MICHIGAN

MAINTENANCE MANUAL
(INTERMEDIATE)

4043

Michigan
Model 110-15
...S SCRAP...

...EQUIPMENT COMPANY

CLARK WARRANTY

CLARK warrants each new Construction Machinery Group product, including attachments and accessories thereto, sold by it to be merchantable and free from defects in material and workmanship.

CLARK will cause any part of a CLARK product covered by this warranty (except as excluded below) which proves to be defective in material or workmanship during six (6) months immediately following the delivery of said product to the person who first puts it into use, to be replaced without charge with a new or repaired part (whichever CLARK elects). CLARK also will cause the labor to remove any such defective part and to install the new or repaired part to be provided without charge to the owner of said CLARK product. The parts and labor to meet this warranty will be furnished by a CLARK distributor designated by CLARK.

CLARK also warrants each replacement part for the products covered by this warranty sold by it to be merchantable and free from defects in material and workmanship. CLARK will cause any such replacement part which proves to be defective during the first six (6) months following its installation in a CLARK product to be replaced, without charge, with a new or repaired part (whichever CLARK elects).

CLARK'S warranty *does not cover:* (i) the replacement of parts found to have been damaged by abuse, accident or a failure to maintain or use the CLARK product or part according to the instructions applicable to it, (ii) the labor to remove and reinstall a defective replacement part after the expiration of the warranty period applicable to the product in which such part is located, (iii) overtime labor premiums, (iv) transportation of the CLARK product to the distributor's service facility or transportation of the distributor's service men to the product's location, (v) the engine or the tires of any CLARK product, nor does it cover the carrier on any truck mounted hydraulic cranes. The warranty of the respective manufacturers of these components shall apply to said items unless said manufacturers make no warranty with respect to said items, in which event CLARK'S warranty shall apply.

The Buyer accepts this warranty and the limitations of liability and disclaimers set forth herein as part of the purchase of the CLARK product or part to which this warranty applies.

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED AND THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

Remedies available to any person claiming under this warranty are exclusive and expressly limited to obtaining the parts and the labor, where applicable, in accordance with terms of this warranty.

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CLARK disclaims all liability for loss, damage or expense attributable to a loss of use of the CLARK product, a loss or damage to property other than the CLARK product, a loss of profits or other commercial loss, or any special or consequential damages (except liability for consequential damages which by law may not be disclaimed).

The term CLARK means Clark Equipment Company or one of its [illegible] whichever last sold the product to which this warranty applies.

The term Construction Machinery Group products refers to ma[illegible]ing types: Tractor shovels (loaders), wheel dozers, scrapers, log skidders, log loaders, hydraulic cranes, cable [illegible]rs, and power shovels. (Not included are: lift trucks, straddle carriers, skid steer loaders, agricultural products [illegible] by CLARK'S Material Handling Group or the General Products Group)

Revised August 1978

MODEL - 110-15B -

S/N - 22HA 167

CLARK® EQUIPMENT

MAINTENANCE MANUAL

SECTION INDEX

FOR

MODEL

110.15

ELEVATING SCRAPER

For your convenience and to facilitate location of the major sections in this manual, the first page of each section is imprinted with a black square in a position corresponding to the section position as listed on this page. To use the rapid index, hold the bound edge of the manual with the left hand and spread unbound edge of pages with right thumb until square is located corresponding to index position of section desired. Then let pages escape under the right thumb until desired section is reached.

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GENERAL INFORMATION

ENGINE

Detroit Diesel, Two Cycle Diesel	6V-71T N70
Rated Horsepower at 2100 RPM	250
Maximum Torque at 1400 RPM	690 ft/lbs.
Number of Cylinders	6
Bore and Stroke	4-14 x 5 in.
Total Displacement	426 cu in
Lubrication	Pressure Feed
Flywheel Housing Size	SAE #1
Type of Governor	Limiting Speed
Full Load	2100 RPM
High Idle	2225
Low Idle	550-600

FILTERS

Lube Oil (Engine)	Full Flow Type	A.C.
	Bypass Type	A.C.
Fuel Oil		A.C.
Air-Engine		Dual Element, Donaldson

COOLING SYSTEM

Radiator	Cast Core, Flat Tube and Fin
Water Pump	Centrifugal Pump
Fan	32" Diameter, 8-Blade Belt Drive
Capacity	18 Gallon

TORQUE CONVERTER

Make	Clark CL-8602-18
Mounting	Engine Flywheel
Maximum Torque Multiplication	3.02:1
Wheel Diameter	16 in
Housing Size	SAE #1
Drive Ratio	Offset 1:1
Charging Pump Flow at 2100 Engine RPM	31 GPM

GENERAL INFORMATION

TRANSMISSION

Make	Clark 5921-1
Model	5921-1
Gearing	Straight Spur Type
Speed	9 Forward, 2 Reverse

DRIVE AXLE

Make and Model	Clark D-37500
Type	Full Floating
Reduction	22.393:1

DIFFERENTIAL

Make and Model	Clark D-37500
Type	Spiral Bevel Pinion and Ring Gear
Reduction	5.429:1

Bayou lane truck
Jerry

TIRES	Optional	Standard
Size	26.5x29-22 Ply	26.5x25-24 Ply
Rim Size	22 in	22 in

BRAKES

Number of Wheels	4
Type	18 in Disc
Actuation	Air over Hydraulic

STEERING SYSTEM

Steering Pump	Manual
Make	Ross
Steering Valve	Manual
Make	Ross
Steering Pump	
Make and Model	Commercial P50
Gear Width	1-3/4 in
Rated FLOW at 2100 RPM and 2000 PSI	42 GPM
Cylinders	
Make	Hancock
Type	Double Acting, Single Stage

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HYDRAULIC SYSTEM

Lift and Ejection System	
Pump	Commercial
Model	P50
Gear Width	1.5 in
Rated Flow at 2100 RPM and 2000 PSI	33.5 gpm
Control Valve	Cessna 30632
Pressure Relief Setting	2250 psi
Elevator Hydraulics	
Pump	Sundstrand
Model	23 Series PV
Rated Flow at 2100 RPM	49 GPM
Motor	Sundstrand 24 MF
Pressure Setting	5000 PSI
Filter	Gresen 10 Micron

ELEVATOR

Drive	
Make	Clark
Reduction Ratio	28.2:1
Sprockets	
Pitch Line Diameter	20.54 in
Number of Teeth	21
Chain	
Make	Rex Chainbelt
Number of Links	90
Pitch	3.110 in
Drags	
Number	18
Length	93.25 in
Width	6.10 in
Length of Elevator	116 in

WEIGHT

Empty	42,100 lbs
Rated Load	36,000 lbs
Gross	78,100 lbs.

WEIGHT DISTRIBUTION

Empty:	Front	69%
	Rear	31%
Loaded:	Front	52%
	Rear	48%

GENERAL DIMENSIONS

Overall Length	408 in
Overall Width	114 in
Overall Height	123 in.
Wheelbase	252 in.
Track Width	82 in.
Maximum Depth of Cut	6.5 in.
Ground Clearance	18 in
Width Required for 180° Turn	31 ft. 8 in.

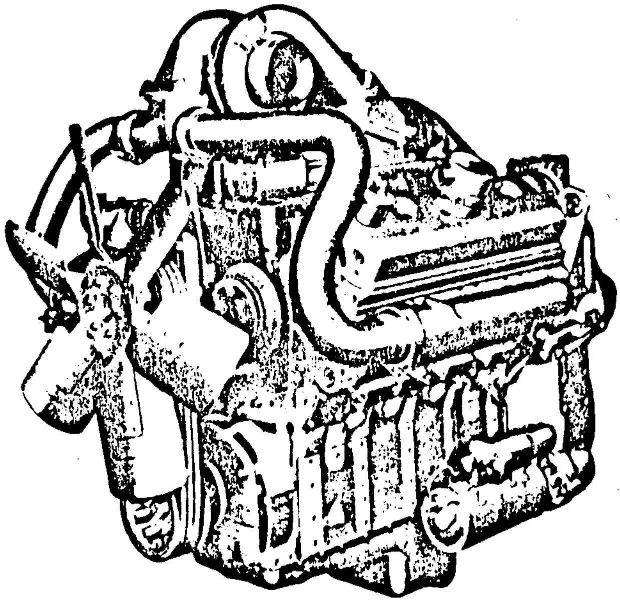
CAPACITIES

Heaped Load	15 cu. yds.
Rated Load	36,000 lbs.

CLARK EQUIPMENT

ENGINE

DETROIT DIESEL SERIES 6V-71T



TYPICAL 6V-71T ENGINE

DESCRIPTION

These units are powered by a GM Diesel Model 6V-71T engine. The engine is of the two-cycle type. In the two-cycle engine, intake and exhaust take place during part of the compression strokes. A blower is provided to force air into the cylinders for expelling the exhaust gasses and to supply the cylinders with fresh air for combustion.

The engine is of the valve-in-head type, with the crankshaft inherently in static and dynamic balance due to the arrangement of the crankshaft throws. There are replaceable liners for ease of maintenance on cylinders. There are also hand hole cover plates in the block to facilitate inspection of the liner ports and cylinders.

Refer to the Detroit Diesel V-71 Engines Maintenance Manual for detailed operating and overhaul procedures.

PREPARATION FOR REMOVAL

CAUTION: Before removing any engine components, disconnect the battery cable from the battery or from the starter motor to prevent damage or serious accidents.

1. Disconnect the hood, grill, and cowling and remove them from the unit.
2. Disconnect the exhaust muffler and pipes at the engine and remove them.
3. Remove the air restriction gauge line.
4. Remove the air cleaner piping and manifold from the unit.
5. Remove the air cleaner from the unit.
6. Drain the crankcase and cooling system.
7. Disconnect and remove the radiator water and oil, inlet and outlet hoses. Remove radiator mounting bolts and with suitable hoist equipment lift the radiator from the unit.
8. Disconnect all air, hydraulic, lube and fuel lines necessary for the removal of the engine. Plug the removed lines to prevent entrance of foreign matter.

9. Disconnect and tag all electrical leads from the starter motor, generator and voltage regulator.

10. Disconnect all instrument and gauge lines, throttle linkage and shut-down cable from engine.

11. Disconnect the torque converter from the engine.

REMOVAL

1. Support the engine with suitable lifting device using the lifting eyes provided on the engine for that purpose.

2. Remove the nuts, bolts, lockwashers, etc. fastening the engine to the mounts on the tractor main frame.

3. Carefully lift the engine out of the frame and mount it on a suitable work stand for further disassembly.

4. Refer to the Detroit Diesel V-71 Engines and Turbocharger Maintenance Manual for further disassembly and assembly procedures for the engine.

INSTALLATION

1. Attach a suitable lifting device to the lifting eyes on the engine.

2. With the rear mounts properly in position on the engine, carefully position the engine on the main frame.

3. Install rear and front mount bolts, washers, and nuts.

4. Install the torque converter on the engine. See Torque Converter Section.

5. Connect all instrument and gauge lines, throttle linkage and shut-down cable to engine.

6. Connect all electrical leads to the starter motor, generator and voltage regulator.

CAUTION: Improper connections or crossed wires can cause severe damage to the electrical system and its components.

7. Using a suitable lifting device, position the radiator on the radiator mounts on the frame and secure it with fasteners removed on disassembly.

8. Attach a suitable lifting device to the radiator and position it on the tractor frame. Secure with mounting bolts.

9. Connect all air, hydraulic, lube and fuel lines which were removed from the engine. Connect radiator inlet and outlet hoses.

10. Using suitable lifting device, position the air cleaner on the unit and secure with fasteners removed on disassembly.

11. Install the air cleaner piping and manifold and the air restriction gauge line.

12. Install the exhaust stack, the hood, cowling, and grill.

13. Fill the crankcase and cooling system. Refer to the Lubrication Chart for recommended oil, coolant and capacities.

14. Tighten the fan and generator belts.

15. Reconnect battery cables.

16. Refer to the Detroit Diesel Maintenance Manual for instructions on starting a new or newly rebuilt engine for the first time.

17. During the run-in period, check for leaks in the air, converter cooling, fuel, hydraulic, lube and air cleaner lines and fittings. Also check gauges for proper operation.

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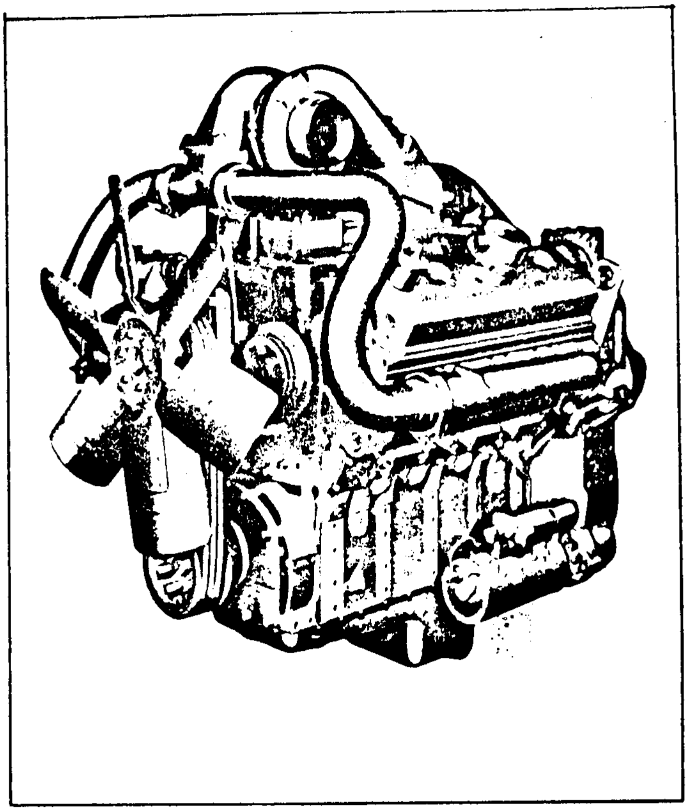
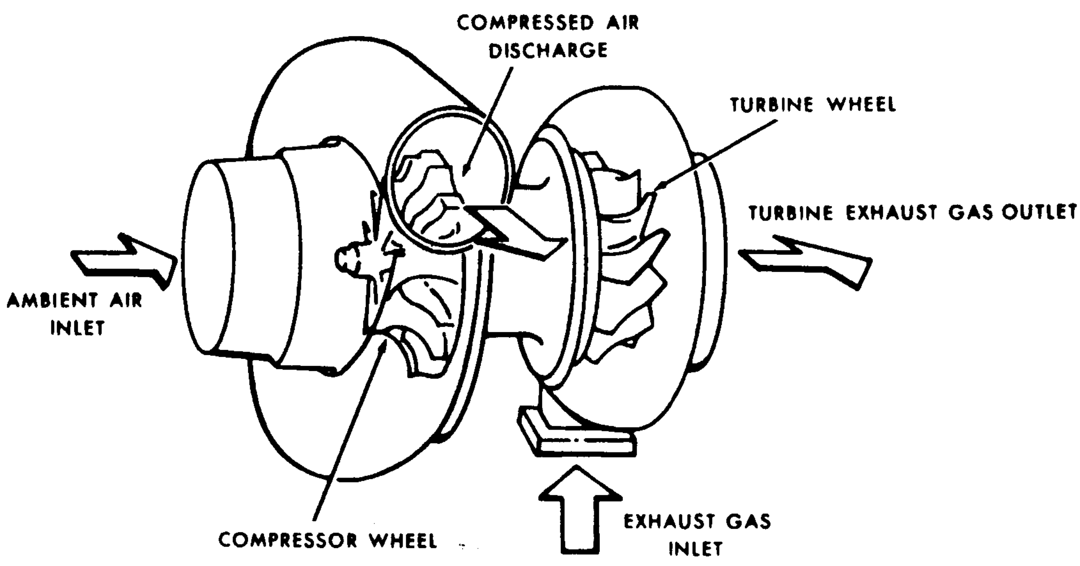


TYPICAL 6V-71T ENGINE

Turbochargers will run trouble-free when properly maintained. When a unit fails unexpectedly, the cause is often neglect of basic service needs.

The turbocharger consists of a turbine housing, a compressor housing and a center housing and rotating assembly. The view below illustrates these components and the direction of exhaust gas and air flows.



Engine exhaust gasses expand through the turbine housing to the atmosphere causing the turbine wheel and shaft to rotate. The compressor wheel mounted on the opposite end of the shaft rotates at turbine speed. The compressor wheel draws air into the compressor housing, compresses it and delivers it to the engine blower. The turbocharger responds to engine demands by reacting to the flow of exhaust gasses. Thus as the power output of the engine increases, the flow of exhaust gasses increases causing an increase in the speed of the rotating components.

The rotating assembly is supported in the center housing on two floating bearings. In addition to the bearings are thrust surfaces which absorb the thrust loads as the rotating assembly changes position during engine operation. This hardware requires adequate lubrication to assure long component life.

TURBOCHARGER LUBRICATION

Oil at engine oil pressure level is supplied to the turbocharger through a line extending from the cylinder block to the top of the center housing. The illustration below reveals the flow of oil inside the housing.

Upon entering the center housing, the oil flows through drilled passages in the housing to the shaft bearings and thrust surfaces. After passing the pressure points, the oil drains into the lower chamber of the housing and returns by gravity to the engine through a line connected to the bottom of the housing. Return is usually to the engine oil pan, but in a few installations, it is to the valve rocker cover.

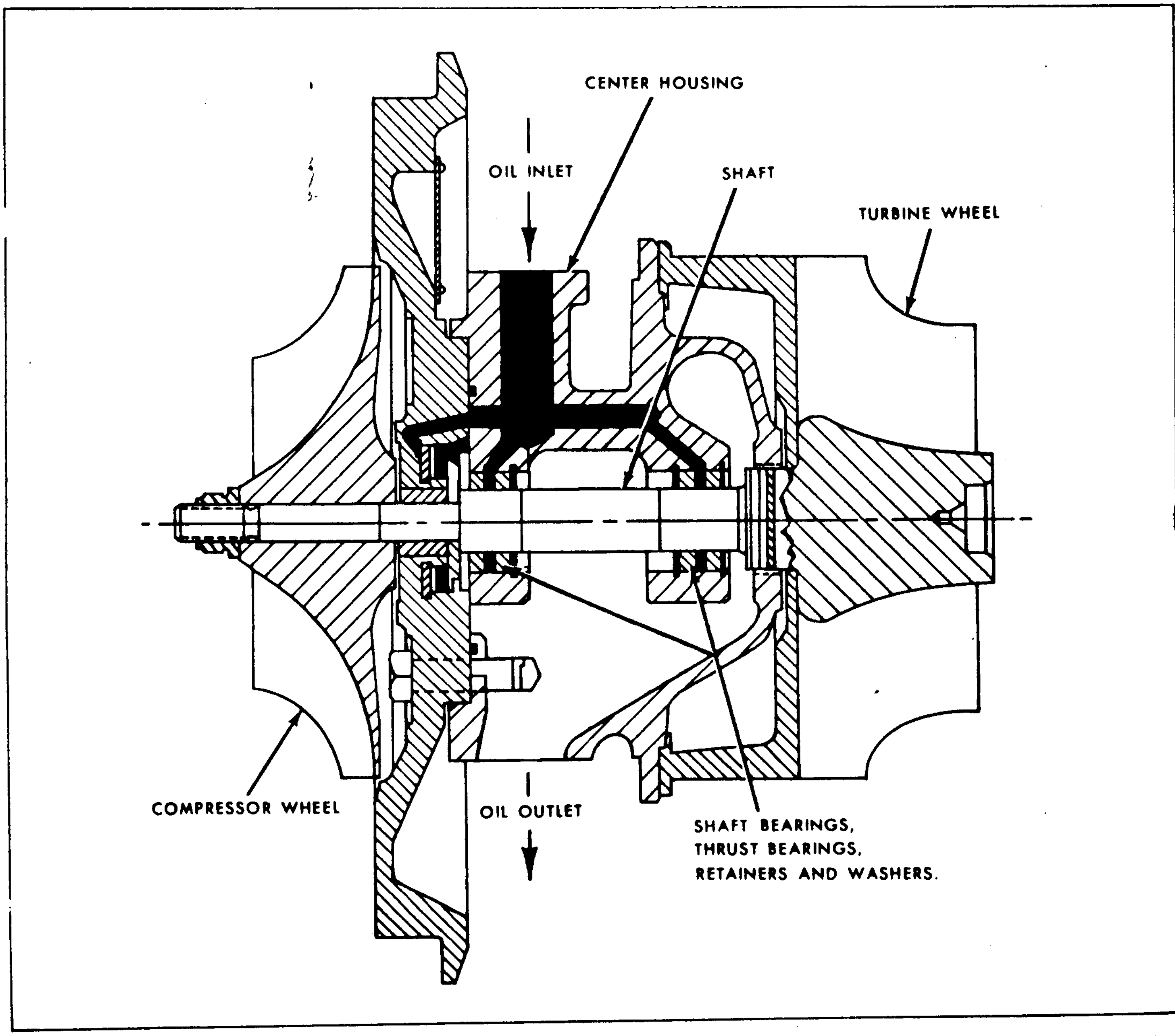
Inspect the oil inlet and return lines frequently to make certain that all connections are tight and the lines are not dented or looped restricting oil flow to or from the center housing. Looping the oil return line disrupts gravity flow to the engine.

Operating Cautions:

After starting a turbocharged engine, allow it to idle for a short period to provide adequate lubrication to the shaft bearings and thrust surfaces before loading the engine.

Units that are new, that have not been operated recently, or that have been drained of oil for service work require prelubrication of the bearings and thrust surfaces before the engine is started. The following procedure is recommended:

1. Thoroughly clean the area around the turbocharger oil inlet line.
2. Remove the oil inlet line from the top of the center housing.
3. Pour approximately four ounces of lubricating oil in the inlet opening of the center housing. Turn the rotating assembly by hand to coat the bearings and thrust surfaces with oil.



4. Connect the oil inlet to the top of the center housing.

OPERATING CONDITIONS

Inadequate air filtering and excessive restrictions to air and exhaust flows are conditions that will adversely affect turbocharger life and performance. Proper air cleaner servicing—and repair when needed—and a leak tight system will greatly assure clean air for the turbocharger. Guard against unnecessary restrictions on air and exhaust flows. Do not allow restriction levels to exceed the limits specified in Detroit Diesel engine service manuals.

Daily Checks:

1. Inspect turbocharger mountings, air and exhaust ducts and connections for leaks. Make this inspection with the engine running and with it shut down.
2. Inspect the engine crankcase breathers for restriction to normal discharge.
3. Check for signs of oil leaking from the turbocharger housings.

If any of the above conditions are noted, refrain from operating the engine until corrective action has been taken.

Compressor Housing Checks:

Remove the inlet duct to the turbocharger periodically and check for dirt and dust buildup on the impeller or in the housing. Excessive accumulations indicate either a leak in the ducting or a faulty air filtering system. Check also for signs of contact between the impeller and the housing.

Lubricant applied under pressure to the center housing while the shaft is not turning may allow oil to enter the turbine and compressor housing. However after the turbocharger has been operated for a time under load conditions and with inlet restriction at normal, lube oil in these sections should disappear. If the oil does not disappear, refer to Chart I of the Trouble Shooting Charts to determine the cause of leakage.

Evidence of oil in inlet or outlet ducts or dripping from either housing indicates a seal problem that will require a major disassembly of the turbocharger. This type of problem is described in Chart 2 of the Trouble Shooting Charts. Determine and correct the cause before operating the engine.

SIGNS OF IMPENDING TROUBLE

Take note of unusual turbocharger noises that are heard while the engine is operating at rated output. A bearing that is failing will produce a shrill whine (over and above normal turbine whine.) Unusual noises may result if there is improper clearance between the turbine wheel and its housing. If such noises are detected, turbocharger failure is imminent. The turbocharger must be removed from the engine, disassembled and inspected in accordance with instructions given in Detroit Diesel engine service manuals.

Also note unusual turbocharger vibrations that occur while the engine is under load. The cause of the vibration should be determined and corrected if failure is to be avoided.

Excessive exhaust smoke can mean an improper air and fuel mixture in the cylinders and could be a result of engine over-loading or a turbocharger malfunction.

Clearances:

For proper operation, the turbocharger's rotating assembly should turn free. Whenever the exhaust ducting is removed, spin the turbine wheel by hand. If it does not spin freely, refer to Chart 3 of the Trouble Shooting Charts to determine the cause of turbine wheel drag.

TROUBLE SHOOTING CHARTS

CHART 1

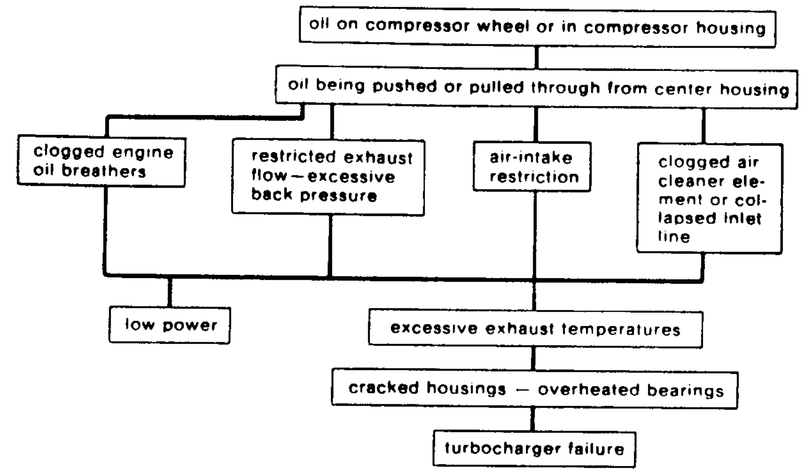


CHART 2

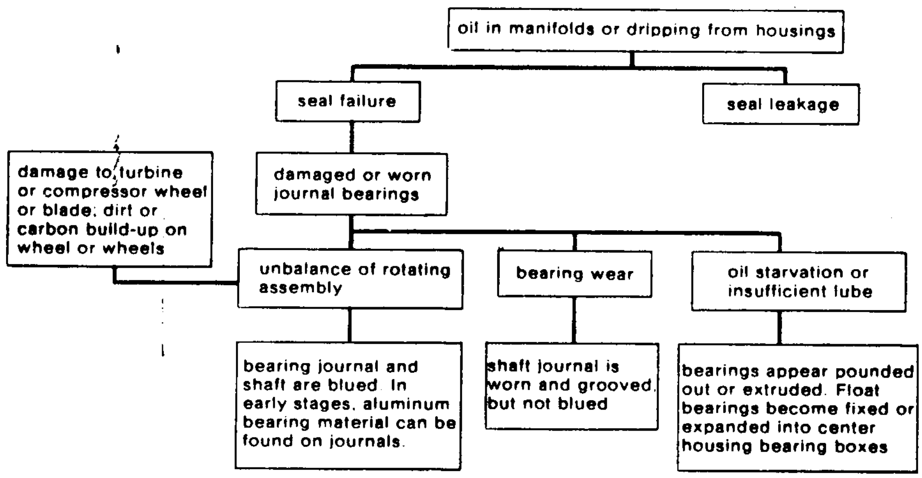
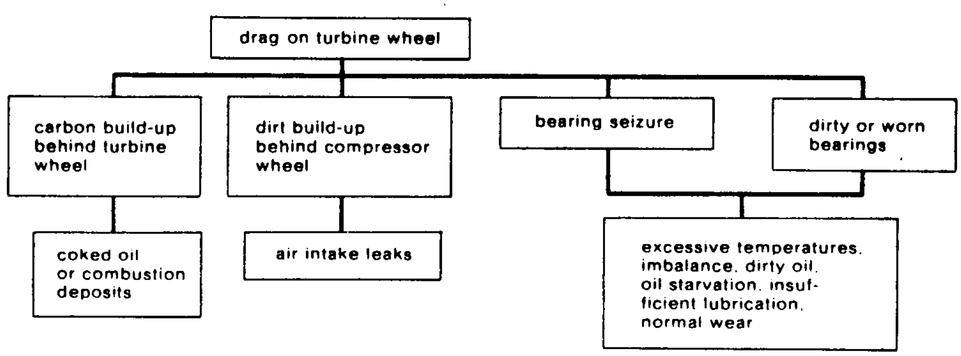


CHART 3



ENGINE AIR CLEANER

Product Description

GENERAL DESCRIPTION

The STG DONACLONE air cleaner is a heavy duty two-stage unit designed to provide extended service life, high reliability and ease of maintenance. It is intended for use on engines that operate in severe dust concentrations. Typical applications include earthmoving, mining, construction and other large off-highway equipment.

The STG incorporates refinements in basic DONACLONE air cleaner design and performance. It has exclusive features permitted by its "T" shape. The increased element area of the STG almost doubles the engine operating period between element servicings. The horizontal element chamber permits several distinct advantages including: reduction of the number of critical seals; lateral element removal which eliminates the need for overhead clearance; clean air outlet positioned to allow short, direct ducting to the engine; heavy gauge steel housing to protect main element; and the added protection of a safety element. The STG comes in several sizes and models that cover the airflow range of 400 to 1300 cfm. Maintainability, reliability and serviceability have been emphasized throughout the design.

STG OPERATION

The first of two cleaning stages in the STG is a cluster of DONACLONE tubes. These pre-cleaner tubes combine inertial and centrifugal forces to remove most of the contaminants from the air. The contaminants are deposited in the dust cup and the pre-cleaned air flows up through the center of the DONACLONE tubes and into the element chamber. Air then flows through the DURALIFE main element which removes virtually all of the remaining contaminants. The DURALIFE safety element, inside the main element, provides continuous air cleaning if the main element is damaged and while it is being serviced.

DURALIFE FILTER MEDIUM

The DURALIFE filter medium is chemically treated and cured to combine structural rigidity with resistance to oil and

The STG DONACLONE air cleaner provides dependable protection for engines operating in severe dust concentrations.

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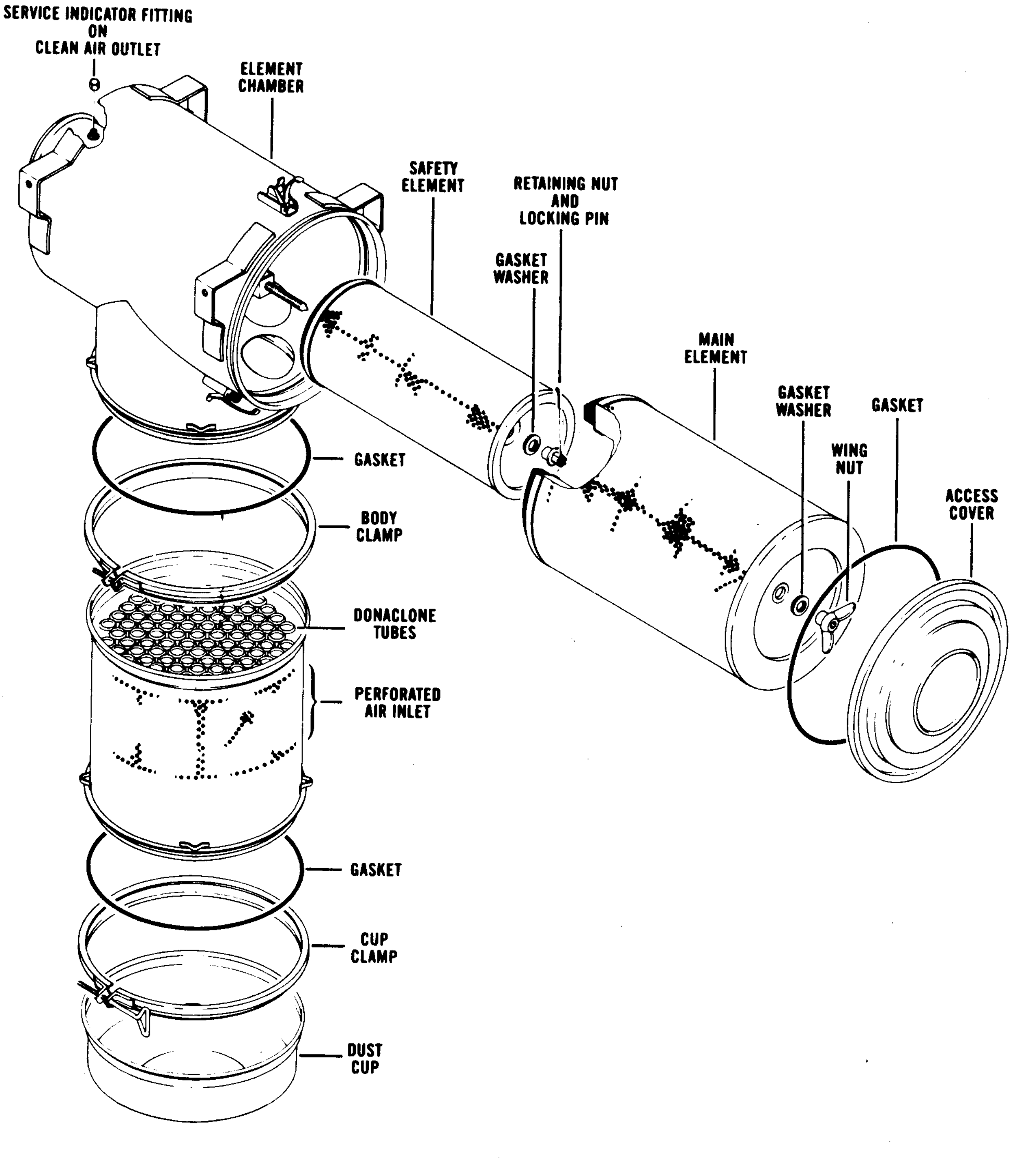
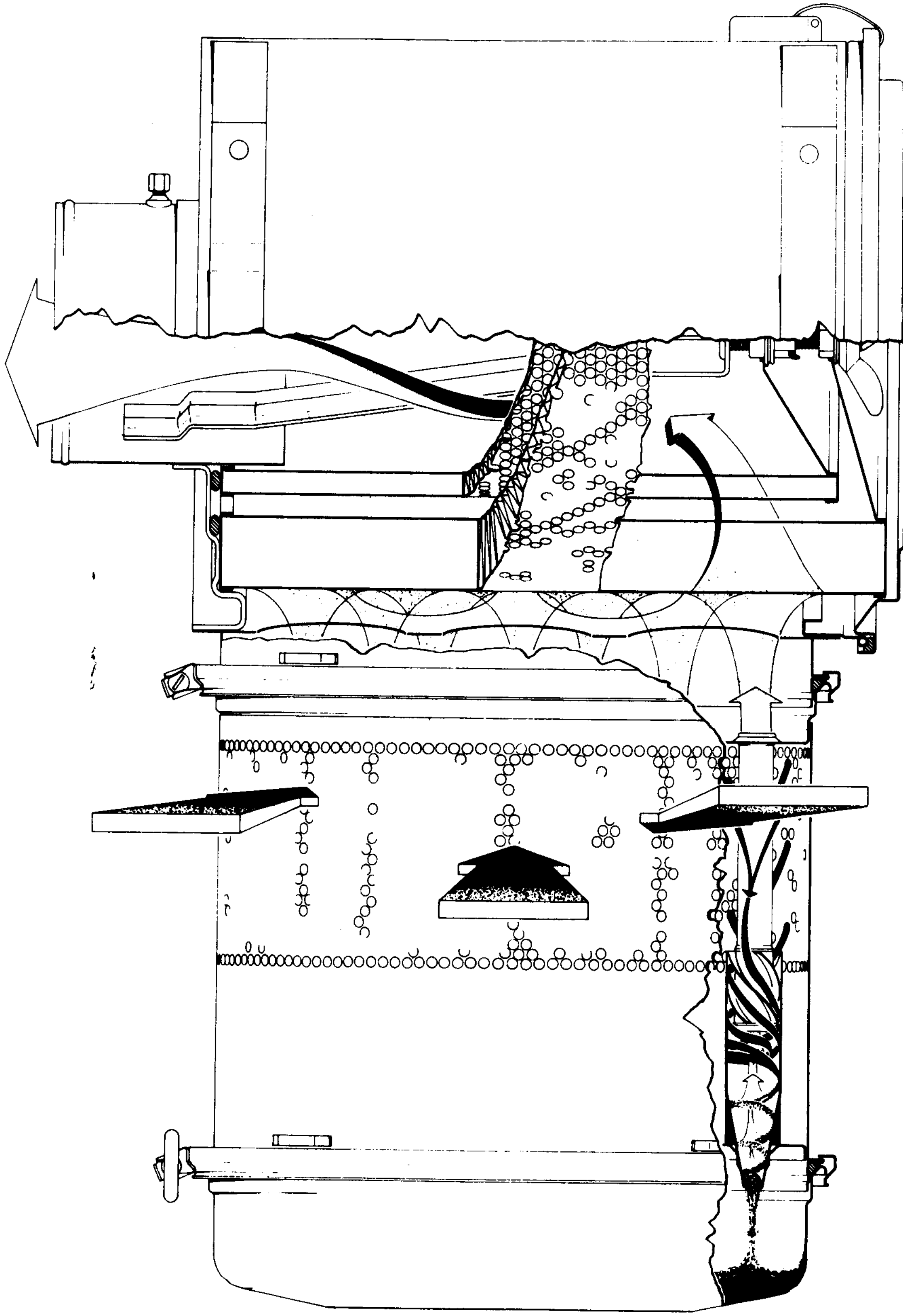


Basic parts of the STG DONACLONE air cleaner show exclusive "T" shaped design.



Functional diagram of the STG shows construction features that provide extended service life, high reliability and ease of maintenance.

water. Porosity of the medium is closely controlled to remove particles down to the desired micron size range. The medium is pleated to enable installing an extended area of filter into a compact space. The pleats are corrugated to keep them apart, and to allow high airflow, high dust capacity and low pressure drop.

High dust capacity, high efficiency and low pressure drop are standard features of DURA-LIFE element for STG air cleaner.

ACCESS COVER

In the STG design, the access cover closes one end of the element chamber and provides peripheral support to one end of the main element. In addition it is the only part that need be removed for element servicing.

CLEAN AIR OUTLET

The clean air outlet tube has a beaded outer end to facilitate a reliable seal of air transfer ducting. The tube also has a fitting for mounting a Donaldson Service Indicator. This fitting has a built-in safety filter that prevents accidental dust entry through the fitting.

Service Instructions

GOOD SERVICING A MUST

The STG air cleaner must be properly serviced to ensure a reliable source of clean air. An organized STG service procedure, made a part of the regular preventive maintenance program, will lower overall costs and ensure effective filtration at all times.

Stop the engine before servicing the air cleaner.

WHEN AND HOW TO SERVICE

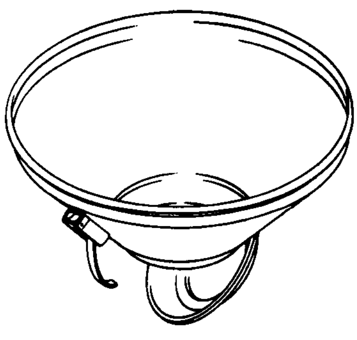
Dust Cup (Standard and Quick-Release)

Empty the dust cup when the dust builds up to within one and one-quarter inches from the top of the cup. Remove and inspect the dust cup daily until a regular service interval can be established.

When replacing the standard or entire quick-release dust cup, be sure a seal is made between the cup and the body to maintain high pre-cleaner efficiency. Replace the gasket if it is not smooth and clean.

This is a dry type air cleaner – do not use oil.

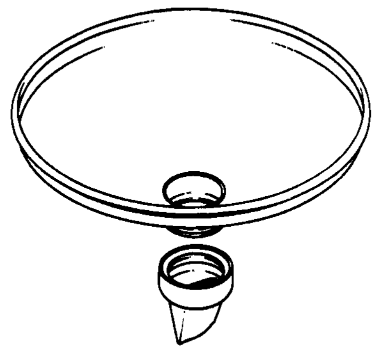
After a regular service interval has been established for the quick-release dust cup, it is serviced by releasing the over-center latch on the service door. This allows the cup to be emptied without removing the entire cup. Before relatching the service door, check its gasket. It too must make a seal to prevent loss of pre-cleaner efficiency.



Quick-release dust cup.

Dust Cup (Vacuator Valve)

The Vacuator Valve eliminates the need for frequent dust cup servicing. However, it should be inspected at regular intervals such as engine oil change or refueling. To function, the Vacuator Valve lips must point down and be kept free of debris. They should be closed except when the engine is idling slowly or stopped. If the Vacuator Valve is lost or damaged, replace it to maintain pre-cleaner efficiency and normal element service life.



Vacuator Valve dust cup.

Main Element

Measuring the restriction of an STG air cleaner is the only sure way to tell whether the main element needs to be serviced. Visual inspection of the element is deceiving. Also, a smoky engine exhaust is not a reliable way to tell when the element needs servicing. Restriction can be measured with a water manometer, a vacuum gauge or with a permanently installed Donaldson Service Indicator. Restriction is measured at maximum engine airflow. Maximum airflow occurs at high idle for naturally aspirated or mechanically supercharged diesel engines. Maximum airflow for carbureted and turbocharged engines occurs at full engine speed and full load. Replace or clean the element when the restriction has reached the level recommended by the engine or equipment manufacturer. After measuring restriction, be sure to replace the restriction tap plug securely.

If the restriction is higher than the recommended maximum inches of water (Service Indicator shows locked red signal), clean the element by one of three methods: (1) washing in a solution of water and Donaldson D-1400 filter cleaning compound, (2) blowing with compressed air, or (3) washing with water alone. D-1400 is a detergent with a carbon-dissolving additive. D-1400 and water are best when the element is loaded with a combination of exhaust carbon, soot, oil and dust. Compressed air is effective when the element is loaded with dust. Washing with water alone will often work when air is not available and the element has only dust on it. Whichever method of cleaning is used, the element should be handled carefully to keep it from being punctured or dented. **Do not attempt to clean the element by beating or rapping it.** The main element, protected by a steel shell, is strong enough to take normal handling, but it will not stand an unlimited amount of abuse. **Do not use gasoline or other volatile solvents to clean elements.** The element or the engine could be damaged.

I. Removal and Inspection

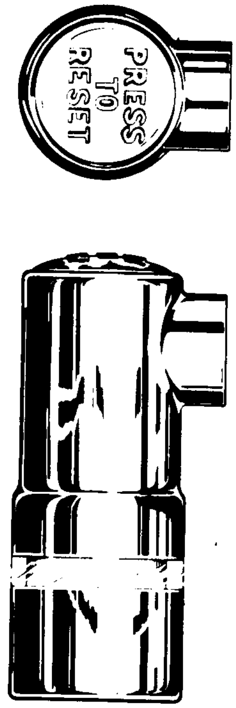
Stop the engine before removing the element. Clean dust off the access cover and unlatch it. Remove the access cover and the main element. **Do not remove the safety element.**

After the main element has been removed, immediately inspect it for dust streaks on the inside. Any dust streak indicates that the element has been damaged.

Also check the main element gasket. It must be smooth and flat. If the element or its gasket is damaged to the extent that dust might bypass or penetrate either of them, the element should be discarded at once and a new element installed in its place.

Service Indicator

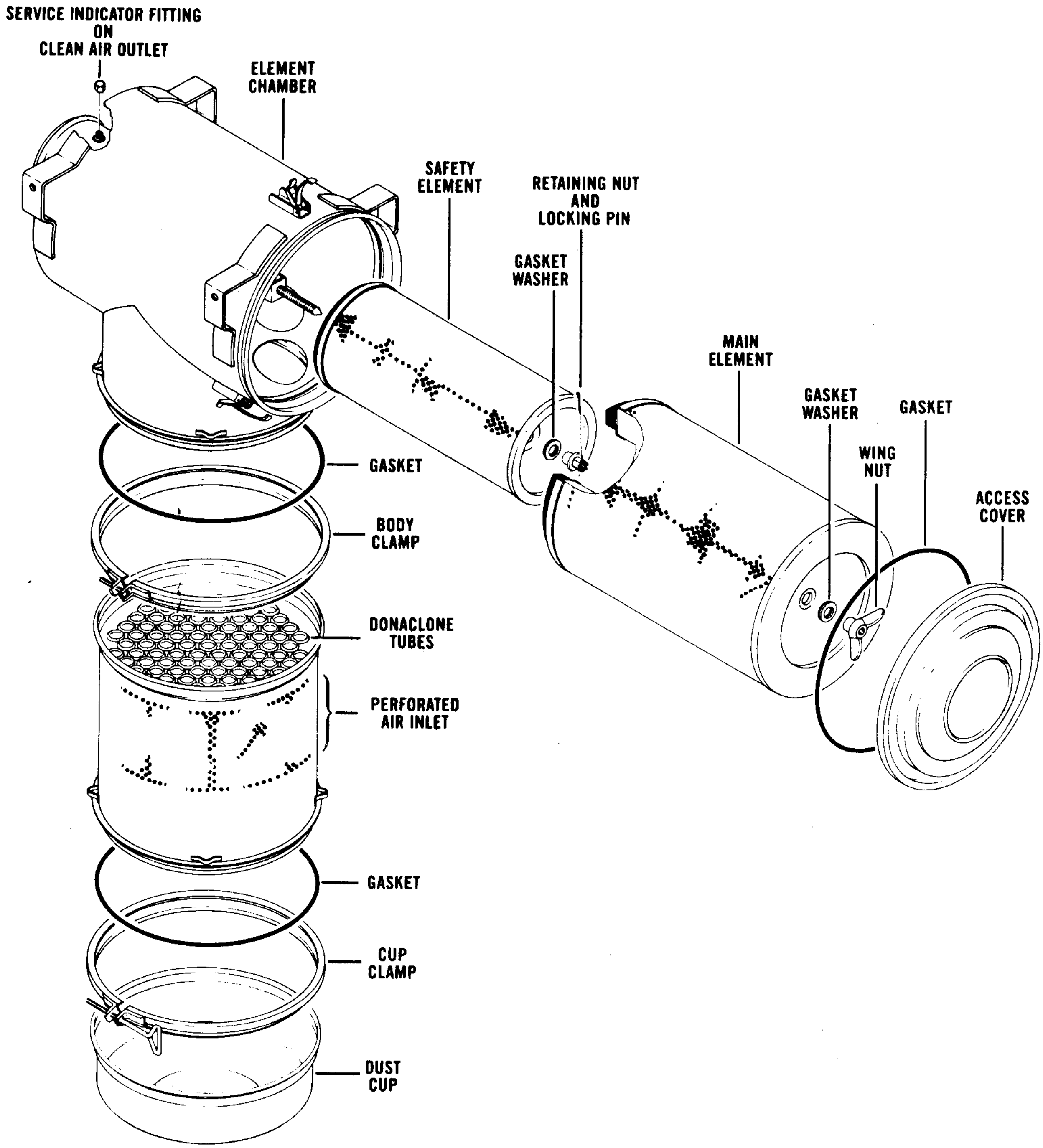
The Donaldson Service Indicator is an air cleaner service gauge that shows a red signal when the main element should be serviced. The resettable red signal locks in view when a pre-set restriction level is reached. Although the red signal locked in view does not mean the engine must be stopped immediately, the air cleaner element should be serviced as soon as possible to prevent possible engine damage. The Service Indicator eliminates guess work and prevents servicing the main element too often and not often enough.



Service Indicator eliminates guess work in element servicing.

AIR CLEANER MAXIMUM RESTRICTION CHART

TYPE ENGINE	MAXIMUM RESTRICTION	ENGINE CHECKING SPEED	LOCATION OF CHECK POINT
Turbo	20"	2100 RPM - Full Load	At Air Cleaner
Charged	20"	2100 RPM - Full Load	At Turbocharger



Exploded view of STG shows parts to inspect and service.

Cleaning Instructions

Donaldson D-1400 and Water

1. If compressed air is available, remove the loose dust by blowing from the inside of the element. Use less than 100 psi, keep the nozzle at least one inch away from the element, and blow on the inside only. If compressed air is not available, run water through the element from the inside. Use a gentle water stream (less than 40 psi).

Blowing out dust with compressed air.

Removing dust with water hose.

2. Soak the element in a solution of water and D-1400 filter cleaning compound. Follow instructions on the package of D-1400.

Washing in water and D-1400.

3. Gently swish the element around in the solution to help loosen the dirt.
4. With a gentle stream of water (less than 40 psi), rinse the entire element until the water comes through the element clear. Good rinsing is important.

Rinsing after washing.

5. Dry the element thoroughly before inspecting it. Mechanical dryers can be used, but heated air must be circulated and must be less than 160°F. Do not use a light bulb to dry the element.

B. Cleaning With Air Only

1. Direct a jet of compressed air against the inside of the element. To prevent

damage to the filter medium, use less than 100 psi, and keep the nozzle at least one inch away from the medium.
2. Move the nozzle up and down each pleat, continuing until no more dust is being removed. Do not blow air against the outside of the element because this will merely force the dirt farther into the pleats.

Cleaning with compressed air.

C. Cleaning With Water Only

1. Run water through the element from the inside only. Use a gentle stream of water (less than 40 psi).

Cleaning with water hose.

2. Run water through the element until the water comes through clear.
3. Dry the element thoroughly before inspecting it. Mechanical dryers can be used, but heated air must be circulated and must be less than 160°F.

III. Inspection Before Installation

A. After cleaning and drying the element, inspect it for damaged gasket, ruptured filter medium and dust on the inside of the element. If the gasket's condition is such that a good air seal cannot be guaranteed, or if the filter medium is ruptured, discard the element and replace it with a new one of the same model. Proper sealing of the element gasket is very important.
B. A good method to detect filter medium ruptures is to place a bright light inside the element. Inspection of the element from the outside will then disclose, by a bright spot of light, any holes or ruptures. Any hole in the element will allow dust to pass the main element.

Inspecting element with bright light.

IV. Installation of New or Cleaned Element

A. Inspect the gasket sealing surface inside the air cleaner. It must be smooth, flat and clean.
B. Inspect the gasket washer on the wing nut. Replace it if a good air seal cannot be guaranteed.
C. Install the main element and tighten wing nut and gasket washer securely.
D. Inspect access cover gasket and replace if necessary.
E. Install access cover and fasten with the over-center latches.

Safety Element

The function of the safety element is to increase overall reliability and engine protection. In order to obtain maximum engine protection, the safety element should not be cleaned. If the safety element becomes plugged, it should be discarded and replaced with a new one.

Although it is possible to clean the safety element using the procedures described for the main element, it is not recommended except in an emergency situation. Maximum engine protection is achieved by replacing the plugged safety element with a new element.

Replace the safety element when the present restriction (measured with a new or cleaned main element) is one third of the way from initial to maximum allowable restriction. For example: a specific air cleaner may have an initial restriction of 12 inches (with new main and safety elements) and a maximum allowable restriction of 30 inches of water. If the restriction is now 18 inches or more (with a new or cleaned main element), the safety element should be replaced.

To remove and replace the safety element:

1. Remove the element access cover.
2. Loosen wing nut and remove main element.
3. Remove locking pin from nut, and remove nut that secures the safety element.
4. Remove safety element and clean out any dust dislodged into the cleaner outlet.
5. Install new safety element.
6. Inspect gasket washer on nut and replace if a good air seal cannot be guaranteed.
7. Tighten nut securely and replace locking pin.
8. Install main element and tighten wing nut securely.
9. Install access cover.

Pre-Cleaner Section

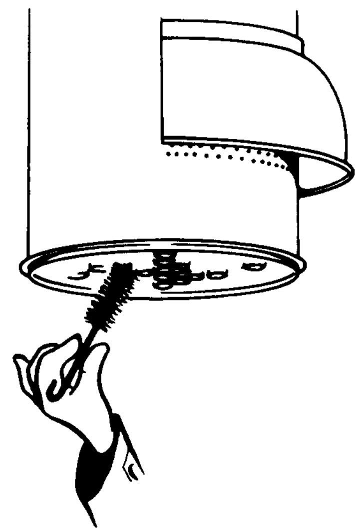
The DONACLONE tubes in the pre-cleaner section should be cleaned at every engine overhaul. More frequent cleaning may be required if tubes become contaminated by oil or sludge.

I. Removal and Inspection

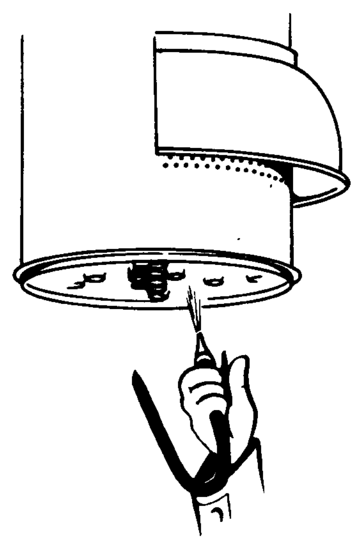
Remove the dust cup, disconnect the inlet options and loosen the mounting band. Remove the tube section from the air cleaner by loosening the body clamp. Light should be visible through all tubes.

II. Cleaning Instructions

A. Light dust plugging of tubes can be removed with a stiff fiber brush. **Do not use wire brush.**



B. Tube section can be blown with compressed air from both ends.



C. Heavy plugging may require washing.
1. Submerge tube section in solution of Donaldson D-1400 and warm water.
2. Soak and agitate until clean.
3. Rinse with clear water and dry thoroughly.

III. Installation of Tube Section

A. Put the tube section back on the air cleaner and tighten the clamp that holds it in place.
B. Install dust cup and inlet options, and tighten remaining clamps securely.

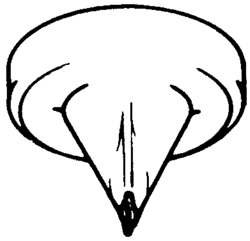
Basic Air Cleaner

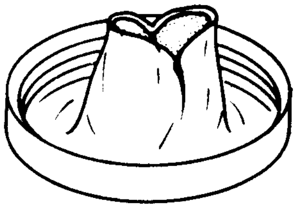
The air cleaner should be inspected periodically to maintain maximum engine protection. This inspection should include the following points:
1. Inspect the air transfer duct between the air cleaner and the engine to make sure that all joints are tight and make positive seals.
2. Make sure all inlet options are free from obstructions and are securely mounted.
3. Air cleaner mounting bolts must be tight enough to hold the air cleaner securely.

STG DONACLONE SERVICE HINTS

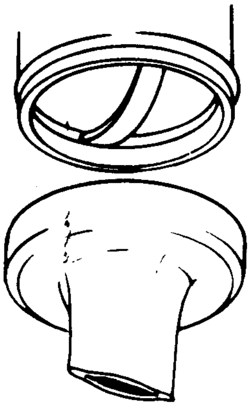
1. Store new and cleaned spare filter elements so they are protected from dust and potential damage.
2. When replacing a filter element, be sure the correct size and model is used.
3. Replace the DURALIFE main element after one year or after six cleanings, whichever occurs first.
4. To determine the need for main element service, use a permanently installed Donaldson Service Indicator, or make periodic checks of restriction with a water manometer or vacuum gauge.
5. Keep spare filters (new or cleaned) on hand to reduce vehicle down-time for servicing.
6. The STG is a dry type air cleaner, do not use oil.
7. To prevent damage to the pre-cleaner tubes, do not expose the air cleaner to temperatures above 160°F.
8. **Do not operate the STG air cleaner without both safety and main elements installed.**

9. The Vacuator Valve lips must point down to function. If the valve has turned inside out, check for a plugged air cleaner inlet.





If the valve turns inside out, and the air intake is not plugged, use P10-4777 spring to keep the valve lips down. The spring and valve lips must be perpendicular to each other.



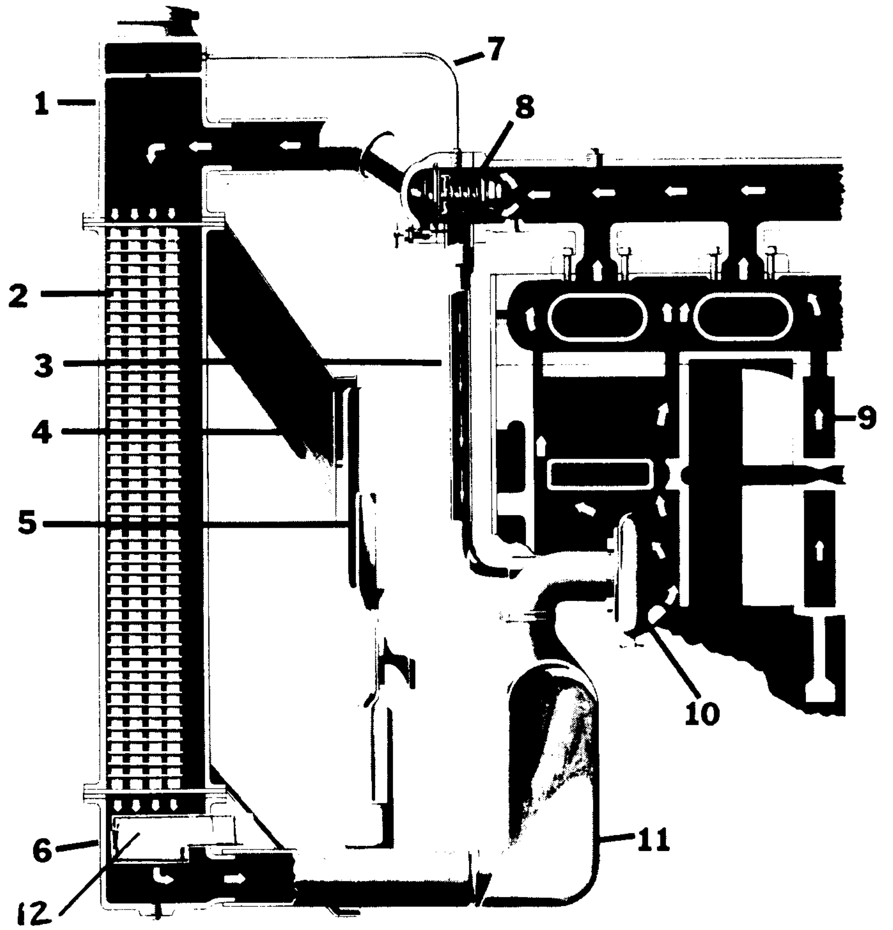
10. If short element service life occurs, check the following items: element cleaning procedure, dust cup gaskets, Vacuator Valve, access cover gasket, DONACLONE tubes, safety element restriction, Service Indicator and air cleaner inlet location. See Table of Contents.

11. If excessive dust is found in the air transfer duct or the engine intake system, check the following: connections between air cleaner outlet and engine; air cleaner outlet to body joint for leaks; main and safety element gasket washers and element gaskets; main and safety element medium for holes, cracks or breaks; and Service Indicator fitting for leaks.

12. **Do not attempt to clean elements by beating or rapping.**

CLARK EQUIPMENT

COOLING SYSTEM



1–Top Tank
2–Radiator Core
3–By-Pass Tube
4–Fan Shroud
5–Fan
6–Bottom Tank
7–Vent Tube
8–Thermostat
9–Water Jacket
10–Water Pump
11–Oil Cooler
12–Trans-Converter Oil Cooler

L-972

Fig. 1–Cutaway of Cooling System

OPERATION

The engines are water cooled and therefore require a cooling system of sufficient capacity to dispel heat generated by ignition of fuel in the cylinders of the engines. Although the cooling system is made up of several parts, many of which are mounted on the engine (service of these engine-mounted parts may be found in the Detroit Diesel Maintenance Manuel) this section will deal only with those components directly concerned with dispelling of heat, i.e. the engine water jacket and the radiator.

The circulation of the coolant through the engine can be followed in Fig. 1. The water pump mounted on the engine draws cooled water from the bottom radiator tank through the crankcase oil cooler and into the cylinder block. The coolant circulates up through the cylinder block into the cylinder head, then to the water manifold and thermostat housing. From the thermostat housing, the coolant returns to the radiator where it passes down through a series of tubes and is cooled by the air stream created by the fan.

When starting a cold engine or when the coolant is below operation temperature, (160 degrees to 185 degrees F.) the coolant is restricted at the thermostat housing and a by-pass tube provides water circulation within the engine during the warm-up period.

A high temperature warning light on the instrument panel comes on when water temperature in the cooling system goes above normal range. The buzzer on the instrument panel will sound when the light comes on.

RECOMMENDED COOLANTS

To avoid damage to cooling system components and possibly to the engine itself, when the unit is operated in below freezing temperatures, an anti-freeze is recommended. This anti-freeze will not damage the cooling system or any of its components. The amount of anti-freeze to be added to the system to protect it from freezing can be found in the table below.

The addition of a rust inhibitor to the cooling system solution retards the formation of rust and helps prevent unnecessary cooling system troubles. Most major brand anti-freezes contain a rust inhibitor, but during warm months soluble oil should be added to the water as a rust inhibitor. The recommended concentration of the soluble oil for each gallon of water in the system is 1/2 ounce.

CAUTION: Anti-freeze and soluble oil solutions should never be mixed in the system except on the advice of your anti-freeze supplier. A harmful reaction may be caused by the resulting solution!!

When adding fresh solution to the system to replace coolant that has been drained or lost through leaks, the soluble oil and water should be premixed in the proper proportions before being added to the system. However, when replacing solution that has been lost through evaporation or leaks, water alone should be added. Since soluble oil does not evaporate, to add additional oil to the system from which only water has evaporated would increase the concentration of the soluble oil above the recommended limit.

PERMANENT-TYPE ANTI-FREEZE

SYS. CAP. GAL.	GALLONS OF PERMANENT (ETHYLENE GLYCOL) TYPE ANTI-FREEZE NEEDED FOR PROTECTION TO FAHRENHEIT TEMPERATURES SHOWN IN TABLE																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
12	26°	19°	10°	0°	-15°	-34°																	
13	27	21	13	3	-9	-25	-45°																
14			15	6	-5	-18	-34°																
15			16	8	0	-12	-26	-43°															
16			17	10	2	-8	-19	-34°															
17			18	12	5	-4	-14	-27	-42°														
18			19	14	7	0	-10	-21	-34°														
19			20	15	9	2	-7	-16	-28	-42°													
20				16	10	4	-3	-12	-22	-34°													
21				17	12	6	0	-9	-17	-28	-41°												
22				18	13	8	2	-6	-14	-23	-34°												
23				19	14	9	4	-3	-10	-19	-30	-40°											
24				19	15	10	5	0	-8	-15	-25	-34°											
25				20	16	12	7	1	-5	-12	-20	-29	-40°										
26					17	13	8	3	-3	-9	-17	-25	-34°										
27					18	14	9	5	-1	-7	-14	-21	-29	-39°									
28					18	15	10	6	-1	-5	-11	-18	-25	-34°									
29					19	16	12	7	2	-3	-9	-15	-22	-29	-39°								
30					20	17	13	8	4	0	-6	-12	-18	-25	-34°								
31						17	14	9	5	1	-3	-10	-15	-22	-29	-39°							
32						18	14	10	6	2	-1	-8	-13	-19	-25	-34°							
33						18	15	11	7	3	0	-6	-11	-17	-22	-30°	-41°						
34						18	15	12	8	5	3	-4	-9	-14	-18	-27°	-34°	-42°					
35						19	16	13	9	6	4	-2	-7	-12	-16	-24	-29	-39°					
36						19	16	14	10	7	5	0	-5	-10	-15	-21	-25	-34°	-42°				
37						19	17	14	10	8	6	1	-4	-8	-14	-18	-21	-31	-39°				
38						20	17	15	11	9	7	2	-3	-7	-12	-16	-18	-28	-34	-42°			
39							18	16	12	9	8	3	0	-5	-9	-14	-16	-25	-31	-39°			
40							18	16	13	10	9	4	1	-3	-7	-12	-14	-22	-28	-34	-41°		
41							19	17	14	11	10	4	2	-1	-6	-11	-12	-19	-25	-31	-38°		
42							19	17	15	12	10	5	3	0	-5	-9	-11	-17	-22	-28	-34	-41°	
43							20	18	16	12	10	7	4	1	-3	-7	-9	-16	-19	-25	-32	-37°	
44							20	18	16	13	10	8	5	2	-2	-6	-7	-14	-17	-23	-29	-34	-40°
45							21	18	17	13	12	8	6	3	0	-5	-6	-12	-16	-21	-27	-32	-37°

ADDING ANTI-FREEZE SOLUTION

The cooling system should be thoroughly flushed with water before adding anti-freeze solution. Pressurized back-flushing of radiator and engine should be done if necessary to remove rust and scale from the system. (See MAINTENANCE Section for procedures).

1. Determine the amount of anti-freeze required for protection to the lowest expected temperature from the Anti-Freeze Chart.

2. Fill the cooling system about 1/3 full of water, then add the required amount of anti-freeze and finish filling the cooling system with water.

   NOTE: Be sure to leave room in the system for expansion.

3. Run the engine at a fast idle until normal operating temperature is reached to mix the solution and release any air trapped in the cooling system. Check coolant level (See cap removal instructions in this section) and add water if necessary.

4. Inspect system for leakage and tighten hose clamps if necessary.

CHECKING ANTI-FREEZE TESTER

The hydrometer used for testing anti-freeze solutions should be checked occasionally to insure that cooling system anti-freeze readings are accurate.

The tester can be checked by taking readings of prepared anti-freeze solutions of known concentrations. For example, in a solution of 1/3 ethylene-glycol anti-freeze and 2/3 water, the tester should register anti-freeze protection to 0 degrees F. A solution of 1/2 ethylene-glycol anti-freeze and 1/2 water should register anti-freeze protection to 34 degrees below 0 degrees F.

When testing the hydrometer, care should be taken to use only clean ingredients to make up the test solutions and to mix them in the exact proportions to prevent erroneous readings. The solutions should be thoroughly mixed before being tested. Since most anti-freeze hydrometers give the most accurate readings at solution temperatures of 100 degrees F., cold solutions should be warmed slightly before being tested.

RADIATOR

A pressure type cooling system is used on these units. The radiator cap seals tight to prevent loss of coolant by evaporation. A combined cap and pressure valve as shown in Fig. 2 is used to maintain proper pressure. The pressure valve begins to allow pressure to escape when radiator internal pressure reaches 7 PSI. The valve will remain tight under normal operating conditions. Also, incorporated into the design of the cap is a valve for admitting air into the system. A vacuum of more than 1/4 pound PSI develops from condensation of vapor or contraction of the coolant.

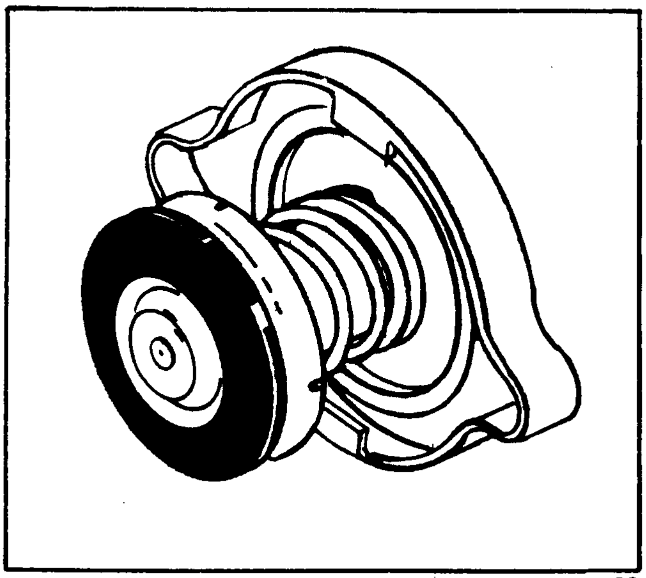


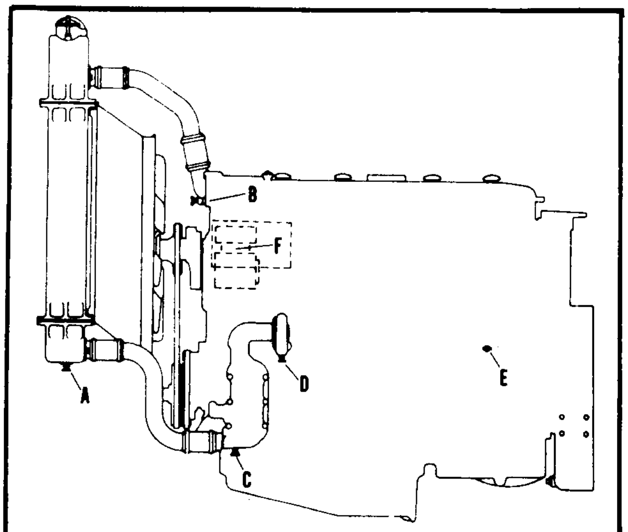
Fig. 2 – Radiator Cap

NOTE: The radiator cap should not be opened when the engine is hot unless absolutely necessary.
When the engine is hot, the pressure in the radiator may be sufficient to expel hot water or steam which can cause serious burns. If it is necessary to remove the radiator cap when the engine is hot, use caution.

1. Turn the cap clockwise to the safety stop. If noise of air escaping is heard, wait until the noise stops. This will prevent getting scalded.

2. Push cap down, turn counterclockwise to stop and remove cap.

REMOVAL OF RADIATOR



A-Drain Cock on Bottom Tank
B-Drain Cock at Bottom of Thermostat Housing
C-Drain Cock at Bottom of Oil Cooler
D-Drain Cock at Bottom of Water Pump
E-Drain Cock at Left Hand Rear of Block
F-Drain Cock on Air Compressor-Left Side of Engine

Fig. 3–Cooling System Drain Points L-208

1. Refer to cooling system drain points illustrated in Fig. 3. Open the drain cocks at these points and drain the cooling system.

2. Remove wiring from headlights and remove front hood.

3. Remove grille and remove all radiator hoses from engine.

4. Attach suitable lifting device to radiator and remove bolts and nuts securing radiator mount to frame.

5. Remove radiator and place on suitable surface for inspection.

CAUTION: The thin copper tubes and fins of the radiator core are fragile and are easily bent or broken.

The radiator may be replaced on the unit by reversing the removal procedure.

PREVENTIVE MAINTENANCE

EVERY 100 HOURS: Check fan belt for proper adjustment and wear. Check anti-freeze (if used) for proper strength. Check hoses, radiator, water pump, oil cooler, water manifold and drain cocks for leaks.

EVERY 1000 HOURS: Back flush radiator and engine block and refill with proper coolant solution. Remove and clean oil cooler.

AS NEEDED: Tighten water manifold, water pump, oil cooler and radiator mounting bolts. Clean radiator core fins. Under extreme conditions this may be necessary daily.

FLUSHING

In general, any flushing compound distributed by a reputable manufacturer will do an acceptable job. Oxalic acid and sodium-bisulfate type cleaners are the most commonly used compounds. Be sure to use the neutralizer compound following a radiator flush with an acid cleaner. The neutralizer is usually supplied with the acid flush.

Follow the cleaning compound manufacturer's recommendations for flushing the system. If the radiator is so badly clogged as to require boiling out, it should be done by a reputable radiator shop.

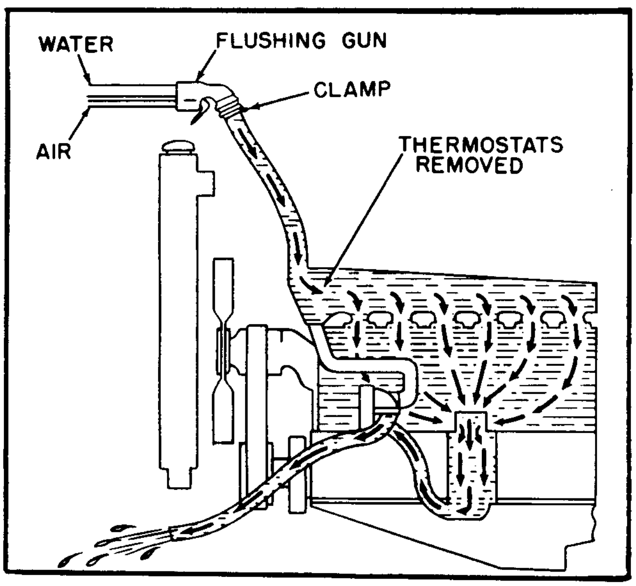


Fig. 4 Back-Flushing Engine Jacket L-2136

If the radiator or engine water jacket is rust clogged, pressure back flushing should be performed to rid the system of this rust. Be sure to remove the thermostats before beginning the block flushing operation.

For back flushing flow diagram of the engine water jacket see Fig. 4. To back flush the engine jacket, proceed as follows:

1. After removing the thermostats, clamp flushing gun to front neck of water manifold.

2. Temporarily block the pump inlet opening and fill the engine jacket with water.

3. Unblock the water pump inlet opening and blow water from the engine jacket with air from the flushing gun. Use full air pressure.

4. Alternately fill water jacket with water and blow out with air pressure until the flush water runs clean.

Some deposits in the water jacket may be so heavy that ordinary cleaners and block flushing will not reach the clogging material. In this case it will be necessary to remove the cover plates to permit more thorough flushing or hand scraping.

COOLING SYSTEM DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Engine coolant temperature too high	Lack of coolant	Fill cooling system with proper amount of coolant. Check for coolant leaks.
	Front of radiator obstructed preventing free passage of air	Remove obstruction
	Fan belt broken or slipping	Adjust or replace fan belt
	Thermostat not opening	Replace thermostat
	Cooling system clogged with rust or scale	Flush cooling system
	Water pump not functioning properly	Repair or replace water pump
Engine coolant temperature too low	Thermostat remains open or opens at too low a temperature	Replace thermostat
	Extremely cold weather	Cover radiator or install radiator shutters.

* * * *

CLARK EQUIPMENT

TORQUE CONVERTER

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the **CLARK** Torque Converter.

Extreme care has been exercised in the design, selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the torque converter, its principal of operation, trouble shooting and adjustments, it is urged that the mechanic study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

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. IMPORTANT: **Always furnish the Distributor with the converter serial and model number when ordering parts.**

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c) External Oil Flow — Converter and Transmission . . . .

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The torque converter 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.

The torque converter and transmission function together and operate through a common hydraulic system. To obtain maximum serviceability they have been designed and built as separate units. It is necessary, however, to consider both units in the study of their function and operation.

To supplement the text herein, and for reference use therewith, the following illustrations are provided:

Fig. A — Internal Oil Flow Torque Converter

Fig. B — Torque Converter Assembly

Fig. C — External Oil Flow—Converter and Transmission

TORQUE CONVERTER ASSEMBLY

The torque converter assembly is composed of: (1) Torque Converter, (2) Output Shaft for driving the transmission, (3) Coupling and Flange to mount the converter charging pump to supply oil under pressure to operate transmission clutches and for converter cooling.

The torque converter is composed of four members: the impeller which is the driving member, the turbine, which is the driven member, the reaction member which is splined on a fixed support, and the drive disc, which couples the converter to the engine. The impeller and drive disc members form the outer shell. The turbine runs within the outer shell and is connected to the output shaft. The oil is the only connection between the turbine and impeller members. The reaction member is splined to the converter support which is fixed and does not rotate in either direction. A gear is splined to the impeller hub and drives through gears rotating the hydraulic pumps mounted on the converter housing cover.

HOW THE UNITS OPERATE—

With the engine running, the converter charging pump draws oil from the transmission sump and directs it through oil filters to the regulating valve located on top of the transmission. From the regulating valve it is then directed through the control cover on the transmission to the converter and to the transmission clutches.

The pressure regulating valve mounted on the top of the transmission remains closed until required pressure is delivered to the transmission for actuating the direction and speed clutches. This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is backed up by a spring to hold the valve spool against its seat until the oil pressure builds up to the specified pressure. The valve spool then moves towards the spring until a port is exposed along the side of the bore. The oil can then flow through this port into a distributor which directs the oil into the converter inlet port.

After entering the converter, the oil is directed through the stator support to the converter cavity and exits between the turbine shaft and converter support. The oil then passes through an oil distributor which directs the oil out of the converter by way of a down stream regulator valve and then to the oil cooler. After leaving the cooler the oil is directed through a hose to the lubricating oil inlet on the transmission, then through a series of tubes to the transmission, bearings, and clutches. The oil then returns to the transmission sump.

A safety valve is built in the transmission control cover and will open to bypass oil only if an excessive pressure is built up due to a blocked passage.

The rear compartment of the converter unit also houses the converter output shaft. A flexible hose provides an overflow to the transmission sump.

The three members of the torque converter are composed of a series of blades. The blades are curved in such a manner as to force the oil to circulate from the impeller to the turbine, through the reaction member 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 through the reaction member, again enters the inner side of the impeller.

Converter "Stall" is achieved whenever the turbine and impeller shaft are stationary and the engine is operating at full power or wide open throttle. CAUTION: Do not maintain "Stall" for more than 30 seconds at a time. Excessive heat will be generated and may cause converter or transmission seal damage.

In converters equipped with Lock-up clutches, a hydraulic clutch, similar to the transmission clutches is used to "lock" the engine mechanically to the output shaft. This is accomplished by hydraulic pressure actuating the lock-up clutch which in turn locks the impeller cover to the turbine hub. During lock-up the converter turns at 1 to 1 speed ratio.

The down stream regulator valve on the converter consists of a valve body and regulator spool. The spool is backed up by a spring to hold the valve until converter oil pressure builds up to specified pressure. The valve is used to maintain a given converter pressure to insure proper performance under all conditions.

The control valve assembly on the transmission consists of a valve body with selector valve spools connected to the steering column by exterior linkage. A detent ball and spring in the selector spool provides four positions, one position for each speed range. A detent ball and spring in the direction spool provides three positions, one each for forward, neutral, and reverse.

On certain models, this valve also contains a shut-off valve spool operated by an air or hydraulic cylinder located on the control cover. This valve is connected to the brake system by a hose line. When the wheel brakes are applied, air or hydraulic fluid enters the valve and overcomes a spring force. This forces the spool 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 the directional control lever in neutral position, oil pressure is blocked at the control valve, and the transmission is in neutral. Movement of the forward and reverse spool 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 direction or speed clutch assembly consists of a drum with internal gear teeth and a bore to receive a hydraulically actuated piston. A piston is inserted into the bore of the drum. The piston is "oil tight" by the use of sealing rings. A bronze disc with internal teeth is inserted into the drum and rests against the piston. Next, a disc with splines at the outer diameter is inserted. Discs are alternated until the required total is achieved. After inserting the last disc, a series of springs and pins are assembled in such a manner that these springs rest on teeth of 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 discs with teeth on the inner diameter and a splined shaft extending through the clutch support. This hub is retained by a snap ring. The discs and inner shaft are free to increase in speed or rotated in the opposite direction as long as no pressure is present in the direction or speed clutch.

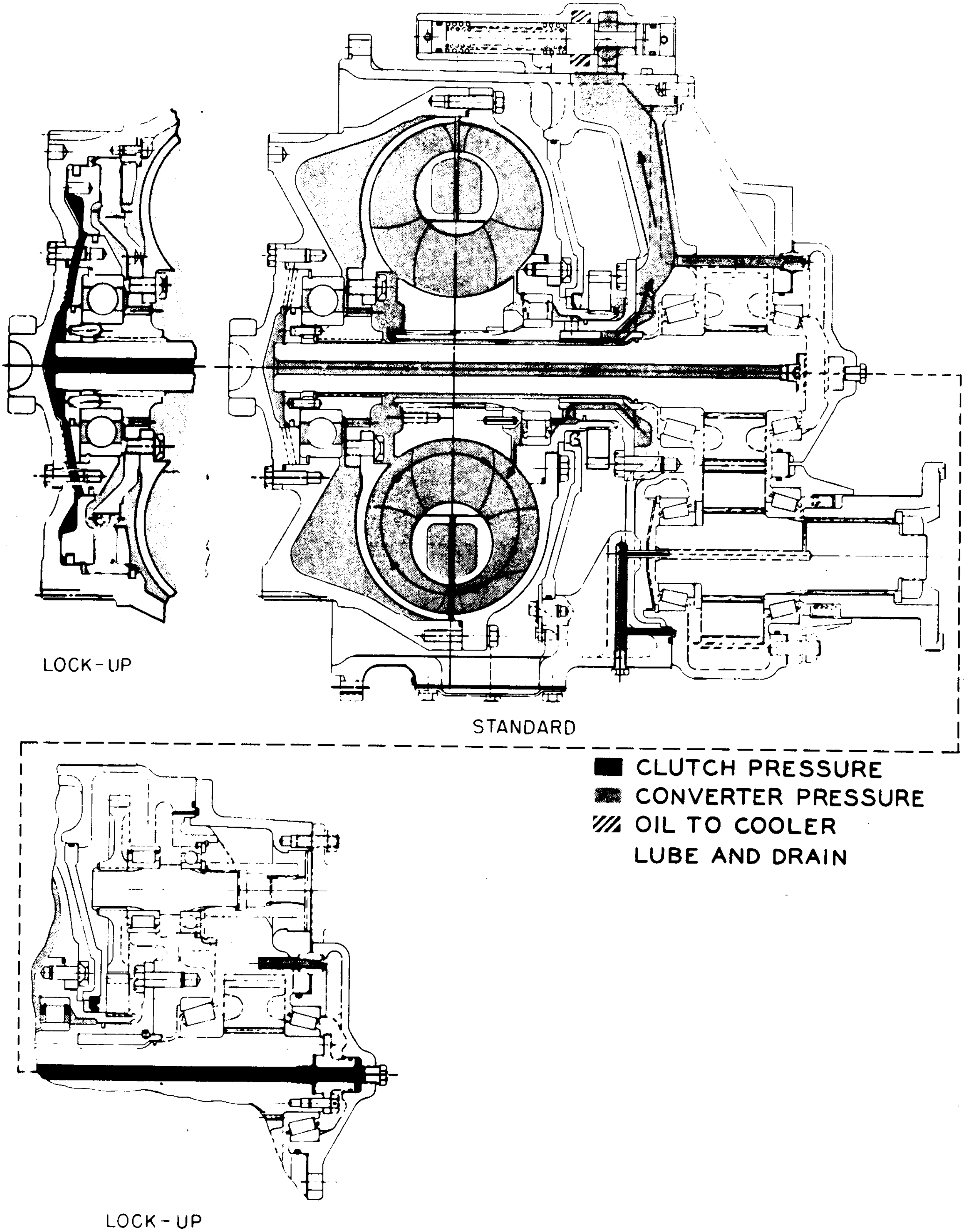
To engage the clutch, as previously stated, the control valve is placed in the desired position. This allows oil under pressure to flow from the control cover valve, through a tube in the transmission case, to a chosen clutch. Once into the drum, oil is directed through a drilled hole into the rear side of the piston bore. Pressure of the oil forces the piston and discs over against the heavy back-up plate. The discs, with teeth on the outer diameter, clamping against discs, with teeth on inner diameter, enables the clutch drum and drive shaft to be locked together and allows them to turn as a unit.

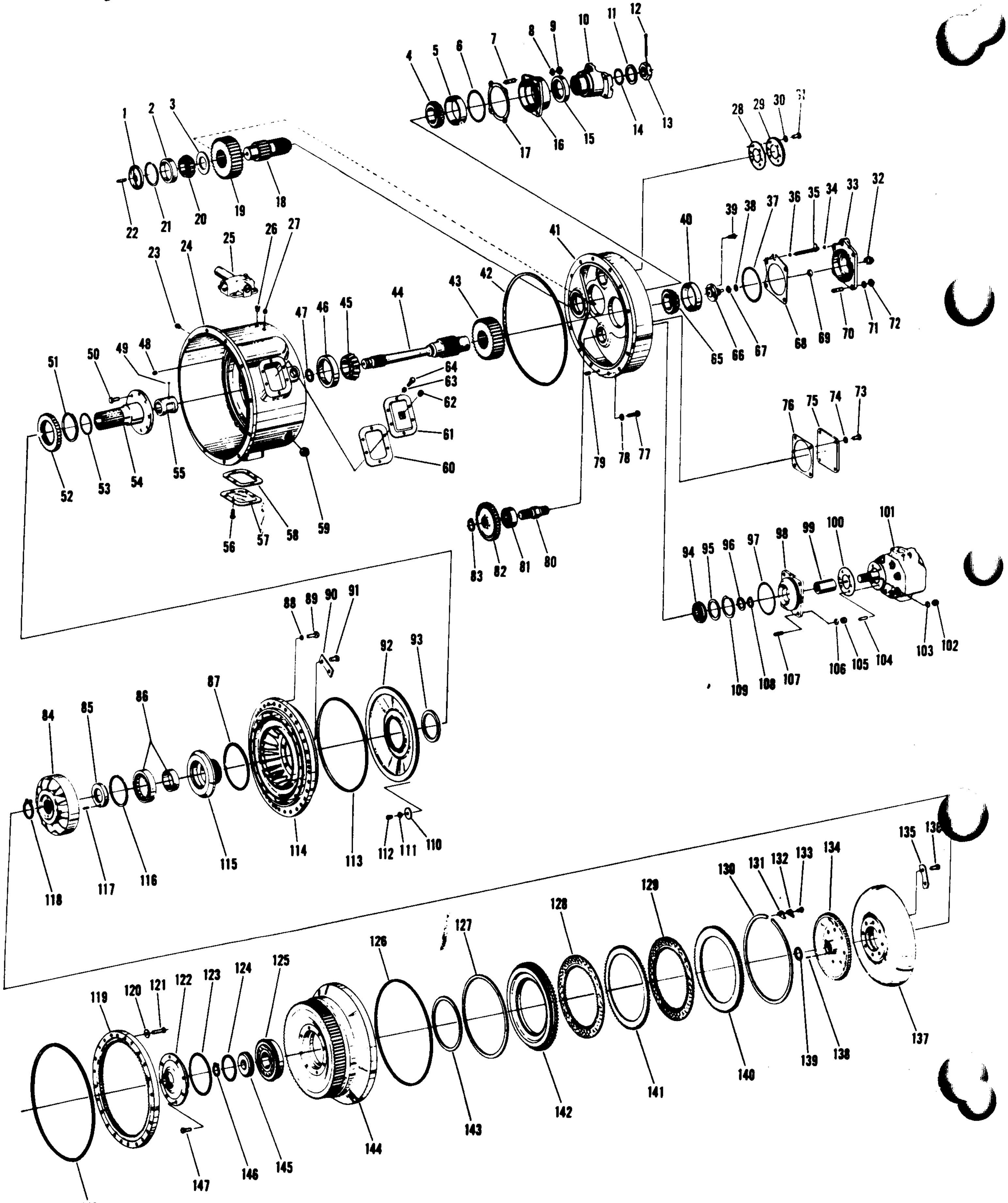
There are bleed balls in the clutch drums which allow quick escape for oil when the pressure to the piston is released.

The transmission gear train consists of six shafts: (1) Input Shaft, (2) Reverse Shaft, (3) Idler Shaft, (4) First and Third Shaft, (5) Second and Fourth Shaft, (6) Output Shaft.

A screen mounted in a frame is positioned on the bottom of the transmission case, to screen out any foreign material. This screen is covered by the sump pan. This pan is provided with magnets to catch any metallic particles.

Some transmissions may have an axle declutching unit as optional equipment, this unit consists of a split output shaft with a sliding splined sleeve to engage or disengage the axle. This is accomplished by manually shifting a lever in the operator's compartment which is mechanically connected to the shift fork on the clutching unit sliding sleeve. This unit, of course, is only used on the four wheel drive machine. On the front drive only or the rear wheel drive only, the output shaft is on one piece type and an output flange assembled only on the required end.


LOCK-UP
STANDARD
CLUTCH PRESSURE
CONVERTER PRESSURE
OIL TO COOLER
LUBE AND DRAIN
LOCK-UP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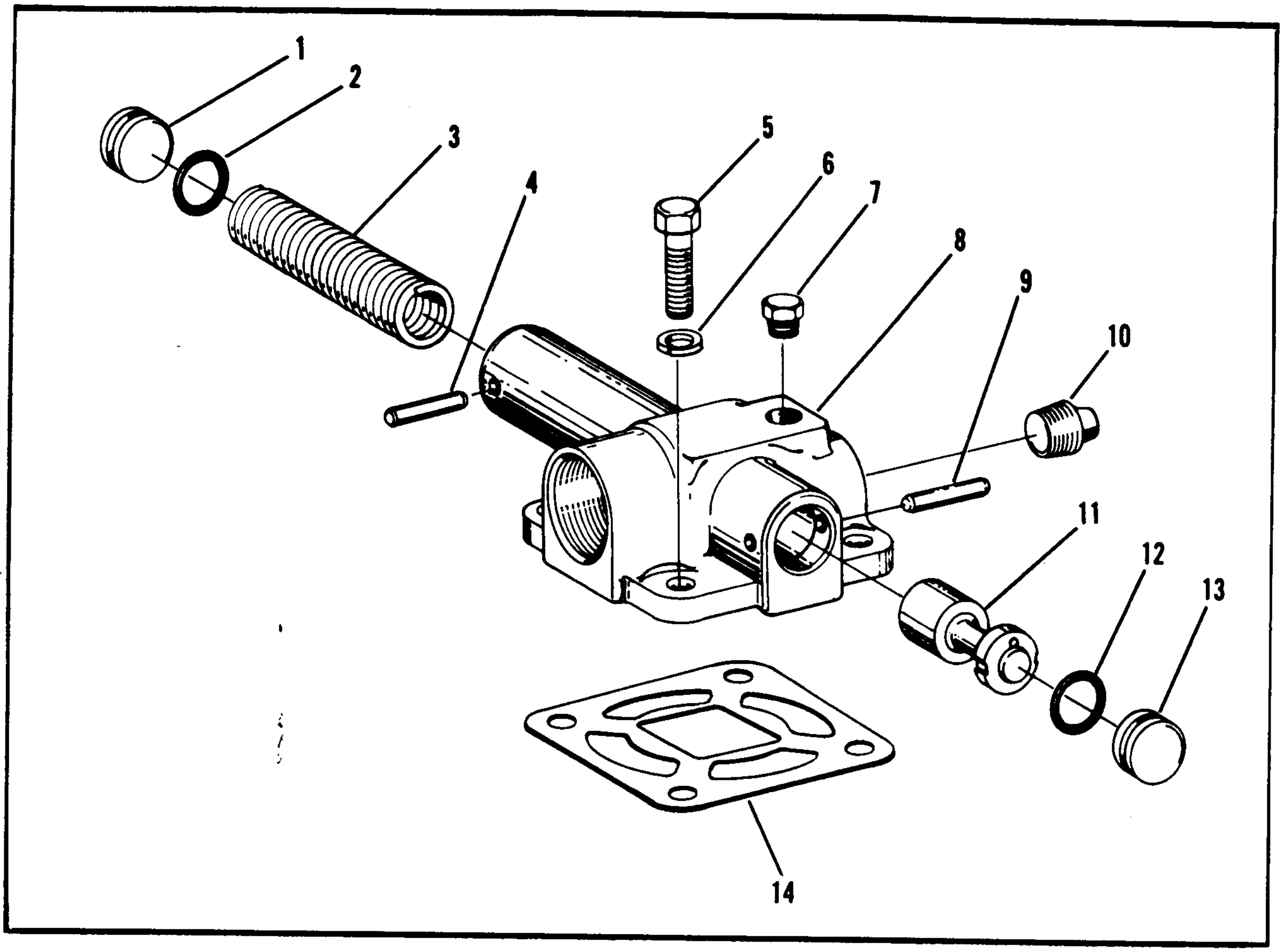
ITEM	DESCRIPTION	QTY.
1	Oil Baffle	1
2	Front Bearing Cup	1
3	Front Bearing Spacer	1
4	Rear Bearing Cone	1
5	Rear Bearing Cup	1
6	Bearing Cap "O" Ring	1
7	Bearing Cap Stud	2
8	Bearing Cap Stud Lockwasher	4
9	Bearing Cap Stud Nut	4
10	Flange	1
11	Flange Washer	1
12	Flange Nut Cotter Pin	1
13	Flange Nut	1
14	Flange "O" Ring	1
15	Oil Seal	1
16	Bearing Cap	1
17	Bearing Cap Shim	AR
18	Output Shaft	1
19	Output Shaft Gear	1
20	Front Bearing Cone	1
21	Front Bearing Snap Ring	1
22	Oil Tube	1
23	Pipe Plug	1
24	Converter Housing	1
25	Downstream Pressure Regulating Valve Assembly	1
26	Pipe Plug	1
27	Pipe Plug	1
28	Pump Hole Cover Gasket	1
29	Pump Hole Cover	1
30	Cover Screw Lockwasher	6
31	Cover Screw	6
32	Tube Nut	1
33	Bearing Cap	1
34	Lube Tube "O" Ring	1
35	Lube Tube	1
36	Lube Tube "O" Ring	1
37	Bearing Cap "O" Ring	1
38	Piston Ring	1
39	Adaptor to Shaft Screw	3
40	Bearing Cup	1
41	Housing Rear Cover	1
42	Cover to Housing "O" Ring	1
43	Turbine Shaft Gear	1
44	Turbine Shaft	1
45	Bearing Cone	1
46	Bearing Cup	1
47	Piston Ring	1
48	Pipe Plug	1
49	Ball	1
50	Sleeve to Housing Screw	8
51	Gear Snap Ring	1
52	Oil Pump Drive Gear	1
53	Piston Ring	1
54	Stator Support Sleeve	1
55	Oil Distributor Sleeve	1
56	Housing Inspection Screw and Lockwasher	12
57	Housing Inspection Cover	2
58	Housing Inspection Gasket	2
59	Drain Plug	4
60	Housing Inspection Gasket	1
61	Housing Inspection Cover	1
62	Vent Plug	1
63	Included in Item 64.	
64	Housing Inspection Screw and Lockwasher	6
65	Bearing Cone	1
66	Lock-up Adaptor	1
67	Piston Ring	1
68	Bearing Cap Shim	AR
69	Oil Seal	1
70	Bearing Cap Stud	4
71	Bearing Cap Stud Lockwasher	4
72	Bearing Cap Stud Nut	4
73	Permanent Pump Hole Cover Screw	8
74	Permanent Pump Hole Cover Screw Lockwasher	8
75	Permanent Pump Hole Cover	2

ITEM	DESCRIPTION	QTY.
76	Permanent Pump Hole Cover Gasket	2
77	Cover to Housing Screw	12
78	Cover to Housing Screw Lockwasher	12
79	Dowel Pin	1
80	Pump Drive Shaft	2
81	Pump Shaft Front Bearing	2
82	Pump Driven Gear	2
83	Driven Gear Snap Ring	2
84	Reaction Member	1
85	Reaction Member Spacer	1
86	Impeller Hub Bearing	1
87	Impeller Hub "O" Ring	1
88	Impeller to Cover Screw Lockwasher	32
89	Impeller to Cover Screw	32
90	Impeller to Hub Screw Lock Plate	4
91	Impeller to Hub Screw	8
92	Oil Baffle	1
93	Oil Seal	1
94	Pump Shaft Rear Bearing	2
95	Rear Bearing Washer—Outer	2
96	Rear Bearing Washer—Inner	2
97	Adaptor "O" Ring	1
98	Pump Adaptor	1
99	Pump Drive Sleeve	1
100	Pump Gasket	1
101	Converter Charging Pump	1
102	Pump Mounting Stud Nut	3
103	Pump Mounting Stud Nut Lockwasher	3
104	Pump Mounting Stud	3
105	Stud Nut	4
106	Stud Nut Lockwasher	4
107	Stud	4
108	Inner Washer Snap Ring	2
109	Bearing Washer Snap Ring	2
110	Oil Baffle Screw Washer	3
111	Oil Baffle Screw Lockwasher	3
112	Oil Baffle Screw	3
113	Oil Baffle "O" Ring	1
114	Impeller	1
115	Impeller Hub	1
116	Impeller Hub Bearing Snap Ring	1
117	Reaction Member Spacer Roll Pin	1
118	Reaction Member Snap Ring	1
119	Ring Gear	1
120	Ring Gear Washer	
121	Ring Gear Stud	
122	Impeller Cover Bearing Cap	1
123	Impeller Cover Bearing Cap "O" Ring	1
124	Piston Ring	1
125	Front Bearing	1
126	Impeller to Cover "O" Ring	1
127*	Piston Ring—Outer	1
128*	Lock-up Inner Disc	1
129*	Lock-up Inner Disc	1
130*	Backing Plate Snap Ring	1
131*	Snap Ring Lock Plate	1
132*	Screw Plate Lock	1
133*	Lock Plate Screw	1
134*	Turbine and Lock-up Hub	1
135	Turbine to Hub Screw Lock Plate	4
136	Turbine to Hub Screw	8
137	Turbine	1
138	Dowel Pin	1
139	Hub Snap Ring	2
140*	Lock-up Backing Plate	2
141*	Lock-up Outer Disc	1
142*	Lock-up Piston	1
143*	Piston Ring—Inner	1
144	Impeller Cover	1
145	Bearing Retainer	1
146	Snap Ring	1
147	Impeller Cover Bearing Cap Screw	8
148	"O" Ring Used With "Wet" Front End	1

*Used With Lock-up Converter Only.

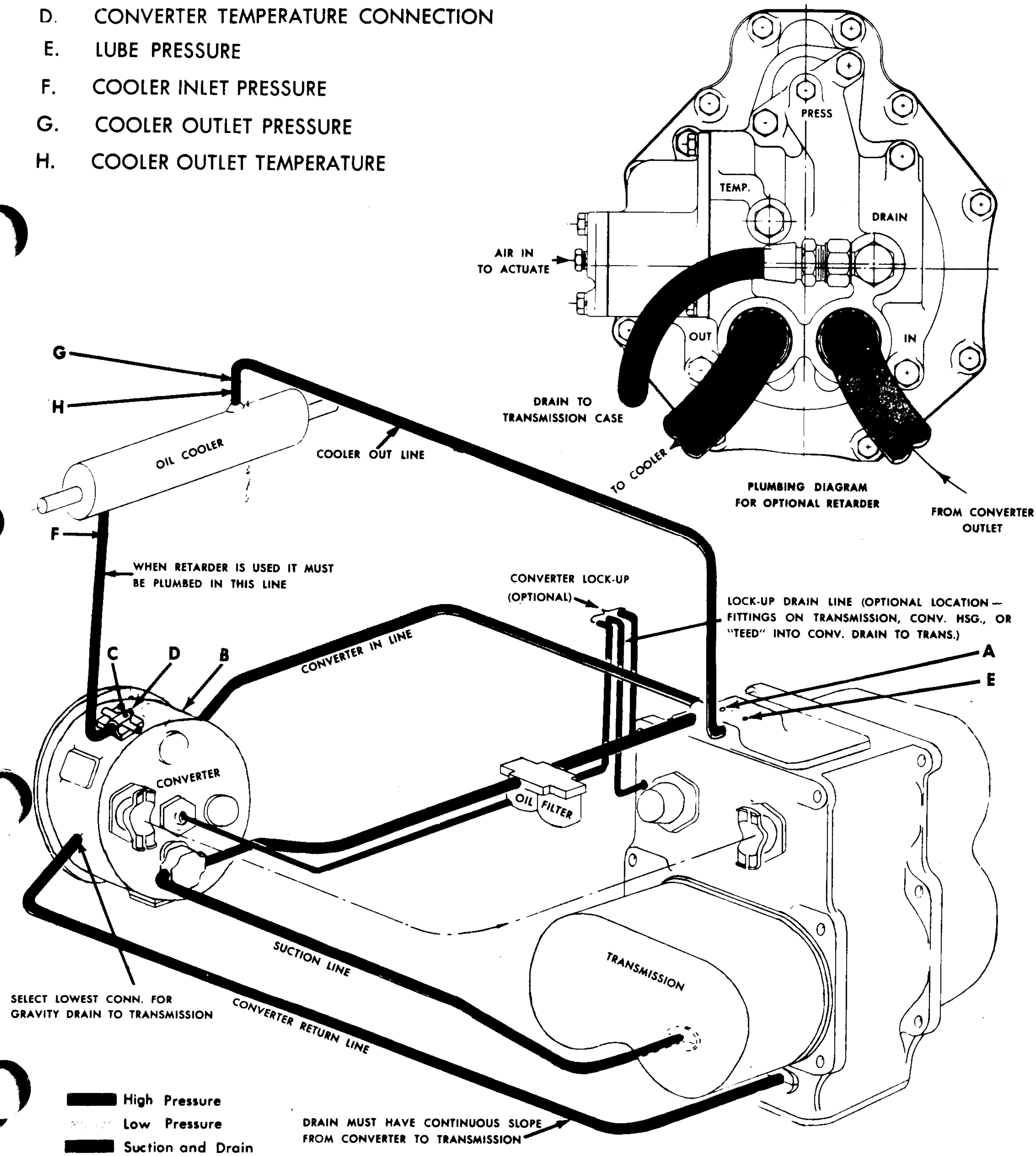


PRESSURE REGULATING VALVE

ITEM	QTY.	DESCRIPTION
1	1	Piston Stop
2	1	Piston Stop "O" Ring
3	1	Pressure Spring
4	1	Piston Stop Roll Pin
5	4	Valve to Housing Screw
6	4	Valve to Housing Screw Lockwasher
7	1	Pressure Tap Pipe Plug
8	1	Pressure Regulating Valve Body
9	1	Piston Stop Roll Pin
10	1	Pipe Plug
11	1	Regulating Valve Piston
12	1	Piston Stop "O" Ring
13	1	Piston Stop
14	1	Gasket
15	1	Regulator Spring – Not Illustrated

FIG J CHECK POINTS

A. CLUTCH PRESSURE
B. CONVERTER INLET
C. CONVERTER OUTLET
D. CONVERTER TEMPERATURE CONNECTION
E. LUBE PRESSURE
F. COOLER INLET PRESSURE
G. COOLER OUTLET PRESSURE
H. COOLER OUTLET TEMPERATURE



OVERHAUL INSTRUCTIONS FOR TORQUE CONVERTER

The following instructions will cover the disassembly and reassembly of the torque converter in a sequence that would normally be followed after the unit is removed from the machine and is to be completely overhauled.

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

DISASSEMBLY OF THE TORQUE CONVERTER

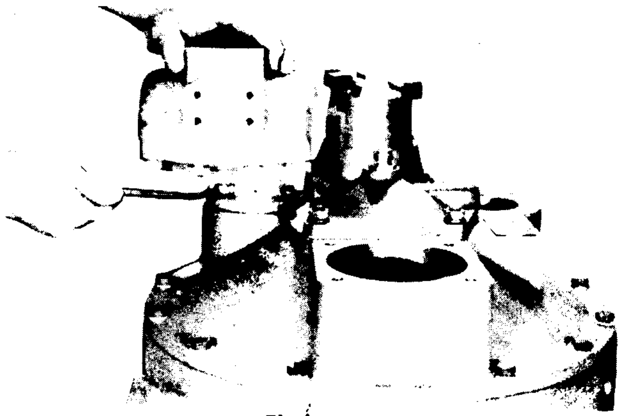


Figure 1
Remove pump stud nuts and washers.

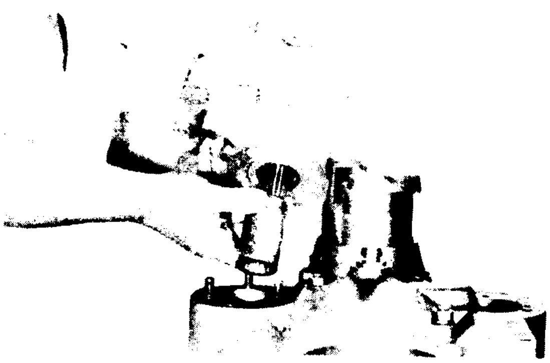


Figure 2
Remove pump assembly and drive sleeve.

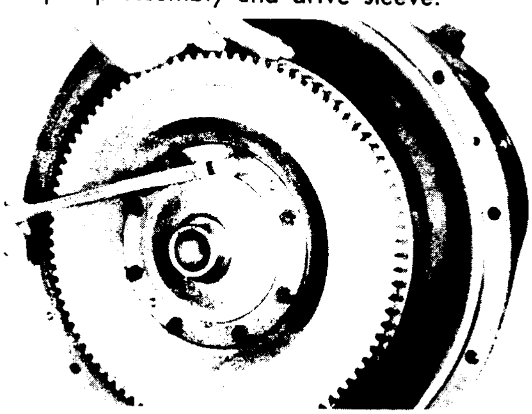


Figure 3
Remove impeller cover bearing cap bolts.

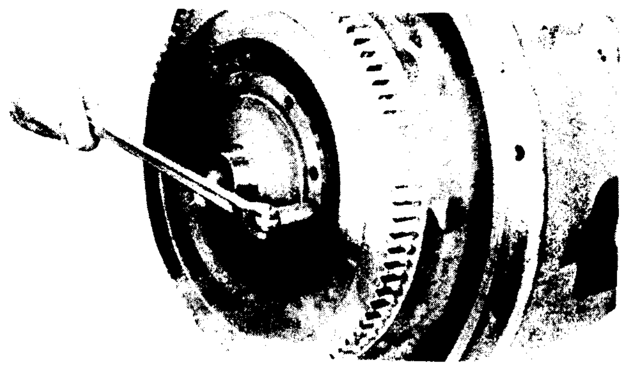


Figure 4
Install two bolts in threaded holes in bearing cap. Turn bolts evenly and remove bearing cap.

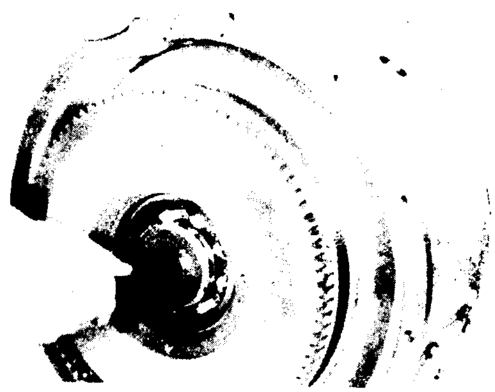


Figure 5
Remove bearing retainer plate snap ring.

Figure 6
Remove impeller to impeller cover bolts.

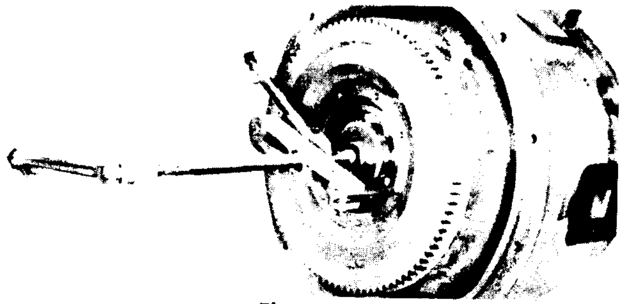


Figure 7

Using a puller as shown in Figure 7, remove bearing retainer plate, impeller cover, and turbine from turbine shaft. **CAUTION**: Secure impeller cover with a chain to prevent assembly from dropping.

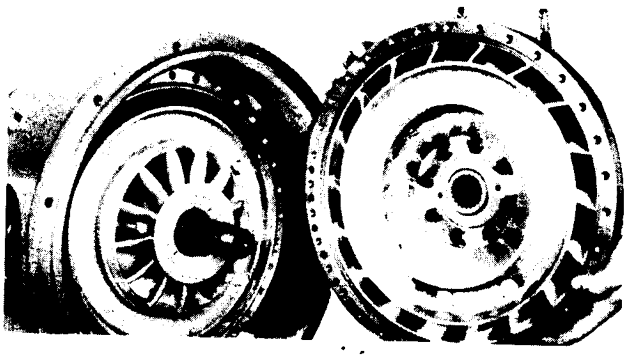


Figure 8

Turbine and impeller cover removed. Block impeller cover on the outer diameter and drive turbine hub from impeller bearing.

If lock-up is not used, omit Figure 9 through 15 and refer to Figure 16.

Figure 9

Straighten tangs on bolt lock and remove bolt, bolt lock and snap ring lock from lock-up cover.

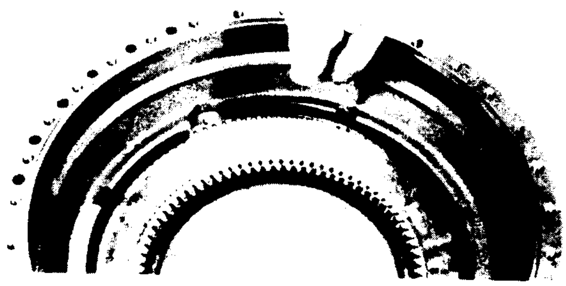


Figure 10

Remove backing plate retainer ring.

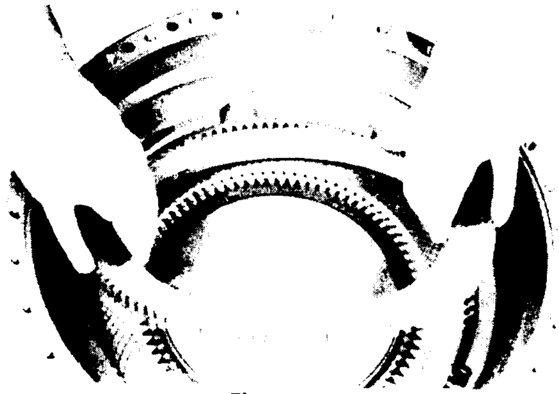


Figure 11

Remove backing plate.

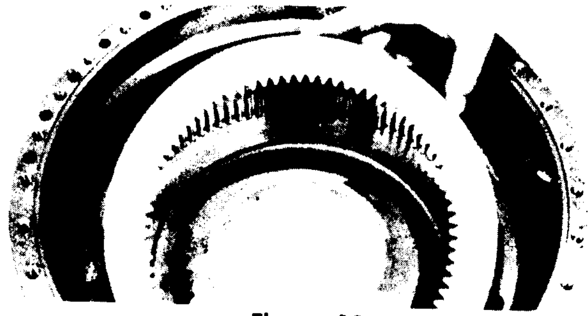


Figure 12

Remove inner and outer lock-up discs.

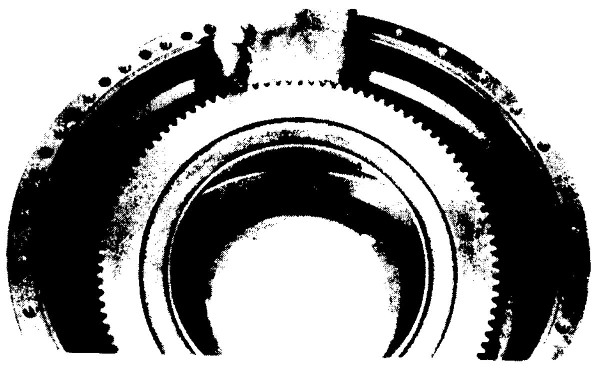


Figure 13

Remove lock-up piston.

Figure 14

Remove lock-up piston outer sealing ring.

Figure 15

Remove lock-up piston inner sealing ring.

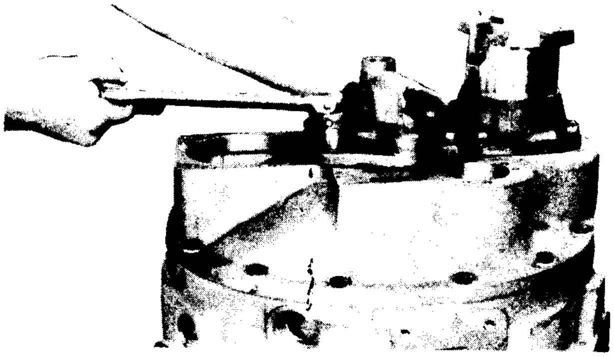


Figure 16

Remove turbine shaft bearing cap.

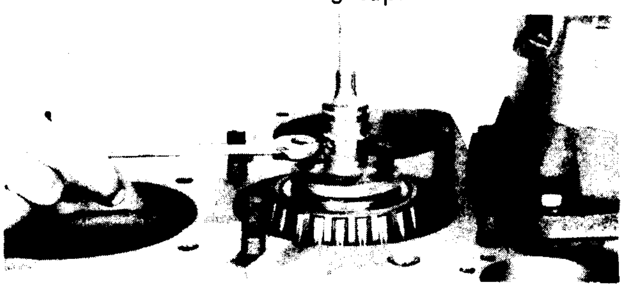


Figure 17

Remove lock wire and adaptor bolts from adaptor. Install two bolts in threaded holes in adaptor. Turn bolts evenly and remove adaptor.

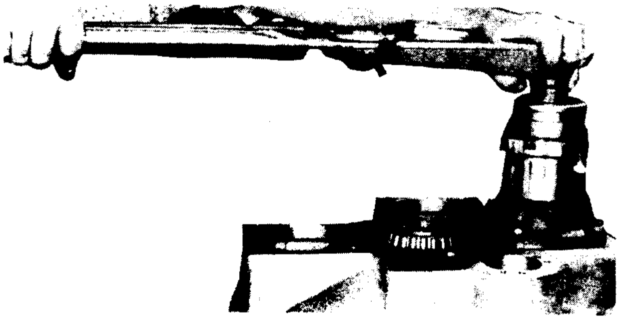


Figure 18

Lock output gears with a soft bar and remove output flange nut. Remove flange washer, "O" ring and flange.

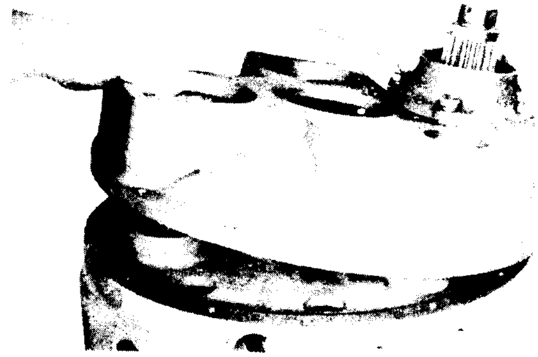


Figure 19

Remove rear housing cover bolts. Remove rear housing.

Figure 20

Remove output shaft bearing cap.

Figure 21

Using a split puller as shown remove output shaft and outer taper bearing.

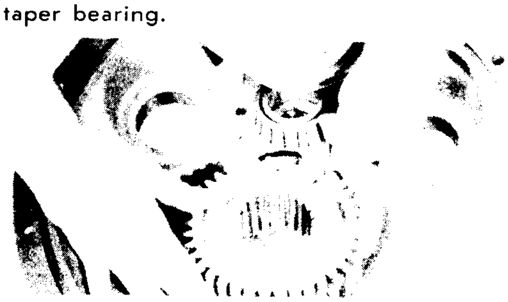


Figure 22

Remove output gear, washer and inner taper bearing from rear housing.

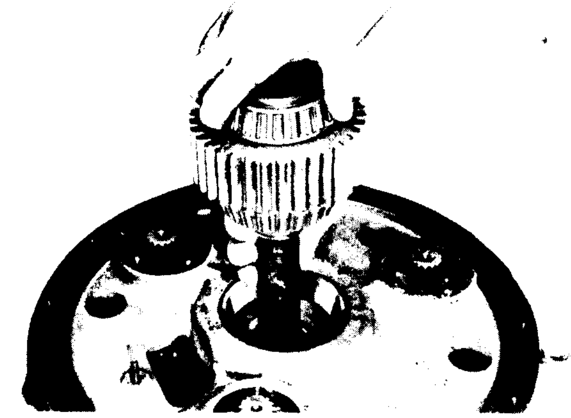


Figure 23
Remove turbine shaft and bearing assembly from converter housing.

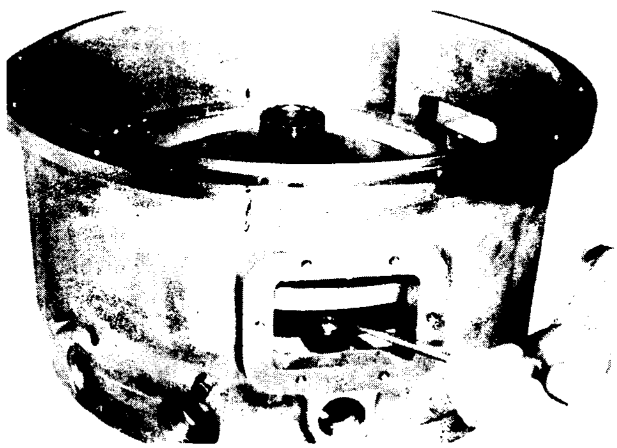


Figure 24
Remove three (3) oil baffle retainer bolts and washers from housing.

Figure 25
Remove reaction member retainer ring.

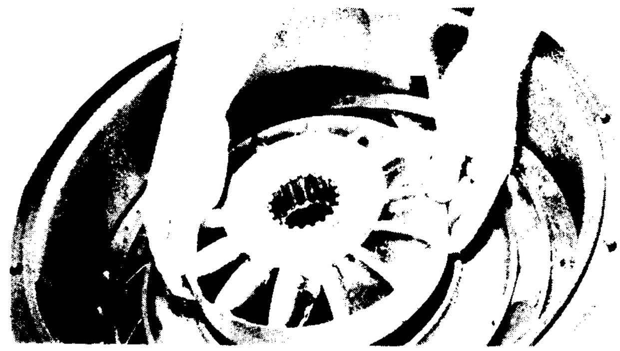


Figure 26
Remove reaction member from stator support. If reaction member is tight, threaded holes are provided to pull same from stator support.

Figure 27
Remove impeller and baffle assembly from converter housing.

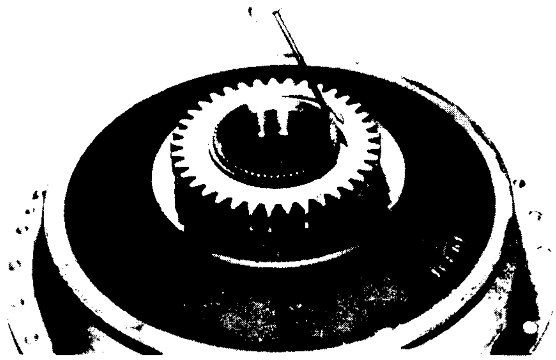


Figure 28
Remove pump drive gear retainer ring. Remove pump drive gear and oil baffle from impeller hub.

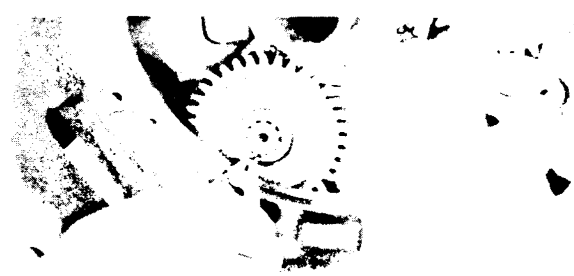


Figure 29
Remove pump driven gear retainer rings.

Figure 30

Remove pump shaft rear bearing retainer ring and washer.

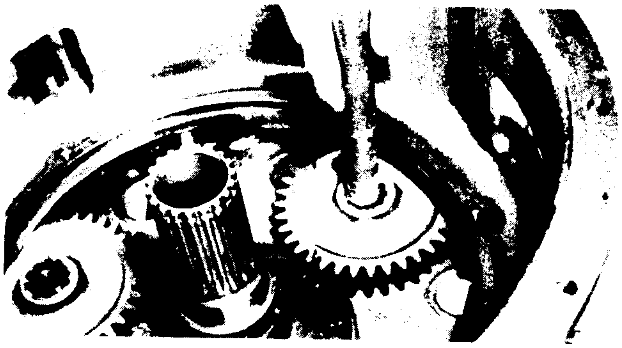


Figure 31

Using a soft bar tap pump shaft assemblies from converter housing.

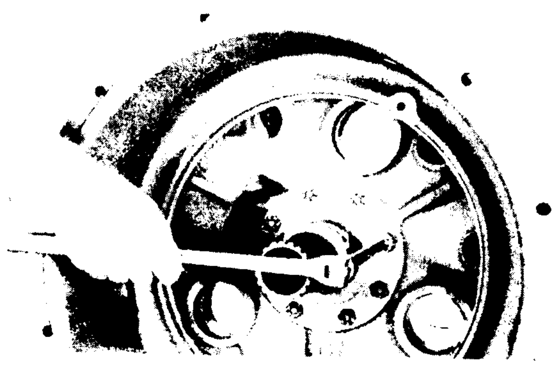


Figure 32

Remove bolts from stator supports.

Figure 33

Remove stator support.

Figure 34

If inner turbine shaft bearing cup is to be replaced remove as shown in Figure 34.

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and slushed up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

Bearings

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

Housings

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: Care should be exercised to avoid inhalation of vapors and skin rashes when using alkali cleaners.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or lapping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in Type "A" Automatic Transmission Fluid and wrap in clean lintless cloth or paper to protect them until installed.

Oil Seals, Gaskets, Etc.

Replacement of spring load oil seals, "O" rings, metal sealing rings, gaskets and snap rings is more economical when unit is disassembled 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 more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. **Apply a thin coat of Permatex No. 2 on the outer diameter of the oil seal to assure an oil tight fit into the retainer. When assembling new metal type sealing rings, same should be lubricated with coat of chassis grease to stabilize rings in their grooves for ease of assembly of mating members.** Lubricate all "O" rings and seals with Type "A" Automatic Transmission Fluid before assembly.

Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts and quills to make certain they are not sprung, bent, or splines twisted, and that shafts are true.

Housing, Covers, etc.

Inspect housings, covers and bearing caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or condition which would cause subsequent oil leaks or failures.

REASSEMBLY OF TORQUE CONVERTER

Instructions given below on reassembly of components are given in the sequence that must be followed in rebuilding.

Figure 35

Install stator support.

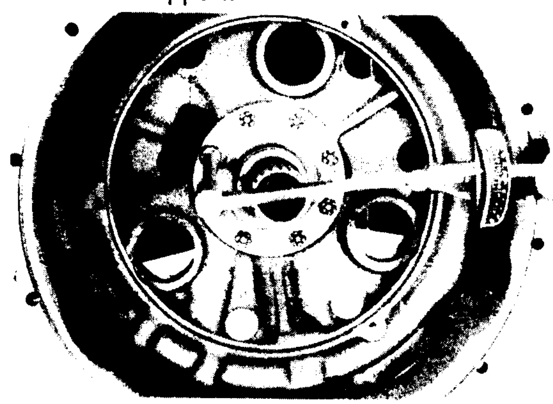


Figure 36

Install support self locking bolts and tighten 70 to 85 ft. lbs. torque.

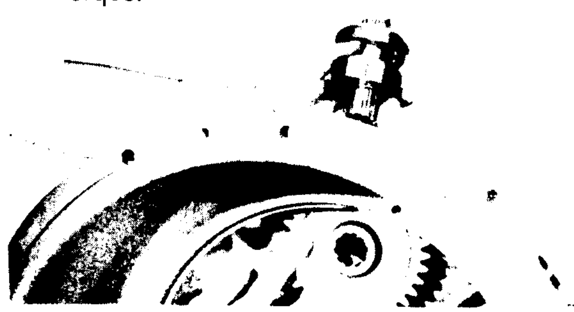


Figure 37

With pump driven gear in position, install pump shaft and bearing assembly through rear of case and into pump driven gear.

Figure 38
Install pump bearing retainer washer and ring.

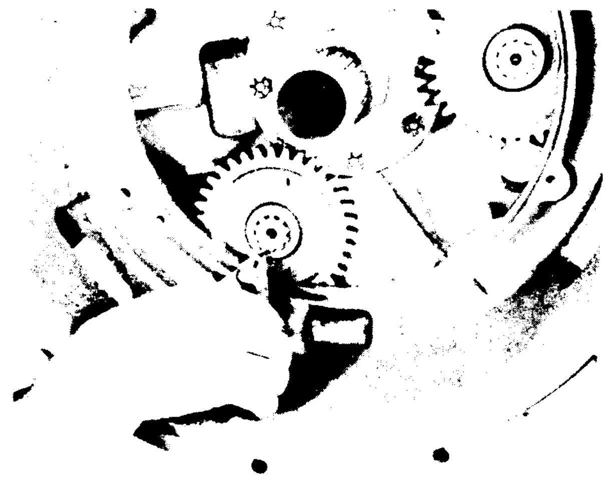


Figure 39
Install pump driven gear to shaft retainer ring. Repeat procedure for all pump shafts and gears.

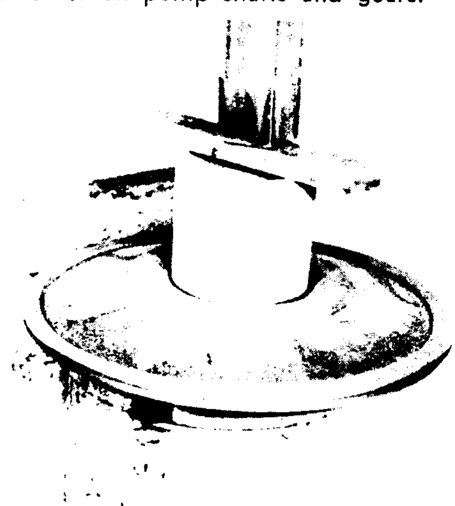


Figure 40
Apply a thin coat of No. 2 Permatex to outer diameter of oil seal and press into bore of oil baffle. Lip of seal must be upward.

NOTE: Before installing oil baffle remove impeller hub bolts and install new impeller to hub "O" ring.

Figure 41
Install oil baffle on impeller and hub assembly. Use caution as not to damage oil seal. Install pump drive gear and retainer ring.

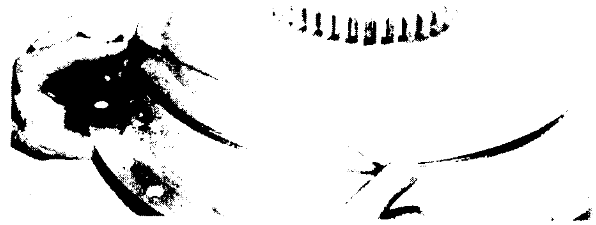


Figure 42
Install oil baffle "O" ring. Lubricate "O" ring with type "A" automatic transmission fluid.

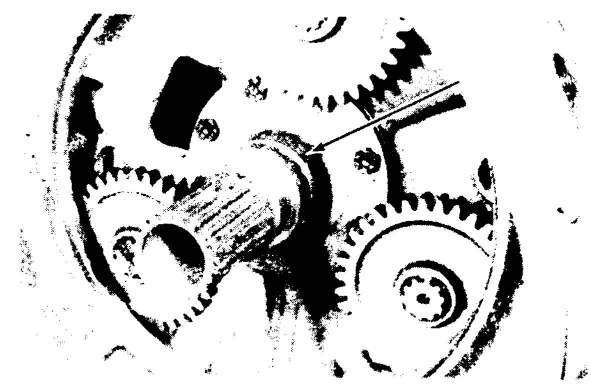


Figure 43
Install stator support sealing ring (see arrow).

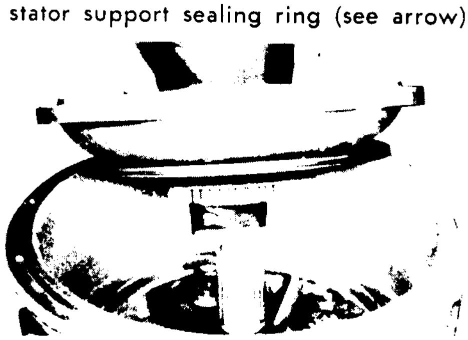


Figure 44
Install impeller and oil baffle assembly over stator support and into converter housing. Use caution as not to damage oil baffle "O" ring.

Figure 45
Install impeller hub bearing inner race.

Figure 46
Press roll pin in reaction member. Press spacer on roll pin.

Figure 47
Install reaction member on stator support and secure with retainer ring.

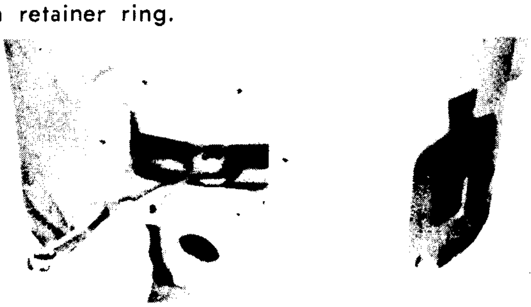


Figure 48
Install oil baffle lockwashers and flat washers on baffle bolts. Install bolts and washers in converter housing. Tighten evenly and securely.

Figure 49
Using a soft bar install turbine shaft inner bearing cup.

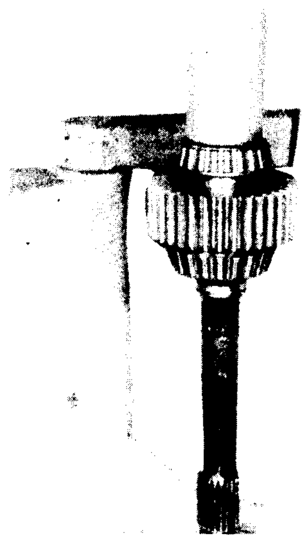


Figure 50
Install turbine shaft inner bearing, gear and outer bearing on shaft.

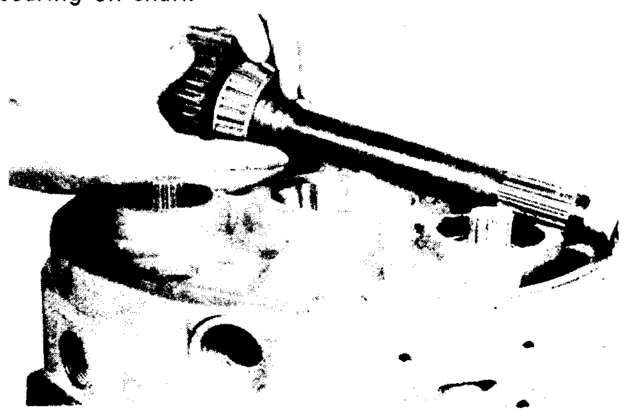


Figure 51
Install turbine shaft oil sealing ring. Block converter housing on pilot end and install turbine shaft assembly in converter housing.

Figure 52

Position output shaft inner bearing, gear spacer and gear in converter housing rear cover.

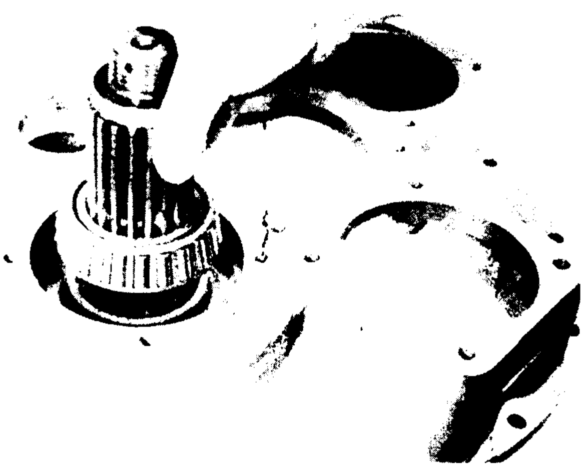


Figure 53

Press outer bearing on output shaft. Turn rear cover over and position output shaft in output gear and spacer. Press output shaft into inner bearing.

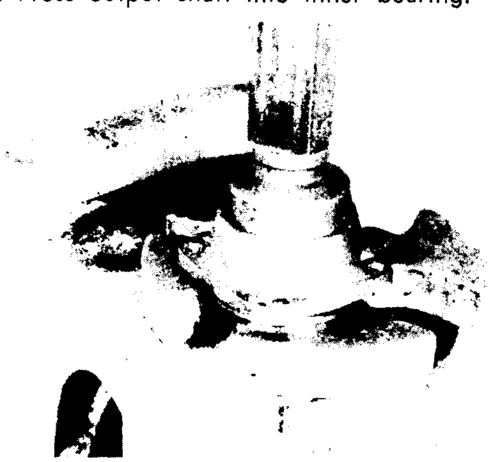


Figure 54

Apply a thin coat of Permatex No. 2 on the outer diameter of the output shaft oil seal. Press oil seal in bearing cap with lip of seal down.

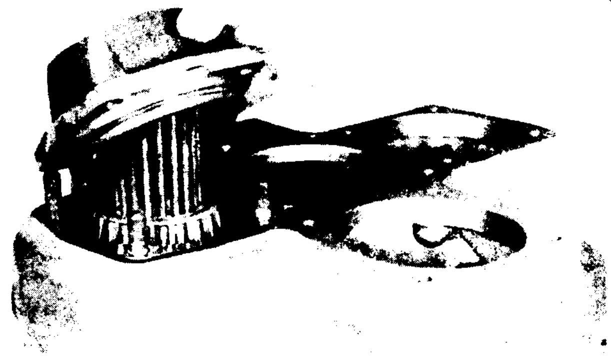


Figure 55

Install new "O" ring on output shaft bearing cap. Install bearing cap on output shaft.

Figure 56

Install stud nuts and tighten securely. This is to insure proper seating of taper bearings.

Figure 57

Loosen stud nuts. Tighten stud nuts evenly finger tight, this will prevent bearing cap from moving while selecting shims. Check gap between bearing cap and rear cover with shims used as a feeler gauge. REMOVE sufficient shims to produce a .002" tight condition. EXAMPLE: Gap is .010"; final shim pack thickness to .008".

Figure 58

Install shim pack, bearing cap, stud lockwashers and stud nuts. Tighten nuts to 47 to 55 ft. lbs. torque.

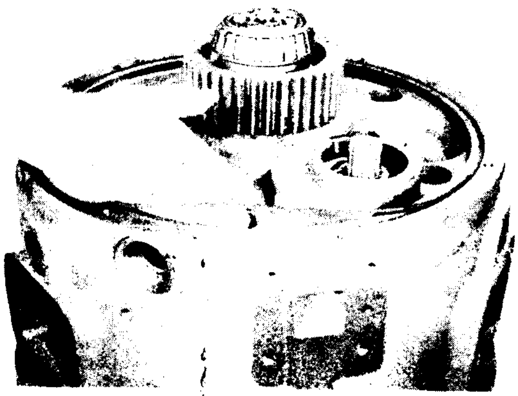


Figure 59

Install converter housing to rear cover "O" ring.

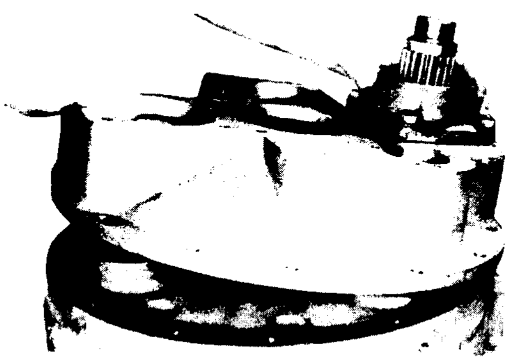


Figure 60

Install rear cover and output shaft on converter housing.

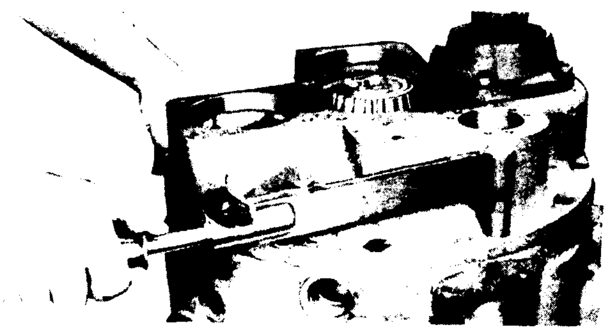


Figure 61

Install rear cover bolts and lockwashers. Tighten bolts 35 to 45 ft. lbs. torque.

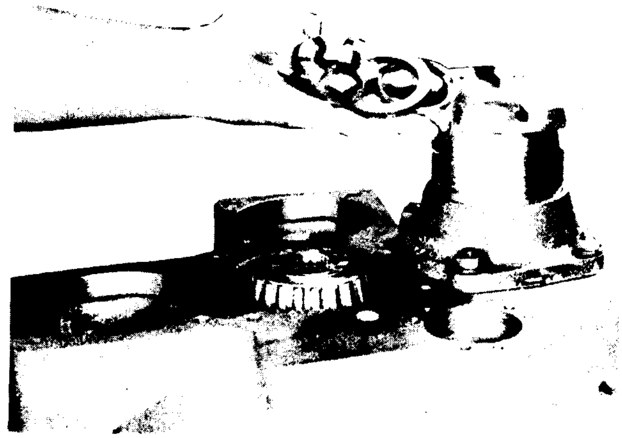


Figure 62

Using a soft bar, lock converter output gears. Install output flange, flange "O" ring, washer, and nut.

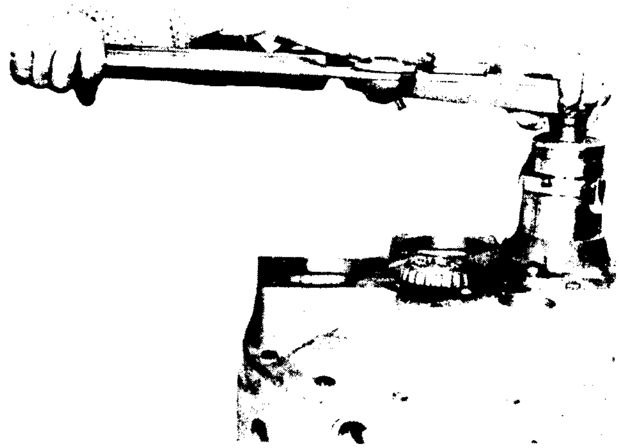


Figure 63

Tighten flange nut 250 to 300 ft. lbs. torque.

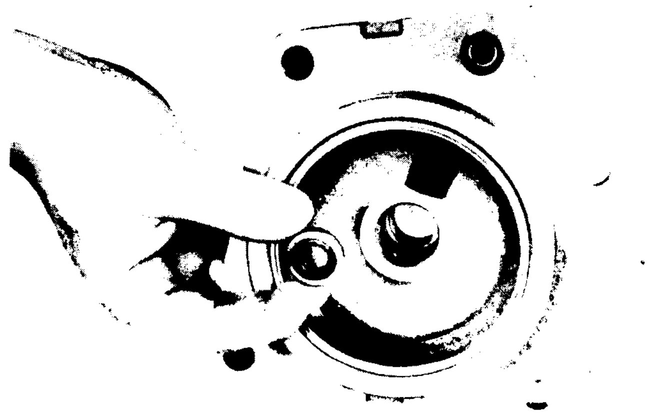


Figure 64

If governor drive is used, install new oil seal (lip of seal up) in turbine shaft bearing cap. Install turbine shaft outer bearing cup in bearing cap.

Figure 65

Install bearing cap on turbine shaft. Install stud nuts and tighten securely. This is to insure proper seating of taper bearings.

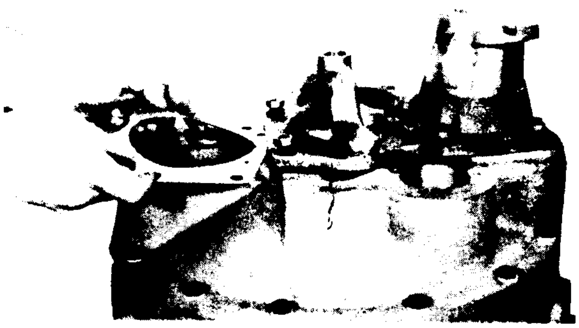


Figure 66

Loosen stud nuts. Tighten stud nuts evenly finger tight, this will prevent bearing cap from moving while selecting shims. Check gap between bearing cap and rear cover with shims used as a feeler gauge. ADD sufficient shims to produce a .002" loose condition. EXAMPLE: Gap is .010"; final shim thickness to be .012". Remove bearing cap.

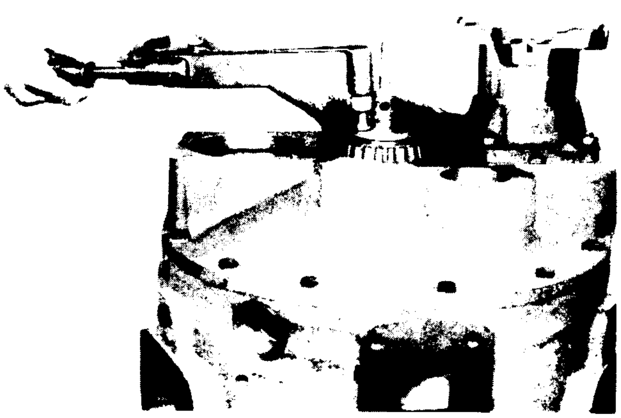


Figure 67

Install adaptor on turbine shaft. **NOTE**: Adaptor will vary for lock-up, lock-up and governor drive, and governor drive. Assembly and disassembly is the same for all. Install bolts and tighten 20 to 25 ft. lbs. torque. Lockwire to prevent loosening.

Figure 68

Install "O" rings on lube tube (see arrows). Using bearing cap as a guide for lube tube flange, install lube tube in rear housing.

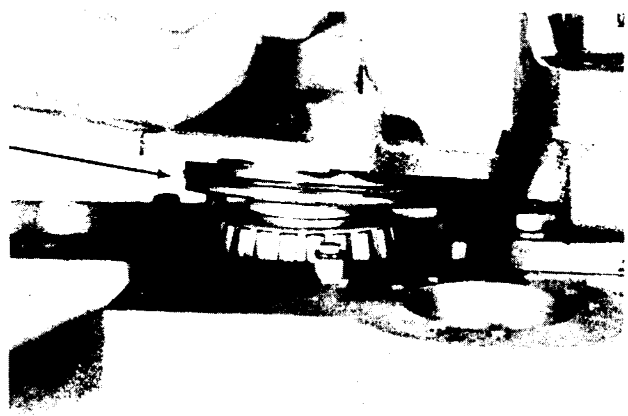


Figure 69

With bearing cap shims and new "O" ring (see arrow) in position install bearing cap.

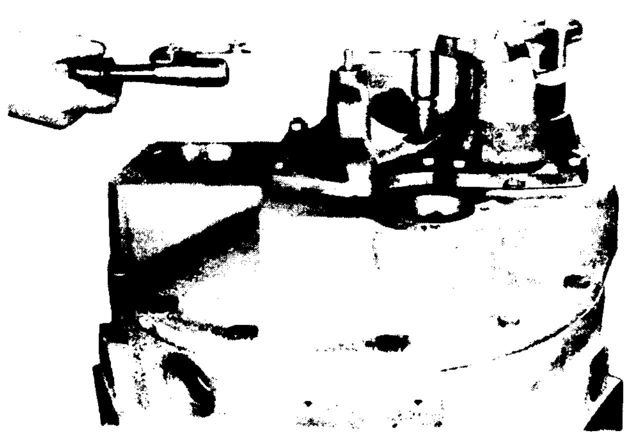


Figure 70

Install lockwashers and nuts. Tighten nuts 47 to 55 ft. lbs. torque.

If lock-up is used refer to Figure 71 through 87. If non lock-up is used refer to figures 88 through 94.

Figure 71
Install lock-up piston inner sealing ring.

Figure 72
Install lock-up piston outer sealing ring.

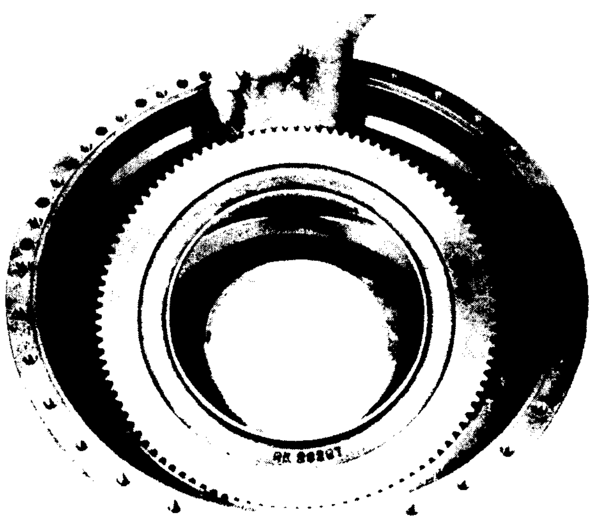


Figure 73
Install lock-up piston in impeller cover.

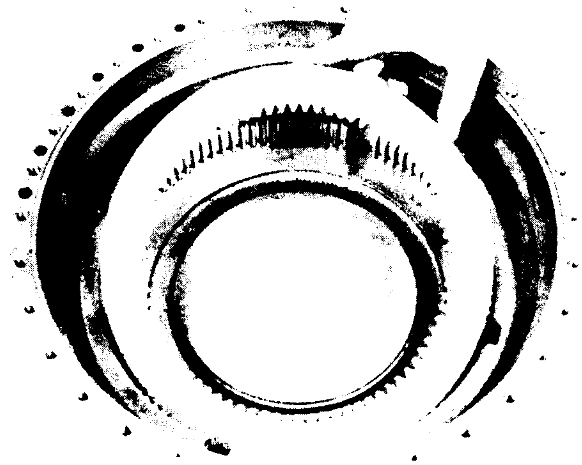


Figure 74
Install one (1) bronze inner disc against lock-up piston.

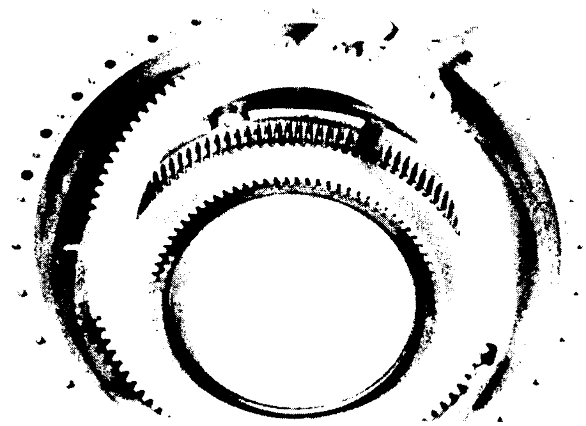


Figure 75
Install one (1) steel outer disc. Install bronze inner disc against steel outer disc.

Figure 76
Install lock-up backing plate with flat side of plate against the last bronze disc.

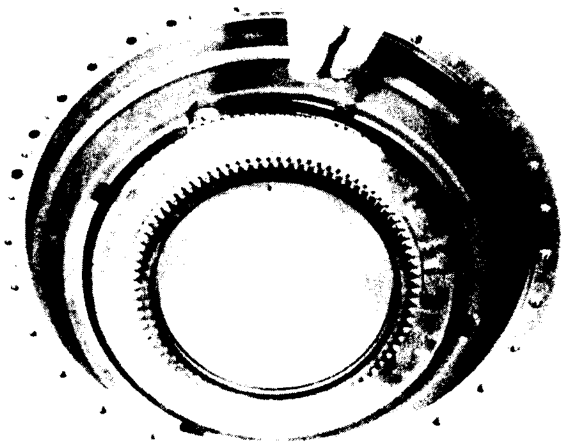


Figure 77
Install backing plate retainer ring, with split in ring at lock plate position.

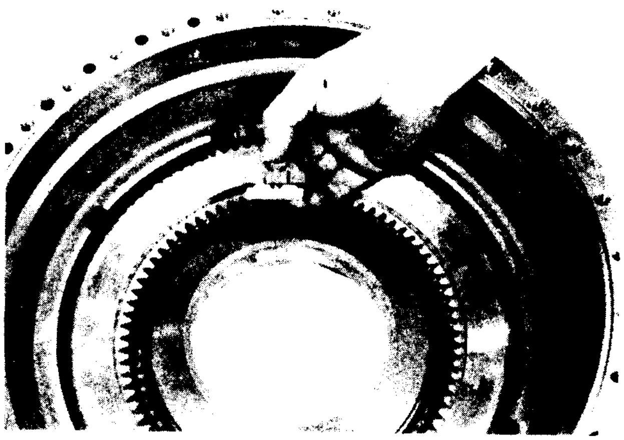


Figure 78
Install retainer ring lock, bolt lock and bolt. Tighten bolt to 10 ft. lbs. torque. Bend tangs of bolt lock over head of bolt.

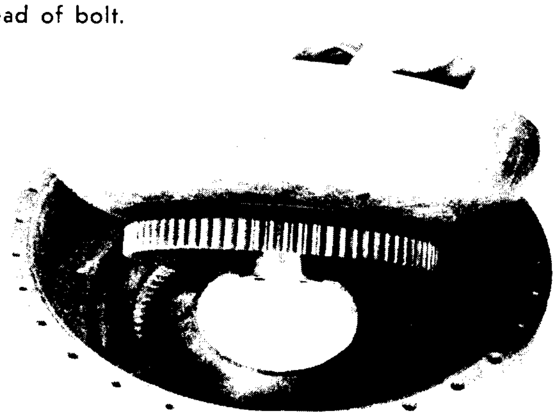


Figure 79
Install turbine and lock-up hub in impeller cover. Turn turbine slowly to allow lock-up hub to engage in inner lock-up discs. Do not force this operation. When turbine is in full position in lock-up discs, turn assembly over and block turbine to prevent it from dropping out of position.

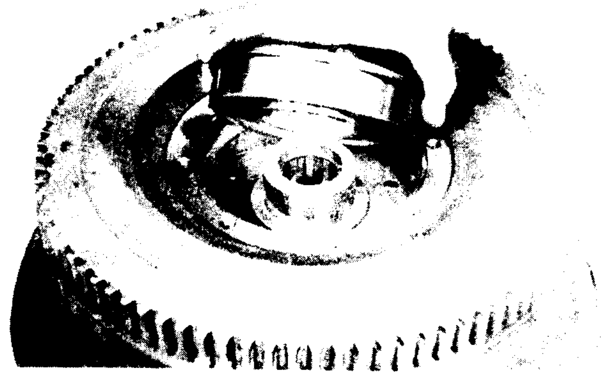


Figure 80
Install impeller cover to turbine hub front bearing.

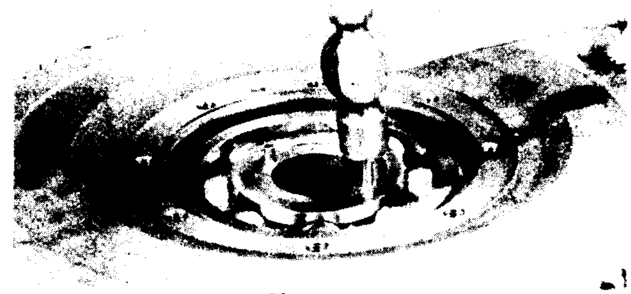


Figure 81
Install turbine hub dowels.

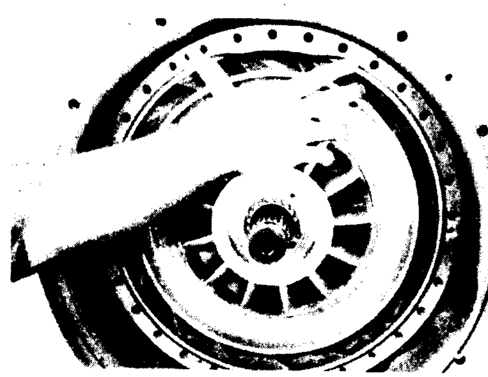


Figure 82
Position impeller to impeller cover "O" ring.

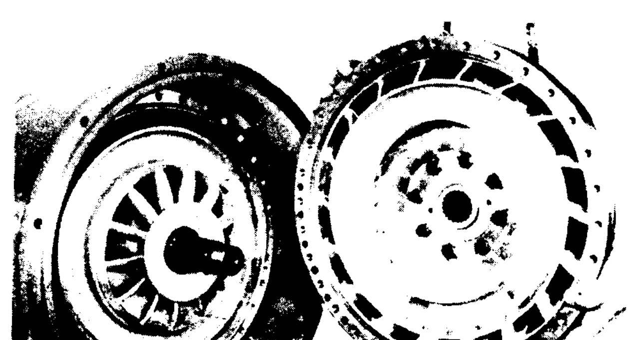


Figure 83
Install turbine and lock-up cover on turbine shaft.

Figure 84

Align holes in impeller with holes in impeller cover. Install bolts and lockwashers. Tighten bolts evenly and securely.

Figure 85

Install bearing retainer plate on turbine shaft.

Figure 86

Install bearing plate retainer ring.

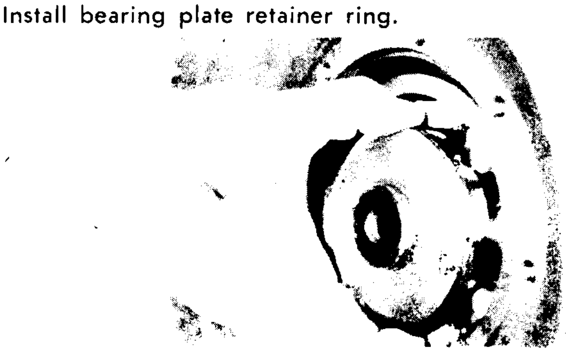


Figure 87

Install bearing plate oil sealing ring.

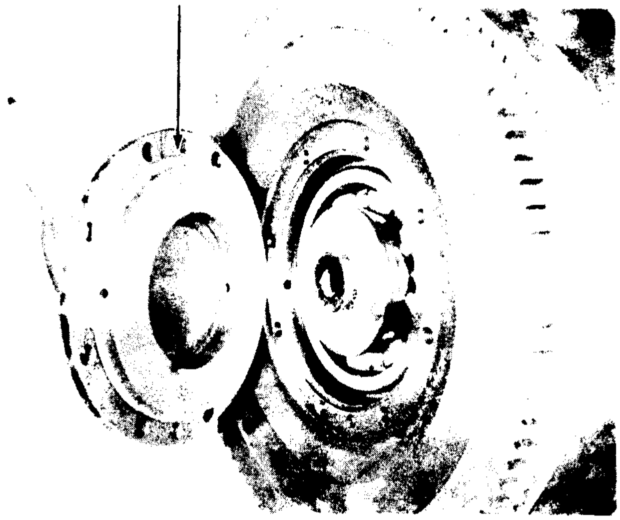


Figure 88

Position new "O" ring (see arrow) on impeller cover bearing cap. Install bearing cap on impeller cover. See Figure 95 for torque.

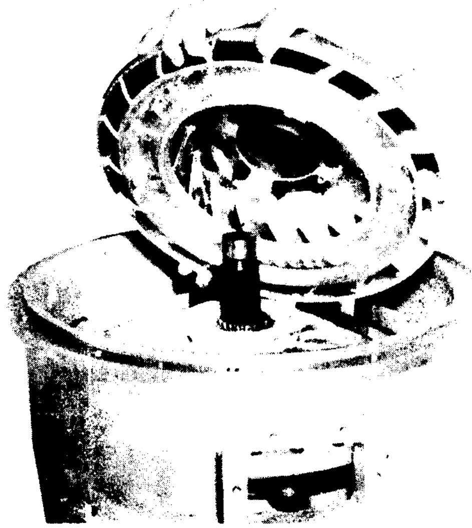


Figure 89

If lock-up is not used install turbine assembly on turbine shaft.

Figure 90

Install impeller cover and bearing assembly on turbine hub. Drive bearing into position. Align holes in impeller with impeller cover and install bolts and lockwashers. Tighten bolts evenly and securely.

Figure 91
Install bearing retainer plate.

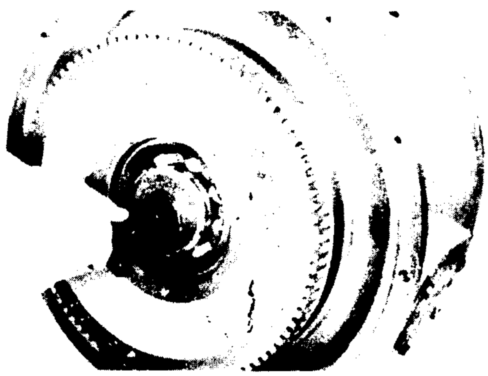


Figure 92
Install bearing plate retainer ring.

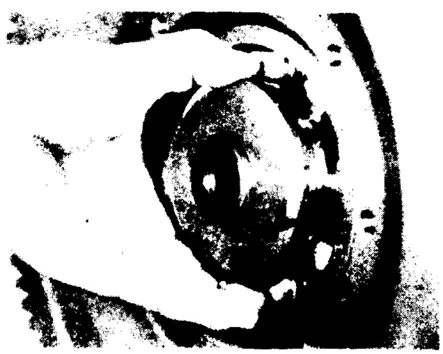


Figure 93
Install bearing plate oil sealing ring.

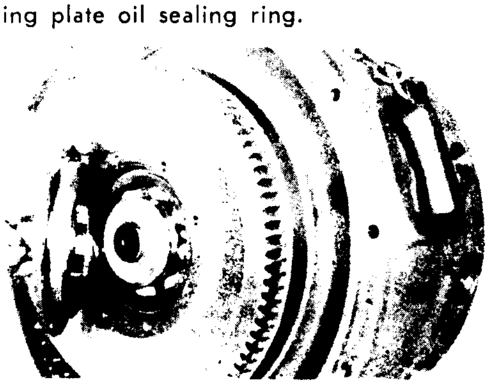


Figure 94
Position new "O" ring on impeller cover **bearing cap.** Install bearing cap on impeller cover.

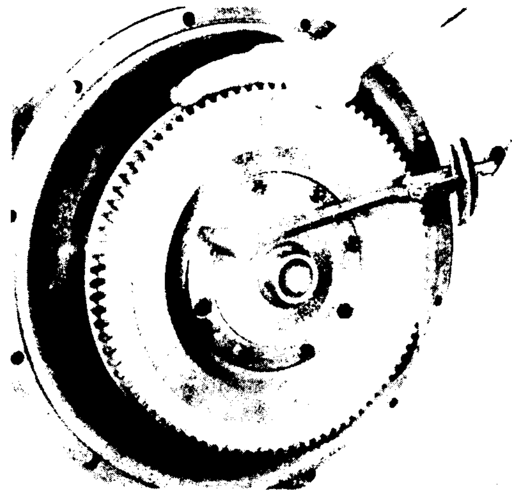


Figure 95
Install self-locking bearing cap bolts in bearing cap and tighten 45 to 60 ft. lbs. torque.

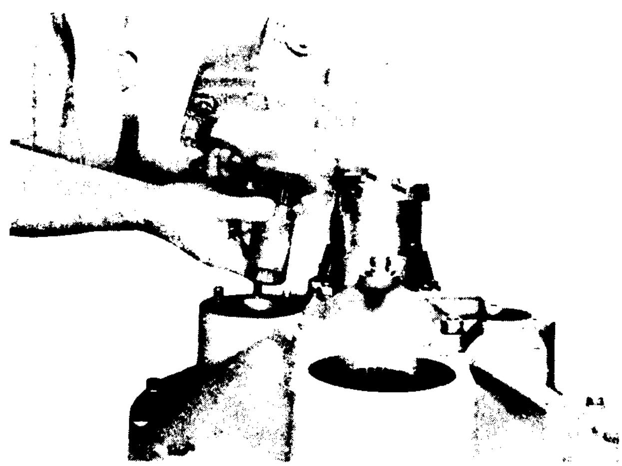


Figure 96
Install pump drive-sleeve and pump on converter housing rear cover.

Figure 97
Install lockwashers and stud nuts. Tighten securely.

SERVICING MACHINE AFTER TORQUE CONVERTER OVERHAUL

The torque converter, transmission and its allied hydraulic system are important links in the drive line between the engine and the wheels. The proper operation of either unit depends greatly on the condition and operation of the other, therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered completed.

After the overhauled or repaired torque converter has been installed in the machine, the transmission, oil cooler, filter and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgment must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
3. Replace oil filter elements, cleaning out filter cases thoroughly.
4. The oil cooler must be thoroughly cleaned. The cooler should be "back flushed" with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary radiator and cooler assembly should be removed from machine for cleaning, using oil, compressed air and steam cleaner for that purpose. DO NOT use flushing compounds for cleaning purposes.
5. Remove transmission sump pan and screen. Clean thoroughly. Use new gasket when reassembling.
6. Remove clutch covers and clutch assemblies. Clean disassembled clutch components thoroughly and check for wear.
7. Remove transmission control cover and check it for foreign material. Check inside of transmission case, gears, shafts and bearings for presence of foreign material. If presence of considerable foreign material is noted inside of case and clutch components, it will be necessary that transmission be disassembled and cleaned thoroughly. DO NOT attempt to clean by use of flushing compounds. It is realized this entails extra labor, however, such labor cost is a minor premium compared to cost of difficulties which can result from presence of such foreign material in the system.
8. **Reassemble all components and using only specified Transmission Fluid, fill torque converter and transmission through filler opening until fluid comes up to FULL mark on transmission dip-stick. Reinstall fill plug and dipstick and run engine two minutes at 500 - 600 RPM to prime torque converter and hydraulic lines. Recheck level of fluid in transmission with engine running at idle (500-600 RPM) and add quantity necessary to bring level up to FULL mark on dipstick. Recheck with hot oil (180 to 200 degrees).**
9. Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

SPECIFICATIONS AND SERVICE DATA — POWER SHIFT TRANSMISSION AND TORQUE CONVERTER

GEAR TYPE Spur

CONTROLS Forward and Reverse — Manual
Speed Selection — Manual

CLUTCH TYPE Multiple discs, hydraulically actuated, spring released, automatic wear compensation and no adjustment. All clutches oil-cooled and lubricated.

CLUTCH INNER DISC Sintered Bronze

CLUTCH OUTER DISC Steel

CLUTCH PRESSURE 180-220

OIL FILTRATION Full flow oil filter safety by-pass, also strainer screen and magnets in sump at bottom of transmission case.

LUBRICATION

TYPE OF OIL See Lubrication Chart

CAPACITY Consult Operator's Manual on applicable machine model for system capacity. Torque Converter, Transmission and allied hydraulic system must be considered as a whole to determine capacity.

CHECK PERIOD Check oil level DAILY with engine running at 500-600 RPM and oil at 180 degrees F. to 200 degrees F.

DRAIN PERIOD Maintain oil level to FULL mark on dipstick. Every 250 hours change oil filter element. Every 500 hours, drain and refill system as follows: Drain with oil at 150 degrees F. to 200 degrees F.

(a) Drain converter at bottom rear of converter housing.

(b) Drain transmission and remove sump. Clean pan and screen thoroughly and replace using new gaskets.

(c) Drain oil filters, remove and discard filter elements. Clean filter shells and install new elements.

(d) Refill transmission to FULL mark on dipstick.

(e) Run engine at 500-600 RPM to prime converter and lines.

(f) Recheck level with engine running at 500-600 RPM and add oil to bring level to FULL mark on dipstick. When oil temperature is hot (180 degrees to 200 degrees), make final oil level check.

RECOMMENDED OILS FOR CLARK POWER SHIFT TRANSMISSIONS AND CONVERTERS HAVING COMMON OIL SYSTEM		
INITIAL FILL	**TYPE "A" SUFFIX "A" or DEXRON***	**AUTOMATIC TRANSMISSION FLUID**
	SUBSEQUENT FILL OR REFILLS	
Prevailing Ambient Temp.	**SAE Spec.**	**Type**
Above 0° F	Type "A" Suffix "A" or Dexron*	Automatic Transmission Fluid
	Type C-2	Hydraulic Fluid
	SAE 10 Mil. 2104B	MS-DG or Grade 10
Below 0° F	Type "A" Suffix "A" or Dexron*	Automatic Transmission Fluid

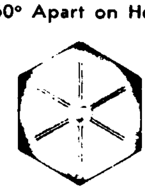
* DEXRON is a Registered Trademark of General Motors Corporation and is completely compatable with Type "A" and may be used as a make up or refill oil in any quantity. NOTE: When changing to oil of a different grade or type, thoroughly flush system with the type and grade oil to be used. This does NOT include Type "A" to DEXRON*.

TORQUE IN (LBS. — FT.)
BOLTS, CAPSCREWS, STUDS AND NUTS

Grade 5 Identification, 3 Radial Dashes 120° Apart on Head of Bolt

Grade 5

Grade 8 Identification, 6 Radial Dashes 60° Apart on Head of Bolt



Grade 8

COARSE THREADS	Grade 5 Dry	Grade 5 Lubricated or Plated	Grade 8 Dry	Grade 8 Lubricated or Plated
3/8 — 16	31 — 34	23 — 25	44 — 48	33 — 36
7/16 — 14	49 — 54	37 — 41	70 — 77	52 — 57
1/2 — 13	75 — 83	57 — 63	106 — 117	80 — 88
9/16 — 12	109 — 120	82 — 90	153 — 168	115 — 127
5/8 — 11	150 — 165	113 — 124	212 — 233	159 — 175

TABLE OF TORQUE LIMITS

	TORQUE IN FT. LBS.								
	Minimum				Maximum				
Converter Series	C270	C5000	C8000	C16000	C270	C5000	C8000	C16000	
BOLT									ITEM
Self Locking			45	70			60	85	Drive Disc Adaptor
Self Locking			70	135			85	145	Stator Support
Body Fit				282				310	Offset Housing
	200	200	250	250	250	250	300	300	Output Flange Nut

PRESSURE AND OIL FLOW CHECK SPECIFICATIONS. ALL CHECKS MADE WITH HOT OIL (180 Degrees F. to 200 Degrees F.)

A.	Clutch Pressure at Transmission Control Cover	180-220 p.s.i. at Engine idle, each clutch and no more than 5 p.s.i. variation between all clutches.
B.	Transmission to Converter Line	See External Oil Flow Diagram.
C.	Converter-Out Pressure	See Pressure and Oil Flow Checks.
D.	Temperature Gauge Connection	See External Oil Flow Diagram.
E.	Lubricating Pressure	25 p.s.i. Maximum at High Free Idle.
	Converter Return Line	See External Oil Flow Diagram.
	Converter Pump Output	See Pump Chart.

TROUBLE SHOOTING GUIDE

The following data is presented as an aid to locating the source of difficulty in a malfunctioning unit. It is necessary to consider the torque converter charging pump, transmission, oil cooler and connecting oil lines as a complete system when running down the source of trouble since the proper operation of any unit therein depends greatly on the condition and operation of the others. By studying the principles of operation together with data in this section, it may be possible to correct any malfunction which may occur in the system.

TROUBLE SHOOTING PROCEDURE BASICALLY CONSISTS OF TWO CLASSIFICATIONS: MECHANICAL AND HYDRAULIC.

MECHANICAL CHECKS

Prior to checking any part of the system from a hydraulic standpoint, the following mechanical checks should be made:

1. A check should be made to be sure all control lever linkage is properly connected and adjusted at all connecting points.

2. Check shift levers and rods for binding or restrictions in travel that would prevent full engagement. Shift levers by hand at transmission case, if full engagement cannot be obtained, difficulty may be in control cover and valve assembly.

HYDRAULIC CHECKS

Before checking on the torque converter, transmission, and allied hydraulic system for pressures and rate of oil flow, it is essential that the following preliminary checks be made.

1. Check oil level in transmission. This should be done with oil temperatures of 180 to 200 degrees F.—DO NOT ATTEMPT THESE CHECKS WITH COLD OIL. To bring the oil temperature to this specification it is necessary to either work the machine or "stall" out the converter. Where the former means is impractical, the latter means should be employed as follows:

Engage shift levers in forward and high speed and apply brakes. Accelerate engine half to three-quarter throttle.

Hold stall until desired converter outlet temperature is reached. CAUTION: FULL THROTTLE STALL SPEEDS FOR AN EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

PRESSURE AND OIL FLOW CHECKS

Whenever improper performance is evident the following basic pressure and oil flow checks should be performed and recorded. It is also recommended that these checks be taken periodically as a preventative maintenance measure. Doing so will permit possible detection of difficulties in advance of actual breakdown, thus permitting scheduling of repair operation. Likewise, repair of minor difficulties can be made at considerably less cost and down-time than when delayed until major and complete breakdowns occur.

Analyzing the results of these checks by comparison with specifications and with each other will indicate in most cases the basic item or assembly in the system as the source of difficulty. Further checking of that assembly will permit isolation of the specific cause of trouble.

(SEE PLUMBING AND CHECK POINT DIAGRAM)

OIL PRESSURE AT **CONVERTER OUT** PORT.

Install hydraulic pressure gauge at **PRESSURE** connection on Converter Regulator Valve or at **CONVERTER OUT** pressure tap. (All models do not have pressure regulating valves.) Check and record oil pressure at 2000 RPM and at maximum speed (engine at full throttle) (see instructions on Stalling Converter previously listed).

CONVERTER MODEL	MAXIMUM CONVERTER OUT PRESSURE
C-270	40 p.s.i.
C-5000	70 p.s.i.
C-8000	70 p.s.i.
C-16000	70 p.s.i.

If a flow meter is available, install in line between converter charging pump and oil filters. Flow meter must be able to withstand 300 p.s.i.

Disconnect hose between pump and filter at filter end and using suitable fittings connect to pressure port of tester. Install hose between filter and tester, connecting same to reservoir port of tester.

DO NOT USE TESTER LOAD VALVE AT ANY TIME DURING TEST. When taking flow reading, all readings should be taken on the first (left) half of flow gauge. Whenever the needle shows on the right half of gauge, correct by switching to higher scale.

If a flow meter is not available for checking converter pump output, proceed with manual transmission and converter checks. If the converter shows leakage within specifications and clutch pressures (180 to 220 p.s.i.) are all equal within 5 p.s.i. refer to paragraph on Low Converter Charging Pump Output.

PUMPS ARE RATED AT 2000 RPM—Refer to Vehicle Manufacture Manual for specific pump output.

NOMINAL PUMP RATINGS:	C-270	C-5000	C-8000	C-16000
	11 G.P.M.	21 G.P.M.	21 G.P.M.	40 G.P.M.
	15 G.P.M.	31 G.P.M.	31 G.P.M.	50 G.P.M.
	21 G.P.M.		40 G.P.M.	65 G.P.M.

Pump output listed applies to a new pump in each case. A 20% tolerance below this figure is permissible; however, if pump output is more than 20% below specification the pump must be replaced and not rebuilt.

TRANSMISSION CLUTCH LEAKAGE

Check clutch pressures at low engine idle with oil at operating temperatures 180° to 200° F. Engine speed must remain constant during entire leakage check. Shift lever into forward 4 or 8 speeds. Record pressures. Shift lever in reverse and 1st. Record pressure. All pressure must be equal within 5 p.s.i. If clutch pressure varies in any one clutch more than 5 p.s.i., repair clutch.

If a flow meter is available install in line coming out of converter pump. See flow diagram for location of pressure on flow checks. Check pump volume at 2000 RPM and at low engine idle. Record readings. See pump volume specifications at 2000 RPM.

Install flow meter in the line coming from transmission to converter. Check oil volume at 2000 RPM and at low idle in the following speed selections. Record readings.

Forward — Low speed thru High   Reverse — Low speed

Subtract readings in each speed from pump volume reading to get transmission clutch leakage.

Example:	Pump Volume at idle	8 gal.	Pump volume	8 gal.
	Forward—Low speed thru High	6 gal.	Forward — Low speed	6 gal.
	Reverse—Low speed	6 gal.	Clutch leakage	2 gal.

If clutch leakage varies more than 1 gal. from one clutch to another, repair clutch.

LEAKAGE IN TRANSMISSION CLUTCHES

Leakage in 3000 series must not exceed 4 gal. max.
Leakage in 5000 series must not exceed 4 gal. max.
Leakage in 8000 series must not exceed 6 gal. max.
Leakage in 16000 series must not exceed 7 gal. max.

CONVERTER LUBE FLOW

Disconnect CONVERTER DRAIN BACK line at transmission with engine running at 2000 RPM and measure oil into a gallon container. Measure oil leakage for 15 seconds and multiply the volume of oil by four to get gallons per minute leakage.

LEAKAGE IN CONVERTER

Leakage in C270 series not to exceed 2 gal. max.
Leakage in C5000 series not to exceed 3 gal. max.
Leakage in C8000 series not to exceed 5 gal. max.
Leakage in C16000 series not to exceed 5 gal. max.

LOW CLUTCH PRESSURE WITH NORMAL CLUTCH LEAKAGE

CAUSE	REMEDY
1. Low Oil Level.	1. Fill to proper level.
2. Broken spring in transmission regulator valve.	2. Replace spring.
3. Clutch pressure regulator valve spool stuck in open position.	3. Clean valve spool and sleeve.
4. Faulty charging pump.	4. See paragraph on charging pump output.

LOW CLUTCH PRESSURE WITH EXCESSIVE CLUTCH LEAKAGE

1. Broken or worn clutch piston sealing rings.	1. Replace sealing rings.
2. Clutch drum bleed valve ball stuck in open position.	2. Clean bleed valve thoroughly.
3. Broken or worn sealing rings on clutch support.	3. Replace sealing rings.
4. Low converter charging pump output.	4. See paragraph on charging pump output.

LOW CONVERTER CHARGING PUMP OUTPUT

CAUSE	REMEDY
1. Low oil level.	1. Fill to proper level.
2. Sump screen plugged.	2. Clean screen and sump.
3. Air leaks at pump intake hose and connections or collapsed hose.	3. Tighten all connections or replace hose if necessary.
4. Defective oil pump.	4. Replace pump.

LOW FLOW THROUGH COOLER WITH LOW CONVERTER IN PRESSURE

1. Defective safety by-pass valve spring.	1. Replace spring.
2. Converter by-pass valve partially open.	2. Check for worn by-pass ball seat.
3. Excessive converter internal leakage. See paragraph E, check converter lube flow.	3. Remove, disassemble, and rebuild converter assembly, replacing all worn or damaged parts.
4. Broken or worn sealing rings in transmission clutches.	4. See paragraph on Clutch leakage.

LOW FLOW THROUGH COOLER WITH HIGH CONVERTER OUT PRESSURE

1. Plugged oil cooler. Indicated if transmission lube pressure is low.	1. Back flush and clean oil cooler.
2. Restricted cooler return line.	2. Clean out lines.
3. Lube oil ports in transmission plugged. Indicated if transmission lube pressure is high.	3. Check lube lines for restrictions.

OVERHEATING

1. Worn oil sealing rings. See paragraph E.	1. Remove, disassemble, and rebuild converter assembly.
2. Worn oil pump.	2. Replace.
3. Low oil level.	3. Fill to proper level.
4. Pump suction line taking air.	4. Check oil line connections and tighten securely.

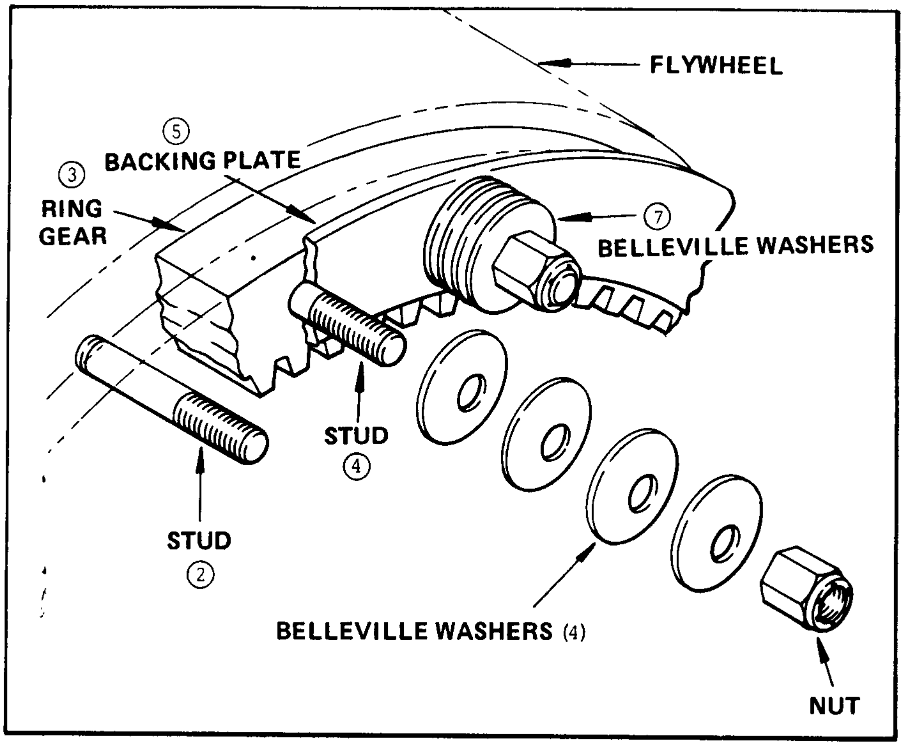
NOISY CONVERTER

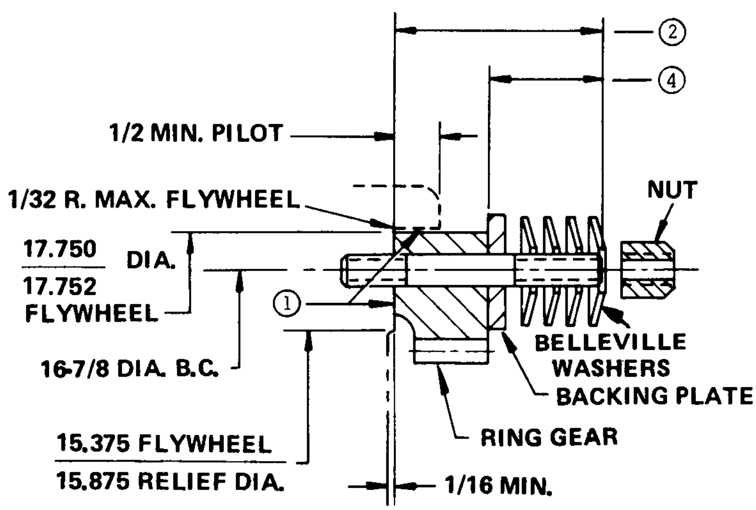
1. Worn coupling gears.	1. Replace.
2. Worn oil pump.	2. Replace.
3. Worn or damaged bearings.	3. A complete disassembly will be necessary to determine what bearing is faulty.

LACK OF POWER

1. Low engine RPM at converter stall.	1. Tune engine check governor.
2. See "Over-heating" and make same checks.	2. Make corrections as explained in "Over-Heating.

C & CL-8000 TORQUE CONVERTERS
FLYWHEEL RING GEAR INSTALLATION PROCEDURE





1 – REMOVE ALL BURRS FROM FLYWHEEL MOUNTING FACE AND PILOT BORE AND CLEAN WITH SOLVENT.

2 – INSTALL THREE STUDS EQUALLY SPACED TO A HEIGHT 2-3/8 + 1/16, – 0, ABOVE THE FLYWHEEL MOUNTING FACE.

3 – INSTALL RING GEAR BY TAPPING LIGHTLY IN PLACE.

4 – INSTALL REMAINING STUDS TO A HEIGHT 1-9/32 + 1/16, – 0, ABOVE RING GEAR FACE.

5 – INSTALL BACKING PLATE.

6 – LUBRICATE STUD THREADS, BELLEVILLE WASHERS & NUTS WITH SAE # 10 OIL.

7 – INSTALL BELLEVILLE WASHERS AND NUTS AS SHOWN. TIGHTEN WITH 45 LBS. FT. OF TORQUE.

FOREWORD

This manual has been prepared to provide the customer and the maintenance personnel with information and instructions on the maintenance and repair of the **CLARK** Power Shift Transmission.

Extreme care has been exercised in the design, selection of materials and manufacturing of these units. The slight outlay in personal attention and cost required to provide regular and proper lubrication, inspection at stated intervals, and such adjustments as may be indicated will be reimbursed many times in low cost operation and trouble free service.

In order to become familiar with the various parts of the transmission, its principal of operation, trouble shooting and adjustments, it is urged that the mechanic study the instructions in this manual carefully and use it as a reference when performing maintenance and repair operations.

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. IMPORTANT: **Always furnish the Distributor with the transmission serial and model number when ordering parts.**

TRANSMISSIONS

DESCRIPTION

The transmission 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 in the field, it is important to first understand their function and how they operate.

The transmission and torque converter function together and operate through a common hydraulic system; therefore, it is necessary to consider both units in study of their function and operation.

The transmission is composed of a control cover, necessary gears, and two kinds of clutches: direction clutches and speed clutches.

The direction and speed clutches are similar in construction. They consist of a drum with internal gear teeth and a bore to receive a hydraulically actuated piston. A piston is inserted into the bore of the drum. The piston is "oil tight" by the use of sealing rings. A bronze disc with internal teeth is inserted into the drum and rests against the piston. Next, a disc with splines at the outer diameter is inserted. Discs are alternated until the required total is achieved. After inserting the last disc, a series of springs and pins are assembled in such a manner that these springs rest on teeth of 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 discs with teeth on the inner diameter and a splined shaft extending through the clutch support. This hub is retained by a snap ring. The discs and inner shaft are free to increase in speed or rotate in the opposite direction as long as no pressure is present in the direction or speed clutch.

OPERATION

With the engine running, the converter charging pump draws oil from the transmission sump and directs it through a filter to the inlet pressure regulating valve located in the transmission control cover. From the regulating valve, oil is then directed through the control cover to the converter and the transmission clutches.

The pressure regulating valve mounted on top of the transmission remains closed until required pressure is delivered to the transmission for actuating the direction and speed clutches. This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is backed up by a spring to hold the valve spool against its seat until the oil pressure builds up to a specified pressure. The valve spool then moves toward the spring until a port is exposed along the side of the bore. The oil can then flow through this port into a distributor which directs the oil into the converter inlet port.

With the engine running and the directional control lever in neutral position, oil pressure is blocked at the control valve and the transmission is in neutral. Movement of the forward and/or reverse spool by hydraulic pressure will direct oil under pressure, to either the forward or reverse direction clutch, as desired, and the opposite one opens to relieve pressure.

To engage a 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, through a tube in the transmission case, to a chosen clutch. Once into the drum, oil is directed through a drilled hole into the rear side of the piston bore. Pressure of the oil forces the piston and discs over against the heavy back-up plate. The discs, with teeth on the outer diameter, clamping against discs with teeth on the inner diameter, enables the clutch drum and drive shaft to be locked together and allows them to turn as a unit. Bleed balls in the clutch drums allow quick escape for oil when the pressure to the piston is released.

The transmission gear train consists of six shafts: (1) Input Shaft, (2) Reverse Shaft, (3) Idler Shaft, (4) First and Third Shaft, (5) Second and Fourth Shaft, (6) Output Shaft.

A screen mounted in a frame is positioned on the bottom of the transmission case, to screen out any foreign material. This screen is covered by the sump pan. This pan is provided with magnets to catch any metallic particles.

EVERYTHING READY?

The transmission 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.

The transmission and torque converter function together and operate through a common hydraulic system. To obtain maximum serviceability they have been designed and built as separate units. It is necessary, however, to consider both units in the study of their function and operation.

HOW THE UNITS OPERATE –

With the engine running, the converter charging pump draws oil from the transmission sump and directs it through oil filters to the regulating valve located on top of the transmission. From the regulating valve it is then directed through the control cover on the transmission to the converter and to the transmission clutches.

The pressure regulating valve mounted on the top of the transmission remains closed until required pressure is delivered to the transmission for actuating the direction and speed clutches. This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is backed up by a spring to hold the valve spool against its seat until the oil pressure builds up to the specified pressure. The valve spool then moves toward the spring until a port is exposed along the side of the bore. The oil can then flow through this port into a distributor which directs the oil into the converter inlet port.

After entering the converter, the oil is directed through the stator support to the converter cavity and exits between the turbine shaft and converter support. The oil then passes through an oil distributor which directs the oil out of the converter by way of a down stream regulator valve and then to the oil cooler. After leaving the cooler the oil is directed through a hose to the lubricating oil inlet on the transmission, then through a series of tubes to the transmission, bearings, and clutches. The oil then returns to the transmission sump.

A safety valve is built in the transmission control cover and will open to bypass oil only if an excessive pressure is built up due to a blocked passage.

The rear compartment of the converter unit also houses the converter output shaft. A flexible hose provides an overflow to the transmission sump.

The three members of the torque converter are composed of a series of blades. The blades are curved in such a manner as to force the oil to circulate from the impeller to the turbine, through the reaction member 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 through the reaction member, again enters the inner side of the impeller.

Converter "Stall" is achieved whenever the turbine and impeller shaft are stationary and the engine is operating at full power or wide open throttle. CAUTION: Do not maintain "Stall" for more than 30 seconds at a time. Excessive heat will be generated and may cause converter or transmission seal damage.

In converters equipped with lock-up clutches, a hydraulic clutch, similiar to the transmission clutches, is used to "lock" the engine mechanically to the output shaft. This is accomplished by hydraulic pressure actuating the lock-up clutch which in turn locks the impeller cover to the turbine hub. During lock-up the converter turns at 1 to 1 speed ratio.

The down stream regulator valve on the converter consists of a valve body and regulator spool. The spool is backed up by a spring to hold the valve until converter oil pressure builds up to specified pressure. The valve is used to maintain a given converter pressure to insure proper performance under all conditions.

The direction or speed clutch assembly consists of a drum with internal gear teeth and a bore to receive a hydraulically actuated piston. A piston is inserted into the bore of the drum. The piston is "oil tight" by the use of sealing rings. A bronze disc with internal teeth is inserted into the drum and rests against the piston. Next, a disc with splines at the outer diameter is inserted. Discs are alternated until the required total is achieved. After inserting the last disc, a series of springs and pins are assembled in such a manner that these springs rest on teeth of 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 discs with teeth on the inner diameter and a splined shaft extending through the clutch support. This hub is retained by a snap ring. The discs and inner shaft are free to increase in speed or rotate in the opposite direction as long as no pressure is present in the direction or speed clutch.

