JLG® GRADALL®

SERVICE MANUAL

GRADALL®

534B

9020-7317

July 2002

Starting S/N
8244001 thru 8744109

CORPORATE OFFICE

JLG INDUSTRIES, INC.
1 JLG DRIVE
McConnellsburg, PA
17233-9533
USA
Telephone: (717) 485-5161
Fax: (717) 485-6417

GRADALL DIVISION

JLG INDUSTRIES, INC.
406 Mill Avenue S.W.
New Philadelphia, OH
44663
USA
Telephone: (330) 339-2211
Fax: (330) 339-8458

JLG GRADALL®

OPERATION & LUBRICATION MANUAL

GRADALL®

534

9103-1148

July 2002

Starting S/N
8444490

Also Covers S/N
8444474

Form #8496 Original Issue 12/84

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McConnellsburg, PA
17233-9533
USA
Telephone: (717) 485-5161
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534B

GRADALL®/LOED

MATERIALS HANDLER
OPERATION & LUBRICATION MANUAL

IMPORTANT

Read and understand this manual and the Gradall/Loed Materials Handler Safety Manual before starting, operating or performing maintenance procedures on this machine.

KEEP THESE MANUALS IN CAB.

AVERTISSEMENT! Si vous ne lisez pas l'anglais, demandez a votre surveillant de vous donner les instructions de securite!

ATENCION! Si no lee ingles, preguntele a su supervisor para las instrucciones de seguridad!

VORSICHT! Wen Sie kein Englisch lesen, bitten Sie ihren Vorgesetzten um die Sicherheitsvorschriften!

Covers Units Starting Serial No. 8444490
And Also Covers Unit No. 8444474

Part No. 9103-1148

Form No. 8496

IMPORTANT SAFETY NOTICE

Safe operation depends on reliable equipment and proper operating procedures. Performing the checks and services described in this manual will help to keep your Gradall Materials Handler in reliable condition and use of the recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced operator we recommend that this manual be read, understood and followed by all who operate the unit.

Danger, Warning and Caution notes in this manual and the Gradall Materials Handler Safety Manual will help you avoid injury and damage to the equipment. These notes are not intended to cover all eventualities; it would be impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

Any procedure not specifically recommended by The Gradall Company must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you aren't sure, contact your Gradall Materials Handler Distributor before operating.

Do not modify this machine without written permission from The Gradall Company.

NOTICE

The Company also reserves the right to change specifications without notice

The Gradall Company
406 Mill Avenue, S.W., New Philadelphia, Ohio 44663

Form No. 8496 12/84

TABLE OF CONTENTS

INTRODUCTION

General

This manual provides important information to familiarize you with safe operating procedures and operator maintenance requirements for the Gradall/Loed 534B Materials Handler.

If you have any questions regarding the materials handler, contact your Gradall Materials Handler Distributor.

Operator Qualifications

Operators of the materials handler must be in good physical and mental condition, have normal reflexes and reaction time, good vision and depth perception and normal hearing. He/she* must not be using medication which could impair his abilities nor be under the influence of alcohol or any other drug during the work shift.

The operator should also posses a valid, applicable driver's license and must have completed a course of training in the safe operation of this type of material handling equipment.

In addition, the operator must read, understand and comply with instructions contained in the following material furnished with the materials handler:

- This Operator's Manual
- Gradall Materials Handler Safety Manual
- All instruction decals and plates
- Any optional equipment instructions furnished

The operator must also read, understand and comply with all applicable Employer, Industry and Governmental rules, standards and regulations.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the 534B Materials Handler in a safe, open area (not hazardous to people or property) to develop the skills and "feel" required for safe, efficient operation.

*Though no offense or discrimination is intended, only the masculine pronouns will be used throughout the remainder of this manual.

Orientation

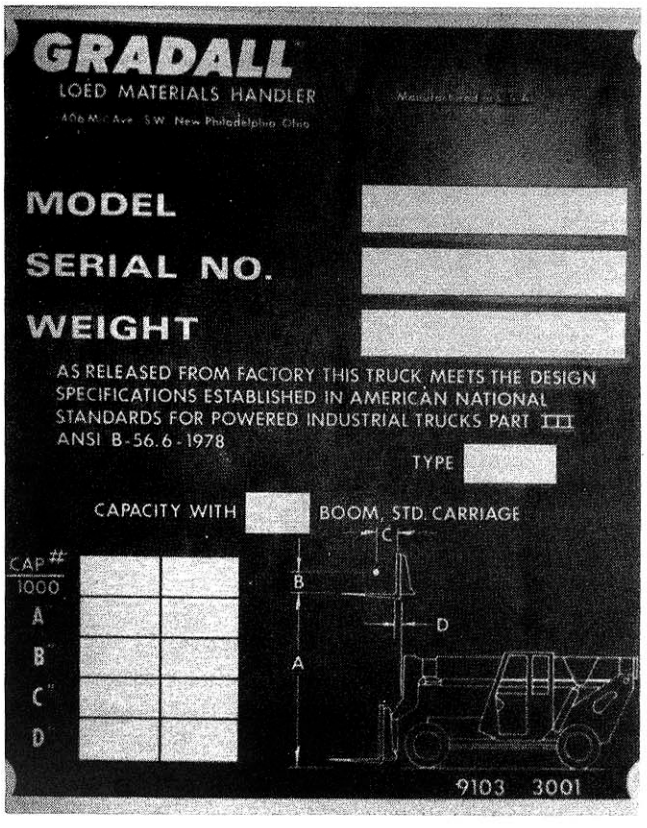
When used to describe location of components in the materials handler, the directions front, rear, right and left relate to the orientation of a person sitting in the operator's seat.

Related Manuals & Decals

Separate publications are furnished with the materials handler to provide information concerning safety, replacement parts, maintenance procedures, theory of operation and vendor components. Replacement manuals, decals and instruction plates can be ordered from your Gradall Materials Handler Distributor.

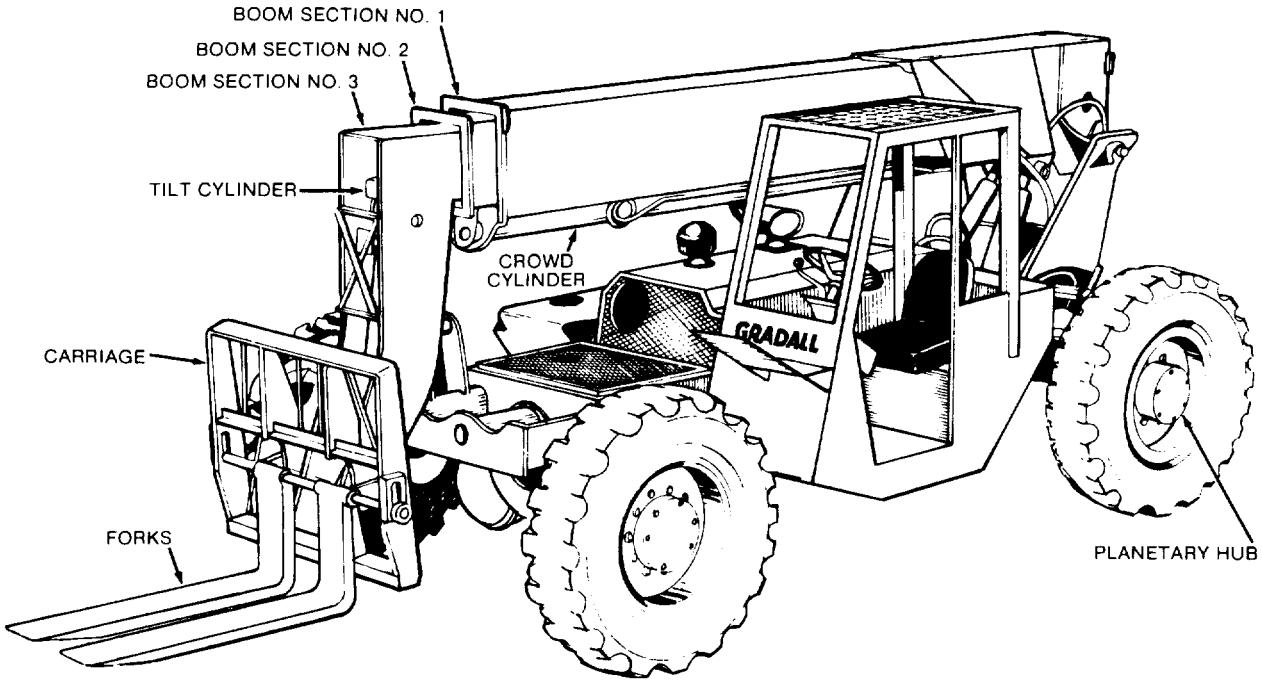
Serial Number Location

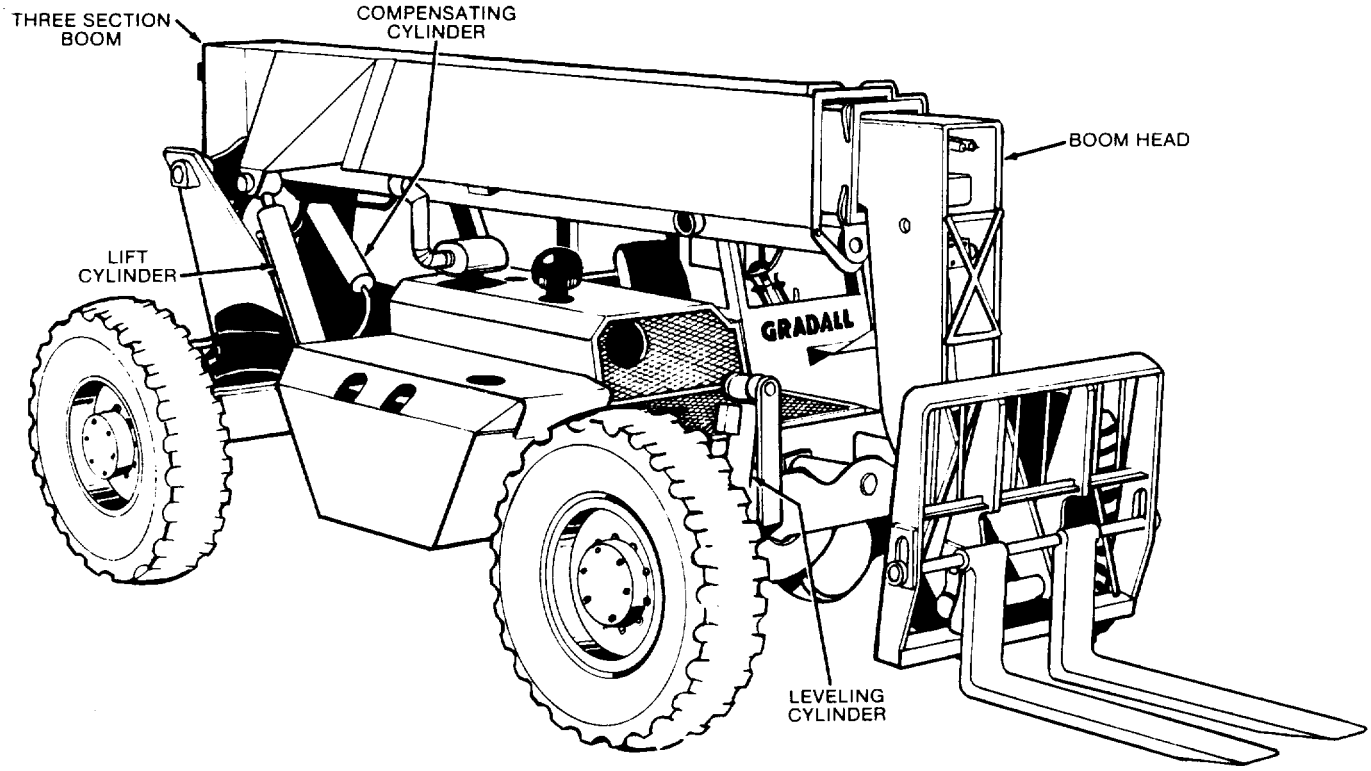
Specify Model and Serial Numbers when ordering parts and when discussing specific applications and procedures with your distributor. The model/serial number plate is located on the cab wall to the right of the operator's seat pedestal.



Nomenclature

The illustrations on page 3 include nomenclature applied to major components of the materials handler. The term "handler" will be used throughout the balance of this manual in place of the words "materials handler".


BOOM SECTION NO. 1
BOOM SECTION NO. 2
BOOM SECTION NO. 3
TILT CYLINDER
CROWD CYLINDER
CARRIAGE
FORKS
PLANETARY HUB
GRADALL


THREE SECTION BOOM
COMPENSATING CYLINDER
BOOM HEAD
LIFT CYLINDER
LEVELING CYLINDER
GRADALL

SAFETY HIGHLIGHTS

Read and understand this manual, the Gradall Loed/Materials Handler Safety Manual and all instructional decals and plates before starting, operating or performing maintenance procedures on this equipment.

Operators of this equipment must have successfully, completed a training program in the safe operation of this type of material handling equipment.

Most safety notes included in this manual involve characteristics of the Model 534B Loed/Materials Handler. Refer to the Gradall/Loed Materials Handler Safety Manual for safety precautions relating to general material handling procedures and practices.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the 534B Materials Handler in a safe open area (not hazardous to people or property) to develop the skills and "feel" required for safe, efficient operation.

Watch for these symbols; they are used to call your attention to safety notices.

This symbol indicates an extreme hazard which would result in high probability of death or serious Injury if proper precautions are not taken.

This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

This symbol indicates a hazard which could result in injury or damage to equipment or property if proper precautions are not taken.

OPERATOR'S CAB

The standard cab is open on three sides and includes an overhead guard to provide protection from falling objects.

⚠ WARNING

Never operate the handler unless the overhead guard is in place and in good condition.

A fully enclosed cab with Plexiglass windows and a lockable door is available as an option. The cab door can be secured in the fully opened or closed position. Be sure the door is fully secured when operating the handler.

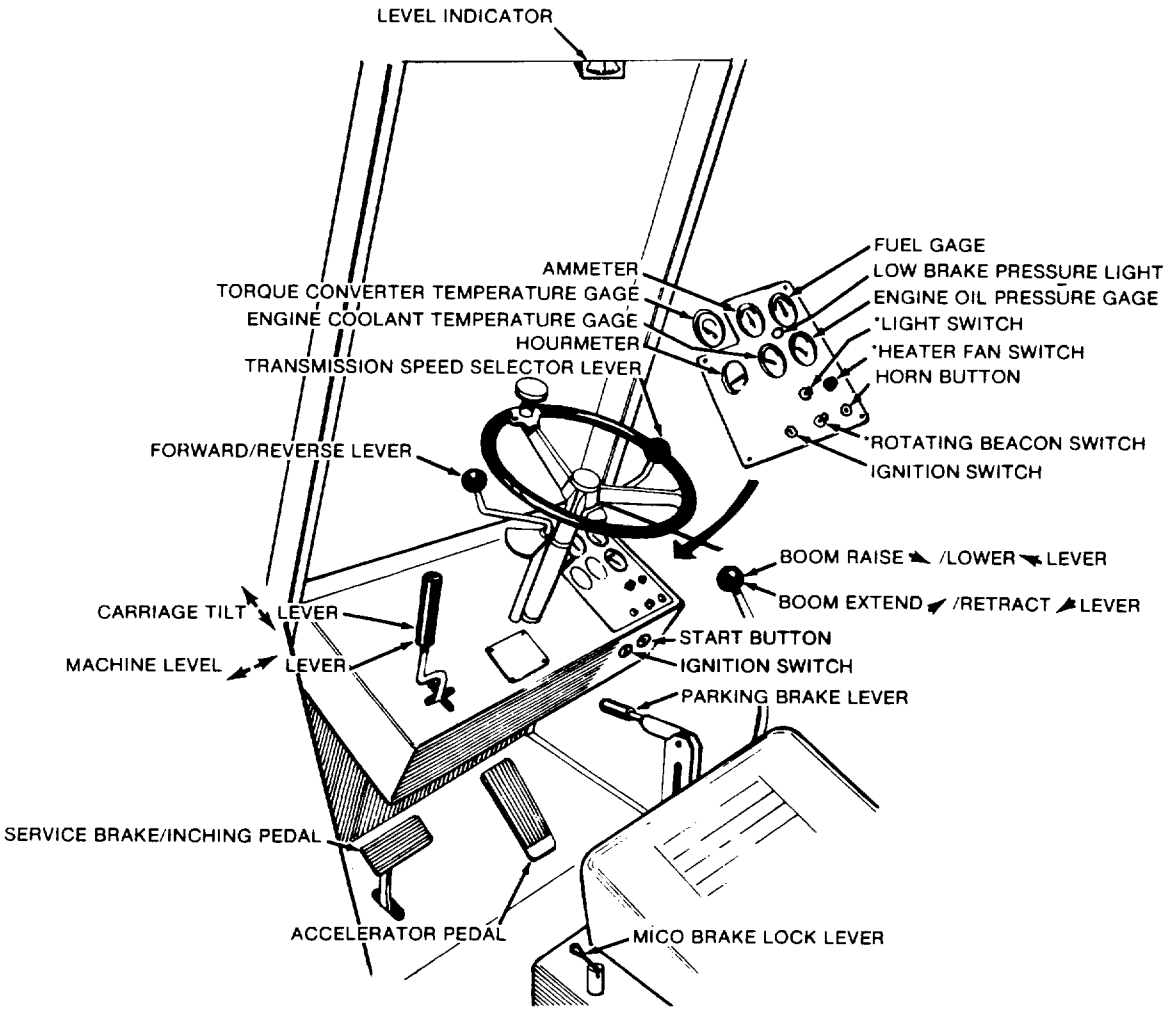
The operator's seat is equipped with a seat belt and includes fore and aft adjustment to compensate for variations in operator size. The adjustment release/lock lever is located beneath front edge of seat. Wear seat belt at all times.

An optional windshield wiper is available for use with enclosed cabs. An ON/OFF control switch is located on the wiper motor.

A variable speed defroster fan is available for use with enclosed cabs. An ON / OFF control switch and speed control are located on the base of the fan.

A variable speed heater fan is available for use with units equipped with a heater. An ON/OFF/SPEED CONTROL knob is located on the dashboard. Hot water to the heater can be controlled by a valve at the engine.

CONTROL AND INSTRUMENT IDENTIFICATION



* Items preceded by an asterisk are optional and may not be furnished on your handler.

CHECKS AND SERVICES
BEFORE STARTING ENGINE

(To be performed at beginning of each work shift)

WARNING

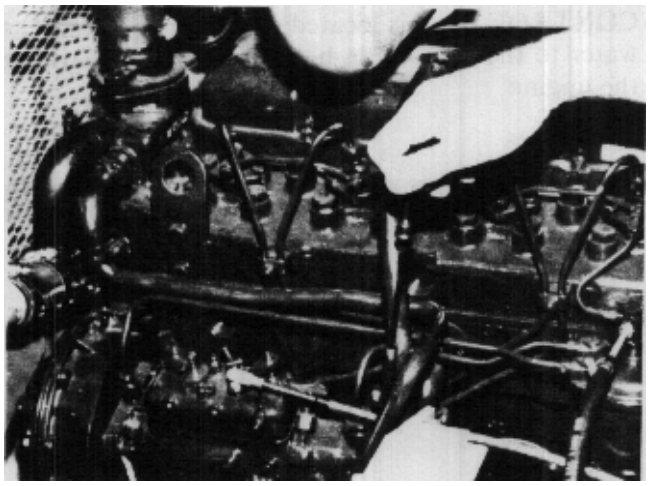
Use extreme caution when checking items beyond your normal reach. Use an approved safety ladder.

Before removing filler caps or fill plugs, wipe all dirt and grease away from the ports. If dirt is allowed to enter these ports, it can shorten the life of o-rings. seals, packings and bearings.

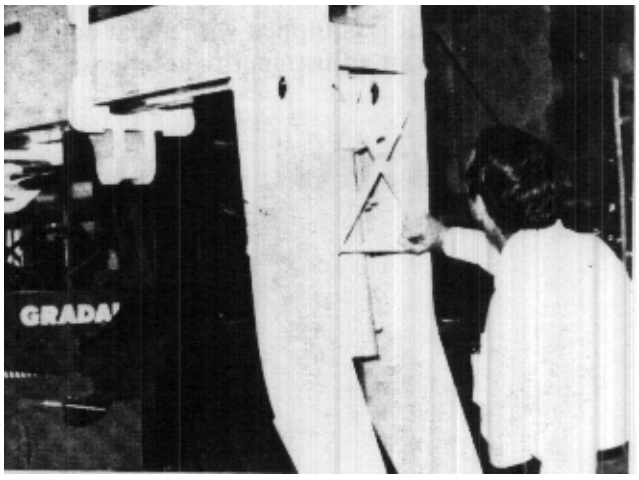
When adding fluids or changing filter elements, refer to the lubrication section of this manual to determine the proper type to be used.

If spark arrestors are required, be sure they are in place and in good working order.

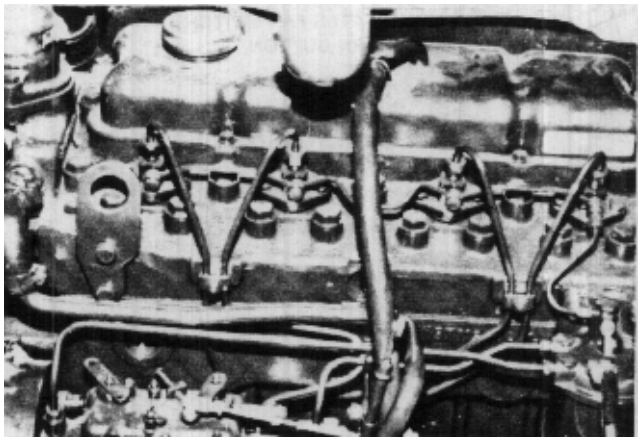
Complete all required maintenance before operating unit.



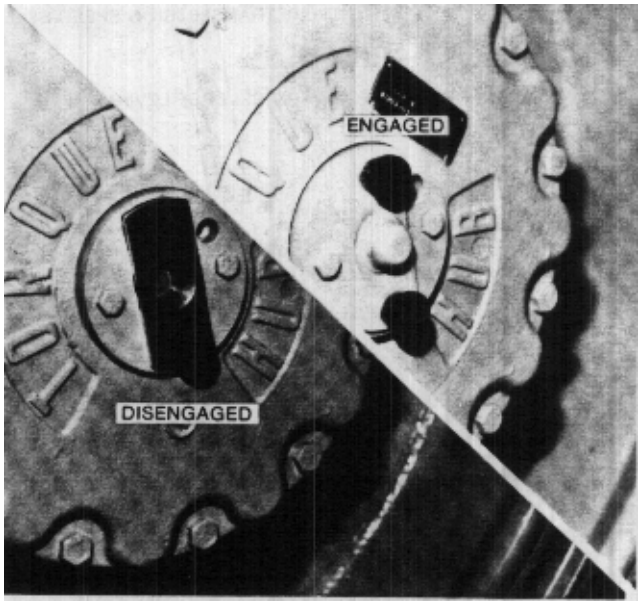
Service the unit in accordance with the lubrication and maintenance schedule.



Inspect all structural members, including attachment, for signs of damage.



Inspect unit for obvious damage, vandalism and needed maintenance. Check for signs of fuel, lubricant, coolant and hydraulic leaks. Open all access doors and look for loose fittings, clamps, components and attaching hardware. Replace hydraulic lines that are cracked, brittle, cut or show signs of abrasion.



Check to be sure rear planetary hubs are properly set for the type of travel expected.

NOTE: If engine is being started at beginning of work shift be sure to perform all " CHECKS AND SERVICES BEFORE STARTING ENGINE" (Page 6).

Starting Engine

1. Check to be sure that all controls are in neutral and that all electrical components (lights, heater, defroster, etc.) are turned off. Set parking brake.

2. Insert ignition key and turn clockwise to ON position. Low brake pressure light should glow and continue to glow until brake system accumulator is fully charged.

3. Depress accelerator pedal approximately 1/4 to 1/3 of travel from top.

⚠ CAUTION

Turning ignition switch to START position while engine flywheel is rotating can cause serious damage to engine and/or starting motor.

NOTE: If temperature requires the use of a starting aid, and if your handler is equipped with a factory-installed ether starting aid, fully raise and depress starting aid knob one time only before cranking engine. If you use a different starting aid, be sure to follow manufacturer's instructions carefully. Excessive ether may damage engine.

4. Turn ignition key clockwise to on position and depress start button to engage starting motor. Release button immediately when engine starts. If engine fails to start within 20 seconds, release button and allow starting motor to cool for a few minutes before trying again.

5. After engine starts, observe oil pressure gage. If gage remains on zero for more than ten seconds, stop engine and determine cause. Correct cause of malfunctioning before restarting engine. Normal engine oil pressure should be in range of 35 - 50 psi (241 - 345 kPa).

6. Warm up engine at approximately 1/2 throttle until engine coolant temperature reaches operating range of 180 - 200°F. (82 - 93°C.).

Cold Weather Starting Aids

Diesel engine ignition is accomplished by heat generated when fuel/air mixture is compressed within the cylinders. Because this heat may be insufficient to start a cold engine in cold weather, the use of starting aids has become common practice.

Because of the wide variety of starting aids available it would be impractical to attempt to provide specific instructions for their use in this manual. Carefully follow instructions furnished with your starting aid.

If you use a starting aid employing ether or a similar substance pay particular attention to manufacturer's warnings.

Normal Engine Operation

Observe gages frequently to be sure all engine systems are functioning properly.

The ammeter shows the charge/discharge rate of the battery charging system. With the engine running, a discharge reading (-) or a continuing high charge reading (+) indicates a problem in the battery charging system.

Be alert for unusual noises or vibration. When an unusual condition is noticed, stop machine in a safe position and shut off engine. Determine cause and correct problem before continuing.

Avoid prolonged idling. Idling causes engine temperature to drop and this permits formation of heavy carbon deposits and dilution of lubricating oil by incompletely burned fuel. If the engine is not being used, turn it off.

⚠ CAUTION

Always keep engine covers closed while engine is running.

continued...

Stopping the Engine

Operate engine at idle speed for a few minutes before turning it off. This allows engine coolant and lubricating oil to carry excessive heat away from critical engine areas.

Do not "gun" engine before shut down; this practice causes raw fuel to remove oil film from cylinder walls and dilute lubricant in crankcase.

To stop engine, allow engine to run at idle for a few minutes and then turn key counterclockwise to stop position. Be sure to remove key from ignition switch before leaving cab.

WARM UP & OPERATIONAL CHECKS

(To be performed at beginning of each work shift)

Complete all required maintenance before operating unit

The safety, efficiency and service life of your unit will be increased by performing the operational checks listed below. Items preceded by an asterisk (*) are optional and may not be furnished on your machine. **Check items during warm-up period.**

*1. Heater, defroster and windshield wiper

*2. Operating lights and rotating beacon

3. Low brake pressure light - should go out with engine running above idle

4. Ammeter - should show low charging rate after charging system has replaced starting drain

When engine warms to operating range, check the following items:

5. Service brake, parking brake and Mico brake lock.

6. Forward and reverse travel in all gears

7. "Inching" travel - should be smooth through full pedal travel

8. Horn and back-up alarm

9. All boom and attachment functions - full stroke

10 Hydraulic Filter Condition Indicator - observe torque converter temperature gage after starting normal operation. When needle has been in operating range for an hour or so, stop handler in a safe area and set parking brake. With engine running, check hydraulic filter condition indicator. When yellow flag fills indicator window, filter is clogged and hydraulic oil is bypassing filter. Filter must be changed before reaching bypass condition (change before yellow flag reaches midpoint of window).

⚠ CAUTION

Continued operation with hydraulics fluid by-passing the filter (yellow flag showing) can cause severe damage to hydraulic system components.

General

The brake system furnished on The handler includes a service brake, parking brake and Mico lock.

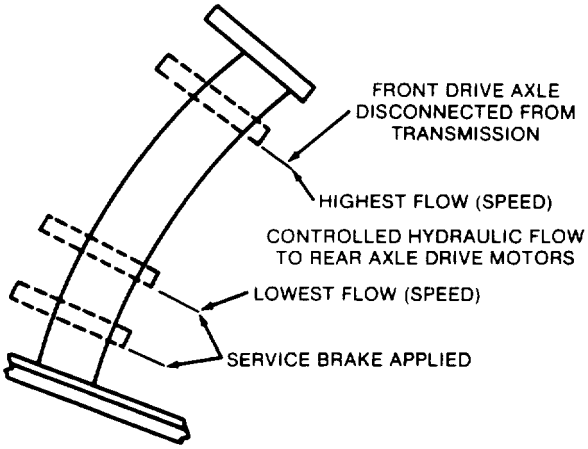
Because service braking and “inching” (slow travel) functions overlap, some features of inching will be discussed here. Refer to Drive Train Section for additional information on inching travel.

Inching Travel

Overlap between service braking and inching occurs because the same foot pedal controls both functions and also because both functions control travel speed. However, the methods of controlling travel speed are quite different: service braking involves a controlled stopping force applied to the front wheels while inching involves a controlled driving force applied to the rear wheels.

The service brake/inching pedal has three separate functions:

1. It disconnects front drive axle from transmission.
2. It controls hydraulic flow to rear axle drive motors (hydraulic flow regulates speed).
3. It applies service brake.



As illustrated, the three functions occur in sequence as service brake/inching pedal is depressed from top to bottom of stroke.

WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel.

Service Brakes

The power-assisted hydraulic service brake is applied only to front wheels of handler.

When the service brake/inching pedal is depressed far enough to actuate the service brake master cylinder, brake fluid flows to wheel cylinders to apply service brake. At the same time, pilot pressure is applied to a piston within master cylinder to intensify (boost) pressure to wheel cylinders.

WARNING

Though it is possible to stop the handler without the power assist feature, very heavy foot pressure is required and stopping distance will be significantly greater.

Mico Lock

The Mico Lock can be used to reduce operator fatigue by temporarily locking a service brake application on using a hand lever rather than holding brake pedal.

WARNING

Never use Mico Lock as a parking brake. The brake application will bleed off after a short time and allow the machine to roll.

To Apply Mico Lock

1. Check to be sure Mico Lock lever is pushed forward to release position (lever horizontal).
2. Depress service brake pedal fully and hold.
3. Pull Mico Lock lever back to lock position (lever vertical) and then release brake pedal.

To Release Mico Lock

Release Mico Lock by pushing lever forward to release position (lever horizontal).

contined...

Parking Brakes

The parking brake locks the front axle by means of a cable actuated brake caliper acting on a brake disc attached to the axle input yoke.

Parking brake tension can be increased by turning knob at end of lever clockwise.

To apply the parking brake, pull parking brake lever to rear (toward vertical position).

To release parking brake, push parking brake lever forward (to horizontal position).

WARNING

Always apply parking brake before leaving cab. Neither leaving the unit in gear nor applying the Mico Lock will prevent unit from rolling. Refer to page 17 for parking procedure.

STEERING SYSTEM

Ninety degree rear wheel power steering is provided to reduce operator fatigue and to permit high maneuverability in close quarters.

It is important that the operator practice maneuvering the handler in a safe, open area until he becomes thoroughly familiar with steering response and clearance required for tailswing and load when turning.

WARNING

Be alert for any increase in effort needed to steer. It any difference is noted, notify maintenance personnel immediately for correction. It power assist feature should fail for any reason IT WOULD BECOME VERY DIFFICULT TO STEER. For this reason it is extremely important that you NEVER TURN ENGINE OFF WHILE TRAVELING.

In the event power steering fails, stop as soon as possible. Do not drive unit until problem has been corrected.

General

The drive train provides two and four wheel drive and includes the engine, torque converter, transmission, propel shaft and front and rear driving axles.

Inching travel is directly related to drive train functions and will be discussed in this section.

Two & Four Wheel Drive

The drive train is designed to provide two wheel drive (front axle driving) or tour wheel drive (both front and rear axles driving).

Under certain conditions, changing from four wheel drive to two wheel drive may cause a difference in the way the machine responds to steering, braking and drive controls. Always be aware of which travel mode you are using.

There are two ways to disengage rear wheel drive:

1. Shift to third gear (rear axle drive is engaged only in first and second gears)
2. Disengage rear planetary hubs (refer to Rear Drive Axle heading in this section)

NOTE: Rear drive axle can also be disengaged in response to overload in associated electrical circuitry causing automatic reset type circuit breaker to trip (open). Breaker will close again in approximately ten seconds.

Torque Converter

There are no operator controls for the torque converter. It functions automatically to permit starting from a standstill in any transmission speed range.

An oil temperature gage is provided to indicate operating temperature of torque converter/transmission. Normal operating temperature is 180 - 200°F. (82 - 93°C.). If overheating occurs, attempt to lower temperature by traveling in a lower gear. If necessary, stop and allow torque converter to cool with engine running and gear selector in neutral. Be sure radiator fins are clean.

⚠ CAUTION

Continued operation of overheated torque converter/transmission can cause serious damage to these components.

Transmission

The transmission provides three speed ranges for both forward and reverse travel.

Gear	1st	2nd	3rd	3rd*
mph	2.8	6.0	15.9	17.9
kmph	4.5	9.6	25.6	28.8

*With rear planetary hubs disengaged

There are three operator controls for the transmission:

1. Gear Selector Lever (for 1st, 2nd and 3rd gears)
2. Direction Selector Lever (for forward, neutral and reverse)
3. Service Brake/Inching Pedal (refer to Inching Travel heading in this section)

To Operate Transmission:

1. Release parking brake and hold handler in position using service brake.
2. Move gear selector to appropriate speed range (1st, 2nd or 3rd gear). The gear selector may be shifted while traveling. When traveling downhill, use the same gear needed to travel up the hill.

⚠ WARNING

Never shift gear selector or direction selector to cause a sudden change of travel speed or direction. Such a change could cause load to shift or machine to tip over. Reversing direction while traveling can also damage transmission.

3. Move direction selector to forward or reverse position as required.
4. Release service brake and depress accelerator to attain appropriate speed.
5. Stop handler by releasing accelerator and applying service brake.
6. Move direction selector to neutral position.
7. Apply Mico Lock or parking brake as appropriate.

Front Driving Axle

The front driving axle includes a differential and planetary drive hubs and is powered by a propeller shaft from the transmission. The service brake/inching pedal is the only operator control for the front axle (refer to Inching travel Heading).

contined...

Rear Driving Axle

The rear driving axle includes planetary hubs which are powered by hydraulic motors mounted on the inner face of the hubs. Hydraulic flow to drive motors is provided only in first and second gear speed ranges. Drive motors are free-floating in third gear.

⚠ CAUTION

Continuous driving for two miles or more in third gear, with rear driving hubs engaged, can damage hydraulic drive motors.

To Disengage Rear Driving Hubs:

1. Apply parking brake and remove key from ignition switch.
2. Remove thumb screws from keeper pin plate.
3. Remove and rotate plate per photo on pg. 6 (cup out - engaged - cup in - disengaged).
4. Secure plate using thumb screws.
5. Repeat procedure for other hub.

To Engage Rear Driving Hubs: Repeat procedure.

NOTE: If machine is moved with keeper pin plate removed, input shaft pin will pop out.

Hydraulic flow to rear axle drive motors is controlled electrically. An automatic reset type breaker is included to prevent damage from overload. **If circuit breaker trips (opens) rear axle drive will be inoperative for approximately ten seconds until breaker resets. Notify maintenance personnel if circuit breaker trips repeatedly.**

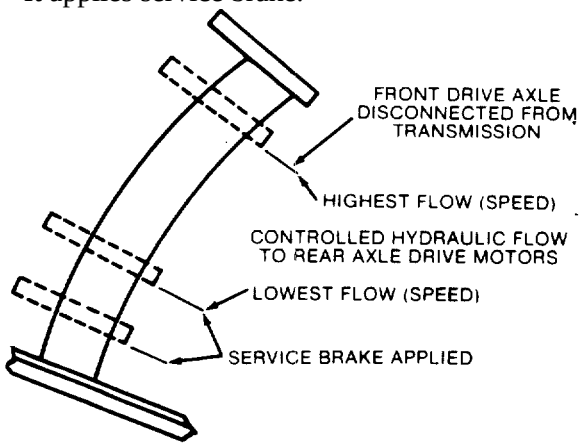
To determine whether circuit breaker has tripped, attempt to move machine using inching travel. If machine does not respond to inching travel pedal circuit breaker is open.

Inching Travel

Inching travel is provided to permit very slow travel while maintaining high engine speed for other functions. Because inching travel depends on hydraulic flow to rear axle drive motors, inching travel functions only in first and second gears. There is no hydraulic flow to drive motors in third gear.

Inching travel is controlled by the service brake/inching travel pedal. This pedal has three separate functions:

1. It disconnects front drive axle from transmission.
2. It controls hydraulic flow to rear axle drive motors (hydraulic flow equals speed).
3. It applies service brake.



As illustrated, the three functions occur in sequence as pedal is depressed from top to bottom of stroke.

To Engage Inching Travel:

1. Depress service brake/inching travel pedal approximately 1-1/2 inches to disengage front driving axle from transmission. At this point rear drive motors are receiving full flow and travel speed will not have changed.
2. Continue to depress pedal to reduce speed - the more pedal travel, the less speed.
3. To stop, depress pedal fully.

OR

To resume normal travel release service brake/ inching travel pedal. Depress accelerator pedal to attain appropriate speed.

⚠ WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel

Leveling

The handler is designed to permit tilting main frame eight degrees to left or right to compensate for uneven ground conditions.

WARNING

Raising the boom (loaded or unloaded) when handler is leaning to the side can cause machine to tip over with little or no warning.

A level indicator is located on upper portion of front window frame to permit operator to determine that machine is or is not level.

The rear axle pivots at the midpoint of the main frame to help assure that wheels will remain in contact with ground. A hydraulic cylinder provides a rigid connection between front axle and main frame to help assure a solid work platform and permit tilting main frame to left or right.

NOTE: The frame leveling function is provided only to level the machine before lifting or placing a load. Do not attempt to use leveling feature to turn on or travel across a slope.

To Level Handler:

1. Position machine in best location to lift or place load and apply brake.
2. Observe level indicator to determine whether machine must be leveled. Note position of indicator for later realignment.
3. If necessary, position boom in carry position and move carriage tilt/machine level lever to left or right to level machine. Move lever to left to lower left side of frame or move lever to right to lower right side frame.
4. Lift or place load as appropriate.
5. Retract and lower boom to carry position.
6. Realign frame to position noted in step 2.

WARNING

If handler cannot be leveled using leveling system, do not attempt to raise or place load. Have surface leveled.

Boom

The three section hydraulically operated boom provides maximum reach of 36 feet above horizontal at 70° elevation and 21 feet forward of forward edge of front tires at 0° elevation (measured to heel of standard forks mounted on standard carriage). Boom travel extends from 4° below horizontal to 70° above horizontal.

Raise boom by pulling boom lever to rear and lower boom by pushing boom lever forward.

Boom extension and retraction is accomplished by a hydraulic crowd cylinder anchored at rear of boom section no. 1 and at front of boom section no. 2 and also by a cable and push beam arrangement within the boom sections. **Extension or retraction of boom section no. 2 is always equaled by a corresponding movement of boom section no. 3.**

A hydraulic cylinder is located within the boom head to tilt the fork carriage or other attachment back and forth as required.

The tilt cylinder is controlled by carriage tilt/ machine level lever. Push lever forward to tilt attachment down or pull lever to rear to tilt attachment up.

Extend boom by moving boom lever to right and retract boom by moving boom lever to left.

A compensating cylinder is pinned to main frame and to base of boom section no. 1. As boom is raised, oil is transferred from rod end of compensating cylinder to rod end of attachment tilt cylinder. Lowering boom causes transfer of oil from barrel end of compensating cylinder to barrel end of attachment tilt cylinder. This transfer of oil causes extension and retraction of tilt cylinder to maintain angle of attachment as boom is raised and lowered.

All cylinders related to boom (attachment tilt, raise/ lower and extend/retract) are protected by pilot operated check valves which prevent load from falling in event of a broken hydraulic hose or tube.

Attachments

Although the carriage/fork combination is most frequently used, a number of other attachments are available for use with the handler. can be provided for light duty work. A truss boom is available to extend maximum reach and height and can be fitted with a winch when required. Consult your Gradall/Loed Materials Handler Dealer for information on attachments designed to solve special material handling problems.

Attachment Capacities

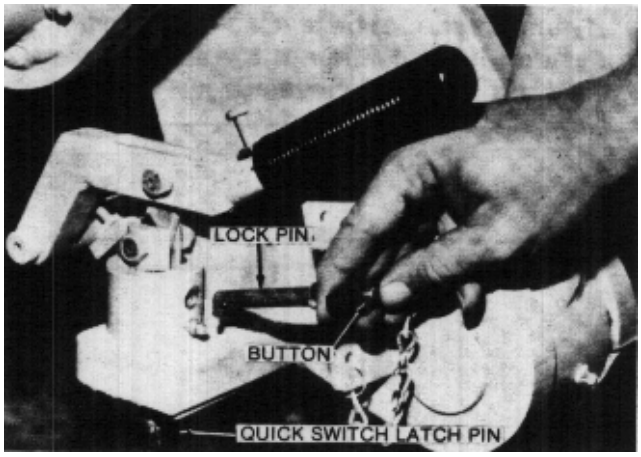
The Rated Capacity Chart, located on left side of dashboard, indicates maximum capacities for handlers equipped with standard carriage/fork combination. These capacities apply only to standard carriage fork combination and cannot be used for other attachments.

A serial number plate is attached to all attachments and indicates maximum capacity for that attachment. **However, the capacity shown on this plate may be incorrect in relation to your machine.**

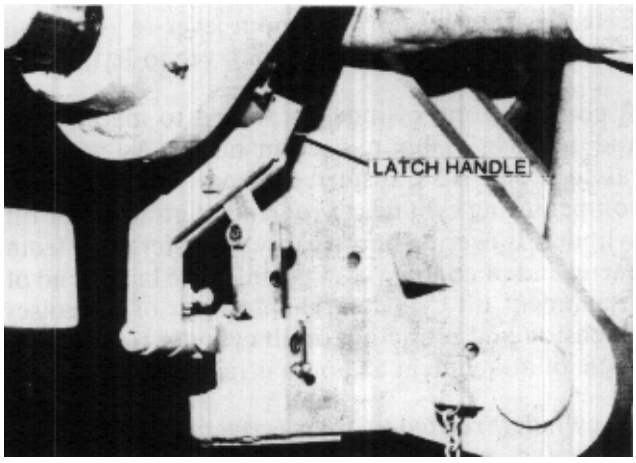
Refer to Attachment Capacity Plate, located below Serial Number Plate on right cab wall, for correct maximum capacity for all attachments furnished with your machine. If attachment in question is not listed on this plate, contact factory for maximum capacity.

Refer to Operating Procedures and Techniques section for instructions on proper use of information shown on capacity plates.

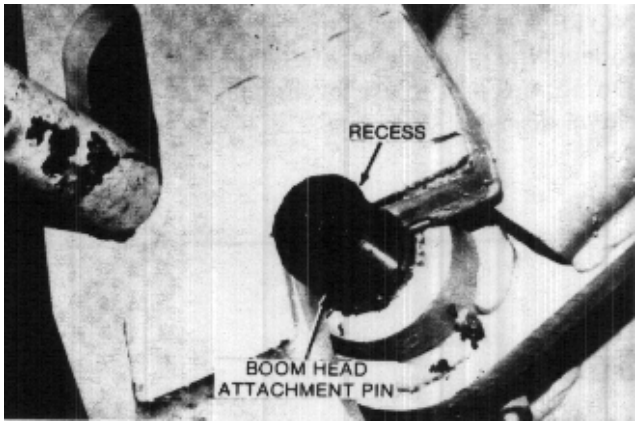
Attachment Installation



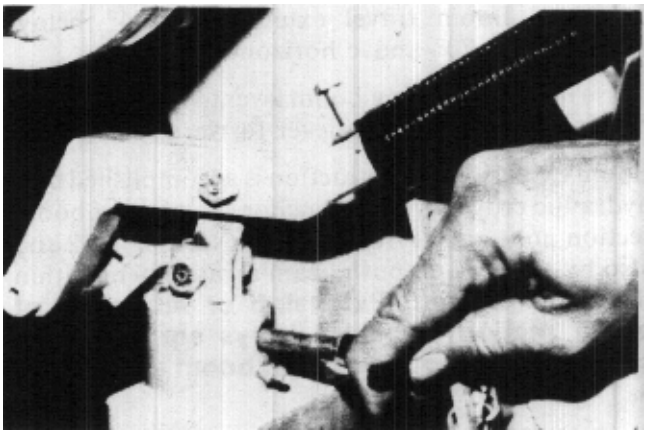
1. Depress button and remove lock pin from quick switch latch pin.



2. Raise handle to retract latch pin fully.



3. Position boom head attachment pin fully in recess of attachment. Tilt upward slightly to assure full engagement.



4. Depress handle fully to engage latch pin in attachment and install lock pin in latch.

OPERATING PROCEDURES & TECHNIQUES

This section highlights some common procedures and discusses areas which may be new to even the experienced operator.

Hydraulic Controls

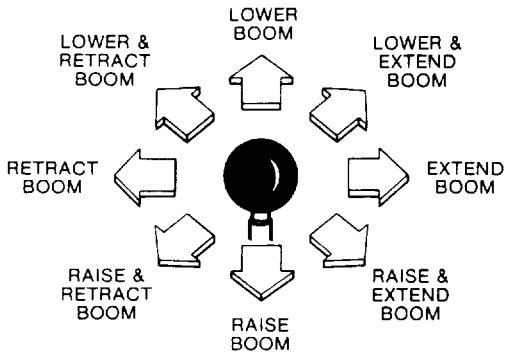
All boom and attachment movements are governed by hydraulic controls. Rapid, jerky operation of hydraulic controls will cause rapid, jerky movement of the load. Such movements can cause the load to shift or fall or may cause the machine to tip over.

Feathering

Feather is a technique of control operation used for smooth load handling. To feather controls. move control lever very slowly until load begins to move, then gradually move lever further until load is moving at desired speed. Gradually move lever toward neutral as load approaches destination. Continue to reduce load speed to bring load to a smooth stop. Feathering effect can be increased by lowering engine speed at beginning and near end of load movement.

Boom Control Lever

The boom control lever can be positioned to cause individual boom movements or combinations of boom movements as illustrated.



With boom raised above horizontal, forks can be inserted under a load by moving boom control lever forward and to the right until forks move forward horizontally.

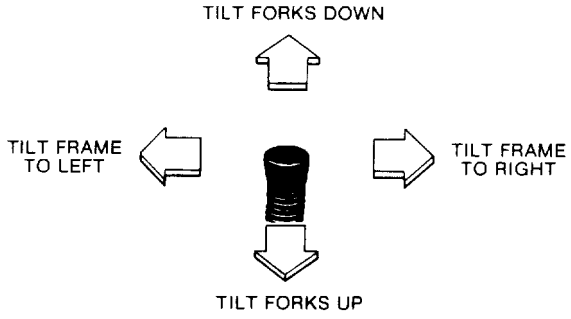
With boom raised above horizontal, forks can be removed from a load by moving boom control lever back and to the left until forks move rearward horizontally.

With boom lowered below horizontal, forks can be inserted under a load by moving boom control lever back and to the right until forks move forward horizontally.

With boom lowered below horizontal forks can be removed from a load by moving boom control lever forward and to the left until forks move rearward horizontally.

The closer the boom to horizontal, the less boom raise/lower movement required for inserting and removing forks.

Carriage Tilt/Machine Level Lever



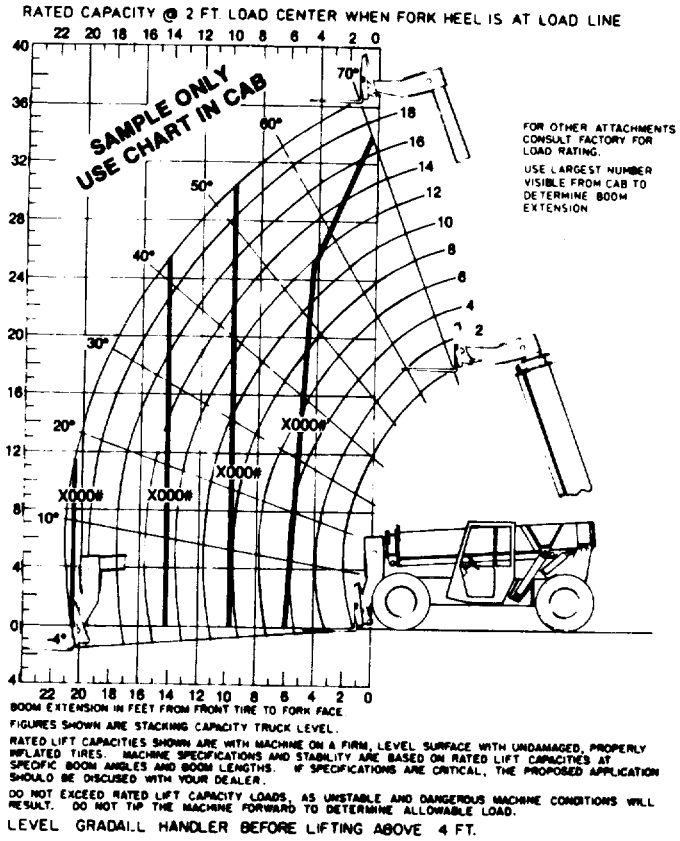
Move lever forward to tilt forks down and move lever to rear to tilt forks up.

Move lever to left to tilt main frame to left and move lever to right to tilt frame to right.

WARNING

Always move boom to carry position (horizontal or below) before leveling frame. Attempting to level machine with boom raised may cause it to tip oven.

Rated Capacity Chart



General

The rated capacity chart, located on left side of dashboard, indicates maximum load capacities for handlers equipped with standard carriage/fork combination. These capacities apply only to the standard carriage/fork combination and cannot be used for other attachments.

WARNING

All loads shown on rated capacity chart are based on machine being on firm, level ground; the forks being positioned evenly on carriage; the load being centered on forks; proper size tires being properly inflated; and the handler being In good operating condition. Machines having 8000 pound capacity must have tires properly filled with calcium chloride.

Elevation:

Numbers at left side of chart (-4' to 40') represent elevation at heel of horizontal fork as measured from level ground. Maximum elevation with boom fully raised and extended is 36 feet. Elevation relates to dimension “A” shown on serial number plate located on right cab wall.

Boom Extension

Numbers across bottom of chart (0' to 22') and numbers parallel to boom (2' to 18') represent boom extension as measured from fully retracted position to extended position. These numbers do not reflect total boom length, only the number of feet of extension from fully retracted position.

Number decals on boom section number two (4, 8 12, 16 and 20) relate directly to boom extension. The largest number which can be read from operator’s seat indicates total boom extension.

Boom extension relates to dimension “D” shown on serial number plate.

Boom Angle

Numbers at ends of angled fines (4° to 70°) represent angle of boom to horizontal as measured from horizontal plane at ground level. Maximum angles are 4° below horizontal with boom fully lowered to 70° above horizontal with boom fully raised.

A boom angle indicator is located on left side of boom section number one to show boom angle. Be sure machine is level from front to rear or indicator will provide incorrect reading.

Load Center

Loads shown on rated capacity chart are based on the load center being two feet above and two feet forward of surfaces of horizontal forks as indicated by dimensions “B” and “C” on serial number plate.

The load center of a load is the center of gravity of the load. For regularly shaped loads of the same material, such as a pallet of blocks, the center of gravity can be located by measuring the load to find its center. For irregular loads, or loads of dissimilar materials, keep the heaviest part of the load as close to the heel of the forks as possible.

In all cases, the load center must be centered between the forks.

Load Limits

Some capacities shown on the rated capacity chart are based on machine stability and some are based on hydraulic lift capacity. The “common sense” or “feel” an experienced operator might apply in regard to “tipping loads” **DOES NOT APPLY to hydraulic load limits.** Exceeding load limits can cause a relief valve to open allowing the load to fall, or in some cases, the machine to tip over.

WARNING

Never use "tipping" method to determine safe lifting capacity. This could cause the load to fall or the machine to tip over.

Material Handling Bucket Capacity

Lift capacity for a material handling bucket, if furnished with the handler, is shown on the Attachment Capacity plate located on right cab wall below Serial Number plate. If part number on bucket does not match part number on Attachment Capacity plate, contact factory for proper bucket lift capacity.

The bucket lift capacity is based on machine being on firm, level ground; proper size tires being properly inflated; and the handler being in good operating condition.

Because maximum bucket rated lift capacity is based on hydraulic limitations, the maximum load may be handled anywhere within reach of machine.

Truss Boom/Winch Capacity

Lift capacity for a truss boom or a truss boom/winch combination. If furnished with the handler, is shown on the Attachment Capacity plate. If the part number shown on the boom does not match the part number shown on Attachment Capacity plate, contact factory for proper boom lift capacity.

The truss boom lift capacity is based on machine being on firm level ground; proper size tires being properly inflated; the handler being in good operating condition; and the load being suspended vertically form the boom.

Side loads or swinging loads can cause structural damage and may cause the machine to tip over.

Because maximum truss boom lift capacity is based on hydraulic limitations, the maximum rated load may be handled anywhere within reach of the machine.

PARKING

1. Position unit in a safe, level parking area.

WARNING

Parking brake may not hold machine on a grade.

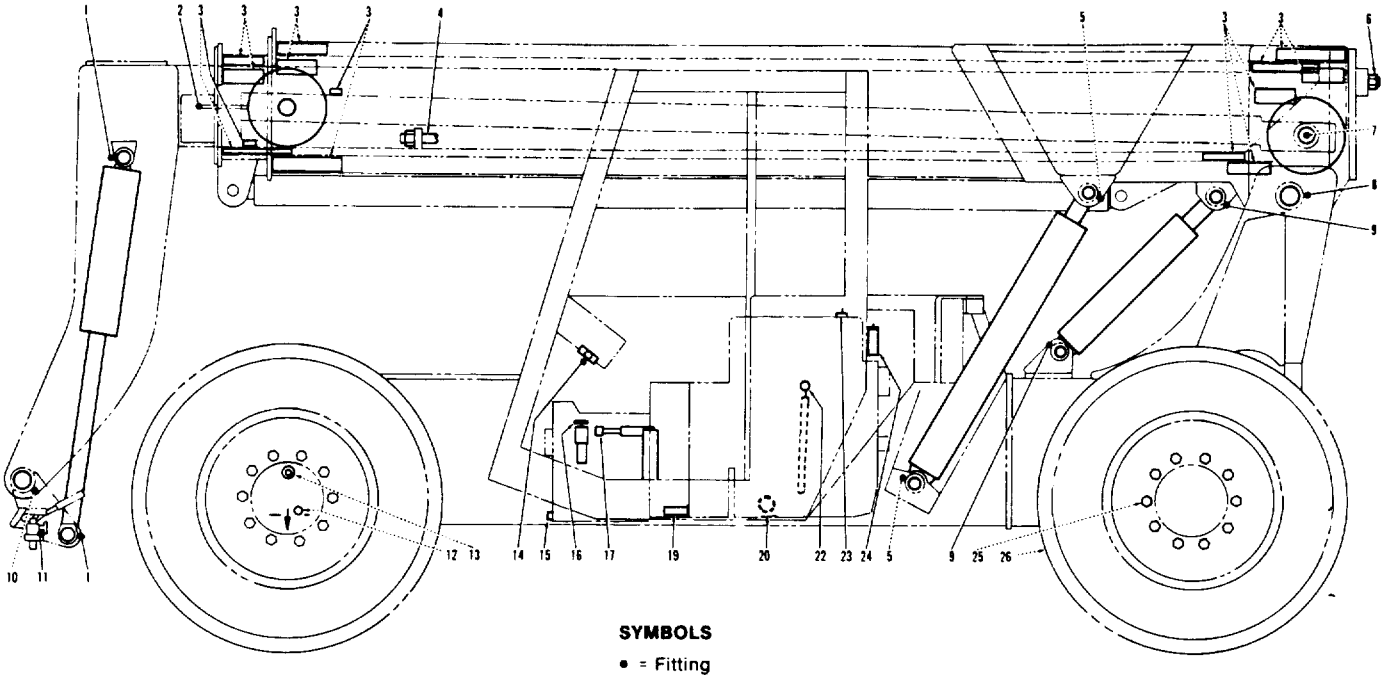
2. Apply parking brake and chock wheels.
3. Retract and lower boom fully.
4. Turn off all electrical accessories.
5. Allow engine to cool at idle speed for a few minutes and then turn off. Remove ignition
6. key.
7. Fill fuel tank to minimize condensation.
8. Disconnect battery if unit is in an area where tampering seems possible.

