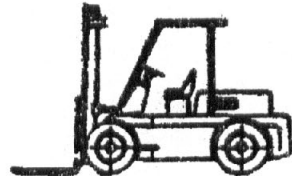
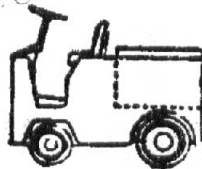


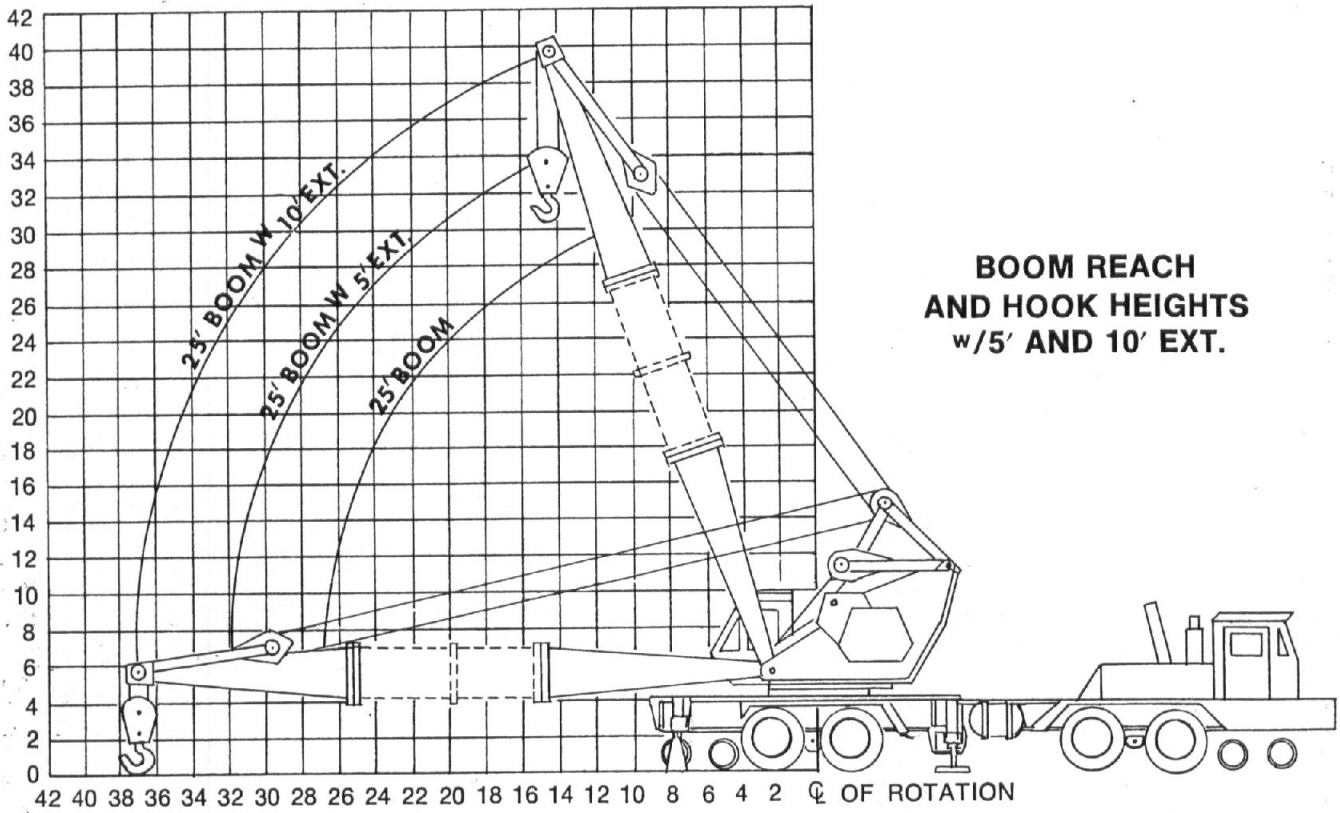


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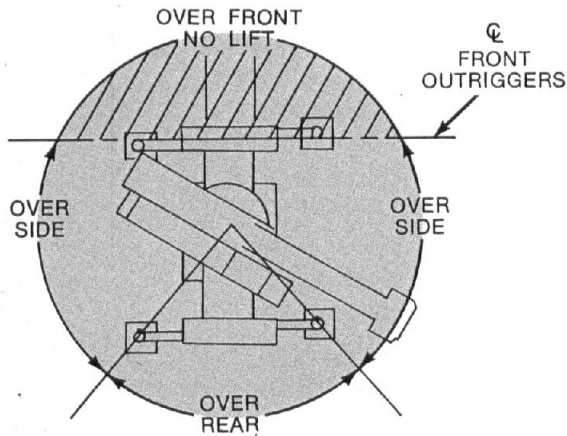
PETTIBONE TIFFIN
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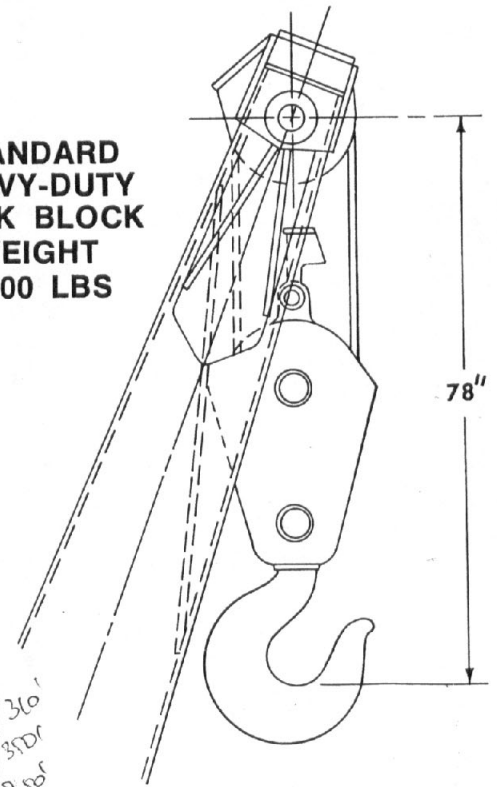
BOOM REACH AND HOOK HEIGHTS w/5' AND 10' EXT.

LIFTING AREAS ON OUTRIGGERS



NOTE: BOOM CROSSING (CENTERLINE OF FRONT OUTRIGGERS) IS CONSIDERED OVER THE FRONT
WARNING: NO OVER THE FRONT LIFTING RECOMMENDED

STANDARD HEAVY-DUTY HOOK BLOCK WEIGHT 1600 LBS



CABLE SPECIFICATIONS

CABLE FUNCTION	TYPE	BREAKING STRENGTH
BOOM HOIST CABLE	7/8" - 6 x 19 - IWRC	39.8 TONS (36.1 MT)
LOAD HOIST CABLE	7/8" - 6 x 37 - IWRC	37.8 TONS (34.3 MT)
DECK WINCH CABLE	3/4" - 6 x 19 - IWRC	29.4 TONS (26.7 MT)

*360
3500
2500*

PETTIBONE CORPORATION

Railroad Sales Division
 Sears Tower Suite 5700
 233 S. Wacker Drive
 Chicago, Illinois 60606

PETTIBONE**MODEL 200 RRC
HYDRAULIC TRUCK KRANE****RATED CAPACITIES
BASED ON 85% OF TIPPING
8 x 4 CARRIER**

WORKING RANGE OF BOOM...

**PETTIBONE 200 RRC LIFTING CAPACITIES
OUTRIGGERS FULLY EXTENDED**

Standard 25' Boom Fully Equipped			Standard 25' Boom Without Rail Gear			*Optional 30 & 35' Booms Fully Equipped		
RADIUS	OVER REAR	OVER SIDE	RADIUS	OVER REAR	OVER SIDE	RADIUS	OVER REAR	OVER SIDE
11	200,000	100,000	11	200,000	86,000			
12	199,000	96,000	12	195,000	82,600			
13	180,800	85,800	13	173,600	73,800	13	180,800	85,800
14	152,000	68,800	14	145,900	59,200	14	152,000	68,800
15	137,000	58,600	15	131,500	50,400	15	137,000	58,600
16	125,000	51,800	16	120,000	44,500	16	125,000	51,800
17	114,000	46,700	17	109,400	40,200	17	114,000	46,700
18	104,000	42,000	18	99,800	36,100	18	104,000	42,000
19	94,200	39,100	19	90,400	33,600	19	94,200	39,100
20	83,500	36,100	20	80,200	31,000	20	83,500	36,100
21	72,800	33,400	21	69,900	28,700	21	72,800	33,400
22	64,700	31,000	22	62,100	26,700	22	64,700	31,000
23	58,400	28,400	23	56,100	24,400	23	58,400	28,400
24	54,200	26,300	24	52,000	22,600	24	54,200	26,300
25	51,400	24,600	25	49,300	21,200	25	51,400	24,600
26	49,500	22,900	26	47,500	19,700	26	49,500	22,900
						27	42,000	22,300
						28	40,300	19,900
						29	38,600	18,400
						30	36,500	17,000
						31	34,800	15,000
						32	32,700	13,500
						33	30,600	11,800
						34	28,800	11,100
						35	27,100	8,400
						36	25,400	6,600

*Minimum radius for 30' boom is 13'.

*Minimum radius for 35' boom is 15'.

*Maximum of 9 parts of line on hook block when using a 30' boom.

*Maximum of 7 parts of line on hook block when using a 35' boom.

200 RRC 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, and with gantry pinned in work position.

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. Handling of personnel from the boom is not authorized.

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

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

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

10. When using optional length 30' boom the load hoist line shall be limited to 9 parts of line on the hook block.

11. When using optional length 35' boom the load hoist line shall be limited to 7 parts of line on the hook block.

12. 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.

13. 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.

PETTIBONE

200 RRC KRANE



MODEL 200 RRC AXLE WEIGHT DISTRIBUTION

Machine equipped with standard 25' (7.62 m) boom, front and rear outriggers,
front and rear Hy-Rail equipment, 100 ton hook block
and optional deck winch mounted

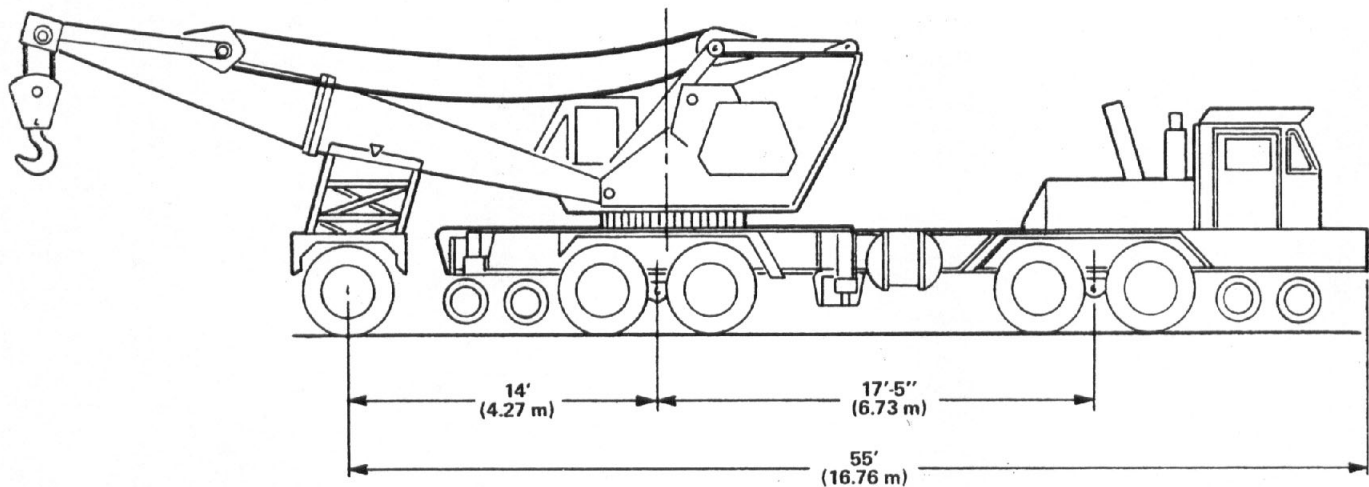
	G.V.W.		Front Tandem		Rear Tandem	
	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.
Machine equipped as above	81,500	36 968	33,250	15 082	48,250	21 886
Machine equipped as above, with only Front Hy-Rail equipment removed	77,800	35 290	27,800	12 610	50,000	22 680
Machine equipped as above, with only Rear Hy-Rail equipment removed	77,900	35 335	34,600	15 695	43,300	19 640
Machine equipped as above, with Front and Rear Hy-Rail equipment removed	74,000	33 566	29,500	13 381	44,500	20 185
Machine equipped as above, with Front and Rear Hy-Rail equipment and Rear Outrigger removed	70,300	31 889	31,000	14 062	39,300	17 827

All of above figures are subject to manufacturer's tolerances.

PETTIBONE

MODEL 200 RRC KRANE

AXLE WEIGHT DISTRIBUTION WITH BOOM TRAILER



Machine equipped with standard 25' (7.62 m) boom, front and rear outriggers, front and rear Hy-Rail equipment, 100 ton hook block and optional deck winch mounted.

	G.V.W.		Front Tandem		Rear Tandem		Trailer	
	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.	lbs.	kgs.
Machine equipped as above	83,200	37 740	26,600	12 066	41,600	18 870	15,000	6 804
Machine less rear Hy-Rail equipment	79,600	36 107	27,700	12 565	36,900	16 738	15,000	6 804
Machine less Rear and Front Hy-Rail equipment	76,000	34 473	22,900	10 387	38,100	17 282	15,000	6 804

All of above figures are subject to manufacturer's tolerances.



PETTIBONE CORPORATION

Railroad Sales Division
Sears Tower—Suite 5700
233 S. Wacker Drive
Chicago, Illinois 60606

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 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.

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Distributor's Name _____

Distributor's Address _____

Distribution Serviceman _____

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

MODIFICATIONS OR FIELD CHANGES

SHORTAGES

REMARKS

1. INSPECTION CODE INTERVALS

D-DAILY

W-WEEKLY

M-MONTHLY

P-PERIODICALLY-1 TO 12 MONTH INTERVALS, OR AS SPECIFICALLY RECOMMENDED BY MANUFACTURER.

2. WHEN APPROPRIATE, ENTER DIAGNOSIS IN SPACE PROVIDED FOR ANY ITEMS REQUIRING ADJUSTMENT OR REPAIR.

3. INDICATE ITEM INSPECTION RESULTS BY CHECKING IN THE SATISFACTORY, ADJUST, OR REPAIR COLUMN PROVIDED.

SERVICE AND MAINTENANCE FOR MODEL 200 R.R.C.

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 SEPERATE CRATE TO PREVENT LOSS IN SHIPMENT.

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

- a. CARRIER ENGINE CRANKCASE. (REFER TO MANUFACTURES MANUAL.)
 - b. TRANSMISSION: CONVERTER, AND AXLES. (REFER TO MANUFACTURES 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 PERMANANT ANTI-FREEZE SOLUTION AND ADD IT TO THE RADIATOR ACCORDING TO MANUFACTURES 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.

PETTIBONE 200 RAILROAD KRANE

OPERATING INSTRUCTIONS

INTRODUCTION

BEFORE OPERATING A RAILROAD KRANE, FAMILIARIZE YOURSELF WITH THE CONTROLS AND INSTRUMENT PANEL. A CAREFUL OPERATOR IS THE BEST INSURANCE AGAINST ACCIDENTS TO THE KRANE 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 EVERYTHING IS WORKING SATISFACTORILY. WATCH PARTICULARLY FOR EXCESSIVE TEMPERATURE IN ENGINE, GEAR BOXES, ETC.

THE MANNER IN WHICH THE RAILROAD 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 RAILROAD 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 RAILROAD 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 RAILROAD 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

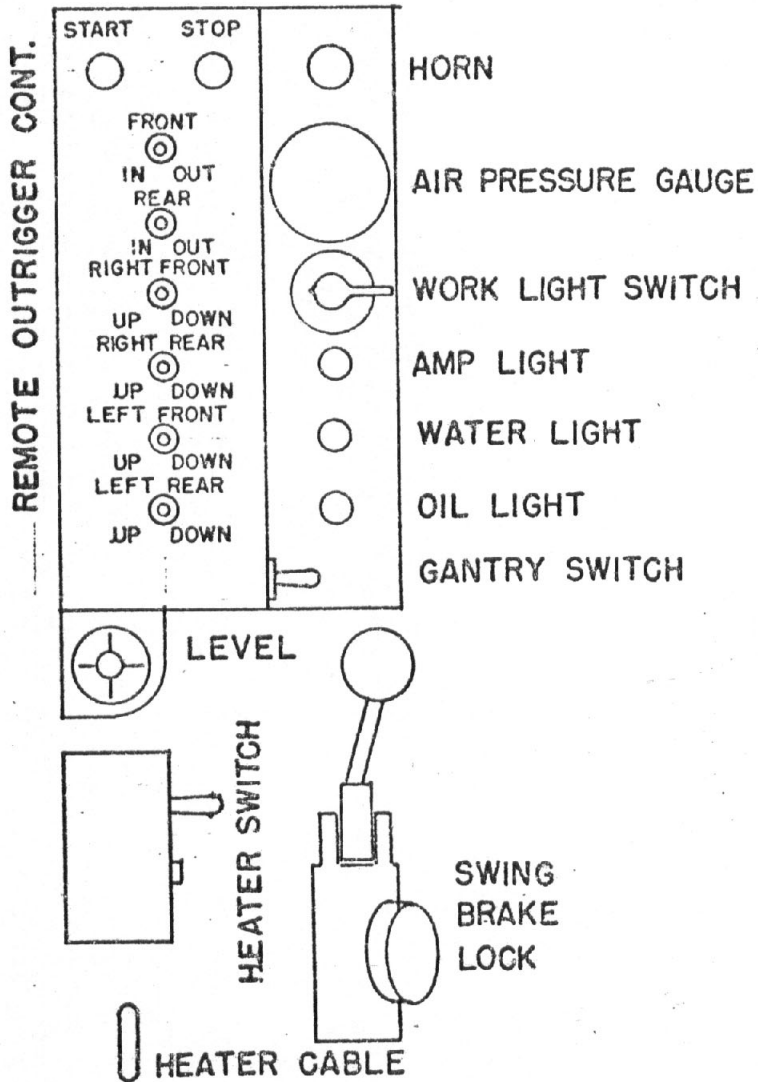
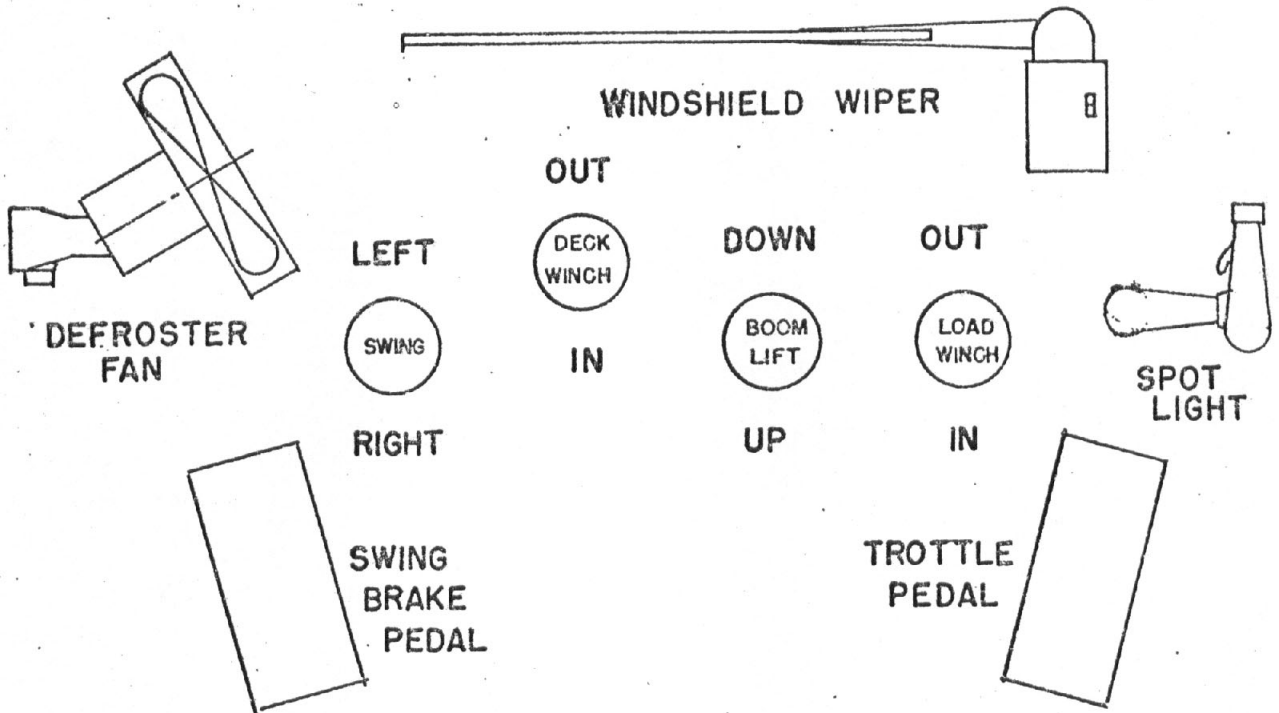
AFTER ARRIVAL AT THE JOB SITE AND THE TRUCK HAS BEEN SPOTTED AT ITS LIFTING LOCATION, SHUT OFF THE ENGINE. LEAVING THE ENGINE SHUT-OFF CABLE IN ITS "OFF" POSITION, PULL THE TWO PUMP GEAR CASE ENGAGEMENT CABLE LEVER. IN ORDER FOR THE GEARS TO MESH PROPERLY, IT SOMETIMES IS NECESSARY TO "JOG" THE STARTER.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

BEFORE LIFTING WITH THIS KRANE THE GANTRY MUST BE IN THE UP (WORK) POSITION AND PINNED. TO LIFT THE GANTRY, RELAX BOOM LIFT CABLES. THROW GANTRY DECK WINCH SWITCH TO GANTRY AND OPERATE DECK WINCH LEVER TO POSITION GANTRY. THROW SWITCH TO DECK WINCH FOR NORMAL KRANE OPERATION. BY PUSHING THE LEVER IN THE UPPER CAB MARKED "WINCH", THE HOOK BLOCK WILL LOWER SLIGHTLY, ALLOWING THE HOOK TO BE DISENGAGED FROM ITS TRAVELING POSITION AND ALLOW THE BLOCK TO SWING FREE. BY PULLING THE LEVER MARKED "BOOM LIFT" THE BOOM WILL RAISE FROM ITS REST. RELEASE THE HOUSE-LOCK LEVER WHICH IS IMMEDIATELY TO THE LEFT 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 LOCK SHOULD ALWAYS BE SET BEFORE THE KRANE IS ROADED FOR ANY APPRECIABLE DISTANCE). PULL THE LEVER MARKED SWING AND THE KRANE WILL SWING TO THE RIGHT. THE SHORT LEVER MARKED "DECK WINCH" CONTROLS THE DECK WINCH FROM THE UPPER CAB, ALSO AS STATED ABOVE, IT CONTROLS THE GANTRY. FOR THE MOST EFFICIENT OPERATION AND IN ORDER TO MAINTAIN SUFFICIENT OIL AND PRESSURE TO PROPERLY ACTUATE THE OPERATING VALVES AND COMPONENTS, THE ENGINE SHOULD OPERATED 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 AVAILABLE AT HIS FINGERTIPS AT ALL TIMES. UNDER NO CONDITIONS SHOULD THE KRANE BE SUBJECTED TO EXCESSIVE SIDE LOADS (I.E. LOCKING THE SWING BRAKE AND WINCHING FROM THE SIDE).

PETTIBONE 200 R.R.C. CRANE CONTROLS



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 1/2 SPEED (ABOUT 800 TO 1000 RPM) AND WITH SWING HOUSE-LOCK SET PULL BACK ON ONE OF THE SWING CONTROL 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 8-1/2 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 LOW OIL (EXCEPT LITTLE OR NO DETERGENT) AND HAS A 4,000 SSU OR PUMPABILITY TEMPERATURE OF ABOUT ZERO TO 20 DEGREES, AND A HIGH TEMPERATURE LUBRICITY FACTOR OF ABOUT 150 TO 175 DEGREES DEPENDING ON THE VISCOSITY INDEX.

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

<u>DESCRIPTION</u>	<u>CAPACITY</u>	<u>TYPE OF LUBRICATION</u>	<u>REMARKS</u>
TRUCK CARRIER (ALL COMPONENT PARTS SEE MFG'S MANUAL)			
HYDRAULIC OIL RESERVOIR AND SYSTEM	8 x 4 CARRIER 175 GALLONS	TEXACO RANDO HD-A (SEE HYDRAULIC LUB- RICATION SHEET)	SEE SERVICE INSTRUCTIONS FOR REQUIRED CHANGER
SLEWING GEAR CASE	12-3/4 PTS.	TEXACO MEROPA #3	CHANGE EVERY 1000 HRS.
LINE WINCH	SEE LINE WINCH SERVICE MANUAL		
TWO PUMP GEAR CASE	4 PTS.	TEXACO #90 GEAR LUBE (MULTI-PURPOSE)	CHANGE EVERY 1000 HRS.
BOOM LIFT WINCH	SEE BOOM LIFT WINCH SERVICE MANUAL		
VICKERS PUMPS		SELF LUBRICATING	
TURNABLE ASSEMBLY		GREASE - EXTREME PRESSURE	GREASE EVERY 40 HRS.
SUMP OIL FILTERS	1000 IN. FILTERING AREA 150 GPM	FILTERS FOR HYDRAULIC CIRCUIT	SERVICE AND CLEAN AT EACH HYDRAULIC OIL CHANGE
BATTERY	AS NEEDED	WATER	KEEP CONNECTIONS PROPERLY CLEAN AND TIGHT
WHEEL LUG NUTS	AS NEEDED TORQUE TO 200 FT/LB.	NONE	

LUBRICATION AND SPECIAL INFORMATION CHART

DESCRIPTION

TIRE PRESSURE

CAPACITY

REAR - 90#
FRONT - 105#

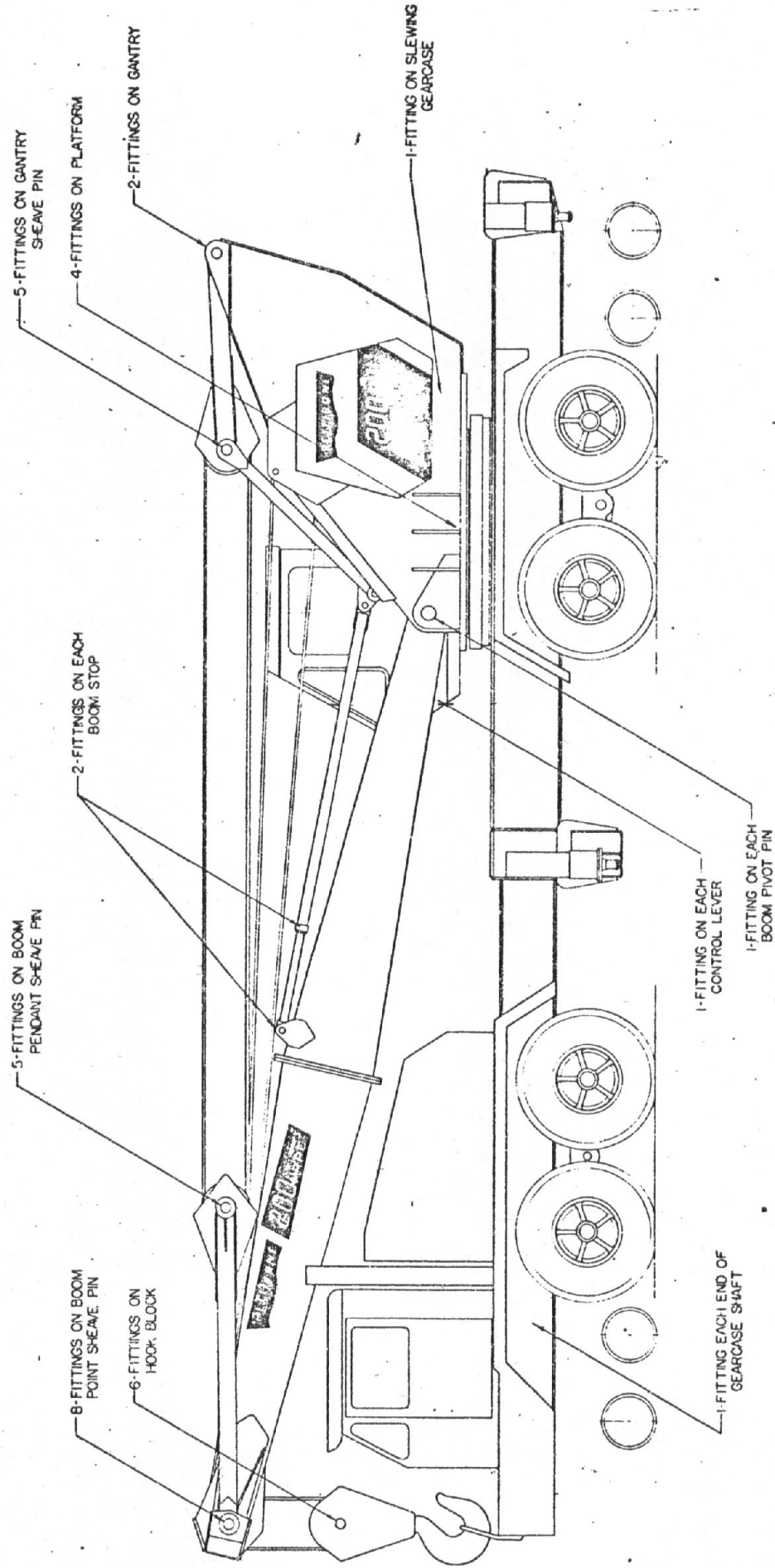
TYPE OF LUBRICATION

NONE

REMARKS

KEEP TIRE PRESSURE
UP TO GIVE LONGER
TIRE LIFE

NOTE: ALL GREASE FITTINGS USE LUBRIPLATE #630-AA FROM FISKE BROTHERS REFINING COMPANY.



200 R.R.C. LUBRICATION

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 2400 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.

PRESSURE RELIEF SETTINGS AND TESTING PROCEDURES FOR CONTROL VALVES

WINCH VALVE

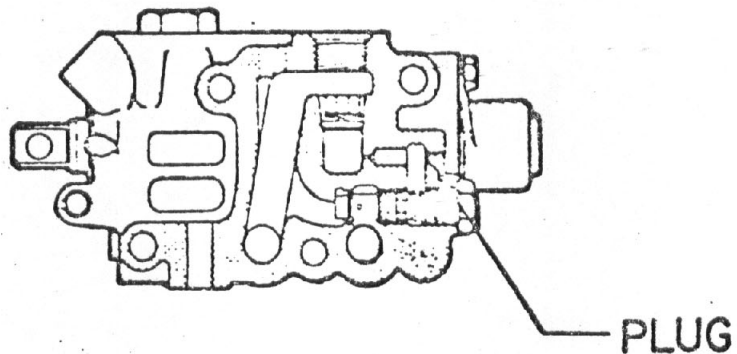
2500 P.S.I.

DECK WINCH SWING VALVE

2500 P.S.I.

TO CHECK THE HYDRASTAT SETTING ON THE MODEL 30 DESIGN VICKERS CONTROL VALVE, THE FOLLOWING PROCEDURE SHOULD BE FOLLOWED. REMOVE THE 1/8" NPT ALLEN HEAD PIPE PLUG, WHICH IS LOCATED DIRECTLY ABOVE THE RELIEF VALVE AS SHOWN IN THE DRAWING BELOW. INSTALL A PRESSURE GAUGE AND TEST AS LISTED BELOW:

1. FOR WINCH VALVE, REMOVE HOOK BLOCK AND USING SINGLE PART LINE ATTEMPT TO LIFT MORE THAN 25,000 POUNDS WITH THE LINE WINCH. HOLD THE VALVE IN A STALLED POSITION AND READ GAUGE.
2. FOR SWING & DECK WINCH VALVE, LOCK THE HOUSE-LOCK AND ATTEMPT TO SWING THE KRANE. HOLD THE VALVE IN A STALLED POSITION AND READ GAUGE.



**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 conditions 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.

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:

<u>SYMPTOM</u>	<u>PROBABLE CAUSE</u>	<u>REMEDY</u>
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

<u>CAUSE</u>	<u>REMEDY</u>
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

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

REMEDY

- Adjust.
Tighten wheel nut.
Tighten lever shaft nut.
Adjust.
Adjust.

NOISE

1. Low fluid level.
2. Air in system.
3. Dirt and sludge in pump.
4. Pump worn.
5. Weakened pressure relief valve spring.

- Check for leaks, refill to level.
Check all connections and bleed systems.
Drain system and clean.
Replace.
Replace spring.

HOW TO ASSEMBLE CONE-DRIVE GEARS

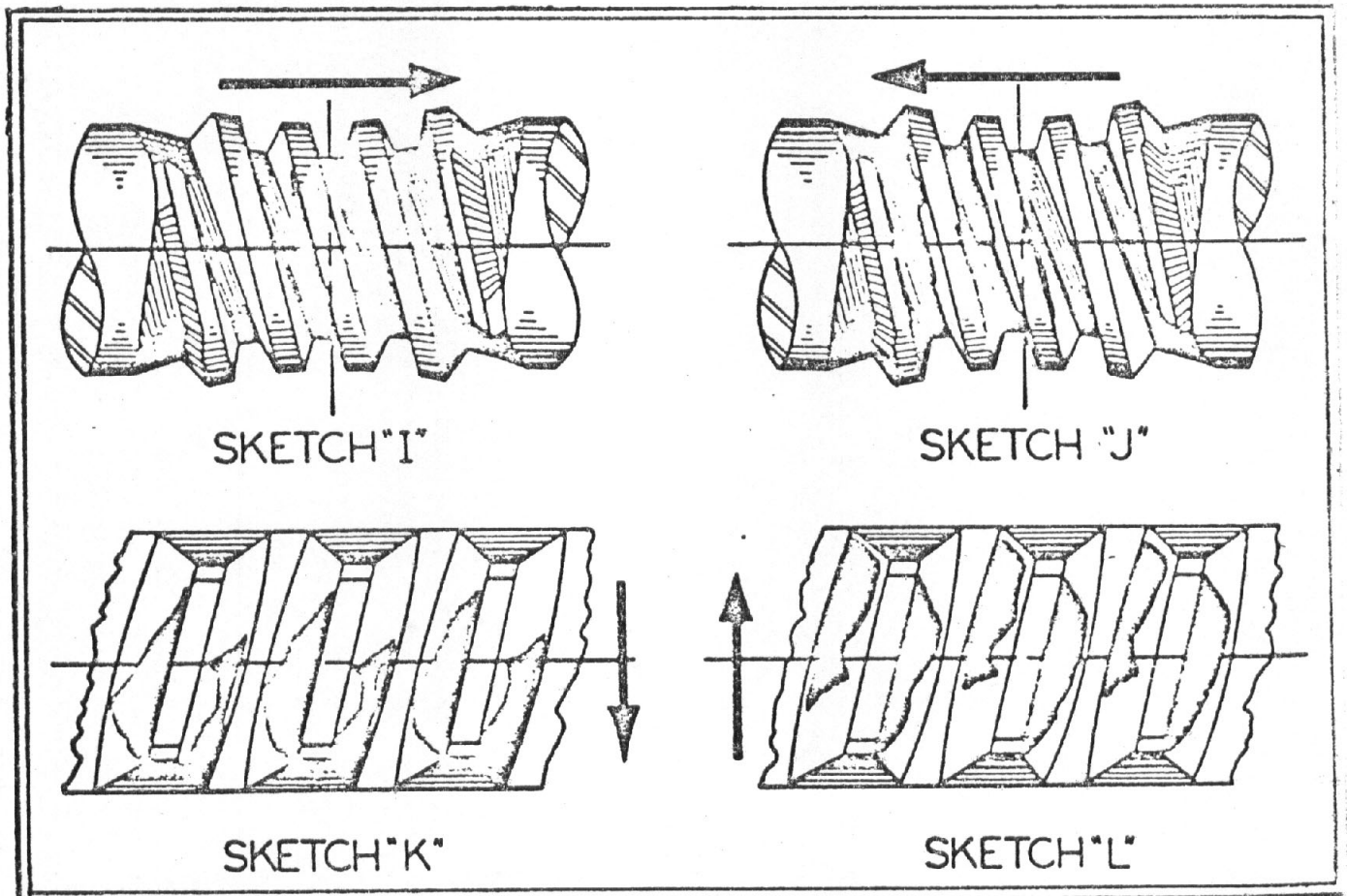
Continued

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

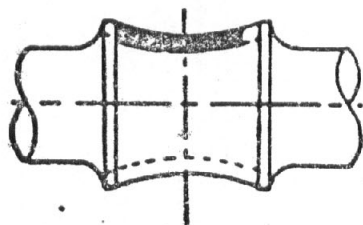
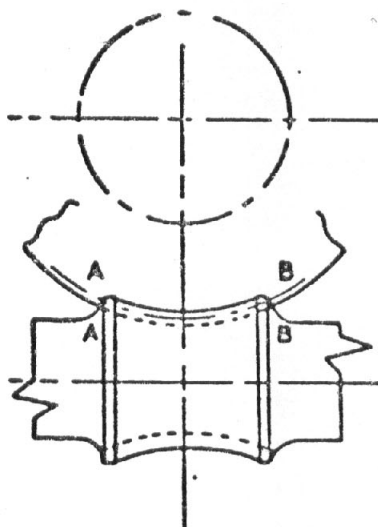
NOTE: When worm and gear are both symmetrical about their centerlines, caution should be exercised in assembling them in the housing to see that the letters "A" and "B" stamped on the gear coincide with the same letters on the worm shoulders as shown in Sketch "a-1".

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.









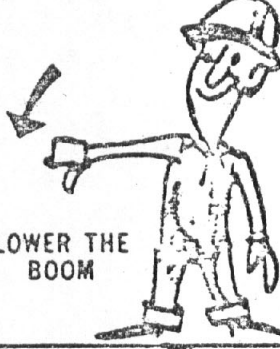







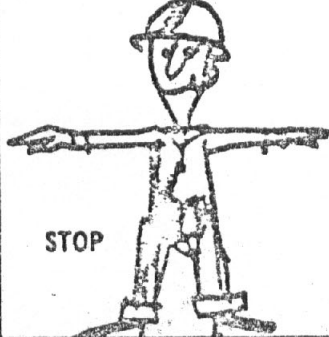
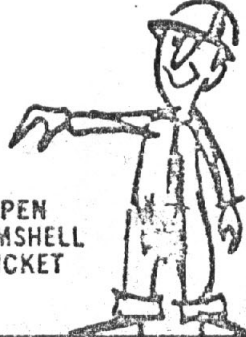



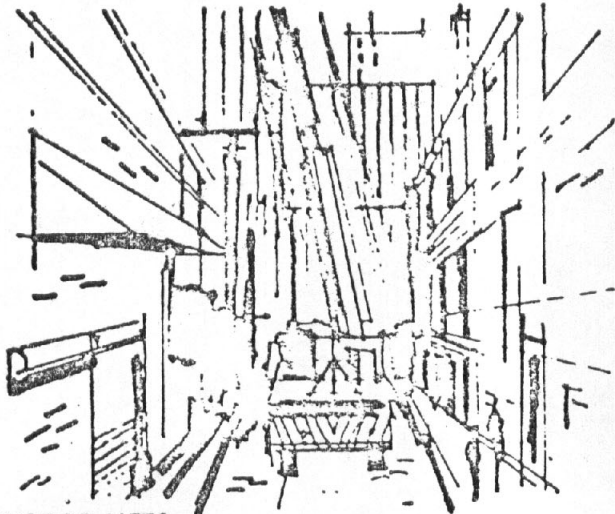
"M"-DRIVE
SIDE



"N"-COAST
SIDE

HAND SIGNALS

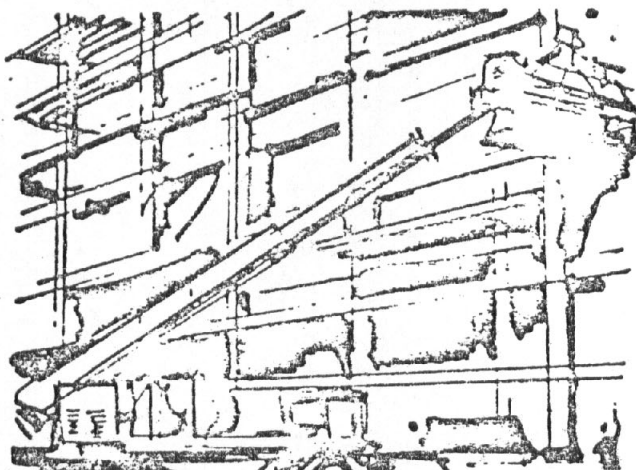
	 <p>RAISE THE LOAD</p>	 <p>RAISE THE LOAD SLOWLY</p>	 <p>LOWER THE LOAD</p>
 <p>LOWER THE LOAD SLOWLY</p>	 <p>RAISE THE BOOM</p>	 <p>RAISE THE BOOM SLOWLY</p>	 <p>RAISE THE BOOM AND HOLD THE LOAD</p>
 <p>RAISE THE BOOM AND LOWER THE LOAD</p>	 <p>LOWER THE BOOM</p>	 <p>LOWER THE BOOM SLOWLY</p>	 <p>LOWER THE BOOM AND HOLD THE LOAD</p>
 <p>LOWER THE BOOM AND RAISE THE LOAD</p>	 <p>SWING THE LOAD IN DIRECTION FINGER POINTS</p>	 <p>BOOM TELESCOPING OUT</p>	 <p>BOOM TELESCOPING IN</p>
 <p>DOG EVERYTHING</p>	 <p>STOP</p>	 <p>OPEN CLAMHELL BUCKET</p>	 <p>CLOSE CLAMHELL BUCKET</p>



INDOOR LIFTS OR WORKING IN CLOSE QUARTERS

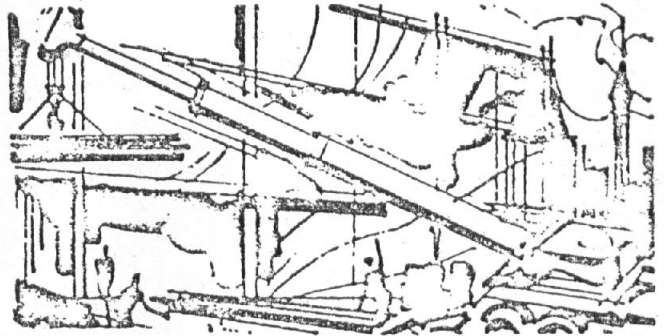
This is one of the main reasons you have a hydraulic crane. Its live boom gets into places stiff booms can't. By making good use of the boom telescoping and hoist actions, you will be able to perform your crane function anywhere your carrier can find space to stand.

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.



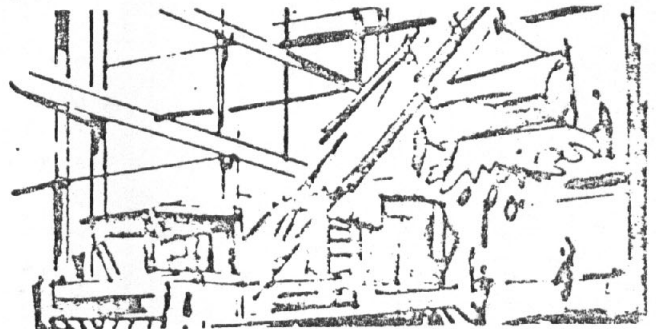
PLACING MACHINERY

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.