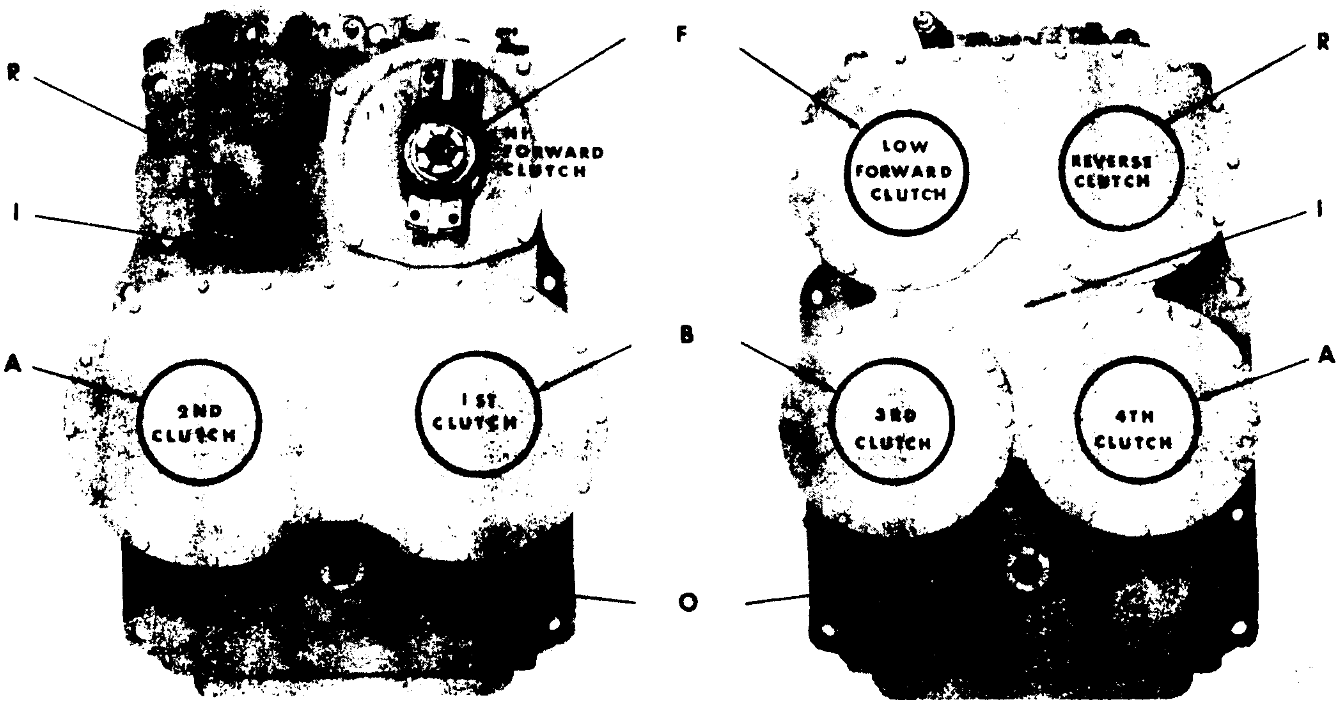
To engage the clutch, the shift lever is placed in the desired position. This allows oil under pressure to flow from the control cover valve, through a tube in the transmission case, to a chosen clutch. Once into the drum, oil is directed through a drilled hole into the rear side of the piston bore. Pressure of the oil forces the piston and discs over against the heavy back-up plate. The discs, with teeth on the outer diameter, clamping against discs, with teeth on inner diameter, enables the clutch drum and drive shaft to be locked together and allows them to turn as a unit.

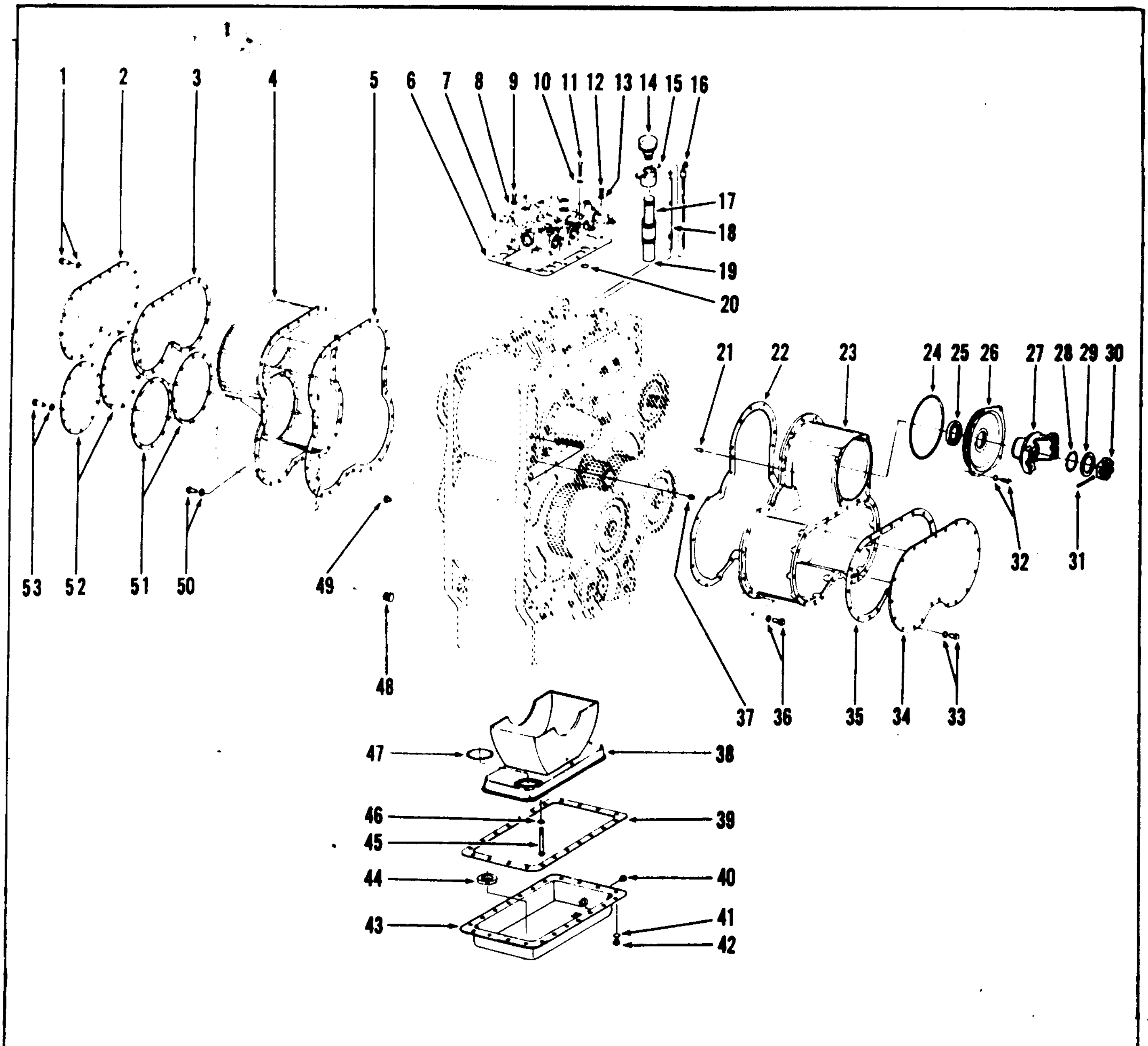
There are bleed balls in the clutch drums which allow quick escape for oil when the pressure to the piston is released.

The transmission gear train consists of six shafts: (1) Input Shaft, (2) Reverse Shaft, (3) Idler Shaft, (4) First and Third Shaft, (5) Second and Fourth Shaft, (6) Output Shaft.

A screen mounted in a frame is positioned on the bottom of the transmission case, to screen out any foreign material. This screen is covered by the sump pan. This pan is provided with magnets to catch any metallic particles.

Some transmissions may have an axle declutching unit as optional equipment, this unit consists of a split output shaft with a sliding splined sleeve to engage or disengage the axle. This is accomplished by manually shifting a lever in the operator's compartment which is mechanically connected to the shift fork on the clutching unit sliding sleeve. This unit, of course, is only used on the four-wheel drive machine. On the front drive only or the rear wheel drive only, the output shaft is a one-piece type and an output flange assembled only on the required end.

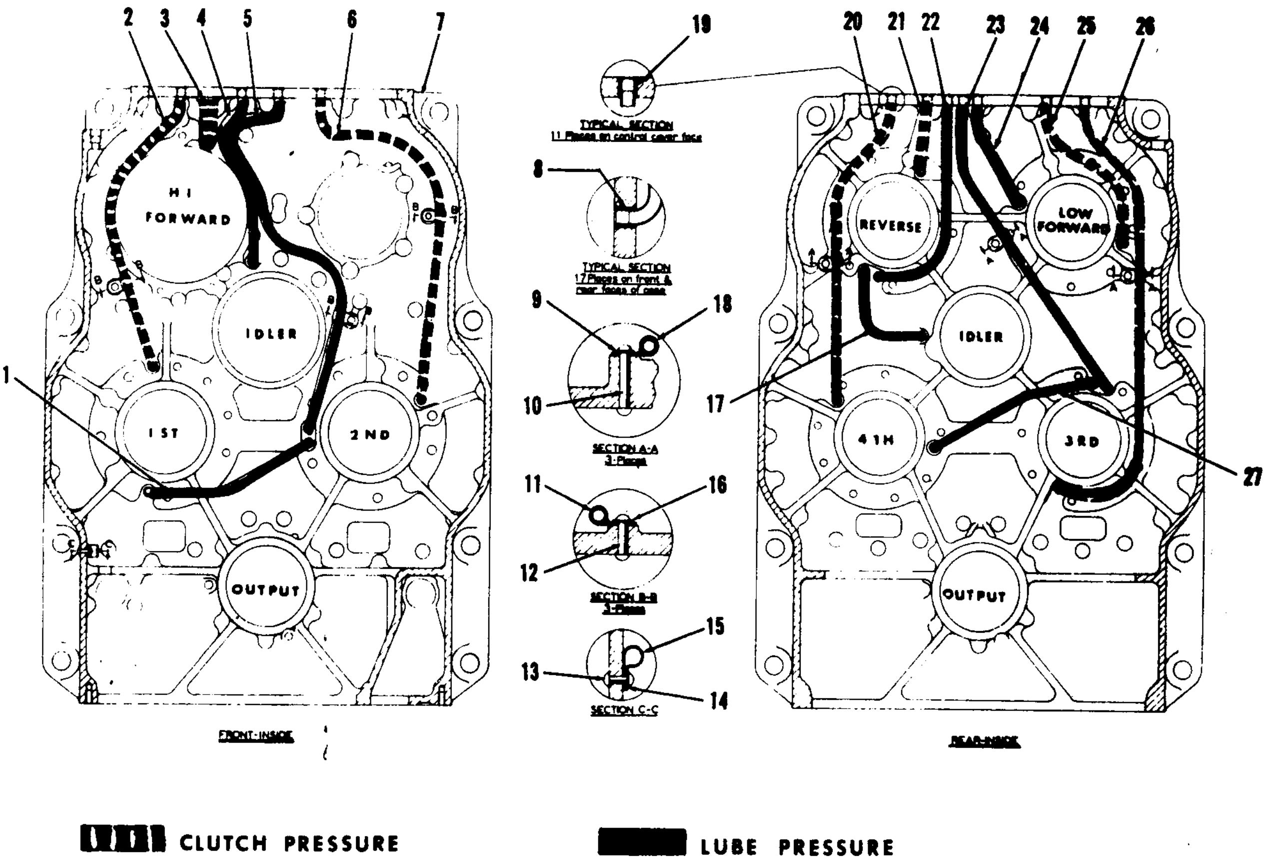




TRANSMISSION ASSEMBLY AND CLUTCH COVER GROUP

TRANSMISSION ASSEMBLY AND CLUTCH COVER GROUP

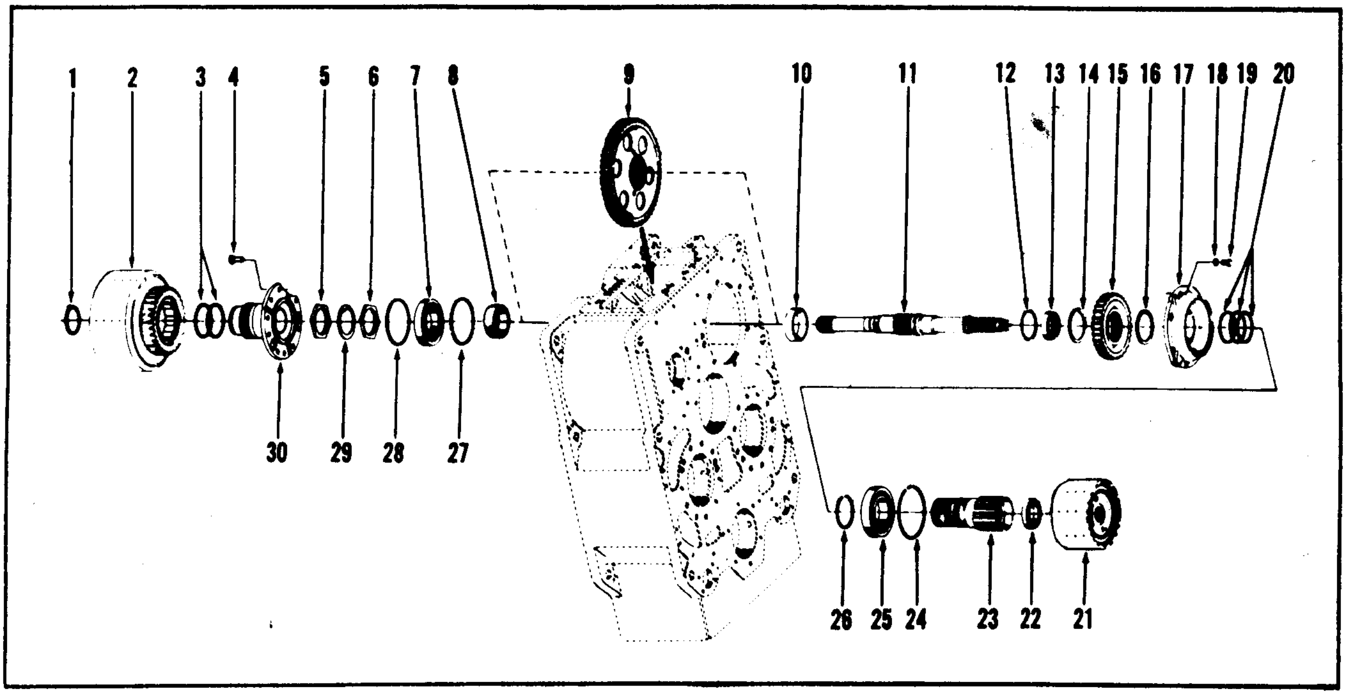
Item No.	Description	No. Req'd
	TRANSMISSION ASSY.	1
1	BOLT & LKWSHR, Plate to Cover (8820 and 16820 only)	20
2	PLATE, Forward & Reverse Cover (8820 and 16820 only)	1
3	GASKET, Cover Plate (8820 and 16820 only)	1
4	COVER, Forward & Reverse—3rd & 4th Clutch	1
5	GASKET, Clutch Cover	1
6	GASKET, Control Cover	1
7	CONTROL COVER ASSY.	—
8	LKWSHR, Control Cover to Case	6
9	BOLT, Control Cover to Case	6
10	LKWSHR, Control Cover to Case	2
11	BOLT, Control Cover to Case	2
12	BOLT, Control Cover to Case	5
13	LKWSHR, Control Cover to Case	5
14	BREATHER, Air	1
15	CAP, Oil Filler	1
16	DIPSTICK, Oil Level	1
17	PIPE, Breather, Inner	1
18	TUBE, Dipstick	1
19	PIPE, Oil Filler	1
20	"O" RING, Control Cover to Case	8
21	PIN, Clutch Cover Locating Dowel	2
22	GASKET, Clutch Cover	1
23	COVER, 1st & 2nd Clutch	1
24	"O" RING, Clutch Cover Plate	1
25	SEAL, Clutch Cover Plate Oil	1
26	PLATE, Clutch Cover	1
27	FLANGE, Input	1
28	"O" RING, Input Flange	1
29	WASHER, Input Flange	1
30	NUT, Input Flange	1
31	COTTER, Input Flange Nut	1
32	BOLT & LKWSHR, Clutch Cover Plate	4
33	BOLT & LKWSHR, Plate to Cover	21
34	PLATE, 1st & 2nd Cover	1
35	GASKET, Cover Plate	1
36	BOLT & LKWSHR, Cover to Case	27
37	PLUG, Drain Line	1
38	FRAME & SCREEN ASSY., Oil Sump	1
39	GASKET, Oil Sump	1
40	PLUG, Drain	1
41	LKWSHR, Sump to Case	22
42	BOLT, Sump to Case	22
43	SUMP ASSY., Oil	1
44	MAGNET, Sump	2
45	BOLT, Frame & Screen to Case	4
46	LKWSHR, Frame & Screen to Case	4
47	"O" RING, Frame & Screen to Case	1
48	PLUG, Transmission Case	1
49	PLUG, Drain	1
50	BOLT & LKWSHR, Cover to Case	33
51	GASKET, Cover Plate (8820 and 16820 only)	2
52	PLATE, 3rd & 4th Clutch Cover (8820 and 16820 only)	2
53	BOLT & LKWSHR, Cover Plate Cover (8820 and 16820 only)	24



CLUTCH PRESSURE LUBE PRESSURE

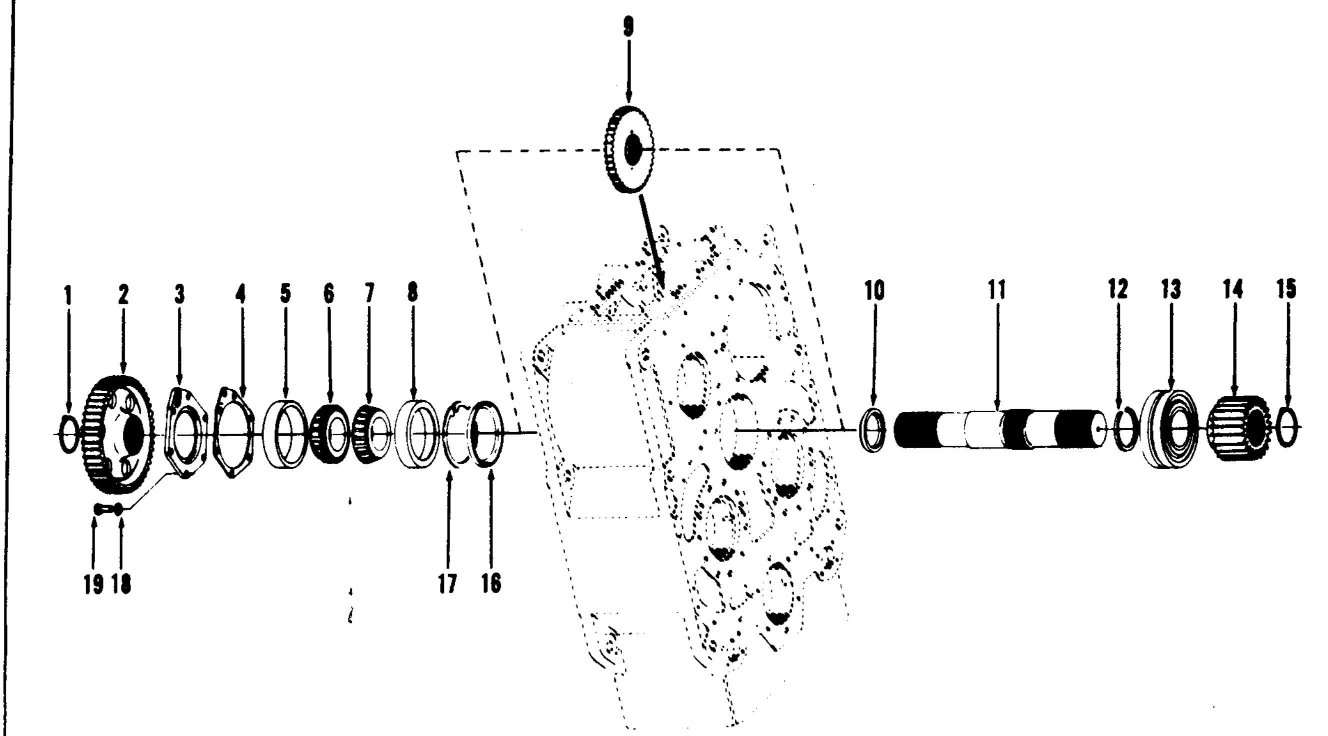
TRANSMISSION CASE AND INTERNAL TUBING

Item No.	Description	No. Req'd	Item No.	Description	No. Req'd
1	TUBE, 2nd to 1st X-Over Lube	1	15	CLIP, Tube	1
2	TUBE, 1st Clutch Pressure	1	16	WASHER, Clip to Case	3
3	PORT, High Forward Pressure	1	17	TUBE, Reverse to Idler X-Over Lube	1
4	TUBE, Idler Shaft Lube	1	18	CLIP, Tube	3
5	TUBE, 2nd Clutch Lube	1	19,	SLEEVE, Tube	11
6	TUBE, 2nd Clutch Pressure	1	20	TUBE, 4th Clutch Pressure	1
7	CASE, Transmission	—	21	TUBE, Reverse Clutch Pressure	1
8	SLEEVE, Tube	17	22	TUBE, Reverse Clutch Lube	1
9	WASHER, Clip to Case	3	23	TUBE, 3rd Clutch Lube	1
10	RIVET, Clip to Case	3	24	TUBE, Forward Clutch Lube	1
11	CLIP, Tube	3	25	TUBE, Forward Clutch Pressure	1
12	RIVET, Clip to Case	3	26	TUBE, 3rd Clutch Pressure	1
13	RIVET, Clip to Case	1	27	TUBE, 3rd to 4th X-Over Lube	1
14	WASHER, Clip to Case	1			



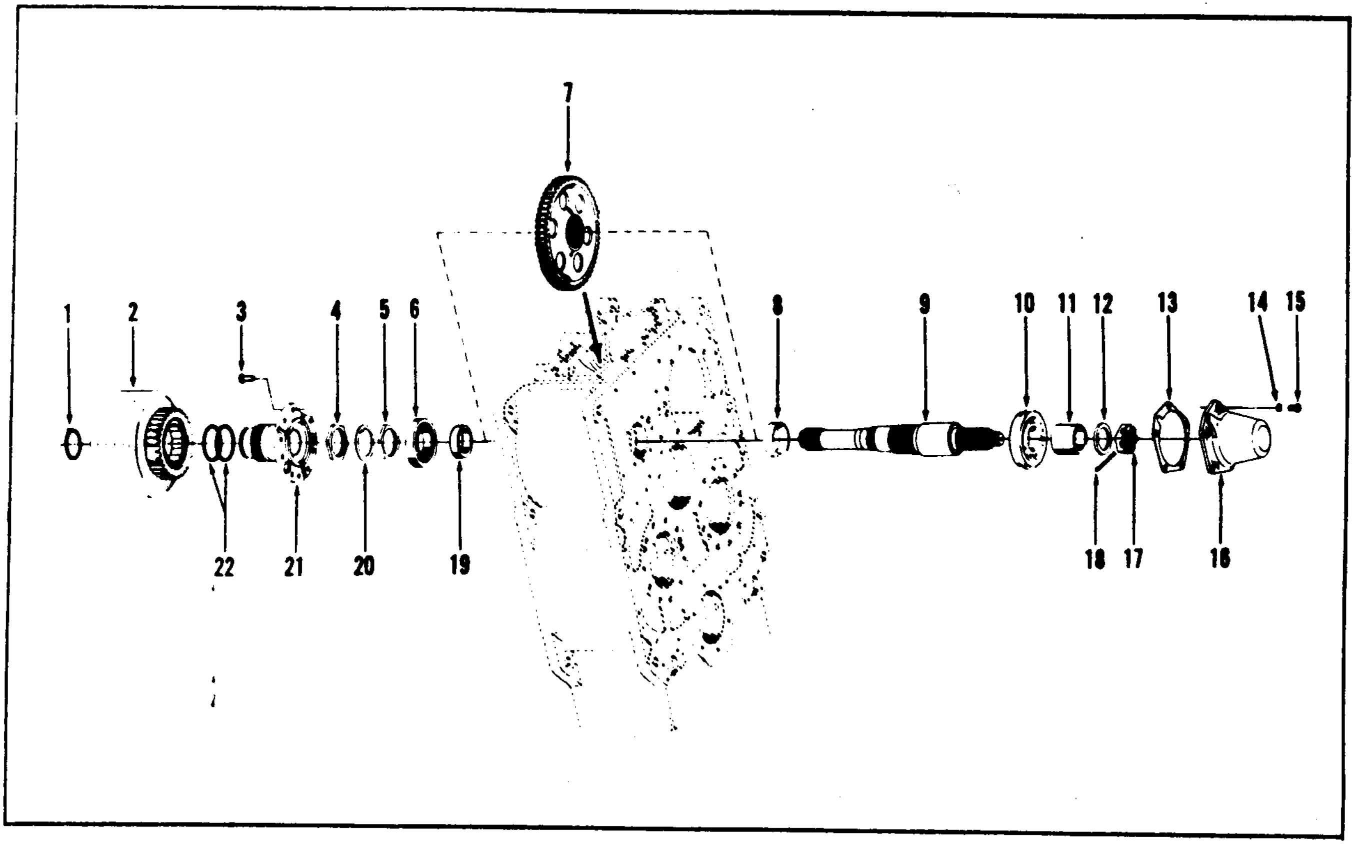
HIGH FORWARD SHAFT GROUP "F"

Item No.	Description	No. Req'd
1	RING, Disc Hub Retaining	1
2	CLUTCH ASSY, Input	—
3	RING, Clutch Support Piston	2
4	BOLT, Clutch Support to Case	8
5	NUT, Bearing Lock	1
6	NUT, Bearing Lock	1
7	BEARING, Rear Drive Shaft	1
8	SPACER, Input Shaft Gear	1
9	GEAR, Input Shaft	1
10	SPACER, Input Shaft Gear **(5820 & 8820 only) 16,820 has internal snap ring in gear, Item No. 9**	1
11	SHAFT, Input	1
12	RING, Bearing Retaining	1
13	BEARING, Clutch Support	1
14	RING, Gear Retaining	1
15	GEAR, Clutch Support	1
16	RING, Gear Retaining	1
17	CARRIER, Bearing	1
18	LKWSHR, Carrier to Case	7
19	BOLT, Carrier to Case	7
20	RING, Piston	3
21	CLUTCH ASSY	—
22	BEARING, Clutch Support **(This bearing is retained with a snap ring in the 16,820 only)**	
23	SLEEVE ASSY, Clutch Support	1
24	RING, Bearing Retaining	1
25	BEARING, Clutch	1
26	PING, Bearing Retaining	1
27	RING, Bearing Retaining	1
28	RING, Bearing Retaining	1
29	LOCK, Bearing Nut	1
30	SUPPORT, Input Clutch	1



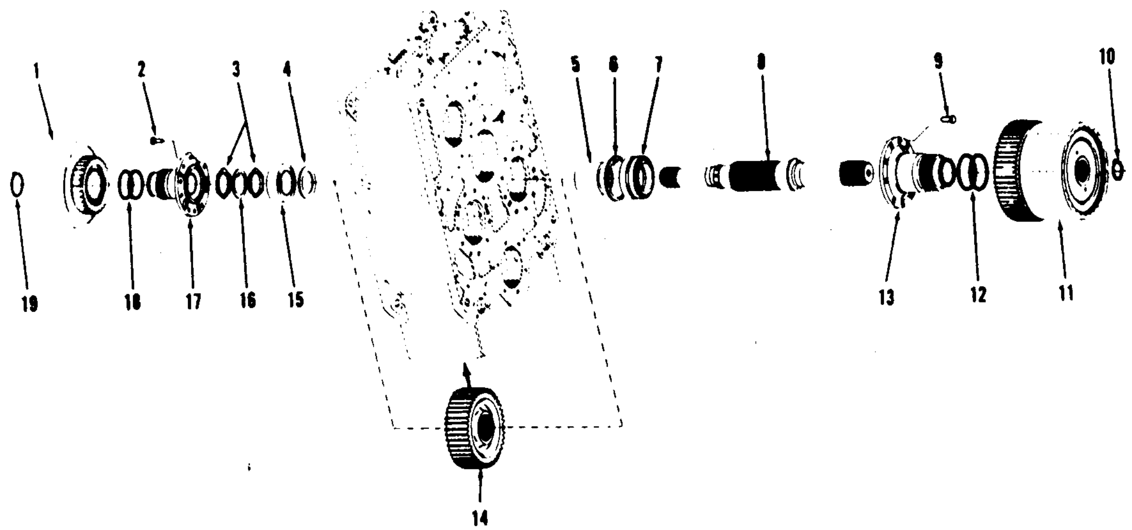
IDLER SHAFT GROUP "I"

Item No.	Description	No. Req'd
1	RING, Gear Retaining	1
2	GEAR, Idler to Low Forward	1
3	CAP, Bearing	1
4	SHIM, Bearing Cap	—
5	CUP, Idler Shaft Tapered Bearing	1
6	CONE, Idler Shaft	1
7	CONE, Idler Shaft	1
8	CUP, Idler Shaft Tapered Bearing	1
9	GEAR, Idler to High Forward	1
10	SPACER, Bearing	1
11	SHAFT, Idler	1
12	RING, Gear Retaining **(5820 only) (8820 & 16820 has internal snap ring in gear, Item No. 9)**	1
13	BEARING, Idler Shaft	1
14	GEAR, Idler to 1st	1
15	RING, Gear Retaining	1
16	BAFFLE, Bearing Oil	1
17	RING, Bearing Retaining	1
18	LKWSHR, Bearing Cap	6
19	BOLT, Bearing Cap	6



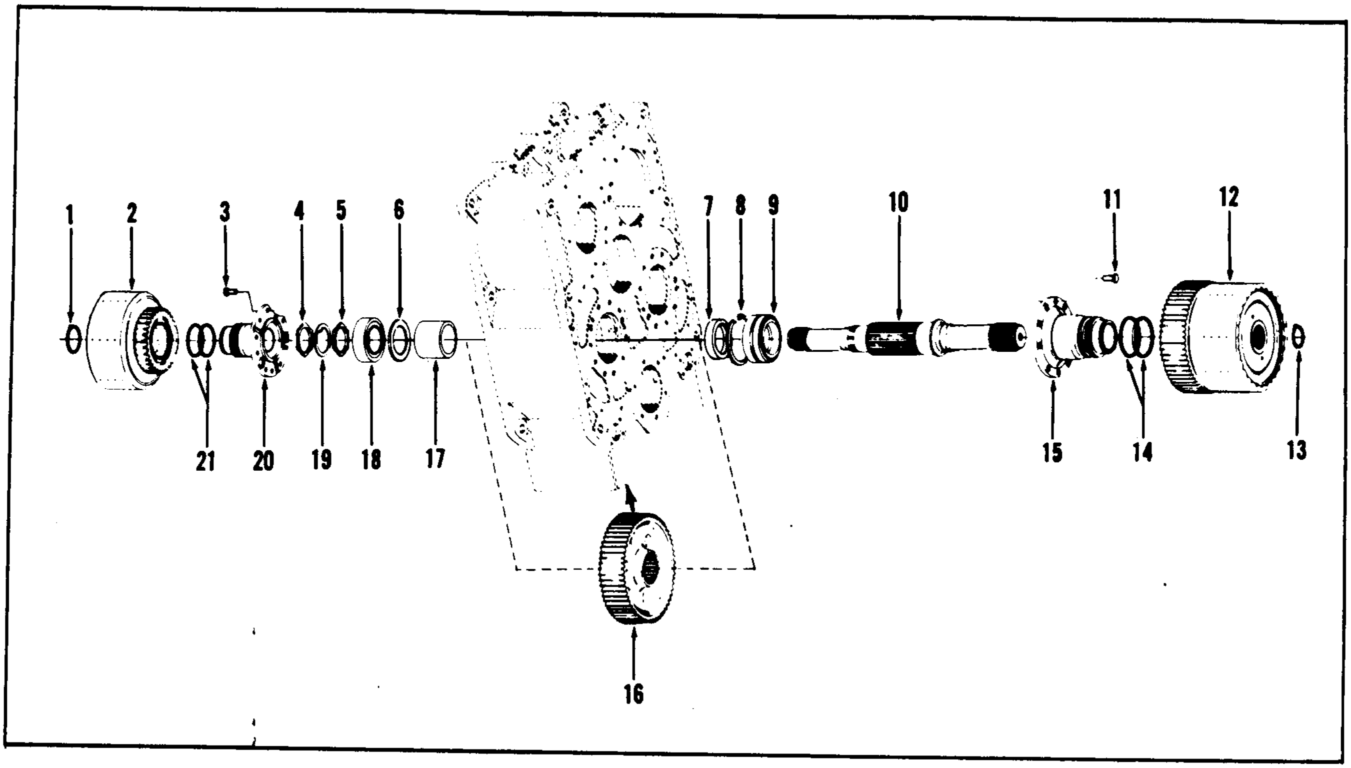
REVERSE SHAFT GROUP "R"

Item No.	Description	No. Req'd
1	RING, Disc Hub Retaining	1
2	CLUTCH ASSY, Reverse	—
3	BOLT, Clutch Support to Case	8
4	NUT, Bearing Lock	1
5	NUT, Bearing Lock	1
6	BEARING, Rear Drive Shaft	1
7	GEAR, Reverse Shaft	1
8	SPACER, Reverse Shaft Gear **(5820 & 8820 only) 16820 has internal snap ring in gear, item 7**	1
9	SHAFT, Reverse	1
10	BEARING, Front Drive Shaft	1
11	SPACER, Bearing	1
12	WASHER, Reverse Drive Shaft	1
13	GASKET, Bearing Cap	1
14	LKWSHR, Bearing Cap	5
15	BOLT, Bearing Cap	5
16	CAP, Bearing	1
17	NUT, Reverse Drive Shaft	1
18	COTTER, Reverse Drive Shaft Nut	1
19	SPACER, Reverse Shaft Gear	1
20	LOCK, Bearing Nut	1
21	SUPPORT, Reverse	1
22	RING, Clutch Support Piston	2



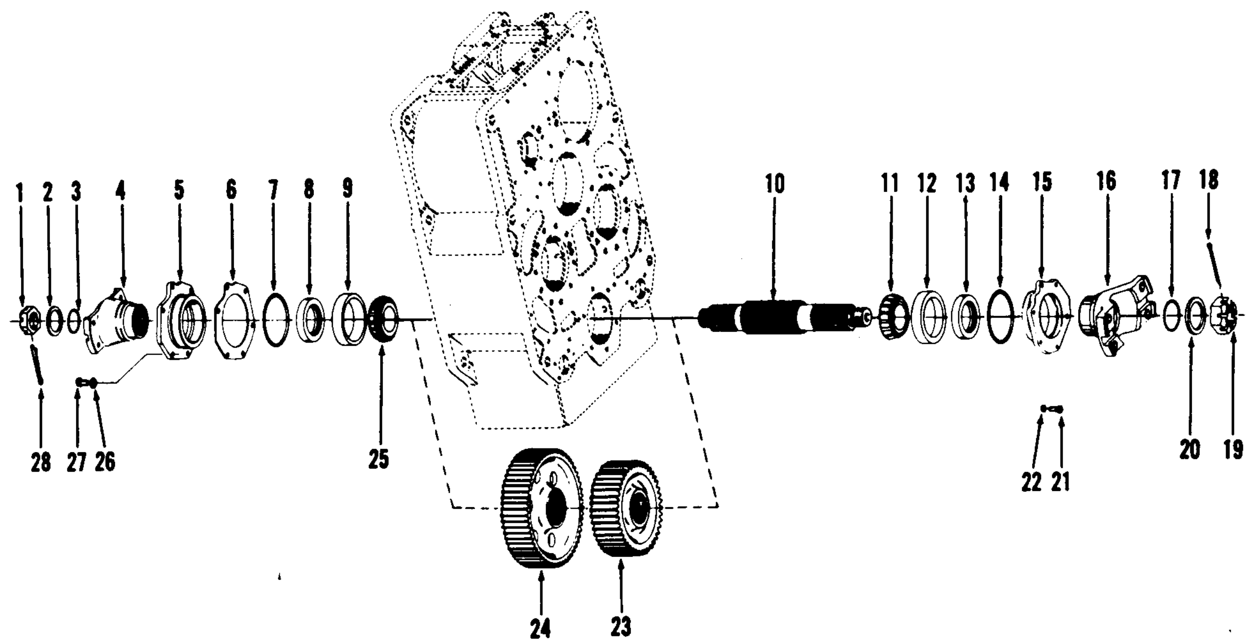
FIRST AND THIRD SHAFT GROUP "B"

Item No.	Description	No. Req'd
1	CLUTCH ASSY, 3rd	—
2	BOLT, Clutch Support to Case	8
3	NUT, Bearing Lock	2
4	SPACER, Bearing	1
5	SPACER, 1st & 3rd Shaft Gear	1
6	RING, Bearing Retaining	1
7	BEARING, 1st & 3rd Shaft	1
8	SHAFT, 1st & 3rd	1
9	BOLT, Clutch Support to Case	8
10	RING, Disc Hub Retaining	1
11	CLUTCH ASSY, 1st	—
12	RING, Clutch Support Piston	2
13	SUPPORT, 1st Clutch	1
14	GEAR, 1st & 3rd Shaft	1
15	BEARING, 1st & 3rd Shaft	1
16	LOCK, Bearing Nut	1
17	SUPPORT, 3rd Clutch	1
18	RING, Clutch Support Piston	2
19	RING, Disc Hub Retaining	1



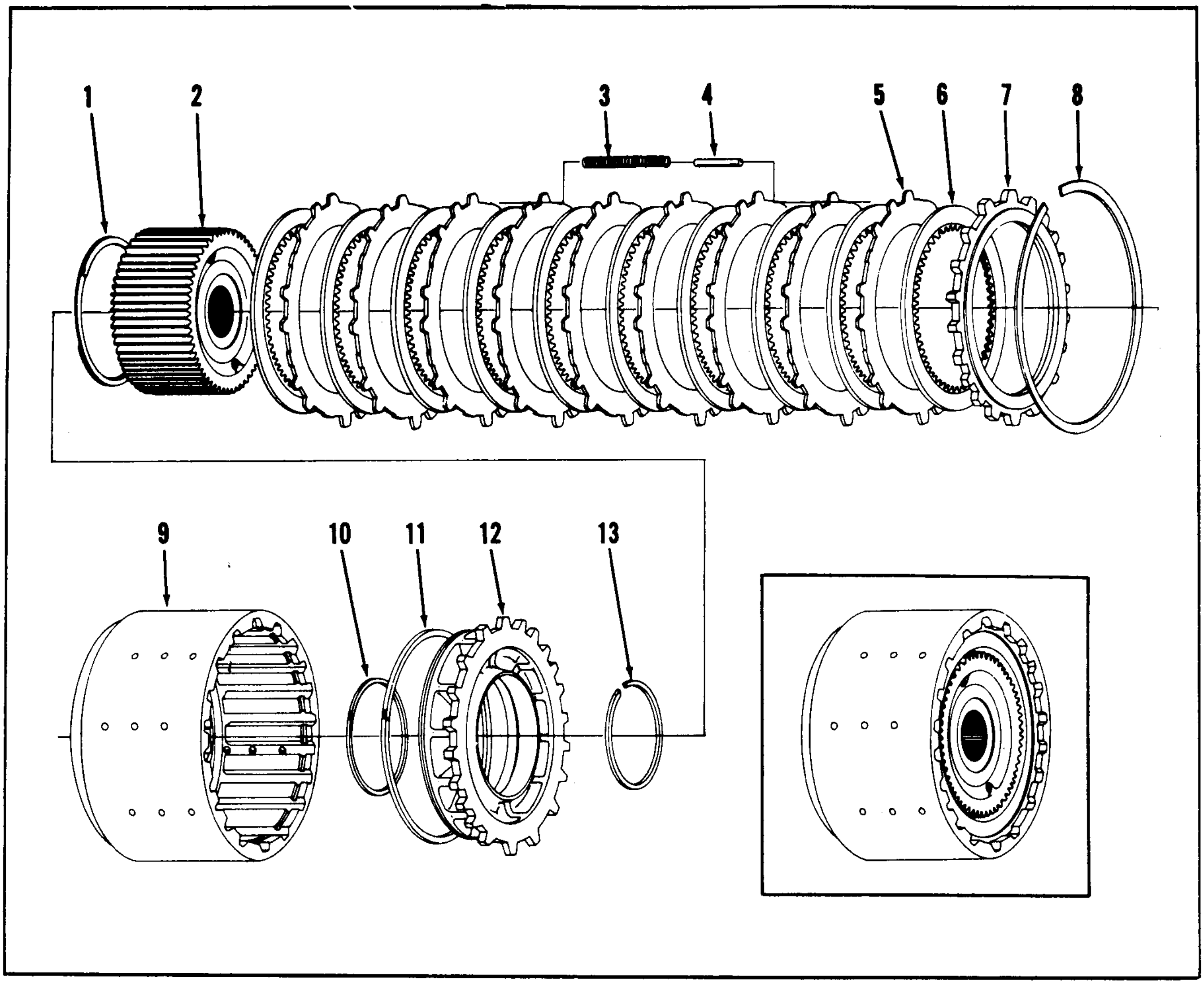
SECOND AND FOURTH SHAFT GROUP "A"

Item No.	Description	No. Req'd
1	RING, Disc Hub Retaining	1
2	CLUTCH ASSY, 4th	—
3	BOLT, Clutch Support to Case	8
4	NUT, Bearing Lock	1
5	NUT, Bearing Lock	1
6	SPACER, Bearing	1
7	SPACER, 2nd & 4th Shaft Gear	1
8	RING, Bearing Retaining	1
9	BEARING, 2nd & 4th Shaft	1
10	SHAFT, 2nd & 4th	1
11	BOLT, Clutch Support to Case	9
12	CLUTCH, 2nd	—
13	RING, Disc Hub Retaining	1
14	RING, Clutch Support Piston	2
15	SUPPORT, 2nd Clutch	1
16	GEAR, 2nd & 4th Shaft	1
17	SPACER, 2nd & 4th Shaft Gear	1
18	BEARING, 2nd & 4th Shaft	1
19	LOCK, Bearing Nut	1
20	SUPPORT, 4th Clutch	1
21	RING, Clutch Support Piston	2



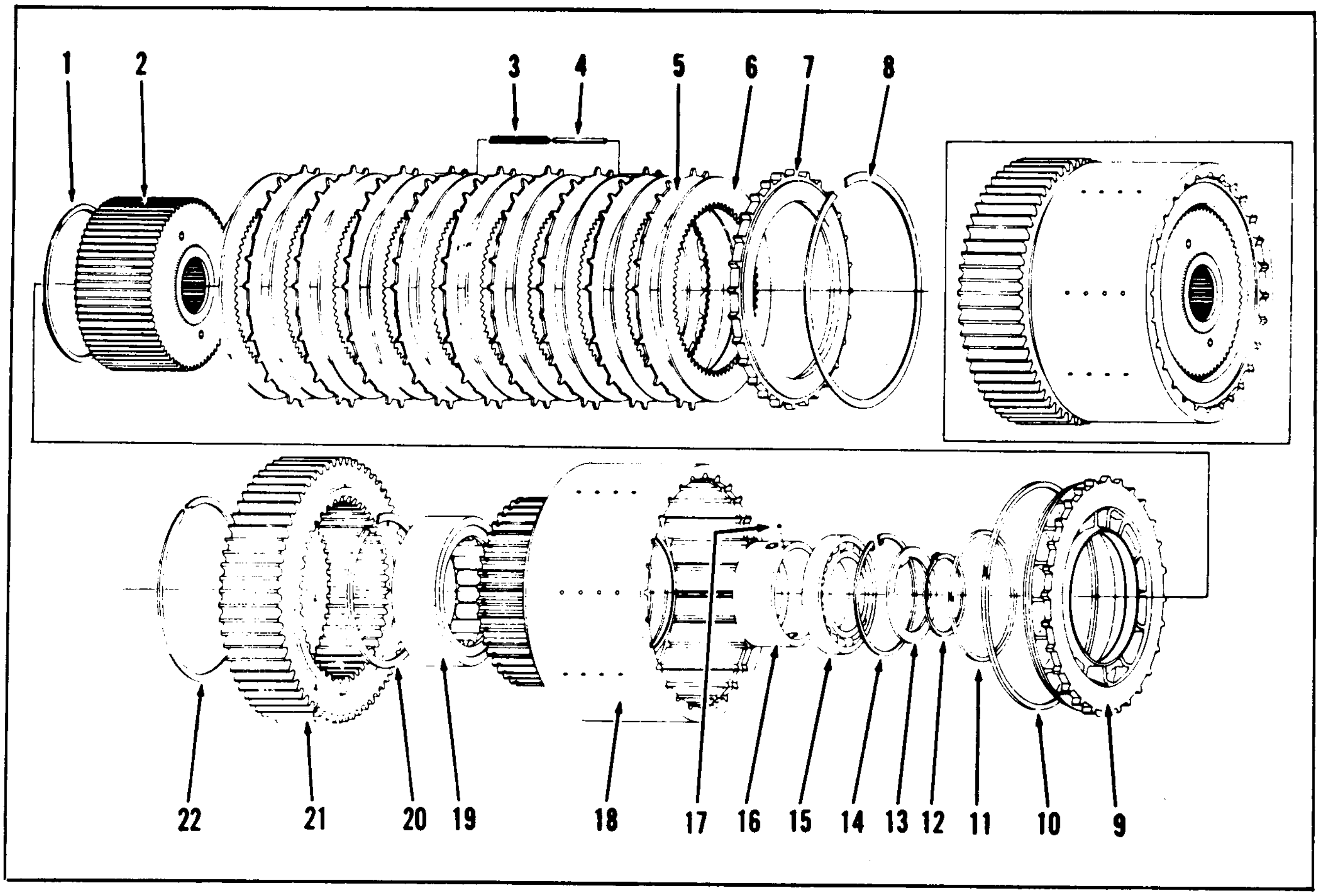
OUTPUT SHAFT GROUP "O"

Item No.	Description	No. Req'd	Item No.	Description	No. Req'd
1	NUT, Output Shaft Flange	1	15	CAP, Output Shaft Bearing	1
2	WASHER, Output Shaft Flange	1	16	FLANGE, Output	1
3	"O" RING, Output Shaft Flange	1	17	"O" RING, Output Shaft Flange	1
4	FLANGE, Output	1	18	COTTER, Output Shaft Flange Nut	1
5	CAP, Output Shaft Bearing	1	19	NUT, Output Shaft Flange	1
6	SHIM, Bearing Cap	—	20	WASHER, Output Shaft Flange	1
7	"O" RING, Bearing Cap	1	21	BOLT, Output Shaft Cap	6
8	SEAL, Bearing Cap Oil	1	22	LKWSHR, Output Shaft Cap	6
9	CUP, Output Shaft Bearing	1	23	GEAR, Output Shaft to 2nd-4th	1
10	SHAFT, Output	1	24	GEAR, Output Shaft to 1st-3rd	1
11	CONE, Output Shaft Bearing	1	25	CONE, Output Shaft Bearing	1
12	CUP, Output Shaft Bearing	1	26	LKWSHR, Output Shaft Cap	6
13	SEAL, Bearing Cap Oil	1	27	BOLT, Output Shaft Cap	6
14	"O" RING, Bearing Cap	1	28	COTTER, Output Shaft Flange Nut	1



HIGH FORWARD CLUTCH GROUP

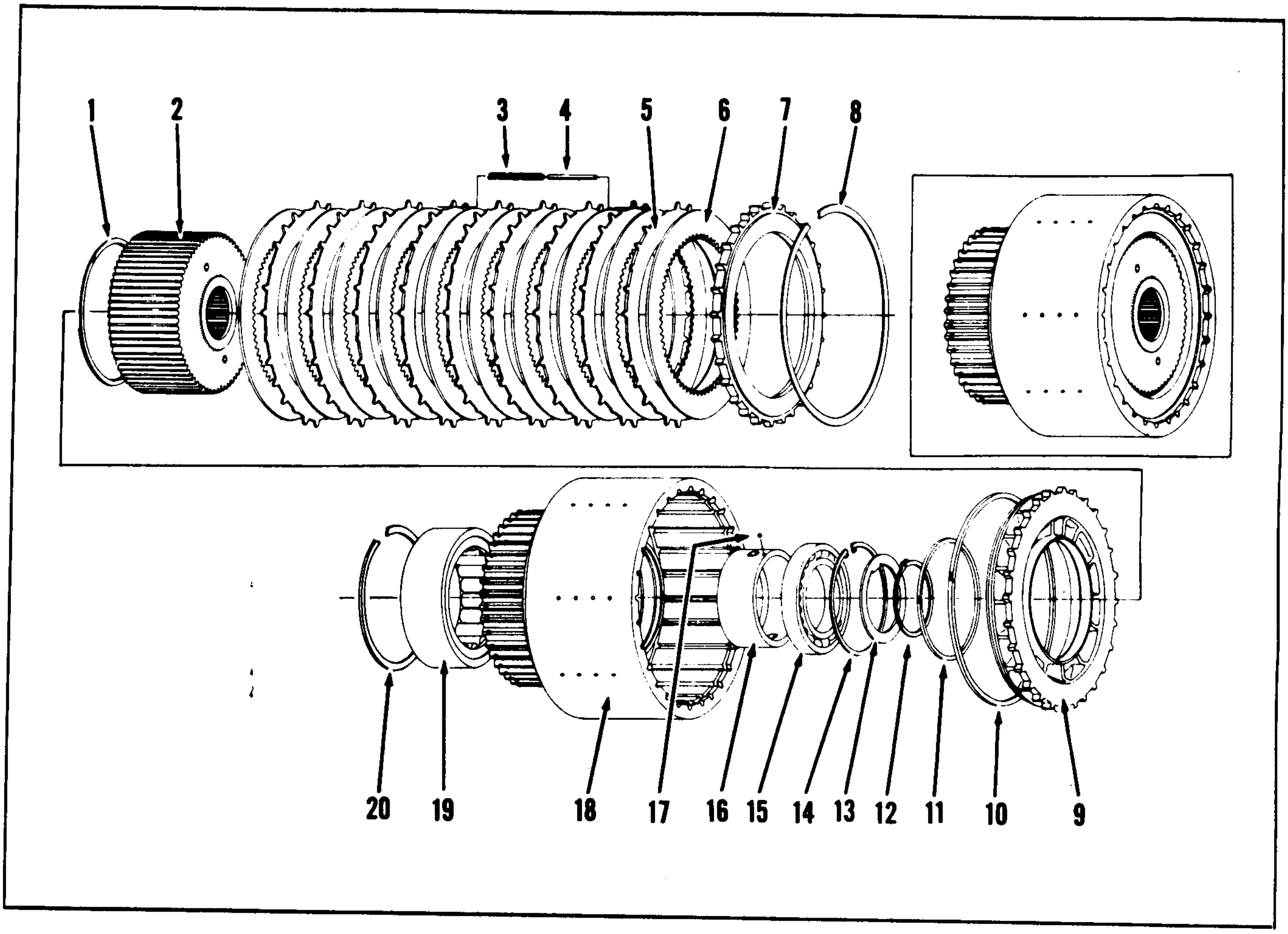
Item No.	Description	No. Req'd
1	BAFFLE, Disc Hub Oil	1
2	HUB, Disc	1
3	SPRING, Clutch Disc Release	(5820 Qty. 6 — 8820 Qty. 8 — 16820 Qty. 7)
4	PIN, Release Spring Guide	(5820 Qty. 6 — 8820 Qty. 8 — 16820 Qty. 7)
5	DISC, Clutch Outer	(5820 Qty. 9 — 8820 Qty. 9 — 16820 Qty. 9)
6	DISC, Clutch Inner	(5820 Qty. 10 — 8820 Qty. 10 — 16820 Qty. 10)
7	PLATE, Clutch Disc End	1
8	RING, End Plate Retaining	1
9	DRUM & HUB ASSY, Clutch	1
10	RING, Inner Piston Sealing	1
11	RING, Outer Piston Sealing	1
12	PISTON, Clutch	1
13	RING, Drum Hub Retaining	1



FIRST AND SECOND CLUTCH GROUP

2 Clutches used in Transmission — Quantity indicated is for 1 Clutch

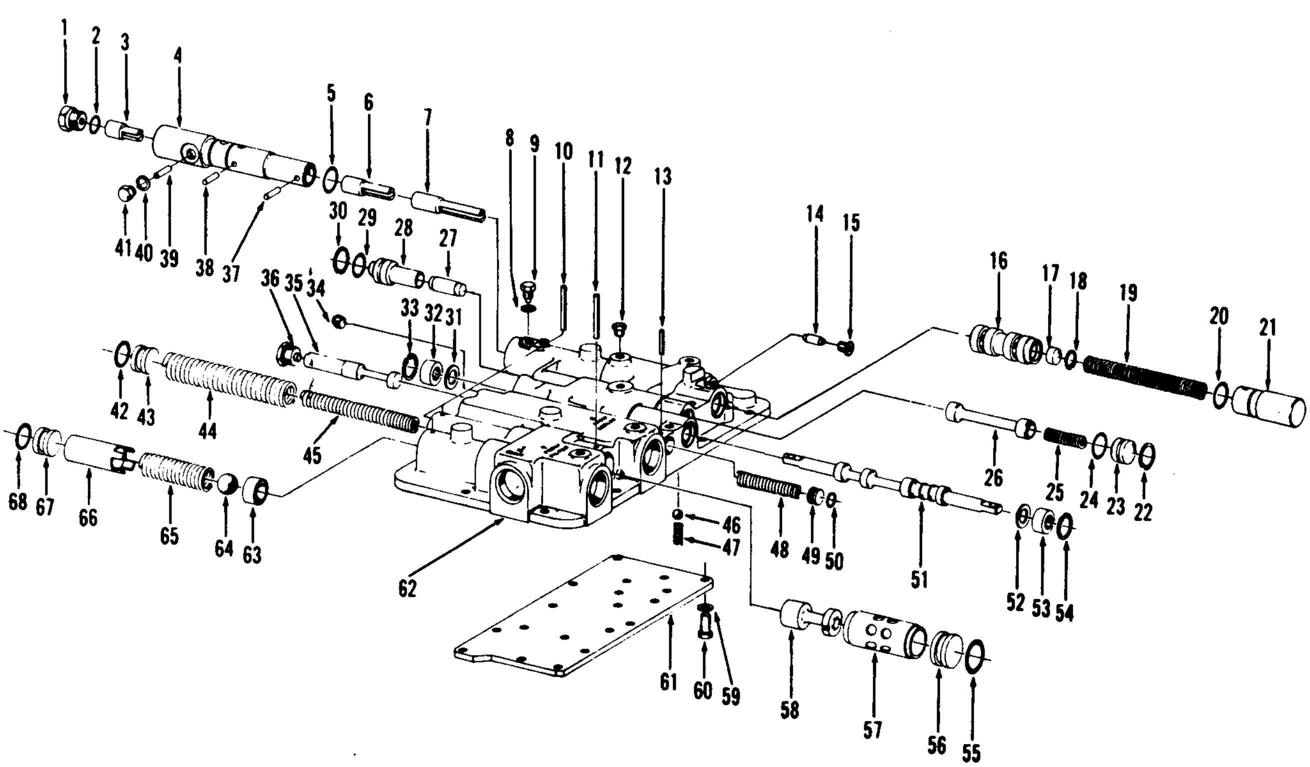
Item No.	Description	No. Req'd
1	RING, Oil Baffle Retaining	1
2	HUB ASSY, Clutch Disc	1
3	SPRING, Clutch Disc Release	(5820 Qty. 8 — 8820 Qty. 7 — 16820 Qty. 8)
4	PIN, Clutch Disc Release Spring	(5820 Qty. 8 — 8820 Qty. 7 — 16820 Qty. 8)
5	DISC, Clutch Outer	(5820 Qty. 9 — 8820 Qty. 9 — 16820 Qty. 11)
6	DISC, Clutch Inner	(5820 Qty. 10 — 8820 Qty. 10 — 16820 Qty. 12)
7	PLATE, Clutch Disc End	1
8	RING, End Plate Retaining	1
9	PISTON, Clutch	1
10	RING, Outer Piston	1
11	RING, Inner Piston	1
12	RING, Washer Retaining	1
13	WASHER, Bearing	1
14	RING, Bearing Retaining	1
15	BEARING, Clutch Support Ball	1
16	RACE, Piston Ring Outer	1
17	BALL, Outer Race Lock	1
18	DRUM ASSY, Clutch (Inc. 16, 17)	1
19	BEARING, Clutch Support Roller	1
20	RING, Bearing Retaining	1
21	GEAR, Clutch Drum Hub	1
22	RING, Gear Retaining	1



INPUT — REVERSE, THIRD AND FOURTH CLUTCH GROUP

4 Clutches used in Transmission — Quantity indicated is for 1 Clutch

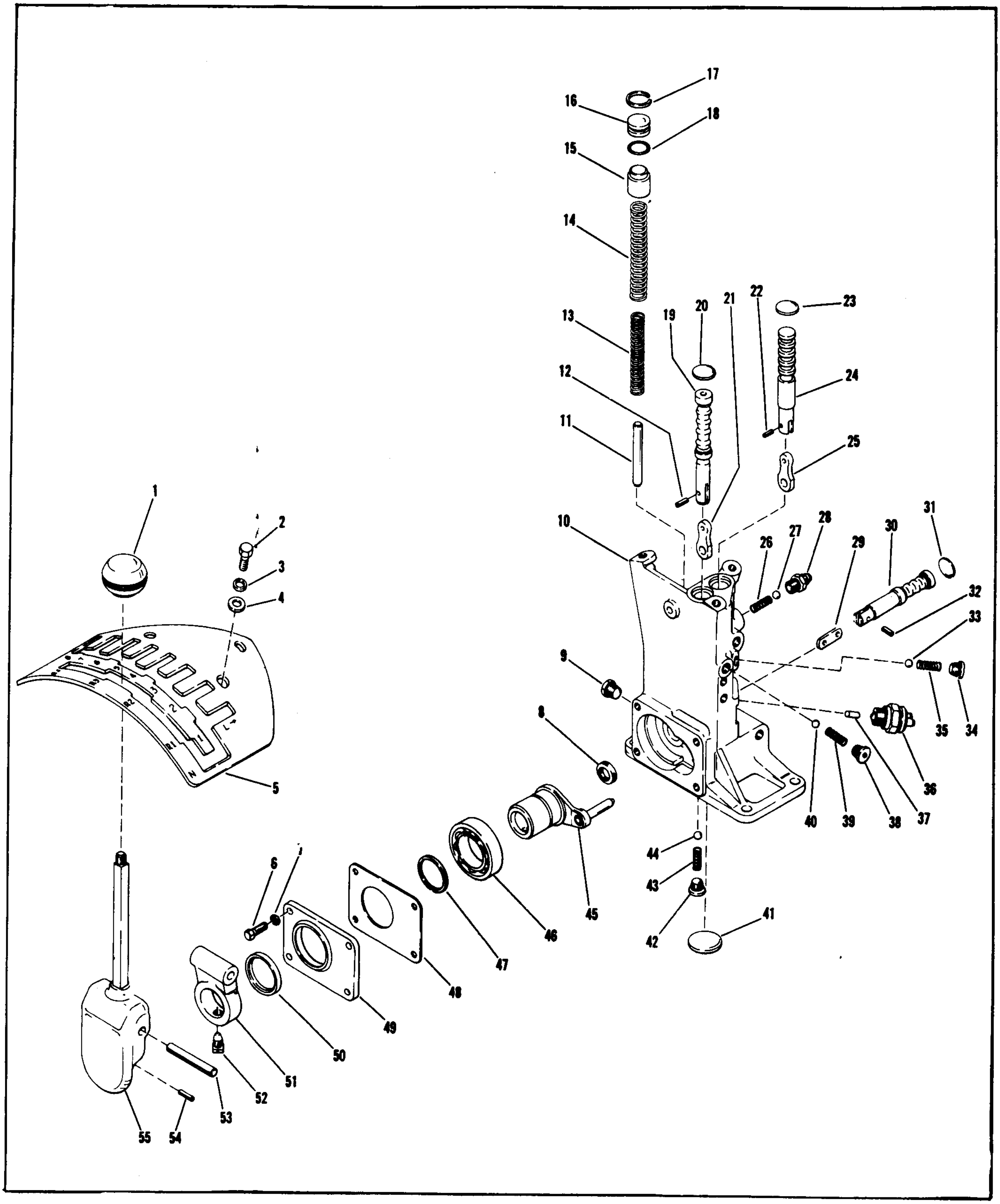
Item No.	Description	No. Req'd
1	RING, Oil Baffle Retaining	1
2	HUB ASSY, Clutch Disc	1
3	SPRING, Clutch Disc Release	(5820 Qty. 6 — 8820 Qty. 8 — 16820 Qty. 7)
4	PIN, Clutch Disc Release Spring	(5820 Qty. 6 — 8820 Qty. 8 — 16820 Qty. 7)
5	DISC, Clutch Outer	(5820 Qty. 9 — 8820 Qty. 9 — 16820 Qty. 9)
6	DISC, Clutch Inner	(5820 Qty. 10 — 8820 Qty. 10 — 16820 Qty. 10)
7	PLATE, Clutch Disc End	1
8	RING, End Plate Retaining	1
9	PISTON, Clutch	1
10	RING, Outer Piston	1
11	RING, Inner Piston	1
12	RING, Washer Retaining	1
13	WASHER, Bearing	1
14	RING, Bearing Retaining	1
15	BEARING, Clutch Support Ball	1
16	RACE, Piston Ring Outer	1
17	BALL, Outer Race Lock	1
18	DRUM ASSY, Clutch (Inc. 16, 17)	1
19	BEARING, Clutch Support Roller	1
20	RING, Bearing Retaining	1



CONTROL COVER ASSEMBLY — TRANSMISSION

CONTROL COVER ASSEMBLY — TRANSMISSION

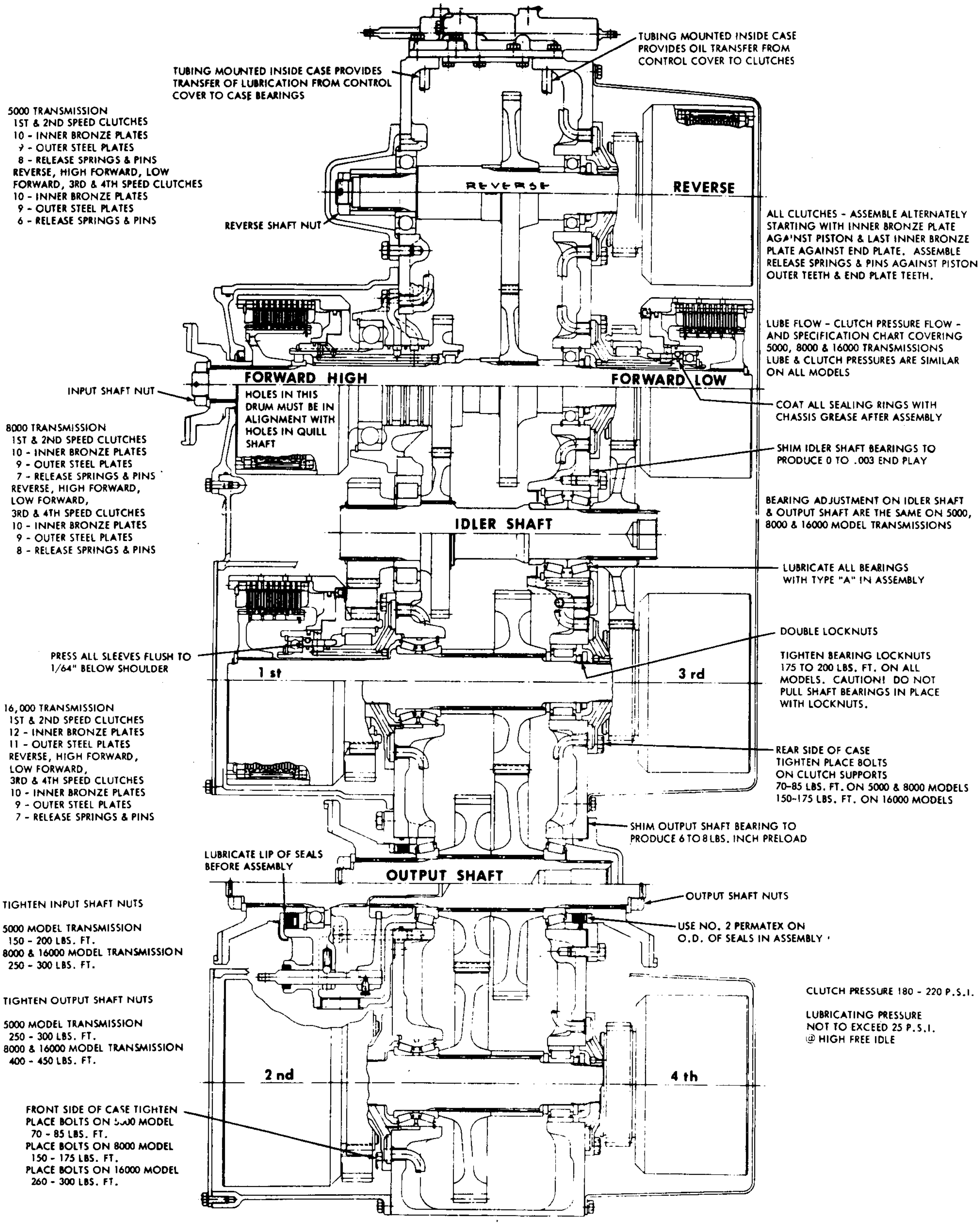
Item No.	Description	No. Req'd
1	PLUG, Shift Cylinder Housing	1
2	"O" RING, Housing Plug	1
3	VALVE, 3rd Speed	1
4	HOUSING, Shift Cylinder	1
5	"O" RING, Housing	1
6	VALVE, 2nd Speed	1
7	VALVE, 1st Speed	1
8	WASHER, Housing Plug	2
9	PLUG, Housing	2
10	PIN, Spring Stop Roll	2
11	PIN, Valve Stop Roll	1
12	PLUG, Housing	5
13	PIN, Shut-Off Valve Stop Roll	1
14	VALVE, Shuttle	1
15	PLUG, Shuttle Valve	1
16	VALVE, Selector	1
17	PLUG, Selector Valve	1
18	RING, Selector Valve Plug Retaining	1
19	SPRING, Selector Valve	1
20	"O" RING, Housing	1
21	HOUSING, End Plug	1
22	RING, Piston Stop Retaining	1
23	STOP, Piston	1
24	"O" RING, Piston Stop	1
25	SPRING, Range Valve	1
26	VALVE, High-Low	1
27	PISTON, High-Low	1
28	GUIDE, High-Low Piston	1
29	"O" RING, Piston Guide	1
30	RING, Piston Guide Retaining	1
31	WASHER, Valve Stop	1
32	SEAL, Valve Oil	1
33	RING, Oil Seal Retaining	1
34	PLUG, Valve Hole	1
35	SPOOL, Shut-Off Valve	1
36	PLUG, Valve Spool Stop	1
37	PIN, Valve Stop	1
38	PIN, Valve Stop	1
39	PIN, Valve Stop	1
40	WASHER, Housing Plug	1
41	PLUG, Cylinder Housing	1
42	"O" RING, Spool Stop	1
43	STOP, Valve Spool	1
44	SPRING, Valve Spool — Outer	1
45	SPRING, Valve Spool — Inner	1
46	BALL, Poppet	1
47	SPRING, Poppet	1
48	SPRING, Shut-Off Valve	1
49	STOP, Shut-Off Valve	1
50	"O" RING, Shut-Off Valve Stop	1
51	VALVE, Forward-Reverse Selector	1
52	WASHER, Valve Stop	1
53	SEAL, Valve Oil	1
54	RING, Oil Seal Retaining	1
55	"O" RING, Valve Spool Stop	1
56	STOP, Valve Spool	1
57	SLEEVE, Valve Spool	1
58	SPOOL, Regulating Valve	1
59	LKWSHR, Plate to Cover	16
60	BOLT, Plate to Cover	16
61	PLATE, Control Cover	1
62	HOUSING, Control Cover	1
63	SEAT, Safety Valve	1
64	BALL, Safety Valve	1
65	SPRING, Safety Valve	1
66	SPACER, Safety Valve	1
67	STOP, Safety Valve	1
68	"O" RING, Safety Valve Stop	1



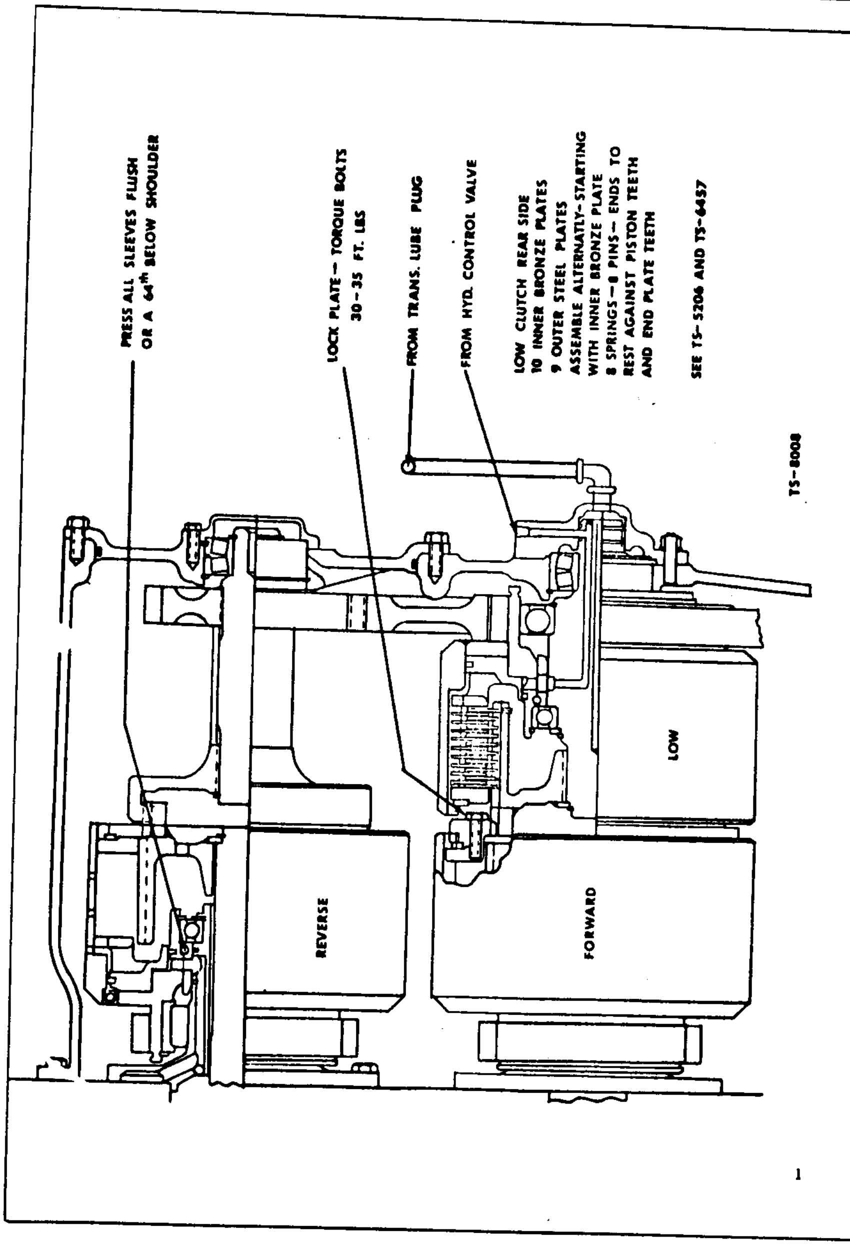
HYDRAULIC CAB CONTROL

HYDRAULIC CAB CONTROL

Item No.	Description	No. Req'd
1	KNOB, Shift	1
2	BOLT, Stop Plate	3
3	LKWSHR, Stop Plate Bolt	3
4	WASHER, Stop Plate Bolt, Flat	3
5	PLATE, Control Position Stop	1
6	CAP SCREW, Bearing	4
7	LKWSHR, Bearing Cap Screw	4
8	OIL SEAL	1
9	PLUG, Pipe—Not used with lock-up	1
10	HOUSING, Shift Control	1
11	PIN, Accumulator Piston Stop	1
12	PIN, Selector Spool Link Roll	1
13	SPRING, Accumulator Piston Inner	1
14	SPRING, Accumulator Piston Outer	1
15	PISTON, Accumulator	1
16	STOP, Valve	1
17	RING, Valve Stop Retainer	1
18	"O" RING, Valve Stop	1
19	SPOOL, Selector	1
20	WELCH PLUG	1
21	LINK, Selector Spool	1
22	PIN, Hi-Lo Range Spool Link Roll	1
23	WELCH PLUG	1
24	SPOOL, Hi-Lo Range	1
25	LINK, Hi-Lo Range Spool	1
26	SPRING, Check Valve	1
27	BALL, Check Valve	1
28	FITTING, Check Valve	1
29	LINK, Reverse & Neutral Lock-up Spool	1
30	SPOOL, Reverse & Neutral Lock-up	1
31	WELCH PLUG	1
32	PIN, Reverse & Neutral Lock-up Spool Link Roll	1
33	BALL, Poppet	1
34	PLUG, Poppet Spring	1
35	SPRING, Poppet	1
36	SWITCH, Neutral	1
37	PIN, Neutral Switch Actuating	1
38	PLUG, Poppet Spring	1
39	SPRING, Poppet	1
40	BALL, Poppet	1
41	WELCH PLUG	1
42	PLUG, Poppet Spring	1
43	SPRING, Poppet	1
44	BALL, Poppet	1
45	SHAFT & PIN ASSY., Speed Selector	1
46	BEARING, Speed Selector Shaft	1
47	RING, Speed Selector Shaft Bearing Retainer	1
48	GASKET, Bearing Cap	1
49	CAP, Bearing	1
50	OIL SEAL, Bearing Cap	1
51	BRACKET, Control Lever	1
52	LOCK SCREW, Control Lever Bracket	1
53	ROLL PIN	1
54	ROLL PIN	1
55	CONTROL LEVER & HOUSING ASSY.	1



Typical 8-Speed Transmission



LOW CLUTCH ASSEMBLY

EIGHT SPEED TRANSMISSION MAINTENANCE

The instructions contained herein cover the disassembly and reassembly of the transmission in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled. It must also be understood that this is a basic transmission with many options. Control covers, clutch covers, companion flanges and output shafts with and without disconnect assemblies may vary on specific models. The units are very similar to trouble shoot, disassemble, repair and reassemble.

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

The unit shown being disassembled and reassembled is an eight-speed **8000** transmission. The eight-speed **5000** transmission and the eight-speed **16000** transmission are basically the same except for size and the specific differences that are explained in the following text.

DISASSEMBLY OF THE TRANSMISSION

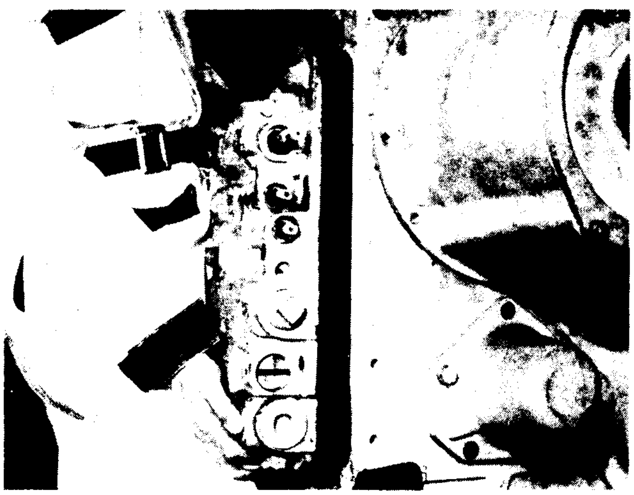


Figure 1
Remove transmission control cover.

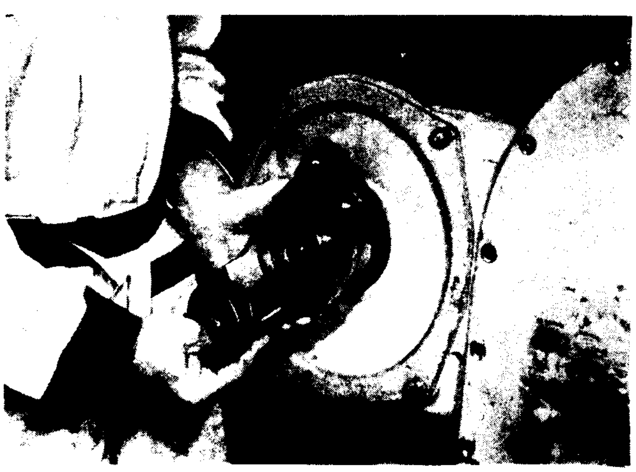


Figure 2
Lock transmission gears with a soft bar and remove input flange nut cotter, flange nut, nut washer, and "O" Ring. Remove flange.

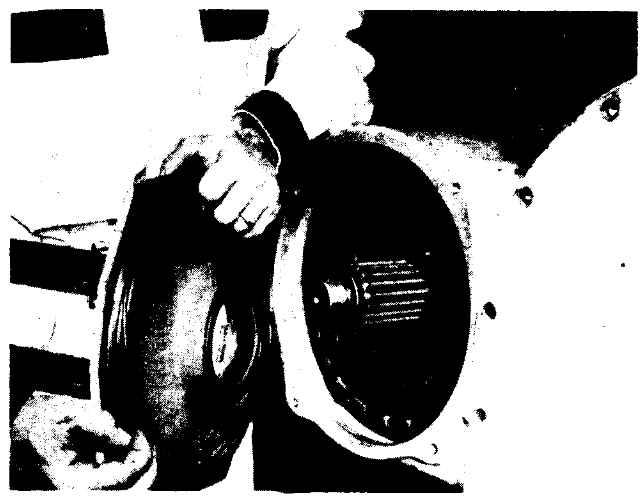


Figure 3
Remove input shaft high forward clutch cover plate, "O" Ring and oil seal.

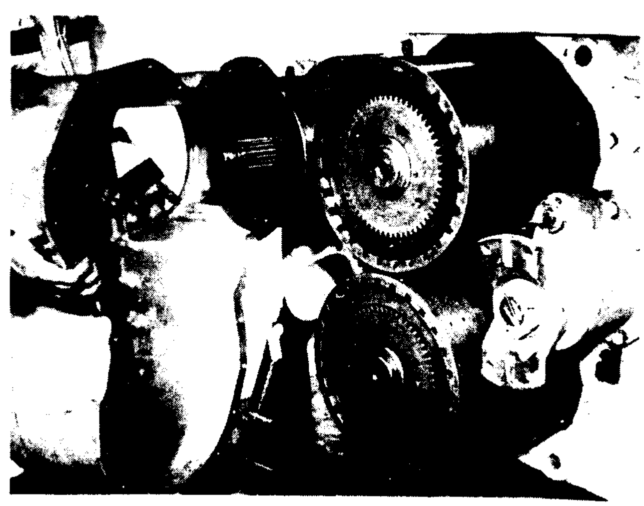


Figure 4
Remove 1st and 2nd, and high forward clutch cover.

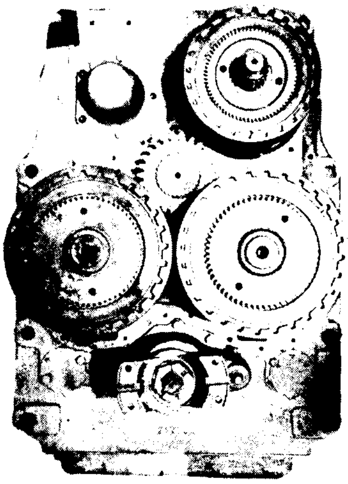


Figure 5
Clutch cover removed.

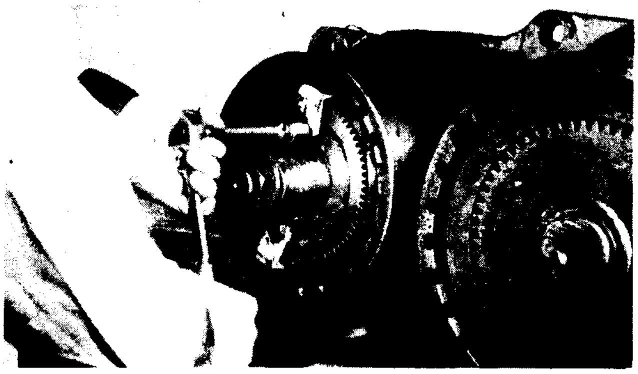


Figure 6
To remove the high forward clutch end plate, a sleeve about 2-1/2" long and 2" I. D. will be needed for the **5800** transmission and a sleeve 3-1/2" long and 3" I. D. will be needed for the **8800** and **16,800** transmissions. Install sleeve, flange nut washer and flange nut as shown in figure 6. Compress clutch disc end plate.

Figure 7
Remove end plate retainer ring. Remove end plate compressor, flange nut, washer and sleeve. Remove clutch end plate.

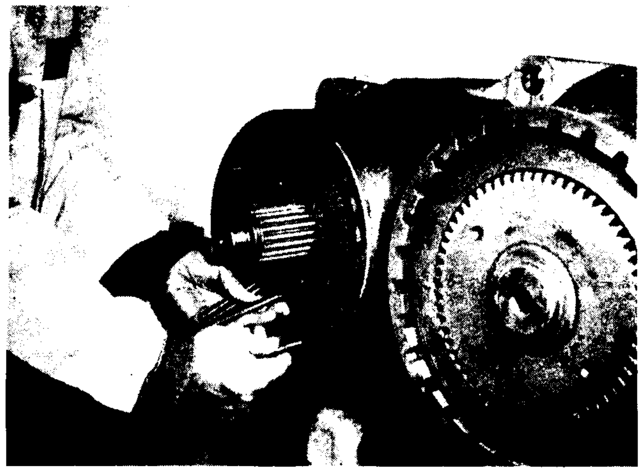


Figure 8
Remove release springs and guide pins.

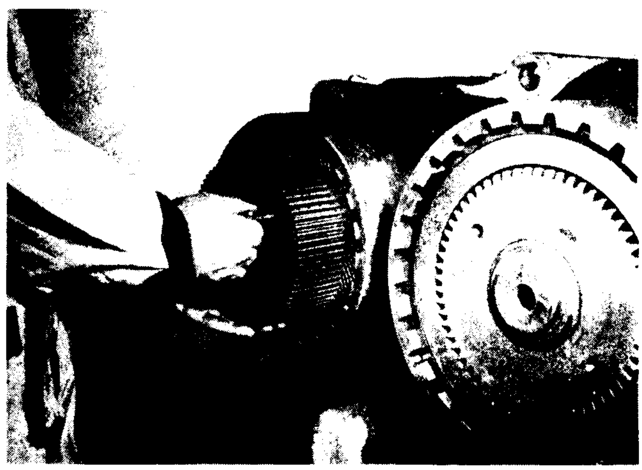


Figure 9
Remove clutch disc hub.

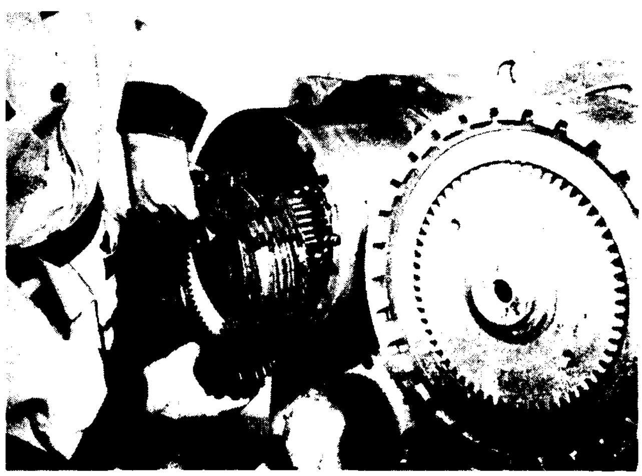


Figure 10
Remove inner and outer clutch disc.

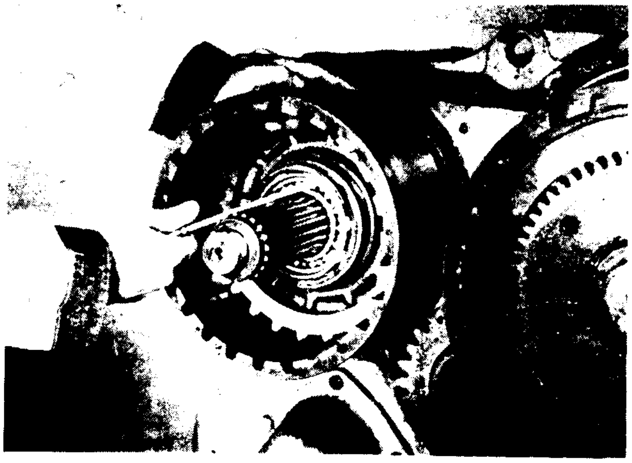


Figure 11
Remove clutch drum retainer ring.

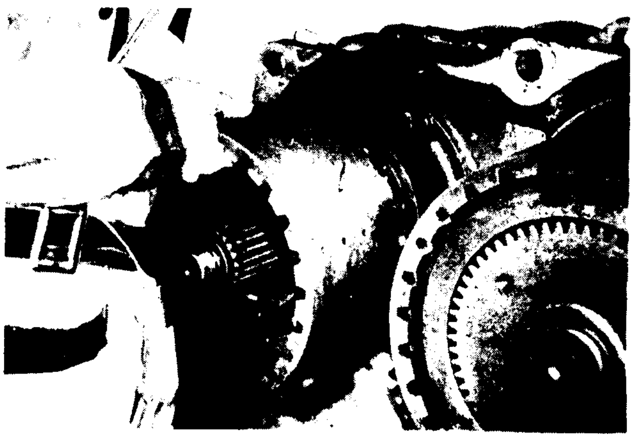


Figure 12

NOTE: All clutches are disassembled in a similar manner. The quantity of clutch discs will differ between the 1st and 2nd clutch and the forward, reverse, 3rd, and 4th. **Do not mix 1st and 2nd clutch plates with forward, reverse, 3rd and 4th.**

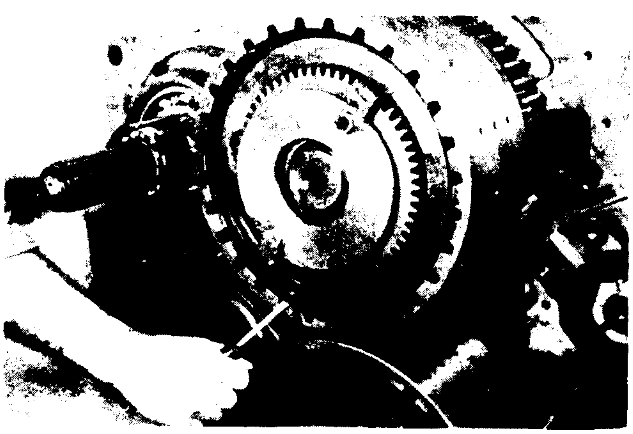


Figure 13
Compress end plate and remove retainer ring.

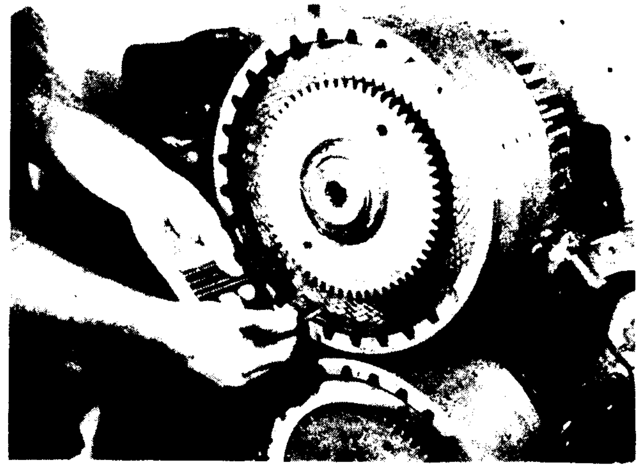


Figure 14
Remove release springs and guide pins.

Figure 15
Remove disc hub retainer ring. Remove disc hub.

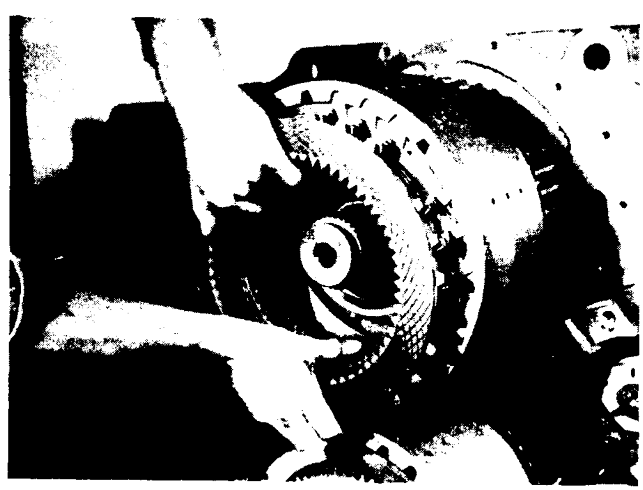


Figure 16
Remove inner and outer clutch disc.

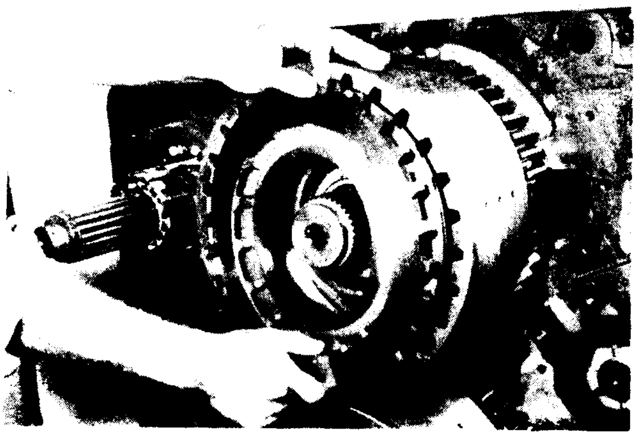


Figure 17
Remove clutch piston.

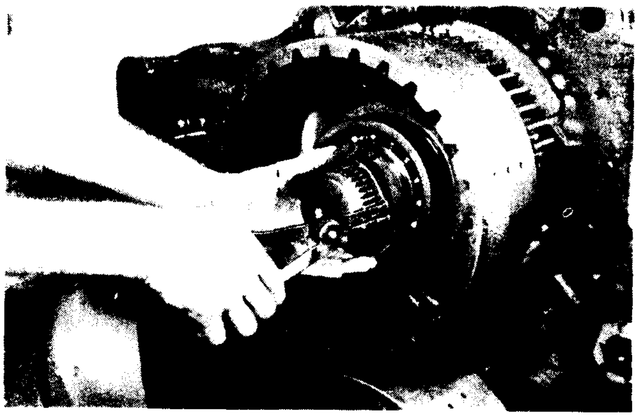


Figure 18
Remove clutch drum to support retainer ring and washer.

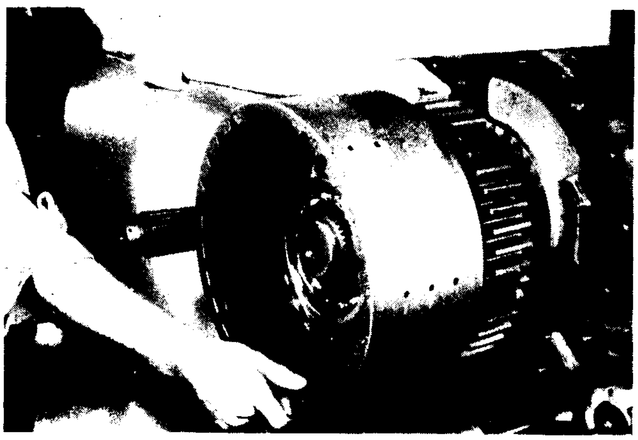


Figure 19
Remove clutch drum from support.

NOTE: If clutch drum hub gear, support bearings, or piston ring outer race are to be replaced, use Figure 20 through Figure 24, if replacement is not necessary, disregard and continue with Figure 25.

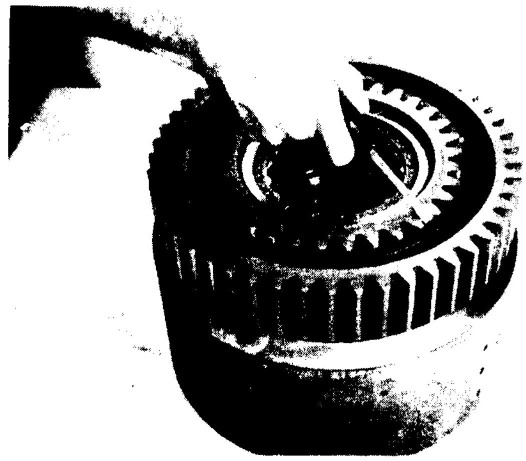


Figure 20
Remove drum hub gear retaining ring. 1st and 2nd clutch only.

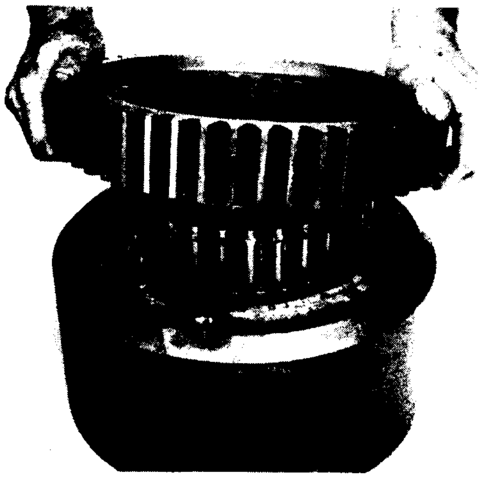


Figure 21
Remove drum hub gear. 1st and 2nd clutch only.

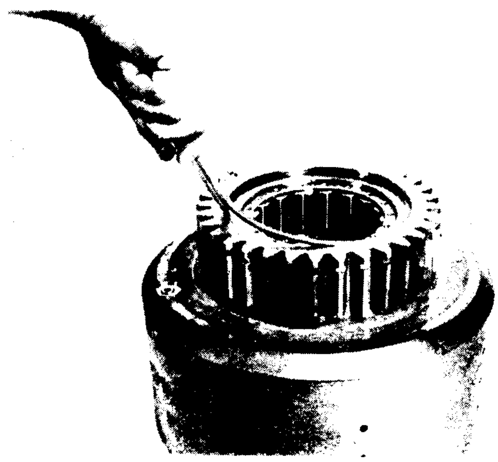


Figure 22
Remove drum to support roller bearing retainer ring. Remove Bearing.

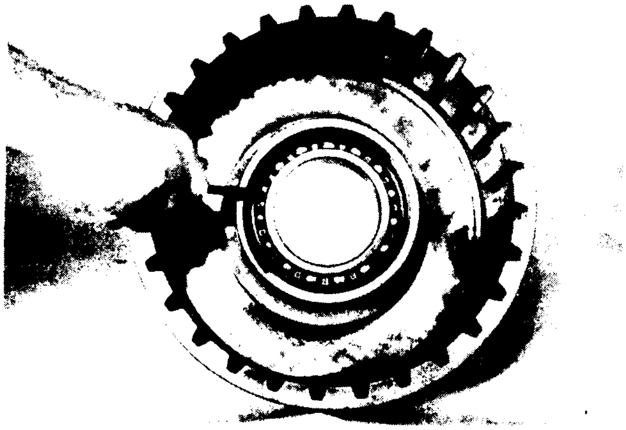


Figure 23
Remove drum to support ball bearing retainer ring. Remove bearing.

Figure 24
Press piston ring outer race from clutch drum. **CAUTION:** Do not lose lock ball.

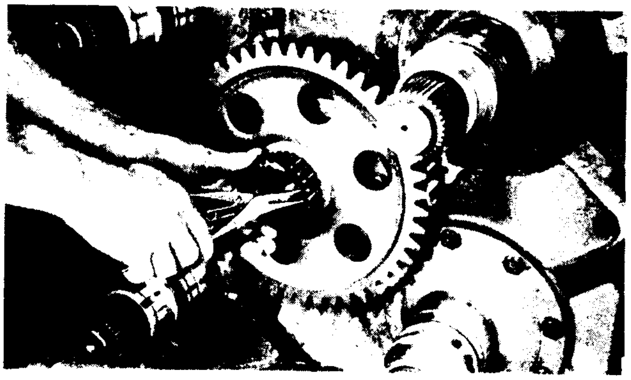


Figure 25
Remove idler gear retainer ring.

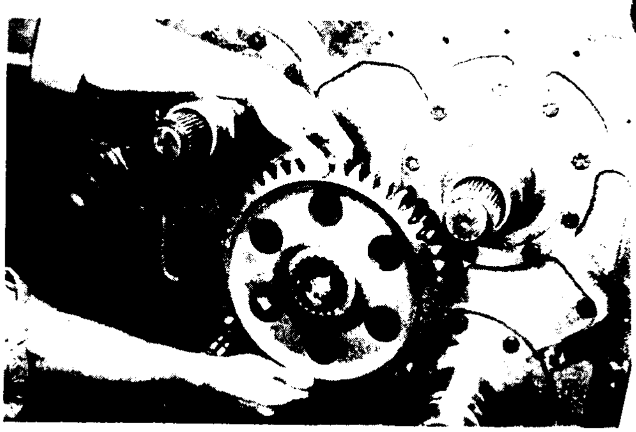


Figure 26
Remove idler gear.

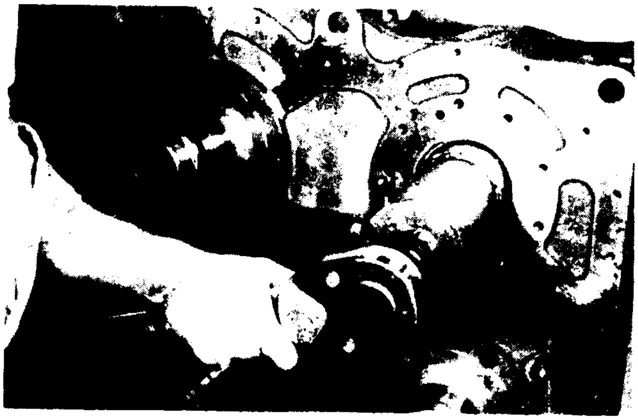


Figure 27
Remove input shaft clutch support. Straighten tangs on shaft nut locks. Lock gears with a soft bar and remove outer lock nut, nut lock, and inner lock nut. Remove reverse, 3rd and 4th supports and lock nuts.

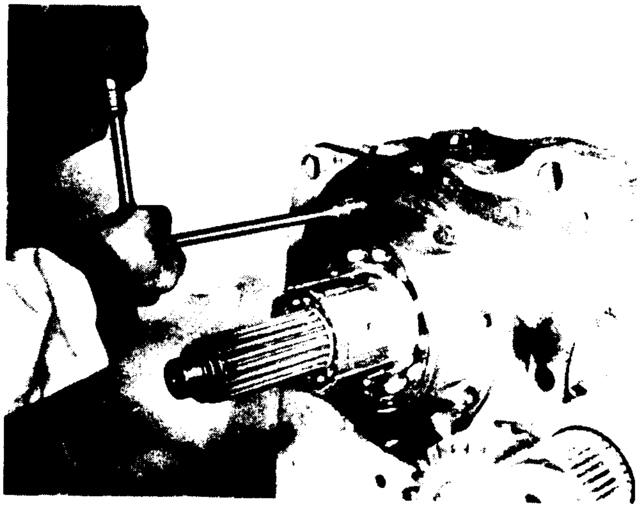


Figure 28
Remove support sleeve bearing carrier bolts.

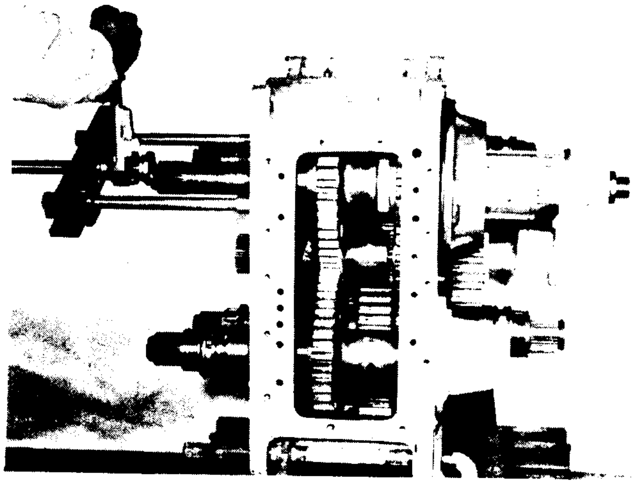


Figure 29
Push input shaft out of ball bearing.

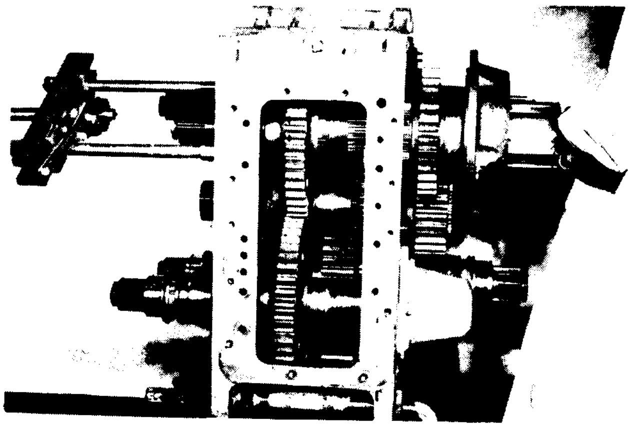


Figure 30
Remove input shaft, bearing carrier and clutch sleeve. Remove input gear and spacer from case.

Figure 31
Tap input shaft on a block of wood to remove bearing carrier and support sleeve.

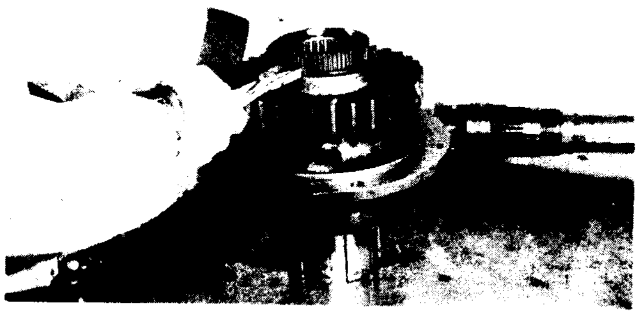


Figure 32
Remove support sleeve gear retainer ring, gear and gear locating ring. **(8800 and 16,800 only.)** On the **5800** the gear and sleeve are one piece. Remove sleeve from carrier.

Figure 33
Remove bearing carrier ball bearing retainer ring.

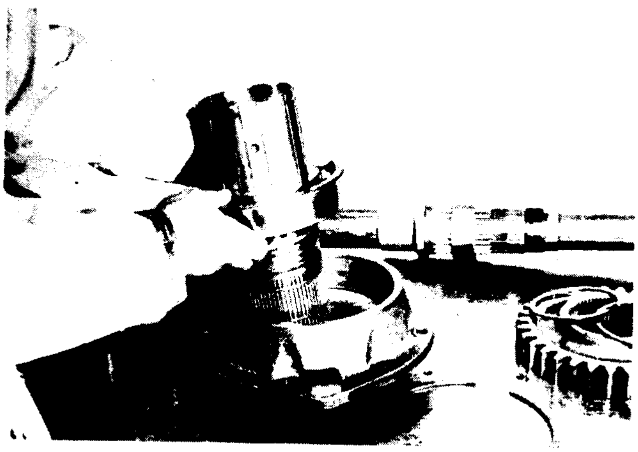


Figure 34
Remove bearing carrier from support sleeve. **(8800 and 16,800 only.)**

CLARK EQUIPMENT

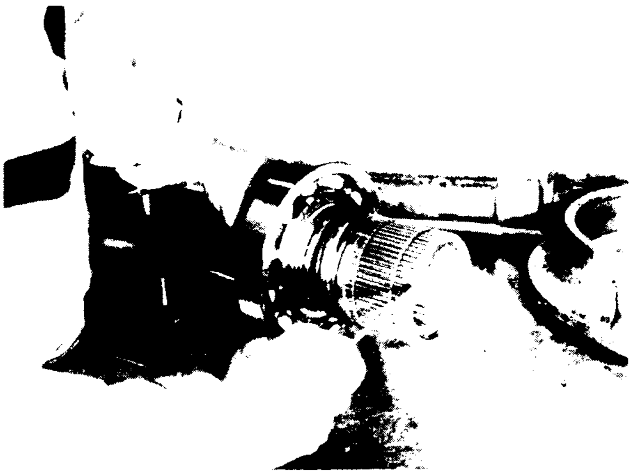


Figure 35
Remove support sleeve inner bearing retainer ring. Remove bearing. This should be done only if sleeve or bearing are to be replaced.

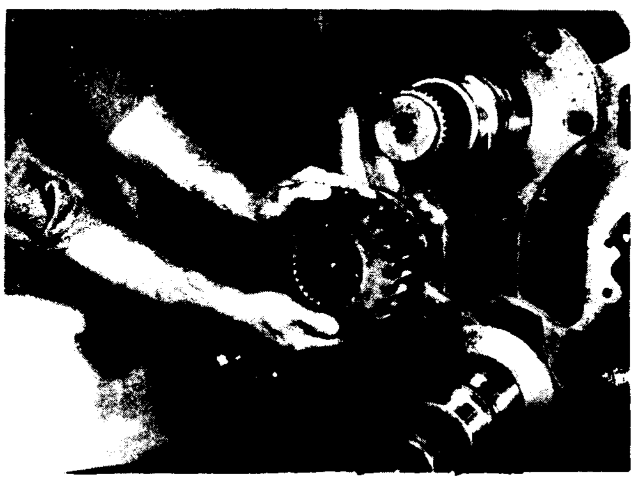


Figure 36
Remove idler gear retainer ring and gear.

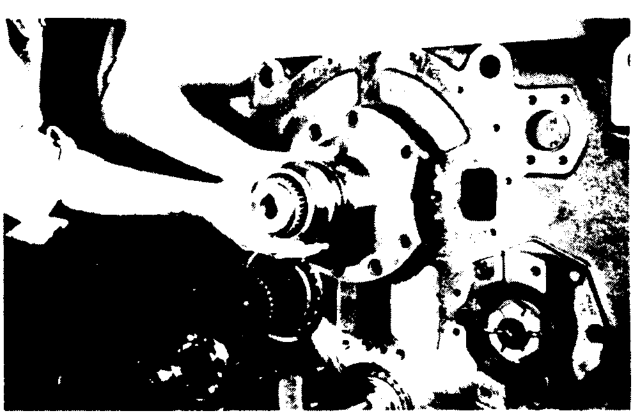


Figure 37
Remove 1st and 2nd clutch support.

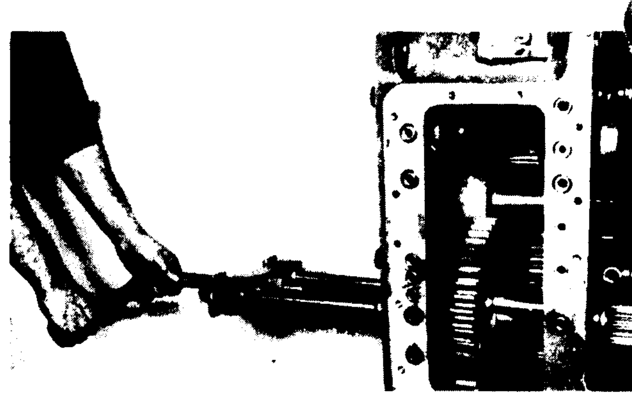


Figure 38
Block reverse gear and remove reverse shaft. Remove gear and spacer from case. **5800** and **8800** have two spacers, **16,800** has one spacer and an internal locating ring in gear.

Remove output shaft companion flange, bearing cap and disconnect assembly.

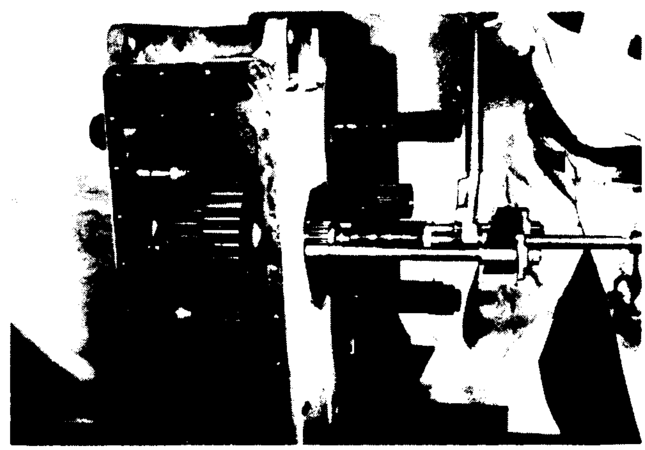


Figure 39
Block output gears and remove shaft. Remove output gears from case.

Figure 40
Block gears and remove 1st speed shaft. Remove gear and spacer from case.

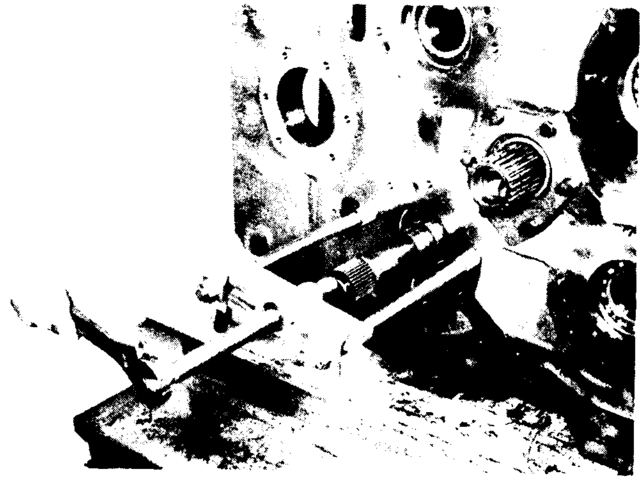


Figure 41
Block gears and remove 2nd speed shaft. Remove gear and spacer from case.

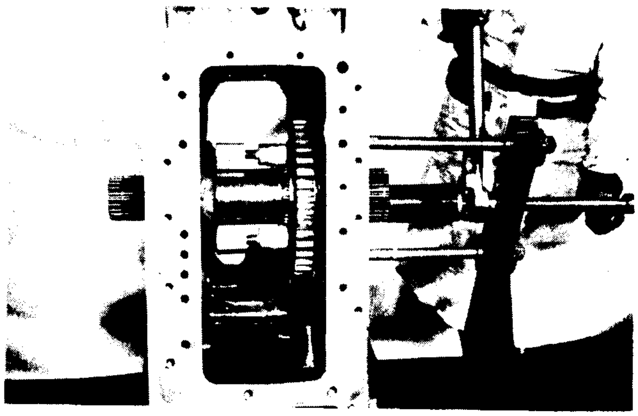


Figure 44
Block idler gear and press idler shaft from case. **NOTE:** Shaft must be removed from side shown because of locating ring in idler gear. (**8800** and **16,800** only). On the **5800** remove idler gear locating ring from shaft.

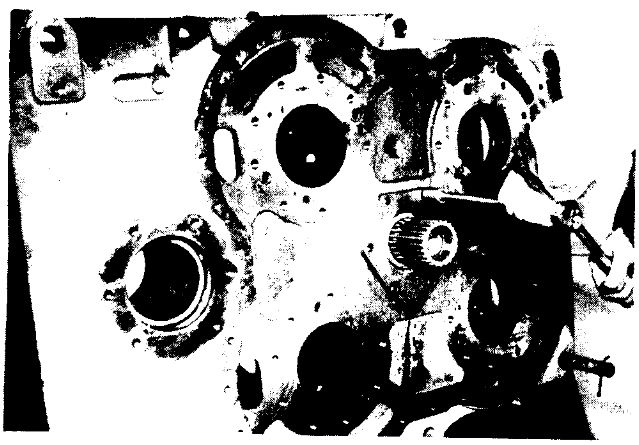


Figure 42
Remove idler shaft bearing cap bolts.

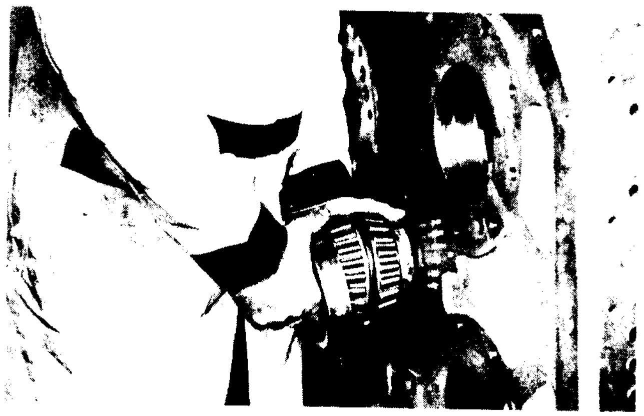


Figure 45
Remove idler shaft, double cone bearing and spacer. Remove gear and spherical roller bearing from case.

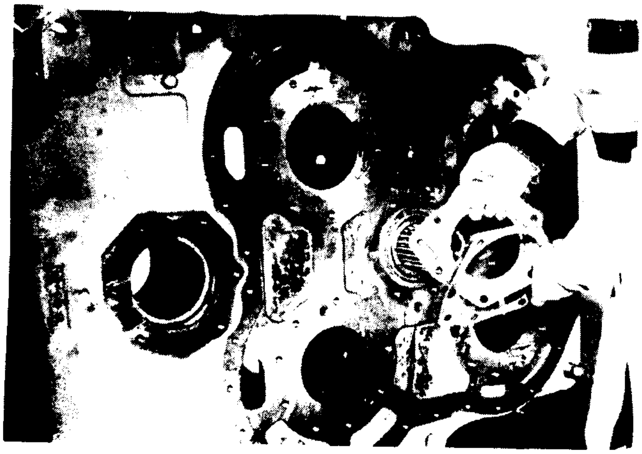


Figure 43
Remove idler shaft bearing cap and shims. Wire shims to bearing cap to prevent loss or damage.

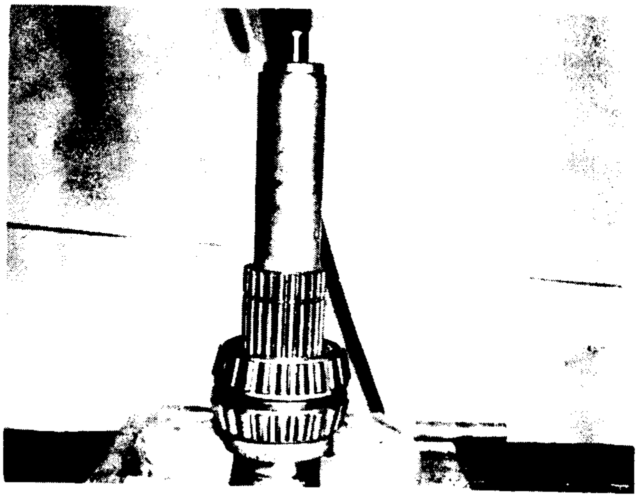


Figure 46
Press double cone bearing and spacer from idler shaft.

Figure 47
Remove idler shaft inner cone bearing cup and oil baffle only if replacement is necessary. No oil baffle on the **16,800.**

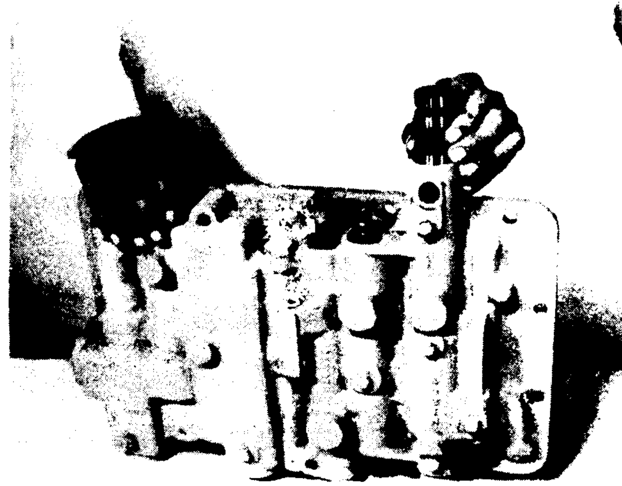


Figure 50
Remove selector valve.

DISASSEMBLY OF CONTROL COVER

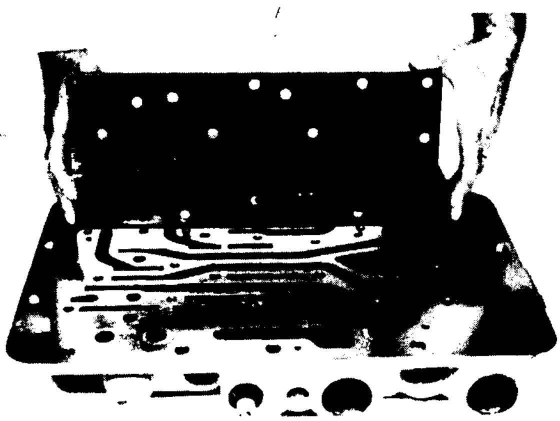


Figure 48
Remove bolts from oil circuit plate. Remove oil circuit plate. **CAUTION:** Do not lose detent ball and spring.

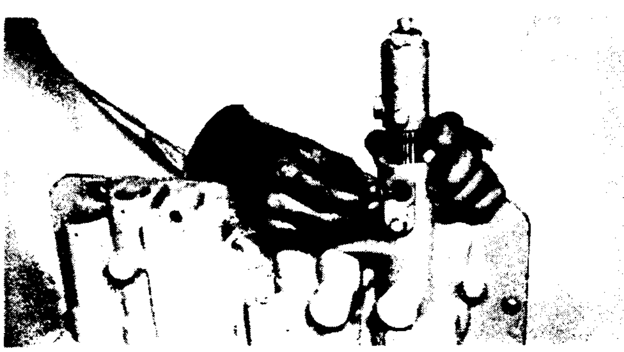


Figure 49
Remove shift cylinder lock plug. Remove shift **cylinder.**

Figure 51
Remove housing end cover lock plug. Remove end cover and selector spring.

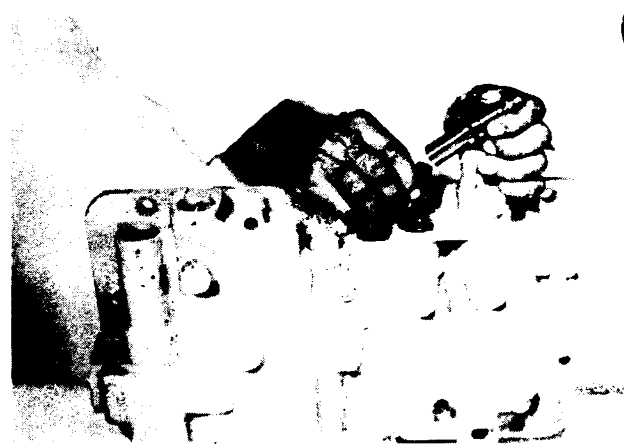


Figure 52
Remove high-low piston glide retainer ring, piston glide and high-low piston.

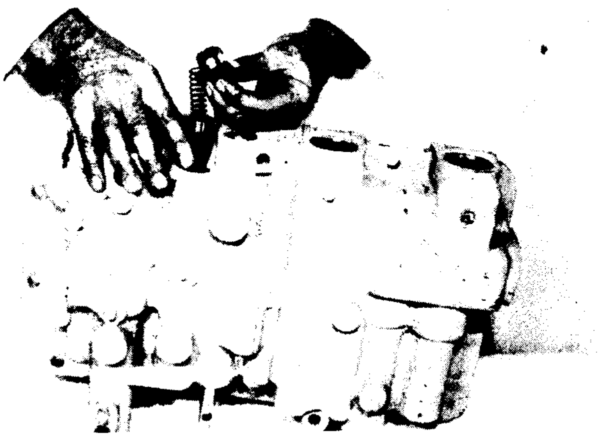


Figure 53
Turn cover over. Remove piston stop retainer ring, piston stop, range valve spring, and high-low valve.

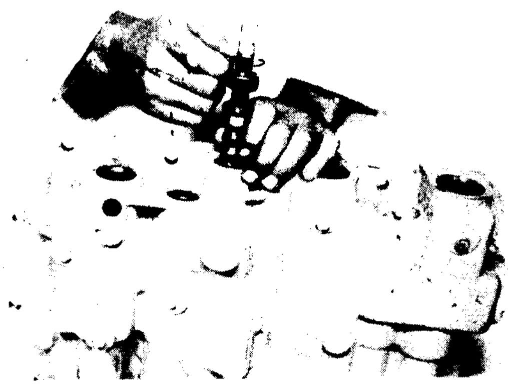


Figure 54
Remove forward and reverse selector valve, retainer ring. Tap lightly on opposite end of selector valve. Valve and valve oil seal will come out together.

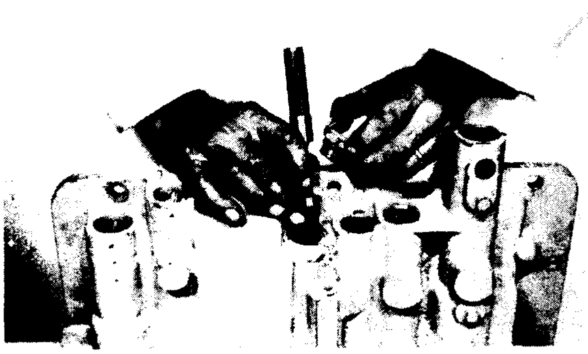


Figure 55
Remove shut-off valve stop plug, valve, and valve spring.

CAUTION: When removing roll pins, it is recommended a press be used to depress valve stop, valve and spool springs.

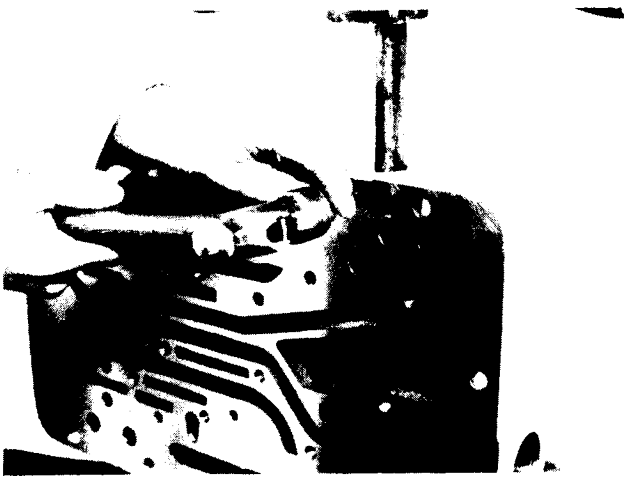


Figure 56
Depress regulating valve spring stop and spring. Using a small drift pin remove roll pin.

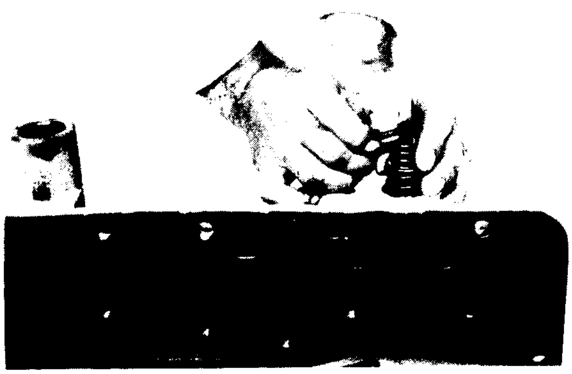


Figure 57
Release press slowly; springs will push spring stop from housing. Remove stop and inner and outer spring.

Figure 58
Remove roll pin on opposite end. Remove regulating valve stop and valve from housing.

CLARK EQUIPMENT

Figure 59
Depress safety valve spring and spring stop. Remove roll pin.

Figure 60
Remove spring stop, spring, safety valve ball, and spacer.

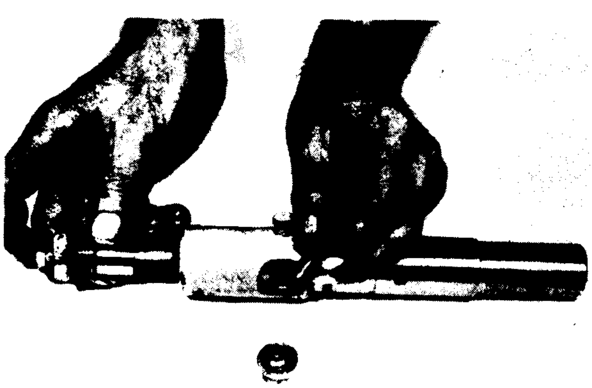


Figure 61
Remove shift cylinder end plug and stop pin retaining plug. Remove 3rd speed valve.

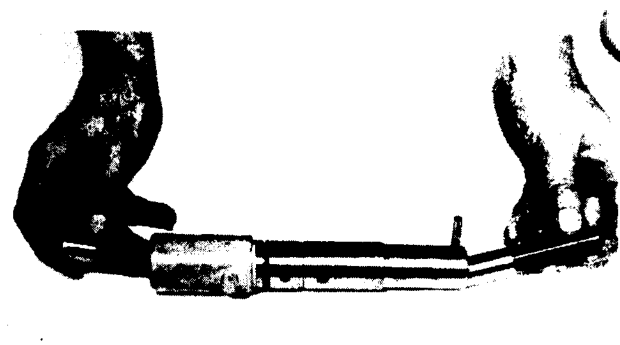


Figure 62
Remove 1st speed valve stop pin. Remove 1st and 2nd speed valve.

REASSEMBLY OF CONTROL COVER

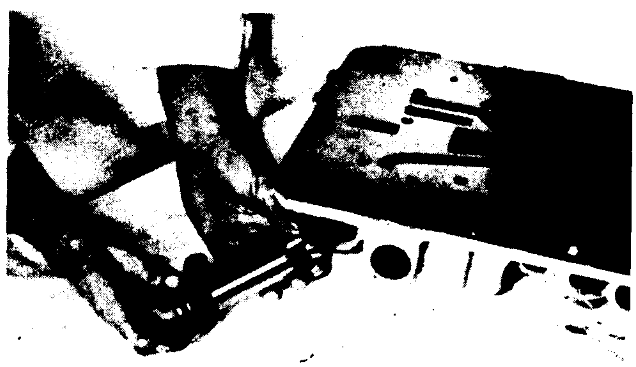


Figure 63
Install safety valve ball, spring, and spacer in cover. Install new "O" Ring on spring stop.

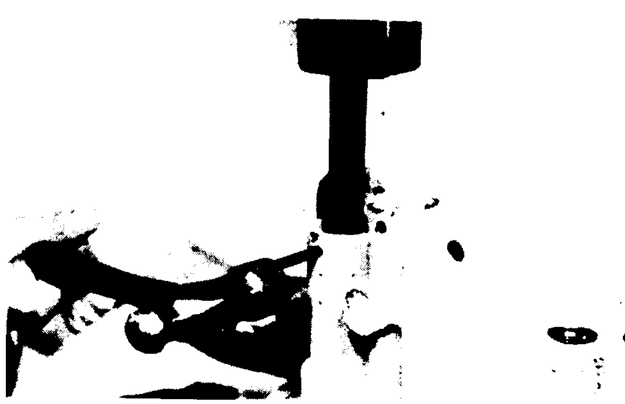


Figure 64
Depress spring stop and spring. Use caution as not to damage "O" ring. Install roll pin.

Figure 65
Install regulating valve spool in valve cover. Install new "O" ring on valve stop. Install valve stop in cover and retain with roll pin.

Figure 66
At opposite end of regulating valve, install inner and outer valve spring. Install new "O" Ring on spring stop. Install spring stop on springs.

Figure 67
Depress spring stop and spring. Install spring stop roll pin.

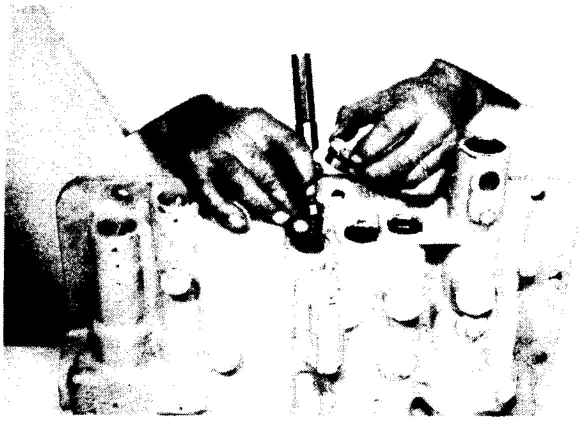


Figure 68
Install shut-off valve spring and valve in cover. Secure with valve spool stop plug.

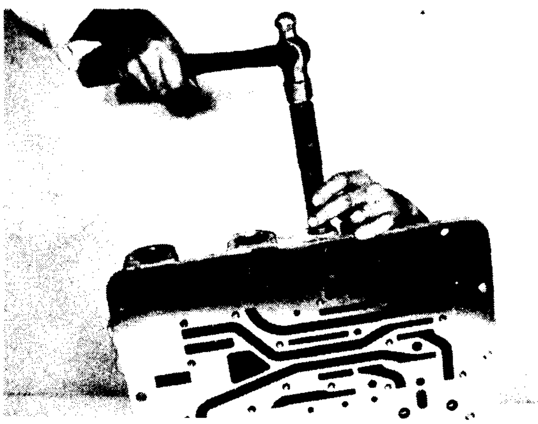


Figure 69
Install forward and reverse selector valve in cover.

NOTE: Detent notches in selector valve must be in line with detent ball and spring hole. Apply a light coat of permatex No. 2 on the outer diameter of a new selector valve oil seal. Install oil seal in housing.

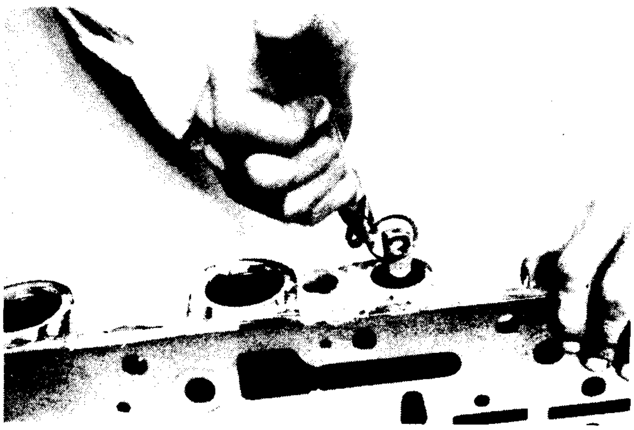


Figure 70
Install selector valve retainer ring.

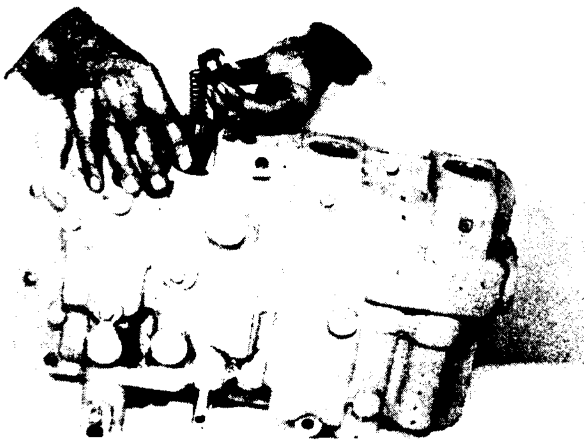


Figure 71

Install high-low valve in cover. Install spring in drilled pocket in end of valve. Install new "O" Ring and spring stop in cover and secure with retainer ring.

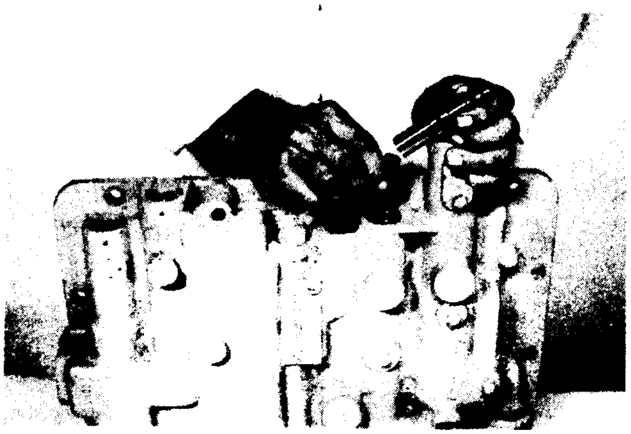


Figure 72

Install high-low piston and piston guide in cover. Secure with retainer ring.

Figure 73

Install selector valve spring and housing end cap in control cover. Secure with lock plug.

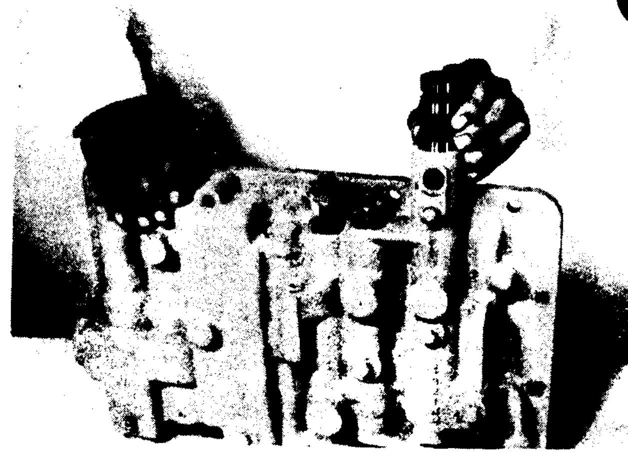


Figure 74

From opposite end install selector valve in cover.

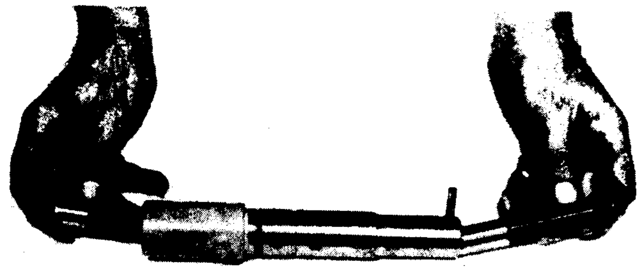


Figure 75

Install 2nd speed valve in shift cylinder with slot in valve lined up with stop pin in cylinder housing. Install 1st speed valve in housing with slot in valve lined up with stop pin. Install stop pin.

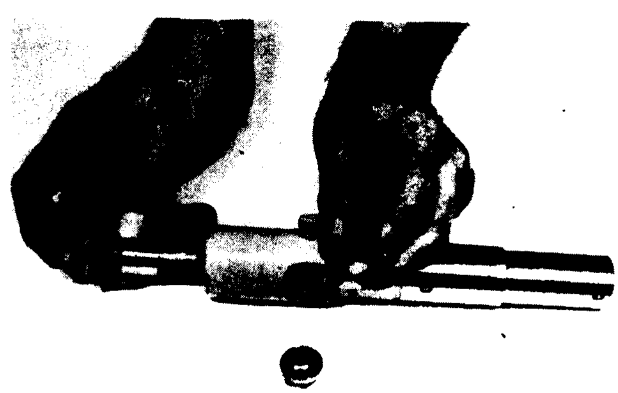


Figure 76

Install 3rd speed valve in housing with slot in valve lined up with stop pin. Install stop pin and pin retainer plug. Install cylinder housing plug.

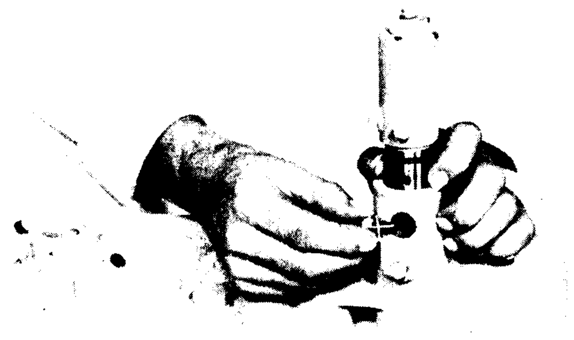


Figure 77
With new "O" Ring in position install shift cylinder assembly in control cover and secure with lock plug.

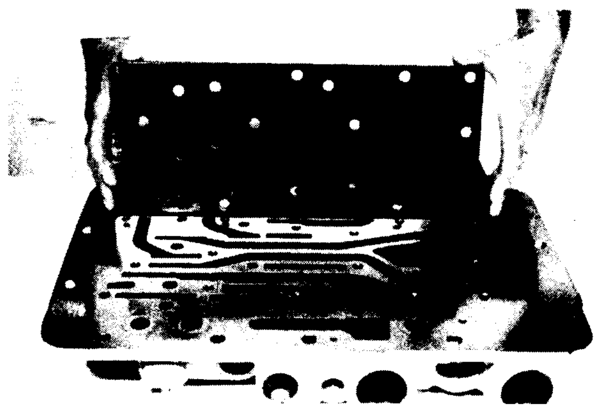


Figure 78
Install poppet ball and poppet spring in drilled port in control cover. Install cover plate. Secure with bolts and external shake proof washers. Tighten 20 to 25 ft. lbs. torque.

TRANSMISSION INTERNAL TUBING

These tubes are not to be removed unless damaged. They should, however, be cleaned and checked for leaks when transmission is disassembled. The tubes are divided into two groups. The high pressure or clutch pressure lines and the low or lubricating pressure lines.

When necessary to replace any tubes, contact your local distributor.

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and moved up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

BEARINGS

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

HOUSINGS

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: Care should be exercised to avoid inhalation of vapors and skin rashes when using alkali cleaners.

All parts cleaned must be thoroughly dried immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or lapping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

BEARINGS

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in type "A" Automatic Transmission Fluid and wrap in clean lintless cloth or paper to protect them until installed.

OIL SEALS, GASKETS, ETC.

Replacement of spring load oil seals, "O" Rings, metal sealing rings, gaskets and snap rings is more economical when unit is disassembled 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 more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency.

Apply a thin coat of permatex No. 2 on the outer diameter of the oil seal to assure an oil tight fit into the retainer. When assembling new metal type sealing rings, same should be lubricated with coat of chassis grease to stabilize rings in their grooves for ease of assembly of mating members. Lubricate all "O" Rings and seals with Type "A" Automatic Transmission Fluid before assembly.

GEARS AND SHAFTS

If magna-flux process is available, use process to check parts. Examine teeth on all gears carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth show spots where case hardening is worn through or cracked, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shafts are true.

HOUSINGS, COVERS, ETC.

Inspect housings, covers and bearing caps to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or condition which would cause subsequent oil leaks or failures.

REASSEMBLY OF TRANSMISSION

Instructions given below on reassembly of components of transmission assembly are given in the sequence that must be followed in rebuilding. Principle of operations cited and views shown are similar and parallel on all shafts. The various drive shafts are assembled in the following order:

1. **Idler Shaft — "I"**
2. **Second and Fourth Shaft — "A"**
3. **First and Third Shaft — "B"**
4. **Input Shaft — "F"**
5. **Reverse Shaft — "R"**
6. **Output Shaft "O"**

REASSEMBLY OF IDLER SHAFT "I"

Figure 79
Install idler bearing cup locating ring, bearing cup and oil baffle in case. No oil baffle in **16,800.**

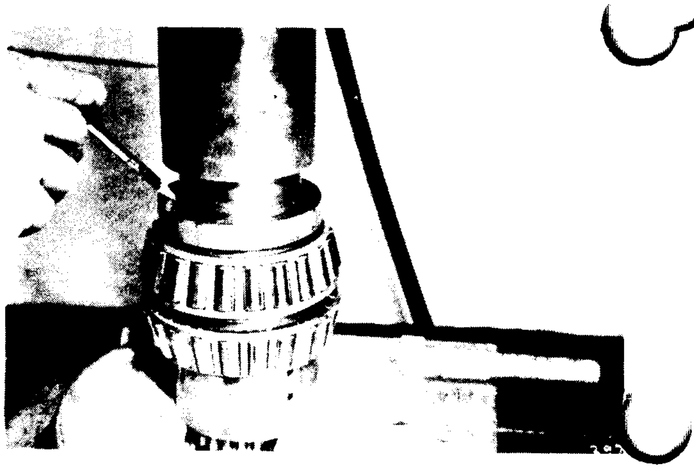


Figure 80
Install idler shaft bearing spacer on idler shaft. **NOTE:** Bearing spacer has an inner and outer chamfer. The inner chamfer must be against shoulder on idler shaft.

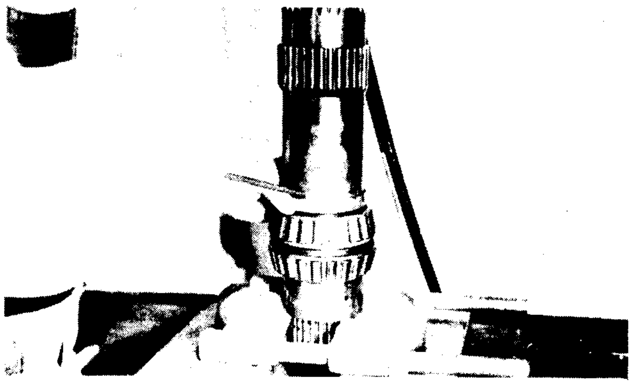


Figure 81
Note spacer position on idler shaft, outer chamfer toward taper bearing.

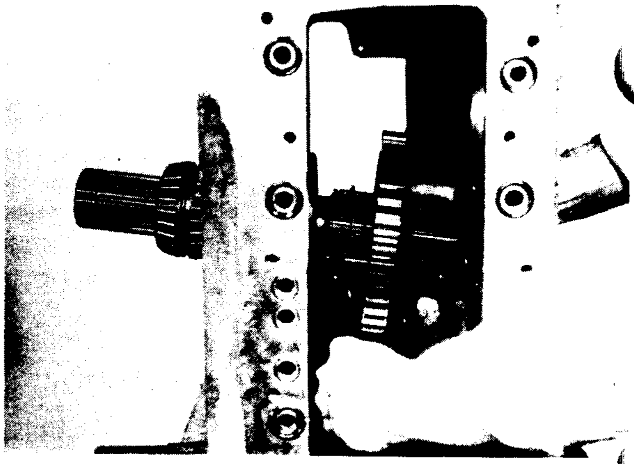


Figure 82
In the **5800** Transmission, insert idler shaft in case bore from rear side, install splitter gear locating ring and gear on idler shaft.

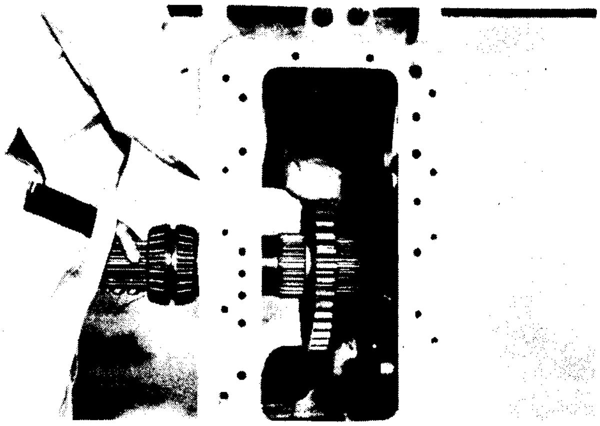


Figure 82A
In the **8800** and **16,800** insert idler shaft in bore of case as shown. Position splitter gear on shaft. **NOTE:** Gear locating ring must be away from double cone bearing.

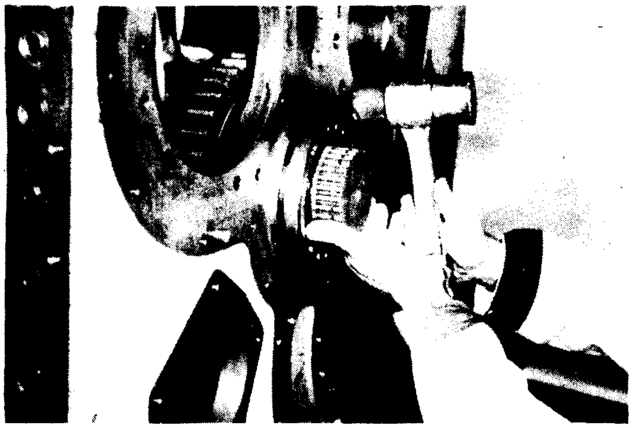


Figure 83
Tap spherical roller bearing in bore of case to center idler shaft.

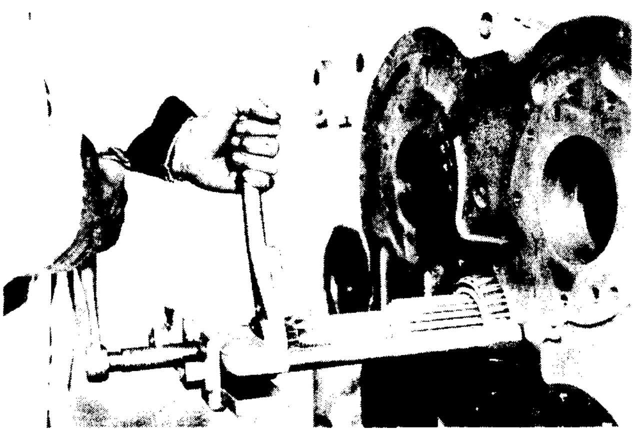


Figure 84
Install pusher tool on taper bearing side to hold shaft while installing spherical bearing.

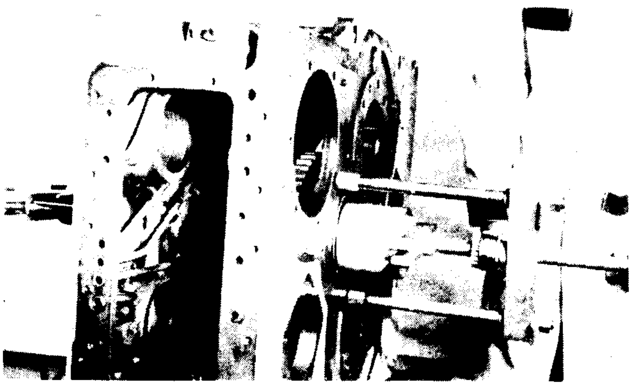


Figure 85
Press spherical bearing and splitter gear into position. On rear of idler shaft install outer taper bearing cup.

Figure 86
Install idler shaft bearing cap and shims. Line oil hole in shims with oil slot in bearing cap. Install bolts and lockwashers and tighten to specified torque. (See Torque Chart.)

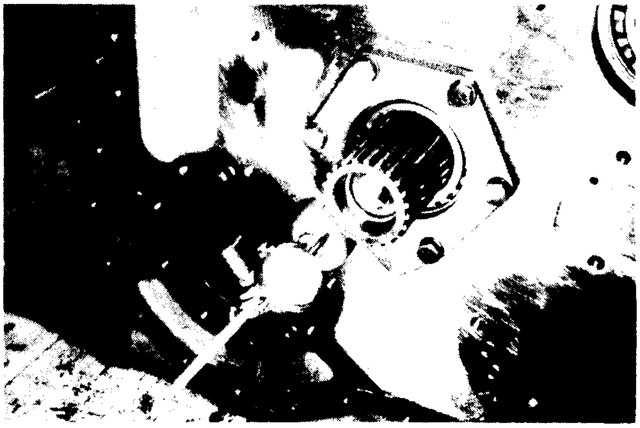


Figure 87
Adjust idler shaft taper bearings by adding or omitting shims. Check adjustment as shown in Figure 87. Adjust taper bearings .0 to .003 end play.

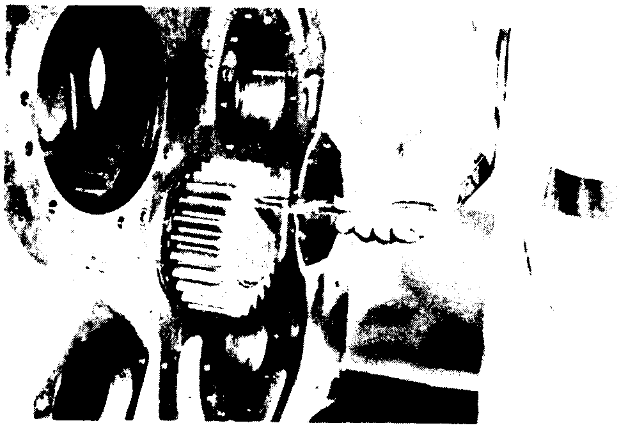


Figure 88
Install idler gear and retainer ring.

Figure 89
Install input shaft bearing locating ring, bearing and bearing retainer ring. (**5800** and **8800** only.)

REASSEMBLY OF 2nd AND 4th SHAFT "A"

Press double taper bearing assembly on shaft.

CAUTION: These bearings are in matched sets and under no circumstances can any of the four (4) parts be changed or mixed up with another bearing.

5800 ONLY:

Position 2nd and 4th gear in case with long hub of gear to front of transmission case.

8800 ONLY:

Position 2nd and 4th gear in case. Hub of gear is the same on both sides.

16,800 ONLY

Position 2nd and 4th gear in case with long hub of gear to rear of transmission case.

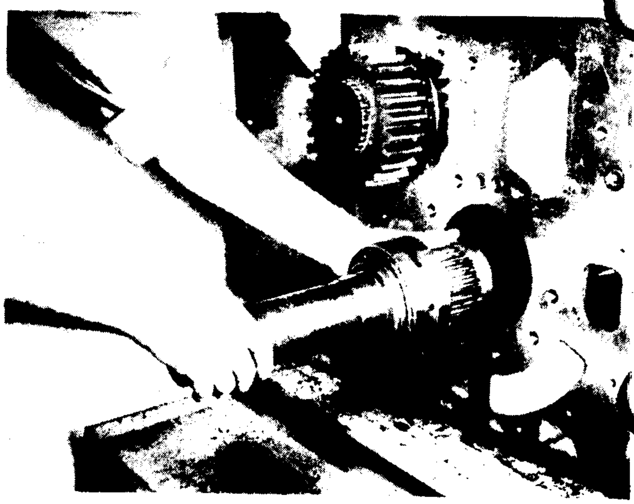


Figure 90
Install short gear spacer on shaft and against taper bearing (**8800** only.) Insert shaft into bore of case and through 2nd and 4th gear. Press shaft and bearing assembly in case until taper bearing shoulders in bore of case. Do not remove shaft pusher.

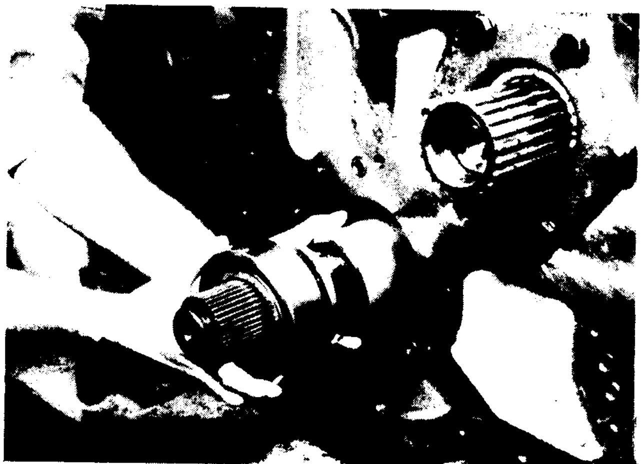


Figure 91
On opposite end of shaft install long gear spacer on shaft and against the 2nd and 4th gear. Install thin spacer on shaft against long spacer. Install roller bearing. Remove shaft pusher. This was left on only to hold shaft while installing bearing. **NOTE:** Bearing must be driven in tight. Check long spacer on shaft. When spacer cannot be turned by hand, stack up between the front and rear bearing is tight. **DO NOT** attempt to draw bearing up tight with bearing lock nut.

REASSEMBLY OF 1st AND 3rd SHAFT "B"

Press double taper bearing assembly on shaft.

CAUTION: These bearings are in matched sets and under no circumstances can any of the four (4) parts be changed or mixed up with another bearing.

5800 ONLY:
Position 1st and 3rd gear in case with long hub of gear to rear of transmission case.

8800 ONLY:
Position 1st and 3rd gear in case with long hub of gear to front of transmission case.

16,800 ONLY:
Position 1st and 3rd gear in case. Hub on gear is the same on both sides.

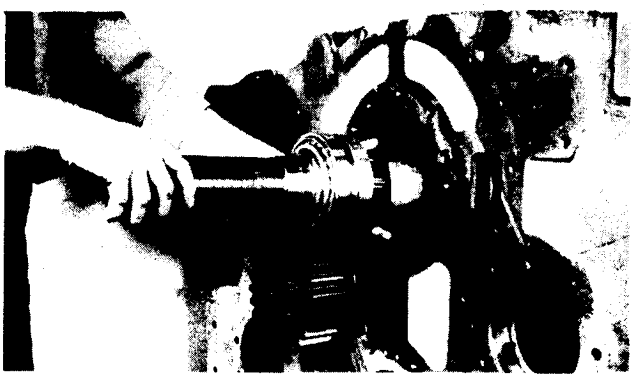


Figure 92
Install long gear spacer on shaft and against taper bearing assembly. Insert shaft into bore of case and through 1st and 3rd gear. Press shaft and bearing assembly in case until taper bearing shoulders in bore of case. **DO NOT** remove shaft pusher.

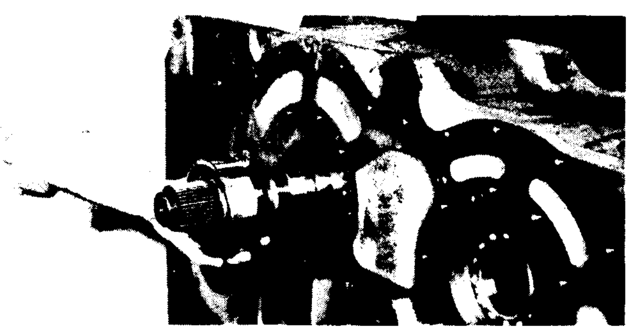


Figure 93
On opposite end of shaft install thin spacer against 1st and 3rd gear. Install roller bearing. Remove shaft pusher. This was left on only to hold shaft while installing bearing. **NOTE:** Bearing must be driven in tight. Check long spacer on shaft. When spacer cannot be turned by hand, stack up between the front and rear bearing is tight. **DO NOT** attempt to draw bearing up tight with bearing lock nut.

REASSEMBLY OF INPUT SHAFT "F"

(See Figure 102 for 5800 Input Shaft Assembly)

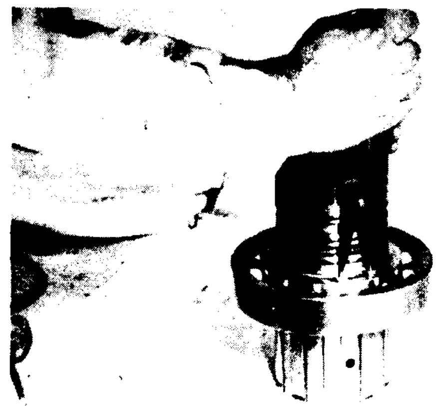


Figure 94
Press ball bearing on support sleeve and secure with retainer ring. (**8800** and **16,800** only.)

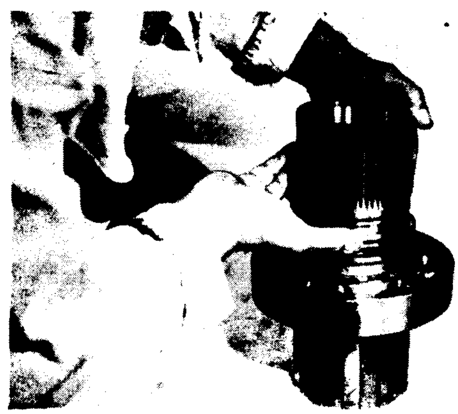


Figure 95
Install support sleeve oil sealing rings. Grease rings to facilitate reassembly. (**8800** and **16,800** only.)

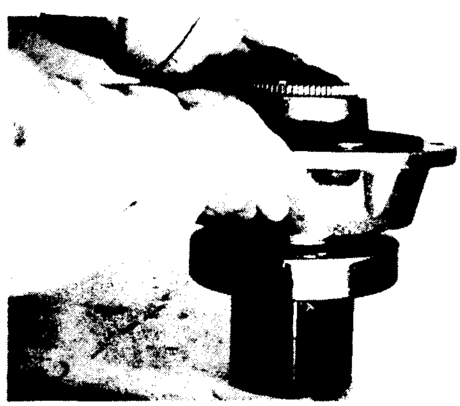


Figure 96
Install support sleeve bearing carrier. (**8800** and **16,800** only.)

CLARK EQUIPMENT

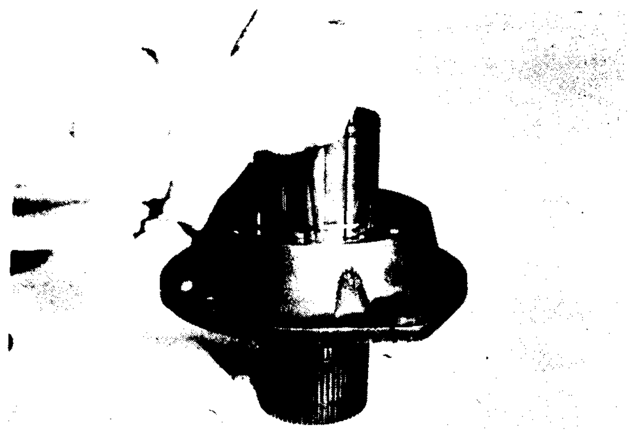


Figure 97
Install bearing to bearing carrier retainer ring. (**8800** and **16,800** only.)

Figure 98
Install inner ball bearing in support sleeve (**16,800** only.) Secure bearing with retainer ring.

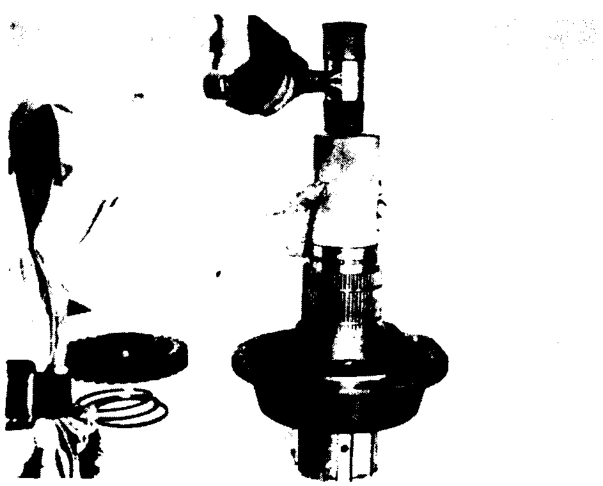


Figure 99
Install inner needle bearing in support sleeve and secure with retainer ring. (**8800** and **16,800** only.)

Figure 100
Install sleeve gear locating ring. Install sleeve gear, with long hub of gear up. (**8800** and **16,800** only.)

Figure 101
Secure sleeve gear with retainer ring. (**8800** and **16,800** only.)

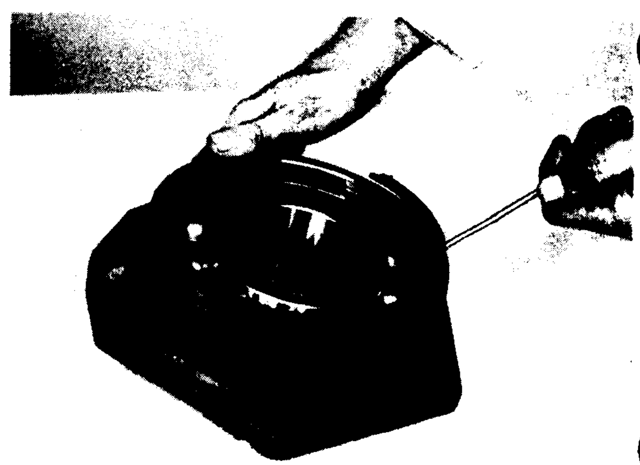


Figure 102
Press ball bearing in support sleeve bearing carrier and secure with retainer ring. (**5800** only.)

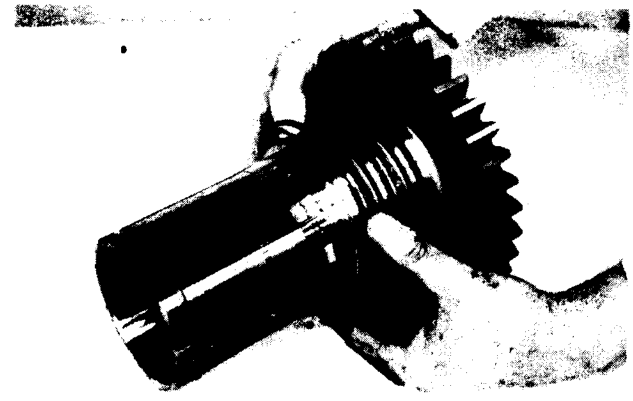


Figure 103
Install support sleeve oil sealing rings. Grease rings to facilitate reassembly. (**5800** only.)

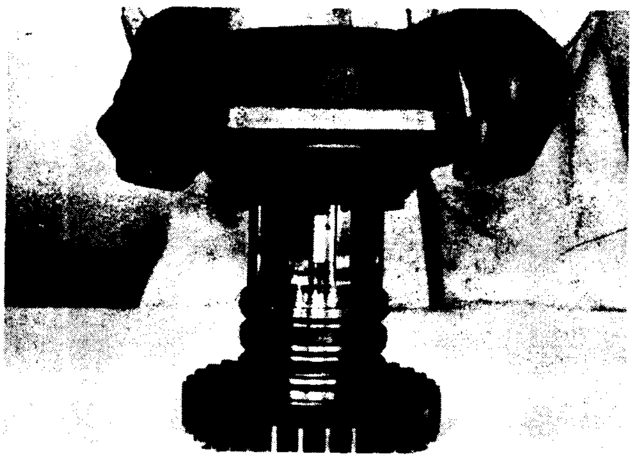


Figure 104
Install bearing carrier on support sleeve. Install inner roller bearing in support sleeve and secure with retainer ring. (**5800** only.)

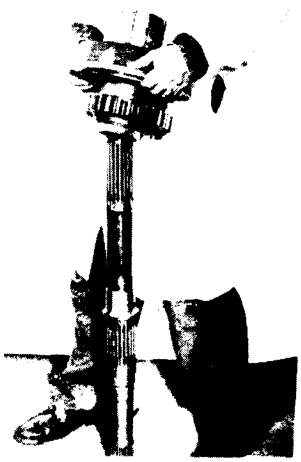


Figure 105
Position clutch support sleeve assembly on input shaft.

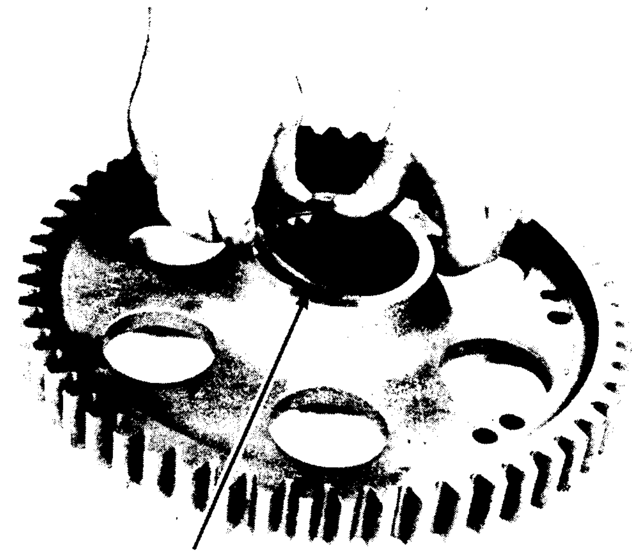


Figure 106
Install internal locating ring in input gear. (**16,800** only.)

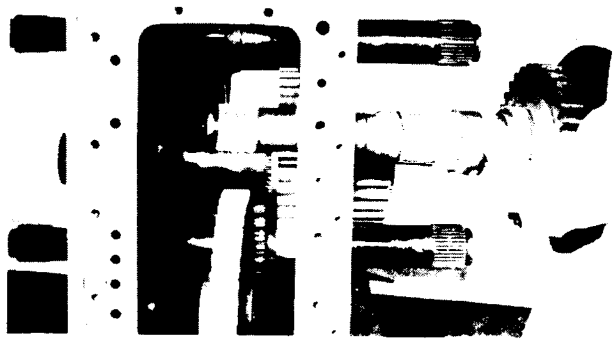


Figure 107
Position gear spacer on input shaft and insert shaft in bore of case. (**Spacer used on 5800 and 8800 only.**)

Figure 108
Position input gear in case with long hub of gear toward rear of case. Install gear spacer. **NOTE: 16,800** spacer has an undercut on one end; this undercut must go toward input gear.

CLARK EQUIPMENT

Figure 109

Install bearing carrier bolts and tighten to specified torque. (See Torque Chart.) Install rear bearing. **NOTE:** Bearing must be driven in tight. Check spacer on shaft. When spacer cannot be turned by hand, stack up between the gear and bearing is tight. **DO NOT** attempt to draw bearing up tight with bearing lock nut.

REASSEMBLY OF REVERSE SHAFT "R"

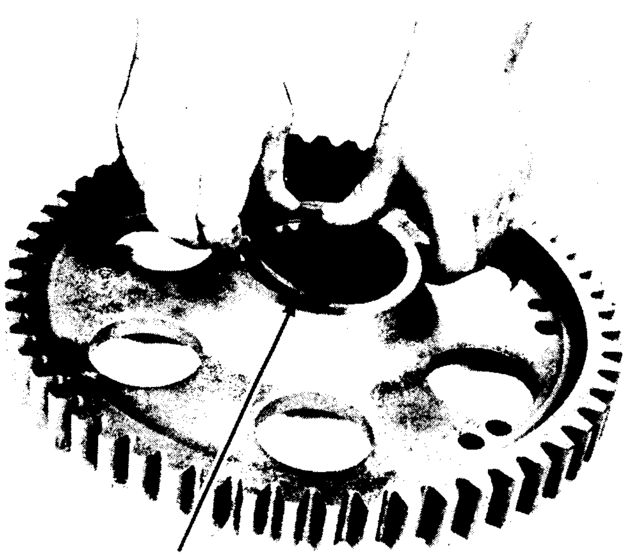


Figure 110

Install internal locating ring in reverse gear. (**16,800** only.)

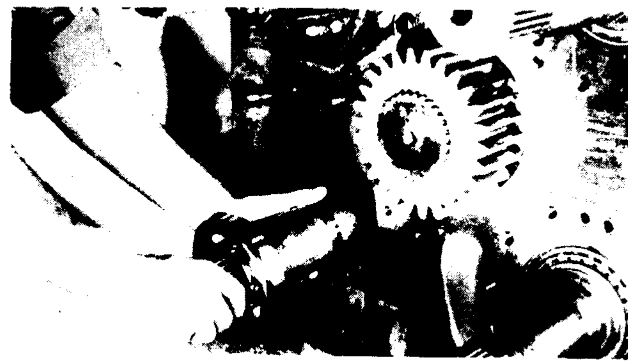


Figure 111

Position reverse gear in case with long hub of gear toward rear of case. Place gear spacer on shaft; **this spacer used on 5800 and 8800 only.** Insert shaft in case and through reverse gear. Press front bearing into case. Use shaft pusher for support to install rear bearing.

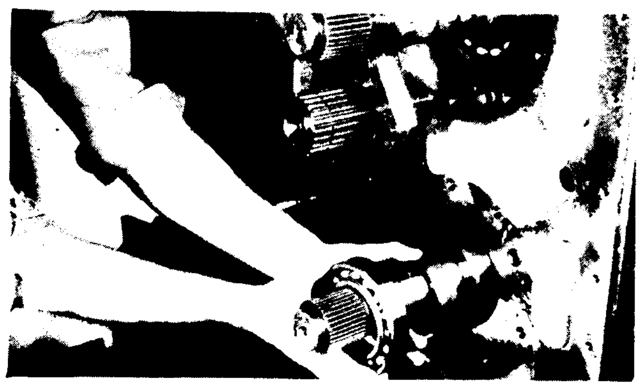


Figure 112

Install gear to bearing spacer. **NOTE: 16,800** spacer has an undercut on one end; the undercut must go toward reverse gear. Install rear bearing. **NOTE:** Bearing must be driven in tight. Check spacer on shaft. When spacer cannot be turned by hand, stack up between the gear and bearing is tight. **DO NOT** attempt to draw bearing up tight with bearing lock nut.

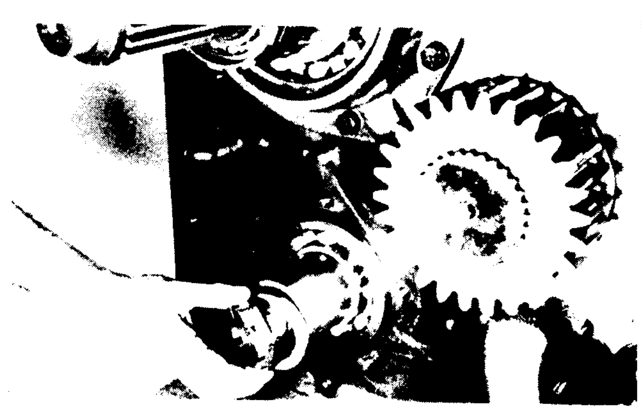


Figure 113

Install spacer, washer and nut. Lock transmission gears with a soft bar and tighten reverse shaft nut to specified torque. (See Torque Chart.)

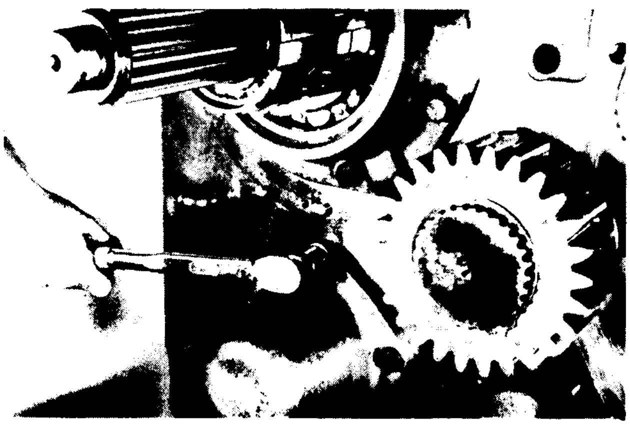


Figure 114

Using new gasket, install reverse shaft bearing cap. Secure with lockwashers and bolts, tighten bolts to specified torque. (See torque chart.)

Figure 115

Install input, reverse, 3rd and 4th shaft lock nuts. Lock gears with soft bar and tighten inner lock nut 175 to 200 ft. lbs. torque. Install nut lock and outer lock nut. Tighten nut 175 to 200 ft. lbs. torque.

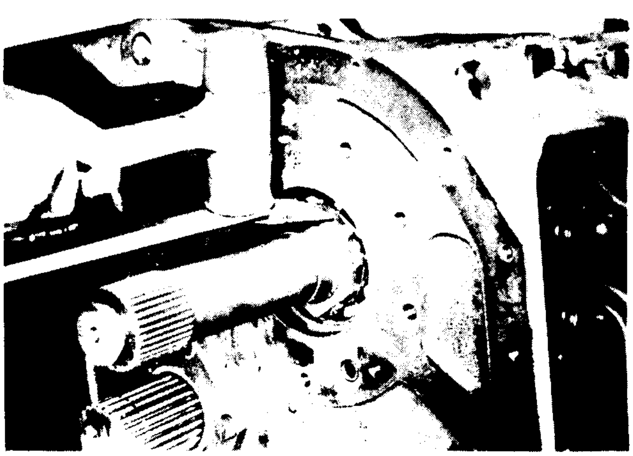


Figure 116

Bend two nut lock tangs on inner lock nut and two nut lock tangs on the outer lock nut.

REASSEMBLY OF OUTPUT SHAFT "O"

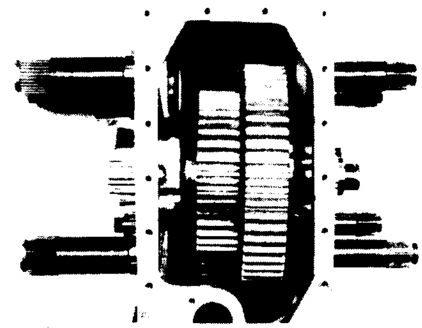


Figure 117

Press taper bearing (large diameter of taper inward) over threaded end of output shaft against shoulder on shaft. Position small output shaft gear in transmission case to the front, with longer offset of gear hub toward the front. Position large output shaft gear in transmission case to the rear. Insert output shaft through rear bore of case and through large and small output gears. Figure 117 shows proper stack up of gears. Drive front taper bearing (large diameter of taper inward) on output shaft until bearing shoulders against small gear. Install bearing cups over front and rear bearings.

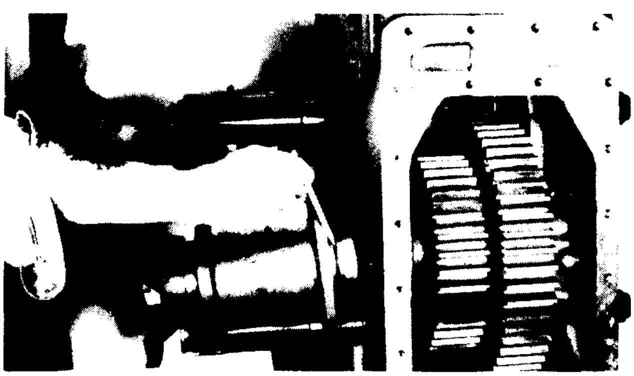


Figure 118

Install new "O" Ring on disconnect housing and install disconnect assembly to transmission case.

Figure 119

Install lockwashers and bolts in disconnect housing. Tighten bolts to specified torque. (See torque chart.)

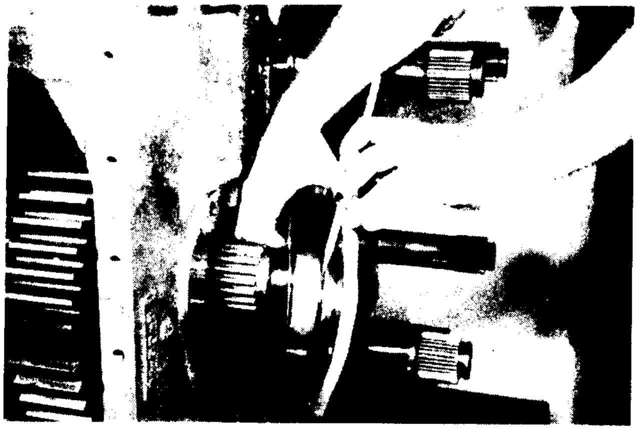


Figure 120

Apply a thin coat of permatex No. 2 on the outer diameter of the output shaft oil seal. Press oil seal, lip of seal inward, into output shaft bearing cap. Install a new "O" Ring on output shaft bearing cap. Lubricate ring with type "A" Automatic Transmission Fluid. Install bearing cap and shims. Do not tighten bearing cap bolts. Disengage disconnect shaft from output shaft.

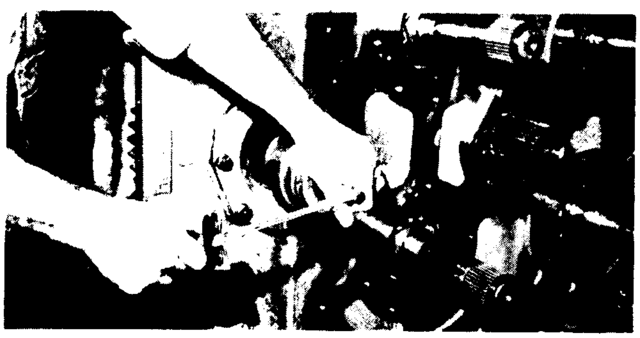


Figure 121

Using an inch pound torque wrench on the output flange nut, determine the amount of torque required to turn gear train.

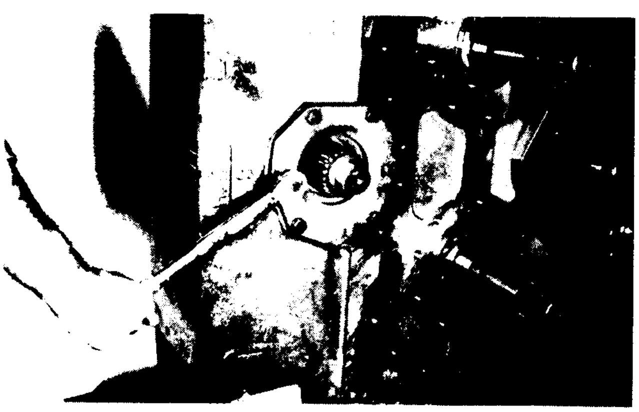


Figure 122

Tighten output shaft bearing cap bolts to specified torque. (See torque chart.)

Figure 123

Add or remove shims from bearing cap to adjust preload. When bearings are adjusted properly, it will take 6 to 8 inch pounds more torque to turn gear train with cap bolts torqued than when bolts were loose.

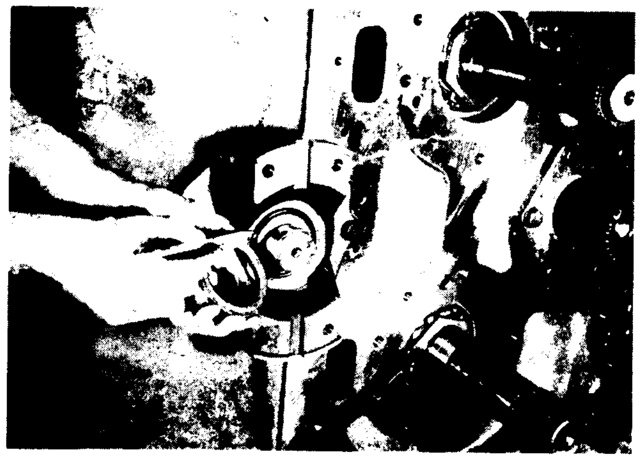


Figure 124

Install output companion flange, flange "O" Ring, washer and nut.

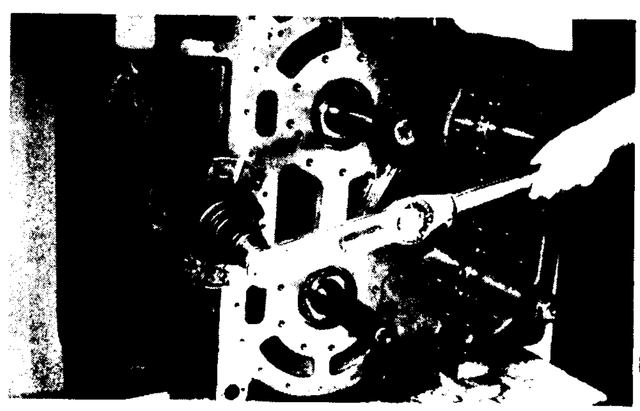


Figure 125

Lock transmission gears with a soft bar and tighten flange nut to specified torque. (See torque chart.)

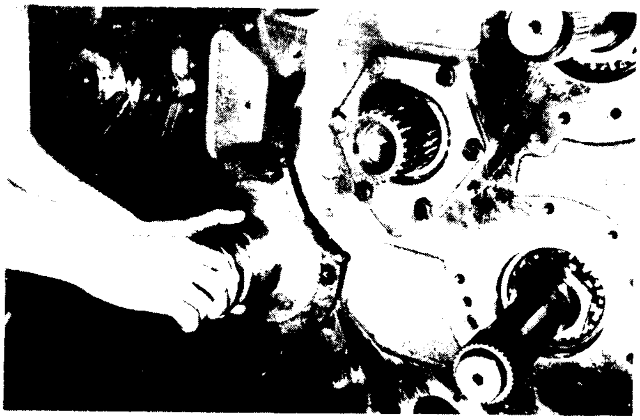


Figure 126
Install clutch supports on 1st, 2nd, 3rd, 4th, input and reverse shafts.

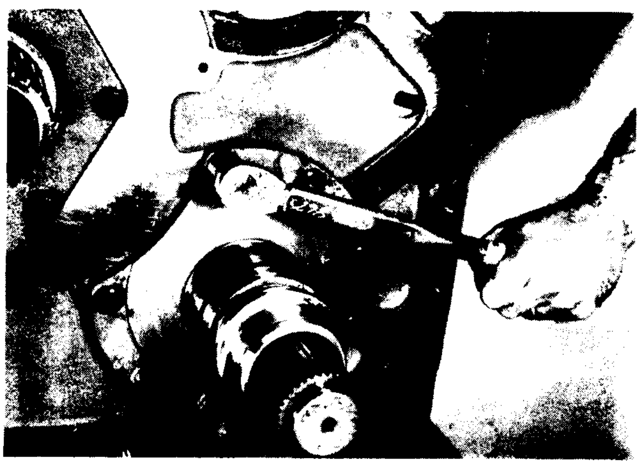


Figure 127
Secure supports with special self-locking bolts. Torque bolts to specified torque. (See torque chart.)

Figure 128
Install oil sealing rings, two on each support. Lubricate rings to facilitate reassembly of clutch drums.

REASSEMBLY OF CLUTCHES

NOTE: All clutches are assembled in a similar manner. The quantity of clutch discs will differ between the 1st and 2nd clutch and the forward, reverse, 3rd, and 4th. **Do not mix 1st and 2nd clutch plates with forward, reverse, 3rd, and 4th.**

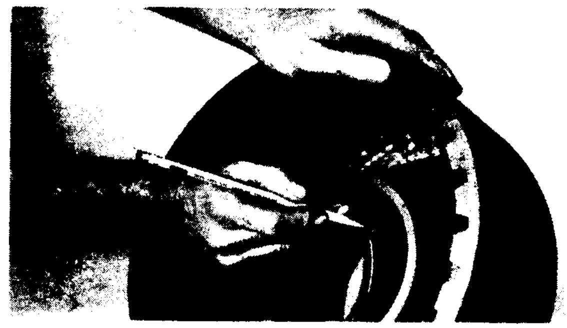


Figure 129
Insert lock ball in clutch piston ring outer race. Press outer race and ball in clutch drum. Outer race must be pressed from flush to 1 64" below shoulder in clutch drum.

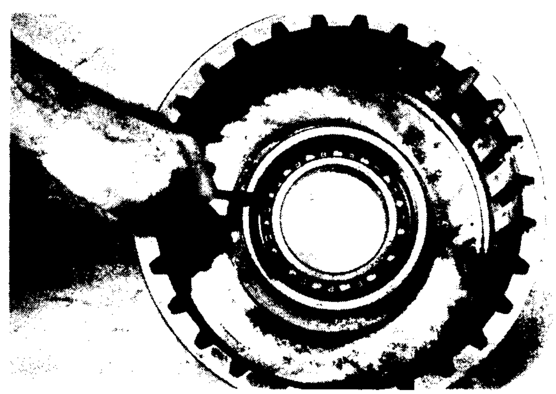


Figure 130
Press support ball bearing in clutch drum, and secure with bearing retainer ring.

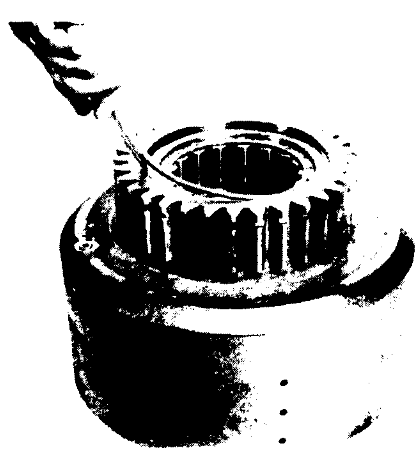


Figure 131
From rear end of clutch drum, press support roller bearing in drum; secure with retainer ring.

CLARK EQUIPMENT

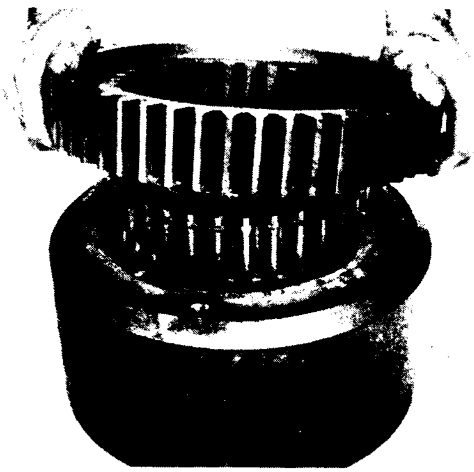


Figure 132
Press clutch drum hub gear on clutch drum with longer offset of gear hub inward. **NOTE:** Clutch drum hub gear is used only on the 1st and 2nd clutch.

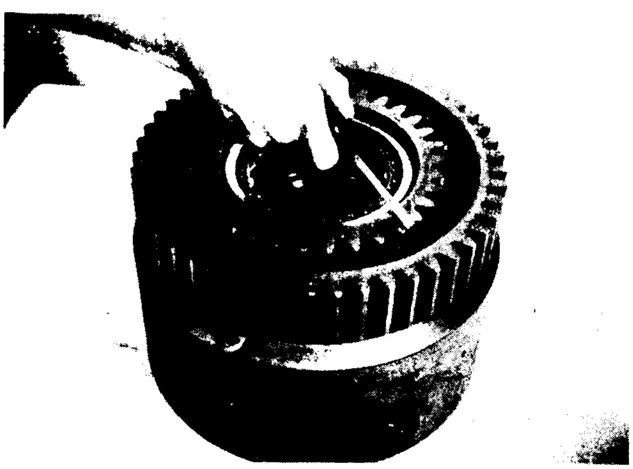


Figure 133
Secure clutch drum hub gear with retainer ring.