   Lock cab (if so equipped).

STORAGE

1. Clean and inspect machine thoroughly and perform all required maintenance.
2. Coat all cylinder rods with a good grade of grease or rust preventative.
3. Park machine in a dry enclosure and remove batteries.
4. Prepare engine in accordance with engine manufacturer's instructions.

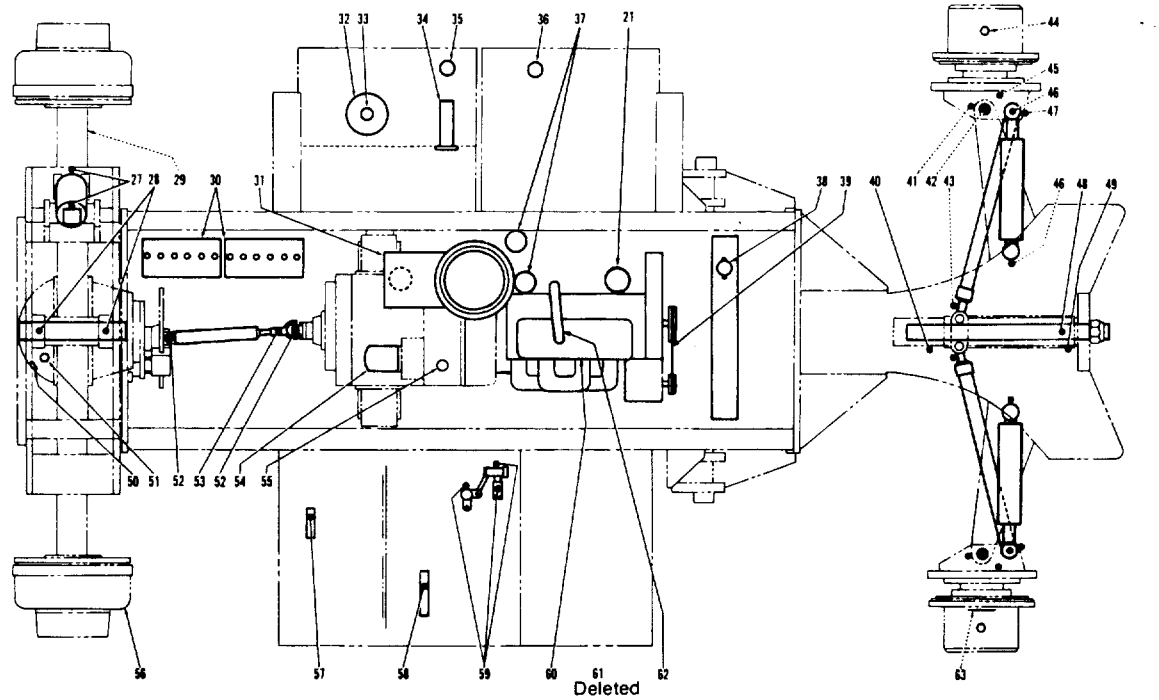
LUBRICATION & MAINTENANCE DIAGRAM



SYMBOLS

● = Fitting

→ = Other Service



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Lubricate Notes

- Lubricate points indicated by dotted leaders on both sides of unit.
- Intervals shown are for normal (8 hour day) usage and conditions. Adjust intervals for abnormal usage and conditions.
- See recommended lubricants (page 20).
- Apply a light coating of engine oil to all linkage pivot points.
- Clean lubrication fittings before lubricating.
- Clean filter and air cleaner housing using diesel fuel. Dry components thoroughly using a lint free cloth.
- Check lubricant levels when lubricant is cool.
- Drain engine and gear cases only after operation when lubricant is hot.

	Daily or Every 10 Hours	Lube Symbol	No. of Points
1.	Carriage Tilt Cylinder Pivots	CG	2
2.	Boom Extension Cable Sheave	CG	1
3.	Boom Slide Bearings (extend boom fully and coat all wear paths on boom sections 2 and 3 - retract and extend boom fully three times and wipe excess grease from bearings)	CG	8
5.	Boom Hoist Cylinder Pivots	CG	2
7.	Boom Retraction Cable Sheave	CG	1
8.	Boom Pivot	CG	1
9.	Compensating Cylinder Pivots	CG	2
10.	Boom Head/Carriage Pivot	CG	2
14.	Carriage Tilt/Machine Level Lever Pivot	CG	1
16.	Transmission Dipstick (check level & replenish as req'd)	ATF	1
22.	Engine Dipstick (check level & replenish as req'd - item 23 is filler port)	EO	1
26.	Tires (inspect for damage)	-	4
27.	Leveling Cylinder Pivots	CG	2
28.	Front Axle Pivot	CG	2
33.	Hydraulic Filter Condition Indicator (check with oil at operating temperature - replace filter as req'd)	-	1
35.	Hydraulic Reservoir (check level & replenish as req'd)	HF	1
36.	Fuel Tank (fill daily after shut down)	DF	1
38.	Radiator (check level and replenish as req'd using proper coolant)	-	1
40	Rear Axle Pivot (front bearing)	CG	1
41	King Pins (upper)	CG	2
42	King Pins (lower)	CG	2
43	Tie Rods (inner pivot)	CG	2
45	Planetary Hub	CG	2
46	Steering Cylinder Pivots	CG	4
47	Tie Rod Pivots (outer)	CG	2
48	Idler Arm Pivot	CG	1
49	Rear Axle Pivot (rear bearing)	CG	1
56	Service Brake Adjustment (check for minimum of 1" space between fully depressed brake pedal and floor)	-	1
57	Accelerator Pedal Pivot (under cab)	CG	1
58	Brake/Inching Travel Pedal Pivot (under cab)	CG	1
59	Boom Lever Linkage (under cab)	CG	1
61	Deleted	CG	3

Weekly or Every 50 Hours

*4	Boom Retraction Cable (inspect cable and replace if damaged - extend boom about 15 feet and check tension - should be torqued to 75 ft/lbs)	-	1
*6	Boom Extension Cable (inspect cable and replace if damaged - extend boom fully and then retract a few feet and check tension - should be torqued to 75 ft/lbs)	-	1
11	Quick Switch Latch	CG	1
12	Front Planetary Hub Level Plugs (check level with arrow pointing down as shown - replenish as req'd) - 2	-	2
24	Brake Master Cylinder Reservoir (under cover behind cab - check level and replenish as req'd)	BF	1
26	Tires (check pressure and adjust as req'd - 55 psi) (on 8000 pound unit, thump check tires for 90% fill of calcium chloride mixture)	-	4
30	Batteries (check electrolyte level & replenish as req'd)	-	2
*39	Engine Drive Belts (check condition and tension - adjust or replace as req'd)	-	2

*To be performed by qualified maintenance personnel in accordance with service manual instructions.

	At End of First Week	Lube Symbo	No. of l Points
*3	Front Boom Slide Bearings (check retaining bolt torque	-	12
13.	Front Hub Drain Plugs (dram and refill)	GO	2
15.	Transmission Drain Plug (drain and refill)	ATF	1
32.	Hydraulic Filter (replace)	-	1
44.	Rear Hub Fill/Level/Drain Plugs (drain and refill - refill with plug at 3 or 9 o'clock position)	GO	2
50.	Front Axle Differential (drain and refill)	GO	1
54.	Transmission Filter (replace)	-	1

Every 2 Weeks or 100 Hours

*3	Boom Slide Bearings (front lower - check for wear & shim or replace as req'd - no wear permitted past bevel - check upper rear bearings when lower front bearings require service - shims are 1/16" thick)	-	4
17	Parking Brake (check for proper adjustment turn lever knob clockwise to increase tension)	-	1
20	Engine Crankcase Dram Plug (drain and refill to level)	EO	1
21	Engine Oil Filter (replace)	-	1
31	Engine Air Cleaner (clean elements and check to be sure vacuator (rubber cone on bottom) is clear and undamaged)	-	1
52	Drive Shaft Universal Joints	CG	2
53	Drive Shaft Spline	CG	1
62	Engine Crankcase Breather Tube (check to be sure it's clear)		1

Every 5 Weeks or 250 Hours

*25	Wheel Lug Nuts (check torque - should be 300 - 310 lb-ft on front/325 - 335 lb-ft on rear	-	40
*29	Front Axle (check mounting bolt torque - should be 545 - 600 lb-ft)	-	8
54	Transmission Filter (replace)	-	1

Every 3 Months or 500 Hours

15	Transmission Drain Plug (drain and refill to level)	ATF	1
19	Transmission Screen (clean)	-	1
32	Hydraulic Filter (replace)	-	1
*35	Hydraulic Fluid (have hydraulic oil tested)	-	1
36	Fuel Tank (drain sediment)	-	1
37	Engine Fuel Filter (replace)	-	1
55	Transmission Breather (clean)	-	1
*60	Engine Intake & Exhaust Valves (adjust)	-	-

Every 6 Months or 1000 Hours

13	Front Planetary Hub Drain Plugs (drain and refill to level)	GO	2
31	Engine Air Cleaner (replace element)	-	1
44	Rear Planetary Hub Drain Plugs (drain and refill to level)	GO	2
50	Front Axle Differential Plug (drain and refill to level)	GO	1
51	Front Axle Differential Breather (clean)	-	1

Every Year or 2000 Hours

34	Hydraulic Reservoir Suction Screen (clean)	-	1
*35	Hydraulic System (drain and refill to level)	HF	1
36	Fuel Tank Breather/Cap (clean)	-	1
38	Engine Cooling System (drain, flush and refill)	-	1
*63	Rear Axle Wheel Spindle Snap Rings. (inspect & replace as req'd.)	-	2

Recommended Lubricants & Capacities

Application	Symbol	When Used	Grade	Specifications	Capacities** English	Capacities** Liters
Engine Crankcase	EO (engine oil)	All year	10W-30	-	12 quarts	7.8
Engine Cooling System	50% water/50% anti-freeze	All year	Permanent	-	24 quarts	22.7
Transmission	ATF (automatic trans. fluid)	All year	-	ATF-FM DEXRON -	20 quarts	18.9
Fuel Tank	DF (diesel fuel)	All year	#2	A.S.L.E. No. H-215*	40gallons	151.4
Hydraulic System	HF (Hydraulic fluid)	All year	-	A.P.I. GL-5	40 gallons	151.4
Differential	GO (multi-purpose lubricant)	All year	EP 80-90	A.P.I. GL-5	8 quarts	8.4
Front Planetary Hubs	GO (multi-purpose lubricant)	All year	EP 80-90	A.P.I. GL-5	2.5 quarts	1.3
Rear Planetary Hubs	GO (multi-purpose lubricant)	All year	EP 80-90	H-152	44 ounces	1.5
Boom Bearing Paths	CG (ectreme pressure lube)	All year	EP2	H-152	-	-
Grease Fitting	CG (ectreme pressure lube)	All year	EP2	Type A-SAE J-1730C	-	-
Brake master Cylinder	BF (brake fluid)	All year	-		-	-

*Specific hydraulic fluid specifications are shown below.
**Capacities are approximate - check level to be sure.

Hydraulic Fluid Specifications:

Grade, ASTM	215	Viscosity:		Carbon Residue, Rams, wt%	0.4
Grade, AGMA	1	SUS at 100° F	215	Zinc, wt%	0.08
Gravity, °API	31.0	SUS at 210° F	48.0	Rust Test. ASTM D 665 A&B	Pass
Color, ASTM	2.0	Viscosity Index	105	Oxidation Test. ASTM D 943.	
Flash Point, COC, °F	440	Aniline Point, °F	222	hours to Neut. No of 2.0	2500
Fire Point, COC, °F	490	Foam Test, ASTM	Pass	Emulstion Test, ASTM D 1401,	
Pour Point, °F	-30	Neutralization Number	1.4	minutes to pass at 130° F	10
				Copper Corrosion, 3 hr at 212° F	1B

Tire Specifications

Standard: 13:00 x 24 - 12 ply rating - 55 psi
Optional for front only: 15:50 x 25 - 12 ply rating - 55 psi

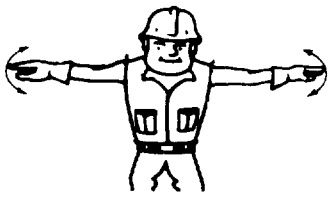
Model 534B-8 (8000 pound rating) must have tires filled to 90% of capacity with calcium chloride mixture (49 gallons of water and 245 pounds of calcium chloride per tire).

HAND SIGNALS

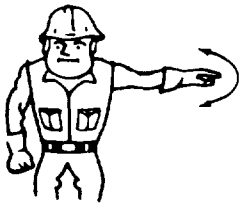
Standard Signals - When handler work conditions require hand signals, they shall be provided or posted conspicuously for the use of both signalman and operator. No handler motions shall be made unless signals are clearly understood by both signalman and operator.

Special Signals - When signals for auxiliary equipment functions or conditions not covered are required, they shall be agreed upon in advance by the operator and signalman.

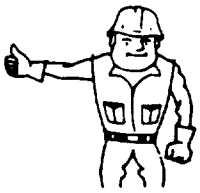
Instructions - When it is desired to give instructions to the operator other than provided by the established signal system, all handler motions shall first be stopped.



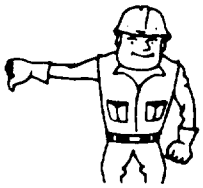
EMERGENCY STOP - With both arms extended laterally, hands open downward, move arms back and forth.



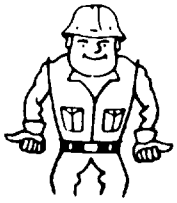
STOP - With either arm extended laterally, hand open downward, move arm back and forth.



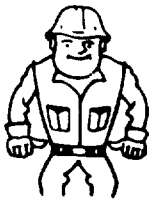
RAISE BOOM - With either arm extended horizontally, fingers closed, point thumb upward.



LOWER BOOM - With either arm extended horizontally, fingers closed, point thumb downward.



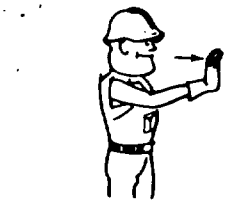
EXTEND TELESCOPIC BOOM - With both hands clenched, point thumbs outward.



RETRACT TELESCOPIC BOOM - With both hands clenched, point thumbs inward.

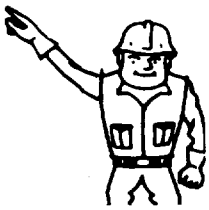
RAISE LOAD VERTICALLY - With either forearm vertical, forefinger pointing up, move hand in small horizontal circle.

LOWER LOAD VERTICALLY - With either arm extended downward, forefinger pointing down, move hand in small horizontal circle.

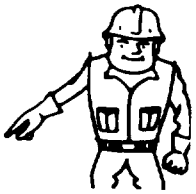


MOVE LOAD OUT HORIZONTALLY - With either arm extended, hand raised and open toward direction of movement, move hand in direction of required movement.

MOVE LOAD IN HORIZONTALLY - With either arm extended, hand raised and open toward direction of movement, move hand in direction of required movement.



TILT FORKS UP - With one arm held at side, extend other arm upward at about 45°.

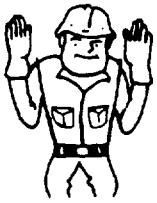


TILT FORKS DOWN - With one arm held at side, extend other arm downward at about 45°.

CLOSE BUCKET - Hold one hand closed and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at closed hand.

OPEN BUCKET - Hold one hand open and stationary. Rotate other hand in small vertical circle with forefinger pointing horizontally at open hand.

MOVE SLOWLY - Place one hand motionless in front of hand giving motion signal. (Raise load slowly is shown.)



THIS FAR TO GO - With hands raised and open inward, move hands laterally, indicating distance to go.

STOP ENGINE - Draw thumb or forefinger across throat.

CALIFORNIA

Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Wash hands after handling.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

GRADALL®

406 Mill Ave. SW, New Philadelphia, Ohio 44663
Phone (330) 339-2211 FAX (330) 339-8468
http://www.gradall.com

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JLG GRADALL®

OPERATION & LUBRICATION MANUAL

GRADALL®

534

9100-3023

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CORPORATE OFFICE

JLG INDUSTRIES, INC.
1 JLG DRIVE
McConnellsburg, PA
17233-9533
USA
Telephone: (717) 485-5161
Fax: (717) 485-6417

GRADALL DIVISION

JLG INDUSTRIES, INC.
406 Mill Avenue S.W.
New Philadelphia, OH
44663
USA
Telephone: (330) 339-2211
Fax: (330) 339-8458

534B

GRADALL®/LOED

MATERIALS HANDLER
OPERATION & LUBRICATION MANUAL

IMPORTANT

Read and understand this manual and the Gradall/Loed Materials Handler Safety Manual before starting, operating or performing maintenance procedures on this machine.

KEEP THESE MANUALS IN CAB.

AVERTISSEMENT! Si vous ne lisez pas l'anglais, demandez a votre surveillant de vous donner les instructions de securite!

ATENCION! Si no lee ingles, preguntele a su supervisor para las instrucciones de seguridad!

VORSICHT! Wen Sie kein Englisch lesen, bitten Sie ihren Vorgesetzten um die Sicherheitsvorschriften!

Covers Units Starting Serial No. 8244001L

Part No. 9100-3023

Form No. 8366

IMPORTANT SAFETY NOTICE

Safe operation depends on reliable equipment and proper operating procedures. Performing the checks and services described in this manual will help to keep your Gradall Materials Handler in reliable condition and use of the recommended operating procedures can help you avoid accidents. Because some procedures may be new to even the experienced operator we recommend that this manual be read, understood and followed by all who operate the unit.

Danger, Warning and Caution notes in this manual and the Gradall Materials Handler Safety Manual will help you avoid injury and damage to the equipment. These notes are not intended to cover all eventualities; it would be impossible to anticipate and evaluate all possible applications and methods of operation for this equipment.

Any procedure not specifically recommended by The Gradall Company must be thoroughly evaluated from the standpoint of safety before it is placed in practice. If you aren't sure, contact your Gradall Materials Handler Distributor before operating.

Do not modify this machine without written permission from The Gradall Company.

The Gradall Company
406 Mill Avenue, S.W., New Philadelphia, Ohio 44663

Form No 8366 12/83

TABLE OF CONTENTS

INTRODUCTION

General

This manual provides important information to familiarize you with safe operating procedures and operator maintenance requirements for the Gradall/ Loed 534B Materials Handler.

If you have any questions regarding the materials handler, contact your Gradall Materials Handler Distributor.

Operator Qualifications

Operators of the materials handler must be in good physical and mental condition, have normal reflexes and reaction time, good vision and depth perception and normal hearing. He/she* must not be using medication which could impair his abilities nor be under the influence of alcohol or any other drug during the work shift.

The operator should also posses a valid, applicable driver's license and must have completed a course of training in the safe operation of this type of material handling equipment.

In addition, the operator must read, understand and comply with instructions contained in the following material furnished with the materials handler:

- This Operator's Manual
- Gradall Materials Handler Safety Manual
- All instruction decals and plates
- Any optional equipment instructions furnished

The operator must also read, understand and comply with all applicable Employer, Industry and Governmental rules, standards and regulations.

Regardless of previous experience operating similar equipment, the operator must be given sufficient opportunity to practice with the 534B Materials Handler in a safe, open area (not hazardous to people or property) to develop the skills and "feel" required for safe, efficient operation.

*Though no offense or discrimination is intended, only the masculine pronouns will be used throughout the remainder of this manual.

Orientation

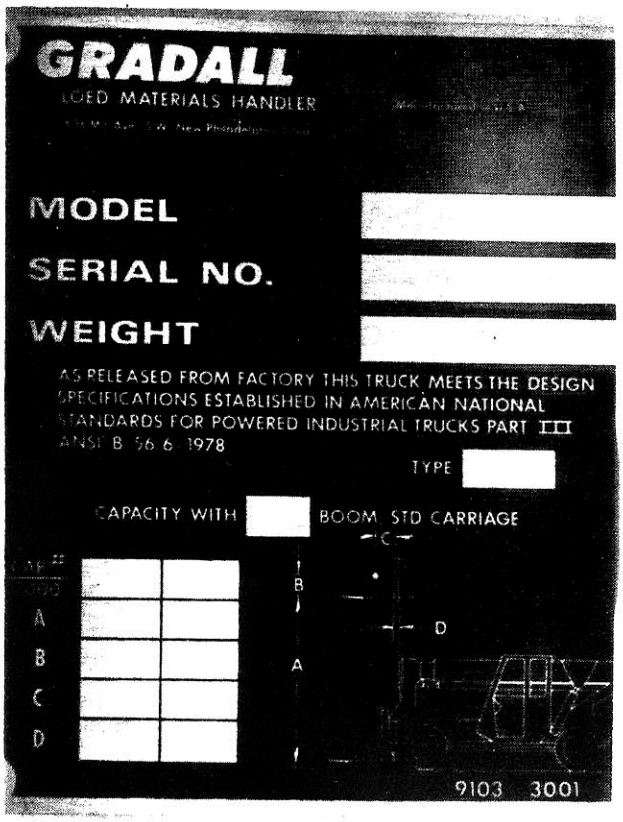
When used to describe location of components in the materials handler, the directions front, rear, right and left relate to the orientation of a person sitting in the operator's seat.

Related Manuals & Decals

Separate publications are furnished with the materials handler to provide information concerning safety, replacement parts, maintenance procedures, theory of operation and vendor components. Replacement manuals, decals and instruction plates can be ordered from your Gradall Materials Handler Distributor.

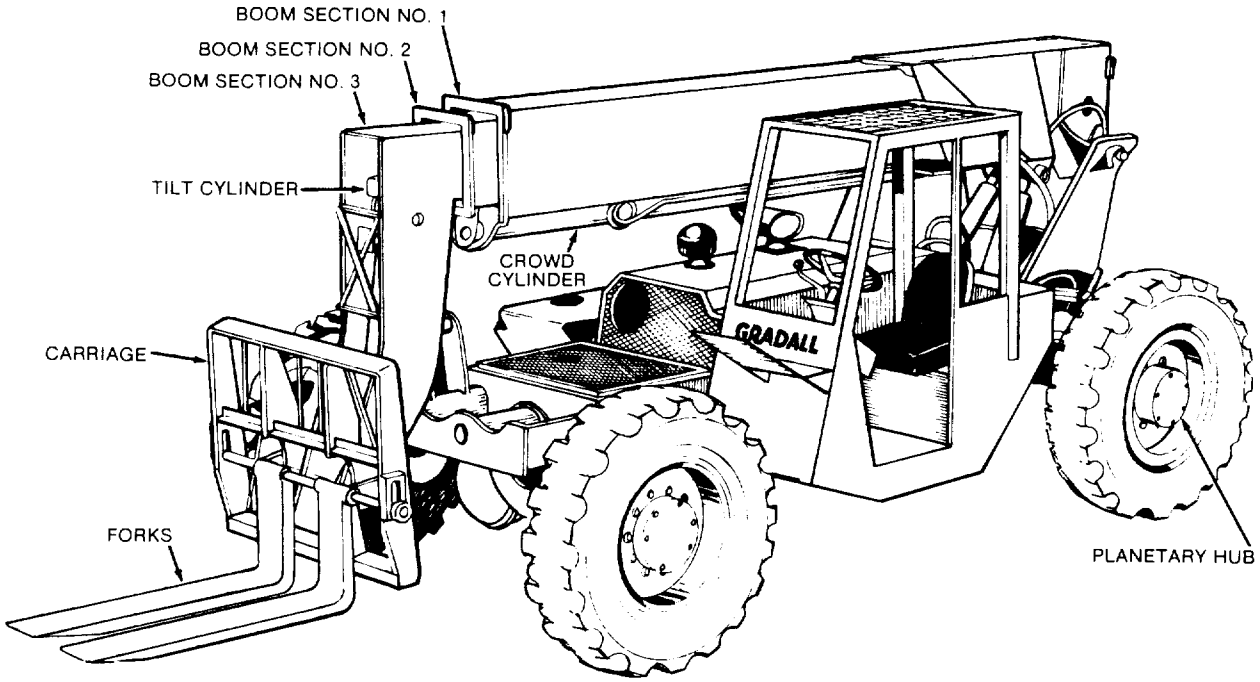
Serial Number Location

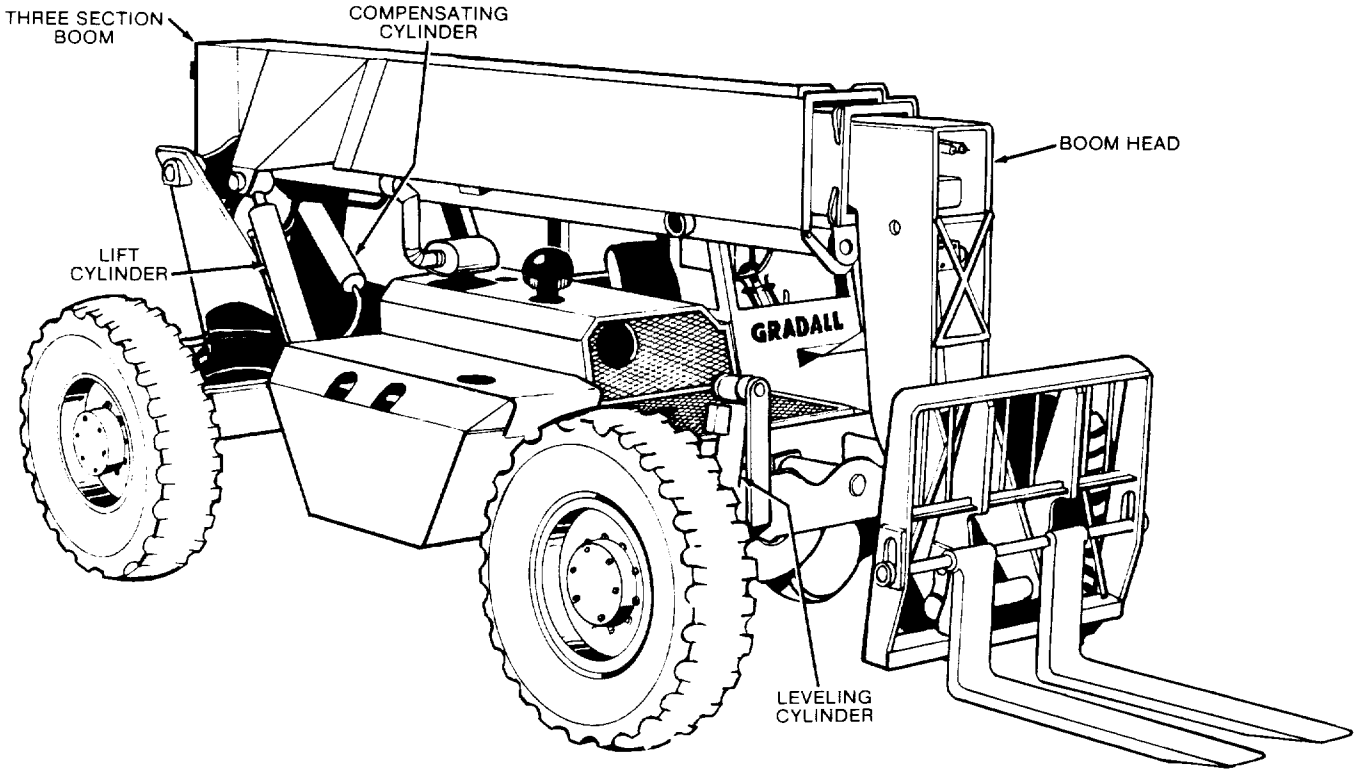
Specify Model and Serial Numbers when ordering parts and when discussing specific applications and procedures with your distributor. The model serial number plate is located on the cab wall to the rig of the operator's seat pedestal.



Nomenclature

The illustrations on page 3 include nomenclature applied to major components of the material handler. The term "handler" will be used throughout the balance of this manual in place of the words "materials handler".


BOOM SECTION NO. 1
BOOM SECTION NO. 2
BOOM SECTION NO. 3
TILT CYLINDER
CROWD CYLINDER
CARRIAGE
FORKS
PLANETARY HUB
GRADALL


THREE SECTION BOOM
COMPENSATING CYLINDER
BOOM HEAD
LIFT CYLINDER
LEVELING CYLINDER
GRADALL

SAFETY HIGHLIGHTS

Read and understand this manual, the Gradall Loed/ Materials Handler Safety Manual and all instructional decals and plates before starting, operating or performing maintenance procedures on this equipment.

Most safety notes included in this manual involve characteristics of the Model 534B Loed/Materials Handler. Refer to the Gradall/Loed Materials Handler Safety Manual for safety precautions relating to general material handling procedures and practices.

Operators of this equipment must have successfull completed a training program in the safe operation of this type of material handling equipment.

Regardless of previous experience operating simila equipment, the operator must be given sufficier opportunity to practice with the 534B Material Handler in a safe open area (not hazardous people or property) to develop the skills and "feel required for safe, efficient operation.

Watch for these symbols; they are used to call your attention to safety notices.

This symbol indicates an extreme hazard which would result in high probability of death or serious injury if proper precautions are not taken.

This symbol indicates a hazard which could result in death or serious injury if proper precautions are not taken.

This symbol indicates a hazard which could result in injury or damage to equipment or property If proper precautions are not taken.

OPERATOR'S CAB

The standard cab is open on three sides and includes an overhead guard to provide protection from falling objects.

WARNING

Never operate the handler unless the overhead guard is in place and in good condition.

A fully enclosed cab with Plexiglass windows and a lockable door is available as an option. The cab door can be secured in the fully opened or closed position. Be sure the door is fully secured when operating the handler.

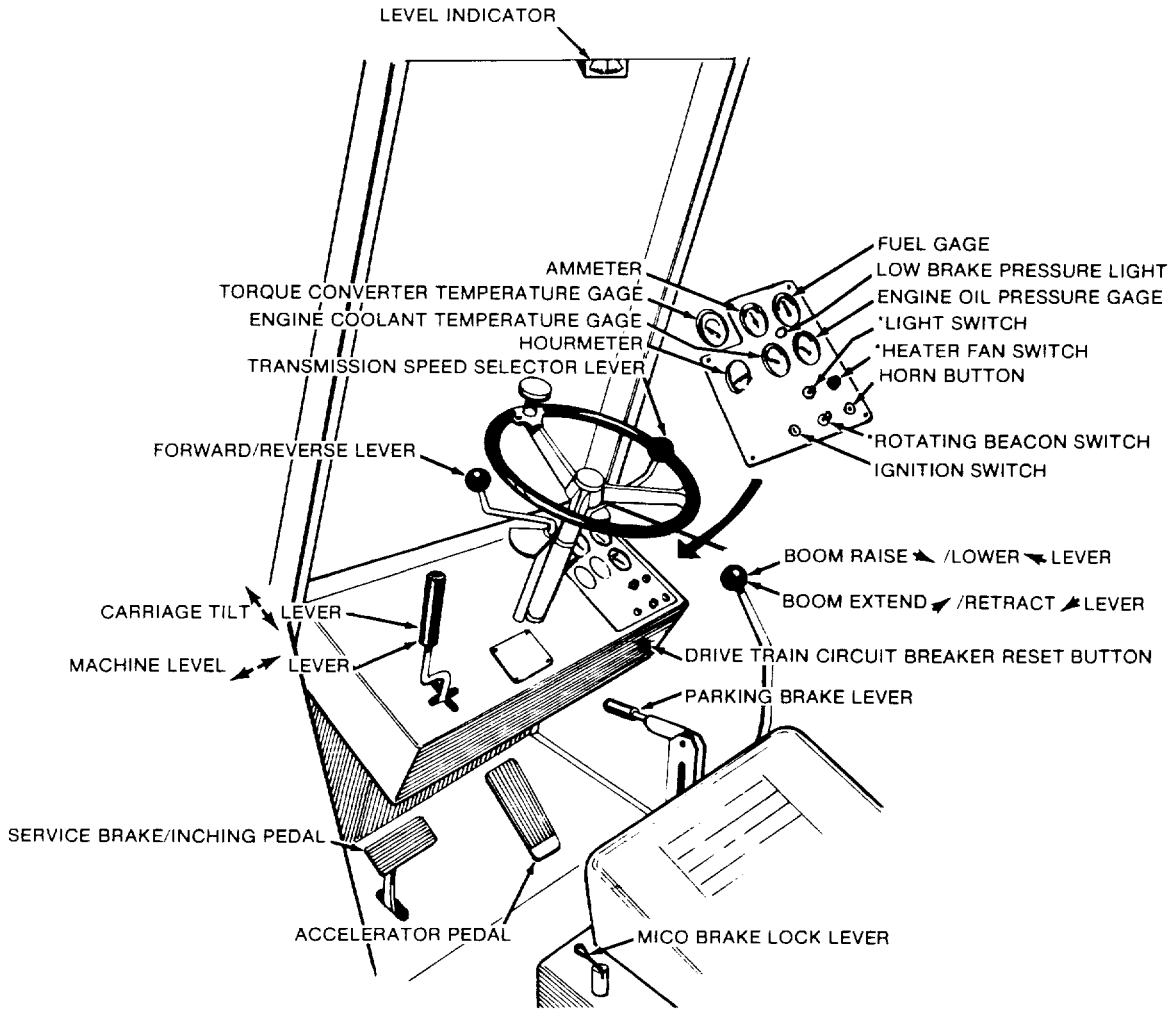
The operator's seat is equipped with a seat belt and includes fore and aft adjustment to compensate for variations in operator size. The adjustment release/lock lever is located beneath front edge of seat. Wear seat belt at all times.

An optional windshield wiper is available for use with enclosed cabs. An ON/OFF control switch is located on the wiper motor.

A variable speed defroster fan is available for use with enclosed cabs. An ON/ OFF control switch and speed control are located on the base of the fan.

A variable speed heater fan is available for use with units equipped with a heater. An ON/OFF/ SPEED CONTROL knob is located on the dashboard. Hot water to the heater can be controlled by a valve at the engine.

CONTROL AND INSTRUMENT IDENTIFICATION



*Items preceded by an asterisk are optional and may not be furnished on your handler.

CHECKS AND SERVICES
BEFORE STARTING ENGINE

(To be performed at beginning of each work shift)

⚠ WARNING

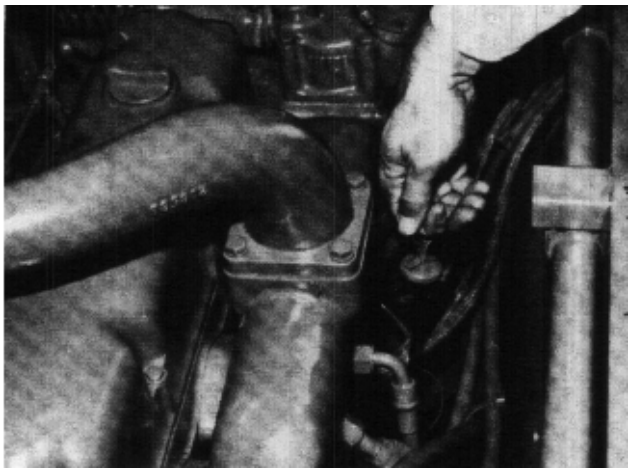
Use extreme caution when checking items beyond your normal reach. Use an approved safety ladder.

Before removing filler caps or fill plugs, wipe all dirt and grease away from the ports. If dirt is allowed to enter these ports, it can shorten the life of o-rings seals, packings and bearings.

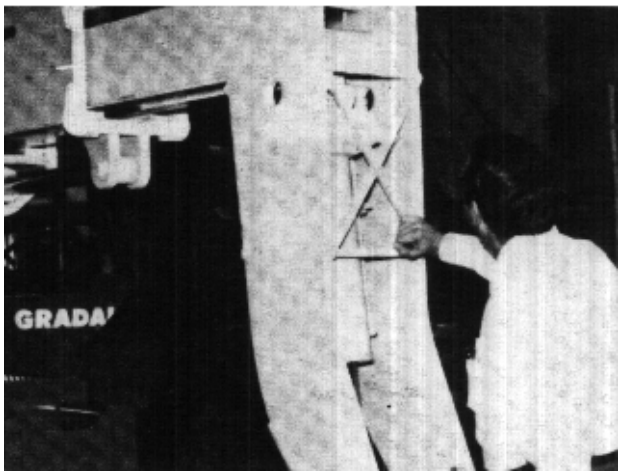
When adding fluids or changing filter elements refer to the lubrication section of this manual to determine the proper type to be used.

If spark arrestors are required, be sure they are ir place and in good working order.

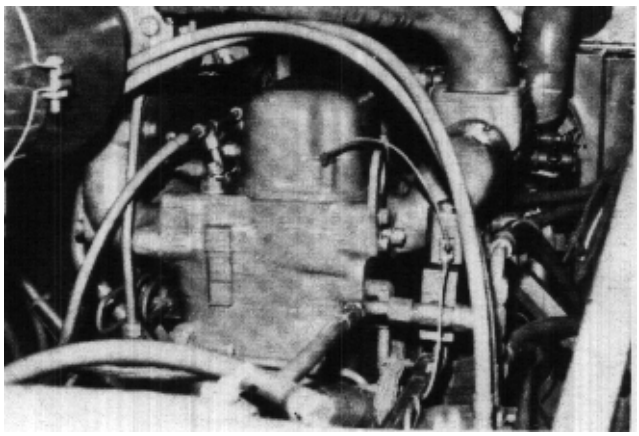
Complete all required maintenance before operating unit.



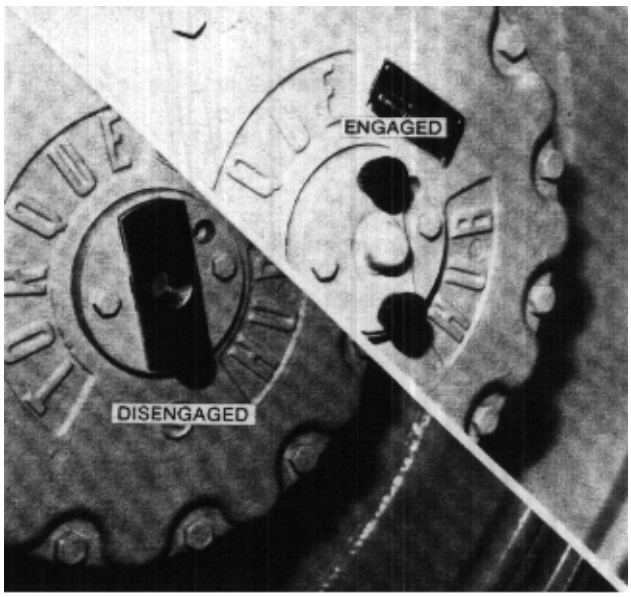
Service the unit in accordance with the lubrication and maintenance schedule.



Inspect all structural members, including attachment, for signs of damage.



Inspect unit for obvious damage, vandalism and needed maintenance. Check for signs of fuel, lubricant, coolant and hydraulic leaks. Open all access doors and look for loose fittings, clamps, components and attaching hardware. Replace hydraulic fines that are cracked, brittle, cut or show signs of abrasion.



Check to be sure rear planetary hubs are properly set for the type of travel expected.

NOTE: If engine is being started at beginning of work shift be sure to perform all "CHECKS AND SERVICES BEFORE STARTING ENGINE" (page 6).

Starting Engine

1. Check to be sure that all controls are in neutral and that all electrical components (lights, heater, defroster, etc.) are turned off. Set parking brake.

2. Insert ignition key and turn clockwise to ON position. Low brake pressure light should glow and continue to glow until brake system accumulator is fully charged.

3. Depress accelerator pedal approximately 1/4 to 1/3 of travel from top.

⚠ CAUTION

Turning ignition switch to START position while engine flywheel is rotating can cause serious damage to engine and/or starting motor.

NOTE: If temperature requires the use of a starting aid, and if your handler is equipped with a factory-installed ether starting aid, fully raise and depress starting aid knob one time only before cranking engine. If you use a different starting aid, be sure to follow manufacturer's instructions carefully. Excessive ether may damage engine.

4. Turn ignition switch key clockwise to start position to engage starting motor. Release key immediately when engine starts. If engine fails to start within 20 seconds, release key and allow starting motor to cool for a few minutes before trying again.

5. After engine starts, observe oil pressure gage. If gage remains on zero for more than ten seconds, stop engine and determine cause. Correct cause of malfunctioning before restarting engine. Normal engine oil pressure should be in range of 35-50 psi (241-345 kPa).

6. Warm up engine at approximately 1/2 throttle until engine coolant temperature reaches operating range of 180-200 F. (82-93 C.).

Cold Weather Starting Aids

Diesel engine ignition is accomplished by heat generated when fuel/air mixture is compressed within the cylinders. Because this heat may be insufficient to start a cold engine in cold weather, the use of starting aids has become common practice.

Because of the wide variety of starting aids available it would be impractical to attempt to provide specific instructions for their use in this manual. Carefully follow instructions furnished with your starting aid.

If you use a starting aid employing ether or a similar substance pay particular attention to manufacturer's warnings.

Normal Engine Operation

Observe gages frequently to be sure all engine systems are functioning properly.

The ammeter shows the charge/discharge rate of the battery charging system. With the engine running, a discharge reading (-) or a continuing high charge reading (+) indicates a problem in the battery charging system.

Be alert for unusual noises or vibration. When an unusual condition is noticed, stop machine in a safe position and shut off engine. Determine cause and correct problem before continuing.

Avoid prolonged idling. Idling causes engine temperature to drop and this permits formation of heavy carbon deposits and dilution of lubricating oil by incompletely burned fuel. If the engine is not being used, turn it off.

⚠ CAUTION

Always keep engine covers closed while engine is running.

Stopping the Engine

Operate engine at idle speed for a few minutes before turning it off. This allows engine coolant and lubricating oil to carry excessive heat away from critical engine areas.

Do not "gun" engine before shut down; this practice causes raw fuel to remove oil film from cylinder walls and dilute lubricant in crankcase.

To stop engine, allow engine to run at idle for a few minute and then turn key counterclockwise to stop position. Be sure to remove key from ignition switch before leaving cab.

WARM UP & OPERATIONAL CHECKS

(to be performed at beginning of each work shift)

Complete all required maintenance before operating unit.

The safety, efficiency and service life of your unit will be increased by performing the operational checks listed below. Items preceded by an asterisk (*) are optional and may not be furnished on your machine. **Check items during warm-up period.**

.

*1. Heater, defroster and windshield wiper

*2. Operating lights and rotating beacon

3. Low brake pressure light-should go out with engine running above idle

4. Ammeter-should show low charging rate after charging system has replaced starting drain

When engine warms to operating range, check the following Items:

5. Service brake, parking brake and Mico brake lock.

6. Forward and reverse travel in all gears

7. "Inching" travel-should be smooth through full pedal travel

8. Horn and back-up alarm

9. All boom and attachment functions - full stroke in both directions

10. Hydraulic Filter Condition Indicator - observe torque converter temperature edge after starting normal operation. When needle has been in operating range for an hour or so, stop handler in a safe area and set parking brake. With engine running, check hydraulic filter condition indicator. When yellow flag fills indicator window, filter is clogged and hydraulic oil is bypassing filter. Filter must be changed before reaching bypass condition (change before yellow flag reaches midpoint of window).

⚠ CAUTION

Continued operation with hydraulic fluid by-passing the filter (yellow flag showing) can cause severe damage to hydraulic system components.

General

The brake system furnished on the handler includes a service brake, parking brake and Mico lock.

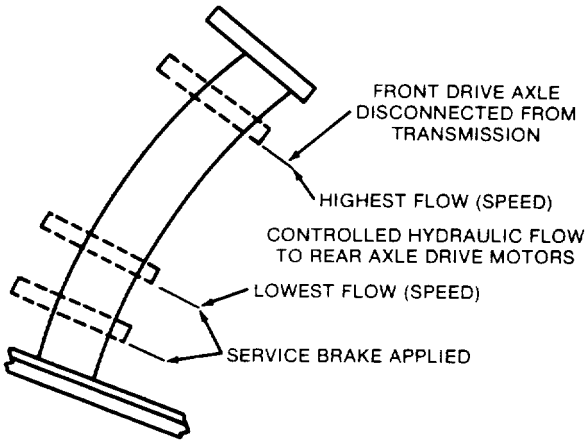
Because service braking and "inching" (slow travel) functions overlap, some features of inching will be discussed here. Refer to Drive Train Section for additional information on inching travel.

Inching Travel

cylinder, brake fluid flows to wheel cylinders to Overlap between service braking and inching occurs because the same foot pedal controls both functions. and also because both functions control travel speed. However, the methods of controlling travel speed are quite different. service braking involves a controlled stopping force applied to the front wheels while inching involves a controlled driving force applied to the rear wheels.

The service brake/ inching pedal has three separate functions:

1. It disconnects front drive axle from transmission.
2. It controls hydraulic flow to rear axle drive motors (hydraulic flow regulates speed).
3. It applies service brake.



As illustrated, the three functions occur in sequence as service brake i inching pedal is depressed from top to bottom of stroke.

WARNING

Practice inching/braking in a safe, open area until you are thoroughly familiar with response of machine to pedal travel.

Service Brakes

The power-assisted hydraulic service brake is applied only to front wheels of handler.

The service brake system includes an accumulator which is pressurized by the pilot hydraulic system. Accumulator pressure is available at the pressure-intensifier type service brake master cylinder.

When the service brake/inching pedal is depressed far enough to actuate the service brake master cylinder, brake fluid flows to wheel cylinders to apply service brake. At the same time, accumulator pressure is applied to a piston within master cylinder to intensify (boost} pressure to wheel cylinders.

A Low Brake Pressure Light is provided to warn the operator when accumulator pressure falls below normal operating range. With engine running above idle speed, the accumulator is charged to operating pressure. When this pressure falls to 300 psi, the low brake pressure light will glow.

As stated above, accumulator pressure provides the power assist feature for service brakes. As pressure falls, the power assist feature decreases.

WARNING

Though it is possible to stop the handler without the power assist feature, very heavy foot pressure is required and stopping distance will be significantly greater.

Mico Lock

The Mico Lock can be used to reduce operator fatigue by temporarily locking a service brake application on using a hand lever rather than holding brake pedal.

WARNING

Never use Mico Lock as a parking brake. The brake application will bleed off after a short time and allow the machine to roll.

To Apply Mico Lock

1. Check to be sure Mico Lock lever is pushed forward to release position (lever horizontal).
2. Depress service brake pedal fully and hold.

continued...

3. Pull Mico Lock lever back to lock position (lever vertical) and then release brake pedal.

To Release Mico Lock

Release Mico Lock by pushing lever forward to release position (lever horizontal).

Parking Brakes

The parking brake locks the front axle by means of a cable actuated brake caliper acting on a brake disc attached to the axle input yoke.

To apply the parking brake, pull parking brake lever to rear (toward vertical position).

To release parking brake, push parking brake lever forward (to horizontal position).

Parking brake tension can be increased by turning knob at end of lever clockwise.

WARNING

Always apply parking brake before leaving cab. Neither leaving the unit in gear nor applying the Mico Lock will prevent unit from rolling. Refer to page 17 for parking procedure.

STEERING SYSTEM

Ninety degree rear wheel power steering is provided to reduce operator fatigue and to permit high maneuverability in close quarters.

It is important that the operator practice maneuvering the handler in a safe, open area until he becomes thoroughly familiar with steering response and clearance required for tailswing and load when turning.

WARNING

Be alert for any increase in effort needed to steer. If any difference is noted, notify maintenance personnel immediately for correction. If power assist feature should fail for any reason IT WOULD BECOME VERY DIFFICULT TO STEER. For this reason it is extremely important that you NEVER TURN ENGINE OFF WHILE TRAVELING.

In the event power steering fails, stop as soon as possible. Do not drive unit until problem has been corrected.

General

The drive train provides two and four wheel drive and includes the engine, torque converter, transmission, propel shaft and front and rear driving axles.

Inching travel is directly related to drive train functions and will be discussed in this section.

Two & Four Wheel Drive

The drive train is designed to provide two wheel drive (front axle driving) or four wheel drive (both front and rear axles driving).

Under certain conditions, changing from four wheel drive to two wheel drive may cause a difference in the way the machine responds to steering, braking and drive controls. Always be aware of which travel mode you are using.

There are three ways to disengage rear wheel drive:

.

1. Shift to third gear (rear axle drive is engaged only in first and second gears)
2. Disengage rear planetary hubs (refer to Rear Drive Axle heading in this section)
3. Depress Rear Drive Circuit Breaker ON/ OFF/ RESET button (early units only) (refer to Rear Drive Axle heading in this section)

NOTE: Rear drive axle can also be disengaged in response to overload in associated electrical circuitry causing circuit breaker to trip (open).

There are no operator controls for the torque converter. It functions automatically to permit starting from a standstill in any transmission speed range.

An oil temperature gage is provided to indicate operating temperature of torque converter/transmission. Normal operating temperature is 180-200°F. (82-93°C.). If overheating occurs, attempt to lower temperature by traveling in a lower gear. If necessary, stop and allow torque converter to cool with engine running and gear selector in neutral. Be sure radiator fins are clean.

⚠ CAUTION

Continued operation of overheated torque converter/transimission can cause serious damage to these components.

Transmission

The transmission provides three speed ranges for both forward and reverse travel.

Gear	1st	2nd	3rd	3rd*
mph	2.8	6.0	15.9	17.9
kmph	4.5	9.6	25.6	28.8

*With rear planetary hubs disengaged

There are three operator controls for the transmission:

1. Gear Selector Lever (for 1st, 2nd and 3rd gears)
2. Direction Selector Lever (for forward, neutral and reverse)
3. Service Brake/Inching Pedal (refer to Inching Travel heading in this section)

To Operate Transmission:

1. Release parking brake and hold handler in position using service brake.
2. Move gear selector to appropriate speed range (1st, 2nd or 3rd gear). The gear selector may be shifted while traveling. When traveling downhill, use the same gear needed to travel up the hill.

⚠ WARNING

Never shift gear selector or direction selector to cause a sudden change of travel speed or direction. Such a change could cause load to shift or machine to tip over. Reversing direction while traveling can also damage transmission.

3. Move direction selector to forward or reverse position as required.
4. Release service brake and depress accelerator to attain appropriate speed.
5. Stop handler by releasing accelerator and applying service brake.
6. Move direction selector to neutral position.
7. Apply Mico Lock or parking brake as appropriate.

Front Driving Axle

The front driving axle includes a differential and planetary drive hubs and is powered by a propeller shaft from the transmission. The service brake/ inching pedal is the only operator control for the front axle (refer to Inching Travel heading).

continued....

Rear Driving Axle

The rear driving axle includes planetary hubs which are powered by hydraulic motors mounted on the inner face of the hubs. Hydraulic flow to drive motors is provided only in first and second gear speed ranges. Drive motors are free-floating in third gear.

⚠ CAUTION

Continuous driving for two miles or more in third gear, with rear driving hubs engaged, can damage hydraulic drive motors.

To Disengage Rear Driving Hubs:

1. Apply parking brake and remove key from ignition switch.
2. Remove thumb screws from keeper pin plate.
3. Remove and rotate plate per photo on pg. 6 (cup out-engaged-cup in-disengaged).
4. Secure plate using thumb screws.
5. Repeat procedure for other hub.

To Engage Rear Driving Hubs: Repeat procedure.

NOTE: If machine is moved with keeper pin plate removed, input shaft pin will pop out.

On/Off/Reset Button (rear drive circuit breaker) (on/off switch function on early units only)

Hydraulic flow to rear axle drive motors is controlled electrically. A circuit breaker is included to prevent damage from overload. **If circuit breaker trips (opens) rear axle drive will be inoperative.** Rear axle drive can be restored by depressing and releasing on/off/reset button.

The on/off/reset button also functions as an on/off switch for rear axle drive on early units.

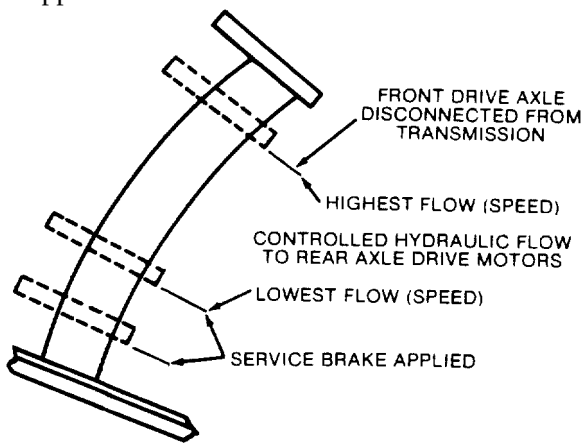
To determine whether switch is on or off or circuit breaker has tripped, attempt to move machine using inching travel. If machine does not respond to inching travel pedal, switch is off or circuit breaker is open.

Inching Travel

Inching travel is provided to permit very slow travel while maintaining high engine speed for other functions. Because inching travel depends on hydraulic flow to rear axle drive motors, inching travel functions only in first and second gears. There is no hydraulic flow to drive motors in third gear.

Inching travel is controlled by the service brake/inching travel pedal. This pedal has three separate functions:

1. It disconnects front drive axle from transmission.
2. It controls hydraulic flow to rear axle drive motors (hydraulic flow equals speed).
3. It applies service brake.



As illustrated, the three functions occur in sequence as pedal is depressed from top to bottom of stroke.

To Engage Inching Travel:

1. Depress service brake/inching travel pedal approximately 1-1/2 inches to disengage front driving axle from transmission. At this point rear drive motors are receiving full flow and travel speed will not have changed.
2. Continue to depress pedal to reduce speed-the more pedal travel, the less speed.
3. To stop, depress pedal fully.

OR

To resume normal travel, release accelerator pedal and then, with engine at idle, release service brake/inching travel pedal. Depress accelerator pedal to attain appropriate speed.

⚠ WARNING

Practice inching/braking in a safe open area until you are thoroughly familiar with response of machine to pedal travel.

Leveling

The handler is designed to permit tilting main frame eight degrees to left or right to compensate for uneven ground conditions.

WARNING

Raising the boom (loaded or unloaded) when handler is leaning to the side can cause machine to tip over with little or no warning.

A level indicator located on upper portion of front window frame to permit operator to determine that machine is or is not level.

The rear axle pivots at the midpoint of the main frame to help assure that wheels will remain in contact with ground. A hydraulic cylinder provides a rigid connection between front axle and main frame to help assure a solid work platform and permit tilting main frame to left or right.

NOTE: The frame leveling function is provided only to level the machine before lifting or placing a load. Do not attempt to use leveling feature to turn on or travel across a slope.

To Level Handler:

1. Position machine in best location to lift or place load and apply brake.
2. Observe level indicator to determine whether machine must be leveled. Note position of indicator for later realignment.
3. If necessary, position boom in carry position and move carriage tilt/machine level lever to left or right to level machine. Move lever to left to lower left side of frame or move lever to right to lower right side of frame.
4. Lift or place load as appropriate.
5. Retract and lower boom to carry position.
6. Realign frame to position noted in step 2.

WARNING

if handler cannot be leveled using leveling system, do not attempt to raise or place load. Have surface leveled.

Boom

The three section hydraulically operated boom provides maximum reach of 36 feet above horizontal at 70° elevation and 21 feet forward of forward edge of front tires at 0° elevation (measured to heel of standard forks mounted on standard carriage). Boom travel extends from 4° below Extend horizontal to 70° above horizontal.

Raise boom by pulling boom lever to rear and lower boom by pushing boom lever forward.

Boom extension and retraction is accomplished by a hydraulic crowd cylinder anchored at rear of boom section no. 1 and at front of boom section no. 2 and also by a cable and push beam arrangement within the boom sections. **Extension or retraction of boom section no. 2 is always equaled by a corresponding movement of boom section no. 3.**

A hydraulic cylinder is located within the boom head to tilt the fork carriage or other attachment back and forth as required.

The tilt cylinder is controlled by carriage tilt/ machine level lever. Push lever forward to tilt attachment down or pull lever to rear to tilt attachment up.

