

**CLARK**  
EQUIPMENT

# MICHIGAN

## OPERATORS MANUAL

No. 722

MODEL 75A

## TRACTOR SHOVEL

Information Contained Herein Pertains to Machine  
Serial Numbers Listed Below:

~~75A GAS~~ - 8123 Thru 12183, 1CA3170 Thru 1CA3899  
75A DIESEL - 8123D Thru 12183D, 1CB893 Thru 1CB1199  
75B 6123 Thru 6299  
75R 7123 Thru 7299

**CLARK EQUIPMENT COMPANY**  
Construction Machinery Division

Model 75A Tractor Shovel

# Warranty

Clark Equipment Company (CLARK) has warranted to the Distributor (Seller) who, pursuant to agreement with CLARK, hereby, on its own behalf, warrants to the Buyer each new CLARK product to be free from defects in material and workmanship under normal use and maintenance as herein provided.

Distributor's sole obligation under this warranty shall be limited to repairing, replacing or allowing credit for, at Distributor's option, any part which under normal and proper use and maintenance proves defective in material or workmanship within six (6) months after delivery to or one thousand (1,000) hours of use by Buyer, whichever shall occur first; provided, however, that (i) the product is placed in use not later than one year after shipment from CLARK'S plant; (ii) that notice of any such defect and satisfactory proof thereof is promptly given by Buyer to Distributor; and (iii) such material shall have been returned to Distributor, with transportation charges prepaid and found by Distributor to have been defective.

This warranty does not apply in respect of damage to or defects in any product caused by overloading or other misuse, neglect or accident, nor does this warranty apply to any product which has been repaired or altered in any way which, in the sole judgment of Distributor, affects the performance, stability or general purpose for which it was manufactured.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES (EXCEPT OF TITLE), EXPRESSED OR IMPLIED, AND THERE ARE NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT SHALL DISTRIBUTOR BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

This warranty does not apply to parts or trade accessories not manufactured by CLARK, or attachments not manufactured or sold by CLARK. Buyer shall rely solely on the existing warranties, if any, of the respective manufacturers thereof.

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## IMPROVEMENTS

It is CLARK'S policy to constantly strive to improve its products. The right therefore is reserved to make changes in design and improvements whenever it is believed the efficiency of the product will be improved thereby, but without incurring any obligation to incorporate such improvements in any product which has been shipped or is in service.

Revised May 1, 1966



# **MICHIGAN**

## **OPERATORS MANUAL**

**MODEL**

**75A**

**TRACTOR SHOVEL**

**No. 1199**

**ALWAYS GIVE SERIAL NUMBER OF MACHINE WHEN ORDERING PARTS**

**CLARK  
EQUIPMENT**

**CLARK EQUIPMENT COMPANY**  
Construction Machinery Division  
BENTON HARBOR, MICHIGAN, U.S.A.

**MICHIGAN**



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## TO OWNERS

You have purchased this Michigan Tractor Shovel with the expectation that it would give you long and faithful service. In its construction we have taken every precaution to see that you get an efficient, long lived, satisfactory machine. It is our sincere hope that you derive from its operation the full measure of value and utility which you looked forward to when purchasing it.

For these reasons, we take the liberty of suggesting that your Michigan Tractor Shovel will always respond at its best with considerate treatment and care. The slight outlay in personal attention and cost required to give it regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated, will repay you many times in low cost operation and trouble free service.

The purpose of this manual is to serve as a guide to the operation, lubrication and maintenance of your Michigan Tractor Shovel. Study this manual carefully before starting or operating your Michigan Tractor Shovel.

Whenever repair or replacement of component parts is required, only Clark-approved parts as listed in the applicable parts manual should be used. Use of "will-fit" or non-approved parts may endanger proper operation and performance of the equipment. The Clark Equipment Company does not warrant repair or replacement parts, nor failures resulting from the use thereof, which are not supplied by or approved by the Clark Equipment Company.



GENERATOR: 2 Cups - Lubricate using 2 or 3 drops of light engine oil.

STARTING MOTOR: 1 Cup - Lubricate using 2 or 3 drops of light engine oil.

DISTRIBUTOR: Each 50 hours of operation place two drops SAE 10 oil on wick under rotor. Remove plug at side of housing and fill with SAE 20 oil each 500 operating hours.

#### LUBRICATE AND SERVICE PERIODICALLY

Check & Service these items at intervals as specified in the following.

PROPELLER SHAFTS AND UNIVERSAL JOINTS: There are three shafts - one from torque converter to transmission, one from transmission to front drive axle, and one from transmission to rear drive axle. Each shaft has 3 points of lubrication - one on each spider assembly and one on slip yoke assembly. Total 9 points. Remove pipe plugs and install grease fitting. Use a hand gun sparingly and apply grease every 500 hours of operation. Use a good grade of semi-fluid general purpose chassis grease. Remove grease fittings and reinstall pipe plugs.

TORQUE CONVERTOR AND TRANSMISSION: Drain and refill the torque converter and transmission every 500 hours of operation. This should be accomplished in the following order:

1. Remove drain plugs from both torque converter and transmission housings and drain thoroughly. Remove transmission sump well and screen, clean thoroughly and replace, using new gaskets.
2. Using type "A" automatic transmission oil, refill through filler opening on left hand side of torque converter housing until oil comes up to level of level plug hole in lower right hand front face of transmission.
3. Reinstall filler & level plugs and run engine two minutes at a fast idle to prime torque converter.
4. Recheck level of oil in transmission and add quantity necessary to bring up to level plug hole in transmission case.

Refill Capacity: Approx. 16 qts.

Cartridge in Transmission & Converter Oil Filter Assembly (Located in engine compartment - right hand side) should be changed every 500 operating hours or each time transmission and torque converter oil is changed.

HYDRAULIC OIL RESERVOIR: Drain, clean and refill hydraulic oil system every 2000 hours of operation or oftener if required. When operating under dusty and dirty operating conditions the system should be cleaned and refilled more often to prevent excessive wear or premature failure of valve, pump or cylinder parts.

When refilling use Premium quality hydraulic oil with following characteristics:

Viscosity Index	90 - 100
SSU Viscosity 100°F	190 - 210
Pour Point	-25°
Rust & Oxidation Inhibitor	
Oil Must Not Foam in Service	

Capacity 60 qts.

**FUEL FILTERS:** (Diesel Only) Replace filter cartridge every 500 hours of operation.

**FRONT DRIVE AXLE:** Drain differential and wheel hubs every 1000 operating hours. Refill with SAE 90 Extreme Pressure gear lubricant. Refill through wheel hub and differential filler openings - 4 qts. each wheel hub, 7 qts. in differential. Total capacity 15 qts.

**REAR DRIVE STEER AXLE:** Drain and refill every 1000 operating hours. Use SAE 90 Extreme Pressure gear lubricant. Capacity 8 qts.

**REAR DRIVE PLANETARY HUBS:** Drain and refill every 1000 operating hours. Use SAE 90 Extreme Pressure gear lubricant. Be sure filler opening is at top center of hub when checking level plug in hub cap. Capacity - 4 qts. each side.

**WHEEL BEARING STEER AXLE (Models 75B and 75R):** Remove wheels and hubs, clean and repack bearings every 2000 operating hours. Use a good grade of wheel bearing grease.

**STEERING ARM BEARINGS - (Model 75B):** Remove cap, steering arm and bearings. Clean and repack bearings every 2000 operating hours. Use a good grade of wheel bearing grease.

SPECIFICATIONS & SERVICE DATA  
 Model 75 A, B, & R

<u>ENGINE</u>	<u>GASOLINE</u>	<u>DIESEL</u>
Make. . . . .	Waukesha	Waukesha
Model . . . . .	190-GLB	190-DLC
Maximum horsepower. . . . .	77	80
Governed RPM. . . . .	2200	2200
Maximum torque, ft. lbs . . . .	220 @ 1200	190 @ 1800
Bore and stroke . . . . .	3-3/4" x 4"	3-3/4" x 4"
Number of cylinders . . . . .	6	6
Displacement, cu. inches. . . .	265	265

<u>POWER TRAIN</u>				
Torque converter:	Industrial type. 3.0 to 1 multiplication factor.			
Transmission:	Four speed, full reversing type with two to four wheel drive shifting.			
Axles:	Spiral bevel ring gear and pinion with planetary reduction in wheels.			
Travel speeds:	<u>1st</u>	<u>2nd</u>	<u>3rd</u>	<u>4th</u>
Forward, MPH. . . . .	0-4	0-8	0-13	0-26
Reverse, MPH. . . . .	0-4	0-8	0-13	0-26

HYDRAULIC SYSTEM

Boom rams:	Two, double acting, 4.5" dia. Chromium plated piston rods; Chevron ring packing.
Bucket rams:	Two, double acting, 4.5" dia. Chromium plated piston rods; Chevron ring packing.
Pump:	Gear driven from engine crankshaft. 34 gallons per minute capacity at governed engine speed.
Valve:	Two spool type with built-in adjustable relief valve.
Reservoir:	Electric welded with baffles and hand hole for cleaning.

BRAKES

Service:	Wheel hydraulic.
Parking:	Wheel mechanical, connected to service brake shoes in wheels.

BATTERY

	<u>GASOLINE</u>	<u>DIESEL</u>
Electrical System . . . . .	12 Volt	12 Volt
Make of Battery . . . . .	Exide	Exide
Number. . . . .	2	2
Part Number . . . . .	SS-1	XF-25

TIRES

Tires . . . . .	13.00 x 24,8 Ply
Tread (front) . . . . .	5' 4"
Tread (rear) . . . . .	5' 6"
Air Pressure . . . . .	30 lbs.

BUCKET

Capacity . . . . .	1 cu. yd.
Lifting capacity, 0 mph . . . . .	8,000 lbs.
Lifting capacity, 4 mph . . . . .	4,000 lbs.
Width outside . . . . .	6' 1"
Maximum dumping height . . . . .	8' 0"
Clearance under bucket hinge, maximum height . . . . .	9' 7"
Angle of dump, maximum height . . . . .	55°
Raising time . . . . .	7.2 sec.
Lowering time . . . . .	5 sec.
Reach from front of tire, dumping clearance 7' 0" dumping angle 51° . . . . .	2' 7-1/2"
Reach from front of frame, dumping clearance 7' 0" dumping angle 51° . . . . .	3' 6-1/2"
Digging depth . . . . .	6"

TURNING RADIUS

Outside corner bucket . . . . .	17' 5"
Outside front wheel hub . . . . .	16' 4"
Outside rear hub . . . . .	17' 8"
Inside front wheel hub . . . . .	9' 7"

OVERALL MEASUREMENTS

Height (over air cleaner cap) . . . . .	6' 8"
Height (to seat cushion) . . . . .	5' 3"
Width (front tires) . . . . .	6' 5-1/2"
Width (rear tires) . . . . .	6' 7-1/2"
Width (rear hubs) . . . . .	6' 10-1/2"
Length (bucket on ground) . . . . .	16' 4"
Length (bucket at carry) . . . . .	16' 10"
Wheelbase . . . . .	6' 3"
Ground clearance . . . . .	15"
Height of drawbar . . . . .	2' 6"

WEIGHTGASOLINEDIESEL

Total . . . . .	12,550 lbs.	12,750 lbs.
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## TIRES

Tires (front) . . . . .	13.00 x 24, 6 Ply
Tires (rear) . . . . .	9.00 x 16, 8 Ply
Tread (front) . . . . .	5' 4"
Tread (rear) . . . . .	4' 10"
Air Pressure (front) . . . . .	25 lbs.
Air Pressure (rear) . . . . .	50 lbs.

## BUCKET

Capacity . . . . .	1 cu. yd.
Lifting capacity, 0 mph. . . . .	7,000 lbs.
Lifting capacity, 4 mph. . . . .	3,500 lbs.
Width outside. . . . .	6' 1"
Maximum dumping height . . . . .	8' 0"
Clearance under bucket hinge, maximum height . . . . .	9' 7"
Angle of dump, maximum height. . . . .	55°
Raising time . . . . .	7.2 sec.
Lowering time. . . . .	5 sec.
Reach from front of tire, dumping clearance 7' dumping angle 51° . . . . .	2' 7-1/2"
Reach from front of frame, dumping clearance 7' 0", dumping angle 51° . . . . .	3' 6-1/2"
Digging depth. . . . .	6"

## TURNING RADIUS

Outside corner bucket. . . . .	10' 6"
Outside front wheel hub. . . . .	8' 4"
Outside rear hub . . . . .	10' 2"
Inside front hub . . . . .	1' 7"
Outside rear corner frame. . . . .	11' 6"

## OVERALL MEASUREMENTS

Height (over air cleaner cap). . . . .	6' 8"
Height (to seat cushion) . . . . .	5' 3"
Width (front tires). . . . .	6' 5-1/2"
Width (rear tires) . . . . .	5' 9"
Width (front hubs) . . . . .	6' 8-1/2"
Width (rear hubs). . . . .	5' 10-1/2"
Length (bucket on ground). . . . .	16' 4"
Length (bucket at carry) . . . . .	16' 10"
Wheelbase. . . . .	6' 3"
Ground clearance . . . . .	13"
Height of drawbar. . . . .	2' 6"

## WEIGHT

## GASOLINE

## DIESEL

Total . . . . .	11,350 lbs.	11,550 lbs
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**TIRES**

Tires (front)	9.00 x 20, 10 Ply
Tires (rear)	13.00 x 24, 6 Ply***
Tread (front)	5' 4"
Tread (rear)	5' 4"
Air Pressure (front)	60 lbs.
Air Pressure (rear)	25 lbs.

**BUCKET**

Capacity	1 cu. yd.
Lifting capacity, 0 mph.	8,000 lbs.
Lifting capacity, 4 mph.	4,000 lbs.
Width outside	6' 1"
Maximum dumping height	8' 0"
Clearance under bucket hinge, maximum height	9' 7"
Angle of dump, maximum height	55°
Raising time	7.2 sec.
Lowering time	5 sec.
Reach from front tire, dumping clearance	7' 0"
dumping angle 51°	
Reach from front of frame, dumping clearance	
7' 0", dumping angle 51°	3' 6-1/2"
Digging Depth	6"

**TURNING RADIUS**

Outside corner bucket	18' 2"
Outside front wheel hub	14' 2"
Outside rear hub	12' 11"
Inside rear hub	6' 2"

**OVERALL MEASUREMENTS**

Height (over air cleaner cap)	6' 8"
Height (to seat cushion)	5' 3"
Width (front tires)	6' 3"
Width (rear tires)	6' 5-1/2"
Width (front hubs)	6' 5"
Width (rear hubs)	6' 8-1/2"
Length (bucket on ground)	16' 4"
Length (bucket at carry)	16' 10"
Wheelbase	6' 3"
Ground clearance	15"
Height of drawbar	2' 6"

**WEIGHT**
**GASOLINE**
**DIESEL**

Total . . . . . 12,100 lbs      12,300 lbs.

\*\*\* Rear tires on this model require 105 lbs. Calcium Chloride and 30 gallons of water inflated to pressure given above.

**CAPACITIES**

	<u>75A</u>	<u>75B</u>	<u>75R</u>
Engine Crankcase - Gas. . . . .	8 qts.	8 qts.	8 qts.
Diesel . . . . .	9 qts.	9 qts.	9 qts.

**Torque Converter & Transmission**

Oil Change refill. . . . .	16 qts.	16 qts.	16 qts.
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NOTE: If torque converter is removed and overhauled an additional 6 qts. or total of 22 qts. are required to fill entire system.

Front Drive Axle. . . . .	15 qts.	15 qts.	---
Rear Drive Steering Axle (Differential)	8 qts.		---
Rear Drive Planetary Wheel Hubs . . .	4 qts.	---	---
Rear Drive Axle . . . . .	---	---	15 qts.
Hydraulic System. . . . .	60 qts.	60 qts.	60 qts.
Master Cylinder . . . . .	2 pts.	2 pts.	2 pts.
Air Cleaner . . . . .	1 qt.	1 qt.	1 qt.
Fuel Tank . . . . .	30 gal.	30 gal.	30 gal.
Radiator. . . . .	22 qts.	22 qts.	22 qts.





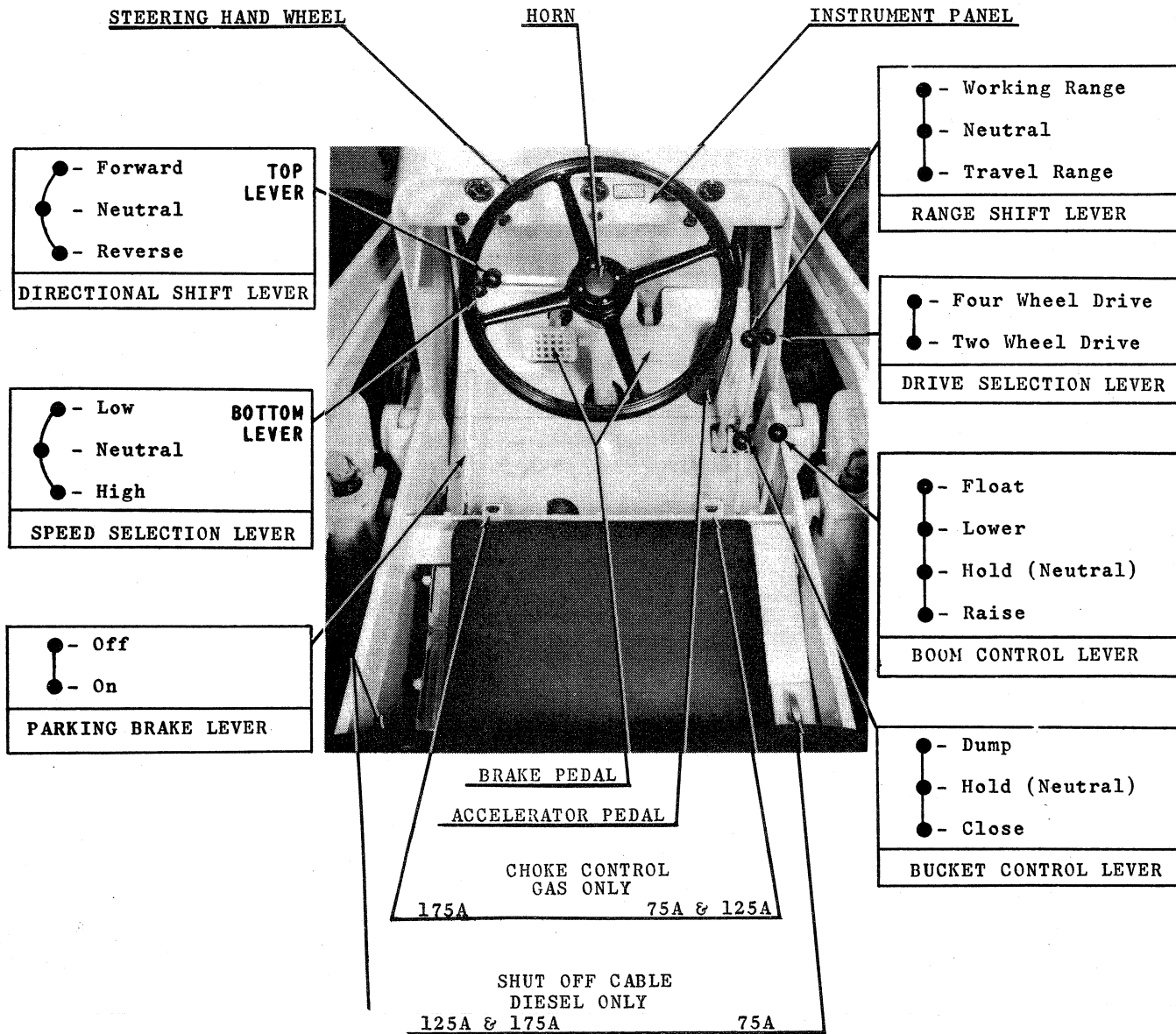
## P R E P A R A T I O N   F O R   O P E R A T I O N

It is essential that the following points be checked before operating this Michigan Tractor Shovel.

Refer to the Lubrication Chart to locate items referred to below.

1. Check the entire unit for damages in transit or storage.
2. Check the oil level in the following to specifications outlined in Lubrication Section:
  - (a) Engine Crankcase
  - (b) Engine Air Cleaner Cup
  - (c) Transmission Case
  - (d) Front Drive Axle
  - (e) Rear Drive Axle
  - (f) Rear Drive Steering Axle Planetary Hubs
  - (g) Brake Master Cylinder
  - (h) Hydraulic Oil Reservoir
3. Check cooling system to be sure radiator is filled and that radiator drain cock and engine block drain cock are closed. When air temperature is 32°F or below, or there is danger of water freezing in the cooling system, use a known, reliable brand of permanent anti-freeze solution and add it to radiator according to manufacturers instructions.
4. Check the batteries to be sure the plates are covered with water. If necessary to add, use only clean distilled water.
5. Check fuel level in fuel tank. Handle fuel in clean containers. For gasoline engines use a gasoline with minimum octane rating of 75. For diesel engines use a # 2 diesel fuel oil. Be sure fuel line shut off cock is open before starting the engine.
6. Check to determine that all drain plugs, drain cocks, filler openings, fuel lines, oil lines, and cooling system connections are tight and do not leak.
7. Check tire pressures. See Specifications Section for proper air pressure. Be sure valve caps are in place to prevent dirt, moisture and foreign material from damaging valve core.
8. Grease all lubrication points of the entire unit. Refer to Lubrication Section as a guide for location, type and quantity of lubricant.

OPERATOR'S COMPARTMENT & CONTROLS



INSTRUMENT PANEL

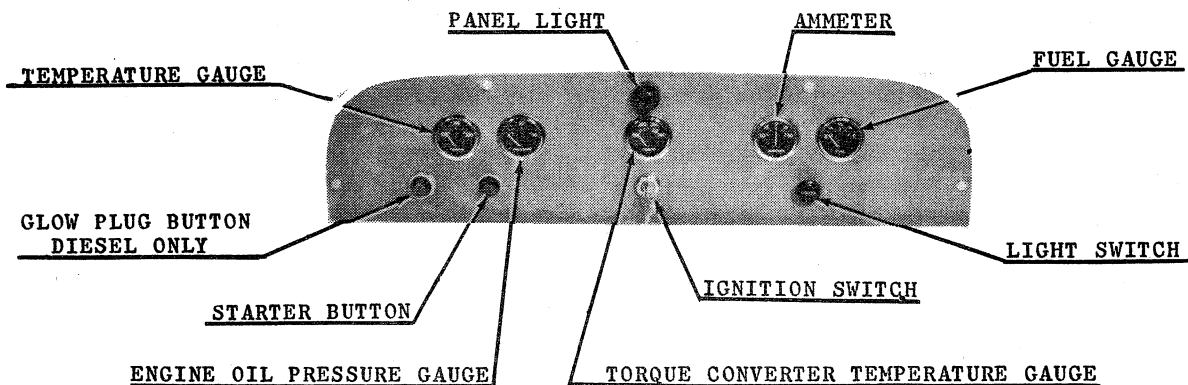


FIGURE 1

## O P E R A T I N G   I N S T R U C T I O N S

Before operating a machine of this type it is highly essential that the operator become thoroughly familiar with the location and function of the various controls and instruments. Reference and study of the illustrations of the Operator's Compartment, Controls and Instruments together with the following paragraphs will aid in acquiring this end.

The operator should work slowly at first until he has become thoroughly accustomed to the machine. Speed and skill will be attained much easier if the necessary time is spent that is required to acquire complete familiarity with the machine and its operation.

A careful operator is the best insurance possible against an accident, therefore, the following safety rules should be observed at all times.

1. The operator shall not leave the machine without first lowering the bucket so that it rests on the ground and making sure all control levers are in neutral position.
2. Never reach between the boom and guide bar to lower the bucket. The bucket can be lowered to the ground even though the engine has been shut off.
3. Do not leave a machine with engine running unattended.
4. The operator shall always face or look in the direction he is traveling.
5. Do not operate the machine with wet or greasy hands.
6. Positively in no case should anyone ride in the bucket or hitch a ride in any manner.
7. The operator must watch pedestrians or workers on foot while in motion.

The terms "right hand" and "left hand", as referred to herein, are determined by sitting in the operator's seat and facing toward the front or bucket end of the machine.

INSTRUMENTS AND OPERATING CONTROLS

FUEL GAUGE is located on the extreme right hand side of the panel and indicates the quantity of fuel in the tank only when the ignition is turned on. When the ignition is turned off, the pointer drops back beyond the "E" (empty) mark.

AMMETER is located on the left of the fuel gauge and shows the current flow to and from the battery. Electrical current going from the generator to the battery registers on the charge (right) side. The gauge will show a discharge when more electrical energy is being consumed than is being received from the generator.

WATER TEMPERATURE GAUGE is located on the extreme left hand side of the panel and indicates the temperature of the fluid in the cooling system. This gauge should register in the vicinity of 180° for normal operation. Never operate the machine when gauge indicates the temperature of the water to be at the boiling point. Shut off the engine and check the cooling system for proper circulation to prevent overheating the engine.

ENGINE OIL PRESSURE GAUGE is located to the right of the water temperature gauge and indicates the pressure in the engines lubrication system. Under normal operation this should register between 25 & 30 pounds pressure. If the gauge fails to register, stop the engine immediately and determine the cause.

TORQUE CONVERTER TEMPERATURE GAUGE is centrally located on the panel and indicates the temperature of the oil in the torque converter and transmission lubrication system. When temperature approaches 250°F or red portion of gauge a shift to a lower gear should be made.

IGNITION SWITCH is centrally located directly beneath the torque converter temperature gauge. This switch controls the electrical circuit to the starting motor and activates the gauges and panel light on the instrument panel.

STARTER BUTTON is located on the left side of the panel beneath the water temperature and engine oil pressure gauges. Press this button to start engine. Release pressure on button as soon as engine starts.

GLOW PLUG BUTTON is located on left side of panel to the left of starter button. See Page 10 for instructions on use thereof.

CHOKE CONTROL is located on the right hand side of the seat kick plate. Pull out choke rod to enrich fuel mixture when starting a cold engine. (Gasoline Engine Only)

LIGHT SWITCH is located on right hand side of the panel beneath the ammeter and fuel gauges.

ACCELERATOR PEDAL is located on the front right hand side of the floorboard. Applying pressure to this pedal increases the flow of fuel, increasing the engine speed.

SHUT OFF CABLE is located at rear of panel along right hand side of seat and is used to shut off diesel engine by cutting fuel supply at injection pump. (Diesel engines only)

BRAKE PEDAL is located centrally and is so designed as to permit brake application with either left or right foot of operator.

HORN BUTTON is located in the center of the steering hand wheel. The horn can only be sounded when the ignition switch is turned on.

DIRECTIONAL SHIFT LEVER is the top lever located on the steering column. The lever is in neutral when in its central position. Forward direction is obtained by pushing forward on lever. Reverse direction is obtained by pulling back on lever.

SPEED RANGE LEVER is the bottom lever located on the steering column. The lever is in neutral when in its central position. Low range is obtained by pushing forward on lever.

RANGE SHIFT LEVER is the inside lever located on the front right hand side of the floorboard adjacent to the accelerator pedal. The lever is in neutral when in its central position. Working range position is obtained by pushing forward on lever. Travel range position is obtained by pulling back on lever. Shift from working range to travel range or vice versa should only be made when machine is stationary.

DRIVE SELECTION LEVER is the outside lever located on the front right hand side of the floorboard adjacent to the accelerator pedal. This lever does not have a neutral position. When the lever is in forward position both front and rear axles are engaged. When lever is pulled backward power is transmitted to the front axle only. Shift from four wheel drive to two wheel drive or vice versa should only be made when machine is stationary.

PARKING BRAKE LEVER is located on the left rear of the floorboard. To set the parking brake pull up and back on lever. To release brake push lever forward and down.

BOOM CONTROL LEVER is the outer lever on the right hand side of the seat. This lever has four positions. Each position can be distinctly felt by the operator when the poppet falls into position as the lever is moved.

To raise the boom and bucket, pull the boom lever backward to the last poppet position. The boom and bucket will raise in direct proportion to the engine speed.

Push the lever forward, one notch ahead of raise position, to "Hold" position. Placing boom lever in "Hold" position will stop and hold the bucket at any height desired.

To lower the boom and bucket, push lever forward to next poppet felt ahead of the hold notch.

The extreme forward poppet is the "Float" position. It allows the bucket to move freely following variations in grade level.

Always place the boom control lever in the "Hold" or neutral position before starting or shutting off the engine. This lever will lower the boom and bucket even though the engine has been shut off.

BUCKET CONTROL LEVER is inner lever on the right hand side of the seat. This lever controls the "Dumping", "Holding", and "Closing" of the bucket. There are no poppet positions or notches, since it is connected to a spring loaded plunger in the control valve. The lever returns to its central or neutral position automatically when released.

To "Dump" the bucket, push the lever forward. Release the lever and it will return to the neutral position, allowing the bucket to remain in the dump position.

To "Close" the bucket, pull the lever backward. Release the lever and it will return to the neutral position, allowing the bucket to remain in the closed position.

The bucket may be stopped and held in any position of its dumping arc by releasing the lever or returning it to its neutral position.

\* \* \* \* \*

After the machine has been properly checked and the operator has familiarized himself with location and function of the various controls, the machine is now ready for operation.

STARTING GASOLINE ENGINE. To start engine, place all control levers in neutral position, turn on ignition switch and press the starter button. Pull out choke slightly for easier starting of a cold engine. Watch oil gauge on dash, when engine starts, to be sure it is registering. Allow the engine to idle for a while until it becomes warmed up.

STARTING DIESEL ENGINE. In warm weather, or with a warm or hot engine, no starting aid is needed. With all control levers in neutral position turn on ignition switch and press down on starter.

With a cold engine use the following procedure:

- a. Prime fuel lines, using hand pump on side of injection pumps.
- b. Depress Glow Plug Button for 30 to 60 seconds with ignition on.
- c. Depress Starter Button while continuing to hold Glow Plug Button in.

- d. If no start occurs after 10 seconds, release starter button and continue to hold glow plug button in for a slightly longer period. Repeat heating and cranking cycle as needed.

**WARNING:** Do not use glow plugs for more than 1-1/2 minutes at a time, to avoid overheating the elements.

To stop Diesel engine, pull up on fuel shut off cable and turn off ignition switch. When engine has stopped, return shut off cable to "down" position.

\*\*\*\*\*

To place machine into motion raise boom and bucket two or three feet above ground by pulling backward on boom control lever. Select two or four wheel drive by use of Drive Selection Lever. (Refer to Fig.1)

Select by use of Range Shift Lever the speed range desired - Working Range for all normal work operations; Travel Range for moving relatively long distances without load. Select Low or High speed by use of Speed Selection Lever. Place Directional Shift Lever in position for direction of travel desired. Gradually apply pressure on accelerator pedal until speed of travel desired has been reached.

When shifting into four wheel drive, operator should raise front wheels slightly off ground, rotate front wheels slightly and then make shift from two wheel drive to four wheel drive. This action will align gear teeth on clutch hubs in transmission to permit shift desired. Front wheels are raised by placing boom control lever in "Lower" position (See Fig. 1), forcing boom and bucket against ground until wheels raise.

There are available to the operator a selection of four speeds in both forward and reverse directions. This is accomplished by use of the Range Shift Lever and Speed Selection Lever. In other words a choice of Low or High Speed is possible in both Working Range and in Travel Range. The Range Shift Lever should only be shifted when vehicle is stationary. A shift from Low to High Speed or vice versa may be made when vehicle is under motion, by momentarily letting up on accelerator, making the shift, and again depressing accelerator pedal.

#### LOADING THE BUCKET

Shift range selection lever forward into work range position. Shift drive selection lever forward to engage four wheel drive. Place directional lever into forward position and shift speed selection lever into either high or low depending on the density of material to be handled. With bucket control lever adjust bucket until pointer on right hand side of bucket indicates it is in the level position.

When loading from a stock pile, drive into the pile with the cutting edge parallel to the ground and push the cutting edge into the pile until the bucket is nearly full. Then pull the boom control lever

back to raise bucket. As the bucket raises, pull bucket lever back to tip bucket back against stops. Continue to raise bucket with boom lever until it breaks out of the pile. Back out of the pile, keeping the load low and deliver load to desired dumping position.

When grading or excavating, the bucket should also be adjusted so that pointer indicates it is in the level position. Place the boom control lever in the "Lower" position (See Figure 1) to force the bucket cutting edge down against the ground as the machine moves forward. If the cutting edge does not penetrate the ground immediately, use the bucket control lever to incline the angle of the cutting edge slightly to give better penetration. When cutting edge penetrates, use bucket control lever to adjust bucket to level position to prevent excessive penetration. The operator may manipulate the boom and bucket control levers slightly to maintain a good grade as the machine moves forward. When maintaining a grade, the machine should be driven in low gear at about half throttle to make an accurate cut. When the bucket is full or the end of the cut is reached, pull backward on the bucket control lever to tip bucket back against the stops, then, raise the boom so that bucket is approximately 15" off the ground for carrying to the dumping position.

#### TRANSPORTING THE LOAD

When transporting the load, the travel speed of the machine will depend on the length of haul and the kind of surface over which the machine must pass. Rough terrain calls for a fairly slow speed. When the bucket is full it should be carried about 15" off the ground. Never transport the load with the bucket fully raised. The nearer the ground that the bucket is held, the better the stability, especially on slopes or when turning the machine.

#### DUMPING THE BUCKET

When dumping into a truck or bin, raise the bucket so that it clears the top edge safely. Move the machine up so the bucket is inside the dumping area. With the boom control lever in the neutral or hold position, push forward slowly on the bucket control lever, thus causing the bucket to tip forward and spill its load. The load may be dumped entirely or a part at a time by manipulating the bucket lever. Dumping the load slowly will ease the shock of suddenly added weight to the truck body. Releasing pressure on the bucket control lever will allow it to return to neutral, holding the bucket in the dumped position. Pull backward on the bucket control lever to return the bucket to "closed" position before backing the machine away from the truck or bin and lower the bucket to carrying position (about 15" above the ground) before returning the machine for another load.

#### BACKFILLING AND BULLDOZING

The bucket can be removed and replaced with a backfiller blade for bulldozing operations. Use the backfiller blade to spread material, strip, level, or to backfill ditches and foundations. Again, one of the slow speed ranges is best when working with a backfiller blade, since backfilling requires more power and slow speed.

The backfiller blade pivots at the same points as on the bucket and



may be dumped and retracted similarly. This feature will be helpful when working wet clay or other sticky material.

The standard bucket can be used as a bulldozer by cutting with it in the normal digging position. Its advantages over a bulldozer blade are: (1) Greatly increased cutting efficiency due to the knife-like edge; (2) Ability to push larger loads of soil; (3) Faster grading work because of greater transporting capacity; (4) Ability to carry dirt to hollows without disturbing the surfaces in between; and (5) the facility with which material can be backed out of banks and the exactness with which it can be deposited where needed. For smoothing up the surface of the dirt, the machine can be run backwards with the bucket on the ground in a partially dumped position. The boom control lever can be placed in the float position and the machine driven rapidly backwards. With the bucket dragging it will float up and down and spread the material evenly.

#### TRAVELING WITHOUT A LOAD IN THE BUCKET

When driving the machine from job to job, shift into travel range and two wheel drive. Shifting the speed selection lever into either low or high will permit speeds of 13 or 26 miles per hour. Use of two wheel drive will keep tires from wearing out on pavement. The bucket should be raised about 15" off the ground and tipped back to afford maximum visibility.





**CLARK EQUIPMENT COMPANY**  
**Construction Machinery Division**  
BENTON HARBOR, MICHIGAN, U. S. A.



**TRACTOR SHOVEL**  
**MODEL 75A**

**LUBRICATION CHART**  
**GENERAL CHASSIS LAYOUT**

	1000 Hours	500 Hours	50 Hours	8 Hours	Key		Key	8 Hours	50 Hours	500 Hours	1000 Hours	
Bucket to Carrier (1 each side)				X	CG		CG	X				Bucket Indicator
Guide Bar to Carrier (1 each side)				X	CG		CG	X				Cylinder to Bucket (1 each side)
Boom to Carrier (1 each side)				X	CG		CG	X				Cylinder to Carrier (1 each side)
Steering Booster (Front)				X	CG		CG	X				Range Selection Bell Crank
Steering Gear			X		GL		CG	X				Range & Axle Selection Lever (1 each lever)
Pitman Arm to Booster Drag Link				X	CG		CG	X				Guide Bar to Frame (1 each side)
Brake Pedal Bell Crank				X	CG		CG	X				Cylinder to Boom (1 each side)
Brake Master Cylinder			X		BF		CG	X				Boom & Bucket Levers (1 each lever)
Steering Booster (Rear)				X	CG		CG	X				Cylinder to Frame (1 each side)
Brake Cable (2 Fittings)				X	CG		CG	X				Boom to Frame (1 each side)
Battery (See Note)				X			HO	X				Hydraulic Oil Reservoir (See Note)
Steering Push Rod Bell Crank (3 Fittings)				X	CG		CG	X				Axle Selection Bell Crank
Air Cleaner (See Note)				X	OE		CG	X				Steer Axle Support (1 each end)
Oil Filter - Gas (See Note)			X				CG	X				Tie Rod End (1 each side)
Push Rod to Steering Arm				X	CG		OE		X			Starter Bearing Oil Cup (See Note)
Oil Filter - Diesel Only (See Note)			X							X		Primary Fuel Filter Diesel Only
Distributor (See Note)			X	X	OE					X		Secondary Fuel Filter Diesel Only
Radiator (See Note)				X			OE	X	X			Engine Crankcase Filler Cap (See Note)
							OE		X			Generator Bearing Oil Cups (See Note)

**NOTES**

**ENGINE CRANKCASE:** Check oil level every 8 operating hours. Drain and refill every 50 operating hours as prescribed below:

Temperature	Viscosity	Type		Capacity	
		Gas	Diesel	Gas	Diesel
70°F and above	SAE 30W	MS	DS	8 Qts.*	9 Qts.*
32°F to 70°	SAE 20W	MS	DS	8 Qts.*	9 Qts.*
0°F to 32°	SAE 10W	MS	DS	8 Qts.*	9 Qts.*
0°F and below	SAE 10W	MS	DS	8 Qts.*	9 Qts.*

\* Quantity indicated includes requirement for oil filter change.

**AIR CLEANER:** Service air cleaner every 8 operating hours or oftener as required. Remove and empty oil cup. Scrape out sediment and wash thoroughly. Refill cup to level mark with same grade oil as used in engine.

**OIL FILTER:** (Gas & Diesel) Remove filter element, drain sludge and clean inside of case each time crankcase is drained. Install new filter element.

KEY	
CG	Chassis Grease
OE	Engine Oil (See Note)
BF	Brake Fluid
HO	Hydraulic Oil
GL	Gear Lube - SAE 90

**STEERING GEAR:** Check oil level every 50 operating hours. Keep reservoir filled with SAE 90 gear lube. Use a high grade straight mineral oil.

**MASTER CYLINDER:** Check fluid level every 50 operating hours. Keep reservoir filled to 1/4 inch from top. Use only Wagner 21-B Heavy Duty Brake Fluid. Keep vent hole in filler cap open at all times.

**RADIATOR:** Check daily - refill as required. Add permanent type anti-freeze when air temperature is 32°F or lower. Capacity 22 Qts.

**NOTES**

**BATTERY:** Check fluid level every 8 operating hours. Clean terminals and keep fluid level above top of plates.

**HYDRAULIC OIL RESERVOIR:** Check daily & maintain to oil level mark. Use premium grade of hydraulic oil. See operation manual for detail specifications. Drain, clean and refill every 2000 hours of operation or oftener if required.

**FUEL FILTERS:** (Diesel Only) Replace filter cartridge every 500 operating hours.

**DISTRIBUTOR:** Each 50 operating hours place two drops SAE 10W oil on wick under rotor. Remove plug at side of housing and fill with SAE 20 oil each 500 operating hours.