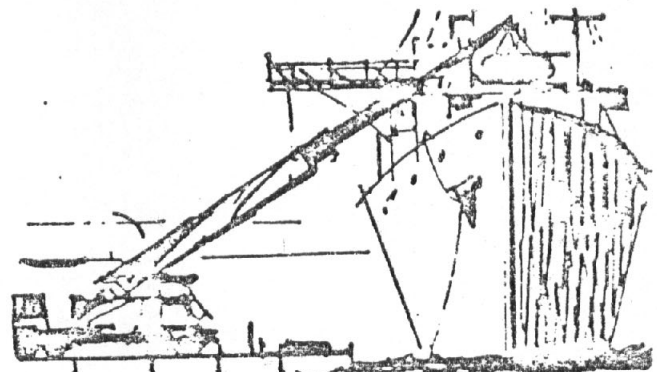
LIFTING STEEL

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.



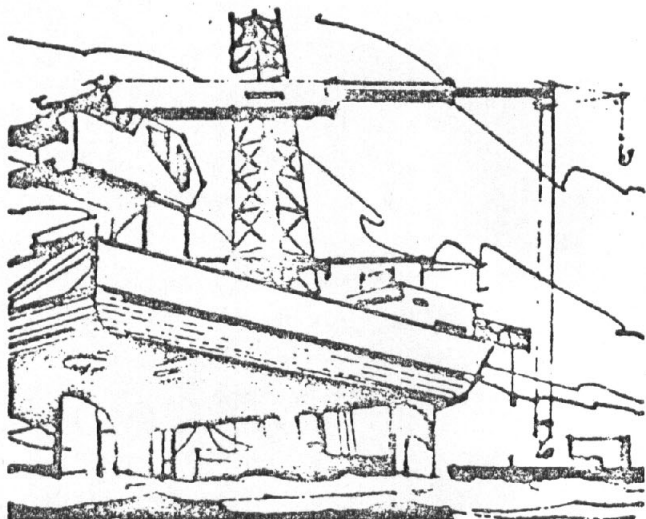
POURING CONCRETE

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.



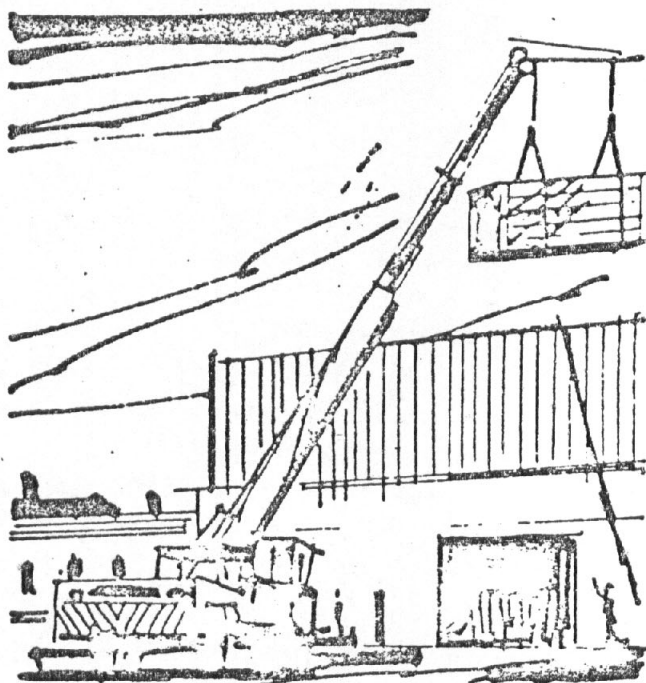
DOCK AND STEVEDORE OPERATIONS

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.



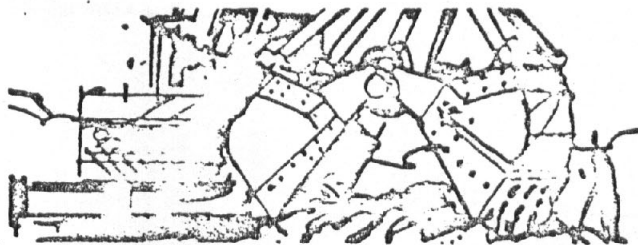
PEDESTAL CRANE

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.



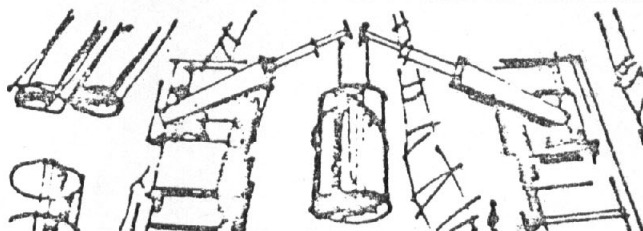
JIB AND FLY OPERATIONS

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.



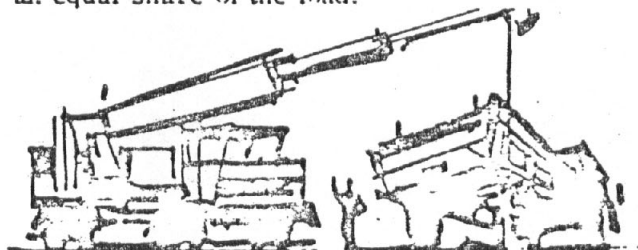
WORKING THE CLAMHELL

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.



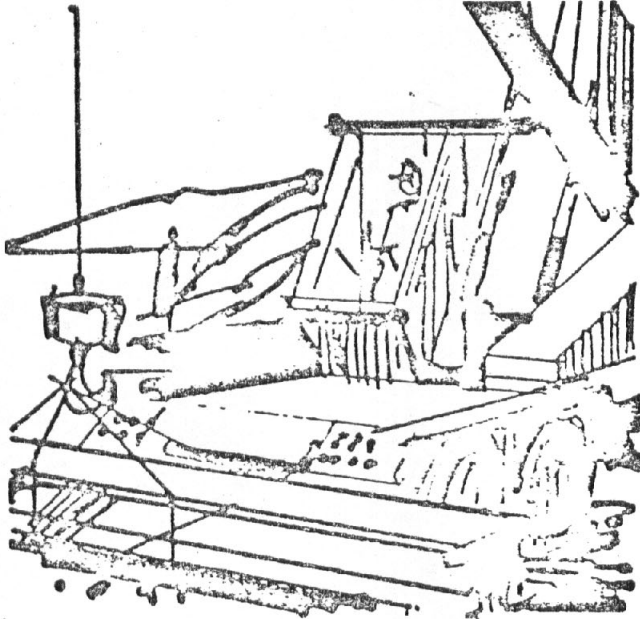
MAINTENANCE FUNCTIONS

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.

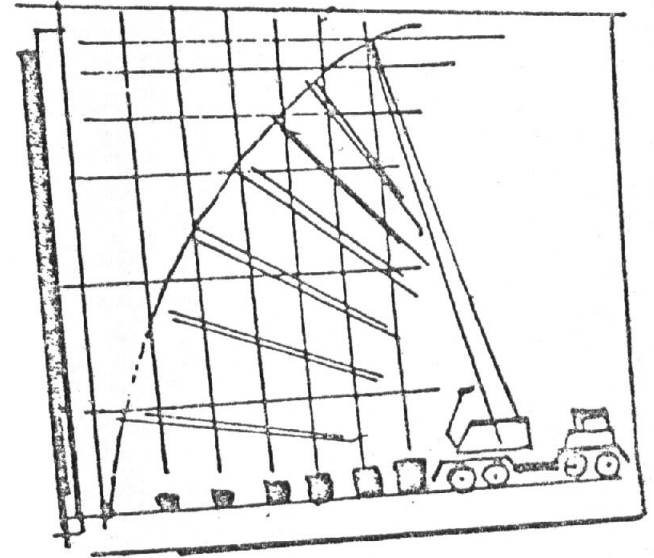
PART FIVE: SAFETY RULES ARE A MUST

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

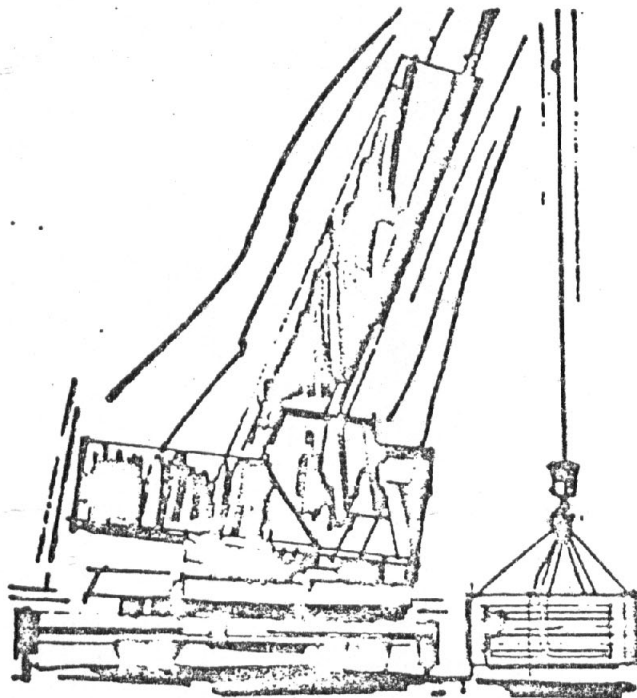
could be harmful to you, or to people working around you, if common sense and simple safety rules are not followed.



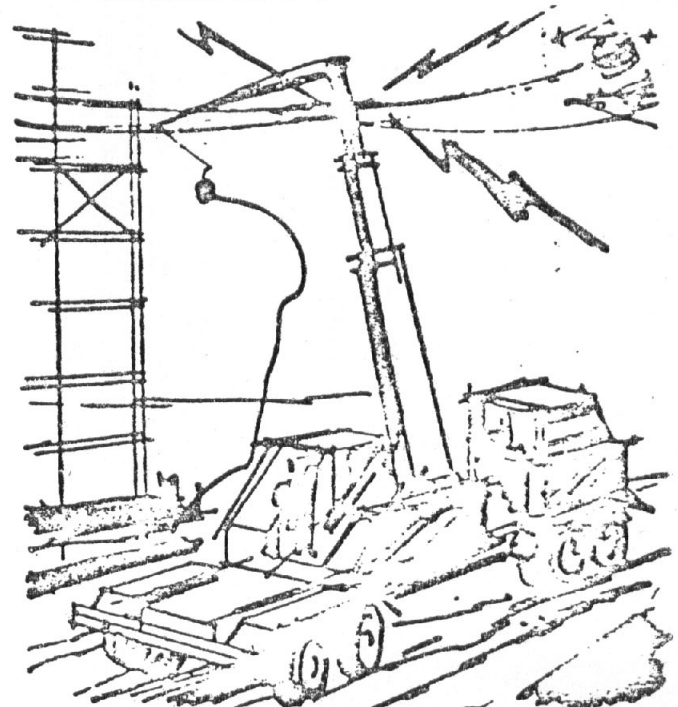
- 1** ALWAYS keep the load as near to the carrier and as close to the ground as possible.



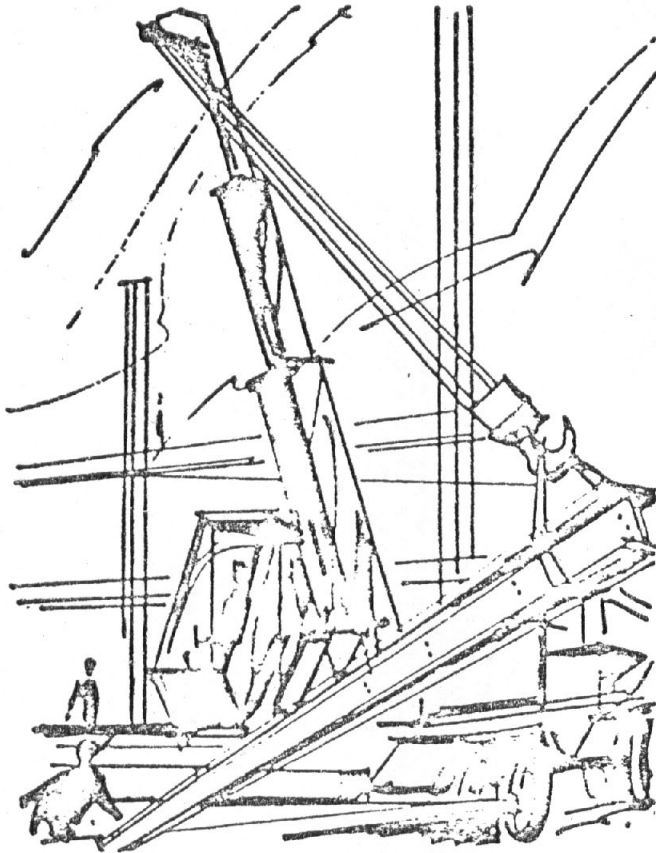
- 2** NEVER exceed the rated lift capacities shown on the load chart. ALWAYS determine the weight of the load and check the capacity chart to determine that the load can be lifted at the desired radius within the rated capacity of the machine.



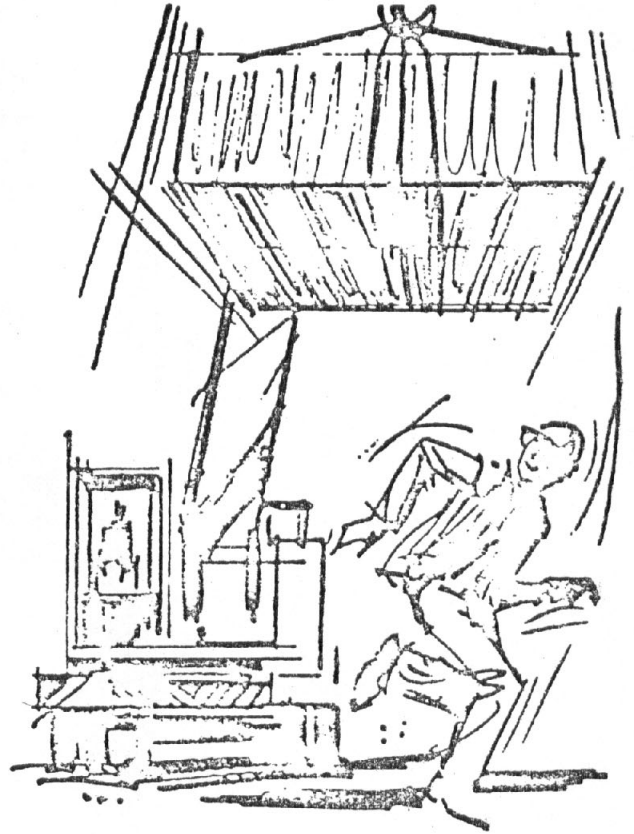
- 3** NEVER use stability of the machine to determine capacity. When you find out, it might be too late.



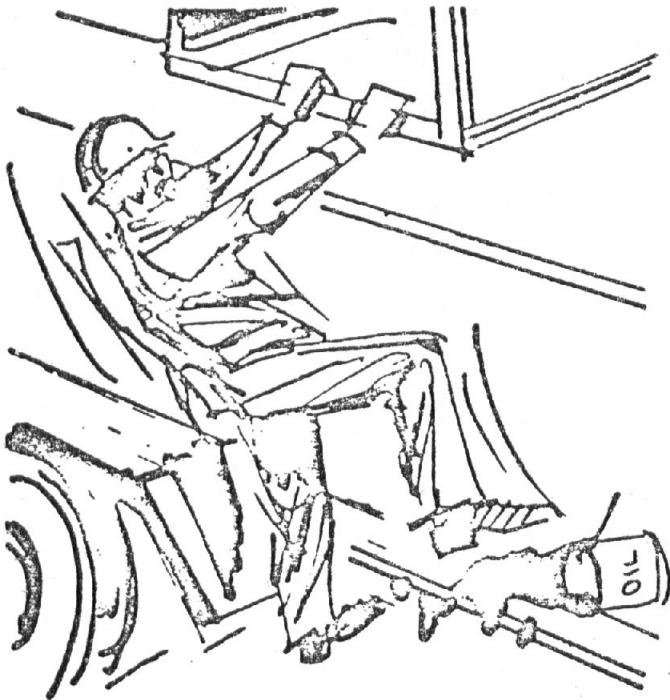
- 4** ALWAYS keep the boom and all parts of crane away from the electrical lines or equipment.



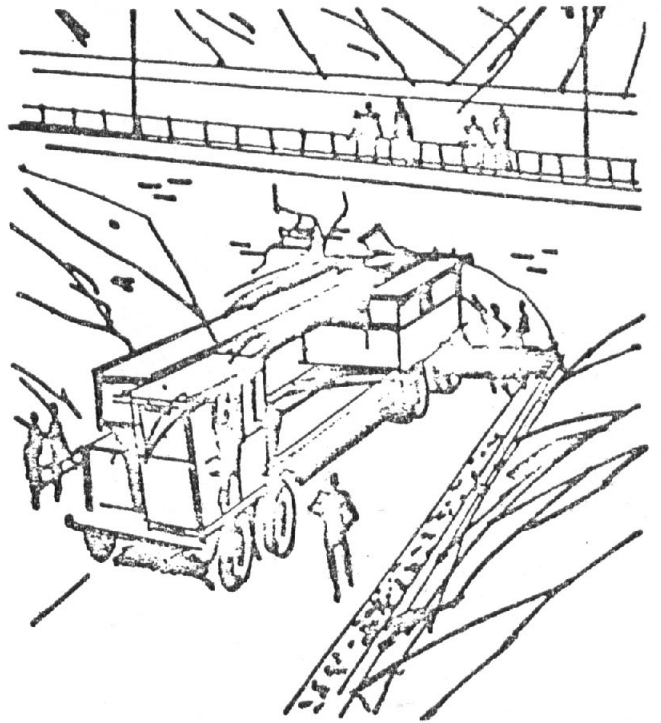
5 NEVER side-load the boom. It is for lifting only.



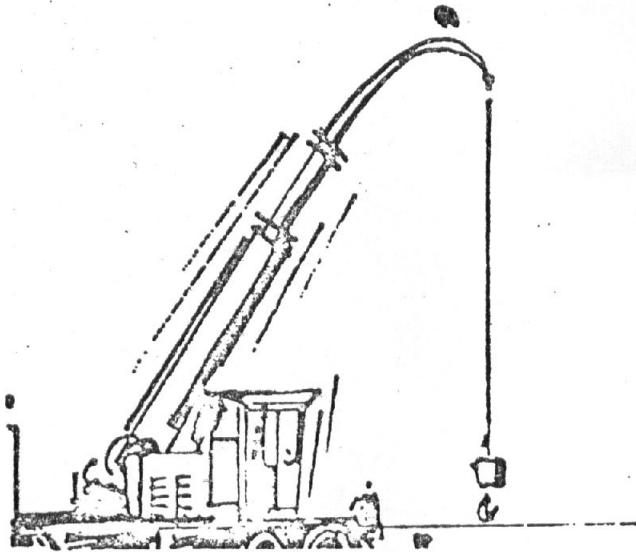
6 NEVER allow persons to stand or work under a load. Use tag lines for positioning loads.



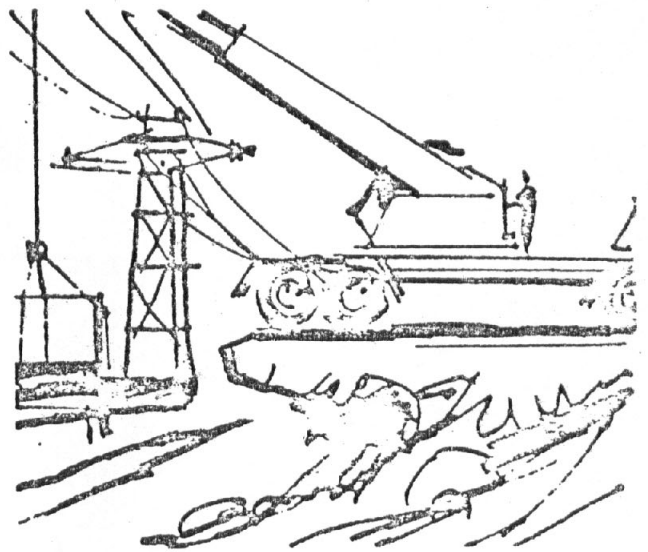
7 ALWAYS keep the machine clean and free from oil and grease at all times. Use the rule of two-hands at all times when climbing around the machine.



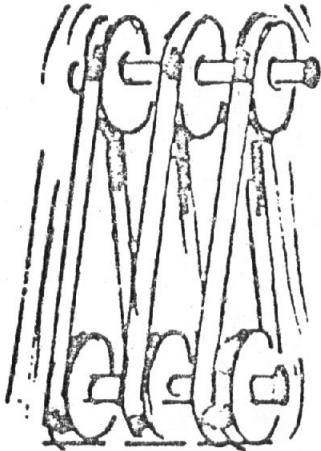
8 ALWAYS check height and width of clearances for traveling in your state. Check rated capacities of bridges. Check local restrictions covering axle weights.



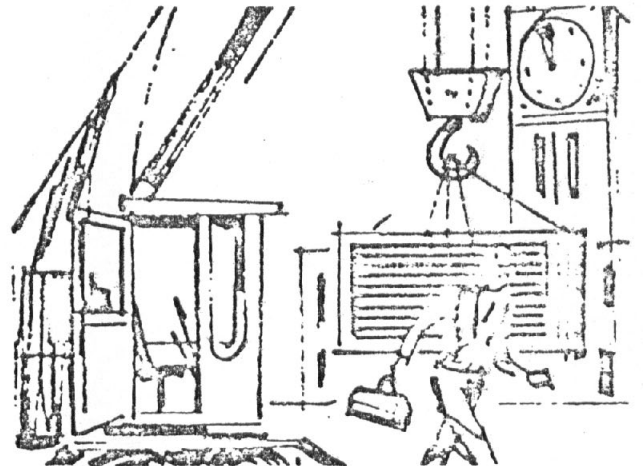
9 ALWAYS keep boom sections telescoped equally at all times for maximum boom strength. NEVER extend one section only leaving the other section retracted. Load charts are based on having equal boom sections.



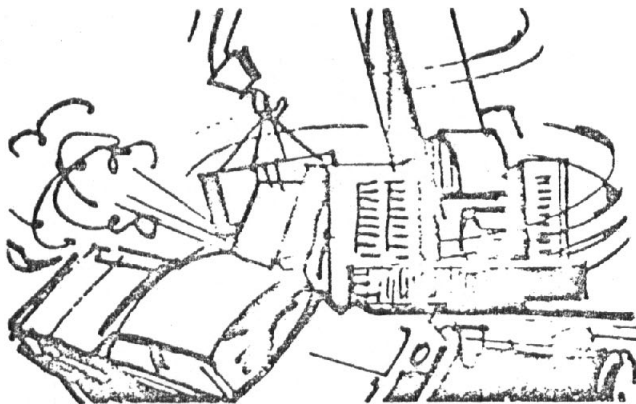
10 ALWAYS stay away from dangerous banks that might give away under you.



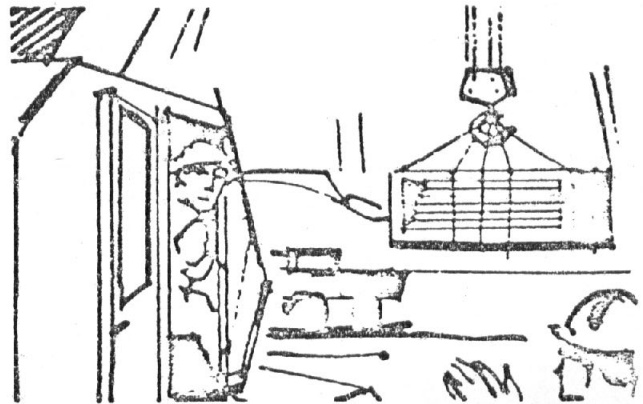
11 ALWAYS use sufficient parts of line for heavy lifts. DON'T take chances, use a good safety allowance.



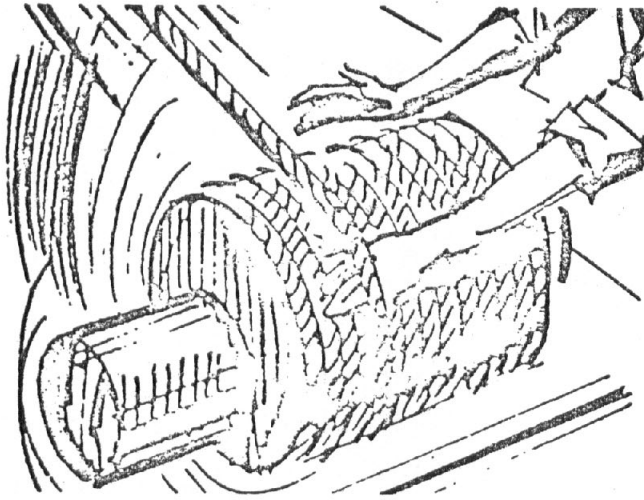
12 NEVER leave the machine with a load up in the air. If you must leave the crane place the load on the ground.



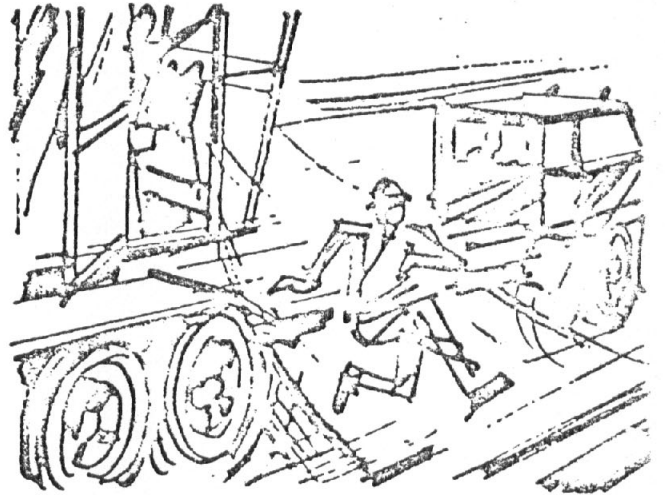
13 ALWAYS make sure you have enough clearance for tail swing of the upperstructure, especially if there are cars or people in the area.



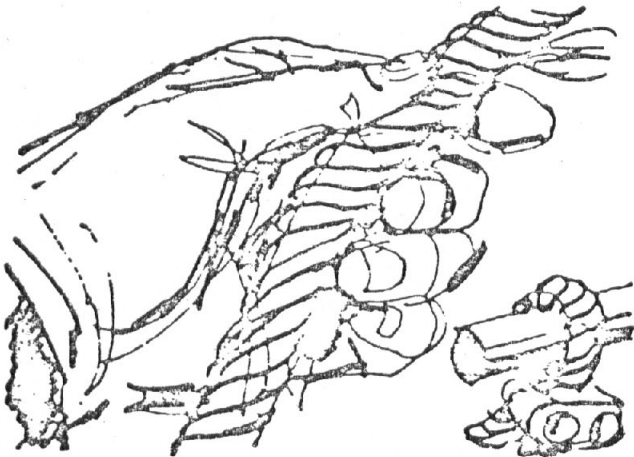
14 ALWAYS watch your load at all times. If you must look elsewhere, stop and hold the load still.



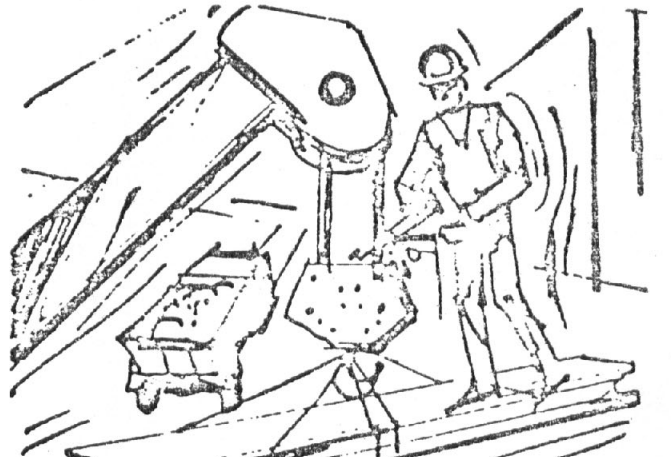
15 ALWAYS be careful to keep your hands away from cable drums, sheaves and pulleys. Replace all guards.



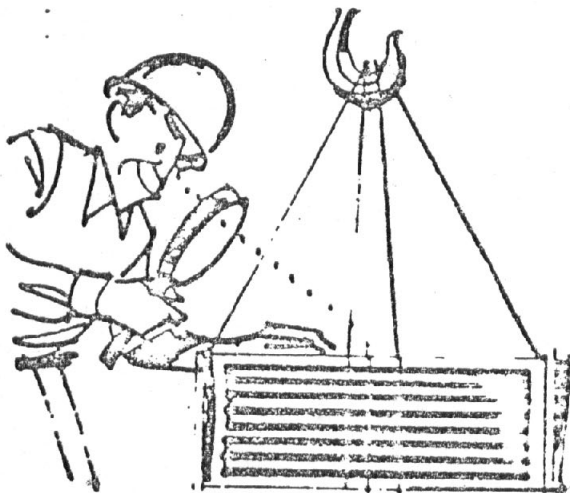
16 NEVER get on or off of a machine in motion.



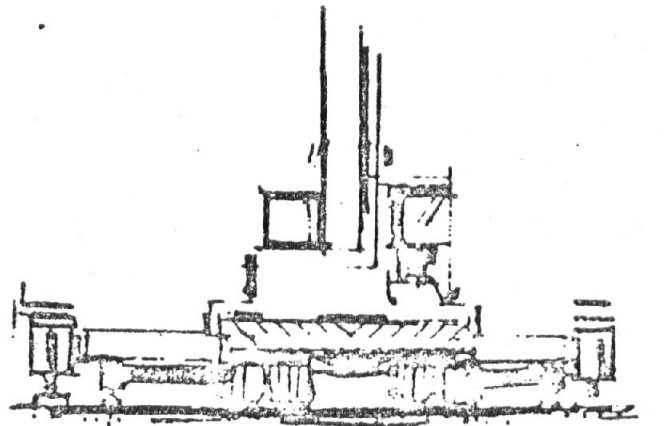
17 ALWAYS make regular inspections of the cables and replace worn, rusty or frayed cables. Inspect the cable clamps often.



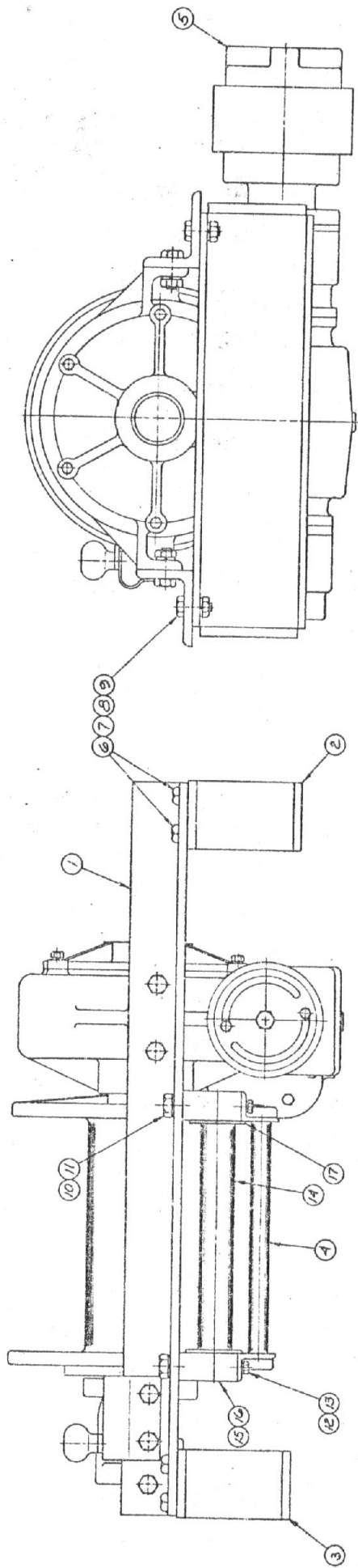
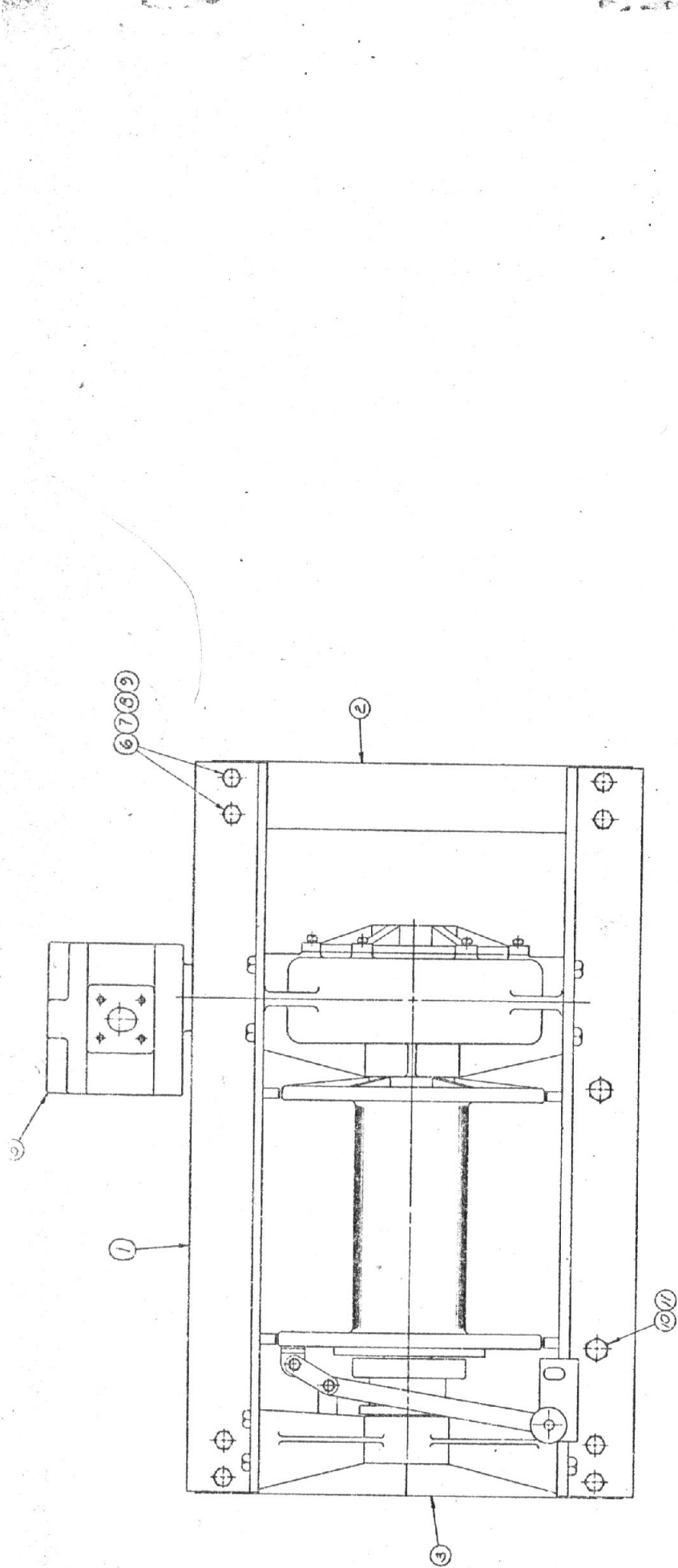
18 ALWAYS stop the crane with load on the ground and boom supported while lubricating or adjusting.



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.



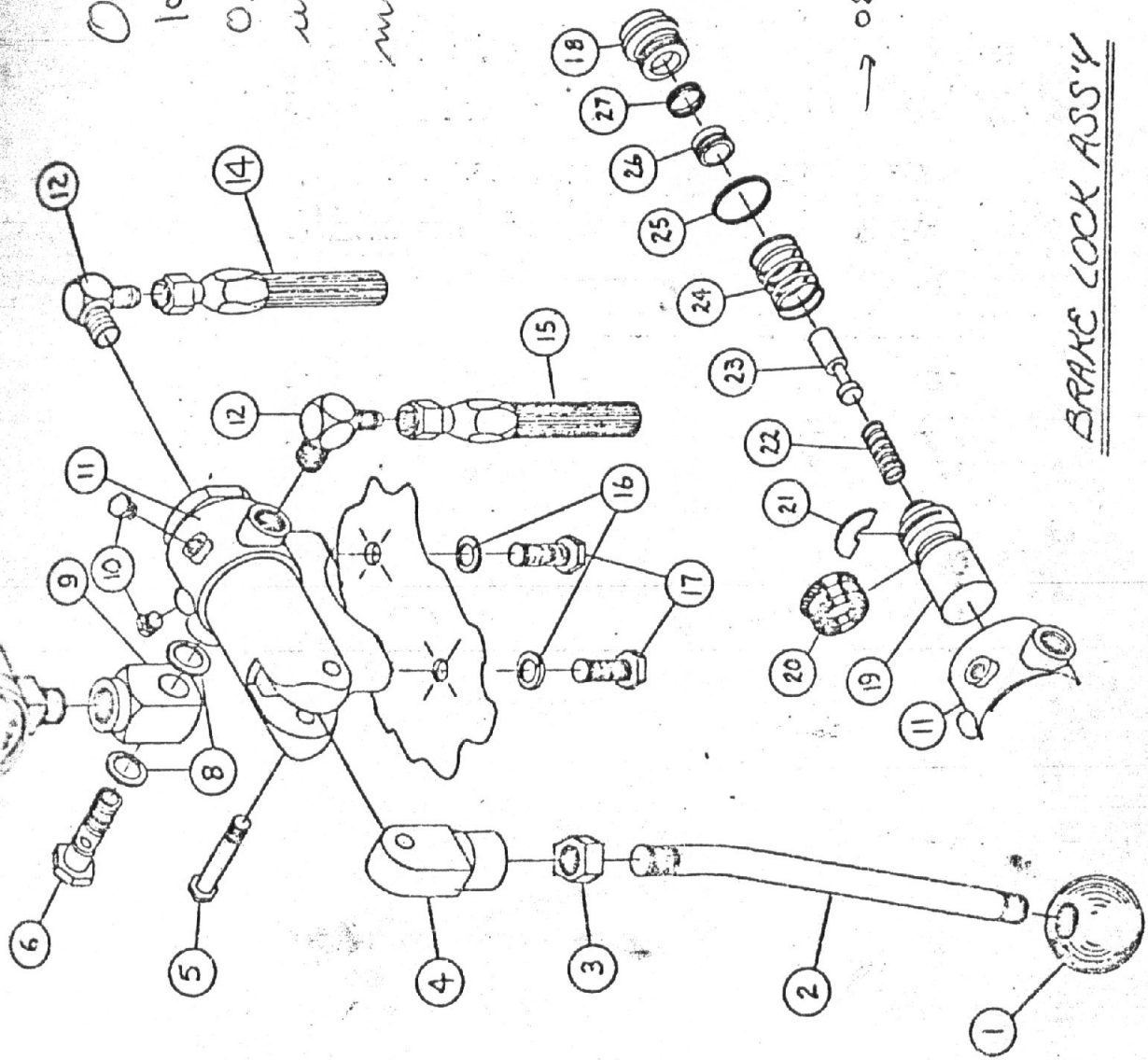
DECK WINCH ASSEMBLY
D-201-164

T (11) WITH UNDER MOUNTING

PLATE (2) , CHECK AND ASSEMBLE

REMOVAL OF TENSION ROD (1)

WITH COMPLETE AND REPLACEMENT



ORIGINAL TYPE
100-290
obsolete now
use new type!

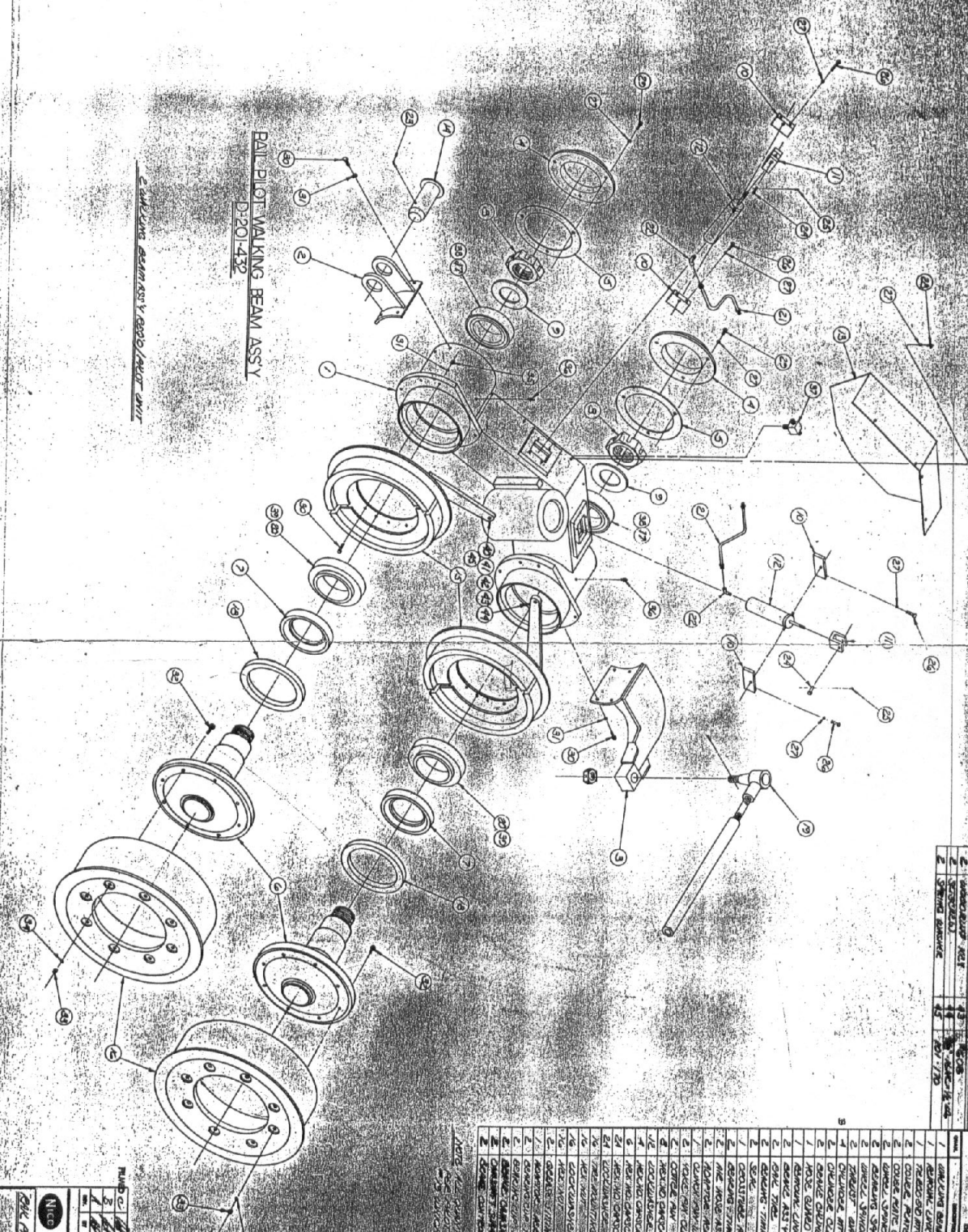
mounting is different
7-30-55
OK

Semi hub
6766

→ 02-640-008

BRAKE LOCK ASS'Y

ITEM	QUANTITY	UNIT	REMARKS
1	1	ASSEMBLY	
2	1	SCREW	
3	1	SCREW	
4	1	SCREW	
5	1	SCREW	
6	1	SCREW	
7	1	SCREW	
8	1	SCREW	
9	1	SCREW	
10	1	SCREW	
11	1	SCREW	
12	1	SCREW	
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97	1	SCREW	
98	1	SCREW	
99	1	SCREW	
100	1	SCREW	



BALL PILOT WALKING BEAM ASSY
D-201432

CALLING 858M ASSY 8820/AVIOR UNIT

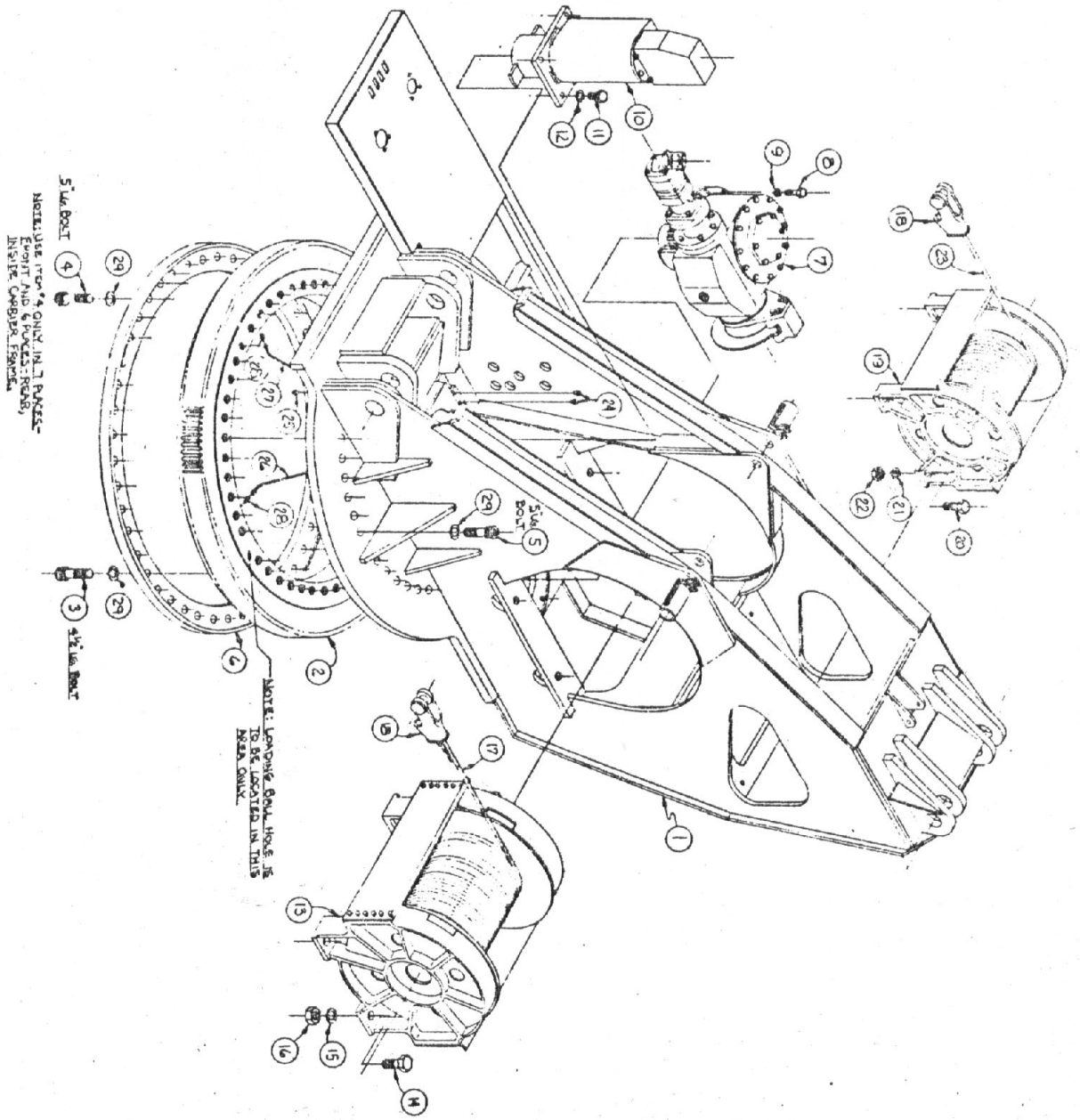
NOTE: ALL DIMENSIONS ARE TO BE OBSERVED UNLESS OTHERWISE SPECIFIED.

