NOTICE

THIS BOOK SHOULD BE KEPT WITH MACHINE

OPERATING AND SERVICE INSTRUCTIONS

NO. 5 8 2

MODEL "410"

HYDRAULIC CRANE
SELF-PROPELLED

(With Attachments)

THIS OPERATOR'S MANUAL APPLIES TO MACHINES NUMBERED SERIALLY FROM NO. 410-100 AND UP.

PRICE $1.50 PER COPY

CONTACT YOUR NEAREST AUSTIN-WESTERN DISTRIBUTOR.
THERE IS ONE NEAR BY.

- TO THE OPERATOR -

Your Hydraulic Crane is the result of a combination of advanced engineering and research, skilled manufacturing, and the latest developments in metallurgical science. The entire design and construction is such that it can withstand usage with a minimum of maintenance, and will operate smoothly and easily with maximum safety to the operator.

A fine mechanism such as this crane will always respond best to considerate treatment and care. Therefore, before operating it, we suggest that even the experienced operator review the entire contents of this booklet. While the material in this booklet has been prepared in sufficient detail to be of maximum assistance to inexperienced operators, the "Old Timers" will find much information and many of the illustrations of considerable help.

If you should need information not given in this booklet, or require the services of a trained mechanic, we urge you to use the extensive facilities offered by the Austin-Western Distributor in your locality. Distributors are kept informed on the best methods of servicing and are equipped to provide prompt, high class service in the field, or in an up-to-date service station.

When in need of parts always give the Austin-Western Distributor your crane and engine serial numbers. We suggest that you write these serial numbers in the spaces provided below for ready reference when parts are required.

Crane Serial No. _____
(Stamped on name plate attached to instrument panel)

Engine Serial No. _____

- WARRANTY -

Company warrants all Austin-Western products sold to Distributor for six (6) months after date of shipment, this warranty being limited to the replacement at the factory of such parts as it appears to Company upon inspection by Company to have been defective in material or workmanship. Company makes no warranty in respect to engines, tires, rims, electrical apparatus, or any other trade accessory not manufactured by Company, such being subject to the warranty of their respective manufacturers. No warranty is made or authorized to be made by Company other than herein set forth. Distributor agrees not to alter any products purchased hereunder nor to do anything that will in any way infringe, impeach or lessen the validity of the patents or trade-marks under which Company's products are made or sold.

We reserve the right to make changes or add improvements at any time without incurring any obligation to make such changes on machines sold previously.

ALWAYS USE GENUINE — AUSTIN-WESTERN — REPAIR PARTS

SATISFACTORY AND EFFICIENT OPERATION OF THIS MACHINE IS ENDANGERED BY THE USE OF INFERIOR REPAIR PARTS. THE USE OF CHEAP AND IMITATION PARTS INVARIABLY MEANS SHORT LIFE AND HIGHER ULTIMATE COST.

IF REPAIR PARTS COULD BE MADE AT LOWER COST AND SOLD AT LESS PRICE WITHOUT SACRIFICING QUALITY WE WOULD DO SO. THE CORRECT MATERIAL FOR THE PURPOSE AND THE KNOWLEDGE ACQUIRED THROUGH MANY YEARS OF MANUFACTURING ENABLES — THE AUSTIN-WESTERN WORKS — TO PRODUCE QUALITY THAT WILL NOT BE FOUND IN IMITATION PARTS.

YOU TAKE AN UNNECESSARY RISK WHEN YOU USE INFERIOR REPAIR PARTS. WE USE MANY BOLTS, STUDS, CAP SCREWS, ETC., THAT ARE LISTED WITH PART NUMBERS. THESE ARE MADE OF ALLOY STEEL AND HEAT TREATED TO GIVE THEM MAXIMUM STRENGTH. THEY MAY LOOK LIKE ORDINARY BOLTS, STUDS OR CAP SCREWS, BUT USE OF A SUBSTITUTE FOR THEM WILL LEAD TO BREAK-DOWNS, DELAYS AND DAMAGE TO MACHINE.

WHEN ORDERING A TAPERED ROLLER BEARING ALWAYS ORDER A SET, WHICH CONSISTS OF ONE BEARING CUP AND ONE BEARING CONE WITH ROLLERS.

ALWAYS USE GENUINE — AUSTIN-WESTERN — REPAIR PARTS

— SAFETY FIRST —

ACCIDENTS ARE CAUSED BY THE FAILURE OF SOME INDIVIDUAL TO OBSERVE SIMPLE AND FUNDAMENTAL SAFE RULES OR PRECAUTION. ACCIDENTS CAN BE PREVENTED BY RECOGNIZING THE CAUSE OF THE ACCIDENTS AND DOING SOMETHING ABOUT IT BEFORE THE ACCIDENT OCCURS.

REGARDLESS OF THE CARE USED IN THE DESIGN OF A MACHINE, THERE ARE POINTS THAT CANNOT BE COMPLETELY SAFEGUARDED WITHOUT INTERFERING WITH ACCESSIBILITY AND EFFICIENT OPERATION.

A CAREFUL OPERATOR IS THE BEST INSURANCE AGAINST AN ACCIDENT.

MANY ACCIDENTS WOULD BE PREVENTED IF THE FOLLOWING RULE WERE OBSERVED:

"NEVER ATTEMPT TO CLEAN, OIL, OR ADJUST A MACHINE WHILE IT IS IN MOTION."

INDEX

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INDEX

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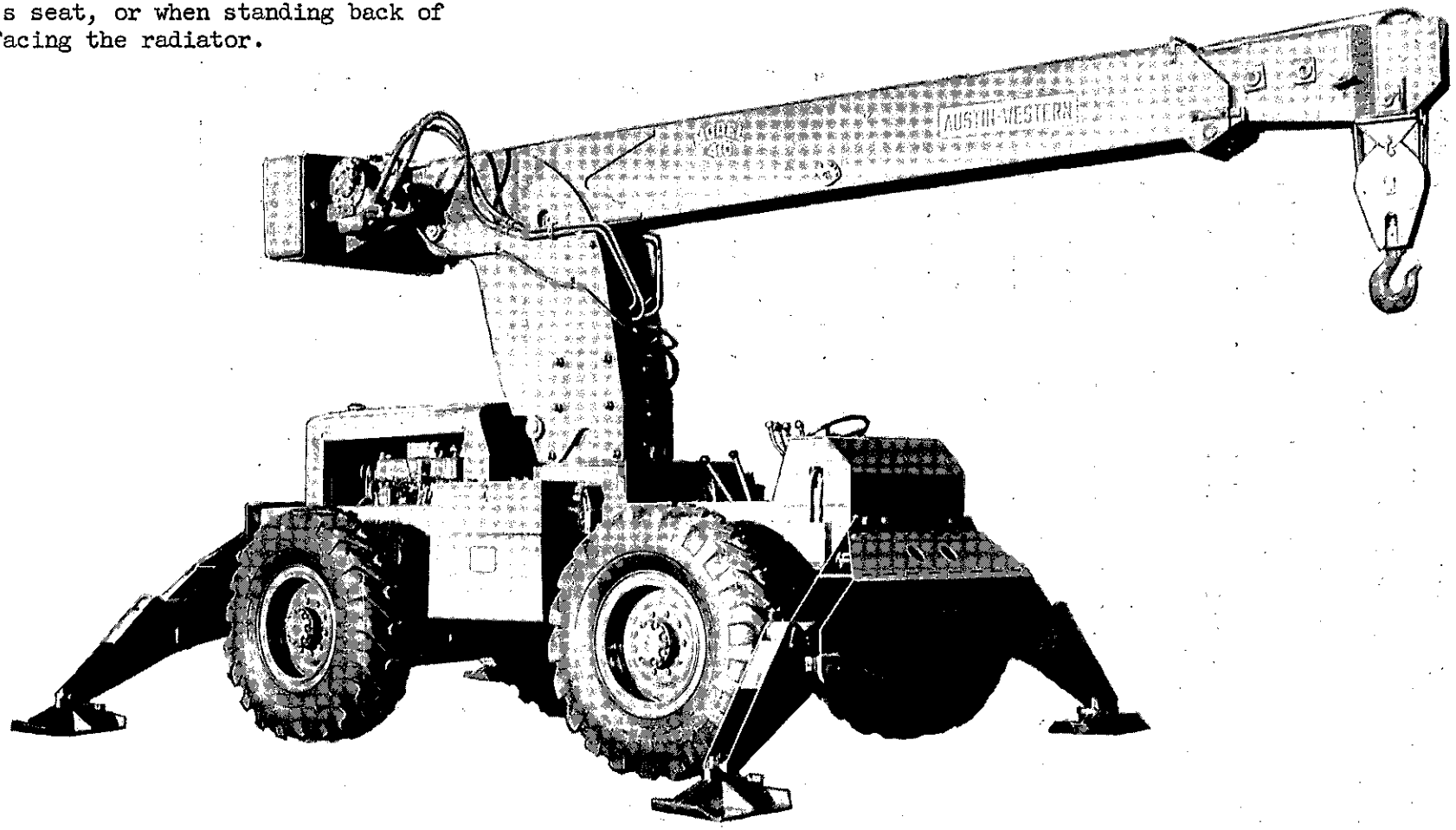
NOTE: Throughout this Manual the use of the terms "LEFT" and "RIGHT" must be understood to avoid confusion when following instructions. "LEFT" and "RIGHT" indicate left and right sides of the Crane as viewed from the operator's seat, or when standing back of and facing the radiator.



RIGHT SIDE VIEW OF STANDARD CRANE
WITH OUTRIGGERS.

1. BASIC CRANE SPECIFICATIONS.

a. BASIC MACHINE equipped with 2-Wheel Drive, 4-Wheel steer, 14.00 x 24-16 ply tires, 60° shipper, UB-264 IHC gas engine, torque converter, 48 GPM hydraulic pump, standard 25' boom.

b. GENERAL DIMENSIONS

Wheelbase.....8'-6"
Overall length:
Boom retracted.....23'-10-1/4"
Mainframe.....14'- 9-3/4"
Centerline of rotation to front bumper plate.....6'- 8-1/2"
Overall height.....11'-1"
Overall width:
Wheels in.....8'-0"
Wheels out.....8'- 9-1/2"
Minimum reach horizontal.....15'
Maximum reach horizontal.....25'
Height, hook to ground, boom horizontal.....96-5/8"
Maximum elevation.....60°
Swing mechanism.....Hydraulic Motor; ring gear and pinion, 360° continuous rotation.
Cable and drum.....Actuated by hydraulic oil motor, vane-type; self-locking worm gear.
Drum size.....10" dia. x 18" long
Cable.....1/2" dia. x 280'long
Gross vehicle weight.....30,400 lbs.

c. CHASSIS

Mainframe.....All steel, 18" high rectangular box sections.
Tires.....14.00 x 24-16 ply
Wheels.....Integral disc and rim
Front driving axle:
Type.....Full floating; double reduction with differential.
Driving and steering knuckles.....Cardan type
Rear axle - non-driving:
Steering knuckles.....Vertical king pin type
Oscillation:
Without lockouts.....10" at centerline of tire
Transmission.....A-W; constant mesh; 3 speeds forward and reverse.
Transfer case.....A-W; constant mesh; single speed.
Service brakes:
Front Wheels:
Type.....15" x 3" internal expanding.
Propeller shaft brake:
Type.....Hydraulic; internal expanding; self-energizing.
Location and size.....12" x 2-1/2" input shaft of transfer case.
Parking brake:
Type.....Mechanical; internal expanding.
Location.....Acts on same shoes as service brake on propeller shaft.
Clutch:
Size and type.....14" dry; single disc; spring loaded.
Engine (Gas):
Make and Model.....IHC-UB-264
Type and number of cylinders.....Overhead Valve - 6 Cyl.
Bore and stroke.....3-11/16 x 4-1/8
Horsepower.....88 at 2000 rpm
Electrical System.....12-volt
Torque Converter:
Size and make.....12" Borg and Beck
Torque ratio.....2.12 to 1
Front Steer.....Booster power steering-.....28° inside turn angle
Rear Steer.....Hydraulic - ..... 28° inside turn angle
Turning radius:
Without outriggers.....15'-8"
With outriggers.....17'-8"
Operator's seat.....Adjustable
Crane controls.....Hydraulic
Hydraulic steering pump:
Make and size.....Hydreco - 14 GPM
Hydraulic crane pump:
Make and size.....Hydreco - 48 GPM

d. CRANE PERFORMANCE

Boom topping speed.....21.4 sec.
Swing speed.....3.2 rpm
Crowd speed:
Extending.....47 fpm approx.
Retracting.....74 fpm approx.
Maximum single-part line pull... 6,700 lbs.

e. OPTIONAL EQUIPMENT

Tires:
16:00 x 20-14 ply.Sure Grip & All-Weather
Boom extensions.....11' and 23'
Rear driving axle (4-Wheel drive):
See specifications for front driving axle (same oscillation as non-driving).
Transfer case.....A-W; constant mesh; two speeds; provides six speeds forward and reverse.
Hydraulic crane pump:
Size and make.....73 GPM-Hydreco
Crane performance with 73 gpm pump:
Boom topping speed.....14.9 sec.
Swing speed.....4.2 rpm
Crowd speed:
Extending.....71 fpm
Retracting.....112 fpm
Hydraulic outriggers (4):
Location.....At extreme outer corners of vehicle.
Engines (Diesel):
Make and model.....IHC-UD-282
Type.....6 cyl., 4-cycle - valve in head.
Bore and stroke.....3.687 x 4.39
Horsepower.....85 at 2000 rpm
Electrical System.....12-volt
Engines (Gas):
Make and model.....Ford - 332
Type and number of cylinders.....V-8, 90° overhead valve.
Bore and stroke.....3.80 x 3.66
Horsepower.....117 at 2000 rpm.
Electrical System.....12 volt
Engine (Diesel):
Make and model.....GMC 3-71
Type & Number of cylinders.....2-cycle 3-cyl.
Bore and stroke.....4-1/4 x 5
Horsepower.....102 @ 2000 rpm
Electrical System.....12-volt
Torque Converter:
Make.....Allison
Model.....370
Torque ratio.....2.5 to 1

f. ATTACHMENTS.

Heater.....Hot Water
Defroster.....Electric fan
Winch,Mechanical (Ft)..Capacity 30,000 lbs.
Winch, Hydraulic (Ft. or Rr).....Capacity 12,800 lbs.
Lights.....Head, tail, directional & flood.
Hourmeter, heavy-duty generator, hood sides, mirror, block assembly with safety hook, electric fuel gauge, pintle hook, load-carrying platform, bulldozer, cab and snow plow.
Clamshell-Hydraulic.....5/8 yard
Magnet.....39" or 45"

2. PERFORMANCE:

a. MAXIMUM ROAD SPEEDS M.P.H. Level Paved Surface - Forward and Reverse - Crane only.

	TIRE SIZES 14.00 x 24 & 16.00 x 20			
3 Speed Transmission	UB-264 Gas	"332" Gas	UD-282 Diesel	GMC-3081 Diesel
1st Gear	4.4	4.4	4.4	4.3
2nd Gear	11.5	11.5	11.5	11.4
* 3rd Gear	18.0	18.0	18.0	19.5
6 Speed Transmission				
1st Gear	2.1	2.1	2.1	2.1
2nd Gear	3.5	3.5	3.5	3.5
3rd Gear	5.4	5.4	5.4	5.3
4th Gear	7.1	7.1	7.1	7.0
5th Gear	11.5	11.5	11.5	11.4
* 6th Gear	18.0	18.0	18.0	19.5

NOTE: The above data will vary on individual machines ± 10% due to variations in engine performance, vehicle and engine break-in, etc.

b. TOWING CAPACITY - LEVEL PAVED SURFACE - G.V.W. of Wheeled Trailer Equipped with Pneumatic Tires and Anti-Friction Bearings. Estimated Rolling Resistance of 70# per ton of trailer weight used for calculations.

Transmission Speed	UB-264 Gas	"332" Gas	UD-282 Diesel	GMC 3081 Diesel
*				
1st Gear	230000	260000	230000	300000
2nd Gear	85000	110000	85000	143000
3rd Gear	55000	74000	55000	97000
**				
1st Gear	230000	260000	230000	300000
2nd Gear	85000	110000	85000	143000
3rd Gear	55000	74000	55000	97000
***				
1st Gear	470000	470000	470000	700000
2nd Gear	300000	350000	300000	480000
3rd Gear	190000	250000	190000	280000
4th Gear	143000	195000	143000	230000
5th Gear	85000	110000	85000	143000
6th Gear	55000	74000	55000	97000

c. MAXIMUM TRACTIVE EFFORT

Transmission Speed	Total Reduction Engine to Drive Wheels	Paved Surface UB-264 Gas	"332" Gas	UD-282 Diesel	GMC 3081 Diesel	Off-the Road UB-264 Gas	"332" Gas	UD-282 Diesel	GMC 3081 Diesel
*									
1st	55.26 to 1	8400#	10000#	8400#	11700#	7500#	7500#	7500#	7500#
2nd	21.24 to 1	3240#	4050#	3240#	5100#	3240#	4050#	3240#	5100#
3rd	13.70 to 1	2030#	2620#	2030#	3400#	2030#	2620#	2030#	3400#
**									
1st	55.26 to 1	8400#	10000#	8400#	12000#	8400#	10000#	8400#	12000#
2nd	21.24 to 1	3240#	4050#	3240#	5100#	3240#	4050#	3240#	5100#
3rd	13.70 to 1	2030#	2620#	2030#	3400#	2030#	2620#	2030#	3400#
***									
1st	114.32 to 1	17500#	20000#	17500#	26800#	17000#	17000#	17000#	17000#
2nd	70.12 to 1	10500#	12300#	10500#	17000#	10500#	12300#	10500#	17000#
3rd	45.24 to 1	6900#	8900#	6900#	10200#	6900#	8900#	6900#	10200#
4th	34.62 to 1	5180#	6850#	5180#	8500#	5180#	6850#	5180#	8500#
5th	21.24 to 1	3240#	4050#	3240#	5100#	3240#	4050#	3240#	5100#
6th	13.70 to 1	2030#	2620#	2030#	3400#	2030#	2620#	2030#	3400#

NOTE: Underlined figures denotes wheel slippage.

NOTE: The above data will vary on individual machines ± 10% due to variations in engine performance, vehicle and engine break-in, etc.

NOTE: For significance of asterisks, refer to bottom of page 11.

d. GRADEABILITY

Transmission Speed	Total Reduction Engine to Drive Wheels	Crane Only - % Grade Paved Surface UB-264 Gas	"332" Gas	UD-282 Diesel	GMC 3081 Diesel	Off-the-Road UB-264 Gas	"332" Gas	UD-282 Diesel	GMC 3081 Diesel
*									
1st	55.26 to 1	26.0%	31.0%	26.0%	36.0%	20.0%	20.0%	20.0%	21.0%
2nd	21.24 to 1	9.0%	11.5%	9.0%	15.0%	7.3%	10.0%	7.3%	13.4%
3rd	13.70 to 1	5.0%	6.9%	5.0%	9.5%	3.3%	5.3%	3.3%	7.9%
**									
1st	55.26 to 1	25.0%	30.0%	25.0%	35.0%	23.0%	28.0%	23.0%	34.0%
2nd	21.24 to 1	8.7%	11.3%	8.7%	14.5%	7.1%	9.5%	7.1%	13.1%
3rd	13.70 to 1	4.8%	6.7%	4.8%	9.2%	3.2%	5.1%	3.2%	7.6%
***									
1st	114.32 to 1	50.0%	55.0%	50.0%	60.0%	45.0%	45.0%	45.0%	50.0%
2nd	70.12 to 1	31.0%	37.0%	31.0%	50.0%	28.0%	34.0%	28.0%	45.0%
3rd	45.24 to 1	20.0%	26.0%	20.0%	30.0%	18.5%	25.0%	18.5%	28.0%
4th	34.62 to 1	14.5%	20.0%	14.5%	25.0%	13.0%	18.0%	13.0%	23.0%
5th	21.24 to 1	8.6%	11.0%	8.6%	14.0%	7.0%	9.3%	7.0%	13.0%
6th	13.70 to 1	4.7%	6.6%	4.7%	9.0%	3.1%	5.0%	3.1%	7.5%

NOTE: * ** ***

NOTE: The above data will vary on individual machines ± 10% due to variations in engine performance, vehicle and engine break-in, etc.

* 2-Wheel Drive, 3-Speed Transmission, Torque Converter, 14.00 x 24 Tires, Outriggers

Gross Weight . . . . . 30,400#
Weight on Driving Axle . . . . . 13,750#

** 4-Wheel Drive, 3-Speed Transmission, Torque Converter, 14.00 x 24 Tires, Outriggers

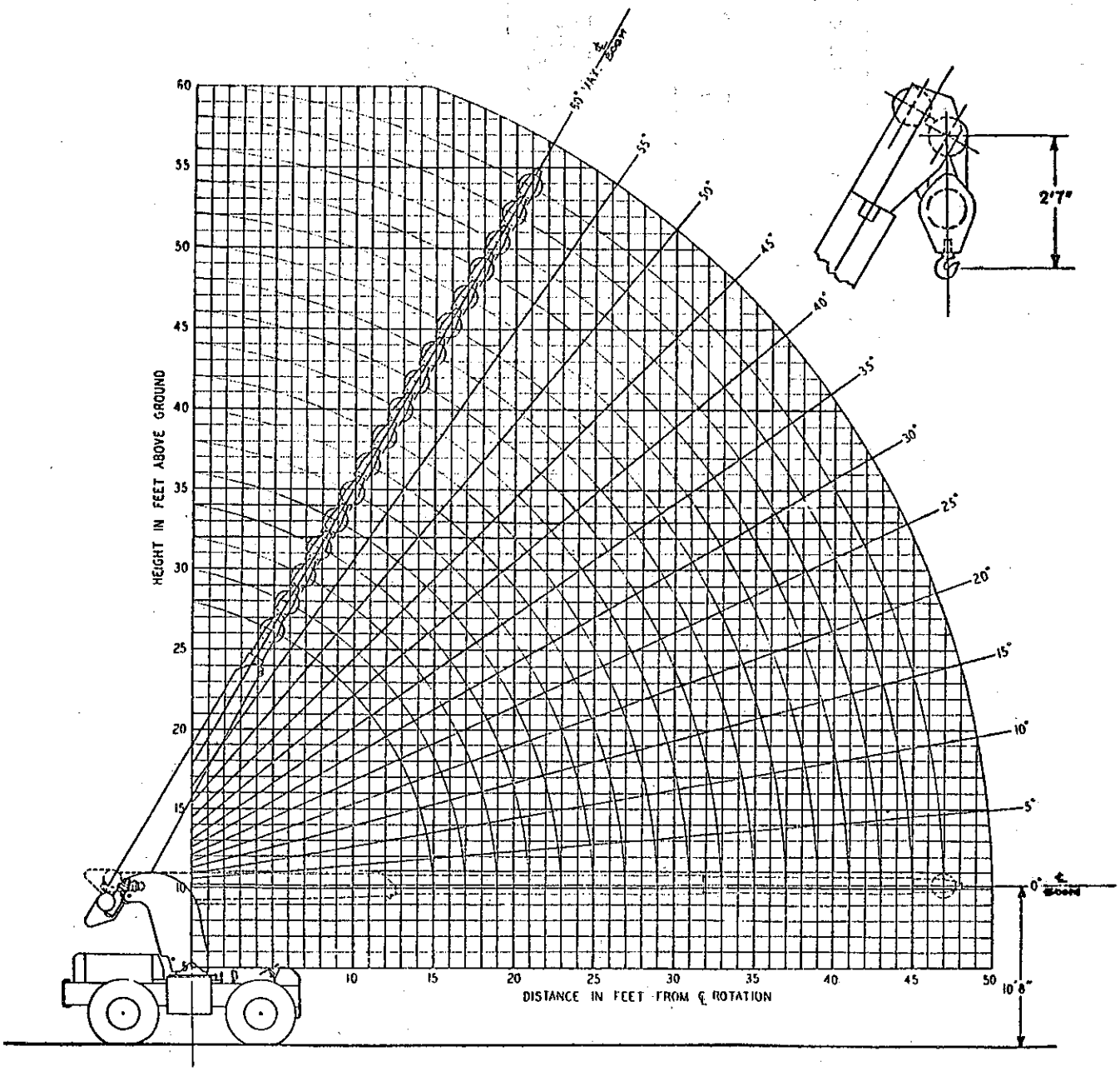
Gross Weight . . . . . 31,300#

*** 4-Wheel Drive, 6-Speed Transmission, Torque Converter, 14.00 x 24 Tires, Outriggers

Gross Weight . . . . . 31,500#

3. SAFE LOAD CHART

LOAD IN POUNDS			
WORKING RADIUS (FEET)	WHEELS IN	WHEELS OUT	WITH OUTRIGGERS
10) Boom Elevated	14,260	16,320	20,000
11)	12,350	13,720	18,200
12)	10,600	11,940	16,650
13)	9,250	10,350	15,400
14)	8,200	9,160	14,280
15	7,380	8,060	13,350
16	6,470	7,270	12,500
17	5,800	6,620	11,670
18	5,350	6,040	10,720
19	4,920	5,500	9,920
20	4,500	5,120	9,200
21	4,120	4,780	7,780
22	3,700	4,330	7,280
23	3,460	4,020	6,820
24	3,220	3,730	6,530
25	3,000	3,460	6,430
26	2,920	3,300	5,840
27	2,750	3,150	5,670
28	2,670	3,050	5,380
29	2,510	2,830	5,130
30	2,310	2,670	4,880
31	2,120	2,500	4,180
32	1,900	2,290	3,980
33	1,790	2,140	3,790
34	1,680	1,990	3,690
35	1,550	1,850	3,600
36	1,520	1,820	3,500
37	1,500	1,790	3,400
38	1,480	1,760	3,300
39	1,460	1,730	3,190
40	1,360	1,610	3,070
41	1,260	1,470	2,940
42	1,150	1,390	2,830
43	1,040	1,310	2,700
44	890	1,160	2,550
45	820	1,070	2,400
46	740	970	2,250
47	650	880	2,100



4. WORKING RANGES.

The above shows various working ranges.
NOTE: Radius is measured from hook to center line of rotation.

5. MANUAL BOOM EXTENSIONS.

Length of Extension	11 feet	23 feet
Horizontal Boom Range..... (Extension IN)	16'-5" to 26'-5"	28'-5" to 38'-5"
Horizontal Boom Range..... (Extension OUT)	26'-0" to 36'-0"	38'-0" to 48'-0"

Borg & Beck Torque Converter - Use Hydraulic Transmission Fluid Type "A".
Capacity - including heat exchanger and lines.....18 Quarts
Allison Torque Converter - Use Hydraulic Transmission Fluid Type "C".
NOTE: Change oil every 2000 hrs. of operation. See Torque Converter Section for filling and draining instructions.

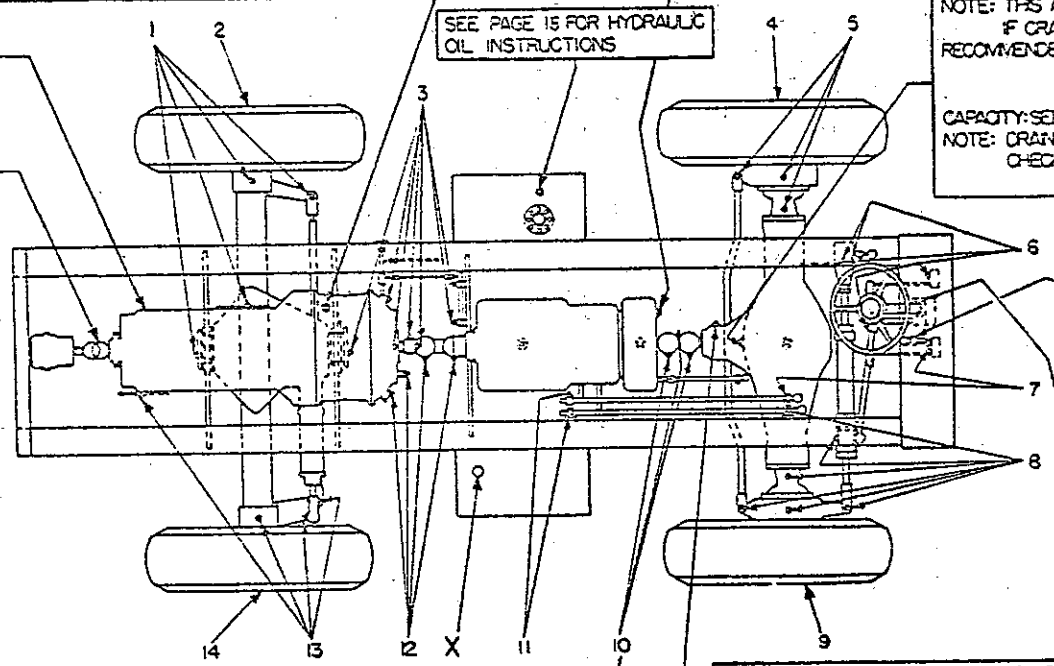
TRANSMISSION & TRANSFER CASE (INTERCONNECTED)
RECOMMENDED LUBRICATION
SAE #90 E.P.
CAPACITY: 20 QUARTS FOR 3 SPEED TRANSMISSION AND TRANSFER CASE.
32 QUARTS FOR 6 SPEED TRANSMISSION AND TRANSFER CASE.
NOTE: DRAIN, FLUSH & REFILL EVERY 1000 HRS. OPERATION.
CHECK LEVEL AT PLUG EVERY 40-50 HRS. OF OPERATION.

FRONT AXLE GEAR CARRIER
NOTE: THIS ALSO APPLIES TO LUBRICATION OF REAR AXLE IF CRANE IS SO EQUIPPED.
RECOMMENDED LUBRICATION
SAE #90 E.P.
CAPACITY: SEE PAGE 16.
NOTE: DRAIN, FLUSH & REFILL EVERY 1000 HRS. OPERATION
CHECK LEVEL AT PLUG EVERY 40-50 HRS. OF OPERATION.

ENGINE
NOTE-SEE SEPARATE SERVICE MANUAL FOR RECOMMENDED LUBRICATION.

HYDRAULIC PUMP PROP. SHAFT.
DISCONNECT PROP. SHAFT & PACK BEARINGS WITH PRESSURE GUN GREASE EVERY 1000 HRS. OPERATION

SEE PAGE 15 FOR HYDRAULIC OIL INSTRUCTIONS



MASTER BRAKE CYLINDER
CHECK & REFILL WITH GENUINE LOCKHEED #21 BRAKE FLUID

Steering Gear
SAE-90 Gear & Trans. Oil
Year around use. Fill to Filler Plug. Capacity 2.28#.

NOTE:- IF CRANE IS EQUIPPED WITH 4 WHEEL DRIVE THE 3 ADDITIONAL FITTINGS (10) ON THE PROPELLER SHAFT BETWEEN THE TRANSFER CASE AND REAR AXLE SHOULD ALSO BE LUBRICATED.

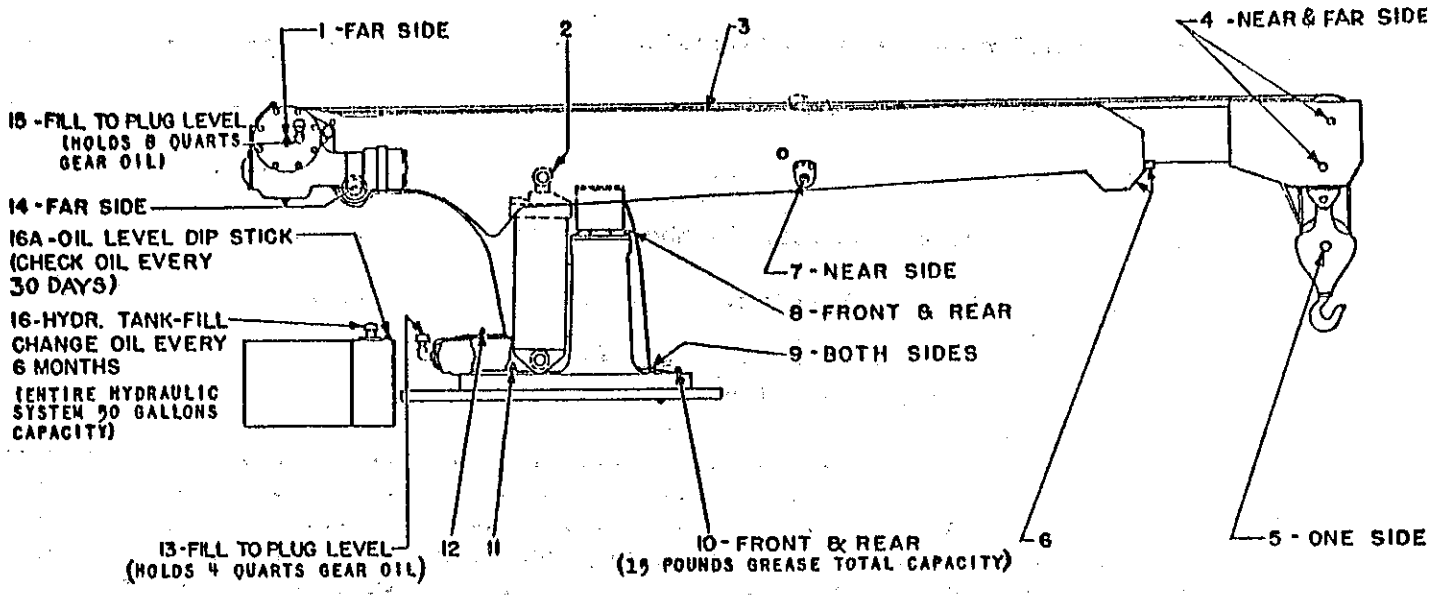
PINION BEARINGS-FRONT AXLE GEAR CARRIER, AFTER REPAIRING OR OVERHAULING BE SURE TO REMOVE PIPE PLUG & INJECT ABOUT ONE (1) PINT OF S.A.E. #90 E.P. LUBRICANT TO PREVENT OPERATING WITH DRY PINION BEARINGS.

References (1) to (14) inclusive - lubricate every 40-50 hours; 2 grease gun strokes with General-Purpose pressure gun grease (Lithium type).

NOTE: Pins, rods, levers, hinges - lubricate every 40-50 hours with a few drops of clean engine oil. This also applies to spring top oilers on electric generators and starting motor groups. See page 16 for further information.

Fuel tank (X) capacity - approximately 30 gallons (Gasoline or Diesel Engine).

1. HYDRAULIC CRANE LUBRICATION CHART - TRACTOR.



2. HYDRAULIC CRANE LUBRICATING CHART - UPPER STRUCTURE.

Lubrication Data

Ref.	Hours	How Lub.	Quantity	Key
1	40-50	1 fitting	2 grease strokes	A
2	"	1 "	2 " "	A
3	"	2 "	2 " " each	A
4	"	2 "	2 " "	A
5	"	1 "	2 " "	A
6	"	4 "	2 " " each	A
7	"	1 "	2 " "	A
8	"	2 "	2 " " each	A
9	"	2 "	2 " " each	A
10	"	2 "	2 " " each	A
11	"	1 "	2 " "	A
12	"	1 "	2 " "	A
13		Remove breather cap and fill to plug level at side of case.		B
14	"	1 fitting	2 grease strokes	A
15		"Fill to plug level. (Set boom in horizontal position. Remove breather cap and fill to plug level at side of case.)		B
16	30 days.	Check oil level at dip stick (16A). Add oil at (16).		C

A. General-Purpose pressure gun grease (Lithium type). Minus 20° F. below zero to 100° F. above zero.

B. SAE grade 140 Non-Extreme Pressure gear lubricant. 0° to 100° F. above zero. SAE grade 80 Non-Extreme Pressure gear lubricant 0° to minus 20° F. below zero. (Similar to Kendall 200 or Mobilube 140. Do not use an Extreme Pressure or Hypoid Lubricant.)

C. Hydraulic Oil Specifications.

Operating Range	SAE No.
For +30° F. and up to +90° F.....	SAE-20 MS or DS

If the crane is stored in a warm place, the crane and SAE-20 oil may be used in outside operation when the air temperature is down to zero. If the crane is stored outside and to be used when the air temperature is 30° F. or down to -5° F., drain the SAE-20 oil into a clean receptacle. The receptacle (oil drum) should be stored and tilted to permit the dregs, debris, and condensate to drain into the low side of the drum. The cleaner oil can later be drained from a higher port or spigot (screened through an 80 mesh wire screen). Destroy the last few gallons in the drum. Refill the hydraulic system with SAE-10 MS or DS. If crane is to be stored outside and to be operated when the air temperature is under -5° F., drain the oil into a clean receptacle and refill with SAE-5 MS or DA (See page 68, paragraphs 9 and 10, for further data.)

3. LUBRICANTS, ENGINE OIL PRESSURE AND LIQUID CAPACITIES.

a. Three speed transfer case and transmission.....20 quarts

b. Six speed transfer case and transmission.....32 quarts

c. Steering Gear..... 1 quart

d. Rear Axle gear carrier and housing (4-Wheel drive).....29 quarts

e. Front Axle gear carrier and housing.....40 quarts

g. IHC - UB-264 Gasoline Engine (see separate instruction book for fuel and oil specifications.)

1. Crankcase..... 8 quarts
2. Oil Filter..... 1 quart
3. Air Cleaner oil cup..... 1 quart
4. Cooling System, including converter heat exchanger.....30 quarts
5. Cooling System, including converter heat exchanger, with cab heater. 31 quarts
6. Oil pressure (hot engine) @ 1200 RPM is.....approximately 30 to 40 lbs.
7. Engine governed speed.....approximately 2000 RPM

h. IHC - UD-282 Diesel Engine (see separate instruction book for fuel and oil specifications.)

1. Crankcase..... 8 quarts
2. Oil Filter..... 1 quart
3. Air Cleaner Oil Cup..... 1 quart
4. Cooling System, including converter heat exchanger.....30 quarts
5. Cooling System, including converter heat exchanger, with cab heater. 31 quarts
6. Oil Pressure (hot engine) @ 1200 RPM is.....approximately 30 to 40 lbs.
7. Engine governed speed.....approximately 2000 RPM

i. Ford 332 Gasoline Engine (see separate instruction book for fuel and oil specifications.)

1. Crankcase..... 6 quarts
2. Oil Filter..... 1 quart
3. Air Cleaner oil cup..... 1 quart
4. Cooling System, including converter heat exchanger..... 27 quarts
5. Cooling System, including converter heat exchanger, with cab heater. 28 quarts
6. Oil Pressure (hot engine) @ 2000 RPM is.....approximately 45 to 50 lbs.
7. Engine governed speed.....approximately 2000 RPM

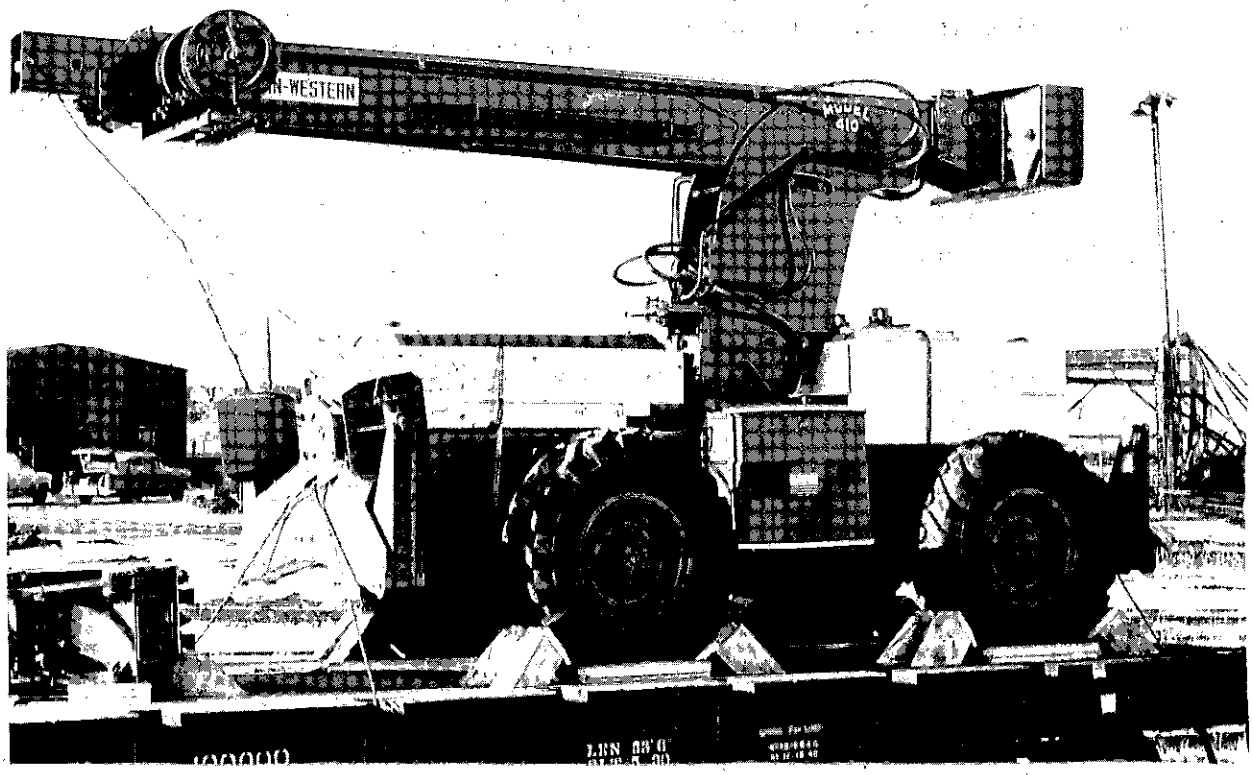
j. GMC 3-71 Diesel Engine (see separate instruction book for fuel and oil specifications.)

1. Crankcase.....13 quarts
2. Oil Filter..... 1 quart
3. Air Cleaner oil cup..... 1 quart
4. Cooling System.....27 quarts
5. Cooling System with cab heater.....28 quarts
6. Oil pressure (hot engine) @ 2000 RPM is.....approximately 40 lbs.
7. Engine governed speed.....approximately 2000 RPM

k. Fuel Tank Capacity. Gasoline or Diesel.... .....approximately 30 gallons

SECTION 3

UNLOADING CRANE



1. INSPECTION.

a. General.

Before unloading the crane, check it thoroly for damage during shipment.

Inspect the tires carefully, also the glass and the cab, if so equipped.

The tool packing list should be checked carefully and any shortage or damage should be immediately reported to an authorized agent of the transportation company involved. In case of damage or pilferage, you have a right to demand that your copy of the transportation document be noted by the transportation company showing whatever shortage or damage is involved.

Any damage or pilferage should be immediately reported to the nearest Austin-Western Distributor and they will assist you in procuring the repairs required and advise you in regard to procedure that should be followed in further handling the claim papers with the transportation company.

b. Crane Blocking.

Remove blocking from the sides, and front and rear of the wheels. Pull spikes from the car floor.

c. Tag Wired to Hood.

See tag wired to hood near radiator indicating water is drained from cooling system. Also see data on card regarding oil placed in the crankcase of engine before it left the factory. Find and install water drain plug wired to engine and fill complete system with clean soft water (or Prestone anti-freeze.)

2. FUEL TANK. (Capacity approximately 30 gallons - Gas or Diesel)

The tank location is back of the driver's seat and on the right side of the main frame. See that no dirt or water gets into the fuel tank. Never fill while engine is running or near anything that might cause a spark.

Open fuel valve under gas tank.

3. DRIVING DOWNHILL.

A safety rule followed by all good drivers is to use the same, or next lower transmission gear, when going down hill as would be used in climbing the same grade.

4. CARE.

This A-W Self-Propelled Crane will give better performance and longer life if the instructions hereinafter outlined are carefully read by the operator and adhered to.

5. ENGINE.

Before starting the engine be sure the radiator is filled with approx. 7 gallons of clean soft water. (See page 16.) (See separate engine instruction manuals.)

6. ENGINE OILS AND FUELS. (See separate instruction books for oil and fuel specifications.) (See page 16.)

Be sure the lubricating oil in the crankcase is up to the "Full" mark on oil level gauge. When testing oil level, the engine should have been stopped at least one hour. The gauge must be withdrawn and wiped clean, and then inserted all the way in and withdrawn for a true reading. Never test the oil level while engine is running.

The selection of a winter engine oil should be based on the lowest anticipated atmospheric temperature, while the selection of a summer oil should be based on the highest temperature expected during the day. Please consult the engine instruction book, which was shipped with your crane, for fuel and lubrication specifications.

7. HOW TO START THE ENGINE.(Warm Weather.)

a. Gas Engine.(see page 19 for controls.)

Set hand brake lever (21).(pull back.)

Place gear shifting lever (18) in neutral position. Slowly depress accelerator (23) about 1/2 inch. (Engine will later run at idling speed.) Turn (fused) switch (31) to "ON" position. Pull choke button (27,) 1/2 open. Do not use choke when engine is warm or pump the accelerator. Push clutch pedal (30) forward and keep it there until engine is running. Push in the starting button (2). (Remove finger the instant engine starts.) When engine starts, the choke button should be pushed into its running position, and all the way in, as soon as engine is warm enough to permit it.

CAUTION: To avoid preignition, idle the engine several minutes before stopping engine.

In extremely cold weather, the most successful starting method is as follows:

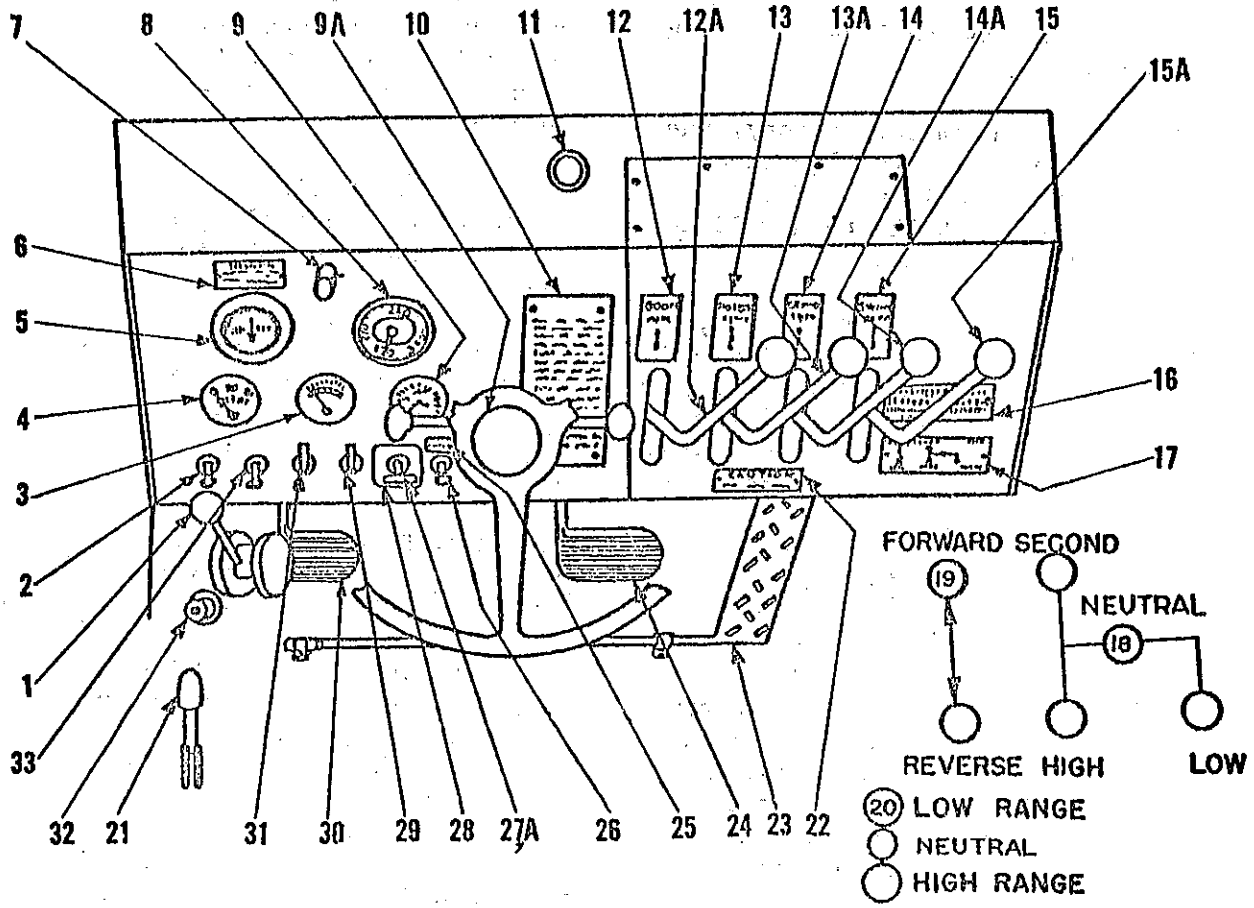
Slowly pump the accelerator pedal (23) one full stroke. Pull out the choke button (27) full distance. Depress accelerator about 1/2 inch. Push clutch pedal forward. Turn switch to "ON" position. Push in the starter button and hold in engagement (not more than 30 seconds) until engine starts. When engine starts adjust throttle to fast idle. Gradually push in the choke button as engine warms up. Do not run starting motor for more than about 30 seconds at any one time because starting motor will be seriously damaged if held too long in contact.

b. Diesel engine.(See page 19 for controls.)

Set hand brake lever (21) (pull back.) Place gear shifting lever (18) in neutral position. Advance throttle slightly; push the stop button (27) forward. Push the clutch pedal (30) forward and keep it there until engine is running. Turn (fused) switch (31) to "ON" position. Push in the starter button (2). (Remove finger the instant the engine starts.)

In cold weather it may be necessary to first push in the electric heater button (26) and hold from 1/2 to 1 minute before pushing in the starter button (2).

CAUTION: Do not hold button in for more than 1 minute. This may burn out the glow plugs. To stop engine, close throttle and pull out stop button (27A).



8. INSTRUMENTS AND OPERATING CONTROLS.

REF.	DESCRIPTION
1.	Hand throttle.
2.	Starter switch.
3.	Ammeter.
4.	Gauge, engine oil pressure.
5.	Brake selector valve. (Used only with 2-Wheel drive.)
6.	Warning instructions. (Used only with 2-Wheel drive.)
7.	Dash light.
8.	Gauge, torque converter heat.
9.	Gauge, engine water temperature.
9A.	Horn button.
10.	Safe load chart.
11.	Plug, master cylinder cover.
12.	Plate, boom control.
12A.	Boom control lever.
13.	Plate, hoist control.
13A.	Hoist control lever.
14.	Plate, crowd control.
14A.	Crowd control lever.
15.	Plate, swing control.
15A.	Swing control lever.
16.	Factory serial number.
17, 18, 19.	Transmission shifting diagram.
20.	Six speed transmission shifting diagram.
21.	Hand brake control lever.
22.	Caution plate. (Move crowd and hoist levers together.)
23.	Foot accelerator.
24.	Foot brake pedal.
25.	Label, manifold pre-heater. (IHC-UD-282 engine.)
26.	Switch, glow plug. (UD-282 engine.)
27.	Control, choke. (Ford 332 and IHC-UD-264.)
27A.	Control, engine shut-off. (GMC-3-71 and IHC-UD-282.)
28.	Plate, emergency stop. (GMC-3-71 engine.)
29.	Light switch.
30.	Clutch foot pedal.
31.	Ignition switch.
32.	Dimmer switch.
33.	Heater switch.

9. UNLOADING CRANE.

To unload crane from rail car or truck, proceed as follows:

a. When shipped from our factory, the boom will be anchored in the lowest and shortest horizontal position. This is necessary in order that the boom will not be damaged during shipment.

b. Start engine. (See paragraph 7, page 18.) Test brakes before moving off car. Push down on clutch pedal (30), page 19. Put transmission into "low" (or reverse gear) and let clutch pedal out slowly, and proceed to remove crane from rail car or truck. Stop engine.

c. Wash all grime and dust-laden grease from all exposed parts. Lubricate balance of crane with grease gun provided. (See pages 14, 15 and 16 for points to be lubricated and lubricant specifications.) Test brakes. Fill master cylinder with fluid. Check tire pressures. Do not over or under inflate tires. (See decalcomania on crane, also page 27.) Check clutch pedal clearance. (See page 86 for adjustments.)

10. HYDRAULIC SYSTEM.
(Capacity 50 gallons)

Consult hydraulic section on page 15, for oil specifications.

Check oil level in oil reservoir. Fill to oil level, see page 15.

11. PRECAUTIONS.

a. KNOW YOUR CRANE. Familiarize yourself with essential points of operating and servicing it by a careful study of this Manual.

b. CLEANLINESS. Essential to the maximum efficiency of the crane is keeping it clean. Never remove inspection cover plugs or breathers without first removing all dirt from around them to prevent its entrance into the engine. Go over the entire crane frequently and clean it. In addition to removing dirt and grease, many troubles caused by loose connections, nuts, or cap screws, will be discovered before they develop.

c. FUEL. Handle fuel carefully to prevent entrance of dirt and water which can cause damage and operational failure of the engine. When not in use, keep oil, grease, and fuel containers clean and well covered.

d. COOLING SYSTEM. Follow instructions in regard to the cooling system in detail. Use the best water obtainable at all times.

e. LUBRICATION. The lubricants recommended in the table of lubricants, pages 14, 15, and 16, are chosen as a result of careful research on the needs of the crane. Do not substitute other grades.

f. START CAREFULLY. Always allow the engine to warm up to proper operating temperature before applying the load.

g. AIR CLEANERS. Maintenance neglect permits entrance of dirt material into the engine, which is the cause of most engine wear. In dusty operating conditions it may be necessary to clean it as many as 4 times per 8 hours. The retaining band should be loosened and the sump removed and the oil and sludge removed therefrom. The detachable screen may be removed by loosening the wing nuts and rotating it approximately one quarter turn, after which the screen should be cleaned in kerosene or diesel fuel. The air cleaner center tube should be cleaned at this time, after which the cleaner should be reassembled. Fill the sump to oil level indicated, using clean oil as used in the engine.

h. PROTECTION. Protect the engine from weather as far as possible. Install hood sides or cover with a tarpaulin when not in use.

i. STARTING. Before starting to use this crane, be sure to inspect it thoroughly and see that all bolts are tight. Grease and oil carefully all bearings and working parts and see that all operating units are free and easy.

SECTION 4

TRACTOR AND CRANE OPERATION

1. GENERAL DESCRIPTION.

This crane is a hydraulically operated, full revolving unit, mounted on a special 4-wheel, rubber-tired tractor. The "Standard" tractor is a 2-wheel drive, 4-wheel steer unit. (for Standard crane specifications, also for 4-wheel drive and other extra equipment, see page 9.)

a. Turntable and Boom.

The turntable is rotated hydraulically 360° by means of a hydraulic motor in conjunction with a worm and gear reducer connected to a pinion, which, through an idler, engages the ring gear teeth.

The boom is raised and lowered hydraulically by a large diameter vertical cylinder connecting the base of the turntable and under side of the boom shipper. The boom can be raised from horizontal position to an inclined angle of approximately 60°.

In addition to the up and down angular movement of the boom, the outer end of the boom can be extended or retracted 10' by means of another hydraulic cylinder mounted inside of the boom itself.

Raising and lowering of the cable hook is also hydraulically controlled and is accomplished by the use of a vane type hydraulic motor in conjunction with a worm and gear reducer, all mounted at the back of the boom.

b. Hydraulic Pump and Controls.

The hydraulic pump for the crane is mounted at the front of the engine and is driven directly off the front of the engine crankshaft by means of a short propeller shaft. The pump, therefore, is in operation at all times the engine is running, making it possible to operate the crane without any other lever engagements, etc., other than opening the throttle to obtain the desired engine speed.

2. TRACTOR OPERATING INSTRUCTIONS. (See page 19 for location of controls.)

a. Tractor transmission (standard) has three speeds forward and reverse. Transmission shift lever (18) is located to the extreme right of operator. Use shift diagram data plate on instrument panel as a guide for selecting desired ratio. Use shift lever (19), at left of transmission shift lever, to obtain forward or reverse motion.

NOTE: Lever (20) provides the 6 speed combination - furnished on special order only. (See page 10 for MPH speeds.)

b. Clutch (30) and brake (24) pedals are located in conventional positions. Clutch should always be disengaged when engaging transmission and when shifting the forward and reverse lever.

c. The 2-wheel drive brakes are located one in each front wheel, and one on the propeller shaft. All three are simultaneously applied at pedal (24).

NOTE: The following instructions apply only to brakes used with 2-wheel drive cranes. Each front driving wheel has a brake. The brake can be used in the conventional way - that is, applying both wheel brakes (also the propeller shaft brake) by stepping on brake pedal. It is also possible to apply the brake on one wheel only. See Brake selector (5), page 19. (This device is not used with 4-wheel drive cranes.)

To apply the brake on one wheel only, use Brake Selector Valve (5). The valve control handle normally should be in the vertical or neutral position, allowing a free flow of hydraulic oil to each wheel and propeller shaft brake cylinder. By positioning the handle per instruction plate (6), and then stepping on the brake pedal, either the right or left wheel can be locked. The other wheel and propeller shaft brake will be free to rotate.

> CAUTION: Always place the handle (5) in desired position before stepping on the pedal. Position handle in the three designated positions only. Always return handle to the vertical or neutral position upon completion of operation.

The Warning Instructions (6), page 19, read as follows:

WARNING		
RETURN LEVER TO NEUTRAL AFTER OPERATING VALVE		
LEFT BRAKE	N	RIGHT BRAKE

The Service Brake (21) (propeller shaft) can be applied by pulling up on lever located to the right of the operator. Head of lever can be revolved to take up and compensate for worn brake and control cable stretch. To correctly adjust, turn head of lever clockwise until considerable resistance is felt when pulling up lever.

d. WARNING: Never allow temperature reading of the torque converter oil heat indicator to rise above 250° . (Gauge (8) starts at 180° F. The operating range stops at 260° F.) If reading rises above 250° , shut vehicle down immediately. Under normal operation, the gauge will never go as high as 250° unless heat exchanger is not functioning properly, or oil level in torque converter is low. If vehicle is operated under adverse conditions where machine is near the stall point, close watch should be kept on the heat indicator. In general operation the oil temperature will run under 180° F. Excessively high engine water temperature at the heat exchanger, or excessive converter stall, may cause the converter temperature gauge needle to show reading beyond the starting point of 180° F. (See separate instructions covering Torque Converters).

3. PREPARATION FOR OPERATION.

The hydraulic oil tank located on the left side of the vehicle, must be full of oil to the top mark on bayonet gauge. Tank filler is located on top of tank. To properly fill the hydraulic tank, it is necessary to operate the boom lift ram and the boom extension ram (crowd) several times to fill the rams and their connecting lines with oil; then recheck the oil level in the tank as previously described, and add oil to fill tank to proper level, if needed.

WARNING: Don't start engine when oil level is low.

4. HOW TO OPERATE THE HYDRAULIC CRANE.

a. Start engine (page 18). Hydraulic pump will start operating immediately. Then adjust throttle (1) to desired position. To make the hydraulic pump operate effectively, run the pump at 700 RPM minimum. However, if heavy loads are to be lifted, and maximum efficiency is required from the crane, pull the throttle all the way open so the pump will deliver maximum flow and pressure.

Throttle setting depends on the operation for which the crane is to be used. After a little practice, the operator should be able to select proper throttle setting without difficulty.

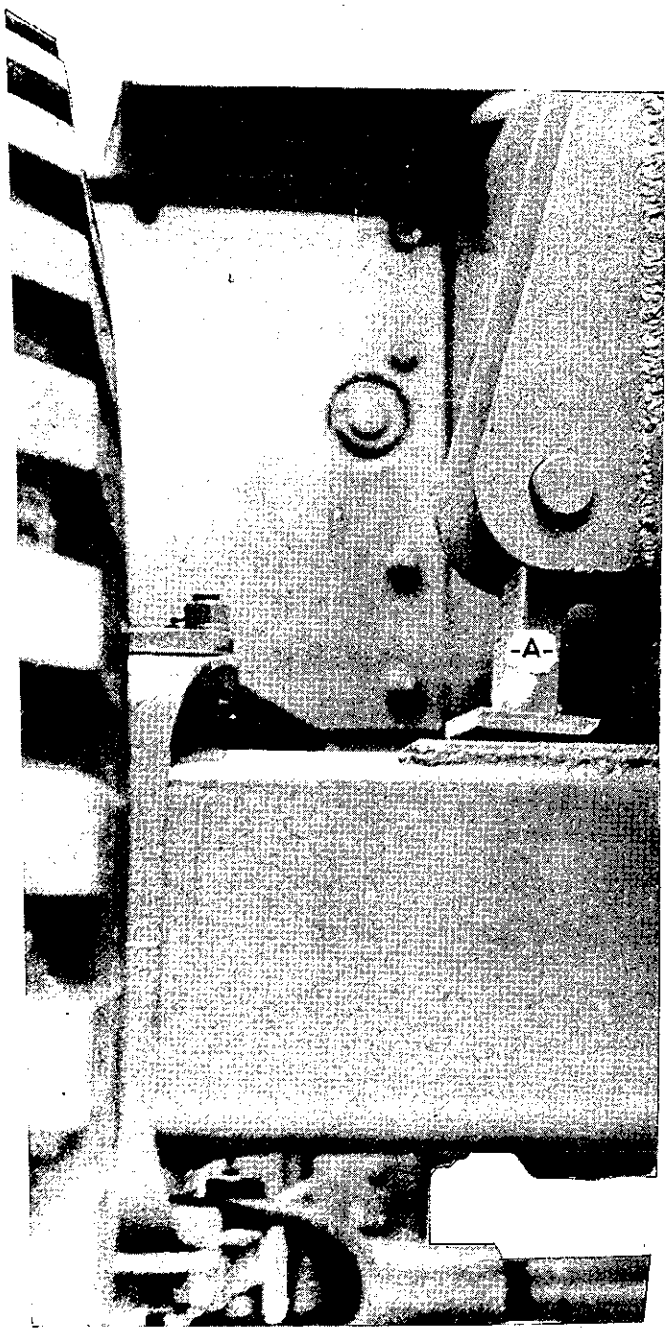
b. Brakes should be applied whenever operating the crane. Parking brake (21) can be used if on level ground. On rough terrain wheel brakes should be applied with the foot pedal (24).

> CAUTION: If medium or maximum lifts are to be made, swing the two rear axle lock-out pads down to rear axle to help maintain stability (see page 23). On completion of operation, swing lock-outs up to the stowed position so as not to limit rear axle oscillation.

c. The lock-out pad (A) (see below) is shown in the lowered position. This position helps to maintain crane stability.

WARNING

LOCKOUTS MUST BE DOWN AT ALL TIMES WHEN LIFTING.
TO BE RAISED ONLY WHEN TRANSPORTING OVER ROUGH GROUND.



d. All crane functions are hydraulically controlled through levers at operator's station (see page 19).

1. Lever (12A) raises and lowers the boom.
   Forward to lower.
   Back to raise.

BOOM

DOWN

UP

2. Lever (14A) controls extension and retraction of boom.
   Forward to extend.
   Back to retract.

CROWD

EXTEND

RETRACT

HOIST

DOWN

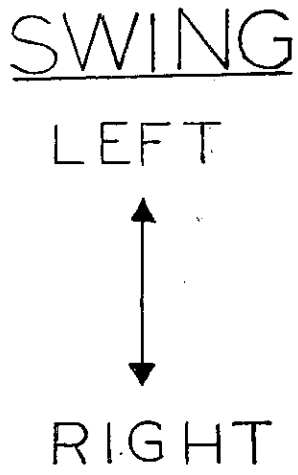
UP

3. Lever (13A) controls crane cable.
   Forward to unreel.
   Back to reel in.

CAUTION

MOVE CROWD AND HOIST LEVERS TOGETHER

4. Lever (15A) controls swing mechanism.
Forward swings left.
Back swings right.



Any two of the four operations can be performed simultaneously. Open valves cautiously until you get the feel of the controls. Boom hoist and swing valve spools are tapered, making it possible to "meter" oil into the system for precision control.

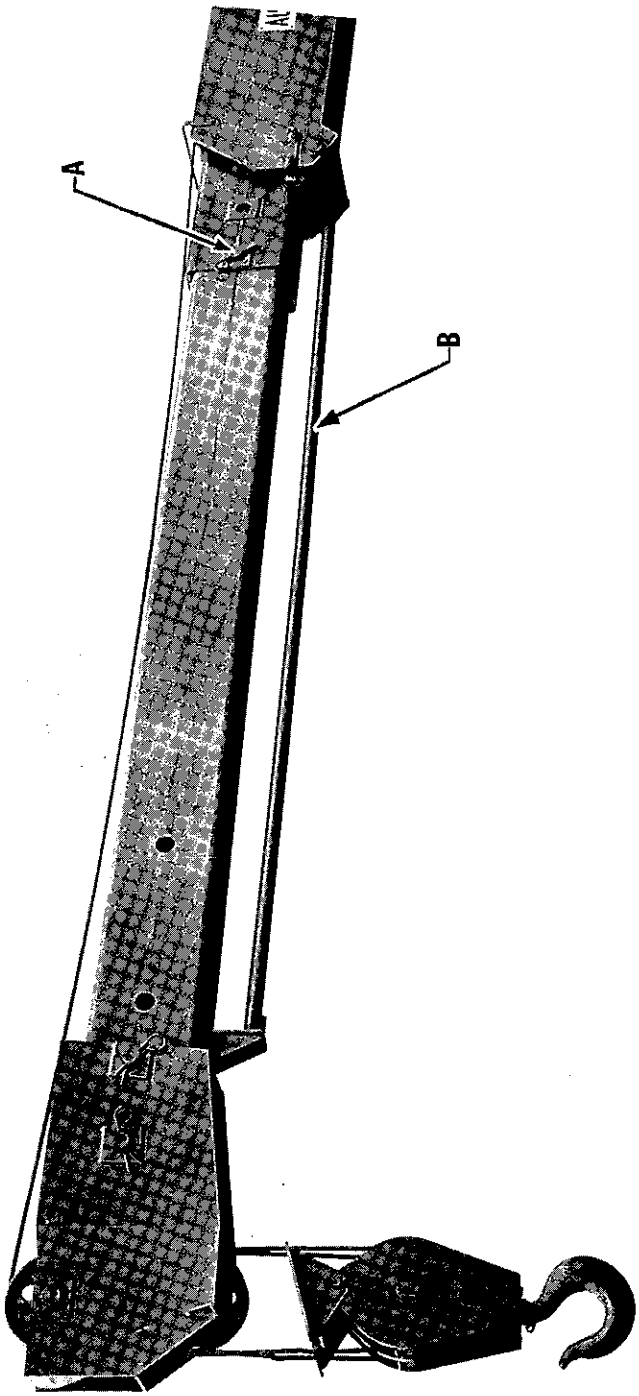
5. BOOM EXTENSION (Push-out rod).

a. CAUTION: When extending boom or using cable hoist, do not jam hoist block into boom point. Move crowd and hoist levers together in same direction, unless there is considerable distance between point and block.

b. Boom length (horizontal), from center line of pivot post to center of hook with boom fully retracted is 15'. With boom fully extended, it is 25 ft. With boom extension out and boom fully extended, a total of 36' can be attained with a 11' manual extension and 48' with a 23' manual extension. (See pages 13 and 26.)

c. To push out boom extension, remove the two 2" diameter retaining pins (see (A) next column) that pass through both the boom and extension. Extend boom to maximum by using crane controls. Assemble the 2 pieces which make up the extension push-out rod (B), which are stowed on side of shipper, to form a long rod. Fit rod between "V" shaped brackets at end of shipper and on end of extension (see next column). Retract boom slowly, pushing out extension until holes in boom and extension line up so that retaining pins can be replaced. Remove push-out rod, disassemble and stow on side of shipper.

d. operation for extending boom. By standing on the front wheel or frame, the operator extends boom half way out and then lays one end of the push-rod in the "V" on the boom tip. With the left hand he grasps the other end of the rod and continues extending the boom out till he can place this end in the "V", and then retracts until the holes line up.



e. To retract extension, remove the two retaining pins and slowly raise the crane block, with cable hoist control, until block contacts the boom extension point. Crane cable will then pull extension back to retracted position. Replace pins.

> CAUTION: The entire operation of extending and retracting the extension should be done with care for the protection of personnel and to prevent damage to the machine.