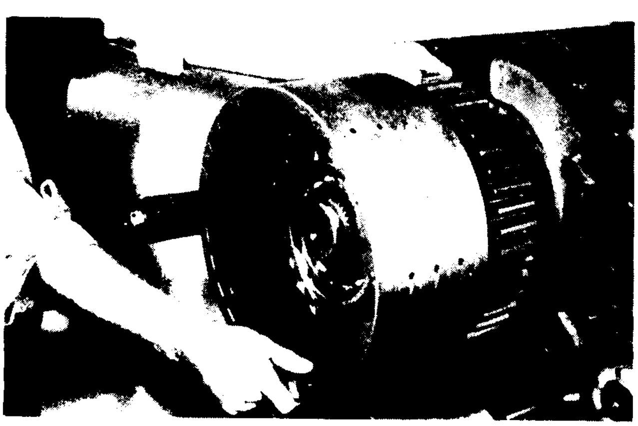


Figure 134
Install clutch drum assembly on clutch support. **CAUTION:** Do not damage clutch support piston rings.

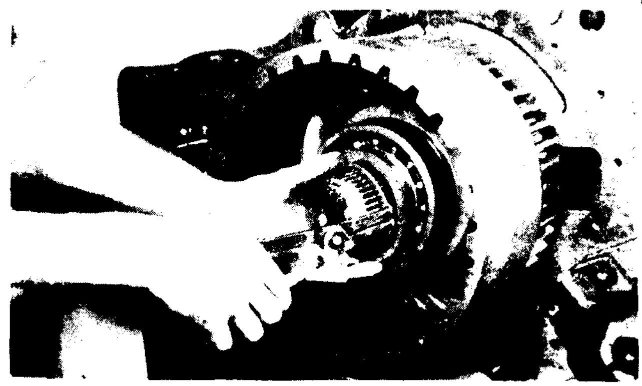


Figure 135
Install clutch drum hub bearing washer and retainer ring.

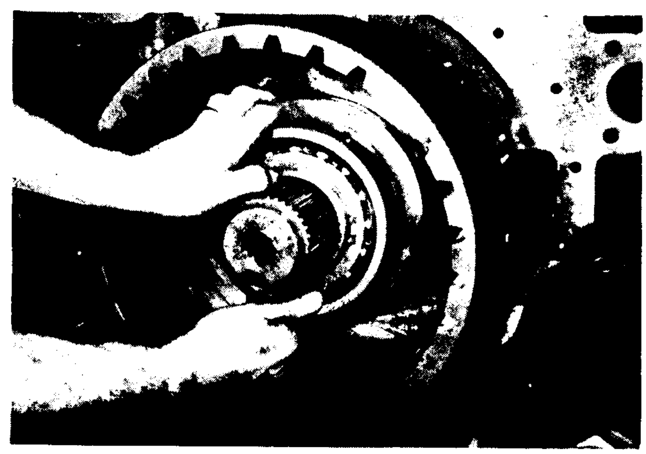


Figure 136
Install clutch piston inner sealing ring. Lubricate piston ring with type "A" Automatic transmission fluid.

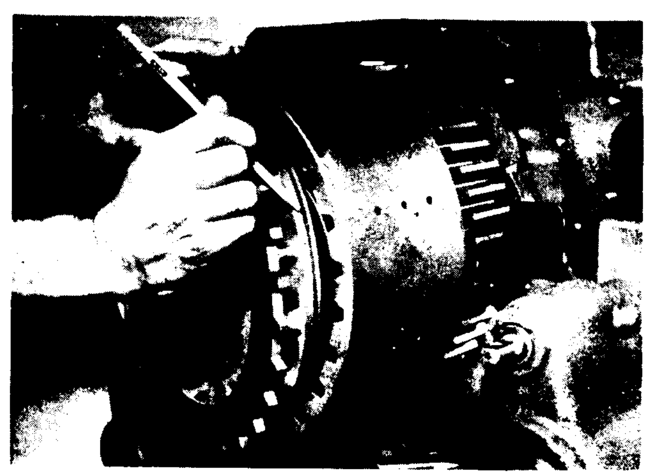


Figure 137
Install clutch piston outer sealing ring. Lubricate ring with type "A" Automatic Transmission Fluid. Slide clutch piston into position in clutch drum. **CAUTION:** Do not damage inner and outer sealing rings.

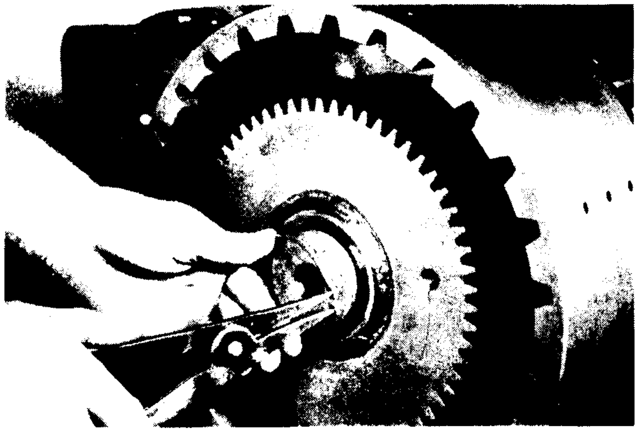


Figure 138
Install clutch disc hub and retainer ring.

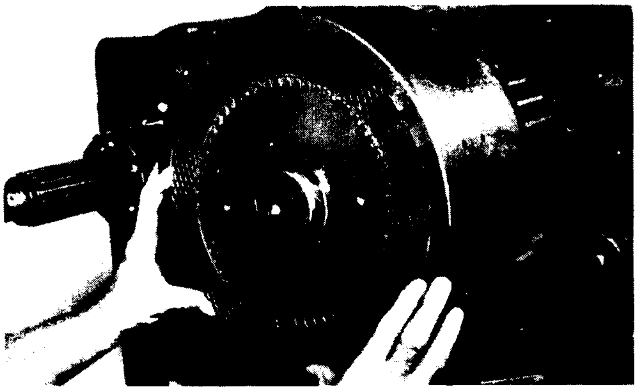


Figure 139
Install one bronze disc on clutch disc hub and against the clutch piston.

Figure 140
Install one steel disc in clutch drum. **NOTE:** The steel disc has teeth missing on the outer diameter. This is to allow passage for the clutch release springs. Insert two or more release springs in drum and against the teeth of the clutch piston. Next, install bronze disc. Alternate clutch discs, steel against bronze and always align the teeth on each steel disc with the teeth on the preceding steel disc. If assembly is correct each release spring is against a tooth on the clutch piston and you start with a bronze disc and end with a bronze disc.

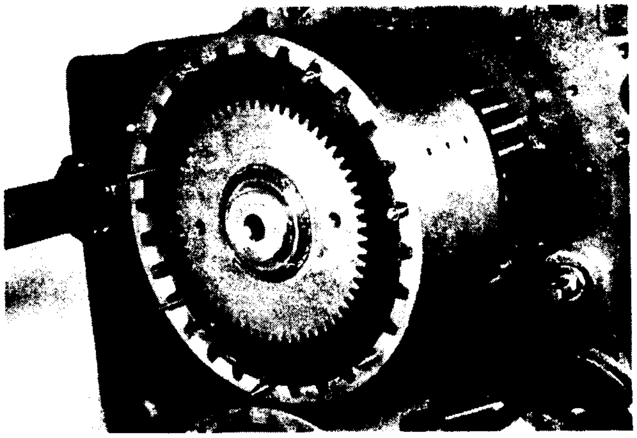


Figure 141
Insert all release springs and guide pins in clutch drum.

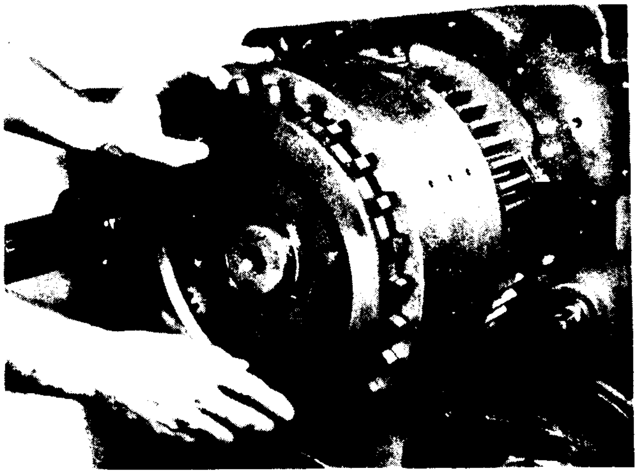


Figure 142
Install end plate.

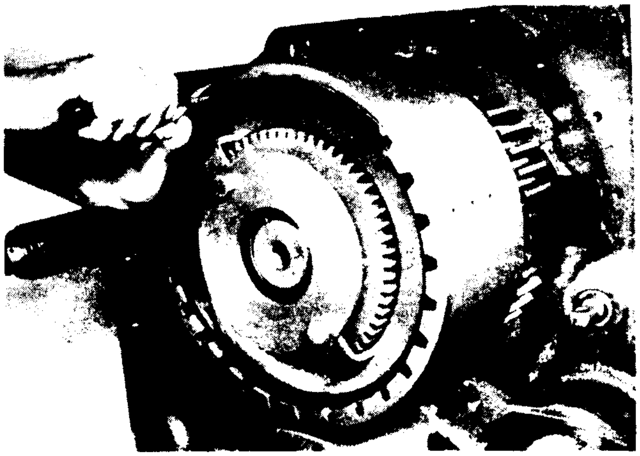


Figure 143
Compress clutch disc end plate and install end plate retainer ring.

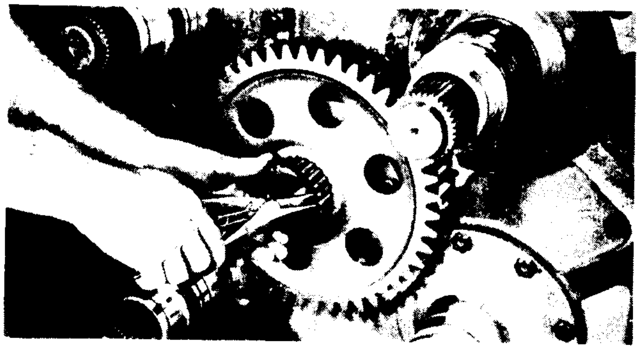


Figure 144
Install large idler on idler shaft with longer offset of gear hub inward. Install idler gear retainer ring.

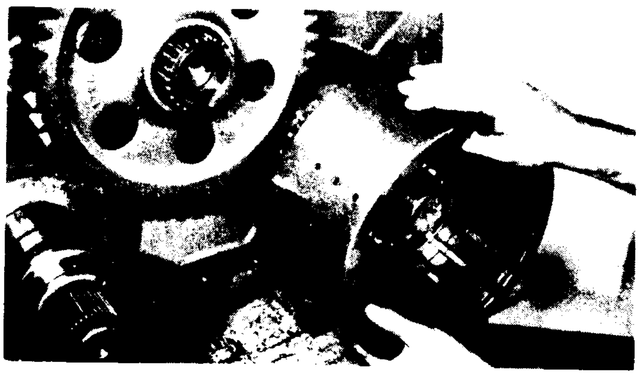


Figure 145
Install input, reverse, 3rd and 4th clutch as previously explained.

REASSEMBLY OF HIGH FORWARD CLUTCH

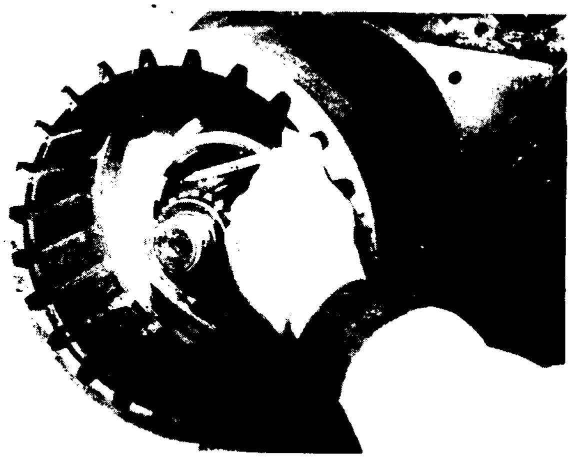


Figure 146
Install high forward clutch drum on clutch support sleeve. Oil hole (see Figure 146) in clutch drum hub must be aligned with oil hole on support sleeve (see Figure 147).

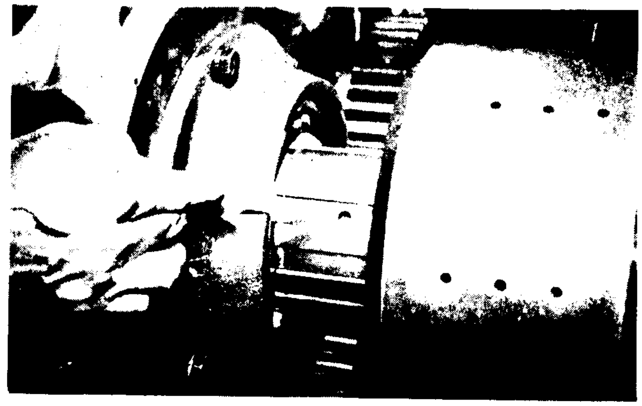


Figure 147
If oil hole in drum hub does not line up with oil hole in support sleeve, clutch will not function.

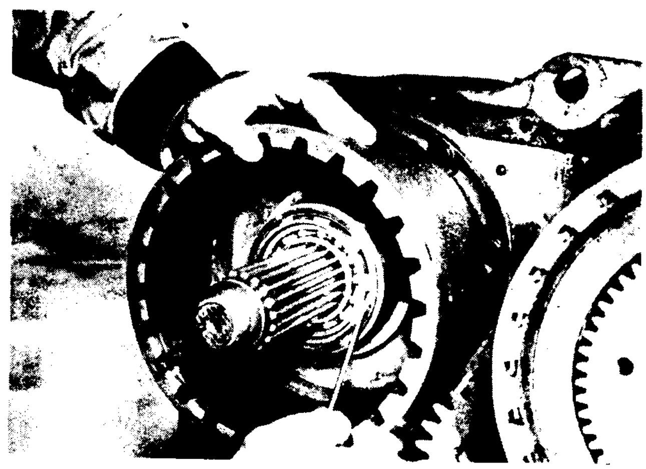


Figure 148
Install drum hub retainer ring. Install piston inner sealing ring on drum hub. Lubricate sealing ring.

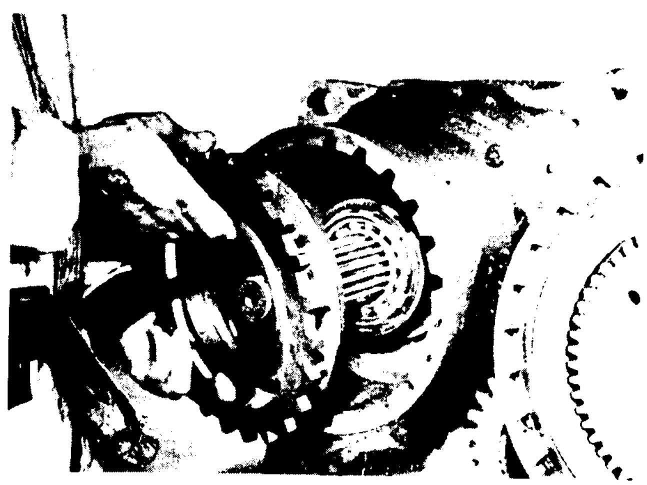


Figure 149
Install clutch piston outer sealing ring. Lubricate sealing ring. Install clutch piston in clutch drum.

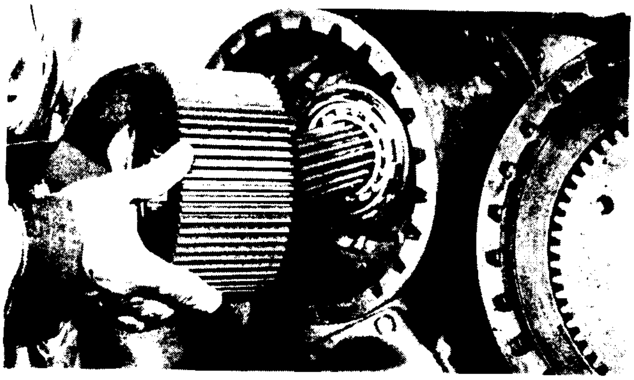


Figure 150
Install clutch disc hub in drum.

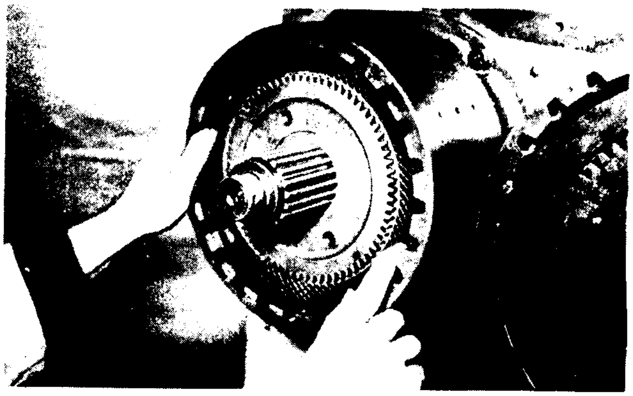


Figure 151
Install one bronze disc on clutch disc hub and against clutch piston.

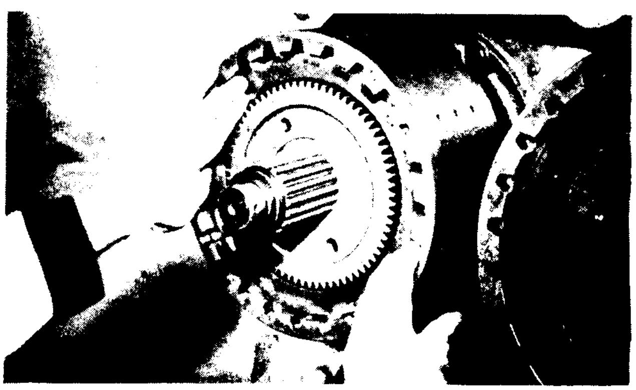


Figure 152
Install one steel disc in clutch drum. **NOTE:** The steel disc has teeth missing on the outer diameter. This is to allow passage for the clutch release springs. Insert two or more release springs in drum and against the teeth of the clutch piston. Next, install bronze disc. Alternate clutch discs, steel against bronze and always align the teeth on each steel disc with the teeth on the preceding steel disc. If assembly is correct each release spring is against a tooth on the clutch piston and you start with a bronze disc and end with a bronze disc.

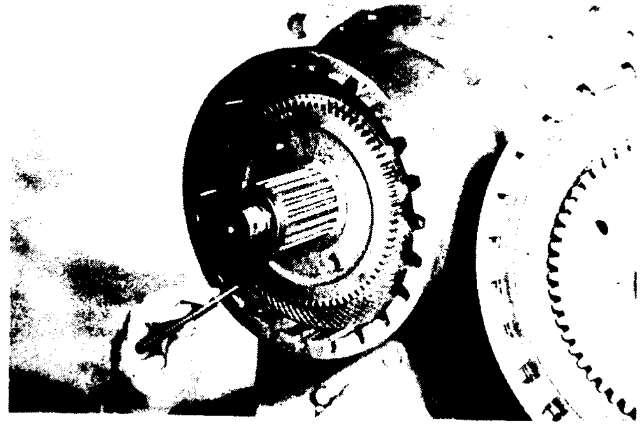


Figure 153
Install remaining release springs and guide pins in clutch pack.

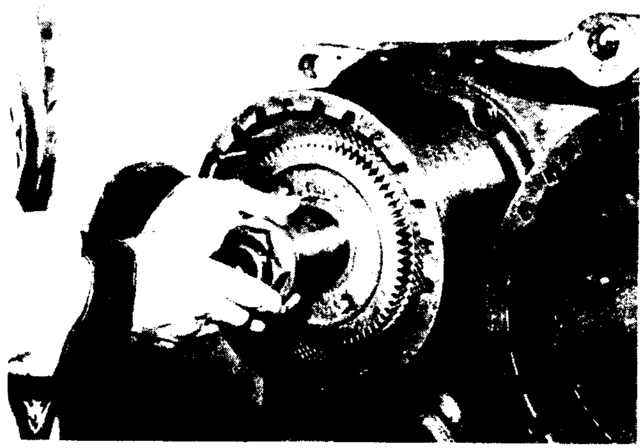


Figure 154
Install spacer, companion flange washer and nut on input shaft.

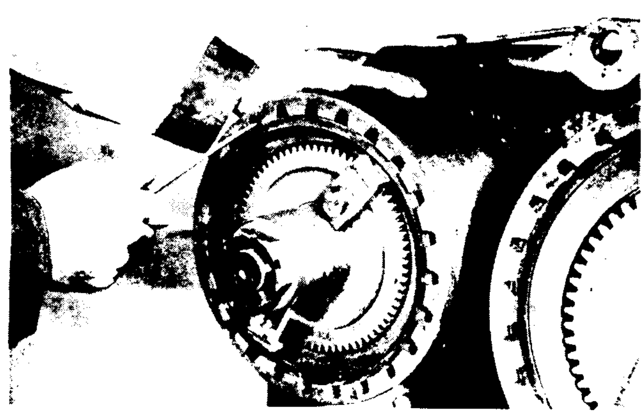


Figure 155
Install clutch end plate. Compress end plate and install end plate retainer ring.

CLARK EQUIPMENT

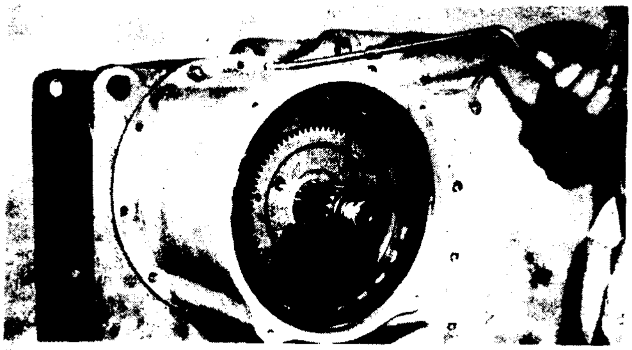


Figure 156
Using new gaskets install clutch cover and cover plates. Tighten clutch cover bolts to specified torque. (See torque chart.)

Figure 157
Apply a thin coat of Permatex No. 2 on the outer diameter of the input shaft oil seal. Press oil seal, lip of seal up into input shaft high forward clutch cover. Install new "O" Ring on cover. Secure with lockwashers and bolts. Tighten to specified torque. (See torque chart.)

Figure 158
Install input flange, flange "O" Ring, washer and nut. Tighten to specified torque. (See torque chart). Install nut cotter.

Figure 159
Install new "O" Ring on sump screen and baffle assembly. Install screen and baffle assembly. Tighten to specified torque. (See torque chart.) Using new gasket and with sump magnets in place install sump pan. Tighten bolts to specified torque. (See torque chart.)

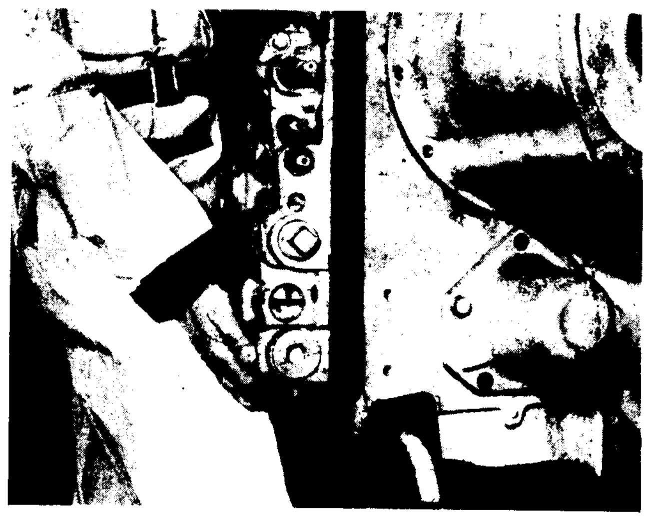


Figure 160
Using new control valve to case "O" Rings and new gasket, install control cover assembly on transmission case. Secure with bolts and lockwashers. Tighten to specified torque. (See torque chart.)

SERVICING MACHINE AFTER TRANSMISSION OVERHAUL

The transmission, torque converter and its allied hydraulic system are important links in the drive line between the engine and wheels. The proper operation of either unit depends greatly on the condition and operation of the other, therefore, whenever repair or overhaul of one unit is performed, the balance of the system must be considered before the job can be considered completed.

After the overhauled or repaired transmission has been installed in the machine, the torque converter, oil cooler, filter and connecting hydraulic system must be thoroughly cleaned. This can be accomplished in several manners and a degree of judgment must be exercised as to the method employed.

The following are considered the minimum steps to be taken:

1. Drain entire system thoroughly.
2. Disconnect and clean all hydraulic lines. Where feasible hydraulic lines should be removed from machine for cleaning.
3. Replace oil filter elements, cleaning out filter cases thoroughly.
4. The oil cooler at bottom of radiater must be thoroughly cleaned. The cooler should be "back flushed" with oil and compressed air until all foreign material has been removed. Flushing in direction of normal oil flow will not adequately clean the cooler. If necessary, radiater and cooler assembly should be removed from machine for cleaning, using oil, compressed air and steam cleaner for that purpose. **DO NOT** use flushing compounds for cleaning purposes.
5. Remove bottom drain cover and plug from torque converter and inspect interior of converter housing, gears, etc. If presence of considerable foreign material is noted, it will be necessary that converter be removed, disassembled and cleaned thoroughly. It is realized this entails extra labor, however, such labor cost is a minor cost compared to cost of difficulties which can result from presence of such foreign material in the system.
6. Reassemble all components and using only specified Transmission Fluid, fill torque converter and transmission through filler opening until fluid comes up to FULL mark on transmission dip-stick. Reinstall fill plug and dipstick and run engine two minutes at 500 - 600 RPM to prime torque converter and hydraulic lines. Recheck level of fluid in transmission **with engine running** at idle (500-600 RPM) and add quantity necessary to bring level up to FULL mark on dipstick. Recheck with hot oil (180 to 200 degrees).
7. Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

CHECK POINTS

A. CLUTCH PRESSURE

B. CONVERTER INLET

C. CONVERTER OUTLET

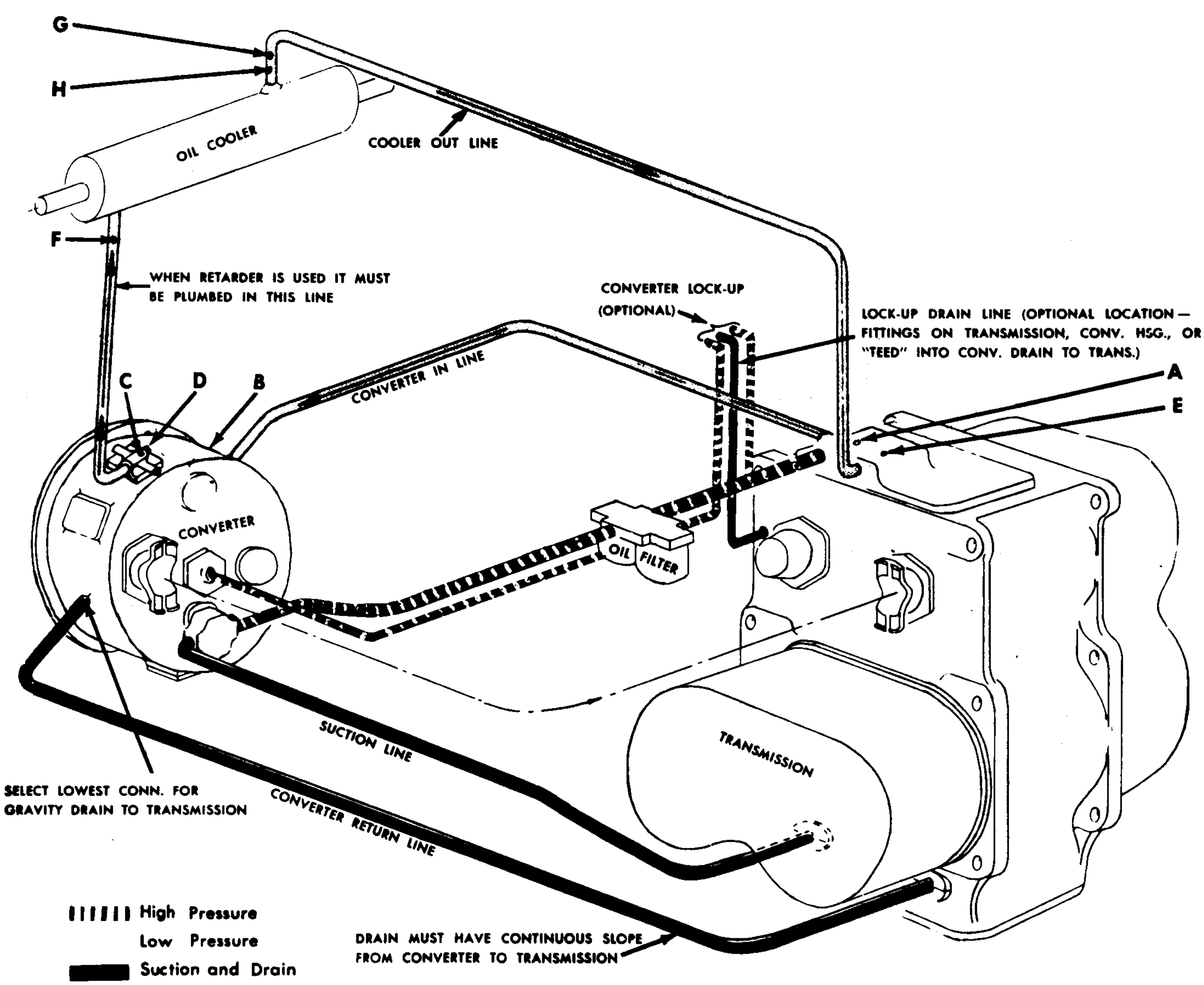
D. CONVERTER TEMPERATURE CONNECTION

E. LUBE PRESSURE

F. COOLER INLET PRESSURE

G. COOLER OUTLET PRESSURE

H. COOLER OUTLET TEMPERATURE



SPECIFICATIONS AND SERVICE DATA — POWER SHIFT TRANSMISSION AND TORQUE CONVERTER

GEAR TYPE	Spur
CONTROLS	Forward and Reverse — Manual Speed Selection — Manual
CLUTCH TYPE	Multiple discs, hydraulically actuated, spring released, automatic wear compensation and no adjustment. All clutches oil-cooled and lubricated.
CLUTCH INNER DISC	Sintered Bronze
CLUTCH OUTER DISC	Steel
CLUTCH PRESSURE	180-220
OIL FILTRATION	Full flow oil filter safety by-pass, also strainer screen and magnets in sump at bottom of transmission case.

LUBRICATION

TYPE OF OIL — See Lubrication Chart

CAPACITY — Consult Operator's Manual on applicable machine model for system capacity. Torque Converter, Transmission and allied hydraulic system must be considered as a whole to determine capacity.

CHECK PERIOD — Check oil level DAILY with engine running at 500-600 RPM and oil at 180 degrees F. to 200 degrees F.

DRAIN PERIOD — Maintain oil level to FULL mark on dipstick. Every 250 hours change oil filter element. Every 500 hours, drain and refill system as follows: Drain with oil at 150 degrees F. to 200 degrees F.

(a) Drain converter at bottom rear of converter housing.

(b) Drain transmission and remove sump. Clean pan and screen thoroughly and replace using new gaskets.

(c) Drain oil filters, remove and discard filter elements. Clean filter shells and install new elements.

(d) Refill transmission to FULL mark on dipstick.

(e) Run engine at 500-600 RPM to prime converter and lines.

(f) Recheck level with engine running at 500-600 RPM and add oil to bring level to FULL mark on dipstick. When oil temperature is hot (180 degrees to 200 degrees), make final oil level check.

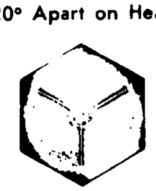
RECOMMENDED OILS FOR CLARK POWER SHIFT TRANSMISSIONS AND CONVERTERS HAVING COMMON OIL SYSTEM

Prevailing Ambient Temp.	SAE Spec.	Type
	INITIAL FILL	
Above 0° F	Type "A" Suffix "A" or Dexron * Type C-2	Automatic Transmission Fluid Hydraulic Fluid
Below 0° F	Type "A" Suffix "A" or Dexron *	Automatic Transmission Fluid
	SUBSEQUENT FILL OR REFILLS	
Above 0° F	Type "A" Suffix "A" or Dexron * Type C-2 SAE 10 Mil. 2104B	Automatic Transmission Fluid Hydraulic Fluid MS-DG Grade 10
Below 0° F	Type "A" Suffix "A" or Dexron *	Automatic Transmission Fluid

* DEXRON is a Registered Trademark of General Motors Corporation

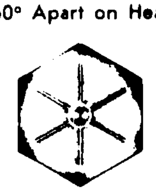
TORQUE IN (LBS. — FT.)
BOLTS, CAPSCREWS, STUDS AND NUTS

Grade 5 Identification, 3 Radial Dashes 120° Apart on Head of Bolt



Grade 5

Grade 8 Identification, 6 Radial Dashes 60° Apart on Head of Bolt



Grade 8

COARSE THREADS	Grade 5 Dry	Grade 5 Lubricated or Plated	Grade 8 Dry	Grade 8 Lubricated or Plated
3/8 — 16	31 — 34	23 — 25	44 — 48	33 — 36
7/16 — 14	49 — 54	37 — 41	70 — 77	52 — 57
1/2 — 13	75 — 83	57 — 63	106 — 117	80 — 88
9/16 — 12	109 — 120	82 — 90	153 — 168	115 — 127
5/8 — 11	150 — 165	113 — 124	212 — 233	159 — 175

CLARK EQUIPMENT

TABLE OF TORQUE LIMITS

	TORQUE IN FT. LBS.								
	Minimum				Maximum				
Converter Series	C270	C5000	C8000	C16000	C270	C5000	C8000	C16000	
BOLT									ITEM
Self Locking			45	70			60	85	Drive Disc Adaptor
Self Locking			70	135			85	145	Stator Support
Body Fit				282				310	Offset Housing
	200	200	250	250	250	250	300	300	Output Flange Nut

PRESSURE AND OIL FLOW CHECK SPECIFICATIONS. ALL CHECKS MADE WITH HOT OIL (180 Degrees F. to 200 Degrees F.)

A.	Clutch Pressure at Transmission Control Cover	180-220 p.s.i. at Engine idle, each clutch and no more than 5 p.s.i. variation between all clutches.
B.	Transmission to Converter Line	See External Oil Flow Diagram.
C.	Converter-Out Pressure	See Pressure and Oil Flow Checks.
D.	Temperature Gauge Connection	See External Oil Flow Diagram.
E.	Lubricating Pressure	25 p.s.i. Maximum at High Free Idle.
	Converter Return Line	See External Oil Flow Diagram.
	Converter Pump Output	See Pump Chart.

TROUBLE SHOOTING GUIDE

The following data is presented as an aid to locating the source of difficulty in a malfunctioning unit. It is necessary to consider the torque converter charging pump, transmission, oil cooler and connecting oil lines as a complete system when running down the source of trouble since the proper operation of any unit therein depends greatly on the condition and operation of the others. By studying the principles of operation together with data in this section, it may be possible to correct any malfunction which may occur in the system.

TROUBLE SHOOTING PROCEDURE BASICALLY CONSISTS OF TWO CLASSIFICATIONS: MECHANICAL AND HYDRAULIC.

MECHANICAL CHECKS

Prior to checking any part of the system from a hydraulic standpoint, the following mechanical checks should be made:

1. A check should be made to be sure all control lever linkage is properly connected and adjusted at all connecting points.

2. Check shift levers and rods for binding or restrictions in travel that would prevent full engagement. Shift levers by hand at transmission case, if full engagement cannot be obtained, difficulty may be in control cover and valve assembly.

HYDRAULIC CHECKS

Before checking on the torque converter, transmission, and allied hydraulic system for pressures and rate of oil flow, it is essential that the following preliminary checks be made.

1. Check oil level in transmission. This should be done with oil temperatures of 180 to 200 degrees F.—DO NOT ATTEMPT THESE CHECKS WITH COLD OIL. To bring the oil temperature to this specification it is necessary to either work the machine or "stall" out the converter. Where the former means is impractical, the latter means should be employed as follows:

Engage shift levers in forward and high speed and apply brakes. Accelerate engine half to three-quarter throttle.

Hold stall until desired converter outlet temperature is reached. CAUTION: FULL THROTTLE STALL SPEEDS FOR AN EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

PRESSURE AND OIL FLOW CHECKS

Whenever improper performance is evident the following basic pressure and oil flow checks should be performed and recorded. It is also recommended that these checks be taken periodically as a preventative maintenance measure. Doing so will permit possible detection of difficulties in advance of actual breakdown, thus permitting scheduling of repair operation. Likewise, repair of minor difficulties can be made at considerably less cost and down-time than when delayed until major and complete breakdowns occur.

Analyzing the results of these checks by comparison with specifications and with each other will indicate in most cases the basic item or assembly in the system as the source of difficulty. Further checking of that assembly will permit isolation of the specific cause of trouble.

(SEE PLUMBING AND CHECK POINT DIAGRAM)

OIL PRESSURE AT **CONVERTER OUT** PORT.

Install hydraulic pressure gauge at **PRESSURE** connection on Converter Regulator Valve or at **CONVERTER OUT** pressure tap. (All. models do not have pressure regulating valves.) Check and record oil pressure at 2000 RPM and at maximum speed (engine at full throttle) (see instructions on Stalling Converter previously listed).

CONVERTER MODEL	MAXIMUM CONVERTER OUT PRESSURE
C-270	40 p.s.i.
C-5000	70 p.s.i.
C-8000	70 p.s.i.
C-16000	70 p.s.i.

If a flow meter is available, install in line between converter charging pump and oil filters. Flow meter must be able to withstand 300 p.s.i.

Disconnect hose between pump and filter at filter end and using suitable fittings connect to pressure port of tester. Install hose between filter and tester, connecting same to reservoir port of tester.

DO NOT USE TESTER LOAD VALVE AT ANY TIME DURING TEST. When taking flow reading, all readings should be taken on the first (left) half of flow gauge. Whenever the needle shows on the right half of gauge, correct by switching to higher scale.

If a flow meter is not available for checking converter pump output, proceed with manual transmission and converter checks. If the converter shows leakage within specifications and clutch pressures (180 to 220 p.s.i.) are all equal within 5 p.s.i. refer to paragraph on Low Converter Charging Pump Output.

PUMPS ARE RATED AT 2000 RPM—Refer to Vehicle Manufacture Manual for specific pump output.

NOMINAL PUMP RATINGS:	C-270	C-5000	C-8000	C-16000
	11 G.P.M.	21 G.P.M.	21 G.P.M.	40 G.P.M.
	15 G.P.M.	31 G.P.M.	31 G.P.M.	50 G.P.M.
	21 G.P.M.		40 G.P.M.	65 G.P.M.

Pump output listed applies to a new pump in each case. A 20% tolerance below this figure is permissible; however, if pump output is more than 20% below specification the pump must be replaced and not rebuilt.

TRANSMISSION CLUTCH LEAKAGE

Check clutch pressures at low engine idle with oil at operating temperatures 180° to 200° F. Engine speed must remain constant during entire leakage check. Shift lever into forward 4 or 8 speeds. Record pressures. Shift lever in reverse and 1st. Record pressure. All pressure must be equal within 5 p.s.i. If clutch pressure varies in any one clutch more than 5 p.s.i., repair clutch.

If a flow meter is available install in line coming out of converter pump. See flow diagram for location of pressure on flow checks. Check pump volume at 2000 RPM and at low engine idle. Record readings. See pump volume specifications at 2000 RPM.

Install flow meter in the line coming from transmission to converter. Check oil volume at 2000 RPM and at low idle in the following speed selections. Record readings.

Forward — Low speed thru High

Reverse — Low speed

Subtract readings in each speed from pump volume reading to get transmission clutch leakage.

Example:	Pump Volume at idle	8 gal.	Pump volume	8 gal.
	Forward—Low speed thru High	6 gal.	Forward — Low speed	6 gal.
	Reverse—Low speed	6 gal.	Clutch leakage	2 gal.

If clutch leakage varies more than 1 gal. from one clutch to another, repair clutch.

LEAKAGE IN TRANSMISSION CLUTCHES

Leakage in 3000 series must not exceed 4 gal. max.
Leakage in 5000 series must not exceed 4 gal. max.
Leakage in 8000 series must not exceed 6 gal. max.
Leakage in 16000 series must not exceed 7 gal. max.

CONVERTER LUBE FLOW

Disconnect CONVERTER DRAIN BACK line at transmission with engine running at 2000 RPM and measure oil into a gallon container. Measure oil leakage for 15 seconds and multiply the volume of oil by four to get gallons per minute leakage.

LEAKAGE IN CONVERTER

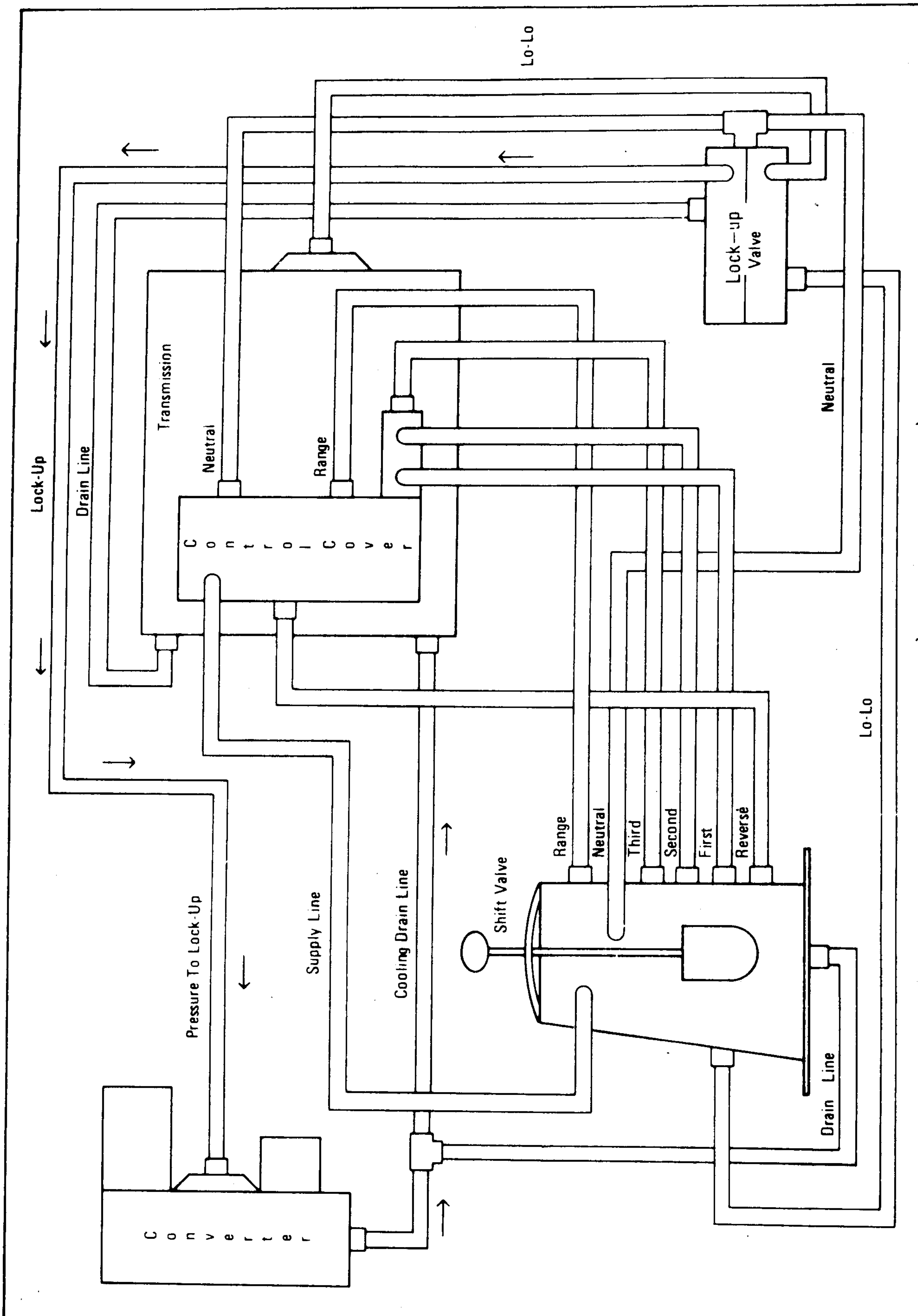
Leakage in C270 series not to exceed 2 gal. max.
Leakage in C5000 series not to exceed 3 gal. max.
Leakage in C8000 series not to exceed 5 gal. max.
Leakage in C16000 series not to exceed 5 gal. max.

LOW CLUTCH PRESSURE WITH NORMAL CLUTCH LEAKAGE

CAUSE	REMEDY
1. Low Oil Level.	1. Fill to proper level.
2. Broken spring in transmission regulator valve.	2. Replace spring.
3. Clutch pressure regulator valve spool stuck in open position.	3. Clean valve spool and sleeve.
4. Faulty charging pump.	4. See paragraph on charging pump output.

LOW CLUTCH PRESSURE WITH EXCESSIVE CLUTCH LEAKAGE

1. Broken or worn clutch piston sealing rings.	1. Replace sealing rings.
2. Clutch drum bleed valve ball stuck in open position.	2. Clean bleed valve thoroughly.
3. Broken or worn sealing rings on clutch support.	3. Replace sealing rings.
4. Low converter charging pump output.	4. See paragraph on charging pump output.



HYDRAULIC SHIFT CONTROL CIRCUIT
W/LOCK-UP IN CONVERTER

LOW CONVERTER CHARGING PUMP OUTPUT

CAUSE	REMEDY
1. Low oil level.	1. Fill to proper level.
2. Sump screen plugged.	2. Clean screen and sump.
3. Air leaks at pump intake hose and connections or collapsed hose.	3. Tighten all connections or replace hose if necessary.
4. Defective oil pump.	4. Replace pump.

LOW FLOW THROUGH COOLER WITH LOW CONVERTER IN PRESSURE

1. Defective safety by-pass valve spring.	1. Replace spring.
2. Converter by-pass valve partially open.	2. Check for worn by-pass ball seat.
3. Excessive converter internal leakage. See paragraph F, check converter lube flow.	3. Remove, disassemble, and rebuild converter assembly, replacing all worn or damaged parts.
4. Broken or worn sealing rings in transmission clutches.	4. See paragraph on Clutch leakage.

LOW FLOW THROUGH COOLER WITH HIGH CONVERTER OUT PRESSURE

1. Plugged oil cooler. Indicated if transmission lube pressure is low.	1. Back flush and clean oil cooler.
2. Restricted cooler return line.	2. Clean out lines.
3. Lube oil ports in transmission plugged. Indicated if transmission lube pressure is high.	3. Check lube lines for restrictions.

OVERHEATING

1. Worn oil sealing rings. See paragraph F.	1. Remove, disassemble, and rebuild converter assembly.
2. Worn oil pump.	2. Replace.
3. Low oil level.	3. Fill to proper level.
4. Pump suction line taking air.	4. Check oil line connections and tighten securely.

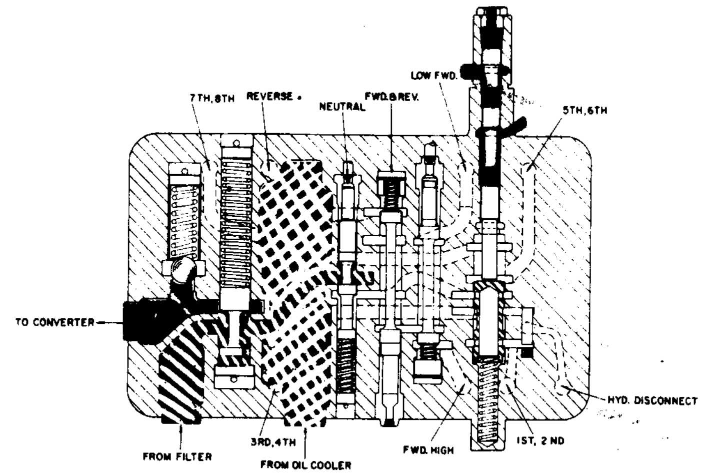
NOISY CONVERTER

1. Worn coupling gears.	1. Replace.
2. Worn oil pump.	2. Replace.
3. Worn or damaged bearings.	3. A complete disassembly will be necessary to determine what bearing is faulty.

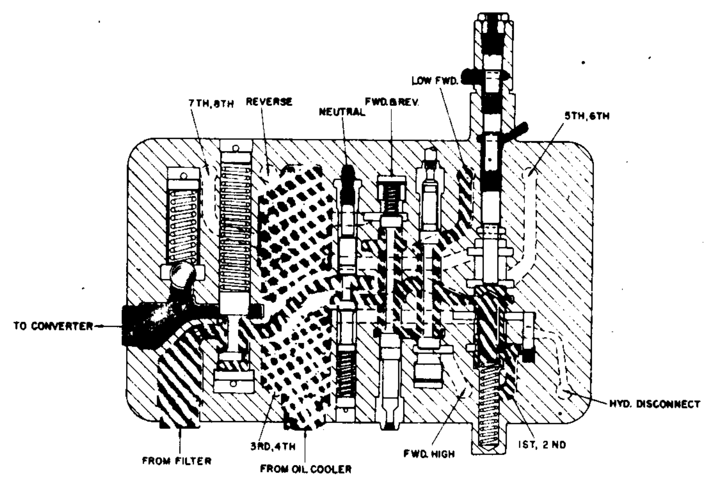
LACK OF POWER

1. Low engine RPM at converter stall.	1. Tune engine check governor.
2. See "Over-heating" and make same checks.	2. Make corrections as explained in "Over-Heating.

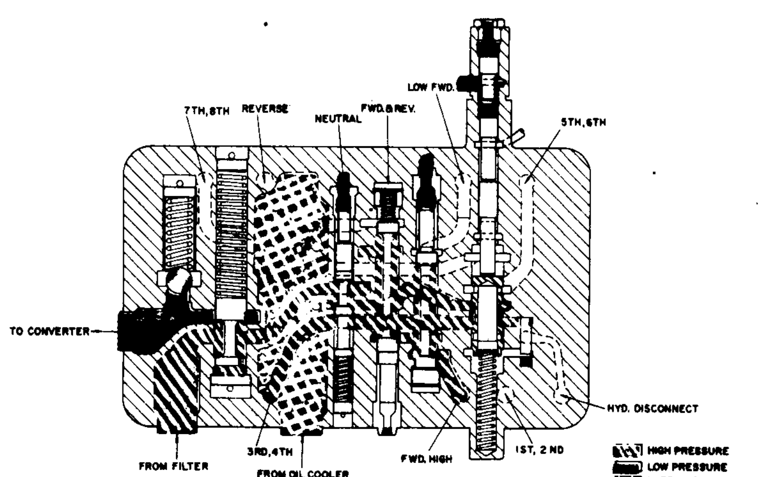
CLARK EQUIPMENT



NEUTRAL
ENGINE RUNNING



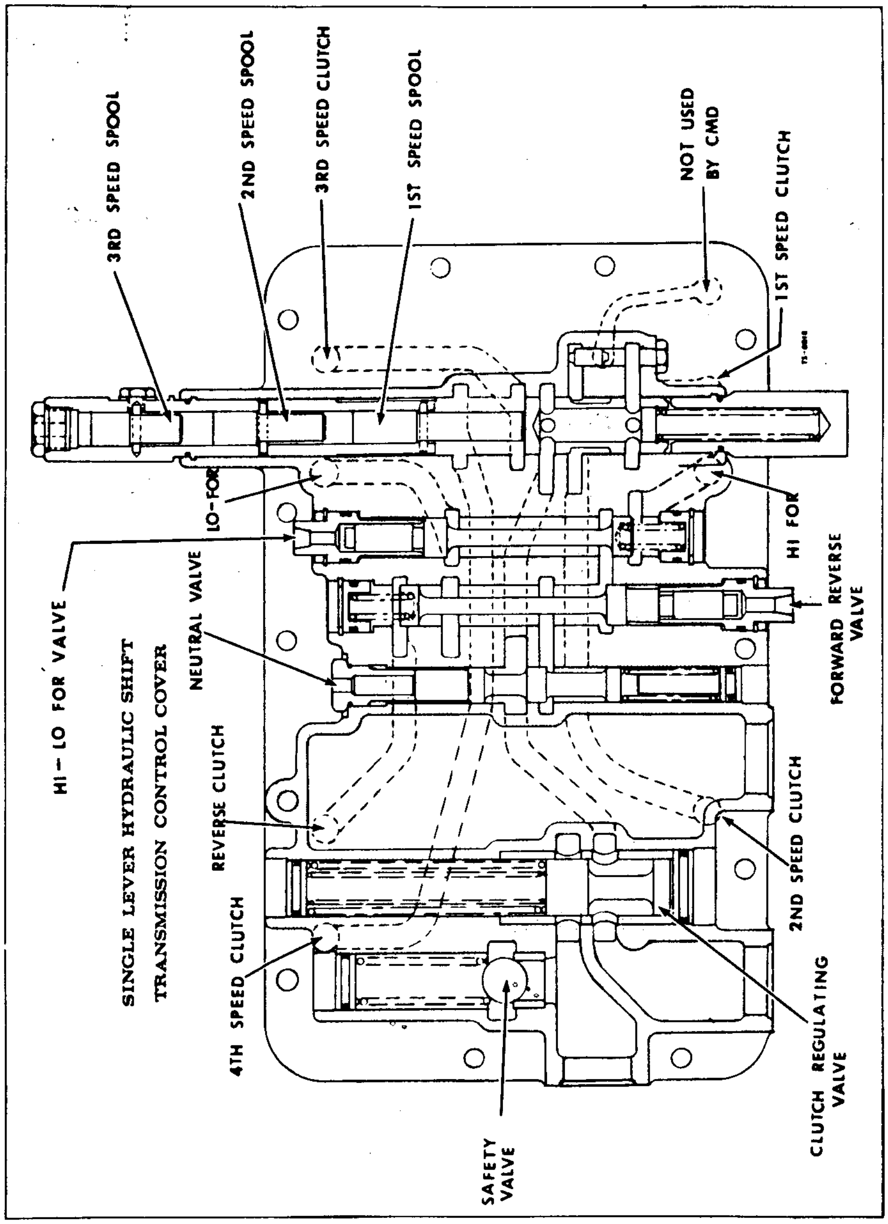
FORWARD- 1st GEAR



FORWARD - 4th GEAR

8-SPEED HYDRAULIC SHIFT CONTROL COVER

CLARK EQUIPMENT



SINGLE LEVER HYDRAULIC SHIFT TRANSMISSION CONTROL COVER

OPERATING CONTROLS

The transmission is controlled by two separate valves connected by hydraulic hoses only.

One valve is the transmission control valve mounted on the transmission; this valve directs oil to the speed and directional clutches and also to the torque converter.

The second valve is the shift control valve and is mounted in the cab.

The shift lever is part of the shift control valve. The function of the shift control valve is to hydraulically position a combination of valve spools in the transmission control cover. This permits the valve spools to direct oil pressure from the converter pump to the appropriate clutches in the transmission, engaging the transmission in the range selected by the operator.

Clutch oil pressure tapped from the clutch pressure port in the transmission control cover is supplied to the shift control valve through a supply hose. This oil is directed by control plungers in the shift control valve through individual hoses connected to the valve spools in the transmission control cover, so that the appropriate valve spool is hydraulically positioned according to the speed range selected by the operator.

A check valve and a small accumulator are incorporated in the shift control housing. The accumulator stores a supply of oil under pressure to assure that shift control valve system has a constant oil supply. The check valve prevents the oil supply stored in the accumulator from flowing backwards toward the clutch pressure port.

NOTE: It must be emphasized at this point that when the shift lever is in reverse position, it will only engage four (4) of the eight (8) speed ranges in the transmission to control reverse travel speed of the machine.

Simplification of the speed ranges engaged according to lever position and quadrant markings for both forward travel speeds and reverse travel speeds can best be explained by referring to the following chart.

Lever Position and Quadrant Markings	Speed Ranges Engaged in Forward Speeds	Speed Ranges Engaged in Reverse Speeds
1	1st	1st
2	2nd	1st
3	3rd	3rd
4	4th	3rd
5	5th	5th
6	6th	5th
7	7th	7th
8	8th	7th

Observe torque converter temperature gauge when working machine. If gauge approaches 250 degrees F., shift to a lower operating speed range.

Shifting from one speed range to another can be made at any time during the working cycle. Momentarily let up on accelerator pedal when shifting into a higher speed range, and accelerate slightly when shifting into a lower speed range.

It is not good driver practice to skip speed ranges when shifting, if machine is in motion. It is better to make progressive shifts, engaging each speed range before proceeding to the next.

SHIFT QUADRANT ADJUSTMENT

The shift lever must line up with each of the markings on quadrant when in corresponding positons.

1. Check and tighten quadrant mounting bolts. Quadrant plate must be positioned so the detents locate the lever in all speed positions.

2. Any stops in the guide plate are provided for over shift stops only and must not prevent detent from locating lever.

TROUBLE SHOOTING THE HYDRAULIC SHIFT CONTROL SYSTEM

Clutch pressure must be up to specification before any of the following conditions are checked.

CAUSE	REMEDY
DELAYED SHIFT	
1. Check valve stuck open.	1. Remove, clean or replace.
2. Check valve spring broken.	2. Replace.
3. Accumulator spring broken.	3. Replace.
4. Restriction in supply line.	4. Clean or replace.
NO HIGH FORWARD CLUTCH ENGAGEMENT	
1. Range hose plugged.	1. Clean or replace hose.
2. Hi-Low valve stuck.	2. Remove spool, determine cause of sticking.
CLUTCH ENGAGING AT WRONG TIME	
1. Hoses crossed between control valve and transmission control cover.	1. Relocate hoses in proper positions.
CLUTCHES NOT ENGAGING	
1. Hoses crossed between control valve and transmission control cover.	1. Relocate hoses in proper position.
2. Speed valves in transmission control cover in wrong sequence.	2. Remove speed valves and replace in proper position.
3. Actuating plungers stuck in bore.	3. Remove plungers, determine cause.

OPERATING INSTRUCTIONS FOR AN 8 SPEED TRANSMISSION EQUIPPED WITH POWER TAKE OFF AND SINGLE LEVER HYDRAULIC CONTROL

TO ENGAGE PTO

1. Vehicle must be stationary.
2. Speed selector lever must be in neutral — converter drive position — not in lockup.
3. Auxiliary PTO control to be in neutral.
4. Engage PTO jaw clutch.
5. Position Auxiliary PTO control in Forward or Reverse.
6. If PTO is to be operated in lockup, speed control lever may be moved to **neutral** lock-up position.

TO DISENGAGE PTO

1. Position speed selector lever in non-lockup position in neutral.
2. Position auxiliary PTO control in neutral.
3. Disengage PTO jaw clutch.

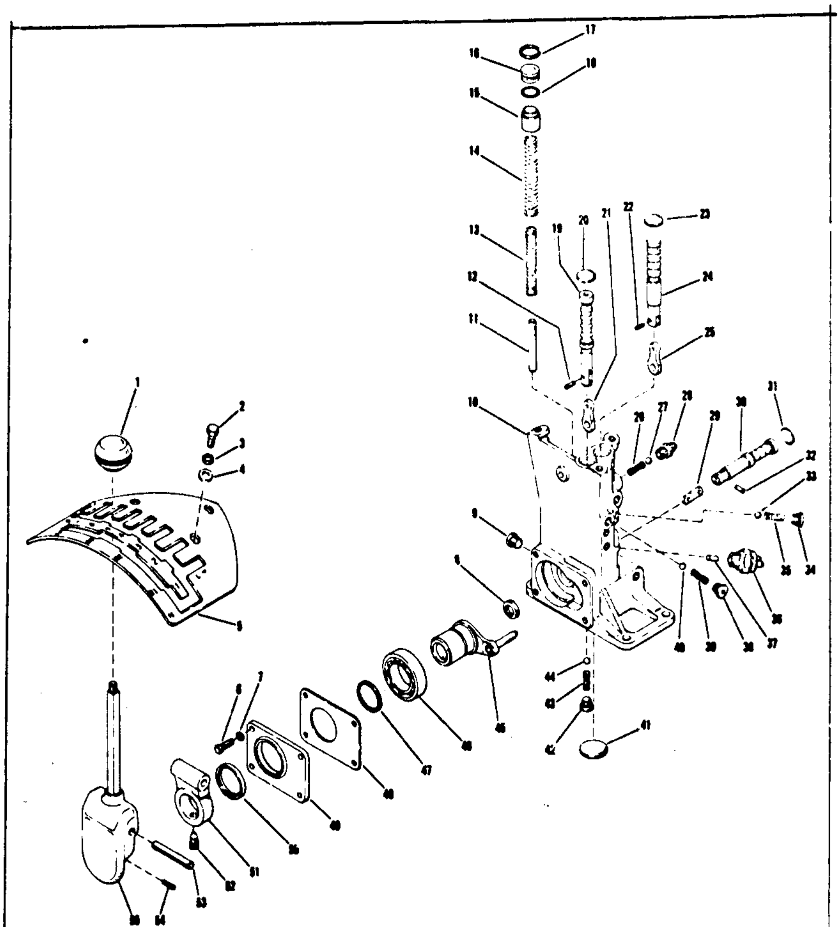
Vehicle may now be shifted into desired speed and direction to propel it.

DO NOT engage PTO while vehicle is in motion.

NEVER shift speed control out of neutral when PTO control is in Forward or Reverse position.

CLARK EQUIPMENT

SHIFT CONTROL



HYDRAULIC CAB CONTROL GROUP

DESCRIPTION AND OPERATION

The cab-mounted shift control valve used in these units is a two-spool, lever-operated type. The spool mounted in a horizontal position (viewed as valve is mounted on unit) controls the forward, neutral and reverse spool in the transmission control cover. The spool mounted in a vertical position controls the first, second and third speed valves in the transmission control cover.

The valve shown in Figure 1 is in the neutral position. Movement of either spool opens ports in the valve to send oil from the valve to the transmission control cover.

Oil for valve operation is tapped from the clutch pressure port in the transmission control cover through a supply hose. As mentioned before, this oil is directed by the control plungers in the valve through individual hoses connected to the transmission control cover and the appropriate control cover valve spools are hydraulically positioned according to the speed range selected by the operator.

A check valve and an accumulator are incorporated in the cab control housing. The accumulator stores a supply of oil under pressure to maintain a constant oil supply to the cab control system. Oil stored under pressure in the accumulator is kept from flowing backwards toward the clutch pressure port by the check valve.

A shift from one speed range to another can be made at any time during the work cycle without benefit of a mechanical clutch. However, to obtain smoother shifts, slight acceleration is recommended when shifting to a lower speed range. This helps synchronize engine speed with that of drive train components.

For further information, refer to the following sections:

Torque Converter	Section 5
Transmission	Section 6
Transmission Shifting System	Section 6A

HYDRAULIC CAB CONTROL MAINTENANCE

The instructions contained herein cover the disassembly and reassembly of the Hydraulic Cab Control that would normally be followed after the unit is removed from the vehicle cab.

The 4 and 8 speed cab control is basically the same except the 8 speed control has a high-low selector valve not needed on the 4 speed.

The difference in maintenance between the 4 and 8 speed valves are explained in the following text.

DISASSEMBLY

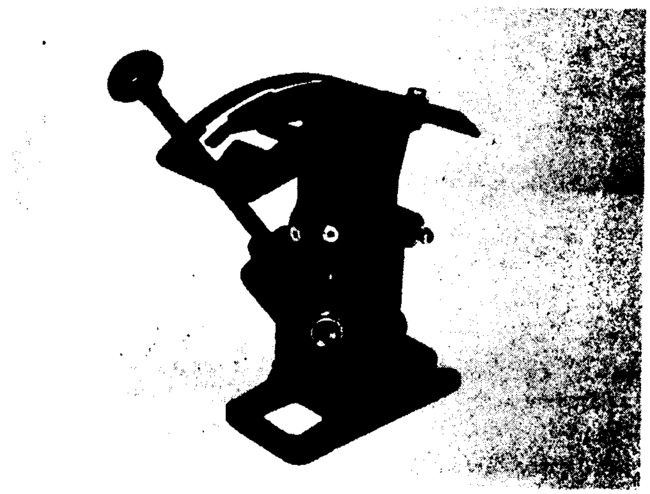


Figure 1

Mark all plumbing lines before removing from hydraulic cab control. Unit being used in this text is an 8 speed.

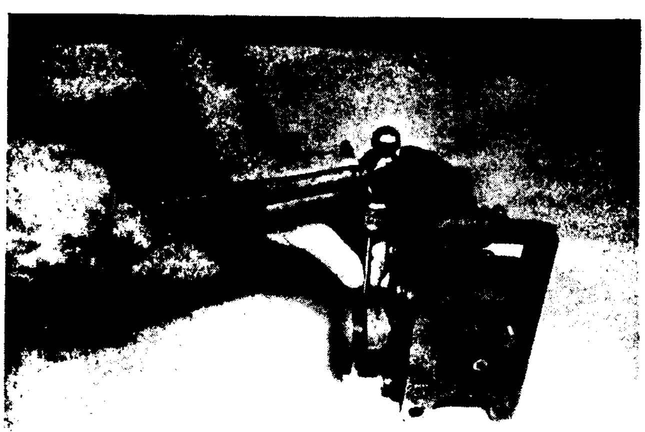


Figure 2

Remove shift lever set screw. Using a small drift remove lever roll pin.

Figure 3

Remove shift lever housing assembly from shaft.

Figure 4

Remove bearing cap and gasket.

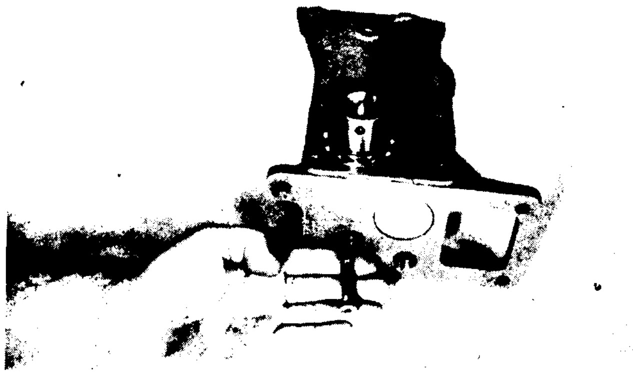


Figure 5

Remove neutral and reverse detent plug spring and ball.

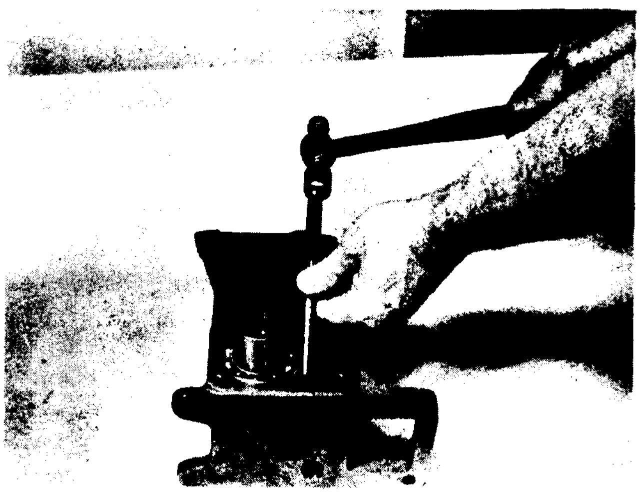


Figure 6

Remove bottom welch plug as shown.

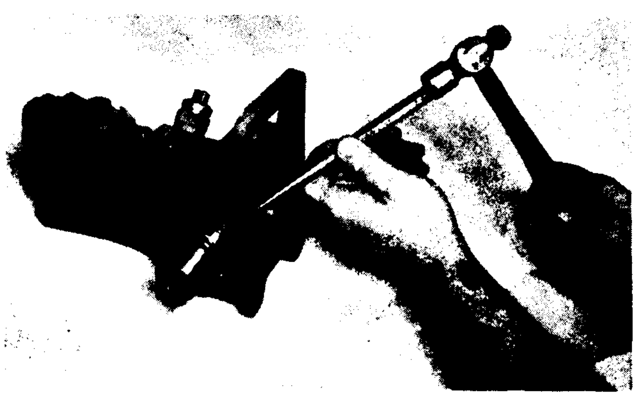


Figure 7

Using a drift through the welch plug hole, tap lightly on the selector shaft to remove shaft and bearing from housing.

Figure 8

Selector shaft, bearing and reverse and neutral lock-up valve removed.

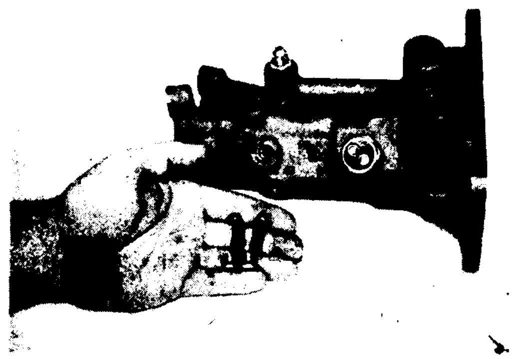


Figure 9

Remove selector and high-low valve detent plugs, springs and balls. **(High-low valve detent not used on 4 speed).**

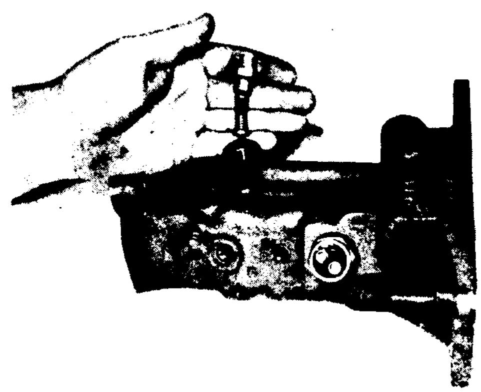


Figure 10

Remove check valve fitting, ball, spring and pin.

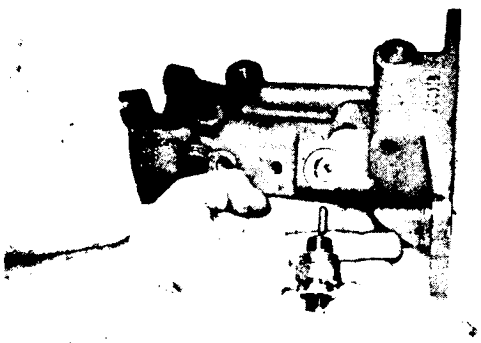


Figure 11
Remove neutral switch and pin.

Figure 12
From bottom of housing remove selector spool and ring assembly.

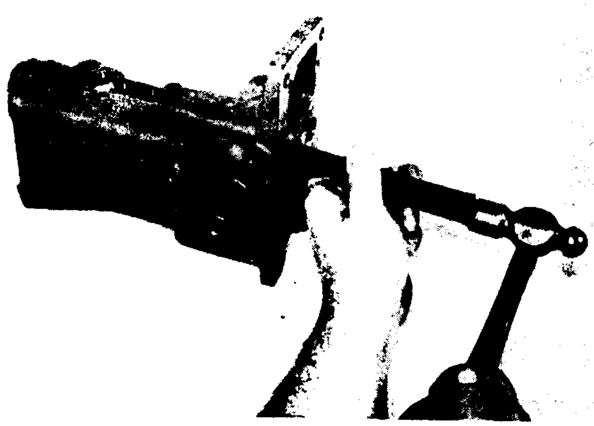


Figure 13
Through welch plug opening in bottom of housing tap high-low valve from housing. **Not used on 4 speed control.**

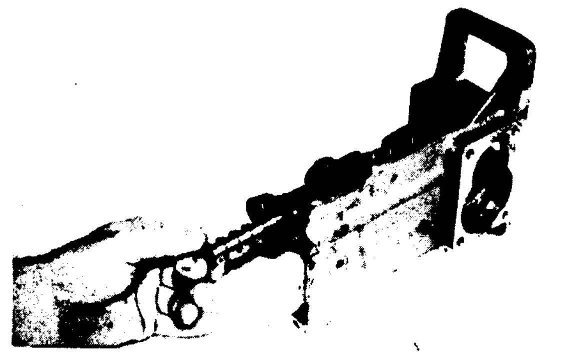


Figure 14
High-low valve and welch plug removed form housing. **Not used in 4 speed.**

CAUTION: When removing accumulator piston, it is recommended a press be used to depress accumulator spring.

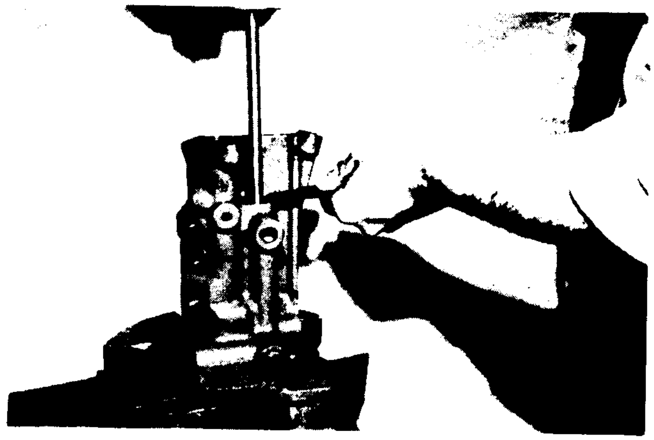


Figure 15
Depress accumulator piston and remove retainer ring.

Figure 16
Accumulator springs will push piston stop and piston from housing.

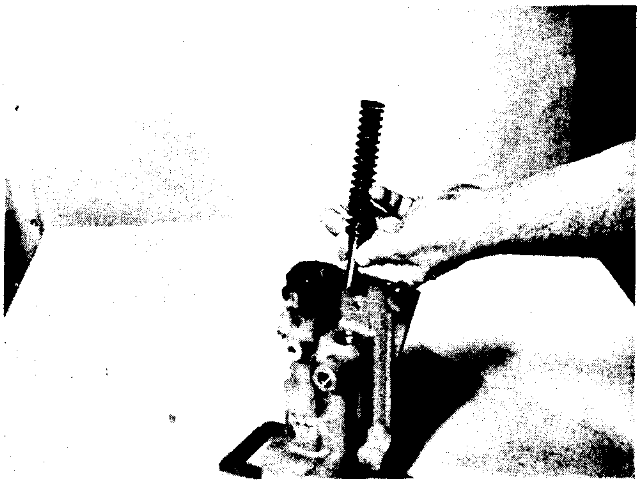


Figure 17

Remove accumulator inner and outer spring and piston stop pin from housing.

Clean and inspect all parts. Replacement of oil seals, "O" Rings, gaskets and snap rings is more economical when unit is disassembled than premature over-haul to replace these parts at a future time.

REASSEMBLY

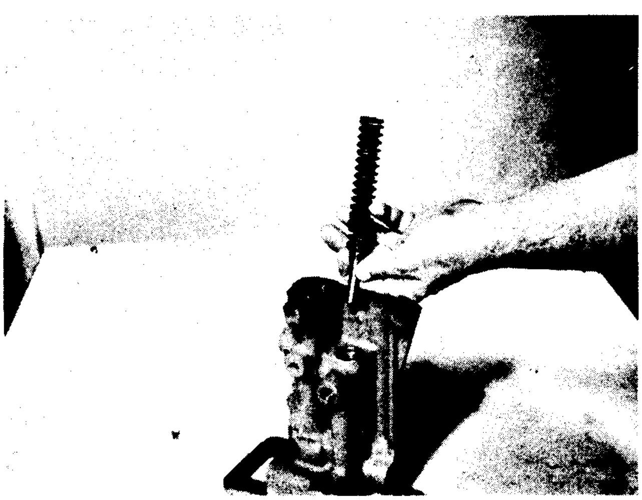


Figure 18

Install accumulator piston stop pin and inner and outer spring.

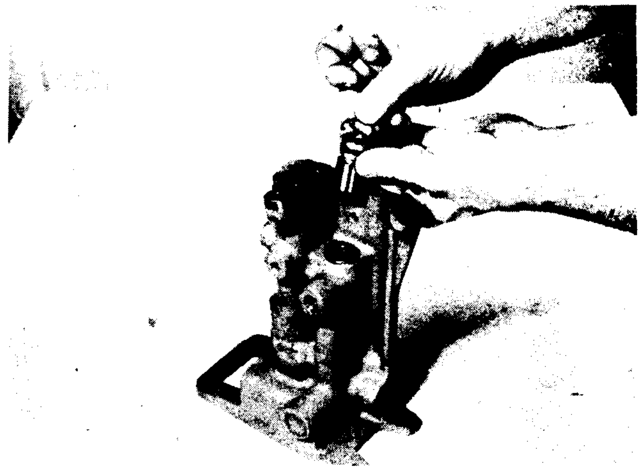


Figure 19

Install new "O" Ring on accumulator piston stop. Place piston and piston stop on springs.

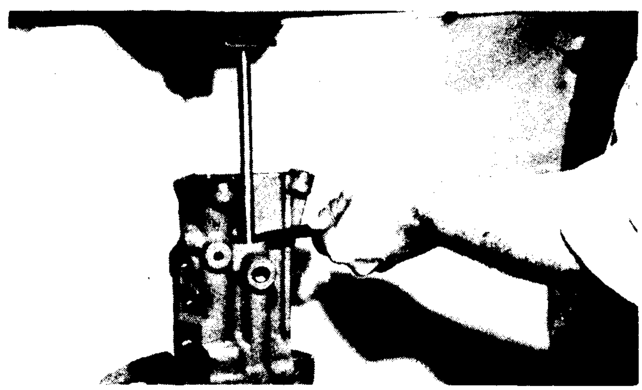


Figure 20

Depress accumulator piston, stop and springs. Install retainer ring.

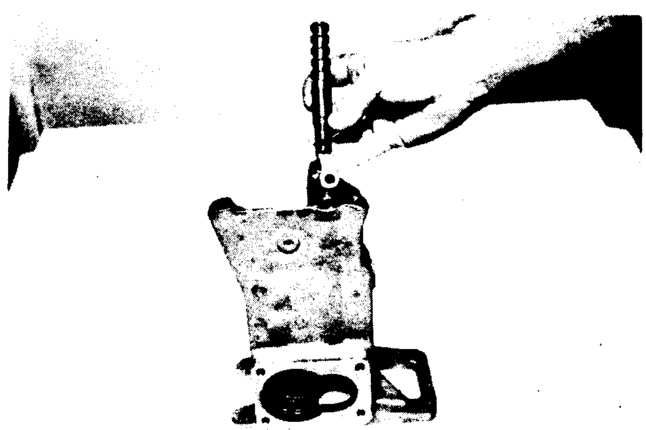


Figure 21

Insert high-low valve and link assembly in housing. **Not used on 4 speed.**

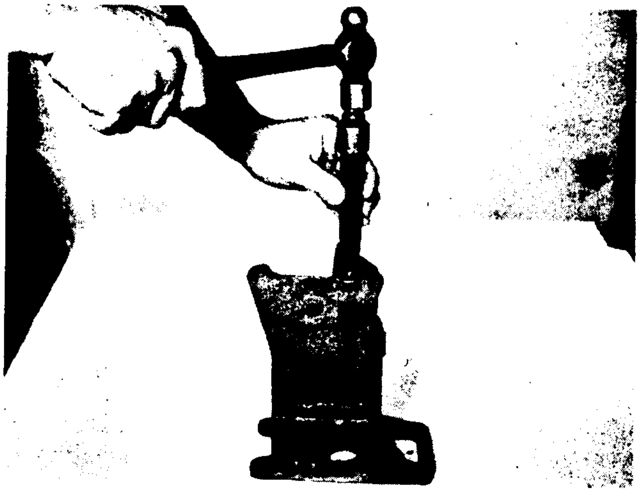


Figure 22

Install high-low valve welch plug. **Not used on 4 speed.**

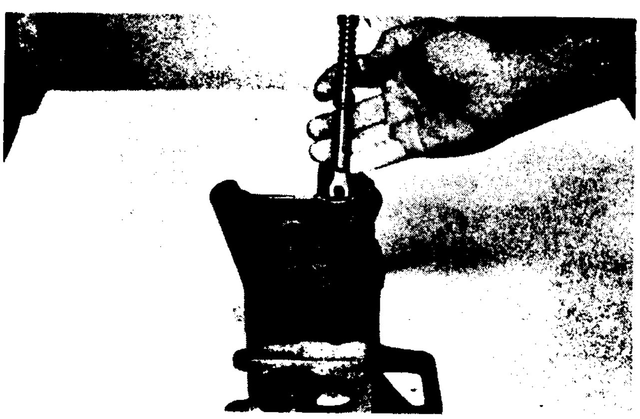


Figure 23

Insert speed selector valve and link assembly in housing.

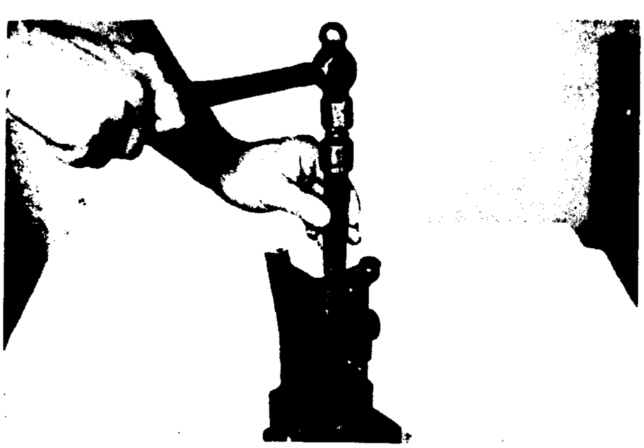


Figure 24

Install speed selector valve welch plug.

Figure 25

Press new oil seal in speed selector shaft with lip of seal up.

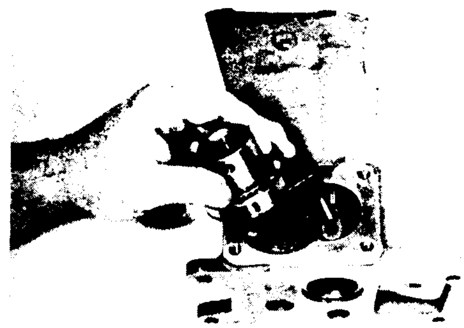


Figure 26

Install speed selector shaft, pin and bearing assembly in housing. **NOTE:** On 8 speed control the selector shaft pin must be inserted in the connector links of both speed selector and high-low valves. On the 4 speed control, only the speed selector link will be used.

Figure 27

Note selector shaft pin in both speed selector and high-low valve links. (8 speed only).

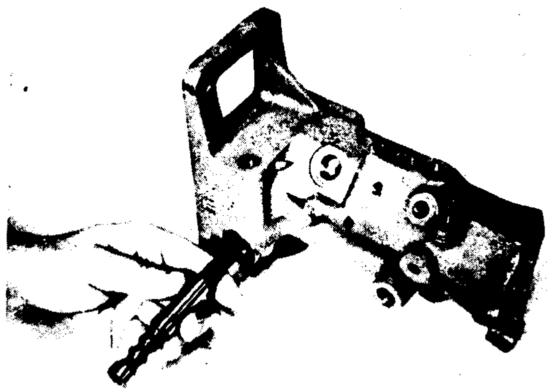


Figure 28

Insert reverse and neutral lock-up valve and link assembly in housing. Use caution as not to damage oil seal in selector shaft.

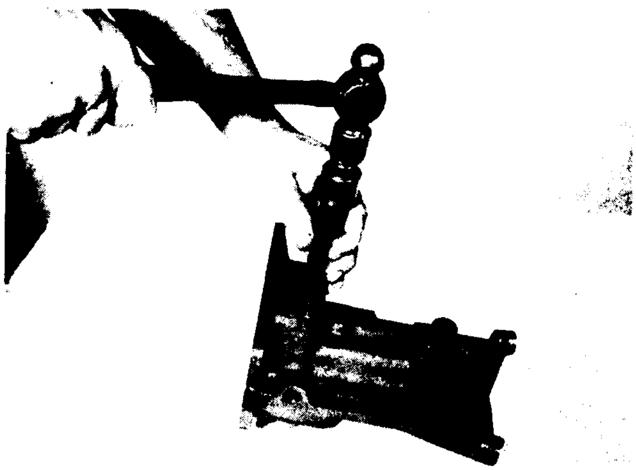


Figure 29

Install reverse and neutral lock-up valve welch plug.

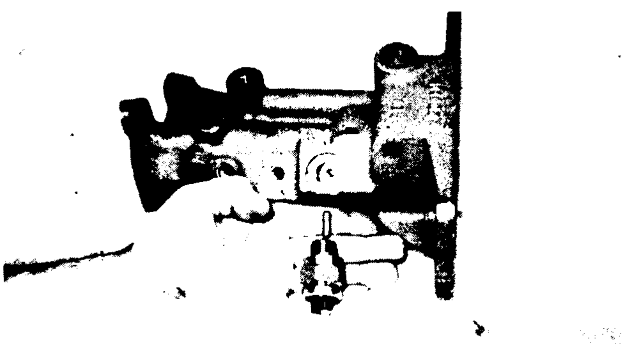


Figure 30

Install neutral switch pin and switch in housing.

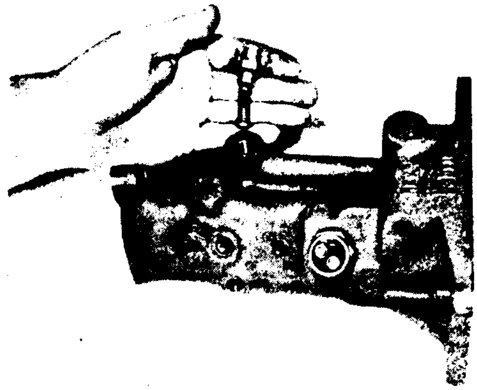


Figure 31

Install check valve pin, spring, ball and fitting in housing.

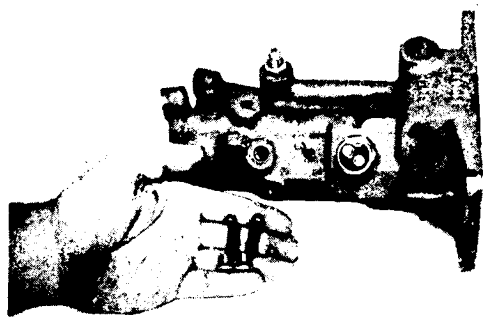


Figure 32

Install speed selector and high-low valve detent ball, spring and plug in housing. **High-low valve detent not used on 4 speed.**

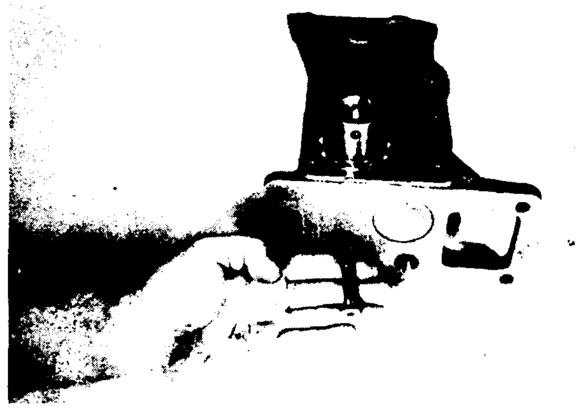


Figure 33

Install bottom welch plug and reverse and neutral lock-up detent ball, spring and plug.

Figure 34

Install new oil seal, with lip of seal down in bearing cap. Position new gasket on bearing cap. Install bearing cap and secure with cap screws.

Figure 35

Install control lever assembly on speed selector shaft. Align control lever with reverse and neutral lock-up link. Install set screw in selector shaft and roll pin through reverse and neutral lock-up link.

Reinstall cab control in vehicle being certain plumbing lines are in their proper location.

FULL HYDRAULIC SHIFT CONTROL MAINTENANCE

The instructions contained herein cover the disassembly and reassembly of the Hydraulic Shift Control Cover that would normally be followed after the control is removed from the transmission and is to be completely disassembled.

The unit shown is a basic 8 speed full hydraulic shift control. The differences between the 4 speed and the 8 speed control are explained in the following text.

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

DISASSEMBLY OF CONTROL COVER

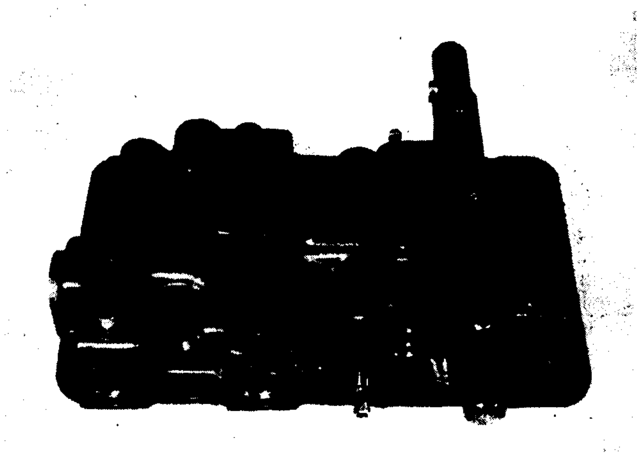


Figure 1
8 Speed full Hydraulic Shift, cleaned and removed from transmission.

Figure 2
Remove shift cylinder and end plug housing lock plug. Remove shift cylinder, end plug and selector valve spring.

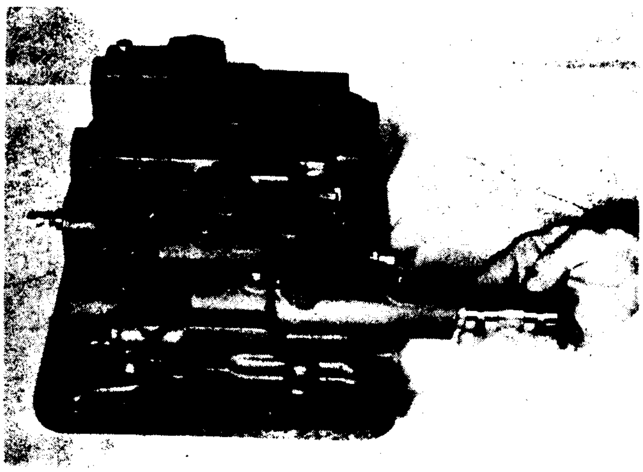


Figure 3
Remove selector valve.

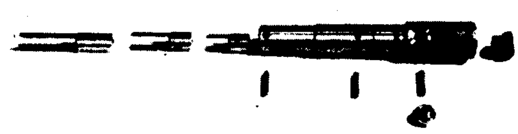


Figure 4
Shift cylinder housing disassembled showing 3rd speed valve (small), 2nd speed valve (medium), and 1st speed valve (large).

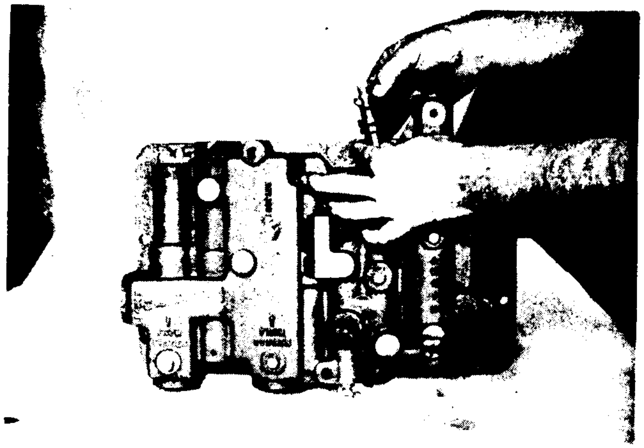


Figure 5

Compress lightly high-low piston guide and remove retainer ring. Remove piston guide and piston. **Not used with 4 speed.**

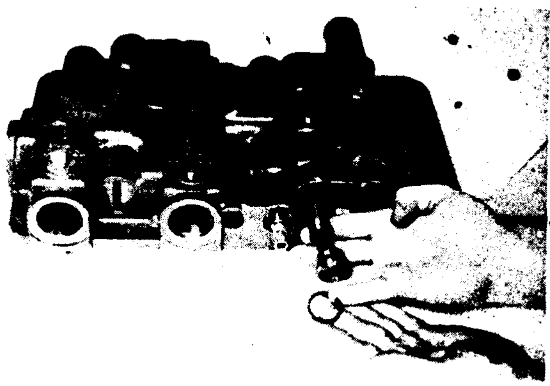


Figure 6

From opposite end remove spring stop retainer ring, spring stop, valve spring and high-low valve. **Not used with 4 speed.**

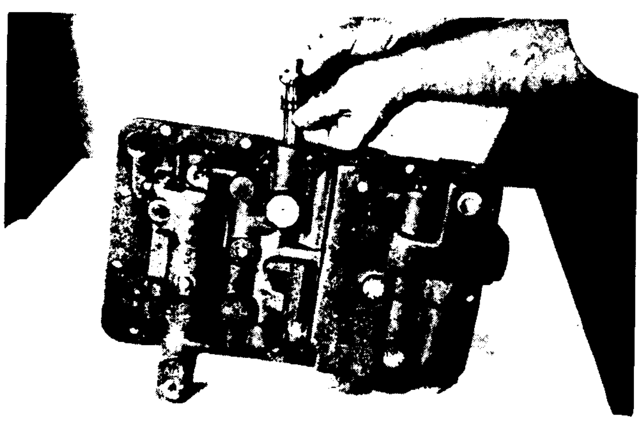


Figure 7

Compress lightly forward and reverse piston guide and remove retainer ring. Remove piston guide and piston.

Figure 8

From opposite end remove spring stop retainer ring, spring stop, valve spring and forward and reverse valve.

Figure 9

Remove neutral valve guide plug, piston, neutral valve, valve spring and stop pin. From opposite end remove spring stop roll pin and spring stop.

CAUTION: It is recommended when removing the roll pins from the pressure regulating and safety valve a press be used to depress valve stop and springs.

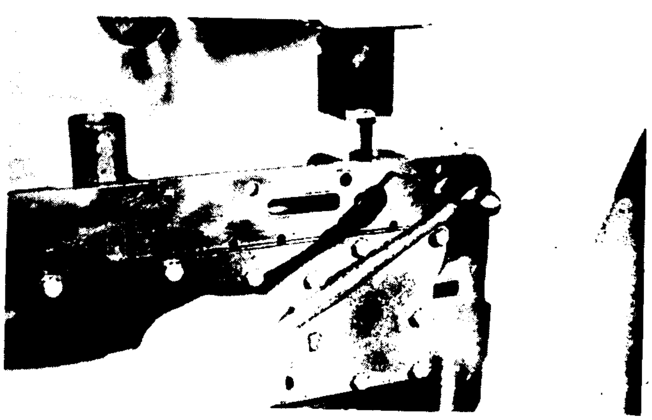


Figure 10

Depress pressure regulating valve stop and spring. Using a small drift, remove roll pin.

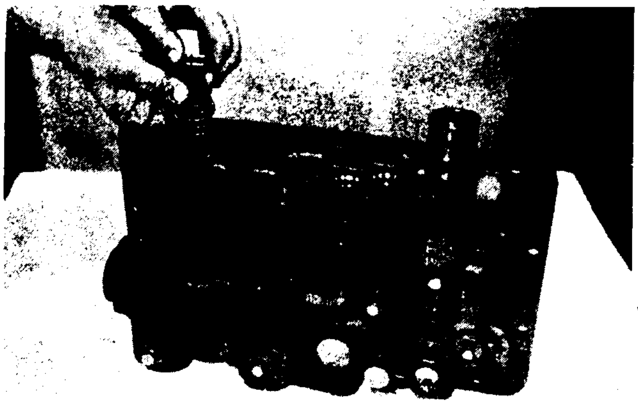


Figure 11
Release press slowly; springs will push spring stop from housing. Remove inner and outer spring.

Figure 12
Remove roll pin on opposite end. Remove valve stop, valve and valve sleeve.

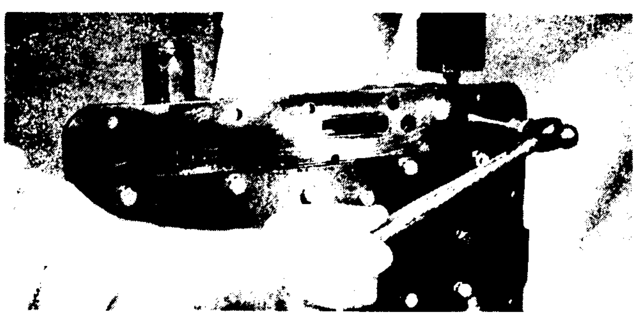


Figure 13
Depress safety valve stop and spring. Remove roll pin.

Figure 14
Remove stop, spacer, spring and safety valve ball.

Figure 15
Remove bolts and washers from oil circuit plate. Use caution as not to scratch or mar control housing surface or oil circuit plate.

REASSEMBLY OF CONTROL COVER

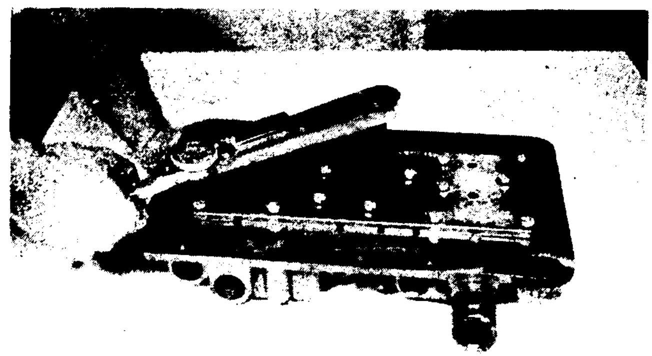


Figure 16
Install oil circuit plate. Install bolts and washers and tighten securely.

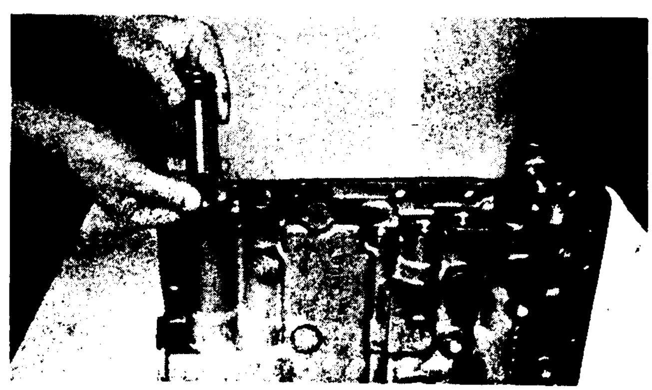


Figure 17
Install safety valve ball, spacer, and spring in cover. Install new "O" Ring on spring stop.

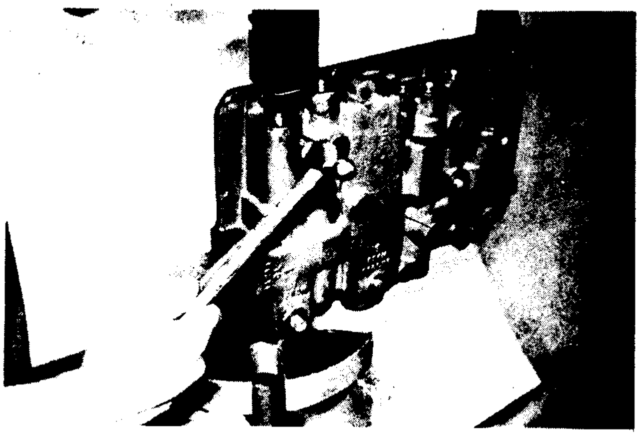


Figure 18

Depress spring stop and spring. Use caution as not to damage "O" Ring. Install roll pin.

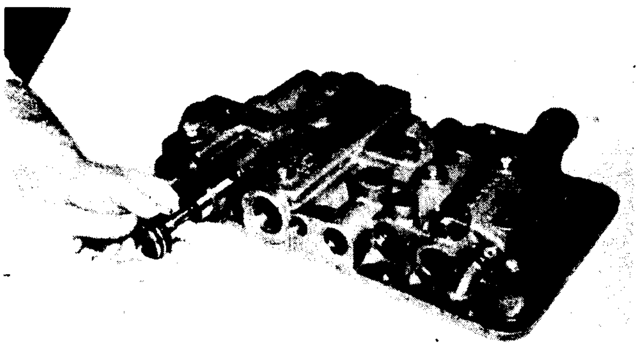


Figure 19

Install pressure regulating valve sleeve and valve. Install new "O" Ring on valve stop. Install valve stop in housing and retain with roll pin.

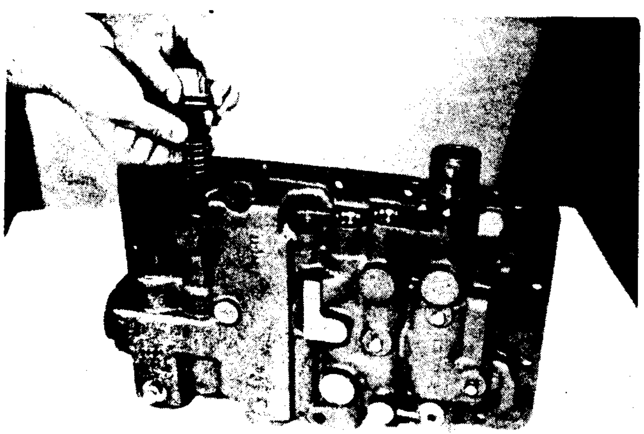


Figure 20

At opposite end of regulating valve, install inner and outer valve spring. Install new "O" Ring on spring stop. Install spring stop on springs.

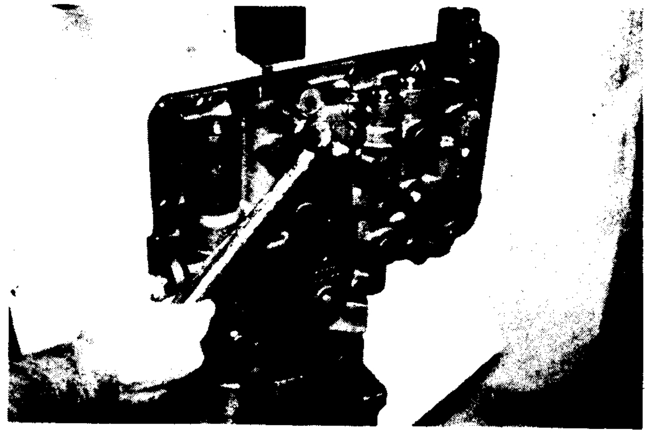


Figure 21

Depress spring stop and spring. Install spring stop roll pin.

Figure 22

Install new "O" Ring on neutral valve spring stop. Install spring stop in housing and retain with roll pin. At opposite end install neutral valve spring, stop pin, neutral valve, valve piston and piston guide plug.

Figure 23

Install new "O" Ring on forward and reverse valve spring stop. Install forward and reverse valve, valve spring and spring stop in housing. Secure with retainer ring.

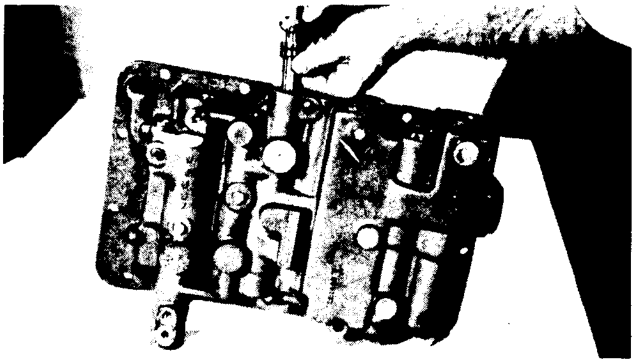


Figure 24

From the opposite end, install forward and reverse piston. Install new "O" Ring on piston guide. Install piston guide in housing and secure with retainer ring.

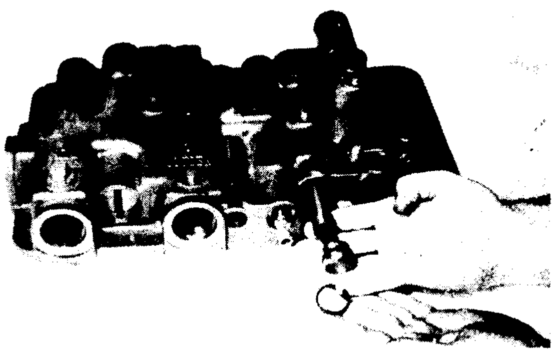


Figure 25

Install new "O" Ring on high-low valve spring stop. Install high-low valve, valve spring and spring stop in housing. Secure with retainer ring. **Not used with 4 speed.**

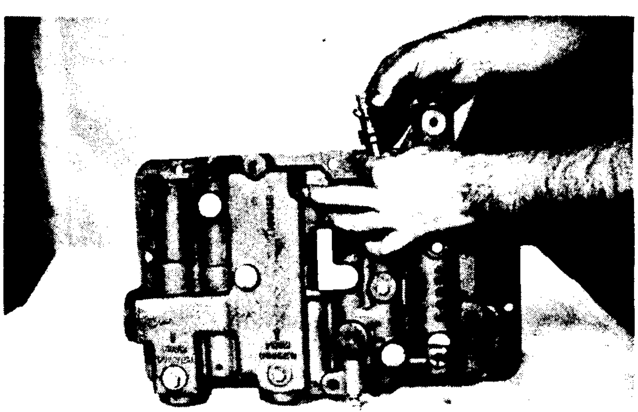


Figure 26

From opposite end, install high-low piston. Install new "O" Ring on piston guide. Install piston guide in housing and secure with retainer ring. **Not used on 4 speed.**

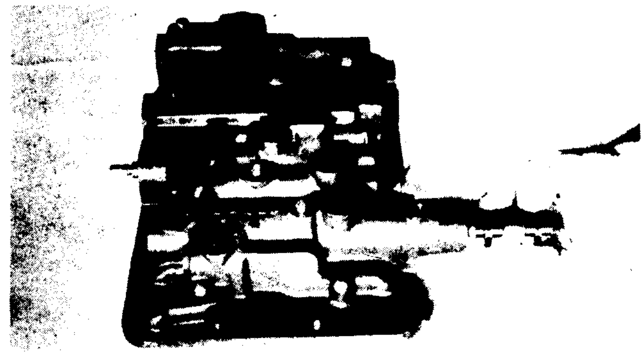


Figure 27

Install selector valve in housing.

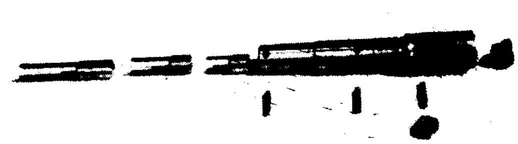


Figure 28

Install 3rd speed valve (small) in housing with slot in valve lined up with stop pin. Install stop pin and pin retainer plug. Install cylinder housing plug.

Install 2nd speed valve (medium) in shift cylinder with slot in valve lined up with stop pin in cylinder housing.

Install 1st speed valve (large) in housing with slot in valve lined up with stop pin. Install stop pin.

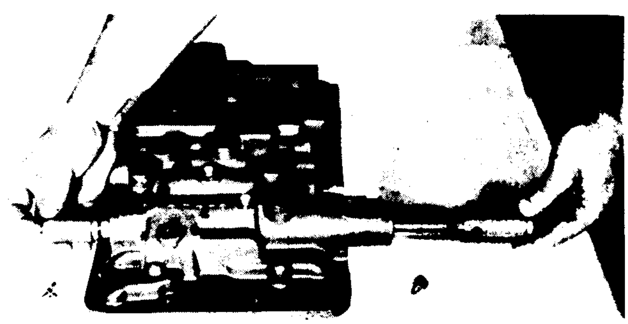


Figure 29

Install New "O" Ring on shift cylinder assembly and end cap. Install selector valve spring in housing. (end cap end). Install end cap and shift cylinder assembly in housing and secure with lock plugs.

Using new control valve to case "O" Rings and new gasket, install control cover assembly on transmission case. Secure with bolts and lockwashers. Tighten securely.

Reinstall all plumbing lines in their proper location. See installation drawing.

TROUBLE SHOOTING THE HYDRAULIC SHIFT CONTROL SYSTEM

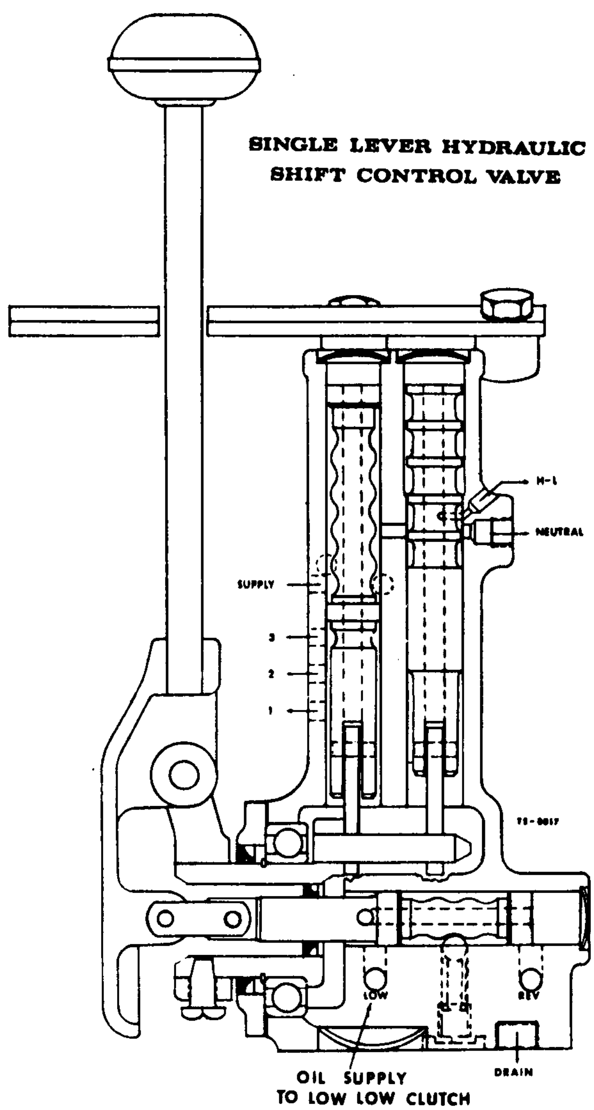
Clutch pressure must be up to specification before any of the following conditions are checked.

CAUSE	REMEDY
DELAYED SHIFT	
1. Check valve stuck open.	1. Remove, clean or replace.
2. Check valve spring broken.	2. Replace.
3. Accumulator spring broken.	3. Replace spring.
4. Restriction in supply line.	4. Clean or replace.
NO HIGH FORWARD CLUTCH ENGAGEMENT	
1. Range hose plugged.	1. Clean or replace hose.
2. Hi-Low valve stuck.	2. Remove spool, determine cause of sticking.
CLUTCH ENGAGING AT WRONG TIME	
1. Hoses crossed between control valve and transmission control cover.	1. Relocate hoses in proper positions.
CLUTCHES NOT ENGAGING	
1. Hoses crossed between control valve and transmission control cover.	1. Relocate hoses in proper position.
2. Speed valves in transmission control cover in wrong sequence.	2. Remove speed valves and replace in proper position.
3. Actuating plungers stuck in bore.	3. Remove plungers, determine cause.

SHIFT QUADRANT ADJUSTMENT

The shift lever must line up with each of the markings on quadrant when in corresponding positons.

1. Check and tighten quadrant mounting bolts. Quadrant plate must be positioned so the detents locate the lever in all speed positions.
2. Any stops in the guide plate are provided for over shift stops only and must not prevent detent from locating lever.


SINGLE LEVER HYDRAULIC
SHIFT CONTROL VALVE
H-L
NEUTRAL
SUPPLY
3
2
1
LOW
REV
DRAIN
OIL SUPPLY
TO LOW LOW CLUTCH

1

LINES WITH PRESSURE COMING OUT OF SINGLE SHIFT CONTROL VALVE USED ON SCRAPERS
9 SPEED TRANSMISSION SHOWN - FOR 8 SPEED TRANSMISSION ELIMINATE LO-LO GEAR

SHIFT LEVER POSITION	CLUTCHES ENGAGE	Lo Lo For line is larger and this feeds Lo Lo For. directly to clutch. All other lines only move spools.
Lo-Lo Gear	Lo Lo For-1st	4 lines with pressure - Pressure to Lo Lo For, 3rd, 2nd, 1st spools. No pressure to neutral, Hi & Lo forward spool.
1st Gear	Lo For-1st	4 lines with pressure - Pressure to neutral spool, 3rd, 2nd, 1st spools.
2nd Gear	Hi For-1st	5 lines with pressure - Pressure to neutral spool, Hi & Lo forward spool, 3rd, 2nd, 1st speed spools.
3rd Gear	Lo For-2nd	3 lines with pressure - Pressure to neutral spool 3rd, 2nd speed spools.
4th Gear	Hi For-2nd	4 lines with pressure - Pressure to neutral spool, Hi & Lo For, 3rd, 2nd spools.
5th Gear	Lo For-3rd	2 lines with pressure - Pressure to neutral spool, 3rd spool.
6th Gear	Hi For-3rd	3 lines with pressure - Pressure to neutral spool, Hi & Lo For. and 3rd speed spool.
7th Gear	Lo For-4th	1 line with pressure - Pressure to neutral spool only.
8th Gear	Hi For-4th	2 lines with pressure - Pressure to neutral and Hi & Lo Forward.
1st Reverse Gear	Rev. -1st	5 lines with pressure - Pressure to neutral spool, reverse spool, 3rd, 2nd, 1st spools.
2nd Reverse Gear	Rev. -2nd	4 lines with pressure - Pressure to neutral spool, reverse spool, 3rd, 2nd spools.

TRANSMISSION
Control Lines

	Neutral	Low Low	1	2	3	High-Low Range	Reverse
Neutral	○	○	●	●	●	○	○
Low-Low	○	●	●	●	●	○	○
1st Gear	●	○	●	●	●	○	○
2nd Gear	●	○	●	●	●	●	○
3rd Gear	●	○	○	●	●	○	○
4th Gear	●	○	○	●	●	●	○
5th Gear	●	○	○	○	●	○	○
6th Gear	●	○	○	○	●	●	○
7th Gear	●	○	○	○	○	○	○
8th Gear	●	○	○	○	○	●	○
1st Reverse	●	○	●	●	●	○	●
2nd Reverse	●	○	○	●	●	○	●

TRANSMISSION

Clutches

	Low Low	1	2	3	4	Fwd Low Range	Fwd High Range	Rev
Neutral	○	●	○	○	○	○	○	○
Low-Low	●	●	○	○	○	○	○	○
1st Gear	○	●	○	○	○	●	○	○
2nd Gear	○	●	○	○	○	○	●	○
3rd Gear	○	○	●	○	○	●	○	○
4th Gear	○	○	●	○	○	○	●	○
5th Gear	○	○	○	●	○	●	○	○
6th Gear	○	○	○	●	○	○	●	○
7th Gear	○	○	○	○	●	●	○	○
8th Gear	○	○	○	○	●	○	●	○
1st Reverse	○	●	○	○	○	○	○	●
2nd Reverse	○	○	●	○	○	○	○	●

CLUTCH PRESSURE SHOULD BE 180-220 PSI AT LOW IDLE NOT TO EXCEED 5 PSI VARIATION BETWEEN CLUTCHES.

LUBE PRESSURE NOT TO EXCEED 25 PSI AT HIGH FREE IDLE.

DRIVELINE

DESCRIPTION AND OPERATION

The purpose of the driveline is to transmit power that is developed by the engine from the torque converter into the transmission and from the transmission to the differential. There this same power is used to operate drive wheels. In operation the drivelines are under almost constant strain and therefore much more service can be obtained from them by proper installation and correct maintenance.

When the engine, torque converter, transmission and differential are installed, they are lined up so that the drivelines must be able to compensate for slight irregularities in the alignment. The drivelines are designed to rotate at a small angle and allow a small amount of leeway in the alignment without damaging the drivelines, torque converter, transmission or differential.

The driveline assembly consists of the following three major components: The universal joint, which allows the driveline to pivot in any direction and accommodate any misalignment of the transmission, torque converter and differential, the hollow propeller tube that makes a light rigid shaft which will not whip or vibrate, and the slip joint that allows the shaft to telescope, thus easing installation and also compensating for possible changes in the distance between the transmission and the differential, torque converter and the transmission.

In normal operation the torque converter, transmission and differential are subject to slight shifts in position, which create a need for variable length drivelines. The driveline slip joint provides for these variations in length by allowing the propeller tube to slip in or out of the slip joint. This eliminates the forces of tension or compression that would be present in a driveline without a slip joint.

If these forces are present, as in the case of a slip joint seizure, they will be transferred to the connected components and will cause serious damage to the universal joints, engine, transmission, torque converter or differential.

7

REMOVAL

Extra care should be taken when handling drivelines since carelessness may result in premature failure of the components. Chips, dents, burrs or other disfigurations of the pilots of the driveline flanges will prevent accurate mating of the flange with the cross and bearings. Misalignment between the cross and bearings and the flanges will cause vibration and excessive wear during operation.

Follow the steps in the order listed below to remove the driveline.

1. Remove the mounting bolts from both ends of the driveline. If the bearings stick to the mounting flanges, tap them with a soft hammer to unseat them. When this is done, the driveline should be at least partially supported.

2. Mark the end of driveline toward front of unit to facilitate assembly. Lower the driveline and place in clean work area for further disassembly.

   CAUTION: Hold bearings on the cross during disassembly. If this is not done, bearings will fall off cross as it is removed from driveline assembly. If bearings stick to mounting flanges, tap with soft hammer to unseat bearings.

3. Remove companion flanges from transmission or torque converter or differential.

DISASSEMBLY

SLIP JOINT

Refer to Fig. 1 and the following instructions.

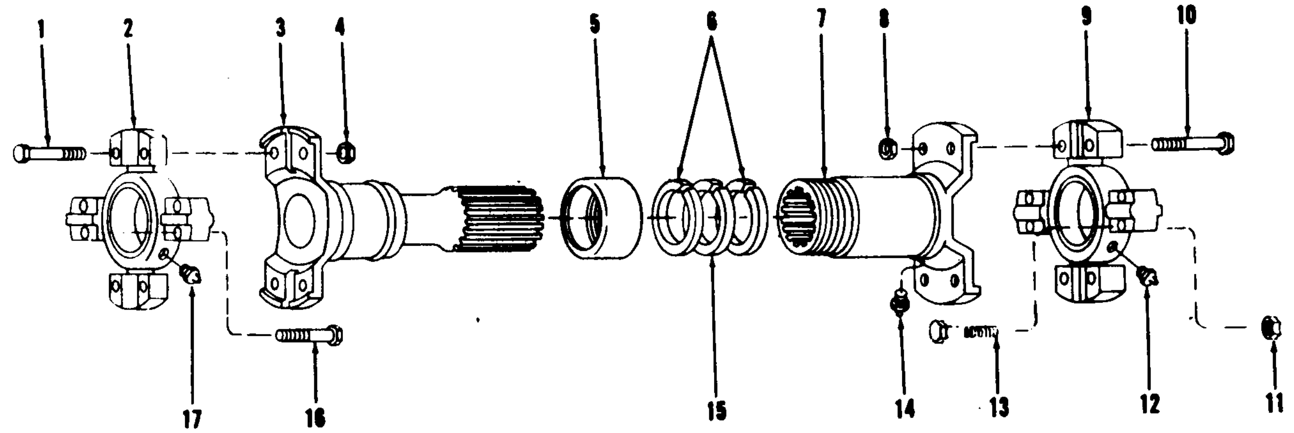
1. Remove retainer from slip yoke and pull slip yoke off splined shaft.

2. Remove retainer, steel washers and felt washer from splined shaft as a unit and separate from each other.

UNIVERSAL JOINTS

Refer to Fig. 1 and the following instructions.

1. Clamp splined shaft and cross assembly in soft-jawed vise.



Item	Description	Qty	Item	Description	Qty
A.	PROP SHAFT ASSY (Incl 1 thru 18)	1	8.	Nut	4
			9.	Spider & Bearing Assy	1
B.	DUST COVER KIT (Incl 5,6,15 & 18)	1	10.	Bolt	4
			11.	Nut	4
1.	Bolt	4	12.	Fitting, Grease	2
2.	Spider & Bearing Assy	1	13.	Bolt	4
3.	Shaft, Solid with Yoke	1	14.	Fitting, Grease	1
4.	Nut	3	15.	Washer, Felt	1
5.	Cover	1	16.	Bolt	4
6.	Washer	2	17.	Fitting, Grease	2
7.	Yoke, Slip	1	18.	*Lock, Nylon	1
				*Not illustrated	

Fig. 1-Exploded View of Driveline Assembly

2. Remove retaining wires from the universal joints at each end of driveline assembly. Remove two (2) bearing caps from each end of the driveline.

3. Remove capscrews and nuts from bearing cap and shaft assembly.

4. Remove cross, seals and bearings as an assembly from shaft. Remove bearings and seals from cross.

5. Disassemble slip yoke and cross assembly, following same procedure as for splined shaft and cross assembly on opposite end of driveline.

6. Remove grease fittings from crosses. Remove grease fittings from slip yoke. Remove dust cap from slip yoke, if necessary by driving or pressing out. Do not remove dust cap unless it is damaged.

INSPECTION

1. Clean all parts in suitable solvent. Clean bearings with brush. Dry all parts with compressed air. Clean out grease passages in crosses and slip yoke.

2. Inspect splines of shaft and flanges for nicks, burrs and excessive wear. Replace if wear is excessive or splines are nicked.

3. Lubricate bearings with light oil; place on a cross trunion and spin by hand to check for wear.

4. Replace steel washers and felt washer if defective in any way.

5. Inspect all machined surfaces of flanges for roughness and pitting. Resurface or replace flanges as condition warrants. Remove any foreign material from flanges that would impair seating of bearings on flanges.

6. Check driveline and campanion flange faces with straight edge for parallelism. If an out-of-parallel flange exceeds the .005 inch maximum, replace with new flange, or machine to within .002 inches of parallelism.

CAUTION: When machining to correct parallelism,

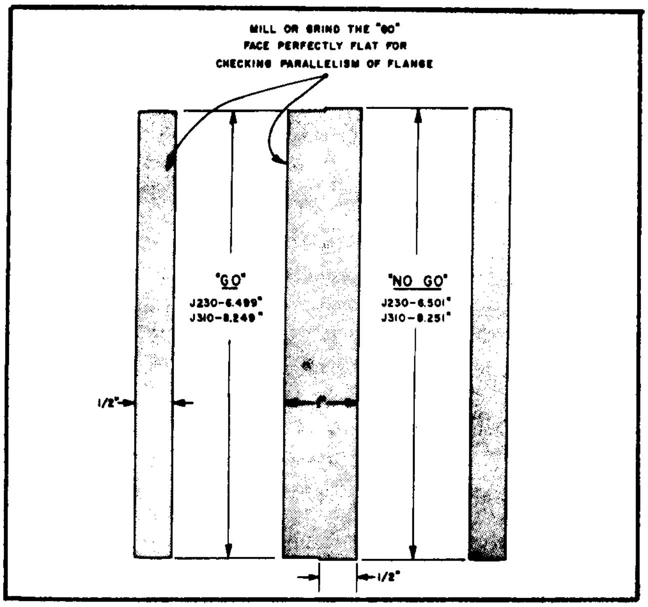


Fig. 2–Go-No Go Gage L-4633

do not remove any more metal than necessary from flange face, as this reduces keyway depth. Measure keyway depth after machining flange face. If minimum depth of .224 inches has not been retained, mill out keyway to prevent bottoming of bearing cap drive key.

7. Check ID of ridge around driving face of flange. A fabricated gauge, such as the one illustrated in Fig. 2 is recommended, both for checking flange ID and checking parallelism. If the ID measurement of the flange does not fall within the allowable limits, replace the flange.

8. Replace all grease seals with new seals.

ASSEMBLY

1. Install two new grease seals on opposite trunions on each cross.

2. Lubricate all bearings with small amount of multi-purpose grease and install bearings over seals on crosses.

   CAUTION: Do not weld retainer wires to bearing caps, as heat transferred to the bearing cap will cause the bearing cap to freeze to the cross.

3. Install the two remaining grease seals and bearings on each cross.

4. Hold any bearings which are not wired together and align with keyways in flange of splined shaft. Install cross and bearing assembly on shaft flange. Tap corner of each bearing with soft hammer to seat bearings and align bolt holes of bearings with holes in flange.

   CAUTION: All bearings must fit firmly against yoke; otherwise driveline will fail prematurely.

5. Secure bearings to shaft flange by installing bolts through bearings and flange, from bearing side of assembly. Install locks and capscrews. Secure capscrews with locks.

6. Check clearance between bearing caps and ID of ridge around shaft flange driving face. Clearance should be less than .0015 inch. If a .0015 inch feeler gage can be inserted at this point, enlarge bolt holes in mating bearing caps by 1/32 inch.

7. Repeat this operation for slip yoke and bearing cap assembly.

8. Install grease fittings in crosses. Install grease fitting in slip yoke. Drive or press dust cap into slip yoke if removed.

SLIP JOINT

1. Lubricate splines of shaft liberally with multi-purpose type grease.

2. Place a steel washer on each side of felt washer and install this assembly on retainer. Install washer and retainer assembly on shaft with threaded end facing out.

3. Assemble slip joint with arrow on splined shaft aligned with arrow on slip yoke. If arrows cannot be found, the yoke lugs must be in line with each other. Assembly of slip joint without proper alignment will result in vibration and premature failure.

4. Install retainer securely on threads of slip yoke.

INSTALLATION

1. Install any driveline mating companion flanges that were removed.

2. Raise driveline into position on unit according to identification marks made when removing. Match drive keys on slip yoke end of driveline with keyways in companion flange. Secure bearing caps to companion flange by installing capscrews. Torque capscrews as specified in Section 23, Standard Nut and Bolt Torque Specifications. Repeat this operation for installing opposite end of driveline.

3. Check clearance between bearing caps and ID of ridge around transmission or torque converter flange, whichever is applicable. Clearance should be less than .0015 inch. If a .0015 inch feeler gage can be inserted at this point, enlarge bolt holes in bearing caps or companion flange, whichever component does not have threads. Do not disturb threaded holes.

4. Make this same check at opposite end of driveline.

After the driveline is repaired and replaced on the unit, a dial indicator should be set up to accurately check driveline run-out. This should be checked at a machined section near each universal joint and should not exceed .020 inch. If the run-out is in excess of .020 inch, the driveline should be removed and the driveline flanges checked for burrs, rolled edges and any other obstructions which would prevvent them from seating properly. Clean and reinstall the driveline, making sure that the capscrews are properly torqued. If the run-out is still more than .020 inch, the driveline must be replaced.

MAINTENANCE

Use a small pry bar to check the transmission, torque converter and differential flanges for looseness. If loose, drop that end of the driveline and twist the flange to examine the back lash between the splines and flange. Replace any flange that does not fit snugly. With the pry bar, also check the universals for play. If there is any looseness, replace the bearings or cross and bearings as the case may be.

Inspect the splines at the slip joint and replace the driveline if they are badly worn. Tighten any loose capscrews to the required torque and make sure that the dust cap on the slip joint is tight.

Noise and vibration caused by the driveline assembly appears only at certain speeds and generally comes and goes as these speeds are approached and passed. When driveline noise becomes excessive, it takes the form of vibration which can be felt throughout the frame.

LUBRICATION

Improper lubrication is one of the most frequent causes of driveline failure. Adequate lubrication of driveline universal joints is critical because of the large loads that the needle bearings at these points must transmit.

Apply grease to the universal joints until it appears at all journal cross bearing caps. The lubricant is required to flow from the outside cavity inward through the needle bearings and out around the seals to completely lubricate the joints. This is necessary to clean out the old lubricant.

Apply the lubricant with either a hand-operated grease gun or a pressure gun.

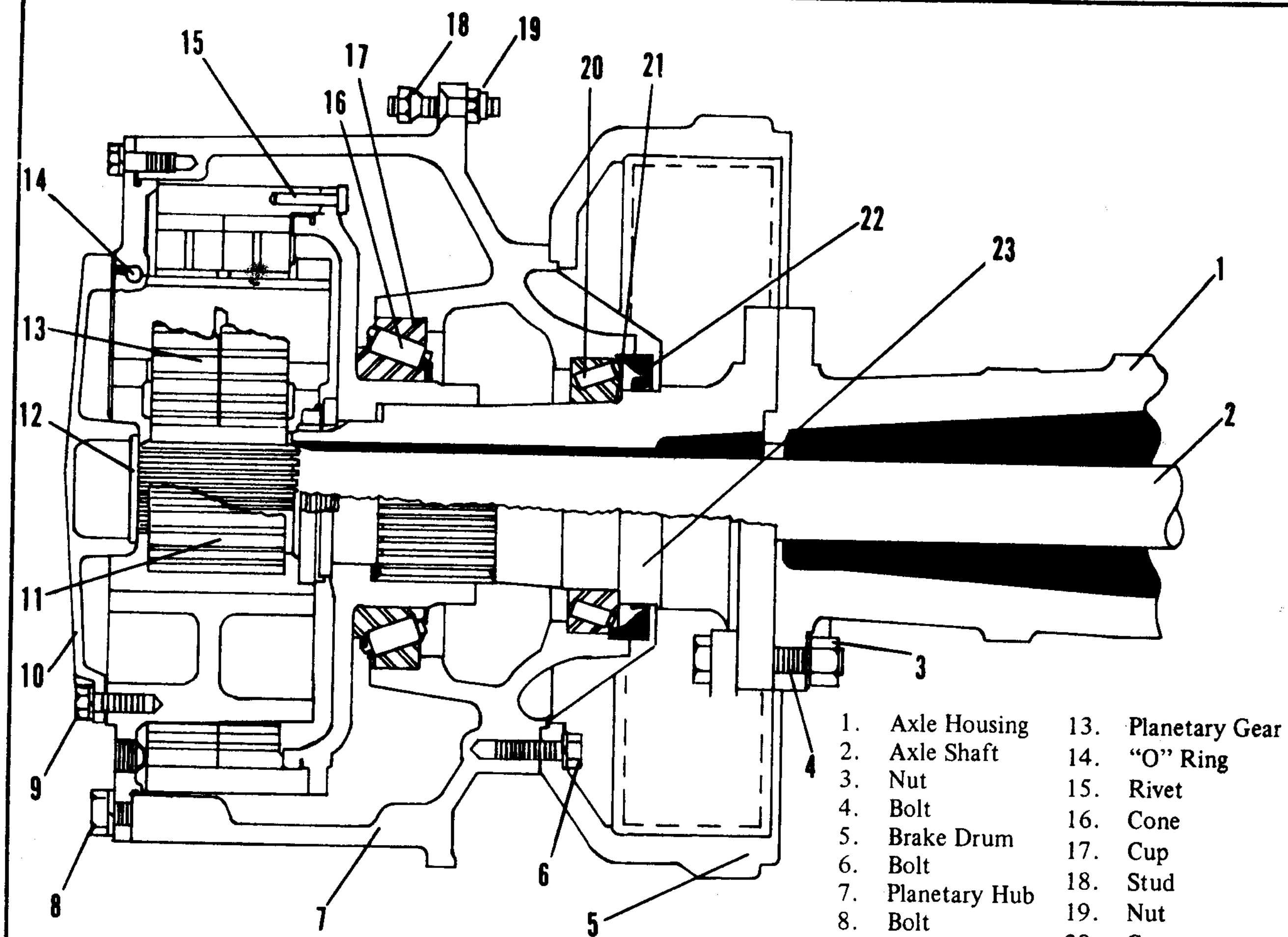
See Section 21, Lubrication Chart of this manual for the recommended lubricant and intervals.

DRIVELINE DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Noise	Lack of lubricant.	Check oil seals. Install proper grade of lubricant.
	Out of balance driveline assemblies.	Check to see if arrows at slip joint and grease fittings are in line.
		Clean dirt from driveline.
	Backlash due to worn trunnion or bearing.	Replace worn parts.
	Excessively worn center bearing.	Install new bearing. Make sure frame cross member is in line.
Vibration	Yokes not in line.	Separate driveline at center and assemble correctly.
	Driveline out of balance.	Replace driveline.
	Driveline sprung from contact with obstruction.	Replace driveline.
	Excessive run-out or distorted yokes.	Disassemble and correct or replace damaged part.
	Loose flange nut on transmission, transfer case, or differential flange.	Check splines; if worn replace driveline. Tighten nut.

* * * *

DRIVE AXLE, DIFFERENTIAL & BRAKES



1.	Axle Housing	13.	Planetary Gear
2.	Axle Shaft	14.	"O" Ring
3.	Nut	15.	Rivet
4.	Bolt	16.	Cone
5.	Brake Drum	17.	Cup
6.	Bolt	18.	Stud
7.	Planetary Hub	19.	Nut
8.	Bolt	20.	Cup
9.	Bolt	21.	Cone
10.	Thrust Cover	22.	Seal
11.	Sun Gear	23.	Stub Spindle
12.	Thrust Cap		

NOTE: Brakes, for service (See Caliper Disc Brake Section.)

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8

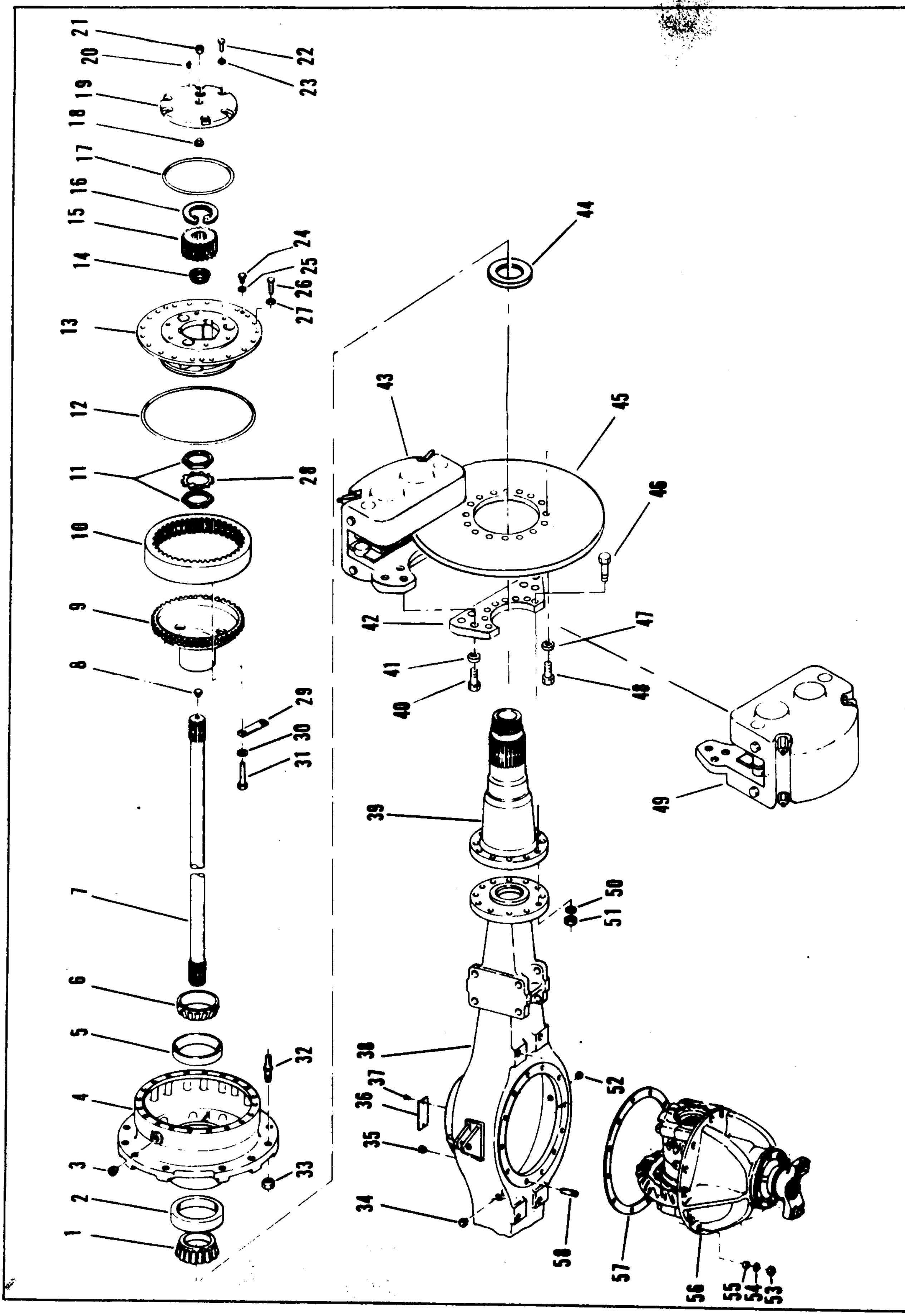
DESCRIPTION AND OPERATION

The drive axle and differential assembly is a full-floating spiral bevel type. Further reduction is provided by the planetary gear set within each wheel hub.

The spiral bevel pinion and ring gear transmit power through the center differential pinions and side gears or through a differential to the axle shaft. The spiral bevel differential assembly is mounted on tapered roller bearings which are adjusted by positioning the two threaded adjusting nuts mounted in the differential carrier and cap assembly. The tapered roller pinion bearing pre-load is adjusted and maintained by a hardened and precision ground spacer positioned between inner and outer bearings.

In the wheel hub, a self-centering sun gear is spline fitted to the axle shaft and drives three planetary pinion gears. These gears in turn mesh with and react against a rigidly mounted internal ring gear. The planet gears rotate on needle roller bearings mounted on hardened and ground pins located in the planet carrier which in turn drives the wheel hub. Positive lubrication keeps all moving parts bathed in lubricant to reduce friction, heat and wear.

CLARK EQUIPMENT COMPANY

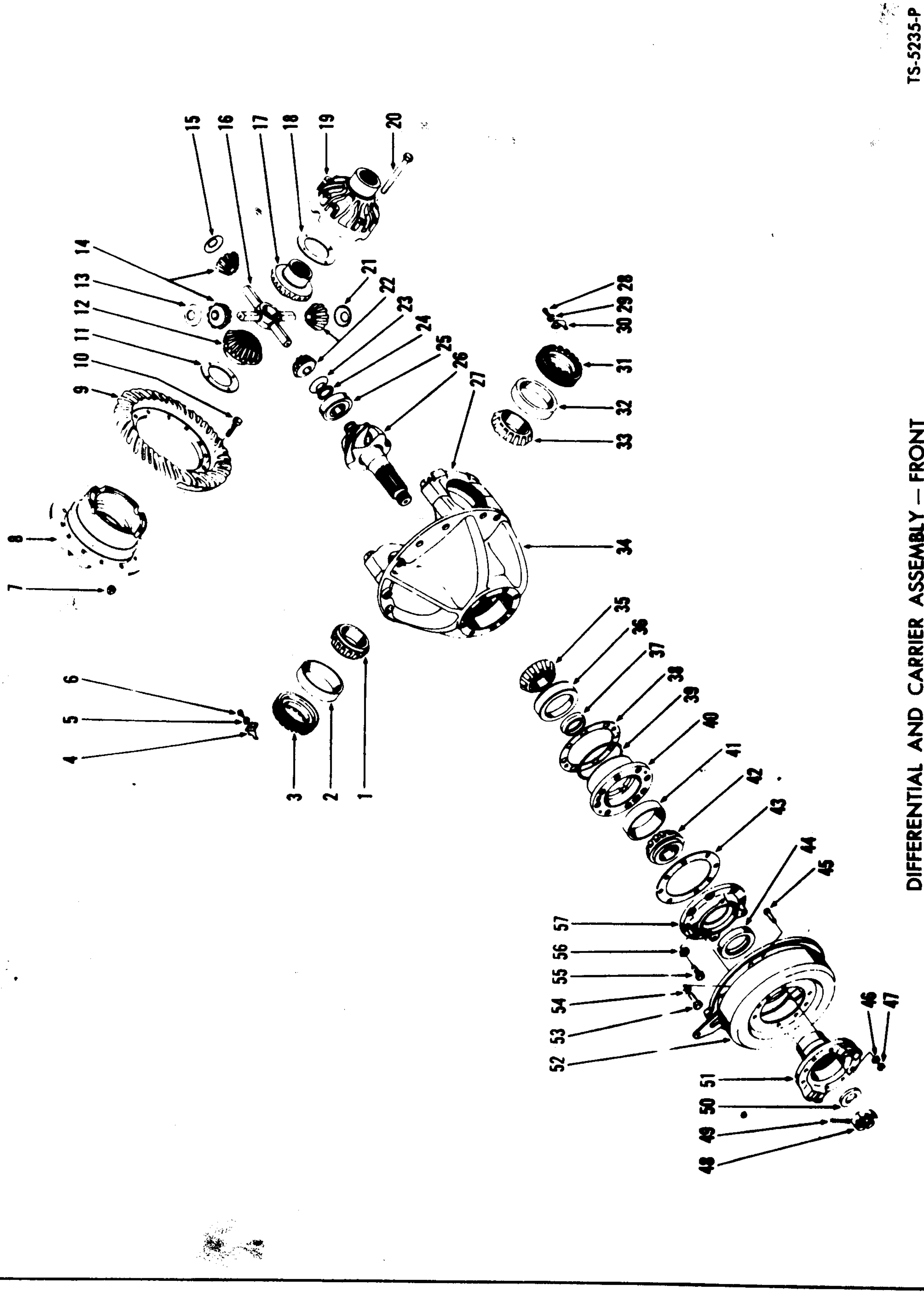


TRACTOR DRIVE AXLE

AXLE ASSEMBLY - DRIVE

Item	Part No.	Description	Qty.
A		AXLE ASSY(Inc 1 thru 58)	1
B		†HUB & DISC ASSY(Inc 2,4,5,32,33,45)	2
C		†GEAR & HUB ASSY(Inc 9,10,29,30 & 31)	1
1		CONE,Inner Hub Brg	2
2		CUP,Inner Hub Brg	2
3		PLUG	2
4		HUB & CUP ASSY(Inc 2,5)	2
5		CUP,Outer Hub Brg	2
6		CONE,Outer Hub Brg	2
7		AXLE SHAFT ASSY (Inc 8)	2
8		OMIT	2
9		HUB,Internal Gear	2
10		GEAR,Internal	2
11		NUT,Spindle	4
12		OMIT	2
13		PLANET CARRIER ASSY- See Index	2
14		WASHER	2
15		GEAR,Sun	2
16		RING,Sun Gear Snap	2
17		O-RING	2
18		OMIT	2
19		THRUST CAP ASSY (Inc 18)	2
20		OMIT	2
21		PLUG	2
22		BOLT	18
23		WASHER	18
24		SCREW	6
25		LKWSHR	6
26		BOLT	40
27		WASHER	40
28		LOCKNUT,Spindle	2
29		PLATE,Retainer	12
30		LKWSHR	24
31		BOLT	24
32		STUD	38
33		NUT	38
34		BREATHER,Air	1
35		PLUG	1
36		NAMEPLATE	1
37		SCREW	2
38		HOUSING,Axle	1
39		END,Spindle	2
40		BOLT	24
41		WASHER	24
42		PLATE,Disc Brake Adapter	4
43		BRAKE HEAD ASSY - See Index	2
44		SEAL	2
45		DISC,Brake	2
46		BOLT	32
47		WASHER	16
48		BOLT	16
49		BRAKE HEAD ASSY - See Index	2
50		WASHER	32
51		NUT	32
52		PLUG	1
53		NUT	10
54		WASHER	10
55		DOWEL	4
56		DIFF & CARRIER ASSY- See Index	1
57		OMIT	1
58		STUD	10
58		†STUD	4
58		†STUD	2

†Not Illustrated



DIFFERENTIAL AND CARRIER ASSEMBLY — FRONT

DIFFERENTIAL AND CARRIER ASSEMBLY — FRONT DRIVE

Item No.	Description	No. Req'd.
A	DIFF. & CARRIER ASSY KIT (Inc. 1 thru 57)	1
1	CONE, Differential Bearing	1
2	CUP, Differential Bearing	1
3	NUT, Differential Adjusting	1
4	LOCK, Differential Adjusting Nut	1
5	LKWSHR, Adjusting Nut Lock	1
6	BOLT, Adjusting Nut Lock	1
7	NUT, Ring Gear	12
8	§DIFF. CASE, Flange Half — See 61	1
9	§RING GEAR — See 60	1
10	BOLT, Ring Gear	12
11	WASHER, Side Gear Thrust	1
12	GEAR, Differential Side	1
13	WASHER, Differential Pinion Thrust	1
14	PINION KIT, Differential (Inc. 22)	1
15	WASHER, Differential Pinion Thrust	1
16	SPIDER, Differential	1
17	GEAR, Differential Side	1
18	WASHER, Side Gear Thrust	1
19	§DIFF. CASE, Plain Half — See 61	1
20	BOLT, Differential Case	8
21	WASHER, Differential Pinion Thrust	1
22	§PINION, Differential - See 14	—
23	WASHER, Differential Pinion Thrust	1
24	RING, Inner Pinion Retaining	1
25	BEARING, Inner Pinion	1
26	§PINION — See 60	1
27	§CAP, Differential — See 34	2
27A	†BOLT, Carrier Cap	4
27B	†WASHER, Carrier Cap	4
28	BOLT, Adjusting Nut Lock	1
29	LKWSHR, Adjusting Nut Lock	1
30	LOCK, Differential Adjusting Nut	1
31	NUT, Differential Adjusting	1
32	CUP, Differential Bearing	1
33	CONE, Differential Bearing	1
34	*CARRIER ASSY KIT, Differential (Inc. 27, 27A, 27B)	1
35	CONE, Center Pinion Bearing	1
36	CUP, Center Pinion Bearing	1
37	KIT, Pinion Bearing Spacer	1
38	‡SHIM, Pinion Bearing Cage (.004)	—
38A	‡SHIM, Pinion Bearing Cage (.007)	—
38B	‡SHIM, Pinion Bearing Cage (.010)	—
39	"O" RING, Pinion Bearing Cage	1
40	CAGE ASSY, Pinion Bearing (Inc. 36, 41)	1
41	CUP, Outer Pinion Bearing	1
42	CONE, Outer Pinion Bearing	1
43	GASKET, Oil Seal Retainer	1
44	SEAL, Pinion Oil	1
45	BOLT, Drum to Flange	8
46	LKWSHR, Drum to Flange	8
47	NUT, Drum to Flange	8
48	NUT, Pinion Shaft	1
49	COTTER, Pinion Shaft Nut	1
50	WASHER, Pinion Shaft	1
51	FLANGE, Companion	1
52	PARKING BRAKE — See Index	—
52A	†DRUM, Brake	1
53	BOLT, Brake Attaching	4
54	LKWSHR, Brake Attaching	4
55	BOLT, Oil Seal Retainer	8
56	LKWSHR, Oil Seal Retainer	8
57	RETAINER, Pinion Oil Seal	1
58	†DIFF. ASSY (Inc. 7 thru 23, 26)	[illegible]
59	†DIFF. BODY SUB-ASSY (Inc. 8, 11 thru 23)	1
60	†GEAR & PINION SET (Inc. 9, 26)	1
61	†DIFF. CASE KIT (Inc. 8, 13, 15, 19 thru 21, 23)	1

§Not Sold Separately
†Not Illustrated
‡As Required

WHEN ORDERING PARTS, ALWAYS STATE MODEL AND SERIAL NO. OF MACHINE

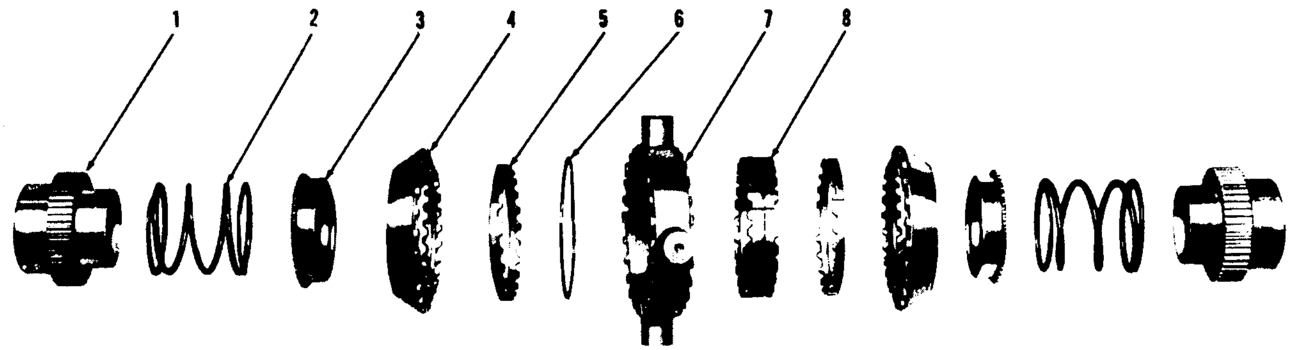


FIG. C TS-249-P

NoSPIN DIFFERENTIAL ASSEMBLY

Item No.	Description	No. Req'd.
1	GEAR, Side	2
2	SPRING	2
3	RETAINER, Spring	2
4	CLUTCH, Driven	2
5	RING, Holdout	2
6	RING, Retaining	1
7	SPIDER	1
8	CAM, Center	1

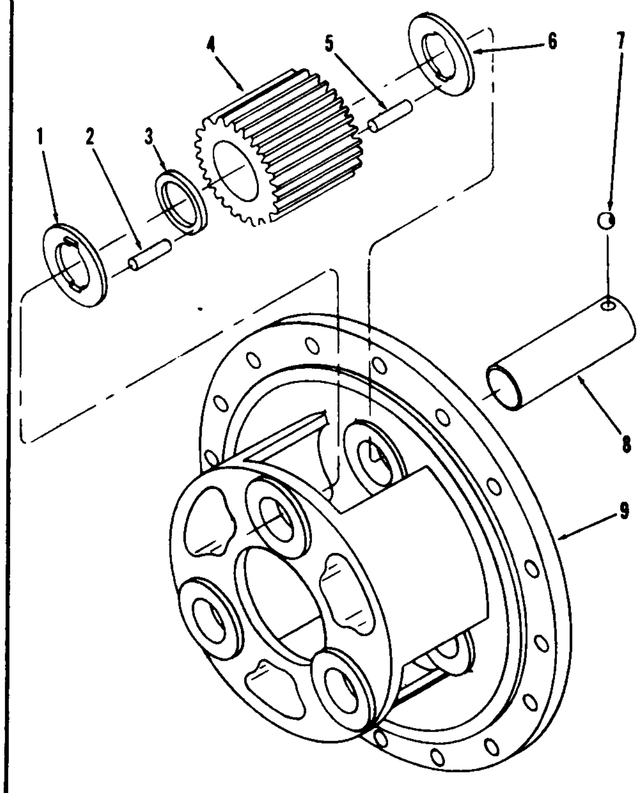


FIG. D TS-460P

Figure D—PLANET CARRIER ASSEMBLY

Item No.	Description	No. Req'd.
1	WASHER, Pinion Thrust	3
2	ROLLER, Pinion	78
3	SPACER, Pinion Roller	3
4	PINION	3
5	ROLLER, Pinion	78
6	WASHER, Pinion Thrust	3
7	BALL, Pinion Shaft Lock	3
8	SHAFT, Pinion	3
9	CARRIER, Planet	1

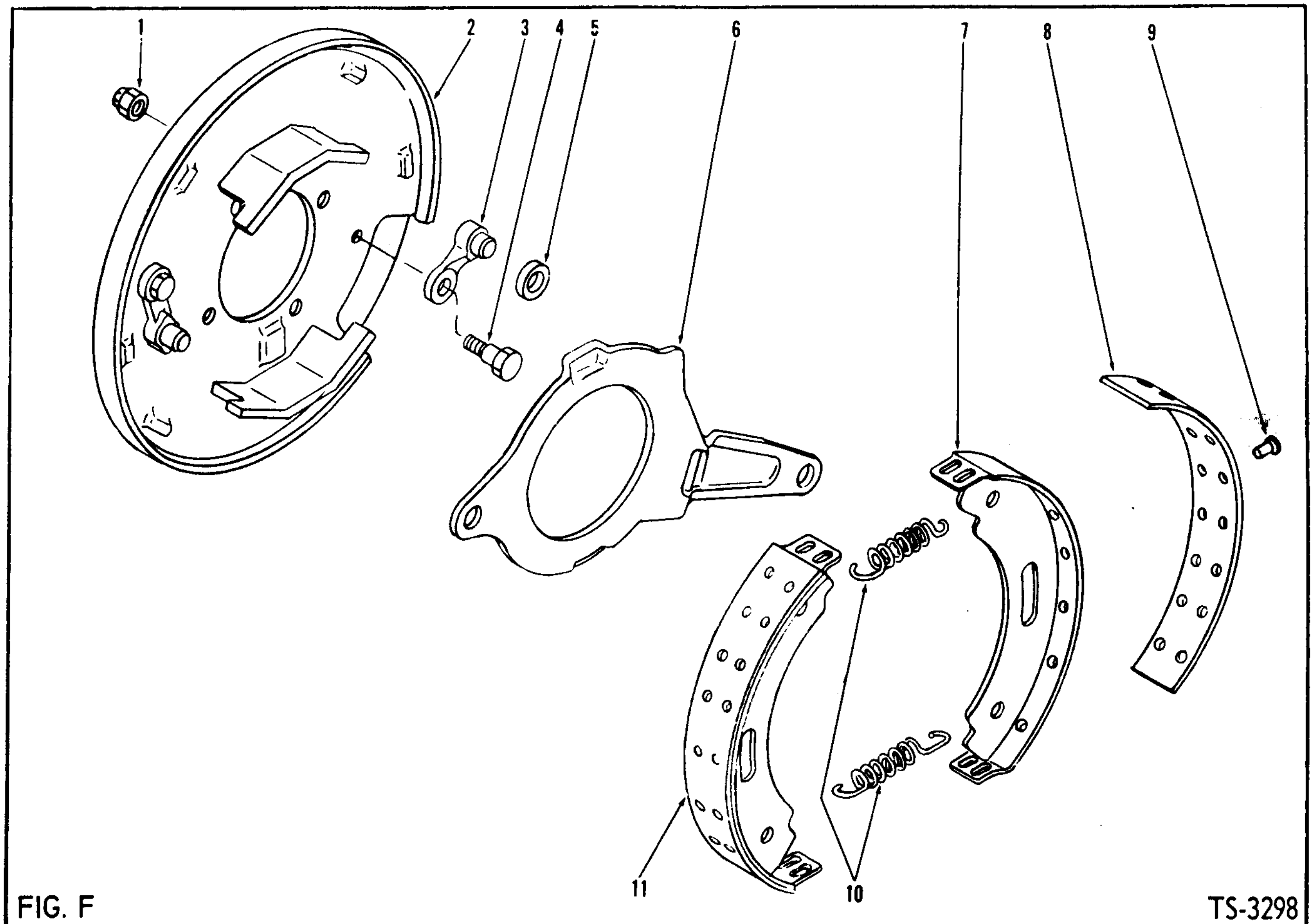


FIG. F

PARKING BRAKE ASSEMBLY

Item No.	Description	No. Req'd.
1	NUT, Pawl to Plate	2
2	PLATE, Brake Backing	1
3	PAWL, Brake	2
4	BOLT, Pawl to Plate	2
5	ROLLER, Brake Actuating	1
6	LEVER, Cam Operating	1
7	SHOE, Brake	2
8	LINING, Brake Shoe	1
9	RIVET, Lining to Shoe	28
10	SPRING, Shoe Return	2
11	SHOE ASSEMBLY, Brake	2

OVERHAUL OF AXLE ASSEMBLY

The instructions contained herein cover the disassembly and reassembly of the axle assembly in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled.

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

NOTE: Placing axles on steel horses facilitates disassembly and reassembly. Greater stability is gained by resting axle mounting pads on horses so that axles are inverted from normal operating positions. Photographs showing this overhaul procedure were taken with axle in inverted position.

DISASSEMBLY OF AXLE

1. Remove drain plugs from planetary housings and from differential housing to drain axle (Fig. 1).

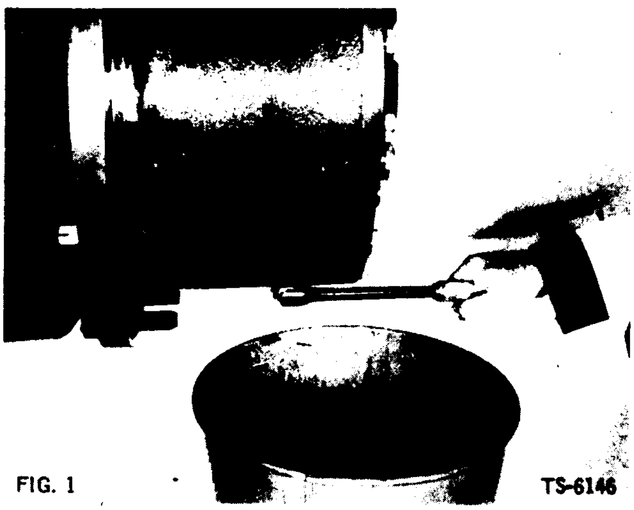
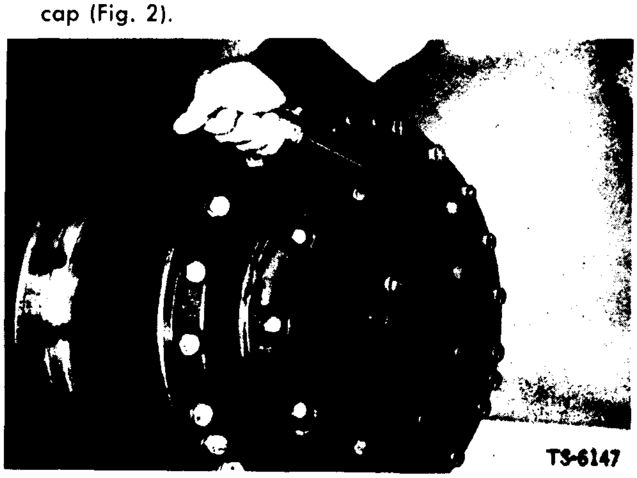


FIG. 1 TS-6146

2. Remove bolts and flat washers securing sun gear thrust cap (Fig. 2).



TS-6147

3. Remove sun gear thrust cap (Fig. 3). Remove "O" ring from cap.

   NOTE: Some early versions of axle assemblies do not have "O" ring feature in thrust cap.

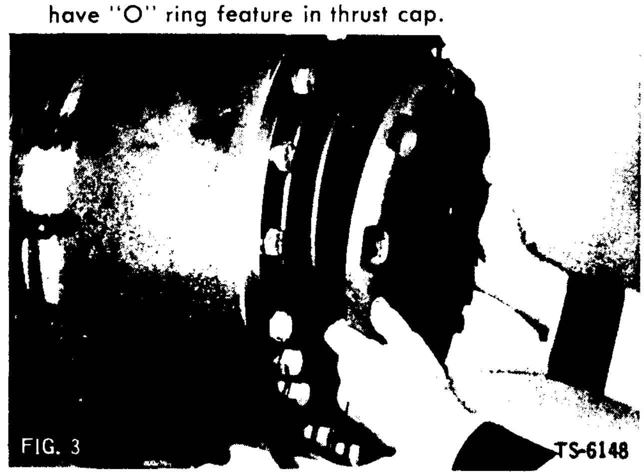


FIG. 3 TS-6148

4. Remove bolts and lockwashers retaining planet carrier (Fig. 4).

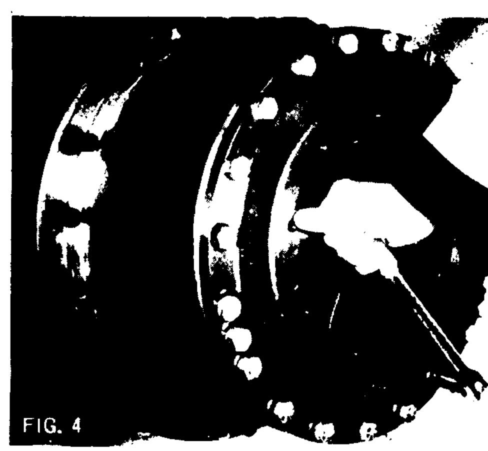
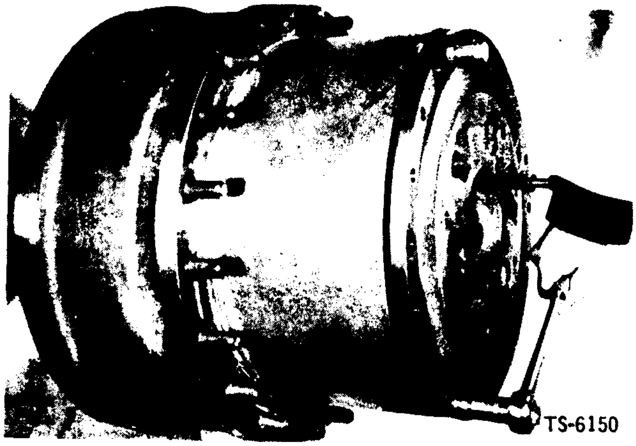
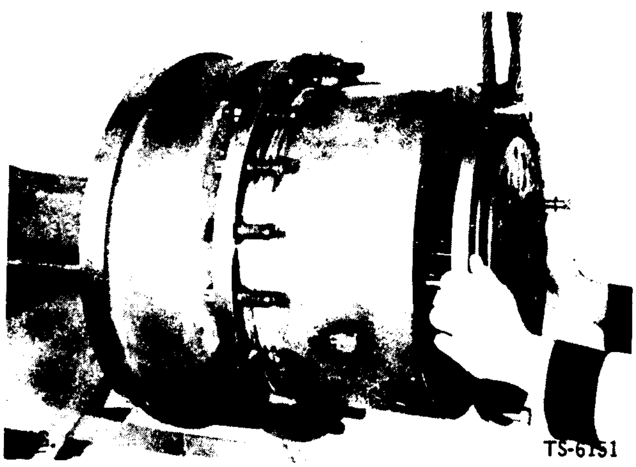


FIG. 4 TS-6149

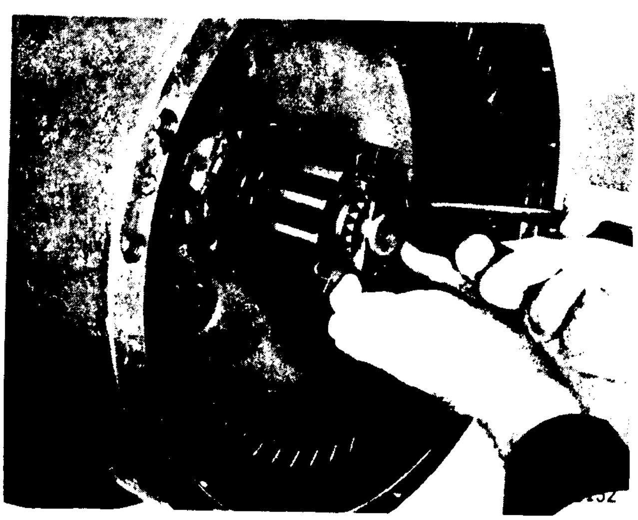
5. Install three mounting bolts in puller holes to pull planet carrier from hub assembly (Fig. 5).



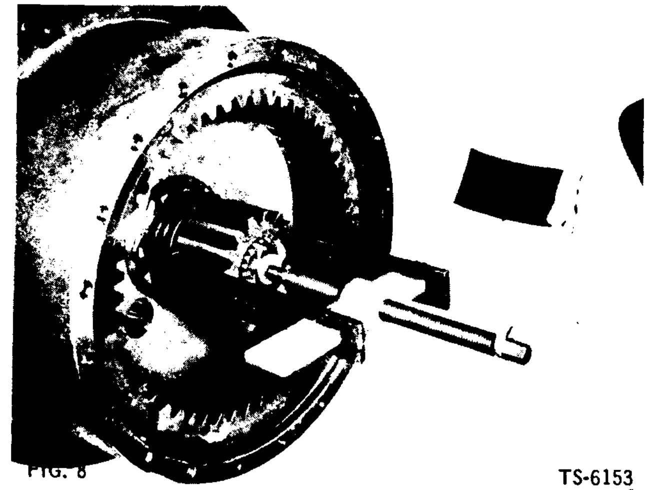
6. Remove planetary assembly (Fig. 6). Remove "O" ring from planetary assembly.



7. Remove sun gear retaining ring (Fig. 7).

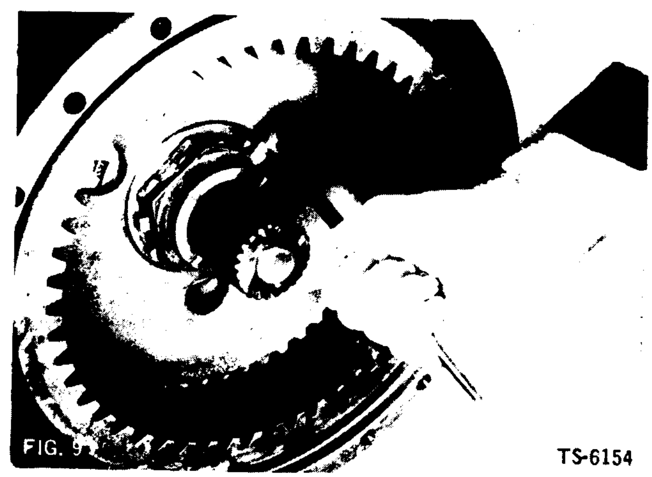


8. Remove sun gear using suitable puller (Fig. 8).



TS-6153

9. Some axle models have thrust ring pressed lightly into end of spindle. If provided, use pry bar to remove thrust ring from end of spindle (Fig. 9).



TS-6154

10. Straighten tangs on nut lock as shown in Fig. 10.

11. Support weight of hub and drum assembly with hoist. Wrap several turns of .010" to .020" shim stock around end of axle shaft to protect shaft splines (Fig. 11). Install special wrench (Clark No. 945940) on outside spindle nut. Tighten guide screws lightly against shim stock.

FIG. 11 S-6156

12. Remove outside spindle nut, nut lock, and inside spindle nut (Fig. 12).

FIG. 12 TS-6157

13. Support weight of brake drum and hub assembly with hoist. Remove internal gear and hub from spindle assembly (Fig. 13). In some cases it will be necessary to use pry bars as shown.

13 TS-6158

14. Pull straight out on brake drum and hub assembly to remove it from axle (Fig. 14). Be sure brake shoes are in fully released position.

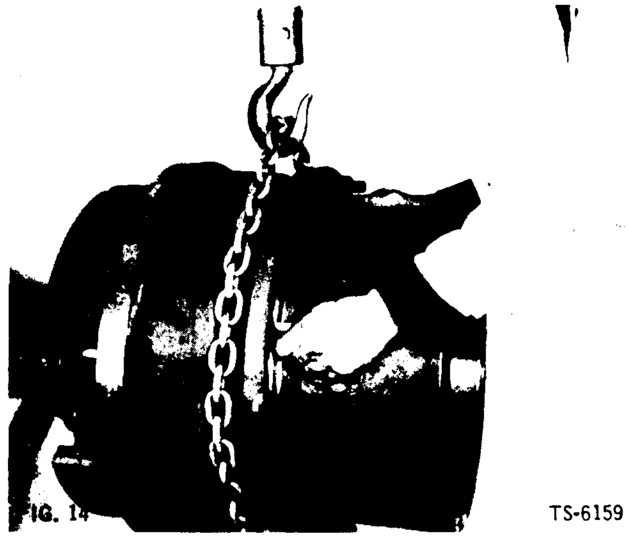
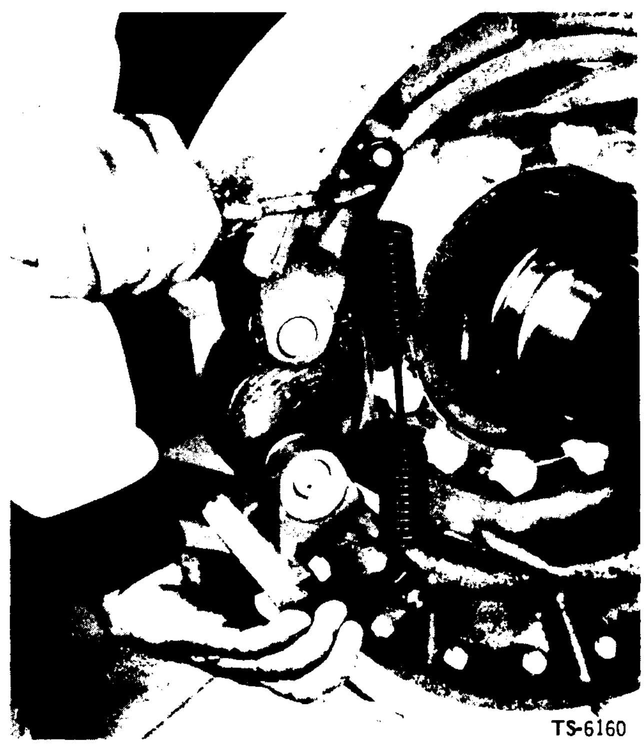


FIG. 14 TS-6159

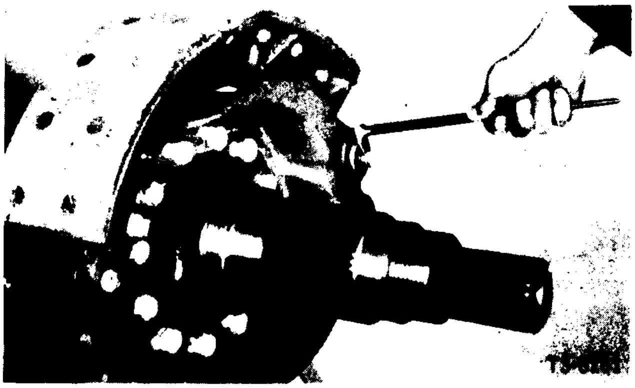
15. Remove cotter pin and spring anchor pin washer. Disengage and remove brake shoe return spring from anchor pin (Fig. 15). *Discard old return spring.*

CAUTION: Use care when removing return spring so as not to cause injury. Spring is under tension and can be projected some distance when released from anchor pin. Support lower brake shoe or it will pivot around anchor pin when spring is released.



TS-6160

16. Cut lockwire and remove anchor pin set screws. Unscrew bolt in anchor pin several turns. Use pry bar under screw head to start anchor pin from spindle support assembly (Fig. 16).
NOTE: Anchor pins of some axle models are held in place by retaining plate and bolt. Remove bolt and anchor plate to remove pins.

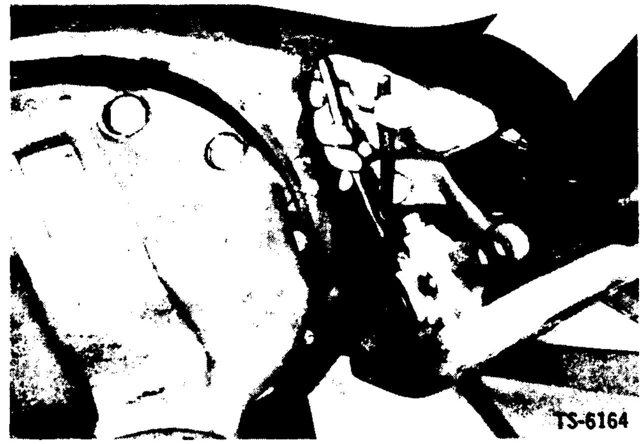


17. Remove anchor pin and remove brake shoe (Fig. 17).

TS-6162

18. Remove cotter pin and pin securing clevis of air chamber to slack adjuster. Remove nuts and lockwashers securing air chamber to air chamber bracket; remove air chamber (Fig. 18).

19. Remove slack adjuster retaining ring (Fig. 19). Remove slack adjuster retaining washer. Note position of slack adjuster adjusting screw. In some applications, screw is adjacent to air chamber bracket. In other applications, it is as shown in Fig. 19.



TS-6164

20. Use soft mallet to drive slack adjuster from brake cam shaft (Fig. 20).

21. Unseat retaining ring that holds cam shaft positioned in brake spider (Fig. 21).

FIG. 21 TS-6166

22. Remove brake cam shaft and cam shaft thrust washer from brake spider (Fig. 22). Remove cam shaft grease washer, felt grease retainer, and "O" ring.

TS-6167

23. If damaged, drive brake cam shaft bushing from brake spider (Fig. 23).

FIG. 23 TS-6168

24. Remove mounting bolts and washer securing spindle and brake spider to axle housing (Fig. 24).

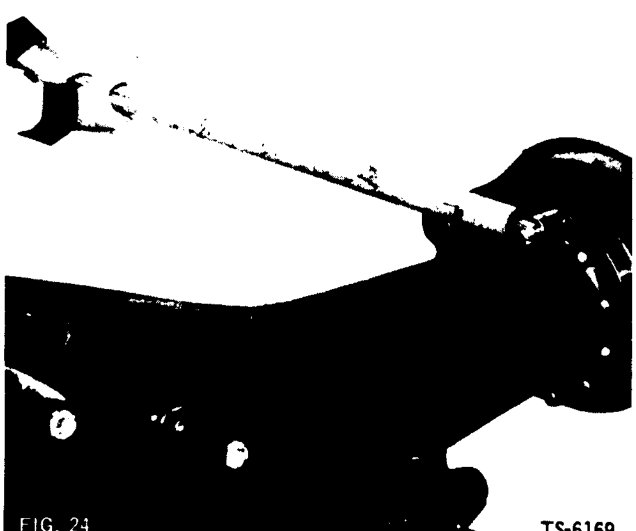


FIG. 24 TS-6169

25. Remove brake spider from spindle (Fig. 25).

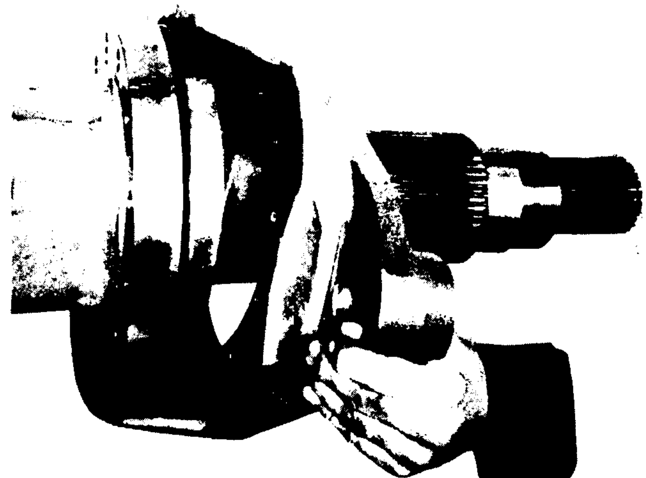


FIG. 25 TS-6170

26. Remove spindle from axle housing (Fig. 26).

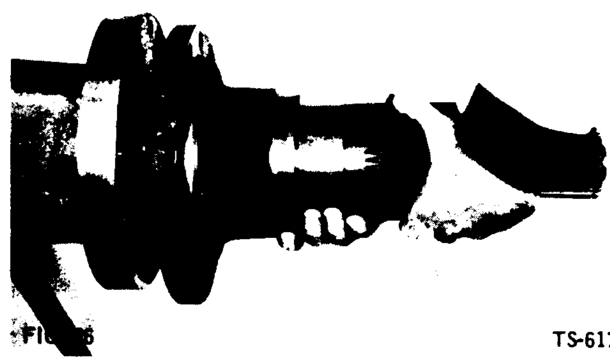


FIG. 26 TS-6171

27. Remove axle shaft from axle housing (Fig. 27).

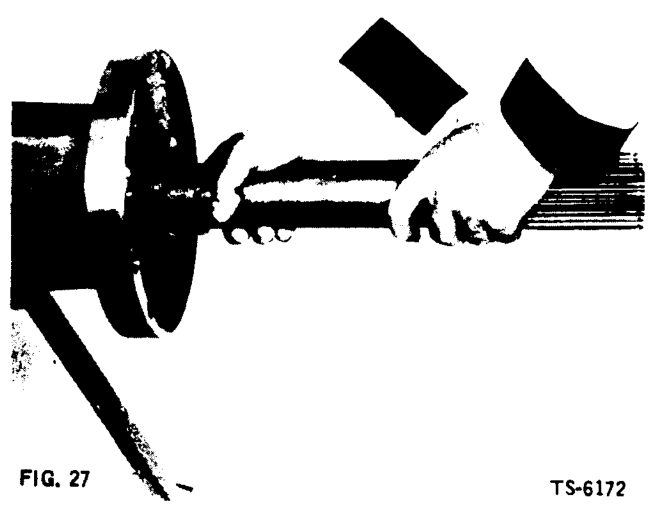


FIG. 27 TS-6172

28. Remove two bolts and lock washers that secure air chamber bracket to axle housing; remove bracket and spacers (Fig. 28).

FIG. 28 TS-6173

29. Disassemble opposite side of axle following instructions given in steps 2 through 28.

30. If axle is equipped with parking brake, proceed as indicated below. If axle is not equipped with parking brake, proceed to step 39. Position socket on flange nut and then install flange retaining tool with two spacers between tool and flange. Spacer dimensions are given in Fig. 30. Loosen flange nut (Fig. 29). Remove flange retaining tool and remove flange nut and washer.

    NOTE: Standard 2 5/8-inch socket will not fit flange nut because socket wall is too thick to enter recess in flange. Machine socket as shown in Fig. 31 to provide proper clearance.

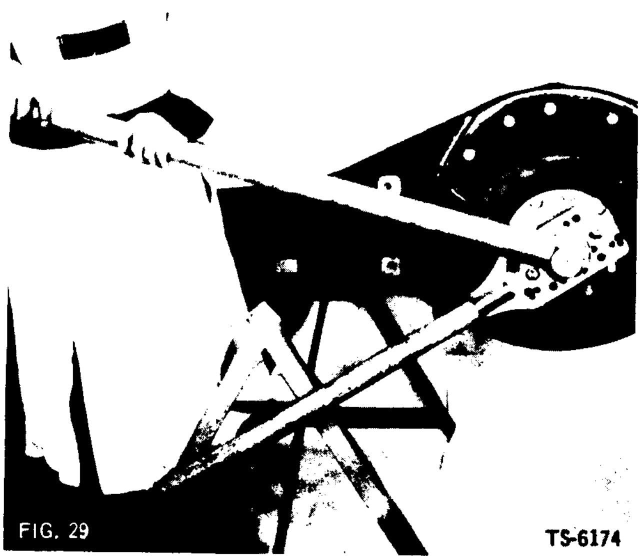


FIG. 29 TS-6174

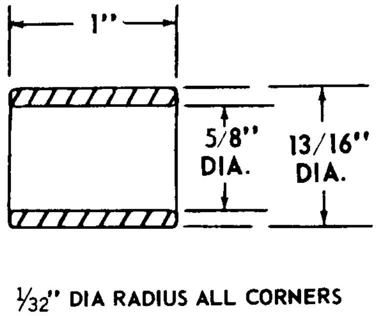


FIG. 30 TS-5685

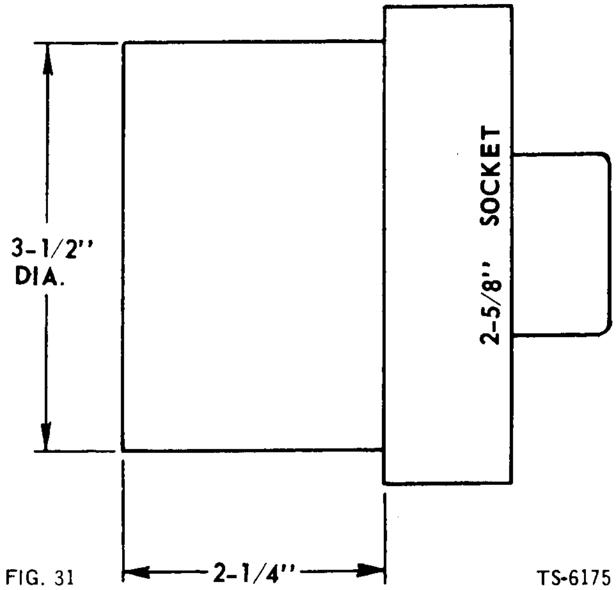


FIG. 31 TS-6175

31. Use suitable puller to pull assembled companion flange and parking brake drum from pinion shaft (Fig. 32).

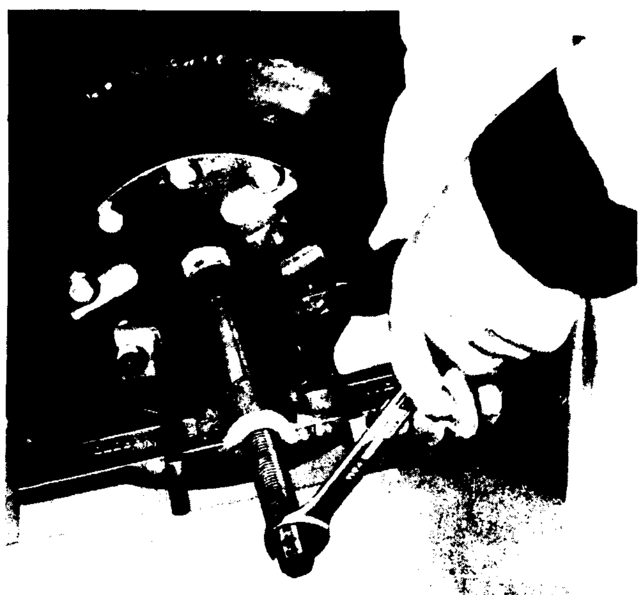


FIG. 32 TS-6176

32. Match mark parking brake drum to companion flange (Fig. 33). This will assure proper balance of parts when reassembled.

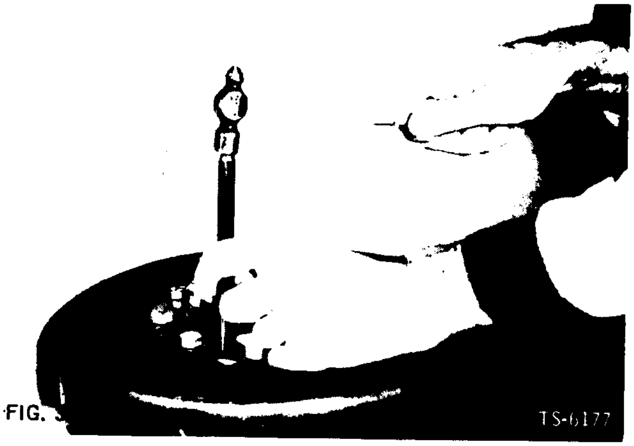


FIG. 3 TS-6177

33. Position assembled parking brake drum and companion flange on press and apply light press pressure to retain parts while removing nuts, lockwashers, and bolts (Fig. 34). Do not distort or score parking brake drum by clamping tightly in vise.