Extend boom by moving boom lever to right and retract boom by moving boom lever to left.

A compensating cylinder is pinned to main frame and to base of boom section no. 1. As boom is raised, oil is transferred from rod end of compensating cylinder to rod end of attachment tilt cylinder. Lowering boom causes transfer of oil from barrel end of compensating cylinder to barrel end of attachment tilt cylinder. This transfer of oil causes extension and retraction of tilt cylinder to maintain angle of attachment as boom is raised and lowered.

All cylinders related to boom (attachment tilt, raise/ lower and extend/retract) are protected by pilot operated check valves which prevent load from falling in event of a broken hydraulic hose or tube.

Attachments

Although the carriage/fork combination is most frequently used, a number of other attachments are available for use with the handler. A material bucket can be provided for light duty work. A truss boom is available to extend maximum reach and height and can be fitted with a winch when required. Consult your Gradall/Loed Materials Handler Dealer for information on attachments designed to solve special material handling problems.

Attachment Capacities

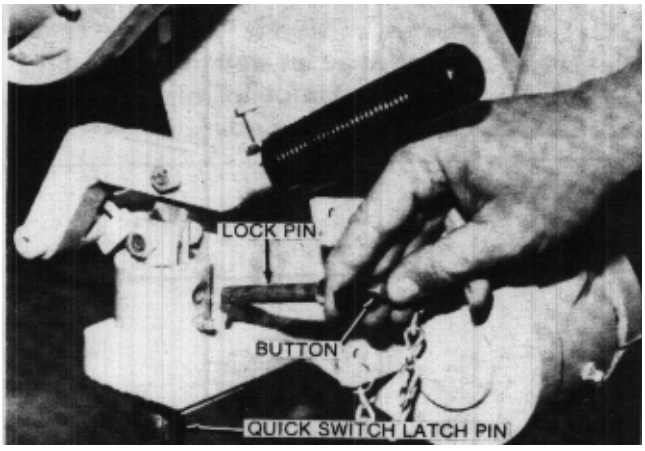
The Rated Capacity Chart, located on left side of dashboard, indicates maximum capacities for handlers equipped with standard carriage/fork combination. These capacities apply only to standard carriage/fork combination and cannot be used for other attachments.

A serial number plate is attached to all attachments and indicates maximum capacity for that attachment. **However, the capacity shown on this plate may be incorrect In relation to your machine.**

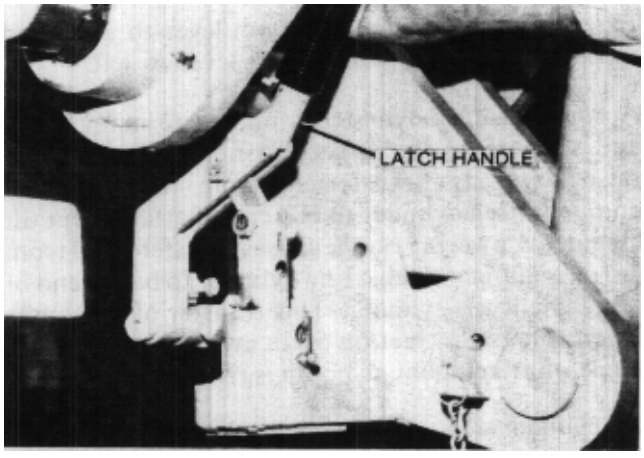
Refer to Attachment Capacity Plate, located below Serial Number Plate on right cab wall, for correct maximum capacity for all attachments furnished with your machine. If attachments furnished listed on this plate, contact factory for maximum capacity.

Refer to Operating Procedures and Techniques section for instructions on proper use of information shown on capacity plates.

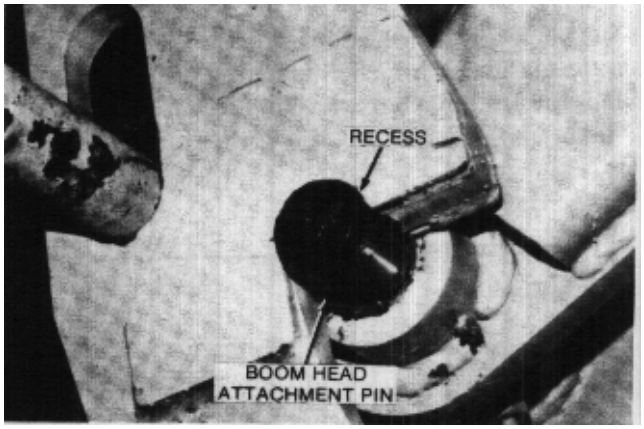
Attachment Installation



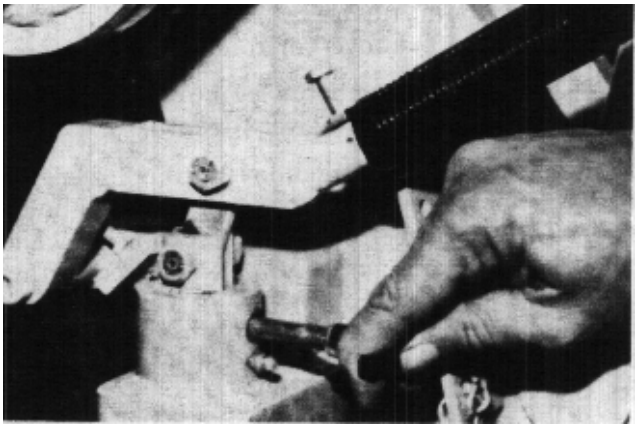
1. Depress button and remove lock pin from quick switch latch pin.



2. Raise handle to retract latch pin fully.



3. Position boom head attachment pin fully in recess of attachment. Tilt upward slightly to assure full engagement.



4. Depress handle fully to engage latch pin in attachment and install lock pin in latch.

OPERATING PROCEDURES & TECHNIQUES

This section highlights some common procedures and discusses areas which may be new to even the experienced operator.

Hydraulic Controls

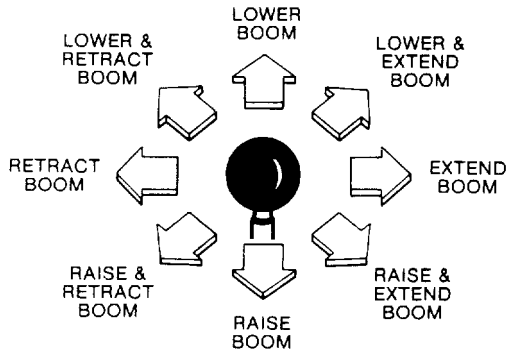
All boom and attachment movements are governed by hydraulic controls. Rapid, jerky operation of hydraulic controls will cause rapid,jerky movement of the load. Such movements can cause the load to shift or fall or may cause the machine to tip over.

Feathering

Feather is a technique of control operation used for smooth load handling. To feather controls, move control lever very slowly until load begins to move, then gradually move lever further until load is moving at desired speed. Gradually move lever toward neutral as load approaches destination. Continue to reduce load speed to bring load to a smooth stop. Feathering effect can be increased by lowering engine speed at beginning and near end of load movement.

Boom Control Lever

The boom control lever can be positioned to cause individual boom movements or combinations of boom movements as illustrated.



With boom raised above horizontal, forks can be inserted under a load by moving boom control lever forward and to the right until forks move forward horizontally.

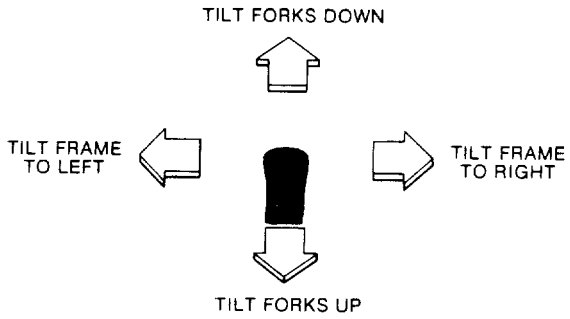
With boom raised above horizontal, forks can be remove from a load by moving boom control level back and to the left until forks move rearward horizontally.

With boom lowered below horizontal, forks can be inserted under a load by moving boom control lever back and to the right until forks move forward horizontally.

With boom lowered below horizontal, forks can be removed from a load by moving boom control lever forward and to the left until forks move rearward horizontally.

The closer the boom to horizontal, the less boom raise/lower movement required for inserting and removing forks.

Carriage Tilt/Machine Level Lever



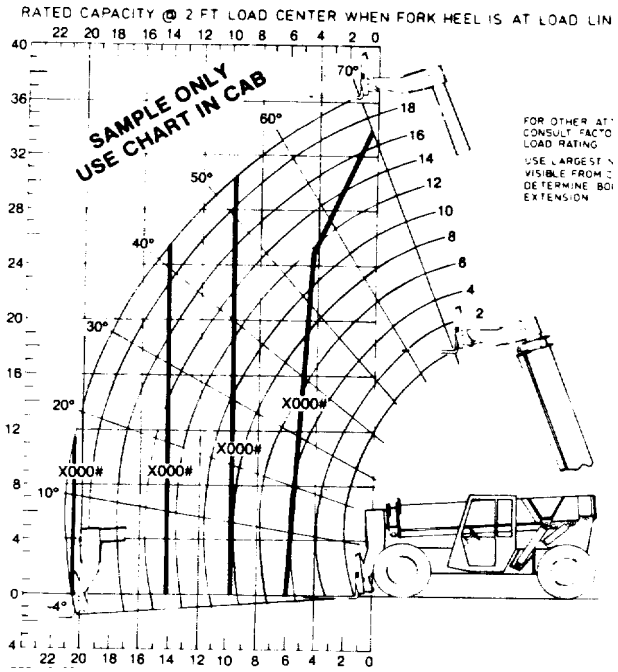
Move lever forward to tilt forks down and move lever to rear to tilt forks up.

Move lever to left to tilt main frame to left and move lever to right to tilt frame to right.

WARNING

Always move boom to carry position (horizontal or below) before leveling frame. Attempting to level machine with boom raised may cause it to tip over.

Rated Capacity Chart



BOOM EXTENSION IN FEET FROM FRONT TIRE TO FORK FACE
FIGURE SHOWN ARE STACKING CAPACITY TRUCK LEVEL.
RATED LIFT CAPACITIES SHOWN ARE WITH MACHINE ON A FIRM, LEVEL SURFACE WITH UNDAMAGED PROPERLY
INFLATED TIRES MACHINE SPECIFICATIONS AND STABILITY ARE BASED ON RATED LIFT CAPACITIES AT
SPECIFIC BOOM ANGLES AND BOOM LENGTHS. IF SPECIFICATIONS ARE CRITICAL. THE PROPOSED APPLICATION
SHOULD BE DISCUSSED WITH YOUR DEALER.
DO NOT EXCEED RATED LIFT CAPACITY LOADS, AS UNSTABLE AND DANGEROUS MACHINE CONDITIONS WILL
RESULT. DO NOT TIP THE MACHINE FORWARD TO DETERMINE ALLOWABLE LOAD.
LEVEL GRADALL HANDLER BEFORE LIFTING ABOVE 4 FT.

9103-3021

General

The rated capacity chart, located on left side of dashboard, indicates maximum load capacities for handlers equipped with standard carriage/ fork combination. These capacities apply only to the standard carriage/fork combination and cannot be used for other attachments.

WARNING

All loads shown on rated capacity chart are based on machine being on firm, level ground; the forks being positioned evenly on carriage; the load being centered on forks; proper size tires being properly inflated; and the handler being in good operating condition. Machines having 8000 pound capacity must have tires properly filled with calcium chloride.

Elevation

Numbers at left side of chart (-4' to 40') represent elevation at heel of horizontal fork as measured from level ground. Maximum elevation with boom fully raised and extended is 36 feet. to dimension “A” shown on serial number plate located on right cab wall.

Boom Extension

Numbers across bottom of chart (0 22') and numbers parallel to boom (2’to 18') represent boom extension as measured from fully retracted position to extended position. These numbers do not reflect total boom length, only the number of feet of extension from fully retracted position.

Number decals on boom section number two (4, 8, 12, 16 and 20) relate directly to boom extension. The largest number which can be read from operator’s seat indicates total boom extension.

Boom extension relates to dimension “D” shown on serial number plate.

Boom Angle

Numbers at ends of angled fines (-4° to 7°) represent angle of boom to horizontal as measured from horizontal plane at ground level. Maximum angles are 4° below horizontal with boom fully lowered to 70° above horizontal with boom fully raised.

A boom angle indicator is located on left side of boom section number one to show boom angle. Be sure machine is level from front to rear or indicator will provide incorrect reading.

Load Center

Loads shown on rated capacity chart are based on the load center being two feet above and two feet forward of surfaces of horizontal forks as indicated by dimensions “B” and “C” on serial number plate.

The load center of a load is the center of gravity of the load. For regularly shaped loads of the same material, such as a pallet of blocks, the center of gravity can be located by measuring the load to find its center. For irregular loads, or loads of dissimilar materials, keep the heaviest part of the load as close to the heel of the forks as possible.

In all cases, the load center must be centered between the forks.

Load Limits

Some capacities shown on the rated capacity chart are based on machine stability and some are based on hydraulic lift capacity. The “common sense” or “feel” an experienced operator might apply in regard to “tipping loads” **DOES NOT APPLY to hydraulic load limits.** Exceeding load limits can cause a relief valve to open allowing the load to fall, or in some cases, the machine to tip over.

WARNING

Never use "tipping" method to determine safe lifting capacity. This could cause the load to fall or the machine to tip over.

Material Handling Bucket Capacity

Lift capacity for a material handling bucket,if furnished with the handler, is shown on the Attachment Capacity plate located on right cab wall below Serial Number plate. If part number on bucket does not match part number on Attachment Capacity plate, contact factory for proper bucket lift capacity.

The bucket lift capacity is based on machine being on lift, level ground; proper size tires being properly inflated; and the handler being in good operating condition.

Because maximum bucket rated lift capacity is based on hydraulic limitations, the maximum load may be handled anywhere within reach of machine.

Truss Boom/Winch Capacity

Lift capacity for a truss boom or a truss boom, winch combination, if furnished with the handler, is shown on the Attachment Capacity plate. If the part number shown on the boom does not match the part number shown on Attachment Capacity plate, contact factory for proper boom lift capacity.

The truss boom lift capacity is based on machine being on firm, level ground; proper size tires being properly inflated; the handler being in good operating condition; and the load being suspended vertically from the boom.

Side loads or swinging loads can cause structural damage and may cause the machine to tip over.

Because maximum truss boom lift capacity is based on hydraulic limitations, the maximum rated load may be handled anywhere within reach of the machine.

PARKING

1. Position unit in a safe, level parking area.

WARNING

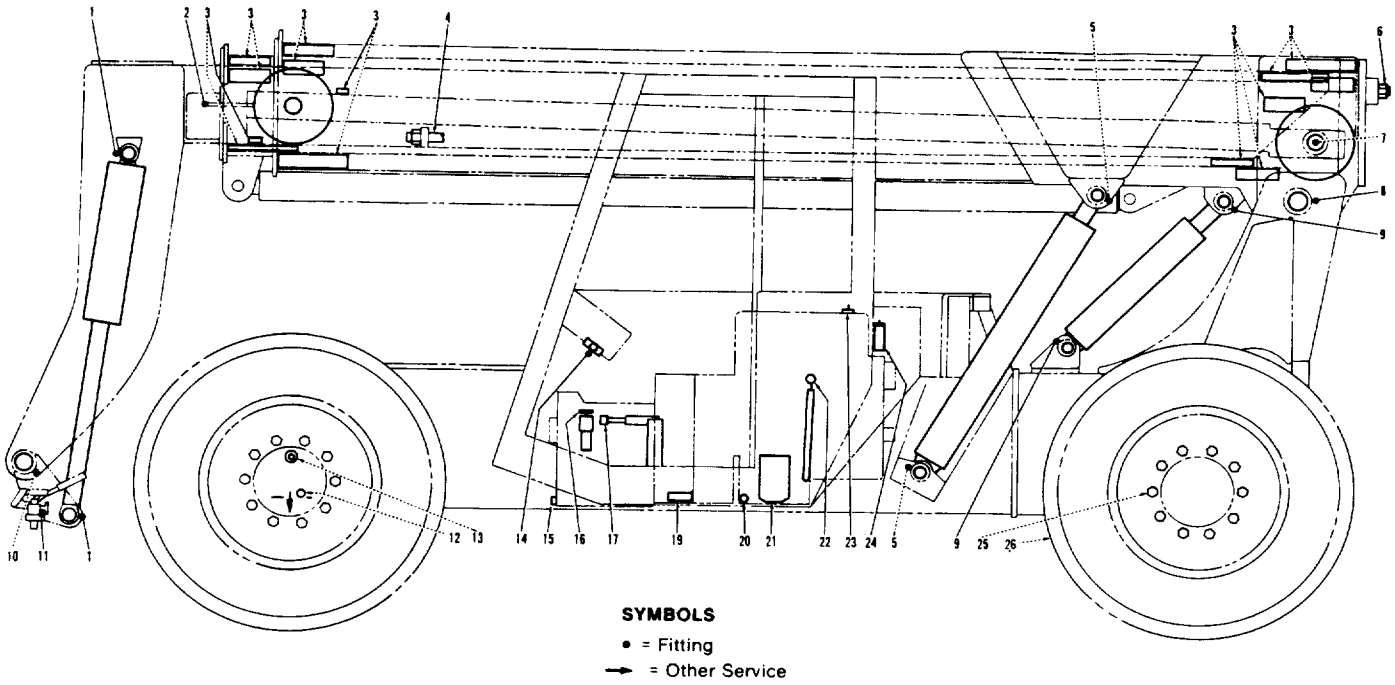
Parking brake may not hold machine on a grade.

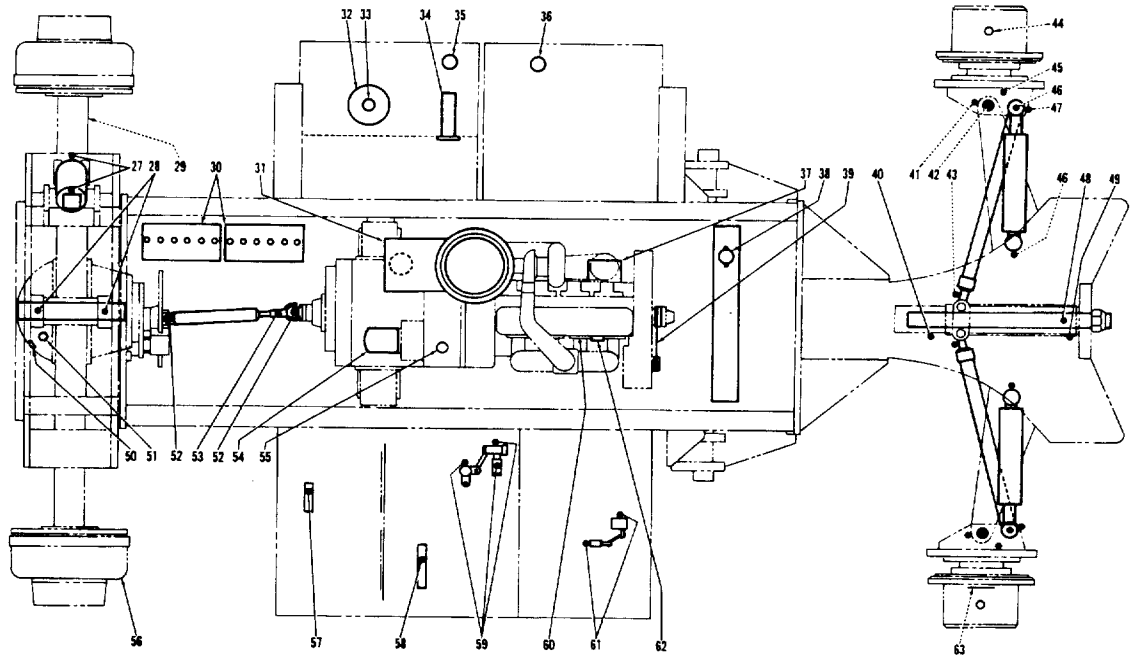
2. Apply parking brake and chock wheels.
3. Retract and lower boom fully.
4. Turn off all electrical accessories.
5. Allow engine to cool at idle speed for a few minutes and then turn off. Remove ignition key.
6. Fill fuel tank to minimize condensation.
7. Disconnect battery if unit is in an area where tampering seems possible.
8. Lock cab (if so equipped).

STORAGE

1. Clean and inspect machine thoroughly and perform all required maintenance.
2. Coat all cylinder rods with a good grade of grease or rust preventative.
3. Park machine in a dry enclosure and remove batteries.
4. Prepare engine in accordance with engine manufacturer's instructions.

LUBRICATION & MAINTENANCE DIAGRAM





Lubrication Notes

- Lubricate points indicated by dotted leaders on both sides of unit.
- Intervals shown are for normal (8 hour day) usage and conditions. Adjust intervals for abnormal usage and conditions.
- See recommended lubricants (page 20)
- Apply a light coating of engine oil to all linkage pivot points.
- Clean lubrication fittings before lubricating.
- Clean filter and air cleaner housing using diesel fuel. Dry components thoroughly using a lint free cloth.
- Check lubricant levels when lubricant is cool.
- Drain engine and gear cases only after operation when lubricant is hot.

Daily or Every 10 Hours	Lube Symbol	No. of Points
1. Carriage Tilt Cylinder Pivots	CG	2
2. Boom Extension Cable Sheave	CG	1
3. Boom Slide Bearings (extend boom fully and coat all wear paths on boom sections 2 and 3-retract and extend boom fully three times and wipe excess grease from bearings)		
5. Boom Hoist Cylinder Pivots	CG	8
7. Boom Retraction Cable Sheave	CG	2
8. Boom Pivot	CG	1
9. Compensating Cylinder Pivots	CG	1
10. Boom Head/Carriage Pivot	CG	2
14. Carriage Tilt/Machine Level Lever Pivot	CG	2
16. Transmission Dipstick (check level & replenish as req'd)	ATF	1
22. Engine Dipstick (check level & replenish as req'd-item 23 is filler port)	EO	1
26. Tires (inspect for damage)	-	4
27. Leveling Cylinder Pivots	CG	2
28. Front Axle Pivot	CG	2
33. Hydraulic Filter Condition Indicator (check with oil at operating temperature-replace filter as req'd)	-	1
35. Hydraulic Reservoir (check level & replenish as req'd.)	HF	1
36. Fuel Tank (fill daily after shut down)	DF	1
38. Radiator (check level and replenish as req'd using proper coolant)	-	1
40. Rear Axle Pivot (front bearing)	CG	1
41 King Pins (upper)	CG	2
42. King Pins (lower)	CG	2
43. Tie Rods (inner pivot)	CG	2
45. Planetary Hub	CG	2
46. Steering Cylinder Pivots	CG	4
47. Tie Rod Pivots (outer)	CG	2
48. Idler Arm Pivot	CG	1
49. Rear Axle Pivot (rear bearing)	CG	1
56. Service Brake Adjustment (check for minimum of 1" space between fully depressed brake pedal and floor)	-	1
57. Accelerator Pedal Pivot (under cab)	CG	1
58. Brake/Inching Travel Pedal Pivot (under cab)	CG	1
59. Boom Lever Linkage (under cab)	CG	3
61. Inching Travel Linkage (under cover behind cab)	CG	2

Weekly or Every 50 Hours	Lube Symbol	No. of Points
[F]4. Boom Retraction Cable (inspect cable and replace if damaged-extend boom about 15 feet and check tension-should be torqued to 75 ft/lbs)	-	1
[F]6. Boom Extension Cable (inspect cable and replace if damaged-extend boom fully and then retract a few feet and check tension-should be torqued to 75 ft/lbs)	-	1
11. Quick Switch Latch	CG	1
12. Front Planetary Hub Level Plugs (check level with arrow pointing down as shown-replenish as req'd)	-	2
24. Brake Master Cylinder Reservoir (under cover behind cab-check level and replenish as req'd)	BF	1
26. Tires (check pressure and adjust as req'd-55 psi) (on 8000 pound unit, thump check tires for 90% fill of calcium chloride mixture)	-	4
30. Batteries (check electrolyte level & replenish as req'd)	-	2
39. Engine Drive Belts (check condition and tension-adjust or replace as req'd)	-	2

At End of First Week	Lube Symbol	No. of Points
[F]3. Front Boom Slide Bearings (check retaining bolt torque	-	12
13. Front Hub Drain Plugs (drain and refill)	GO	2
15. Transmission Drain Plug (drain and refill)	ATF	1
32. Hydraulic Filter (replace)	-	1
44. Rear Hub Fill/Level/Drain Plugs (drain and refill-refill with plug at 3 or 9 o'clock position)	GO	2
50. Front Axle Differential (drain and refill)	GO	1
54. Transmission Filter (replace)	-	1

Every 2 Weeks or 100 Hour	Lube Symbol	No. of Points
[F]3. Boom Slide Bearings (front lower-check for wear &, shim or replace as req'd-no wear permitted past bevel-check upper rear bearings when lower front bearings require service-shims are 1/16" thick)	-	4
17. Parking Brake (check for proper adjustment turn lever knob clockwise to increase tension)	-	1
20. Engine Crankcase Drain Plug (drain and refill to level)	EO	1
21. Engine Oil Filter (replace)		
31 Engine Air Cleaner (clean elements and check to be sure vacuator (rubber cone on bottom) is clean and undamaged)	-	1
52. Drive Shaft Universal Joints	CG	2
53. Drive Shaft Spline	CG	1
62. Engine Crankcase Breather Tube (check to be sure it's clear)	-	1

Every 5 Weeks or 250 Hours	Lube Symbol	No. of Points
[F]25. Wheel Lug Nuts (check torque-should be 300-310 lb-ft on front/325-335 lb-ft on rear	-	40
[F]29 Front Axle (check mounting bolt torque-should be 545-600 lb-ft)	-	8
54. Transmission Filter (replace)	-	1

Every 3 Months or 500 Hours	Lube Symbol	No. of Points
15. Transmission Drain Plug (drain and refill to level)	ATF	1
19 . Transmission Screen (clean)	-	1
32. Hydraulic Filter (replace)	-	1
35. Hydraulic Fluid (have hydraulic oil tested)	-	1
36 . Fuel Tank (drain sediment)	-	1
37. Engine Fuel Filter (replace)	-	1
55. Transmission Breather (clean)	-	1
*60. Engine Intake & Exhaust Valves (adjust)	-	-

Every 6 Months or 1000 Hours	Lube Symbol	No. of Points
13. Front Planetary Hub Drain Plugs (drain and refill to level)	GO	2
31. Engine Air Cleaner (replace element)	-	1
44. Rear Planetary Hub Drain Plugs (drain and refill to level)	GO	2
50. Front Axle Differential Plug (drain and refill to level)	G0	1
51. Front Axle Differential Breather (clean)	-	1

Every Year or 2000 Hours	Lube Symbol	No. of Points
34. Hydraulic Reservoir Suction Screen (clean)	-	1
*35. Hydraulic System (drain and refill to level)	HF	1
36 Fuel Tank Breather/Cap (clean)	-	1
38. Engine Cooling System (drain, flush and refill)	-	-

[F]To be performed by qualified maintenance personnel in accordance with service manual instructions.

Recommended Lubricants & Capacities

Application	Symbol	When Used	Grade	Specifications	Capacities	
					English	Liters
Engine Crankcase	EO (engine oil)	All Year	SAE 30W	-	7.5 quarts	7.1
Engine Cooling System	50% water/ 50% anti-freeze	All Year	Permanent	-	24 quarts	22.7
Transmission	ATF (automatic trans. fluid)	All Year	-	ATF-FM DEXRON	20 quarts	18.9
Fuel Tank	DF (diesel fuel)	All Year	#2	-	40 gallons	151.4
Hydraulic System	HF (hydraulic fluid)	All Year	-	A.S.L.E. No. H-215*	40 gallons	151.4
Differential	GO (multi-purpose lubricant)	All Year	EP 80-90	A.P.I. GL-5	8 quarts	8.4
Front Planetary Hubs	GO (multi-purpose lubricant)	All Year	EP 80-90	A.P.I. GL-5	2.5 pints	1.3
Rear Planetary Hubs	GO (multi-purpose lubricant)	All Year	EP 80-90	A.P.I. GL-5	44 ounces	1.5
Boom Bearing Paths	CG (extreme pressure lube)	All Year	EP 2	H-152	-	-
Grease Fittings	CG (extreme pressure lube)	All Year	EP 2	H-152	-	-
Brake Master Cylinder	BF (brake fluid)	All Year	-	Type A-SAE J-1703C	-	-

*Specific hydraulic fluid specifications are shown below.
**Capacities are approximate - check level to be sure.

Hydraulic Fluid Specifications:

Grade, ASTM	215	Viscosity:		Carbon Residue, Rams. wt	
Grade, AGMA	1	SUS at 100°F	215	Zinc, wt%	0.4
Gravity, ° API	31.0	SUS at 210°F	48.0	Rust Test, ASTM D 665 A&B	0.08
Color, ASTM	2.0	Viscosity Index	105	Oxidation Test, ASTM D 943,	Pass
Flash Point COC, ° F	440	Aniline Point, °F	222	hours to Neut. No. of 2.0	
Fire Point, COC. ° F	490	Foam Test, ASTM	Pass	Emulstion Test, ASTM D 1401	2500
Pour Point, ° F	-30	Neutralization Number	1.4	minutes to pass at 130°F	
				Copper Corrosion 3 hr. at 212°F	1B
					1B

Replacement Filter Elements

Hydraulic Oil Filter	9020-7906
Transmission Filter	9020-4732
Engine Oil Filter	9020-6263
Engine Fuel Filter	9020-6260
Engine Air Cleaner	9020-6222

Tire Specifications

Tire Specifications:
Standard: 13:00 x 24-8 ply rating-55 psi
Optional for front only: 15:50 x 25-8 ply rating-55 psi
Model 534B-8 (8000 pound rating) must have tires filled to 90% of capacity with calcium chloride mixture (49 gallons of water and 245 pounds of calcium chloride per tire).

CALIFORNIA

Proposition 65 Warning

Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Wash hands after handling.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

GRADALL®

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GRADALL HANDLER 534B PREVENTIVE MAINTENANCE

CRANKCASE OIL:
Check Level Daily
Change Monthly
7½ qt. - SAE 30W
Cahnge Oil Filter Monthly

BOOM BEARINGS: Follow Manufacturers Recommendations
Grease Daily (6)
Check Wear Two Weeks
Lube Rear Sheaves

BOOM CABLE:
Tighten Weekly
75 ft. lbs.

FUEL FILTER:
Change - Three Months

BOOM TRUNION PIN:
Grease Daily (1)

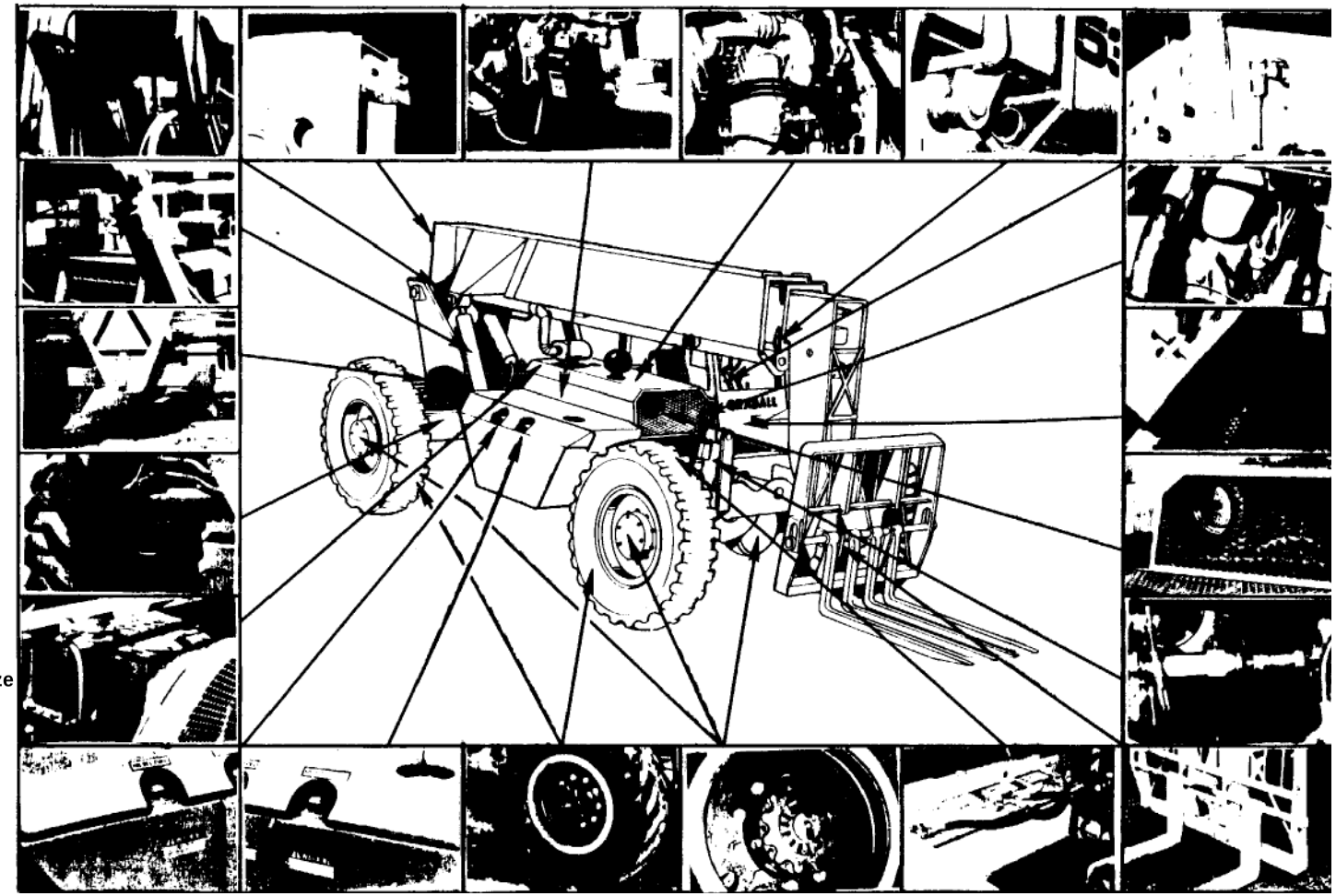
CYLINDERS:
Grease Daily (14)
MPEP Contains Moly N
LG 1 No. 2

REAR AXLE PIVOT:
Grease Daily

REAR AXLE LINKAGE:
Grease Daily (15)

RADIATOR:
Check Level Daily
3 gal. Water-3 gal. Anti-freeze

FUEL TANK:
Fill Daily
40 gal. #2 Diesel



MASTER BRAKE CYL.
Check Weekly 1 qt.
Brake Fluid
SAE J-1703 or J-70C

TRANSMISSIONS:
Check Level Daily
Change Yearly - 5 gal.
AFT-FM Dextron Qualified
Change Filter 6 Months

BRAKES:
Test Weekly
Adjust as Required

AIR CLEANER ELEMENT:
Clean - Three Weeks
Change - Six Months

DRIVE SHAFT:
Grease Every Two Weeks

TILT CARRIAGE:
Grease Daily - Slide Bars
& Manual Quick - Switch

NOTE: See Service Manual For Complete Details

HYDRAULIC RESERVOIR:
Check Level Daily
Inspect Oil - Yearly
Change Filter - Yearly
Oil Specs - See Manual

TIRES:
Check Pressure Weekly
55 psi.

FRONT & REAR AXLES:
Check Level Weekly
Change Lube Six Months
Multi-Purpose Gear Lube
API GL-5
Torque Per Manual

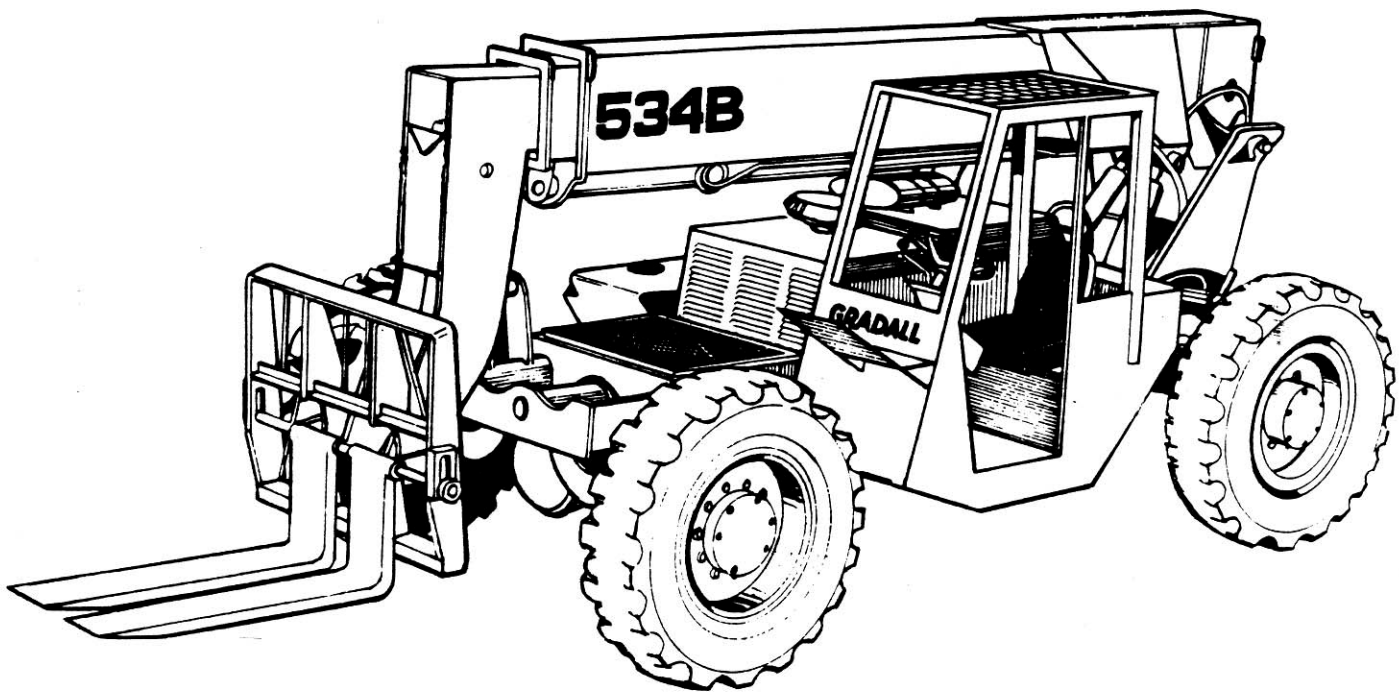
BATTERY:
Check Level Weekly

FORM NO. HE 28327

GRADALL®
Hydraulic Equipment
New Philadelphia, OH 44663

STARTING SERIAL
Covers Units Starting Serial No. 8444490
And Also Covers Unit No. 8444474

BEFORE OPERATING OR MAINTAINING MACHINE, BE SURE TO READ AND UNDERSTAND THE 534B OPERATOR'S AND MAINTENANCE MANUAL, ALL SAFETY NOTATIONS AND SERVICE LITERATURE. KEEP ALL PERSONNEL CLEAR OF MACHINE WHILE OPERATING, TESTING AND ADJUSTING.



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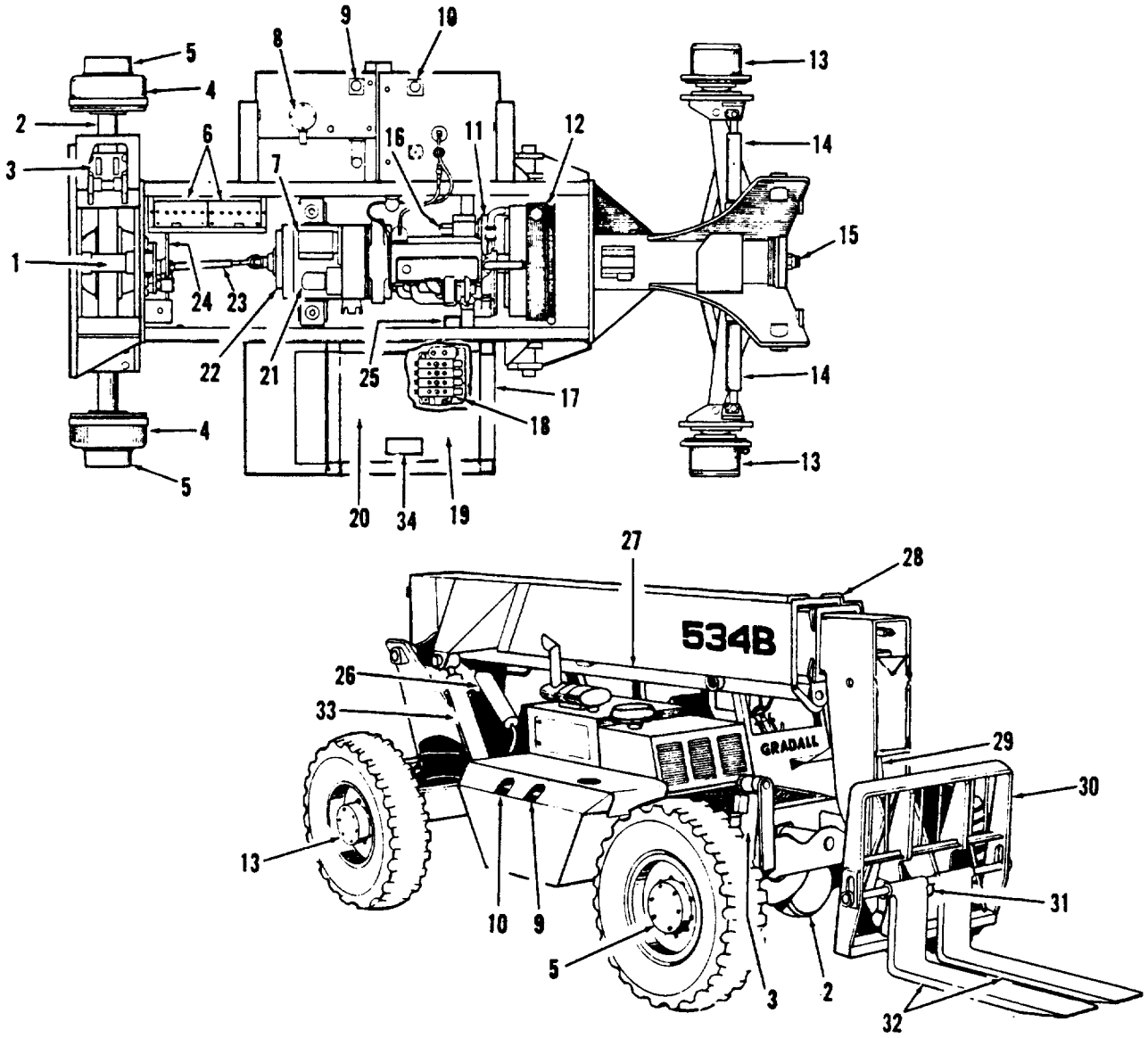
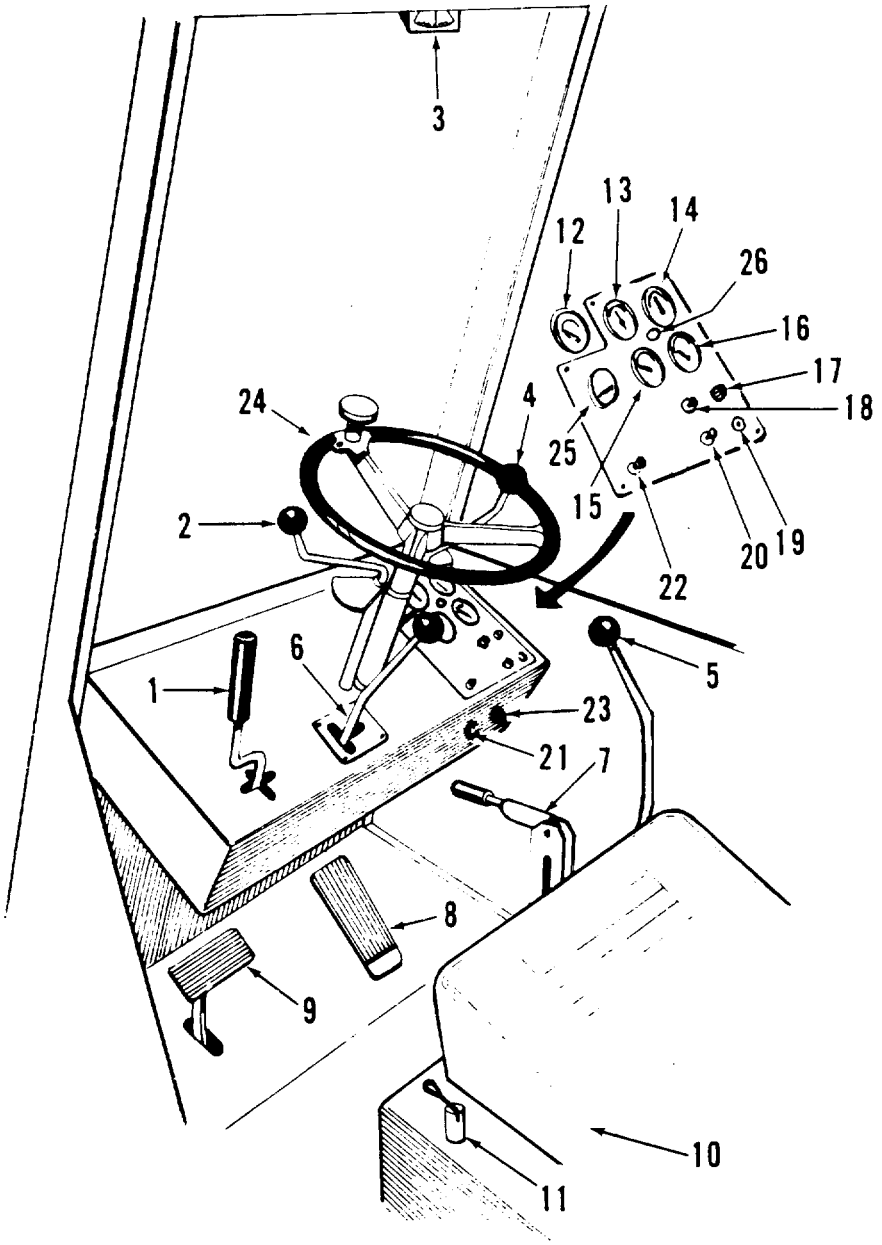
NOMENCLATURE



1. Front Axle Pivot
2. Front Planetary Axle
3. Sway Cylinder
4. Front Axle Brake
5. Front Axle Planetary
6. Batteries
7. Main Tandem Pump
8. Reservoir Filter
9. Reservoir Dip Stick
10. Fuel Tank Fill Cap
11. Power Unit
12. Radiator
13. Rear Drive Planetary
14. Steering Cylinder
15. Rear Axle Pivot
16. Pilot Pump
17. Valve Compartment
18. Main Valve Bank (Under Cab)
19. Operator's Cab
20. Operator's Controls
21. Transmission Filter
22. Transmission & Torque Converter
23. Drive Shaft
24. Parking Brake Assembly
25. Pilot Relief Valve
26. Compensating Cylinder
27. Crowd Cylinder
28. Three Section Boom
29. Tilt Cylinder
30. Carriage
31. Manual "Quick-Switch"
32. Forks
33. Lift Cylinders (2)
34. Brake Master Cylinder

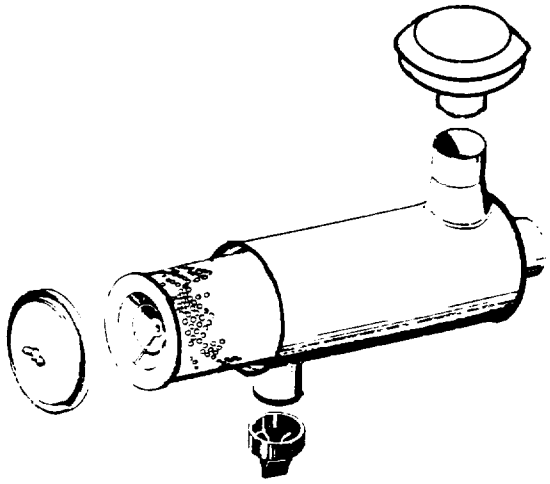
CAB CONTROLS & GAGES



1. CARRIAGE TILT & SWAY CONTROL LEVER
2. FORWARD-REVERSE LEVER
3. LEVEL INDICATOR
4. TRANSMISSION SPEED SELECTOR LEVER
5. BOOM CONTROL (Up-Down - In-Out)
6. AUXILIARY CONTROL LEVER (Option)
7. PARKING BRAKE LEVER
8. ACCELERATOR PEDAL
9. BRAKE-INCHING PEDAL
10. SEAT POSITION CONTROLS
11. MICO BRAKE LOCK LEVER
12. TRANSMISSION TEMPERATURE GAGE
13. AMMETER GAGE
14. FUEL GAGE
15. TEMPERATURE GAGE
16. OIL PRESSURE GAGE
17. HEATER FAN SWITCH (Option)
18. LIGHT SWITCH (Option)
19. HORN BUTTON
20. ROTATING BEACON SWITCH (Option)
21. IGNITION KEY
22. ETHER START KNOB (Option)
23. STARTER BUTTON
24. STEERING WHEEL
25. HOUR METER
26. BRAKE WARNING LIGHT (Low Pressure)

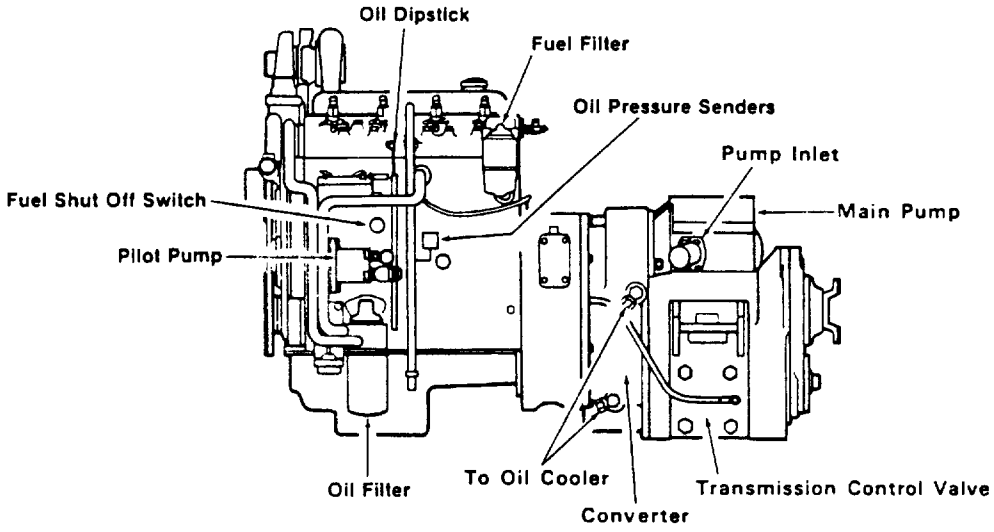
ENGINE

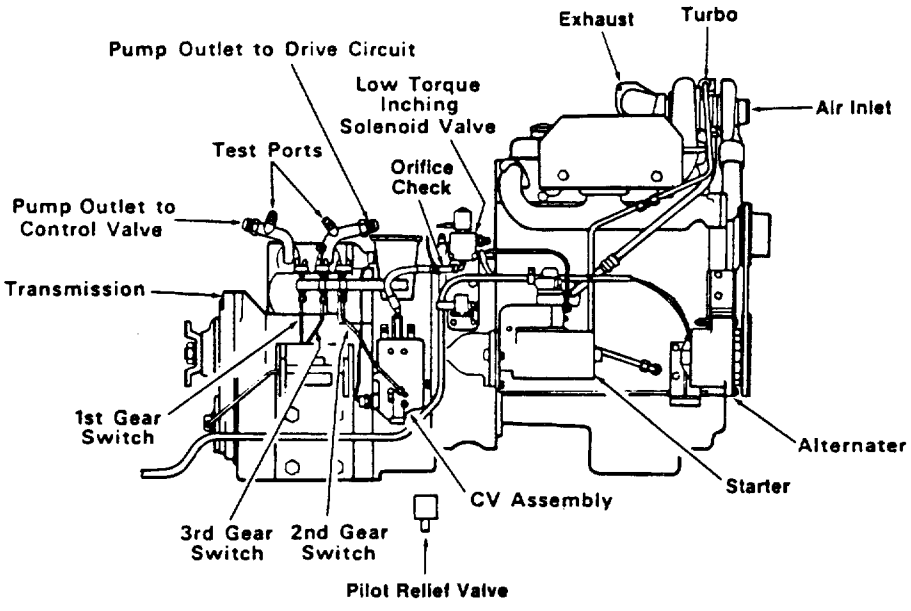
To supply power for the front wheel drive and for the various hydraulic circuits'a diesel engine is used. It runs at 900 rpm low idle. Depressing the accelerator pedal all the way, the engine will run 2800 rpm. With a nominal load the engine will average out at 2600 rpm and will produce 102 gross BHP. The engine speed governs both over-the-road travel speed and the hydraulic circuit speeds.



Engine Filters

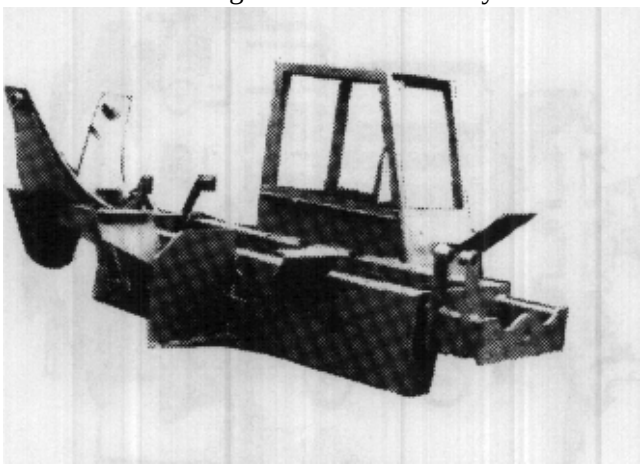
The engine has a two stage dry air cleaner, a pre-cleaner with continuous dust ejector, plus a cleanable and replaceable dry filter element. The fuel filter is a replaceable element type and the oil filter is a full flow replaceable element type.





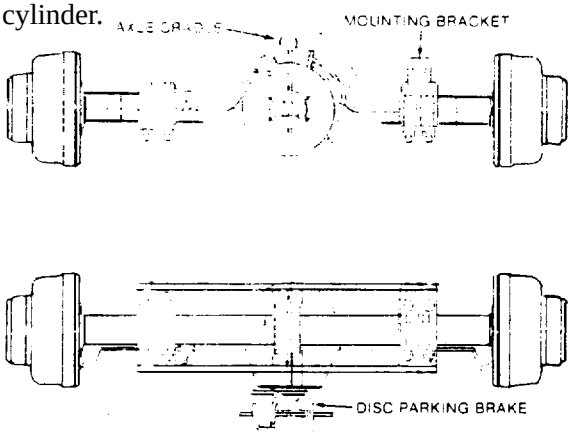
MAIN FRAME

The 534B has an all welded main frame with 1032 pounds of counterweight on rear for stability.



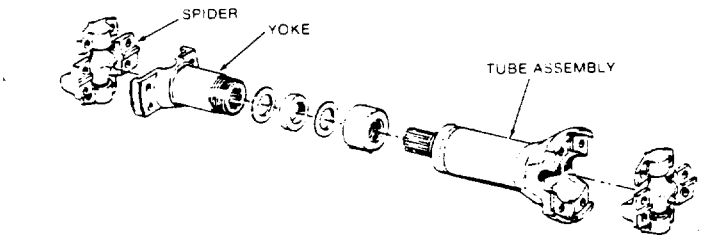
FRONT DRIVE AXLE

The front axle is bolted to the axle cradle which pivots on the front of the main frame. The angle of the axle (left or right) to the frame is controlled by a sway cylinder.