6. SAFE LOAD CHART.

a. Be sure to study and fully understand the "Safe Load Chart", (page 12); also working range and boom extension information shown on page 13.

b. The 4 drive wheels are offset. This means that all wheels may be removed and turned inside out, and reassembled to the wheel hubs. (If directional tires are used, place the left wheel on right side and the right tire on the left side.) Please study the "Safe Load Chart" (on page 12) for increased load lifting values when wheels are turned out.

c. When the weight of load is not known, swing the boom to the side and test by lifting the load slightly. If the load is loose and can be safely lifted a few inches, then it may be safe to lift and swing it at that radius; but not necessarily exceeding the original radius at which the weight was test lifted.

For example -- if a 9200 lb load is side lifted at 20 ft. radius (with outriggers) and by swinging slightly, the radius shifts to 22 ft. or more (due to ground not being level), then the boom is overloaded and the crane may tip.

A loose known weight of 9200 lbs is one thing. A machine (9200 lbs) bolted to a floor and stuck over floor bolts, is another matter. (Loosen the weight; use hydraulic hand jacks as required.)

A steel door (9200 lbs) stuck in door guides is something else. (Loosen the door. Use hydraulic hand jacks as required.)

In case of doubt:

d. Lower all 4 outriggers, if available, or turn all four wheels out.

e. Place all 4 wheels (outriggers) on solid level footing. Lock all brakes, (21) and (24), page 19. Locate boom at elevation at which you expect to swing.

f. Test lift from the side of crane. Tighten up lift cable slowly. If weight doesn't move, don't race engine and jam hoist control to start the load, because a boom can be bent thru this abuse. The "Safe Load Chart" shows safe lifting capacities, but a rough operator can impose unsafe shock loads.

g. If the tires squeeze down drastically (no outriggers), recheck tire pressure and inflate as per instructions (See page 27). After tire inflation, if the tires still squeeze down drastically, then an unsafe overload is being lifted.

h. Do not jam the hydraulic control levers at wide open engine throttle, expecting to jar loose a weight that is stuck. Instead tighten the lift cable slowly and move the weight slowly. (Loosen the weight. Use hydraulic hand jacks as required). Do not lower a weight fast and expect to stop it fast on short notice. Instead lower it slowly and evenly. Failure to follow these instructions may result in bent booms or other serious damage.

i. CAUTION ON OVERLOADING.

The capacity of the crane is limited to its safe lift at the side (crane on level ground) with a safety factor of about 15 to 20%. The design of the structure is based on this tipping moment and the load capacity is inversely proportional to the radius. Greater loads than are shown in the safe load diagram can be handled with the boom at the front without tipping, but in so doing the stress in the crane structure goes up to unsafe figures. Broken or bent tractor frames, base plates, booms or shippers, will be evidence of over-loading beyond the safe load limit.

7. BOOM EXTENSIONS.

a. When crane is <u>not</u> fitted with extension, then the boom head "AA" is bolted into the main crowd boom as shown at "A", and the horizontal reach is from 15' to 25'.

The illustration "AA" below, shows the boom head unbolted from the main crowd boom "A".

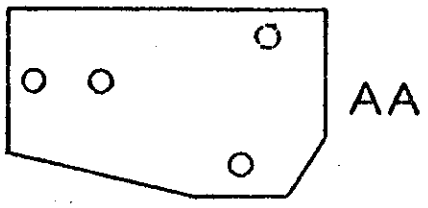
b. When an 11 ft. or 23 ft. extension is desired, then the boom head "AA" must be unbolted from the main crowd boom "A" and rebolted to the right end of the extension at "AAA".

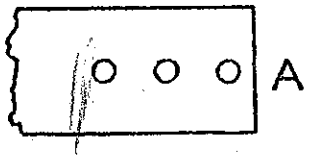
The section may then be telescoped into the main boom throat as required and cross pins installed at either position (1) and (2).

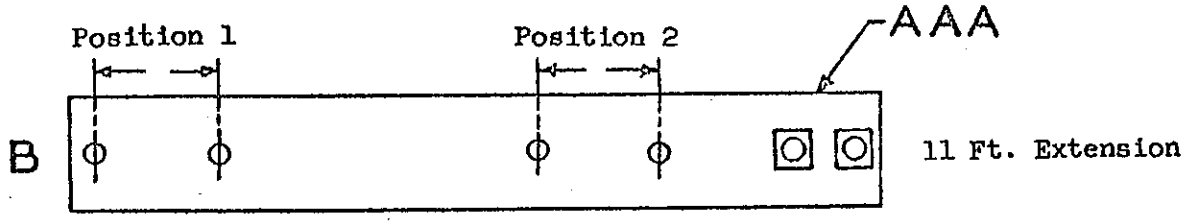
The maximum horizontal reach of the 11 ft. extension is 36 ft. (extension out). With the extension <u>in</u> and main boom <u>in</u>, the minimum horizontal reach is 16'-5".

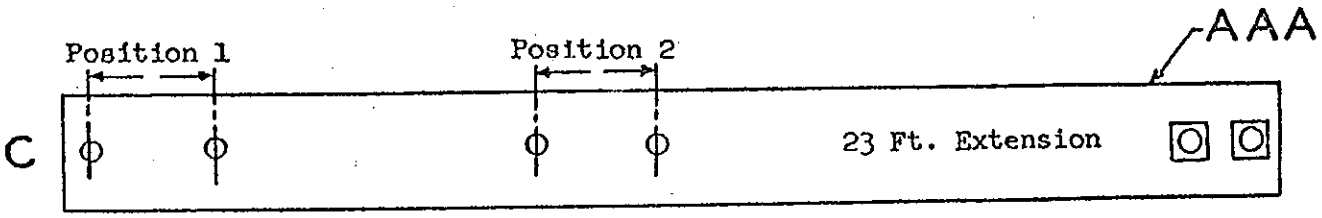
The maximum horizontal reach of the 23 ft. extension is 48 ft. (extension out). With the extension <u>in</u> and main boom <u>in</u>, the minimum horizontal reach is 28'-5"

c. NOTE: See bottom of page 13 for complete horizontal extension data.









8. TIRE INFLATION.

Front and Rear		
	Normal Load	Maximum Load
14.00 x 24 — 16 ply	75 lbs.	80 lbs.
16.00 x 20 — 14 ply	40 lbs.	55 lbs.
Variation of 2 lbs. permissible.		

9. MAINTENANCE HYDRAULIC SYSTEM.

a. Check hydraulic tank oil level regularly. It must always be to top mark of dip stick. If at any time hydraulic pump should cavitate, (that is, make loud rattling or squealing sound), shut off pump immediately. Check oil level as well as the pump, for you may well save a pump from destruction.

b. Following is copy of decalcomania located at the hydraulic tank. (See page 15)

OIL LEVEL INSTRUCTIONS

REMOVE THIS PIPE PLUG AT LEAST ONCE EVERY 30 DAYS AND CHECK HYDRAULIC LEVEL. ADD OIL, IF LEVEL IS BELOW BOTTOM MARK OF DIP STICK, TO BRING LEVEL TO TOP MARK..

c. Lubricate your crane frequently. Proper lubrication will greatly increase the lift of the machine. (See lubrication data, pages 14, 15 and 16.)

10. SUB-ZERO STARTING INSTRUCTIONS.

a. Extreme care should be exercised in the preparation of the crane for operation in severe cold weather conditions, with emphasis being placed on the flushing and cleaning of all old lubricants from the system.

b. All hoses leading to hydraulic rams and oil motors should be disconnected. The rams and vane type motors should then be actuated through their full cycle of operation, by external means, so as to void the system of all old oil. Remove drain plug from bottom of hydraulic tank and drain completely.

c. Remove drain plugs from bottom of crane worm gear cases. Drain and flush thoroughly so as to remove all old gear lubricants from gears and housings.

d. Remove drain plug from bottom of base plate and remove pivot post ring gear cover plate. Remove all old general purpose grease from swing drive gears and housings, flush and clean thoroughly.

e. After removing all old lubricants from entire crane, replace all parts and plugs and refill entire system with hydraulic oil and lubricants conforming to specifications shown on lubrication chart, page 15.

f. If crane has not been winterized, in emergency proceed as follows:

Select one crane control lever and move it until engine begins to stall or hydraulic oil relief valve opens. Return lever past neutral so as to reverse action to original position. Repeat this rocking procedure, each time progressively moving farther than the time before. Continue until this operation is in maximum position and oil has warmed sufficiently to flow freely in this circuit.

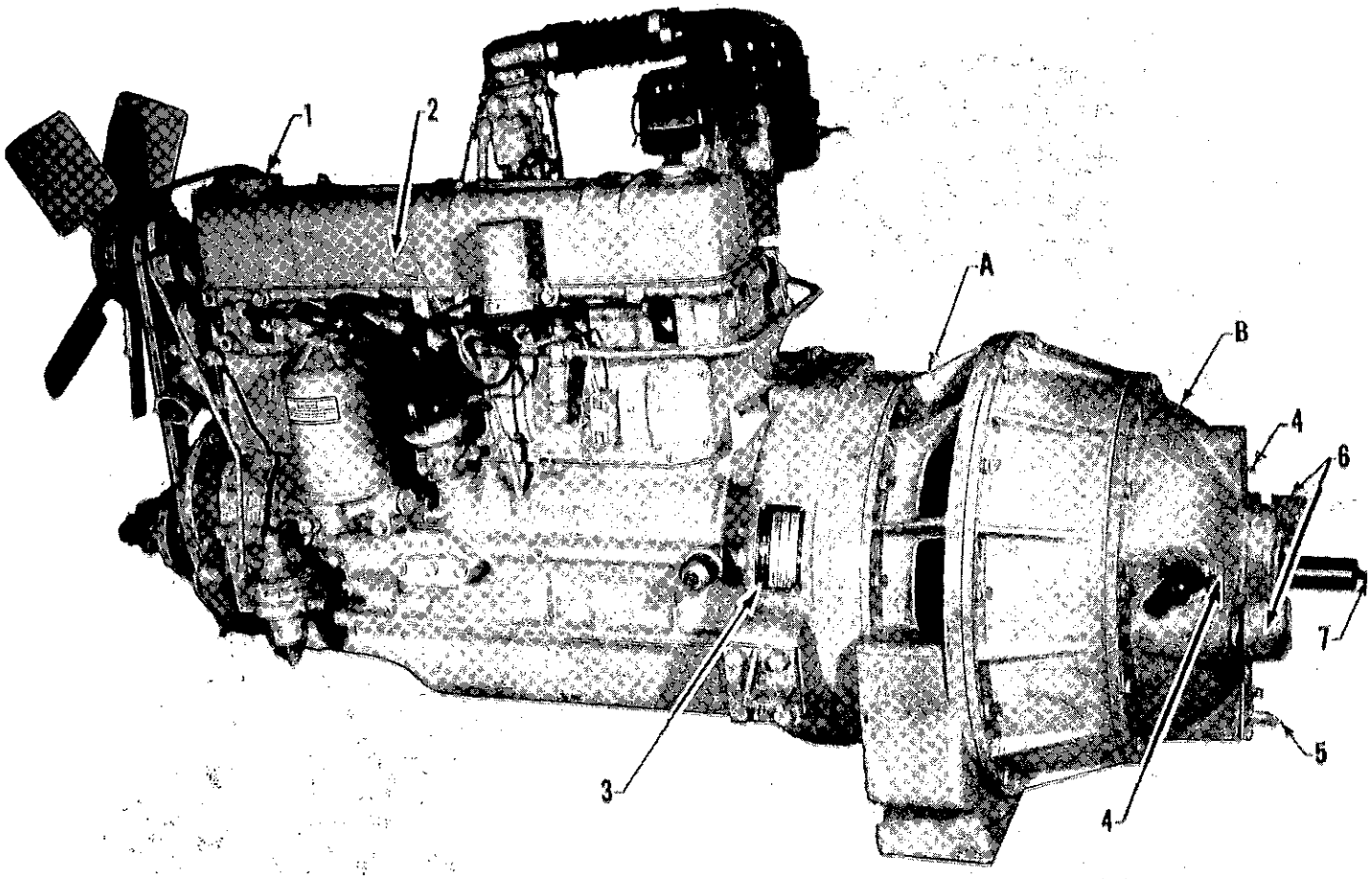
Follow this procedure with each additional control until oil has reached proper operating temperature, which will be indicated by controls and functions of crane working freely. Drain oil from tank and replace with oil suitable for temperature involved. (See page 15 for oil specifications.)

11. REMOVAL FROM OPERATION.

a. Lubricate the unit completely before storing or shipping.

b. When this unit is removed from operation for a period of more than 30 days, we suggest leaving the oil in the hydraulic tank and system, unless removal is required for weight reduction in transportation or to comply with safety regulations.

c. Coat both upper and lower boom shoes as well as track or surface on which these shoes operate, with rust inhibitor. The same material should be used on all hydraulic cylinder piston rods projecting out beyond the packing gland. All ram piston rods should be retracted.

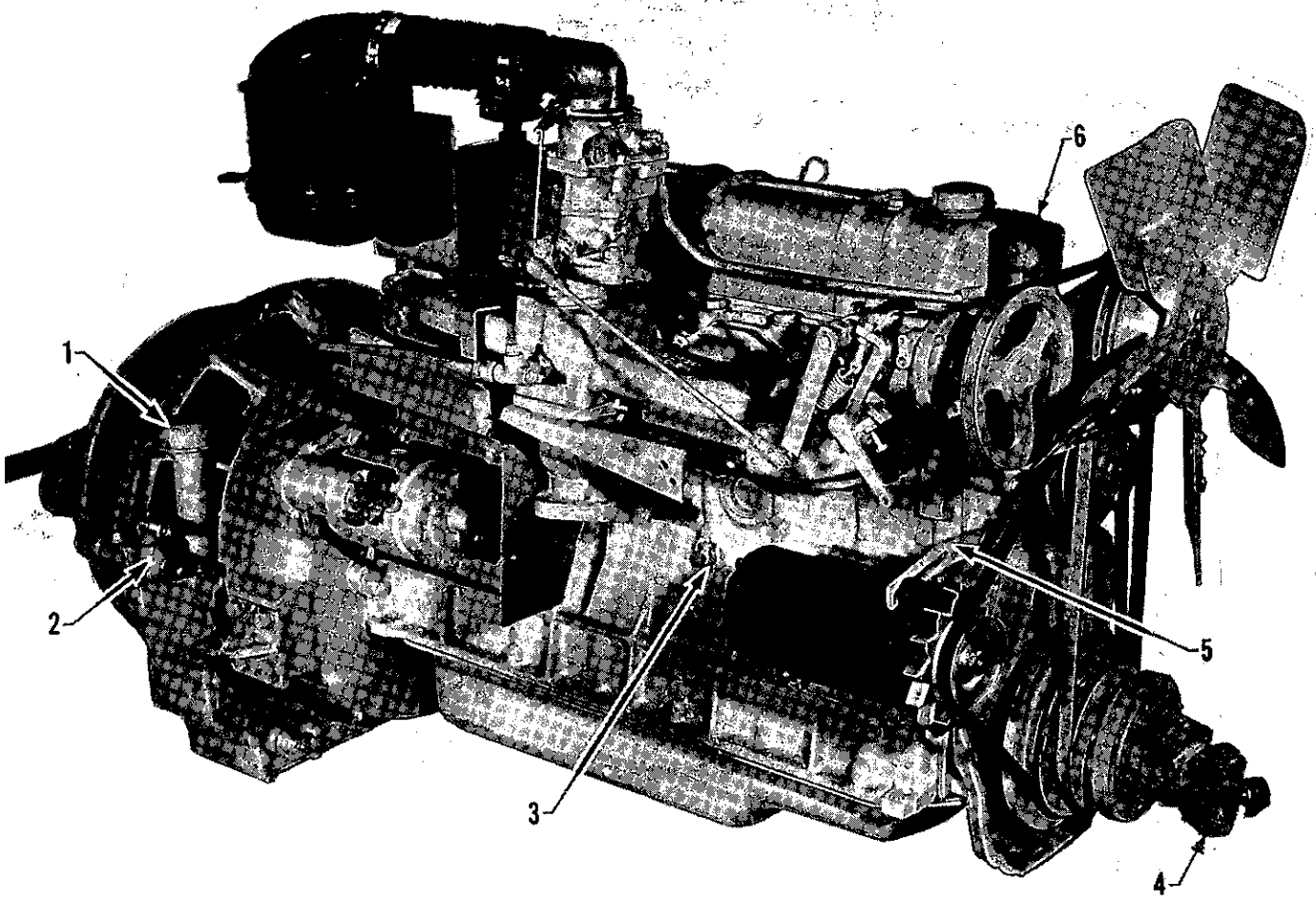


12. ENGINES.

a. Right Side of IHC UB-264 gasoline engine, with Torque Converter (A) and Clutch Compartment (B).

b. See separate IHC Instruction Book.
c. See separate IHC Engine Repair Parts Catalog.
d. See page 91 for Torque Converter Assembly.
e. See page 86 for Clutch Assembly.
f. Please note the following points as shown in above photo:

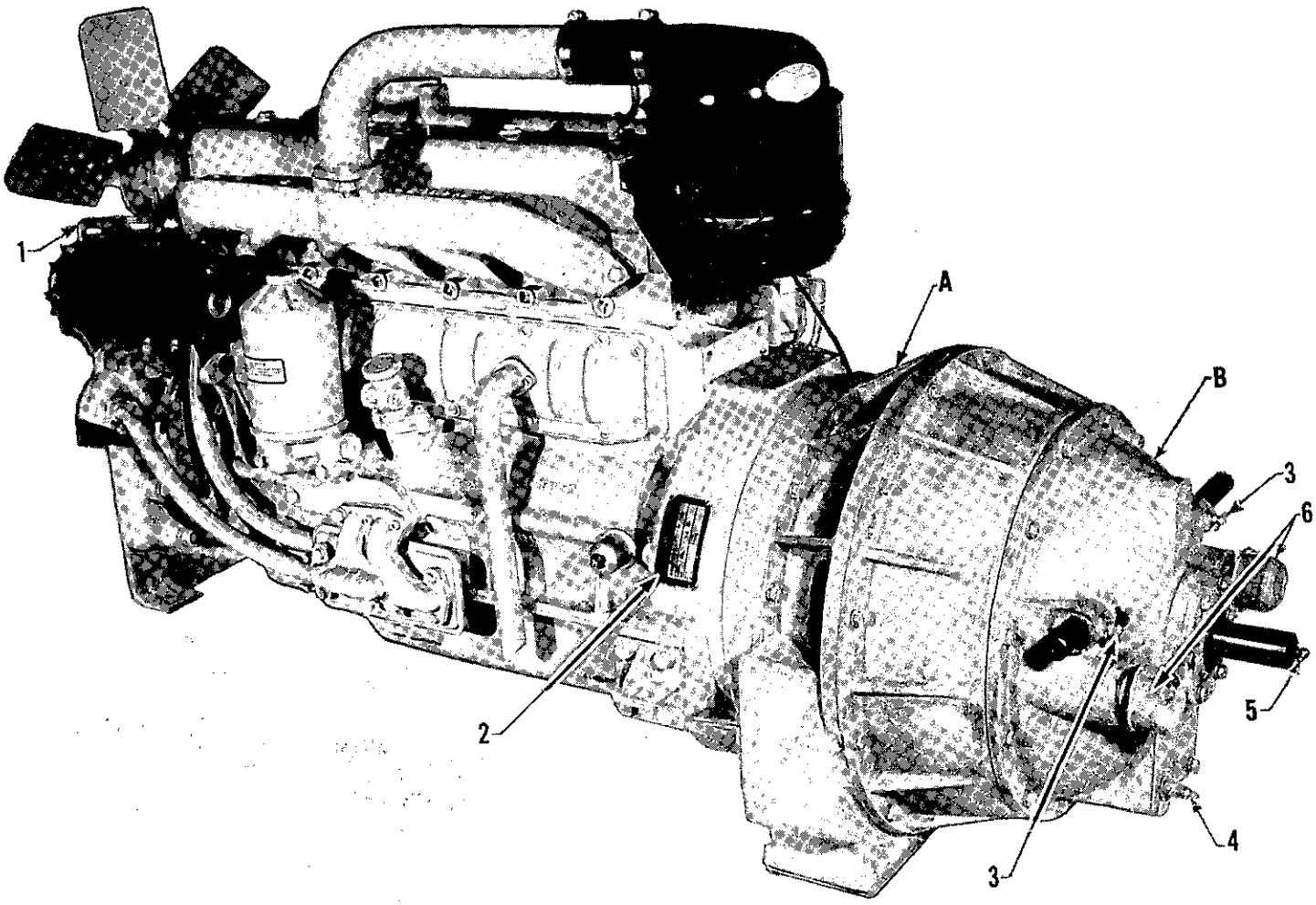
(1) Engine oil filler cap.
(2) Engine crankcase oil bayonet gauge.
(3) IHC engine serial number name plate.
(4) Clutch release shaft grease fitting.
(5) Clutch release bearing grease fitting.
(6) Clutch Compartment Breathers.
(7) Grease fitting for Flywheel Pilot Bearing.



g. Left side of IHC UB-264 Gasoline Engine with Torque Converter and Clutch Compartment attached.

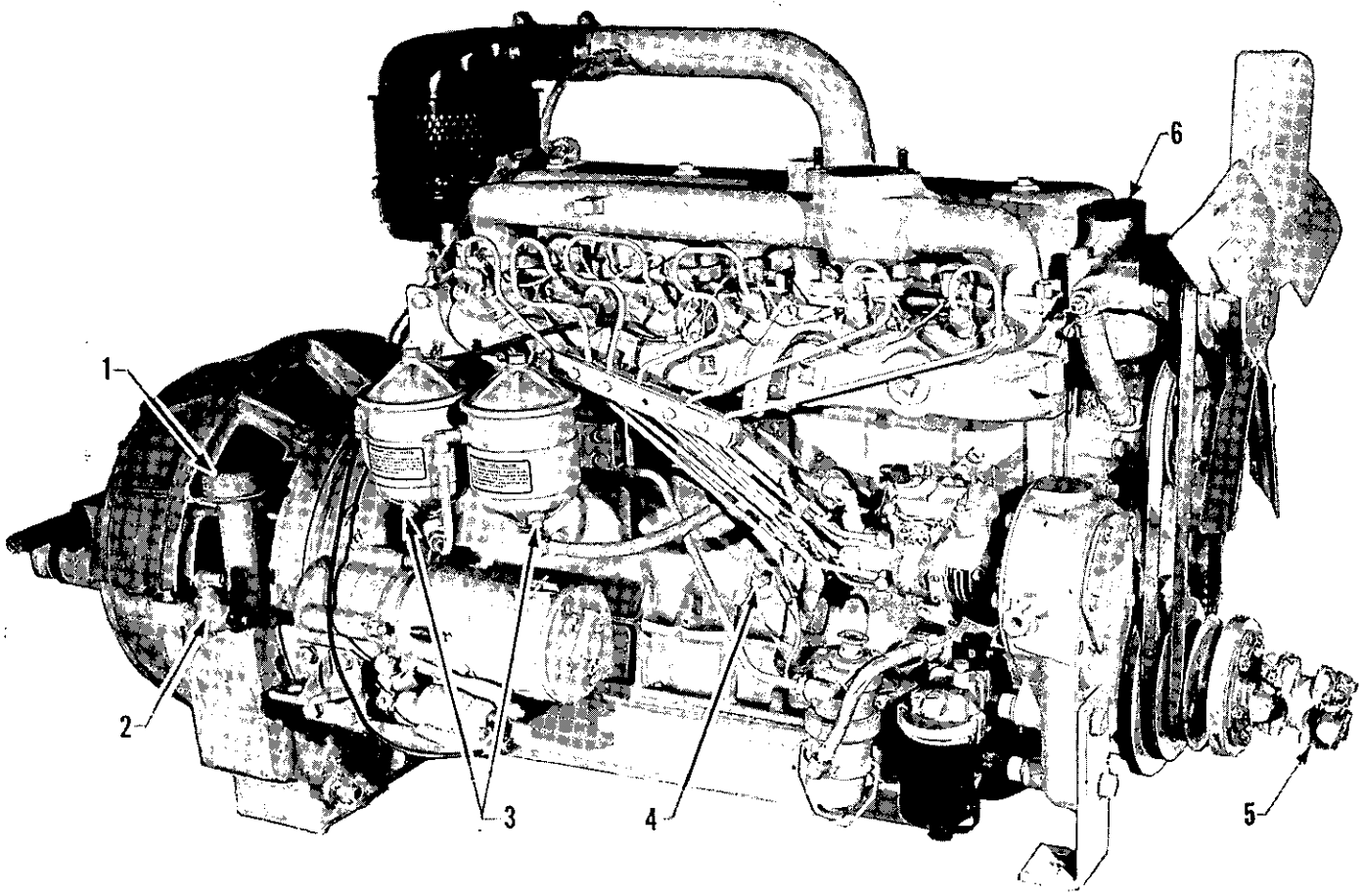
h. Please note the following points as shown in above photo:

(1) Torque Converter filler cap and level gauge.
(2) Torque Converter by-pass valve.
(3) Engine block drain cock.
(4) Universal joint coupling for hydraulic pump. (Crane circuit)
(5) Generator belt adjusting link.
(6) Thermostat housing.



i. Right side of IHC UD-282 Diesel Engine with Torque Converter (A) and Clutch Compartment (B) attached.
j. See separate IHC Instruction Book.
k. See separate IHC Engine Repair Parts Catalog.
l. See page 91 for Torque Converter Assembly.
m. See page 86 for Clutch Assembly.
n. Please note the following points as shown in above photo:

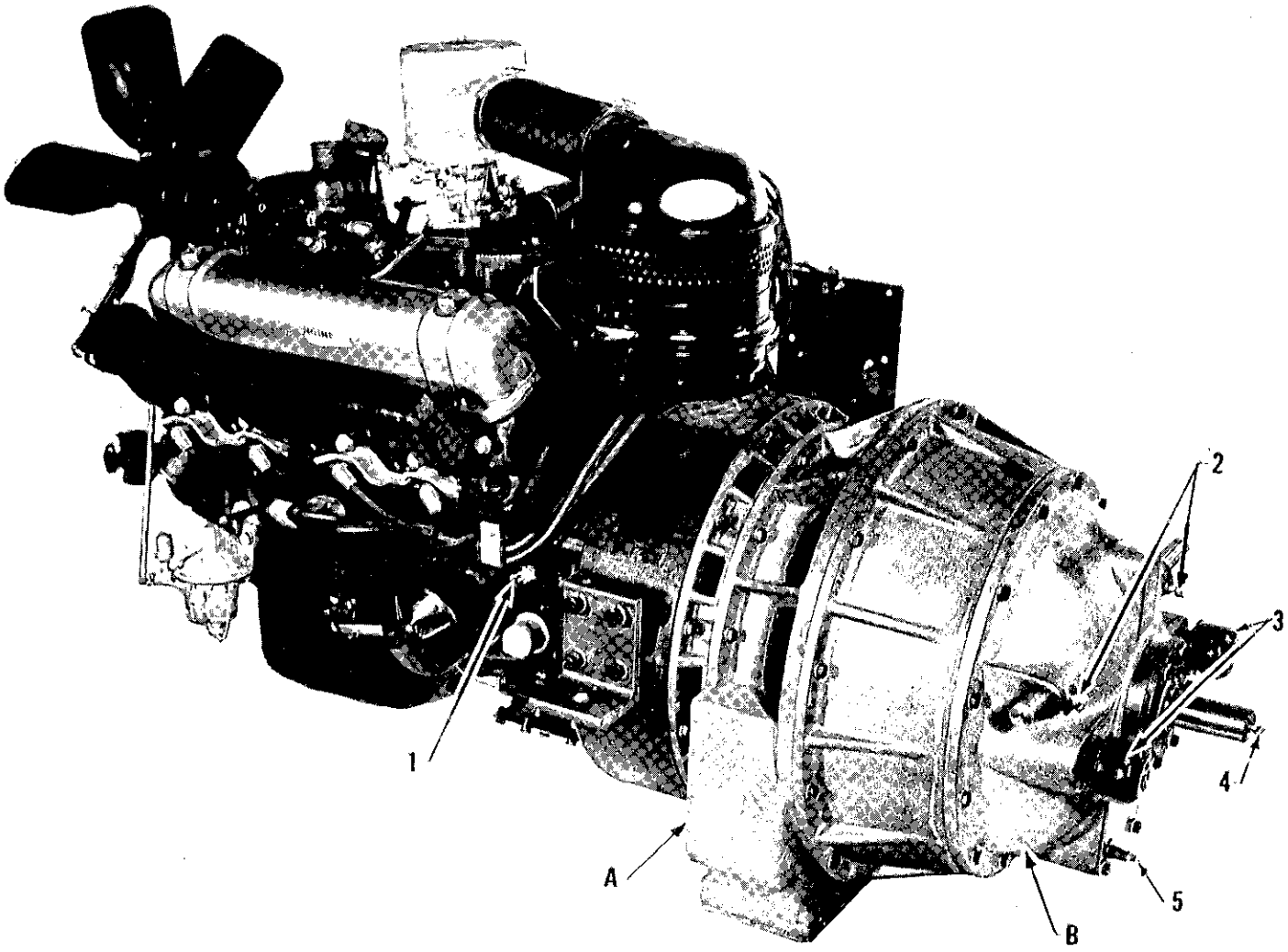
(1) Generator belt adjusting link.
(2) Engine serial number name plate.
(3) Clutch release shaft grease fitting.
(4) Clutch release bearing grease fitting.
(5) Flywheel pilot bearing grease fitting.
(6) Clutch Compartment Breathers.



o. Left side of IHC UD-282 Diesel Engine with Torque Converter and Clutch Compartment attached.

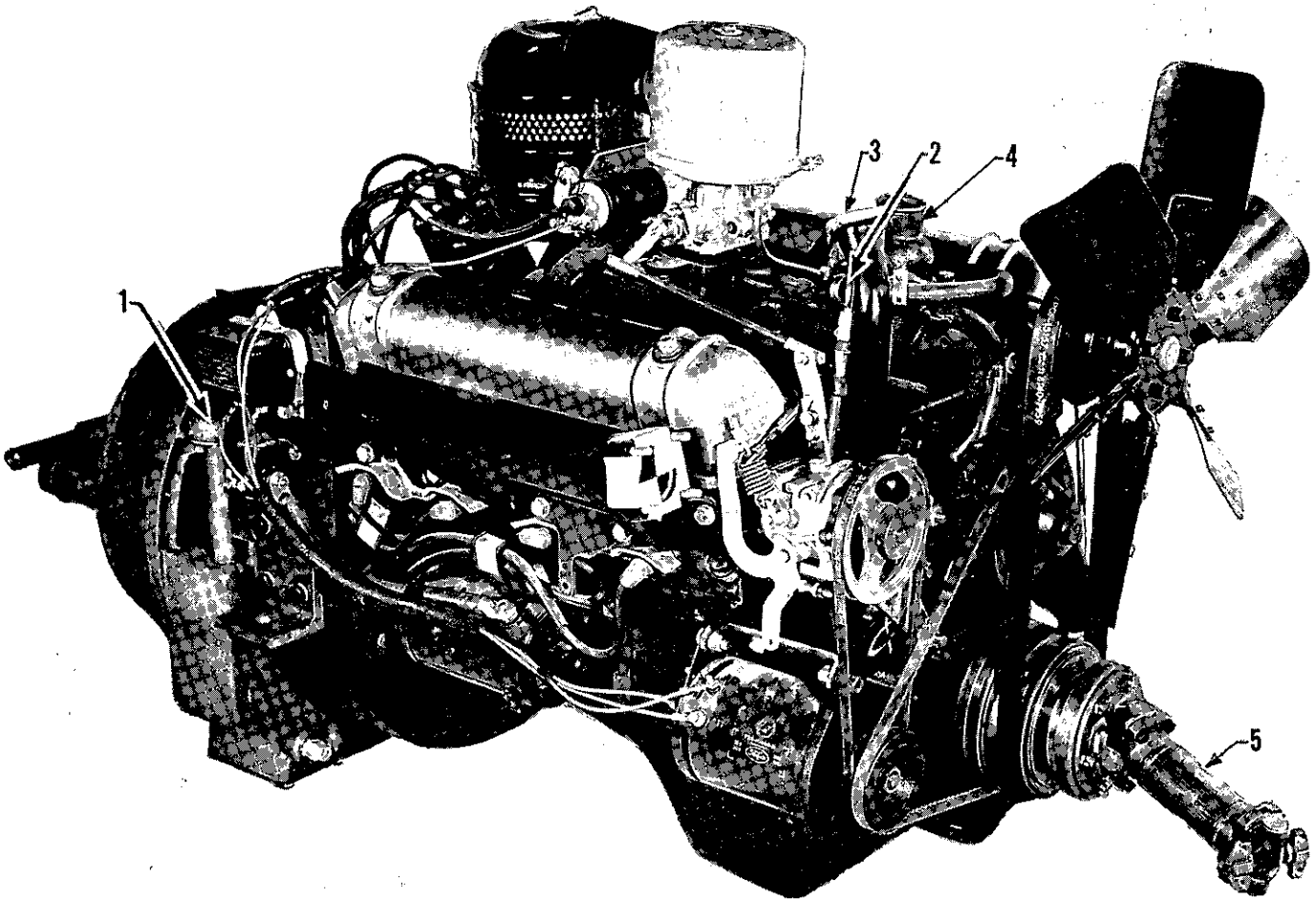
p. Please note the following points as shown in above photo:

(1) Torque Converter filler cap and level gauge.
(2) Torque Converter by-pass valve.
(3) Fuel filter drain plugs.
(4) Engine oil filler and bayonet gauge.
(5) Propeller shaft assembly for hydraulic group. (Crane Circuit.)
(6) Thermostat housing.



q. Right side of Ford "332" Gasoline Engine with Torque Converter (A) and Clutch Compartment (B) attached.
r. See separate Ford Instruction Book.
s. See separate Ford Engine Repair Parts Catalog.
t. See page 91 for Torque Converter Assembly.
u. See page 86 for Clutch Assembly.
v. Please note the following points as shown in above photo:

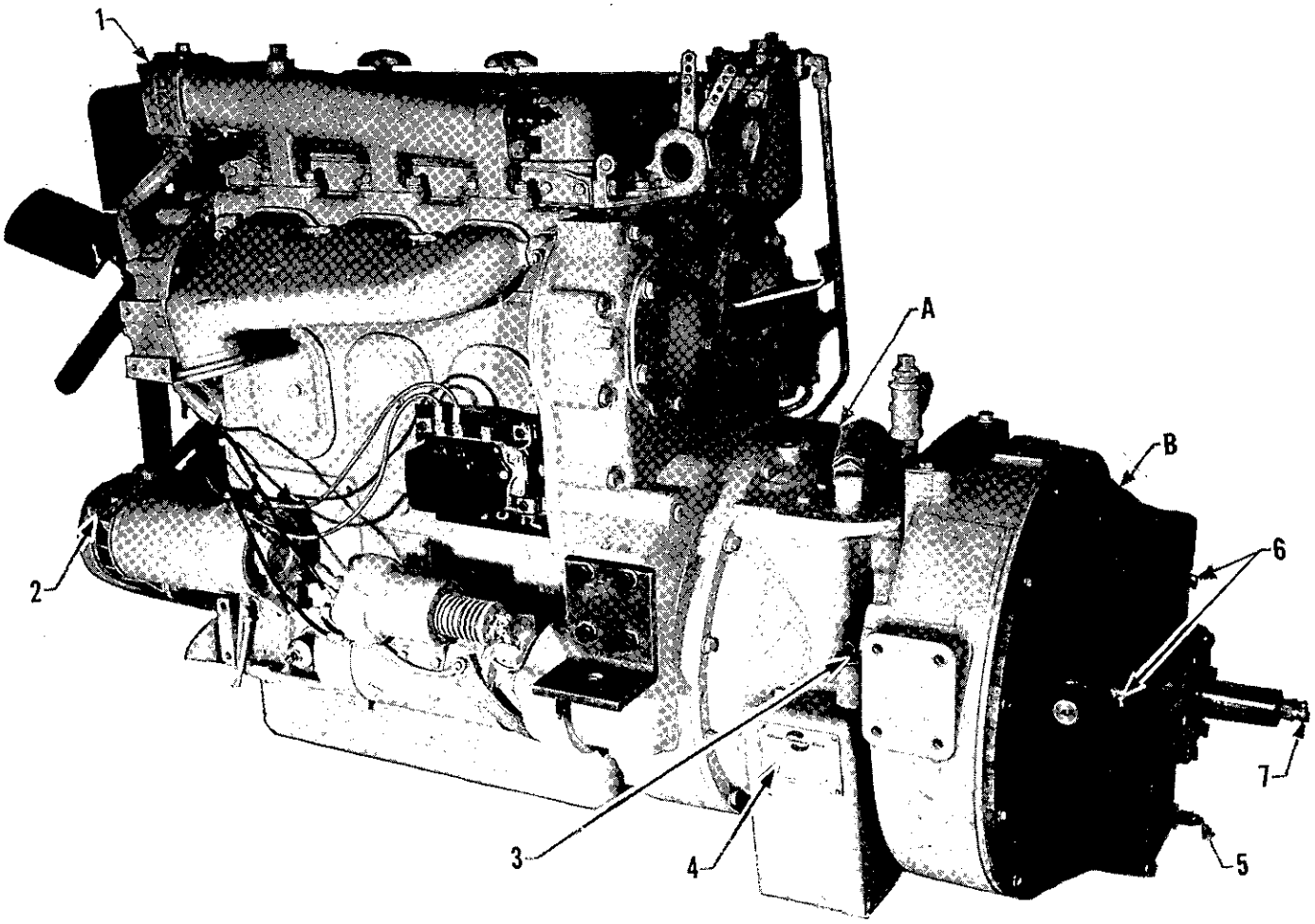
(1) Engine block drain cock.
(2) Clutch release shaft grease fittings.
(3) Clutch Compartment Breathers.
(4) Grease fitting for flywheel pilot bearing.
(5) Clutch release bearing grease fitting.



w. Left side of Ford "332" Gasoline Engine with Torque Converter and Clutch Compartment attached.

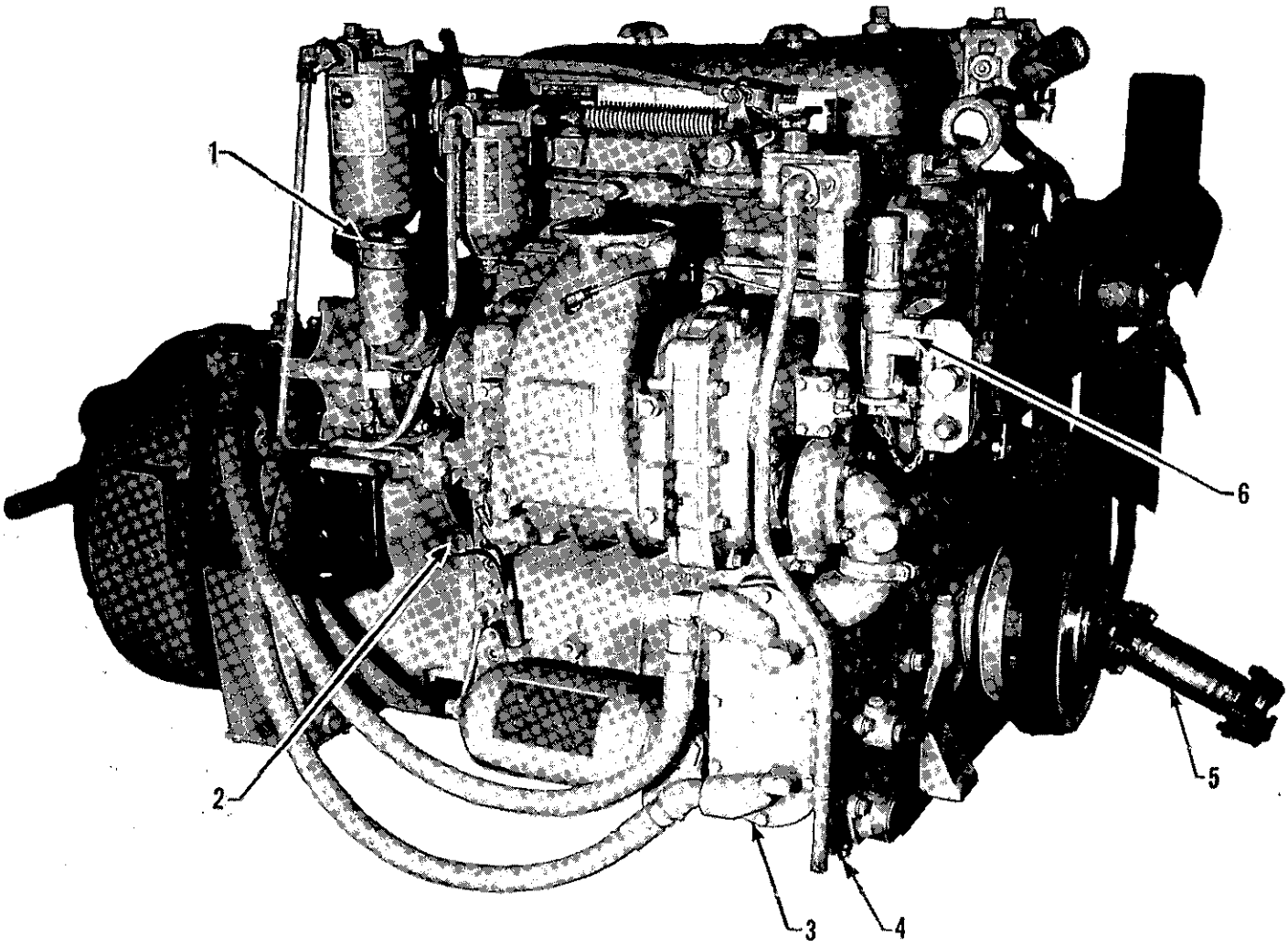
x. Please note the following points as shown in above photo:

(1) Torque Converter filler cap and level gauge.
(2) Engine crankcase oil bayonet gauge.
(3) Engine oil filler cap.
(4) Thermostat housing.
(5) Propeller shaft assembly for hydraulic pump. (Crane Circuit.)



w. Right side of GMC 3-71 Diesel Engine with Torque Converter (A) and Clutch Compartment (B) attached.
x. See page 86 for clutch assembly.
y. Please note the following points as shown in above photo:

(1) Engine Thermostat housing.
(2) Generator belt adjusting link.
(3) Torque Converter oil level bayonet gauge. (Allison)
(4) Torque Converter serial number name plate. (Allison)
(5) Clutch release bearing grease fitting.
(6) Clutch release shaft grease fitting.
(7) Flywheel pilot bearing grease fitting.



z. Left side of GMC 3-71 Diesel Engine with Torque Converter and Clutch Compartment attached.

zz. Please note the following points as shown in above photo:

(1) Engine oil filler cap.
(2) Engine crankcase oil level bayonet gauge.
(3) Torque Converter oil cooler.
(4) Engine block drain cock.
(5) Propeller shaft assembly for hydraulic pump. (Crane Circuit.)
(6) Ether starting device.

1. HYDRAULIC SYSTEM. (See Flow Diagram on Pages 72 and 73.)

a. General.

The hydraulic system is sealed in its entirety, except for the breather filler cap. It consists of reservoir, filter, filler screen, pump, control valves, rams and necessary piping. It requires periodic attention, and this is summed up in the following paragraphs:

b. Draining Hydraulic System.

When, for any reason, the hydraulic oil in the system is to be removed, it will be necessary to not only drain the hydraulic oil tank itself by removing the bottom plug, but the oil also must be removed from all hydraulic lines and all hydraulic cylinders. To accomplish this, disconnect the hydraulic hoses attached to each cylinder and then by means of an overhead crane or a set of chain blocks extend and retract each cylinder individually and allow the oil to pour out of the cylinder openings. In addition, all hydraulic lines should be disconnected at their lowest point and drained completely. All connections are to be replaced at same location and tightened to prevent leakage.

c. Hydraulic Oil.

The oil in the hydraulic system can be contaminated by dust of a gritty nature. By maintaining the quality of oil in the hydraulic system, you increase the life of the pump, valves, and rams, and you also keep your machine at a high degree of efficiency. Change the hydraulic oil at least once a year, flushing out the supply tank thoroughly, using clean hydraulic oil only. Keep oil supply free from dust. Use clean cans when changing oil.

d. Hydraulic Oil - Type. (See Page 15, paragraph c.)

1. Hydraulic oils are required to perform the dual functions of lubrication and transmission of power. Select oil with care, with the assistance of your oil supplier.

In general, a high quality of motor oil of the proper viscosity meeting the A.P.I. classifications of MS or DS (corresponding to the former Heavy Duty Type classification) may be used. See Page 15 and Page 68, paragraph 9 and 10.

NOTE: The use of an oil of the ML Type (formerly Regular Type) is not recommended.

2. Viscosity.

Viscosity is the measure of fluidity. The oil must have sufficient body to provide adequate sealing effect between working parts of pumps, valving, cylinders, etc., but not enough to cause pump intake cavitation, sluggish valve action, or in extreme cases, resistance to flow. Viscosity recommendations must at best be a compromise, which takes into consideration the working temperature range, and the class of service. Refer to table of oil viscosity recommendations, page 15, paragraph c.

3. Viscosity Index.

The viscosity index is a measure of the rate at which temperature changes cause a change in oil viscosity. It is very desirable that the oil viscosity remain as nearly constant as possible under the wide range of temperature conditions encountered in operating mobile and construction machinery. The viscosity index (V.I.) of hydraulic oil should be high, not less than 78 for this type of service. A high viscosity index, however, should not be obtained at a sacrifice of other characteristics.

4. Pour Point.

The pour point indicates the lowest temperature at which the oil is fluid, and is a consideration for extreme starting conditions, when operating under a wide range of temperature variations. Hydraulic oil should pour freely and have a viscosity of not more than 4000 S.U.S. at the lowest starting temperature.

5. Additives.

Research has developed a number of addition agents which materially improve various characteristics of hydraulic oils. They may be compounded with a view toward increasing chemical stability, improving lubricating properties, inhibiting corrosion, together with cold pour point characteristics.

Proper use of addition agents requires specialized knowledge and they should be incorporated by the oil manufacturer only, as serious trouble may otherwise result.

6. Cleanliness.

Thorough precautions should be taken to keep the hydraulic system clean and free from water and dirt. Keep the oil clean as well to prevent the entrance of foreign material.

7. Operating Temperature.

Normal operating oil temperatures in excess of 160° F. should be avoided.

8. Grade.

The recommendations charted on page 15, paragraph c, are based on the normal operating temperatures of the hydraulic system. This is a most important consideration in the selection of oil. The chart is based on a maximum temperature rise in the hydraulic system of 90° F. and make it possible for the oil motors to develop maximum and efficient driving torque.

e. Oil Reservoir.

1. The hydraulic oil reservoir (A), page 38, is located on the left side of the tractor. An oil level bayonet gauge is attached to a square head pipe plug (B) in top of tank, and oil in the tank should be maintained to top mark. The screen group at the filler opening is provided to keep out debris from the inside of the reservoir and system, should someone inadvertently use unclean cans and pour unclean oil into the reservoir.

2. There is a filter installed inside the hydraulic reservoir for filtering the oil just prior to its entering the pump inlet line. A servicing decalcomania is attached to outside of hydraulic tank which reads as follows:

> WARNING
>
> Hydraulic oil filter inside tank. Remove filter every 200 hours of operation and clean thoroughly. Remove round tank cover by removing 6 capscrews. Reach in tank and turn filter counter-clockwise 1/8th turn. Pull filter back approximately 1-1/2 inches to clear end of suction tube and remove from tank.
>
> TO CLEAN: Immerse and swish in any non-caustic cleaning solvent for a short period of time. Shake off excess solvent or blow dry from inside out with compressed air.
>
> IMPORTANT: When reinstalling filter, sealing "O" ring must seat properly on suction tube. Slide filter on tube until it bottoms on flange. Turn filter clockwise until retainers snap in place on suction line flange pins.

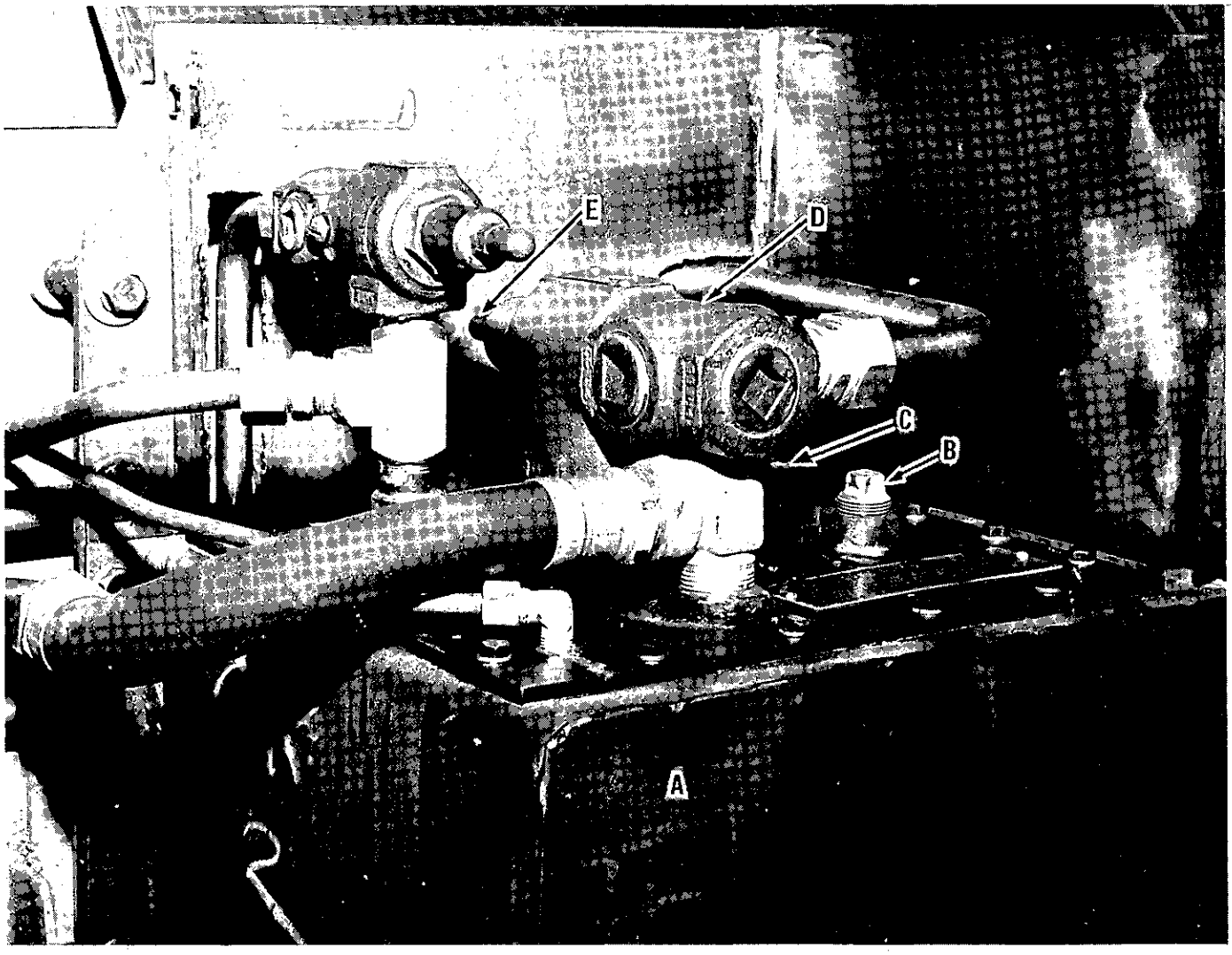
IMPORTANT: Clean hydraulic tank breather cap (C) occasionally and lubricate it with light oil to prohibit dirt and dust from entering system.

f. Relief Valve (Hydraulic Crane).

The relief valve (D), located on top of hydraulic tank, has been properly set at the factory and should not be tampered with. Should loss of power occur (slow action in rams) your trouble is most likely due to insufficient pump speed caused by idling engine too slow. Proper relief valve setting is 1200 lbs. Never attempt to set the relief valve without using a pressure gauge, as too high a setting will materially shorten the life of the hydraulic working parts.

g. Procedure for Checking and Setting Relief Valve.

An appropriate hydraulic pressure gauge should always be used when setting the relief valve. The gauge may be installed into the hydraulic system on the elbow (B), page 74, at the hoist vane motor. The pipe-tap was put in the elbow specifically for this purpose, as it is accessible and the gauge can be read from the operator's station. To obtain a correct hydraulic pressure reading on the gauge, lower the cable hook a considerable



This photo shows the Hydraulic Oil Tank (located on left side of main frame).

distance so there will be no danger of fouling the hook sheave block with the boom point. Then with the boom fully retracted hold the boom crowd control lever in the retract position (this will open the relief valve) at the same time holding the cable hoist control lever in the up position. The reading on the gauge will be the pressure at which the relief valve is unloading. This should be taken with engine at 3/4 to full throttle.

h. To adjust the pressure up or down, remove top cap (E) of relief valve and loosen lock nut. Then by using a screw driver, turn set screw to the right to raise the pressure and to the left to lower the hydraulic pressure. Pressure should be set at 1200 PSI.

After desired pressure is obtained, tighten lock nut, being careful that set screw does not move out of adjustment, and replace top cap. Care should be taken to be sure lock nut and cap are tight so there will be no chance for these parts to loosen due to vibration.

2. HYDRAULIC TUBES AND FITTINGS.

a. The tubing used is of butt welded steel construction and is amply strong for the purpose intended.

b. The tube fittings are Ermeto flareless and have proven very satisfactory for hydraulic applications, providing certain precautions are taken in assembly and disassembly.

c. Should it be necessary to disassemble any tube fitting nut, in reassembly, pull nut up finger tight and then give 1/8th turn only, with a wrench. This is important and must be observed.

d. To install a new tube or fitting, never tighten over two turns after sleeve has shouldered in body of fitting, as this will distort the sleeve and tubing, thereby preventing a leak-proof seal.

3. HYDRAULIC HOSE.

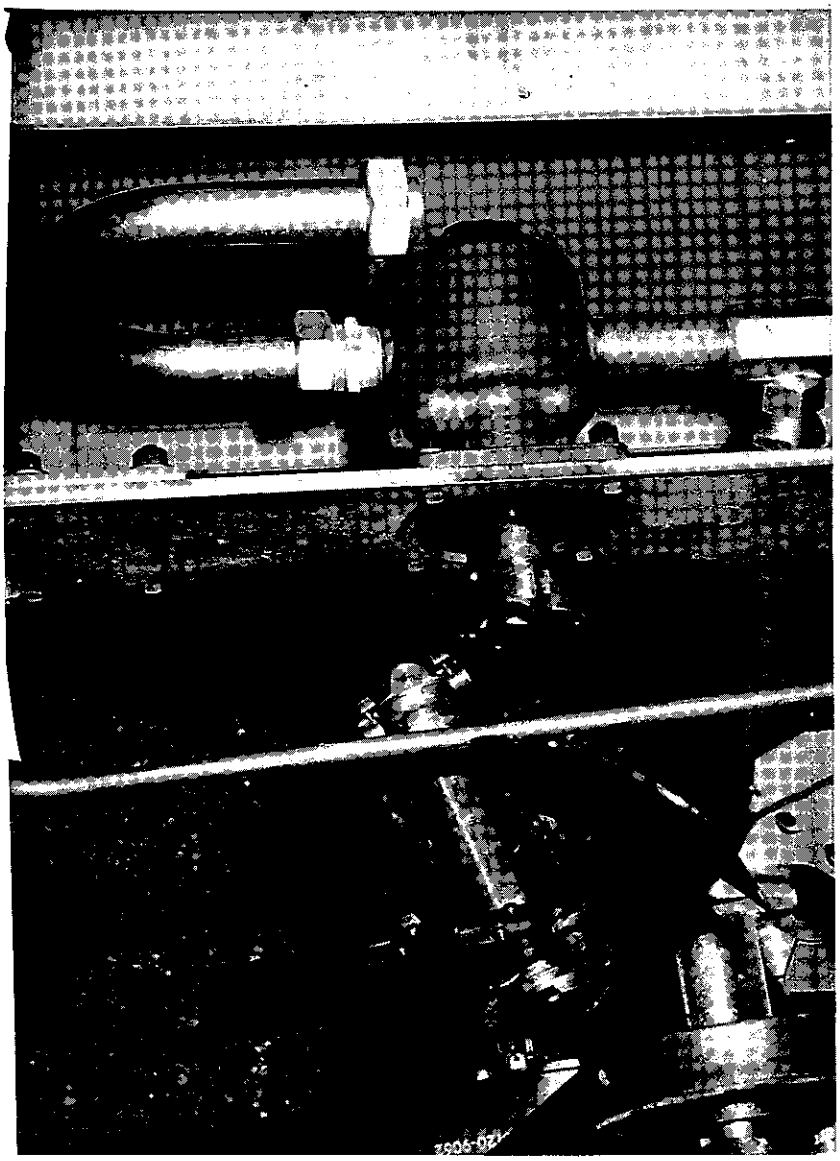
a. The rubber hydraulic connecting hose is amply strong to stand the pressures encountered. Constant vibration may tend to loosen some of the fittings, and they should be inspected occasionally and tightened with the special wrenches provided.

b. These hoses were made at the factory with swedged on couplings, and if leaks do occur, new hose assemblies must be used.

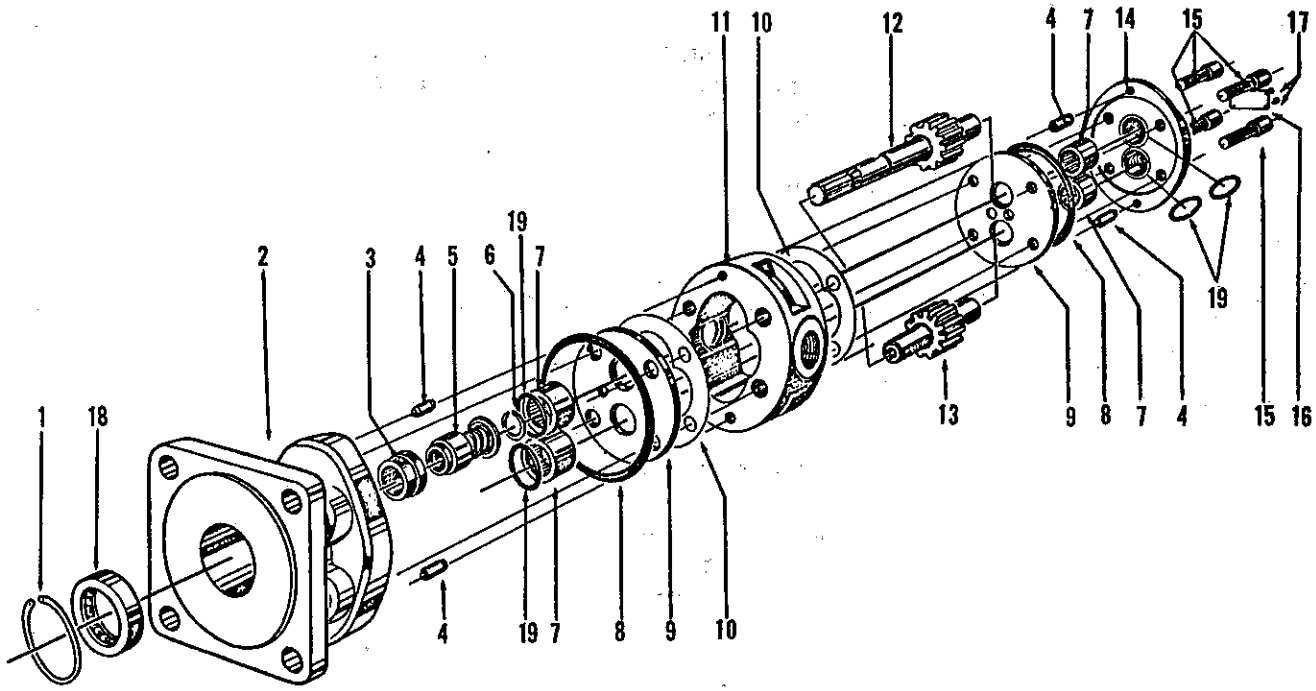
c. All hydraulic hoses leading to and from the swivel valve (35), page 71, except the small drain line, have been coded by means of numbers 1 through 6 inclusive, which are stamped in the hose couplings. When replacing hoses, observe the number on each hose coupling, being sure this number matches the number stamped at the swivel valve hose opening. This prevents the possibility of getting a hose connected to the wrong circuit. The pipes coming out of the frame should be tagged with numbers corresponding to those stamped in the connecting hose end coupling.

4. HYDRAULIC PUMP - CRANE CIRCUIT.

A. The hydraulic pump located in the front of the engine, and driven by a short propeller shaft, is an important unit and should be handled with care. Loss of volume will more than likely be due to loose connections or slow pump speed. We strongly recommend leaving the pump alone. Should anything occur that would lead you to believe the pump might be in need of repair, procure another pump, or repair pump, using pages 40 to 55 inclusive as a guide for disassembly and reassembly.



B. Above is shown the hydraulic pump drive shaft and piping. This pump is available in either a 48 or 73 GPM. capacity.



MAIN HYDRAULIC PUMP (HYDRECO - 48 GPM.)

C. Hydraulic Pump Dismantling. (For machines equipped with Hydreco pump.)

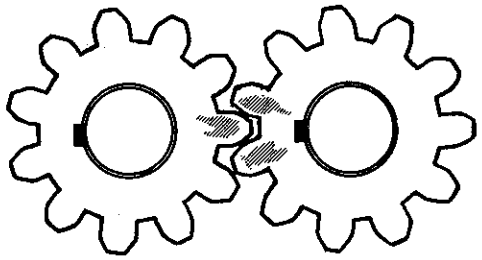
1. Clean outside of the pump with an oil solvent, fuel oil or gasoline, and dry thoroughly. With file or oil stone remove sharp edges or burrs from shaft splines, drill point, keyway or shaft end before proceeding with disassembly. Mark sections of pump with prick punch for proper reassembly.

NOTE: Servicing is facilitated by bolting the adapter to a special bench mounted assembly plate. (See page 46.)

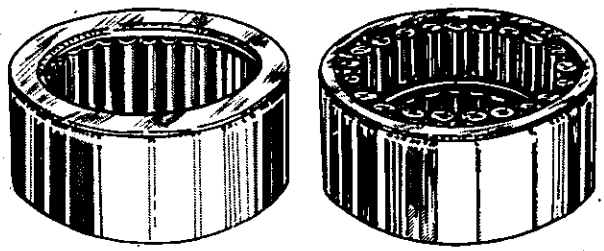
2. Remove the four cover cap screws (15) (see above). Remove the cover (14) which may come off separately or with the housing (11).

To prevent possibility of leakage, avoid scoring or nicking machine surfaces of pump sections. DO NOT USE A SCREW DRIVER to pry the sections apart. Tap with fibre hammer, if necessary, to loosen.

Note position of relief pocket and drilled holes in the wear plate (9) for proper reassembly. Mark the drive (12) and driven gears (13) with an India stone, (see right, above) for proper reassembly. Note the location and number of gaskets when disassembling.



Remove driver shaft (12) and gear. Unbolt adapter end from bench plate. Press out the bearing (7). Remove seal assembly (3) and (5) and snap ring (6), freeing shaft (12) and wear plate (9). This pump is equipped with an outboard ball bearing. Be sure to coat end of shaft with white lead and remove any burrs before pressing out to prevent the



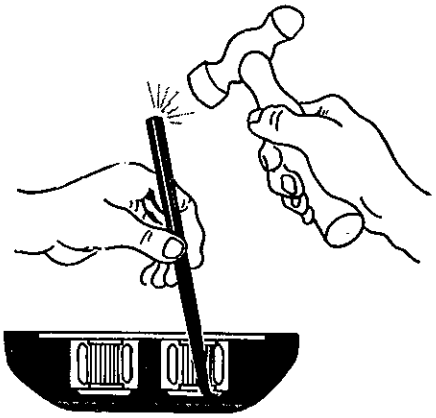
Type "A" Bearing Type "B" Bearing

bearing from being scored. Remove dowel pins (4) from adapter (2) and cover ends (14), with pliers or a lever jaw wrench.

3. Type "A" Roller Bearings. (See page 40)

Check bearings for freeness of rollers and pitted, broken, or excessively worn rollers. Replace bearing if it is possible to insert a feeler of .020" thickness between rollers.

More gap indicates rollers are worn excessively. Remove roller bearings by starting them with a tool shown on page 46. Insert tool under the bearing and into the cored hole between the bearing bores (see below). Complete removal of bearing using puller (see page 46) and tap out with heavy bar (shown below at right).



3A. Type "B" Roller Bearings. (See page 40)

Remove retaining ring and all rollers. Start bearing shell out with tool, (page 46). Complete removal with puller, (page 46). Tap out with heavy bar as shown above at right.

4. Ball Bearing. (Outboard bearing)

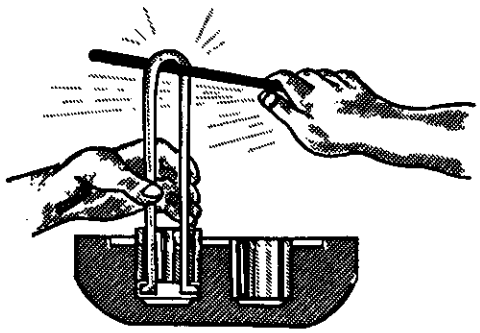
a. Remove outboard bearing retaining snap ring (1) with ring pliers.

b. Reach down through the drive shaft bearing bore with a brass drift and tap out the outboard bearing (18). Tap opposite sides alternately.

CAUTION: Replace roller or ball bearings only if necessary, and then only with the SAME MAKE AND TYPE as originally installed.

5. Seal Seat.

The seal seat (3) should not be removed unless the seal face is excessively worn or damaged. To remove the seal seat, invert the adapter (2) and drive out the seat (3) with a wooden block. If a new seat (3) is required, press into adapter, using a seal seat driver (page 46).



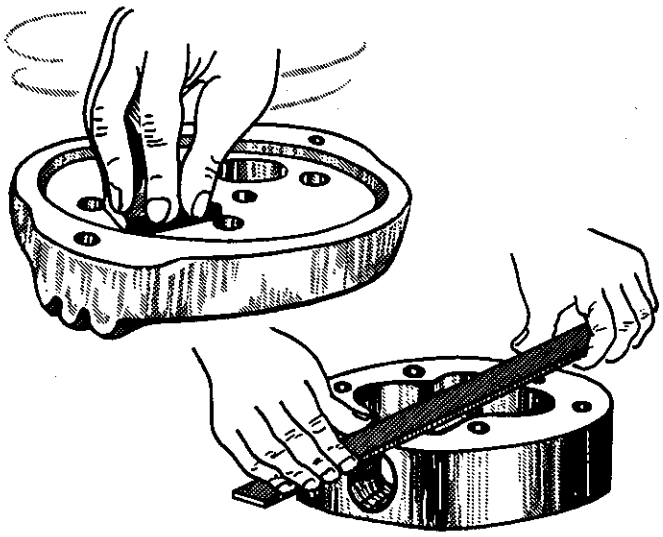
CAUTION: To prevent bending of drive shaft, push (drive or keyed end of shaft) through the gear and press on straight end of shaft.

D. Inspection and Check of Pump Parts For Wear.

1. Wash all parts in oil solvent, or fuel oil. Dry thoroughly with clean cloths or dry compressed air.

2. Inspect all parts of the pump.

3. With a small piece of flat file remove nicks and burrs from around the bearing bores and drilled holes of adapter (2) and cover (14) (see top of page 42). Clean up burrs and nicks on the machined mating surfaces of housing (11), cover (14) and adapter (2) (see top of page 42) with India stone and a fine mill file. Rewash before assembly.

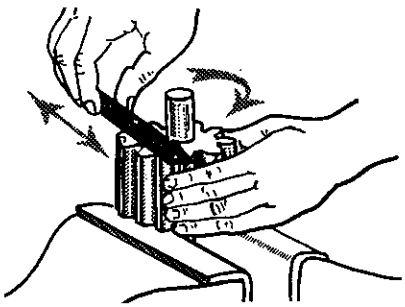


4. Shafts.

Inspect at bearing points and seal areas for rough surfaces and excessive wear.

5. Gears.

Inspect edge of teeth and gear face for scoring. Stone face of gears (see below) and edge of teeth before reassembly.



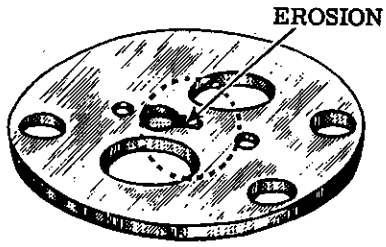
6. Gaskets.

Always replace housing gaskets (10) if damaged. Replace all seal rings (8).