FIG. 34 TS-6178

34. Remove lower parking brake spring with brake spring pliers (Fig. 35).

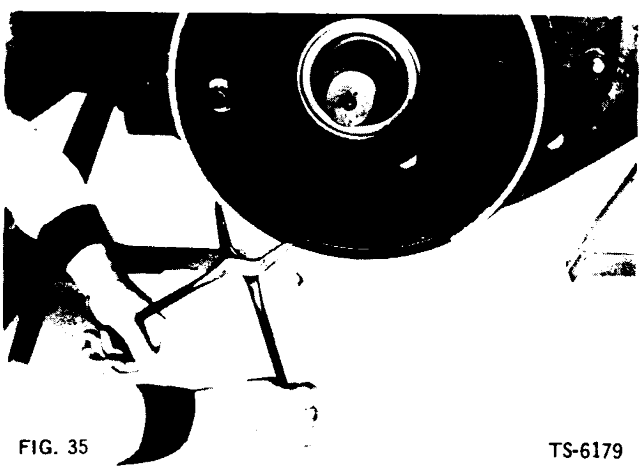


FIG. 35 TS-6179

35. Spread brake shoes and remove assembled brake shoes and upper parking brake return spring (Fig. 36).

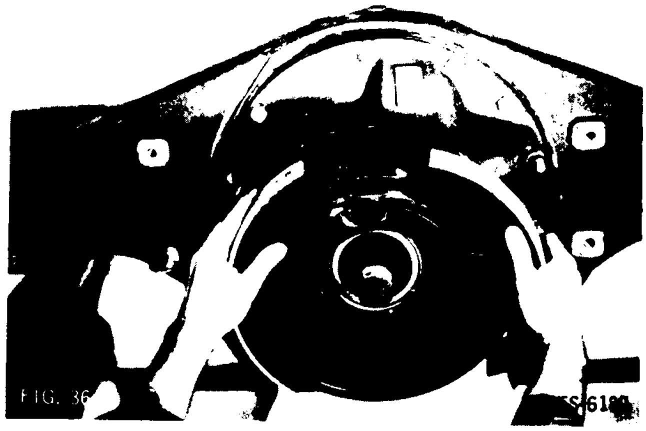


FIG. 36 TS-6180

36. Remove brake operating cam lever and roller from brake backing plate (Fig. 37).

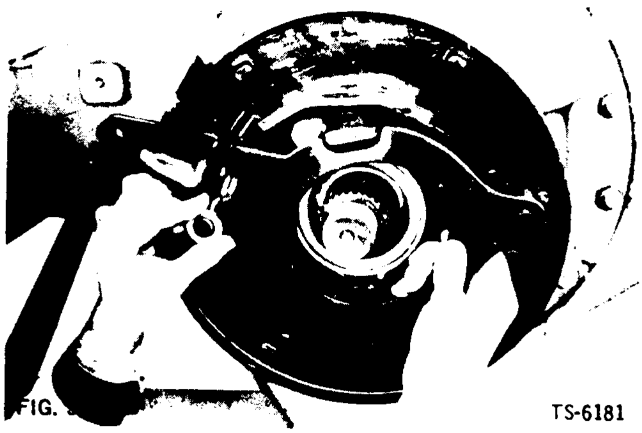
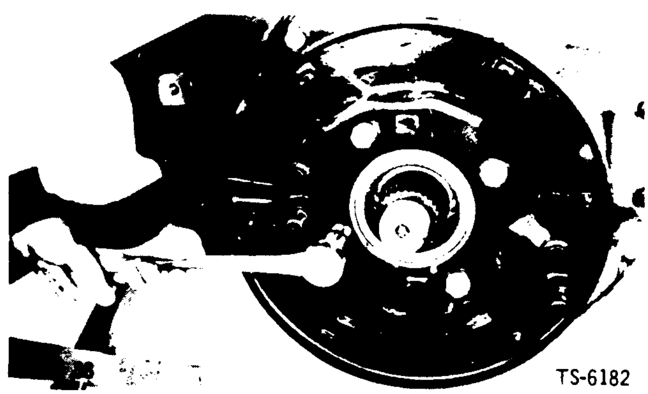


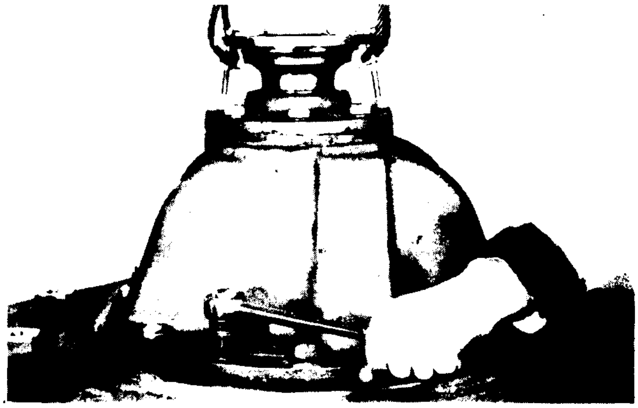
FIG. TS-6181

37. Remove bolts and lockwashers securing brake backing plate to differential and carrier assembly (Fig. 38). Temporarily reinstall companion flange on pinion shaft to facilitate removal of differential and carrier assembly.



TS-6182

38. Support weight of differential and carrier assembly with hoist. Remove bolts, nuts, washers, and dowels securing differential carrier to axle housing (Fig. 39).



39. Lift differential and carrier assembly from axle housing with hoist (Fig. 40). If necessary, break seal between parts by tapping with plastic hammer. Remove differential gasket.

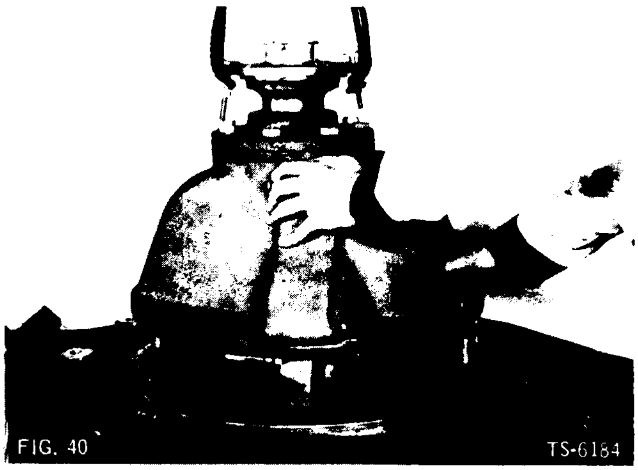


FIG. 40 TS-6184

Disassembly of Planet Carrier Assembly

1. Place planet carrier assembly in press as shown and press out pinion shaft (Fig. 41). Take care to catch pinion shaft lock ball released as shaft is pressed out.

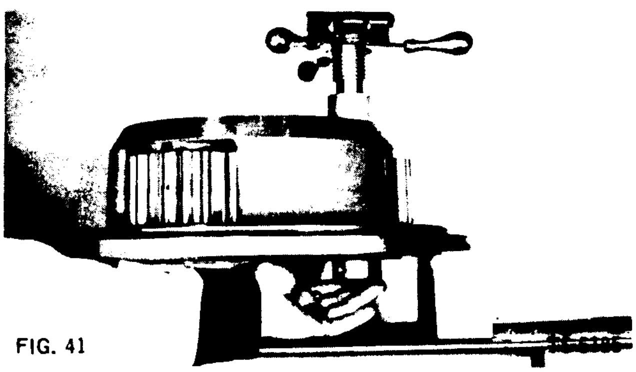


FIG. 41

2. Carefully remove pinion shaft, planet pinion, pinion thrust washers, pinion rollers, and pinion roller spacer (Fig. 42). Rollers will drop from pinions. Take care to prevent losing them.

FIG. 42 TS-6186

Disassembly of Hub and Drum Assembly

1. Match-mark hub and drum to insure proper reassembly (Fig. 43).

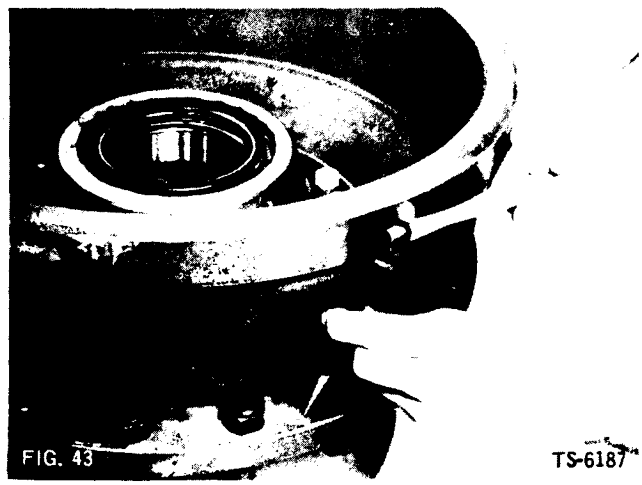


FIG. 43 TS-6187

2. Cut lockwires and remove bolts securing brake drum to hub (Fig. 44). Remove brake drum and oil catcher.

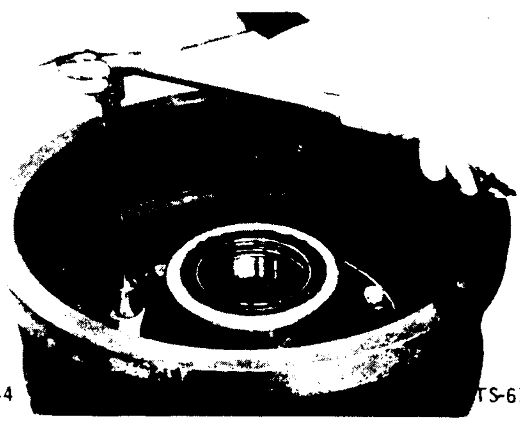


FIG. 44 TS-6188

3. Pry out oil seal (Fig. 45).

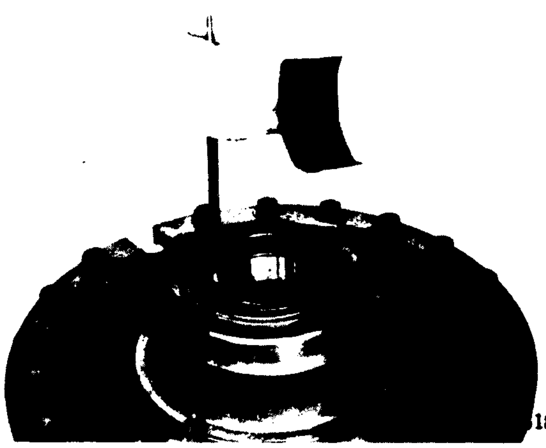


FIG. 189

4. Lift out bearing cone (Fig. 46).

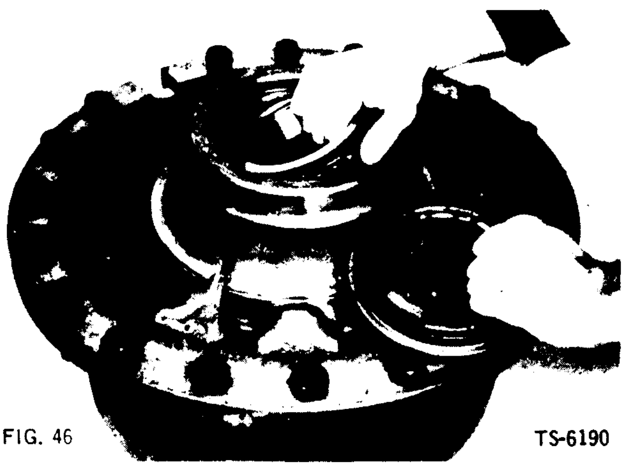


FIG. 46 TS-6190

5. If replacement of the bearing cups is required, drive out cups with a soft drift (Fig. 47). Exercise care to prevent damage to the bearing bores when driving out cups.

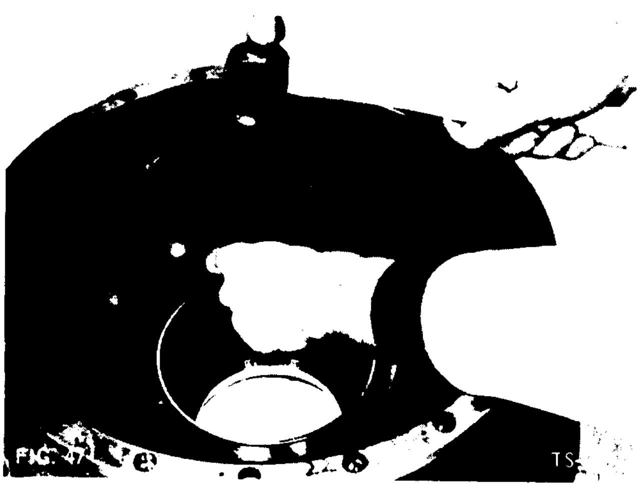


FIG. 47 TS

6. If any wheel studs are damaged, remove nut that secures each stud to hub. Drive out studs. Always replace entire set if any are damaged (Fig. 48).

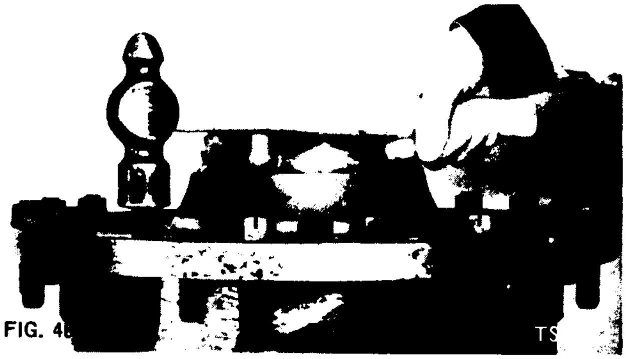
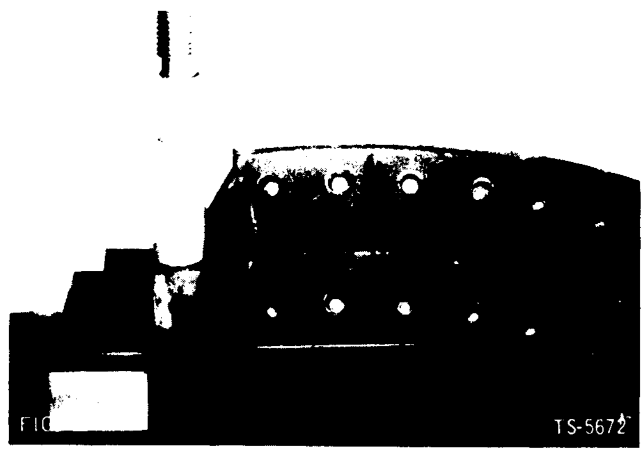


FIG. 4 TS

Disassembly of Brake Shoes

1. If worn or damaged, press brake shoe bushing from brake shoe (Fig. 49). If inside diameter of bushing exceeds 1.513" for 20x5 brakes, or 1.263" for 16½x6 brakes, it should be replaced.

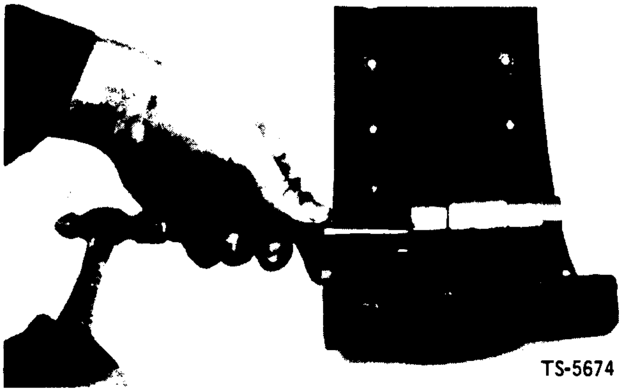


FI TS-5672

2. Remove cotter pin and drive out cam roller pin lock pin with punch (Fig. 50).

FIG. 50 TS-5673

3. Drive out cam roller pin (Fig. 51). Remove roller.



TS-5674

4. Check brake lining for oil or grease saturation, wear, and looseness. If loose, tighten retaining bolts to 200 to 220 *inch*-pounds torque. If saturated with grease, replace all lining blocks. To remove linings, remove nuts, lockwashers, and bolts retaining lining to shoes (Fig. 52).

   NOTE: When replacing brake linings, all linings on both sides of axle assembly should be replaced at the same time.

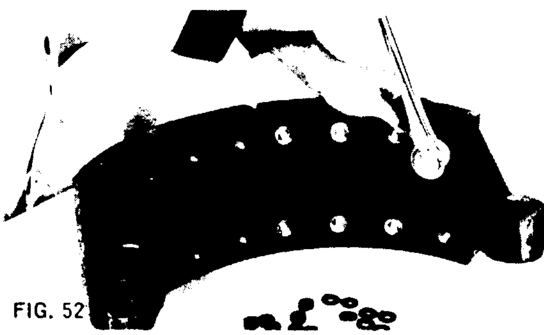


FIG. 52 TS-5675

Disassembly of Internal Gear and Hub

1. Drive bearing cone from hub (Fig. 53).

FIG. 53 TS-6193

2. If replacement of internal gear is necessary, cut lockwires and remove bolts securing internal gear to hub (Fig. 54). Separate internal gear from hub.

   NOTE: On some axle models, internal gears are secured to hubs with bolts inserted through drilled holes in internal gear and screwed into hub instead of as shown in Fig. 54.

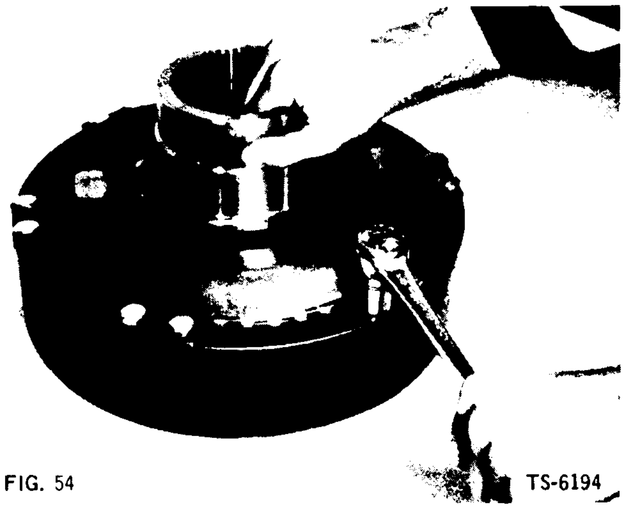


FIG. 54 TS-6194

Disassembly of Differential and Carrier

1. Mount differential on differential overhaul stand. Check and record ring gear backlash with dial indicator. This information is necessary for reassembly unless a new gear set is installed (Fig. 55).

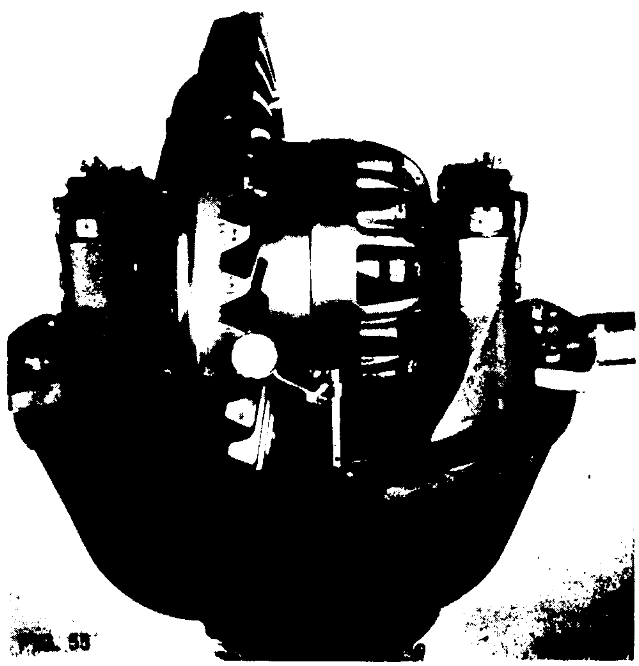


FIG. 55

2. If axle is not equipped with parking brake, companion flange nut should be loosened now to facilitate flange removal later. Position socket on flange nut and then install flange retainer tool with two spacers between tool and flange. Spacer dimensions are given in Fig. 30. Loosen flange nut (Fig. 56).

   NOTE: Standard 2 ⅝-inch socket will not fit flange nut because socket walls are too thick to enter flange. Machine socket as shown in Fig. 31 to provide proper clearance.

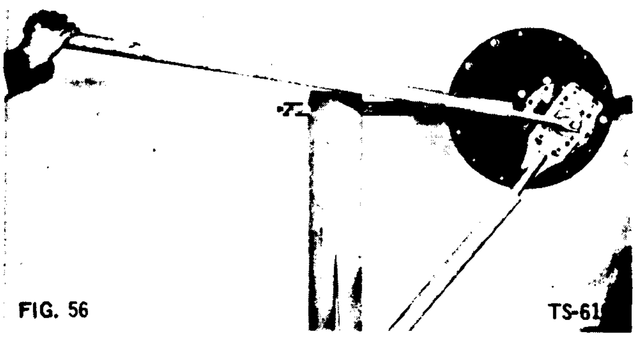


FIG. 56 TS-61

3. Remove lockwire and adjusting nut lock. Before removing bearing cap bolts, use center punch to matchmark bearing caps to carrier assembly. This is to insure correct match in reassembly (Fig. 57).

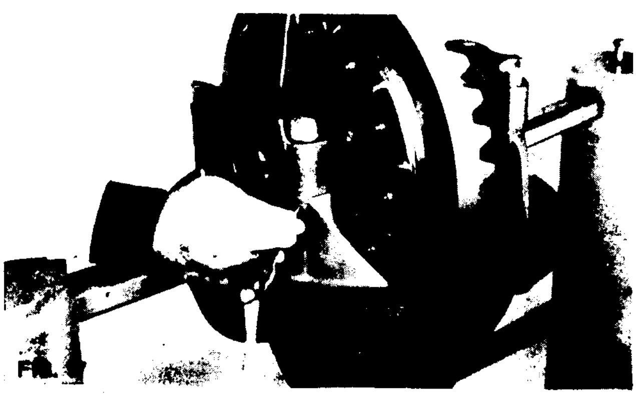


FIG.

4. Remove bearing cap bolts and bearing caps (Fig. 58).

FIG. 58 TS-619

5. Insert metal bar through differential to facilitate hoisting. Raise ends individually and remove adjusting nuts and bearing cups (Fig. 59).

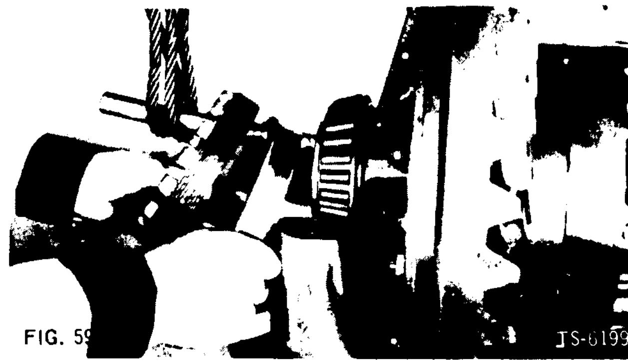


FIG. 5 TS-6199

6. Hoist differential with assembled bearing cones from carrier assembly (Fig. 60). Tilt differential to allow ring gear to pass web in differential carrier.

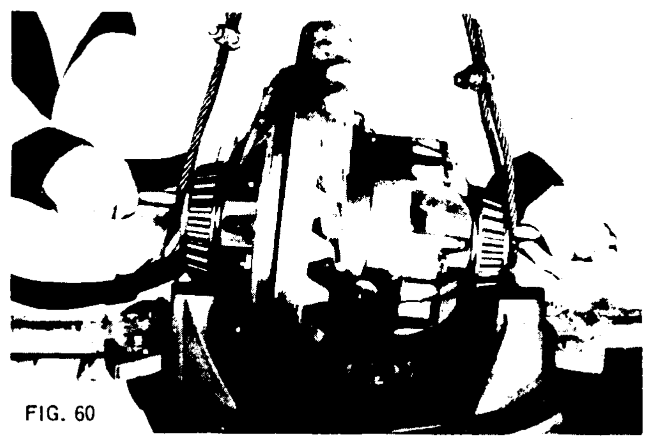
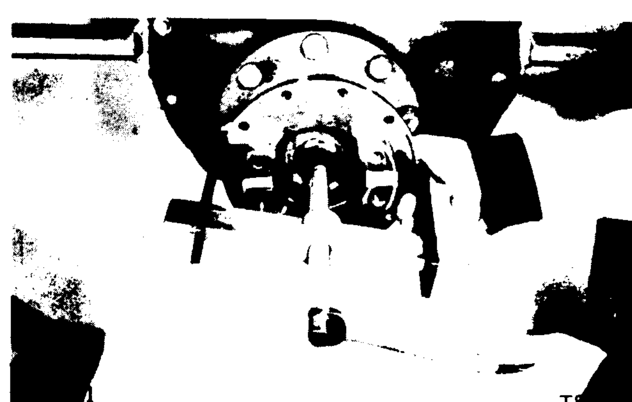


FIG. 60

7. If axle is not equipped with parking brake, remove shaft nut that was loosened as shown in Fig. 56. Remove washer. Remove companion flange from pinion shaft with puller (Fig. 61). If companion flange was removed to provide access to parking brake and reinstalled to facilitate handling differential, it can probably be removed by hand.



8. Remove bolts securing seal retainer to carrier and remove retainer (Fig. 62). If necessary, tap with soft mallet to break seal between parts.

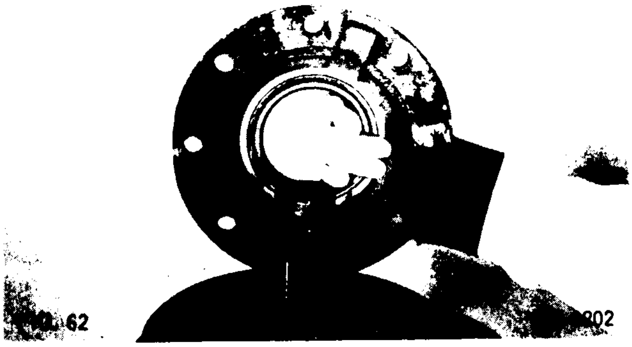


FIG. 62

9. Screw two bolts in puller holes and pull bearing cage from carrier assembly (Fig. 63). This pulls outer pinion bearing cone from shaft. Turn each bolt equally to prevent damage to carrier, shaft, or bearings. After bearing cage is pulled out a short distance, back off puller screws and insert .030" shim stock under puller screws before pulling is continued, to reduce possible damage to shim pack under flange of bearing cage.

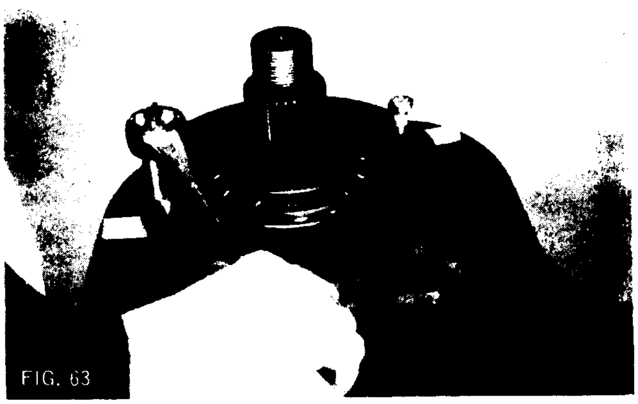


FIG. 63

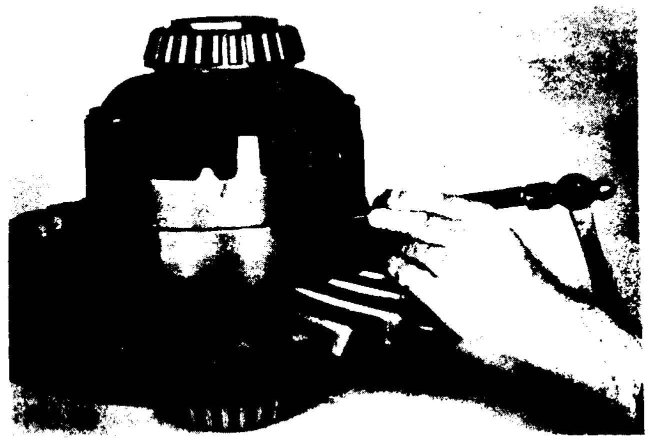
10. Remove pinion shaft assembly from carrier (Fig. 64). Remove bearing cage shims. Retain bearing cage shim pack intact for possible reuse in reassembly.

FIG. 64 TS-6204

Disassembly of Standard Differential

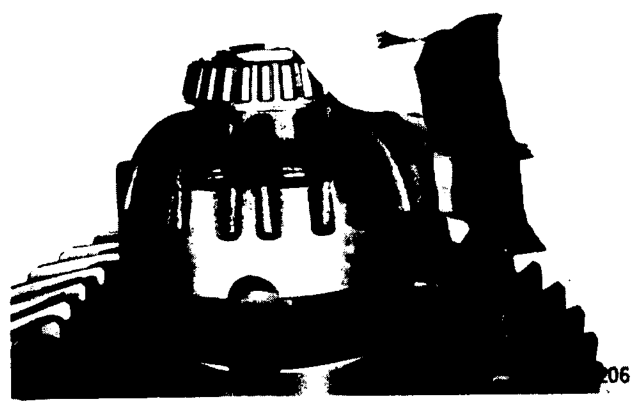
1. Match-mark case halves to insure correct reassembly (Fig. 65). Cut lockwires that secure differential case bolts.

   NOTE: If axle assembly is equipped with NoSPIN differential, proceed to Fig. 68 for special instructions.



2. Remove differential bolts securing case halves. Lift off plain case half (Fig. 66). Use soft mallet if necessary to aid removal.

   NOTE: Some differential case halves are secured with bolts and self-locking nuts instead of bolts and lockwires.



3. Remove spider, pinions, and thrust washers (Fig. 67).

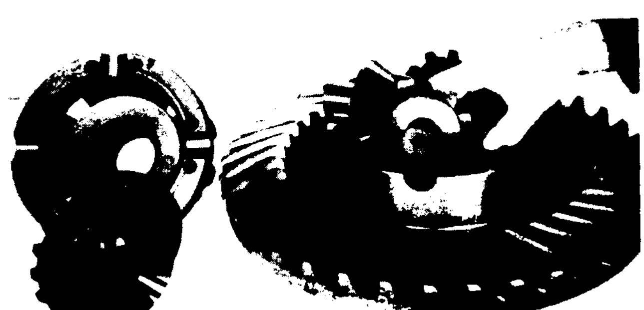


FIG. 67 TS-6207

Disassembly of NoSPIN Differential

1. Remove alternate differential case half bolts. Back off remaining bolts slowly and evenly, turning each a few turns at a time (Fig. 68). This will release spring load of NoSPIN unit.

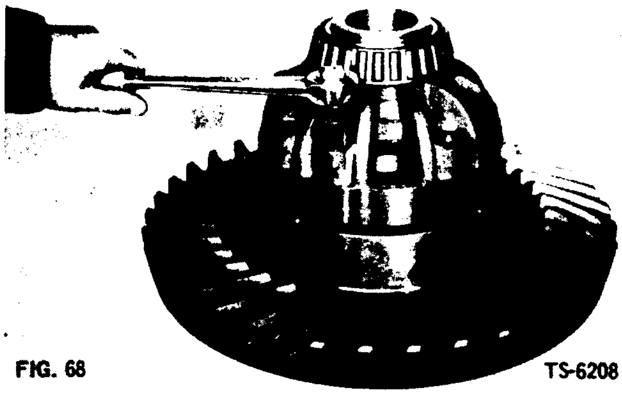


FIG. 68 TS-6208

2. Lift off differential case half to provide access to No-SPIN unit (Fig. 69).

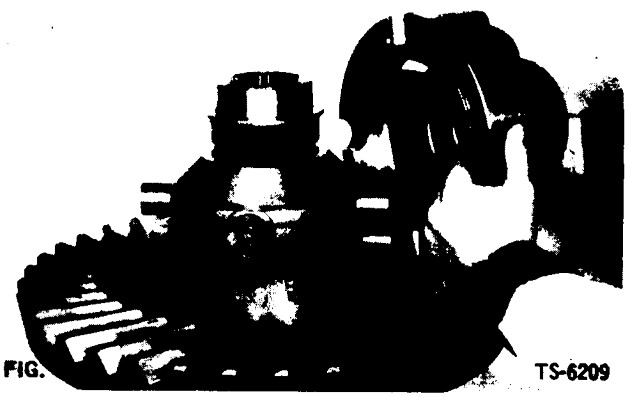
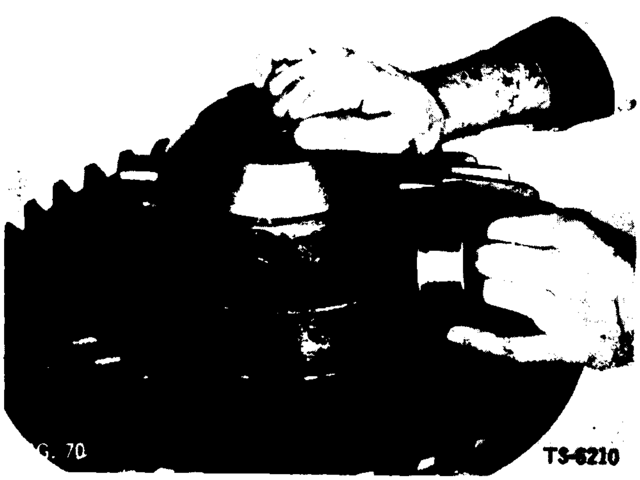


FIG. TS-6209

3. Remove side gear and spring from differential (Fig. 70).



G. 70 TS-6210

4. Remove assembled driven clutch, spring retainer, and holdout ring from differential (Fig. 71).

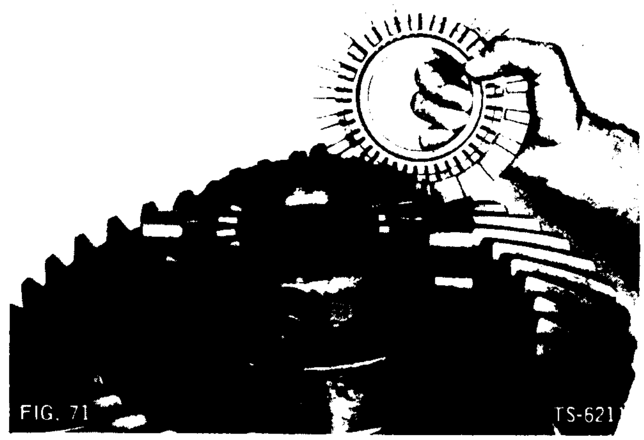
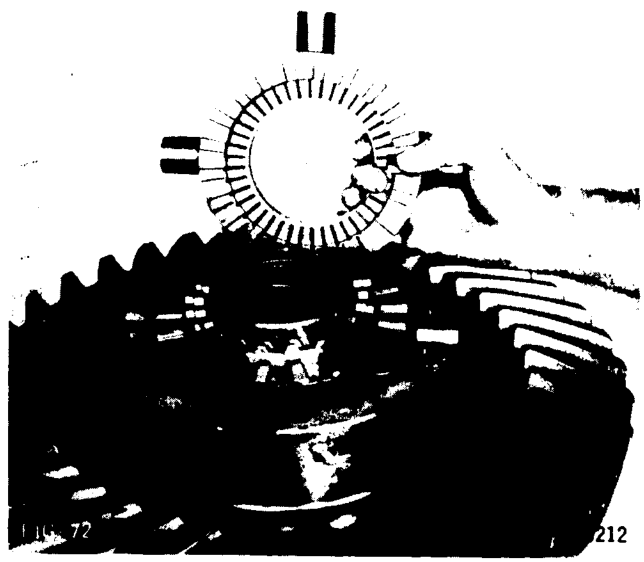


FIG. 71 TS-621

5. Remove spider from differential (Fig. 72).



72 212

6. Remove lower assembled driven clutch, spring retainer, and holdout ring from differential (Fig. 73).

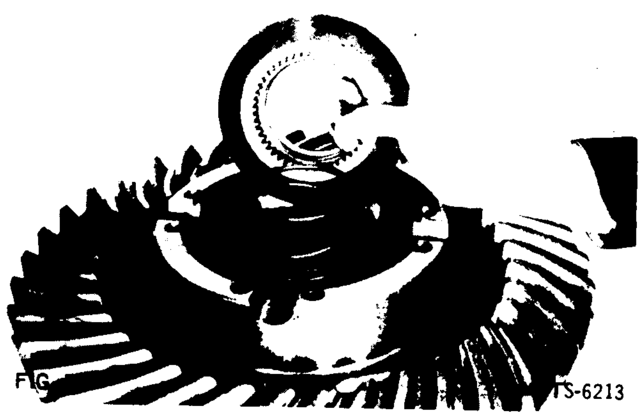


FIG S-6213

7. Remove lower spring and side gear from differential case (Fig. 74).

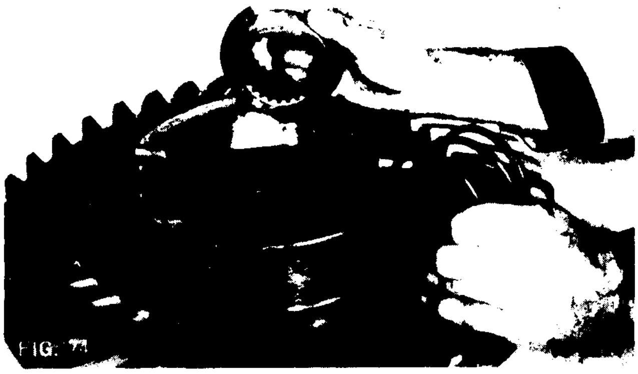


FIG. 74

8. Lift spring retainer from driven clutch (Fig. 75).

FIG. 75

9. Remove holdout ring, using expanding snap ring pliers (Fig. 76).

FIG. 76 TS-7683

10. If necessary to remove center cam from spider, use three small screwdrivers or tapered wedges to spread snap ring into spider (Fig. 77). Press center cam out through spider.

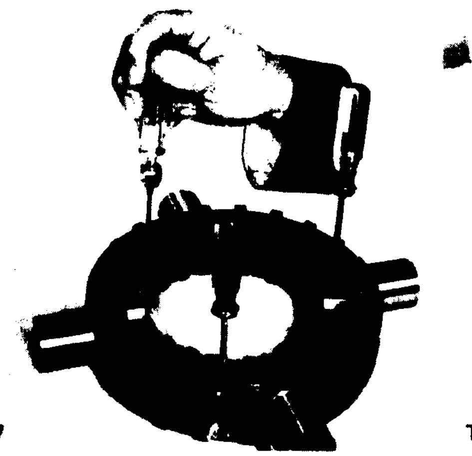


FIG. 77 TS-6112

11. Remove snap ring from spider (Fig. 78).

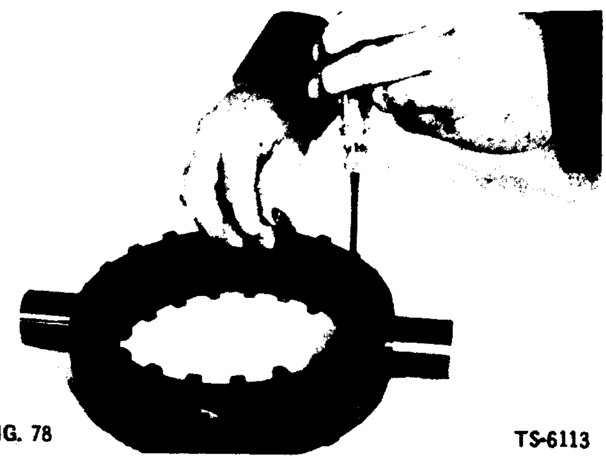


FIG. 78 TS-6113

Disassembly of Differential Case Parts

1. Remove nuts that secure ring gear to case half. Place case half and ring gear in press and apply light pressure to hold parts while removing nuts (Fig. 79).

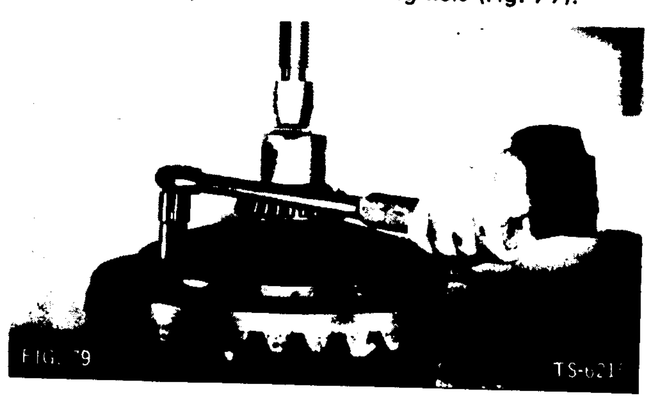


FIG. 79 TS-621

2. Use soft hammer to drive ring gear from case half (Fig. 80).

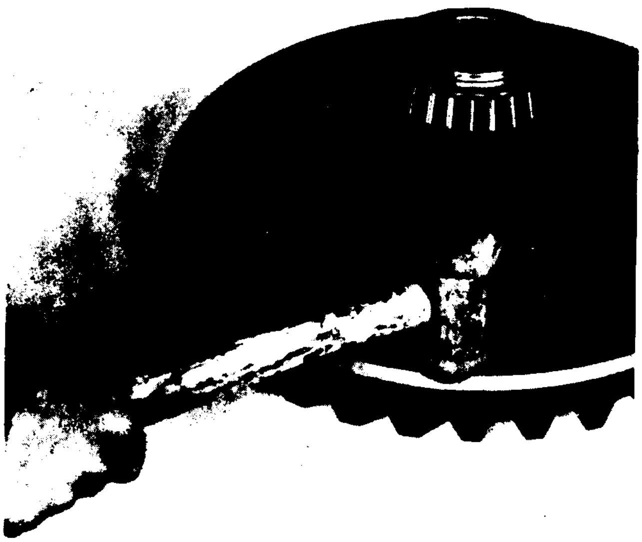


FIG. 80 TS-6216

3. If replacement is required, remove differential bearing cones with a suitable puller (Fig. 81).

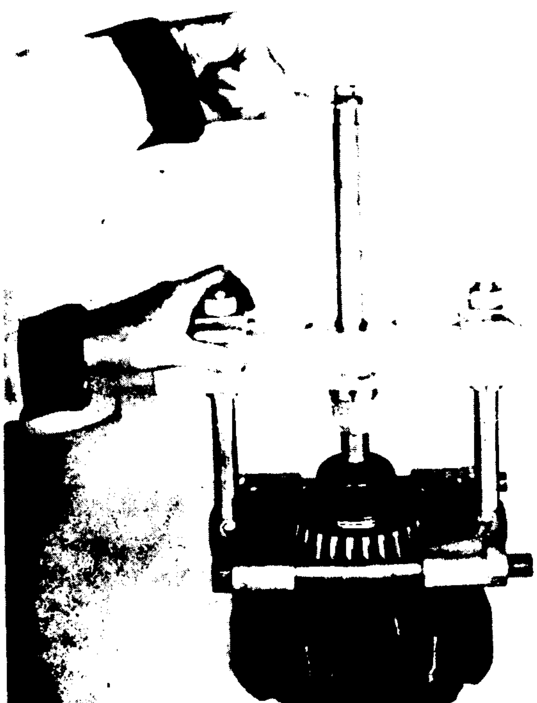


FIG. 81 TS-6217

Disassembly of Pinion Shaft Assembly

1. Press pinion shaft from pinion bearing cage assembly. This will release outer pinion bearing cone (Fig. 82).

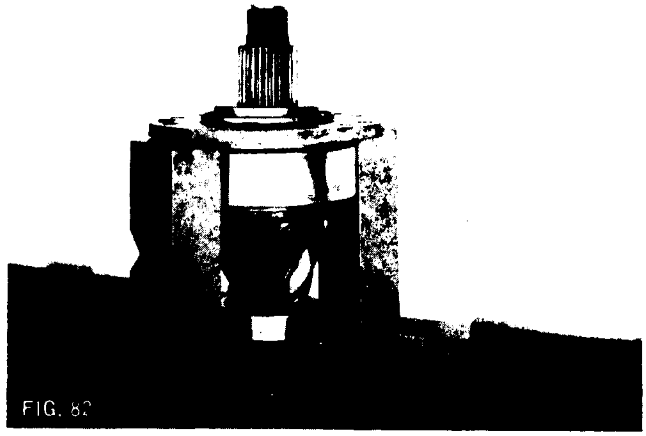


FIG. 82

2. Press center pinion bearing cone from pinion assembly (Fig. 83).

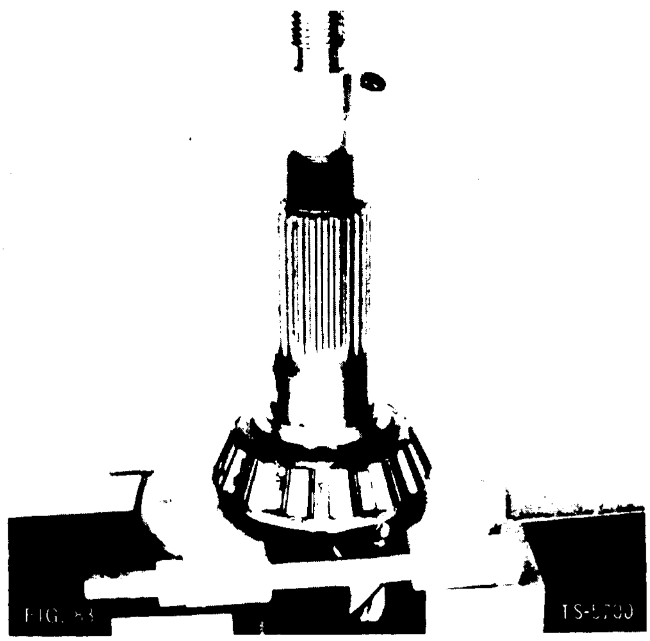


FIG. 83 TS-5700

3. Remove inner pinion bearing retaining ring (Fig. 84).

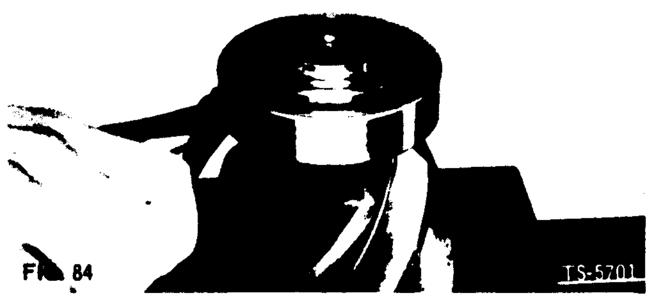
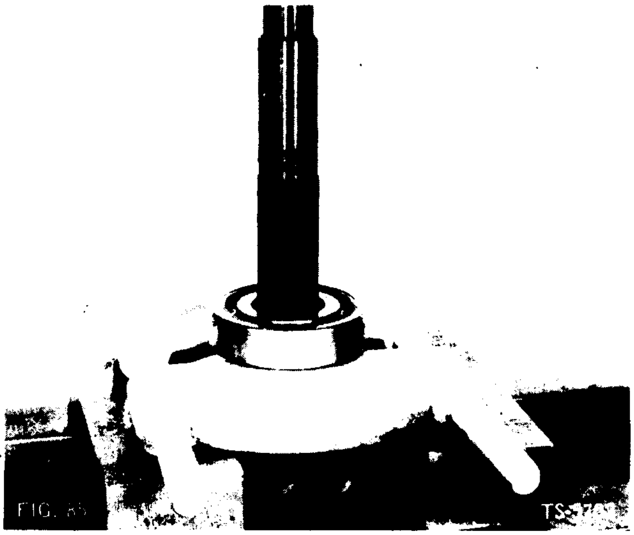


FIG. 84 TS-5701

4. Press inner bearing from pinion assembly (Fig. 85).



5. If worn or damaged, drive bearing cups from pinion bearing cage (Fig. 86).

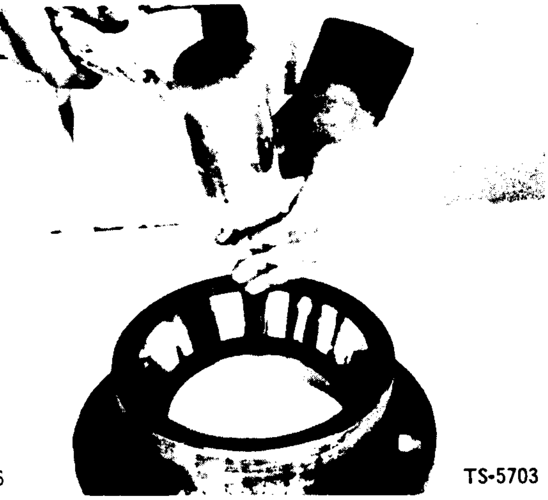


FIG. 86 TS-5703

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and slushed up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: *Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.*

Bearings

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

Housings

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: *Care should be exercised to avoid skin rashes and inhalation of vapors when using alkali cleaners.*

Thoroughly dry all parts cleaned immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or laping compound.

Brake Shoes and Brake Bands

Do not use solvents or cleaning fluids on brake shoes and linings. Thoroughly clean them with wire brush.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lintless cloth or paper to protect them until installed.

Oil Seals, Gaskets and Retaining Rings

Replacement of spring loaded oil seals, gaskets and snap rings is more economical when unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. At reassembly, lubricate lips of oil seals with Lubriplate.

Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth and ground and polished surfaces on all gears and shafts carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shafts are true. Differential pinions and side gears must be replaced as sets. Differential ring gear and bevel pinion must also be replaced as a set if either is damaged.

Housing and Covers

Inspect housing, covers and planet spider, and differential case to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures.

Service Brakes

Inspect anchor pins for wear or damage. If they are worn beyond dimensions indicated in Brake Wear Limits Chart, or if they are pitted, scored or deeply nicked, replace anchor pins.

Check brake shoe bushings for wear. If inside diameter exceeds dimensions indicated in Brake Wear Limits Chart, replace bushings.

Check cam roller for wear and distortion. If inner diameter is worn beyond dimensions indicated in Brake Wear Limits Chart, or if outer diameter has flat spot more than ¼ inch wide extending across roller, replace rollers.

Check cam roller pins for wear and corrosion. If worn beyond dimensions indicated in Brake Wear Limits Chart, or if pitted, scored, or deeply nicked, replace cam roller pins.

Inspect cam shafts for wear or corrosion of bearing surfaces. If worn beyond dimensions indicated in Brake Wear Limits Chart, or if bearing surfaces are pitted, scored, or deeply nicked, replace cam shafts.

Check brake linings for wear, cracks, and oil saturation. If linings are worn to within 1/16" of retaining bolts or otherwise damaged, replace brake linings.

Check cam shaft brake spider bushings and brake chamber bracket bushings for wear, cracks, distortion, or other damage. If inside diameter is worn beyond dimensions indicated in Brake Wear Limits Chart, replace bushings.

Inspect brake drums for cracks, heat checks, scoring, or other damage. Turn down on lathe if necessary. If drum diameter exceeds dimensions indicated in Brake Wear Limits Chart, replace drum.

Replace brake shoe return springs each time axle is overhauled.

BRAKE WEAR LIMITS CHART

ITEM	20x5 20x7	16½x6
Anchor Pins—O. D.	1.478"	1.228"
Brake Drum—Max. Rebore	20.250"	16.750"
Brake Shoe Bushings—I. D.	1.513"	1.263"
Camshaft Bushings—I. D.	1.526"	1.526"
Camshaft—O. D.	1.469"	1.469"
Cam Roller—I. D.	.895"	.770"
Cam Roller Pin—O. D.	.859"	.735"

Parking Brake

Inspect brake backing plate for distortion. Check that cam levers on backing plate swivel freely, but that mounting rivets are firmly seated in plate. Replace backing plate if damaged or if cam levers are loosely mounted.

Inspect brake linings for grease saturation, wear, or looseness. Replace if worn to less than 5/32 inch. Rivet new brake linings to shoes following sequence indicated in Fig. 87.

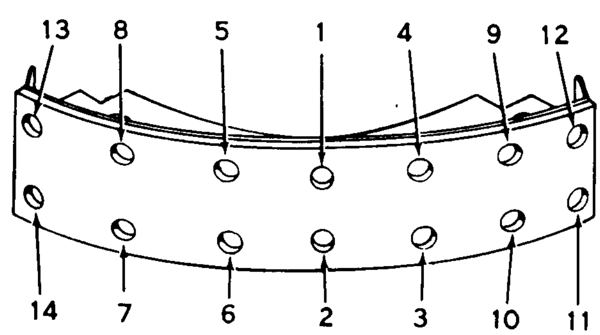


FIG. 87 TS-6219

Inspect brake drums for cracks, heat checks, scoring, or other damage. Turn down on lathe if necessary. If drum diameter exceeds 13.340 inches, replace drum.

NoSPIN Differential

Check splines on the side gear and driven clutch. Remove any burrs or small chipped edges with stone or burr grinder. If large sections of spline are broken away, replace part. Check side gear hub for fractures.

New springs will measure 4 1/4 inch or more in height. Old springs should not be less than 4 1/4 inch high.

Failure of hydrogen copper weld between cam and clutch member will result in erratic operation by alternately driving on one side only or driving both wheels with the NoSPIN locked. If weld failure has occurred, it will be possible to rotate cam ring in driven clutch member by lightly tapping cams.

Inspect driven clutch teeth on spider and driven clutches. Very slight chips can be touched up with a stone. If excessively chipped or rounded, these parts must be replaced. Compare shape of teeth with those on a new part. If a part is replaced due to chipped teeth, always replace the mating part as it may have invisible fractures.

Cams on the center cam and driven clutch must not be excessively chipped. A smooth wear pattern up to 50 percent face width is acceptable on clutch cams.

Holdout rings have a frictional resistance to rotation obtained by friction spring. Check for fractures or severe chipping of cams on this part.

Friction spring wear should not exceed .003 inch at points of contact. Compare with measurement at unworn portion. If extreme care is not exercised in removing this part, it may be damaged. Replace with new part if, after assembly, the holdout ring rotates easily. It should, however, be possible to rotate it by hand. Compare with a new part.

Center cam must be free to rotate within limits of keys in spider.

Check the spring retainers for fractures or spline damage.

Breathers

Wash breather on axle housing with solvent; shake dry. Make sure breather is not clogged.

REASSEMBLY OF AXLE

The following instructions describe the procedure to be followed when reassembling and installing components of axle. Instructions cover reassembly of only one side of axle. Reassembly of opposite group is identical unless otherwise noted.

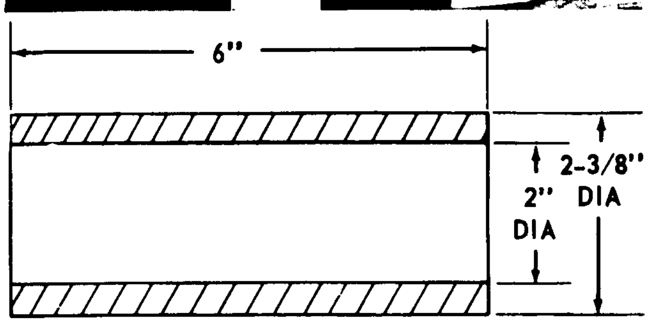
IMPORTANT: Both Grade 5 and Grade 8 fastening hardware have been used in the production of the axle assemblies covered by this manual. A table of proper torque values for both Grade 5 and Grade 8 hardware is provided at the rear of this manual. Grade of hardware may be determined by the "hash" marks contained on the head of each bolt; Grade 5 having three hash marks and Grade 8 having six hash marks as indicated below. In all cases except where specified in text, use torque value specified in table for applicable bolts.

GRADE 5

GRADE 8

Reassembly of Pinion Shaft

1. Press inner pinion bearing on pinion using steel tubing for driver (Fig. 88). Driver dimensions are given in Fig. 89.



1/32" DIA RADIUS ALL CORNERS

FIG. 89 TS-7684

2. Install inner pinion bearing retaining ring (Fig. 90).

3. Press center pinion bearing cone onto pinion shaft (Fig. 91). Bearing driver dimensions are given in Fig. 92.

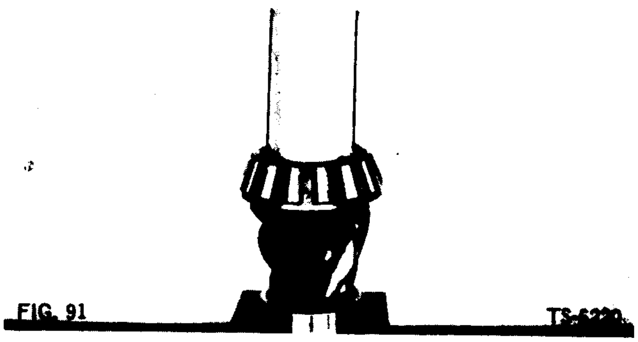


FIG. 91 TS-6220

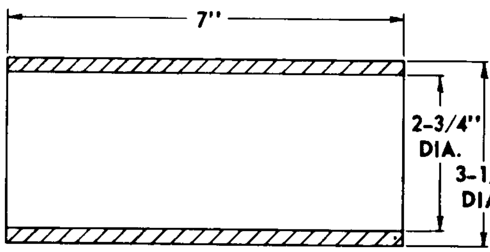
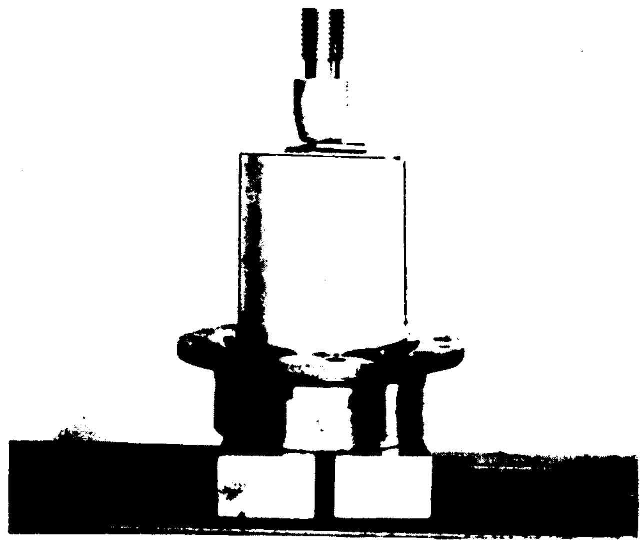


FIG. 92 1/32" DIA RADIUS ALL CORNERS TS-6221

4. A pinion bearing spacer and shim kit is provided for service repair of differential and carrier assemblies. This kit, consisting of a spacer and quantity of shims, is used to obtain proper pinion bearing preload as described below. Position bearing spacer and one .010" shim on pinion shaft (Fig. 93).

93 TS-5707

5. Press bearing cups into pinion bearing cage (Fig. 94). Bearing driver dimensions are shown in Figs. 95 and 96.



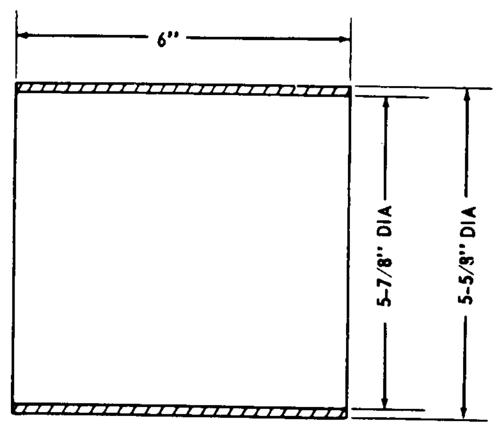


FIG. 95 1/32" DIA RADIUS ALL CORNERS TS-6284

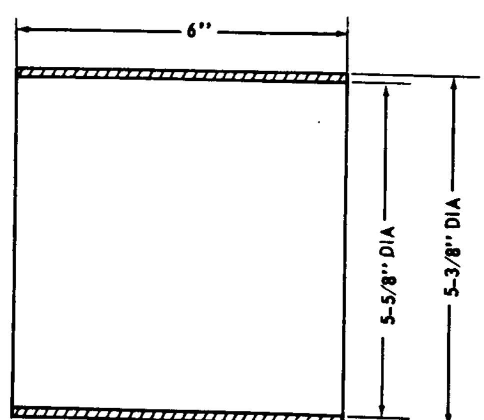


FIG. 96 1/32" DIA RADIUS ALL CORNERS TS-6222

6. Position pinion bearing cage assembly on pinion shaft. Position outer pinion bearing cone on pinion shaft and press into place using steel tubing for driver (Fig. 97). Driver dimensions are shown in Fig. 92.

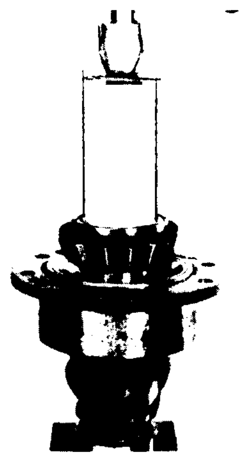


FIG. 97 TS-5711

7. Keep pinion and cage assembly in press with approximately 500 pounds of press pressure exerted on driver. Wrap several turns of soft wire or cord around pinion cage and pull in horizontal line with spring scale. While pulling in straight line, (90 degrees from centerline of shaft), read spring scale and measure rotating torque (Fig. 98). Multiply reading on spring scale by one-half diameter of bearing cage to obtain preload torque. Correct preload torque is 13 to 23 in. lbs. If preload is not within these limits, remove shims to increase preload or add shims to decrease preload.

   NOTE: This is a preliminary check. Final bearing preload check must be made with pinion shaft and bearing cage assembly in differential carrier housing.

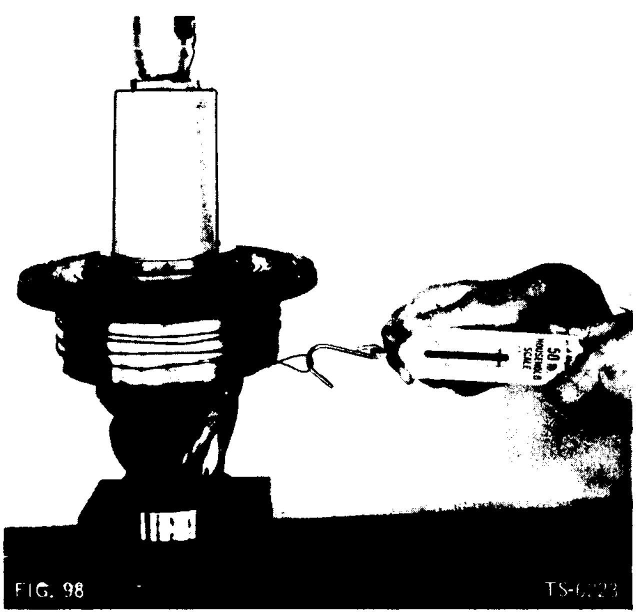


FIG. 98 TS-6223

Reassembly of Differential Ring Gear and Bearings

NOTE: Lubricate all differential bearings, gears, and thrust washers with SAE 90 EP lubricant, SCL type.

1. Press differential bearing cones on case halves (Fig. 99). Bearing driver dimensions are given in Fig. 100.

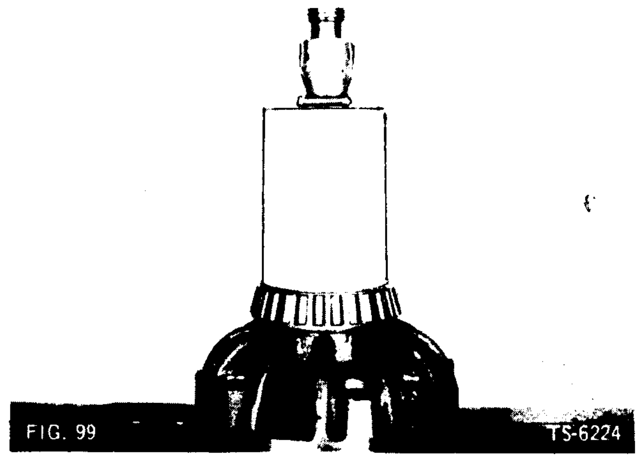
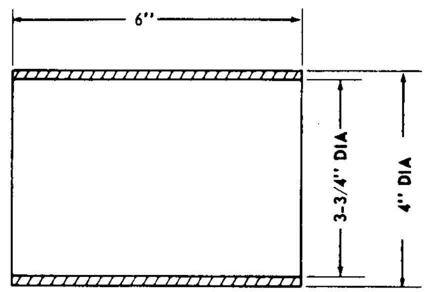


FIG. 99 TS-6224



1/32" DIA RADIUS ALL CORNERS

FIG. 100 TS-6225

2. Check ring gear mounting surface of flanged half of differential case for burrs. Remove burrs with file (Fig. 101).

FIG. 1 TS-6226

3. Install ring gear. Install bolts so internal diameter of ring gear prevents turning of hex head. Install ring gear bolt nuts and torque to 120 to 135 ft. lbs. Position ring gear and flanged hub in press and apply light press pressure to facilitate torquing nuts (Fig. 102).

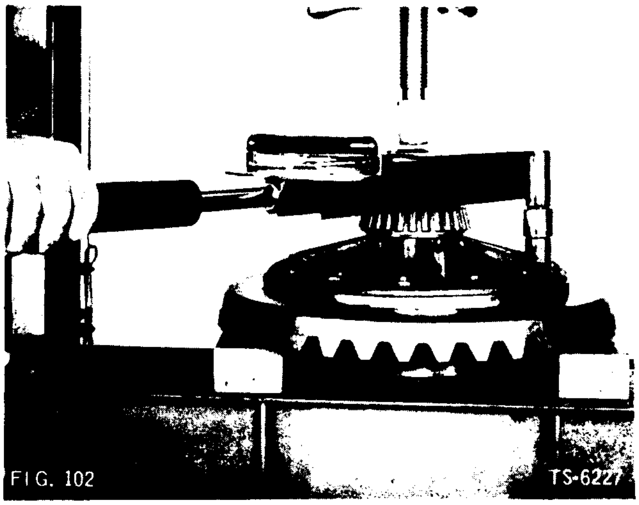


FIG. 102 TS-6227

NOTE: Axle Part Nos. 130788, 131507, and 190010 are equipped with NoSPIN differentials. Refer to Figs. 107 through 118 for reassembly instructions.

Reassembly of Conventional Differential

1. Lubricate and install thrust washer and side gear in differential case and ring gear assembly (Fig. 103). Engage holes in thrust washer on dowels projecting from thrust washer bearing surface in differential case.

FIG. 103 TS-622[illegible]

2. Place pinions and thrust washers on differential spider, lubricate, and set in position on installed side gear.

   NOTE: It is very important that tang on each pinion thrust washer engages groove in case halves as shown by arrows in Fig. 104.

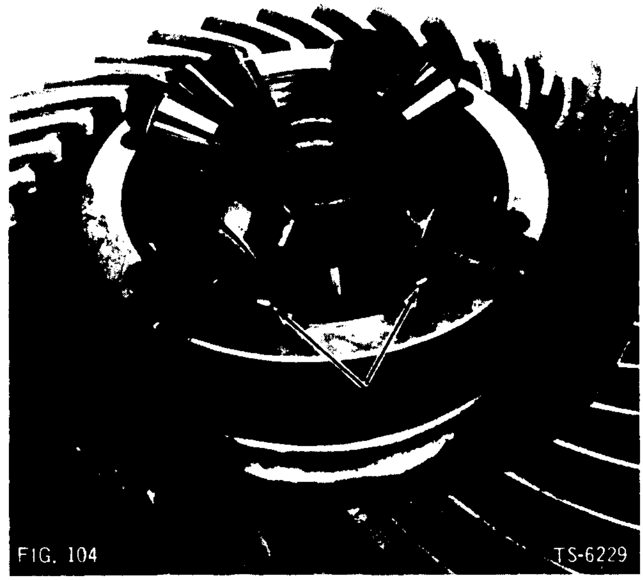


FIG. 104 TS-6229

3. Align match-marks and install remaining case half on other case half assembly, making sure of full gear engagement (Fig. 105). Install bolts and tighten to specified torque.

   NOTE: Some differential cases are held together with thru bolts and self-locking nuts instead of bolts in tapped holes. The bolt heads must extend from the ring gear side of the case assembly.

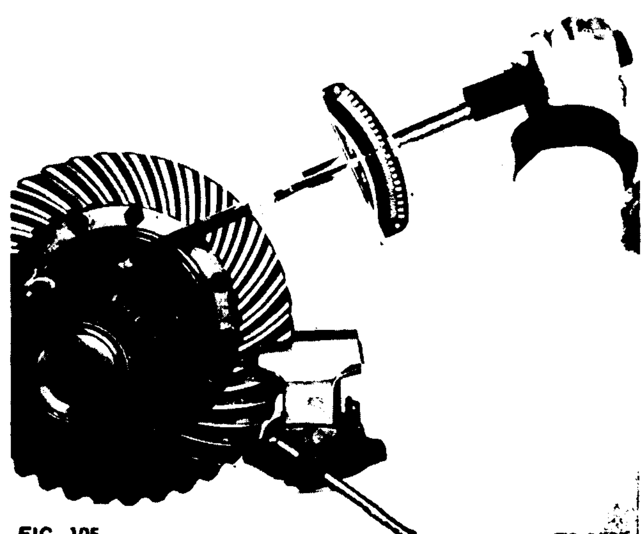


FIG. 105 **TS-62[illegible]**

4. Lockwire bolts in pairs (Fig. 106) on axles that use tapped differential case bolt holes.

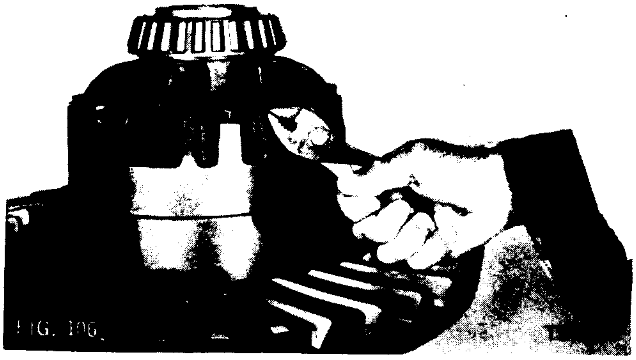


FIG. 106

Reassembly of NoSPIN Differential

NOTE: Lightly lubricate parts of NoSPIN differential during assembly. Special lubricants are not required for use with this differential.

1. Install snap ring in internal groove of spider (Fig. 107).

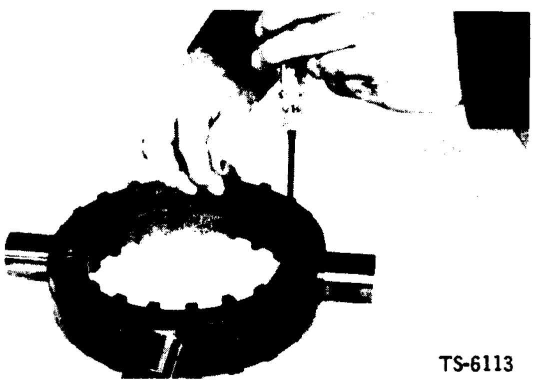


FIG. 107 TS-6113

2. Position center cam in spider. Spread snap ring while inserting center cam (Fig. 108). Make sure center cam ring groove is fully engaged by snap ring to retain center cam.

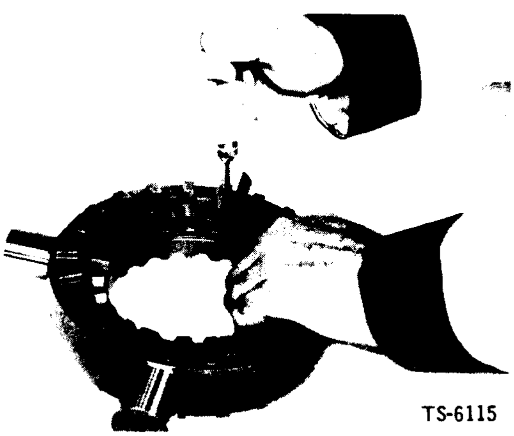


FIG. 108 TS-6115

3. Install holdout ring on drive clutch with snap ring pliers (Fig. 109).

FIG. 109 TS-6116

4. Install spring retainer in driven clutch (Fig. 110).

FIG. 110 TS-6109

5. Install side gear and spring in differential case half (Fig. 111).

FIG. 111 TS-6214

6. Position assembled driven clutch, holdout ring, and spring retainer on spring (Fig. 112).

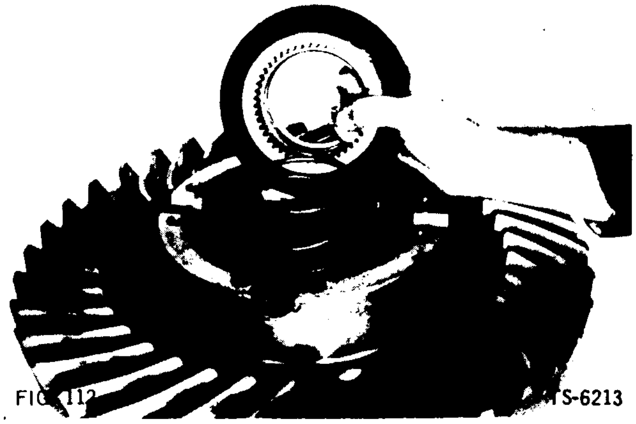


FIG. 112 TS-6213

7. Install assembled spider and center cam on driven clutch. Make sure that keys on spider engage keyways on driven clutch (Fig. 113).

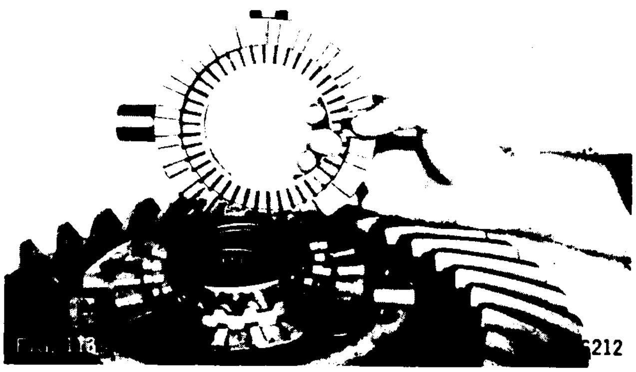


FIG. 113 TS-6212

8. Install the upper driven clutch, with its assembled holdout ring and spring retainer, on the spider. Make sure spider keys engage keyways in driven clutch (Fig. 114).

FIG. 114

9. Install spring and side gear on driven clutch (Fig. 115).

TS-6210

10. Position case half on differential (Fig. 116). Manually press on case half to compress springs to assure that case halves seat fully together. If they do not, splines in the NoSPIN parts are not properly aligned. Align parts and again check to make sure that case halves seat fully.

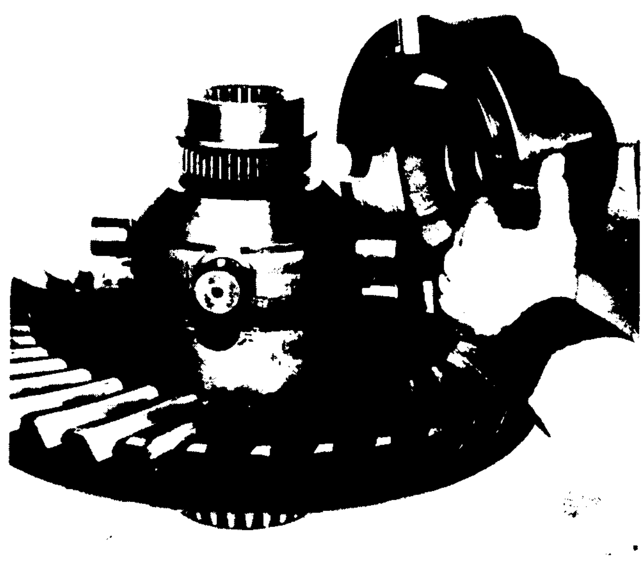


FIG. 116 TS-6209

11. Install four case bolts in alternate holes and tighten them evenly until all are seated, taking care that No-SPIN parts do not bind (Fig. 117). Install remaining bolts and tighten all bolts to specified torque as shown in Fig. 105.

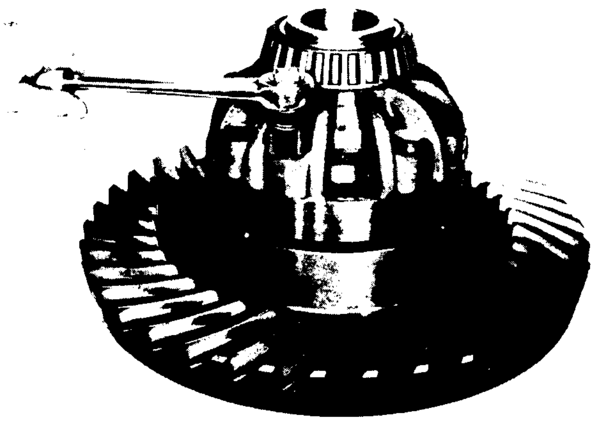


FIG. 117 TS-6208

12. After torquing bolts, insert axle shaft into differential so that it engages side gear and check for backlash between clutch teeth of NoSPIN differential (Fig. 118). A backlash of approximately 5/32 inch must be present. If proper backlash does not exist, disassemble differential case halves and recheck for correct assembly. After reassembly, torque case bolts and lockwire bolts in pairs as shown in Fig. 106.

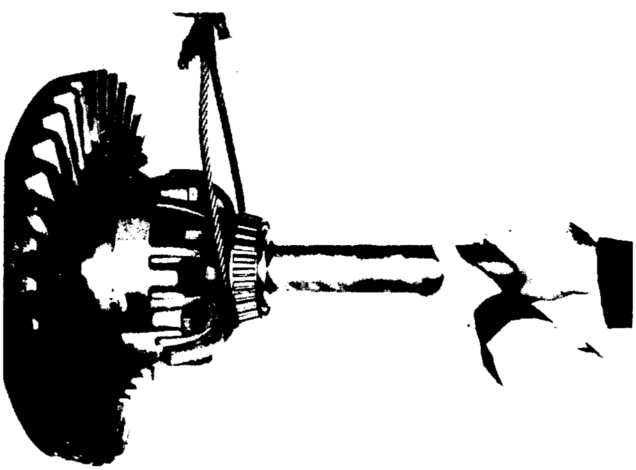
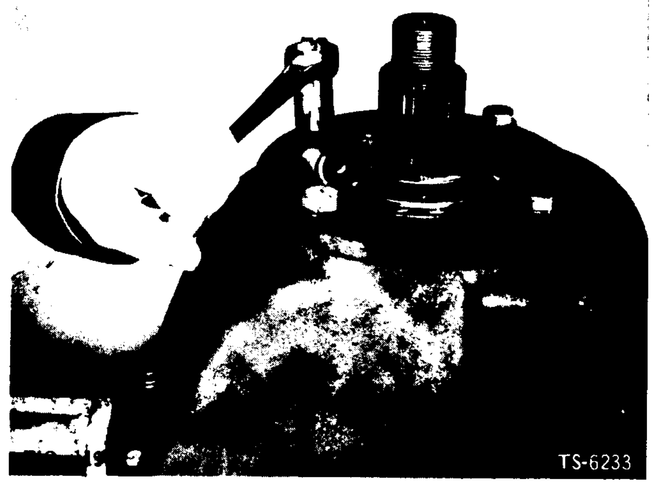


FIG. 118 TS-6232

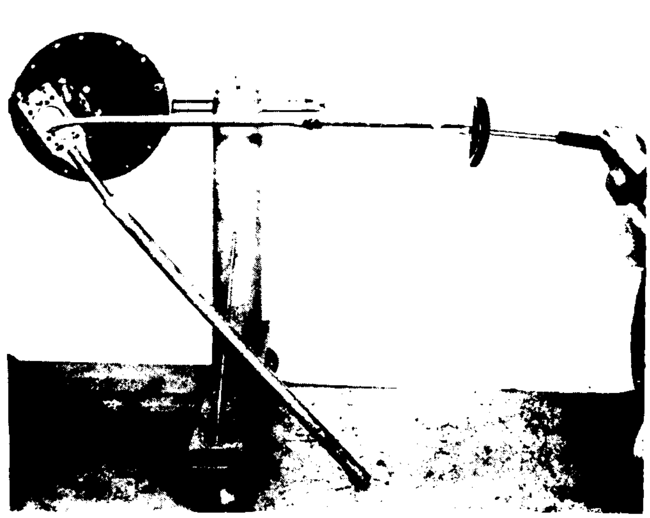
Reassembly of Differential and Carrier

1. Install bearing cage and pinion shaft assembly in differential carrier assembly, using original shim pack or its equivalent thickness. Use four pinion oil seal retainer bolts with flat washers to pull pinion shaft assembly fully into carrier assembly (Fig. 119). Make sure oil passages are aligned.

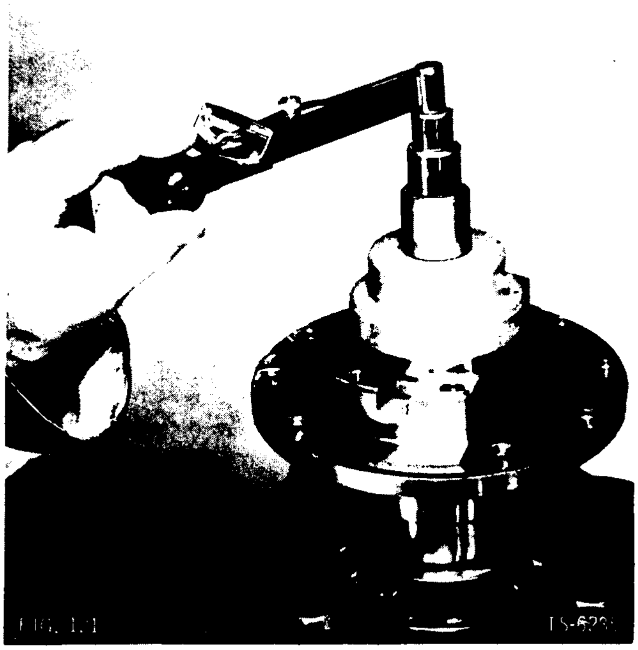
NOTE: Some differential carrier housings have blind tapped holes for mounting pinion shaft assembly. If holes are blind, use stacks of flat washers on bolts when installing pinion shaft assembly without oil seal retainer to prevent bolts from bottoming in blind holes.



2. Temporarily install companion flange on end of pinion shaft without installing pinion oil seal retainer. Install companion flange retaining tool on companion flange using spacers shown in Fig. 30 and socket shown in Fig. 31. Torque companion flange nut to 600 ft. lbs. (Fig. 120).



3. Use "inch-pound" torque wrench to check bearing preload (Fig. 121). If bearing preload is not between 13 and 23 in. lbs., disassemble parts and add shims to decrease preload or remove shims to increase preload.



4. Position differential carrier and pinion assembly in differential stand so that pinion shaft is down. Insert bar through differential to facilitate hoisting. Position differential into carrier, tilting it so that ring gear will clear inner bearing boss in carrier (Fig. 122).

NOTE: If differential bearing cones are replaced it is also necessary to replace differential bearing cups.

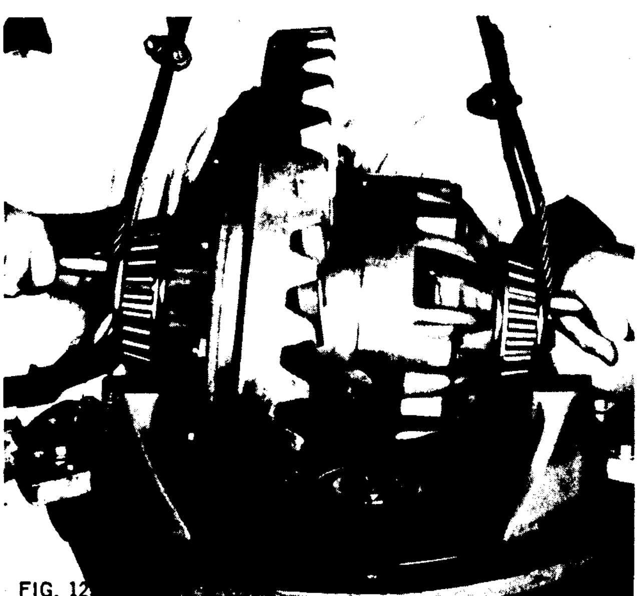
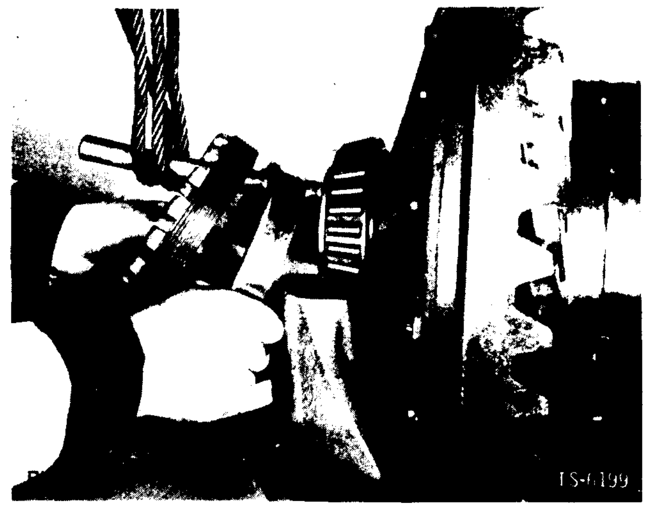


FIG. 12

5. Position differential bearing cup and differential adjusting nut on lifting bar on one side of differential and lift bar slightly with hoist. Position bearing cup and adjusting nut on carrier (Fig. 123). Repeat procedure to install opposite bearing cup and adjusting nut. Take care to prevent cross-threading of nuts.

NOTE: If differential bearing cones are replaced, new bearing cups must be used.



TS-6199

6. Position bearing caps on bearings and nuts, making sure match-marks made during disassembly are properly aligned. Install bearing cap bolts (Fig. 124) and tighten until snug, but do not torque. Rotate adjusting nuts from time to time to assure that they are not cross-threaded.

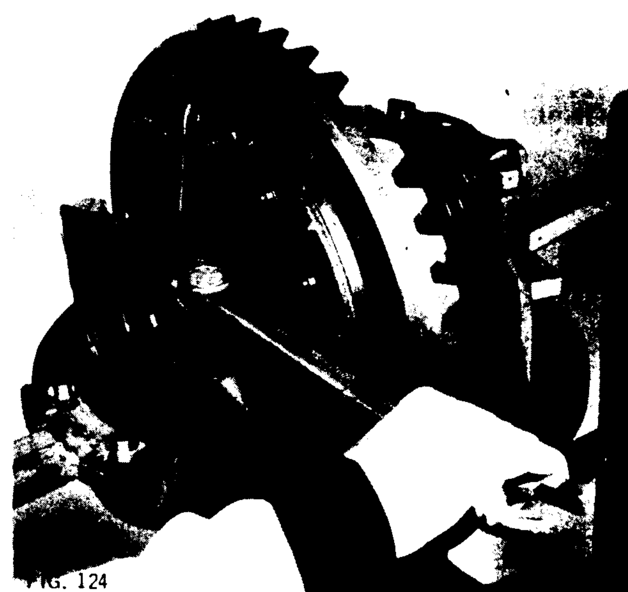


FIG. 124

7. Tighten bearing adjusting nuts to adjust bearings to zero end play (Fig. 125). This condition may be checked with screwdriver as shown (Fig. 126). All bearing rollers must rotate as ring gear rotates, but it should not be possible to move bearing rollers sideways in cage when prying against them with screwdriver.

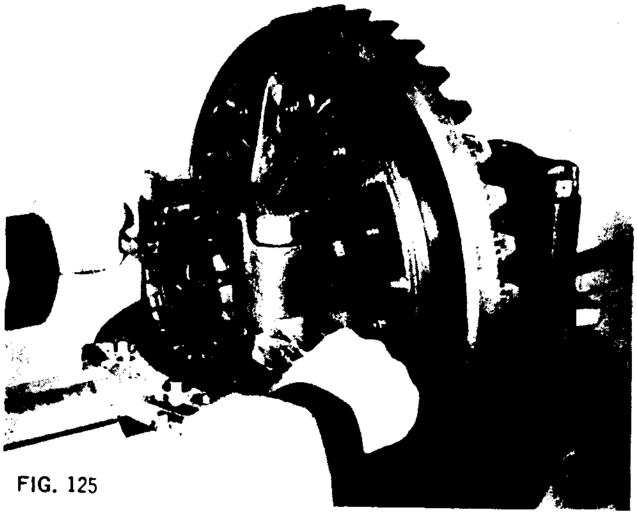


FIG. 125

FIG. 126

8. Use a dial indicator to check backlash between ring gear and pinion shaft gear. Backlash is adjusted by moving ring gear toward or away from pinion shaft gear as shown in Fig. 127. Move ring gear by loosening one adjusting nut and tightening opposite lock nut. When loosening one lock nut and tightening opposite, move each lock nut same distance so that bearing adjustment made in previous paragraph is not disturbed. Adjust position until gear backlash is between .010" and .014" if new gear set is used, or adjust to backlash noted at disassembly for old gears.

FIG. 127 TS-6239

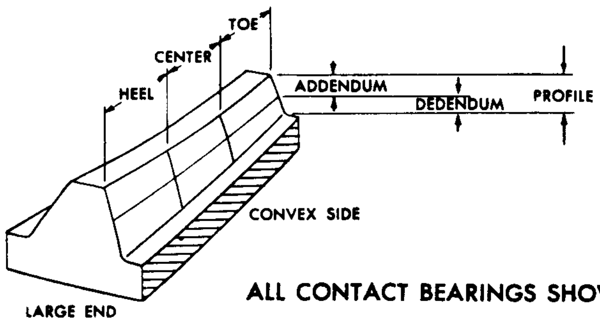
9. Check ring and pinion gear for proper tooth contact. Paint ring gear with a mixture of red lead and linseed oil (Fig. 128). When ring and pinion gears are rotated, the red lead is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts. As a rule, painting about 10 or 12 teeth is sufficient for checking purposes.

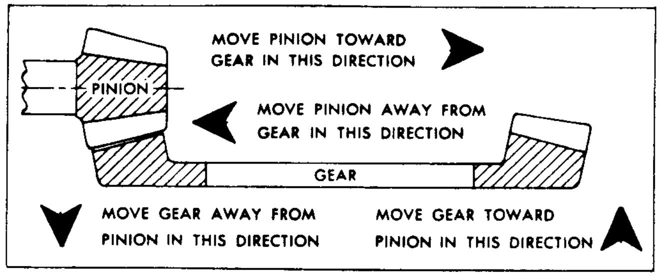
FIG. 128 TS-6240

Sharper impressions may be obtained by applying a small amount of resistance to the ring gear with a flat steel bar and using a wrench to rotate the pinion. Gears should be rotated, under slight load, until ring gear has turned at least one revolution in both directions.

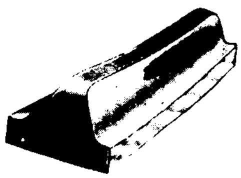
Check tooth contact pattern on drive side (convex side) of ring gear teeth. Coast side will automatically correct when drive side pattern is correct. Refer to gear tooth contact chart (Fig. 129). If proper tooth contact pattern is not as shown, readjust backlash or add to or subtract from shim pack between bearing cage flange and differential housing. Addition of or subtraction of shims should be made in small increments until proper contact is established. Split shims are provided to permit removal or insertion between bearing cage and differential housing.

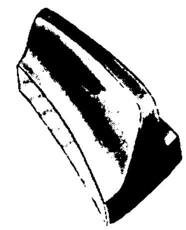
SPIRAL BEVEL AND HYPOID TOOTH BEARING CONTACT CHART





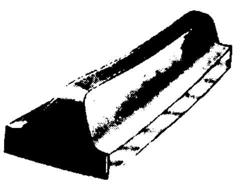
ALL CONTACT BEARINGS SHOWN BELOW ARE ON RIGHT HAND SPIRAL RING GEAR – THE DRIVE IS ON THE CONVEX SIDE OF THE TOOTH.

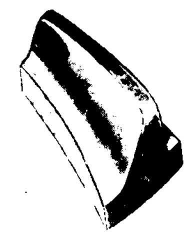




CONDITION 1

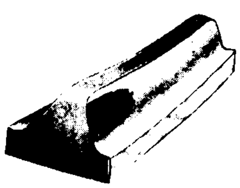
TYPICAL PREFERRED BEARING ON BOTH SIDES OF TOOTH WHILE UNDER A LIGHT LOAD

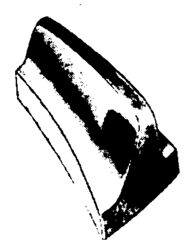




CONDITION 2

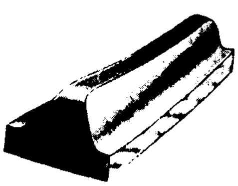
TOE BEARING ON BOTH SIDES OF TOOTH-GEAR SET NOISY. TO MOVE BEARING TOWARD HEEL INCREASE BACKLASH WITHIN LIMITS BY MOVING GEAR AWAY FROM PINION.

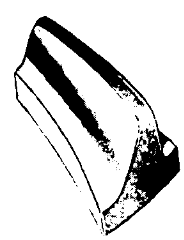




CONDITION 3

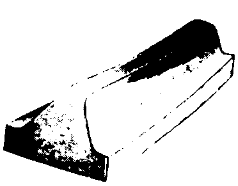
HEEL BEARING ON BOTH SIDES OF TOOTH-GEAR SET NOISY AND COULD RESULT IN EARLY GEAR FAILURE. TO MOVE BEARING TOWARD TOE DECREASE BACKLASH WITHIN LIMITS BY MOVING GEAR TOWARD PINION.

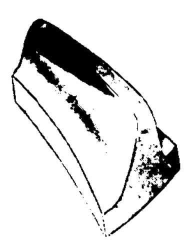




CONDITION 4

LOW BEARING ON GEAR AND HIGH BEARING ON PINION. CORRECT BY PULLING PINION AWAY FROM GEAR. INCREASE MOUNTING DISTANCE BY ADDING SHIMS BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.





CONDITION 5

HIGH BEARING ON GEAR AND LOW BEARING ON PINION. CORRECT BY MOVING PINION IN TOWARD GEAR. DECREASE MOUNTING DISTANCE BY REMOVING SHIMS FROM BETWEEN BEARING CAGE AND DIFFERENTIAL HOUSING.

BACKLASH

BACKLASH SHOULD BE MEASURED WITH A DIAL INDICATOR RIGIDLY MOUNTED WITH THE STEM PERPENDICULAR TO THE TOOTH SURFACE AT THE EXTREME HEEL.

FIG. 129

TS-5574

10. Tighten bearing cap bolts to specified torque (Fig. 130). With dial indicator, recheck ring gear and pinion backlash. Recheck differential bearings for end play as described in step 4.

FIG. 130

11. Use dial indicator to check back face of ring gear. Rotate at least one full turn (Fig. 131). Runout must not exceed .005 total indicator reading. If runout is excessive, remove assembly and check for burrs or dirt under mounting surface of ring gear. Reassemble and recheck.

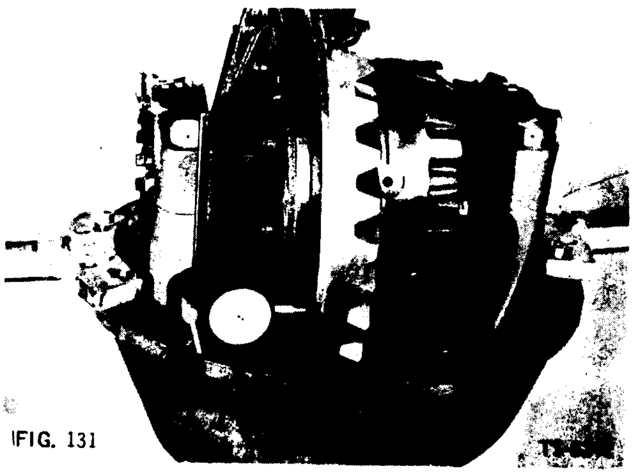


FIG. 131

12. Install adjusting nut lock with bolt and lockwasher (Fig. 132).

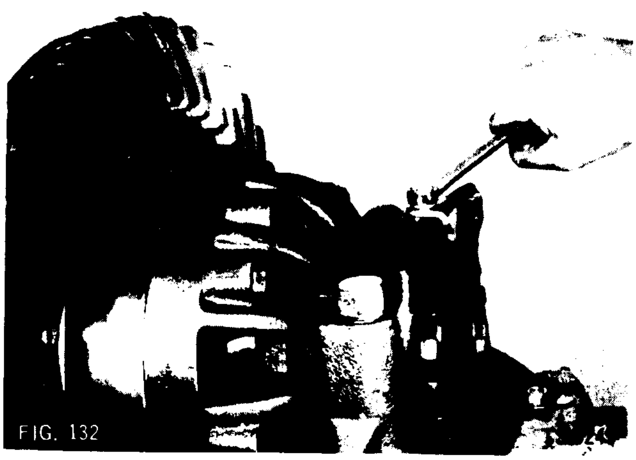


FIG. 132

13. Lockwire together the bearing cap bolts and adjusting nut bolt (Fig. 133).

FIG. 133

14. Remove companion flange and remove bolts and washers that were used for temporary installation of pinion shaft assembly. Coat outside diameter of seal with Permatex No. 2 and press into pinion oil seal retainer so that lip of seal will face toward pinion. Coat lip with Lubriplate. Install gasket and pinion oil seal retainer. Secure with 8 bolts and lockwashers and tighten bolts to specified torque (Fig. 134).

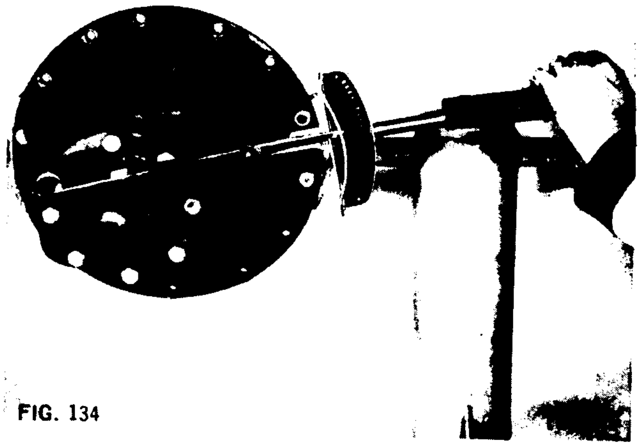


FIG. 134

15. On axle models that do not have a parking brake, install companion flange on end of pinion shaft with flat washer and nut. Torque nut to 600 ft. lbs. as shown in Fig. 120. Secure nut with cotter pin. On axle models with parking brake, companion flange should be installed temporarily to facilitate handling the differential.

Reassembly of Internal Gear and Hub

1. Position internal gear on hub, aligning matchmarks made at disassembly. Secure with bolts and locking plates and tighten to specified torque (Fig. 135). Lockwire bolts in pairs.

   NOTE: Some axles use bolts without locking plates, with bolts inserted through internal gear and threaded into hub.

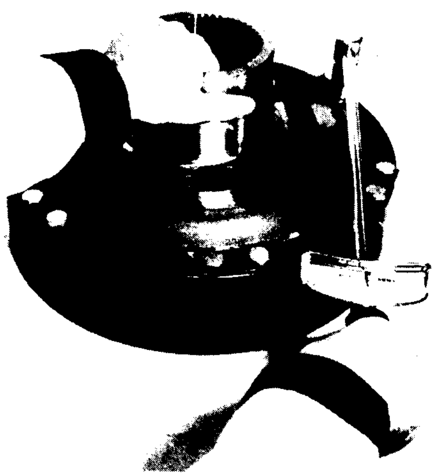


FIG. 135 TS-6246

2. Check that bearing seat on hub is free of nicks and burrs. Press bearing cone on internal gear and hub using bearing driver (Fig. 136). Bearing driver dimensions are given in Fig. 137.

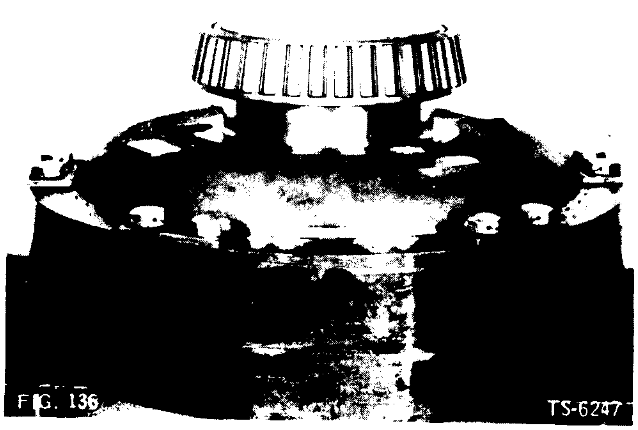
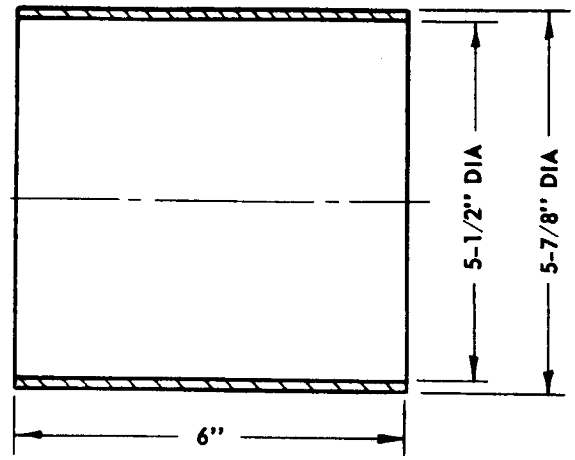


FIG. 136 TS-6247



1/32" DIA RADIUS ALL CORNERS

FIG. 137 TS-6248

Reassembly of Brake Shoes

1. Install brake linings on brake shoes with washers and nuts. Torque nuts to 200 to 220 in. lbs. (Fig. 138). Tighten nuts in sequence shown in Fig. 139.

FIG. 138 TS-5745

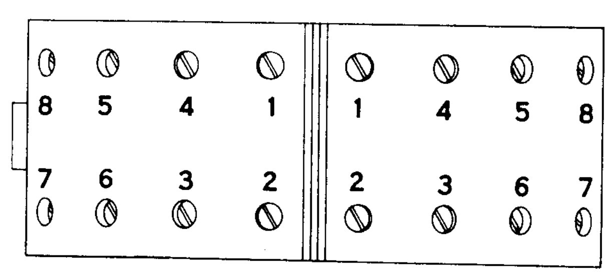


FIG. 139 TS-5746

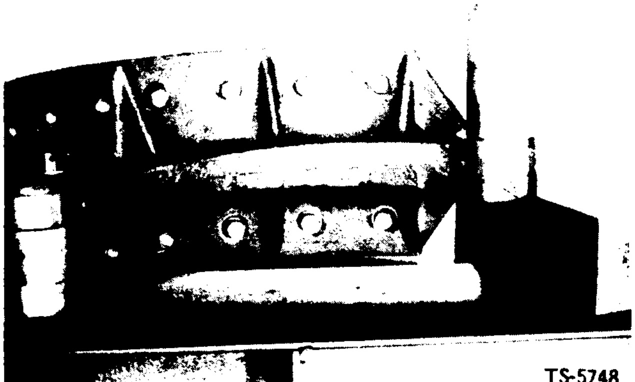
2. Tap brake lining plugs into brake lining bolt holes (Fig. 140).

FIG. 140 TS-6249

3. Position brake cam roller on brake shoe. Apply light coat of Never-Seez on brake cam roller pin and insert pin. Secure pin with cam roller pin lock pin and cotter pin (Fig. 141).

FIG. 141 TS-5747

4. Press brake shoe bushings into brake shoe (Fig. 142).



TS-5748

Reassembly of Hub and Drum Assembly

1. If wheel studs were removed, replace entire set of studs with new set. Install stud nuts and tighen to 200 ft. lbs. torque (Fig. 143).

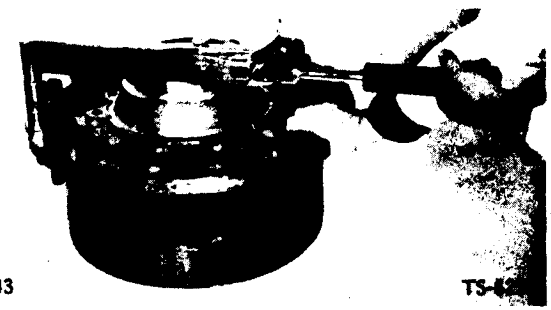


FIG. 143 TS-[illegible]

2. Check bearing bores in wheel hub to be sure all nicks and burrs have been removed from both bores and bearing seats. Install bearing cups in hub with wide diameter of taper toward outside of hub. Use bearing driver to drive cups into place (Fig. 144). Bearing driver dimensions are given in Fig. 145. Make sure bearings are fully seated.

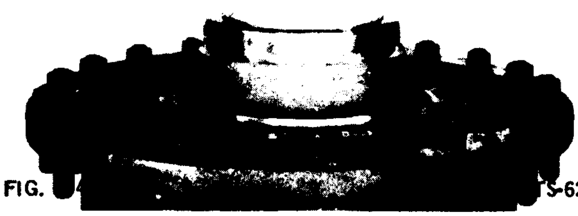
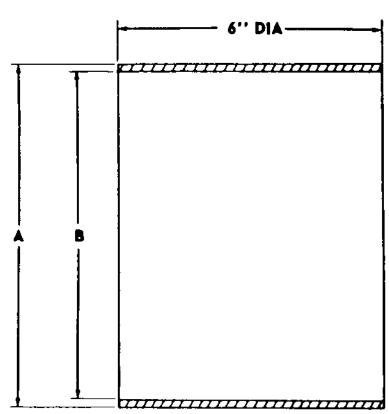


FIG. [illegible] TS-6251



	INNER CUP	OUTER CUP
A	6-1/2"	7-3/8"
B	6-1/4"	7"

1/32" DIA RADIUS ALL CORNERS

FIG. 145 TS-6252

3. Lubricate inner wheel hub bearing cone with gear oil and position in wheel hub bearing cup (Fig. 146).

FIG. 146 TS-6190

4. Coat outside diameter of oil seal with Permatex No. 2. Lubricate lip of seal with Lubriplate. Press or drive oil seal into hub using seal driver (Fig. 147). Fig. 148 shows driver dimensions. Spring-loaded lip of seal must face inward. Wipe off excessive Permatex after seating seal.

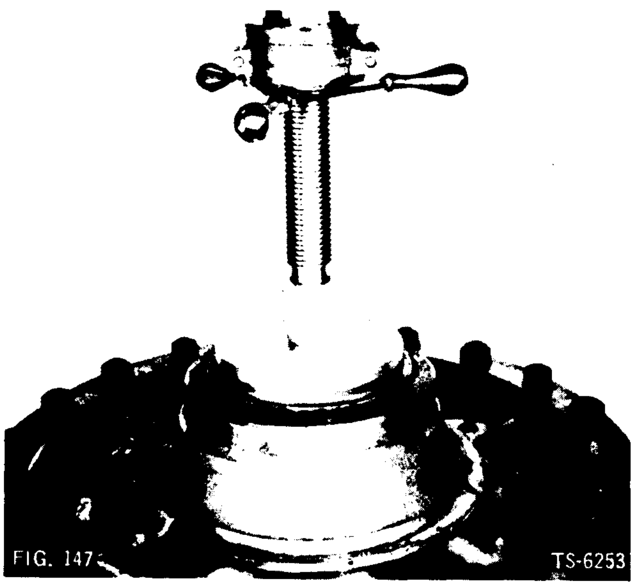


FIG. 147 TS-6253

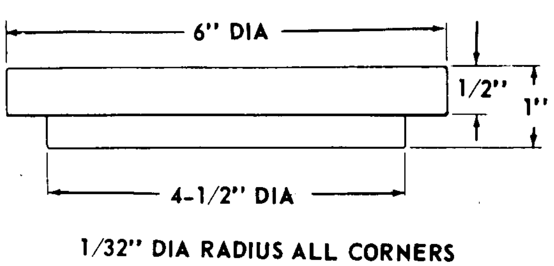


FIG. 148 TS-6254

5. Position oil catcher on hub (Fig. 149).

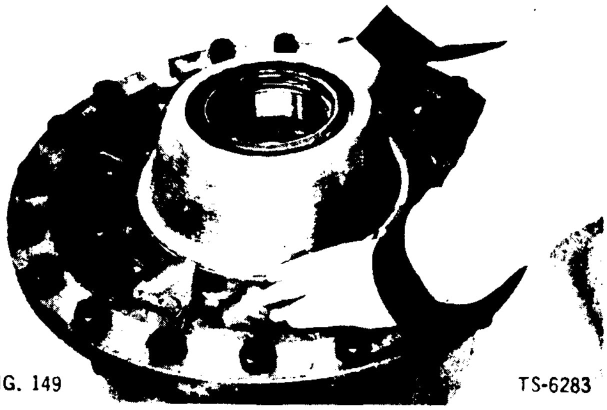


FIG. 149 TS-6283

6. Position brake drum on hub. Install bolts and flat washers. Tighten bolts to torque specifications (Fig. 150).

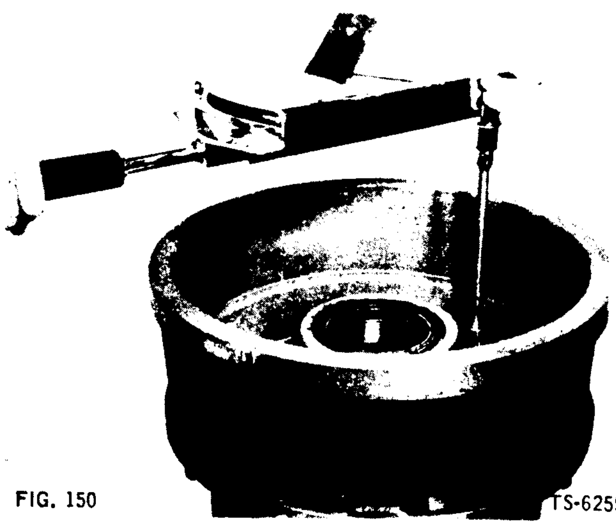


FIG. 150 TS-6255

7. Lock-wire bolts in pairs (Fig. 151).

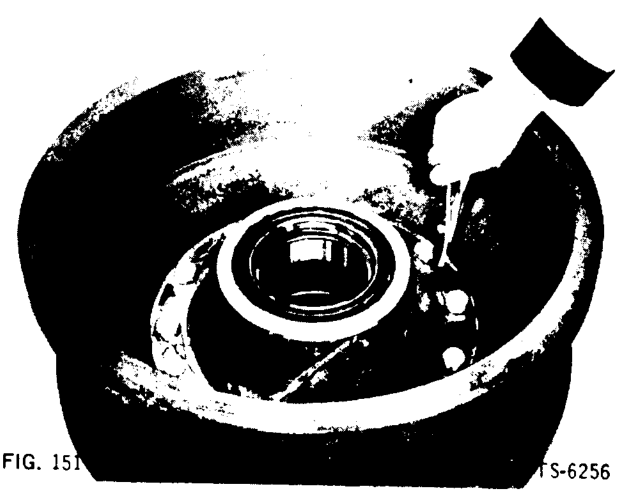


FIG. 151 TS-6256

Reassembly of Planet Carrier

1. Coat inside of planet pinion with chassis grease to retain pinion needle rollers. Each pinion contains a double row of needle rollers, with a spacer between rows. Install a row of 28 rollers, roller spacer and another row of 28 rollers in each pinion (Fig. 152).

FIG. 152 TS-6257

2. Position assembled pinion and two pinion thrust washers in planet carrier, making sure tangs on thrust washer engage the grooves in the spider (Fig. 153).

FIG. 15 TS-6186

3. Press in pinion shaft, making sure the pinion shaft ball recess aligns with groove in spider. Insert pinion shaft ball and complete press (Fig. 154). Press end of pinion shaft flush with face of carrier.

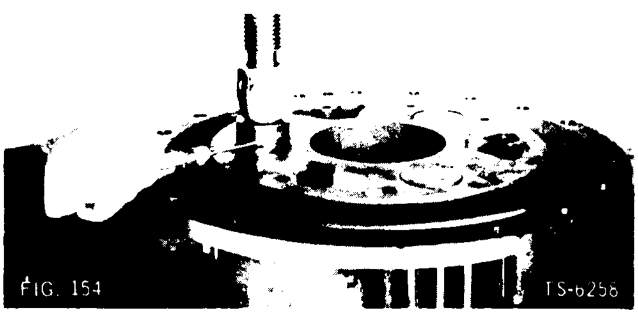


FIG. 154 TS-6258

4. Stake pinion shaft ball groove in two places to retain shaft (Fig. 155).

FIG. 155 TS-6259

Reassembly of Axle Parts

1. Coat both sides of differential gasket lightly with gasket sealer and position carefully on axle housing (Fig. 156).

FIG. 156

2. Position differential carrier on axle housing (Fig. 157).

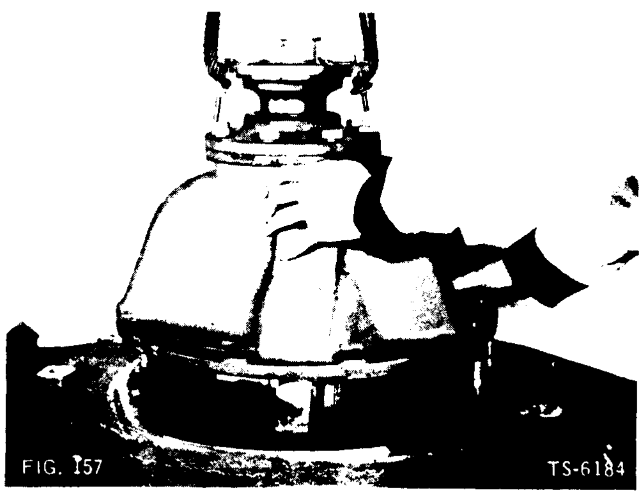


FIG. 157 TS-6184

3. Secure differential carrier to axle housing with bolts, nuts, washers, and tapered dowels (Fig. 158). Tighten nuts on the four studs first, then tighten all bolts evenly until they are snug. Tighten all nuts and bolts to specified torque.

   NOTE: Some axles use bolts of several different lengths without nuts and dowels. Determine length of bolt required by checking thickness of differential carrier flange and depth of mounting holes. Select correct bolt for each position.

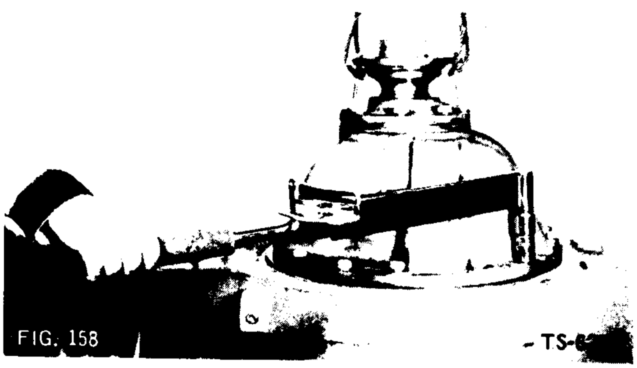
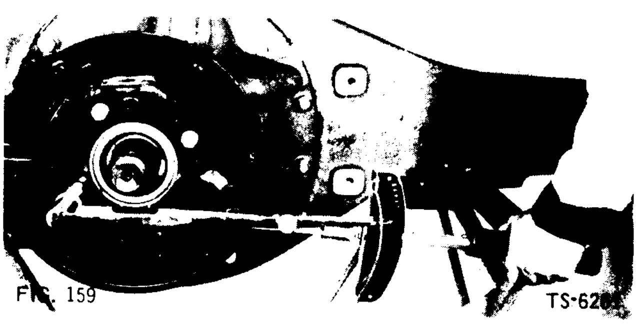


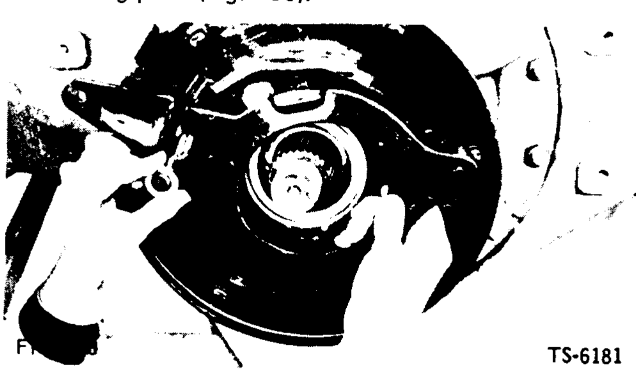
FIG. 158 — TS-6

4. On axles which incorporate a parking brake, remove companion flange which was temporarily installed to facilitate hoisting differential. Position parking brake backing plate on differential and carrier assembly and secure with four bolts and lockwashers. Tighten bolts to specified torque (Fig. 159).



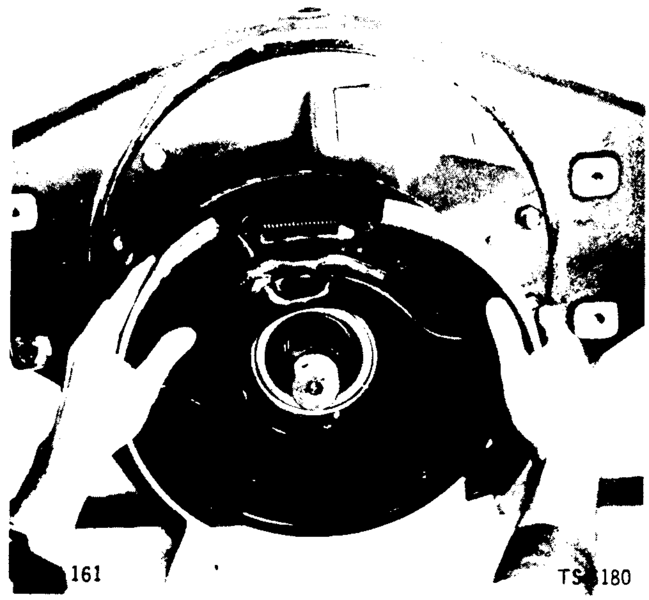
F . 159 TS-62

5. Position brake operating cam lever and roller on brake backing plate (Fig. 160).



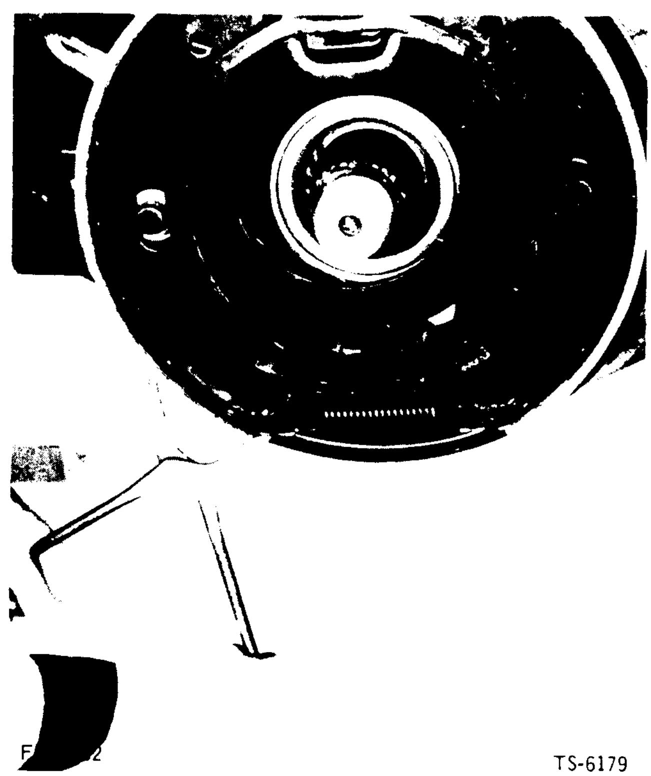
TS-6181

6. Assemble parking brake shoes and upper brake shoe return spring. Spread shoes apart and position shoes on brake backing in engagement with operating cam lever and roller (Fig. 161).



161 TS 180

7. Install lower brake shoe return spring with brake spring pliers (Fig. 162).



TS-6179

8. Position parking brake drum on companion flange, taking care to match punch marks made at disassembly. Secure parts with bolts, nuts, and lockwashers. Tighten bolts to specified torque (Fig. 163). When torquing bolts, place companion flange under light pressure in press to hold assembled parts. Do not score or distort parking brake drum by clamping in a vise.

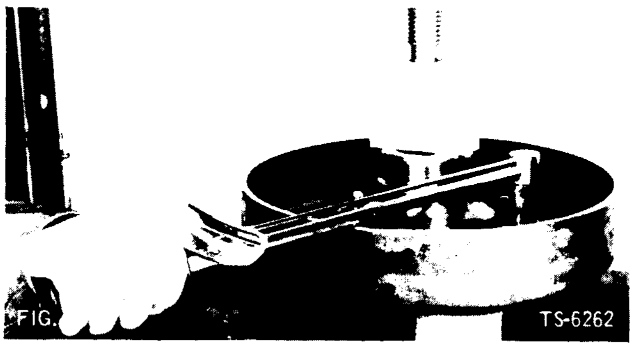


FIG. TS-6262

9. Position assembled parking brake drum and companion flange on pinion shaft. Secure with flat washer and companion flange nut. Torque nut to 600 ft. lbs. (Fig. 164). Install cotter pin to retain nut.

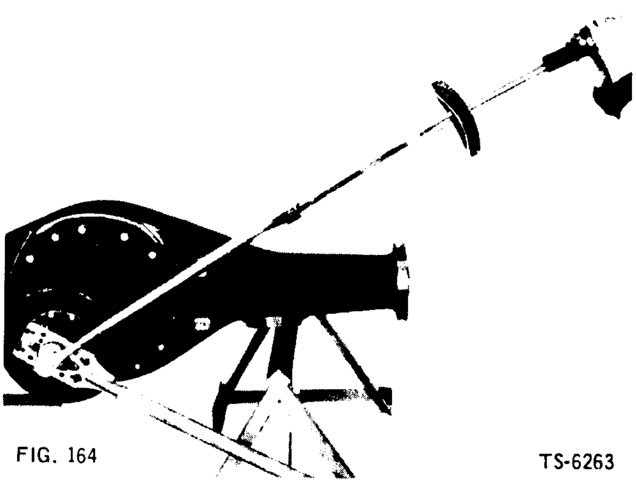


FIG. 164 TS-6263

10. Position air chamber brackets and spacers on axle housing; secure each bracket with two bolts and lockwashers. Tighten finger tight only to permit alignment of bracket after brake camshaft is installed (Fig. 165).

FIG. 165 TS-626

11. Slide axle shaft into position in axle housing so that splines engage differential side gear. Position shaft so that end having retaining ring groove for sun gear is toward the outside (Fig. 166).

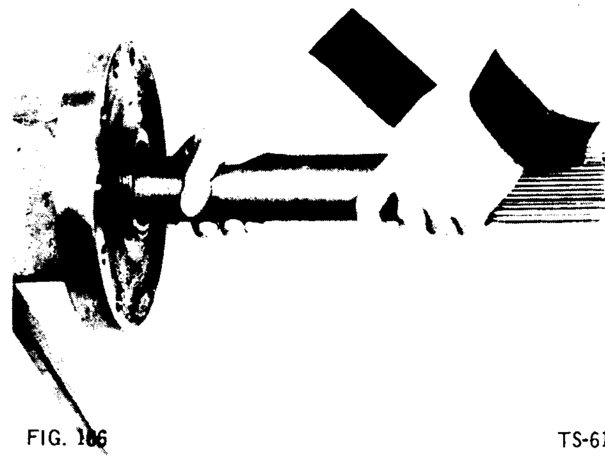
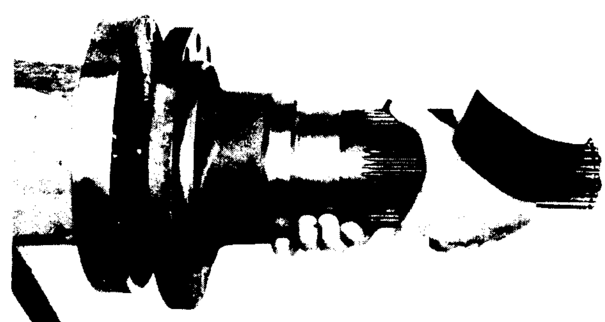


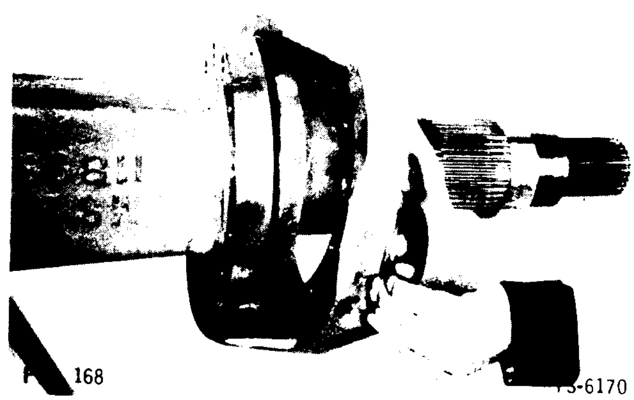
FIG. 166 TS-6172

12. Position spindle on spindle support assembly (Fig. 167).



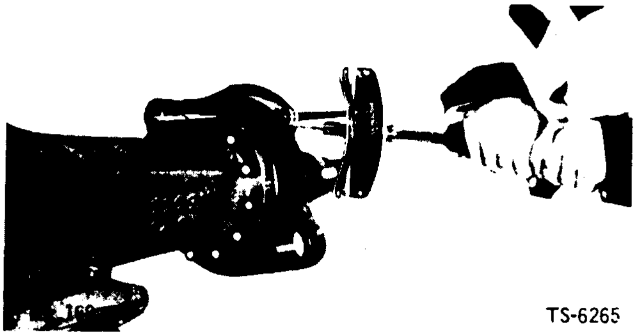
F 167 TS-6171

13. Position brake spider on spindle (Fig. 168).



168 -6170

14. Secure spindle and brake spider to axle housing with bolts, lockwashers, and nuts and tighten to specified torque (Fig. 169).



169 TS-6265

15. Tap brake camshaft bushing into brake spider (Fig. 170).

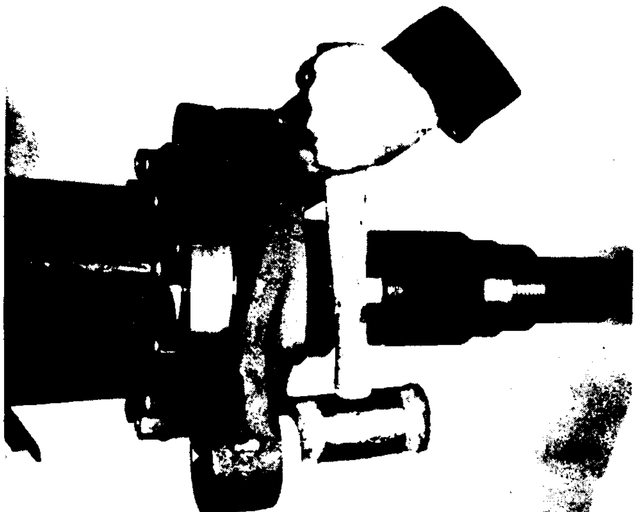


FIG. 170 TS-6266

16. Position thrust washer and "O" ring on brake cam shaft. Insert cam shaft through bushing in brake spider and position felt grease retainer, grease washer, and retaining ring on cam shaft (Fig. 171).

TS-6167

17. Seat felt grease retainer in recess in brake spider. Install retaining ring in retaining ring groove. (Fig. 172).

FIG. 1 TS-6166

18. Position air chamber bracket and spacers, which were previously installed, so that there is no binding between cam shaft and air chamber bracket bushing. Tighten bracket mounting bolts to specified torque (Fig. 173).

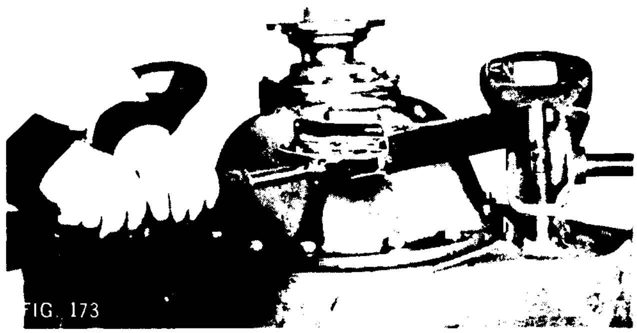


FIG. 173

19. Position slack adjuster on cam shaft. Secure with retaining ring and washer (Fig. 174). Be sure to install slack adjuster so that adjusting screw points in same direction as before disassembly. In some applications adjusting screw is adjacent to air chamber bracket. In others it is as shown in Fig. 174.

174 TS-6164

20. Position air chamber on air chamber bracket (Fig. 175). Secure with nuts and lockwashers. Tighten nuts to specified torque. Secure clevis of brake chamber to slack adjuster with pin and cotter pin.

. 175 TS-6163

21. Position brake shoe on spindle support. Retain brake shoe by inserting brake shoe anchor pin (Fig. 176). Install second brake shoe in same manner.

176

22. Install brake shoe return spring (Fig. 177). Before installing spring, make sure that slack adjusters are adjusted to allow brake shoes to come together as closely as possible so that spring tension will be at a minimum during installation. Install spring anchor pin washers and cotter pins.

CAUTION: Do not use pliers with serrated jaws to assemble brake spring. Do not use any tool which will nick or score spring. This will cause early failure. Tool shown is brake pliers which has provisions on end of handle for installing spring.

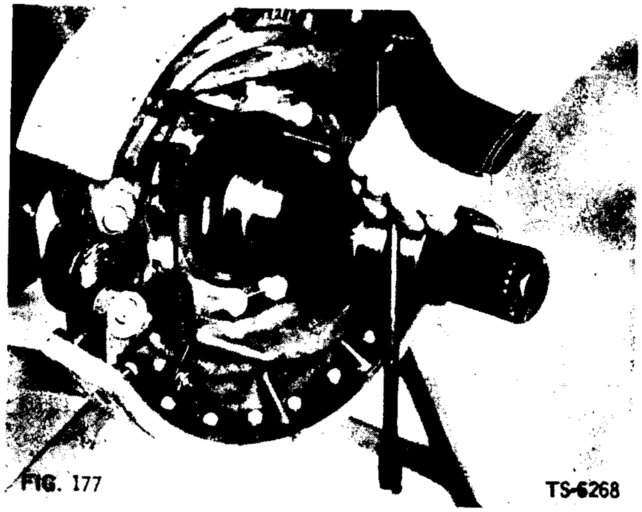
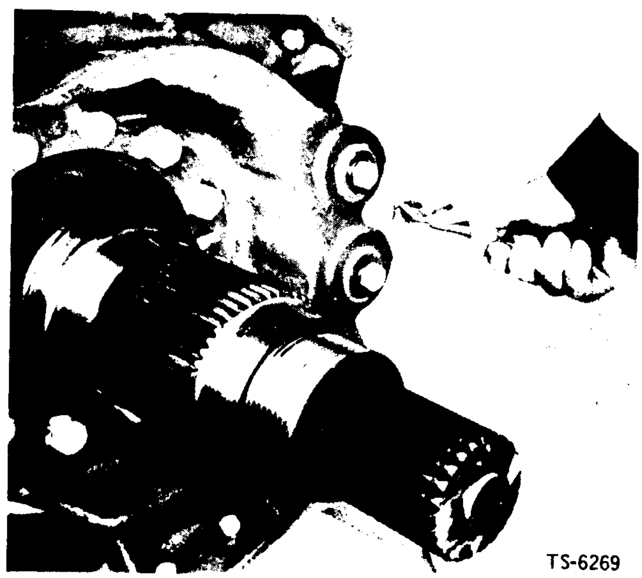


FIG. 177 TS-6268

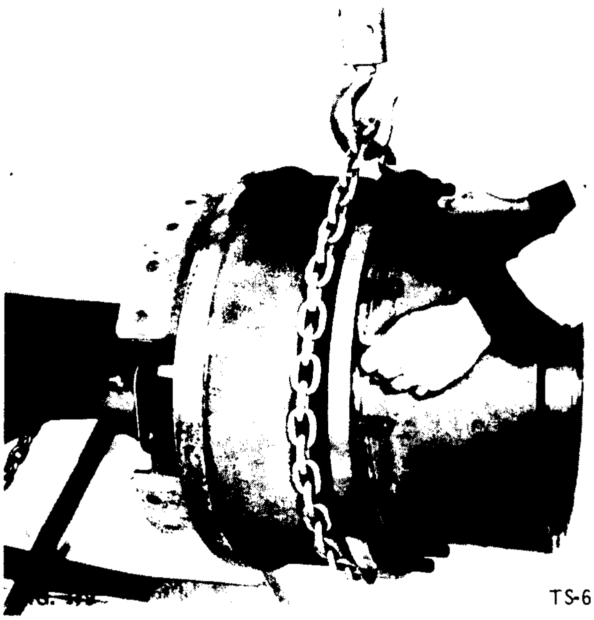
23. Lock brake shoe anchor pins with anchor pin set screws. Lockwire set screws (Fig. 178).

NOTE: On some axles, brake anchor pins are held in place with retaining plate, bolt, and lockwasher. Tighten bolt to specified torque.



TS-6269

24. Lubricate lip of hub and drum oil seal with Lubriplate. Position hub and drum on axle (Fig. 179). Care should be taken to align hub and drum assembly with spindle so that no cocking of inner hub bearing occurs when sliding assembly on spindle. If difficulty is encountered when trying to position the brake drum over the brake shoes, check for improper adjustment of slack adjuster. During installation, slack adjusters must be adjusted to minimize brake spring tension.



TS-6159

25. Continue to support hub and drum with hoist. Position internal gear and hub on axle so that it engages splines on spindle (Fig. 180).

FIG. 180 TS-6270

26. Install inner spindle nut on spindle. Wrap several turns of .010 inch to .020 inch shim stock around splines of axle shaft to protect splines. Install spindle nut socket wrench, Part No. 945940, on nut (Fig. 181) and tighten guide bolts lightly against axle shaft.

NOTE: The tapered roller bearings utilized in wheel hub must be preloaded in accordance with procedure steps and specifications given below. One of two methods may be used in adjusting the required preload on these bearings. It should be noted that preload specifications differ for use of new bearings and when wheel bearings are being reused.

FIG. 181 TS-6271

First (Preferred) Method

27. Tighten inner nut while rotating wheel hub in both directions until there is a slight binding (Fig. 182).

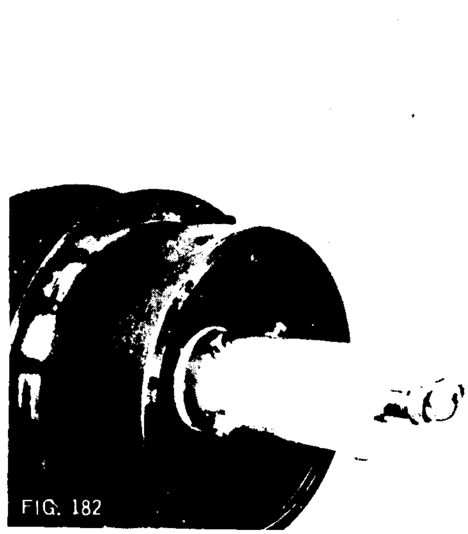


FIG. 182 TS-6272

28. Install torque wrench adapter bar, as shown in Fig. 183. The adapter bar can be fabricated locally to specifications outlined in Fig. 184. Bar illustrated will accommodate wheel hubs with planetary bolt circle diameters of 12½, 16½, 19½, and 23 inches.

FIG. 183 TS-6273

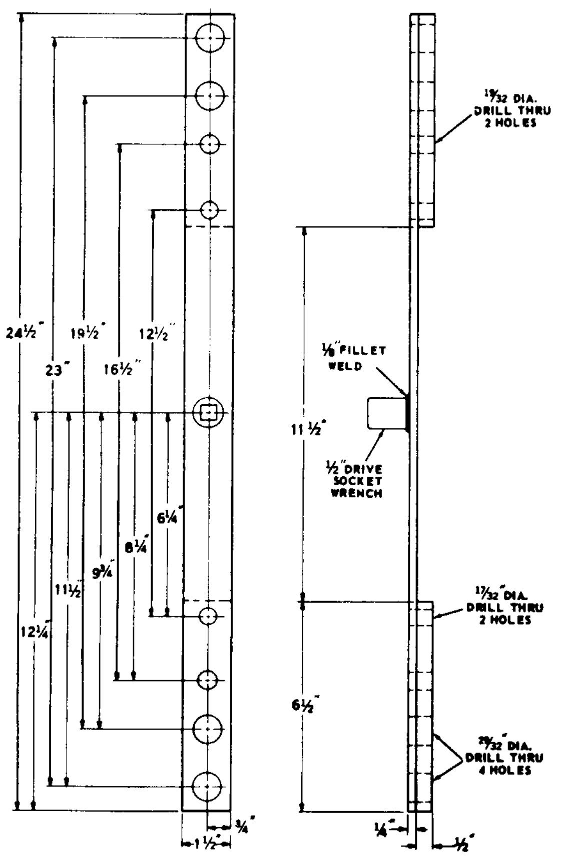


FIG. 184 TS-5623

29. Install torque wrench, 0 to 50 ft. lb. scale, if available, and check rotating torque or rolling resistance of wheel hub (Fig. 185). Rotating torque when using new bearings should be between 15 and 20 ft. lbs. On used bearings rotating torque should be between 6 and 12 ft. lbs.

CAUTION: Make certain wheel brake is in complete release position and that it is not dragging on brake drum.

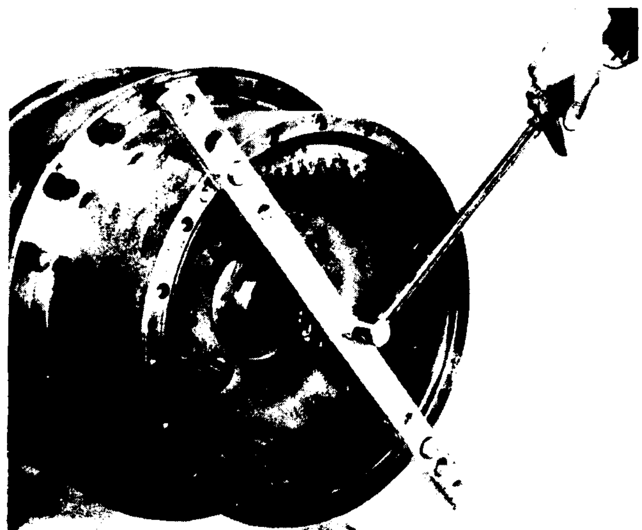


FIG. 185 TS-6274

30. If rotating torque is not to specifications given above, remove adapter bar and tighten or loosen inner nut until rotating torque is within specifications. After tightening or loosening nut as required, rap wheel hub several times with plastic or rawhide faced mallet while rotating hub to seat bearings. Recheck rotating torque as indicated in step 29.

Second (Optional) Method

31. Attach heavy string or cord to one of wheel studs on hub and wrap cord around wheel hub several times attaching pound pull scale to end of cord as shown in Fig. 186. Tighten inner nut until rotating torque measured on pull scale is between 21 and 28 lbs. for new bearings and between 9 and 17 llbs. for used bearings.

NOTE: Bearing preload rotating torque, using a pound pull scale, is figured by multiplying the radius (distance from center of wheel to outside diameter of wheel hub) by the reading on the pull scale and dividing by 12 to arrive at ft. lbs. of torque. For example: Wheel hub radius of 8-5/16 inches times 24 lbs. (reading on pull scale) equals 211 in. lbs. Dividing by 12 equals approximately 17 ft. lbs. which is within specifications of 15 to 20 ft. lbs. rotating torque for new bearings.

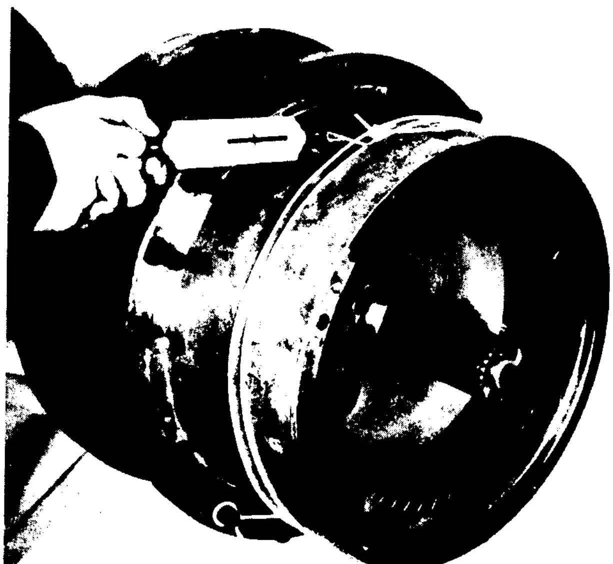


FIG. 186 TS-6275

32. Install nut lock and outer nut and tighten securely as shown in Fig. 182 to lock inner nut in position. Recheck rotating preload torque by one of two methods outlined above.

33. Bend two tangs of nut lock against flats on inner nut and bend two tangs against flats of outer nut (Fig. 187).

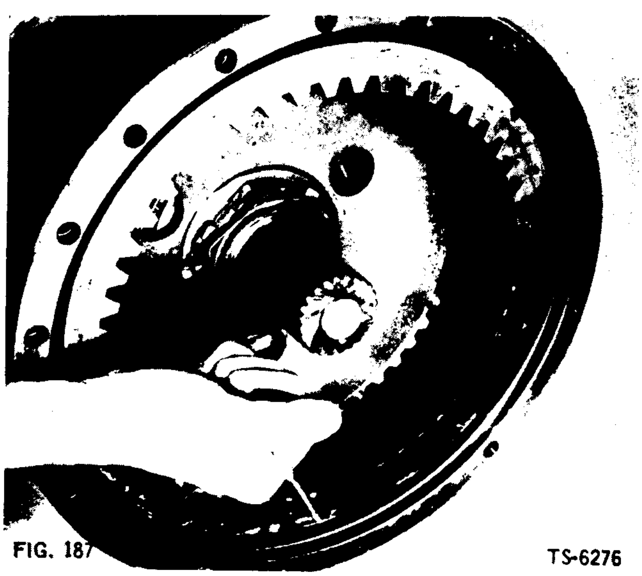
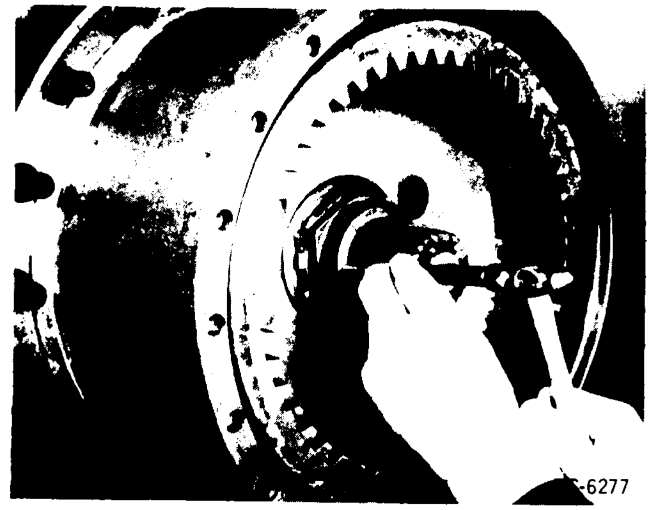


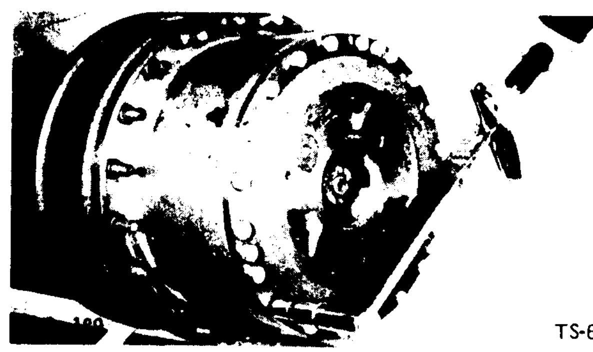
FIG. 187 TS-6276

34. Some axles use thrust ring in end of spindle. If provided, tap thrust ring into spindle until it is fully seated (Fig. 188).



-6277

35. Install planet carrier "O" ring on planet carrier assembly, and install planet carrier assembly on hub with bolts and lockwashers. Tighten bolts to specified torque (Fig. 189).



TS-6278

36. Position sun gear on axle shaft; secure with sun gear retaining ring (Fig. 190).

TS-6279

37. Install cap-to-carrier "O" ring seal in groove in sun gear thrust cap assembly. Install thrust cap on planet carrier. Make certain that "O" ring, if used, is properly positioned in the groove in the mounting face, and is not twisted. Apply light coat of Permatex No. 2 to threads of bolts and install. Tighten to specified torque (Fig. 191).

NOTE: Early versions of some axles did not include "O" ring feature. On these units, apply light coat of Permatex No. 2 on mounting face of thrust cap before installing on planet carrier.

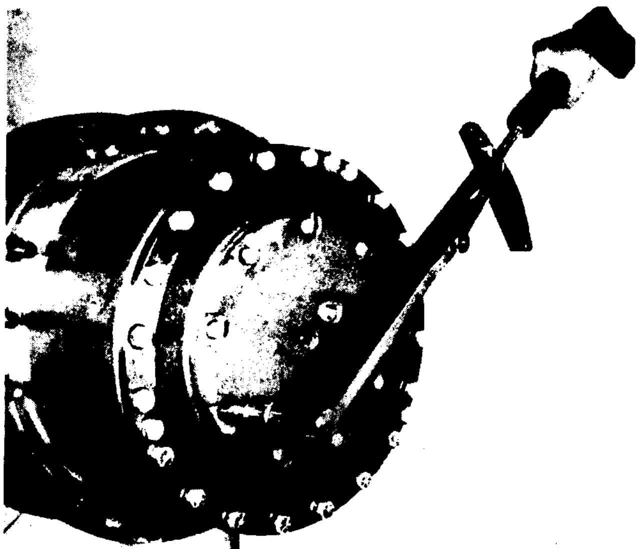


FIG. 191 TS-6280

Brake Adjustment

NOTE: Some axle models have slack adjuster positioned so that adjusting screw is adjacent to air chamber bracket (Fig. 192). Others have slack adjuster positioned so that adjusting screw points away from air chamber bracket (Fig. 193).

Adjust brakes of axle models that have slack adjusters positioned so that the adjusting screw is adjacent to the air chamber bracket as follows:

1. Use torque wrench and 9/16 inch socket to adjust slack adjusters to attain correct brake lining-to-brake drum clearance.

2. Position socket on adjusting screw and press it on screw far enough to cause locking collar to disengage locking mechanism.

3. While holding in locking collar, rotate adjusting screw clockwise until 20 ft. lbs. torque is indicated on torque wrench (Fig. 192).

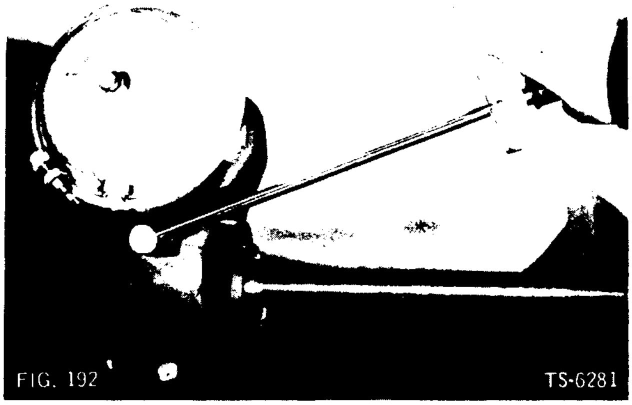


FIG. 192 TS-6281

4. Back off adjusting screw one-half turn. Locking collar should automatically return to locking position to lock adjustment when socket is removed. This provides proper brake lining-to-drum clearance.

5. After axle is assembled into machine and brake air lines are connected, recheck brake adjustment as follows: With minimum air pressure and with brakes fully activated and applied, adjust at slack adjuster to obtain 1 ½ inch travel on brake chamber push rod when brakes are released. Adjust all slack adjusters on machine for same travel distance.

Adjust brakes of axle models that have slack adjusters positioned so that adjusting screw points away from air chamber bracket as follows:

6. Use 9/16-inch, open-end wrench to make adjustment. Position wrench on adjusting screw and push in until locking collar releases adjusting screw (Fig. 193).

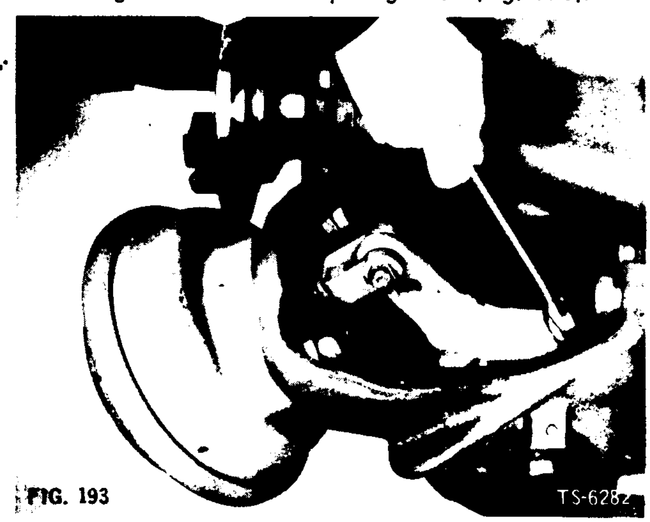


FIG. 193 TS-6282

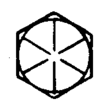
7. While holding locking collar in, rotate adjusting screw clockwise until brake lining is snug against inside of brake drum.

8. Back off adjusting screw one-half turn. Locking collar should automatically return to locking position to lock adjustment when wrench is removed. This provides proper brake lining-to-drum clearance.

9. After axle is assembled into machine and air brake lines are connected, recheck brake adjustment as directed in step 5 above.

TABLE OF TORQUE LIMITS

GRADE 5

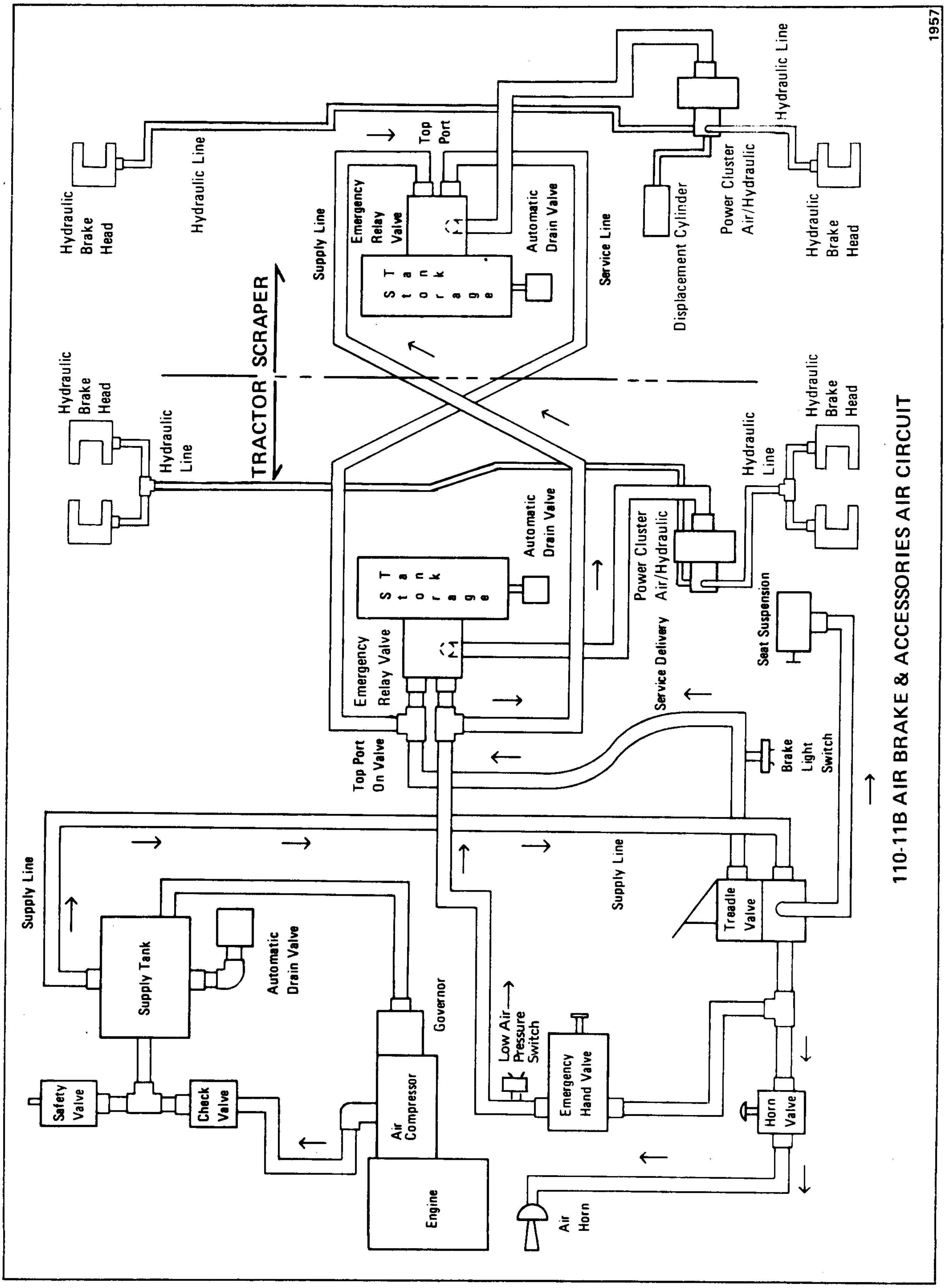


GRADE 8

COARSE THREADS	GRADE 5 DRY	GRADE 5 LUBRICATED OR PLATED	GRADE 8 DRY	GRADE 8 LUBRICATED OR PLATED
3/8-16	30-35	20-25	45-50	30-35
7/16-14	50-55	35-40	70-75	50-55
1/2-13	75-85	60-65	105-115	80-90
9/16-12	110-120	80-90	155-165	115-125
5/8-11	150-165	115-125	215-230	160-175
3/4-10	265-290	200-220	375-415	285-310
7/8-9	395-430	295-325	605-670	455-500
1-8	590-650	445-490	910-1000	685-750
1-1/8-7	795-875	595-655	1290-1415	965-1065
1-1/4-7	1120-1230	840-925	1820-2000	1360-1495

FINE THREADS	GRADE 5 DRY	GRADE 5 LUBRICATED OR PLATED	GRADE 8 DRY	GRADE 8 LUBRICATED OR PLATED
3/8-24	35-40	25-30	50-55	35-40
7/16-20	55-60	40-45	80-85	60-65
1/2-20	85-95	65-70	120-130	90-100
9/16-18	120-130	90-100	175-185	130-140
5/8-18	170-185	130-140	240-260	180-200
3/4-16	300-325	225-245	420-460	315-345
7/8-14	435-475	325-360	670-735	500-550
1-12	645-710	485-535	995-1095	745-820
1-1/8-12	890-980	670-735	1445-1590	1085-1190
1-1/4-12	1240-1365	930-1025	2015-2215	1510-1660

* * * *



110-11B AIR BRAKE & ACCESSORIES AIR CIRCUIT

AIR BRAKE SYSTEM

DESCRIPTION

An air system is used to actuate an air chamber on a hydraulic master cylinder which supplies hydraulic pressure to disc brake heads at each wheel. Air is also used to operate horn and the seat suspension. A diagram of air circuit is shown in Figure 1.

OPERATION

The air system is charged by means of an air compressor mounted on and driven by the engine. Air is pulled into the inlet from the engine air inlet duct. The air is compressed in the cylinders by pistons and discharged into reservoirs. When the air pressure reaches 120 psi, a governor on the compressor controls an unloader mechanism in the cylinder block to regulate the air pressure. A check valve installed in discharge line near supply reservoir allows air to flow only in one direction. A safety valve also installed in discharge line near supply reservoir permits air to escape should reservoir pressure go above 150 psi. When the pressure drops to 150 psi the valve prevents any further escape of air. The supply reservoir furnishs air to the foot operated service brake valve supply chamber. Installed in the bottom of the supply reservoir and 2 service reservoirs is an automatic drain valve. This valve is designed to eject moisture and contaminats from the reservoir upon a slight reduction in reservoir pressure. Manual draining can be accomplished by depressing and holding the wire stem, in the exhaust port, upward until draining is completed.

Air from supply tank passes into bottom chamber of foot operated brake valve in operator's compartment. When the operator depresses the treadle, air pressure from the supply reservoir flows through the top chamber of foot valve to relay valve on service tank on tractor and to one on scraper. Air pressure flows through delivery port on relay valves out service ports to air cylinder on power cluster. The air pressure drives piston in cylinder forward which moves piston in master cylinder pressurizing fluid. Fluid under pressure enters brake heads moving pistons against brake lining which press against each side of a brake disc to apply brakes. When the driver releases the treadle, an exhaust valve opens in the bottom of the foot valve exhausting air in the delivery line to atmosphere. When the air pressure is exhausted in the delivery line, the piston in the air cylinder is spring returned to retracted position. In turn the piston in master cylinder is allowed to spring return to it's retracted position releasing hydraulic pressure on pistons in brake heads releasing brakes.

Air pressure to operate horn and suspension for operator's seat is also supplied through bottom supply chamber on foot valve. Connected to supply chamber is a foot operated on-off valve which supplies air pressure to horn when operator depresses button on top of valve. Also connected to air supply chamber on bottom of foot brake valve, is the supply line to the relay valve and service tank on tractor and scraper. This air supply must pass through a hand operated emergency valve mounted on dashboard in operator's compartment. This valve is basically an on-off, push-pull control valve. The button must be pushed in and held until air pressure in system reaches 40 psi. After pressure is reached, then button will stay in and air pressure will be supplied to relay valves. Should the foot operated brake valve fail to apply the brakes, pull button on hand valve. The air supply is shut off across hand valve and exhausted to atmosphere between hand valve and relay valves on tractor and scraper. When the supply pressure to relay valve drops below 60 psi, the supply inlet port on relay valve is sealed off and air is supplied to brake chambers from storage tank on tractor and scraper.

The emergency hand valve is never to be used as a means for parking a machine. Over a period of time the air pressure will leak off releasing brakes. To release the brakes, the button must be pushed in. A red colored ring on the control button, when exposed, indicates the valve is in the "off" position. Installed in supply line between foot valve and hand valve is a pressure switch. When the air pressure drops below 75 psi, the switch closes an electrical circuit for a warning buzzer and red light to alert operator of low air pressure.

POWER CLUSTER

DESCRIPTION

The power cluster assembly, illustrated in Figure 1, is used to transform air pressure to hydraulic pressure. Air pressure applied to one end of the power cluster results in hydraulic pressure at the other end. The power cluster assembly consists of an air cylinder group and a hydraulic cylinder group which can be separated and worked on individually, if need be.

OPERATION

(NUMBERS IN PARENTHESIS REFER TO FIGURE 1)

When the operator depresses the brake treadle valve, pressurized air from the treadle valve enters the inlet port of the air cylinder shell (1). Air entering forces the piston (4) and rod to stroke the hydraulic cylinder and compress the air piston return spring (6). The piston (4) also strokes a spring loaded stroke indicator rod (16) which extends through a drilled bolt, one of those mounting the air cylinder. The cylinder shell wall is sealed by a cup (2) carried on the piston (4), which also carries a felt wiper (3) that cleans and lubricates the wall. A boot (5) stretched between the piston (4) and the cylinder head (7) excludes dust, moisture, and oil from the opening into the hydraulic cylinder. Air displaced on the atmospheric side of the air piston (4) passes through a filtered breather (9) located in the air cylinder head (7)

When air is released, the return spring (6) forces the piston (4) and rod back to static position in advance of the hydraulic cylinder. The stroke indicator rod (16) follows the piston (4).

The standard master cylinder housing (18) includes a brake fluid reservoir which is joined to the cylinder bore by intake and compensating (by-pass) ports. In static position, fluid by-passes to compensate the closed hydraulic system for temperature expansion and contraction or seepage. During an application, initial piston movement seals off the by-pass, then the stroke displaces fluid, through an outlet check valve (19), into the system and pressure builds when this fluid movement ceases. A primary cup (23), ahead of the piston (24), seals the pressure system and the piston carries a secondary seal cup which prevents fluid loss at the open rear of the cylinder.

Upon release, a return spring (22) forces the piston (24) back to it's stop faster than the displaced fluid can unseat the check valve (19) and return, and a vacuum forms. Reservoir fluid ahead of the secondary cup on piston (24) is sucked through passages in the piston face, supercharging the system, and the fluid excess by-passes into the reservoir. The return spring (22) also seats the outlet check valve (19) to trap up to 18 psi residual pressure in the system. Residual pressure assists system sealing and raises the fluid boil point. The check valve also assists the service "bleeding" operation.

MAINTENANCE

Should even a small air leak (slow bubbling when covered with suds) or a hydraulic pressure internal leak develop, a unit in brake service should be deadlined to avoid the possibility of a hazardous sudden complete failure many vehicle operators prefer scheduled maintenance:

At lube or oil change: Clean dirt from area of fluid filter cap. Remove cap and fill reservoir to within 1/2" to 3/8" of top. For best results use super heavy duty brake fluid, SAE 70R-3.

At brake adjustment - inspection: Brake lining clearance adjustemnt is needed when the stroke of the cluster travel indicator rod approaches 1" - 1-1/4" as illustrated in Figure 2. Also check cluster air cylinder for dents and leaks, hose or pipe connections for leaks and wear, and hydraulic cylinder for an internal pressure leak.

At brake reline: Comprehensive inspection of the power cluster and connections. Some shops install new piston cups or a repair kit to assure trouble-free operation during the life of the new lining.

An air cylinder leak, except at the inlet fitting, is due to a worn piston cup, a dent or corrosion in the cylinder shell, or a piston loose on it's rod.

Internal pressure leak in the hydraulic cylinder, due to worn primary cup, pitted cylinder, or corrosion, is demonstrated by creep of the stroke travel indicator during ~~and~~ extended holding application at low pressure.

Fluid leak at the rear of the hydraulic cylinder is due to cylinder pitting or a worn secondary cup.

Should hydraulic pressure build and fail to release (brakes "lock-up") the hydraulic by-pass port is blocked by dirt or corrosion, or a swollen primary cup which extends over the port. A swollen cup indicates an improper or contaminated brake fluid.

Air in the hydraulic lines lengthens the stroke and must be bled from the system.

At the cluster master cylinder, check for:

1. Fluid level - low, below reservoir ports
2. Filler cap vent - blocked, producing vacuum which sucks air past the piston secondary cup.
3. Secondary cup - worn, or pitted hydraulic cylinder.
4. Check valve - fails to retain residual pressure in system.

For servicing it is more convenient to remove the cluster to a work bench.

REMOVAL

1. Lower blade and shut off engine.
2. Disconnect air line at power cluster master cylinder.
3. Disconnect hydraulic lines at power cluster master cylinder.
4. Remove bolts and lockwashers which secure power cluster to mounting bracket and remove power cluster from unit.
5. Drain any remaining brake fluid from the master cylinder reservoir.
6. Remove dirt and grease from power cluster.

   CAUTION: If assembly is cleaned with solvent, all ports must be plugged to prevent solvents from entering the master cylinder. Certain solvents will ruin rubber parts.

CLARK EQUIPMENT COMPANY

DISASSEMBLY

(NUMBERS IN PARENTHESIS REFER TO FIGURE 1)

1. Separate air cylinder from the cluster by removing fastening bolts (14). Separate cylinder shell (1) from head (7) by taking out 8 shell capscrews (28) and slide shell (1) from head (7) and piston (4).
2. Piston cups (2) and wiper (3) can be stripped from the piston (4).
3. Piston (4), spring (6) and boot (5) can be pulled from head (7).
4. After removing the air cylinder, pick lock ring (26) from groove in end of hydraulic cylinder bore. Internal parts should slide out or can be fished out.
5. Do not overlook valve seat in end of bore.

ASSEMBLY

(NUMBER IN PARENTHESIS REFER TO FIGURE 1)

1. Before assembling, lubricate master cylinder bore and parts with brake fluid SAE 70R3.
2. Place check valve (19), check valve spring (20), spring retainer (21), piston return spring (22), primary cup (23), piston assembly (24), and stop plate (25) into master cylinder body (18). Service all parts in master cylinder body (18) with retaining ring (26).
3. Be sure retaining ring is seated firmly in groove and that piston returns against the stop plate.
4. Before assembling the air cylinder, lubricate the shell interior (1) and saturate the piston cup (2) and felt wiper (3) with a light engine oil.
5. Install boot (5) in piston groove. Align piston (4) and spring (16) with head (7) and compress them in order to snap boot (5) into groove on head (7).
6. Pass a small diameter drift through the shell air inlet and use it to hold the spring compression while guiding the shell (1) over the piston (4) and head (7). Install 8 bolts (28) and lockwashers (29) to secure shell (1) to head (7).

7. Place mounting plate (27) on end of master cylinder body (18) and place air cylinder assembly over end of master cylinder body (18) and line up mounting holes. Install bolts (14) and lockwashers (15) through mounting flange on master cylinder body (18) and mounting plate (27) into tapped holes in air cylinder assembly.

8. Install stroke indicator (16) through mounting hole in hydraulic cylinder and air cylinder. Apply compressed air to air inlet of air cylinder and check for smooth operation of power cluster before unit is installed on machine.

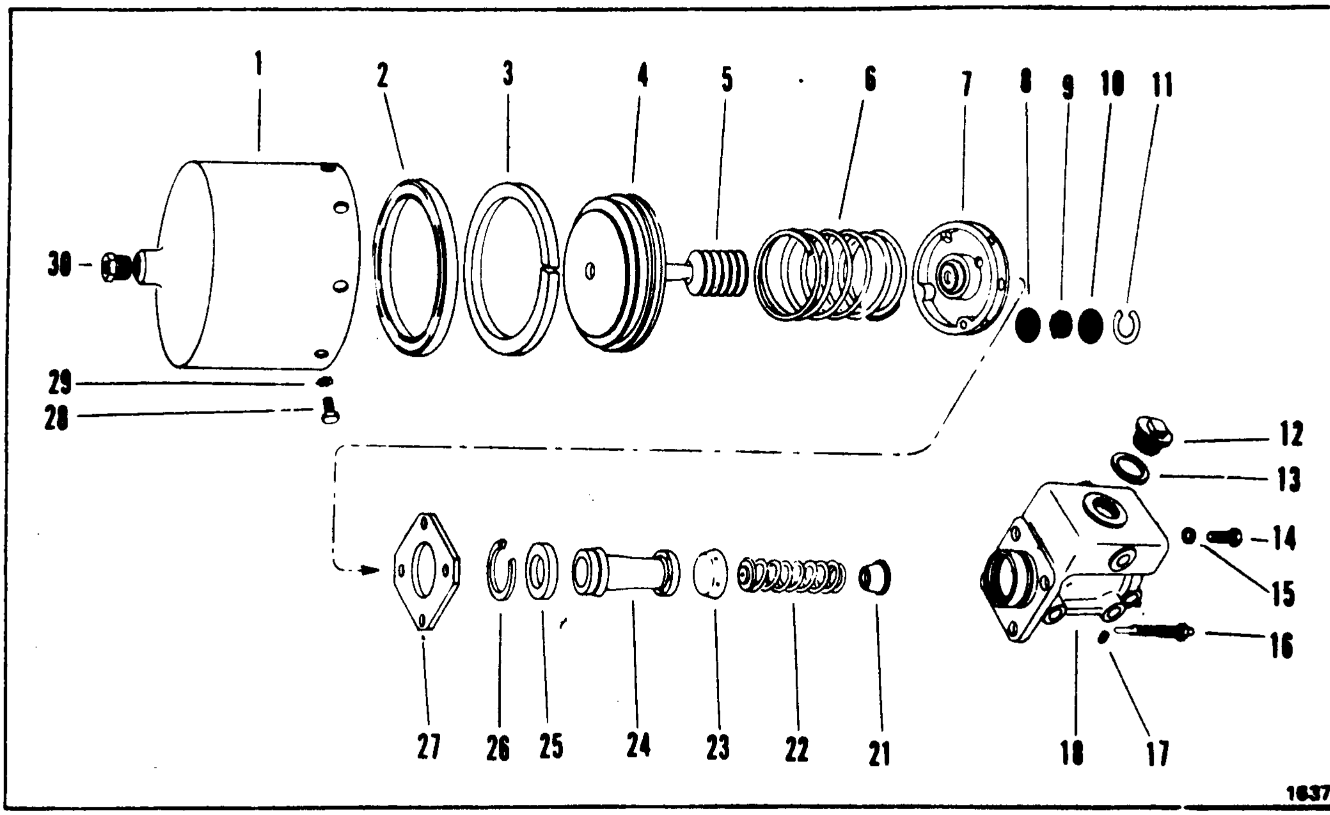
INSTALLATION

1. Secure power cluster assembly to mounting bracket on machine with bolts and lockwashers removed on removal of power cluster.

2. Connect brake line to master cylinder from brake head. Fill hydraulic reservoir of master cylinder with brake fluid, SAE 70R-3.

3. Bleed brake system through bleeder screws located on top of brake head on axle.

CLARK EQUIPMENT COMPANY



BRAKE POWER CLUSTER ASSEMBLY - TRACTOR AND SCRAPER
Figure 1

Item	Description	Qty.	Item	Description	Qty.
A	*POWER CLUSTER ASSY (Inc 1 thru 30)	1	15	LKWSHR,Master Cylinder to Air Cylinder	3
	*NOTE: Two Assy's are required for Rear Axle - Quantities listed are for one.		16	INDICATOR,Stroke	1
			17	PLUG,Master Cylinder	1
			18	HOUSING,Master Cyl.	1
1	SHELL,Air Cylinder	1			
2	§ CUP,Piston (See 31)	1			
3	§ WIPER,Piston (see 31)	1	21	RETAINER,Check Valve Spring	1
4	PISTON,Air Cylinder	1	22	SPRING,Piston Return	1
5	§ BOOT,Piston Rod (See 31)	1	23	§ CUP,Primary (See 31)	1
6	SPRING,Piston Return	1	24	§ PISTON ASSY,Master Cylinder (See 31)	-
7	HEAD ASSY,Air Cylinder (Inc 8 thru 11)	1	25	PLATE,Piston Stop	1
8	SCREEN,Filtering	1	26	RING,Stop Plate Retaining	1
9	HAIR,Filtering	1	27	PLATE,Master Cylinder Mounting	1
10	SCREEN,Filtering	1	28	BOLT,Shell to Head	8
11	RING,Filter Retain.	1	29	LKWSHR,Shell & Head	8
12	CAP,Master Cylinder Filler	1	30	BUSHING,Shell Reducing	1
13	GASKET,Filler Cap	1			
14	BOLT,Master Cylinder to Air Cylinder	3	31	REPAIR KIT (Inc 2,3, 5,19,23 & 24)	1

§ Not Sold Separately

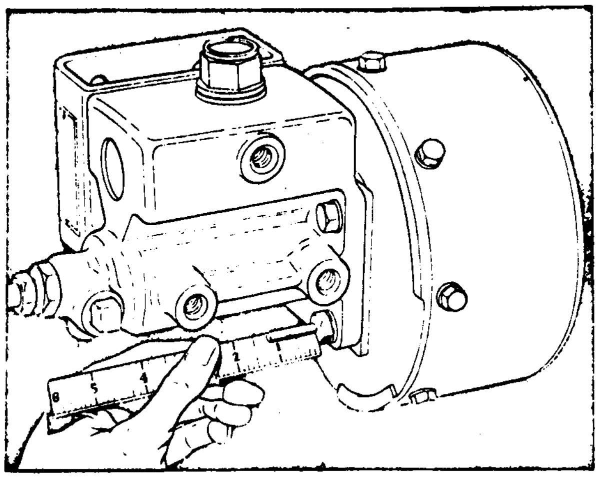


Figure 2

Should even a small air leak (slow bubbling when covered with suds) or a hydraulic pressure internal leak develop, a unit in brake service should be deadlined to avoid the possibility of a hazardous sudden complete failure. Many vehicle operators prefer scheduled maintenance:

At lube or oil change: Clean dirt from area of fluid filler cap. Remove cap and fill reservoir to within ½"-⅜" of top. For best results use super heavy duty brake fluid, SAE 70R-3.

At brake adjustment — inspection: Brake lining clearance adjustment is needed when the stroke of the cluster travel indicator rod approaches:

1" - 1-1/4" as illustrated in Figure 2.

Also check cluster air cylinder for dents and leaks, hose or pipe connections for leaks and wear, and hydraulic cylinder for an internal pressure leak.

At brake reline: Comprehensive inspection of the power cluster and connections. Some shops install new piston cups or a repair kit to assure trouble-free operation during the life of the new lining.

An air cylinder leak, except at the inlet fitting, is due to a worn piston cup, a dent or corrosion in the cylinder shell, or a piston loose on its rod.

Internal pressure leak in the hydraulic cylinder, due to worn primary cup, pitted cylinder, or corrosion, is demonstrated by creep of the stroke travel indicator during an extended holding application at low pressure.

Fluid leak at the rear of the hydraulic cylinder is due to cylinder pitting or a worn secondary cup.

Should hydraulic pressure build and fail to release (brakes "lock up") the hydraulic by-pass port is blocked by dirt or corrosion, or a swollen primary cup which extends over the port. A swollen cup indicates an improper or contaminated brake fluid.

Air in the hydraulic lines lengthens the stroke and must be bled from the system. At the cluster master cylinder, check for:

Fluid level — low, below reservoir ports.

Filler cap vent — blocked, producing vacuum which sucks air past the piston secondary cup.

Secondary cup — worn, or pitted hydraulic cylinder.

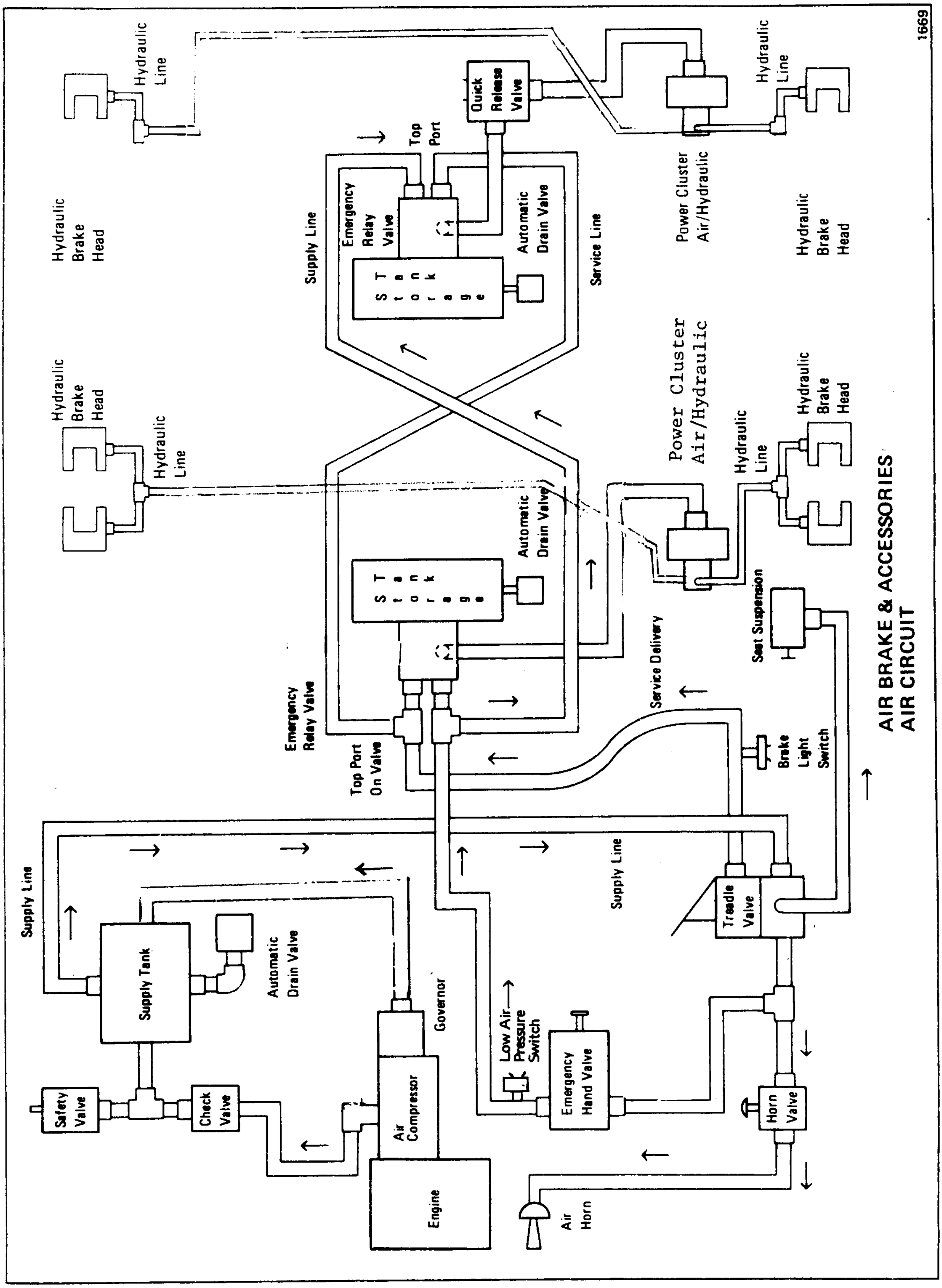
Check valve — fails to retain residual pressure in system.

For servicing, it is more convenient to remove the cluster to a work bench. Remove filler cap and pour off brake fluid.

Air Cylinder: Separate air cylinder from the cluster by removing fastening bolts. Separate cylinder shell from head by taking out shell cap screws (8, 5/16"—18 x 5/8") and slide shell from head and piston. Piston cup and wiper can be stripped from the piston. Piston, spring and boot can be pulled from head. Before assembling, lubricate the shell interior and saturate the piston cup and felt wiper with a light engine oil. Install boot in piston groove. Align piston and spring with head and compress them in order to snap boot into groove on head. Pass a small diameter drift through the shell air inlet and use it to hold the spring compression while guiding the shell over the piston and head.

Hydraulic Cylinder: After removing the air cylinder, pick lock ring from groove in end of hydraulic cylinder bore. Internal parts should slide out or can be fished out. Do not overlook valve seat in end of bore. Before assembling, lubricate cylinder bore and parts with brake fluid. Be sure that lock ring is seated firmly in groove and that piston returns against the stop plate.

CLARK EQUIPMENT COMPANY



AIR BRAKE & ACCESSORIES
AIR CIRCUIT

CALIPER DISC BRAKE ASSEMBLY

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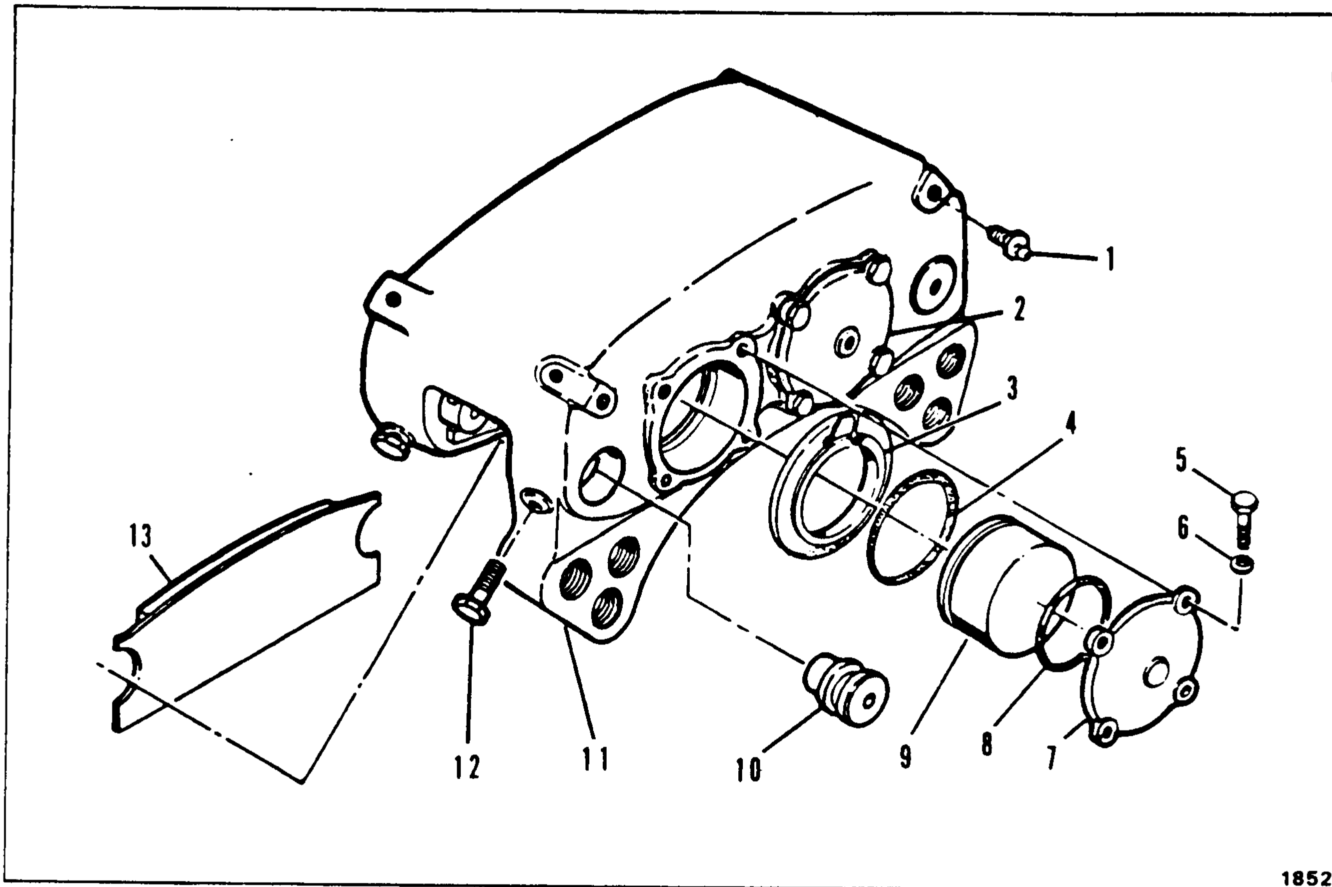

BRAKE HEAD ASSEMBLY – TRACTOR & SCRAPER

Item	Part No.	Description	Qty.
A		BRAKE HEAD ASSY (Inc. 1 thru 13)	1
		– Quantities listed are for one (1) Brake Head Assy	
B		REPAIR KIT (Inc. 3, 4, 8)	1
1		VALVE, Bleeder	2
2		CAP, Inlet	1
3		BOOT – See "B"	4
4		PACKING – See "B"	4
5		BOLT	8
6		WASHER	8
7		CAP	1
8		PACKING – See "B"	2
9		PISTON	4
10		PIN	4
11		TORQUE PLATE ASSY	1
12		BOLT	4
13		CARRIER & LINING ASSY	2
14		†TUBE & NUT ASSY (Use where applicable)	1
15		†VALVE, Bleeder (Use where applicable)	1

†Not Illustrated

DESCRIPTION AND OPERATION

NOTE: Photographs used in this manual were taken with the axle assembly detached from the machine for maximum clarity and expediency.

The brake head assemblies covered by this manual are of the caliper type and are designed for use with SAE 70R3 type brake fluid. The brake head is bolted to a mounting flange on the tractor's axle.

The brake head assembly consists of the following components: a torque plate, which has four (4) bores for a corresponding number of pistons, the two bores closest the wheel assembly having a blind closure, and the two bores farthest from the wheel assembly covered with caps. The caps differ only in that one is drilled and threaded to receive the fluid supply while the other has no inlet. The caps are fastened to the torque plate with four bolts and washers per cap, and are sealed with packing. A packing is installed in a groove in each bore in the torque plate. A protective boot is installed in a groove in each bore of the torque plate, and is snapped into a piston groove at the time of piston installation. The two carrier and lining assemblies are retained in the torque plate by four pins. The four retaining pins are locked in place by four bolts.

The brake is actuated by fluid which enters the brake head through the threaded inlet in the inlet cap. The two piston bores on each side of the torque plate are interconnected by internal passages to allow for free flow of hydraulic brake fluid. The two sides of the torque plate are connected by means of a tube and nut assembly to allow for passage of fluid to all piston bores.

When the brake is actuated, the hydraulic pressure forces the pistons against the carrier and lining assemblies, which in turn are forced against the disc creating a braking action. The reaction to the braking action is supplied by the retaining pins which resist the rotating force imparted to the carrier and lining assemblies by the disc. The pins also retain the carrier and lining assemblies in their respective positions when the brake pressure is released.

For location and identification of component parts, refer to the Brake Head Exploded View, (Figure 1, Page 1). and the Crossectional View (Figure 2) shown below.

