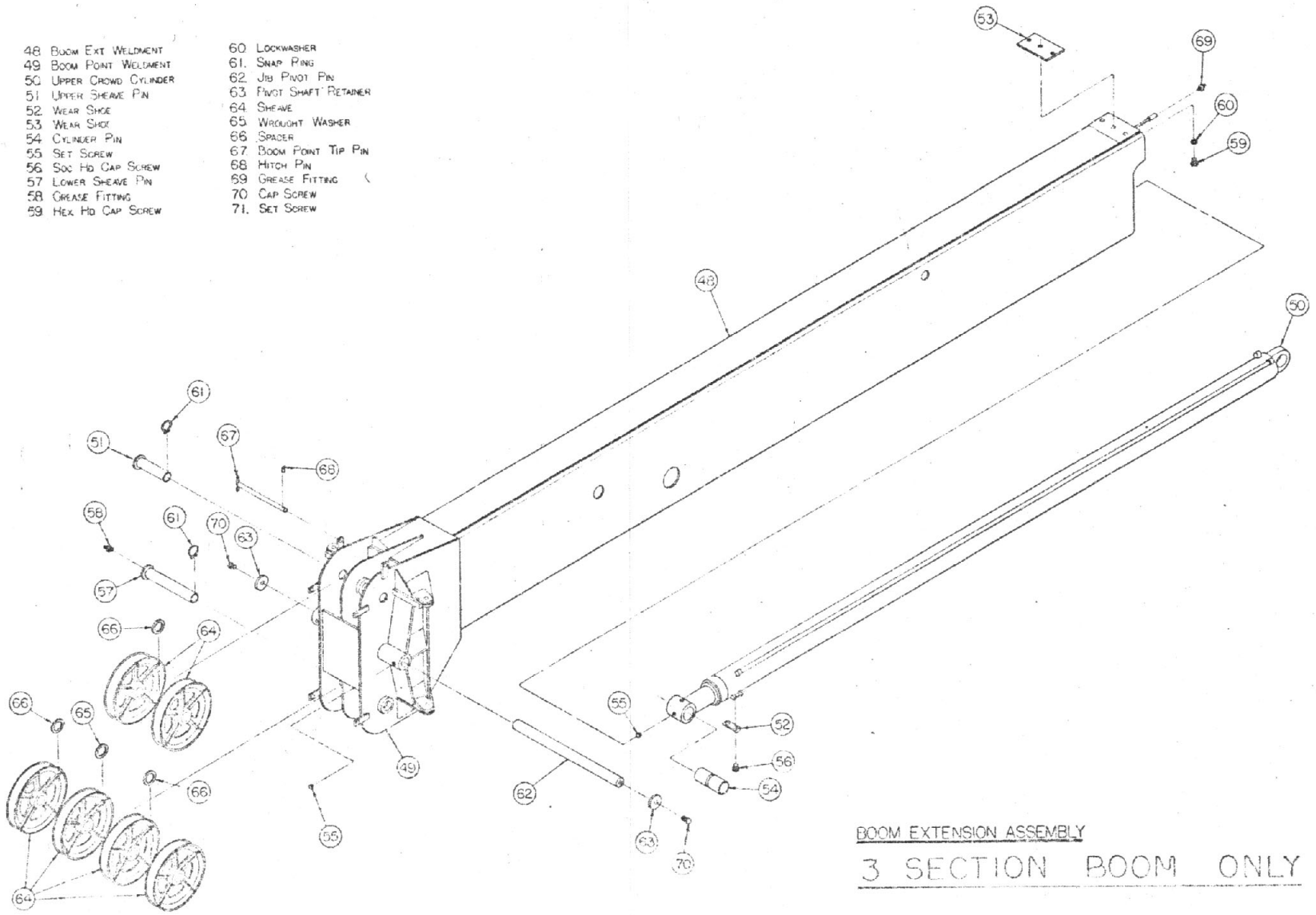
63. 22' Man Weldment
64. Boom Point Weldment
65. Slider Box Pin
66. Hitch Pin
67. Upper Sheave Pin
68. Lower Sheave Pin
69. Snap Ring
70. Jib Pivot Pin
71. Pivot Shaft Retainer
72. Sheave
73. Wrought Washer
74. Spacer
75. Boom Point Tip Pin
76. Hitch Pin
77. Grease Fitting
78. Cap Screw
79. Set Screw



22' MANUAL ASSEMBLY

4 SECTION BOOM ONLY

48 Boom Ext Weldment
49 Boom Point Weldment
50 Upper Crowd Cylinder
51 Upper Sheave Pin
52 Wear Shoe
53 Wear Shoe
54 Cylinder Pin
55 Set Screw
56 Soc Hd Cap Screw
57 Lower Sheave Pin
58 Grease Fitting
59 Hex Hd Cap Screw
60 Lockwasher
61 Snap Ring
62 Jib Pivot Pin
63 Pivot Shaft Retainer
64 Sheave
65 Wrought Washer
66 Spacer
67 Boom Point Tip Pin
68 Hitch Pin
69 Grease Fitting
70 Cap Screw
71 Set Screw



BOOM EXTENSION ASSEMBLY

3 SECTION BOOM ONLY

MAIN BOOM AND BOOM ASSEMBLY

a. Removal

(1) Remove setscrews (15) and drive cylinder pin (4) from shipper section. This will release lift cylinders from the shipper (1).

(2) Disconnect the 4 hydraulic hoses from the crowd cylinders.

(3) Attach a sling to the boom assembly (4 complete sections) and place a light strain on boom with a second krane or lifting device.

(4) Remove capscrews (25), lockwashers (26) and pin keepers (9) from ends of pivot shaft anchored in shipper support.

(5) Remove pivot shaft (3) and lift the complete boom assembly from the shipper support and lower to ground.

Note: After the complete boom assembly has been removed from the shipper support it must be taken apart as follows:

b. Disassembly of Boom Sections

(1) Remove the 3 lower front wear shoes (2, 34, 51), the capscrews (21, 42, 61), and lockwashers (22, 43, 62) holding them in place in their boom sections (1, 32, 48).

(2) Remove the setscrews (16) from the base end of lower crowd cylinder (37). Drive pin (7) out of hole in shipper section. Slide the 3 boom sections forward and out of the shipper.

(3) Remove cylinder pin (38), the capscrews (40) and lockwashers (41) holding it in place from the cylinder carrier (33) and slide the lower crowd cylinder (37) out the rear of the cylinder carrier (33).

(4) Remove the hitch pin (66) and slider box pin (65) from the 22' manual section (63) and slide the 22' manual section (63) from the boom extension section (48).

(5) Remove the setscrews (45) from the base end of upper crowd cylinder (50) and drive pin (39) out of hole in boom section (32).

(6) Pull the slider box (49) and upper crowd cylinder (50) forward enough to remove setscrews (55) from rod end of cylinder (50) and drive pin (54) out of slider box (49) and the cylinder (50). Remove slider box (49).

(7) Remove the upper crowd cylinder (50) from remaining 2 sections (32, 48).

(8) Now slide the boom section (32) and the boom extension section (48) apart.

Note: After the boom sections have been disassembled, and the crowd cylinders removed, disassembly of each section can be accomplished as follows:

c. Shipper Section Assembly

(1) The angle indicator (8) can be taken off by removal of capscrews (23) and lockwashers (24).

(2) The rear roller (11) can be taken off by removal of capscrews (27) and lockwashers (28) then removing flange bearings (14). Removal of setscrew (17) will loosen key (13) which will allow shaft (10) to be removed from roller (11) which can then be removed from shipper section (1).

(3) The hose roller (12) can be taken off by removal of capscrew (29), nut (31) and lockwasher (30).

(4) Inspect the bushings (5) in pivot hub for wear. If scored or worn sufficiently to allow vertical shaft movement approximately 1/16", replace the bushings (5).

(5) Inspect wear shoe (2) for excessive wear and replace if necessary.

(6) Inspect bearing in rod end of boom lift cylinder and replace if necessary.

d. Boom Section Assembly

(1) The rear wear shoe (35) can be taken off by removing setscrew (46). Inspect wear shoe (35) for excessive wear and replace if necessary.

(2) The lower crowd cylinder wear shoe (36) can be taken off by removing socket head capscrew (47). Inspect wear shoe (36) for excessive wear and replace if necessary.

(3) Inspect the wear shoe (34) for excessive wear and replace if necessary.

e. Boom Extension Section Assembly

(1) The rear wear shoe (52) can be taken of by removing capscrew (59) and lockwasher (60). Inspect wear shoe (52) for excessive wear and replace if necessary.

(2) The lower crowd cylinder wear shoe (53) can be taken off by removing socket head capscrew (56). Inspect wear shoe (53) for excessive wear and replace if necessary.

(3) Inspect wear shoe (51) for excessive wear and replace if necessary.

f. 22' Manual Section Assembly

(1) The boom point sheaves (72) can be taken out as follows: Pull out hitch pins (76) from tip pins (75) and remove tip pins (76). Take off snap rings (69) and remove upper sheave pin (67) and lower sheave pin (68). Inspect sheave pins and replace if necessary. Inspect the boom point sheaves for cracked or damaged edges and excessive wear in groves. Replace if necessary.

(2) The jib pivot pin can be taken out by removing the setscrews (79) and capscrews (78) and pivot shaft retainer (71).

g. Assembly

(1) Assemble the complete krane boom in reverse order of disassembly.

(2) Note that all brass bolts should be torqued to 35 ft/lb or 420 in/lb and then safety wired.

(3) Install complete boom assembly on shipper support, reconnect crowd cylinder hoses and lift cylinders.

NOTE: IF A 3-SECTION BOOM IS USED, DISASSEMBLE AS SHOWN: WORK THROUGH SECTION "d".

e. Boom Extension Assembly

(1) Rear wear shoe (53) can be taken off by removing capscrew (59) and lockwasher (60). Inspect wear shoe (53) for excessive wear and replace if necessary.

(2) The lower crowd cylinder wear shoe (52) can be taken off by removing socket head capscrew (56). Inspect wear shoe (52) for excessive wear and replace if necessary.

(3) The boom point sheaves (64) can be taken out as follows: Pull out hitch pins (68) from tip pins (67) and remove tip pins (67). Take off snap rings (61) and remove upper sheave pin (51) and lower sheave pin (57). Inspect sheave pins and replace if necessary. Inspect the boom point sheaves for cracked or damaged edges and excessive wear in groves. Replace if necessary.

(4) The jib pivot pin can be taken out by removeing the setscrews (55) and capscrews (70) and pivot shaft retainer (63).

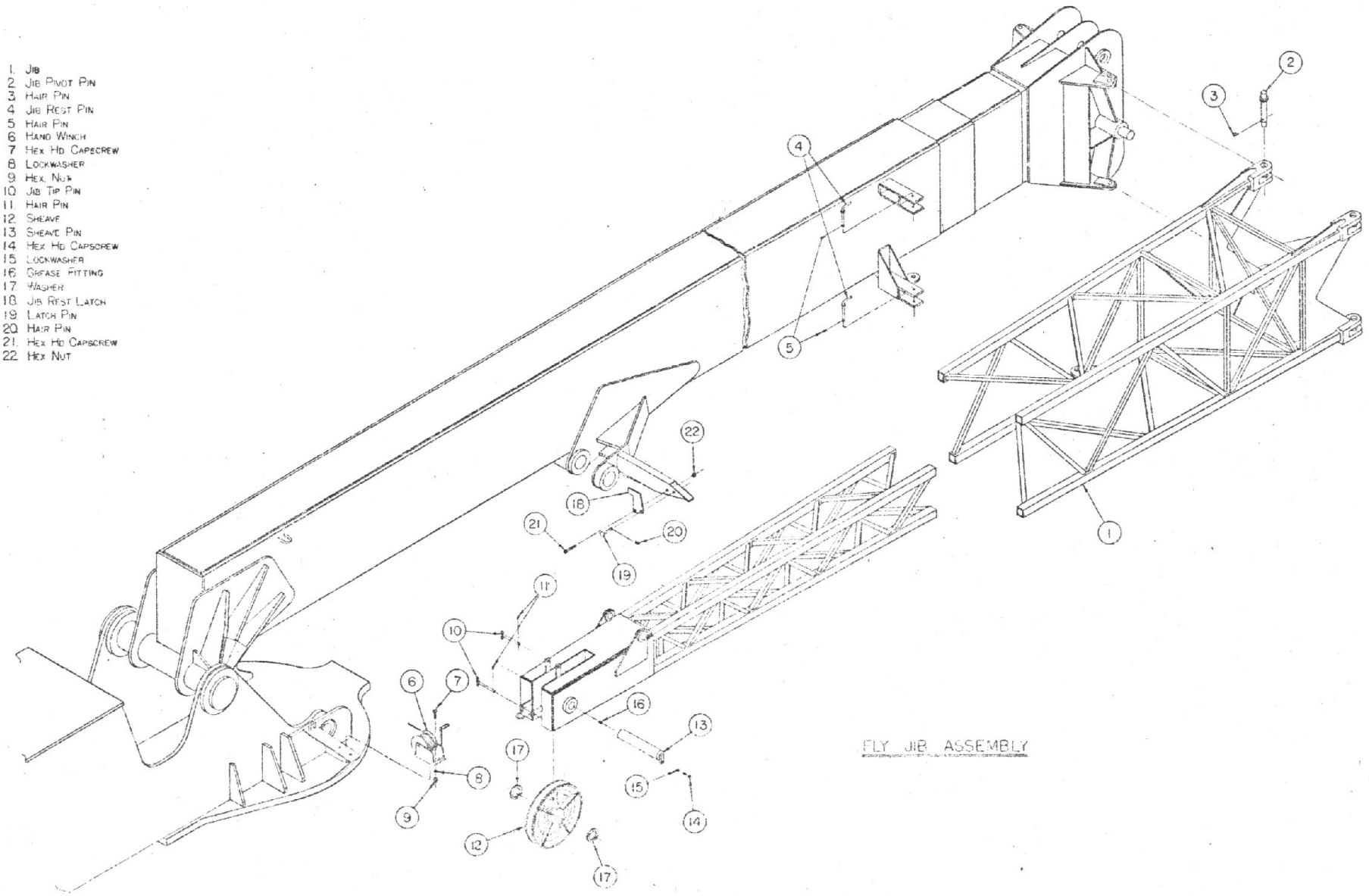
f. Assembly

(1) Assemble the complete krane boom in reverse order of disassembly.

(2) Note that all brass bolts should be torqued to 35 ft/lb or 420 in/lb and then safety wired.

(3) Install complete boom assembly on shipper support, reconnect crowd cylinder hoses and lift cylinders.

1. JIB
2. JIB PIVOT PIN
3. HAIR PIN
4. JIB REST PIN
5. HAIR PIN
6. HAND WINCH
7. HEX HD CAPSCREW
8. LOCKWASHER
9. HEX. NUT
10. JIB TIP PIN
11. HAIR PIN
12. SHEAVE
13. SHEAVE PIN
14. HEX HD CAPSCREW
15. LOCKWASHER
16. GREASE FITTING
17. WASHER
18. JIB REST LATCH
19. LATCH PIN
20. HAIR PIN
21. HEX HD CAPSCREW
22. HEX NUT



FLY JIB ASSEMBLY

FLY JIB ASSEMBLY

When jib is not used, it is hung on side of boom. To remove jib for use or inspection and repair, follow these instructions:

a. Removal

(1) Pull hair pin (20) from latch pin (19), pull latch pin (19) from rear jib rest and rotate jib rest latch (18) downward.

(2) Pull hair pins (5) from jib rest pins (4). Pull jib rest pins (4) from front jib rest.

(3) Place pins (2) into jib rear holes and ear holes on boom point. Insert hair pins (3) into pins (2).

(4) Using a line attached to tip of jib, pull jib away from boom and swing around boom point. Place remaining two pins (2) into jib holes and ear holes on boom point. Insert hair pins (3) into pins (2).

The jib is now ready for use. If repairs are needed, do as follows:

b. Repairs

Sheave can be repaired as follows:

(1) Remove hair pins (11) from jib tip pins (10). Pull out jib tip pins (10).

(2) Remove capscrew (14) and lockwasher (15) and pull out sheave pin (13).

(3) This will release sheave (12) and washers (17).

(4) Inspect sheave (12) for cracked or damaged edges and excessive wear in groove. Replace if needed.

(5) Check sheave bearings for wear. If excessive wear is encountered, press bearings from sheave (12) and replace with new bearings.

(6) Inspect pins (10) and (11) for wear and replace if necessary.

(7) Reassemble in reverse order of disassembly. Lubricate where needed. Jib is now ready for use.

(8) If hand winch is in need of repair it can be removed by taking off capscrew (7), nut (9) and lockwasher (8). Remove the hand winch (6) and inspect it and cable for wear. Replace as needed. Reassemble in reverse order of disassembly.

c. The jib can be replaced in the storage position as follows:

(1) Remove hair pins (3) from pins (2) on boom point left hand side only!

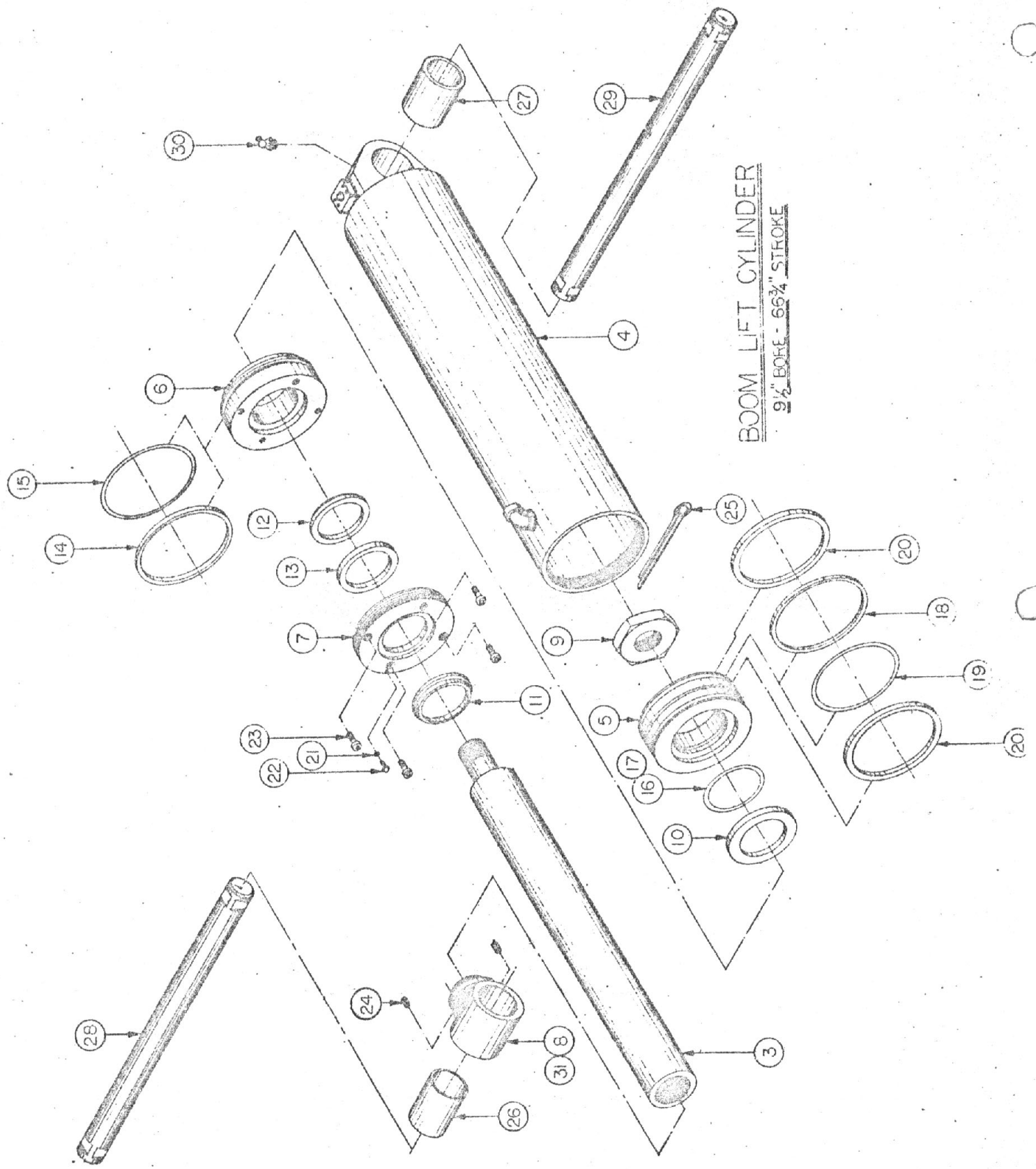
(2) Using a line attached to tip of jib, swing jib around toward the boom section.

(3) Attach line from hand winch (6) to jib tip and winch jib up on to rear rest.

(4) Swing jib rest latch into place and pin using pin (19). Place hair pin (20) into pin (19).

(5) Place jib rest pins (4) into front jib rest and place hair pins (5) into jib rest pins (4).

(6) Krane is now ready for use without jib or over road travel.


BOOM LIFT CYLINDER
9½" BORE - 66¾" STROKE
27
29
30
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25
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18
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5
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23
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24
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31
26
3

BOOM LIFT CYLINDERS

a. Removal

(1) Disconnect hydraulic lines from lift cylinders.

(2) Remove setscrews (not shown) from shipper section and from shipper support which hold upper pin (28) and lower pin (29) in position.

(3) Insert blocks between cylinders and shipper support to support cylinder when upper mounting pin (28) is removed.

(4) Remove upper mounting pin (28) and bushings (26).

(5) Attach sling to cylinders, one at a time, and pull lower pin (29) and bushing (27) from position. Lift the cylinder from the machine. After one cylinder has been removed in this manner, repeat procedure to remove other cylinder.

b. Disassembly

(1) Remove head bolts (23) from thread ring (7).

(2) Withdraw piston and rod assembly from the body.

(3) Remove piston (5) and all components from piston rod (3). Discard all packings and replace with new.