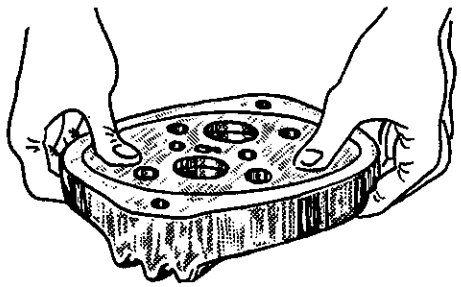
7. Wear Plates.

Replace if found scored or excessively worn.

NOTE: Do not turn wear plates (9) as counterbored relief pocket is on gear side only. If wear plate is steel backed, bronze side should be next to gears. Even though slight wear is shown on gear pattern, check for erosion path in vicinity of relief pocket, (see right, above) and replace if in evidence.



8. Check for proper seating of wear plate in adapter or cover, (below). A rocking motion indicates either a burr on face of adapter or cover.



9. Recommended Wear Tolerances.

a. Discard any housing (11) whose gear bores measure greater than 3.259" through the dowel pin hole centerline.

b. Replace both gears (12 & 13) if the differential between the housing width and the gears, with no gaskets in the pump, is in excess of .0035".

c. Assembled, the total end clearance between the gear faces and the housing width should be .0025" minimum and .0035" maximum.

d. Replace shaft (12 & 13) if wear at the roller pattern exceeds .001" from that of the major diameter.

e. Replace wear plates (9) that have severe score marks or show erosion marks in the vicinity of the counterbored relief pocket.

f. If the pump shafts have been replaced because wear at the roller patterns exceeded .001", also replace the bearings.

g. Replacement of seal assembly (5) and seat (3) is recommended if drive shaft is replaced.

E. Pump Assembly.

1. Type "A" Roller Bearings.

Lubricate rollers (7) with light grease. Coat I.D. of bearing bore with white lead. Press bearing assembly into bearing bore of adapter and cover with tool. (See page 46.)

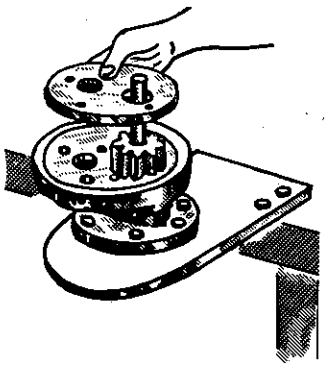
1A. Type "B" Roller Bearings.

Coat rollers with light grease, bearing bore with white lead and press bearing into bearing bore of adapter and cover.

2. Final Housing and Cover Assembly.

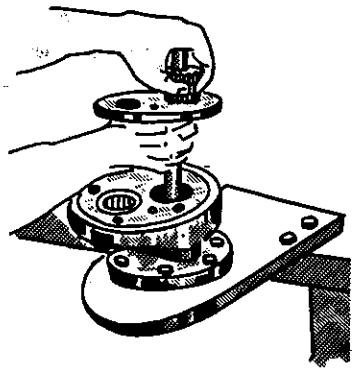
a. Install dowel pins (4) in adapter (2).

b. To assemble the wear plate (9), bearing and seal assembly (3) and (5), use the adapter end (2) bolted to the bench plate as a support. (See below). Insert the drive shaft (12) in the adapter end with the long end UP in the side that has a bearing driven in. Put the wear plate over drive shaft making sure the counterbored relief pocket is FACING the gear.



Place the bearing on the drive shaft. Now assemble the oil seal parts in the following order: Back up washer, coil spring, synthetic rubber ring. (Lubricate this ring with a light grease or oil) and the seal cup with lapped surface UP. Make certain the rubber ring (8) is not cut when placing it on the shaft and when passing it over the key slot or spline. Press the entire seat assembly down against the spring and compress it. When released, the spring should return the cup to the position held before compressing. If it sticks on shaft, replace the oil seal assembly.

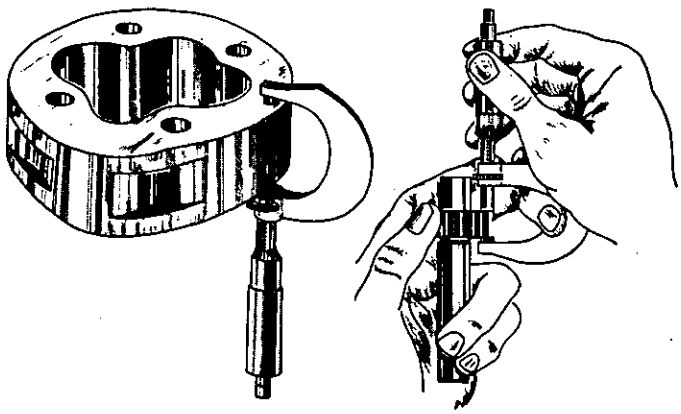
c. Wipe off any foreign matter from seal seat. Lubricate the lapped surfaces of the seal seat and seal cup with light oil. Turn the entire drive shaft assembly over and install in adapter end as shown below. Use a composition hammer to drive entire assembly down, driving bearing into bearing bore. Place "O" ring seal around wear plate. Lubricate with light oil the section of the wear plate that comes into contact with the gear face.



d. Pumps with Outboard Bearings.

With an India stone polish out any scratches on drive shaft that were made when shaft was driven out through the bearing.

e. Clearance between gear face and wear plate is provided by the plastic shim gasket between housing, adapter and cover. With micrometer, measure housing width and width of gears. (See below).



f. Insert driver assembled gear and shaft (12) into adapter end. Line up marks previously made on gear faces if original gears are reinstalled.

(Page 40.) If new gears are used keep keyways 180° apart. Note that on some models shaft and gear are made in one piece. Lubricate face of gears with light oil.

g. Place proper gasket as selected by chart (below), over gears and on face of wear plate (9). If it is not practical to use micrometers to measure gears and housing use a gasket that measures .002" thickness.

h. Line up punch marks and place pump housing (11) over gears and gasket. Tap down with fibre hammer.

i. Select another gasket from chart or if no measurement (2e) is available use a gasket of .002" thickness. Place gasket on housing face. Lubricate gear face with clean oil.

j. After selecting proper gasket from the chart, and putting it in place on the housing face, install the wear plate, making sure that the 1/16" deep counterbored relief pocket is in its original position facing the gears and is rotated 180° from the pocket of the adapter wear plate. Place seal ring (8) around the wear plate and position on wear plate with an equal air gap around each shaft. Put cover (14) in place and tap down, being careful not to pinch "O" ring seal (8).

Chart below indicates size, number and location of shim gaskets to be used to provide proper clearance between gear face and wear plate.

CLEARANCE CHART			
	Gear Width Greater (+) or less (-) THAN HOUSING WIDTH	ADAPTER SIDE	COVER SIDE
2025 SERIES PUMPS	+.002	.004	.002
	+.001	.003	.002
	.001	.002	.002
	-.001	.002	.001
	-.002	.001	.001
NOTE: Brass shim gaskets used on 2000 Series Pumps are .001 and .002 in thickness.			

If gears are so worn that housing width becomes more than .0035" greater than gear width, both gears (12 & 13) should be replaced.

k. Install dowel pins (4) in cover. Line up punch marks previously made on housing and cover and put in place. Tap cover down on dowel pins with fibre hammer until cover bottoms on housing. Be careful not to pinch "O" ring seal around wear plate.

l. Install four cap screws. Pump may be furnished with either hollow head cap screws or hex head type. If hex head, be sure that proper washer is in place before installing. If for any reason replacement of cap screws is required, always use same type as originally furnished. If hollow head cap screws are used, the shoulder of the screw must ride against the spot face of the cover and both surfaces should be free of burrs to prevent leaks.

Tighten gradually opposite cap screws, using torque wrench set at 60 ft. pounds torque. After assembly turn shaft with a 6" Crescent wrench. If shaft will turn with a slight drag and not too freely, proper clearances are assured between gears and wear plate. If shaft is too tight or too free, add or remove (.001") or (.002") gaskets as necessary for proper clearance.

3. Assembly of Outboard Bearings.

a. Coat I.D. of bearing bore with white lead.

b. Lubricate the bearing (18) with light grease.

c. Drive outboard bearing (18) down over drive shaft with special tool, until it bottoms. (See page 46.)

d. Insert snap ring (1) in bearing bore.

e. Remove grease plug and repack outboard bearing bore with good quality bearing grease. Use fingers for repacking. A grease gun will force grease into the oil seal and cause it to leak.

F. Break-In of Repaired Pumps.

1. If shop test stand is available on which the pump can be mounted and operated against full pressure and at maximum speed, the following procedure is recommended for break-in and test:

a. Start pump and run for 2 minutes at zero pressure. Be sure that test stand reservoir is filled and that all inlet and outlet lines are open.

b. By restricting pump discharge line with needle valve, raise discharge pressure to 500 PSI for 10 seconds and lower to zero pressure for 10 seconds. Continue this procedure for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

c. Stop pump and rotate drive shaft coupling by hand to determine if drive shaft is free. If it cannot be turned freely, remove and rebuild pump.

d. Resume test and apply 1000 PSI for 10 seconds intermittently for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

e. Stop pump and check freeness as in (c). Check for possible leaks at mating surfaces of adapter, housing and cover and around seal assembly and the four assembly cap screws.

f. Be sure oil level is up to normal in oil reservoir. Start pump and run pressure to 1000 PSI and run flow test by whatever means is available on the test stand.

2. If a shop test stand is not available, the following alternate break-in and test procedure may be used:

a. Mount repaired pump in place on equipment and run pump at one quarter engine speed for 5 minutes at zero pressure.

b. Operate control valve until relief pressure is attained, then hold in this position for 10 seconds and release for 10 seconds. Follow this procedure for 10 minutes.

c. Increase engine speed to one-half throttle, and repeat step (b) for 10 minutes.

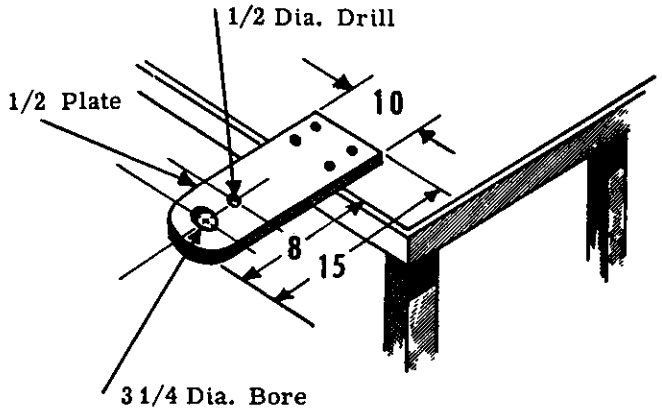
d. Increase engine speed to full throttle, and repeat step (b) for 5 minutes.

e. Idle engine and check pump for possible leaks at mating surfaces of housing, adapter end cover, shaft seal area, and any of the cap screws.

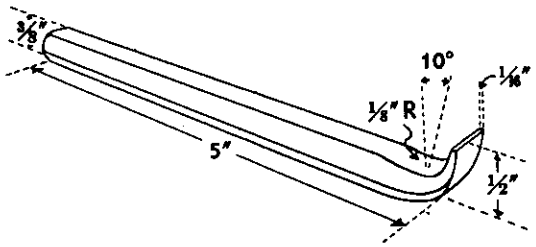
TROUBLE SHOOTING

POSSIBLE PUMP TROUBLES	CAUSES	REMEDIES
I. Cavitation, pump unusually noisy.	a) Low oil supply. b) Heavy oil. c) Dirty oil filter. d) Restriction in suction line.	a) Fill to proper level. b) Change to proper oil. c) Clean and replace filter. d) Remove.
II. Pump takes too long to respond or fails to respond.	a) Low oil supply. b) Insufficient relief valve pressure. c) Pump worn or damaged.	a) Fill to proper level. b) Reset to correct pressure setting using gauge. c) Inspect, repair or replace.
III. Oil heating up.	a) Foreign matter lodged between the relief valve plunger and relief valve seat. b) Using very light oil in a hot climate. c) Dirty oil. d) Oil level too low. e) Insufficient relief valve pressure. f) Relief valve pressure too high. g) Pump worn (slippage).	a) Inspect and remove foreign matter. b) Drain and refill with proper oil. c) Drain, flush and refill with clean oil. d) Fill to proper level. e) Set to correct pressure. f) Same as "e". g) Replace or repair.
IV. Oil foaming.	a) Air leaking into suction line from tank to pump. b) Wrong kind of oil. c) Oil level too low.	a) Tighten all connections. b) Drain and refill with a non-foaming type of hydraulic oil. c) Fill to proper level.

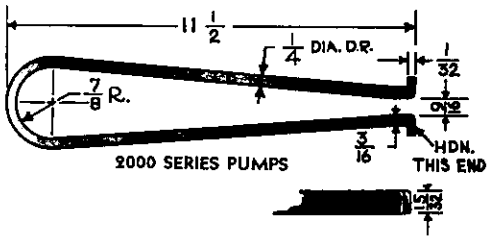
G. Special Tools for Pump Repair. (Not furnished. Can easily be made locally.)



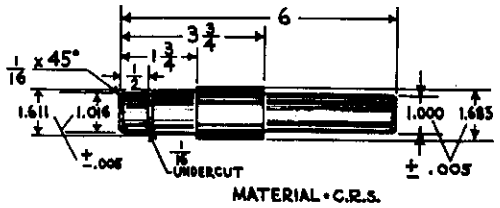
Bench Mount



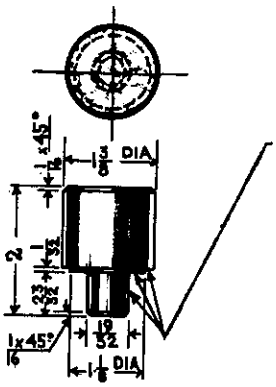
Bearing Pry Bar



Bearing Puller

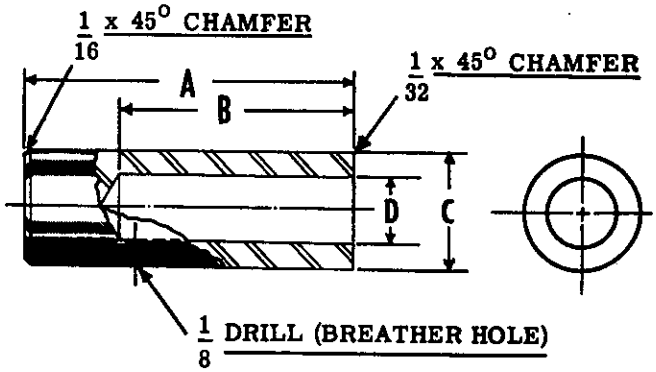


Seal Driver

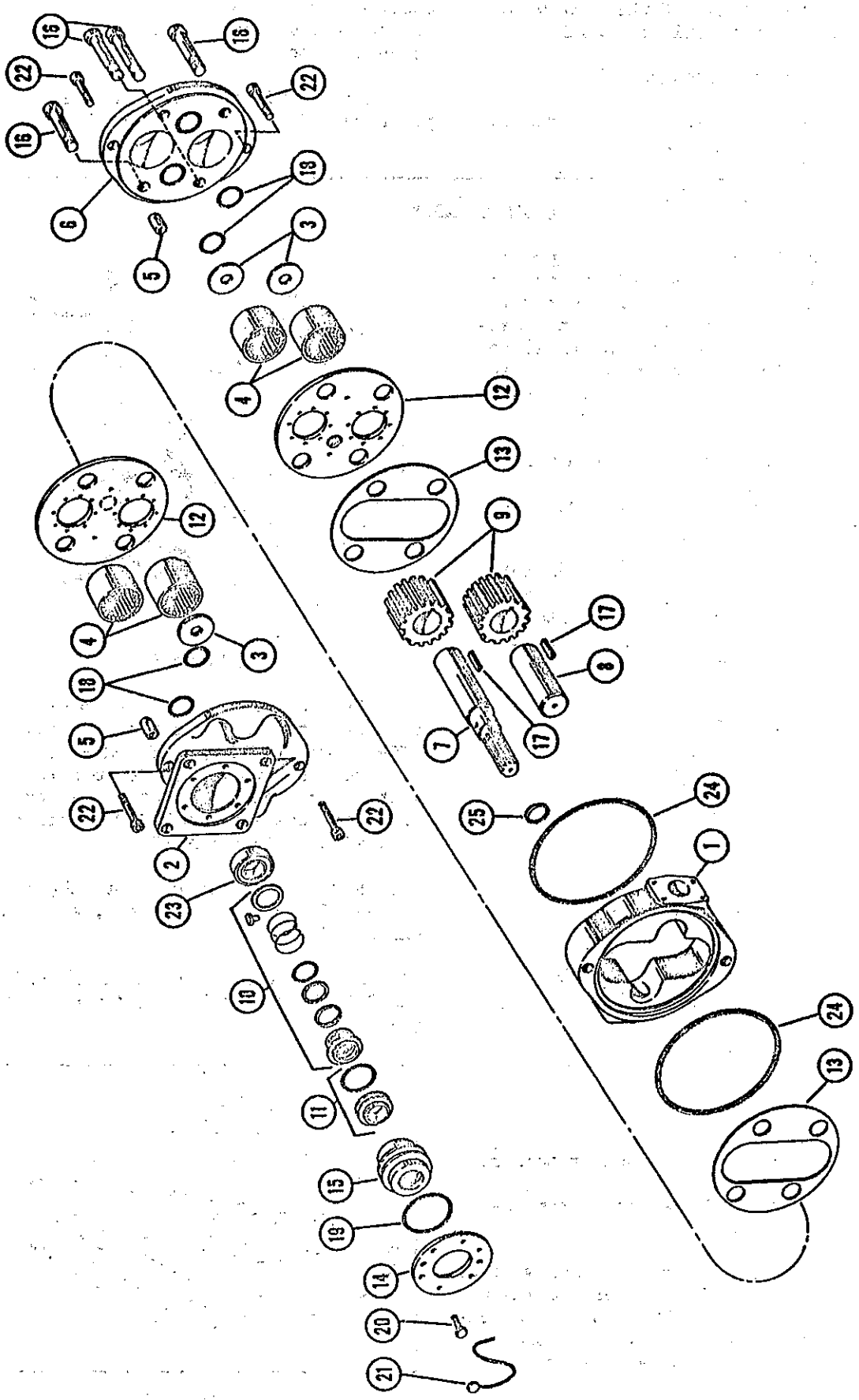


These surfaces must be concentric or square to each other within .0005" T.I.R.

Roller Bearing Driver



Outboard Bearing Driver



MAIN HYDRAULIC PUMP (HYDRECO - 73 G.P.M.)

H. OVERHAULING INSTRUCTIONS FOR HYDRECO 73 - G.P.M. PUMP.
PREPARATION FOR DISASSEMBLY OF PUMP.

1. Clean the outside of the unit with an oil solvent, fuel oil or gasoline.

2. Dry the unit thoroughly.

3. Remove sharp edges or burrs from the shaft splines, drill point, keyway or shaft end before disassembling. Remove the burrs and sharp edges with a file or an oil stone.

4. Mark sections of the unit with a prick punch for proper reassembly.

I. DISASSEMBLY

The following 20-step disassembly procedure is recommended. After disassembling, it may or may not be necessary to remove the bearings from the end cover and adapter cover. (See disassembly steps 16 to 20). Replace these bearings if necessary, but be sure to use the same type as the original.

1. Remove snap ring or key from shaft.

2. Remove wire seal and cap screws at seal retainer.

3. Remove seal retainer, seal assembly, coil spring, seal drive pin and washer. Use cap screws (see Figure 4) to start removal. NOTE: See Page 53, Figure 18 for sequence of removal.

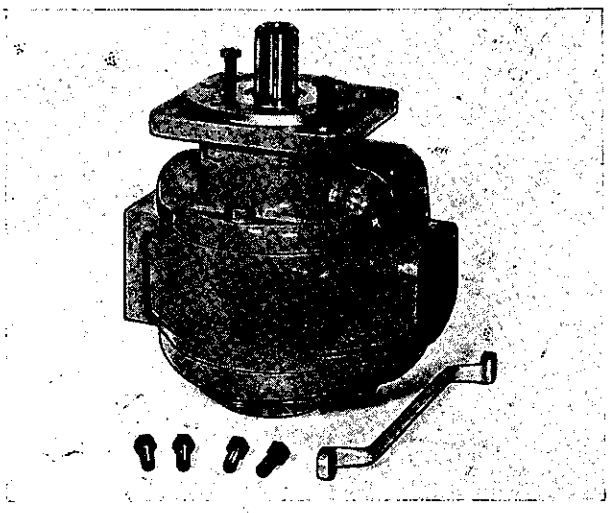


Figure 4

4. Remove seal ring from seal retainer.

5. TAP or PRESS OUT seal seat from retainer. (See Figure 5).

6. Remove two socket head cap screws from pump adapter cover. NOTE: Service may be facilitated by bolting the unit to a special bench mounted assembly plate. (See Figure 6 — Foot Mounting and Flange Mounting).

7. Remove all cap screws in cover.

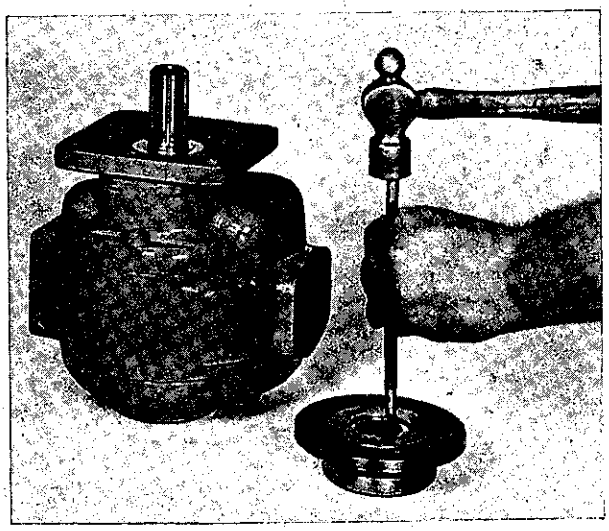


Figure 5

8. Remove end cover. The cover may come off separately or with the housing. CAUTION: DO NOT USE A SCREW DRIVER to pry the sections apart. It is important that machined surfaces are not scored or nicked. If it is necessary to LOOSEN sections, tap them with a FIBRE HAMMER.

9. Remove wear plate. Note the position of relief pocket, seal rings, and metal shims, if any.

10. Remove housing and mark the DRIVE gear and DRIVEN gear with an India oil stone. (See Figure 7).

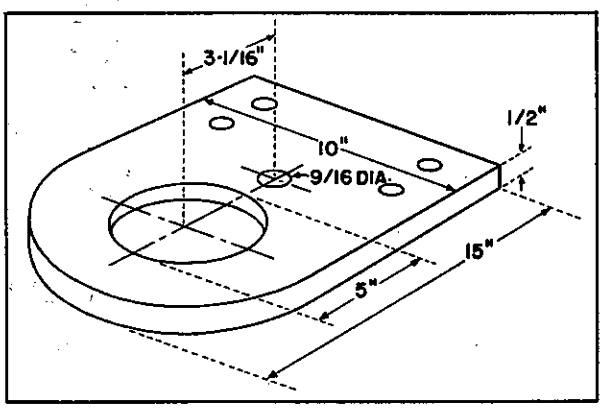


Figure 6

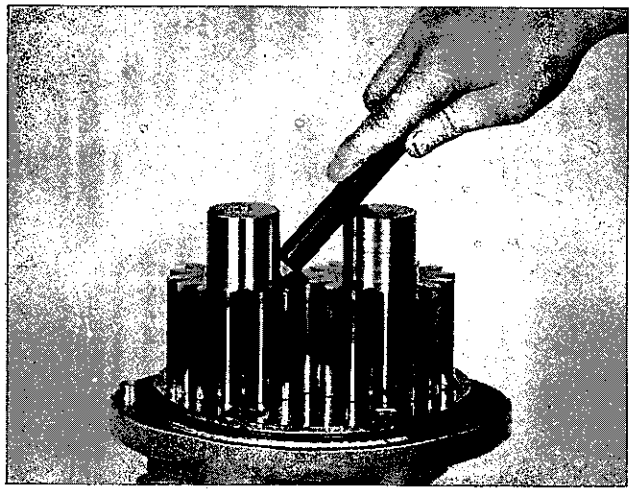


Figure 7

11. Slide drive and driven gears off the shaft.

12. Remove drive shaft and driven shaft.

13. Remove the Pratt and Whitney key from the drive and driven shaft.

14. Remove the other wear plate noting same items as in Step 9. NOTE: The next 6 disassembly steps pertain to the removal of bearings from the end cover and adapter cover. REPLACE ONLY IF NECESSARY.

15. Before removing Roller Bearings, inspect for:

a. Freeness of rollers.
b. Pitted condition.
c. Broken or excessively worn rollers.

NOTE: Refer to page 51, Items 3 to 5. If any of the above conditions exist, proceed with the disassembly.

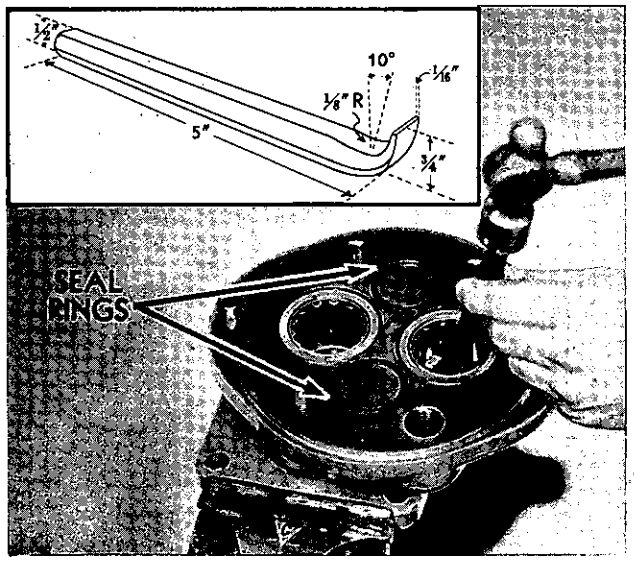


Figure 8

16. Insert the tool (see Figure 8) under the bearing and tap tool with a hammer until bearing is raised.

17. Complete the removal of bearing with a standard bearing puller. (See Figure 9). We suggest Owatonna Bearing Puller MD956-B1.

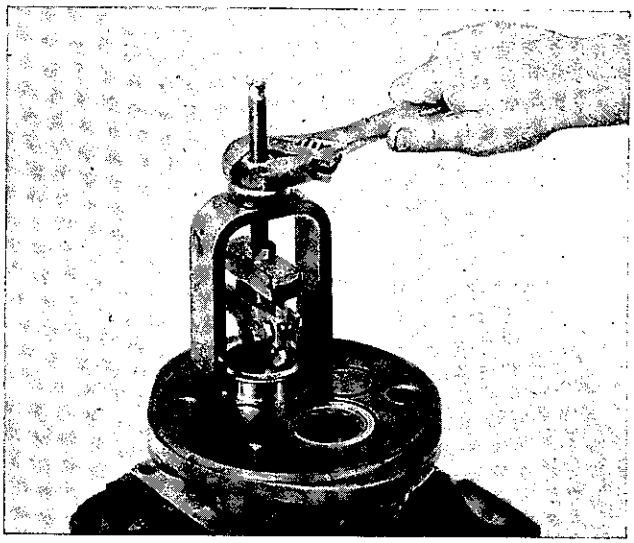


Figure 9

18. Remove the thrust washer from bottom of the bearing bores.

19. Remove dowel bushings from both end covers.

20. Remove thrust bearing by tapping lightly with a drift pin of soft material inserted through the drive shaft bearing bore. Tap opposite sides alternately. (See Figure 10)

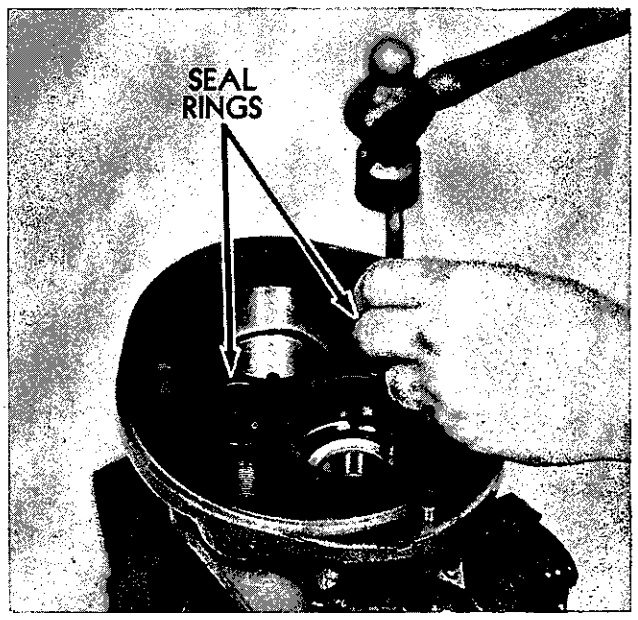


Figure 10

J. INSPECTION OF DISASSEMBLED UNIT

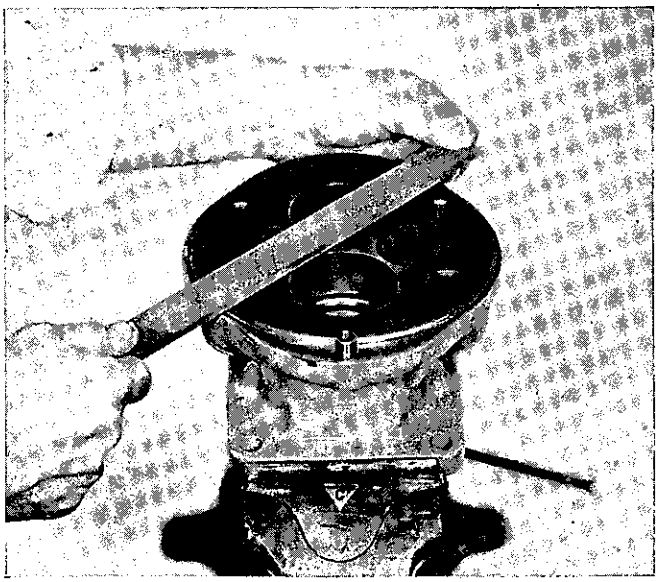


Figure 11

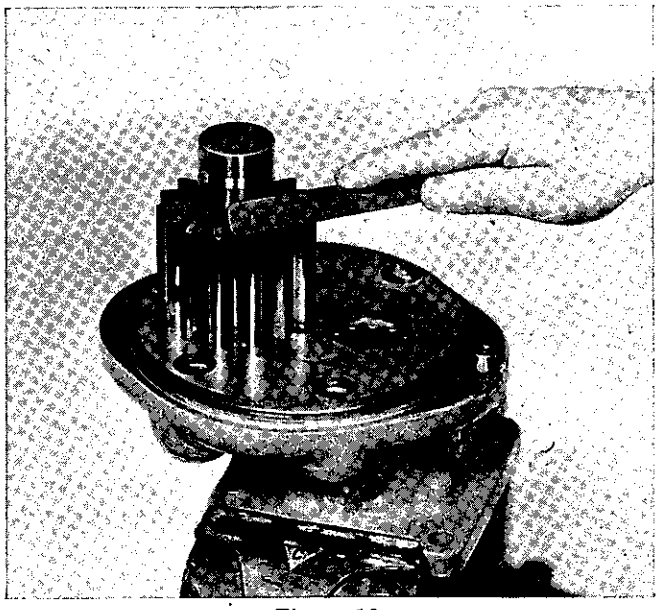


Figure 12

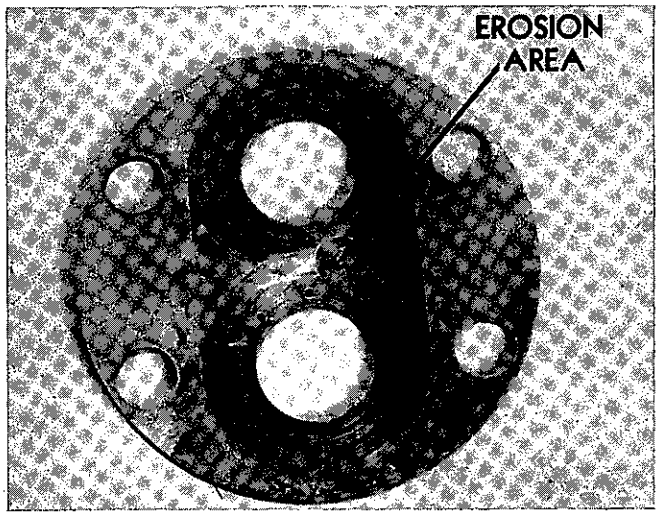


Figure 13

1. Remove all nicks or burrs from the machined surfaces with a small piece of flat mill file. (See Figure 11).

2. Check seating of wear plates in adapter cover and end cover. A rocking motion of the wear plates indicates a burr on the machined surface and/or a bent wear plate.

3. Inspect the shafts at bearing points and seal areas for rough surfaces and excessive wear.

4. Inspect the edge of the gear teeth and gear face for scoring. Stone the face of the gears (See Figure 12) and edge of gear teeth before reassembly. We suggest the use of MF166 India File for this operation.

5. Check bearing rollers for freeness, pitting, broken or excessive wear. Replace, using procedure outlined on page 49, Steps 15 to 19. Note: Replace only with SAME MAKE AND STYLE as originally installed.

6. Replace wear plates that have severe score marks, heavy wear, or show erosion marks in the vicinity of the counterbored relief pocket. Note: Arrow designates erosion path in Figure 13. Caution: DO NOT REVERSE WEAR PLATES AS THE COUNTERBORED RELIEF POCKET IS ON ONE SIDE ONLY.

K. RECOMMENDED WEAR TOLERANCES

1. Discard the housing if either of the following conditions exist:

   a. If the gear bore measures greater than 6.412 through the dowel pin hole center line, replace it.

   b. If the housing shows severe score marks that extend past the gear bore center line. NOTE: If the wear has been smooth and even, it is not necessary to replace the housing.

2. Replace the gears when the differential between the gear face width and the housing face width, with no gaskets, is in excess of .004.

3. Replace the drive and driven shafts if wear at the roller patterns is in excess of .001 from that of the major diameter.

4. End clearance, at final assembly, between the gear faces and the housing width should be .0035 minimum and .005 maximum.

5. If the shafts were replaced, as indicated in Step 3, replace the bearings.

6. Replace all seal rings, metal shims, if torn or mutilated.

7. If the bearings are loose in the bores replace the end cover and adapter cover.

8. Replacement of seal seat and seal assembly is recommended.

L. REASSEMBLY

1. Lubricate bearing rollers with light grease.

2. Coat inside of the bearing bores with white lead.

3. Install thrust washers to bearing bores. NOTE: Be sure that the BRONZE SIDE of the thrust washer is facing the shaft ends.

4. Using bearing driver, see Figure 14, press bearings into the bearing bores of adapter and end cover.

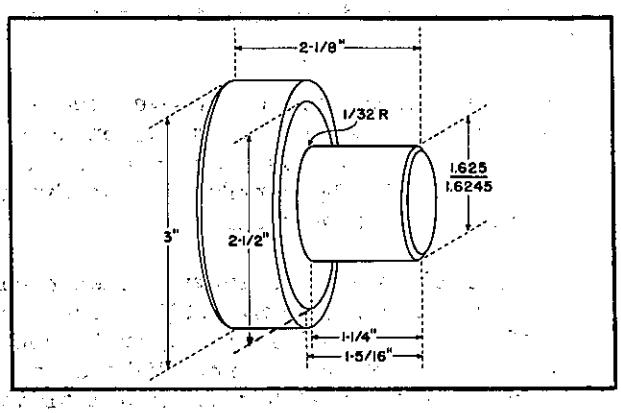


Figure 14

5. Insert seal rings to seal ring grooves in adapter cover, see Figure 8.

6. Bolt adapter cover to bench plate.

7. Install a wear plate. NOTE: Make sure that the counterbored relief pocket is UP and on the discharge side of unit.

8. Using light oil, lubricate gear contact section of wear plate.

9. Install seal ring around O.D. of wear plate.

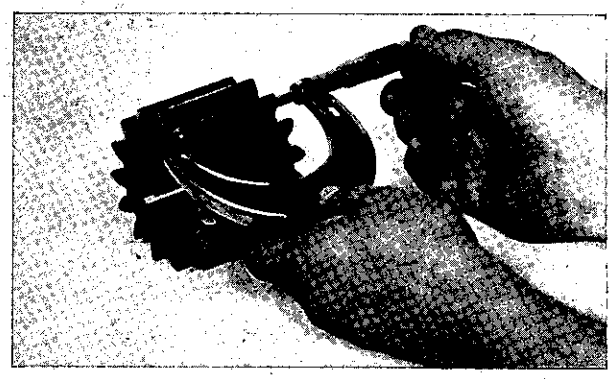


Figure 15

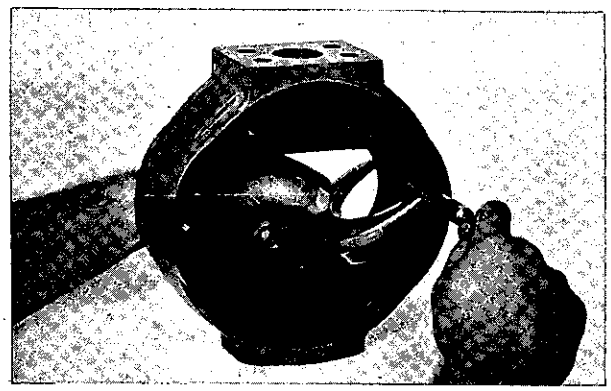


Figure 16

10. Install hollow dowel pin to adapter and end cover. NOTE: Clearance between gear face and wear plate is provided by the metal shim gasket between the adapter, housing and end cover. With a micrometer measure width of housing and width of gears. (See Figures 15 and 16). The chart at the top of following page indicates number and location of shim gasket used to provide proper clearance between gear face and wear plate.

CLEARANCE CHART

GEAR WIDTH GREATER (+) OR LESS (-) THAN HOUSING WIDTH	NOTE: Brass shim gaskets are .001 and .002 in thickness. ADAPTER SIDE	COVER SIDE
+.002	.003	.003
+.001	.003	.003
.000	.003	.002
-.001	.002	.001
-.002	.002	.001

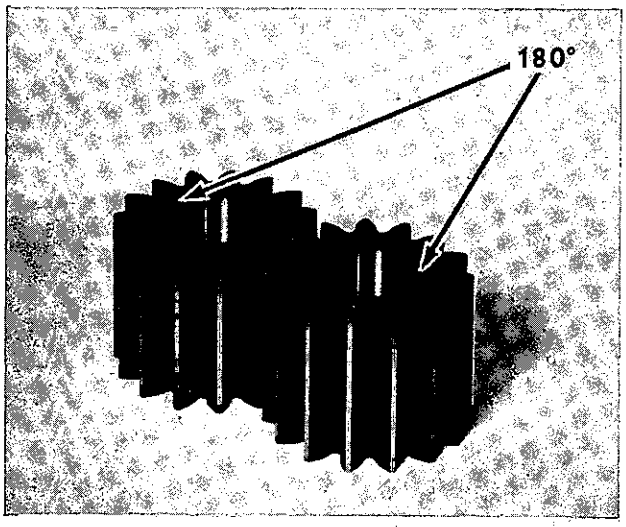


Figure 17

11. Install keys to drive and driven shafts, then install shafts to adapter bearing bores.

12. Slide gears over shafts, aligning keyway with key. NOTE: If original gears are used, line up marks previously made on gear faces. If new gears are used, keep keyways 180° apart. (See Figure 17). Lubricate face of gears with light oil.

13. Install metal shims using CLEARANCE CHART FOR SELECTION.

14. Aligning punch marks, install housing over gears. Tap in position with fibre hammer. NOTE: If new housing is used, be sure that discharge port is on the discharge side.

15. If necessary, select other metal shims from the CLEARANCE CHART and install to housing face.

16. Install cover wear plate with relief pocket facing gears. NOTE: If direction of rotation of the pump is KNOWN -- install with counterbored relief pocket on the discharge side. If direction of rotation is UNKNOWN -- install with relief pocket on the suction side.

17. Place seal ring around the outside of wear plate and center the wear plate with shafts. Then install the seal rings to the grooves in pump cover and install the dowel bushing, see Figure 10.

18. Install the end cover over the shafts aligning punch marks with marks on housing. With a fibre hammer tap the cover down to the housing. NOTE: Be careful not to pinch "O" ring seal around wear plate.

19. Install the four large socket head capscrews and snug down. NOTE: The shoulder of the cap screw seats against spot faced surface of the cover. Make sure both surfaces are free of burrs. Final tightening of the cap screws should be done with a torque wrench set at 110 ft. lbs. on cap screws diagonally opposite one another.

20. Rotate shaft by hand or with wrench. If shaft is too tight or too free, add or remove as many metal shims as necessary.

21. Install two socket head cap screws to dowel bushing location in cover and torque to 50 ft. lbs.

22. Set the unit upright on cover and install the remaining two socket head cap screws to dowel bushing location in adapter and torque to 50 ft. lbs.

M. INSTALLATION OF SEAL SEAT AND SEAL ASSEMBLY

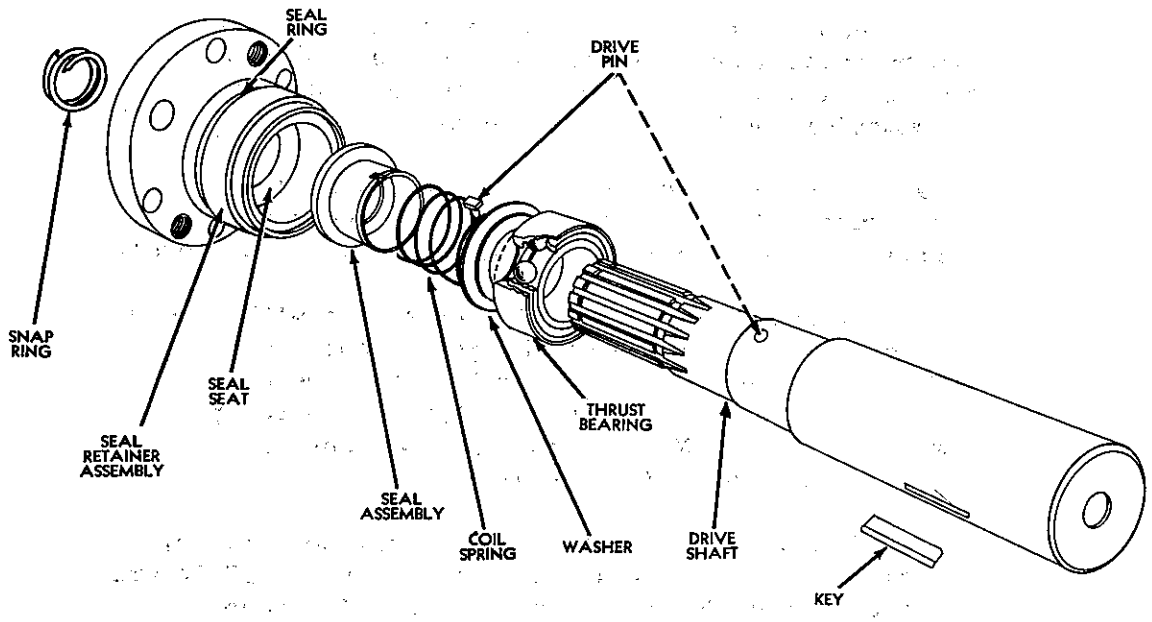


Figure 18

1. Lubricate thrust bearing with light grease.

2. Install thrust bearing over drive shaft and bottom against the shoulder. NOTE: The ends of the outer race or shell have a wide and narrow section. Be sure the widest section is UP or faces the drive end of the shaft.

3. Install steel washer over the shaft with the flat even surface facing the drive end of shaft.

4. Install the seal assembly drive pin to the shaft with the long section in line with the shaft.

5. Install coil spring to the shaft.

6. Using light grease, lubricate the seal ring and the back-up ring in seal assembly. Install seal assembly over the drive shaft with lapped surface facing towards the drive end of the shaft. NOTE: Make certain the key slot in seal assembly is aligned with seal drive pin in the shaft.

7. Using light grease, lubricate rubber ring on the seal seat. Press the seal seat and outer seal ring into the seat bore of seal retainer until bottomed.

8. Assemble seal ring to the groove in retainer and lubricate with light grease. NOTE: Before proceeding wipe off any foreign matter from the seal seat and seal assembly. Lubricate both lapped surfaces with light oil.

9. Place seal retainer over the shaft and press down on assembly enough to start cap screws (See Figure 19), then snug down evenly until bottomed. Torque cap screws to 50 ft. lbs. NOTE: When compressing the seal assembly make sure the seal drive pin in the shaft enters and engages the drive pin slot in the seal assembly.

10. Secure cap screws with wire.

11. Install snap ring to spline end of shaft.

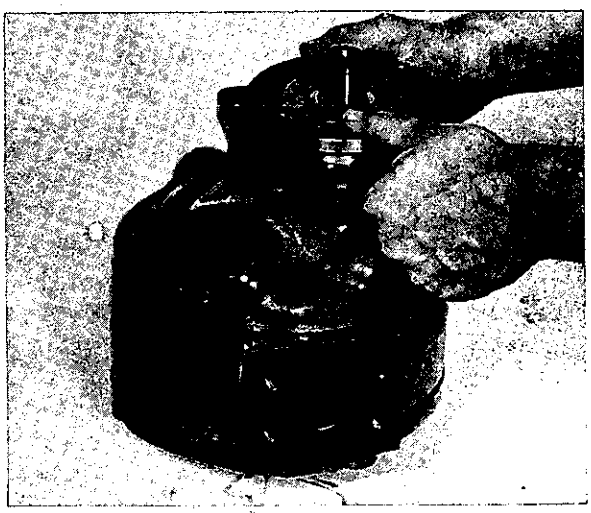


Figure 19

N. TESTING AND BREAKING-IN OF REPAIRED PUMPS.

1. If shop test stand is available on which the pump can be mounted and operated against full pressure and at maximum speed, the following procedure is recommended for break-in and test:

a. Start pump and run for 2 minutes at zero pressure. Be sure that test stand reservoir is filled and that all inlet and outlet lines are open.

b. By restricting pump discharge line with needle or globe valve, raise discharge pressure to 500 PSI for 10 seconds and lower to zero pressure for 10 seconds. Continue this procedure for 5 minutes. CAUTION: Do not apply pressure for more than 10 second intervals.

c. Stop pump and rotate drive shaft coupling by hand to determine if drive shaft is free. If it cannot be turned freely, remove and rebuild pump.

d. Resume test and apply 1000 PSI for 10 seconds intermittently for 5 minutes. CAUTION: Do not apply pressure for more than 10 second intervals.

e. Stop pump and check freeness as in (c). Check for possible leaks at mating surfaces of adapter, housing and cover and around seal assembly and the four assembly cap screws.

f. Be sure oil level is up to normal in oil reservoir. Start pump and run pressure to 1000 PSI and run flow test by whatever means is available on the test stand.

2. If a shop test stand is not available, the following alternate break-in and test procedure may be used:

a. Mount repaired pump in place on equipment and run pump at one quarter engine speed for 5 minutes at zero pressure.

b. Operate control valve until relief pressure is attained, then hold in this position for 10 seconds and release for 10 seconds. Follow this procedure for 10 minutes.

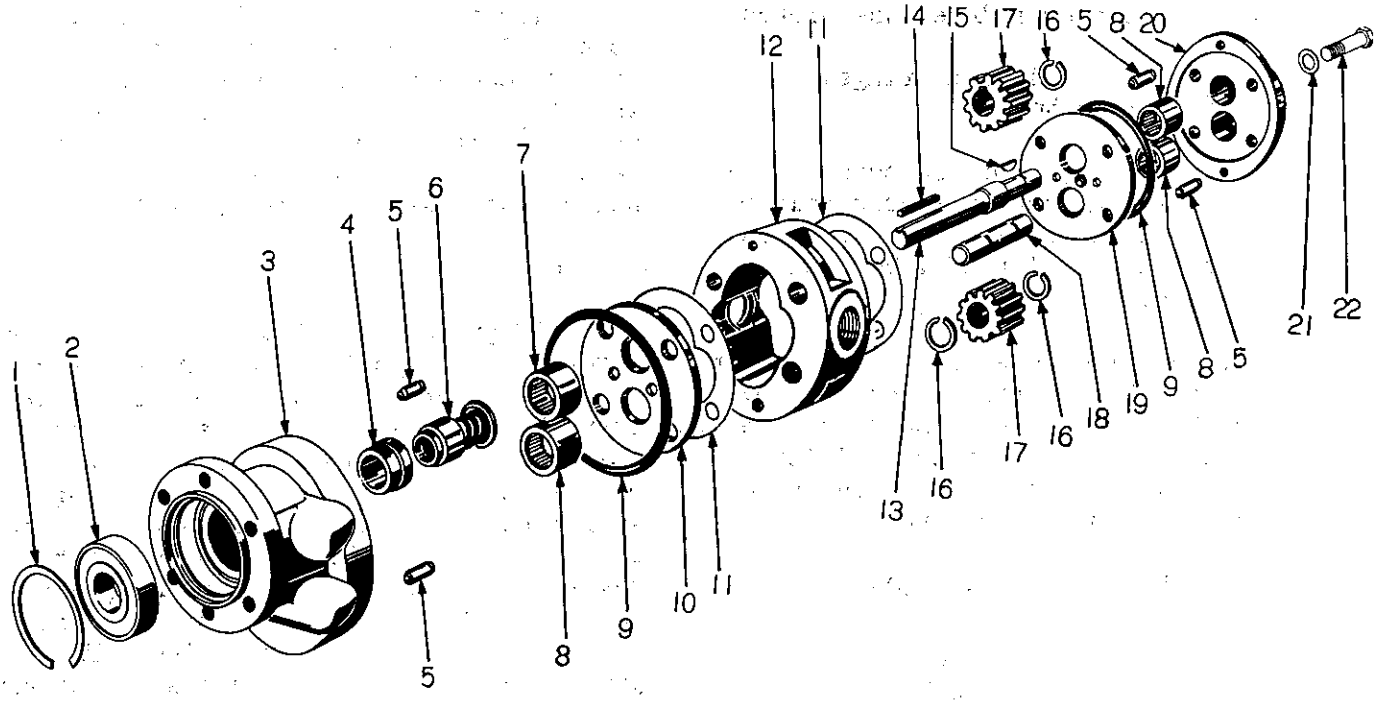
c. Increase engine speed to one-half throttle, and repeat step (b) for ten minutes.

d. Increase engine speed to full throttle, and repeat step (b) for 5 minutes.

e. Idle engine and check pump for possible leaks at mating surfaces of housing, adapter end cover, shaft seal area, and any of the cap screws.

TROUBLE SHOOTING

POSSIBLE PUMP TROUBLES	CAUSES	REMEDIES
I. Pump unusually noisy.	a - Low supply	a - Fill to proper level.
	b - Heavy oil.	b - Change to proper oil.
	c - Dirty oil filter.	c - Clean and replace filter.
	d - Suction line too small.	d - Increase size of suction line.
	e - Restriction in suction line.	e - Remove.
	f - Air leak in suction line.	f - Check for loose connection.
	g - Oil temperature extremely high causing vapor to form in the oil.	g - Check entire circuit.
	h - Pump sucking air through the shaft oil seal when pump is idling.	h - Check by squirting oil around the seal. Replace if faulty.
II. Pump takes too long to respond or fails to respond.	a - Low oil supply.	a - Fill to proper level.
	b - Insufficient relief valve pressure.	b - Reset to correct pressure setting using gauge.
	c - Pump worn or damaged.	c - Inspect, repair or replace
III. Oil heating up.	a - Foreign matter lodged between the relief valve plunger and relief valve seat.	a - Inspect and remove foreign matter.
	b - Using very light oil in a hot climate.	b - Drain and refill with proper oil.
	c - Dirty oil.	c - Drain, flush and refill with clean oil.
	d - Oil level too low.	d - Fill to proper level.
	e - Insufficient relief valve pressure.	e - Set to correct pressure.
	f - Relief valve pressure too high.	f - Same as "e".
	g - Pump worn (slippage).	g - Replace or repair.
IV. Oil foaming.	a - Air leaking into suction line from tank to pump.	a - Tighten all connections.
	b - Wrong kind of oil.	b - Drain and refill with non-foaming type of hydraulic oil.
	c - Oil level too low.	c - Fill to proper level.
	d - Improper tank or reservoir baffling.	d - Baffle correctly.
	e - Discharge lines not below oil level.	e - Extend lines below oil level.



5. HYDRAULIC PUMP - STEERING AND OUTRIGGER CIRCUIT (HYDRECO).

A. Hydraulic Pump Dismantling.

1. Clean outside of the pump with an oil solvent, fuel oil or gasoline, and dry thoroughly. With file or oil stone remove sharp edges or burrs from shaft splines, drill point, keyway or shaft end before proceeding with disassembly. Mark sections of pump with prick punch for proper reassembly.

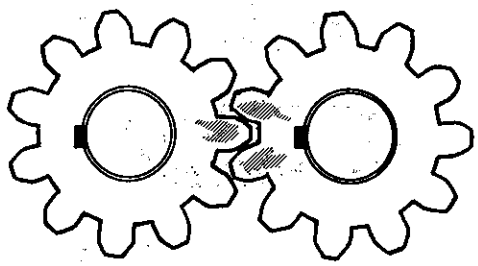
NOTE: Servicing is facilitated by bolting the adapter to a special bench mounted assembly plate. (See page 62.)

2. Remove the four cover cap screws (22) (see above). Remove the cover (20) which may come off separately or with the housing (12).

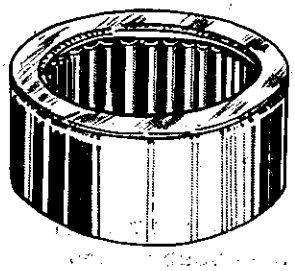
To prevent possibility of leakage, avoid scoring or nicking machine surfaces of pump sections. DO NOT USE A SCREW DRIVER to pry the sections apart. Tap with fibre hammer, if necessary, to loosen.

Note position of relief pocket and drilled holes in the wear plate (10) and (19) for proper reassembly. Mark the drive and driven gears (17) with an India stone, (see right, above) for proper reassembly.

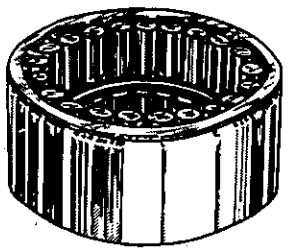
Note the location and number of gaskets when disassembling.



Remove driver shaft (13) and gear (17). Unbolt adapter end from bench plate. By pressing on keyed end of shaft, press out the bearing (7). Remove seal assembly (4) and (6) and snap ring (16), freeing shaft (13) and wear plate (10). This pump is equipped with an outboard ball bearing. Be sure to coat end of shaft with white lead and remove any burrs before pressing out to prevent the



Type "A" Bearing



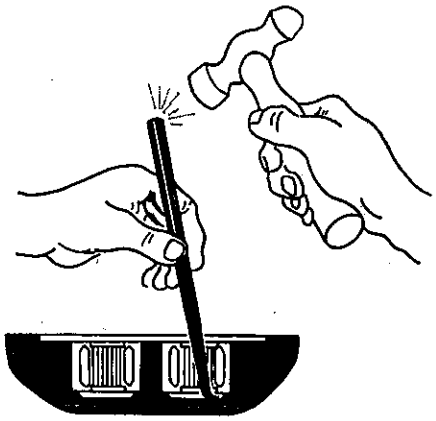
Type "B" Bearing

bearing from being scored. Remove dowel pins (5) from adapter (3) and cover ends (20), with pliers or a lever jaw wrench.

3. Type "A" Roller Bearings. (See page 56.)

Check bearings for freeness of rollers and pitted, broken, or excessively worn rollers. Replace bearing if it is possible to insert a feeler of .020" thickness between rollers.

More gap indicates rollers are worn excessively. Remove roller bearings by starting them with a tool shown on page 62. Insert tool under the bearing and into the cored hole between the bearing bores (see below). Complete removal of bearing, using puller, and tap out with heavy bar (shown below at right).



3A. Type "B" Roller Bearings. (See page 56.)

Remove retaining ring and all rollers. Start bearing shell out with tool, (page 62). Complete removal with puller. Tap out with heavy bar as shown above at right.

4. Ball Bearing. (Outboard bearing)

a. Remove outboard bearing retaining snap ring (1) with ring pliers.

b. Reach down through the drive shaft bearing bore with a brass drift and tap out the outboard bearing (2). Tap opposite sides alternately.

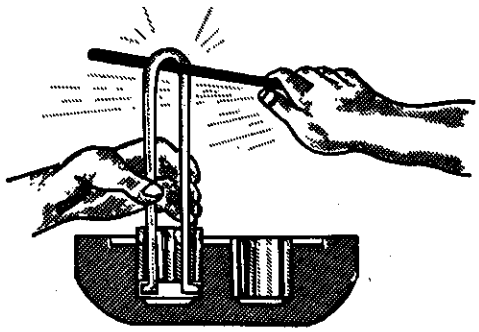
CAUTION: Replace roller or ball bearings only if necessary, and then only with the SAME MAKE AND TYPE as originally installed.

5. Seal Seat.

The seal seat (4) should not be removed unless the seal face is excessively worn or damaged. To remove the seal seat, invert the adapter (3) and drive out the seat (4) with a wooden block. If a new seat (4) is required, press into adapter, using a seal seat driver (page 62).

6. Gears.

If gears or shafts must be replaced, remove snap rings (16) and press off gears on an arbor press. (Some models may be furnished with shaft and gear made in one piece). To reassemble, coat gear bore with white lead, and after installing one snap ring, press onto shaft until the gear covers approximately one quarter of the key slot. Hold key in place and press gear onto shaft until it contacts snap ring. Install second snap ring. The same procedure is used for driven shaft except no key is required.



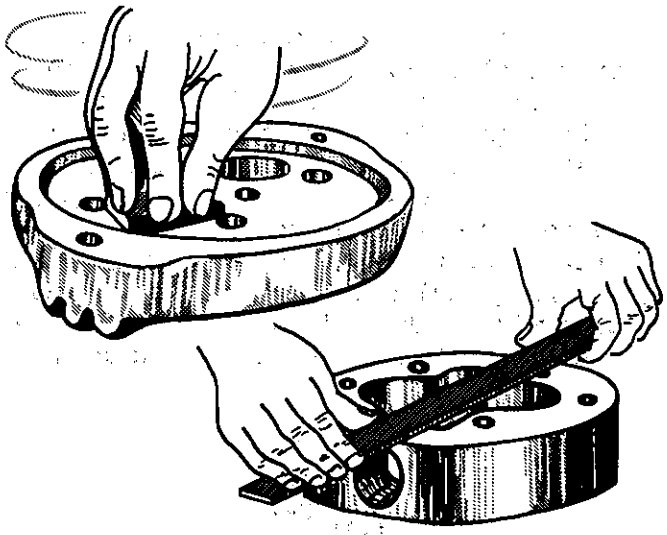
CAUTION: To prevent bending of drive shaft, push (drive or keyed end of shaft) through the gear and press on straight end of shaft.

b. Inspection and Check of Pump Parts For Wear.

1. Wash all parts in oil solvent, or fuel oil. Dry thoroughly with clean cloths or dry compressed air.

2. Inspect all parts of the pump.

3. With a small piece of flat file remove nicks and burrs from around the bearing bores and drilled holes of adapter (3) and cover (20) (see top of page 58). Clean up burrs and nicks on the machined mating surfaces of housing (12), cover (20) and adapter (3) with India stone and a fine mill file. Rewash before assembly.

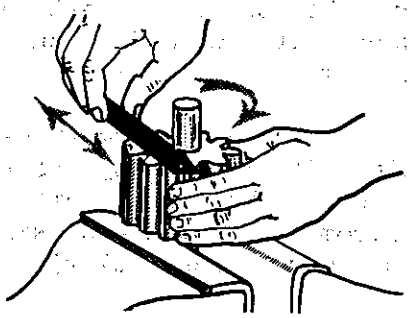


4. Shafts.

Inspect at bearing points and seal areas for rough surfaces and excessive wear.

5. Gears.

Inspect edge of teeth and gear face for scoring. Stone face of gears (see below) and edge of teeth before reassembly.



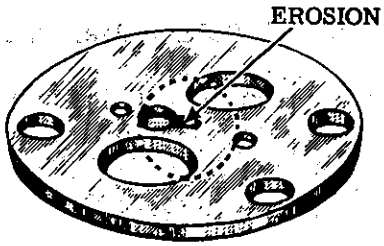
6. Gaskets.

Always replace housing gaskets (11) if damaged. Replace all seal rings (9).

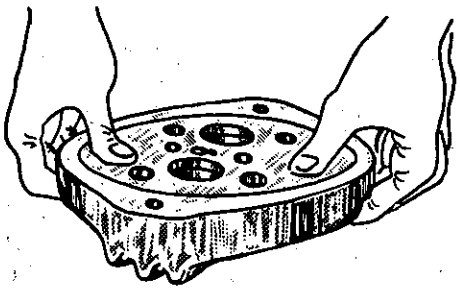
7. Wear Plates.

Replace if found scored or excessively worn.

NOTE: Do not turn wear plate (10) and (19) as counterbored relief pocket is on gear side only. If wear plate is steel backed, bronze side should be next to gears. Even though slight wear is shown on gear pattern, check for erosion path in vicinity of relief pocket, (see right, above) and replace if in evidence.



8. Check for proper seating of wear plate in adapter or cover, (below). A rocking motion indicates either a burr on face of adapter or cover.



9. Recommended Wear Tolerances.

a. Discard any housing (12) whose gear bores measure greater than 3.259" through the dowel pin hole centerline.

b. Replace both gears (17) if the differential between the housing width and the gears, with no gaskets in the pump, is in excess of .0035".

c. Assembled, the total end clearance between the gear faces and the housing width should be .0025" minimum and .0035" maximum.

d. Replace shaft (13) and (18) if wear at the roller pattern exceeds .001" from that of the major diameter.

e. Replace wear plates (10) and (19) that have severe score marks or show erosion marks in the vicinity of the counterboard relief pocket.

f. If the pump shafts have been replaced because wear at the roller patterns exceeded .001", also replace the bearings.

g. Replacement of seal assembly (6) and seat (4) is recommended if drive shaft is replaced.

C. Pump Assembly.

1. Type "A" Roller Bearings.

Lubricate rollers (7) and (8) with light grease. Coat I.D. of bearing bore with white lead. Press bearing assembly into bearing bore of adapter and cover with tool. (See page 62.)

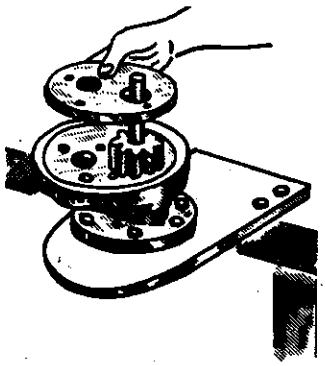
1A. Type "B" Roller Bearings.

Coat rollers with light grease, bearing bore with white lead and press bearing into bearing bore of adapter and cover.

2. Final Housing and Cover Assembly.

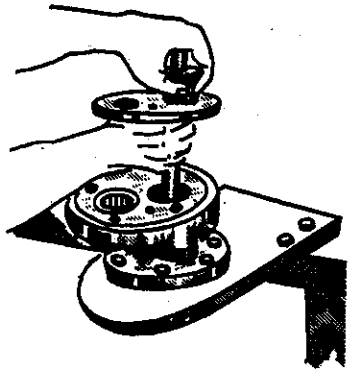
a. Install dowel pins (5) in adapter (3).

b. To assemble the wear plate (10), bearing and seal assembly (4) and (6), use the adapter end (3) bolted to the bench plate as a support. (See below). Insert the drive shaft (13) in the adapter end with the long end UP in the side that has a bearing driven in. Put the wear plate over drive shaft making sure the counterbored relief pocket is FACING the gear.



Place the bearing on the drive shaft. Now assemble the oil seal parts in the following order: Back up washer, coil spring, synthetic rubber ring. (Lubricate this ring with a light grease or oil) and the seal cup with lapped surface UP. Make certain the rubber ring (9) is not cut when placing it on the shaft and when passing it over the key slot or spline. Press the entire seat assembly down against the spring and compress it. When released, the spring should return the cup to the position held before compressing. If it sticks on shaft, replace the oil seal assembly.

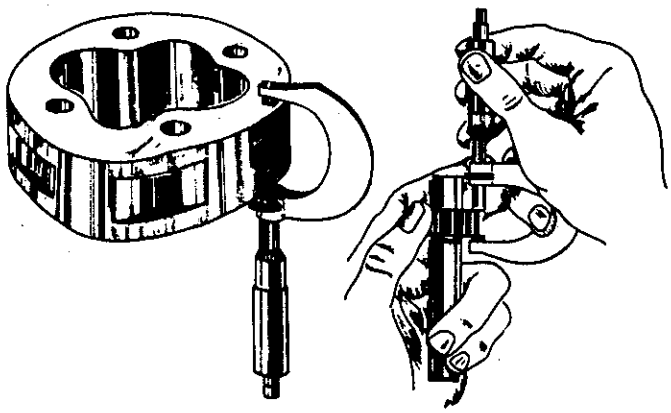
c. Wipe off any foreign matter from seal seat. Lubricate the lapped surfaces of the seal seat and seal cup with light oil. Turn the entire drive shaft assembly over and install in adapter end as shown below. Use a composition hammer to drive entire assembly down, driving bearing into bearing bore. Place "O" ring seal around wear plate. Lubricate with light oil the section of the wear plate that comes into contact with the gear face.



d. Pumps with Outboard Bearings.

With an India stone polish out any scratches on drive shaft that were made when shaft was driven out through the bearing.

e. Clearance between gear face and wear plate is provided by the plastic shim gasket between housing, adapter and cover. With micrometer, measure housing width and width of gears. (See below).



f. Insert driver assembled gear (17) and shaft (13) into adapter end. Line up marks previously made on gear faces if original gears are reinstalled.

(Page 56.) If new gears are used keep keyways 180° apart. Note that on some models shaft and gear are made in one piece. Lubricate face of gears with light oil.

g. Place proper gasket as selected by chart (below), over gears and on face of wear plate (10). If it is not practical to use micrometers to measure gears and housing use a gasket that measures .002" thickness.

h. Line up punch marks and place pump housing (12) over gears and gasket. Tap down with fibre hammer.

i. Select another gasket from chart or if no measurement (2e) is available use a gasket of .002" thickness. Place gasket on housing face. Lubricate gear face with clean oil.

j. After selecting proper gasket from the chart, and putting it in place on the housing face, install the wear plate, making sure that the 1/16" deep counterbored relief pocket is in its original position facing the gears and is rotated 180° from the pocket of the adapter wear plate. Place seal ring (9) around the wear plate and position on wear plate with an equal air gap around each shaft. Put cover (20) in place and tap down, being careful not to pinch "O" ring seal (9).

Chart below indicates color, number and location of shim gaskets to be used to provide proper clearance between gear face and wear plate.

CLEARANCE CHART			
	Gear Width Greater (+) or less (-) THAN HOUSING WIDTH	NOTE: Only plastic shim gaskets are used on 1500 Series Pumps ADAPTER SIDE	COVER SIDE
1500 SERIES PUMPS	+.002	.002	.002
	+.001	.001	.002
	.001	.001	.001
	-.001	--	.001
	-.002	--	--
COLOR CODE:	.001 - Amber	.002 - Red	.0015 - Purple

If gears are so worn that housing width becomes more than .0035" greater than gear width, both gears (17) should be replaced.

k. Install dowel pins (5) in cover. Line up punch marks previously made on housing and cover and put in place. Tap cover down on dowel pins with fibre hammer until cover bottoms on housing. Be careful not to pinch "O" ring seal around wear plate.

l. Install four cap screws. Pump may be furnished with either hollow head cap screws or hex head type. If hex head, be sure that proper washer (21) is in place before installing. If for any reason replacement of cap screws is required, always use same type as originally furnished. If hollow head cap screws are used, the shoulder of the screw must ride against the spot face of the cover and both surfaces should be free of burrs to prevent leaks.

Tighten gradually opposite cap screws, using torque wrench set at 60 ft. pounds torque. After assembly turn shaft with a 6" Crescent wrench. If shaft will turn with a slight drag and not too freely, proper clearances are assured between gears and wear plate. If shaft is too tight or too free add or remove (.001) or (.002") gaskets as necessary for proper clearance.