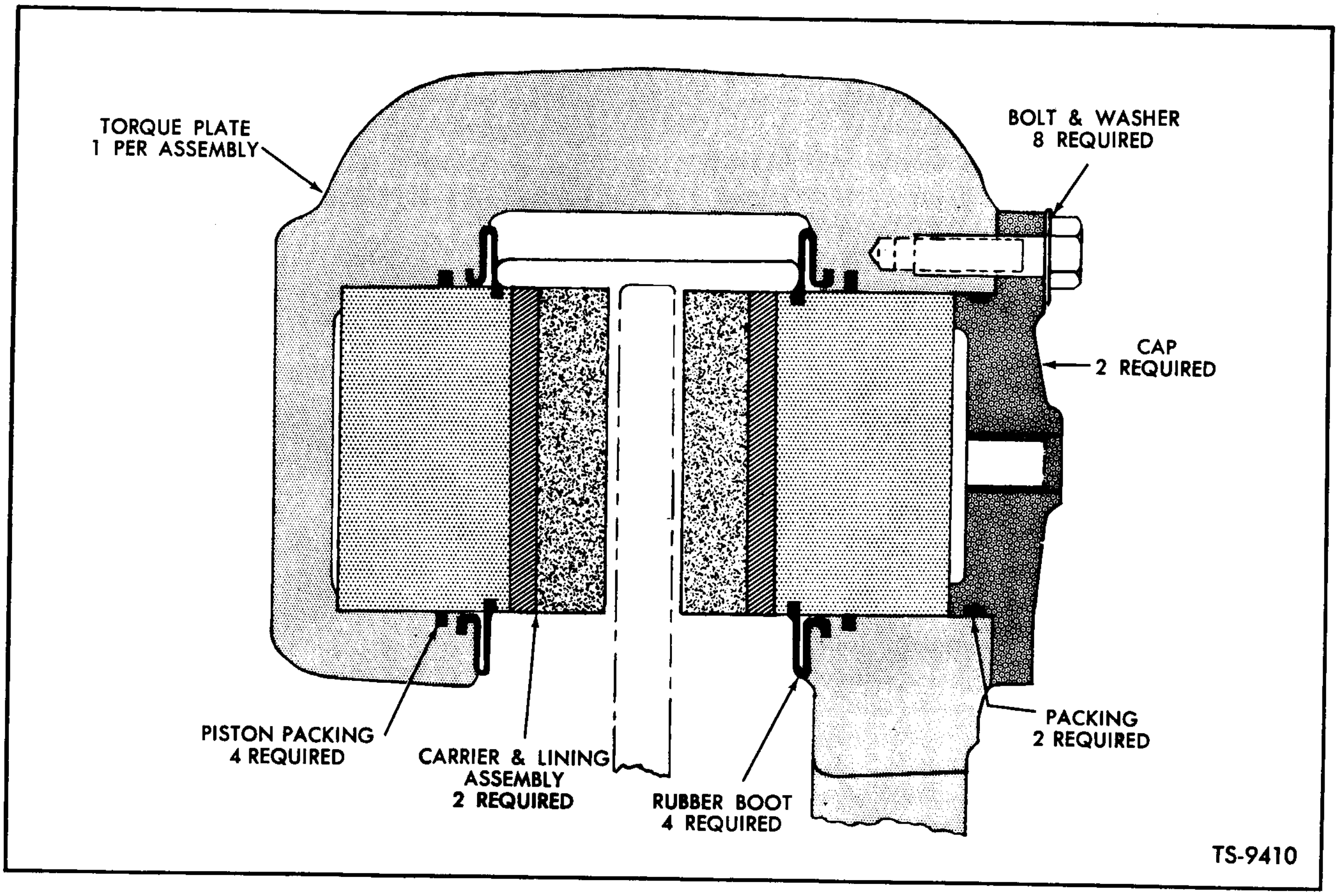

Fig. 2. Brake Head Cross-sectional View

MAINTENANCE

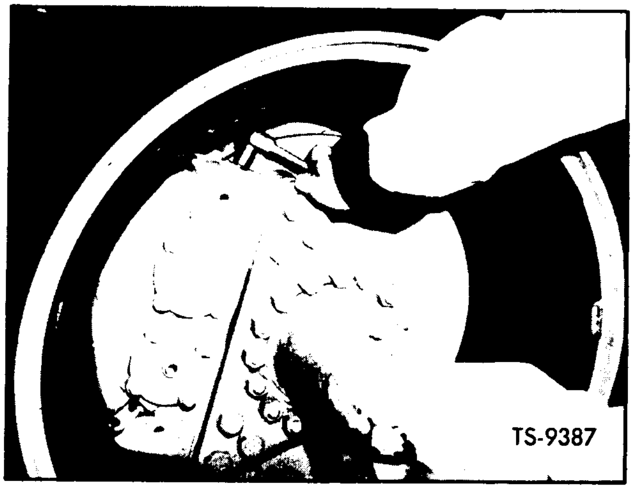

*Fig. 3. **Loosen Locking Bolts***

Inspect brake assembly daily to insure that all bolts are tight and there are no leaks. Inspect for boot deterioration and lining wear. Linings should be replaced when friction material is worn to ⅛" thickness. Linings can be removed and replaced without removing rims.

Replace excessively worn brake linings as follows:

1. Refer to Figure 3 and loosen the two locking bolts at the most accessible end of the brake head.

2. Remove the unlocked pin from the side of brake head closest to the differential. A device consisting of a 2" diameter pipe coupling, two large flat washers and a bolt the same diameter and thread size as the hole drilled and tapped in the retaining pin, as shown in Figure 4, may be helpful in extracting the unlocked pin.

*Fig. 4. **Pin Removal Device***

*Fig. 5. **Loosen Unlocked Pin***

3. Place pipe coupling over end of unlocked pin. Cover open end of coupling with the two large flat washers. Insert bolt in drilled and tapped hole on end of unlocked pin and turn in a clockwise direction with a wrench to loosen unlocked pin as shown in Figure 5.

4. When pin turns freely, remove extracting device and remove pin as shown in Figure 6.

5. Using a large punch and a hammer drive the second unlocked pin away from disc as shown in Figure 7. Access to second unlocked pin can best be gained by working through hole vacated by first unlocked pin guiding punch next to edge of disc.

6. After driving back second unlocked pin, brake linings can be removed by rotating along outer diameter of disc and out of brake head assembly.

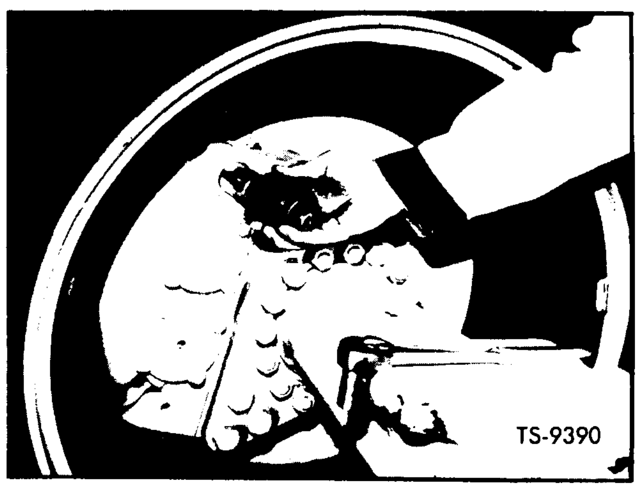

*Fig. 6. **Remove Unlocked Pin***

Fig. 7. Drive Second Unlocked Pin Back

Fig. 9. Install New Brake Lining

7. Refer to Figure 8 and remove brake carrier and lining assemblies from both sides of disc by rotating lining along contour of disc.

8. Open bleeder screws on both sides of brake head and depress all four pistons as far back into brake head as possible. A small pry bar may be used if required.

9. Close both bleeder screws.

10. Replace carrier and lining assemblies by rotating same along contour of disc and seat against retaining pin as shown in Figure 9.

11. Reinstall retaining pins. A suitable "C" clamp may be used to force pins in place.

12. Retighten locking bolts, making sure bolts seat in groove in retaining pins. See Figure 10.

13. Pump brake pedal several times until linings are in contact with disc.

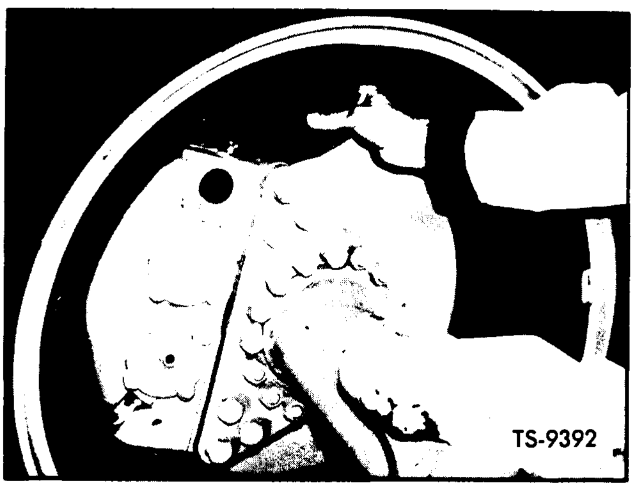

Fig. 8. Remove Brake Lining

Fig. 10. Tighten Locking Bolts

N O T E S

OVERHAUL INSTRUCTIONS

The following instructions will cover the disassembly and reassembly of the caliper type disc brake assembly in a sequence that will normally be followed after the wheel and tire assembly has been removed and the brake assembly is to be completely overhauled.

DISASSEMBLY

1. With machine securely blocked and wheel and tire assembly removed, attach a chain hoist to brake head assembly with bolts and flatwashers through drilled and tapped holes in retaining pins as illustrated in Figure 11, then remove mounting bolts.

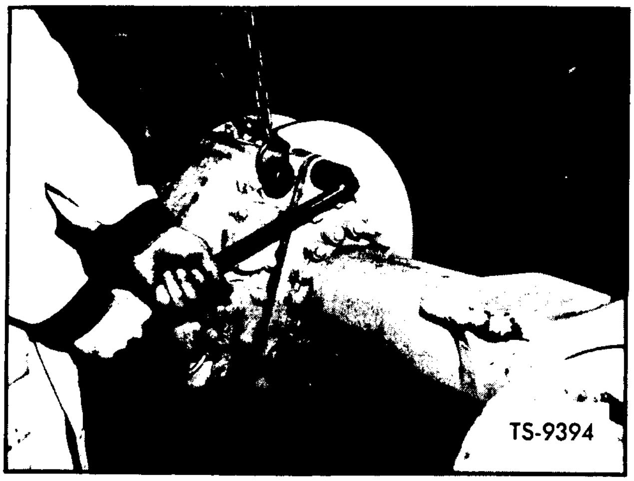

Fig. 11. Attach Hoist and Remove Mounting Bolts

2. With the aid of hoist, place brake head assembly on work bench or other working surface to be used for disassembly of brake head.

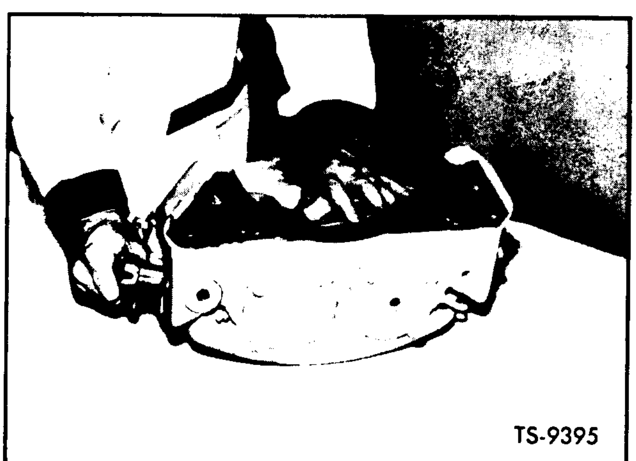

Fig. 12. Loosen Locking Bolts

3. Loosen two of the four locking bolts with wrench as shown in Figure 12.

4. Remove the two unlocked pins by pressing outward as illustrated in Figure 13.

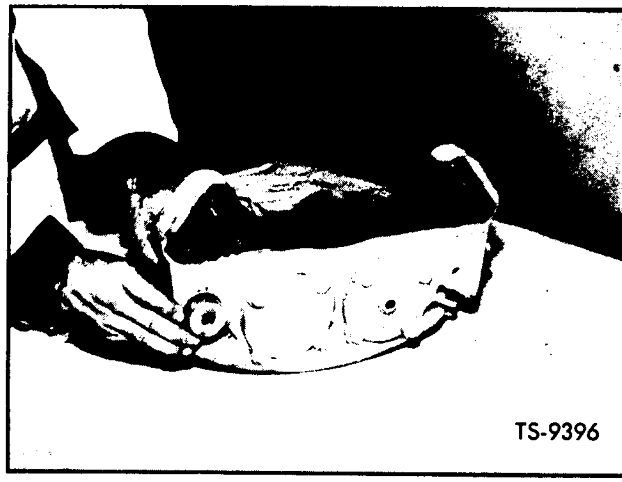

Fig. 13. Remove Unlocked Pins

5. With two unlocked pins removed, both carrier and lining assemblies may be easily removed by simply lifting outward as shown in Figure 14.

Fig. 14. Remove Carrier and Lining Assemblies

Fig. 15. Open Bleeder Screws

6. Open bleeder screws on both sides of brake head as shown in Figure 15.

Fig. 16. Remove Bolts

7. Remove bolts holding piston retaining caps in place as shown in Figure 16.

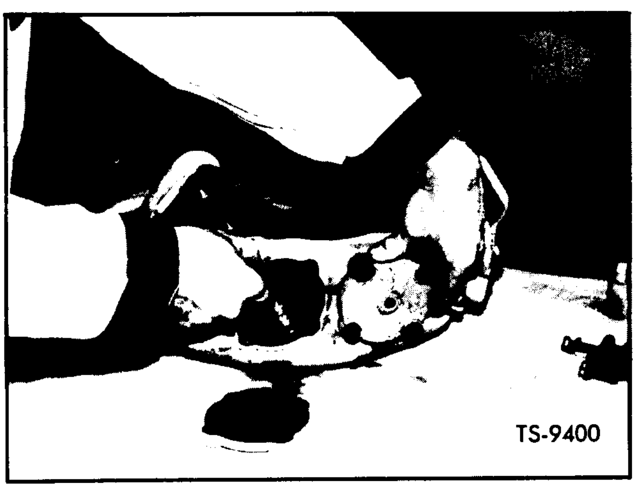

Fig. 17. Remove Piston Retaining Caps

8. Remove piston retaining caps as shown in Figure 17. A small screwdriver may be used to loosen piston retaining cap if necessary.

9. Remove pistons on open side of brake head by pressing pistons in toward center of brake head as shown in Figure 18. A clean cloth may be used inside brake head to catch piston as it is removed, protecting same from being nicked or scratched.

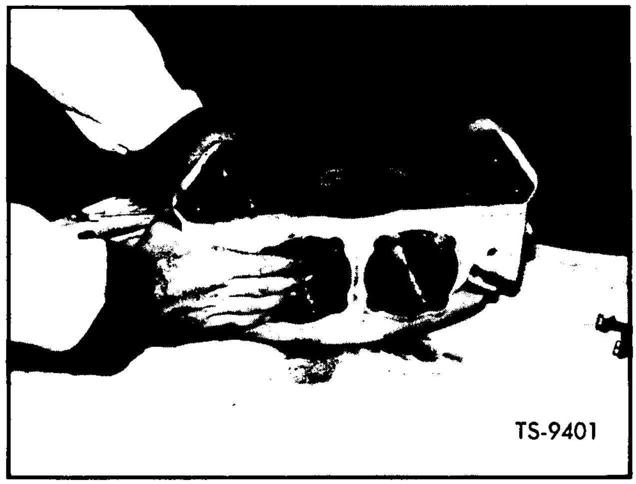

Fig. 18. Press Out Pistons

10. Remove blind side pistons by prying in to center of brake head with pair of screwdrivers as shown in Figure 19. Alternate method may be used by closing blind side bleeder screw and removing crossover tube, and attaching an external hydraulic source to crossover tube hole pushing piston out with hydraulic pressure.

CAUTION: No fluid other than normal hydraulic brake fluid may be allowed to enter brake head. Deterioration of rubber parts will result if this precaution is not observed.

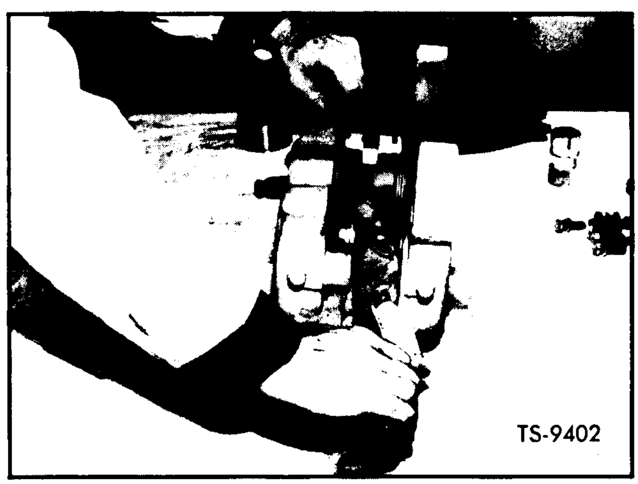

Fig. 19. Remove Blind Side Pistons

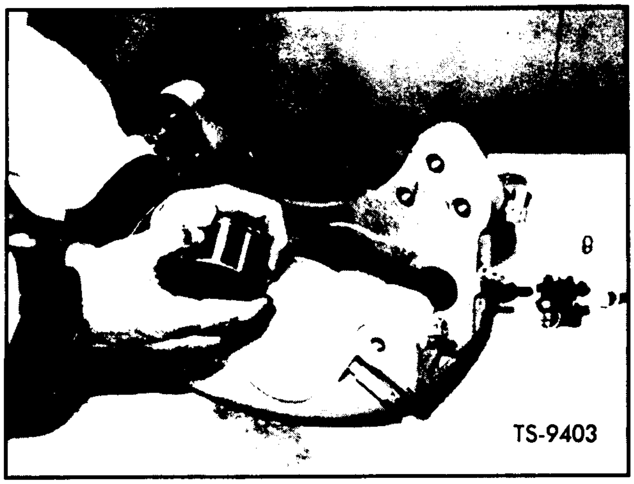

Fig. 20. Inspect Pistons

11. Inspect pistons for minor scratches and nicks and blend with crocus cloth. If piston is badly scratched, nicked, or worn, replace piston. Piston showing evidence of excessive wear or rubbing off of the chromed surface will cause undue friction and must be replaced. Visually inspect pistons as shown in Figure 20.

12. Remove rubber boots as shown in Figure 21. Do not use tools which will damage boot.

13. Replace all old rubber boots if brake head had extended use. If brake head has not seen extended use, carefully inspect visually as in Figure 22.

14. With the aid of a small piece of shim stock or other such device, carefully lift piston bore packings out of groove as shown in Figure 23. Extreme care must be exercised not to damage this seal if its reuse is intended, as any cuts or other abrasions will necessitate replacement of the seal.

15. If brake head has seen extensive use, replace cylinder bore packing seal. If brake head has seen limited use, visually inspect packing, as shown in Figure 24, for cuts or other abrasions that will make seal ineffective.

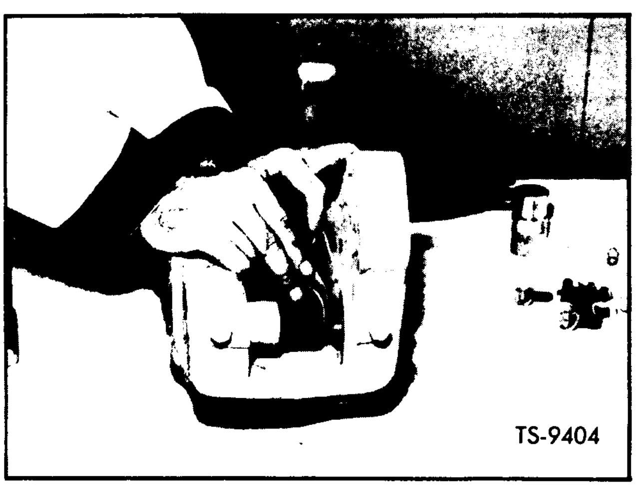

Fig. 21. Remove Rubber Boots

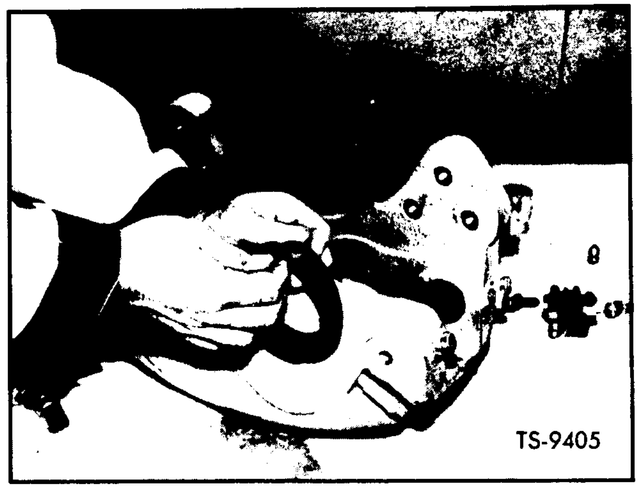

Fig. 22. Visually Inspect Rubber Boots

16. Clean torque plate with solvent. Make sure no solvent remains in fluid passages or grooves. Inspect cylinder bores for minor nicks or scratches and blend with crocus cloth. Replace torque plate if broken or severely damaged.

REASSEMBLY

17. Lubricate packing and pistons with brake fluid or silicone grease compatible with brake fluid. DO NOT USE PETROLEUM TYPE OILS OR LUBRICANTS.

18. Reinstall cylinder bore packings in grooves. Be careful not to damage packings. Press into grooves as shown in Figure 25.

19. Reinstall rubber boots in cylinder bore grooves as shown in Figure 26.

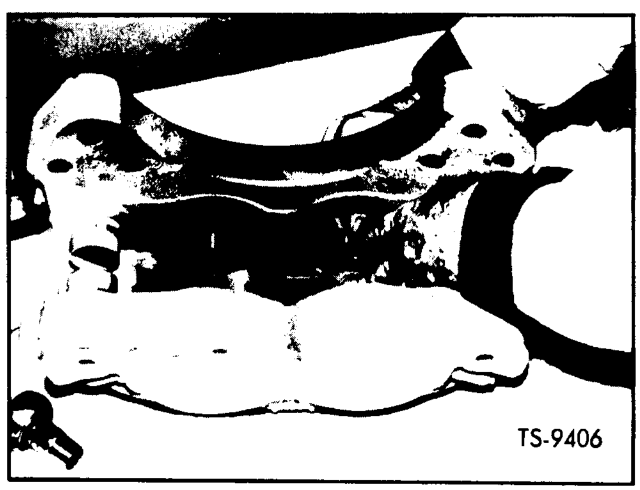

Fig. 23. Remove Piston Bore Packing

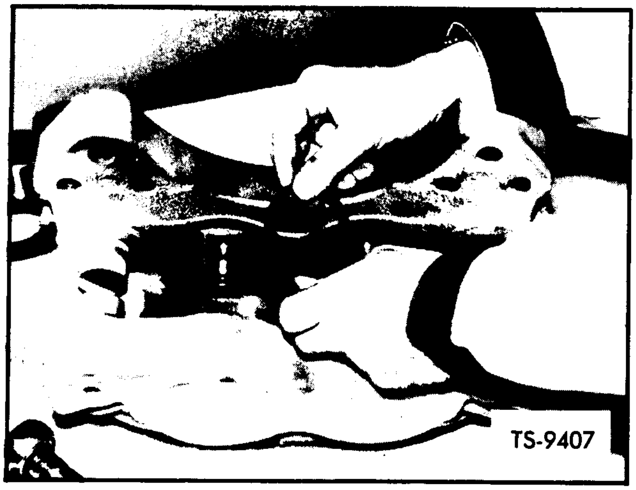

Fig. 24. Inspect Packing Seals

20. Reinstall pistons in cylinder bores by sliding piston thru rubber boot as shown in Figure 27. Be careful not to

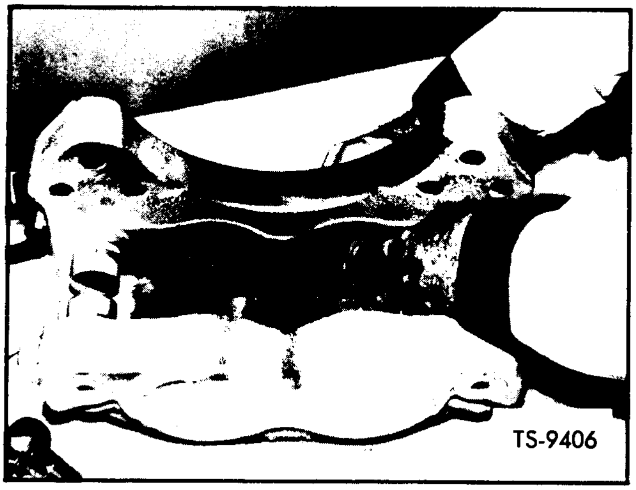

Fig. 25. Reinstall Packings in Grooves

turn lip of boot under when installing piston. *CAUTION: Do not damage boot.*

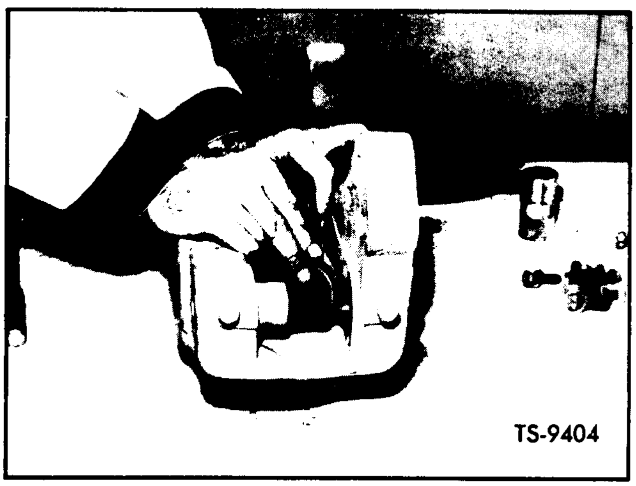

Fig. 26. Reinstall Rubber Boots

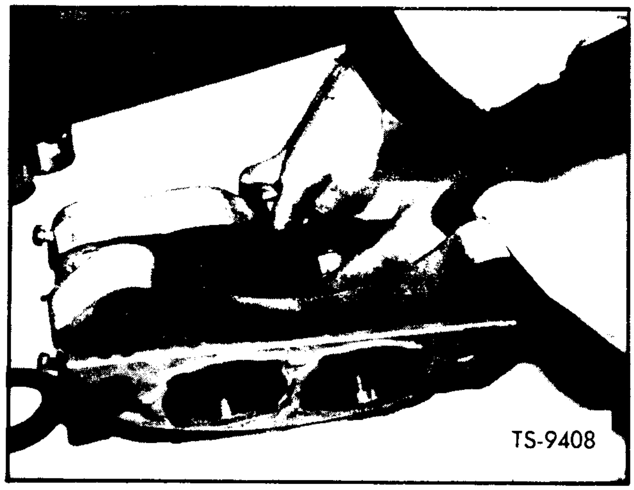

Fig. 27. Reinstall Pistons

21. As piston slides into cylinder bore, snap lip on rubber boot into groove on piston, being careful not to leave

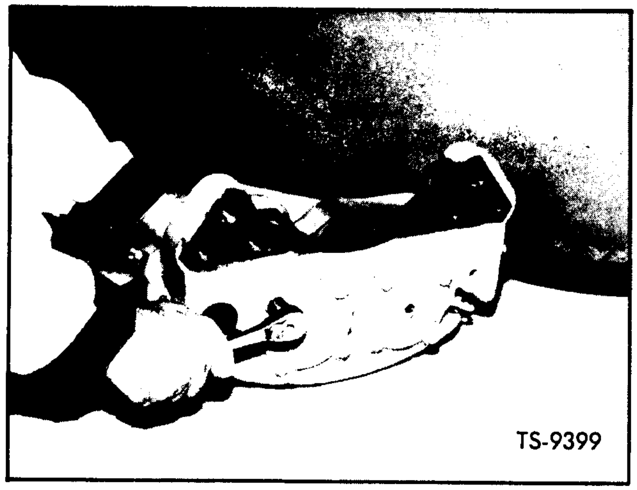

Fig. 28. Reinstall Retaining Caps

lip on boot twisted. A properly fitted lip will insure a good seal.

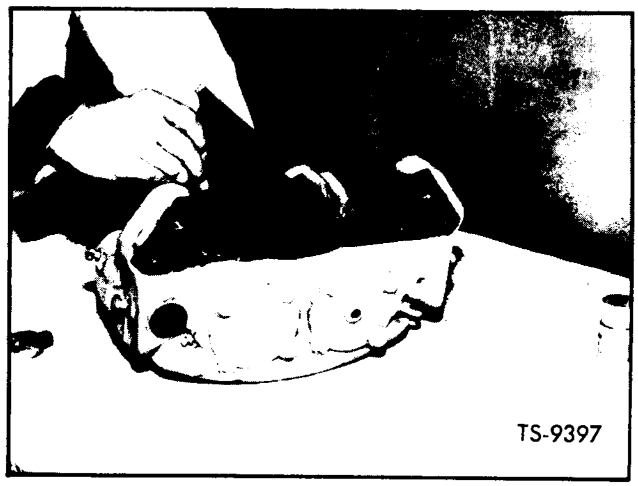

Fig. 29. Install Carrier and Lining

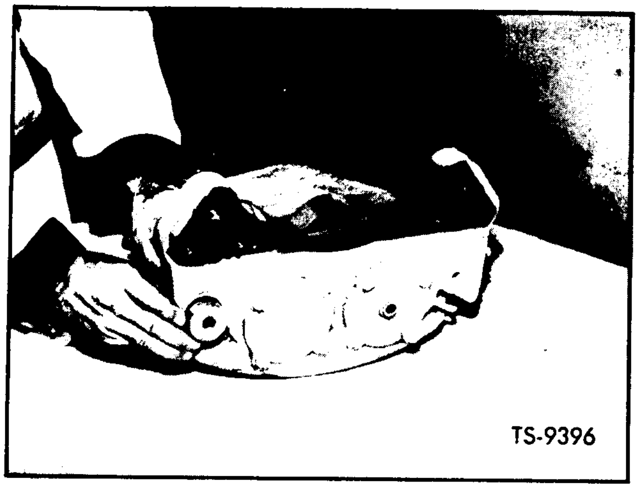

Fig. 30. Reinstall Retaining Pins

22. Lubricate cylinder retaining cap packings with brake fluid and install in retaining caps. Reinstall retaining caps on torque plate with original bolts and washers as shown in Figure 28. Torque bolts to 38 to 42 ft. lbs. with dry threads.

23. Install carrier and lining assemblies in torque plate as shown in Figure 29. If lining material is worn to ⅛ inch thickness replace lining.

24. Reinstall carrier and lining retaining pins in torque plate as shown in Figure 30. If pins are deeply grooved, they should be replaced or rotated so that grooved end is opposite the end of carrier and lining.

25. Reinstall locking bolts in torque plate. Make sure the locking bolt is aligned with the groove in the retaining pin so that it may perform its function. See Figure 31.

26. Inspect disc for undue wear or damage. If disc has been worn to less than 0.450 thickness or shows evidence of damage, it must be replaced.

Fig. 31. Reinstall Locking Bolts

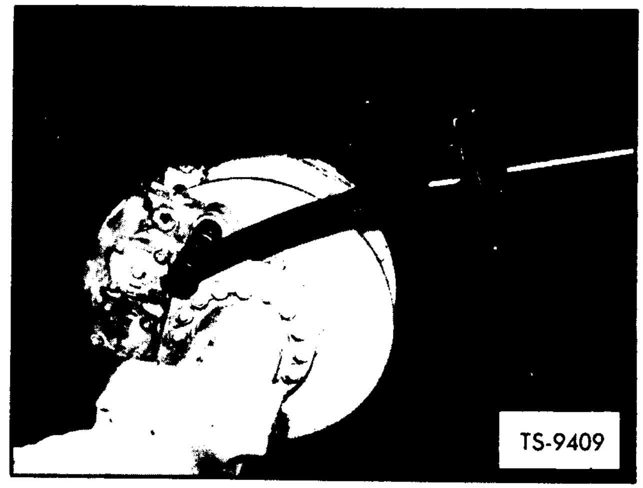

Fig. 32. Torque Mounting Bolts

27. Reinstall brake head on axle as shown in Figure 32. Torque mounting bolts to 220-240 ft. lbs. dry. Close both bleeder screws and reconnect hydraulic brake line to piston retaining inlet cap.

Bleed Brake System: After reinstalling brake head assembly on machine, the brake system must be bled to remove air bubbles and air pockets left in the system.

NOTE: It is recommended to use a bleeder hose on bleeder valves whenever possible to keep fluid away from linings. Keep master cylinder filled during the bleeding process.

1. Open bleeder valve (see Item 1, Figure 33), and actuate brakes several times until fluid coming from bleeder valve is free of bubbles. Depress brake pedal and close bleeder valve, then release brake pedal.

2. Open second bleeder valve (see Item 2, Figure 33). Depress brake pedal several times until fluid coming from bleeder valve is free of bubbles. Depress brake pedal and close bleeder valve, then release brake pedal.

3. Actuate brakes several times.

4. Repeat Steps 1 and 2 until no bubbles are observed in fluid from bleeder valves.

5. Repeat entire process at each brake head to finish bleeding system.

NOTE: Master cylinder must be kept full at all times.
Recomended brake fluid — SAE 70R3, CLARK 850487.

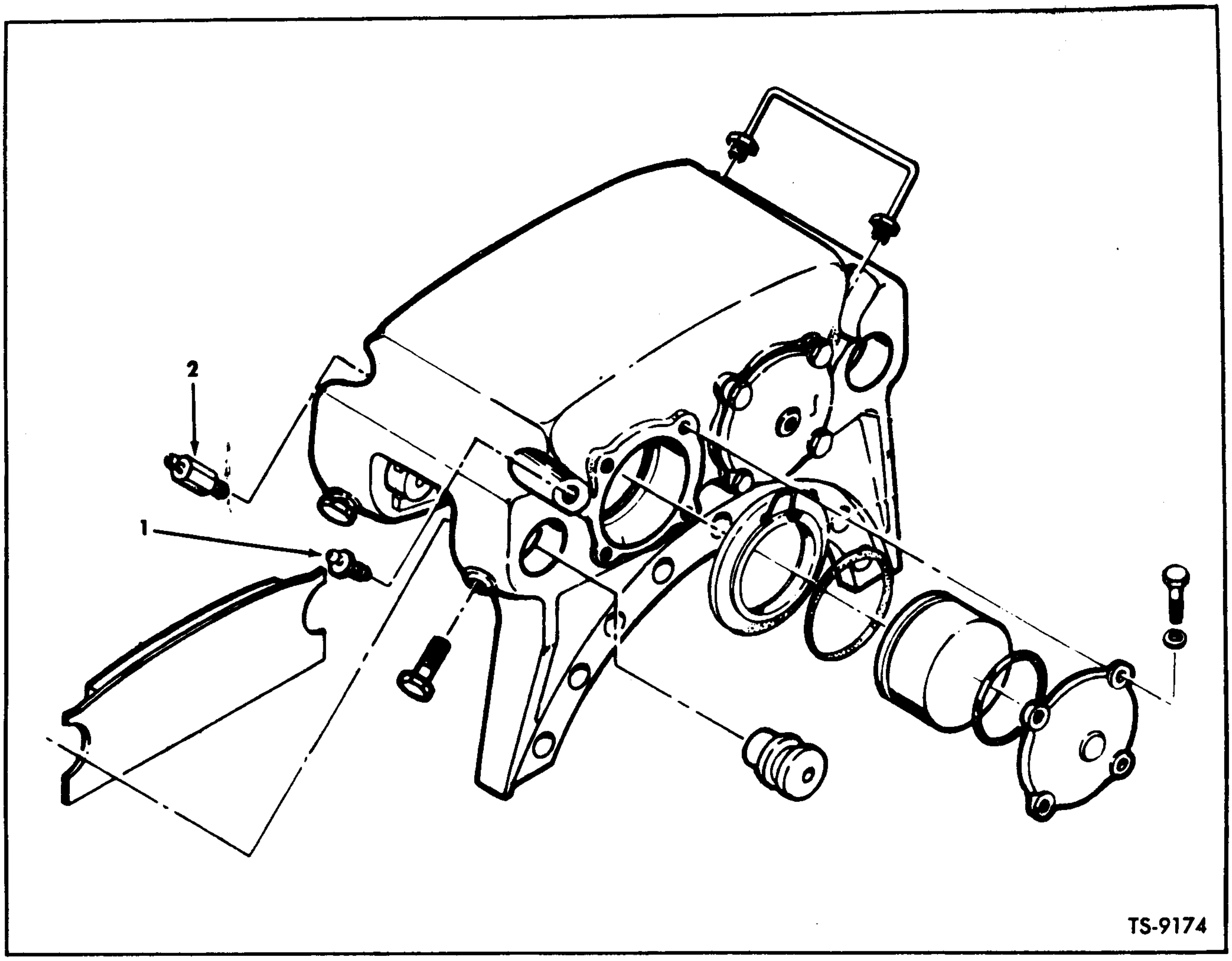

Fig. 33. Brake Head Assembly

N O T E S

ELECTRICAL SYSTEM

DESCRIPTION

A twenty-four volt grounded system is used to supply the electrically-operated components of this unit. Current is supplied by two twelve-volt batteries connected in series for cranking the engine and operating the accessories when the engine is not running. The electrical circuits explained in the text can be followed on the wiring diagram in figure 1.

CHARGING CIRCUIT

The charging circuit is traced from the generator since that is the source of current for this circuit. Charging current leaves the generator at the "BAT" terminal and passes through field relay to positive terminal on voltage regulator. From the negative post on the regulator, the current flows to Field 1 post on generator and is grounded through case of the generator. From the "BAT" post on the generator current flows to the positive (+) terminal of the battery, through the battery and through the line from the negative (-) battery terminal to engine block. The charging current then returns to the generator through the negative (-) grounded terminal of the generator to complete the circuit.

CRANKING MOTOR CIRCUIT

The cranking motor will be traced from the battery since that is the source of current for the cranking motor. When the cranking motor switch is closed, current flows from the positive terminal of the battery through the "B" terminal of the cranking motor to the ignition switch. Current flowing through the solenoid windings forces a heavy contact disc across the "B" and "A" terminal studs of the solenoid as long as the starter switch is engaged. Battery current is then shunted directly from the "B" solenoid terminal through the "A" terminal directly to the cranking motor through the internal cranking motor ground connection to the vehicle's chassis, through the chassis, and returns to the negative terminal of the battery to complete the cranking motor circuit.

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ACCESSORY CIRCUIT

The accessory circuits are supplied either from the batteries or the generator, depending on whether the generator is operating. If the generator is operating and the battery is discharged, the generator supplies current for both operating the accessories and charging the batteries. When the batteries are well charged, generator output will be regulated so as to provide only enough current to operate accessories.

LIGHTS

Current for operating the headlights, tail lights (if so equipped) and other electrical accessories installed on the unit is taken from the output voltage terminal on ignition switch. The headlight current passes through a 25-amp fuse installed between the ignition switch and the light switch. Flow is then to the headlights and through the headlight ground wire to the chassis. Current flows through the chassis to the negative (-) terminal on the grounded battery to complete the circuit.

HOURMETER

The hourmeter is connected into the electrical system because it is an electrically operated instrument. Current flows from "BAT" terminal on generator to a pressure switch on engine. When the engine is started and the oil pressure from its crankcase reaches 4 psi and above, the switch is closed, completing the circuit through the hourmeter to negative (-) ground in instrument panel, which is ground to chassis of vehicle.

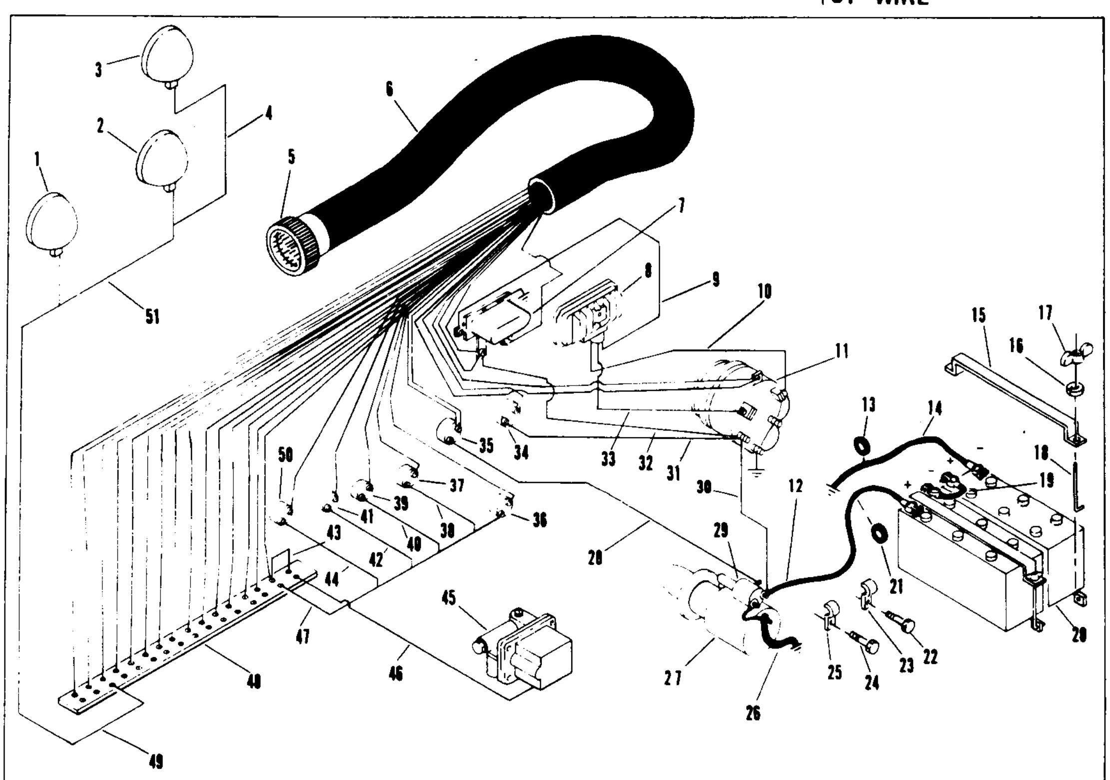
OPERATION

The heavy duty cranking motor converts electrical energy from the storage batteries into mechanical power for cranking the engine. The switch in the cockpit energizes a solenoid on the cranking motor. The solenoid, in turn, operates the shift mechanism of the cranking motor, engaging the cranking motor pinion with the engine flywheel ring gear. This shifting of the solenoid also closes the switch between the batteries and cranking motor and cranking begins.

NOTE: Never operate the cranking motor more than 30 seconds at a time without pausing to allow the cranking motor to cool for at least two minutes. Overheating, caused by excessively long cranking periods, may seriously damage the cranking motor.

The generator supplies current for the lights and other accessories and recharges the batteries when the engine is running. Generator output is controlled by means of current and voltage regulators in accordance with load requirements and state of charge of the battery. WHEN OPERATING NORMALLY, THE GENERATOR SHOULD MEET LOAD REQUIREMENTS AND KEEP THE BATTERY FULLY CHARGED, but it should not deliver a high charge to fully charged batteries. The lack of current flow to the batteries is shown by the light located on the dash pannel. Light off will indicate whether the generator is producing sufficient output, under substantial speeds to prevent prolonged and unnecessary drain on the batteries.

1 HEADLIGHT, L.H.
2 HEADLIGHT, R.H.
3 HEADLIGHT, R.H.
4 WIRE
5 PLUG, Cannon
6 HARNESS, Loom
7 RELAY
8 REGULATOR (Inc. w/ Engine)
9 WIRE
10 WIRE
11 ALTERNATOR (Inc. w/ Engine)
12 CABLE, Battery
13 GROMMET
14 CABLE, Ground
15 CLAMP, Battery
16 LKWSHR
17 NUT, Wing
18 "J" BOLT
19 CABLE, Battery
20 BATTERY
21 GROMMET
22 BOLT (Inc. w/ Engine)
23 CLAMP
24 BOLT (Inc. w/ Engine)
25 CLAMP
26 STRAP, Ground
27 STARTER (Inc. w/ Engine)
28 WIRE (
29 SOLENOID (Inc. w/ Engine)
30 WIRE
31 WIRE
32 WIRE
33 WIRE
34 SWITCH, Hourmeter Pressure
34A BUSHING
34B NIPPLE
34C TEE
35 SWITCH, Neutral Safety
36 SWITCH, Oil Pressure
37 SWITCH, Water Temperature
38 WIRE
39 SWITCH, Low Brake Pressure
40 WIRE
41 SWITCH, Converter Temperature
42 WIRE
43 WIRE
44 WIRE
45 VALVE, Shutdown (Inc. w/ Engine)
46 WIRE
47 WIRE
48 BOARD, Terminal
49 WIRE
50 SWITCH, Brake Input
51 WIRE



ELECTRICAL SYSTEM

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Fig. 1–Electrical Wiring Diagram

METER REQUIREMENTS

Diagnosing electrical trouble is difficult without the aid of proper instruments. With these instruments connected in the circuit, it should be possible to determine whether changes in adjustments are required, whether the system is performing satisfactorily or whether a specific unit or part needs replacement or repairs. A voltmeter and an ammeter should be sufficient to handle all of the normal demands.

Accuracy of diagnosis will depend primarily upon meter accuracy. Voltmeter scales should read to .1 volt dimensions as settings in tenths of volts are specified in the following pages. If a choice is available, more accuracy is desired in the voltmeter than in the ammeter. It is desirable to have a voltmeter that is accurate within 1% at full scale readings. There are a number of reputable companies which have test sets in one form or another which should prove to be satisfactory. All meters should be checked against a standard every three months. Meters are normally quite rugged in spite of their light weight construction, but more than full scale deflection, hard jolts or other rough handling may cause them to lose calibration. A check against a known standard at frequent intervals is good insurance as an inaccurate meter is worse than none at all.

ELECTRICAL DIAGNOSIS

Because of the interaction of electrical units upon each other, it is difficult in most cases to designate a single unit as being responsible for a particular trouble which may arise. Therefore, diagnosis for the entire electrical system will be outlined in detail in this section. Servicing, repairs and maintenance of the components of the electrical system will be found in the following sections.

CRANKING MOTOR CIRCUIT DIAGNOSIS CHART

TROUBLE	CAUSE	REMEDY
The lights go out as the cranking motor switch is closed.	Excessive resistance in the circuit between battery and cranking motor.	Check cables for resistance (See Sections 13 and 13A).
The lights dim considerably as the cranking motor switch is closed and the cranking motor operates slowly or not at all.	A. Defective battery.	A. Check battery (See Section 13A).
	B. Mechanical condition in engine.	B. Check for tight pistons, bearings, heavy oil.
	C. Mechanical condition in cranking motor.	C. Check for bent armature, loose pole shoe screw, worn bearings
	D. Low temperature.	D. Check engine for thickened oil check battery for reduced efficiency (See Section 13A).
The lights stay bright but no cranking action takes place when cranking motor switch is closed.	Open circuit in cranking motor or control circuit.	Place heavy jumper across solenoid main terminals eliminating solenoid control circuit. If cranking motor operates, control circuit is bad. If cranking motor does not operate, it should be tested.

CHARGING CIRCUIT DIAGNOSIS CHART

TROUBLE	CAUSE	REMEDY
Fully charged battery and low charging rate or low battery and high charging rate.	Normal generator - regulator operation	None necessary
Fully charged battery and high charging rate.	A-Poor ground connection at regulator B-High battery temperature which reduces resistance of batteries to charge so that they will accept a high rate even though voltage regulator setting is normal C-Improper voltage regulator setting D-Defective voltage regulator unit E-Grounded generator field circuit (in either generator, regulator or wiring)	A-Check ground wire and connections B-See Section 13A C-See Voltage Setting Adjustment under regulator. D-See Test and Adjustments under regulator. E-See Test and Maintenance of Generators and Test and Adjustments of regulator.
Low battery and low or no charging rate.	A-Loose connections, frayed or damaged wiring B-Defective battery C-Low regulator setting D-Defective voltage regulator E-Defects within generator	A-Check wiring B-Check battery (See Section 13A) C-See Voltage Setting Adjustment under regulator. D-See Test and Adjustments under regulator. E-See Test and Maintenance of Generators.

* * * *

CLARK EQUIPMENT

BATTERIES

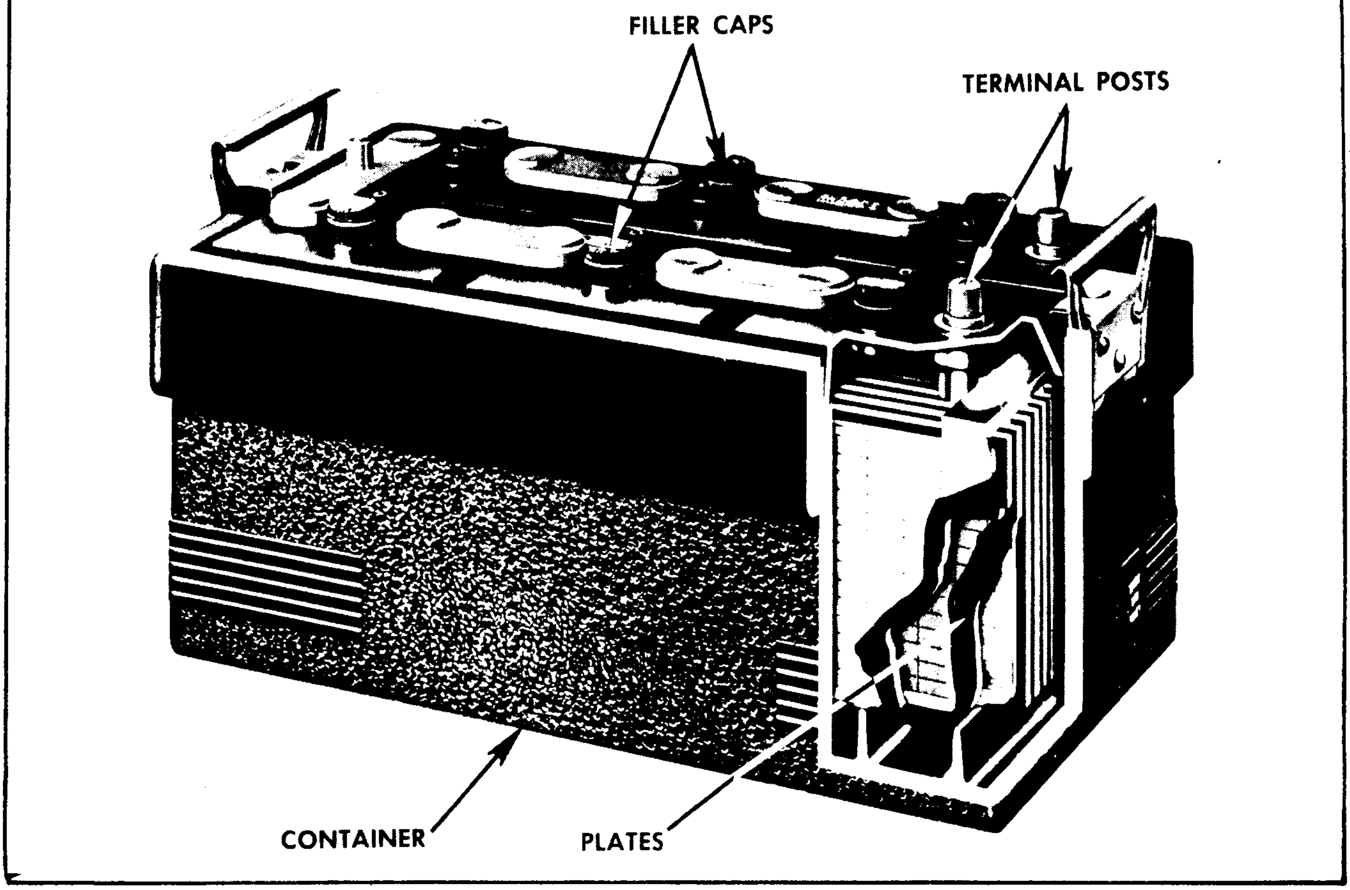


Fig. 1—Cross Section of Typical Battery

DESCRIPTION

The storage batteries used on this unit are of the lead-acid type with six (6) two-volt cells. There are two of these 12 volt batteries connected in series, thus making the electrical system 24 volts.

During operation, the storage battery functions as an electrochemical device for converting chemical energy into the electrical energy required for cranking the engine or operating the accessories when the engine is shut-down.

There are four essential chemicals in a lead-acid battery: Lead Peroxide, found on positive plates; Sulphuric acid, found in the Electrolyte; Water, found in the electrolyte; and Spongy lead, found in the negative plates.

The plates are made of a grid framework of lead-antimony alloy. The positive plates are filled with small grains of a dark brown lead peroxide material while the negative plates are filled with slate gray colored spongy lead. Both types of plates are extremely porous to allow the electrolyte to penetrate freely.

Positive and negative plates are each burned to a lead alloy casting called a strap. This assembly is called a group. These groups are interleaved and insulated with separators. The insulating separators are necessary because all the plates will lose their stored energy if one positive plate touches a negative plate. Separators are made of thin sheets of non-conductive porous materials such as chemically treated wood, porous rubber, porous sheets of resin impregnated fiber alone or in combination with perforated rubber or fiber glass mats.

These interleaved and insulated groups are called elements. The element is the working unit of each cell, with six cells composing a battery. The container for such a battery is molded of hard rubber or asphalt composition. After placement in containers, elements are connected to one another by pure lead top connectors.

The sponge lead and lead peroxide which fill the respective plates are called the "active" materials of the battery. But these materials cannot become active until they are covered by a water solution of solphuric acid called the "electrolyte". The sulphuric acid of the electrolyte supplies the sulphate which combines with each of the plate materials and releases electrical energy.

OPERATION

When a cell is discharged by completing an external circuit such as pressing the starter switch, the sulphuric acid acts on both the positive and negative plate active materials to form a new chemical compound called lead sulphate. This sulphate comes from the acid solution making it weaker as the discharge continues. The amount of acid consumed is in direct proportion to the amount of electricity used from the cell. Thus we can measure how much acid is contained in the electrolyte by the use of a hydrometer.

By passing an electrical current through the battery in a direction opposite to that of discharge we can decompose the lead sulphate. The sulphate is expelled from the plates and returns to the electrolyte thereby restoring it to its original chemical condition ready to deliver electricity again. Hydrogen and oxygen gases are given off at the negative and positive terminals respectively as the plates reach a fully charged condition. This is the result of the decomposition of water by an excess of charging current not utilized by the plates.

CAUTION: These gases are highly explosive! Do not allow sparks or flame near a charging battery!

Water is the only chemical, under normal conditions, which is lost as a result of charging a battery. It should be replaced as soon as the liquid level falls below the top of the plates. Sulphuric acid need never be replaced in a cell unless it has been lost. Improper addition of acid creates a high concentration which chars and disintegrates the wooden plate separators and also may start an undesirable chemical reaction which is injurious to battery plates.

THE MEANING OF SPECIFIC GRAVITY

Battery strength is measured in terms of specific gravity of the electrolyte. A 1.260 specific gravity reading of electrolyte at 80 degrees F. normally indicates a fully charged battery. (All measurements for specific gravity must be made at 80 degrees F. or corrected for that temperature.) This specific gravity of 1.260 means that water and acid together weigh 1.260 as much as an equal volume of water. When a battery discharges, the acid and lead combine to form lead sulphate, lowering the acid content, and thus lowering the specific gravity. Upon charge, the sulphate is removed from the active material of the plates and returns to the electrolyte as sulphuric acid with a corresponding increase in electrolyte gravity.

The state of charge of a battery should be measured with a hydrometer. Figure 2 shows what specific gravity of electrolyte at 80 degrees F. means.

If the temperature of the electrolyte is not reasonably close to 80 degrees F. when the specific gravity is taken, it should be corrected to 80 degrees F. For every 10 degrees BELOW 80 degrees F., .004 should be SUBTRACTED from the specific gravity reading. For every 10 degrees ABOVE 80 degrees F., .004 should be ADDED to the reading.

For example—Electrolyte at 0 degrees F. has a specific gravity of 1.225, indicating a 75 percent charge. Correcting for the 80 degrees temperature difference, however, we must subtract 8 x .004 (.004 subtracted for every 10 degrees BELOW 80 degrees) or .032. 1.225 minus .032 gives a corrected reading of 1.193 which shows only 50% charge. The correction becomes very important when extreme electrolyte temperatures are encountered.

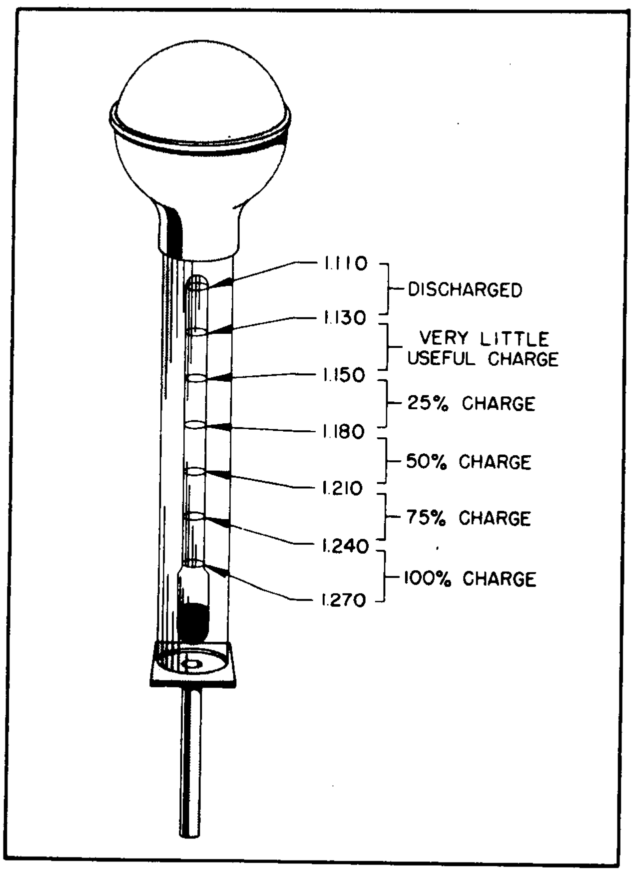


Fig. 2- Hydrometer Comparing State of Charge to Specific Gravity

MAINTENANCE & SERVICE

THE ELECTROLYTE LEVEL of each cell should be checked at the interval specified in this section and water added if necessary. The proper level to maintain is 3/8 to 1/2 inch above the plates. To insure maximum battery life, use only distilled water or water recommended by the battery manufacturer. After adding water in freezing weather, operate the engine for at least thirty (30) minutes to thoroughly mix the electrolyte.

EXCESSIVE USE OF WATER indicates leakage or overcharging. Normal water usage for a unit operating eight hours per day is about one or two ounces per month. For heavy duty operation (24 Hour) normal consumption should run about one or two ounces per week. Any appreciable amount of increase over these figures should be considered a danger signal.

OVERCHARGING which causes overheating is first indicated by excessive use of water. If allowed to continue, cell covers will push up at the positive ends and in extreme cases the battery container will become distorted and cracked. With any of these indications present, the voltage regulator setting should be carefully checked.

LEAKAGE can be detected by continual wetness of the battery or EXCESSIVE corrosion of the terminals, battery carrier and surrounding area. (A slight amount of corrosion is normal in acid batteries.) Inspect the case, covers and sealing compound for holes, cracks or other signs of leakage. Check battery hold down connections to make sure tension is not great enough to crack the battery or loose enough to allow vibration to open the seams. A badly leaking battery should be replaced.

TO REMOVE CORROSION, clean the battery with a solution of ordinary baking soda and a stiff wire brush and flush with clear water. Make sure none of the soda solution is introduced into the electrolyte as it is highly injurious to the electrolyte. Be sure terminals are clean and tight. A light coating of petrolatum will prevent corrosion at the terminals. Clean terminals are very important in a voltage regulated system because corrosion creates resistance in the charging circuit which causes undercharging and gradual starvation of the battery.

ADDITION OF ACID will be necessary if considerable electrolyte has been lost through leakage. Before adding acid, make sure the battery is fully charged. This is accomplished by putting the battery on charge and taking hourly specific gravity readings on each cell. When all the cells are gassing freely and three successive hourly readings show no rise in specific gravity, the battery is considered charged. Additional acid may now be added. Continue charging for another hour and again check the specific gravity. Repeat the above procedure until all cells indicate a specific gravity of 1.260 to 1.265 corrected to 80 degrees F.

NOTE: Use 1.400 strength acid when making gravity adjustments. Acid of higher strength will attack the plates and separators before it has a chance to diffuse into the solution.

HIGH TEMPERATURE OPERATION may make a tropical adjustment of gravity desirable. This will reduce battery maintenance and increase battery life. A tropical climate is considered one in which water never freezes. Under these conditions, it is permissible to lower the specific gravity of a fully charged battery to 1.225. This is accomplished by fully charging the battery and then removing a portion of the electrolyte and replacing it with distilled water. Continue charging to mix the electrolyte thoroughly and check gravity. Repeat the addition of distilled water until the gravity of all cells is 1.225. The following are states of charge for various specific gravity readings of a battery adjusted for tropical climate:

SP. GR.	STATE OF CHARGE
1.225	Fully charged
1.180	75% charged
1.135	50% charged
1.090	25% charged
1.045	Discharged

IDLE BATTERIES should not be allowed to stand unattended. If equipment is to stand unused for more than two weeks, the batteries should be removed and placed in a cool, dry place where they may be checked periodically and charged when necessary. Remember, all lead-acid batteries discharge slowly when not in use. This self discharge takes place even though the battery is not hooked up in a circuit and is more pronounced in warm weather than in cold. The rate of self discharge of a battery kept at 100 degrees F. is about six times that of a battery kept at 50 degrees F. and self discharge of a battery kept at 80 degrees F. is about four times that of one at 50 degrees F. Over a thirty day period, the average self discharge runs about .002 specific gravity per day at 80 degrees F.

To offset results of self discharge, idle batteries should receive a booster charge (not a quick charge) at least once every thirty days. Batteries allowed to stand for long periods of time in a discharged condition are attacked by a crystalization of the lead sulphate on the plates. Such batteries are called sulphated and are in the majority of cases irreparably damaged. In less severe cases, the sulphated battery may be restored to limited service by prolonged charging at a low rate (approximately ½ normal rate).

A battery operated with insufficient charge over a long period due either to a faulty generator or an incorrect voltage regulator setting is likewise liable to become sulphated. Such a battery should never be subjected to a prolonged overcharge which may happen if the generator or voltage regulator is reset to deliver proper charge. This overcharge will result in severely buckled plates which may pinch and chafe the separators. This results in perforated separators and an eventual short circuit in the cell. Such undercharged battery should be removed from the unit and subjected to the prolonged charge.

An undercharged battery is extremely susceptible to freezing when allowed to stand in cold weather. The electrolyte of a battery in various stages of charge will start to freeze at temperatures indicated.

The temperatures below indicate the points at which the first ice crystals appear. Lower temperatures must be reached for a solid freeze. Solid freezing of the electrolyte may crack the container and damage the positive plates. As will be noted, a 3/4 charged battery is in no danger of freezing. Therefore, a 3/4 charge or better is desirable, especially during winter weather.

SPECIFIC GRAVITY CORRECTED TO 80°F.	FREEZING TEMPERATURE DEGREES FAHRENHEIT
1.280	-90°F.
1.250	-60°F.
1.200	-19°F.
1.150	+5°F.
1.100	+19°F.

TESTING

There are two ways of testing a battery to determine its condition. These tests are to be performed when the battery alone is suspected of manfunctioning.

FIRST–Put the battery on charge to determine whether it takes a charge satisfactorily. If it does, it is probably in good condition.

SECOND–Subject the battery to a high rate discharge test after a long slow charge. This test may be made if the corrected hydrometer reading of the electrolyte is above 1.250. If the reading falls below this figure, the high discharge test SHOULD NOT BE MADE since the battery will not maintain a good voltage reading.

With the fuel shut off, operate the starter motor and quickly check the voltage across each cell with a low reading voltmeter. Do not operate the starter motor for more than thirty (30) seconds at a time without allowing it to cool off for a few minutes or the motor will be damaged by overheating. If there is no electric starting motor of if the test is made outside the vehicle, a current of at least 200 amperes must be drawn from the battery while the voltages are checked.

If the voltage during the high discharge test falls below 1.5 per cell, the battery is either discharged or is wearing out. It should be recharged and tested a second time. Remember that low temperature will cause voltage drops to lower values under the high discharge test. For this reason, it is recommended that the load test be made with the electrolyte at approximately 80 degrees F.

If, after the test, the specific gravity varies more than .025 points between cells, one or more things may be wrong. The low cell may be shorted, in which case the battery should be discarded; the low cell may have lost electrolyte, meaning specific gravity should be restored after fully charging the battery; or the battery may be wearing out. These above three ailments may also result in a variation of more than 0.2 volts between cells during the high discharge test.

A worn out battery is not difficult to distinguish from one with a shorted cell. A worn out battery can be determined by its length of service and whether it will fully charge. If it does take a full charge, the standing loss due to self discharge will probably average .002 to .003 specific gravity points per day due to small internal short circuits resulting from long service. Also, a worn out battery will sustain a heavy load such as cranking the engine longer than will a badly shorted cell, although it may show a good charge, will not sustain heavy duty discharge more than a few seconds. As the seriousness of the internal short decreases, the ability to sustain heavy duty discharge increases until the battery reacts like a worn out battery. Under these circumstances, it must be treated as a worn out battery, regardless of its length of service.

Providing the voltage did not fall below 1.5, or the variation between cells did not exceed 0.2 volts during the high discharge test or specific gravity does not vary more than .025 points after completion of the test, the battery is sound.

DIAGNOSIS

It is advisable to add a word of caution about the proper procedure to follow when a battery shows signs of continual overcharge or undercharge. Although overcharge is by far the most common cause of battery failure, undercharging when allowed to continue can quickly destroy the usefulness of a battery.

The symptoms of overcharging have already been mentioned. These signs should be looked for periodically, especially the over consumption of water. If leakage is not a factor, then overcharging is the cause. Water is not lost through evaporation because the sulphuric acid in the electrolyte has the ability to attract moisture from the atmosphere. Thus the only way that water can be lost is through gassing of the electrolyte which occurs only when a charge is maintained on a battery after it is fully charged.

To remedy constant overcharging of a battery, the voltage regulator setting should be reduced. This may make the reading of the voltage regulator lower than the specifications called for but the specifications are set up for average conditions. The lowest voltage regulator setting which keeps the batteries adequately charged with a minimum use of water is considered the correct setting. This setting may vary widely depending upon the application. Bear in mind, however, that the setting should fall within the range set up in the regulator specifications.

Undercharging is another malady which must be dealt with promptly if the batteries are to give satisfactory service. The most logical way to check for battery undercharging is with a hydrometer. Daily hydrometer checks will show a consistently low gravity reading on undercharged batteries. The cranking motor will also be sluggish and may become inoperative.

Undercharging can be remedied by raising the voltage regulator setting within the limits of the specifications. This must be done carefully, however, as a setting of 0.2 volts over what is actually needed can result in definite overcharge to the batteries. Keep a careful check on battery water consumption after such an adjustment is made.

Overloading the unit with extra electrical items which are installed in the field without the approval of the factory may disturb the balance of the electrical system. Additions should never be made until it has been definitely established that the existing system is adequate to furnish the necessary current. In many cases, higher output equipment will be necessary to safely carry the extra load. Under such a condition, the regulator cannot be adjusted to compensate for the load because the capacity of the generator is not high enough to do the job. Undercharged, sulphated batteries are the result of an overloaded system.

* * * *

CLARK EQUIPMENT

INSTRUMENT PANEL

The vandalism resistant instrument panel may be closed and locked, or opened by inserting key in vandalism lock and sliding protective door to the left to expose the instrument panel for operation. Lock the protective door in the open position. The key may be left in the lock while the machine is in operation, but the key should be removed and the protective door locked if the machine is not in operation.

It is good practice to observe lights frequently while working the machine. Each light on the instrument panel serves as an important check for operating conditions of the torque converter and transmission, and of the engine and accessories. Do not operate the unit if lights are not functioning properly. A check for burned out warning light bulbs can be made by pushing the "TEST" button located on the instrument panel. Button is indicated in Figure 6. Leave the ignition switch on at all times when the engine is running or the lights will not function.

Red Oil Pressure Light, the top light in the nine-light cluster located on the right-hand side of the instrument panel, monitors tractor engine oil pressure. If the light should come on while the engine is running above low idle, shut down engine immediately and determine the cause.

Red Water Temperature Light monitors tractor engine water temperature. If the light comes on during operation, coolant termperature is near boiling point. Idle tractor engine, carefully remove radiator cap and add water. When temperature lowers sufficiently to cause light to go off, shut off engine and troubleshoot cooling system for cause of overheating.

Red Battery Light Monitors current flow from the alternator. Light will come on when the alternator stops producing electrical energy.

Red Brake Pressure Light monitors air pressure in the reservoir for operating air-operated components on the units, such as air-over-hydraulic brakes, horn, seat, etc. The brake pressure light comes on when the reservoir pressure drops below 75 psi.

Yellow Downshift Light monitors temperature of fluid in tractor torque converter and transmission lubricating system. When temperature in these systems reaches approximately 250°F, the downshift light will come on, warning the operator to shift to a lower speed range (the warning buzzer will not sound).

Warning Buzzer indicates trouble in one of the systems monitored by the instrument panel. If one of the red lights come on, the warning buzzer will emit a shrill, clearly audible sound to indicate a deficiency. The warning buzzer will sound each time the ignition switch is turned to the "ON" position. The buzzer sounds when the ignition switch is turned on because the engine is not running; hence, there is low oil pressure in the engine, and the battery is not being charged.

Tachometer registers the rpm (speed in revolutions per minute) of the tractor engine. The tachometer is designed to assist the operator in selecting and maintaining the power requirements necessary to obtain maximum operating efficiency of the machine for any operating conditions. The tachometer rpm range is calibrated in 100 rpm increments, starting with 0 rpm up through 4000 rpm.

Always operate the machine in the recommended operating range. Operating range is listed in Specifications and Service Data at the rear of this manual. Whenever tachometer indicated rpm is either above or below that rpm range for normal operation, downshift or upshift, depending on whether the reading is at the low or high range side.

The tachometer is equipped with an integral hourmeter which indicates the working time of the machine in hours and tenths of hours.

Test Button is used to test warning lights to see whether or not these lights have burned out bulbs. This button does not check wiring or senders.

Ignition Switch energizes all applicable warning lights for the specific machine, the warning buzzer, and the starting motor circuit. Turn handle to right for "ON" position.

Starter Switch energizes cranking motor to start engine. Press to operate; release when engine starts. Do not crank engine continuously for more than 30 seconds to avoid damage to cranking motor. Pause a few minutes between cranking cycles, if difficulty is encountered temporarily cease cranking to let windings cool.

Heater Switch energizes optional heater fan motor to force warm air from the heater into the cab. Press the turn heater "ON". Press button again to turn heater off.

Wiper Switch turns wipers on by being pushed. Light in button will come on indicating wiper circuit is on. Press button again to turn wipers off.

Load Lights Switch energizes load lights so that machine may be operated at night. Light in button will come on indicating load light circuit is on. Press button again to turn load lights off. These load lights are optional equipment.

Turn Signal Switches energize turn signals for either left or right-hand turn. Buttons are marked "L" for left-hand turn indicator and "R" for right-hand turn indicators. Desired direction button is pushed to activate turn signals and bulb inside button flashes. Button is pressed again to turn off optional turn signals. Both signal switches can be energized at the same time for "EMERGENCY" flasher.

Defroster Switch energizes optional defroster fan motor to force warm air out onto cab window, removing frost and preventing formation of frost and ice on the windshield. Light in button will come on indicating defroster fan is "ON". Button is pressed again to turn defroster fan off.

Precleaner Switch energizes the optional precleaner motor. Light in button will come on indicating precleaner fan motor is "ON". Button is pressed again to turn precleaner fan off.

Headlights Switch turns headlights, tail lights and instrument panel lights on. Light in button will come on indicating headlights are on. Button is pressed again to turn headlights off.

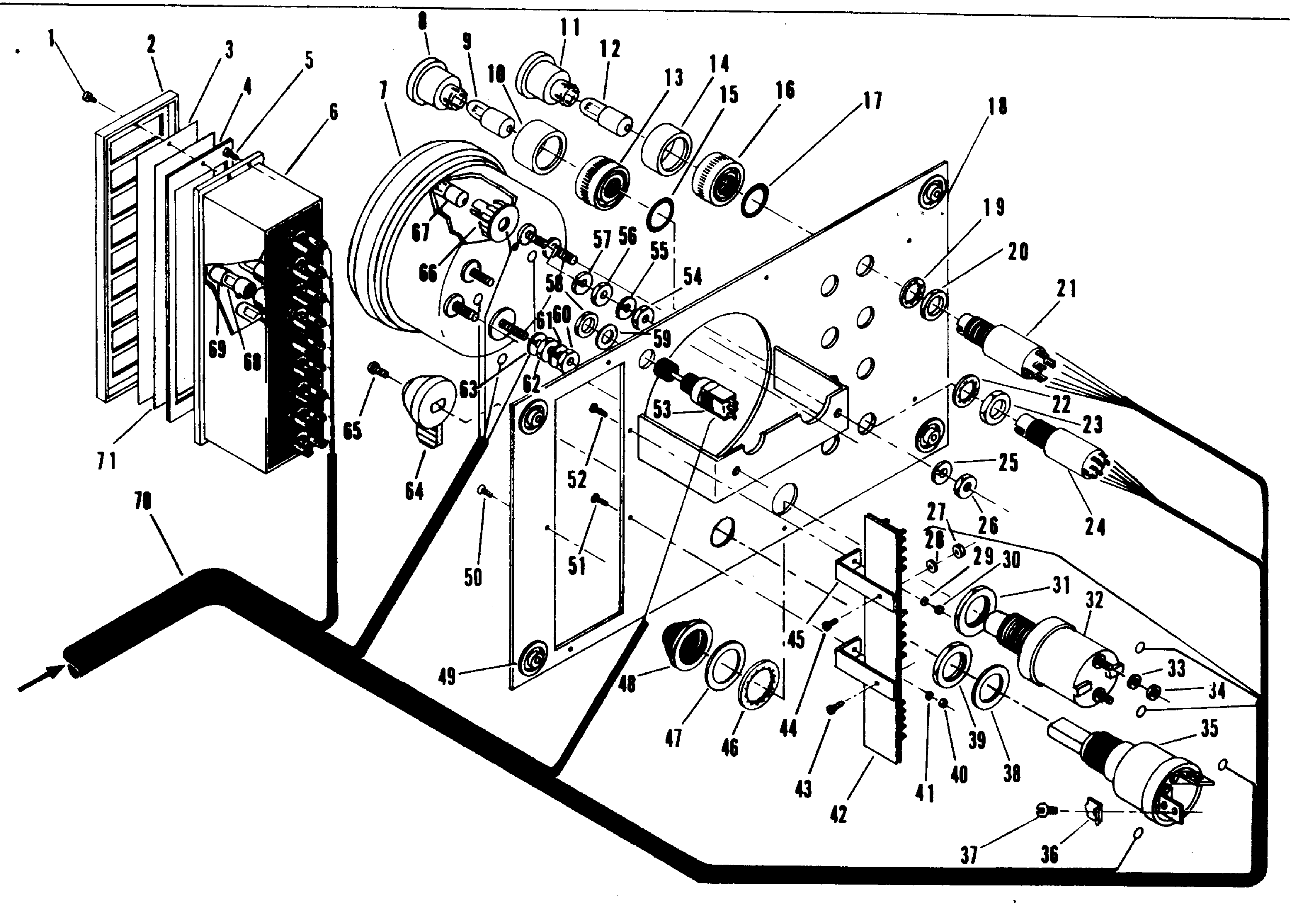
ELECTRICAL SYSTEM AND INSTRUMENT PANEL DIAGNOSIS CHART

TROUBLE	CAUSE	REMEDY
When ignition is on and nothing on the instrument panel will operate	Dead battery	Service and charge battery
	Fuse blown	Check wiring for short circuit and replace blown fuse F108 (24 V DC IN)
	Loose or defecting wiring or connector plug	Check all wiring tighten connector plug on left end of instrument panel
	Defective ignition switch	Replace ignition switch inside instrument panel
Tachometer not working properly	Alternator belts loose	Tighten alternator belts
	Fuse blown	Check wiring for short circuit and replace blown fuse F107 (24 V DC OUT)
	Out of adjustment	Adjust tachometer (see write-up)
	Loose or defective wiring	Check wire #32 that connects to REL terminal on alternator
	No output from alternator due to faulty voltage regulator or alternator	Check voltage regulator and alternator and repair if necessary. Voltage output from REL terminal on alternator should be at least 11-volts AC
	Defective tachometer	Replace tachometer
None of the warning lights or buzzer will operate when the test button is pushed. NOTE: The ignition switch must be on for the warning lights and buzzer to operate.	Fuse blown	Check wiring for short circuit and replace blown fuse F107 (24 V DC OUT)

TROUBLE	CAUSE	REMEDY
One or more of the warning lights will not work when test button is pushed	Burnt out bulb(s) in instrument panel warning light assembly	Remove bezel and replace bulb(s) (see write up)
	Loose ground wire	Check ground wire #17
Warning light will not work in operation but will burn when test button is pushed. Test button only checks bulbs.	Defective sender	Replace sender that is on engine, converter, or brake line
	Loose or defective wiring	Check wiring to senders
Buzzer will not work when a red warning light is on	Buzzer defective	Replace buzzer in instrument panel.
Turn Signals not working properly	Blown fuse	Check wiring for short circuit and replace blown fuse F105
	Burnt out bulb(s)	Replace burnt out bulb(s) in front and rear signal lights.
	Loose or defective wiring	Check wiring to turn signal lights.
	Defective flasher	Replace flasher inside instrument panel
	Lack of good ground between signal light and frame	Check signal light mounting on metal base for ground through fasteners.
Battery warning light on and buzzer sounds	Loose or defective wiring	Check all wiring. Especially check wire #31 to REL terminal on alternator
	Loose or worn out alternator belts causing slippage	Tighten or replace alternator belts
	Misadjusted or defective voltage regulator	Check and adjust voltage regulator so the alternator will charge at the rate of 27-1/2 volts. Replace defective voltage regulator

TROUBLE	CAUSE	REMEDY
	Defective alternator	Replace or repair alternator. Voltage from REL terminal on a alternator needs to be at least 11-volts AC to energize the normally closed battery light relay inside the instrument panel.
	Defective battery light relay	Replace battery light relay inside instrument panel
Hourmeter not working	Defective hourmeter sender switch	Replace hourmeter sender switch. This switch is normally open and makes contact at 4 psi engine oil pressure
	Loose or defective wiring	Check wire #34 and #27
	Defective hourmeter	Replace hourmeter and tachometer assembly inside instrument panel
One of accessories will not operate NOTE: All accessories except head lights and windshield wiper are optional equipment	Fuse blown	Check for short circuit and replace any blown fuses.
	Loose or defective wiring	Check wiring to accessory that will not work
	Defective accessory	Replace or repair defective part.
	Defective accessory switch	Replace defective accessory switch inside instrument panel
Light in accessory switch button will not come on when pressed	Burnt out bulb	Pull rubber boot and cap off accessory switch, replace bulb, reinstall rubber boot and cap.
Nothing happens when starter button is pressed	Transmission cab control not in neutral position	Put cab control in neutral position
	Fuse blown	Check for short circuit and replace F108 fuse (24 V DC IN)

TROUBLE	CAUSE	REMEDY
	Dead battery	Service and charge battery
	Loose or defective wiring or battery cables	Check all wiring and cables attached to starter
	Defective neutral start switch	Replace defective neutral start switch on transmission cab control
	Defective starter switch	Replace starter switch inside instrument panel
Water inside instrument panel	Washing instrument panel with high water pressure or steam pressure	Do not wash instrument panel with high pressure water or steam. Remove face of instrument panel and dry out inside of panel
	Defective seal, leaking around switches or instruments	Tighten any loose switches or instruments. Tighten screws that holds face of panel to chassis. Check all seals, be sure the tach adjustment plug in the rear of the panel is in place
Fuse in panel will not stay in or will not make contact	Defective fuse holder	Replace defective fuse holder inside panel.



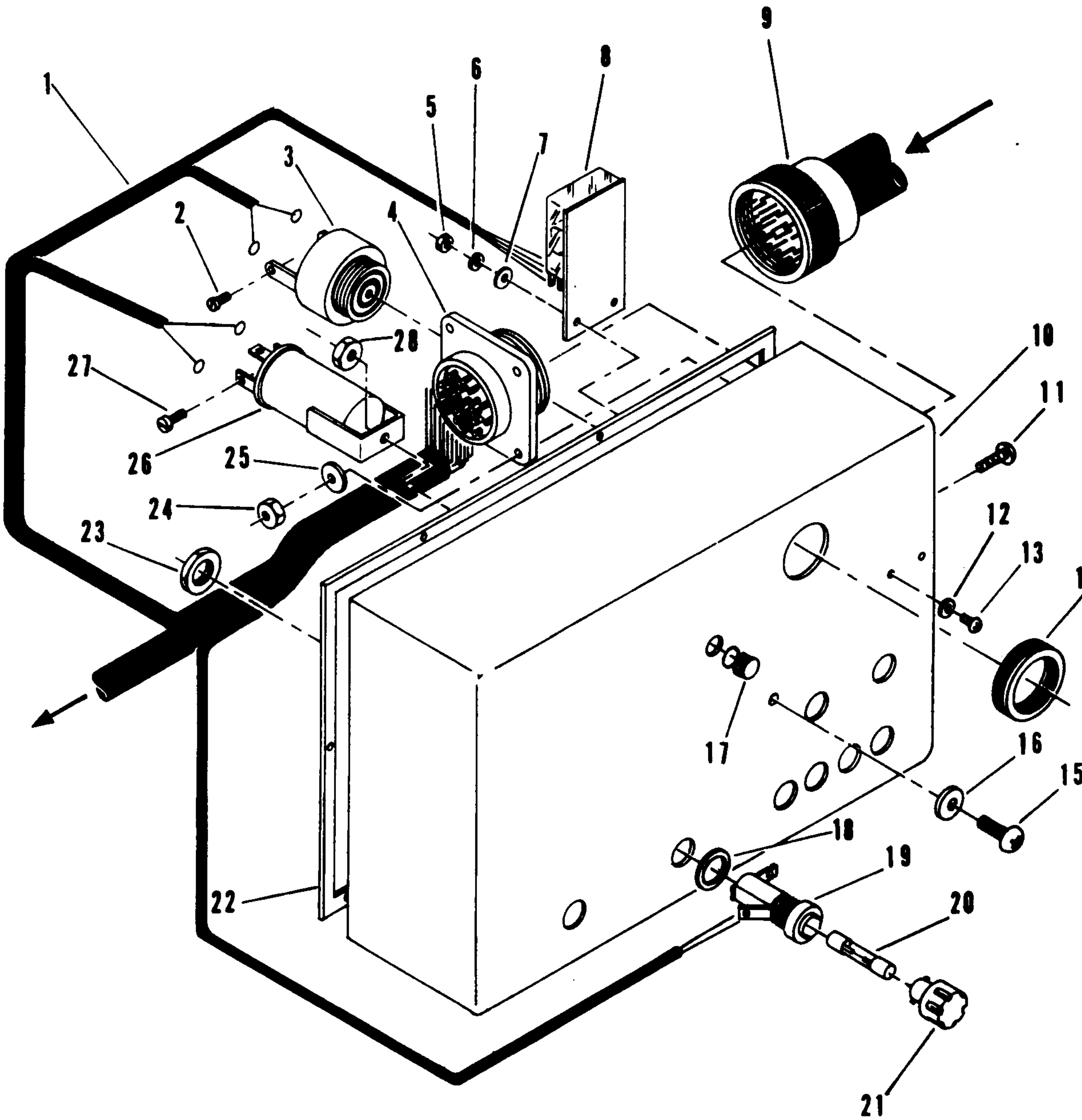
ELECTRICAL SWITCHES AND INSTRUMENT PANEL - FRONT

ELECTRICAL SWITCHES AND INSTRUMENT PANEL - FRONT

Item	Description	Qty.
A	INSTRUMENT PANEL ASSY,Complete	1
1	SCREW,Pan Head	2
2	COVER,Bezel	1
3	GLASS	1
4	SEAL,Rubber	1
5	SCREW,Pan Head	2
6	BOX,Lamp	1
7	TACHOMETER,Hour	1
8	CAP,Left Switch	1
8A	†CAP,Right Switch	1
9	BULB,G.E. 327	2
10	COVER,Rubber	2
11	CAP,Switch	6
12	BULB,G.E. 327	6
13	§CAP (Inc with 24)	2
14	COVER,Rubber	6
15	§O-RING (Inc with 24)	2
16	§CAP (Inc with 21)	6
17	§O-RING (Inc with 21)	6
18	PANEL	1
19	§LKWSHR (Inc with 21)	6
20	§NUT (Inc with 21)	6
21	§SWITCH (Inc 11,12,14, 16,17,19 & 20)	6
22	§LKWSHR (Inc with 24)	2
23	§NUT (Inc with 24)	2
24	SWITCH,LH (Inc 8,9, 10,13,15,22 & 23)	1
24A	SWITCH,RH (Inc 8,9, 10,13,15,22 & 23)	1
25	LKWSHR (Inc with 7)	1
26	§NUT (Inc with 7)	1
27	§ NUT,Plain Hex	2
28	§ FLATWASHER	2
29	FLATWASHER	1
30	NUT	1
31	§NUT (Inc with 32)	1
32	SWITCH (Inc 31,33, 34,46,47 & 48)	1
33	§LKWSHR (Inc with 32)	2
34	§NUT (Inc with 32)	2

Item	Description	Qty.
35	SWITCH,Ignition (Inc 36,37,38,39,64&65)	1
36	§LKWSHR (Inc with 35)	2
37	§SCREW (Inc with 35)	2
38	§WASHER (Inc with 35)	1
39	§NUT (Inc with 35)	1
40	NUT	1
41	WASHER	1
42	BOARD,Terminal	1
43	§SCREW,Pan Head (Inc with 42)	1
44	§SCREW,Pan Head (Inc with 42)	1
45	§STRAP,Steel (Inc with 42)	2
46	§LKWSHR (Inc with 32)	1
47	§FLATWASHER (Inc w/32)	1
48	§COVER,Start (Inc with 32)	1
49	MOUNT,Shock	4
50	SCREW	6
51	SCREW,Pan Head	1
52	SCREW,Pan Head	1
53	SWITCH,Test (Inc 58 & 59)	1
54	§NUT (Inc with 7)	1
55	§LKWSHR (Inc with 7)	1
56	§NUT (Inc with 7)	1
57	§LKWSHR (Inc with 7)	1
58	§NUT (Inc with 53)	1
59	§FLATWASHER (Inc with 53)	1
60	§NUT (Inc with 7)	1
61	§LKWSHR (Inc with 7)	1
62	§NUT (Inc with 7)	1
63	§LKWSHR (Inc with 7)	1
64	§LEVER (Inc with 35)	1
65	§SCREW (Inc with 35)	1
66	LIGHT ASSY,Tachometer (Inc with 7)	1
67	§BULB (Inc with 7)	1
68	BULB	9
69	FILM,Legend	1
70	§WIRE BUNDLE (Inc in Instrument Panel)	1

† Not Illustrated
§ Not Serviced Separately



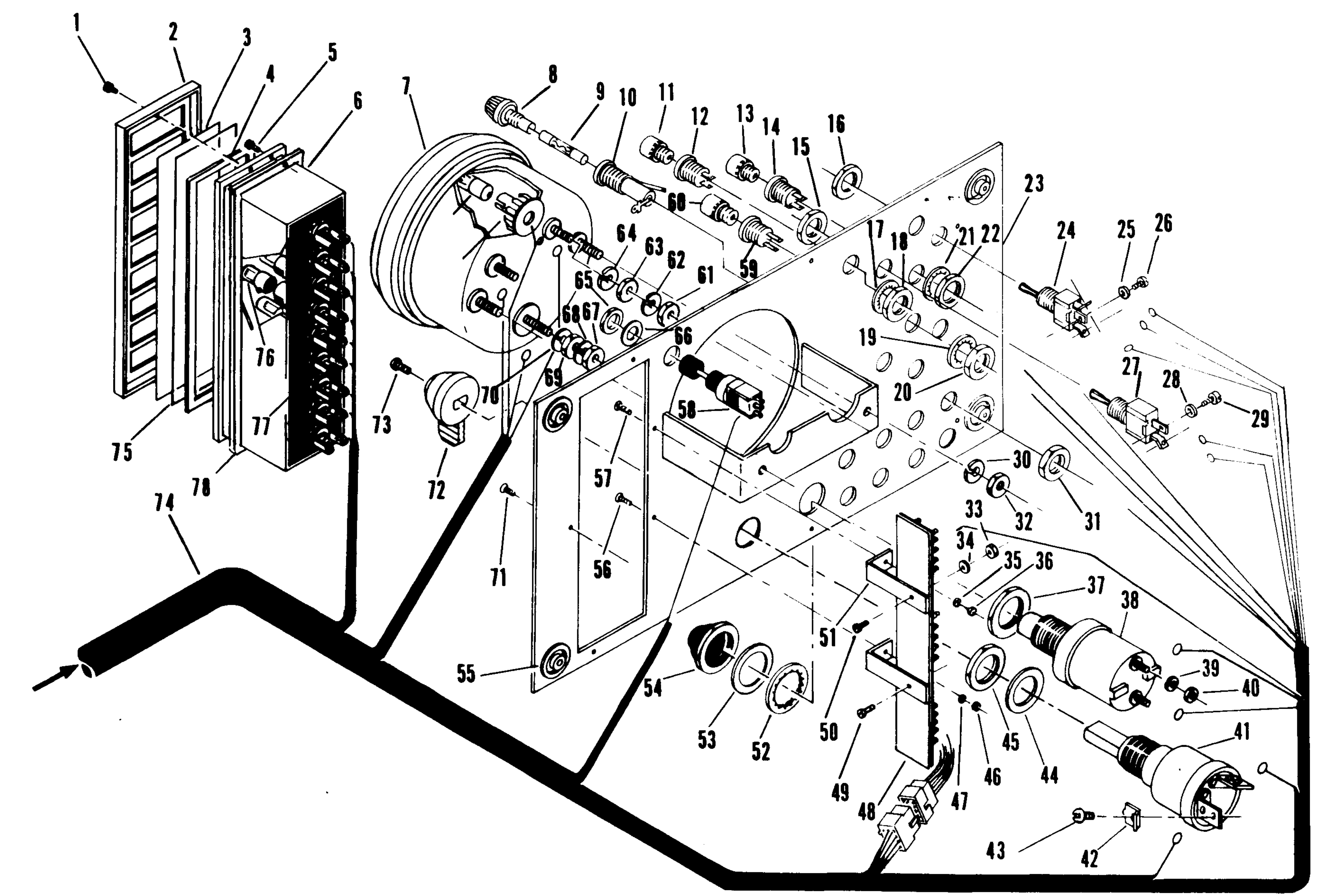
INSTRUMENT PANEL - REAR

1608A

INSTRUMENT PANEL - REAR

Item	Description	
1	§ WIRE BUNDLE (Inc in Instrument Panel)	1
2	§ SCREW (Inc with 3)	2
3	WARNING DEVICE ASSY (Inc 2)	1
4	CONNECTOR (Inc 9)	1
5	NUT	2
6	§ LKWSHR	2
7	FLATWASHER	2
8	RELAY ASSY	1
9	CONNECTOR (Inc with 4)	1
10	BOX,Panel Back	1
11	SCREW,Pan Head	4
12	FLATWASHER	2
13	SCREW,Crosspoint	2
14	NUT,Retainer (Inc with 3)	1
15	SCREW,Pan Head	1
16	FLATWASHER	1
17	COVER,Dust (Inc with 10)	1
18	WASHER (Inc with 19)	1
19	FUSEHOLDER (Inc 18,20,21 & 23)	8
20	FUSE	7
21	CAP,Fuseholder (Inc with 19)	8
22	SEAL (Inc with 10)	1
23	NUT (Inc with 19)	8
24	NUT	4
25	FLATWASHER	4
26	FLASHER (Inc 27)	1
27	SCREW (Inc with 26)	3
28	NUT	1
29	FUSE	1

§ Not Serviced Separately



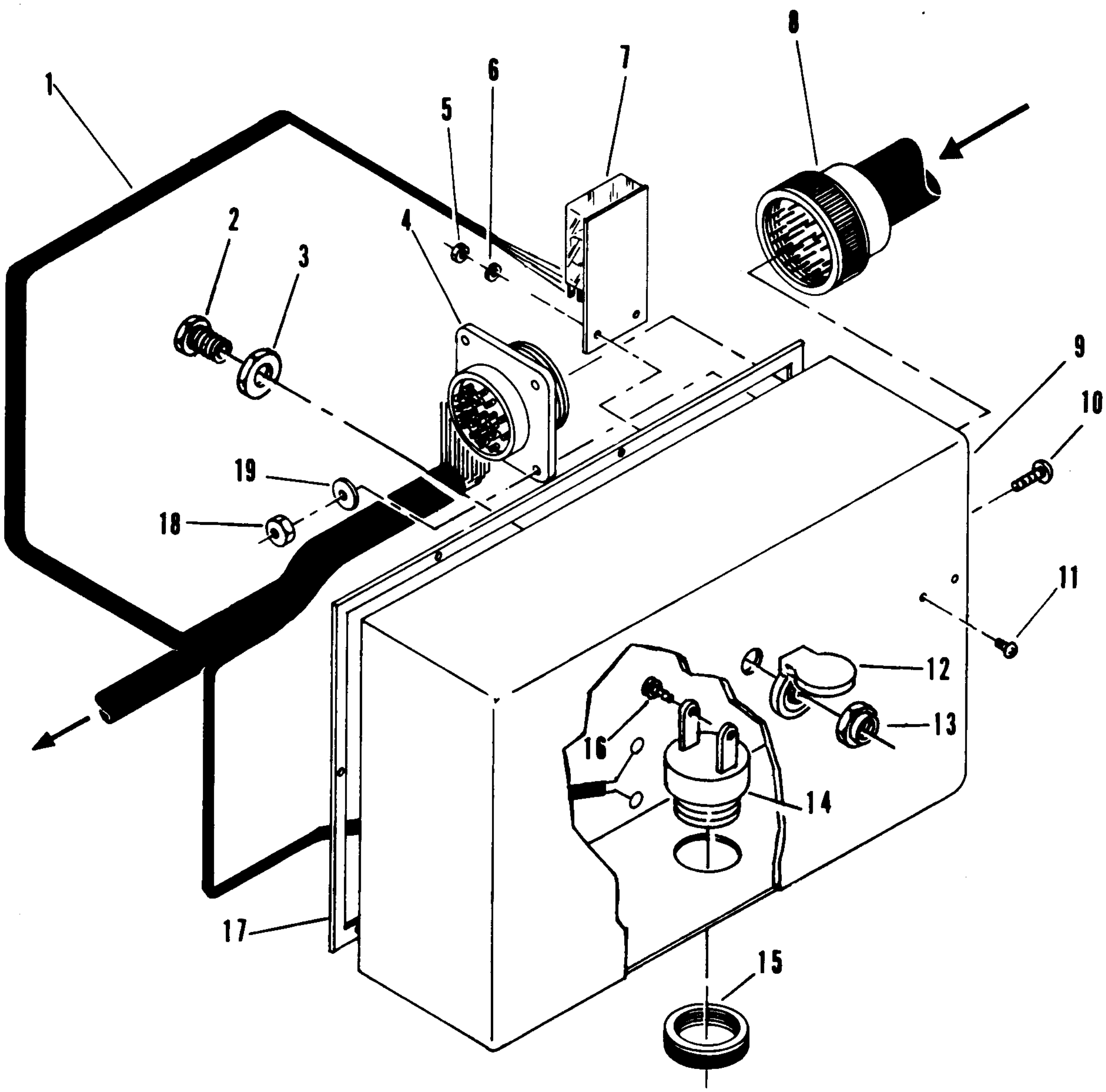
ELECTRICAL SWITCHES AND INSTRUMENT PANEL (FRONT)

1935

ELECTRICAL SWITCHES AND INSTRUMENT PANEL – FRONT

Item	Part No.	Description	Qty.
A		INSTRUMENT PANEL ASSY (Inc. Front & Rear)	1
1		SCREW, Pan Head	2
2		COVER, Bezel	1
3		GLASS, Lens	1
4		SEAL, Rubber	1
5		SCREW	2
6		BOX, Lamp	1
7		TACHOMETER, Hour	1
8		§CAP, Fuseholder (Inc. w/ 10)	8
9		FUSE (10 Amp)	2
9A		†FUSE (2 Amp)	2
9B		†FUSE (25 Amp)	3
9C		†FUSE (35 Amp)	1
10		FUSEHOLDER	8
11		§BULB (ON) (Inc. w/ 12)	2
12		LIGHT ASSY (Inc. 11)	2
13		§BULB (LO) (Inc. w/ 14)	2
14		LIGHT ASSY (Inc. 13)	2
15		§NUT (Inc. w/ 27)	2
16		§NUT (Inc. w/ 24)	2
17		§LKWSHR (Inc. w/ 12)	2
18		§NUT (Inc. w/ 12)	2
19		§LKWSHR (Inc. w/ 59)	2
20		§NUT (Inc. w/ 59)	2
21		§LKWSHR (Inc. w/ 14)	2
22		§NUT (Inc. w/ 14)	2
23		PANEL	1
24		SWITCH (SPDT) (Inc. 16)	3
25		LKWSHR (Inc. w/ 24)	3
26		SCREW (Inc. w/ 24)	3
27		SWITCH (SPST) (Inc. 15)	2
28		LKWSHR (Inc. w/ 27)	2
29		SCREW (Inc. w/ 27)	2
30		§LKWSHR (Inc. w/ 7)	1
31		§NUT (Inc. w/ 10)	1
32		§NUT (Inc. w/ 7)	1
33		§NUT (Inc. w/ 48)	2
34		§WASHER (Inc. w/ 48)	2
35		WASHER	1
36		NUT	1
37		§NUT (Inc. w/ 38)	1
38		SWITCH, Starter (Inc. 37, 39, 40, 52, 53, 54)	1
39		§LKWSHR (Inc. w/ 38)	2
40		§NUT (Inc. w/ 38)	2
41		SWITCH, Ignition	1
42		§LKWSHR (Inc. w/ 41)	2
43		SCREW (Inc. w/ 41)	2
44		§WASHER (Inc. w/ 41)	1
45		§NUT (Inc. w/ 41)	1
46		NUT	1
47		WASHER	1
48		BOARD, Terminal	1
49		§SCREW, Pan Head (Inc. w/ 48)	1
50		§SCREW, Pan Head (Inc. w/ 48)	1
51		§STRAP, Steel (Inc. w/ 48)	2
52		§LKWSHR (Inc. w/ 38)	1
53		§WASHER (Inc. w/ 38)	1
54		§COVER, Start Button (Inc. w/ 38)	1
55		MOUNT, Shock	4
56		SCREW	1
57		SCREW	1
58		SWITCH, Test (Inc. 65, 66)	1
59		LIGHT (Inc. 17, 18, 60)	2
60		§BULB, Light (HI) (Inc. w/ 59)	2
61		§NUT (Inc. w/ 7)	1
62		§LKWSHR (Inc. w/ 7)	1
63		§NUT (Inc. w/ 7)	1
64		§LKWSHR (Inc. w/ 7)	1
65		§NUT (Inc. w/ 58)	1
66		§WASHER (Inc. w/ 58)	1
67		§NUT (Inc. w/ 7)	1
68		§LKWSHR (Inc. w/ 7)	1
69		§NUT (Inc. w/ 7)	1
70		§LKWSHR (Inc. w/ 7)	1
71		SCREW	5
72		§LEVER (Inc. w/ 41)	1
73		§SCREW (Inc. w/ 41)	1
74		§WIRE BUNDLE (Inc. w/ Inst. Panel)	1
75		LEGEND, Film	1
76		LAMP	9
77		SOCKET, Strip	1
78		GASKET, Box	1

† Not Illustrated
§ Not Sold Separately



ELECTRICAL SWITCHES AND INSTRUMENT PANEL – REAR

1936

ELECTRICAL SWITCHES AND INSTRUMENT PANEL – REAR

Item	Part No.	Description	Qty.
1		§WIRE BUNDLE (Inc. w/ Instrument Panel)	1
2		BUSHING (Inc. 3)	1
3		§NUT (Inc. w/ 2)	1
4		CONNECTOR (Inc. w/ 1)	1
5		NUT	2
6		LKWSHR	2
7		RELAY ASSY	1
8		WIRING HARNESS	1
9		BOX, Panel Back (Inc. w, 3, 12, 13)	1
10		SCREW, Pan Head	4
11		SCREW	2
12		COVER (Inc. 13)	1
13		§NUT (Inc. w/ 12)	1
14		ALARM (Inc. 15, 16)	1
15		§RETAINER (Inc. w/ 14)	1
16		SCREW (Inc. w/ 14)	2
17		SEAL (Inc. w/ 9)	1
18		NUT	4
19		WASHER	4

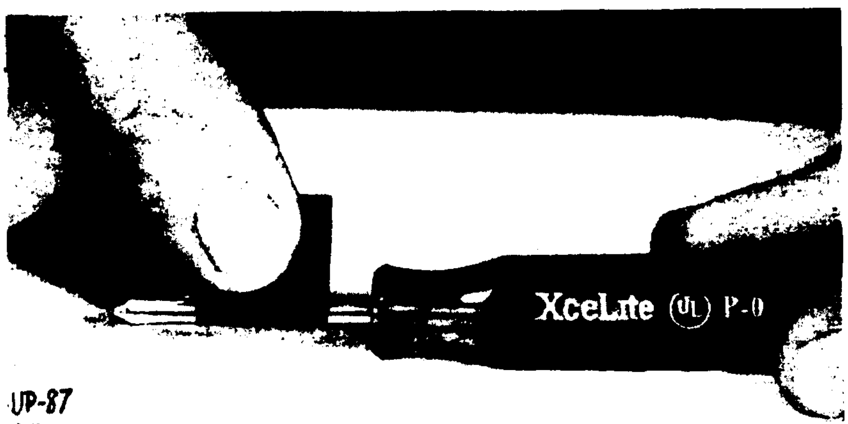
§Not Sold Separately

TACHOMETER CALIBRATION

To calibrate the tachometer, the following adjustment can be made after the instrument panel is installed in the cockpit:

A. Remove the front access panel of the cockpit

B. Insulate the shaft of a small (No. 0) Phillips type screwdriver, with a layer of plastic tape (See Figure).



UP-87

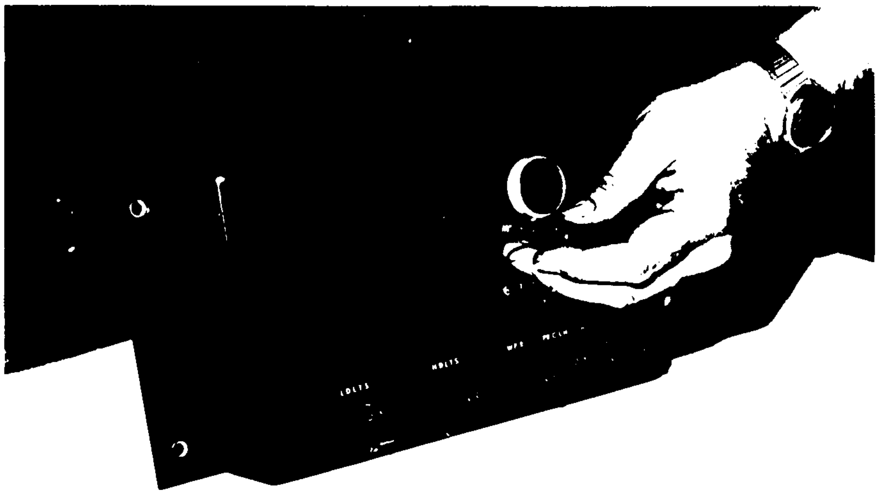
INSULATING SCREWDRIVER SHAFT

C. Remove plug from access hole in rear of instrument panel.

D. Connect master tachometer or precalibrated tachometer to engine.

E. Start engine. After a few minutes warm up, set throttle to 80% of governed engine speed.

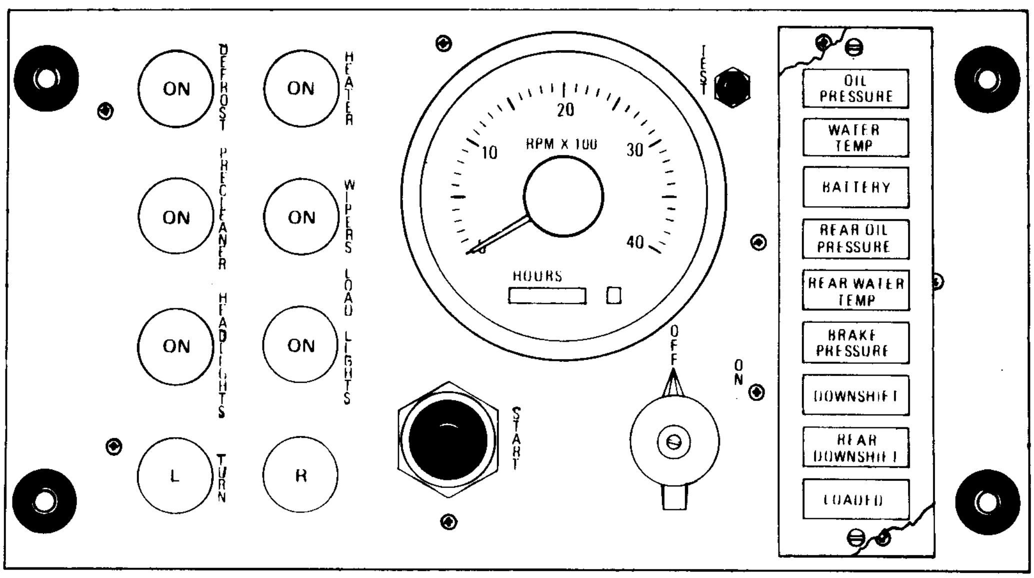
F. Using Phillips type screwdriver with insulated shaft, adjust the potentiometer inside the access hole until the alternator tachometer agrees with the indication on the master tachometer.



TACHOMETER ADJUSTMENT

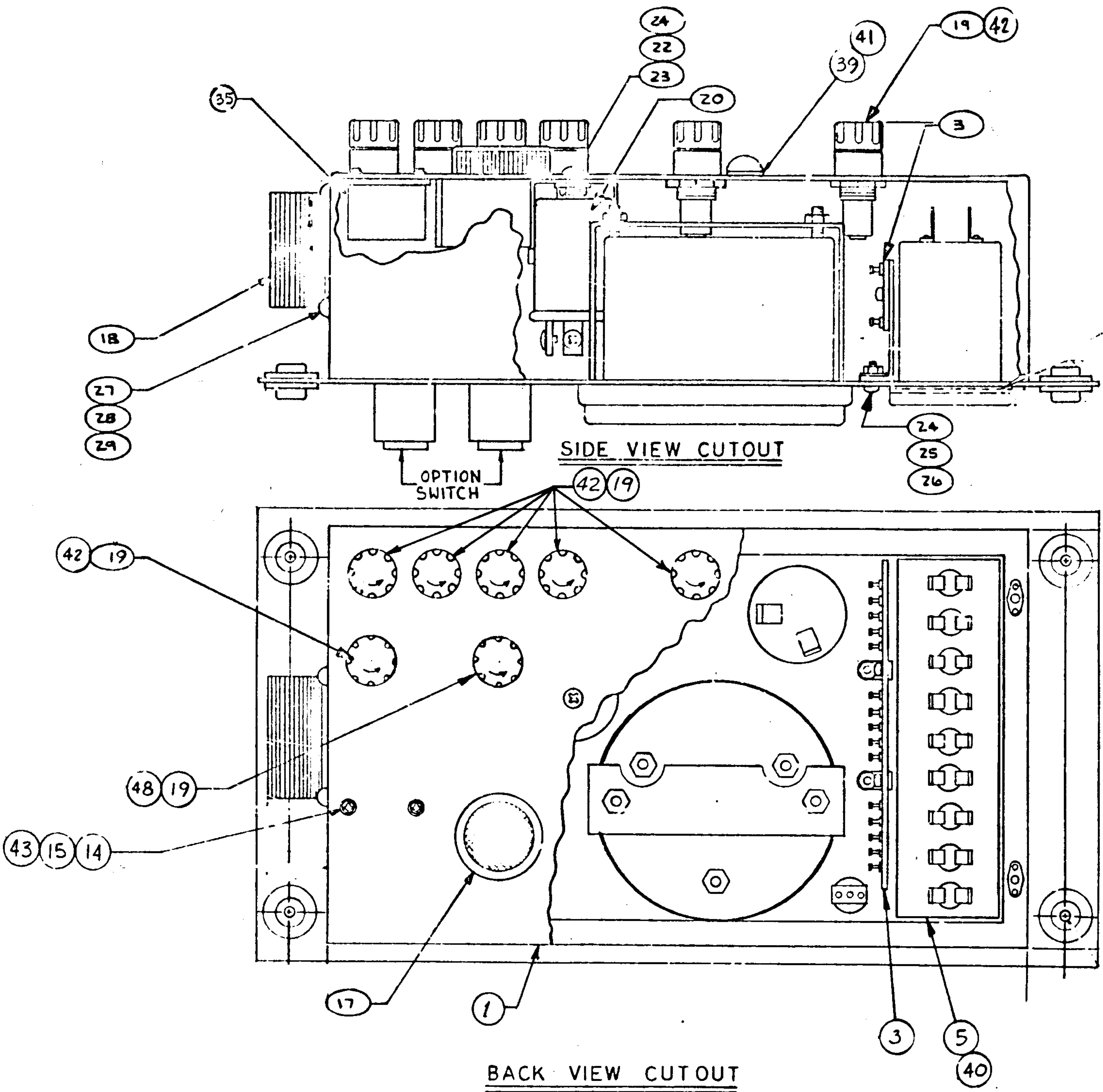
G. Replace plug in instrument panel access hole, replace front access panel on cockpit, disconnect master tachometer.

NOTE: A loose alternator belt may cause tachometer fluctuations.



FRONT VIEW

1668


24
22
23
20
41
39
19
42
35
3
18
27
28
29
24
25
26
OPTION SWITCH
SIDE VIEW CUTOUT
42
19
42
19
48
19
43
15
14
17
1
3
5
40
BACK VIEW CUTOUT

INSTRUMENT PANEL

KEY	DESCRIPTION	QUANTITY
1	Chassis Assembly	1
2	Panel Face	1
3	Component Board	1
4	Hour Tachometer	1
5	Light Indicator	1
6	Accessory Switch	6
7	Turn Switch, L	1
8	Turn Switch, R	1
9	Starter Switch	1
10	Ignition Switch	1
11	Shock Mount	4
12	Screw	6
13	Screw	2
14	Flatwasher	4
15	Screw	2
16	Test Switch	1
17	Warning Buzzer	1
18	Connector	1
19	Fuse Holder	8
20	Flasher	1
21	Washer	1
22	Nut	1
23	Screw	1
24	Flatwasher	2
25	Nut	2
26	Screw	4
27	Flatwasher	4
28	Nut	4
29	Relay Assembly	1
30	Rubber Seal	1
31	Cover Bezel	1
32	Lens	1
33	O-ring	1
34	Bulbs	9
35	Snap Plug	1
36	Fuse (25A)	7
37	Locking Nut	2
38	Legend Film	1
39	Rubber Gasket	1
40	Screw	2
41	Fuse (35A)	1
42	Screw	2

INSTRUMENT PANEL

The following items of the instrument panel can be serviced without opening the panel.

1. Warning light bulbs
2. Accessory switch bulbs, buttons, and rubber seals
3. Fuses
4. Adjustment of the tachometer
5. Replacement of shock mounts

To service the following items of the instrument panel the panel will have to be removed from the unit and the face of the panel will have to be removed.

1. Ignition switch replacement
2. Starter button replacement
3. Complete accessory switch replacement
4. Flasher replacement
5. Tachometer replacement
6. Warning buzzer replacement
7. Fuse holder replacement
8. Battery light relay switch replacement
9. Push to test button
10. Cannon plug replacement
11. Warning light assembly replacement
12. Electrical diode board assembly replacement

Removal of instrument panel from dashboard

1. Remove access door from front of cockpit
2. Unscrew cannon plug from end of instrument panel
3. Remove 4 screws that holds instrument panel to dashboard
4. Remove instrument panel from bottom

Removal of face of instrument panel (See Figure)

1. Remove bezel that covers warning lights by removing two screws (Key 47)

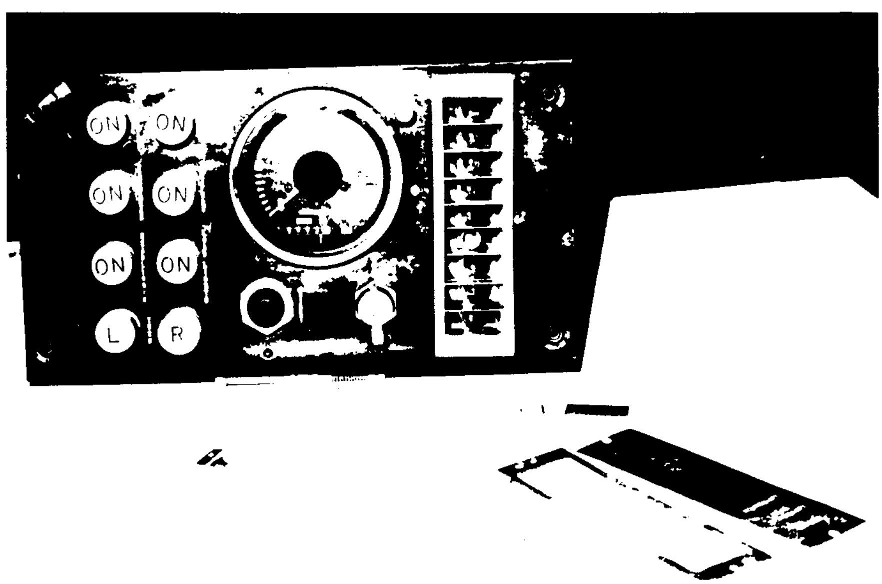
2. Remove two screws (Key 13), and five screws (Key 12) around the outside face of the panel that gently lift off the face of the panel.

   NOTE: The two screws (Key 49) that are between the tach and the warning light bezel should not be removed.

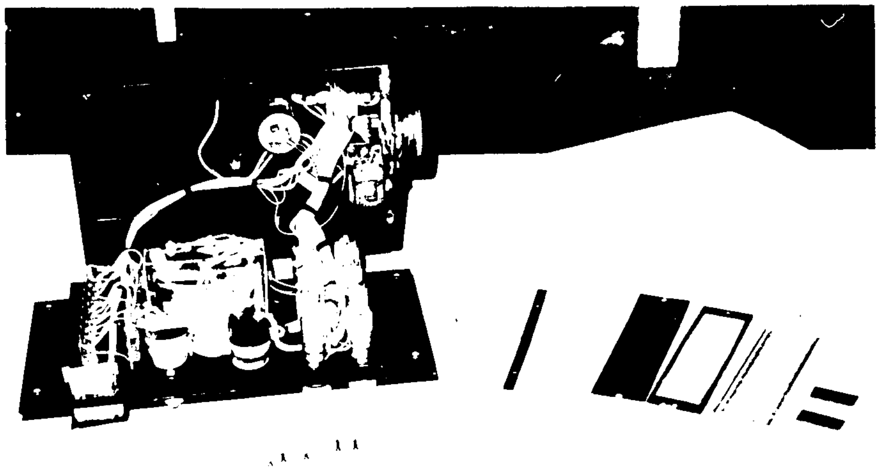
Replacement of warning light bulbs (See Figure)

1. Any bulbs not lit up when you push the test button should be replaced

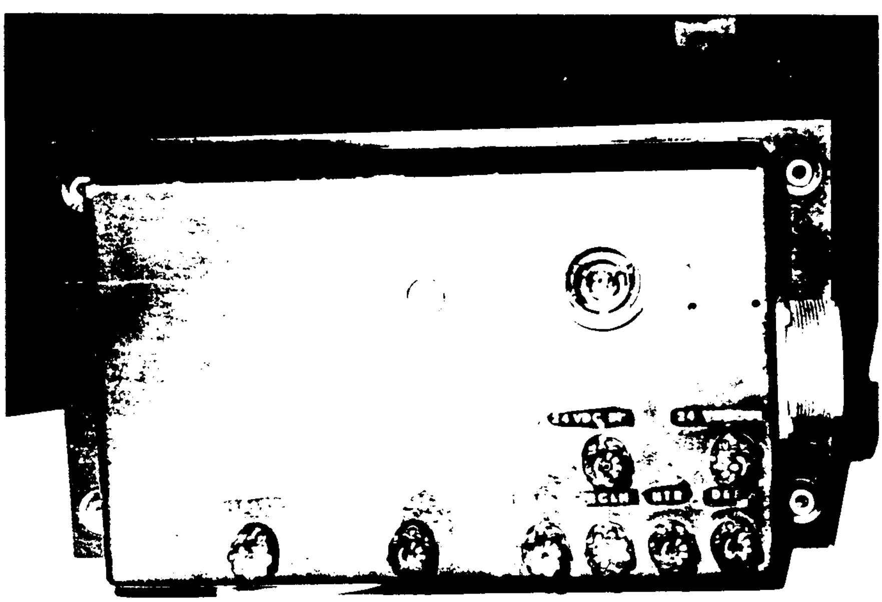
2. To replace bulbs, remove two screws, warning light bezel, and metal petitions between bulbs.



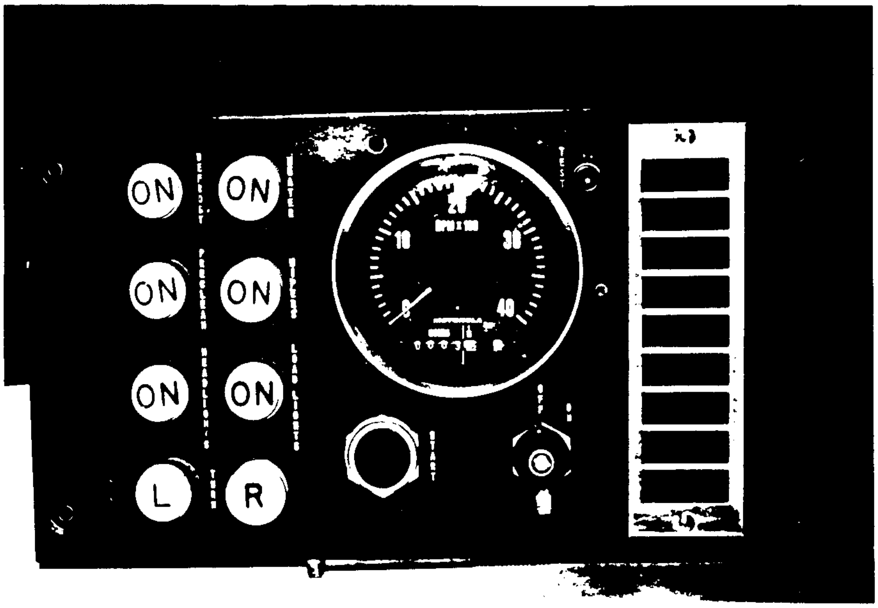
REPLACEMENT OF WARNING LIGHT BULB



REMOVAL OF FACE OF INSTRUMENT PANEL

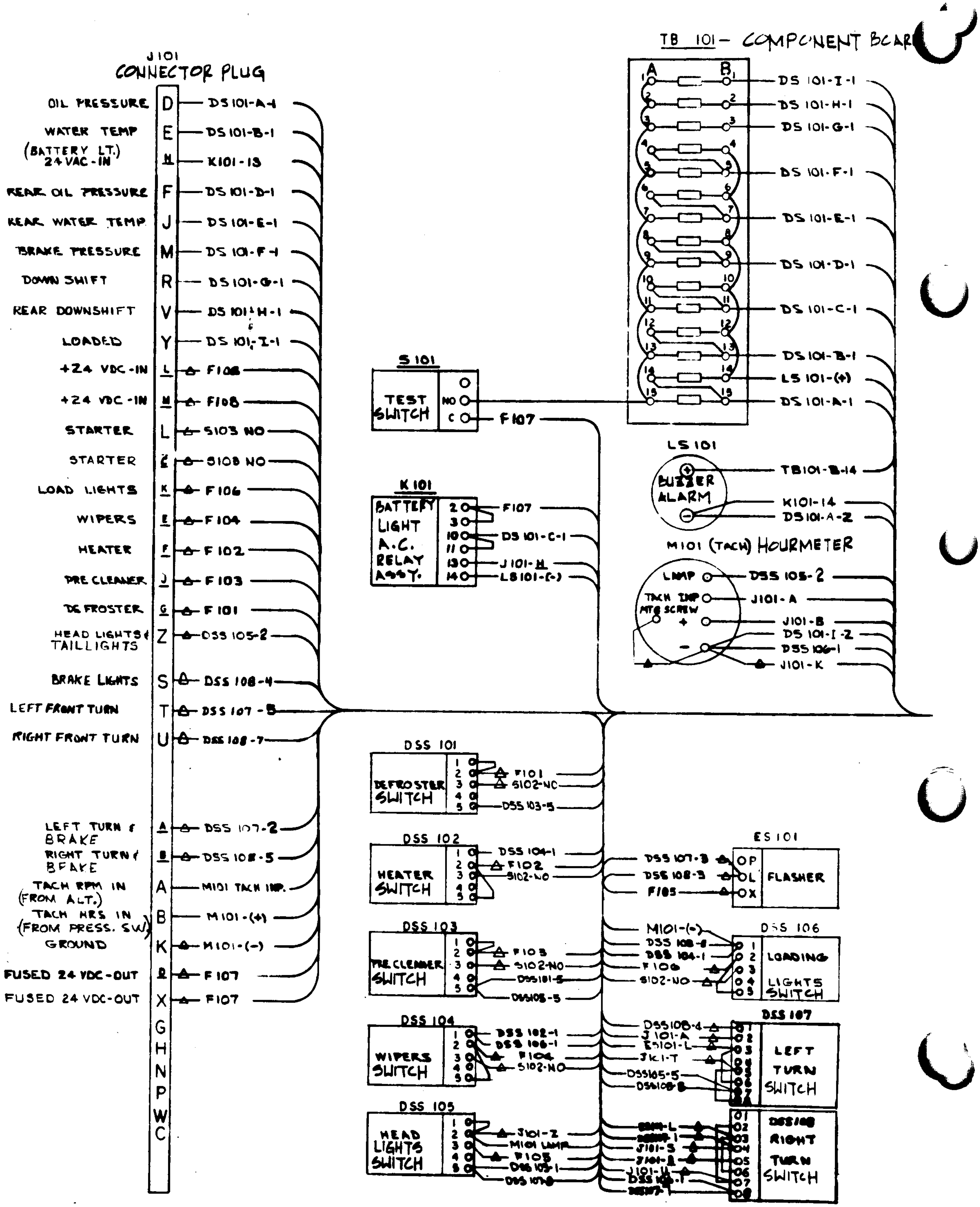


REAR VIEW OF INSTRUMENT PANEL

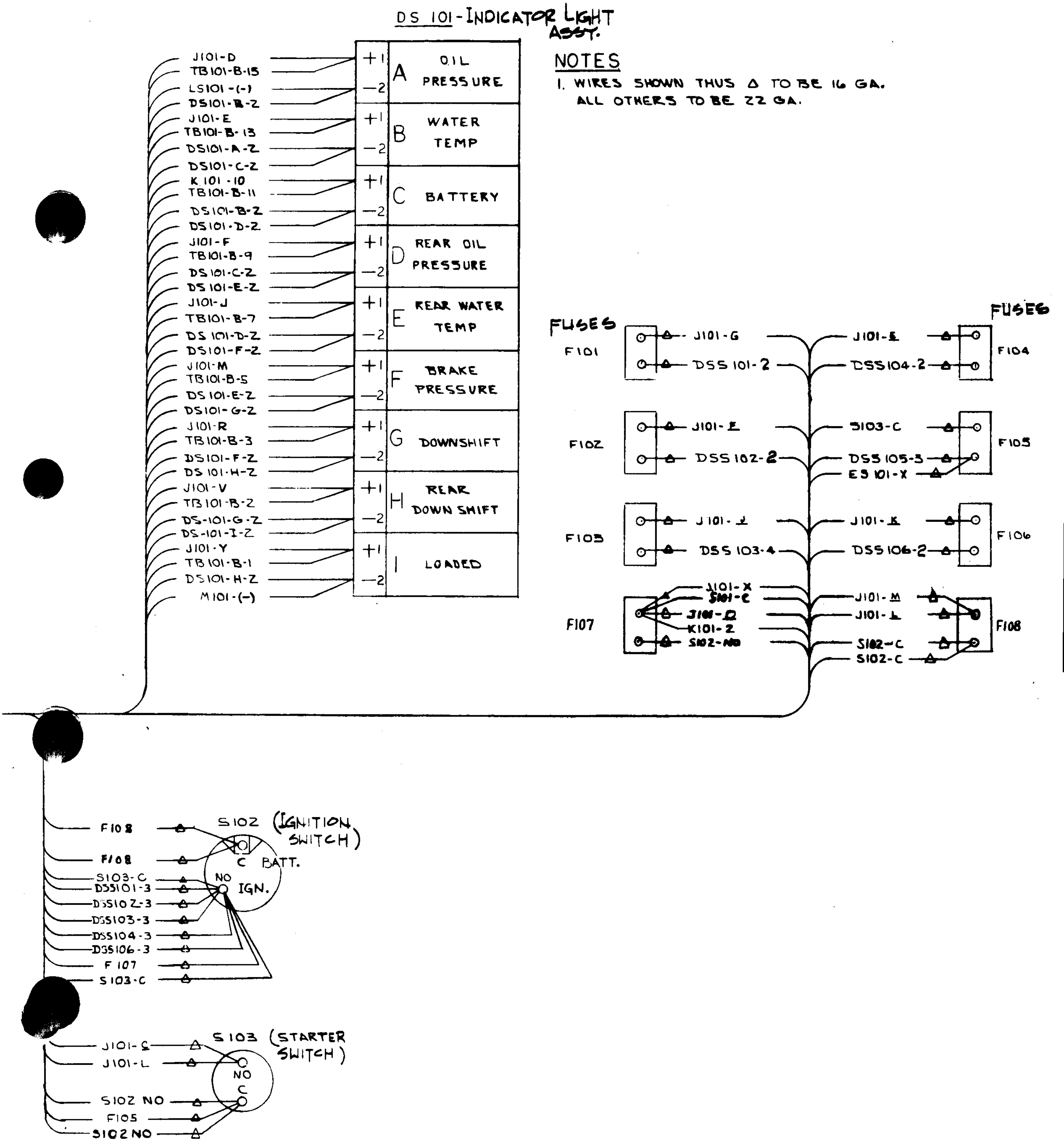


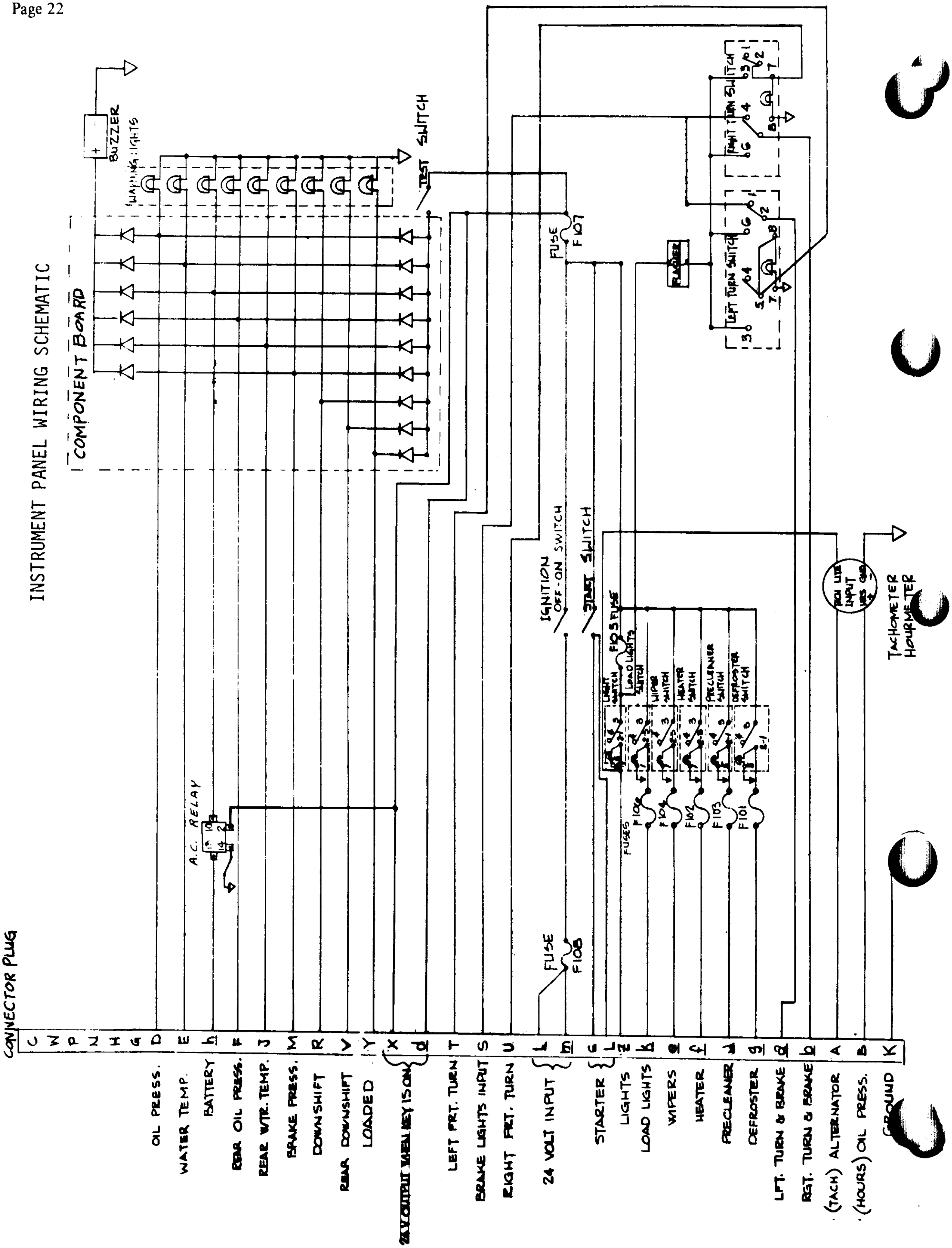
FRONT VIEW OF INSTRUMENT PANEL

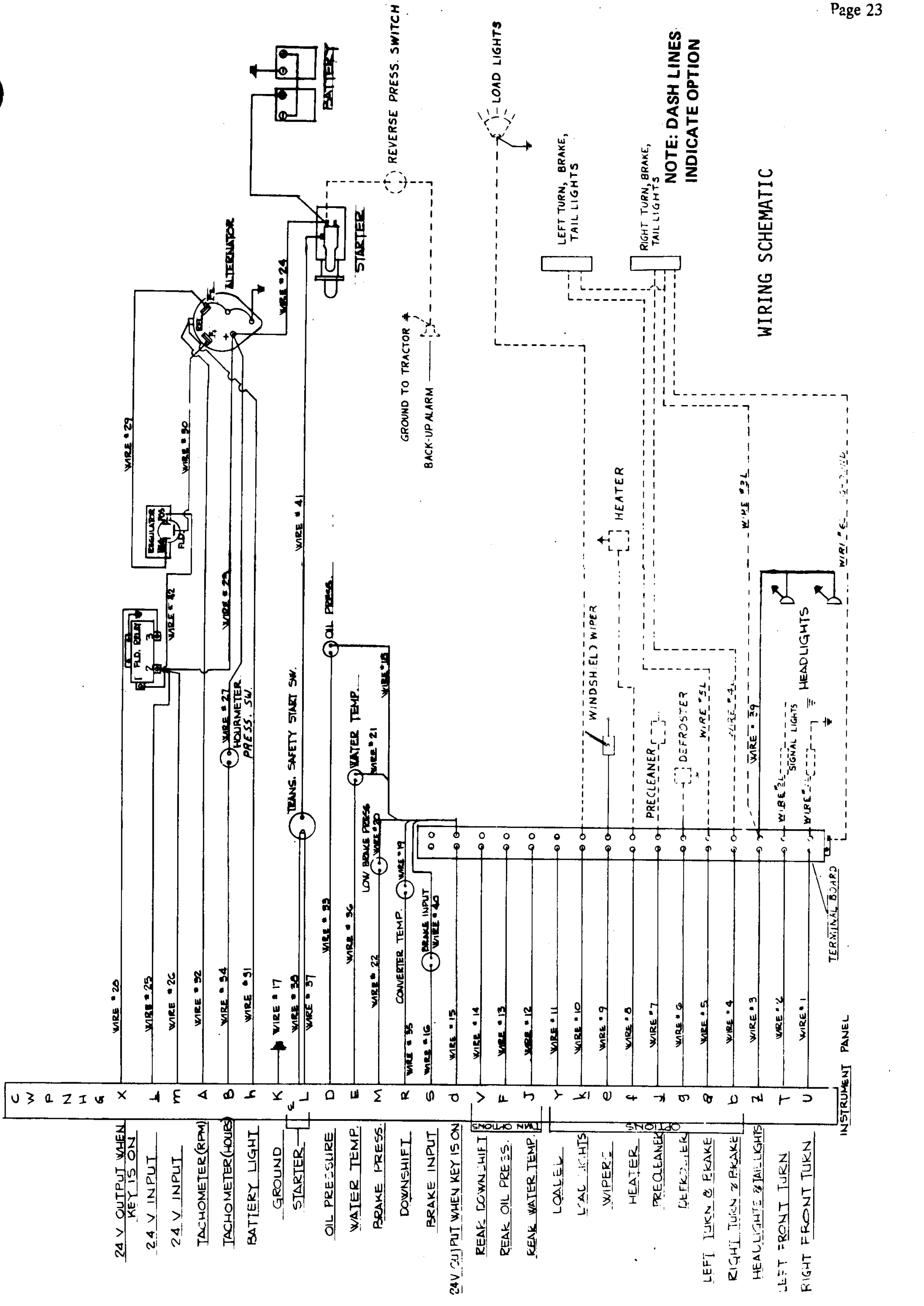
INSTRUMENT PANEL WIRING DIAGRAM



INSTRUMENT PANEL WIRING DIAGRAM




INSTRUMENT PANEL WIRING SCHEMATIC
COMPONENT BOARD
BUZZER
WARNING LIGHTS
TEST SWITCH
FUSE F107
FLASHER
LEFT TURN SWITCH
RIGHT TURN SWITCH
IGNITION OFF-ON SWITCH
START SWITCH
F105 FUSE
LIGHT SWITCH
LOAD LIGHTS SWITCH
WIPER SWITCH
HEATER SWITCH
PRECLEANER SWITCH
DEFROSTER SWITCH
FUSES
F106
F104
F102
F103
F101
A.C. RELAY
FUSE F108
TACHOMETER HOURMETER
CONNECTOR PLUG
OIL PRESS.
WATER TEMP.
BATTERY
REAR OIL PRESS.
REAR WTR. TEMP.
BRAKE PRESS.
DOWNSHIFT
REAR DOWNSHIFT
LOADED
24 V OUTPUT WHEN KEY IS ON
LEFT FRT. TURN
BRAKE LIGHTS INPUT
RIGHT FRT. TURN
24 VOLT INPUT
STARTER
LIGHTS
LOAD LIGHTS
WIPERS
HEATER
PRECLEANER
DEFROSTER
LFT. TURN & BRAKE
RGT. TURN & BRAKE
(TACH) ALTERNATOR
(HOURS) OIL PRESS.
GROUND


WIRING SCHEMATIC
NOTE: DASH LINES INDICATE OPTION
BATTERY
REVERSE PRESS. SWITCH
LOAD LIGHTS
STARTER
ALTERNATOR
REGULATOR
FLD. RELAY
LEFT TURN, BRAKE, TAIL LIGHTS
RIGHT TURN, BRAKE, TAIL LIGHTS
GROUND TO TRACTOR
BACK-UP ALARM
HEATER
WINDSHIELD WIPER
PRECLEANER
DEFROSTER
HEADLIGHTS
SIGNAL LIGHTS
OIL PRESS.
WATER TEMP.
TRANS. SAFETY START SW.
HOURMETER PRESS. SW.
LOW BRAKE PRESS
CONVERTER TEMP.
BRAKE INPUT
TERMINAL BOARD
INSTRUMENT PANEL
24 V OUTPUT WHEN KEY IS ON
24 V INPUT
24 V INPUT
TACHOMETER (RPM)
TACHOMETER (HOURS)
BATTERY LIGHT
GROUND
STARTER
OIL PRESSURE
WATER TEMP.
BRAKE PRESS.
DOWNSHIFT
BRAKE INPUT
24 V OUTPUT WHEN KEY IS ON
REAR DOWNSHIFT
REAR OIL PRESS.
REAR WATER TEMP.
TWIN OPTIONS
OPTIONS
LOADER
LOAD LIGHTS
WIPERS
HEATER
PRECLEANER
DEFROSTER
LEFT TURN & BRAKE
RIGHT TURN & BRAKE
HEADLIGHTS & TAILLIGHTS
LEFT FRONT TURN
RIGHT FRONT TURN

Tests and Maintenance of

DELCOTRON® GENERATORS

(20-DN SERIES, 250 TYPE)

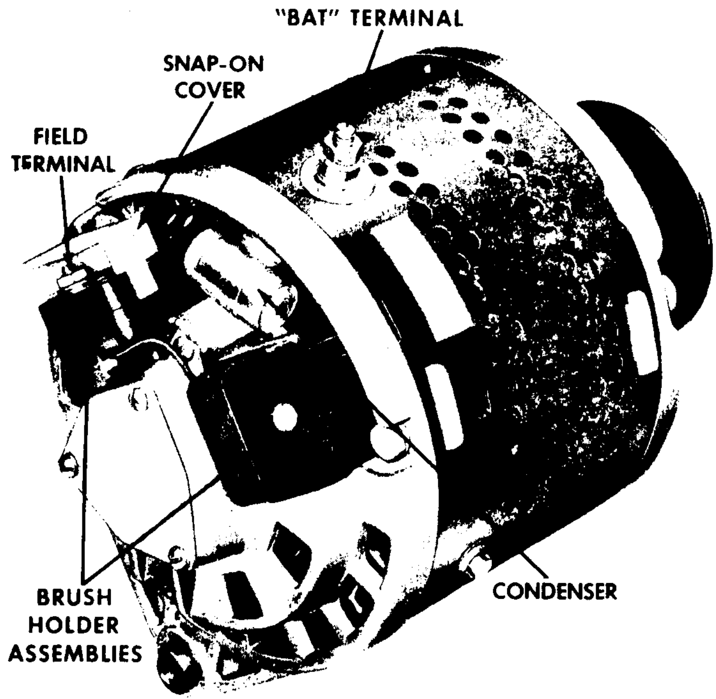


Figure 1—Typical Delcotron generator.

Delcotron® generators of the type shown in Figure 1 are designed and constructed to provide extra long periods of reliable service.

These Delcotron generators feature two separate brush assemblies, each made up of two extra-long brushes. A special constant-tension brush spring holds each brush in contact with the slip ring. The brush assemblies are enclosed to reduce any accumulation of dirt and other foreign material on the brushes and slip rings. These features promote extra-long brush and slip ring life.

The brush assemblies are accessible on the outside of the end frame, and can be removed by detaching the attaching screws. No prior disassembly procedures are necessary. With this feature, a quick inspection of the brushes and slip rings can be made with a minimum of effort. Also, this feature permits replacement of the brushes and brush springs without further disassembly.

The rotor is mounted on ball bearings that have grease reservoirs which eliminate the need for periodic lubrication. Two felt seals on the drive end frame protect the bearing from entry of dirt and other foreign material. Also, the drive end bearing and slip ring end bearing are sealed on the side away from the grease reservoirs. A special collar on the shaft between the slip rings and slip ring end frame bearing protects the slip rings from any lubricant which might leak through the sealed bearing.

The stator windings are assembled on the inside of a laminated iron core that is attached to the generator shell, or frame. Six rectifier diodes are mounted into two heat sinks which are attached to the Delcotron generator shell, or frame. One of the heat sinks is insulated from the shell, and the output terminal is connected to the insulated heat sink. The other heat sink is grounded directly to the shell, or is grounded by means of a ground strap or lead. On insulated applications, the ground strap is omitted so that both heat sinks are insulated. The six diodes change the a.c. voltages to a d.c. voltage which appears at the output terminal on the generator.

A view of a typical model having one of the heat sinks grounded directly to the

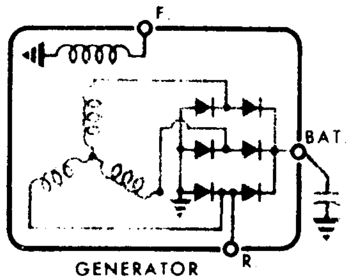


Figure 5—Internal wiring diagram.

10. Separate the drive end frame and rotor assembly from the shell.
11. To remove the drive end bearing, remove the shaft nut, washer, woodruff key, and pulley.
12. Then separate the drive end frame from the rotor by pushing the shaft from the end frame. Remove the retainer plate and then push the bearing out of the end frame.
13. To remove the slip ring end frame bearing, use pullers against the collar, and pull the collar and bearing off together. Note that the collar, when properly assembled, leaves a space between the collar and the outer race of the bearing. **The bearing when correctly assembled is flush with the end of the shaft.**

DIODE CHECKS

As shown in Figure 6 there are six diodes mounted in the stator and shell assembly. Three diodes are mounted into one heat sink and the other three diodes are mounted into a second heat sink.

Each diode may be checked electrically for a shorted or open condition. Scrape enough insulation from the diode stem so the test prod makes good contact. Any one of the three methods outlined below may be used.

Diode Tester Method: Special diode testers are available from various test equipment manufacturers and suppliers that will check each diode without disconnecting the stator leads from the diodes. To check the diodes with one of these testers, follow the procedure recommended by the tester manufacturer.

Ohmmeter Method: One method of checking diodes is to use an ohmmeter of the type commonly found in service stations. The lowest range scale on the ohmmeter should be used, and the ohmmeter should have a 1½ volt cell. To determine the cell voltage, turn the selector to the lowest scale, and then connect the ohmmeter leads to a voltmeter. The voltmeter will indicate the cell voltage.

In order to use an ohmmeter to check the diodes, the stator leads must be disconnected. This can be accomplished by clipping the three stator leads with diagonal cutters as close to the diode stems as possible (Fig. 6). With the stator disconnected, check a diode in each heat sink by connecting one of the ohmmeter leads to the heat sink and the other ohmmeter lead to the diode stem, and note the reading (Fig. 6). Then reverse the ohmmeter lead connections, and note the reading. If both readings are very low, or if both readings are very high, the diode is defective. A good diode will give one low reading and one high reading. Check the other diodes in both heat sinks in the same manner. (To reconnect the stator leads, see section entitled "Stator Replacement.")

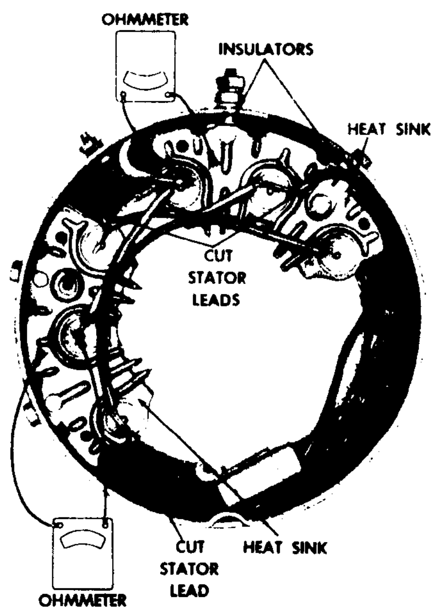


Figure 6—Checking diodes. NOTE: Epoxy covering and lead tape used on some models not shown in illustration.

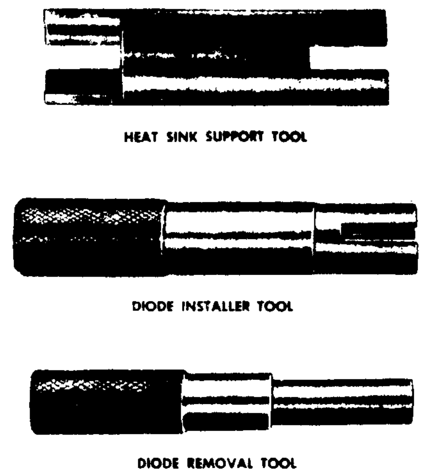


Figure 7—Typical tools.

Test Lamp Method: An alternate method of checking the diodes is to use a test lamp of not more than 12 volts in place of the ohmmeter. CAUTION: Do not use 110-volt test lamps to check diodes.

With the stator disconnected, connect the test lamp leads across each diode as previously described first in one direction and then in the other. If the lamp lights in both checks, or fails to light in both checks, the diode is defective. When checking a good diode, the lamp will light in only one of the two checks. (To reconnect the stator leads, see section entitled "Stator Replacement.")

DIODE REPLACEMENT

In order to avoid damage to the heat sink and the diode being installed, it is recommended that special tools be used when replacing a diode. These tools are available from various tool manufacturers and suppliers. Typical tools are shown in Figure 7.

NOTE: Negative case diodes have black marking on the case, and positive case diodes have red marking on the case. Although the diodes may be covered completely with paint, the red and black marking will show through the covering paint. Visually inspect the diodes for color markings (Fig. 8) and note that the heat sink connected to the Delcotron generator output terminal is insulated from the shell, and the other heat sink on grounded generators is grounded to the shell. The following tabulation shows the proper location of the diodes.

Ground Polarity of Delcotron Generator	Color marking on diode in grounded heat sink	Color marking on diode in insulated heat sink
Negative	Black	Red
Positive	Red	Black

To replace a defective diode, cut with diagonal cutters the leads connected to the diode stem as close to the stem as possible.

Support the outside of the heat sink around the defective diode with the special heat sink support tool and locate the special diode removal tool over the defective diode inside the shell assembly (Fig. 8). Use an arbor press or vise to push the defective diode out of the heat sink. CAUTION: Do not strike the assembly, as the shock may damage the good diodes.

To install a new diode, support the flat heat sink surface underneath the diode hole with a smooth flat surface, such as a solid cylinder with smooth flat ends, and press the new diode into the heat sink with an arbor press or vise. Use the special diode installer tool which just fits over the outside edge of the diode (Fig. 8).

To reconnect the leads, place the connector clip which is included in the diode service package over the diode stem and the flexible lead and if applicable the stator lead into the connector. Scrape enough insulation from the diode stem to insure good contact. Crimp just enough to hold the assembly together, and then solder securely, using rosin core 60% tin 40% lead solder. CAUTION: Do not heat excessively, as this may damage the diode. Avoid bending or moving the diode stem, as excessive movement can cause internal damage and result in diode failure. Cover the clip, leads, and diode seal with red insulating paint, and tie the leads together as in the original assembly to resist vibrations. Replace epoxy, if any was removed, with Delco-Remy Part No. 1966807 epoxy, in which case red insulating paint is not required.

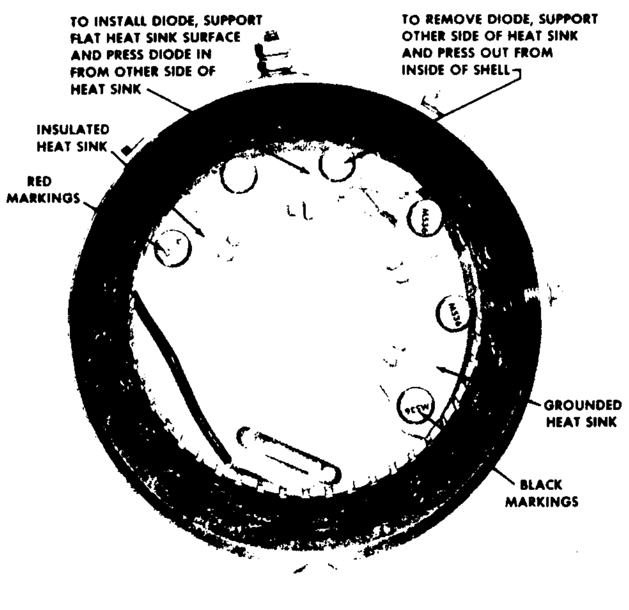


Figure 8—Removing and installing diodes.

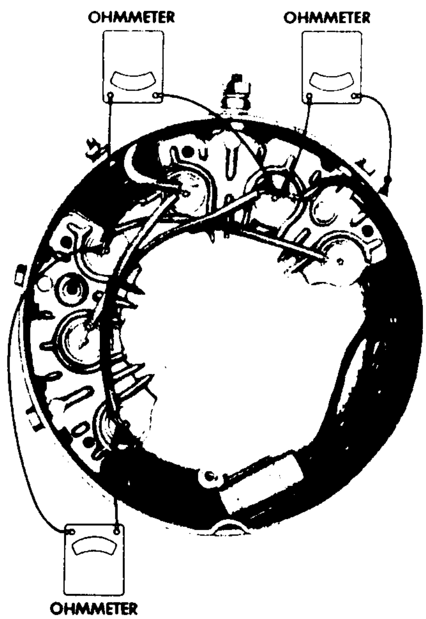


Figure 9—Checking stator windings. NOTE: Epoxy covering and lead tape used on some models not shown in illustration.

STATOR CHECKS

The stator may be checked for grounds and opens with an ohmmeter or a test lamp of not more than 12 volts. These checks may be made with the stator leads disconnected from the diodes, or with the stator leads connected to the diodes **provided** all the diodes are in good condition. Scrape enough insulation from the leads to insure good contact with the test prods.

Ohmmeter Method: Connect the ohmmeter to the two pairs of stator leads as shown in Figure 9. Use an ohmmeter with $1\frac{1}{2}$ volt cell, and use the lowest range scale on the ohmmeter. If either reading is very high (infinite) the stator winding is open.

To check for grounds, connect the ohmmeter from any stator lead to the ground screw or the shell, and note the reading. Then reverse the ohmmeter lead connections, and note the reading. If **both** readings are very low, the stator is grounded.

Due to the low resistance of the windings, it is not practical to check the stator for shorts without laboratory test equipment. However, if all other electrical checks are normal and the generator fails to supply rated output, shorted stator windings are indicated.

Test Lamp Method: Check the stator for opens by connecting a test lamp of not more than 12 volts to the two pairs of stator leads in the same manner shown in Figure 9. CAUTION: Do not use a 110-volt test lamp. If the lamp fails to light in either check, the stator is open.

To check for grounds, connect the test lamp from either stator lead to the Delcotron generator ground screw in the same manner shown in Figure 9. Then reverse the lead connections. If the lamp lights in **both** checks, the stator is grounded.

STATOR REPLACEMENT

The stator and shell assembly are serviced as one complete unit. If a defective stator is found, clip with diagonal cutters the three stator leads as close to the diode stems as possible (Fig. 6). Note very carefully the stator lead locations, and the location of the two heat sinks with respect to the end frame locating notch on the shell. Also note carefully the proper position of the output terminal and the insulating washers used on the insulated heat sink. Remove both heat sink assemblies, and assemble onto the new stator and shell assembly.

To connect the stator leads, place the clips furnished in the service package over the top of the diode stem and the stator lead into the clip. Also, any other leads attached to the diode stem must be clipped off, and then placed into the clip in the same manner as for the stator lead. Crimp just enough to secure the assembly, and then solder with rosin core 60% tin 40% lead solder. CAUTION: Avoid excessive heating as this may damage the diodes, and scrape enough insulation off the leads to insure good contact with the clips. Cover the clips, leads and diode seals with red insulating paint, and tie the leads together as in the original assembly for vibration resistance. Replace with epoxy if any was removed, in which case red insulating paint is not required.

ROTOR CHECKS

The rotor may be checked electrically for grounded, open, or short circuited field coils. To check for grounds, connect a 12-volt test lamp or an ohmmeter from either slip ring to the rotor shaft or to the rotor poles. If the lamp lights, or if the ohmmeter reading is low, the field windings are grounded (Fig. 10).

To check for opens, connect the test lamp or ohmmeter to each slip ring. If the lamp fails to light, or if the ohmmeter reading is high (infinite), the winding is open (Fig. 10).

The windings are checked for short-circuits by connecting a battery and ammeter in series with the two slip rings. Note the ammeter reading and refer to Delco-Remy Service Bulletin 1G-186 or 1G-187 for specifications. An ammeter reading above the specified value indicates shorted windings. An alternate method is to check the resistance of the field by connecting an ohmmeter to the two slip rings (Fig. 10). If the resistance reading is below the specified value, the winding is shorted. The specified resistance value can be determined by dividing the voltage by the current given in Bulletin 1G-186 or 1G-187.

SLIP RING SERVICING

If the slip rings are dirty, they may be cleaned with 400 grain or finer polishing cloth. Turn the rotor in a lathe with the polishing cloth held on the slip rings, and blow away all dust after the cleaning operation.

Slip rings which are rough or out of round should be trued in a lathe to .002 inch maximum indicator reading. Remove only enough material to make the rings smooth and round. Finish with 400 grain or finer polishing cloth and blow away all dust.

To replace a slip ring, measure the distance from the end of the shaft to the slip ring, so the new slip rings can be pressed on to the same dimension. Then unsolder the connections, remove the binding cord, and pull the slip ring assembly off the shaft with bearing pullers. Press the new slip ring onto the shaft with a tube or collar that just fits over the shaft, and locate to the dimension as previously measured. Secure the leads to the shaft with glass cord or other suitable binding cord, and paint with electrical insulating varnish or shellac.

Solder the leads with rosin core 60% tin 40% lead solder. New slip rings must be trued in a lathe to .002 inch maximum indicator reading. Finish with 400 grain or finer polishing cloth.

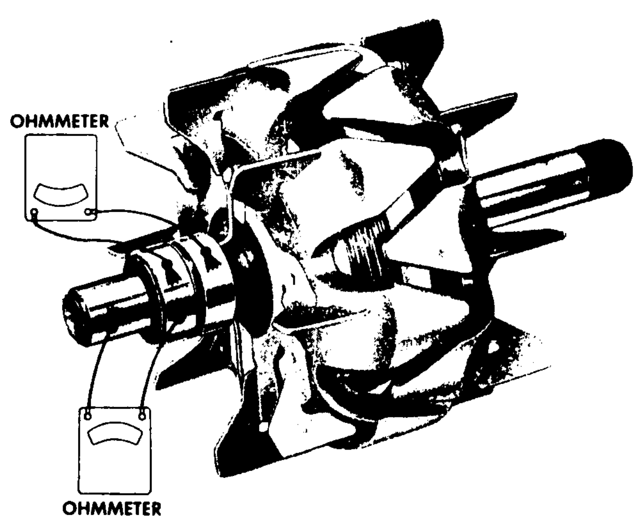


Figure 10—Checking rotor.

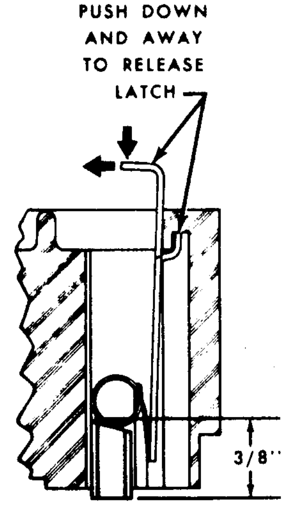


Figure 11—Allowable extent of brush wear.

BRUSH REPLACEMENT

Brushes should not be allowed to wear beyond the ⅜ inch length shown in Figure 11. To remove the brush, push the back and spring assembly down and away as shown in Figure 11. **Do not touch** or otherwise bend the spring as it may become permanently distorted. When assembling brushes, make sure the brushes and brush leads are located as shown in Figure 12.

The brush springs should be visually inspected for discoloration, corrosion, and distortion. If the brush springs appear to be satisfactory, and the brushes move up and down freely in the holder, the springs may be reused. If there is any doubt as to their condition, they should be replaced.

LUBRICATION

The grease reservoir in each end frame provides an adequate supply of lubricant for long periods of operation. A record of lubrication requirements, made over a service period of reasonable length, will establish the lubrication periods required. Although Delcotron generators of this type are designed to provide exceptionally long periods of service without lubrication attention, the period between lubrication attention should not exceed 250,000 miles. IMPORTANT: In order to obtain satisfactory bearing life, it is absolutely essential that only Delco-Remy lubricant Part No. 1948791 be used as outlined in the next paragraph.

Before reassembly after Delcotron generator overhaul, each reservoir should be half filled with Delco-Remy lubricant Part No. 1948791. CAUTION: Make sure that after assembly the reservoirs will be only half filled. Over-filling will cause the bearing seal to be pushed out of the bearing during assembly. At overhaul periods, replace bearings and seals with new ones. Lubricate bearings and seals before assembly.

If the bearings are inspected before the overhaul period, they may be reused if the grease supply in the bearing is not low. However, if the grease supply in the bearing is low, the bearing should be replaced with a new bearing. Press against the inner race only when assembling the bearing on the slip ring end.

CAUTION: Make sure the sealed side of the bearing is on the side away from the grease reservoir, and the open side is toward the grease reservoir.

Also insure that the collar on the slip ring end is assembled so a space exists between the collar and the outer race of the bearing. Satisfactory bearing life will be obtained only if recommended lubrication procedures are followed.

REASSEMBLY

Reassembly is the reverse of disassembly. Torque the shaft nut to 60 ft. lbs. If the rotor is held in a vise during the tightening process use **extreme care** not to tighten excessively as this will distort and damage the rotor.

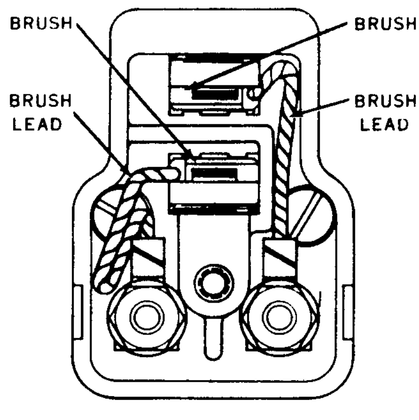


Figure 12—Brush holder assembly.

OUTPUT CHECK

To check the generator for output, make electrical connections as shown in Figure 13. Although terminal locations may vary depending on the model involved, always connect the "BAT" or output terminal of the generator to the same polarity post of the battery; and the generator ground, or other terminal, to the same polarity post of the battery. The field winding also must be connected across the battery. Then operate at specified speed, adjust the load across the battery as required to obtain specified voltage, and compare the output with the values given in Delco-Remy Test Specifications Bulletin 1G-186 or 1G-187. The current output may vary slightly with different generator temperatures.

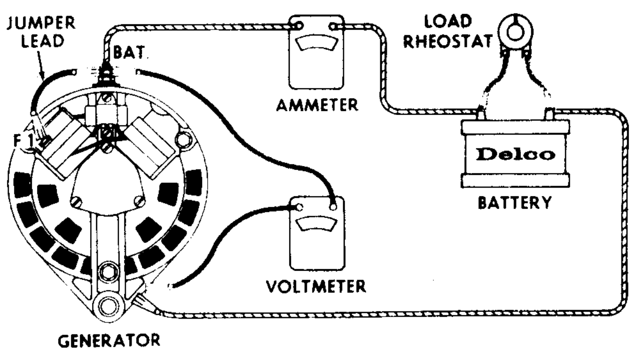


Figure 13—Checking Delcotron generator output.

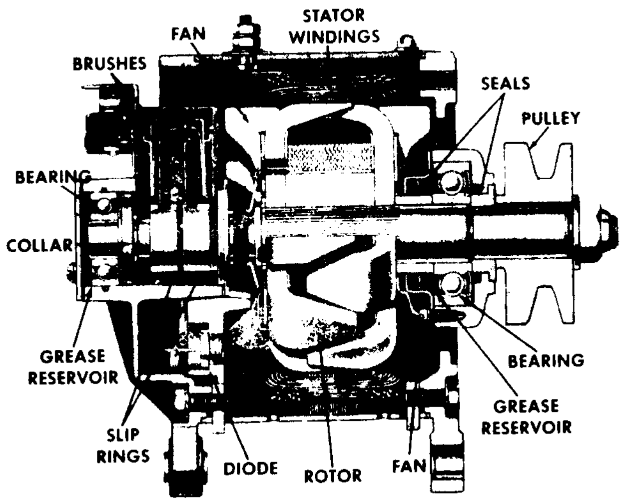


Figure 2—Cross-sectional view of typical model.

shell is shown in Figure 1, and a cross-sectional view is shown in Figure 2. In Figure 3 is an end view of a typical model which has one of the heat sinks grounded by means of a ground strap. The ground strap and condenser lead must be relocated as shown to permit operation on a system of the opposite polarity. Also, on most positive ground

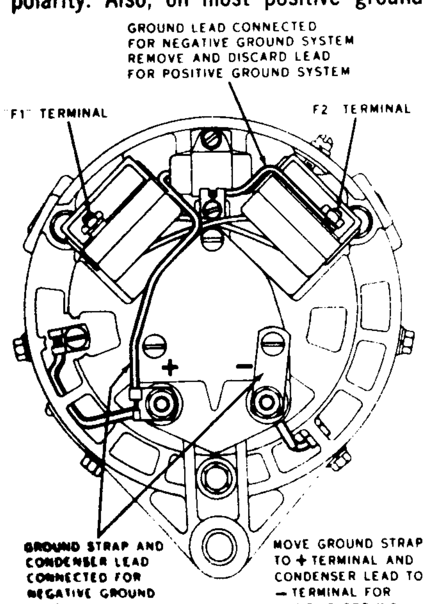


Figure 3—End view of model used on either negative or positive ground.

systems, the ground lead must be discarded. Thus, a Delcotron generator of this type may be used on either a negative ground or a positive ground system. A generator used on an insulated system uses a capacitor with two leads, and this arrangement is shown in Figure 4. In Figure 5 is shown a typical wiring diagram of a negative ground Delcotron generator.

CAUTION: The ground polarity of this type generator, and the ground polarity of the battery, **must** be the same **before** making connections. Instant damage to the wiring and diodes may result if the unit is connected to the battery with the ground polarities not matched.

MAINTENANCE

Periodic maintenance is limited to inspections for loose mounting bolts, a loose drive pulley, or a loose drive belt. If the generator is noisy, it may be caused by loose mounting bolts, a loose drive pulley, worn or dirty bearings, a defective diode or a grounded or shorted stator. If the noise continues after checking the mounting bolts and the pulley, the generator must be removed from the vehicle and disassembled for further checks.

DISASSEMBLY

The Delcotron generator consists of four main components—the two end frames, the stator, and the rotor. A disassembly procedure for a typical model is given below; design variations may result in slightly different disassembly procedures.

1. Remove the brush holder snap-on covers or cover.
2. Detach the field lead or leads from the terminals on the brush holders and grounding screw.
3. Remove the brush holder cover plates.
4. Remove both screws holding each brush holder to the end frame.
5. Lift both brush holders from the end frame.
6. Remove the screw attaching the condenser to the end frame.
7. Remove the three slip ring end frame attaching screws and the three "T" nuts.
8. Remove the slip ring end frame from the shell by prying them apart with two screwdrivers at opposite ends.
9. Remove the three drive end frame attaching screws and the three "T" nuts.

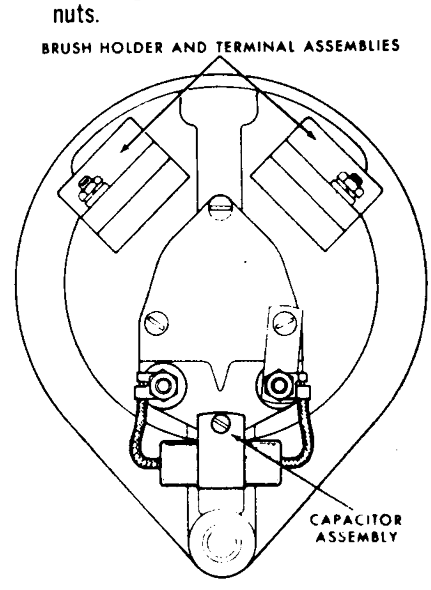


Figure 4—End view showing capacitor arrangement on generator that may be used on negative ground, positive ground, or insulated systems.

TESTS AND ADJUSTMENTS OF
TRANSISTOR REGULATOR
24 VOLT, NEGATIVE GROUND,
(30-RD SERIES, 250 TYPE)

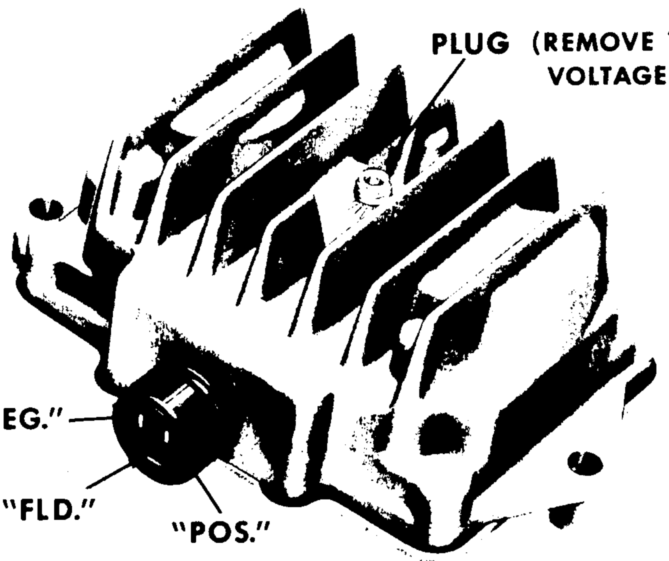


Figure 1—Typical transistor regulator.

The transistor regulator illustrated in Figure 1 and Figure 2 is an assembly composed principally of transistors, diodes, capacitors, and resistors. These components form a completely static electrical unit containing no moving parts.

The function of the regulator in the charging circuit is to limit the generator voltage to a preset value by controlling the generator field current.

The voltage at which the generator is limited is determined by the regulator adjustment. Once adjusted, the generator voltage remains practically unchanged, since the regulator is relatively unaffected by such factors as length of service, changes in temperature, or by changes in generator output and speed.

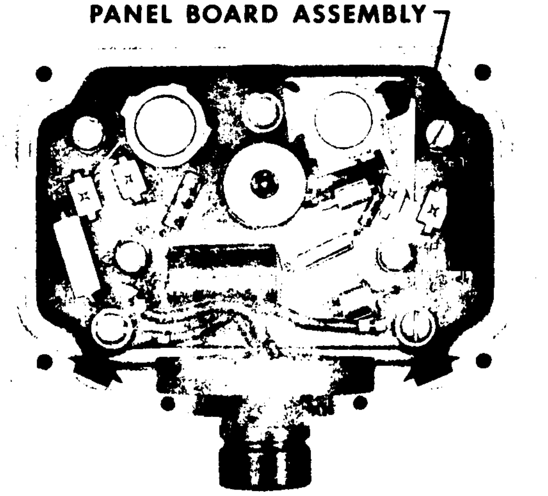


Figure 2—Underneath side of regulator with bottom plate removed. Arrows identify panel mounting screws.

OPERATING PRINCIPLES

In the negative ground circuit illustrated in Figure 3, when the switch is closed and the engine is not running, the indicator lamp lights because its circuit from the battery is completed to ground through the indicator light relay contacts, which are normally closed.

The winding on the indicator light relay is connected to the "R" terminal on the generator. In this type of circuit, the indicator light relay contacts will not separate to cause the light to go out until the generator is in operation. If the generator should fail to operate properly, the relay contacts will close and the lamp will light to indicate trouble in the circuit.

When the generator begins to operate, a.c. voltages are induced in the stator windings.

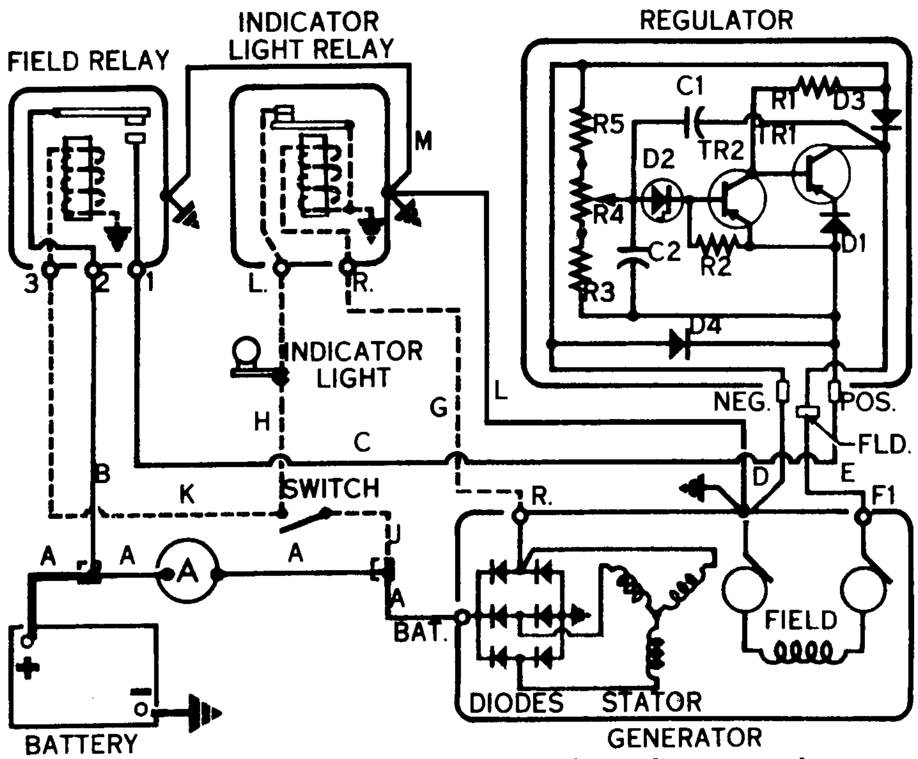


Figure 3 -Negative ground circuit with light relay winding connected to "R" terminal on generator.

These voltages are changed, or rectified, to a d.c. voltage which appears at the output, or "BAT," terminal on the generator. The generator then supplies current to charge the battery and operate vehicle accessories.

As generator speed increases, the voltage reaches the pre-set value and the components in the regulator cause transistor TR-1 to alternately "turn off" and "turn on" the generator field voltage. The regulator thus operates to limit the generator output voltage to the pre-set value.

ANALYZING CHARGING SYSTEM TROUBLES

In order to check these circuits, it is *necessary* to use an adapter at the regulator. This adapter is available from various automotive-type supply outlets, including United Motors Service under Packard Cable Test Adapter Catalog No. 1303. Note that the test leads on the adapter are of three different lengths, and the following illustrations show these lead lengths.

If the trouble is located in the generator during the test procedures, refer to section on generators.

To analyze the system make sure all connections between the battery, junction block, and generator, (leads marked A in the wiring diagram), are clean and tight. Then remove the wiring harness connector from the regulator, and connect the adapter between the wiring harness connector and the regulator.

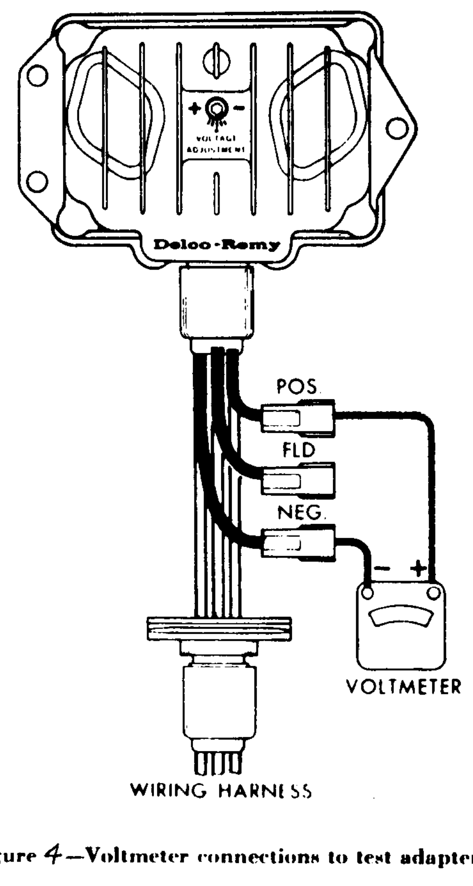


Figure 4—Voltmeter connections to test adapter.

When the trouble is found, it is not necessary to make further checks; however, it is often advisable to complete all checks to insure that no other troubles exist.

TEST PROCEDURES

IMPORTANT: Observe the following test procedures exactly. Do not deviate. Improper connections and procedures may instantly damage the equipment.

If the regulator is found to be defective, it must be replaced or repaired as covered beginning on page .

If the battery condition is satisfactory, but the indicator light behavior is abnormal, begin with Step H, Page . If the battery is undercharged or overcharged, begin with Step A.

A. To check the field pro- ceed as follows.

1. Connect a voltmeter to the test adapter as shown in Figure 4.
2. Make sure the switch is off.
3. If the voltmeter reads battery voltage, the field relay contacts are stuck closed, and the relay must be replaced. If the voltmeter reads zero, proceed to Step 4.
4. Turn the switch on.
5. If the voltmeter reads battery voltage, proceed to Part B.
6. If the voltmeter reads zero, ~~check~~ check for excessive resistance or an open in leads A, B, C, D, J, and K and in the switch. If the leads and switch are satisfactory, replace the relay.

B. To check the field circuit, proceed as follows.

1. Connect a voltmeter to the test adapter as shown in Figure 5.
2. Turn the switch on.
3. If the voltmeter reads about 1 or 2 volts *less* than battery voltage, proceed to Part C, Page , entitled "Check the generator for specified output as follows."
4. If the voltmeter reads zero volts, the regulator is defective and must be replaced or repaired. IMPORTANT: The regulator defect may have been caused by a defective generator field. Check the field as follows *before* installing the new regulator.
   a. *Turn the switch off and disconnect the battery ground strap.*
   b. *Disconnect the adapter from the regulator.*
   c. Connect an ohmmeter to the adapter as shown in Figure 6.
   d. If the ohmmeter reads high, there is an open, or excessive resistance in the field winding, or in lead E.
   e. If the ohmmeter reads low the winding is shorted or grounded.
   f. Disconnect ohmmeter and reconnect the battery ground strap.
5. If the voltmeter reads battery voltage, the regulator is shorted and must be replaced or repaired, or the generator field winding is open or grounded. Check as follows:
   a. *To check the field, turn the switch off and disconnect the battery ground strap.*
   b. *Disconnect the adapter from the regulator.*
   c. Connect an ohmmeter to the adapter as shown in Figure 6.
   d. If the ohmmeter reads high, there is an open, or excessive resistance in the field winding, or in lead E.

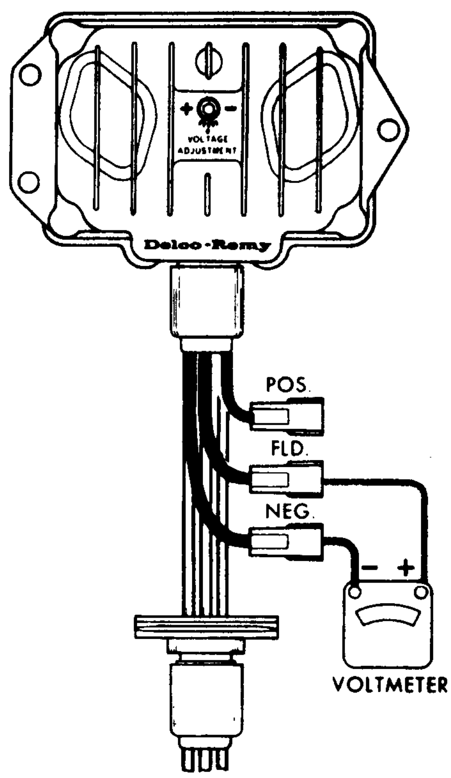


Figure 5 —Voltmeter connections to test adapter.

   e. If the ohmmeter reads low the winding is shorted or grounded.
   f. Disconnect ohmmeter and reconnect the battery ground strap.

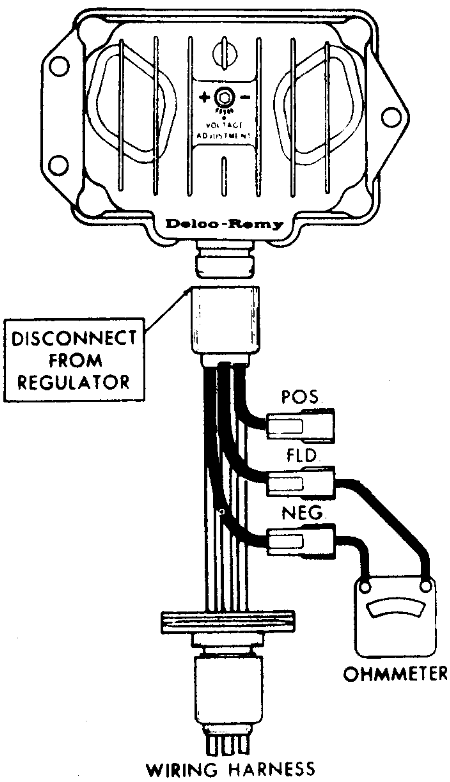


Figure 6 —Ohmmeter connections to test adapter.

To check the regulator, connect a voltmeter as shown in Figure 5 and operate the engine at moderate speed. If the voltage is uncontrolled and increases with speed to values above the specified setting range, replace the regulator.

C. Check the generator for specified output as follows:

1. Connect an ammeter in the circuit at the output or "BAT" terminal on the generator.
2. Connect a voltmeter to the adapter as shown in Figure .
3. Turn on the switch.
4. Operate the generator at specified speed, and check for rated output as given in Delco-Remy Service Bulletin 1G-186 or 1G-187. Load the battery with a carbon pile or with accessories if needed to obtain rated output. If the generator does not provide rated output, repair per section on generators.
Reinstall on the vehicle, connect an ammeter in the circuit at the generator "BAT" terminal as before, and proceed to Step D.

D. Excessive resistance in the sensing circuit, consisting of leads B, C, and D and the regulator, can cause an overcharged battery or light flicker. If the trouble is not battery overcharge, or light flicker, proceed to Part E. Otherwise proceed as follows.

1. For negative ground systems, connect a voltmeter as shown in Part 1 and Part 2 in Figure 7 .
2. Turn on switch but do not start engine.
3. If the two voltmeter readings total more than .3 volt, check for excessive resistance in leads B, C, and D, which can cause an overcharged battery. If these leads are satisfactory, the field relay contacts may have excessive resistance. In this case replace the relay.

E. A voltage setting not tailored to meet vehicle requirements can result in an undercharged or an overcharged battery. To adjust the voltage setting, proceed as follows:

1. Connect a voltmeter to the adapter as shown in Figure .

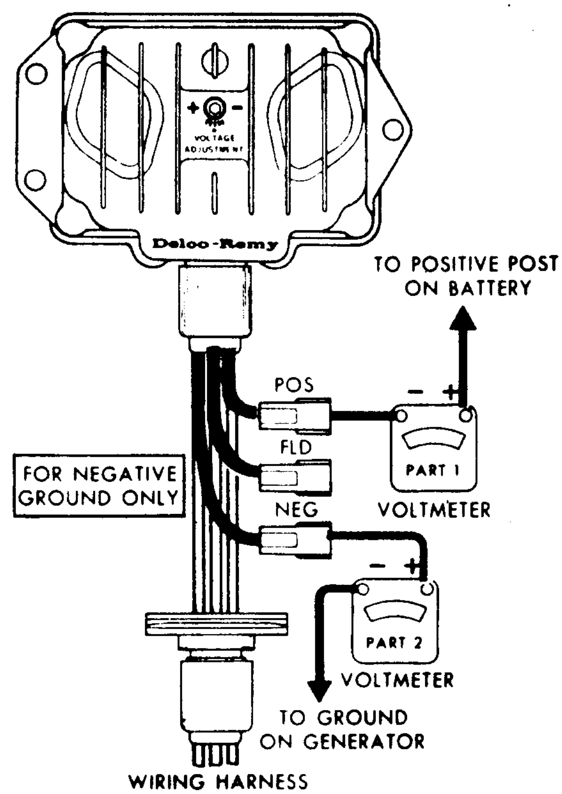


Figure 7 —Voltmeter connections to test adapter for negative ground circuits only.

2. Connect an ammeter in the circuit at the output or "BAT" terminal on the generator.
3. Turn all accessories off.
4. Operate generator at approximately 3000 r.p.m.
5. The generator output should be at least 10 amperes below the rated generator output for this check.
6. To adjust voltage setting, remove plug (Fig. 1) and turn slotted adjusting button inside regulator.
7. For an undercharged battery, raise voltage setting by turning one notch and then check for an improved battery condition after a service period of reasonable length. (NOTE: After two notches in each direction, there is a positive stop).
8. For an overcharged battery, lower voltage setting by turning one notch and then check for an improved battery condition after a service period of reasonable length. (NOTE: After two notches in each direction, there is a positive stop.)
9. If the regulator cannot be adjusted to a value within the specified range as given in Bulletin 1R-186 or 1R-187, replace the regulator.
   NOTE: If repeated regulator failures are experienced on the vehicle, but no defects are found, a shorted, grounded, or open generator field winding, or grounded leads, of an *intermittent* nature should be suspected.

F. If the indicator light now operates normally, no further checks are needed. The following sections describe normal indicator light behavior.

G. With the switch on and the engine not running, normal indicator light behavior is the light should be on. If it is not, check for excessive resistance in the switch and in leads J and H. If satisfactory, either the bulb is burned out, or the indicator light relay contacts have excessive resistance.

H. With the switch on and the engine running, normal indicator light behavior is the light should be out. If it is not, replace the light relay.

REGULATOR REPAIR

To check the regulator for defective components, proceed as follows:

1. Remove the bottom plate from the regulator. (Fig. 2)
2. Remove the three panel board attaching screws identified by arrows (Fig. 2), and lift the assembly from the housing.
3. To aid in reassembly, note any identifying markings on the two transistors and their respective locations on the panel board and heat sink assembly. (Fig. 8)

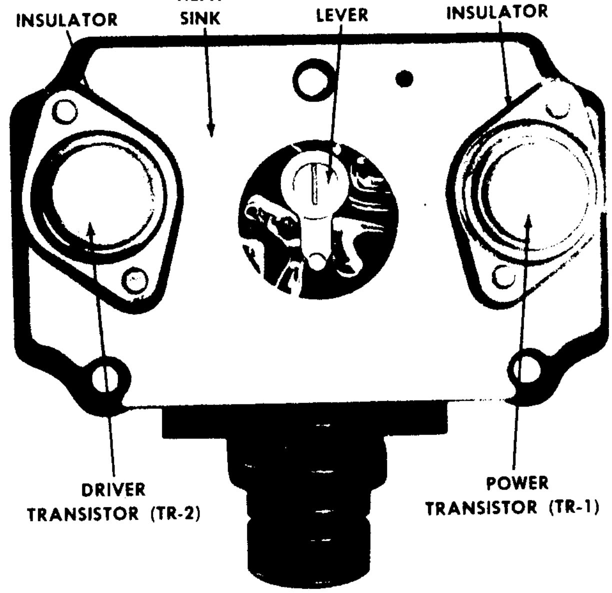


Figure 8 —Panel board and heat sink assembly.

4. Note the insulators between the transistors and the heat sink, and the insulators separating the heat sink from the panel board. (Fig. 8)
5. Remove the transistor attaching screws, and separate the transistors and heat sink from the panel board.

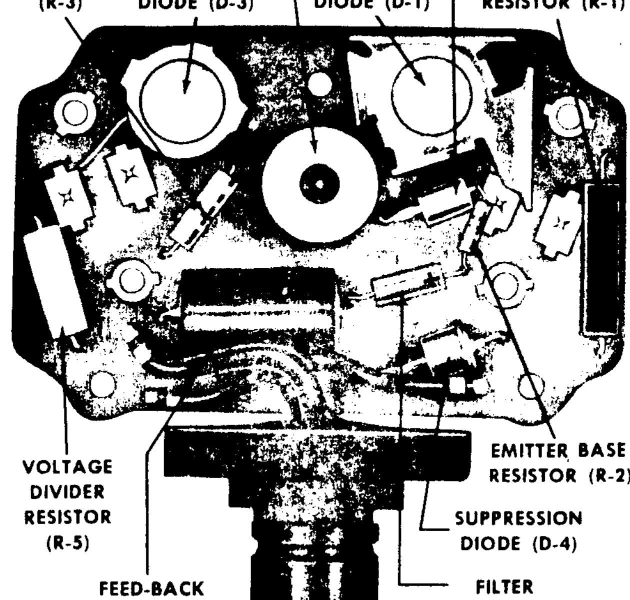


Figure 9 —Identification of component parts (Parts keyed to Fig. 3).

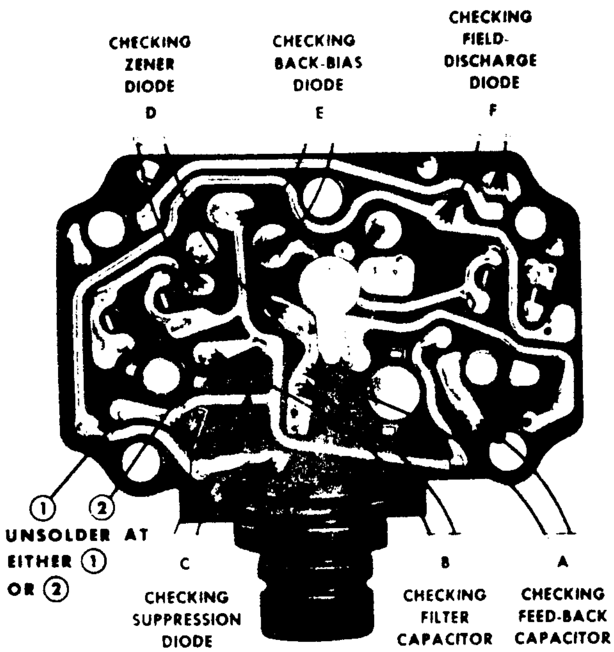


Figure 10 —Checking components.