(4) Remove capscrew (22), spring lockwasher (21), gland (6), steel shoulder ring (10), piston leather back-up (16) and static piston "O" ring (17). Remove and replace phenolic ring (13), rod "U" cup (12) and rod wiper (11) if necessary.

c. Cleaning, Inspection, and Repair

(1) Clean all parts with approved cleaning solvent. Dry thoroughly.

(2) Inspect the body, rod and piston for scoring. Remove fine scoring marks with a lapping stone or fine crocus cloth. Replace deeply scored parts.

(3) Inspect cylinder shafts (23 & 29) for wear. Replace as required.

d. Reassembly

(1) Install phenolic ring (13) and rod "U" cup (12) in head gland (6). Install rod wiper (11) in thread ring (7), and bolt together with capscrew (22) and spring lockwasher (21).

(2) Install head assembly on rod (3).

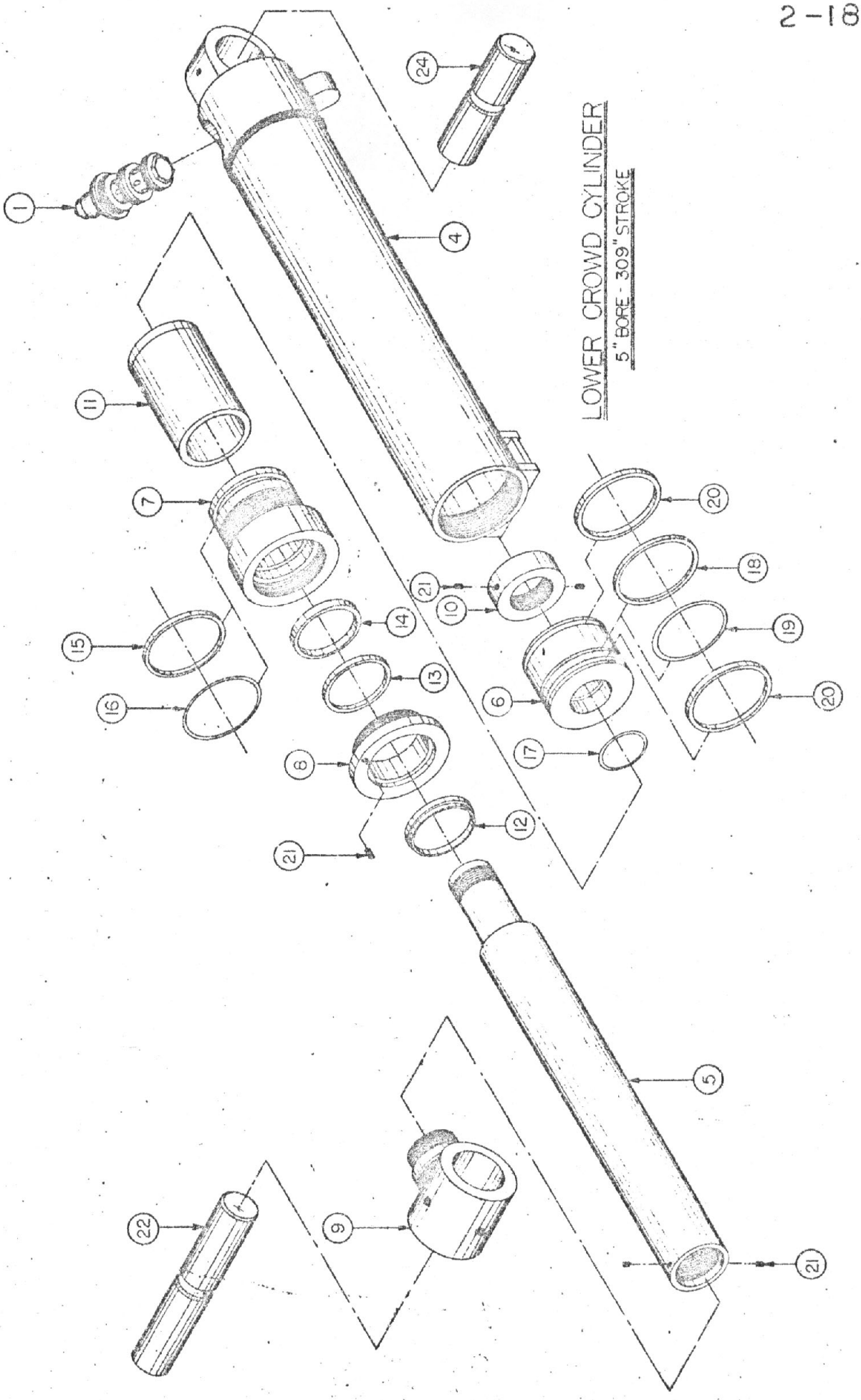
(3) Install steel shoulder ring (10), piston leather back-up (16) and static piston "O" ring (17) in piston (5), and install piston on rod and tighten securely.

(4) Lubricate assembly lightly with hydraulic oil.

(5) Install assembly in body, replace head screws (23) and tighten securely.

e. Installation

(1) Install cylinders on krane, assemble attaching hardware and connect hydraulic lines.


LOWER CROWD CYLINDER
5" BORE - 309" STROKE
1
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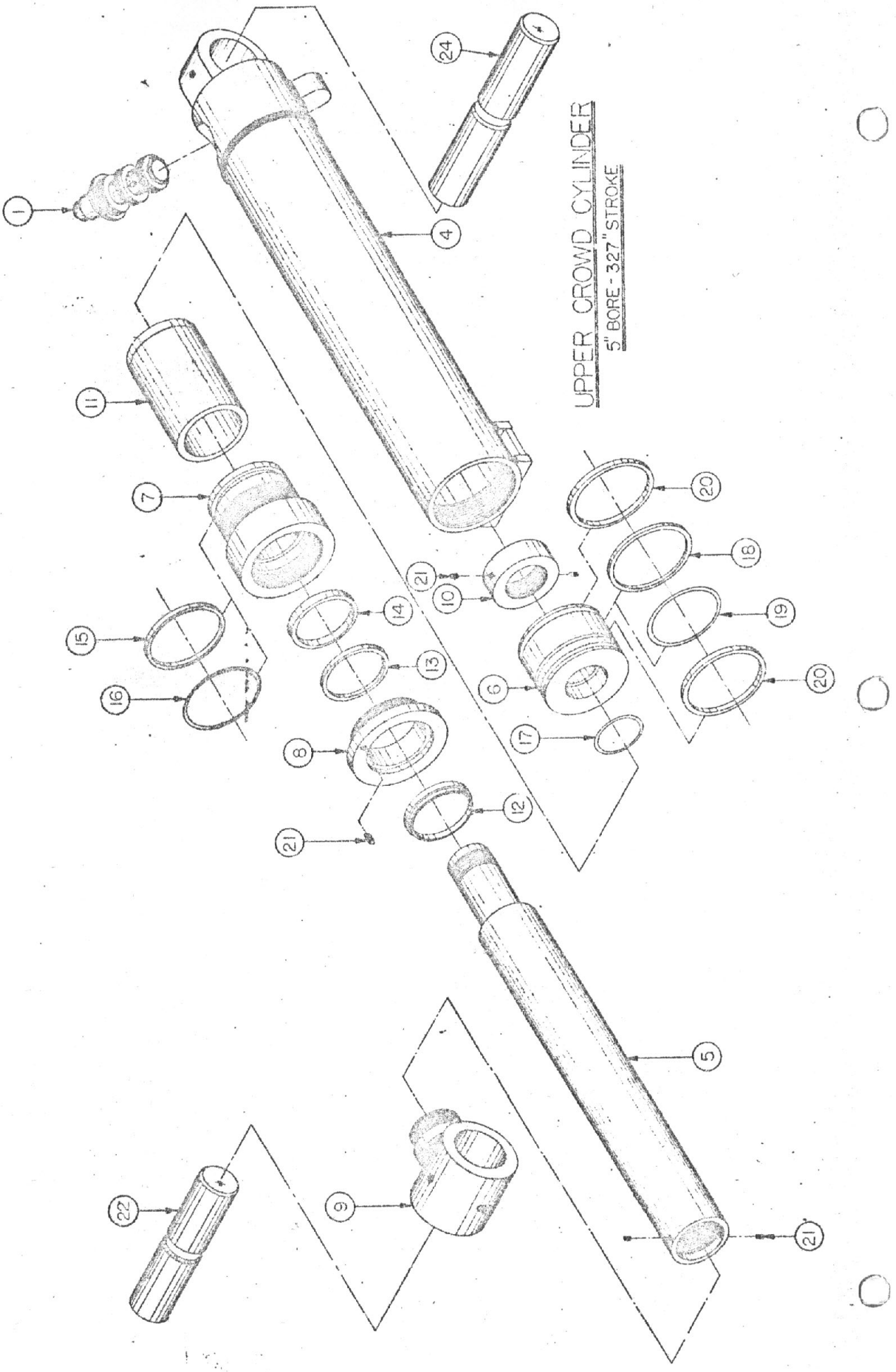
UPPER CROWD CYLINDER
5" BORE - 327" STROKE
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4
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12
21
10
6
17
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19
20
5
9
22
21

BOOM CROWD CYLINDER

The rod packings in each cylinder are located in the cylinder head to seal the oil as the piston rod emerges from the cylinder. A rod scraper in the packing gland tends to remove foreign matter from the piston rod before it is drawn into the cylinder. If excessive oil passes the rod scraper and packing gland, the packing needs to be tightened or replaced. However, a light film of oil should adhere to the piston rod at all times as it emerges from the cylinder, to enable the rod scraper to remove mud, or grit which may settle on the rods.

To tighten the packing gland where it leaks excessively, if fastened with bolts turn the gland bolts to the right on top of the packing gland 1/4 turn each. However, if it still leaks try another 1/4 turn on the bolts.

CAUTION: Do not over-tighten as cylinder will chatter and you will loose the film of oil to protect the rod, also tighten each bolt the same, as not to draw the packing gland one sided. Where gland bolts are not used turn gland to the right until leak stops.

To Replace the Packing, Proceed as Follows:

Be sure the valve control levers are in neutral and tension is removed from cylinder. Disconnect the hose at the cylinder ports; drain the cylinder and remove it from the machine.

a. Disassembly

Remove the gland bolts, where used, holding the packing gland to the cylinder head and remove the gland. Also remove the head to which the gland is bolted or screwed. Note the "O" ring oil seal inserted between head and cylinders. If ring has been damaged by cutting or pinching, it must be replaced.

Draw the entire piston assembly from the cylinder and inspect the piston packing or cups for wear. If gland packing needs replacing remove piston from rod and piston rod can be withdrawn from cylinder head and gland. New gland packing can then be installed and piston rod pushed back through gland and cylinder head. Piston reapplied and nut replaced. Assembly can be pushed into cylinder and bolted together. Gland to be adjusted as required.

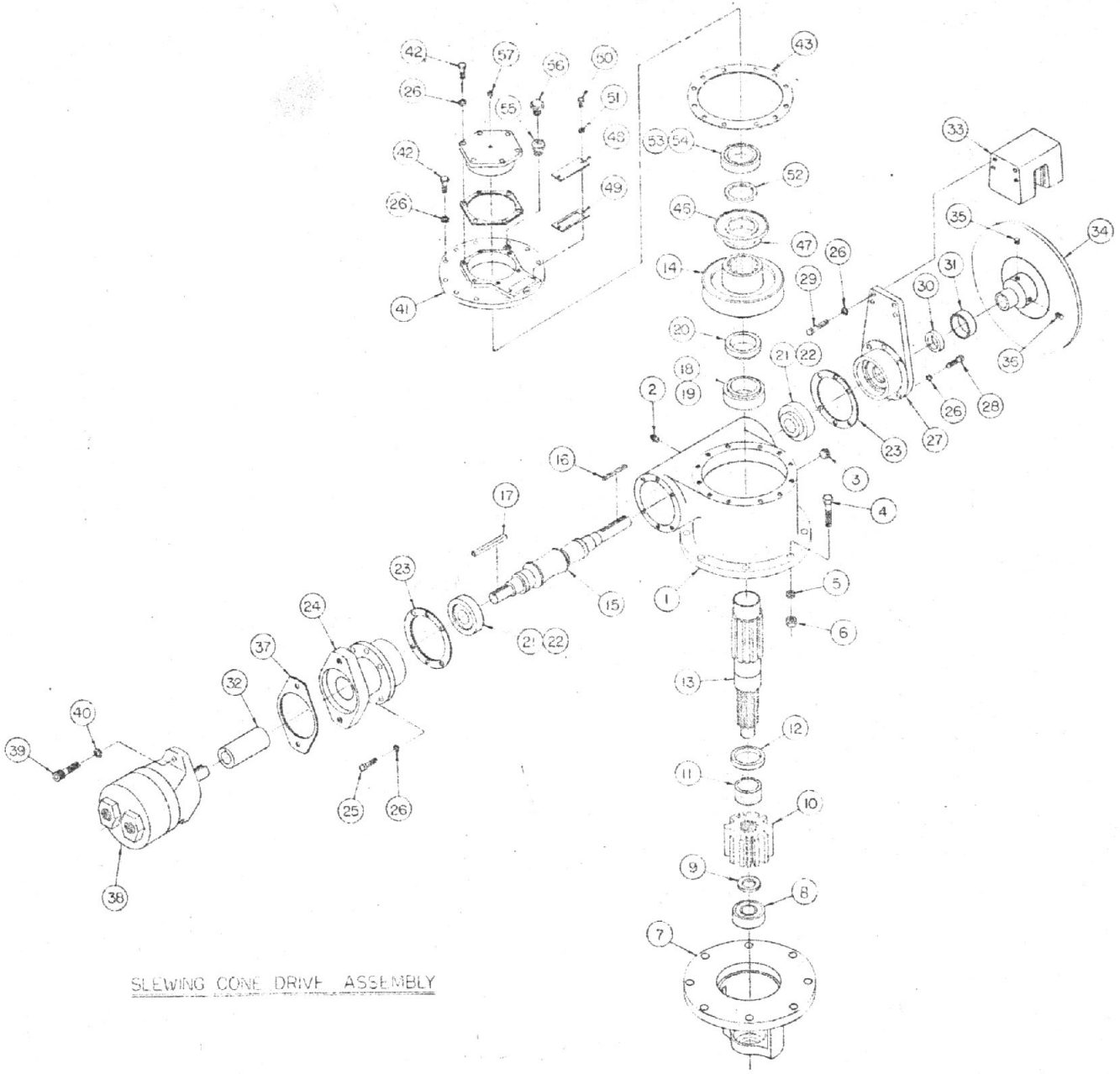
b. Reassembly

Replace the piston rod assembly in the cylinder. Re-bolt the cylinder head to the cylinder. Be sure the "O" ring oil seal is in place between the head and cylinder. There must be a metal fit between the gland and the cylinder head when the packing has been properly installed. Reassemble the cylinder to the boom and reconnect the hose.

Start the engine. Operate the cylinder to remove excess air. Refill the hydraulic reservoir with oil as recommended. Inspect the cylinder and connections for oil leaks.

NOTE: If the wall of the cylinder is scored, it must be replaced with a new cylinder or returned to the factory for rebuilding.

1. Housing
2. Pipe Plug
3. Soc Hd Pipe Plug
4. Hex Hd Capscrew
5. Lockwasher
6. Hex Nut
7. Pinion Case
8. Bearing
9. Spacer
10. Pinion Gear
11. Spacer
12. Oil Seal
13. Worm-Pinion Shaft
14. Gear
15. Worm
16. Key
17. Key
18. Bearing Cone
19. Bearing Cup
20. Spacer
21. Bearing Cone
22. Bearing Cup
23. Shims
24. Motor Adapter
25. Hex Hd Capscrew
26. Lockwasher
27. Bearing-Seal Housing
28. Hex Hd Capscrew
29. Hex Hd Capscrew
30. Oil Seal
31. Bearing
32. Coupling
33. Brake
34. Brake Disc
35. Set Screw
36. Set Screw
37. Motor Shims
38. Motor
39. Soc Hd Capscrew
40. Lockwasher
41. Housing Cover
42. Hex Hd Capscrew
43. Cover Gasket
44. Bearing Cap
45. Shims
46. Grease Retainer
47. Shims
48. Inspection Plate
49. Plate Gasket
50. Hex Hd Capscrew
51. Lockwasher
52. Spacer
53. Bearing Cone
54. Bearing Cup
55. Flushing
56. Air Vent
57. Grease Fitting



SLEWING CONE DRIVE ASSEMBLY

SLEWING CONE DRIVE ASSEMBLY

Following removal of slewing assembly from shipper support, disassembly can be cone as follows:

a. Disassembly

(1) Disconnect hydraulic lines to motor (38) and line from brake lock to brake (33).

(2) Remove capscrew (39) and lockwasher (40) and remove motor (38). Remove motor coupling (32), key (17) and shims (37).

(3) Disassemble, clean, inspect, repair and reassemble motor (38) following the instructions in Denison Manual.

(4) Remove capscrew (4), nut (6) and lockwasher (5). Remove pinion case (7) with bearing (8) out of pinion case (7).

(5) Remove pinion gear (10), spacer (11) and oil seal (12) from worm pinion shaft (13). Remove pinion shaft (13).

(6) Remove bearing (18 & 19) and then remvoe spacer (20) and gear (14).

(7) Remove shims (47), grease retainer (46), spacer (52) and bearing cup (54).

(8) Remove capscrew (42) and lockwasher (26). Then remove entire housing cover (41), cover gasket (43) and bearing cone (53).

(9) Remove capscrew (29) and lockwasher (26) from bearing and seal housing (27). Remove brake (33).

(10) Loosen setscrews (35 & 36) in brake disc (34) and remove disc from worm shaft (15) and remvoe key (16).

(11) Remove capscrew (28) and lockwasher (26) and remove bearing and seal housing (27), shim set (23) and bearing cup (22).

(12) Remove capscrew (25) and lockwasher (26) and pull motor adapter (24) with shims (23), and bearing cone (21) from housing (1) bearing cone (21) can then be pressed from motor adapter (24).

(13) Remove worm shaft (15) from housing (1).

b. Cleaning, Inspection, and Repair

(1) Clean all parts with an approved solvent. Dry thoroughly.

(2) Inspect shafts (13 & 15) for scoring and wear.

(3) Inspect bearing cones (18, 21, & 53) for rough spots while rotating the bearings. Inspect the bearing cups (19, 22, & 54) for rough spots. Replace as required.

(4) Inspect the bearing (31) for scoring and excessive wear. If play exceeds .025" replace bearing.

(5) Inspect worm gear teeth for excessive wear. Check wear by meshing worm (15) with gear (14). If end play of worm shaft exceeds 1/32", replace gear (14).

(6) Inspect worm (15) for scoring. Replace if required.

(7) Inspect keys (16 & 17) for wear. If keys are loose fitting in respective keyways, replace.

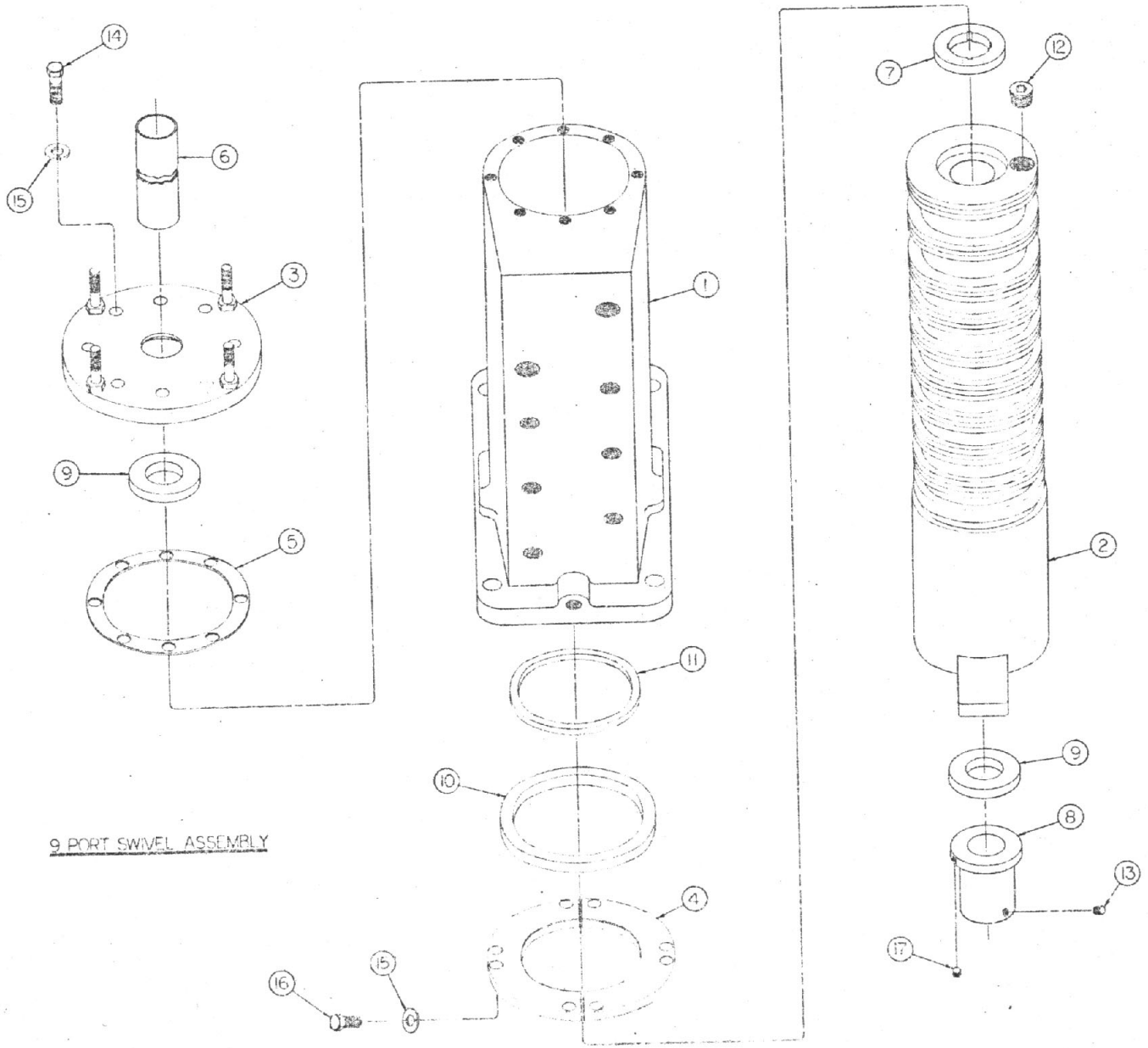
c. Assembly

(1) Assemble gear case assembly in reverse order of disassembly.