3. Assembly of Outboard Bearings.

a. Coat I.D. of bearing bore with white lead.

b. Lubricate the bearing (2) with light grease.

c. Drive outboard bearing (2) down over drive shaft with special tool, until it bottoms. (See page 62.)

d. Insert snap ring (1) in bearing bore.

e. Remove grease plug and repack outboard bearing bore with good quality bearing grease. Use fingers for repacking. A grease gun will force grease into the oil seal and cause it to leak.

d. Break-In of Repaired Pumps.

1. If shop test stand is available on which the pump can be mounted and operated against full pressure and at maximum speed, the following procedure is recommended for break-in and test.

a. Start pump and run for 2 minutes at zero pressure. Be sure that test stand reservoir is filled and that all inlet and outlet lines are open.

b. By restricting pump discharge line with needle valve, raise discharge pressure to 500 PSI for 10 seconds and lower to zero pressure for 10 seconds. Continue this procedure for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

c. Stop pump and rotate drive shaft coupling by hand to determine if drive shaft is free. If it cannot be turned freely, remove and rebuild pump.

d. Resume test and apply 1000 PSI for 10 seconds intermittently for 5 minutes.

CAUTION: Do not apply pressure for more than 10 second intervals.

e. Stop pump and check freeness as in (c). Check for possible leaks at mating surfaces of adapter, housing and cover and around seal assembly and the four assembly capscrews.

f. Be sure oil level is up to normal in oil reservoir. Start pump and run pressure to 1000 PSI and run flow test by whatever means is available on the test stand.

2. If a shop test stand is not available, the following alternate break-in and test procedure may be used:

a. Mount repaired pump in place on equipment and run pump at one quarter engine speed for 5 minutes at zero pressure.

b. Operate control valve until relief pressure is attained, then hold in this position for 10 seconds and release for 10 seconds. Follow this procedure for 10 minutes.

c. Increase engine speed to one-half throttle, and repeat step (b) for 10 minutes.

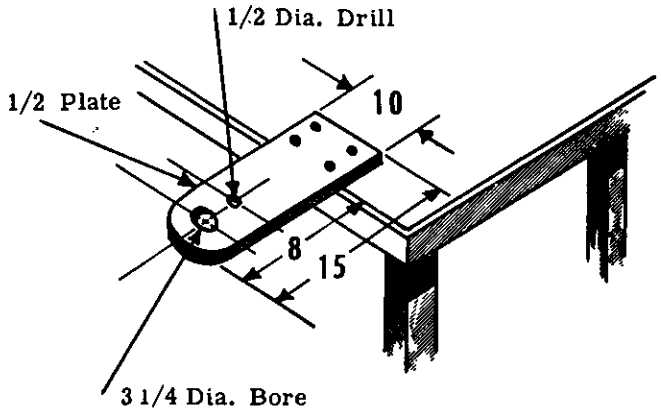
d. Increase engine speed to full throttle, and repeat step (b) for 5 minutes.

e. Idle engine and check pump for possible leaks at mating surfaces of housing, adapter end cover, shaft seal area, and any of the capscrews.

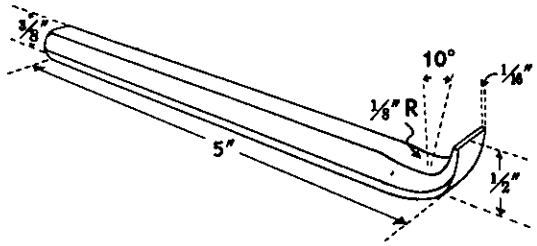
TROUBLE SHOOTING

POSSIBLE PUMP TROUBLES	CAUSES	REMEDIES
I. Cavitation, pump unusually noisy.	a) Low oil supply. b) Heavy oil. c) Dirty oil filter. d) Suction line too small. e) Restriction in suction line.	a) Fill to proper level. b) Change to proper oil. c) Clean and replace filter. d) Increase size of suction line. e) Remove.
II. Pump takes too long to respond or fails to respond.	a) Low oil supply. b) Insufficient relief valve pressure. c) Pump worn or damaged.	a) Fill to proper level. b) Reset to correct pressure setting using gauge. c) Inspect, repair or replace.
III. Oil heating up.	a) Foreign matter lodged between the relief valve plunger and relief valve seat. b) Using very light oil in a hot climate. c) Dirty oil. d) Oil level too low. e) Insufficient relief valve pressure. f) Relief valve pressure too high. g) Pump worn (slippage).	a) Inspect and remove foreign matter. b) Drain and refill with proper oil. c) Drain, flush and refill with clean oil. d) Fill to proper level. e) Set to correct pressure. f) Same as "e". g) Replace or repair.
IV. Oil foaming.	a) Air leaking into suction line from tank to pump. b) Wrong kind of oil. c) Oil level too low. d) Improper tank or reservoir baffling.	a) Tighten all connections. b) Drain and refill with a non-foaming type of hydraulic oil. c) Fill to proper level. d) Baffle correctly.

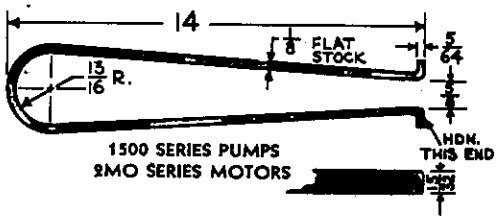
f. Special Tools for Pump Repair. (Not furnished. Can easily be made locally.)



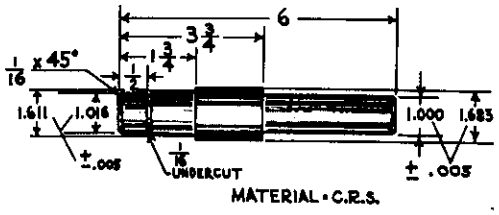
Bench Mount



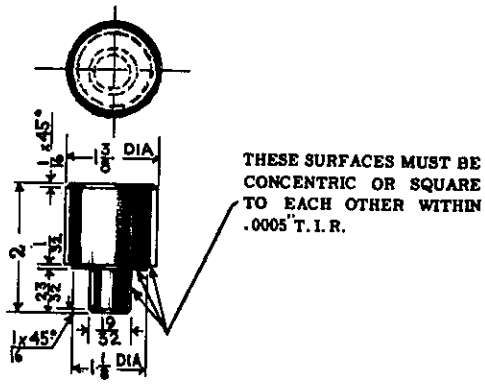
Bearing Pry Bar



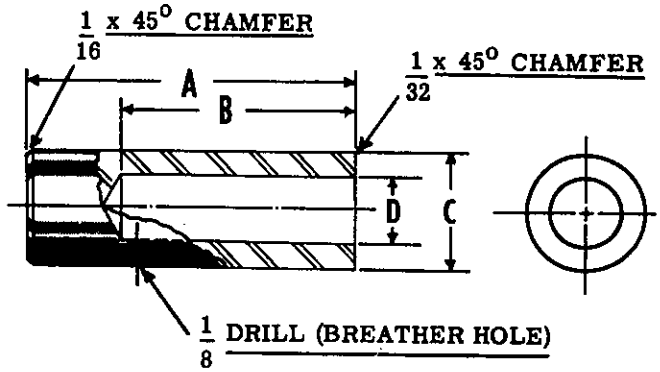
Bearing Puller



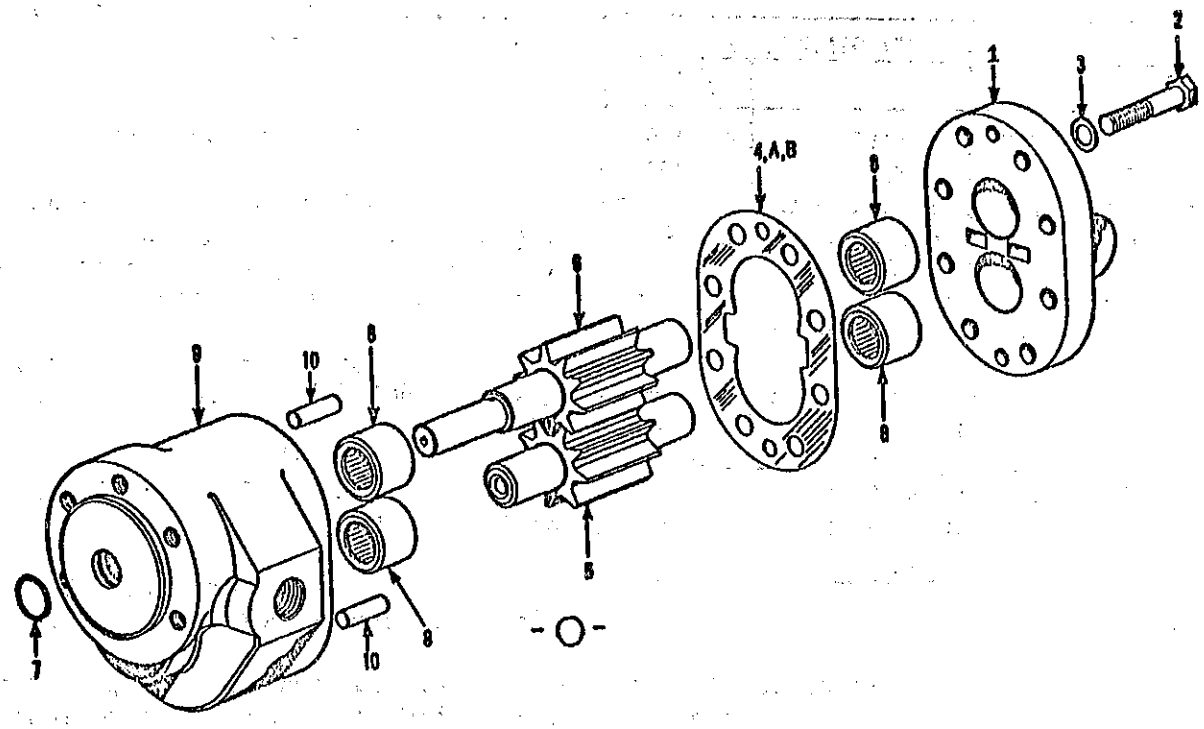
Seal Driver



Roller Bearing Driver



Outboard Bearing Driver



BOOM SWING HYDRAULIC MOTOR.

6. HYDRAULIC MOTOR, SWING CIRCUIT.

A. The above shows an exploded view of the Pesco hydraulic motor used in the swing circuit. This hydraulic motor can be driven in either direction, depending on the flow of oil as controlled by the operator. This is a flange mounted, gear type with needle bearings. The inlet and outlet parts are the same size.

B. Hydraulic Motor disassembly.

1. Clean outside of motor with solvent, fuel oil or gasoline, and dry thoroughly. Remove any burrs or sharp edges from shaft keyways, etc., before disassembly. Identify all related parts when disassembling to facilitate their return to original position, if still serviceable.

2. Remove (1) by removing eight capscrews (2) and washers (3). If cover sticks to body due to dowel pins, it should be tapped with a rawhide mallet and separated.

3. Remove shim(s) (4), driven gear (5), drive gear (6), and seal ring (7), from body (9).

NOTE: Needle bearings and dowel pins should not be removed from body and cover except for replacement purposes.

Wash all metal parts in a suitable cleaning solvent and blow dry with clean filtered compressed air.

C. Inspection chart.

INSPECT FOR	REPAIR OR REPLACEMENT.
Visual cracks or damage.	Replace.
Damaged threads.	Retap or replace.
Damage to shim surface.	Refinish on a piece of fine abrasive paper held to a true flat surface plate. Remove only enough metal to smooth up surface.

D. Tolerance Chart.

NOMENCLATURE	NEW DIMENSIONS	
	MAX.	MIN.
Body Gear bore I.D.	3.0015	3.0005
Gear Tip dia. O.D.	2.9985	2.9980
Bearing bore I.D.	Nominal dia.	1.250 *
Gear Journal O.D.	1.2501	1.2498
Gear width	2.200	2.199 **

* Nominal Dimension given due to spread of needles.

** Gear faces may be ground to a maximum of .0005 from each face; face must be flat and parallel and gears must be matched within .0002 to provide required end clearance as given in the reassembly procedure.

E. Reassembly.

Shaft seal ring should be lubricated prior to reassembly to prevent burning before drive fluid has reached seal. Lubrication of other parts is not required.

1. Install new bearings (8) into body (9) and cover (1), if they were removed during overhaul. Press bearing into body and cover to a depth of .031" below the surface that the gear faces run on.

CAUTION: Be careful not to damage or distort bearings when pressing them into their recesses.

2. Install new seal ring (7), drive gear (6), and driven gear (5) into body. Add shim(s) (4) as required to give an end clearance of .001" - .002" between gear faces and cover surface.

3. Install cover (1) into its original position with washers (3) and capscrews (2).

F. If new body and/or new cover is to be used, it will need to be drilled and reamed for new dowel pins.

1. Dowel pin installation.

a. After pump is assembled and moving parts rotate freely in their respective positions, tighten capscrews and recheck freedom of rotation.

b. Use holes in cover to locate and drill 27/64" (.421) diameter to a depth of 1.938".

c. Ream .430" - .431" diameter to a depth of 1.875".

d. Re-ream cover for .0005" maximum clearance over dowel pins.

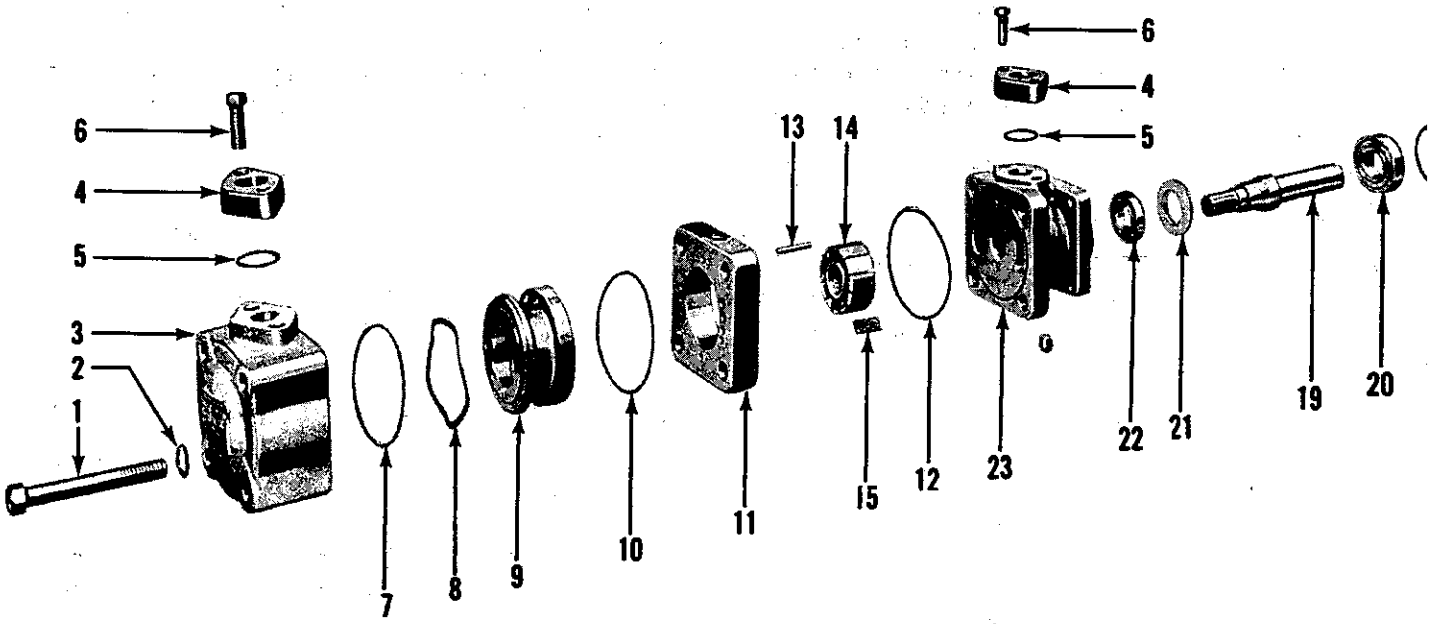
e. Blow out all metal particles with compressed air and press pins into body.

G. Test procedure.

1. If shop test stand is available on which the motor can be mounted and operated against pressure, the following procedure is recommended;

2. Use SAE No. 10 oil at 130° to 150° for both run-in and calibration. Provide for a drain port return line.

3. Run-in at 800 to 1000 RPM at 1300 to 1500 psi. for maximum of 2 minutes in each direction of rotation. There should be no external leakage allowed during test.



The above shows an exploded view of Vickers Hydraulic Motor (single cartridge type) used in the Cable Hoist Circuit.

7. HYDRAULIC MOTOR, CABLE HOIST CIRCUIT.

A. Disassembly, Inspection and Repair.

1. Disassembly of Cover End. Remove the four cover screws (1) and washers (2). Note position of port opening in cover (3) with reference to that of body (23) before removal so that the cover may be returned to its proper assembled position at reassembly. Remove cover (3), sealing rings (7) and (10), wave washer (8), pressure plate (9), ring (11) together with locating pins (13), rotor assembly (14) and vanes (15). If unit incorporates port flanges (4) and sealing rings (5), they can be removed by removing screws (6) that hold them in place.

2. Disassembly of Opposite, or Shaft End of Motor. This end of the motor must be opened to gain access to bearing and oil seal. Remove snap ring (18) and carefully pull outward on drive shaft (19). Bearing (20) will come away with it.

3. Drive Shaft Bearings and Shaft Seal.

a. Before further disassembly is undertaken, it should be noted that drive shaft bearing (20) is a press fit on the shaft and that bearing (22) is closely fitted to its bore in motor body (23). Wash the bearings thoroughly in a clean solvent and test each one for wear. Rotate each bearing applying hand pressure to the running race to determine whether the balls or races have become pitted or cracked. Check for looseness. A small amount of end play is permissible. However, an excessive amount in any one bearing will require replacement of that bearing. Remove bearing (20) from the drive shaft with an arbor press. Remove bearing (22) from the body by tapping it out with a drift punch from the cover end. Shaft seal (21) must be removed from the body before bearing (22) can be removed.

b. Shaft seal (21), located in the motor body, has also been pressed into position in the body for a tight fit. Examine the seal carefully for possible leakage and wear. Check oil seal sealing lip and that area of the drive shaft that the seal rides against for possible scoring marks. If any are found, both the

seal and shaft must be replaced. The oil seal can be removed by inserting a suitable driver through the inside diameter of bearing (22) in the body, engaging the seal, and driving outward. A seal, once removed, cannot be reused.

B. Inspection and Repair.

NOTE: Wash all parts, except seals, gaskets and "O" rings, in clean mineral oil solvent and lay them aside for inspection. Replace all seals with new ones at reassembly.

1. Pressure Plate, Ring, Rotor and Vanes.

a. Check ring (11), and vanes (15), for signs of wear. Check the cam contour surface of the ring for possible scoring marks. Very minor abrasions can be removed, providing proper machine tools are available. Check vanes for corresponding score marks. All vanes should slide freely in the rotor slots without any side play. Replace vanes in sets if worn.

b. Clean and check rotor (14) for wear on sides and at shaft hole and vanes slots. Inspect rocking beams. Any indication of wear will necessitate replacement with a new rotor.

2. Port Openings in Body and Cover. Check both port openings for possible distortion due to improper piping procedures. These parts should be replaced if it appears the area about the threaded port has been distorted or fatigued.

C. Reassembly.

NOTE: Assembly procedures will be facilitated by lubricating all parts with clean hydraulic fluid just before assembly.

1. Shaft End.

a. Bearings. Assemble bearing (20) in its proper location on the drive shaft. Place bearing (22) in its corresponding position in the motor body. Properly seat both bearings with the aid of a bearing driver that contacts only the inner race of bearing (20) and outer race of bearing (22). Protect splined or rotor end of drive shaft when seating bearing (20).

b. Oil Seal. In assembling oil seal (21) to its position in body, the sealing lip should face inward. Press seal in place with a suitable device that contacts only the O.D. of the seal. Make certain the seal is pressed firmly in place to avoid a cocked condition within its bore; however take care not to collapse the seal while doing so.

c. Drive Shaft. Before returning the drive shaft and its bearing to the body, take necessary precautions to make certain the shaft seal sealing lip is not damaged when passing the splined end of the shaft through it. A good procedure is to smoothly wrap the end with cellophane tape. Slide the shaft into the body bearing until the shaft bearing is firmly seated. If necessary, tap the drive shaft lightly to make certain of this. Reassemble snap ring (18) to hold this shaft assembly in place.

2. Cover End.

a. Position the body assembly on a mounting flange and return sealing ring (12) to its groove in face of body (23) and add rotor (14) to the exposed splined end of drive shaft.

NOTE: If vaseline or petroleum jelly is used to retain seals, use such bonding material sparingly. An excess amount will tend to float the seal out of its groove when pressure is applied.

b. Reassemble two pins (13) into the body and return ring (11) to its position on the body.

Add vanes with their rounded edge facing the inner contour of the ring. When assembling these vanes, make certain they rest squarely in their slots and not on the vane clips. Check this assembly closely by rotating the shaft by hand and noting vane action. No vane should extend beyond the side face of the rotor. If one does, it is resting on the vane clip that is adjacent to the body side of the rotor.

c. Position pressure plate (9) on the two locating pins (13) and add seal (10) to its location on the face of ring (11). This plate is symmetrical and will fit in either one of two positions.

d. Reassemble seal (7) to its step on the outer end of the pressure plate and add wave washer (8). Carefully lower cover (3) down over the pressure plate and onto ring (11) making certain not to dislocate either the seal at the ring end of the pressure plate or the groove formed by the pressure plate and cover. Once the cover is in position, slowly rotate it so that its port opening corresponds with the installation the motor is intended for.

e. Secure cover (3) and ring (11) to body (23) with four screws. The threads of these screws should be well lubricated to assure correct torque tightness. Torque to 250 ± 10 ft. lbs.

f. Rotate the drive shaft by hand to make certain no binding condition exists.

8. SHAFT ROTATION OF VICKERS HYDRAULIC MOTORS.

The hydraulic motor drive shafts rotate in either right or left hand direction, depending on the direction of oil flow as controlled by the operator. In view of this the rings may be assembled in either position. The vanes, however, must be installed with the radius ends toward the ring bore.

9. CRANE OPERATION AT HIGH TEMPERATURES ABOVE 90° F.

Page 15, paragraph C, indicates SAE-20 MS or DS oil may be used when the air temperature is between +30° F. and +90° F. If the air temperature is much above +90° F., and SAE-20 is used, then the internal parts of the motors may not deliver full efficiency. The oil temperature in this event may raise above 160° F. and it may be necessary to drain the SAE-20 and replace it with SAE-30 MS or DS oil.

Long extended periods of operation at oil temperatures in excess of 160° F. should be avoided.

10. CRANE OPERATION AT COLD AIR TEMPERATURES.

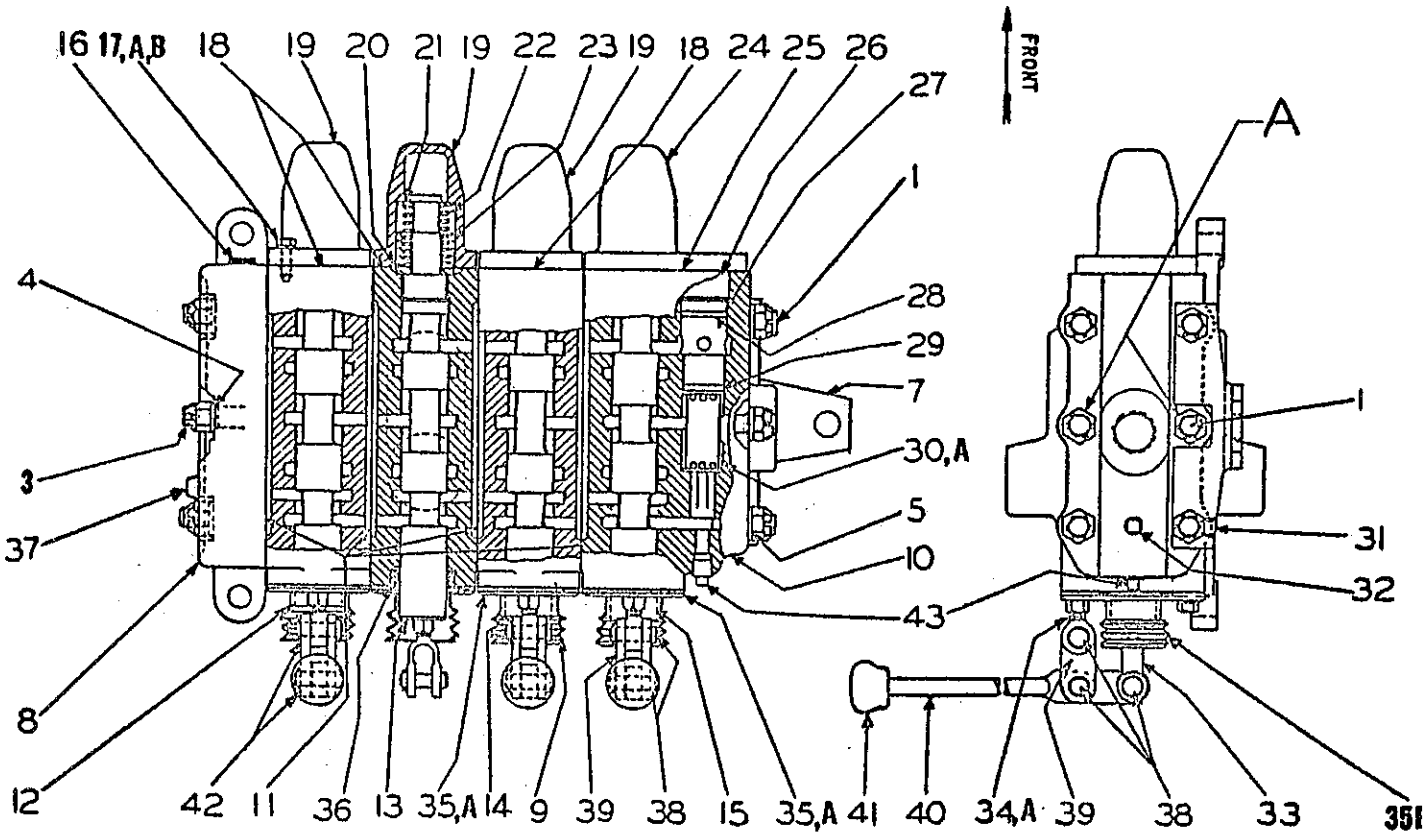
Page 15, paragraph C, indicates SAE-5 MS or DS may be used if the crane is stored outside and to be operated when the air temperature is under -5° F.

When the outside air temperature is colder than -15° F., consult a major Oil Company Lubrication Engineer , or the Aurora Service Department, for additional recommendations.

NOTE: When operating air temperatures return to +30° F. and up to +90° F., refill the hydraulic system with SAE-20 MS or DS, A.P.I. classification. The A.P.I. specifications correspond to the former "Heavy Duty" type classification.

11. THE FOLLOWING DATA REFERS TO THE VARIOUS PUMPS AND MOTORS AS USED ON THE CRANE.

MAKE	MFR'S. MODEL NUMBER	A-W PART NUMBER	FUNCTION
Hydreco	Model - 1515T19B2	PGF-15081	14 Gallon Pump-Steering Circuit
Hydreco	Model - 2025R15J1	HCF-5227	48 Gallon Pump-Crane Circuit
Pesco	Model - 051725-030-01	HCF-4999	Motor - Swing Mechanism
Vickers	Model - M2-540-150-6FC-13	HCF-2802	Motor - Cable Hoist
Hydreco	Model - 3020H11B2	HCF-5233	73 Gallon Pump-Crane Circuit



12. HYDRAULIC CONTROL VALVE BANK - CRANE CIRCUIT. (Shown Above)

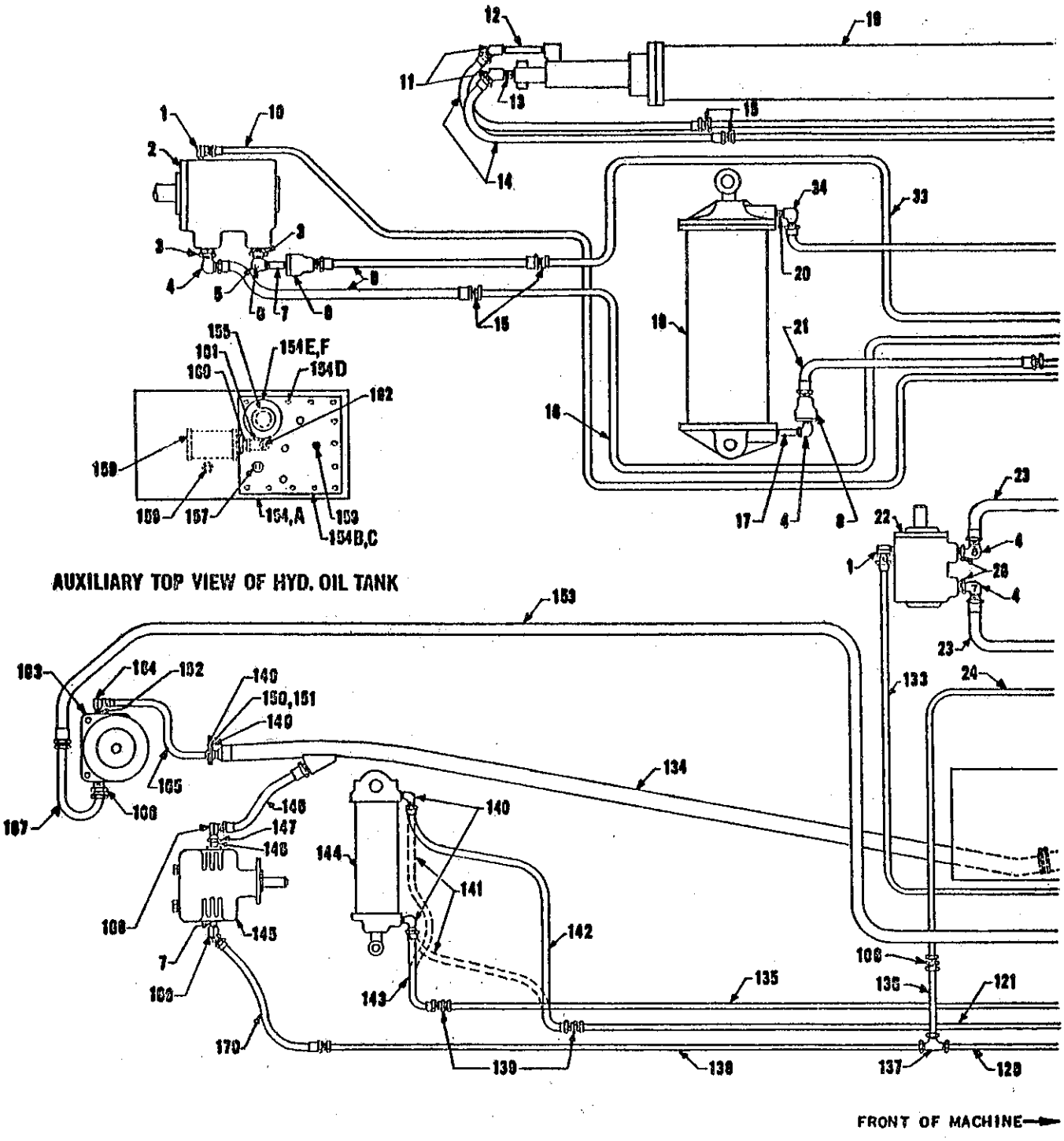
a. A separate trouble-free valve is used to control each operation of the crane, and all the valve bodies are bolted together to form a single unit. Each movable valve is held in a neutral position by the use of one spring. The spring and parts within the end cap do not require adjustment or cleaning, from one season to another, and this likewise applies to the chevron seals. Do not alter the position of the nuts at each end of tie rods.

b. The valve assembly has been carefully built and assembled at the factory and should need no attention or service.

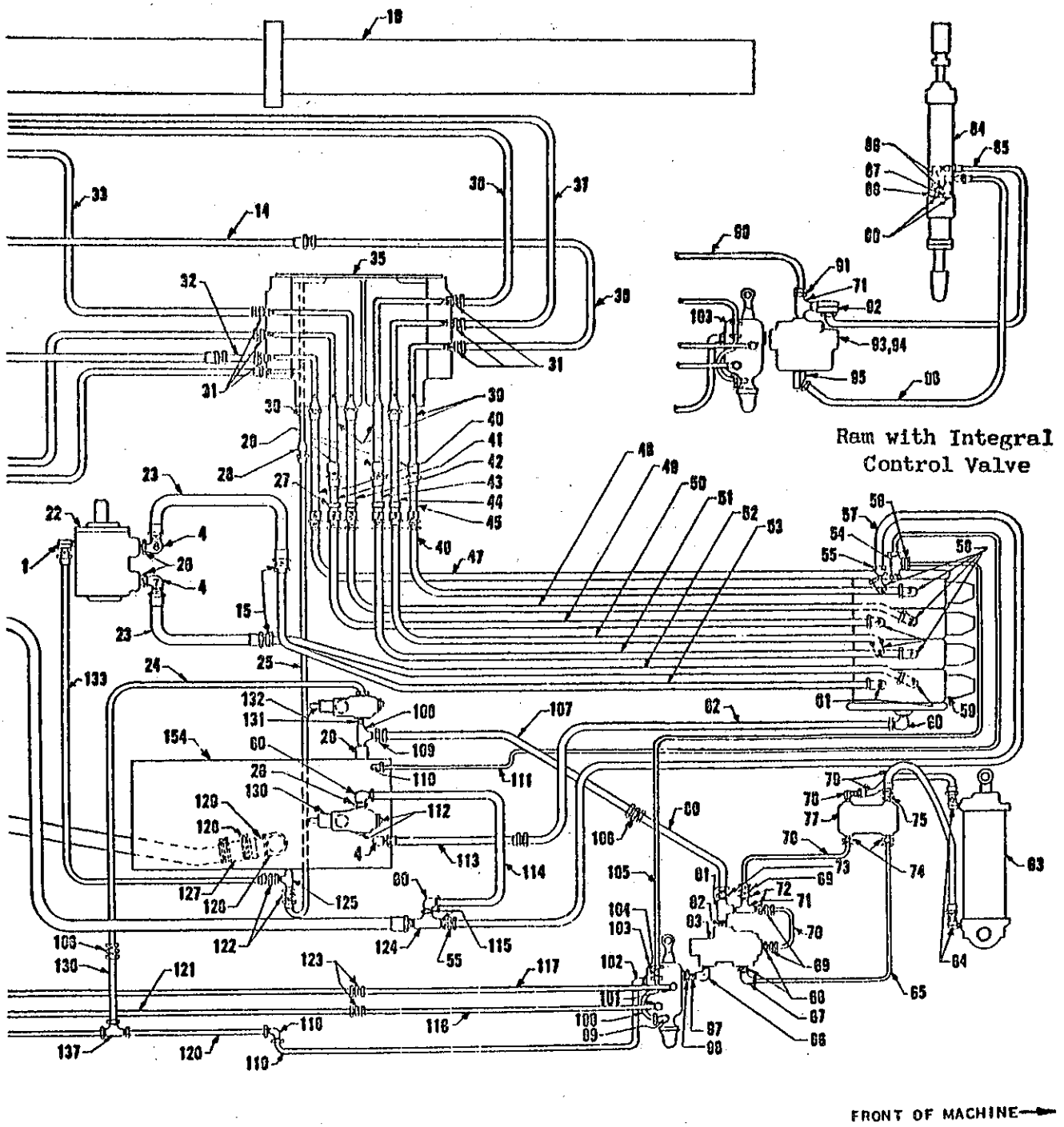
c. The valve bank assembly is put together with carefully selected and pre-compressed gaskets. The two center tie rods (A) are set with an 85 ft. lb. torque wrench setting and the four end tie rods are set at 120 ft. lbs. We strongly suggest you leave the assembly alone. The oil seals (36) in the valve plug end are replaceable, but should need no attention or replacement for a long time, unless the exposed ends of the plugs become dirt-laden and cut out the seals.

d. The spool valve has less than .001" clearance in the bore of the valve body, and it is imperative to keep the oil clean so as not to scratch or cut the surfaces.

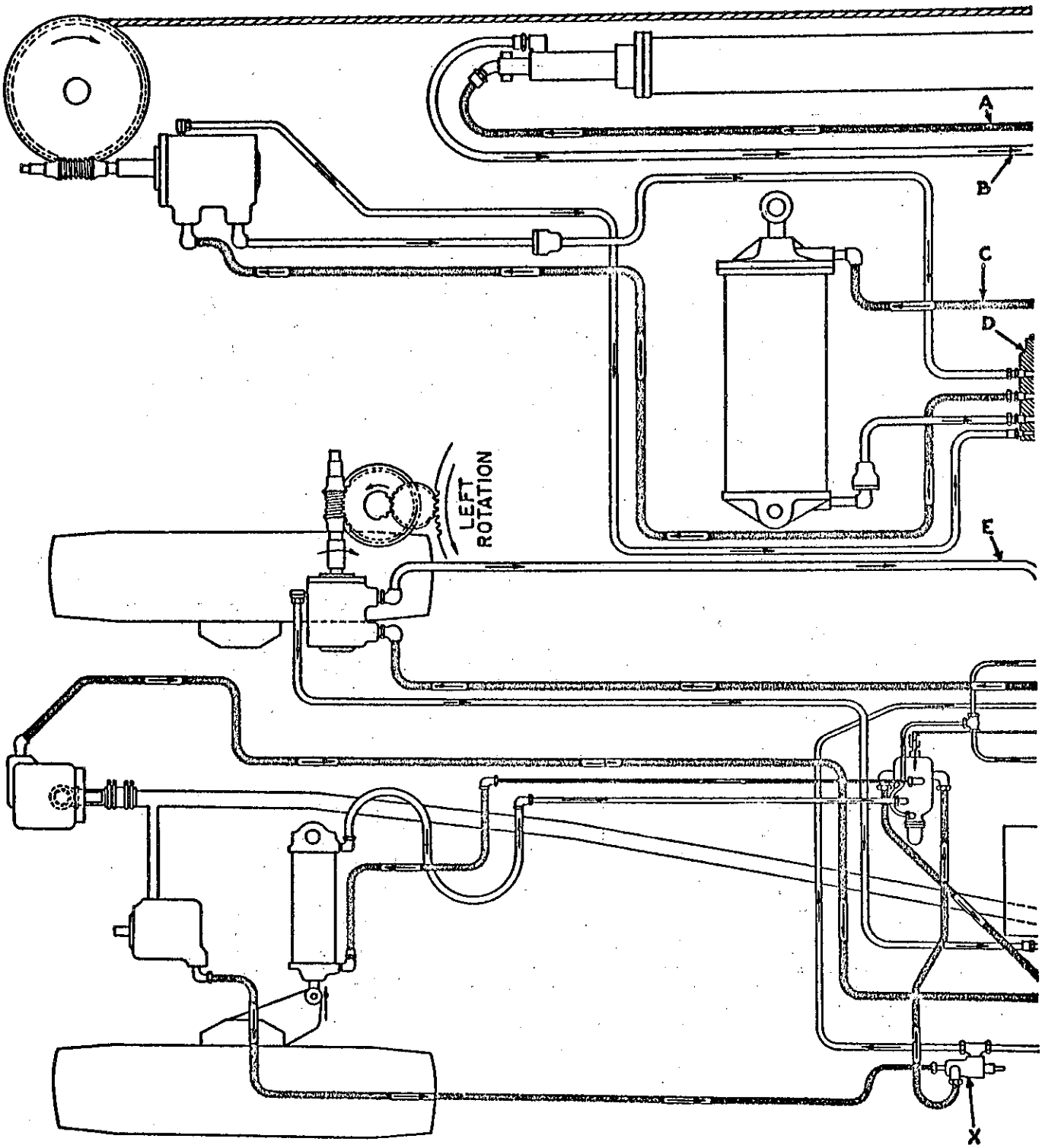
e. Item (28) is a flow-regulator valve built into the R.H. or swing valve body. Its function is to regulate the flow of oil to maintain a smooth boom swing cycle.



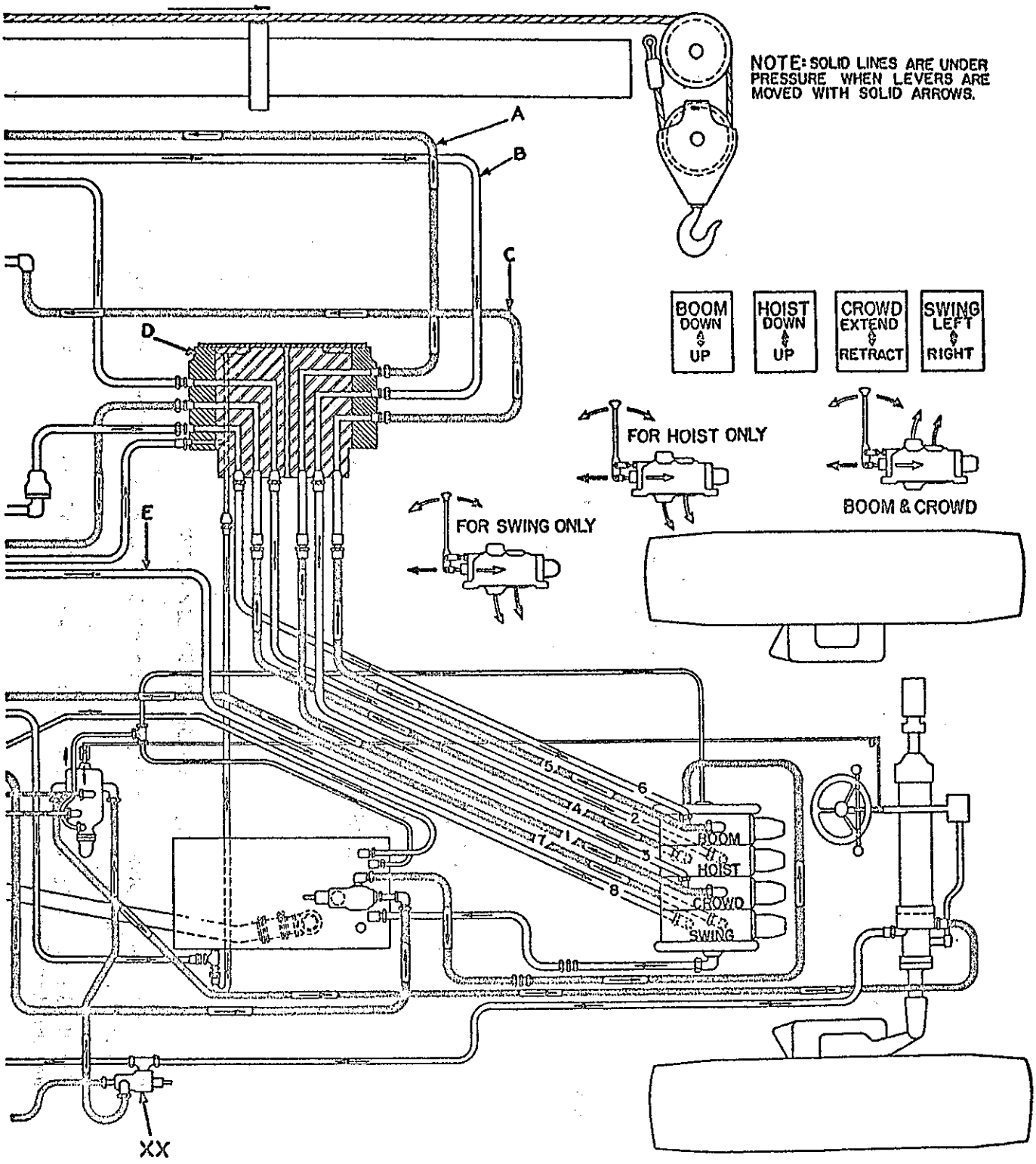
3. FOUR WHEEL STEER HYDRAULIC PIPING. (See Repair Parts Catalog.)
NOTE: For items located to the right of Ref. 137 above, use the drawing on page 71.



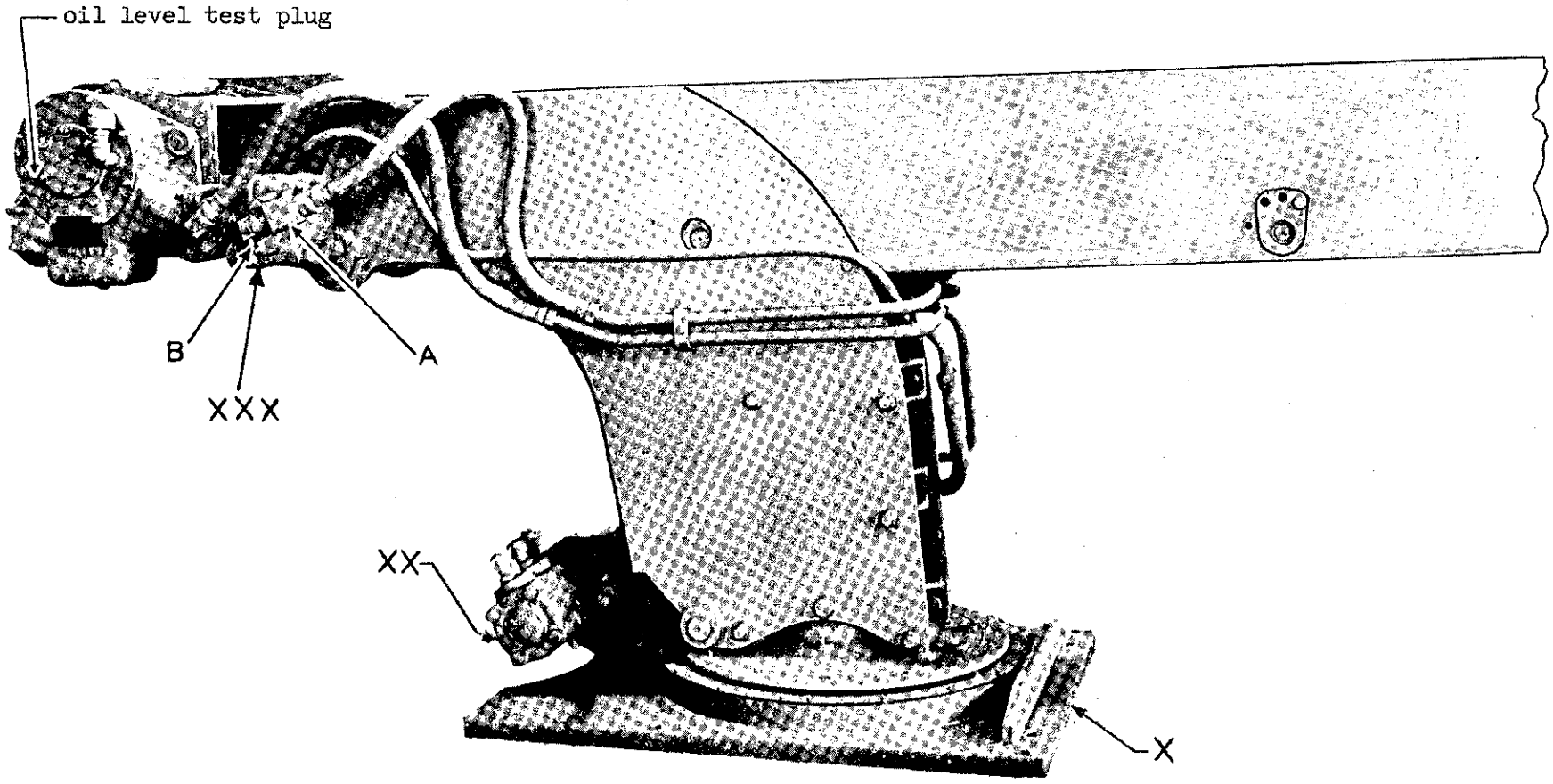
13A. FOUR WHEEL STEER HYDRAULIC PIPING. (See Repair Parts Catalog.)
NOTE: For items located to the left of Ref. 137 above, use the drawing on page 70.



14. FOUR WHEEL STEER HYDRAULIC OIL FLOW DIAGRAM.
NOTE: For items located to the right of Ref. X above, use the drawing on page 73.



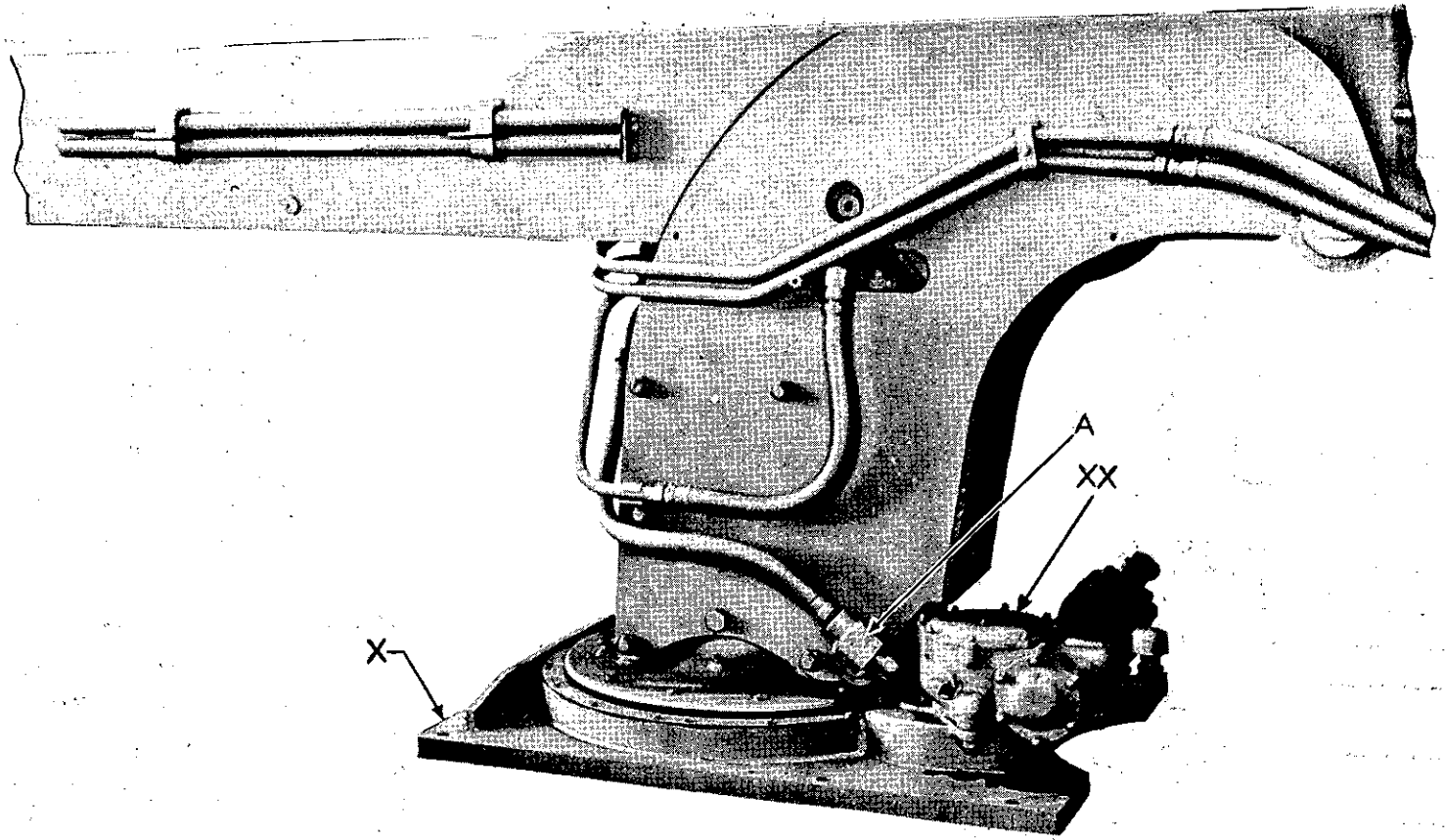
14A. FOUR WHEEL STEER HYDRAULIC OIL FLOW DIAGRAM.
NOTE: For items located to the left of Ref. XX above, use the drawing on page 72.



15. **CRANE UPPER STRUCTURE.**

The above Photo shows the Right Side of the Main Base Plate (X) with Swing Motor (XX).

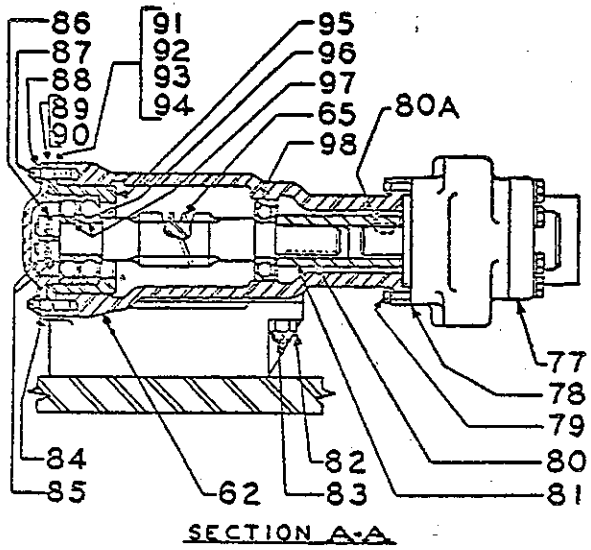
The Cable Hoist Hydraulic Motor is shown at (XXX) with Oil Volume Restrictor (A).



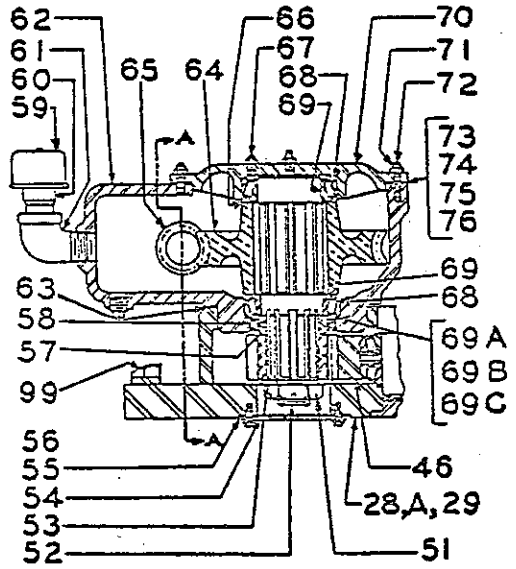
16. This Photo shows the Left Side of the Main Base Plate (X) with Swing Worm Drive Case (XX).

Restrictor valves (see Ref. (A) in photo 15 and 16 above) are located in the return line of the cable hoist motor and the lower end of the boom lift cylinder. These are one-way valves to control the dropping speed of the load. When raising the boom or cable, the internal moveable valve will open to permit full volume of oil to flow into the cylinder or oil motor. When lowering the boom or cable, the internal moveable valve will be forced against its tapered seat and the restriction part of the valve will then reduce the amount of oil flowing out of either the boom lift cylinder or cable hoist motor, thus reducing the lowering speed.

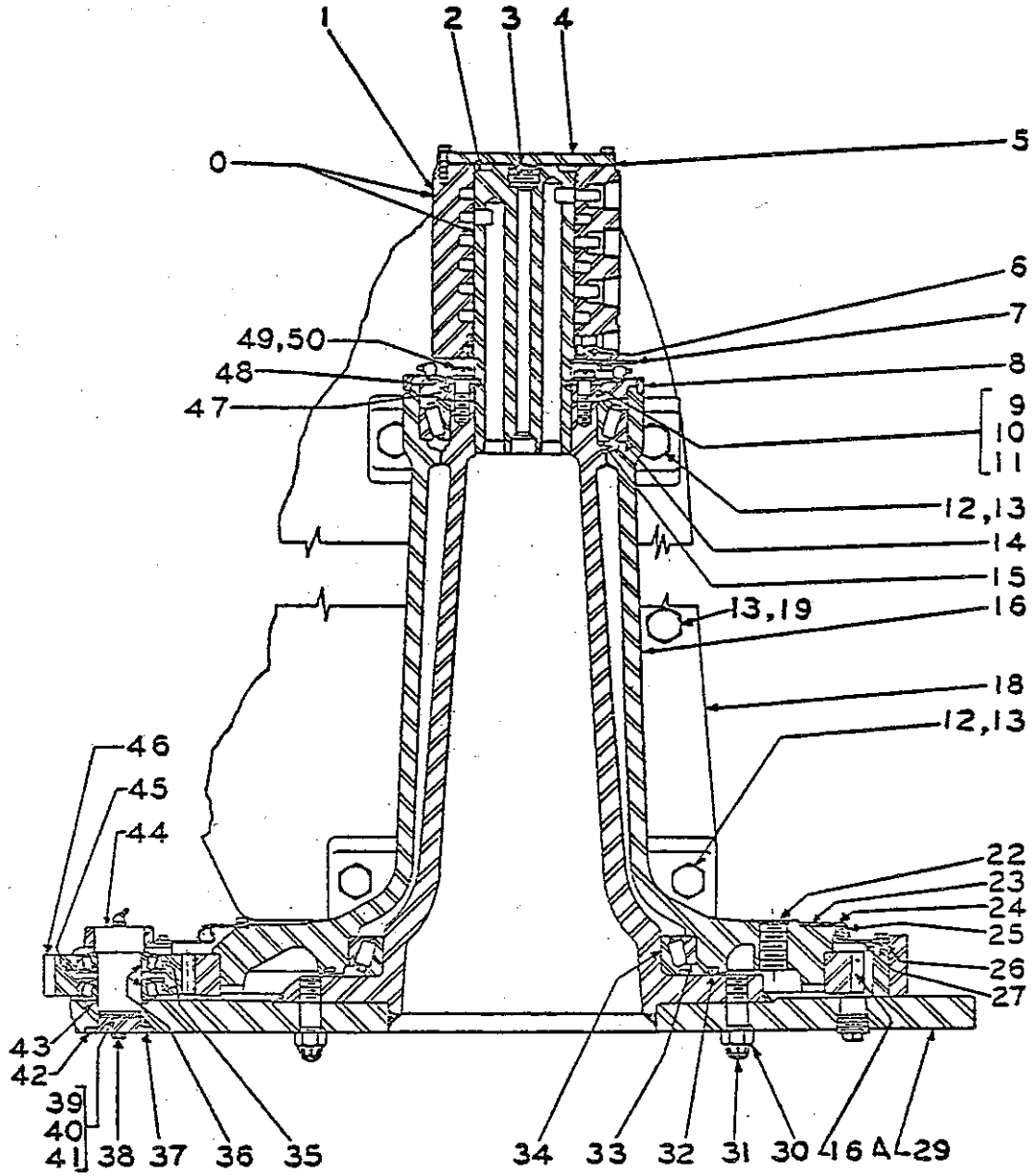
Should the load drop faster than is considered normal, when lowering either the cable or boom, or if it fails to come down fast enough, it may be the oil check plunger within the valve is stuck. It will be necessary to disassemble the restrictor valve, clean it and check for free movement and reassemble. Be sure the valve is always installed in proper direction of flow of oil.



17. This shows the assembly of the Swing Worm Group.



18. Shown above is the Swing Mechanism Group.



19. Shown above is the Pivot Post Group with Swivel Valve (1).

20. SWIVEL VALVE. (See page 76, paragraph 19.)

To remove swivel valve (1), elevate boom to its maximum and block it in place. Disconnect hoses underneath the turntable and hoses at control valve bank which lead to the side of the swivel valve casting. Loosen the bolts (49), located directly under the swivel valve body that hold the two small slotted retaining plates (47) in position. The retaining plates normally fit into a groove, machined in the swivel valve plug. With nuts loosened and swivel valve held so that valve weight can be removed from plates, slide retaining plates out until retainer clears groove in plug. Entire valve plus any hoses that are attached can then be removed from the pivot post casting. To reassemble this unit, the above procedure is reversed.

IMPORTANT: When reassembling swivel valve, coat exposed sides of plug that enters top of pivot post with rust inhibiting grease to prevent plug from rusting in pivot post.

21. PIVOT POST BEARINGS. (See page 76, paragraph 19.)

Procedure to obtain proper preload on pivot post bearings. The pivot post should be set in position with the idler gear (46) removed from the base plate (29). The ring gear cover (23) and felt (25) should also be removed, as well as the bottom felt (32) which is mounted in a groove on the under side of the outer pivot post. This is to eliminate any drag that would occur between these parts and the pivot post. Remove expansion plug at (22) and insert a capscrew. Attach a torque wrench to the capscrew. Adjust bearings, by means of shims (9), (10) and (11) under the top cap of pivot post so that a reading of from 12 to 15 ft. pounds is obtained on the wrench. The pivot post should then be removed and bottom felt reinstalled. Care should be taken to use the same amount of shims when reassembly takes place. Finally remove the capscrew at (22) and replace the expansion plug.

The idler gear bearings (35) and (36), page 76, should be adjusted without drag from a mating part. Adjust (add or remove shims (39), (40) and (41) as required) the bearings so that a very slight drag is felt when gear is revolved.

22. SWING MECHANISM AND CABLE HOIST HYDRAULIC WINCH.

Both the swing mechanism and cable hoist are driven by means of hydraulic motors in conjunction with worm and gear reducers. The gear sets have been carefully adjusted at the factory to give trouble-free operation.

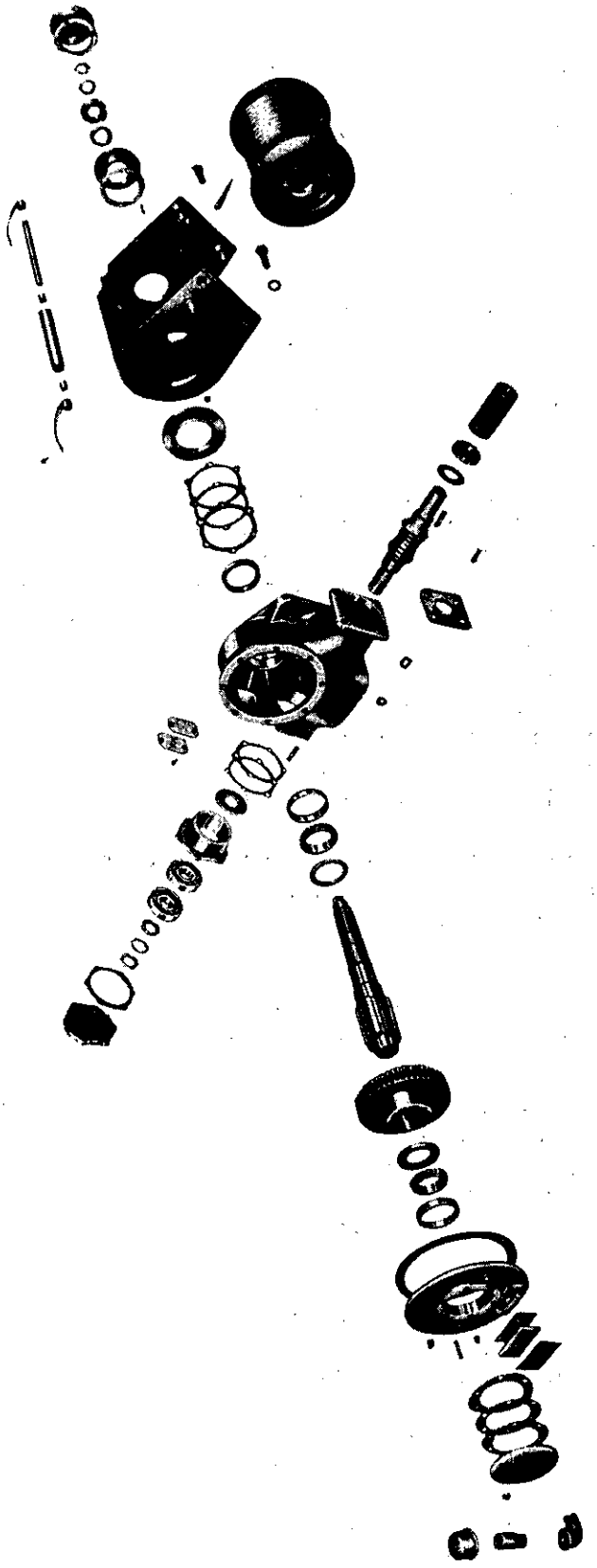
The vane motors are carefully manufactured to provide maximum output and efficiency and should not be tampered with. If trouble is encountered and it has definitely been established the trouble is in the oil motor, procure another oil motor using page 65, paragraph 7, as a guide for disassembly and reassembly and for ordering parts for the cable hoist motor. Use page 63, paragraph 6, for repairing Swing Mechanism Motor.

For worm and gear replacement and adjustment for cable hoist drive, see page 78. (For swing drive see page 76, paragraphs 17 and 18.)

The factory adjustment of the gear drive is done with meticulous care and should not be tampered with unless major repairs are being made. The worm and gear should always be replaced in matched sets. If only the gear set is to be replaced, with no bearing replacement being involved in the repair work the following procedure should be used:

Shim packs should be kept intact and reassembled exactly as they were before disassembly took place.

The old gear should be pressed or driven off the drive shaft and the new gear pressed on the shaft in the following manner. For Cable Hoist Drive (see illustration 23, page 78, looking at the drive end of the worm with the worm on the bottom and gear on top, marking on side of gear should always be on the left when gear set is assembled in housing.



For Swing Drive (see page 76, paragraphs 18 and 19), looking at drive end of the worm with the worm to the left and gear to the right, marking on side of gear is assembled in housing with number up. If adjusting shims are reassembled exactly as they were originally, you will then have the same relative position between the two gears of the new set as existed between the old gear set.

If it should be necessary to replace units (in either drive) other than the gear set, e.g., bearing, shafts, etc., the following procedure should be used to obtain the correct tooth contact; after worm and gear have been assembled in the housing, lightly paint both sides of gear teeth with prussian blue. As a rule, coating about 5 to 6 teeth with prussian blue is sufficient for checking purposes. When the worm is rotated the prussian blue is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. Sharper contact impressions can be obtained by applying a small amount of resistance to the gear when rotating the worm. Rotate the worm by hand, letting the painted teeth pass through the worm threads several times. Worm threads should now show a bearing contact on the drive side for approximately 3/4 of the length of the worm thread. Center of threads should be as near to dead center of gear as possible.

Rotate the pinion again, but meshing with the unpainted gear teeth. The gear teeth should now indicate a bearing contact of approximately 1/2 of the tooth width with the pattern of contact being approximately in the same place as the lap marks on the tooth. The other side of the worm thread and gear teeth should also show very nearly the same contact when similarly checked by reversing the rotation.

23. Shown above is the Cable Hoist Drive.

If the drive is not correctly aligned, it may be adjusted by removing or adding an estimated amount to or from the shims. This is done in the following manner: If the worm is out of end position, shims should be added or removed between the ball bearing cage and the housing. If the gear is out of side position, shims should be added or removed on both sides of the Timken bearing adjustment.

After sufficient operation under full load, the pinion will seat itself and show a bearing contact for approximately 75% of the width of the gear teeth, and the full length of the worm thread.

Bearing readjustment will be necessary whether just the gear set is replaced or other parts are involved in the repair work to obtain correct preload on roller bearings. Remove the worm from the housing leaving the gear in place.

NOTE: It will be necessary to pull gear out of housing far enough to clear worm before worm can be removed. Keep the worm shaft adjusting shims intact so that when worm is reassembled the same amount of shims are used. It is now possible to rotate the gear without contact with the mating part. Add or remove shims under the outside cover only of the cable hoist worm gear case, if adjusting cable hoist bearings. Add or remove shims under the top cover only of the swing drive gear case, if adjusting swing drive bearings. Adjust bearings so that a very slight drag is felt when rotating the gear by hand or until there is approximately .0005"to .001" preload on bearings.

Reassemble worm in housing using same amount of shims as used to obtain proper tooth contact.

24. HYDRAULIC RAM CYLINDERS, CRANE.

a. The ram cylinders should require little or no attention through many years of trouble-free service. The honed cylinder walls are of special annealed quality steel and pistons are constructed to eliminate scoring by the use of special molded cups or rings and spacer shoes. Piston rods are chrome plated. Piston rod glands contain an "O" ring assembly, sealing the piston rod.