With the transistors separated from the assembly, an ohmmeter may be used to check the transistors and components on the panel board for defects. An ohmmeter having a 1½ volt cell, which is the type usually found in service stations, is recommended. The low range scale on the ohmmeter should be used.

If a component part on the panel board is found to be faulty, it should be replaced before proceeding with the remaining checks. A 25 watt soldering gun is recommended, and a 60% tin 40% lead solder should be used when re-soldering. Avoid excessive heat which may damage the panel board. Chip away any epoxy involved, and apply new epoxy which is commercially available.

The component parts are identified in Figures 8 and 9 , with the symbols also shown in Figure 3.

In order to check the panel board assembly, it is necessary to unsolder the emitter-base resistor at location No. 1 or location No. 2 as shown in Figure 10. Earlier production regulators used a wire-wound emitter-base resistor soldered at location No. 1, and later regulators use a solid resistor soldered at location No. 2.

In all of the following checks, connect the ohmmeter as shown and then reverse the ohmmeter leads to obtain two readings.

Feed-Back Capacitor, Part A, Fig. 10: If both readings are zero, the capacitor is defective. Visually inspect for open soldered connections and broken leads.

Filter Capacitor, Part B, Fig. 10: If both readings are zero, the capacitor is defective. Visually inspect for open soldered connections and broken leads. To assemble a new capacitor properly, note the location of the "+" identifying mark in Figure .

Suppression Diode, Part C, Fig. 10: If the two readings are identical, the diode is faulty.

Zener Diode, Part D, Fig. 10: Replace the diode if both readings are zero, if both readings are infinite, or if both readings are identical.

Back-Bias Diode, Part E, Fig. 10: Replace the diode if both readings are zero, if both readings are infinite, or if both readings are identical.

Field-Discharge Diode, Part F, Fig. 10: Replace the diode if both readings are zero, if both readings are infinite, or if both readings are identical.

Driver-Collector Resistor, Part A, Fig. 11: If both readings are infinite, the resistor is open.

Voltage-Divider Resistor R-3, Part B, Fig. 11: If one reading is infinite or nearly infinite, or if both readings are infinite or nearly infinite, the resistor is open.

Voltage Divider Resistor R-5, Part C, Fig. 11: If one reading is infinite or nearly infinite, or if both readings are infinite or nearly infinite, the resistor is open.

Potentiometer, Parts D and E, Fig. 11: If one reading is infinite or nearly infinite in Part D, the potentiometer is open. If both readings are infinite in Part E, the potentiometer is open. NOTE: When installing a new potentiometer mount on the panel board, and turn the potentiometer adjustment to the middle position. Then, after all tests have been completed and the unit has been reassembled as shown in Figure 8 , connect to a generator and adjust the potentiometer to 14 volts. Then, with the adjusting lever in the vertical position (Fig. 8) use a soldering iron to melt the adjusting lever into the potentiometer.

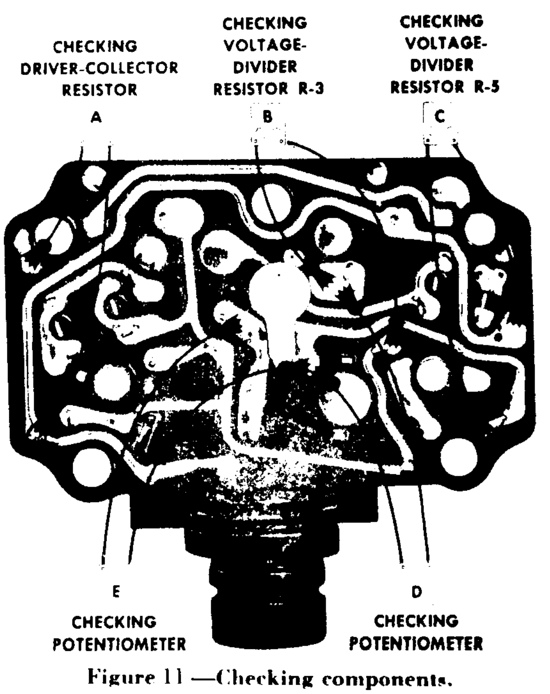


Figure 11 —Checking components.

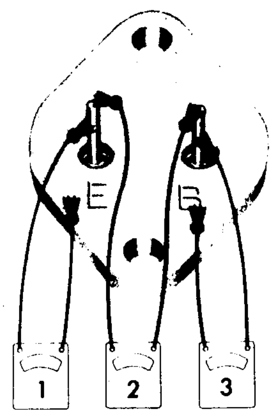
Emitter-Base Resistor (Ohmmeter Check Not Illustrated): Since this resistor has been unsoldered from the panel board at one end, merely connect an ohmmeter across the resistor — an infinite reading indicates an open. Replace if defective. If not defective, *resolder to the panel board.*

Driver and Power Transistors, Fig. 12: If both readings in Step 1 are zero, or if both readings are very low and identical, the transistor is shorted. Similarly, if both readings in Step 2, or in Step 3, are zero or very low and identical, the transistor is shorted.

Driver and Power Transistors, Fig. 13: If both readings in Step 1 are infinite, or if both readings are very high and identical, the transistor is open. Similarly, if both readings in Step 2 are infinite or very high and identical, the transistor is open.

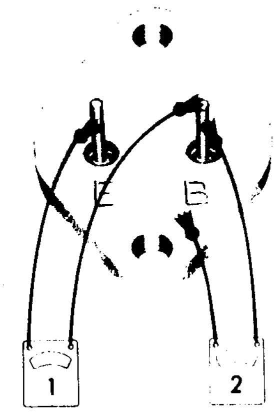
Reassembly and Final Check

During assembly, coat with silicone grease both sides of the flat insulators used between the transistors and heat sink, and also the heat sink on the side on which the transistors are mounted.



CHECKING TRANSISTOR FOR SHORTS

Figure 12—Checking transistor.



CHECKING TRANSISTOR FOR OPENS

Figure 13—Checking transistor.

The silicone grease which is available commercially, increases heat conduction and thereby provides better cooling.

After the regulator has been reassembled, the voltage setting should be checked and adjusted if necessary as covered in Section E, Page .

VOLTAGE SETTING ADJUSTMENT

The desired voltage regulator setting is one which keeps the battery in a satisfactory state of charge (¾ charge or more) without causing excessive battery overcharge (as evidenced by excessive battery water usage).

The "normal" setting (values shown in the "Voltage Table" above) usually will be satisfactory for the vehicle operated in average type service conditions. However, if operating service conditions are above or below average, the voltage regulator setting must be adjusted or tailored to adapt it to the battery and type of service conditions.

Either of two conditions may persistently exist which indicate the need for adjusting the regulator setting: (1) battery is being overcharged, (2) battery remains undercharged. Corrections should be made as follows:

1. If the battery uses too much water at the "normal" setting, reduce the voltage setting approximately 0.3 volt and check for decreased battery water usage over a reasonable period. If necessary, repeat this process until the battery remains charged with a minimum use of water.
2. If the battery is consistently undercharged (evidenced by inability to crank the engine) at the "normal" setting, increase the voltage setting 0.3 volt and check for improved condition over a reasonable service period. If necessary, repeat this process until the battery remains charged with a minimum use of water.

The external adjustment type regulator has positive stops on the adjusting mechanism that will prohibit excessively high and low settings.

To adjust the voltage regulator setting of the external adjustment type regulator, remove the access plug from the regulator. Then for an undercharged battery insert screwdriver into slot and turn clockwise one notch (0.3 volt) to increase the setting. For an overcharged battery, turn counterclockwise one notch (0.3 volt) to decrease setting. See Figure 17. Then check for an improved battery condition over a service period of reasonable length. If necessary, repeat the above procedure for a higher or lower setting.

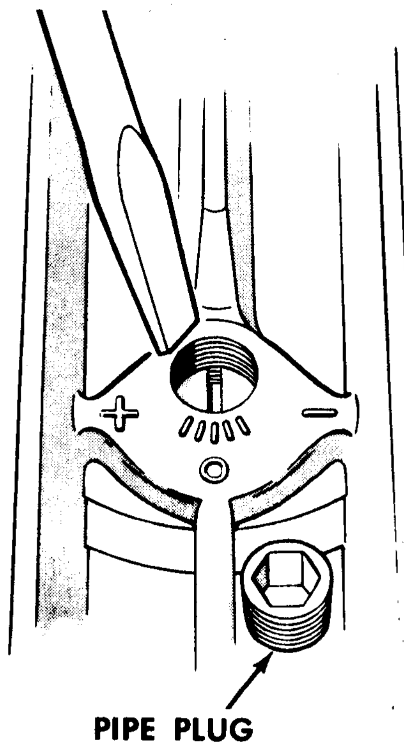


Figure 17—Adjustment screw of external adjustment type regulator.

CLARK EQUIPMENT

SCRAPER

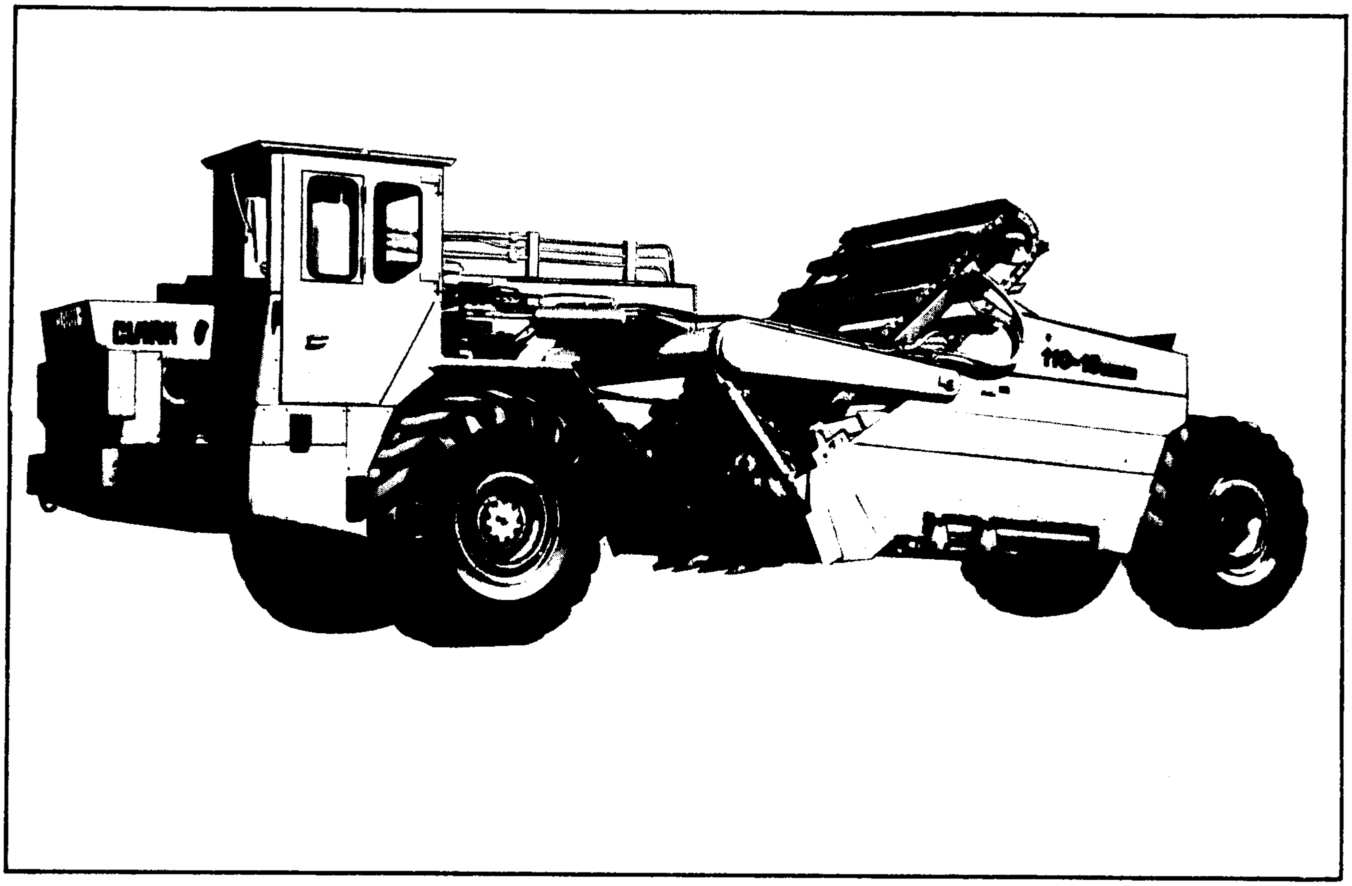


Fig. 1–Left Hand Model View

DESCRIPTION AND OPERATION

The scraper assembly consists of the hitch, pull yoke, main frame or bowl, endgate, rolling floor, cutting blades, tail structure and elevator.

The hitch connecting the scraper to the tractor is equipped with a horizontal and vertical pin arrangement. This type of arrangement allows the unit to travel over almost any terrain and allows the tractor to assume any angle to the scraper, not exceeding 90°.

The pull yoke assembly consists of a crosspipe, a gooseneck and two pull arms. The assembly is fabricated from steel pipe and plate and is welded together to form a strong, rigid pull yoke. One end of the gooseneck is welded to the crosspipe and the other end to the yoke side of the hitch arrangement. The pull arms are welded to the ends of the crosspipe and the other end to the yoke side of the hitch arrangement. The pull arms are welded to the ends of the crosspipe and are fastened to the bowl by means of a pin on each side. The hydraulic cylinder lugs are welded to the pull arms at the crosspipe. The pull yoke is designed to provide sufficient turning clearance for the tractor, with stability, whether the scraper is digging, hauling or ejecting its load.

The main frame, or bowl, is that portion of the scraper in which the load is carried. It is supported by the hydraulic cylinders and the pull yoke. The pivot point on both sides of the bowl is at the top leading edge of the bowl at the ends of the pull arms. The bowl is of double wall construction of welded rectangular tubing. The sides are held in alignment by fabricated box sections welded top and bottom in the rear and across the bottom in the front. This type of structure provides an all-welded, highly torsion resistant assembly.

The endgate is of single wall construction with channel reinforcements weld around the outside. It is pinned to the endgate hydraulic cylinder and operates freely within the bowl. When in a closed position, the endgate acts as the rear portion of the scraper bowl.

The rolling floor is of double wall construction of welded rectangular tubing. The strike-off blade is hinged to the front edge of the rolling floor. The purpose of the rolling floor is to form the bottom of the bowl and to eject the load during the dumping cycle.

The rolling floor is supported throughout its travel by cast rollers operating in a track incorporated in the sides of the bowl.

The cutting blades are made of heat treated alloy steel to provide increased resistance to wear. The blades are so designed as to allow many different arrangements which can be tailored to suit the job conditions. Specially hardened plow bolts are used to mount the blades to the blade base or moldboard.

The scraper tail structure is formed by a number of lengths of square tubing. They are welded to the rear of the bowl and converge to the rear where they are welded to a piece of formed steel which serves as a guard for the rear of the unit rather than a pusher surface.

The elevator is mounted in the mouth of the bowl and is supported on two sides top and bottom by arms which are attached to the bowl in a hinge type arrangement. The elevator frame is constructed from rectangular tubing and provides length and width for the chain and drag assembly. The chain and drag assembly is powered by a hydrastatic motor driving through a 28.2:1 reduction axle. The chain and drag assembly is driven at the bottom of the frame by two sprockets which are bolted to the planetary hubs of the elevator axle. The elevator is discussed in Section 17.

The bowl is raised and lowered by the two cylinders pinned to the pull yoke and to the bottom front of the bowl. When the cylinders are lowered, the bowl lowers. When the cylinders are raised, the bowl is raised. The bowl is maintained in any given vertical position by the hydraulic cylinders. (Fig. 2.)

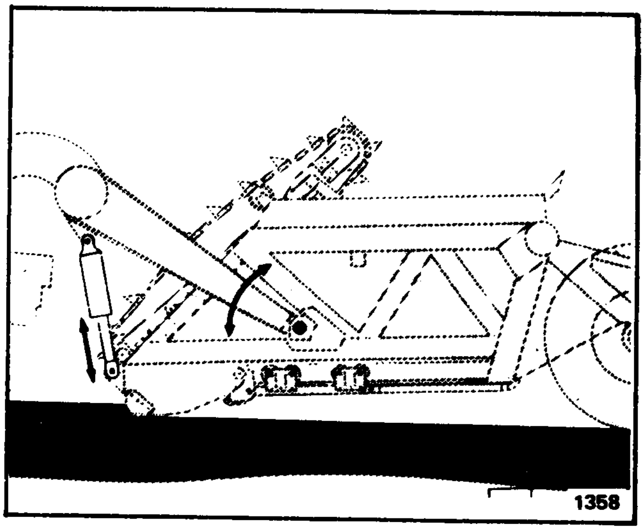


Fig. 2–Bowl Operation

The endgate is pushed forward and pulled rearward (Fig. 3) by one hydraulic cylinder mounted on the tail structure and pinned to the endgate actuator.

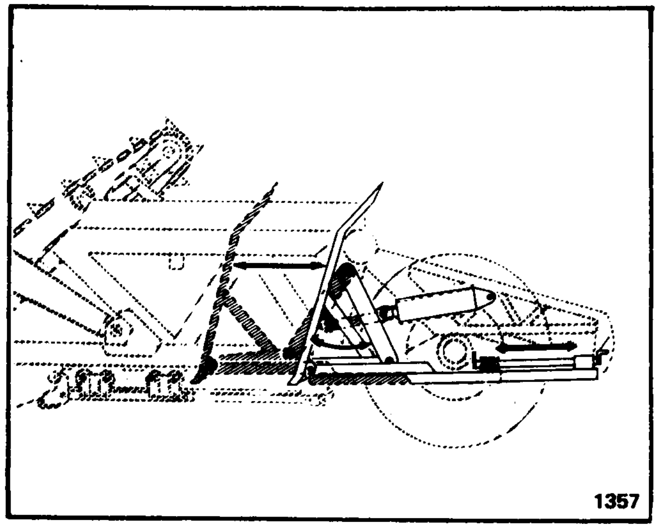


Fig. 3–Endgate Operation

The rolling floor is pulled rearward and pushed forward by a hydraulic cylinder pinned to the rolling floor actuator and mounted on the tail structure.

The rolling floor and endgate double-acting hydraulic cylinders are actuated through one section of the control valve and are cross-ported from a common pressure line so that they act opposite each other on either actuation of the control valve.

PROPER BLADE ARRANGEMENT

The scraper blades and the scraper blade base or moldboard are designed so that one type of blade can

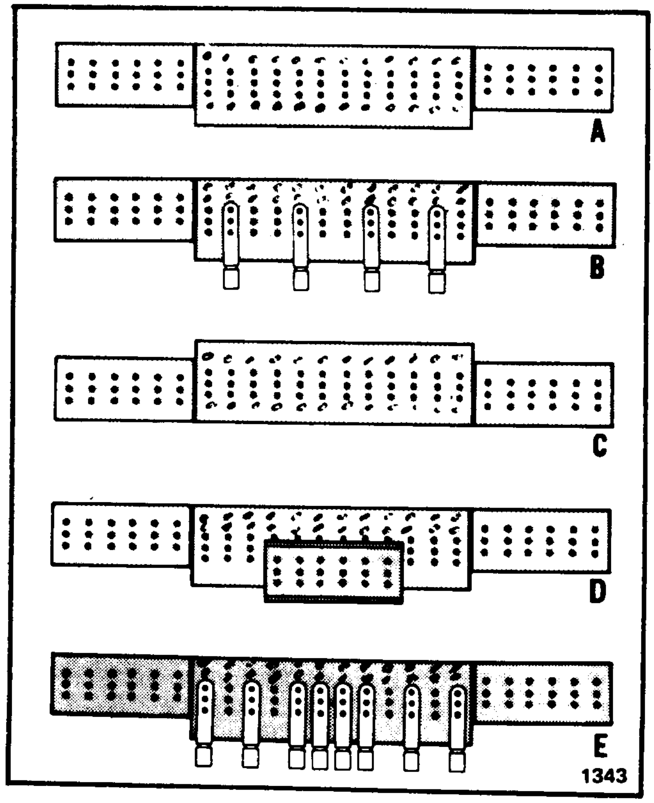


Fig. 4–Recommended Blade Arrangements

be used for the various blade arrangements. (Fig. 4). In addition to this, the blades are reversible, thereby prolonging the useful life of the blades. Use of the proper blade arrangement for certain types of cuts or soil conditions can save a great deal of money in blade replacement and labor. Scraper blades should not be allowed to wear to the point that the blade base or moldboard is doing the cutting.

The five inch drop center arrangement is recommended for hard, rock-free soils when a maximum drop center is required. See Fig. 4A. In extremely hard or compacted materials, chisels may be added to the drop center arrangement for increased loading efficiency. See Fig. 4B.

The straight edge arrangement is recommended whenever a level cut or a level fill is desired. This arrangement is also recommended for loading windrowed materials. (Fig. 4C). Move outside blades down even with center section.

When loading extremely plastic or gumbo materials, the blade arrangement shown in Fig. 4D is recommended. Eight chisels may be mounted side by side to help strip this material so that it may be broken up by the elevator. (Fig. 4E).

TIGHTENING SCRAPER BLADES

When tightening or replacing cutting blades, plow bolts must be tightened correctly. These bolts have square shanks that fit into square holes in the blades to keep them from turning. If the square bolt shanks are not seated properly in the blade holes, the bolts cannot be tightened adequately and the blades will eventually loosen. Therefore, to make sure that the plow bolts are tightened to 550 to 600 ft. lbs., pound the bolt heads while drawing up the nuts with a torque wrench. When the torque on the nuts cannot be reduced below 550 ft. lbs. by additional pounding on the bolt heads, the bolts are properly seated and correctly tightened.

DISCONNECTING SCRAPER & TRACTOR

1. Lower scraper bowl and relieve pressure in hydraulic system.

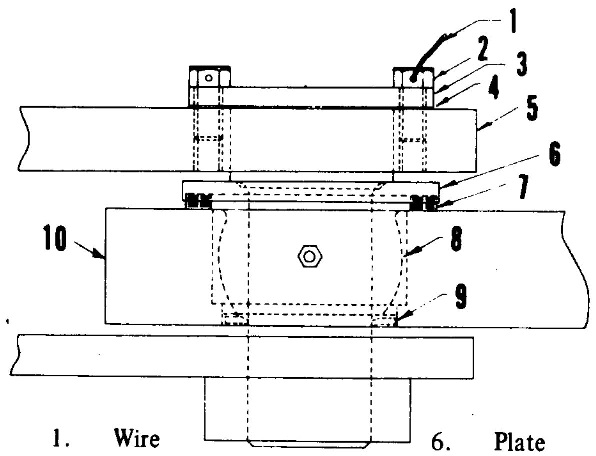
2. Depressurize all air tanks and disconnect air and hydraulic lines that would be affected by the disconnection of the tractor from the scraper. All lines should be marked or labeled in some way to facilitate reassembly. Lines should be disconnected at the most convenient location or at points where the danger of damage to fittings and lines is least likely. Use caution to prevent dirt from entering the disconnected lines and other parts. All electrical wiring should be disconnected and labeled.

3. Block up the front end of the tractor with timbers or heavy duty stands. Support the pull yoke with a crane or other suitable lifting device.

4. Disconnect the steering cylinders on the rod end and swing them outward. Cylinder is disconnected by removing the front steering pin bolt and lockwasher and then removing the front steering pin.

5. Remove bolts locking upper and lower kingpins in position. Remove kingpins using a hammer and drift or hydraulic jack and install bolts in tapped holes in the pin head and use as puller bolts.

6. Use the crane or suitable lifting device to lift the scraper away from the tractor.



1. Wire
2. Bolt
3. Pin
4. Shim
5. Hitch
6. Plate
7. Felt
8. Bushing
9. Seal
10. Yoke

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Fig. 5–Pin Installation

CONNECTING SCRAPER TO TRACTOR

Numbers in parenthesis refer to Fig. 5.

1. Glue new felt seal (7) to seal plate (6).

2. Press new seal (9) into pull yoke (10) bore.

3. Make sure opposing bearing is properly seated.

4. Insert kingpin (3) in bore and seat by tapping until bolts (2) can be started in tapped holes in hitch yoke (5).

5. Pull kingpin (3) into bore with bolts (2) and apply force with hammer as necessary to fully seat pin.

6. Tighten bolts (2) to 20 ft. lbs. and measure gap between pin head and machined surface of hitch.

7. Add shims (4) of thickness corresponding to gap measurement in Step 6.

8. The same procedure applies to horizontal kingpins. The lower vertical kingpin seats against the head and no shims required. This allows no preload and no end play.

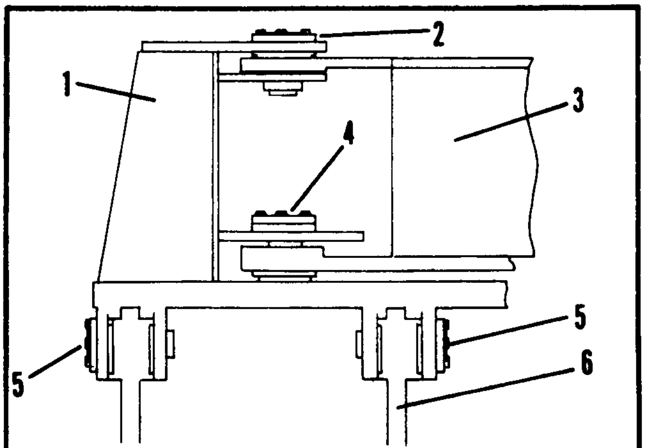
HITCH

Numbers in parenthesis refer to Fig. 6.

The hitch consists of the steering frame (1) and the pull yoke (3). The steering frame (1) is mounted on the trunion mount (6) with mounting pins (5) in self-aligning bushings.

The pull yoke (3) consists of the yoke assembly, upper vertical kingpin (2) and lower vertical kingpin (4). The pull yoke (3) is pinned to the sides of the scraper bowl and is connected to the steering frame (1) by the upper vertical kingpin (2) and the lower vertical kingpin (4).

The pins (2, 4 & 5) and bushings should be inspected for excessive wear and replaced if necessary. The pins (2, 4 & 5) should be lubricated according to the instructions outlined in the Lubrication Chart of this manual.



1. Steering Frame
2. Upper Vertical Kingpin
3. Pull Yoke
4. Lower Vertical Kingpin
5. Horizontal Kingpins
6. Trunion Mount

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Fig. 6–Hitch Arrangement

ENDGATE INSTALLATION AND REMOVAL

Numbers in parenthesis refer to Fig. 7.

1. Endgate
2. Nut
3. Bearing
4. Bolt
5. Actuator
6. Pin
7. Washer
8. Pin
9. Nut
10. Bushing
11. Pin
12. Bolt
13. Bolt
14. Bracket
15. Roller
16. Nut
17. Nut
18. Lockwasher
19. Yoke
20. Track
21. Nut
22. Lockwasher
23. "U" Bolt
24. Bushing
25. Pin
26. Pin

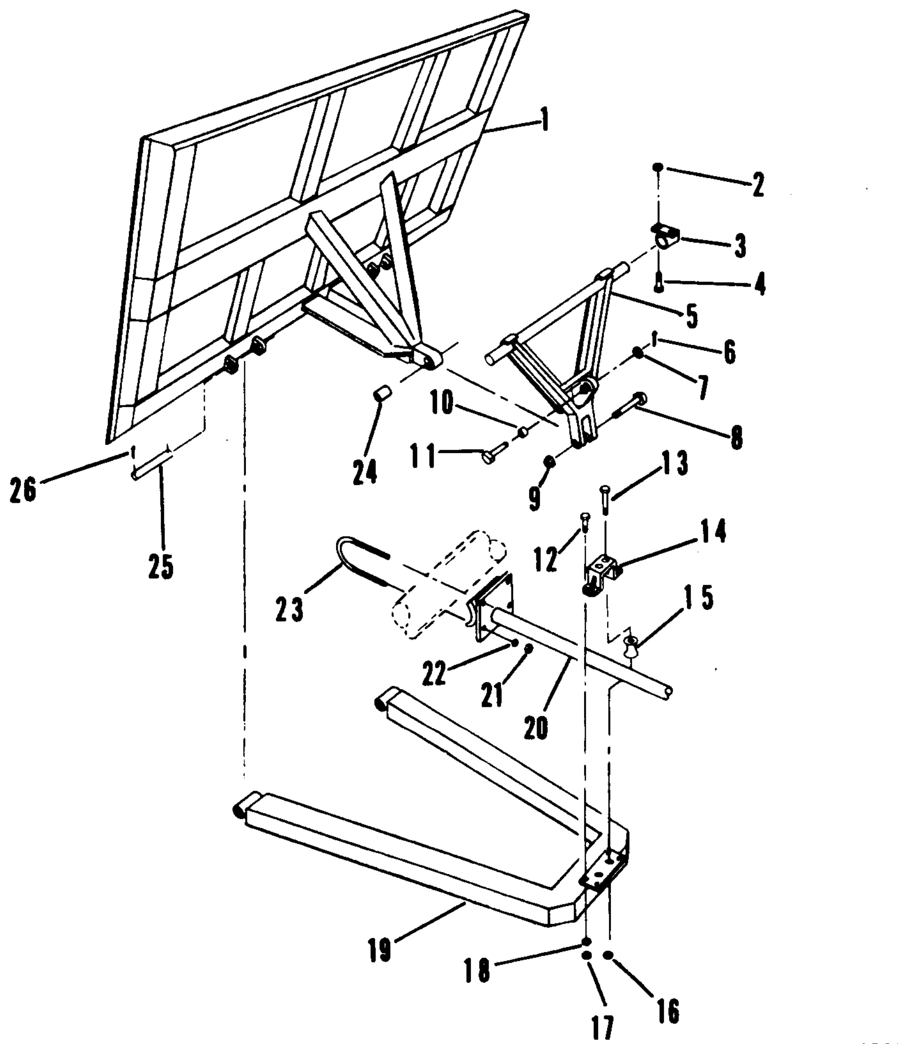

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Fig. 7–Exploded View of Endgate Assembly

1. Remove cotter pins (26) from pins (25) and remove pins (25).
2. Remove nut (9) from pin (8). Remove pin (8) from actuator (5).
3. Use a suitable lifting device to remove the endgate (1) from the unit.
4. To install the endgate (1) in the unit position it in the scraper bowl and replace pin (8) fastening actuator (5) to endgate (1). Secure with nut (9).
5. Replace pins (27) fastening stabilizer (19) to endgate (1). Secure with cotter pins (26).

ENDGATE CLEARANCE

Numbers in parenthesis refer to Fig. 7.

The endgate must be properly adjusted to function properly. It must operate squarely in the bowl and move to the rear just the right amount to maintain proper operation.

The endgate should be checked for proper centering by measuring the space between the scraper bowl wall and the edge of the endgate. (Fig. 8). Measurement should be equal on both sides.

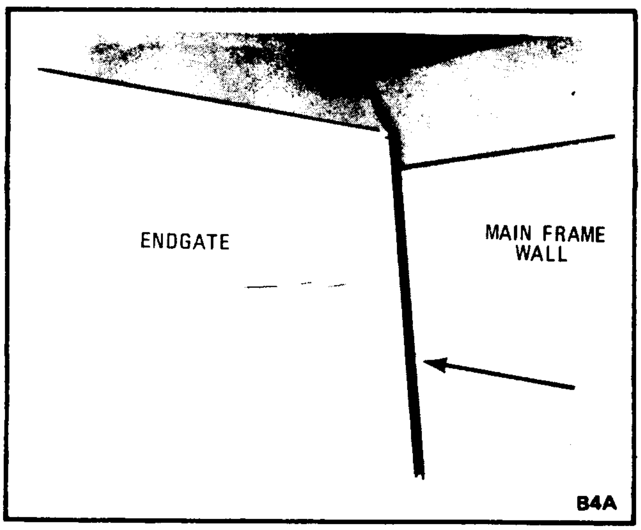


Fig. 8–Endgate Centering Measurement

If endgate rubs main frame wall on either side, the endgate is not centered properly. To properly center the endgate, loosen the nuts (20 & 21) securing the roller track (17) to the scraper tail structure. Move the roller track (17) to the right or left as required and tighten nuts (20 & 21) securely.

Fully retract endgate. Clearance between endgate vertical member and inside of upper main frame horizontal member should be ¼ to ½ inch,
Should adjustment be required, observe the following procedure:

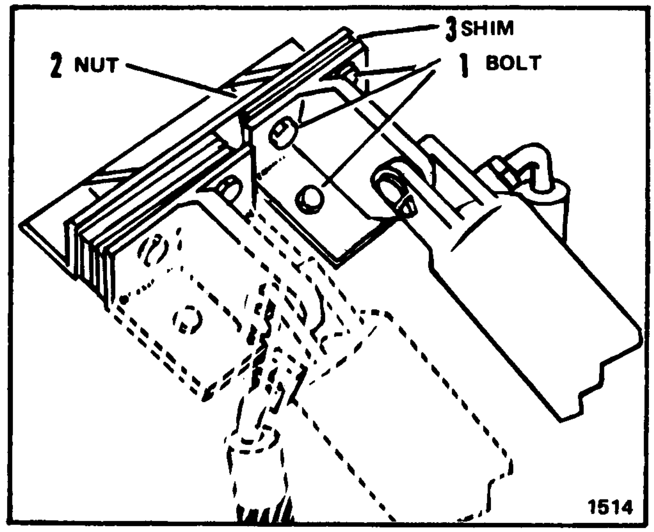


Fig. 9 – Endgate Clearance Adjustment

1. Remove tail frame cover revealing endgate cylinder, rolling floor cylinder, and vertical mounting bolts. Horizontal mounting bolts are accessible beneath tail frame.
2. Remove nuts and bolts (1) securing shims (3) in cylinder hanger.
3. Loosen nuts and bolts (2) securing cylinder hanger to tail structure.
4. Add or remove shims as required. Add shims to increase clearance and remove shims to decrease clearance.
5. Secure nuts and bolts (1 & 2) and check endgate clearance again. If clearance is within the 1/8" limit, endgate is properly adjusted.

ROLLING FLOOR INSTALLATION AND REMOVAL

Numbers in parenthesis refer to Fig. 11.

1. Block rolling floor (27) in position to prevent accidental falling.
2. Remove cotter pins (11) from drilled pins (28) and drive drilled pins from yoke (10). Allow yoke (10) to swing to the ground.
3. Remove bolts (17) and nuts (18) securing hangers (13) to rolling floor (27).
4. Lower rolling floor (27) to the shop floor.
5. Install the rolling floor (27) on the unit by placing it under the scraper bowl and jacking it into position.
6. Secure yoke (10) to rolling floor (27) with drilled pins (28) and cotters (11)

7. Secure brackets (13) with rolling floor rollers (12) mounted on them to the rolling floor (27) using bolts (17) and nuts (18)

ROLLING FLOOR CLEARANCE

It is recommended that ½" clearance be maintained between the strike-off blade and the moldboard when the rolling floor is in its most forward position. If clearance exceeds ½", refer to Fig. 10 and to procedure outlined below.

1. Loosen bolts (2) and remove bolts and nuts (1).
2. Add shims (3) to decrease clearance and subtract shims to increase clearance.
3. Tighten bolts and nuts (1 & 2), operate rolling floor and check clearance again. Repeat procedure if measurement is not as specified.

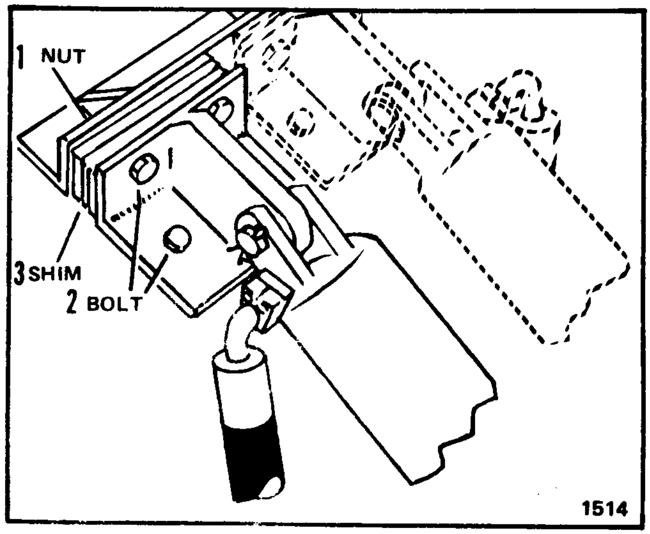


Fig. 10 – Rolling Floor Clearance Adjustment

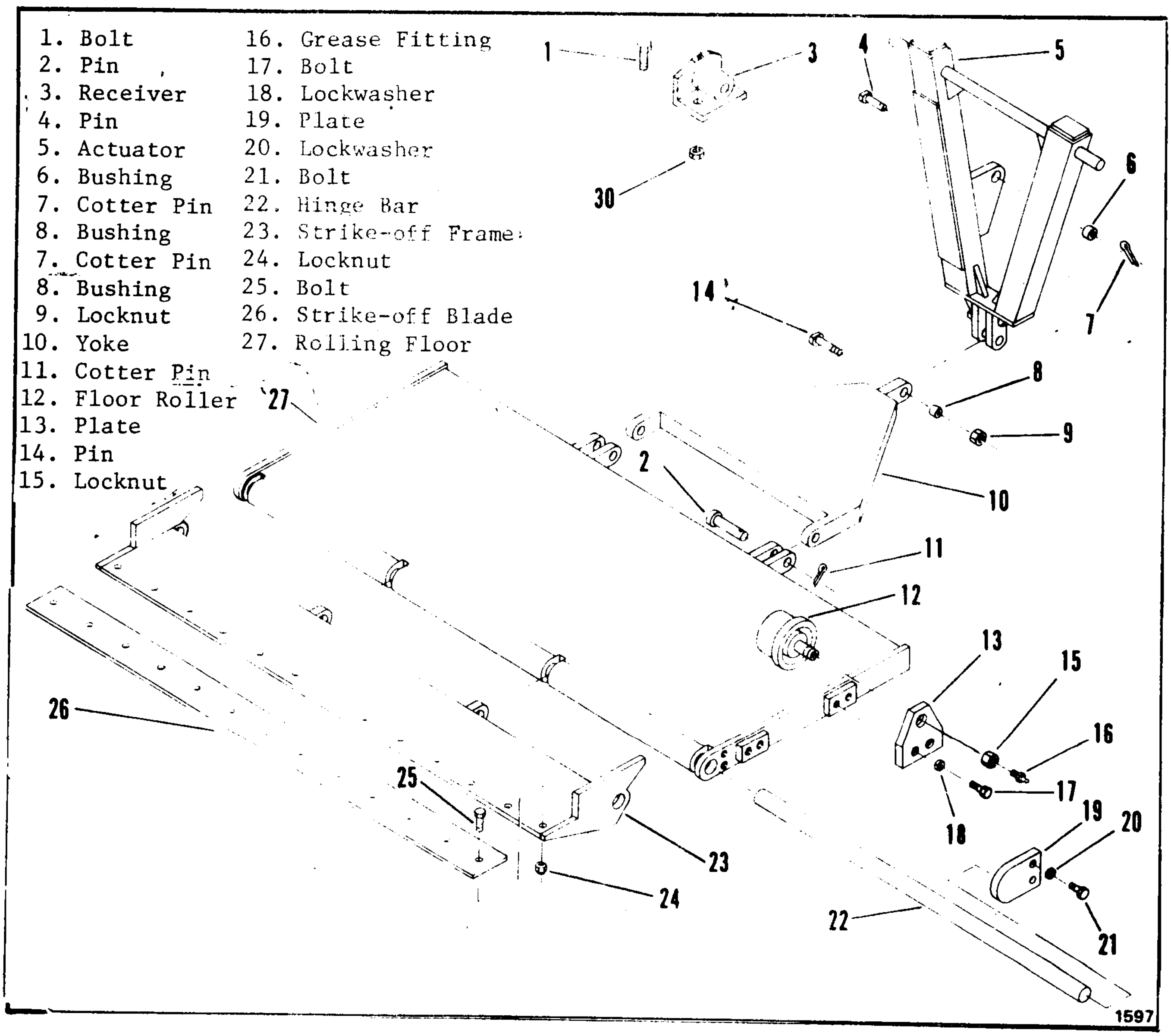


Fig. 11 – Exploded View of Rolling Floor

Strike-off Blade Adjustment

Recommended clearance between the strike-off blade and the moldboard is .35 to .50 with rolling floor completely closed. Refer to Fig. 14 and the following instructions:

1. Make sure there are no obstructions, such as rocks or packed dirt, preventing the rolling floor from being in its most forward position.

2. On the inside of the scraper bowl, just behind and above the moldboard, is a drilled block. A tapped block is bolted to the rear of the drilled block attached to the wall of the bowl. The rear of this block assembly can be raised or lowered as necessary to adjust strike-off blade by adding shims between the two blocks.

3. For correct adjustment, position strike-off blade so that the top edge of the strike-off blade cams are parallel with blocks as shown in Fig. 14. Remove two socket head capscrews from each block and measure space between the front and rear block. Add shims as necessary to take up this space. Care should be taken not to add too many shims.

4. After the necessary thickness of shims have been added to the block assemblies on each side of bowl, reinstall two socket head capscrews in each assembly and operate strike-off blade and rolling door, observing contact of strike-off blade with blocks for proper adjustment.

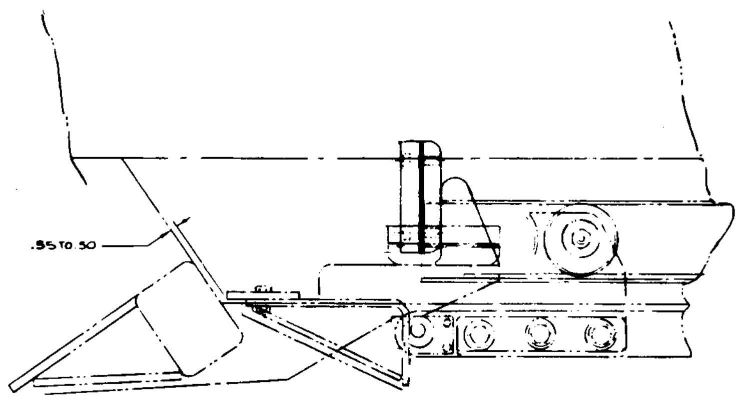


Fig. 14A - Rolling Floor Clearance

ROLLING FLOOR ROLLER ADJUSTMENT

The rolling floor rollers require 1/16 to 3/16 inches clearance between the inside of the roller flange and the outside of the roller track.

Should adjustment be required, observe Fig. 12 and the following procedure is applied:

1. Remove bolts (3) securing rolling floor mounting bracket (1) to rolling floor.
2. Add or remove necessary shims (2) between mounting bracket (1) and rolling floor. If shims (2) are painted, remove paint.
3. Replace roller bracket (1) and bolts (3). Tighten bolts securely.

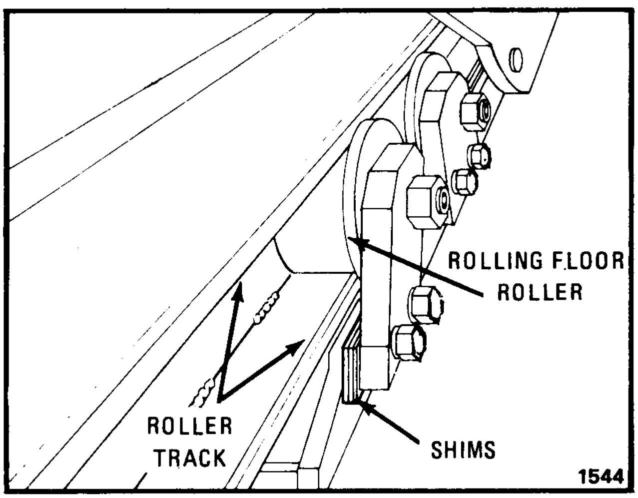


Fig. 12 – Rolling Floor Roller Clearance and Adjustment

REMOVAL & DISASSEMBLY

Numbers in parenthesis refer to Fig. 13.

1. Remove bolts securing roller bracket to rolling floor.
2. Grip bracket securely in a vise and remove jam nut securing roller to roller bracket. Tap roller from roller bracket. Preserve woodruff key (6).
3. Tap roller shaft (5) on working surface to dislodge and remove spacer (2).

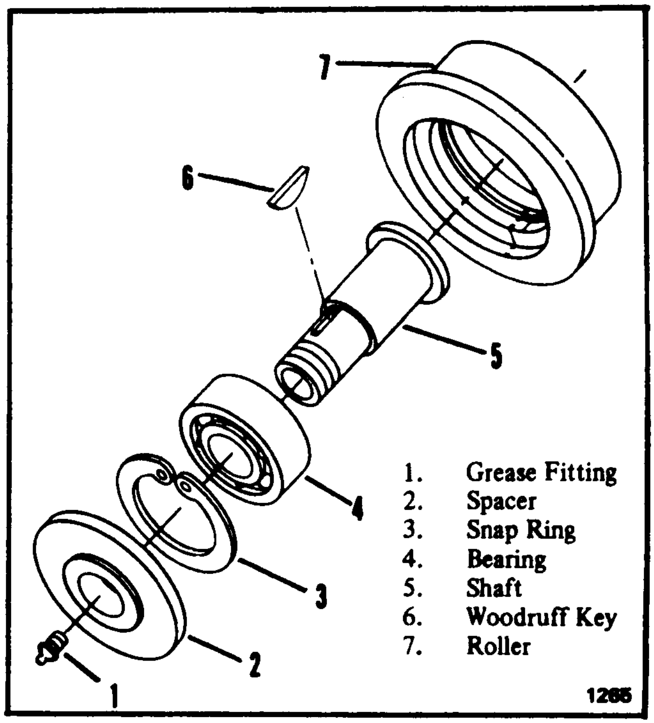


Fig. 13 – Exploded View of Rolling Floor Roller

4. Remove snap ring (3) and lift bearing (4) and shaft (5) from the roller (7). Press the shaft (5) from the bearing (4).

INSPECTION, ASSEMBLY INSTALLATION

1. Check bearing (4) for excessive wear and shaft (5) for galling. Clean out snap ring groove in roller (7).
2. Press bearing (4) on shaft (5) and make sure bearing seats against shaft shoulder.
3. Place bearing (4) and shaft (5) assembly in roller (7) and secure with snap ring (3).
4. Slide spacer (2) over shaft (5) and seat in roller (7).
5. Thread grease fitting (1) into shaft (5). Place woodruff key (6) in slot in shaft (5).
6. Position roller assembly in bracket and secure with self-locking nut. Position roller and bracket assembly on rolling floor and secure with bolts and nuts removed previously.

* * * *

ELEVATOR

The heart of the elevating scraper and the feature which sets it apart from other scrapers is the elevator. The elevator is composed mainly of the following: (1) elevator frame, (2) planetary axle with hydraulic motor and idler rollers at head of elevator to support the chain as it rotates around the elevator frame.

REMOVAL OF THE ELEVATOR ASSEMBLY

It is rarely necessary to remove the elevator assembly. The only case in which the elevator assembly should be removed from the unit is when the elevator frame is bent so that the elevator cannot be properly adjusted for rectangularity; in this case the elevator frame must be replaced.

Extreme caution must be exercised when removing the assembly. Thoroughly understand the instructions outlined below before attempting removal of the elevator assembly.

1. Disconnect hose at tubes at top of elevator frame on both sides of scraper and cap tubes and hose to prevent contamination of system.

2. Remove capscrew, flatwasher and locknut fastening upper elevator arm to elevator rest on main frame. Support the elevator assembly with a hoist of sufficient capacity to handle the assembly.

3. Lift the elevator assembly slightly to allow better alignment and to ease the tension from lower elevator arm.

4. Remove cotter pin and flatwasher from the lower elevator arm stub. Perform the operation on the opposite side of the elevator.

5. Use a pry bar to remove the lower elevator arms from the lower elevator arm stubs.

6. Lift the elevator straight up and out of the main frame handling it with care to avoid injury to equipment and personnel.

7. Place the elevator on suitable stands or on the floor and begin needed service.

DRIVE SPROCKET SERVICE

The drive sprockets are designed to be reversed after wearing on one side. This design feature allows almost a "double life" for the drive sprockets. The sprockets must not be allowed to wear on one side to the point that it is not advantageous to reverse them.

Sprockets must be turned when they are worn sufficiently to justify turning them. When new chains or chain parts are installed, place new sprockets on the unit.

Turning the sprockets is left largely up to the service man. Since job conditions vary so widely, no flat hourly recommendation is in order to reverse the drive sprockets.

When the sprockets are to be turned, it is best, if possible, to have a full load in the scraper. This will make handling of the chain and drag assembly much easier. Another method is to fasten the top chain so it will not roll back over the top idler.

Thoroughly understand the instructions listed before reversing the sprockets.

1. Part the chain by removing pin cotter and driving a pin through the chain using a heavy hammer or similar object as a back-up. See Fig. 1.

2. Remove the capscrews and locknuts fastening the sprocket to the axle.

3. Tap the sprocket with a hammer to remove it from the axle hub flange.

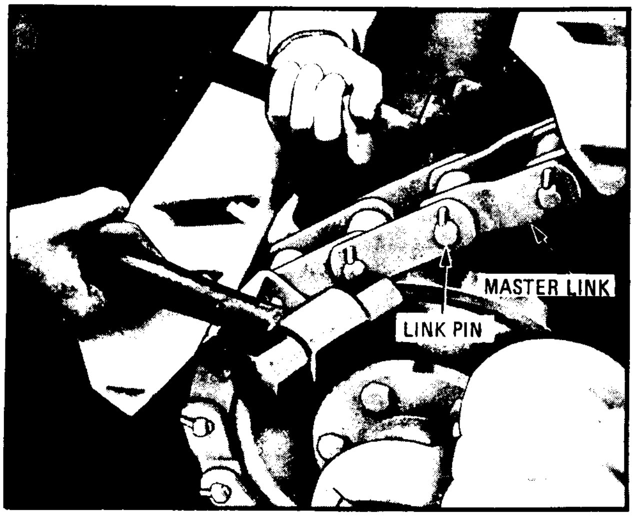


Fig. 1- Parting Chain

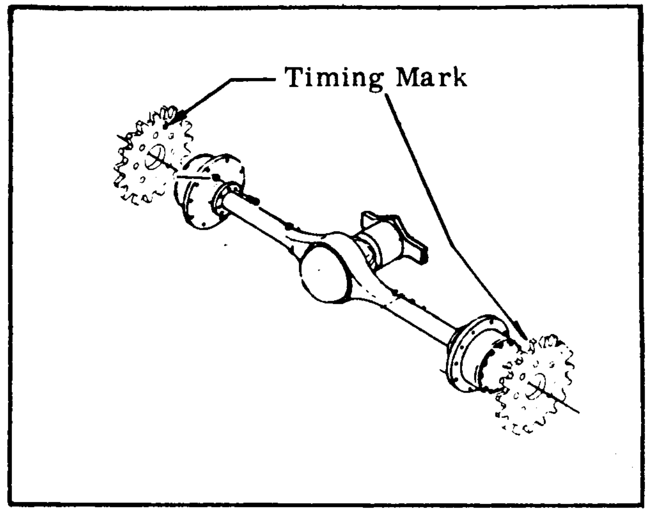


Fig. 2- Timing Mark Alignment

4. Swap sides of elevator with sprockets.

   NOTE: Make sure that the timing marks are properly aligned when placing the sprockets on the axle hubs. Fig. 2.

5. Replace the two pins and cotters removed to part the chain with new parts.

   The sprockets will now be running on the unworn sides, hence the term, "double life". The instructions listed above will also apply when the sprockets are being replaced with new ones.

CLARK EQUIPMENT

STUB SPINDLE

DESCRIPTION

Two stub spindles are used in the elevator assembly. Their purpose is to allow chain to rotate around upper end of elevator frame. The idlers are adjustable on the elevator frame to achieve the proper chain tension.

REMOVAL

1. Part chain at a master link as near to idler rollers as possible. Use a heavy hammer and a similar object as a backup to drive the chain pin with the cotter intact through the chain. Repeat this process on the chain on the opposite side of elevator.
2. Remove four locking bolts and nuts from each idler assembly securing it to elevator frame. Remove idler roller assemblies with cross tube and lower to floor. Remove bolts and locknuts securing stub spindle assembly to cross tube.
3. Place the stub spindle and wheel assembly on a suitable working surface which should be free of grit and dirt.

DISASSEMBLY

1. Remove hub cap from end of hub. Cap is pressed in end of hub and can be removed with screw driver by wedging blade between flange on cap and end of hub.
2. Remove cotter pin from end of stub spindle. After removing castle nut and bearing washer, the hub and wheel assembly can be removed from spindle. The outer bearing cone will fall out of hub when removing assembly from spindle.
3. To remove the inner bearing cone from hub, the seal cover plate and seal must be taken off hub. Remove 8 locknuts and slip plate off end of hub. Remove seal from end of hub and discard. Slip inner bearing cone out of end of hub.
4. The outer and inner bearing cups may be removed from the hub using a hammer and soft drift of mild steel.

INSPECTION AND CLEANING

1. Clean all bearings in clean solvent and air dry. If they are not worn to the point that they are unfit for further use, dip them in an oil bath of clean light weight oil and wrap them in a wax paper type wrap.
2. Wash all other parts except those discarded in the same solvent used to wash the bearings. These parts may be dried with compressed air.
3. Inspect all parts for excessive wear, burrs, signs of galling or any other conditions which might make them unfit for further use.

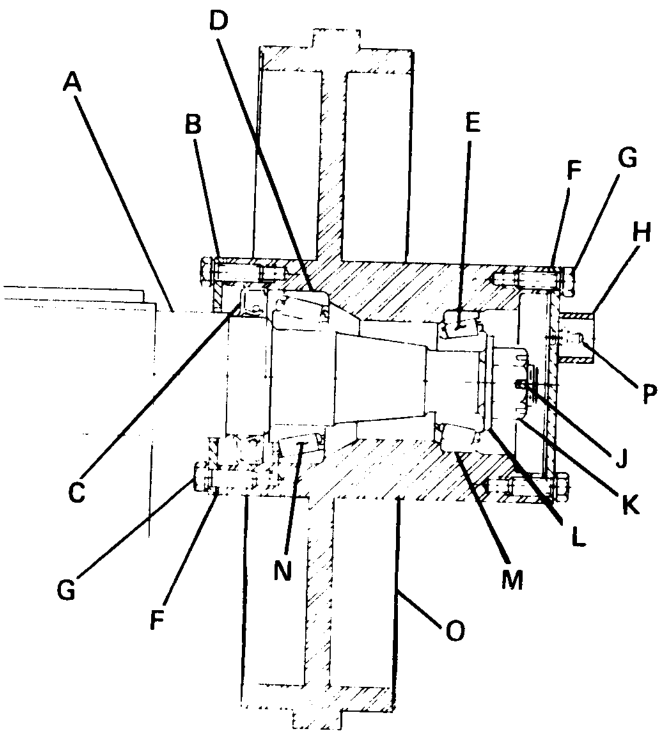
ASSEMBLY

1. Press bearing cups into each end of hub.
2. Pack inner bearing cone with grease and spread liberal amount of grease on cup. Install inner cone in end of hub.
3. Press new seal in end of hub with lip of seal turned outward to keep foreign matter out of bearings. Slip cover plate over ends of bolts in hub and install locknuts.
4. Install hub and wheel assembly on spindle taking care that lip of seal does not get rolled up on shoulder of spindle or folded back and damaged. Tap around OD of hub with a light hammer to seat the inside bearing cone into the inside bearing cup.
5. Pack outside bearing cone with grease and spread liberal amount of grease on bearing cup. Install bearing cone on spindle making sure that it is firmly seated against the outside bearing cup in the hub.
6. Install the bearing washer on the spindle. Place the castle nut on the spindle and draw it down until the bearings bind. This will aid in seating the bearings. Back the castle nut off until the hub turns freely and has no detectable end pla
7. Install cotter pin.

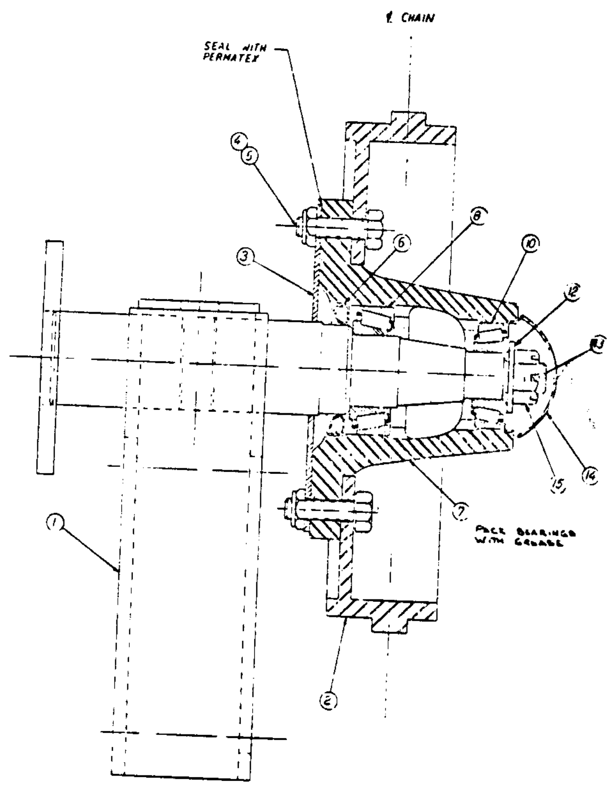
8. Install hub cap. With screw driver or flat edge tool tap cap into hub. If cap is repeatedly struck in the center, it may be caved in and interfere with end of stub spindle when hub rotates.

INSTALLATION

Installation of the stub spindle assembly is the opposite of the removal procedures. Replace shims between cross shaft and bolt flanges on stub spindle assemblies as they were before disassembly.



A REF: SPINDLE ASSY
B COVER
C OIL SEAL
D CUP
E CONE
F GASKET
G BOLT
H COVER ASSY
J COTTER PIN
K NUT
L WASHER
M CUP
N CONE
O ROLLER ASSY
P GREASE FITTING



1 Hanger
2 Idler Roller
3 Cover Plate
4 Capscrew
5 Locknut
6 Seal
7 Hub
8 Bearing, Inner
10 Bearing, Outer
12 Washer
13 Cotter Pin
14 Hub Cap
15 Nut

CLARK EQUIPMENT

CHAIN & DRAG ASSEMBLY

DESCRIPTION

The chain and drag assembly consists of 16 drags and two lengths of chain composed of 80 links each. Attached to every fifth link is an angle link or attachment link to which the drags are fastened. The chain and drag assembly is pulled along at the bottom by a hydraulically-driven planetary axle attached to the bottom of the elevator frame and is idled at the top by idler rollers which support the chain and keep it clear of the elevator frame.

OPERATION

As the sprocket and axle assembly rotate (rotation is clockwise viewed from the right hand side of the unit), the chain and drag assembly is pulled around the elevator frame. This action forces the drags past the cutting edge. The drags then pulverize the material being loaded and force it to the rear of the bowl. When the bowl is beginning to become fully loaded, the drags continue to force the material being loaded upward and rearward into the bowl. Use of this principle allows the bowl to be fully loaded and for each load to be free of voids. Pulverized material spreads more evenly and compacts more readily to exacting compaction requirements.

REMOVAL

Occasionally, the chain and drag assembly will become so worn that the necessary maintenance will require removal of the entire chain and drag assembly from the unit.

A full load of dirt in the bowl will be helpful in providing support of the weight of the assembly.

If the chain and drag assembly is to be removed for any reason, the following instructions apply:

1. Support two drags as near the top of the elevator frame as possible. See Fig. 1.
2. Part the chain assembly at a master link as near as possible to the lowest drag supported by the hoist, as shown in Fig. 1. To part the chain, remove the cotter with a punch and use a hammer and drift to drive the pin from the chain. Repeat this procedure on the opposite side of the elevator.

CAUTION: Do not peen the ends of the pins. Strike the pins with a few strong, sharp blows, rather than many soft ones.

3. Lift the chain and drag assembly from the elevator frame with the hoist and lay it flat on the floor and begin needed repairs.

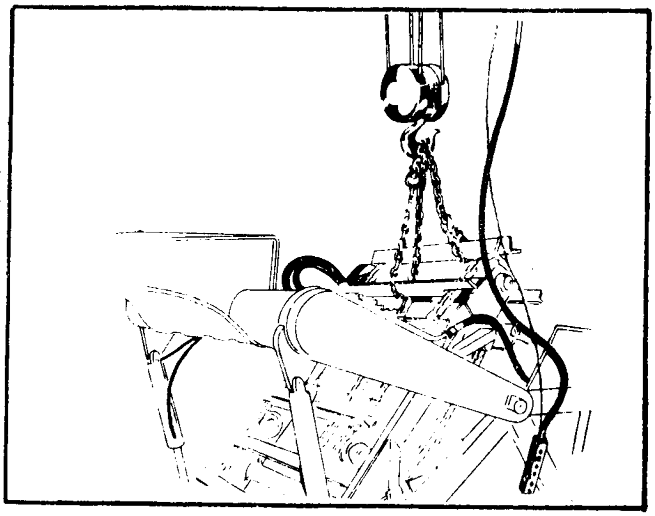


Fig. 1 – Hoist on Chain & Drag Assembly

DISASSEMBLY

1. Drags are removed from the chains by removing bolts and nuts fastening them to the chains.
2. To disassemble the chain at any given point, or at all points, follow the instructions given for parting the chain in the REMOVAL portion of this section.

INSPECTION

1. Inspect all drags for cracked welds, straightness and excessive wear, usually indicated by cracked welds. Replace drags if they are bent and cannot be straightened cold.

NOTICE: NEVER heat a drag to straighten it! If the drag is heated, the alloy steel from which it is fabricated will be annealed and will bend easily.

2. Inspect the attachment links on the chain for elongated holes. Replace the links if they are elongated or otherwise distorted.
3. Inspect all pin cotters to see that they are not sheared or missing.
4. If difficulty is found in installing the chain pins, DO NOT grind them in an effort to make them fit. This will destroy the press fit essential to proper and efficient operation of the chain assembly.

ASSEMBLY AND INSTALLATION

1. The chain and drag assembly is assembled and installed in the opposite manner in which it was removed from the unit and disassembled. Use caution when handling this assembly as the large weights involved in the assembly create a dangerous operation.

ADJUSTMENT

Operate elevator and observe chain to see that it operates squarely on the top idler rollers and on the sprockets of the elevator drive axle. Adjustment is indicated if chains do not operate squarely on the sprockets and idler rollers, and also if the bottom edge of the drags hits the motor cover or the frame.

The chain tension on this unit should be set by measuring 10" up from the top of elevator frame to the top edge of drag. This measurement should be taken 37" up the frame from the centerline of the sprocket on the elevator drive axle. (See Fig. 2).

To effect chain adjustment, refer to Fig. 3, and the following instructions:

1. Loosen locking bolts and nuts (1), securing locking collar to idler.
2. Loosen locking nut (2) securing adjustment bolt (3) in position.
3. Tighten adjustment bolt (3), on each side, to achieve the 10" adjustment between the top edge of the drag and the top of the elevator frame (Fig. 2) secure with locking nut (2).
4. Secure locking bolts and nuts (1) to 235 ft/lbs torque lubed.
5. Operate elevator to see if chains are operating squarely on rollers and sprockets.

If the chain adjustment dimensions are equal on both sides of the elevator, the chains should run squarely on the sprockets and rollers. If chains do not run squarely, it will be necessary to perform the following:

1. Loosen all elevator drag bolts and nuts.
2. Loosen locking nuts and bolts (1), securing locking collar to idler. This assembly should be free to slide on the elevator frame.
3. Lubricate elevator adjustment bolt (3) threads and tighten on each side to achieve the 10" adjustment shown in Fig. 2.
4. Start tractor engine and run elevator 6 to 8 revolutions.
5. Tighten elevator drag bolts and locknuts to 82 ft/lbs lubed.
6. Retorque adjustment bolts (3), until the 10" adjustment is reached.
7. Run elevator again 6 to 8 revolutions.
8. Repeat items 6 and 7 until the 10" adjustment dimension is maintained.

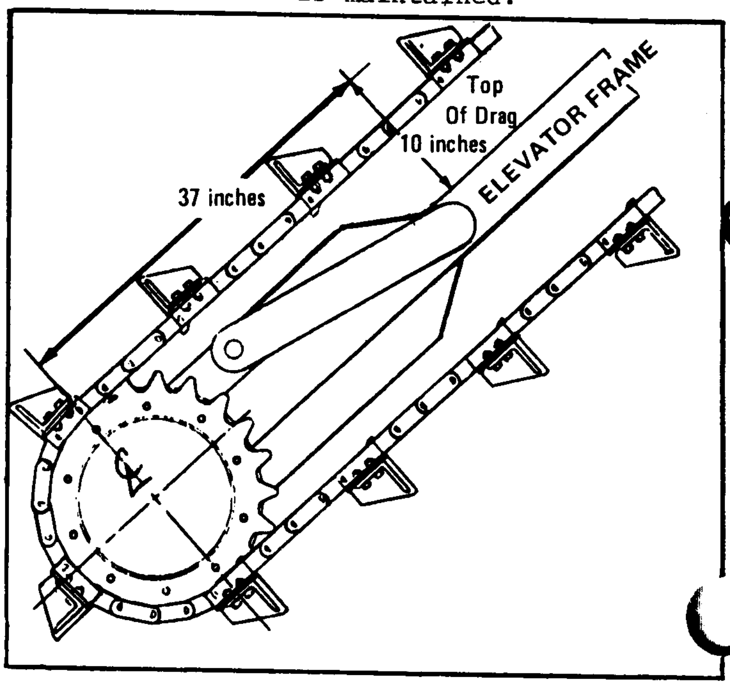


FIGURE 2

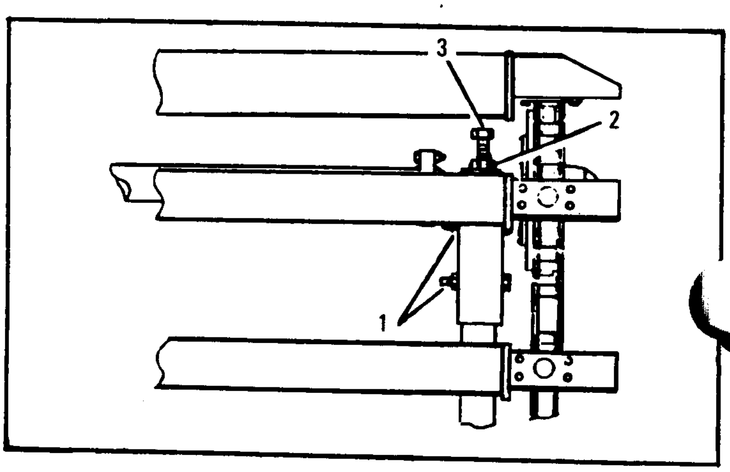


FIGURE 3

ELEVATOR DRIVE AXLE

DESCRIPTION

The axle assembly is a full-floating spiral bevel type with further reduction provided by planetary gear set within the wheel hub.

PRIMARY REDUCTION

The spiral bevel pinion and ring gear transmit power through the center differential pinions and side gears to the axle shaft. The spiral bevel differential assembly is mounted on tapered roller bearings which are adjusted by positioning of the two threaded adjusting nuts mounted in the differential carrier and cap assembly. The tapered roller pinion bearing preload is adjusted and maintained by a hardened and precision ground spacer positioned between inner and outer bearings. Spacer is selected at assembly.

SECONDARY REDUCTION

In the wheel hub, a self-centering sun gear is spline fitted to the axle shaft and drives three planetary pinion gears. These gears in turn mesh with and react against a rigidly mounted internal ring gear. The planet gears rotate on needle roller bearings mounted on hardened and ground pins located in the planet carrier which in turn drives the wheel hub. Positive lubrication keeps all moving parts bathed in lubricant to reduce friction, heat and wear.

LUBRICATION

Proper lubrication is necessary to assure long periods of trouble-free operation. Not only is it important that the required lubrication schedule be maintained, but also that the proper type of lubricant be used. The following are the only lubricants recommended for use in these axles. Consult applicable Operators Manual for machine model involved for capacities and lubrication schedules.

DIFFERENTIAL AND PLANETARIES

*SAE 90 Extreme Pressure Gear Lube, SCL Type (Sulfo-Chloro-Lead), per MS-8 Specifications given herein.

*NOTE: When operating at ambient temperatures consistently below 0° F, use SAE 80 and when consistently above 100° F, use SAE 140. SAE 80 and SAE 140 grades when used should contain like additives specified for SAE 90 grade.

EXTREME PRESSURE GEAR LUBE
Specifications MS-8

Lubricants purchased under this specification shall be a well-refined mineral oil properly compounded with sulphur-chlorine-lead type extreme pressure additives. They shall be free of fillers or abrasives, such as fuller's earth, talc, graphite, cork, etc. They shall be stable, non-abrasive, and non-corrosive whether or not in the presence of small percentages of water.

PHYSICAL AND CHEMICAL PROPERTIES

S. S. U @ 210° F	90-100 Seconds
S. S. U @ 100° F	1400 Seconds Max.
A. P. I. Gravity	14.4-15.9 Degrees
Pour Point	—10° F. Max.
Flash Point	350° F. Min.
Fire Point	400° F. Min.
Sulphur (Added)	1.20% Min.
Sulphur (Total)	3.00% Min.
Chlorine	1.20% Min.
Lead as Lead Oxide (PbO)	2.00% Min.
Moisture	.20% Max.
Load Carrying Capacity	
Timken Test Lever Load	70 lbs. Min.
Timken Abrasion Test (Total Loss)	2.0 mg. Max.
Heating Test	
Evaporation Loss	4.0% Max.
Viscosity Increase	10.0% Max.

EXPLODED VIEWS

To supplement the illustrations provided in the overhaul section of the manual, exploded view illustrations are supplied. Legends, keyed to the index numbers on the illustrations, are adjacent to the illustrations to aid in parts identification on the axles. The exploded views are as follows:

Fig. A — Drive Axle Assembly

Fig. B — Differential and Carrier Assembly

Fig. D — Planet Spider Assembly

The following compounds, or their equivalent, are required for the overhaul of the elevator:

Material	Use
Lubriplate	Apply to lips of all oil seals at reassembly.
Mixture of Red Lead and Linseed Oil	Paint ring gear teeth to check for proper differential gear and pinion engagement.
Never-Seez Compound	Apply to eccentric anchor pins of brake.
Permatex No. 2	Used for numerous sealing applications.

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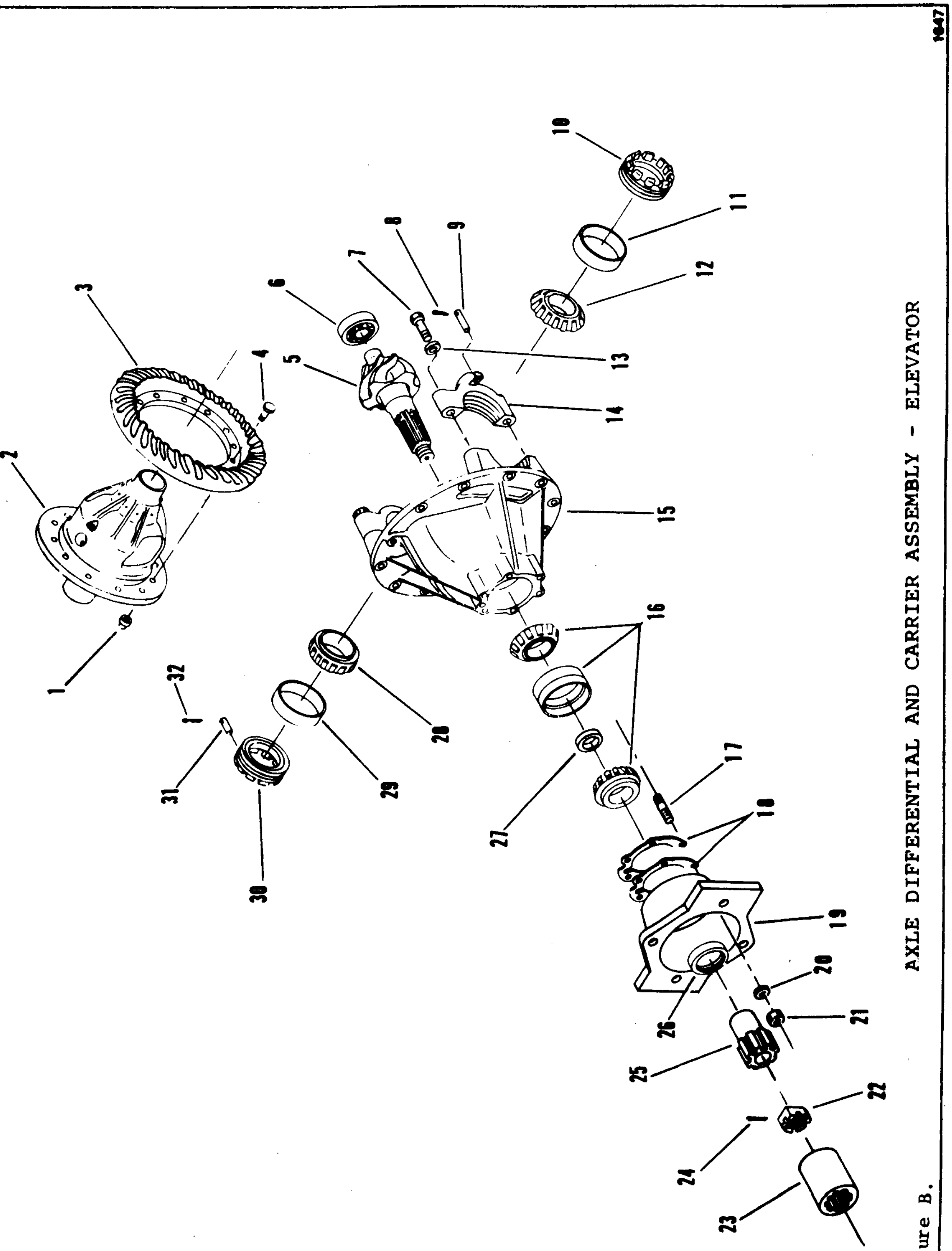
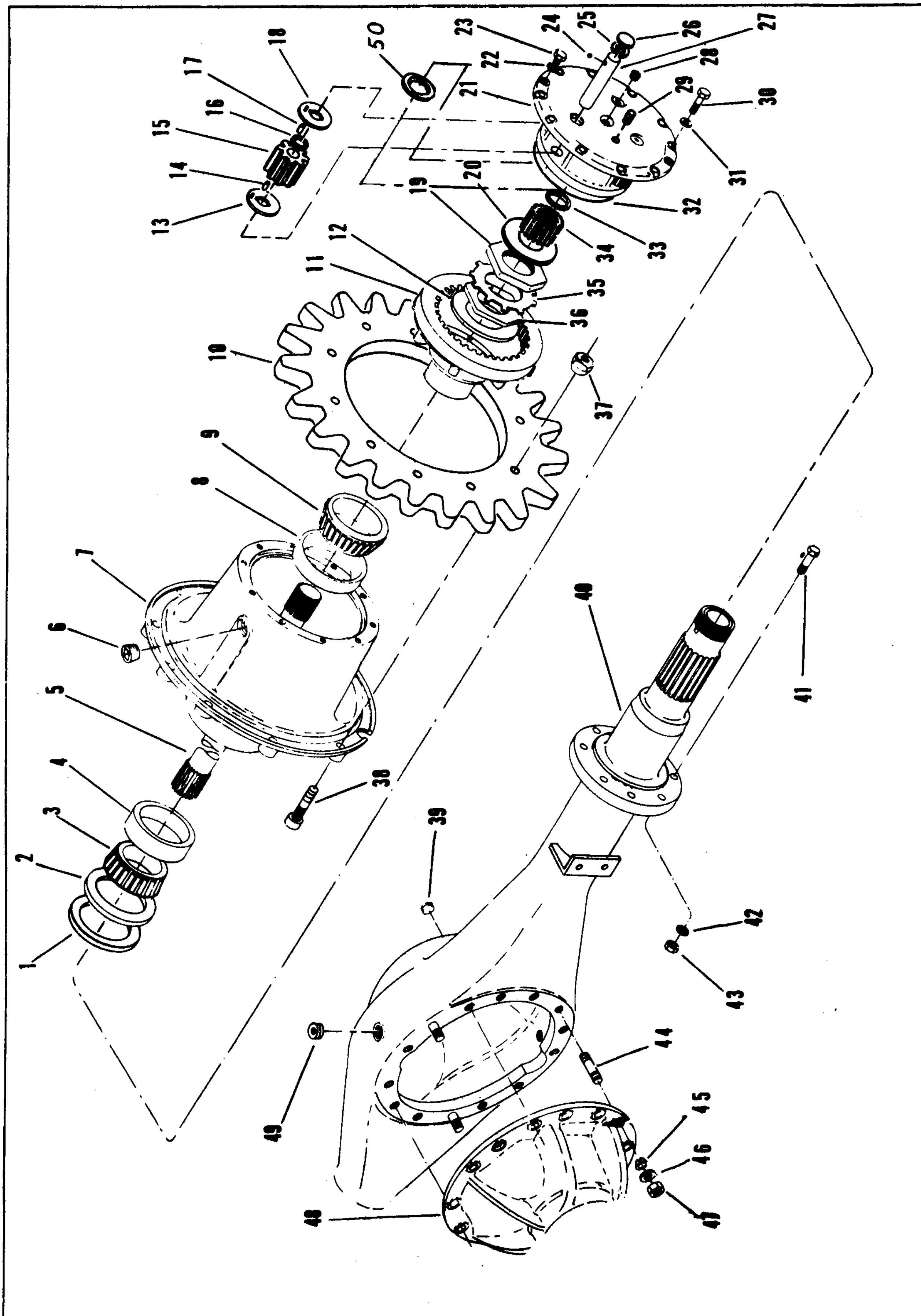


Figure B. AXLE DIFFERENTIAL AND CARRIER ASSEMBLY - ELEVATOR

AXLE DIFFERENTIAL AND CARRIER ASSEMBLY - ELEVATOR

Item	Part No.	Description	Qty.
A		DIFFERENTIAL ASSY (Inc 1 thru 32)	1
1		NUT,Ring Gear Bolt	12
2		CARRIER,Ring Gear	1
3		SET,Ring Gear and Pinion (Inc Item 5)	1
4		BOLT,Ring Gear	12
5		PINION (See Item 3)	-
6		BEARING,Inner Pinion	1
7		BOLT	4
8		COTTER,Lock Pin	1
9		PIN,Differential Adjusting Nut Lock	1
10		NUT,Differential Adjusting	1
11		CUP,Differential Bearing	1
12		CONE,Differential Bearing	1
13		LKWSHR	4
14		CAP,Differential Carrier	2
15		CARRIER,Differential	1
16		BEARING ASSY,Pinion	1
17		STUD,Motor Adapter Mounting	6
18		SHIM,Adapter Mounting	AR
18A		SHIM,Adapter Mounting	AR
19		ADAPTER,Motor Flanged	1
20		WASHER,Motor Adapter Mounting	6
21		NUT,Motor Adapter Mounting	6
22		NUT,Pinion Shaft	1
23		COUPLING,Drive	1
24		COTTER,Pinion Shaft	1
25		ADAPTER,Motor	1
26		SEAL,Pinion Oil	1
27		SPACER,Pinion Bearing Cone	1
28		CONE,Differential Bearing	1
29		CUP,Differential Bearing	1
30		NUT,Differential Adjusting	1
31		PIN,Differential Adjusting Nut Lock	1
32		COTTER,Lock Pin	1



AXLE ASSEMBLY - ELEVATOR

Figure A.

AXLE ASSEMBLY - ELEVATOR

Item	Part No.	Description	Qty.
A		AXLE ASSY (Inc 1 thru 49)	1
1		PROTECTOR,Hub Oil Seal	2
2		SEAL,Hub Oil	2
3		CONE,Hub Bearing - Inner	2
4		CUP,Bearing - Inner	2
5		SHAFT,Axle	2
6		PLUG,Hub Drain	2
7		HUB ASSY (Inc 4 & 8)	2
8		CUP,Bearing - Outer	2
9		CONE,Hub Bearing - Outer	2
10		SPROCKET	2
11		HUB,Internal Gear	2
12		WASHER,Housing Tube	2
13		WASHER,Planet	2
14		ROLLER,Planet Gear	87
15		GEAR,Planet	3
16		SPACER,Roller	3
17		ROLLER,Planet Gear	87
18		WASHER,Planet	3
19		NUT,Outer Spindle	2
20		WASHER,Sun Gear Thrust	2
21		SPIDER,Planet Carrier	2
22		WASHER	4
23		BOLT,Planet Carrier Puller	4
24		BALL,Planet Shaft	3
25		SNAP RING,Planet Shaft	3
26		PLUG,Planet Expansion	3
27		SHAFT,Planet	3
28		PLUG,Planet Carrier	2
29		PLUG,Planet Oil Level	2
30		BOLT,Planet Carrier	24
31		WASHER	24
32		"O" RING,Planet Carrier	2
33		RING,Sun Gear Retaining	2
34		GEAR,Sun	2
35		LOCK,Spindle Nut	2
36		NUT,Inner Spindle	2
37		LOCKNUT	20
38		BOLT	20
39		PLUG,Housing Drain	1
40		HOUSING,Axle	1
41		BOLT	16
42		LKWSHR	16
43		NUT	16
44		STUD,Carrier to Housing	12
45		DOWEL,Carrier Stud	3
46		WASHER,Carrier Stud	12
47		NUT,Carrier Stud	12
48		DIFFERENTIAL & CARRIER ASSY	1
49		PLUG,Housing	1
50		WASHER, AXLE SHAFT - Thrust	1

CLARK EQUIPMENT

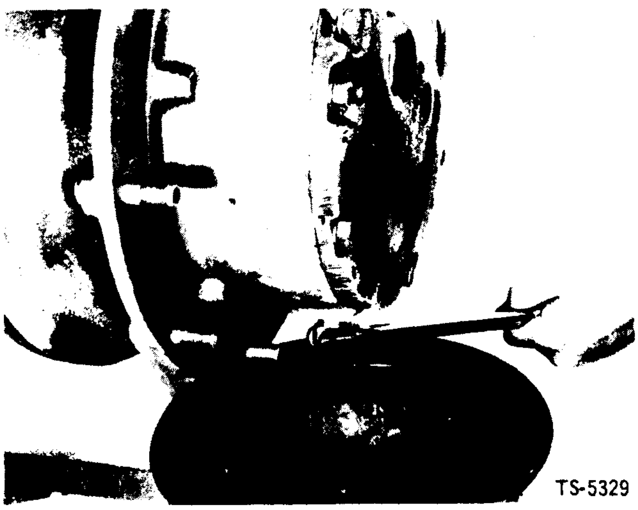
OVERHAUL OF AXLE ASSEMBLY

The instructions contained herein cover the disassembly and reassembly of the axle assembly in a sequence that would normally be followed after the unit has been removed from the machine and is to be completely overhauled.

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

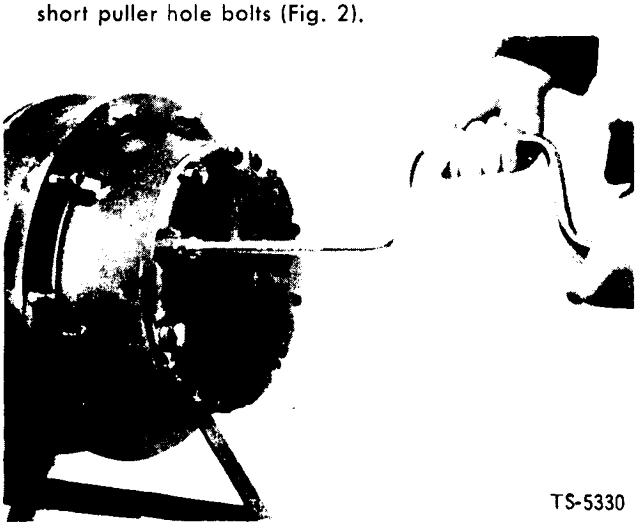
DISASSEMBLY OF AXLE

1. Remove drain plugs from planetary housings and from differential housing to drain axle (Fig. 1).



TS-5329

2. Remove mounting bolts and flat washers securing planet spider assembly to hub assembly. Remove two short puller hole bolts (Fig. 2).



TS-5330

3. Install two mounting bolts in puller holes and turn in bolts to pull planet spider assembly from hub assembly (Fig. 3).

TS-5331

4. Remove planet spider assembly (Fig. 4).

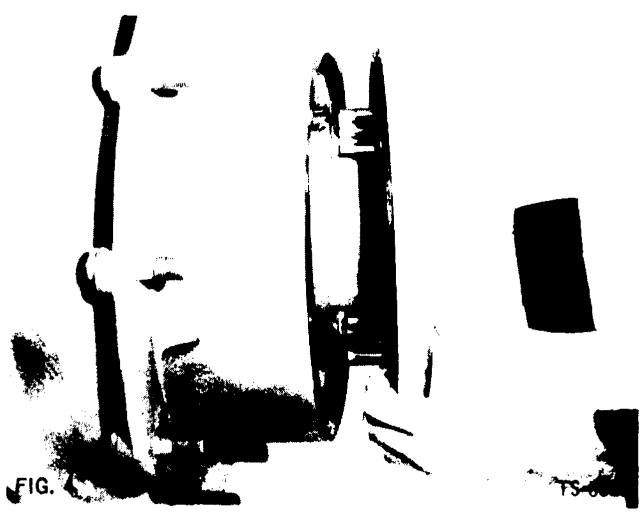
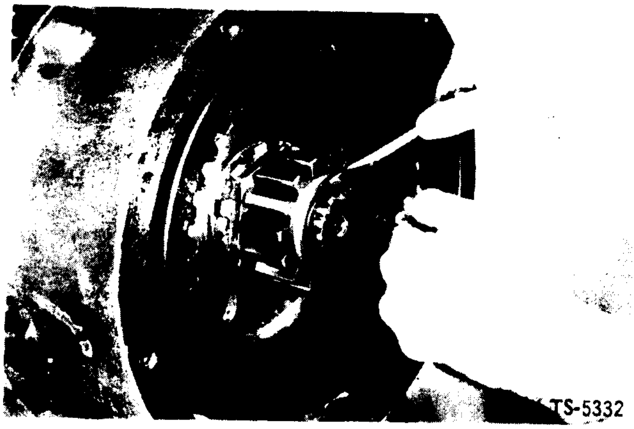


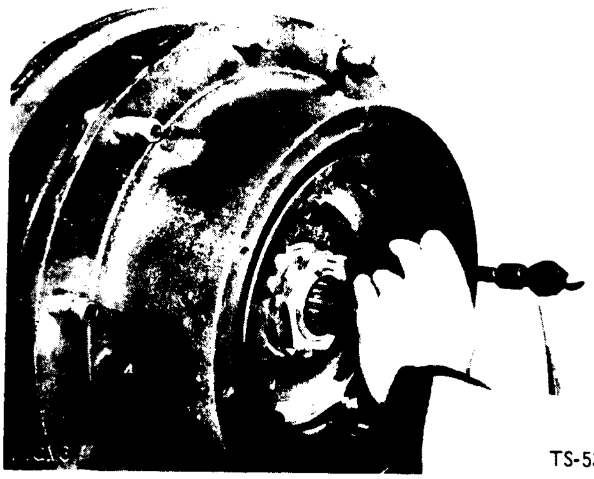
FIG. TS-

5. Remove retaining ring securing sun gear to end of axle shaft. To remove retaining ring, pry it out of groove with small screwdriver or pointed tool while prying off with larger screwdriver (Fig. 5). Remove sun gear.



TS-5332

6. Straighten tangs on nut lock as shown in Fig. 6.



TS-5333

7. Remove nut, nut lock, second nut, and thrust washer from spindle assembly (Fig 7).

FIG. TS-5334

8. Support weight of brake drum and hub assembly with hoist. Use pry bars to remove internal gear and hub from spindle (Fig. 8).

TS-5898

9. If bearing cone on internal gear and hub requires replacement, use suitable puller to remove (Fig. 9).

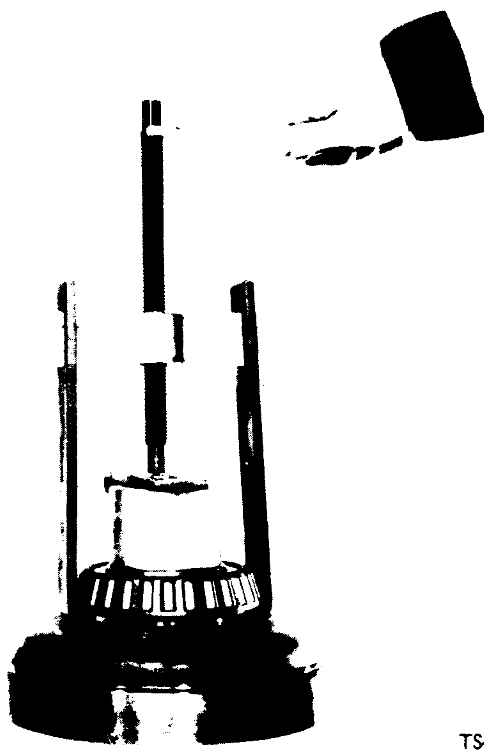


FIG. 9 TS-5336

10. Pull straight out on brake drum ~~and~~ hub assembly to remove it from axle (Fig. 10).

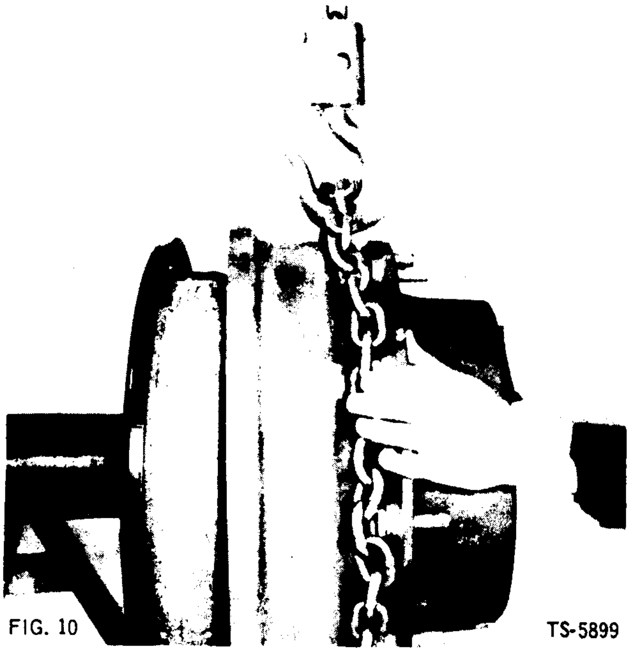


FIG. 10 TS-5899

13. Pull straight out on axle shaft to remove it (Fig. 13).

FIG. 13 TS-5928

14. Support weight of differential with hoist. Remove bolts, stud nuts and washers securing differential to axle housing (Fig. 14).

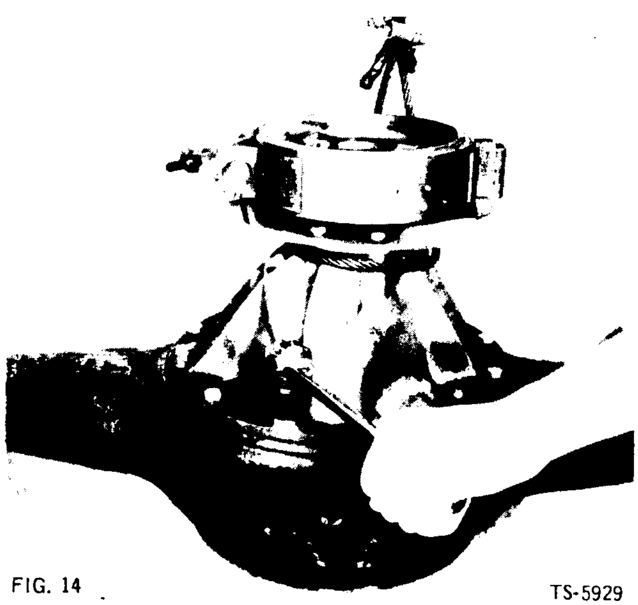


FIG. 14 TS-5929

15. Carefully hoist differential from axle housing. (Fig. 15). If necessary, tap differential housing with soft hammer to break loose joint between parts.

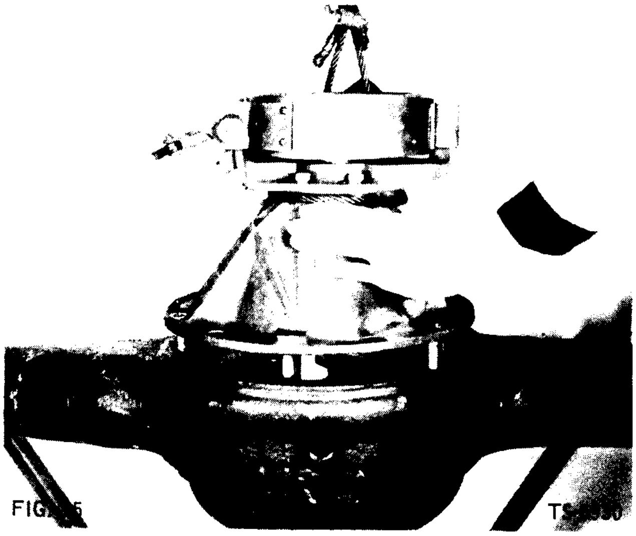


FIG. 15 TS-5830

Disassembly of Planet Spider Assembly

1. Drill hole in expansion plug and pry it out.

2. Remove snap ring from planet shaft.

3. Place planet spider assembly in press as shown in Fig. 26, and press out pinion shaft securing pinion to spider. Take care to catch pinion shaft ball released by shaft movement.

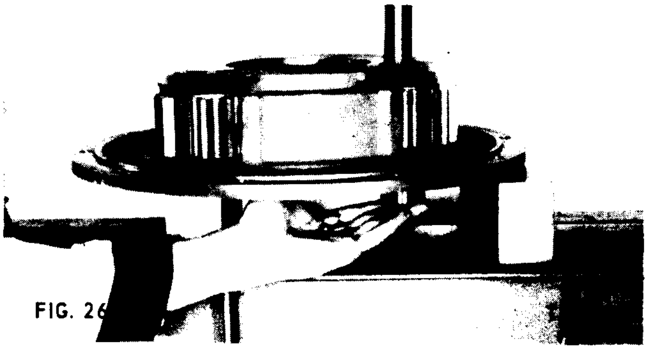


FIG. 26

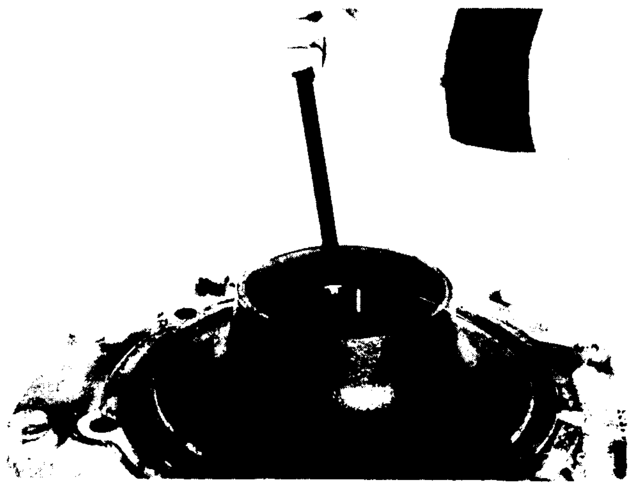
4. **Carefully remove pinion shaft, planet pinion, pinion thrust washers, pinion rollers, and pinion roller spacer (Fig. 27). Rollers will drop from pinions. Take care to prevent losing them.**

FIG. 27 TS-5813

CLARK EQUIPMENT

DISSAMBLY OF HUB AND DRUM ASSEMBLY

1. Pry out oil seal (Fig. 21).



2. Lift out bearing cone (Fig. 22).

FIG. 22 TS-5362

3. If inner bearing cup is damaged, invert hub and drive out cup using drift (Fig. 23). Exercise care to prevent damage to bearing bores when removing bearing cups.

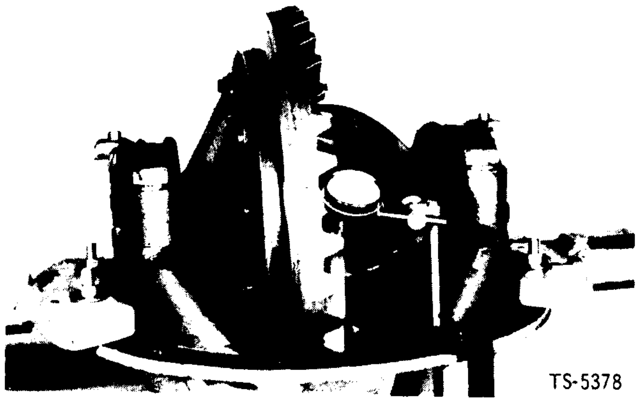
FIG. 23

4. If outer bearing cup is damaged, again invert hub and drive out cup using drift (Fig. 24). Exercise care to prevent damage to bearing bores when removing bearing cups.

TS-5364

Disassembly of Differential

1. Mount differential on differential overhaul stand. Check and record ring gear backlash with dial indicator. This information is necessary for reassembly unless a new gear set is installed (Fig. 39).

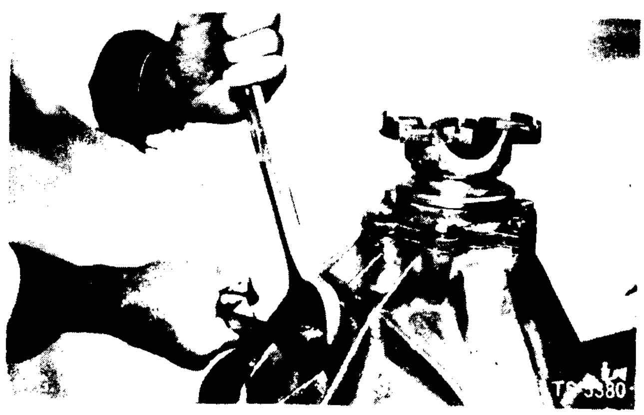


TS-5378

2. Remove cotter pin, and loosen nut securing adapter to differential pinion shaft (Fig. 40). This will facilitate later adapter removal.

FIG. 40 TS-5946

3. Differential thrust screw is provided on some models. Straighten tang on nut lock and remove thrust screw nut and thrust screw (Fig. 41).



4. Use center punch to mark bearing caps to differential carrier assembly to assure that parts will be installed in proper location during reassembly (Fig. 42).

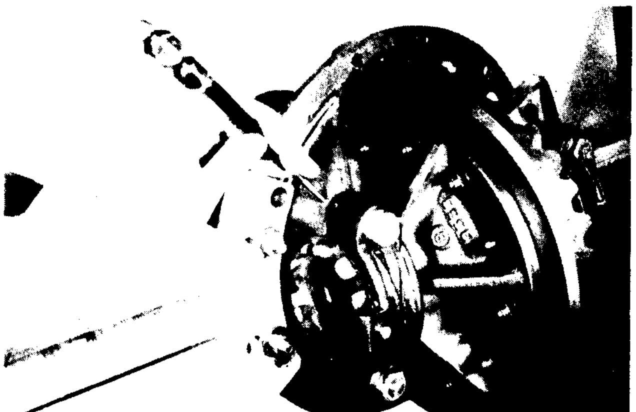


FIG. 42 TS-5947

5. Remove cotter pins and differential adjusting nut lock pins from bearing caps. Cut lockwires and remove bearing cap bolts and bearing caps (Fig. 43).

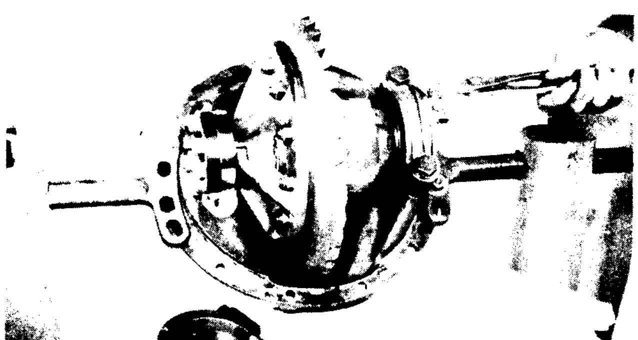


FIG. 43 TS-5382

6. Remove two adjusting nuts and lift ring gear and case assembly from differential (Fig. 44).

44 TS-5948

7. Remove pinion shaft nut and remove companion flange from pinion shaft with suitable puller (Fig. 45).

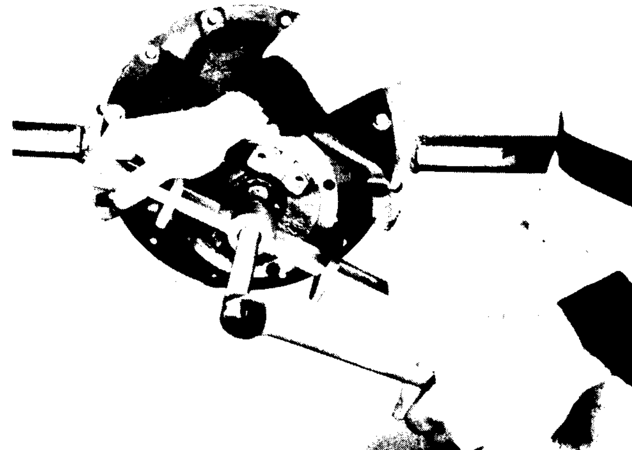


FIG. 45 TS-5949

8. Remove bolts and lockwashers securing pinion bearing retaining flanged adapter to differential carrier assembly; remove flanged adapter with assembled oil seal (Fig. 46).

9. Use chisel to drive oil seal from pinion bearing retaining flanged adapter (Fig. 47). Take care to prevent scoring oil seal seat

FIG. 47 TS-5951

10. Press pinion assembly from carrier (Fig. 48).

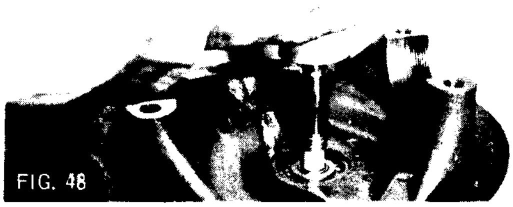


FIG. 48 TS-5385

11. Press bearing cones and cups and bearing spacer from shaft of pinion (Fig. 49).

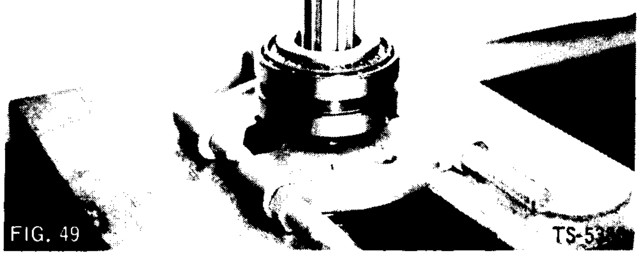


FIG. 49 TS-53

Disassembly of Differential Ring Gear and Case Assembly

1. Remove bolts and self-locking nuts securing ring gear to case; remove ring gear (Fig. 50). If tapered roller bearing cones require replacement, use suitable puller to remove from ring gear carrier.

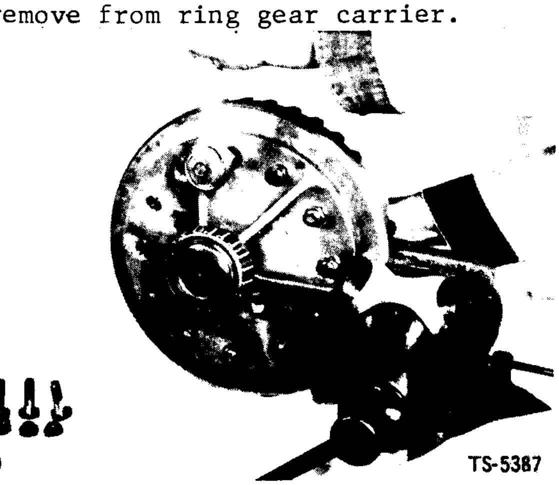


FIG. 50 TS-5387

CLEANING AND INSPECTION

CLEANING

Clean all parts thoroughly using solvent type cleaning fluid. It is recommended that parts be immersed in cleaning fluid and slushed up and down slowly until all old lubricant and foreign material is dissolved and parts are thoroughly cleaned.

CAUTION: Care should be exercised to avoid skin rashes, fire hazards and inhalation of vapors when using solvent type cleaners.

Bearings

Remove bearings from cleaning fluid and strike larger side of cone flat against a block of wood to dislodge solidified particles of lubricant. Immerse again in cleaning fluid to flush out particles. Repeat above operation until bearings are thoroughly clean. Dry bearings using moisture-free compressed air. Be careful to direct air stream across bearing to avoid spinning. Do not spin bearings when drying. Bearings may be rotated slowly by hand to facilitate drying process.

Housings

Clean interior and exterior of housings, bearing caps, etc., thoroughly. Cast parts may be cleaned in hot solution tanks with mild alkali solutions providing these parts do not have ground or polished surfaces. Parts should remain in solution long enough to be thoroughly cleaned and heated. This will aid the evaporation of the cleaning solution and rinse water. Parts cleaned in solution tanks must be thoroughly rinsed with clean water to remove all traces of alkali. Cast parts may also be cleaned with steam cleaner.

CAUTION: Care should be exercised to avoid skin rashes and inhalation of vapors when using alkali cleaners.

Thoroughly dry all parts cleaned immediately by using moisture-free compressed air or soft, lintless absorbent wiping rags free of abrasive materials such as metal filings, contaminated oil or laping compound.

INSPECTION

The importance of careful and thorough inspection of all parts cannot be overstressed. Replacement of all parts showing indication of wear or stress will eliminate costly and avoidable failures at a later date.

Bearings

Carefully inspect all rollers, cages and cups for wear, chipping or nicks to determine fitness of bearings for further use. Do not replace a bearing cone or cup individually without replacing the mating cup or cone at the same time. After inspection, dip bearings in clean light oil and wrap in clean lintless cloth or paper to protect them until installed.

Oil Seals, Gaskets and Retaining Rings

Replacement of spring loaded oil seals, gaskets and snap rings is more economical when unit is disassembled than to risk premature overhaul to replace these parts at a future time. Loss of lubricant through a worn seal may result in failure of other more expensive parts of the assembly. Sealing members should be handled carefully, particularly when being installed. Cutting, scratching, or curling under of lip of seal seriously impairs its efficiency. At reassembly, lubricate lips of oil seals with Lubriplate.

Gears and Shafts

If magna-flux process is available, use process to check parts. Examine teeth and ground and polished surfaces on all gears and shafts carefully for wear, pitting, chipping, nicks, cracks or scores. If gear teeth are cracked or show spots where case hardening is worn through, replace with new gear. Small nicks may be removed with suitable hone. Inspect shafts to make certain they are not sprung, bent, or splines twisted, and that shafts are true. Differential pinions and side gears must be replaced as sets. Differential ring gear and bevel pinion must also be replaced as a set if either is damaged.

Housing and Covers

Inspect housing, covers and planet spider, and differential case to be certain they are thoroughly cleaned and that mating surfaces, bearing bores, etc., are free from nicks or burrs. Check all parts carefully for evidence of cracks or conditions which would cause subsequent oil leaks or failures.

REASSEMBLY OF AXLE

The following instructions describe the procedure to be followed when reassembling and installing components of axle. Instructions cover reassembly of only one side of axle. Reassembly of opposite group is identical unless otherwise noted.

IMPORTANT: Both Grade 5 and Grade 8 fastening hardware have been used in the production of the axle assemblies covered by this manual. A table of proper torque values for both Grade 5 and Grade 8 hardware is provided at the rear of this manual. Grade of hardware may be determined by the "hash" marks contained on the head of each bolt; Grade 5 having three hash marks and Grade 8 having six hash marks as indicated below. In all cases except where specified in text, use torque value specified in table for applicable bolts.

GRADE 5

GRADE 8

Reassembly of Differential Ring Gear and Case

NOTE: Lubricate all differential bearings and thrust washers with SAE 90 EP lubricant, SCL type.

1. If they were removed, press new tapered roller bearing cones fully onto bearing seats on both ends of

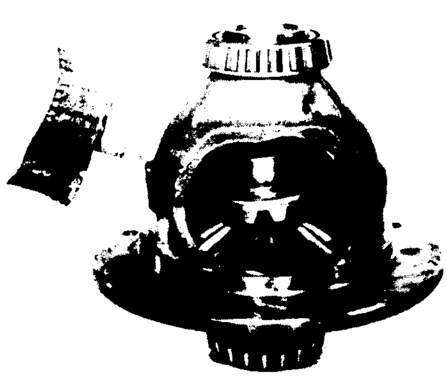


FIG. 58 TS-5394

5. Check ring gear mounting surface of case for burrs. Remove burrs with file (Fig. 62).

FIG. 62

6. Position ring gear on case assembly. Secure with bolts and lock nuts (Fig. 63). Use new nuts to assure proper locking characteristics.

FIG. 63 TS-5399

7. Tighten differential ring gear nuts to specified torque (Fig. 64).

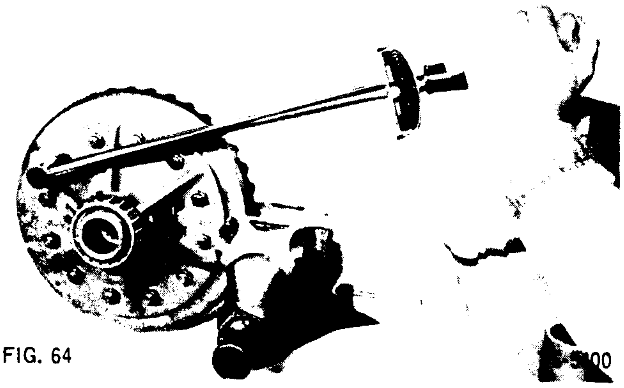


FIG. 64 TS-5400

Reassembly of Differential Pinion Shaft

NOTE: Lubricate all differential bearings and thrust washers with SAE 90 EP lubricant, SCL type.

1. Press inner pinion bearings onto end of pinion shaft. Stake inner pinion bearing to pinion shaft in four places (Fig. 65). Use square end staking tool and stake in sequence shown in Fig. 66.

FIG. 65 TS-5401

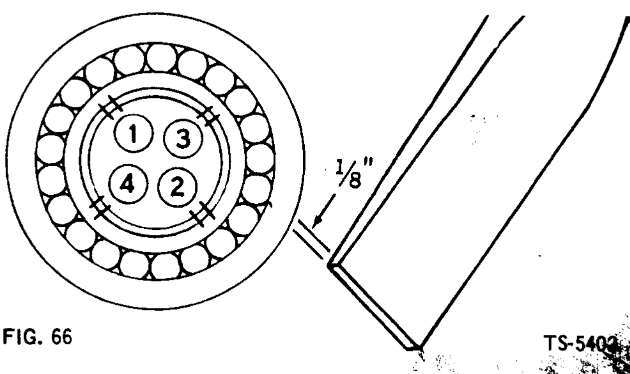
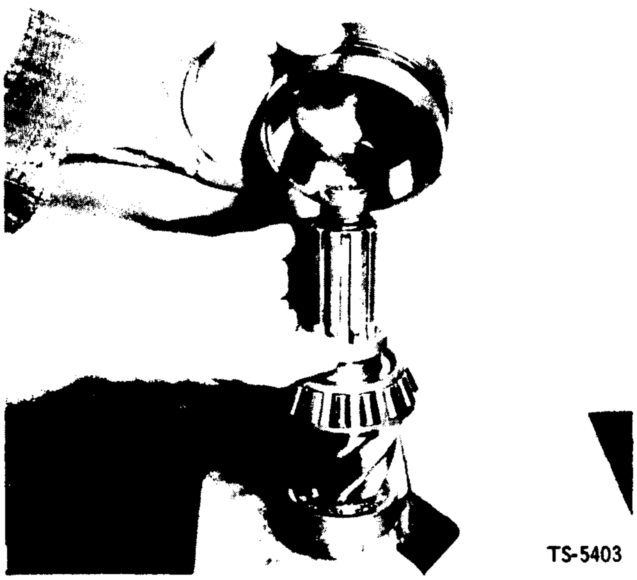


FIG. 66 TS-5402

CLARK EQUIPMENT

2. A pinion bearing and shim kit is provided for service repair of differential and carrier assemblies. This kit, consisting of a spacer and quantity of shims, is used to obtain proper pinion bearing preload as described below. Press inner pinion bearing cone on shaft of pinion. Position bearing spacer and one .010" shim against bearing cone and install double bearing cup on bearing (Fig. 67). Cup must be positioned with letter "P" stamped on end toward pinion.



TS-5403

3. Press outer bearing cone on pinion (Fig. 68). Lubricate bearings with gear lube and rotate several revolutions to assure normal bearing contact.

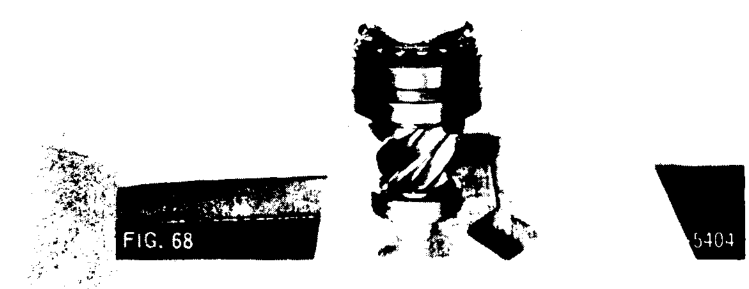
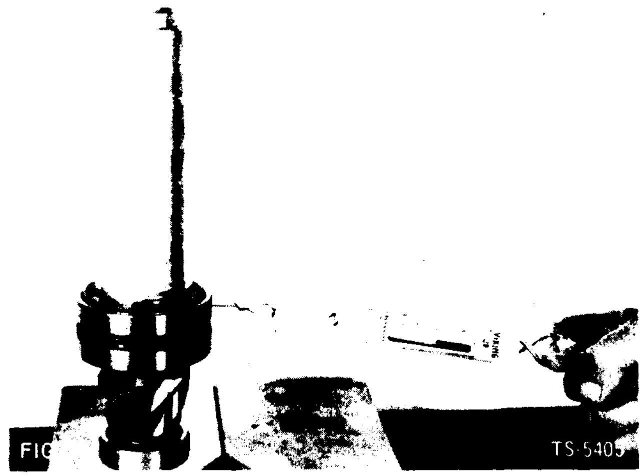


FIG. 68 5404

4. While assembly is in press, apply 500 lbs. pressure to check bearing preload torque. Wrap soft wire or cord around bearing cap and pull in horizontal line with spring scale (Fig. 69). While pulling in straight line (90° from centerline of shaft), read spring scale to measure rotating torque. Multiply reading on spring scale by one-half diameter of bearing cups to obtain preload torque. Correct preload torque is 13 to 23 in. lbs. If bearing preload is not within these limits, remove shims to increase preload or add shims to decrease preload.

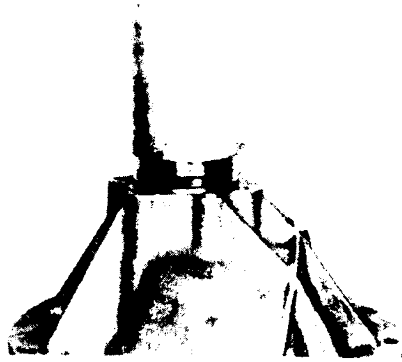
NOTE: This is a preliminary check. Final check of bearing preload must be made with pinion shaft and bearing assembly in differential carrier housing.



FI TS-5405

5. After preload is set, press pinion shaft assembly into differential carrier (Fig. 70). Pressure should be applied only on end of double bearing cup, making sure bearing cup is seated firmly against shoulder in carrier housing.

FIG. 70



TS-5406

6. Temporarily install pinion bearing retainer without seal or gasket on differential carrier assembly. Secure with bolts and lockwashers and tighten to specified torque (Fig. 71).

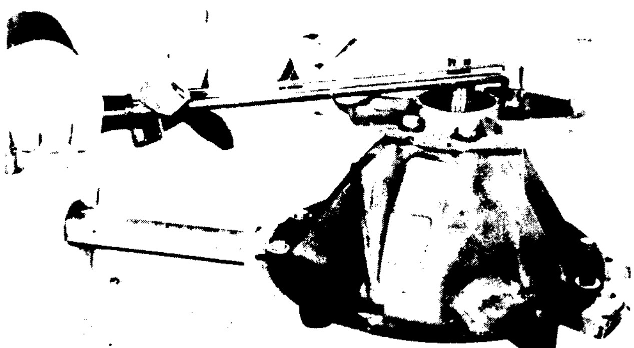


FIG. 71 TS-5955

7. Position adapter on differential pinion. Use torque wrench to tighten pinion shaft nut to 300 ft/lbs (Fig. 72).

FIG. 72 TS-5956

8. Use "inch pound" torque wrench to check bearing preload (Fig. 73). If bearing preload is not between 13 and 23 in. lbs., disassemble parts and add shims to decrease preload or remove shims to increase preload. If preload is satisfactory, remove nut, adapter and flanged adapter.

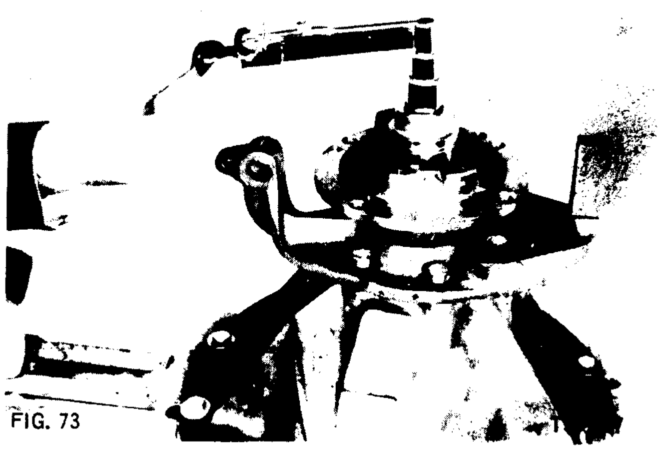


FIG. 73

9. Coat outside diameter of oil seal lightly with Permatex No. 2 or equivalent. Install seal in pinion bearing retaining flanged adapter. Seal driver dimensions are given in Fig. 75. Wipe off excess Permatex. Lubricate lips of seal with Lubriplate.

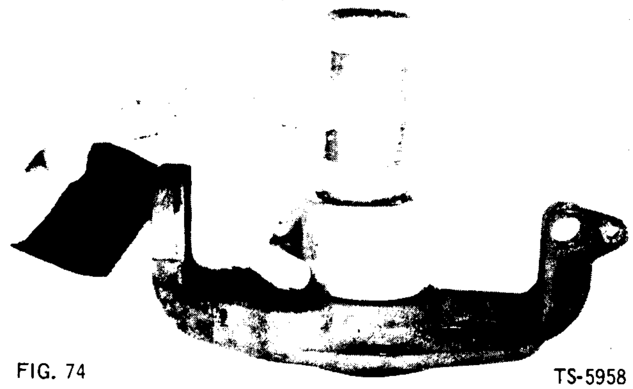


FIG. 74 TS-5958

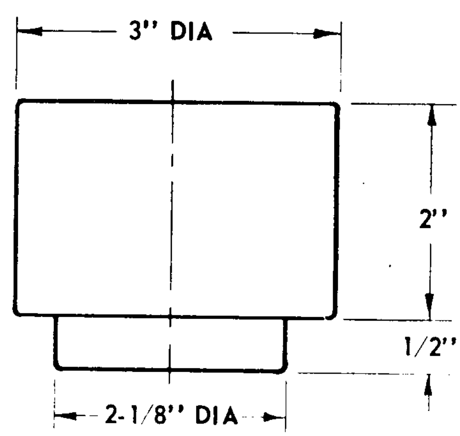


FIG. 75 TS-5959

10. Position the pinion bearing retaining flanged adapter and bearing retainer gasket on the differential carrier so that the cutout in the gasket and the drainback slot in the bracket align with the drainback hole in the carrier (Fig. 76). Secure with bolts and lockwashers and tighten to specified torque.

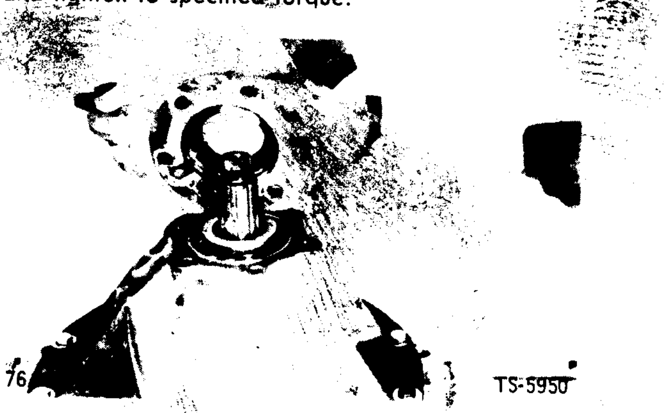
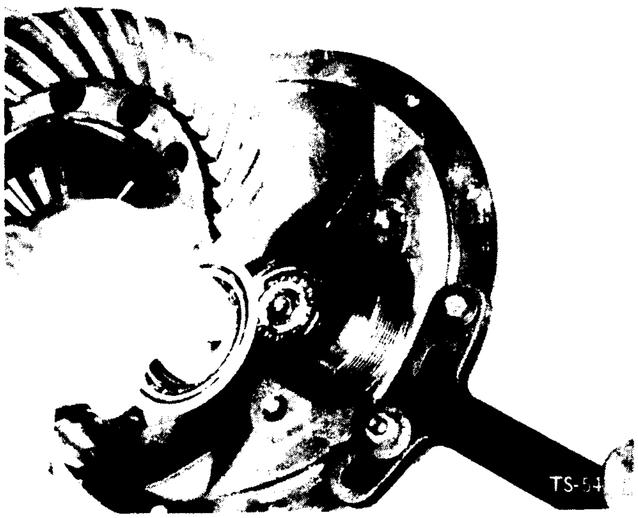


FIG. 76 TS-5950

11. Position flange on pinion shaft; secure with nut torqued to 300 ft. lbs. (Fig. 72). Lock nut with cotter pin.

Reassembly of Differential

1. Make sure bearing cones are properly seated on differential case. Position bearing cups on cones and set ring gear and case assembly in differential carrier (Fig. 77). If bearing cones have been replaced, new bearing cups must also be used.



TS-54

2. Position bearing cap adjusting nuts in differential carrier, taking extreme care that nuts are not cross-threaded (Fig. 78).

TS-5412

3. Position bearing caps on bearings and nuts, making sure match marks made during disassembly are properly aligned. Install bearing cap bolts (Fig. 79) and tighten until snug but do not torque.

TS-5413

4. Tighten bearing adjusting nuts to adjust bearings to zero end play. This condition may be checked with screwdriver as shown (Fig. 80). All bearing rollers must rotate as ring gear rotates, but it should not be possible to move bearing rollers sideways in cage when prying against them with screwdriver.

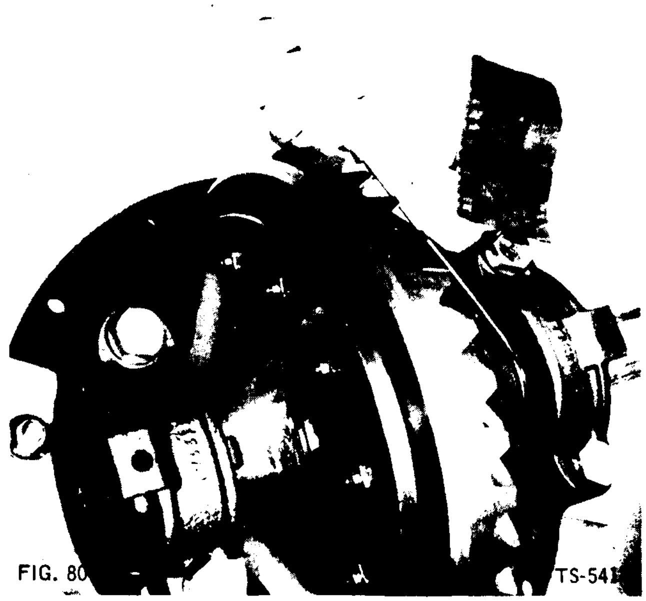
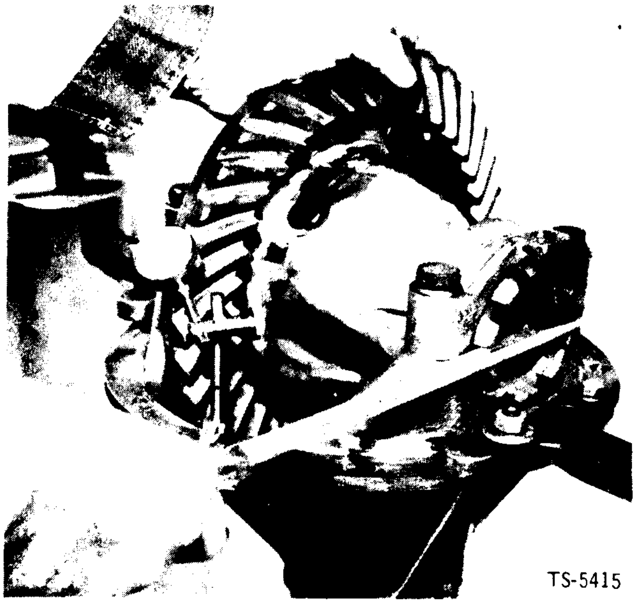


FIG. 80 TS-541

5. Use a dial indicator to check backlash between ring gear and pinion shaft gear. Backlash is adjusted by moving ring gear toward or away from pinion shaft gear (Fig. 81). Move ring gear by loosening one adjusting nut and tightening opposite lock nut. When loosening one lock nut and tightening opposite, move each lock nut same distance so that bearing adjustment made in previous paragraph is not disturbed. Adjust position until gear backlash is between .008" to .013", if new gear set is used, or adjust to backlash noted at disassembly for old gears.

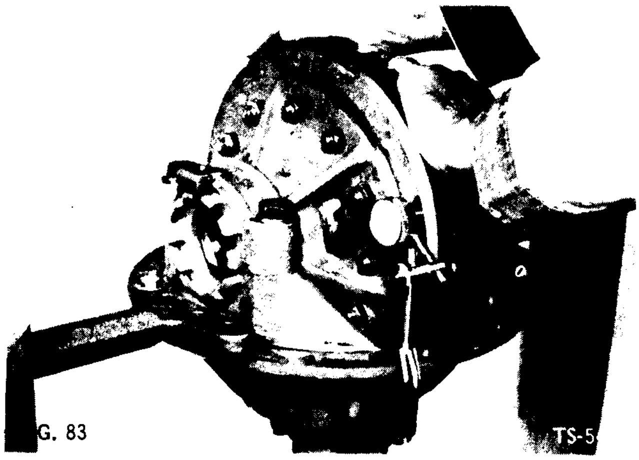


TS-5415

6. Tighten bearing cap bolts to specified torque (Fig. 82). With dial indicator, recheck ring gear and pinion backlash. Recheck differential bearings for end play as described in step 4.

TS-5416

7. Use dial indicator to check back face of ring gear. Rotate at least one full turn (Fig. 83). Runout must not exceed .007" total indicator reading. If runout is excessive, remove assembly and check for burrs or dirt under mounting surface of ring gear. Reassemble and recheck.



G. 83 TS-5

8. Install adjusting nut lock pins and secure with cotter pins (Fig. 84).

. 84 TS-5418

9. Lockwire cap bolts to prevent them from loosening (Fig. 85).

FIG. 85 TS-5419

CLARK EQUIPMENT

10. If differential is equipped with differential thrust screw, apply light coat of Permatex No. 2 to screw threads and turn in screw until it just contacts back of ring gear, then back off 1/4 turn (.010" clearance) Fig. 86). Tighten lock nut and secure by bending tang of lockwasher against flat of nut to secure adjustment.

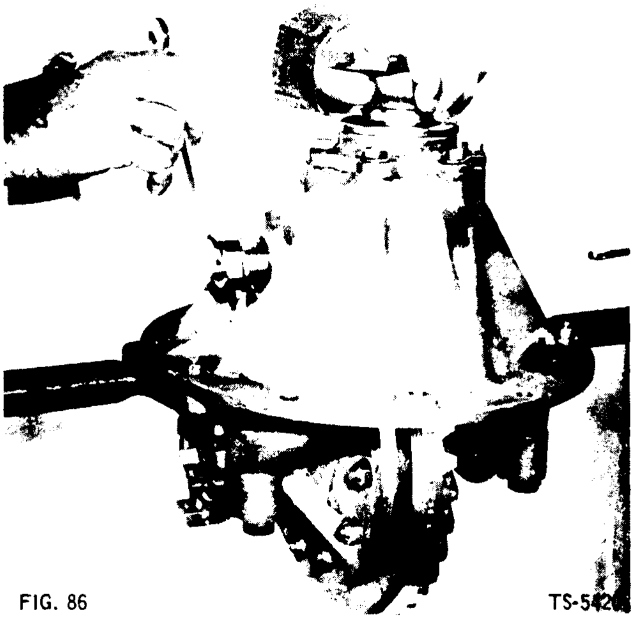


FIG. 86 TS-5420

11. Paint ring gear teeth with mixture of red lead and linseed oil (Fig. 87). Rotate pinion shaft to cause one full revolution of ring gear. Check tooth pattern on ring to determine if proper pinion-to-ring gear tooth engagement exists. Refer to gear tooth contact chart. If proper contact pattern is not as shown (Fig. 88), readjust backlash to secure correct tooth pattern.

FIG. 87

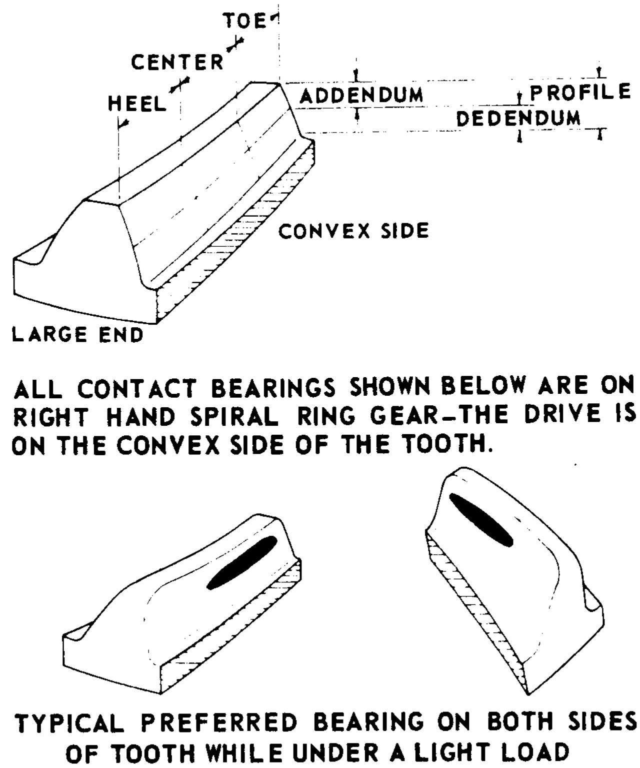


FIG. 88 TS-5422

Reassembly of Hub and Cup Assembly

1. Check bearing bores in wheel hub to be sure all nicks and burrs have been removed from both bores and bearing seats. Install bearing cups in hub with wide diameter of taper toward outside of hub. Use bearing driver to press cups into place (Fig. 105). Bearing driver dimensions are given in Fig. 106 and 107. Make sure cups are fully seated in hub.

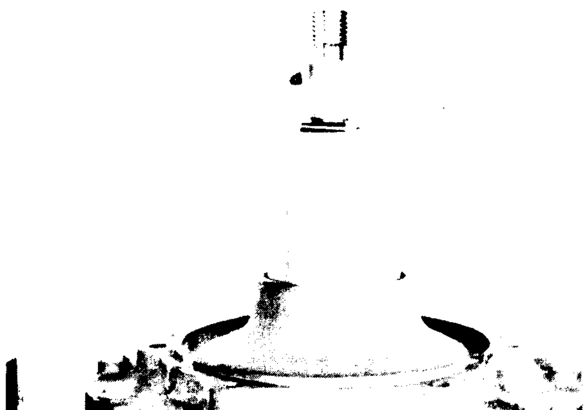


FIG. 10[illegible] [illegible]S-5968

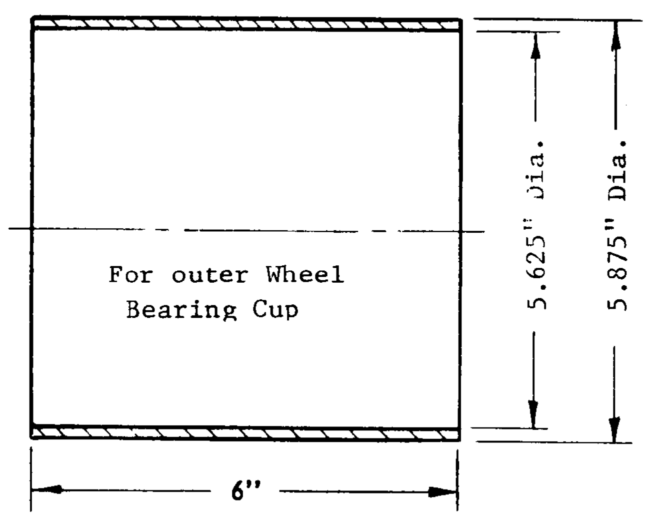


FIG. 106 TS-5969

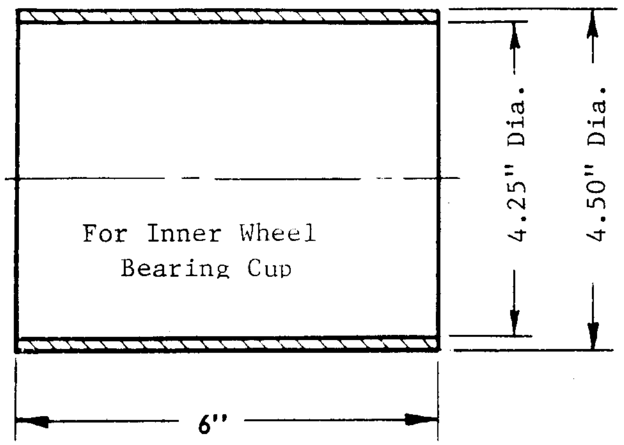


FIG. 107 TS-5970

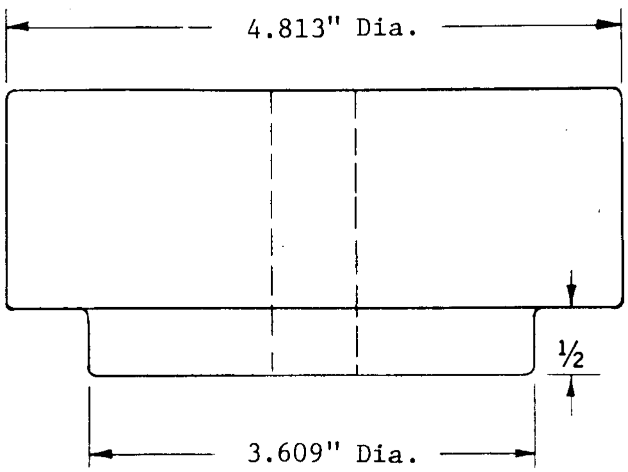


FIG. 110 TS-5432

2. Lubricate inner wheel hub bearing cone with gear oil and position in wheel hub bearing cup (Fig. 108).

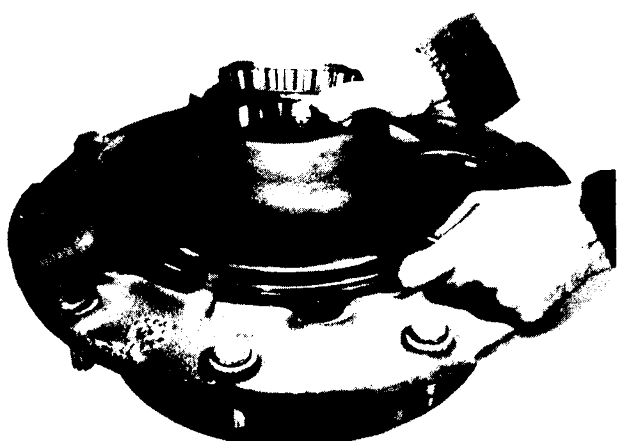


FIG. 108 TS-5362

3. Coat outside diameter of oil seal with Permatex No. 2. Lubricate lip of oil seal with Lubriplate. Press in or drive oil seal into hub using suitable driver (Fig. 109). Figure 110 shows driver dimensions. Position oil seal in bore with "Oil Side" marked on seal toward inside of hub. After installing seal, install seal protector.

FIG. 109 TS-5431

Reassembly of Planet Spider

Coat inside of planet pinion with chassis grease to retain pinion needle rollers. Each pinion contains a double row of needle rollers with a spacer between rows. Install one full row of rollers, roller spacer, and another full row of rollers in each pinion (Fig. 133).

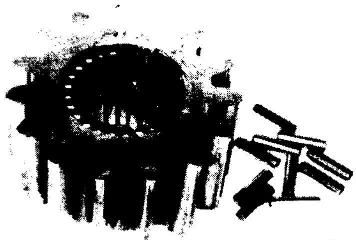


FIG. 133 TS-5908

2. Position assembled planet pinion and two pinion thrust washers in planet spider assembly, making sure tangs on thrust washers engage the grooves in the spider (Fig. 134).

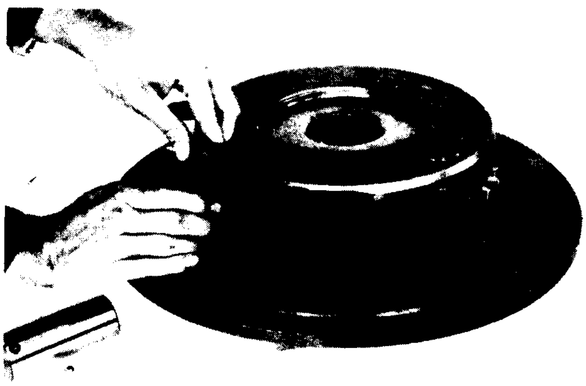


FIG. 134 TS-5813

3. Press in pinion shaft, making sure the pinion shaft ball recess aligns with groove in spider. Insert pinion shaft ball and complete press (Fig. 135). Press end of pinion shaft flush with face of spider assembly.

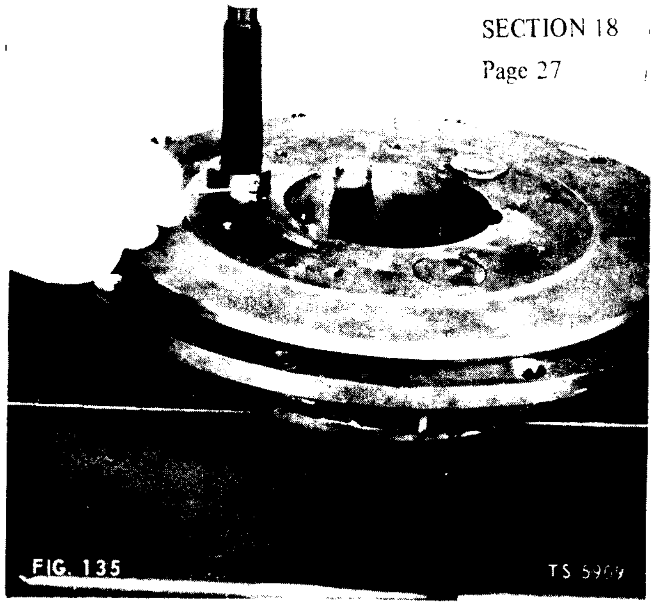


FIG. 135 TS-5909

4. Turn planet spider over, apply light coat of Permatex No. 2 to sealing surfaces of expansion plugs, and position planet expansion plug in seat on spider. Tap sharply on center of plug to retain it in seat (Fig. 117). Repeat procedure to install remaining two planet pinions.

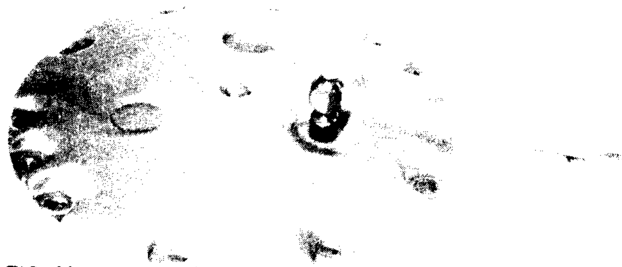


FIG. 117 TS-5439

Reassembly of Axle Parts

1. Check differential mounting flange of axle housing to make sure it is free of dirt and burrs. Apply coat of Permatex No. 2 to mounting flange and position differential on axle housing so that studs in housing engage tapered holes in differential carrier flange (Fig. 118).

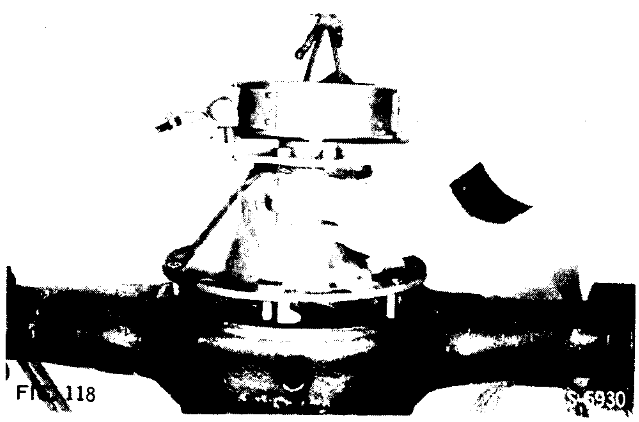
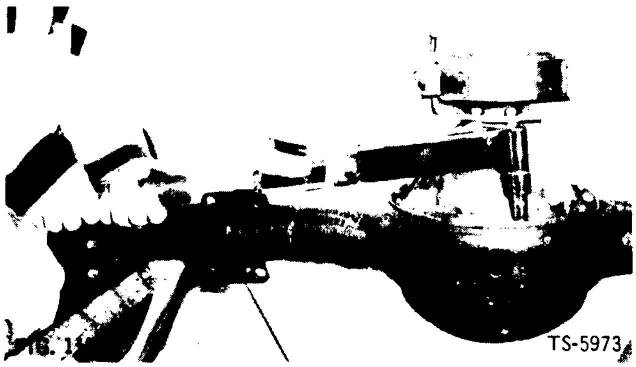


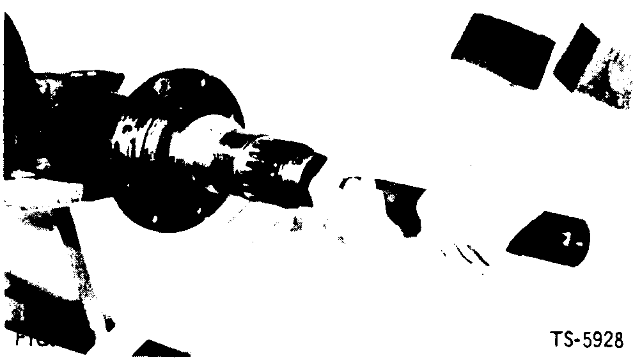
FIG. 118 TS-5930

2. Install three tapered dowels on studs and secure with three washers and stud nuts. Secure carrier to housing with mounting bolts and flat washers. Tighten to specified torque (Fig. 119).



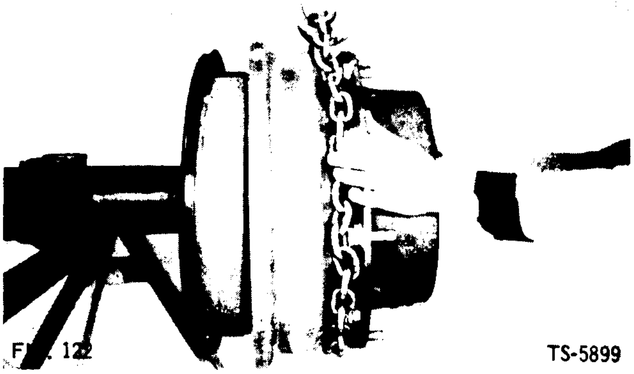
TS-5973

3. Install axle shaft in housing so that splines at inner end of shaft engage splines of differential side gears. End of shaft with retaining ring groove must be toward planetary end of axle (Fig. 120).



TS-5928

4. Lubricate lip of hub and drum oil seal with Lubriplate. Position hub and drum assembly on axle (Fig. 122). Care should be exercised to align hub and drum assembly with spindle so that no cocking of inner hub bearing occurs when sliding on spindle. If difficulty is encountered when trying to slide drum over brake shoes, it is probably caused by improper adjustment of brake shoe cams. During installation, cams must be adjusted so that brake spring tension is at a minimum.



TS-5899

5. Press tapered roller bearing cone on internal gear and hub (Fig. 123). Bearing driver dimensions are given in Fig. 124.

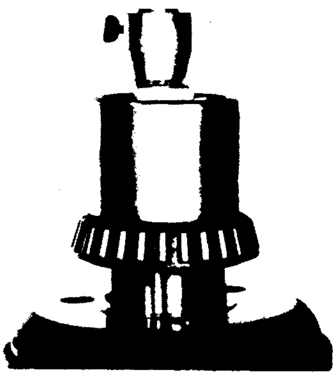


FIG. 123 TS-5461

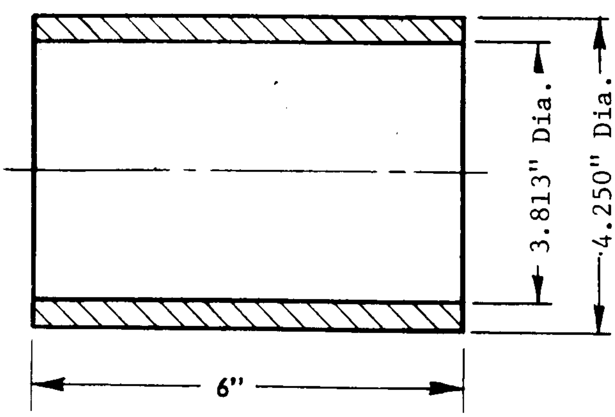


FIG. 124 TS-5975

6. Lubricate bearing cone with gear lube and position internal gear and hub on axle so that it engages splines on spindle (Fig. 125).

FIG. 125

7. Install flat washer and inner nut on spindle.

NOTE: The tapered roller bearings utilized in wheel hub must be preloaded in accordance with procedure steps and specifications given below. One of two methods may be used in adjusting the required preload on these bearings. It should be noted that preload specification differs for use of new bearings and when wheel bearings are being reused.

First (Preferred) Method

8. Tighten inner nut while rotating wheel hub in both directions until there is a slight binding (Fig. 126).

FIG. 126 TS-5462

9. Install torque wrench adapter bar, as shown in Fig. 127, using two 7/16-14 x 1-3/4 bolts. The adapter bar can be fabricated locally to specifications outlined in Fig. 128. Bar illustrated will accommodate wheel hubs with planetary bolt circle diameters of 11-3/8" and 16-1/2".

TS-5976

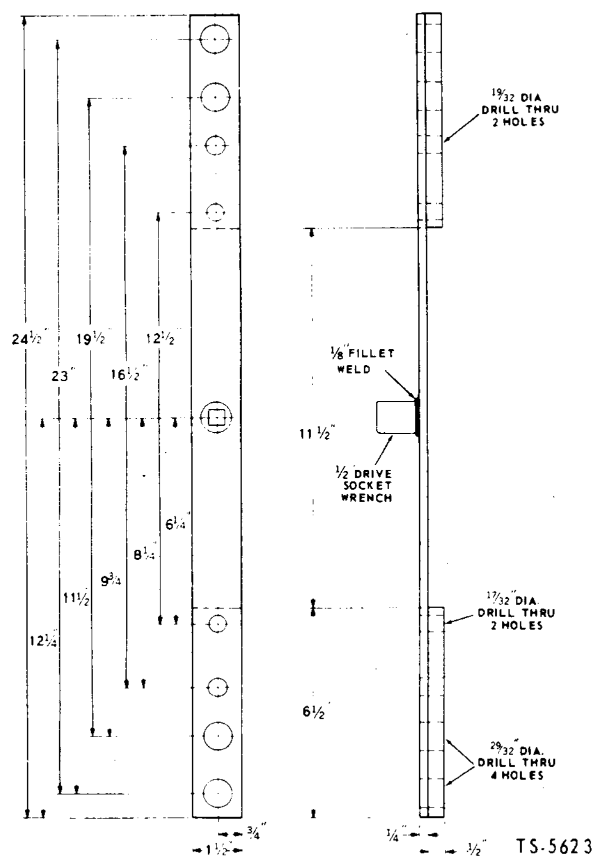


FIG. 128

CLARK EQUIPMENT

10. Install torque wrench, 0 to 50 ft. lb. scale if available and check rotating torque or rolling resistance of wheel hub (Fig. 129). Rotating torque when using new bearings should be between 10 and 15 ft. lbs. On used bearings rotating torque should be between 5 and 10 ft. lbs.

CAUTION: Make certain wheel brake is in complete release position and that it is not dragging on brake drum.

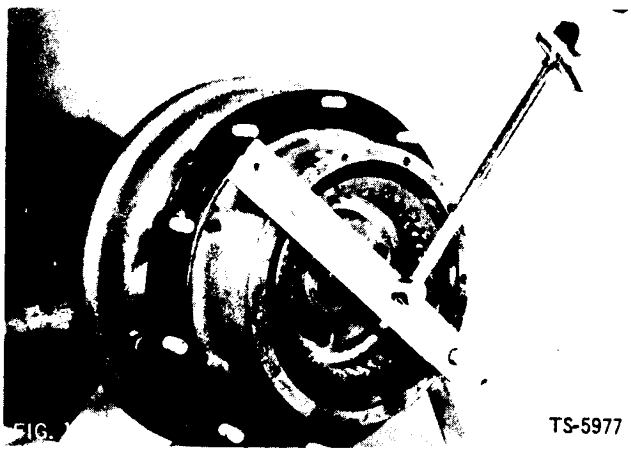


FIG. TS-5977

11. If rotating torque is not to specifications given above, remove adapter bar and tighten or loosen inner nut until rotating torque is within specifications. After tightening or loosening nut as required, rap wheel hub several times with plastic or rawhide faced mallet while rotating hub to seat bearings. Recheck rotating torque as indicated in Step 11.

Second (Optional) Method

12. Attach heavy string or cord to one of wheel studs on hub and wrap cord around wheel hub several times, attaching pound pull scale to end of cord as shown in Fig. 130. Tighten inner nut until rotating torque measured on pull scale is between 20 to 29 lbs. for new bearings and 10 to 20 lbs. for used bearings.


G. TS-[illegible]8

NOTE: Bearing preload rotating torque using a pound pull scale is figured by multiplying the radius (distance from center of wheel to outside diameter of wheel hub) by the reading on the pull scale and dividing by 12 to arrive at ft. lbs. of torque. For example: Wheel hub radius of 6-1/8" times 25 lbs. (reading on pull scale) equals 153 in. lbs. Dividing by 12 equals 12 ft. lbs. which is within specification of 10 to 15 ft. lbs. rotating torque for new bearings.

13. Install nut lock and outer nut and tighten securely to lock inner nut in position. Recheck rotating preload torque by one of two methods outlined above.

14. Bend two tangs of nut lock against flats on inner nut and bend two tangs against flats of outer nut (Fig. 131).

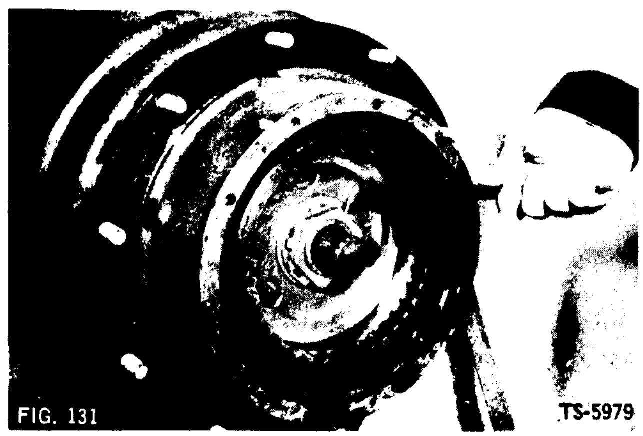
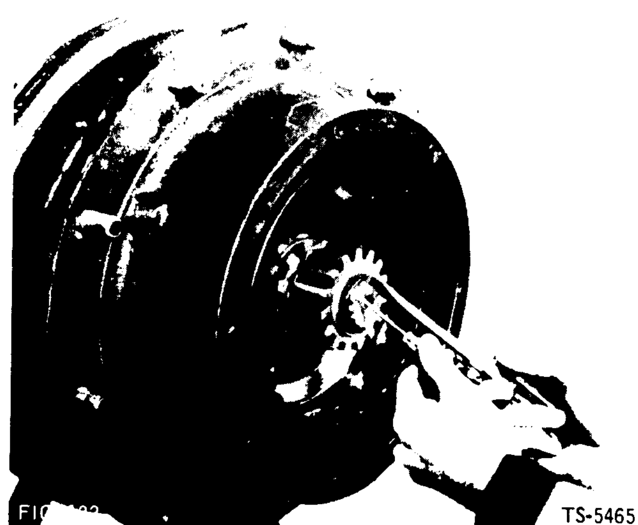


FIG. 131 TS-5979

15. Install sun gear on splined end of axle shaft. Secure gear with retaining ring. Install by seating one end in retaining ring groove and then prying with small screwdriver while sliding it into groove with larger screwdriver (Fig. 132).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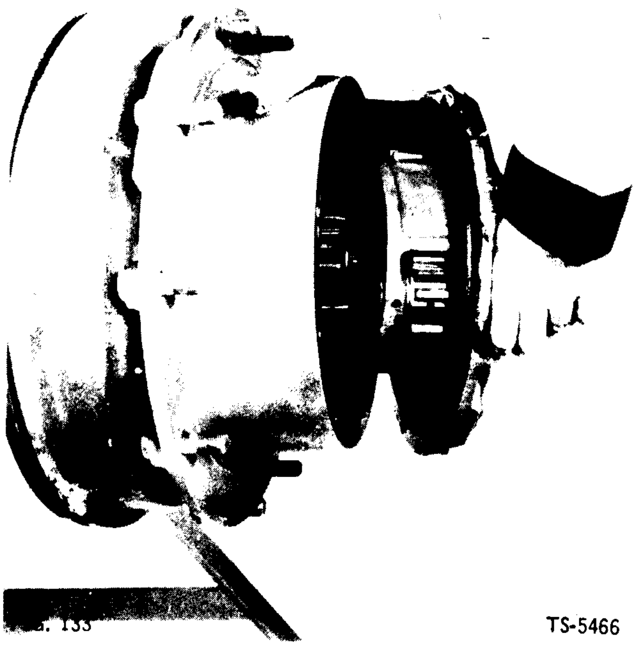
16. Apply coat of Permatex No. 2 on mounting flange of planet spider. Position planet spider on axle so that planetary gears engage ring gear and sun gear (Fig. 133).



. 133 TS-5466

17. Install one planet assembly with arrow down and oil filler hole in hub on top. Torque planet bolts (Ref. Fig. 133 and 134).

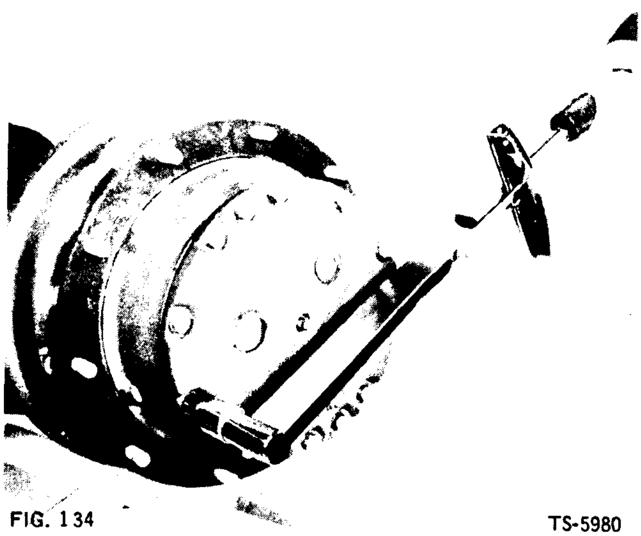


FIG. 134 TS-5980

18. Reinstall all drain plugs.

19. Attach timing fixtures to inside of elevator drive housing, mounting flanges; use the two open holes in each flange (Fig. E & F).

20. Turn assembled wheel and slip pin through fixture and into sprocket mounting hole (See Fig. F). Be sure arrow on planet is pointing down (See Fig. E).

21. On opposite wheel end install planet assembly, but do not engage planet pilot in hub bore. Be sure arrow on planet assembly is pointing down.

22. Rotate wheel hub in timing fixture and slide pin through fixture and into sprocket hole. NOTE: Pins are .100 under the sprocket hole diameter. This will allow the .200 tolerance between sprocket holes. If planet mounting holes line up in planet spider and wheel hub, install bolts and torque; assembly will be timed.

23. If planet mounting holes do not line up remove timing fixture pin from sprocket mounting hole (on end being worked on only) and index wheel hub one hole either right or left, and check planet mounting holes again.

24. Continue this procedure indexing one sprocket hole at a time until planet mounting holes line up with holes in hub. NOTE: Oil filler hole in hub must be a minimum on two inches above axle centerline when timing position is found.

25. If all possible sprocket holes are tried and planet mounting holes do not line up, remove planet assembly index to different tooth mesh and repeat timing procedure.

26. With planet arrows down, fill axle with proper gear lube, 10 pints in each wheel end, and 34 pints in center.

CHECKING OIL LEVEL

(With scraper bowl level)

To check oil level during operation, position arrows on planet assemblies down and remove the oil level plug in each planet assembly (See Fig. E). Oil level should be at bottom of each level hole. If not, add oil to each wheel hub to bring level up. It will then be necessary to fill center also. Remove oil filler plug on top of housing and insert graduated scale or similar object in filler hole; oil level should be 3-3/4 inches below filler hole (See Fig. G).

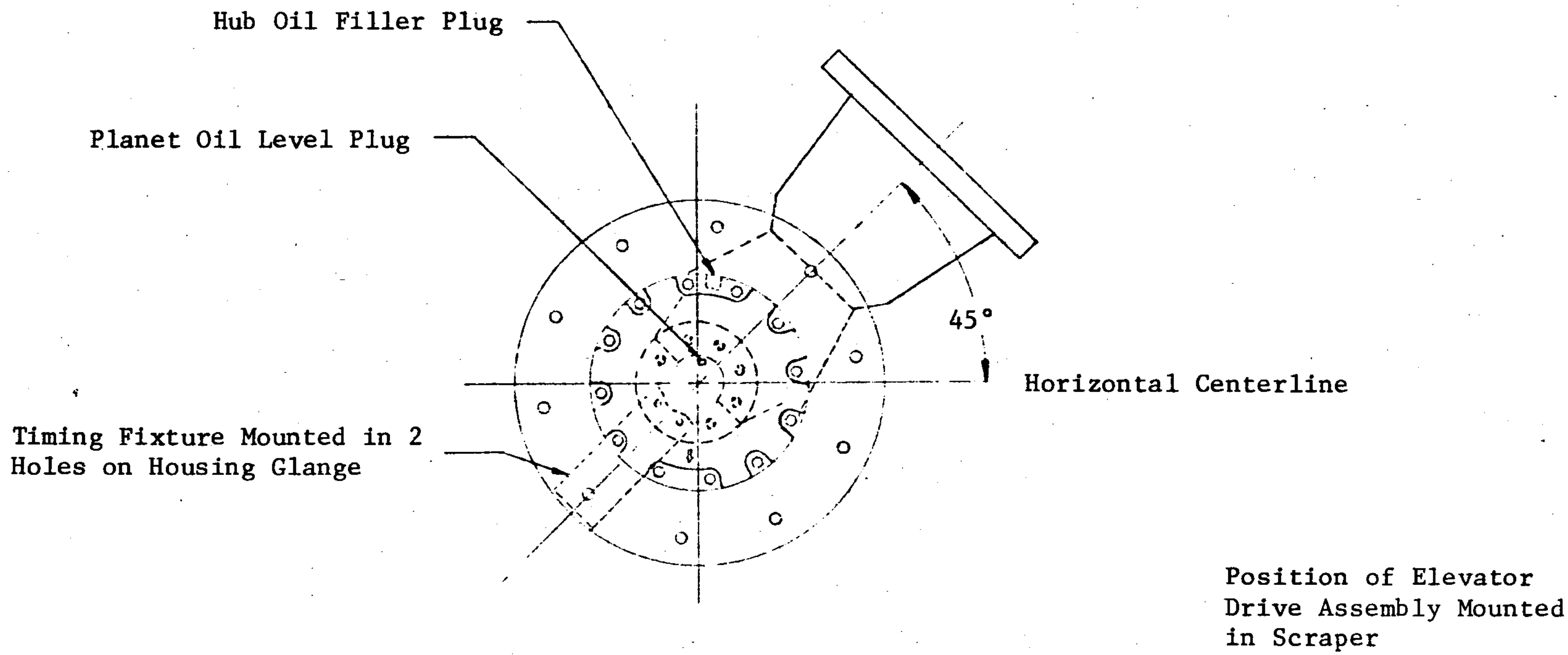

Hub Oil Filler Plug
Planet Oil Level Plug
Timing Fixture Mounted in 2 Holes on Housing Glange
45°
Horizontal Centerline
Position of Elevator Drive Assembly Mounted in Scraper

FIGURE E

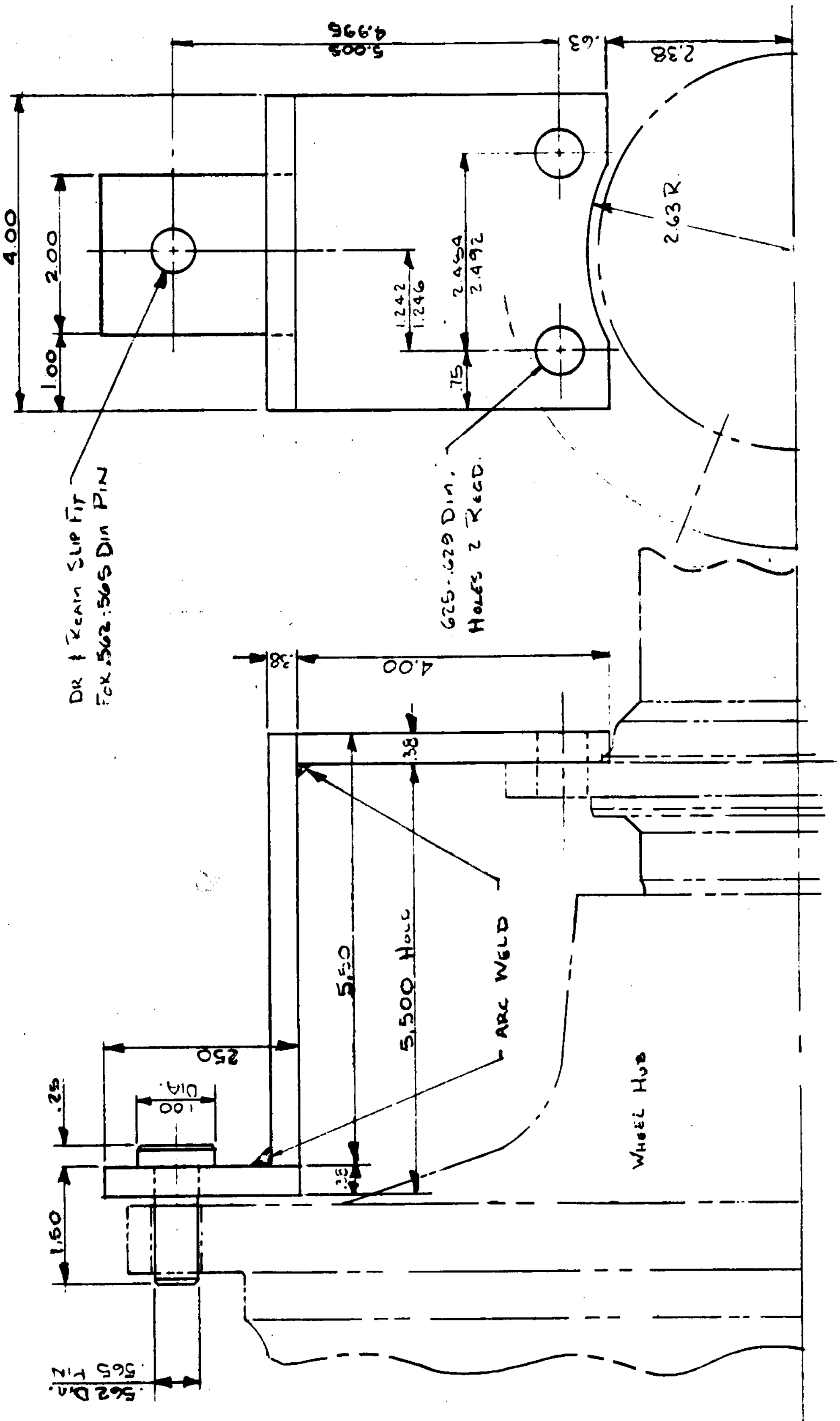
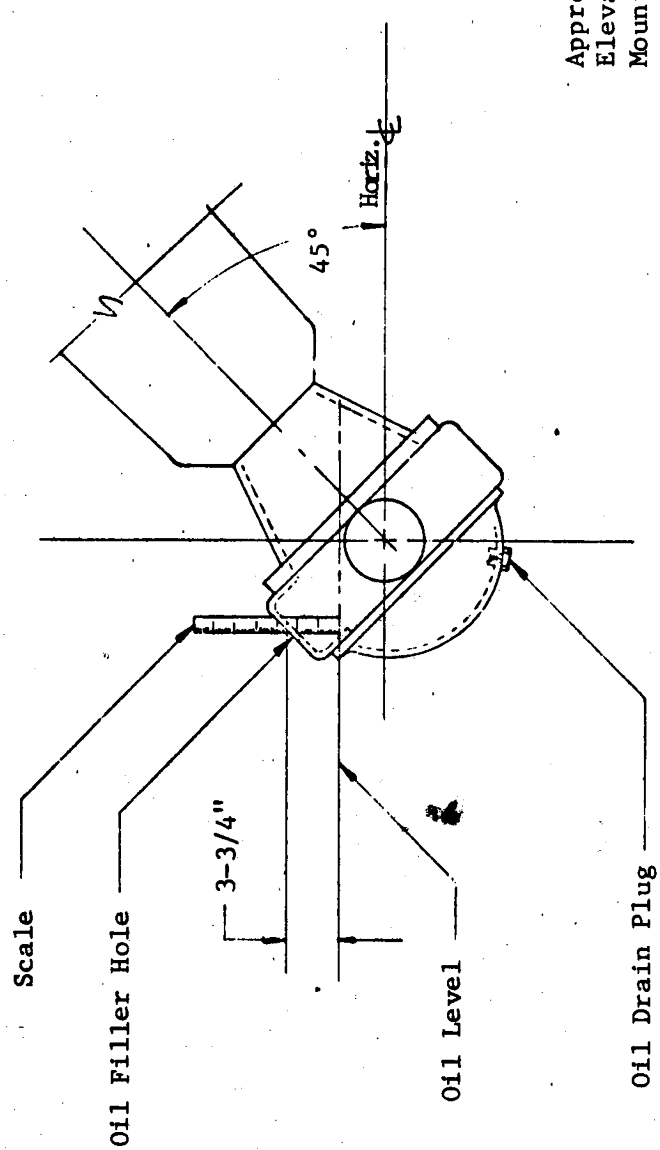


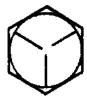
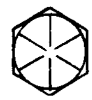
Fig. F: Timing Fixture for Elevator Drive Axle
(2 Req'd.)



Approximate Position of
Elevator Drive Assembly
Mounted in Scraper

FIGURE G.

TABLE OF TORQUE LIMITS

	GRADE 5 		GRADE 8 	
COARSE THREADS	DRY	LUBRICATED OR PLATED	DRY	LUBRICATED OR PLATED
3/8 - 16	30-35	20-25	45-50	30-35
7/16 - 14	50-55	35-40	70-75	50-55
1/2 - 13	75-85	60-65	105-115	80-90
9/16 - 12	110-120	80-90	155-165	115-125
5/8 - 11	150-165	115-125	215-230	160-175
3/4 - 10	265-290	200-220	375-415	285-310
7/8 - 9	395-430	295-325	605-670	455-500
1 - 8	590-650	445-490	910-1000	685-750
1-1/8 - 7	795-875	595-655	1290-1415	965-1065
1-1/4 - 7	1120-1230	840-925	1820-2000	1360-1495
FINE THREADS				
3/8 - 24	35-40	25-30	50-55	35-40
7/16 - 20	55-60	40-45	80-85	60-65
1/2 - 20	85-95	65-70	120-130	90-100
9/16 - 18	120-130	90-100	175-185	130-140
5/8 - 18	170-185	130-140	240-260	180-200
3/4 - 16	300-325	225-245	420-460	315-345
7/8 - 14	435-475	325-360	670-735	500-550
1 - 12	645-710	485-535	995-1095	745-820
1-1/8 - 12	890-980	670-735	1445-1590	1085-1190
1-1/4 - 12	1240-1365	930-1025	2015-2215	1510-1660

HYDRAULIC SYSTEM

BOWL LIFT AND EJECTION HYDRAULIC SYSTEM SERVICE

GENERAL OPERATION

The scraper hydraulic control system is supplied oil from the rear section of the tandem pump mounted on the converter.

The lift and ejection circuits are controlled by a two-spool directional valve which is located in the cockpit.

BOWL LIFT CIRCUIT

The scraper bowl is raised and lowered by the lift cylinders, which are pinned to the scraper pull yoke and to the edges of the bowl to control vertical position of the cutting edge.

To describe the operation of the bowl, it will be assumed that the bowl control lever is in neutral position, and that the scraper blades are touching the ground. When the bowl control lever is pulled rearward, the bowl control spool in the main hydraulic system control valve is pulled outward from the valve body by mechanical linkage. A passage in the control valve is opened allowing oil to flow from the main hydraulic system control valve through the line to the rod ends of the lift cylinders and the cylinders are retracted, thus lifting the cutting edge. Oil in the blind ends of the cylinders returns to the main hydraulic system control valve, and is subsequently returned to the front hydraulic reservoir.

When the bowl control lever is returned to the neutral position, the spool in the main hydraulic system control valve is centered by a spring, thus blocking any oil which might be returning through the lines to the valve and the cylinders are able to support a load in the bowl by hydraulic pressure in a static condition in the rod ends of the cylinders.

When the bowl control lever is pushed forward, oil is routed to the blind ends of the lift cylinders. Oil in the rod ends of the lift cylinders is returned to the main hydraulic system control valve and from the valve to the front hydraulic reservoir. This lowers the bowl to ground level and the cutting edge into the ground.

EJECTION CIRCUIT

The ejection system is operated by two double-acting hydraulic cylinders. Both cylinders are controlled by one spool of the main hydraulic system control valve.

To describe the operation of the ejection system, it will be assumed that the rolling floor is fully forward and that the endgate is fully retracted. When the ejection control lever is pulled rearward, oil is routed from the main hydraulic system control valve to the rod end of the rolling floor cylinder and to the blind end of the endgate cylinder. Oil in the blind end of the rolling floor cylinder and oil in the rod end of the endgate cylinder is allowed to return under low pressure to the main hydraulic system control valve and to the front hydraulic reservoir. As a result, the rolling floor cylinder retracts and the endgate cylinder extends. Thus, the rolling floor cylinder retracts and the endgate cylinder extends. Thus, the rolling floor is pulled from beneath the load and the endgate moves forward to eject the balance of the load.

When the handle is released, a spring within the main hydraulic system control valve returns the spool to the center position, shutting off both pressure and tank ports in the valve, thus causing a static condition in the ejection system.

When the eject control lever is pushed forward, the lever will stay in the detent position and the spool in the main hydraulic system control valve is forced inward. This action routes oil through the line to the rod end of the endgate cylinder and to the blind end of the rolling floor cylinder. Oil is returned to the main hydraulic system control valve from the rod end of the rolling floor cylinder and the blind end of the endgate cylinder. Oil is returned through the valve to the front hydraulic reservoir. When the rolling floor is closed and the cylinder is extended completely, the pressure will build up to 1800 psi, and the pressure detent will release and the handle will return to neutral automatically.

NOTE: If the pressure builds up to 1800 psi due to an obstruction or the strike-off blade hitting the ground, the detent will release the handle back neutral before the rolling floor is closed completely.

CHECK BOWL & EJECTION PRESSURE

To assure proper operation of the bowl and ejection systems, check operating pressure as follows:

1. Bring hydraulic oil to operating temperature and shut down engine.

2. Vent hydraulic tank cap and retighten. Use a hydraulic pressure gauge of at least 3000 psi capacity. With engine shut down, remove pipe plug from line located on right side of yoke at horizontal hitch point. See Fig. 25 and install gauge here.

3. Start engine and operate bowl or ejector control lever until cylinders it pressurizes reach the end of their stroke. Accelerate engine to 2100 governed rpm. Pressure reading should be between 2250 and 2500 psi.

4. The hydraulic control valve is preset to within the 2250 to 2500 psi pressure range. No adjustment is available for the lift and ejection control valve. The relief valve in the control valve must be replaced as a unit if the pressures do not meet standards.

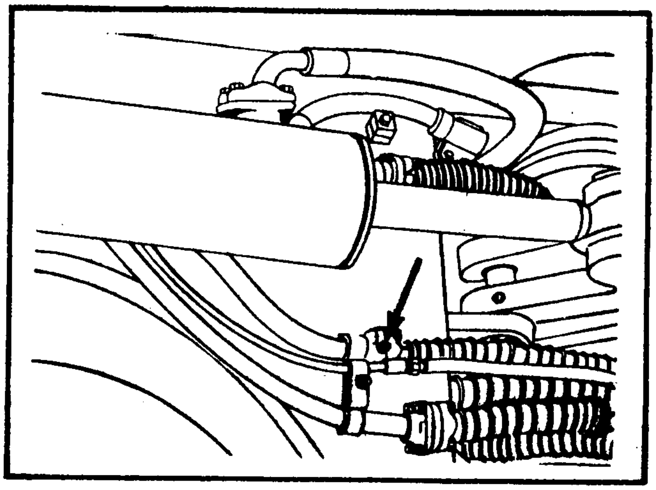


Fig. 25. Check Bowl & Ejector Pressure

HYDRAULIC HINTS

following is provided as an aid in servicing the hydraulic system and its components.

1. The first and foremost point in any hydraulic system is, KEEP IT CLEAN. It won't live long if you don't.

2. If any hydraulic component fails and allows steel, rubber, or other foreign material to enter the system, change the hydraulic oil and put a new filter in the system. Change the replacement filter after 10 hours of operation, then resume normal filter change interval.

3. If a line in the system is ever opened to atmosphere, wipe off the tank cap and remove it and allow air in the system to bleed to atmosphere.

Remember oil and filter changes cost less than hydraulic components. Change them as required.

5. When trouble shooting the system, make mechanical checks first. Many times, the trouble is in linkage or some other mechanical area. Make least expensive checks first.

MAINTENANCE

If a hydraulic system is to function properly, it must be properly maintained. The intervals for maintentnace are recommendations only and must be tailored to job conditions as required. eplace all hydraulic filters after the first 50 hours of operation.

10-HOUR MAINTENANCE

1. Inspect entire system for leaks.
2. Check reservoir level.

50-HOUR MAINTENANCE

1. Clean cylinder rods

250-HOUR MAINTENANCE

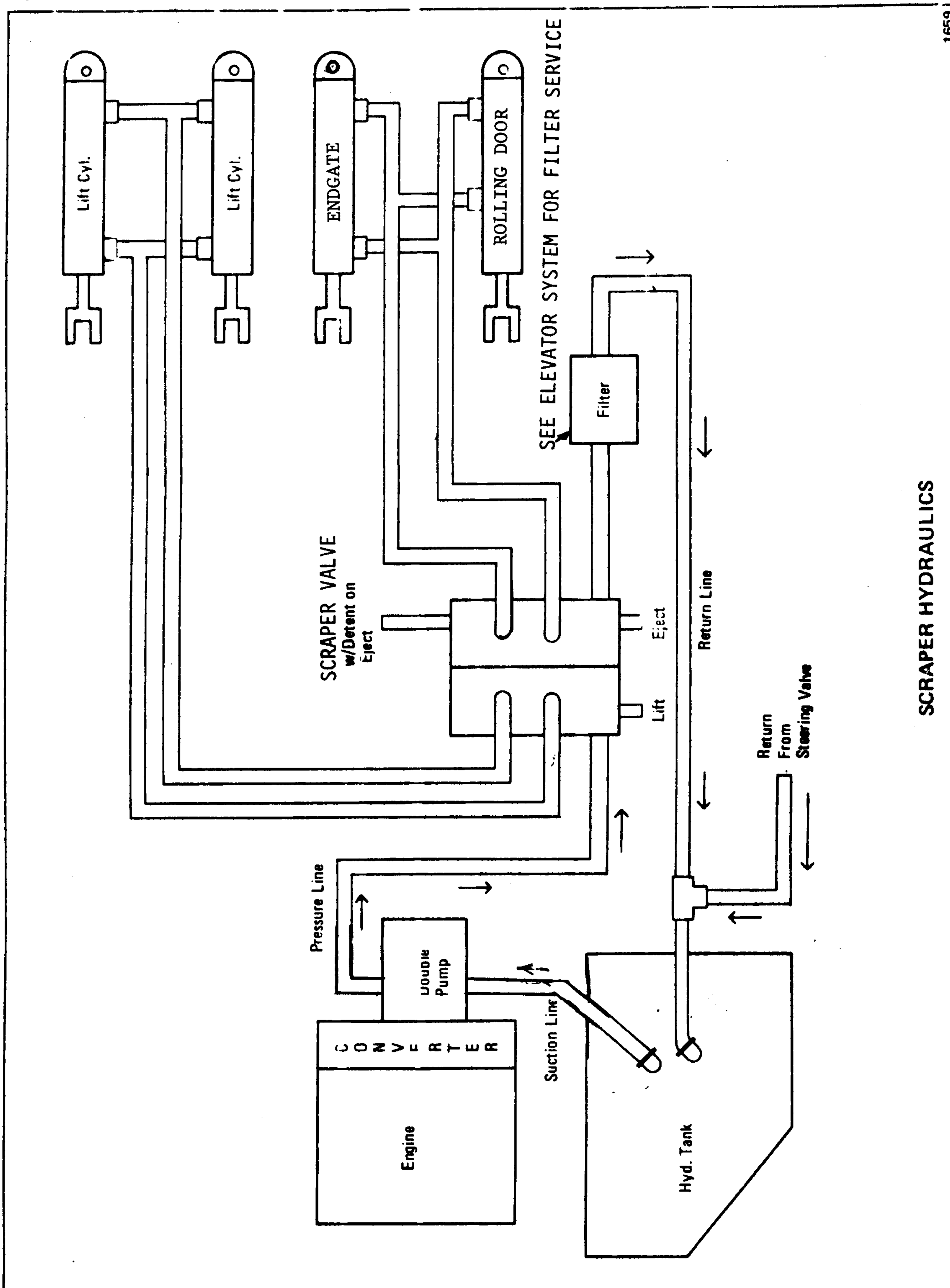
1. Replace hydraulic system filter.

1000-HOUR MAINTENANCE

1. Change oil and filter.

HYDRAULIC SYSTEM DIAGNOSIS
LIFT AND EJECTION SYSTEM

Condition	Reason	Remedy
Neither rolling floor nor endgate will operate, or will operate eratically.	Low oil level.	Fill to recommended level.
	Faulty relief valve.	Replace relief valve.
	Faulty pump.	Check flow & overhaul as needed.
	Valve work ports plugged.	Remove, clean, replace valve.
Lift system works, but ejection system does not	Ejection cylinder rings worn.	Remove, overhaul, replace ejection cylinders.
Ejection system works, but lift system does not.	Lift cylinder rings worn.	Remove, overhaul, replace lift cylinders.



SCRAPER HYDRAULICS

CLARK EQUIPMENT

HYDRAULIC OIL PUMP

DESCRIPTION AND OPERATION

These pumps consist mainly of two gears in constant mesh, closely fitted inside a housing. The drive shaft drives one gear integral with the shaft which in turn drives the driven gear. Shaft bushings and thrust plates in combination with machined surfaces are used to seal in the working gears. See Fig. 1.

As the gears rotate and come out of mesh, they trap inlet oil between the gear teeth and the housing. The trapped oil is carried around to the outlet chamber. As the gears mesh again they form a seal which prevents oil from backing up to the inlet or suction side. The oil is forced out at the outlet port and sent through the system.

This oil is pushed out by the continuous flow of trapped oil coming into the outlet chamber with each rotation of the gears.

At the inlet side, vacuum feeds in more oil from the reservoir to replace that drawn out by the turning gears. Fig. 2 is an exploded view of the pump.

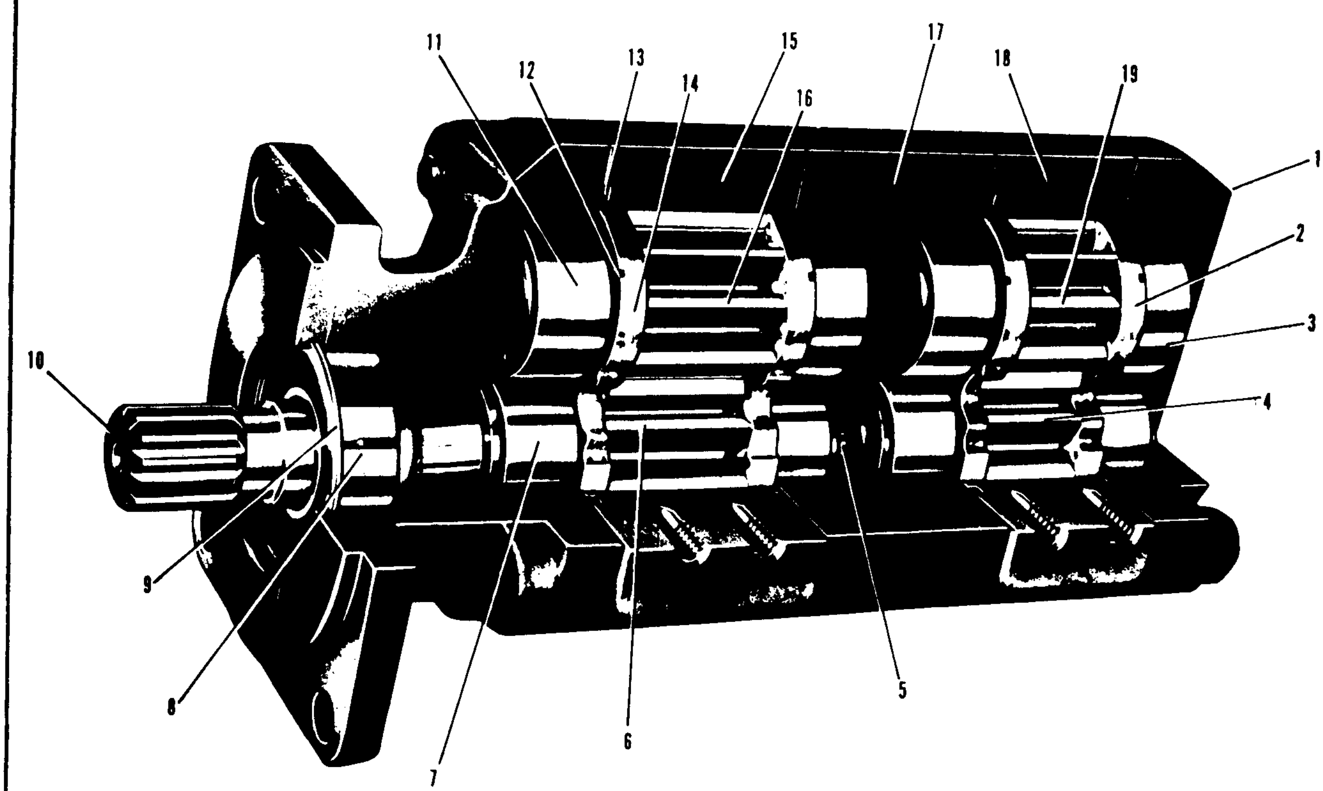


Fig. 1–Cutaway View of Double Pump

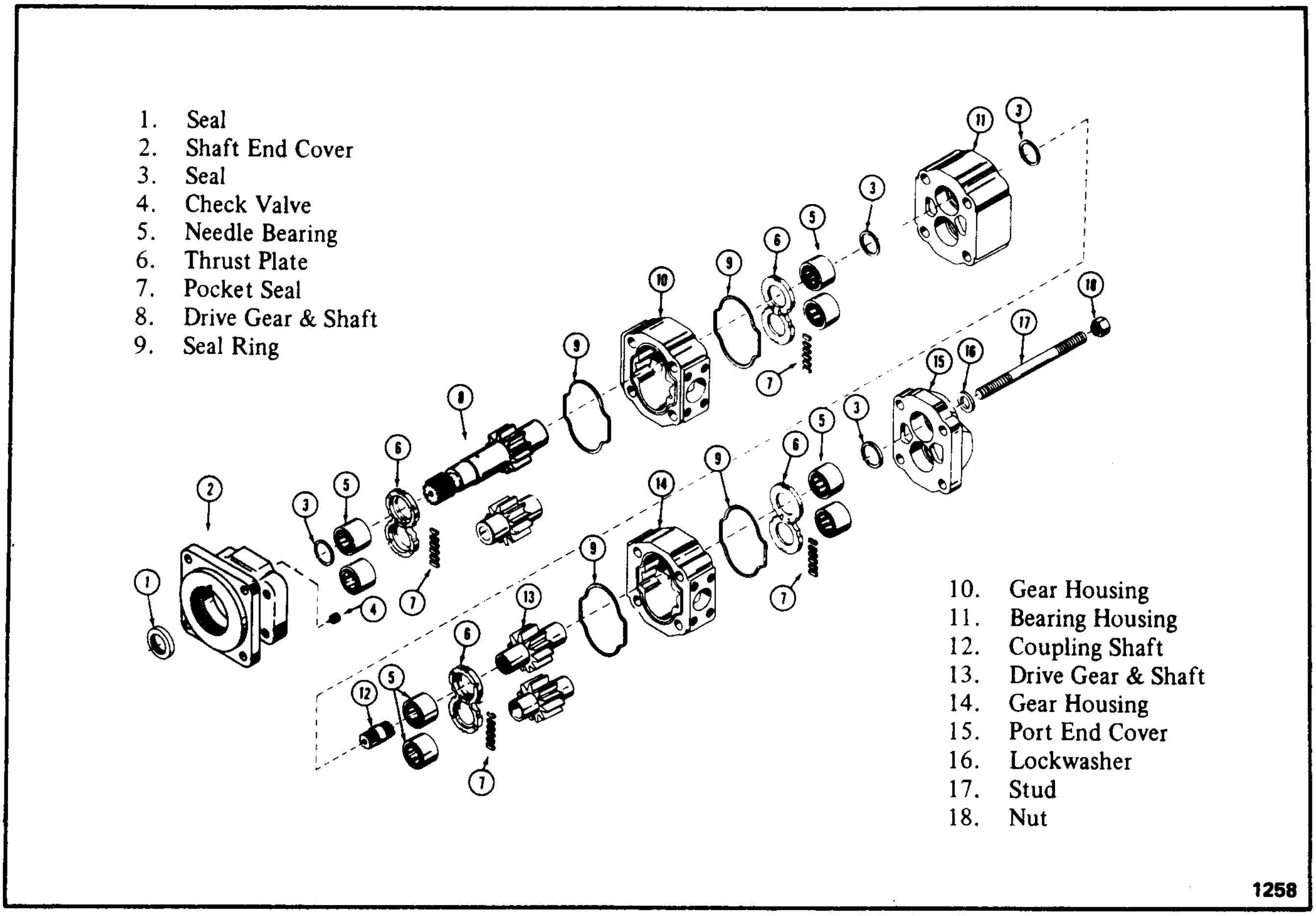


Fig. 2–Exploded View of Double Pump

REMOVAL

Instructions for removal cover all pumps used on the unit.