(2) Replace seals (12 & 30) and shim sets (23 & 45).

d. Installation

(1) Install swing gear case and motor in reverse order of removal.



1. Body
2. Spool
3. Cover
4. Support Ring
5. Gasket
6. Tube
7. Collar
8. Collar
9. Seal
10. Seal
11. Piston Ring
12. Pipe Plug
13. Set Screw
14. Cap Screw
15. Lockwasher
16. Cap Screw
17. Set Screw

9 PORT SWIVEL ASSEMBLY

9 PORT SWIVEL ASSEMBLY

Following removal of swivel from shipper support, disassembly can be done as follows:

a. Disassembly
(1) Remove capscrew (16) and lockwasher (15) from bottom of swivel body (1) and remvoe support ring (4).

(2) Remvoe capscrew (14), and lockwasher (15), cover (3) with seal (9) and gasket (5).

(3) Remvoe seal (9) from cover (3).

(4) Remove spool (2) with component parts from body (1).

(5) Remove seal (10) from body (1).

(6) Loosen setscrews (13) and remove setscrews (17) and pull lower collar (8) from tube (6).

(7) Remove tube (6) from top collar (7).

(8) Remove piston rings (11) from spool (2) if necessary.

b. Cleaning, Inspection, and Repair
(1) Clean all parts with approved solvent. Dry thoroughly.

(2) Inspect all fittings on swivel joint for damaged threads.

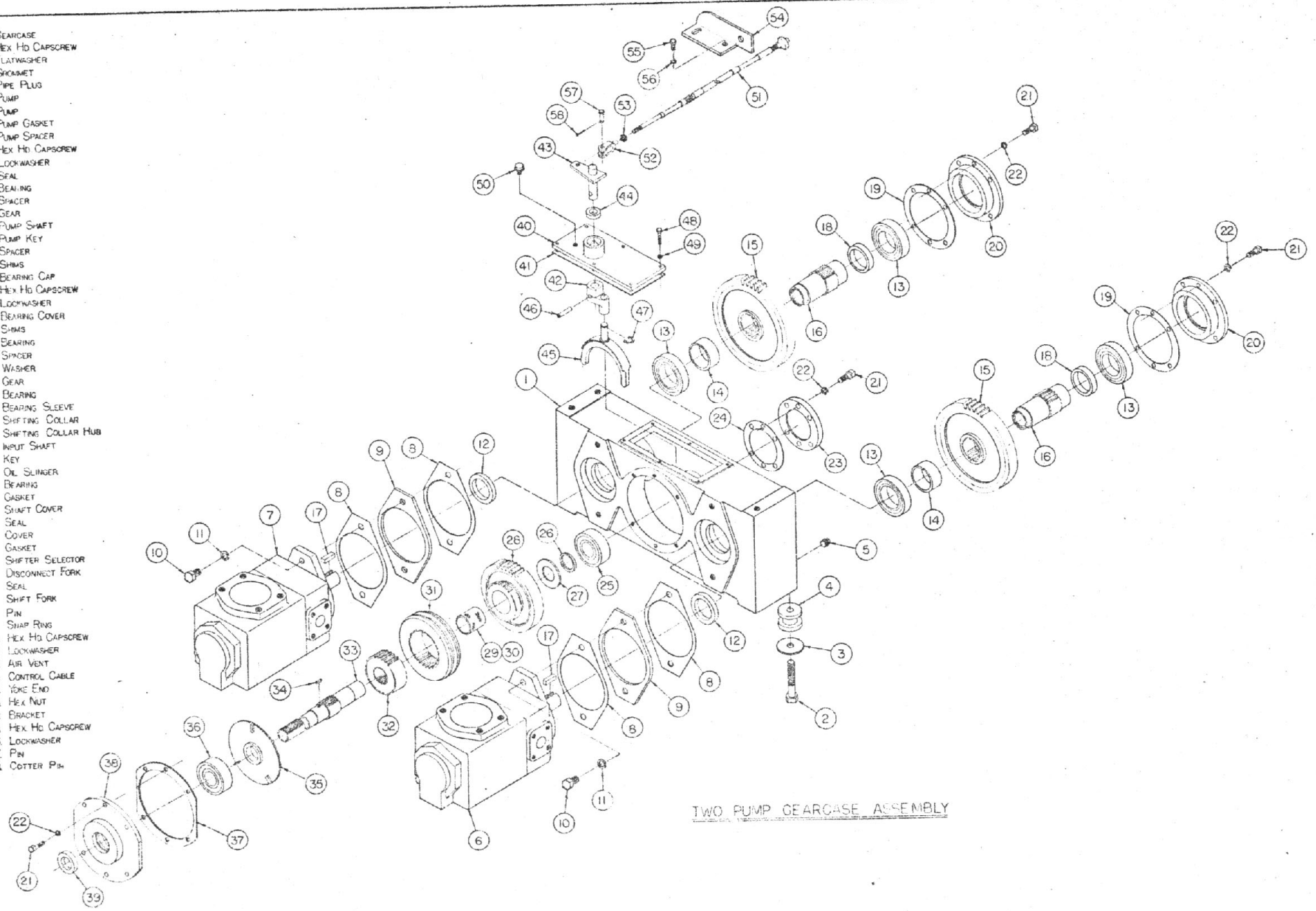
(3) Inspect the collector ring brushes for wear. Replace if worn to a point where brush holder spring tension does not hold them firmly against the collector rings. Replace springs if weak.

(4) Polish collector rings - refer to remote control section of this book.

c. Assembly
(1) Assemble unit in reverse order of disassembly. Replace seals (9) and (10) and gasket (5).

d. Installation
(1) Install the unit in the superstructure in the reverse order of removal.

1. Gearcase
2. Hex Hd Capscrew
3. Flatwasher
4. Grommet
5. Pipe Plug
6. Pump
7. Pump
8. Pump Gasket
9. Pump Spacer
10. Hex Hd Capscrew
11. Lockwasher
12. Seal
13. Bearing
14. Spacer
15. Gear
16. Pump Shaft
17. Pump Key
18. Spacer
19. Shims
20. Bearing Cap
21. Hex Hd Capscrew
22. Lockwasher
23. Bearing Cover
24. Shims
25. Bearing
26. Spacer
27. Washer
28. Gear
29. Bearing
30. Bearing Sleeve
31. Shifting Collar
32. Shifting Collar Hub
33. Input Shaft
34. Key
35. Oil Slinger
36. Bearing
37. Gasket
38. Shaft Cover
39. Seal
40. Cover
41. Gasket
42. Shifter Selector
43. Disconnect Fork
44. Seal
45. Shift Fork
46. Pin
47. Snap Ring
48. Hex Hd Capscrew
49. Lockwasher
50. Air Vent
51. Control Cable
52. Yoke End
53. Hex Nut
54. Bracket
55. Hex Hd Capscrew
56. Lockwasher
57. Pin
58. Cotter Pin



TWO PUMP GEARCASE ASSEMBLY

TWO PUMP GEAR CASE

a. Removal

(1) Drain hydraulic reservoir and remove suction lines from reservoir to pumps on pump case.

(2) Remove pin (46) from end (52) from end of flexible control cable (51) and disconnect from fork (43).

(3) Remove capscrews from flanged yoke (4) at end of pump drive (Two Pump Driveshaft Assembly) and remove drive shaft from machine. The one end of drive shaft is bolted to face of crankshaft pulley and other end bolts to drive shaft adapter (2) on pump input shaft.

(4) Remove four capscrews (2), flat washer (3) and rubber mounting (4) and lower pump case assembly to ground.

b. Disassembly

(1) Remove capscrews (10) and lockwashers (11) and pull pumps (6) and (7) from pump case.

(2) Remove six capscrews (48) and lockwashers (49) from top cover (40) and remove cover with cover gasket (41) and with shift fork assembly (43).

(3) After cover and fork assembly (43) has been removed the fork assembly can be disassembled by removing drive pin from disconnect fork pin pull pin and fork (43) from shift selector (42).

(4) Remove capscrews (21) and lockwashers (22) and pull cover (23) with shims (24).

(5) Remove bearing (13) and spacer (18).

(6) Remove capscrews (21), lockwashers (22), cover (38) with oilseal (39) and bearing (36). Remove bearing from cover.

(7) Remove shaft (33) from case with oil slinger (35), shifting collar (31), shifting collar hub (32).

(8) Remove gear (28) with bearings (29)and bearing sleeve (30) and remove bearings from gear.

(9) Remove capscrews (21) and lockwahsers (22) and pull bearing cap (20) at each end of case with bearing (13) and spacer (18).

(10) Remove shaft (16) and spacer (14) from gear (15) and housing at both ends of case.

(11) Remove gear (15) and spacer (18) from case at both ends.

(12) Remove bearing (13) and oil seal (12) from housing at both ends.

c. Cleaning, Inspection, and Repair

(1) Clean all parts with an approved solvent. Dry thoroughly.

(2) Inspect all gears for excessive wear. Replace if necessary.

(3) Inspect shafts (16) and (33) for wear and scoring.

(4) Inspect all bearings for worn rollers and rough spots while rotating the bearings. Replace if required.

(5) Inspect the key (34) for wear. If any loose fitting in respective keyways, replace.

d. Assembly

(1) Assemble the gear case in reverse order of disassembly.

(2) Assemble pumps to case.

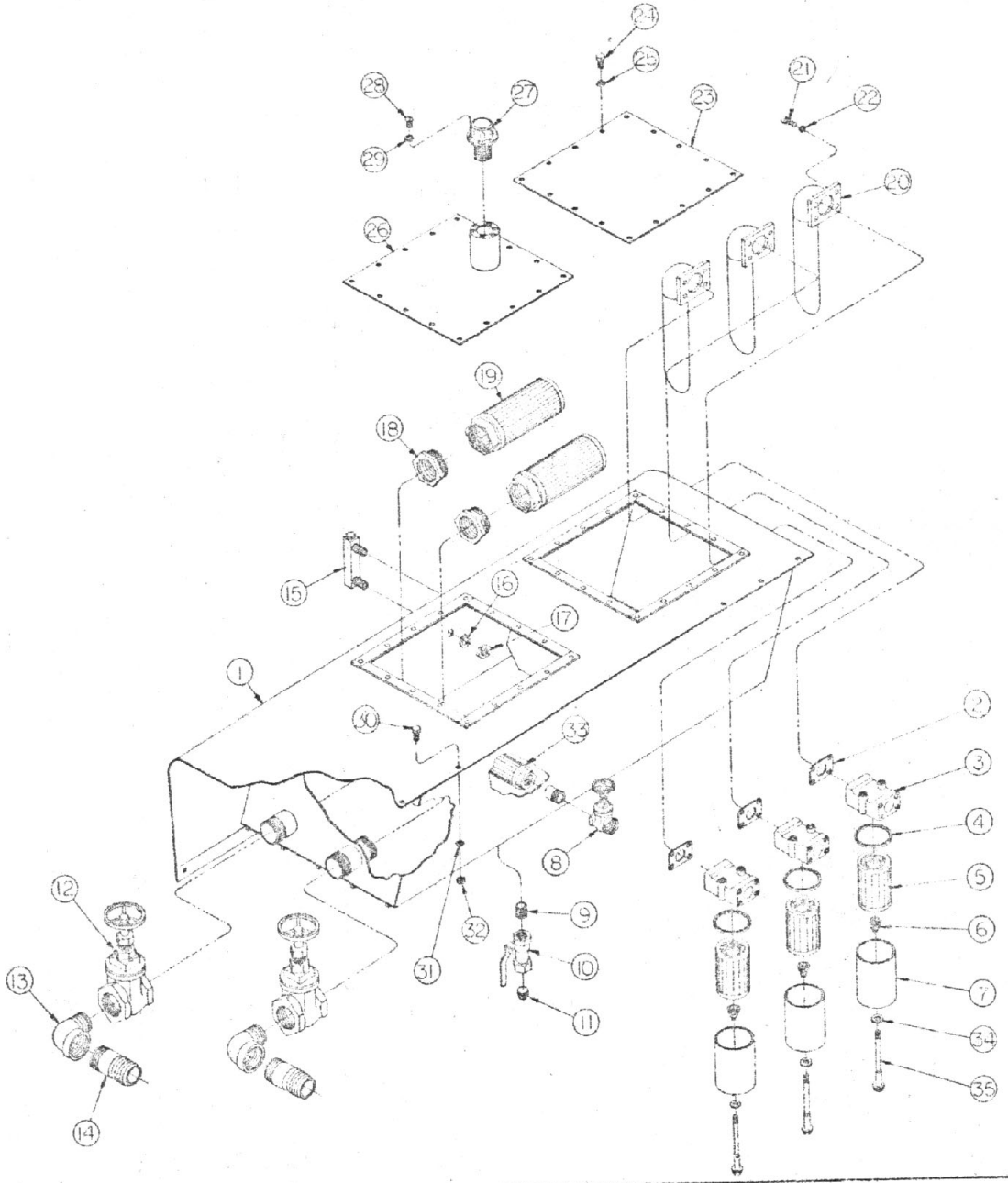
(3) Replace the seals (12) and (39) with new seals and replace gaskets and shims (24) and (19) with new.

e. Installation

(1) Install the gear case assembly with hydraulic pumps in reverse order of removal.

(2) Install pump drive shaft.

(3) Connect hydraulic lines to pumps.



HYDRAULIC OIL TANK ASSEMBLY

1. Tank Weldment
2. Gasket
3. Filter
4. Seal
5. Filter Element
6. Spring
7. Body
8. Gate Valve
9. Nipple
10. Ball Valve
11. Plug
12. Gate Valve
13. Street Elbow
14. Swagged Fitting
15. Oil Level Gauge
16. Lockwasher
17. Nut
18. Bushing
19. Strainer
20. Tank Return Pipe
21. Capscrew
22. Lockwasher
23. Cover
24. Capscrew
25. Lockwasher
26. Cover
27. Cap & Filter Assembly
28. Screw
29. Lockwasher
30. Capscrew
31. Lockwasher
32. Nut
33. Filter
34. Washer
35. Bolt

HYDRAULIC RESERVOIR

a. Removal

It should not be necessary to remove the hydraulic reservoir from carrier fender unless it is damaged and should be replaced. If reservoir must be removed it can be done as follows:

(1) Remove plug (11) and connect a drain hose to ball valve (10). Then drain reservoir.

(2) Disconnect the return line manifold (not shown) from the three hydraulic filters (3) at rear of reservoir (1).

(3) Disconnect the suction lines at front of reservoir at the swagged fittings (14).

(4) Disconnect hydraulic lines connected to gate valve (8) on side of tank and single line at rear.

(5) Remove capscrews (30) lockwashers (31) and nuts (32) and remove reservoir assembly from carrier fender.

b. Disassembly

(1) Remove capscrews (24) and lockwashers (25) and remove covers (23) and (26).

(2) Remove capscrews (28) and lockwashers (29) and remove cap and filter assembly (27).

(3) Remove strainers (19) and (33) from inside of reservoir.

(4) Tank return pipe (20) can be removed if necessary - remove capscrew (21) and lockwasher (22). This will remove pipe (20) gasket (2) and filter (3).

(5) Filter (3) can then be disassembled. Remove bolt (35) and lockwasher (34). Body (7) can be removed from filter mount (2) to remove filter element (5). Filters need not be removed from tank for this procedure.

c. Cleaning, Inspection, and Repair

(1) Clean inside of tank thoroughly removing any dirt or sludge which may have accumulated.

(2) Replace strainers (19) and (33) with new if necessary.

(3) Clean cap and filter (27) and replace if necessary.

(4) Replace elements (5) in three return filters.

d. Assembly

Reassemble all parts in reservoir in reverse order of disassembly.

e. Installation

(1) Install reservoir in place on top of carrier fender and anchor in place with capscrews (30) lockwashers (31) and nuts (32).

(2) Connect suction lines to reservoir at swagged fitting (14) making sure all connections are tight.

(3) Connect return line manifold (not shown) to the three hydraulic filters (3) at rear of reservoir (1).

(4) Connect hydraulic lines at gate valve (8) on side of tank and single line at rear.

(5) Refill reservoir. See the lubrication chart for proper grade of oil.

BRAKE MASTER CYLINDER

Item Part

1. Push rod
2. Boot
3. Lockwire
4. Stop plate
5. Secondary cup
6. Piston
7. Primary cup
8. Spring
9. Housing
10. Gasket
11. Cap
12. Gasket
13. Adapter

#F8448 Repair Kit

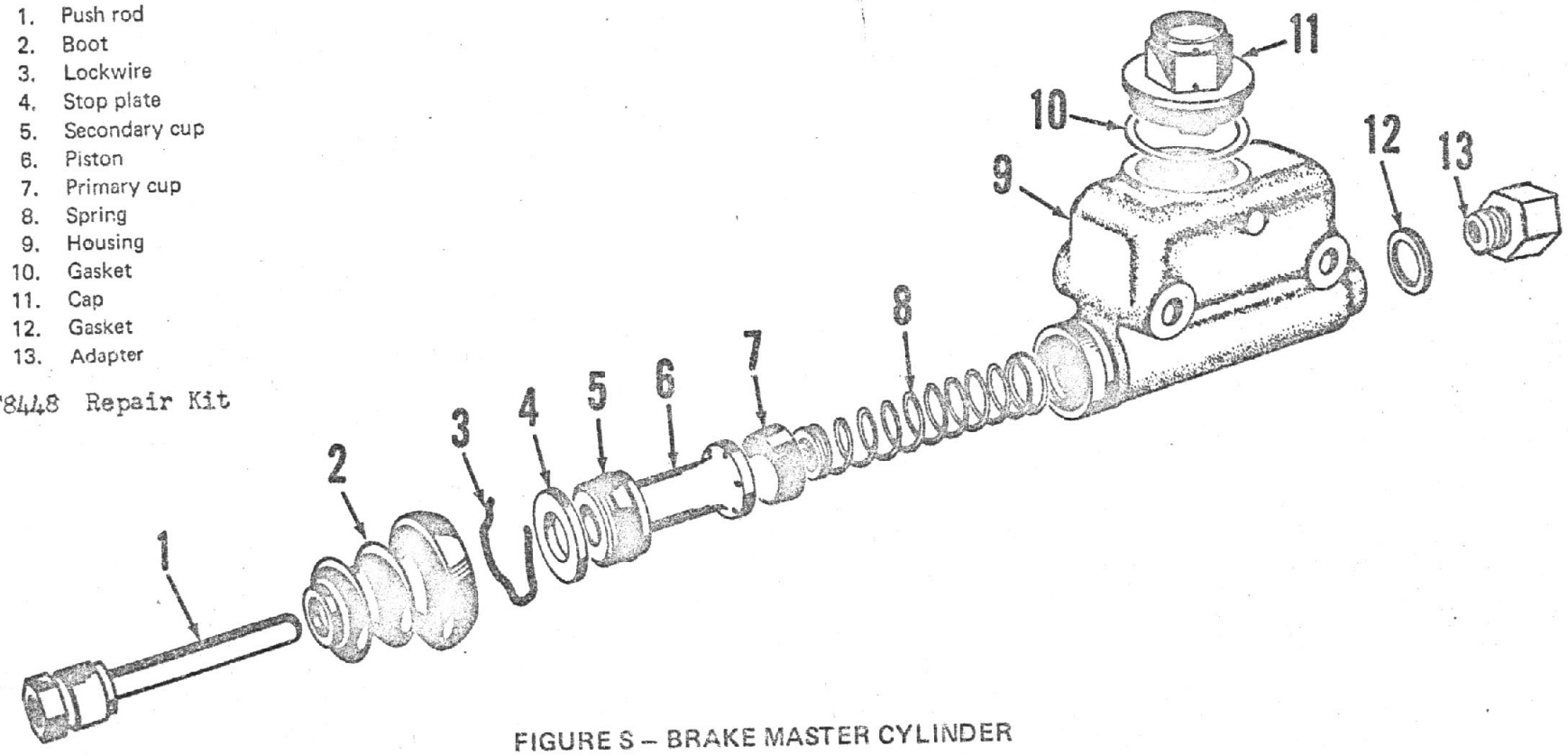


FIGURE 5 – BRAKE MASTER CYLINDER

BRAKE MASTER CYLINDER

Following disconnection of hydraulic line to brake lock and removal of master cylinder from cab floor, disassembly can be done as follows:

a. Disassembly

(1) Slide boot (2) off of housing (9).

(2) Using a small screwdriver, pry lockwire (3) and stop plate (4) from housing (9). Remove lockwire.

(3) Remove pushrod (1), boot (2) and stop plate (4) from housing.

(4) Remove piston assembly (6) and spring (8). Remove secondary cup (5) and primary cup (7) from piston assembly (6).

(5) Remove cap (11) and gasket (10) from filling opening on top of housing (9).

(6) Remove adapter (13) and copper gasket (12).

b. Cleaning, Inspection, and Repair

(1) Discard piston, cup, and boot.

(2) Clean all other metal parts of brake master cylinder in an approved cleaning solvent; dry thoroughly with compressed air.

(3) Inspect housing for cracks, distortion, and damaged threads.

(4) Inspect piston for cracks, wear, or scoring; replace if camaged.

c. Reassembly

(1) Install copper gasket (12) and adapter (13) into housing (9).