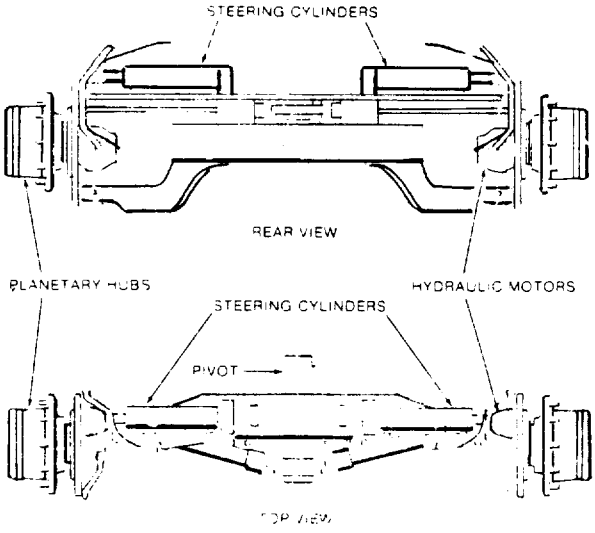
DRIVE SHAFT

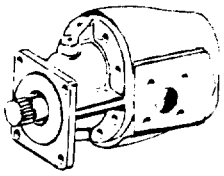
An automotive type drive shaft is used to transmit rotary motion from the transmission to the front axle. A manually operated disc parking brake is bolted to the drive shaft.



REAR DRIVE AND STEERING AXLE

The rear axle assembly pivots up and down on the main frame. Each wheel is powered by a hydraulic motor, driving through a planetary hub. Two steering cylinders are used to turn the wheels. At maximum turn radius, the outside wheel turns about 90° to the pivoting axle. The inside wheel turns about 87°. *When in 3rd gear. the hydraulic motors are not powered.*





HYDRAULIC MOTORS

TIRES

Four 13:00 x 24-12PR, G3 tires are standard. *15.5 x 25-12 PR are optional on the front.* The larger tires give higher floatation in sand and mud. All tires are inflated to 55 psi.

The tires on the Model 534B-8 are filled with calcium chloride for counterweight. Each tire has a mixture of 49 gallons of water and 245 pounds of calcium chloride. Thump sound check once a week and after tire repair.

NOTE: Tires must be properly filled on all 534B-8 models to handle rated loads. When filling, keep valve stem at top. The fluid should be at a level covering the valve stem. This protects the wheel from corrosion and rusting.

TRANSMISSION AND TORQUE CONVERTER

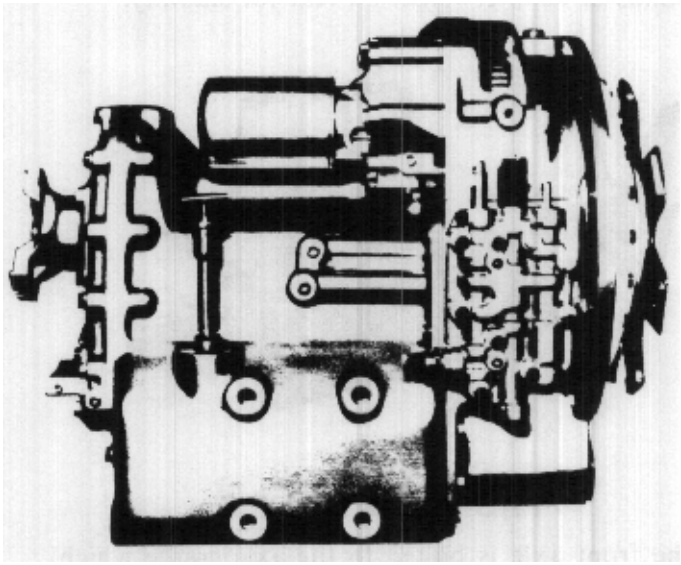
The tranmission - torque converter combination has neutral starting, shifting without stopping, 3 speeds forward and 3 speeds in reverse.

Gear selection lever is on the right side of the steering column. The neutral, forward or reverse lever is on the left side.

When the brake foot pedal is pressed down, either for braking or inching, the transmission de-clutches and no power goes to the front axle.

The transmission is fitted with a replaceable oil filter. The oil cooler assembly is located in the bottom portion of the engine radiator.

The main tandem pump for the hydraulic system is mounted to a take-off on the back of the transmission.

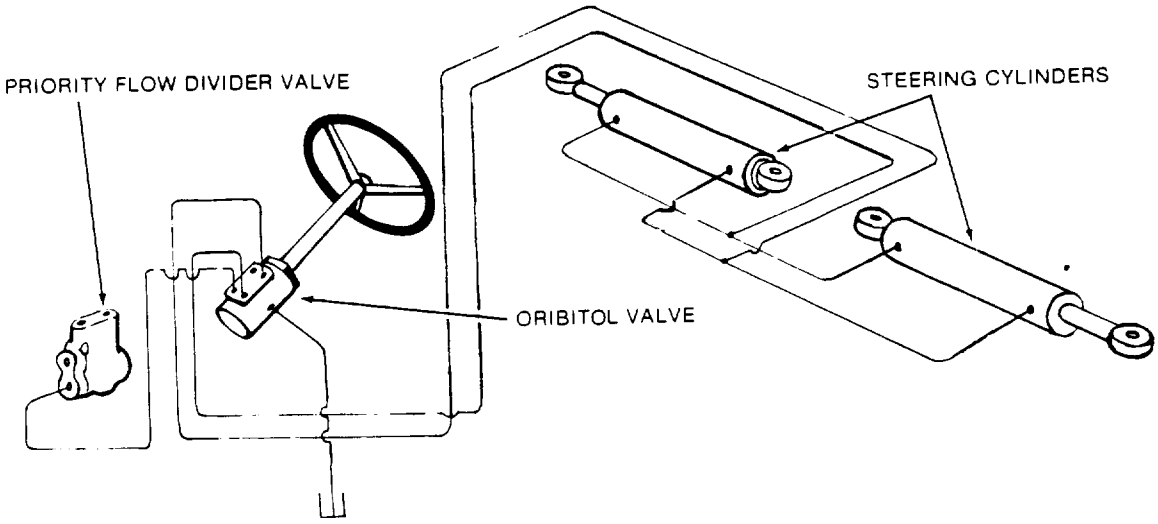


STEERING CIRCUIT

Oil for the steering is taken from the base pump section through a priority flow divider valve. Any movement of the steering wheel actuates the flow divider plunger and allows up to 10 gpm to be diverted to the steering orbitrol valve at the base of the steering post. The priority flow divider valve also has a 2000 psi steering relief valve. As the steering wheel is turned, oil is routed to ends of the two rear steering cylinders.

A one-way check valve is provided between the priority valve and the orbitrol valve to prevent the back-up of oil that might cause a kick-back at the steering wheel.

If the steering circuit is not being used, all the fluid from the pump section is routed to the Fwd/Rev Valve.



HYDRAULIC SERVICE BRAKES

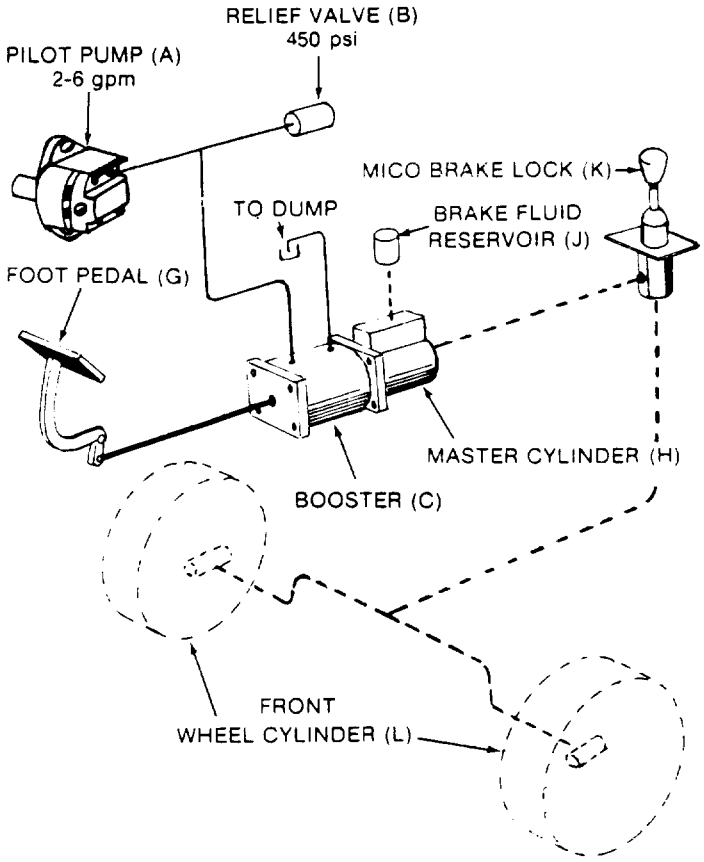
To actuate the service brakes, two different circuits are used. One uses system hydraulic oil. and the other uses brake fluid.

The hydraulic oil circuit consists of the pilot pump (A), and the pilot relief valve (B), and a booster brake valve (C).

Downward pressure on the brake pedal (G) activates the booster and a combination of foot power and hydraulic power from the booster exerts increased pressure to activate the master brake cylinder (H).

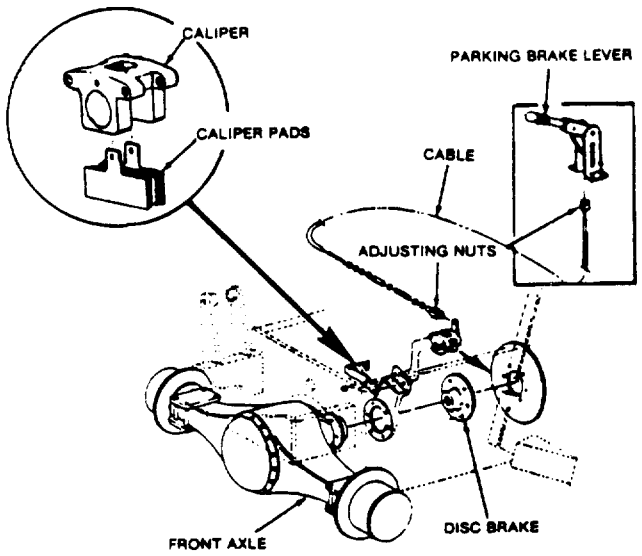
The brake fluid circuit takes over at this point. Brake fluid from the reservoir (J) flows to the master cylinders and continues on to the Mico Brake Control Valve (K). From here, the fluid is routed to both front wheel brake cylinders (L).

The Mico Brake Lock is for short term use, such as when working on a slope. The Mico Brake Lock Lever (K) is located to the left of the operator's seat. *The brakes must be pressurized by foot pedal before setting Mico Lock Brake Lever*. The brake fluid reservoir (J) is located behind the cab, under the valve corner.

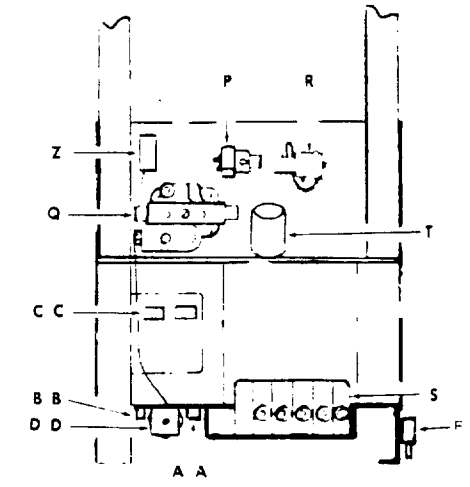


MECHANICAL PARKING BRAKE

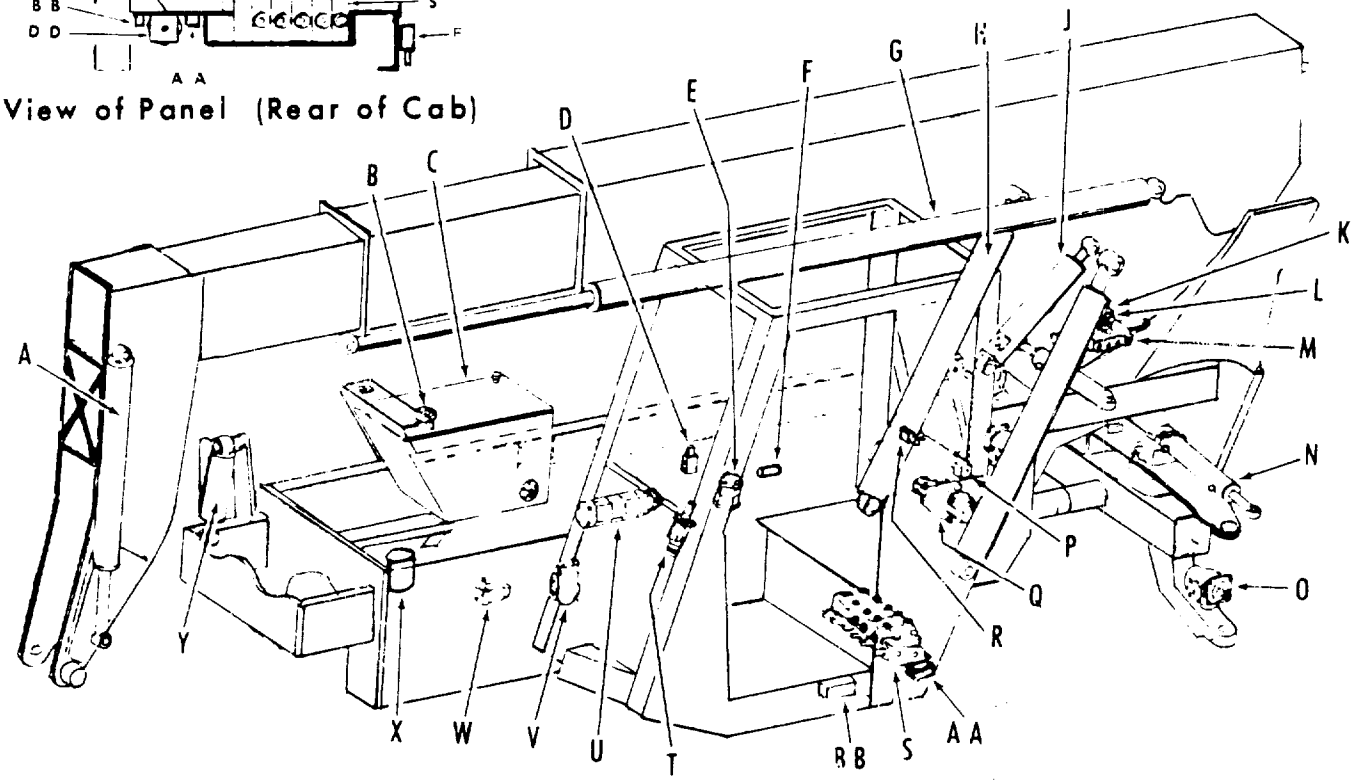
The operator can actuate the mechanical parking brake by pulling back on the floor mounted lever. A cable is connected to the caliper type of disc brake which is mounted between the front axle and the drive shaft. The caliper pads open or close on the disc in the drive line. Brake adjustment is made by adjusting cable end nuts, or by turning knob on parking brake lever.



HYDRAULIC SYSTEM



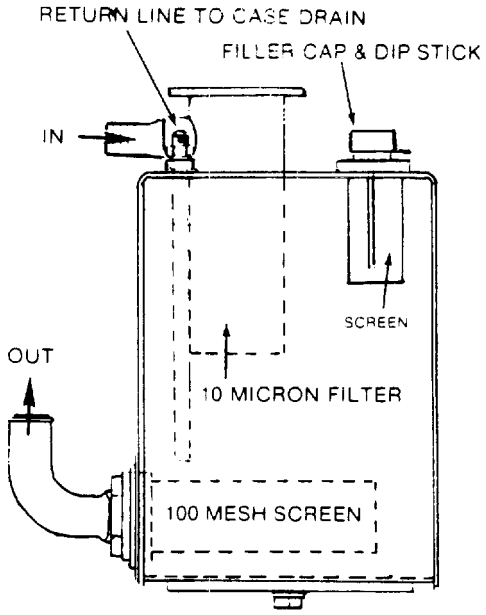
View of Panel (Rear of Cab)



- A- TILT CYLINDER
- B- RESERVOIR FILTER
- C- HYDRAULIC OIL RESERVOIR
- D- LOW TORQUE INCHING SOLENOID VALVE
- E- PILOT PUMP
- F- PILOT RELIEF VALVE (450 psi)
- G- CROWD CYLINDER
- H- HOIST (Lift) CYLINDERS (2)
- J- COMPENSATING CYLINDER
- K- PARALLEL SOLENOID VALVE
- L- SERIES SOLENOID VALVE
- M- SERIES/PARALLEL VALVE
- N- STEERING CYLINDERS (2)
- O- REAR HYDRAULIC DRIVE MOTORS
- P- FWD/REV PILOT PRESSURE CONTROL VALVE
- Q- FWD/REV VALVE
- R- CAVITATION SOLENOID VALVE
- S- MAIN CONTROL VALVES
- T- ORBITROL STEERING VALVE (Under Cab at Base of Steering Post)
- U- MAIN TANDEM PUMP
- V- PRIORITY VALVE
- W- DRIVE CIRCUIT MAIN RELIEF VALVE
- X- BRAKE CIRCUIT ACCUMULATOR
- Y- SWAY CYLINDER
- Z- BRAKE FLUID RESERVOIR
- AA- ROTARY INCHING VALVE
- BB- LOW TORQUE INCHING SWITCH
- CC- FORWARD/RESERVE SWITCHES (Under Dash Panel)
- DD- BRAKE BOOSTER & MASTER CYLINDER

HYDRAULIC RESERVOIR

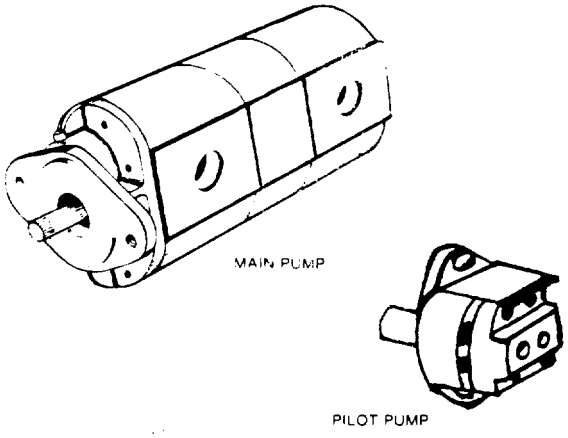
The reservoir is located on the right side of the machine, directly in front of the fuel tank. It holds 24 gallons of hydraulic oil. The system holds 40 gallons. The measuring dip stick is a part ot the filler cap. In the filler opening is a wire screen. Oil returning to the reservoir passes thru a 10 micron replaceable type filter. As oil is drawn off by the pumps, it passes thru a 100 mesh screen.



HYDRAULIC PUMPS

The main pump is a two section tandem pump which delivers 63 gpm at 2600 rpm. Each of the two section is rated at 31.5 gpm. The base section services the steering and the rear wheel drive. The end section serves the main control valves for the other circuits. The tandem pump is mounted with a direct drive from the transmission. Each section is protected by a 3000 psi relief valve.

The pilot pump is a one section pump, mounted on the right side of the engine. The output of the pilot pump is 2 to 6 gpm. It is protected by a 450 psi relief valve.



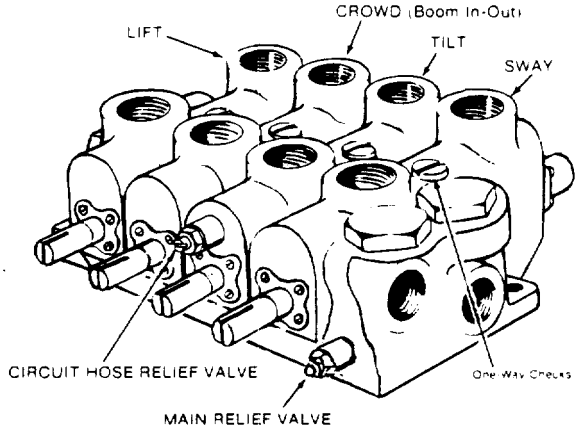
MAIN CONTROL VALVE BANK

The main control valve bank for the sway, tilt, crowd and lift circuits is located on the floor board under the operator's seat. Each valve plunger is connected to the operator's control levers.

The standard valve bank consists of an inlet section with a built-in adjustable relief valve cartridge rated at 3000 psi., the four control valves and an end section.

The tilt control valve has two built in and adjustable circuit relief valves rated at 3250 psi.

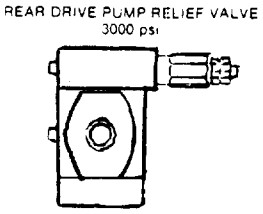
If the auxiliary hydraulic circuit is used for the truss boom winch, another valve section is added between the tilt valve and the sway valve.

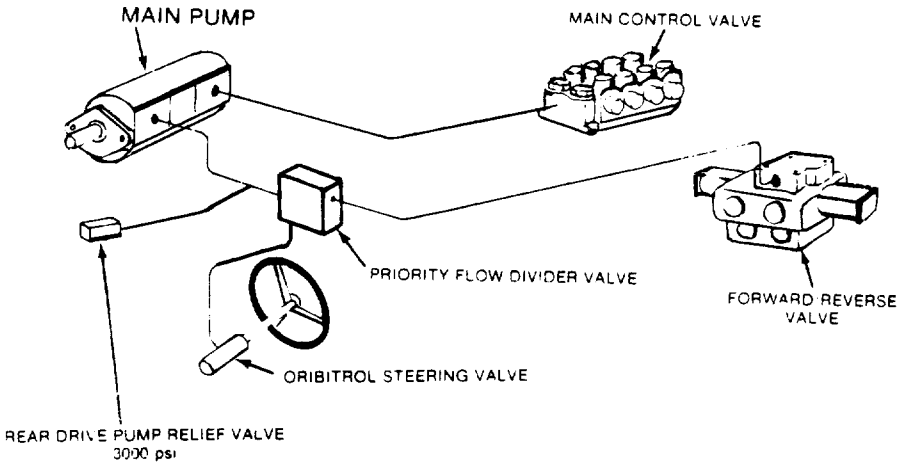


MAIN PUMP CIRCUITS

The two section main tandem pump supplies oil for two separate circuits. Oil from the base section supplies oil through a Priority Valve (to assure a supply of oil for steering) and also routed to Fwd/Rev Control Valve. Oil from the end section is routed to the main control valve. Both circuits have 3000 psi relief valves.

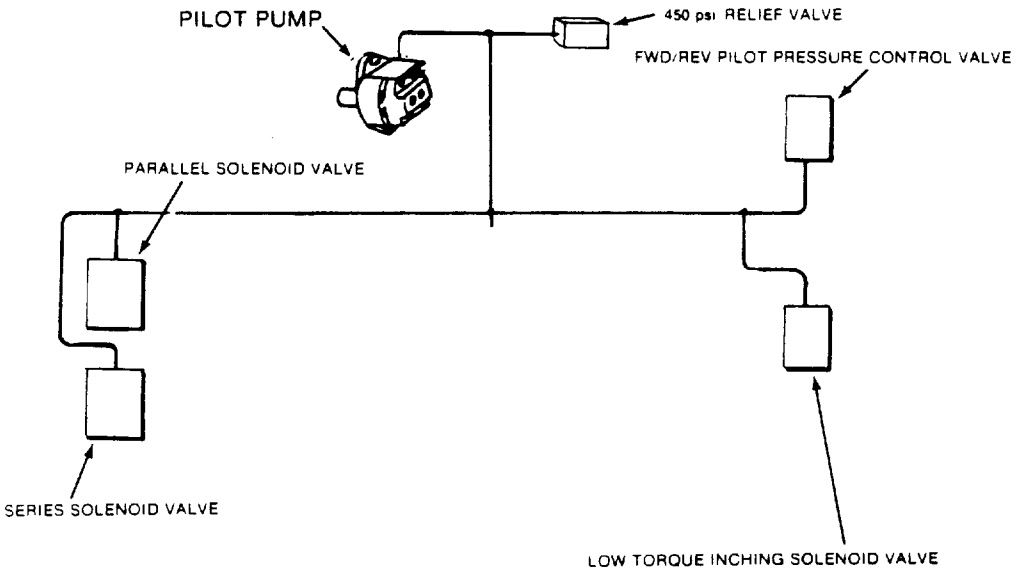
The rear drive pump relief valve is located inside the frame on the left side. The other relief valve is located within the Main Control Valve. The main control valve is located under the operator's seat.





PILOT PUMP CIRCUIT

The pilot pump supplies oil for the brake booster circuit, the parallel solenoid valve, the series solenoid valve, the Fwd/Rev pilot pressure control valve, and the low torque inching solenoid valve.

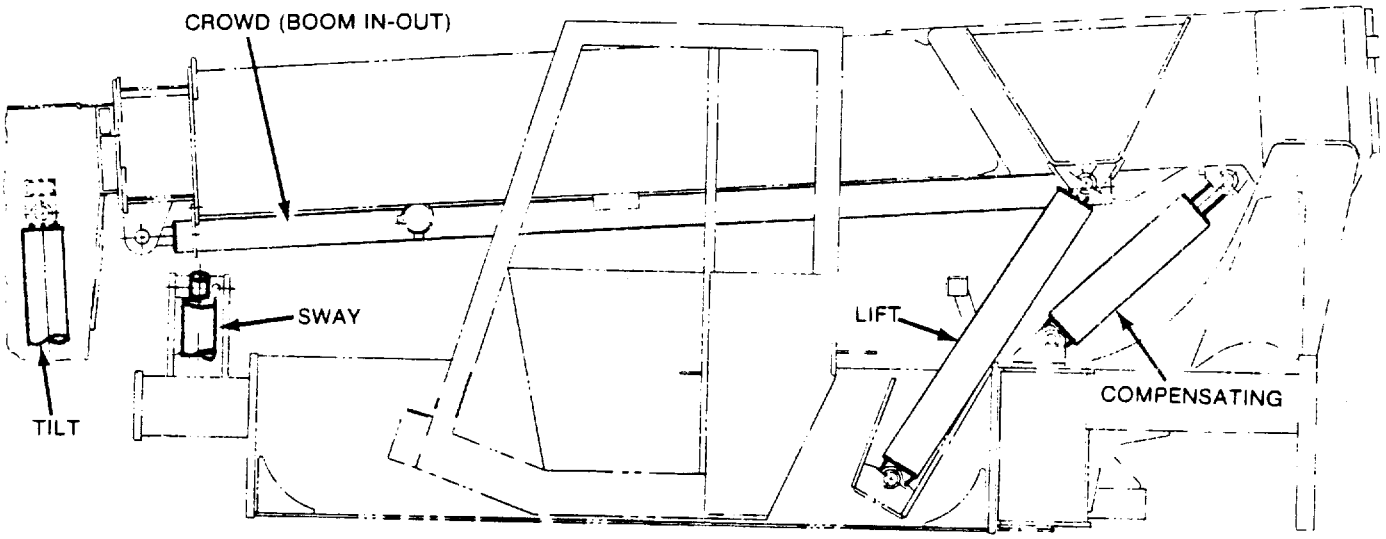


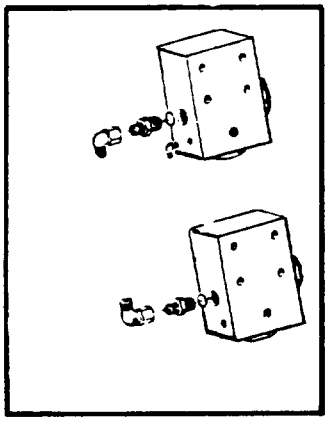
HYDRAULIC CYLINDERS

There are eight hydraulic cylinders: Sway, Lift (2), Compensating, Tilt, Crowd (Boom In-Out), and Rear Wheel Steering (2).

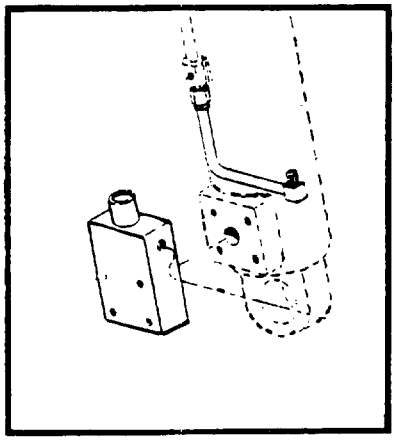
On the Tilt, Crowd and Lift Cylinders, a counter-balance valve is used to protect against broken hoses and to control lowering actions.

The Sway Cylinder has two piloted check valves to provide a positive lock of oil in the cylinder. Pressure applied to the Circuit from the valve in either direction, unseats the check plunger and allows the desired two-way flow of oil.





Check Valves

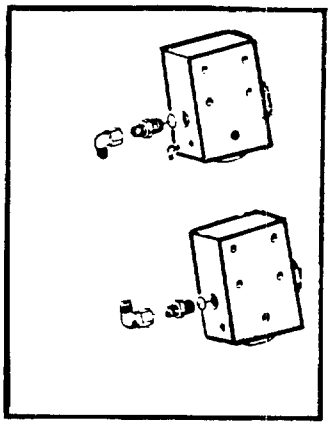


Counter Balance Valve

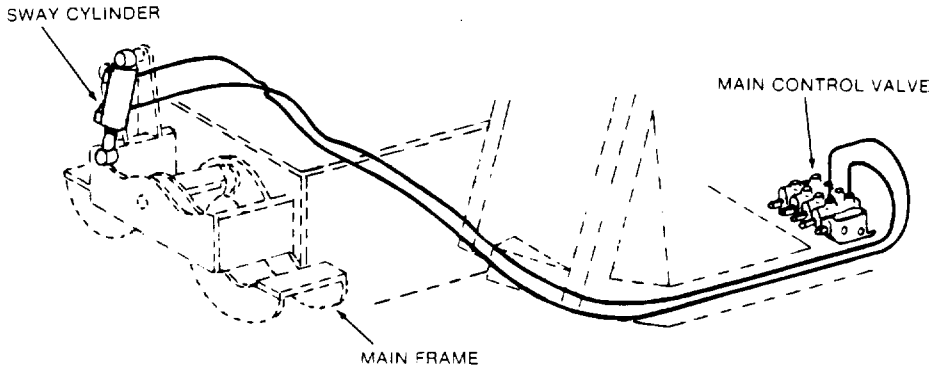
SWAY CIRCUIT

The sway circuit permits the operator to level the main frame of the machine in relation to the position of the front axle. With the sway cylinder the operator can tilt the frame up to 8° in either direction from horizontal. Movement of the sway lever to the right or left actuates a plunger in the first control valve section, and oil is routed to the sway cylinder, and the machine sways right or left.

There is a bubble level in the cab to assist the operator in determining when the frame and boom is level.



Check Valves



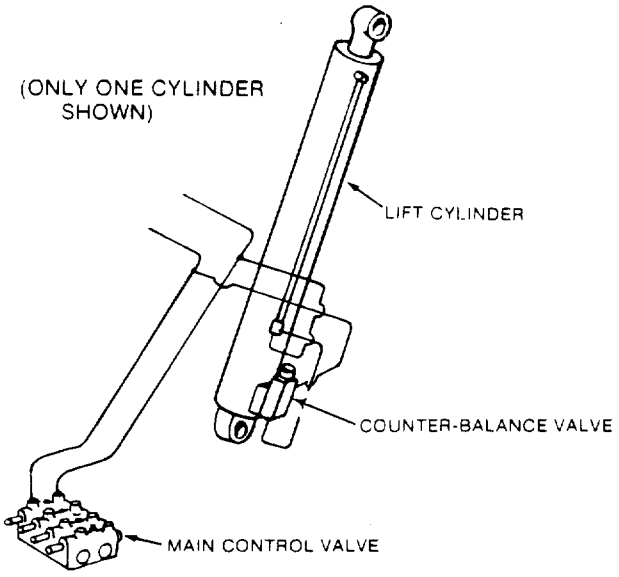
LIFT CIRCUIT

The lift circuit allows the operator to raise the boom assembly up 70ø and lower it to a -4° angle.

Movement of the boom control lever back, raises the boom and a forward motion, lowers the boom. An angle indicator is located on the left side of the main boom section.

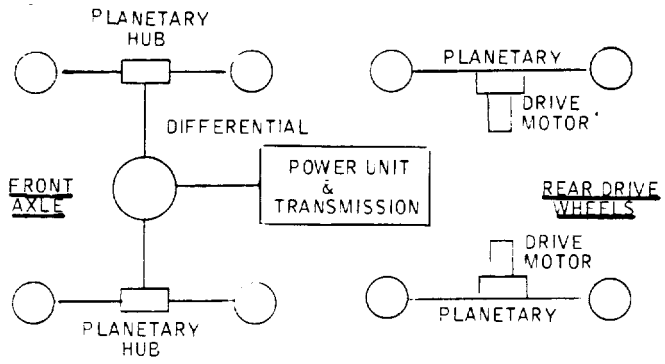
At the base of both lift cylinders is a counterbalance valve. The valves serve as a lock-out valve to hold oil in the cylinder should a hose break or to prevent boom movement should the lever be actuated while the engine is shut off. It also serves as a flow valve to control the downward movement of the boom at a controlled speed.

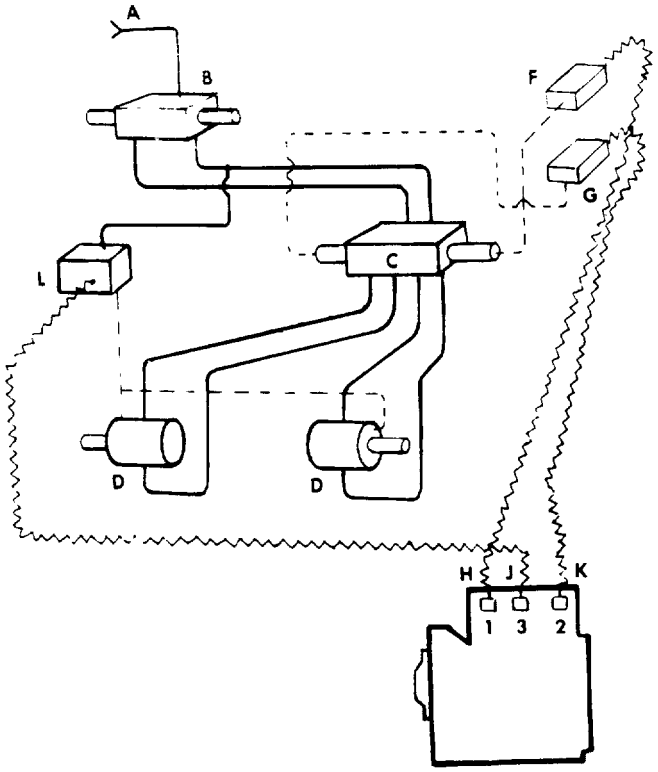
The 534B-6 models have 4½" cylinder. The 534B-8 models have 5" cylinder.



FRONT & REAR WHEEL DRIVE

The 534B hasaconventional front wheeldrive, with power from the engine. It has a torque converter and transmission with a drive shaft and differential, and a pair of planetary wheel ends. The rear drive uses hydraulic oil to turn the motors and planetary hubs at each rear wheel.





The oil supply to the rear drive motors will vary depending on the position of the gear selection lever. The purpose of this is to coordinate the speed of the rear wheels with the speed of the front wheels.

The 534B has a variety of options to control forward and reverse, speed and power. An inching control enables the operator to move the carrier slowly when maneuvering or handling a load.

1. In first gear. A combination of low transmission gear ratio to the front driving axle is used. The rear drive uses parallel valving of hydraulics to rear drive motors.

   With the lever in 1st gear position, an electrical contact is made at the sending unit (H) on the transmission. The current activates the parallel solenoid valve (F). This sends pilot oil to one end cap of the series/parallel valve (C). The plunger shifts into a parallel hydraulic mode and the main pump oil is routed to the two drive motors (D) equal. As the operator presses down on the accelerator, the engine r.p.m. will increase and so will the oil flow.

2. In second gear the gear ratios to the front axle are changed to gain more speed and the hydraulic valving is changed to series mode.

   When the lever is shifted into the 2nd gear position, an electrical current contact is made (J) on the transmission. This activates the series solenoid valve (G) and the opposite end cap of the series/parallel valve (C) is pressurized. The plunger shifts and the oil is routed in series to the two drive motors. The motors turn faster to match the speed of the front axle drive.

3. In third gear a higher gear ratio is used for maximum speed in the front axle and the rear drive s disengaged.

   When in 3rd gear the rear wheel drive is not functioning because the hydraulic drive can't keep up with the front wheel drive. Since the 1st and 2nd gear solenoid valves are not activated, the series/parallel valve (C) returns to neutral and the oil in the drive motors simply circulates, doing nothing. To reduce drag due to pumping a full charge of rear motor oil, a cavitation valve opens a direct line from the rear motors to tank. It allows some of the oil to go to the tank, therefore reducing the motor oil volume, therefore reducing the drag.

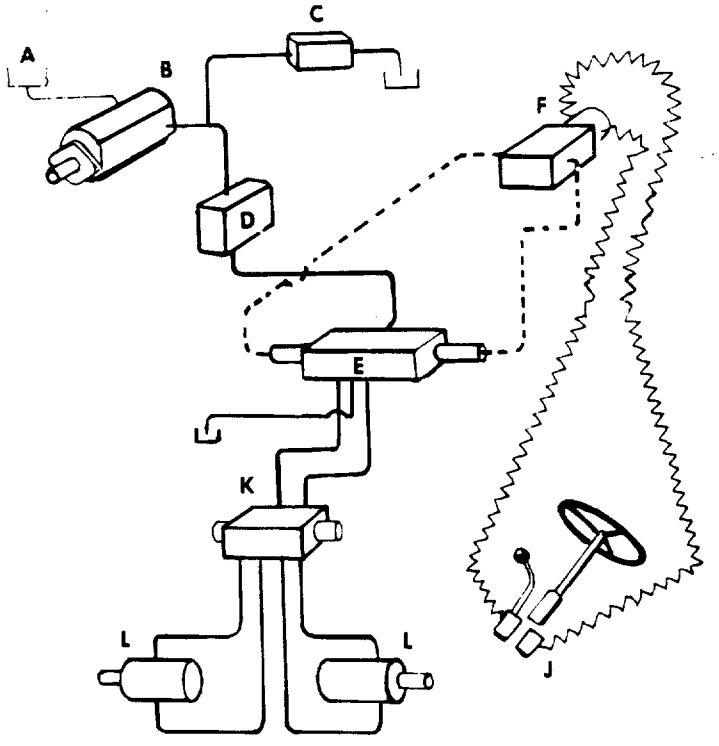
FORWARD/REVERSE LEVER (Neutral)

When Forward/Reverse Lever is in neutral position, electrical contacts are not made at the Fwd/Rev Switches (J) and the oil flow in the circuit is as follows:

Oil from reservoir (A) is drawn into the main pump section (B). It then flows to the priority valve (D) where a portion is available for the steering circuit. First, the oil is exposed to the circuit main relief valve (C) which is set at 3000 psi. The oil leaves the priority valve and goes into the Forward/Reverse Valve (E). Since it has not been activated from the Fwd/Rev Switches (J) the Fwd/Rev Pilot Pressure Control Valve (F) keeps it in neutral and the oil passes thru and goes back to the reservoir.

FORWARD/REVERSE LEVER (Shifted)

With the Fwd/Rev control lever shifted forward, 1st, 2nd or reverse, electrical contact is made at the Fwd/Rev Pressure Control Valve (F) and depending on the position (forward or reverse) pilot oil is sent to the end caps of the Fwd/Rev Valve (E). The plunger shifts and oil is routed back to the rear drive motors (L).



INCHING

The inching feature allows the operator, when carrying a load, to move the handler very slowly for maneuvering in tight places.

To operate the inching feature, the operator depresses the brake-inching foot pedal (A) approximately 1/2" to 1". This creates movement of the linkage (B) making contact with the low torque inching switch (D). As this first movement occurs and physical contact is broken, the switch is energized and it activates the low torque inching solenoid valve (E). This sends pilot circuit oil down to the de-clutch valve (F) on the transmission and the transmission de-clutches and there is no power to the front axle.

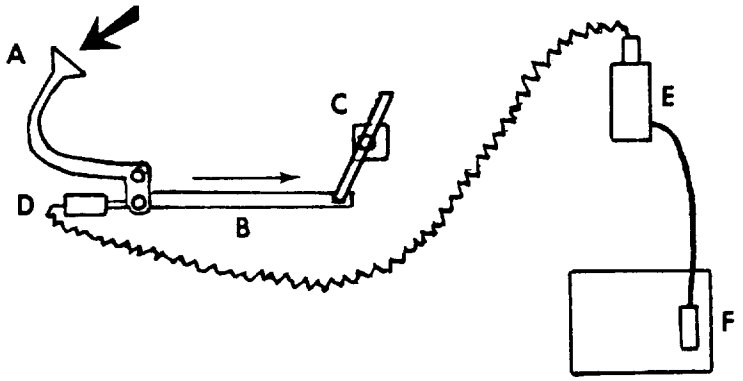
As the linkage (B) continues to move, the arm on the inching valve moves. This movement causes pilot control pressure to bleed off to tank, thereby metering the Forward/Reverse valve to neutral.

As the operator continues to depress the brake-inching pedal (A) and the inching valve (C) rotates, the pressure controlling the Fwd/Rev Valve varies.

Depending on the stroke of the plunger, in the Fwd/Rev control valve varying, volume of oil is routed on to the series/parallel valve and to the rear drive motors.

The further down the operator depresses the brake-inching pedal, the lower oil volume goes to the motors.

As the operator continues to depress the brake-inching pedal, the front axle brakes are applied and normal braking occurs.



TILT & COMPENSATING CIRCUITS

The tilt circuit raises or lowers the angle of the fork or other attachment a total of 114°. It is a dual circuit combining with a compensating cylinder to automatically adjust the level of the fork continuously as the boom is raised or lowered.

Movement of the tilt control lever(sway) forward or backward adjusts the angle of the attachment. Forward lowers the fork and backwards raises the fork.

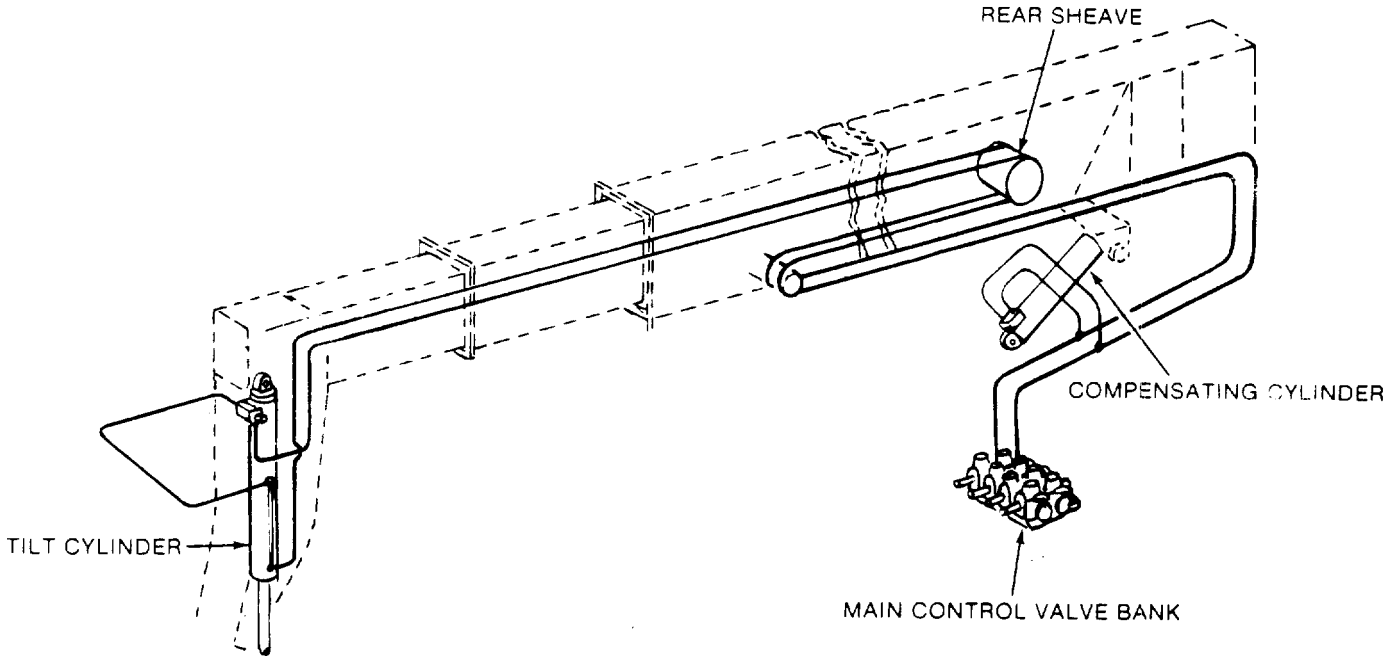
Oil from the Tilt Control Valve section is routed to both cylinders. The compensating cylinders is a plain cylinder and the tilt cylinder uses the counter-balance valve.

Both cylinders are of identical size so that as the boom angle changes, a like volume of oil is transferred to or from the tilt cylinder, keeping the fork level or in the same position.

The 534B-6 models 4" cylinders are used and on the 534B-8 models 5" cylinders are used.

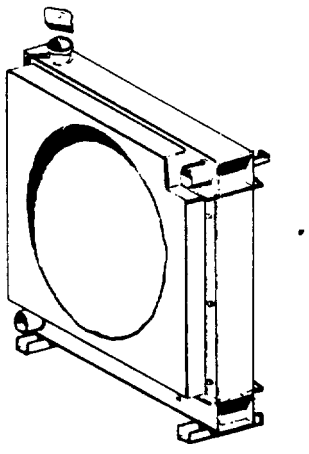
The oil lines which are used to carry the oil thru the booms pass around the rear sheaves on the push boom assembly.

The oil lines are secured to the front end of the 3rd boom section with springs to keep them tight.



OIL COOLER CIRCUIT

To help keep the temperature of the hydraulic oil to a nominal level, various circuits on the machine dump oil thru a heat exchanger radiator located in back of the engine radiator.

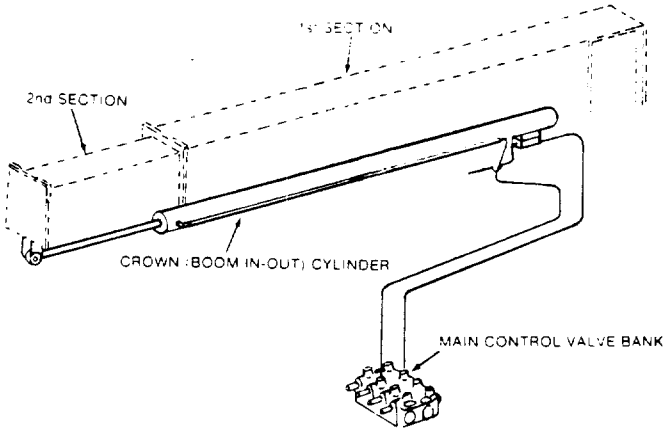


CROWD (Boom In-Out) CIRCUIT

The crowd circuit allows the operator to extend and retract the boom sections a total of 18 feet. Nine foot extension is obtained from the movement of a hydraulic cylinder joined to the first section and the second section. Movement of the 2nd section and a combination of cables and sheaves moves the 3rd section.

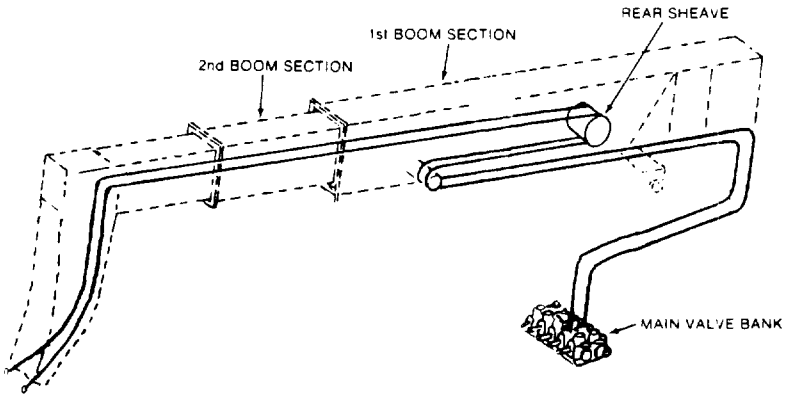
The control lever is the same as used to raise and lower the boom, but for the crowd the operator moves it to the right and left. Moving it to the right the booms.

Oil from the 3rd valve section routes the oil to the base of the crowd cylinder. A counterbalance valve is used on the cylinder for protection and speed control.

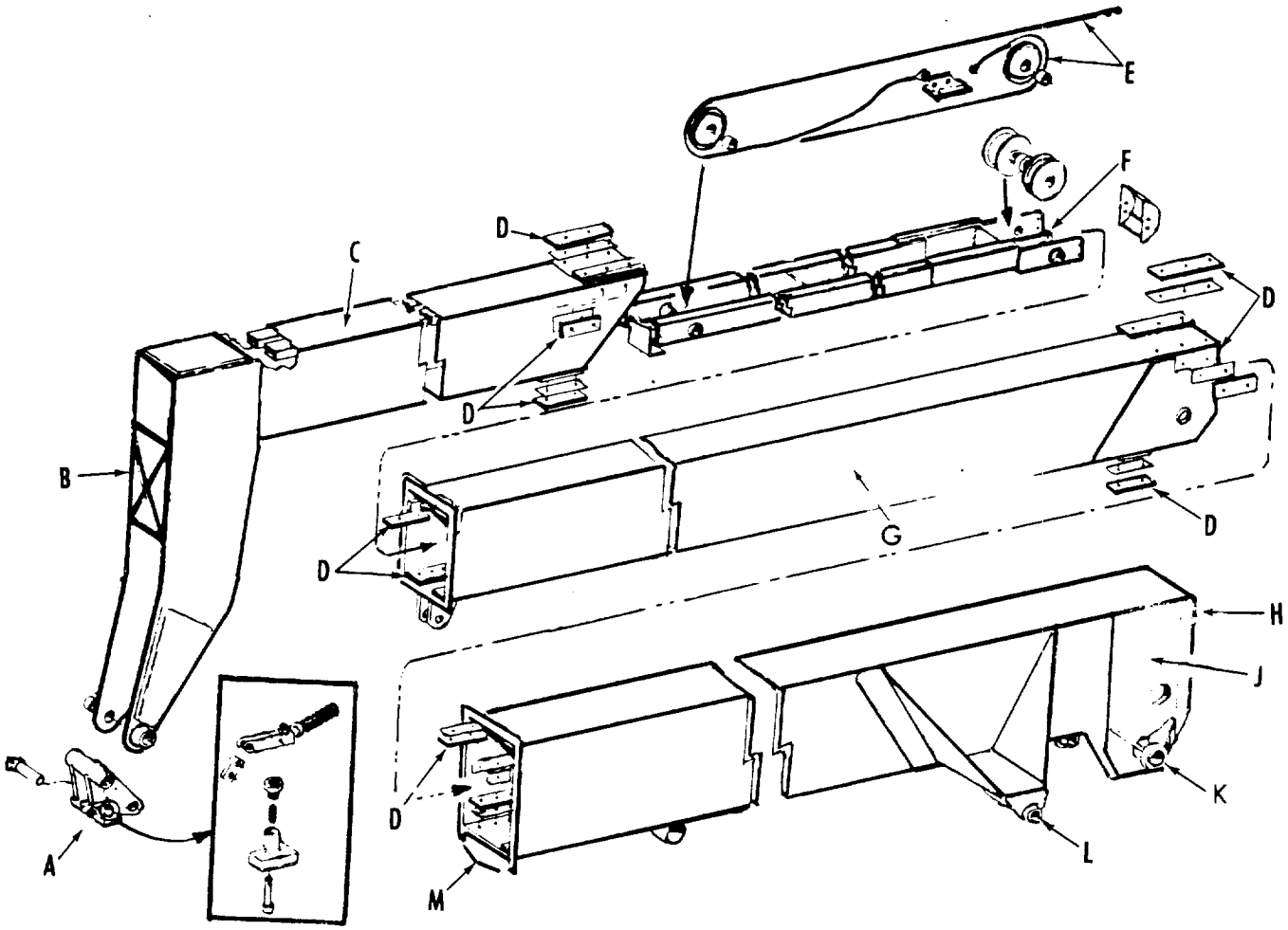


AUXILIARY HYDRAULIC SYSTEM

When the 534B is equipped with a truss boom and hydraulic winch, an additional control valve section is added between the Sway Valve section and the Tilt Valve section. The oil is routed from the control valve up thru the boom to power the winch on the truss boom.



BOOM SECTIONS



A—Manual "Quick-Switch"
B—Boom Head
C—3rd Boom Section
D—Boom Slider Pads
E—Boom Cables & Sheaves
F—Push Beam
G—2nd Boom Section
H—Rear Cable Anchor
J—1st Boom Section
K—Boom Trunion Pin
L—Boom Hoist Cylinder Pin
M—Crowd Cylinder Support

BOOM SLIDER PADS

The boom sections move in and out on slide wear pads. These pads are positioned on the top bottom and sides of the boom to protect the boom frame against excessive wear.

It is important that these pads be lubricated on a regular basis and kept clean. The Slider pads are shim adjusted and regular inspection and adjustment is required.

SLIDER PAD TORQUE:
1/2" = 60 ft. lbs.
3/8" = 20 ft. lbs.
Use #242 Loctite

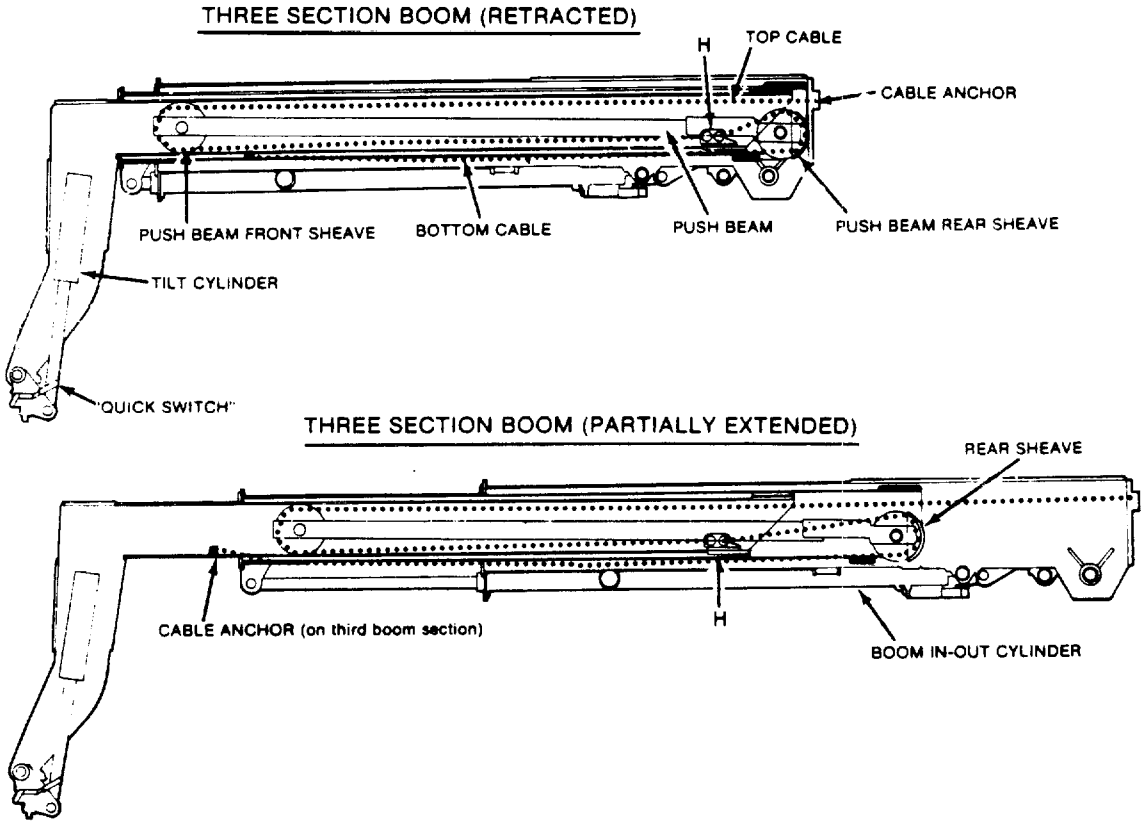
BOOM CROWD (IN-OUT) MOVEMENT

When the control lever for the crowd action is activated, the 2nd and 3rd boom sections move in and out equally.