ITEM	DESCRIPTION	QTY	UNIT	REMARKS
1	WALKING BEAM ASSEMBLY	1	ASSEMBLY	
2	SCREW	1	SCREW	
3	SCREW	1	SCREW	
4	SCREW	1	SCREW	
5	SCREW	1	SCREW	
6	SCREW	1	SCREW	
7	SCREW	1	SCREW	
8	SCREW	1	SCREW	
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97	SCREW	1	SCREW	
98	SCREW	1	SCREW	
99	SCREW	1	SCREW	
100	SCREW	1	SCREW	

NATIONAL IRON COMPANY
 2100 W. 11th Street
 Des Moines, Iowa 50319
 PHONE: 515-281-1171
 FAX: 515-281-1172
 WWW: www.nationaliron.com

BALL PILOT WALKING BEAM ASSY
 D-201432-000

TURRET ASSEMBLY
 NO. b-200-905



TURRET ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

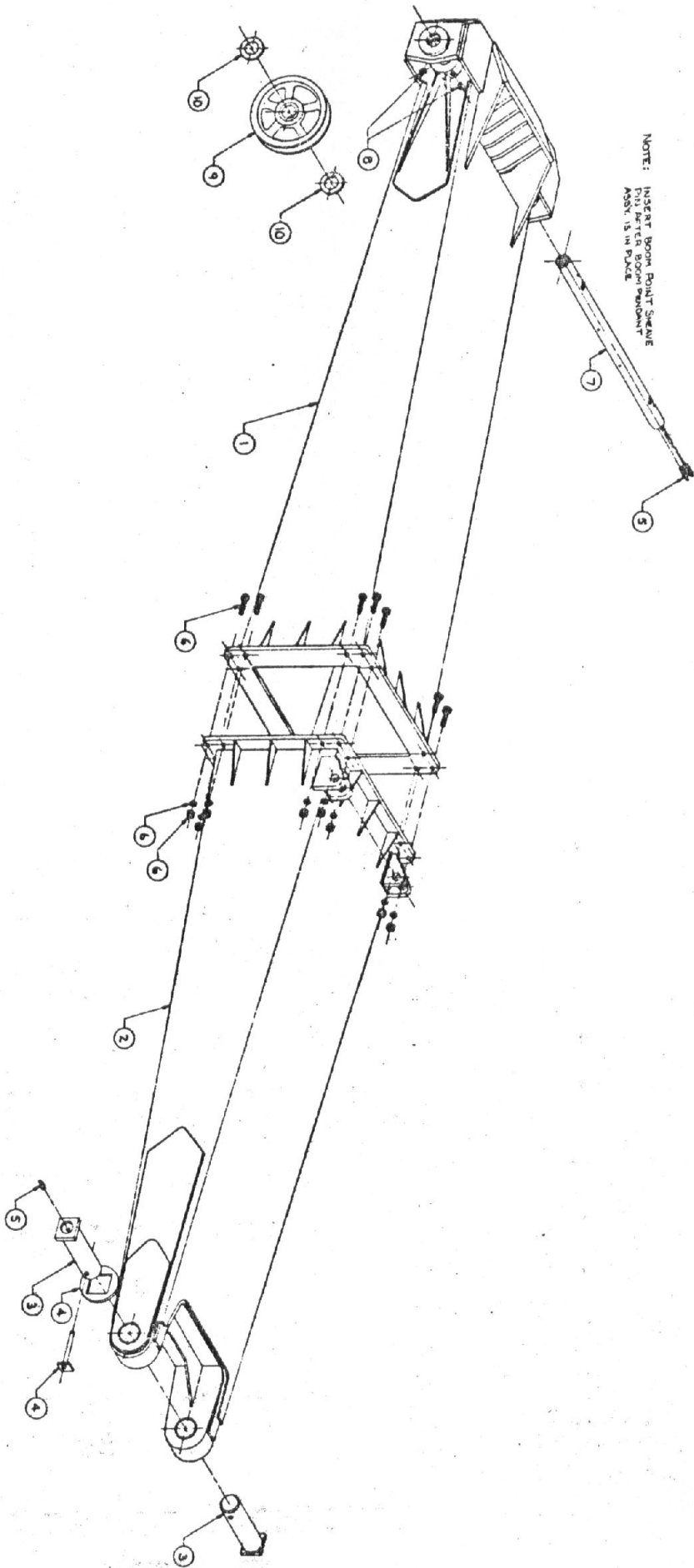
<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-863	TURRET WELDMENT	1
2	100-793	TURRET BEARING	1
3		LOWER TURRET BEARING BOLTS, 1-3/8" NC SOC HD CAPSCREW 4-1/2" LG	28
4		LOWER TURRET BEARING BOLTS 1-3/8" NC SOC HD CAPSCREW 5" LG	13
5		UPPER TURRET BEARING BOLTS 1-3/8" NC SOC HD CAPSCREW 5" LG	40
6	D-200-929	SLEWING BASE PLATE	1
7	D-200-915	SLEWING DRIVE UNIT	1
8		SLEWING DRIVE MTG BOLTS 5/8"-11 NC HEX HD CAPSCREW 2-1/2" LG	7
9		SLEWING DRIVE MTG LOCKWASHER	7
10	D-200-918	HYDRAULIC SWIVEL UNIT	1
11		HYDRAULIC SWIVEL NTG BOLTS 3/4"-11 NC HEX HD CAPSCREW 2-1/4" LG	4
12		HYDRAULIC SWIVEL NTG LOCKWASHER 3/4"	4
13	100-791	LOAD HOIST WINCH	1
14		LOAD HOIST WINCH MTG BOLT 1-3/8"-6 NC HEX HD CAPSCREW 4-1/2" LG	4
15		LOAD HOIST WINCH MTG LOCKWASHER 1-3/8"	4
16		LOAD HOIST WINCH MTG NUT 1-3/8"-6 NC	4
17	100-788	LOAD HOIST CABLE	1
18	100-790	BECKET	2
19	100-792	BOOM HOIST WINCH	1
20		BOOM HOIST WINCH MTG BOLTS 1"-8 NC HEX HD CAPSCREW 4" LG	4
21		BOOM HOIST WINCH MTG LOCKWASHER 1"	4

TURRET ASSEMBLY

FOR 100 TON RAILROAD WRECKING CRANE (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
22		BOOM HOIST WINCH MTG NUT 1"-8 NC HEX NUT	4
23	100-789	BOOM HOIST WINCH CABLE	1
24	100-003	GREASE FITTING	4
25	2021-2-4S	STRAIGHT MALE CONNECTOR	4
26	B-100-785	GREASE TUBE	2
27	B-100-784	GREASE TUBE	2
28	2021-4-4S	STRAIGHT MALE CONNECTOR	4
29		TURRET BEARING BOLT WASHER 1-3/8" HARD PLATE WASHER	81

BOOM ASSEMBLY
NO. D-200-906



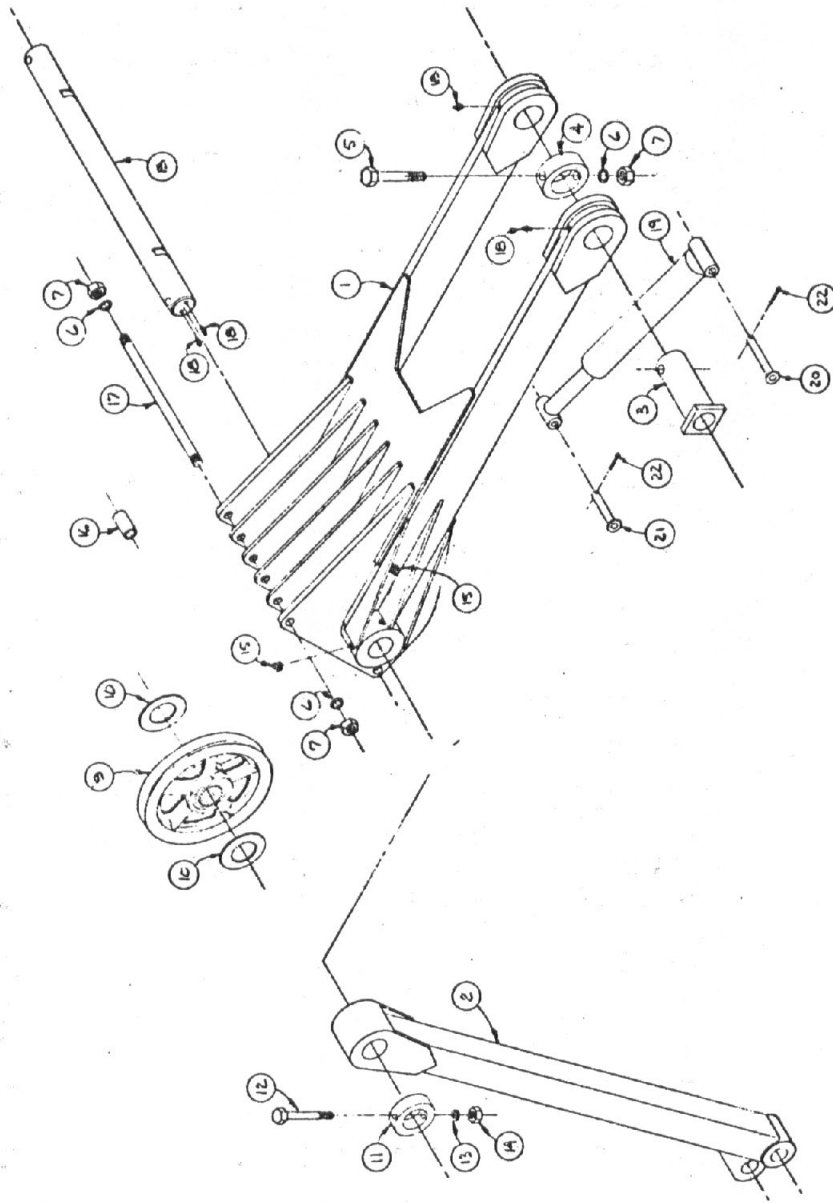
NOTE: INSERT BOOM POINT SWAGE
PIN AFTER BOOM PIVOTMENT
ASSY. IS IN PLACE

BOOM ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-864	UPPER BOOM WELDMENT	1
2	D-200-865	LOWER BOOM WELDMENT	1
3	B-100-771	BOOM PIVOT PIN	2
4	B-200-917	BOOM PIVOT PIN KEEPER	2
5		GREASE FITTING, 1/8" NPT	10
6		BOOM CONNECTING BOLTS, 1"-8 NC HEX HD CAPSCREW w/NUT & LOCKWASHER	12
7	B-100-768	BOOM POINT SHEAVE PIN	1
8		BOOM POINT SHEAVE PIN SETSCREW, 3/4-10 NC SOC HD SS CUP PT 1" LG	4
9	100-795	BOOM POINT SHEAVE	6
10	A-200-914	BOOM POINT SHEAVE THRUST WASHER	12

MOVABLE GANTRY ASSY

NO. D-200-908

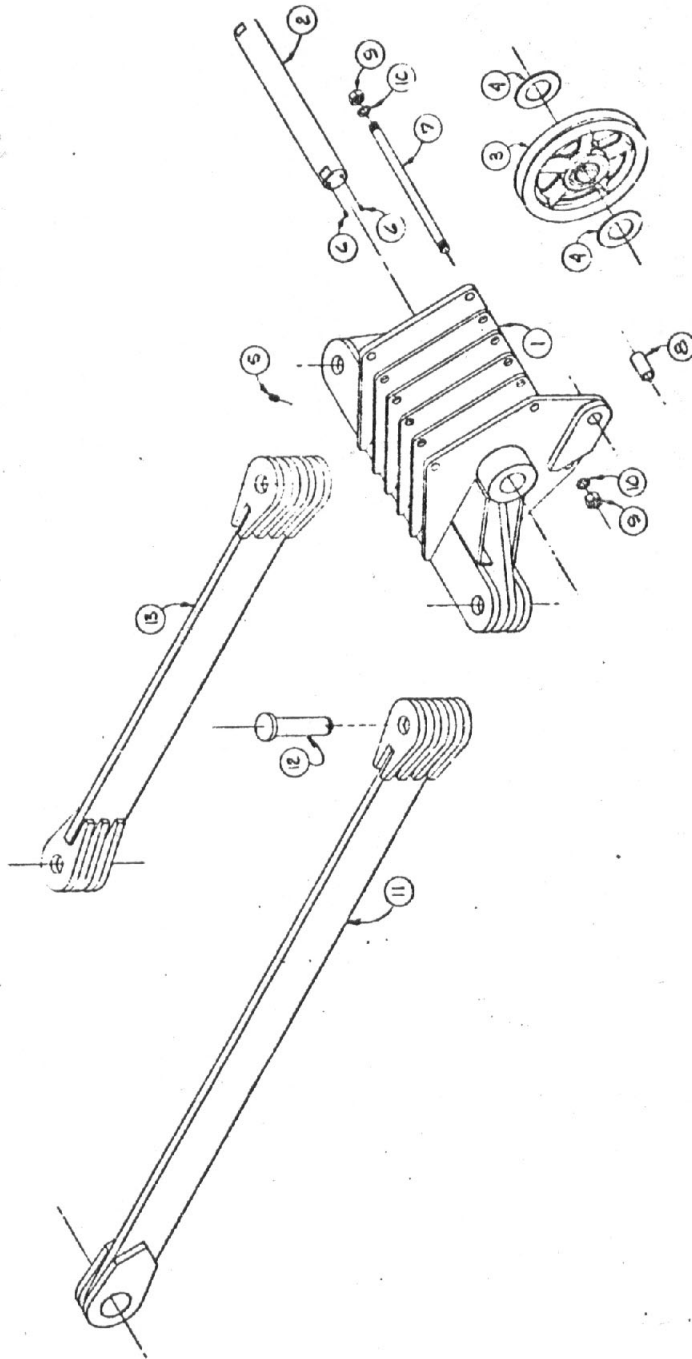


MOVEABLE GANTRY ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-866	MOVEABLE GANTRY WELDMENT	1
2	C-200-874	MOVEABLE GANTRY LEG WELDMENT	2
3	B-100-772	MOVEABLE GANTRY PIVOT PIN	2
4	A-200-921	MOVEABLE GANTRY PIVOT PIN KEEPER	2
5		MOVEABLE GANTRY PIVOT PIN KEEPER BOLT 3/4"-10 NC x 7-1/2" LG	2
6		MOVEABLE GANTRY PIVOT PIN KEEPER LOCKWASHER 3/4"	6
7		MOVEABLE GANTRY PIVOT PIN KEEPER NUT 3/4"-10 NC	6
8	B-100-770	MOVEABLE GANTRY SHEAVE PIN	1
9	100-794	MOVEABLE GANTRY SHEAVE <i>Johnton Dnk-18-20</i>	5
10	A-200-911	MOVEABLE GANTRY SHEAVE THRUST WASHER	10
11	A-200-920	MOVEABLE GANTRY SHEAVE PIN KEEPER	2
12		MOVEABLE GANTRY SHEAVE PIN KEEPER BOLT 5/8"-11 NC x 6" LG	2
13		MOVEABLE GANTRY SHEAVE PIN KEEPER LOCKWASHER 5/8"	2
14		MOVEABLE GANTRY SHEAVE PIN KEEPER NUT 5/8"	2
15		MOVEABLE GANTRY SHEAVE PIN KEEPER SETScrew 3/4"-10 NC SOC HD CAPSCREW	4
16	D-200-866-10	SPACER	10
17	D-200-866-11	STUD	2
18	100-003	GREASE FITTING	7
19	100-931	MOVEABLE GANTRY LIFT CYLINDER	1
20	B-201-100	LOWER GANTRY LIFT CYLINDER PIN	1
21	B-201-100	UPPER GANTRY LIFT CYLINDER PIN	1
22		CYLINDER PIN COTTER, 1/8" x 2" LG	1

BOOM PENDANT ASSEMBLY

D-201-048

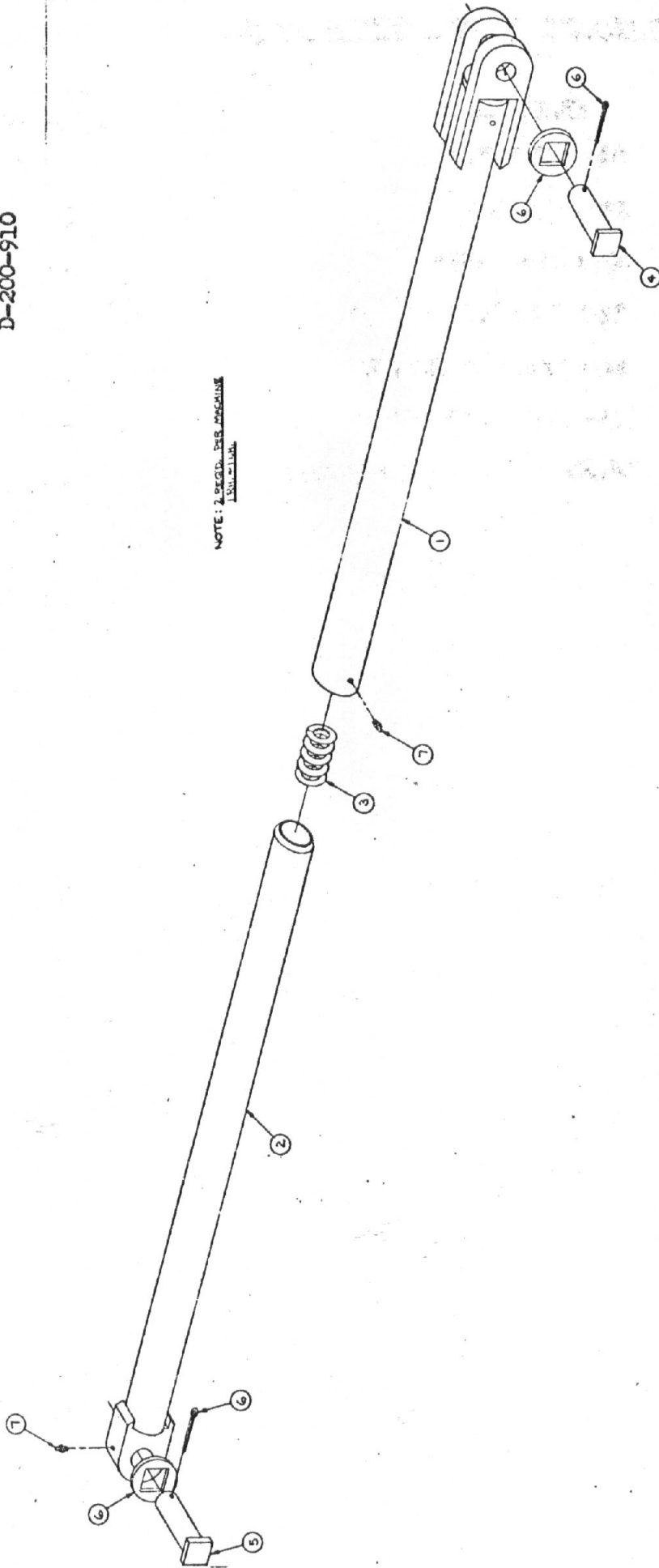


BOOM PENDANT ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-201-044	PENDANT WEIDMENT	1
2	B-100-769	PENDANT SHEAVE PIN	1
3	100-794	PENDANT SHEAVE	5
4	A-200-911	PENDANT SHEAVE THRUST WASHER	10
5		PENDANT SHEAVE PIN SETSCREW, 3/4"-10 NC x 1" LG, SOC HD CAPSCREW	4
6	100-003	GREASE FITTING	5
7	D-201-044-11	TIE STUD	3
8	D-201-044-10	SPACERS	15
9		NUT, 3/4"-10 NC	6
10		LOCKWASHER, 3/4"	6
11	C-201-045	MAIN PENDANT LINK	2
12		MAIN PENDANT LINK PIN	2
13	C-201-046	PENDANT LINK EXTENSION	2 OPT.

BOOM STOP ASSEMBLY

D-200-910



NOTE: 2. CHECK THE MACHINE
MANUAL

BOOM STOP

FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-879	BOOM STOP BASE	1
2	D-200-879	BOOM STOP ROD	1
3	100-796	BOOM STOP SPRING	1
4	B-200-923	BOOM STOP BASE END PIN	1
5	B-200-924	BOOM STOP ROD END PIN	1
6	B-200-925	BOOM STOP PIVOT PIN KEEPER	2
7	100-003	GREASE FITTING ALEMITE 1610	2

SLEWING GEARCASE ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-915	SLEWING GEARCASE ASSEMBLY	1
2	D-201-003	CONE DRIVE HOUSING	1
3	C-100-866	CONE DRIVE GEAR	1
4	B-100-867	WORM GEAR	1
5	C-201-015	WORM DRIVE PINION SHAFT	1
6	100-899	NEEDLE BEARING - TORRINGTON	1
7	100-005	SNAP RING	1
8	100-926	SNAP RING	1
9	B-100-886	SLEWING PINION GEAR	1
10		ROLLER BEARING - TIMKEN	1
11		ROLLER BEARING - TIMKEN	1
12		BEARING - TIMKEN	1
13	D-200-916	LOWER BEARING SUPPORT	1
14	100-892	OIL SEAL	1
15	100-893	OIL SEAL	1
16	A-201-053	BRASS BEARING <i>D-200-876</i>	1
17	100-891	ROLLER BEARING - ROLLWAY	1
18	D-201-004	SLEWING MOTOR ADAPTOR	1
19	100-114	SHIM	AR
20	D-200-877	SLEWING BRAKE MOUNT	1
21	B-200-990	DRIVE COUPLING	1
22	<u>D-200-876</u>	<u>SLEWING BRAKE DISC</u> 16t	1
23	B-28015	BEARING RETAINER	1
24	B-201-008	OIL SEAL RETAINER	1
25	B-201-009	CONE DRIVE HOUSING BEARING CAP	1

SLEWING GEARCASE ASSEMBLY

FOR 100 TON RAILROAD WRECKING CRANE (CONTINUED)

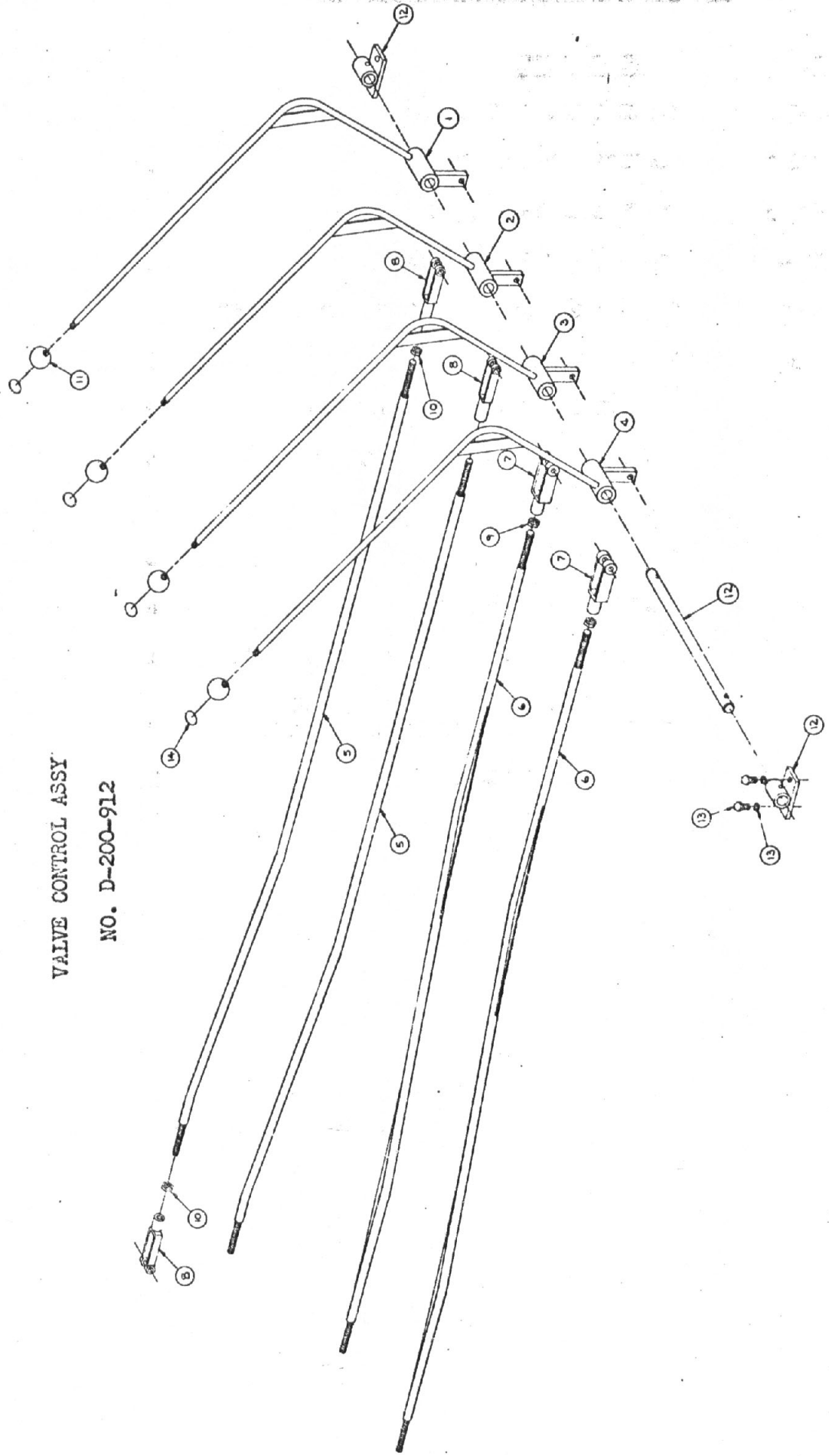
<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
26	C-28000	CONE DRIVE HOUSING COVER	1
27	B-201-026	BEARING SUPPORT COVER	1
28	A-201-005	SLEWING DRIVE SHAFT SPACER	1
29		1/2"-13 NC HHCS x 1-3/4" IG	2
30	100-896	SLEWING MOTOR	1
31	100-124	LOCKWASHER	1
32	100-123	LOCKNUT	1
33	B-201-055	SPACER	1
34	B-201-056	SPACER	1
35	A-201-054	SLEWING BEARING SUPPORT DAM	1
36	100-115	SHIM	AR
37		KEY	1
38		KEY	1
39	100-116	SHIM	AR
40	A-23758-A	CONE DRIVE HOUSING GASKET	1
41	100-122	BREATHER FILTER	1
42		90° 3/8" STREET ELBOW	1
43		1" x 3/8" REDUCER BUSHING	1
44	A-23742-1	INSPECTION PLATE	1
45		1/2" STANDARD PIPE PLUG	1
46	100-286	DISC BRAKE ASSEMBLY	1
47	A-23743	INSPECTION PLATE GASKET	1
48	100-117	SHIM	AR
49	100-118	SHIM	AR
50	100-119	SHIM	AR

SLEWING GEARCASE ASSEMBLYFOR 100 TON RAILROAD WRECKING CRANE (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
51	100-111	SHIM	AR
52	100-112	SHIM	AR
53	100-113	SHIM	AR
54	A-201-120	SLEWING MOTOR GASKET	1
55	A-201-121	SLEWING MOTOR ADAPTOR GASKET	1
56		KEY	1
57		5/8"-11 NC HHCS 1-1/2" LG w/LOCKWASHER	24
58		5/8"-11 NC HHCS 2" LG w/LOCKWASHER	4
59		5/8"-11 NC HHCS 2-1/2" LG w/LOCKWASHER	6
60		5/8"-11 NC HHCS 2-1/4" LG w/LOCKWASHER	6
61		1/4"-20 NC HHCS 5/8" LG w/LOCKWASHER	4
62		1/4"-20 NC HHCS 1/2" LG w/LOCKWASHER	2

VALVE CONTROL ASSY

NO. D-200-912

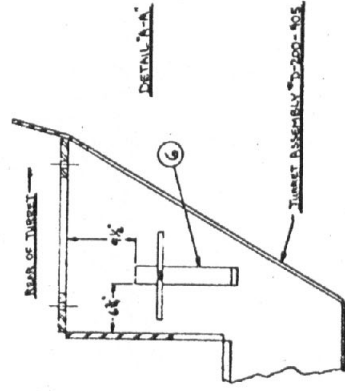
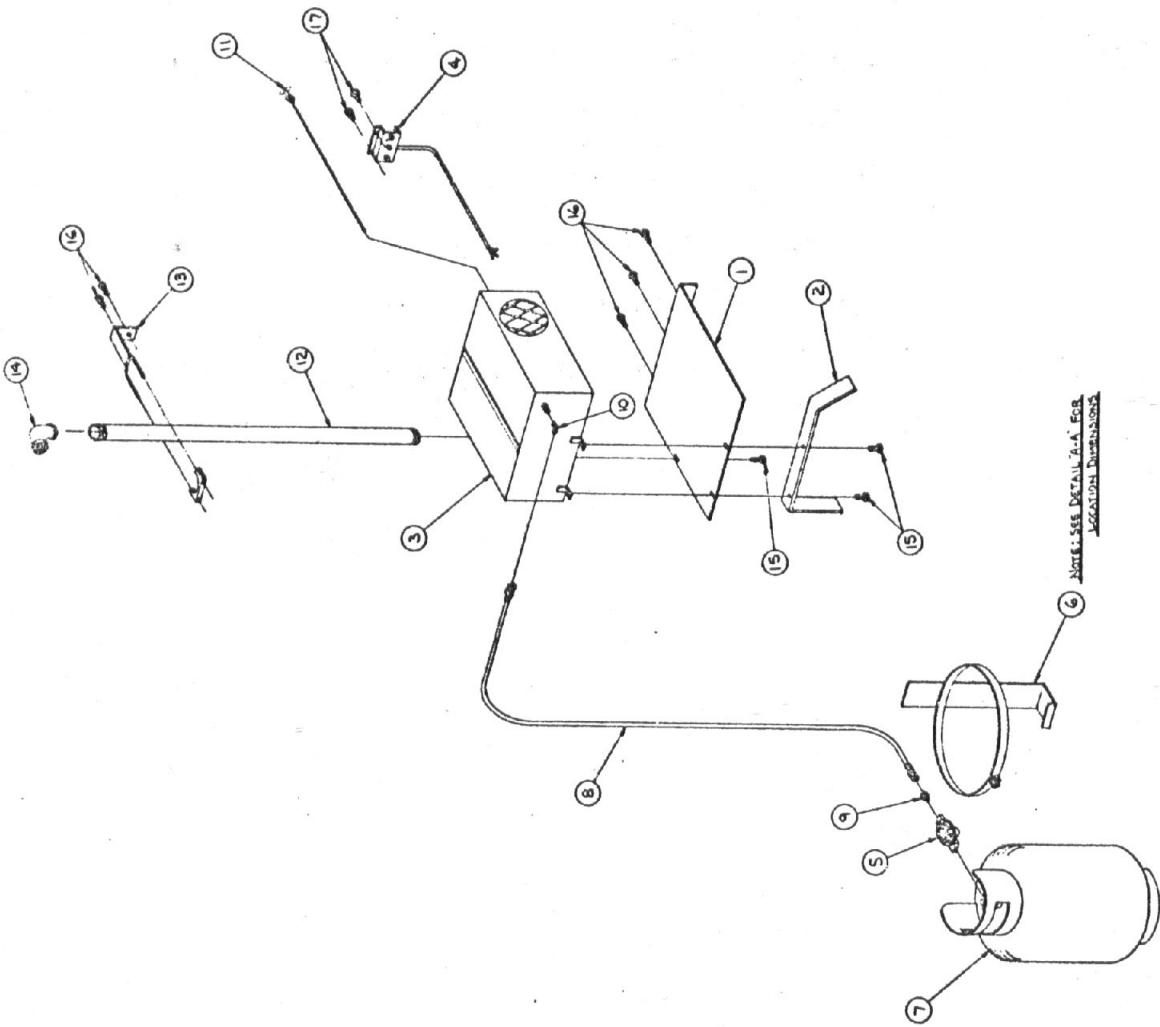


VALVE CONTROL ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-892-2	CONTROL LEVER WELDMENT	1
2	D-200-892-1	CONTROL LEVER WELDMENT	1
3	D-200-892-3	CONTROL LEVER WELDMENT	1
4	D-200-892-4	CONTROL LEVER WELDMENT	1
5	B-200-868	SWING AND DECK WINCH VALVE CONTROL ROD	2
6	B-200-873	BOOM HOIST AND LIFT WINCH CONTROL ROD	2
7	2708-6A	ADJ CLEVIS 5/8-18 NF w/CLEVIS PINS	2
8	2708-7B	ADJ CLEVIS -1/2-20 NF w/CLEVIS PINS	6
9		5/8-18 NF NUT	2
10		1/2-20 NF NUT	6
11	A-34044-1	CONTROL LEVER KNOBS	4
12	B-200-903	VALVE CONTROL LEVER PIVOT SHAFT ASS'Y	1
13		PIVOT SHAFT MTG BOLTS 3/8"-16 NC HEX HD CAPSCREW, 3/4" LG w/LOCKWASHER	2
14	A-200-650	CONROL HANDLE DECAL	1

HEATER INSTALLATION ASSY

D-201-163



NOTE: SEE DETAIL A.A. FOR
DIMENSIONAL DIMENSIONS

HEATER INSTALLATION ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	B-200-993	HEATER MOUNTING PLATE	1
2	B-200-994	HEATER MOUNTING PLATE BRACKET	1
3	100-517	HEATER - HUNTER #UH-47-6	1
4		HEATER CONTROL (PART OF 100-517)	1
5		REGULATOR (PART OF 100-517)	1
6	100-548	LP GAS BOTTLE BRACKET	1
7	100-549	20 LB. LP GAS BOTTLE	1
8	100-972	HOSE ASSEMBLY	1
9	2021-4-6S	STRAIGHT MALE CONNECTOR	1
10	2024-2-6S	90° MALE CONNECTOR	1
11	100-426	CONTROL CABLE	1
12		1-1/4" SCD 40 PIPE x 59" LG	1
13	B-200-336	EXHAUST PIPE MOUNTING BRACKET	1
14		1-1/4" 90° NPT SCD 40 ELBOW	1
15		1/4"-20 NC x 3/4" LG w/NUT & LOCKWASHER	3
16		5/16"-18 NC x 3/4" LG w/NUT & LOCKWASHER	5
17		#10-24 NC x 1/2" LG w/NUT & LOCKWASHER	2

Windshield Wipers for Crane Cab

Motor WC 19612

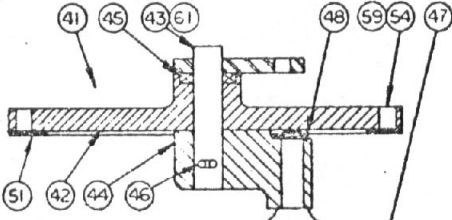
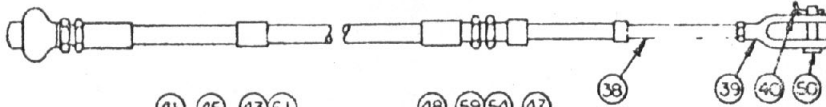
ARM LE-721156

Blade BD-721020-14

2 PUMP GEARCASE ASSY

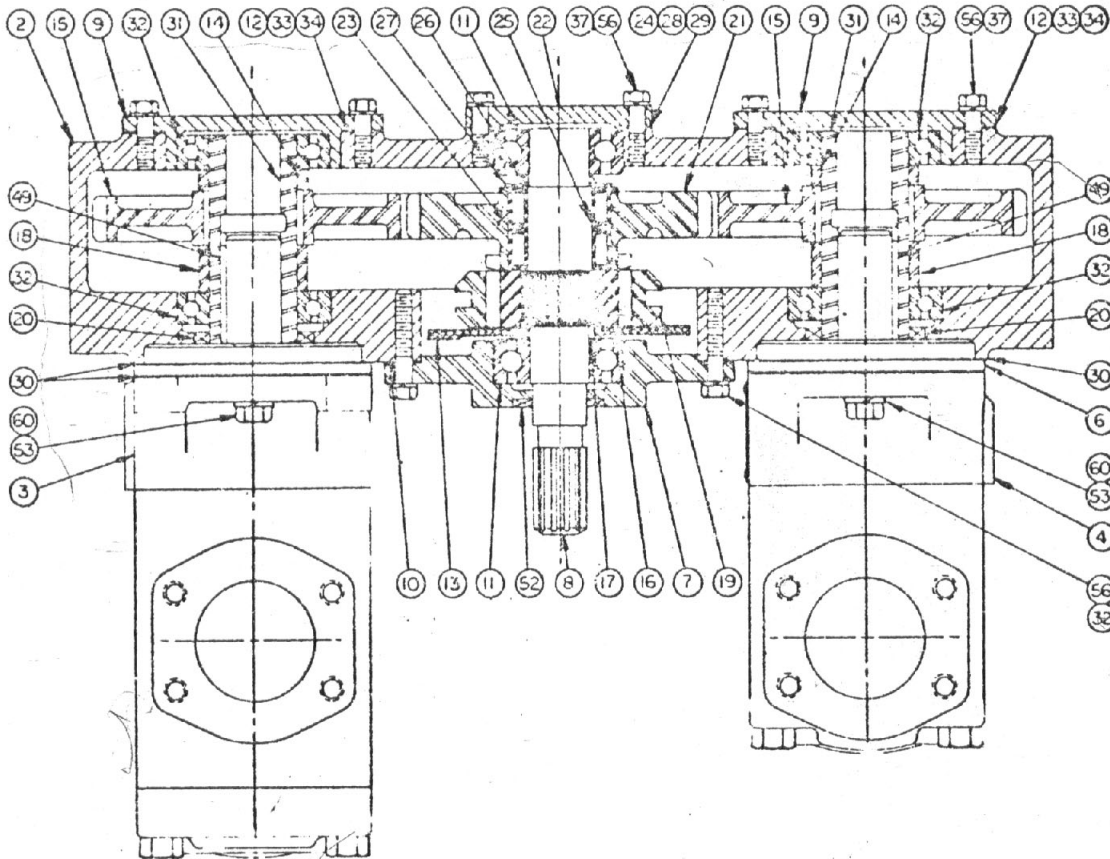
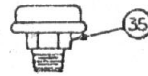
NO. C-201-039

CONTROL CABLE ASSMBLY



SHIFT COVER FORK ASSY

AIR VENT



2 PUMP GEARCASE ASSEMBLY

100 TON RAILROAD WRECKING CRANE

3715
1682.00
- 10%

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	C-201-039	GEAR CASE ASSEMBLY	1
2	D-200-066	GEAR CASE	1
3	100-876	PUMP 4535 VQ 60A 38-10 cc-20L - 15802	1
4	100-877	PUMP 45VQ 60A-1C-20L	1
5	B-201-118	CABLE MNTG BRKT	1
6	A-200-770	PUMP SPACER	2
7	B-24714-1	INPUT SHAFT COVER	1
8	B-200-820	INPUT SHAFT 218.70.	1
9	B-24720-1	BEARING CAP	2
10	A-24773-3	COVER GASKET	1
11	100-153	BEARING 1307	1
12	A-24773-2	BEARING CAP GASKET	2
13	B-25165-1	OIL SLINGER	1
14	A-24770-1	BEARING SPACER	2
15	100-185	GEAR 50 TOOTH	2
16	100-179	SHIFTING COLLAR HUB	1
17	A-24769-1	INPUT SHAFT KEY	1
18	A-24770-2	BEARING SPACER	2
19	100-180	SHIFTING COLLAR 24501-4	1
20	100-154	OIL SEAL → Rom # 20547	2 CR 19657
21	100-181	GEAR 41 TOOTH	1
22	A-24735-1	BEARING COVER	1
23	100-183	BEARING	1
24	A-24773-1	BEARING COVER GASKET	1
25	100-182	BEARING SLEEVE 24501-13	1

2129.22
1778.12

2544.