**GENERATOR AND STARTING MOTOR:** Every 50 operating hours add a few drops SAE 10W engine oil to respective oil cups.



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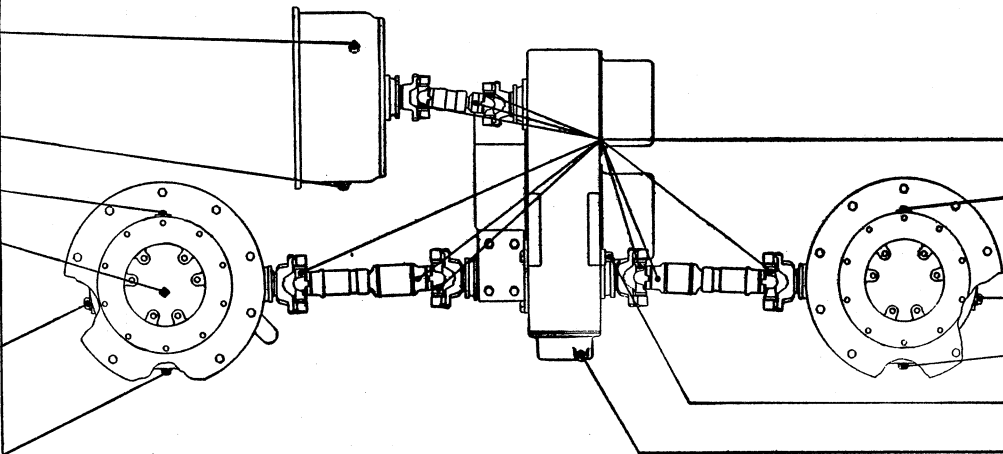


TRACTOR SHOVEL  
MODEL 75A

LUBRICATION CHART  
DRIVE LINE

FRONT OF MACHINE

	1000 Hours	500 Hours	50 Hours	8 Hours	KEY
Torque Converter Filler Plug (See Note)		X			TA
Torque Converter Drain Plug (See Note)		X			
Planetary Gear Filler Drain Plug (See Note)	X				EPGL
Planetary Gear Level Plug (See Note)			X		
Rear Drive Steer Axle Filler & Level Plug (See Note)	X	X			EPGL
Rear Drive Steer Axle Drain Plug (See Note)	X				



	1000 Hours	500 Hours	50 Hours	8 Hours	KEY
Propeller Shaft (See Note)		X			CG
Planetary Gear Filler & Drain Plug (See Note)			X		EPGL
Front Drive Axle Filler & Level Plug (See Note)			X		EPGL
Front Drive Axle Drain Plug (See Note)			X		
Transmission Level Plug (See Note)		X	X		TA
Transmission Drain Plug (See Note)			X		

NOTES

**TORQUE CONVERTER & TRANSMISSION:** Check oil level every 8 operating hours at transmission level plug on lower right front face of transmission case. Drain & refill converter & transmission every 500 operating hours. Fill through filler plug left hand side of converter until oil comes up to level plug in transmission. Run engine at fast idle 2 minutes to prime converter. Recheck oil level in transmission, add as required. Use type "A" Automatic Transmission Oil. Capacity approx. 16 Qts. Transmission oil sump screen should be removed and cleaned every 500 operating hours. Do not use flushing oil or compound to flush system.

**FRONT DRIVE AXLE:** Check oil level every 50 operating hours. Drain & refill every 1000 operating hours. Refill thru wheel hub & differential filler openings - 4 Qts. each wheel hub, 7 Qts. in differential. Use SAE 90 Extreme Pressure gear lube.

KEY	
EPGL	Extreme Pressure Gear Lube - SAE 90
TA	Type "A" Transmission Oil
CG	Chassis Grease

NOTES

**REAR DRIVE STEER AXLE:** Check oil level every 50 operating hours. Drain & refill every 1000 operating hours. Use SAE 90 Extreme Pressure gear lube. Capacity - 8 Qts.

**REAR DRIVE PLANETARY HUBS:** With filler plug at top center of hub, check oil level every 50 operating hours. Drain & refill every 1000 operating hours. Use SAE 90 Extreme Pressure gear lube. Capacity - 4 Qts. each side.

**PROPELLER SHAFTS:** 3 points each shaft. Remove pipe plugs, insert fittings, grease sparingly each 500 operating hours. Remove fittings & reinsert plugs. Use chassis grease.



**CLARK EQUIPMENT COMPANY**  
**Construction Machinery Division**  
BENTON HARBOR, MICHIGAN, U. S. A.



**TRACTOR SHOVEL**  
**MODEL 75B**

**LUBRICATION CHART**  
**GENERAL CHASSIS LAYOUT**

	1000 Hours	500 Hours	8 Hours	Key		Key	8 Hours	500 Hours	1000 Hours	
Bucket to Carrier (One Each Side)				X	CG	CG	X			Bucket Indicator
Cylinder to Bucket (One Each Side)				X	CG	CG	X			Guide Bar to Carrier (One Each Side)
Boom to Carrier (One Each Side)				X	CG	CG	X			Cylinder to Carrier (One Each Side)
Steering Gear			X		GL	CG	X			Brake Pedal Bell Crank
Pitman Arm to Booster Drag Link				X	CG	CG	X			Range Selection Lever
Brake Master Cylinder			X		BF	CG	X			Range Selection Bell Crank
Brake Cable (Two Fittings)				X	CG	CG	X			Guide Bar to Frame (One Each Side)
Battery (See Note)				X		CG	X			Cylinder to Boom (One Each Side)
Steering Booster (Front)				X	CG	CG	X			Boom & Bucket Levers (One Each Side)
Steering Booster (Rear)				X	CG	CG	X			Cylinder to Frame (One Each Side)
Air Cleaner (See Note)				X	OE	CG	X			Boom to Frame (One Each Side)
Push Rod to Steering Arm				X	CG	HO	X			Hydraulic Oil Reservoir (See Note)
Oil Filter Gas (See Note)			X			CG	X			Tie Rod
Wheel Bearing (See Note)					WB	WB	X			Steering Arm Bearings (See Note)
Steering Knuckle (Two Each Side)				X	CG	CG	X			Steering Knuckle (Two Each Side)
Tie Rod				X	CG	CG	X			Tie Rod
Oil Filters - Diesels Only (See Note)		X						X		Primary Fuel Filter (Diesel Only)
Distributor (See Note)		X	X		OE	OE	X			Starter Bearing Oil Cup (See Note)
Generator Bearing Oil Cups (See Note)		X			OE			X		Secondary Fuel Filter (Diesel Only)
Radiator (See Note)				X		OE	X	X		Engine Crankcase Filler Cap (See Note)

**NOTES**

**ENGINE CRANKCASE:** Check oil level every 8 operating hours. Drain and refill every 50 operating hours as prescribed below:

Temperature	Viscosity	Type		Capacity	
		Gas	Diesel	Gas	Diesel
70°F and above	SAE 30W	MS	DS	8 Qts.*	9 Qts.*
32°F to 70°F	SAE 20W	MS	DS	8 Qts.*	9 Qts.*
0°F to 32°F	SAE 10W	MS	DS	8 Qts.*	9 Qts.*
0°F and below	SAE 10W	MS	DS	8 Qts.*	9 Qts.*

\*Quantity indicated includes requirement for oil filter change.

**AIR CLEANER:** Service air cleaner every 8 operating hours or oftener as required. Remove and empty oil cup. Scrape out sediment and wash thoroughly. Refill cup to level mark with same grade oil as used in engine.

**OIL FILTER:** (Gas & Diesel) Remove filter element, drain sludge and clean inside of case each time crankcase is drained. Install new filter element.

**STEERING ARM BEARINGS:** Remove cap, steering arm and bearings. Clean and repack bearings every 2000 operating hours. Use a good grade of wheel bearing grease.

KEY	
CG	Chassis Grease
OE	Engine Oil - See Note
BF	Brake Fluid
HO	Hydraulic Oil
GL	Gear Lube - SAE 90
WB	Wheel Bearing Grease

**STEERING GEAR:** Check oil level every 50 operating hours. Keep reservoir filled with SAE 90 gear lube. Use a high grade straight mineral oil.

**MASTER CYLINDER:** Check fluid level every 50 operating hours. Keep reservoir filled to 1/4 inch from top. Use only Wagner 21-B Heavy Duty Brake Fluid. Keep vent hole in filler cap open at all times.

**RADIATOR:** Check daily - refill as required. Add permanent type anti-freeze when air temperature is 32°F or lower. Capacity 22 Qts.

**NOTES**

**BATTERY:** Check fluid level every 8 operating hours. Clean terminals and keep fluid level above top of plates.

**HYDRAULIC OIL RESERVOIR:** Check daily & maintain to oil level mark. Use premium grade of hydraulic oil. See operation manual for detail specification. Drain, clean and refill every 2000 hours of operation or oftener if required.

**FUEL FILTERS:** (Diesel Only) Replace filter cartridge every 500 operating hours.

**DISTRIBUTOR:** Each 50 operating hours place two drops SAE 10W oil on wick under rotor. Remove plug at side of housing and fill with SAE 20 oil each 500 operating hours.

**GENERATOR AND STARTING MOTOR:** Every 50 operating hours add a few drops SAE 10W engine oil to respective oil cups.

**WHEEL BEARINGS:** Remove wheels and hubs, clean and repack bearings every 2000 operating hours. Use a good grade of wheel bearing grease.

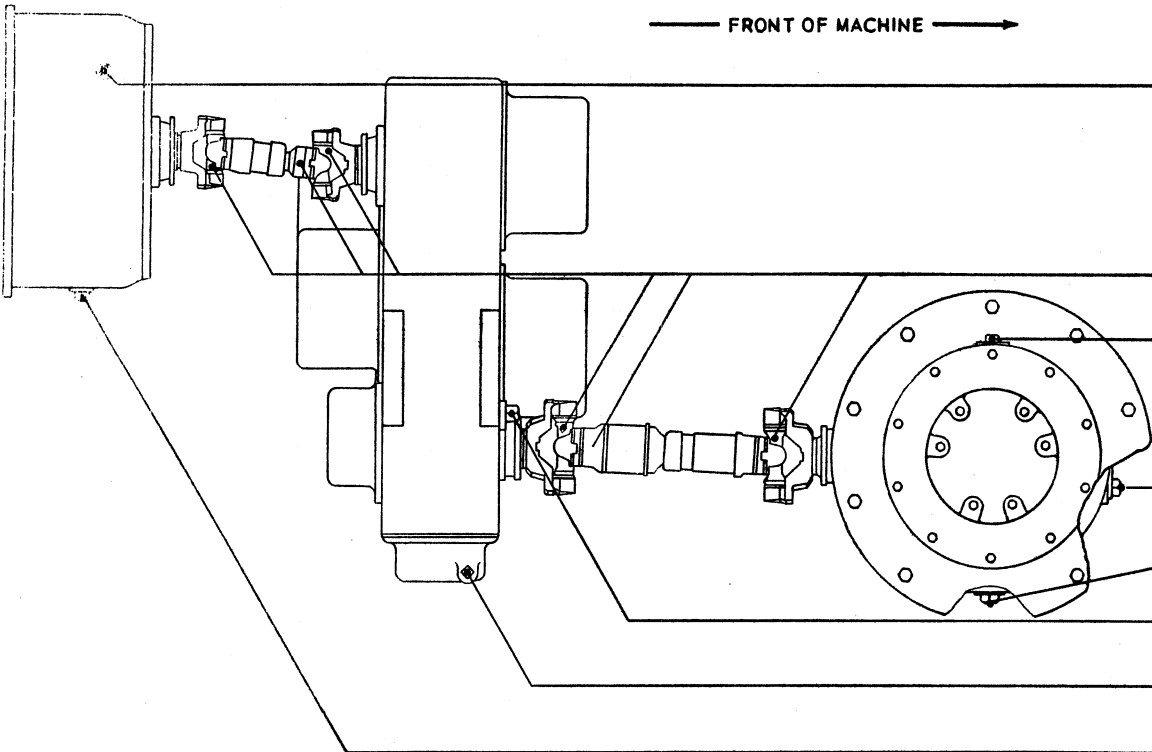


CLARK EQUIPMENT COMPANY  
Construction Machinery Division  
BENTON HARBOR, MICHIGAN, U. S. A.



TRACTOR SHOVEL  
MODEL 75B

LUBRICATION CHART  
DRIVE LINE



Key	8 Hours	50 Hours	500 Hours	1000 Hours	
TA			X		Torque Converter Filler Plug (See Note)
CG			X		Propeller Shaft (See Note)
EPGL			X		Planetary Gear Filler & Drain Plug (See Note)
EPGL	X		X		Front Drive Axle Filler & Level Plug (See Note)
			X		Front Drive Axle Drain Plug (See Note)
TA	X		X		Transmission Level Plug (See Note)
			X		Transmission Drain Plug (See Note)
			X		Torque Converter Drain Plug (See Note)

NOTES

**TORQUE CONVERTER & TRANSMISSION:** Check oil level every 8 operating hours at transmission level plug on lower right front face of transmission case. Drain & refill converter & transmission every 500 operating hours. Fill through filler plug left hand side of converter until oil comes up to level plug in transmission. Run engine at fast idle 2 minutes to prime converter. Recheck oil level in transmission, add as required. Use type "A" Automatic Transmission Oil Capacity approx. 16 Qts. Transmission Oil sump screen should be removed and cleaned every 500 operating hours. Do not use flushing oil or compound to flush system.

KEY	
EPGL	Extreme Pressure Gear Lube - SAE 90
TA	Type "A" Automatic Transmission Oil
CG	Chassis Grease

NOTES

**FRONT DRIVE AXLE:** Check oil level every 50 operating hours. Drain & refill every 1000 operating hours. Refill thru wheel hub & differential filler opening - 4 Qts. each wheel hub, 7 Qts. in differential. Use SAE 90 Extreme Pressure gear lube.

**PROPELLER SHAFTS:** 3 points each shaft. Remove pipe plugs, insert fittings grease sparingly each 500 operating hours. Remove fittings & reinsert plugs. Use chassis grease.



**CLARK EQUIPMENT COMPANY**  
**Construction Machinery Division**  
BENTON HARBOR, MICHIGAN, U. S. A.



**TRACTOR SHOVEL**  
**MODEL 75R**

**LUBRICATION CHART**  
**GENERAL CHASSIS LAYOUT**

	1000 Hours	500 Hours	50 Hours	8 Hours	KEY		KEY	8 Hours	50 Hours	500 Hours	1000 Hours	
Cylinder to Bucket One Each Side				X	CG		CG	X				Bucket Indicator
Bucket to Carrier One Each Side				X	CG		CG	X				Cylinder to Carrier One Each Side
Guide Bar to Carrier One Each Side				X	CG		CG	X				Pitman Arm to Drag Link
Boom to Carrier One Each Side				X	CG		CG	X				Steering Booster - R.H.
Steer Axle Support - Front				X	CG		CG	X				Steering Knuckle Two Each Side
Steering Gear				X	GL		CG	X				Tie Rod End
Steering Knuckle Two Each Side				X	CG		WB					Wheeling Bearing - See Note
Tie Rod End				X	CG		CG	X				Tie Rod Arm
Steering Booster - L.H.				X	CG		CG	X				Range Selection Lever
Brake Pedal Bell Crank				X	CG		CG	X				Guide Bar to Frame One Each Side
Steer Axle Support - Rear					CG		CG	X				Cylinder to Boom One Each Side
Brake Master Cylinder				X	BF		CG	X				Range Selection Bell Crank
Brake Cable - Two Fittings				X	CG		CG	X				Boom & Bucket Levers (1 each lever)
Battery - See Note				X			CG	X				Cylinder to Frame One Each Side
Air Cleaner - See Note				X	OE		CG	X				Boom to Frame One Each Side
Oil Filter, Gas - See Note				X			HO	X				Hydraulic Oil Reservoir See Note
Oil Filters Diesel Only See Note				X					X			Primary Fuel Filter Diesel Only
Distributor - See Note				X	OE		OE	X				Starter Bearing Cup - See Note
Generator Bearing Oil Cups (See Note)				X	OE				X			Secondary Fuel Filter Diesel Only
Radiator				X			OE	X	X			Engine Crankcase Filler Cup See Note

**NOTES**

**ENGINE CRANKCASE:** Check oil level every 8 operating hours. Drain and refill every 50 operating hours as prescribed below:

Temperature	Viscosity	Type		Capacity	
		Gas	Diesel	Gas	Diesel
70°F and above	SAE 30W	MS	DS	8 Qts.*	9 Qts.*
32°F to 70°	SAE 20W	MS	DS	8 Qts.*	9 Qts.*
0°F to 32°	SAE 10W	MS	DS	8 Qts.*	9 Qts.*
0°F and below	SAE 10W	MS	DS	8 Qts.*	9 Qts.*

\*Quantity indicated includes requirement for oil filter change.

**AIR CLEANER:** Service air cleaner every 8 operating hours or oftener as required. Remove and empty oil cup. Scrape out sediment and wash thoroughly. Refill cup to level mark with same grade oil as used in engine.

**OIL FILTER:** (Gas & Diesel) Remove filter element, drain sludge and clean inside of case each time crankcase is drained. Install new filter element.

KEY	
CG	Chassis Grease
OE	Engine Oil - See Note
BF	Brake Fluid
HO	Hydraulic Oil
GL	Gear Lube - SAE 90
WB	Wheel Bearing Grease

**STEERING GEAR:** Check oil level every 50 operating hours. Keep reservoir filled with SAE 90 gear lube. Use a high grade straight mineral oil.

**MASTER CYLINDER:** Check fluid level every 50 operating hours. Keep reservoir filled to 1/4 inch from top. Use only Wagner 21-B Heavy Duty Brake Fluid. Keep vent hole in filler cap open at all times.

**RADIATOR:** Check daily - refill as required. Add permanent type anti-freeze when air temperature is 32°F or lower. Capacity 22 Qts.

**BATTERY:** Check fluid level every 8 operating hours. Clean terminals and keep fluid level above top of plates.

**NOTES**

**HYDRAULIC OIL RESERVOIR:** Check daily & maintain to oil level mark. Use premium grade of hydraulic oil. See operation manual for detail specifications. Drain, clean and refill every 2000 hours of operation or oftener if required.

**FUEL FILTERS:** (Diesel Only) Replace filter cartridge every 500 operating hours.

**DISTRIBUTOR:** Each 50 operating hours place two drops SAE 10W oil on wick under rotor. Remove plug at side of housing and fill with SAE 20 oil each 500 operating hours.

**GENERATOR AND STARTING MOTOR:** Every 50 operating hours add a few drops SAE 10W engine oil to respective oil cups.

**WHEEL BEARINGS:** Remove wheels and hubs, clean and repack bearings every 2000 operating hours. Use a good grade of wheel bearing grease.



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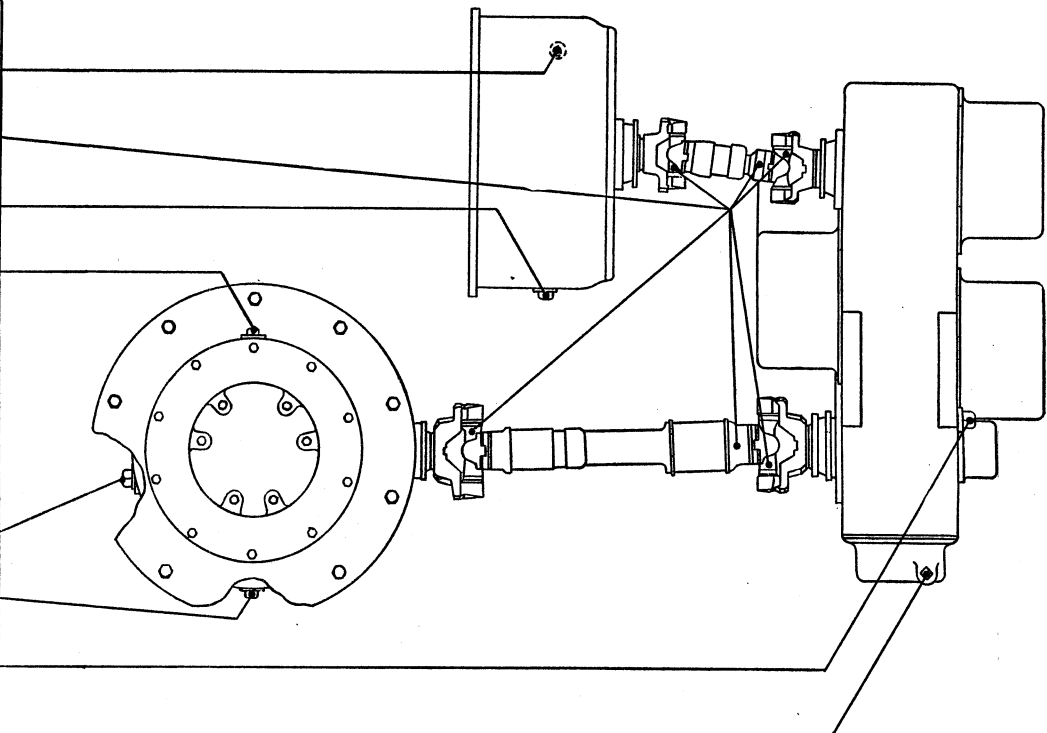


TRACTOR SHOVEL  
MODEL 75R

**LUBRICATION CHART**  
DRIVE LINE

— FRONT OF MACHINE —→

	1000 Hours	500 Hours	8 Hours	Key
Torque Converter Filler Plug		X		
Propeller Shaft (See Note)		X		CG
Torque Converter Drain Plug (See Note)		X		
Planetary Gear Filler & Drain Plug (See Note)	X			EPGL
Rear Drive Axle Filler & Level Plug (See Note)	X		X	EPGL
Rear Drive Axle Drain Plug (See Note)	X			
Transmission Level Plug (See Note)		X	X	TA
Transmission Drain Plug (See Note)		X		



**NOTES**

**TORQUE CONVERTER & TRANSMISSION:** Check oil level every 8 operating hours at transmission level plug on lower right front face of transmission case. Drain & refill converter & transmission every 500 operating hours. Fill through filler plug left hand side of converter until oil comes up to level plug in transmission. Run engine at fast idle 2 minutes to prime converter. Recheck oil level in transmission, add as required. Use type "A" Automatic Transmission Oil. Capacity approx. 16 Qts. Transmission oil sump screen should be removed and cleaned every 500 operating hours. Do not use flushing oil or compound to flush system.

KEY	
EPGL	Extreme Pressure Gear Lube - SAE 90
TA	Type "A" Automatic Transmission Oil
CG	Chassis Grease

**NOTES**

**REAR DRIVE AXLE:** Check oil level every 50 operating hours. Drain & refill every 1000 operating hours. Refill thru wheel hub & differential filler openings - 4 Qts. each wheel hub, 7 Qts. in differential. Use SAE 90 Extreme Pressure gear lube.

**PROPELLER SHAFTS:** 3 points each shaft. Remove pipe plugs, insert fittings grease sparingly each 500 operating hours. Remove fittings & reinsert plugs. Use chassis grease.



SECTION 50  
L U B R I C A T I O N

The lubrication diagrams are divided into two groups covering: (1) General Chassis Layout and (2) Drive Line - Torque Converter, Transmission, Axles, and connecting Propeller shafts.

The importance of proper lubrication cannot be overemphasized. It is the most essential single factor in a well planned preventive maintenance program. Refer to lubrication diagrams to locate the various points to be serviced. Before servicing always wipe dirt and foreign material from around grease fittings, clips, plugs, or covers to prevent dirt, grit or foreign material from entering.

GREASE DAILY:

Use a good grade of semi-fluid general purpose chassis lubricant and grease every 8 hours of operation the following points:

MODEL 75A

Bucket Indicator Pointer - R.H. Side.....	1	fittings
Bucket to Carrier - 1 each side.....	2	fittings
Cylinder to Bucket - 1 each side.....	2	fittings
Guide Bar to Carrier - 1 each side.....	2	fittings
Boom to Carrier - 1 each side.....	2	fittings
Boom Cylinder to Boom - 1 each side.....	2	fittings
Bucket Cylinder to Carrier - 1 each side.....	2	fittings
Guide Bar to Frame - 1 each side.....	2	fittings
Boom to Frame - 1 each side.....	2	fittings
Boom Cylinder to Frame - 1 each side.....	2	fittings
Range & Axle Selection Levers - 1 each lever.....	2	fittings
Boom & Bucket Control Levers - 1 each lever.....	2	fittings
Range Selection Bell Crank.....	1	fittings
Axle Selection Bell Crank.....	1	fittings
Steer Axle Support - 1 each end.....	2	fittings
Push Rod to Steering Arm.....	1	fittings
Tie Rod End - 1 each side.....	2	fittings
Steering Push Rod Bell Crank.....	3	fittings
Emergency Brake Cable.....	2	fittings
Steering Booster - 1 each end.....	2	fittings
Brake Pedal Bell Crank.....	1	fittings
Pitman Arm to Booster Drag Link.....	1	fittings
Starter Pedal (Diesel only).....	1	fittings

GREASE DAILY:

Use a good grade of semi-fluid general purpose chassis lubricant and grease every 8 hours of operation the following points:

MODEL 75B

Bucket Indicator Pointer - R.H. Side.....	1 fitting
Bucket to Carrier - 1 each side.....	2 fittings
Cylinder to Bucket - 1 each side.....	2 fittings
Guide Bar to Carrier - 1 each side.....	2 fittings
Boom to Carrier - 1 each side.....	2 fittings
Boom Cylinder to Boom - 1 each side.....	2 fittings
Bucket Cylinder to Carrier - 1 each side.....	2 fittings
Guide Bar to Frame - 1 each side.....	2 fittings
Boom to Frame - 1 each side.....	2 fittings
Boom Cylinder to Frame - 1 each side.....	2 fittings
Range Selection Lever.....	1 fitting
Boom & Bucket Control Levers - 1 each lever.....	2 fittings
Range Selection Bell Crank.....	1 fitting
Push Rod to Steering Arm.....	1 fitting
Tie Rod End.....	4 fittings
Emergency Brake Cable.....	2 fittings
Steering Booster - 1 each end.....	2 fittings
Brake Pedal Bell Crank.....	1 fitting
Pitman Arm to Booster Drag Link.....	1 fitting
Steering Knuckle - 2 each side.....	4 fittings
Starter Pedal (Diesel only).....	1 fitting

MODEL 75R

Bucket Indicator Pointer - R.H. Side.....	1 fitting
Bucket to Carrier - 1 each side.....	2 fittings
Cylinder to Bucket - 1 each side.....	2 fittings
Guide Bar to Carrier - 1 each side.....	2 fittings
Boom to Carrier - 1 each side.....	2 fittings
Boom Cylinder to Boom - 1 each side.....	2 fittings
Bucket Cylinder to Carrier - 1 each side.....	2 fittings
Guide Bar to Frame - 1 each side.....	2 fittings
Boom to Frame - 1 each side.....	2 fittings
Boom Cylinder to Frame - 1 each side.....	2 fittings
Range Selection Lever.....	1 fitting
Boom & Bucket Control Levers - 1 each lever.....	2 fittings
Range Selection Bell Crank.....	1 fitting
Tie Rod Arm.....	1 fitting
Tie Rod End - 1 each side.....	2 fittings
Emergency Brake Cable.....	2 fittings
Steering Booster - 1 each end.....	2 fittings
Steer Axle Support - 1 each end.....	2 fittings
Brake Pedal Bell Crank.....	1 fitting
Pitman Arm to Booster Drag Link.....	1 fitting
Steering Knuckle - 2 each side.....	4 fittings
Starter Pedal (Diesel only).....	1 fitting

**SERVICE DAILY:**

Check and service the following points every 8 hours of operation or oftener as required.

**ENGINE OIL LEVEL:** Check engine oil level daily, or oftener as required. Add oil to maintain oil level to full mark on dipstick. Engine should not be running when checking oil level.

**AIR CLEANER CUP:** Clean and refill daily, or oftener as required. This is important. Under some operating conditions this unit may require cleaning several times each day. To clean, remove cup and wash out in clean kerosene. Refill cup with clean oil to height of oil level mark. Use same grade of oil as is used in engine crankcase.

**RADIATOR FILLER CAP:** Check and refill as required. Use clean, soft water. Be sure to add a permanent type anti-freeze solution to cooling system when air temperature is 32°F or lower, or when there is danger of water freezing in the cooling system. Use a known, reliable brand of permanent anti-freeze solution and add it to radiator according to manufacturer's instructions.

**RADIATOR DRAIN COCK:** When necessary to drain cooling system, remove radiator filler cap and open both radiator and engine block drain cocks.

**FUEL TANK FILLER CAP:** Located at front of machine. Fill with clean fuel handled in clean containers. Use a good brand procured from a reliable company. For gasoline engines use a gasoline of minimum octane rating of 75. For diesel engines use a #2 diesel fuel oil.

**TORQUE CONVERTER AND TRANSMISSION:** Check daily the level of lubricant in transmission by removing level plug located on lower right hand front face of transmission. Use a good grade of type "A" automatic transmission oil. When necessary to add oil to maintain proper level, remove filler plug on left hand side of torque converter housing and fill to level indicated by level plug in transmission case.

**HYDRAULIC OIL RESERVOIR:** Located in back of operator's seat. Check and maintain supply to level indicated on window in rear side of reservoir. The bucket must be resting on the ground and engine shut off when checking oil level in reservoir. When necessary to add use a premium quality hydraulic oil with following characteristics:

Viscosity Index	90 - 100
SSU Viscosity @ 100°F	190 - 210
Pour Point	-25°
Rust & Oxidation Inhibitor	
Oil Must Not Foam in Service	

**BATTERY:** Clean terminals and check fluid level in each cell. Keep fluid level above plates and separators. Use only clean distilled water.

LUBRICATE AND SERVICE EVERY 50 HOURS OF OPERATION:

Be sure machine is setting level when checking various lubricant levels.

ENGINE CRANKCASE: Drain and refill the engine crankcase every 50 hours of operation. Engine crankcase oil should be drained while oil is warm. Do not use kerosene to flush out crankcase. Refill with a good grade of heavy duty engine oil, procured from a reliable manufacturer, of viscosity as indicated below:

<u>Temperature</u>	<u>Viscosity</u>	<u>Type</u>		<u>Capacity</u>	
		<u>Gas</u>	<u>Diesel</u>	<u>Gas</u>	<u>Diesel</u>
70°F and above	30	MS	DS		
32°F to 70°F	20W	MS	DS		
0°F to 32°F	10W	MS	DS		
0°F and below	10W	MS	DS	8 qts.*	9 qts.*

\* Quantity indicated includes requirement for changing oil filter element.

OIL FILTER: Replace oil filter cartridge every 50 hours of operation or whenever engine crankcase oil is changed. Remove drain plug from side of filter housing and clean out housing before inserting new cartridge. Be sure cover gaskets are in place and cover securely tightened after servicing filter. Be sure drain plug is in place and securely tightened.

FRONT AXLE DIFFERENTIAL FILLER PLUG: Check lubricant level after each 50 hours of operation. Keep lubricant level up to bottom of filler plug hole. When necessary to add use SAE 90 Extreme Pressure lubricant.

REAR AXLE DIFFERENTIAL FILLER PLUG: Check lubricant level after each 50 hours of operation. Keep lubricant level up to bottom of filler plug hole. When necessary to add use SAE 90 Extreme Pressure lubricant.

REAR DRIVE PLANETARY GEAR FILLER AND LEVEL PLUGS: Filler plug is located on the external diameter of the wheel hub and level plug is located slightly off center of wheel hub cap. Wheel should be rotated until filler plug is positioned at top center. This will position level plug slightly below center of wheel. Remove plug and check lubricant level after every 50 hours of operation. Keep lubricant level up to bottom of level plug hole. When necessary to add use SAE 90 Extreme Pressure lubricant.

BRAKE MASTER CYLINDER: Check fluid level after each 50 hours of operation. To add or replace use only Wagner 21-B Heavy Duty Brake Fluid. Keep vent hole in filler cap open at all times.

STEERING GEAR: Check oil level after each 50 hours of operation by removing plug from steering gear housing. To add or replace oil, use a high grade straight mineral gear oil. Use SAE 90 for year round operation.

SECTION 100  
ENGINE

## Gasoline

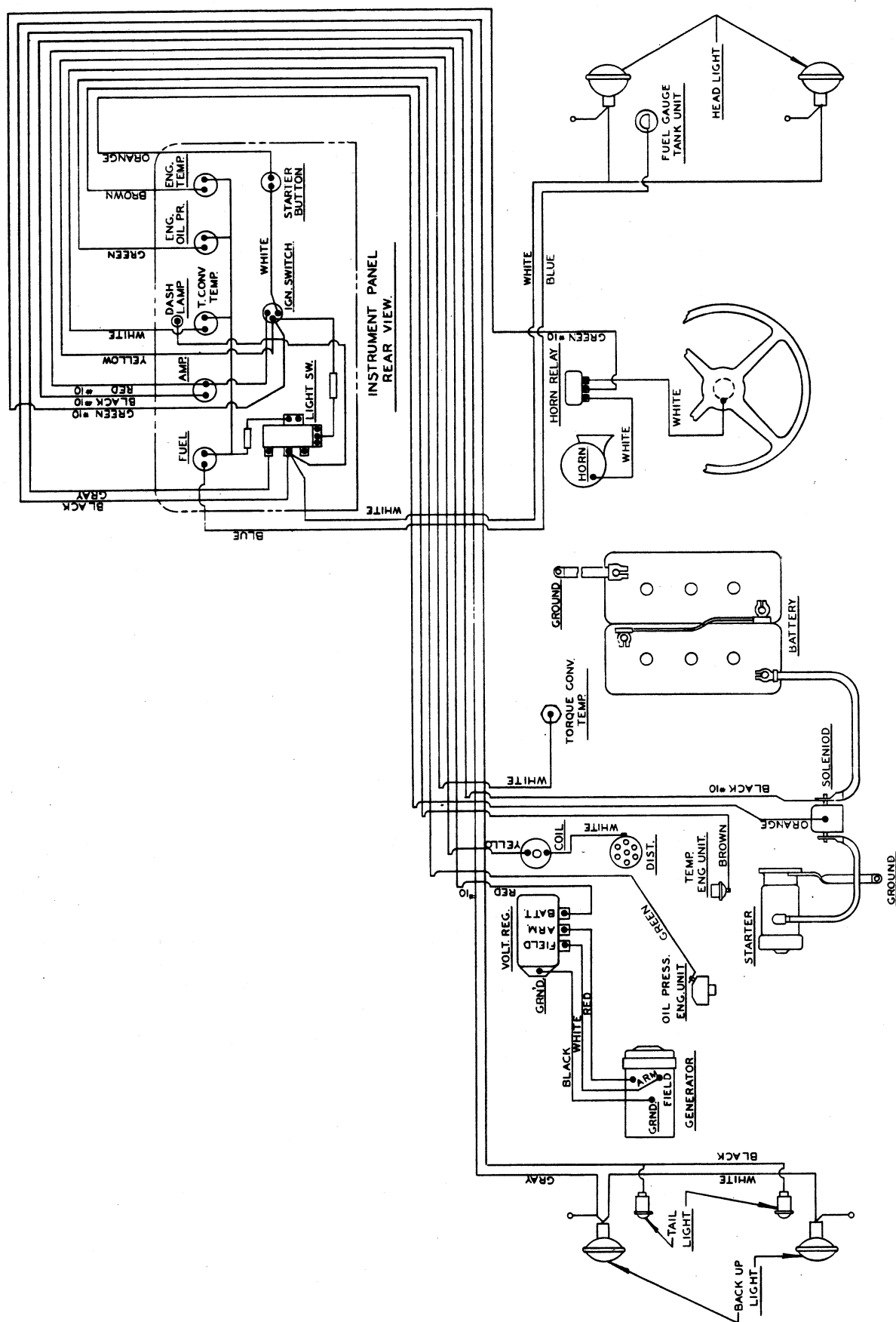
Make.....	Waukesha
Model.....	190-GLB
Maximum Horsepower.....	77
Governed RPM.....	2200
Maximum torque, ft. lbs.....	220 @ 1200
Bore and stroke.....	3-3/4" x 4"
Number of cylinders.....	6
Displacement, cubic inches.....	265

## Diesel

Make.....	Waukesha
Model.....	190-DLC
Maximum Horsepower.....	80
Governed RPM.....	2200
Maximum torque, ft. lbs.....	190 @ 1800
Bore and stroke.....	3-3/4" x 4"
Number of cylinders.....	6
Displacement, cubic inches.....	265

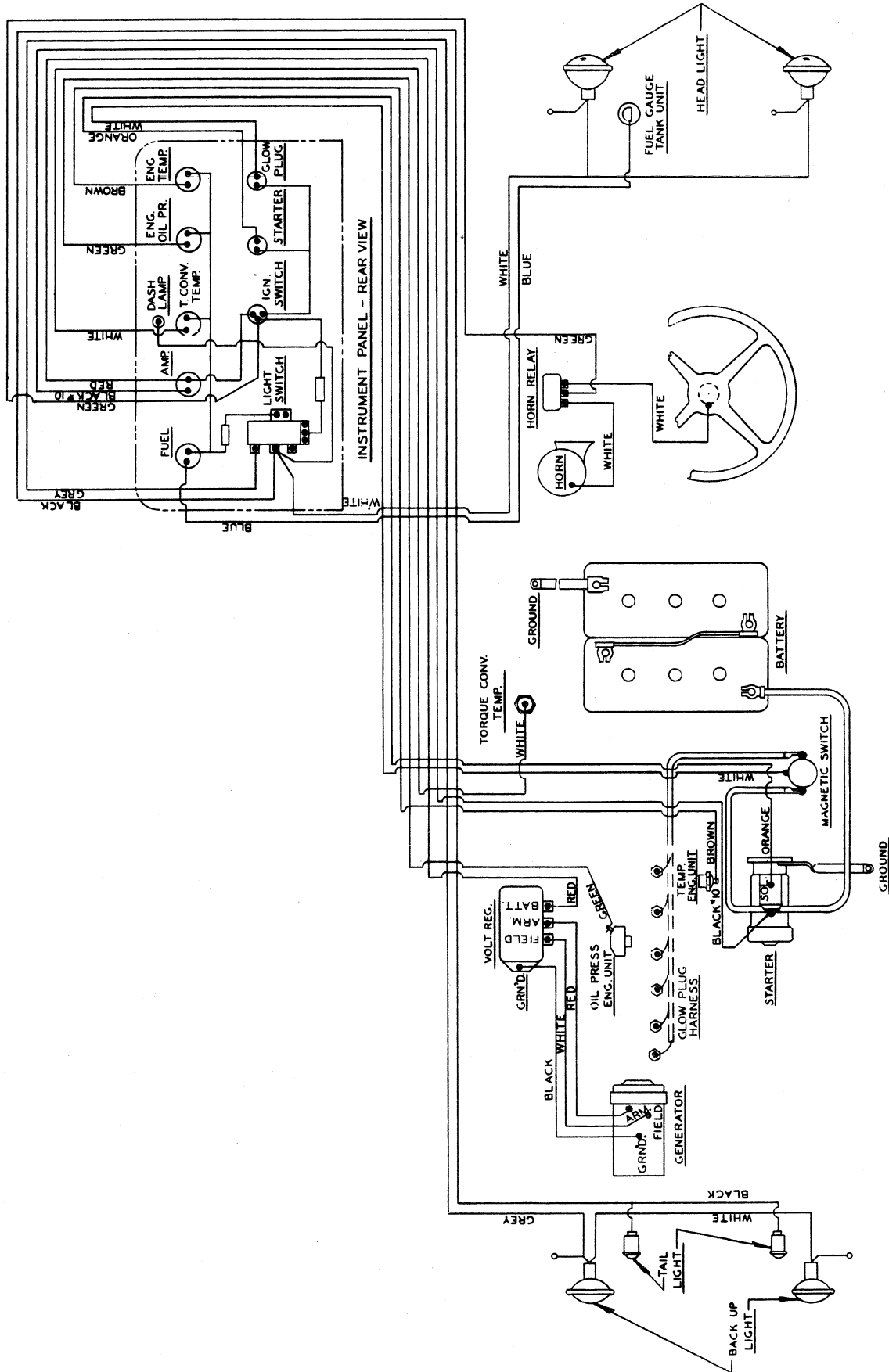
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Consult the Waukesha Service Manual for instructions on repair, maintenance and overhaul of the engine. The Lubrication Section in front of this manual covers lubrication of the engine.



TS-178

## WIRING DIAGRAM-GAS MODEL



TS-177

WIRING DIAGRAM - DIESEL MODEL





## SECTION 200

## TORQUE CONVERTER UNIT AND TRANSMISSION ASSEMBLY

The torque converter unit and transmission assembly portion of the power train enacts an important role in delivering engine power to the driving wheels.

In order to properly maintain and service these units it is important to first understand their function and how they operate.

To supplement the text below and for reference use there with, the following illustrations are provided: Fig. 1 - Front View of Torque Converter; Fig. 2 - Front View of Transmission; Fig. 3 - Rear View of Transmission; Fig. 4 - Oil Flow in Torque Converter; Fig. 5 - Oil Flow in Transmission; Fig. 6 - External Piping Diagram Oil Flow between Torque Converter, Transmission and Cooler.

In order to obtain maximum serviceability, the torque converter and transmission units have been designed as separate components, and will be described under separate headings.

## TORQUE CONVERTER UNIT

The torque converter unit is composed of (1) the torque converter, (2) the transmission pressure pump, (3) pressure regulator and relief valves, (4) the out-put shaft for driving the transmission, (5) a coupling and mounting flange to receive the hydraulic pump for operating bucket and boom mechanism, and a coupling and mounting flange for the steering booster pump for hydraulic steering.

The torque converter is composed of three members: The impeller or driving member, the turbine or driven member and the stator or reaction member. The impeller or driving member forms the outer shell of the converter and the turbine and stator operate within the shell but turn free or independent of the impeller. The impeller or outer shell is driven by the engine flywheel and turns at engine speed.

The turbine, or driven member, is splined to the turbine shaft in turn is geared to the out-put shaft.

The stator is positioned between the turbine and the impeller, and is mounted on a one-way clutch which in turn runs on a fixed support. The one-way clutch enables the stator to rotate in the same direction as engine, but restrains it from rotating opposite the engine direction.

A shaft, driven by the engine, extends thru the hollow turbine shaft and drives the transmission pressure pump mounted on the out side of the converter housing cover. The drive gear on the inside provides a coupling which receives the driving shaft of the bucket operating pump mounted on the outside of this cover. With this arrangement both pumps turn at engine speed, regardless of the turbine shaft speed.

The regulator valve, mounted on the converter housing cover, regulates the amount of pressure delivered to the transmission. The relief valve mounted near the top of the converter housing limits the amount of pressure applied to the torque converter. The oil by-passing from this valve is returned to the transmission sump by a line connected to the top of the transmission case.