Power to move the booms in and out come from a hydraulic cylinder which is located under the main 1st boom section. It moves the 2nd boom section. As the 2nd boom section moves in or out, a combination of a push assembly and sheaves and cables move the 3rd boom section. The push beam assembly is fastened to the 2nd boom section at the rear sheave pin and moves with it.

Two cables are used. The top one is bolted to the rear of the main boom and runs forward around the push beam front sheave and back to the anchor point at the bottom rear of the 3rd boom section. The lower cable is anchored near the front bottom of the main boom and passes back around the rear sheave and is anchored at point (H) of the 3rd boom section. As the 2nd boom section moves out forcing the push beam and sheaves with it, the top cable has to move forward at point (H) taking the 3rd boom section with it.

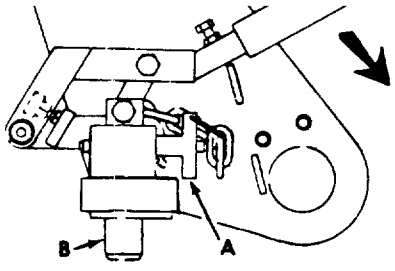
When retracting the booms, the 2nd section moves in, forcing the lower cable to pull at point (H) and the 3rd boom section moves in.



MANUAL "QUICK-SWITCH" ASSEMBLY

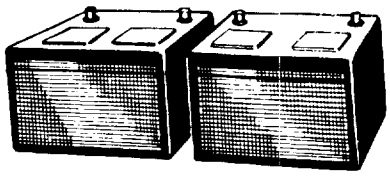
A manual, lever operated "Quick-Switch" Assembly is used at the front of the boom head to attach the fork and carriage, truss boom or material bucket.

To engage the attachment a button is depressed and a locking pin (A) removed. Raising the lever moves the engaging plunger (B) up. Lowering the lever moves the plunger down.



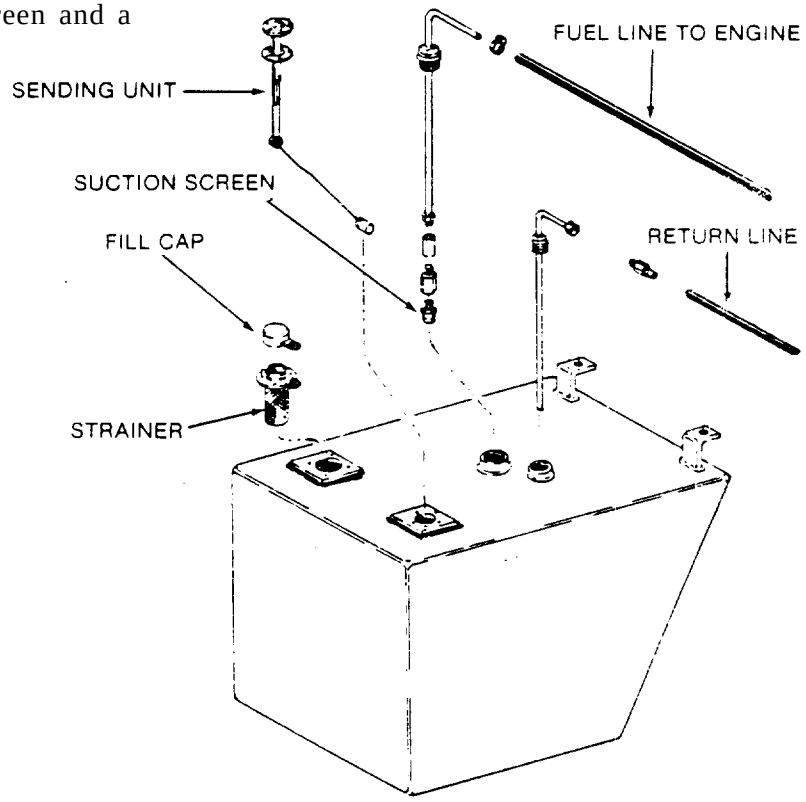
ELECTRICAL

The electrical circuit consists of a 12 volt, 55 amp. alternator, two batteries, each rated at 565 Cold Cranking amps at 0ø F, and 12 volt gages. Use the electrical schematic for trouble shooting the circuit.



FUEL TANK

A 40 gallon fuel tank is mounted to the frame on the right hand side of the machine. It includes a wire mesh strainer at the fill cap a suction screen and a sending unit to the cab fuel gage.



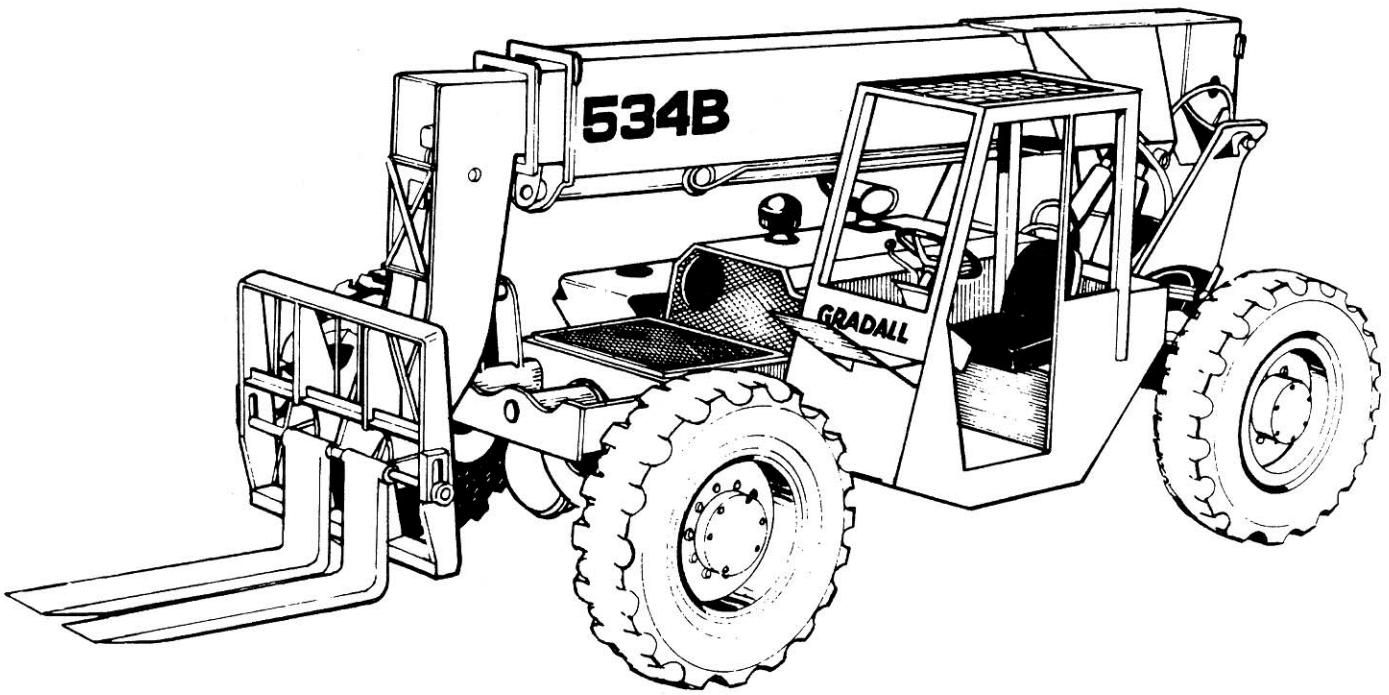
THE
GRADALL®
COMPANY

406 Mill Avenue S.W.
New Philadelphia, Ohio 44663
(216) 339-2211

Printed in U.S.A.

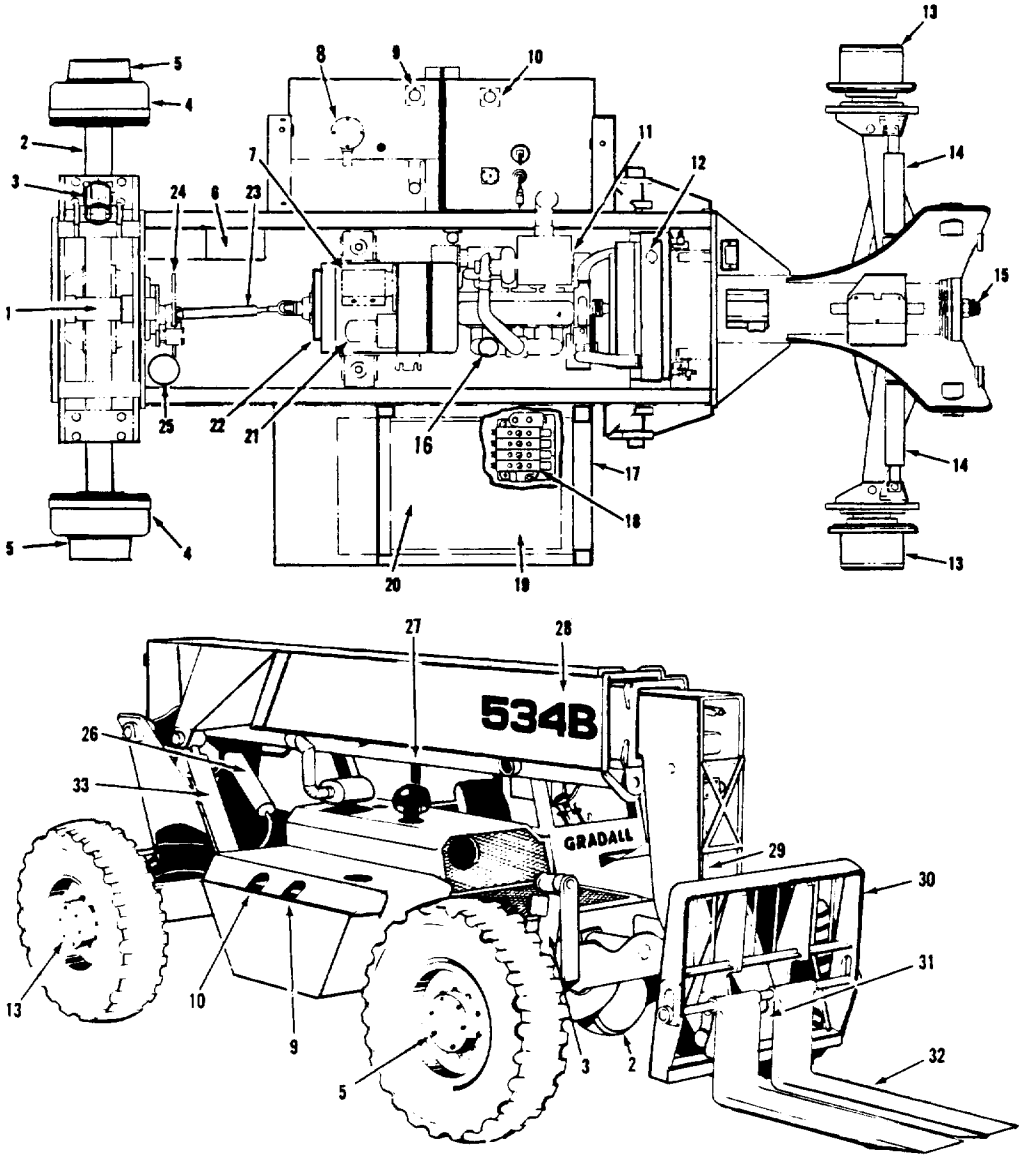
STARTING SERIAL NO. 8244001L

BEFORE OPERATING OR MAINTAINING MACHINE, BE SURE TO READ AND UNDERSTAND THE 534B OPERATOR'S AND MAINTENANCE MANUAL, ALL SAFETY NOTATIONS AND SERVICE LITERATURE. KEEP ALL PERSONNEL CLEAR OF MACHINE WHILE OPERATING, TESTING AND ADJUSTING.



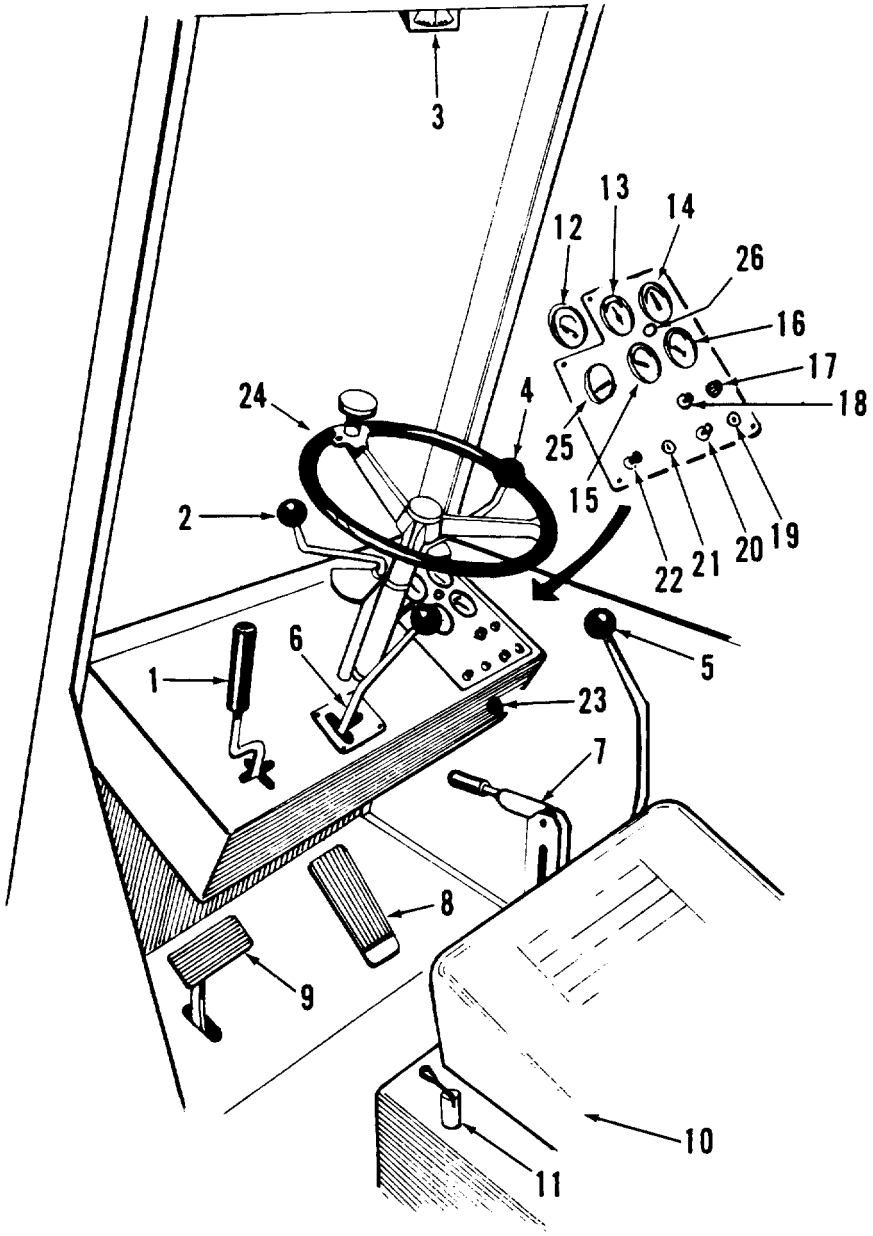
CONTENTS

NOMENCLATURE



1. Front Axle Pivot
2. Front Planetary Axle
3. Sway Cylinder
4. Front Axle Brake
5. Front Axle Planetary
6. Batteries
7. Main Tandem Pump
8. Reservoir Filter
9. Reservoir Dip Stick
10. Fuel Tank Fill Cap
11. Power Unit
12. Radiator
13. Rear Drive Planetary
14. Steering Cylinder
15. Rear Axle Pivot
16. Pilot Pump
17. Valve Compartment
18. Main Valve Bank (Under Cab)
19. Operator's Cab
20. Operator's Controls
21. Transmission Filter
22. Transmission & Torque Converter
23. Drive Shaft
24. Parking Brake Assembly
25. Brake Circuit Accumulator
26. Compensating Cylinder
27. Crowd Cylinder
28. Three Section Boom
29. Tilt Cylinder
30. Carriage
31. Manual "Quick-Switch"
32. Forks
33. Lift Cylinders (2)

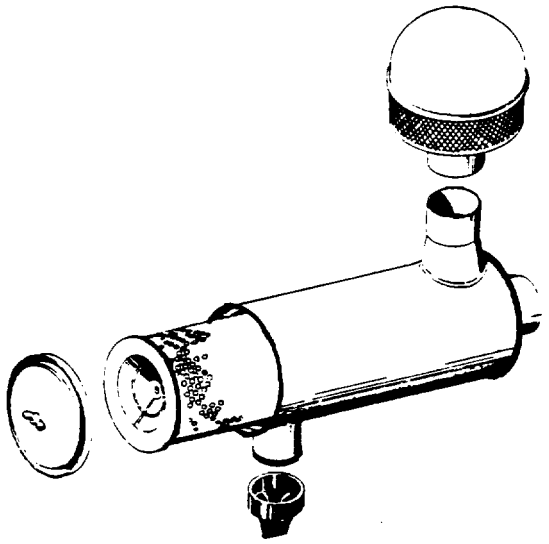
CAB CONTROLS & GAGES



1. CARRIAGE TILT & SWAY CONTROL LEVER
2. FORWARD-REVERSE LEVER
3. LEVEL INDICATOR
4. TRANSMISSION SPEED SELECTOR LEVER
5. BOOM CONTROL (Up-Down - In-Out)
6. AUXILIARY CONTROL LEVER (Option)
7. PARKING BRAKE LEVER
8. ACCELERATOR PEDAL
9. BRAKE-INCHING PEDAL
10. SEAT POSITION CONTROLS
11. MICO BRAKE LOCK LEVER
12. TRANSMISSION TEMPERATURE GAGE
13. AMMETER GAGE
14. FUEL GAGE
15. TEMPERATURE GAGE
16. OIL PRESSURE GAGE
17. HEATER FAN SWITCH (Option)
18. LIGHT SWITCH (Option)
19. HORN BUTTON
20. ROTATING BEACON SWITCH (Option)
21. IGNITION SWITCH
22. ETHER START KNOB (Option)
23. CIRCUIT BREAKER OFF-ON RESET BUTTON (Part of CM Assembly)
24. STEERING WHEEL
25. HOUR METER
26. BRAKE WARNING LIGHT (Low Pressure)

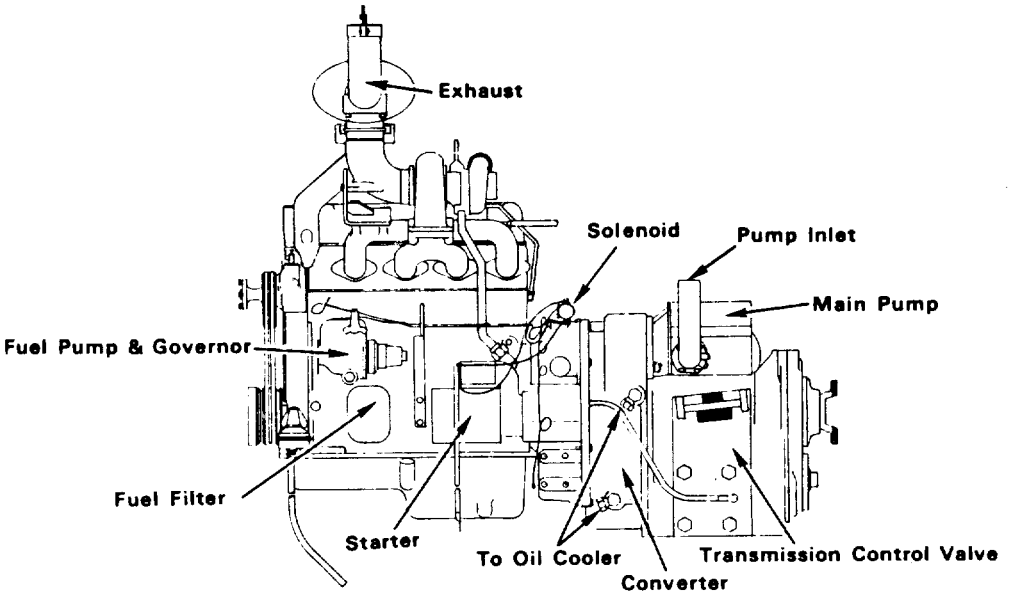
ENGINE

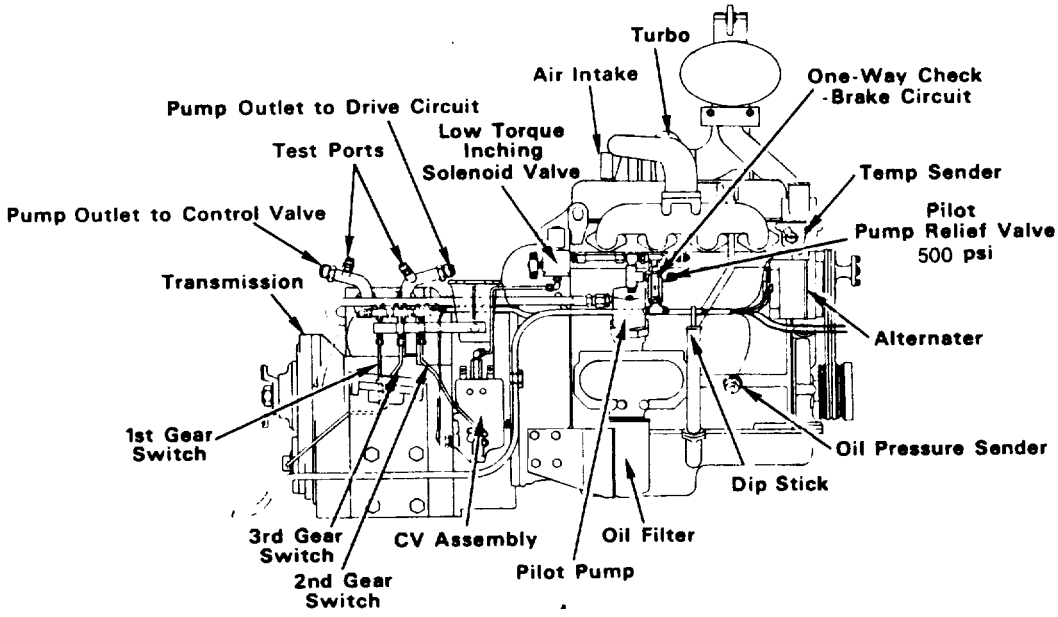
To supply power for the front wheel drive and for the various hydraulic circuits, a diesel engine is used. It runs at 900 rpm low idle. Depressing the accelerator pedal all the way, the engine will run 2800 rpm. With a nominal load the engine will average out at 2600 rpm and will produce 90 gross BHP. The engine speed governs both over-the-road travel speed and the hydraulic circuit speeds.



Engine Filters

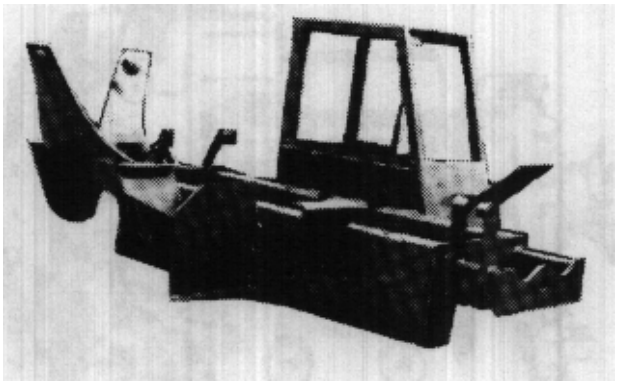
The engine has a two stage dry air cleaner, a pre-cleaner with continuous dust ejector, plus a cleanable and replaceable dry filter element. The fuel filter is a replaceable element type and the oil filter is a full flow replaceable element type.





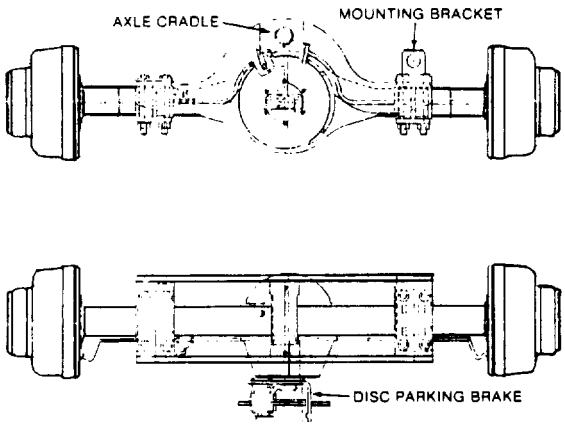
MAIN FRAME

The 534B has an all welded main frame with 850 pounds of counterweight on rear for stability.



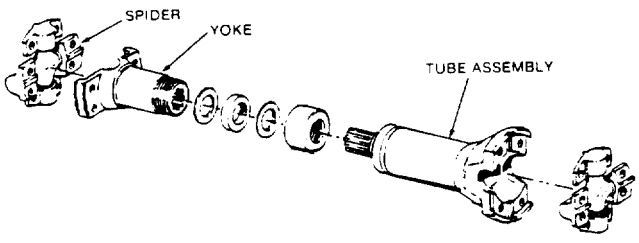
FRONT DRIVE AXLE

The front axle is bolted to the axle cradle which pivots on the front of the main frame. The angle of the axle (left or right) to the frame is controlled by a sway cylinder.



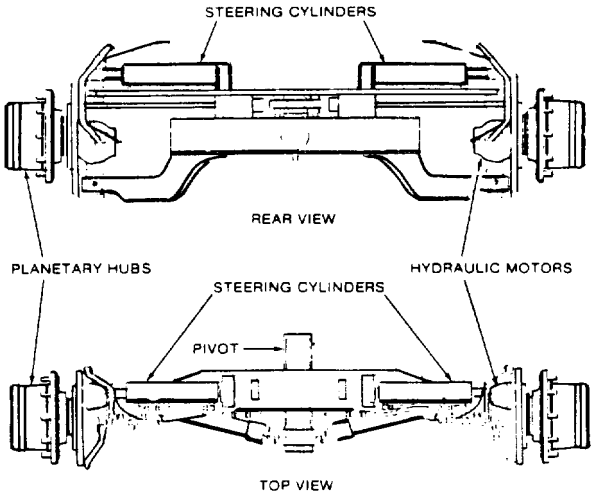
DRIVE SHAFT

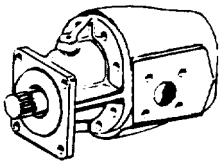
An automotive type drive shaft is used to transmit the rotary motion from the transmission to the front axle. A manually operated disc parking brake bolted to the drive shaft.



REAR DRIVE AND STEERING AXLE

The rear axle assembly pivots up and down on the main frame. Each wheel is powered by a hydraulic motor, driving through a planetary hub. Two steering cylinders are used to turn the wheels. At maximum turn radius, the outside wheel turns about 90° to the pivoting axle. The inside wheel turns about 87°. *When in 3rd gear, the hydraulic motors are not powered.*





HYDRAULIC MOTORS

TIRES

Four 13:00 x 24-8PR, G3 tires are standard. 15.5 x 25-8 PR are optional on the front. The larger tires give higher floatation in sand and mud. All tires are inflated to 55 psi.

The tires on the Model 534B-8 are filled with calcium chloride for counterweight. Each tire has a mixture of 49 gallons of water and 245 pounds of calcium chloride. Thump sound check once a week and after tire repair.

NOTE: Tires must be properly filled on all 534B-8 models to handle rated loads. When filling, keep valve stem at top. The fluid should be at a level covering the valve stem. This protects the wheel from corrosion and rusting.

TRANSMISSION AND TORQUE CONVERTER

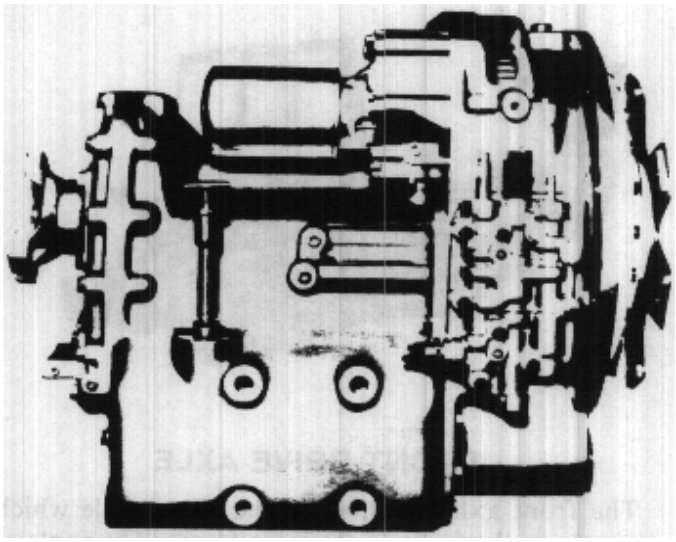
The transmission-torque converter combination has neutral starting, shifting without stopping, 3 speeds forward and 3 speeds in reverse.

Gear selection lever is on the right side of the steering column. The neutral, forward or reverse lever is on the left side.

When the brake foot pedal is pressed down, either for braking or inching, the transmission de-clutches and no power goes to the front axle.

The transmission is fitted with a replaceable oil filter. The oil cooler assembly is located in the bottom portion of the engine radiator.

The main tandem pump for the hydraulic system is mounted to a take-off on the back of the transmission.

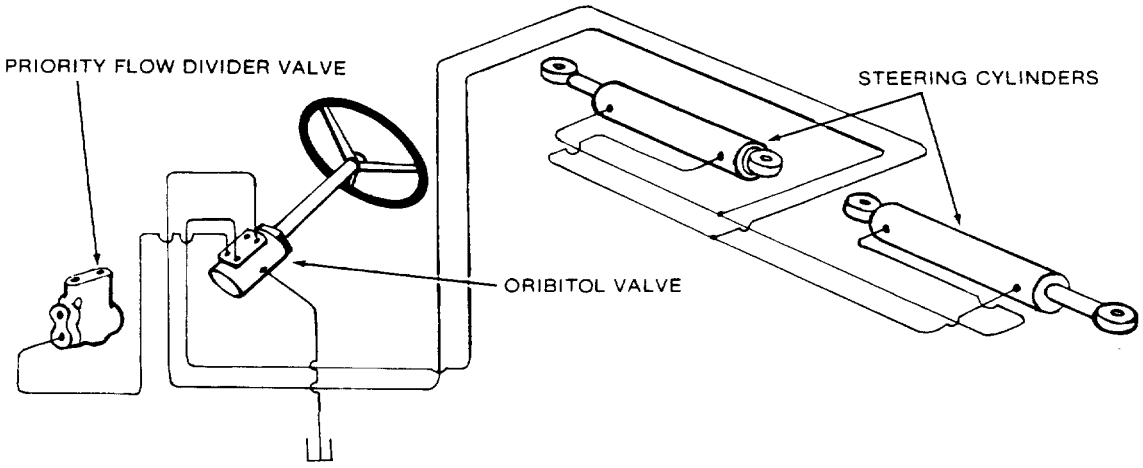


STEERING CIRCUIT

Oil for the steering is taken from the base pump section through a priority flow divider valve. Any movement of the steering wheel actuates the flow divider plunger and allows up to 10 gpm to be diverted to the steering orbitrol valve at the base of the steering post. The priority flow divider valve also has a 2000 psi steering relief valve, As the steering wheel is turned, oil is routed to ends of the two rear steering cylinders.

A one-way check valve is provided between the priority valve and the orbitrol valve to prevent the back-up of oil that might cause a kick-back at the steering wheel.

If the steering circuit is not being used, all the fluidfrom the pump section is routed to the Fwd / Rev Valve.



HYDRAULIC SERVICE BRAKES

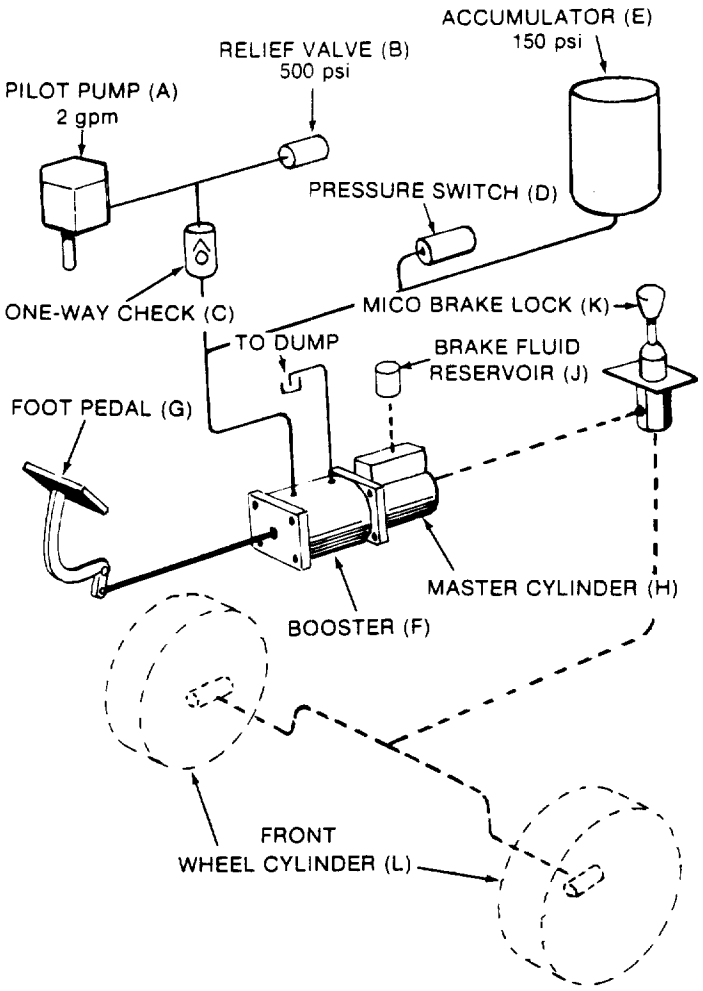
To actuate the service brakes, two different circuits are used. One uses system hydraulic oil, and the other uses brake fluid.

The hydraulic oil circuit consists of the pilot pump (A), the pilot relief valve (B). a one-way check valve (C), which prevents any back-up of oil. A pressure switch sender (D) to activate the dash light, an accumulator (E) which contains a nitrogen pre-charge, and a booster brake valve (F).

Downward pressure on the brake pedal (G) activates the booster and a combination of foot power and hydraulic power from the booster exerts increased pressure to activate the master brake cylinder (H).

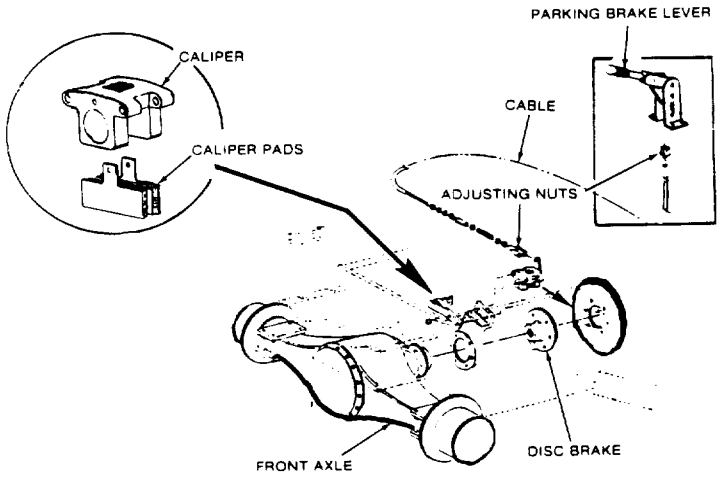
The brake fluid circuit takes over at this point. Brake fluid from the reservoir(J) flows to the master cylinder and continues on to the Mico Brake Control Valve (K). From here, the fluid is routed to both front wheel brake cylinders (L).

The Mico Brake Lock is for short term use, such as when working on a slope. The Mico Brake Lock Lever (K) is located to the left of the operator's seat. *The brakes must be pressurized by foot pedal before setting Mico Lock Brake Lever.* The brake fluid reservoir (J) is located behind the cab, under the valve cover.

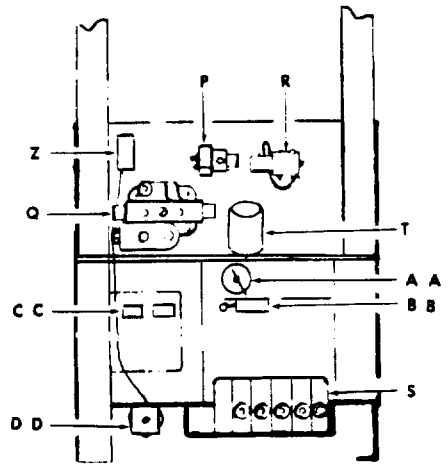


MECHANICAL PARKING BRAKE

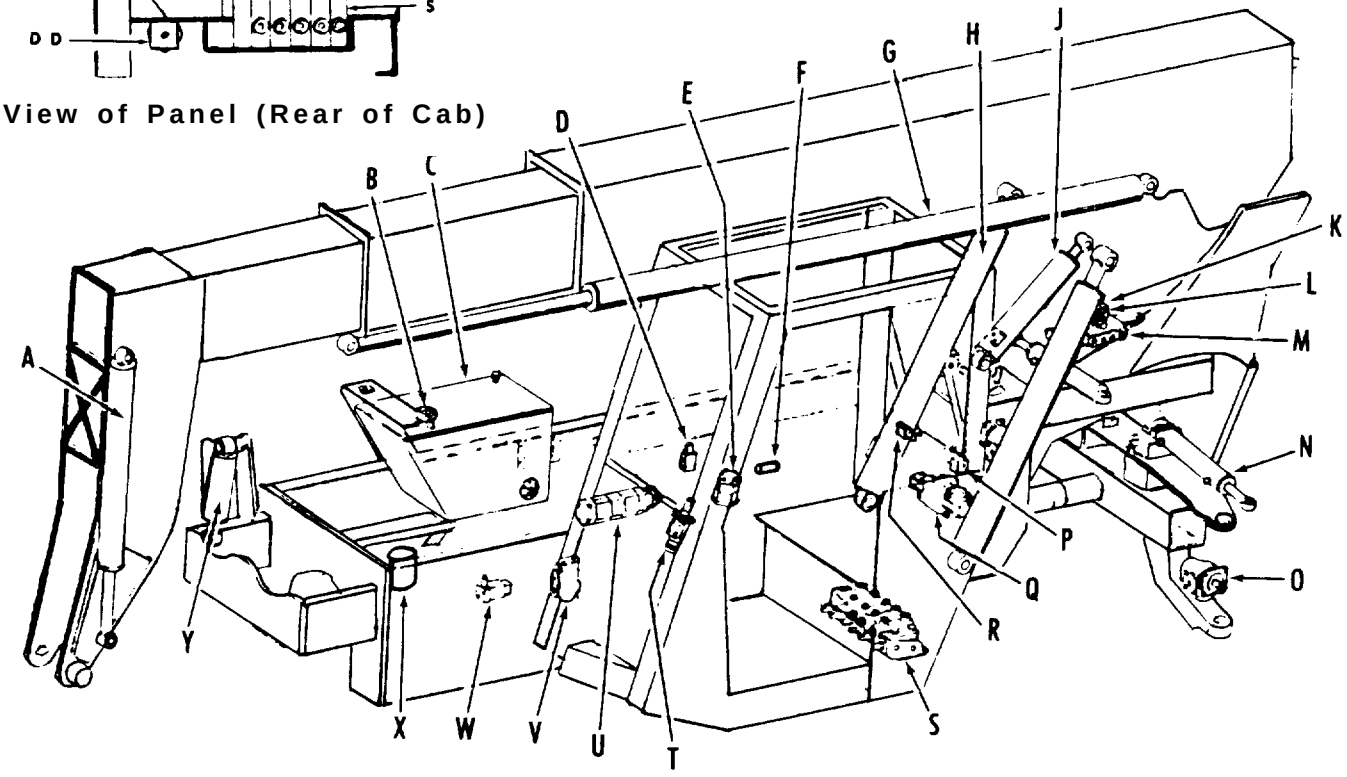
The operator can actuate the mechanical parking brake by pulling back on the floor mounted lever. A cable is connected to the caliper type of disc brake which is mounted between the front axle and the drive shaft. The caliper pads open or close on the disc in the drive line. Brake adjustment is made by adjusting cable end nuts, or by turning knob on parking brake lever.



HYDRAULIC SYSTEM



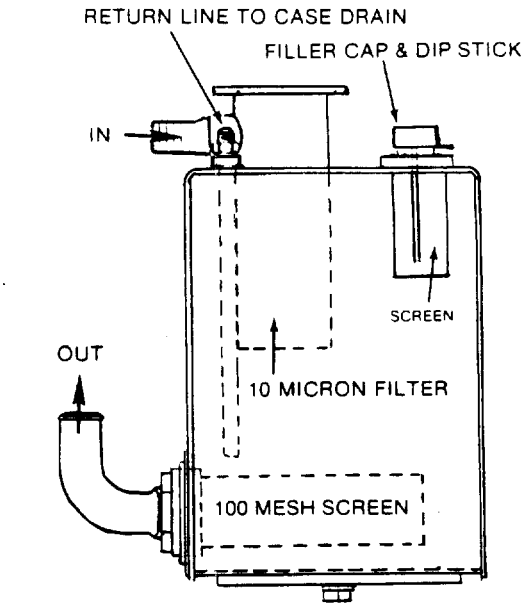
View of Panel (Rear of Cab)



A- TILT CYLINDER
B- RESERVOIR FILTER
C- HYDRAULIC OIL RESERVOIR
D- LOW TORQUE INCHING SOLENOID VALVE
E- PILOT PUMP
F- PILOT RELIEF VALVE 500 psi
G- CROWD CYLINDER
H- HOIST (Lift) CYLINDERS (2)
J- COMPENSATING CYLINDER
K- PARALLEL SOLENOID VALVE
L- SERIES SOLENOID VALVE
M-SERIES/PARALLEL VALVE
N- STEERING CYLINDERS (2)
O- REAR HYDRAULIC DRIVE MOTORS
P- FWD/REV PILOT PRESSURE CONTROL VALVE
Q- FWD/REV VALVE
R- CAVITATION SOLENOID VALVE
S- MAIN CONTROL VALVES
T- ORBITROL STEERING VALVE
(Under Cab at Base of Steering Post)
U-MAIN TANDEM
V- PRIORITY VALVE
W- DRIVE CIRCUIT MAIN RELIEF VALVE
X-BRAKE CIRCUIT ACCUMULATOR
Y- SWAY CYLINDER
Z- BRAKE FLUID RESERVOIR
AA-POTENTIOMETER (Under Seat)
BB- LOW TORQUE INCHING SWITCH
(Under Seat)
CC- FORWARD/REVERSE SWITCHES
(Under Dash Panel)
DD-BRAKE BOOSTER & MASTER CYLINDER

HYDRAULIC RESERVOIR

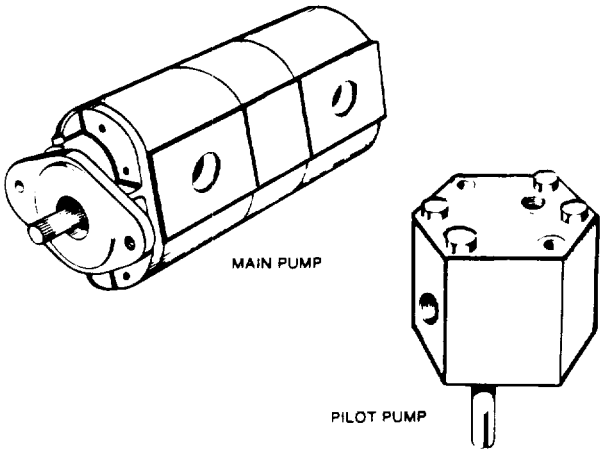
The reservoir is located on the right side of the machine. directly in front of the fuel tank. It holds 24 gallons of hydraulic oil. The system holds 40 gallons. The measuring dip stick is a part of the filler cap. In the filler opening is a wire screen. Oil returning to the reservoir passes thru a 10 micron replaceable type filter. As oil is drawn off by the pumps, it pasees thru a 100 mesh screen.



HYDRAULIC PUMPS

The main pump is a two section tandem pump which delivers 63 gpm at 2600 rpm. Each of the two sections is rated at 31.5 gpm. The base section services the steering and the rear wheel drive. The end section serves the main control valves for the other circuits. The tandem pump is mounted with a direct drive from the transmission. Each section is protected by a 3000 psi relief valve.

The pilot pump is a one section pump, mounted on the left side of the engine on the tachometer drive. The drive turns at l/2 of engine speed. The output of the pilot pump is 1 to 2 gpm. It is protected by a 500 psi relief valve.



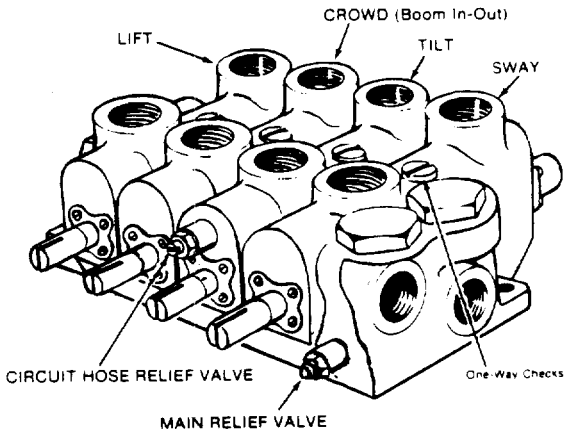
MAIN CONTROL VALVE BANK

The main control valve bank for the sway, tilt, crowd and lift circuits is located on the floorboard under the operator's seat. Each valve plunger is connected to the operator's control levers.

The standard valve bank consists of an inlet section with a built-in adjustable relief valve cartridge rated at 3000 psi., the four control valves and an end

The tilt control valve has two built in and adjustable circuit relief valves rated at 3250 psi.

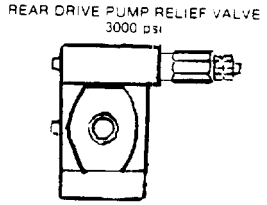
If the auxiliary hydraulic circuit is used for the truss boom winch, another valve section is added between the tilt valve and the sway valve.

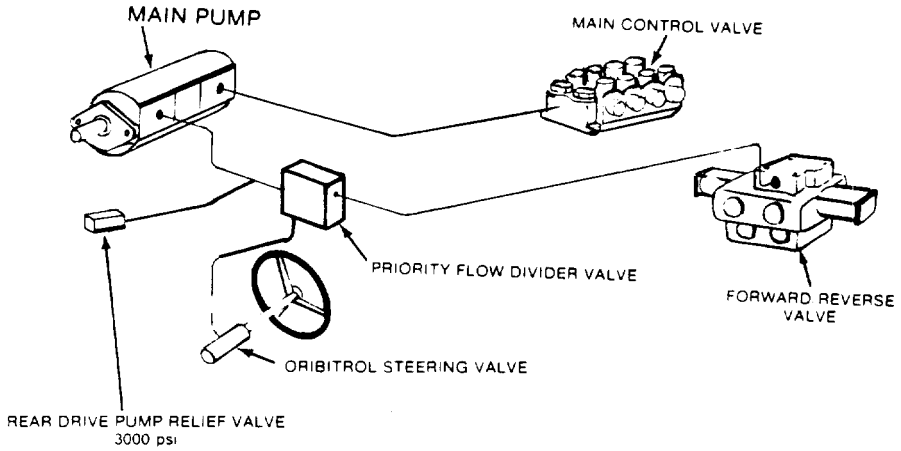


MAIN PUMP CIRCUITS

The two section main tandem pump supplies oil for two separate circuits. Oil from the base section supplies oil through a Priority Valve (to assure a supply of oil for steering) and also routed to Fwd/Rev Control Valve. Oil from the end section is routed to the main control valve. Both circuits have 3000 psi relief valves.

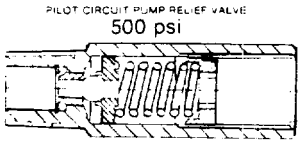
The rear drive pump relief valve is located inside the frame on the left side. The other relief valve is located within the Main Control Valve. The main control valve is located under the operator's seat.

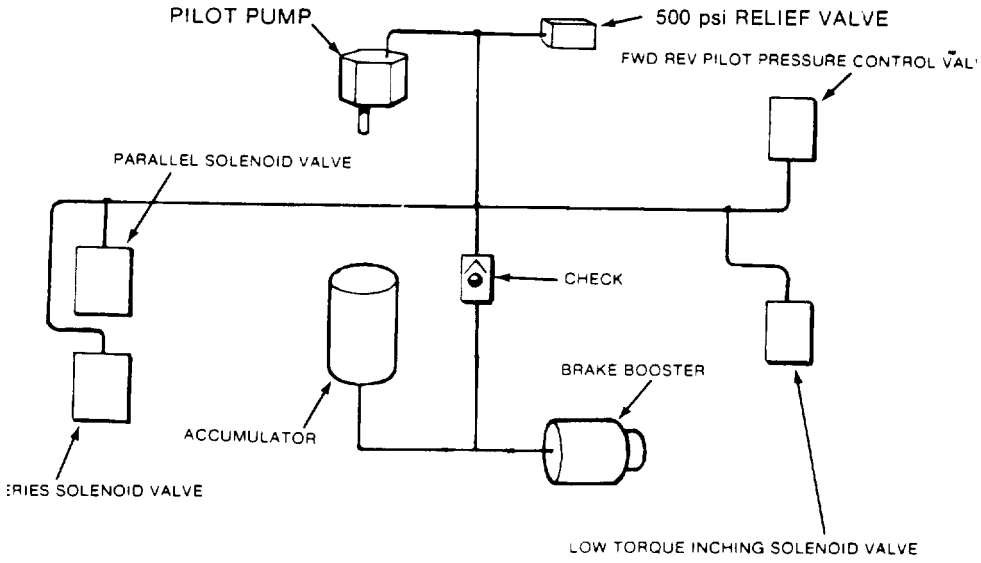




PILOT PUMP CIRCUIT

The pilot pump supplies oil for the brake booster circuit' the parallel solenoid valve, the series solenoid valve, the Fwd/Rev pilot pressure control valve, and the low torque inching solenoid valve.



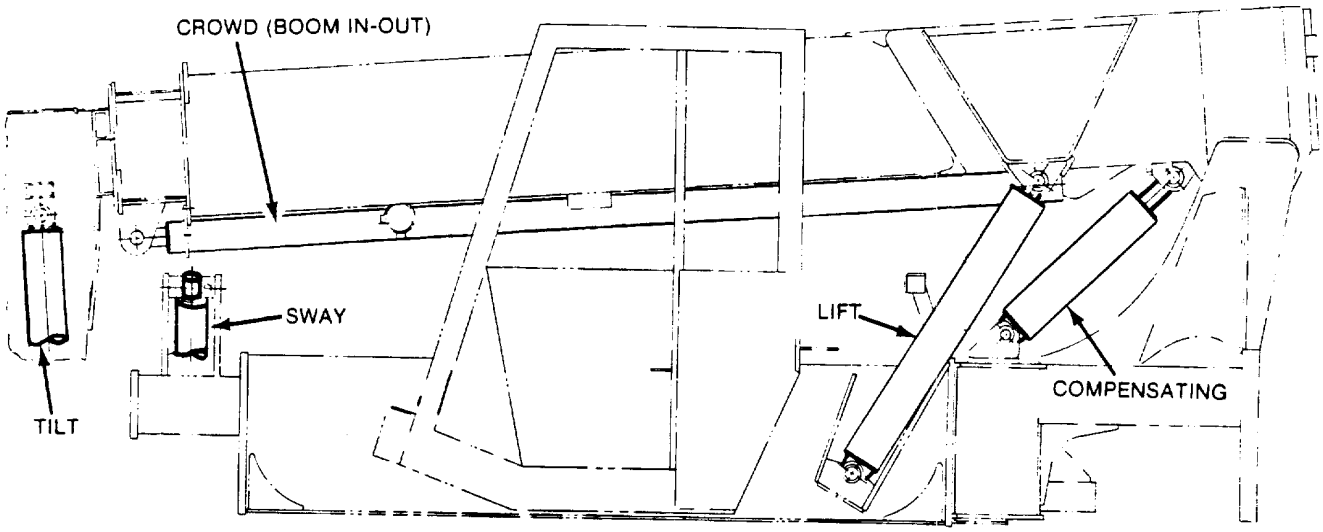


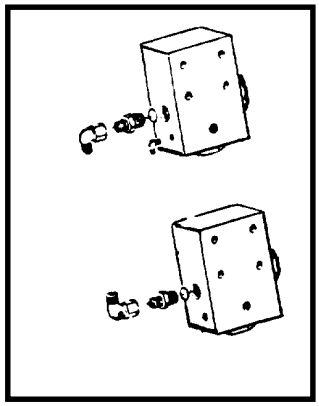
HYDRAULIC CYLINDERS

There are eight hydraulic cylinders: Sway, Lift (2), Compensating, Tilt, Crowd (Boom In-Out), and Rear Wheel Steering (2).

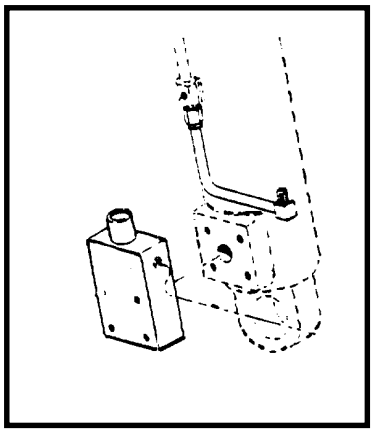
On the Tilt, Crowd and Lift Cylinders, a counter-balance valve is used to protect against broken hoses and to control lowering actions.

The Sway Cylinder has two piloted check valves to provide a positive lock of oil in the cylinder. Pressure applied to the Circuit from the valve in either direction, unseats the check plunger and allows the desired two-way flow of oil.





Check Valves

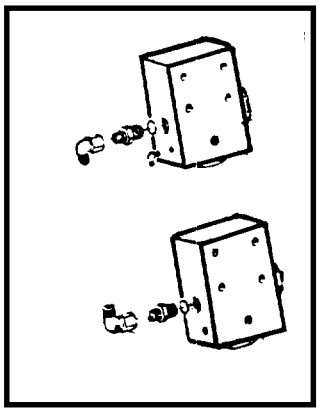


Counter Balance Valve

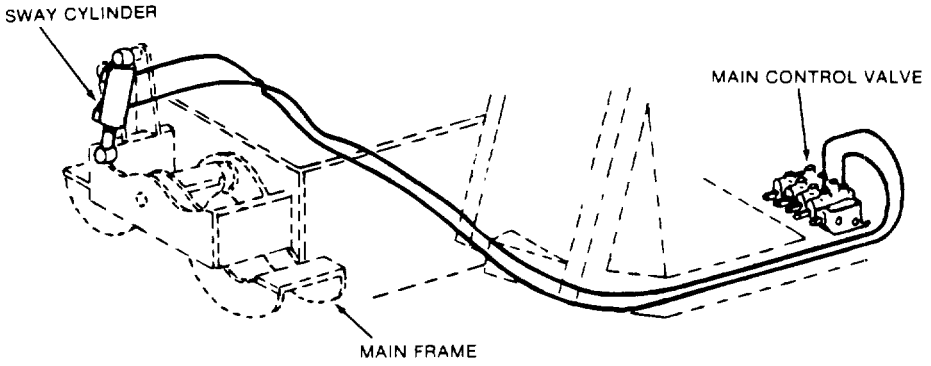
SWAY CIRCUIT

The sway circuit permits the operator to level the main frame of the machine in relation to the position of the front axle. With the sway cylinder the operator can tilt the frame up to 8ø in either direction from horizontal. Movement of the sway lever to the right or left actuates a plunger in the first control valve section, and oil is routed to the sway cylinder, and the machine sways right or left.