1587.00

2 PUMP GEARCASE ASSEMBLY100 TON RAILROAD WRECKING CRANE (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
26	A-24768-1	BEARING SPACER	1
27	A-24666-1	HARDENED WASHER	1
28	A-24766-1	SHIM 1/64"	AR
29	A-24766-2	SHIM 1/32"	AR
30	A-24772-1	PUMP GASKET	4
31	B-24636-2	PUMP SHAFT	2
32	100-155	BEARING <i>210 WD</i>	4
33	A-24766-3	SHIM 1/64"	AR
34	A-24766-4	SHIM 1/32"	AR
35	100-160	AIR VENT	1
36	A-11251	1/2" SQUARE HEAD PIPE PLUG	2
37		3/8" STANDARD LOCKWASHER	24
38	100-156	PUSH PULL CONTROL	1
39	100-157	YOKE	1
40		COTTER PIN	1
41	C-24820-1	COVER & SHIFT FORK ASSEMBLY	1
42	C-24758-1	COVER	1
43	A-24760-3	DISCONNECT FORK	1
44	A-24745-2	SHIFTER SELECTOR	1
45	100-158	OIL SEAL	1
46	100-184	PIN	1
47	100-178	SHIFTER FORK	1
48	100-176	SNAP RING	1
49	A-18982-15	PUMP SHAFT KEY	2
50	A-11288	YOKE PIN	1

2 PUMP GEARCASE ASSEMBLY

100 TON RAILROAD WRECKING CRANE (CONTINUED)

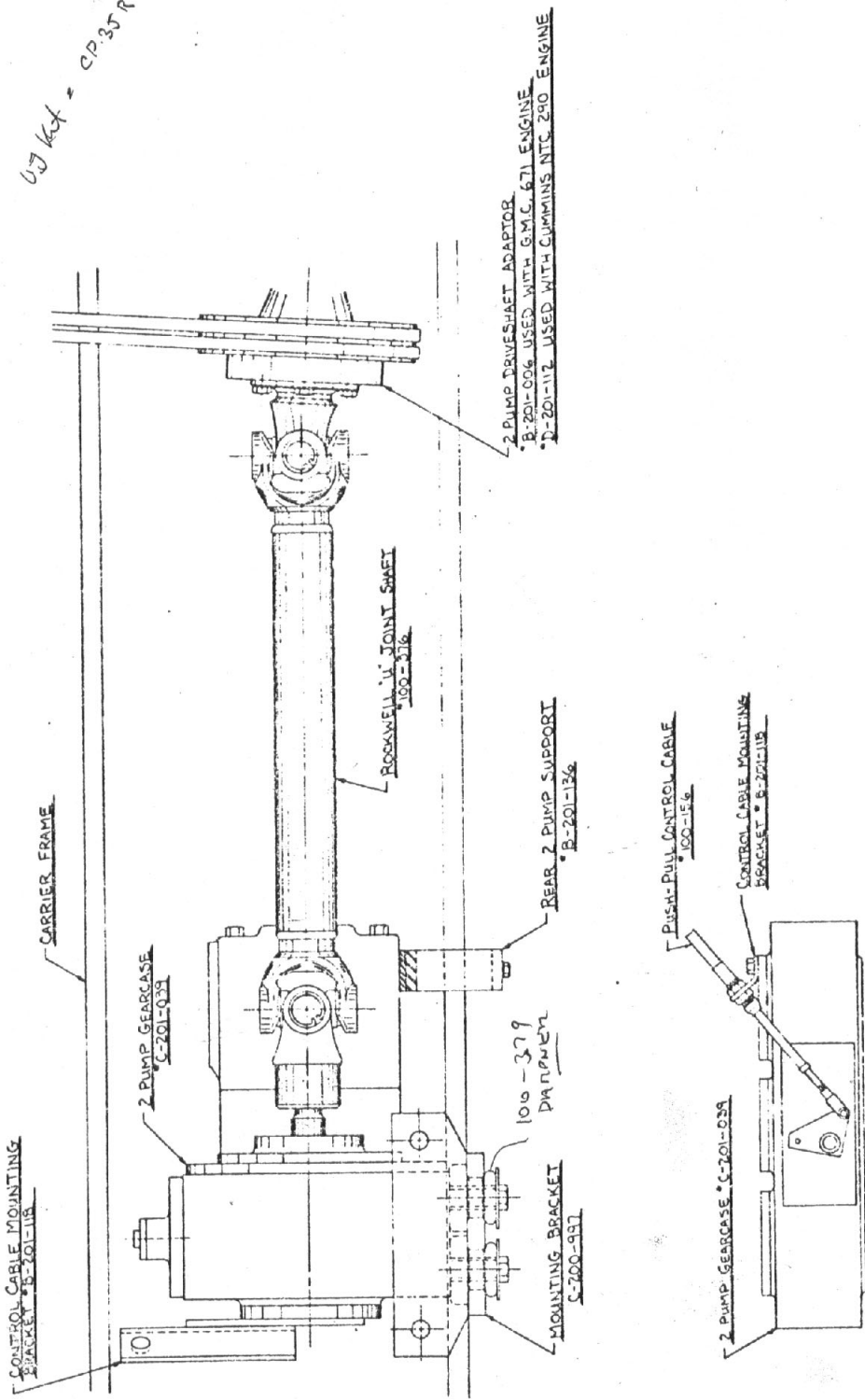
<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
51	A-24950-1	GASKET	1
52	100-145	OIL SEAL <i>CN-12456</i> <i>16 Lyo Rom</i>	1
53		5/8" STANDARD LOCKWASHER	4
54		5/16" STANDARD LOCKWASHER	6
56		3/8"-16 NC x 1" LG H.H.C.S.	24
59		5/16"-18 NC x 1" LG H.H.C.S.	6
60		5/8"-11 NC x 3/4" LG H.H.C.S.	4
61	B-201-125	DISCONNECT FORK ARM MOD.	1

2 PUMP INSTALLATION

ASSEMBLY

NO. D-201-002

100-379
67 Key - CP-35 R



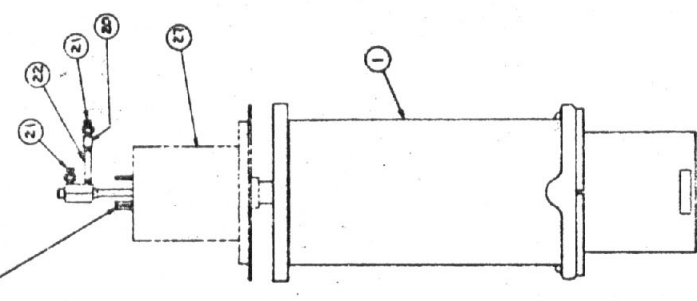
*R-201-006 USED WITH G.M.C. 671 ENGINE
*R-201-112 USED WITH CUMMINS NTC 290 ENGINE

SWIVEL & FITTING

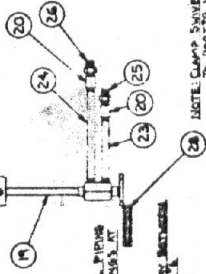
ASSEMBLY

NO. D-200-918

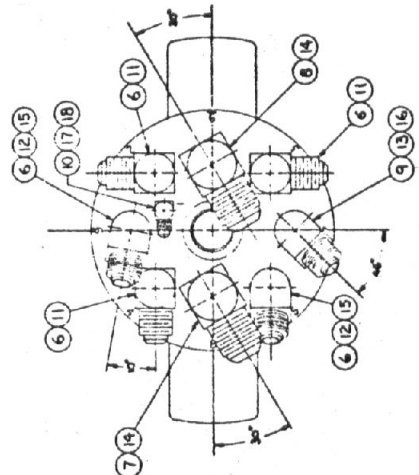
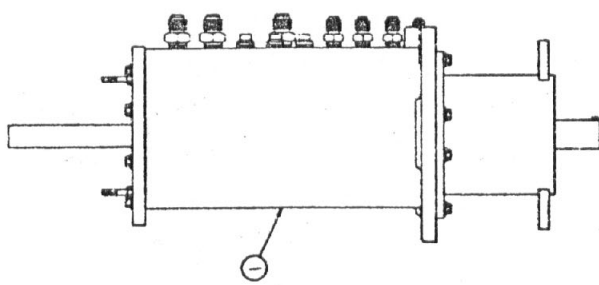
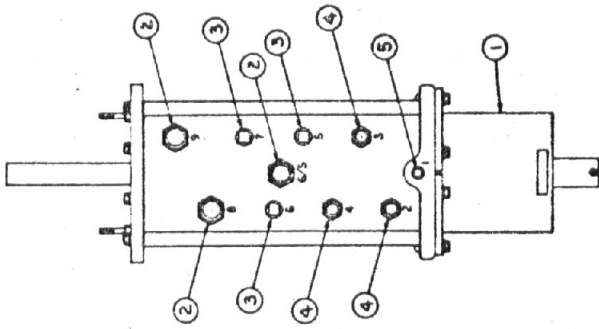
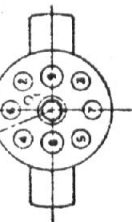
NOTE: LOCATE SWIVEL PIPES IN ABOVE COLLECTOR RING AS SHOWN IN TOP VIEW



NOTE: CLAMP SWIVEL PIPES AS SHOWN IN TOP VIEW



NOTE: LOCATE SWIVEL PIPES AS SHOWN IN TOP VIEW AT 90 DEGREE



BOTTOM VIEW

SWIVEL AND FITTING ASSEMBLY
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	D-200-922	SWIVEL ASSEMBLY	1
2	2021-20-20S	STRAIGHT MALE CONNECTOR	3
3		1" NPT PIPE PLUG	3
4	2021-16-16S	STRAIGHT MALE CONNECTOR.	3
5		3/4" NPT PIPE PLUG	1
6		1" SCD 80 PIPE NIPPLE - 10" LG	5
7		1-1/4" SCD 40 PIPE NIPPLE - 18" LG	1
8		1-1/4" SCD 40 PIPE NIPPLE - 20" LG	1
9		1" SCD 40 PIPE NIPPLE - 15" LG	1
10		3/8" SCD 40 PIPE NIPPLE - 21" LG	1
11	2025-16-16S	90° FEMALE CONNECTOR	3
12		1" SCD 80 COUPLING	2
13		1" SCD 40 COUPLING	1
14	2025-20-20S	90° FEMALE CONNECTOR	2
15	2023-16-20S	45° MALE CONNECTOR	2
16	2023-16-16S	45° MALE CONNECTOR	1
17		3/8" SCD 40 COUPLING	1
18	2024-6-6S	90° MALE CONNECTOR	1
19	100-819	SWIVEL PIPING ASSEMBLY	1
20		1/8" NPT SCD 40 COUPLING	3
21	2021-4-6S	STRAIGHT MALE CONNECTOR	1
22		1/8" NPT SCD 40 NIPPLE - 2" LG	2
23		1/8" NPT SCD 40 NIPPLE - 4" LG	1
24		1/8" NPT SCD 40 NIPPLE - 6" LG	1

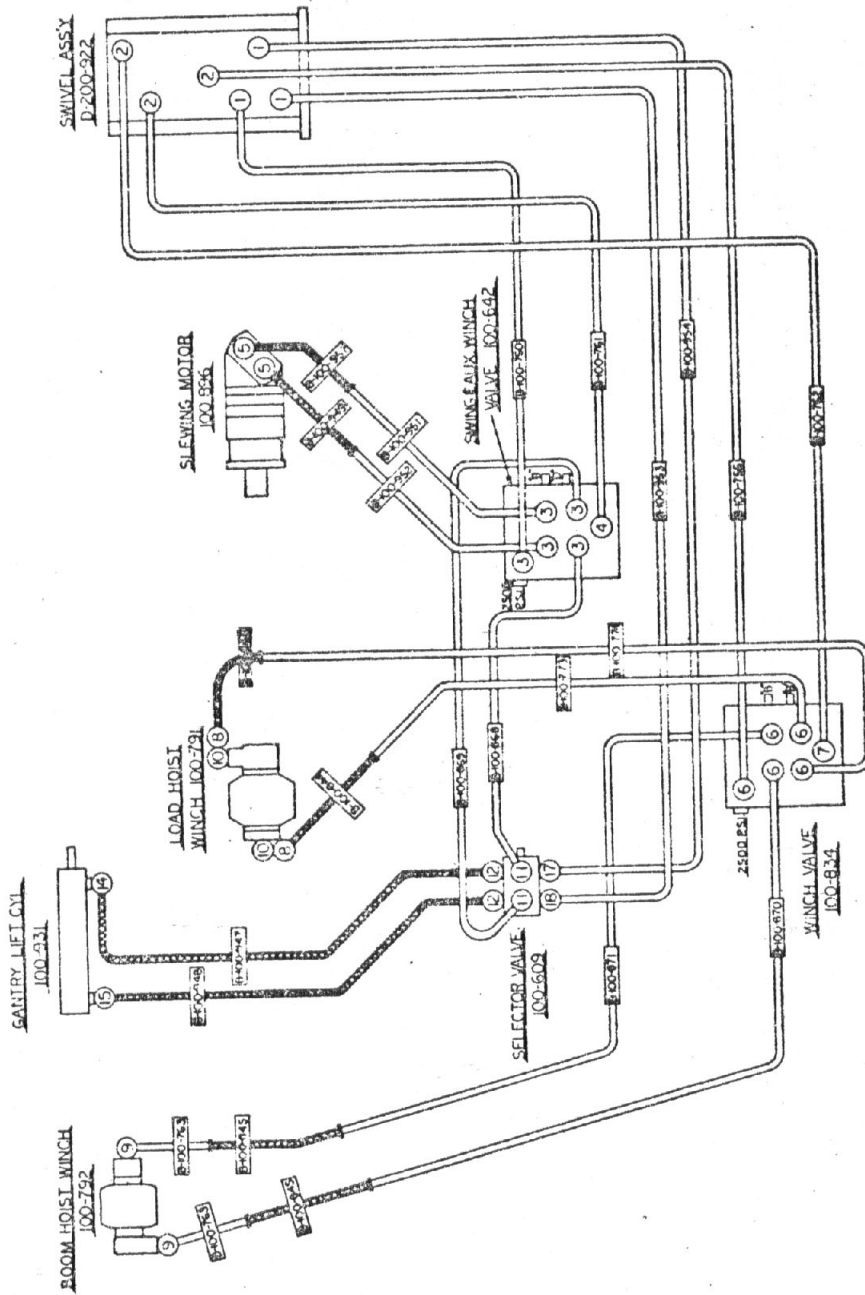
SWIVEL AND FITTING ASSEMBLY

FOR 100 TON RAILROAD WRECKING CRANE (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
25	2021-2-6S	STRAIGHT MALE CONNECTOR	1
26	2021-2-4S	STRAIGHT MALE CONNECTOR	1
27	100-966	COLLECTOR RING	1
28	A-200-790	SWIVEL PIPING CLAMP	1

UPPER HYDRAULIC SCHEMATIC

NO. D-200-926



UPPER HYDRAULIC SCHEMATIC

FOR

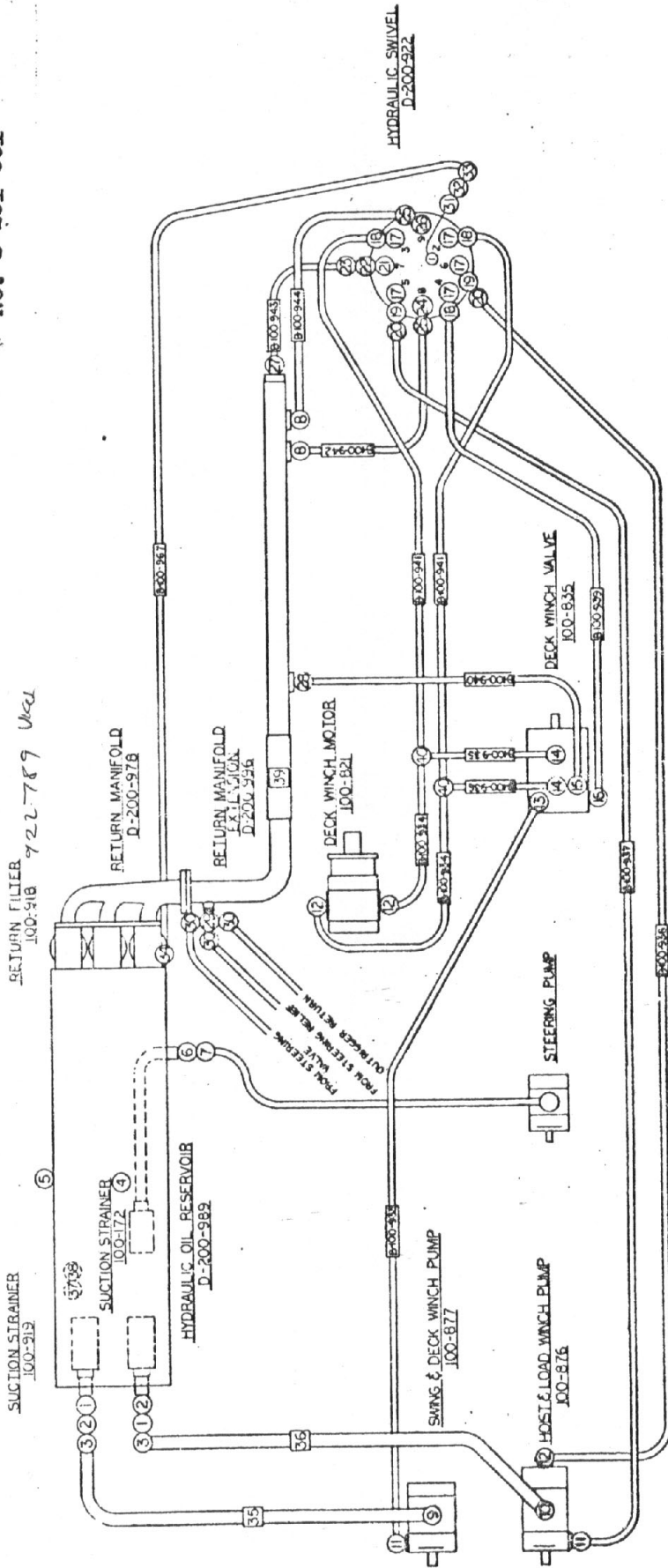
100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1.	2021-16-16S	STRAIGHT MALE CONNECTOR	4
2.	2021-20-20S	STRAIGHT MALE CONNECTOR	3
3.	202702-16-16S	STRAIGHT "O" RING BOSS CONNECTOR	5
4.	202702-20-20S	STRAIGHT "O" RING BOSS CONNECTOR	1
5.	2062016-16S	90° "O" RING BOSS CONNECTOR	2
6.	16PA	IMPERIAL SPLIT FLANGE KIT	5
7.	20PA	IMPERIAL SPLIT FLANGE KIT	1
8.	2062-20-20S	90° "O" RING BOSS CONNECTOR	2
9.	2062-24-24S	90° "O" RING BOSS CONNECTOR	2
10.	B-200-944	ADAPTER	2
11.	2021-12-16S	STRAIGHT MALE CONNECTOR	2
12.	2023-12-10S	45° MALE CONNECTOR	2
14.	2024-8-10S	90° MALE CONNECTOR	1
15.	2023-8-10S	45° MALE CONNECTOR	1
17.	2024-12-16S	90° MALE CONNECTOR	1
18.	202413-12-16S	90° MALE CONNECTOR (EXTRA LONG)	1

100 GPN 21875-1
50 GPM 21875

LOWER HYDRAULIC SCHEMATIC

NO. D-201-001



UPPER HYDRAULIC SCHEMATIC

257

FOR

100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1.	2021-16-16S	STRAIGHT MALE CONNECTOR	4
2.	2021-20-20S	STRAIGHT MALE CONNECTOR	3
3.	202702-16-16S	STRAIGHT "O" RING BOSS CONNECTOR	5
4.	202702-20-20S	STRAIGHT "O" RING BOSS CONNECTOR	1
5.	2062016-16S	90° "O" RING BOSS CONNECTOR	2
6.	16PA	IMPERIAL SPLIT FLANGE KIT	5
7.	20PA	IMPERIAL SPLIT FLANGE KIT	1
8.	2062-20-20S	90° "O" RING BOSS CONNECTOR	2
9.	2062-24-24S	90° "O" RING BOSS CONNECTOR	2
10.	B-200-944	ADAPTER	2
11.	2021-12-16S	STRAIGHT MALE CONNECTOR	2
12.	2023-12-10S	45° MALE CONNECTOR	2
14.	2024-8-10S	90° MALE CONNECTOR	1
15.	2023-8-10S	45° MALE CONNECTOR	1
17.	2024-12-16S	90° MALE CONNECTOR	1
18.	202413-12-16S	90° MALE CONNECTOR (EXTRA LONG)	1

CPR SN-1106
2 100-919 *Shaw*
1 100-042 *u - howl*
120-60

LOWER HYDRAULIC SCHEMATIC FOR 100 TON R. R. C. (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
26		1-1/4" SCD 40 PIPE NIPPLE 2016	1
27	2021-16-16S	STRAIGHT MALE CONNECTOR	1
28	2023-20-20S	45° MALE CONNECTOR	1
29		3/4" SCD 40 NPT CROSS	1
30	2024-12-8S	90° MALE CONNECTOR	3
31		3/8" PIPE x 21" LG	1
32		3/8" SCD 40 COUPLING	1
33	2024-6-6S	90° MALE CONNECTOR	1
34	2024-4-6S	90° MALE CONNECTOR	1
35		3-1/2" SUCTION HOSE 24" LG	1
36		3-1/2" SUCTION HOSE 18" LG	1
37	100-984	3/4" NPT GATE VALVE	1
38		3/4" NPT PIPE PLUG	1
39	<i>TW 65 7mm 3/2 x 10</i>	3-1/2" SUCTION HOSE 49" LG	1
40	2033-16-16	TEE	2

AIR LINE SCHEMATIC FOR SWING BRAKE & THROTTLE100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	2021-4-6S	STRAIGHT MALE CONNECTOR	5
2	2024-6-6S	90° MALE CONNECTOR	3
3	2027-6-6S	JIC UNION	4
4	2024-4-6S	90° MALE CONNECTOR	2
5	2024-8-6S	90° MALE CONNECTOR	1
6	2021-8-6S	STRAIGHT MALE CONNECTOR	1
7	2024-8-4S	90° MALE CONNECTOR	1
8	2023-4-4S	45° MALE CONNECTOR	2
9	2062-4-4S	"0" RING BOSS CONNECTOR	1
10		1/4" NPT CLOSE NIPPLE SCD 40	3
11		1/4" NPT TEE SCD 40	3
12		1/4" NPT TEE SCD 40	1
13	2024-2-4S	90° MALE CONNECTOR	3
14	2023-2-4S	45° MALE CONNECTOR	2
15		1/8" NPT NIPPLE 2" LG SCD 40	1
16	100-815	DRAIN COCK	1
17	100-814	RELIEF VALVE	1
18	100-813	LOW PRESSURE SWITCH	1
19		1/4 NPT 90° ELBOW	1
20		1/4 NPT NIPPLE 1-1/2" LG	2
21		1/4 NPT NIPPLE 3" LG	1
22	100-955	AIR REGULATOR	1
23	100-956	CYLINDER OUTLET PLUG w/GASKET	3
24	100-958	CHECK VALVE	1

AIR LINE SCHEMATIC FOR SWING BRAKE & THROTTLE

100 TON RAILROAD WRECKING CRANE (CONTINUED)

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
25		PIPE PLUG 1/2" SCD 40	3
26		PIPE PLUG 1/4" SCD 40	1
27		1/8" NPT COUPLING SCD 40	1
28	269P-1/4" x 1/8"	90° PLASTIC TUBE CONNECTOR	2
29	269P-1/4" x 1/4"	90° PLASTIC TUBE CONNECTOR	2

CARRIER AIR SYSTEM SCHEMATIC
FOR 100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	649-F-3/8" x 3/8"	90° MALE CONNECTOR	1
2	651-F-3/8" x 1/4"	RUN TEE	1
3	PART OF 100-966	AIR REGULATOR	1
4		1/4" NPT SCD 40 CLOSE NIPPLE	2
5		1/4" NPT SCD 40 TEE	3
6	648-3/8" x 1/4"	STRAIGHT MALE CONNECTOR	3
7		1/4" NPT SCD 40 90° ST. ELBOW	1
8		1/4" NPT SCD 40 NIPPLE 1-1/2" LG	4
9		1/4" NPT SCD 40 NIPPLE 3" LG	2
10		1/4" NPT SCD 40 90° ELBOW	2
11	269P-1/4" x 1/4"	90° MALE PLASTIC CONNECTOR	19
12	269P-1/4" x 1/8"	90° MALE PLASTIC CONNECTOR	17
13	2023-4-4S	45° MALE CONNECTOR	1
14	2024-4-6S	90° MALE CONNECTOR	1
15	2021-2-6S	STRAIGHT MALE CONNECTOR	1
16	2021-2-4S	STRAIGHT MALE CONNECTOR	1
17		1/8" NPT SCD 40 COUPLING	2
18		1/8" NPT SCD 40 NIPPLE 4" LG	1
19		1/8" NPT SCD 40 NIPPLE 6" LG	1

FREEFALL WINCH ELECTRIC SWITCH (IN CAB)

NICO # 101-132

MICRO SW: BM-1RQ1-A2 (absorber)

BA-2RQ1-A2 ←

BOOM LIMIT SWITCH

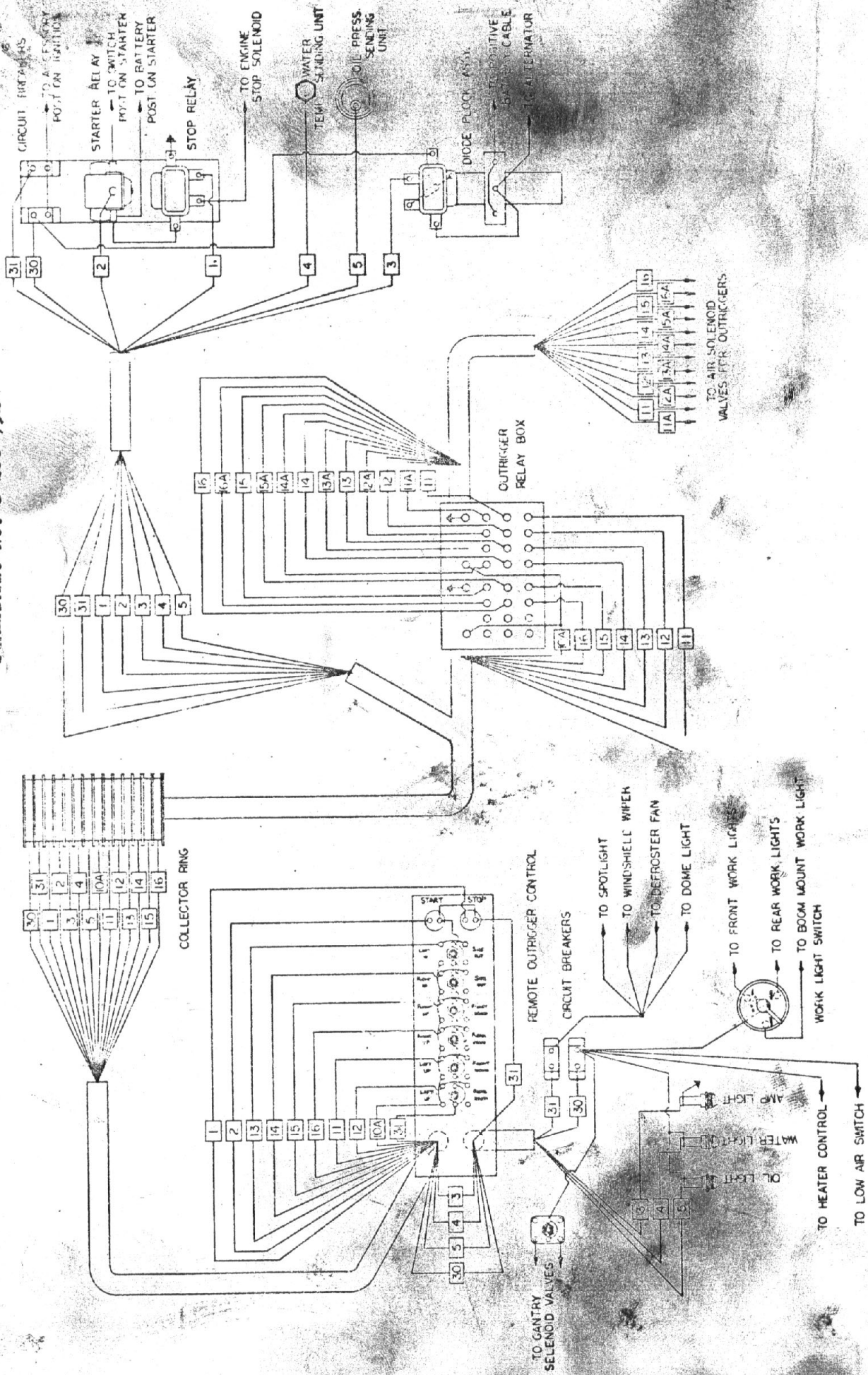
NICO # 101-391

MICRO # BAF1-2 RN-18CH

750-083 Relay Freefall Switch Delta 116967 → 1191361

UPPER ELECTRICAL & CONTROL

SCHEMATIC NO. D-200-952

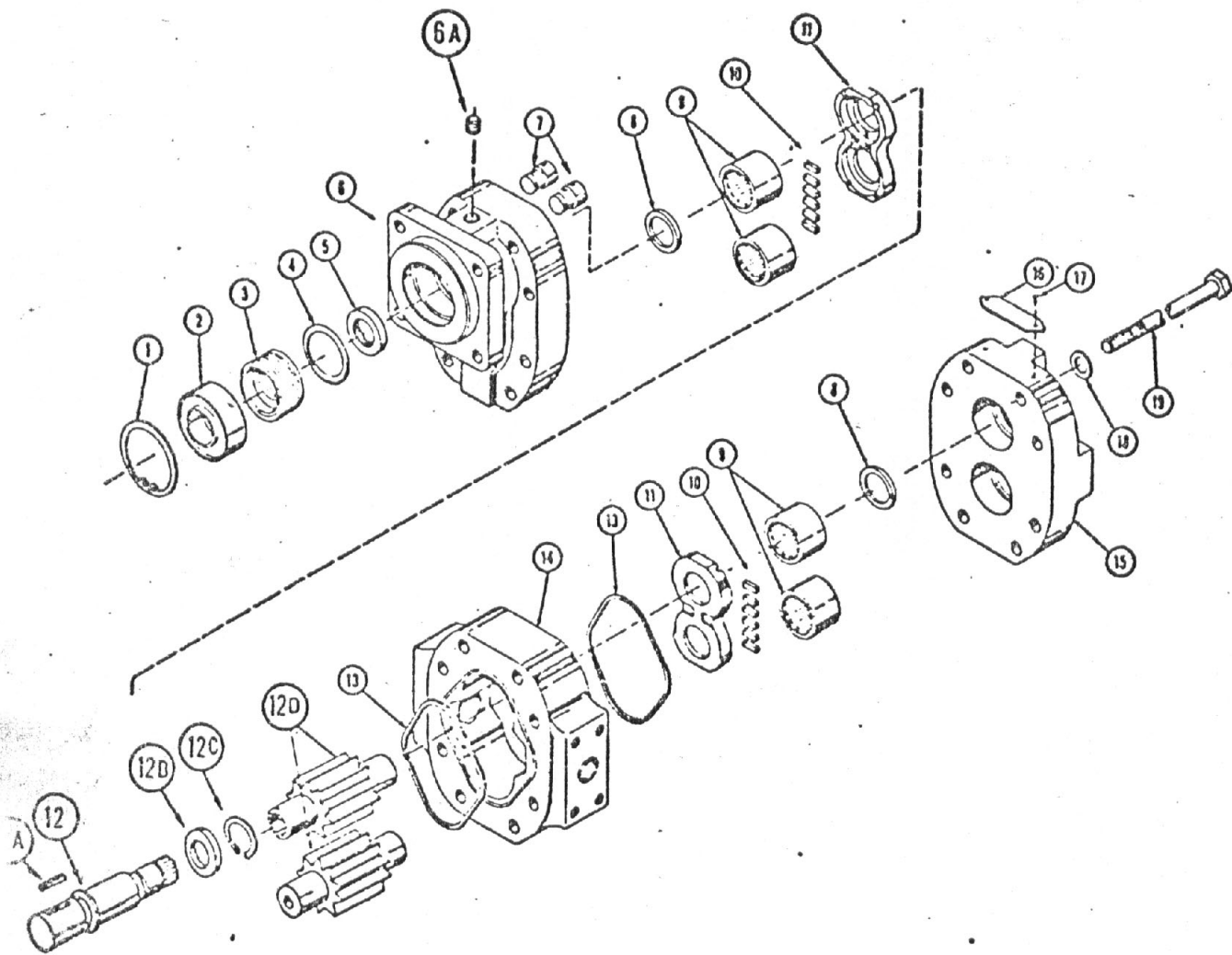


DECK WINCH ASSEMBLY

FOR

100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	100-820	DECK WINCH ASSEMBLY	1
2	C-201-096-1	RIGHT MOUNTING BRACKET	1
3	C-201-096-2	LEFT MOUNTING BRACKET	1
4	C-201-103-7	CABLE GUIDE BAR	1
5	100-821	MOTOR	1
6		HEX HEAD CAPSCREW, 5/8"-11 NC x 2-1/2" LONG	8
7		HEX NUT, 5/8"-11 NC	8
8		LOCKWASHER, 5/8" STD.	8
9		TAPER WASHER, 5/8"	8
10		HEX HEAD CAPSCREW, 3/4"-10 NC x 2" LONG	2
11		LOCKWASHER, 3/4" STD.	2
12		HEX HEAD CAPSCREW, 3/8"-16 NC x 1" LONG	4
13		LOCKWASHER, 3/8" STD.	4
14	C-201-103-1	UPPER ROLLER	1
15	100-930	BUSHING	2
16	C-201-103-2	ROLLER MOUNTING BLOCK	2
17		FLAT WASHER, 1-1/4" STD.	2



DECK WINCH MOTOR ASSEMBLY

100-821

DECK WINCH MOTOR ASSEMBLY
FOR
100 TON RAILROAD WRECKING CRANE

<u>ITEM</u>	<u>PART NO.</u>	<u>DESCRIPTION</u>	<u>QUANTITY</u>
1	X96-315	SNAP RING	1
2	VB1669	SPACER	1
3	RA1072	SEAL RETAINER	1
4	I3006-164	"O" RING	1
5	X73-50-1	SEAL	1
6	SB1685-4	SHAFT END COVER	1
6A	X1-11	PIPE PLUG	1
7	M1391K	CHECK ASSEMBLIES	2
8	WB1669-1	RING SEALS	2
9	R1032	ROLLER BEARINGS	4
10	BA3026-6	POCKET SEAL STRIP	1 STRIP
11	BA1058	THRUST PLATES	2
12A	X10-38	KEY	1
12	AL1135	DRIVE SHAFT	1
12B	AF1669	BEARING RETAINING RING	1
12C	X97-137	RETAINING RING	1
12D	PA1006M-25	MATCHED GEARS	1 SET
13	UB3006-252	GASKET SEALS	2
14	SA1688-25-36	GEAR HOUSING	1
15	YA1603	PORT END COVER	1
16	A2078-45-2	NAME PLATE	1
17	X41-4	DRIVE SCREWS	2
18	X144-3	WASHERS	8
19	X2-104	CAPSCREWS	8

Fairmont

HY-RAIL

**SERVICE INSTRUCTIONS
AND PARTS LISTS
IMPORTANT**

Before placing a new unit in service read the starting and operating instructions in this book.

Bulletins enclosed in these covers sometimes apply to more than one series of the same class of equipment, therefore be sure to consult the sections which refer to the unit, or car and engine, being used.

Mention factory engine and unit serial numbers when ordering parts or writing us.

FAIRMONT RAILWAY MOTORS, Inc.

FAIRMONT, MINNESOTA, U. S. A.

DISTRICT OFFICES

Chicago Philadelphia Washington, D. C. St. Louis St. Paul

IN CANADA: Fairmont Railway Motors, Ltd., Toronto, Ont.

Printed In U. S. A.

507-235-335

SERVICE INSTRUCTIONS AND PARTS LIST**FAIRMONT****A60 SERIES 4072****HY-RAIL[®] GROUP****Heavy Duty**

Vehicle loads and weight distribution determine the required Hy-Rail equipment to be used, based on the load capacity of the Hy-Rail Group.

Some applications may use the Series 4072 equipment on one end of the vehicle and Series 2545 on the other. For such cases see Bulletin 911 covering the Series 2545.

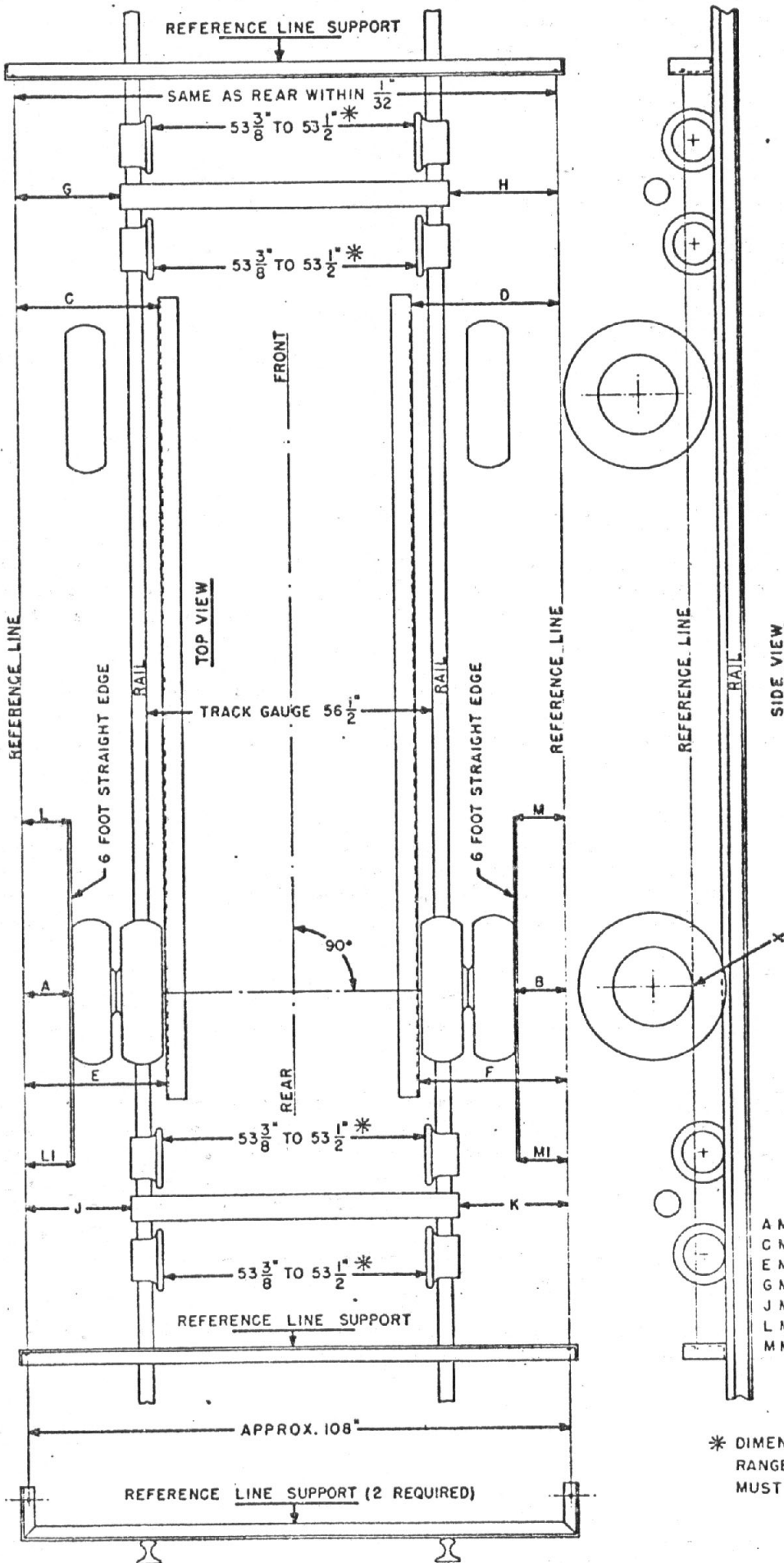
Series 4072 - Maximum load capacity 34,000 pounds.

Series 2545 - Maximum load capacity 15,000 pounds.

This bulletin contains brief instructions for the care and operation of Series 4072 Hy-Rail Groups and lists parts for the rail equipment. Before ordering repair parts see page 9.

The guide wheel assemblies are raised and lowered hydraulically. If the carrier has a hydraulic system delivering 5 to 8 GPM at 1500 P.S.I., this can be used for the rail equipment. Otherwise it requires a power take off on the vehicle transmission and Power Pack 101982 which includes a hydraulic pump, reservoir and piping for the rail equipment.

FAIRMONT RAILWAY MOTORS, INC.**FAIRMONT, MINNESOTA****Printed in U. S. A.**



- A MUST EQUAL B WITHIN 1/32"
- C MUST EQUAL D WITHIN 1/32"
- E MUST EQUAL F WITHIN 1/32"
- G MUST EQUAL H WITHIN 1/16"
- J MUST EQUAL K WITHIN 1/16"
- L MUST EQUAL LI WITHIN 1/16"
- M MUST EQUAL MI WITHIN 1/16"

* DIMENSIONS MUST BE IN THE RANGE OF $53\frac{3}{8}$ " TO $53\frac{1}{2}$ " AND MUST BE EQUAL WITHIN $\frac{1}{16}$ "

**CHECKING
ALIGNMENT OF
HY-RAIL**

On units that have hy rail equipment applied check alignment by following steps listed below except omit step No. 2. On new applications step No. 1 must be completed before equipment is applied to vehicle. Application prints are furnished with each group.

Remaining steps should be completed in order listed.

1. Check basic vehicle on which rail equipment is to be mounted.
 - A. Frame must be square within 1/8" on the diagonal.
 - B. Rear axle must be square with front end of frame within 1/8". NOTE THIS IS MOST IMPORTANT
2. Apply rail equipment, following instructions on application print furnished with each group.
3. Place vehicle on straight level track and lock rail wheels in the rail position (see page 4 for details.) If no track is available, use 2 x 4's laid on level floor to simulate track. Space 2 x 4's so they are 56-1/2" between inside edges.
4. Adjust rear guide wheel loads to approximately 25% of vehicle curb weight. (See pages, 5 and 6 for details.)
5. Establish parallel reference lines on each side of vehicle as shown on page 2.
 - A. These lines can most easily be established by improvising two supports or brackets. These can be fabricated out of scrap angle iron or other material. No dimensions are critical except the distance between the lines must be the same within 1/32" for both front and rear.
 - B. Clamp reference line supports to the rail in front of and behind the vehicle. Be sure the supports are at right angles to the track. Stretch wires or cords between the brackets so reference lines are level and approximately in line with bottom edge of vehicle wheel rim (point X)
 - C. Shift reference line supports laterally on rail as necessary so dimension "A" is equal to "B" and "C" is equal to "D" within 1/32". At the front measure from outside of frame to reference line. Take rear measurement from reference lines to edge of vehicle rim directly below the axle. Rotate wheels 180° and recheck. When shifting supports be sure they are kept at right angles to track so reference lines remain parallel.
6. When parallel reference lines have been established equidistant on each side of vehicle, measurements can be taken from these lines as shown on page 2 to insure correct alignment.
 - A. Check guide wheel gauge. Take measurement back-to-back of wheel flanges when wheels are locked in rail position. This dimension should be 53-7/16 to 53-3/8" on both front and rear. Dimensions must be in the range of 53-3/8 to 53-1/2" and must be equal within 1/16". The guide wheels have no toe-in. If wheels are not within limits for being "straight ahead," correct by adjusting tie rod lengths.
7. With vehicle wheels straight ahead, mount or adjust steering lock so wheels are held in this position. Refer to application print furnished with group for details on mounting.
8. As a final check on the alignment, operate the unit on rail moving both forward and in reverse. If vehicle does not track correctly in both directions, recheck all steps.