The out-put shaft receives power from the turbine shaft by means of helical gears and delivers it thru a propeller shaft to the transmission.

### TRANSMISSION ASSEMBLY

The transmission assembly is a constant mesh power shifted type with manual low and high range selector.

The design enables the operator to manually select either high or low range depending upon working conditions. Once the range is selected, the transmission can be power shifted from low to high, forward or reverse by finger tip control. This is accomplished by merely moving two levers on the steering column to the desired position.

The transmission assembly consists of (1) the control valve assembly, (2) speed and direction clutches, (3) the constant mesh gear train, (4) the range selector mechanism, (5) the oil screen and sump, and (6) the rear axle de-clutching unit for the four wheel drive models.

The control valve assembly is mounted on the under side of the transmission top cover. The functions of this valve assembly are to direct oil pressure to the desired speed or direction clutch, and to effect a neutral position when the wheel brakes are applied.

The speed and direction clutch assemblies are mounted on the sides of the transmission and are enclosed by removable covers. The purpose of the speed, or direction clutch is to direct the power flow thru the transmission in the desired direction and speed.

The constant mesh gear train delivers power in the chosen direction and speed to the range selector mechanism.

The range selector mechanism enables the power to flow from the input shaft thru the out-put shaft in the chosen range of speeds.

The oil screen and sump are located on the bottom of the transmission case and provide a screened reservoir for oil being picked up by the pump.

The rear axle de-clutching unit is located on the rear side of the transmission case and houses the rear out-put shaft. Drive to the rear axle can be disconnected by manually shifting a splined coupling sleeve.

### HOW THE UNITS OPERATE

With the engine running, the pump draws oil from the transmission sump and delivers it back to the transmission control cover, thru a flexible hose, under pressure of 150 to 200 lbs. per sq. in.

The pressure regulator valve mounted on the rear of the converter housing cover remains closed until required pressure is delivered to the transmission control cover for actuating the direction and speed clutches.

This regulator valve consists of a hardened piston operating in a closely fitted bore. The piston is backed up by a spring of sufficient strength to hold the piston against its seat until

oil pressure acting on it's inner end, overcomes the spring force. This allows the piston to move toward the spring until a port is exposed along the side of the bore. The oil can then flow thru this port and into a tube sealed by "O" rings connecting the converter housing cover to the converter housing.

After entering the converter housing, the oil is directed thru a drilled hole to a large chamfer in the pilot bore of the converter housing center wall. The stator support pilots into this bore and has a series of holes which register with this chamfer and direct oil into the cavity of the torque converter. Oil enters the converter between the impeller hub bearing and the impeller hub piston ring. The piston ring prevents oil pressure from acting on the impeller hub oil seal. The area between the piston ring and oil seal is vented to the rear compartment of the converter housing to provide escape for oil seeping past the piston ring. The stator support flange is sealed against exterior leakage by an "O" ring.

After entering the converter cavity the oil exits between the turbine and the stator via the clearance between the bore of the stator support and the O. D. of the turbine shaft.

A piston ring, located next to the turbine shaft bearing, blocks the flow thru the bearing and allows it to again enter other sets of holes in the stator support. These holes are connected to an annular groove in the pilot of the stator support, which registers with an exit port drilled thru the converter housing and located on the under side approximately 30° off center.

The oil leaving the converter housing exit port is directed, thru a steel tube, to the cooler located in the engine radiator lower tank. After leaving the cooler it is directed, thru another steel tube, to the oil filter, then to a "tee" at the top of the transmission case and serves to lubricate the transmission before returning to the sump.

The relief valve located near the top side of the converter housing remains closed until the pressure within the converter reaches the proper amount. This valve consists of a steel ball held against a hardened seat by a cone shaped spring. A flexible hose connects this valve to the top of the transmission case and provides an exit for surplus oil.

The rear compartment of the converter unit also houses the out-put shaft and gears. This compartment provides a magnetic drain plug. The converter unit and transmission are filled thru this compartment. A flexible hose provides an overflow to the transmission sump, and also allows the converter to breathe air thru the transmission filtered breather.

The three members of the torque converter are composed of a series of blades. These blades are curved in such a manner as to force the oil to circulate from the impeller to the turbine, thru the stator and again into the impeller. This circulation causes the turbine to turn in the same direction as the impeller. Oil enters the inner side of the impeller and exits from the outer side into the outer side of the turbine. It then exits from the inner side of the turbine and after passing thru the stator, again enters the inner side of the impeller.

When the torque demand increases, the turbine member turns at a slower speed than the impeller, the oil flows thru the stator in such a manner as to apply a turning force in a direction opposite to that of the engine. The one-way clutch in the stator prevents this rotation and the stator remains motionless. The converter will multiply torque under this condition.

With further increase in torque demand the turbine member continues to slow down and eventually stop. At this point the converter is at "stall" and the torque multiplication is at it's maximum.

As the torque demand diminishes, the turbine speed will approach that of the impeller and when this ratio is almost one to one, the oil flows thru the stator in such a manner as to force it to turn in the same direction as that of the engine. The one-way clutch then allows the stator to turn and the converter acts as a fluid coupling with no torque multiplication.

The control valve assembly on the transmission consists of a valve body with two selector valve slides connected by internal linkage to control levers on the outside of the control cover and to the steering column by exterior linkage. A detent ball and spring in each of the slides provide a neutral; on one a forward & reverse position, while on the other a low & high position. The valve also contains a spring loaded slide valve and a pressure sealing cup. This valve is connected to the brake system master cylinder by a hydraulic line. When the wheel brakes are applied, brake fluid enters the valve and overcomes the spring force. This forces the slide to shift over and block pressure from entering the directional clutches. In this manner a "neutral" is established without moving the control levers.

With the engine running and both control levers in neutral position, oil pressure from the converter unit is blocked at the control valve, and the transmission is in neutral. Movement of the forward & reverse slide will direct oil, under pressure, to either the forward or reverse direction clutch as desired, and the opposite one is open to relieve pressure. The same applies to the low & high lever. The machine will not move until both slides are moved to the desired position.

The direction or speed clutch assembly consists of a drum with internal splines and a bore to receive a hydraulically actuated piston. This drum is bolted to a hub which in turn is splined to a tubular shaft or quill and secured by a snap ring. A piston is inserted into the bore of the drum. The piston is made oil tight by the use of synthetic rubber lip seals. A steel disc with external splines is inserted into the drum splines and rests against the piston. Next, a steel plate with sintered bronze facings and splines at the inner diameter, is inserted. Another steel, then bronze, then steel etc. is inserted until the required total is achieved. After inserting the last bronze plate, a series of springs are assembled in such a manner that these springs rest on teeth of the first plate inserted next to the piston. A heavy back-up plate is then inserted and secured by a snap ring.

A hub with I.D. and O.D. splines is inserted into the splines of the bronzed faced discs and over a splined shaft extending thru the tubu-

lar shaft or quill. This hub is positioned by a snap ring on either end. This arrangement allows the tubular shaft or quill, together with the hub, drum and steel plates, to turn as a unit.

The bronze plates and inner shaft are free to remain stationary or turn in the opposite direction as long as no pressure is present in the direction clutch.

To engage the clutch, as previously stated, the control valve is placed in the desired position. This allows oil under pressure to flow from the control cover valve, thru a tube or line in the transmission case, to the chosen clutch quill shaft bearing retainer. This retainer has a bore which houses a portion of the clutch drum hub. In this hub there are two piston rings which allow oil to flow from the stationary bearing cap to the rotating drum hub, without losing pressure.

Once into the drum hub, oil is directed thru a drilled hole into the rear side of the piston bore. Pressure of the oil forces the piston and steel plates over against the heavy back-up plate.

The steel plates clamping against the bronze plates enables the quill and shaft to be locked together and allows them to turn as a unit.

There is a spring loaded bleed valve in the clutch drum hub which allows quick escape for oil when the pressure to the piston is released.

The transmission gear train consists of five shaft mountings as follows: (1) Input shaft, (2) reverse shaft, (3) first & third shaft, (4) second & fourth shaft, (5) out-put shaft.

All except the out-put shaft consist of a shaft and a quill, each mounted in the case on tapered roller bearings. Each of these shaft and quill combinations are fitted with a direction clutch or speed clutch which locks the two together when oil pressure is applied to the desired clutch. With the shaft and quill locked together, the gears mounted on them can transmit power.

The out-put shaft is mounted on tapered roller bearing and carries, on bushings, a low range gear and a high range gear, which are in constant mesh with the balance of the gear train. Each of these gears is filled with clutching teeth and either can be locked to the out-put shaft by sliding a splined sleeve into the desired gear. This is accomplished by moving a lever in the operators compartment connected to the transmission shift rail and fork or range selector mechanism, by mechanical linkage.

At the bottom of the transmission case a removable tube extends up and into a boss at the inside of the rear wall, which in turn receives the flexible hose connecting to the transmission pressure pump. A screen mounted in a steel frame is positioned on the bottom of the case fitting over this tube and sealed with a gasket at either side. This screen is held in place by the sump cover pan. This pan is fitted with a magnetic drain plug.

The rear axle de-clutching unit consists of a split out-put shaft,

with a sliding splined sleeve to engage or dis-engage the rear axle. This is accomplished by manually shifting a lever in the operators compartment which is mechanically connected to the shift fork on the de-clutching unit sliding sleeve. This unit of course, is only used on the four wheel drive machines. On the front drive only or the rear wheel drive only, the out-put shaft is of one piece and a companion flange assembled only on the required end.









## TORQUE CONVERTER

Item No.	Description	No. Req'd.
1	Gear, Converter Drive .....	1
2	Bolt, Impeller to Drive Disc .....	30
3	Converter Disc. Assy. ....	1
4	Bearing, Disc Hub .....	1
5	Turbine, Converter .....	1
6	Hub, Turbine .....	1
7	Ring, Front Thrust Washer, Retaining .....	1
8	Washer, Front Thrust .....	1
9	Spring, Sprag .....	2
10	Reaction Member, Converter .....	1
11	Washer, Rear Thrust .....	1
12	Ring, Impeller Hub Bearing, Retainer .....	1
13	Bearing, Impeller Hub .....	1
14	"O" Ring, Impeller to Hub .....	1
15	Impeller, Converter .....	1
16	Washer, Impeller to Drive Disc. ....	30
17	Lockwasher, Impeller to Drive Disc .....	30
18	Nut, Impeller to Drive Disc. ....	30
19	Washer, Impeller to Hub .....	6
20	Bolt, Impeller to Hub .....	6
20A	Lockwire, Impeller to Hub .....	AR
21	"O" Ring, Converter Support .....	1
22	Seat, By-Pass Ball .....	1
23	Spring, By-Pass .....	1
24	Fitting, By-Pass Plug .....	1
25	Seal, By-Pass Plug .....	1
26	Ball, By-Pass .....	1
27	Lockwasher, Converter Support to Housing .....	6
28	Bolt, Converter Support to Housing .....	6
29	Housing, Converter .....	1
30	Plug, Magnetic Drain .....	1
31	Converter Support Assembly .....	1
32	Ring, Converter Support Oil .....	1
33	Seal, Converter Support Oil .....	1
34	"O" Ring, Impeller to Drive Disc .....	1
35	Hub, Converter Impeller .....	1
36	Ring, Impeller Hub Bearing Locating .....	1
37	Ring, End Plate Retainer .....	1
38	End Plate and Bushing Assembly .....	1
39	Outer Race, Reaction Member .....	1
40	Over-running Clutch Assy. (Inc. Items 9 & 40) .....	1
41	End Plate and Bushing Assembly .....	1
42	Ring, End Plate Retainer .....	1
43	Ring, Turbine Hub Retainer .....	2
44	Washer, Turbine to Hub .....	8
45	Bolt, Turbine to Hub .....	8
45A	Lockwire, Turbine to Hub .....	AR

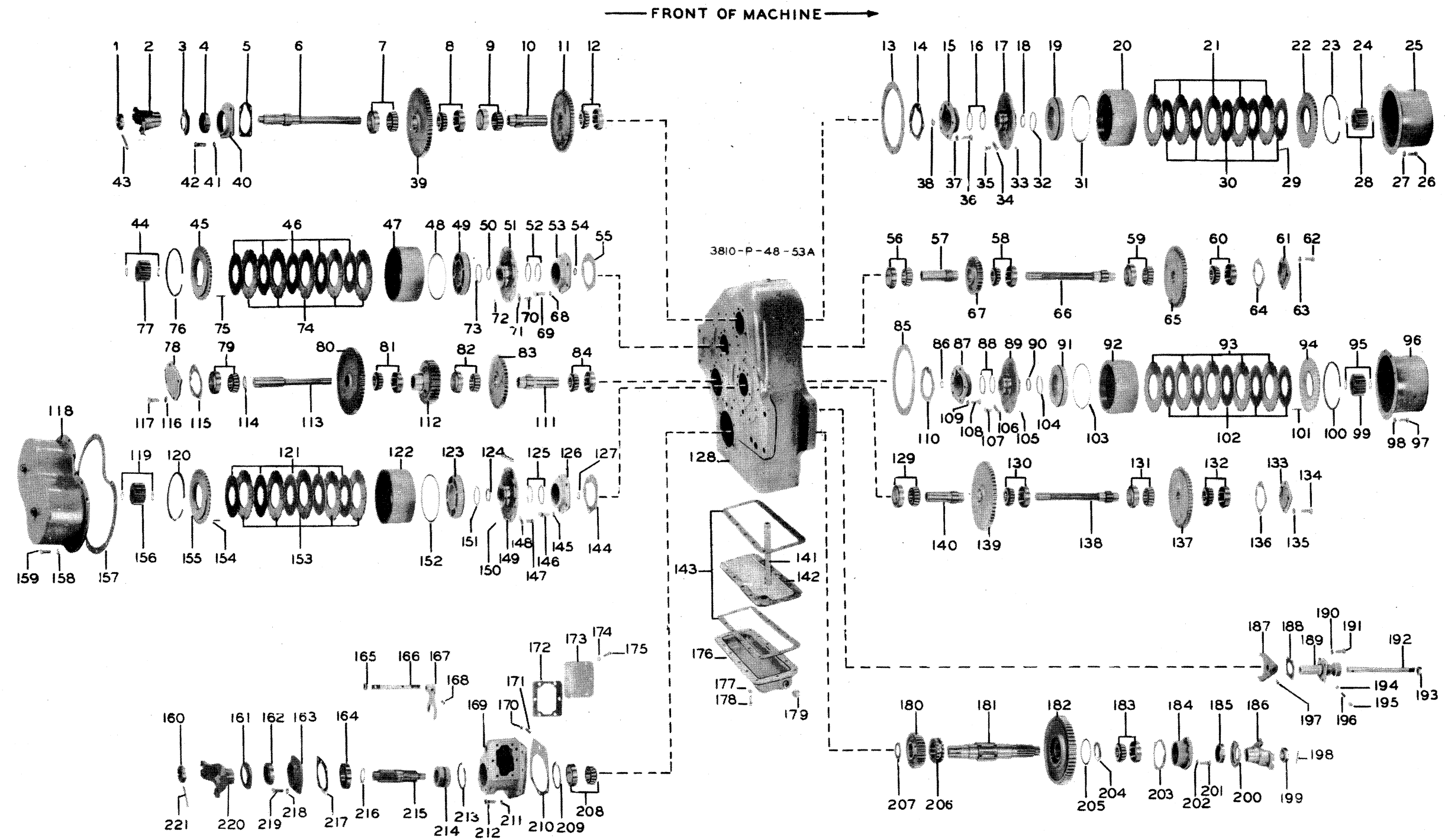
## TORQUE CONVERTER (CONT'D)

<u>Item</u> <u>No.</u>	<u>Description</u>	<u>No.</u> <u>Req'd.</u>
46	Shaft, Main Drive Gear .....	1
47	Oil Ring, Main Drive Shaft .....	1
48	Bearing, Main Drive Gear Retainer .....	1
49	Gear, Main Drive (33T) .....	1
50	Nut, Main Drive Gear Retainer .....	1
51	Shaft, Oil Pump .....	1
52	Piston Ring, Oil Pump Shaft .....	1
53	Gear, Out-Put Shaft (32T) .....	1
54	Spacer, Out-Put Gear .....	1
55	Ring, Oil Pump Drive Gear Hub Retainer .....	1
56	Bearing, Oil Pump Drive Gear Hub .....	1
57	Ring, Oil Pump Driven Gear Hub Brg. Retainer .....	1
58	Bearing, Oil Pump Driven Gear Hub .....	1
59	Hub, Oil Pump Driven Gear .....	1
60	"O" Ring, Oil Cross-Over Tube .....	1
61	Tube, Oil Cross-Over .....	1
62	"O" Ring, Oil Cross-Over Tube .....	1
63	Gear, Oil Pump Driven (43T) .....	1
64	Cover, Converter Housing .....	1
65	Bearing, Oil Pump Driven Gear Hub .....	1
66	Ring, Oil Pump Driven Gear Hub Brg. Retainer .....	1
67	Ring, Oil Pump Driven Gear Hub Brg. Retainer .....	1
68	Hose, Valve Body to Converter Pump .....	1
69	Gasket, Valve Body .....	1
70	"O" Ring, Valve Body to Converter Housing .....	2
71	Roll Pin, Regulating Valve Body .....	1
72	Spring, Regulating Valve, Outer .....	1
73	Stop, Regulating Valve Piston .....	1
74	"O" Ring, Regulating Valve Stop .....	1
75	Spring, Regulating Valve, Inner .....	1
76	Body, Regulating Valve .....	1
77	Bolt, Regulating Valve Body .....	2
77A	Bolt, Regulating Valve Body .....	1
78	Lockwasher, Regulating Valve Body .....	3
79	Roll Pin, Regulating Valve Body .....	1
80	Piston, Regulating Valve Body .....	1
81	Stop, Regulating Valve Body .....	1
82	"O" Ring, Regulating Valve Stop .....	1
83	Cap, Out-Put Shaft .....	1
84	Oil Seal, Out-Put Shaft .....	1
85	Deflector, Out-Put Shaft .....	1
86	Flange and Deflector Assy. ....	1
87	Nut, Out-Put Shaft Flange .....	1
88	Cotter, Flange Nut .....	1
89	Bolt, Out-Put Shaft Bearing Cap .....	4
90	Lockwasher, Bearing Cap .....	4
91	Shim, Out-Put Bearing Cap (.004) .....	AR
91A	Shim, Out-Put Bearing Cap (.007) .....	AR
91B	Shim, Out-Put Bearing Cap (.010) .....	AR

## TORQUE CONVERTER (CONT'D)

<u>Item</u> <u>No.</u>	<u>Description</u>	<u>No.</u> <u>Req'd.</u>
92	Oil Pump Assy. ....	1
93	Gasket, Oil Pump ....	1
94	Bearing, Oil Pump Drive Gear Hub ....	1
95	Stud, Oil Pump Mounting ....	6
96	Ring, Oil Pump Driven Gear Hub Retainer ....	1
97	Bearing, Oil Pump Driven Gear Hub ....	1
98	Bolt, Cover To Housing ....	12
99	Lockwasher, Cover to Housing ....	12
100	"O" Ring, Housing to Cover Sealing ....	1
101	Gear, Oil Pump Drive (46T) ....	1
102	Gear, Oil Pump Driven (43T) ....	1
103	Hub, Oil Pump Driven Gear ....	1
104	Bearing, Oil Pump Driven Gear Hub ....	1
105	Ring, Oil Pump Driven Gear Hub Brg. Retainer ....	1
106	Hub, Oil Pump Drive Gear ....	1
107	Bearing, Out-Put Shaft ....	1
108	Shaft, Out-Put ....	1
109	Bearing, Out-Put Shaft ....	1
110	Washer, Main Drive Gear Nut Retainer ....	1
111	Ring, Main Drive Gear Bearing (.088-.090) ....	AR
111A	Ring, Main Drive Gear Bearing (.091-.093) ....	AR
111B	Ring, Main Drive Gear Bearing (.094-.096) ....	AR
111C	Ring, Main Drive Gear Bearing (.097-.099) ....	AR

AR - As Required



## TRANSMISSION

**TRANSMISSION ASSEMBLY**

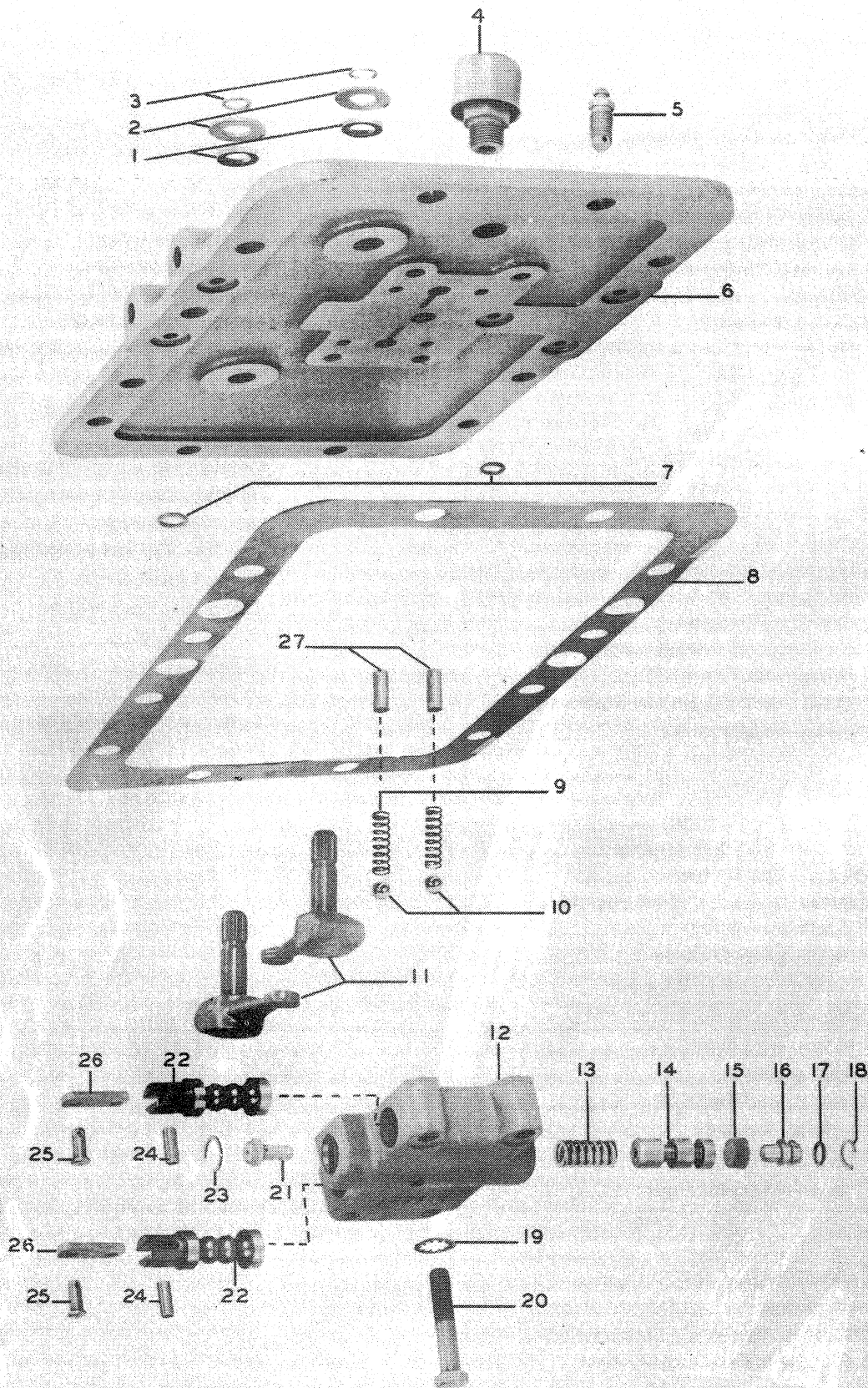
Item No.	Description	No. Req'd.	Item No.	Description	No. Req'd.
1	Nut, Flange .....	1	39	Gear, Input Shaft Forward (45T).....	1
2	Input Flange & Deflector Assy. (Includes Item 3).....	1	40	Cap, Input Shaft Bearing.....	1
3	Deflector, Input Flange .....	1	41	Lockwasher, Bearing Cap.....	4
4	Oil Seal, Input Shaft.....	1	42	Screw, Bearing Cap .....	4
5	Shim, Bearing Cap (.004) .....		43	Pin, Flange Nut Cotter.....	1
5A	Shim, Bearing Cap (.007) .....		44	Ring, Disc Hub Retainer .....	2
5B	Shim, Bearing Cap (.010) .....		45	Plate, Clutch Disc End.....	1
6	Shaft, Input .....	1	46	Disc, Clutch Inner.....	5
7	Bearing, Input Shaft.....	1	47	Drum, Clutch .....	1
8	Bearing, Input Shaft.....	1	48	Ring, Piston Outer Sealing .....	1
9	Bearing, Quill Shaft.....	1	49	Piston, Clutch .....	1
10	Shaft, Quill .....	1	50	Ring, Hub Retainer.....	1
11	Gear, Input Shaft Reverse (43 TEETH) 1		51	Clutch Drum Hub Ass'y .....	1
12	Bearing, Quill Shaft .....	1	52	Ring, Hub Oil Sealing .....	1
13	Gasket, Cover .....	1	53	Cap, Clutch Bearing .....	1
14	Shim, Clutch Bearing Cap (.004) .....		54	"O" Ring, Bearing Cap.....	1
14A	Shim, Clutch Bearing Cap (.007) .....		55	Shim, Clutch Bearing Cap.....	
14B	Shim, Clutch Bearing Cap (.010) .....		55A	Shim, Clutch Bearing Cap.....	
14C	Shim, Clutch Bearing Cap (.020) .....		55B	Shim, Clutch Bearing Cap.....	
15	Cap, Clutch Bearing.....	1	55C	Shim, Clutch Bearing Cap.....	
16	Ring, Hub Oil Sealing.....	2	56	Bearing, 1st-3rd Shaft.....	1
17	Clutch Drum Hub Ass'y.....	1	57	Shaft, Quill .....	1
18	Ring, Hub Retainer .....	1	58	Bearing, 1st-3rd Shaft .....	1
19	Piston, Clutch .....	1	59	Bearing, 1st-3rd Shaft .....	1
20	Drum, Clutch .....	1	60	Bearing, 1st-3rd Shaft .....	1
21	Disc, Clutch Outer .....	5	61	Cap, 1st-3rd Shaft Bearing.....	1
22	Plate, Clutch Disc End.....	1	62	Screw, Bearing Cap.....	4
23	Ring, End Plate Retainer .....	1	63	Lockwasher, Bearing Cap.....	4
24	Hub, Clutch Disc .....	1	64	Shim, Bearing Cap (.004).....	
25	Clutch Cover Ass'y.....	1	64A	Shim, Bearing Cap (.007).....	
26	Screw, Cover .....	10	64B	Shim, Bearing Cap (.010).....	
27	Lockwasher, Cover .....	10	65	Gear, 1st-3rd Drop (44T).....	1
28	Ring, Disc Hub Retainer.....	2	66	Shaft, 1st-3rd Drive.....	1
29	Spring, Clutch Release.....	10	67	Gear, 1st-3rd Drive (29T).....	1
30	Disc, Clutch Inner .....	5	68	Lockwasher, Bearing Cap.....	4
31	Ring, Piston Outer Sealing.....	1	69	Screw, Bearing Cap.....	4
32	Ring, Piston Inner Sealing.....	1	70	Screw, Drum To Hub.....	8
33	Pin, Relief .....	1	71	Spring, Relief.....	1
34	Spring, Relief .....	1	71A	Washer, Relief Spring.....	1
34A	Washer, Relief Spring .....	1	71B	Guard, Relief Spring.....	1
34B	Guard, Relief Spring .....	1	71C	Washer, Clutch Drum Balance.....	4
34C	Washer, Clutch Drum Balance.....	4	72	Pin, Relief .....	1
35	Screw, Drum to Hub.....	8	73	Ring, Piston Inner Sealing.....	1
36	Screw, Bearing Cap.....	4	74	Disc, Clutch Outer.....	5
37	Lockwasher, Bearing Cap.....	4	75	Spring, Clutch Release.....	10
38	"O" Ring, Bearing Cap.....	1	76	Ring, End Plate Retainer.....	1
			77	Hub, Clutch Disc.....	1
			78	Cap, 2nd-4th Shaft Bearing.....	1

**TRANSMISSION ASSEMBLY (Continued)**

Item No.	Description	No. Req'd.	Item No.	Description	No. Req'd.
79	Bearing, 2nd-4th Shaft.....	1	119	Ring, Disc Cover Retainer.....	2
80	Gear, 2nd-4th High (57T).....	1	120	Ring, End Plate Retainer.....	1
81	Bearing, 2nd-4th Shaft.....	1	121	Disc, Clutch Inner.....	5
82	Bearing, 2nd-4th Shaft.....	1	122	Drum, Clutch.....	1
83	Gear, 2nd-4th Drive (43T).....	1	123	Piston, Clutch.....	1
84	Bearing, 2nd-4th Shaft.....	1	124	Ring, Hub Retainer.....	1
85	Gasket, Cover.....	1	125	Ring, Hub Oil Sealing.....	2
86	"O" Ring, Bearing Cap.....	1	126	Cap, Clutch Bearing.....	1
87	Cap, Clutch Bearing.....	1	127	"O" Ring, Bearing Cap.....	1
88	Ring, Hub Oil Sealing.....	2	128	Transmission Case Ass'y.....	1
89	Clutch Drum Hub Ass'y.....	1	129	Bearing, Reverse Shaft.....	1
90	Ring, Hub Retainer.....	1	130	Bearing, Reverse Shaft.....	1
91	Piston, Clutch.....	1	131	Bearing, Reverse Shaft.....	1
92	Drum, Clutch.....	1	132	Bearing, Reverse Shaft.....	1
93	Disc, Clutch Outer.....	5	133	Cap, Reverse Shaft Bearing.....	1
94	Plate, Clutch Disc End.....	1	134	Screw, Bearing Cap.....	4
95	Ring, Disc Hub Retainer.....	2	135	Lockwasher, Bearing Cap.....	4
96	Clutch Cover Ass'y.....	1	136	Shim, Bearing Cap (.004).....	
97	Screw, Cover.....	4	136A	Shim, Bearing Cap (.007).....	
98	Lockwasher, Cover.....	1	136B	Shim, Bearing Cap (.010).....	
99	Hub, Clutch Disc.....	1	137	Gear, Reverse Idler (52T).....	1
100	Ring, End Plate Retainer.....	1	138	Shaft, Reverse Drive.....	1
101	Spring, Clutch Release.....	10	139	Gear, Reverse Drive (54T).....	1
102	Disc, Clutch Inner.....	5	140	Shaft, Quill.....	1
103	Ring, Piston Outer Sealing.....	1	141	Pipe, Sump Intake.....	1
104	Ring, Piston Inner Sealing.....	1	142	Oil Screen and Frame Assembly.....	1
105	Pin, Relief.....	1	143	Gasket, Sump Cover.....	2
106	Spring, Relief.....	1	144	Shim, Clutch Bearing Cap (.004).....	
106A	Washer, Relief Spring.....	1	144A	Shim, Clutch Bearing Cap (.007).....	
106B	Guard, Relief Spring.....	1	144B	Shim, Clutch Bearing Cap (.010).....	
106C	Washer, Clutch Drum Balance.....	4	144C	Shim, Clutch Bearing Cap (.020).....	
107	Screw, Drum To Hub.....	8	145	Lockwasher, Bearing Cap.....	4
108	Screw, Bearing Cap.....	4	146	Bolt, Bearing Cap.....	4
109	Lockwasher, Bearing Cap.....	4	147	Bolt, Drum to Hub.....	8
110	Shim, Clutch Bearing Cap (.004).....		148	Spring, Relief.....	1
110A	Shim, Clutch Bearing Cap (.007).....		148A	Washer, Relief Spring.....	1
110B	Shim, Clutch Bearing Cap (.010).....		148B	Guard, Relief Spring.....	1
110C	Shim, Clutch Bearing Cap (.020).....		148C	Washer, Clutch Drum Balance.....	4
111	Shaft, Quill.....	1	149	Clutch Drum Hub Ass'y.....	1
112	Gear, 2nd-4th Shaft (32T).....	1	150	Pin, Relief.....	1
113	Shaft, 2nd-4th Drive.....	1	151	Ring, Piston Inner Sealing.....	1
114	Ring, 2nd-4th Gear Locating.....	1	152	Ring, Piston Outer Sealing.....	1
115	Shim, Bearing Cap (.004).....		153	Disc, Clutch Outer.....	5
115A	Shim, Bearing Cap (.007).....		154	Spring, Clutch Release.....	10
115B	Shim, Bearing Cap (.010).....		155	Plate, Clutch Disc End.....	1
116	Lockwasher, Bearing Cap.....	4	156	Hub, Clutch Disc.....	1
117	Screw, Bearing Cap.....	4	157	Gasket, Cover.....	1
118	Clutch Cover Ass'y.....	1	158	Lockwasher, Cover.....	16

**TRANSMISSION ASSEMBLY (Continued)**

Item No.	Description	No. Req'd.	Item No.	Description	No. Req'd.
159	Bolt, Cover .....	16	202	Lockwasher, Out-Put Shaft Bearing Cap .....	4
160	Nut, Flange .....	1	203	Shim, Bearing Cap (.004) .....	
161	Deflector, Out-Put Flange .....	1	203A	Shim, Bearing Cap (.007) .....	
162	Oil Seal, Out-Put Shaft .....	1	203B	Shim, Bearing Cap (.010) .....	
163	Cap, Rear Out-Put Bearing .....	1	204	Thrust Washer, Out-Put Gear .....	1
164	Bearing, Out-Put Shaft .....	1	205	Oil Ring, Low Gear .....	1
165	Oil Seal, Shift Shaft .....	1	206	Hub, Hi and Lo Shift .....	1
166	Shift Rail, 2 and 4 Wheel Drive .....	1	207	Thrust Washer, Out-Put Gear .....	1
167	Shift Fork, 2 and 4 Wheel Drive .....	1	208	Bearing, Out-Put Shaft .....	1
168	Screw, Shift Fork .....	1	209	Retainer Ring, Out-put Shaft Bearing .....	1
169	Housing, Rear Out-Put Shaft .....	1	210	Shim, Rear Out-Put Shaft Housing .....	1
170	Ball, Mesh Lock .....	1	211	Lockwasher, Rear Housing .....	7
171	Spring, Mesh Lock .....	1	212	Bolt, Rear Housing .....	7
172	Gasket, Cover Plate .....	1	213	Locating Ring, Out-Put Shaft Bearing .....	1
173	Plate, Rear Housing Cover .....	1	214	Shift Hub, Rear Out-Put Shaft .....	1
174	Lockwasher, Cover Plate .....	6	215	Shaft, Rear Out-Put .....	1
175	Bolt, Cover Plate .....	6	216	Ring, Rear Out-Put Shaft Locating .....	1
176	Sump Cover .....	1	217	Gasket, Bearing Cap .....	1
177	Lockwasher, Sump Cover .....	14	218	Lockwasher, Bearing Cap .....	4
178	Bolt, Sump Cover .....	14	219	Bolt, Bearing Cap .....	4
179	Drain Plug (Magnetic) .....	1	220	Flange and Deflector Ass'y (Includes Includes Item 161) .....	1
180	High Gear and Bushing Ass'y (29T) .....	1	221	Cotter, Out-Put Flange Nut .....	1
180A	Bushing, High Gear (29T) .....	1			
181	Out-Put Shaft and Bushing Assembly .....	1			
181A	Bushing, Out-Put Shaft .....	1			
182	Low Gear and Bushing Ass'y (55T) .....	1			
182A	Bushing, Low Gear (55T) .....	1			
183	Bearing, Out-Put Shaft .....	1			
184	Cap, Out-Put Shaft Bearing .....	1			
185	Oil Seal, Out-Put Shaft .....	1			
186	Out-Put Flange and Deflector Ass'y (Include Item 200) .....	1			
187	Fork, High and Low Shift .....	1			
188	Gasket, Hi and Low Support .....	1			
189	Support, Hi and Lo Shift Shaft .....	1			
190	Lockwasher, Support .....	1			
191	Bolt, Support .....	1			
192	Shaft, Hi and Lo Shift .....	1			
193	Oil Seal, Support .....	1			
194	Ball, Mesh Lock (Support) .....	1			
195	Plug, Mesh Lock (Support) .....	1			
196	Spring, Mesh Lock (Support) .....	1			
197	Lock Screw, Shift Fork .....	1			
198	Cotter, Flange Nut .....	1			
199	Nut, Flange .....	1			
200	Deflector, Flange .....	1			
201	Bolt, Out-Put Shaft Bearing Cap .....	4			



CONTROL VALVE AND COVER

3816-P-48-55G



## TRANSMISSION CONTROL COVER PARTS

<u>Item No.</u>	<u>Description</u>	<u>No. Req'd.</u>
1	Oil Seal, Selector Arm .....	2
2	Washer, Selector Arm Shaft .....	2
3	Ring, Selector Arm Shaft Washer Retainer .....	2
4	Breather Assembly .....	1
5	Bleeder Valve .....	1
6	Control Cover .....	1
7	"O" Ring .....	5
8	Gasket, Control Cover .....	1
9	Spring, Selector Valve Detent .....	2
10	Ball, Selector Valve Detent .....	2
11	Selector Arm & Shaft Assembly .....	2
12	Housing, Control Valve .....	1
13	Spring, Shutoff Valve .....	1
14	Valve, Selector Shutoff .....	1
15	Sealing Cup, Selector Shutoff .....	1
16	Valve Stop, Selector Shutoff .....	1
17	Seal, Selector Shutoff Valve Stop .....	1
18	Ring, Shutoff Valve Stop Retainer .....	1
19	Lockwasher, Valve Housing Bolt .....	4
20	Bolt, Valve Housing .....	4
21	Guide, Valve Spring .....	1
22	Selector Valve .....	2
23	Ring, Shutoff Valve Spring Retainer .....	1
24	Pin, Shutoff Valve Link .....	2
25	Clevis Pin, Selector Valve Link .....	2
26	Link, Selector Valve .....	2
27	Ball Stop, Selector Valve Detent .....	2