There is a bubble level in the cab to assist the operator in determining when the frame and boom is level.



Check Valves



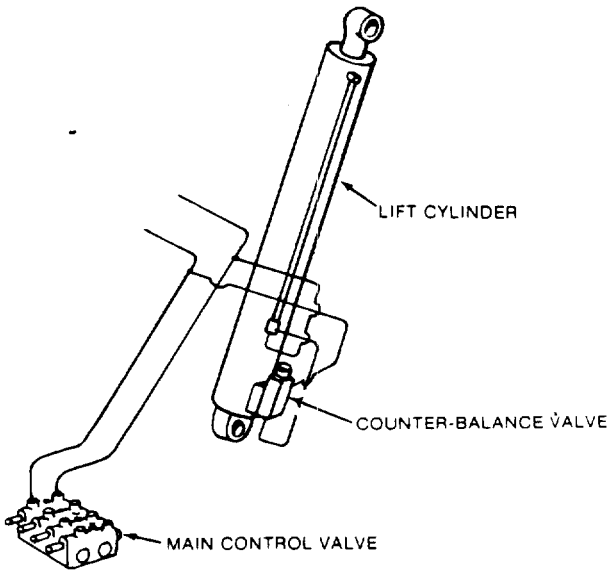
LIFT CIRCUIT

The lift circuit allows the operator to raise the boom assembly up 70ø and lower it to a -4° angle.

Movement of the boom control lever back, raises the boom and a forward motion, lowers the boom. An angle indicator is located on the left side of the main boom section.

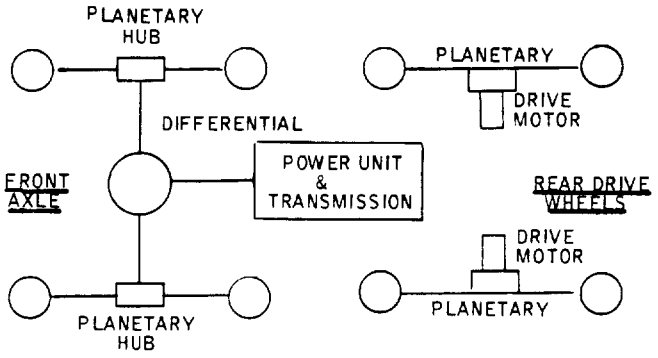
At the base of both lift cylinders is a counterbalance valve. The valves serve as a lock-out valve to hold oil in the cylinder should a hose break or to prevent boom movement should the lever be actuated while the engine is shut off. It also serves as a flow valve to control the downward movement of the boom at a controlled speed.

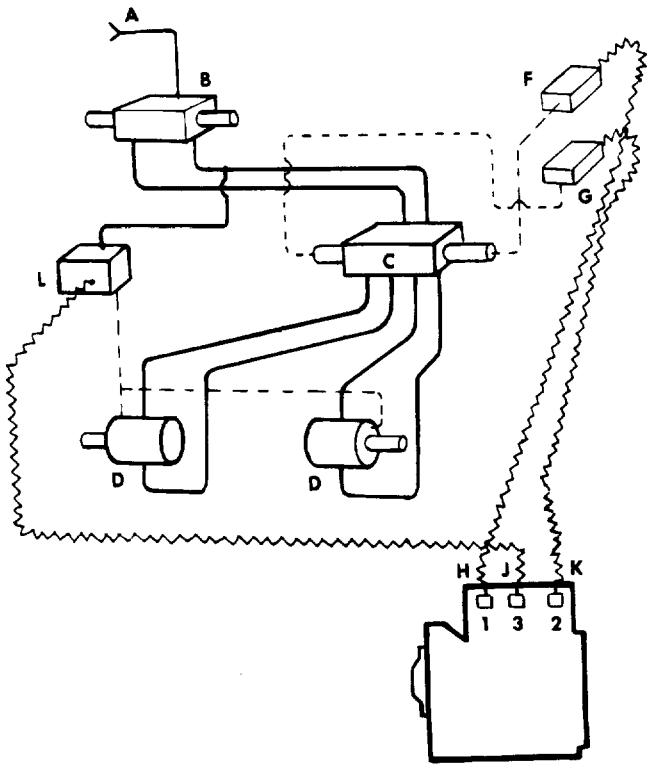
The 534B-6 models have 4 1/2″ cylinder. The 534B-8 models have 5″ cylinder.



FRONT & REAR WHEEL DRIVE

The 534B has a conventional front wheel drive, with power from the engine. It has a torque converter and transmission with a drive shaft and differential, and a pair of planetary wheel ends. The rear drive uses hydraulic oil to turn the motors and planetary hubs at each rear wheel.





The oil supply to the rear drive motors will vary depending on the position of the gear selection lever. The purpose of this is to coordinate the speed of the rear wheels with the speed of the front wheels.

The 534B has a variety of options to control forward and reverse, speed and power. An inching control enables the operator to move the carrier slowly when maneuvering or handling a load.

1. In first gear. A combination of low transmission gear ratio to the front driving axle is used. The rear drive uses parallel valving of hydraulics to rear drive motors.

   With the lever in Ist gear position, an electrical contact is made at the sending unit (H) on the transmission. The current activates the parallel solenoid valve (F). This sends pilot oil to one end cap of the series/parallel valve (C). The plunger shifts into a parallel hydraulic mode and the main pump oil is routed to the two drive motors (D) equally. As the operator presses down on the accelerator, the engine r.p.m. will increase and so will the oil flow.

2. In second gear the gear ratios to the front axle are changed to gain more speed and the hydraulic valving is changed to series mode.

   When the lever is shifted into the 2nd gear position, an electrical current contact is made (J) on the transmission. This activates the series solenoid valve (G) and the opposite end cap of the series/parallel valve (C) is pressurized. The plunger shifts and the oil is routed in series to the two drive motors. The motors turn faster to match the speed of the front axle drive.

3. In third gear a higher gear ratio is used for maximum speed in the front axle and the rear drive is disengaged.

   When in 3rd gear the rear wheel drive is not functioning because the hydraulic drive can't keep up with the front wheel drive. Since the Ist and 2nd gear solenoid valves are not activated, the series/parallel valve (C) returns to neutral and the oil in the drive motors simply circulates, doing nothing. To reduce drag due to pumping a full charge of rear motor oil, a cavitation valve opens a direct line from the rear motors to tank. It allows some of the oil to go to the tank, therefore reducing the motor oil volume, therefore reducing the drag.

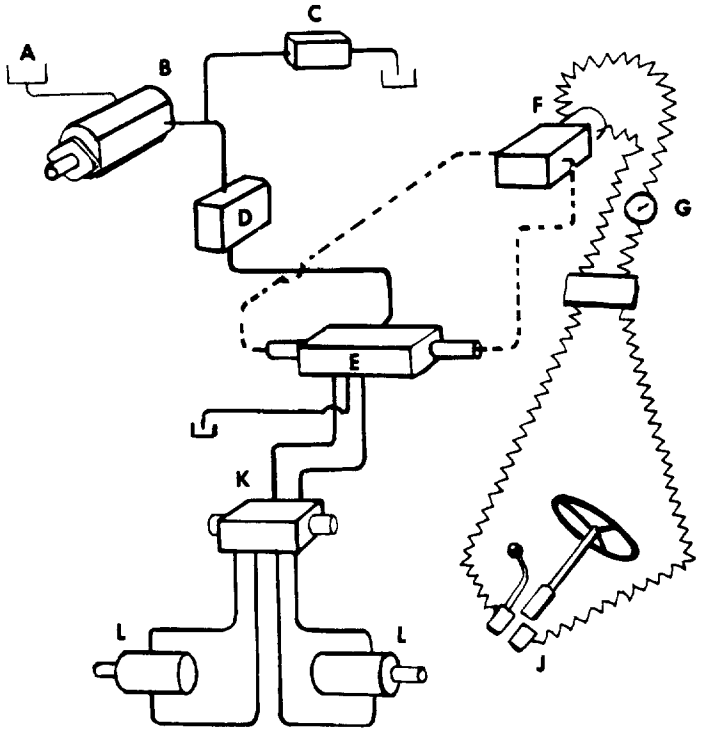
FORWARD/REVERSE LEVER (Neutral)

When Forward/ Reverse Lever is in neutral position, electrical contacts are not made at the Fwd/ Rev Switches (J) and the oil flow in the circuit is as follows:

Oil from reservoir (A) is drawn into the main pump section (B). It then flows to the priority valve (D) where a portion is available for the steering circuit. First, the oil is exposed to the circuit main relief valve (C) which is set at 3000 psi. The oil leaves the priority valve and goes into the Forward/Reverse Valve (E). Since it has not been activated from the Fwd/ Rev Switches (J) the Fwd/ Rev Pilot Pressure Control Valve (F) keeps it in neutral and the oil passes thru and goes back to the reservoir.

FORWARD/REVERSE LEVER (Shifted)

With the Fwd/ Rev control lever shifted forward, Ist, 2nd or reverse, electrical contact is made at the Fwd/ Rev Pressure Control Valve (F) and depending on the position (forward or reverse) pilot oil is sent to the end caps of the Fwd/ Rev Valve (E). The plunger shifts and oil is routed back to the rear drive motors (L).



INCHING

The inching feature allows the operator, when carrying a load, to move the handler very slowly for maneuvering in tight places.

To operate the inching feature, the operator depresses the brake-inching foot pedal (A) approximately 1/2" to 1". This creates movement of the linkage (B) up to rocker arm (C) which has a tab on it making contact with the low torque inching switch (D). As this first movement occurs and physical contact is broken, the switch is energized and it activates the low torque inching solenoid valve (E). This sends pilot circuit oil down to the de-clutch valve (F) on the transmission and the transmission de-clutches and there is no power to the front axle.

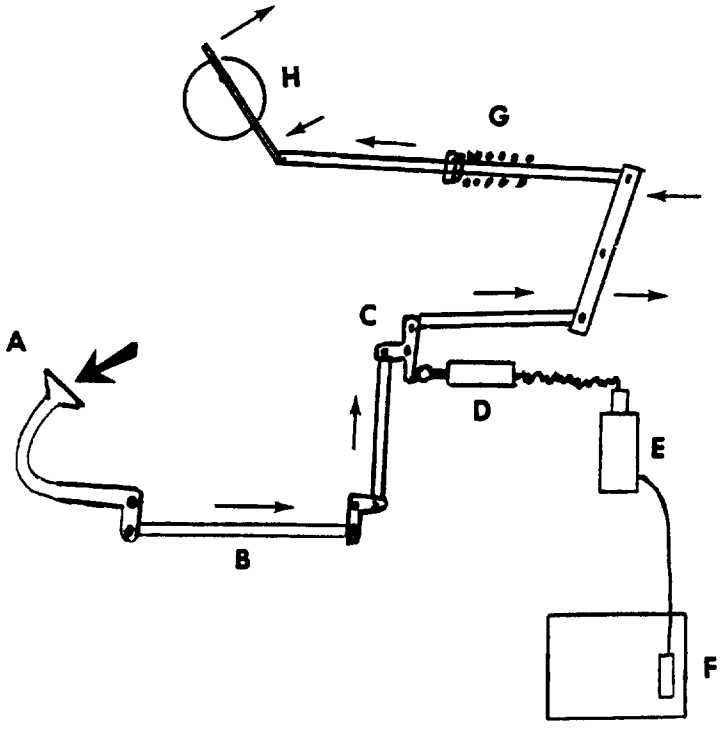
As the rocker arm (C) continues to move the linkage in the inching panel moves. Spring (G) serves as an adjustable buffer. The linkage movement then forces the control arm on the potentiometer (H) to rotate. *The potentiometer is basically a rheostat in the electrical circuit going to the Forward/Reverse Pilot Pressure Control Valve (J)*

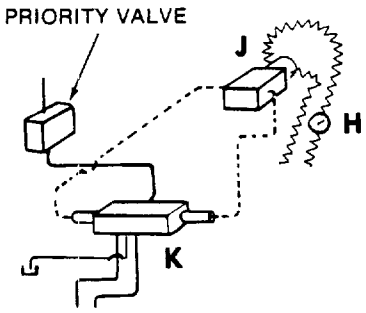
As the operator continues to depress the brake-inching pedal (A) and the potentiometer (H) rotates, the electrical current controlling the Fwd/Rev Pilot Control Valve varies.

The Fwd/Rev Pilot Pressure Control Valve sends pilot oil pressure to either end cap of the Fwd/Rev valve (K). Depending on the strokes of plunger, in the Fwd/Rev control valve varying, volume of oil is routed on the series/parallel valve and to the rear drive motors.

The further down the operator depresses the brake-inching pedal, the lower oil volume goes to the motors.

As the operator continues to depress the brake-inching pedal, the front axle brakes are applied and normal braking occurs.





TILT & COMPENSATING CIRCUITS

The tilt circuit raises or lowers the angle of the fork or other attachment a total of 114°. It is a dual circuit combining with a compensating cylinder to automatically adjust the level of the fork continuously as the boom is raised or lowered.

Movement of the tilt control lever (sway) forward or backward adjusts the angle of the attachment. Forward lowers the fork and backwards raises the fork

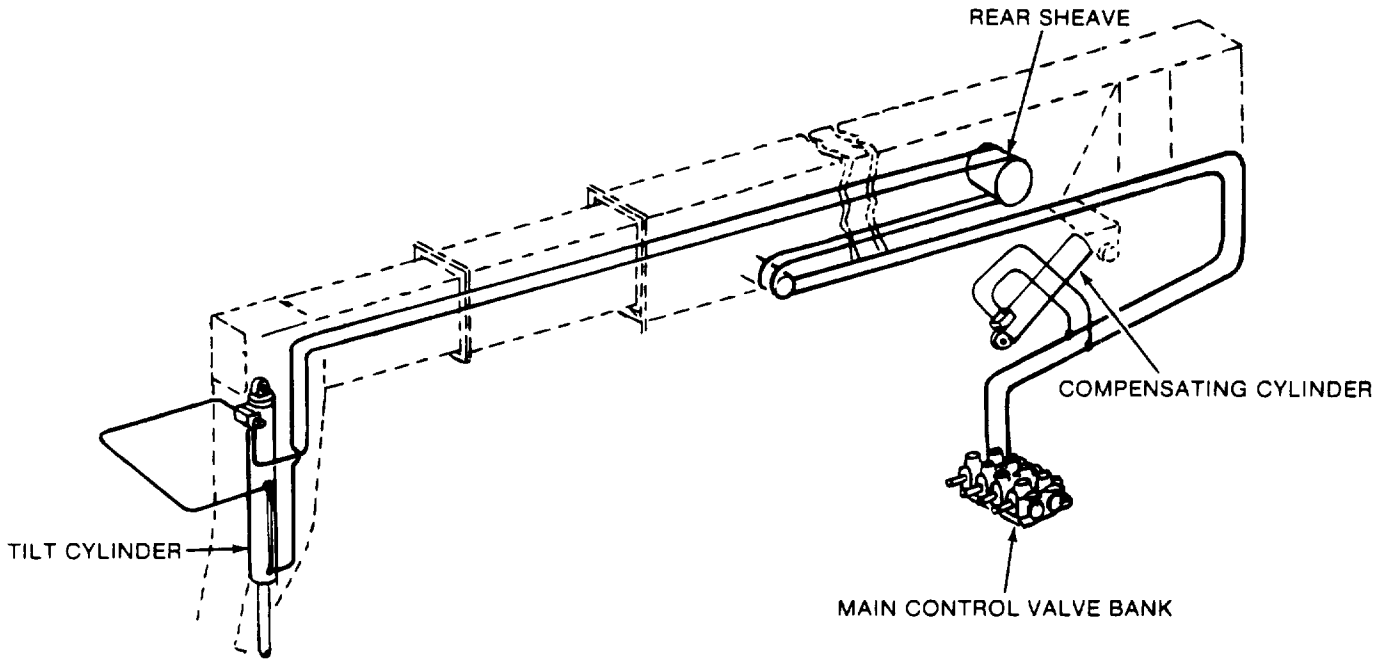
Oil from the Tilt Control Valve section is routed to both cylinders. The compensating cylinders a plain cylinder and the tilt cylinder uses the counter-balance valve.

Both cylinders are of a identical size so that as the boom angle changes, a like volume of oil is transfered to or from the tilt cylinder, keeping the fork level or in the same position.

The 534B-6 models 4" cylinders are used and on the 534B-8 models 5" cylinders are used.

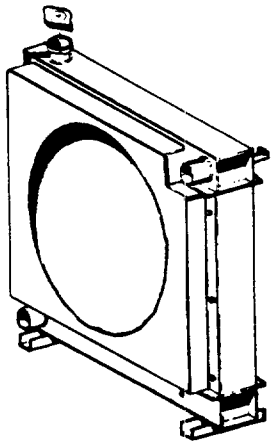
The oil lines which are used to carry the oil thru the boom pass around the rear sheaves on the push boom assembly.

The oil lines are secured to the front end of the 3rd boom section with spring to keep them tight.



OIL COOLER CIRCUIT

To help keep the temperature of the hydraulic oil to a nominal level, various circuits on the machine dump oil thru a heat exchanger radiator located in back of the engine radiator.

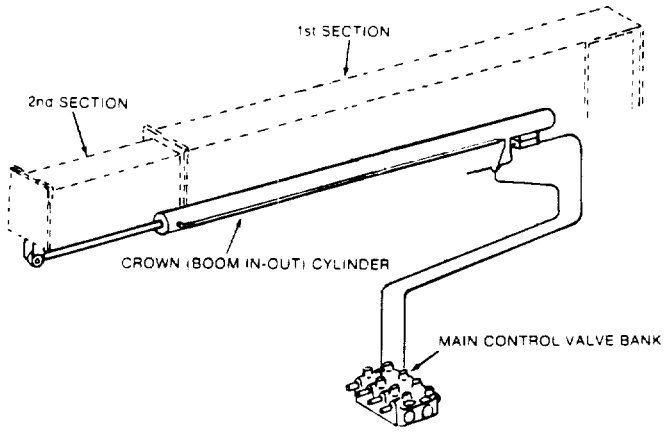


CROWD (Boom In-Out) CIRCUIT

The crowd circuit allows the operator to extend and retract the boom sections a total of 18 feet. Nine foot extension is obtained from the movement of a hydraulic cylinder joined to the first section and the second section. Movement of the 2nd section and a combination of cables and sheaves moves the 3rd section.

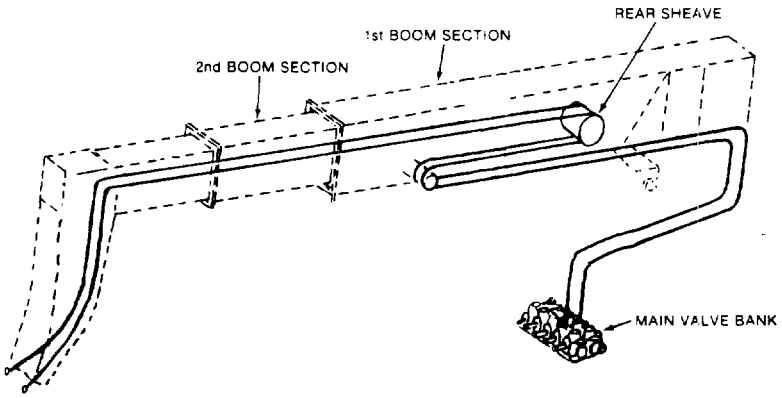
The control lever is the same as used to raise and lower the boom, but for the crowd the operator moves it to the right and left. Moving it to the right extends the booms and moving it to the left retracts the booms.

Oil from the 3rd valve section routes the oil to the base of the crowd cylinder. A counterbalance valve is used on the cylinder for protection and speed control.

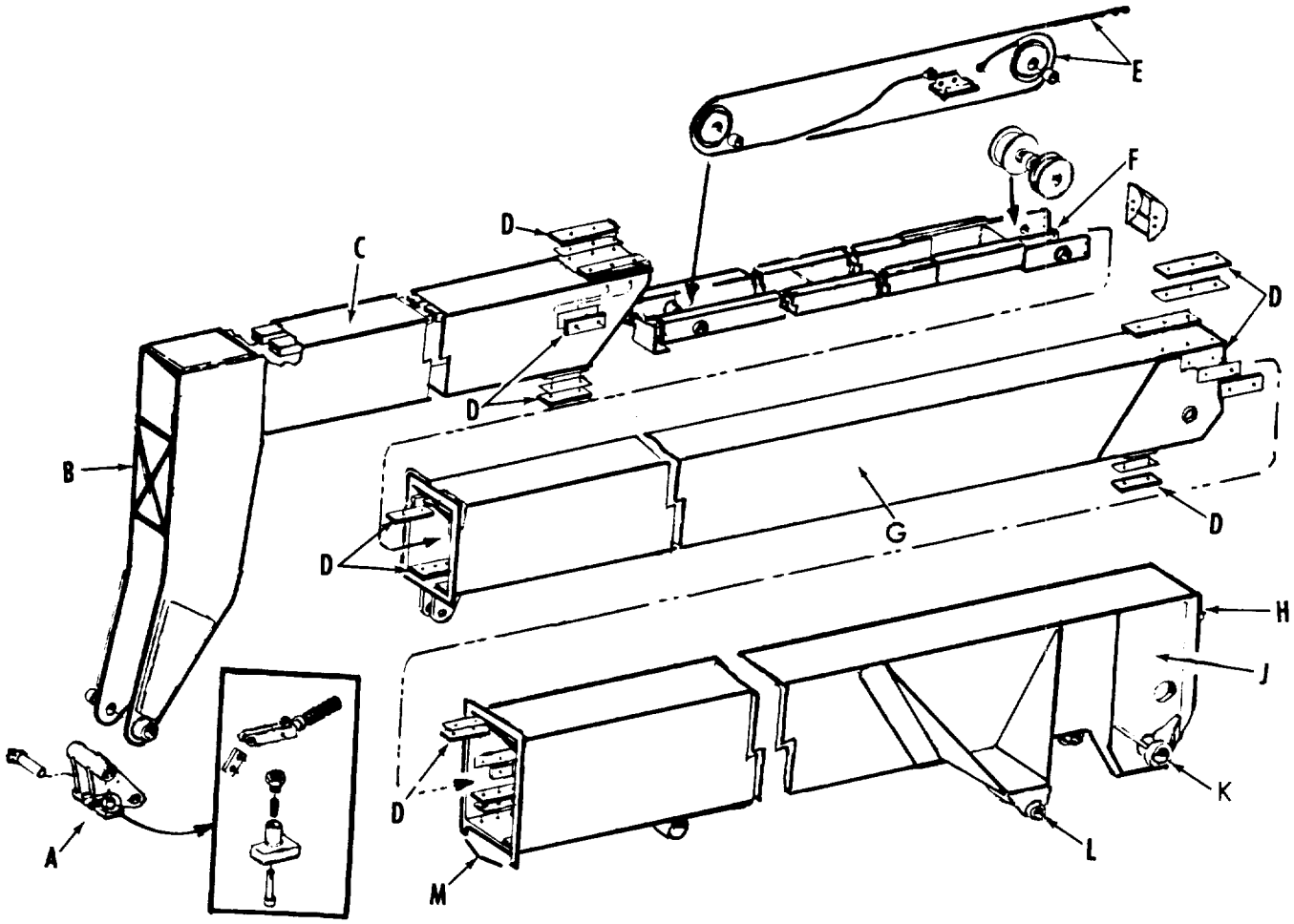


AUXILIARY HYDRAULIC SYSTEM

When the 534B is equipped with a truss boom and hydraulic winch, an additional control valve section is added between the Sway Valve section and the Tilt Valve section. The oil is routed from the control valve up thru the boom to power the winch on the truss boom.



BOOM SECTIONS



A- Manual "Quick-Switch"
B- Boom Head
C- 3rd Boom Section
D- Boom Slider Pads
E- Boom Cables & Sheaves
F- Push Beam
G- 2nd Boom Section
H- Rear Cable Anchor
J- 1st Boom Section
K- Boom Trunion Pin
L- Boom Hoist Cylinder Pin
M- Crowd Cylinder Support

BOOM SLIDER PADS

The boom sections move in and out on slide wear pads. These pads are positioned on the top, bottom and sides of the boom to protect the boom frame against excessive wear.

It is important that these pads be lubricated on a regular basis and kept clean. The slider pads are shim adjusted and regular in inspection and adjustment is required.

BOOM CROWD (IN-OUT) MOVEMENT

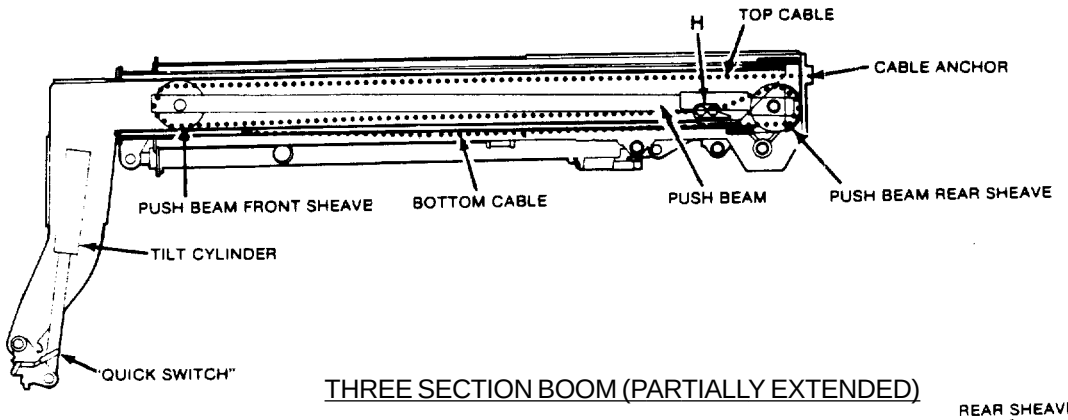
When the control lever for the crowd action is activated, the 2nd and 3rd boom sections move in and out equally.

Power to move the booms in and out come from a hydraulic cylinder which is located under the main Ist boom section. It moves the 2nd boom section. As the 2nd boom section moves in or out a combination of a push assembly and sheaves and cables move the 3rd boom section. The push beam assembly is fastened to the 2nd boom section at the rear sheave pin and moves with it.

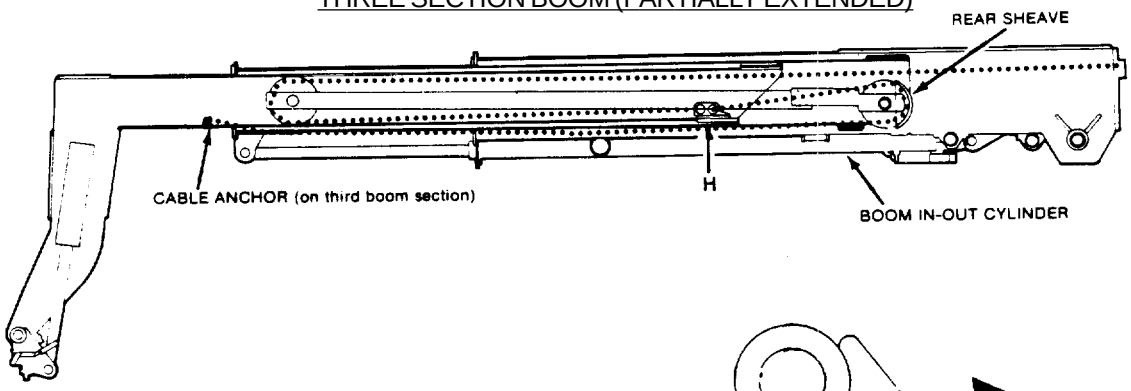
Two cables are used. The top one is bolted to the rear of the main boom and runs forward around the push beam front sheave and back to the anchor point at the bottom rear of the 3rd boom section. The lower cable is anchored near the front bottom of the main boom and passes back around the rear sheave and is anchored at point (H) of the 3rd boom section. As the 2nd boom section moves out, forcing the push beam and sheaves with it, the top cable has to move forward at point (H) taking the 3rd boom section with it.

When retracting the booms, the 2nd section moves in, forcing the lower cable to pull at point (H) and the 3rd boom section moves in.

THREE SECTION BOOM (RETRACTED)



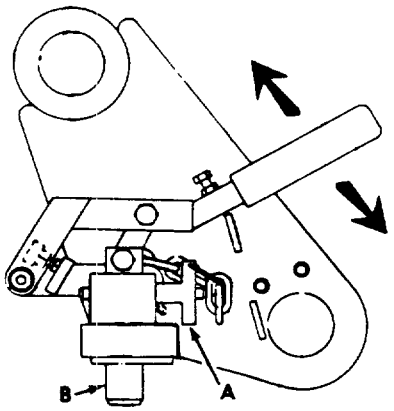
THREE SECTION BOOM (PARTIALLY EXTENDED)



MANUAL "QUICK-SWITCH" ASSEMBLY

A manual, lever operated "Quick-Switch" Assembly is used at the front of the boom head to attach the fork and carriage, truss boom or material bucket.

To engage the attachment a button is depressed and a locking pin (A) removed. Raising the lever moves the engaging plunger (B) up. Lowering the lever moves the plunger down.

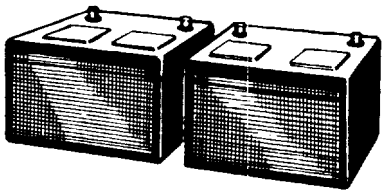


ELECTRICAL

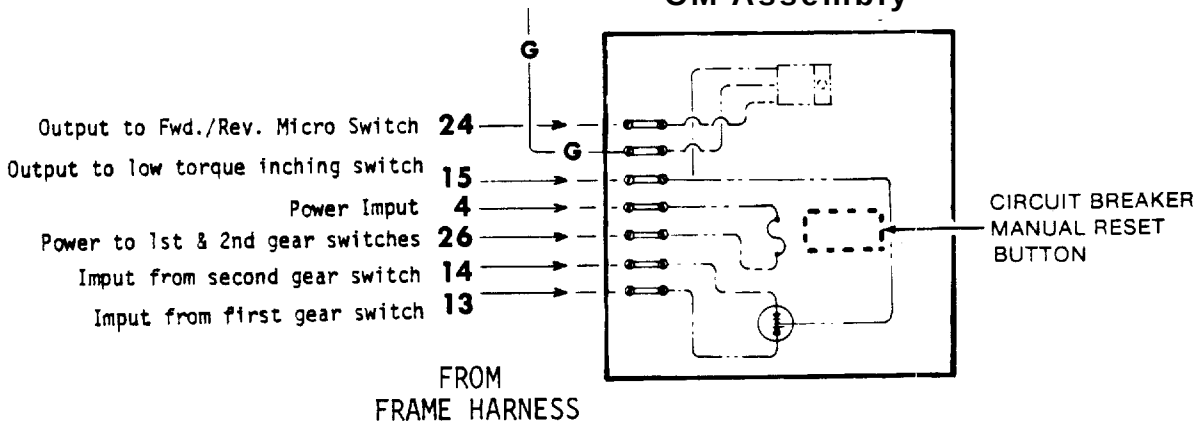
The electrical circuit consists of a 12 volt, 55 amp. alternator, two batteries, each rated at 565 Cold Cranking amps at 0ø F, and 12 volt gages. Use the electrical schematic for trouble shooting the circuit.

A CM Assembly is located under the right hand dashboard which contains a voltage regulator, diodes, capacitors and a circuit breaker with a 5 amp manual re-set button.

A voltage regulator in the CM valve converts the 12 volts to continuous 6 volts for use in the Potentiometer and the Forward/Reverse Pilot Pressure Control Valve.

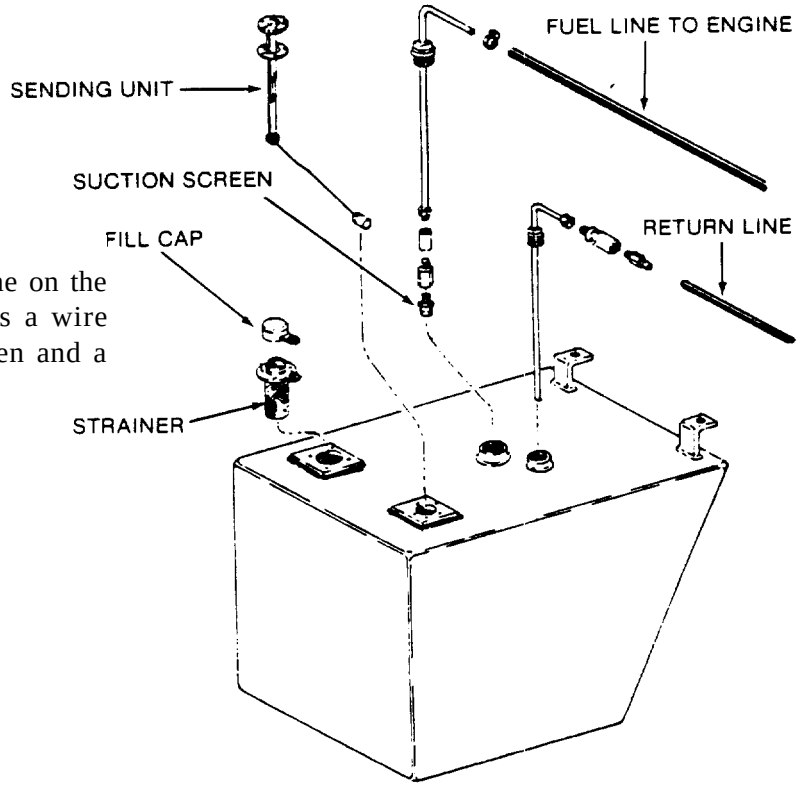


CM Assembly



FUEL TANK

A 40 gallon fuel tank is mounted to the frame on the right hand side of the machine. It includes a wire mesh strainer at the fill cap, a suction screen and a sending unit to the cab fuel gage.



THE
GRADALL®
COMPANY

406 Mill Avenue S.W
New Philadelphia, Ohio 44663
(216) 339-2211

Printed in U.S.A.

Installation and Service Instructions

MECHANICAL

Sliding Caliper Disc Brakes

515 SERIES

TABLE 1

Model Number	Lining Kit	Model Number	Lining Kit	Model Number	Lining Kit
02-515-116	20-060-036	02-515-174	20-060-082	† 02-515-180	20-060-082
†* 02-515-147	20-060-082	† 02-515-175	20-060-082	02-515-186	20-060-063
02-515-148	20-060-082	02-515-176	20-060-063	† 20-100-297	20-060-082
†* 02-515-149	20-060-082	02-515-178	20-060-082		
02-515-150	20-060-082	† 02-515-179	20-060-097		

* Drive line parking brake package.
† Use spacer(s) behind lining (dead side).

NOTE: Repair Kit 02-500-133 used with all models.

READ GENERAL INSTALLATION GUIDELINES SHEET (81-600-001) BEFORE PROCEEDING

⚠ WARNING

MICO Disc Brake Linings do not contain asbestos. Brake lining compounds do, however, contain elements that may become airborne during the life of the lining. To prevent any health problems associated with lining dust, we suggest ventilators be installed as needed on enclosed or stationary equipment. A Material Safety Data Sheet is available upon request.

When installing these MICO 515 Series Brakes, it is of utmost importance to maintain parallelism between mounting bolts and that caliper be centered evenly and squarely over disc. This will prevent binding of caliper and ensure even lining to disc contact.

⚠ CAUTION

These MICO 515 Series Brakes are designed to be used with a disc thickness of 12.7 mm (.50"). For other disc thicknesses, contact MICO, Inc.

MOUNTING PROCEDURE

1. Using Figure 1 and Table 2, determine "A" dimension and locate caliper mounting holes.
2. Distance from mounting surface to head of mounting bolt is 82.6 mm (3.25") regardless of disc thickness.
3. Mount brake on disc and bolt securely to vehicle or machine using grade 5 or better mounting bolts or pins.

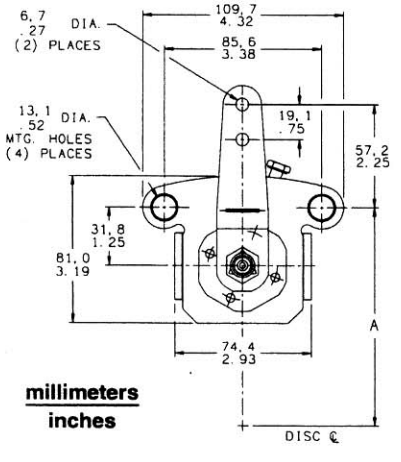


FIGURE 1

DISC CENTERLINE TO MOUNTING HOLE DIMENSION

DISC DIA.	"A" DIM.
150 mm (6")	85.9 mm (3.38")
205 mm (8")	111.3 mm (4.38")
255 mm (10")	136.7 mm (5.38")
305 mm (12")	162.1 mm (6.38")
355 mm (14")	187.5 mm (7.38")
405 mm (16")	212.9 mm (8.38")
455 mm (18")	238.3 mm (9.38")
510 mm (20")	263.7 mm (10.38")

TABLE 2

For disc diameters greater than 510 millimeters, add 9.7 mm (20 inches, add .38") to disc radius to obtain "A" dimension.

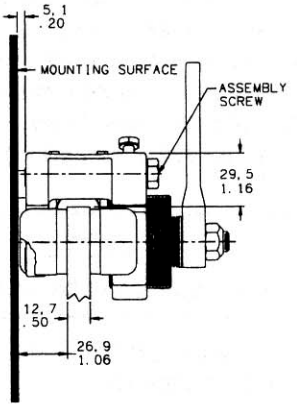


FIGURE 2

ADJUSTMENT PROCEDURE

NOTE

Do not use lever as a means to turn brake module. To do so will cause piston to extend and create false settings.

1. Thread in brake module housing until lining assemblies contact disc completely. Back off brake module until a flat surface lines up with set screw. Tighten set screw securely.
2. Remove lock nut and lever from piston. Position lever in desired location.
3. Install lock nut on piston. Torque 12.2-14.9 N-m (9-12 lb-ft).
4. Attach actuating mechanism to lever.

CHANGE BALL & CAM PROCEDURE

(Refer to Figures 3 & 4)

NOTE

Do not use the operating lever as a means to turn the brake module.

1. Disconnect actuating mechanism from lever (2) and loosen set screw (11).
2. Remove brake module housing (6) and lever assembly from housing (14).
3. Remove lock nut (1) and lever (2) from piston (9).
4. Depress retainer (4) and remove retaining ring (3) from piston (9).
5. Remove retainer (4) and five belleville springs (5) from piston (9).

NOTE

Note stacking sequence of belleville springs (5) for assembly purposes.

6. Remove piston (9), two cam plates (7) and three balls (8) from brake module housing (6).
7. Lubricate three new balls (8) with heavy, waterproof grease and place between ramps of new cam plates (7).
8. Install new cam plates (7) on piston (9) making sure locking lugs are aligned with holes on piston.
9. Install piston (9) assembly into brake module housing (6) making sure locking lugs of cam plate (7) align with holes in brake module housing. Lightly coat face of piston with heavy, waterproof grease.
10. Install five belleville springs (5) and retainer (4) on piston (9).

NOTE

Note stacking sequence of belleville springs (5).

11. Depress retainer (4) and install retaining ring (3) in groove on piston (9).
12. Thread in brake module housing (6) until lining assemblies (12) contact disc completely. Back off brake module until a flat surface lines up with set screw (11). Tighten set screw securely.
13. Install lever (2) in desired location on piston (9).
14. Install lock nut (1) on piston (9). Torque 12.2-14.9 N-m (9-12 lb-ft).
15. Attach actuating mechanism to lever.

CHANGE LINING PROCEDURE

(Refer to Figure 4)

See Table 1 for Lining Kit required for your brake. Lining assemblies (12) can be replaced without removing brake module housing (6).

1. Remove cap screw (10) and spring clip (13); allow lining assemblies (12) to drop out of housing (14). **NOTE: On small diameter discs with large hubs, it may be necessary to remove one mounting bolt and swing housing to free lining assemblies. Earlier models used a compression spring which is not included in the lining kit.**
2. Thread brake module housing (6) out of housing (14) so that piston (9) is flush with housing.
3. Install new lining assemblies (12) in housing (14).
4. Install new spring clip (13) and cap screw (10) and torque 13.6-16.3 N-m (10-12 lb-ft). **NOTE: If the lining kit does not include new spring clip (13), reinstall compression spring.**
5. To continue, refer to ADJUSTMENT PROCEDURE Section.

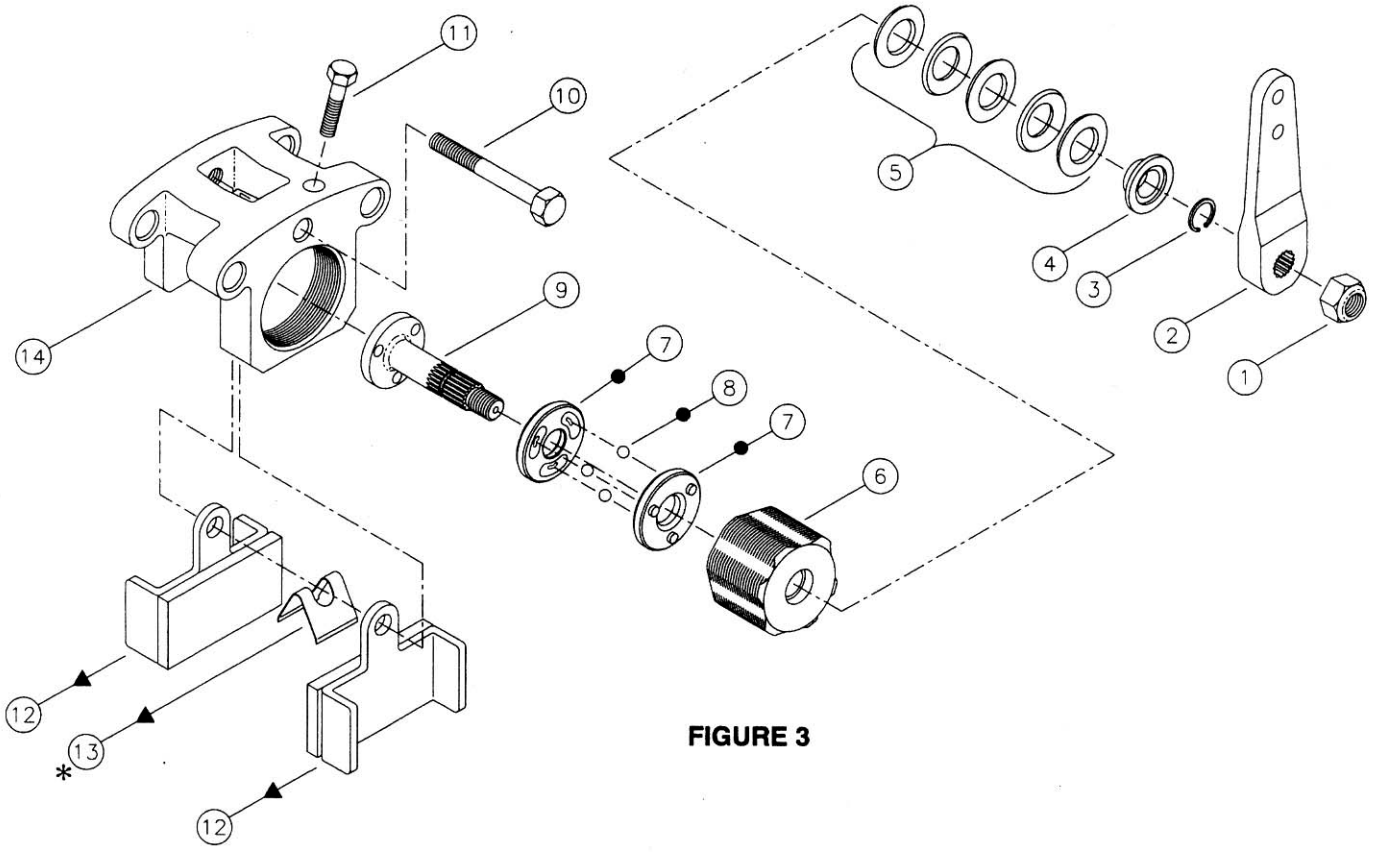


FIGURE 3

▲ **Items included in Lining Kit**
● **Items included in Repair Kit**
* **Not included in all Lining Kits**

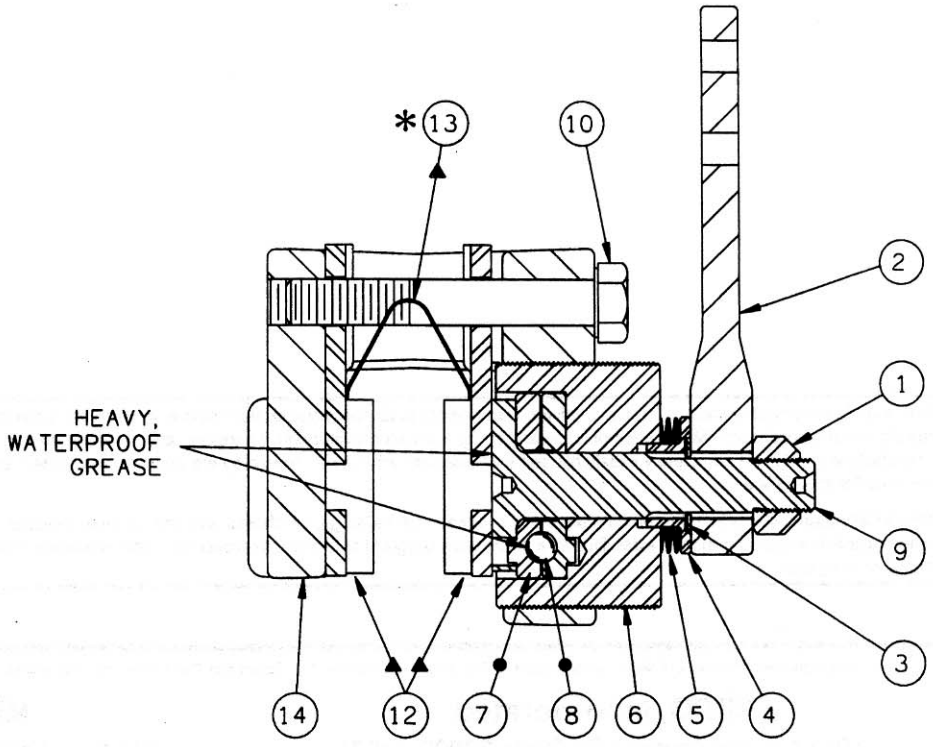


FIGURE 4

MICO could not possibly know of and give advice with respect to all conceivable applications in which this product may be used and the possible hazards and/or results of each application. MICO has not undertaken any such wide evaluation. Therefore, anyone who uses an application which is not recommended by the manufacturer, first must completely satisfy himself that a danger will not be created by the application selected, or by the particular model of our product that is selected for the application.

MICO has made every attempt to present accurate information in catalogs, brochures and other printed material. MICO can accept no responsibility for errors from unintentional oversights that may exist. Due to a continuous program of product improvement, both materials and specifications are subject to change without notice or obligation.

MICO, Incorporated
1911 Lee Boulevard (Zip Code 56003-2507)
P.O. Box 8118 / North Mankato, MN U.S.A. 56002-8118
☎ 507.625.6426 **Facsimile** 507.625.3212

MICO West Division
701 East Francis Street (Zip Code 91761-5514)
P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎ 909.947.4077 **Facsimile** 909.947.6054

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Printed in U.S.A.

General Guidelines for installing Hydraulic Brake Components

MICO Hydraulic Brake Components are precision built devices and must be treated as such. The following guidelines must be followed at the time of installation to ensure optimum performance.

Where to Mount

To properly locate the brake component or brake line, you must. . .

1. Make it convenient for operator.
2. Use the shortest and most protected route. Protect components from road salts and general debris.
3. Avoid exposing components and lines in wheel compartments.
4. Avoid mounting near engine, exhaust lines, muffler or anywhere that heat may be generated. **NOTE: Excessive heat transferred to brake fluid may result in damage to lines or seals.**
5. Mount units that have to be bled lower than master cylinder and with bleeder screws on top to facilitate bleeding.

Internal Heat - Cause, Effect, Solution

It is possible for heat to come from within the system itself as in the case of heat generated by the friction of lining to drum when braking. This heat can cause the fluid to expand. If the fluid is then held captive, subsequent cooling and contracting can cause a pressure drop.

MICO Hydraulic Locking Devices that include a pressure accumulator are designed to dampen these fluctuations of pressure and to absorb the increase in pressure within its operating range.

Cleanliness

It is impossible to overemphasize the importance of cleanliness during installation. All lines, fittings and adjacent areas must be cleaned of dirt or road residue before any lines or fittings are disconnected. Special care must be taken so dirt and road residue are not allowed to enter the hydraulic brake system. This can contaminate the system and interfere with the proper operation of the brakes and other hydraulic components. Always. . .

1. Use good, clean, quality fluid. Improper or contaminated brake fluid may cause gummy deposits and softening and swelling of other rubber seals in the entire brake system. Such a condition must be corrected immediately.
   a. Use brake fluid which conforms to SAE Spec. No. J1703 or DOT 3 or 4 if the product is used with a system utilizing automotive brake fluid.
   b. Refer to vehicle manufacturer for fluid specification if product is used with:
      1. Mineral based hydraulic oil.
      2. Phosphate ester base fluid.
      3. Water/glycol fluid.
      4. Water-in-oil emulsion fluid.
      5. DOT 5 or silicone fluid.
2. Be sure fittings and seats are clean before making connections. Do not use sealants, tapes, teflon or cement compounds on any connections or fittings. These sealants or compounds can contaminate the hydraulic brake system and interfere with the operation of brake system components.
3. Clean top of master cylinder before removing filler cap.

How to Mount

To properly mount components and brake lines to withstand the most severe vibration conditions, always. . .

1. Follow the procedures outlined in Vehicle Manufacturer's Service Manual or SAE Standards when making new connections or adding to existing brake system. Use only steel brake tubing conforming to SAE specifications.
2. Use the proper size bolt for the hole and secure with a steel lock washer whenever possible.
3. Secure tubing to frame with proper size tube clamps to avoid possible fractures or fittings loosening and leaking.
4. Use good, factory flared lengths of steel tubing. Hand made flares, when used, must be double flared. Any flash or loose particles must be moved.
5. Use flexible brake line between frame and body.
6. Use grommets or some other means to protect brake lines that pass through the frame or firewall.
7. Make sure fittings and connections are in good condition and tightened to proper torque values as specified in the installation and service instructions.

Importance of Bleeding

The hydraulic brake system must be bled whenever any line has been disconnected. Air trapped in the system can cause spongy and inadequate brakes. There are two methods of bleeding hydraulic systems, pressure bleeding and manual bleeding. Both methods are acceptable and adequate but pressure bleeding is recommended if the equipment is available. Follow bleeding instructions as specified by vehicle manufacturer.

To properly bleed the system. . .

1. Be certain all fittings are tight to avoid leaking.
2. Depress pedal and open up bleeder screws to allow air to escape. Air will always seek the highest level.
3. Retighten bleeder screws and allow pedal to return.
4. Repeat cycle until pedal is firm.
5. Make several static brake applications and then repeat cycle once more.

Leak in the System

Even the smallest leak in a brake system will adversely affect the system. A leak may eventually deplete the reserve supply and reduce braking pressure. To help prevent leaking. . .

1. Check connections during bleeding and static brake processes to be sure they are tight.
2. Always reinstall new hoses, lines and fittings if they look the least bit questionable.
3. Brake hoses, brake lines, MICO locking device, brake components, cylinders, and all fittings must be routinely inspected for leaks, damage or wear. Adequate fluid levels must be maintained. In the event of any loss of fluid, the brake system must be carefully inspected for leaks.

MICO, Incorporated
1911 Lee Boulevard (Zip Code 56003-2507)
P.O. Box 8118 / North Mankato, MN U.S.A. 56002-8118
☎ (507) 625-6426 **Facsimile** (507) 625-3212

MICO West Division
701 East Francis Street (Zip Code 91761-5514)
P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎ (909) 947-4077 **Facsimile** (909) 947-6054

Form No. 81-600-001 Revised 5/97 Printed in U.S.A.

Burnishing Procedures for MICO Caliper Disc Brakes

TECHNICAL NOTICE

Maximum torque will be achieved only after the brake has been properly burnished. Actual customer testing will be required to determine final acceptance and approval of brake system components.

MICO recommends the following SAE burnishing procedures be performed immediately following the installation and adjustment of the brake. These "SAE recommended practices" (J360; paragraph 7.3 for parking brakes and J786a; paragraph 5.5 for service brakes) are intended to be used as guidelines only. Contact the vehicle (or equipment) manufacturer for specific recommendations.

PARKING BRAKE: Make 10 stops from 10 mph (45 m/s) at 3 ft/s^2 (0.9 m/s^2). Space the stops a minimum of 2.5 miles (4000 m) apart and operate the vehicle at 20 mph (9 m/s) between stops.

SERVICE BRAKE: Make at least 200 "Brake Snubs", not less than 50 in a series, from 40 to 20 mph (64 to 32 km/hr.) at 10 ft/s^2 (3 m/s^2) in normal gear range. [A "Brake Snub" is the act of retarding a motor vehicle between two positive speed values by the use of a brake system.]

Accelerate to 40 mph at moderate acceleration after each "snub" and drive 40 mph (64 km/hr) between snubs.

At every 25th application (minimum), make a **full** stop from 40 mph (46 km/hr.).

APPLICATION INTERVALS:

- For light trucks and buses [6,000-10,000 lb. (2,700-4,500kg) GVW]: 1.0 mile (1.6 km)
- For truck, bus, and combination of vehicles [over 10,000 lb. (4,500 kg) GVW]: 1.5 miles (2.4 km)

NOTE: Other burnish procedures which produce similar braking conditions and performance characteristics are permissible.

After burnishing, adjust the parking brake and actuation system in accordance with MICO specifications (or the appropriate manufacturer's specifications for components of the actuation system not supplied by MICO).

Immediately following any dynamic stop resulting from the application of the parking brake, the brake and disc must be inspected for any unusual wear or conditions and then adjusted in accordance with MICO specifications.

Recommended Disc Material

High quality brake discs should be used in conjunction with MICO Caliper Disc Brakes. Depending on strength and performance requirements, low to medium carbon steel is generally recommended. Fabrication procedures are as follows:

1. Flame cut or machine to required outside diameter with inside diameter machined to size.
2. Stress relieve after all machining operations.
3. Blanchard ground to a surface finish of 54 Ra to 72 Ra with a visible cross-hatch pattern.
4. Surfaces to be parallel within .05 mm (.002").
5. Surfaces to be flat within .13 mm (.005").

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MICO West Division

701 East Francis Street (Zip Code 91761-5514)
P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎ 909.947.4077 **Facsimile** 909.947.6054

Form No. 81-950-016 Revised 10/14/98 Printed in U.S.A.

Recommended Brake Service Procedures to Reduce Exposure to Non-Asbestos Fiber

TECHNICAL NOTICE

FOR ALL MICO NON-ASBESTOS BRAKE LININGS

Recently manufactured brake linings no longer contain asbestos fibers. In place of asbestos, these linings contain a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers, and carbon fibers. At present, OSHA does not specifically regulate these non-asbestos fibers, except as nuisance dust. Medical experts do not agree about the potential long-term risks from working with and inhaling non-asbestos fibers. Some experts nonetheless think that long-term exposure to some non-asbestos fibers may cause diseases of the lung, including pneumoconiosis, fibrosis and cancer. Therefore, MICO recommends that workers use caution to avoid creating and breathing dust when working on brakes that contain non-asbestos fibers.