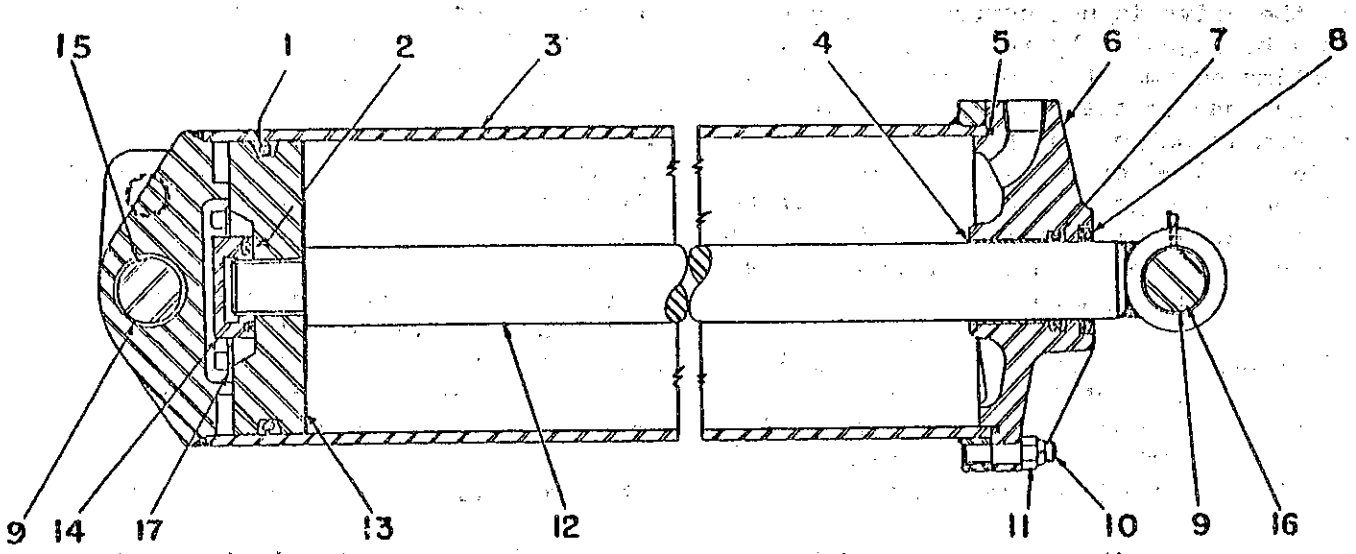
In making cylinder component replacements, do not replace with other questionable material, as the special molded rings and cups supplied as original equipment are the only type recommended.

b. Boom Lift Ram. (See page 80.)

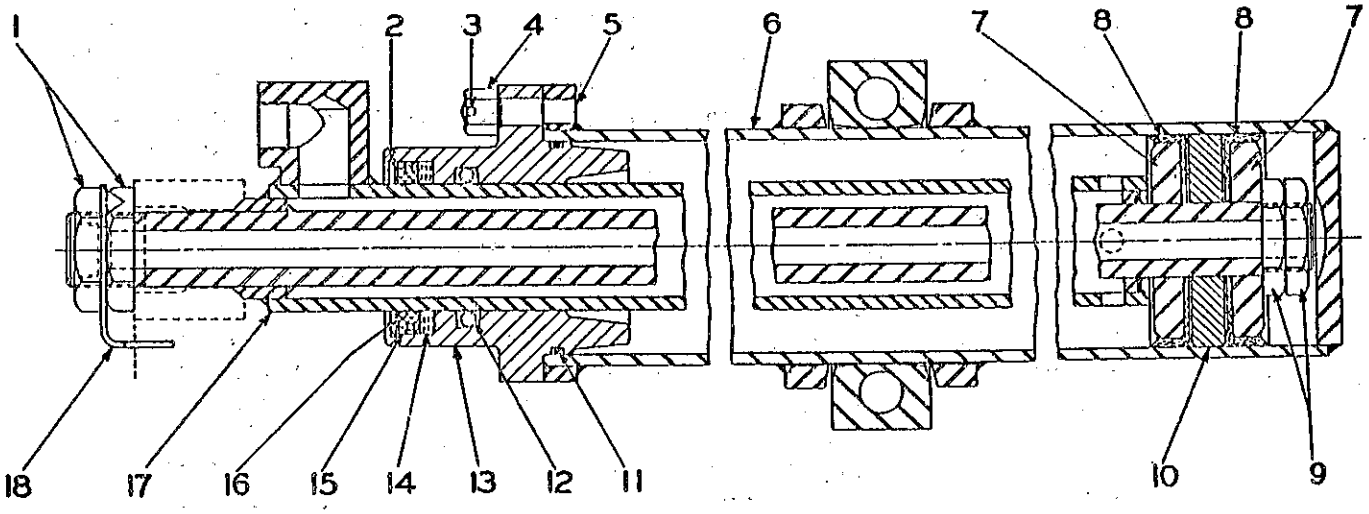
1. This ram is attached at its upper end to the boom and is supported at the lower end by the crane turntable. If this cylinder fails it will be necessary to remove it as a unit from the machine to examine or make repairs. First, remove set screw from cross pin at piston rod upper connection and remove pin. Next, remove one of the two cotter pins holding ram base pin in turntable and drive out pin. The cylinder unit can then be pulled out for examination or repair.

CAUTION: Prop boom up carefully before disassembly.

2. To disassemble the cylinder, remove nuts on cylinder head and then the entire piston rod and piston assembly will come out of the cylinder bore. The piston seal is an "O" ring of large cross section and should be free of all scratches and indications of wear; if it appears worn or damaged, install a new part. Be sure nut on end of piston rod holding piston in place is tight. There is also a small "O" ring on the stub end of the piston rod to seal leakage from one side of the piston to the other through this stub end fit. A similar "O" ring of much smaller construction in the upper cylinder head acts as a packing gland or piston rod seal.



3. Shown above is the Boom Lift Ram.

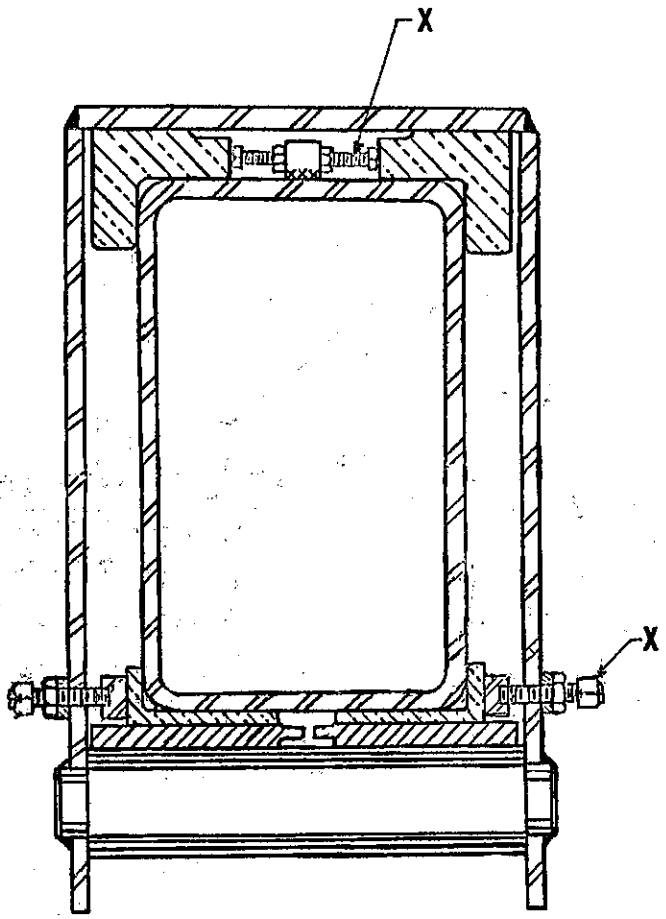


c. Shown above is the Boom Crowd Ram.

1. The crowd cylinder, located inside the boom, is held in position at its rear end by an anchor bracket attached to the piston rod. About half-way out on the cylinder is a loose bracket held in place by two collars welded to the cylinder tube. This bracket, by means of two cross pins, supports the cylinder to the boom itself.

2. To remove the cylinder, with boom horizontal, disconnect the nut and jam nut at rear end of boom which holds the piston rod to the bracket. Disconnect the two hydraulic hoses and then the entire boom with its cylinder can be removed from the shipper and placed on the ground. The two cross pins can now be removed and cylinder can be taken from the inside of the boom.

3. Removing the nuts from the cylinder head on the packing gland end will permit removal of the complete piston rod and piston assembly. The interior construction of this cylinder provides for two hydraulic cups held in place by a nut, two spreaders and a piston separating the two cups. Removing the nut on the inner end of the piston rod, the cups and spreaders can be removed and inspected or replaced. In the packing gland head, the oil seal is an "O" ring, and it should be examined for freedom from scratches, flat spots, etc.



25. Shown above is the Boom Upper and Lower Front Shoe Group.

26. BOOM UPPER SHOES. (See Above.)

a. There should be approximately 1/16 of an inch clearance between the shoes and shipper in order to maintain a minimum horizontal movement between boom and shipper.

b. This clearance is obtained by moving the shoes all the way out against the shipper, then back off the adjusting screws approximately 3/8 to 1/2 turn each.

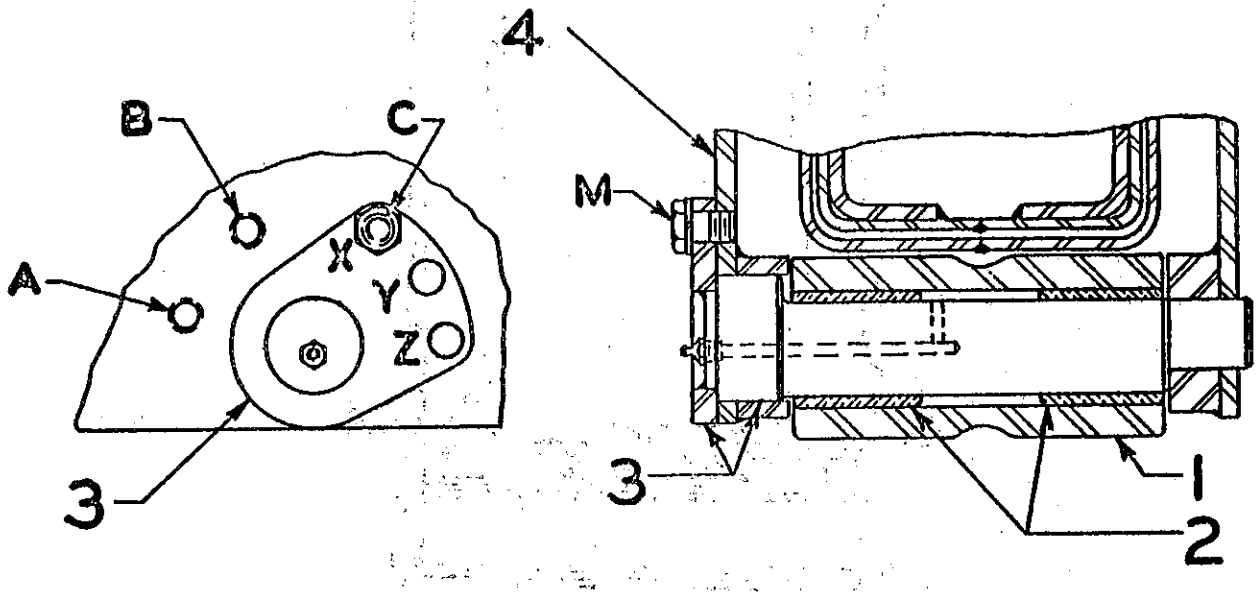
c. The vertical clearance between top of shoe and shipper should be zero. This is controlled by the eccentric adjustment of the rear lower roller group. (See illustration 28, page 82.)

27. BOOM LOWER FRONT SHOES. (See Above.)

a. The clearance between the lower shoes and lower edge of the boom should be approximately 1/16 of an inch in order to maintain a minimum horizontal movement between the boom and shipper.

b. Adjusting screws at X are provided for maintaining the desired clearance.

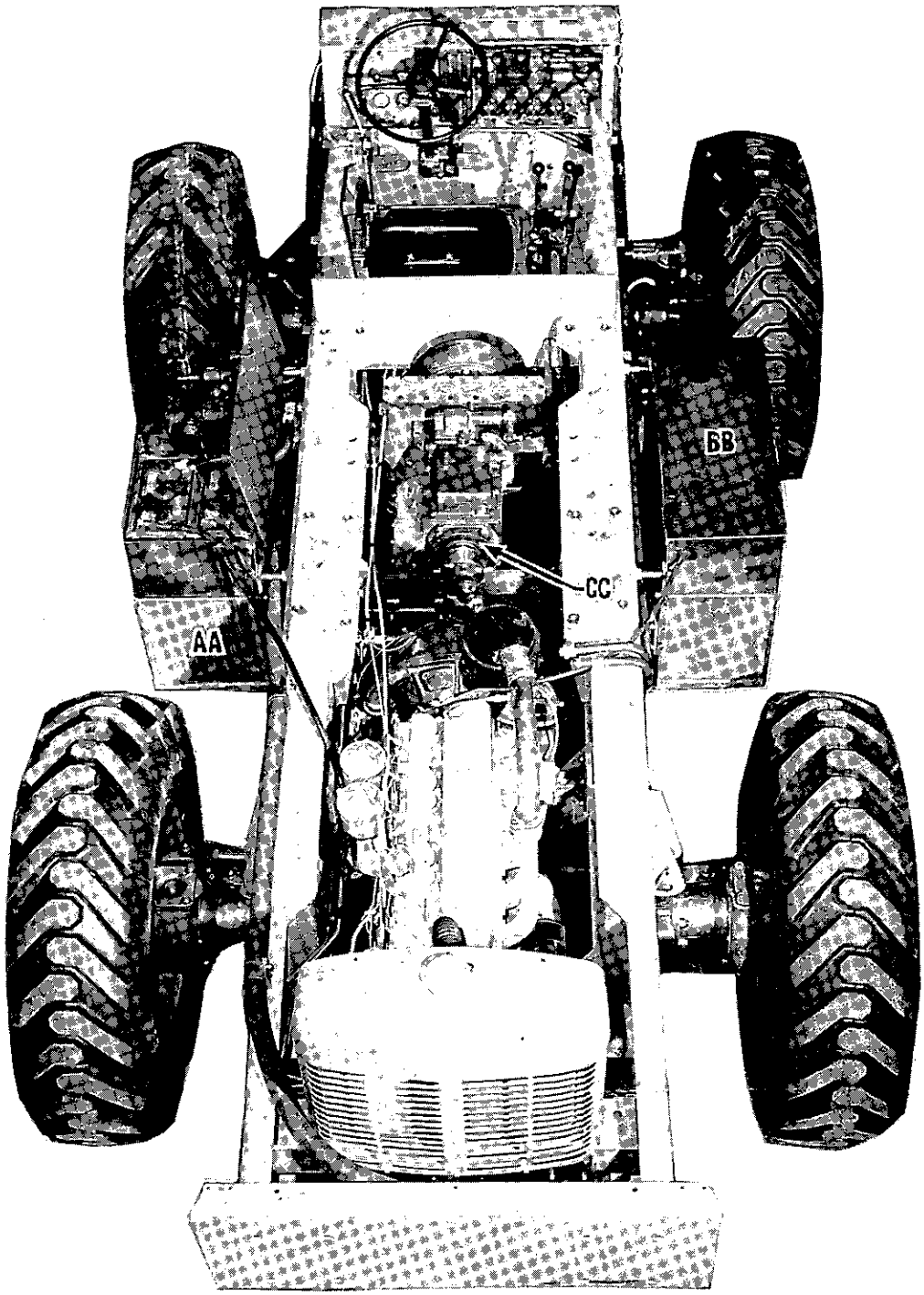
CAUTION: Do not allow excessive clearance between boom and shoes.



28. Shown above is the Boom Lower Rear Roller Group.

29. BOOM LOWER REAR ROLLER.

a. Shaft (3) is an eccentric and is provided for the purpose of establishing zero clearance between the top of the boom and the two upper shoe faces (see page 81, paragraph 26). Ref. (A), (B) and (C) shown in the above illustration are tapped holes in the side of the shipper. Ref. (X), (Y), and (Z) are capscrew holes in the side of the eccentric arm. Moving the arm to position (C) and (X) provides the loosest adjustment. Moving the arm to position (A) and (Z) provides the tightest adjustment.



1. The above Photo shows the Top View of a Tractor equipped with the following items:

   a. 4-wheel steer.

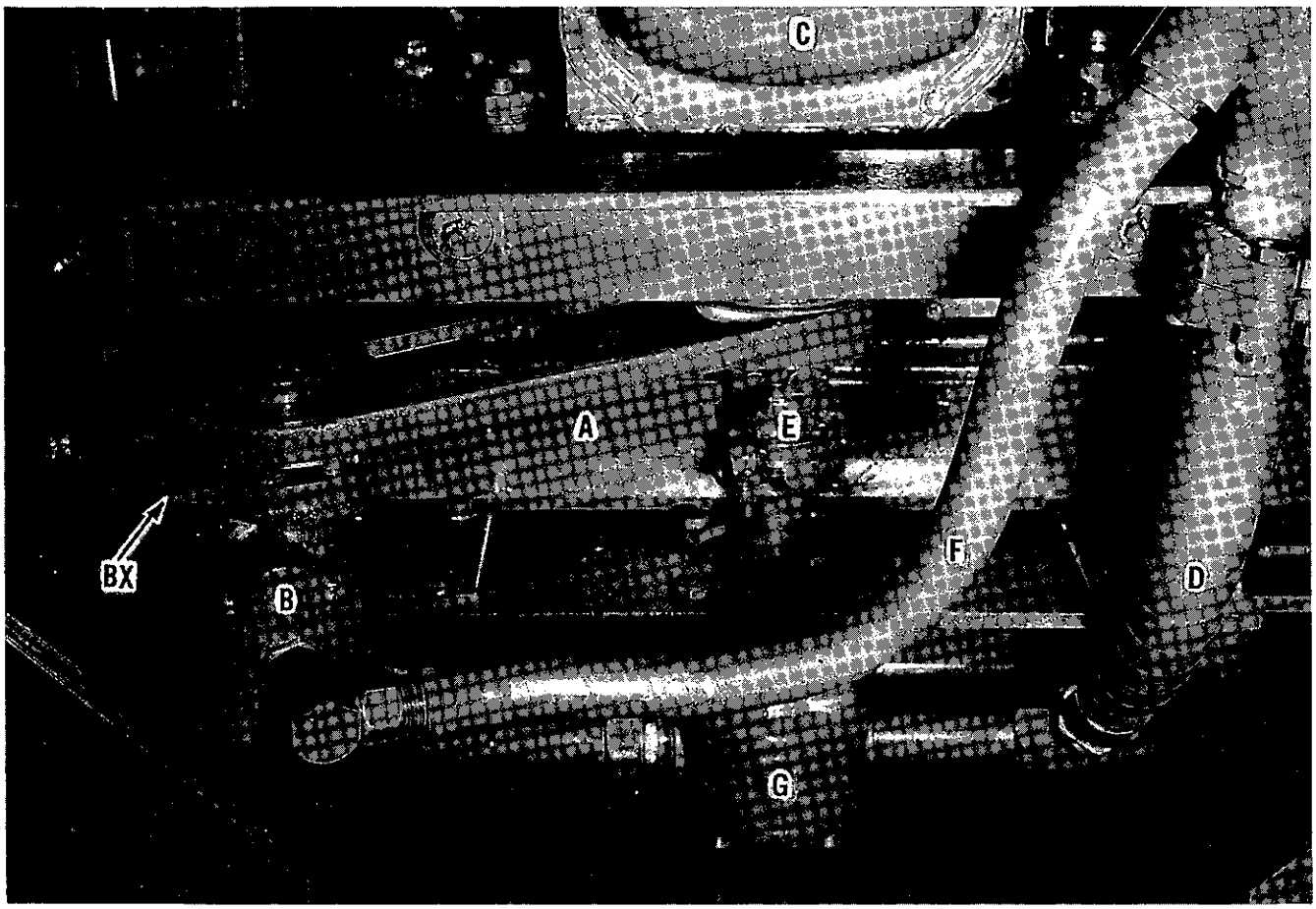
   b. Engine with torque converter.

   c. Transmission.

   d. The hydraulic oil tank (AA) is shown on the left.

   e. The lidded fuel tank (BB) is shown on the right.

   f. The clutch brake (CC) arrangement is adjusted from underneath the tractor.



2. This Photo shows a "worm's-eye" view of the area directly below the Radiator (A).

b. Steering oil pump (rotates clockwise).

c. Engine oil pan.

d. Large suction line, from hydraulic oil tank to(48)(73) gallon crane pump.

e. Pump universal joint drive.

f. Smaller oil suction oil line to steering hydraulic oil pump.

g. Main hydraulic pump.

3. REPLACING FAN-GENERATOR OR HYDRAULIC PUMP BELTS.

a. To replace fan-generator belt or hydraulic pump drive belt, disconnect propeller shaft which connects the large hydraulic pump to the front of engine crank-shaft. Disconnect propeller shaft by removing the four capscrews holding pump fitting yoke to spider trunnion, as shown below. Worn belts can then be fed down thru the opening and replaced.

b. To tighten or loosen hydraulic pump drive belt, loosen the two capscrews and the setscrew which fasten the pump support plate (BX), page 84, to the mainframe bracket and swivel the plate as required for proper belt tension; then retighten the screws.

4. CLUTCH AND CLUTCH BRAKE.

a. Main Clutch Adjustment.

First inspect the clutch pedal linkage.

Return spring must have sufficient tension of its own to lift the pedals clear up to the pedal stop without pulling it up with your hand. If you can lift the foot pedal upward against the floorboard with your hand, then the tension of the spring should be made tighter, or the linkage parts may be binding and require oiling to loosen them up.

Make certain this return action is positive, even with a slow foot action.

Be sure the clutch release lever is located on the shaft so it does not strike the transmission bell housing, either in release or full engaged position of clutch.

The clutch itself should be in fully engaged position and there should be ample clearance between the clutch throwout bearing (8) (see page 87) and the clutch fingers. This is necessary to permit the clutch to operate satisfactorily.

Adjust linkage between clutch and clutch pedal to obtain not less than 1-1/4" or more than 2" free pedal movement. This will give the clutch throwout bearing approximately 1/8" free movement before it contacts the clutch fingers, assuring full engagement when pedal is in its highest position.

To ascertain if the clutch is disengaging properly, stop the engine. Have someone depress the clutch pedal to within 2-2½" of the floorboard. Then try to turn the propeller shaft yoke with your hands. If it turns freely you can consider the clutch linkage is adjusted correctly and that the clutch is properly disengaging.

NOTE: When the clutch pedal is fully depressed to the floorboard, you cannot fully turn the yoke easily because the transmission clutch brake is applied. Raising the clutch pedal about 1½" will release the transmission clutch brake.

CLUTCH ADJUSTMENT WARNING: Do not disturb the factory setting of the three finger adjusting nuts (6) (see page 88) inside the clutch housing, as these have been properly set at the factory, and without special tools it is impossible to obtain perfect alignment and adjustment. The only field adjustment necessary is in the outside linkage. Never make any adjustment of the three nuts (6).

b. Clutch Abuse.

Abuse consists of slipping the clutch, such as trying to move the tractor in high reverse speed or any forward speed which the engine cannot pull. In such cases, shift the transmission gears to lower speed which the engine can pull. Do not slip the clutch unnecessarily lest you be burdened with costly repairs and the tractor not available for work.

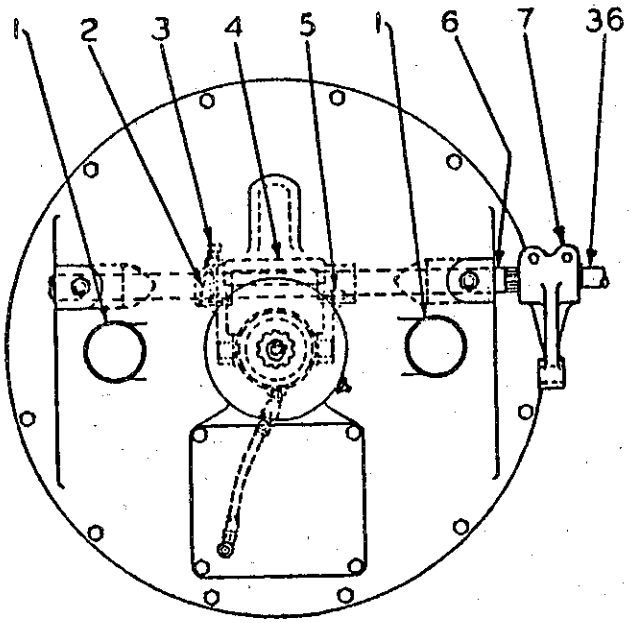
Riding the clutch pedal with your foot, or over-lubrication of the clutch release and pilot bearings, constitute other forms of abuse.

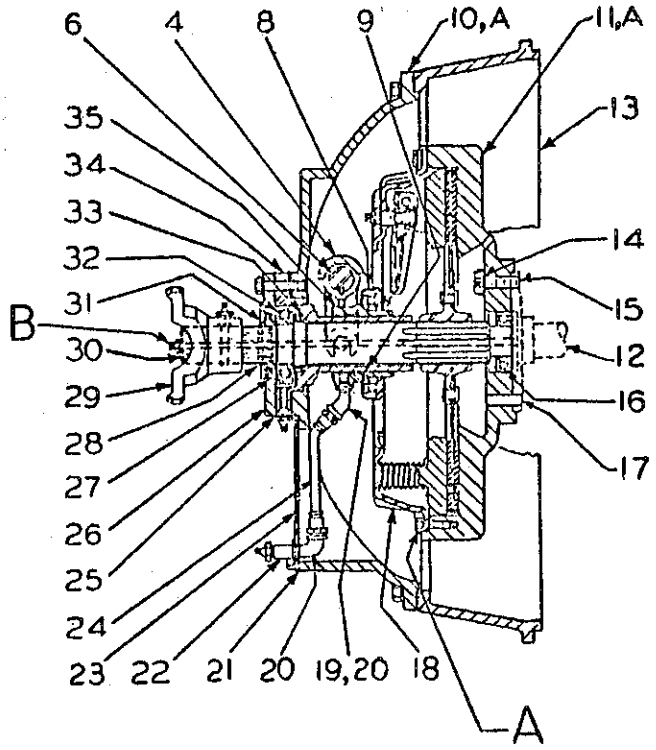
c. Clutch Lubrication.

Clutch throwout bearing (8) (see page 87) is lubricated thru the exposed high pressure fitting (22) extending thru the plate (23). Do not over-lubricate this clutch throwout bearing. Usually it only takes one, and not more than two strokes of pressure gun to replenish grease.

Clutch pilot bearing (16) is lubricated thru lubrication fitting (B) in the end of shaft (30). Consult lubrication chart, page 14, Ref. 3, for frequency of servicing operation.

Warped and cracked pressure plates, and premature worn facings, indicate excessive heat and are generally caused by excessive clutch slippage, or over-greasing. In cases where too much lubricant has been applied accidentally, causing temporary slippage, wash the entire clutch compartment with kerosene to remove all traces of grease.





d. Clutch Removal. (General)

The clutch may be easily removed from the tractor in about 30 minutes. The engine or transmission will not be removed or disturbed. Ordinary hand tools, such as socket wrenches, are all that is required. One man can do the job easily.

To remove Clutch. Remove the 8 capscrews at both yokes. Next remove the clutch to transmission propeller shaft group. Remove the cotter and pin at the upper end of clutch release shaft lever.

Remove the inspection door (23) (see above). Remove coupling (22) from hose (24).

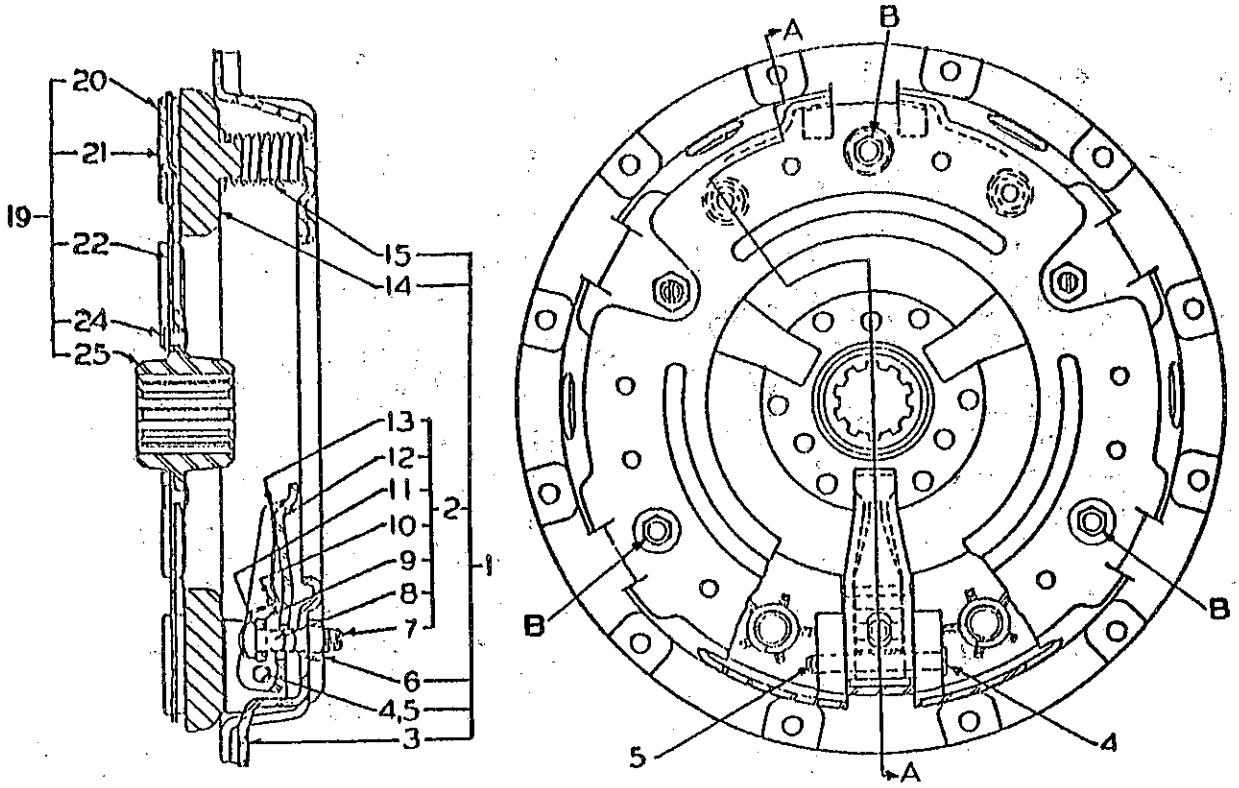
Remove the capscrews from bearing cover (26). The shaft (30), with (26), (34) and (35) may now be removed. Remove the capscrews from housing (10) and lower it to the ground.

Procure three 3/8" x 2-1/2" NC capscrews with plain washers, and these should now be screwed into the three holes located in the pressure plate (B) (see page 88). These screws will compress the 9 clutch springs and keep the clutch group assembled during clutch removal. (Remove these screws after clutch has been reinstalled.)

The 12 capscrews at (A), (see above), may now be removed, after which the clutch drive member group may be lifted out of the bell housing.

e. Clutch Inspection.

After new clutch linings are riveted to the driven disc, the outside diameter of the disc should run true (within .020") with the splined hole at hub (25), (see next page).



f. Clutch Installation.

Replace clutch pilot bearing (16), (see page 87), if worn, keeping the bearing seal away from the crankshaft flange. Lubricate the bearing at point (B). Clean out the flywheel of all dust and lining material.

Install the driven disc into the flywheel, with the short end of the splined hub toward the crankshaft.

Install the clutch, leaving the capscrews (A) loose. Insert the shaft (30) through the driven disc hub and clutch pilot bearing. Then tighten the clutch solidly to the flywheel. Remove shaft (30), also three capscrews used to keep clutch group assembled.

Install and tighten the bell housing (10) to clutch flywheel housing.

Assemble shaft (30) to sleeve (34). Replace seals (33) and (27), keeping seal lips turned as shown. Replace bearing (32) if worn or damaged; then install spacer (31) and snap ring (28).

Enter shaft (30) with sleeve (34) into bell housing (10). Slip cap (26) over shaft and install capscrews in cap. Reinstall parts (22), (23) and (24), also propeller shaft.

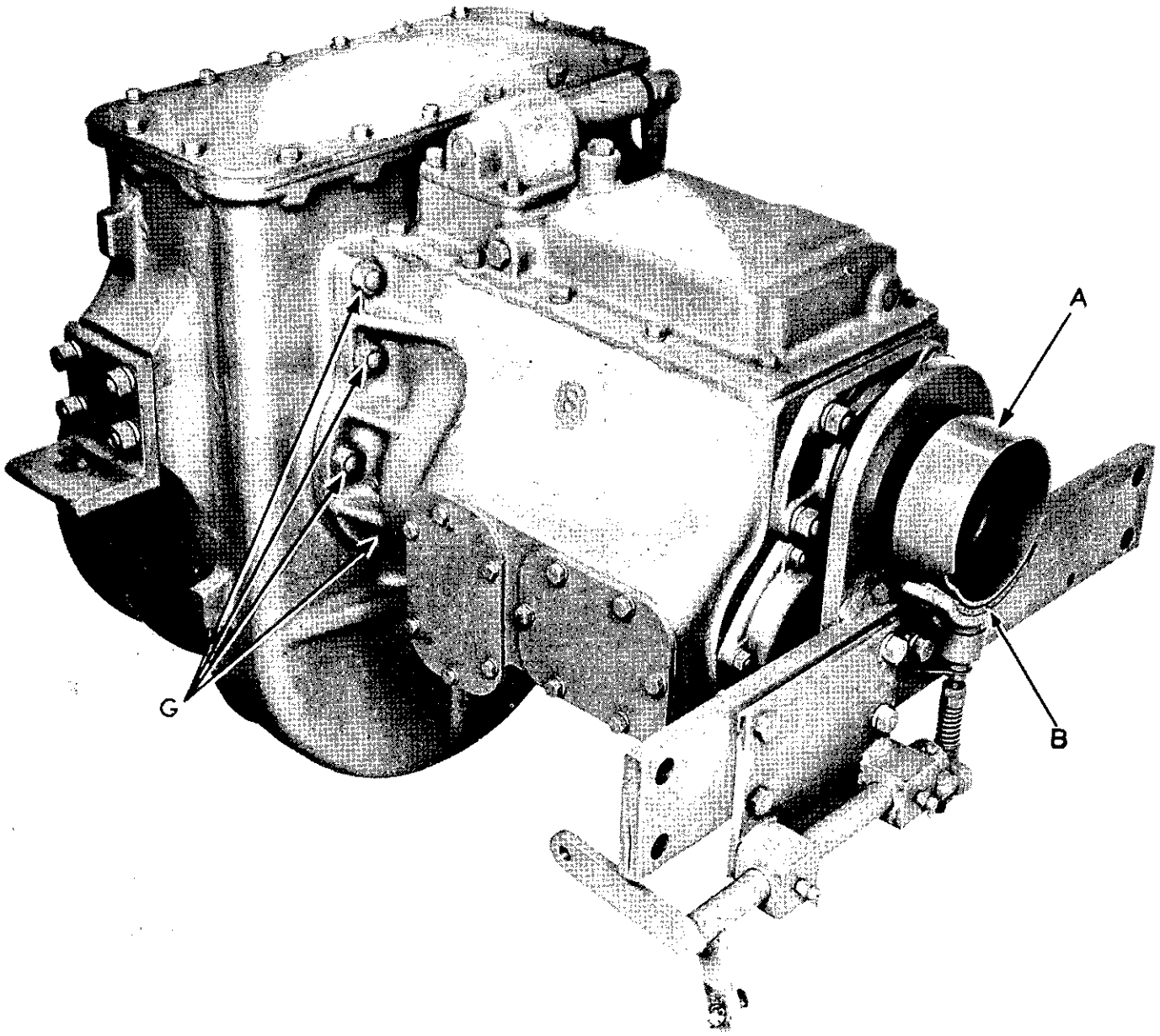
Lubricate all bearings (16), (8) and (32). Readjust clutch linkage as previously described.

g. Clutch Brake.

(1) Function of Clutch Brake.

(a) The powerful A-W clutch brake (A) and (B) (see page 89) provides a speed retarding effort to the clutch driven member and transmission gears, when shifting gears.

(b) The brake consists of a drum (A), which is spline driven. A lined brake shoe (B), together with external linkage, is interconnected to the clutch foot pedal. When the foot pedal is pressed to the floorboard, the linkage moves, which in turn moves the lined shoe against the external drum (A).



The above photo shows a typical Transmission and Transfer Case Group (Left Side).

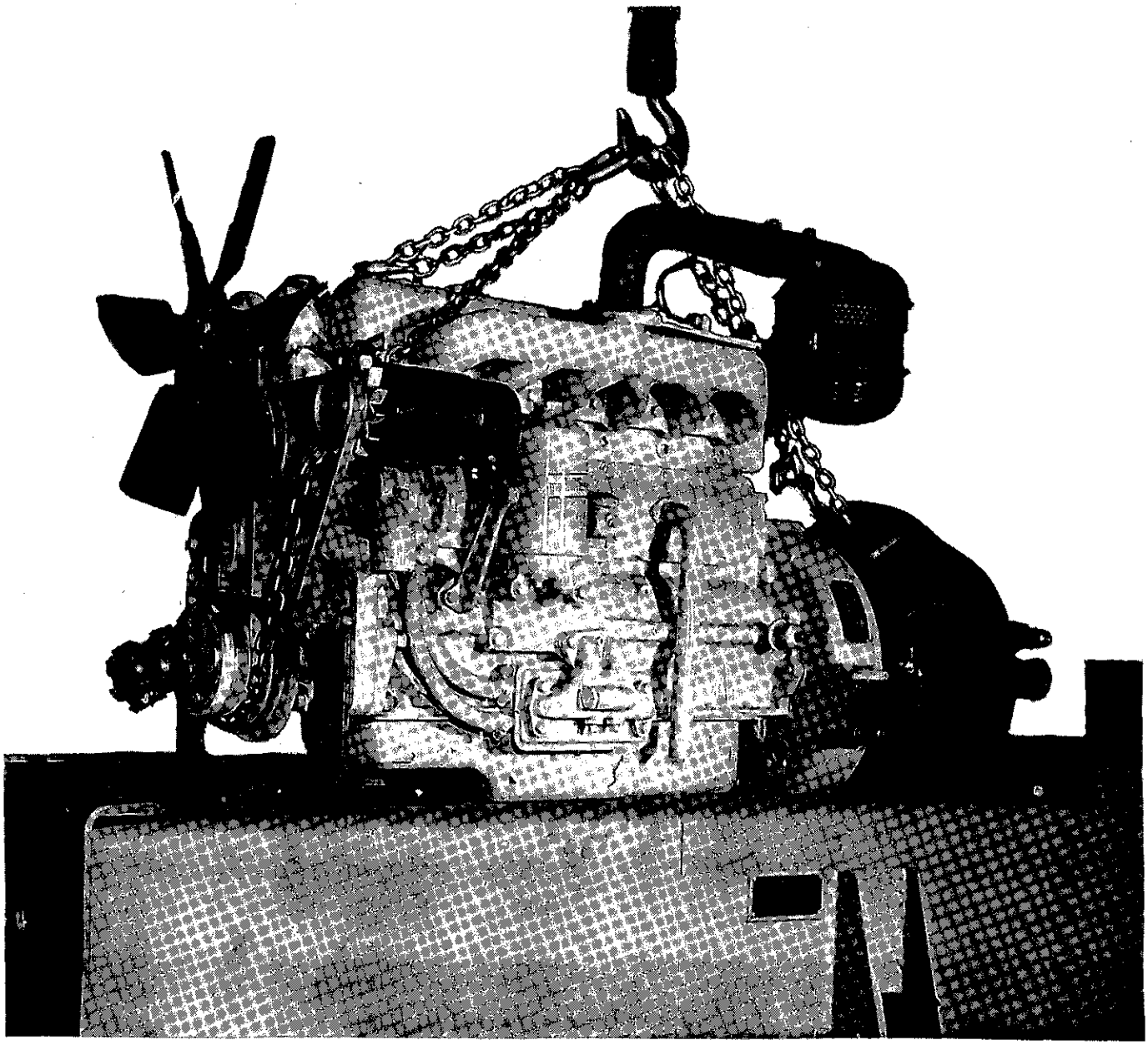
h. Clutch Brake Adjustment.

(1) First adjust the main clutch as previously described. (See page 86, paragraph A.)

(2) Be sure linkage and return spring have proper adjustment to prohibit brake drag when brake is fully released.

(3) Adjust linkage of clutch brake so that when top of clutch pedal is approximately 1-1/2" from floor, brake lining will start to contact drum. This will assure a fully disengaged clutch before clutch brake starts to become effective.

(4) Adjust clutch brake as follows: Close the engine throttle to near idling position (about 700 engine RPM). Set adjustment so transmission gears will come to a rolling stop in three or four seconds.



5. REMOVAL OF ENGINE WITH TORQUE CONVERTER.

a. Boom must be crosswise of crane so boom or counterweight does not obstruct the removal of the engine. The front wheels must be turned as far as possible so additional room is gained to remove the transfer case assembly.

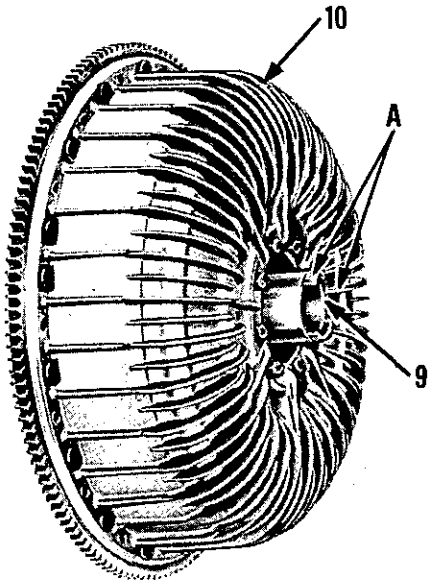
b. Drain radiator and remove hood and radiator.

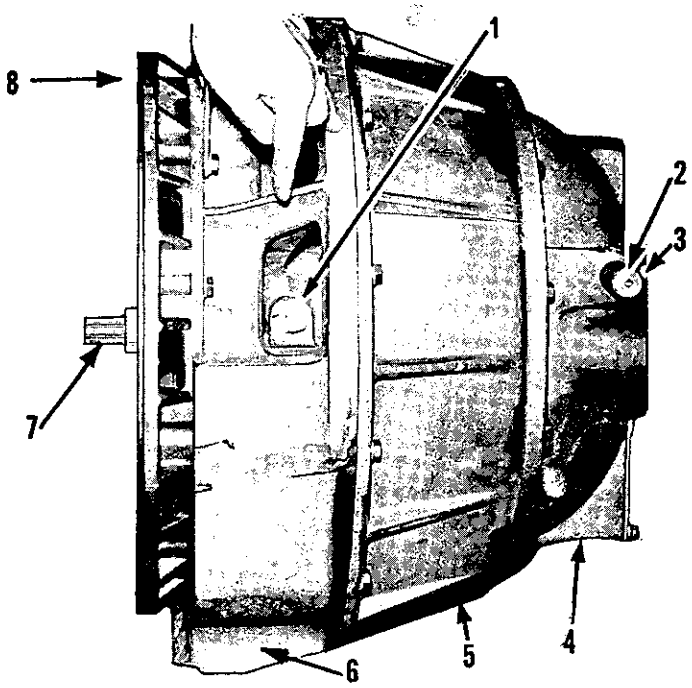
c. Loosen front end pump drive at joint. Slide yoke toward pump as far as possible. Remove pump belt from small pump by following procedure outlined on page 85, paragraph 3.

d. Unhook engine controls. All electrical connections on engine (be sure to disconnect battery terminals first) must be disconnected and left with the harness to the dash panel. Remove air cleaner tube from cleaner to carburetor so it will clear exhaust pipe.

e. Remove engine mounting bolts, exhaust pipe connection, clutch propeller shaft to transmission, and clutch brake linkage.

f. Disconnect clutch release shaft extension through hole in side of frame. Engine can now be slung and removed from the frame.





6. TORQUE CONVERTER.

a. The above photo shows the converter (Borg and Beck) with reservoir and clutch group. The converter is a 3-element, 12" unit. Torque ratio at stall is 2.12 to 1. It is cooled by air as well as oil to water heat exchanger. (See page 95) The oil capacity, including heat exchanger, is 15 quarts of type "A" automatic transmission oil. (This converter is similar to the Borg and Beck converters as used in Ford trucks; however, the Ford converters and charging pumps cannot be used with A-W cranes.)

1. Item (8) is a bolted in place adaptor.

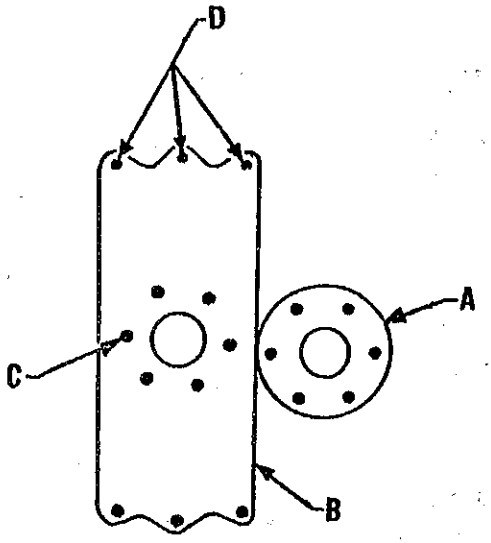
2. The clutch release shaft is shown at (2). There are 2 grease fittings (3) which provide lubricant to the cross shaft. One stroke of lubricant every 40 hours of operation.

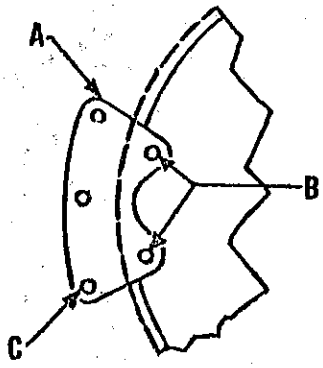
3. Item (4) is the clutch bell housing.

4. Spacer (5) is located between the clutch bell housing (4) and item (6) which is the torque converter oil reservoir housing.

5. The shaft (7) enters into the converter at (9). The adaptor flange (8) bolts to the engine bell housing.

6. Item (10) is the Borg and Beck Converter assembly. The charging pump driving tangs are shown at (A).





b. The Ford-332 engine has a conventional flywheel and the converter is driven by means of a bolted in place flange and plate, see above.

The flange (A), locates against the Ford—332 crankshaft. The plate (B), locates against the flange (A). Six bolts pass through plate (C) and (A) and screw directly into the Ford-332 engine crankshaft.

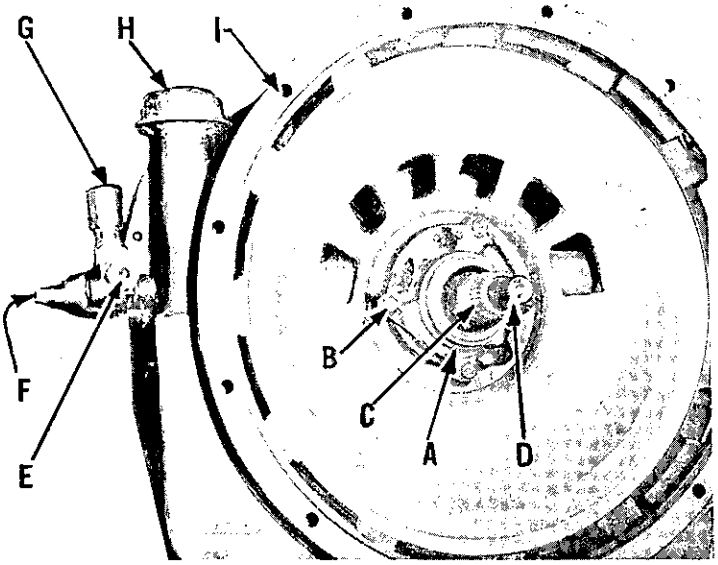
The pilot end of the converter, slips directly into the flange, in the bore (A).

Six converter outer rim bolts enter into the six bolt holes (D), (see above). The converter is attached to plate (B) by use of a suitable socket wrench and reaching thru the electric starter opening. The six nuts should be cottered and locked in place.

c. The IHCo. UB-264 and UD-282 engines have a conventional flywheel and the converter is driven by means of 9 driving plates (A), see above.

The plates are attached to the flywheel in sets of 3, by 9 bolts with spacers between the plate and flywheel. The converter is then attached to the plates by 6 studs and again there are spacers between the converter and the plates. The nuts on the 6 converter studs are accessible thru a hole in the front side of the engine flywheel housing.

This is accomplished by using a suitable socket wrench, inserting same thru the opening into the holes in the flywheel. Hug lock nuts are used to secure these together. See also (X), bottom of page 93.



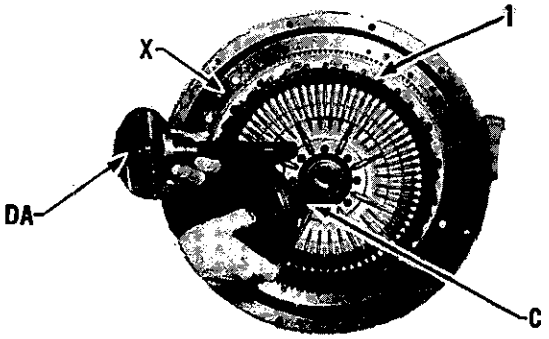
d. The above photo shows the Converter Side of the Reservoir Housing.

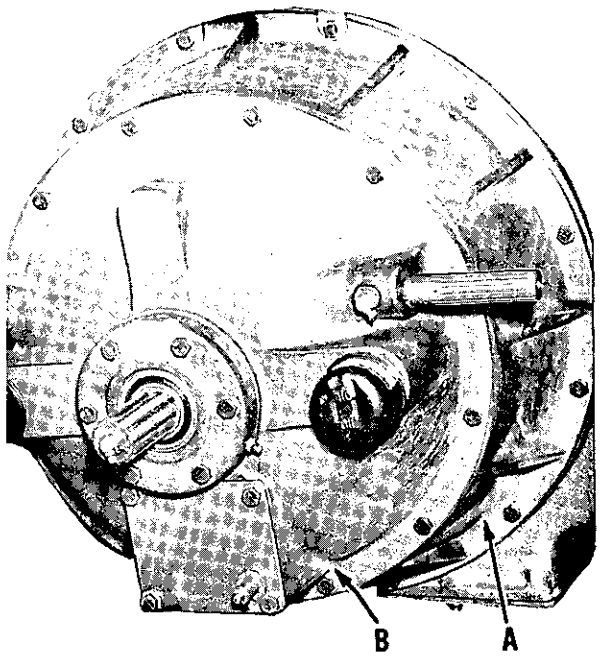
(A) is the converter oil pump.

(B) The four capscrew holes (B) are unequally spaced and this prevents incorrect assembly. Torque on the pump mounting bolts at assembly time is 17 to 20 ft. lbs.
Warning! Failure to comply will result in the pump internal gears locking and breaking the driving tangs at the converter, see (A), page 96. The end clearance at the internal pump gears is .001 to .002. Do not reduce this clearance. Do not add shims.

(C) is the stationary end of pump.

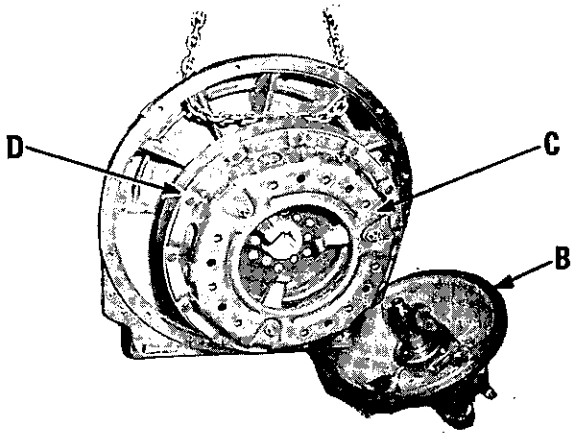
(D) is the spline driven shaft. It internally engages the converter turbine. See (DA) in lower photo.





e. The above photo shows the Clutch Compartment Group.

(A) is the converter housing to clutch spacer.
(B) is the clutch bell housing.



f. The above photo shows the bell housing (B) removed. This can be accomplished when the engine-converter as a group, is assembled to the crane.

1. The clutch flywheel (D) is shown above. It bolts to the flange of driven shaft. See (DA) in left photo. To remove the shaft, remove the six "place" bolts and flywheel (D). Remove six cover bolts back of flange (DA). Then pull the shaft out of the housing.

2. The clutch (C) (above photo) is 14" in size.

3. For complete clutch and clutch brake adjustment, removal and reinstallation, see pages 86, 87, 88 and 89.

g. Testing Converter Oil Level.

The reservoir capacity is 15 quarts (initial fill at the factory) including converter. Converter cannot be drained. Use type "A" Automatic Transmission Oil.

The oil reservoir should be drained every 500 hours of operation.

Refill with type "A" oil, bringing oil level up to bayonet gauge full mark. Remove gauge; see (H), page 93. Start engine, idling it slowly for one minute, then stop the engine. Recheck oil level, add oil as required, and retest as many times as necessary to establish full mark, bayonet gauge reading.

Check oil level every 8 hours of operation.

h. Testing Converter Pump, Oil Pressure.

When the engine and converter are assembled in the crane mainframe, the converter oil pump high pressure may be tested as follows:

Through a ported hole (side of housing) shown at right upper photo page 91, remove plug(1)and connect a flexible hose (with a 100 lb. pressure gauge attached) to the threaded opening.

Shift the transmission into neutral speed.

Start engine to warm it up, also to warm up the oil in the converter system.

Run the engine at wide open throttle. The oil pressure (hot oil) at the gauge, should show approximately 40 psi., provided there is the proper amount and quality of oil in the reservoir.

If the gauge shows very little pressure, stop the engine. Drain the oil from the converter reservoir. Remove the following parts as shown on Page 96, namely, cover (14), gasket (13), and screen (12).

Oil is delivered to the suction side of the oil pump by the screwed-in suction pipe (15). The upper end of this pipe terminates at the port (X).

Fill a quart can with clean type "A" Automatic Transmission oil and slip the open end of the can upward into the reservoir and over the lower end of suction tube (15).

Request some one to shift the transmission into neutral travel speed and solidly lock the brake.

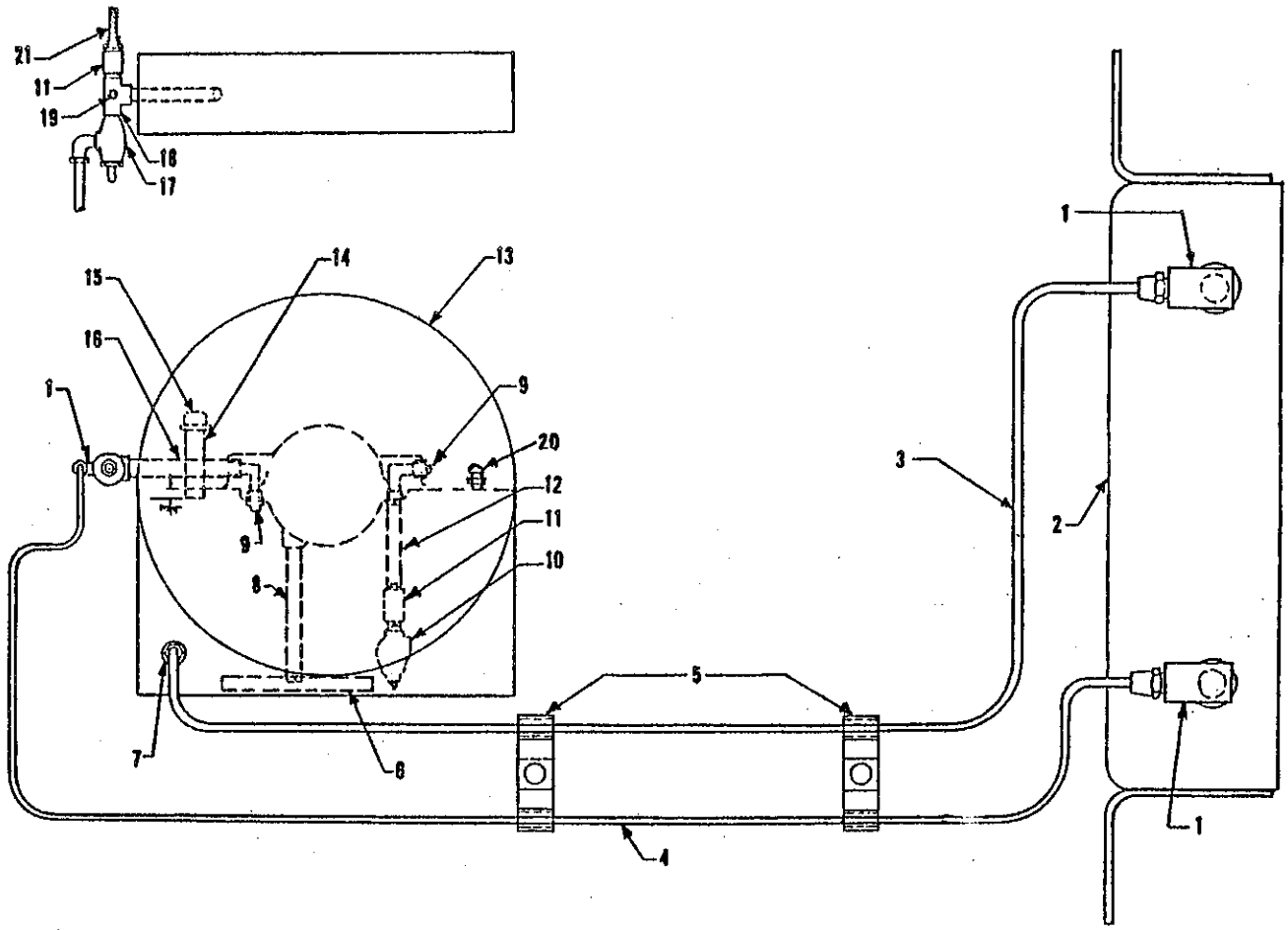
Then run the engine at about 1/2 throttle for one minute, then stop the engine and lower the can to observe if the oil pump vacuum has lifted the oil out of the can.

If the oil in the can is at the approximate level that it was at the start, then the converter oil pump driving tangs (A), page 96, are more than likely sheared or broken off, due to the inner pump gears galling or locking.

This type of failure is usually caused by unclean or heavy oil being poured into the system at filling point (H), page 93.

Over-tightening the four bolts (C) page 96, beyond safe torque, namely, 17-20 ft. lbs., can also cause the pump gears to lock, and result in the tangs (A), page 96, shearing off.

In a case of this kind, the engine-converter as a group must be removed from the crane.



BORG AND BECK TORQUE CONVERTER COOLING SYSTEM

1. TORQUE CONVERTER AND RESERVOIR REMOVAL.

1. The engine, with converter, must be removed as a group from the frame.

Before removing the engine group, drain the oil from the reservoir by removing the lower drain plug (1) page 96. Remove lower cover (14), and screen (12).

2. Remove the bolts at rim (B) page 93, and slip the clutch bell housing out of the clutch (C), if inspection of clutch is desired.

3. Remove the 12 engine to reservoir bolts (D) at outside flange, page 96.

To prevent oil leaks at the threads, these bolts must have a copper washer behind each bolt head. They are installed from the inside of the reservoir.

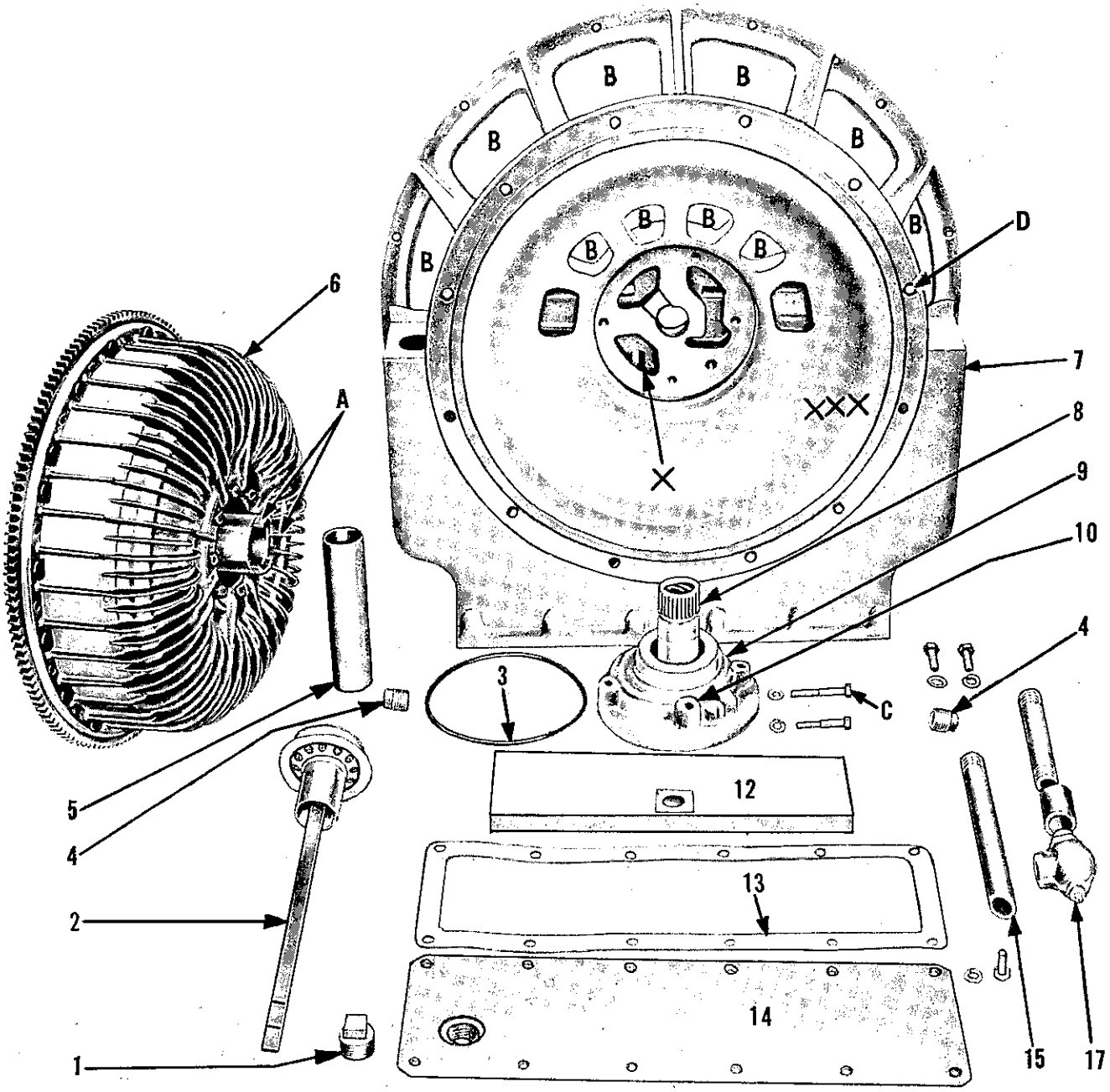
The reservoir (7) may now be carefully pulled endwise away from the converter (6).

4. Remove the electric starter from the Ford engine, and through the bell housing port remove the converter drive plate attaching nuts. (The drive plates are bolted to the converter.)

WARNING: If the converter has been operated with a faulty type of oil, or quantity of oil, or debris mixed with the oil, there is danger of the oil pump locking internally and causing the two oil pump drive tangs (A) page 96, to shear off.

When this happens, the oil supply from the reservoir to the internal part of converter will be cut off completely, and on running the engine or moving the crane, the complete converter will generate intense heat.

The crane will not move as it should because the internal converter rotors will not be charged with an ample oil supply.



j. DISMANTLED CONVERTER-RESERVOIR GROUP.

1. Reservoir drain plug.

2. Bayonet oil level gauge and breather cap.

3. "O" ring for back of flange of oil pump (9).

4. Plugs.

5. Riser for bayonet gauge (2).

6. Converter. Unless the converter is operated without a full supply of fluid oil, it will require no service or dismantling. If in doubt contact the A-W Works, Aurora, Ill., attention Service Department, for advice and procurement of a completely assembled converter.

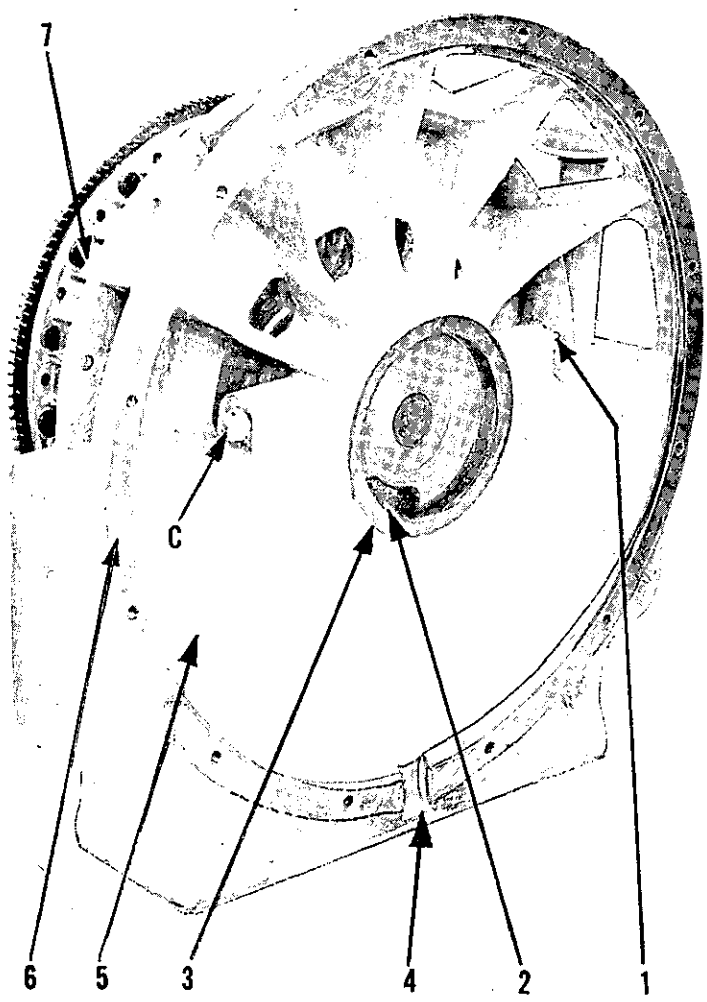
7. Reservoir housing.

8. Stationary splined end of oil pump (9).

9. Oil pump. Consists of items (8), (9) and (10). Unless the oil pump is operated without a full supply of fluid oil, it will require no service or dismantling. If in doubt contact the A-W Works, Aurora, Ill., attention Service Department, for advice and procurement of a completely assembled oil pump.

10. The four unequally spaced bolt holes in the oil pump cover (10), cannot be incorrectly assembled to the center location shown in the reservoir housing (7).

It is essential that these bolts be evenly tightened to 17-20 psi. with a torque wrench.



k. The above photo shows the clutch end of the converter reservoir housing.

1. This is the location where the 30 lb. low pressure relief valve and pipe arrangement screws into the housing. See (F), page 93, top left photo.

2. This locates where excess converter oil drains back into the lower part of the reservoir.

3. A cover and seal group bolts against this flange. The seal prevents oil from passing into the clutch compartment.

4. This slot permits drainage to the ground and prevents oil-water contamination to the clutch group.

5. This is the converter reservoir housing.

6. This is the face against which the clutch bell housing is bolted.

7. Converter.

ℓ. See reservoir screen (12), page 96.

The pump suction pipe (15) screws upward into a threaded port (X) located inside the reservoir, and the lower beveled end of the pipe (15) extends into the hole located in the top of the screen itself.

The upper threaded end of suction pip (15) empties into port (X) shown near the center of reservoir (7), page 96.

The oil screen (12) cannot move upward beyond the bosses cast inside the reservoir.

m. The high pressure relief valve (17) page 96, with fittings, screws upward into the inside of the reservoir (7), near (XXX page 96. The unloading pressure is 50 psi

On the Crane, oil pressure test procedures are shown on page 94, paragraphs G and H.

Do not conduct a pressure test until it has been first determined that the reservoir bayonet gauge oil level is at full mark (engine stopped), also that the oil in the system is of the proper grade of clean oil; namely, type "A" Automatic Transmission Oil.

n. 50 psi. high pressure relief valve test when valve is removed from the Crane. This valve is item (17), page 96.

1. Drain the oil from converter at plug (1).

2. Remove cover (14) and screen (12).

3. Unscrew valve (17) from the pipe coupling.

4. Provide suitable air test apparatus, namely-

Not less than 75 psi. air supply to the high pressure side of an adjustable pressure regulator, (similar to an oxygen regulator).

Connect a hose to the low pressure side of the adjustable pressure regulator.

Attach the male threaded end of the relief valve (17) to the end of the low pressure hose.