1. Relieve pressure in front and rear hydraulic reservoirs.

2. Remove and plug pressure and suction lines from pump.

3. Remove bolts securing pump to converter face and slide pump away from converter.

DISASSEMBLY

Both single and double pumps are included in disassembly, inspection and assembly.

Remember that dirt is the enemy of any hydraulic system. The first requirement of good maintenance of hydraulic equipment is cleanliness. Make sure to disassemble and assemble hydraulic equipment in a clean area.

1. Place the pump in a vise with the drive shaft pointing down.

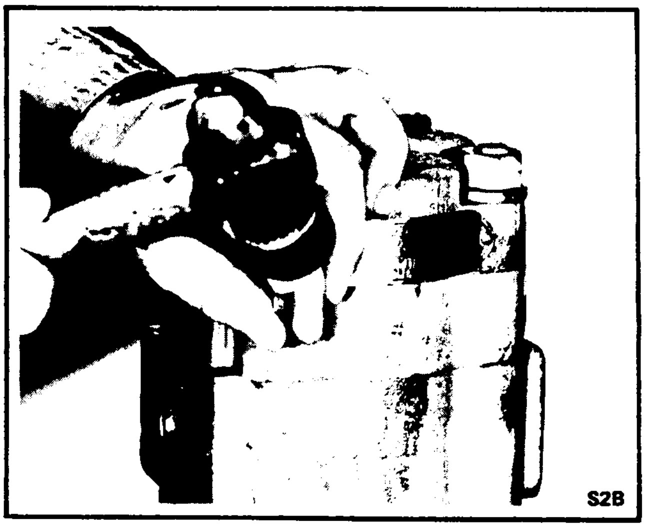


Fig. 3–Match-marking Pump Sections

CAUTION: Do not grip on or near any machined surfaces during assembly or disassembly. Index mark all sections with a prick punch. Be sure to align these marks when assembling pump. See Fig. 3.

2. Remove the 4 bolts or hex nuts and washers with a

socket wrench. See Fig. 4.

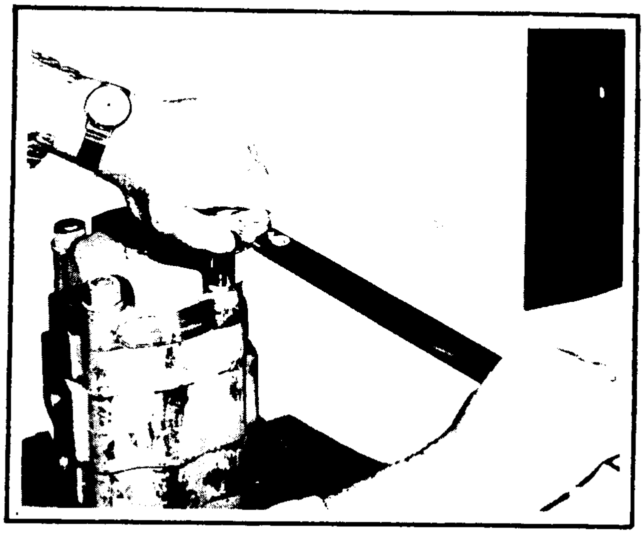


Fig. 4–Removing Pump Bolts

3. Lift off the port end cover. If necessary to pry loose, be careful not to damage the machined surfaces. See Fig. 5. If the thrust plate remains in the gear housing, it can be tapped out later with a wooden hammer handle. Be careful not to distort the thrust plates.

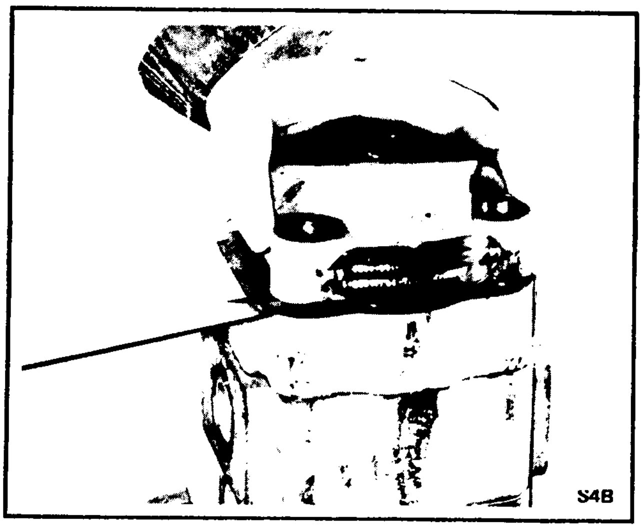


Fig. 5–Removing Port End Cover

4. Lift the gear housing from the gears. If necessary to pry loose, take care not to damage the machined surfaces.* See Fig. 6.

5. Remove the drive and driven gears. Keep the gears together because they are a matched set. Take care not to damage the machined surfaces of the gears.* See Fig. 7.

6. Remove the connecting shaft.* See Fig. 8.

7. Lift or pry off the bearing carrier. Take care not to damage the machined surfaces.* See Fig. 9.

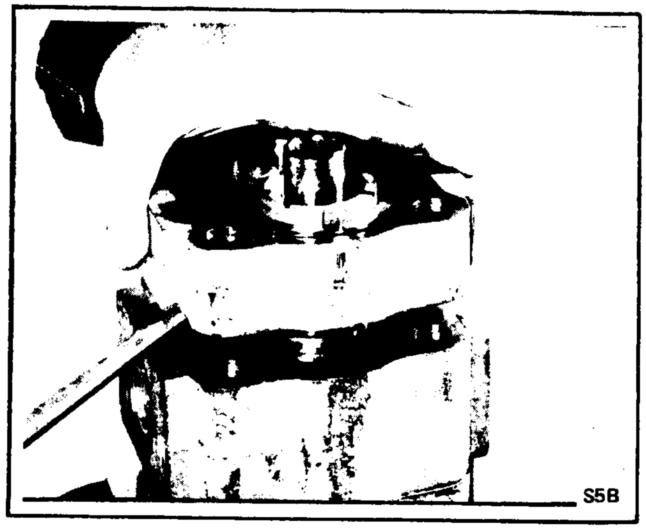


Fig. 6 Lifting Off Gear Housing

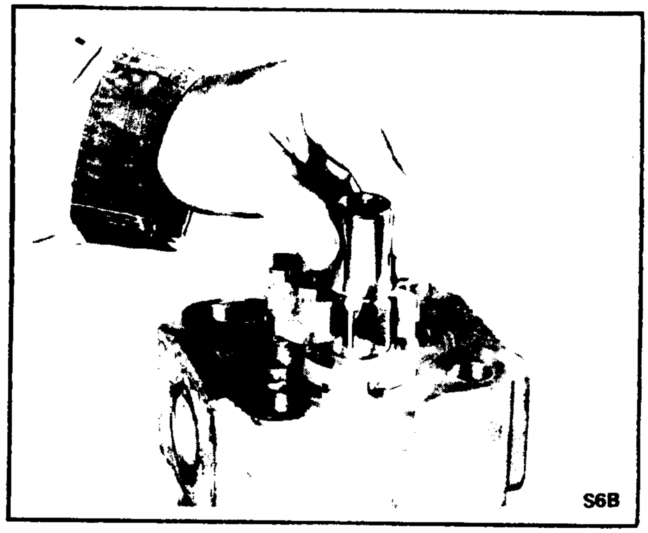


Fig. 7–Removing Drive and Driven Gears

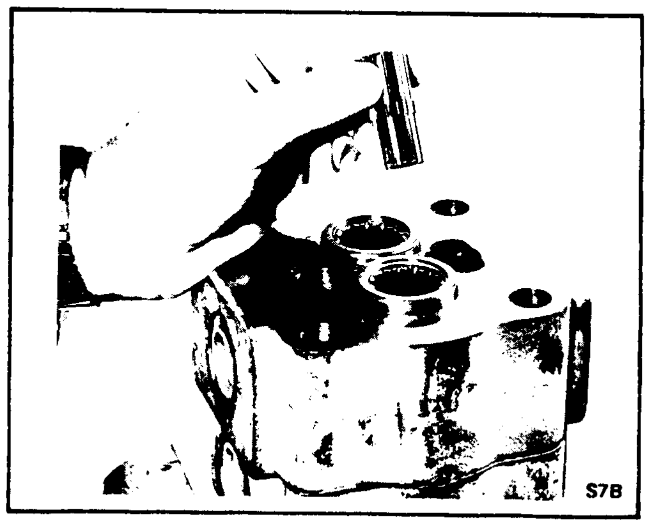


Fig. 8 Removing Connecting Shaft

8. Lift or pry off the first section gear housing. Be

careful not to damage machined surfaces. Remove thrust plate as described in step 3. See Fig. 10.

Fig. 9–Removing Bearing Carrier

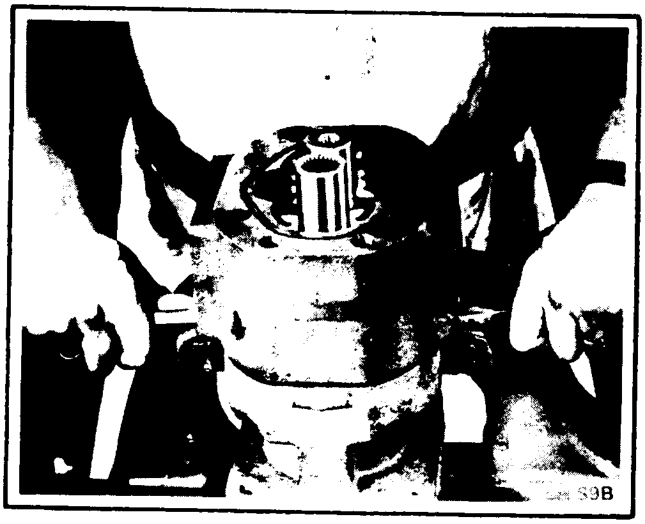


Fig. 10–Lifting Off First Section Gear Housing

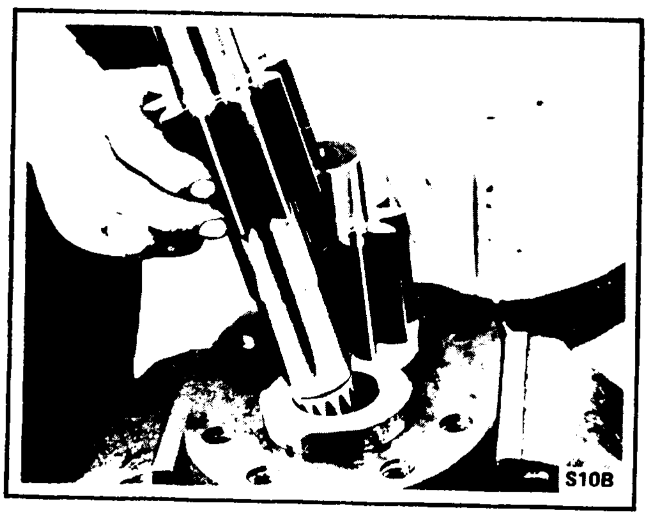


Fig. 11–Removing Drive and Driven Gears

9. Remove the drive gear with shaft and the driven gear. Keep these together as they are a matched set. Take care not to damage the machined surfaces of the gears. See Fig. 11.

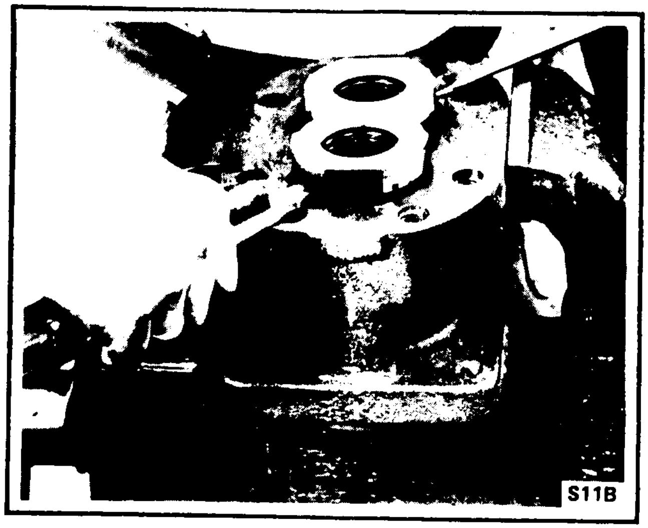


Fig. 12–Removing Thrust Plate

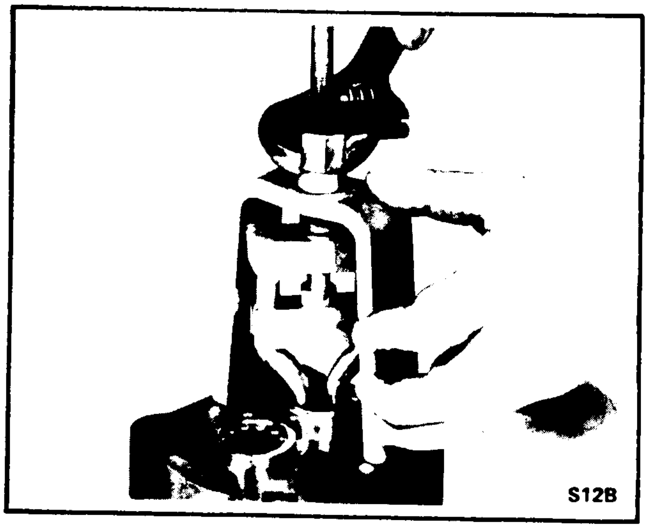


Fig. 13–Pulling Roller Bearings

10. Pry the thrust plate from the shaft end cover, port end cover or bearing carrier with a screwdriver or similar tool. Avoid distorting the thrust plate. Remove and discard all rubber pocket seals and gasket seals. See Fig. 12.

11. Examine all roller bearings for scoring, spauling, or pitting. If replacement is necessary, pull the bearings with a bearing puller. See Fig. 13.

12. Check the ring seals for wear. Replace if necessary. To replace, pull the drive gear bearing with a bearing puller and remove ring seal from the bottom of the bearing bore. See Fig. 14.

13. If the pump is equipped with an outboard bearing,

place the shaft end cover in a vise with the mounting face up. Remove the bearing snap ring with a small screwdriver or awl. See Fig. 15.

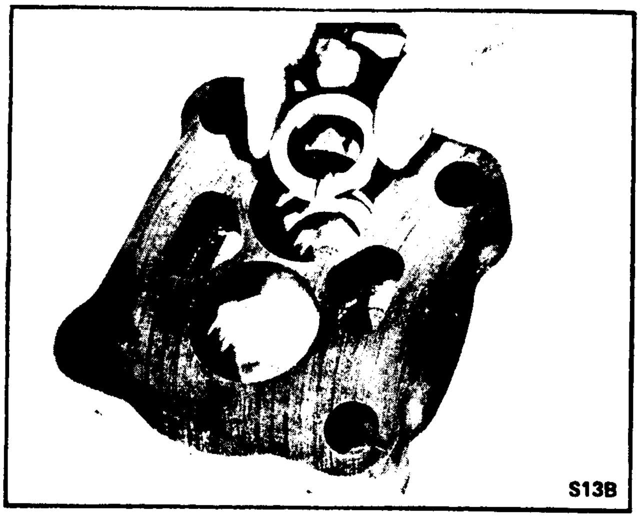


Fig. 14 Removing Ring Seal

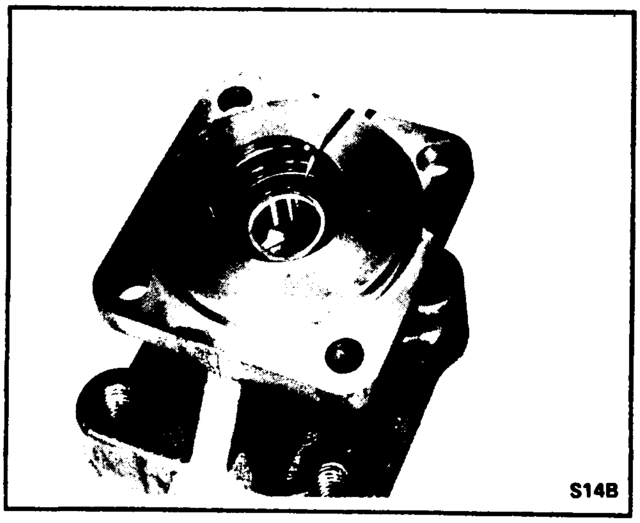


Fig. 15 Removing Bearing Snap Ring

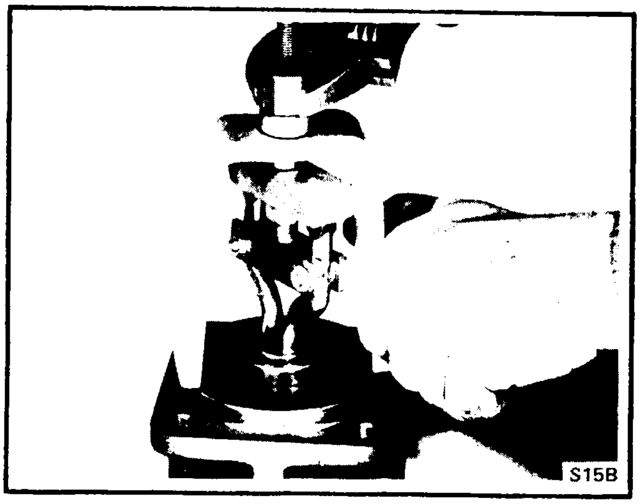


Fig. 16 Removing Outboard Bearing

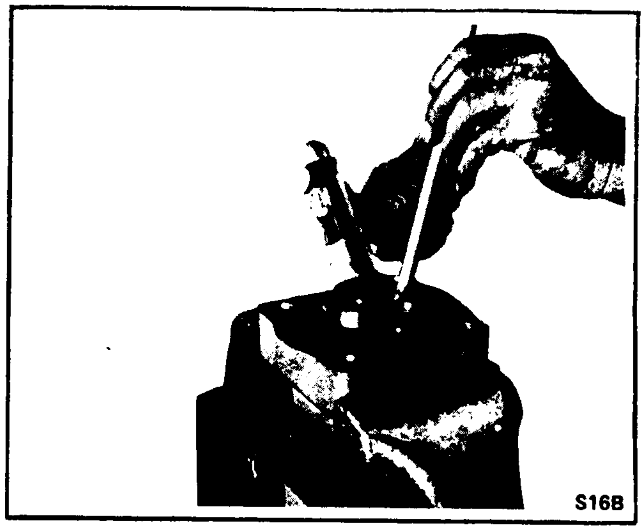


Fig. 17- Removing Double Lip Seal

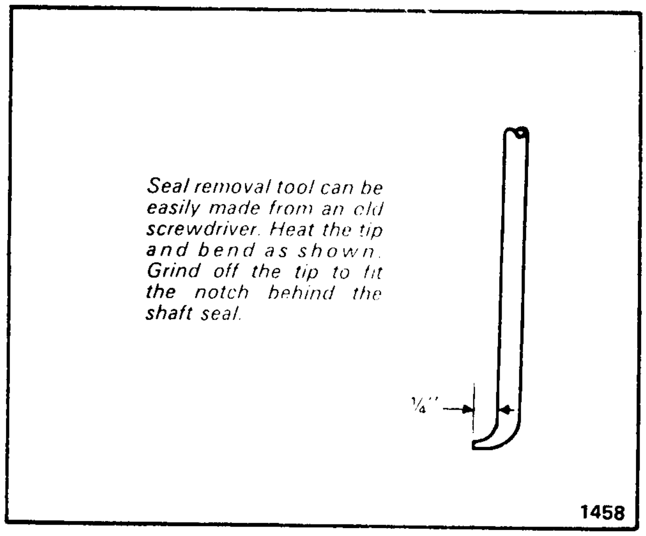


Fig. 18–Seal Removing Tool

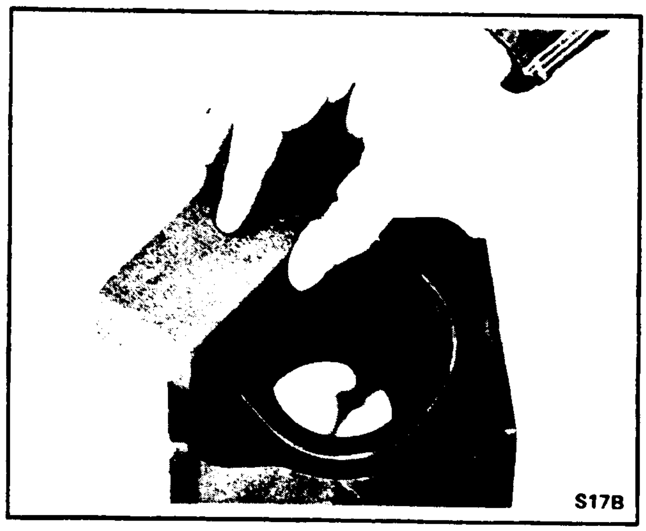


Fig. 19–Stoning Off Machined Surfaces

14. If pump is equipped with an outboard bearing, it

should be removed with a bearing puller as shown in Fig. 16.

15. Grip the shaft end cover in a vise with the mounting face down. See Fig. 17. Remove double lip seal by inserting the special tool shown in Fig. 18 into the notch between the double lip seal and the shaft end cover. Tap out the seal and discard it.

16. Stone off all machined surfaces with a medium grit carborundum stone. See Fig. 19.

INSPECTION

GEAR HOUSINGS

1. Wear in excess of .005" cut-out necessitates replacement of the gear housing.

2. Place a straight edge across the bore. If a .005" feeler gage can be fitted under the straight edge in the cut-out area, replace the gear housing. Pressure pushes the gears against the housing on the low pressure side. As the hubs and bearings wear, the cut-out becomes more pronounced. Excessive cut-out in a short period of time indicates excessive pressure or oil contamination. If the relief valve settings are within prescribed limits, check for shock pressures or tampering. Withdraw an oil sample and check it and the tank for dirt or other foreign matter.

GEARS

1. Any wear on gear hubs detectable by touch, or in excess of .002" necessitates replacement.

2. Scoring, grooving or burring of outside diameter of teeth requires that the gear be replaced.

3. Nicking, grooving or fretting of teeth surfaces ruins the gears.

DRIVE SHAFTS

1. Replace drive shafts if there is any wear detectable by touch in the seal areas or at the drive coupling. .002" wear is the maximum allowable.

2. Wear in the shaft seal areas indicates oil contamination. Wear or damage to splines necessitates replacement.

THRUST PLATES

1. The thrust plates seal the gear section at the sides of the gears. Wear here will allow internal shippage; that is, oil will bypass within the pump.

2. .002" maximum wear is allowable. Replace thrust plates if they are scored, eroded or pitted.

3. Check the center of the thrust plate where the gears mesh. Erosion here indicates oil contamination.

4. Pitted thrust plates indicate cavitation or oil aeration.

5. Discolored thrust plates indicate overheating; probably insufficient oil.

BEARINGS

1. If gears are replaced, bearings must be replaced. Bearings should fit into the bore with a light press fit. A neat hand fit is allowable. If bearings can fall out, bore may be oversize.

SEALS AND GASKETS

1. Replace all rubber and polynur seals whenever disassembling pump. Include all "O"rings, pocket seals behind thrust plates, shaft seal and gasket seals.

ASSEMBLY

1. If bearings have been removed, deburr bearing bores. Rinse parts in solvent and air blast all parts. Do not dry with a cloth. See Fig. 20.

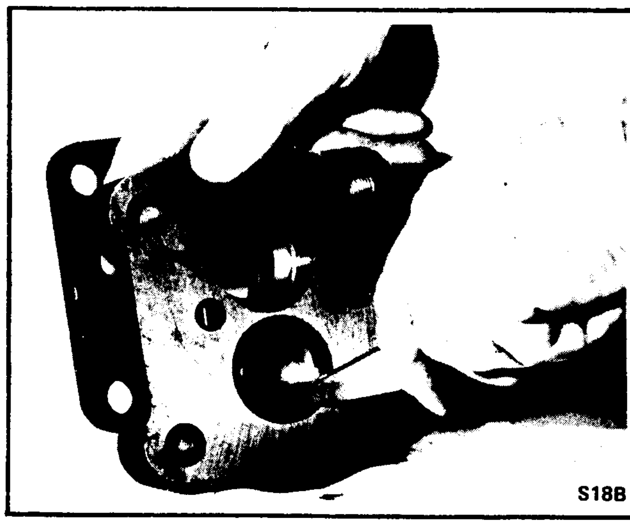


Fig. 20–Deburring Bearing Bores

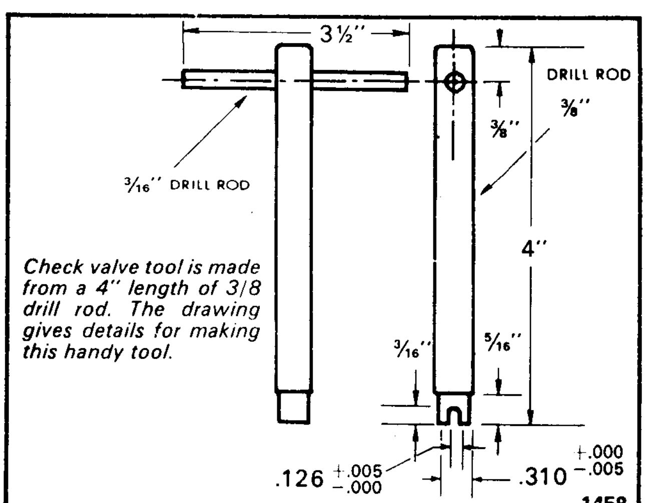


Fig. 21–Check Valve Removal Tool

2. Grip the shaft end cover in the vise with the mounting face down. Examine the plug or 2 check valves, whichever is used to be sure that they are tightly in place. Replace only if parts are missing. To replace a damaged plug, screw in the new plug until one thread of the hole is visible. Peen around the edge of the bore with a prick punch to secure. Check valves can be removed with the tool illustrated in Fig. 21. Thread in the new valve with the tool until tight. Peen with a 1½" steel ball to secure as shown in Fig. 22.

3. Coat the outside of the double lip seal and its recess with purple Loctite Seal Retainer. With the metal side of the double lip seal up, press it into the mounting flange side of the shaft end cover with an arbor press and bar. Make certain double lip seal is fully seated in the recess. Wipe off surplus Locktite.

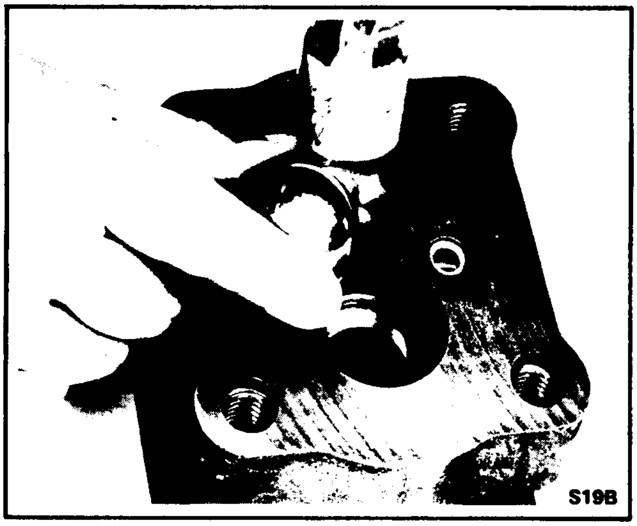


Fig. 22–Peening Over Check Valve Bores

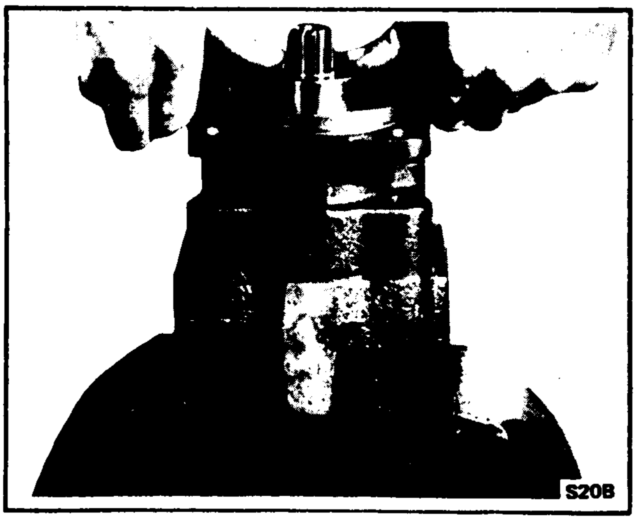


Fig. 23 Fitting Outboard Bearing

4. If the pump is equipped with an outboard bearing, guide the bearing into recess in the shaft end cover. This is not a press fit. See Fig. 23.

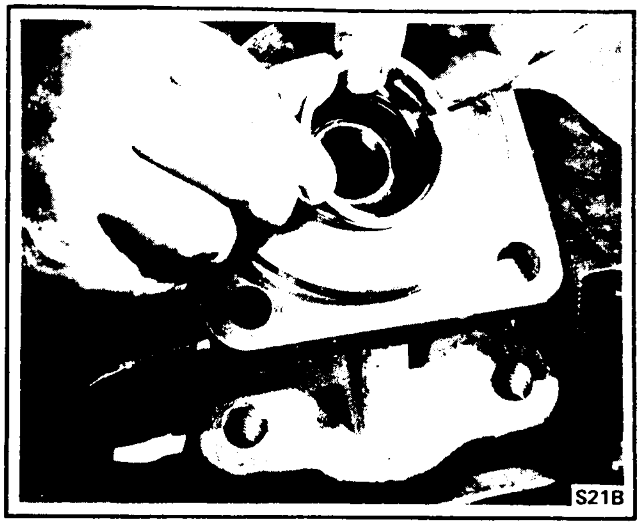


Fig. 24 Inserting Snap Ring

5. Insert the snapring into its groove to retain the outboard bearing. See Fig. 24.

NOTE: Assembly steps 6, 7, 8, 9, 10 and 11 apply to shaft end cover, bearing carriers and port end cover.

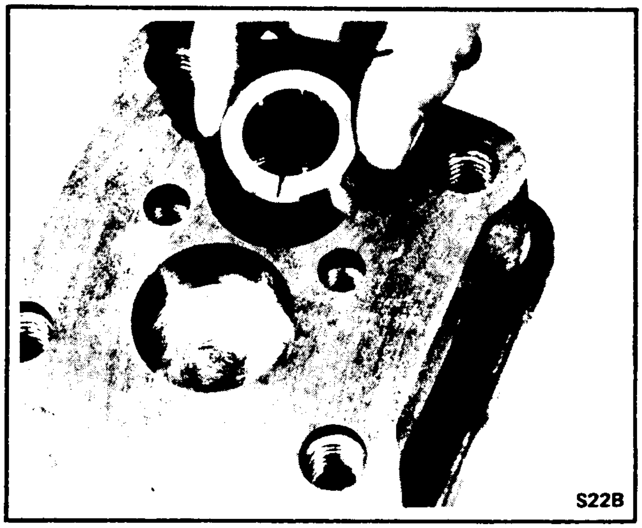


Fig. 25–Replacing Ring Seal

6. If ring seals are being replaced, insert into bottom of drive gear bearing bore. The notch in the ring seal must be visible. This is a check to be certain the notched side is next to the bearing. See Fig. 25.

7. If any bearings have been removed from the shaft end cover, port end cover or bearing carrier, replace them by pressing into the bearing bore with an arbor press. See Fig. 26.

8. Cut two pocket seals 7/32" long from the pocket seal strip. Grease these pocket seals and insert them into the middle slots in the thrust plate. See Fig. 27.

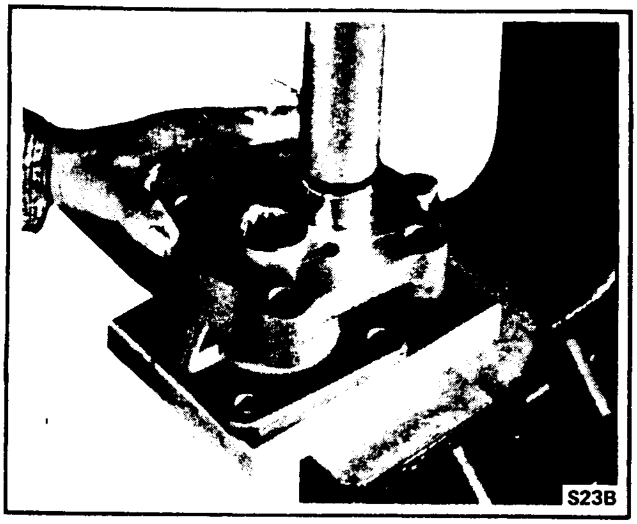


Fig. 26–Pressing Roller Bearings

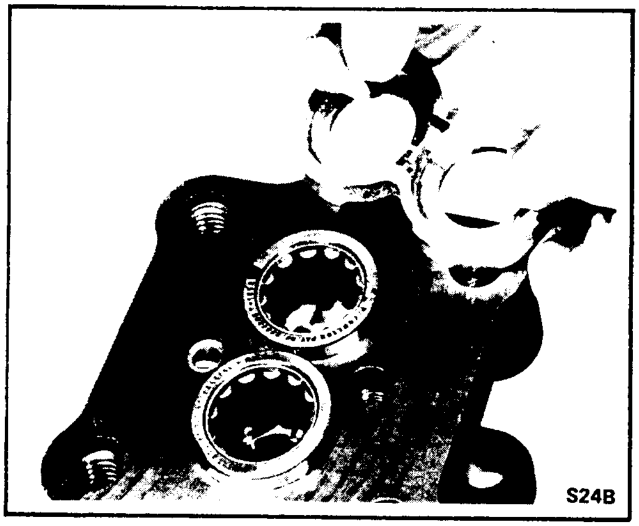


Fig. 27–Inserting Pocket Seals

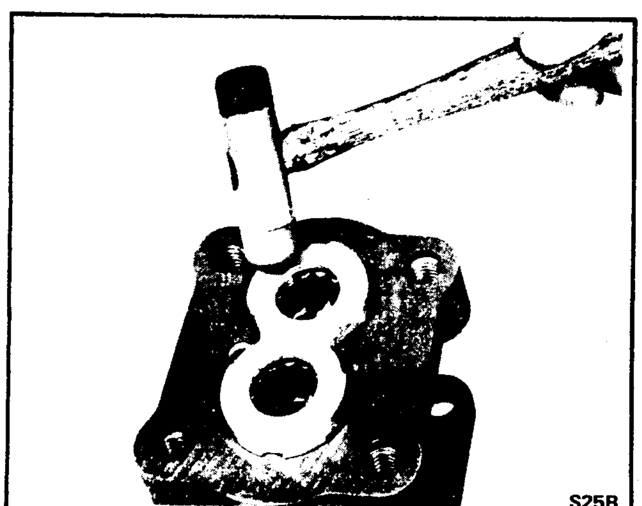


Fig. 28–Seating Thrust Plate

9. With the pocket seals down, place the thrust plate over the bearing in the shaft end cover. Tap the thrust plate with a soft hammer to about 1/32" from the machined surface. See Fig. 28.

10. Cut four pocket seals approximately ¼" long from the pocket seal strip. Insert one pocket seal into each of the slots in the thrust plate. Push each pocket seal all the way in so that they touch the roller bearings. Tap the thrust plate down firmly against the machined surface with a soft hammer. Use a sharp razor blade to trim exposed end of the pocket seal square and flush with the thrust plate. See Fig. 29.

Fig. 29–Trimming Pocket Seals

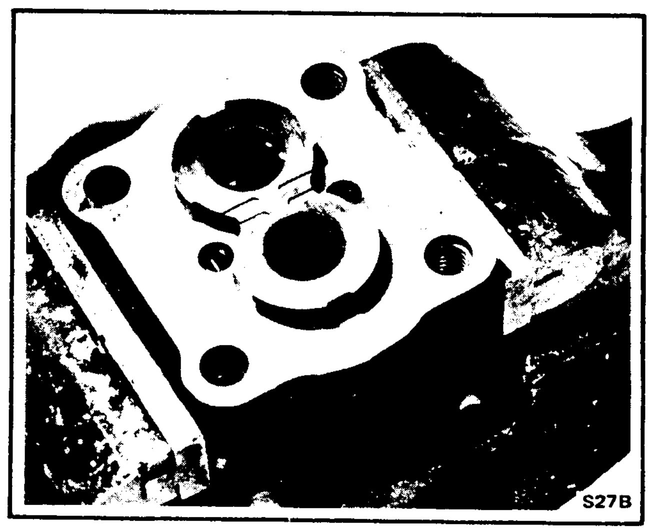


Fig. 30–Shaft End Cover Properly Gripped in Vise

11. Grip the shaft end cover in the vise with the mounting face down. See Fig. 30.

12. Lightly grease the drive shaft. Insert the integral gear and drive shaft with a twisting motion. See Fig. 31. Be careful not to damage the double lip seal. Push down carefully until gear rests against thrust plate. Insert the driven gear.

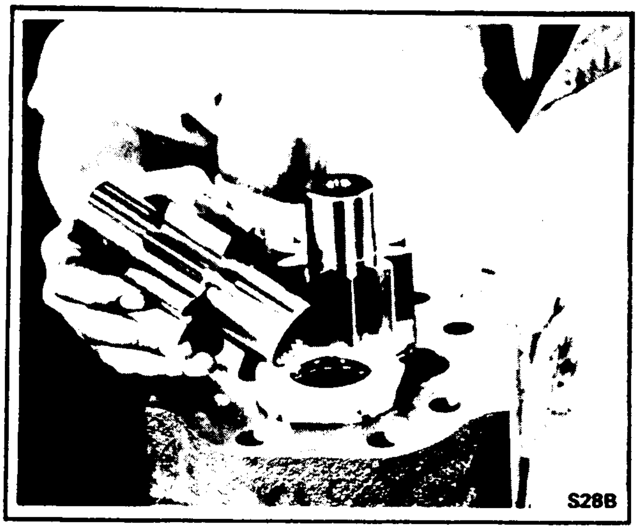


Fig. 31 Inserting Drive Shaft

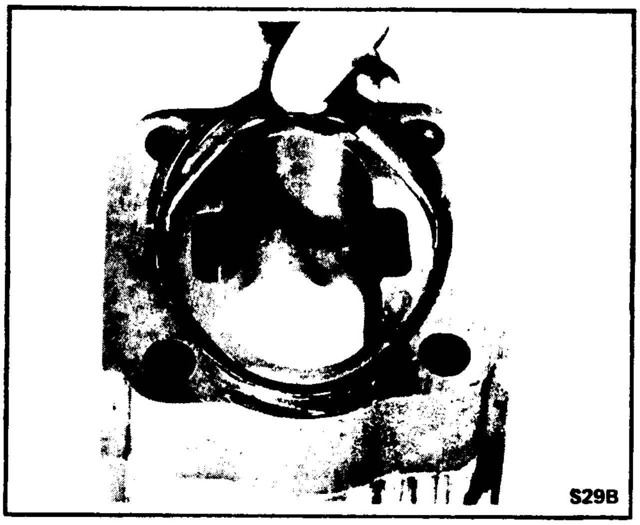


Fig. 32 Inserting Gaskets in Gear Housings

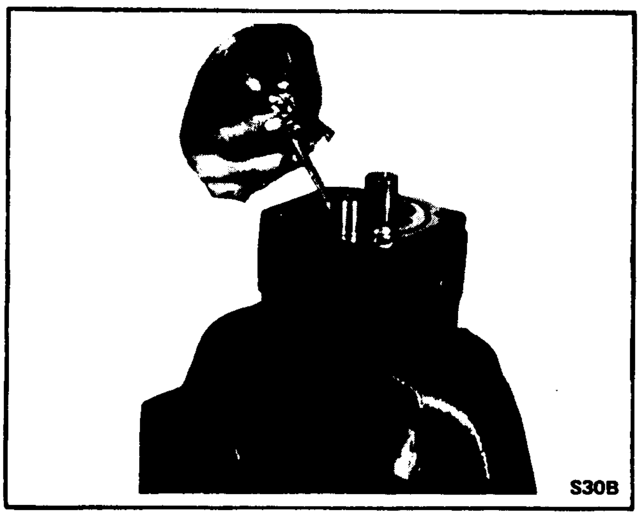


Fig. 33 Oiling Gears

13. Grease the new gasket seals and insert them into the grooves in both sides of all gear housings. See Fig. 32.

14. Slide the first section gear housing over the gears and tap it with a soft hammer until it rests tightly against the shaft end cover. Be careful not to pinch the gasket seal. Squirt oil over the gears to provide initial lubrication when pump is started. See Fig. 33.

15. Position the bearing carrier with thrust plates on the gear housing so that the roller bearings receive the journals of the drive and driven gears. Make sure that the index marks are properly aligned. See Fig. 34. Tap the bearing carrier tight with a soft hammer.*

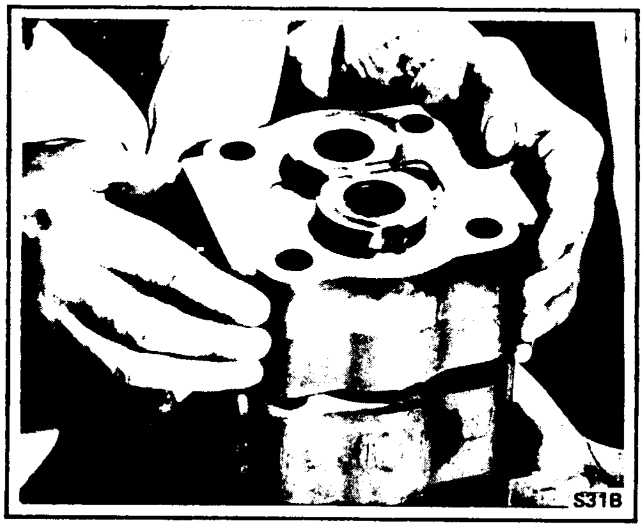


Fig. 34 Positioning Gear Housings

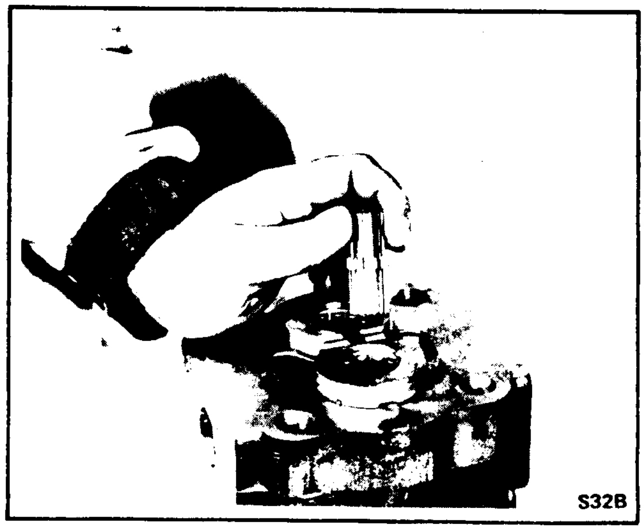


Fig. 35 Inserting Connecting Shaft

16. Insert the connecting shaft in the spline of the drive gear.* See Fig. 35.

17. Insert the drive and driven gears of the second section in their respective bearings. Push down tightly against the thrust plate.* See Fig. 36.

18. Slide the second section gear housing over the gears and tap it tight against the bearing carrier with a soft

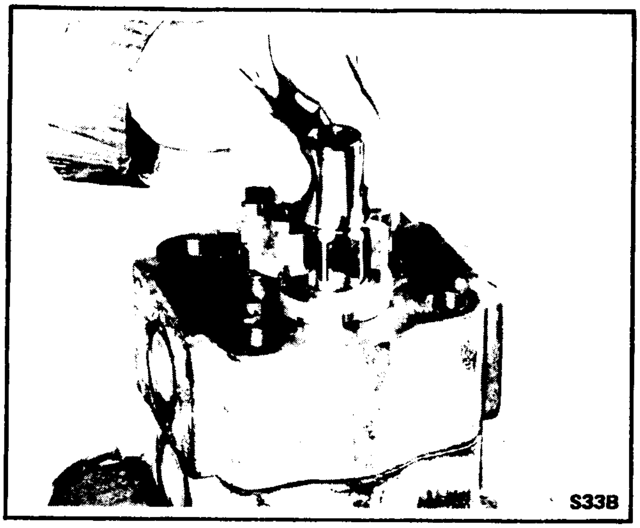


Fig. 36–Inserting Drive and Driven Gears

Fig. 37–Installing Second Section Gear Housing

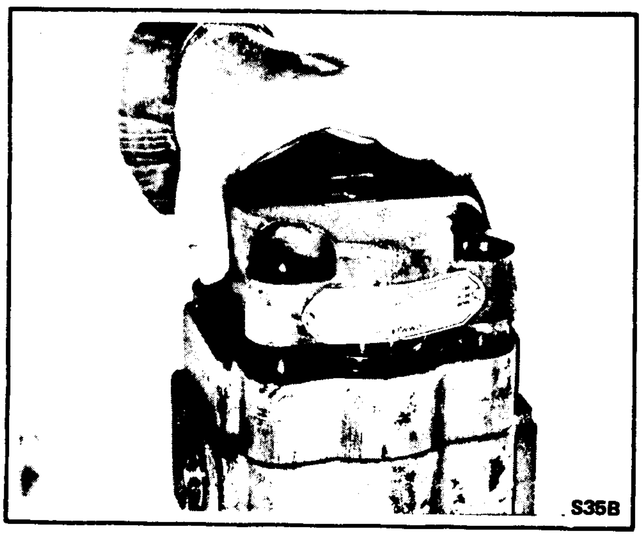


Fig. 38–Replacing Port End Cover

hammer. Be careful not to pinch the gasket seal. Squirt oil over the gears to provide initial lubrication when the pump is started.* See Fig. 37.

19. Place the port end cover over the gear journals and tap tightly against the gear housing. Be careful not to pinch the gasket seal. See Fig. 38.

20. Thread the 4 fasteners into the shaft end cover and snug-up alternately or cross-corner. Rotate the drive shaft with a 6" wrench to make sure there is no binding in the pump. See Fig. 39.

21. After the fasteners are tight and you are sure there is no internal binding, torque the diagonally opposite fasteners to 200 ft. lbs. See Fig. 40.

*Applies to double pump only.

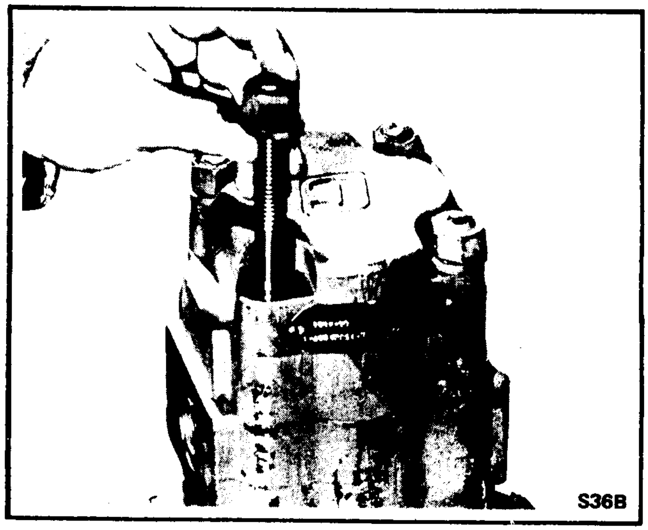


Fig. 39–Replacing Fasteners

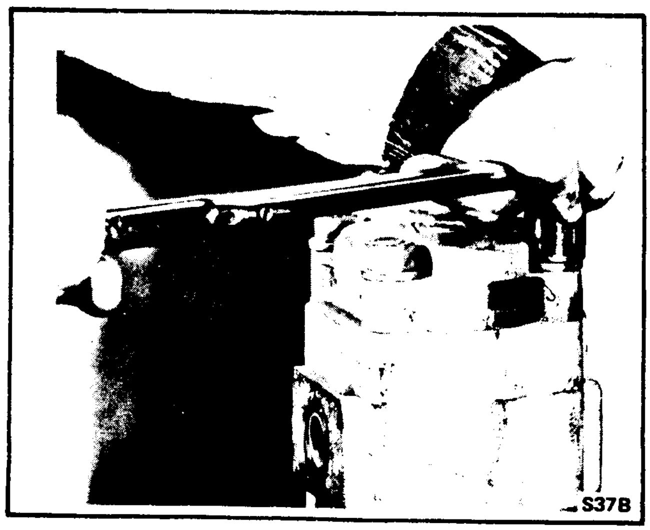


Fig. 40–Torquing Fasteners

CLARK EQUIPMENT

HYDRAULIC CYLINDER

The hydraulic cylinders on these units are the doubleacting type. The "Double Acting" hydraulic cylinder is extended by hydraulic oil pressure and retracted by reversing the pressure, rather than retracting by pressure-release method.

REMOVAL

When removing the lift cylinders from the machine, the lift cylinders are connected to the yoke and lower front of the main frame to lift and lower the moldboard. Care should be taken to avoid damaging the cylinder and to avoid injury to the service man. The cutting edge must be on supports or ground before the cylinders can be removed. Follow the steps in the order listed below to remove the lift cylinders.

1. Remove cotter pin from upper cylinder pin. Remove cylinder pin washer.

2. Support the cylinder so that it will not fall in the direction of the serviceman when the cylinder pin is removed.

3. Remove the cylinder pin by driving it from the cylinder base and yoke and pull yoke cylinder lug. After moving it flush with the cylinder base end, a drift may be used to finish the removal procedure.

4. Lower the cylinder to the floor using the lower cylinder pin (still intact) as a hinge.

5. Remove the lower cylinder pin using the same procedure as on the upper cylinder pin.

6. Reinstallation of the cylinder assembly is the reverse of the above procedure.

DISASSEMBLY

In the disassembly of the hydraulic cylinder, every precaution should be taken to keep dirt and other foreign matter from the cylinder. The presence of any foreign matter in the cylinder can cause expensive damage to any or all of the components. Refer to Fig. 1 and the following instructions.

The following service procedures apply to the lift cylinders and the endgate cylinder located at the rear of the machine.

1. Secure the cylinder on a substantial work bench equipped with a large vise to securely hold the cylinder assembly. A chain vise, if available is ideal to use in this situation.

2. Remove capscrews fastening the gland to the head. See Fig. 2.

3. Slide the gland assembly down the rod to make visible the retaining ring securing the the barrel. See Fig. 3.

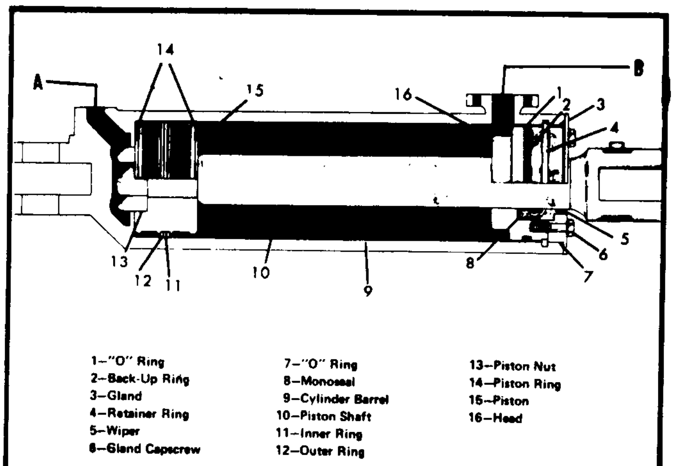


Fig. 1–Hydraulic Cylinder Assembly

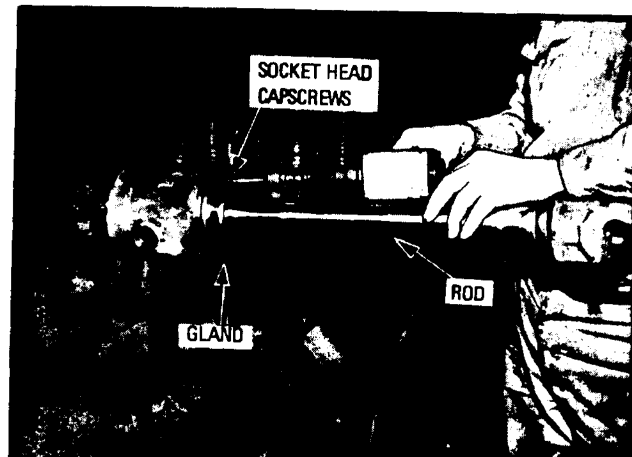


Fig. 2–Disassembly of Gland Assembly

L1

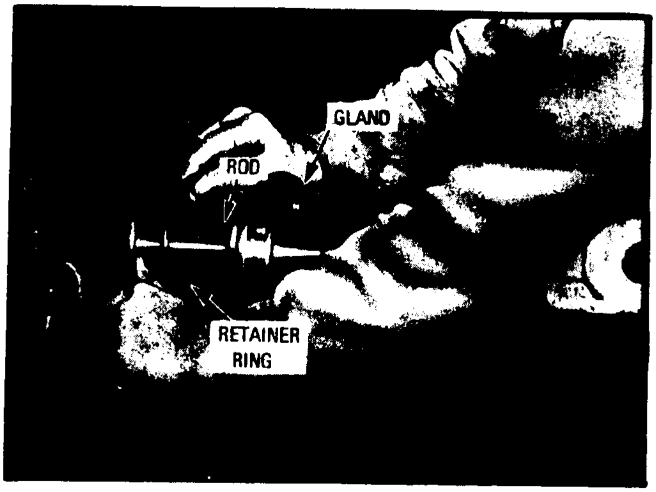


Fig. 3–Removal of Retaining Ring

4. Remove the retaining ring from the groove in the barrel.

5. The rod and piston assembly may then be removed from the barrel as shown in Fig. 4.

6. Remove the piston locknut from the end of the piston rod and remove the piston.

CAUTION: Care must be taken to avoid scratching or denting the cylinder rod.

7. The gland assembly, monoseal and head may then be removed from the rod.

8. Remove outer ring, inner ring and piston rings from piston.

9. Remove gland sleeve, "O" ring and wiper from gland.

10. Clean and inspect all parts and replace all worn parts.

A rod or barrel with very light scratches can be repaired by using fine crocus cloth to remove the rough edges. If a rod or barrel has deep scratches, in most cases it must be replaced.

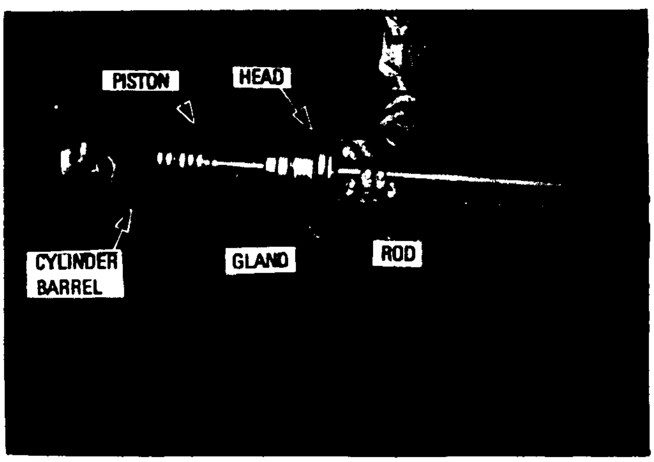


Fig. 4–Removal of Rod and Piston Assembly

It is a good practice, while in the field, to inspect the rod wiper frequently. Wipe the cylinder rods with a slightly oily cloth to remove the dirt and sand or foreign material. The oil will tend to soften the dirt and it will not leave scratches as it is wiped away. Do not leave excess oil on the surface of the rod so that heavy sand and dirt deposits can stick to the rod. Reassembly of the lift cylinder and the endgate cylinder is the reverse of the disassembly procedure. It is recommended that all "O" rings, seal rings, back-up rings, shaft wipers and monoseals be replaced each time the cylinders are disassembled. Repair kit containing above listed items is available.

Service procedures outlined above apply to all hydraulic cylinders on this unit. When assembling piston rod assembly into cylinder barrel, place used "O" ring from head into retaining groove in barrel. This procedure will reduce the chances of damaging outer ring and inner ring on piston by retaining ring groove in cylinder barrel.

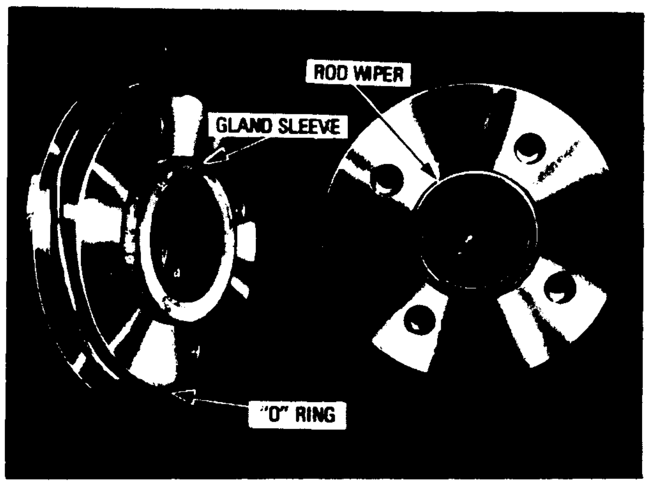


Fig. 5–Gland Assembly

1. Place new wiper, gland sleeve and barrel-to-gland "O" ring on gland as shown in Fig. 5.

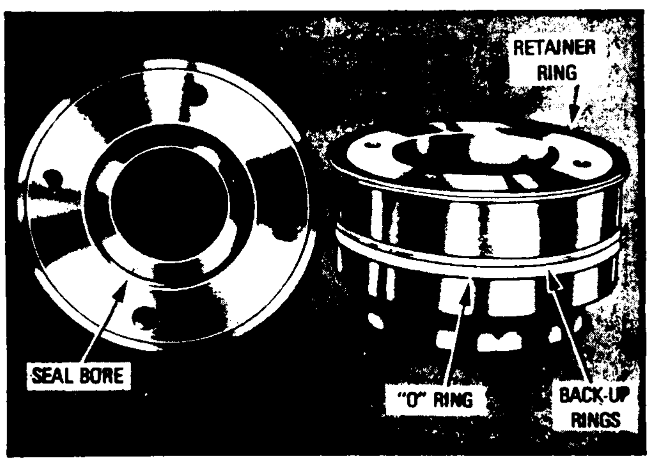


Fig. 6–Head Assembly

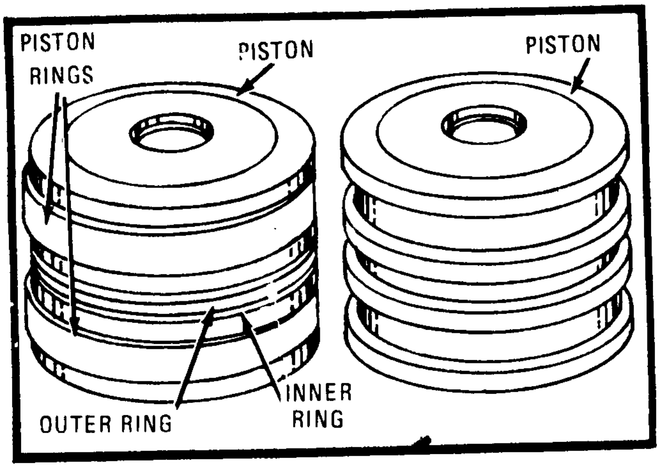


Fig. 7–Piston Assembly

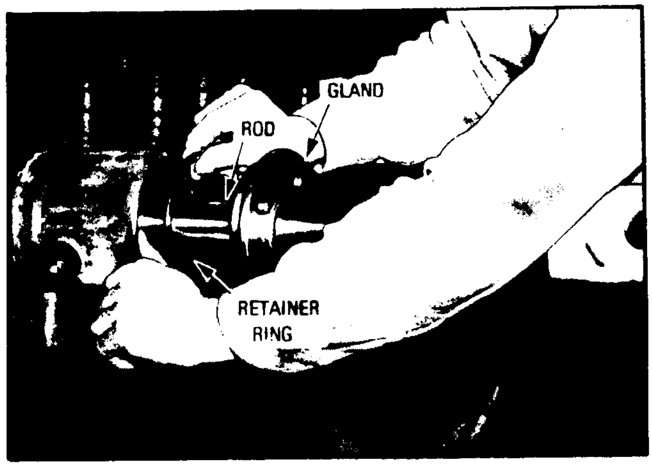


Fig. 8– Installation of Retaining Rings

2. Place new "O" ring and back-up ring on cylinder head. The concave side of the back-up ring must be turned toward the "O" ring. The flat side of the "O" ring must be facing to the same end of the gland as the rod monoseal. See Fig. 6.

3. The new monoseal is to be assembled with flared end toward piston.

4. Install one new inner ring first in the center recessed slot.

5. Install new rings, one each inner and outer. Be careful that outer ring does not get scuffed from assembly. See Fig. 7.

6. Install the piston rings (2) in the grooves on either side of the center groove containing the inner ring and outer ring. Make certain that the ends where the piston rings come together are opposite each other.

7. Install the new "O" ring in the inside bore of the piston.

8. Be careful not to damage the wiper seal or gland sleeve, when installing the gland assembly on the cylinder rod.

9. Place a new retainer ring on the shaft.

10. Place the head assembly on the rod. The rod monoseal must go next to the gland.

11. Place the piston assembly onto the small end of the rod and fasten it to the rod with the locknut removed to disassembly the rod assembly.

12. Thoroughly coat the inside of the barrel and the rod assembly with the same oil that is used in the hydraulic system.

13. Install the rod assembly, piston first in the barrel. When the piston and head are in place, install the retainer ring. See Fig. 8.

14. Slide the gland down the cylinder rod until it is flush with the barrel and insert the capscrews. Start them into the head and screw them finger tight all the way around.

15. Tighten two capscrews opposite each other first, then tighten all capscrews to 40 ft. lbs. of torque.

* * * *

CLARK EQUIPMENT

HYDRAULIC CONTROL VALVE

DESCRIPTION

The hydraulic control valve consists of a relief valve and two single-acting hollow plungers. The plungers are equipped with return springs which return the plungers to the neutral position after each actuation of the plungers, except the closing position of the ejection is detented.

The high pressure release port allows oil to return through the junction block to the filter and into the reservoir when the scraper components are inactive.

OIL FLOW

Oil from the pump flows into the control valve housing through the high pressure inlet port. The distribution of oil to the scraper control cylinders is controlled by the manual control levers, which move the plungers in or out of the housing.

If all of the plungers are in the neutral position, the oil flows down the central passage and out the return-to-reservoir port.

Return oil from the cylinders flows into the valve housing, into the high pressure release port, through the filter and into the hydraulic reservoir.

REMOVAL

1. Disconnect all lines leading into the control valve.
2. Remove cotter pins and small pins fastening valve handles to control valve.
3. Remove capscrews and locknuts fastening valve to side of cockpit.
4. Remove valve from cockpit. Before starting disassembly of valve, wash it thoroughly in solvent.

DISASSEMBLY

1. Plug all ports and clean outside of valve thoroughly.
2. Remove 12 point capscrews from spool caps and remove spool caps.
3. Remove spools from valve body. Be sure to identify spools with respective spool bores to assure proper reassembly. NOTE: Do not remove spool screws or snap rings from spool assemblies unless spool centering spring is to be replaced. Springs need not be replaced unless they are broken or have been excessively weak.
4. To disassemble flow control spool, remove snap ring, deep washer, spring, flat washer, and second deep washer. Remove spool plug, spring, shim, and plunger from spool body. Remove o-rings from plug and plunger.
5. Remove lift check plugs, springs and plungers.
6. Remove system relief valve from valve body.
7. Remove all plugs from valve body.
8. Remove all o-rings and back-up washers from valve body.
9. Thoroughly clean and dry all parts.

INSPECTION

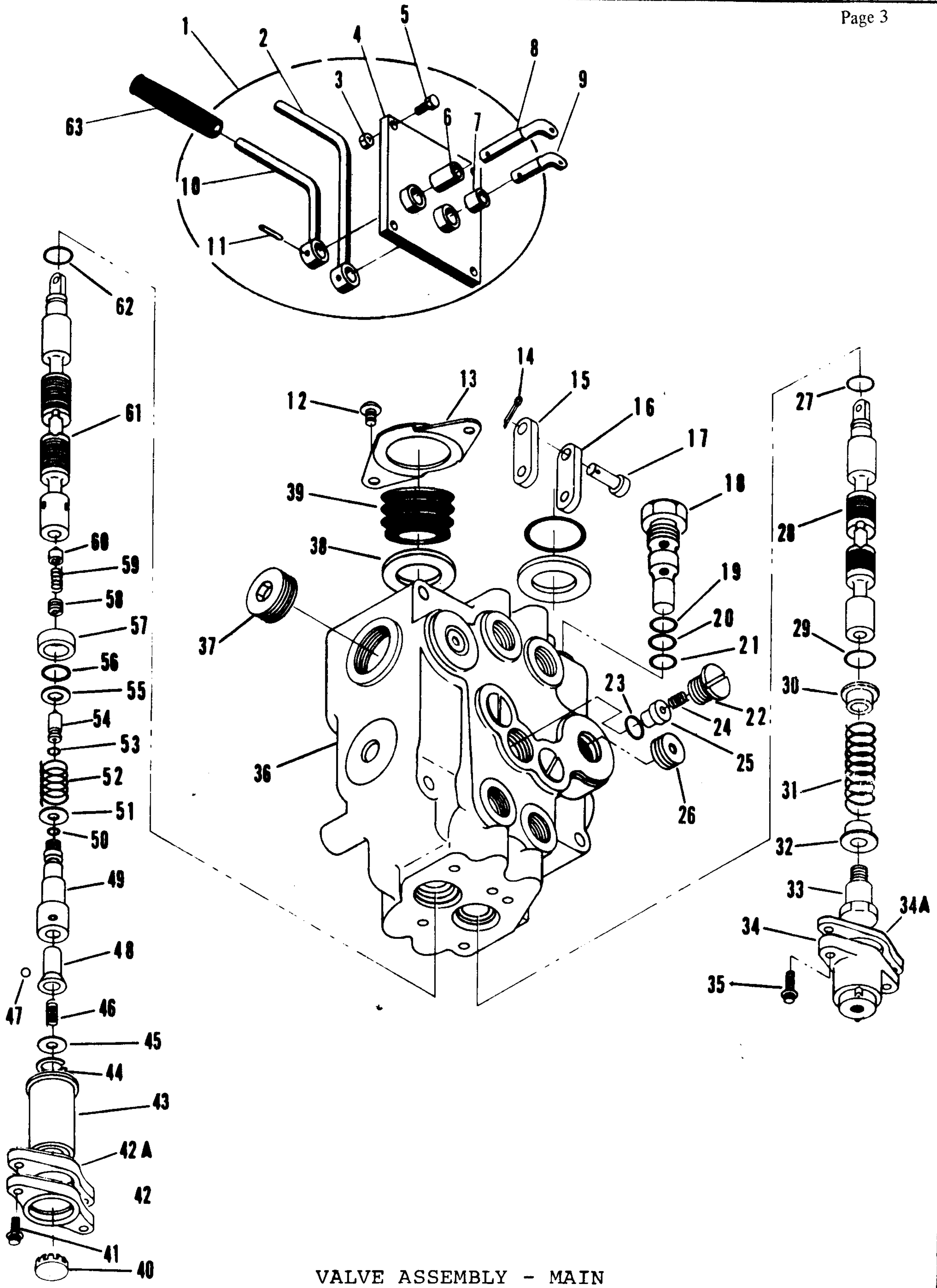
1. Remove nicks and burrs from all parts with emery cloth.
2. Inspection of o-rings and back-up washers is not necessary. These parts should be replaced with new parts when control valve is disassembled for service.
3. Inspect lift check seat in valve body for excessive wear, burrs or roughness.
4. Inspect spool springs, lift check springs, and flow control spring for breakage.
5. Thoroughly clean cartridge type relief valve in solvent and blow out with air, if relief valve tests defective, replace as a new item.
6. Thoroughly clean small screen on end of flow control plunger.

REASSEMBLY

1. All parts should be cleaned and dried thoroughly. Metal parts should be lightly oiled prior to assembly.
2. Install new back-up washer in relief valve chamber.
3. Install new o-ring in relief valve chamber. (Place o-ring inboard of leather back-up washer).
4. Install new o-rings in spool bores.
5. Install new o-rings on all plugs and relief valve assemblies.
6. Install new o-ring on flow control plunger.
7. To reassemble flow control spool, install plunger, shim, and spring in spool body and retain with spool plug. (Tighten plug to 5 ft. lbs. torque). Install deep washer, flat washer, spring, second deep washer and retain with snap ring.
8. Oil spools and insert spools in proper bore.
9. Install spool caps and retain with 12 point capscrews.
10. Install system relief valve in valve body.
11. Install lift check plungers, springs and plugs in valve body.
12. Install plugs in body.
13. Run operational check on control valve.

INSTALLATION

1. Replace all "O"rings in hoses and flange adapters with new parts.
2. Installation is accomplished by reversing the removal procedure.



VALVE ASSEMBLY - MAIN

1650

CLARK EQUIPMENT COMPANY

VALVE ASSEMBLY - MAIN

Item	Description	Qty.
A	CONTROL VALVE ASSY (Inc 12 thru 62)	1
B	SEAL KIT (Inc 19,20, 21,23,27,29,50,53, 56 & 62)	1
1	CONTROL ASSY (Inc 1 thru 11 & 63)	1
2	HANDLE	1
3	NUT	4
4	PLATE	1
5	BOLT,Bracket to Cockpit	4
6	BUSHING	1
7	BUSHING	1
8	LINKAGE	1
9	LINKAGE	1
10	HANDLE	1
11	PIN	2
12	SCREW,Machine	4
13	RETAINER	2
14	COTTER	4
15	LINK	2
16	LINK	2
17	PIN	4
18	RELIEF VALVE ASSY (Inc 18,19,20 & 21)	1
19	§O-RING (See 'B')	1
20	§WASHER,Back-Up (See 'B')	1
21	§O-RING (See 'B')	1
22	PLUG ASSY (Inc 23)	2
23	§O-RING (See 'B')	2
24	SPRING	2
25	PLUNGER	2
26	PLUG	2
27	§O-RING (See 'B')	1
28	§SPOOL & BODY ASSY (See 'A')	1
29	§O-RING (See 'B')	1
30	WASHER	1
31	SPRING	1
32	WASHER	1
33	SCREW,Spool	1
34	CAP	1
34A	RETAINER	1
35	BOLT	2
36	§BODY & SPOOL ASSY (See 'A')	1
37	PLUG,Shipping	–
38	WASHER	2
39	SEAL,Dust	2
40	PLUG,Button	1
41	BOLT	2
42	CAP	1
42	BLOCK	1
43	CAP	1
44	RING,Retaining	1
45	WASHER	1
46	SPRING	1
47	BALL	3
48	PLUNGER,Detent	1
49	RETAINER,Detent	1
50	§O-RING (See 'B')	1
51	WASHER,Detent	1
52	SPRING,Detent	1
53	§O-RING,Detent (See 'B')	1
54	PISTON,Detent	1
55	WASHER,Detent	1
56	§O-RING (See 'B')	1
57	SLEEVE	1
58	GUIDE,Detent	1
59	SPRING	1
60	POPPET	1
61	§SPOOL & BODY ASSY (See 'A')	1
62	§O-RING (See 'B')	1
63	GRIP	2

§Not Sold Separately

ELEVATOR HYDRAULIC SYSTEM SERVICE

GENERAL OPERATION

The elevator is powered by a fixed displacement piston motor. This motor is bolted to an adapter on the differential of the elevator axle. The elevator motor is reversible and is powered by hydraulic oil from a variable displacement piston pump, which is mounted on the rear face of the torque converter.

The elevator speed and direction is controlled by the operator via cable linkage that connects the cab control to the control lever on the elevator pump.

ELEVATOR SYSTEM PRESSURES

(See Page 21 of this section for pressure check port location) These readings should be taken at engine high idle.
Charge pressure readings at elevator pump:

180 - 220 PSI - Warm oil, pump in neutral
240 - 270 PSI - Cold oil, pump in neutral
150 - 190 PSI - Pump in stroke

Charge pressure readings at elevator motor:

150 - 190 PSI - Pump in stroke
Less than 20 PSI- Pump in neutral

NOTE: The charge relief valve on the side of the charge pump should be set from 190 to 210 PSI. The charge relief valve on the motor relief valve should be set from 160 to 180 PSI.

High pressure circuit readings at motor manifold, forward and reverse:

5,100 to 5,300 PSI - Cracking pressure at low pump flow
5,600 to 6,000 PSI - Pressure at full pump flow, going over relief

NOTE: See Pages 22 and 22A of this section for proper procedure for chaining down elevator to check these pressures. The elevator motor should not be run over relief for over a ten-second period, to prevent heating of the hydraulic oil.

EXPLANATION OF SCHEMATIC

Charge Pump Circuit

Oil flows from the reservoir through a filter to the inlet of the charge pump mounted on the main pump, which is driven at pump shaft speed. The purpose of the charge pump is to provide a flow of oil through the motor and pump for cooling purposes, to supply oil under pressure to maintain a positive pressure on the low pressure side of the main pump/motor circuit, to provide sufficient oil under pressure for control purposes, and for internal leakage makeup.

SECTION 20E
Page 1A

EXPLANATION OF SCHEMATIC (Continued)

Main Pump and Motor Circuit

Oil from the charge pump is directed to the low pressure side of the main circuit by means of one of two check valves. The second check valve is held closed by the oil under high pressure on the other side of the main circuit.

Oil flows in the main circuit in a continuous closed loop. The quantity of oil flow is determined by pump speed and displacement while direction of flow is determined by the swashplate angle from neutral.

A manifold valve assembly, connected across the main circuit, includes elements essential to provide the proper operation of the pump and motor. The manifold valve contains two pilot operated high pressure relief valves which serve to prevent sustained abnormal pressure surges in either of the two main hydraulic lines by dumping oil from the high pressure line to the low pressure line during pressure surges due to sudden changes in the load on the elevator.

Also provided in the manifold valve assembly is a shuttle valve and a charge pressure relief valve. The shuttle valve functions to establish a circuit between the main line that is at low pressure, and the charge pressure relief valve to provide a method of controlling the charge pressure level and also a means of removing the excess cooling oil added to the circuit by the charge pump. The shuttle valve is spring centered to a closed position so that during the transition of the reversing of pressures in the main lines, none of the high pressure oil is lost from the circuit.

Cooling Circuit

Excess cooling oil from the manifold charge pressure relief valve enters the motor case, then flows through case drain lines to the pump case. In this way the charge pump cooling oil is circulated through each of the hydraulic element in series to aid in cooling. The cooling oil then exits from the pump case, and is returned to the reservoir. During periods of operation when the main pump is in neutral, the shuttle valve will be closed and the excess from the charge pump is directed to the cooling circuit by the neutral charge relief valve in the charge pump. When operating at this condition, cooling flow is not admitted to the motor because it is at rest.

Controls

Control of speed and direction is accomplished by the movement of a single control lever from a neutral position. The pump swashplate is spring loaded to neutral position to insure positive neutral. The swashplate is provided with two opposed single acting Servo cylinders to move the swashplate and thus vary pump displacement. Pressurizing one of the cylinders while exhausting the other will move the swashplate from its neutral position. To obtain the reverse direction from neutral, the opposite cylinder is pressurized and the other is exhausted. Oil is directed to the desired Servo cylinder by the control valve which is activated by a signal from the operator through the control lever or from the swashplate and its feedback linkage system. If the circuit pressures tend to overcome the swashplate-Servo piston preset position, the feedback linkage connecting the swashplate to the control valve will activate the control valve and supply adequate pressure to the Servo piston and maintain the swashplate in its

EXPLANATION OF SCHEMATIC (Continued)

Controls (Continued)

position determined by the operator. The control valve is spring centered and contains sufficient underlap to open both Servo cylinders to drain when the control lever is in neutral. This permits the Servo cylinder centering springs to move the swashplate to the zero stroke position, insuring a positive neutral.

ELEVATOR CONTROL ADJUSTMENT

The operator controls the elevator speed and direction by moving the elevator cab control. This cab control is connected to the elevator pump control lever with a cable.

The control linkage should be adjusted so the control lever on the elevator pump is stroked full in the forward direction when the handle in the cockpit is moved full forward. This may be checked by marking a drag, running the elevator forward at maximum speed no load, operating the engine at 2100 rpm, and counting the revolutions of the elevator chain. Under these conditions the elevator speed should be at least 13 chain revolutions per minute. When loading, the maximum elevator speed should be approximately 276 fpm or 11-3/4 chain revolutions per minute at 2100 engine rpm.

If the elevator control cable is out of adjustment or has been replaced or disconnected and the clevis replaced on either end, the control lever must be adjusted as follows to center neutral on the pump control lever.

1. Disconnect cable clevis at pump lever by removing pin. Pump lever is spring returned to neutral.

2. Move cab control to neutral. When lever moves into neutral, a snap should be felt as a steel ball centers over the hole in the center of control lever.

3. Back off jam nut on clevis at pump end of cable and adjust clevis until hole in clevis end lines up with hole in pump lever.

4. Slip clevis end on pump lever and reinstall clevis pin and cotter pin.

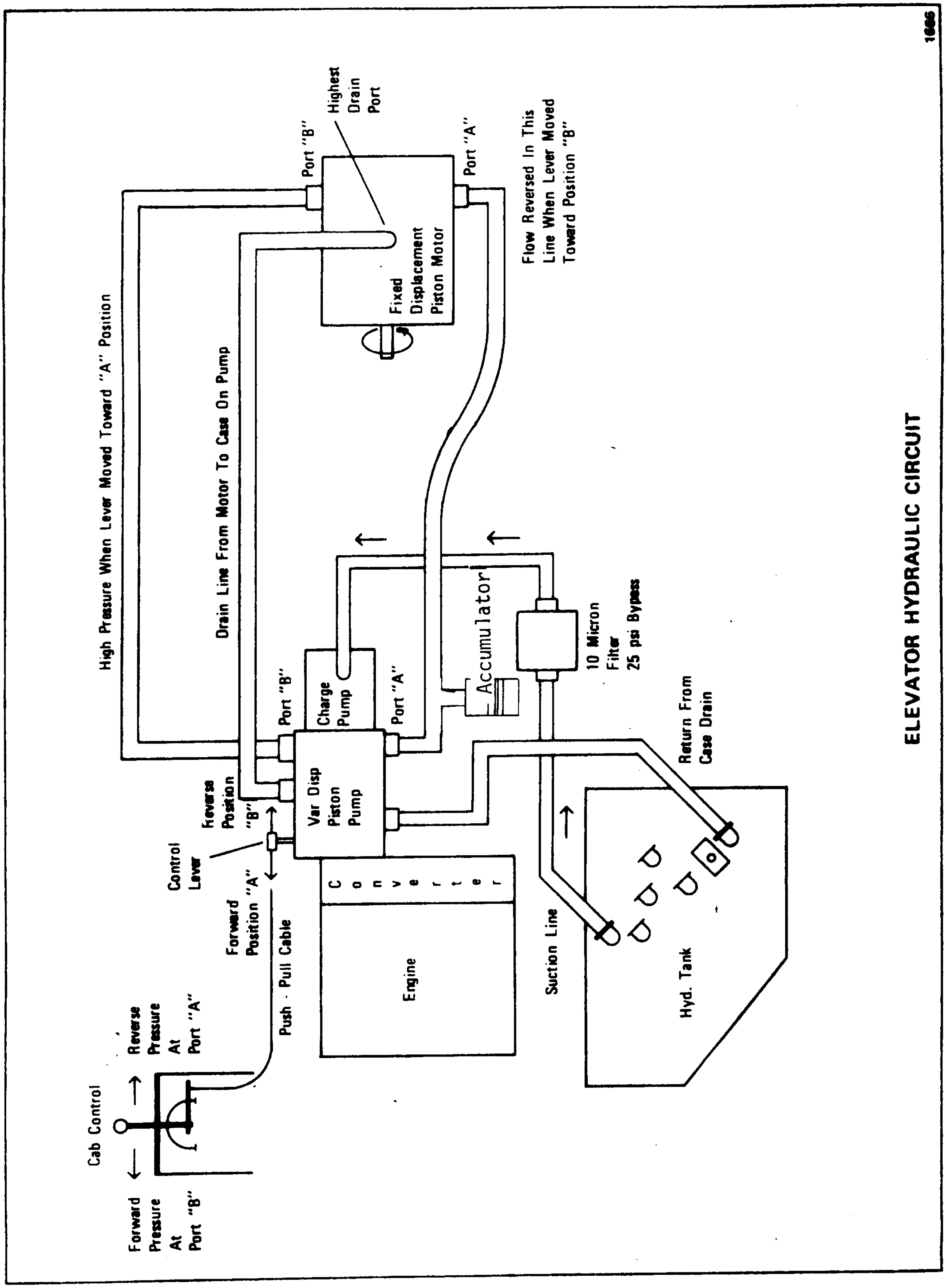
5. Start engine and move elevator control lever forward or in reverse and back to neutral. If elevator continues to run, shut down engine and see Section III under "Elevator System Trouble Shooting Procedure."

6. If all threads on pump end of cable shaft have been used up and further adjustment is needed, remove lever knob from control lever.

7. Remove screws from console plate and slip plate off over control lever.

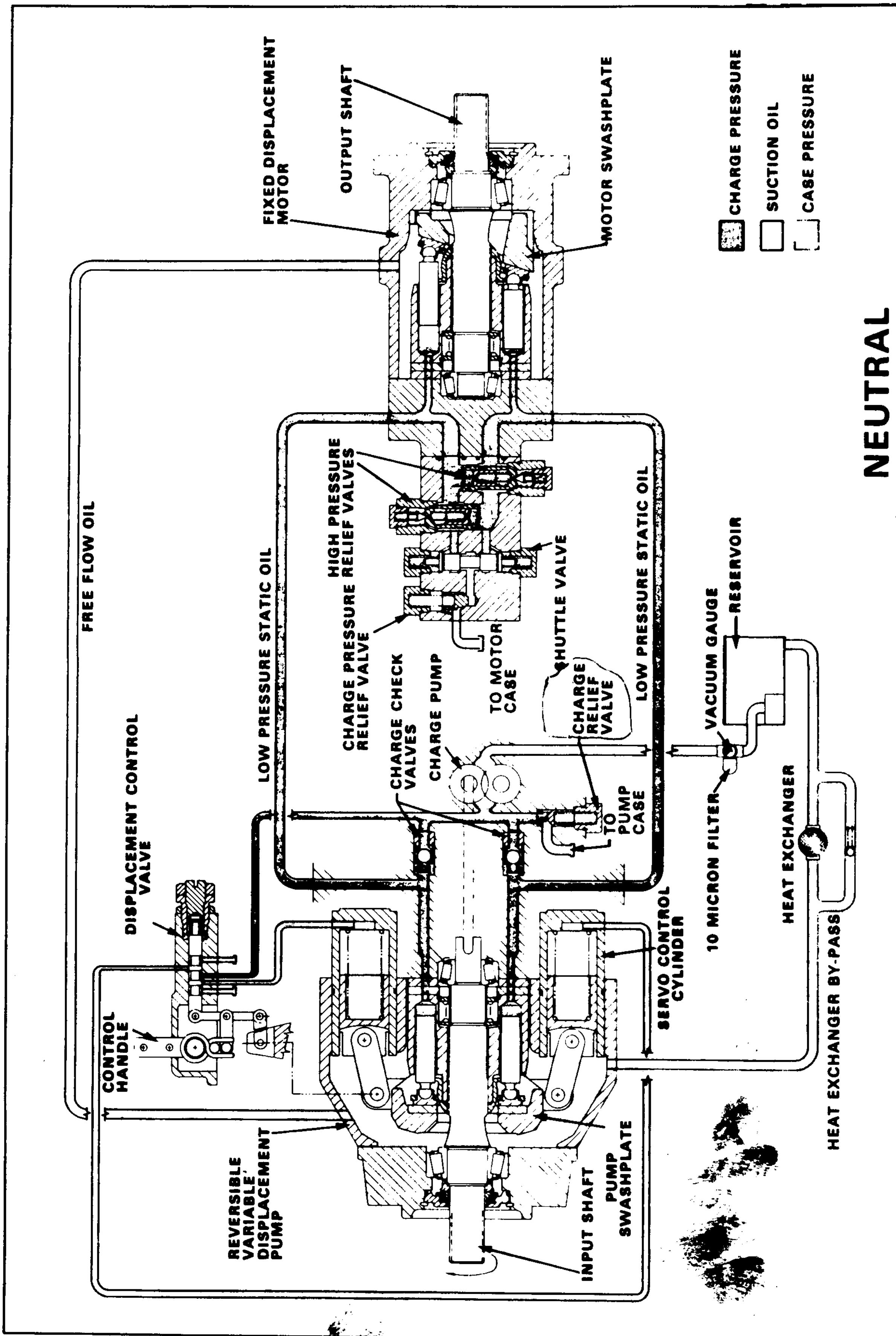
8. Remove pin from clevis and adjust until hole in clevis lines up with hole in output lever on control.

9. Install clevis pin and key and reinstall console plate and control lever knob.

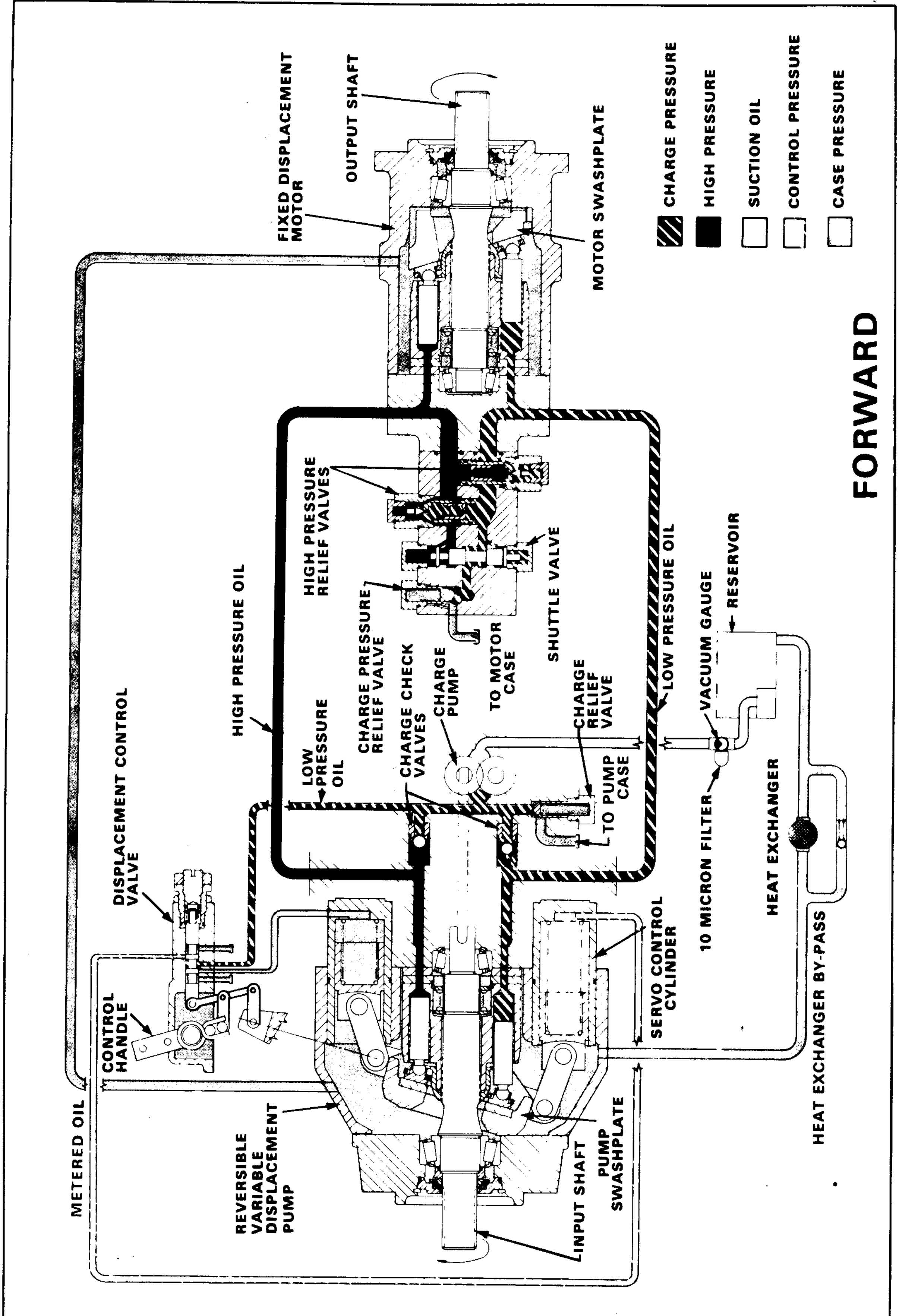


ELEVATOR HYDRAULIC CIRCUIT

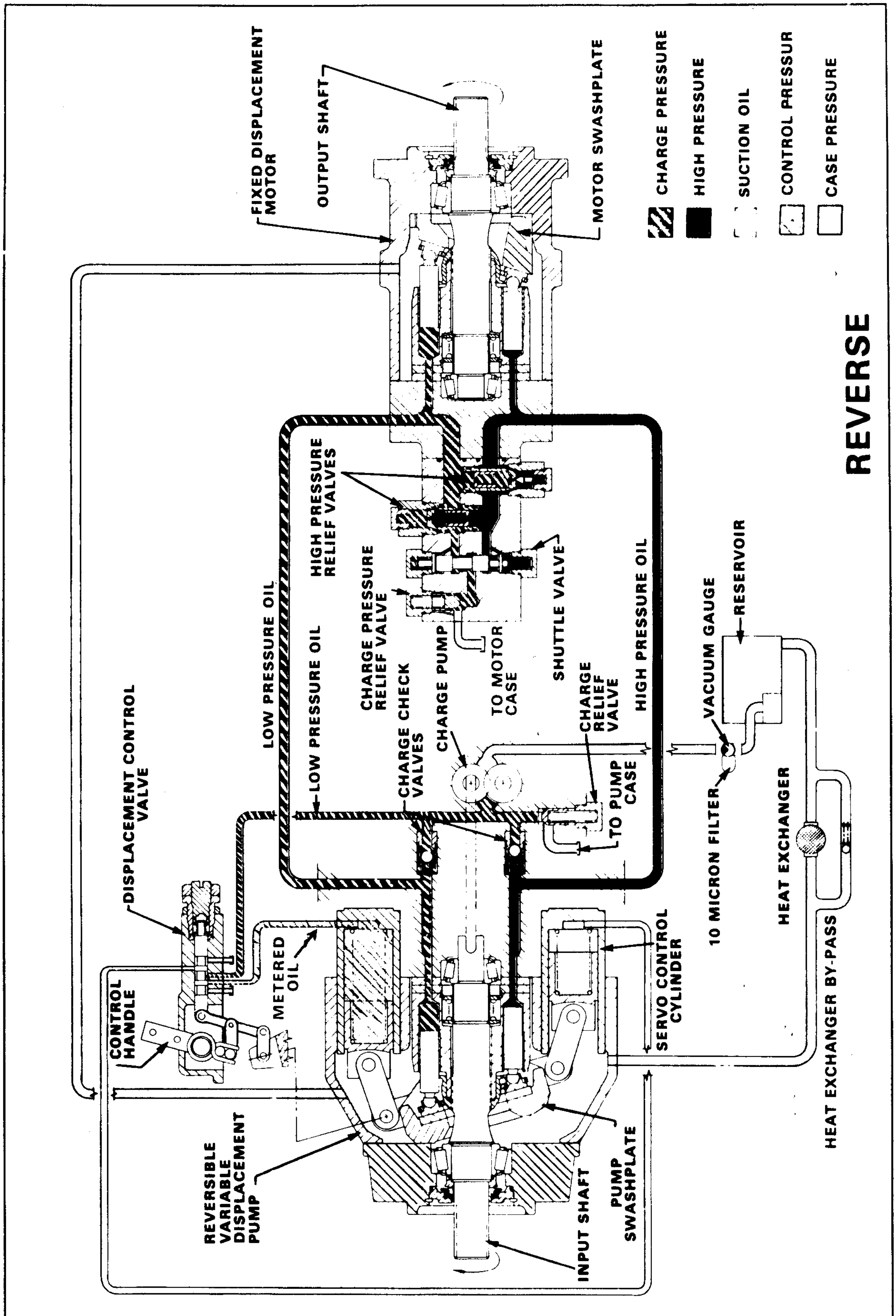
TYPICAL HEAVY DUTY VARIABLE PUMP—FIXED MOTOR TRANSMISSION SCHEMATIC



TYPICAL HEAVY DUTY VARIABLE PUMP—FIXED MOTOR TRANSMISSION SCHEMATIC



TYPICAL HEAVY DUTY VARIABLE PUMP—FIXED MOTOR TRANSMISSION SCHEMATIC



HYDRAULIC FILTER SERVICE

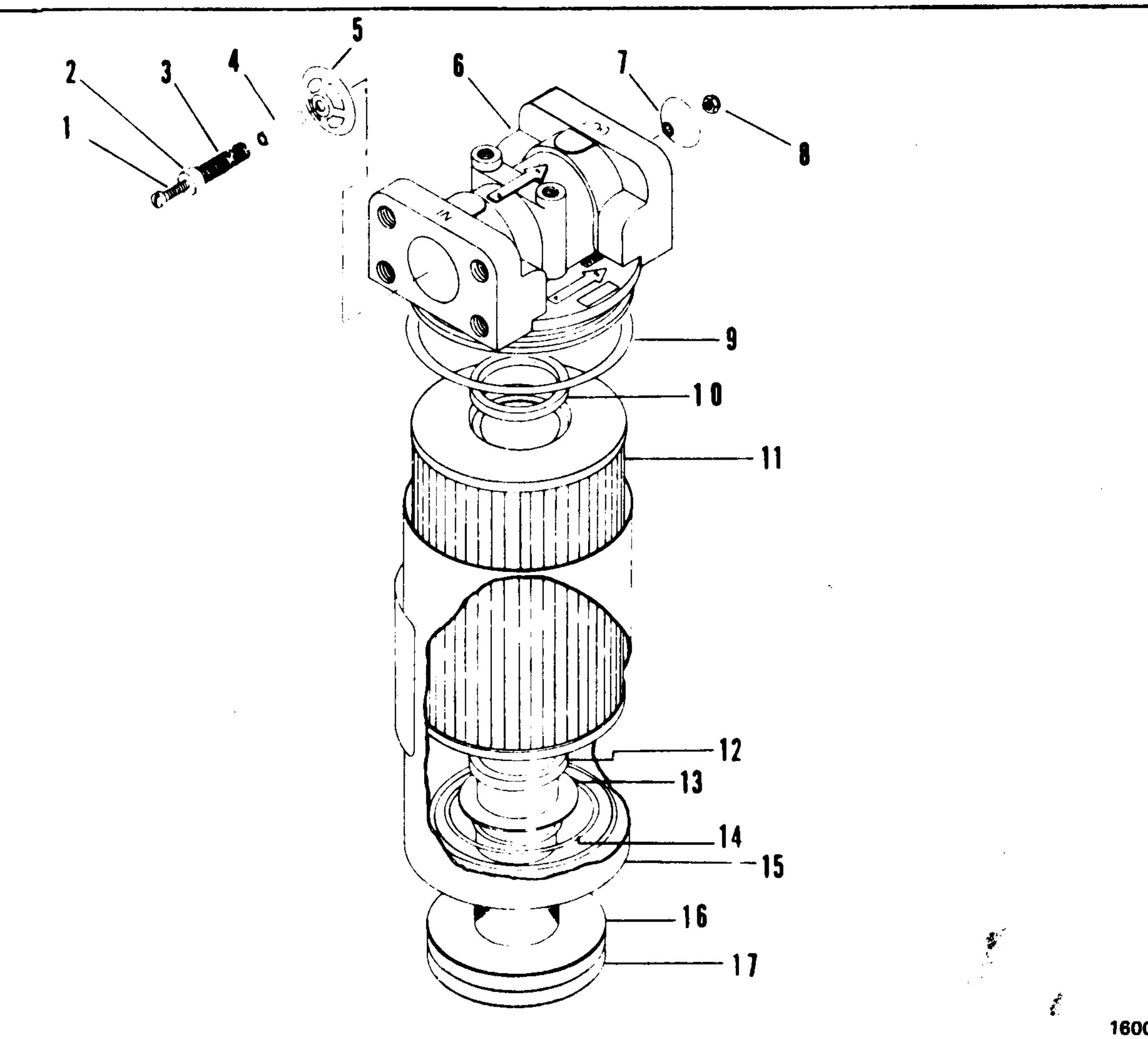
The hydraulic filter for the elevator system is in the suction line for the elevator charge pump. This is a full flow 10 micron filter. The charge pump can not draw enough vacuum in the suction line to open the 25 PSI bypass, even if the filter element is completely clogged. 100% of the hydraulic oil is filtered before it enters the closed loop elevator circuit. When the element starts becoming plugged it will reduce the charge pressure and will not allow the pump to reach full stroke at maximum pressure. If the filter element becomes completely plugged then the elevator will not operate. The element in this filter should be changed after the first 50 hours of operation on a new unit, and every 250 hours after that.

If the element requires changing more frequently, the hydraulic oil should be examined for water content or other contamination. If excessive contamination is found, then the entire hydraulic system should be flushed out and new hydraulic oil added.

NOTE: The unit should never be operated without an intact 10 micron filter element in the elevator suction filter.

Replacing Filter Element

A filter element kit is available that includes the element and all necessary seals and gaskets. When replacing element kit in the filter be sure to clean housing. When tightening center post, hold housing from turning, otherwise "o" ring (Key 9) may stretch out of shape, causing leakage. Tighten center post to a maximum of 20 ft/lbs.



FILTER ASSEMBLY - HYDRAULIC

Item	Description	Qty.
A	FILTER ASSY (Inc 1 thru 17)	1
B	ELEMENT KIT (Inc 9, 10, 11, 12, 16)	1
C	HEAD ASSY (Inc 1 thru 8)	1
1	§SCREW, By-Pass (See 'C')	1
2	§CAP, Stem By-Pass (See 'C')	1
3	§SPRING, By-Pass (See 'C')	1
4	§SPACER, By-Pass (See 'C')	1
5	§GUIDE, By-Pass (See 'C')	1
6	§HEAD (See 'C')	1
7	VALVE, By-Pass (See 'C')	1
8	LOCKNUT, By-Pass (See 'C')	1
9	"O" RING, Seal Housing (See 'B')..	1
10	SEAL, Rubber (See 'B')	1
11	ELEMENT (See 'B')	1
12	SEAL, Rubber (See 'B')	1
13	WASHER, Back-Up	1
14	SPRING, Conical	1
15	HOUSING	1
16	GASKET, Center Post Seal	1
17	POST, Center	1

§ Not Sold Separately

ELEVATOR SYSTEM

TROUBLE SHOOTING PROCEDURE

1. System* Will Not Operate in Either Direction

Cause	Remedy
A. System Low on Oil	1. Check oil level in reservoir and replenish if necessary. Use only approved oils. Consult the Owner's Manual.
	2. Locate and fix leaks causing the loss of oil.
B. Faulty Control Linkage to Pump	1. Check the entire linkage, from control lever to pump arm, to make sure it is connected and free to operate as it should. Adjust linkage to pump arm. Do Not move pump arm to meet linkage.
C. Disconnected Coupling	1. Check to see that the coupling from the engine to the pump shaft and the coupling from the motor shaft to the driven mechanism is not slipping or broken.
D. Low or Zero Charge Pressure	1. Install pressure gage (capable of 600 PSI) in either the charge pump or in the side of the main pump.

* The word "system" denotes both pump and motor plus all lines, valves, filters, controls, etc., leading to and in between them.

Low or Zero Charge Pressure - Continued

NOTE: Charge pressure may also be taken by attaching a pressure gage to the port on the rear of the motor manifold. This port, however, is blocked by the Shuttle Valve when the hydrostatic system is in neutral; therefore, the system must be operating in the forward or reverse direction to obtain a pressure reading at this port. Operating pressure may also be taken at the manifold.

2. Set pump speed to at least 500 RPM. Charge pressure should read at least 120 PSI or more when the main pump is pumping and the motor is operating. If the pressure is lower than 100 PSI, stop machine, locate and repair cause of low charge pressure.

3. Low charge pressure may be caused by:

   a. Charge pressure relief valve in charge pump or motor manifold damaged or stuck open.

   b. Filter or suction line from reservoir to charge pump clogged.

   c. Charge pump drive shaft sheared.

   d. Internal damage to pump or motor

   e. Cold or low oil supply.

E. Low and Fluctuating Charge Pressure

1. Air in system. Air will also cause system to be noisy. Check all fittings, especially around filter, in the suction line and locate the point or points where air is being drawn into the system. Tighten fittings and joints where air leaks exist.

2. Charge pressure relief valve in the motor manifold stuck open. Pressure will be normal when the pump is in neutral but low when in stroke.

3. Internal damage to pump or motor.

F. Faulty Check Valves

1. Remove the two check valves located in the end cap of the pump under the charge pump and check the following:

   a. Check valve to see if poppet or ball is missing.

   b. Check to see if the valve seat is eroded.

NOTE: If any of the above conditions exist, replace both check valves.

G. Faulty High Pressure Relief Valve

1. Switch the two high pressure relief valves. If the system operates in the direction in which it would not operate before, one of the high pressure relief valves is inoperative. Both relief valves should be examined and the damaged relief valve replaced. Reinstall both relief valves and retest system.

H. Internal Damage To Pump or Motor

Indicated by:

1. Low or zero charge pressure. (See 1-E). Charge pressure may also fluctuate rapidly.

2. Maximun obtainable operating pressure in both forward and reverse is less than the normal relief valve setting. Charge pressure, which will also be lower than normal, may drop to zero when the maximun pressure is reached.

3. Pieces or flakes of brass in the reservoir and filter.

4. Noisy unit (pump or motor).

NOTE: If either unit is considerably worn or damaged, the other unit should also be carefully checked or cleaned.

2. System Operates in One Direction Only.

Cause	Remedy
A. Faulty Control Linkage	1. Check the entire linkage to make sure it is connected and free to operate as it should. Adjust linkage to the pump arm. Do Not move pump arm to linkage. 2. Make sure the control "stop," if used, is not out of adjustment.

B. Faulty High Pressure Relief Valve

1. Switch the two high pressure relief valves. If the system operates in the direction in which it would not operate before, one of the high pressure relief valves is inoperative. Both relief valves should be examined and the damaged relief valve replaced. Reinstall both relief valves and retest system.

C. One Check Valve Faulty

Follow instructions given in 1-F.

D. Faulty Displacement Control Valve (Located on Variable Displacement Units)

NOTE: Do Not change the position of any of the hex nuts or the slotted plug on the end of the control unless it is necessary to remove the control valve spool.

1. Disconnect control linkage at directional control arm. Move the control arm back and forth by hand. If it moves freely with no resistance, the control valve should be removed and checked for broken parts or a bent control shaft.

III. Neutral Difficult or Impossible to Find

Cause	Remedy
A. Faulty Linkage	1. Disconnect control linkage at directional control arm. If system now returns to enutral, the linkage to the control is out of adjustment or binding in some way.
B. Control Valve Out of Adjustment	1. See II-D NOTE.

2. If the hex nuts and slotted plug have been moved out of adjustment, the following steps must be taken.

   a. Disconnect control linkage at the control arm.

   b. Remove the two plugs on the rounded part of the control housing.

   c. Loosen the smaller of the two jam nuts and back the slotted plug off two turns (counter-clockwise).

   d. Turn the slotted plug in (clockwise) until you feel it make contact with the spring seat on the control spool. It should just barely contact the spring seat.

   e. Hold the slotted plug with a large screwdriver to prevent it from moving and tighten the small jam nut.

   f. Loosen the larger of the two jam nuts.

   g. Turn the hex behind this jam nut in or out until by looking into the two body ports, the lands on the control spool appear to be symmetrically located in each hole.

   h. Replace plugs and start system. If system creeps in either direction, turn hex behind large jam nut in or out until neutral is found.

   i. Hold hex to prevent it from moving and tighten large jam nut.

j. Reconnect control linkage.

C. Servo Cylinder Out of Adjustment

1. Remove the two sleeve retainers.
2. Return the servo cylinders to their original position. When the proper position of the servo cylinders was established at the factory, both the servo cylinder and the pump housing were marked with corresponding scribed lines. Matching these lines will return the cylinder or cylinders to their original position and re-establish neutral.
3. Re-install the two sleeve retainers and restake, if necessary.

NOTE: Servo cylinders do not move out of position on their own. If they get out of adjustment it has to be done by human hands.

IV. System Operating Hot (Reservoir Temperature Above 180°)

Cause	Remedy
A. Oil Level Low	1. Replenish oil supply.
D. Clogged Filter or Suction Line	1. Replace filter. Clean or replace suction line. Check for collapsed suction line.
E. Internal Leakage (Usually accompanied by loss of acceleration and power)	1. One of the high pressure relief valves may be stuck partially open. Install gages and read the charge pressure and operating pressure in both directions.

If the operating pressure is 200 psi or more, lower than normal in one direction and normal in the other, switch the high pressure relief valves. If the low pressure also switches to the opposite side of the circuit, disassemble, check, and clean the faulty (low) relief valve. Reinstall and recheck. Charge pressure should be normal at all times.

2. Internal parts of pump or motor (or both) worn. Maximum obtainable operating pressure lower than the normal high pressure relief valve setting in <u>both</u> directions. When this pressure is reached, charge pressure may drop to or very near to zero. System will also be noisy at this point with the most noise issuing from the unit that is most worn. If either unit is considerably worn or damaged the other unit should also be carefully checked. Replace the worn parts in the units affected or replace the complete unit.

V. System Noisy

<u>Cause</u>

A. Air in System

1. Low oil level in reservoir.

2. Suction line between reservoir and charge pump, including suction filter, leaking at some point and allowing air to be drawn into system. A good indication of air in the system is a considerable amount of foam in the reservoir.

	3. End of return line within the reservoir not submerged in oil.
B. Hose or Tubing Not Properly Insulated	1. Make sure hose or tubing is not touching any metal that can act as a sounding board for natural hydraulic hum.
	2. Insulate hose and tubing clamps with rubber to absorb noise.

VI. Acceleration and Deceleration Sluggish

Cause	Remedy
A. Air is System	1. See Step V-A.
B. Low Charge Pressure	1. See Step 1-D.
C. Control Orifice Plug Partially Blocked	1. Remove the bolts that hold the control housing in place and check the orifice. If this is clean, remove the charge pump and blow clean air through the passage between the charge pump and control.
D. Internal Wear or Damage	1. See Step I-H.
E. Engine Lugs Down	1. Consult vehicle engine manual.

HEAVY DUTY TRANSMISSION START-UP PROCEDURE

Before installing a transmission on a machine, inspect the transmission for damage in shipping or handling. All tools, pans, cans, plugs, etc., must be clean prior to use on the system. Never use drained oil.

(1) After the units have been installed, remove the threaded plug in the charge pressure port from the side of the main pump housing (See Figure 1). Install a 600 PSI gauge with a short section of hose to this port. The threaded plug may be either 1/8 NPT or 7/16-20 straight thread.

(2) Check all fittings to be sure they are tight.

(3) Loosen the charge pump line at the inlet to the charge pump (See Figure 1).

(4) Fill the pump case through the case drain opening with an approved oil (See last page for oils).

(5) Fill the reservoir with an approved oil. When oil appears at the loosened hose at the charge pump inlet, tighten the hose and continue filling the reservoir. Leave reservoir cap loose so air will escape.

NOTE: If gravity feed does not fill the line to the charge pump, it must be filled by hand.

(6) <u>The pump must be in neutral</u>. It is recommended that the control linkage be left disconnected until after initial start-up.

(7) With the coil wire removed or the rack closed, turn the engine over for fifteen seconds.

(8) Start the engine <u>maintaining as low an idle as possible</u> for five minutes. During start-up, pressure surges will be seen on the 600 PSI gauge. While running at low idle, charge pressure must be above 100 PSI. If it is not, shut down and trouble shoot -

(9) Increase engine speed to approximately 1000 RPM. Charge pressure on the 600 PSI gauge should be 270 - 310 PSI.

(10) Shut down engine and connect linkage to displacement control.

(11) Check fluid level in reservoir and add an approved oil if necessary.

(12) Start engine and run at 1500 to 2000 RPM. Charge pressure should be 270 - 310 PSI.

(13) Move the directional control handle slightly to the forward and reverse position. Charge pressure will drop to 150-190 PSI when pump is in stroke.

(14) Should the charge pressure fall below 100 PSI during the start-up procedure discontinue start-up until trouble has been found.

(15) Shut down engine, remove gauge and replace plug in gauge port. Check reservoir oil level and tighten oil fill cap.

Machine is now ready for operation.

HEAVY DUTY VARIABLE DISPLACEMENT PUMP

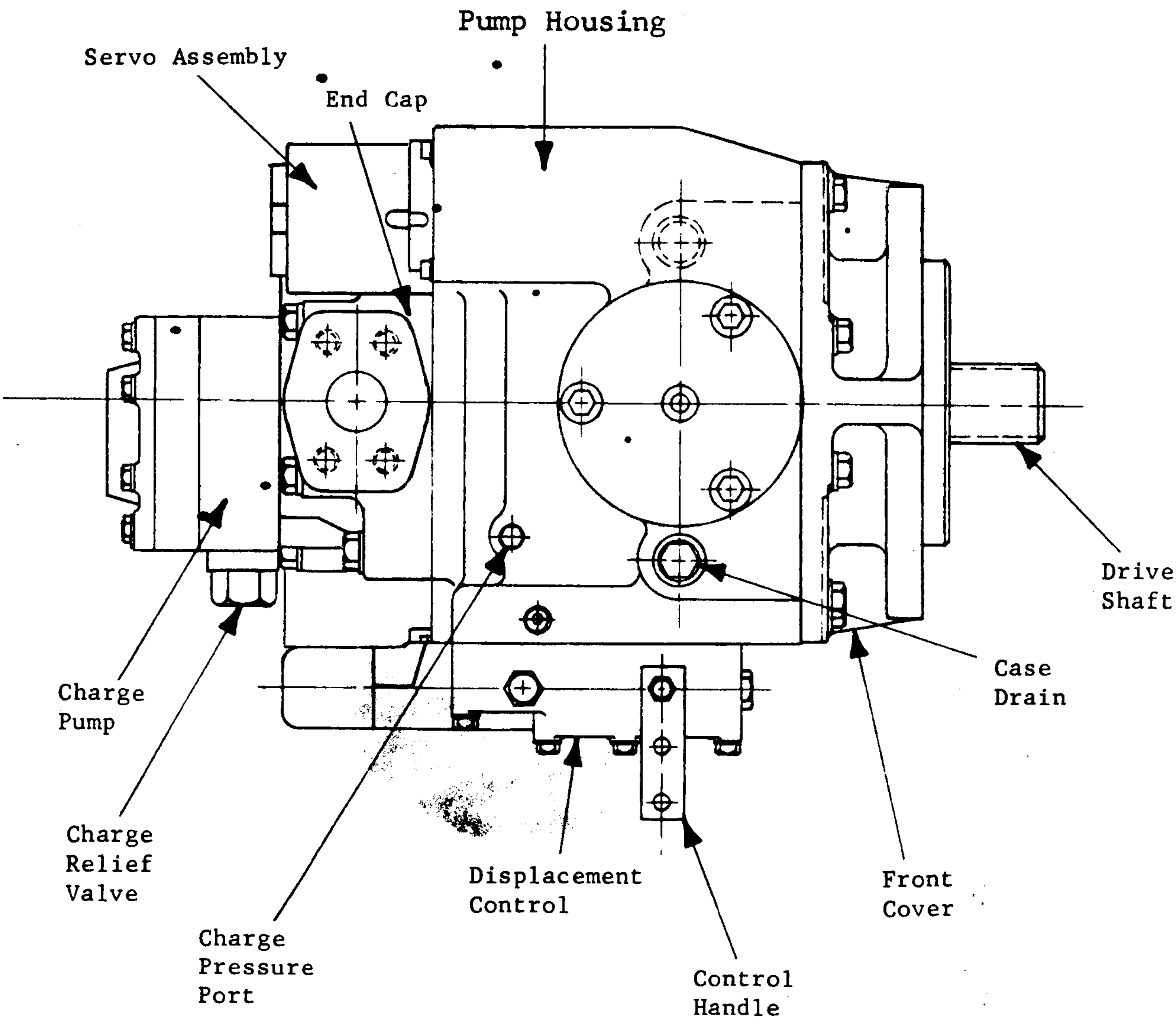


Figure I.

NOTE: **On units that have the accumulator installed, this pump charge pressure should read 290 ± 20 psi above case pressure when the pump is in neutral. The motor charge pressure should read 160 to 180 psi above case pressure when the pump is cammed forward or reverse. All the above measurements should be taken with the engine at high idle.**

ELEVATOR MOTOR

WHERE TO TAKE SYSTEM PRESSURE READINGS

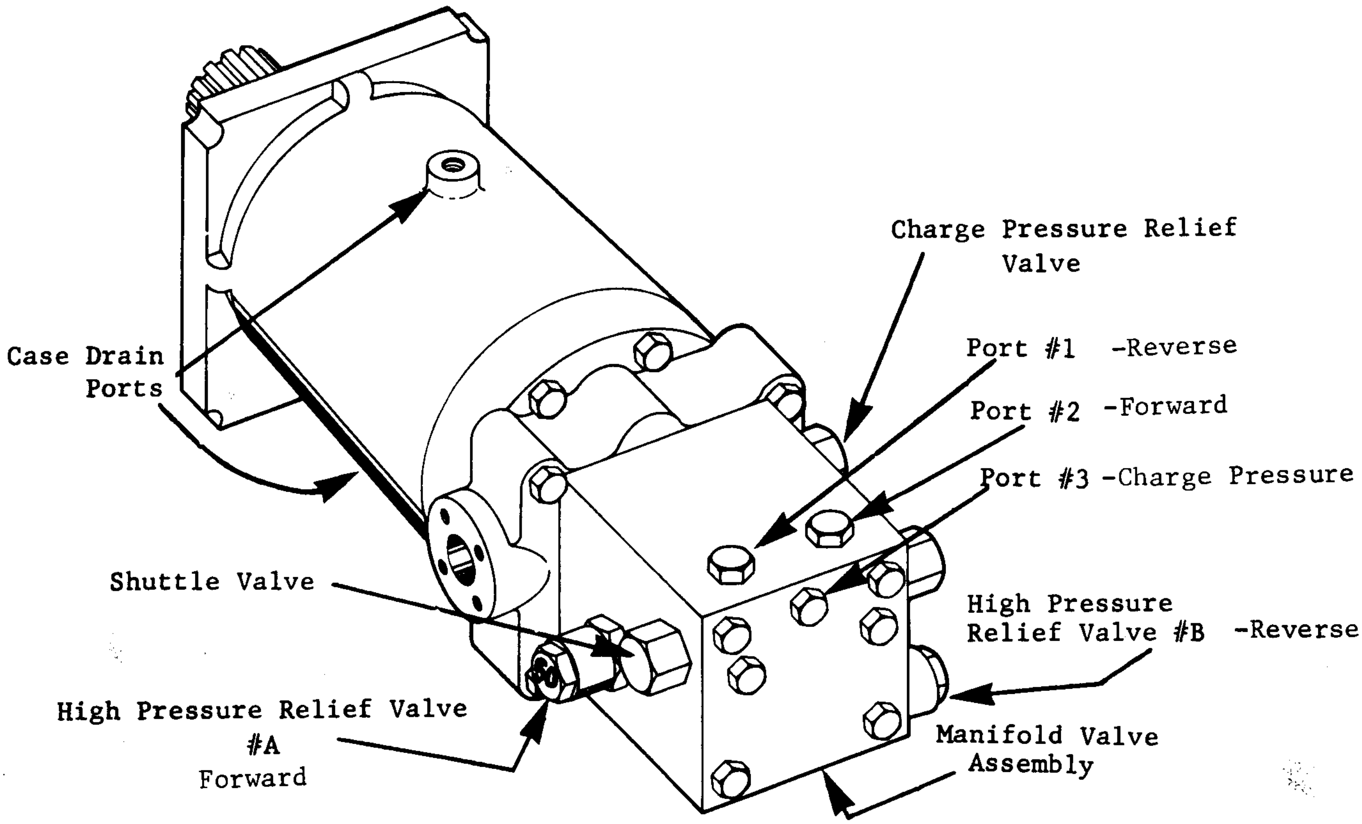


FIGURE 1

System operating pressure can be taken by attaching a high pressure gage (10,000 p.s.i.) to ports #1 and #2. The reading taken at port #1 indicates the pressure monitored by high pressure relief valve "B". The reading taken at port #2 indicates the pressure monitored by high pressure relief valve "A". The relief valves have a two (2) digit number stamped on the exposed end stating valve setting (i.e. "50" = 5000 p.s.i.).

Charge pressure may be read by attaching a gage (600 p.s.i.) to port #3. This port, however, is blocked by the shuttle valve when the system is neutral. The system must be operating in either forward or reverse direction to obtain a reading at this port.

NOTE: Ports #1, 2, and 3 are tapped 7/16-20 straight thread if the manifold assembly is a square steel block, high pressure "O" ring adapters should be used. Older manifold assemblies were cast and were tapped 1/8 N.P.T. High pressure 1/8 pipe thread adapters should be used.

HOW TO TAKE ELEVATOR MOTOR PRESSURE READINGS
(NO PRESSURE OVERRIDE VALVE)

1. Place elevator control lever in NEUTRAL and shut off engine.
2. Place two one-half inch chains fastened around opposing drags, as shown in Figure 2, and located one on each side just clearing the tubing on the inside of the elevator frame. This will allow the elevator to be stalled in either direction without damaging the frame, axle, or drags.
3. Remove motor dust shield.
4. Clean off area around pressure taps indicated in Figure 1 (Page 21) before removing plugs. Relieve pressure in system by removing hydraulic tank cap.
5. Remove plug from port number 2, Figure 1, (Page 21) and install a high pressure gauge and hose of at least 7500 psi capacity. NOTE: Hoses must be long enough to allow the gauges to be slipped under the chain and out to the outside of the scraper frame to allow readings to be taken at a safe distance from the elevator, Repeat on port number 1. Remove plug from port number 3 and attach a gauge of 600 psi capacity to this port.
6. Make sure elevator control lever is in NEUTRAL position. Start engine and hold at low idle.

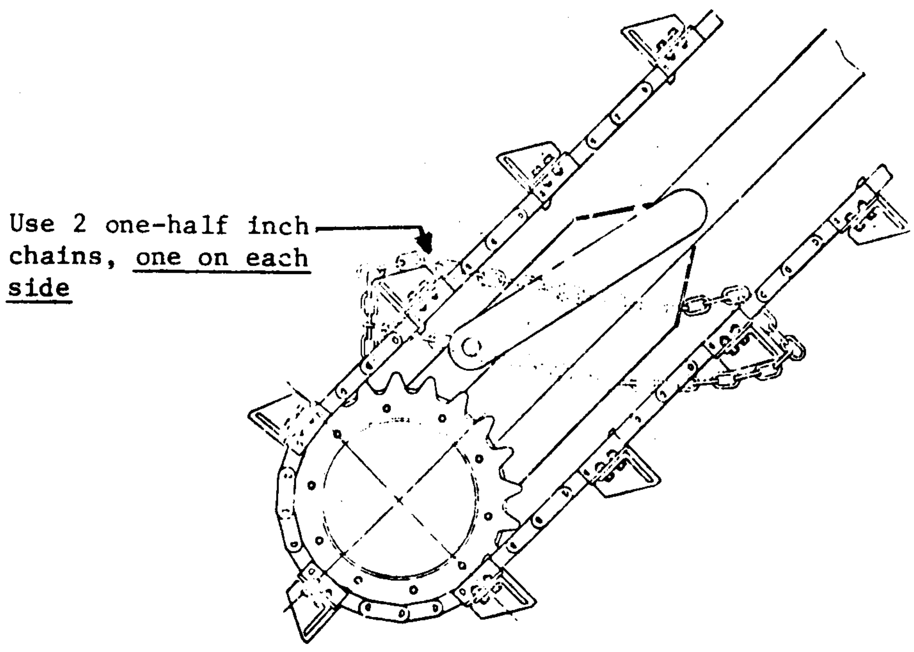


FIGURE 2

7. Engage elevator lever slowly into forward position until slack is removed from chains used to stall elevator.

8. When slack is removed from stalling chains, accelerate engine to maximum obtainable rpm. The gauge in port number 2 should register 5100 to 5300 psi, cracking pressure at low pump flow, and 5600 to 6000 psi, pressure at full pump flow (going over relief). The gauge in port number 1 should show little or no pressure since charge pressure is being monitored here. Gauge should register at about charge pressure i.e. 150 to 190 psi. The gauge in port number 3 is measuring charge pressure. Gauge should register between 150 and 190 psi pressure.

9. Return engine to low idle and place elevator lever in NEUTRAL. Move elevator lever into reverse position slowly and observe as elevator begins to take up slack in the stalling chains. When slack has been removed from the chains, accelerate engine to maximum rpm. The gauge in port number 2 should register low pressure or about 150 to 190 psi. Gauge in port number 1 should register 5100 to 5300 psi, cracking pressure at low pump flow, and 5600 to 6000 psi, pressure at full pump flow (going over relief). Gauge in port number 3 again measures charge pressure at 150 to 190 psi. NOTE: The gauge in port number 3 will register no pressure when the system is in NEUTRAL. Therefore, the system must be in forward or reverse before taking charge pressure readings.

   If reading on gauge in port number 2 is not within specified limits, relief valve "A" is not functioning properly. Refer to Trouble Shooting Guide.

   If reading on gauge in port number 1 is not within specified limits, relief valve "B" is not functioning properly. Refer to Trouble Shooting Guide.

   If charge pressure is not within indicated limits, further troubleshooting of the pump and motor will be necessary.

10. Stop engine, remove gauges, install plug and motor cover, and continue operations if pressure readings are within limits.

CONTENTS

REPLACEMENT OF MAIN PUMP
REPLACEMENT OF MOTOR
REPLACEMENT OF CHARGE PUMP
REPLACEMENT OF CHECK VALVES
REPLACEMENT OF MANIFOLD
REPLACEMENT OF HIGH PRESSURE RELIEF VALVES
REPLACEMENT OF DISPLACEMENT CONTROL
REPLACEMENT OF MOTOR OR PUMP FRONT SEAL

INTRODUCTION

It may become necessary to replace a part of the hydrostatic transmission. The following procedures will assist you. As with all hydraulic equipment, cleanliness is very important. Before removing any of these components, clean the immediate area to prevent dirt from getting into the transmission. While working on the transmission, it would be a good opportunity to inspect all hoses for tightness, change the filter and oil, if necessary, and replace any oil lost during servicing.

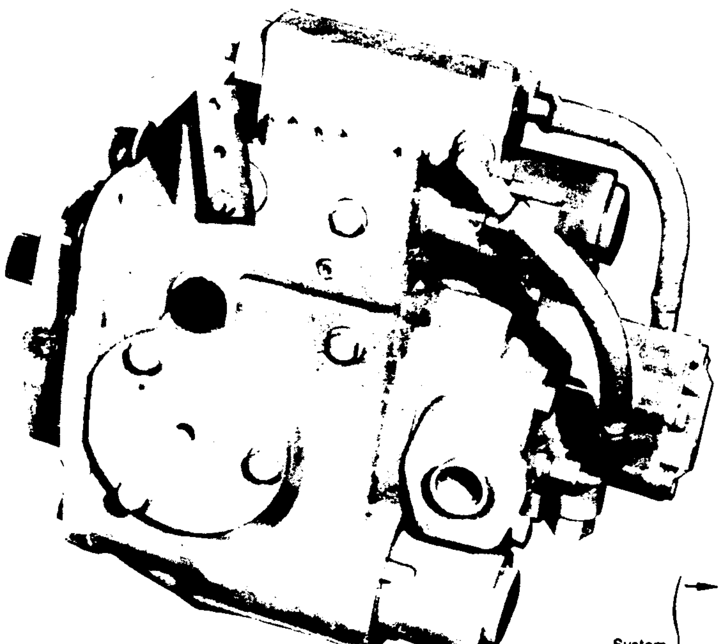
HOW TO TAKE ELEVATOR MOTOR PRESSURE READINGS WITH ELEVATOR PUMP WHICH HAS PRESSURE OVERRIDE VALVE

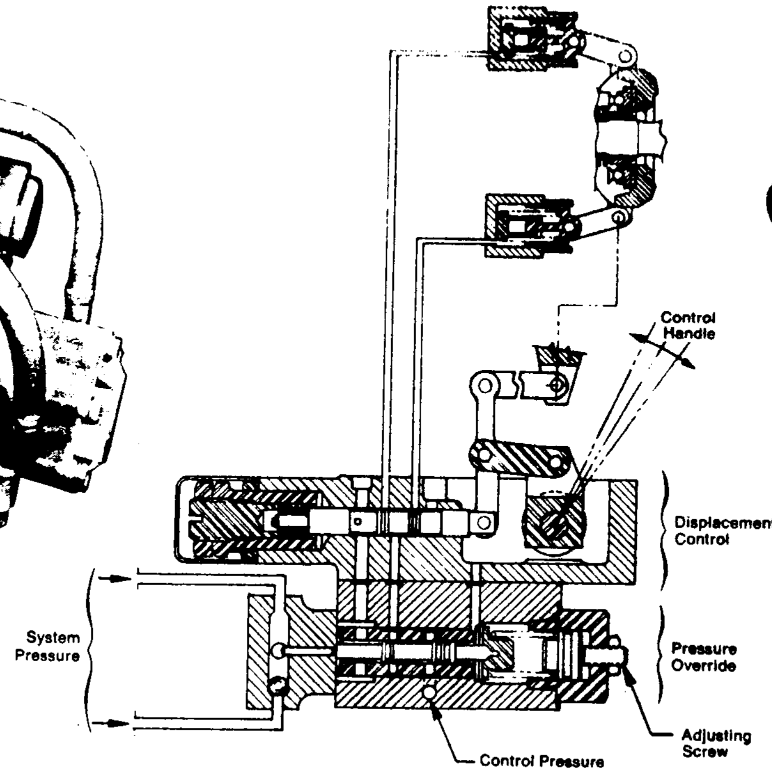
1. Place elevator control lever in NEUTRAL and shut off engine.
2. Place two one-half inch chains fastened around opposing drags, as shown in Figure 2 (Page 22) and located one on each side just clearing the tubing on the inside of the elevator frame. This will allow the elevator to be stalled in either direction without damaging the frame, axle, or drags.
3. Remove motor dust shield.
4. Clean off area around pressure taps indicated in Figure 1 (Page 21) before removing plugs. Relieve pressure in system by removing hydraulic tank cap.
5. Remove plug from port number 2, Figure 1, (page 21) and install a high pressure gauge and hose of at least 7500 psi capacity. NOTE: Hoses must be long enough to allow the gauges to be slipped under the chain out to the outside of the scraper frame to allow readings to be taken at a safe distance from the elevator. Repeat on port number 1. Remove plug from port number 3 and attach a gauge of 600 psi capacity to this port.
6. Make sure elevator control lever is in NEUTRAL position. Start engine and hold at low idle.
7. Engage elevator lever slowly into forward position until slack is removed from chains used to stall elevator.
8. To check the motor high pressure relief valves, turn the pressure override adjustment screw on the pump in two revolutions so the pressure override valve setting will be higher than the motor relief settings. Remove slack from stalling chains, then stroke the pump slowly forward and you should read 6,000 to 6,500 psi cracking pressure on the gauge at <u>1/4 stroke.</u> If this pressure reads low then shims will have to be added to relief valve. If this pressure reads high then shims will have to be removed. When this pressure is set then return the pressure override adjustment screw on the pump to its original position.
9. When slack is removed from stalling chains, accelerate the engine to high free idle, and cam the pump slowly forward. The pressure from port number 2 should read a constant pressure of 5,500 $\pm$ 100 psi at 1/4, 1/2, 3/4, and full pump stroke. If you read this constant pressure then you know the pressure override valve is set correctly. If you do not read this pressure then turn the adjusting screw of the pressure override valve in to raise the pressure and out to lower the pressure.
10. Gauge in port number 3 measures charge pressure at the motor when pump is in stroke. Gauge should register between 150 and 190 psi. (Check for dirty charge pump suction filter if charge pressure is low.)
11. Repeat this procedure for checking the pressure in the reverse elevator direction. Pressure will be read from port number 1 in the reverse direction.
12. If pressures are still not within indicated limits, then further trouble shooting of the pump and motor will be necessary.

HOW TO TAKE ELEVATOR PUMP CHARGE PRESSURE READINGS

1. Charge pressure at the pump can be checked by installing a 600 psi gauge in the "Charge Pressure Port" shown in Figure 1 on Page 20. With the pump in NEUTRAL start the engine and accelerate to high free idle. The gauge should read 270 to 310 psi. When the pump is stroked the pressure gauge should read 150 - 190 psi.

Pressure Override Valve





OPERATING CHARACTERISTICS

Principles of Operation

The Pressure Override Control is a three (3) way normally open valve which operates in series with the Displacement Control Valve. During normal system operation, control pressure is ported thru the Pressure Override Control Valve to the Displacement Control Valve for control of the pump's displacement. If the system demands a pressure above the override setting, the Pressure Override Valve will control the displacement of the pump by reducing the control pressure level to the Displacement Control. During this mode of operation, a ball check senses the pressure from both sides of the high pressure loop and ports the higher pressure into the valve against a signal piston. The signal piston forces the spool against a spring. As the system pressure increases above the override pressure level, the spool moves and compresses the biasing spring. The spool moves until the controlling land on the spool covers the controlling port in the housing and reduces the control pressure to the displacement control. As the control pressure reduces, the internal forces tending to rotate the swashplate overcome the holding force of the servo pistons and allow the pump's displacement to decrease.

The Pressure Override Control Valve modulates the control pressure to the Displacement Control Valve to maintain a pump displacement which will produce a system pressure level equal to the override pressure setting.

The override pressure setting can be adjustable by turning the adjusting screw to vary the preload on the spring. The override pressure setting should be a minimum of 500 p.s.i. below the delief valve setting. The override pressure setting will vary approximately 1000 p.s.i. per each full turn of the adjusting screw.

Pumps not factory machined to accept the Pressure Override Control may be converted or reworked. Contact your local representative or the factory for details.

PRESSURE OVERRIDE CONTROL SYSTEM

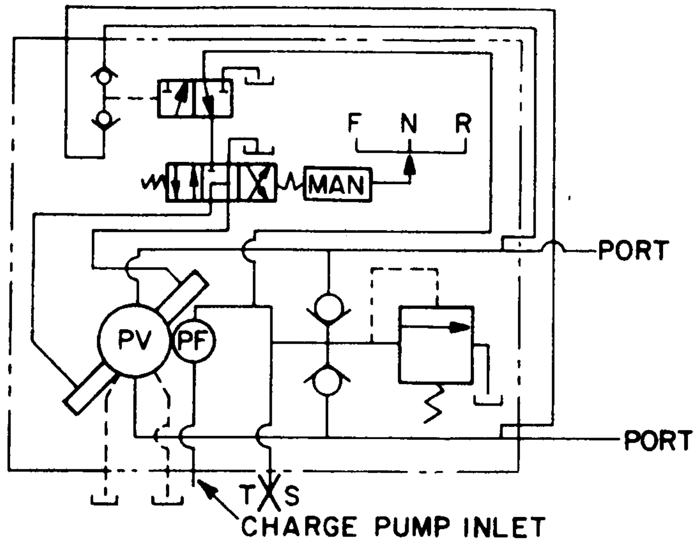
The pressure override control is used in conjunction with Sundstrand heavy duty variable pumps equipped with a displacement control. The pressure override control will override the displacement control at a predetermined system pressure, known as override pressure.

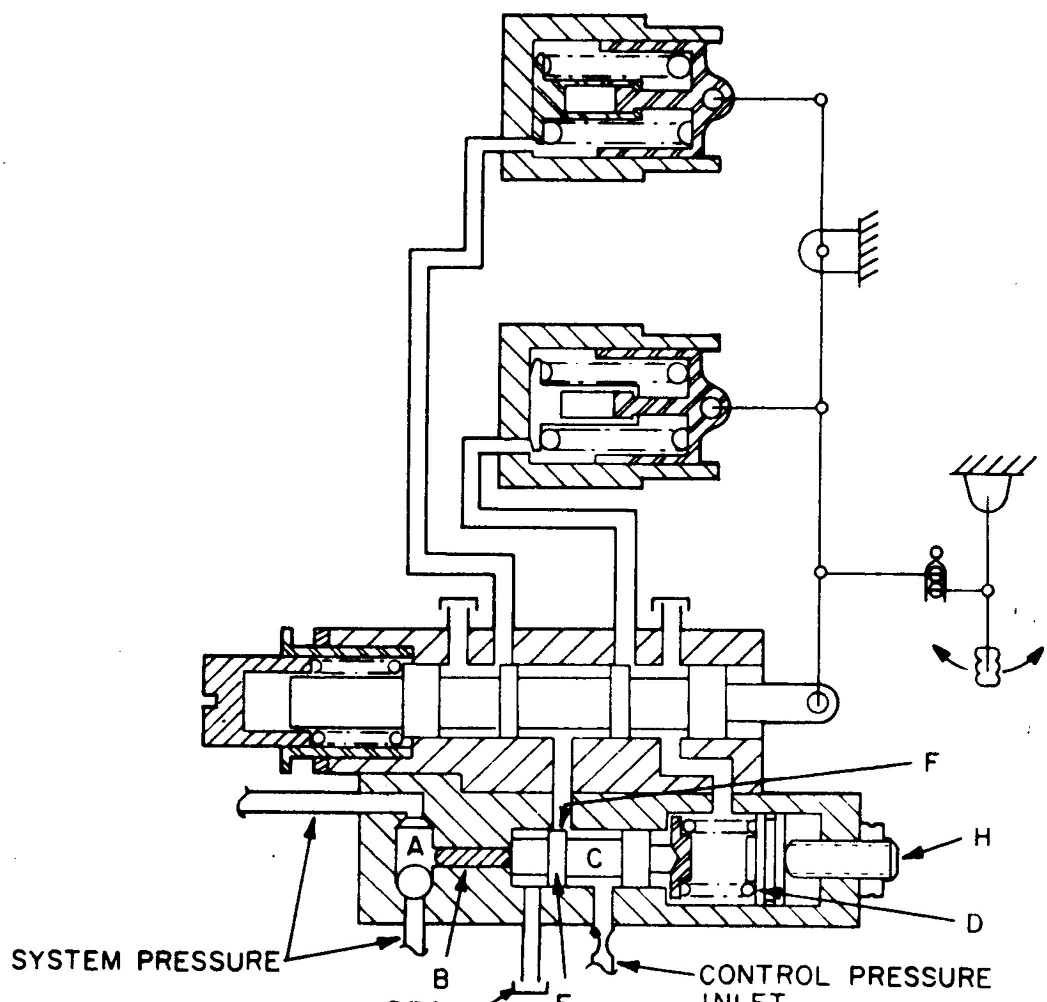
The pressure override control valve assembly is a three-way valve with charge pressure (supply pressure) ported to the displacement control in the normally open position. In the closed position the supply pressure is cut off to the displacement control and the control is allowed to drain to tank.

PRESSURE OVERRIDE CONTROL OPERATION

During normal operation, the transmission system pressure is below the override pressure, and the pressure override valve is in the open position and, therefore, does not affect the displacement of the variable pump. Thus the displacement of the variable pump is controlled by the displacement control during normal operation.

The pressure override control valve will override the displacement control and will control the displacement of the variable pump when the load requires a system pressure above the override pressure. During this mode of operation, a ball check senses the pressure from both sides of the loop and ports the higher pressure into cavity (A) (See following issustration) and against signal position (B). The signal piston (B) forces the controlling spool against a spring (D). As the system pressure increases the spool (C) moves toward the spring (increased force on spring also increases spring deflection) until controlling land (E) on the spool covers the controlling port (F). The override pressure is defined as the system pressure when land (E) covers port (F).





PRESSURE OVERRIDE CONTROL

As the system pressure increases above the override pressure, the spool and land (E) shift further toward the spring and the port (F) is opened to the tank thus draining the pressurizer servo cylinder and allowing displacement of the variable pump to decrease.

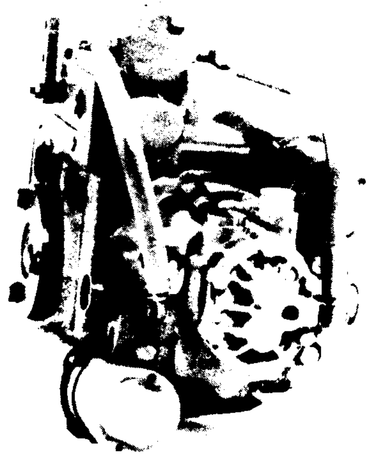
The pressure override will modulate so that a servo pressure is maintained, to maintain a displacement which will yield a system pressure equal to the override pressure.

The override pressure is adjustable by turning the screw (H) and varying the preload on the spring. The override pressure will vary approximately 1,000 psi per full turn of the screw (H).

FEATURES OF THE PRESSURE OVERRIDE

1. The pressure override control prevents continuous operation of the high presure relief valves.
2. Operates in series with the displacement control.
3. Adjustable from 1,000 to 5,500 psi.
4. High pressure relief valves set a minimum of 500 psi higher than the pressure override.
5. Displacement control modulates when system pressure is below the override pressure.
6. Override control modulates when system pressure is equal to the override pressure.
7. The system pressure is used as a feedback signal to the pressure override.
8. At the override pressure (pre-set):
   A. Override spool stops flow to displacement control.
   B. Pump servo piston drained to case through the displacement control and override control.
9. Response time is slow, approximately 1 second maximum flow to no flow - the pressure override must be associated with high pressure relief valves. The response time will vary with pump size, system pressure, swashplate angles, etc.
10. Protects the system from excessive heat by preventing continuous operation of the relief valves.

replacement of pressure override valve and displacement control valve



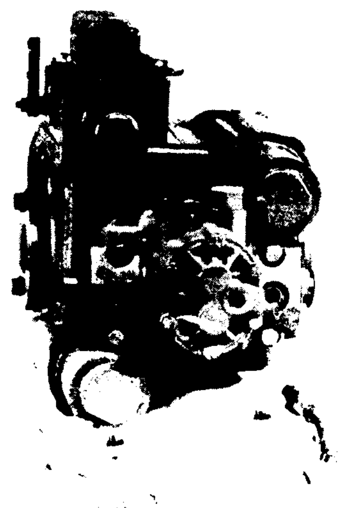


FIG. KK

FIG. LL

FIG. MM

A. REMOVAL

1. Remove control linkage from displacement control valve assembly.

2. Remove the two (2) hoses connected between the pump end cap and pressure override valve. See figure KK .

3. Remove the six (6) bolts holding the P.O.R. valve to the displacement control valve.

4. Remove "O" rings from P.O.R. valve. See figure LL .

5. Remove the remaining three (3) bolts in the displacement control. Lift valve away from housing and remove cotter pin and washer. See figure V and figure MM .
Remove pin from link in pump.

NOTE: *Caution must be exercised to prevent these parts from falling into pump.*

6. Remove orifice and "O" rings from control valve, see figure MM.

B. INSTALLATION

1. Install orifice, tip down and new "O" rings in control valve.

2. Install new gasket on control valve dry.

3. Install pin in control valve links and pump link.

4. Place washer in pin, install new cotter pin and spread.

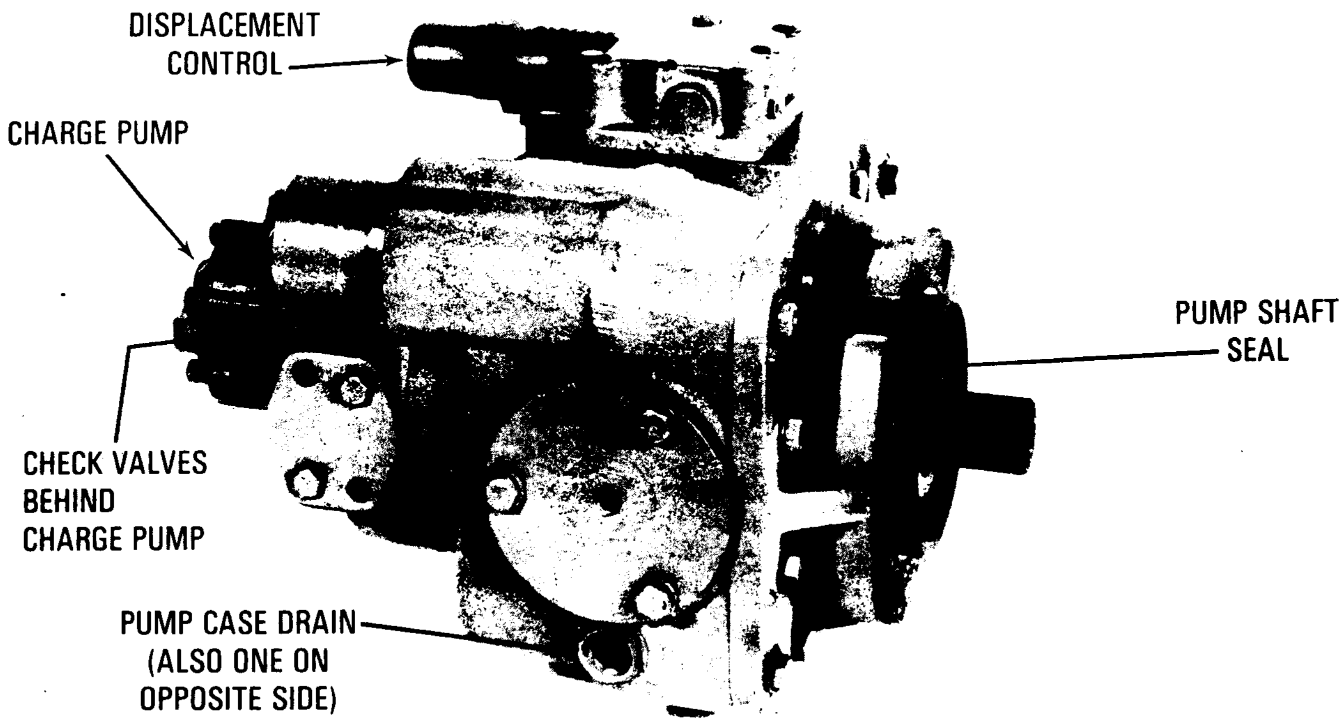
NOTE: *Caution should be exercised during installation of these parts to prevent them from falling into unit. Lightly coating parts with petroleum jelly (not grease) is advised.*

5. Install valves to pump using the three (3) shortest bolts in the back holes. Fig. LL .

6. Install new "O" rings in P.O.R. valve.

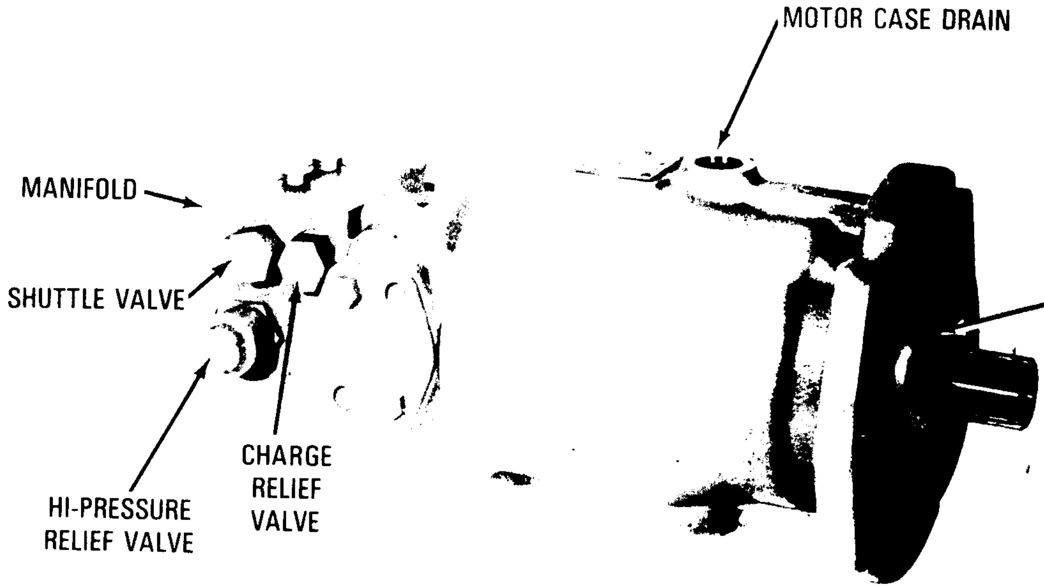
7. Install P.O.R. to displacement control valve with remaining six (6) bolts and torque all nine (9) bolts to 10-11 foot pounds.

8. Install two (2) pressure override hoses to the valve and pump end cap.



VARIABLE DISPLACEMENT PUMP

FIG. A



FIXED DISPLACEMENT MOTOR

FIG. B

replacement of main pump

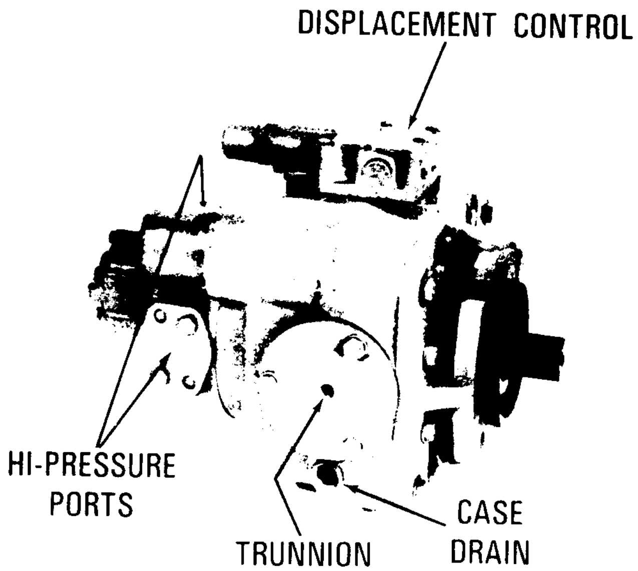


FIG. C

A. REMOVAL (See Figure C)

1. Remove control linkage from Displacement Control.

2. Loosen reservoir cap to relieve any system pressure.

3. Place drain pan or bucket under the pump.

4. Remove the five (5) hoses. Place clean plastic plugs in lines and pump ports to prevent oil loss as each line is removed. (Do not use rags).

5. Remove the four (4) mounting bolts.

6. Place a sling around pump or an eye bolt in the trunnion, remove pump from application.

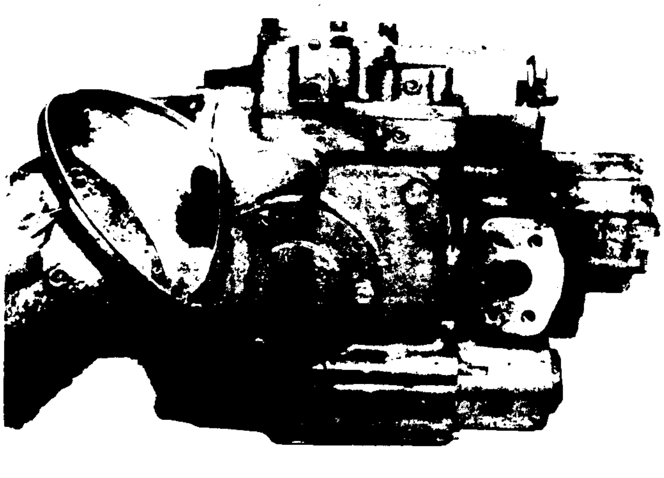


FIG. D

B. INSTALLATION

1. Mount pump on application using the four (4) mounting bolts.

2. Remove all shipping plugs as lines are installed. See plumbing diagram at rear of bulletin for correct line installation. Be sure lines are tightened to correct torques.

NOTE: *It is recommended the pump case be filled by hand to assure proper lubrication upon start-up. See Fig D.*

3. Install control linkage to Displacement Control. Consult owners manual for setting of neutral.

replacement of motor

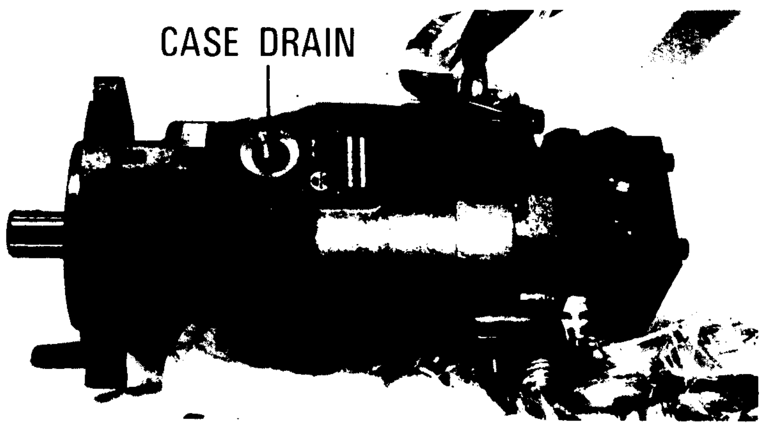


FIG. E

A. REMOVAL

1. Loosen the reservoir cap to relieve any system pressure.

2. Place drain pan or bucket under the motor.

3. Remove the three (3) hoses. Place clean plastic plugs and bags in lines and plug motor ports to prevent draining entire system. (Do not use rags).

4. Remove the four (4) mounting bolts.

5. Place a sling or similar support around motor and remove from application.

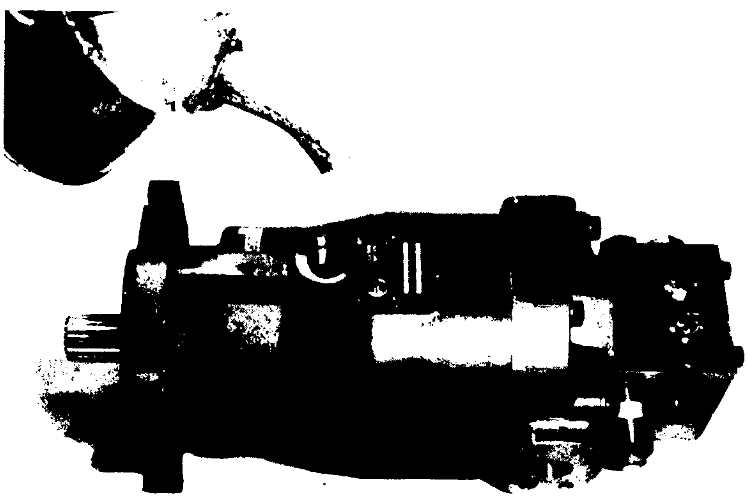


FIG. F

B. INSTALLATION

1. Mount motor on application using the four (4) mounting bolts.

2. Remove all shipping plugs as lines are installed. See plumbing diagram at rear of bulletin for correct line installation. Be certain lines are tightened to correct torques.

NOTE: *It is recommended that the motor case be filled by hand to assure proper lubrication upon start up. See Figure F.*

replacement of charge pump

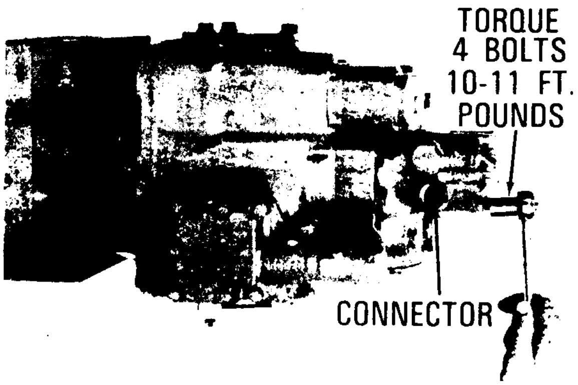


FIG. G

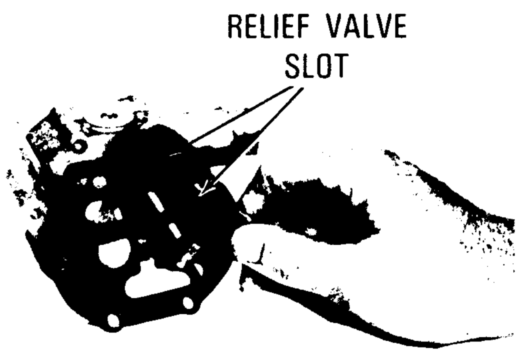


FIG. H

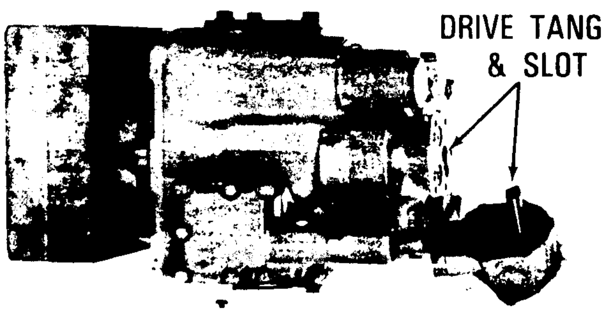


FIG. I

A. REMOVAL

1. Remove the line connecting charge pump to reservoir and plug with clean plastic plug to prevent draining of reservoir.

2. Remove the four (4) capscrews.

NOTE: *Do not remove the capscrew at the top and bottom of the charge pump, as these hold the charge pump together. See Figure G.*

3. Pull charge pump away from main pump.

NOTE: *Do not use sharp tools to pry charge pump from main pump. A scratch on the sealing surface may cause a leak. If charge pump does not pull loose, tap lightly on side of charge pump with plastic hammer to break paint or gasket seal.*

B. INSTALLATION

1. Install a new gasket. Make sure the new gasket is properly installed. See Figure H. If positioned wrong the relief valve port is covered by the gasket.

2. Line up the drive tang on charge pump shaft with slot in main pump shaft. See Figure I. The charge pump should assemble freely with main pump freely. Do not force charge pump into position.

3. Torque the four (4) mounting bolts to 10-11 ft. lbs.

replacement of charge pump

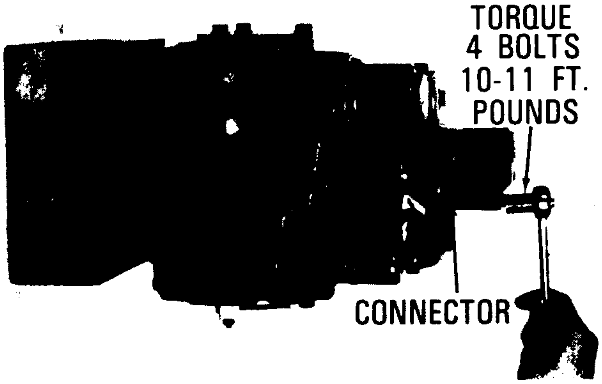


FIG. J

4. Install connector to charge pump. Torque 14-20 ft. lbs.

5. Install line from reservoir to connector on charge pump.

NOTE: *Excessive tightening may distort charge pump and cause leaks or malfunction.*

6. Check oil level in reservoir.

replacement of check valves

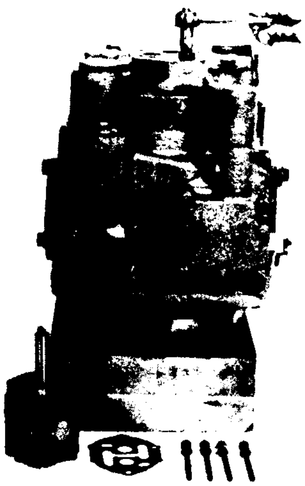


FIG. K

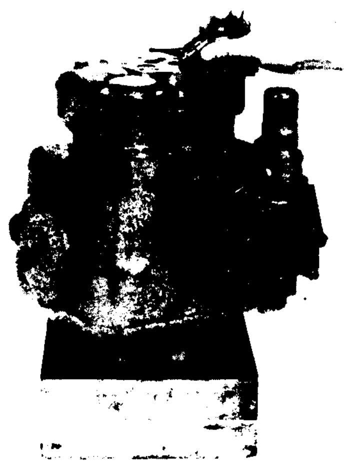


FIG. L

A. REMOVAL

1. Remove charge pump. See Section 3.

2. Using a drag link, unscrew check valve from end cap. See Figure K.

NOTE: *There are two check valves. It is advisable to replace both check valves when servicing unit. See Figure L.*

FIG. M

B. INSTALLATION

1. Prior to installation, inspect "O" rings for damage. See Figure M. Apply a light coat of oil.

On 20 through 23 series pumps, torque check valves 30-40 ft. lbs.

On 24 through 27 series pumps, torque check valves to 80-90 ft. lbs.

NOTE: *The checks must be below the face of the end cap. See Figure K.*

replacement of manifold

SECTION 5

A. REMOVAL

1. Prior to removal of manifold assembly, remove all dirt and clean area where manifold assembly is attached to end cap.

2. Place drain pan under manifold to catch oil.

3. Remove the four (4) corner bolts holding manifold to motor end cap. See Figure N.

4. Grasp manifold to prevent it from dropping and remove remaining two (2) mounting bolts. See Figure P. There is no gasket between the manifold and end cap. Sealing is obtained by "O" rings and back up rings.

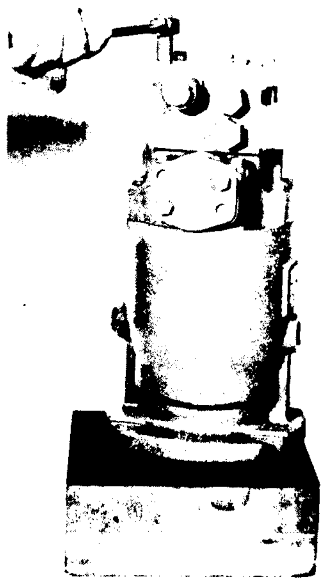


FIG. N

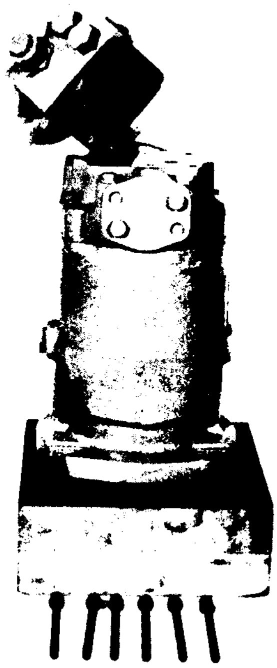


FIG. P

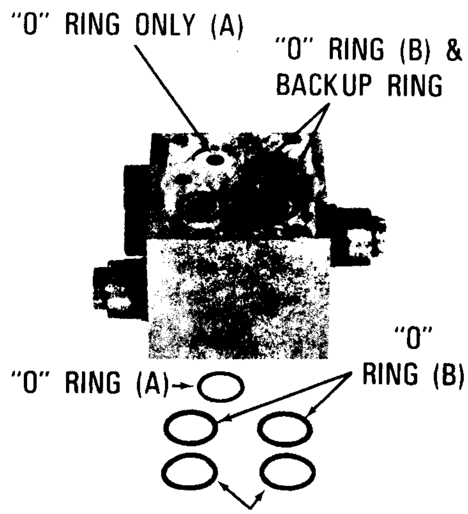


FIG. Q

B. INSTALLATION

1. Use new "O" rings and back up Rings.

2. The two grooves side by side require an "O" ring and back up ring. The "O" ring goes into the groove first. Then install the back up ring on top of the "O" ring. The flat side of the back up ring faces away from the "O" ring.

3. The remaining groove requires only an "O" ring. See Figure Q.

4. Place manifold against motor end cap. Install bolts being certain "O" rings *did not* slip from their grooves. Torque bolts 19-21 ft. lbs.

5. Check reservoir for oil level.

replacement of high pressure relief valves

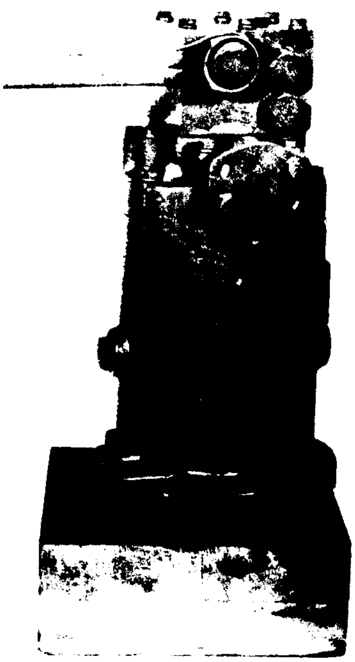


FIG. S

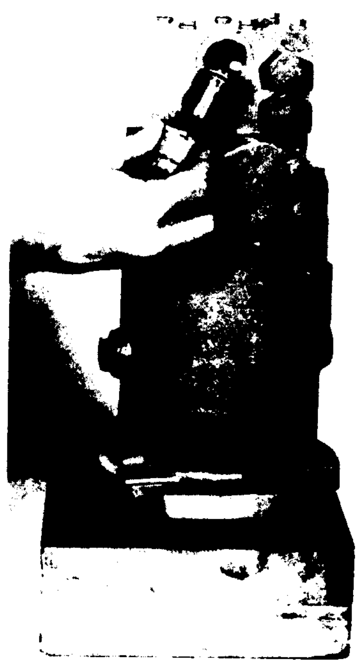


FIG. T

A. REMOVAL

1. Apply a wrench on Hex portion of valve and unscrew from manifold block. See Figure S.

NOTE: *There are two relief valves in manifold block.*

B. INSTALLATION

1. Prior to installation, inspect "O" rings and back up rings for damage.

2. Apply a lubricant to the "O" ring and install in manifold block.

3. Torque valve to 20 ft. lbs.

replacement of displacement control valve

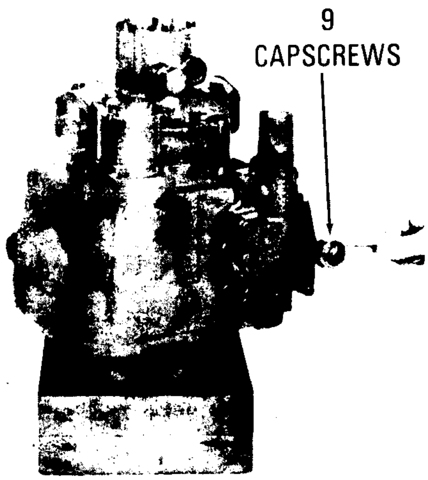


FIG. U

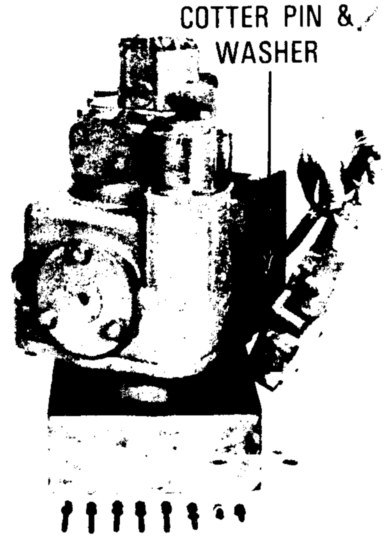


FIG. V

A. REMOVAL

1. Remove control linkage from Displacement Control Valve Assembly.
2. Remove the nine (9) capscrews holding valve to pump housing. See Figure U.
3. Lift Valve away from housing and remove cotter pin and washer. See Figure V. Remove pin from link in pump.

NOTE: *Caution must be exercised to prevent these parts from falling into pump.*

4. Remove orifice and "O" rings from control valve, See Figure W.

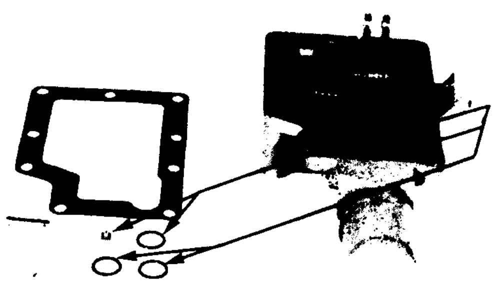


FIG. W

B. INSTALLATION

1. Install orifice, tip down, and new "O" rings in Control Valve.
2. Install new gasket on control valve dry.
3. Install pin in control valve links and pump link.
4. Place washer in pin, install cotter pin and spread.

NOTE: *Caution should be exercised during installation of these parts to prevent them falling into unit. Lightly coating parts with petroleum jelly (not grease) is advised.*

5. Install valve to pump and torque the nine (9) bolts 10-11 ft. lbs.

replacement of motor or pump shaft seal

FIG. Y

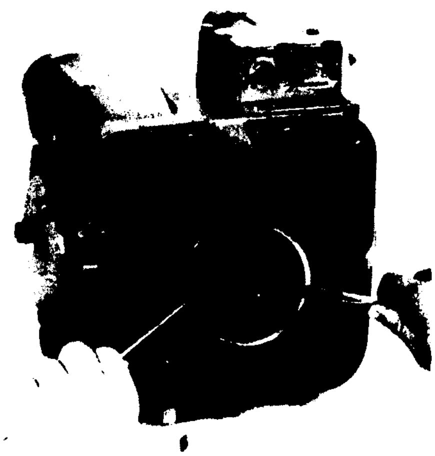


FIG. Z

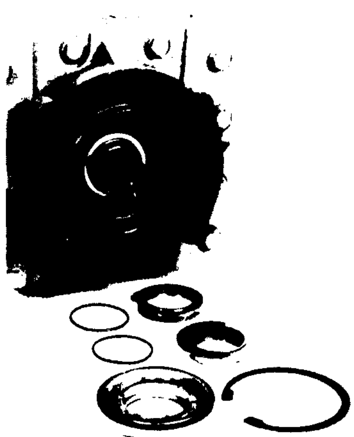


FIG. AA

FIG. CC

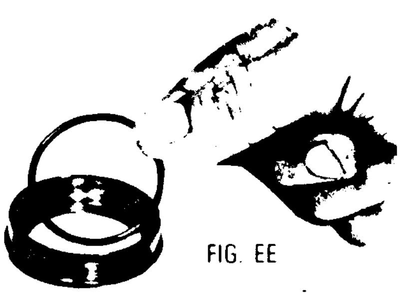


FIG. EE

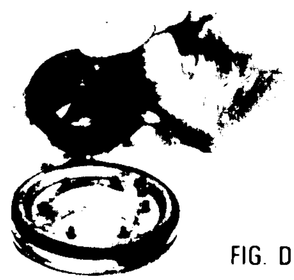


FIG. DD

A. REMOVAL

1. Remove unit from installation. See Section 1 or 2.

2. Insert Tru-Arc #7 pliers in snap ring holes, compress ring and roll out. See Figure Y.

3. Remove aluminum seal retainer with screwdriver. See Figure Z.

4. Remove steel stationary seal (This generally comes out with retainer). See Figure AA.

5. With fingers or two screwdrivers remove bronze rotating part of seal from drive shaft. See Figure FF.

6. See Figure CC and account for all the parts shown.

B. INSTALLATION

NOTE: *Always replace both stationary and rotating parts of seal. Do not mix old and new parts.*

1. Wash and clean air dry new seal parts.

2. Install the seal springs into aluminum seal retainer. Install new "O" rings dry on stationary steel part of seal and place seal into retainer so notch is located in pin in retainer. See Figure DD.

3. Install large "O" ring on O.D. of retainer. See Figure DD.

4. Install new "O" ring in I.D. of bronze rotating part of seal. See Figure EE.

replacement of shaft seal

FIG. FF

FIG. GG

5. Wrap a piece of plastic around drive shaft and slide rotating bronze part over shaft making sure it is seated. Do not press on seal surface. See Figure FF.

6. Install stationary seal and retainer into place and press retainer in so snap ring groove is open. See Figure GG.

7. Close snap ring with pliers. Install snap ring with tapered edge out.

8. For ease of installation start snap ring in groove with side opposite snap ring holes. See Figure HH.

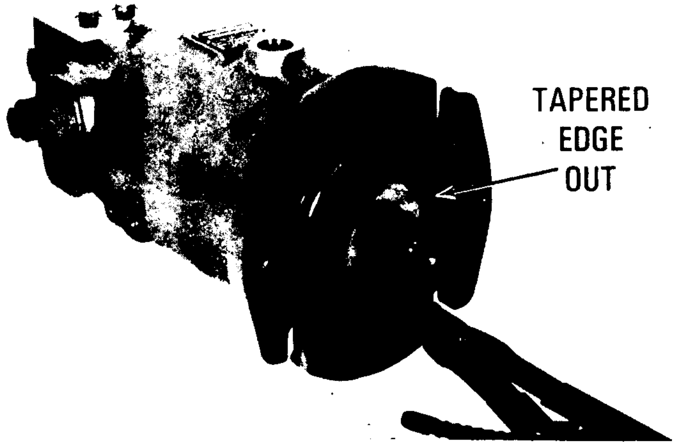
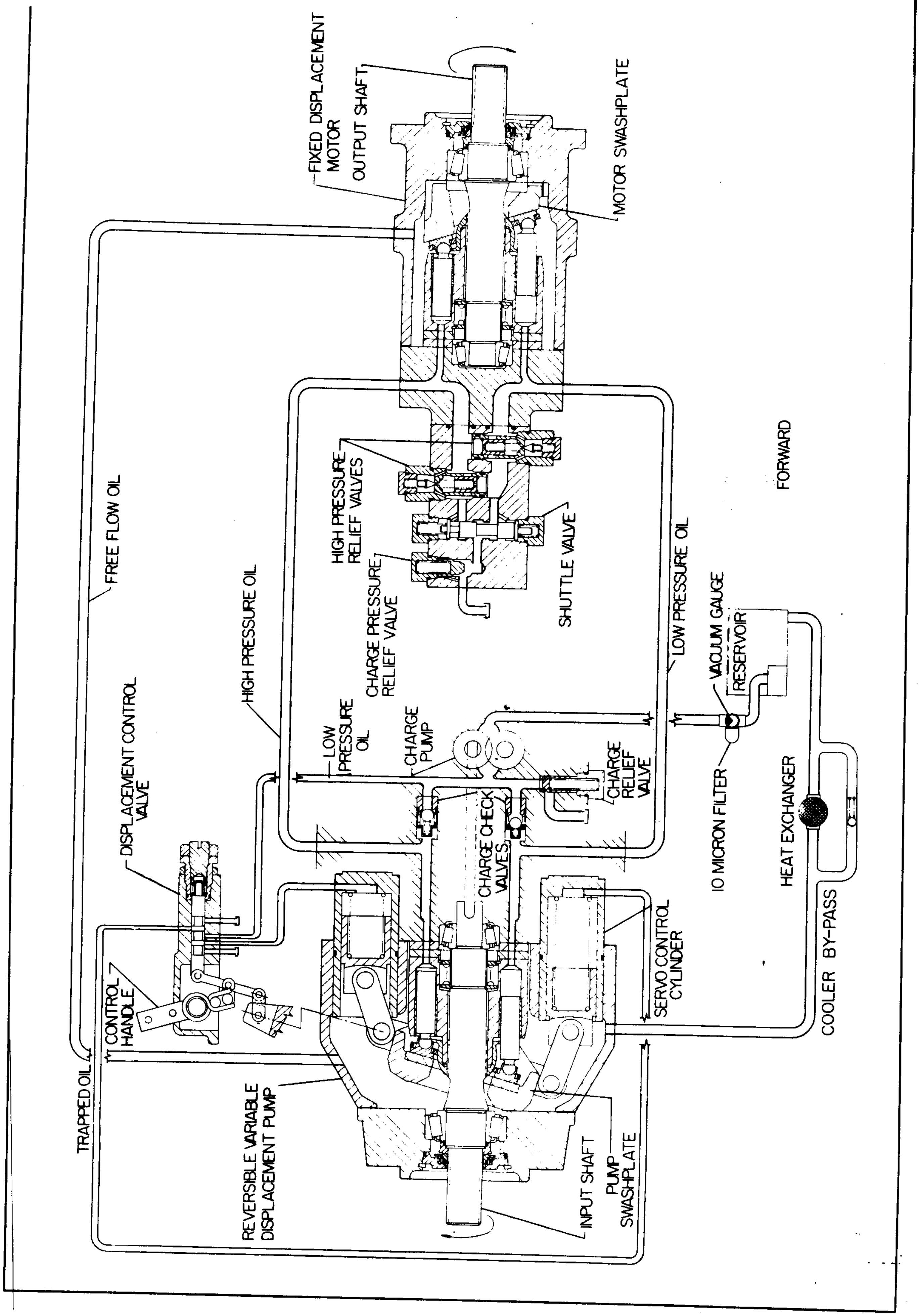
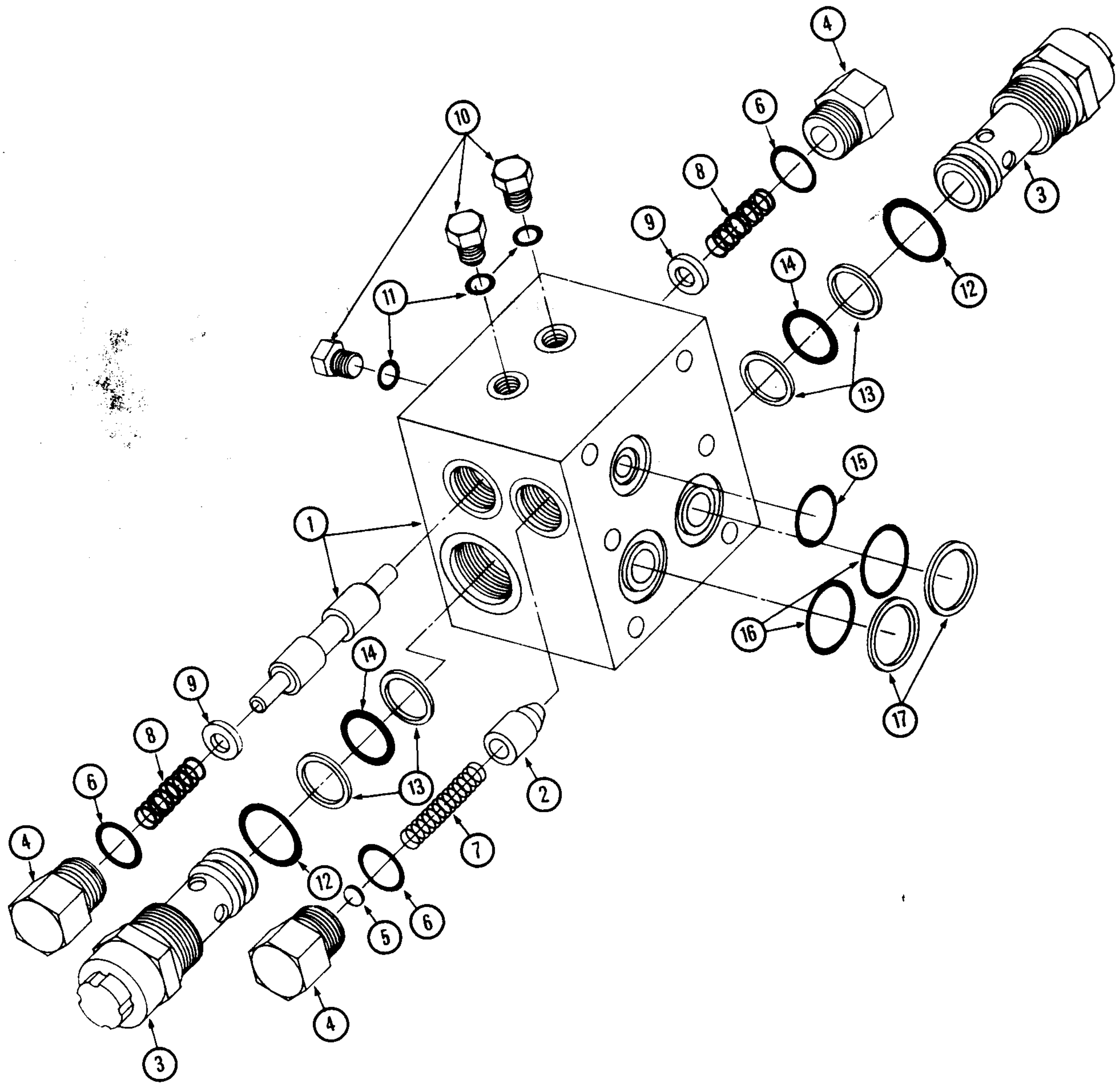


FIG. HH


FIXED DISPLACEMENT MOTOR
OUTPUT SHAFT
MOTOR SWASHPLATE
HIGH PRESSURE RELIEF VALVES
SHUTTLE VALVE
CHARGE PRESSURE RELIEF VALVE
FREE FLOW OIL
HIGH PRESSURE OIL
LOW PRESSURE OIL
FORWARD
VACUUM GAUGE
RESERVOIR
DISPLACEMENT CONTROL VALVE
LOW PRESSURE OIL
CHARGE PUMP
CHARGE RELIEF VALVE
CHARGE CHECK VALVES
10 MICRON FILTER
HEAT EXCHANGER
SERVO CONTROL CYLINDER
COOLER BY-PASS
CONTROL HANDLE
TRAPPED OIL
REVERSIBLE VARIABLE DISPLACEMENT PUMP
INPUT SHAFT
PUMP SWASHPLATE

MOTOR MANIFOLD VALVE ASSEMBLY
PARTS LIST



MOTOR MANIFOLD VALVE ASSEMBLY
PARTS LIST

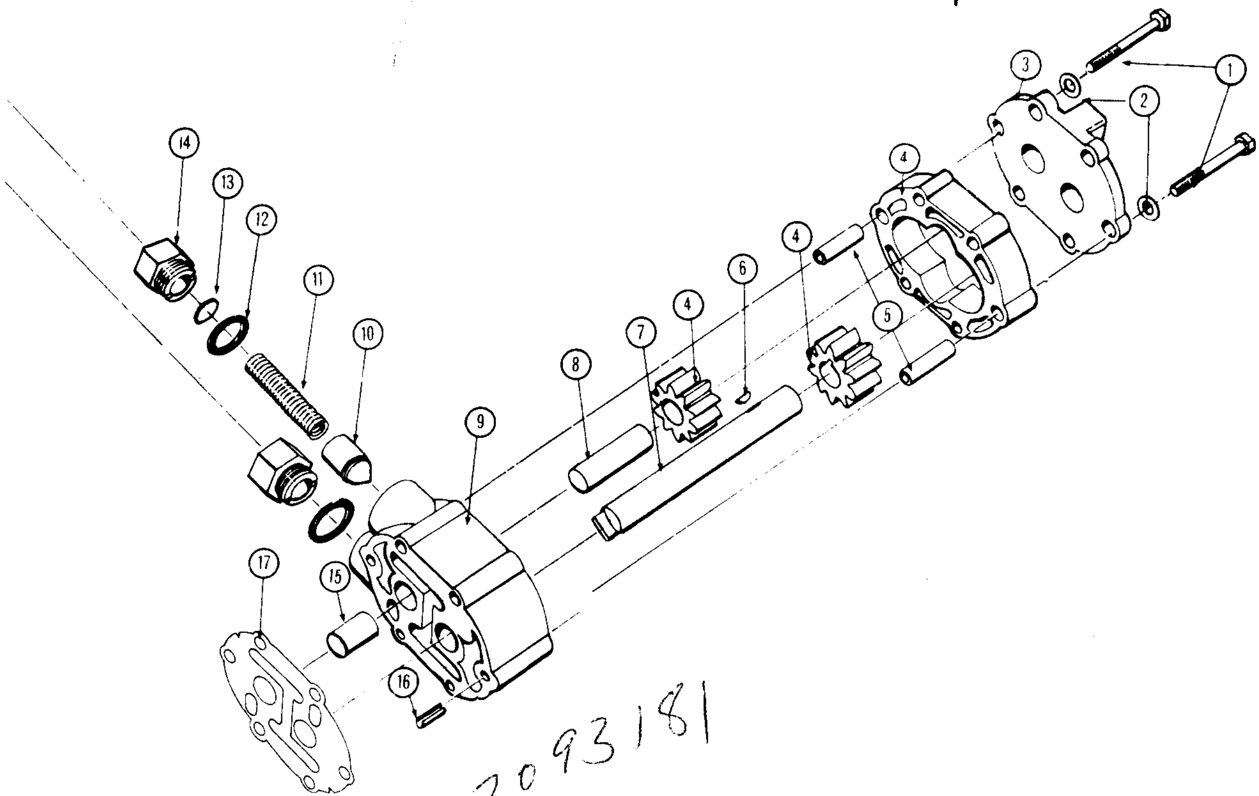
REF #	QTY	DESCRIPTION
1	1	Housing-Shuttle Assembly
2	1	Charge Relief Valve
3	2	High Pressure Relief Valve (1)
4	3	Hex Plug
5	A/R	Shim
6	3	"O" Ring
7	1	Charge Relief Spring
8	2	Shuttle Valve Spring
9	2	Washer
10	3	Hex Plug
11	3	"O" Ring
12	2	"O" Ring
13	4	Back Up Ring
14	2	"O" Ring
15*	1	"O" Ring
16*	2	"O" Ring
17*	2	Back Up Ring

(1) PSI rating is stamped on end plug of High Pressure Relief Valve.

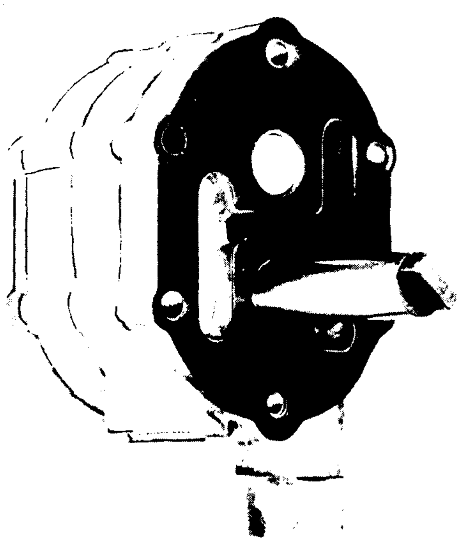
* Not part of manifold. Must be ordered as needed.