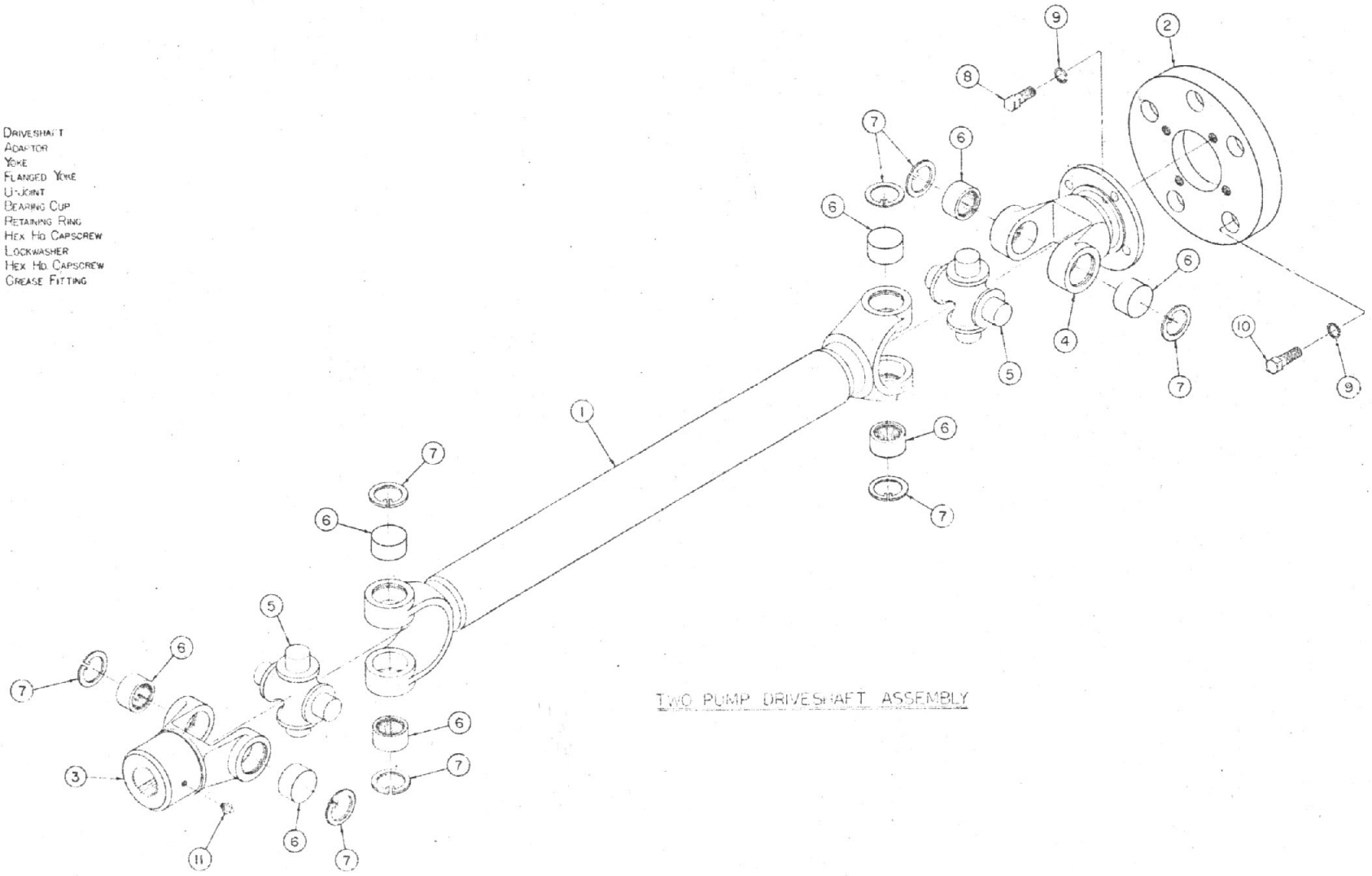
(2) Install cap (11) and gasket (10) into filling opening on top of housing (9).

(3) Place secondary cup (5) and primary cup (7) on piston assembly (6).

(4) Position spring (8) and piston assembly (6) in housing (9). Place push rod (1), boot (2) and stop plate (4) into housing and secure with lockwire (3).

(5) Place master cylinder assembly back into cab floor and reconnect hydraulic line to brake lock.

1. Driveshaft
2. Adaptor
3. Yoke
4. Flanged Yoke
5. U-Joint
6. Bearing Cup
7. Retaining Ring
8. Hex Hd. Capscrew
9. Lockwasher
10. Hex Hd. Capscrew
11. Grease Fitting



TWO PUMP DRIVESHAFT ASSEMBLY

TWO PUMP DRIVESHAFT

Following removal of capscrews (8) from flanged yoke (4) and removing driveshaft from carrier disassembly may be done as follows:

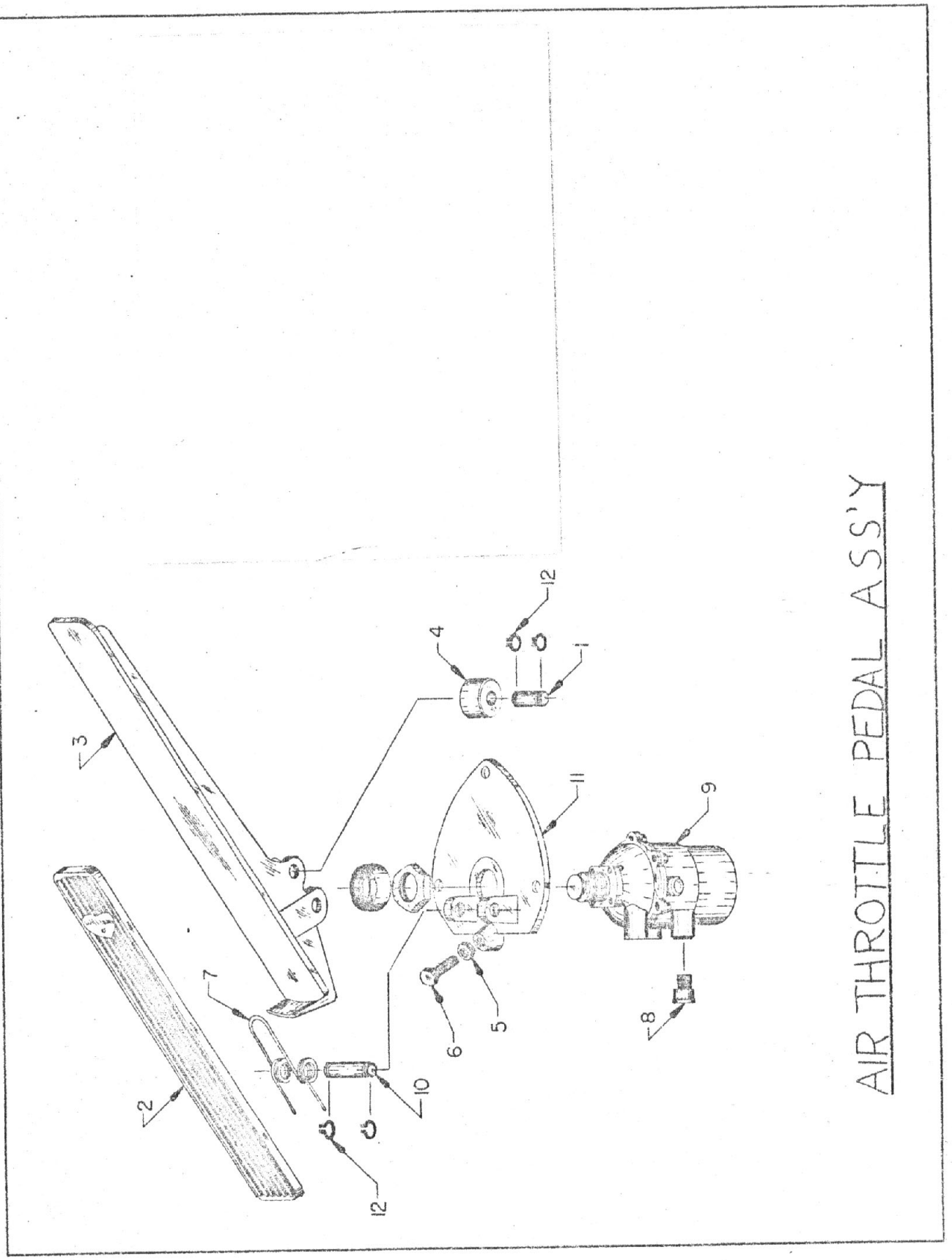
1. Remove retaining rings (7) from driveshaft (1), yoke (3) and flanged yoke.
2. Remove bearing caps (6) and grease fitting (11).

CLEANING, INSPECTION AND REPAIR

1. Clean all metal parts with an approved cleaning solvent; dry thoroughly with compressed air.
2. Inspect all parts for cracks, breaks,distortion or other damages.
3. Replace all damaged and worn parts.

ASSEMBLY

1. Reassemble all part in driveshaft in reverse order of disassembly.


AIR THROTTLE PEDAL ASS'Y
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AIR THROTTLE PEDAL

Following disconnection of air lines to valve assembly and removal of mounting plate bolts from floor; disassembly can be done as follows:

1. Remove retaining rings (12) from treadle pin (10) and remove treadle pin from mounting plate allowing removal of treadle (3), treadle cover (2), and spring (7) from mounting plate.

2. Remove retaining rings (12) from push rod pin (1) and remove push rod pin from treadle allowing removal of roller (4).

3. The valve assembly may be removed and disassembled as follows:

   a. Remove push rod (32) and dust boot (8) from valve assembly.

   b. Remove nut (4) from rod guide (6) allowing the valve to be removed from mounting plate.

   c. Remove screws (9) from outlet body (7) allowing removal of inlet body (31), "O"-rings (27) and (28), cartridge assembly (14 - 26 & 29), thrust ring (1), balance piston (2), spring (30), and shim (5).

   d. Rod guide may be removed from inlet body by removing screws (10), screen (34) may also be removed.

   e. Plug (11) and breather (35) may be removed from outlet body.

CLEANING, INSPECTION AND REPAIR

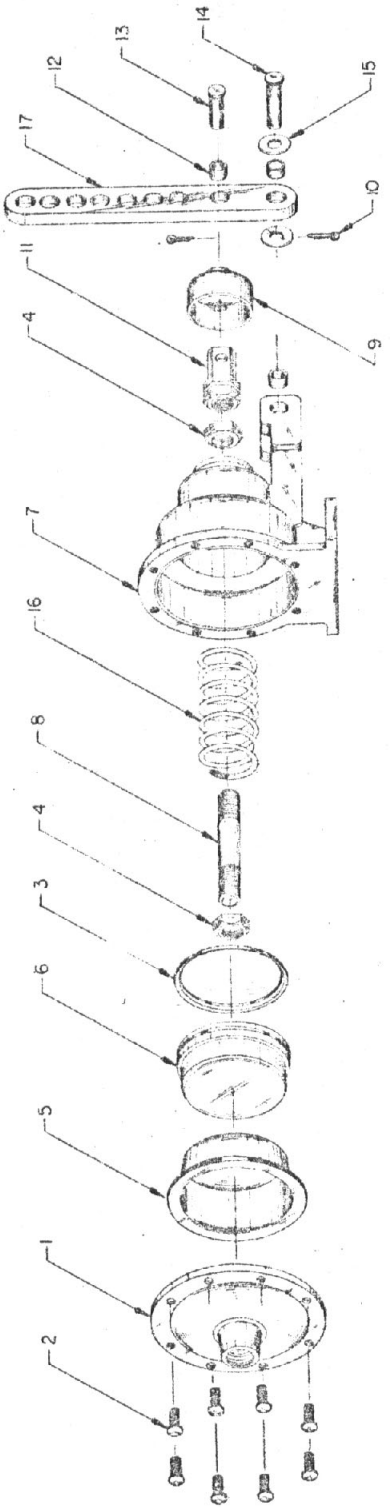
1. Clean all metal parts with an approved cleaning solvent; dry thoroughly with compressed air.

2. Inspect all parts for cracks, distortion, damaged threads, scoring, and signs of wear.

3. Replace worn parts with repair kit #101-128.

ASSEMBLY

1. Reassemble all parts in air throttle pedal assembly in reverse order of disassembly.



AIR THROTTLE CYLINDER ASSEMBLY

AIR THROTTLE CYLINDER

Following disconnection of air line to throttle cylinder and removal of throttle cylinder from mounting bracket, disassembly can be done as follows:

1. Remove machine screws (2) from cover (1) allowing the cover to be removed from body (7). Upon removal of cover, the diaphram (5), piston (6), thrust ring (3), and spring (16) may now be removed.

2. Remove cotter pins (10) from clevis pins (13) and (14) allowing lever (17) to be removed.

3. Remove dust boot (9), clevis (11), jam nut (4) and piston rod (8).

CLEANING, INSPECTION, AND REPAIR

1. If the diaphram (5), boot (9), clevis pin (14), cotter pin (10), clevis (16), and thrust ring (3) are damaged or worn, discard and replace with repair kit #101-126.

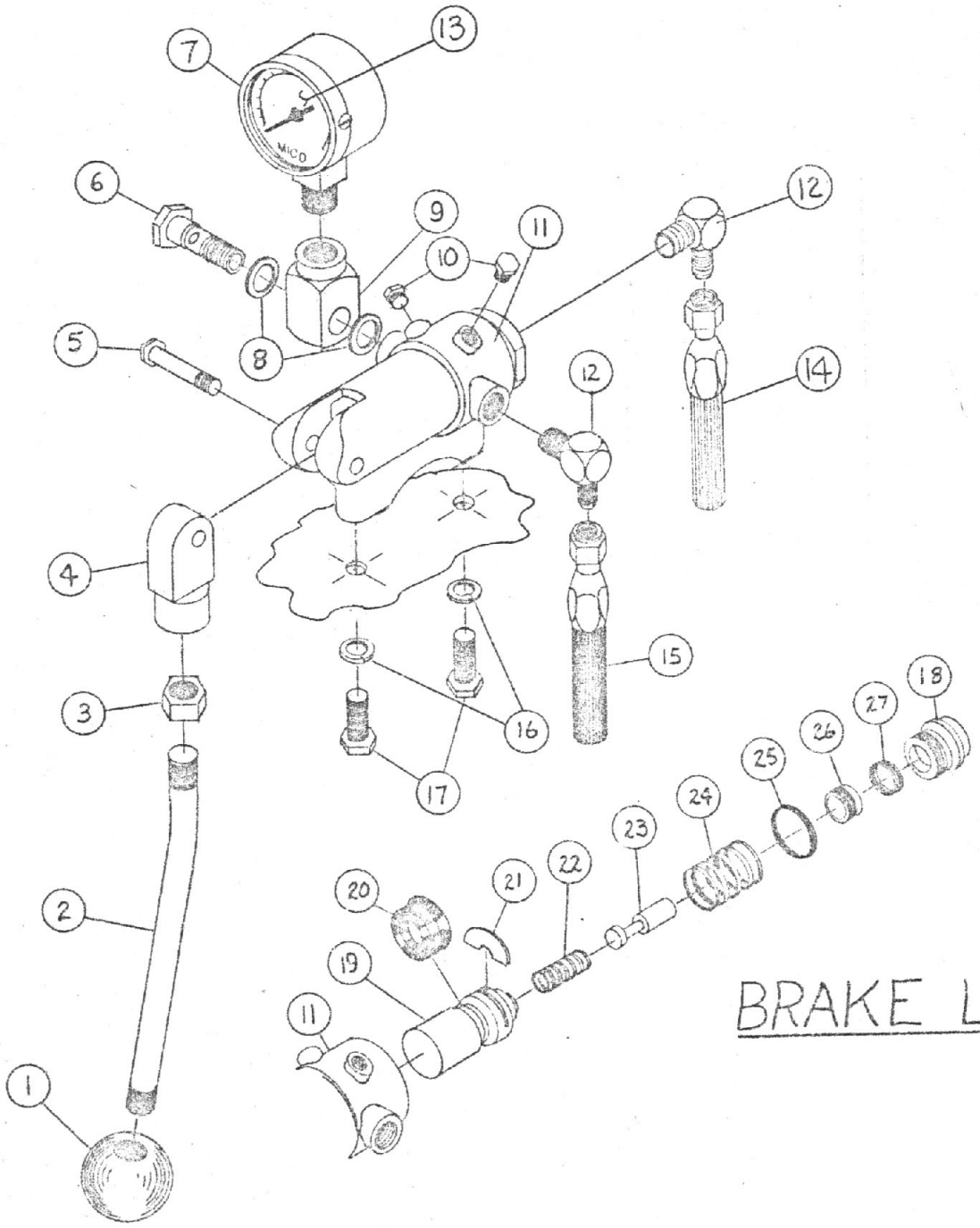
2. Clean all other metal parts with an approved cleaning solvent; dry thoroughly with compressed air.

3. Inspect body (7) for cracks, distortion, and damaged threads.

4. Inspect piston (6) for scoring, wear, or cracks; piston rod for wear and damaged threads.

ASSEMBLY

1. Reassemble all parts in throttle cylinder in reverse order of disassembly.



BRAKE LOCK IS BOLTED
DIRECTLY TO CAB
REAR DECK

BRAKE LOCK ASS'Y

BRAKE LOCK ASSEMBLY

Following removal of hose assemblies (14) and (15) and capscrew (17) from brake lock,disassembly can be done as follows:

1. Remove grip ball (1) from handle (2).
2. Loosen nut (3) allowing removal of handle from cam (4).
3. Remove pin (5) from cylinder (11) allowing the cam to be removed from cylinder.
4. Remove gauge (7) from fitting (9).
5. Remove bolt (6) from cylinder allowing gaskets (8) and fitting to be removed.
6. Remove bleeder screws (10) and elbows (12) from cylinder.
7. Remove cylinder head (18) from cylinder allowing removal of valve seat (27), retainer (26), "O" ring seal (25), spring (24), shim (23), spring (22), and piston (19).
8. Remove lock (21) and cup (20) from piston.

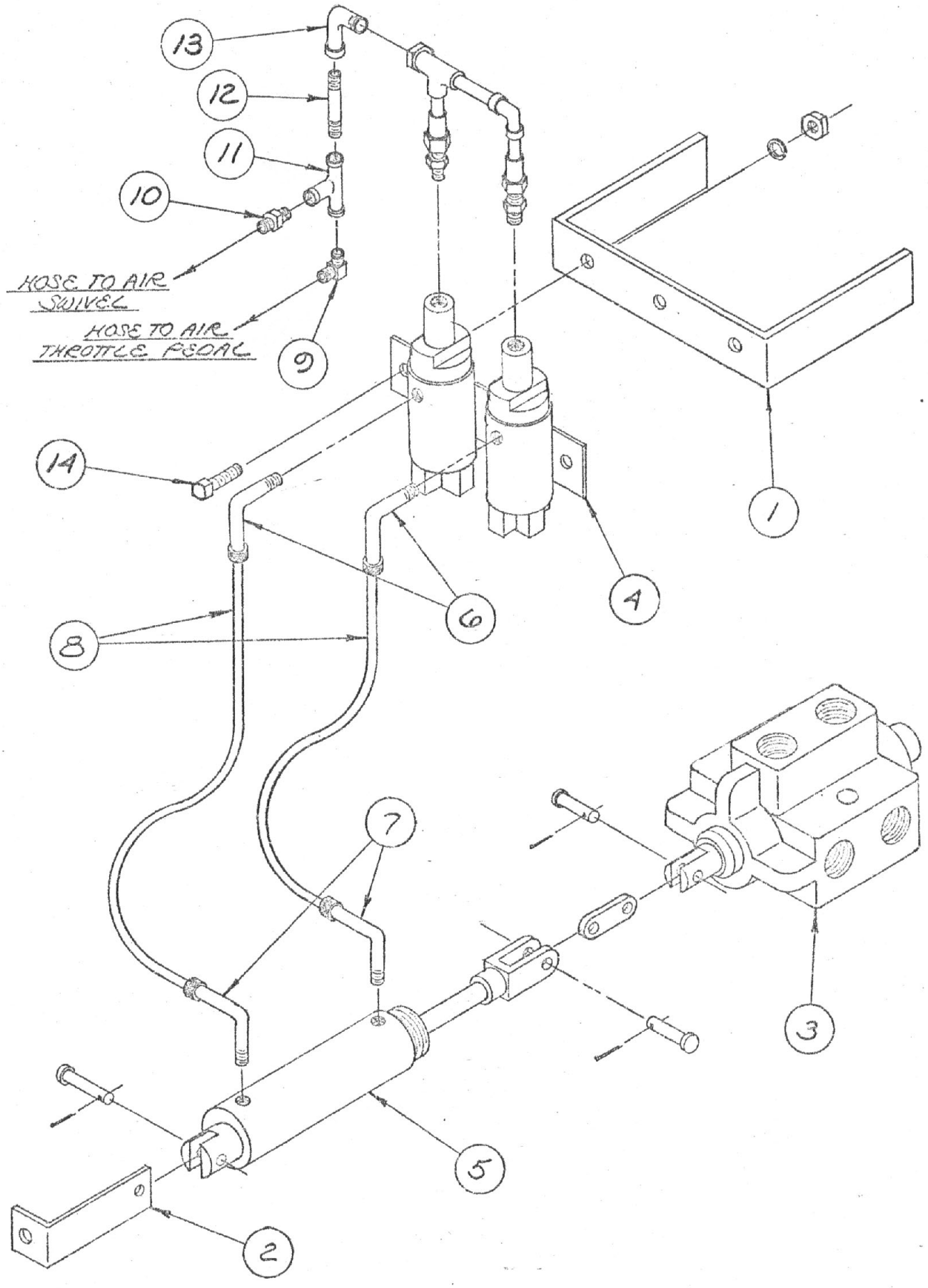
CLEANING, INSPECTION AND REPAIR

1. Clean all metal parts with an approved cleaning solvent; dry thoroughly with compressed air.
2. Inspect all part for cracks, distortion, damaged threads, scoring, and signs of wear.
3. Replace worn parts with repair kit #101-129.