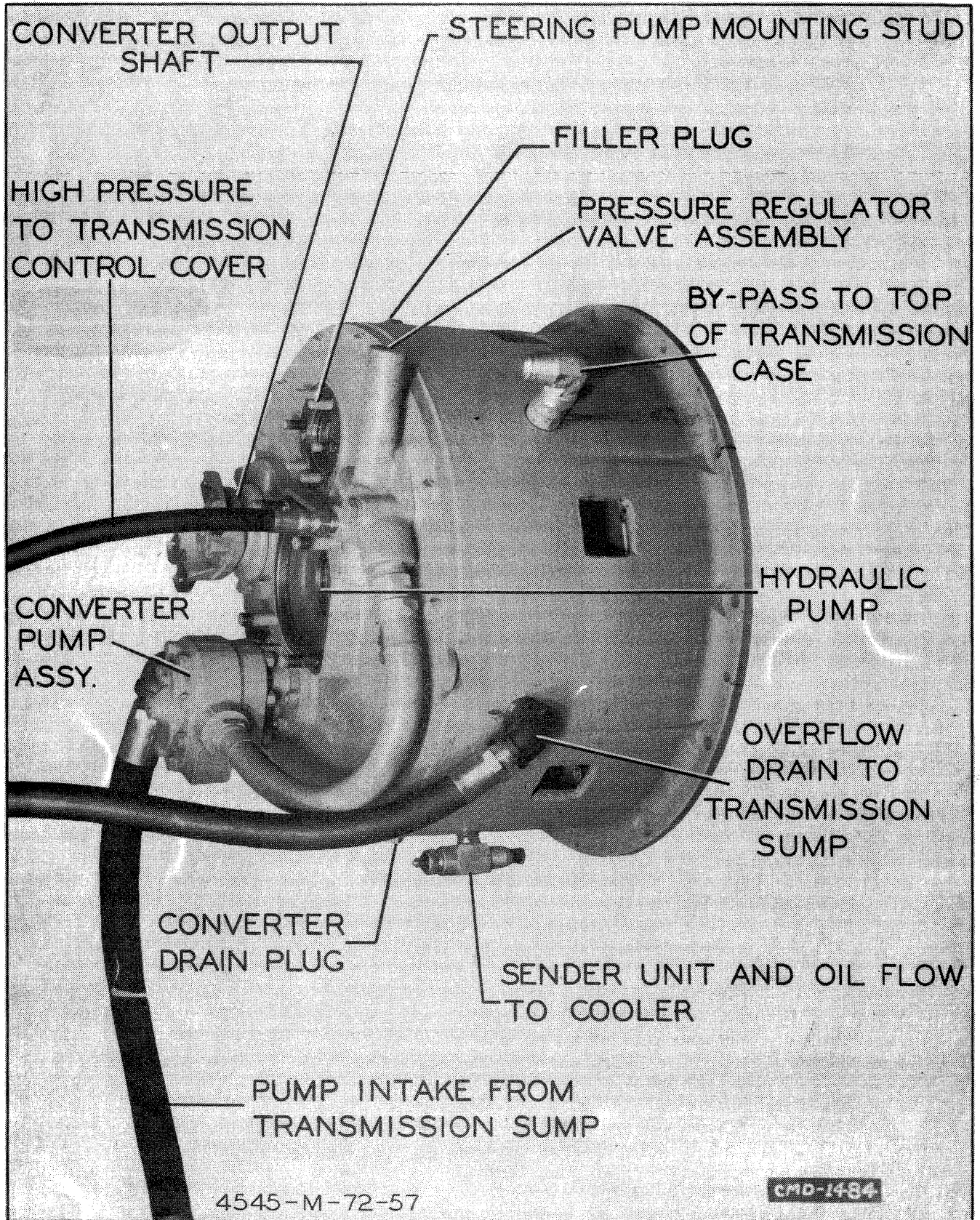


Fig. 1 Torque Converter

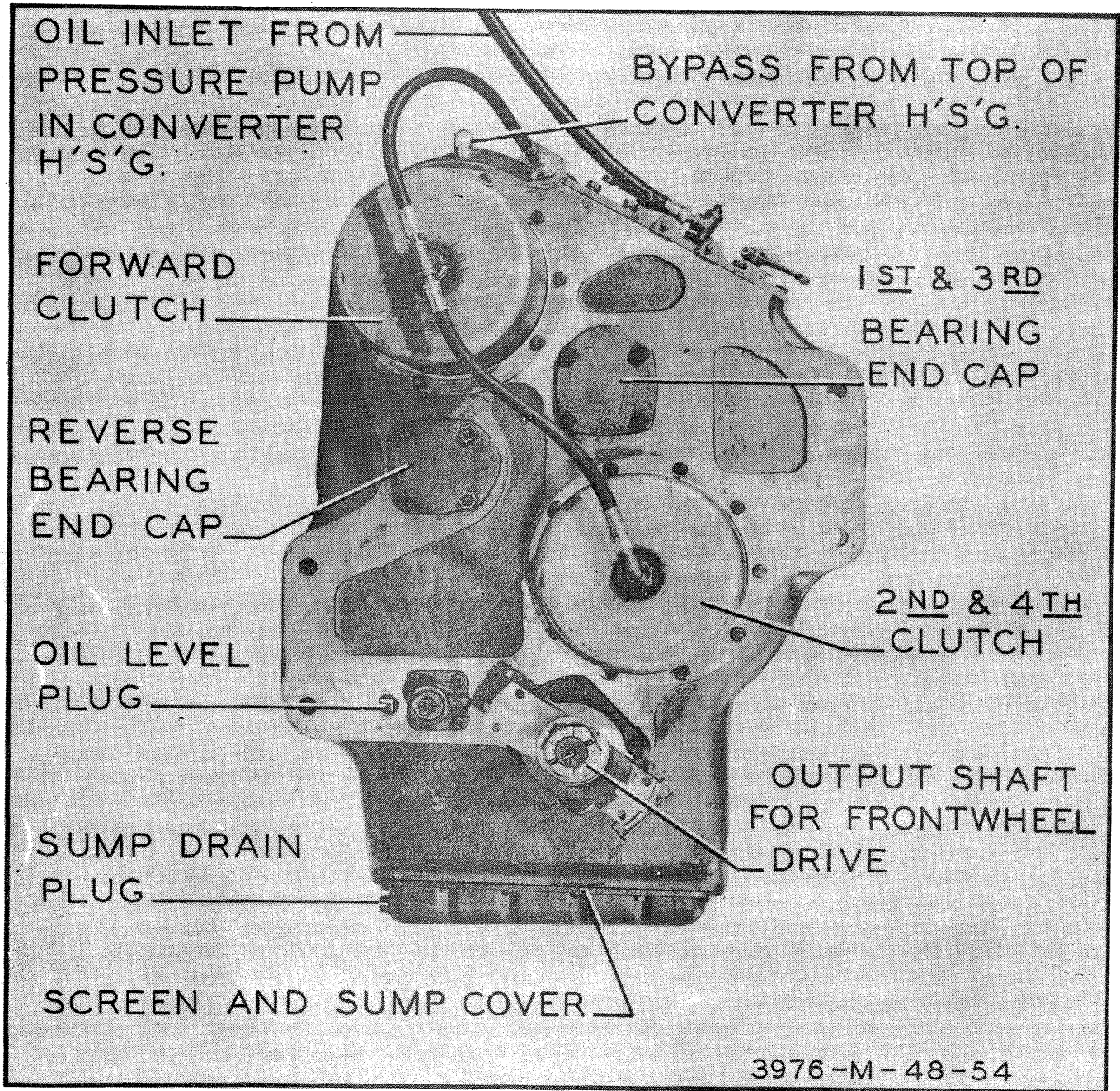


Fig. 2 Front View Transmission Assembly



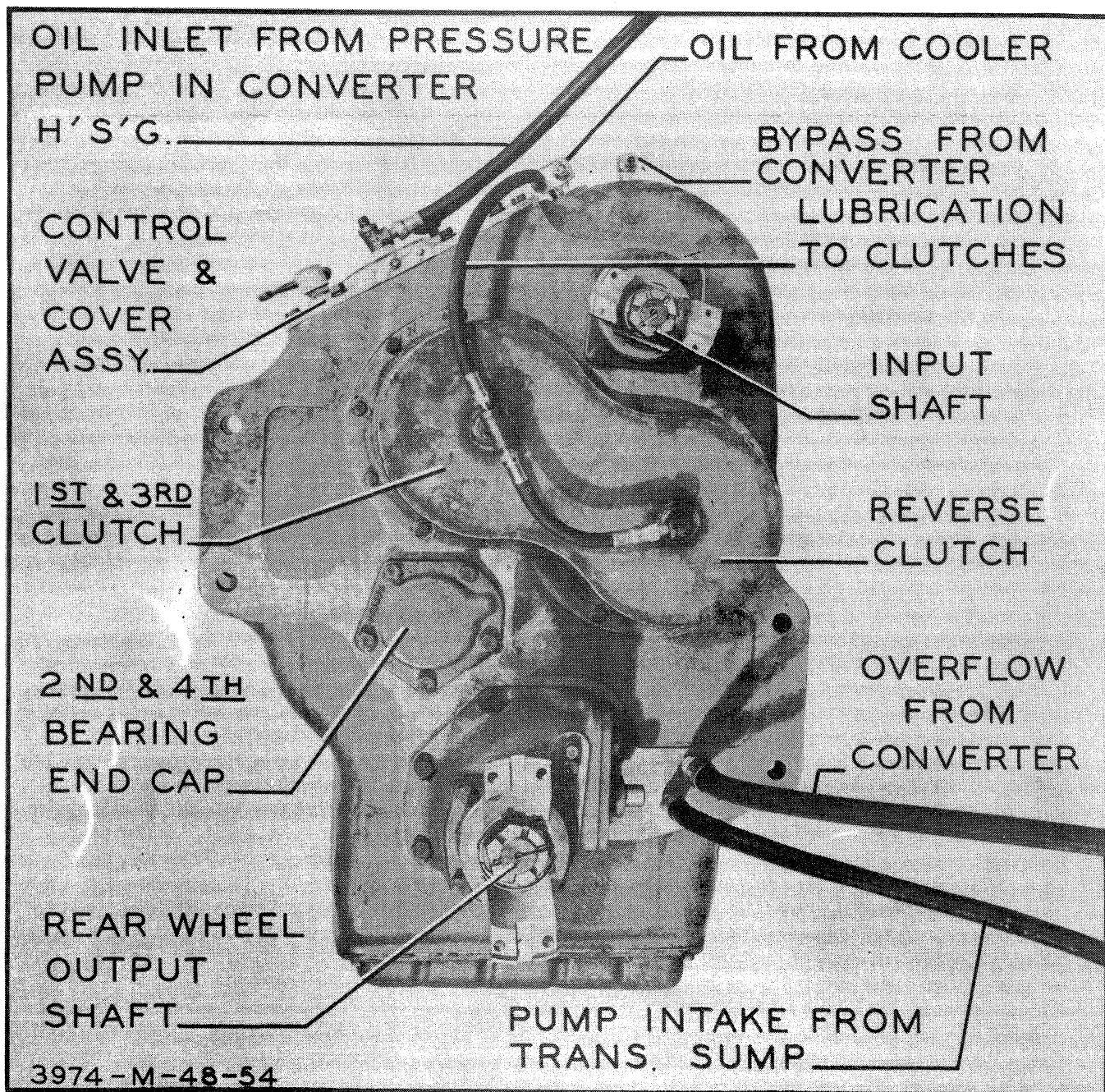


Fig. 3 Rear View Transmission Assembly

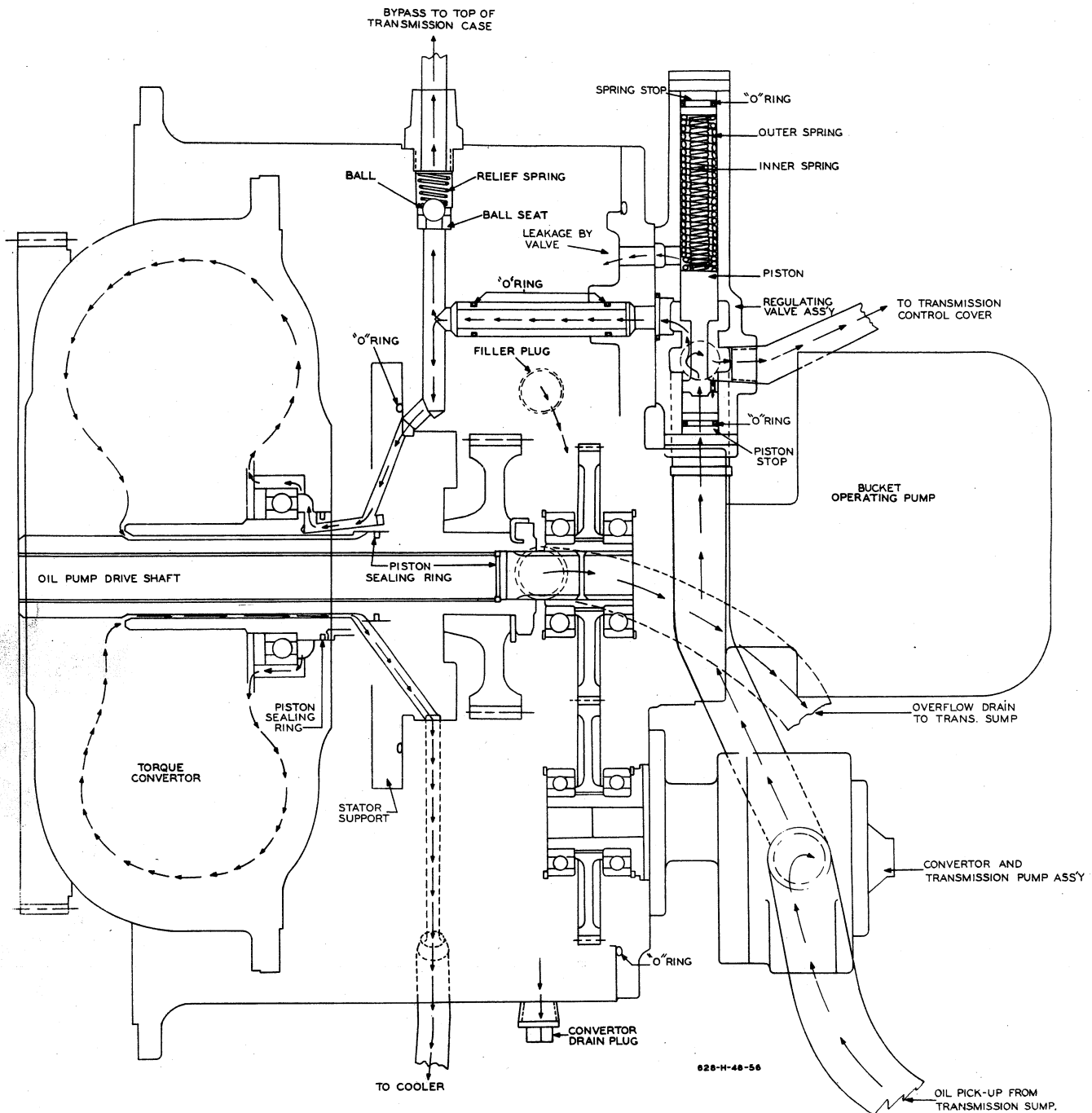
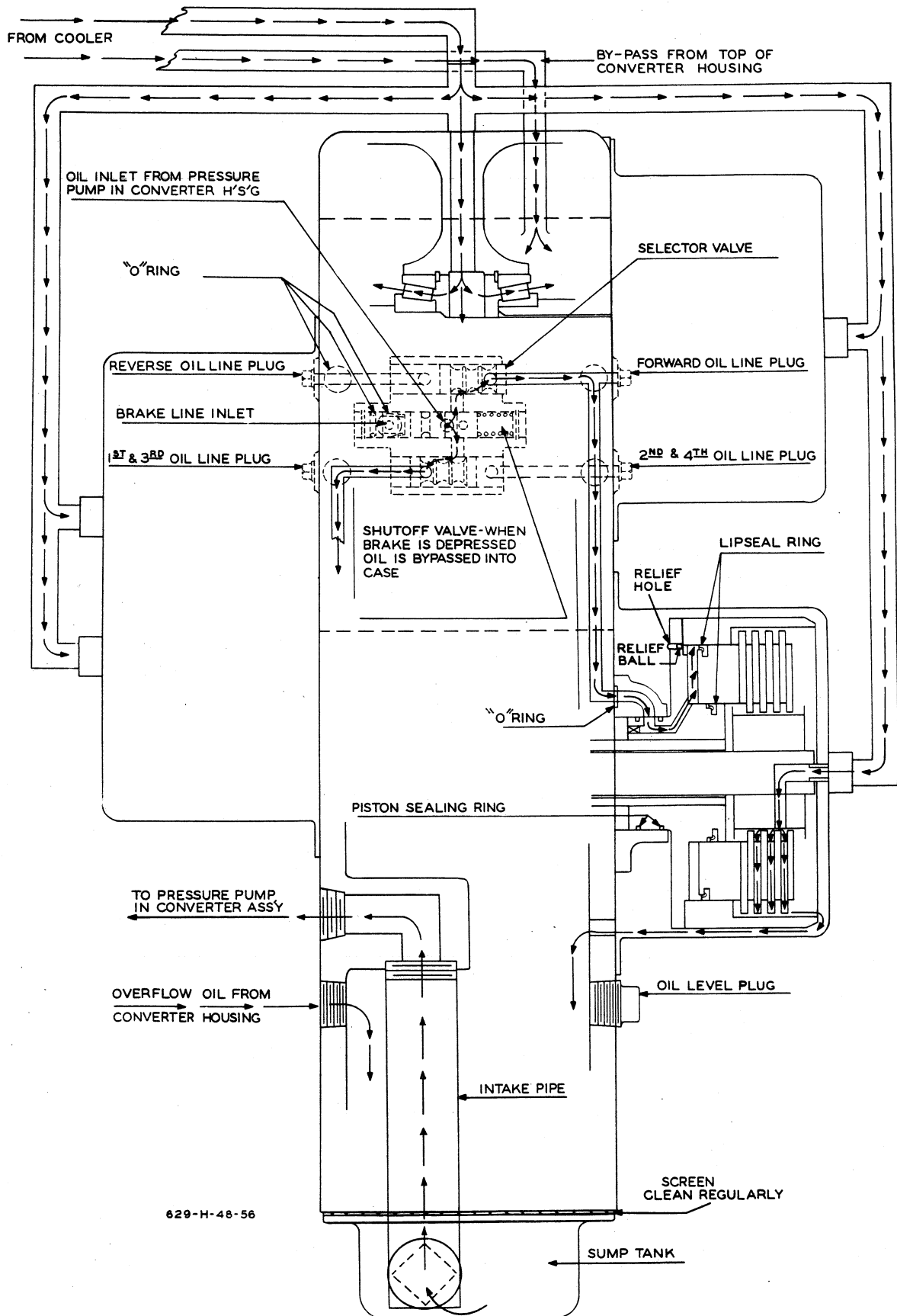
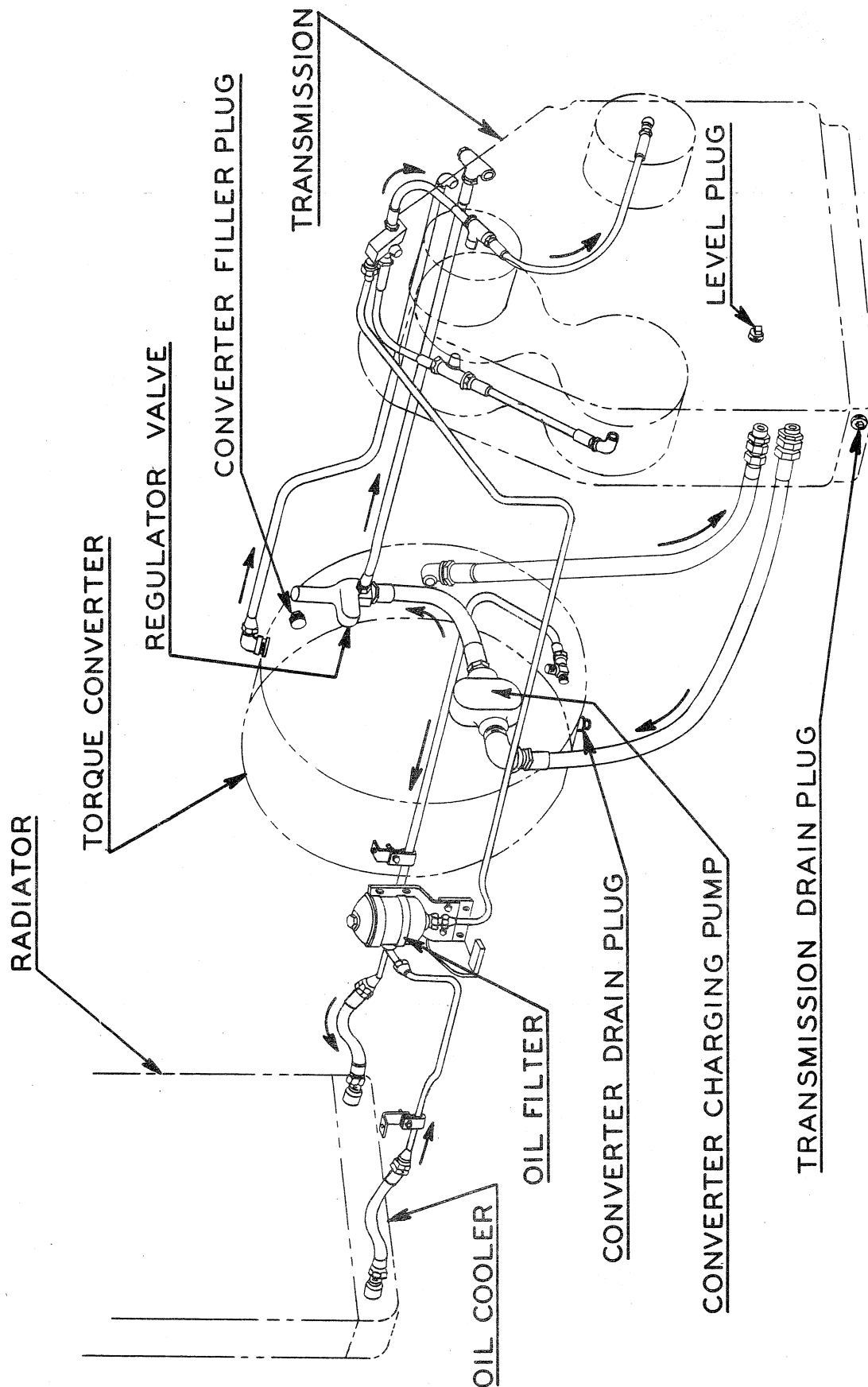


Fig. 4 Oil Flow - Torque Converter



629-H-48-56

Fig. 5 Oil Flow - Transmission Assembly



TS-256M

PIPING DIAGRAM  
TRANSMISSION-TORQUE CONVERTER-OIL COOLER  
Figure 6



## SPECIFICATIONS AND RECOMMENDATIONS

## A. LUBRICATION

1. TYPE OIL: Type "A" Automatic Transmission Fluid.
2. OIL CAPACITY: Oil Change refill - Approximately 16 qts. NOTE: If torque converter is removed and overhauled an additional 6 qts. or total of 22 qts. are required to fill entire system. (CHECK OIL LEVEL DAILY).
3. FILLING INSTRUCTIONS: Remove level plug in front side of transmission case. Add oil thru filler opening in converter unit housing until oil flows out of level plug hole in transmission case. Install plugs and run engine for approximately two minutes. This allows oil to be pumped into the torque converter and cooling system. Stop engine and re-fill to proper level.
4. OIL CHANGE PERIOD: Drain converter unit and transmission every 500 hours. Remove and clean transmission sump screen. Re-fill with new oil. Never under any circumstance use any flushing oil or compounds for cleansing the system.

## B. RATIOS

1. TORQUE CONVERTER UNIT:
  - a. Out-put shaft gears - .969 to 1
  - b. Torque converter automatically varies from - 1.00 - 1 to 3.00 - 1, depending on power requirements.

## TRANSMISSION:

a. 4th forward	.509 - 1	4th reverse	.505 - 1
3rd forward	1.023 - 1	3rd reverse	1.015 - 1
2nd forward	1.72 - 1	2nd reverse	1.71 - 1
1st forward	3.46 - 1	1st reverse	3.43 - 1

## C. CONVERTER AND TRANSMISSION HYDRAULIC SYSTEM

1. CONVERTER PRESSURE PUMP:
  - a. Capacity - 6-1/2 to 7 gallons per minute at 1500 R.P.M.
  - b. Pressure - 150 to 200 lbs.
2. DIRECTION & SPEED CLUTCH PRESSURE - 150 to 200 lbs.

## D. ADJUSTMENTS:

1. Adjust all taper bearings to required 10 to 13 inch lbs. torque to rotate each shaft, except 2nd - 4th quill shaft. Adjust quill shaft 9 to 12 inch lbs. torque to rotate shaft. CAUTION: Preload on quill shaft should not exceed the clutch shaft. (See Reassemble of 2nd - 4th shaft) Torque all bolts that secure bearing caps to transmission case when adjusting preload.



TROUBLE SHOOTING CHART

TROUBLE

PROBABLE CAUSE

REMEDY

A. Engine running and machine will not move.

1. Brakes not released. 1. Release.

2. Range shift disengaged. 2. Engage.

3. Direction or speed selector lever disengaged. 3. Engage.

4. Control lever linkage not connected to control cover arm. 4. Connect linkage.

5. Oil level too low. 5. Add oil thru converter unit filler hole until oil in transmission reaches the recommended level.

6. Pump not primed. 6. Check for air leak between oil pump and intake pipe.

B. Machine loses power and moves slowly at wide open throttle.

1. Oil level low. 1. Check and correct reason for loss of oil and re-fill transmission.

2. Regulating valve springs not functioning properly. 2. Check condition of spring and replace as required.

## TROUBLE

- B. Machine loses power and moves slowly at wide open throttle.

## PROBABLE CAUSE

3. Control valve not re-  
turning to normal posi-  
tion.

## REMEDY

3. Check pressure shut-off valve for proper operation. Install a gage in the top side of the transmission control cover at 1/4" pipe plug. The location of the fitting is shown by A, Figure 7. This is the pump to shut-off valve line. With engine idling, transmission in neutral, note pressure on the gage. Depress brake pedal slowly, and pressure should fall off slightly, then when pedal is fully depressed, gage reading should be the same as before. If reading is higher, this indicates that the shut-off valve is not returning to a fully neutral position. If this is so, first check to see that the brake fluid is bleeding back into the master cylinder. Now remove control cover and check shut-off valve return spring for breakage or slide valve for sticking.

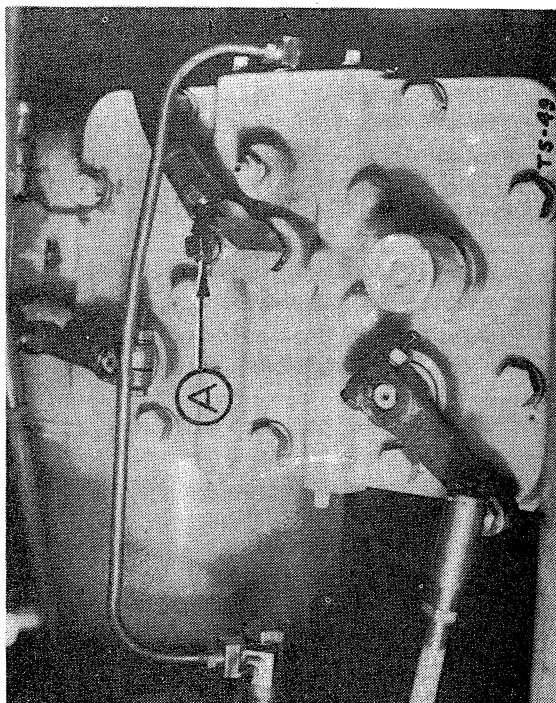


Fig. 7 Top View of Control Cover

TROUBLE

B. Machine loses power and moves slowly at wide open throttle.

PROBABLE CAUSE

4. Plugged filter screen.

5. Insufficient oil pressure.

6. Reaction member (stator) slipping in torque converter.

REMEDY

4. Drain transmission and remove filter screen from bottom of case. Clean screen thoroughly and re-install. Re-fill transmission.

5. Install gage on 1/4" fitting on top of valve assembly, location of the fitting is shown by A, Figure 7. Engage levers in each individual speed with range selector in neutral position. If pressure reading on gage is below 140 lbs. with hot oil at 1500 R.P.M. of engine, inspect clutches for internal leakage. Replace sealing rings and "O" rings if excessive wear is noticeable.

6. Operate machine through "stall torque test". Block drive wheels or position front of machine against a stationary object. Attach a Tachometer to the engine and start engine. Place control levers in a forward and 4th position and open throttle. Check reading on Tachometer. CAUTION: Never operate machine in "stall torque test" with no rotation of drive wheels for more than thirty seconds. A properly

TROUBLE
PROBABLE CAUSE
REMEDY

- |    |   |    |  |    |   |
|----|---|----|--|----|---|
| B. | Machine loses power and moves slowly at wide open throttle.   | 6. | Reaction member (stator) slipping in torque converter.               | 6. | functioning torque converter will be indicated by a reading of between 1600 and 1900 engine R.P.M. If reading is less than required and engine is functioning properly the torque converter one-way clutch should be inspected. |
| C. | Machine will move in one direction only.  | 1. | Selector valve not functioning properly and is restricted in travel. | 1. | Remove valve cover and correct faulty condition.  |
|    |   | 2. | Internal leakage, in that particular speed or direction clutch.      | 2. | Refer to "5" under "B".   |
| D. | Machine reaches rated power in one speed or direction but loses power in the opposite direction or speed. | 1. | Direction selector lever linkage not functioning properly.           | 1. | Check linkage and make necessary adjustments.   |
|    |   | 2. | Low oil pressure on direction or speed clutches.                     | 2. | Refer to "5" under "B".   |
| E. | Converter and transmission overheating.   | 1. | Oil level low.   | 1. | Check oil level. If low fill to recommended level.  |
|    |   | 2. | Engine running hot.  | 2. | Check engine and torque converter cooling system.   |
|    |   | 3. | Not operating in proper speed.                                       | 3. | Shift to lower speed.   |
|    |   | 4. | Pressure low on direction or speed clutches.                         | 4. | Install gage on 1/4" fitting on top of valve assembly, location of the  |

TROUBLE

E. Converter and transmission overheating.

PROBABLE CAUSE

4. Pressure low on direction or speed clutches.

REMEDY

fitting is shown by A, Figure 7. Engage lever in each individual speed with range selector in neutral position. If pressure reading on gage is below 140 lbs. with hot oil at 1500 R.P.M. of engine, check as follows: (1) Check condition of regulator valve spring and regulating valve for defects. Replace if necessary. (2) Check shut-off valve for proper operation in same manner as described under "Shut-off valve spring not returning to normal position." Refer to "3" under "B". (3) Inspect "O" rings between valve housing assembly and transmission case to make sure no internal leakage exists. Replace "O" rings if necessary. (4) Check volume of oil flowing through cooler. This must be done with speed selector levers engaged. This should be approximately four (4) gallons per minute at 1500 R.P.M. of engine, when oil is hot. If oil flow is not to specifications, inspect intake to pump for restrictions such as plugged screen, loose suction pipe. (5) Inspect clutches for internal leakage. Replace sealing

## TROUBLE

E. Converter and transmission overheating.

## PROBABLE CAUSE

4. Pressure low on direction or speed clutches.

## REMEDY

rings and "N" rings if excessive wear is noticeable. (6) Check volume of oil flow. This can be accomplished, by positioning the two shift levers in a neutral position and then disconnecting one end of the lines that connects the top of the transmission case with the outlet side of the cooler, and, the oil by-pass line that connects the top of the converter to the top of the transmission case. The volume of flow thru each line should be checked individually. The combined volume from both lines should equal approximately seven (7) gallons per minute at 1500 R.P.M. engine speed. (7) Defective pump. Remove pump from back cover and inspect pump. Replace if necessary.

5. Overrunning Clutch locked in both directions.

Run machine on level ground for approximately 1/4 mile. If oil temperature increases and does not decrease, inspect overrunning clutch.



**OVERHAUL INSTRUCTIONS FOR TORQUE CONVERTER  
AND TRANSMISSION ASSEMBLY**

The following instructions will cover the disassembly and reassembly of the torque converter and transmission assembly in a sequence that would normally be followed after units have been removed from the machine and are to be completely overhauled.

**CAUTION:** Cleanliness is of extreme importance and an absolute must in the repair and overhaul of these units. Before attempting any repairs, the exterior of each unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

Reference in text is made to item numbers called out on exploded views of units given earlier in this section as a guide to location of parts referred to in this text. DO NOT order parts for replacement from views given in this text. Refer to Parts Book covering your machine.

**DISASSEMBLY OF TORQUE CONVERTER****DISASSEMBLY OF THE CONVERTER END COVER ASSEMBLY**

1. Remove all capscrews on the outside diameter of end cover (64).
2. The entire end cover assembly may now be removed from converter housing (29) by tapping lightly on lip of casting at the dowel pin location.
3. Remove hydraulic hose (68) from oil pump (92) and regulating valve assembly.
4. Remove oil pump (92) and gasket (93) from back cover (64).
5. Remove regulating valve assembly, gasket (69) and "O" rings (70) from back cover.
6. Remove cotter pin (88) and flange nut (87) from shaft (108).
7. Pull flange and deflector from shaft.
8. Remove capscrews from bearing cap.
9. Push shaft (108) from end cover.
10. Press bearings from shaft and remove gear and spacer.
11. Remove retaining ring (55) from inside face of back cover.
12. From back side of cover press hub (106) and bearing (56) from back cover (64).
13. Remove drive gear (101) from back cover.
14. Remove retaining ring (67) from back side of cover and press bearing (94) from cover.
15. Bearing spacer will be free to be removed.
16. Remove retainer ring from hub (106).
17. The driven gears (63) and (102) can be removed in the same manner as stated above.

**DISASSEMBLY OF REGULATING VALVE ASSEMBLY**

1. Remove split pin (79) from valve body (76) by holding valve stop (81) in place with a small rod or bar.
2. After pin (79) has been removed from valve body, the stop (81) can be removed by slowly releasing the bar. Caution: Do not score or damage bore of housing.

## SECTION 200

3. Remove valve piston (80) spring (75) and outer spring (72) from body.
4. Valve stop (73) can be removed after pin (71) is removed from opposite end.

## DISASSEMBLY OF CONVERTER FROM CONVERTER HOUSING

1. Remove pump drive shaft (51) from torque converter.
2. Remove oil ring (52) from shaft (51).
3. Remove six capscrews (28) and lift converter housing (29) from converter.

## DISASSEMBLY OF TORQUE CONVERTER

1. Remove capscrews and nuts on outer diameter of torque converter.
2. The drive disc assembly (3) may be removed. Use puller holes provided in disc (3).
3. Remove bearing (4) from drive disc hub assy. (3).
4. Remove retaining ring (43) from converter main shaft (46).
5. Lift turbine member (5) upward from main shaft.
6. Remove lockwire and capscrews and press turbine hub (6) from turbine member.

## DISASSEMBLY OF OVER-RUNNING CLUTCH

1. Remove retaining ring (7) from outer end of stator support (31).
2. Lift end thrust washer (8) from stator support end of re-action member (10).
3. The re-action member and over-running clutch can be lifted from the stator support as an assembly.
4. To remove sprags from re-action member it is necessary to remove the retaining ring (42) and end plate (41).

## DISASSEMBLY OF IMPELLER (Item 15)

1. Remove retaining ring (36) from stator support (31) and lift off impeller member (15).
2. Remove locating ring from impeller hub (35) to pull bearing.
3. The impeller hub may be pressed from impeller member after lock wire and capscrews are removed from impeller hub.
4. Remove oil seal from hub and "O" ring from impeller.

## DISASSEMBLY OF MAIN DRIVE GEAR AND SHAFT FROM STATOR SUPPORT

1. Remove nut (50) and washer (110) from end of shaft.
2. Remove gear (49) from shaft.
3. Remove locating ring (111).
4. Pull bearing and shaft assembly from stator support.
5. Disassemble bearing and oil ring from shaft.
6. Remove retainer ring (N.I.).

## RE-ASSEMBLY OF TORQUE CONVERTER

Cleanliness of the respective parts is absolutely necessary in re-assembling. Dirt in its several forms, can and will cause trouble. Therefore, before re-assembling the torque converter unit, make sure that all parts have been thoroughly cleaned with a suit-

able cleaning fluid. All parts should be wiped and blown dry with moisture free compressed air after cleaning.

A thorough visual examination of all parts should be made before re-assembly. Any parts that show excessive wear or damage should be replaced. Small nicks and burrs may be removed with a hone or a crocus cloth. It is recommended that all gaskets, sealing rings, oil seals, snap rings and internal lockwashers be replaced.

#### ASSEMBLY OF IMPELLER TO CONVERTER SUPPORT (Items 15 & 31)

1. Install "O" ring (14) into converter impeller. Lubricate "O" ring with type "A" automatic transmission oil.
2. Install impeller hub (35) to converter impeller and secure with six capscrews, flat washer and lockwire. NOTE: Apply light coating of permotex to threads of capscrews.
3. Press impeller hub bearing into position and secure with snap ring.
4. Press oil seal into impeller hub with lip of seal inward. Use permotex on outside diameter of seal. Lubricate oil seal with type "A" automatic transmission oil for assembly.
5. Install steel oil ring (32) on converter support and lubricate for assembly.
6. Install impeller to converter support. (CAUTION: Do not damage oil ring and seal).
7. Assemble retaining ring (36) to secure converter impeller to converter support.

#### ASSEMBLY OF OVER-RUNNING CLUTCH

(Refer to Figure 8)

1. Insert locating ring (37) into re-action member (10) on end toward sharp edges of the blades.
2. Assemble over-running clutch end plate (38) against locating ring with the radius toward ring.
3. Press over-running clutch outer race (39) into re-action member (10) against end plate. Re-action member should be heated so as not to shear aluminum from re-action member. Hot oil at 250° is recommended.
4. Place inner end plate thrust washer (11) into position on stator support (31).
5. With impeller (15) positioned with inside face upward, install re-action member to converter support with sharp edges of blades downward.
6. Lay over-running clutch spring (9) inside of re-action member on end plate.
7. Install sprags one at a time into re-action member aligning grooves with spring. (Refer to Figure 8).
8. Install sprags so that re-action member rotates clockwise and locks in position counter-clockwise. (CAUTION: If one sprag is in opposite of the other sprags the re-action member will not rotate either direction). (Refer to Figure 8).
9. After the over-running clutch sprags are assembled and will rotate clockwise and lock counter-clockwise, assemble another spring into grooves of sprags.

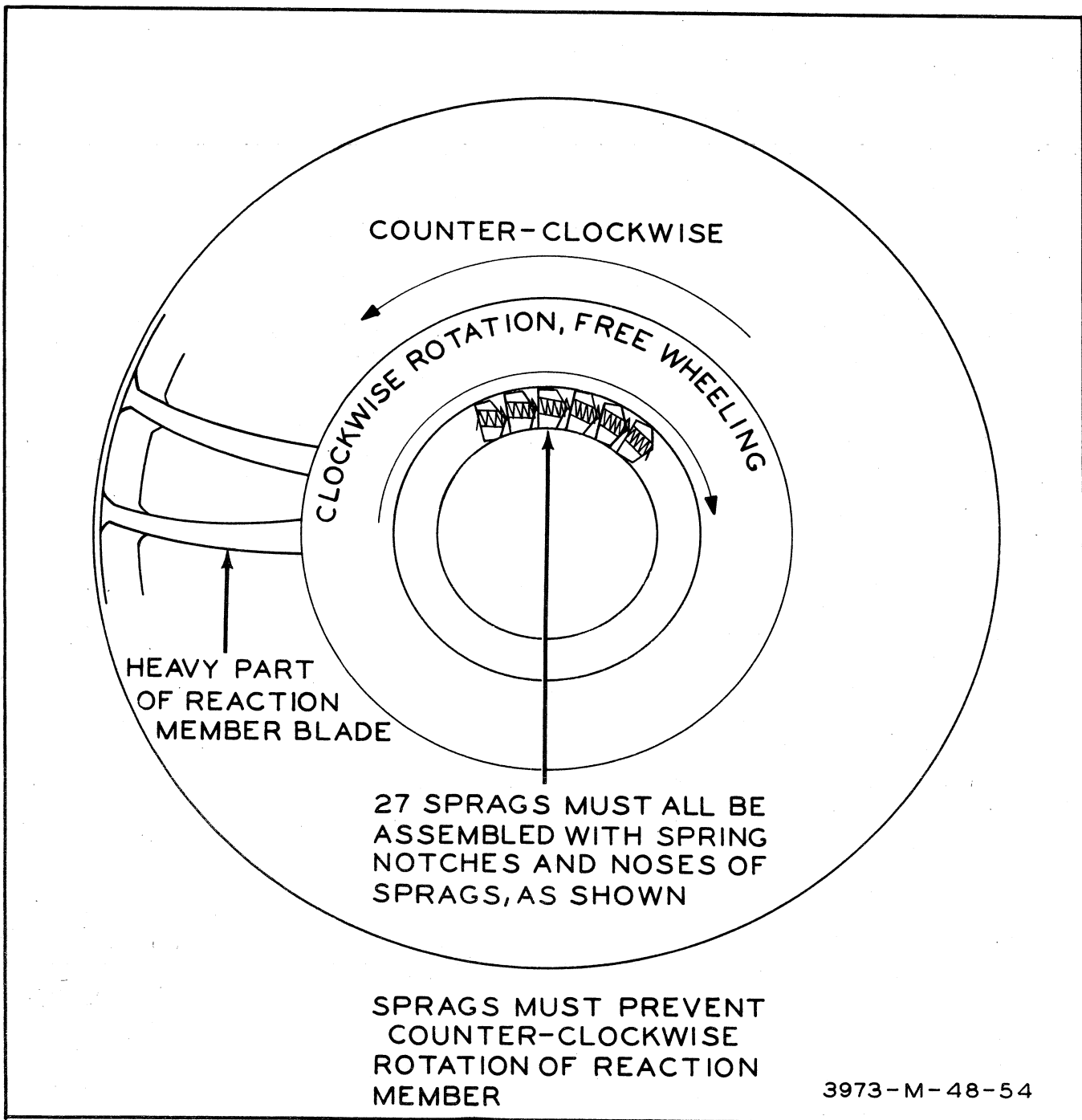


Fig. 8 Assembly of Sprags - Over Running Clutch

10. Lubricate sprags with type "A" automatic transmission oil and insert remaining end plate (41) in place with the radius outward so that the flat surface is against spring and sprags.
11. Secure end plate with locating ring (42).
12. Place outer end plate thrust washer (8) on support with bronze face against end plate.
13. Secure re-action member to converter support with retaining ring (7).

#### ASSEMBLY OF TURBINE MEMBER

1. Assemble turbine hub (6) to turbine member (5) and secure with six capscrews and lock wire.
2. Install steel oil ring (47) on main drive shaft (46). Lubricate for assembly.
3. Install locating ring (N.I.) on shaft (46).
4. Press bearing into position on shaft and lubricate with type "A" automatic transmission oil.
5. Install main drive shaft through converter support (31).
6. Assemble snap ring (111) into groove of support to lock the bearing into position. NOTE: Snap rings are available in variable thicknesses. Ring of proper thickness must be selected to assure no end play in turbine shaft.
7. Install locating ring (43) on opposite end of main drive gear shaft. Install turbine member and hub assembly.
8. Secure turbine hub (6) with retaining ring (43) on end of shaft.
9. Assemble main drive gear (49) to main drive shaft (46) and secure with retaining washer and nut. Lock nut securely.

#### ASSEMBLY OF DRIVE DISC

1. Install sealing ring (34) on outer diameter of impeller (15). Lubricate sealing ring with type "A" automatic transmission oil.
2. Press bearing (4) in drive disc hub (3).
3. Assemble drive disc and bearing assembly to impeller assembly (15) and secure with capscrews, steel washers, lockwashers and nut

#### ASSEMBLY OF TORQUE CONVERTER TO CONVERTER HOUSING

1. Install sealing ring (21) in grooves at rear face of converter support (31).
2. Position converter on pilot end. Set housing (29) over converter and secure in place with six converter support screws and lockwashers.