PARTS LIST
Charge Pump

7093308



7093181

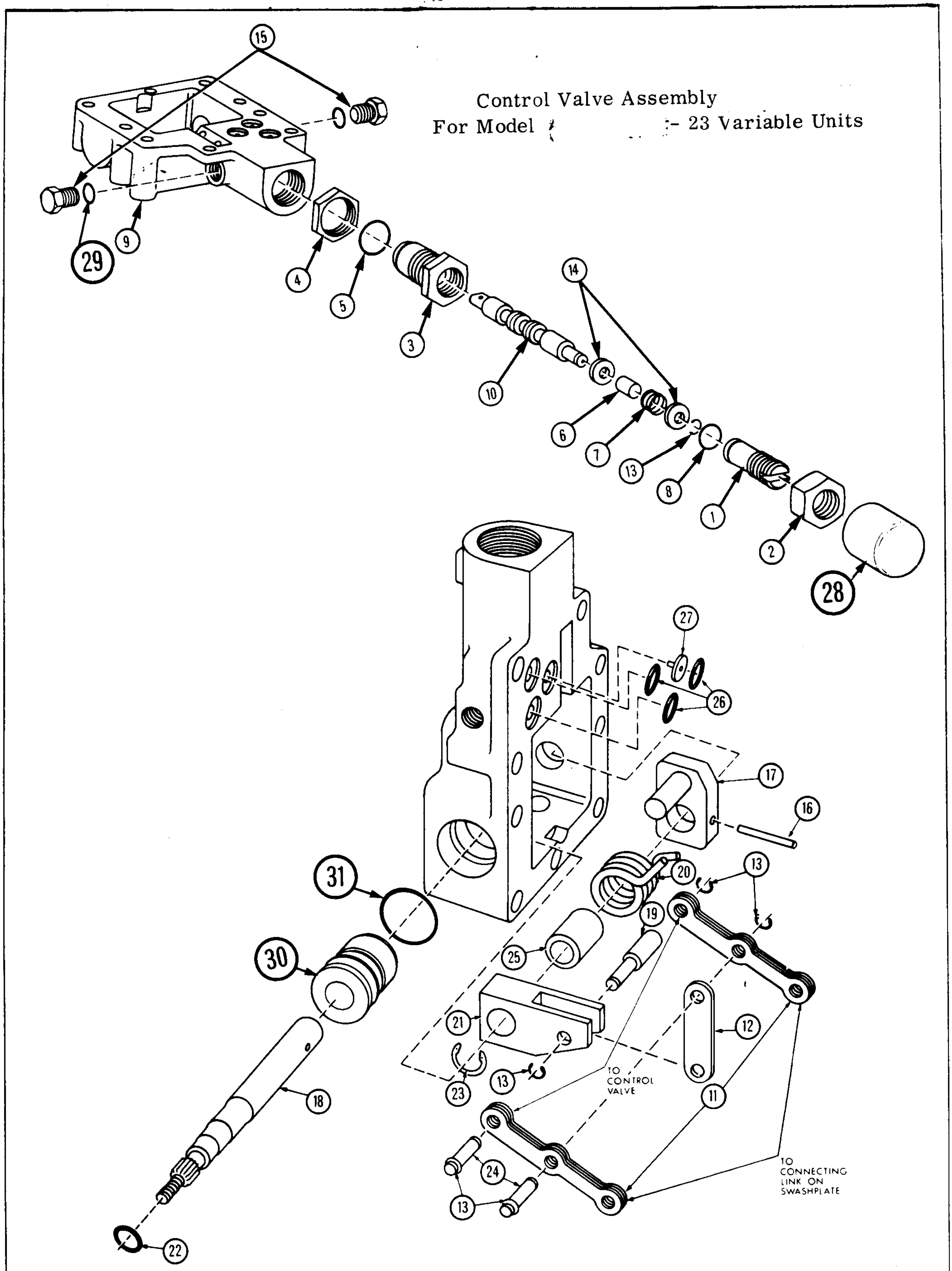


LEFTHAND ROTATION

RIGHTHAND ROTATION

PARTS LIST
Charge Pump

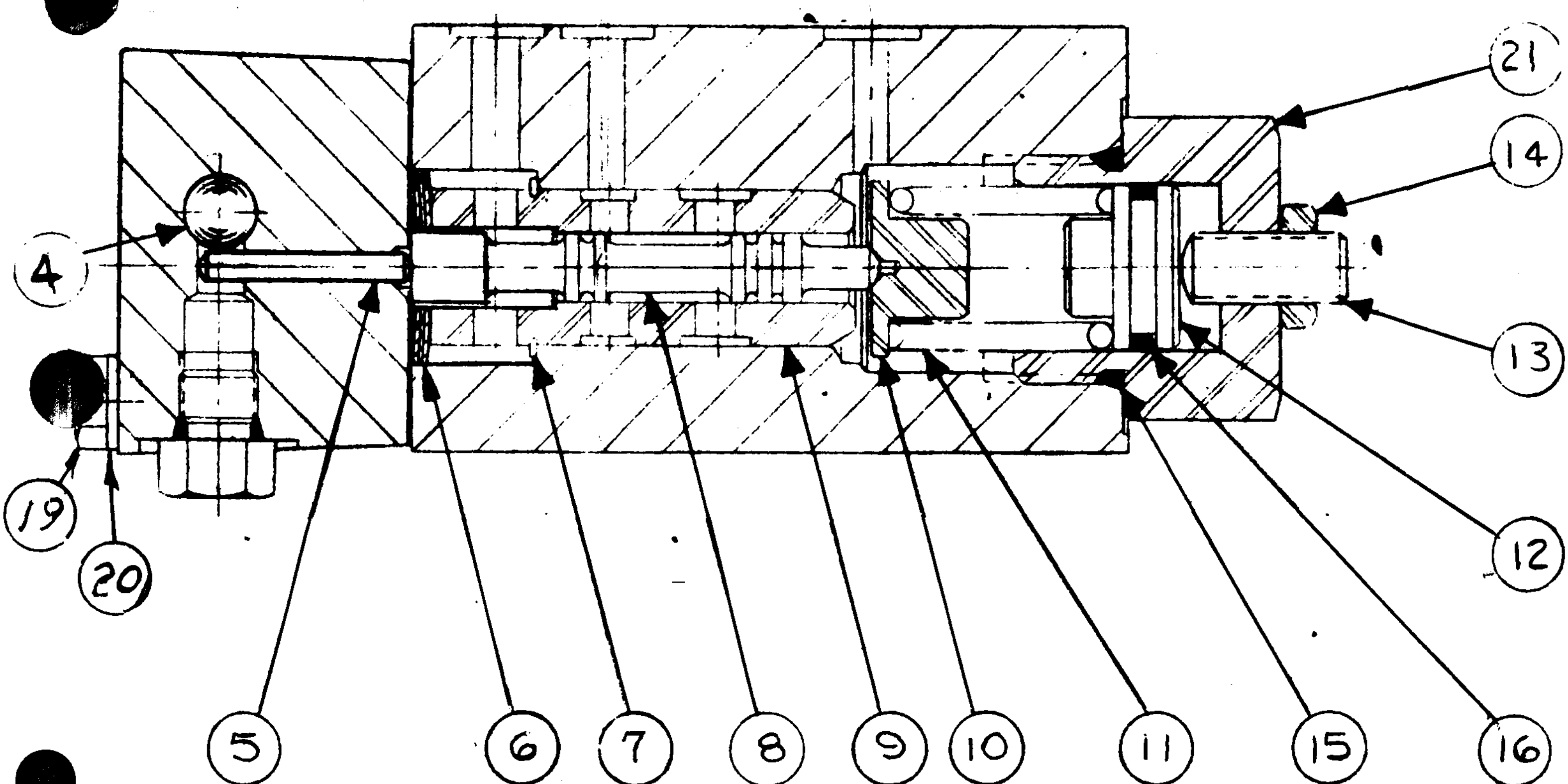
REF #	QTY	DESCRIPTION
1	2	Screw
2	2	Washer, Plain
3	1	End Cap
4	1	Spacer Plate Assembly
5	2	Pin
6	1	Key
7	1	Shaft-Drive
8	1	Pin
9	1	Body Assembly, Pump
10	1	Valve, Relief
11	1	Spring
12	1	"O" Ring
13	A/R	Shim
14	1	Plug
15	1	Spacer
16	1	Pin
17	1	Gasket (Order as needed)


Control Valve Assembly
For Model - 23 Variable Units
TO CONTROL VALVE
TO CONNECTING LINK ON SWASHPLATE

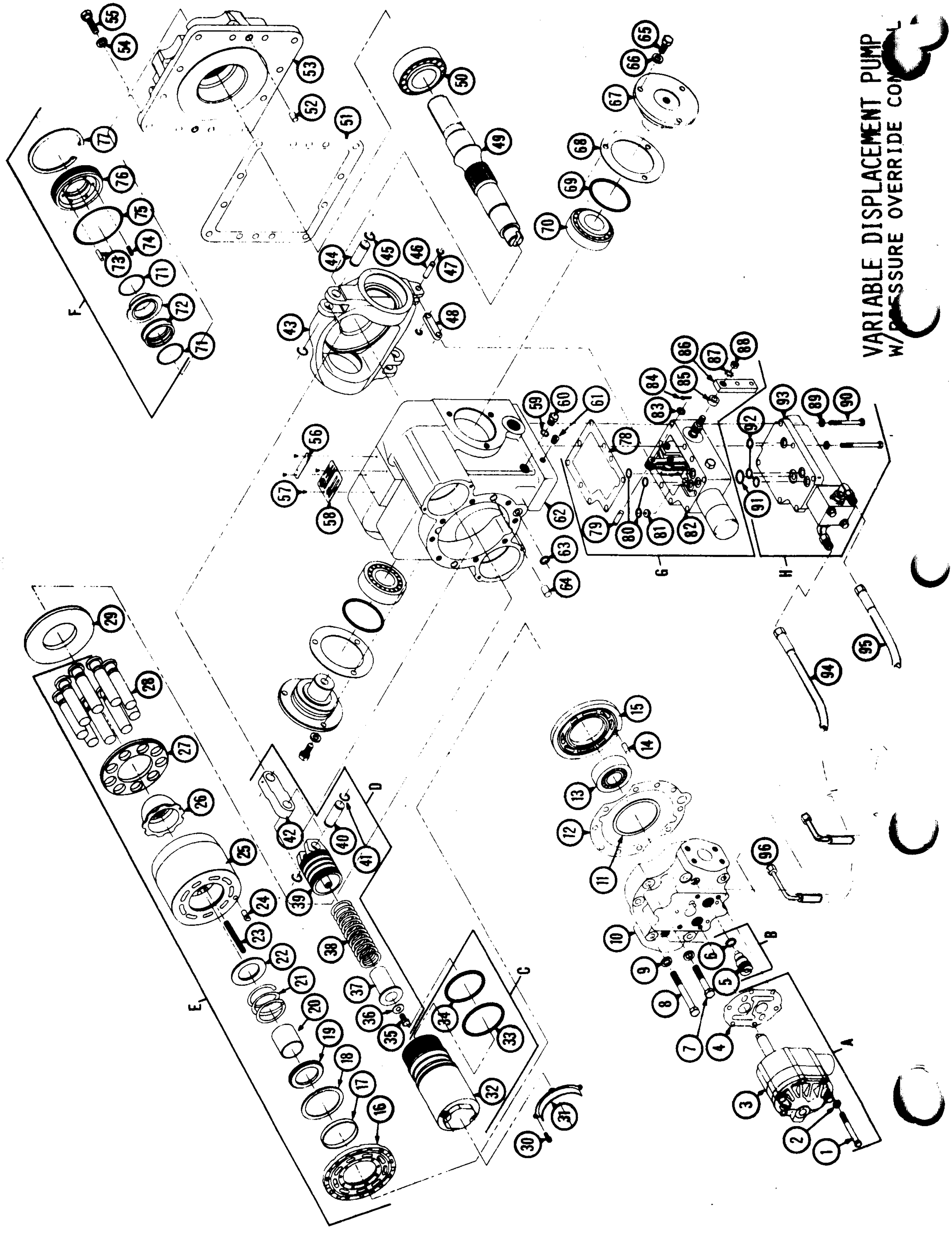
PARTS LIST
Control Valve Assembly
For Model 20 - 21 - 22 - 23 Variable Units

Ref #	Qty	Description
1	1	Spring Adjusting Screw
2	1	Hex Jam Nut
3	1	Spring Housing
4	1	Lock Nut
5	1	"O" Ring
6	1	Centering Spring Sleeve
7	1	Centering Spring
8	1	"O" Ring
9	1	Control Valve Housing
10	1	Control Valve
11	6	Control Valve Link
12	1	Link
13	6	Retaining Ring
14	2	Washer
15	2	Hex Head Plug
16	1	Spring Pin
17	1	Return Spring Actuator
18	1	Control Handle Shaft
19	1	Return Spring Stop
20	1	Neutral Return Spring
21	1	Control Shaft Link
22	1	"O" Ring
23	1	Retaining Ring
24	2	Pivot Pin
25	1	Return Spring Sleeve
26	3	"O" Ring
27	1	Orifice
28	1	Cover
29	2	"O" Ring
30	1	Bushing
31	1	"O" Ring

PRESSURE OVERRIDE VALVE



Item	Description	Qty
1	Housing, Pressure Override	1
2	Cover, Valve	1
3	Gasket, Cover	1
4	Ball, Metal	1
5	Pin, Straight	1
6	Washer, Spring	3
7	Ring, Retaining	1
8	Valve, Pressure Override	1
9	Sleeve, Pressure Override	1
10	Seat, Spring	1
11	Spring, Pressure Override	1
12	Seat, Spring	1
13	Screw, Set	1
14	Nut, Hex, Jam	1
15	"O" Ring	1
16	"O" Ring	1
17	Elbow, Straight Thread	1
18	Elbow, Straight Thread	1
19	Screw, Hex Head Cap	2
20	Washer, Plain	2
21	Plug, Threaded	1
22	Plug, Straight Thread	1


VARIABLE DISPLACEMENT PUMP
W/ SSURE OVERRIDE CO L
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ELEVATOR PUMP WITH PRESSURE OVERRIDE CONTROL

Item	Part No.	Description	Qty.
		PUMP	1
A		CHARGE PUMP KIT	1
B		CHECK VALVE	2
C		SERVO SLEEVE KIT	2
D		SERVO PISTON KIT	2
E		CYLINDER BLOCK KIT	1
F		SEAL KIT	1
G		CONTROL VALVE KIT	1
H		CONTROL VALVE KIT	1
1		SCREW	4
2		WASHER	4
3		CHARGE PUMP	1
4		GASKET	1
5	NSS	CHECK VALVE (SEE B)	2
6		O-RING	2
7		SCREW	3
8		SCREW	5
9		WASHER	8
10		END CAP	1
11		SHIM	AR
12		GASKET	1
13		BEARING	1
14		PIN	1
15		PLATE	1
16	NSS	PLATE (SEE E)	1
17	NSS	PILOT (SEE E)	1
18	NSS	RING, RETAINER (SEE E)	1
19	NSS	RETAINER (SEE E)	1
20	NSS	GUIDE (SEE E)	1
21	NSS	SPRING (SEE E)	1
22	NSS	SEAT (SEE E)	1
23	NSS	SPRING (SEE E)	6
24	NSS	PIN (SEE E)	1
25	NSS	CYLINDER BLOCK (SEE E)	1

NSS - NOT SERVICED SEPARATELY

Item	Part No.	Description	Qty.
26	NSS	GUIDE (SEE E)	1
27	NSS	RETAINER (SEE E)	1
28	NSS	PISTON (SEE E)	9
29		PLATE	1
30		SCREW	4
31		RETAINER	2
32	NSS	SLEEVE (SEE C)	2
32A	NSS	PLUG	4
33	NSS	O-RING (SEE C)	2
34	NSS	O-RING (SEE C)	2
35	NSS	SCREW (SEE D)	2
36	NSS	WASHER (SEE D)	2
37	NSS	GUIDE (SEE D)	2
38	NSS	SPRING (SEE D)	2
39	NSS	PISTON (SEE D)	2
40	NSS	PIN (SEE D)	2
41	NSS	RING (SEE D)	4
42	NSS	LINK (SEE D)	2
43		SWASH PLATE	1
44		PIN	2
45		RETAINER RING	4
46		PIN	1
47		RETAINER RING	2
48		LINK	1
49		SHAFT	1
50		BEARING	1
51		GASKET	1
52		PIN	2
53		COVER	1
54		WASHER	12
55		SCREW	12
56		ARROW, DIR	1
57		DRIVE SCREW	4
58		NAMEPLATE	1
59		O-RING	1

NSS - NOT SERVICED SEPARATELY

Item	Part No.	Description	Qty.
60		PLUG	1
61		PLUG	1
62		HOUSING	1
63		O-RING	1
64		PIN	2
65		SCREW	6
66		WASHER	6
67		TRUNNION	2
68		GASKET	AR
69		O-RING	2
70		BEARING	2
71	NSS	O-RING (SEE F)	2
72	NSS	SEAL KIT (SEE F)	1
73	NSS	PIN (SEE F)	1
74	NSS	SPRING (SEE F)	6
75	NSS	O-RING (SEE F)	1
76	NSS	RETAINER (SEE F)	1
77	NSS	RING (SEE F)	1
78		GASKET (SEE G)	1
79		PIN (SEE G)	1
80		O-RING (SEE G)	3
81		PLUG	1
82	NSS	CONTROL	1
83		WASHER	1
84		PIN	1
85		SPACER	1
86		HANDLE	1
87		WASHER	1
88		NUT	1
89		WASHER (SEE G)	9
90		SCREW (SEE G)	9
91		O-RING (SEE H)	1
92		O-RING (SEE H)	3
93	NSS	PRESSURE OVERRIDE VALVE ASSEMBLY (SEE H)	1

NSS - NOT SERVICED SEPARATELY

Item	Part No.	Description	Qty.
94		HOSE	1
95		HOSE	1
96		CONNECTOR	2

ACCUMULATOR

DESCRIPTION

The elevator hydraulic circuit utilizes a 30 cubic inch hydraulic accumulator as a supply reservoir to boost charge pump in replinishing oil to maintain charge pressure on the low pressure side of hydrostatic circuit. The accumulator is of the piston type utilizing dry nitrogen as the gas medium.

OPERATION

The accumulator, precharged with dry nitrogen at zero hydraulic pressure, is charged with hydraulic oil through the low pressure side of hydrostatic circuit by the charge pump. The charge pump pressure is above that of the gas pressure forcing the piston in the accumulator toward the gas filler valve thus compressing the nitrogen gas. When the operating conditions of the elevator cause a drop in charge pump pressure on the low pressure side of the hydrostatic circuit, the pressure on the gas side of accumulator becomes greater than hydraulic pressure forcing oil out of accumulator to maintain charge pump pressure.

Peroidically it is necessary to check the accumulator precharge gas pressure and recharge same, as required. This operation should be performed at same time the brake accumulator is serviced. See Section 8B, Page 1.

CHECKING ACCUMULATOR PRECHARGE

1. Shut engine off and bleed off all hydraulic pressure in the accumulator.
2. Remove gas valve protector plate or caps from accumulator. See Figure 21.
3. Turn handle on regulator valve of Charging and Checking Device No. 944283 in counterclockwise direction until all tension on the regulator diaphragm is relieved.
4. Turn T-handle valve on gas chuck of Checking Device all the way out by turning in counterclockwise direction.
5. Attach gas chuck to accumulator, using wrench to tighten swivel nut.
6. Turn T-handle on gas chuck all the way in by turning in clockwise direction to depress valve core in gas valve. Reading obtained on regulator gauge indicates Accumulator Prehcarge Gas Pressure.

Cautions:

A. Do not loosen swivel nut attaching regulator to nitrogen cylinder without closing nitrogen cylinder valve.

B. Do not loosen swivel nut attaching gas chuck to accumulator without first backing T-handle valve out all the way by turning in counterclockwise direction.

C. Do not attach Charging and Checking Device, No. 944283, to either nitrogen cylinder or accumulator without first turning handle of regulator valve in counterclockwise direction until all tension on regulator diaphragm is relieved, and turning T-handle valve on gas chuck all the way out by turning in counterclockwise direction.

REMOVAL AND DISASSEMBLY

REMOVE ACCUMULATOR FROM SYSTEM

Make certain that hydraulic pressure is at zero. Piston then will be against hydraulic end cap or at bottom of accumulator body because of gas pressure on opposite side of piston.

Remove guard from over gas valve. To release gas, unscrew gas valve part way until gas begins to escape through safety hole drilled through side of gas valve. Wait until all gas pressure is relieved, then remove gas valve.

Remove accumulator from hydraulic system. Threaded holes in end caps may be used as a means of attachment for lifting, or use a sling around the body.

NOTE: The following disassembly instructions are basically the same for all models of accumulators, except that on the 7" I.D. models the hydraulic end cap is removable. The 2", 4", and 5-3/4" models have a welded hydraulic end cap which cannot be removed.

DISASSEMBLE ACCUMULATOR FROM SYSTEM

With accumulator laying horizontal, hold accumulator body with a strap wrench, or vise gripping over hydraulic end cap. Install three pins into holes of cap at gas end, then remove gas cap, using a long bar working against the pins. Remove "o" ring and back-up rings from end cap.

Remove piston using pliers on cast web and while pulling, rotate piston slightly to aid in removal. Remove teflon rings. To remove v-"o" ring from piston, lift ring with small, smooth screw driver or similar tool, moving the tool around the piston several times while using other hand to work ring off the piston.

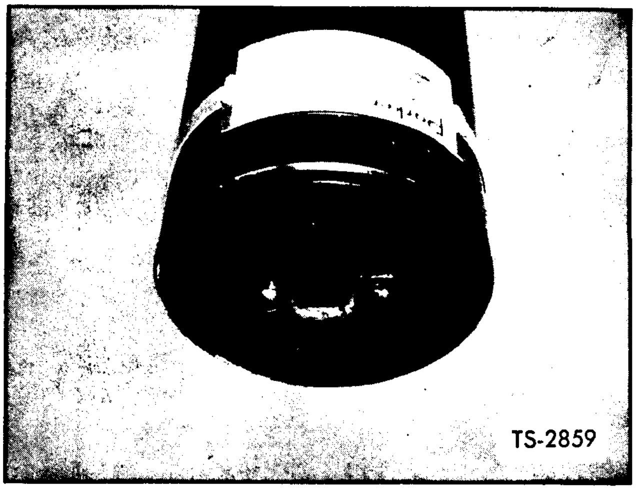


Fig. 21. Accumulator — Gas Valve End

Precharge Gas Pressure should be **75 to 95 PSI at ambient temp-erature** of 60°F. Check precharge of accumulator when its temperature is equal to ambient temperature. If there is a noticeable temperature difference, delay pressure check until temperatures are more nearly alike. For each 10°F difference in ambient temperature from 60°F, precharge pressure will rise or fall 6 PSI from **75 SPI** specifications given above. If precharge is not within specification given above, proceed with recharging as outlined below. See Figure 23.

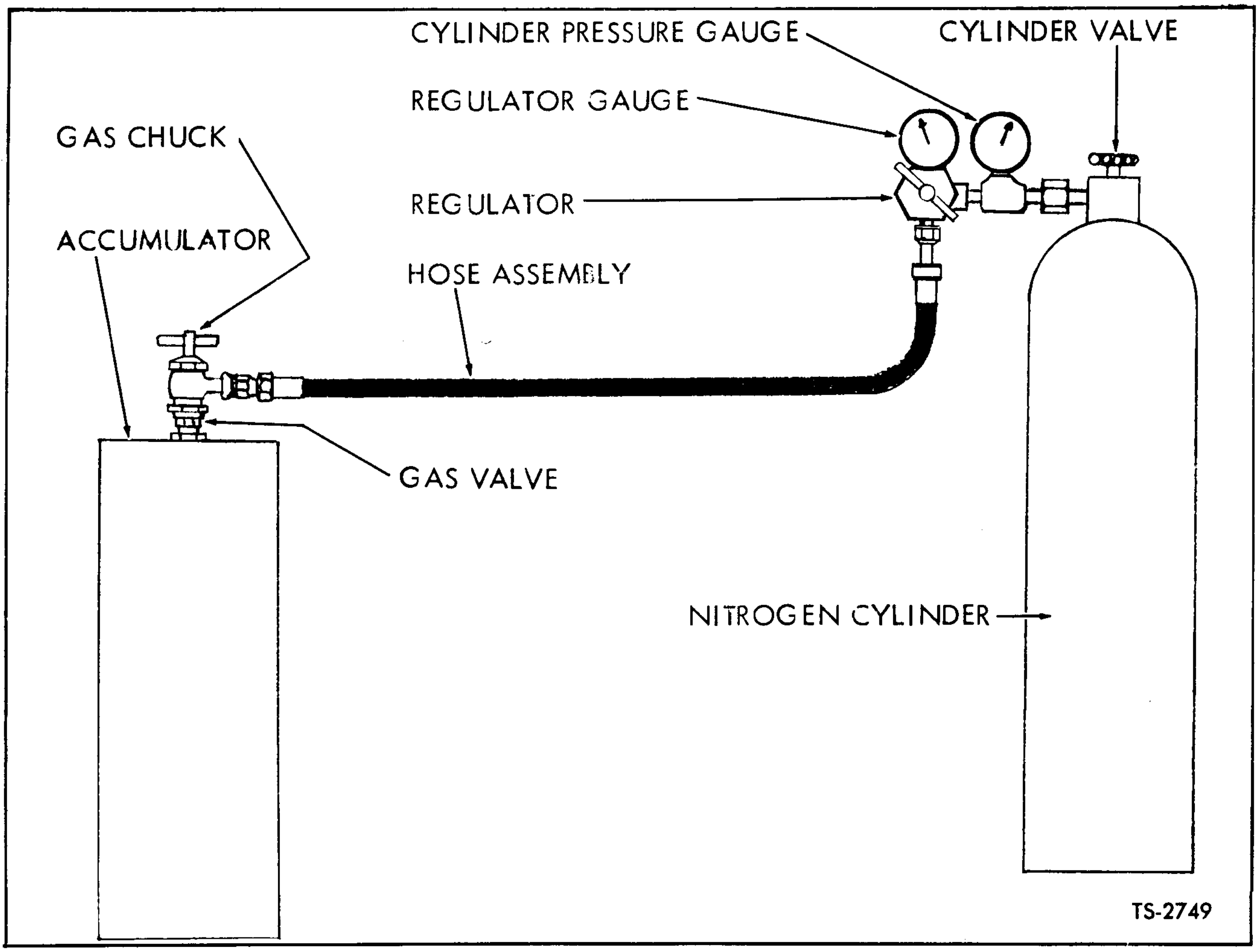


Fig. 23. Accumulator Charging and Checking Device Hook-Up

If no No. 944283 Checking and Charging Device is available, a 1,000 PSI capacity gauge may be used. See Figure 22.

Fig. 22. Checking Accumulator Pressure

ACCUMULATOR RECHARGING PROCEDURE

1. With engine off, bleed off all hydraulic accumulator pressures by loosening hose in bottom of accumulator.

2. Remove gas valve protector cap from accumulator.

3. Attach Charging and Check Device, No. 944283, to nitrogen cylinder and to accumulator, as shown in Figure 23. Use wrench to tighten swivel nuts onto accumulator gas valve and to nitrogen cylinder. Turn T-handle valve on gas chuck all the way in by turning in a clockwise direction to depress valve core in gas valve.

4. Turn handle on regulator valve in counterclockwise direction until all tension on the regulator diaphragm is relieved. Open valve in nitrogen cylinder which will allow nitrogen gas to flow as far as the regulator.

5. Turn handle of regulator valve slowly in clockwise direction until desired charging pressure reading is reached on regulator gauge. Recharge pressure should be 75 to 95 PSI.

6. When required pressure is reached, close valve on nitrogen cylinder. Turn T-handle valve on gas chuck all the way out by turning in a counterclockwise direction.

7. Loosen swivel nuts on gas chuck and regulator valve and remove charging device from both accumulator and nitrogen cylinder. A slight release of pressure will be present when hose is removed. This is caused by nitrogen gas that was trapped in the hose assembly, and does not affect accumulator charge.

8. Replace gas valve protector caps or plate on accumulator. Valve cap should be wrench tight after charging accumulator to insure a positive seal.

CLEANING

Thoroughly clean parts in solvent and dry with compressed air. Clean bore of body with a clean lintless cloth soaked in clean solvent. Bore must be clean of any visible particles or particles detectable to touch.

INSPECTION

Inspect piston for cracks, burrs around "o" ring grooves, or damage. Examine body bore, using a light for scratches or scoring. Inspect end caps for damaged threads or burrs on "o" ring grooves.

REPAIR AND REPLACEMENT

Minor nicks, scratches or light scoring of the body bore can be removed by using crocus cloth. Dress bore until all apparent imperfections have been removed.

Teflon rings need not be replaced at each overhaul, but to test for any wear, install rings on piston. Lay a straight edge across both Teflon rings. Rings should clear center lands of seal groove enough to barely see "daylight" under the straight edge. If not, rings are worn and must be replaced. Check at 3 or 4 points around piston for this condition. Piston rides on the Teflon rings and does not touch body bore.

Replace rubber "o" rings and v-"o" rings at each overhaul.

REASSEMBLY

Coat all internal parts with clean hydraulic fluid before reassembly. Install new back-up ring first, then a new "o" ring on hydraulic end cap and install into body bore. Care should be exercised not to drag "o" ring over threads.

End cap will stop against chamfer leading into hones bore (extreme tightness not required - "o" ring sealing is not dependent upon cap tightness). Cap should be flush with end of body within 1/16" to 3/32" above or below.

With new v-"o" ring and Teflon rings on piston, install piston, hollow side toward gas end, in bore of body. Do not let v-"o" ring drag on threads. Piston must go into bore exactly square and very slowly. (V-"o" ring will squeeze up the chamfer if done slowly, but may be damaged if forced quickly). Piston will fit snug. Use hammer and wood block to tap piston into place until all of piston is 2" below beginning of honed bore. Keep pressure against piston while tapping v-"o" ring through

REASSEMBLY (Continued)

the bore chamfer, otherwise piston will bounce back, damaging the "o" ring. Cover port opening to keep out dirt.

Install new back-up ring and new "o" ring on gas end cap and install same as hydraulic end cap.

Replace gas valve core and "o" ring, then install gas valve.

Remount accumulator, but do not connect to hydraulic system at this time. Precharge system with required pressure and when required precharge is reached, install gas valve guard. Connect hydraulic system.

MAINTENANCE

NOTE: Repair Kit (see Parts List) is available for all accumulator models.

Occasional replacement of v-"o" ring seal on the piston is the only maintenance required Replacement of other seals on end caps and gas valve is recommended while disassembled to replace piston v-"o" ring, or for repair.

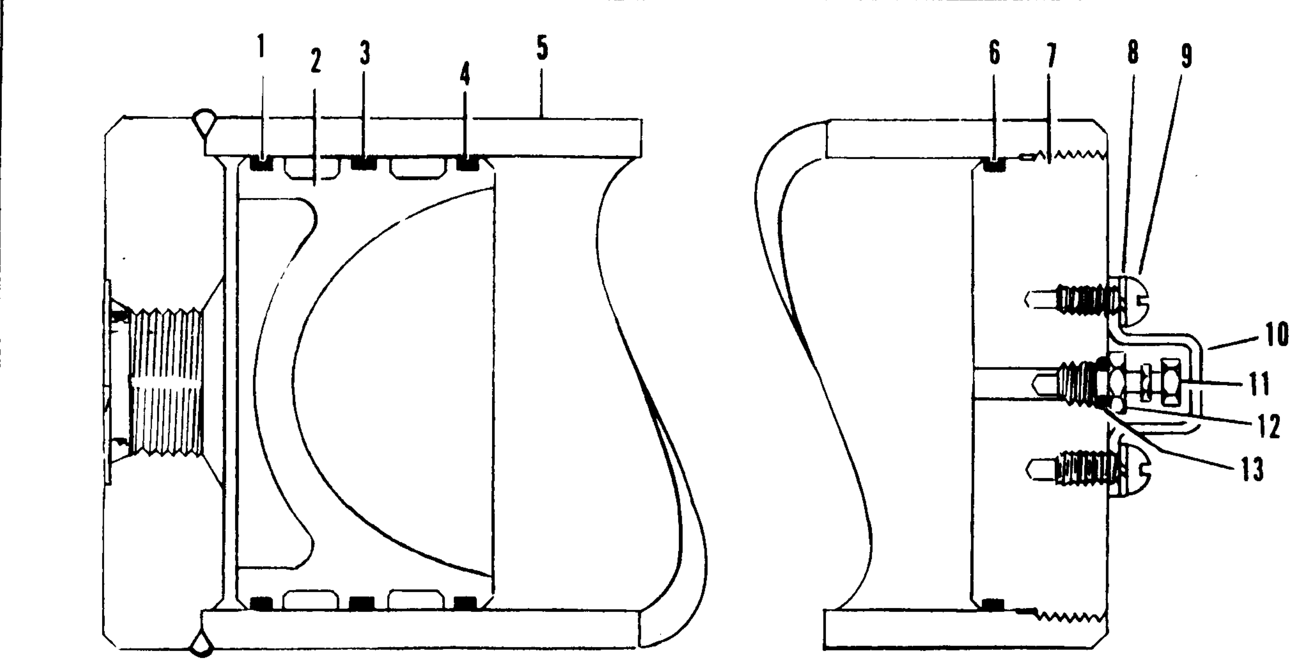
Periodic checking of precharge pressure will detect whether v-"o" ring wear is sufficient to begin reducing sealing performance. Allowing for temperature difference, if any, from time of its pressure checking, precharge pressure will rise if oil gathers in the gas side and will fall if gas leaks into the oil side or out past gas end seals. It is suggested that a check be made a week after installation, and thereafter once a month.

CHECKING PROCEDURE

1. Release hydraulic pressure. Allow all oil to be discharged and piston to bottom against hydraulic end cap or at bottom of body.

2. Attach gaging assembly to gas end.

Replace seals when continuing change of the gas precharge is detected. When change is first observed, resort to frequent checking as a guide to how soon seal replacement must be made. In this manner maintenance can be planned ahead without the need for any emergency shutdown.



HYDRAULIC ACCUMULATOR ASSEMBLY

CAUTION

This is a Gas Pressurized System

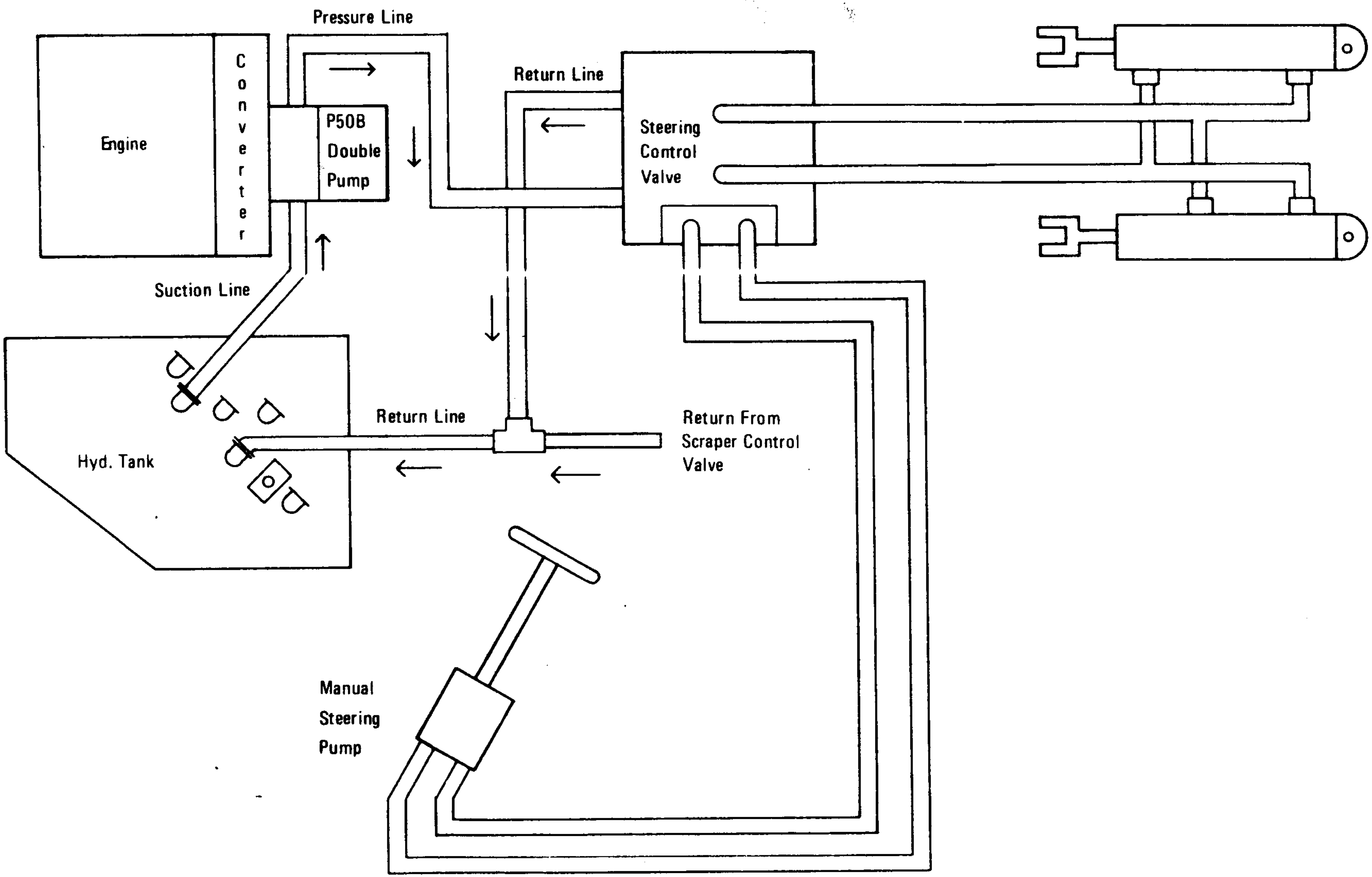
Do not disconnect any part of system without first relieving accumulator pressure. To release pressure, back off suspension system relief valve screw until suspension arms are resting on their stops (with engine down).

Before attempting to service components of accumulator, release gas by unscrewing gas valve until gas begins to escape through safety hole. When pressure is relieved, remove gas valve.

Item	Part No.	Description	Qty.
A		ACCUMULATOR ASSY (Inc 1 thru 15)	1
B		REPAIR KIT, Accumulator (Inc 3, 5, 6, 8, 13, 13A, 14A, 15)	1
1		§RING, Piston Wear (See 'B')	1
2		§PISTON (See 'A')	1
3		§"O" RING, Piston (See 'B')	1
4		§RING, Piston Wear (See 'B')	1
5		§CYLINDER (See 'A')	1
6		§"O" RING, Cylinder Cap (See 'B')	1
7		CAP, Cylinder	1
8		LKWSHR, Gas Valve Protector	2
9		SCREW, Gas Valve Protector	2
10		CAP, Gas Valve Protector	1
11		§CAP, Gas Valve (See 'B')	1
11A		†§CAP, Gas Valve Core Remover (See 'B')	1
12		VALVE ASSY, Gas (Inc 13, 14A)	1
12A		†§CORE, Gas Valve (See 'B')	1
13		§"O" RING, Gas Valve (See 'B')	1

† Not Illustrated
§ Not Sold Separately

WHEN ORDERING PARTS, ALWAYS STATE MODEL AND SERIAL NO. OF MACHINE



15 YD. HYDRAULIC STEERING CIRCUIT

STEERING SYSTEM

When the tractor engine is running and the tractor is centered or not being steered to either right or left, the steering system portion of the tandem pump draws oil from the front hydraulic reservoir through the suction line. Oil leaves the steering system section of the tandem pump and enters the steering valve.

The orifice edges in the steering valve are arranged so that oil leaves the steering valve to flow through the filter and into the front hydraulic reservoir. See Section Steering Valve for details on steering valve operation.

LEFT TURN

When the steering wheel is rotated in a counterclockwise direction, the tractor will begin a left-hand turn. A small quantity of pressurized oil is sent to the steering valve from the manual pump.

The orifice control edges in the steering valve move sufficiently to allow a given volume of oil to flow to the rod end of the left hand steering cylinder and to the blind end of the right hand steering cylinder. Oil from the blind end of the left hand steering cylinder and from the rod end of the right hand steering cylinder to the steering valve is routed back to the hydraulic reservoir.

The severity of the counterclockwise steering wheel rotation determines the amount of oil and the rate at which it travels to the steering valve from the manual pump. Once inside the steering valve, this volume of oil at a given flow rate acts against orifice control edges in the steering valve to produce the turning motion. The more severe the steering wheel rotation, the greater volume of oil is delivered from the manual pump. The greater the volume of oil delivered to the steering valve from the manual pump in the least time the greater the distance the orifice control edges shift. The greater the distance the orifice control edges shift, the larger the volume of pressurized oil from the engine-driven pump is delivered to the steering cylinders. The larger volume of pressurized oil flow to the cylinders in a given time, the faster the unit will turn.

This design allows greater steering control of the unit and eliminates dangerous "jerk steering."

Mechanical linkage is found in the steering system only between the steering wheel and the manual pump and at the point where the tractor connects to the scraper.

An illustration of the mechanical steering linkage appears in Fig. 2. For graphic explanation of mechanics of the steering linkage in left and right hand turns, see Figs. 3 and 4.

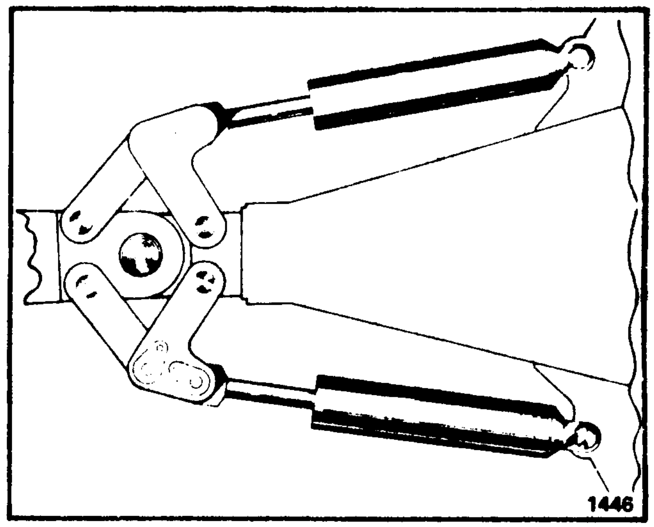


Fig. 2 – Steering in Neutral Position

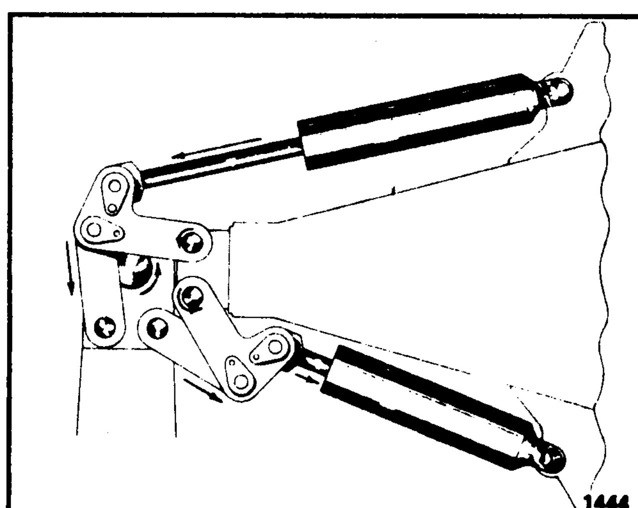
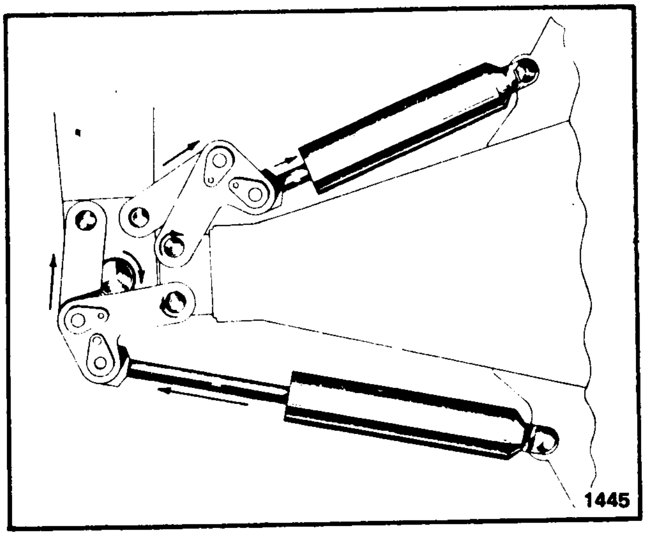


Fig. 3 – Left Hand Turn



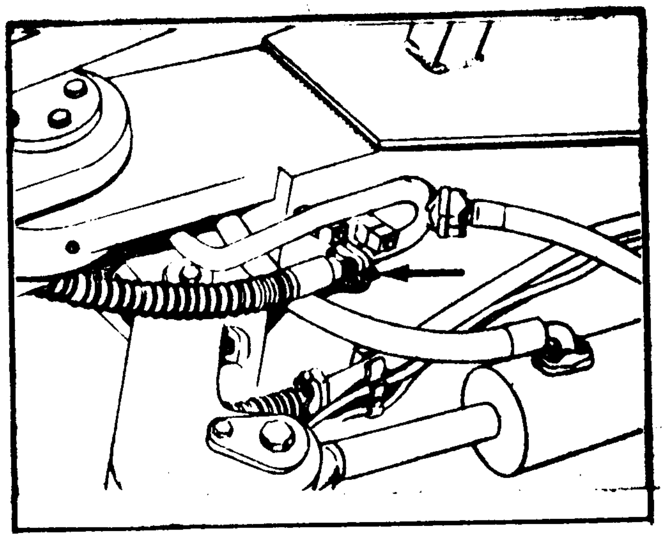


Fig. 9 - Check Steering Pressure

Check Steering Pressure: To assure proper operation of the steering system, pressure should be checked as follows:

a. Bring hydraulic oil to operating temperature and shut down engine.

b. Vent cap. Remove pipe plug from steering crossover line and install a hydraulic pressure gage of at least 3000 psi capacity in the port from which the pipe plug was removed. See Fig. 9.

c. Start engine and turn tractor to right or left until tractor rests solidly against steering stops. Hold tractor against steering stops and accelerate engine to maximum rpm. Gage reading should be 2000 psi.

d. If steering pressure is not within 50 psi of specified pressure, adjustment is recommended. The rear belly pan on the tractor must be removed to gain access to the steering valve which is mounted on the tractor frame lower crossmember. Remove the cap as illustrated in Fig. 10 and insert an Allen wrench into the adjustment screw head. Turn the adjustment screw clockwise to increase pressure and counterclockwise to decrease pressure. When pressure is properly adjusted, replace the cap.

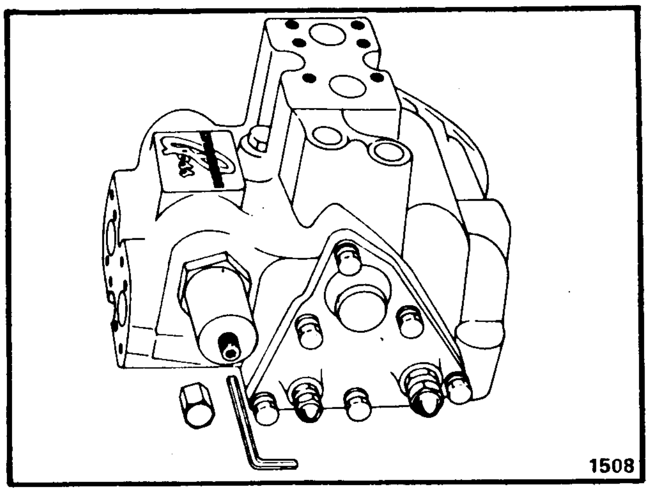


Fig. 10 – Adjusting Steering Pressure

TROUBLE-SHOOTING GUIDE

1. Steering wheel turns left and vehicle steers right - cylinder lines or handpump lines are crossed.

2. Lump as the steering wheel is turned - dirt between spool and body or large adjusting screw has been backed out.

3. Steering wheel continues to turn easily after vehicle has reached the end of travel - the cylinders are leaking or the dual relief are maladjusted.

4. Excessive wheel turns - inadequate pump flow at steering pressure.

5. System holds pressure with valve in neutral - spool stuck from dirt or small adjusting screw maladjusted.

6. Handpump sealing ring blown - faulty system relief valve. System has seen 6000 PSI plus.

7. Vehicle will steer in one direction only - object or dirt will allow switching valve spool to move in only one direction.

CLARK EQUIPMENT

STEERING VALVE

DESCRIPTION

The control valve is of linear spool design. The spools are spring centered and hydraulically positioned. The valve is of the open center type, meaning there is a continuous flow of oil through the valve as long as the power pump is operating. Actuation of the valve is through the use of differential pressures acting across orifice control edges.

The function of the control valve is to enable the operator to control the direction, flow rate and pressure of the oil required to steer the unit.

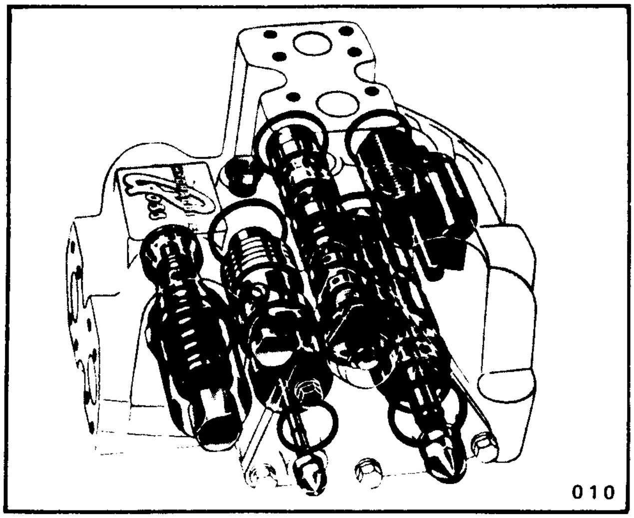


Fig. 1 Phantom View of V-2 Steering Valve

The switching valve (Figure 2) is a simple spool valve that switches hand pump and cylinder ports to the proper position for each direction steered. The switching valve is actuated by pressure and is spring centered with 3/16" of travel in each direction.

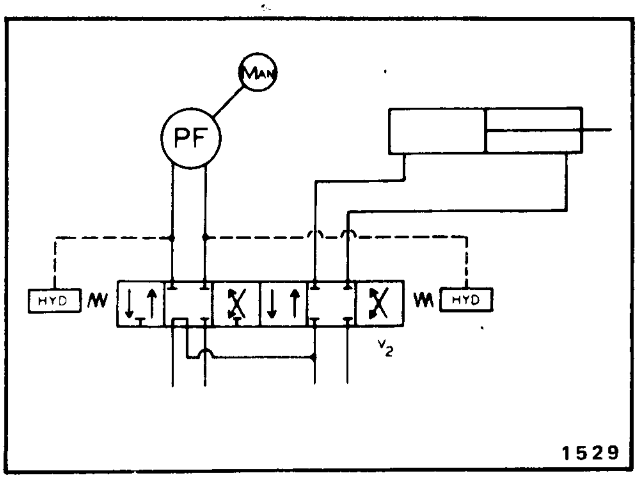


Fig. 2 Switching Valve Schematic

The schematic diagram (Figure 3) shows internal flow of the valve and shows that the valve assembly consists of two valves, two orifices and two check valves.

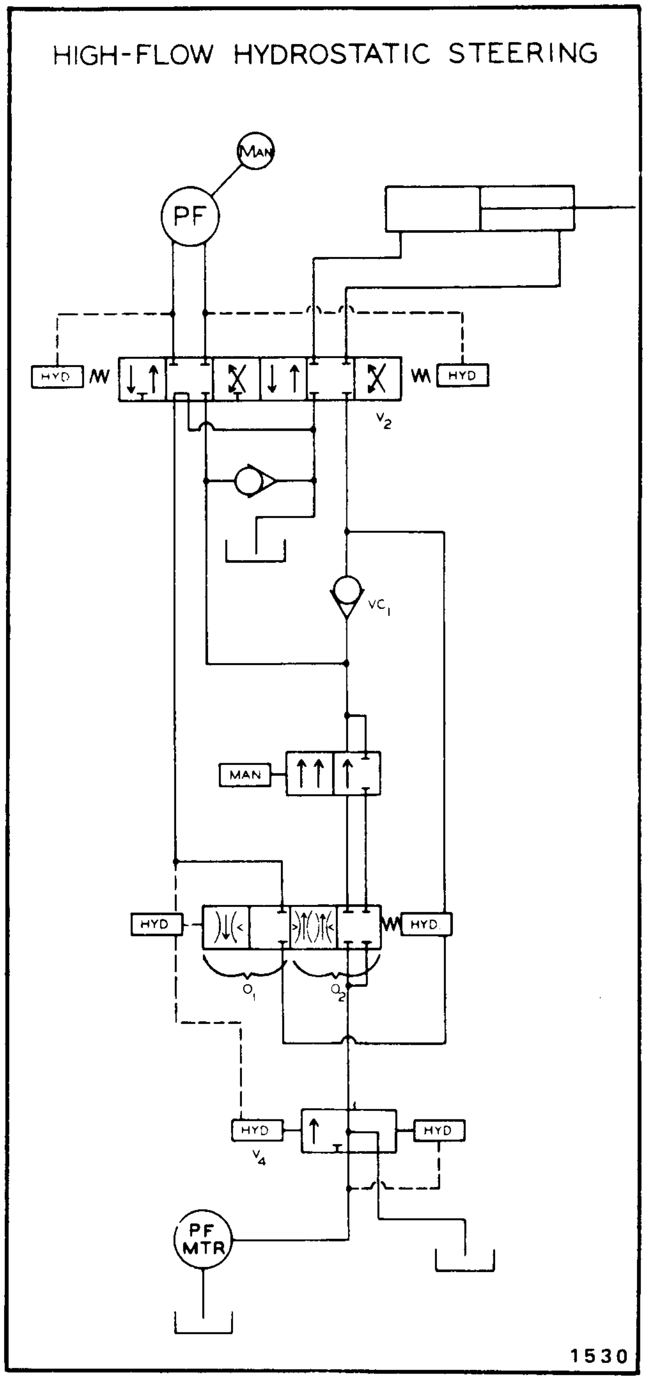


Fig. 3 V2 Valve Schematic

The orifice consists of two parts as shown in Fig. 4. The small inner spool is stationary, while the larger outer spool is moveable and is actuated by hand pump pressure.

OPERATION

Oil from the hand pump enters through the large orifice (see Figure 4) and passes through the control edge of the small orifice spool. Flow can be traced through the orifice shown in Fig. 4.

The pressure drop across the small orifice control edge causes a differential pressure to exist on the orifice and the larger orifice spool shifts until the centering spring force equals the shifting force on the orifice.

After the large orifice has shifted, the oil from the handpump passes through the large orifice control edges to the cylinders. The steering ratio is determined by the ratio of the small orifice control edge area to the large orifice control edge area. The dual ratio function is attained by permitting or denying flow from one of the large orifices.

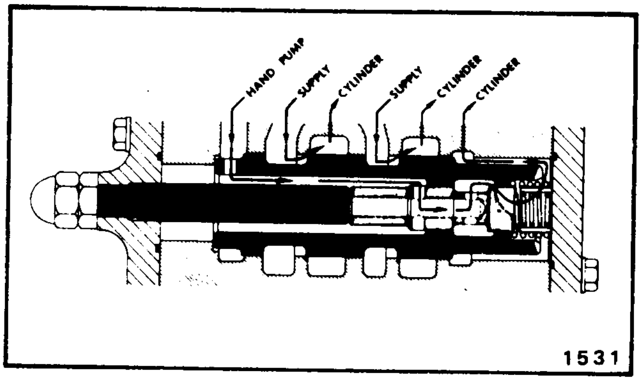


Fig. 4 – Orifice Arrangement

The throttling valve, illustrated in Fig. 5, increases the system pressure to the pressure necessary for the steering maneuver. The throttling valve maintains equal pressure in both the hand pump and power pump circuits. Therefore, the pressure differential across the engine-driven pump inlet orifices equals the pressure drop across the hand pump inlet orifice. Since the hand pump circuit and the power pump circuit have the same orifice pressure differential, the volume of oil to the cylinder depends on the ratio of orifice area sizes.

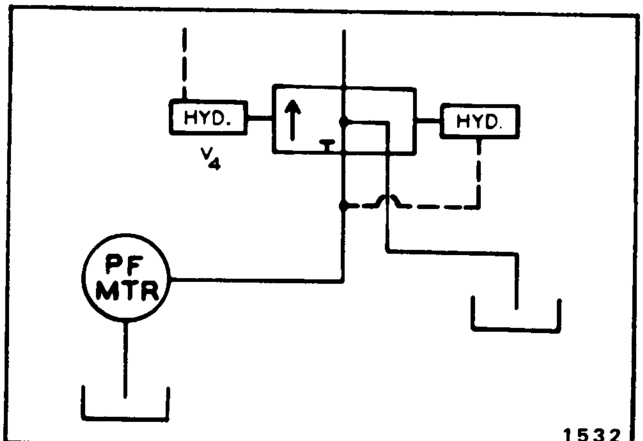


Fig. 5 – Throttling Valve Schematic

The two check valves shown in Fig. 2 are the manual steering check valve (VC1) and the charging check valve. The manual steering check valve closes when oil is not flowing to the cylinders from the power pump. The manual steering check valve also directs oil from the hand pump to the cylinders in case of engine or power pump failure. The manual steering check valve also causes the steering wheel to reflect the feel of a conventional power steering system if there is insufficient pressure to steer the vehicle.

The charging check valve facilitates charging a dry system with oil. The charging check valve also prevents cavitation if the vehicle is manually steered rapidly. For this reason, the charging check valve should be checked regularly by manually steering the unit in a stationary position and observing whether or not the steering wheel reflects a spongy feeling, which would indicate that cavitation in the handpump circuit is present. If a spongy feeling is observed, the charging check valve must be checked closely to see that it is functioning properly.

REMOVAL

1. Clean off all outside dirt from valve and hose fittings.
2. Remove connecting lines one at a time and cap each line. Plug valve ports with clean plastic plugs before removing any additional lines.
3. Remove bolts securing steering valve to steering valve mount.
4. Carefully remove the steering valve.

DISASSEMBLY

NOTE: It is recommended that servicing of the valve for any malfunctioning traceable to the valve be performed only at the valve manufacturer's factory. This requirement is necessary due to the fact that the adjustment requirements for porting of the valve spools is extremely critical in this unit and can only be accomplished on a special test stand.

Service is recommended only for repair of external valve leaks, which consists ONLY of "O"ring replacement.

Before beginning disassembly, it must be remembered that this system MUST be kept free of dirt and foreign matter to avoid contamination of the internal components of the system.

Numbers in parentheses refer to Fig. 6.

1. Finish removing external surface dirt BEFORE placing valve on work bench. This will eliminate or lessen the chances of internal valve parts becoming contaminated from external dirt and foreign matter such as paint.

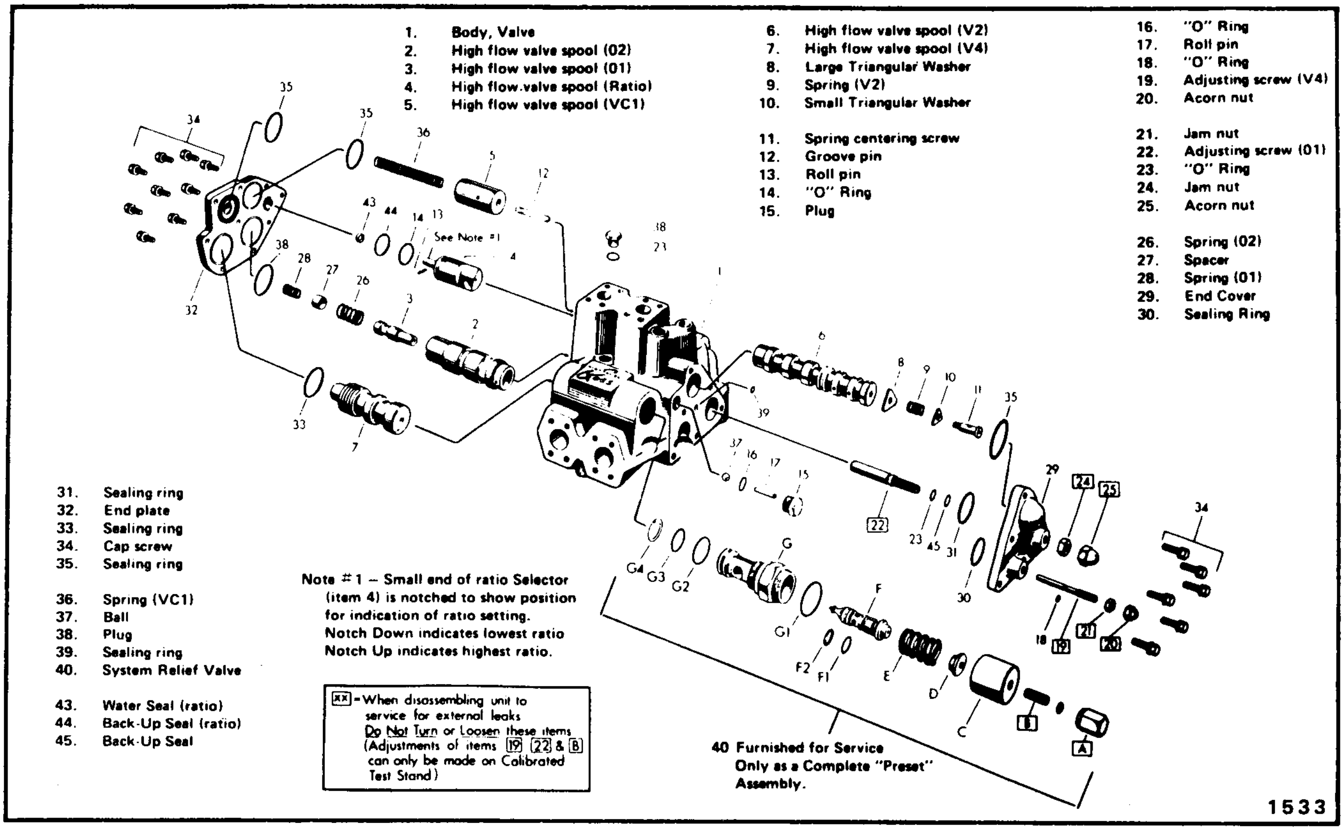


Fig. 6–Steering Valve Assembly

2. Place valve on CLEAN working surface. Remove bolts (34) securing cover (32) to valve body (1). Remove and discard sealing rings (35 & 33). Remove and discard water seal (43).

3. Remove bolts (34) securing end cover (29) to valve body (1).

   CAUTION: DO NOT REMOVE NUTS (20 & 25) OR NUT "A" OF SYSTEM RELIEF VALVE!

4. Remove end cover (29) and discard sealing rings (30, 31, 35 & 39).

Disassembly procedures in the field or shop must end at this point. Further disassembly can only be accomplished at the valve manufacturer's factory where there is a special test stand available for the extremely critical valve porting requirements necessary for proper operation of the valve in this system. Go no further than the steps listed above.

INSPECTION

1. Clean metal parts in clean petroleum base solvent and dry with clean, dry compressed air. Do not wipe parts dry with cloth. Lint deposited by cloth may cause binding and sticking of closely fitted parts. Do not use carbon tetrachloride in cleaning. Carbon tetrachloride causes deterioration of rubber and synthetic parts.

2. Inspect cap (29) and cover (32) for signs of pitting, rust or erosion.

ASSEMBLY

1. Lubricate new "O"ring (14) and new backup seal (44) and assemble to valve spool (4). Carefully place into bore in valve body (1).

   NOTE: Small end of ratio valve spool (4) is notched to show position for indication of steering ratio setting. If the notch is inserted DOWN, the ratio valve spool (4) is in the LOWEST ratio position. If the notch is inserted UP, the highest steering ratio position will be obtained.

2. Place new sealing rings (33 & 35) into place on cover (32). Use clean oil-soluble grease to hold seals in place on cover.

3. Assemble cover (29) to valve body (1) with bolts (34). Torque bolts to 25 to 30 ft. lbs.

4. Assemble cover (32) to valve body (1) with bolts (34). Torque bolts to 25 to 30 ft. lbs.

5. Carefully place new seal (43) into bore with sealing lip outward.

INSTALLATION

1. Position valve on valve mount.

2. Replace bolts removed from valve on removal of valve from unit.

3. Connect hoses removed when valve was removed from unit.

* * * *

STEERING CHARACTERISTICS

PURPOSE

This portion is to help Service Personnel determine if a problem exists and what to do should difficulties arise with Ross Gear hydrostatic steering system.

CHARACTERISTICS OF THE SYSTEM

1. The system is designed such that two to three and one-half revolutions of the steering wheel is needed to turn the machine 180° or lock to lock. To accomplish this bring the hydraulic system temperature to approximately 150°, accelerate the engine to high idle with two or three fingers against a spoke, turn the wheel at a constant rate (about one revolution per three seconds).

   Due to system design orificing the tractor will turn at a speed commensurate to the engine pump flow. Turning the steering wheel at a faster rate will not turn the tractor faster but will result in high steering wheel effort.

2. Free movement of the steering wheel is normal if it is limited to approximately 45° of wheel travel, see Figure 1. This is the amount of movement necessary for the steering column pump to displace a quantity of oil great enough to shift the spools within the steering valves.

   If steering wheel free movement is excessive (1/2 to 1 turn at the wheel) valve leakage is occurring. This leakage occurs at two main areas. Spool leakage and cylinder overload relief setting too low, see Figure 2.

   A good check for excessive movement is as follows:

   A. Machine straight ahead, apply brakes, engine at low idle.

   B. Turn steering wheel slowly, system relief should occur (engine pulls down and steering wheel becomes difficult to turn) after the steering wheel has turned 1/4 to 1/2 revolutions.

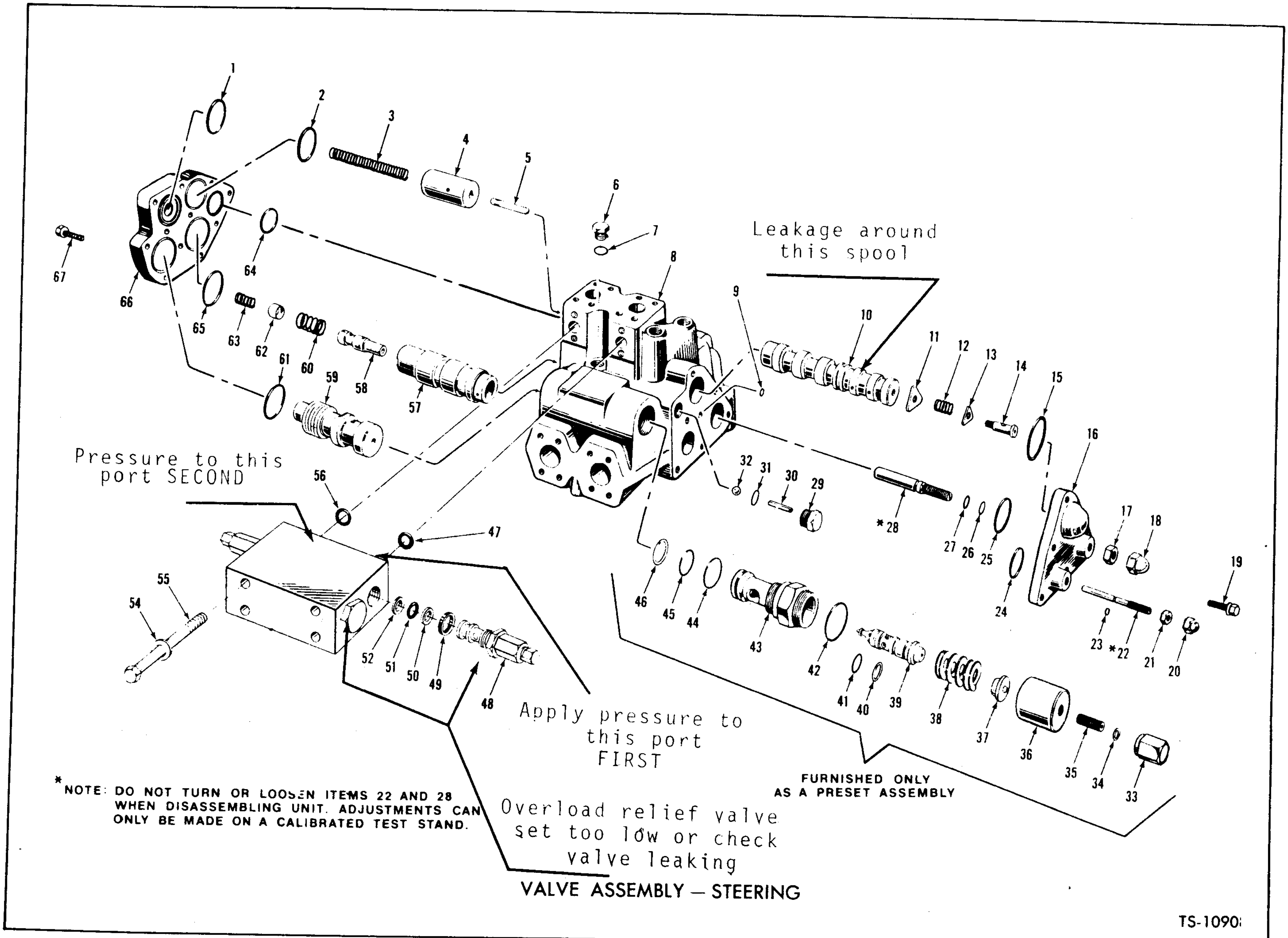

Leakage around this spool
Pressure to this port SECOND
Apply pressure to this port FIRST
Overload relief valve set too low or check valve leaking
FURNISHED ONLY AS A PRESET ASSEMBLY
*NOTE: DO NOT TURN OR LOOSEN ITEMS 22 AND 28 WHEN DISASSEMBLING UNIT. ADJUSTMENTS CAN ONLY BE MADE ON A CALIBRATED TEST STAND.
VALVE ASSEMBLY — STEERING
TS-1090

Figure 2

Excessive leakage allows one to freely turn the steering wheel 2 to 3 revolutions. Leakage can also be detected by driving the machine slowly over very rough ground in 2nd gear. Remove hands from steering wheel and watch steering cylinder movement. Maximum movement should be 1/4 to 3/8 inch. Leakage will also cause the machine to wander.

Causes of leakage:

A. Excessive clearance between spool, Item 10, Figure 2, and valve body.

This cannot be corrected in the field and the valve must be replaced.

B. Sticky spool, Item 10.

Contaminated oil will leave deposits of dirt around valve body lands and not allow spool to center, Figure 3. The valve may be disassembled and washed with clean solvent.

A rough sliding surface on Item 14, Figure 2, may cause sticking, if this is suspected one can polish the bolt, Figure 4, 5, and 6. Upon removal of valve end plate, Item 66, the spool should be flush with the valve body, Figure 7 and 8. This is neutral position. Push in slightly and let go. The spool should return to neutral. Avoid polishing spool and valve body lands as this will round off the square cut of the land which will cause more leakage, Figure 9.

C. Leaking checks and cylinder overload relief valves, Figure 10.

Cylinder overload relief valve setting should by 2600 - 3000 psi cracking pressure. This can be checked by removing relief assembly from the valve, Items 47 through 56, and with appropriate fittings attached and apply pressure with a Porta-Power to port 47 then 56.

Excessive leakage allows one to freely turn the steering wheel two to three revolutions. Leakage can also be detected by driving the machine slowly over very rough ground in 2nd gear. Remove hands from steering wheel and watch steering cylinder movement. Maximum movement should be ¼ to 3/8 inch. Leakage will also cause the machine to wander.

Causes of leakage:

A. Excessive clearance between spool, Item 10, Fig. 7, and valve body.

   This cannot be corrected in the field and the valve must be replaced.

Figure 10

Figure 8

Figure 11

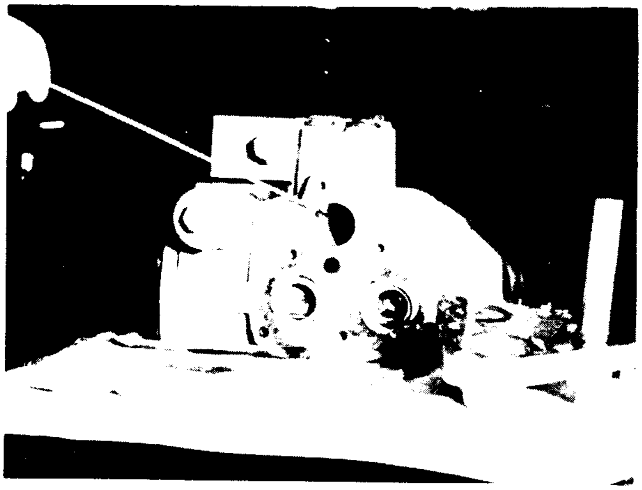


Figure 9

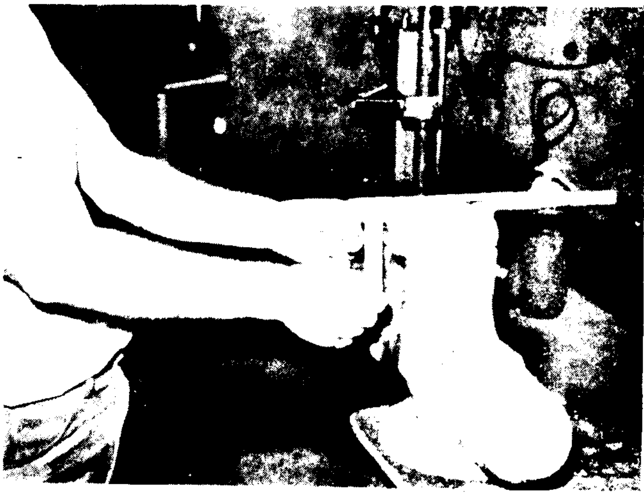


Figure 12

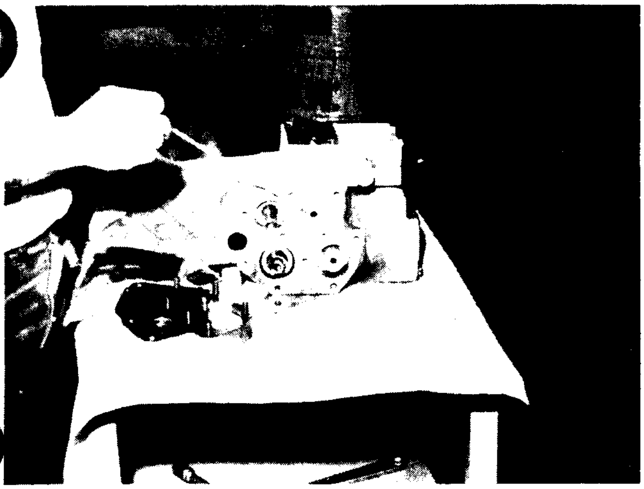


Figure 13

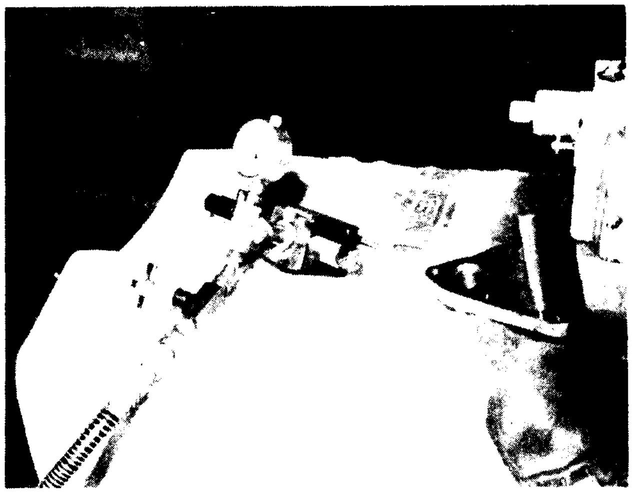


Figure 16

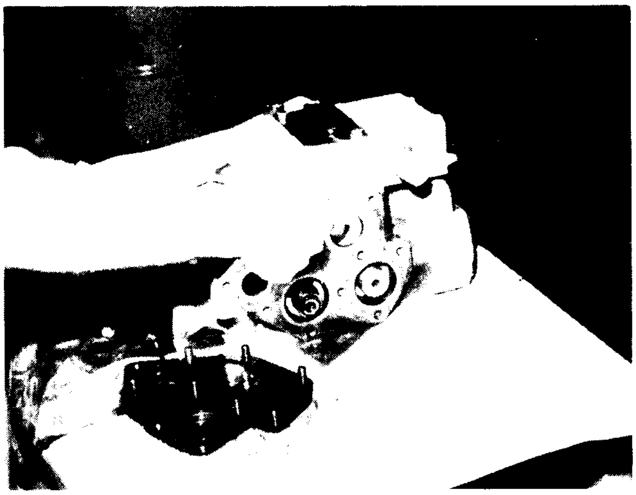


Figure 14

Figure 17

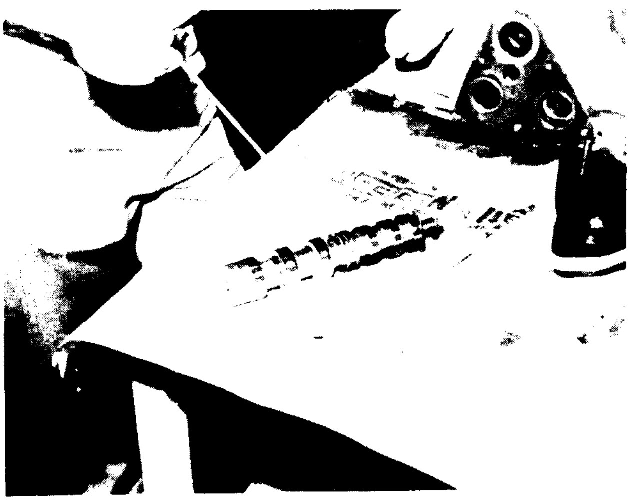


Figure 15

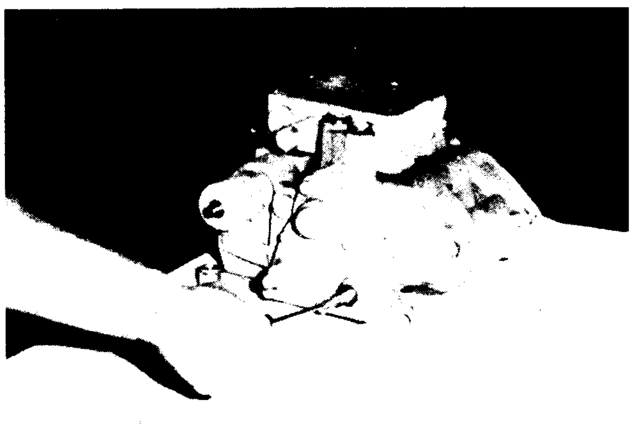


Figure 18

No leakage should occur while holding 2000 psi in the system. In extreme cases one can increase main relief, Figure 11, to 2900 psi turn against steering stop. This procedure is not recommended since maximum main relief is 2900 psi and cylinder overloads are nearly the same. <u>HIGHER MAIN RELIEF SETTING MAY DAMAGE THE VALVE.</u>

3. Because of entraped air (during assembly) in the hand pump loud "banging" or "thumbing" noises can be heard. This "banging" or "thumbing" usually occurs while turning the steering wheel at pressures less than relief. Air will also cause a "soft" or "spongy" feeling as well as erratic steering. The machine should not be operated under these conditions.

   To relieve the system of this air procede as follows:

   A. Determine if oil in the hydraulic tank is at the proper level.
   B. Start engine and check for steering system leaks.
   C. Accelerate engine to half throttle, operate scraper hydraulics to bring oil temperature to 150°F.
   D. With engine at half throttle turn machine against right steering stop, continue to turn steering wheel (it will turn hard) for several minutes (two to three). Turn machine against left steering stop. Again, continue to turn steering wheel for two to three minutes. Repeat until indications of air are gone.

Do not confuse this "banging" with over relief "banging". Over relief banging occurs after one has held the system against relief then releases the steering wheel. This "banging" is normal and will not harm the system.

4. When parking the tractor on a hard surface with the tractor in any degree of turn the tires will "wrapup" or will attempt to turn the tractor in the opposite direction. This is a result of the rubber in the tire being forced into tension and/or compression. The wheels will remain in this position as long as the steering wheel is not turned. If the steering wheel is moved with the engine not running the machine will steer a few inches until the tires "unwrap".
5. Valve adjustments are made at the factory on a calibrated test bench. However, if steer reaction time is slow one can turn adjustment screw, Figure 12, clockwise until slight jerk steer occurs. Caution should be used when doing this. Turning the adjustment to far will cause the machine to jerk steer or continually turn in a particular direction until the steering wheel is released or turned the opposite direction. One-fourth to three-eights turn is usually sufficient.
6. If it becomes necessary to disassemble the valve the following procedure should be followed:

Clean Work Conditions

It is a must that the system be kept free of dirt or foreign matter in the oil circuit. Cleanliness in servicing this power steering system is absolutely necessary.

If it is necessary to disassemble any of the units, make sure that a clean work bench or table is used.

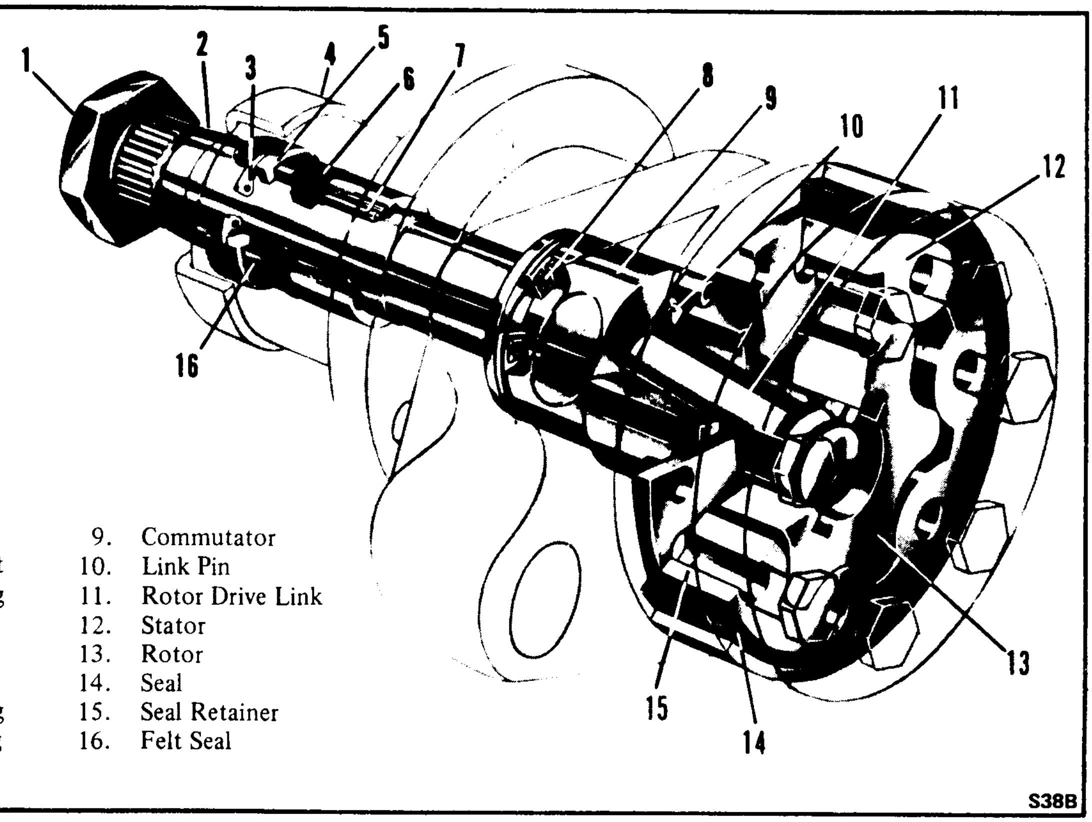
Outside dirt should be cleaned off before disconnecting lines.

Finish cleaning off outside dirt before placing on work bench.

When disassembled, parts should be cleaned in clear-clean petroleum base solvent and blown dry with clean, dry air. Avoid wiping valve and pump parts with cloth since lint may cause binding and sticking of closely fitted parts. Do not use carbon tetrachloride as it causes deterioration of rubber seals.

CLARK EQUIPMENT

HAND PUMP



1. Wheel Nut
2. Coupling Shaft
3. Retaining Ring
4. Water Seal
5. Washer
6. Seal
7. Needle Bearing
8. Thrust Bearing
9. Commutator
10. Link Pin
11. Rotor Drive Link
12. Stator
13. Rotor
14. Seal
15. Seal Retainer
16. Felt Seal

Fig. 1 – Cutaway View of Manual Pump

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The manual pump illustrated in Fig. 1 is a positive displacement, bidirectional rotary type. It is manually operated by the operator to control the direction of steering through normal steering action of the steering wheel.

The pump provides pressure when the steering wheel is rotated to actuate control valve spools. The pump also provides pressure for manual steering in the event of an inactive power pump caused by engine or pump failure.

Oil is metered to the steering cylinders by the manual pump to maintain the relationship between the steering wheel and the position of the steering cylinder rods.

The manual pump assembly is composed of two major elements: The rotor-type pumping element and the commutator (9). The rotor-type pumping element is composed of the stator (12) and the rotor (13). These components are connected to each other and to the steering wheel by means of the rotor drive link (11), coupling shaft (2) and commutator (9) drive pin.

OPERATION

Numbers in parentheses refer to Fig. 1.

The pump element consists of two primary parts; the stator (12) and the rotor (13). The stator (12) is designed to have seven concave configurations. These concave configurations serve as oil cavities during pumping action. Seven convex configurations are place diametrically opposite each configuration.

The rotor (13) has six lobes designed in a form similar to that of the stator (12) chambers. The rotor is designed so that each lobe has a diametrically opposite lobe; therefore, when one rotor lobe is in a cavity of the stator (12) its opposite lobe is at the crest of the stator's convex form opposite the cavity. As the rotor (13) is rotated, each lobe in sequence is moved out of its cavity to the crest of the stator's convex form, forcing each opposite lobe in sequence into a stator (12) cavity. See Fig. 2 for an illustration of rotor operation and for commutator rotation later in this section.

Due to the interaction between the rotor (13) and the stator (12), there are 42 fluid pumping actions in one complete rotation of the rotor (13). When the rotor (13) is rotating, oil is continuously flowing out of three of the cavities while three other cavities are continuously admitting oil to the pumping element. One cavity of the seven is inactive as it changes from a pressure cavity to a suction cavity.

The commutator (9) is a rotary spool which channels the oil from the pumping element to the pump pressure port and the oil moving from the pump suction port to the pumping element. As the steering direction changes, the pressure and suction ports in the pump change places, i.e. the suction port in a left turn becomes a pressure port in a right turn, and vice versa.

In the end of the pump body to which the pumping element is attached, seven channel holes are drilled. The location of these seven holes coincides with the location of the seven concave configurations of the stator (12). These seven holes lead internally to the commutator (9). Internally, the pump body incorporates two circular sections, each of which leads to one of the pump ports.

The commutator (9) design incorporates six holes and six slots alternately and equally spaced around its outer diameter. See Fig. 2 "Commutator Operation". The commutator hole locations are such that they coincide with the axial locations of the seven holes in the pump body bore. The holes in the pump body are, as mentioned in the above paragraph, aligned with the seven holes in the stator (12). The six holes of the commutator (9) lead through the commutator walls to the inner center space in the commutator. The inner center space is connected to the upper circular channel of the pump body and its connecting external port.

The rotor drive link (11) sometimes called the toggle bar, links the rotor to the coupling or input shaft (2). The steering wheel is attached to the coupling or input shaft (2) by a rigid shaft attached to the steering wheel at one end and driving the coupling or input shaft (2) through a universal joint arrangement. Manual effort is applied through the steering wheel to the rotor (13). This effort produces the pressure differential in the line to the control valve. This pressure differential actuates the valve spool that, when actuated, directs high pressure oil from the power pump to the manual pump. The high pressure oil from the power pump enters the external intake port of the manual pump. This oil flows through the commutator holes to the intaking fluid cavities in the stator (12). See Fig. 2. This action and oil flow pattern continues as long as the manual effort is applied to the steering wheel. As soon as manual effort ceases to be applied, the pressure differential ceases to exist, the valve spool centers, and the oil becomes static, except that which is moving from the power pump into the valve and back directly to the reservoir.

As the steering wheel is rotated clockwise, as in a right hand turn, oil enters the external port connected to the lower circular channel in the pump body. Oil flows through the commutator (9) slots and three of the seven pump body holes to the intaking fluid cavities. The three discharging (pressure) cavities allow flow through three of the seven pump body holes to deliver oil to the inner center space of the commutator to the upper circular channel of the pump body and its connecting external port. The above flow pattern is reversed for a left turn.

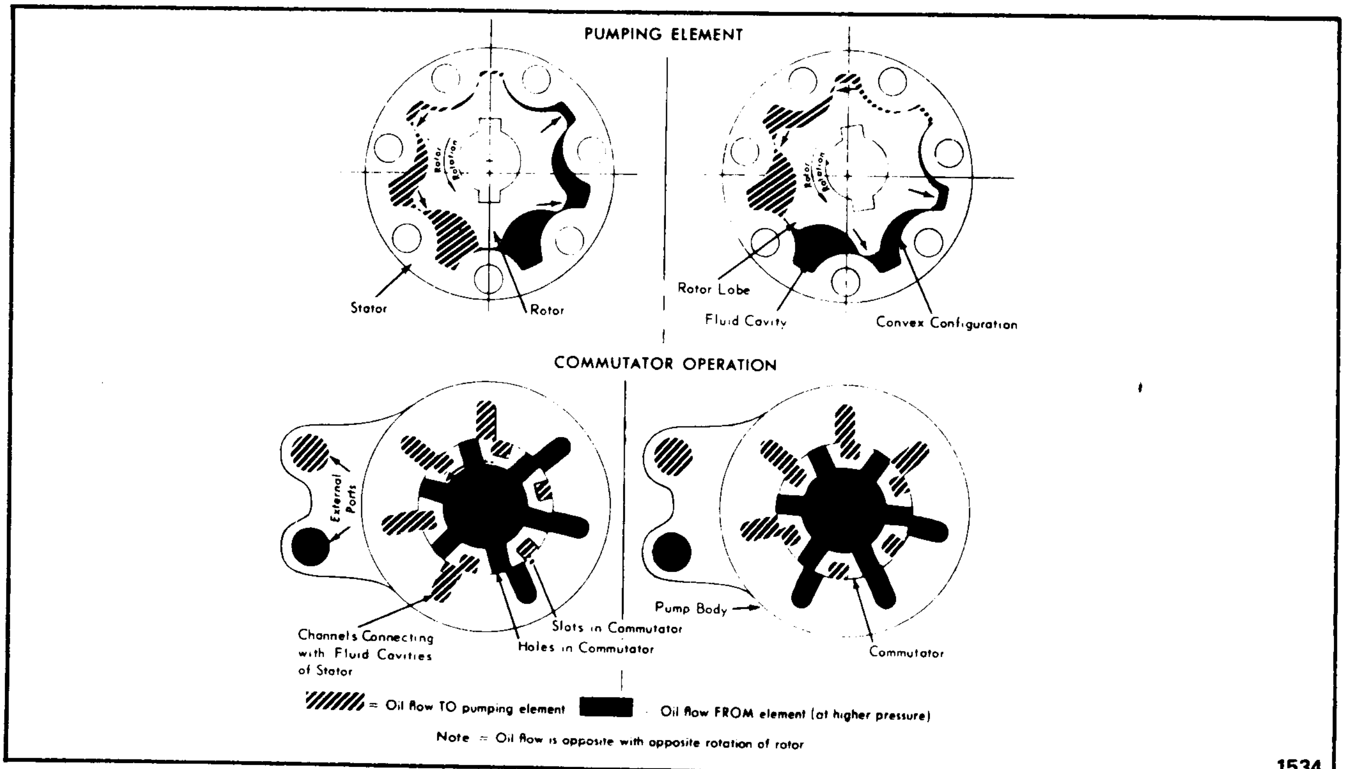


Fig. 2–Rotor Operation and Coincidental Rotation of Commutator

REMOVAL

1. Remove steering pump access panel located in front of and just below the level of the cockpit floor.
2. Remove u-bolt that holds steering column to the dash.
3. Remove bolts fastening steering column base to the floorboard.
4. Pull the complete steering column and pump assembly up into the cockpit, far enough to reach hose fittings.
5. Remove surface dirt from steering pump as thoroughly as possible and disconnect manual pump hoses, label right and left, and plug the hoses and pump ports.
6. Remove steering wheel by removing cover plate and nut.
7. Loosen lower steering column clamp assembly and slip column jacket tube up so that the coupling connecting pin can be removed.

DISASSEMBLY

Numbers in parentheses refer to Fig. 3.

1. Plug both port holes and clean exterior thoroughly. After exterior has been thoroughly cleaned and dried, the plugs may be removed.

   WARNING: The internal parts in this unit are finely finished. The lapped surfaces could be easily damaged by careless handling.

2. Remove water seal (21) and remove and discard felt seal (20).
3. Grip pump body (13) in a vise. Secure in vise across the mounting flange with the bottom end facing upward.
4. Remove bolts (1) securing lower end plate (2) to pump body (13).
5. DO NOT attempt to pry or hammer end plate (2) loose. The end plate should be gently bumped sideways with a soft hammer to loosen its connection with the stator. Wrap end plate (2) in plastic or waxed paper. Place masking tape or thick paper around O.D. of end plate (2) to protect edges.
6. Lift off seal retainer (3) with seal (4). It may be necessary to lightly bump the retainer (3) to loosen it. Protect edges against nicking and scratching.
7. Lightly tap stator (5) sideways to loosen its connection with the spacer plate (6). Wrap to protect against damage.

   NOTE: The stator (5) and rotor (5A) must be kept in a matched set.

8. Lift out the rotor drive link (8) with pins (7) and commutator (9) and pin (8A). Separate all parts and lay aside.
9. Remove coupling shaft (10).
10. Remove needle thrust bearing (11) and bearing race (12).
11. Invert pump body (13) in vise and secure with coupling shaft end facing upward.
12. Remove snap ring (19). After removal of snapring (19), the washer (18), nylon spacer (17) back-up ring (16) and seal (15). Discard seal (15) and back-up ring (16).
13. Do not remove needle bearing (14) from pump body (13) unless bearing is to be replaced. If needle bearing is to be removed, it must be replaced with a new one on assembly. If it is necessary to replace the needle bearing (14), an arbor of proper diameter must be used. The bearing must be pressed out toward the bottom end. Be sure to protect the lapped surface of the pump body (13) by resting body on a piece of wood. Take care to avoid damage to bore above bearing.

INSPECTION FIG. 3

Visually inspect all parts for general good condition. Inspect the following lapped surfaces for abnormal wear or scoring:

PUMP BODY

Inspect commutator (9) bore. Inspect shaft bore in seal area, commutator (9) outside diameter. Inspect spacer plate (1) and end plate (2) for abnormal wear.

NOTE: A polish pattern on the rotor side of these plates due to rotor action is normal; circular marks on the spacer plate due to commutator contact is normal.

ROTOR SET

Use a feeler gage to check the pumping element as shown in Fig. 4. If there is more than .005" clearance, the pumping element will have to be replaced. Use a micrometer to measure the thickness of the stator (5) and rotor (5A). If rotor thickness is more than .002" less than the thickness of the stator, the pumping element must be replaced.

Metering element (5) requires special attention in handling to avoid nicks and scratching and it is recommended that the rotor (5B), stator (5A), vanes (5D) and springs (5C) be checked in the assembled condition. To inspect the metering element, place the assembly, face down, on the lapped face of the end plate (2) and check for freedom of rotor rotation within the stator. The actioh of the spring loaded vanes may be observed during rotation and the vanes should move freely in their slots, without bind, due to the forces of the springs.

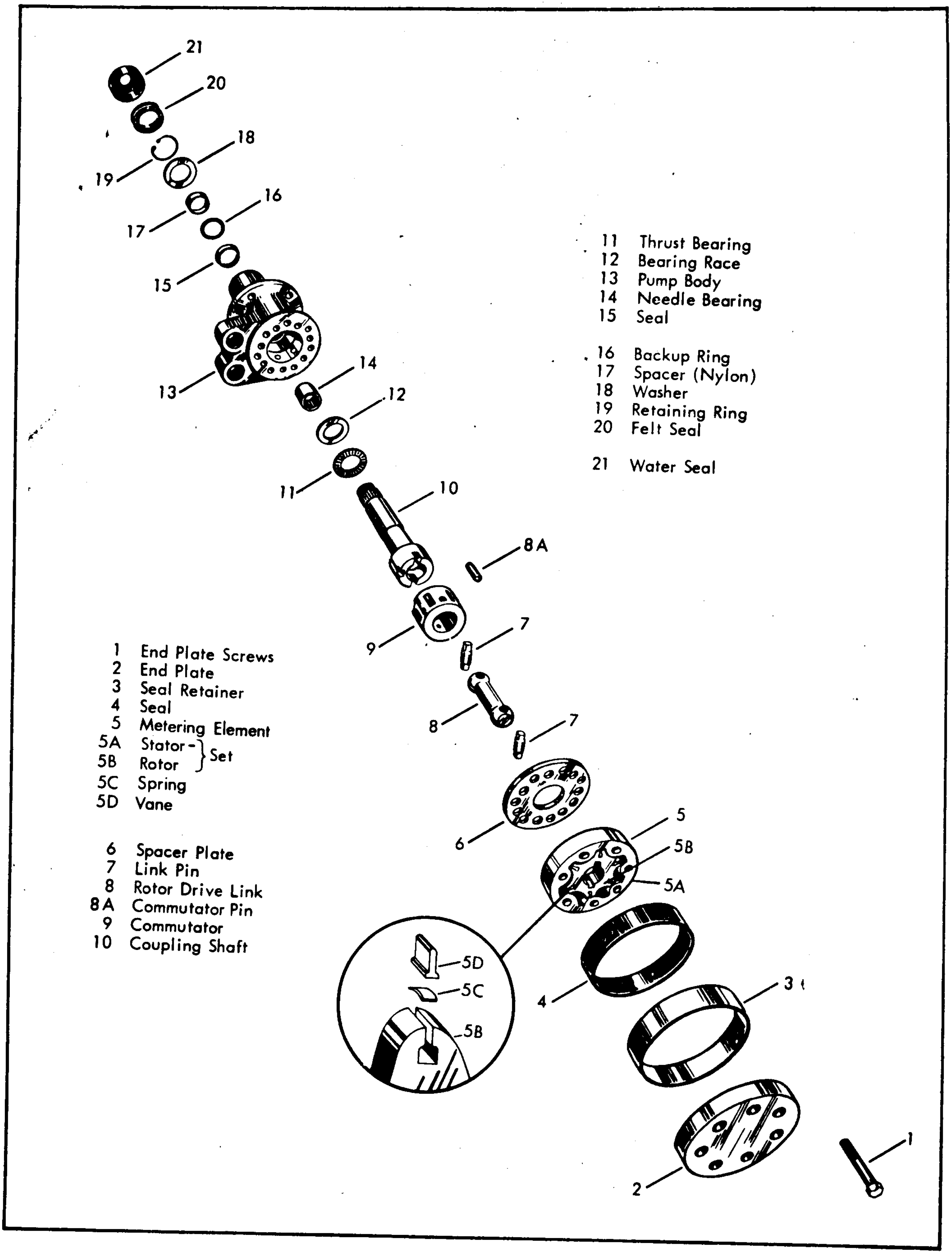


Fig. 3–Exploded View of Manual Pump

COUPLING SHAFT

Use an inside micrometer or telescoping gage to compare the body (13) bore with the large end of the coupling shaft (10). A difference of more than .006" is unsatisfactory and the part showing the excessive wear should be replaced. Inspect the coupling shaft (10) for signs of unevenness or score marks at the thrust bearing, needle bearing, and seal contact areas. Replace the shaft (10) if wear is excessive.

IMPORTANT: Before beginning assembly, clean all parts with clean petroleum base solvent and air dry. DO NOT wipe dry with rags! Remove all dried paint from edges of lapped surfaces. Unless otherwise indicated, DO NOT oil parts before assembly. All sealing of one body component to another is dependent on lapped surfaces and seepage may occur as a result of dust retained in an oil film.

Numbers in parentheses refer to Fig. 3.

1. If needle bearing (14) was removed, press replacement bearing into pump body (13) FROM BOTTOM END (protect surface of bottom end face of pump body). Press against hardened end of bearing shell on which bearing part number appears. See dimension drawing for mandrel in Fig. 5. Press slowly and make sure bearing is not misaligned in bore. Press bearing (14) into specific location shown in Fig. 5 measured from lower end face of pump body (13) to lower end of bearing (14). Bearing rollers MUST turn freely after installation.

2. Carefully secure pump housing (13) in vise across mounting flange with bottom end up.

3. Assemble needle thrust bearing (11) and bearing race (12) to coupling shaft (10). Assemble coupling shaft into pump body (13). Seat coupling shaft against bearing and make sure shaft turns freely.

ROTOR DRIVE LINK PINS

Inspect for unusual wear and surface condition of of rotor drive link pins (7) and pin holes of link (8). Check the condition of thrust bearing (11), bearing race (12), and oil seal retainer parts (18 & 19).

4. Assemble pin (7) in one end of rotor drive link (8) and install pin into slot of coupling shaft (10).

5. Assemble pin (8A) into commutator (9). Hold in place with oil soluble grease.

6. Lightly oil commutator bore with clean oil of the same type to be used in the hydraulic system. Install commutator (9) into commutator bore and engage driving pin (8A) in one of the driving slots of the coupling shaft (10). DO NOT engage pin in shallow slot.

   NOTE: Commutator must be carefully inserted with a slight rotary motion to avoid cocking and seizing.

7. Install spacer plate (6) on end face of pump body (13) and align the two pieces so that the channel bores and bolt bores of the two pieces coincide.

8. Assemble pin (7) in upper end of rotor drive link (8).

9. Install rotor (5A) on spacer plate (6) and engage rotor (5A) with pin (7). Set stator (5) in place over rotor (5A) and align bolt bores.

10. Lightly lubricate edges of seal (4) with oil soluble grease. Install seal (4) with seal retainer (3) to outer diameter of rotor set and spacer plate (6).

11. Install end plate (2) on rotor set. Lapped face of end plate (2) must face rotor set. Align bolt bores.

12. Install bolts (1) loosely with finger torque. Evenly and alternately tighten bolts to 18 to 22 ft. lbs.

    NOTE: When tightening with wrench, occasionally rotate coupling shaft (10) to insure that it is not binding as the assembly is tightened. If the coupling shaft does not turn evenly after the screws are tightened, back off and retighten the bolts. Some drag is normal since the unit was assembled dry. If stickiness or binding cannot be eliminated, disassemble the pump and check for foreign material, nicks or burrs between the elements of the rotor set, or on other lapped surfaces.

13. Invert pump and secure in vise with coupling shaft (10) facing upward.

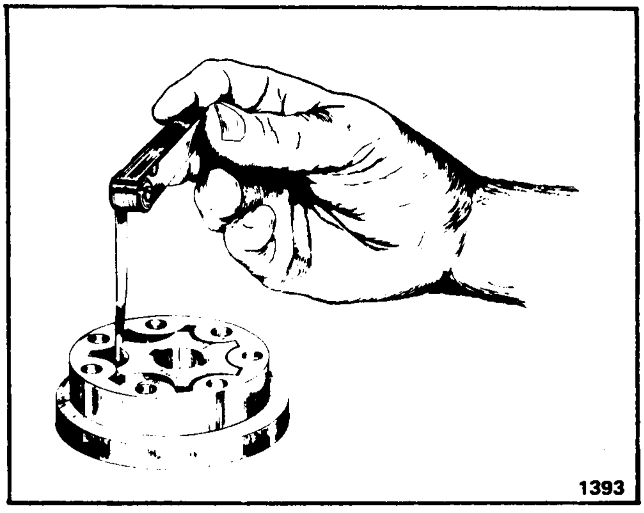


Fig. 4–Measuring Rotor-Stator Clearance

14. Lubricate new seal (15) with oil soluble grease and gently install with sealing lip in.

    CAUTION: Take care not to damage lip of seal when passing seal over shaft threads and splines. When seal is installed, make certain that sealing lip is not turned backwards, a condition which would impair the sealing ability of the seal. DO NOT use sharp tools for seal installation.

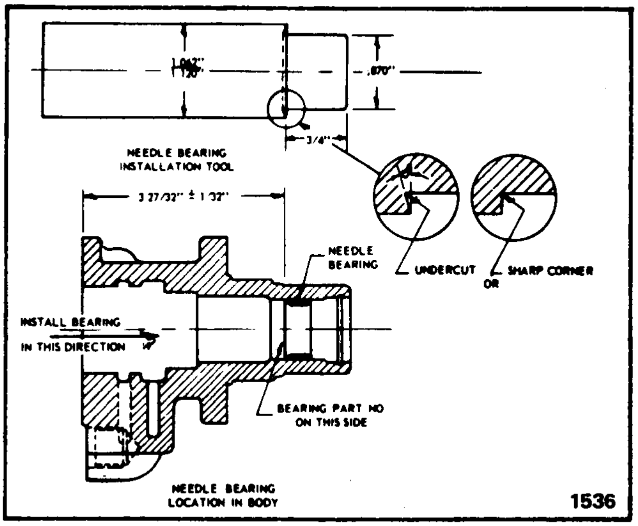


Fig. 5–Needle Bearing Installation

15. Assemble new back-up ring (16), spacer (17) and washer (18) into body and secure with retaining ring (19). Be sure the rounded edge of the retaining ring (19) is facing inward.

16. Install new felt washer (20) and water seal (21).

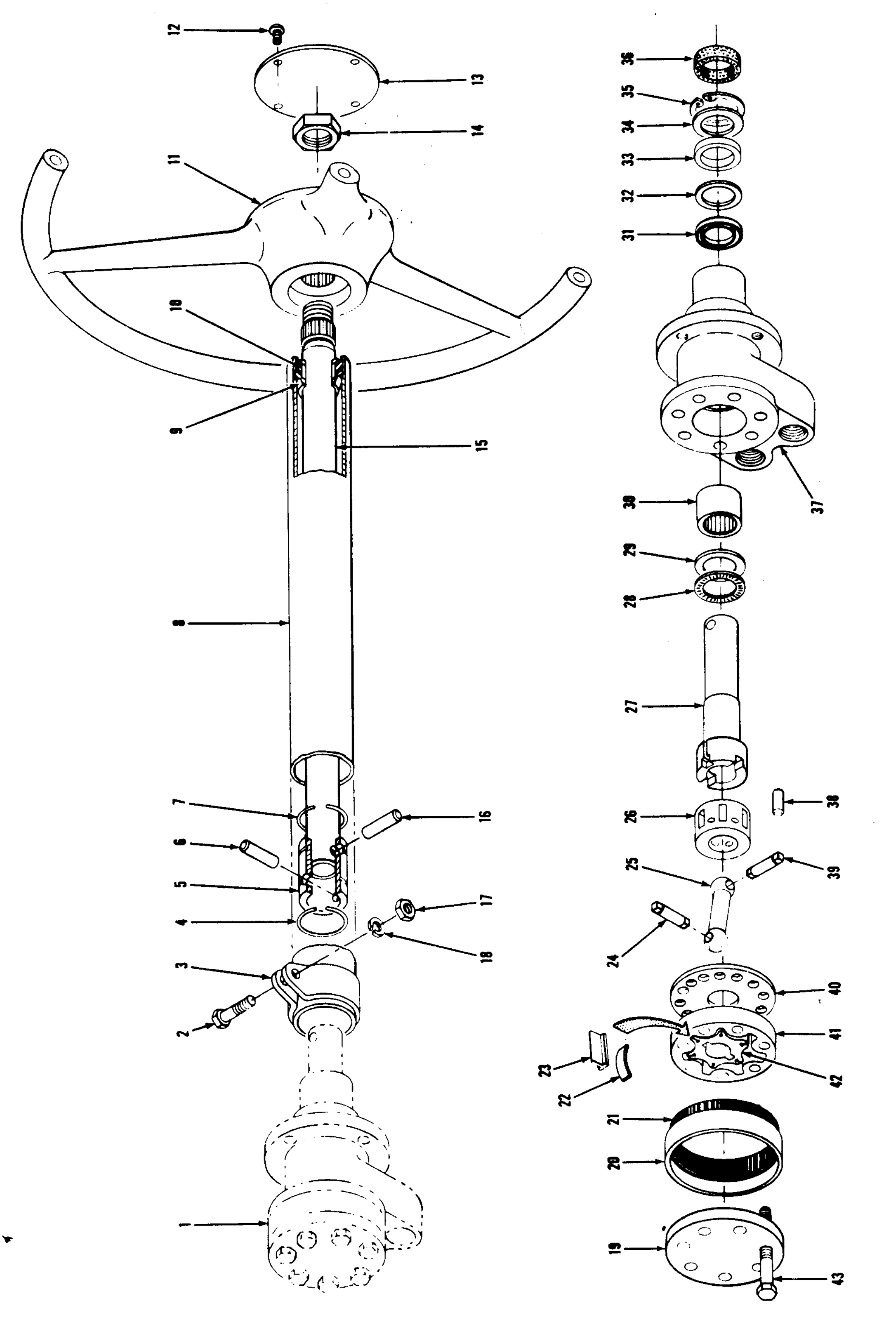
17. Fill pump with clean oil of the same type used in the hydraulic system. Turn the drive shaft until the oil appears at both pump ports.

18. When oil is visible at both pump ports, plug the ports to prevent the entry of dirt into the manual pump and subsequently into the hydraulic system of the entire unit.

INSTALLATION

Reverse the removal procedure for installation.

* * * *



TS-10846

STEERING COLUMN & PUMP ASSEMBLY

STEERING COLUMN AND PUMP ASSEMBLY

Item	Description	Qty.
A	STEERING COLUMN & PUMP ASSY (Inc 1 thru 46)	1
B	SEAL KIT, Pump Shaft (Inc 3l, 32 & 33)	1
1	PUMP, Hydrostatic (Inc 19 thru 46)	1
2	BOLT, Clamp	1
3	CLAMP ASSY (Inc 2, l7 & l8)	1
4	RING, Pin Retaining	1
5	COUPLING, Shaft	1
6	PIN, Connecting	1
7	RING, Pin Retaining	1
8	TUBE ASSY JACKET (Inc 9 & 10)	1
9	BUSHING & RETAINER ASSY (Inc 10)	1
10	§BUSHING (See 8 & 9)	1
11	WHEEL, Steering	1
12	SCREW, Plate Attaching	4
13	PLATE, Operating Precaution	1
14	NUT, Steering Wheel	1
15	SHAFT, Steering Wheel	1
16	PIN, Connecting	1
17	NUT, Clamp	1
18	LKWSHR	1
19	COVER, Pump End	1
20	RETAINER, Seal	1
21	SEAL, Rotor	1
22	§SPRING, Vane (See 42)	6
23	§VANE (See 42)	6
24	PIN, Link	1
25	LINK, Rotor Drive	1
26	§COMMUTATOR (See 37)	1
27	SHAFT, Pump	1
28	BEARING, Thrust	1
29	RACE, Bearing	1
30	BEARING, Needle (See 37)	1
31	§SEAL, Shaft (See 'B')	1
32	§RING, Seal Back-Up (See 'B')	1
33	§SPACER, Shaft Seal (See 'B')	1
34	WASHER, Shaft	1
35	RING, Seal Retaining	1
36	SEAL, Felt Shaft	1
37	BODY ASSY, Pump (Inc 26, 30 & 38)	1
38	PIN, Commutator (See 37)	1
39	PIN, Link	1
40	PLATE, Spacer	1
41	§STATOR (See 42)	1
42	ROTOR ASSY (Inc 22, 23 & 41)	1
43	BOLT, End Cover to Pump Body	7
44	†BOLT, Pump Mounting	4
45	†LKWSHR, Pump Mounting	4
46	†WASHER, Pump Mounting	4

† Not Illustrated
§ Not Sold Separately

110-15 SUSPENSION SYSTEM

GENERAL OPERATION

The suspension system consists of two suspension arms which are pivoted from the tractor frame in rubber bushed bearings. The drive axle is bolted to the arms which are pinned through hydraulic cylinders back to the mainframe. A stabilizer bar is pinned transversely from the axle housing to the mainframe. Self-aligning bearings are used in the cylinder ends and stabilizer ends. Bonded rubber stops on the frame serve as limit stops.

An engine driven pump transmits oil from the hydraulic tank through a filter to the head end of the suspension cylinders which are teed into a piston type accumulator charged with dry nitrogen. The oil is routed back to the reservoir through an orifice valve built into the barrel of one of the cylinders. The rod ends of the cylinders are plumbed back to the reservoir to assure lubrication of the rod gland, to prevent piston seal leakage from dripping externally and to add damping to the circuit. The adjustable orifice in the cylinder head end return passage limits the rate of flow back to reservoir when the poppet valve is open.

FUNCTION AND ADJUSTMENTS ON THE 110-15 SUSPENSION SYSTEM

1. PUMP

   Maintains constant oil supply to system for proper operation and compensates for any leakage from the working side (base) of the cylinder. For servicing see section on pump.

2. RELIEF

   Protects pump, if for any reason flow return to tank becomes blocked or adjustment screw is turned in fully through error. Will allow cylinder to bottom if relief setting is lower than operating PSI of system. Should always be set at proper setting. For servicing, see section on relief valve.

3. RELIEF VALVE ADJUSTMENT

   Remove hose and adapter from outlet end of inline filter and insert plug in the end of filter and cap hose. Remove plug from top of relief valve and insert gauge. Start and run engine, and take pressure reading. Gauge should read 2250 - 2300 psi. If pressure is above maximum or below minimum, adjust by turning screw located on relief valve.

4. INLINE FILTER

   Inline filter traps foreign particles in oil before they enter accumulator and suspension cylinders. A relief valve in filter allows flow to bypass the filter element at a differential pressure which cracks relief at 80 PSI. A 40 micron filter element is available for periodic changing every 250 hours to prevent excessive build-up of pressure from accumulation of foreign matter and crushing the element. For servicing see section on inline filter.

FUNCTION AND ADJUSTMENTS ON THE 110-15 SUSPENSION SYSTEM (Continued)

5. JUNCTION BLOCK (Orifice Valve)

Adjusting screw left-hand cylinder controls rate of flow of oil through the cylinder for proper balance of oil flow over internal poppet valve and out orifice to tank.

A. Remove acorn nut and jam nut, then turn adjusting screw in junction block on left-hand suspension cylinder in until it bottoms out and is completely closed.

B. Start engine and hold it at high idle with transmission in neutral. The suspension cylinders should fully extend approximately 4-1/2" and stop at the extreme top position.

C. Turn the adjusting screw out, which allows the suspension cylinder to collapse until the plunger in the left cylinder contacts the base end of the cylinder. This is about half stroke on the rod and it can be felt because the unit will stop its downward movement.

D. Turn the adjusting screw in until the suspension cylinder just begins to raise above this center position approximately 1/8" to 1/4".

E. Lock the adjusting screw in this position. The cylinder should hold this position at both high and low idle.

Adjustment in too far will raise the machine too high and may go over relief valve due to complete blockage of pump flow.

Adjustment out too far will allow the plunger to ride against the cylinder base end at all times, which may cause a hydraulic chatter. If the orifice valve is properly adjusted as per the above procedure, no improvement in the ride quality can be achieved by further adjustment of this valve. For servicing the suspension cylinder, see section on Suspension Cylinder.

6. ACCUMULATOR

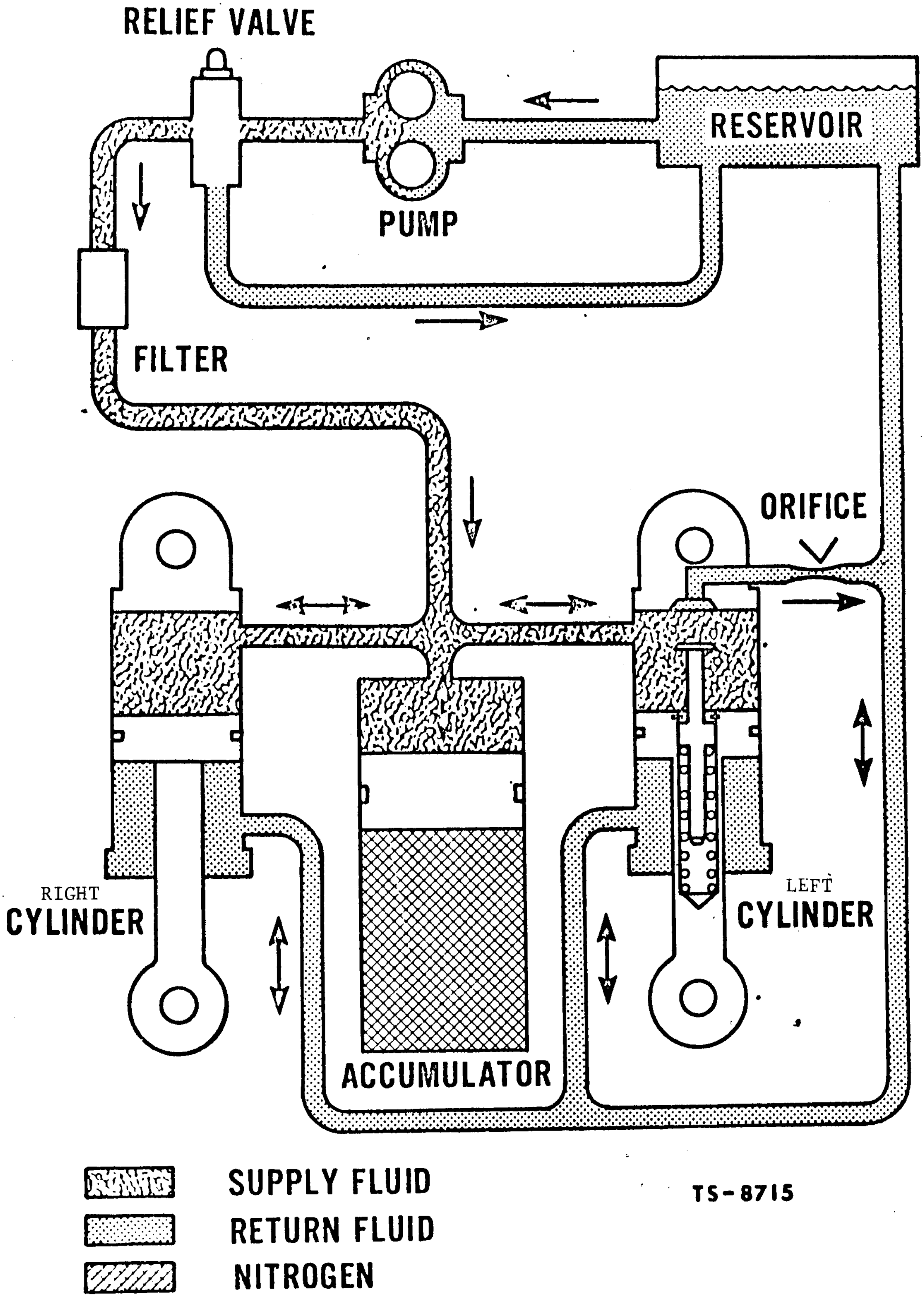
Functions as a spring in the system. Reducing the nitrogen precharge pressure in the suspension accumulator will not soften the ride. It should be set at 475 psi and left at that setting. For servicing, see section on Accumulator.

7. INOPERATIVE SUSPENSION

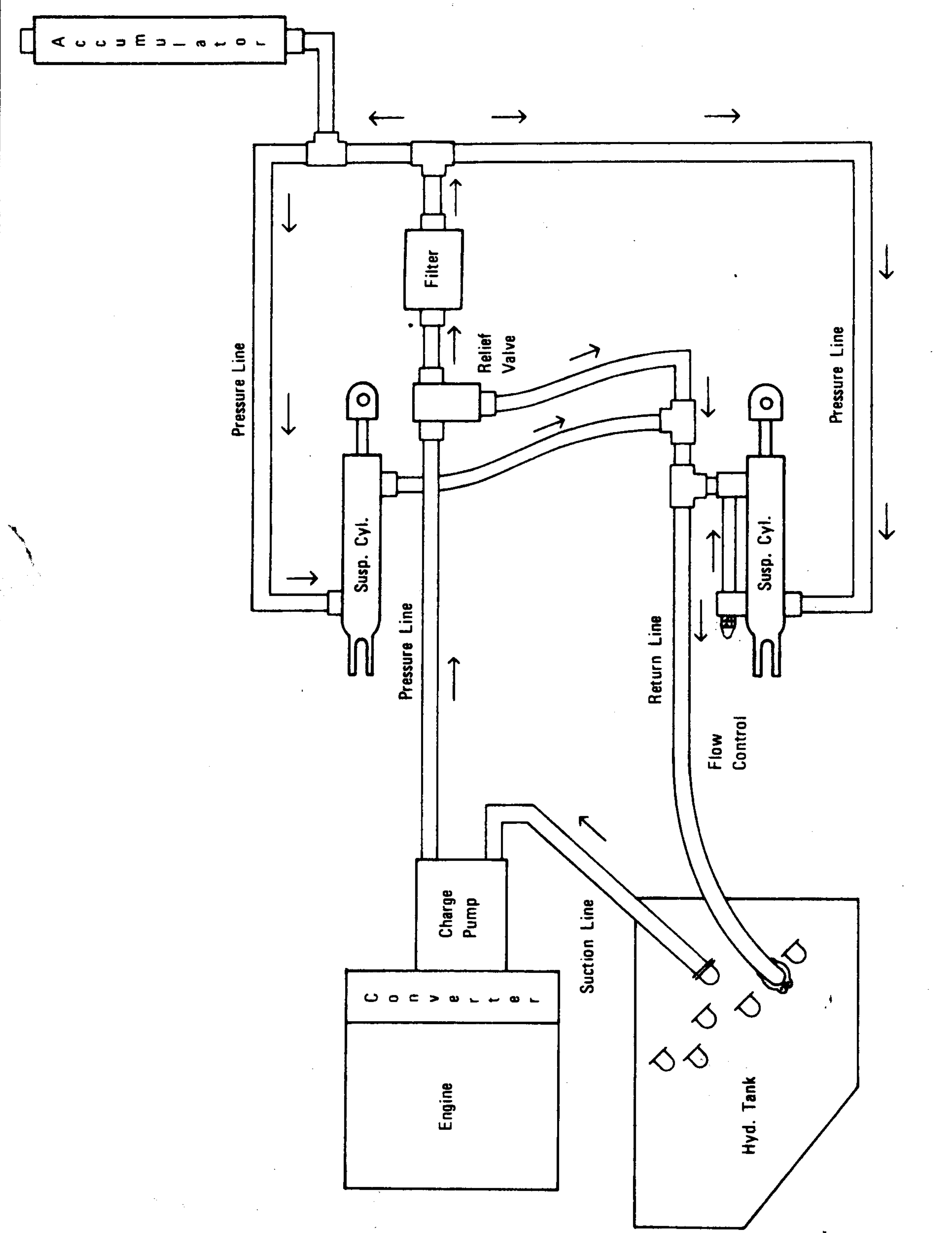
The machine should not be operated with the suspension inoperative, except to run it in for repair at low travel speed, and then only for a short distance, and the relief valve adjustment should be screwed out so the suspension arms will ride on blocks. This will prevent excessive heat build-up due to the oil going over the relief valve at high pressure.

8. LEFT-HAND CYLINDER ROD POPPET VALVE, INTERNAL

Controls centering height of cylinder extension at 2-1/2", not adjustable. For servicing, see section on Suspension Cylinder.


RELIEF VALVE
PUMP
RESERVOIR
FILTER
ORIFICE
RIGHT
CYLINDER
LEFT
CYLINDER
ACCUMULATOR
SUPPLY FLUID
RETURN FLUID
NITROGEN

TS-8715



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110-15 YD. SUSPENSION HYDRAULIC CIRCUIT

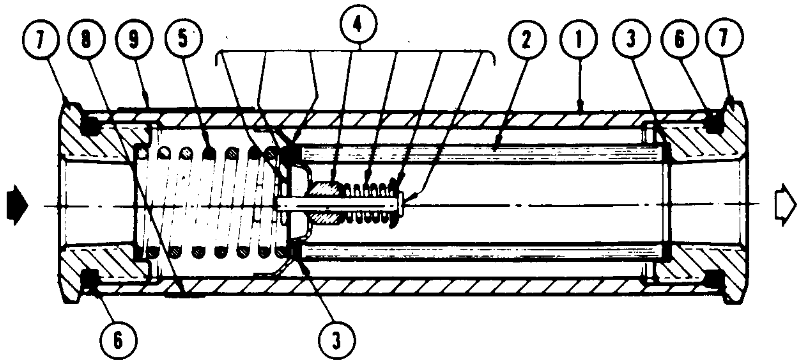
SUSPENSION SYSTEM TROUBLE SHOOTING

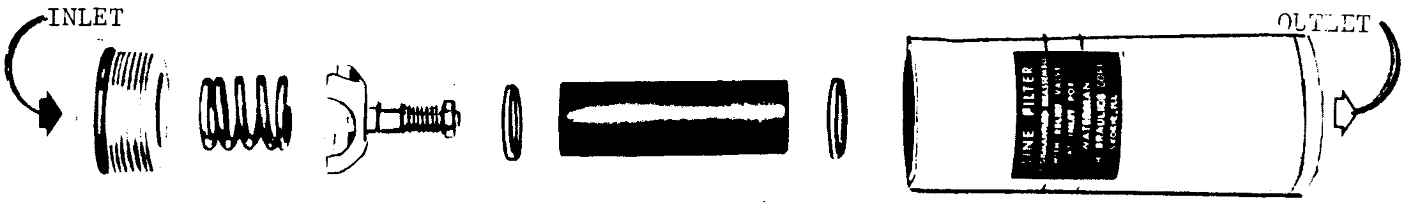
TROUBLE	CAUSE	REMEDY
1. Oil heating	a. Oil supply low. b. Contaminated oil. c. Oil in system too light.	a. Fill reservoir. b. Drain reservoir and refill with clean oil. c. Drain reservoir and refill with proper viscosity oil.
2. Oil foaming.	a. Low oil level. b. Air leaking into suction line. c. Wrong cause of oil.	a. Fill reservoir. b. Check for damaged or missing "o" rings and replace. c. Drain and fill reservoir with non-foaming oil.
3. Noisy pump caused by cavitation.	a. Oil supply low. b. Oil too heavy. c. Leak in suction line. d. Restriction in suction line.	a. Fill reservoir. b. Change to proper viscosity oil. c. Check for damaged or missing "o" rings and replace. Tighten fittings. d. Clean line and check for collapsed hose.
4. Pump shaft seal leakage.	a. Worn shaft seal. b. Broken diaphragm seal. c. Bearings out of position. d. Excessive internal wear.	a. Replace shaft seal. b. c.& d. If replacing the shaft seal not stop leakage, the pump should be disassembled and checked for items b.,c.,d.
5. Suspension cylinder will not raise off blocks, or they bottom out too easily when the scraper is being loaded, causing an uneven cut.	a. Suspension orifice valve out of adjustment b. Relief valve setting too low. c. Oil filter plugged. d. Defective suspension pump. Check flow. e. Defective pump drive adapter on engine.	a. Adjust the adjusting screw in block on left hand cylinder. b. Check and set relief valve at 2250 - 2300 PSI. c. Suspension filter should be serviced. d. Replace or repair suspension pump. e. Replace or repair defective parts.

SUSPENSION SYSTEM TROUBLE SHOOTING

TROUBLE	CAUSE	REMEDY
6. Suspension cylinder stays extended out at full stroke. <u>Note</u>: This will cause hydraulic oil to heat.	a. Suspension orifice valve out of adjustment. b. Broken snap ring allows plunger inside rod to stay seated, blocking passage of oil as rod is extended.	a. Adjust the adjusting screw in left hand cylinder. b. Remove left hand suspension cylinder and repair.
7. Tractor suspension system gives an inferior ride.	a. Orifice valve out of adjustment. b. Relief valve setting too low. c. Incorrect gas pressure in accumulator. d. Oil filter plugged. e. Defective suspension pump.	a. Adjust orifice valve screw. b. Correct relief valve setting. c. Recharge accumulator to 475 PSI. d. Service suspension filter. e. Repair or replace pump.
8. Suspension cylinder leaking around rod end of cylinder.	a. Monoseal, "o" ring, or backup ring worn or damaged.	a. Disassemble cylinder and install cylinder repair kit, P/N 1577635.
9. Suspension cylinder leaking around adjustment screw on orifice valve.	a. Flat copper washers missing. b. Foreign matter between washers and mating surface. c. Incorrect flat copper washer installed.	a. Replace washers. b. Clean surface. c. Replace with correct flat washer.
10. Hydraulic chatter in the suspension system, erratic movement up and down, and tires jerking and making noise like trouble is in driveline.	a. Orifice valve out of adjustment. b. Air entrapped in circuit.	a. Adjust orifice valve screw. b. Crack open plug on relief valve and bleed air.

INLINE FILTER SERVICE





Unscrew cap at inlet end to remove other parts

The inline filter contains a 40 micron element which should be serviced every 250 hours at same time other filters are serviced on the machine. The removal and replacement of element is as follows:

1. Disconnect hose from adapter in outlet end of filter and cap hose.

2. Hold inlet end of filter on hexagon shoulders with a wrench and unscrew filter body.

3. Remove spring, relief valve assembly, gaskets, and old element from filter body.

4. Discard old element. If gaskets are damaged, replace with new parts.

5. Clean filter body and parts and reassembly filter on machine.

6. Inspect "o" ring on inlet cap and replace if damaged.

7. Start machine after reassembly of filter and check for leaks.

ACCUMULATOR SERVICE

The accumulator is the spring in the system. It is sized and precharged so that its nonlinear spring rate allows the desired suspension travel for all axle loadings.

Periodically it is necessary to check the Accumulator Precharge Gas Pressure and recharge same, as required. This operation should be performed every 500 operating hours or at 90-day intervals, whichever occurs first. Accumulator should only be recharged with dry nitrogen gas.

IMPORTANT: Do not use gases of a combustible nature such as acetylene, hydrogen, etc.

Accumulator may be recharged either on the job site or by removing same and transporting same to location where dry nitrogen gas is available. Before removing accumulator or recharging same in place on machine, it is an absolute necessity that pressure in the applicable hydraulic system be bled off or relieved. This may be accomplished by following procedure as outlined below.

Recharging can be accomplished by a local welding supply house or a bottled gas distributor, however for your convenience when operating on job sites some distance from sources for nitrogen gas, a Checking and Charging Device, Part No. 944283, has been made available. This device, as shown in illustration herein, should be ordered through your MICHIGAN Distributor. This device is attached directly to a nitrogen tank or cylinder and the accumulator checked and recharged as outlined in instructions herein. A cylinder of dry nitrogen gas can be procured from a local welding supply house or bottled gas distributor.

CHECKING ACCUMULATOR PRECHARGE

1. Shut engine off and wait until unit settles down, with suspension arms resting on their stops.

2. Remove gas valve protector plate or caps from accumulator. See Figure 21.

3. Turn handle on regulator valve of Charging and Checking Device No. 944283 in counterclockwise direction until all tension on the regulator diaphragm is relieved.

4. Turn T-handle valve on gas chuck of Checking Device all the way out by turning in counterclockwise direction.

5. Attach gas chuck to accumulator, using wrench to tighten swivel nut.

6. Turn T-handle on gas chuck all the way in by turning in clockwise direction to depress valve core in gas valve. Reading obtained on regulator gauge indicates Accumulator Prehcarge Gas Pressure.

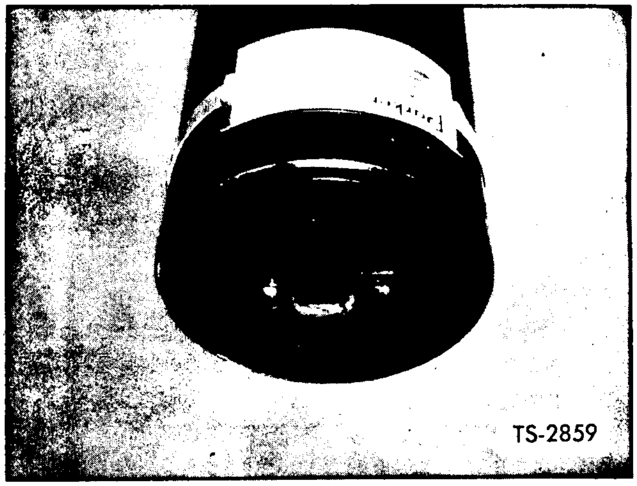


Fig. 21. Accumulator — Gas Valve End

Precharge Gas Pressure should be 475 PSI plus or minus 25 PSI at ambient temperature of 60°F. Check precharge of accumulator when its temperature is equal to ambient temperature. If there is a noticeable temperature difference, delay pressure check until temperatures are more nearly alike. For each 10°F difference in ambient temperature from 60°F, precharge pressure will rise or fall 6 PSI from 475 PSI specifications given above. If precharge is not within specification given above, proceed with recharging as outlined below. See Figure 23.

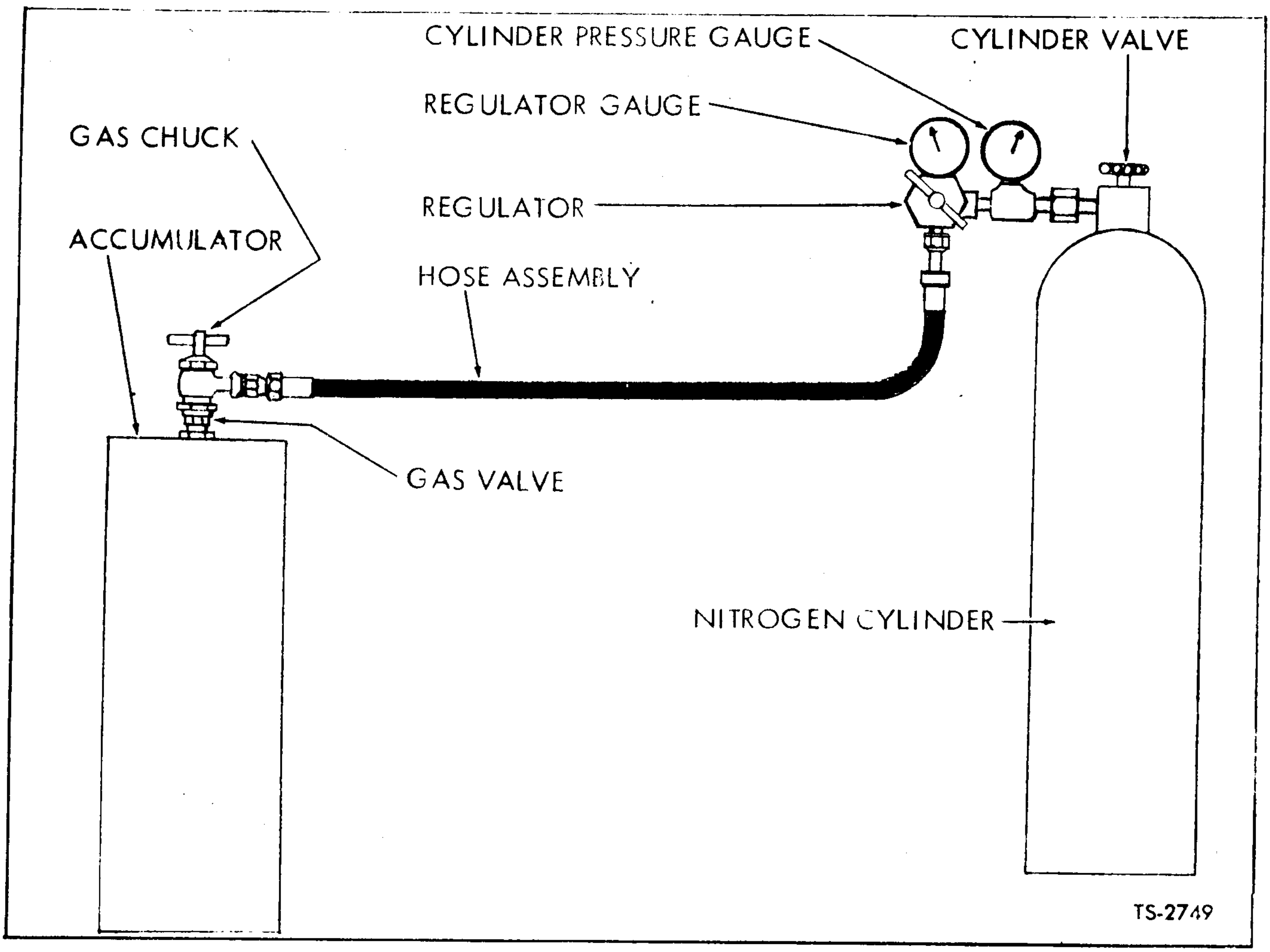


Fig. 23. Accumulator Charging and Checking Device Hook-Up

If no No. 944283 Checking and Charging Device is available, a 1,000 PSI capacity gauge may be used. See Figure 22.

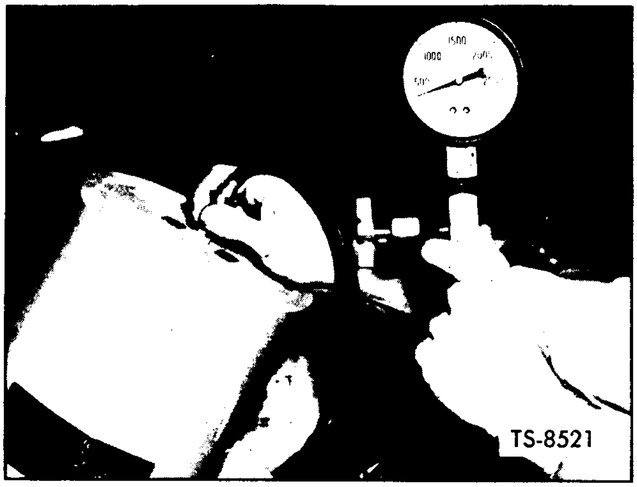


Fig. 22. Checking Accumulator Pressure

ACCUMULATOR RECHARGING PROCEDURE

1. With engine off, back off on suspension relief valve set screw until suspension arms are resting on their stops.

2. Remove gas valve protector plate or caps from accumulator.

3. Attach Charging and Check Device, No. 944283, to nitrogen cylinder and to accumulator, as shown in Figure 23. Use wrench to tighten swivel nuts onto accumulator gas valve and to nitrogen cylinder. Turn T-handle valve on gas chuck all the way in by turning in a clockwise direction to depress valve core in gas valve.

4. Turn handle on regulator valve in counterclockwise direction until all tension on the regulator diaphragm is relieved. Open valve in nitrogen cylinder which will allow nitrogen gas to flow as far as the regulator.

5. Turn handle of regulator valve slowly in clockwise direction until desired charging pressure reading is reached on regulator gauge. Recharge pressure should be 475 PSI plus or minus 25 PSI.

6. When required pressure is reached, close valve on nitrogen cylinder. Turn T-handle valve on gas chuck all the way out by turning in a counterclockwise direction.

7. Loosen swivel nuts on gas chuck and regulator valve and remove charging device from both accumulator and nitrogen cylinder. A slight release of pressure will be present when hose is removed. This is caused by nitrogen gas that was trapped in the hose assembly, and does not affect accumulator charge.

8. Replace gas valve protector caps or plate on accumulator. Valve cap should be wrench tight after charging accumulator to insure a positive seal.

Cautions:

A. Do not loosen swivel nut attaching regulator to nitrogen cylinder without closing nitrogen cylinder valve.

B. Do not loosen swivel nut attaching gas chuck to accumulator without first backing T-handle valve out all the way by turning in counterclockwise direction.

C. Do not attach Charging and Checking Device, No. 944283, to either nitrogen cylinder or accumulator without first turning handle of regulator valve in counterclockwise direction until all tension on regulator diaphragm is relieved, and turning T-handle valve on gas chuck all the way out by turning in counterclockwise direction.

REMOVAL AND DISASSEMBLY

REMOVE ACCUMULATOR FROM SYSTEM

Make certain that hydraulic pressure is at zero. Piston then will be against hydraulic end cap or at bottom of accumulator body because of gas pressure on opposite side of piston.

Remove guard from over gas valve. To release gas, unscrew gas valve part way until gas begins to escape through safety hole drilled through side of gas valve. Wait until all gas pressure is relieved, then remove gas valve.

Remove accumulator from hydraulic system. Threaded holes in end caps may be used as a means of attachment for lifting, or use a sling around the body.

NOTE: The following disassembly instructions are basically the same for all models of accumulators, except that on the 7" I.D. models the hydraulic end cap is removable. The 2", 4", and 5-3/4" models have a welded hydraulic end cap which cannot be removed.

DISASSEMBLE ACCUMULATOR FROM SYSTEM

With accumulator laying horizontal, hold accumulator body with a strap wrench, or vise gripping over hydraulic end cap. Install three pins into holes of cap at gas end, then remove gas cap, using a long bar working against the pins. Remove "o" ring and back-up rings from end cap.

Remove piston using pliers on cast web and while pulling, rotate piston slightly to aid in removal. Remove teflon rings. To remove v-"o" ring from piston, lift ring with small, smooth screw driver or similar tool, moving the tool around the piston several times while using other hand to work ring off the piston.

CLEANING

Thoroughly clean parts in solvent and dry with compressed air. Clean bore of body with a clean lintless cloth soaked in clean solvent. Bore must be clean of any visible particles or particles detectable to touch.

INSPECTION

Inspect piston for cracks, burrs around "o" ring grooves, or damage. Examine body bore, using a light for scratches or scoring. Inspect end caps for damaged threads or burrs on "o" ring grooves.

REPAIR AND REPLACEMENT

Minor nicks, scratches or light scoring of the body bore can be removed by using crocus cloth. Dress bore until all apparent imperfections have been removed.

Teflon rings need not be replaced at each overhaul, but to test for any wear, install rings on piston. Lay a straight edge across both Teflon rings. Rings should clear center lands of seal groove enough to barely see "daylight" under the straight edge. If not, rings are worn and must be replaced. Check at 3 or 4 points around piston for this condition. Piston rides on the Teflon rings and does not touch body bore.

Replace rubber "o" rings and v-"o" rings at each overhaul.

REASSEMBLY

Coat all internal parts with clean hydraulic fluid before reassembly. Install new back-up ring first, then a new "o" ring on hydraulic end cap and install into body bore. Care should be exercised not to drag "o" ring over threads.

End cap will stop against chamfer leading into hones bore (extreme tightness not required - "o" ring sealing is not dependent upon cap tightness). Cap should be flush with end of body within 1/16" to 3/32" above or below.

With new v-"o" ring and Teflon rings on piston, install piston, hollow side toward gas end, in bore of body. Do not let v-"o" ring drag on threads. Piston must go into bore exactly square and very slowly. (V-"o" ring will squeeze up the chamfer if done slowly, but may be damaged if forced quickly). Piston will fit snug. Use hammer and wood block to tap piston into place until all of piston is 2" below beginning of honed bore. Keep pressure against piston while tapping v-"o" ring through

REASSEMBLY (Continued)

the bore chamfer, otherwise piston will bounce back, damaging the "o" ring. Cover port opening to keep out dirt.

Install new back-up ring and new "o" ring on gas end cap and install same as hydraulic end cap.

Replace gas valve core and "o" ring, then install gas valve.

Remount accumulator, but do not connect to hydraulic system at this time. Precharge system with required pressure and when required precharge is reached, install gas valve guard. Connect hydraulic system.

MAINTENANCE

NOTE: Repair Kit (see Parts List) is available for all accumulator models.

Occasional replacement of v-"o" ring seal on the piston is the only maintenance required Replacement of other seals on end caps and gas valve is recommended while disassembled to replace piston v-"o" ring, or for repair.

Periodic checking of precharge pressure will detect whether v-"o" ring wear is sufficient to begin reducing sealing performance. Allowing for temperature difference, if any, from time of its pressure checking, precharge pressure will rise if oil gathers in the gas side and will fall if gas leaks into the oil side or out past gas end seals. It is suggested that a check be made a week after installation, and thereafter once a month.

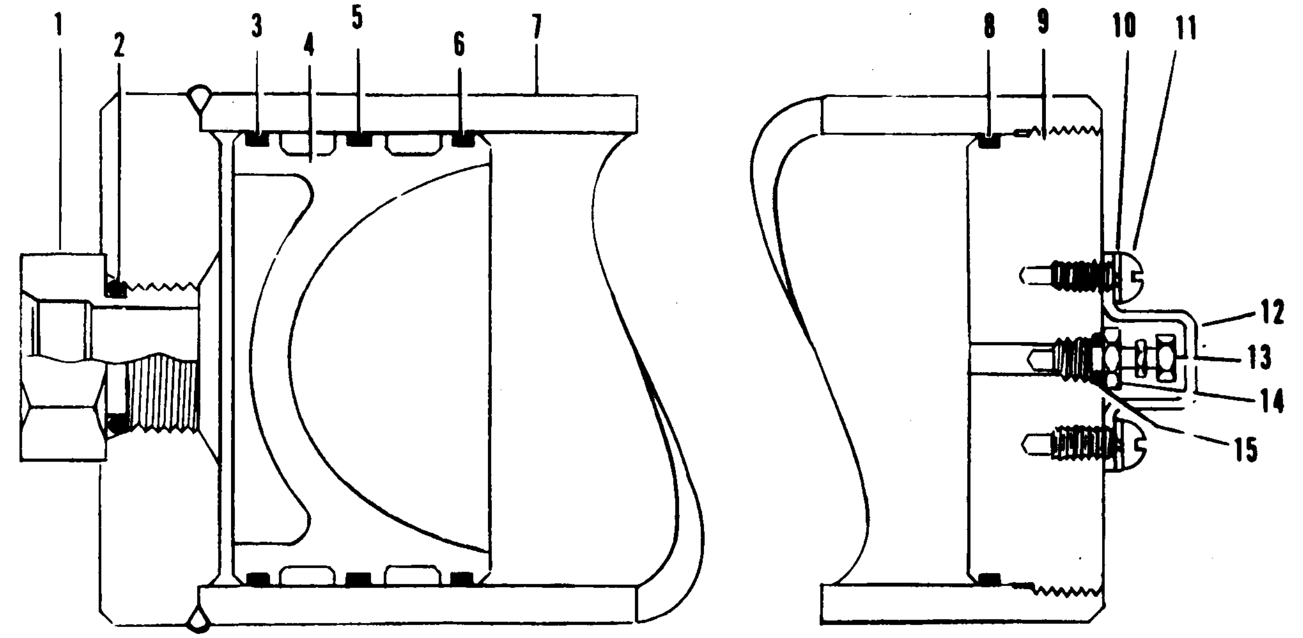
CHECKING PROCEDURE

1. Release hydraulic pressure. Allow all oil to be discharged and piston to bottom against hydraulic end cap or at bottom of body.

2. Attach gaging assembly to gas end.

Replace seals when continuing change of the gas precharge is detected. When change is first observed, resort to frequent checking as a guide to how soon seal replacement must be made. In this manner maintenance can be planned ahead without the need for any emergency shutdown.

CLARK EQUIPMENT COMPANY



HYDRAULIC ACCUMULATOR ASSEMBLY – TRACTOR

1641

CAUTION

This is a Gas Pressurized System

Do not disconnect any part of system without first relieving accumulator pressure. To release pressure, back off suspension system relief valve screw until suspension arms are resting on their stops (with engine down).

Before attempting to service components of accumulator, release gas by unscrewing gas valve until gas begins to escape through safety hole. When pressure is relieved, remove gas valve.

Item	Description	Qty.
A	ACCUMULATOR ASSY (Inc 1 thru 15)	1
B	REPAIR KIT, Accumulator (Inc 3, 5, 6, 8, 13, 13A, 14A, 15)	1
1	ADAPTER UNION (Inc 2)	1
2	"O" RING, Adapter	1
3	§RING, Piston Wear (See 'B')	1
4	§PISTON (See 'A')	1
5	§"O" RING, Piston (See 'B')	1
6	§RING, Piston Wear (See 'B')	1
7	§CYLINDER (See 'A')	1
8	§"O" RING, Cylinder Cap (See 'B')	1
9	CAP, Cylinder	1
10	LKWSHR, Gas Valve Protector	2
11	SCREW, Gas Valve Protector	2
12	CAP, Gas Valve Protector	1
13	§CAP, Gas Valve (See 'B')	1
13A	†§CAP, Gas Valve Core Remover (See 'B')	1
14	VALVE ASSY, Gas (Inc 13, 14A)	1
14A	†§CORE, Gas Valve (See 'B')	1
15	§"O" RING, Gas Valve (See 'B')	1

† Not Illustrated
§ Not Sold Separately

RELIEF VALVE SERVICE

Removal of valve assembly from machine is as follows:

1. Disconnect hose from adapter in bottom of valve and cap hose.

2. Disconnect hose from adapter on inlet port of valve and cap hose.

3. Disconnect hose from adapter on outlet end of inline filter and remove filter and adapter connecting filter to relief valve.

4. Remove relief valve from bracket by removing 2 bolts and locknuts.

5. Clamp valve assembly with acorn nut turned up in bench vice and remove valve cap by applying wrench at largest hexagon shoulders next to top of valve body. Screw valve cap out of valve body and remove.

6. Remove valve body from vice and turn upside down. The poppet seat and spring should fall out.

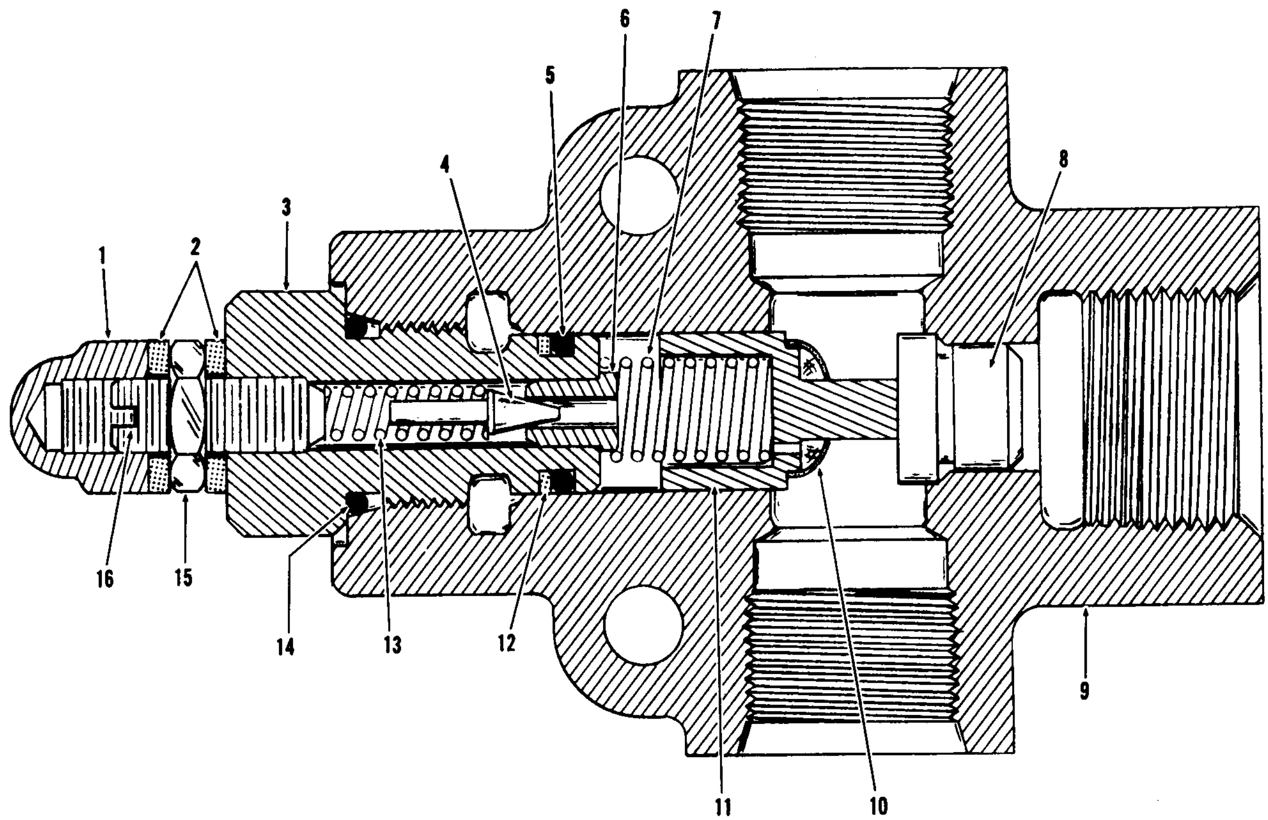
7. Clean and inspect valve body and parts for wear or damage, and replace, if worn or damaged.

8. To remove pilot plunger and spring from valve cap body, take acorn nut and flat washer off of adjusting screw. Back off jam nut and back adjusting screw out of end of valve cap with screw driver. Turn cap upside down to remove spring and plunger.

9. Before reassembly of parts, lubricate parts for ease of assembly and to prevent possible damage to "o" rings and back-up ring.

10. Install valve in reverse of removal from machine.

11. After valve has been reinstalled on machine, set relief valve pressure as instructed in section on "Relief Adjustment" under "Suspension Function and Adjustment."



VALVE — PRESSURE RELIEF SUSPENSION SYSTEM — TRACTOR

Item No.	Description	No. Req'd.
A	VALVE ASSY (Inc. 1 thru 17)	1
1	NUT, Acorn	1
2	WASHER, Stat-O-Seal	2
3	CAP, Valve	1
4	PLUNGER, Pilot	1
5	"O" RING	1
6	SEAT, Pilot	1
7	SPRING	1
8	SEAT, Poppet	1
9	§BODY, Valve — Order Item "A"	—
10	§SCREEN, Poppet — Order Item 11	—
11	POPPET ASSY (Inc. 10)	1
12	RING, Back-Up	1
13	SPRING, Pilot	1
14	"O" RING, Valve Cap	1
15	NUT, Jam	1
16	SCREW, Adjusting Set	1
17	†PLUG	2

§Not Sold Separately
†Not Illustrated

SUSPENSION PUMP SERVICE

DISASSEMBLY

1. Remove key (#13) from shaft.
2. Clean outside of pump thoroughly.
3. Clamp pump in vise, shaft down.
4. Remove tie bolts (#2) 4 each.
5. Remove tie bolts (#1 and #3) 2 each.
6. Use sharp tool to mark across front plate, body and back plate. This will assure proper reassembly.
7. Remove pump from vise — Hold pump in hands and bump shaft against wooden block to separate front plate (#16) from back plate (#4). Body (#6) will remain with either front plate or back plate.
8. To separate body from section it remains with, place drive gear (#8) in bearing and tap protruding end with plastic hammer.
9. Remove O-ring (#5) from back plate assembly.
10. Remove diaphragm (#9) from front plate by prying with sharp tool.
11. Remove springs (#14) 2 each and steel balls (#15) 2 each, from front plate.
12. Lift back-up gasket (#10) and protector gasket (#11) from front plate.
13. Lift diaphragm seal (#12) from front plate.
14. Remove shaft seal (#17) from front plate.

INSPECT PARTS FOR WEAR

GENERAL

1. Clean and dry all parts.
2. Remove nicks and burrs from all parts with emery cloth.

GEAR ASSEMBLY

1. Inspect drive gear shaft (#8) for broken keyway.
2. Inspect both the drive gear and idler gear shafts at bearing points and seal areas for rough surfaces and excessive wear.
3. If shafts measure less than .6850 in bearing area the gear assembly should be replaced. (One gear assembly may be replaced separately; shafts and gears are available as assemblies only.)
4. Inspect gear face for scoring and excessive wear.
5. If gear width is below the following figures – gear assembly should be replaced.

Pump Disp.	.423	.507	.602	.729	.870
Gear Width	.309	.371	.441	.535	.636

Pump Disp.	1.042	1.250	1.505	1.810
Gear Width	.767	.924	1.107	1.330

6. Assure that snap rings are in grooves on either side of drive and idler gears.
7. If edge of gear teeth are sharp – break edge with emery cloth.

FRONT AND BACK PLATES

1. Oil grooves in bearings in both front plate and back plate should be in line with dowel pin holes and 180 degrees apart. This positions the oil grooves closest to the respective dowel pin holes.
2. If I.D. of bearings in front plate or back plate exceed .691 – front or back plate should be replaced. (Bearings are not available as separate items.)
3. Bearings in front plate should be flush with islands in groove pattern.
4. Check for scoring on face of back plate – if wear exceeds .0015, back plate should be replaced.

BODY

1. Check inside gear pockets for excessive scoring or wear.
2. Body should be replaced if I.D. of gear pocket exceeds 1.719.

REASSEMBLY

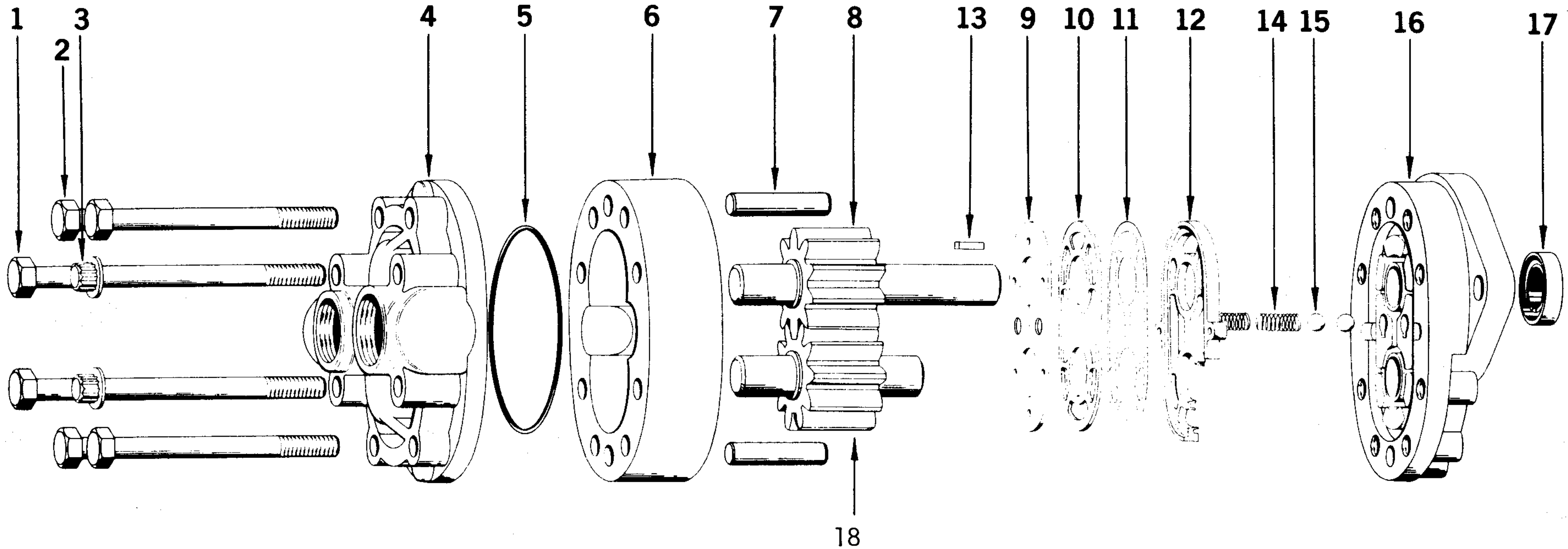
1. The diaphragm, back-up gasket, diaphragm seal, protector gasket, O-ring and shaft seal should be replaced as new parts.
2. Tuck diaphragm seal (#12), shown cutaway in drawing, into grooves in front plate with open part of "V" section down. (Use dull tool.)
3. Press protector gasket (#11) and back-up gasket (#10) into diaphragm seal.
4. Drop steel balls (#15) into respective seats and place springs (#14) over balls.
5. Place diaphragm (#9) on top of back-up gasket – bronze face up.
6. Entire diaphragm must fit inside the raised rim of the diaphragm seal.
7. Dip gear assemblies into oil and slip into front plate bearings.
8. Install dowel pins (#7) in body (#6).
9. Apply a thin coat of heavy grease to both milled faces of body. Slip body over gears onto front plate – half moon port cavities in body must face away from front plate; note small drilled hole in one of cavities. This hole must be on pressure side of pump.
10. Install O-ring (#5) in groove in back plate (#4).
11. Slide back plate over gear shafts until dowel pins are engaged.
12. Install bolts (#1, #2, and #3) and draw up evenly to 23 ft. lbs. torque.
13. Work shaft seal over drive gear shaft taking care not to cut rubber sealing lip. (Oil seal liberally before assembly.)
14. Seat shaft seal by tapping with plastic hammer.
15. Rotate pump shaft by hand or with pliers. Pump will have small amount of drag, but should turn freely after short period of use.

GENERAL INFORMATION

Direction of rotation on all 24300 Series Pumps may be reversed by removing the tie bolts and rotating back plate and body 180 degrees. It is important that relationship of the back plate, body and front plate is correct. You will note two half moon cavities in the body which must face away from the front plate. Note also a small drilled hole in one of these cavities. This hole must be on the pressure side of the pump. Suction side of back plate is always side with larger port boss.

PLACING PUMP BACK INTO SERVICE

1. If shop test stand is available the following procedure for testing rebuilt pumps is recommended:
   a. Mount pump on test stand making sure that the proper level of clean oil is available in reservoir. Check suction line for leaks and obstructions.
   b. Start pump and run for three minutes at zero pressure.
   c. Intermittently load pump to 500 P.S.I. for three minutes.
   d. Intermittently load pump to 1000 P.S.I. for three minutes.
   e. Intermittently load pump to 2000 P.S.I. for three minutes.
   f. Remove pump from test stand and check for freeness of drive shaft. Check for leaks.
2. If shop test stand is not available the following procedure for testing rebuilt pumps is recommended:
   a. Mount pump on equipment and run pump at 1/2 engine speed at zero pressure.
   b. By operating control valve build pressure intermittently for three minutes.
   c. Increase engine speed to full throttle and build pressure intermittently for three minutes.
   d. Idle engine and check for leaks.



SUSPENSION PUMP
PARTS LIST

REFERENCE NUMBER	DESCRIPTION	REQ'D PER ASS'Y
1	Tie Bolts	2
2	Tie Bolts	4
* 3	Tie Bolts	2
4	Back Plate Assembly	1
5	O-Ring	1
6	Body	1
7	Dowel Pin	2
8	Drive Gear Assembly	1
9	Diaphragm	1
10	Back-up Gasket	1
11	Protector Gasket	1
12	Diaphragm Seal	1
13	Key	1
14	Spring	2
15	Steel Ball	2
16	Front Plate Assembly	1
17	Shaft Seal	1
18	Idler Gear Assembly	1

* Twelve point cap screws used.

SUSPENSION CYLINDER SERVICE

The left and right suspension cylinders connect axle pads vertically to tractor mainframe and act as springs to dampen shock imposed on unit when driving over uneven terrain. The head end of the cylinders are pressurized to support unit with an orifice valve at head of left cylinder to control flow of oil back to tank. Contained in the same cylinder is a poppet valve which controls extended length of cylinder rods as oil under pressure passes through head end of left cylinder.

When removal is necessary of either left or right suspension cylinders from machine for servicing, the following procedure should be followed:

1. Raise the front of the tractor by hoist or by using the lift cylinders (the bowl should be full of dirt to raise the tractor by the lift cylinders) until the suspension cylinders are fully extended. First, place a support stand under the front bumper and then place blocks between the suspension arms and the frame and lower the machine until it rests on the stand and the blocks. The suspension cylinder should stay extended at least 4", but both tires should be touching the ground and supporting the weight of the drive axle.

2. Kill the engine, lower the blade, set the parking brake, and block the tires to prevent the machine from moving.

3. Loosen and then replace cap on hydraulic tank to relieve pressure.

4. Remove cotter pin from lower cylinder pin and drive pin out of arm lugs and cylinder rod lug. Note position of spacers on either side of rod lug before removing. These spacers must be reassembled in same position.

5. To remove right suspension cylinder, disconnect hose on bottom and top ports of cylinder, also remove fitting and hose from tank port on suspension relief valve, cap ends of hose, cap relief valve tank port. Remove cotter pin from top pin and drive pin out of cylinder yoke and cylinder hanger, manually collapse the cylinder and lift cylinder out through top of frame and lower to floor.

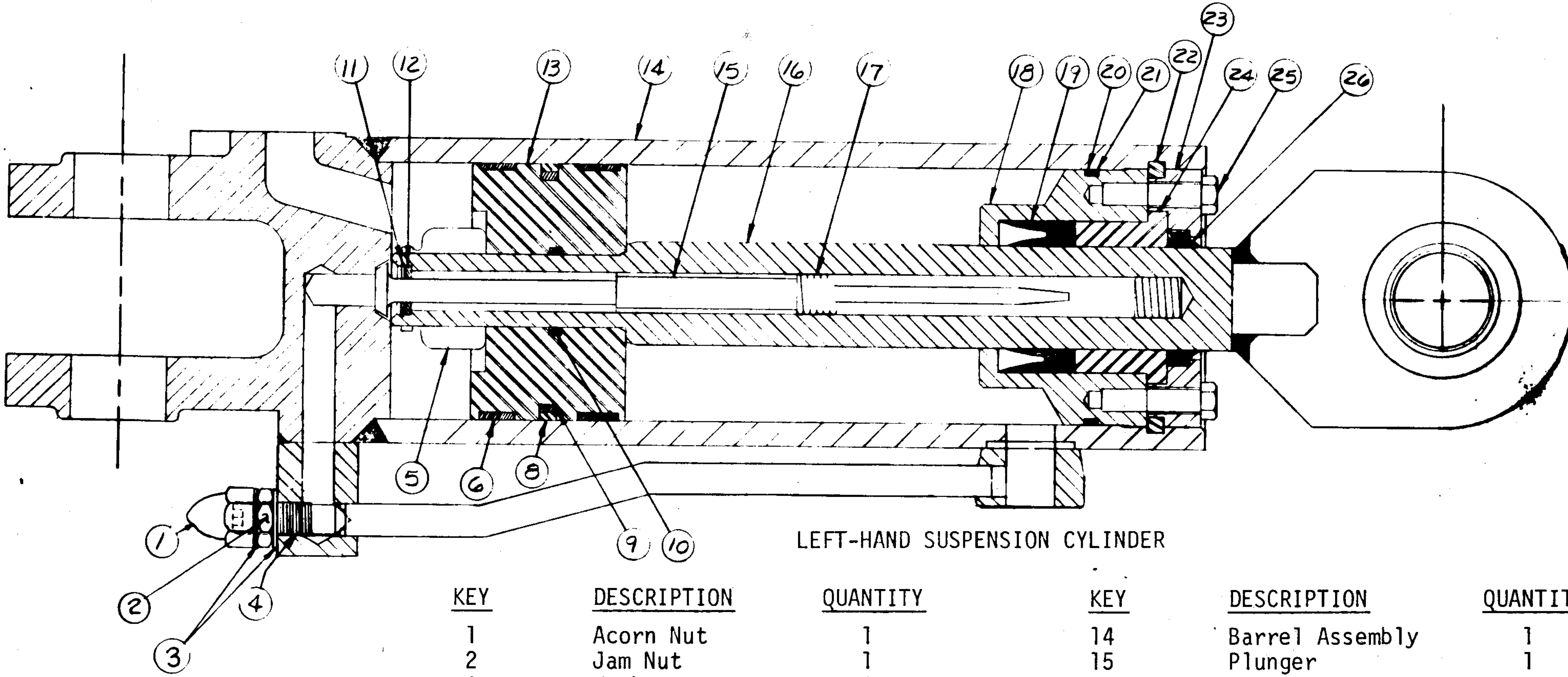
6. To remove left suspension cylinder, remove manifold from bottom port and hose from top port of cylinder and cap opening in manifold and hose. Remove cotter pin from cylinder pin and drive pin out of cylinder yokes and cylinder hanger, manually collapse the cylinder, and lift cylinder out through top of frame and lower to floor.

DISASSEMBLY

The disassembly of left and right suspension cylinders is the same as given in the section on hydraulic cylinders. The left cylinder rod assembly contains a poppet valve in the piston end. To remove poppet valve from rod, remove snap ring by using snap ring pliers. The "c" washer and poppet valve have pressure on them from spring and will pop out when snap ring is removed. Care should be exercised when removing snap ring due to spring force. When replacing spring, "c" washer, valve, and snap ring, install snap ring with sharp edge toward "c" washer.

INSPECTION AND REASSEMBLY

Inspect and reassemble left and right cylinders using instructions given in section on hydraulic cylinders. Install cylinders on machine in reverse to removal. Make certain pin spacers are correctly installed on cylinder pins with small outside diameter of spacer toward cylinder. If orifice valve screw has been removed and parts inspected, it will be necessary to readjust after cylinders have been installed. See orifice valve under "Function and Adjustments in Suspension System," for adjustment.



LEFT-HAND SUSPENSION CYLINDER

KEY	DESCRIPTION	QUANTITY	KEY	DESCRIPTION	QUANTITY
1	Acorn Nut	1	14	Barrel Assembly	1
2	Jam Nut	1	15	Plunger	1
3	Washer	2	16	Rod Assembly	1
4	Set Screw	1	17	Spring	1
5	Locknut	1	18	Cylinder Cap	1
*6	Wear Ring	2	*19	Monoseal	1
*8	Outer Ring	1	*20	O-Ring	1
*9	Inner Ring	1	*21	Backup Ring	1
*10	O-Ring	1	*22	Retainer	1
11	Snap Ring	1	23	Flange	3
12	Washer	1	*24	Bushing	1
13	Piston	1	25	Capscrew	6
			*26	Rod Wiper	1

*PARTS INCLUDED IN CYLINDER REPAIR KIT, P/N 1577635.

LUBRICATION

The importance of a conscientiously applied lubrication program cannot be overemphasized. Proper lubrication of any mechanical apparatus is necessary to insure long periods of trouble-free operation. It not only is important that the required lubrication schedule be maintained, but also that the proper type of lubricant be used. The following are lubricants recommended for various components of the unit.

COMPONENT ON UNIT	TEMPERATURE RANGE	RECOMMENDED LUBRICANT
Transmission Fluids	30°F (0°C) & Above	Engine Oil (API-MS or DG) SAE-SD or SE) Grade 30
	–10°F (–25°C) & Above	Engine Oil (API-MS or DG) (SAE-SD or SE) Grade 10 MIL-L-2104B or 2104C Grade 10
	–30°F (–35°C) & Above	DEXRON
	Up to 0°F (–17°C) & Below	MIL-L-10295B
	–60°F (–50°C) & Above	Conoco Polar Start DN-600 Fluid
Hydraulic System Fluids	30°F & Above	Engine Oil (API-MS or DG) (SAE-SE or SD) or MIL-L-2104B or 2104C Grade 20
	30°F & Below	Engine Oil (API-MS or DG) (SAE-SE or SD) MIL-L-2104B or 2104C Grade 10
Drive Axle Lubricants (EPGL)	100°F (37°C) & Above	Extreme Pressure Sulfo-Chloro-Lead or MIL-L-2105B (API-GL5) SAE - 140
	0°F (–17°C) to 100°F(37°C)	Extreme Pressure Sulfo-Chloro-Lead or MIL-L-2105B (API-GL5) SAE 90
	–10°F to 30°F (–23°C to 0°C)	Extreme Pressure Sulfo-Chloro-Lead or MIL-L-2105B (API-GL5) SAE 80
	–10°F & Below (–23°C)	MIL-L-10324A Special Polar
Chassis Greases (LBG)	0°F (–17°C) & Above	Lithium Soap or Lithium Lead Base Multi-Purpose Grease, Grade 2
	0°F(–17°C) & Below	Grade 1
Wheel Bearing Grease (WBG)	All Temperatures	Extreme Pressure Wheel Bearing Grease Grade 2, Lithium Soap or Lithium Lead Base Type. 40 lbs. Minimum Lever Load by Timken Test.

MODEL I-10-15

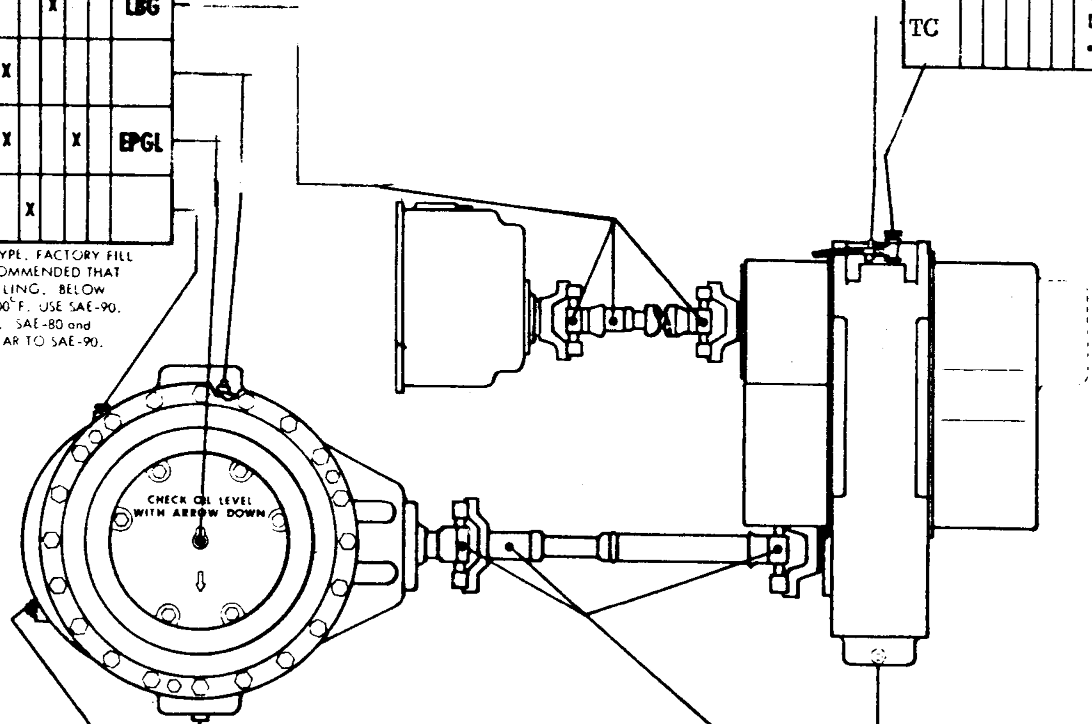
MAINTENANCE SCHEDULE

SYSTEM	OPERATION	Daily or Shift	TIME INTERVAL (HOURS) 50	100	250	500	1000
Engine, Controls, Cooling System and Accessories	Engine Maintenance		See Engine Manufacturer's Manual				
	Check Air Cleaner Service Indicators	●	●	●	●	●	●
	Check Cooling System for Leaks		●	●	●	●	●
	Drain Fuel Tank Sediment		●	●	●	●	●
	Check Anti-Freeze Protection		●	●	●	●	●
	Tighten Air Cleaner Connections		●	●	●	●	●
	Check Engine RPM				●	●	●
	Check Engine Shut-Off Controls					●	●
	Clean Radiator Cores					●	●
	Service Air Cleaner Filter Elements					●	●
	Check Turbocharger (See Text)	●	●	●	●	●	●
Torque Converter and Transmission System	Clean Torque Converter and Transmission Breathers		●	●	●	●	●
	Check Transmission Clutch and Lube Pressures					●	●
Electrical System	Check Lights and Fuses	●	●	●	●	●	●
	Service Batteries		●	●	●	●	●
	Clean and Tighten Electrical Connections					●	●
	Inspect, Test and Lubricate Electrical Units						●
Axles, Prop Shafts, Wheels and Tires	Check Tire Pressure and Casings	●	●	●	●	●	●
	Tighten Wheel Nuts and Inspect Rims		●	●	●	●	●
	Clean Axle Breathers					●	●
Steering System	Check Steering Pressure					●	●
Brake System	Bleed Moisture From Air Reservoirs	●	●	●	●	●	●
	Check Brake Chambers and Lines for Leaks	●	●	●	●	●	●
	Lubricate Brake and Accelerator Pedals and Rollers			●	●	●	●
	Check and Adjust Service Brakes			●	●	●	●
General Maintenance	Clean Dirt, Trash, etc., from Transmission Guards	●	●	●	●	●	●
	Visually Inspect Unit	●	●	●	●	●	●
	Check All Hydraulic Systems For Leaks		●	●	●	●	●
	Clean Cylinder Rods		●	●	●	●	●
	Adjust and Lubricate Operator's Seat				●	●	●
	Tighten Mounting Bolts				●	●	●
	Steam Clean Unit					●	●
	Inspect Scraper Frame					●	●
	Inspect Frame					●	●
	Check Accumulator Pressure			●	●	●	●
Bowl, Ejector and Elevator System	Check Chain Centering	●	●	●	●	●	●
	Check Chain Slack	●	●	●	●	●	●
	Check Endgate Clearance	●	●	●	●	●	●
	Check Endgate Center	●	●	●	●	●	●
	Check Rolling Floor Clearance	●	●	●	●	●	●
	Check Rolling Floor Roller Clearance	●	●	●	●	●	●
	Check Bowl and Ejector Pressure					●	●
	Check Elevator Gearbox Breather					●	●

DESCRIPTION	HOURS 1000	500	100	50	8	KEY
PROP SHAFT 3 Fittings			X			LBG
PLANETARY DRAIN PLUG (See Text)	X					
PLANETARY FILL & LEVEL PLUG *(Cap. 13 Qts.) (See Text)	X			X		EPGL
AXLE BREATHER (See Text)		X				

** SCL SIGNIFIES SULFO-CHLORO-LEAD TYPE. FACTORY FILL IS MADE WITH SCL TYPE LUBE AND IT IS RECOMMENDED THAT SAME TYPE BE USED WHEN ADDING OR REFILLING. BELOW 0°F. TO MINUS 10°F. USE SAE-80. UP TO 100°F. USE SAE-90. ABOVE 100°F. CONSISTENTLY, USE SAE-140. SAE-80 and SAE-140 SHOULD CONTAIN ADDITIVES SIMILAR TO SAE-90.

KEY	HOURS 8	50	100	500	1000	DESCRIPTION
TC						TRANSMISSION & TORQUE CONVERTER DIP STICK & FILL PLUG *(Cap. 16½ Gal.) (See Text)



← FRONT OF MACHINE —

MODEL 110-15 TRACTOR

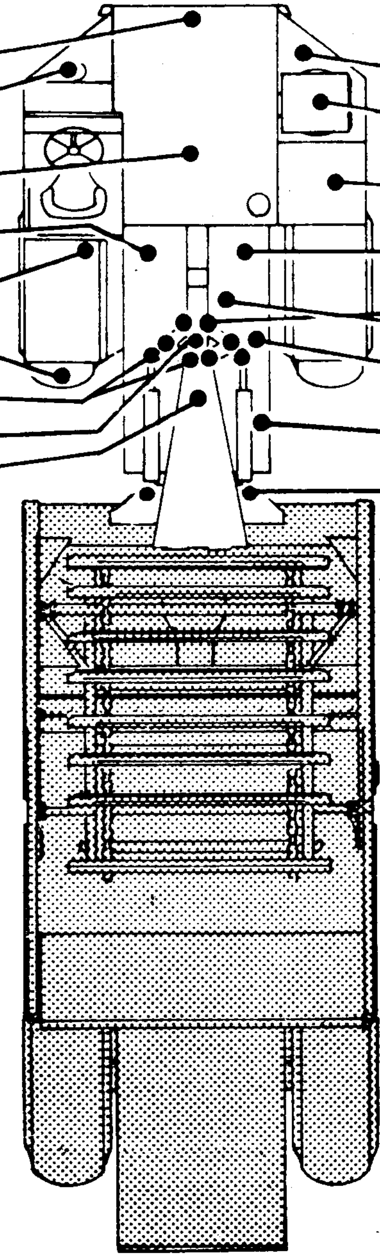
* NOTE: Capacities listed are approximate U.S. measures. Refer to specifications and service data for Metric and Imperial measures.

TS-8408

DESCRIPTION	1000	500	100	50	8	KEY
DIFFERENTIAL FILL & LEVEL PLUG *(Cap. 33½ Qts.) (See Text)	X			X		EPGL
DIFFERENTIAL DRAIN PLUG (See Text)	X					

KEY	8	50	100	500	1000	DESCRIPTION
				X		TRANSMISSION & TORQUE CONVERTER DRAIN PLUG (See Text)
LBG			X			PROP SHAFT 3 Fittings

KEY	HOURS 8	50	100	250	500	1000	2000	DESCRIPTION
	x							RADIATOR (See Text)
HF	x	x				x		HYDRAULIC OIL RESERVOIR
	x							ENGINE & ACCESSORIES
				x				HYDRAULIC SYSTEM FILTER (See Text)
	x							TIRES (See Text)
				x				BREATHER Clean & Wash
LBG	x							REAR STEERING LINKAGE 4 Fittings Each Side
LBG	x							KING PINS – UPPER & LOWER 2 Fittings
LBG	x							TRUNNION PILOT PIN FRONT & REAR 1 Fitting Each



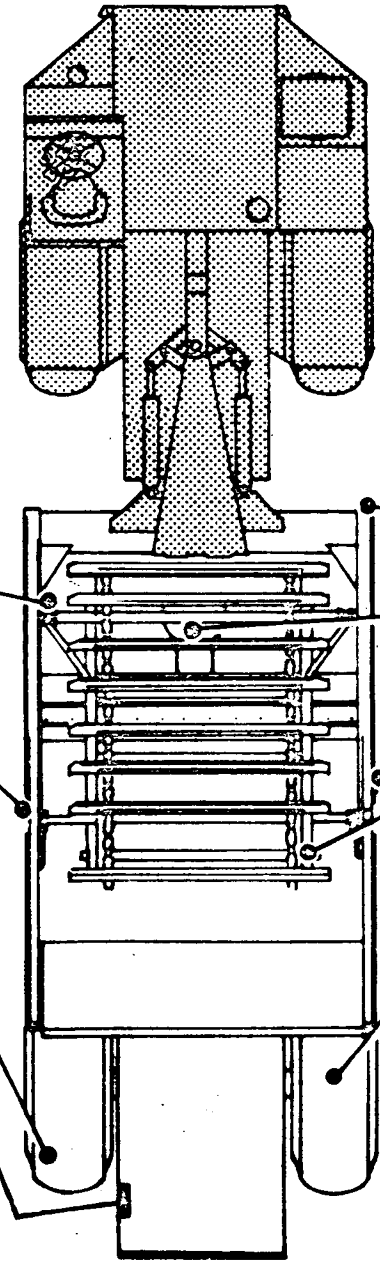
DESCRIPTION	HOURS 2000	1000	500	250	100	[illegible]	8	KEY
FUEL TANK (See Text)		x				x	x	
AIR CLEANER (See Text)							x	
BATTERIES (See Text)							x	
HYDRAULIC SYSTEM FILTER (See Text)				x				
STEERING LINKAGE (Front) 2 Fittings Each Side							x	LBG
SUSPENSION SYSTEM FILTER				x				
SUSPENSION CYLINDER 2 Fittings Each Side							x	LBG
TRANSMISSION & TORQUE CONVERTER FILTER (See Text)							x	
STEERING CYLINDERS 2 Fittings							x	LBG

MODEL 110-15
TRACTOR LUBRICATION

1672

MODEL 110-15
SCRAPER LUBRICATION

KEY	8	50	100	250	500	1000	2000	DESCRIPTION
EPGL				X				CHECK ELEVATOR DRIVE AXLE PLANETARY HUBS
						X		DRAIN (See Text)
LBG	X							YOKE ARM PINS 1 Fitting Each Side
	X							TIRES (See Text)
LBG.	X							CENTRAL LUBRICATION SYSTEM



DESCRIPTION	2000	1000	500	250	100	50	8	KEY
BOWL CYLINDER PIN 2 Fittings Each Side							X	LBG
CHECK ELEVATOR DRIVE AXLE DIFFERENTIAL				X				EPGL
DRAIN (See Text)		X						
ROLLING FLOOR ROLLER 2 Fittings Each Side							X	LBG
IDLER BEARINGS (Repack)	X		X					LBG
WHEEL BEARINGS (Repack)	X							LBG

1673