ASSEMBLY

1. Reassemble all parts in brake lock assembly in reverse order of disassembly.

EXTENDABLE COUNTERWEIGHT CONTROL ASSEMBLY



EXTENDABLE COUNTERWEIGHT CONTROL ASSEMBLY

Following disconnection of hose to air swivel from adaptor (10) and hose to air throttle pedal from adaptor (9), disassembly may be done as follows:

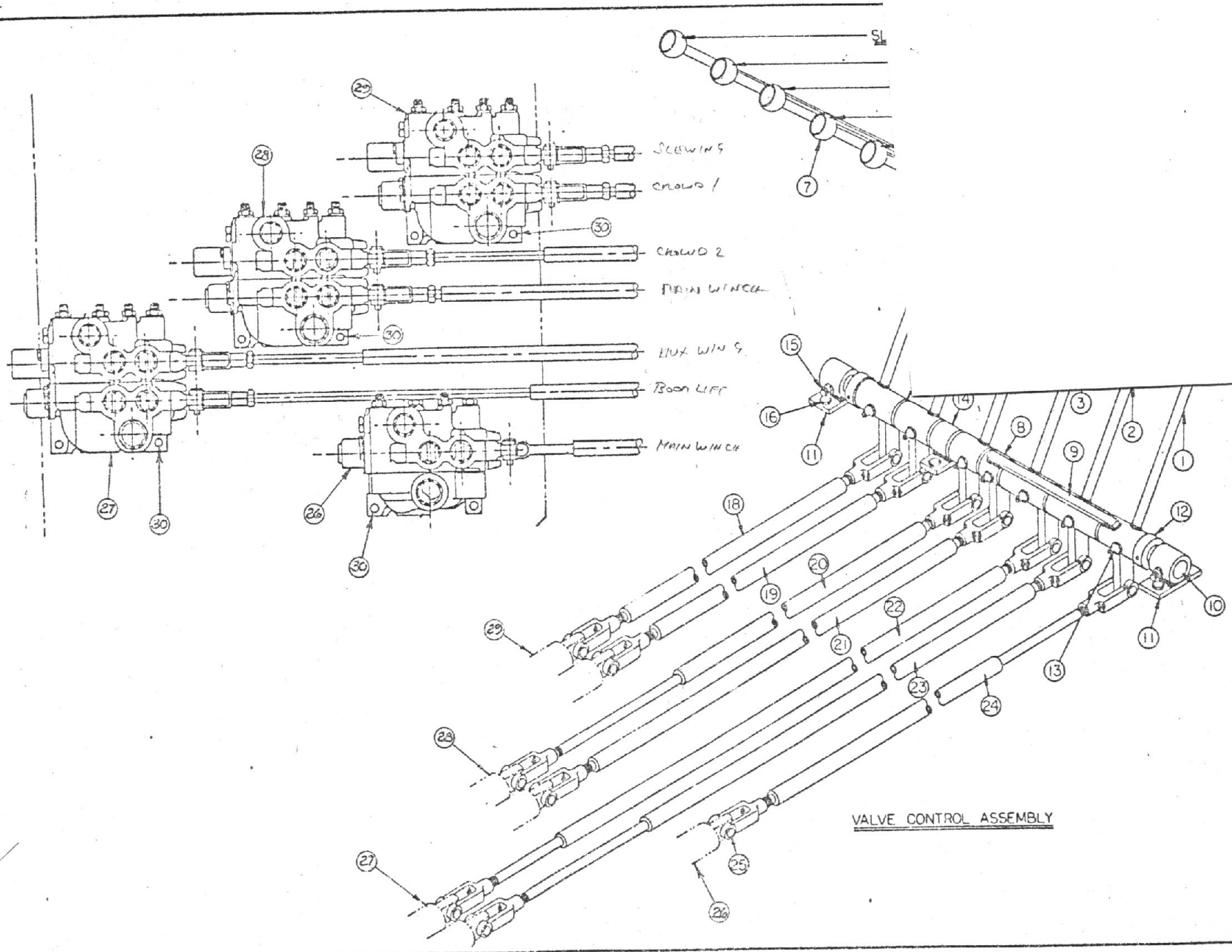
1. Remove tubing (8) from elbows (6) and (7) and remove hex. head capscrew (14) from valve mounting bracket (1) allowing solenoid valve (4) to be removed.
2. Remove adaptor (9) and (10), pipe tee (11), nipple (12), and elbow (13).
3. Remove elbow (6) from solenoid valve and elbow (7) from cylinder (5).
4. Remove cylinder pins from cylinder allowing cylinder to be removed.

CLEANING, INSPECTION AND REPAIR

1. Clean all metal parts with an approved cleaning solvent; dry thoroughly with compressed air.
2. Inspect all parts for cracks, breaks, wear and other damages.
3. Replace all damaged and worn parts.

ASSEMBLY

1. Reassemble all parts in extendable counterweight control assembly in reverse order of disassembly.



VALVE CONTROL ASSEMBLY

VALVE CONTROL ASSEMBLY

DISASSEMBLY

1. Remove yoke pin (25) from connecting rod (18), (19), (20), (21), (22), (23) and (24) allowing removal of connecting rods.

2. Remove capscrew (16) from control rod brackets (11) and (14) allowing control rod assembly to be removed from cab.

3. Once removed from cab, remove capscrew (15) from mounting brackets allowing mounting brackets to be removed from control rod shaft (10).

4. Loosen and remove set callars (12) from control rod shaft allowing removal of control rods (1), (2), (3), (4), (5), (6) and thrust washer (17).

5. Remove control rod ball handles from control rods.

6. Remove grease fittings (13) from control rods.

7. Remove valve mounting bolts (30) and remove valves (26), (27), (28) and (29).

CLEANING, INSPECTION AND REPAIR

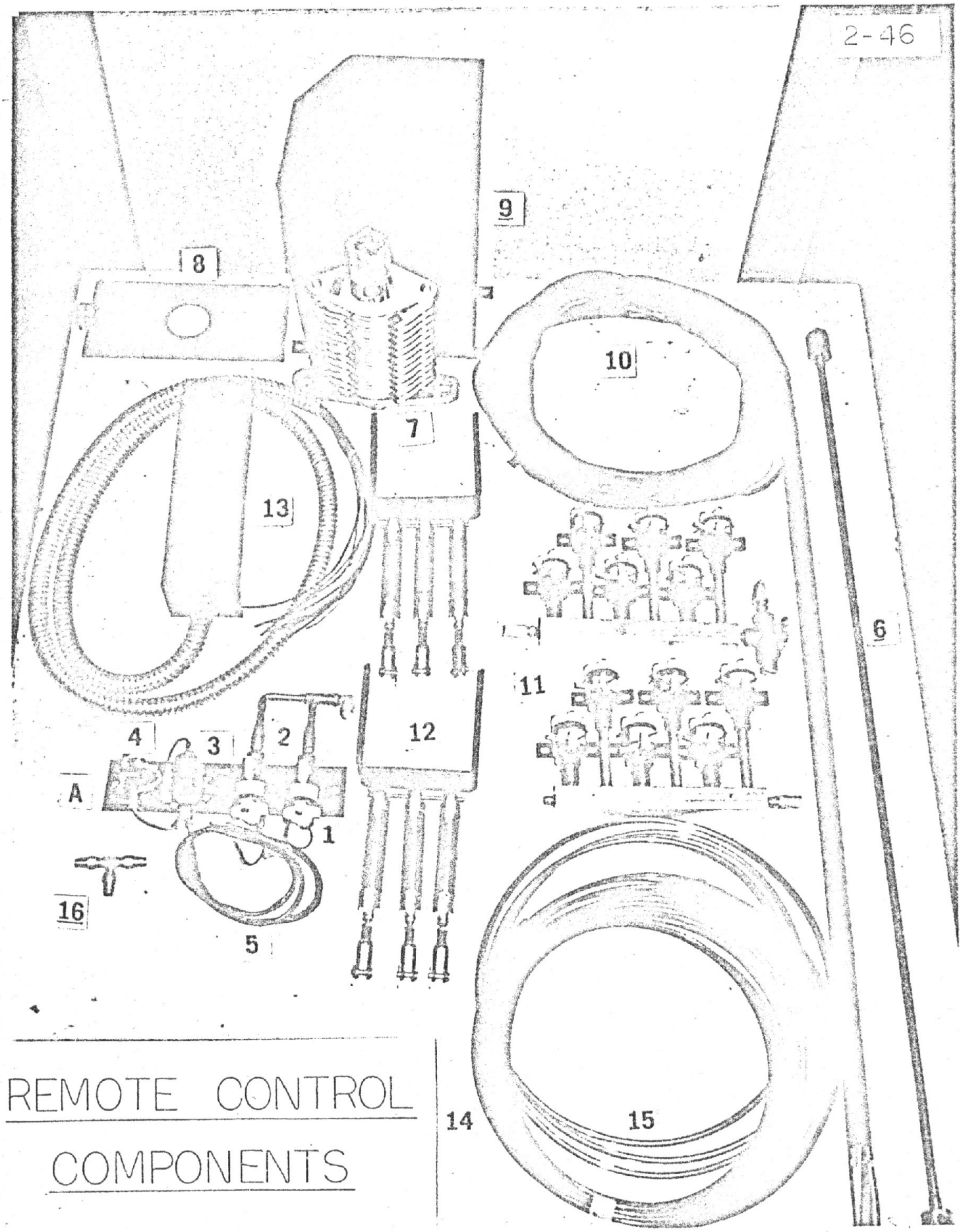
1. Clean all metal parts in an approved cleaning solvent; dry thoroughly with compressed air.

2. Inspect all part for cracks, breaks, wear, or other damages.

3. Replace all damaged and worn parts.

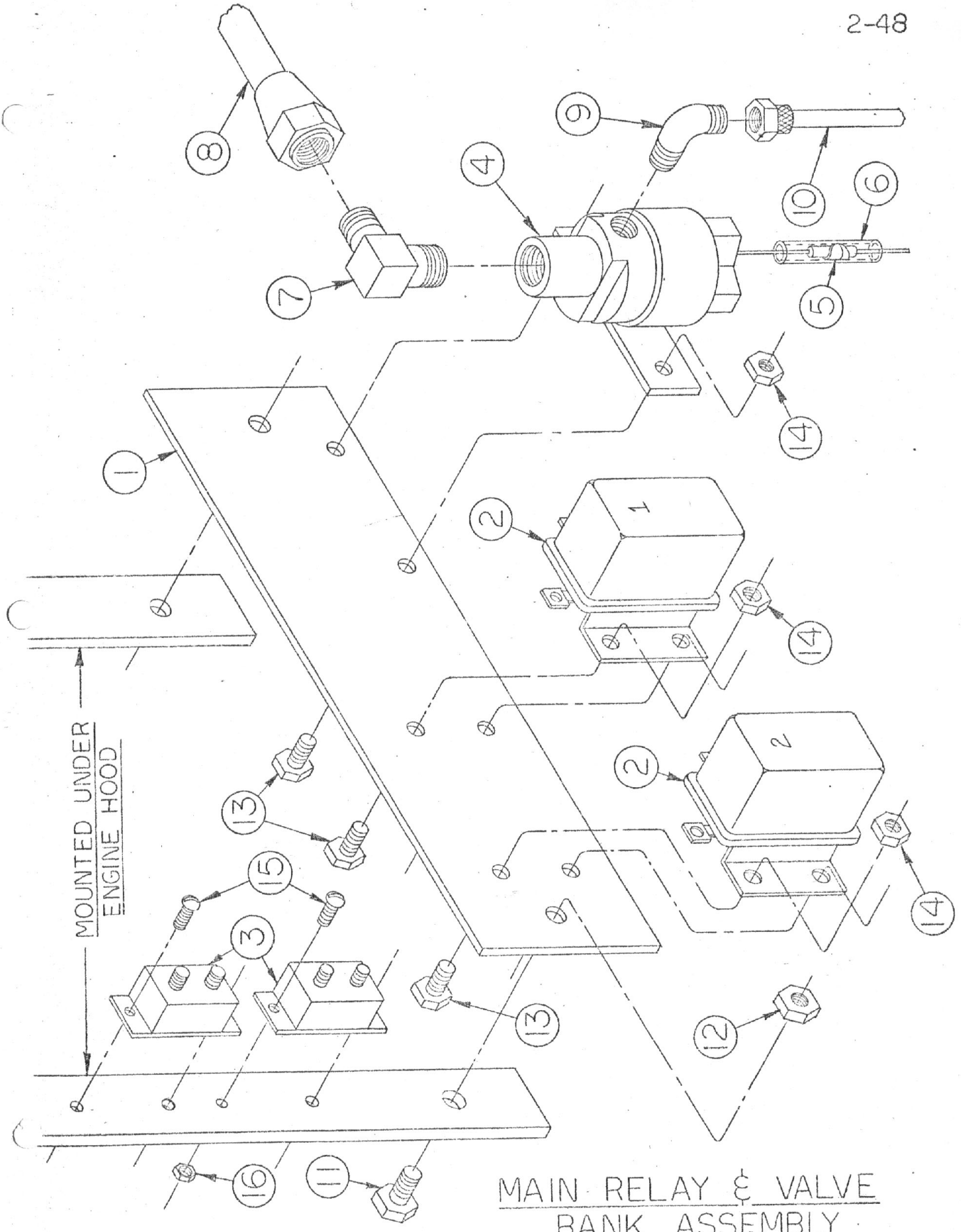
ASSEMBLY

1. Reassemble all parts for assembly in reverse order of disassembly.



REMOTE CONTROL COMPONENTS

INDEX TO REMOTE CONTROL COMPONENTS



MAIN RELAY & VALVE BANK ASSEMBLY

MAIN RELAY & VALVE BANK ASSEMBLY

A. REMOVAL

1. Disconnect all wiring.

2. Remove bolts, item 11, and nuts, item 12, from mounting bracket, item 1, and remove mounting bracket.

3. Remove bolts, item 13, and nuts, item 14, from relays, item 2, and remove relays. If they are damaged, replace them with new.

4. Remove bolts, item 13, and nuts, item 14, from solenoid valve, item 4, and remove valve.

   a. Remove copper tube, item 8, from elbow, item 7, and remove elbow from solenoid valve.

   b. Remove black nylon tube, item 10, from elbow, item 9, and remove elbow from solenoid valve.

   c. If any of tese items are damaged, replace them with new.

   d. If wire is to be removed from solenoid valve, slide plastic sleeve, item 6, from disconnect terminal, item 5, and disconnect wire.

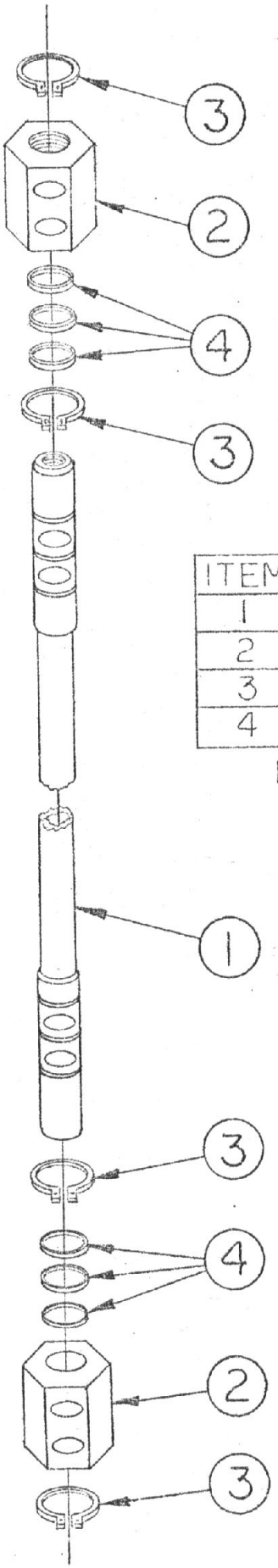
5. Remove screws, item 15, and nuts, item 16, from hood mounted bracket and remove circuit breakers, item 3. If they are damaged, replace them with new.

B. REASSEMBLY

1. Replace all items in reverse order of disassembly, and remount them under the engine hood.

2. Reconnect all wiring, copper tube and nylon hose.

3. Check for mistaken hook-ups.



ITEM	PART NO.	DESCRIPTION	QTY.
1	RC 3016	SPOOL	1
2	RC 3015	JACKET	2
3	RC 13033	RETAINING RING	4
4	RC 3018	SEAL	6

REPAIR KIT #101-127

PNEUMATIC SWIVEL ASSEMBLY

PNEUMATIC SWIVEL ASSEMBLY

A. REMOVAL

1. Remove the retaining ring, item 3, from one end with special purpose pliers. Do not overstretch the rings, as they will not return to the proper size.

2. Slowly slide the swivel jacket from the swivel spool; taking care not to damage the seals, item 4.

3. Remove the other retaining ring; being careful not to drop it onto the polished surfaces of the spool.

4. Slide the disassembled end through the tube provide in the collector ring harness. It is imperative that this end be kept clean. Cover it with a plastic bag and tape if necessary.

5. Following removal of swivel from plastic tube, remove the other end retaining ring and slide other swivel jacket from swivel spool. Then remove last retaining ring.

6. Pull out the seals (nearer the center first) with a sharp instrument, being very careful not to touch the inside of the glands (the spool is brass and is easily scratched on its polished surfaces). Once the seal is out of its gland, it may easily be rolled off the end with your fingers.

7. Clean the swivel spool and jacket thoroughly with solvent and a soft cloth; inspect the gland surfaces for scratches. If the glands are scratched or have a dull finish, rebuilding is not recommended. To do so will result in poor life of the seals. Scratched surfaces may be polished as a temporary measure, however, precision clearances and seal compression will be adversely affected and extended satisfactory service cannot be expected. If replacement parts are needed - use repair kit #101-127.

8. Grease the glands with silicone grease.

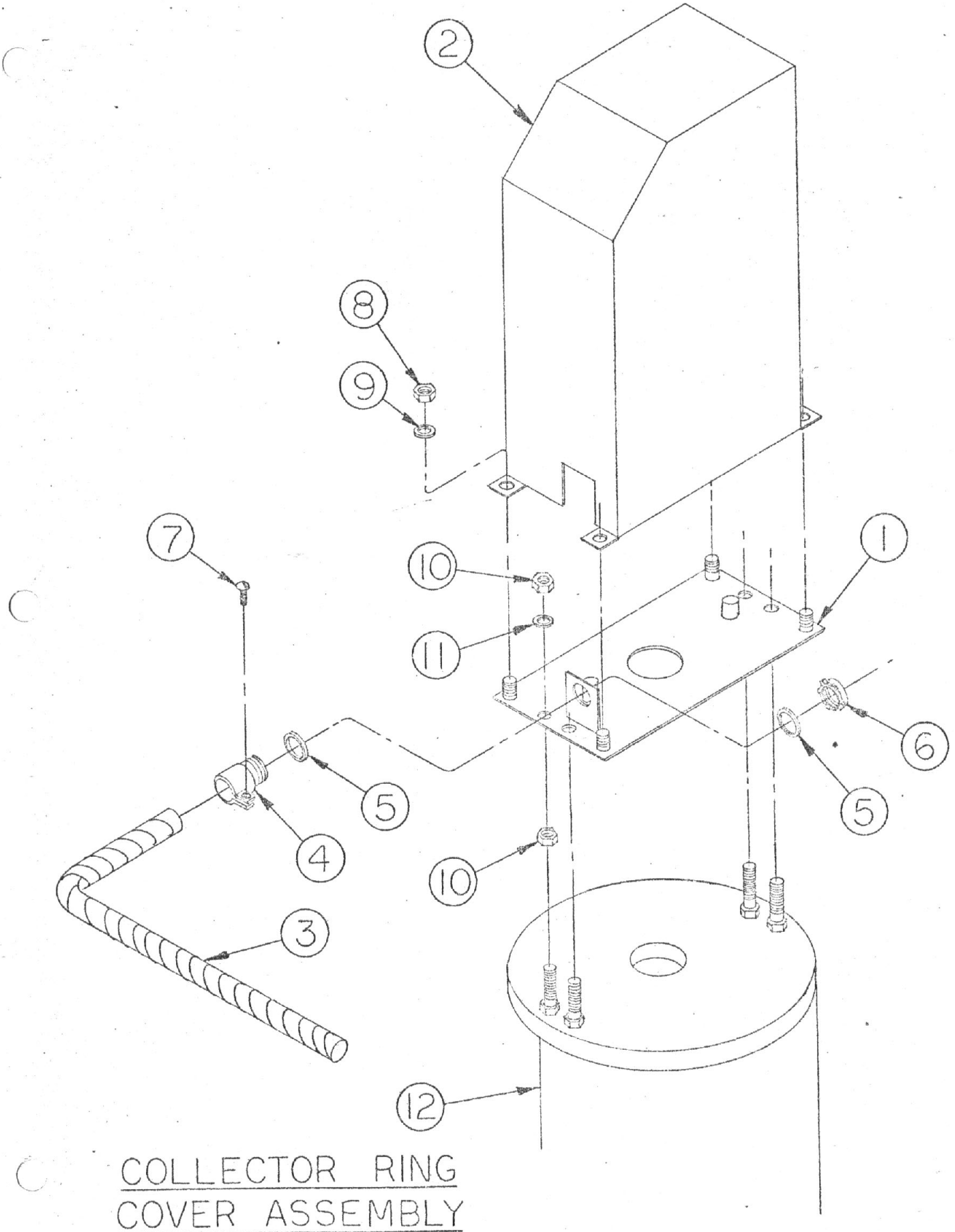
B. REASSEMBLY

1. Replace the seals, item 4, (outside seals first) by rolling them onto the spool with your fingers. Distribute the grease over the entire seal surface.

2. Reassemble all parts in reverse order of disassembly and replace swivel into tube in collector ring harness. Then replace retaining ring, item 3, jacket, item 2, and end retaining ring onto spool, item 1.