#### ASSEMBLY OF CONVERTER OUTPUT SHAFT AND CONVERTER HOUSING COVER

1. Install steel oil ring (52) on pump drive shaft (51). Lubricate ring with type "A" automatic transmission oil.
2. Insert pump drive shaft through main drive gear shaft (46). and into splines of drive disc hub (3) with oil ring toward threaded end of shaft.
3. At the inside face of cover (64) insert retainer ring (55) and press bearing (56) against ring.
4. Insert drive gear (101) in to position and press hub (106) through gear into bearing (56) with the long end of hub toward the outside face.

5. Insert bearing spacer into position and press bearing (94) against spacer.
6. Secure bearing (94) with retainer ring (67).
7. Assemble the driven gears (63) and (102) in the same manner as described above.
8. Press bearing race (109) into converter housing with tapered side outward.
9. Press bearing on output shaft (108) opposite threaded end.
10. Install output shaft gear (53) with large offset opposite the bearing.
11. Install gear spacer (54) and press bearing on shaft with taper toward threads.
12. Set bearing, shaft and gear assembly in converter housing with bearing in bearing race.
13. Insert small "O" ring (60 & 62) on oil tube.
14. Insert oil tube (61) in converter end cover.
15. Place sealing ring (100) into groove at outer diameter of converter end cover.
16. Assemble converter end cover to converter housing. CAUTION: Make certain oil tube, dowel pin and oil pump drive shaft are in alignment. Secure with capscrews and lockwashers.
17. Install bearing race in converter end cover.
18. Press oil seal into converter end cap (83) with lip inward. Coat outer diameter of oil seal with Permatex.
19. Select shims to obtain proper pre-load tension of 10 to 13 inch pounds on tapered bearings. Install bearing end cap on converter end cover and secure with capscrews.
20. Install dust deflector (85) on companion flange and assemble flange to shaft. Secure with nut and cotter pin.
21. Install relief ball, spring and secure with by-pass fitting (24).
22. Install new gasket and pump to back cover.
23. Install hose (68) to oil pump.

#### ASSEMBLY OF REGULATING VALVE

1. Insert valve (80) in bottom end of body (76) with small end of valve outward.
2. Install "O" ring (82) on valve stop (81) and install stop in bore of body. CAUTION: Valve (80) has a small hole in one end, this must be against stop (81).
3. Insert pin (79) in valve body to secure valve stop in place.
4. From opposite end of body (76) insert spring (75) and outer spring (72) in body down against end of valve (80).
5. Install "O" ring (74) on stop (73) and insert stop in bore against springs.
6. Holding stop in place secure stop (73) in place with split pin (71).
7. Assemble gasket (69) and "O" rings (70) in place and install regulating valve assembly to converter back cover.

#### ASSEMBLY OF PUMP

1. Install gasket (93) to cover and place pump (92) in place and secure with lockwasher and nuts.
2. Install hose from pump to regulating valve.

DISASSEMBLY OF TRANSMISSION

Keep each shaft, bearing, and gear parts together. All bearing cap shims should be attached to bearing caps after disassembly.

It will not be necessary to remove locating rings from their grooves in center web of transmission case unless damaged.

A. DISASSEMBLY OF CONTROL COVER & VALVE ASSEMBLY:

1. Remove control cover (6) and valve assembly, that is secured by bolts, from top of transmission case. CAUTION: Do not lose "O" rings (7).
2. On a clean bench remove cotter pins and clevis pins (25) from selector arms (11) and selector valves (22).
3. Remove valve housing (12) that is secured by bolts (20), from cover (6). CAUTION: Do not lose poppet balls (10), spring (9) and ball stops (27).
4. Remove selector valves (22) from bores of valve housing (12).
5. Remove retainer rings (23-18) from center bore of valve housing.
6. Remove spring guide and stop (21) from end of bore.
7. From same end remove spring (13) and shutoff valve (14) from center bore.
8. From same end push sealing cup (15) and valve stop (16) out the opposite end of center bore. CAUTION: Do not score valve bore.
9. Remove "O" ring (17) from shutoff valve stop (16).
10. Remove retainer rings (3) and pull selector arms (11) from cover (6).
11. Remove washers (2) and press oil seals (1) from cover.

B. DISASSEMBLY OF FORWARD, REVERSE, FIRST - AND SECOND - FOURTH CLUTCH GROUPS:

1. Remove forward clutch cover (25).
2. Remove large retainer ring (23) that secures disc end plate (22) in clutch drum (20).
3. Remove disc hub retainer ring (28) and pull disc hub (24) from shaft (6).
4. Remove the second retainer ring (28) from shaft (6). Need not remove if servicing clutch assembly only.
5. Remove ten release springs (29) from outer perimeter of drum (20).
6. Remove the ten disc (21 & 30) from drum.
7. Remove clutch hub locating ring (18) on quill shaft (10). Pull drum (20) from shaft.
8. Remove clutch piston (19) from drum.
9. Remove outer sealing ring (31) from piston and inner sealing ring (32) from hub (17).
10. Remove lockwire, clutch hub bolts (35), spring guard, relief spring (34), balancing washers, and relief spring washer, from clutch hub and drum.
11. Separate clutch hub (17) from drum (20) and remove relief pin (33).
12. Remove the two steel sealing rings (16) from hub.
13. All clutch groups can be removed in the above outlined manner.

9. Press bearing (129) from quill shaft.

I. DISASSEMBLY OF 2ND - 4TH DRIVE PARTS:

1. Disassemble 2nd - 4th clutch group. (Refer to second paragraph under disassembly of transmission.
2. Remove bearing end cap (78), that is secured by bolts, from rear side of case.
3. From front side of case drive clutch shaft (113) outwards through gear (112)(32 teeth) and gear (80)(57 teeth).
4. Remove gear (80) from inside of case.
5. Press bearing (79) from clutch shaft (113) and remove locating ring (114) from shaft.
6. From front side of case remove bearing cap (87) that is secured by bolts.
7. From rear side of case, drive quill shaft (111) outwards through bearing (82) and gear (83)(43 teeth).
8. Remove bearing cone (82) and gear (83) from inside of case.
9. Press bearing (84) from quill shaft.
10. From rear side of case drive gear (112)(32 teeth) from bearing cone (81) and remove bearing and gear from inside of case.
11. Remove bearing cup (82) from gear (112).

REASSEMBLY OF TRANSMISSION

Specifications: Refer to Specification Sheet

Cleanliness of respective parts is absolutely necessary in reassembling. Dirt in it's several forms, can and will cause trouble. Therefore, before reassembling the transmission unit, make sure that all parts have been thoroughly cleaned with a suitable cleaning fluid. All parts should be wiped, or blown dry with moisture free compressed air after cleaning.

A thorough visual examination of all parts should be made before re-assembly. Any parts that show excessive wear or damage should be replaced. Small nicks and burrs may be removed with a hone or crocus cloth. We recommend that all gaskets, sealing rings, oil seals and retaining rings be replaced.

When assembling tapered bearings be sure that bearings are held tight in bearing cups; this will prevent damage to bearings.

Lubricate all bearings, sealing rings, oil rings, oil seals, clutch disc and bushings with Type A Transmission Fluid, before assembly.

Lubricate shut-off valve sealing cup (15) in control valve and cover assembly with 21-B Heavy Duty Brake Fluid before assembly.

To prevent Oil Leaks perform the following:

Apply a thin layer of No. 2 Permatex to outside diameter of oil seals before pressing seals in place.

After preload on all bearings has been adjusted to the specified torque, apply a very thin coat of shellack to all external bearing cap shims. CAUTION: Torque all bearing cap bolts before shellack has time to dry.



After assembling companion flanges pack ends of splines with No. 2 Permatex before assembling nuts.

A. ASSEMBLY OF 2ND - 4TH SPEED DRIVE PARTS:

1. From rear side of transmission press cup (81) into center web of case. The large tapered end of bearing cup toward rear of transmission. CAUTION: Make certain that the bearing cup is seated against locating ring.
2. Press bearing cup (82) into gear (112)(32 teeth). Large tapered end of bearing cup outwards. CAUTION: Make certain the cup is seated in gear.
3. Assemble gear (112)(32 teeth) into center web of case. Long end of gear toward rear of transmission.
4. Block gear (112)(32 teeth) securely; then drive bearing (81) on gear and into bearing cup. The large tapered end of bearing (81) toward rear of transmission. CAUTION: Make certain that bearing is seated against shoulder of gear.
5. Assemble bearing (82) in gear (112) against bearing cup. Insert gear (83)(43 teeth) into position in case and drive quill shaft (111) through gear and into bearing. Large off set in gear (83) toward front of transmission.
6. Assemble bearing (84) on quill shaft (111). Large tapered end of bearing toward rear of transmission.
7. Assemble bearing cup (84) in bore of case against bearing. Large tapered end of bearing cup toward rear of transmission.
8. Insert "O" ring (86) into bearing cap (87).
9. Select shims (110) and secure bearing cap (87) to case with bolts (108).
10. Assemble locating ring (114) on clutch shaft (113).
11. Press bearing (79) on shaft (113) with large tapered end of bearing against locating ring.
12. Position gear (80)(57 teeth) in case with large off set in gear toward center bearing (81).
13. Assemble clutch shaft (113) through gear (80)(57 teeth), gear (112)(32 teeth) and quill shaft (111).
14. Assemble bearing cup (79) in bore of case with large tapered end of bearing cup toward front of case.
15. Select shims (115) and secure bearing end cap (78) to case with bolts (117).
16. Loosen bearing cap (87) on front side of case. Quill shaft bearings must be loose when adjusting preload on clutch shaft bearings.
17. Add or remove shims (115) to adjust preload on clutch shaft bearings (79 & 81). (See specifications).
18. After bearing end cap bolts have been torqued and preload has been obtained; adjust preload on quill shaft bearings (82-84) by adding or removing shims (110).
19. Preload on quill shaft (111) should not exceed preload on clutch shaft (113).
20. When preload is obtained on 2nd - 4th shaft bearings; loosen both bearing caps. This is to prevent friction between this and the following preload settings.

**B. ASSEMBLY OF REVERSE SPEED DRIVE PARTS:**

1. From rear side of transmission press bearing cup (130) into center bore of case against locating ring. Large tapered end of bearing cup toward rear side of case.
2. Position bearing (130) in cup then hold gear (139)(54 teeth) in place and assemble quill shaft (140) through gear and into bearing. Large off-set in gear toward rear side of transmission.
3. Assemble bearing (129) on quill shaft. Large tapered end of bearing toward front of transmission.
4. Assemble bearing cup (129) in bore against bearing (129).
5. Insert "O" ring (127) in bearing cap (126).
6. Select shims (144) and assemble bearing cap (126) to case and secure with bolts (146).
7. Add or remove shims to obtain preload on bearings.
8. From front side of transmission press bearing cup (131) in center bore of case against locating ring. Large tapered end of bearing cup toward front of case.
9. Position bearing (131) in cup then hold gear (137)(52 teeth) in place; assemble clutch shaft (138) through gear and into bearing. Large off set in gear toward front side of transmission.
10. Assemble bearing (132) to clutch shaft (138). Large tapered end of bearing toward rear side of transmission.
11. Assemble bearing cup (132) in bore against bearing.
12. Select shims (136) and assemble bearing end cap (133) to case and secure with bolts (134).
13. Add or remove shims to obtain preload on bearings.
14. After preload is obtained loosen both bearing caps. This will prevent friction between this and the following preload settings.

**C. ASSEMBLY OF FORWARD SPEED DRIVE PARTS:**

1. From front side of transmission, press bearing cup (9) into center web of case, against locating ring. Large tapered end of bearing cup toward front of transmission.
2. Position bearing (9) in cup then hold gear (11)(43 teeth) in place and assemble quill shaft (10) through gear and into bearing. Large off-set in gear toward front side of transmission.
3. Assemble bearing (12) on quill shaft (10). Large tapered end of bearing toward rear of transmission.
4. Assemble bearing cup (12) in bore against bearing (12).
5. Insert "O" ring (38) in bearing cap (15).
6. Select shims (14) and assemble bearing cap (15) to case and secure with bolts (36).
7. Add or remove shims to obtain preload on bearings.
8. From rear side of transmission press bearing cup (8) in center bore of case against locating ring. Large tapered end of bearing cup toward rear of case.
9. Position bearing (8) in cup then hold gear (39)(45 teeth) in place and assemble input shaft (6) through gear and into bearing. Large off-set in gear toward rear side of transmission.
10. Assemble bearing (7) on input shaft (6). Large tapered end of bearing toward front side of transmission.
11. Assemble bearing cup (7) in bore against bearing.

12. Select shims (5) and assemble bearing end cap (14) to case and secure with bolts (42).
13. Assemble companion flange (2) and secure with nut (1).
14. Add or remove shims to obtain the proper preload on bearings.
15. After preload is obtained remove flange nut and flange (2) from input shaft (6).
16. Remove bearing cap (40) and press oil seal (4) into bearing cap with lip of seal inward. NOTE: Drag from oil seal must not interfere with bearing preload adjustments.
17. Reassemble bearing cap (40) and shims (5) and secure in place with bolts.
18. Insert flange on input shaft and secure in place with nut and cotter pin (43).
19. Loosen bearing caps. This is to prevent friction between this and the following preload adjustments.

D. ASSEMBLY OF 1ST - 3RD SPEED DRIVE PARTS:

1. From rear side of transmission, press bearing cup (58) into center web of case, against locating ring. Large tapered end of bearing cup toward rear of transmission.
2. Position bearing (58) in cup then hold gear (67)(29 teeth) in place and assemble quill shaft (57) through gear and into bearing. Large off-set in gear toward rear side of transmission.
3. Assemble bearing (56) on quill shaft (57). Large tapered end of bearing toward front of transmission.
4. Assemble bearing cup (56) in bore against bearing (56).
5. Insert "O" ring (54) in bearing cap (53).
6. Select shims (55) and assemble bearing cap (53) to case and secure with bolts (69).
7. Add or remove shims to obtain preload on bearings.
8. From front side of transmission press bearing cup (59) into center bore of case against locating ring. Large tapered end of bearing cup toward front of case.
9. Position bearing (59) in cup then hold gear (65)(44 teeth) in place; assemble clutch shaft (66) through gear and into bearing. Large off-set in gear toward front side of transmission.
10. Assemble bearing (60) on clutch shaft (66). Large tapered end of bearing toward front side of transmission.
11. Assemble bearing cup (60) in bore against bearing.
12. Select shims (64) and assemble bearing cap to case and secure with bolts (62).
13. Add or remove shims to obtain the proper preload on bearings.
14. After preload is obtained torque all bolts that secure bearing caps to case. These have been left loose for preload adjustments.

If machine is not equipped with four wheel drive it will be necessary to install the out-put gear, thrust washer, bearing, bearing spacer, nut and cotter pins on out-put shaft.

If machine is equipped with four-wheel drive it will be necessary to assemble and install the rear axle de-clutching unit as follows:

E. ASSEMBLY OF REAR AXLE DE-CLUTCHING UNIT:

1. Press oil seal (165) into shift rail (166) bore of housing (169), lip of seal inward.

2. From threaded end, press bearing (164), on rear out-put shaft (215) against locating ring (216).
3. Slide shift hub (214) from pilot end of rear out-put shaft.
4. Press rear out-put shaft in housing with bearing seated against locating ring (213).
5. Press oil seal into bearing cap (163) with lip of seal downward.
6. Shellack gasket (217) and secure bearing cap (163) to housing with bolts.
7. Assemble flange (220) to rear out-put shaft (215) and secure with nut (160) and cotter pin (221).
8. Insert shift fork (167) in housing (169) on shift hub (214).
9. Assemble shift rail (166) through oil seal (165) housing and shift fork (167).
10. Secure shift fork (167) to shift rail (166) with lockscrew (168) and lockwire.
11. Insert poppet ball (170) and spring (171) in face of housing against shift rail.
12. Shellack gasket (172) to cover plate (173) and secure cover to housing with bolts (175).
13. Press bearing cup (208) in bore of housing against locating ring (209). Large tapered end of bearing cup outwards.

**F. ASSEMBLY OF OUT-PUT SHAFT PARTS:**

**CAUTION:** Make certain when you replace bushings in out-put shaft gears that the bushings are pressed beyond the faces of the gears.

1. Install oil ring (205) on out-put shaft low gear (182)(55 teeth).
2. Press bearing cup (183) into front bearing cap (184). Large tapered end of bearing cup outward.
3. Hold low gear (182) into position in case. Oil ring on gear is toward front of transmission.
4. Insert out-put shaft, opposite pilot end, through gear (182).
5. Assemble thrust washer (204) on shaft against gear.
6. Drive bearing (183) on shaft against thrust washer. Large tapered end of bearing toward rear of case.
7. Select shims (203) and assemble bearing cap (184) to case and secure with bolts (201). **CAUTION:** Do not damage oil ring on gear (182).
8. Assemble shift hub (206) and high gear (180)(29 teeth) on shaft.
9. Assemble thrust washer against gear (207).
10. Drive bearing (208) on shaft against thrust washer (207).
11. Shellack shim (210) and assemble rear axle de-clutching unit to case and secure with bolts (212).
12. Assemble companion flange (186) on out-put shaft (181) and secure in place with nut (199).
13. With shift hub (206) in neutral add or remove shims from bearing cap (184) to obtain preload on bearings. **NOTE:** If shift hub is in neutral you will not rotate any gears to adjust preload on bearings.
14. After preload is obtained remove companion flange (186) and nut (199).
15. Remove bearing cap (184) and press oil seal (185) in cap with lip of seal downward. **NOTE:** Drag from oil seal must not interfere with bearing preload adjustments.

16. Install bearing cap (184) to housing and secure with bolts.  
CAUTION: Do not damage oil ring on low speed gear (182).
  17. Assemble companion flange on shaft and secure with nut (199) and cotter pin (198).
  18. Press oil seal (193) in end of high - low shift support (189). Lip of seal inward.
  19. Insert high - low shift shaft (192) through oil seal and into support.
  20. Insert poppet ball (194), poppet spring (196) and secure in place with mesh lock plug (195).
  21. Shellack gasket (188) to support (189).
  22. Through opening in bottom of case insert shift fork (187) into shift hub (206).
  23. Insert support and shaft assembly in bore of case aligning shift shaft with shift fork.
  24. Secure shift support to case with bolts (191).
  25. Secure shift fork (187) to shaft (192) with lock screw (197) and lockwire.
  26. Shellack gasket (143) to sump cover (176) and screen assembly (142).
  27. Secure screen assembly and sump cover to bottom of case with bolts; be certain that sump intake pipe is tight and free of air leaks.
- G. ASSEMBLY OF FORWARD, REVERSE, 1st - 3RD, AND 2ND - 4TH, CLUTCH GROUPS.
1. Insert relief pin (33) in clutch hub (17) and assembly hub to clutch drum (20).
  2. Assemble relief spring (34) against pin and secure spring with relief spring washer, relief spring guard and bolts (35).
  3. From opposite side of relief spring guard secure hub (17) to drum (20) with balancing washers and bolts (35).
  4. Assemble and torque the remaining bolts to hub and secure all bolts and lockwires.
  5. Assemble the two steel sealing rings (16) on clutch hub (17).
  6. Insert lip sealing ring (32) inside drum on hub with lip of seal downward.
  7. Assemble large sealing ring (31) on piston (19). Lip of seal toward smooth side of piston.
  8. Insert piston (19) into clutch drum (20). Smooth side of piston inwards. CAUTION: Rotate piston slightly so as not to damage sealing rings.
  9. Assemble clutch drum (20) and hub (17) to the forward quill shaft (10) and secure in place with retainer ring (18). CAUTION: Make certain that you do not damage steel oil rings (16) when entering bearing cap (15).
  10. Insert locating ring (28) on clutch shaft (6) and assemble disc hub (24) to shaft.
  11. Secure clutch hub (24) on shaft with second locating ring (28).
  12. NOTE: Disc with teeth on outer diameter have a .020 dish. The disc should be assembled so the dish is in the same direction.
  13. Place one steel disc (21) teeth on outer diameter into drum (20).
  14. Install one bronze disc (30), teeth on the inner diameter, into drum (20).
  15. Align the four tooth section on next steel disc with the four tooth section on first steel disc rotate one tooth before installing.

16. Align the teeth of remaining disc with second steel disc. Insert the ten release springs (29). CAUTION: Be sure that the springs are setting on teeth of first steel disc installed.
17. Insert end plate (22) and secure with large retainer ring (23).
18. Shellack gasket (13) to clutch cover (25) and secure cover to transmission case with bolts (26). NOTE: All clutch groups are assembled in the same manner.

#### H. ASSEMBLY OF CONTROL COVER AND VALVE ASSEMBLY:

NOTE: Be certain that center bore is free of scratch marks.

1. Insert selector arm and shafts (11) through control cover bores.
2. Slide oil seals (1) over shafts then press oil seals into bores of cover. Lip of seal inward.
3. Assemble washers (2) over shafts against oil seals and secure shafts to cover with retainer rings (3).
4. Insert shut-off spring guide and valve stop (21) in center bore of housing (12) and secure into place with retainer ring (23).
5. From opposite end in center bore insert spring (13) against stop (21).
6. Insert shut-off valve (14) in center bore against spring. Tapered end of valve must be against spring.
7. Lubricate sealing cup (15) with Brake Fluid and insert cup in center bore against valve (14). Lip of sealing cup outward.
8. Assemble "O" ring (17) on shut-off valve stop (16) and insert stop in center bore against sealing cup.
9. Secure stop (16) in center bore with retainer ring (18). CAUTION: Spring (13) must be depressed in order to assemble retainer ring in bore. If shut-off valve stop (16) is pressed beyond brake fluid inlet hole, "O" ring will be damaged when spring is released.
10. Insert selector valve assemblies (22) in outside bores of valve housing. CAUTION: Make certain valves are free in bore.
11. With machined surface of cover upwards, insert poppet spring stops (27), poppet springs (9) and poppet balls (10) in location.
12. Insert "O" ring (7) into cover (6).
13. Assemble valve assembly to cover aligning poppet balls and secure valve assembly with bolts (20). Torque bolts to specification.
14. Assemble clevis pins (25) through selector valve links (26) and into selector arms (11), then secure with cotter pins. CAUTION: It may be necessary to shift selector arms back and forth to align valve to cover with the capscrews loosened slightly.
15. Shellack gasket (8) to control cover and insert "O" ring (7) into indentation of cover.
16. Secure control cover and valve assembly to top of transmission with bolts.
17. Tighten bleeder valve (5) in control cover.
18. Assemble breather assembly (4) to control cover. NOTE: Make certain breather has been cleaned.

SECTION 300  
DRIVE AXLE

## DESCRIPTION

Axle assembly is full floating, spiral bevel type with a one piece housing. The axle assembly and transmission are connected by a slip type propeller shaft. The axle is a reduction bevel gear and pinion type with further reduction provided by planetary gear set within wheel hub.

## REMOVAL FROM MACHINE

To remove axle assembly from machine, proceed as outlined below:

1. Drain differential and wheel hubs.
2. Jack up front end of machine two inches off floor. Block rear wheels to prevent movement.
3. Block up front end of machine and remove tire and rim assemblies.
4. Disconnect brake line at tee. Remove clevis retaining parking brake lever cable and remove two screws and clip holding cable to backing plate.
5. Disconnect propeller shaft.
6. Remove eight bolts and nuts retaining axle to frame and lower axle assembly from chassis. CAUTION: Be sure hoist is attached to, or jack for lowering axle is in place, before loosening and removing axle to frame bolts.

## AXLE DISASSEMBLY

To disassemble axle assembly, proceed as follows. Procedure covers one side of axle only, however, may be repeated on opposite side as required:

1. Remove hub thrust cap and washer assembly.
2. Remove axle shaft and sun gear assembly.
3. Remove sun gear retaining ring and sun gear from axle shaft.  
NOTE: If axle shaft replacement only is required, disassembly need only be carried to this point.
4. Remove differential carrier capscrews and lift differential and carrier assembly from housing.
5. Remove planet spider assembly. Use two 1/2-13 x 1" jack-screws to pull planet spider assembly from hub and drum assembly.

6. Straighten tangs on housing tube nut lock and remove outer tube nut, nut lock and inner tube nut.
7. Remove internal gear hub, internal gear, hub sleeve, and outer hub bearing cone. Using suitable puller, pull hub bearing cone from hub. Cut lockwires, remove capscrews and remove internal gear from hub. Push hub sleeve out of gear hub.
8. Remove hub and drum assembly. If replacement is required remove hub oil seal, inner hub bearing cone and outer and inner hub bearing cups.
9. Normal replacement of brake shoes or wheel cylinders does not require removal of brake assembly from housing.

#### DIFFERENTIAL AND CARRIER DISASSEMBLY

- A. Un-clinch ring gear thrust screw nut lock and remove thrust screw nut. Lift nut lock from screw, then remove thrust screw.
- B. Remove differential carrier caps in the following manner:
  1. Mark caps in relation to carrier so they may be identified as to the side they are to be re-assembled.
  2. Remove differential adjusting nut lock, capscrews and lock washer.
  3. Remove differential carrier capscrews and lift caps from assembly.
- C. Remove differential bearing adjusting nuts, and lift differential body assembly from carrier. CAUTION: During this operation be very careful not to damage the differential bearing cones.
- D. Remove pinion bearing retainer capscrews and driving from inner end of pinion, remove complete pinion shaft assembly from carrier.

#### Break Down of Sub-Assemblies:

1. Differential and ring gear:
  - a. Using suitable wrench, remove nut from case bolts and drive bolts from case.
  - b. Separate case halves and remove side gears, pinion, spider, and thrust washer.
  - c. If ring gear is to be replaced, capscrews and lock nuts must be removed from ring gear and case.
  - d. Drive ring gear from case.
  - e. If differential bearings are to be replaced, the cones may be pulled from case halves, with proper puller.



## 2. Pinion assembly (Break-down)

- a. Place pinion in vise, equipped with copper or bronze jaws, with companion flange end up.
- b. Remove pinion nut cotter; remove pinion shaft nut.
- c. Pull companion flange and dust shield from pinion shaft; and remove oil seal and retainer assembly.
- d. Bearing cage and cap assembly and outer bearing cone may be removed from shaft.
- e. Lift bearing spacer and center bearing cap from assembly; then if pinion or bearings are to be replaced, the center bearing cone may be pulled from the pinion shaft.

## PLANET SPIDER DISASSEMBLY

1. On a suitable clean bench, drive planet pinion shaft outward from side opposite lock ball.
2. Planet pinion gear may be removed with bearing, spacer, and thrust washers.
3. The other planet spider assemblies may be removed in the same manner.

## CLEANING AND INSPECTION

Immerse all parts except bearing in suitable cleaning fluid until lubricant is dissolved and parts are cleaned thoroughly.

### Bearings

Dip bearings in cleaning fluid and slush up and down slowly until bearings are clean.

Remove bearings from fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Repeat above operation until bearings are cleaned thoroughly. Blow bearing dry with compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings. Bearing may be slowly rotated by hand to facilitate drying procedure.

### Housing

Clean interior of housing thoroughly. Remove any portions of gaskets that are stuck on mating faces of housing and differential carrier.

### Inspection of Parts

Examine differential side gears, pinions and thrust washers for damage or excessive wear. Check clearance between pinions and

spider arms and thickness of all thrust washers. If differential side gears and pinions are worn or damaged, always replace with complete set consisting of four pinions, two side gears and all thrust washer.

If magna-flux inspection equipment is available, inspect all parts except bearings using this method to detect cracks, fissures not visible otherwise, to determine serviceability of parts. Surface of companion flange which contacts oil seal lip must be round, smooth finished and free from nicks, scratches, grooves or scores.

### Bearings

Carefully inspect rollers, cages and cups, for wear, chipping or nicks to determine fitness of bearings for further use. After inspection dip bearings in gear oil and wrap in clean cloth or paper to protect them until installed.

### Oil Seals

Replacement of spring loaded oil seals when unit is disassembled, is more economical than premature overhaul to replace these parts at a future time. Further, loss of lubricant through a worn seal may result in failure of other differential parts. Handle seals carefully, particularly when seals are being installed. Cutting, scratching or curling under, of lip of seal seriously impairs efficiency.

### Gears & Shafts

If magna-flux process is available, use process to check parts. Examine teeth of all gears carefully for wear, pitting, chipping, nicks or scores. If gear teeth show spots where case hardening is worn through, install new gear. Small nicks may be carefully removed with a suitable hone. Examine pinion gear teeth for wear and check pinion shaft for evidence of twisting, particularly at splines. If evident, install new set of gears.

Pinion and drive (ring) gears are available only in matched sets and must be installed as such to assure satisfactory operation.

Inspect axle shafts to make certain that they are not sprung, bent or splines twisted and that shafts are true.

### DIFFERENTIAL AND CARRIER REASSEMBLY

#### A. Build up pinion assembly as follows:

1. Press center bearing cone into pinion shaft, with taper upward; then set center bearing cap in position on cone.
2. Select spacer and shims, obtain a rolling pinion bearing resistance torque of 13 to 28 inch pounds

- with pinion assembled in carrier. This check to be made before differential is assembled and not to include pinion oil seal drag. (NOTE: The production spacers are ground to a variable length as required to obtain proper preload on the bearings. Service wise spacer and shim kit is provided to obtain the same results.)
3. Install bearing spacer with cone taper toward center bearing then add proper amount of shim.
  4. Press outer bearing cup into bearing cage and set bearing cage onto center bearing.
  5. Install outer bearing cone on shaft with taper downward.
  6. Press new oil seal, with lip upward, into seal retainer. CAUTION: Refer to paragraph No. 2.
  7. Install retainer and seal assembly on companion flange on pinion shaft, be sure gasket is in place.
  8. Install pinion shaft washers and nut; then tighten nut securely to 500 pounds feet min. torque; then secure nut with cotter pin.
- B. Press pinion assembly into carrier, making certain the shims are in place between face of carrier and pinion bearing cage.
- C. Install pinion retainer screws and tighten securely with proper torque. Tighten the larger head capscrews to 95 pounds feet torque. Tighten the smaller head capscrews to 65 pounds feet torque.
- D. After ring gear has been secured with capscrews to flange half of case, assembly differential and case as follows:
1. Install side gear thrust washer and side gear in flange half of case.
  2. Install four pinions and thrust washers on differential spider; then put spider in position in case.
  3. Set other side gear in place on pinions and install thrust washer on side gear.
  4. Place plain half of case on assembly being certain the matching marks on plain half is in line with mark on flange half.
  5. Insert differential case bolts through case from flange side and install nuts then tighten securely.
  6. Press bearing cones onto differential case.
- E. Place differential bearing cups over cones and install ring gear and body assembly in carrier.
- F. Install differential bearing adjusting nuts in carrier and then install carrier caps to hold assembly in place. Tighten carrier cap bolts until lockwashers are just flattened out.

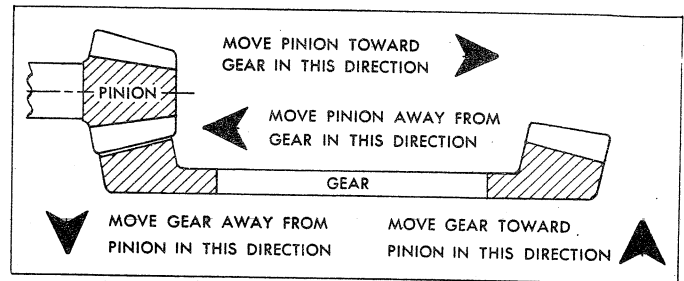
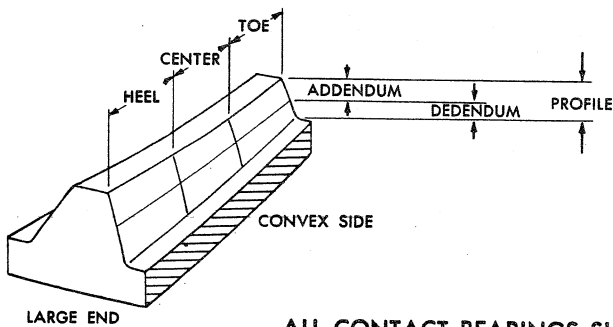
- G. Tighten adjusting nuts\* to seat bearings. Differential bearing nuts to be adjusted to take up all slack in differential bearings, then proceed with backlash and tooth contact adjustment as per chart.
- H. When the proper adjustment has been obtained, tighten carrier cap screws to 360 pounds feet torque and recheck backlash. If backlash is within limits (.008 to .013) install adjusting nut locks and secure in place with cap screws and lockwasher. Lockwire the cap screws as an added safety measure.

#### PLANET SPIDER REASSEMBLY

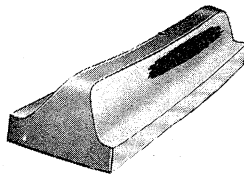
- 1. Lubricate the inside of planet pinion gear with a heavy grease, this is to hold bearings in place during assembly.
- 2. Set planet pinion on thrust washer with tang side away from planet pinion gear.
- 3. Insert 29 bearings and install spacer then the remaining 29 bearings.
- 4. Set thrust washer on top with tang side away from planet pinion gear.
- 5. Install pinion gear, bearings, spacer and thrust washers assembly into planet spider with tang into indentation of planet spider.
- 6. Install shaft through planet spider assembly with lock ball in place.
- 7. With a small center punch stake planet spider near shaft and lock ball so shaft will not fall out during installation of the complete planet spider assembly to axle.

#### DRIVE AXLE REASSEMBLY

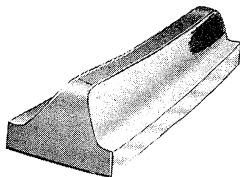
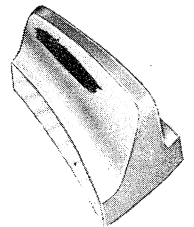
- 1. Being certain housing face is clean, place new gasket in position and install differential and carrier in housing, securing in place with carrier to housing capscrews.
- 2. If brake assembly has been removed from housing, assemble to housing, securing in place with special bolts, nuts, and lockwashers provided. Brake assembly should be positioned with wheel cylinder at top center position.
- 3. Install inner and outer hub bearing cups into hub and drum assembly. Place inner hub bearing cone in position and install hub oil seal with lip of seal toward bearing. Assemble hub and drum assembly onto housing.

**SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART**


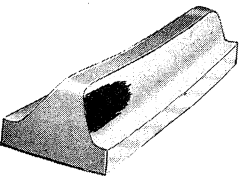
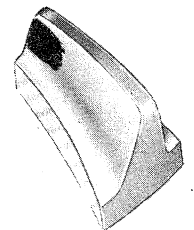
ALL CONTACT BEARINGS SHOWN BELOW ARE ON RIGHT HAND SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.


**FIG. 1**

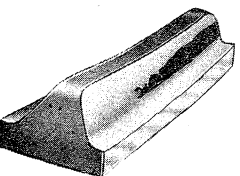
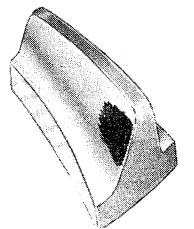
TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD


**FIG. 2**

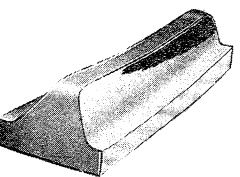
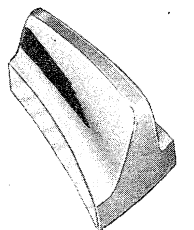
TOE BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.


**FIG. 3**

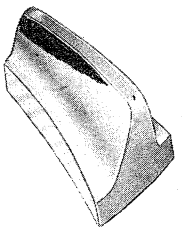
HEEL BEARING ON BOTH SIDES OF TOOTH — GEARSET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.


**FIG. 4**

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR (INCREASE MOUNTING DISTANCE).


**FIG. 5**

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR (DECREASE MOUNTING DISTANCE).


**BACKLASH**

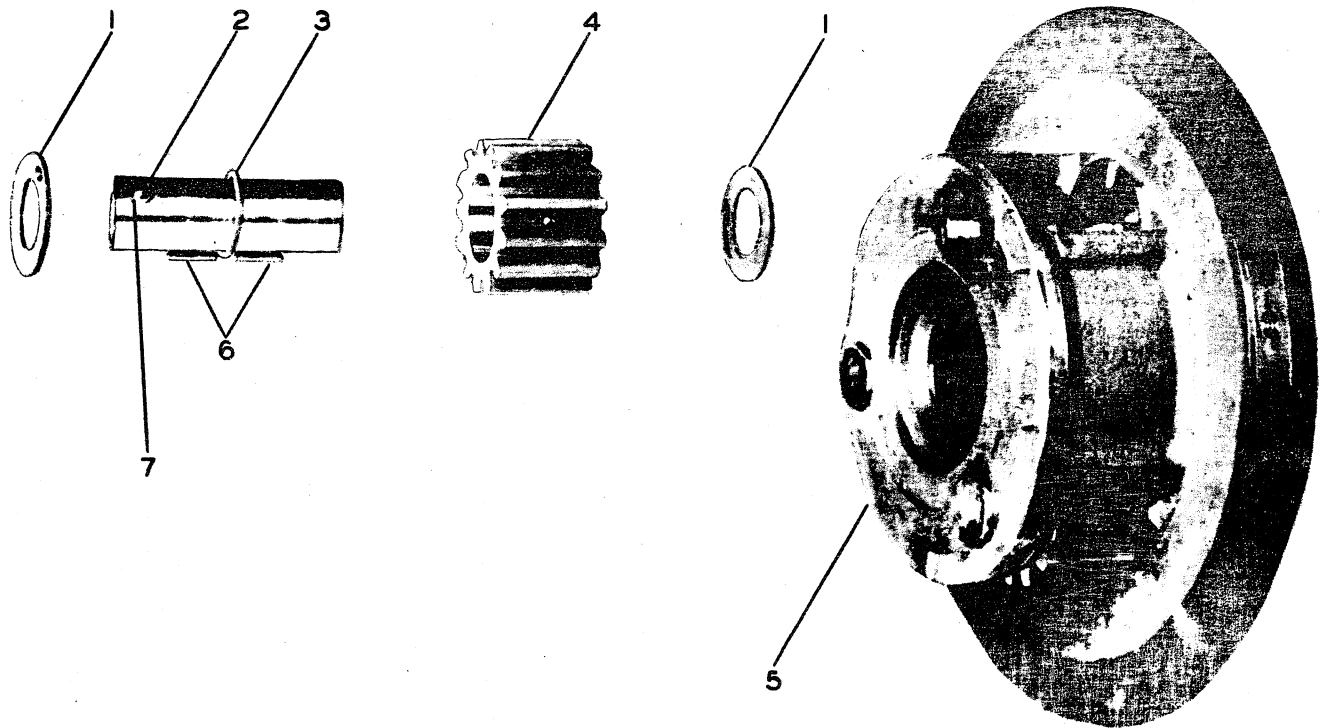
BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL. THE AMOUNT SHOULD VARY FROM .007 TO .014 DEPENDING UPON THE PITCH OF THE GEAR — FINE PITCHES BEING NEAR THE LOW SIDE AND COARSER PITCHES NEAR THE HIGH SIDE.

Fig. 1 Tooth Contact Chart

4. Assemble internal gear into internal gear hub, securing in place with special capscrews provided. Wire capscrews in place in pairs with lockwire. Assemble outer hub bearing cone in place on internal gear hub and assemble gear, hub, and bearing in position on housing.
5. Insert hub sleeve in place between gear hub and housing and assemble inner tube nut in position. Nut should be tightened so that there is no end play in hub bearings, but hub should rotate freely by hand. Nut should be then backed off  $1/6$  of a turn or one flat on nut. Install nut lock and outer tube nut. Lock in place turning tangs of nut lock to contact alternately the inner and outer nuts.
6. With new gasket in place install planet spider assembly in position securing in place with special capscrews and lockwashers provided.
7. Assemble sun gear in place on axle shaft and place on axle shaft and place retaining ring in position in groove on shaft.
8. Insert splined end of shaft into axle housing, aligning splines with differential side gear and aligning gear teeth on sun gear with teeth on planet pinions.
9. With new gasket in place assemble hub thrust cap assembly in position, securing in place with capscrews and lockwashers.