OPERATING TO USE ON RAILROAD TRACK:
INSTRUCTIONS

1. Drive Hy-Rail onto track, pneumatic tires centered on rails. This may be easily accomplished by driving past the track about 35 feet at any road crossing and then backing Hy-Rail onto rails. It may be necessary to go back and forth more than once to get all four wheels centered on rails.
2. Engage PTO to start hydraulic pump.
3. Remove safety pins (one at front and one at rear). Each safety pin has two spring loaded steel balls which lock the pins in position. In order to remove safety pin it is necessary to depress button in "T" end of pin, this releases the ball locks.
4. At the front of vehicle engage the axle locks by moving the two short levers (one each side) to the rail position as indicated on the plates. This locks the axle in position so when guide wheels are lowered and locked, the front pneumatic wheels will be clear of the rail. If axle locks are not secured, the front springs will sag when rail wheels are lowered, causing the pneumatic wheels to hang down, fouling the rail, switches and turnouts.

Shift control valve lever to lower rail wheels to the on track position. Center valve lever when the mechanical lock engages.

5. Replace safety pins. As mentioned above, the button in "T" end of pin must be depressed to release ball locks in order to insert safety pins.
6. CAUTION--Check each rail wheel to see that it is on the rail. It is a good practice to double check to be sure that--all eight guide wheels are down and flanges are inside the rails, and the two safety pins are in place.
7. After guide wheels are locked in the on rail position secure the front wheels in the straight ahead position with the steering wheel lock located on the steering column.

The Fairmont Hy-Rail is not designed for high speed on-track operating. It should not be operated at speeds above 25 MPH on tangent main line track, but railroad rules governing speeds should be observed at all times. Speeds should be reduced on curves and branch lines depending on conditions.

The guide wheels are not insulated. Depending on conditions they may or may not operate track signals. Be prepared to stop at all highway crossings.

TO REMOVE FROM RAILROAD TRACK FOR HIGHWAY USE:

1. Approach crossing and stop with front wheels over road crossing. Release steering lock.
2. Remove safety pins on rear wheels. Shift control lever to raise rear wheels so pins can be inserted securing rail wheels up in the highway position. After rear wheels are raised and locked in place, release, raise and secure front rail wheels. Release front axle locks.
3. Make sure that both safety pins are in place.

**RAIL
EQUIPMENT**

TYPE AND MOUNTING---Hydraulically operated load bearing type bolted directly onto vehicle frame, all weight carried on frame above the springs. No unsprung weight added.

GUIDE WHEELS---Cast steel, heat treated and precision turned. 16 inch tread diameter, mounted on individual spindles on taper roller bearings.

TRACK GAUGE---The gauge of guide wheels is set at 53-3/8" to 56-1/2". Front and rear guide wheels are assembled and adjusted to be centered directly in front and behind the vehicle wheels.

When checking gauge of guide wheels, measurement can be taken between the inside or back of flanges. This measurement should read 53-3/8" to 53-1/2".

WHEEL LOAD---Total front end weight, NOT TO EXCEED 34,000 POUNDS, for all four front guide wheels. 2500 to 8500 pounds for each of the four rear guide wheels. These figures are based on curb weight of vehicle which does not include passengers, baggage or variable load. A rule of thumb--set the rear at approximately 25% of rear weight total for four guide wheels. Load remaining on inner tires should not exceed manufacturer's rating when on rail.

OPERATION---Guide wheels are raised and lowered hydraulically, and securely held in either position by mechanical locks and safety pins.

LUBRICATION---Lubricate moving parts every 2000 miles or each time basic vehicle is serviced.

**VEHICLE
WHEELS**

Most vehicles require wheel modifications or hub spacers to properly space tires for on track operation. Before installing replacement wheels be sure they are the type required.

TIRES

Keep tires inflated to recommended pressure at all times for both highway and rail operation.

Pressures should be evenly maintained at all times.

**GUIDE
WHEELS**

Guide wheels are accurately turned for long life, balance and true running. Taper roller bearings are adjusted to .005 end play. Wheels should rotate freely except for a slight drag of the grease seal. Wheel bearings should be cleaned and repacked with automotive type wheel bearing grease approximately every 10,000 rail miles. Fill void with grease when bearings are repacked.

WHEEL GAUGE

With guide wheels locked down or in rail position, the truck gauge is set at 53-3/8" minimum to 56-1/2" maximum, and may be measured with two Fairmont M21138 pocket gauges and a 6 ft. steel tape, or Fairmont M30292 Max-Min car wheel gauge.

Measurement can also be taken between the inside or back of flanges. This measurement should read 53-3/8" to 53-1/2".

Wheel gauge may be corrected, if necessary, by shifting shims from one side of the pivot bearing to the other.

WHEEL TRAM

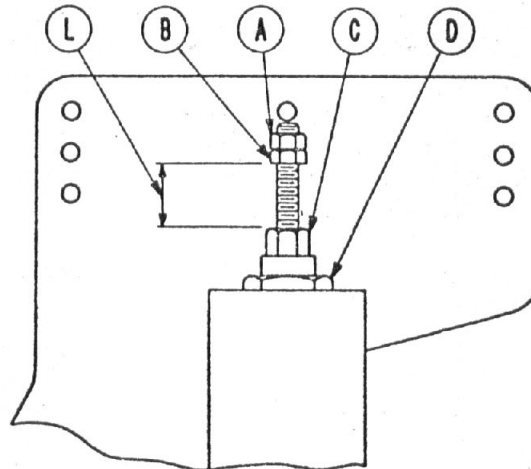
With track gauge set as above, guide wheels should be positioned directly in front of and behind the vehicle wheels. See page 3 for alignment details. The tram or alignment with vehicle wheels may be changed by loosening the bolts in the axle clamps. Shift axle and wheels as required to properly align with vehicle wheels, then securely tighten bolts in axle clamps.

**GUIDE WHEEL
LOAD**

REAR WHEELS---For maximum performance and safety the rear guide wheels should carry approximately 25% of the curb weight of the rear wheels. (Curb weight does not include passengers or variable load.) This will be between 2500 and 8500 pounds per wheel or 5000 and 17,000 pounds per side depending on vehicle and curb weight.

TO CHECK THE LOAD--With rail wheels raised and locked in the highway position, adjust nuts marked "B" to just contact adjusting nut "C", and lock with jam nut "A".

Place vehicle on a level section of tangent track, lower and lock all eight guide wheels to the on track position. Load is then determined by measuring the distance between nut "B" and load adjusting nut "C" as follows:



NOTE:

DUE TO TIRE CAPACITY ETC, DIMENSION "L" ON PETTIBONE 200 RRC SHOULD BE 1-1/8" OR 10,000 POUNDS PER SIDE.

1/2"	-	5,000	pounds load per side
3/4"	-	7,000	pounds load per side
1"	-	9,000	pounds load per side
1-1/4"	-	11,000	pounds load per side
1-1/2"	-	13,000	pounds load per side
1-3/4"	-	15,000	pounds load per side
2"	-	17,000	pounds load per side
2-1/4"	-	19,000	pounds load per side
(Solid Spring) 2-1/2"	-	21,000	pounds load per side

Load adjustment is made by loosening the large lock nut "D" and turning the load adjusting nut "C" to the required dimension "L". After adjustment is made be sure to securely tighten lock nut "D".

FRONT WHEELS--The front wheels are adjusted to raise vehicle front tires approximately 1" to 1-1/2" above the rail.

SAFETY PINS

Each rail wheel assembly is secured in the rail or highway position with a safety pin. Each pin has two spring loaded hard steel balls that protrude beyond the diameter of the pin. Pushing on plunger in "T" end of safety pin releases the internal plunger and spring, allowing the balls to sink below the outside diameter of pin. Periodic inspection for wear and free operation is advisable.

STEERING LOCK

The lock is clamped to steering wheel column. A fork engages a spoke of the steering wheel. Front wheels should be straight ahead when steering wheel lock is engaged.

INSTRUCTIONS FOR ORDERING PARTS

When this bulletin is received, complete the following record from the number plate on the left front fender under the hood, and name plate on vehicle visor. Always mention these factory serial numbers when writing about the car or ordering parts.

FAIRMONT Car No. _____ Class _____ Series _____

 _____ Group _____ Special _____

TO INSURE PROMPT AND CORRECT SHIPMENT of parts always give.

- (1) Quantity of each part wanted.
- (2) Symbol number of part as shown in this book.
- (3) Description of part as shown in this book.
- (4) Factory serial numbers recorded above.
- (5) State whether shipment is to be by mail, express, or freight.

All parts are shipped f.o.b. factory, transportation charges to be paid by customer. Terms are strictly cash with order.

Parts are listed by description, symbol and quantity. Quantities in right-hand columns show the number of parts in each assembly or group. Items printed in capitals are assemblies which include all parts listed immediately following and indented to the right. When assemblies can be used, always order them to save work of fitting separate parts. If in doubt, as to any part wanted, send full description or sketch, or send old part with order.

For descriptive purposes the engine end of car is named front, and right and left are determined by looking from rear to front.

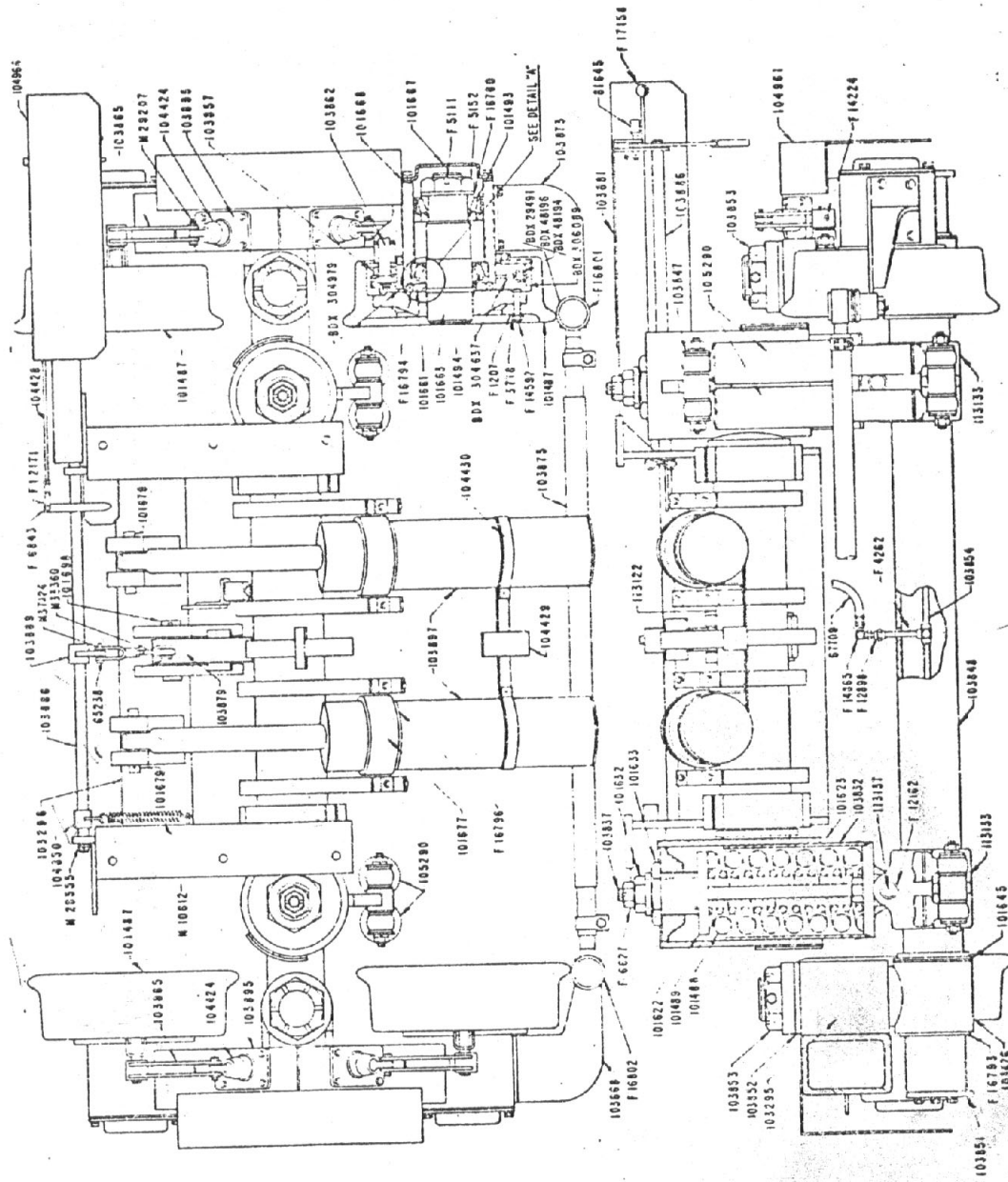
Common bolts, nuts and washers are not listed in this bulletin, as they can be obtained from any railroad stores department.

A name and number plate is located on the front and rear mounting frame of each HY-RAIL Group. Always give us this number when ordering repairs.

ALWAYS GIVE FACTORY CAR AND ENGINE SERIAL NUMBERS AND ENGINE MODEL WHEN ORDERING PARTS OR WRITING US.

WARRANTY

- FAIRMONT products are designed to give the utmost service and are manufactured from high grade material, by competent workmen under careful supervision. All equipment and parts made by this company are warranted against defects in material or workmanship for a period of 90 days from date of shipment.
- Water jackets of FAIRMONT engines, if not more than three-fourths full of water, are warranted not to break by freezing during the full life of the engine.
- Other equipment and parts not manufactured by this company, but which are furnished in connection with FAIRMONT products, are covered directly by the warranty of the manufacturer supplying the same. However, we obligate ourselves to assist in obtaining adjustments on such equipment or parts when necessary.
- This company will repair or replace free of charge at its option, f.o.b. factory, such parts of our manufacture as our Inspection Department decides have become defective during the warranty period.
- Material claimed defective must be returned to the factory within 30 days from date of claim for replacement. Ordinary wear and tear, abuse, misuse, and neglect are not covered by this warranty.



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GUIDE WHEELS AND MOUNTING

RAIL PILOT UNIT (front)	116116	1
RAIL PILOT UNIT (rear)	113283	2
Mounting Frame (rear)	115284	2
Cross Tube (upper)	115290	2
Bar	103298	4
Grease Fitting 1/8" MPT	F4252	4
Grease Fitting 90° 1/8" MPT	F9217	20
Washer (spring seat - (upper)	101622	4
Spring (outer)	101488	4
Boot	101623	4
Clamp (boot)	F14687	8
Housing (spring)	113992	4
Grease Fitting 1/8" MPT	F4252	8
Adjusting Stud 3-1/2" 8 Thd.	101632	4
Nut 3-1/2" 8 Thd.	101633	4
Hex Castle Nut 1-1/8" - 12	F6627	4
Cotter Pin 1/4 x 2 "	F1547	4
AXLE CLAMP (both halves)	113133	4
Cap Screw 3/4-10 x 2-1/2" (counter-bore)	F16474	16
Lockwasher 3/4"	F1354	16
Pin (spring housing to axle clamp)	113137	4
Retaining Ring	F12162	8
Shock Absorber	105290	8
Washer (shock absorber mounting - upper)	103847	16
Axle	103848	2
Spacer 5" ID x 6-1/2" OD x 123"	101645	12
SWIVEL BEARING WITH BUSHING	103426	4
Bushing (bronze - ream after installation - 5,000 & .002	103428	8
Brass Washer 3-9/16 ID x 5-15/16 x 1/2"	103852	4
Hex Nut 3-1/2"-8 Thd. - Slotted	103853	4
Retaining Ring (swivel bearing to axle)	F16793	4
End Plate (axle)	103851	4
Bolt 1-1-13 x 1-3/4" hex head	F1095	16
Grease Fitting 90° 1/8" MPT	F9217	8
Bolt 1/2 x 5-1/2" hex head	F1525	4
Grease Fitting 1/4"-28 MPT	F8014	8
Wheel Arm	103295	4
Hydraulic Grease Fitting	F15173	8
Spindle with Wheel Hub (guide wheels)	101663	8
Oil Seal (spindle)	F16794	8
Ring (oil seal)	101661	8
Bearing with Race (inner)	101494	8
Bearing with Race (outer)	101493	8
Washer 2-17/32 ID x 4-1/2 OD x 1/4"	F16760	8
Hex Slotted Nut 2-1/2"-12	F5152	8
Cotter Pin 3/8 x 4"	F5111	8
Gasket (hub cap)	101668	8
Hub Cap	101667	8
Rail Wheel 16"	101487	8
Shim - .020 (use as necessary)	106910	8
Wheel Bolt 5/8-18	F14592	64
Lock Washer 5/8"	F1207	64
Hex Nut 5/8"-18 UNF	F3718	64
Mounting Bracket (tie rod - left)	103868	2

Mounting Bracket (tie rod - right)	103873	2
Tie Rod	103875	2
Ball Joint (tie rod - left)	F16802	2
Ball Joint (tie rod - right)	F16801	2
Mounting Frame	116125	1
Cross Tube	113115	1
Housing Spring	113129	2
Spacer	113140	2
Backing Plate (brake assembly)	103857	8
Anchor Stud 3/4-16 Thd. x 3-3/16"	103860	16
Support (camshaft)	103861	8
Camshaft	103862	8
BRAKE ASSEMBLY 14" (less Back-up Plate Studs, Camshaft & Support)	F17069	8
Lock Washer (anchor stud)	BDX 24959	16
Nut (anchor stud)	BDX 46755	16
Brace (anchor stud)	BDX 304978	8
Shoe Return Spring	BDX 304979	16
Shoe with Lining	BDX 318857	16
Adjusting Screw	F18016	8
Socket (adjusting screw)	F18015	8
Pivot Nut (adjusting screw)	F18017	8
Spring (adjusting screw)	BDX 304637	8
Pin	F18019	32
Spring	F18021	32
Seat (spring)	F18020	64
Bowed Washer	F13824	8
Woodruff Key #15	F2989	8
Brake Lever	103865	8
Set Screw 3/8 x 3/8" NYLOK	F14224	8
AIR PIPE ASSEMBLY	103854	2
Air Pipe (less fittings)	103855	4
Tee 1/4" FPT	F11118	2
Coupling	103856	4
Nipple 1/4 x 3-1/2"	F4262	2
AIR CYLINDER	104424	8
Cylinder only	101711	8
Trunnion	103894	8
Snap Ring	F13827	16
Rod (piston)	104395	8
Piston Cup	F16762	8
Back-up Plate (piston cup)	101515	16
Spring	101516	8
Cap (cylinder)	101517	8
Wiper (rod) RW 3/4 x 1-1/8 x 9/32"	F14954	8
ADAPTER WITH "O" RING 9/16-18 M. Str. Thd. x 9/16-18 JIC Thd.	F13326	8
"O" Ring .468 x .624 x .078"-90	F11302	8
Hose with Fittings 13-1/2" (9-16"-18" JIC Thd. union each end)	70413	8
Mounting Trunnion	103895	8
Pin (brake arm to cylinder)	M29207	8
Mounting Bracket (air valve)	101518	2
Air Valve	F16764	2
Elbow 45° 1/4 MPT x 9/16"-18 JIC Thd.	F11117	4
Hose with Fittings 18" (9/16"-18 JIC Thd. union each end)	67709	2
Elbow 90° 1/4 MPT x 9/16"-18 JIC Thd. (swivel)	F14865	6
Coupling 1/4"	F12898	2
Hose with Fittings 6-1/2" (9/16"-18 JIC Thd. union each end)	104427	4

HYDRAULIC PIPING

CONTROL BRACKET TO CONTROL VALVE "IN" PORT

Nose Piece	F15304	1
Cap	F17146	1
Bushing Hex, 3/8 NPTF x 1/2 NPTF	F12657	1
Nipple Hex, 1/4 NPTF x 3/8 NPTF	F13373	1
Bulkhead Fitting	F11108	1
Tee 1/4 FPT. x 1/4 MPT x 1/4 FPT	F10680	1
Nipple Hex 1/4 NPTF x 3/8 NPTF	F13373	1
Nose Piece	F15303	1
Adaptor	F13513	1
Hose with Fitting	81172	1
Elbow 90°	F11114	1

CONTROL VALVE "OUT" PORT TO CONTROL BRACKET

Elbow 90° 3/8 NPTF x 3/4-16 JIC Thd.	F11114	1
Hose with Fitting	81172	1
Bulkhead Union	F14861	1
Hose with Fitting	68719	1
Adaptor	F12027	1
Body	F15378	1
Plug	F15270	1

CONTROL VALVE #1 PORT TO MANIFOLD HEAD END SIDE

Elbow 45°	F18562	1
Hose with Fitting	74857	1
Elbow 90°	F10988	5
Manifold Block	104429	1
Strap	104430	1

MANIFOLD ROD END SIDE TO CONTROL VALVE #2 PORT

Elbow 90°	F10988	1
Hose with Fitting	748587	1
Elbow 45°	F18562	1

MANIFOLD HEAD END SIDE TO CYLINDER HEAD END

Hose with Fitting	78317	2
Elbow 90° (long)	F10987	2

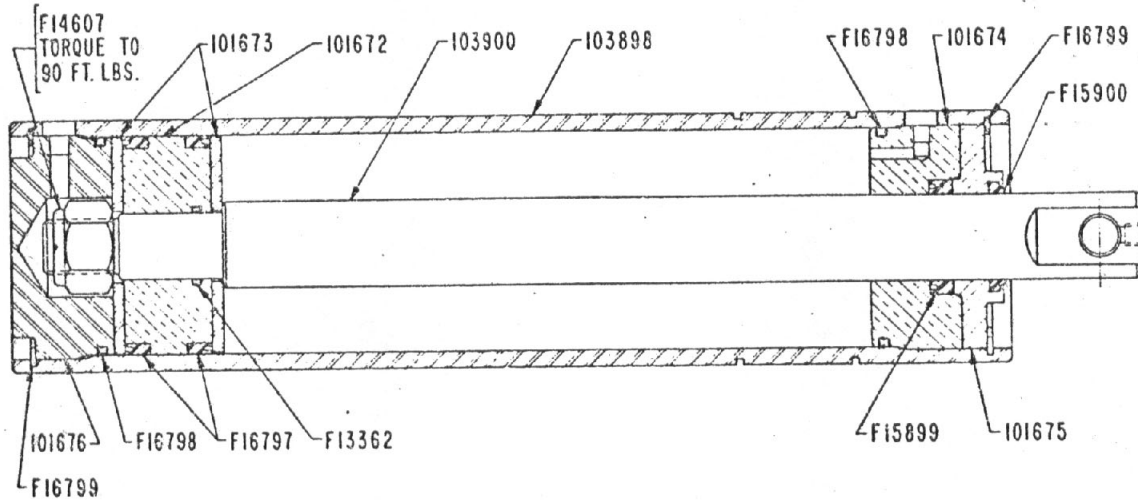
MANIFOLD ROD END SIDE TO CYLINDER ROD END

Hose with Fitting	78316	2
Elbow 90° (long)	F10987	2

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Elbow 45° 9/16-18 JIC x 9/16"-18 JIC(swivel)	F14242	4
Tee 9/16"-18 JIC (bulkhead)	F13178	4
Shield (hose)	I04961	4
4-Way Valve	F18510	2
Lock	116001	2
Spacer	113536	8
Lock Pin 1-3/4 x 4-3/4"	101698	2
Ball Handle	F13454	1
Stud 1/2 x 2-1/2	116033	1
Bracket	116030	1
Handle Assembly	116026	1
Rod	116056	1
Pin 5/16" DIA	108777	1
Rod Assembly (front)	116023	1
Bar 1/8 x 5 x 5	116022	1
Bar 1/4 x 4 x 4-3/8	116021	1
Bracket	115999	1
Bracket	116002	1
Bar 1/4 x 3-1/2 x 10	116044	1
Bracket	116005	1
Lock R.R.	116045	1
Lock L.R.	116047	1
Ball Joint	F14955	1
Sleeve	69859	6
Stud	106575	2
Lock Assembly (front)	116001	1
Crank Assembly (front)	116127	1
Crank	116128	1
Crank	116129	1
Crank Assembly	116048	1
Handle	116049	1
Crank	116051	1
Crank	116054	1

HYDRAULIC CYLINDER



CYLINDER	103897	4
Cylinder (only)	103898	4
Rod (piston)	103900	4
Quad Ring	F13362	4
Piston	101672	4
"U" Cup Packing UC 4-1/2 x 5 x 9/16" Type 1	F16797	8
Washer (piston)	101673	8
Hex Elastic Stop Nut 1-1/4"	F14607	4
Packing Gland	101674	4
"U" Cup Packing UC 2 x 2-5/8 x 1/2" Type 1	F15899	4
Quad Ring	F16798	8
Back-Up Ring	101675	4
Wiper (rod) RW 2 x 2-1/2 x 3/8"	F15900	4
Cap (cylinder)	101676	4
Retaining Ring	F16799	8
Cylinder Mounting	101677	4
Retaining Ring	F16796	8
Pin 1" x 4-7/8"	F16799 116043	4
Grease Fitting - 1/8" MPT	F4252	4
Pin 1" x 4-7/8"	101679	4

AIR PIPING

VEHICLE AIR BRAKE SYSTEM TO LEFT REAR WHEEL STOP

Tee 9/16-18 JIC x 1/4 MPT x 1/4 FPT	F12783	1
Hose Fitting	F12248	2
Hose 3/8" ID	F12247	
Elbow 90° 1/4 NPTF x 9/16-18 JIC Thd.	F10988	1
Bulkhead Fitting	F11108	1
Nipple Hex 1/4 NPTF x 3/8 NPTF	F13373	1
Nose Piece	F15303	1

CONTROL BRACKET TO AIR VALVE

Body Assembly	F15110	1
Plug	F15111	1
Adaptor	F12056	1
Hose with Fitting	75048	1
Bulkhead union	F12504	1
Hose with Fitting	75048	1

HY-RAIL GROUP
MOUNTING BRACKET GROUP

Spacer	116124
Pilot	116131
Pilot	116061
Bracket	116062
Bracket	116063
Wheel Stop L. F.	116064
Wheel Stop	116067
Bar	116132
Pad	116069
Strap	116075
Bumper	112753
Bracket	112754
Hook (right)	F10812
Hook (left)	116076
Spacer	116134
Rod (hook)	116138
Yoke End (hook rod)	M22621
Rod	116080
Bar 1/8 x 2 19 1/4	M6812
Bar 3/16 x 1 1/2 x 3 5/16	116140
Spring	116086
Pilot	116087
Pilot	85717
Bracket	116062
Wheel Stop (rear)	116063
Bar	116088
Knob	116090

STEERING LOCK GROUP

STEERING LOCK

Latch Support	86046
Lock Lever	112781
Roll Pin 3/16 x 2"	F13752
Spring	79788
Cl,a,p Bar (spring)	79789

POWER PACK GROUP

Yoke	116035
Hose with Fittings	
Hose with Fittings	
Hose with Fittings	
Hose with Fittings	
Hose with Fittings	
Hose with Fittings	
Hose with Fittings	

WHEEL MODIFICATION GROUP

Spacer Wedge Ring	97574
Spacer Band	F16379
	F16380

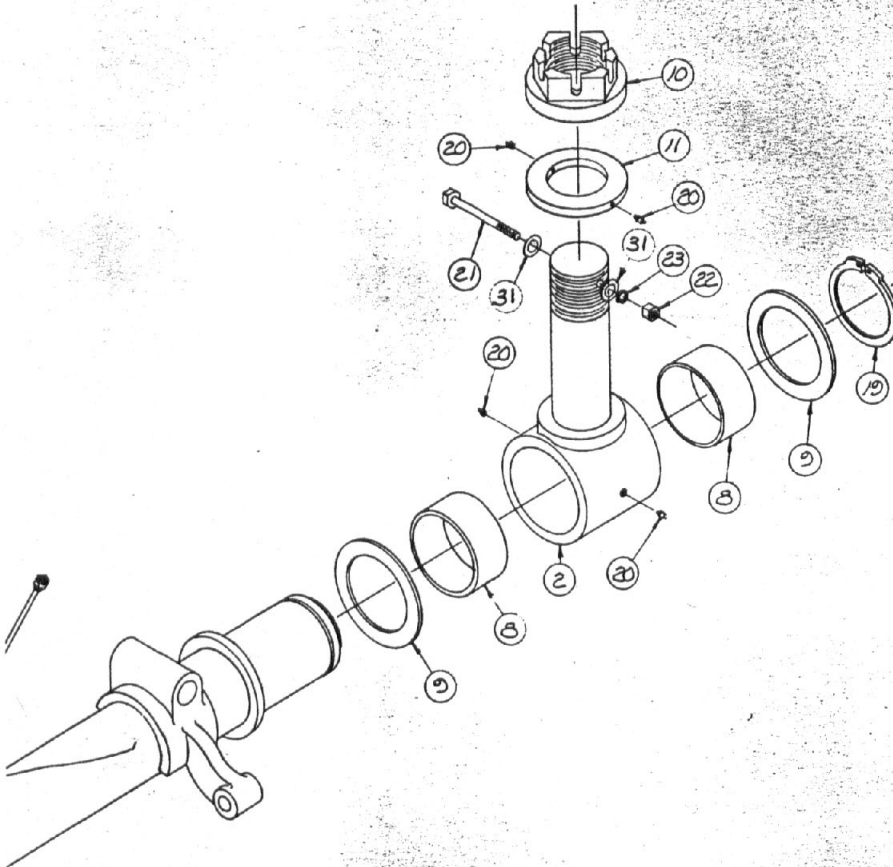
Instruction Plate (maint.)

Fairmont

Inspection Motor Cars
Section Motor Cars
B & B and Extra Gang Cars
Hy-Rail Motor Cars
Push Cars and Trailers
Motor Car Engines
Roller Axle Bearings
Wheels and Axles
Weed Mowers
Weed Sprayers
Weed Burners
Extinguisher Cars
Ballast Maintenance Cars
Oil Spray Cars
Derrick Cars
Tie Sprayers
Tie Coaters
Tie Removers
Tie Handlers
Spike Pullers
Rail Lifters
Tie Nippers
Tie Brushes
Crib Reducers
Tie Bed Scarifiers
Grouting Equipment
High Speed Spot Boards

BILL OF MATERIALS

QUAN.	DESCRIPTION	MARK	DRAWING
1	MAIN AXLE W/COMPT		D-201-496
2	WALKING BEAM PIVOT	2	C-201-462
2	SPRING GUIDE W/COMPT	3	D-201-490-1
2	AXLE END PLATE	4	A-201-497
2	SPRING GUIDE MTS. PIN	5	A-201-499
2	SECONDARY SPRINGS	6	A-101-099
2	MAIN SPRINGS	7	A-101-098
4	BUSHING	8	A-201-486
4	SPACER	9	A-201-493
2	PIVOT NUT	10	B-201-487-1
2	PIVOT WASHER	11	B-201-487-2
1	HOSE ASS'Y.	12	B-101-101
2	HOSE ASS'Y	13	B-101-100
2	PIPE NIPPLE	14	1/2" x 40" CG
1	PIPE TEE	15	1/2" NPT
3	ADAPTOR - AEROQUIP	16	2085-2-43
1	PIPE NIPPLE	17	1/2" x 4" CG
4	SNAP RING	18	101-096
2	SNAP RING	19	101-097
12	GREASE FITTING	20	100-268
2	HEX. HD. CAPSCR.	21	3/16" 14NC x 5 1/2 LG.
2	HEX. NUT	22	3/16" 14NC
2	COCKWASHER	23	3/16" STD
2	SCOTED HEX. NUT	24	1/4" 7NC
2	SPRING SPACER	25	A-201-512
2	COUPLER PIN	26	1/2" x 2" CG
3	HEX. HD. CAPSCR.	27	1/2" 13NC x 1 3/4 LG
3	COCKWASHER	28	1/2" STD
2	ADAPTOR	29	2045-2-25
2	SPRING CANISTER SPACER	30	A-201-622
4	FLAT WASHER	31	1/16"



FRONT RAIL PILOT MAIN AXLE ASS'Y
D-201-496

REV.	BY	DATE	DESCRIPTION
F	AD	1-18-77	ITEM 14 WAS 41
C	AD	5-1-78	ITEM 14 WAS 31
D	AD	11-28-77	ITEM 14 WAS 35-24
C	AD	4-5-77	ITEM 14 WAS 35-24
B	AD	2-28-77	ITEM 14 WAS 35-24
A	AD	9-30-74	ITEM 14 WAS 29

NICO NATIONAL IRON COMPANY
DULUTH, MINNESOTA
Division of FETTCHE CORPORATION

FRONT RAIL PILOT MAIN AXLE ASS'Y

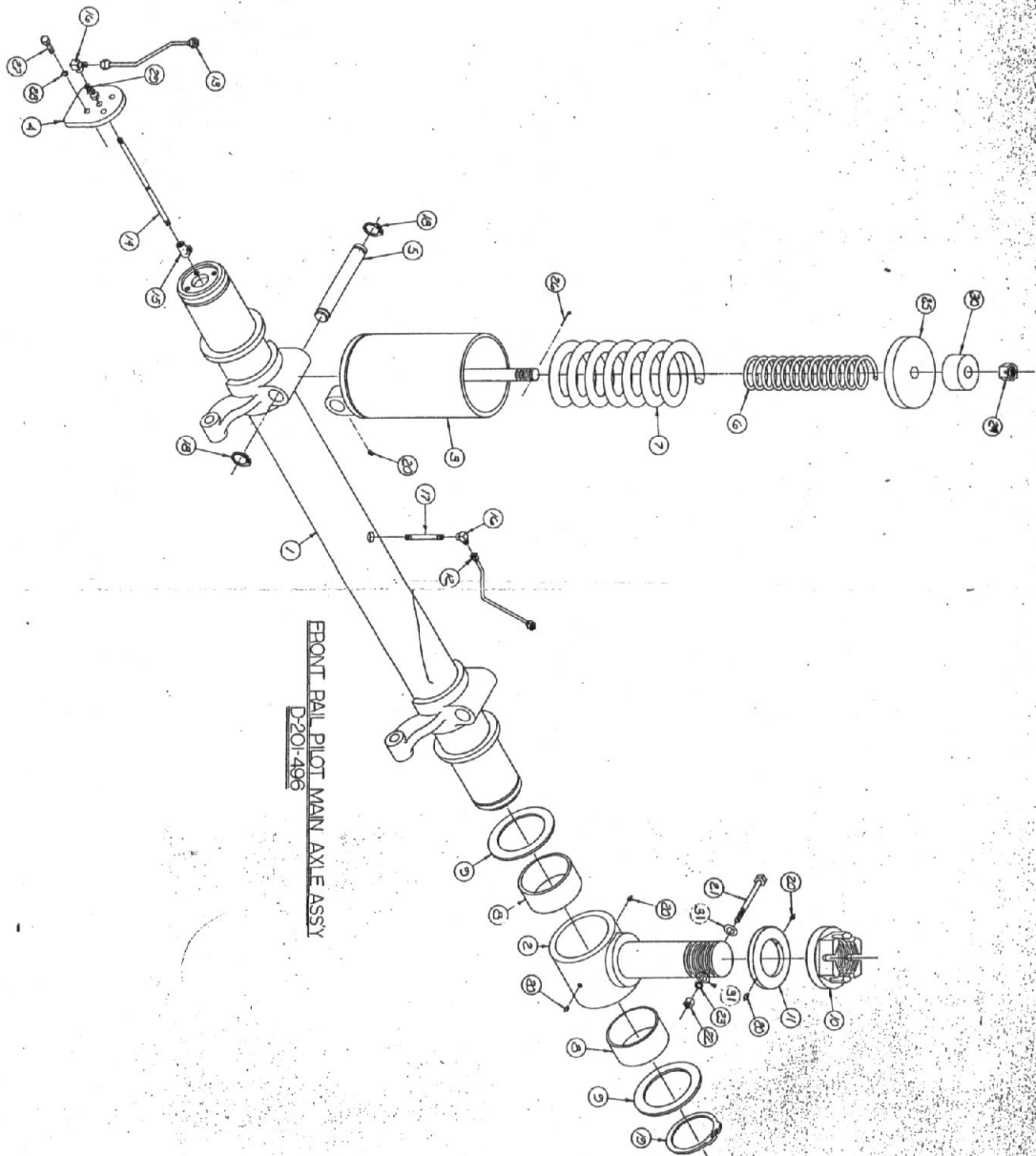
100TON RAIL

SEARCH BY: AD DATE: 5-6-76 SCALE: 2"=1'-0"

CUST. ORDER NO.: D201-496

JOB NO.: DMC-41496-000

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FRONT RAIL PILOT MAIN AXLE ASSY
D-20-496

ITEM	QTY	UNIT	DESCRIPTION
1	1	O.D. 1.500 I.D. 1.250	MAIN RAIL BUSHING
2	1	O.D. 1.250 I.D. 1.100	WASHER
3	1	O.D. 1.250 I.D. 1.100	WASHER
4	2	O.D. 1.250 I.D. 1.100	NUT
5	1	O.D. 1.250 I.D. 1.100	WASHER
6	1	O.D. 1.250 I.D. 1.100	WASHER
7	1	O.D. 1.250 I.D. 1.100	WASHER
8	1	O.D. 1.250 I.D. 1.100	WASHER
9	1	O.D. 1.250 I.D. 1.100	WASHER
10	1	O.D. 1.250 I.D. 1.100	WASHER
11	1	O.D. 1.250 I.D. 1.100	WASHER
12	1	O.D. 1.250 I.D. 1.100	WASHER
13	1	O.D. 1.250 I.D. 1.100	WASHER
14	1	O.D. 1.250 I.D. 1.100	WASHER
15	1	O.D. 1.250 I.D. 1.100	WASHER
16	1	O.D. 1.250 I.D. 1.100	WASHER
17	1	O.D. 1.250 I.D. 1.100	WASHER
18	1	O.D. 1.250 I.D. 1.100	WASHER
19	1	O.D. 1.250 I.D. 1.100	WASHER
20	1	O.D. 1.250 I.D. 1.100	WASHER
21	1	O.D. 1.250 I.D. 1.100	WASHER
22	1	O.D. 1.250 I.D. 1.100	WASHER
23	1	O.D. 1.250 I.D. 1.100	WASHER
24	1	O.D. 1.250 I.D. 1.100	WASHER
25	1	O.D. 1.250 I.D. 1.100	WASHER
26	1	O.D. 1.250 I.D. 1.100	WASHER
27	1	O.D. 1.250 I.D. 1.100	WASHER
28	1	O.D. 1.250 I.D. 1.100	WASHER
29	1	O.D. 1.250 I.D. 1.100	WASHER
30	1	O.D. 1.250 I.D. 1.100	WASHER
31	1	O.D. 1.250 I.D. 1.100	WASHER

QUANTITY	1
DATE	2-17-68
BY	[Signature]
NATIONAL IRON COMPANY 2700 N. CENTRAL AVENUE CHICAGO, ILL. 60641 TEL: 312-332-7000	

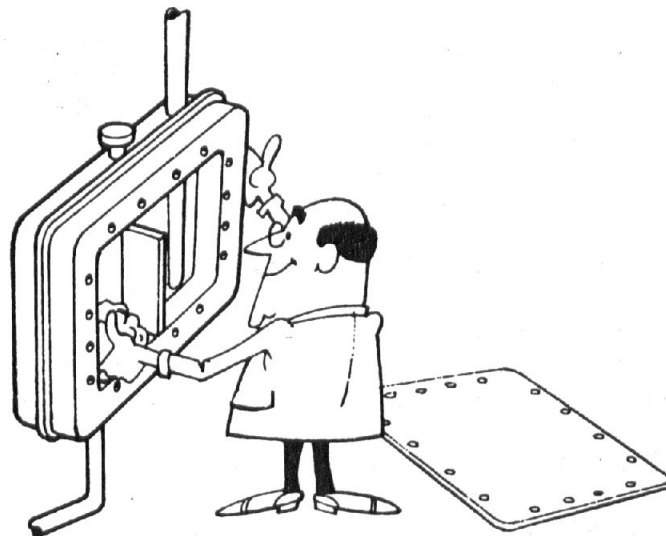
Hydraulic Hints

BULLETIN NO. MH-16
DATE 2-21-73
PAGE 1 OF 3
FILE IN SECTION 10

KEEP IT CLEAN

Without doubt, the most common of hydraulic system ailments is contamination. Dirty fluid can be the result of dirty plumbing. In this bulletin, the term plumbing will include the reservoir, tube, hoses, and fittings. Clean fluid cannot be expected to do an adequate job if it has to travel through dirty plumbing before reaching the work.

Cleanliness at installation is the primary consideration in hydraulic plumbing. This bulletin outlines the steps and precautions to be taken at installation and provides a detailed procedure for flushing a hydraulic system.



RESERVOIR

The reservoir should be thoroughly cleaned and painted before installation in the system. Inside, the reservoir should be painted with a sealer to minimize oxidation which can be caused by condensation. The sealer must be a composition that will not react chemically to the hydraulic fluid. Some fire-resistant fluids require special sealers other than that used for standard mineral-based fluids. Suitable sealers usually can be recommended by the fluid supplier.

PLUMBING AND FITTINGS

All lines should be smooth and clean on the inside. If the line is threaded, be sure to ream the end until the inside burr is removed. Burred edges not only obstruct flow but also may break off and contaminate the fluid later. When applying sealer compound, the two end threads are kept free of compound to avoid contamination. Sand blasting, degreasing and pickling are recommended for thoroughly cleaning lines prior to installation. Limit sand blasting to pieces where there is no danger that sand particles might remain lodged after the piece is flushed clean.

If possible, blow compressed air through the lines to evaporate the solvent and remove any dust that may have collected. For safety reasons, when blowing with compressed air, always make sure the air isn't blown into open machinery or at people. Once a tube or fitting has been cleaned, open ends should be capped and plugged immediately and left covered until installation. Rags or waste should not be used for this purpose, because they may deposit harmful lint which can cause severe damage in a hydraulic system.

MAINTENANCE

A good preventive maintenance program includes periodically draining and cleaning the reservoir and flushing with a solvent compatible with the hydraulic fluid being used. Periodic inspection and sampling of fluid will dictate whether flushing the system is required.

A sample of fluid that is representative of that in circulation should be taken (not from the bottom of the reservoir). If it is cloudy, off-color, contains suspended sediment, or if on standing, shows separate sediment or liquid layers, then changing the fluid charge is recommended. Prior to installation of a new fluid charge is an ideal time to clean and flush the system.

RESERVOIR CLEANING

The reservoir in a hydraulic system is a settling basin for any contamination. Although there are other places in the plumbing where contaminants may accumulate, the reservoir is usually where the majority of them will settle. If inspection shows that the fluid is in poor condition, the fluid should be drained and the reservoir cleaned.

Remove all accumulated sediment of other forms of contamination from the bottom of the reservoir. Wipe down the interior of the reservoir to remove any further impurities. After the reservoir is thoroughly cleaned, the system can be refilled with new fluid.

While on the subject of reservoirs, the inside of large reservoir covers is often one of the most neglected parts of a system. Although not many mobile applications require a reservoir of this size, if one is used in a mobile application, it can be the source of rust contaminating the system. A large cover is subject to condensation and vibration; thus, as rust forms it flakes off into the hydraulic fluid.

Be sure to thoroughly clean and then paint the underside of a cover before reinstalling it. In severe cases, an aluminum cover may be the answer. Self-tapping screws to hold covers in place are "taboo" unless they go into blind holes.