3. Check for freeness of rotation.

4. Connect plumbing and check for leaks.



COLLECTOR RING
COVER ASSEMBLY

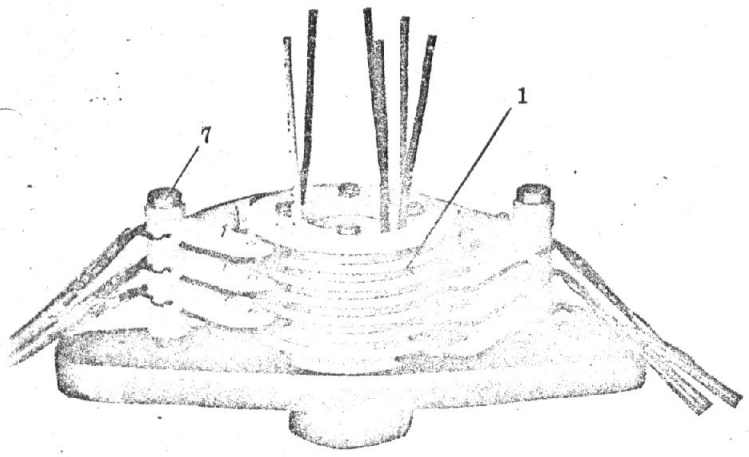
COLLECTOR RING COVER ASSEMBLY

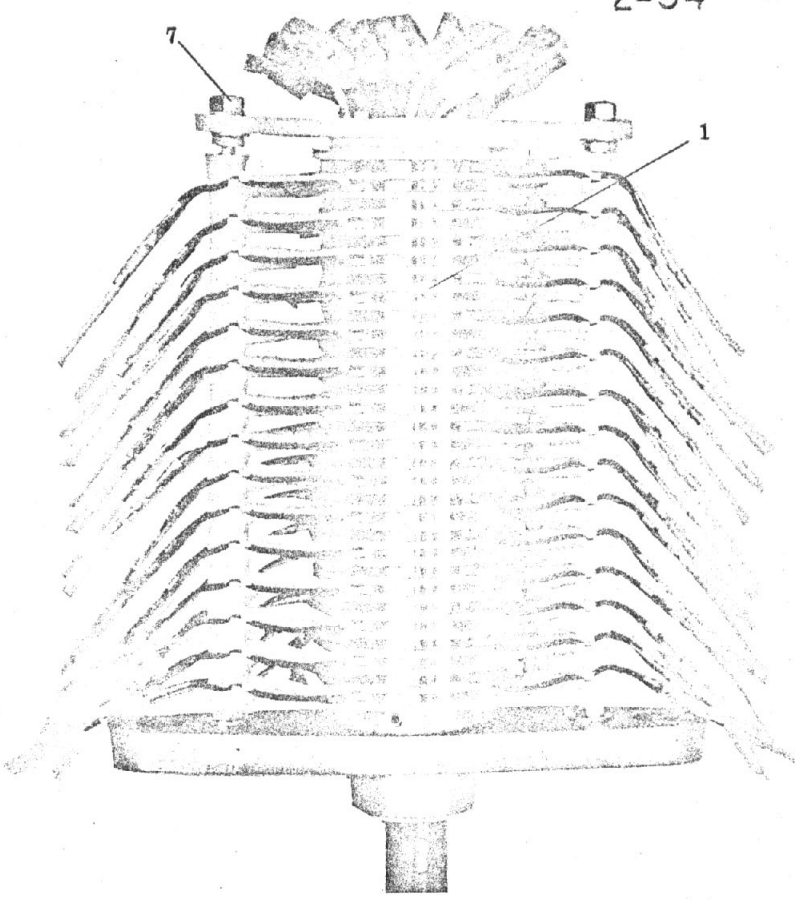
A. REMOVAL

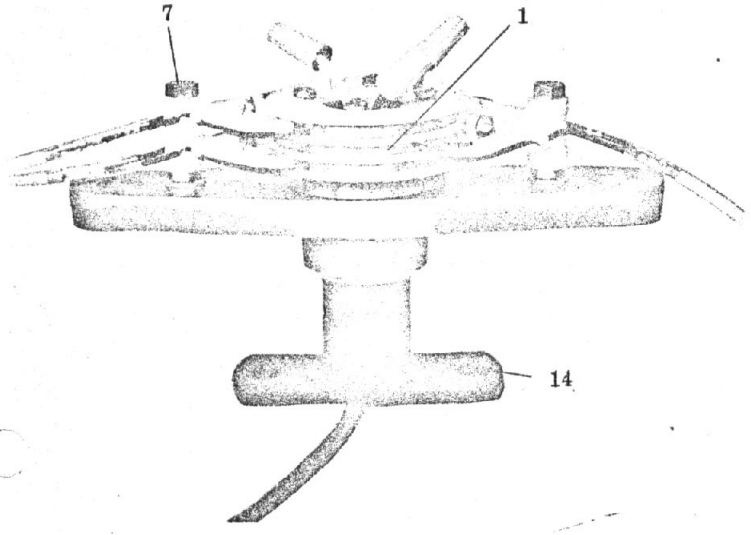
1. Remove nuts, item 8, and lockwashers, item 9, from mounting base plate, item 1.
2. Remove cover box, item 2.
3. Release screw, item 7, from harness clamp, item 4, and remove wiring harness, item 3.
4. Disconnect wiring to collector ring.
5. Remove nut, item 6, and washers, item 5, from harness clamp, item 4.
6. Remove harness clamp from base plate, item 1.
7. Remove nuts, item 10, and lockwashers, item 11, from swivel bolts, item 12.
8. Remove mounting base plate, item 1, from swivel, item 12.
9. Check all parts for damage and replace if necessary.

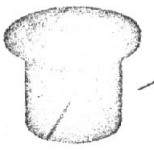
B. REASSEMBLY

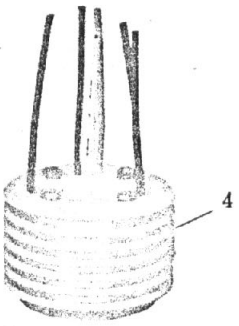
1. Replace items in reverse order of disassembly.
2. Reconnect wiring.
3. Check for mistaken hook-ups.

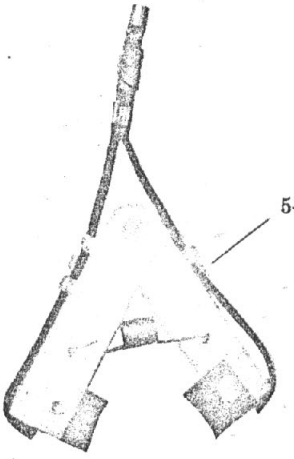


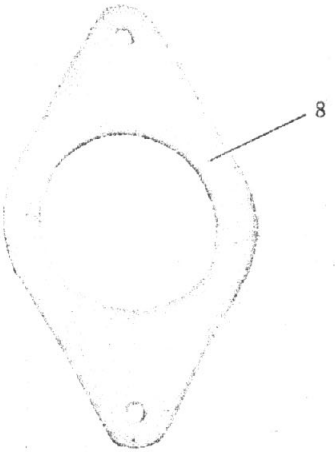


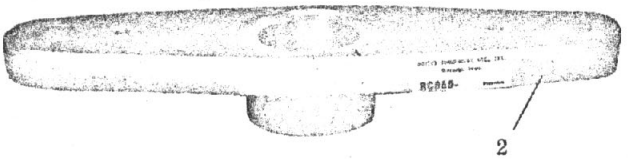


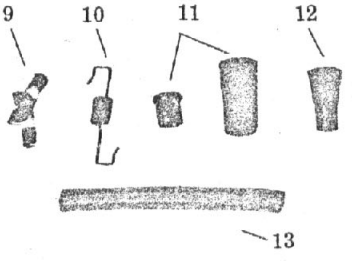












COLLECTOR RING ASSEMBLY

COLLECTOR RING ASSEMBLY

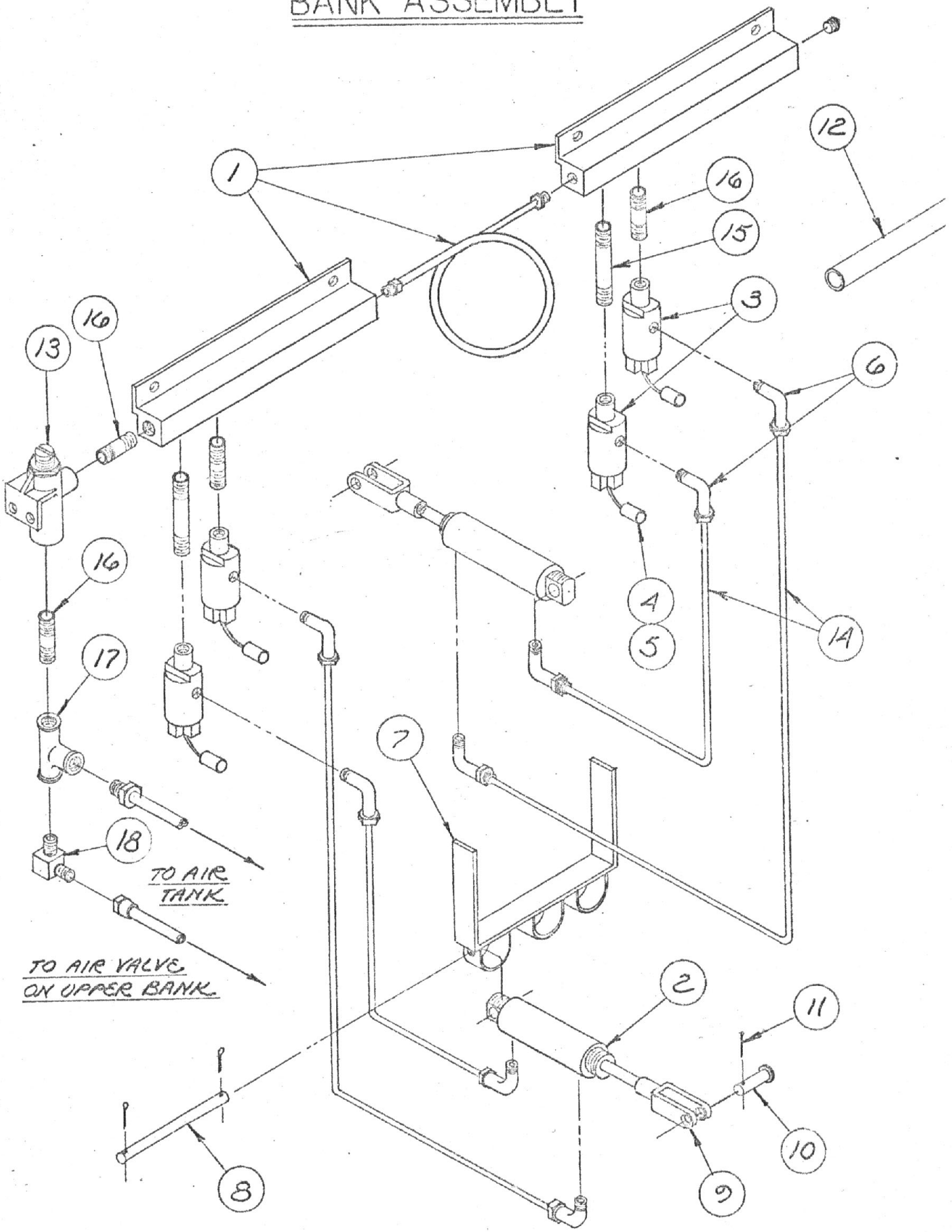
A. REMOVAL

1. Following removal of collector ring cover disconnect air lines from top of air swivel (RC-3014)
2. Remove air swivel as per swivel removal instructions.
3. Tag and disconnect the electrical wiring from collector ring, item 1.
4. Loosen setscrew securing ring to swivel conduit.
5. Lift collector ring off collector ring mounting base plate (shown on collector ring cover assembly 0 item 1).
6. Remove brush holder studs, item 7, and remove brush and arm assemblies items 5 & 6 from collector ring brush turntable bracket, item 2.
7. Remove core assembly, item 4, from turntable bracket, item 2.
8. Clean the brushes and ring with fine sandpaper - then blow out with air. If grease or oil exists on ring it may have to be washed with solvent.
9. Inspect the ring, brushes and brush holders for chipped, corroded, pitted and broken condition. Replace all parts if necessary.
10. Inspect brush springs, item 10, for a loss of tension. Replace any if necessary.
11. Inspect brushes, items 5 & 6, for excessive worn condition. Replace any brushes if necessary.

B. REASSEMBLY

1. Replace items in reverse order of disassembly.
2. Reconnect wiring.
3. Check for mistaken hook-ups.
4. Be sure that wires at top of ring cannot catch on any portion of the krane upper in operation.

OUTRIGGER CYLINDER BANK ASSEMBLY



OUTRIGGER CYLINDER BANK ASSEMBLY

DISASSEMBLY

1. Disconnect wire loom (12) from terminal connections (4) and (5) on solenoid valve (3).
2. Remove tubing (14) from solenoid valve 90° elbow (6) and cylinder 90° elbow (6).
3. Remove copper tube to air tank from pipe tee (17) and copper tube to air valve from 90° adaptor (18) allowing removal of adaptor, pipe tee, pipe nipple (16) and air regulator (13) from manifold (1).
4. Remove 90° elbow from air solenoid allowing removal of air solenoid and pipe nipples (15) and (16) from manifold.
5. Remove copper tubing from inbetween the manifolds.
6. Remove manifolds from mounting brackets and pipe plug from manifold.
7. Remove cylinder pin (8) from cylinder mounting bracket (7) and hair pin (11) from clevis pin (10) allowing removal of cylinders.
8. Remove cylinders from mounting brackets.
9. Remove 90° elbow from air cylinders.

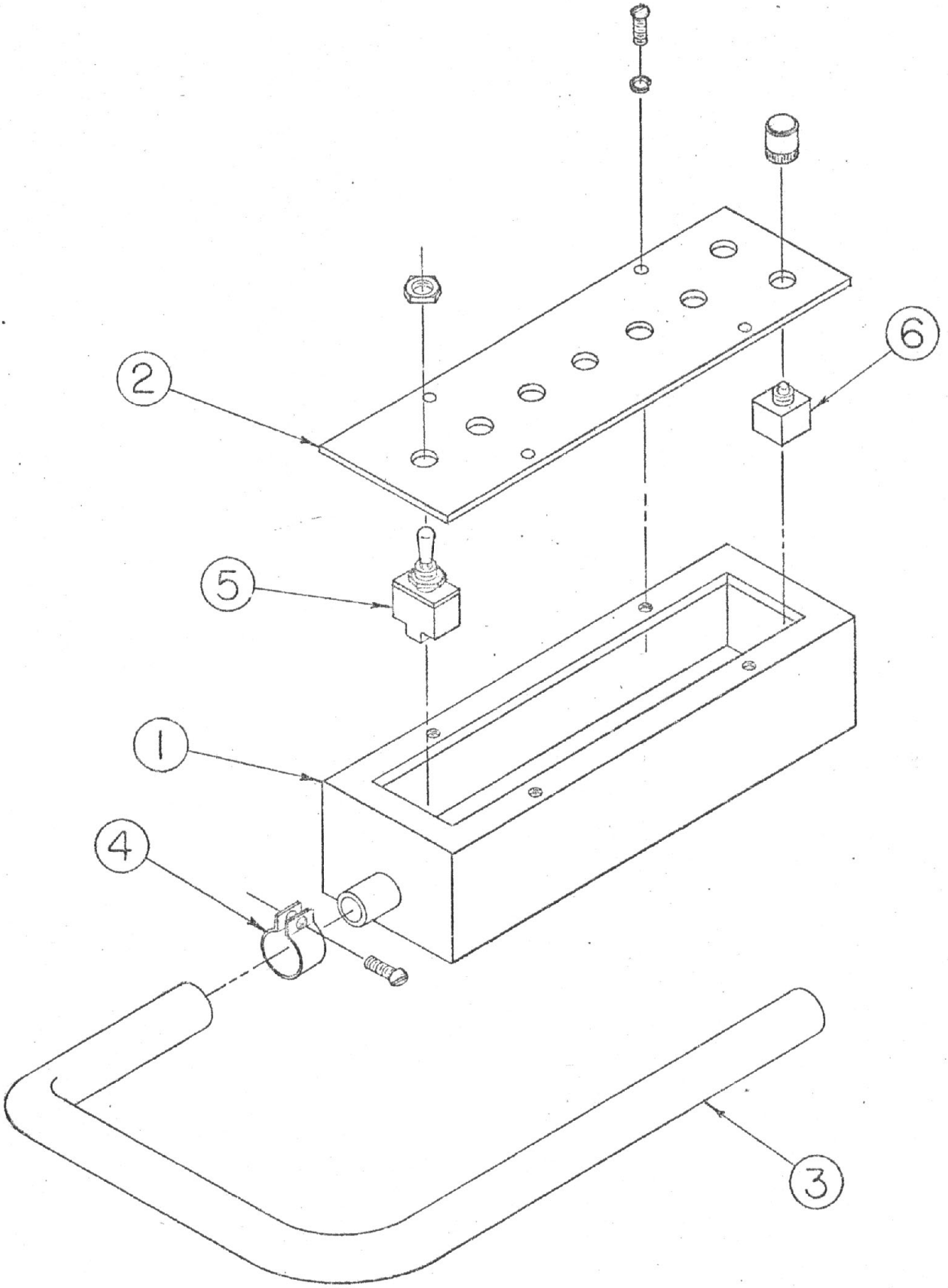
CLEANING, INSPECTION AND REPAIR

1. Clean all metal parts with an approved cleaning solvent; dry thoroughly with compressed air.
2. Inspect all parts for cracks, breaks, distortion and other damages.
3. Replace all damaged and worn parts.

ASSEMBLY

1. Reasemmble all parts in outrigger cylinder bank assembly in reverse order of disassembly.

OUTRIGGER CONTROL ASS'Y



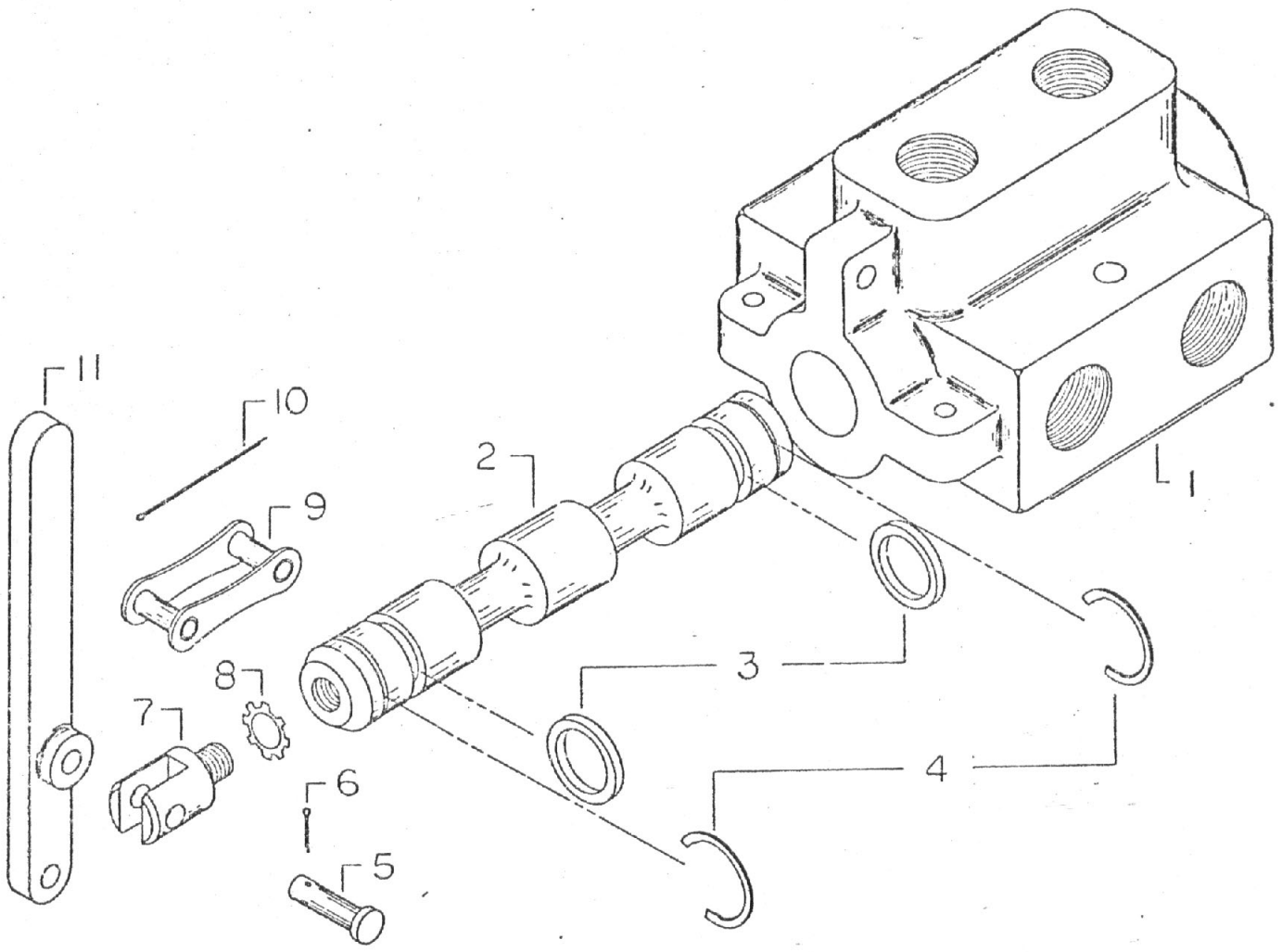
OUTRIGGER CONTROL ASSEMBLY

A. REMOVAL

1. Remove screws and lockwashers from aluminum plaque, item 2.
2. Remove plaque from sheetmetal box, item 1.
3. Remove push button switch rubber cover, by turning counterclockwise, and slide push button switch, item 6, from plaque.
4. If switch, item 6, is defective, replace with new.
5. Remove nuts from toggle switches, item 5, and remove switches from plaque.
6. If switches, item 5, are defective, replace them with new.
7. Disconnect wiring from switches.
8. Remove screw from connector, item 4, and slide wire harness, item 3, from box, item 1.
9. Replace any defective wiring.

B. REASSEMBLY

1. Slide wiring harness into box and reconnect wiring to switches.
2. Replace items in reverse order of disassembly.
3. Check for mistaken hook-ups.



SELECTOR VALVE

DOUBLE SELECTOR VALVE ASSEMBLY

A. REMOVAL

1. Following removal of valve from platform valve mounting plate, remove link cotter pin, item 10, and handle link, item 9.