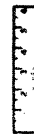
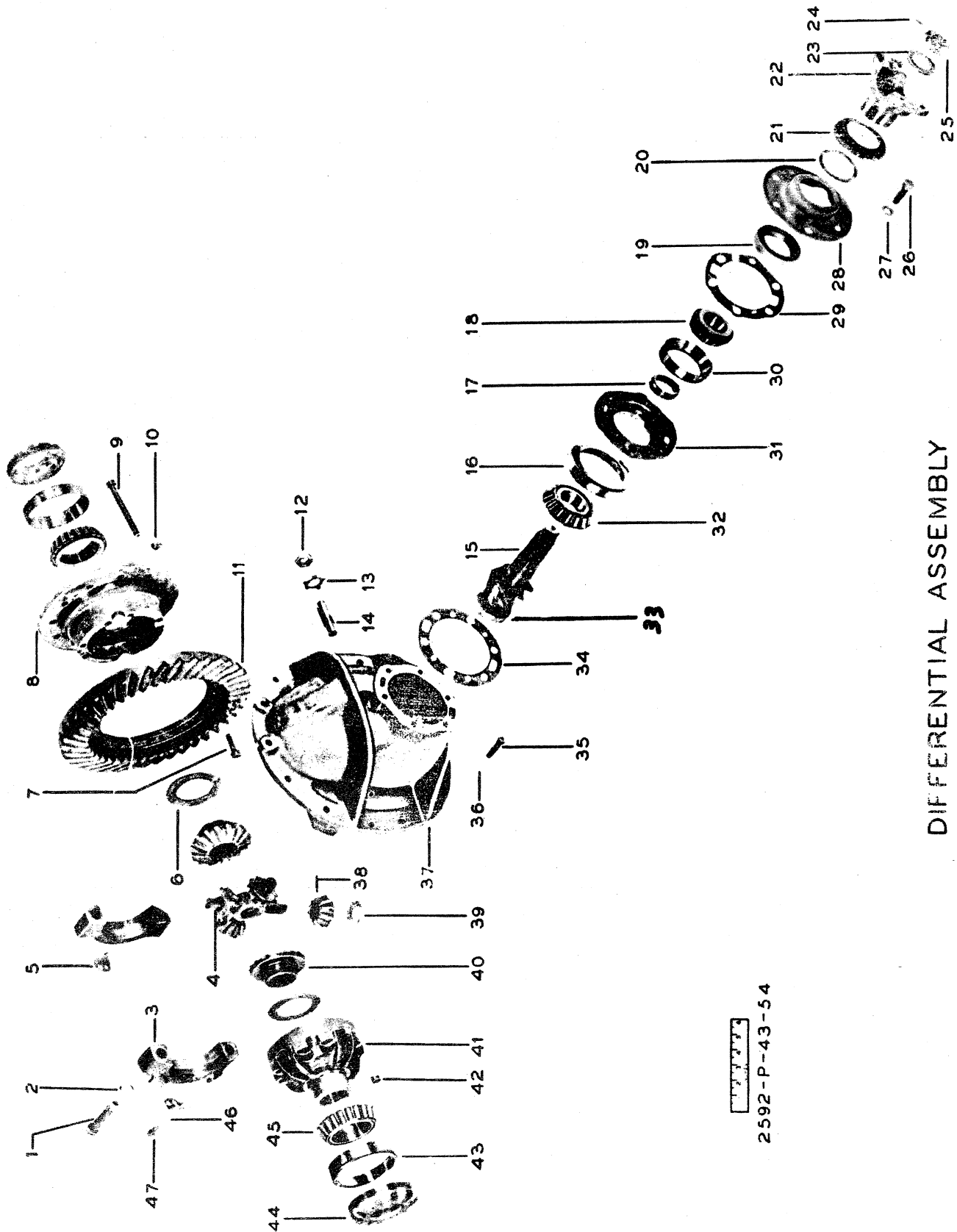
#### INSTALLATION INTO MACHINE

1. Raise axle assembly into position under machine and secure in place special bolts and nuts provided. Draw nuts up evenly and tighten securely.
2. Reconnect propeller shaft.
3. Connect brake lines at wheel cylinder and tee. Attach parking brake cable retaining clip and connect cables to brake assembly.
4. Bleed brakes and adjust as described in "Brake" Section.
5. Fill axle with lubricant as prescribed in "Lubrication" Section
6. Reinstall tire and rim assemblies, drawing up nuts evenly and securely.



TS- 59- P

<u>Item No.</u>	<u>Description</u>	<u>No. Req'd.</u>
1	Pinion Thrust Washer .....	12
2	Pinion Shaft .....	6
3	Roller Spacer .....	6
4	Planet Pinion .....	6
5	Planet Spider .....	2
6	Pinion Roller .....	348
7	Pinion Shaft Ball .....	6



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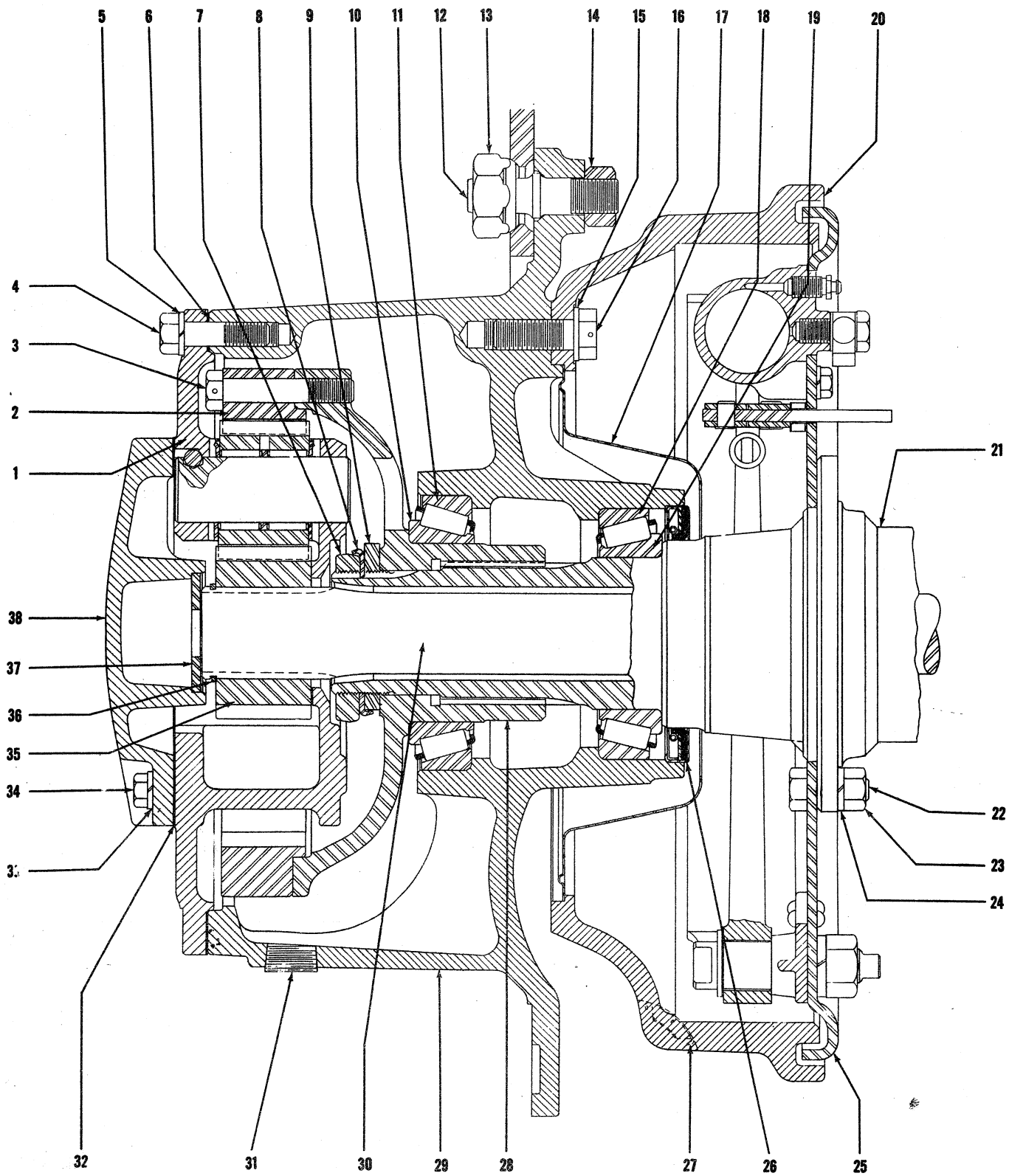
DIFFERENTIAL ASSEMBLY



## DIFFERENTIAL &amp; CARRIER ASSEMBLY

Item No.	Description	No. Req'd.
1	Diff. Carrier Cap Mtg. Capscrew .....	4
2	Diff. Carrier Cap Mtg. Capscrew Washer .....	4
3	Diff. Carrier Cap .....	2
4	Differential Spider .....	1
5	Diff. Adj. Nut Lock .....	2
6	Diff. Side Gear Thrust Washer .....	2
7	Ring Gear Bolt .....	12
8	Diff. Case - Flange Half .....	1
9	Diff. Case Bolt .....	8
10	Ring Gear Bolt Nut .....	12
11	Ring Gear .....	1
12	Diff. Thrust Screw Nut .....	1
13	Diff. Thrust Screw Nut Lock .....	1
14	Diff. Thrust Screw .....	1
15	Pinion .....	1
16	Pinion Center Bearing Cup .....	1
17	Pinion Bearing Spacer & Shim Kit .....	1
18	Pinion Outer Bearing Cone .....	1
19	Pinion Oil Seal .....	1
20	Pinion Oil Seal Gasket .....	1
21	Pinion Dust Shield .....	1
22	Companion Flange .....	1
23	Pinion Shaft Washer .....	1
24	Pinion Shaft Cotter Pin .....	1
25	Pinion Shaft Nut .....	1
26	Pinion Oil Seal Ret. Screw .....	6
27	Pinion Oil Seal Ret. Screw Lockwasher .....	6
28	Pinion Oil Seal Ret. .....	1
29	Oil Seal Ret. Gasket .....	1
30	Pinion Outer Bearing Cup .....	1
31	Pinion Outer Bearing Cage .....	1
32	Pinion Center Bearing Cone .....	1
33	Pinion Center Bearing .....	1
34	Bearing Cage Shim .....	AR
35	Carrier to Axle Housing Screw .....	10
35A	Carrier to Axle Housing Screw .....	4
36	Carrier to Axle Housing Screw Lockwasher .....	14
37	Diff. Carrier .....	1
38	Diff. Pinion .....	4
39	Diff. Pinion Thrust Washer .....	4
40	Differential Side Gear .....	2
41	Diff. Case - Plain Half .....	1
42	Diff. Case Bolt Nut .....	8
43	Diff. Bearing Cup .....	2
44	Diff. Adjusting Nut .....	2
45	Differential Bearing Cone .....	2
46	Diff. Adjusting Nut Lock Screw Lockwasher .....	2
47	Diff. Adjusting Nut Lock Screw .....	2

AR - As Required



TS-206

DRIVE AXLE ASSEMBLY

## AXLE ASSEMBLY - FRONT DRIVE

<u>Item</u> <u>No.</u>	<u>Description</u>	<u>No.</u> <u>Req'd.</u>
1	Planet Spider Assembly .....	2
2	Internal Gear .....	2
3	Bolt, Internal Gear Attaching .....	16
4	Bolt, Planet Spider Attaching .....	20
5	Lockwasher, Planet Spider Attaching .....	20
6	Gasket, Planet Spider .....	2
7	Housing Tube Nut - Outer .....	2
8	Housing Tube Nut Lock .....	2
9	Housing Tube Nut - Inner .....	2
10	Hub Bearing Cone - Outer .....	2
11	Hub Bearing Cup - Outer .....	2
12	Stud, Wheel .....	20
13	Nut, Wheel .....	20
14	Nut, Wheel Stud .....	20
15	Washer, Brake Drum .....	12
16	Bolt, Brake Drum to Hub .....	12
17	Oil Throw .....	2
18	Hub Bearing Cup - Inner .....	2
19	Hub Bearing Cone - Inner .....	2
20	Brake Drum .....	2
21	Axle Housing .....	1
22	Bolt, Brake Attaching .....	16
23	Nut, Brake Attaching .....	16
24	Lockwasher, Brake Attaching .....	16
25	Brake & Cylinder Assembly .....	1
26	Hub Oil Seal .....	2
27	Clip, Inspection Hole Cover .....	2
28	Internal Gear Hub & Screw Kit .....	2
29	Hub & Cup Assembly (Inc. Items 11 & 18) .....	2
30	Axle Shaft .....	2
31	Plug, Hub Drain & Filler .....	2
32	Gasket, Thrust Cap .....	2
33	Lockwasher, Thrust Cap .....	12
34	Bolt, Thrust Cap .....	12
35	Sun Gear .....	2
36	Snap Ring, Sun Gear .....	2
37	Washer, Sun Gear Thrust Cap .....	2
38	Cap, Sun Gear Thrust .....	2



SECTION 301  
DRIVE STEERING AXLE

## DESCRIPTION

Axle assembly is full floating, spiral bevel type. The axle assembly and transmission are connected by a slip type propellor shaft. The axle is a reduction bevel gear and pinion type with further reduction provided by planetary gear set within wheel hub. Steering is accomplished by trunions mounted on tapered roller bearings with drive through a constant velocity universal in axle shaft.

## REMOVAL FROM MACHINE

To remove axle assembly from machine, proceed as outlined below:

1. Drain differential and wheel hubs.
2. Jack up rear end of machine about two inches off floor. Block front wheels to prevent movement.
3. Block up rear end of machine and remove tire and rim assemblies.
4. Disconnect rear steering push rod at steering arm tie rod joint.
5. Disconnect propeller shaft.
6. Remove eight bolts and nuts retaining axle to pivot frame and lower axle assembly from chassis. CAUTION: Be sure hoist is attached to or jack for lowering axle is in place before loosening and removing axle to pivot frame bolts.

## AXLE DISASSEMBLY

Procedure covers one side of axle only. Repeat if required on opposite side.

If repair or adjustment on differential and carrier assembly only is required, remove tie rod assembly and separate housing at outer end, removing eight screws, nuts and lockwashers. Entire wheel hub and spindle assembly together with axle shafts may be pulled from housing. If additional disassembly is desired proceed as outlined below:

1. Remove hub thrust cap.
2. Remove planet spider assembly. Use two 1/2 - 13 x 1" jackscrews to pull planet spider assembly from hub assembly.
3. Straighten tangs on housing tube nut lock and remove outer tube nut, nut lock, and inner tube nut.
4. Remove internal gear hub, internal gear, hub sleeve, and outer hub bearing cone. Using suitable puller, pull outer hub bearing cone. Cut lockwires, remove capscrews and remove internal gear from hub. Push hub sleeve out of gear hub.
5. Remove hub assembly. If replacement is required, remove hub oil

seal, inner hub bearing cone and outer and inner hub bearing cups.

6. Remove capscrews and lockwashers retaining steering spindle assembly oil seal and thrust washer.
7. Remove axle shaft and universal joint assembly.
8. Remove outer end dust and oil seal assembly. Note carefully position of pieces for use in reassembly.
9. Remove nuts, lockwashers and screws retaining steering arm and trunion caps to steering spindle support assembly and remove steering trunion and trunion bearing cones. Care should be exercised to keep shim packs wired together as removed from upper and lower trunions for use in reassembly.

#### **DIFFERENTIAL AND CARRIER DISASSEMBLY**

- A. Un-clinch ring gear thrust screw nut lock and remove thrust screw nut. Lift nut lock from screw, then remove thrust screw.
- B. Remove differential carrier caps in the following manner:
  1. Mark caps in relation to carrier so they may be identified as to the side they are to be re-assembled.
  2. Remove differential adjusting nut lock, capscrews and lock washer.
  3. Remove differential carrier capscrews and lift caps from assembly.
- C. Remove differential bearing adjusting nuts, and lift differential body assembly from carrier. CAUTION: During this operation be very careful not to damage the differential bearing cones.
- D. Remove pinion bearing retainer capscrews and driving from inner end of pinion, remove complete pinion shaft assembly from carrier.

#### **Break Down of Sub-Assemblies:**

1. Differential and ring gear:
  - a. Using suitable wrench, remove nut from case bolts and drive bolts from case.
  - b. Separate case halves and remove side gears, pinion, spider, and thrust washer.
  - c. If ring gear is to be replaced, capscrews and lock nuts must be removed from ring gear and case.
  - d. Drive ring gear from case.
  - e. If differential bearings are to be replaced, the cones may be pulled from case halves, with proper puller.
2. Pinion assembly (Break-down)
  - a. Place pinion in vise, equipped with copper or bronze jaws, with companion flange end up.
  - b. Remove pinion nut cotter; remove pinion shaft nut.
  - c. Pull companion flange and dust shield from pinion shaft;

- and remove oil seal and retainer assembly.
- d. Bearing cage and cap assembly and outer bearing cone may be removed from shaft.
  - e. Lift bearing spacer and center bearing cap from assembly; then if pinion or bearings are to be replaced, the center bearing cone may be pulled from the pinion shaft.

#### PLANET SPIDER DISASSEMBLY

1. On a suitable clean bench, drive planet pinion shaft outward from side opposite lock ball.
2. Planet pinion gear may be removed with bearing, spacer, and thrust washers.
3. The other planet spider assemblies may be removed in the same manner.

#### CLEANING AND INSPECTION

Immerse all parts except bearing in suitable cleaning fluid until lubricant is dissolved and parts are cleaned thoroughly.

##### Bearings

Dip bearings in cleaning fluid and slush up and down slowly until bearings are clean.

Remove bearings from fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Repeat above operation until bearings are cleaned thoroughly. Blow bearing dry with compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings. Bearing may be slowly rotated by hand to facilitate drying procedure.

##### Housing

Clean interior of housing thoroughly. Remove any portions of gaskets that are stuck on mating faces of housing and differential carrier.

##### Inspection of Parts

Examine differential side gears, pinions and thrust washers for damage or excessive wear. Check clearance between pinions and spider arms and thickness of all thrust washers. If differential side gears and pinions are worn or damaged, always replace with complete set consisting of four pinions, two side gears and all thrust washer.

If magna-flux inspection equipment is available, inspect all parts except bearings, using this method to detect cracks, fissures not visible otherwise, to determine serviceability of parts. Surface of companion flange which contacts oil seal lip must be round, smooth finished and free from nicks, scratches, grooves or scores.

##### Bearings

Carefully inspect rollers, cages and cups, for wear, chipping or nicks

to determine fitness of bearings for further use. After inspection dip bearings in gear oil and wrap in clean cloth or paper to protect them until installed.

### Oil Seals

Replacement of spring loaded oil seals when unit is disassembled, is more economical than premature overhaul to replace these parts at a future time. Further, loss of lubricant through a worn seal may result in failure of other differential parts. Handle seals carefully, particularly when seals are being installed. Cutting, scratching or curling under, of lip of seal seriously impairs efficiency.

### Gears & Shafts

If magna-flux process is available, use process to check parts. Examine teeth of all gears carefully for wear, pitting, chipping, nicks or scores. If gear teeth show spots where case hardening is worn through, install new gear. Small nicks may be carefully removed with a suitable hone. Examine pinion gear teeth for wear and check pinion shaft for evidence of twisting, particularly at splines. If evident, install new set of gears. Pinion and drive (ring) gears are available only in matched sets and must be installed as such to assure satisfactory operation.

Inspect axle shafts to make certain that they are not sprung, bent or splines twisted and that shafts are true.

### DIFFERENTIAL AND CARRIER REASSEMBLY

#### A. Build up pinion assembly as follows:

1. Press center bearing cone onto pinion shaft, with taper upward; then set center bearing cap in position on cone.
2. Select spacer and shims, obtain a rolling pinion bearing resistance torque of 13 to 28 inch pounds with pinion assembled in carrier. This check to be made before differential is assembled and not to include pinion oil seal drag. (NOTE: The production spacers are ground to a variable length as required to obtain proper preload on the bearings. Service wise spacer and shim kit is provided to obtain the same results.)
3. Install bearing spacer with cone taper toward center bearing then add proper amount of shim.
4. Press outer bearing cup into bearing cage and set bearing cage onto center bearing.
5. Install outer bearing cone on shaft with taper downward.
6. Press new oil seal, with lip upward, into seal retainer. CAUTION: Refer to paragraph No. 2.
7. Install retainer and seal assembly on companion flange on pinion shaft, be sure gasket is in place.
8. Install pinion shaft washers and nut; then tighten nut securely to 500 pounds feet min. torque; then secure nut with cotter pin.

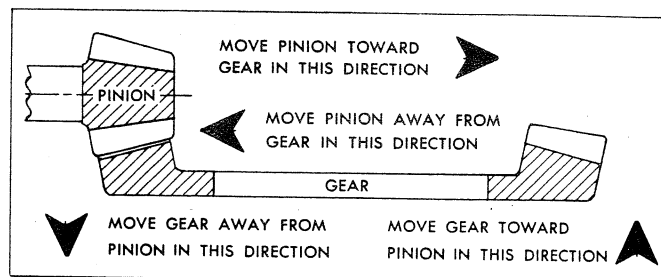
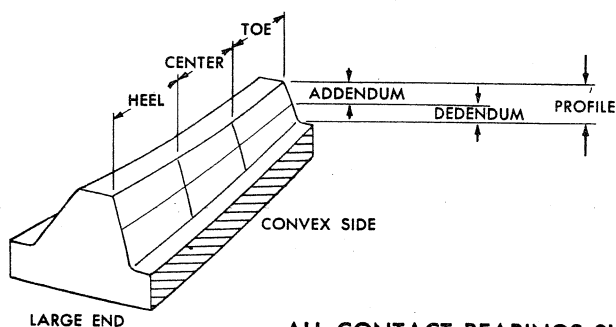
#### B. Press pinion assembly into carrier, making certain the shims are in place between face of carrier and pinion bearing cage.



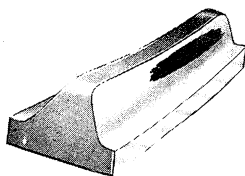
- C. Install pinion retainer screws and tighten securely with proper torque. Tighten the larger head capscrews to 95 pounds feet torque. Tighten the smaller head capscrews to 65 pounds feet torque.
- D. After ring gear has been secured with capscrews to flange half of case, assemble differential and case as follows:
  - 1. Install side gear thrust washer and side gear in flange half of case.
  - 2. Install four pinions and thrust washers on differential spider; then put spider in position in case.
  - 3. Set other side gear in place on pinions and install thrust washer on side gear.
  - 4. Place plain half of case on assembly being certain the matching marks on plain half is in line with mark on flange half.
  - 5. Insert differential case bolts through case from flange side and install nuts then tighten securely.
  - 6. Press bearing cones onto differential case.
- E. Place differential bearing cups over cones and install ring gear and body assembly in carrier.
- F. Install differential bearing adjusting nuts in carrier and then install carrier caps to hold assembly in place. Tighten carrier cap bolts until lockwashers are just flattened out.
- G. Tighten adjusting nuts to seat bearings. Differential bearing nuts to be adjusted to take up all slack in differential bearings, then proceed with backlash and tooth contact adjustment as per chart.
- H. When proper adjustment has been obtained, tighten carrier cap screws to 360 pounds feet torque and recheck backlash. If backlash is within limits (.008 to .013) install adjusting nut locks and secure in place with cap screws and lockwasher. Lockwire the cap screws as an added safety measure.

#### PLANET SPIDER REASSEMBLY

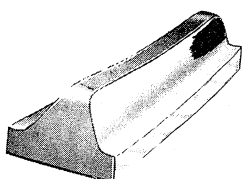
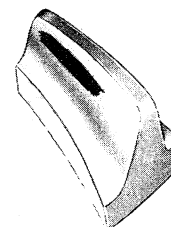
- 1. Lubricate the inside of planet pinion gear with a heavy grease, this is to hold bearings in place during assembly.
- 2. Set planet pinion on thrust washer with tang side away from planet pinion gear.
- 3. Insert 29 bearings and install spacer then the remaining 29 bearings.
- 4. Set thrust washer on top with tang side away from planet pinion spider.
- 5. Install pinion gear, bearings, spacer and thrust washers assembly into planet spider with tang into indentation of planet spider.

**SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART**


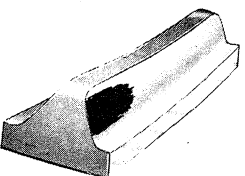
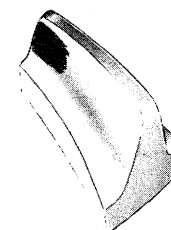
ALL CONTACT BEARINGS SHOWN BELOW ARE ON RIGHT HAND SPIRAL RING GEAR — THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.


**FIG. 1**

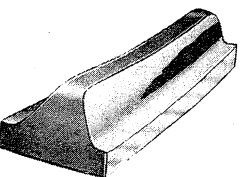
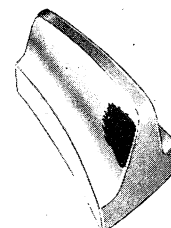
TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD


**FIG. 2**

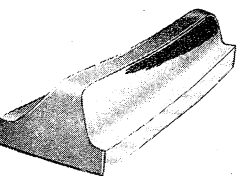
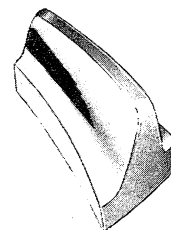
TOE BEARING ON BOTH SIDES OF TOOTH — GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.


**FIG. 3**

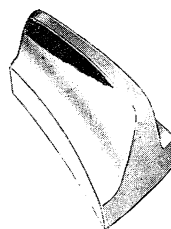
HEEL BEARING ON BOTH SIDES OF TOOTH — GEARSET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.


**FIG. 4**

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR (INCREASE MOUNTING DISTANCE).


**FIG. 5**

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR (DECREASE MOUNTING DISTANCE).


**BACKLASH**

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL. THE AMOUNT SHOULD VARY FROM .007 TO .014 DEPENDING UPON THE PITCH OF THE GEAR — FINE PITCHES BEING NEAR THE LOW SIDE AND COARSER PITCHES NEAR THE HIGH SIDE.

Fig. 1 Tooth Contact Chart

ENGINEERING APPROVED

REV. 5-1-63

6. Install shaft through planet spider assembly with lock ball in place.
7. With a small center punch stake planet spider near shaft and lock ball so shaft will not fall out during installation of the complete planet spider assembly to axle.

#### AXLE REASSEMBLY

1. Being certain housing face is clean, place and carrier in housing, securing in place with carrier to housing capscrews.
2. If oil seal and thrust washer has been removed from housing outer end, replace with new in following order-oil seal spacer washer, oil seal and universal thrust washer. Be sure lip of oil seal points toward flanged end of housing member. Stake washer in place using center punch. Stake housing member at three points around washer.
3. Place steering trunion oil retainer in position and press trunion bearing cups in place in housing outer end. Trunion oil retainer is used under upper bearing cup only.
4. Insert housing outer end into spindle support member. Tilt housing outer end slightly to insert bearing cones into position. Align bearings with bores in support member and assemble steering trunions and shims in place. Shims should be used as required to produce a bearing fit of no perceptible end play, but still permit free rotation of spindle support on housing member without binding. Shims should be evenly distributed on top and bottom trunions. Assemble nuts and lockwashers drawing same up evenly. NOTE: Steering arm is assembled on top left hand side using special screws provided. Install lockwire in place.
5. Assemble outer end dust and oil seal assembly in following order:
  - a. Oil seal retainer gasket
  - b. Oil seal retainer
  - c. Oil seal (Felt)
  - d. Dust seal
  - e. Dust seal spring
  - f. Dust seal retainer
  - g. Seal retainer ring

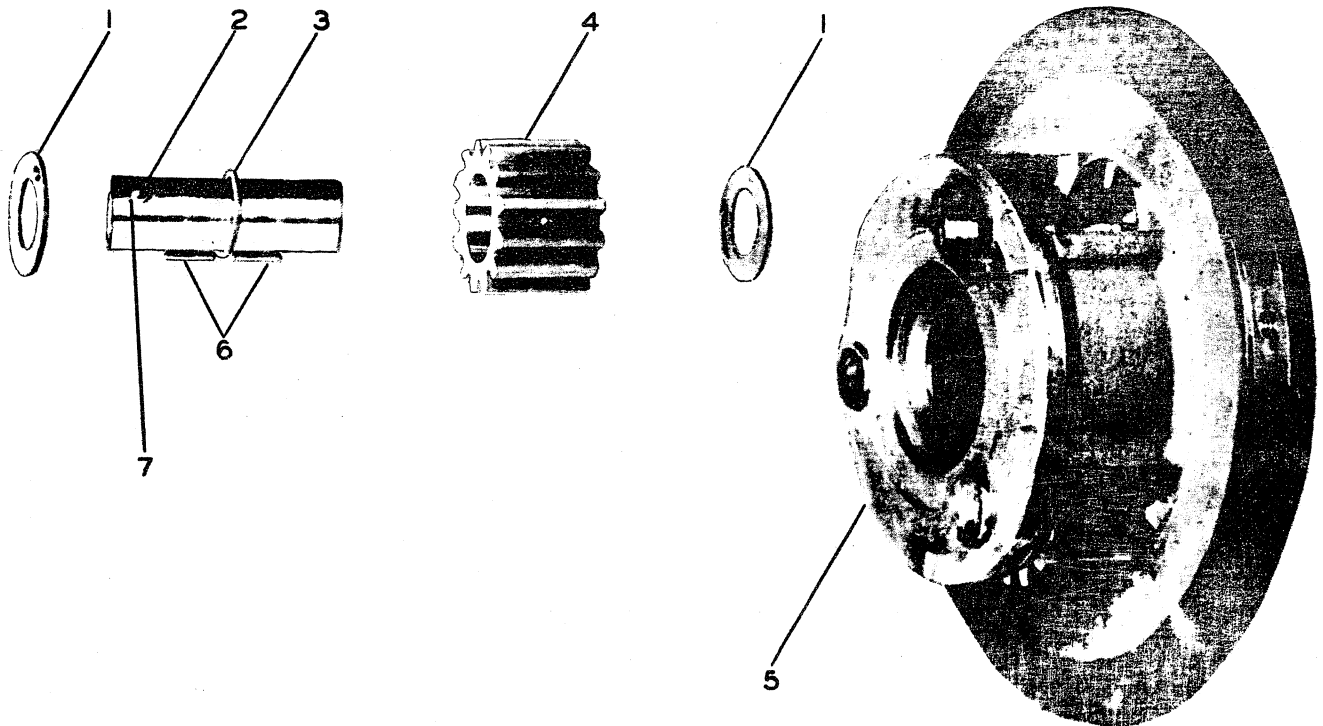
Sealing members should be so positioned that "splits" in same do not line up with each other.

6. If steering spindle bushing, oil seal or thrust washer have been removed, replace with new, assembling oil seal with lip toward threaded end of spindle. Stake thrust washer in place using center punch. Stake spindle member at three points around washer.
7. Assemble spindle support and housing outer end assembly to housing. Draw up nuts and lockwashers evenly and tighten securely.

8. Pack spindle support assembly with Soda Soap No. 1 consistency, heavy oil base, working grease into trunion bearings. Pack universal joint with same grease as above.
9. Assemble axle shaft and universal joint assembly inserting long end into housing taking care not to damage oil seal and aligning splines with side gear in differential and carrier assembly. Fill remainder of cavity in spindle support assembly with grease as described in paragraph 8 above.
10. Using new gasket assemble steering spindle assembly to spindle support using special capscrews provided.
11. Press inner and outer hub bearing cups in place in wheel hub. Place inner bearing cone in position and press oil seal into place with lip toward inner hub bearing. Assemble hub assembly onto steering spindle.
12. Assemble internal gear into internal gear hub, securing in place with special capscrews provided. Wire capscrews in place in pairs with lockwire. Assemble outer hub bearing cone place on internal gear hub and assemble gear hub and bearing in position on housing.
13. Insert hub sleeve in place between gear hub and steering spindle and assemble inner tube nut in position. Nut should be tightened so that there is no end play in hub bearings, but hub should rotate freely by hand. Nut should then be back off 1/6 of a turn or one flat on nut. Install nut lock and outer tube nut and lock in place, turning tangs of nut lock to contact alternately the inner and outer nuts.
14. Using new gasket install planet spider assembly in position securing in place with special capscrews and lockwashers provided.
15. Assemble sun gear in place on axle shaft.
16. With new gasket in place assemble hub thrust cap in position, securing in place with capscrews and lockwashers.
17. Assemble tie rod assembly in place.

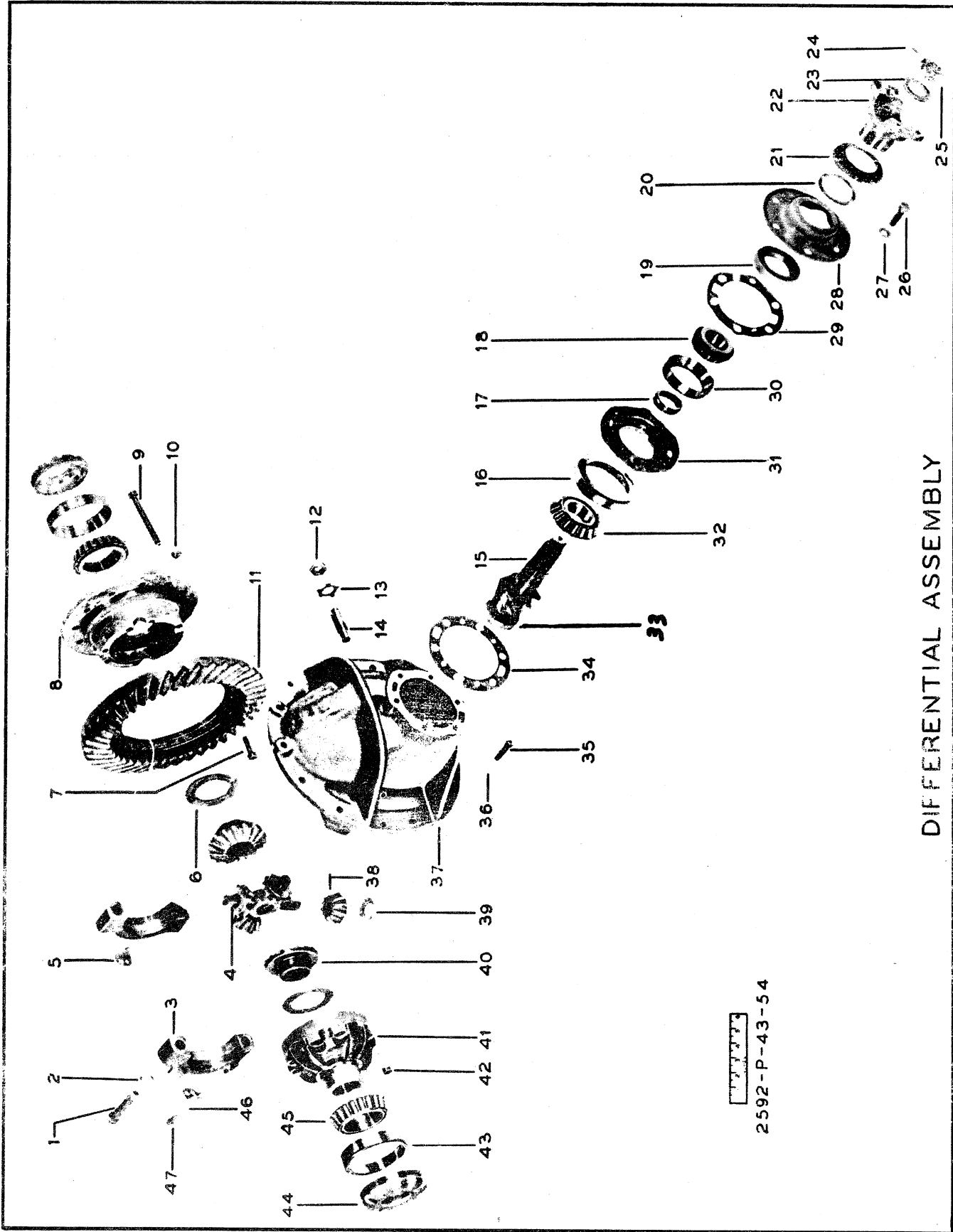
#### INSTALLATION INTO MACHINE

1. Raise axle assembly into position under machine and secure in place with special bolts and nuts provided. Draw nuts up evenly and tighten securely.
2. Reconnect propeller shaft.
3. Reconnect rear steering push rod to steering arm.
4. Fill axle with lubricant as prescribed in "Lubrication Section."
5. Reinstall tire and rim assemblies, drawing up nuts evenly and securely.



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<u>Item</u> <u>No.</u>	<u>Description</u>	<u>No.</u> <u>Req'd.</u>
1	Pinion Thrust Washer .....	12
2	Pinion Shaft .....	6
3	Roller Spacer .....	6
4	Planet Pinion .....	6
5	Planet Spider .....	2
6	Pinion Roller .....	348
7	Pinion Shaft Ball .....	6



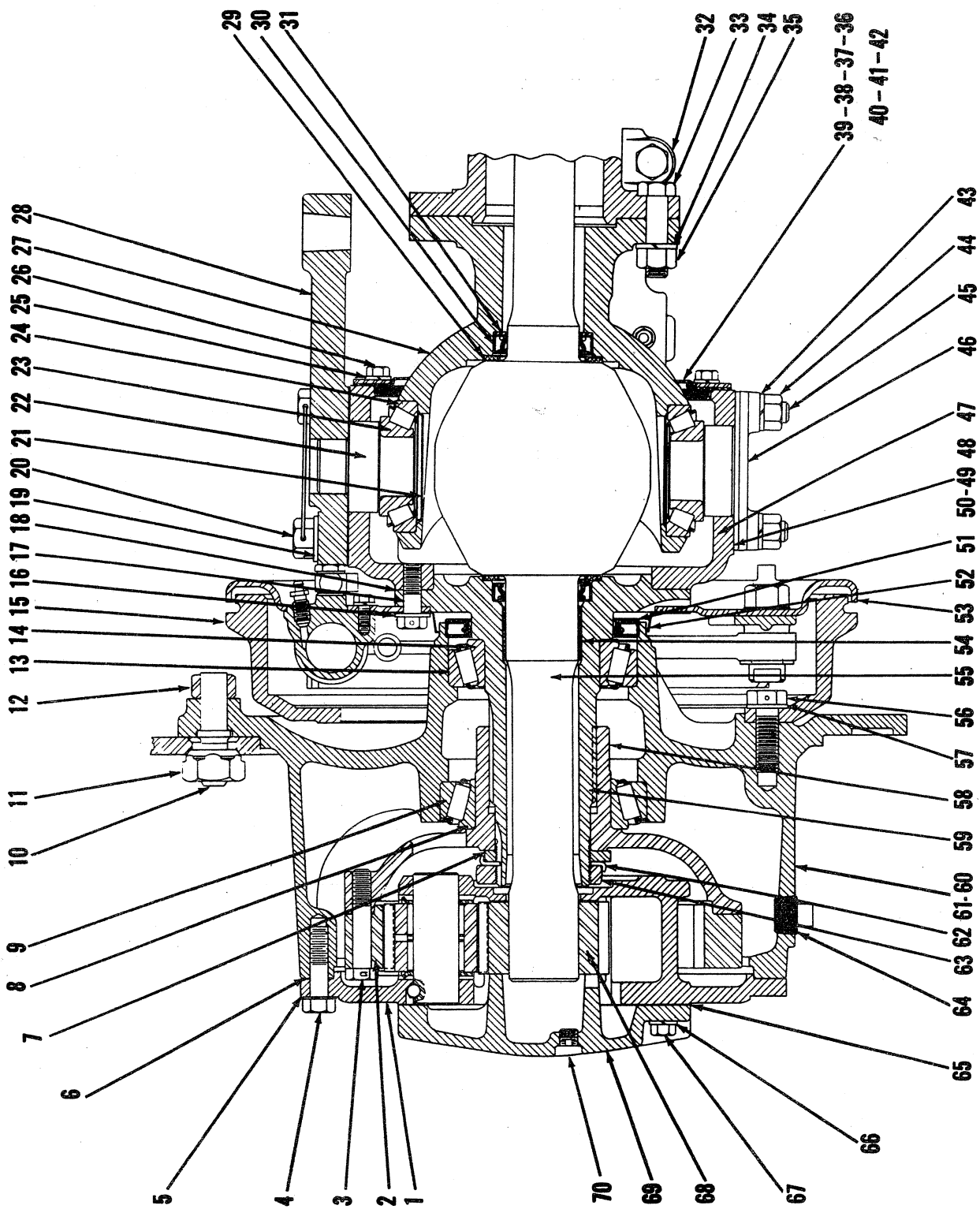
DIFFERENTIAL ASSEMBLY

2592-P-43-54

## DIFFERENTIAL &amp; CARRIER ASSEMBLY

Item No.	Description	No. Req'd.
1	Diff. Carrier Cap Mtg. Capscrew .....	4
2	Diff. Carrier Cap Mtg. Capscrew Washer .....	4
3	Diff. Carrier Cap .....	2
4	Differential Spider .....	1
5	Diff. Adj. Nut Lock .....	2
6	Diff. Side Gear Thrust Washer .....	2
7	Ring Gear Bolt .....	12
8	Diff. Case - Flange Half .....	1
9	Diff. Case Bolt .....	8
10	Ring Gear Bolt Nut .....	12
11	Ring Gear .....	1
12	Diff. Thrust Screw Nut .....	1
13	Diff. Thrust Screw Nut Lock .....	1
14	Diff. Thrust Screw .....	1
15	Pinion .....	1
16	Pinion Center Bearing Cup .....	1
17	Pinion Bearing Spacer & Shim Kit .....	1
18	Pinion Outer Bearing Cone .....	1
19	Pinion Oil Seal .....	1
20	Pinion Oil Seal Gasket .....	1
21	Pinion Dust Shield .....	1
22	Companion Flange .....	1
23	Pinion Shaft Washer .....	1
24	Pinion Shaft Cotter Pin .....	1
25	Pinion Shaft Nut .....	1
26	Pinion Oil Seal Ret. Screw .....	6
27	Pinion Oil Seal Ret. Screw Lockwasher .....	6
28	Pinion Oil Seal Ret. .....	1
29	Oil Seal Ret. Gasket .....	1
30	Pinion Outer Bearing Cup .....	1
31	Pinion Outer Bearing Cage .....	1
32	Pinion Center Bearing Cone .....	1
33	Pinion Center Bearing .....	1
34	Bearing Cage Shim .....	AR
35	Carrier to Axle Housing Screw .....	10
35A	Carrier to Axle Housing Screw .....	4
36	Carrier to Axle Housing Screw Lockwasher .....	14
37	Diff. Carrier .....	1
38	Diff. Pinion .....	4
39	Diff. Pinion Thrust Washer .....	4
40	Differential Side Gear .....	2
41	Diff. Case - Plain Half .....	1
42	Diff. Case Bolt Nut .....	8
43	Diff. Bearing Cup .....	2
44	Diff. Adjusting Nut .....	2
45	Differential Bearing Cone .....	2
46	Diff. Adjusting Nut Lock Screw Lockwasher .....	2
47	Diff. Adjusting Nut Lock Screw .....	2

AR - As Required



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# AXLE ASSEMBLY-REAR DRIVE STEER



## AXLE ASSEMBLY - REAR DRIVE STEER

Item No.	Description	No. Req'd.
1	Planet Spider Assembly .....	2
2	Internal Gear .....	2
3	Screw, Internal Gear .....	16
4	Capscrew, Planet Spider .....	20
5	Lockwasher, Planet Spider Capscrew .....	20
6	Gasket, Planet Spider .....	2
7	Nut, Steering Spindle - Inner .....	2
8	Hub Bearing Cone - Outer .....	2
9	Bearing Cup - Outer .....	2
10	Stud, Wheel .....	20
11	Nut, Wheel .....	20
12	Nut, Wheel Stud .....	20
13	Bearing Cup - Inner .....	2
14	Hub Bearing Cone - Inner .....	2
15	Brake Assembly .....	2
16	Washer, Steering Spindle .....	20
17	Bolt, Steering Spindle .....	20
18	Gasket, Steering Spindle .....	2
19	Washer, Steering Arm Screw - Outer .....	2
19	Washer, Steering Arm Screw - Inner .....	2
20	Screw, Steering Arm - Outer .....	2
20	Screw, Steering Arm - Inner .....	2
21	Oil Retainer, Steering Trunnion .....	2
22	Steering Trunnion .....	1
23	Bearing Cone, Steering Trunnion .....	4
24	Bearing Cup, Steering Trunnion .....	4
25	Lockwasher, Outer End .....	24
26	Capscrew, Outer End .....	24
27	Housing, Outer End .....	2
28	Steering Arm .....	1
29	Washer, Universal Joint Thrust .....	4
30	Oil Seal, Universal Joint Shaft .....	4
31	Washer, Oil Seal .....	2
32	Tie Rod End Assembly .....	2
33	Capscrew, Outer End .....	16
34	Omit	
35	Nut, Outer End .....	16
36	Retainer, Oil Seal, Outer End .....	2
37	Gasket, Outer End Oil Seal Retainer .....	2

**AXLE ASSEMBLY - REAR DRIVE STEER(CONT'D)**

<u>Item No.</u>	<u>Description</u>	<u>No. Req'd.</u>
38	Oil Seal, Outer End .....	2
39	Dust Seal, Outer End .....	2
40	Spring, Outer End Dust Seal .....	2
41	Seal Retainer, Outer Dust .....	2
42	Ring, Outer End Seal Retaining .....	4
43	Lockwasher, Steering Trunnion Stud .....	14
44	Nut, Steering Trunnion Stud .....	14
45	Stud, Steering Trunnion .....	12
46	Steering Trunnion - Flanged .....	3
47	Steering Spindle Support Ass'y. ....	1
48	Shim, Steering Trunnion - Thick .....	AR
49	Shim, Steering Trunnion - Medium .....	AR
50	Shim, Steering Trunnion - Thin .....	AR
51	Seal, Hub Oil .....	2
52	Oil Slinger .....	2
53	Brake Disc Assembly	
54	Bushing, Steering Spindle .....	2
55	Axle Shaft & Universal Joint Assembly .....	2
56	Bolt, Brake Drum .....	12
57	Washer, Brake Drum .....	12
58	Internal Gear Hub .....	2
59	Steering Spindle Assembly (Inc. Item 54) .....	2
60	Hub & Drum Assembly .....	2
61	Hub & Cup Assembly (Inc. Items 9 & 13) .....	2
62	Nut Lock, Steering Spindle .....	2
63	Nut, Steering Spindle - Outer .....	2
64	Filler Plug, Wheel Hub .....	2
65	Gasket, Sun Gear Thrust Cap .....	2
66	Lockwasher, Thrust Cap .....	12
67	Capscrew, Thrust Cap .....	12
68	Sun Gear .....	2
69	Cap, Sun Gear Thrust .....	2
70	Plug, Oil Level Thrust Cap .....	2

AR - As Required

SECTION 400  
STEER AXLE

## DESCRIPTION

The steering axle is a pivoted mounted jack knife type designed for short turning radius. The axle is mounted on removable caps at front and rear of mounting brackets. Caps are secured with capscrews at both front and rear mounting points.