FLUSHING SYSTEM

If contamination is evident in fluid samples, then chances are accumulation has occurred somewhere within the plumbing. The only way to effectively remove accumulated contaminants and thoroughly clean the entire system is by flushing. This is done by circulating a small percentage of special petroleum solvent cleaner with the fluid charge long enough to loosen and remove the deposits. The fluid should then be drained while it is hot, the reservoir cleaned manually as previously outlined, and the system flushed.

The most effective way to clean a hydraulic system is to first drain the dirty fluid from the system; then clean the reservoir and add clean fluid with the solvent added. Flushing is usually most effective at about 150°F. The fluid should remain in the system from 10 to 50 hours depending on the condition. A careful watch on the filters will indicate when the system is clean.

After removing the flushing liquid used for cleaning, it is recommended to flush the system first with clean hydraulic fluid to pick up the remaining cleaner. Then drain the system again and check filters and bottom of the reservoir.

SOLVENTS

Fluid suppliers are the best source for recommended solvents. Solvents such as alcohol, kerosene, carbon tetrachloride and others should not be used.

Because it is impossible to remove all of the cleaning solvent from the system, these low viscosity materials tend to reduce the viscosity of the new fluid.

Another thing to remember is that a low-viscosity solvent may not hold in suspension the contaminants it washes off a surface. The contaminant then settles in another part of the system and may not flush out.

CONCLUSION

For prolonged service life, contamination must be periodically removed from hydraulic systems. Most of this effort can be saved if adequate steps are taken to prevent contaminants from entering the system in the first place. New systems not properly installed may be contaminated.

Once the system is in operation, proper periodic cleaning will prevent component failure and prevent system downtime. Remember, hydraulic components are more costly than fluid.

Service Letter

HYDRAULIC OIL CHANGES

Good maintenance practice makes it desirable to keep condition of the hydraulic oil under observation. If the oil is kept clean, is in good chemical condition, and its viscosity meets the operating temperature range, it should be left in the vehicle.

No hard and fast rule can be laid down for making oil changes because of the great variety of service conditions. Therefore, only experience can truly dictate how long the service period must be for a particular application. In one instance, changes every 100 hours for systems in hard continuous service will give good protection. On the other hand, when the oil filter element is replaced frequently, service conditions are favorable, the hydraulic oil may be in service for thousands of hours. However, periodic test by the oil supplier are recommended to confirm suitability for continued use.

Some of the considerations affecting life of the hydraulic oil are operating temperature, type of service, contamination, filtration, and the quality of the oil.

WHAT OIL TO USE - WHEN TO CHANGE

The basic recommendations for oils are those that meet the A.P.I. service classification M.S. (Engine

sequence tested oils). These oils give the assurance of adequate wear protection and excellent chemical stability under mobile operation conditions.

Oil companies may have different types of oils that provide wear protection and chemical stability. Vickers will be glad to offer concurrence with your oil suppliers recommendations for formulations or brands.

For extremely wide seasonal variations, the viscosity grade of oil should be changed in Spring and Autumn as is done with automobile engines. To get the best service life, change to MS, 10W, for temperatures below freezing and MS, 5W, or 5W20 for extreme cold below 0°F. Use heavier viscosity oil for operating temperatures above 180°F. If the vehicle is to be shipped in the Fall, Winter, or early Spring, ship it with a low viscosity oil.

In special cases, such as hydrostatic transmissions, control mechanisms might require different viscosity oils. These will be outlined in the OEM's operation and maintenance manuals.

DRAIN THE SYSTEM

When draining the system it is de-

10-19-73

2 2

irable to remove ALL of the used oil. Allow sufficient time for thorough draining so that a minimum of the old oil remains in the system. In most cases, bleeding at the lowest point in the system will help. It is also advisable to drain only after the oil is fully warmed up. By doing this, oil impurities do not have a chance to settle out and can be removed with the drained oil.

Systems which have accumulated deposits to interfere with the operation of the vehicle must be flushed with light viscosity oil. Flush with an oil containing a rust inhibitor because it protects metal surfaces against rust formation after draining out the hot flushing oil.

When hydraulic oil is added to replenish the drained system, it should always be poured through a 25 micron filter. If such a filter is not available, a funnel with a fine wire screen (200 mesh or better) can be used. It is important that

oil be clean and free of all substances which will cause improper operation and excessive wear of any unit in the system.

WHAT TO DO IF A PUMP OR MOTOR FAILS

When a hydraulic pump or motor fails, the system is contaminated. Remove the unit for repair. After removal, the reservoir must be drained and the oil thrown away. The reservoir must be flushed and cleaned to remove all contamination. Lines, cylinders, and valves, must be flushed to remove all contamination. Cylinders and valves should be inspected for wear.

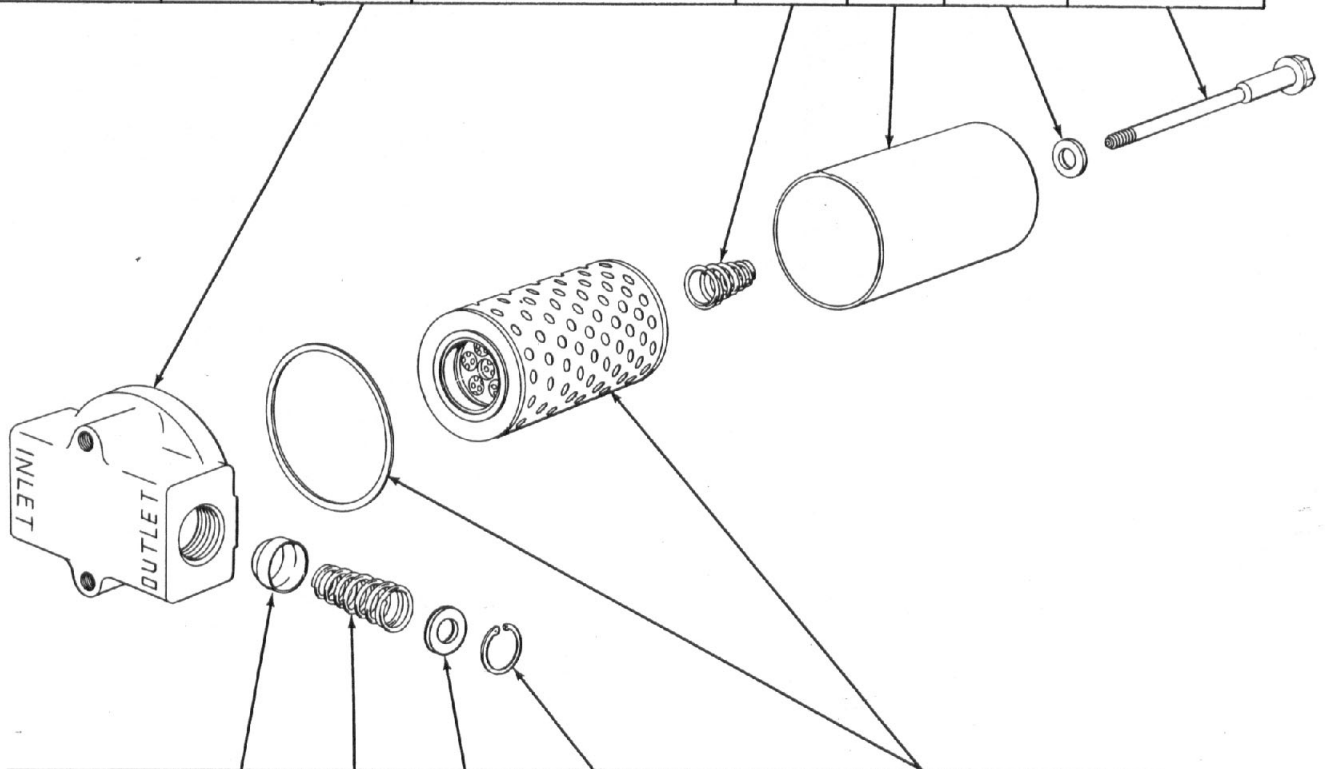
Filters must have new cartridge elements installed. Any return lines without filters should have auxiliary filters installed of at least 25 micron rating, adequate to handle maximum flow encountered, without bypassing. The system should then be started up. After 40-50 hours any auxiliary filters may be removed.

This procedure will enable you to start with a clean system, with new MS oil.

**Service Parts
Information**

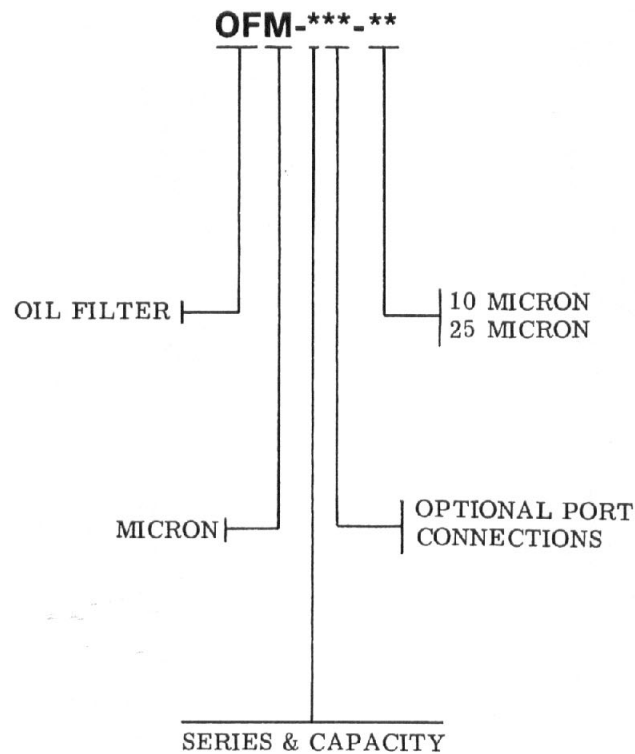
**OFM SERIES -100, -200 & -300
LOW PRESSURE RETURN LINE FILTERS**

MODEL	CAPACITY (GPM)	BASE	PORT CONNECTION	SPRING	BODY	WASHER	BOLT
OFM-100-**	0-50	936965	1" 4-BOLT FLANGE	936955	263231	936949	936947 TORQUE TO 12-15 LBS. FT.
OFM-101-**		936967	1" PIPE THREAD				
OFM-102-**		936974	1" TUBE				
OFM-200-**	0-125	936975	1-1/4" 4-BOLT FLANGE	936958	936954	936950	936948 TORQUE TO 30-35 LBS. FT.
OFM-201-**		936977	1-1/2" 4-BOLT FLANGE				
OFM-202-**		936978	1-1/2" PIPE THREAD				
OFM-300-**	100-300	936980	2" 4-BOLT FLANGE				
OFM-301-**		936889	2-1/2" 4-BOLT FLANGE				



MODEL	POPPET	SPRING	WASHER	SNAP RING	SINGLE FILTER ELEMENT KIT (INCLUDES SEAL)	THREE-PAK ELEMENT KIT (INCLUDES SEAL)
OFM-1**-10	936944	936941	938375	87764	923069	923115
OFM-1**-25		939000			922788	923116
OFM-2**-10	936945	936942	938376	936939	923070	923117
OFM-2**-25		939001			922789	923118
OFM-3**-10	936946	936943	936854	936940	923070	923117
OFM-3**-25		939002			922789	923118

MODEL CODE BREAKDOWN



OFM FILTERS, IN THEIR STANDARD FORM, ARE APPROVED FOR USE WITH WATER-GLYCOL, PHOSPHATE ESTER AND CHLORINATED HYDROCARBON FIRE-RESISTANT FLUIDS. THEY ARE NOT RECOMMENDED FOR USE WITH WATER AND OIL EMULSIONS.

Agincourt
Louis LeBlanc
297-3121

5N-1106
Model 220 RRC
Braden
Model Hoist

C2H16 ↗

stripped final planet gear

entire winch

30512-72

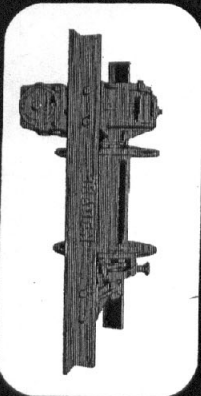
\$ 10574.78

6 web

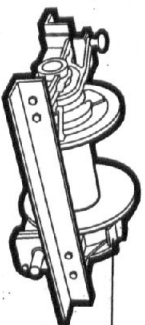
MATERIAL LIST

BRADEN

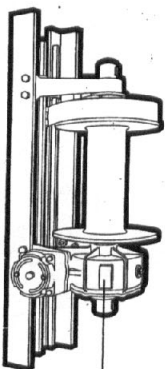
AMSU10



TIPS ON ORDERING PARTS FOR YOUR BRADEN WINCH



LOW-MOUNT MODEL



UPRIGHT MODEL

WINCH MODEL NUMBER
WINCH SERIAL NUMBER

Most Braden winches have a raised pad on the housing which is embossed with the model and serial numbers of the winch. Since both of these numbers are extremely important in the shipment of the proper replacement parts, your order should always reference these numbers.

FOR BEST RESULTS, USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS!

TO ORDER —

- (1) List model and serial numbers of the winch.
- (2) Refer to exploded view and select the component(s) needed and note item number.
- (3) Find item number on material list, show part number, description and quantity required on your order.
- (4) Refer to Parts Price List and show price for each component or assembly.

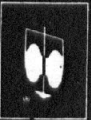
New updated Braden parts sheets contain both the 5-digit computer number as well as the catalog number for all parts. Eventually, when it is feasible, parts lists will contain 5-digit numbers only and all parts which can be so marked will be stamped with this number.

Refer to the manual "Control and Drive Groups" for parts information on levers, flexible controls, gasket kits, mounting and driving kits, universal joint and shaft groups and attaching groups.

The Parts and Service Division is an autonomous division and carries a large parts inventory in a special area detached from units parts storage. This makes it possible to service customer requirements in an expeditious manner.

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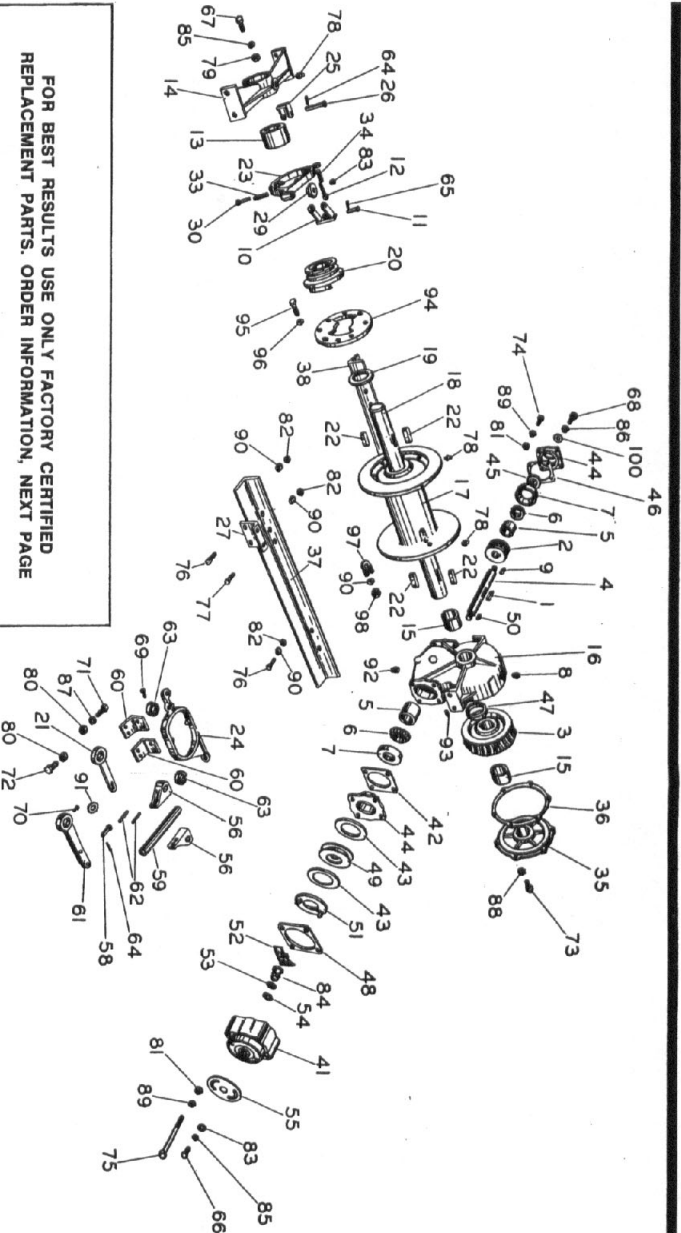
12-7401-28



BRADEN WINCH

DIVISION OF BRADEN INDUSTRIES, INC.
PHONE: 918—251-8511 • BROKEN ARROW, OKLAHOMA 74012

BRADEN AMSU10-12F, AMSU10-12FA, MSU10-12F, MSU10-12FA — COMPONENTS



FOR BEST RESULTS USE ONLY FACTORY CERTIFIED REPLACEMENT PARTS. ORDER INFORMATION, NEXT PAGE

MATERIAL LIST VARIABLES
 AMSU10-12F, AMSU10-12FA, MSU10-12F, MSU10-12FA

ITEM	DESCRIPTION	AMSU10-12F				AMSU10-12FA				MSU10-12F				MSU10-12FA				
		S-DIGIT NO.	PART NO.	REQ. NO.	REQ. NO.	S-DIGIT NO.	PART NO.	REQ. NO.	REQ. NO.	S-DIGIT NO.	PART NO.	REQ. NO.	REQ. NO.	S-DIGIT NO.	PART NO.	REQ. NO.	REQ. NO.	
18	Cabin Drum Shaft	2272	AMSU10-138	1	2272	AMSU10-138	1	2272	AMSU10-138	1	2272	AMSU10-138	1	2272	AMSU10-138	1	2272	AMSU10-138
21	Chain Shifter Lever	11388	MUS-243	1	11388	MUS-243	1	11388	MUS-243	1	11388	MUS-243	1	11388	MUS-243	1	11388	MUS-243
24	Shifter Fork	11458	MUS-145G	1	11392	MUS-343	1	11392	MUS-343	1	11392	MUS-343	1	11392	MUS-343	1	11392	MUS-343
27	Shifter Fork Bracket	1842	MU-143D	1	1802	MU-143C	1	1802	MU-143C	1	1802	MU-143C	1	1802	MU-143C	1	1802	MU-143C
28	Shifter Knob	11310	MU-143E	1	1130	MU-143E	1	1130	MU-143E	1	1130	MU-143E	1	1130	MU-143E	1	1130	MU-143E
33	Knob Spring	12963	MU-146F	1	12927	MU-246F	1	12927	MU-246F	1	12927	MU-246F	1	12927	MU-246F	1	12927	MU-246F
37	Rear Base Angle	12923	MU-146F	1	12923	MU-246F	1	12923	MU-246F	1	12923	MU-246F	1	12923	MU-246F	1	12923	MU-246F
38	Rear Base Angle	11027	MU-146F	1	11027	A-563B	2	11027	A-563B	2	11027	A-563B	2	11027	A-563B	2	11027	A-563B
58	Control Shaft Bearing	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F
59	Control Shaft	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F
60	Control Shaft Bracket	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F	1	11289	MU-146F
62	Control Lever	11878	MU-190	2	11878	MU-190	2	11878	MU-190	2	11878	MU-190	2	11878	MU-190	2	11878	MU-190
64	Key	11033	6-184	2	11033	6-184	2	11033	6-184	2	11033	6-184	2	11033	6-184	2	11033	6-184
65	Collar	18008	D12-100	1	18008	D12-100	1	18008	D12-100	1	18008	D12-100	1	18008	D12-100	1	18008	D12-100
66	Shifter	12923	S031-08S0TK	2	12923	S031-08S0TK	2	12923	S031-08S0TK	2	12923	S031-08S0TK	2	12923	S031-08S0TK	2	12923	S031-08S0TK
67	Small Bearing Capscrew	11772	S031-12PHS	2	11772	S031-12PHS	2	11772	S031-12PHS	2	11772	S031-12PHS	2	11772	S031-12PHS	2	11772	S031-12PHS
71	Large Bearing Capscrew	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS
77	Small Bearing Capscrew	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS	1	13838	S050-12PHS
80	Hex Nut	11780	S037P	6	11780	S037P	6	11780	S037P	6	11780	S037P	6	11780	S037P	6	11780	S037P
81	Lockwasher (%)	18003	A037	6	18003	A037	6	18003	A037	6	18003	A037	6	18003	A037	6	18003	A037

BASIC MATERIAL LIST
 AMSU10-12F, AMSU10-12FA, MSU10-12F, MSU10-12FA

ITEM	DESCRIPTION	S-DIGIT NO.	PART NO.	REQ. NO.
1	Worm Key	11484	M12-200A	1
2	Worm, Left	11054	C-200L	1
3	Worm Gear, Right	11287	M59-40R	1
4	Worm Gear, Left	11286	M59-40L	1
5	Worm Shaft	11485	M8-200S	2
6	Bearing Cup	18002	C-100A	2
7	Worm Drive	18002	MU-190	2
8	Worm Pinion	18002	ES-070S	2
9	Worm Key	11566	M5-311A	1
10	Brake Shoe Assy.	88010	M5-311-D	1
11	Brake Link Pin	18017	MU-131B	1
12	Brake Link	11587	M5-131L	1
13	Bearing Lub Bushing	11031	B-348B	1
14	Worm Housing Bushing	11031	B-348B	1
15	Worm Housing Flushing	81085	MU-134-D	2
16	Cable Drum	11204	MSU12-135	1
17	Retaining Ring	11046	B3-139	1
18	Clutch	11283	M58-141	1
20	Shifter Fork Bracket	22725	MU-143D	4
21	Pivotal Pin	18021	MU-143B	1
22	Drag Brake Spring	18002	A-145B	1
26	Worm Housing Cover Assy.	81053	M59-144-D	1
34	Worm Housing	11709	M6-144G	1
35	Worm Gear	11813	M5-146	2
36	Worm Gear Housing	11943	M5-146	2
41	Bearing Container Gasket (%)	11006	A-248A	2
42	Bearing Container	22728	AMS10-148	2
43	Grass Seal	11006	A-248A	2
44	Grass Seal	11006	M5-146G	2
45	Bearing Container Gasket (%)	11281	M58-139	2
46	Thrust Ring	11595	M5-150G	1
47	Brake Housing Gasket	81114	M5-151-D	1
48	Brake Housing	11810	M5-263	1
49	Brake Rod Assy.	88006	M12-258-D	1
50	Adjusting Nut Washer	11601	M5-157A	1
51	Adjusting Nut Gasket	11601	M5-157B	1
52	Adjusting Plate	11002	M5-188	1
53	Adjusting Plate Washer	26957	S021-205L	1
54	Adjusting Nut Washer	13880	S022-17PHS	2
55	Adjusting Nut Gasket	11047	B043-07PH5	1
56	Adjusting Nut	21964	S043-10PH5	1
57	Control Shaft	12923	S043-10PH5	4
58	Control Shaft Bracket	22699	S043-10PH5	4
59	Control Shaft	22699	S043-10PH5	4
60	Control Shaft Bracket	22699	S043-10PH5	4
61	Control Shaft	22699	S043-10PH5	4
62	Control Shaft Bracket	22699	S043-10PH5	4
63	Control Shaft	22699	S043-10PH5	4
64	Control Shaft Bracket	22699	S043-10PH5	4
65	Control Shaft	22699	S043-10PH5	4
66	Control Shaft Bracket	22699	S043-10PH5	4
67	Control Shaft	22699	S043-10PH5	4
68	Control Shaft Bracket	22699	S043-10PH5	4
69	Control Shaft	22699	S043-10PH5	4
70	Control Shaft Bracket	22699	S043-10PH5	4
71	Control Shaft	22699	S043-10PH5	4
72	Control Shaft Bracket	22699	S043-10PH5	4
73	Control Shaft	22699	S043-10PH5	4
74	Control Shaft Bracket	22699	S043-10PH5	4
75	Control Shaft	22699	S043-10PH5	4
76	Control Shaft Bracket	22699	S043-10PH5	4
77	Control Shaft	22699	S043-10PH5	4
78	Control Shaft Bracket	22699	S043-10PH5	4
79	Control Shaft	22699	S043-10PH5	4
80	Control Shaft Bracket	22699	S043-10PH5	4
81	Control Shaft	22699	S043-10PH5	4
82	Control Shaft Bracket	22699	S043-10PH5	4
83	Control Shaft	22699	S043-10PH5	4
84	Control Shaft Bracket	22699	S043-10PH5	4
85	Control Shaft	22699	S043-10PH5	4
86	Control Shaft Bracket	22699	S043-10PH5	4
87	Control Shaft	22699	S043-10PH5	4
88	Control Shaft Bracket	22699	S043-10PH5	4
89	Control Shaft	22699	S043-10PH5	4
90	Control Shaft Bracket	22699	S043-10PH5	4
91	Control Shaft	22699	S043-10PH5	4
92	Control Shaft Bracket	22699	S043-10PH5	4
93	Control Shaft	22699	S043-10PH5	4
94	Control Shaft Bracket	22699	S043-10PH5	4
95	Control Shaft	22699	S043-10PH5	4
96	Control Shaft Bracket	22699	S043-10PH5	4
97	Control Shaft	22699	S043-10PH5	4
98	Control Shaft Bracket	22699	S043-10PH5	4
99	Control Shaft	22699	S043-10PH5	4
100	Control Shaft Bracket	22699	S043-10PH5	4

NOTE: Refer to "Material List Variables" for items not shown in basic material list.

HUNTER HEATERS

Installation
Operation
Service

1416 Graham Lane
Burlington
LA 78163
TX AUS 257

ARCTIC

Burlington
Arctic Furnace

416-637-3468

Hand Forms

Dealer:
VAN KIRK Heating Systems
105 SCARSDALE
Dunell
Tel. 267-3501
New York
416-836-6908
North on
Holloway
King 9 11

Hand
and Mr. L. E. Williams
and Mrs. S. - Adams
y...



Models

UH-47-6LP
12 Volts D.C.
(24 Volts D.C.)

HUNTER MANUFACTURING CO.

30525 Aurora Road

Solon, Ohio

WARNING

DO NOT OPERATE HEATER IN AN ENCLOSED AREA UNLESS THE EXHAUST GASES ARE PIPED TO THE OUTSIDE. EXHAUST GASES MAY CONTAIN CARBON MONOXIDE, A COLORLESS, ODORLESS AND POISONOUS GAS.

BEFORE PERFORMING ANY MAINTENANCE OR INSPECTION OTHER THAN OPERATING TESTS OF THE UNIT, DISCONNECT THE POWER SOURCE.

DO NOT OPERATE THE HEATER WITH THE COVERS OFF.

ADDENDUM SHEET

UH-47-6LP INSTALLATION INSTRUCTIONS
(FORM H-317)

PLEASE NOTE: The following instructions inadvertently were left out of this manual when printed. Please read before beginning installation.

1. To install the Hunter model UH-47-6LP in any position but horizontal, it will be necessary to rotate or otherwise adjust the mercury over-turn switch so that the pigtailed always come off the bottom of the switch, otherwise the electrical circuit will be open.
2. The fuel supply (propane) must be from a gas bottle designed for or modified for vapor take-off only. When installing the gas bottle be sure to use the regulator and excess flow valve supplied with the heater. It is to be installed in the gas valve on the bottle. The excess flow valve is a safety requirement of D.O.T., National Highway Administration.
3. Fuel line should be 3/8". If available, a short piece of flexible line may be used at the regulator to make bottle changing more convenient. This should be approved 300 lb. test neoprene hose such as normally can be obtained from any reliable LP gas supplier.

HUNTER MANUFACTURING COMPANY
30525 AURORA ROAD
CLEVELAND (SOLON), OHIO 44139

TABLE OF CONTENTS

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INSTALLATION AND OPERATING INSTRUCTIONS

FOR HUNTER MODEL UH-47-6LP HEATER

SECTION I

DESCRIPTION

The UH-47-6LP Heater is a propane burning, thermostatically controlled heating device. Air for combustion and air for heat circulation are provided for by a 12 volt motor/blower assembly. Spark for combustion is a 12 volt ignition system, which consists of a high tension coil, vibrator, and igniter.

This product is the result of controlled testing, experimentation and a background of experience in the design and manufacture of military and civilian heating equipment.

The UH-47-6LP Heater is primarily intended to heat truck cabs and medium size truck bodies. However, the compact and relatively lightweight design allows this heater to be used in many special applications where additional heat is required but space is limited.

SPECIFICATIONS

Basic Case Dimensions	6-1/4" x 12" x 15-1/2"
Weight	24 lbs.
Shipping Weight	30 lbs.
Diameter Heated Air Outlet	5"
Exhaust Outlet	1-1/4" Dia. Standard Steel Pipe
Heat Exchanger	Stainless Steel Cross Flow Air Delivery
Electrical Supply	12 Volt D. C. 5 Amp (24 Volt D. C. 3 Amp)
Fuel Consumption (Input)	Approx. 1 Lb/Hr. - on high thermostat setting
Fuel Control	Electrically Operated Solenoid Valve
Burner	Fixed Jet Type
Ignition	Vibrator and High Tension Coil
Control on Heater	Standard
Remote Control	Optional

AUXILIARY EQUIPMENT - TO BE ORDERED SEPARATELY

Defroster Duct Adapter	Part No. 1-47060
Duct Adapter for 4" duct	Part No. 47744
Remote Control Kit	Part No. 1-47797
Drivers Service Kit	Part No. 1-47444

BEFORE INSTALLING

1. Inspect the entire heater for damage or lost parts which may have occurred during shipment.
2. Inspect the controls for loose or missing hardware.
3. Inspect all lines, tubing, and fittings to see that they are secure and free of breaks, kinks or other damage.

NOTE: A Warranty Card is packed with each heater leaving the factory. Attached is a return postal card. It is the duty of the dealer to insure that both the owner's copy and the registration card be completed and the registration card returned to Hunter Manufacturing Company. To be certain that you obtain the benefits of the above warranty, this card should be returned within ten (10) days from the date you purchased this equipment.

SECTION II

INSTALLATION INSTRUCTIONS

THE FOLLOWING GENERAL INSTRUCTIONS ARE INTENDED TO PROVIDE SUFFICIENT INFORMATION TO INSTALL THE HEATER PROPERLY.

The heater is normally installed within the compartment being heated. It can be installed at some point not within the compartment being heated by using a flexible heat duct and remote control kit. If the heater is installed outside it should be protected from the weather by some type of enclosure.

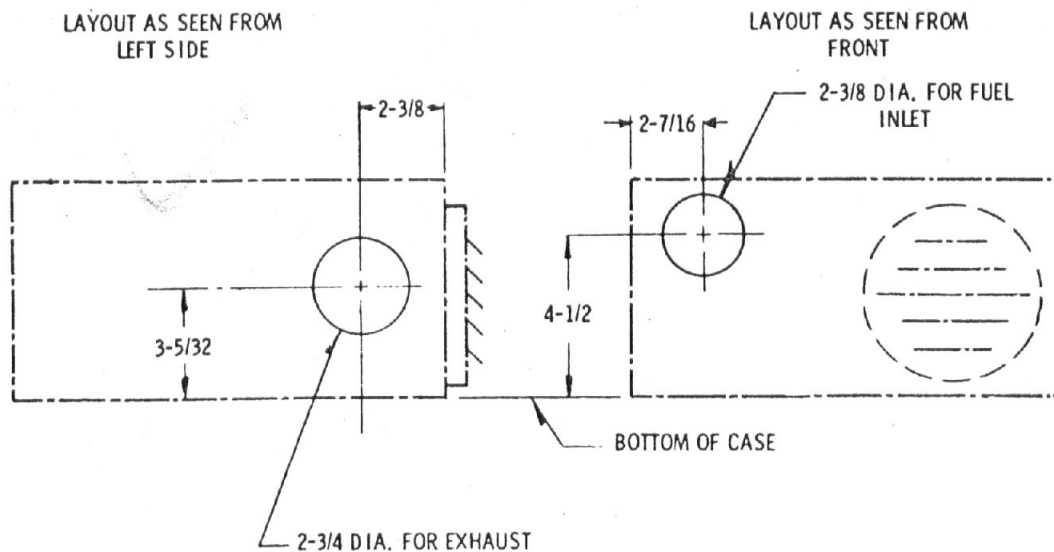


Figure 1. Model UH-47-6LP Heater, Mounting Dimensions.

A. LOCATION

THE FOLLOWING POINTS SHOULD BE OBSERVED WHEN DETERMINING AND INSTALLATION LOCATION FOR THE HEATER:

1. There should be sufficient clearance allowed to permit air to circulate around the heater case. Minimum 2" for top and sides.
2. The exhaust must be piped directly to the outside, well away from the heated compartment. DO NOT TERMINATE EXHAUST PIPE WHERE EXHAUST GAS CAN RE-ENTER PERSONNEL COMPARTMENT THROUGH WINDOWS OR OTHER OPENINGS, OR GATHER IN POCKETS BENEATH VEHICLE.
3. The heated air outlet should not be restricted or blocked.
4. Before making any permanent connections or bolted installations, cut or drill all holes which may be required by the following paragraphs B through E. Also see Figure 1.

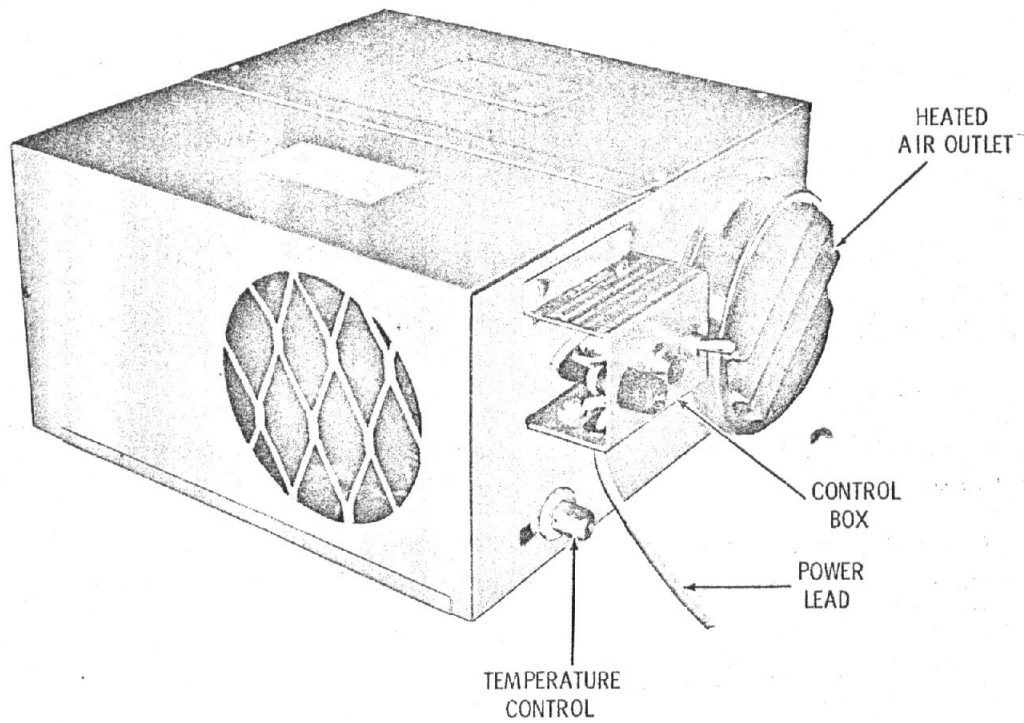


Figure 2. Model UH-47-6LP Heater, 3/4 front view.

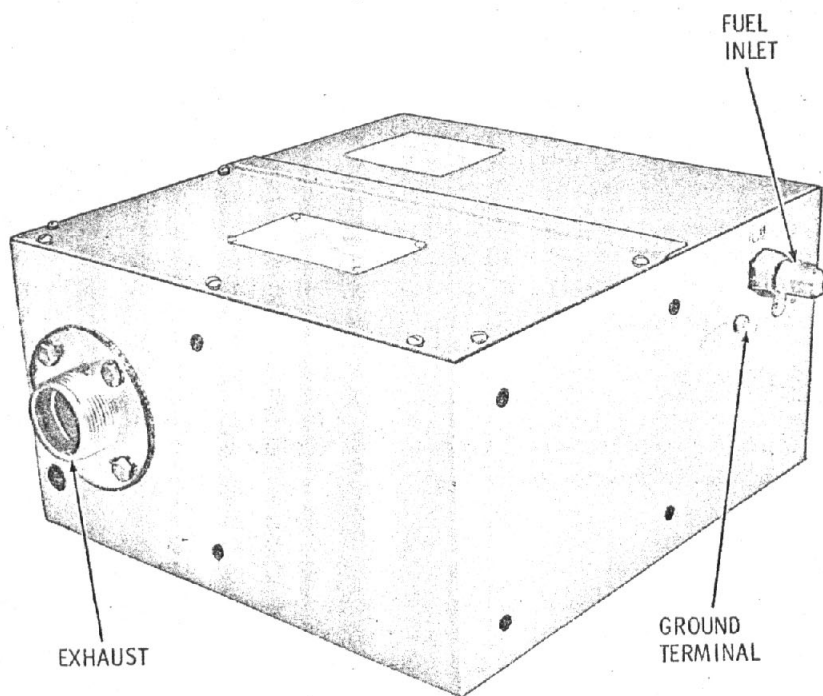


Figure 3. Model UH-47-6LP Heater, 3/4 rear view.

B. EXHAUST SYSTEM

Temporarily secure heater using angle brackets supplied with heater.

Parts furnished:

One 90° elbow 1-1/4" standard steel pipe, Part No. 46006

One nipple 1-1/4" standard steel pipe, Part No. 47008

One insulator, Part No. A-47023

The parts furnished should be sufficient to properly direct the exhaust outside the heated compartment.

1. Determine where the exhaust pipe will pass through the heated compartment and cut a 2-3/4" diameter hole for mounting the exhaust insulator.
2. Bolt the exhaust insulator in position.

NOTE: The exhaust gases must not be permitted to collect in pockets or to return to the heated compartment through leaks.

3. Connect the exhaust system using the 90° elbow or 1-1/4" pipe coupling and pipe nipple provided.
4. Once outside, the exhaust system should be further extended so that the exhaust gases are carried well away from the heated compartment. Extension of the exhaust system can be accomplished with standard 1-1/4" steel pipe. If the installation necessitates an elaborate exhaust system, with bends, etc. , it may be more advantageous to use thinwall electric conduit or flexpipe. By using an ESM box connector and adapter either 1-1/4" or 1" conduit can be connected to the 1-1/4" standard steel pipe to extend the exhaust.

C. GROUND CONNECTION

A ground line should be connected between the heater ground terminal and the vehicle motor block or chassis.

D. ELECTRICAL LEAD

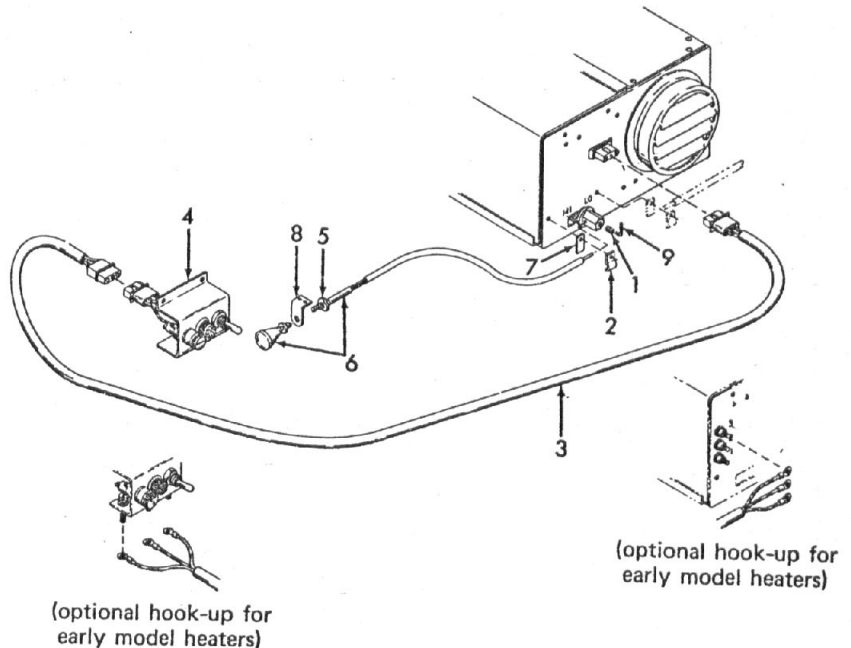
A six foot length of #12 insulated copper wire is included with the heater. Connect the electrical lead to a good power source; i. e. , battery, starter solenoid, or accessory panel of the vehicle.

E. REMOTE CONTROL HOOKUP KIT (Refer to Fig. 4) (Optional)

NOTE: Disconnect electrical power supply before installing this kit.

1. Remove the control box from the front of heater.
2. Mount the control box in a convenient location which is within reach of the wiring harness provided.
3. Hook up the color coded 3 cable harness. Use one color wire to connect the Number 1 terminals. Use another color wire to connect the Number 2 terminals. Use the remaining wire to connect the Number 3 terminals. On later models, plug in the cable harness.
4. Determine a mounting location for the push pull control cable. The location should be such that the cable can reach the heater with a minimum number of bends. Mount the bracket with the screws provided. Remove the large locknut from the cable. Thread the cable through the hole in the bracket and then through the locknut. Lock the cable in the bracket using the locknut behind the bracket.
5. To attach the cable to the heater, push the cable knob all the way "in" and place the heater control knob in the extreme LO position.
6. Using the hex key provided, loosen the setscrew in the heater control knob. Thread the cable wire through the cross drilled hole in the heater control knob. Fasten the cable in place between the rod clip and spacer provided with the kit. The rubber cable sheath should be even with the inside edge of the rod clip. Once the cable is clamped in place and the heater control knob is in the extreme low position, the setscrew must be tightened to hold the cable wire in position. The heater control knob should move freely from the LO to HI positions as the cable control knob is pulled and pushed.
7. The control cable may be installed from the opposite side of the heater. Remember that the control knobs will operate in reverse of the installation described above.
8. The ON-OFF switch on the control box must still be used to shut the heater off completely.

Index Number	Part Number	Description
1	13802	Setscrew
2	8104	Rod Clip
3	2-47792	Harness (3 cable)
4		Control Box (part of Heater Assembly)
5	5762	Lock Nut
6	6357	Push Pull Control
7	47657	Spacer
8	47483	Bracket
9	6318	Hex Key



Kit No. 1-47797 fits both early and late model heaters.

Figure 4. (Optional) Remote Control Hookup.

SECTION III

OPERATING INSTRUCTIONS

A. TO START

To start the heater, depress the toggle switch on the control box to the START position. Hold the switch in this position approximately 30 to 45 seconds. When the switch is released, the green pilot light should remain on. If the light goes out, repeat the start cycle. If the light still goes out, move the temperature control knob to a slightly higher setting and repeat the start cycle.

If the pilot light goes out while the heater is operating, a malfunction has occurred in the heater. Turn to the troubleshooting section for possible remedies.

B. TO STOP

Place the toggle switch in the OFF position. This heater is equipped with a purge thermostat and will stop automatically when it has cooled to a factory predetermined point. This feature will prevent the collecting of raw fuel and vapor in the heat exchanger.

SECTION V

SERVICE INSTRUCTIONS

REMOVAL, DISASSEMBLY AND REPLACEMENT OF MAJOR COMPONENTS

BURNER HEAD ASSEMBLY (Refer to Fig. 7)

A. REMOVAL

1. Disconnect high tension lead at igniter.
2. Disconnect fuel line between solenoid valve and burner.
3. Remove the five screws holding burner head to heat exchanger and remove burner head and head gasket.
4. Disconnect combustion air hose.

B. REPLACEMENT

Replacement is reverse of above.

BURNER JET ASSEMBLY

A. REMOVAL

1. Disconnect high tension lead at igniter.
2. Remove igniter.
3. Remove burner head assembly.
4. Loosen and remove burner jet nut.
5. Withdraw burner jet from burner head.