5. Gradually adjust the regulator to raise the air pressure to 50-55 psi. as observed at the pressure regulator dial gauge. If the relief valve spring tension is correctly adjusted, the movable valve in the relief valve will lift from its seat, permitting air to lightly escape from the female opening of the relief valve.

6. If the converter has been operated with a faulty type of oil, or quantity of oil, or debris mixed with the oil, the internal seats of the relief valves may have been damaged beyond repair and require complete valve replacement.

7. If re-lapping the internal valve seats proves unsatisfactory, install new valves. Always test new or salvaged valves for proper unloading pressure.

8. Finally, relock the nut at the adjusting screw, then reinstall the relief valve group into the reservoir in the correct position, (XXX) page 96.

9. Next replace the screen (12), gasket (13) and cover (14). Replace plug (1) and refill the reservoir, following the instructions shown on page 94, paragraph G.

10. Restart the engine for running test.

o. 30 psi. Low Pressure relief valve test when valve is removed from the crane. This valve is shown at the upper left photo, item (F), page 93.

1. Unloosen and remove the hot oil to cooler pipe (E). Loosen and remove the oil temperature gauge fitting (G).

2. Hold the inner long nipple with a suitable tool to keep it from unscrewing from the reservoir, then unscrew the valve group (F).

3. Attach the male threaded end of the relief valve to the end of the low pressure hose at the adjustable testing regulator.

4. Gradually adjust the regulator to raise the air pressure to 30-31 psi. as observed at the pressure regulator dial gauge.

If the relief valve spring tension is correctly adjusted, the movable valve in the relief valve will lift from its seat, permitting air to lightly escape from the female opening of the relief valve. Relock the nut at the adjusting screw.

5. Reinstall the valve, see paragraph 2. Reinstall parts, paragraph 1. Recheck the oil level in the reservoir.

6. Restart the engine for running test.

7. TRANSMISSION AND TRANSFER CASE. (Refer to photo, page 89.)

a. General.

If internal repairs are to be made, then the assembled transmission and transfer case should be removed as a group from the tractor frame.

Before dismantling, if the machine is in operating condition, it is best to drain the gear oil from the transmission and transfer cases and refill them with flushing oil (kerosene or diesel fuel) and run the machine slowly back and forth for several minutes. It is best to drain this first washout; refill with clean flushing oil, and repeat. In this way the second washing will usually get everything clean and free of oil.

CAUTION: Do not use gasoline as there is danger of explosion and fire.

b. To Remove Transmission With Transfer Case from Tractor.

(The engine, radiator and upper crane structure need not be disturbed or removed from the main frame.)

1. Remove propeller shafts from transfer case drives.

2. Remove transfer case grease filler nipple and elbow which goes thru the rear plate of operator's station and screws into transfer case.

3. Remove clutch brake linkage and controls completely to avoid damage to them. Remove hand brake control cable and hydraulic brake line to transfer case brake.

4. Shifter controls must be removed from the frame at transmission to allow controls to clear transmission. Also loosen controls at drive position. Also disconnect transmission main shift rail from shift lever by loosening set screw that holds lever to shift rail. Slide lever off rail. Pull forward and reverse shift lever out of shift rail groove and away from transmission.

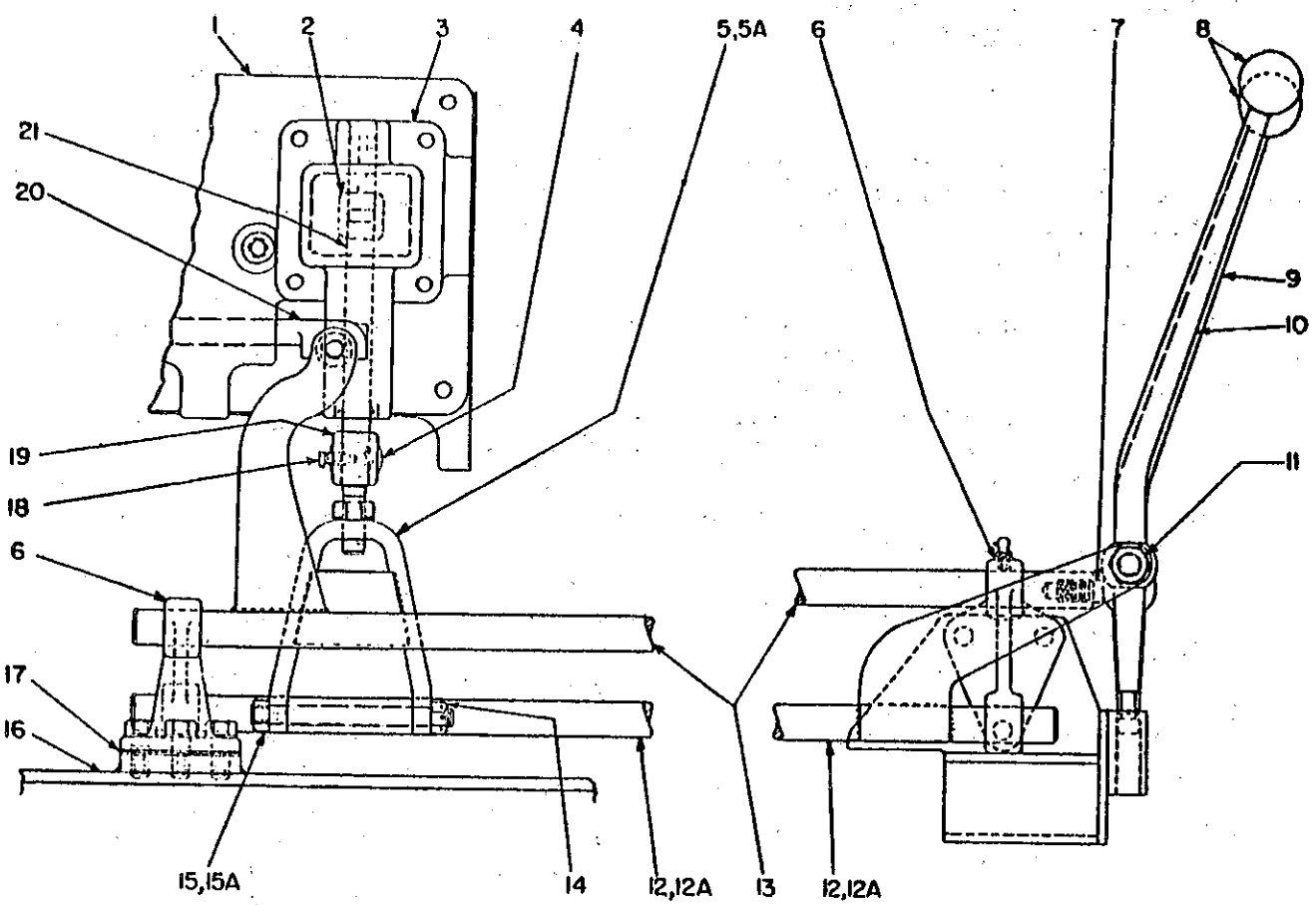
5. Remove shielding behind driver's seat that covers transfer case brake drum to allow more space to move transmission and transfer case forward.

6. Some means must be used to lower or support the transmission and transfer case assembly when mount bolts are removed. A transmission jack, or wheeled floor jack, can be used if a plate is fastened securely to jack pad; this in turn must have legs or brackets welded to it that will bolt to the transfer case and a support inserted under transmission case. When a suitable stand for lowering or supporting this assembly is ready and fastened in place, remove the mount bolts in transfer case. Remove the two bolts that go thru supports welded to inside of the frame. Remove the four mounting bolts on rear support for the transmission. By tilting this support and lifting the entire assembly, it can be moved forward to clear transfer case supports. Care must be taken to be sure the shifting controls are free before lowering the assembly to the floor.

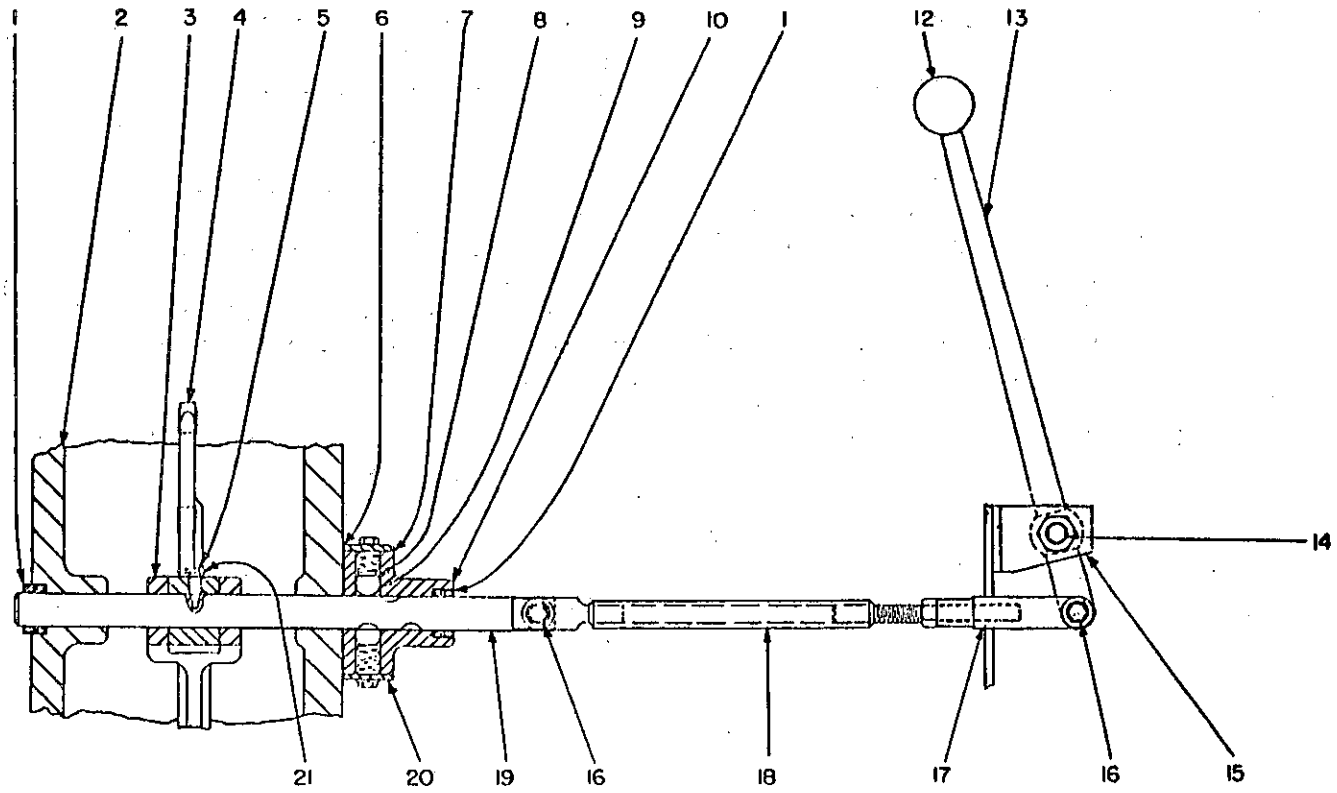
7. When the assembly is on the floor, the front end of the crane must be raised 18 or 20 inches so assembly can be moved out in the clear. Raising of the machine is necessary to clear the tank and step that extend below the frame on both sides.

8. To reassemble in tractor frame, reverse above procedure.

9. To remove the transfer case from the transmission, it will be necessary to first remove entire unit from tractor as described above.



8. The above shows the Three Speed Transmission Shift Linkage. (See page 105 paragraph 17, for transmission illustration.)



9. The above shows the Two Speed Transfer Case Shift Linkage. (This is not used on the single speed transfer case shown on page 102, paragraph 13.)

10. TRANSFER CASE DISASSEMBLY. (Single Speed, see page 102.)

The single speed transfer case (2-wheel front drive for 3 speed transmission) is attached to the machined rear face of the transmission. This case pilots over the outer race of the end bearing (43) on top transmission shaft. Nine large studs (17) hold the transmission and transfer cases together with an oil-tight gasket (18) in between.

After the transmission and transfer case group is removed from the tractor, proceed as follows:

a. Remove lock and bolt (12) from center of the brake drum at transfer case. Also nuts (19). Remove drum (9).

b. Remove all nuts (23), thus enabling the brake back plate (8) with flange (4) to be removed as a unit. Be careful not to allow oil seal (14) in brake drum hub to drag on keyway in transmission main shaft as it will cut it.

c. Remove upper transfer case gear (46) and spacer (45) by sliding them off the spline. (Note the way the radius on spacer was installed.)

d. Remove (pull off) transmission from transfer case, after first removing the nuts (17) with lock washers.

e. To inspect seal (7) remove snap ring (5) and carefully press hub (10) out of bearing (6). Inspect, clean, replace parts as required and reassemble parts with snap ring (5).

f. Remove the following: nut (26), yoke (28), cap with seal (30), cap (38). The shaft (39) can now be removed by driving it out (use a light hammer and bronze drift) either left or right.

11. TRANSFER CASE REASSEMBLY. (See page 102, illustration 13)

a. Clean, inspect and replace parts as required. Reassemble lower shaft parts as shown. (31) is a gasket. (42A), (B), and (C) consists of two gaskets and a set of shims. Shims may be added or removed as required to establish zero end clearance at the two Timken cups (41).

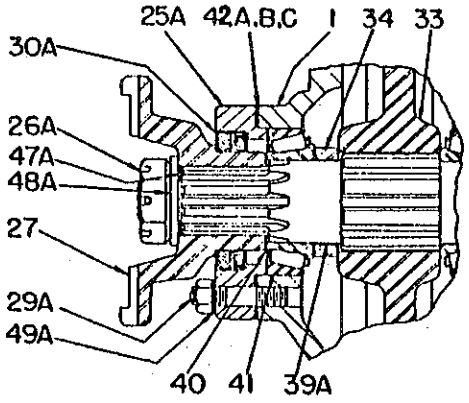
The nuts at (29) of course are the first to be tightened, very tightly, also nut (26). (Cotter it).

b. Rebolt the transfer case (1) to the transmission case at nuts (17) & gasket (18). Install gasket (24). Slip part (45) and (46) onto shaft (44), watch seal (14) and carefully slip group (4) over shaft (44).

NOTE: Oil port (A) must be turned up as shown in order for oil through (AA) to deliver oil to ball bearing (6). Carefully tighten nuts (23), (15) and capscrew (12). Lock (12) must be securely fastened and ears bent over in a solid fashion in order to prevent the capscrew from becoming loosened. Rebolt drum (9) to flange (10), thru nuts (19). For transfer case brake adjustment, see page 111, paragraph 25.

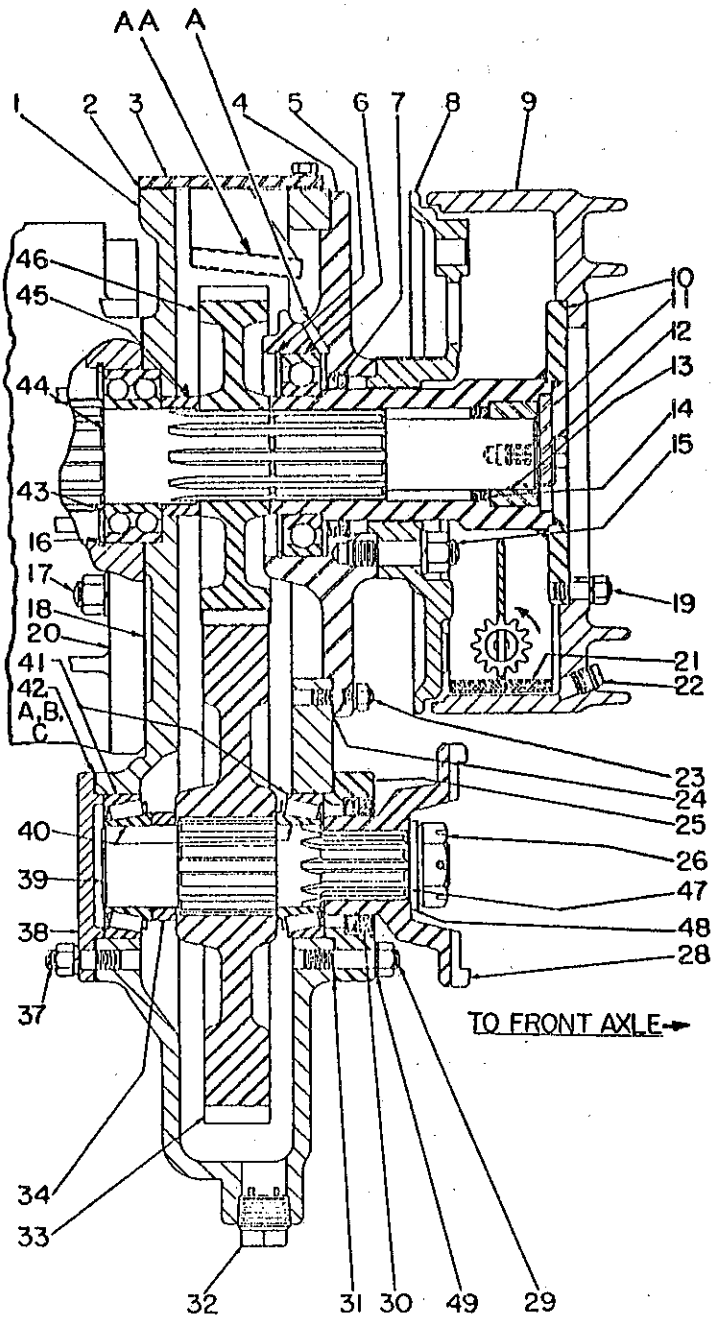
c. To assemble brake drum and casting as a unit requires considerable care. With a long punch, reach inside splined brake hub and remove the spacer (13). Be careful not to drive on oil seal.

d. Carefully place group (8) over main shaft until seal is almost to keyway in end of main shaft. Place a piece of shim stock over keyway and carefully slide group (8) into place. It may be necessary to work edge of seal (14) into place with a thin screw driver blade. (Be sure blade of screw driver isn't too sharp.) Inspect seal for cuts, and if it is OK, push group (10) and drum into place and bolt tightly. Be sure to put spacer (13) in properly and lock in place with bolt (12). Transmission and transfer case is now ready to assemble to crane. When hydraulic brake line is connected, it is necessary to bleed the brake system thoroughly. It may require bleeding of the wheel cylinders also.



12. The above illustration shows a longer, lower transfer case shaft (39A) and associate parts required, to provide drive to rear axle. Used only when crane is fitted with drive to all four wheels, and 3 speed transmission.

The reassembly instructions on page 101, paragraph 11, may be followed at (B) and (A), with the following exception. The bearing group with yoke (28) and nut (26) are to be tightened first. After the required amount of shims (42A, B or C) have been installed, the yoke group (27) and nut (26A) are to be tightened last.



13. The above shows the single speed transfer case group, used only with the 3 speed transmission, 2-wheel front axle drive cranes. (Uses short lower transfer case drive shaft (39).)

14. TRANSFER CASE DISASSEMBLY. (See 2-speed group, page 104)

The 2-speed transfer case (4-wheel drive, and 3 speed transmission) is attached to the machined rear face of the transmission. This case pilots over the outer race of the end bearing (56) top transmission shaft. Nine large studs (32) hold the transmission and transfer cases together with an oil tight gasket in between. Yoke hub (66) supplies power to the front axle, while yoke (50) supplies power to the rear axle. After the transmission and transfer case group is removed (see page 99, paragraph b) from the tractor, proceed as follows:

a. Remove nut (63), page 104, and pull hub and drum (21) off of shaft (64). Remove nuts (34) and pull brake plate (23) off of shaft (64). Remove nuts (14) and flange (22). Remove cover (16). Bend back lock plate (19) and remove the capscrew with plate (17). The following parts can now be pulled off of shaft (18); namely, ball bearing (60), narrow spacer (11), gear (7) with two ball bearings (8), and wide spacer (10) located between the bearings (8). To remove the parts inside gear (7) first drive out the bearing nearest spacer (11), then lift out the wide spacer (10). Next remove the snap ring (9) and finally press out the last bearing (8).

b. Remove the transfer case to transmission stud nuts (32) and slip the transfer case off the main shaft (18). Lift out gear (6), remove snap ring (5) at shaft (18), and gear (4) may now be slipped off the shaft.

c. Remove lock screw (21) inside the case shown on page 100, paragraph 9. This lock screw attaches the shift lever to the shift rail (19). Remove the shift rail and shifters (3) and (4). (See page 100 for shifting details, also spring (8), balls (9), plates (20) with capscrews.)

NOTE: There is a neutral position shift rail (19).

d. Remove nut (48), page 104, yoke (50), cap (52). Drive shaft (64) (use light hammer and bronze drift) to the left, toward large gear (43) so that snap ring (38) may be removed. Next use a light hammer with bronze drift and carefully drive countershaft (64) to the right and out of the case. Lift out gear (37) and snap ring (38), gear(39), large gear (43) and inner cone (54).

e. To remove bearings (55) from gear (43), proceed as follows: Push spacer (45) to one side; then with light hammer and bronze drift, drive through the bore and loosen; then carefully remove that bearing with spacer (45). The other ball bearing (55) may now be pressed out.

15. TRANSFER CASE REASSEMBLY.

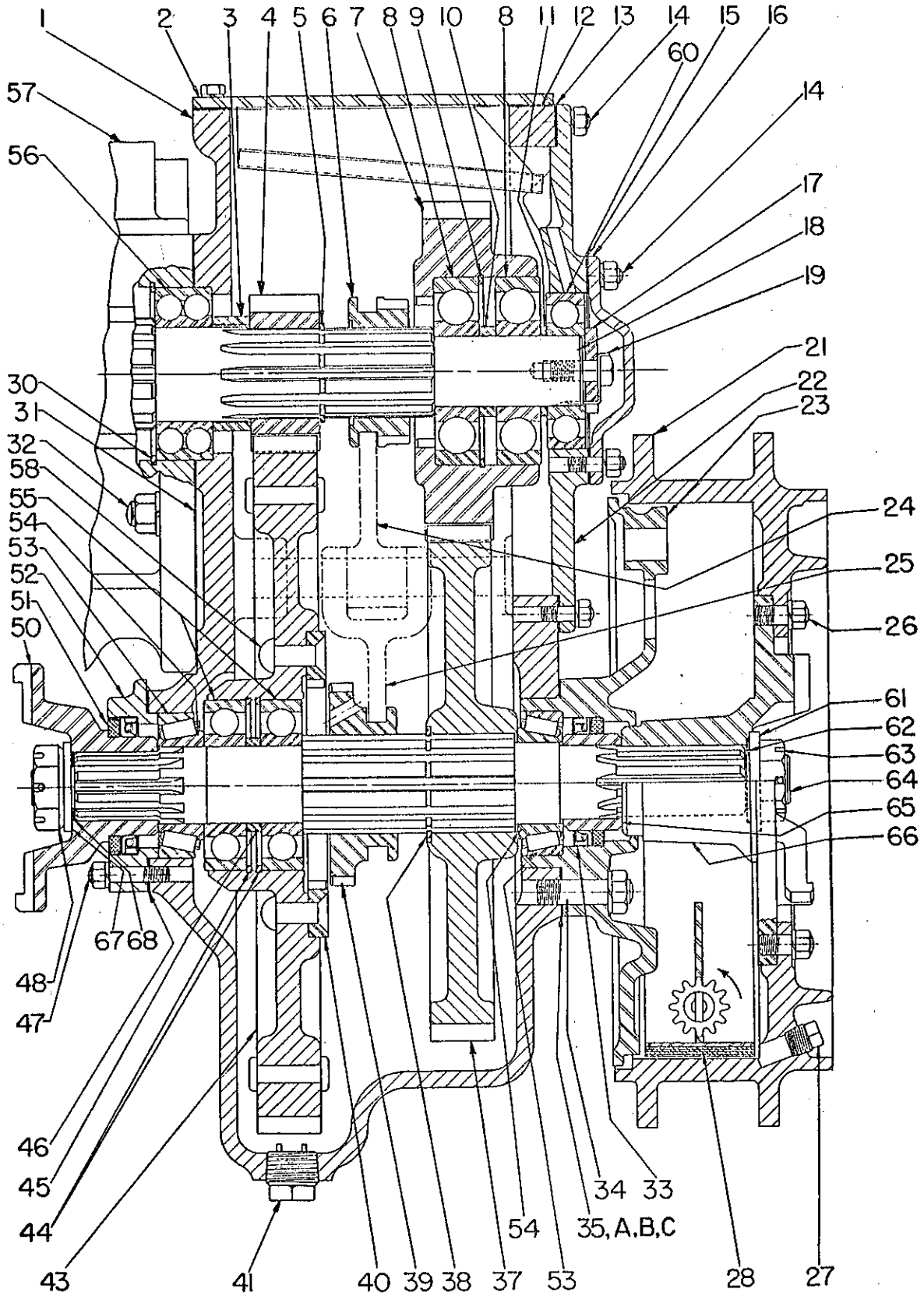
a. Clean, inspect and replace parts required. Proceed in reverse order to assemble. Be careful when slipping the snap ring (38) over the shaft (64). Do not bend or distort it. See that it drops clear down in a concentric way into its groove.

b. Remember during assembly that nut (63) must be tightened first and all the thrust is forced progressively against the snap ring (38) through the following parts: Yoke (66), sleeve (65), inner Timken cone (54), hub (37), and finally snap ring (38). The teeth of gear (40) face in the right direction, while those of gear (39) face left.

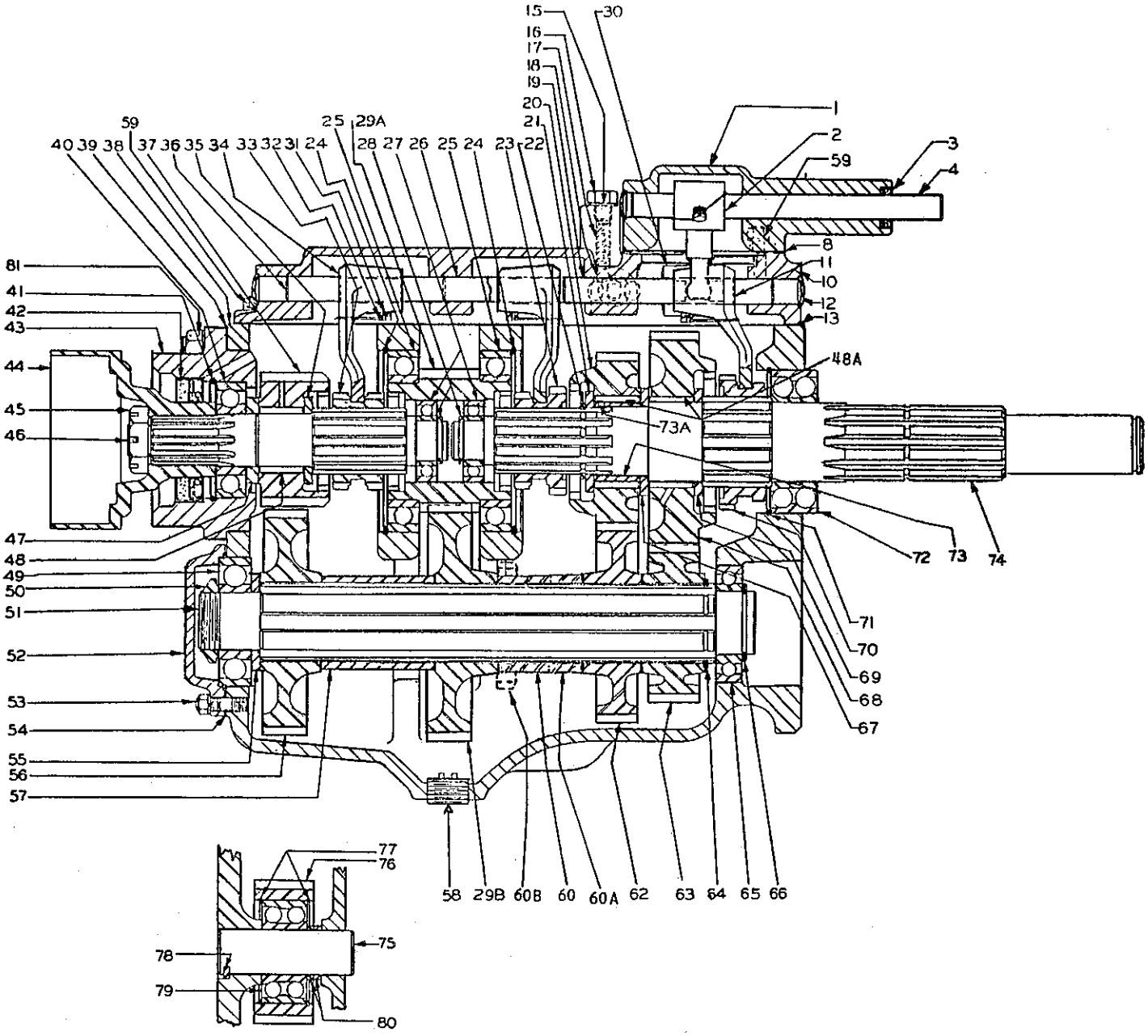
c. (46) consists of one gasket. Two gaskets are located at (35) together with a set of adjusting shims. Shims may be added or removed as required to establish zero end clearance at the two Timken cones (54). Left bearing (8) is held in place endwise by snap ring (9). The outer race of the right ball bearing (8) floats endwise, also bearing (60).

d. Bolt the transfer case to the transmission case at nuts (32), after installing gasket (31). The following parts are all locked and clamped together against the shaft shoulder by washer (17) and capscrew (19); namely, all three inner ball races and two spacers (10 & 11). The double row ball bearing (56), sleeve (3), and gear (4) are locked in place endwise by snap ring (5).

e. For transfer case brake adjustment and brake piping drawings, see page 109, paragraph 23, and page 108, paragraph 22.



16. The above shows the 2-Speed Transfer Case. (Used with 4-Wheel Drive and 3 Speed Transmission)



SECTIONAL VIEW SHOWING
REVERSE IDLER GEAR

17. The above shows the "Three Speed Transmission"

18. TRANSMISSION DISASSEMBLY.

After the transmission and transfer case are removed from the tractor, and the transfer case separated from the transmission, proceed as follows:

a. Remove propeller shaft joint from rear of transmission, also the clutch brake drum (Ref. 44). This is held on by a nut (Ref. 45). Care must be taken when removing this drum as it fits the splined shaft very tightly.

b. Remove cover (1). Remove cover (43) from the rear of transmission with gears (37) and bearings, as a unit. This can later be reassembled as a unit.

c. Remove snap ring (24) from center drive pinion (29A). Bearing (25) must be removed. It fits tight in the case bore and it cannot be pried out by using the gear as a pry point. Gear (29A) will chip very easily. Use a soft offset punch and drive against drive pinion group (29A), forcing the left bearing to move to the left. After this bearing is part way out of the case, you can then drive on outer race of bearing, thus forcing it all the way out of the case. Remove the drive pinion (29A) through the left bearing opening in case.

d. Remove small snap ring (28) from main shaft and carefully drive off main shaft bearing (27). This will allow you to remove high and 2nd speed shifter (23).

e. Next remove snap ring (22) from 2nd speed pinion and the pinion retainer (21). The main shaft may now be removed from the case by pulling it in the right direction. (The radius on the thrust washers (67) and (69) is later reassembled with the radius toward the right of the transmission case.) At this time the eighty four needle bearings (forty two in each gear) will have to be accounted for.

f. Next remove the countershaft cover (52) on the left end of the transmission. Remove the countershaft nut (50). To hold the countershaft, when removing the countershaft nut, wedge some soft material between the gears and the case.

g. You can now drive the countershaft toward the right of the transmission by using a brass drift punch.

19. REASSEMBLY.

a. Place countershaft in position and slide all parts into place as shown at illustration (17).

NOTE: The hubs on the low speed pinion (63) and 2nd speed gear (62) have a long end extending to the left. The countershaft drive gear (29B) and the reverse drive gear (56) have the long hub of the gear extending toward the right. (Note the radius on thrust washer (55) is turned toward the right.)

When gears are all on splined shaft, tighten countershaft lock nut (50). The proper tension on this nut is determined by the amount of drag on the two spacers on this countershaft. They should not be tightened completely, but sufficiently so each spacer (57) and (60) can be turned with your fingers. (Not a loose turn but with considerable drag.) It is necessary to bump each end of the countershaft (51) with a brass drift punch to get the bearings into place and thus allow the proper adjustment on the countershaft nut to be attained. This proper adjustment is very necessary to allow the gears to align properly and eliminate any transmission howl. When adjustment is correct, stake or lock the nut (50) in place, then replace countershaft bearing cap and gasket. (Permatex the gasket to prevent oil leakage.)

b. Reassemble the main shaft in much the same manner as used in disassembly. The needle bearings must be inserted in the low speed gear (68) first (forty two needle bearings) and then the spacer (67) and the 2nd speed gear (20). (Gear (20) also has forty two needle bearings.) Dowel (73A) and the hole in sleeve (73) are installed to the left side.

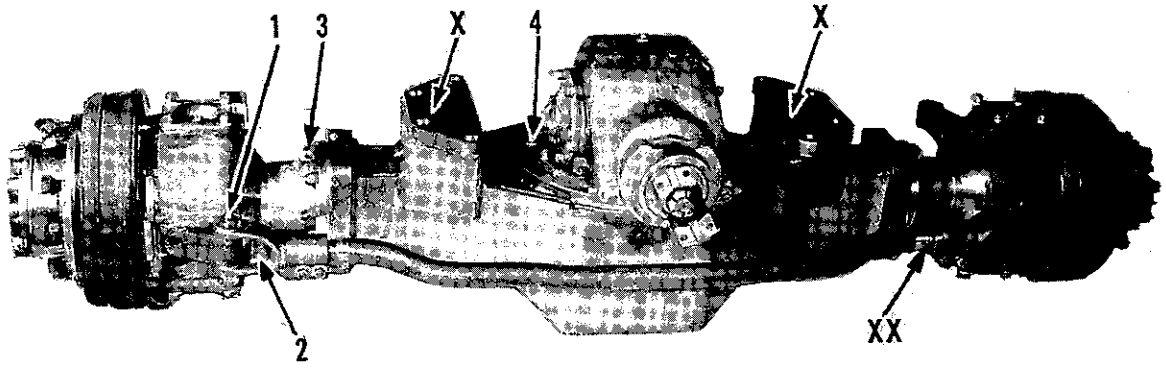
NOTE: The drive pinion group is a matched set of gears. They have been ground and then the teeth marked on each gear thus: "XX" and "X". The tooth on the gear with the "X" is to match the two teeth with the "XX". These marks are visible when looking into the transmission from the reverse idler gear end.

Be sure the snap ring (22) is in place on the 2nd speed pinion. Follow the assembling in the same routine as applied in the removal of the main shaft.

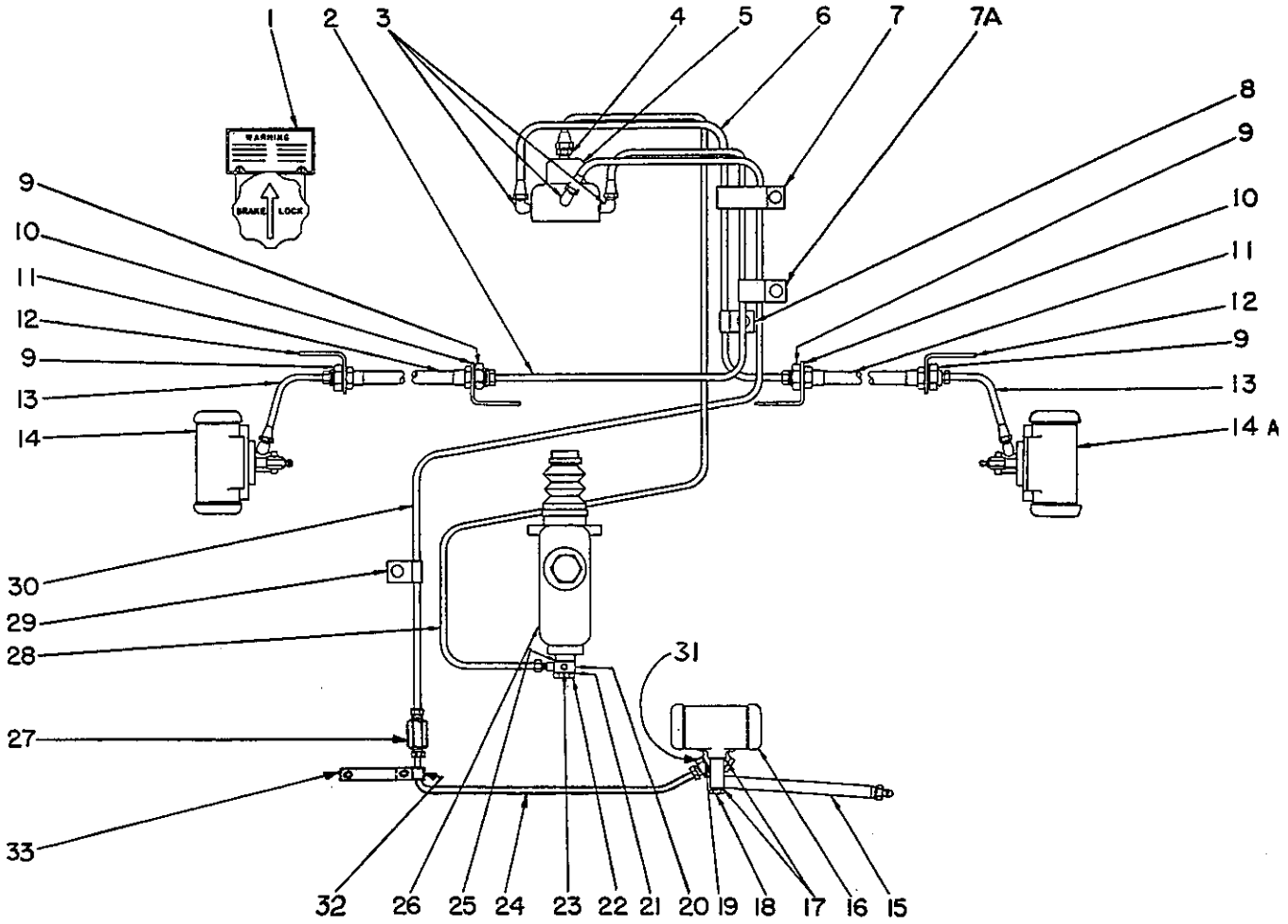
c. Reverse idler gear must be assembled with the two spacers (80) toward the center of the transmission case. (Both on the same end of the gear.)

d. Assemble transmission to transfer case and use new gaskets with Permatex wherever necessary.

e. The 3 speed transmission shift linkage is shown at (8), page 100.



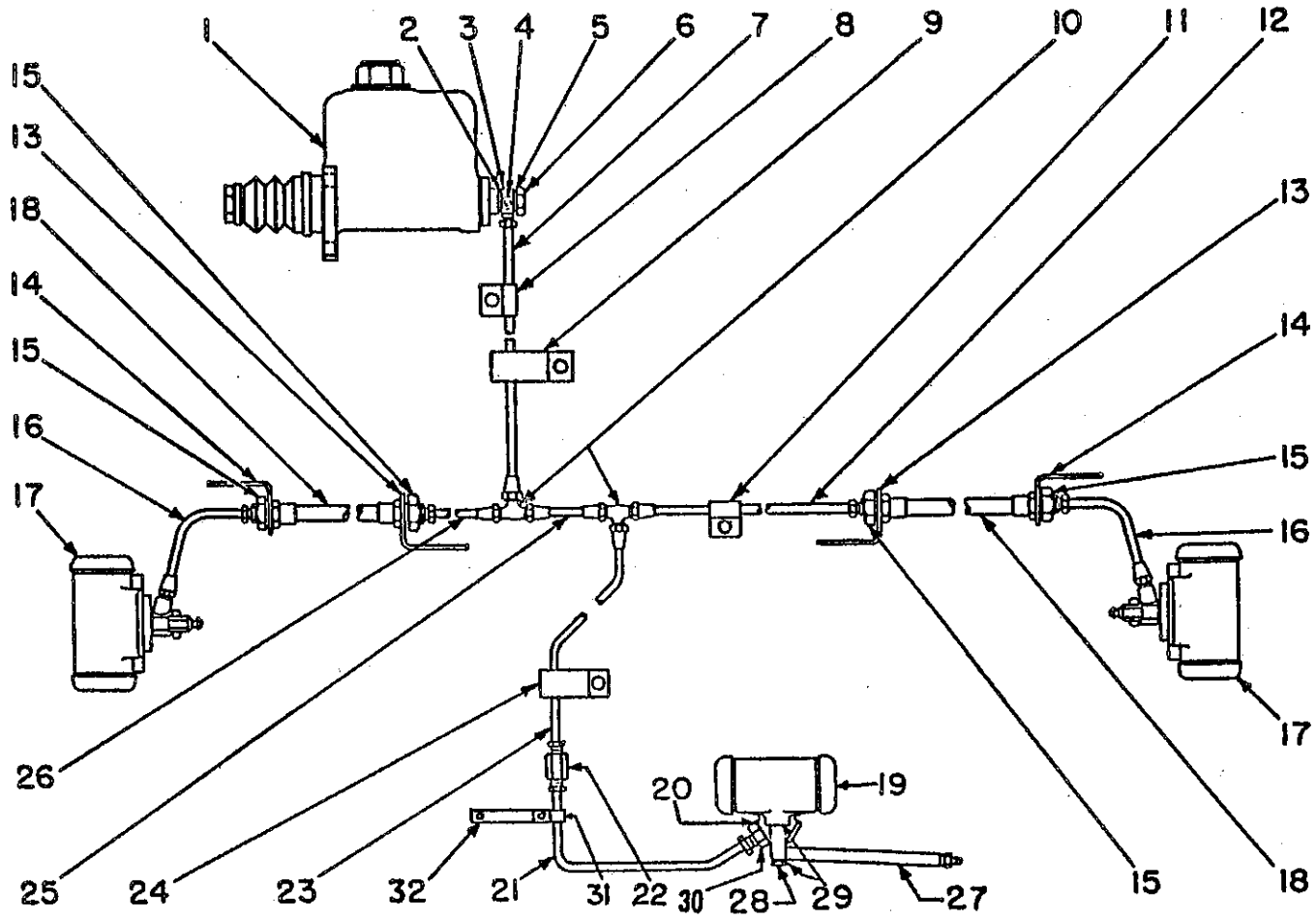
20. The Above Shows the Front Axle with the drive as used on all Cranes.



21. The Above Illustration Shows the 2-Wheel Front Drive Brake Piping. (See Page 110, Paragraph 24-a for Operation.)

References (1) and (5) show the selector valve group and data plate. (See Page 21, paragraph 2-c.) Reference (14)(two used) shows the right and left wheel hydraulic brake cylinders.

Reference (26) shows the master cylinde group. Reference (16) shows the transfe case brake cylinder. (See page 102, Ref (21); also page104, Ref. (28).)

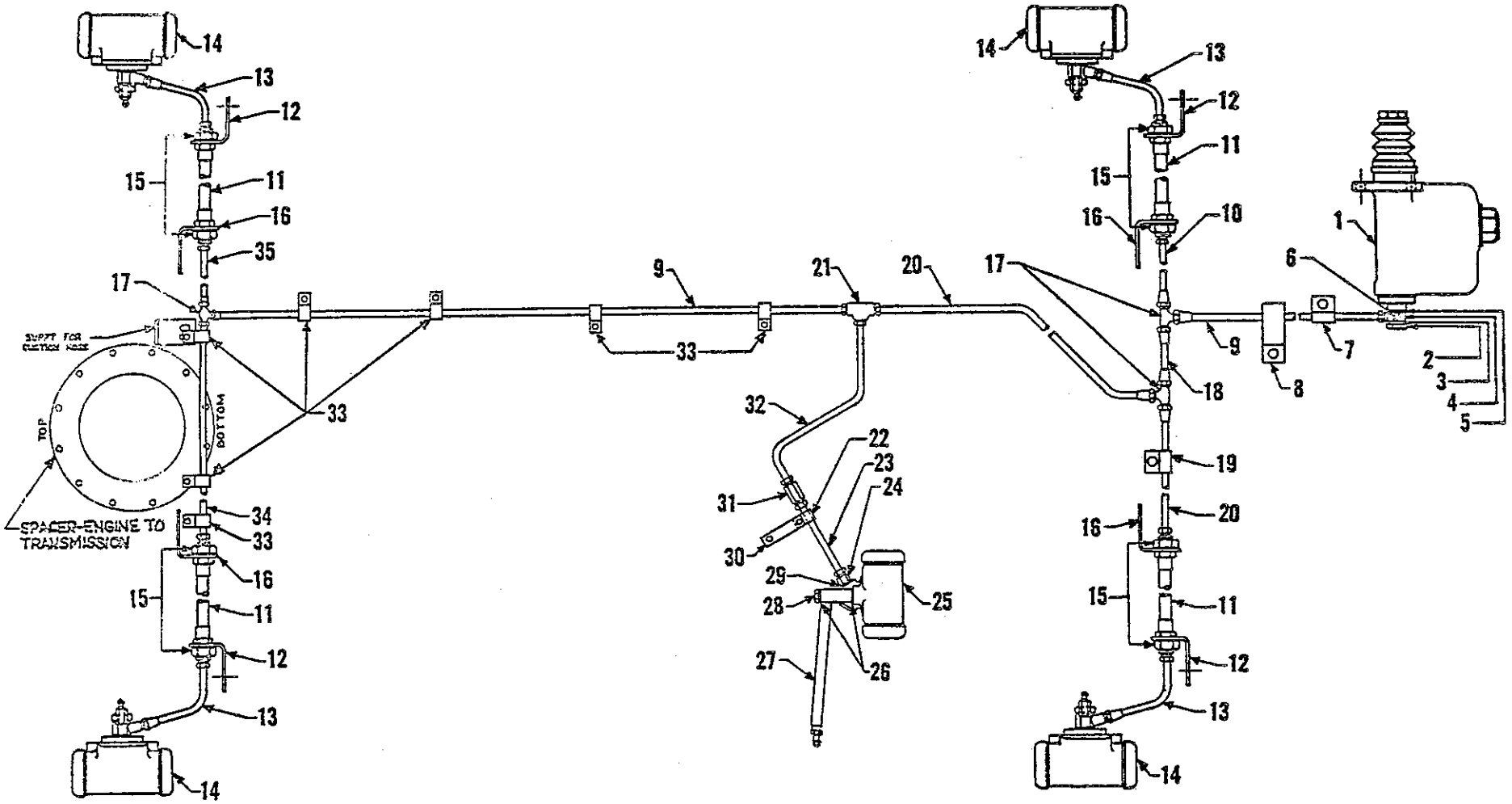


22. The Above Shows the Brake Piping Applied to Cranes Having 4-Wheel Drive, and Brakes on Front Wheels. (See Paragraph 24-a for Operation.)

a. Reference (1) shows the master cylinder group.

b. Reference (17) (two used) shows the right and left wheel hydraulic brake cylinders.

c. Reference (19) shows the transfer case brake cylinder.



23. The Above shows the Brake Piping Applied to Cranes Having Brakes on all 4-Wheels.

a. Reference (1) shows master cylinder group.

b. Reference (14) (four used) shows individual wheel cylinders.

c. Reference (25) shows transfer case brake cylinder.

24. HYDRAULIC BRAKE SYSTEM.

a. The wheel brakes and the propeller shaft brake utilizes a standard hydraulic system, having a compensating type master cylinder operated by a foot pedal and a brake actuating cylinder at the brake drum, together with the required piping, hose, and operating fluid. When a push is exerted on the foot pedal, pressure is created within the master cylinder, causing the column of fluid contained in the master cylinder, piping, etc., to move the drum cylinder pistons, which in turn forces the brake shoes into contact with the brake drum.

When the foot pedal is released, the brake shoe return springs retract the brake shoes and return the drum cylinder pistons to their normal or "off" position, thereby reversing the movement of the column of fluid within the system so that it flows back into the master cylinder.

b. Brake Foot Pedal Adjustment.

The foot pedal should be adjusted so there is approximately 2" of free movement at the tread portion of the pedal before the pressure stroke begins. Should the master cylinder link be adjusted so there is no backlash in the foot pedal, the master cylinder piston and cup may not return sufficiently to uncover the internally located master cylinder compensating port (X) (see page 115), which may cause failure of the brake to fully release.

If the brake does not fully release, the frictional drag will cause the fluid to further expand as its temperature is raised. This expansion of build will cause an increase in brake drag and may, in extreme cases, result in self-application of the brake to the point where the vehicle cannot be moved until the pressure is relieved, either by bleeding, or allowing the fluid to cool.

c. Bleeding the Hydraulic Brake System.

Whenever the hydraulic line is disconnected from the master cylinder, it will be necessary (after reconnecting the line) to bleed the entire hydraulic system at the three drum cylinders to expel any air that may have been taken into the system. Fill the master cylinder reservoir with genuine Lockheed or Delco brake fluid before bleeding the line. Keep the reservoir at least half full of fluid at all times.

Bleed the wheel brake cylinders first, and the propeller shaft brake cylinder last. To bleed the line, unscrew the hex shouldered portion of bleeder screw at the cylinder, three-quarters of a turn to the left and push pedal down slowly. This produces a pumping action which forces fluid through the tubing and drum cylinder, carrying with it any air that may be present in the line.

When air bubbles cease to appear, and the fluid stream is a solid mass, hold the brake pedal down and have a mechanic close the bleeder screw. Repeat this procedure at each of the remaining drum cylinders.

Fluid drained out of the system dur-

ing the bleeding operations should not be used again as it may contain dirt or foreign matter which may be injurious to the system. After drum cylinder is bled the supply of fluid in the reservoir should be replenished.

> CAUTION: Be sure to keep the reservoir half full of brake fluid when bleeding the brake system. Should the reservoir be drained during the bleeding operations, air will again enter the system and rebleeding will be necessary.

d. Brake Pedal Adjustment.

IMPORTANT: A distance of 9" from floor to top and center of brake pedal pad should be maintained when pedal is in the up position. Adjustment can be made by loosening set screw in pedal stop, located directly beneath floor board.

IMPORTANT: Always compensate for any adjustment made on pedal by adjusting linkage to master brake cylinder.

25. PROPELLER SHAFT BRAKE ADJUSTMENT.

a. Do not adjust brake when drum is hot. If the brake is adjusted when drum is hot and expanded, the shoes may drag when the drum cools and contracts.

b. There are two points for adjustment in a brake system of this type to compensate for normal brake lining wear. These points are the adjusting screw (6) and the anchor pin (15); see page 112. The adjusting screw takes up the clearance between the brake lining and the brake drum. The anchor pin serves to centralize the shoes.

c. To adjust Brakes to Compensate for Wear: Jack up one front wheel. Remove the four 3/8" pipe plugs (22) from brake drum (9) shown on page 102.

Release brake. Revolve wheels, causing brake to rotate until arrow that is cast into the brake drum (9), page 102, points down. Thru lower right hand 3/8" pipe plug hole in brake drum, insert a pry between the lining of the shoe and the brake drum, and move the shoe assembly until the other shoe is against the drum.

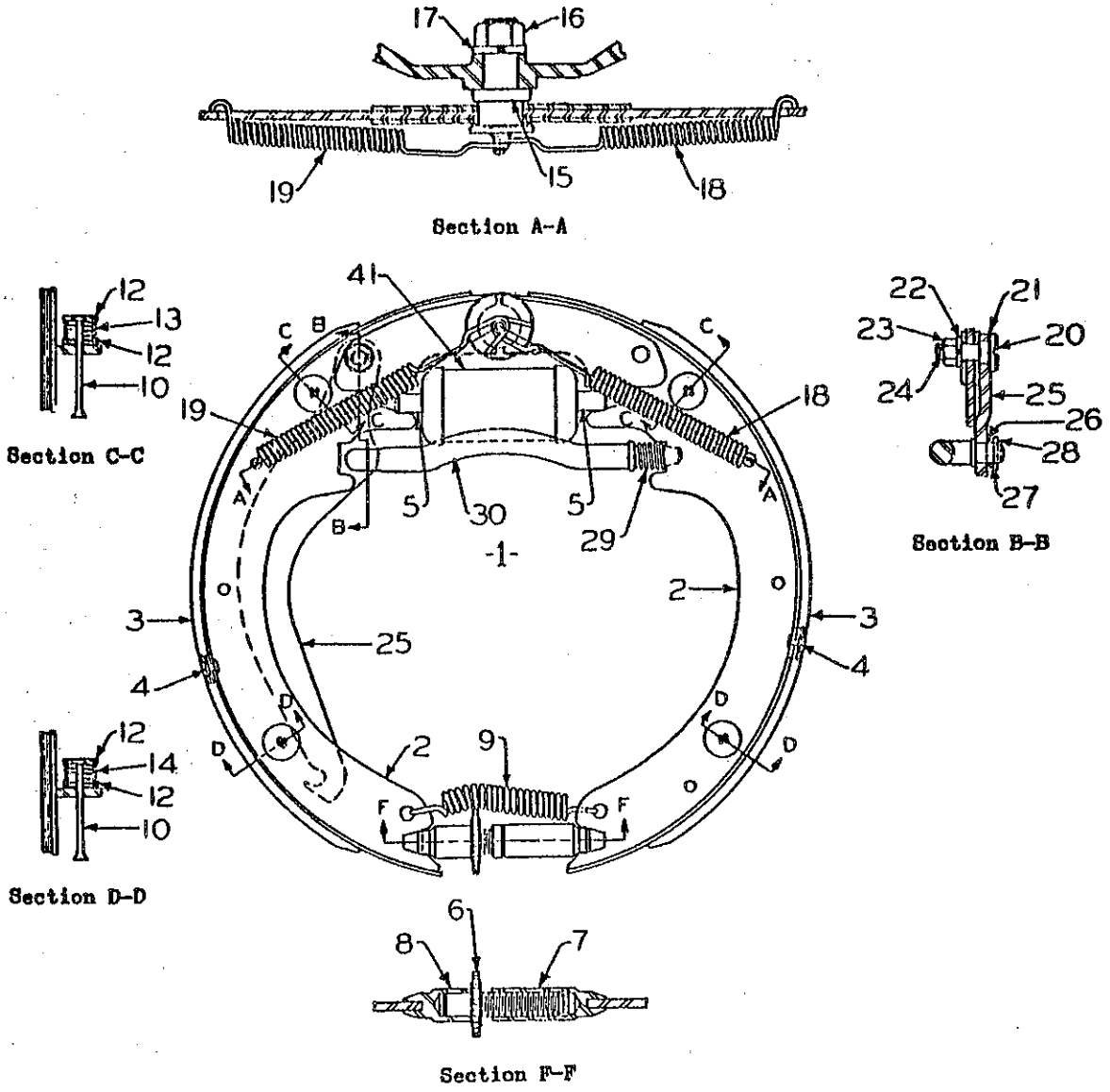
Insert .015" feeler gauge between the lining and the drum at lower end of shoe. Turn the adjusting screw (6), page 112, with a screw driver, which causes the adjusting screw to force the brake shoe against the drum until .015" clearance between lining and drum is obtained.

Check the clearance at the upper end of the shoe. .015" clearance at each end of this shoe indicates correct anchor pin position and insures proper brake lining contact with drum. In the event .015" clearance at each end of shoe is not found in checking, it will be necessary to move the anchor pin (15), page 112, to the correct position.

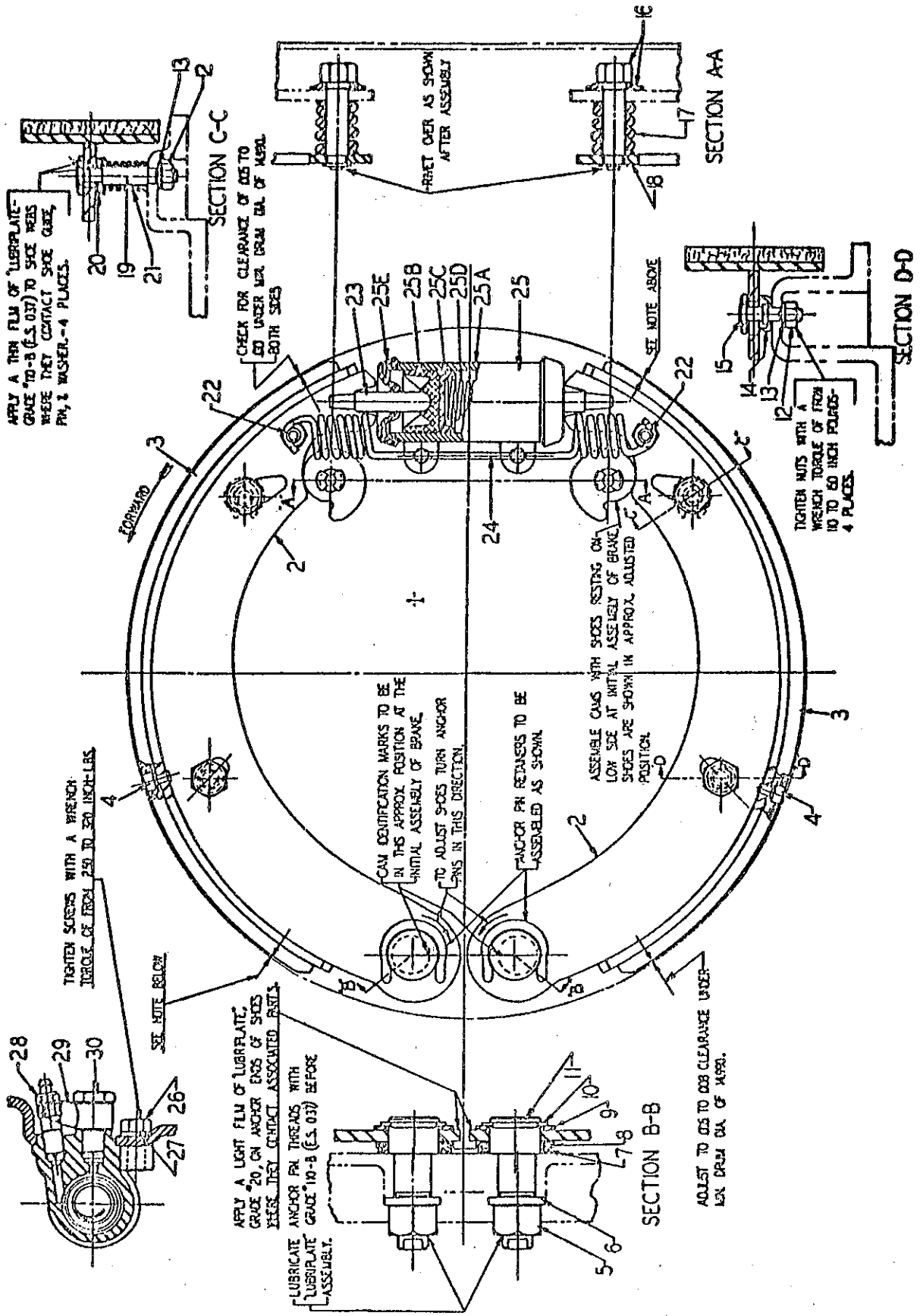
To adjust the anchor pin (15), loosen the anchor pin nut (16), just enough to permit turning the anchor pin with a screw driver (inserted through adjusting hole in the upper face of the drum). To decrease clearance between the drum and lining at the anchor pin end of the shoe, turn the screw driver to the right. With the shoe against the drum, turn the adjusting screw and anchor pin in the necessary direction to obtain .015" lining to drum clearance at both ends of shoes.

Tighten anchor pin nut (16) securely with a wrench while holding the anchor pin (15) with a screw driver. Again check the shoe clearance to be certain the anchor pin has not moved.

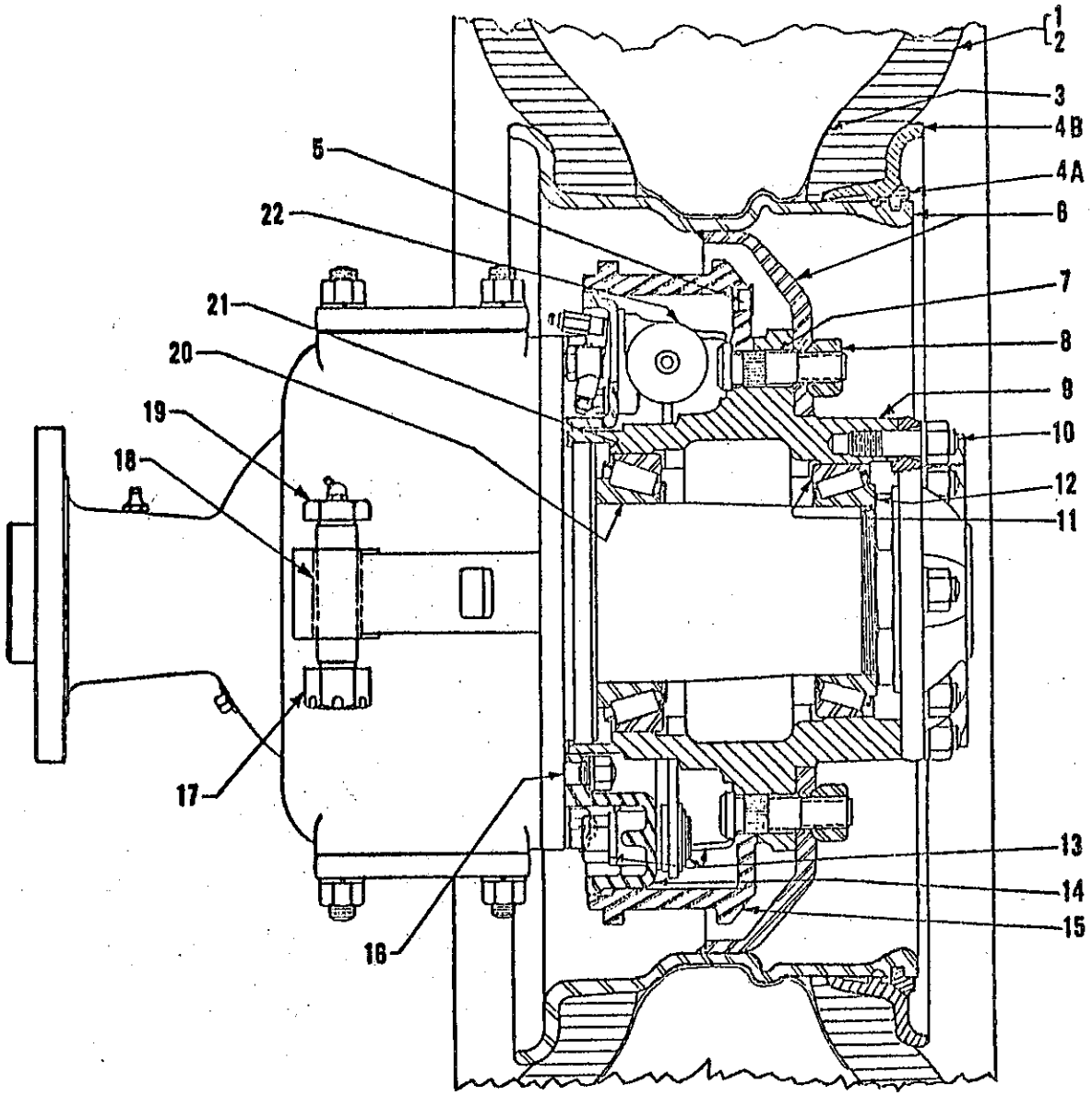
Install the four 3/8" pipe plugs (22) into brake drum (9) shown on page 102.



26. The Above Illustration shows the Propeller Shaft Brake Band Group as used on the Transfer Case. (See page 102, paragraph 13, or page 104, paragraph 16.) The instructions shown on page 111, paragraph 25, will apply to this group in general.



27. The above illustration shows the front wheel brake band group. The brake cylinder (25) is assembled to the wheel group at top location as viewed on this page.



28. The Above Illustration Shows the Right Front Wheel Group. (The Left Front Wheel Group is of Same Construction.) (also rear wheels which have brakes)

29. WHEEL BRAKE ADJUSTMENT.

a. Remove the two front wheels (see Ref. (6) above). Remove rubber plugs (5) from the brake drum (15). Revolve drum to a position where you can insert a feeler gauge between the lining and drum at lower end of shoe. Turn the top adjusting screws (Ref. 16, page 113) until a clearance of .005 to .008" is obtained between the lining and drum at lower end of the shoes.

b. Check clearance at the upper end of the shoe. A clearance of .005 to .010" is required at this point.

c. IMPORTANT: If the correct clearance cannot be obtained by turning top adjusting screw (16), page 113, only, loosen nut (5) at the lower anchor pin adjustment (11). This can then be rotated to shift lower end of shoe slightly. Adjust each individual wheel brake shoe as described above, then re-lock nut (5). Replace rubber plugs (5) in drum (15) above.

d. PRECAUTIONS: Use only alcohol to clean rubber parts and the inside of master and drum cylinders. Kerosene or gasoline may cause damage to, or failure of, the hydraulic system.

Do not allow grease, oil, paint, brake fluid, or foreign matter to come in contact with the brake lining.

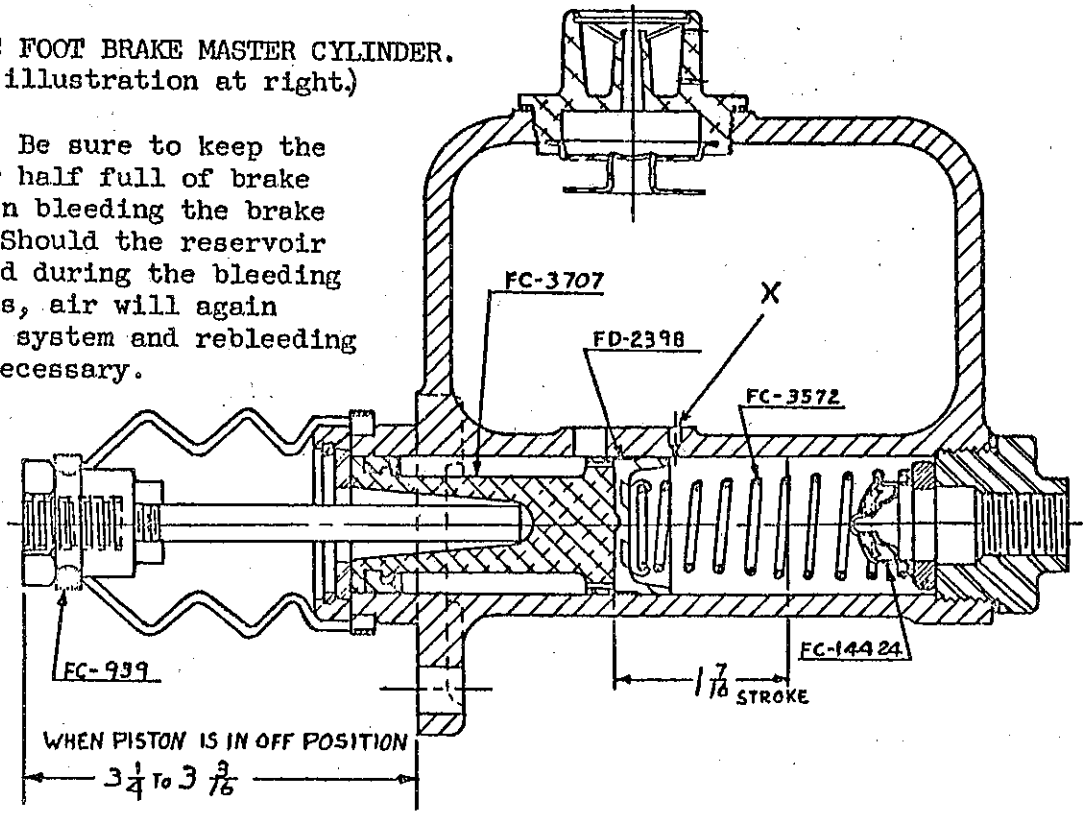
If brake shoes are not properly lined, poor braking will result. It is better to install new brake shoe and lining groups when linings are badly worn.

e. Hand Brake.

Periodic mechanical adjustments are not required to the hand brake mechanism. Lubricate daily the hand lever pins, using SAE-10W oil.

30. HYDRAULIC FOOT BRAKE MASTER CYLINDER. (See the illustration at right.)

CAUTION: Be sure to keep the reservoir half full of brake fluid when bleeding the brake system. Should the reservoir be drained during the bleeding operations, air will again enter the system and rebleeding will be necessary.



31. FRONT AXLE.

In making repairs to parts located at either end of main axle housing, including replacing the drive shafts, it is unnecessary to remove the main axle housing from the front end of the frame. However, should repairs be necessary to the gear carrier or main axle housing itself, then the axle assembly must be removed from the frame. If possible, place the machine on a level place and block the rear wheels securely.