Two tie rods connect steering knuckles to a control steering arm at which point the rear end of steering booster ass'y. is attached. The steering drag link attaches to the steering booster at the rear end and to the Pitman arm at the front, which in turn is connected to the steering gear assembly.

## REMOVAL FROM MACHINE

To remove axle assembly from machine, proceed as follows:

1. Jack up rear end of machine to raise wheels about two inches off floor. Block front wheels to prevent movement.
2. Block up rear end of machine and remove tire and wheel assemblies.
3. Disconnect steering booster at under steering arm joint.
4. Remove capscrews retaining mounting caps at pivot mounting brackets and remove axle assembly from machine.

## AXLE OVERHAUL

In event of major overhaul and disassembly of steering axle, refer to exploded view of axle assembly in Figure 1 for relative positioning of components.

## MAINTENANCE AND INSPECTION

Clean all parts thoroughly in suitable cleaning fluid. Inspect all parts for wear or evidence of damage. Inspect needle bearings and condition of wheel bearings. If condition so indicates replacement should be made at this time. Press out old bearings and press in new at same depth. If thrust bearings show wear, a new one should be used in reassembly.

Check steering arm pivot pin and bearings. Replace if worn, chipped or damaged. After inspection dip bearings in gear oil and wrap in clean cloth or paper to protect them until installed.

## STEER AXLE ADJUSTMENTS

After reassembly and installation into machine, check the wheel alignment. The steering wheels should track square with the drive wheels with no toe-in or toe-out. There is no caster or chamber adjustments to be made as this feature is designed into axle proper. Adjust the alignment of the steering wheels by loosening the lock nut and screw on rods and turning the tie rod. Turn tie rod until the wheel is in alignment making sure the steering wheel does not turn. NOTE: Tie rods should be the same length. Adjust both wheels. Tighten lock nut and screw to secure adjustment.

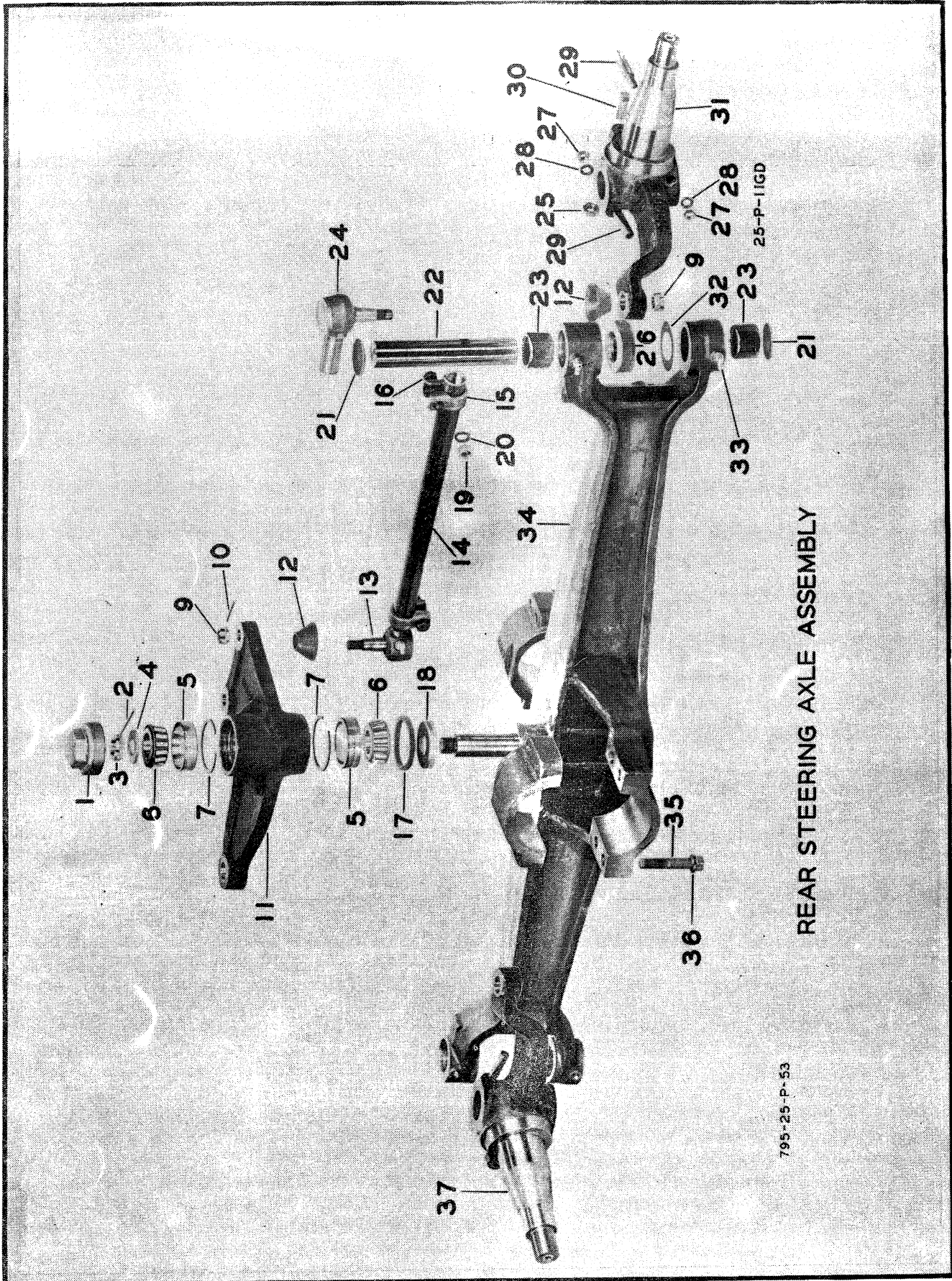


Figure 1

Item No.	Description	Item No.	Description
1	Spider Hub Grease Cap	20	Tie Rod Clamp Bolt Lockwasher
2	Spider Nut Cotter Pin	21	Axle Center Expansion Plug
3	Spider Nut	22	Knuckle Pin
4	Spider Washer	23	Steering Knuckle Pin Bearing
5	Spider Bearing Cup	24	Tie Rod End Assembly, R.H.
6	Spider Bearing Cone	25	Knuckle Stop Screw Nut
7	Spider Bearing Snap Ring	26	Knuckle Thrust Bearing
9	Tie Rod End Nut	27	Knuckle Pin Draw Key Nut
10	Tie Rod End Ball Bolt Cotter	28	Knuckle Pin Draw Key Lockwasher
11	Steering Spider	29	Knuckle Pin Draw Key
12	Tie Rod End Ball Cover	30	Knuckle Stop Screw
13	Tie Rod End Assembly, L.H.	31	Steering Knuckle, R.H.
14	Tie Rod	32	Knuckle Shim
15	Tie Rod Clamp	33	Knuckle Pin Grease Fitting
16	Tie Rod Clamp Bolt	34	Axle Center Assembly
17	Spider Hub Felt	35	Axle Center Bearing Mounting Cap Capscrew
18	Spider Hub Felt Cup	36	Axle Center Bearing Mtg.
19	Tie Rod Clamp Bolt Nut	37	Steering Knuckle, L.H.

Rotate the hand wheel through limits of its travel checking to see that stops on steering knuckles bottom before ball nut on steering gear bottoms. If ball nut bottoms before the steering knuckles reach the stops, adjust the knuckle stop screws. If not, readjust the Pitman arm on the Pitman shaft and recheck for above stops.

After above check, adjust Pitman arm stops. Pitman arm stops limit the number of degrees Pitman arm can move in either direction and prevent resultant excessive thrust and cramping of the steering booster. The Pitman arm should strike the stops slightly before the steering knuckles strike the stops on the axle.

See Lubrication Section for proper greases.

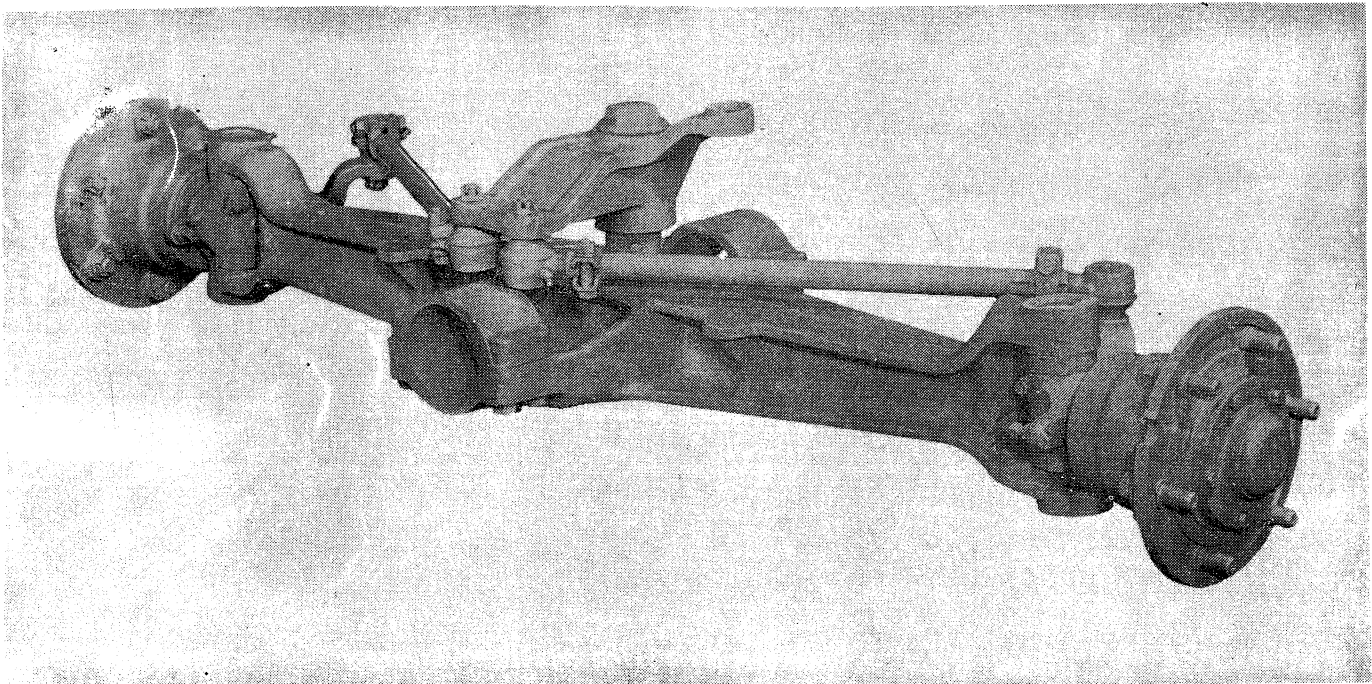


Figure 2 Rear Steer Axle Assembly

SECTION 500  
PROPELLER SHAFTS

The propeller shafts employed are of roller bearing construction with each bearing held in place by an integral key and pilot, and two capscrews. Each roller bearing is protected by a cork seal which in turn is held in place by the steel bearing retainer. The cork seals and retainers serve as grease seals to keep lubrication in the joint and as dirt seals to prevent dirt and moisture from entering.

There are no adjustments to be made on the propeller shafts in service, except that they be kept lubricated as described in lubrication section of this manual.

These propeller shafts are very simple to service. To disassemble, remove the four capscrews and the lock holding the spider bearings to the yoke and tap apart.

When reassembling always use the special capscrews provided with propeller shaft as ordinary heat treated screws are inadequate. A torque wrench should be used when tightening these capscrews. Proper torque for screws on propeller shaft from torque convertor to transmission is 20 to 25 foot pounds. Proper torque on propeller shafts from transmission to axle assembly is 45 to 55 foot pounds.





SECTION 600  
HYDRAULIC SYSTEM

## DESCRIPTION

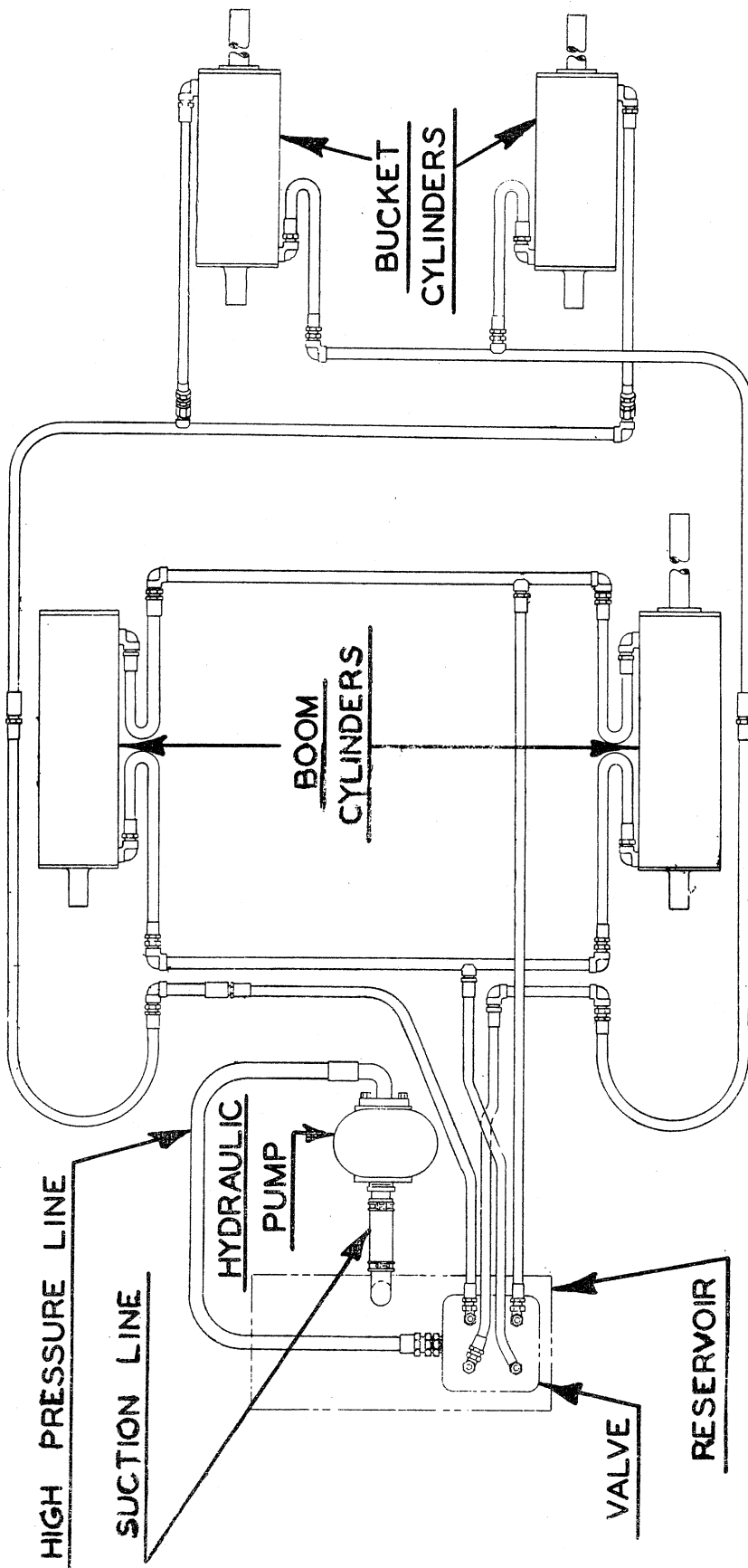
The hydraulic system consists of the following units: oil reservoir, hydraulic pump for bucket and boom, steering booster pump, a control valve, two boom hoist cylinders, two bucket control cylinders, a hydraulic steering booster, connecting hoses, and fittings.

All internal parts of the system are automatically lubricated by the hydraulic oil. Therefore, the use of the proper oil is necessary to insure long and efficient operation of the hydraulic system. Only hydraulic oil should be used in the system. Use a good quality hydraulic oil containing qualities of low pour point, oxidation and rust inhibitors and non-foaming characteristics. See Lubrication Section for detailed specifications.

The hydraulic system must be kept clean. Dirt in the hydraulic system is the most common cause for wear or failure of a pump or valve. Periodic draining, cleaning and refilling with new oil is desirable to ensure proper operation and service ability.

## DRAINING THE SYSTEM

1. ALWAYS DRAIN THE SYSTEM AFTER WORKING THE MACHINE AND WHILE THE OIL IS STILL WARM. WARM OIL FLOWS MORE FREELY AND CARRIES MORE DIRT AND SLUDGE WITH IT.
2. To thoroughly drain the cylinders and hoses raise the boom and bucket to full height with the bucket dumped. Securely block or chain the booms and bucket in the raised position. Then shut off the engine.
3. Remove the cover and breather from the top of the reservoir. Clean the breather to permit passage of air.
4. Disconnect control valve to pump hose and drain reservoir.
5. Disconnect the boom & bucket cylinder hoses at the lowest points to drain the cylinders.
6. Remove hand hole cover from rear face of reservoir and clean all dirt and sludge from the bottom of the reservoir being careful not to force dirt into the lines and valve.
7. After the oil has stopped draining and the dirt and sludge removed, reconnect all hoses and unions.
8. Refill the reservoir nearly to the top with clean hydraulic oil.
9. Be sure all control levers are in neutral position. Then start the engine and let it run at idle speed for a few minutes.



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HYDRAULIC DIAGRAM

Figure 1

10. Place the boom lever in raise position to pump oil in the boom hoists. Then remove the blocks or chains holding the boom and bucket up. DO NOT STAND OR WORK UNDER THE BOOMS OR BUCKET AFTER REMOVING THE BLOCK OR CHAINS.
11. Operate the unit by raising, lowering, dumping, and closing the bucket until all the oil ceases to foam. This will "bleed" the system forcing trapped air to escape through the reservoir breather.
12. After the oil has ceased to aerate, add oil in the reservoir to bring the oil level up to the oil level mark. This is necessary to replace oil drawn into the cylinder and hoses.
13. Check all connections for leaks. Be sure the reservoir cap is in place.

#### HYDRAULIC PUMPS

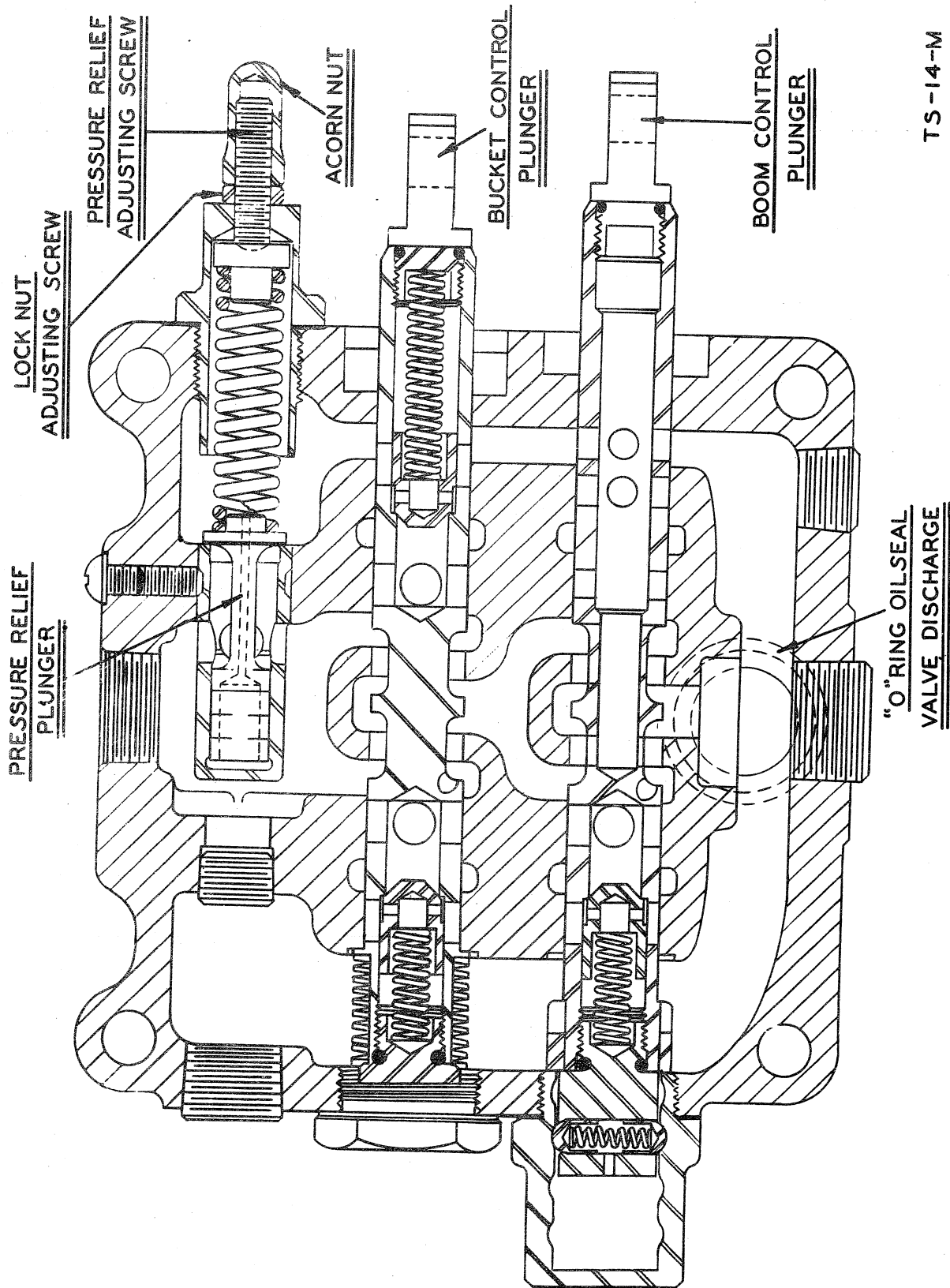
There are two pumps employed in the system. These pumps are coupled to the drive line and engine and operate as soon as the engine is started. They draw oil from the reservoir and force it, under pressure, into the control valve and steering booster valve. The engine should not be operated without sufficient oil circulating through the system to provide constant lubrication to the pump mechanism.

The larger pump is mounted centrally on the front of the torque converter and is connected by means of a splined shaft. To remove pump, disconnect pump to control valve hose at pump, draining oil reservoir into clean container. Disconnect pump to oil reservoir hose at reservoir. Loosen nuts retaining pump to torque converter housing. Pull pump away from torque converter slightly to permit removal of nuts from studs and then remove pump. Reassembly is accomplished by reversing above steps. Be sure to replace oil drained from the reservoir.

The small pump is mounted on the upper front of the torque converter. This pump provides oil pressure for the steering booster. See Steering Section.

#### HYDRAULIC VALVE

The function of the hydraulic valve is to direct the flow of hydraulic oil under pressure to the boom and bucket cylinders as selected manually by the operator when operating the boom and bucket control levers. When the control levers are in neutral position, and the engine running, the oil is continuously passed through the pump, valve and reservoir. With the control levers in Raise, Lower, Dump or Close positions the oil is directed to the energized side of the cylinder pistons and the oil on the opposite side flows back through the valve to the reservoir. When the boom control lever is in the Float position the oil is free to pass through the valve to and



# HYDRAULIC VALVE

Figure 2

from either side of the boom cylinder pistons without being affected by the oil coming from the pump. (See Fig. 2)

The only adjustment required on the valve is the periodic checking and setting of the pressure relief valve. An improperly set relief valve will impose an undue strain on the entire hydraulic system and cause the machine to operate in an unsatisfactory manner.

To check and adjust the pressure relief valve, use a hydraulic pressure gauge of at least 2000 lbs. capacity. With engine shut off, move boom control lever into "Raise" position. Remove the acorn nut located on the left hand side of valve adjacent to bucket control plunger.

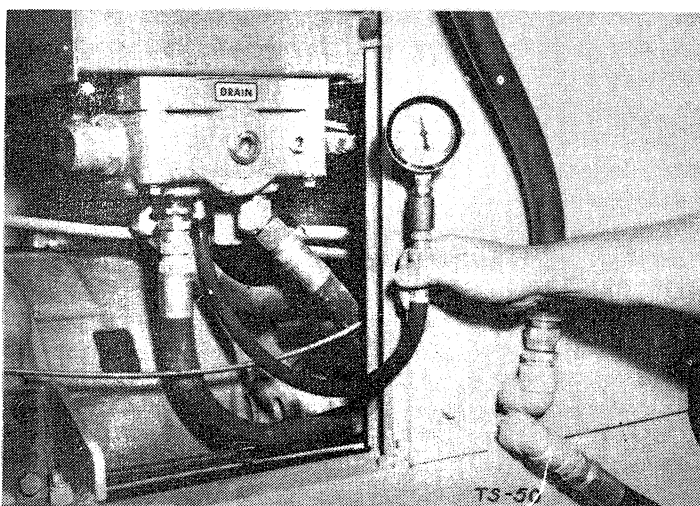


Fig. 3 Hydraulic Pressure Gauge

Start engine and raise boom to its extreme height. When cylinder reaches the end of its stroke take a pressure gauge reading. If gauge reading indicates pressure to exceed 1350 lbs., bring engine back to idle and adjust valve. Turn relief adjusting screw counter clockwise to reduce oil pressure.

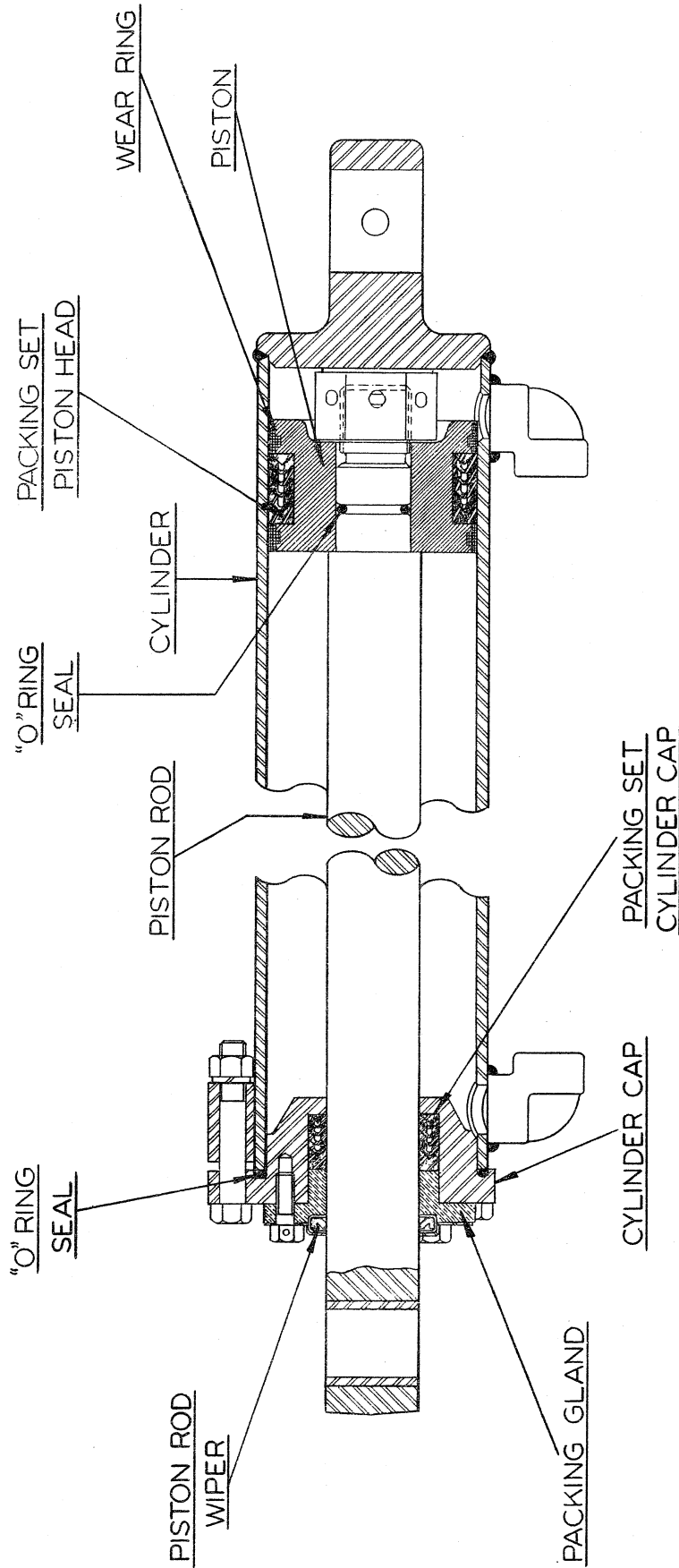
Repeat above process until gauge indicates oil pressure to be 1350 lbs. When correct adjustment has been made

as given above, lock pressure relief screw in place and replace acorn nut. Shut off engine and place boom control lever in "Lower" position and remove gauge line from valve. Replace plug in valve.

#### HYDRAULIC CYLINDERS

The boom and bucket cylinders are of the double acting type. The packing employed is self-seating and does not require adjustment. There are two sets of packings in each cylinder, one in the piston head and the one in the cylinder cap assembly. A wiper seal is provided in the cylinder cap assembly for the purpose of removing foreign material from the piston rod.

When removing boom cylinder from machine, be sure valve control levers are in neutral position with bucket resting on the ground.



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HYDRAULIC CYLINDER ASSEMBLY

Figure 4

Disconnect hoses and drain cylinder. Remove cylinder support anchor pins & bolts and remove cylinder from machine.

When removing bucket cylinder from machine, rotate bucket forward until lower anchor pin is aligned with access hole in carrier. Block bucket securely in this position. Disconnect hose and drain cylinder and line. Remove anchor pin retainer bolts and using suitable punch or drift drive out anchor pins. Remove cylinder from machine.

The boom and bucket cylinder assemblies are similar insofar as internal construction and servicing after removal from machine. (See Fig. 4). Procedure for dis-assembly and replacement of packings is as follows:

1. Remove four bolts retaining cylinder cap to cylinder and pull entire piston assembly from cylinder.
2. Remove cotter pin and nut from end of shaft and remove piston and cylinder cap assembly.
3. Remove four capscrews retaining packing gland to cylinder cap and remove gland, chevron packings and piston rod wiper.
4. If chevron packings, "O" rings, wiper seal or wear rings are worn or damaged they should be replaced.
5. In reassembly the following special tools will be required: a tapered sleeve for starting wiper seal and cylinder head packings over step in piston rod and a clamping ring for purpose of compressing piston head packings to permit entrance of chevrons into cylinder without damage.
6. Replacement chevron packings should be assembled in both cylinder cap and piston head so that lips of chevrons point toward threaded end of piston rod. Chevrons should also be assembled so that split in rings do not line up with each other.
7. Order of reassembly is as follows:
8. Assemble chevron packings in cylinder cap. Place packing gland in position. Place wiper seal and retainer in position with lip of seal toward outside. Install capscrews in place and draw down tightly & evenly.
9. Using tapered sleeve assemble cylinder cap assembly over threaded end of piston rod.
10. Place new "O" ring in position in groove provided in piston rod.
11. Assemble piston head in place on rod and install nut and cotter.

12. Install new chevron packings and wear rings on piston head and using clamping ring insert piston assembly into cylinder.
13. Place new "O" ring in recess provided in cylinder cap and rebolt cylinder cap assembly to cylinder.
14. Reassemble cylinder to machine and reconnect hoses. Add oil to bring reservoir level to proper height.

STEERING BOOSTER: See Steering Section.



SECTION 700  
STEERING SYSTEM

The steering mechanism consists of steering gear assembly, pitman arm, drag link, hydraulic steering booster, steering booster pump, connecting linkage and allied parts of steering axle.

## STEERING GEAR

The steering gear is of the recirculating type. The worm shaft is mounted in the gear housing between two tapered roller bearings. The lower bearing is adjustable toward upper bearing for removing worm shaft end play. Helical cut groove in worm is finished to serve as race for balls between worm and nut. Worm nut fits over worm. Balls are inserted in groove between worm and nut in two separate circuits. Two tabular guides fit into nut and are clamped in place. These guides deflect balls from helical path at end of circuit in nut retaining them to helical part at start of circuit. The balls are the only contact between worm and nut. When worm is turned, nut moves along worm as with an ordinary screw thread. At the same time balls roll freely between worm and nut. This produces screw action with rolling movement instead of sliding contact between parts.

Gear should be kept filled to level of filler plug with correct lubricant. See Lubrication Section and Chart.

## STEERING GEAR ADJUSTMENT

Correct adjustment of steering gear is very important. While there are but two adjustments to be made, the following procedure must be followed step by step:

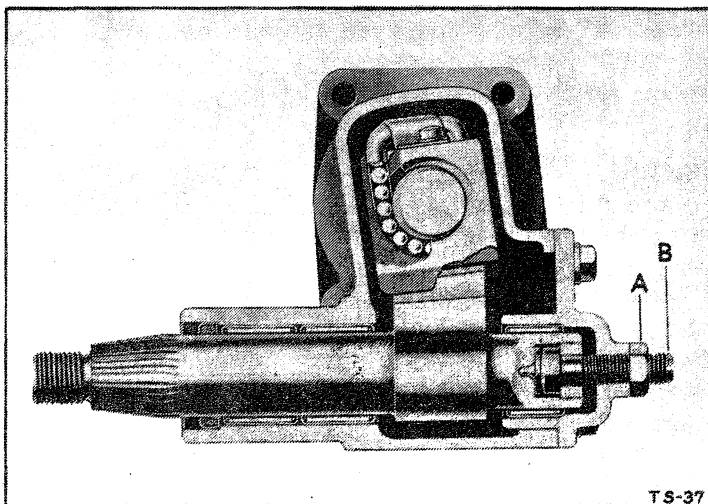


Fig. 1 Lash Adjustment

1. Disconnect steering connecting rod from pitman arm, taking care to note relative positions of steering connecting rod parts before disturbing them.
2. Loosen lock nut "A", Figure 1, and turn lash adjuster "B", Figure 2, a few turns in counter clockwise direction. This removes from screw bearings the load imposed by close meshing of rack and sector teeth. Turn steering wheel GENTLY in one direction until stopped by gear, then back away about one turn. Do not turn steering wheel hard against stops when gear is disconnected; damage to ball guides may result.

3. Measure the pull at the rim of the wheel which is required to keep the wheel in motion. This pull can be measured by attaching a spring scale to the rim of the wheel with a piece of cord, then pulling on the spring scale to turn the wheel. The line of the scale should be

kept tangent to the rim of the wheel. The proper pull at the wheel rim under these conditions should be 1 - 1-1/2 lbs. If the actual value does not lie between these limits, adjustment of screw bearings is necessary.

4. To adjust screw bearings, loosen lock nut "C", Figure 2, and turn screw bearings adjuster "D", clockwise until there is no perceptible end play in screw. Check pull at wheel rim as above, re-adjusting, if necessary, to obtain proper pull. Set up lock nut "C", and re-check pull, as it must lie within the specified limits AFTER the lock nut is set up.

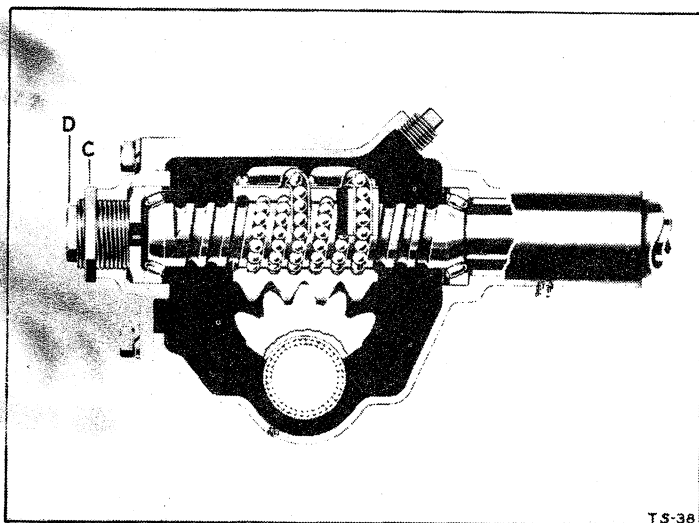


Fig. 2 Screw Bearing Adjustment

obtain proper pull. Set up lock nut "A", and re-check pull, as it must lie within the specified limits AFTER the lock nut is set up.

6. Re-assembly steering connecting rod to pitman arm.

## STEERING BOOSTER

This unit is a double acting hydraulic steering booster with an integral control valve. When the steering wheel is moved, the pitman arm through the drag link and ball stud actuates the control valve. The control valve allows the hydraulic oil from the pump to pass into the booster cylinder. The oil under pressure exerts force against the piston rod to the steering linkage, causing a turning action in the steering axle wheels. The amount of turning action is in proportion to the amount of movement of the steering wheel.

When the steering gear is stationary, the control valve remains in neutral position. This permits the oil to circulate through the booster to the reservoir, meanwhile, maintaining enough pressure to hold the booster cylinder and wheels in position.