B. REPLACEMENT

Replacement is reverse of above.

HEAT EXCHANGER (Refer to Figs. 6 & 10)

A. REMOVAL

1. Remove burner head.
2. Remove the control assembly by removing the two retaining screws in the case and the heater control knob. Slide the control assembly off the actuating rod.
3. Remove the four screws holding the heat exchanger, and withdraw the exchanger.

B. REPLACEMENT

Replacement is the reverse of the above.

NOTE: Be sure the actuating rod is through the "V" bi-metal blade and bracket on the exchanger before attempting to install the control assembly.

TEMPERATURE CONTROL ADJUSTMENT (Refer to Fig. 10)

NOTE: This adjustment is preset at the factory and does not usually require resetting. The factory setting is made at room temperature. If field adjustments are made at lower temperatures, it may be necessary to reset the temperature control.

1. Place the temperature control knob in the extreme LO position.
2. Loosen setscrew in the brass stop.
3. Hold the actuating rod firmly against the switch actuating lever. Move the brass stop to allow the bi-metal blade approximately 1/16" of free movement. Tighten the setscrew in brass stop.
4. Move the temperature control knob through the complete HI-LO range and check to be sure the bi-metal blade does not bind against the brass stop.

MOTOR BLOWER ASSEMBLY (Refer to Fig. 8)

A. REMOVAL

1. Remove heater covers.
2. Remove thumbscrew and lift off motor hold down strap.
3. Remove nut on solenoid valve hold down stud, and disconnect the motor ground connect.
4. Disconnect electrical leads from motor to terminal strip.
5. Disconnect combustion air hose at burner head.
6. Rotate motor blower assembly (toward center of heater) and lift out of case.

B. CIRCULATING AIR BLOWER DISASSEMBLY

1. Remove motor blower assembly.
2. Remove the air inlet flange on the circulating air housing.
3. Turn the fan so that the setscrew is pointed toward the air outlet and loosen setscrew.
4. Remove fan.
5. Remove back-up plate.

C. CIRCULATING AIR BLOWER REASSEMBLY

1. Reassembly is the reverse of disassembly.
2. When replacing fan, check clearance between inlet flange and top of fan - should be 0.060".

D. COMBUSTION AIR BLOWER DISASSEMBLY

1. Remove three screws from air housing.
2. Match-mark air inlet housing cover and pry off evenly on edge.
3. Loosen setscrew in blower wheel and remove.
4. Remove back plate.

E. COMBUSTION AIR BLOWER REASSEMBLY

Replacement is the reverse of the above.

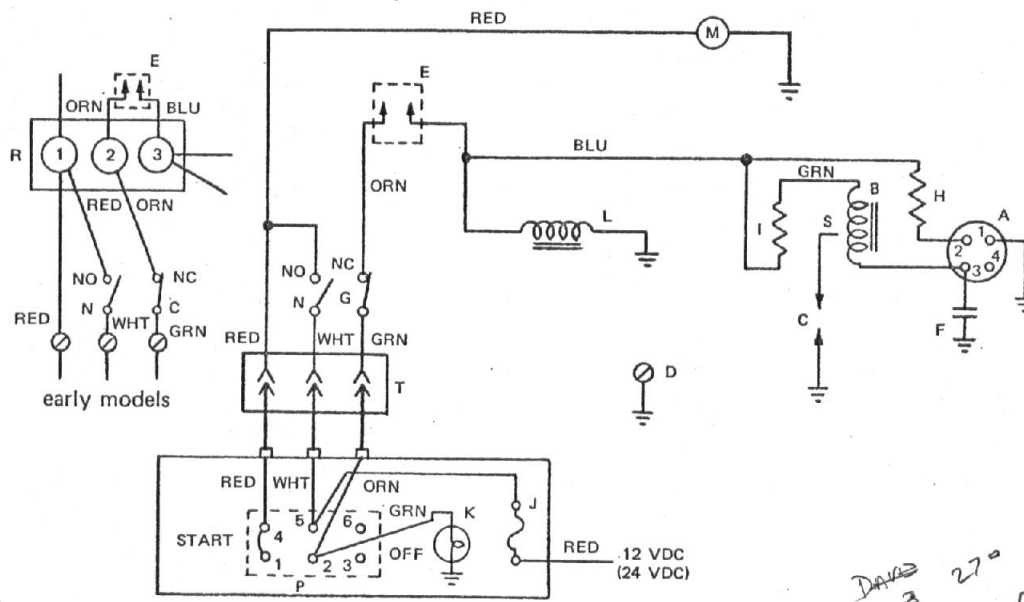
IGNITION COIL (Refer to Fig. 9, item 2)

A. TO REMOVE

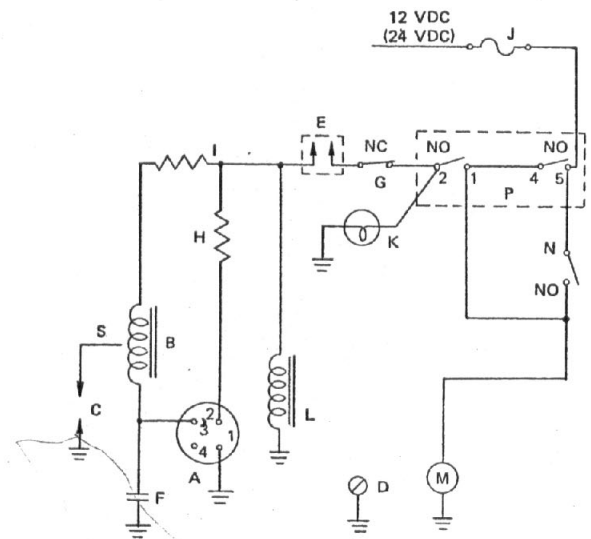
1. Disconnect the high tension lead at coil.
2. Loosen the two nuts holding the electrical connector to the coil and remove the leads.
3. Loosen the clamp holding the coil and remove coil.

B. REPLACEMENT

Replacement is the reverse of the above.



Handwritten notes:
 1-49240
 12V.
 24V.
 1-49660
 Kit + solder
 wire
 Dave 270



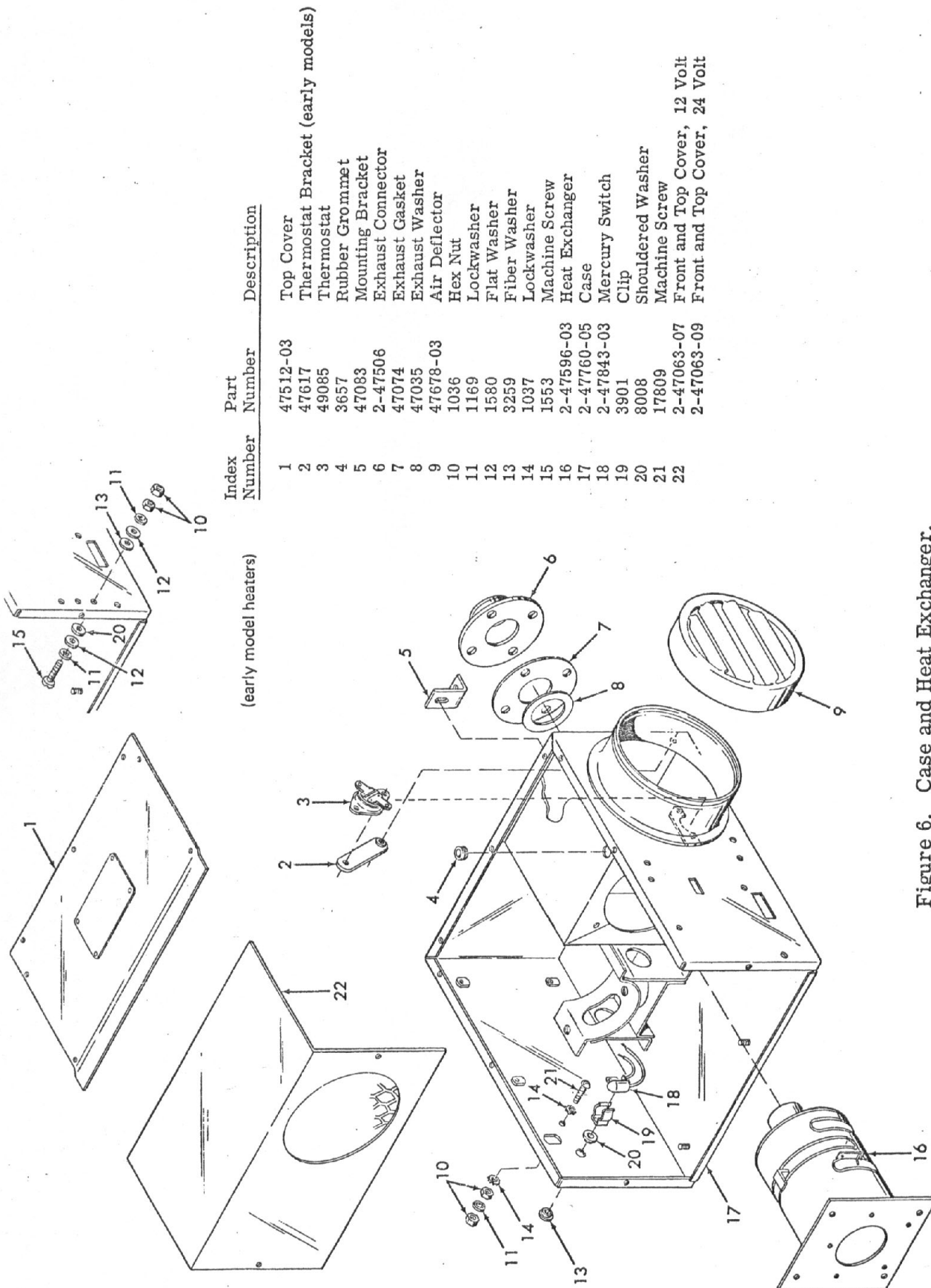
KEY TO DIAGRAM

ITEM	HUNTER PART NO.	
	12 VDC	24 VDC
VIBRATOR	A 43215	43215
SPARK COIL	B	
IGNITER	C 47182	47182
GROUND SCREW	D	
MERCURY SWITCH	E 2-47843-02	2-47843-0
CONDENSER	F 43238	43238
TEMP. CONTROL SW.	G 2282	2282
RESISTOR	H 43228	43239
RESISTOR	I 43227	43209
FUSE 10 AMP.	J 43273	43273
LAMP	K 26243	76243
SOLENOID VALVE	L 2-47796	2-47796-0
MOTOR	M 2-47633	2-47633-0
FLAME SWITCH	N 47431	47431
ON-OFF SWITCH	P 2084	2084
TERMINAL BLOCK	R 6367	6367
IGNITER WIRE	S 2-47456-01	2-47456-0
CONNECTOR	T 1-170595	1-170595

NOTE: Index no. B coil and call out. Prior to S/N 3525 use P/N 1-170168 coil kit.

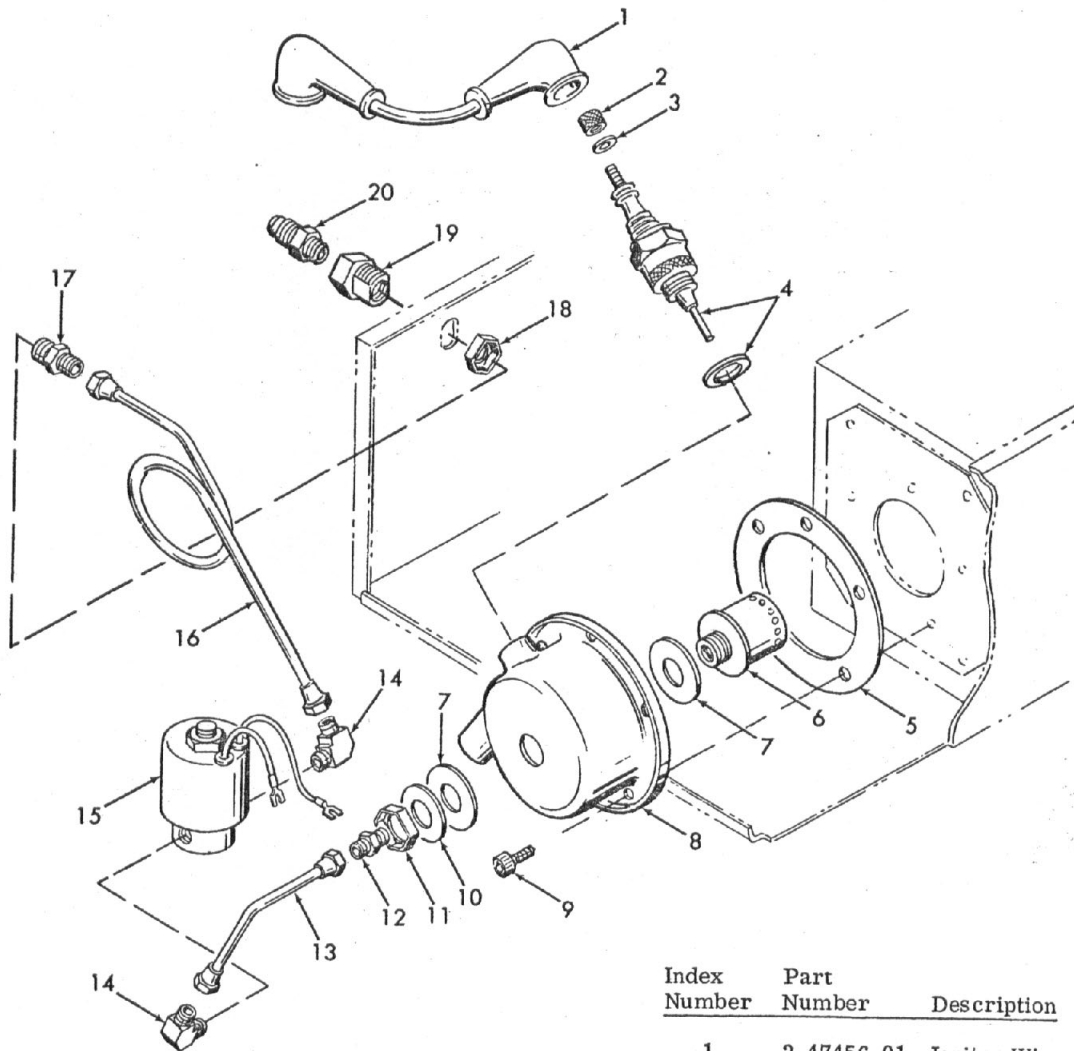
Starting with S/N 3525 use P/N 1-170165 coil. When in doubt use kit no. 1-170168 which will fit all UH47-6LP heaters.

Figure 5. Wiring.



Index Number	Part Number	Description
1	47512-03	Top Cover
2	47617	Thermostat Bracket (early models)
3	49085	Thermostat
4	3657	Rubber Grommet
5	47083	Mounting Bracket
6	2-47506	Exhaust Connector
7	47074	Exhaust Gasket
8	47035	Exhaust Washer
9	47678-03	Air Deflector
10	1036	Hex Nut
11	1169	Lockwasher
12	1580	Flat Washer
13	3259	Fiber Washer
14	1037	Lockwasher
15	1553	Machine Screw
16	2-47596-03	Heat Exchanger
17	2-47760-05	Case
18	2-47843-03	Mercury Switch
19	3901	Clip
20	8008	Shouldered Washer
21	17809	Machine Screw
22	2-47063-07	Front and Top Cover, 12 Volt
	2-47063-09	Front and Top Cover, 24 Volt

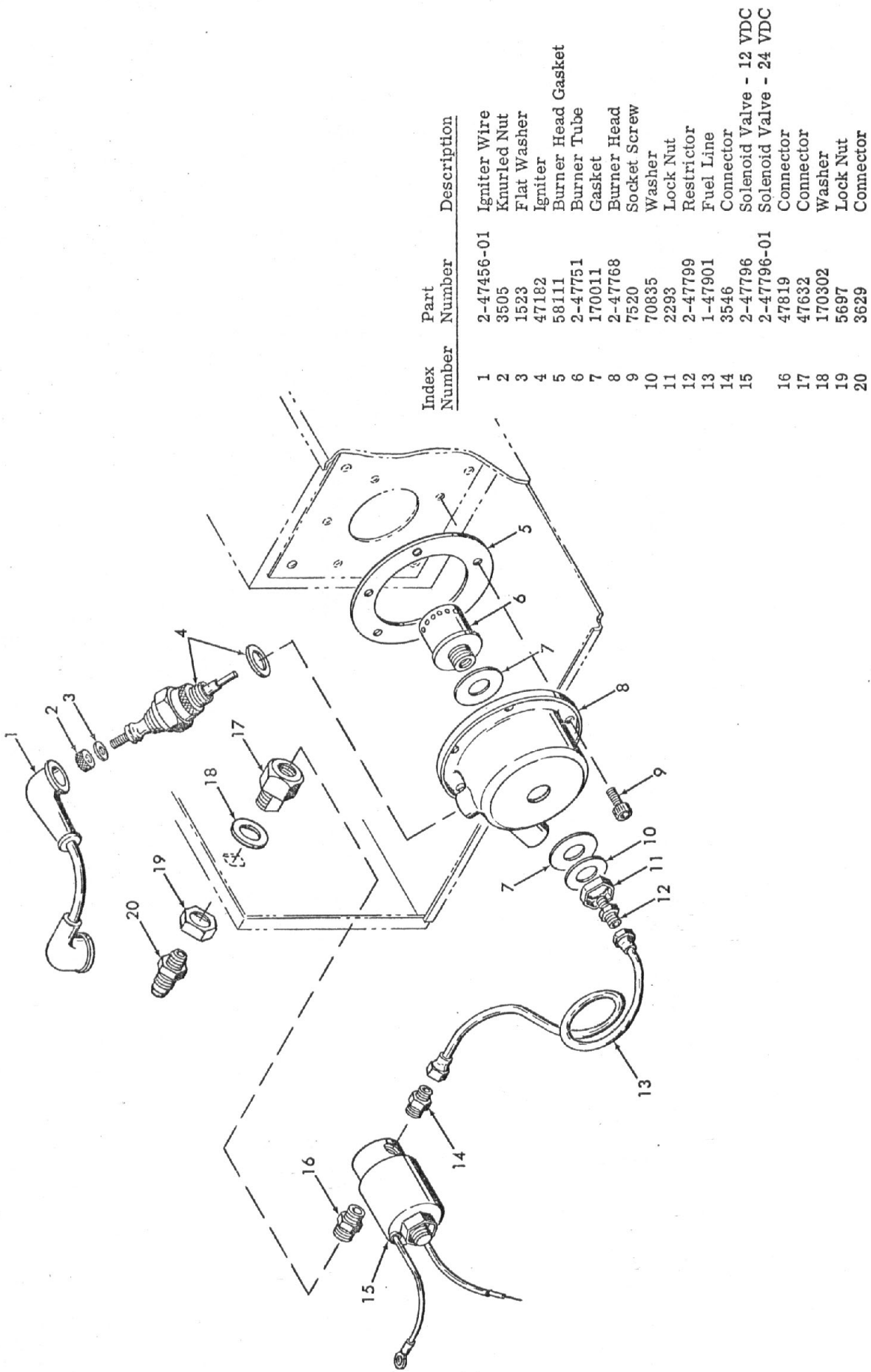
Figure 6. Case and Heat Exchanger.



Index Number	Part Number	Description
1	2-47456-01	Igniter Wire
2	3505	Knurled Nut
3	1523	Flat Washer
4	47182	Igniter
5	58111	Burner Head Gasket
6	2-47751	Burner Tube
7	170011	Gasket
8	2-47768	Burner Head
9	7520	Socket Screw
10	70835	Washer
11	2293	Lock Nut
12	2-47799	Restrictor
13	1-47900	Fuel Line
14	22319	Male Elbow
15	2-47796	Solenoid Valve - 12 VDC
	2-47796-01	Solenoid Valve - 24 VDC
16	1-47901	Fuel Line
17	3546	Connector
18	5697	Lock Nut
19	47632	Connector
20	3629	Connector

Complete Burner Head Assembly, Part No. 2-47768, Includes Items 6 through 11

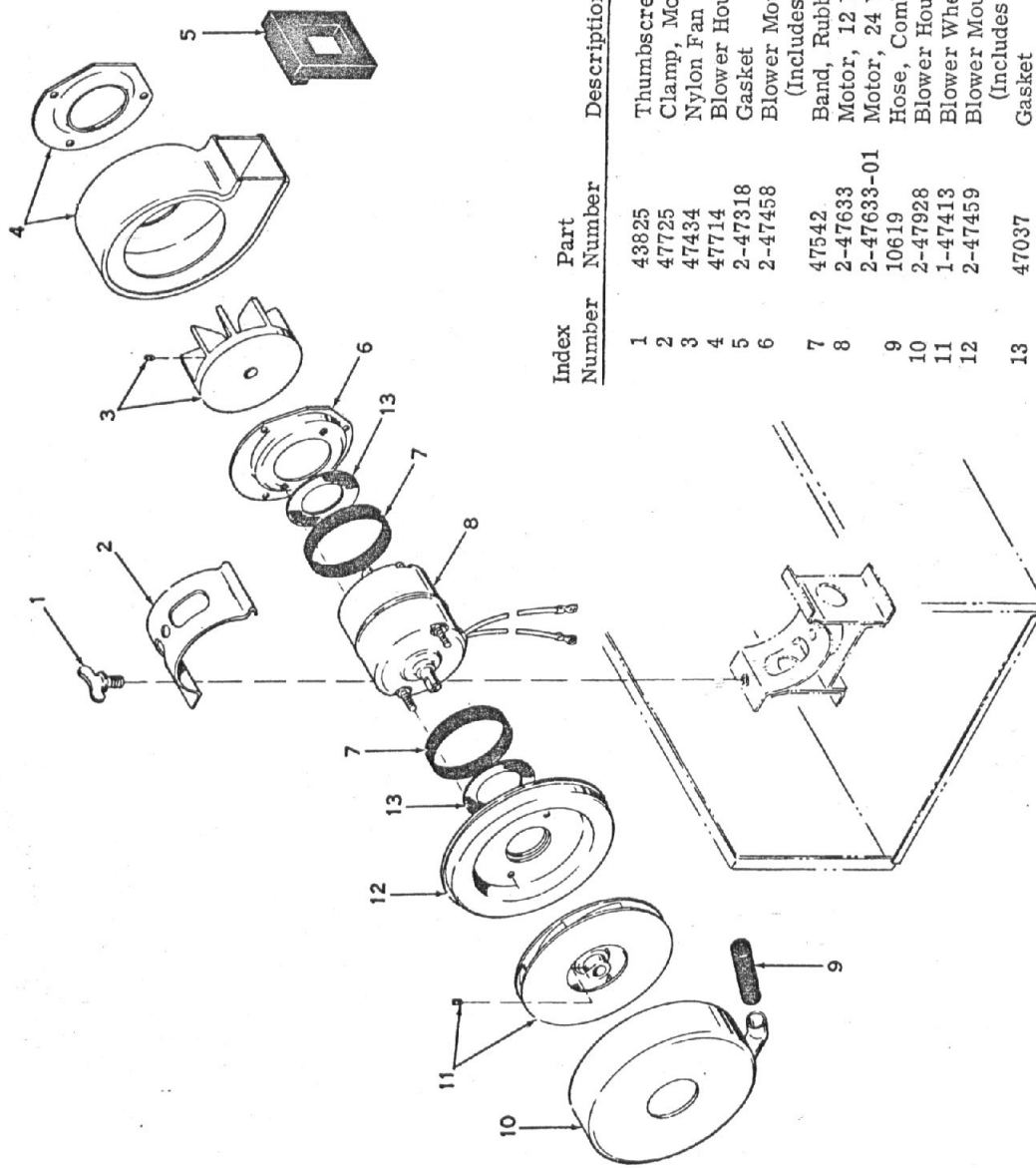
Figure 7. Burner Head Assembly (Early Models)



Index Number	Part Number	Description
1	2-47456-01	Igniter Wire
2	3505	Knurled Nut
3	1523	Flat Washer
4	47182	Igniter
5	58111	Burner Head Gasket
6	2-47751	Burner Tube
7	170011	Gasket
8	2-47768	Burner Head
9	7520	Socket Screw
10	70835	Washer
11	2293	Lock Nut
12	2-47799	Restrictor
13	1-47901	Fuel Line
14	3546	Connector
15	2-47796	Solenoid Valve - 12 VDC
16	2-47796-01	Solenoid Valve - 24 VDC
17	47819	Connector
18	47632	Connector
19	170302	Washer
20	5697	Lock Nut
	3629	Connector

Complete Burner Head Assembly, Part No. 2-47768, Includes Items 6 through 11

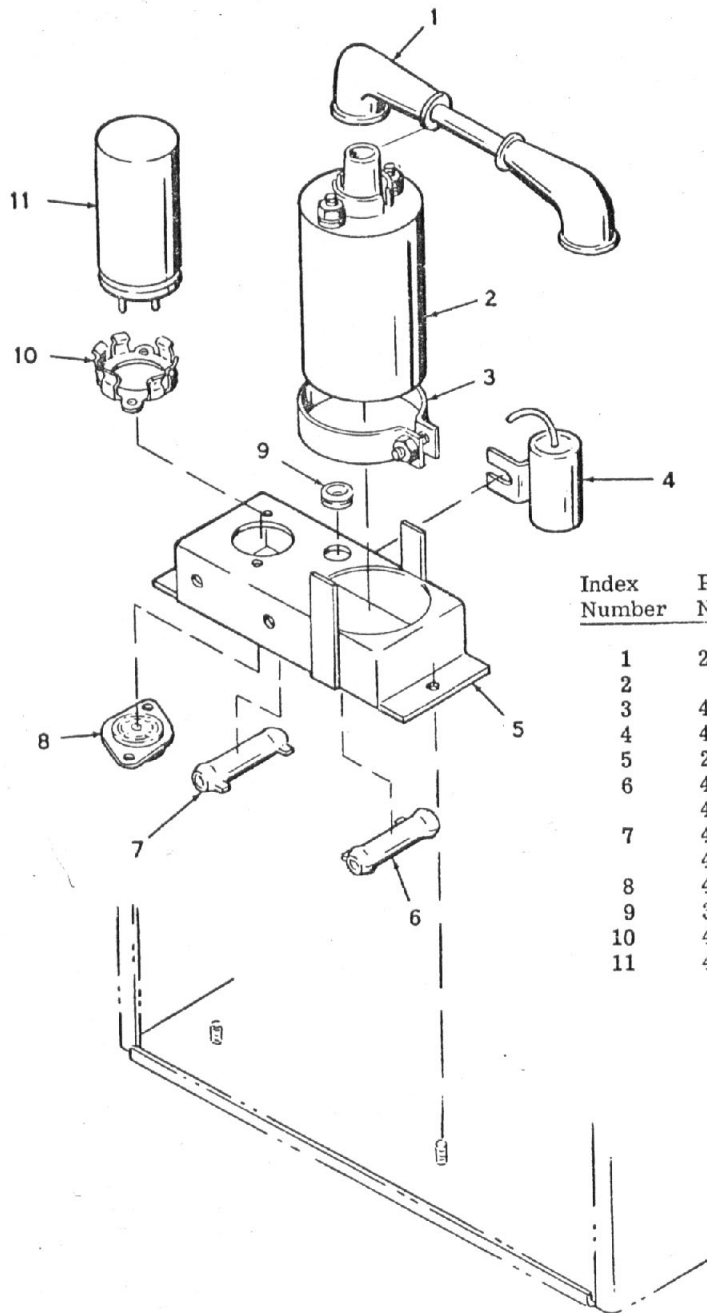
Figure 8. Burner Head Assembly (Late Models)



Index Number	Part Number	Description
1	43825	Thumbscrew
2	47725	Clamp, Motor Mounting
3	47434	Nylon Fan
4	47714	Blower Housing Circulating Air
5	2-47318	Gasket
6	2-47458	Blower Mounting Plate, Circulating Air (Includes Gasket, Item 13)
7	47542	Band, Rubber
8	2-47633	Motor, 12 VDC
	2-47633-01	Motor, 24 VDC
9	10619	Hose, Combustion Air Outlet 2"
10	2-47928	Blower Housing, Combustion Air
11	1-47413	Blower Wheel
12	2-47459	Blower Mounting Plate, Combustion Air (Includes Gasket, Item 13)
13	47037	Gasket

Complete Motor and Blower Assembly, (12 Volt Only), Part No. 1-47724, Includes Items 3 through 13

Figure 9. Motor and Blower Assembly.



Index Number	Part Number	Description
1	2-47456-01	Igniter Wire
2		Coil
3	47578	Coil Clamp
4	43238	Condenser
5	2-47765	Ignition Pack Wraparound
6	43228	Resistor, 15 Ohm, 12 Watt
	43239	Resistor, 30 ohm, 10 Watt (24 Volt)
7	43227	Resistor, 2 Ohm, 12 Watt
	43209	Resistor, 1 Ohm, 25 Watt (24 Volt)
8	46236	Socket
9	3657	Rubber Grommet
10	47204	Vibrator Cup
11	43215	Vibrator

NOTE: Index no. 2 coil and call out. Prior to S/N 3525 use P/N 1-170168 coil kit.

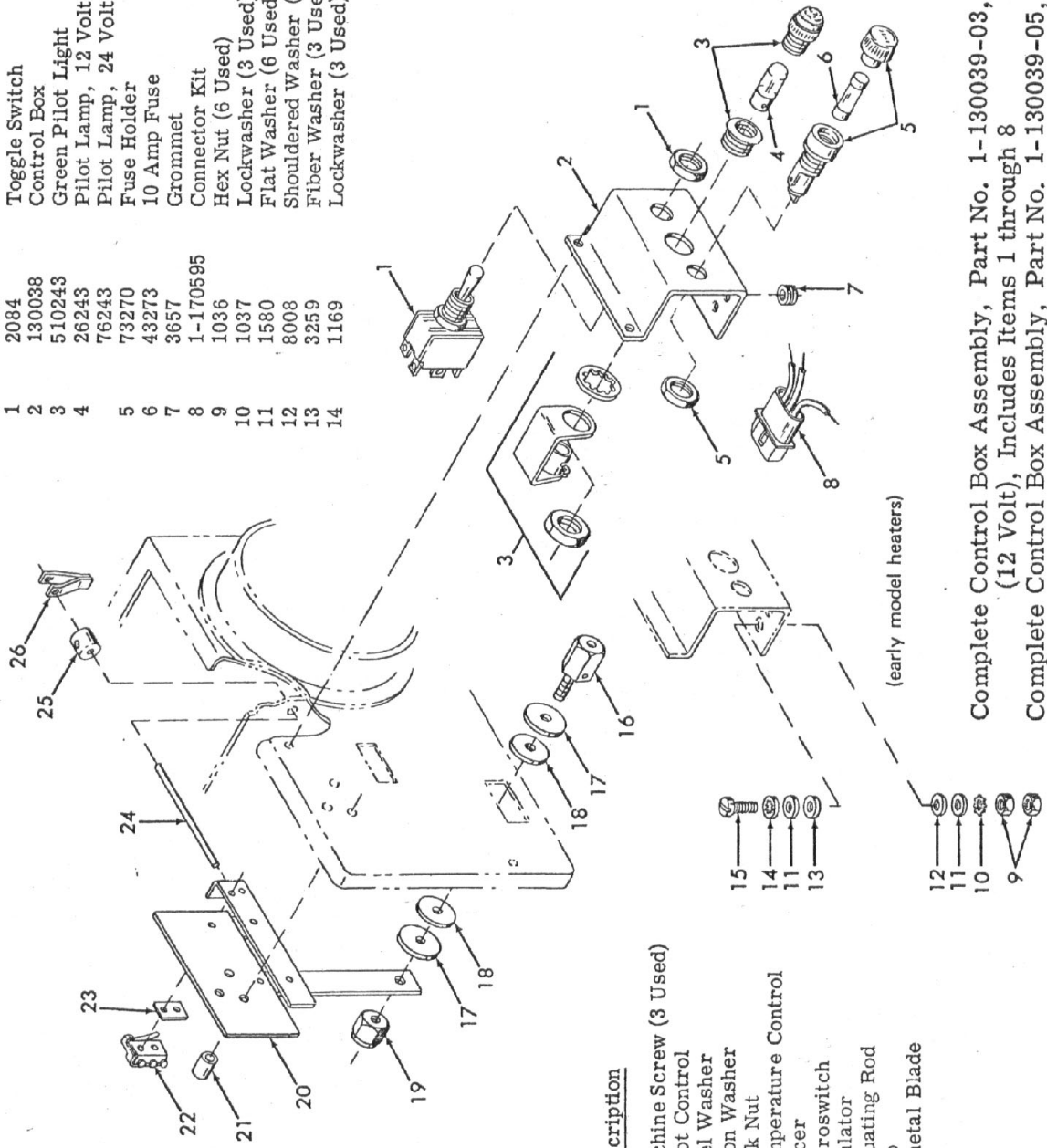
Starting with S/N 3525 use P/N 1-170165 coil. When in doubt use kit no. 1-170168 which will fit all UH47-6LP heaters.

Complete Power Pack Assembly, Part No. 1-47721-01, (12 Volt)
 Complete Power Pack Assembly, Part No. 1-47721-04, (24 Volt)

Figure 10. Power Pack Assembly

Index Number	Part Number	Description
--------------	-------------	-------------

1	2084	Toggle Switch
2	130038	Control Box
3	510243	Green Pilot Light
4	26243	Pilot Lamp, 12 Volt
5	76243	Pilot Lamp, 24 Volt
6	73270	Fuse Holder
7	43273	10 Amp Fuse
8	3657	Grommet
9	1-170595	Connector Kit
10	1036	Hex Nut (6 Used)
11	1037	Lockwasher (3 Used)
12	1580	Flat Washer (6 Used)
13	8008	Shouldered Washer (3 Used)
14	3259	Fiber Washer (3 Used)
15	1169	Lockwasher (3 Used)



Index Number	Part Number	Description
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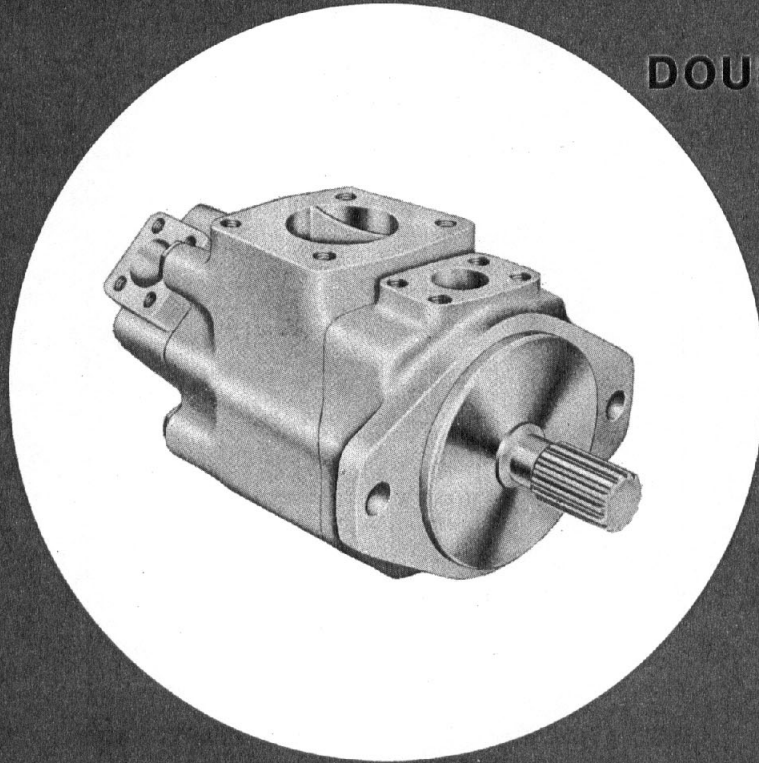
15	1503	Machine Screw (3 Used)
16	47880	Pivot Control
17	65838	Steel Washer
18	6289	Nylon Washer
19	4310	Lock Nut
20	2-47976	Temperature Control
21	47958	Spacer
22	170301	Microswitch
23	47649	Insulator
24	47774	Actuating Rod
25	400383	Stop
26	4774-01	Bimetal Blade

Complete Control Box Assembly, Part No. 1-130039-03,
 (12 Volt), Includes Items 1 through 8
 Complete Control Box Assembly, Part No. 1-130039-05,
 (24 Volt), Includes Items 1 through 8

Figure 11. Temperature Control Assembly.

SPERRY VICKERS

DOUBLE PUMPS



OVERHAUL MANUAL

**2520V, 3520V, 3521V, 3525V,
4520V, 4521V, 4525V,
and 4535V SERIES**

SPERRY VICKERS
TROY, MI. 48084

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SECTION I - INTRODUCTION

A. PURPOSE OF MANUAL

This manual has been prepared to assist the users of Vickers High Performance double pumps in properly installing, maintaining and repairing their unit. The double pumps are described in detail and their theory of operation is discussed in addition to instructions for installation, maintenance and overhaul.

The general series of models covered are 2520V, 3520V, 4520V, 2521V, 3521V, 4521V, 3525V, 4525V and 4535V. The information given applies to the latest design series listed in Table I. Earlier designs are covered only insofar as they are similar to present equipment.

TABLE I - MODEL CODE BREAKDOWN

4521V60E11-11AA6D10L***

SPECIAL FEATURES SUFFIX*
*002 - Foot mounting

L - LEFT HAND ROTATION
(OMIT FOR RIGHT HAND ROTATION)

DESIGN NUMBER

RELIEF VALVE SETTING
(INTEGRAL RELIEF VALVE MODELS ONLY)

C - 750 PSI	G - 1750 PSI
D - 1000 PSI	H - 2000 PSI
E - 1250 PSI	J - 2250 PSI
F - 1500 PSI	K - 2500 PSI

CONTROLLED FLOW RATE
(INTEGRAL FLOW CONTROL MODELS ONLY)

2 - 2 GPM	8 - 8 GPM
4 - 4 GPM	10 - 10 GPM
6 - 6 GPM	12 - 12 GPM
7 - 7 GPM	

OUTLET POSITIONS
(VIEWING FROM COVER END)

(With body outlet #1 opposite inlet)

AA #2 Outlet	#2 Outlet (cover)
AB #2 Outlet	135° CCW from inlet
AC #2 Outlet	45° CCW from inlet
AD #2 Outlet	45° CW from inlet
	135° CW from inlet

(With #1 outlet 90° CCW from inlet)

BA #2 Outlet	135° CCW from inlet
BB #2 Outlet	45° CCW from inlet
BC #2 Outlet	45° CW from inlet
BD #2 Outlet	135° CW from inlet

(With #1 outlet in line with inlet)

CA #2 Outlet	135° CCW from inlet
CB #2 Outlet	45° CCW from inlet
CC #2 Outlet	45° CW from inlet
CD #2 Outlet	135° CW from inlet

(With #1 outlet 90° CW from inlet)

DA #2 Outlet	135° CCW from inlet
DB #2 Outlet	45° CCW from inlet
DC #2 Outlet	45° CW from inlet
DD #2 Outlet	135° CW from inlet

SERIES

VANE TYPE PUMP

RING SIZE - SHAFT END

<u>25**</u>	<u>35**</u>	<u>45**</u>
12	25	42
14	30	47
17	35	50
21	38	60

Code	INLET	OUTLET Shaft Pump	OUTLET Cover Pump
A	4-bolt flg.	4-bolt flg.	4-bolt flg.
B	4-bolt flg.	SAE str. thd.	SAE str. thd.
E	4-bolt flg.	4-bolt flg.	SAE str. thd.
F	4-bolt flg.	SAE str. thd.	4-bolt flg.

RING SIZE - COVER END

<u>**21</u>	<u>**20</u>	<u>**25</u>	<u>**35</u>
5	5	12	25
6	8	14	30
8	11	17	35
9	12	21	38
11	14		

SHAFTS

- 0 - Special shaft covered in suffix number
- 1 - Straight keyed
- 3 - Threaded
- 4 - Involute spline
- 6 - Straight stub
- 11 - Splined

B. GENERAL INFORMATION

1. **Related Publications** - Service parts information and installation dimensions are not contained in this manual. The parts catalogs and installation drawings listed in Table II are available from any Vickers Mobile Division application engineering office or from:

Vickers Mobile Hydraulics Division
Service Department
P. O. Box 302
Troy, Michigan 48084

2. **Model Codes** - There are many variations within each basic model series, which are covered by variables in the model code. Table I is a complete breakdown of the codes covering these units. (When integral flow control and relief valve features are not used, the letters and numbers are omitted.) Service

inquiries should always include the complete unit model number, which is stamped on the pump cover.

TABLE II - PARTS CATALOGS AND INSTALLATION DRAWINGS

MODEL SERIES	PARTS CATALOG	INSTALLATION DRAWING
2520V	M-2302-S	M-257188
2521V	M-2303-S	M-257189
3520V	M-2304-S	M-257190
3521V	M-2305-S	M-257191
3525V	M-2306-S	M-242944
4520V	M-2307-S	M-257192
4521V	M-2308-S	M-257193
4525V	M-2309-S	M-242946
4535V	M-2301-S	M-273836
Flow Control & Relief Valve	See Above Catalogs	M-259204

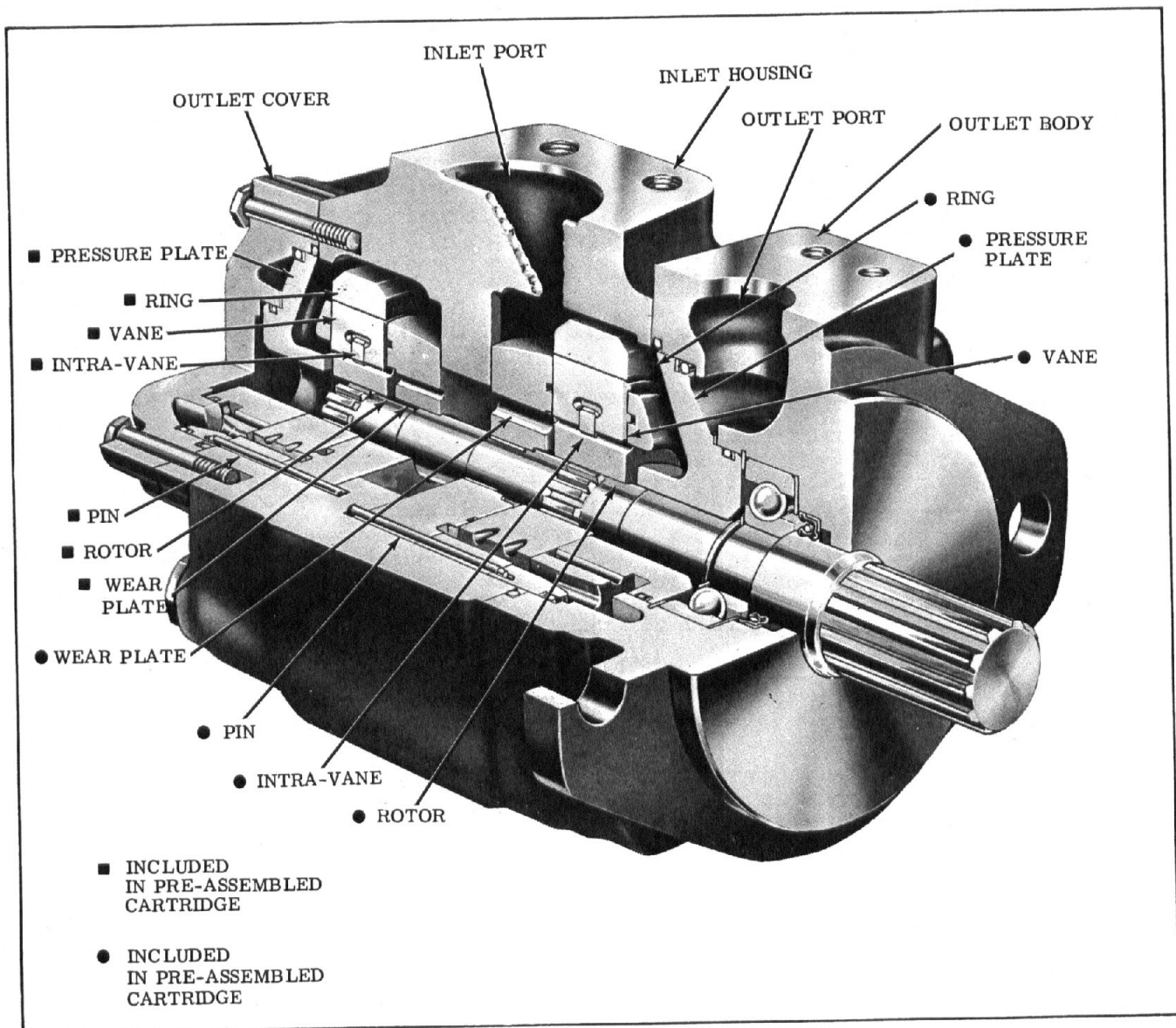


Figure 1 - Cutaway View of Typical Double Pump

SECTION II - DESCRIPTION

A. GENERAL

Pumps in this series are used to develop hydraulic fluid flow for the operation of Mobile equipment. The positive displacement pumping cartridges are of 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.