If the machine can be operated, it will be easier to wash out the main axle housing before disassembly is started. First remove the drain plug and allow all the oil to flow from the gear case. Then refill the case with kerosene or diesel fuel.

CAUTION: Do not use gasoline as it is dangerous, because it may explode and cause a fire. Run engine slowly with the kerosene or fuel oil in gear case for several minutes, both forward and reverse, and drain gear case. If you wish to get it absolutely clean, refill case a second time with clean kerosene or diesel fuel and repeat washing operation.

32. WHEEL REMOVAL AND REASSEMBLY.

All the wheels are attached in the same manner, so the following will apply to either right or left hand wheel.

a. Remove the eight nuts and lock washers from the drive flange studs (X) shown on page 117. Remove the drive flange (1).

If the drive flange sticks too tightly to be pulled off by hand, secure a couple of 1/2" hardened set screws to remove the flange. Lubricate the threads of hardened set screws well before inserting them in the threaded holes provided in the drive flange. Be sure to clean the threaded holes carefully and blow out all dirt present. The flange can then be forced off by screwing the set screws in through the flange against the wheel face.

b. Unlock the bent over edge of lock washer (7), page 117, and remove the hub bearing lock nut (6).

Remove the lock washer (7), the drilled washer (8), and the adjusting nut (with pin) (9).

Jack up on axle housing inside of wheel until wheel clears ground, and place a well greased metal plate under the tire. Lower jack until weight of wheel only rests on plate.

c. Slide the wheel off. Be sure to catch the bearing cone, forced off by wheel, so it does not fall to the ground and become dirty.

d. If the hub bearing felt (14) is worn or damaged, replace it by prying off the inner bearing and removing the washer (13) and felt (14).

e. Be sure to wash all the old grease from inside the wheel and from axle end and bearings. Repack the bearings with wheel bearing grease when reassembling. If bearings show any flat spots or chipping, replace both cone and cup.

f. In reassembly, after replacing the wheel and outer bearing replace the adjusting nut (9) with pin on outside. Tighten this nut up snugly. (Back it up one hole of the drilled washer (8) for bearing clearance.) The slight preload thus put on the wheel bearings will prevent any misalignment due to working strains.

g. Replace the drilled washer (8). Be sure one of the holes aligns with the pin protruding from the adjusting nut (9). If they fail to align, try taking the washer off and turning the other side inward. If this fails to align the pin and a hole in the washer, then the nut will have to be loosened slightly.

h. Replace the lock washer (7). Replace and securely tighten the lock nut (6). Bend one edge of the lock washer (7) so as to firmly fix the lock nut (6).

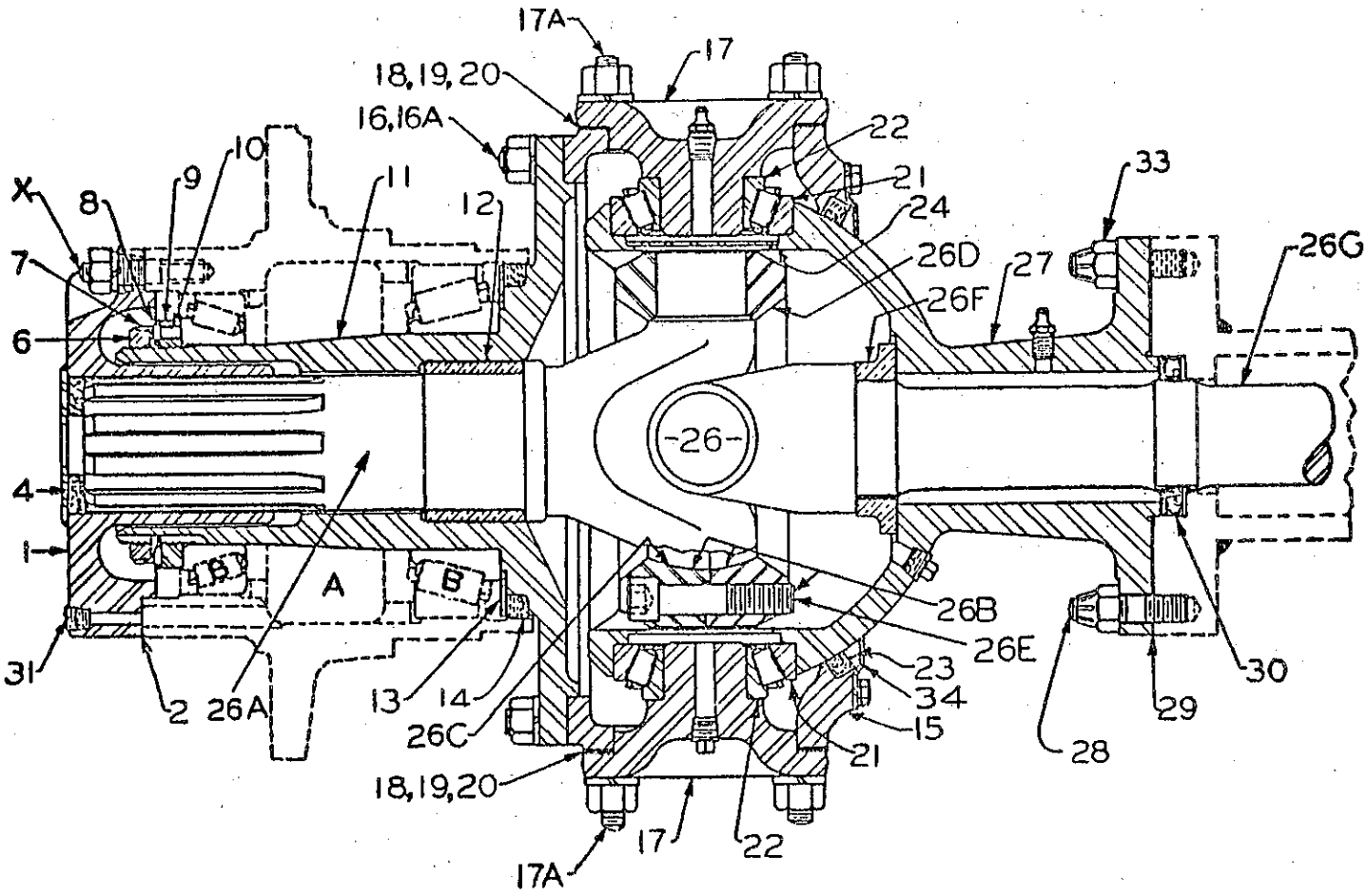
i. Replace the drive flange (1).

NOTE: Each drive flange (1) has a 1/8" pipe plug (31) recessed into the outside edge. When installing the flange, the plugged hole should mate a similar hole drilled sidewise into the wheel hub, and terminating into the compartment (A).

j. The two Timken bearings (B) are packed or completely charged with lubricant at time of assembly at the factory; therefore, it should not be necessary to pump still more lubricant into the plugged port (31) when the crane is being used at temperatures above 32° F.

k. The purpose of the plug (31) in flange (1) is to make it possible (without removing the front wheels) to pump winterizing oil into compartment (A) when the temperature lowers to 32° F. and under. (1/4th pint of SAE-10W pumped into each wheel port (31) will winterize the wheel bearing grease at location (B).)

l. If an excess amount of pressure gear grease is pumped through opening (31) into compartment (A) during temperatures above 32° F., the excess lubricant should be kept off the tires.



33. The Above Illustration Shows the Wheel Steering Joint Assembly, as used on all driving axles.

34. UNIVERSAL JOINT WITH AXLE SHAFT REMOVAL.

a. Follow the instructions in paragraph covering "Wheel Removal", page 116, paragraph 32.

b. Remove the nuts and lock washers from studs (16) and (16A).

c. Loosen the eight studs located in caps (17).

d. Remove the steering knuckle (11).

e. Grasp the splined end of universal joint now exposed and carefully pull the joint, with axle shaft attached, out of housing. Be especially careful not to damage the oil seal (30).

f. Place the universal joint and axle assembly on a bench (or a box if bench is not available).

g. Wash all parts carefully with kerosene. Check and lubricate them carefully before reassembly.

35. AXLE UNIVERSAL JOINT DISASSEMBLY. (For cleaning and inspection purposes only.)

a. Whenever the joint is removed from its housing for any purpose, it is a good idea to wash it and inspect it.

b. Clean and inspect all parts. If worn, chipped, or cracked, procure a new drive joint group, or parts, from your nearest Austin-Western distributor.

36. WHEEL STEERING KNUCKLE DISASSEMBLY.

a. Follow the instructions covering "Universal Joint With Axle Shaft Removal", paragraph 34, on this page.

b. Remove the huglock nuts (33) from the eight studs (28), page 117, located in the outer end of axle main housing. Remove the tie rod fork bolts (1), page 107. Pull the entire trunnion (27), page 117, and knuckle flange off the studs. It may stick and require force to remove it. At this point it is well to check the seal (30) in end of trunnion socket, and replace it, if necessary. Be sure to oil it well before reassembly.

c. Remove the four nuts (17A) from top pivot bearing cap (17) and remove the cap and shims (18), (19), and (20). Keep the cap and shims together. (It will be well to tie them together if original parts are to be reassembled again.) Now remove the lower pivot bearing cap (17), following the same procedure used to remove the upper pivot bearing cap (17). Slip the knuckle flange (15) off flanged (inner) end of trunnion socket (27). The felt (23) can now be removed and replaced with a new one, if necessary.

d. For reassembling, reverse the above procedure.

> CAUTION: Before reassembling be sure to wash and inspect all parts carefully. Cleanliness is most essential in preventing wear.

37. WHEEL PIVOT BEARING ADJUSTMENT.

((21) and (22)). (With the wheel removed but steering knuckle still on the crane.) (See page 117. paragraph 33.)

a. Remove the four nuts (17A) from top pivot bearing cap (17) and remove the cap and shims (18), (19) and (20). Keep the cap shims together. (It will be well to tie them together so they can be easily assembled in the original position.) Mark the cap (17) so it can be put back in the original position.

b. Carefully wash out the bearing cup (21) and its compartment. Be sure to remove all grit and chips present. Wash bearing cone and rollers carefully. If bearings show signs of chipping or flat spots, replace both the cup and the cone with new ones.

c. Remove the lower pivot bearing cap (17) with shims (18), (19), and (20). Keep these together for reassembly in original position.

d. Wash the bearing cone, rollers, and cup carefully. If there are any signs of chipping or flat spots, replace both the cup and the cone with new ones.

e. Pack the bearings with grease and reassemble both caps with shims in original positions.

f. Tighten the nuts (17A) evenly on both caps (17). If there is any vertical end play at the bearings (21) and (22), they will have to be adjusted by removing equal amounts of shim thickness from both top and bottom. If too tight, add new shims of same thickness, to both top and bottom bearing caps.

Continue this adjustment until the play is just out of bearings when studs are tight, then remove a thin shim (.005") from under both the top and the bottom bearing cap. This will bind the bearings slightly and is called "pre-loading". This is done to eliminate slight play from existing when these bearings are actually carrying the weight of machine while at work. The shims are of three different thicknesses; namely, .005", .007", and .020".

> CAUTION: The nuts (17A) holding top and bottom pivot bearing caps (17) must be left loose until the axle and knuckle drive joint group has been put in place and knuckle (11) has been securely tightened in place by the nuts on studs (16) and (16A), page 117. Otherwise, knuckle flange (15) will distort and the pre-loading effect will be destroyed.

38. FRONT (AND REAR) WHEEL TOE-IN ADJUSTMENT. (See page 107, paragraph 20)

a. The crane is equipped with a tie rod adjusting nut (XX) (which has both right and left hand threads). Turn the adjusting nut so that front toe-in is 0". Then retighten the two clamp bolts. Measurements to be made at the side wall of tires as close to center line of axle as possible.

b. No toe-out should be tolerated. Failure to comply with the above will cause excessive tire tread wear. (This likewise applies to the rear wheels. See page 124 and 125.)

39. REMOVAL OF FRONT AXLE ASSEMBLY FROM FRAME. (See page 107, paragraph 20)

a. Place machine on level place.

b. Block both rear wheels securely to prevent possibility of machine rolling forward or backward. Remove axle group as shown on page 107.

40. FRONT AXLE GEAR CARRIER DISASSEMBLY. (After Removing the Assembly from Axle Housing (41). (See page 120, paragraph 41)

a. Remove the lock wires and nuts on the four studs (37).

b. Remove the bearing caps (38). (If they are not already marked, mark them so they can be put back in exactly the same position in reassembly.)

c. Lift out the bull gear and differential group (39).

d. If ball bearings (33) on differential hub are worn, replace them with new ones.

e. If you desire to remove the one-piece bull pinion and bevel gear hub (31), proceed as follows:

1. Remove the twelve nuts and washers from studs (5).

2. Remove the left bearing cap (2). Save the gasket (6) and all shims (7), (8), and (9). Wire these to the cap so they will be replaced in original position. Threaded draw screw holes are provided to remove this cap if it sticks.

3. Remove the right bearing cap (2), saving the gasket (6) and shims (7), (8), and (9). Wire them to the cap to prevent mix-up. Threaded draw screw holes are provided for easy removal of this cap.

4. Remove the bearing cone and roller assembly (3) from ring gear end of shaft (31). If bearing cone (3) cannot readily be driven from shaft, pour hot oil over bearing only, to expand it for easier removal.

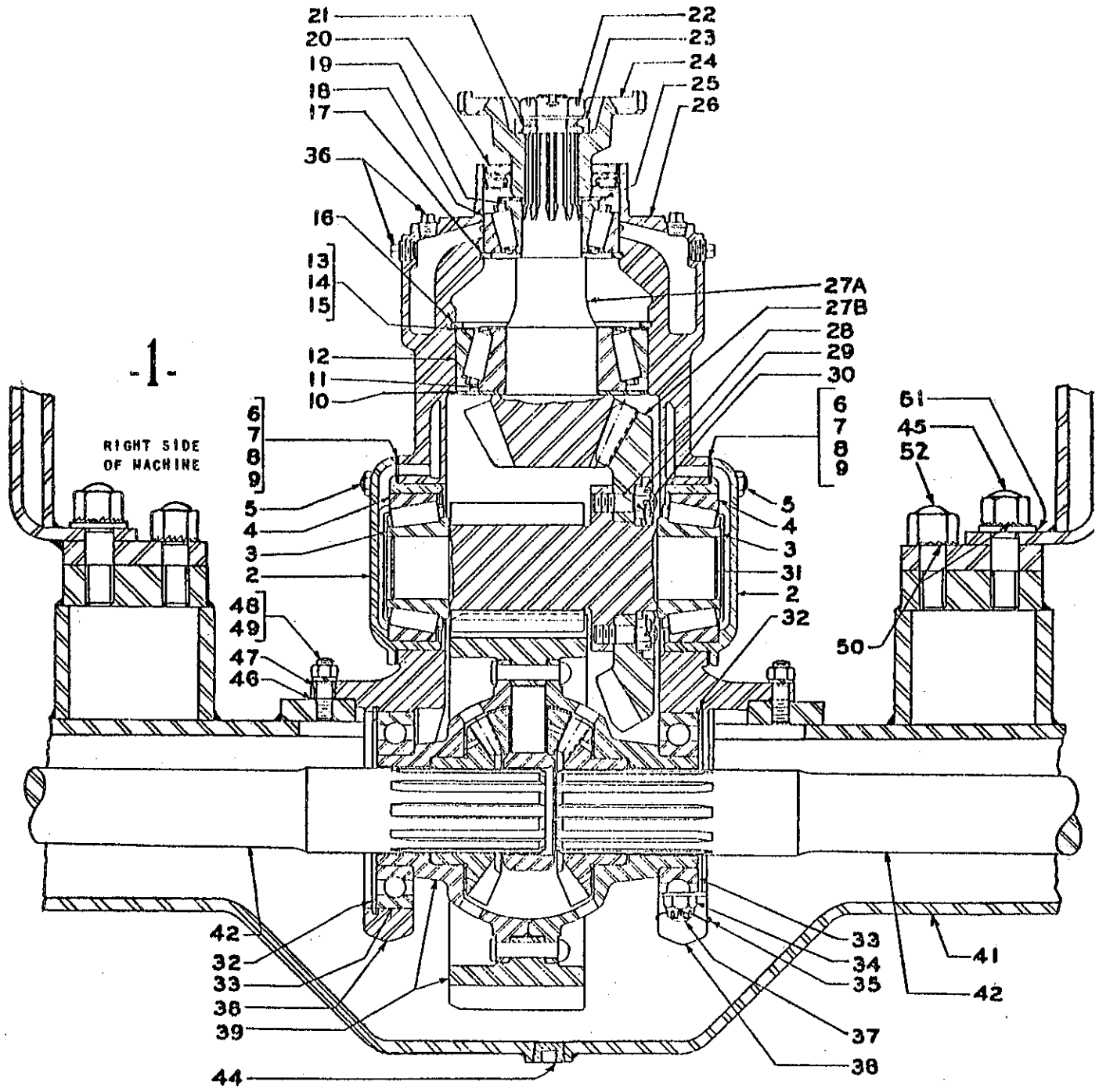
NOTE: Keep the shaft (31) cold as possible.

5. Slip the shaft (31) sidewise out through side of case after removing the nine nuts (29) holding the bevel gear (27B). If inspection shows chipping or flat spots on either bearing, replace both the cone and cup of that bearing. Clean and check all parts carefully before reassembly.

f. If you desire to remove the bevel pinion (27A) proceed as follows:

1. Remove the cotter and nut (22). Remove washer (23) and universal joint fitting yoke (24). Place a bronze drift on threaded end of pinion shaft, and drive it back through bearing (19). Be careful to save all the shims (13), (14), and (15), also washer (25). Check oil seal (20) and replace it with new one if necessary.

2. If inspection shows any flat spots or chipping on bearings (11), (12), (18), or (19), replace both the bearing cone and the cup of damaged bearing.



41. The Above Illustration Shows The Front Axle Gear Carrier Group.

42. FRONT AXLE GEAR CARRIER REASSEMBLY. (See above)

a. After all usable parts have been carefully cleaned, proceed as follows:

1. Assemble cup (12) with shims (13), (14), and (15), also cup (18), into the carrier casting (26).

2. Place washer (10) and cone (11) on shaft (27A) as shown. Next insert shaft (27A) into location. Install cone (19), washer (25), seal (20), yoke (24), gasket (21), washer (23), and finally nut (22).

3. Tighten nut (22) sufficiently to remove all end clearance at bearings (11) and (19). Do not over-tighten nut (22) because the bearings (11) and (19) will be adjusted too tightly endwise.

Shaft (27A) should turn freely, except for the friction applied by the seal (20) around the yoke (24).

4. If you install too many shims (13), (14) or (15), the teeth of pinion (27A) will extend too far into the ring gear teeth near arrow (27B).

The teeth of both pinion (27A) and gear (27B) should be approximately flush with one another at the back side, or near arrow point (27B).

If you do not install a sufficient quantity of shims (13), (14) or (15), then the teeth of pinion (27A) will be outward from the teeth of gear (27B).

See pages 122 and 123 for proper tooth contact.

5. When installing a new bevel gear (27B), or a new pinion and gear hub (31), be sure to fit the two together before putting them into the gear carrier. By doing this you will be sure they fit together properly.

The bevel gear is held firmly in place by nine nuts (29) through the backing flange. It is therefore best to mark (with paint) the bevel gear and hub flange to make alignment easy. The bevel gear should be a snug fit on the studs (30).

Insert gear hub (31) (with bearings off) into one side of the gear carrier housing.

Align the bevel gear holes with flange studs and drive the gear into place tightly against the flange, as shown on page 120.

Be careful not to damage the gear teeth.

Insert and tighten the nine nuts (29). Install lock wire (28).

If necessary use fine emery cloth and reduce shaft diameter so a light tap fit will seat cones (3) into position.

Align the oil holes and replace both of the bearing caps (2), together with the gasket (6) and the shims (7), (8) and (9), but first make sure the bearing cup (4) is in good condition. If otherwise, replace it and bearing cone (3).

Check the position of gasket (6) and shims (7), (8) and (9), and the bearing caps (2).

Oil ports in case and cap must align and the shims must be properly placed, or the flow of oil will be cut off, and the lubrication of the bearing will then be insufficient.

If end play exists in the one piece pinion and gear hub (after the caps (2) are tightened), it can be eliminated by removing shims (7), (8) and (9), as required.

See page 122, paragraph 43, for diagrams on proper tooth contact. Be sure the pinion and gear hub has only a slight drag when both caps (2) are tight. If pinion needs to be adjusted for proper mesh with bevel gear, add or remove shims (13), (14) or (15), as required.

6. Place the large spur gear and differential group (39) in position after installing the hub bearings (33).

The spur gear is offset to clear the bevel gear. Replace the bearing caps (38) and tighten the nuts on studs (37) and wire them to prevent their loosening.

7. Install a new gasket (46). Lower the now completely assembled gear carrier down into front axle housing (41). Then install both axle groups (42). Carefully push the axles and wheels back into axle housing and replace and tighten the huglock nuts (33), page 117.

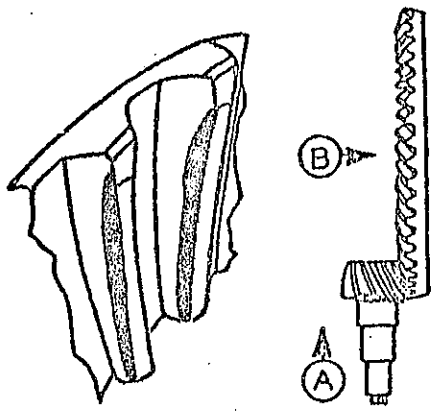
8. Put the tapered dowel bushing (47) in proper place and tighten this stud nut first; then tighten the rest of the nuts on studs (48).

9. **Fill axle housing with recommended oil. See lubrication chart, page 14.**

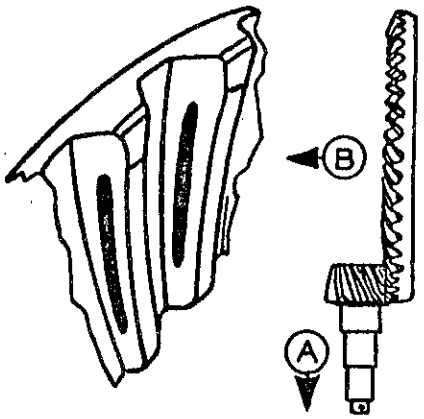
10. **Reassemble axle group to frame, Check the toe-in adjustment. See page 119, paragraph 38, "Front Wheel Toe-In Adjustment". Pour about a pint of this oil into either hole located at front side of the pinion compartment near fitting yokes. These two holes have 3/8" square head pipe plug in them. This oil prevents the bearings (13) and (19) from insufficient lubrication when first starting newly assembled axle.**

43. CHECKING TOOTH CONTACT.

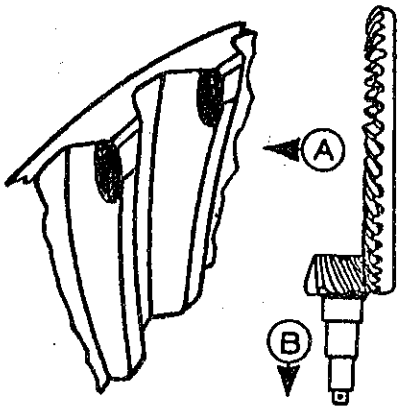
a. This is accomplished by means of oiled red lead applied lightly, or sparingly, to the drive side of the bevel gear teeth. When the pinion is rotated the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. Sharper contact impressions can be obtained by applying a small amount of resistance to the gear when rotating the pinion. (Hold a block of wood against the gear and use a wrench to rotate the pinion.) When making adjustments always check the drive side of the bevel gear teeth. Coast side contact will be automatically correct when the drive side contact is correct. As a rule, coating about 12 gear teeth with red lead is sufficient for checking purposes.



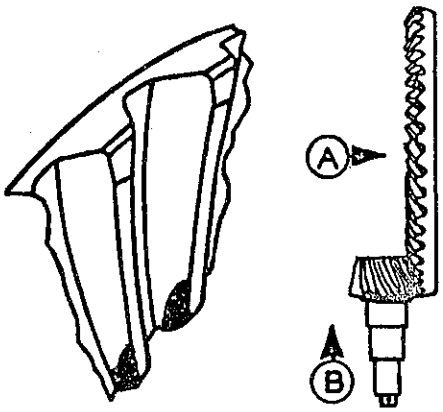
1. The above diagram shows a HIGH NARROW CONTACT, which is undesirable and will result in noisy operation, galling, and overloading of the teeth. To obtain correct contact, add shims to move the pinion (A) in toward the toe of the gear teeth (toward the center of the axle) to lower contact area to the proper location. This adjustment will decrease the backlash between the pinion and gear teeth, which can be corrected by moving the gear (B) away from the pinion. A backlash of .005" to .010" is correct. Several adjustments of both pinion and gear may be necessary before correct contact and backlash are secured.



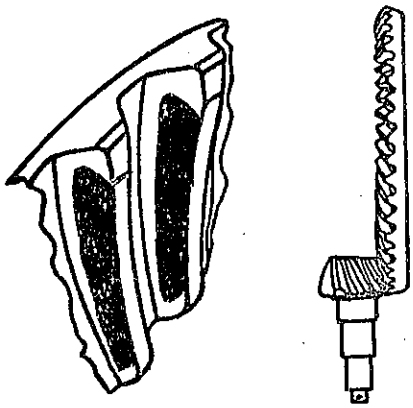
2. The above diagram shows a LOW NARROW CONTACT, which will result in galling, grooving of teeth, and noise. To secure correct contact, remove shims to move pinion (A) out from gear (away from center of axle) a sufficient amount to move the contact area to the proper location. To obtain correct backlash (.005" to .010") move the gear (B) in toward the pinion.



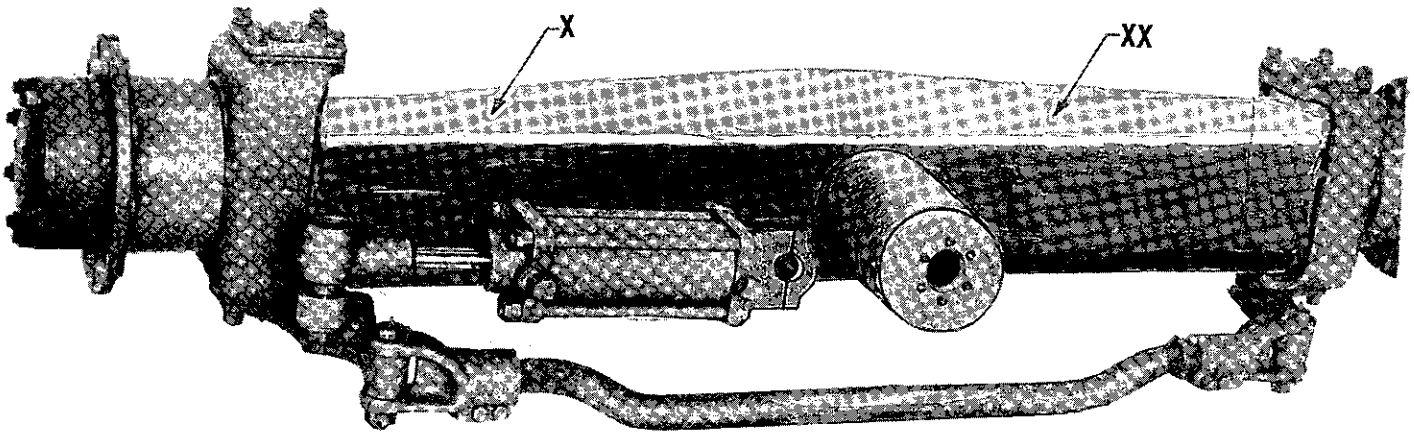
4. The above diagram shows a SHORT HEEL CONTACT, which produces approximately the same results as a short toe contact: noise, excessive gear tooth wear, and chipping of tooth edges. To correct this condition, the gear (A) must be moved in toward the pinion to increase the lengthwise contact and to move the contact toward the toe of the teeth. Correct backlash (.005" to .010") is obtained by moving the pinion (B) out toward the heel of the gear teeth (away from the center of the axle).



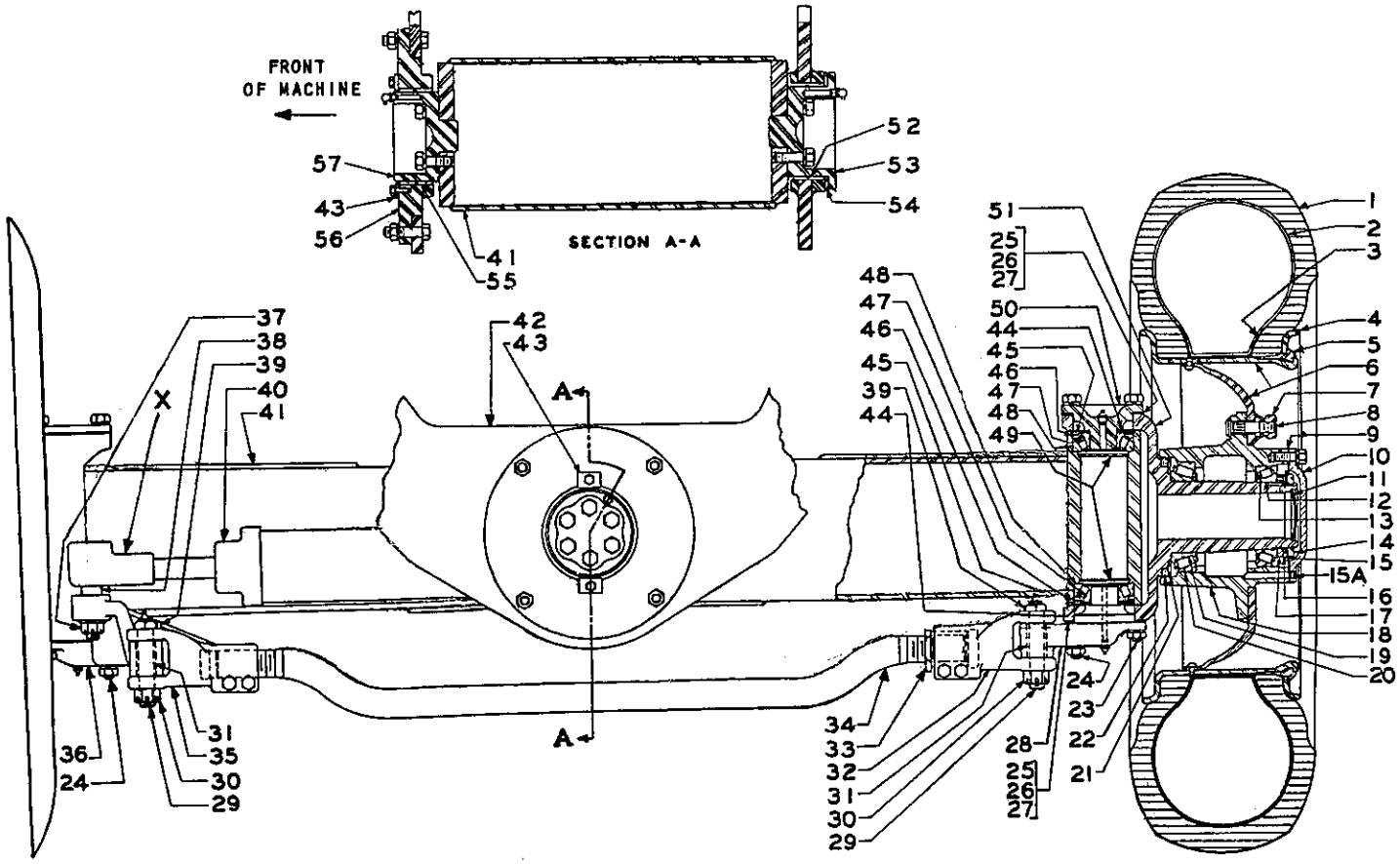
3. The above diagram shows a SHORT TOE CONTACT, which, because the contact area overlaps the toe of the bevel gear teeth, will result in chipping of tooth edges and excessive wear at this point if not corrected. To secure correct contact, move the gear (A) away from the pinion. This will increase the lengthwise contact and move the contact area toward the heel of the gear teeth. Correct backlash (.005" to .010") is obtained by moving the pinion (B) in toward the gear (toward the center of the axle).



5. The above diagram shows when ADJUSTMENTS HAVE BEEN PROPERLY MADE. This is the correct tooth contact that will be secured. Note that the area of contact starts near the toe of the gear teeth and extends about 80% of the tooth length toward the heel. This adjustment results in a quiet running gear and pinion set, which, because the load is distributed over the teeth within the proper area, will deliver all the long service built into it.



44. The Above Photo Shows the Steerable, Non-Driving, Rear Axle Group. (Used with the 3 traveling speed, 2-wheel drive crane.)

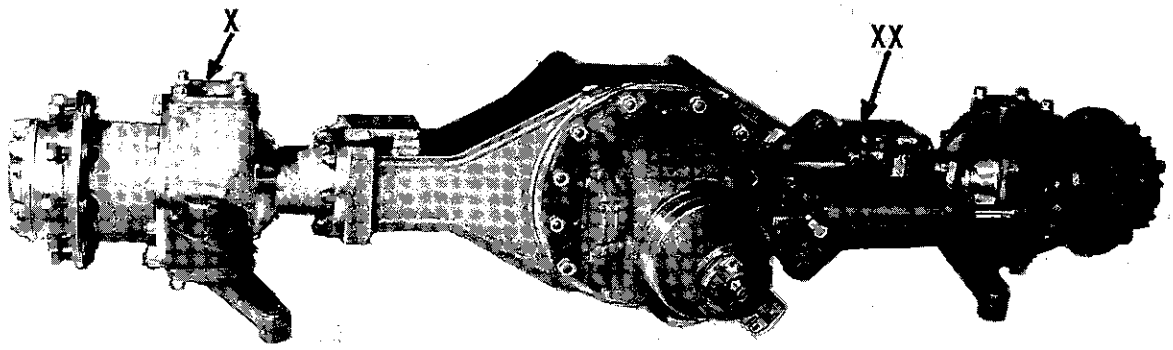


45. The Above Illustration Shows the Internal, Non-Driving, Rear Wheel Assembly Details. (Used with the 3 traveling speed crane.)

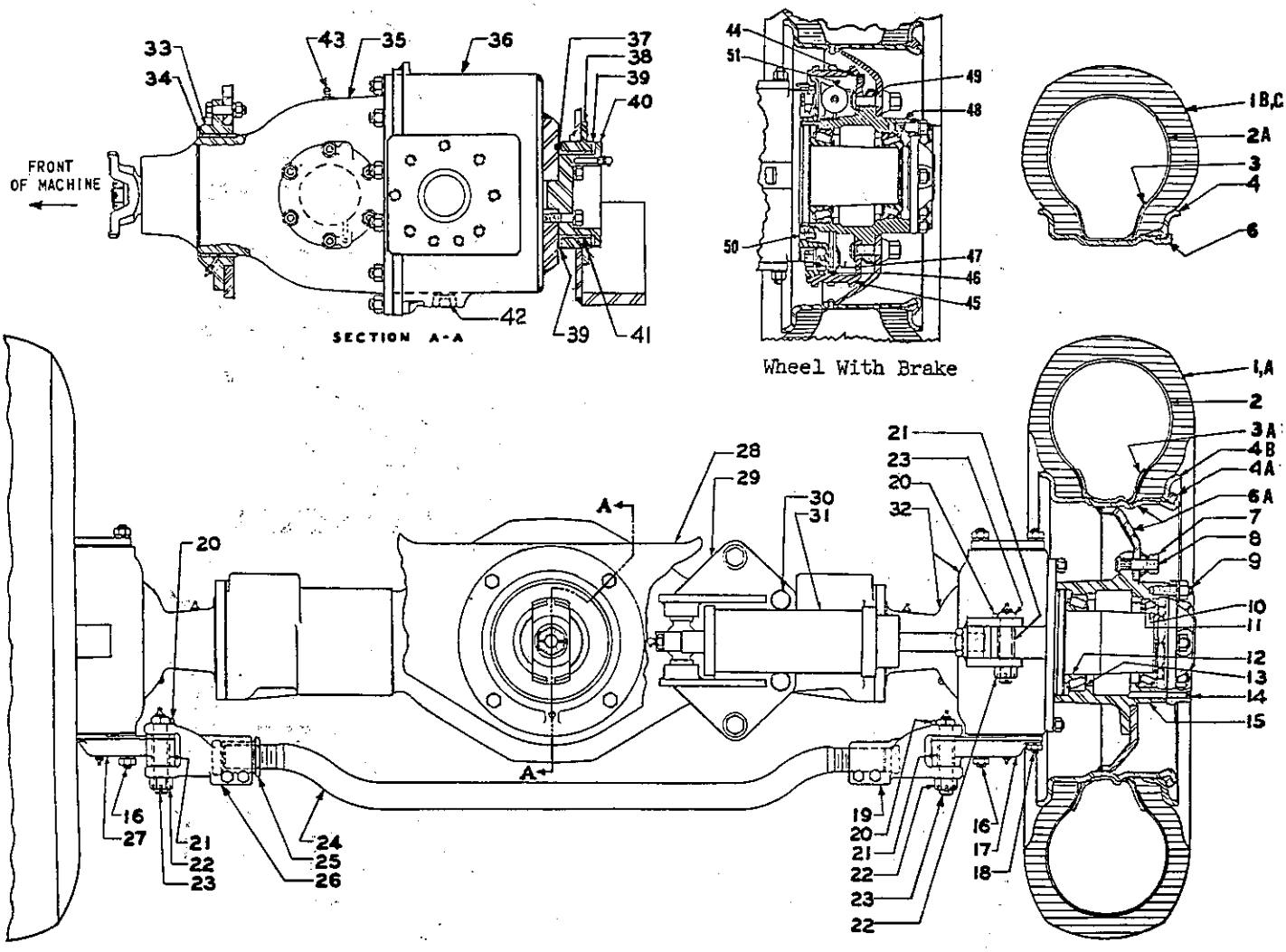
a. The wheel bearings (12-13) and (19-20) are to be assembled, and adjusted exactly as shown on page 116, paragraph 32.

b. The bearings (47) and (48), upper and lower, are to be assembled and adjusted exactly as shown on page 118, paragraph 37.

c. The ram (40) stroke, extreme left to right, controls the maximum steering angle of approximately 25 degrees. The threaded piston rod socket (X) may be set as required for equal wheel steering angle.



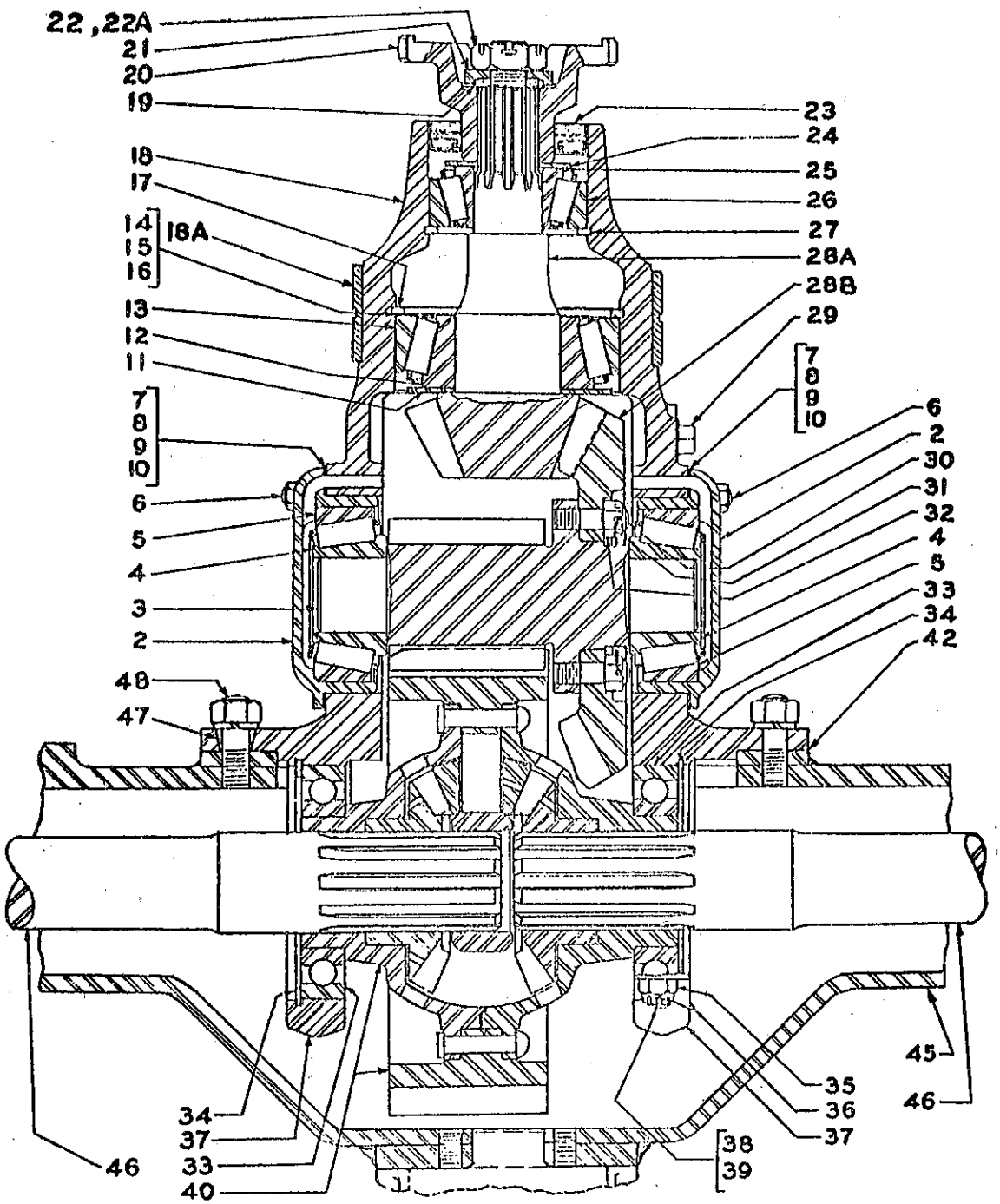
46. The Above Photo Shows the Steerable, Driving, Rear Axle Group. (Used with 4-wheel drive crane.)



47. The Above Illustration Shows the Internal Rear Driving Wheel Assembly Details. (Same on both sides.)

a. The bearings (10-11) and (12-13) are to be assembled and adjusted exactly as shown on page 116, paragraph 32.

b. The transmission groups(32) are subject to all instructions shown on pages 117, 118 and 119, paragraphs 33, 34, 35, 36, 37 and 38.



48. The Above Illustration Shows The Driving Rear Axle Gear Carrier Group. (See page 127 for Removal and Dismantling Instructions.)

49. TO REMOVE THE REAR GEAR CARRIER, PROCEED AS FOLLOWS:

a. Disconnect the propeller shaft at (XXX), page 128. Disconnect the hydraulic hoses at steering ram (31), page 125. Block the front tires as a safety measure. Use jacks to raise the rear end of tractor sufficiently to remove the following parts shown on page 125, paragraph 47: parts (33), (40), (39), and (37). Raise the rear end of the tractor sufficiently and roll the axle group rearward on its own wheel tires. (Carefully place suitable blocking under the main frame as a safety measure before removing the rear axle as a group, as shown on page 125, paragraph 46.)

b. Place the rear axle housing on suitable blocks. Remove both wheels (6A) and pins (23), paragraph 47. Remove both right and left trunnion groups (32), together with axle shafts. (Please turn to pages 117 and 118 and read paragraphs 34, 35, 36, and 37.)

c. Remove the nuts at studs (48), page 126. Lift the gear carrier housing (18) out of the main axle housing (45). (Don't lose dowel bushing (47) because you must have it at time of reassembly.)

50. REAR AXLE GEAR CARRIER DISASSEMBLY. (After Removing the Assembly from the Axle Housing.)

Disassembly of the rear gear carrier is exactly the same as applies to the front gear carrier. (See pages 119 and 120, paragraphs 40 and 41.)

51. REASSEMBLY OF THE REAR AXLE GEAR CARRIER is exactly the same as applied to the front gear carrier. (See pages 120 and 121, paragraphs 41 and 42, and pages 122 and 123, paragraph 43.) The illustration, paragraph 41, shown on page 120, is to be followed during reassembly.

a. Page 125, paragraph 47, shows the driving rear axle (4-wheel drive) to frame front trunnion (33) and rear trunnion group (40). This means the rear axle oscillates on bushings (34) and (41). The maximum limits of oscillation are controlled by the right and left axle stops (X) and (XX), page 125, paragraph 46.

b. Page 124, paragraph 45, shows the non-driving rear axle, (2-wheel drive). It oscillates the same way as shown under step "a" above, and the maximum limits of oscillation are controlled by the right and left axle stop points (X) and (XX), page 124, paragraph 44.

52. PROPELLER SHAFT AND DRIVE GROUP. (Refer to paragraph 53, page 128.)

a. "Worm's-eye" view. Notice the ends of propeller shaft (X) are timed at the spline so that both front and rear yokes (O) are in alignment. This detail is important and will apply to all propeller shafts having slip spline construction.

b. The transfer case drain plug (1) is in clear view. The transmission drain plug is at (2). (See page 89 for left side and top view of the transmission.)

c. The clutch pedal return spring and clutch bell housing shaft external lever are shown at (3).

d. The breather caps (4) at the bell housing should be kept clean internally. Remove and wash them every 50 hours of operation, after which, dip them in clean engine lubricating oil, then replace.

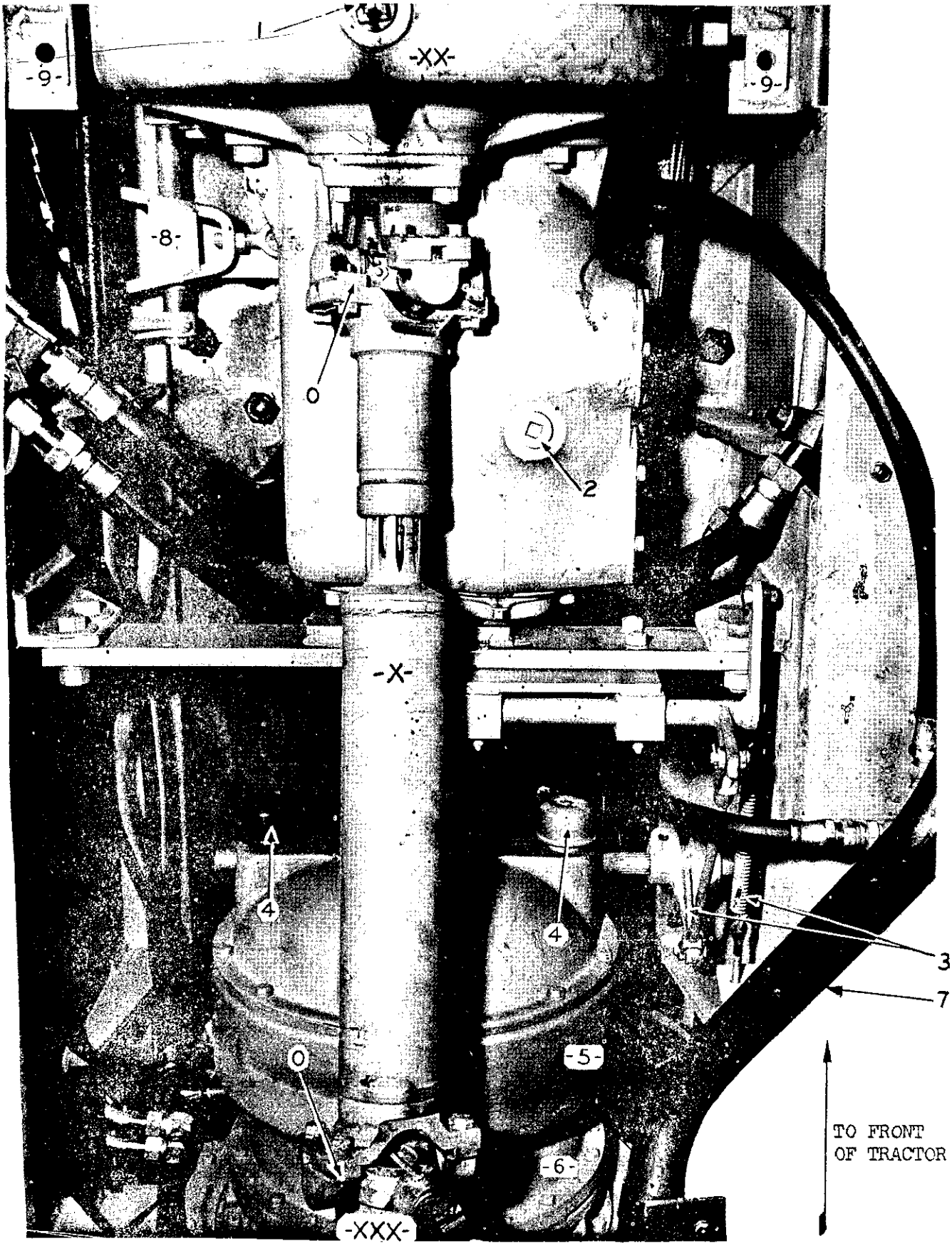
e. Ref. (5) is the clutch bell housing.

f. Ref. (6) is the torque converter.

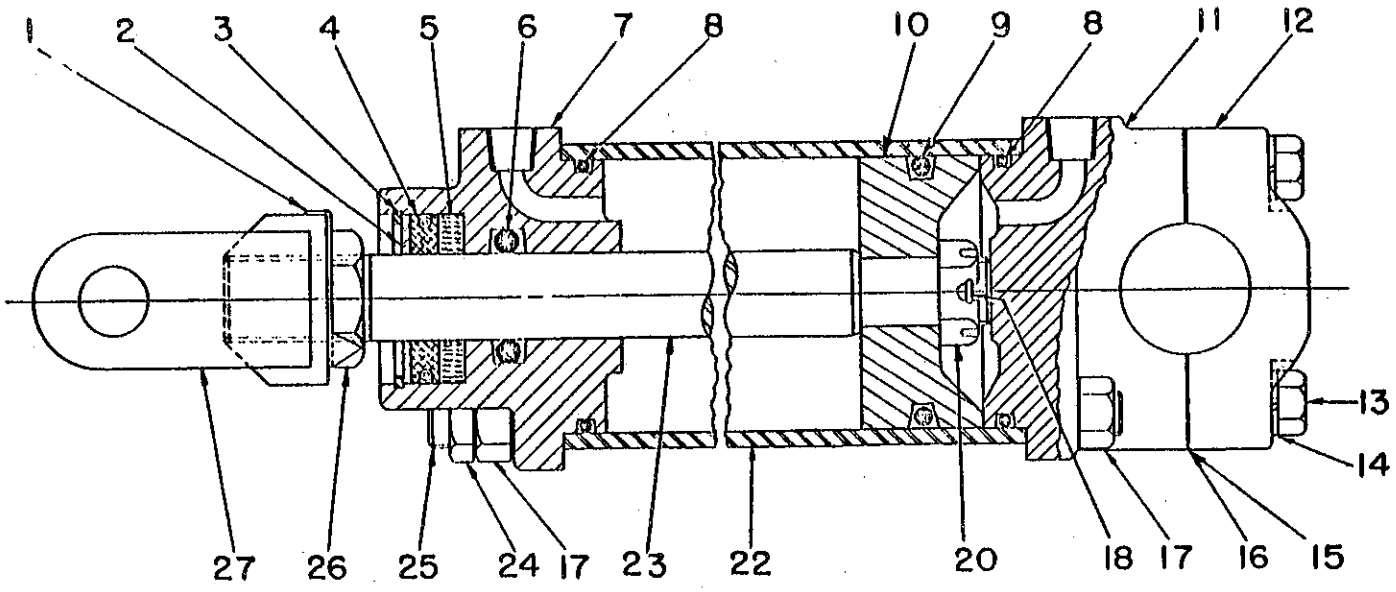
g. Ref. (7) is the large main oil suction pipe running between the hydraulic oil tank and large Hydreco oil pump driven off the fan end of the engine crankshaft.

h. Ref. (8) is part of the rear end of the transmission shift linkage. (See page 100, paragraph 8, Ref. 6, 13 and 5.)

i. Ref. (9) shows pads welded into the right and left main frame sides, and are provided for the purpose of mounting a single speed transfer case, which is supplied when a customer prefers to buy a 3 traveling speed crane instead of a 6 traveling speed crane.



53. The above photo ("worm's-eye" view) shows the Propeller Shaft Drive Group (X), located between the Transfer Case (XX) (top of photo) and the drive and steer rear Axle Combination (XXX).



54. The Above Illustration Shows the Rear Steering Ram Used With The Rear Axle Group.

a. The following instructions apply to maintenance of the rear steering hydraulic ram group shown in illustration above.

b. Shims (15 and 16) are provided for wear adjustment.

c. The "O" ring (6) and wiper group (2) to (4) inclusive, likewise the seal (5), have been in production for many years, and unless an accident is experienced, through maloperation, no parts replacement is required.

d. The maximum stroke of piston rod (23) from extreme left to right, controls the steering angle of the drive wheels. To equalize the stroke between the right and left drive wheels, proceed as follows:

1. Loosen lock nut (26), and with thin grip wrench, near nut (26), rotate the piston rod as required to establish approximately 25 degrees of wheel steering angle, right to left.

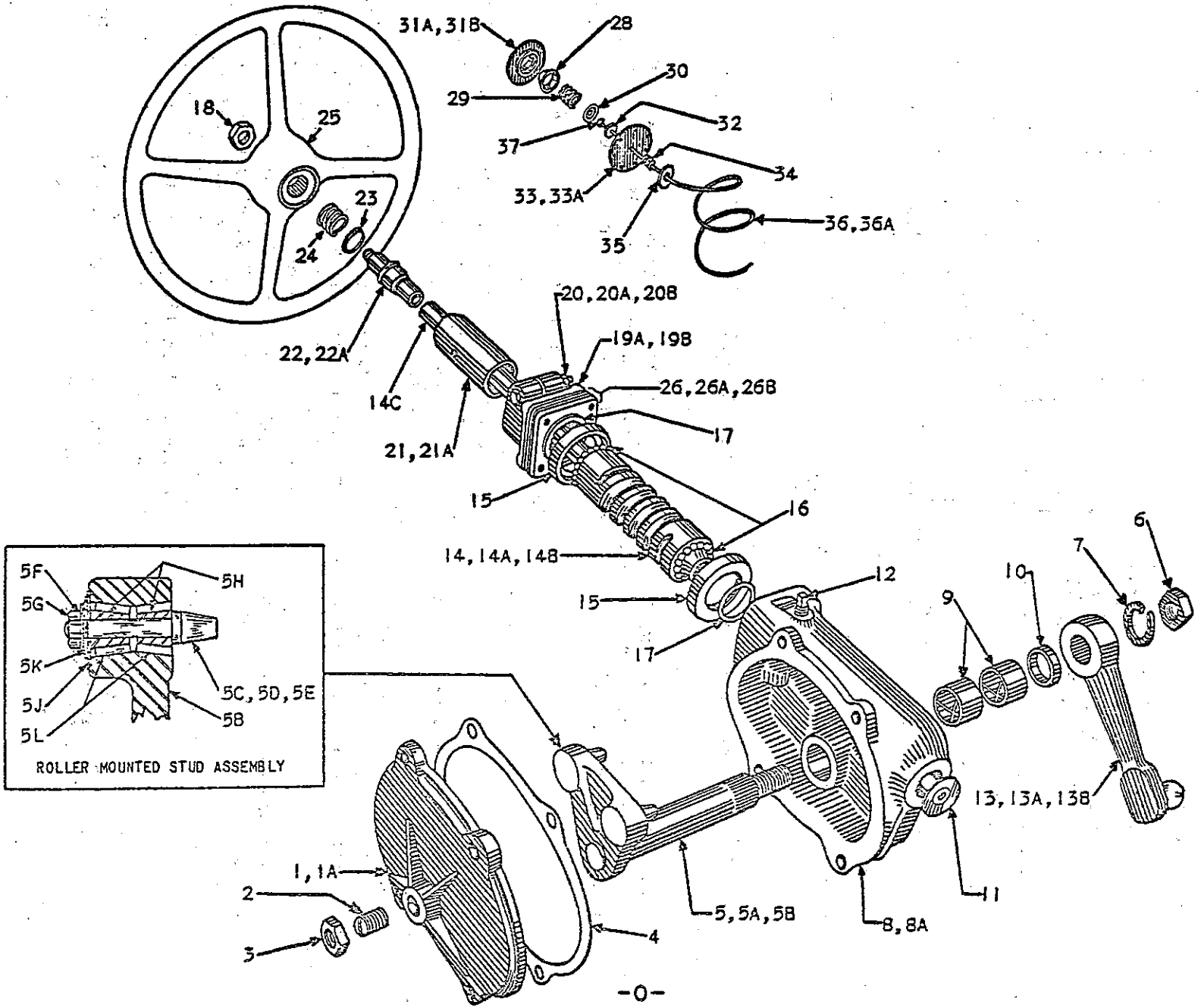
2. Relock nut (26) and bend lock plate (1) into correct position, to prevent nut (26) from becoming loose.

e. To dismantle the ram, proceed as follows:

Remove yoke (27), lock plate (1), nut (26), nuts (24) & (17), and lift off the head (7). Oil and replace all the "O" rings (6), (8) and (9).

When removing or tightening nut (20), do not clamp the chrome plated piston rod (23) in a vise or use pipe wrenches on it, because a roughened or bent piston rod (23) will result in oil leakage at the outer seal (5). Instead attach the nut and yoke (26 and 27) to the piston rod (23), holding the yoke at left in a vise (or bar). Then loosen or tighten nut (20) and install the cotter pin (18).

Reassembly is the reverse of the above instructions.



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FRONT AXLE STEERING GEAR AND COLUMN

55. FRONT AXLE STEERING GEAR.
(Refer to page 129A)

a. When making adjustments, free the steering gear of all load, preferably by disconnecting the drag link (X), page 131, from the steering arm.

b. Top Adjustment of Ball Thrust Bearings on Cam.

Adjust to a barely perceptible drag but allow the steering wheel to turn freely (with the thumb and forefinger lightly gripping the rim).

Before making this adjustment, loosen the housing side cover adjusting screw to free the studs in the cam groove.

To adjust, remove the clamp screws and move up the housing upper cover to permit removal of shim. (Shims are of .002", .003" and .010" thickness.)

Clip and remove a thin shim, or more as required. Reassemble clamp screws and tighten. Draw down tight. Test adjustment and if necessary remove or replace shims until adjustment is correct.

c. Side Adjustment for Minimum Backlash of Tapered Studs in Cam Groove.

Adjust so that a very slight drag is felt through the mid-position while turning the steering wheel slowly from one extreme position to the other.

Backlash of studs in the groove shows up as backlash at steering wheel and at ball on steering arm.

The groove is purposely cut shallower, therefore narrower, in the mid-position range of travel of each stud to provide close adjustment where usually the straight ahead driving action takes place. It also makes this close adjustment possible after normal wear occurs without causing a bind elsewhere.

Therefore, adjust through the mid-position. Do not adjust in positions off mid-position, as backlash at these points is normal and not objectionable.

To adjust, tighten side cover adjusting screw until the adjustment is correct and tighten the lock nut to hold it. Then give the gear a final test.

NOTE: Secure the gear at all points loosened prior to making the adjustment. Also check tightness of mounting bracket bolts and nuts and of steering arm on lever shaft and the nut and lockwasher.

With all supporting brackets clamped tight, turn steering wheel to see if any stiffness exists. If so, the column is probably out of alignment and needs correcting.

d. Steering Gear Connection With Steering Unit and Front Wheels.

Normally, the steering gear (steering wheel travel) should be in approximately its mid-position when the front wheels are straight-ahead.

To check, (the drag link must be disconnected from the steering arm) turn the steering wheel to the right as far as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn wheel back just one half of this total movement thus placing the gear in mid-position.

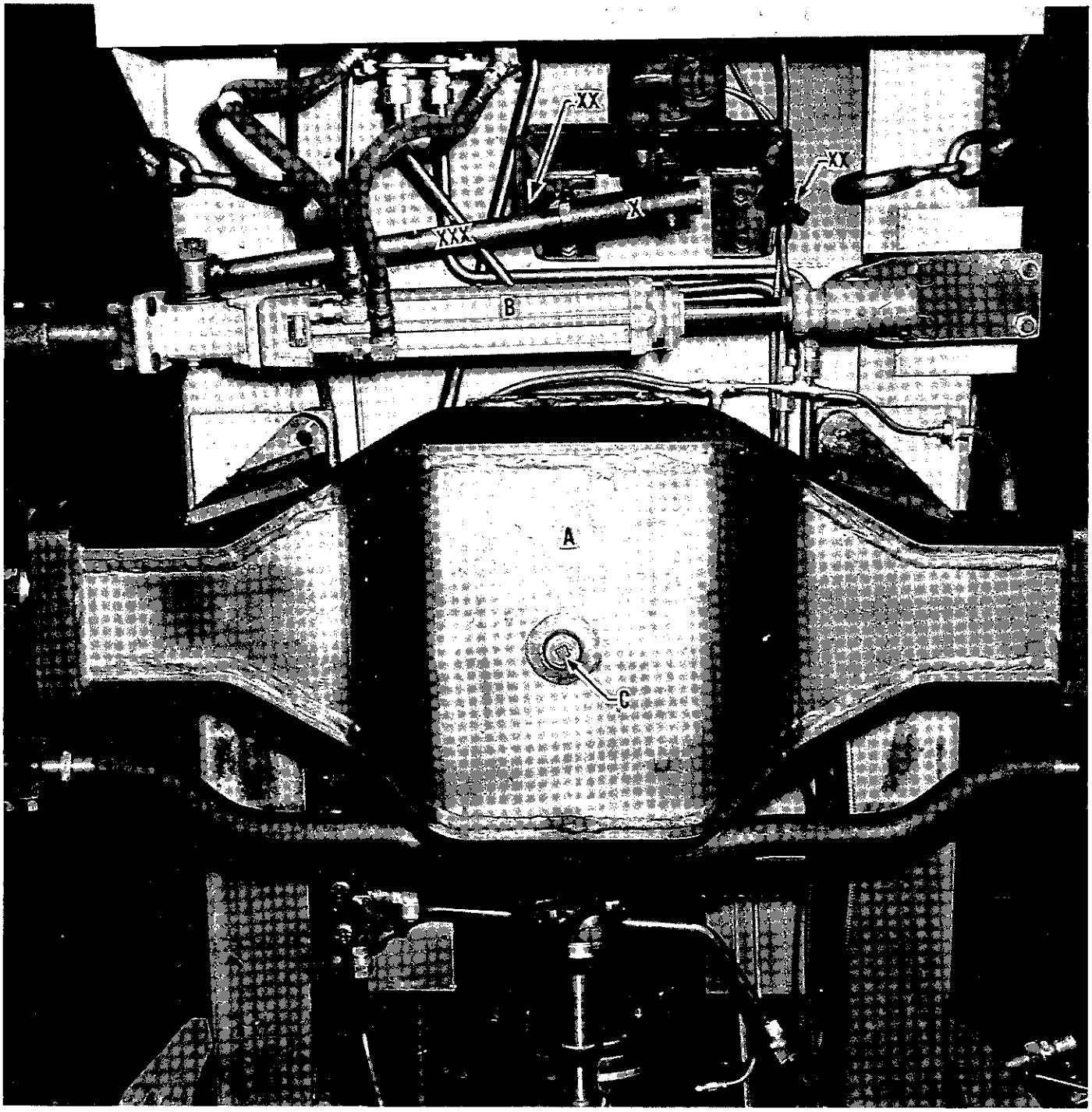
Place front wheels straight ahead. The ball on the steering gear arm should now line up, or nearly so, with the ball socket (X) on the drag link.

The drag link to Steering Unit can be adjusted in length to take up minor variations.

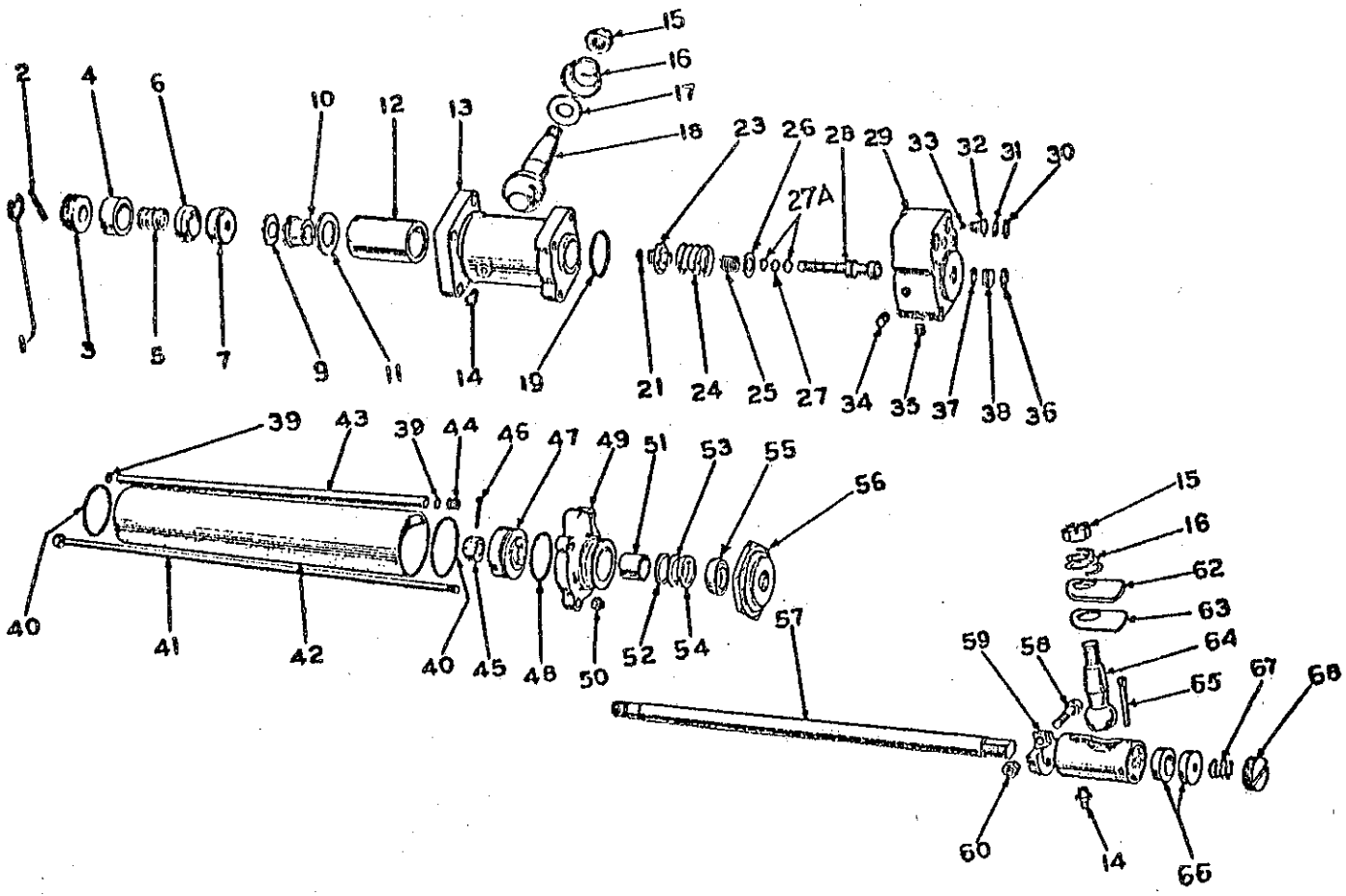
e. Lubrication.

Lubricate, page 14, through the pipe plug hole or fitting in the top of the housing. Fill housing slowly until lubricant begins to run out of vent hole in the jacket tube.

Keep housing full by adding lubricant periodically according to usage -- at least each spring and fall.



56. The above photo shows a "worm's-eye" view of the lower side of the Front Axle Housing (A). The Steering Booster is shown at (B), Front Axle Housing Drain Plug at (C), Steering Gear Lever Ball Socket at (X).



57. The Above Exploded View Shows the VICKERS Hydraulic Steering Booster Ram.

58. STEERING BOOSTER UNIT (Front).

a. For tractors furnished with a Vickers Power Steering Unit.

b. Operation.

The Vickers Hydraulic Steering Booster (b) arranged as shown on page 131, paragraph 56, utilizes hydraulic pressure from the engine driven pump.