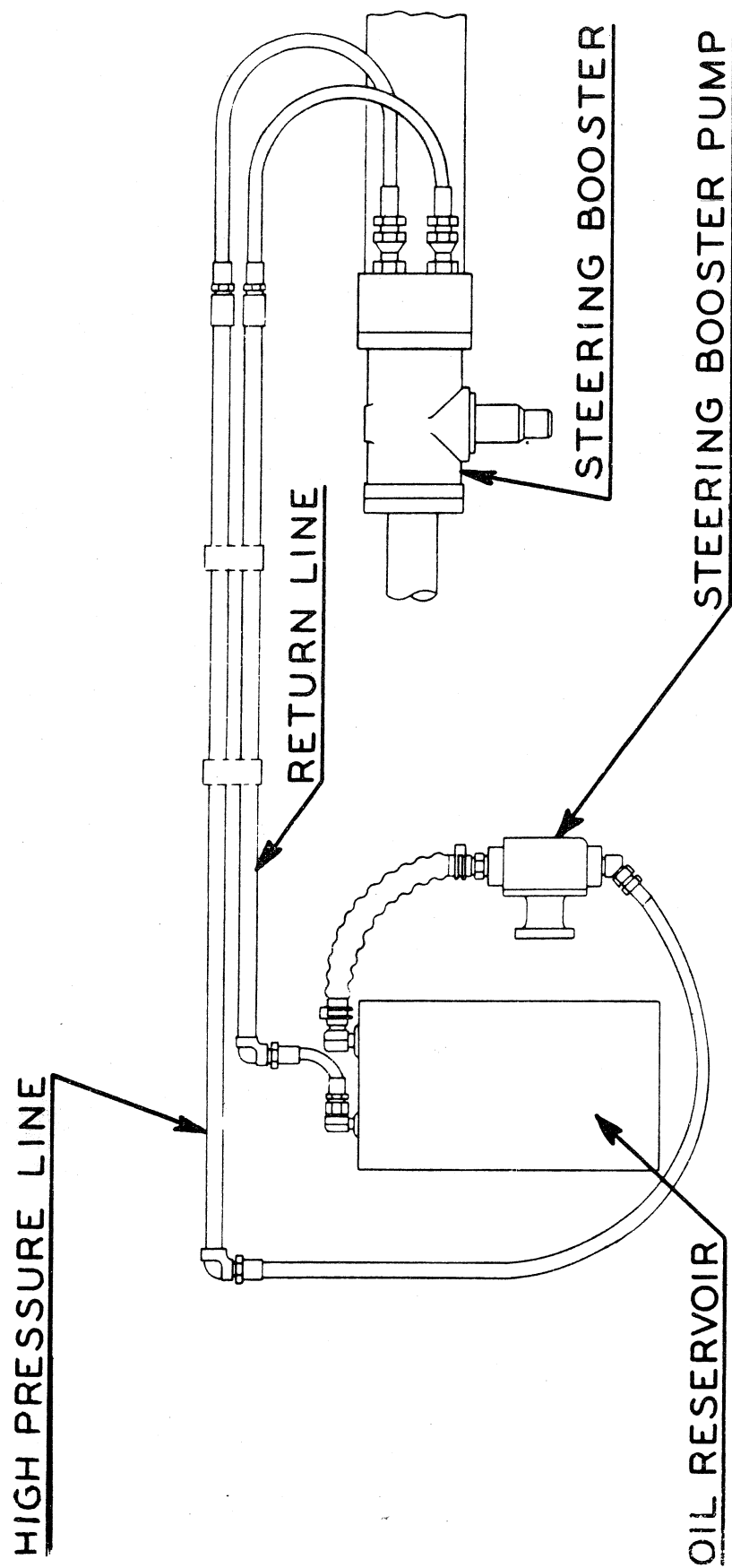
An integral relief valve, built into the unit, automatically protects the booster unit, hydraulic pump, and all line connections from excess-

ive overload pressures. This relief valve is tested and set at the factory to operate at a specified pressure, namely, 950-1000 p.s.i. Further adjustment of this relief valve is not required.

The hydraulic oil serves to lubricate the internal working parts of the steering booster. In addition grease fittings are provided at ball stud end and at anchor bracket joint. These are to be greased sparingly with pressure gun at regular lubrication periods. See Lubrication Section and Chart.

Mechanical adjustments of steering booster are not required other than take up of ball joints which may be necessary due to normal wear.

Pitman arm stops limit the number of degrees that Pitman arm can move in either direction and prevent resultant excessive thrust and cramping of the steering booster. Proper adjustment of these stops is important. The Pitman arm should strike the stops slightly before the steering knuckles strike the stops on the axle.



HYDRAULIC DIAGRAM-STEERING BOOSTER

Figure 4

SECTION 801  
BRAKES

## DESCRIPTION

The hydraulic, double shoe, internal-expanding service brakes are operated by an automotive type foot pedal. The hydraulic brake system consists of brake pedal and linkage, master cylinder, fluid lines, wheel cylinders and brake assemblies attached to the brake backing plate.

The hand brake is a multiple lever type operated by the driver's left hand.

## MASTER CYLINDER

The function of the master cylinder assembly is to displace fluid for brake application, to constantly maintain the correct volume of fluid in the system under all temperature conditions, for automatic replacement of fluid lost through gravity seepage or slight leaks, and to add fluid or super-charge the system on the return stroke of pedal after each brake application.

## MASTER CYLINDER REMOVAL

Disconnect lines at master cylinder. Disconnect push rod from brake pedal linkage. Remove mounting bolts and nuts and remove master cylinder from machine.

## MAINTENANCE AND INSPECTION

Service of the master cylinder, while it is on the machine, consists of keeping reservoir filled to 1/4" of top.

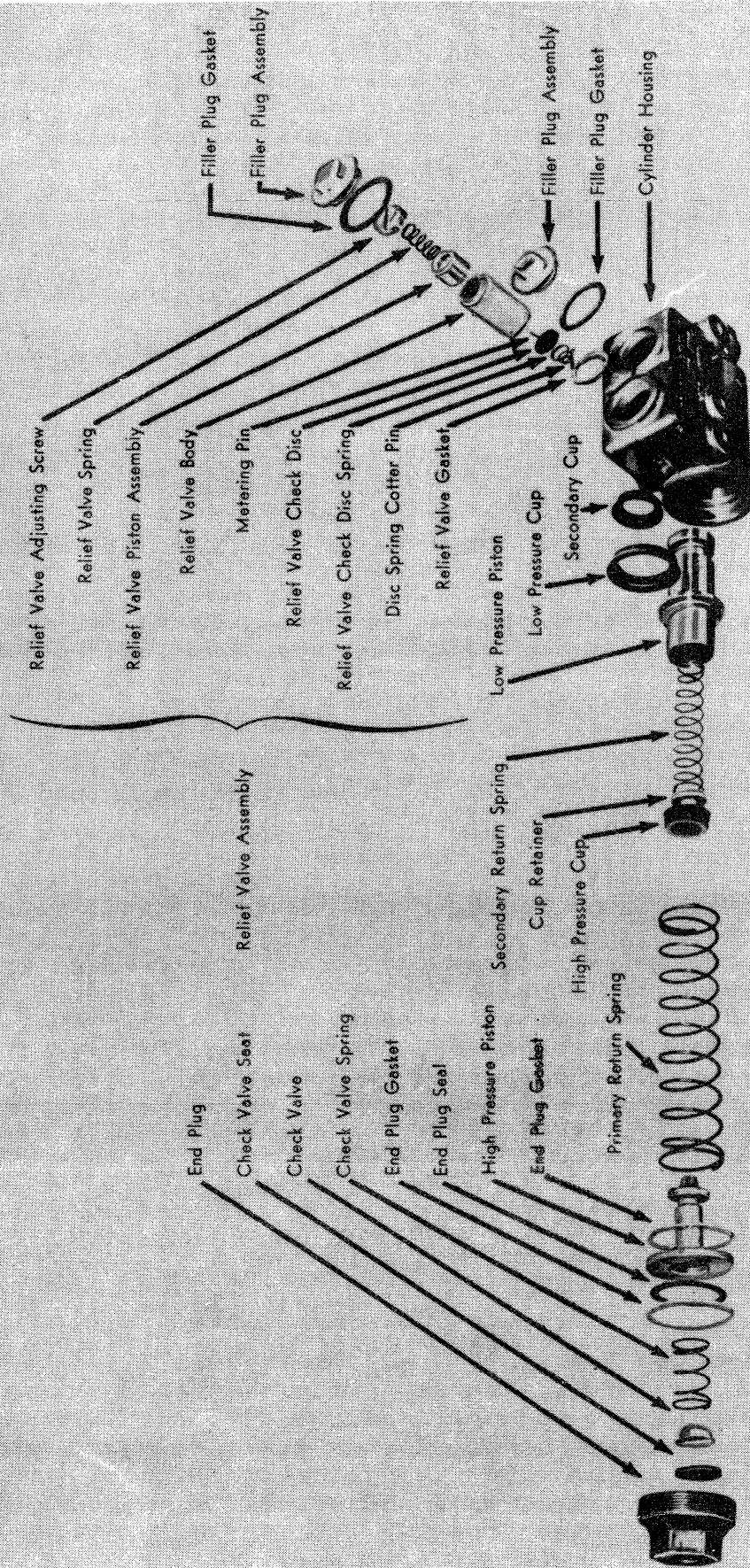
If master cylinder is disassembled, clean hydraulic parts well and keep them clean so that there is no trace of dirt, metal filings, sludge or other deposits when the unit is ready for assembly. Use lint-free cloth in cleaning as particles of lint or threads may block the by-pass port when unit is placed into service. Internal parts must be cleaned in clean denatured alcohol or hydraulic brake fluid. CAUTION: Mineral base cleaning solvents (gasoline, kerosene, etc.) deteriorate rubber parts causing them to become soft, tacky and swollen. Cylinder castings may be cleaned with usual cleaning methods but must be finished clean with denatured alcohol or brake fluid to remove all traces of solvent.

## DIS-ASSEMBLY OF MASTER CYLINDER

1. Place cylinder assembly in horizontal position in a vise. Remove forward filler plug which will expose slotted top of the Relief Valve Assembly. Remove the relief valve assembly by turning out, counterclockwise. Use a very wide bladed screwdriver for this purpose to prevent damage to the screwdriver slot. Screwdriver must be wide enough to fit into both notches on the relief valve body. The slotted center screw is for valve adjustment purpose only and not for removal of relief valve. It is necessary that relief valve be removed to prevent damaging large low pressure cup when removing low pressure piston in a later operation.

TS-179

# BRAKE MASTER CYLINDER





2. Loosen the large end plug by means of a 1-5/16 wrench. This plug will be very tight and it is recommended that machined face of hex portion of this plug be tapped smartly with a hammer before attempting to loosen it. In doing this be careful not to make sharp dents or impressions near threaded outlet hole. If this surface is dented, it will make it difficult to obtain a tight seal when later connecting brake line adaptor.

After end plug has been loosened, unscrew by hand and while unscrewing keep a reasonably heavy pressure against plug. Frequently primary piston will follow end plug out as it is unscrewed. This is due to two return springs within cylinder being seated against base of primary piston.

3. If primary piston does not follow end plug out as described in previous paragraph, it will be necessary to free end plug gasket from hanging in the threaded portion of cylinder housing.

Free this gasket by pushing securely against base of the primary piston with one hand and prying out end plug gasket by means of a thin bladed screw driver with the other. While performing this, remember to keep as heavy a pressure as possible against base of primary piston.

Again remember that internal return springs of cylinder are seated against base of primary piston and it is possible that this piston may fly out with considerable force if released suddenly.

4. Removal of remaining internal parts of cylinder after the end plug has been removed is very simple. As previously described, primary piston upon being freed will expel itself. The large and small return springs may then be pulled from within cylinder as they are free at both ends. Next remove inside plug gasket. After this gasket has been taken out, secondary piston may be removed by forcing through with a screw driver or rod from push rod end.

#### ASSEMBLY OF MASTER CYLINDER

1. Place cylinder housing, threaded end up, in a vertical position in a vise. Set a socket (about 5/8 size) on vise beam so that it will project into smaller bore of cylinder housing. This socket will hold secondary piston up so that high pressure piston may be entered in a later step.
2. Tighten vise securely with cylinder housing resting on vise beam. Next insert low pressure piston. When doing this make certain that the two cups are on correctly. The open or forward side of these cups must be in the same direction as open or cylinder end of low pressure piston. Push low pressure piston down until it stops against socket standing in small bore. Insert inside plug gasket, being certain that this gasket is up square and snug to its shoulder within cylinder housing.
3. Insert small return spring into high pressure cylinder of low-pressure piston. Next insert the large return spring.

4. Pre-assemble high pressure piston, check valve, check valve seat, check valve spring, and plug gasket, and end plug in position shown.
5. Using both hands compress check valve spring until base of the high pressure piston seats against gasket and gasket seats to end plug. Make certain to hold enough pressure on this assembly to keep high pressure piston base, end plug gasket, and end plug in good alignment.
6. While securely holding parts in alignment insert assembly and by constant downward pressure and through a slight rotating motion enter high pressure piston into its cylinder. When entering this piston use extreme caution to prevent damaging or folding back of high pressure cup.
7. While maintaining downward pressure with one hand, screw end plug in. Watch the end plug gasket carefully during this operation to insure against its misalignment which will make it difficult to start threads.

Tighten end plug very tightly. It is recommended that a heavy wrench be used and struck smartly several times to insure proper sealing of end plug gaskets.

#### BLEEDING BRAKE SYSTEM

Since the proper operation of the hydraulic system requires a "solid" column of fluid without air bubbles at all points in the pressure system it becomes necessary, under certain conditions, to "bleed" fluid from system in order to expel air bubbles which have become mixed with the fluid. The necessity of bleeding is indicated by a soft or spongy pedal.

The transmission and wheel cylinders must be bled. The transmission must be bled first. The bleeder screw is located on the control cover (left side of machine.) Loosen bleeder screw, Fig. 2, one full turn and depress brake pedal slowly, tighten screw and allow pedal to return to "off" position. Repeat this operation until fluid flows free of air bubbles from bleeder screw opening. Repeat procedure for wheel cylinders, bleeding the longest line first. After wheel cylinders have been bled, bleed transmission again.

Fluid withdrawn from system during "bleeding" operation should not be used again. Keep master cylinder filled with clean fluid during "bleeding" operation.



Fig. 2 Transmission Bleeder Screw



## WHEEL CYLINDERS

The wheel cylinder has two opposed pistons. Each piston transfers hydraulic pressure into equal mechanical force, expanding the brake shoes to which it is connected, into contact with the brake drum.

## WHEEL CYLINDER INSPECTION

After dismantling wheel cylinder, inspect for the following:

1. If mineral oil is present in the system, the rubber cups will be enlarged and very soft. These cannot be used and should be discarded.
2. Cylinder walls must be smooth and not pitted or scratched and be free from burrs. Remove light pits, scratches and burrs with a hone. If cylinder does not clean up with light honing, cylinder must be replaced.
3. Occasionally grease retainers become worn allowing grease from wheel bearings to leak through in the brake drum. When grease comes into contact with the end closures, they become soft and enlarged, preventing them from protecting the cylinder from foreign matter. If this occurs, replace defective parts.

NOTE: A brake adjustment should be made after a wheel cylinder is removed for reconditioning as previous adjustment is lost when shoes are moved out for wheel cylinder removal. Refer to brake adjustments. It will also be necessary to bleed brakes, by referring to that paragraph of this section, as air will have entered the system with the wheel cylinder removed.

## BRAKE PEDAL ADJUSTMENT

Refer to Fig. 3

Proper pedal adjustment is important, otherwise the compensating feature of the master cylinder cannot function. Fluid cannot return from the lines. Brakes will drag after several applications if master cylinder by-pass port is blocked.

It is imperative that master cylinder be against its stop and that pedal link rod be adjusted for clearances where it seats in master cylinder piston. There should be at least 1 to 1-1/2 inch free play or lash in pedal before pressure stroke starts.

## BRAKE SHOES

When linings require replacement, pedal travel increases and cannot be readily compensated for by adjustment. Remove old linings and reline the shoes.

## MINOR BRAKE SHOE ADJUSTMENTS

When brake lining becomes worn allowing the brake pedal too much travel, it is necessary to adjust brake lining in closer relation with brake drum. This adjustment changes the toe adjustment only. The anchor adjustments are not moved. Adjustment is made at the outside of the brake backing plate, Fig. 4.

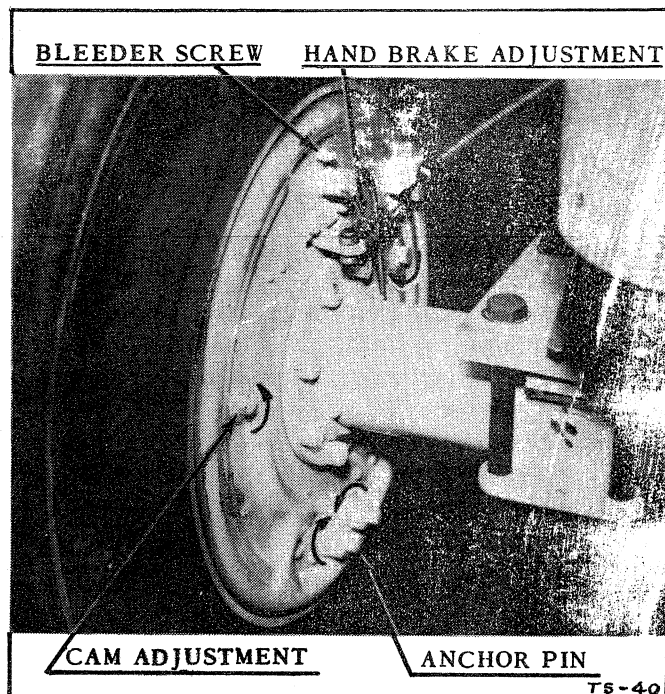
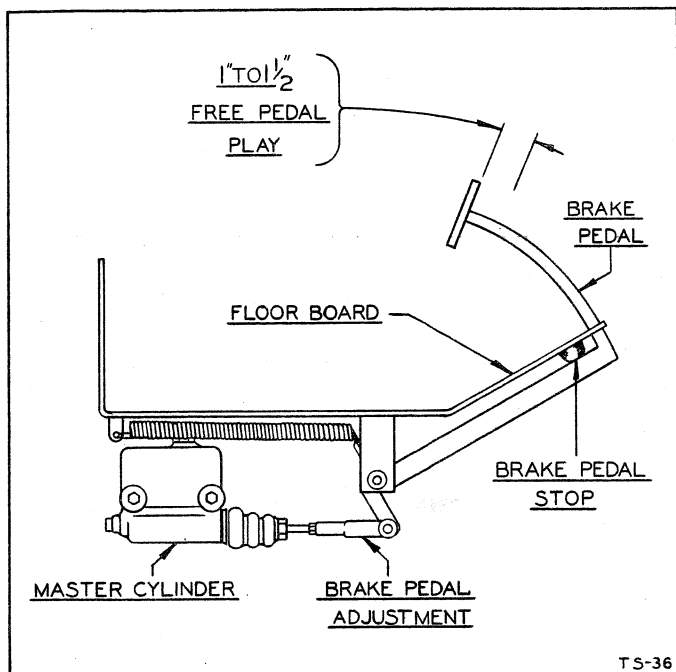


Fig. 3 Brake Pedal Adjustment

Fig. 4 Brake Adjustments

### MAJOR BRAKE ADJUSTMENTS

See Fig. 4

1. Raise wheels off the ground.
2. Rotate shoe adjusting cam in direction of arrow until lining drags on drum.
3. Rotate eccentric shoe anchor in direction of arrow until drag is relieved.
4. Repeat 2 & 3 in sequence until drag cannot be relieved.
5. Back off shoe adjusting cam and then anchor adjustment just enough to relieve drag. (Lining to drum clearance as indicated by feeler gauge should be .010 at toe of shoe and .005 at heel.)
6. Adjust other shoe in same manner.
7. Tighten anchor pin nuts to 150 foot pounds making sure no pin rotation occurs during tightening.
8. Complete the minor adjustment as outlined in preceeding paragraph. Check the operation of wheels and brakes to be sure brakes will set but that there is no bind when brakes are released.

If new linings have been installed, complete a major and minor adjustment at the time of installation. After machine has been operated for 50 hours, recheck brake adjustment.

SECTION 900  
AIR CLEANER

The purpose of the air cleaner is to prolong the life of the engine by preventing dirt and grit from being drawn into the engine through the carburetor and intake manifold. Entrance of such foreign material into the engine causes rapid wear of all internal working parts. The air cleaner itself must therefore be cleaned as often as dirt accumulations build up. The oil cup at bottom of cleaner must be cleaned and refilled daily, or oftener as required. Under some operating conditions, this unit may require cleaning several times each day.

To service, remove cup and wash out in clean kerosene or solvent. Refill cup with clean oil to height of oil level bead. Use same grade of oil as is used in engine crankcase.

It is very important that air cleaner hose and tubing be checked periodically for improper connections and leaks. Considerable quantities of foreign material can be drawn into the engine through minute openings or loose connections and offset completely any effort to maintain an efficient cleaner.

The air cleaner body should be removed periodically and cleaned thoroughly to remove any particles which may have become caught in the filtering element.



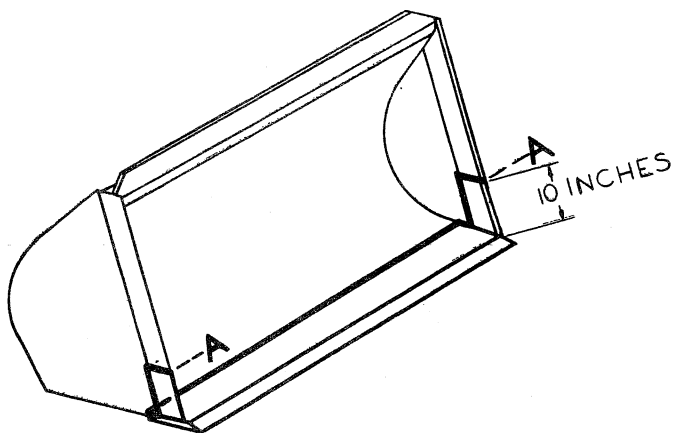
## SECTION 1200

## CUTTING EDGE REPLACEMENT ON BUCKET

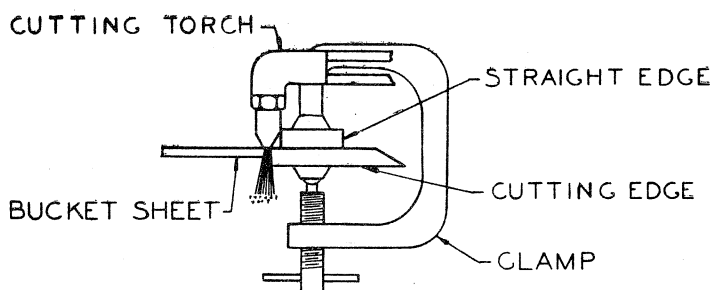
Cutting edge replacement kit will include one bottom cutting edge and two sections of side cutting edge; one for left hand one for right hand side.

To replace cutting edge of the bucket, follow the procedure outlined below:

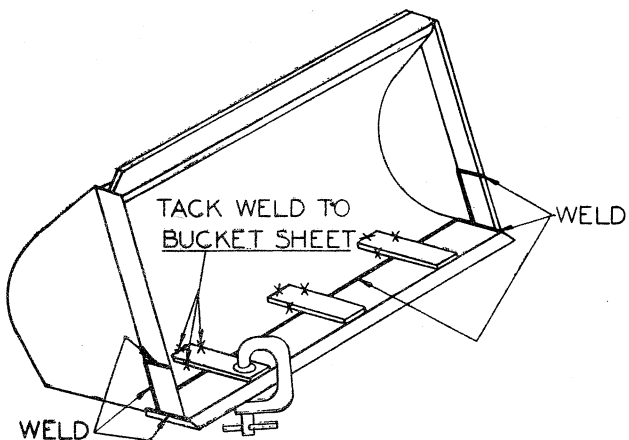
1. Lay a straight edge on the cutting edge so that back edge of same lines up with front edge of bucket sheet as illustrated in View B.
2. Guide the cutting torch along the straight edge to cut through the cutting edge and weld along line AA as shown in View A. Side cutting edge should be cut through at a point measuring 10 inches up on cutting edge. Measurement should be taken from point at which side cutting edge joins bottom cutting edge.
3. Grind to clean up rough edge left by cutting torch.
4. Place new cutting edge in position and align in position by clamping three flat plates to cutting edge as shown in View C. Tack weld plates to bucket sheet in three places as shown. Tack weld cutting edge to bucket sheet alternately on top and bottom. Weld cutting edge to bucket sheet, laying weld at points shown in View C and D. Use same procedure for aligning and welding side cutting edges. Grind all welds on inside of bucket to present smooth surface to entry of material into bucket. After aligning plates have been removed, grind off residue of tack welds on bucket sheet.
5. Use a 3/16" low hydrogen welding rod equivalent to AWS-E-10016.



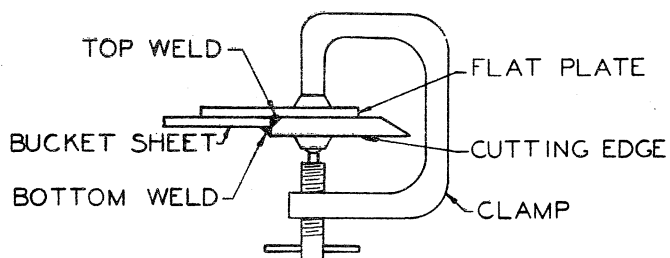
VIEW A



VIEW B



VIEW C



VIEW D



# OPERATORS MANUAL SUPPLEMENT

No. 1616

## Revision in Method of Checking Transmission Fluid Level

**55A-B Tractor Shovel**

**125A Tractor Shovel**

**75A-B-R Tractor Shovel**

**175A Tractor Shovel**

**85A Tractor Shovel**

**180 Tractor Dozer**

**Old Method:** Check transmission fluid level when fluid is hot (180° F. to 200° F.) *with engine shut down.*

**New Method:** Check transmission fluid level when fluid is hot (180° F. to 200° F.) *with engine idling (550-600 rpm).*



Existent Operators Manuals on above listed model machines presently specify checking transmission fluid level with engine shut down. Field experience has indicated that a more accurate and satisfactory check can be made with the engine idling, therefore, instructions printed in manual should be disregarded and the new method employed.

**NOTE:** Safety regulations may in certain operations or areas designate that engine must be shut down before a man is permitted to work underneath the machine. In these cases, the old method may continue to be employed except that fluid level must be checked within *one minute* after shutting down engine. This time limit is necessary to circumvent fluid draining from torque converter into transmission thus raising level in that unit and resulting in an inaccurate check.



**Use Operators Manuals Nos. 1169, 1171, 1198, 1199, 1339, 1388, 1396, 1512 and 1513 with this Supplement.**

**MICHIGAN**

**CLARK EQUIPMENT COMPANY • Construction Machinery Division • Benton Harbor, Michigan**  
**IN CANADA: Canadian Clark, Ltd., St. Thomas, Ontario**





Subject: Cold Weather Starting Procedure -  
Diesel Engines - All Models MICHIGAN Machines

MICHIGAN machines do not require extensive preparation for cold weather operation beyond addition of a permanent type antifreeze to the cooling system, and a change of engine oil to a viscosity suitable for anticipated temperatures in which the machine is to operate. At temperatures below 32°F. a change of oil in hydraulic system to Type "A" Automatic Transmission Fluid will aid starting by reduction of resistance in the main hydraulic pump. Probably the most important item to insure prompt starting is proper maintenance of the electrical system, especially the batteries.

Batteries must be kept fully charged at all times, since in cold weather the capacity of a battery to deliver full power is greatly reduced. A fully charged battery at 15°F. is capable of delivering only 70% of its rated amperage, and at lower temperatures becomes even more inefficient. Service batteries weekly as follows:

1. Add distilled water to cover plates and separators, but do not overfill. Overfilling causes dilution of the electrolyte, and sputtering during the charging cycle. This may result in battery freezing and corroded terminals.
2. Keep terminals clean and tight. Dirty or loose connections offer high resistance.
3. Keep vent plugs in place, and tight, to prevent entrance of foreign material into cells.
4. Check specific gravity regularly with a hydrometer, and recharge or replace batteries that continually show low reading.

Glow plug circuits used on Waukesha and Cummins Diesels also should be checked to be sure they are in proper working order.

1. Visually inspect wiring to make certain insulation is not frayed or cracked, and that terminals are clean and tight.
2. Remove glow plugs and inspect for cleanliness. Test glow plug heating by connecting to electrical source as follows:

Waukesha - 12B thru 125A	12 Volts
Waukesha - 175A, 180	24 Volts
Cummins - All Models	6 Volts

3. On Cummins Diesels only, remove and clean fuel nozzle, in intake manifold, and check that fuel connections are tight.

To avoid unnecessary cranking because of air locks in cold fuel oil, change fuel filters only when engine is hot; then start and run engine after filter change, and check that there is no fuel restriction nor leakage.

suitable capsules to facilitate handling. The fluid starting aid consists of cylindrical capsule dispenser and a sliding, piercing shaft with separate tubes leading from capsule dispenser to hand operated pump and from hand operated pump to atomizing nozzle in intake manifold.

1. Insert starting fluid (capsule form) in dispenser. Pull the piercing shaft all the way up and secure cap.
2. Turn ignition switch ON and push piercing shaft down to break capsule and fill dispenser with starting fluid.
3. Depress accelerator to full throttle position.
4. Press starter switch firmly and simultaneously pull pump plunger out. Push plunger in slowly to force starting fluid into air intake. Continue to operate pump, and when engine starts, lock plunger. Do not operate cranking motor for more than 20 seconds at a time to avoid overheating motor.

Caution: If engine fails to start, do not repress starter until cranking motor stops rotating. Serious damage to cranking motor may result if above procedure is not complied with.

5. Immediately after engine starts observe engine oil pressure gauge to make sure oil pressure is obtained in engine lubricating system.
6. Allow engine to warm up for a few minutes before driving or operating machine.

Note: Always remove empty capsule from dispenser, and push piercing shaft all the way down when not in use.

If difficulty is experienced in starting either Waukesha, Cummins or G. M. Diesel engines, please refer to respective Operation and Maintenance Manuals of engine manufacturer for further shooting procedures.

**OPERATORS MANUAL SUPPLEMENT****No. 1660**

**SUBJECT: LUBRICATION** — Rear Drive Steer Axle Universal Joint (Enclosed Type), Trunnion Bearings and Spindle Supports. Applicable to Models 55A, 75A, 85A, 125A, 175A and 180 Tractor Shovels and Dozer.

The above listed models employing the use of the enclosed type Axle Shaft and Universal Joint in the Rear Drive Steer Axle, as illustrated in Figure 1 (85A shown) are lubricated at original assembly with a Lithium Soap Grease, Light Oil Base, No. 1 Consistency.

**NOTE:** Existent Operators Manuals on certain of above listed models specify use of a Soda Soap, No. 1 Consistency, Heavy Oil Base Grease. This specification is hereby superseded by the Lithium Soap Grease specified above.

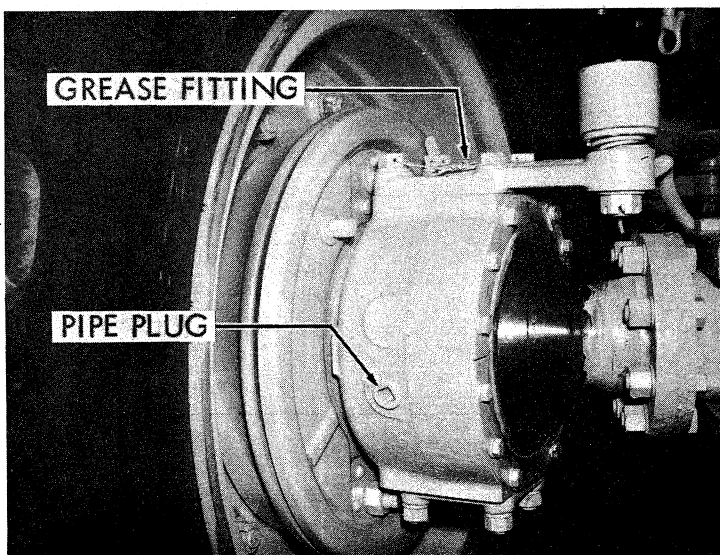


Figure 1

It is not normally necessary to relubricate the axle shaft U-joint and trunnion bearings, prior to axle overhaul, unless the oil and dust seal has shown indications of loss of lubricant. Lubricant loss by seepage may be compensated for every 500 operating hours by adding lubricant sparingly by use of a hand gun thru grease fitting in the upper bearing trunnion. On older units which do not provide a grease fitting, addition may be added through pipe plug opening in spindle support by use of appropriate fitting and hand gun. For replenishment purposes use the Lithium Soap Grease indicated above or use a good grade of general purpose chassis grease. Chassis grease is compatible with the original fill.

Whenever axle assembly is overhauled, however, the spindle support, trunnion bearings and axle shaft and universal joint should be packed with Lithium Soap Grease, Light Oil Base, No. 1 Consistency. **DO NOT** at any time attempt to lubricate these members with SAE 90 Extreme Pressure Gear Lubricant as is used in Differential and Carrier Assembly and Planetary Wheel Hubs.



This Supplement to be used with Operators Manuals No. 1169, 1171, 1198, 1199, 1388, 1396, 1512, 1513 and 1577.



# OPERATORS MANUAL SUPPLEMENT

No. 1751

## Revision of Lubrication Period for Propeller Shafts — All Models of MICHIGAN Tractor Shovels, Dozers and Scrapers

**Old Recommendation:** Lubrication every 500 operating hours  
Using Chassis Grease

**New Recommendation:** Lubrication every 100 operating hours  
Using Lithium Soap Multi-Purpose Grease



Existent Operators Manuals presently specify lubricating each propeller shaft assembly (3 fittings each assembly) with a hand grease gun every 500 operating hours using a good grade of general purpose chassis grease. Field experience has indicated that more frequent lubrication is required when severe and heavy duty service is encountered. Since the line of demarcation between normal and heavy duty service is difficult to define it is recommended that each propeller shaft be lubricated every 100 operating hours with a hand grease gun.

In addition, the recommendation for lubricant to be used is changed from Chassis Grease to a Lithium Soap Multi-Purpose Grease of grades specified below according to ambient temperature. The Lithium Soap Multi-Purpose Grease can also be used on all other grease fitting points of lubrication indicated on the lubrication chart.

### TEMPERATURE RANGE

0° F. and Above  
Below 0° F.

### GREASE CONSISTENCY

Heavy Oil Base — Grade 2  
Light Oil Base — Grade 0



### This Supplement applicable to following Operators Manuals:

1169	1201	1473	1486	1512	1577	1648
1171	1388	1474	1487	1513	1629	1649
1198	1396	1484	1488	1514	1644	1651
1199	1438	1485	1489	1547	1646	1706



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# **OPERATORS MANUAL SUPPLEMENT**

**No. 2546**

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**SUBJECT:** Revision in Lubricant Recommendations for Wheel Bearing Grease for Use in Wheel Bearings and Center Steer Arm Bearings on Non-Driving Type Axles.

**Models Affected:** 12B, 35B-I, 55B-I, 75B-I, 75R-I Tractor Shovels.  
110, 210, 310, 410 Tractor Scrapers (All Series)  
Both Conventional and Elevating Types.  
700 Backhoe/Loader.

**Old Recommendation:** Present Operators Manuals specify use of ordinary Wheel Bearing Grease or Lithium Base Multi Purpose Grease. This specification superseded by the following:

**New Recommendation:** Use an Extreme Pressure Wheel Bearing Grease, Grade 1, Lithium Soap or Lithium Lead Base Type, having a Load Carrying Capacity of 40 lbs. Minimum Lever Load by Timken Test.

★

**This Supplement applicable to the following Operator Manuals**

1201	1486	4002	1851	2464
1876	1473	2019	1514	4003
1396	4015	4005	2193	2496
1199	2301	2444	2432	2434

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**CLARK EQUIPMENT COMPANY**  
Construction Machinery Division





**MICHIGAN**

# **— OPERATORS MANUAL SUPPLEMENT —**

**No. 2584**

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**SUBJECT: Recommended Center Bolt Torque Values for Converter,  
Transmission and Steering System Filter Assemblies — Classi-  
fied by Make of Filter Assembly Used — Applicable to All  
Models of MICHIGAN Tractor Shovels, Dozers & Scrapers.**

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**This Supplement to be Used with following Operators Manuals**

1169	1489	1841	2028	2193	2450
1171	1514	1851	2064	2283	2454
1198	1577	1853	2068	2288	2464
1199	1706	1859	2081	2323	2475
1201	1728	1876	2097	2346	2515
1396	1770	1890	2098	2347	2533
1473	1795	1926	2115	2361	
1484	1797	1927	2138	2366	
1486	1813	2006	2139	2432	
1488	1840	2019	2178	2444	

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**CLARK EQUIPMENT COMPANY**  
**Construction Machinery Division**

Three different makes of filter assemblies have been used in the converter, transmission and steering hydraulic systems of the MICHIGAN line. These involve filter assemblies manufactured by Fram, A.C. Spark Plug Division of G.M.C. and Fleetguard Division of Cummins Engine Co. Since the manufacturer's recommended torque value for tightening of the center bolt varies with each make of filter, it is necessary to identify the make of filter in order to apply the proper torque value when periodically replacing the filter element in these filter assemblies.

Listed below is data on filter assembly features which will permit filter identification and center bolt torque values applicable to each make and type.

**FRAM:**

1. Small single element filter used on Series I Tractor Shovels and Dozers, Models 12B, 35, 45, 55, 75, 85, 125, 175, and 180 converter and transmission hydraulic systems and 35, 45 steering hydraulic systems.

Recommended center bolt torque .....25 ft. lbs.

2. Large single element filter used on 480I Dozer converter and transmission hydraulic systems S/N 43124 thru 43140, and 2SC1 thru 2SC8; and 310 Tractor Scraper steering hydraulic systems S/N 3VG101 thru 6VG999.

Recommended center bolt torque .....145  $\pm$  5 ft. lbs.

**A.C. Spark Plug Division of GMC:**

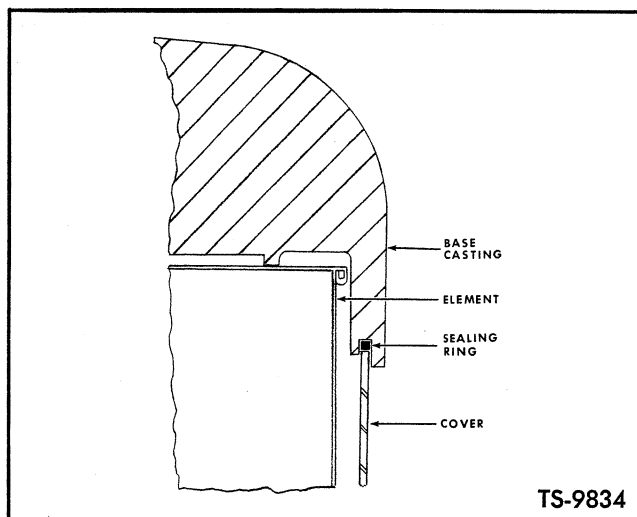
All single and dual element installations. A.C. filters may be identified by characteristics of the sealing area between base casting and cover as illustrated in Figure 1.

Recommended center bolt torque .....50  $\pm$  5 ft. lbs.

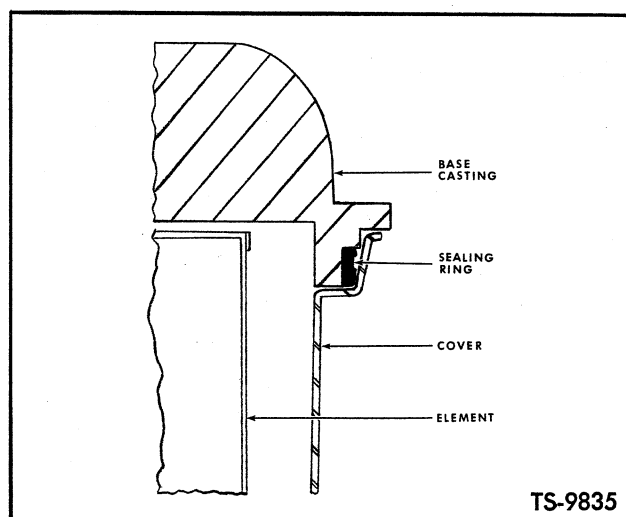
**FLEETGUARD Division of Cummins Engine Co.:**

All single element installations. Fleetguard filters may be identified by characteristics of the sealing area between case casting and cover as illustrated in Figure 2.

Recommended center bolt torque .....30  $\pm$  5 ft. lbs.



**Fig. 1. A.C. Spark Plug Div. Filters**



**Fig. 2. Fleetguard Div. Filters**

**MICHIGAN**

# **OPERATORS MANUAL SUPPLEMENT**

**No. 2938**



**SUBJECT: Revised Lubricant Recommendations for Transmission  
& Converter Hydraulic System and Main & Steering Hy-  
draulic System.**



**APPLICABLE TO: All Models of MICHIGAN Line of Tractor Shovels, Doz-  
ers & Scrapers.**



**NOTE: The revised lubricant recommendations outlined herein super-  
secede and replace all previous recommendations contained in operators  
manuals, lube charts, operators manual supplements and service bulle-  
tins.**



**Use this Supplement with applicable machine model Operators  
Manual.**



**CLARK EQUIPMENT COMPANY**