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

1. Basic Pump - The pump illustrated in Figure 1 is representative of all double pumps in these series. The unit consists principally of an outlet body, inlet housing, outlet cover, driveshaft and two pumping cartridges. The principal components of each cartridge are an elliptical cam ring, a slotted rotor splined to the driveshaft, a pressure plate, a

wear plate and ten (or twelve) vanes fitted to the rotor slots. Fluid enters the cartridge through the inlet port in the center housing and is discharged through the pressure plates to the outlet ports.

2. Flow Control and Relief Valve - All double pumps in these series (except 3525V, 4525V and 4535V) 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 in the cover-end cartridge system only. Fluid not required in the system is directed to the tank.

C. APPLICATION

Pump ratings in gpm as shown in the model coding are at 1200 rpm. For ratings at other speeds, methods of installation and other application information, refer to the applicable sales installation drawing or consult Vickers Mobile Division application engineering personnel.

SECTION III - PRINCIPLES OF OPERATION

A. PUMPING CARTRIDGE

As mentioned in Section II, fluid flow is developed in the pumping cartridge. The action of the cartridge is illustrated in Figure 2. The rotor is driven within the ring by the driveshaft, which is coupled to a power source. As the rotor turns, centrifugal force on the vanes, aided by under-vane pressure fed from the outlet port, causes them to follow the elliptical inner surface of the ring.

Radial movement of the vanes and turning of the rotor cause the chamber volume between the vanes

to increase as the vanes pass the inlet sections of the ring. This results in a low pressure condition which allows atmospheric pressure to force fluid into the chambers.

This fluid is trapped between the vanes and carried past a sealing land to the outlet section of the ring. As the outlet section is approached, the chamber volume decreases and the fluid is forced out into the system. System pressure is fed under the vanes, assuring their sealing contact against the ring during normal operation.

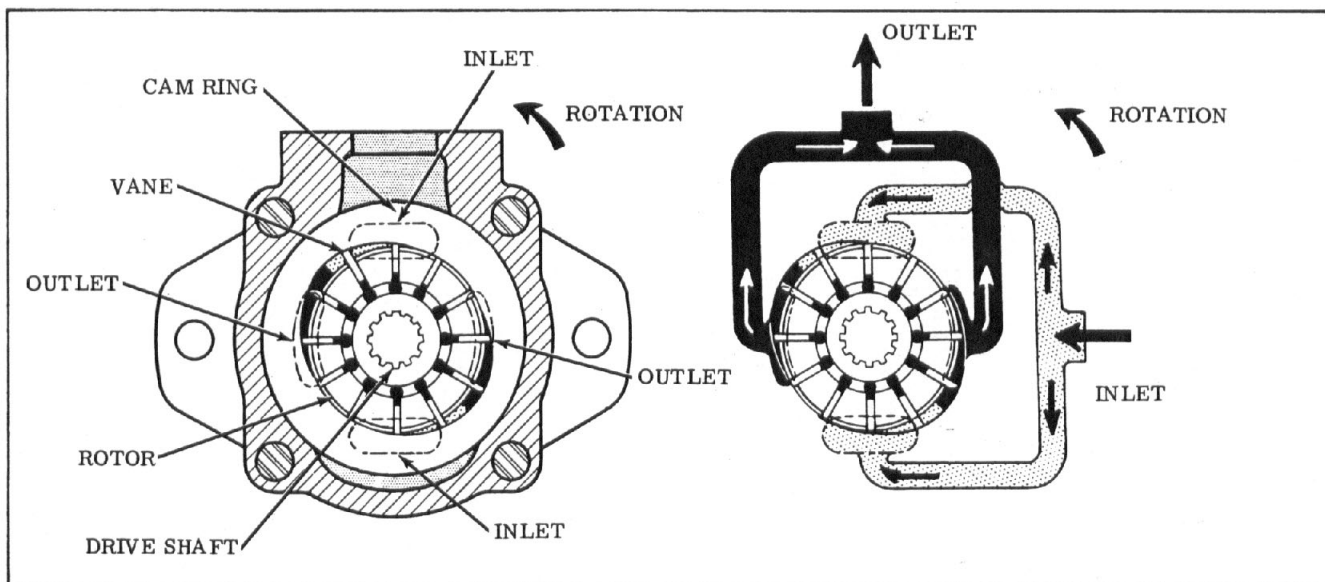


Figure 2 - Operation of Pumping Cartridge (Straight Vane Cartridge Shown)

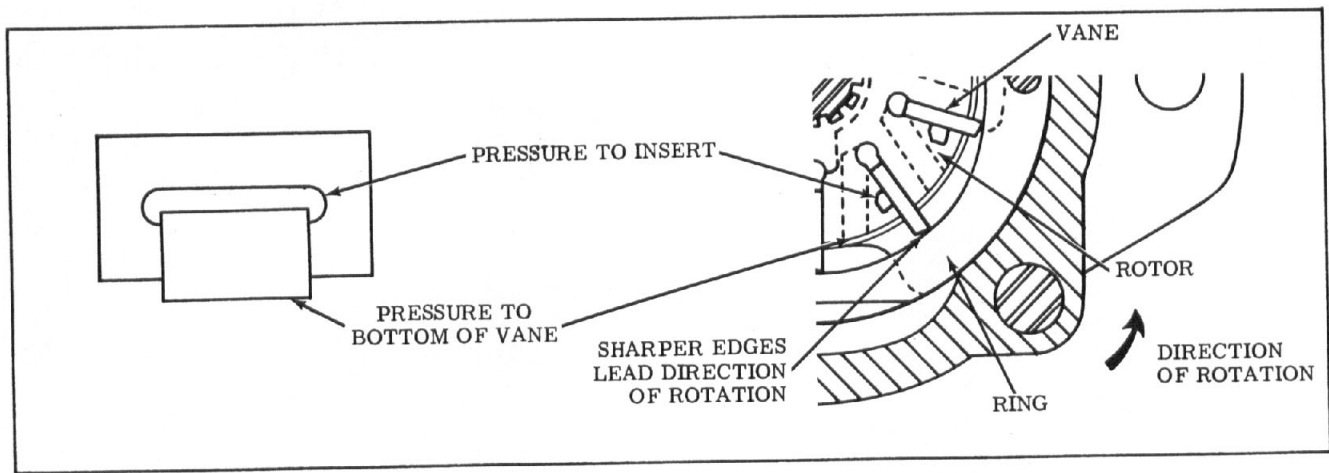


Figure 3 - Pressure Feed to Vanes in Intra-Vane Cartridge

B. VANE PRESSURE FEED

The opportunity to compensate for tendency to wear is apparent as the vanes are forced outward and in contact with the ring.

The intra-vane design provides a means of controlling the outward thrust of the vane against the ring to maintain the tip loads within reasonable limits. In the intra-vane cartridge, full system pressure is continuously applied for outward vane thrust only over the area between the vane and insert. This area is small and thrust is correspondingly light. During vane travel through pressure areas, full system pressure is also applied against the bottom area of the outer vane. The valving of pressure to and from the bottom area of the vane is through holes drilled in the rotor, as shown in Figure 3. This selective application of pressure maintains the vane in substantially constant radial hydraulic balance in all positions.

In the straight vane cartridge, system pressure is present under the full vane area at all times.

C. HYDRAULIC BALANCE

The pump ring is shaped so that the two pumping chambers are formed 180 degrees apart (Figure 2). Thus, opposing hydraulic forces which would impose side loads on the shaft cancel each other out.

D. PRESSURE PLATE

The pressure plate seals the pumping chamber as shown in Figure 4. System pressure is effective against the area at the back of the plate, which is larger than the area exposed to the pumping cartridge. Thus, an unbalanced force holds the plate against the cartridge, sealing the cartridge and providing the proper running clearance for the rotor and vanes.

The pressure plate also contains passages for feeding pressure under the vanes in straight vane cartridges and to the space between the vanes and inserts in intra-vane cartridges (Figure 3).

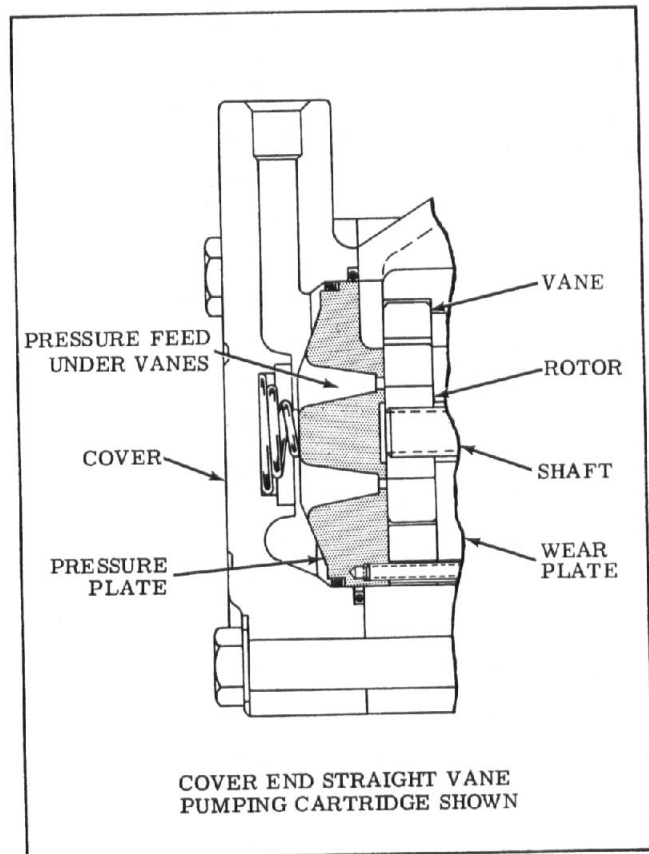


Figure 4 - Pressure Plate Functions

E. FLOW CONTROL AND RELIEF VALVE

In pumps with straight-vane cover-end cartridges, it is possible to incorporate a combination flow control and relief valve in a special outlet cover. As shown schematically in Figure 5, this option consists essentially of (1) a flow control orifice in the pressure outlet port, (2) a spring-loaded hydrostat spool which functions as a pressure compensator and (3) a spring-loaded relief valve poppet, located inside the hydrostat.

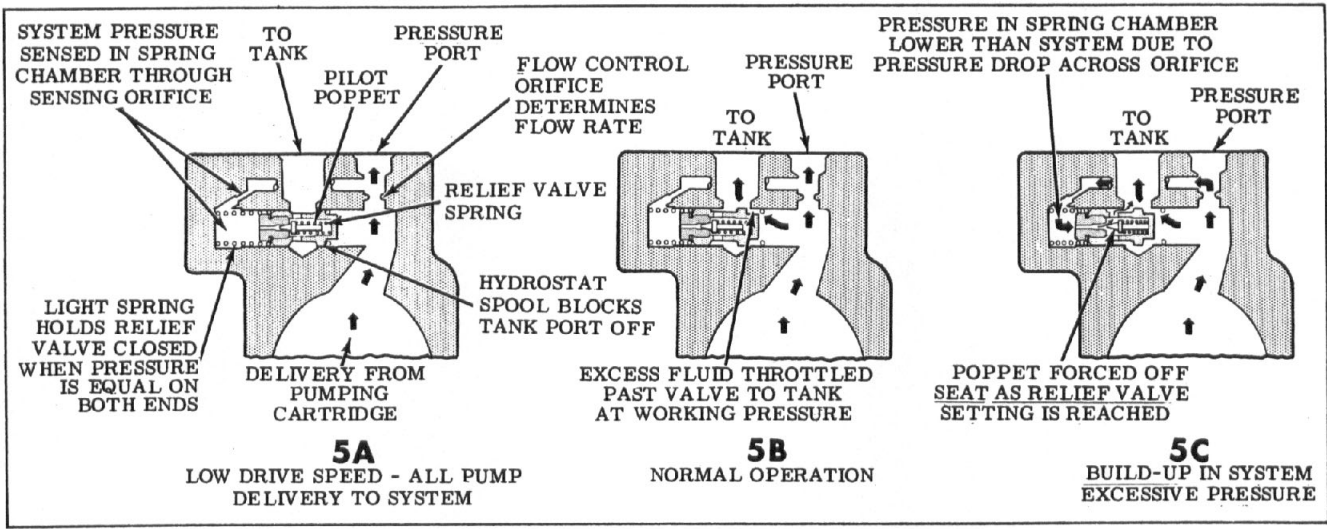


Figure 5 - Flow Control and Relief Valve Operation

1. Flow Control Operation - The light spring shown at the left of the hydrostat in Figure 5 is equivalent to approximately 40 psi. In flow control operation, the hydrostat, because of this spring, operates as a balanced compensating piston--maintaining a constant rate of flow across the flow control orifice.

View A shows the condition when the pump is driven slowly and its output is less than the controlled flow rate. Pressure at the pressure port is effective at the spring end of the hydrostat. However, in this condition, there is no pressure differential across the flow control orifice; therefore pressure is the same at both ends of the hydrostat, and the light spring holds it closed. All of the pump delivery is through the pressure port.

In view B, the hydrostat is operating as a compensating piston. Pump output is more than the controlled flow rate, resulting in a pressure differential across the flow control orifice. The hydrostat now is balanced between upstream pressure (at the

right in the illustration) and the combination of spring force and downstream pressure at the left. It assumes a position which maintains a 40 psi pressure differential across the flow control orifice. At the same time it throttles pump output in excess of the controlled flow rate to the tank port.

2. Relief Valve Operation - View C shows the operation when the preset maximum pressure is reached, as determined by the spring force on the relief valve poppet inside the hydrostat.

Reaching the relief valve setting has caused the poppet to unseat. There now is flow from the pressure port, through the sensing orifice, through an opening in the end of the hydrostat, past the poppet and to tank. This flow creates a pressure differential across the sensing orifice, which again results in a pressure differential at the two ends of the hydrostat. The hydrostat still operates in balance, but now throttles all the pump output (except as required to maintain system pressure) to tank at the relief valve setting plus 40 psi.

SECTION IV - INSTALLATION AND OPERATING INSTRUCTIONS

A. INSTALLATION DRAWINGS.

The installation drawings listed in Table II show the correct installation dimensions and optional port locations.

B. MOUNTING AND DRIVE CONNECTIONS

Vickers high performance vane pumps are designed for foot or face mounting.

1. Direct Drive - A pilot on the pump mounting flange (Figure 6) assures correct mounting and shaft alignment, provided the pilot is firmly seated in the accessory pad of the power source. Care should be exercised in tightening all flange mounting screws to prevent misalignment.

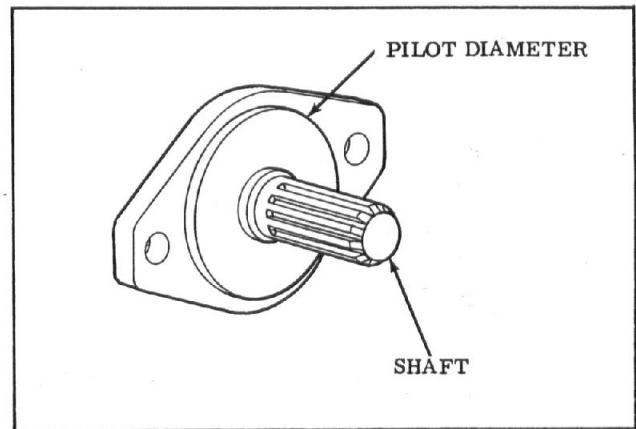


Figure 6 - Drive End of Pump

If gaskets are used between flanges, they should be installed carefully so as to lie flat and should not be the type that will take a set. Shaft keys and couplings must be properly seated to avoid slipping and possible shearing. Proper coupling alignment is essential to long pump life.

CAUTION

Vickers pump shafts are designed to be installed in couplings with a slip fit or very light press. Pounding a coupling end onto the shaft can injure the bearings. Shaft tolerances are shown on the pump installation drawings. (See Table II.)

2. Indirect Drive - Indirect drive is not recommended for these pumps.

C. SHAFT ROTATION

NOTE

Vickers pumps are normally assembled for right hand (clockwise) rotation as viewed from their shaft ends. A pump made for left hand rotation is identified by an "L" in the model code. (See Table I.)

If it is desired to reverse the direction of drive rotation, it is necessary to disassemble the pump and reverse the rings, rotors and vanes. (See Section VI.)

CAUTION

Never drive a pump in the wrong direction of rotation. Seizure may result, necessitating extensive repairs.

D. PIPING AND TUBING

1. All pipes, fittings, hose and tubing must be thoroughly cleaned before installation. Recommended methods of cleaning are sand blasting, wire brushing and pickling.

NOTE

For instructions on pickling refer to Vickers instruction sheet M-9600.

2. To minimize flow resistance and the possibility of leakage, only as many fittings and connections as are necessary for proper installation should be used.

3. The number of bends in hydraulic lines should be kept to a minimum to prevent excessive turbulence and friction of oil flow and to minimize pressure drop in the lines. Tubing must not be bent too sharply. The generally accepted minimum radius for bends is three times the inside diameter of the tube.

E. HYDRAULIC FLUID RECOMMENDATIONS

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 prime requirement for satisfactory system performance and life. Oil must be selected with the same care as any other system component and with the assistance of a qualified supplier.

TWO IMPORTANT FACTORS IN SELECTING AN OIL 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 maximum system operating temperature.

SUITABLE TYPES OF OIL ARE:

1. Crankcase Oil meeting API service classification MS - The MS (most severe) classification is the key to proper selection of crankcase oils for Mobile hydraulic systems.

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 anti-wear qualities of MS 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 compounding found in MS 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 III.

(c) Have sufficient chemical stability for Mobile hydraulic system service.

The following types of oil are suitable if they meet the above three provisions and satisfy the requirements of Table III below:

- Series 3 Diesel Engine Oil
- Automatic Transmission Fluid Types A, F and DEXRON
- Hydraulic Transmission Fluid Types C-1 and C-2

Table III summarizes oil types recommended for use with Vickers equipment in Mobile hydraulic systems by viscosity and service classification.

TABLE III - HYDRAULIC FLUID VISCOSITY RECOMMENDATIONS

Hydraulic System Operating Temperature Range (Min. * to Max.)	SAE Viscosity Designation	American Petroleum Institute (API) Service Classification
0° F to 180° F	10W	MS
0° F to 210° F	10W-30**	MS
50° F to 210° F	20-20W	MS

*Ambient Start Up Temperature

**See paragraph on Viscosity Index

OPERATING TEMPERATURE

The temperatures shown in Table III 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 conditions represent a specialized field where extensive use is made of heating equipment before starting. If necessary, this, and judicious use of SAE 5W or SAE 5W-20 oil in line with the viscosity guide lines shown in the table, may be used. Dilution of SAE 10W (MS) oil with maximum of 20% by volume of kerosene or low temperature diesel fuel is permissible. 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 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 (film strength) 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 80 SSU and 180 SSU. During sustained high temperature operation viscosity should not fall below 60 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. 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, depress foam and depress the pour point. The most desirable oils for hydraulic service contain higher amounts of antiwear compounding.

SPECIAL REQUIREMENTS

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

CLEANLINESS

High speed, high pressure pumps demand close tolerances on machined parts. Contamination can destroy finishes and fits. Thorough precautions should always be observed to insure that the hydraulic system is kept clean.

1. Clean (flush) entire system to remove paint, metal chips, welding shot, etc.

2. Filter each change of oil to prevent introduction of contaminant into the system.

3. Provide continuous oil filtration to remove sludge and products of wear and corrosion generated during operation.

4. Provide continuous protection of system from entry of contamination originating in atmospheric work environments.

5. During usage, proper oil filling and servicing of filters, breathers, reservoirs, etc., cannot be over-emphasized.

F. OVERLOAD PROTECTION

A relief valve must be installed in the system, unless it is an integral part of the pump. The relief valve limits pressure in the system to a prescribed maximum to protect the system components from excessive pressure. The setting of the relief valve depends on the work requirements of the system and the maximum pressure ratings of the system components. Full flow pressure must be within the maximum operating pressure recommended for the pump.

CAUTION

The integral relief valve available protects the cover pump system only. A separate relief valve must be provided for the shaft end pump system.

G. START-UP

Whenever it is possible to do so, fill the pump ports with system hydraulic fluid prior to connecting it into the lines. This will make it easier for the pump to prime when it is first started.

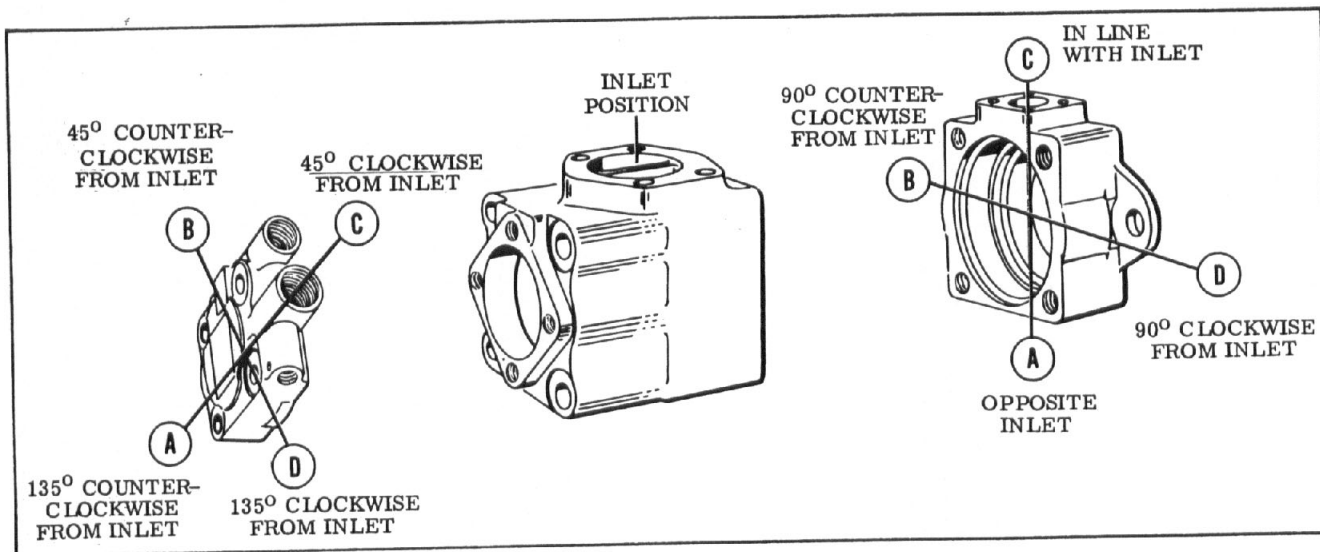


Figure 7 - Port Positions

No Load Starting - These pumps are designed to start up with no load on the pressure ports. They should never be started against a load or a closed center valve. It is recommended that a provision be made to purge air from the system on initial start-up --such as cracking an outlet fitting or installing a valve in the outlet line to open it to the atmosphere. When there is a solid stream of fluid at the outlet, the fitting or valve should be closed.

Self-Priming - A minimum drive speed of 600 rpm is recommended for start-up. The pump should prime itself immediately if the above points are observed, and the inlet line is free of air leaks.

After startup, it is recommended that you run the pump for a short time at moderate speed and load.

H. PORT POSITIONS

Double pump outlet covers and outlet bodies can be assembled in four positions with respect to the inlet housing. Positions are viewed from the cover end. These positions, identified by two letters in the model code (Table I), are illustrated in figure 7.

Disassembly and assembly procedures are in Section VI.

SECTION V - SERVICE, INSPECTION AND MAINTENANCE

A. SERVICE TOOLS

Two special tools are required to service these pumps. A driver should be used to assure installation of the shaft seal without damage, and a "bullet" placed over the end of the shaft to avoid damaging the seal lip when the shaft is installed.

The driver can be made from tubular stock machined to dimensions shown in Figure 8. The recess in the tool will be deep enough so uniform pressure is applied to the recessed area in the seal channel, rather than on the lip of the seal. The inside diameter of the tool will not interfere with the spring around the lip of the seal.

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 pump inlet pipe opening in the reservoir, extensive damage to the pump can result. In

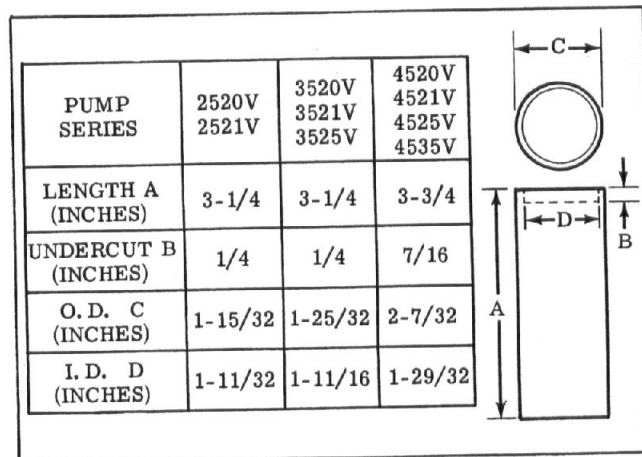


Figure 8 - Shaft Seal Driver

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, metal particles and 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. Air bubbles in the reservoir also can be harmful to the pump and other components. If bubbles are seen, the air source should be found and eliminated.

5. 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 should always be poured through a fine wire screen - 200 mesh or finer.

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 flow in the system. Lubrication of the shaft couplings should be as specified by their manufacturers.

F. REPLACEMENT PARTS

Only genuine replacement parts manufactured or sold by Vickers and its distributors should be used. These are identified in the parts catalogs listed in Table II.

G. TROUBLE SHOOTING

Table IV lists possible difficulties experienced with vane pumps and hydraulic systems. It also indicates the probable causes and remedies for each of the troubles listed.

It should always be remembered that failures can also be due to improper installation, inadequate maintenance and other system component malfunctions. A thorough understanding of the system and its components is important for reliable trouble shooting.

SECTION VI - OVERHAUL

NOTE

Preassembled replacement cartridges are available for rapid field overhaul of these pumps. If a replacement cartridge is being used, proceed as in step B-1 following for disassembly and step D-3 for reassembly.

A. GENERAL

Plug all removed units and cap all lines to prevent the entry of dirt into the system during shutdown. During disassembly, pay particular attention to identification of the parts for correct reassembly.

Figure 9 shows the proper relationship of the parts for disassembly and reassembly. Various steps in the overhaul process are shown in figures 10 through 17.

B. DISASSEMBLY

1. Basic Pump - Remove the foot mounting and

shaft key, if used. Support the pump on blocks or clamp the body in a vise as shown in figure 10. If a vise is used, use protective jaws to avoid damage to the body and its machined surfaces.

Mark the pump body, inlet housing and cover for correct reassembly. Remove four cover screws and lift the cover off the pump (Figure 11). Remove the pressure plate spring (if used) and the cover "O" ring. Pull and/or pry out the cover end cartridge as shown in Figure 12.

Next, remove four screws attaching the inlet housing to the body. Lift off the inlet housing (Figure 13) and the body "O" ring. Turn the shaft to free the large cartridge and pull the cartridge from the body. Remove the large snap ring and pull the shaft and bearing. Drive the shaft seal and wiper out from the shaft end of the body. If it is necessary to remove the shaft bearing, first remove the small snap ring and then press the shaft out of the bearing, supporting the bearing inner race.

TABLE IV - TROUBLE SHOOTING

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. (See Section VI.) Replace the necessary parts. Check the drive alignment.
	Fluid intake pipe in reservoir restricted.	Check all strainers and filters for dirt and sludge. Clean or replace as 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. (See start-up procedure Section IV-H.)	Check the inlet connections to determine where air is being drawn in. Tighten any loose connections. Replace seals where necessary. 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)	As required, remove and disassemble the relief valve hydrostat. 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.
INSUFFICIENT PRESSURE BUILD-UP	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.
	System relief valve set too low.	Use a pressure gauge to correctly adjust the relief valve.
	Worn parts causing internal leakage of pump delivery. Damage to a system component.	Replace pump cartridge, Check system components for excessive leakage of fluid. Repair or replace as required.
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 may 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.

TORQUE SPECIFICATIONS		
FT. LBS.	SERIES	FT. LBS.
45 ± 5	2520V	70 ± 5
45 ± 5	2521V	70 ± 5
45 ± 5	3520V	90 ± 5
45 ± 5	3521V	90 ± 5
70 ± 5	3525V	90 ± 5
45 ± 5	4520V	265 ± 10
45 ± 5	4521V	265 ± 10
70 ± 5	4525V	265 ± 10
265 ± 10	4535V	—

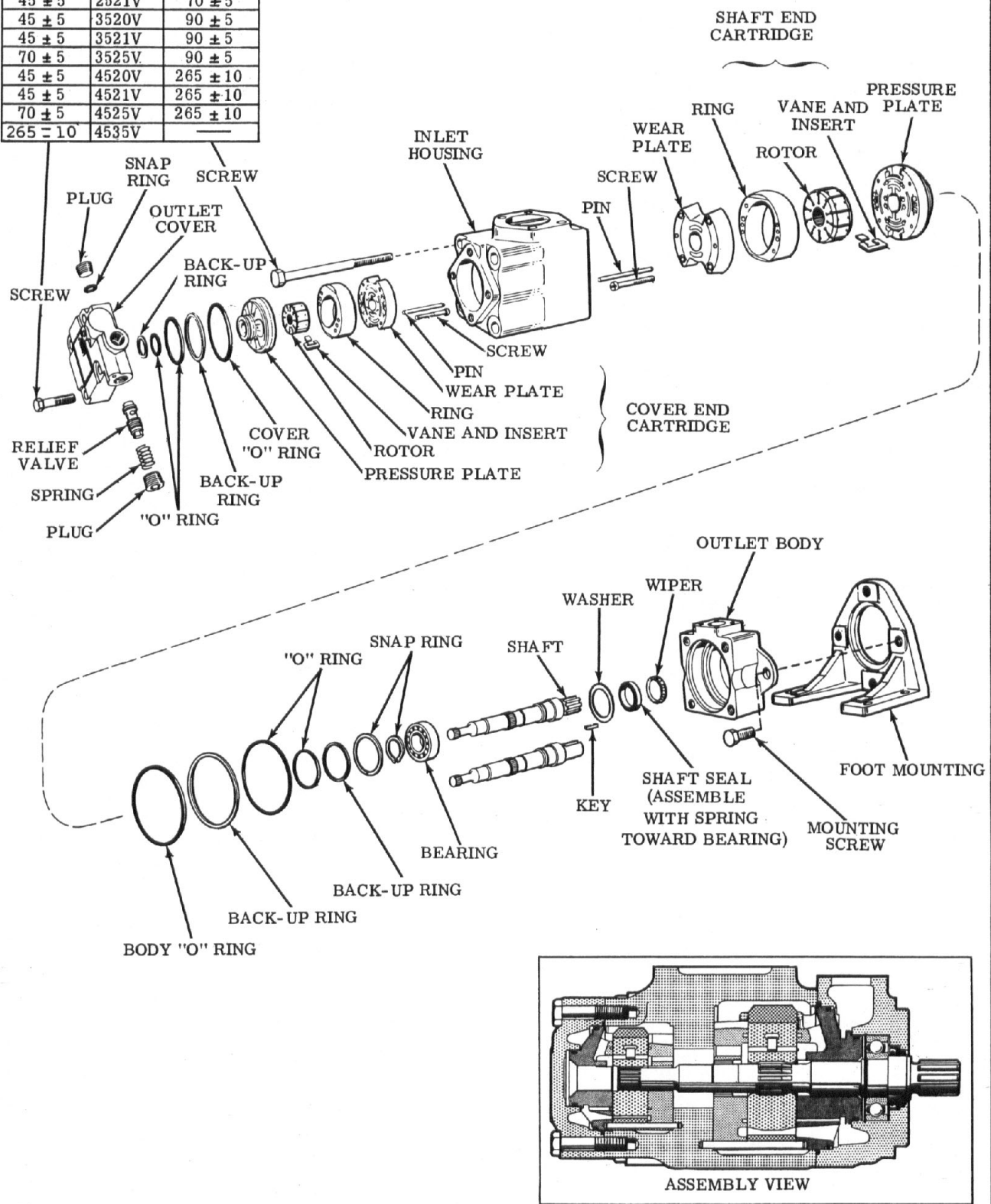


Figure 9 - Exploded View of Typical Double Pump

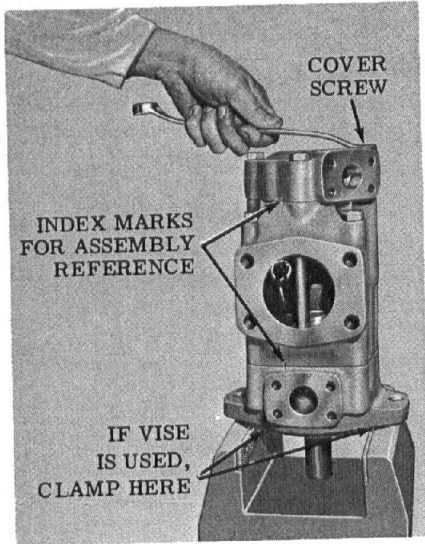


Figure 10 - Beginning Disassembly

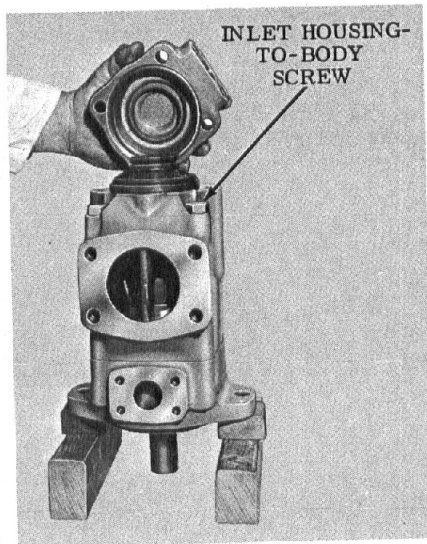


Figure 11 - Removing Pump Cover

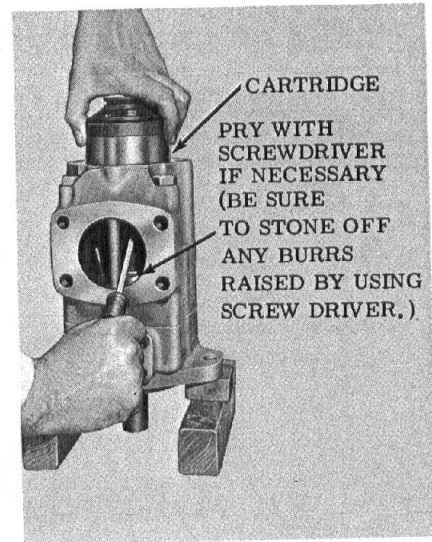


Figure 12 - Removing Cover End Cartridge

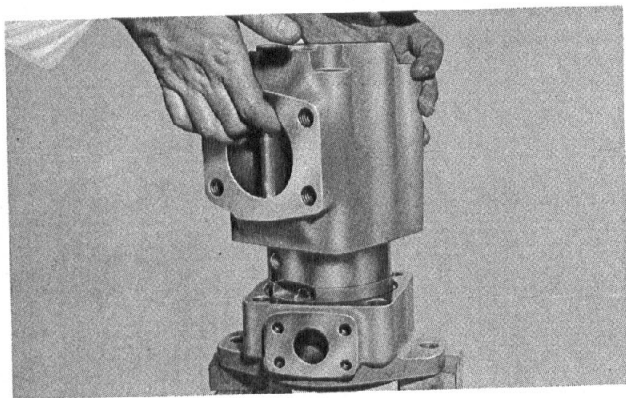


Figure 13 - Removing Inlet Housing

2. Cartridge Assemblies - Remove the "O" ring(s) and back-up ring(s) from the pressure plate. Remove the fillister head screws and lift off the wear plate. Note the position of the ring, rotor and vanes for correct reassembly. Separate the ring, rotor, vanes, locating pins and pressure plate.

3. Flow Control and Relief Valve Covers - Remove the pipe plugs. Insert a screwdriver or a finished bronze or steel rod in the control valve bore in the end opposite the spring to push the spring and valve out. Be careful not to score the valve bore. Do not remove the snap ring if it can be avoided.

C. INSPECTION AND REPAIR

1. Discard the shaft seal and all "O" rings and back-up rings. Use a new gasket kit for reassembly. Wash the metal parts in clean mineral solvent, blow them dry with filtered, dehydrated air and place them on a clean surface for inspection.

2. Check the wearing surfaces of the cartridge parts for scoring and excessive wear. Remove light

score marks by lapping. Lubricating, Moly-Koteing or the equivalent is desirable after lapping to prevent seizure during start-up. Replace any heavily scored or badly worn parts.

NOTE

Replacement cartridge kits are available pre-assembled. If the old cartridges are worn extensively, new kits should be used. Refer to the parts catalogs listed in Table II.

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

4. Rotate the bearing while applying pressure to check for wear, looseness and pitted or cracked races.

5. Inspect the seal and bushing mating surfaces on the shaft for scoring or wear. Replace the shaft if marks cannot be removed by light polishing.

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 repair the valve sub-assembly, which is preset and tested. If the valve is defective, replace it. Replace the pump cover if the valve bore is damaged.

D. REASSEMBLY

NOTE

Coat all parts except seals and back-up rings with clean hydraulic fluid to facilitate reassembly and provide initial lubrication. Use small amounts of petroleum jelly to hold the "O" rings in place during assembly.

1. Flow Control and Relief Valve Covers - Install the snap ring if it was removed. Insert the valve sub-assembly in the bore, narrow land against the snap ring. Insert the spring and replace the pipe plugs. If sealing compound is used, exercise care that none gets into the valve bore.

2. Cartridges

NOTE

The direction of rotation is as viewed from the shaft end; right hand rotation is clockwise; left hand, counterclockwise.

(a) Intra-Vane Cartridges - Place the pressure plate on blocks as shown in Figure 14 and the rotor on the plate with the arrow pointed in the correct direction of rotation. Install the locating pins.

Position the ring over the pins and rotor, again observing the rotation arrow (Figure 15). Place the inserts in the vanes and install both in the rotor slots. Be sure the sharp edges are toward the direction of rotation (see Figure 16) and that both vanes and inserts move freely in the slots. Install the wear plate and screws (Figure 17).

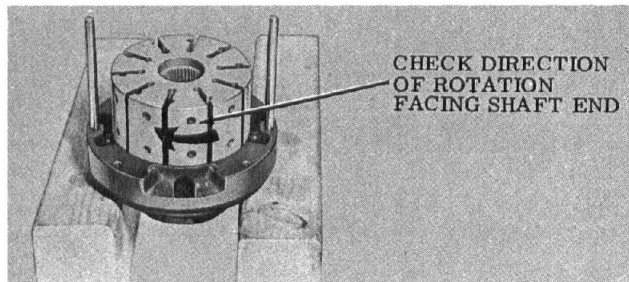


Figure 14 - Installing Rotor

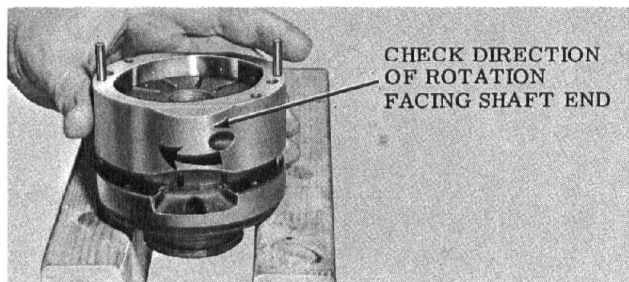


Figure 15 - Installing Ring

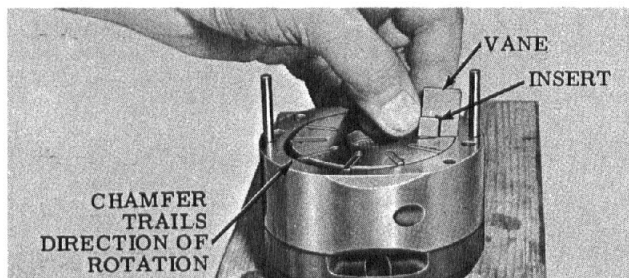


Figure 16 - Installing Vane and Inserts

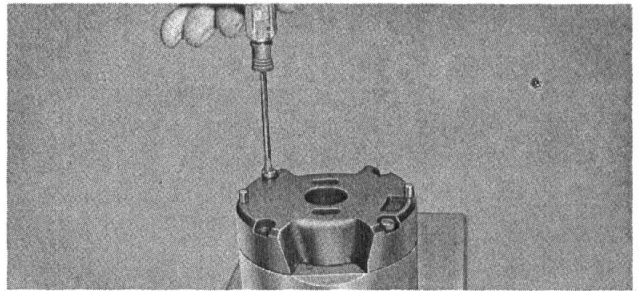


Figure 17 - Installing Wear Plate

(b) Straight Vane Cartridges - Place the rotor on the pressure plate and insert the vanes in the rotor slots. The radius edges of the vanes must be toward the ring.

Install the locating pins in the pressure plate and place the ring over them with the ring arrow pointing in the correct direction of rotation. Install the wear plate and screws. Be certain to tighten the screws evenly and securely.

3. Basic Pump - Soak a new shaft wiper in hydraulic fluid and install the wiper and seal. Use the seal installing tool (Figure 8) to prevent damaging the seal. Be certain the seal O.D. is below the chamfer in the body.

Clamp the body in a vise or place it on blocks as at disassembly and place the bearing spacer against the seal. Cover the end of the shaft with a "bullet" lubricated with grease or petroleum jelly to protect the seal. Press the shaft into the bearing in an arbor press, supporting the bearing inner race. Remove the "bullet." Install the small snap ring. Tap the shaft and bearing gently into the body and install the snap ring.

Install the "O" ring and then the back-up ring on the cartridge pressure plate hub. Lay the body "O" ring in place and install the large back-up ring and then the "O" ring on the cartridge. Carefully install the cartridge in the body so one of the chamfers or flats on the ring will align with the inlet port when the inlet housing is installed.

Place the inlet housing over the cartridge so the locating pins are properly engaged and the inlet is in the correct position with respect to the body outlet. Install the four screws and torque tighten them as shown in Figure 9.

Install the cover end cartridge, being certain the pins engage in the housing. Place the large back-up ring and then the "O" ring on the pressure plate.

If the cartridge is intra-vane, install the small "O" ring and then the back-up ring on the pressure plate hub. Put the cover "O" ring in place in its groove. If a pressure plate spring is used (straight vane models), stick it in the cover with petroleum jelly. Install the cover and screws. Tighten the screws to the torque shown in Figure 9.