⚠ WARNING

1. Whenever possible, work on brakes in a separate area away from other operations.
2. Always wear a respirator approved by NIOSH or MSHA during all brake service procedures. Wear the respirator from removal of the wheels through assembly.
3. **NEVER** use compressed air or dry brushing to clean brake parts or assemblies. OSHA recommends that you use cylinders that enclose the brake. These cylinders have vacuums with high efficiency (HEPA) filters and worker's arm sleeves. But, if such equipment is not available, carefully clean parts and assemblies in the open air.
4. During disassembly, carefully place all parts on the floor to avoid getting dust into the air. Use an industrial vacuum cleaner with a HEPA filter system to clean dust from the brake drums, backing plates and other brake parts. After using the vacuum, remove any remaining dust with a rag soaked in water and wrung until nearly dry.
5. Grinding or machining brake linings. If you must grind or machine brake linings, take additional precautions because contact with fiber dust is higher during these operations. In addition to wearing an approved respirator, do such work in an area with exhaust ventilation.
6. Cleaning the work area. **NEVER** use compressed air or dry sweeping to clean the work area. Use an industrial vacuum with a HEPA filter and rags soaked in water and wrung until nearly dry. Dispose of used rags with care to avoid getting dust into the air. Use an approved respirator when emptying vacuum cleaners and handling used rags.
7. Worker clean-up. Wash your hands before eating, drinking or smoking. Do not wear your work clothes home. Vacuum your work clothes after use and then launder them separately, without shaking, to prevent fiber dust from getting into the air.
8. Material safety data sheets on this product, as required by OSHA, are available from MICO.

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P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎ 909.947.4077 **Facsimile** 909.947.6054

Form No. 81-950-016 Revised 10/14/98 Printed in U.S.A.

Service Instructions
HYDRAULIC BRAKE VALVE
Master Cylinder Section

REPAIR KIT 02-400-184

MASTER CYLINDER SECTION - **Automotive Brake Fluid**

POWER ASSIST SECTION - **Mineral Base Hydraulic Oil**

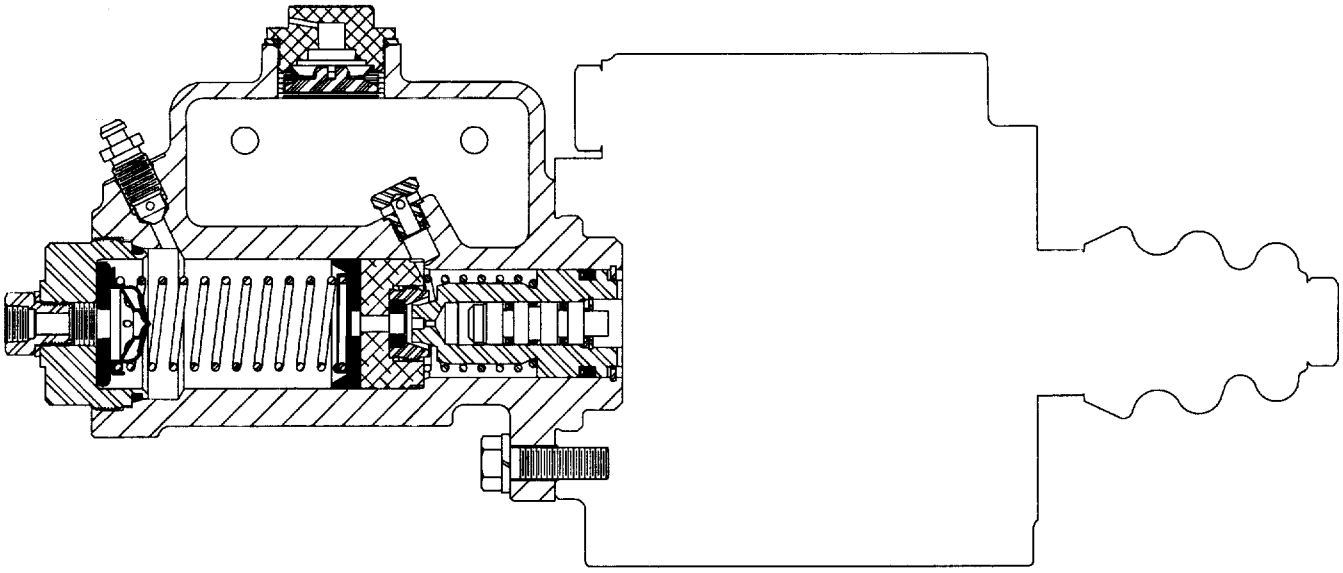

FIGURE 1

This instruction sheet services the Master Cylinder Section for these model numbers:

02-460-272
02-460-392
02-460-402

TYPICAL SYSTEM SCHEMATIC

(This circuit may not apply to your installation)

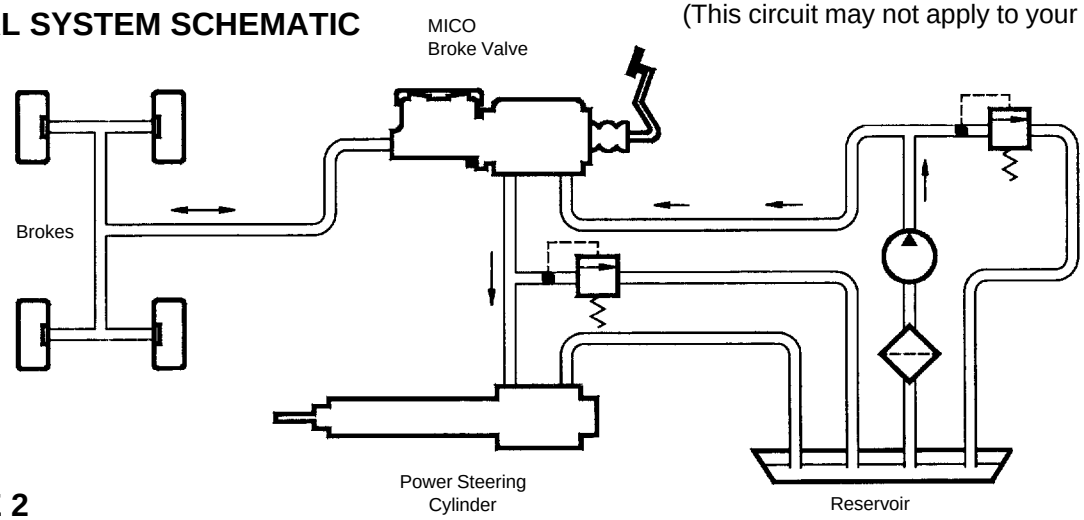

FIGURE 2

REMOVING BRAKE VALVE FROM VEHICLE AND SEPARATING SECTIONS

(Refer to Figures 1 & 3)

1. Remove Brake Valve from vehicle by disconnecting necessary fluid lines, disconnecting push rod and removing mounting bolts. Drain fluid from assembly.
2. Separate Master Cylinder Section from Power Assist Section by removing three cap screws and three lock washers.

CONNECTING SECTIONS AND MOUNTING BRAKE VALVE ON VEHICLE

(Refet to Figures 1 & 3)

1. Attach Master Cylinder Section to Power Assist Section with three cap screws and three lock washers. Torque 29.8-36.6 Nm (22-27 lbs-ft).
2. Install unit on vehicle and connect fluid lines. Connect push rod. Bleed system of air. Tighten fittings if leaks occur. Make several applications to be sure brake valve is working properly. **NOTE: All fittings must be inspected for leaks and tightened if leaks occur.**

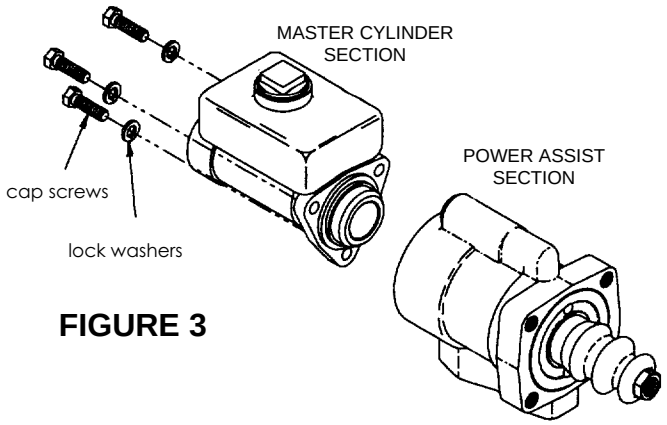

FIGURE 3

MASTER CYLINDER DISASSEMBLY

(Refer to Figures 1 & 4)

1. Remove filler plug (15) and gasket (14) from housing (2).
2. Drain fluid from unit before disassembling.
3. Place master cylinder section in a soft jawed vise in a vertical position with end plug (11) facing up.
4. Remove adapter (13) and gasket (12) from end plug (11). **NOTE: Not all models use adapter (13) or gasket (12).**
5. Remove end plug (11) from housing (2).

⚠ CAUTION
End plug (11) is under tension of spring (7).

6. Remove check valve (8), seat (9) and o-ring (10) from end plug (11).
7. Remove spring (7) from housing. Remove retainer (6) from spring (7).
8. Use a wooden dowel to push cup (5), piston assembly (4) and piston assembly (3) out of end plug (11) end of housing (2). **NOTE: Be careful not to scratch or mar housing bore.**
9. Remove retaining ring (1) from housing (2).

MASTER CYLINDER ASSEMBLY

(Refer to Figures 1 & 4)

Use only automotive brake fluid in Master Cylinder Section.

LUBRICATE ALL RUBBER COMPONENTS FROM REPAIR KIT WITH CLEAN TYPE FLUID USED IN THE SYSTEM.

1. Clean all parts thoroughly before assembling.
2. Install new retaining ring (1) in housing (2).
3. Carefully install new piston assembly (3), new piston assembly (4) and new cup (5) in end plug (11) end of housing. Note direction of piston assemblies (3 & 4) and cup (5). **NOTE: Be careful not to scratch or mar housing bore.**
4. Install new retainer (6) on spring (7). Install spring (7) in housing, retainer end first.
5. Install new o-ring (10), new seat (9) and new check valve (8) on end plug (11). Install end plug (11) into housing. Torque end plug (11) 61.0-81.4 Nm (45-60 lbs-ft).
6. Install new gasket (12) and adapter (13) in end plug (11). Torque adapter (13) 47.5-54.2 Nm (35-40 lbs-ft). **NOTE: Not all models use gasket (12) or adapter (13).**
7. Remove master cylinder section from soft jawed vise.
8. Install new gasket (14) and filler plug (15) on housing (2).

- ● **Items included in Repair Kit 02-400-184**
- ⁎ **Not used on all models**

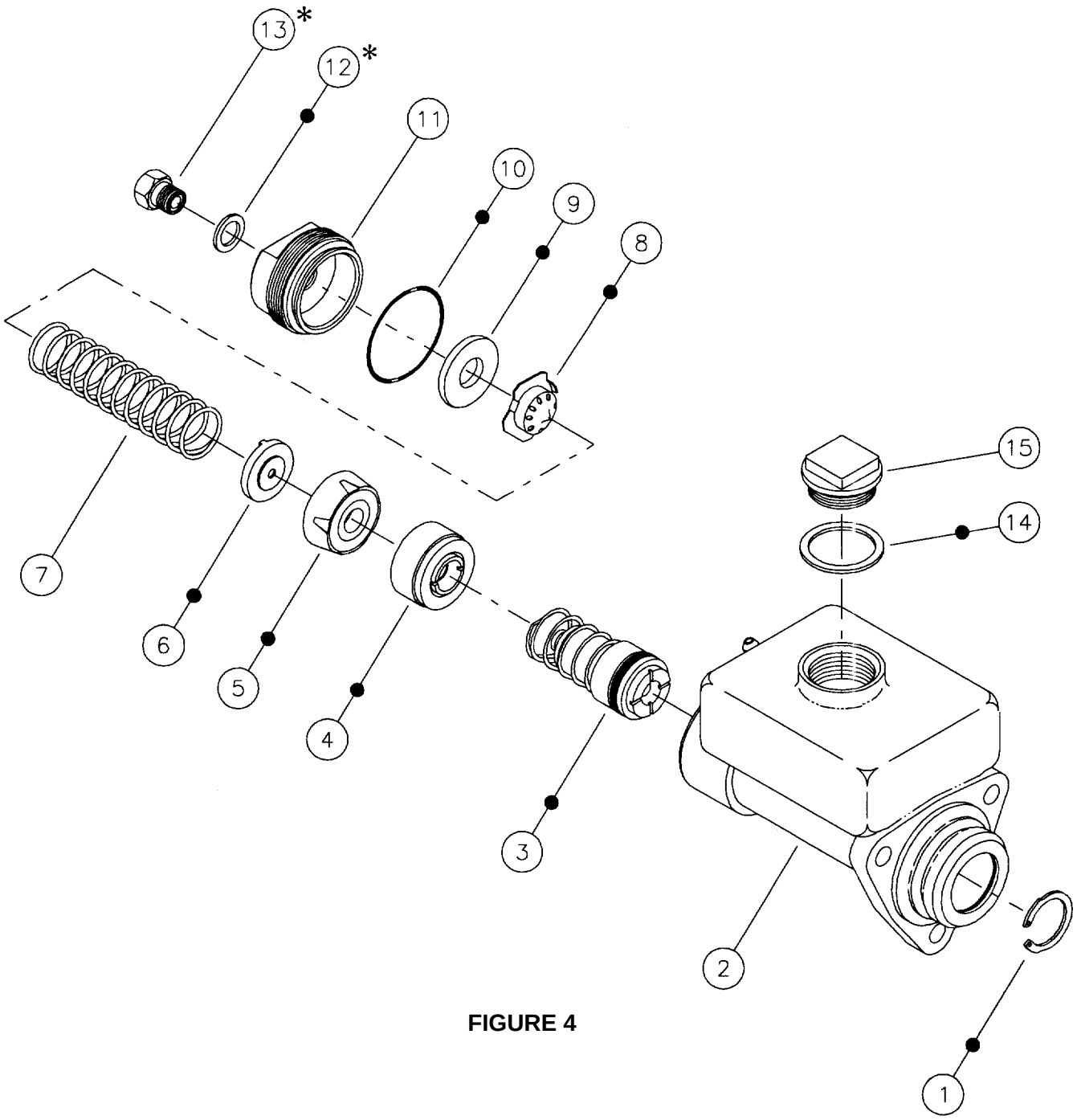

FIGURE 4

BLEEDING PROCEDURES

NOTE

Use only proper fluid specified by vehicle manufacturer. Never reuse fluid that has been drained from the system. Be sure that you maintain a high level of fluid in the reservoir during and after the entire bleeding process.

PRESSURE BLEEDING INSTRUCTIONS

1. Master Cylinder must be mounted to power assist section.
2. Fill reservoir with proper fluid.
3. Be certain all fittings are tight to avoid leaking.
4. DO NOT DEPRESS PEDAL.
5. Connect pressure bleeder into reservoir adapter. Recommended bleeding pressure is 2.07 bar (30 psi) maximum. **NOTE: Make sure to use correct pressure bleeder for type fluid used in system.**
6. Open bleeder screw closest to master cylinder outlet. Most of the air contained in the system will escape by this route. Close bleeder screw.
7. Continue to the next bleeder screw and so on. At each point when air bubbles disappear close bleeder screw.
8. Remove pressure bleeder.
9. Open bleeder screw at master cylinder. Actuate cylinder to remove any residual air. Tighten bleeder screw before permitting pedal to return.
10. Actuate pedal several times. If pedal is spongy, check for system leaks and repeat bleeding process.

BENCH BLEEDING INSTRUCTIONS

(Refer to Figure 5)

1. This process can be done in a bench vise or on the vehicle with master cylinder mounted to power assist section.
2. Remove master cylinder filler cap assembly.
3. Connect a length of tubing to an outlet port and immerse the other end below the fluid level in the master cylinder reservoir. Keep reservoir fluid within 12.7 mm (.50") of inside reservoir top.
4. Actuate master cylinder piston with a smooth object large enough to hold the small internal piston from coming out. Slowly stroke and release master cylinder piston. **SEE CAUTION BELOW.** Repeat until air bubbles in reservoir have ceased.
5. Remove tubing. This should be done quickly so the loss of fluid will be minimized.
6. If cylinder was bench bled in a vise, it must now be attached securely to the power assist section and mounted on vehicle. Finish all plumbing connections before continuing to step 7.
7. Bleed remaining air from system by depressing brake pedal and opening bleeder fitting closest to master cylinder. Close bleeder fitting before brake pedal is released. Continue to next bleeder port. In all cases the bleeder fittings must be closed before the brake pedal is released or air will be pulled in through the bleeder and ingest unwanted air in the system.
8. Fill reservoir to within 12.7 mm (.50") of top. Install filler plug and torque 33.9-40.7 Nm (25-30 (lbs-ft).
9. Be certain all fittings are tight to avoid any leaking.
10. Actuate pedal several times. If brake pedal feels spongy, check for system leaks and repeat bleeding process.

⚠ CAUTION

Care must be taken so as not to over stroke this cylinder. The cylinder does not incorporate a piston stop. Over stroking this cylinder may cause it to leak from push rod end of cylinder. Maximum recommended stroke for this cylinder is 31.8 mm (1.25").

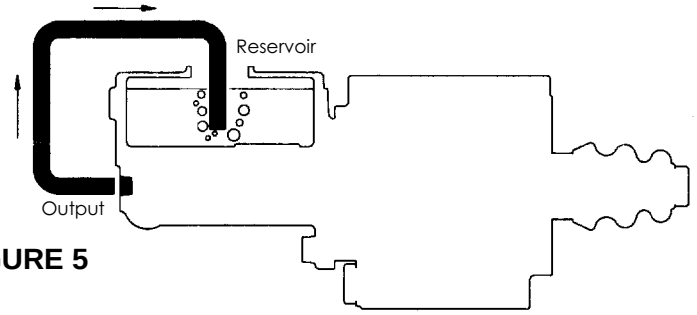

FIGURE 5

MICO has made every attempt to present accurate information in catalogs, brochures and other printed material. MICO can accept no responsibility for errors from unintentional oversights that may exist. Due to a continuous program of product improvement, both materials and specifications are subject to change without notice or obligation.

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1911 Lee Boulevard (Zip Code 56003-2507)
P.O. Box 8118 / North Mankato, MN U.S.A. 56002-8118
☎(507) 625-6426 **Facsimile** (507) 625-3212

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P.O. Box 9058 / Ontario, CA U.S.A. 91762-9058
☎(909) 947-4077 **Facsimile** (909) 947-6054

Form No. 81-460-159 Revised 3/98 Printed in U.S.A

STARTING SERIAL
Covers Units Starting Serial No. 8444490
And Also Covers Unit No. 8444474

Before testing the hydraulic system it is important that you read and understand System Operations of 534B. and the Safety Manual. Then make the following checks:

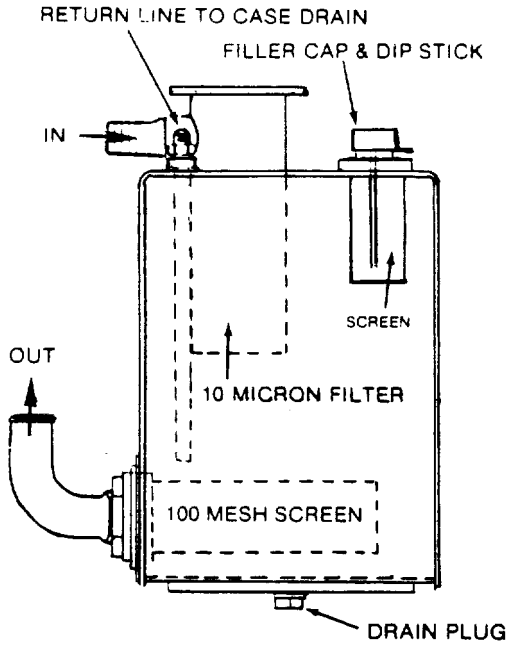
Engine RPM: Using tachometer, check engine rpm at both idle speed and h~high speed (with the accelerator fully depressed). The tachometer reading should be:*

Idle . . . . . 1000 rpm approx.
High . . . . . 2800 rpm approx.

Next, check with the boom retracted fully while holding back on the control lever. It should read about 2600 rpm.

**If unable to get proper rpm call in a qualified engine mechanic and follow manufacturer's recommendations.*

Reservoir: Drain some oil from the plug at the bottom of the reservoir into a glass bottle and allow it to settle. If dirt or water is present, drain and clean reservoir, replace filter and fill with new hydraulic fluid to proper level. Start engine and bring oil to operating temperature. **Never test pressures with cold oil.**

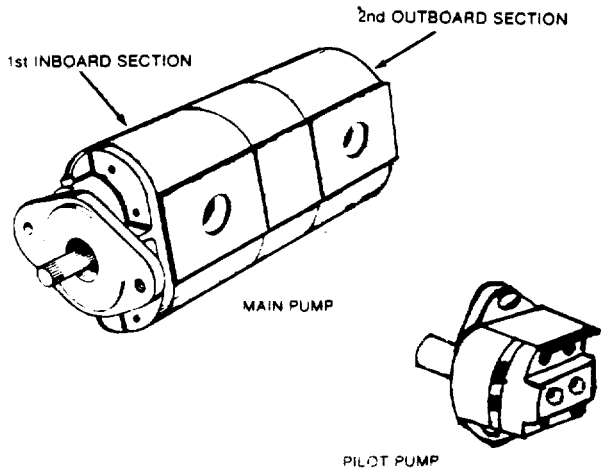


WARNING: DO NOT OPERATE GRADALL MATERIAL HANDLER UNLESS FLUID IS AT PROPER LEVEL

PUMPS

Speed of hydraulic functions is determined by the volume of oil provided to the functions. Power (force) is determined by the pressure built up to perform work. Slow action in a circuit indicates that either the pump is not putting out the required volume or that leakage is taking place.

The ability of a pump to build up pressures strong enough approx. enough to open the pump relief valve is one indication of pump efficiency. However, it is possible for the pump to build up this pressure, and still not be putting out the required volume of oil.



BLEEDING OFF CIRCUIT PRESSURE

To remove a high pressure build-up in a circuit, physically drain off oil. This can be done for relieving circuit pressures or for situations such as removal of a Mini-check test port.

1. Place forks on ground and shut off engine. Set parking brake.

2. Install Mini-check hose, less the gage. Point the hose towards oil container. Use a covered container to avoid splash.

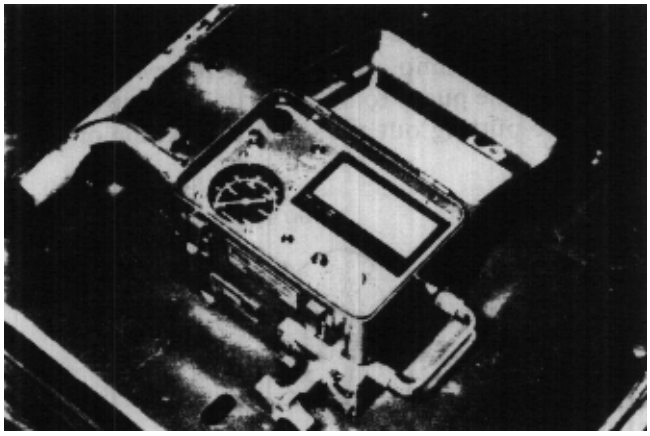
3. Drain off and collect the oil.

With a hydraulic failure or an engine shut-off, it is necessary to bleed the pilot fine going to the lock-out valve. Remove one end of the fine and drain the fluid into an open container. *For instance if under these conditions the boom is raised, it is necessary to bleed the line to lower the boom.*

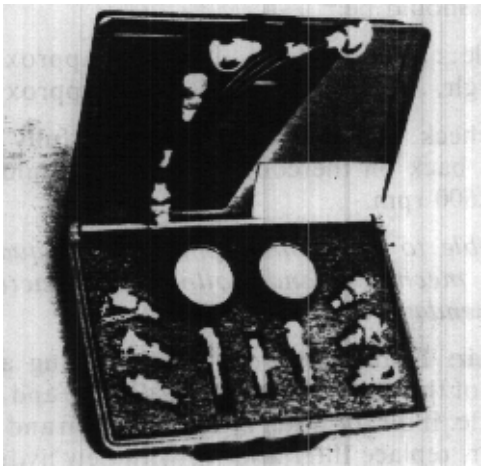
Form No. 8503

TOOLS NEEDED TO TEST SYSTEM

Hydraulic Flow Meter. This meter measures pump flow under varying pressure conditions. You can measure actual pump output, both with no resistance and with resistance imposed against it. Contact your Gradall Materials Handler Distributor.



Hydraulic Pressure Gages. We recommend a 0-1000 psi gage and a 0-5000 psi gage for ease of testing Kit 7713-4197 includes both gages and a selection of adapters and hoses.



Other Tools Needed:

3/16" Allen wrench for steering valve.
Volt Ohm-Ampere Meter.
Selection of wrenches and screwdrivers.

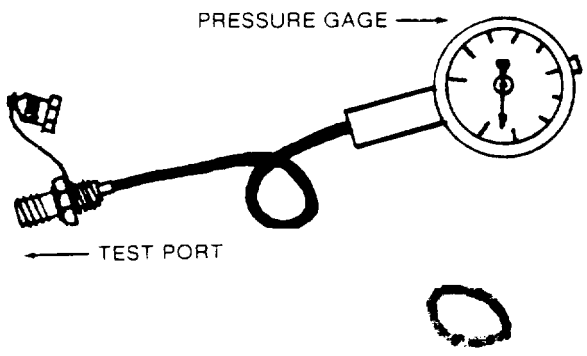
HOW TO TEST PUMP FLOW

Insert a flow meter in to the output(pressure port)of the pump. and observe actual pump flow. Tests should be made for volume with no resistance and then with resistance equal to the pump relief valve setting. .An inefficient or worn pump may pump full volume of oil under no load, but almost nothing under full resistance.

Flow meter readings will show less than the theoretical rating because of back pressures, the thinning out of oil because of temperature, and the resistance caused by relief vales. At 180°F flow meter reading will show less gallon age than at 120° F. As a pump works, the pump output will also be reduced depending upon the degree of internal wear.

TEST PORTS

The Gradall Materials Handler has test ports for main relief and circuit relief testing. Mini-check type of test ports have a one-way check valve to prevent loss of oil whenever the cap is removed. the gage (or hose) adapter is installed and tightened, the one-way check is unseated and the circuit is available for testing.



TESTING HYDRAULIC RELIEF VALVE PRESSURES

The reason for testing the main relief valves is to assure that the relief valves open and to limit the pressure in the lines at that time.

A. The engine should be turning at full governed rpm.

B. The hydraulic oil should be warmed up to operating temperature.

C. The test gage or gages should be installed in the circuit being tested.

D. The circuit function should be stalled by either running the cylinder to the end of its stroke or by stalling the motor action.

E. With the control levers actuated, a gage reading is taken. The gage indicates the setting of the respective relief valve.

Circuit relief valves are used in some circuits to protect the Gradall Materials Handler from external forces.

Other relief valves are installed the circuit to limit the pressures for that circuit or to control flow during specific actions.

ADJUSTING RELIEF VALVES

All of the relief valves can he adjusted using an allen wrench or a screwdriver. Loosen the lock nut, and turn the adjusting screw clockwise to increase the pressures. Turning it counter-clockwise will decrease the pressures. The valve adjustment is sensitive, so adjust in small moves, like 1/8 to 14 turn at a time. Tighten lock nut after adjustment.

HOW TO TEST AND ADJUST MAIN CONTROL VALVE RELIEF

Set pressures with oil at operating temperature and engine at 2800 rpm.

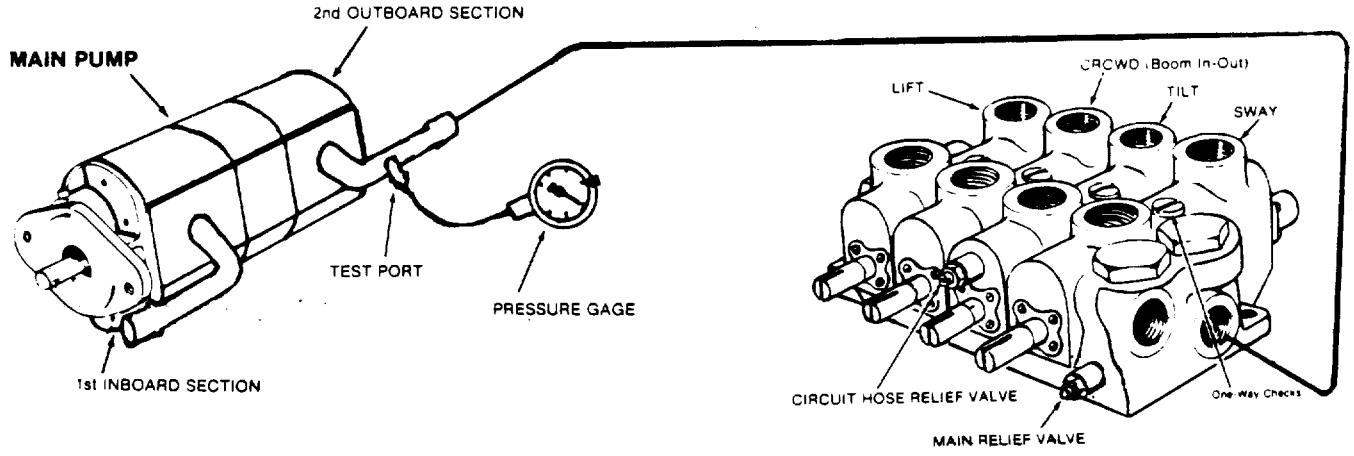
1. Install gage in test port tandem pump outboard tube.

2. Retract boom fully and hold control lever full to left.

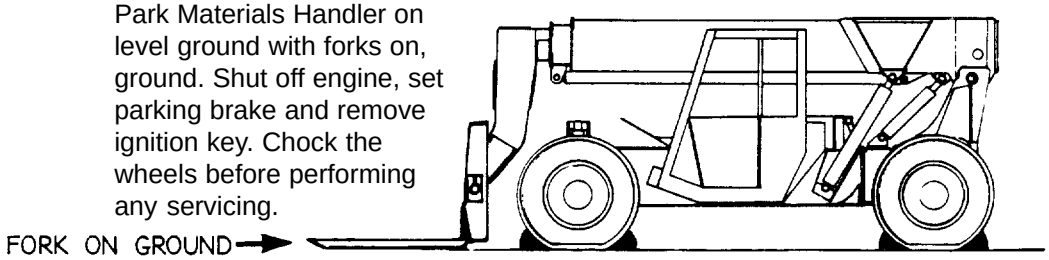
3. Gage should read 3000 psi.

4. Adjust, reseal or replace relief valve, as necessary.

5. Remove gage and recap test port.



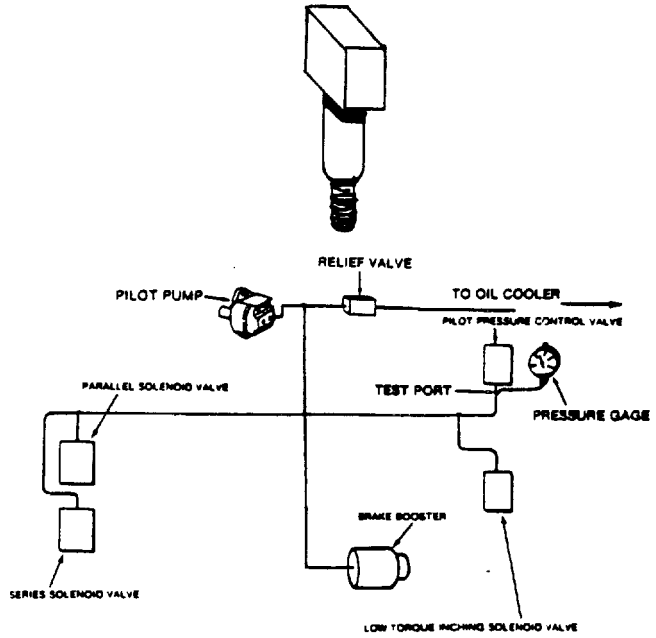
Park Materials Handler on level ground with forks on, ground. Shut off engine, set parking brake and remove ignition key. Chock the wheels before performing any servicing.



HOW TO TEST AND ADJUST PILOT CIRCUIT PUMP RELIEF VALVE

1. Remove the one end of the hose (at Pilot Pressure Control Valve) that comes from the pressure side of the Pilot Pump.
2. Install 1000 psi gage in end of this hose.
3. Start engine and run at idle rpm.
4. The pilot pressure should read 450 psi.
5. If adjustment is needed, loosen jam nut on the relief valve and screw adjusting screw clockwise to raise pressure and counter-clockwise to lower pressure. Set pressure at 450 psi. Tighten jam nut.
6. If adjustment cannot be made, replace relief valve.
7. Replace hoses and remove gage.

PILOT CIRCUIT PUMP RELIEF VALVE
450 psi



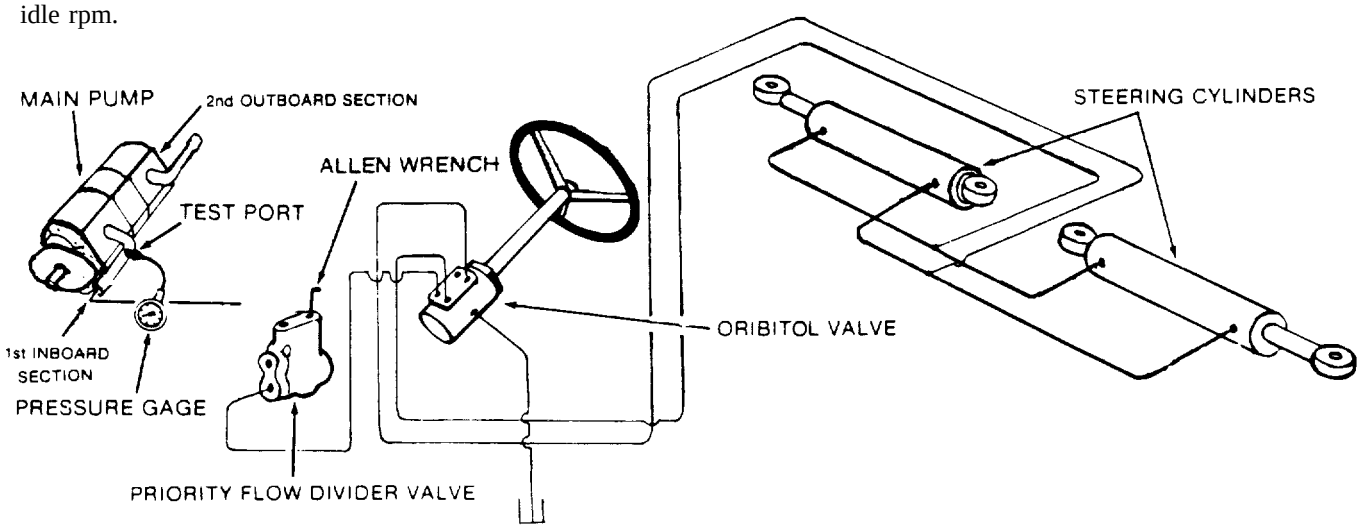
TESTING AND ADJUST STEERING CIRCUIT RELIEF VALVE

The circuit relief for the steering circuit is located in the priority flow divider valve.

1. Insert the pressure gage the test port on the tube coming from the 1st or inboard pump section.
2. Turn the steering wheel in either direction until the rear wheels bottom against the stops. continue to attempt to turn the wheel.
3. The gage should read 2000 psi with engine at idle rpm.

If the adjustment is needed. remove the hose and fitting from the rear top port of the priority valve and adjust pressure. Using an allen wrench. Located inside the port. turn clockwise to increase pressure or counter-clockwise to decrease the pressure.

NOTE: The circuit relief is to be maintained at 2000 psi.

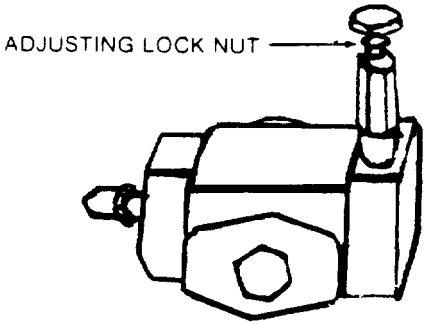


HOW TO TEST AND ADJUST DRIVE CIRCUIT RELIEF VALVES

1. Remove lock wire from Rear Drive Main Relief valve.
2. Install pressure gage in test port (1st, inboard section) of the tandem pump tube.
3. Start engine and loosen lock nut and "bottom lightly" and back off 1/2 turn.
4. Tighten lock nut after adjustment
5. Place transmission in forward position and 2nd gear.
6. Hold inching, service brake completely down and set Mico Brake Lever.
7. Slowly release service brake pedal, metering oil rear dries.
8. Observe gage reading. The circuit relief in the Forward Reverse Control Valve should open between 3000 and 3200 psi.
9. Adjust, reseal or replace relief valve as necessary. The forward circuit relief valve is located close to the inside of the machine within the Forward Reverse Control Valve.

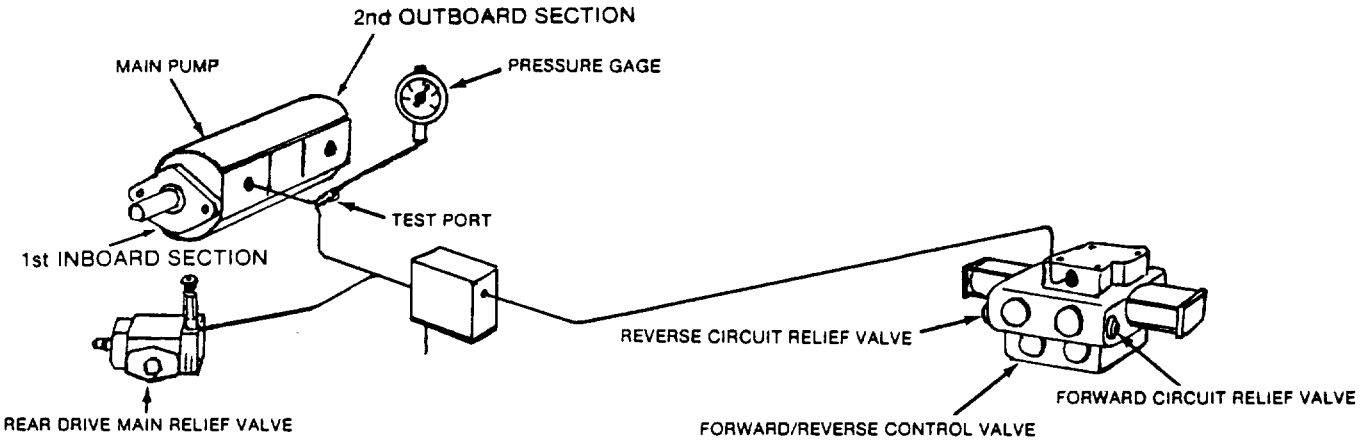
   REPEAT THE ABOVE STEPS WITH TRANSMISSI0N IN REVERSE. The reverse relief valve is toward the outside of the machine within the Forward Reverse Control Valve.

10. After completing these checks, lower the main drive relief valve to 3000 psi. while stalled in forward or reverse. Tighten lock nut.
11. Turn engine off and lock wire Rear Drive Main Relief Valve.
12. Remove Test gage and recap test port.



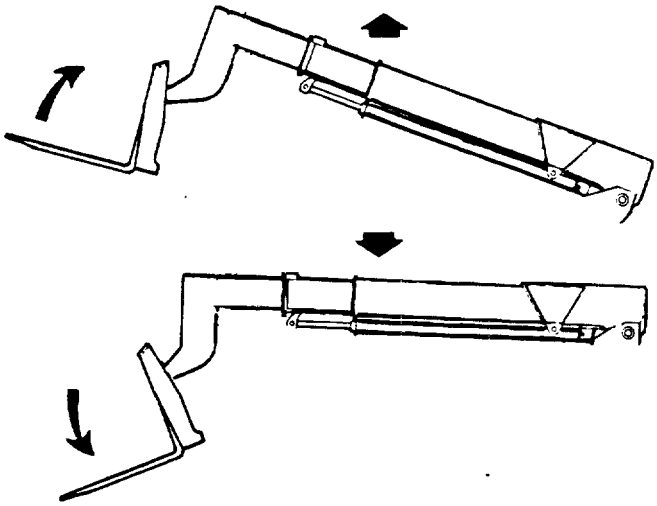
REAR DRIVE MAIN RELIEF VALVE

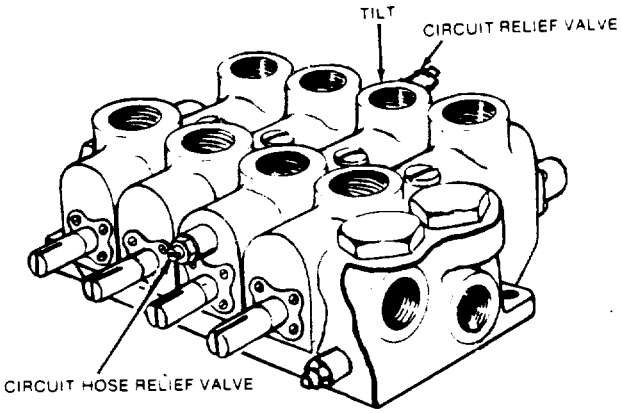
NOTE: Park Materials Handler on level ground with the forks on ground. Chock the wheels before performing this test. Use caution while letting the brake pedal out once pedal is released far enough, the front wheels will engage and attempt to drive the unit.

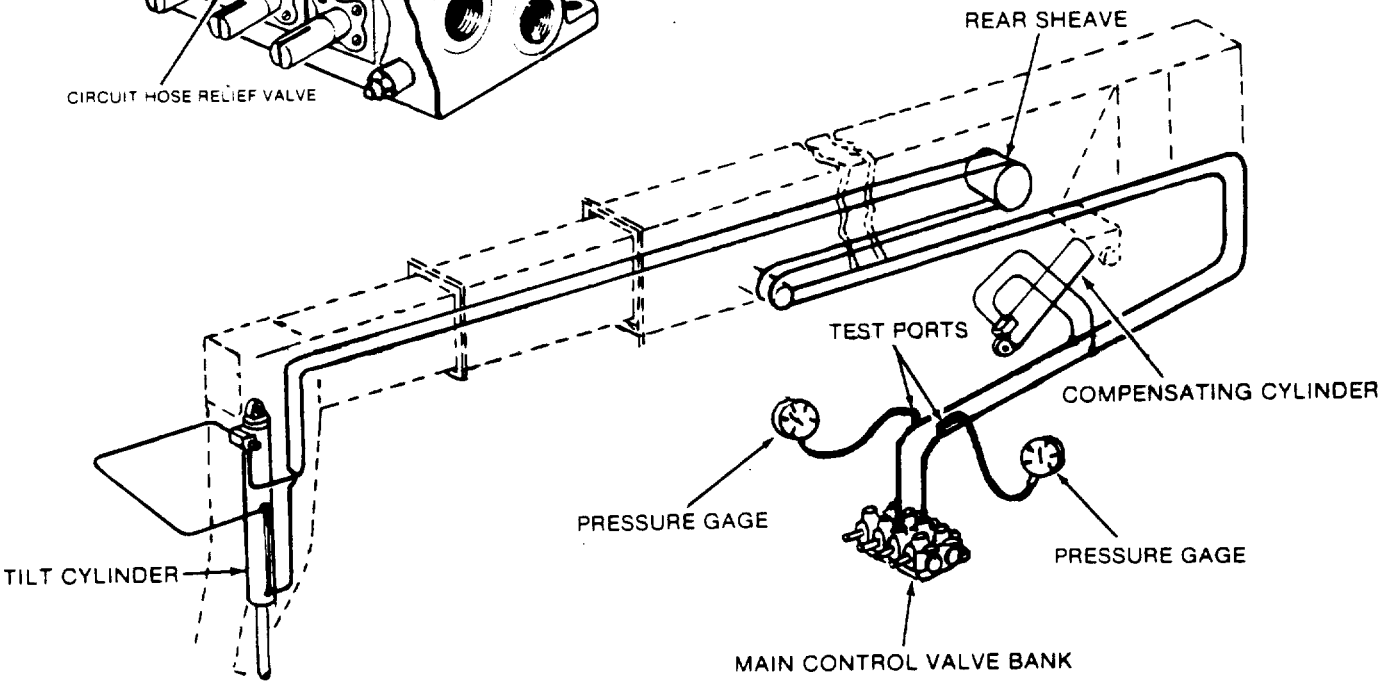


HOW TO TEST TILT CIRCUIT RELIEF VALVES

1. Install gage in test port closest to the cab.
2. Retract the tilt cylinder and raise the boom.
3. The gage should read 3250 psi while the boom is raising.
4. Adjust, reseal or replace relief valve as necessary.
5. Remove gage and recap test port.
6. Place gage in other test port.
7. Extend the tilt cylinder and lower the boom.
8. The gage should read 3250 psi while the boom is lowering.
9. Adjust, reseal or replace relief valve as D necessary.
10. Remove gage and recap test port.



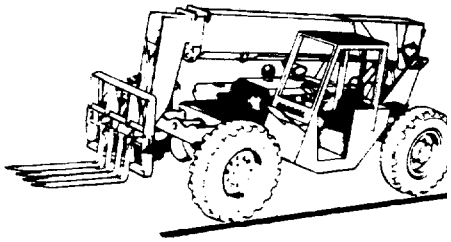


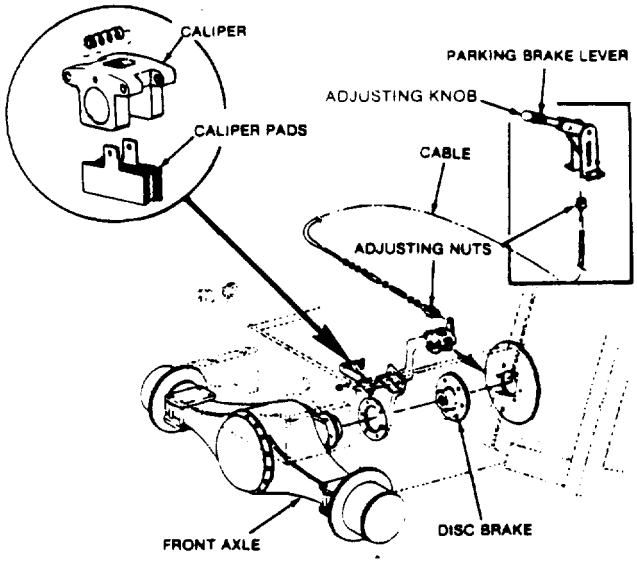


HOW TO TEST AND ADJUST THE PARKING BRAKES

Slowly and safely drive unit on a 10 to 15 degree incline. Make sure the area is clear of traffic, and workmen. Apply parking brakes. If brakes do not hold, return to a level surface and turn the hand knob on the top of the parking brake lever clockwise. Retest the parking brake on the incline.

If the knob adjustment fails to hold the Materials Handler, there is another adjustment at the other end of the parking brake cable.





HOW TO TEST AND ADJUST THE SERVICE BRAKES

1. In a clear, safe area, slowly drive the Gradall Loed Materials Handler on a level surface and 1st the service brakes.

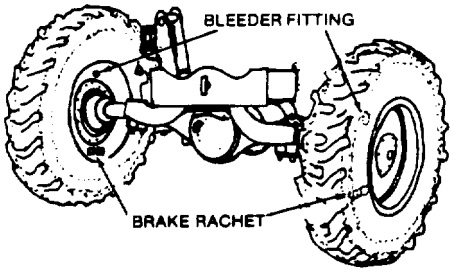
2. If this test is OK. try the same test on a 10 to 15 degree ramp. Apply foot pedal and set mico rock.

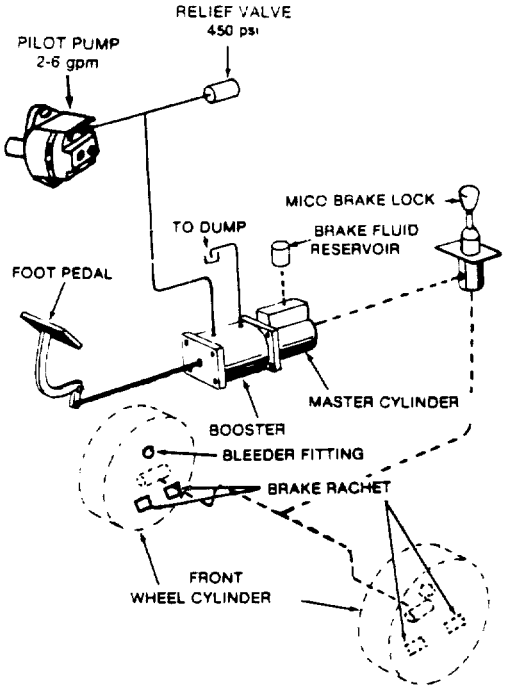
3. If the brakes don't hold on the ramp, or if the unit stops too quickly, make the following adjustments, from level ground, with fork on ground.

4. a. Use the bleeder fittings located at each front wheel to bleed air from the brake lines.

   b. Pull plugs from lower inside of each front axle hub, and with a screwdriver or brake adjusting tool, turn the brake rachet until each side bottoms and then back off 2 clicks. **To tighten the left rachet, turn rachet down; to tighten the right rachet, turn rachet up.**

   c. Make sure the brake fluid reservoir, located behind the operator's cab, is full.





HOW TO TEST AND ADJUST THE INCHING MECHANISM

In a safe area, drive the Gradall, Loed Materials Handler and test the inching brake. If it is properly adjusted you should be able to move the Handler very slowly. and under full control. Attempt to inch while turning a sharp turn. If the unit does not respond smoothly, test and adjust as follows:

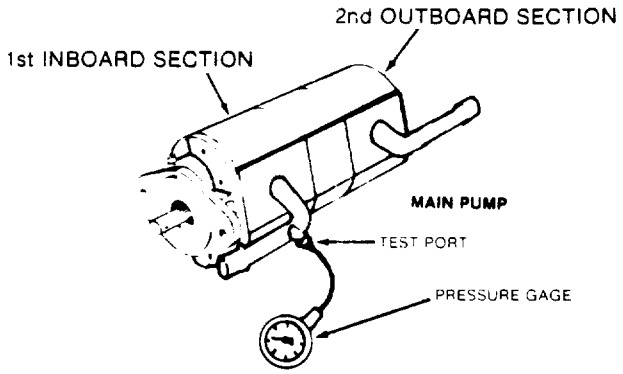
1. Make sure the service brakes are properly adjusted.

2. Install a 0-5000 psi test gage in the tube coming from the #1 pump section.

3. Install a 0-2000 psi test gage in the test port Located in the front brake lines. Bleed the brake lines.

4. Depress the foot pedal to full brake application It should be 3/4" to 1" from the floor. Adjust the brake linkage, if needed.

5. Check the low torque machine switch adjustment. It is located under the floor plate. This switch should disengage with the first 1/2" to 1" of brake pedal movement.



6. **You are now ready to test the inching components:**

   A. Start engine and depress the service brake foot pedal completely down.

   B. Place gear shift in first gear forward with the rear wheels straight.

   C. Increase engine power to full rpm.

   D. Back off on the brake pedal until the brake line gage reads 425 psi. HOLD PEDAL 1N THIS POSITION.

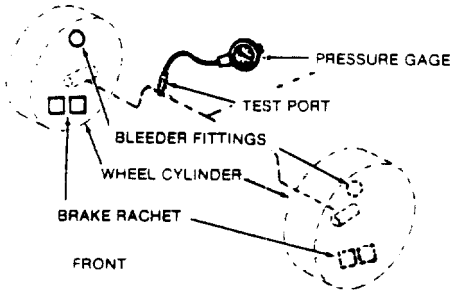
7. At the same time the gage on the #1 Pump tube should read 1100-1300 psi. y over or under, mechanical adjustment of the inching linkage is required.

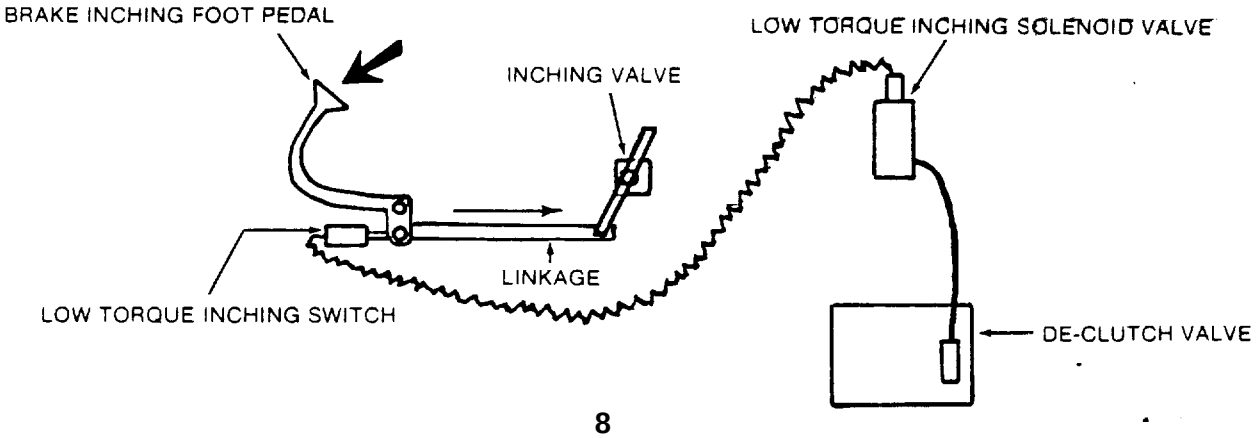
8. If the test gage reading is over 1300 psi, increase linkage length to inching valve by adjusting yoke one turn and repeat test.

9. If the test gage reading is under 100 psi decrease the linkage length to inching valve by turning yoke one turn and repeat test.

10. After adjustment, test the Materials Handler to make sure it inches corrective. Remove gages and recap test ports when test is completed.

NOTE: Inching valve spool should not be bottomed out against the stop in either direction





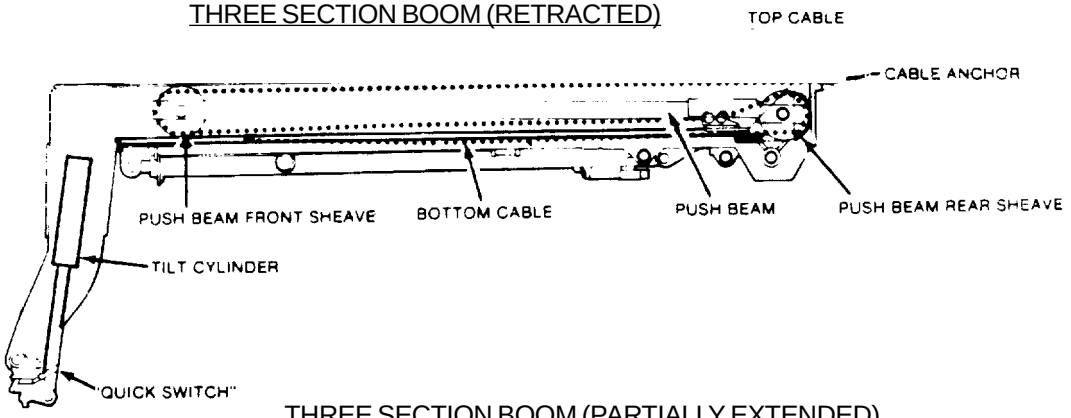
HOW TO CHECK AND ADJUST THE BOOM CABLE

Two boom cables move the boom sections. The cables are fastened to the rear of the main boom and to the bottom side of the main boom.

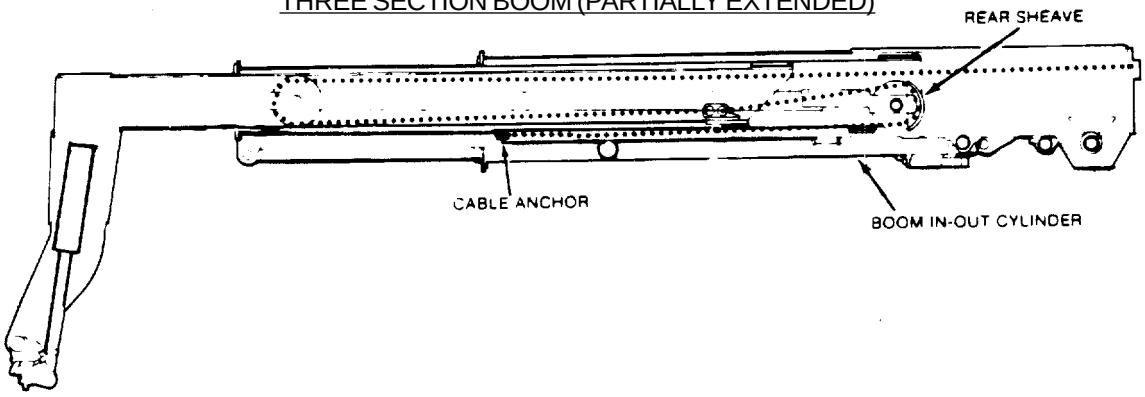
Start engine and run the boom all of the way out, then retract it slightly. Stop Engine. Remove the cover from the rear of the main boom and visually check for any sag in the top cable.