Movement of the steering wheel is transmitted through Pitman arm ball stud (X); this in turn actuates a control valve (A) in the steering booster (B), page 133, paragraph 59. This control valve directs the hydraulic oil to the booster cylinder producing a linear movement of the cylinder and attached drag link (XXX). Steering action whether continuous or otherwise, instantly produces a corresponding movement of the drag link (XXX).

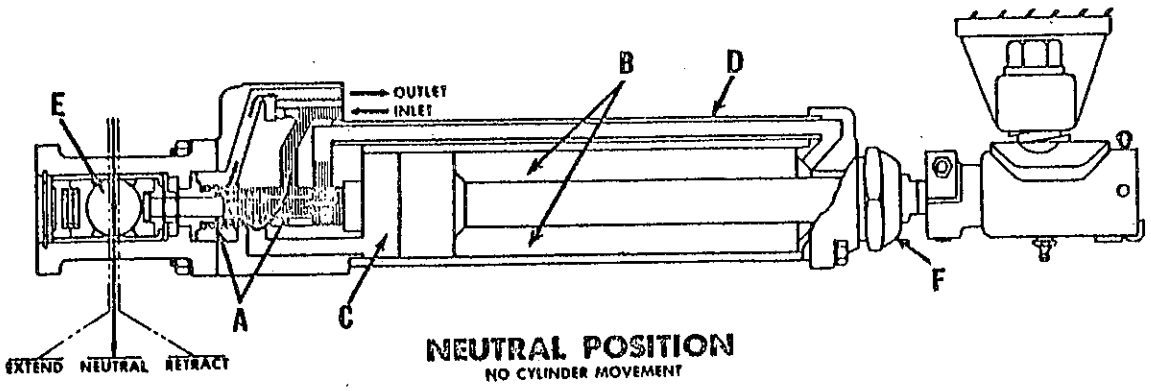
The force applied to the drag link (XXX) by the booster is automatically the amount of thrust necessary for all steering requirements.

The action of the booster's hydraulic mechanism as shown schematically in illustration shown on page 133, paragraph 59, responds automatically to any movement of ball stud (E).

Movement of the ball stud (E) to the right removes the control valve (A) to the right, directing oil pressure to rod end of the booster cylinder chamber (B) producing a linear movement of the cylinder and attached drag link to the right. Oil from head end of booster cylinder at (C) is directed back to oil tank.

Booster cylinder (D) and valve body move to right until control valve again reaches neutral position. Further movement of control valve by steering gear is necessary to produce additional drag link movement.

Booster action in opposite direction (to left) is produced when control valve actuated by ball stud (E) is moved to the left, directing oil to the head end of the cylinder.



59. The Above Schematic Drawing Shows Booster in Neutral Position.

A light spring centering device (A) holds the control valve in the neutral position when there is no movement of the steering wheel.

Oil circulates through control valve to tank while maintaining only enough pressure to stabilize the selected position of booster cylinder (D) and vehicle wheels.

Pitman arm stops (XX), page 131, paragraph 56, prevent over-travel of Pitman arm, and prevent excessive thrust and cramping of booster and steering linkage.

60. DISASSEMBLY.

Remove booster unit from vehicle. Disconnect flexible hose connections and Pitman arm and frame bracket ball studs. Disconnect drag link adaptor flange. Cover or protect openings in hydraulic system. Disassembly is accomplished in the order of index numbers assigned to Page 132, Paragraph 57. The following points are recommended at disassembly of booster.

a. Special Tools.

Use of a pronged or "Tee" shaped tool which can be made up to fit the keyway of the threaded control ball housing plug (3) will facilitate its removal and avoid the possibility of damage to the plug face and female threads of sleeve (12).

b. Control Valve Disassembly.

Removal of valve spool can be accomplished only by complete disassembly of control ball stud parts located in housing (13). This procedure is necessary for gaining access to the two "O" ring seals (21) and (27) which should be discarded and replaced with new seals at each overhaul. Back-up rings (27A) are located on both sides of spool "O" ring seal (27) and should also be replaced at each overhaul. Be sure to install grain sides of back-up rings against the "O" ring.

1. Disengage control ball stud housing (13) from cylinder head (29) by removing four nuts (50). Slide housing (13) with assembled spool (28) free of cylinder head spool bore and remove large centering spring (24) from the projecting spool. It will be noted at this point that the spool is secured internally in the ball stud housing.

2. Disassembly of the housing component parts is necessary to gain access to valve stem centering nut (10) and its lock washer (9). This is accomplished by removing snap ring (1), key (2), plug (3), spacer (4), spring (5), seat (6), ball stud (18), and seat (7). After removing component housing parts, pull lockwasher (9) out, and unscrew centering nut (10) by working screwdriver against lugs of centering nut to unscrew it. Next, slide valve spool with attached springs, seals and retainers out of the control stud housing.

61. INSPECTION.

a. Replace all sealing elements with new. Wash all remaining disassembled parts in a good grade of solvent. Lay them aside on a clean lint-free surface for inspection.

b. Inspect all fluid passages in valve body (29), retainer housing (13), cylinder (42), tube (43) and spool (28).

c. Check each disassembled part for excessive wear, cracks or pitting that might render them unfit for further service. Replace all defective parts.

d. Inspect valve spool lands for deep scoring. Also check valve spool bore for similar scoring. Replace these parts if badly damaged or worn. Do not rework, or touch up the valve spool. This practice will only result in poor booster performance and probably creeping of the piston rod.

IMPORTANT

Replacement of the valve spool requires careful reassembly and testing as outlined in paragraph (62) (Reassembly) following.

62. REASSEMBLY.

NOTE: Immerse all parts in clean hydraulic oil to facilitate reassembly. Reassemble parts in reverse order of index numbers as shown in paragraph (57), and check the following points in the process.

a. SEALS. Make certain that all seals, wipers and packing are replaced with new parts at reassembly. Seals must be properly seated to prevent external leakage and air intake into the system. All seals should be assembled with a liberal coat of grease or petroleum jelly.

b. PISTON ROD AND PISTON SUBASSEMBLY. Assemble piston to rod (57) at the control valve end. Make certain that cotter pin is used to anchor nut (45). Expand piston ring to assemble ring in groove of piston.

c. SHAFT BUSHING. If bushing (51) has been removed, it should be replaced by a new part. Press new bushing (51) into its seat in cylinder cap (49).

d. CONTROL VALVE ASSEMBLY.

1. Wash disassembled parts and prepare booster for reassembly.

a. Add back-up rings (27-A) and replace "O" rings (27), (21) and (19) with new ones in reassembly. "O" rings should be coated liberally with a light grease or vaseline prior to assembly.

2. Install "O" ring (27), and back-up rings (27-A) with rough side against "O" ring in "O" ring groove on stem of spool (28). Use a sleeve or cover with a stiff paper to avoid cutting the "O" ring in assembly. Locate washer (26) and inner center springs followed by retainer (23). Be certain "O" ring (21) is placed in "O" ring groove of retainer (23). Press the assembly slowly into ball stud housing (13), taking care not to damage "O" ring (21).

3. Slide sleeve (12) into housing (13) and over spool stem (28). Install washer (11).

4. Screw centering nut (10) on spool stem (28) approximately 17 turns, leaving about 3 threads showing.

5. Next place the large outer spring (24) over the assembled valve. Making certain that "O" ring (19) is in place, place on the pilot of ball stud housing (13). Place ball stud housing (13) in position and fasten with four nuts. Be certain the opening in housing (13) is in the correct position for final assembly to the Pitman arm. Tighten nuts on stay bolts to 20-25 ft/lbs torque.

6. The booster is now ready for centering. Refer to paragraph 63-c for this operation.

7. Install lockwasher (9). Insert tab on I.D. of washer (9) in slot of spool (28). One of the tabs on the O.D. of washer (9) will line up with one of eight slots on centering nut (10). Engage tab of washer (9) by bending into slot of centering nut (10). This may be accomplished best by determining the tab to be bent and then removing washer (9) from the assembly, and bending the tab with pliers. Reinstall washer (9) in the assembly, making certain it engages nut (10) properly.

8. Place ball stud seat (7) in position over washer (11). Insert ball stud (18), ball stud seat (6), spacer (4), spring (5), and plug (3).

9. Screw plug (3) in against the

spring solidly. Then back off to first key slot in sleeve (12).

10. Insert key (2) and snap ring (1).

11. Reassemble the booster to the vehicle. Insert grease in ball stud housing (13) thru Alemite fitting (14).

e. ANCHOR BALL STUD HOUSING. Assemble housing (59) by threading it to the end of rod (57). Align with rod flats and assemble locking screw and nut (58). Do not assemble housing components (64) thru (68) until control valve centering tests have been completed. (See Test Procedures.)

f. CYLINDER HEAD ASSEMBLY. Install check valve components, ball spring, washer and lock washer in proper sequence in the check valve bore. Return all plugs to their respective locations in the valve body housing.

CAUTION

Never use compressed air for flushing of hydraulic units. Compressed air carries water and dirt particles which are detrimental to the proper functioning of hydraulic equipment.

Complete the reassembly of the booster. Insert the four stay bolts (41) thru cap (49), valve body (29) and housing retainer (13). With cylinder (42) and return tube (43) proper aligned between the valve body and retainer assemblies, tighten each of the four nuts (50) to 20-25 ft/lbs torque.

63. TEST PROCEDURE.

These hydraulic boosters should be tested after each overhaul with either a commercial test stand or a field circuit.

a. TEST CONDITIONS.

Fluid temperature - 110° to 130° F.
Fluid medium - DTE light oil or equivalent.
Rated pressure - 1000 psi.
Test volume - 10 gpm maximum.

b. TEST PROCEDURE. Secure booster adequately, and in such a manner that will permit unhampered movement of the piston rod. Connect booster to pump lines with test equipment installed. Make certain all air is bled from the system and that all oil lines are tight.

NOTE

Check for seal leakage and body porosity at all tests.

c. CENTERING TEST.

1. With pump at full delivery rate and control ball stud (18) in neutral position, there should be no piston rod movement. Activate stud (18) in either direction to move rod. Release ball stud to stop rod travel short of complete stroke. If rod creeps at this test, readjustment of the control valve is necessary.

2. Operate the pump at 1000 to 1200 rpm. Insert a screwdriver in position in slot of the spool (28). Hold the centering nut (10) firmly in position, and adjust the spool until the rod is in 1/2 extended position. To do this, turn the spool clockwise to retract or counterclockwise to extend the rod. The spool is centered when the rod does not creep in either direction.

3. Lock valve spool in place by installing the lockwasher. Insert inside diameter tabs of the lockwasher in the slot of the spool. One of the outside diameter tabs should then line up with one of the centering nut slots. Bend it into the slot.

4. Assemble remainder of parts to booster and check for rod creepage. With six gallons per minute circulating thru the booster, there must be no movement of the rod. Repeat centering test to assure proper control.

NOTE

To "crack" relief valve, apply full volume flow to inlet port and shift control ball stud to retract or extend the rod fully. Hold ball stud in activating position and observe gage. Needle will flutter at "cracking" pressure.

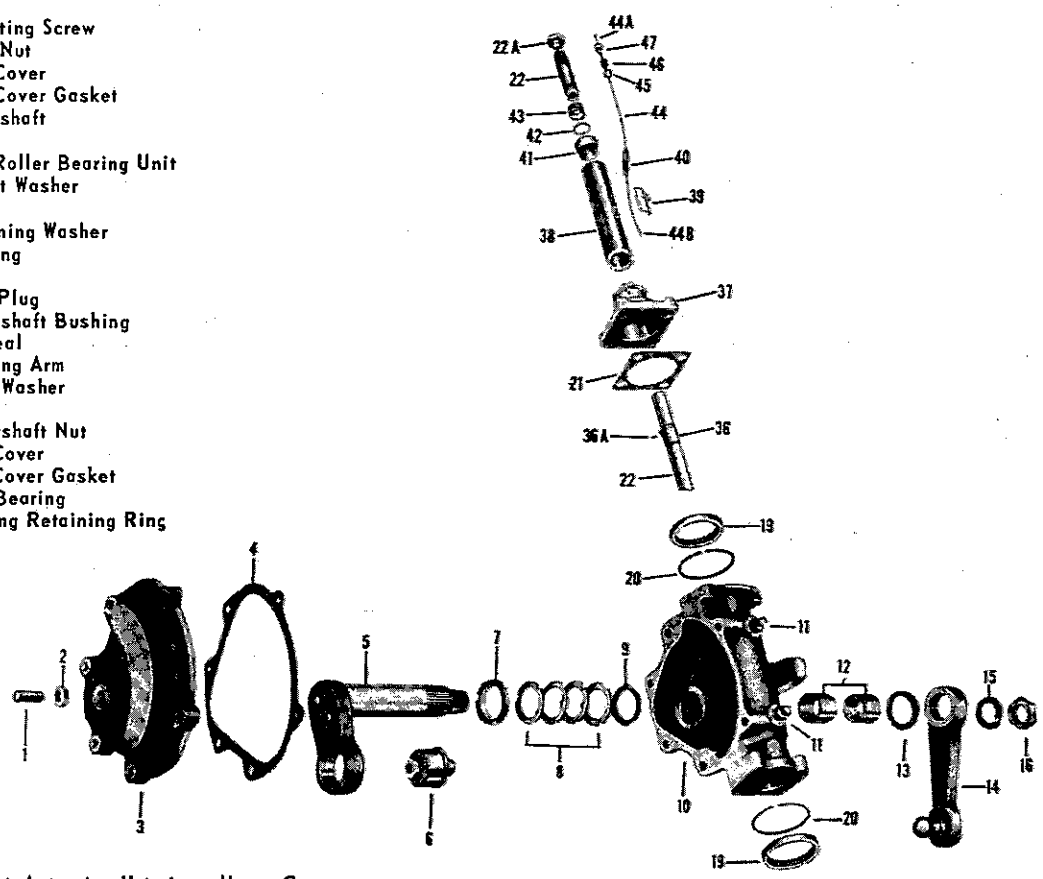
d. ROD PACKING TEST. Center piston rod at midpoint of travel. With booster lines open to flow, adjust rod packing nut (F) so that a maximum of 50 lbs. pressure is required to move rod in either direction of travel.

1 Adjusting Screw
2 Lock Nut
3 Side Cover
4 Side Cover Gasket
5 Levershaft

6 Stud Roller Bearing Unit
7 Thrust Washer
8 Shims
9 Retaining Washer
10 Housing

11 Pipe Plug
12 Levershaft Bushing
13 Oil Seal
14 Steering Arm
15 Lock Washer

16 Levershaft Nut
17 End Cover
18 End Cover Gasket
19 Cam Bearing
20 Bearing Retaining Ring



21 Gasket, Actuating Housing - Upper Cover
22 Cam and Wheel Tube Assembly
22A Wheel Nut
23 Thrust Bearing
24 Thrust Washer
25 Actuator Retainer Screw

26 Washer, Seal
27 Actuator Housing
28 Gasket, Actuator Housing
29 Actuating Lever
30 Centering Washer

31 Actuator
32 Springs, Centering
33 Tongued Washer
34 Lock Washer
35 Adjusting Nut

36 Contact Ring
36A Mounting Screw
37 Upper Cover
38 Jacket Tube
39 Contact Brush
40 Insulator

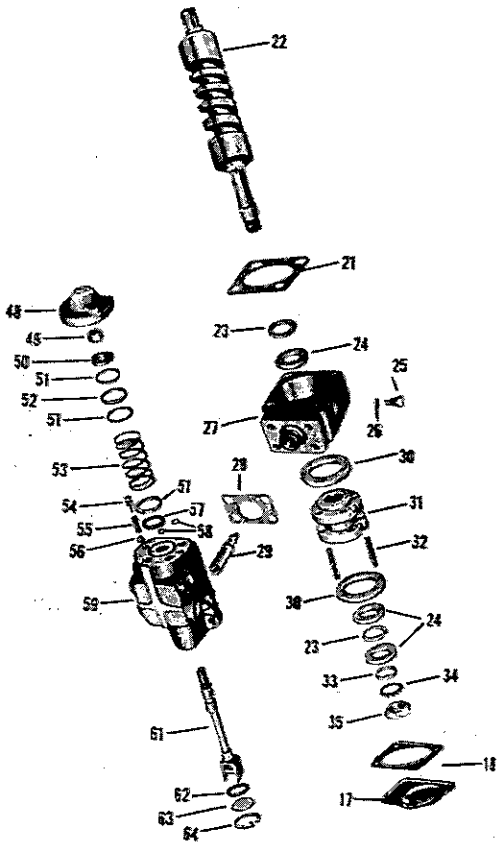
41 Jacket Tube Bearing
42 Spring Seat
43 Spring
44 Horn Cable
44A Upper Terminal
44B Lower Terminal

45 Contact Washer
46 Contact Spring
47 Insulating Ferrule
48 End Cover - Valve Housing
49 Elastic Stop Nut
50 Washer

51 Centering Washer
52 "O" Ring
53 Spring
54 Plug Assembly w/"O" Ring
55 Spring

56 Steel Ball
57 "O" Ring
58 "O" Rings
59 Valve Body and Spool
61 Flexure Rod Assembly

62 "O" Ring
63 Cover Plate
64 Retainer



EXPLODED VIEW OF ROSS HYDRAULIC POWER STEERING GEAR ASSEMBLY

64. FRONT AXLE BOOSTER STEER (A-W TYPE).

A. OPERATION.

The Ross Hydraulic Power Steering Gear arrangement is shown on page 136 and utilizes hydraulic pressure from the engine driven pump. A priority or flow control valve is located in the hydraulic line to regulate the amount of hydraulic oil going to the Ross Power Steering valve, which in turn is directed to the front steering ram. The front steering ram group is similar to the rear steering ram as shown on page 129 and the instructions shown under paragraph 54 will apply to both units.

The action of the steering gear is both manual and hydraulic in effect. When the cam is turned to the left or right, by the driver's effort on the steering wheel, the stud of the inner lever is moved through the groove of the cam (worm), thus rotating the levershaft and providing angular movement of the steering gear pitman arm. Whenever the driver's effort at the steering wheel exceeds the preload of the centering springs, the control valve is actuated and the hydraulic power is applied to the hydraulic ram assembly to provide the driver with power steering.

B. MAINTENANCE DATA.

1. ADJUSTMENTS.

(Reference numbers in parentheses can be identified from exploded view, page 136.)

When making adjustments, free the steering gear of all load, preferably by disconnecting the drag link from the steering gear arm and, loosen the instrument board bracket clamp on steering gear column to make sure the steering column is not binding, thus preventing the valve from centering. Loosen any clamp on column that is located over the bearing in upper end of column tube.

2. ADJUSTMENT NO. 1 - THRUST BEARINGS. (Ref. 23 & 24)

The valve is mounted on the bottom end of gear. The upper cover need not be removed because this adjustment is made on the lower end after removal of lower end cap.

a. Before adjusting thrust bearings turn gear off its center position to free the stud (6) in the cam groove (22).

b. Remove capscrews holding upper cover (37) and remove cover and jacket tube assembly.

c. Reassemble screws in actuator housing (27) with 3/8" thick spacers under heads of screws. This is to hold the actuator and cam assembly in the gear when making the adjustment.

d. Straighten prong of lock washer (34). Remove adjusting nut (35), tongued washer (33), and lower thrust washers and thrust bearing (23,24).

e. Insure that the threads of the nut and cam shaft are free of interference by running the nut onto the cam shaft using only the fingers to drive the nut. If the nut cannot be driven all the way with finger-torque, the threads are fouled and must be cleared with a thread file or other means until the nut goes on freely.

f. Reassemble thrust washers and thrust bearings (23, 24), tongued washer (33, with internal lug), and pronged washer (34, with thirteen external prongs), and adjusting nut (35).

Adjust as Follows:

g. Drive on nut (35) and tighten to 10 foot pounds torque. Back off nut 10^{o} - 20^{o} which can be done by moving the nut relative to the pronged washer approximately 1 1/2 width of a lug. Observe lug nearest in alignment with a notch in the adjusting nut and bend the lug tight against the notch root.

(If torque wrench is not available, adjustment may be made with 10" Multi-Slip Joint pliers. Avoid use of long handled wrench as too much torque can be easily applied. This adjustment is similar to a wheel bearing adjustment and should provide a light preload of the needle thrust bearings without lash or heavy drag.)

h. Reassemble upper cover (37) and jacket tube assembly and other parts to the gear.

3. ADJUSTMENT NO. 2 - STUD IN CAM GROOVE.

NOTE: Backlash of the stud in the cam groove shows up as backlash at steering wheel and at ball on steering wheel and at ball on steering arm.

Adjust through mid-position to the high spot. Do not adjust in an end position. Backlash in the end positions is normal and not objectionable.

A shim pack (8) is used between the lever and housing to prevent the taper stud from being pulled into the cam groove by external forces on the levershaft.

The shim pack consists of .003", .010",and .020" shims between two washers (7, 9). When compressed solid the shim pack should be of sufficient thickness to hold the taper stud out of the cam groove but not so thick as to prevent adjusting to the high spot.

To Adjust:

a. Tighten side cover adjusting screw (1) until a very slight drag (high spot) is felt when turning the gear through mid-position. If the high spot cannot be felt, remove shims from shim pack until it can.
(Note: Remove only enough shims to permit feel of high spot.) When adjusted to positive high spot, back off adjusting screw 1/16 turn and lock adjustment with lock nut. Hold adjusting screw with screw driver while tightening nut.

b. If the high spot can be felt without removal of shims, additional shims may be needed in the shim pack. The only positive way of knowing is to add shims until high spot cannot be felt, then remove shims and adjust as directed in paragraph "a" above.

c. After adjustment is locked with lock nut, turn gear through full travel (extreme left turn to extreme right turn, or vice versa) to check adjustment.

After this adjustment, reconnect the gear at all points loosened prior to making the adjustment. Before reclamping the upper column bracket, refer to "Column Alignment" instructions, number 6. Also check tightness of mounting flange bolts and nuts, steering arm on levershaft, and nut on the levershaft.

4. ADJUSTMENT OF STUD ROLLER BEARING UNIT. (Ref. 6)

The foregoing adjustments will suffice in nearly every instance, but in some cases it may be necessary to adjust the stud-roller bearing unit in the levershaft. In order to make this adjustment the shaft must be removed from the gear.

The roller bearing should be preloaded at all times. Adjust to a noticeable drag.

Factory adjustments on new units are set to three inch pounds of torque to revolve stud. Used or replacement units should also be set to approximately three inch pounds torque.

Note: Operation of a correctly adjusted unit may feel rough to the hands but under steering load it will be properly distributed, which will assure normal service life. The stud should be rotated several full turns and reversed before checking rolling torque.

a. Wash bearings in solvent and lubricate with oil recommended for lubrication of gear.

Should any roller be damaged or lost, replace with a complete new set. Do not make a partial replacement.

b. Use new locking washer. (If old washer must be used, break off bent prong to prevent using again.)

c. Tighten nut as required. (Hold stud from turning by using spanner wrench on washer.)

d. Revolve stud several complete turns and reverse and test adjustment.

e. Lock adjustment by bending over locking washer prong that is at right angle to a side of the nut. Do not use the washer twice unless the prong used has been removed.

f. Lubricate with lubricant used in gear.

5. ADJUSTMENT OF VALVE (Ref. 59).

There is no adjustment on this control valve (59); however, when clamped to the actuator housing (27) the spool of the valve must not be pulled off center.

6. COLUMN ALIGNMENT.

Alignment of the column is of paramount importance. THE STEERING COLUMN MUST NOT BE SPRUNG IN ANY DIRECTION FROM ITS FREE POSITION. A bind in the wheel tube, due to column misalignment, will prevent centering the control valve in neutral position. It can cause wheel tube failure due to bending stresses.

7. REMOVAL OF GEAR FROM CHASSIS.

Before removing a gear, note the hookup of hydraulic lines. Identify by tagging lines and noting the ports each connect to.

The following is a general procedure outline.

a. Remove horn button from steering wheel by gripping with downward pressure of fingers and twisting either right or left. Unscrew the three screws to remove base plate. Remove wheel nut (22A).

b. Remove steering wheel, using wheel puller.

c. Remove steering gear arm (14) from levershaft (5). Use arm puller if possible. Do not hammer off arm without using support against the end of the shaft and use light blows as they are more effective. Heavy blows may cause brinelling of the cam lead.

d. Disconnect the hydraulic lines at control valve. Tag to identify ports each connects to.

e. Plug all ports to keep out dirt.

f. Release column from upper support bracket.

g. Remove mounting flange bolts and remove gear from chassis.

8. DISASSEMBLY OF GEAR.

The following procedure applies to complete disassembly of gear after removal from chassis. For partial disassembly the procedure may differ depending upon the parts involved.

a. Removal of Levershaft:

1. Loosen lock nut (2) and unscrew adjusting screw (1) a few turns.

2. Remove housing side cover (3).

3. Slide levershaft (5) from housing (10) having first made sure there are no burrs on the outer end of shaft to damage the bushing (12) and seal (13) in the housing. Keep shim pack (7,8,9) intact.

b. Removal of Control Valve.

1. Remove four screws holding valve (59) to actuator housing (27) and remove valve.

c. Removal of Cam and Tube Assembly:

1. Unlock actuator retainer screw (25) and remove actuator housing (27).

2. Remove whole assembly of cam and wheel tube and valve actuator assembly as a unit from housing (10) or remove after further disassembly.

Further disassembly of actuator and bearings can be made as follows:

3. Remove adjusting nut (35) after straightening bent prong of lock washer (34). Remove tongued spacer washer (33) and lower thrust washers and needle bearing (23,24).

4. Remove lower centering washer (30) from end of actuator (31) and remove actuator taking care not to lose springs (32) that are in the actuator.

5. Remove upper centering washer (30), thrust washer (24) and needle bearing (23).

9. REASSEMBLY OF GEAR.

a. Replace all gaskets and seals.

b. If needle bearings (19) in ends of housing (10) have been removed, replace them. Take care not to press bearing too hard against retaining ring.

c. Reassembly is reverse of disassembly as shown under "Disassembly of Gear" instructions, number 8.

10. INSTALLATION IN CHASSIS.

a. Place gear in chassis and clamp securely.

b. Install steering wheel. Draw nut tight. Suggested torque setting: 55-65 foot pounds.

c. Install horn button parts.

d. Center steering gear. Count number of turns of steering wheel from extreme left turn to extreme right turn, or vice versa. Turn the wheel back half this number of turns to the mid-position.

e. Set front wheels straight ahead, parallel with the frame rails. Measure from each rail to a corresponding point on each tire and make sure this dimension is the same on both sides.

f. Connect drag link to ball on steering arm.

g. Install steering arm on levershaft of gear. If arm does not line up with splines of shaft, turn steering wheel left or right, no more than approximately 1/4 turn, until it does. With lockwasher under nut, draw nut to specified torque.

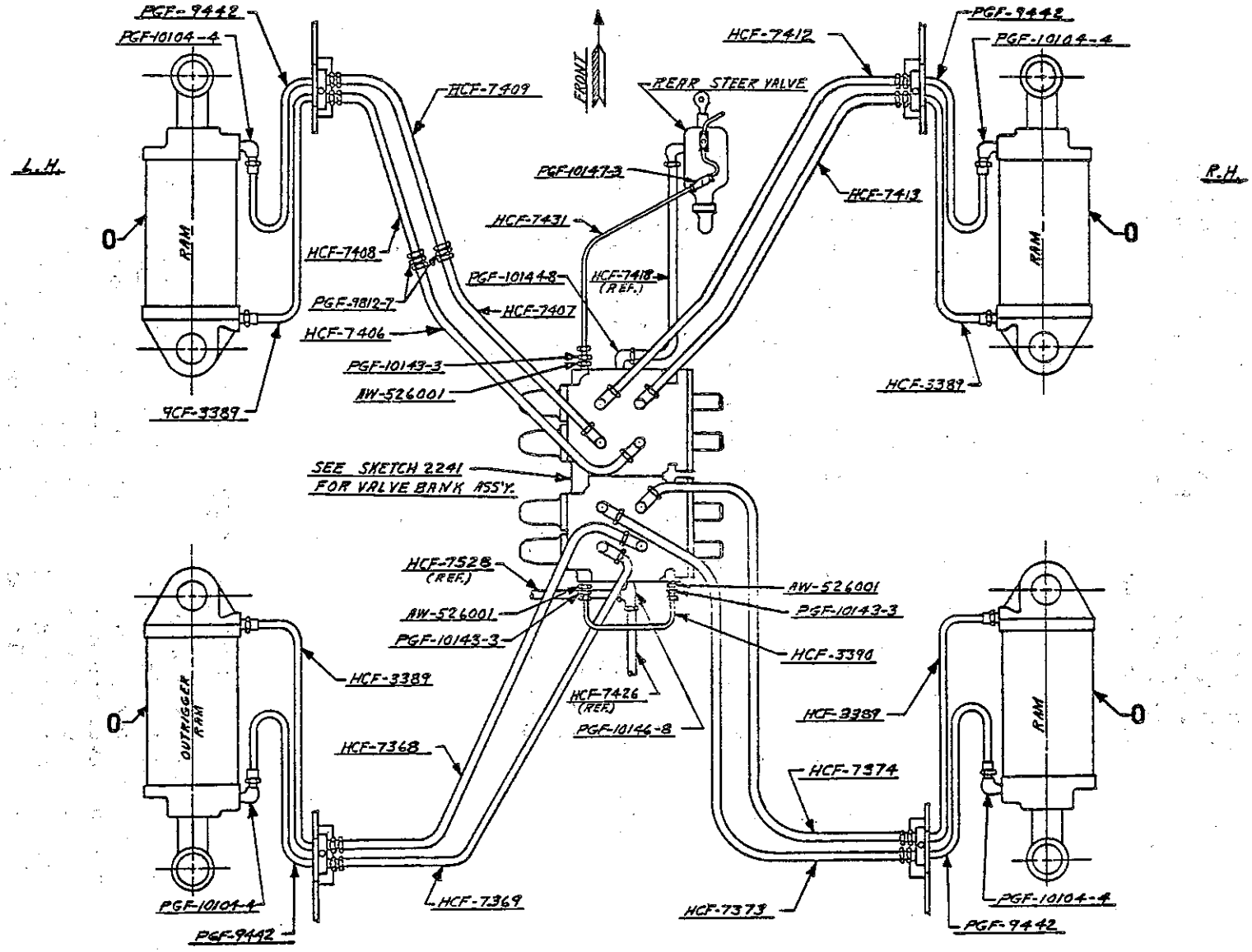
h. Install hydraulic lines.

11. LUBRICATION.

a. Use SAE90 gear and transmission oils.

b. Fill steering gear housing with lubricant. Fill housing from upper-most filler plug. Housing should be full to insure adequate lubrication of all internal parts.

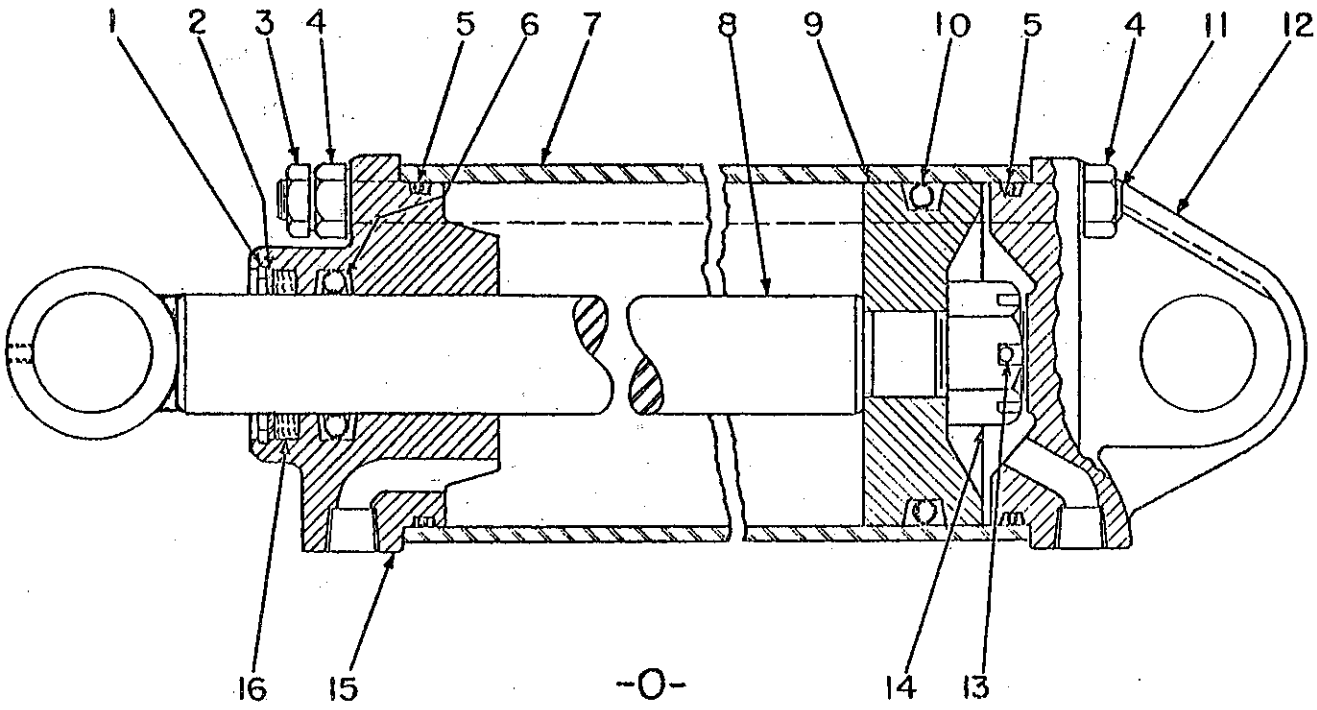
Capacity: 2.28 lbs.



65. HYDRAULIC OUTRIGGERS HYDRAULIC PIPING DIAGRAM

66. HYDRAULIC OUTRIGGERS.

a. The hydraulic pump for the outrigger circuit is the same pump as is used for the steering circuit. (See paragraph 5, page 56.) This pump is located at the front of the engine and is driven by a "V" belt. The pump is an important unit and should be handled with care. Loss of volume will more than likely be due to loose connections or slow engine and pump speed. Page 8 shows the outriggers as assembled and in the down position. The hydraulic control valve bank levers are located to the right of the operator's seat. The levers may be used either individually or simultaneously. The hydraulic piping arrangement is shown on the previous page.



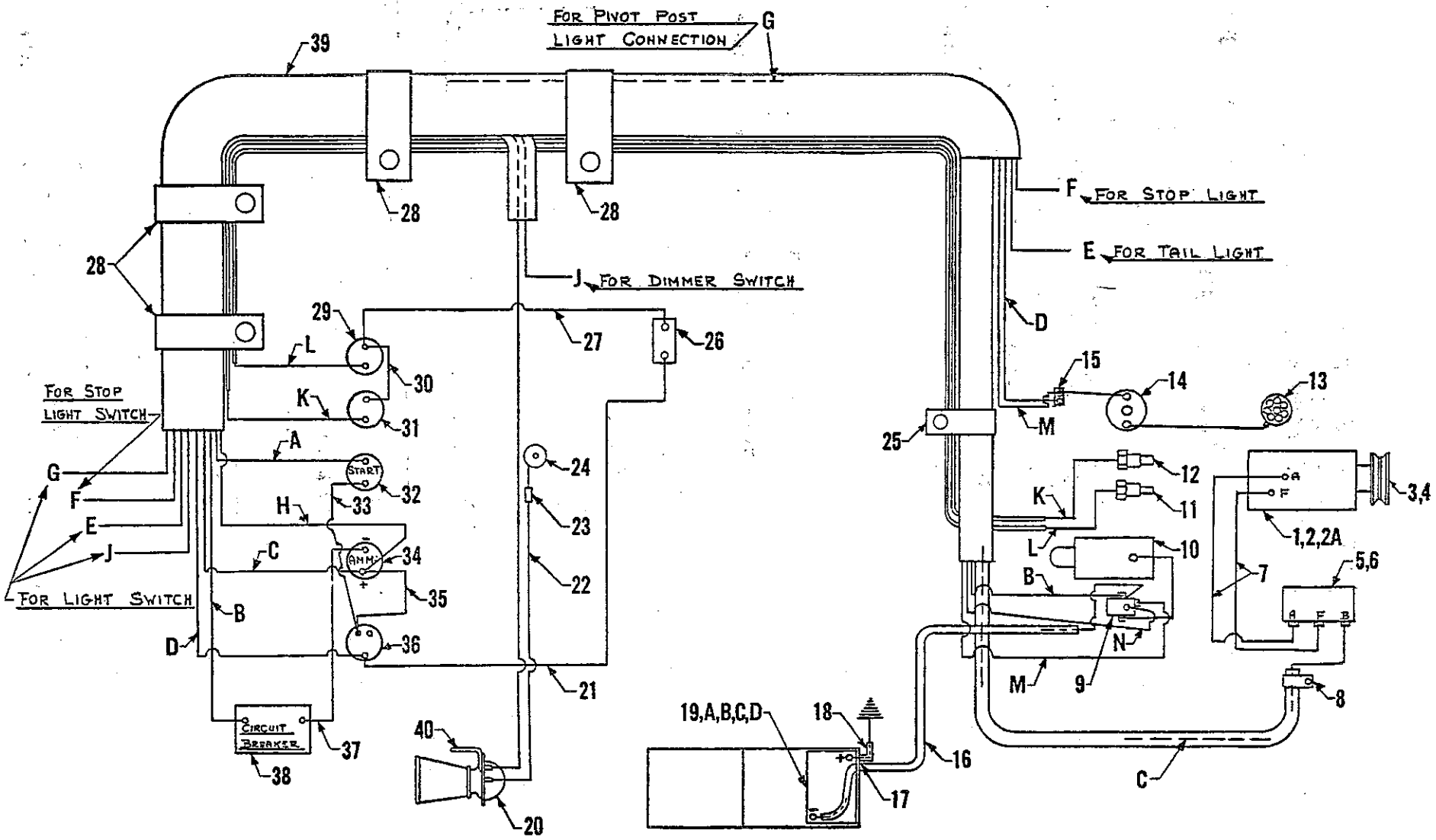
HYDRAULIC OUTRIGGER RAM

b. The above sketch shows the double acting ram used at each of the four outriggers. (See "O" on previous page.) To remove the ram group lower the outriggers by extending the ram. Remove the pin at the cylinder base and rod end. Remove the two hydraulic hoses. The ram group is now free to be removed.

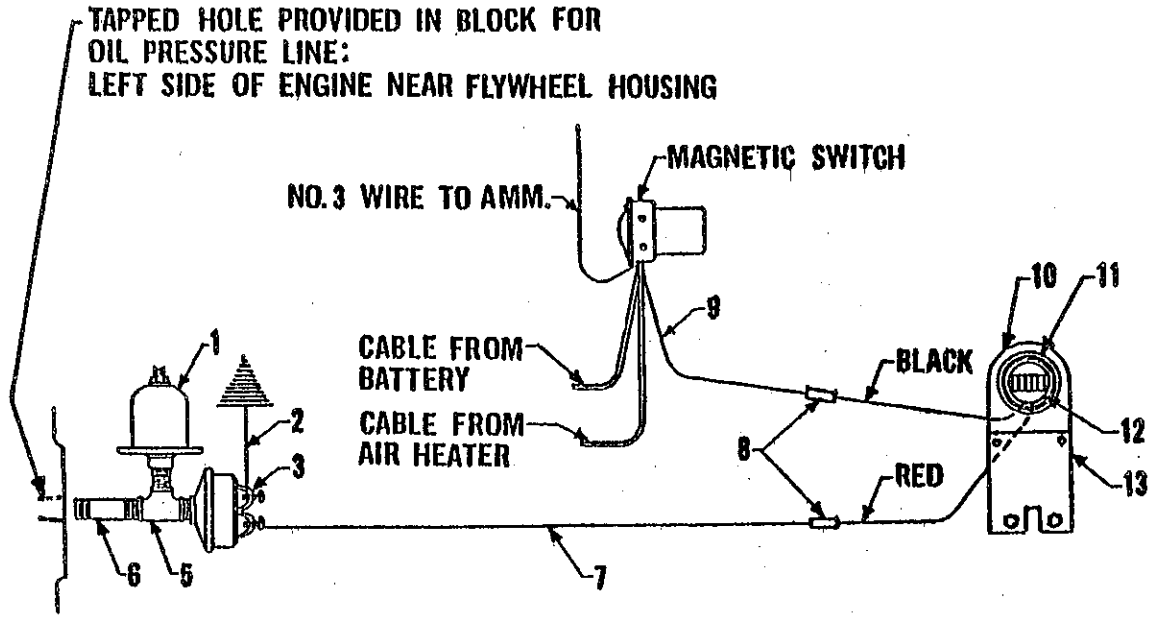
c. To dismantle the ram, proceed as follows:

Remove the four tie rods (11) by removing the jam nut (3) and nut (4). The group will now come apart. To replace "O" ring (6) and felt (16), it will be necessary to remove the large nut (14) at end of the piston rod and remove the piston (9). Remove snap ring (1) and washer (2) to remove felt (16).

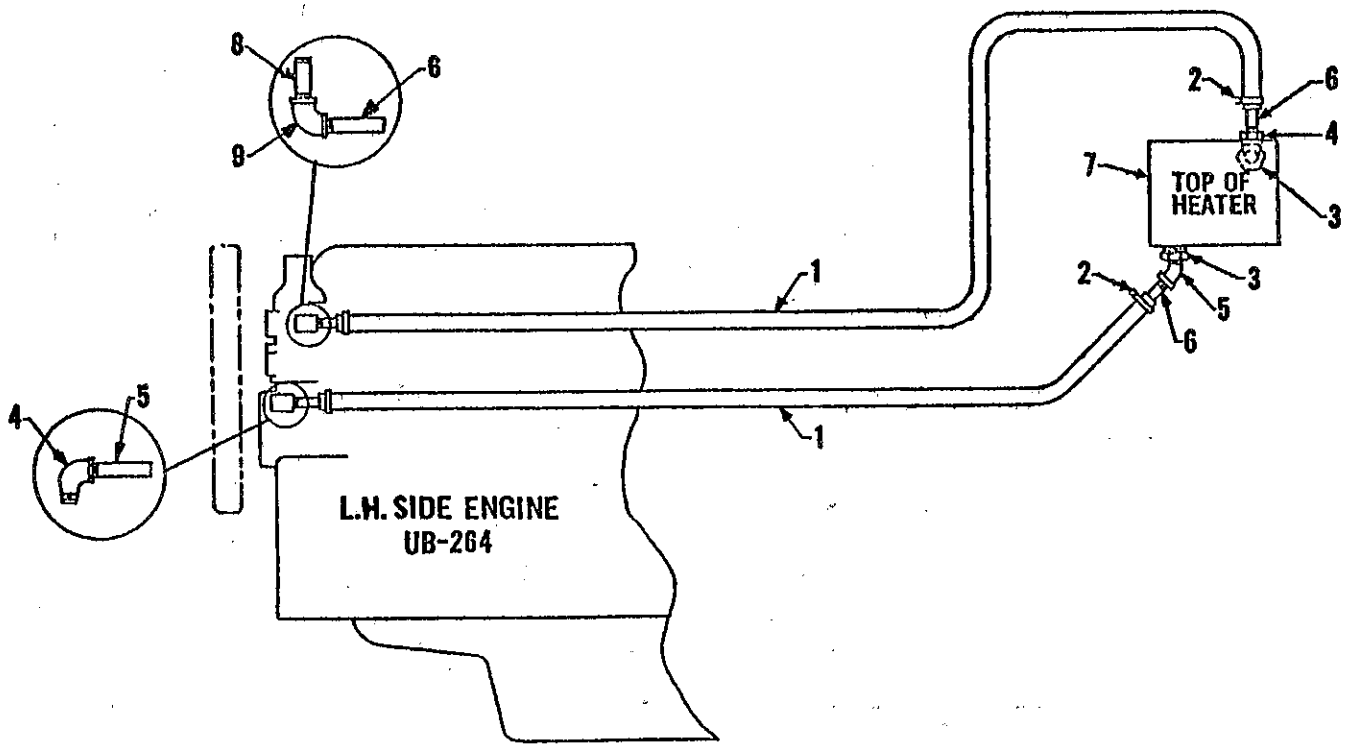
Reassembly is the reverse of above instructions.



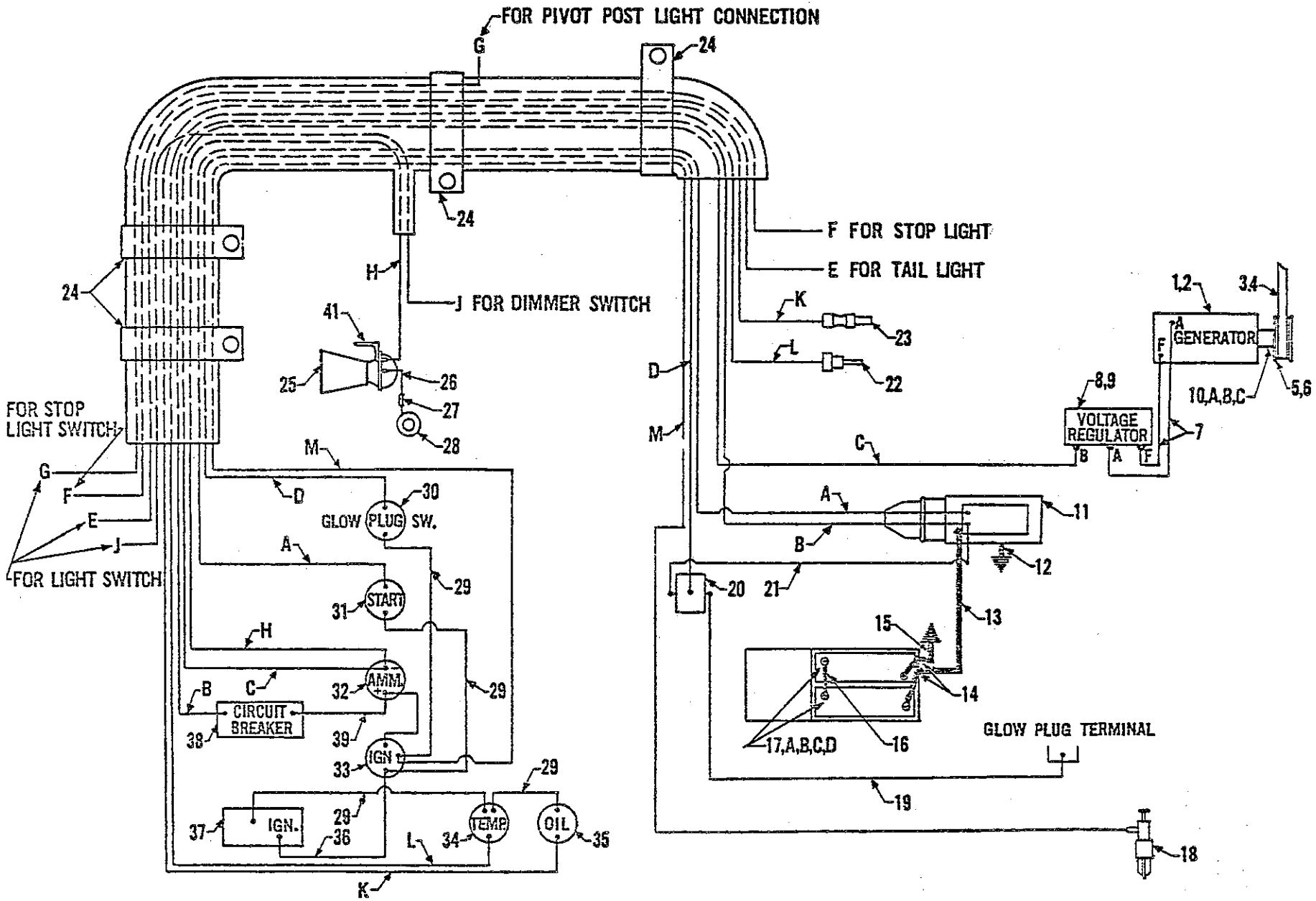
67. ELECTRICAL ACCESSORIES AND WIRING DIAGRAM
(For IHCo. - UB-264 Engine)
(See Repair Parts Book for part numbers and other details)



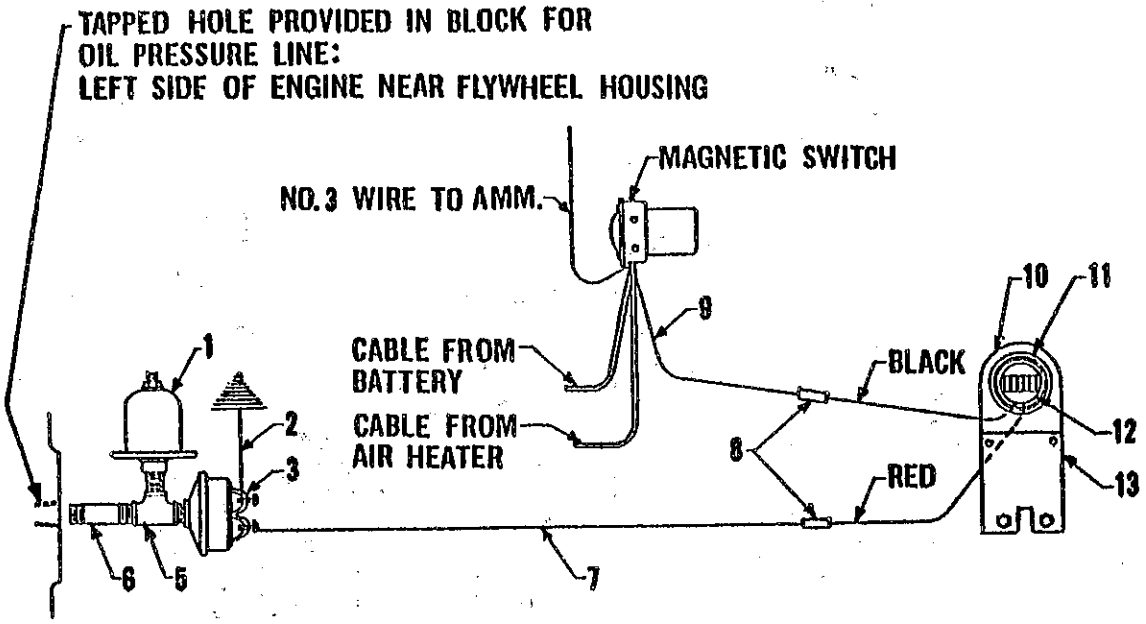
68. HOURMETER WIRING DIAGRAM
(For IHCo. - UB-264 Engines)
(See Repair Parts Book for part numbers and other details)



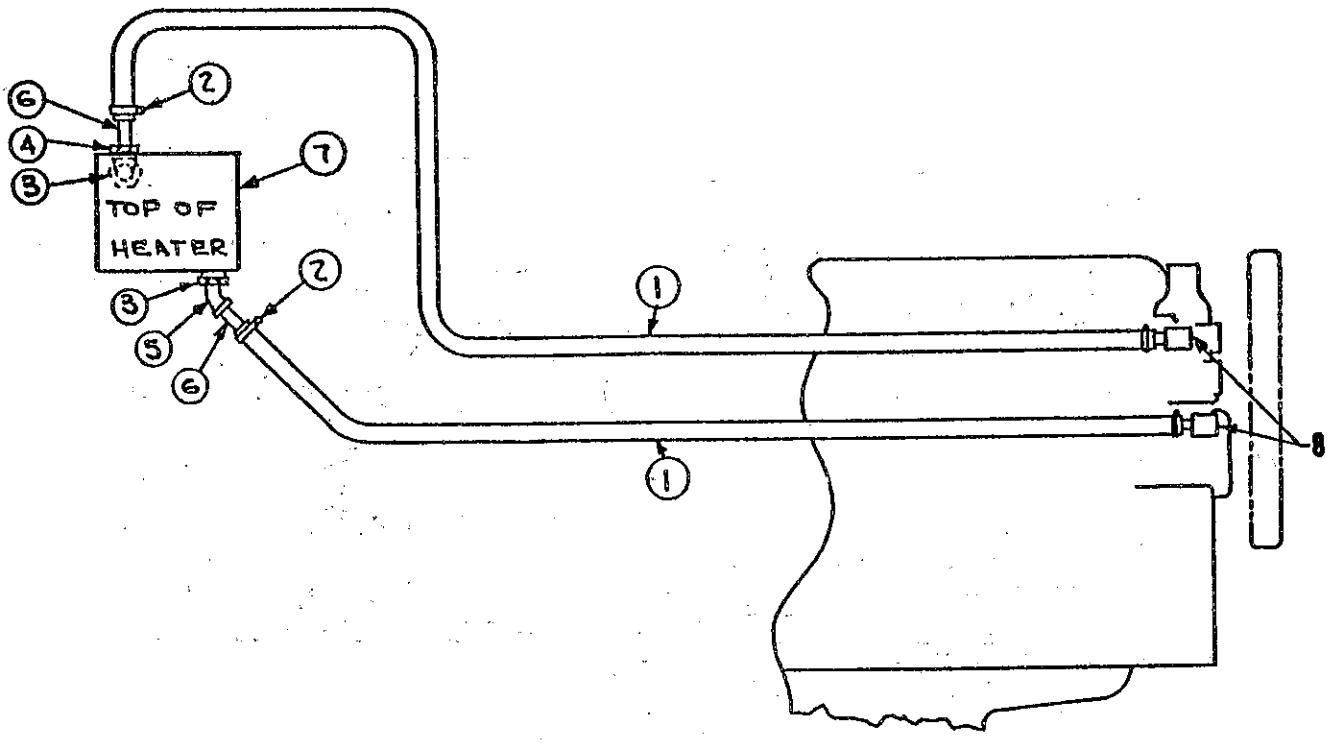
69. HEATER PIPING DIAGRAM
(For IHCo. - UB-264 Engine)
(See Repair Parts Book for part numbers and other details)



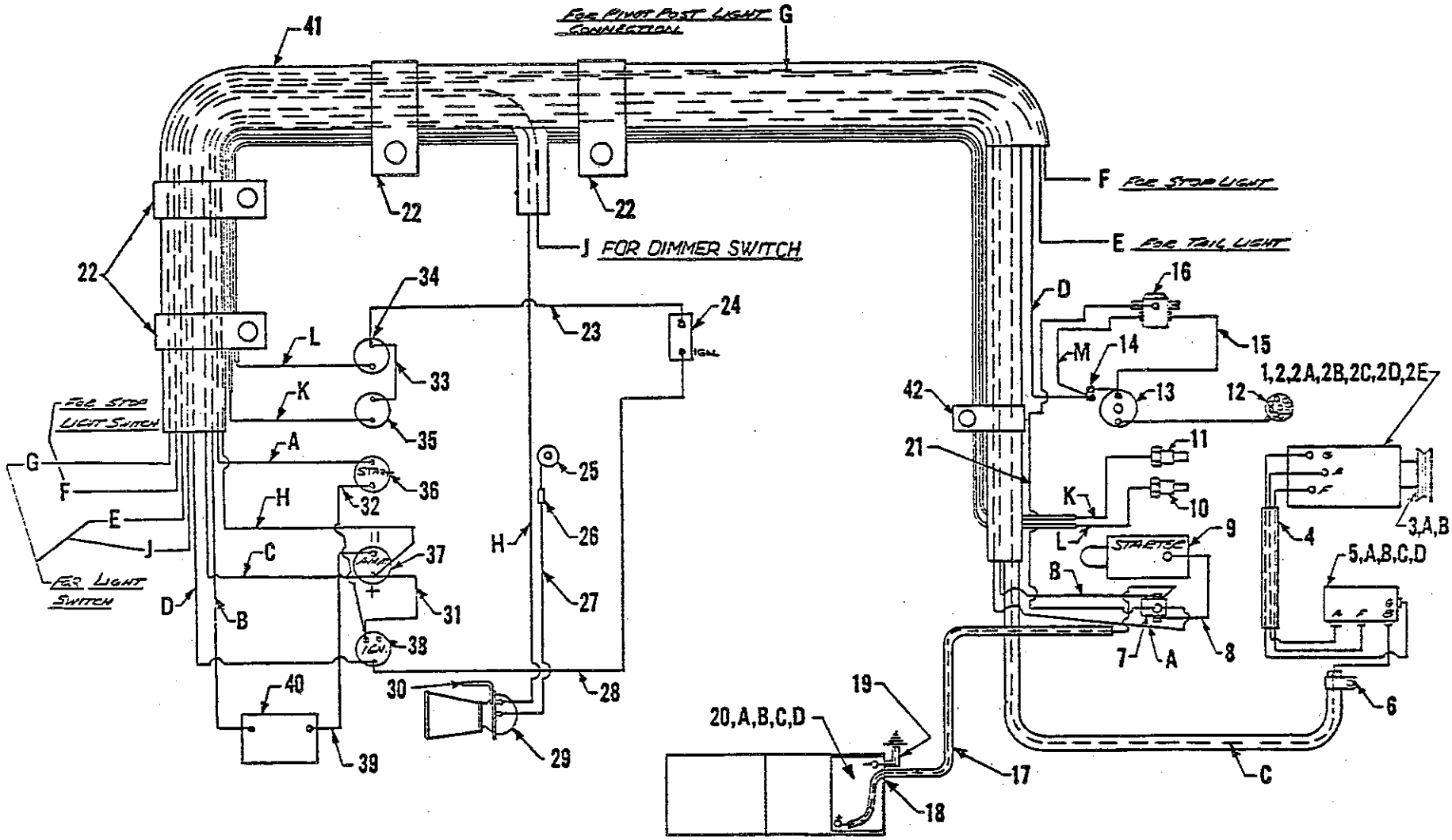
70. ELECTRICAL ACCESSORIES AND WIRING DIAGRAM
(For IHCo. - UD-282 Engine)
(See Repair Parts Book for part numbers and other details)



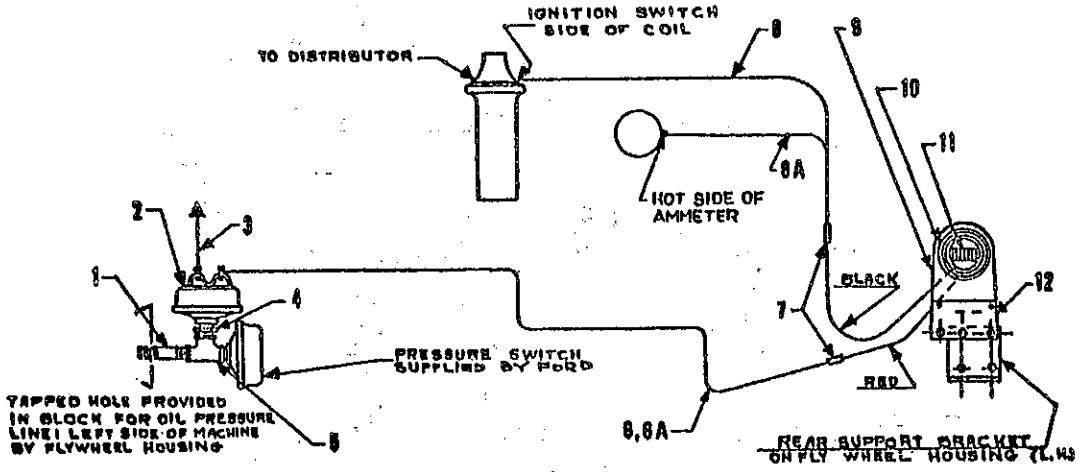
71. HOURMETER WIRING DIAGRAM
(For IHCo. - UD-282 Engines)
(See Repair Parts Book for part numbers and other details)



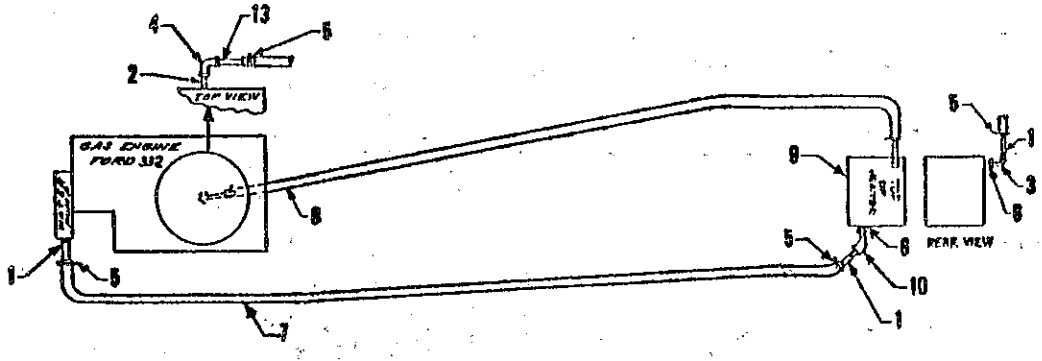
72. HEATER PIPING DIAGRAM
(For IHCo. - UD-282 Engine)
(See Repair Parts Book for part numbers and other details)



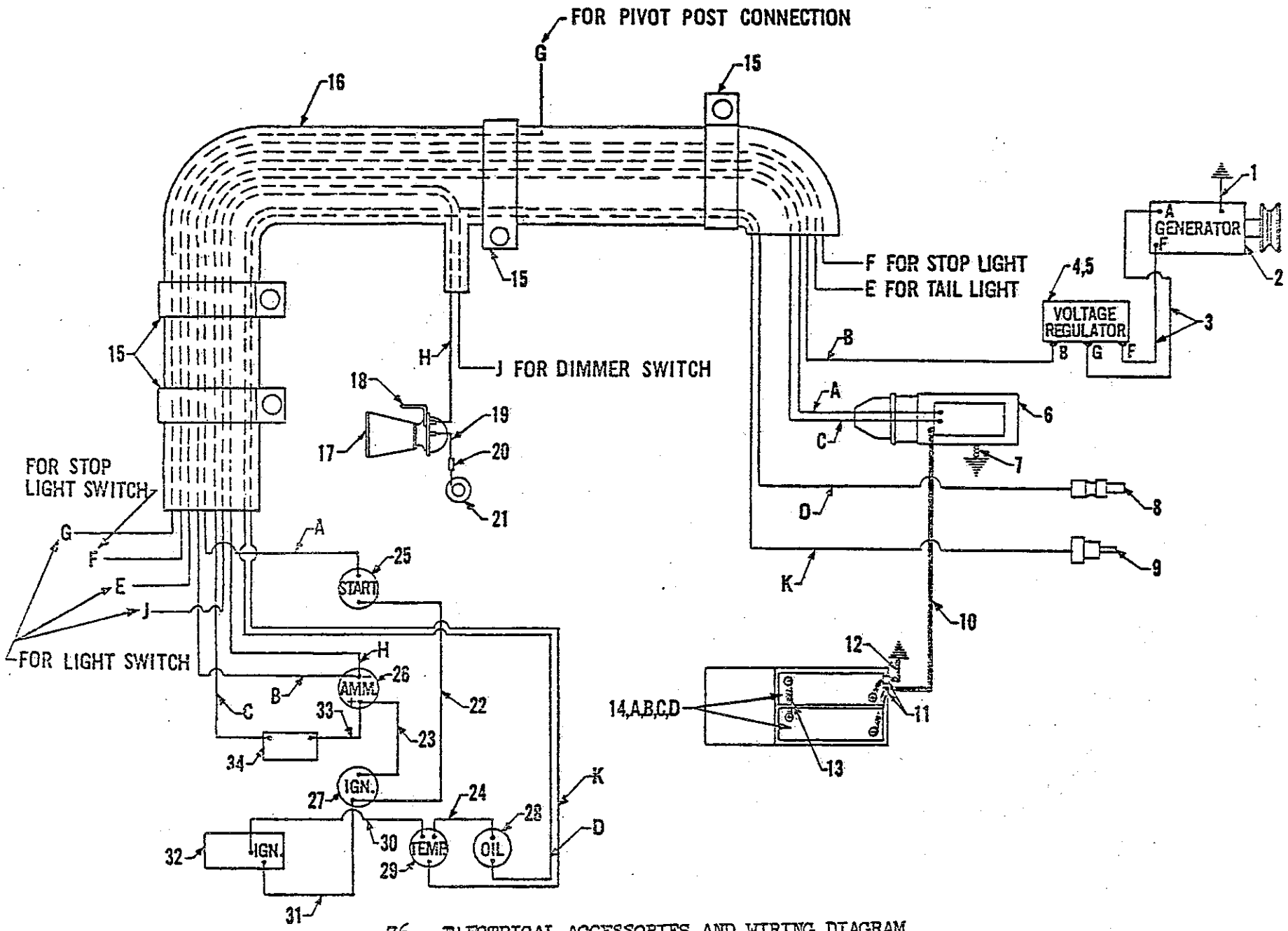
73. ELECTRICAL ACCESSORIES AND WIRING DIAGRAM
(For Ford 332 Engines)
(See Repair Parts Book for part numbers and other details)



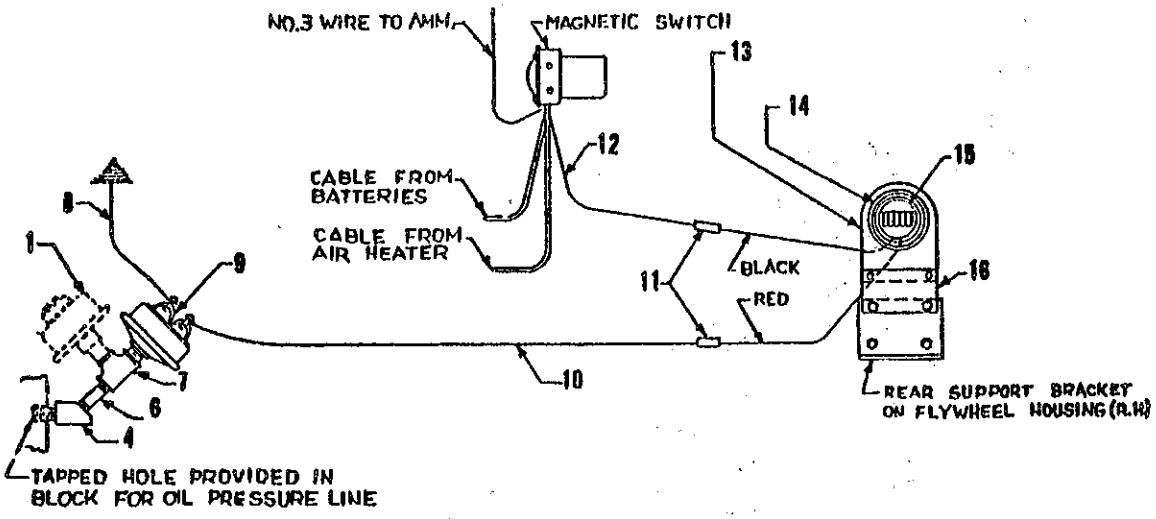
74. HOURMETER WIRING DIAGRAM
(For Ford 332 Engines)
(See Repair Parts Book for part numbers and other details)



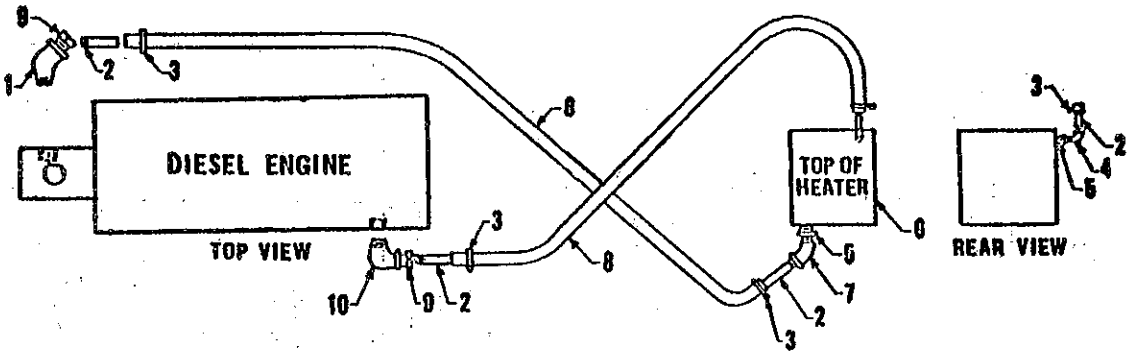
75. HEATER PIPING DIAGRAM
(For Ford 332 Engines)
(See Repair Parts Book for part numbers and other details)



76. ELECTRICAL ACCESSORIES AND WIRING DIAGRAM
(For GMC - 3-71 Engine)
(See Repair Parts Book for part numbers and other details)



77. HOURMETER WIRING DIAGRAM
(For GMC-3-71 Engine)
(See Repair Parts Book for part numbers and other details)



78. HEATER PIPING DIAGRAM
(For GMC-3-71 Engine)
(See Repair Parts Book for part numbers and other details)

Memos