2. Remove small cotter pin, item 6, remove handle pin, item 5, and remove handle, item 11.

3. If needed, handle adapter, item 7, can be unscrewed from spool, item 2, and lockwasher, item 8, can be removed.

4. Remove snap ring, item 4, from rear end of spool.

5. Slide spool, item 2, forward out of valve housing, item 1.

6. Remove spool seals, items 3, from spool.

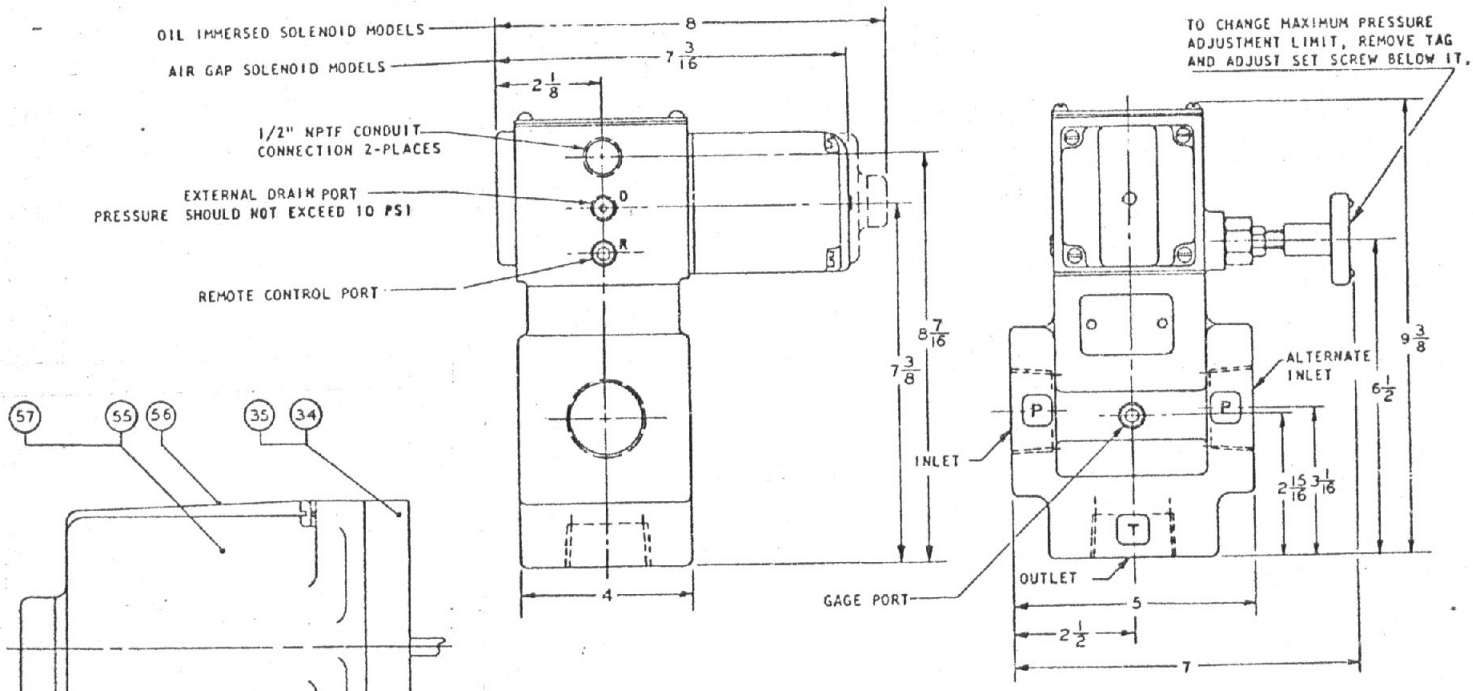
7. If any pieces are damaged, replace with new - note that housing and spool are not sold as separate items. Because of factory machining and matching of housing and spool, individual ones are not interchangeable.

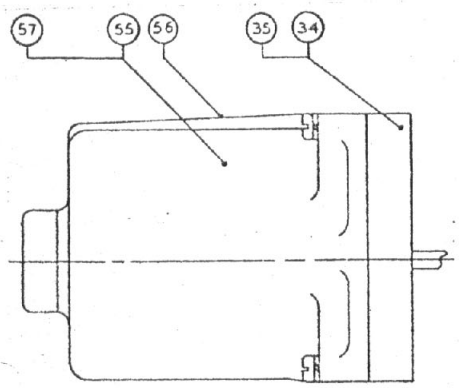
B. REASSEMBLY

1. Replace items in reverse order of disassembly.

2. Bolt valve down to valve mounting plate.

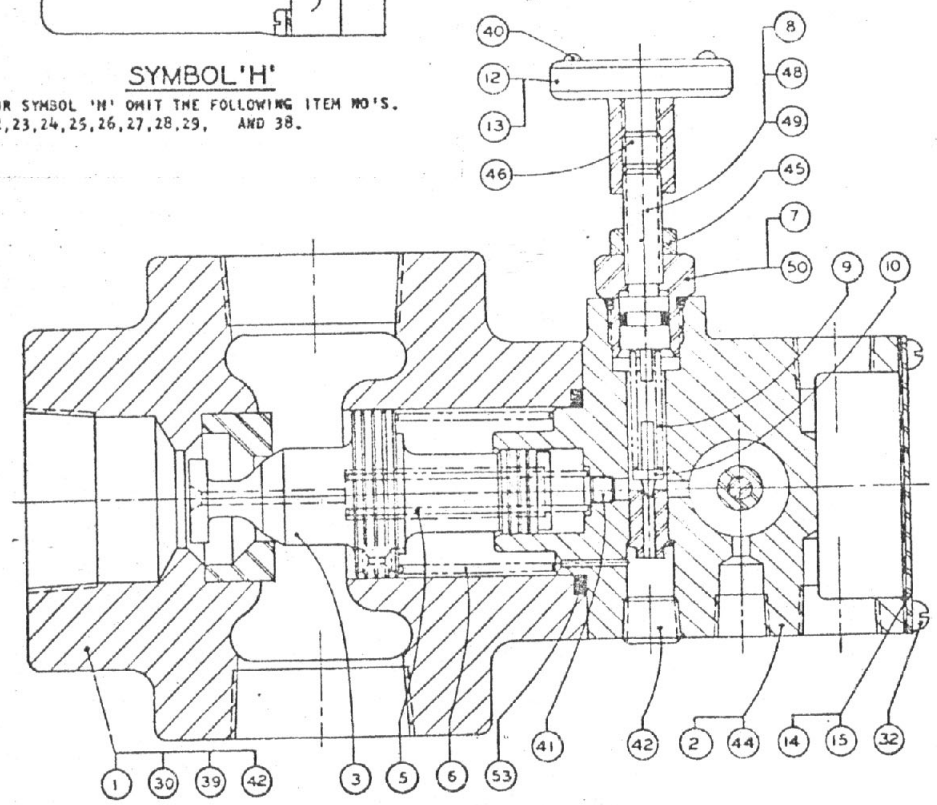
3. Reconnect hydraulic lines and air cylinder and check for leaks.

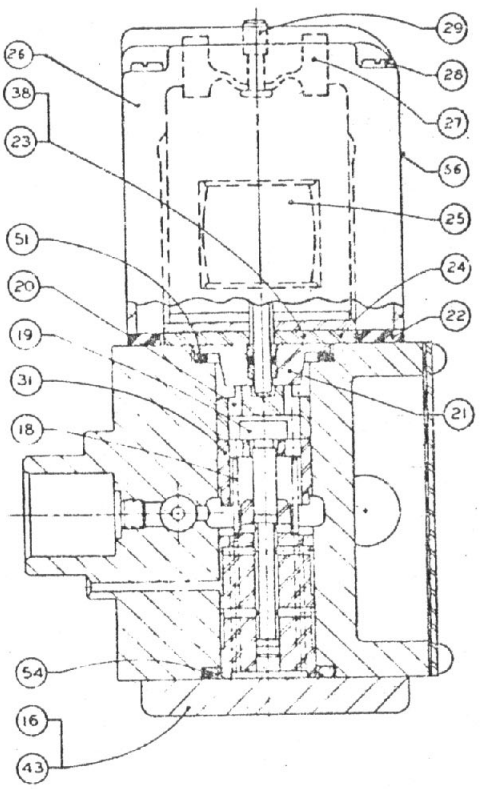




SYMBOL 'H'

FOR SYMBOL 'H' OMIT THE FOLLOWING ITEM NO'S. 22,23,24,25,26,27,28,29, AND 38.





DUMP VALVE

DUMP VALVE

REMOVAL, DISASSEMBLY, INSPECTION & REASSEMBLY

Following removal of hydraulic hoses and fittings, from dump valve, disassemble as follows:

1. Remove body screws, item 32, cover plate, item 14, and gasket, item 15, from pilot body, item 2.

2. Remove capscrews, items 44, and remove pilot body, item 2, from body, item 1.

3. Following removal of pilot body, remove "O" ring, item 53, spring, item 5, and spool, item 3 from body, item 1. Inspect these items for damage and replace if needed. The reassemble these items in the reverse order of disassembly, and place aside until later.

4. Going to pilot body, item 2, loosen and remove nut, item 7. This will remove handle assembly.

5. Remove cone, item 10, spring, item 9, and "O" ring, item 50. Inspect these items for damage and replace if needed.

6. Remove screws, items 40, and remove tag, item 13, from handle knob, item 12.

7. Remove setscrew, item 46, plunger, item 8, and teflon ring, intem 48, from knob, item 12. Inspect these items for damage and replace if needed. Reassemble these items in reverse order of disassembly and screw back into pilot body.

8. Remove capscrews, items 43, and end cap, item 16, from pilot body.

9. Remove "O" ring, item 54, from pilot body and inspect for damage. Replace if needed.

10. Rebolt end cap to pilot body.

11. Remove body screws, items 28, and remove solenoid assembly and gasket, item 22.

12. Remove capscrews, items 35, adaptor plate, item 34, and gasket, item 22.

13. Remove pin and guide sub-assembly, item 21, and replace if needed.

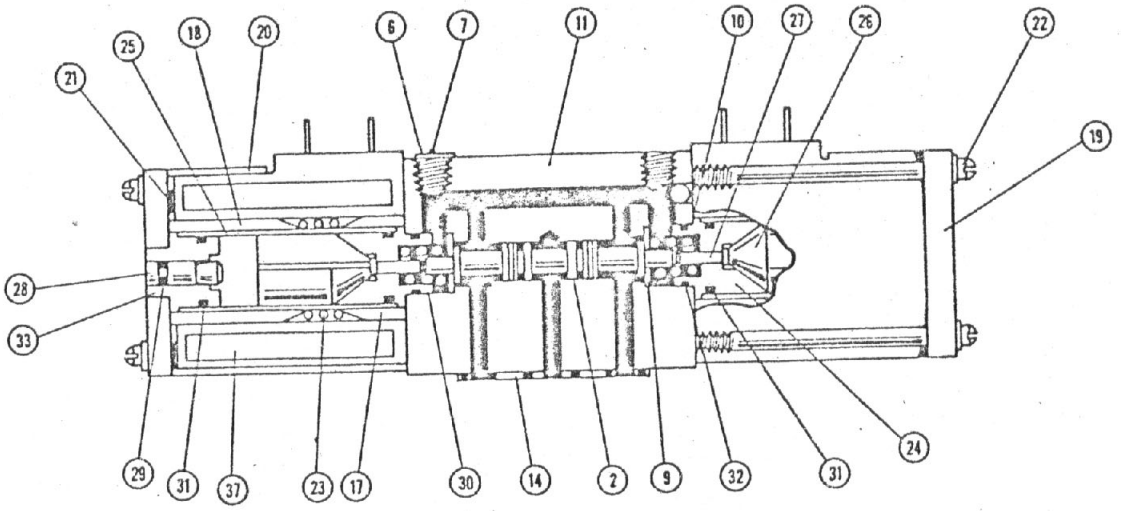
14. Remove "O" ring, item 51, cup washer, item 20, spool, item 19, cup washer, item 31, and spring, item 18. Inspect for damage and replace if needed.

15. Reassemble items in reverse order of disassembly, replacing gaskets if needed.

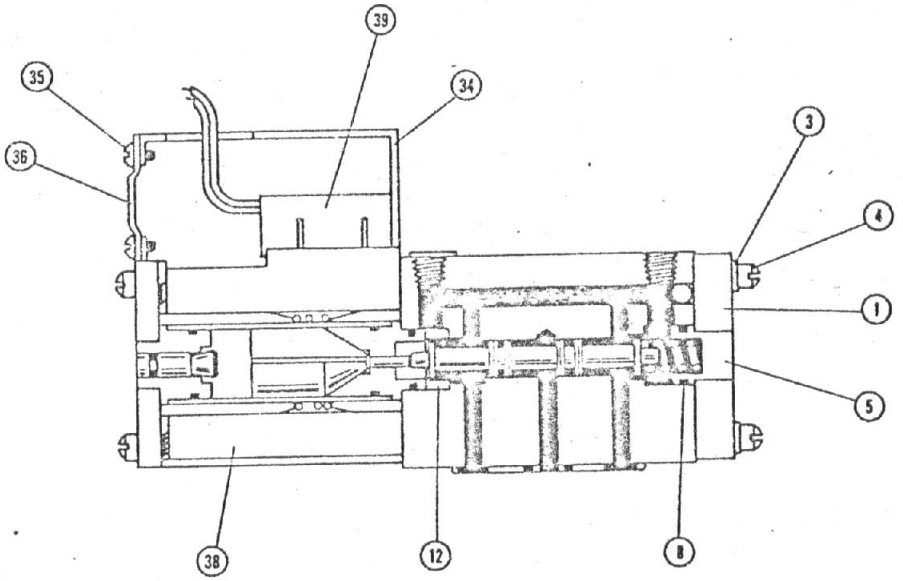
16. Rebolt pilot body to body using capscrews, item 44.

17. Reconnect fittings and hoses and check for leaks.

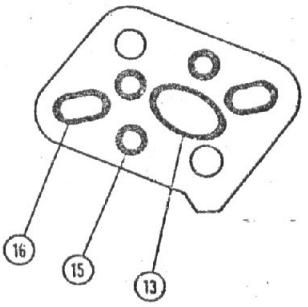
DOUBLE DC SOLENOID VALVE



SINGLE AC SOLENOID VALVE



STANDARD SEAL PLATE



SOLENOID VALVE ASSEMBLY

SOLENOID CONTROLLED DIRECTIONAL VALVE ASSEMBLY

A. REMOVAL

1. Following the disconnecting of hydraulic hoses and fittings, unplug the electrical wiring. Remove valve from bracket. Disassemble as follows:

2. Remove screws, items 4, and remove end cap, item 1.

3. This will allow removal of plug, item 5, "O" ring, item 8, spring, item 10, and spool, item 2.

4. Going to other end of valve, remove screws, items 22, identification plate, (not listed), and end plate, item 19.

5. Remove case, item 20, coil, item 37, outer sleeve, item 18, spring, item 33, inner sleeve, item 17, guide tube, item 25, external push pin guide, item 33, actuator pin, item 28, and quad ring, item 29.

6. Remove plunger and pin (not listed) and cone, item 30.

7. Going to bottom of valve, remove bolts, sub plate, (not listed) standard seal plate, item 14, "O" ring, item 13, and "O" rings, item 15.

8. Check all pieces for damage and replace if needed.

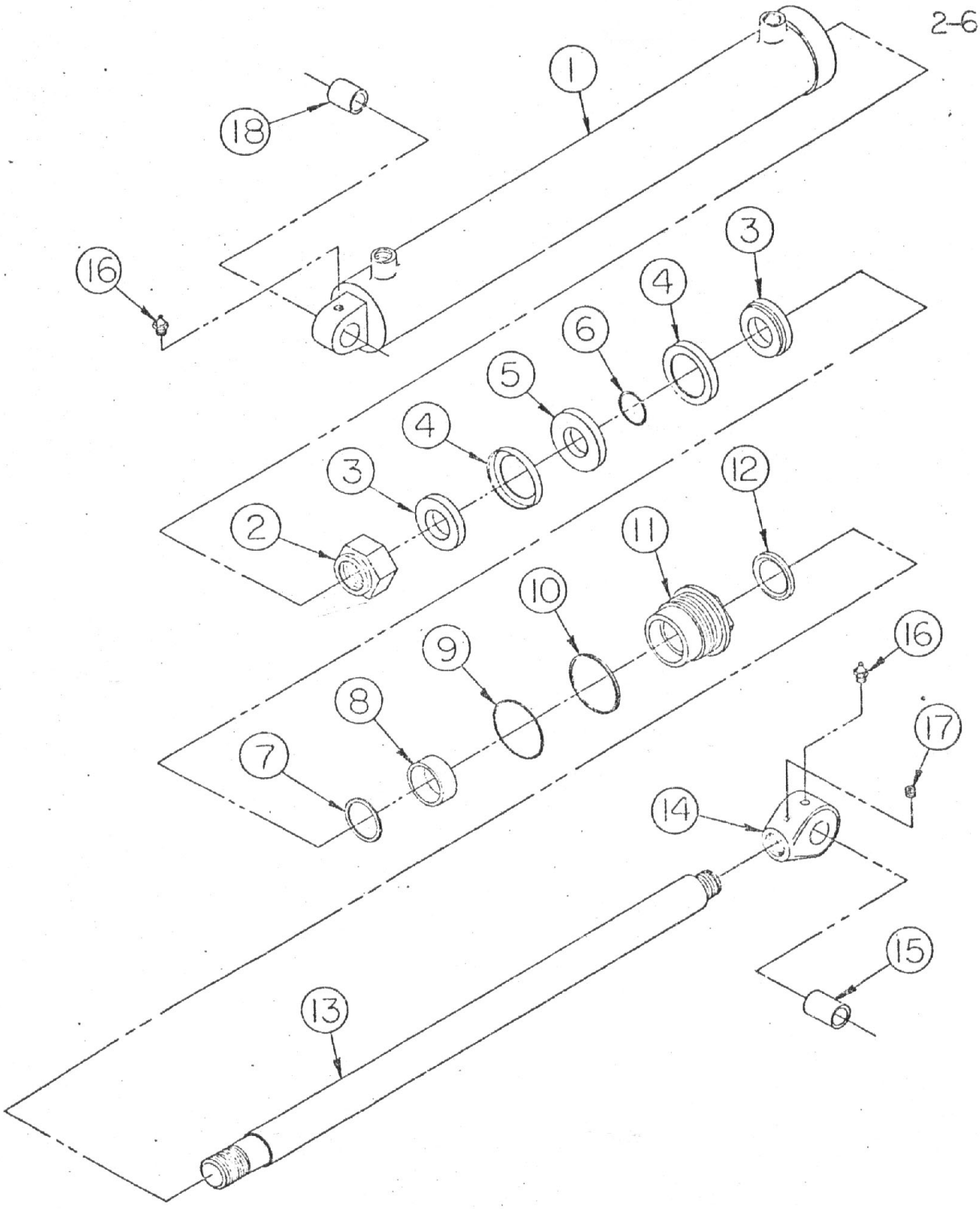
B. REASSEMBLY

1. Replace items in reverse order of disassembly.

2. Rebolt valve to bracket.

3. Reconnect wiring.

4. Reconnect hydraulic fittings and hoses and check for leaks.



1. END CAP & BARREL ASS'Y.
2. NUT
3. RETAINING RING
4. CUP
5. PISTON
6. PISTON SEAL
7. SNAP RING
8. PACKING SET
9. "O" RING
   SEAL KIT #100-738
10. BACK UP WASHER
11. CYLINDER HEAD
12. ROD WIPER
13. ROD
14. ROD EYE
15. BUSHING
16. GREASE FITTING
17. SET SCREW
18. BUSHING

COUNTERWEIGHT EXTENSION CYLINDER #100-601

COUNTERWEIGHT EXTENSION CYLINDER ASSEMBLY

A. REMOVAL

Following removal of cylinder from shipper support, disassemble as follows:

1. Remove set screw, item 17, from rod eye, item 14, and remove rod eye from rod, item 13.

2. Slide rod wiper, item 12, from end of rod.

3. Unscrew cylinder head, item 11, from end cap and barrel assembly, item 1, and slide head off rod.

4. Back-up washer, item 10, and "O" ring, item 9, can be removed from cylinder head.

5. Remove snap ring, item 7, and packing set, item 8, from cylinder head.

6. Slide rod, item 13, from end cap and barrel assembly, item 1.

7. Unscrew nut, item 2, and remove retaining rings, item 13, cups, items 4, piston, item 5, and piston seal, item 6, from rod, item 13.

8. Remove grease fittings, items 16, from rod eye, item 14, and end cap and barrel assembly, item 1.

9. Remove bushing, item 15, from rod eye.

10. Remove bushing, item 18, from end cap and barrel assembly.

11. Inspect items for damage and replace with new if needed.

B. REASSEMBLY

1. Replace items in reverse order of disassembly.

2. Replace cylinder in shipper support.

3. Reconnect hydraulic fittings and hoses and check for leaks.

CRANE ILLUSTRATION

PETTIBONE

HYDRAULIC TRUCK KRANE

MODEL 100TK-LSPC

RATED CAPACITIES
BASED ON 85% OF TIPPING
8 x 4 CARRIER

WORKING RANGE OF BOOM . . .

PETTIBONE 100 TK-LSPC RATED LIFTING CAPACITIES
OUTRIGGERS & COUNTERWEIGHT FULLY EXTENDED

	OVER SIDE / OVER REAR							OVER REAR						
Radius In Feet	BOOM LENGTH				90' Boom & 22' Ext.	90' Boom & 32' Fly	111' Boom & 32' Fly	BOOM LENGTH				90' Boom & 22' Ext.	90' Boom & 32' Fly	111' Boom & 32' Fly
	37' Boom	50' Boom	62' Boom	90' Boom	111' Boom	122' Boom	143' Boom	37' Boom	50' Boom	62' Boom	90' Boom	111' Boom	122' Boom	143' Boom
10	100,000				*	**	***	100,000				*	**	***
12	95,000	66,000						95,000	66,000					
15	75,000	59,000	45,000					75,000	59,000	45,000				
20	60,000	48,000	40,000					60,000	48,000	40,000				
25	40,000	39,000	35,000	28,000	20,000	15,000		40,000	39,000	35,000	28,000	20,000	15,000	
30	28,000	28,000	27,000	24,000	18,000	15,000		28,000	28,000	28,500	24,000	18,000	15,000	
35		19,700	19,700	19,700	15,500	14,000	7,500		21,000	21,500	19,700	15,500	14,000	7,500
40		14,800	15,000	15,000	13,500	12,500	7,500		17,000	17,500	15,000	13,000	12,500	7,500
45			12,000	12,000	11,800	11,500	7,500			13,500	14,000	11,800	11,500	7,500
50			9,400	9,400	10,500	10,500	7,000			11,000	11,500	10,500	10,500	7,000
55			7,200	7,200	9,500	9,500	6,500			8,500	9,500	9,500	9,500	6,500
60				6,200	8,100	8,500	6,000				7,500	8,500	8,500	6,000
65				5,000	6,500	6,900	5,500				6,000	7,500	8,000	5,500
70				3,800	5,300	5,900	5,000				4,500	6,500	6,500	5,000
75				2,800	4,400	4,900	4,500				3,500	5,400	5,500	4,500
80				1,900	3,500	3,800	4,000				2,500	4,300	4,700	4,000
85				1,000	2,800	3,000	3,400				1,600	3,700	4,000	3,700
90					2,000	2,300	2,700					3,000	3,500	3,400
95					1,500	1,800	2,100					2,200	2,700	3,200
100					1,000	1,300	1,400					1,600	2,100	2,700
105					500	500	1,000					1,000	1,600	2,100
110													1,000	1,700
115														1,400
120														1,000

*This is Maximum Capacity for Manual section regardless of boom length.
**This is Maximum Capacity for Lattice section regardless of boom length.
***This is Maximum Capacity for Manual and Lattice sections when used together, regardless of boom length.

100 TK-LSPC LIFTING CAPACITY AND SAFETY INSTRUCTIONS

1. Rated lifting capacities are the freely suspended maximum loads covered by the manufacturer's warranty with the machine standing on firm, uniform and level surface, with outriggers fully extended and locked down, with the 5,000 lb. counterweight attached to the upper and fully extended. In no case do rated capacities exceed 85% of tipping.

2. Radius of load is the horizontal distance from a projection of axis of rotation before loading, to the center of vertical hoist line or tackle with load applied.

3. At radii where no ratings are shown on the chart, operation is not intended, or approved.

4. The weight of all auxiliary handling devices such as hoist blocks, hooks and slings is considered as part of the load.

5. Practical working loads shall be established by the user and depend on supporting surface, wind, proper operating speeds, and in general, careful and competent operation.

6. When using fly section with extended booms, the main boom load chart must not be exceeded.

7. Fly capacities are based on single line operation. Use of a two part line VOIDS warranty.

8. With some boom combinations maximum capacities may not be possible with standard wire rope length.

9. With some boom combinations the boom lift cylinders may not raise the load, however operational safety is not affected by this condition.

10. When using 32' swing back fly, reduce the capacity over the main boom by 2,000 lbs.

11. The hydraulic power boom sections are independently operated with the first section extending 25'9" and the second section extending 27'3". Power telescoping boom sections must be extended and retracted equally. The maximum load which may be telescoped is limited by hydraulic pressure, boom angle and boom lubrication. It is safe to attempt to telescope any load within the limits of the load chart.

12. Handling of personnel from the boom is not authorized except with equipment installed by Pettibone Corporation, or division manufacturing the crane.

13. The winches on this crane are equipped with automatic (Fail-Safe), spring set, hydraulic released brakes.

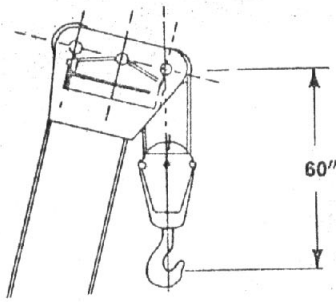
14. For clam-shell or concrete bucket operations, the weight of the bucket and load must not exceed 90% of the rated lifting capacity at chart radius.

15. Load handling devices should be kept at a minimum of 12" below the boom point when lowering or extending boom to prevent two blocking.

16. Lifting over the front of carrier is not allowed and can cause an unsafe condition resulting in structural damage to carrier chassis.

17. Operator should be familiar with federal, state and local safety regulations. The operator's failure to adhere to recommended safety practices may result in serious personal injury and equipment damage.

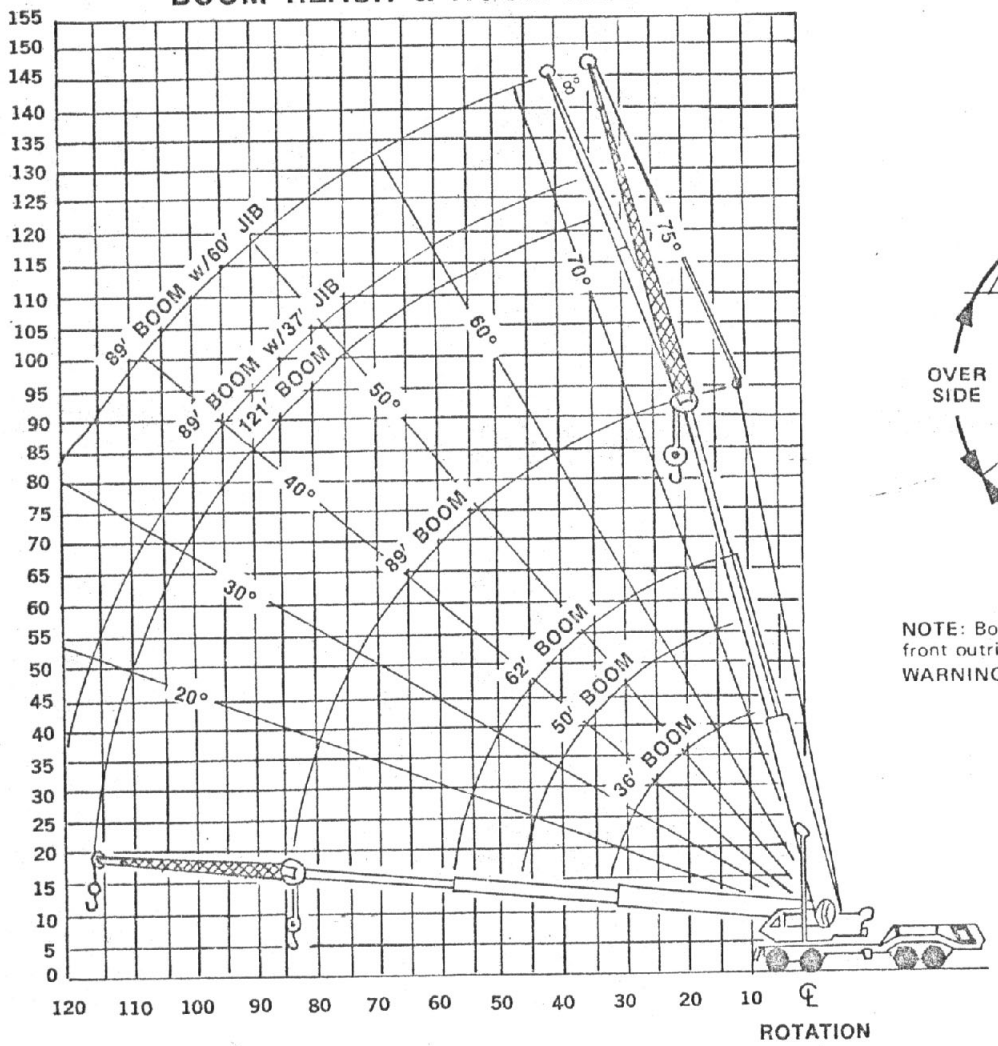
18. The use of cranes and all attendant devices is subject to certain hazards that cannot be protected against by mechanical means, but only by the exercise of intelligence, care and common sense. It is therefore essential to have competent and careful operators, physically and mentally fit, and thoroughly trained in the safe operation of cranes and all devices attached thereto.



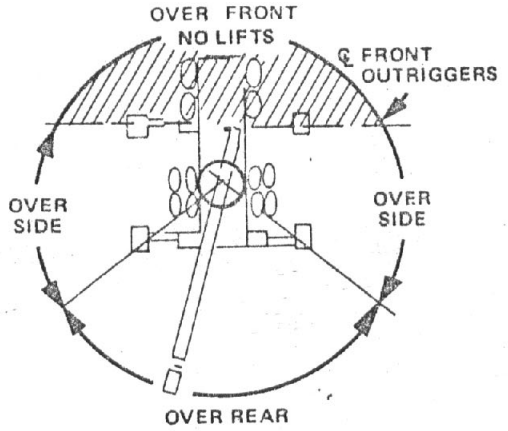
CABLE CAPACITY (POUNDS)

NO. OF PARTS OF LINE	¾" - 6x19 - IWRC
1	16,000
2	30,000
3	44,000
4	58,000
5	72,000
6	85,000
7	100,000
8	100,000

BOOM REACH & HOOK HEIGHTS



LIFTING AREAS ON OUTRIGGERS



NOTE: Boom crossing heavy dashed line (centerline of front outriggers) is considered over-the-front.
WARNING: No over-the-front lifting recommended.

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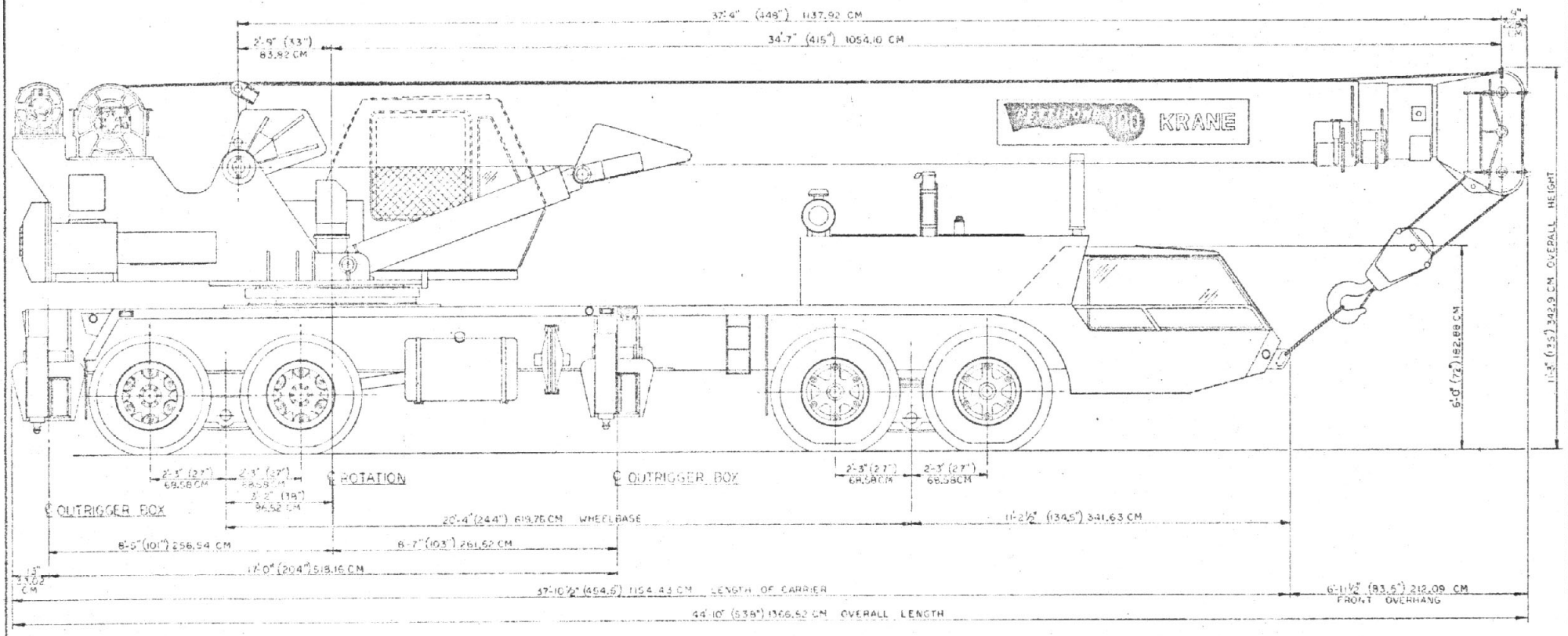
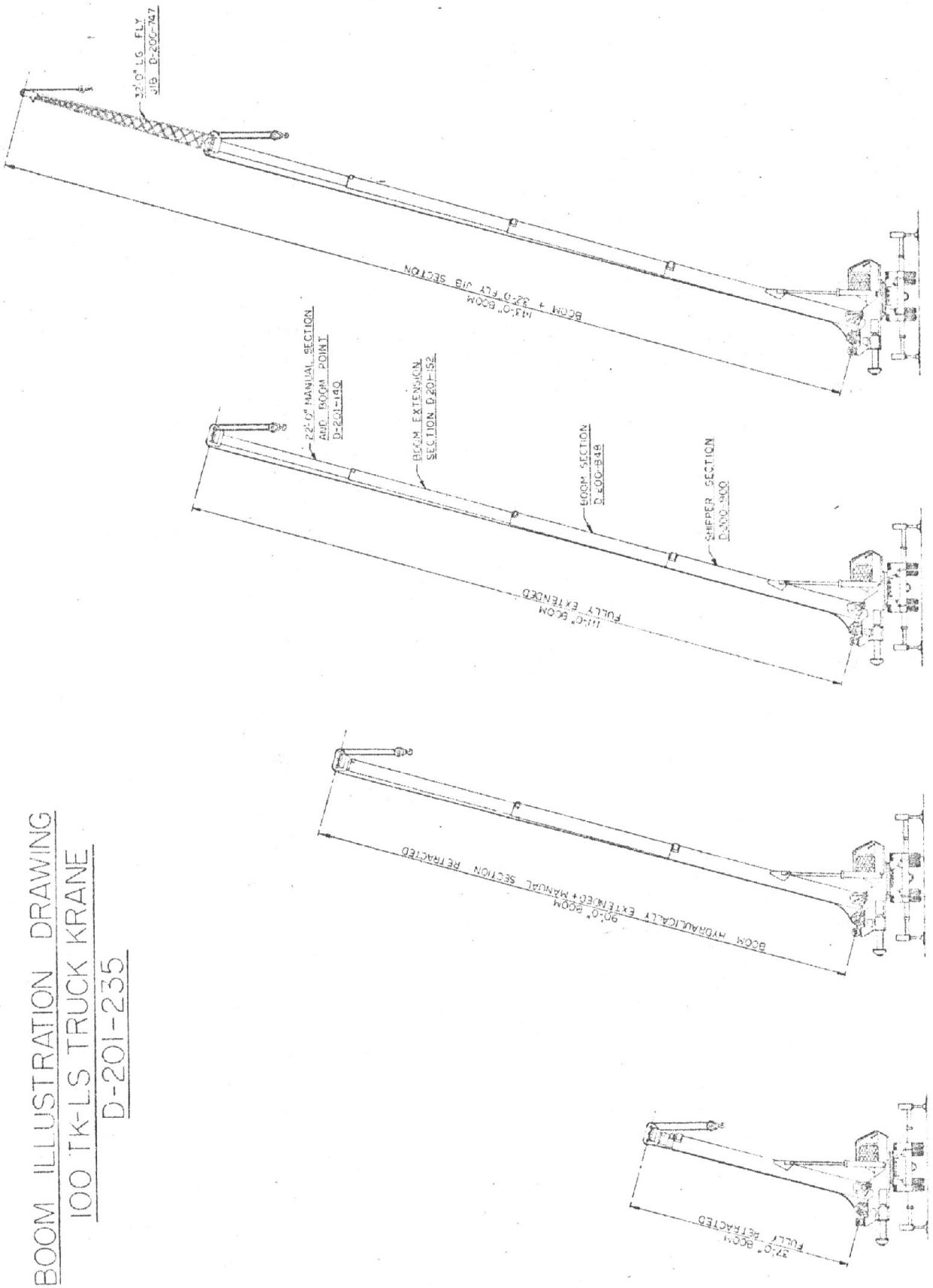


PETTIBONE 100 TK-LS TRUCK KRANE

BOOM ILLUSTRATION DRAWING
100 TK-LS TRUCK KRANE
D-201-235



CARRIER
OPERATORS AND SERVICE
INSTRUCTIONS

OPERATING PROCEDURES

INTRODUCTION

Before starting this crane, familiarize yourself with the controls, instrument panel, shifting diagrams, and most of all the contents of this manual. This will help to insure that proper operating procedures are followed and that good driving habits are achieved.

The manner in which the carrier is operated and cared for during the first 100 working hours will determine its future life, its freedom drom unnecessary troubles and its overall operation. This duty of the operator placed in charge of this unit is to strictly adhere to the instructions received when the crane is delivered and also to the contents of this manual.

Proper lubrication and maintenance are essential for satisfactory performance of this crane. Follow fhe lubrication information noted in this manual.

The vehicle you are about to drive in not just a truck, but a piece of construction equipment. In its design the manufacturer has included a power unit, braking system and frame construction, all of which are heavier and more powerful than the average highway vehicle and in order to obtain satisfactory results the operator must understand the following instructions:

1. Check the level of the engine oil, radiator water, hydraulic oil and battery electrolite. If the engine or hydraulic oil are low, it should be topped off using the lubricant shown in the "Lubrication Chart" affixed to the operator's cab window. (Caution - the radiator has a 7 PSI pressure cap. If the radiator is hot, use extreme caution in removing the cap.)

2. Check the tightness of the wheel clamps using the wrench and lever supplied in the cab. Nuts should be firm, but do not over-tighten. This could damage the clamps and nuts.

3. Check the "free play" of the clutch pedal. This should be approximately 1" prior to engaging the clutch. If the clutch has lost its adjustment, request service or adjust clutch linkage as per the instruction manual before further use.

PRE-STARTING INSTRUCTIONS

Before starting the engine in this crane the following precautions must be taken.

1. Check the gearshift to insure that it is in the "Neutral" position. The neutral position will bel indicated by a red light appearing on the dash panel when the ignition key is switched to the "On" position.

2. The hydraulic selector valve should be on "Power Steering".

3. The engine brake switch, which is located in the dash panel should be in the "Off" position.

4. The emergency brakes should be in the "On" position.

5. The brake lock should be in the "Off" position.

STARTING THE ENGINE

Depress the accelerator pedal and start the engine. Check to insure that the oil pressure gauge registers 60 to 80 PSI oil pressure. If the gauge does not show a pressure build up within a few seconds, "Shut Down" the engine immediately and request service.

After engine has started, run engine at 800/1000 R.P.M. until the air pressure gauge registers 125 to 130 PSI. Do not attempt to move carrier until the correct pressure is obtained, because the emergency brakes cannot be released.

DRIVING THE VEHICLE

Depress the clutch, release the "Emergency Brakes", engage 1st gear (Red Light Out) and move the vehicle smoothly raising the engine speed on the road before making the next gear change. The clutch should be fully depressed when making a gear change and the "Double De-Clutch" method should be used for both up-shift and down-shift. When operating vehicles fitted with "Air Shift", it is necessary to hesitate in neutral and insure that the red light comes on as you pass through the gate.

The Auxiliary Transmission or 'Range Shift' is normally in three or four ratios for operating on flat level ground; it is recommended to start in'Intermediate' or 2nd, Low. After the vehicle is rolling it is then possible to shift to "High Range" or "Over-drive". NOTE: When operating on steep hills or "Off Highway" shift into "Low-Range" to permit better control of the vehicle and the load.

RUNNING TEMPERATURES AND PRESSURES

For normal operation, the engine, brakes, and accessory reading should be as follows:

1. Engine water temperature. . . . . .175/185 Degrees

2. Engine Oil Pressure. . . . . 60/80 PSI

3. Air Pressure. . . . . 100/130 PSI (Below 80 PSI)

AIR BRAKE SYSTEM

IMPORTANT: For all tests, check dash gauge with a test gauge known to be accurate.

1. Drain Reservoirs - Open drain cocks on each reservoir and any filter used in system. Close drain cocks after all devices have been completely drained of all condensation (preferabley overnight).

2. Check Brake Chamber Push Rod Travel - Adjust at slack adjuster if stroke is excessive.

3. Check Stop Light Switch - With no air pressure in the system, start engine and apply brake pedal or treadle and observe dash gauge pressure when top light lights. Stop light should normally light when dash gauge registers approximately 5 PSI. Release brakes.

4. Check Low Pressure Indicator - Run engine, continuing pressure build-up. Low pressure indicator buzzer must sound or warning light must remain lighted until dash gauge pressure reached approximately 65 PSI when warning buzzer must top sounding or warning light must go out.

5. Pressure Build-Up Test - Run engine at fast idle: Time required to raise air pressure from 50 to 90 pounds will vary with different vehicles but should not exceed 5 minutes. Average is about 1½ minutes. Check operation of safety valve.

6. Governor Setting Test - Run engine. Governor should cut out, stopping further compression, at maximum pressure setting. Reduce air pressure by series of brake applications. Governor should cut in resuming compression at minimum pressure setting.

7. Leakage Tests - Run engine until governor cuts out. Stop engine. Wait until air pressure stabilizes. With brakes released, dash gauge pressure drop should not exceed 2 pounds per minute for single vehicles. Make a full brake application and allow pressure to stabilize. Pressure drop should not exceed 3 pounds per minute for single vehicles or 4 pounds per minute for combination vehicles. Check system connections and applicable units if leakage in either test is excessive.

8. Operating Tests - Connect accurate test gauge in brake valve delivery line or service line outlet on vehicles with trailer connections. Fully charge air brake system. Depress brake pedal or treadle fully. Test gauge pressure should approximately equal dash gauge pressure. (Some vehicles have pedal or treadle stop arragnement to

prevent full brake valve delivery pressure; do not alter this unless higher delivery pressure is required to increase brake effectiveness.) Hold pedal or treadle at several different positions; delivery should vary rapidly in accordance with changes in pedal or treadle positions, and air should release to 0 PSI with same speed.

Check for quick application and release of all brakes at each wheel.

The following tests will vary depending upon the type of tractor protection valve on the vehicle. Determine type of tractor protection equipment before proceeding with the following tests.