If there appears to be excessive sag in the top boom cable. tighten the rear cable anchor nut. Secure cable with wrench to prevent it from twisting and tighten the adjusting nut to approximately 50 to 75 foot pounds of torque. Tightening the rear of the top cable will automatically take up any slack in the bottom cable.

THREE SECTION BOOM (RETRACTED)



THREE SECTION BOOM (PARTIALLY EXTENDED)



BOOM SLIDER PAD ADJUSTMENT

Slider pads are used between booms to prevent boom wear. If excessive clearance appears between the boom sections. pads should be adjusted by shimming.

HOW TO TEST PADS FOR EXCESSIVE CLEARANCE (OVER 1/16") BETWEEN BOOMS

To test the boom clearance, extend the boom fully and place the head or the attachment on the ground Raise and lower the boom slowly and observe the clearance between the pads and the boom sections.

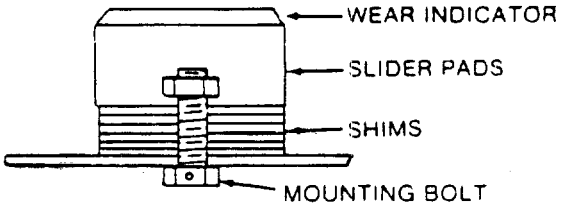
Also inspect the mating surface of each of the top and bottom pads. These pads are beveled on the sides. When they wear down to a point where there is no more bevel, they should be replaced

If adjustment is called for, shims should be added to bring the pads back into close contact with the adjacent boom. Add shims until no more shims can be added.

PROCEDURE FOR INSTALLING BOOM BEARING RETAINING BOLTS

- Shim bearing to proper fit.
- When installing bearing retaining bolt. make sure end of bolt is not sticking out of bearing insert to the point where it would be in the bearing wear area. To achieve this, you may have to use washers under the heads of the bolts as shims. If this causes the bolt heads to hit other boom bearings exchange these bolts for ones of correct length.
- 3/8" bearing retainer bolts should be installed with loctite and then torqued to 20-ft./lbs
- 1/2" bearing retainer bolts should be installed with loctite and then torqued to 60-ft./lbs.
- When rechecking bolts at correct torque after loctite has set they should not turn. If they do turn more than 360ø they must be removed and loctite reapplied.

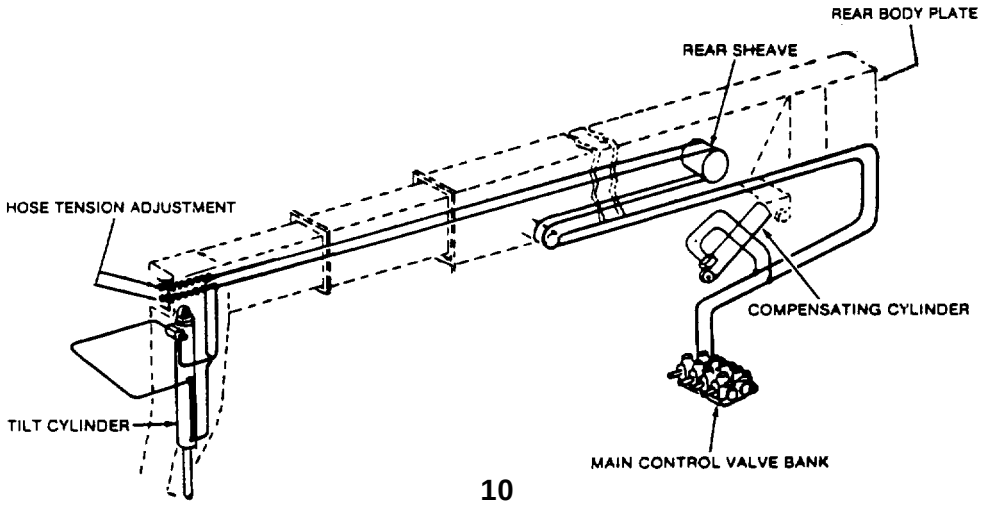
  NOTE: When removing bearing pad bolts to reapply loctite only remove one bolt at a time. Reinstall the bolt and tighten before removing another bolt. This prevents the shims or bearing pad from falling out of place.



HOW TO CHECK AND TIGHTEN BOOM HOSES

The hoses carrying oil to the front of the boom are clamped to the bottom plate of the main boom. To keep them against the two sheave assemblies, hose tensioning devices are clamped to each hose at the very front top of the inner boom.

Remove the rear main boom plate and visually inspect, using a flashlight, to see if the hoses are tight against the rear sheave. If there appears to be slack in the hoses, tighten them by turning in on the adjusting nuts. Loosen the jam nut and tighten as required. When proper tension is obtained, tighten the jam nut and replace the rear plate.



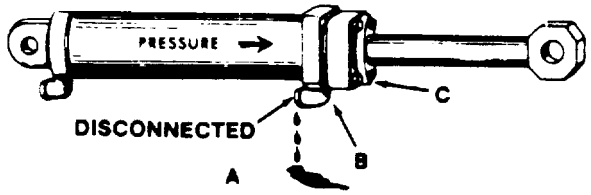
HOW TO TEST HYDRAULIC CYLINDER EFFICIENCY (By-Pass Test)

One of the easiest tests is to observe the amount of oil being forced past the piston rings inside of the cylinder. The amount of oil which flows indicates the condition of the cylinder.

A. Oil flowing from open cylinder port indicates worn piston rings, or worn "O" ring between the piston and the cylinder rod.

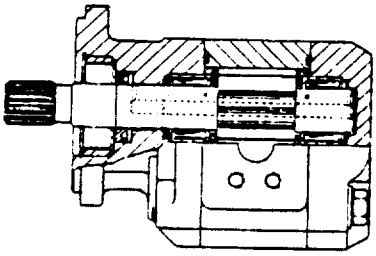
B. Leakage indicates leaking head to barrel seal.

C. Leakage indicates loose or worn rod packing.



HOW TO TEST HYDRAULIC MOTORS

1. Set fork on the ground.
2. Disconnect the hose at the rod end of the cylinder. Plug or cap this hose.
3. Actuate control to extend cylinder.
4. Observe the oil by-pass coming from the cylinder port. (See A, B & C)



HOW TO TEST HYDRAULIC MOTORS (Always check pump and circuit relief valves before checking motors)

We recommend that hydraulic motors be placed on a test stand to evaluate their efficiency.

HYDRAULIC CIRCUITS

Circuit	GPM	Pump Relief Valve psi	Circuit Relief Valve psi
Sway	31.5	3000	
Tilt	31.5	300	3250
Crowd (In-Out)	31.5	3000	
Lift	31.5	3000	
Auxiliary	31.5	3000	
Rear Drive	31.5	3000	3000 to 3200
Steering	0-16 (on demand)	3000	2000
Pilot	2 to 6	450	

Before testing the hydraulic system it is important that you read and understand System Operations of 534B, and the Safety Manual. Then make the following checks:

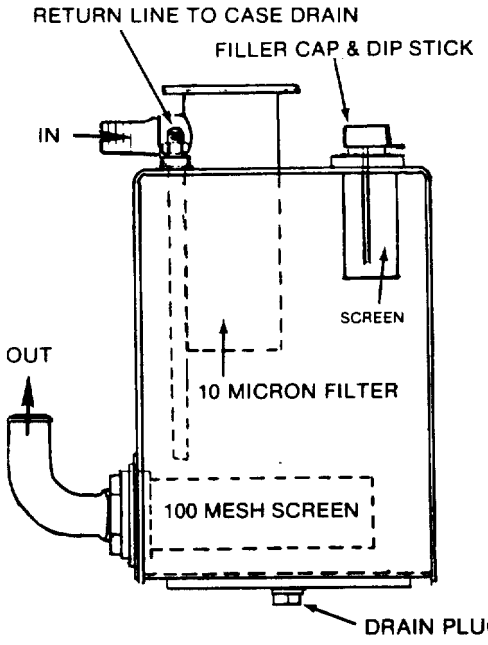
Engine RPM: Using tachometer, check engine rpm at both idle speed and high speed (with the accelerator fully depressed). The tachometer reading should be:*

Idle.....900 rpm approx.
High .....2800 rpm approx.

Next, check with the boom retracted fully while holding back on the control lever. It should about 2600 rpm.

**If unable to get proper rpm call in a qualified engine mechanic and follow manufacturer's recommendations.*

Reservoir: Drain some oil from the plug at the bottom of the reservoir into a glass bottle and allow it to settle. If dirt or water is present, drain and clean reservoir, replace filter and fill with new hydraulic fluid to proper level. Start engine and bring oil to operating temperature. **Never test pressures with cold oil.**

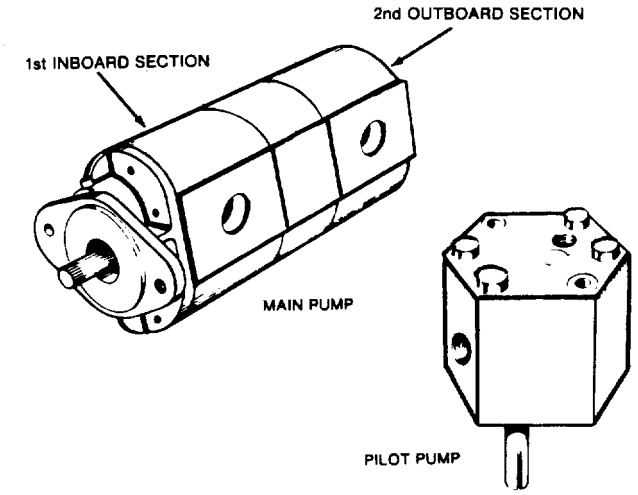


WARNING: DO NOT OPERATE GRADALL MATERIALS HANDLER UNLESS FLUID IS AT PROPER LEVEL.

PUMPS

Speed of hydraulic functions is determined by the volume of oil provided for the functions. Power (force) is determined by the pressure built up to perform work. Slow action in a circuit indicates that either the pump is not putting out the required volume or that leakage is taking place.

The ability of a pump to build up pressures strong enough to open the pump relief valve is one indication of pump efficiency. However, it is possible for the pump to build up this pressure, and still not be putting out the required volume of oil.



BLEEDING OFF CIRCUIT PRESSURE

To remove a high pressure build-up in a circuit, physically drain off oil. This can be done for relieving circuit pressures or for situations such as removal of a Mini-check test port.

1. Place forks on ground and shut off engine. Set parking brake.

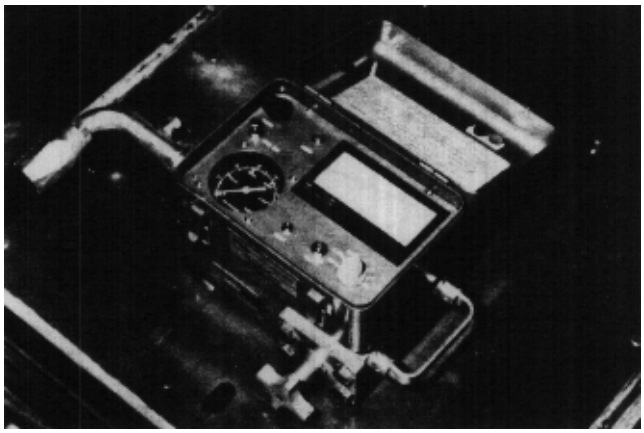
2. Install Mini-check hose, less the gage. Point the hose towards oil container. Use a covered container to avoid splash.

3. Drain off and collect the oil.

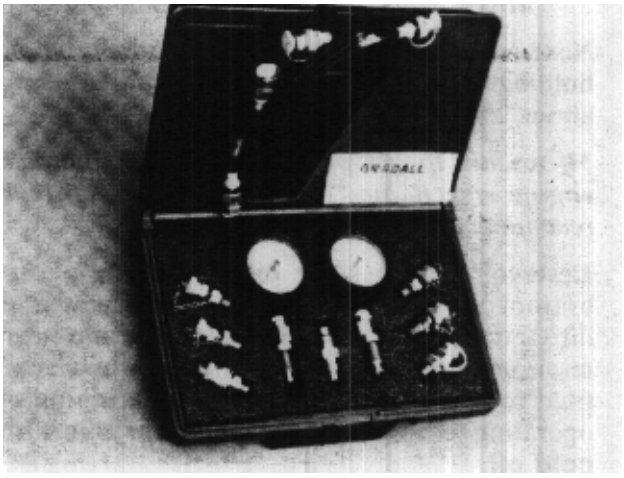
With a hydraulic failure or an engine shut-off, it is necessary to bleed the pilot line going to the lock-out valve. Remove one end of the line and drain the fluid into an open container. *For instance if under these conditions the boom is raised, it is necessary to bleed the line to lower the boom.*

TOOLS NEEDED TO TEST SYSTEM

Hydraulic Flow Meter. This meter measures pump flow under varying pressure conditions. You can measure actual pump output, both with no resistance and with resistance imposed against it. Contact your Gradall Materials Handler Distributor.



Hydraulic Pressure Gages. We recommend a 0-1000 psi gage and a 0-5000 psi gage for ease of testing. Kit 7713-4197 includes both gages and a selection of adapters and hoses.



Other Tools Needed:
5/16" Allen wrench for pilot valves.
3/16" Allen wrench for steering valve.
Volt Ohm-Ampere Meter.
Selection of wrenches and screwdrivers.

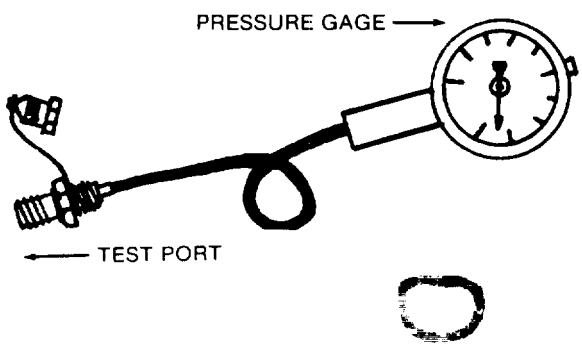
HOW TO TEST PUMP FLOW

Insert a flow meter into the output (pressure port) of the pump, and observe actual pump flow. Tests should be made for volume with no resistance and then with resistance equal to the pump relief valve setting. An inefficient or worn pump may pump full volume of oil under no load, but almost nothing the under full resistance.

Flow meter readings will show less than the theoretical rating because of back pressures, the thinning out of oil because of temperature, and the resistance caused by relief valves. At 180ø F., flow meter reading will show less gallonage than at 120° F. As a pump works, the pump output will also be reduced depending upon the degree of internal wear.

TEST PORTS

The Gradall Materials Handler has test ports for main relief and circuit relief testing. Mini-check type of test ports have a one-way check valve to prevent loss of oil whenever the cap is removed. As the gage (or hose) adapter is installed and tightened, the one-way check is unseated and the circuit is available for testing.



TESTING HYDRAULIC RELIEF VALVE PRESSURES

The reason for testing the main relief valves is to assure that the relief valves open and to limit the pressure in the lines at that time.

A. The engine should be turning at full governed rpm.

B. The hydraulic oil should be warmed up to operating temperature.

C. The test gage or gages should be installed in the circuit being tested.

D. The circuit function should be stalled by either running the cylinder to the end of its stroke or by stalling the motor action.

E. With the control levers actuated, a gage reading is taken. The gage indicates the setting of the respective relief valve.

Circuit relief valves are used in some circuits to protect the Gradall Materials Handler from external forces.

Other relief valves are installed in the circuit to limit the pressures for that circuit or to control flow during specific actions.

ADJUSTING RELIEF VALVES

All of the relief valves can be adjusted using an allen wrench or a screwdriver. Loosen the lock nut, and turn the adjusting screw clockwise to increase the pressures. Turning it counter-clockwise will decrease the pressures. The valve adjustment is sensitive, so adjust in small moves, like 1/8 to 1/4 turn at a time. Tighten lock nut after adjustment.

HOW TO TEST AND ADJUST MAIN CONTROL VALVE RELIEF

Set pressures with oil at operating temperature and engine at 2800 rpm.

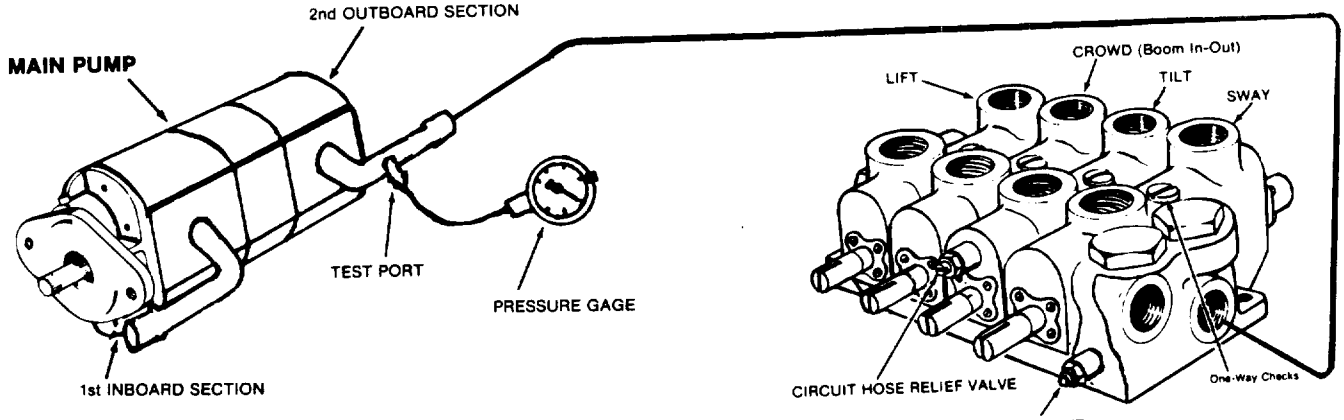
1. Install gage in test port tandem pump outboard tube.

2. Retract boom fully and hold control lever full to left.

3. Gage should read 3000 psi.

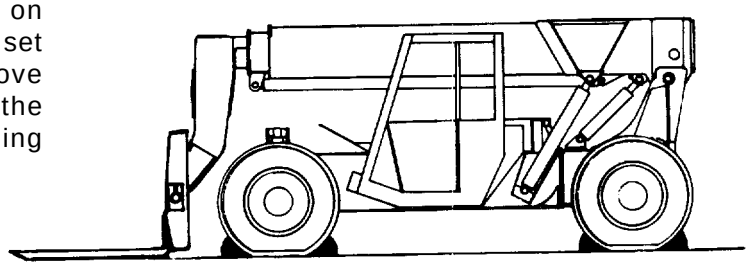
4. Adjust, reseal or replace relief valve, as necessary.

5. Remove gage and recap test port.

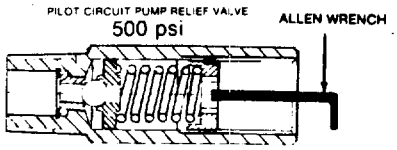


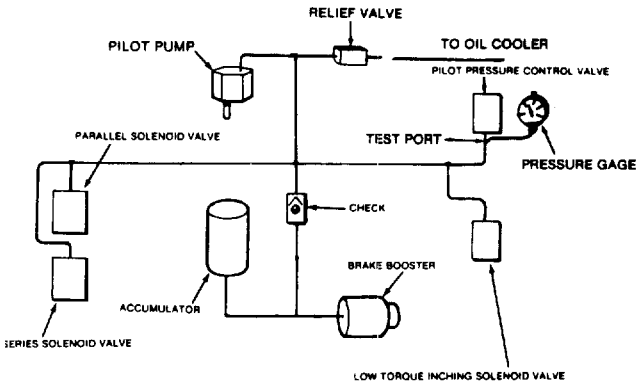
Park Materials Handler on level ground with forks on ground. Shut off engine, set parking brake and remove ignition key. Chock the wheels before performing any servicing

FORK ON FROUND →



HOW TO TEST AND ADJUST PILOT PUMP RELIEF VALVE





1. Remove the one end of the hose (at Pilot Pressure Control Valve) that comes from the pressure side of the Pilot Pump.
2. Install 1000 psi gage in end of this hose.
3. Start engine and run at idle rpm.
4. The pilot pressure should read 500 psi.
5. If adjustment is needed, remove line in relief valve (located near pilot pump), and raise or lower pressure to reach 500 psi. Use a 5/16″ allen wrench to adjust this valve.
6. If adjustment cannot be made, replace relief valve.
7. Replace hoses and remove gage.

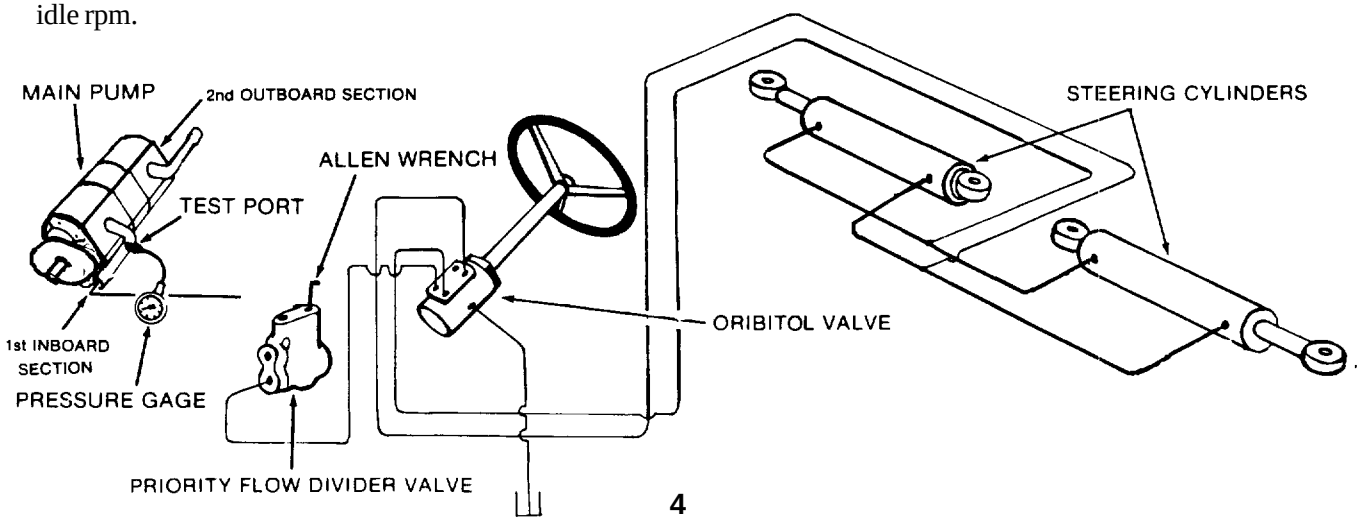
TESTING AND ADJUSTING THE STEERING CIRCUIT RELIEF VALVE

The circuit relief for the steering circuit is located in the priority flow divider valve.

1. Insert the pressure gage in the test port on the tube coming from the Ist or inboard pump section.
2. Turn the steering wheel in either direction until the rear wheels bottom against the stops. continue to attempt to turn the wheel.
3. The gage should read 2000 psi with engine at idle rpm.

If the adjustment is needed, remove the hose and fitting from the rear top port of the priority valve and adjust pressure. Using an allen wrench, located inside the port, turn clockwise to increase pressure or counter-clockwise to decrease the pressure.

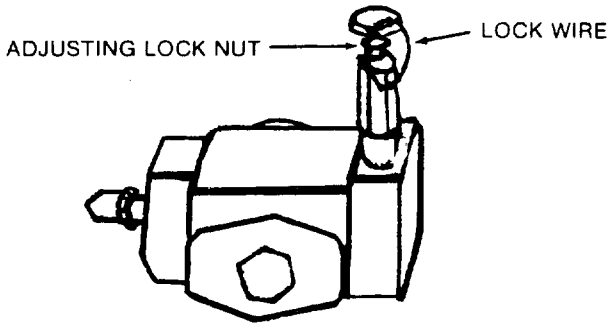
NOTE: The circuit relief is to be maintained at 2000 psi.



TO TEST AND ADJUST DRIVE CIRCUIT RELIEF VALVES

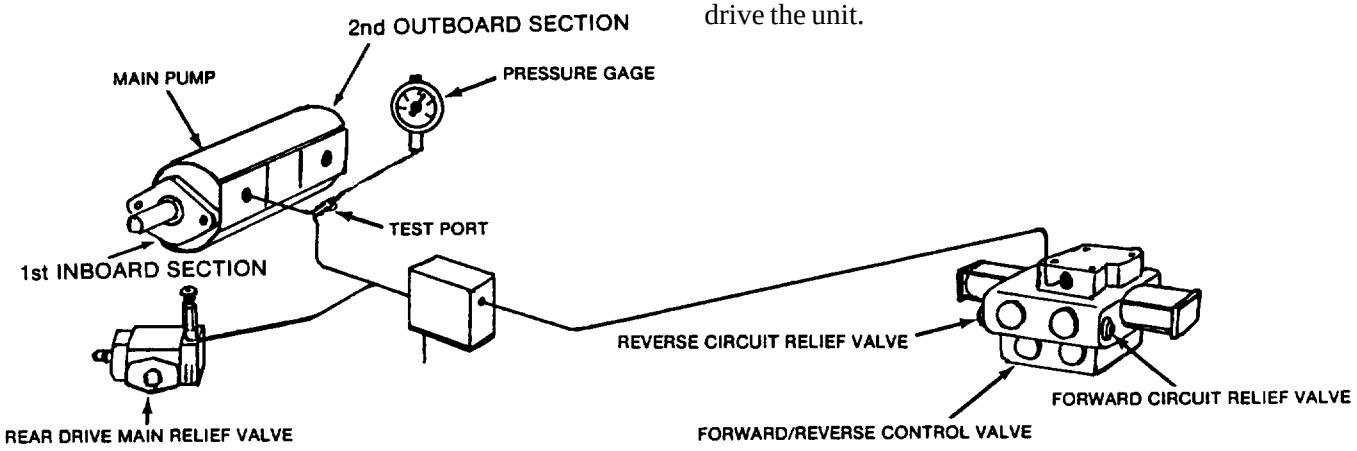
1. Remove lock wire from Rear Drive Main Relief Valve.
2. Install pressure gage in test port (1st, inboard section) of the tandem pump tube.
3. Start engine and loosen lock nut and "bottom lightly" and back off 1/2 turn.
4. Tighten lock nut after adjustment
5. Place transmission in forward position and 2nd gear.
6. Hold inching/service brake completely down and set Mico Brake Lever.
7. Slowly release service brake pedal, metering oil to rear drives.
8. Observe gage reading. The circuit relief in the Forward/Reverse Control Valve should open between 3000 and 3200 psi.
9. Adjust reseal or replace relief valve as necessary. The forward circuit relief valve is located closest to the inside of the machine within the Forward/Reverse Control Valve.

   REPEAT THE ABOVE STEPS WITH TRANSMISSION IN REVERSE. The reverse relief valve is toward the outside of the machine within the Forward/Reverse Control Valve.
10. After completing these checks, lower the main drive relief valve to 3000 psi, while stalled in forward or reverse. Tighten lock nut.
11. Turn engine off and wire Rear Drive Main Relief Valve.
12. Remove Test gage and recap test port.



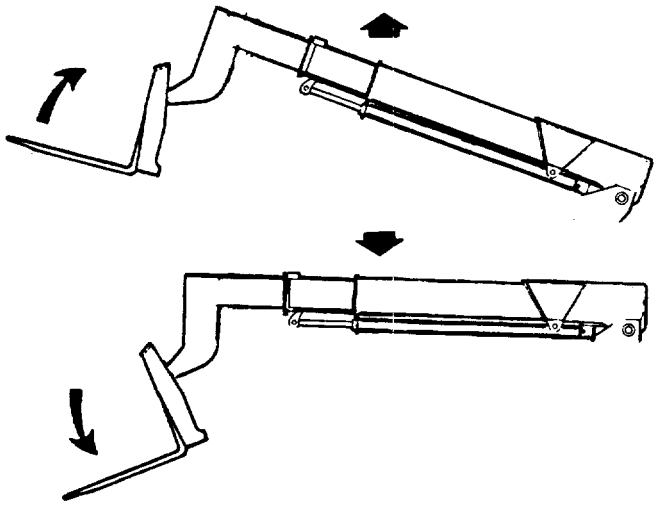
REAR DRIVE MAIN RELIEF VALVE

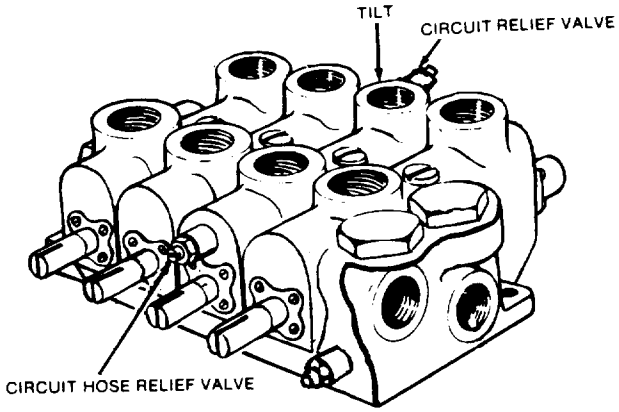
NOTE: Park Materials Handler on level ground with the forks on ground. Chock the wheels before performing this test. Use caution while letting the brake pedal out once pedal is released far enough, the front wheels will engage and attempt to drive the unit.

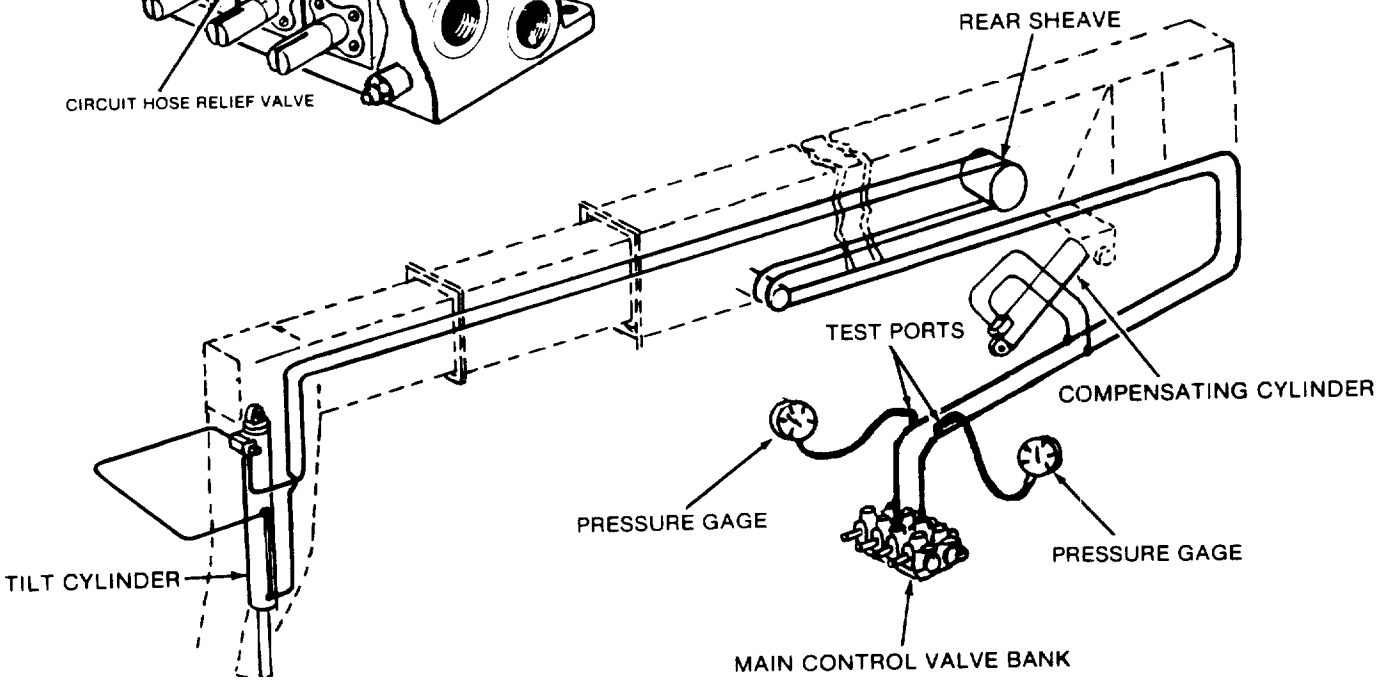


HOW TO TEST TILT CIRCUIT RELIEF VALVES

1. Install gage in test port closest to the cab.
2. Retract the tilt cylinder and raise the boom.
3. The gage should read 3250 psi while the boom is raising.
4. Adjust, reseal or replace relief valve as necessary.
5. Remove gage and recap test port.
6. Place gage in other test port.
7. Extend the tilt cylinder and lower the boom.
8. The gage should read 3250 psi while the boom is lowering.
9. Adjust, reseal or replace relief valve as necessary.
10. Remove gage and recap test port.



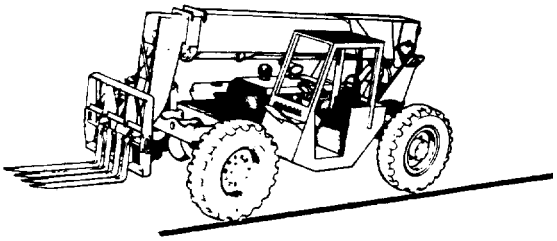


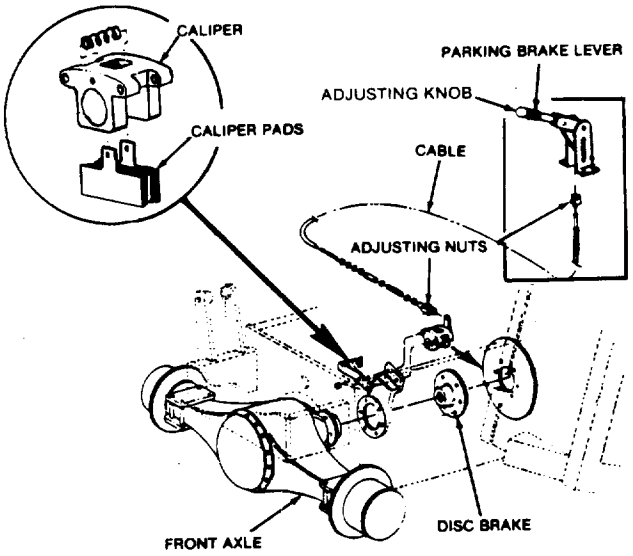


HOW TO TEST AND ADJUST THE PARKING BRAKES

Slowly and safely drive unit on a 10 to 15 degree incline. Make sure the area is clear of traffic, and workmen. Apply parking brakes. If brakes do not hold, return to a level surface and turn the hand knob on the top of the parking brake lever clockwise. Retest the parking brake on the incline.

If the knob adjustment fails to hold the Materials Handler, there is another adjustment at the other end of the parking brake cable.





HOW TO TEST AND ADJUST THE SERVICE BRAKES

1. In a clear, safe area, slowly drive the Gradall/Loed Materials Handler on a level surface and test the service brakes.

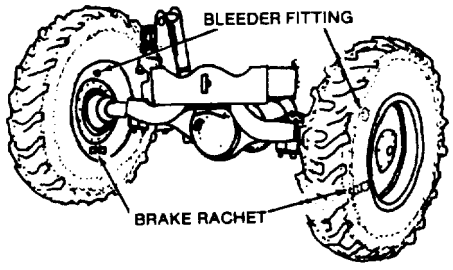
   If this test is OK, try the same test on a 10 to 15 degree ramp. Apply foot pedal and set mico lock.

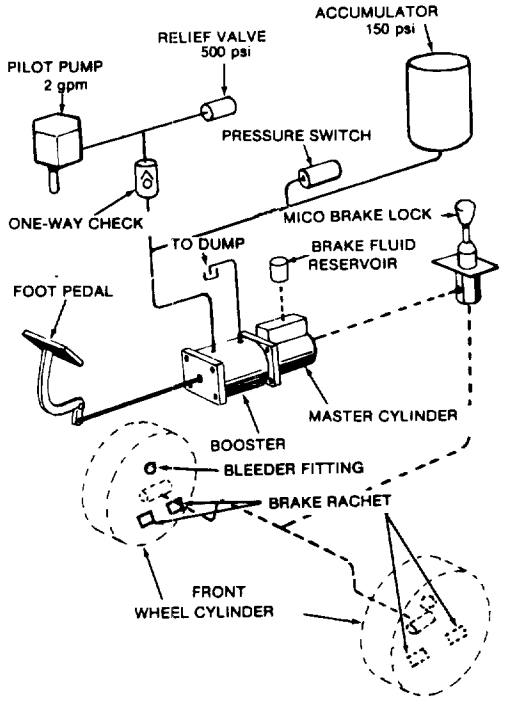
   If the brakes don't hold on the ramp, or if the unit stops too quickly, make the following adjustments, from level ground, with fork on ground.

   4. a. Use the bleeder fittings located at each front wheel to bleed air from the brake lines.

      b. Pull plugs from lower inside of each front axle hub, and with a screwdriver or brake adjusting tool, turn the brake rachet until each side bottoms and then back off 2 clicks. **To tighten the left rachet, turn rachet down; to tighten the right rachet, turn rachet up.**

      c. Make sure the brake fluid reservoir, located behind the operator's cab, is full.





HOW TO TEST AND ADJUST THE INCHING MECHANISM

In a safe area, drive the Gradall/Loed Materials Handler and test the inching brake. If it is properly adjusted you should be able to move the Handler very slowly, and under full control. Attempt to inch while turning a sharp turn. If the unit does not respond smoothly, test and adjust as follows:

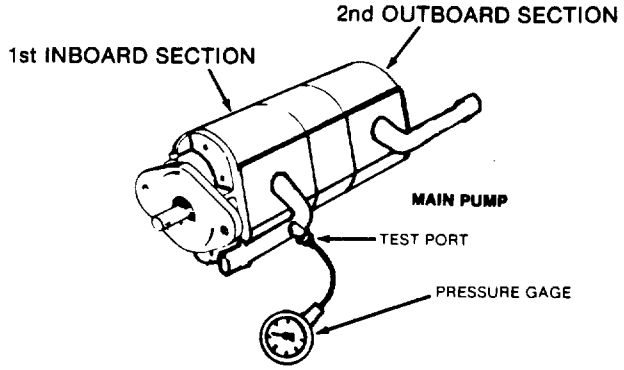
1. Make sure the service brakes are properly adjusted.

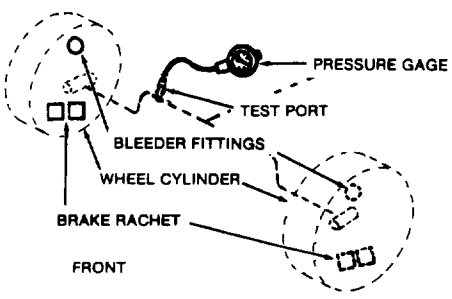
2. Install a 0-5000 psi test gage in the tube coming from the # I pump section.

3. Install a 0-2000 psi test gage in the test port located in the front brake lines. Bleed the brake lines.

4. Depress the foot pedal to full brake application. It should be 3/4" to 1" from the floor. Adjust the brake linkage, if needed.

5. Check the low torque inching switch adjustment. It is located under the inching control assembly, under the seat mounting plate. This switch should disengage with the first 1/2" to 3/4" of brake pedal





6. **You are now ready to test the inching components:**

   A. Start engine and depress the services brake foot pedal completely down.

   B. Place gear shift in first gear forward with the rear wheels straight.

   C. Increase engine power to full rpm.

   D. Back off on the brake pedal until the brake line gage reads 425 psi. HOLD PEDAL IN THIS POSITION.

7. At the same time the gage on the #1 Pump tube should read 1200 psi. If over or under 1200 psi, mechanical adjustment of the inching linkage is required.

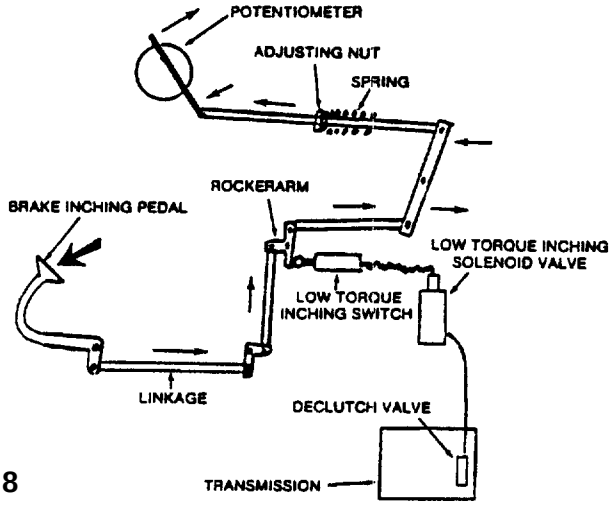
8. If the test gage reading is over 1200 psi, tighten the adjusting nut to add compression to the spring.

9. If the test gage reading is under 1200 psi, loosen the adjusting nut to have less compression to the spring. Secure the jam nut after adjustment.

   Note: This adjustment can be made by the operator as he holds the brake pressure at 425 psi.

10. If unable to get 1200 psi pressure, repeat the pressure test again, making sure all inching brake linkage has smooth movement. Also too high, or too low operating temperature of the torque converter/transmission will cause pressure to vary.

11. After adjustment, test the Materials Handler to make sure it inches correctly. Remove gages and



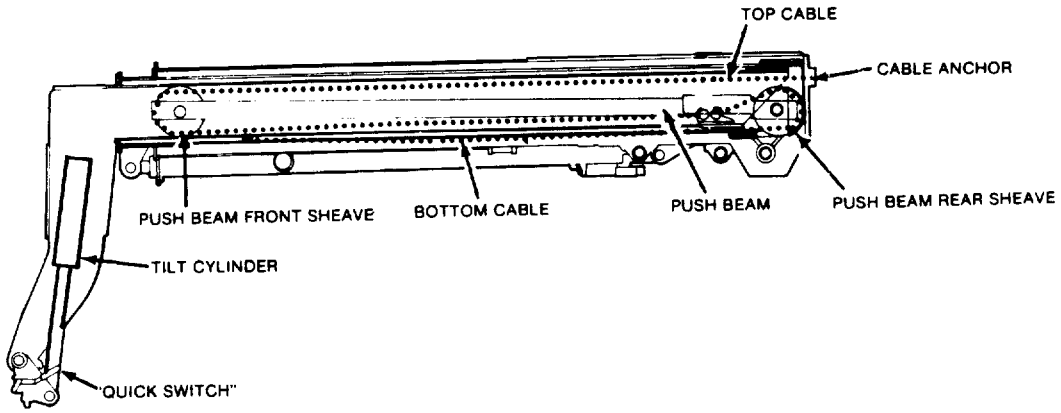
HOW TO CHECK AND ADJUST THE BOOM CABLE

Two boom cables move the boom sections. The cables are fastened to the rear of the main boom and to the bottom side of the main boom.

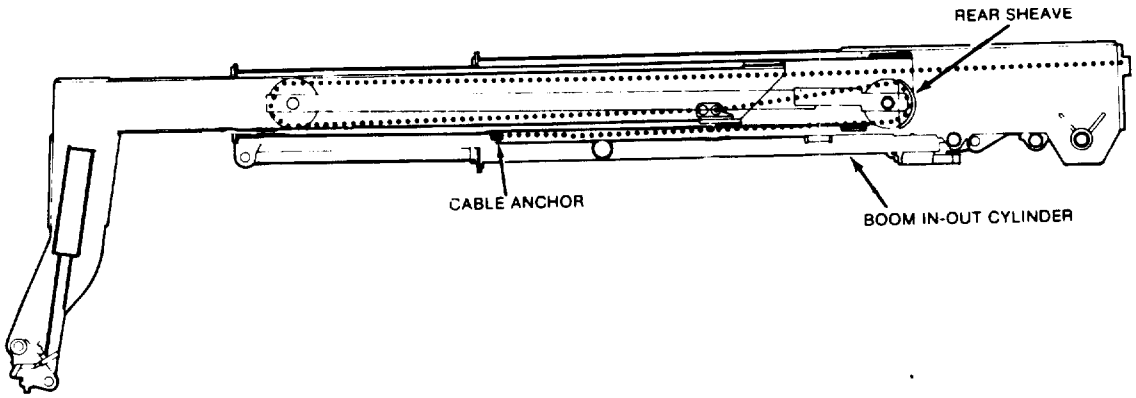
Start engine and run the boom all of the way out, then retract it slightly. Stop Engine. Remove the cover from the rear of the main boom and visually check for any sag in the top cable.

If there appears to be excessive sag in the top boom cable, tighten the rear cable anchor nut. Secure cable with wrench to prevent it from twisting and tighten the adjusting nut to approximately 50 to 75 foot pounds of torque. Tightening the rear of the top cable will automatically take up any slack in the bottom cable.

THREE SECTION BOOM (RETRACTED)

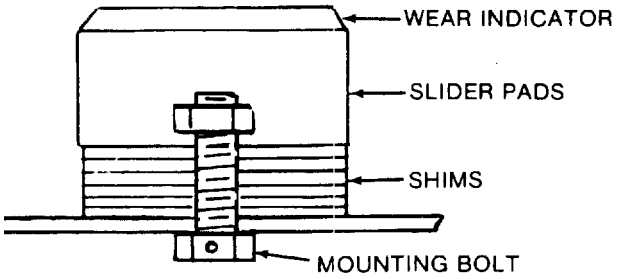


THREE SECTION BOOM (PARTIALLY EXTENDED)



BOOM SLIDER PAD ADJUSTMENT

Slider pads are used between booms to prevent boom wear. If excessive clearance appears between the boom sections, pads should be adjusted by shimming.



HOW TO TEST PADS FOR EXCESSIVE CLEARANCE (OVER 1/16") BETWEEN BOOMS

To test the boom clearance, extend the boom fully and place the head or the attachment on the ground. Raise and lower the boom slowly and observe the clearance between the pads and the boom sections.

Also inspect the mating surface of each of the top and bottom pads. These pads are beveled on the sides. When they wear down to a point where there is no more bevel, they should be replaced.

If adjustment is called for, shims should be added to bring the pads back into close contact with the adjacent boom. Add shims until no more shims can be added.

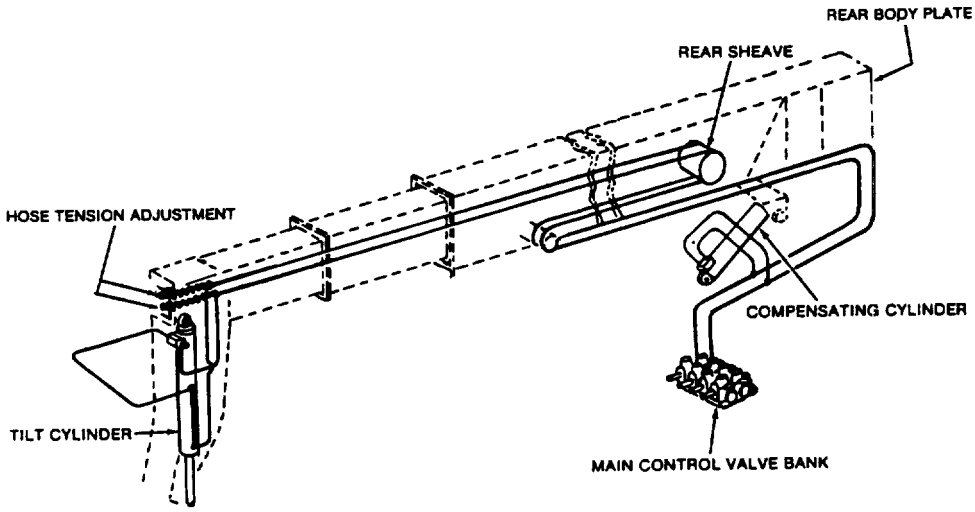
TO ADD SHIMS

Each slider pad is attached to the boom using either two or three bolts. Loosen the bolts and position the boom to open the gap for that pad area. (On the top pads and on the bottom pads, this can be done by applying down pressure or by raising the boom slightly above ground level). Add shims and tighten the locking bolts. *Note: To maintain proper bolt engagement in pad, bolt length may have to be changed to compensate for shim removal or addition. A bolt too long will damage pad and one too short may allow bolt to lose torque and fall out.*

HOW TO CHECK AND TIGHTEN BOOM HOSES

The hoses carrying oil to the front of the boom are clamped to the bottom plate of the main boom. To keep them against the two sheave assemblies, hose tensioning devices are clamped to each hose at the very front top of the inner boom.

Remove the rear main boom plate and visually inspect, using a flashlight, to see if the hoses are tight against the rear sheave. If there appears to be slack in the hoses, tighten them by turning in on the adjusting nuts. Loosen the jam nut and tighten as required. When proper tension is obtained, tighten the jam nut and replace the rear plate.



HOW TO TEST THE CM ASSEMBLY (UNDER DASHBOARD)

The function of the CM Assembly is to supply a continuous regulated 6 volt supply to the F/R Pilot Pressure Control Valve. The assembly includes a 5 amp manual reset breaker.

The CM Assembly must be removed from the Materials Handler for testing.

A Volt/Ohm Meter and two test leads are needed to test this unit.

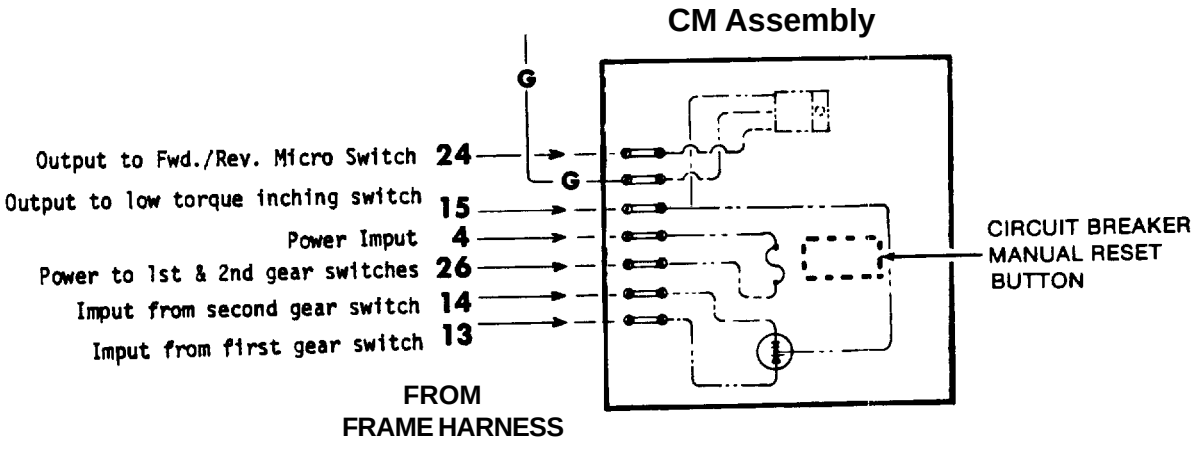
1. To test the Circuit Breaker, connect the leads on the Ohm meter to terminals 4 and 26 in the CM Assembly. The meter should read 0 with the breaker button set to the "IN-OFF" position. It should read "infinity" in the "OUT-ON" position.

2. To test regulator, connect a test lead from the negative post of a 12 volt battery to terminal "G". Also connect a test lead from the positive post of the battery to terminal 13. Using the volt meter, measure the voltage between terminal "G" ground and terminal 24. The meter should read 6 volts.

   Move test lead from terminal 13 to terminal 14. Measure the voltage between terminal "G" and 24 again. It should read 6 volts.

If these values cannot be achieved, replace the CM Assembly.

The 5 amp circuit breaker protects the rear drive electrics. If you have an electrical problem and this circuit breaker is not affected, then the problem is not in the rear drive electrics.



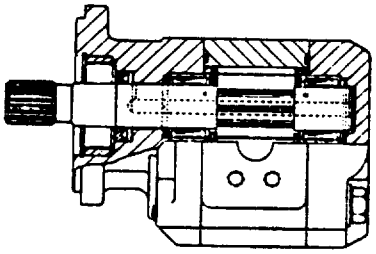
HOW TO TEST HYDRAULIC CYLINDER EFFICIENCY (By-Pass Test)

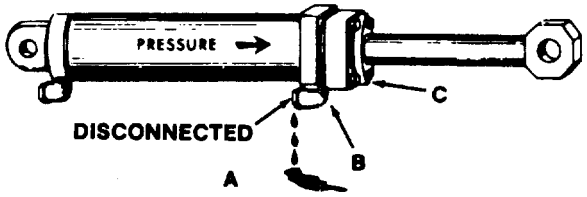
One of the easiest tests is to observe the amount of oil being forced past the piston rings inside of the cylinder. The amount of oil which flows indicates the condition of the cylinder.

A. Oil flowing from open cylinder port indicates worn piston rings, or worn "O" ring between the piston and the cylinder rod.

B. Leakage indicates leaking head to barrel seal.

C. Leakage indicates loose or worn rod packing.





HOW TO TEST A CYLINDER

1. Set fork on the ground.
2. Disconnect the hose at the rod end of the cylinder. Plug or cap this hose.
3. Actuate control to extend cylinder.
4. Observe the oil by-pass coming from the cylinder port. (See A, B & C)

HOW TO TEST HYDRAULIC MOTORS (Always check pump and circuit relief valves before checking motors)

We recommend that hydraulic motors be placed on a test stand to evaluate their efficiency.

HYDRAULIC CIRCUITS

Circuit	GPM	Pump Relief Valve psi	Circuit Relief Valve psi
Sway	31.5	3000	
Tilt	31.5	3000	3250
Crowd (In-Out)	31.5	3000	
Lift	31.5	3000	
Auxiliary	31.5	3000	
Rear Drive	31.5	3000	3000 to 3200
Steering	0-16 (on demand)	3000	2000
Pilot	2 to 3	500	

GRADALL® MATERIAL HANDLER TROUBLE SHOOTING FOR 544 & 534B DRIVE SYSTEM

The Gradall Material Handlers, Models 544 and 534B have unique 4 wheel drive systems. The drive is a design between independent mechanical front drive and hydraulic rear drive systems, accomplished through an electric interface. This guide covers the hydraulic drive system and the electric interface between it and the mechanical drive. (Trouble shooting the mechanical drive proper is not covered.) In order to trouble shoot one must have basic tools and a basic understanding of how the drive works:

The front wheels are driven through a powershift transmission. This transmission is the "master" drive system. By "master" we mean the hydraulic rear drive senses what the mechanical drive is doing and reacts accordingly. The rear drive signal for forward and reverse is obtained from two microswitches located under the dash near the transmission control cable. This signal ultimately drives the spool of the forward/reverse valve. The sigual for first gear for the rear drive comes from a pressure switch connected to the first gear clutch port on the transmission. Likewise, the second gear signal originates at the second gear clutch port. Both of these signals control the series/parallel valve spool, i.e., parallel flow in first, series flow in second. During third gear operation the rear drive automatically free wheels, this means that in third the machine is two wheel drive which yields a fuel efficient system during long high speed runs. This free-wheel signal comes from the third gear transmission clutch pressure port. The free-wheeling signal actuates the cavitation valve.

NOTE: When roading over two (2) miles the rear hubs shouid be disengaged.

Inching is accomplished by disconnecting the mechanical front wheel drive and powering only with the rear wheels. When depressing the clutch/brake pedal, an electrical signal is sent disconnecting the front drive transmission, further movement of the clutch/brake pedal varies the flow to the rear drive through the utilization of the hydraulic controller.

REAR WHEELS DRAG ENGINE DOWN

PROBLEM	PROBABLE CAUSE	REMEDY
CAVITATION VALVE NOT OPERATIONAL	Loose wire at cavitation valve or third gear pressure switch.....	Repair
SERIES PARALLEL SHIFTED IN THIRD GEAR	Too much back pressure in pilot drainline at series/parallel valve.....	Repair
	Faulty third gear pressure switch	Replace
	Faulty cavitation valve.....	Check wiring from pressure switch. eck valve.
	Faulty series/parallel valve (broken springs, sticky spool).....	Check solenoids and wiring. Clean spool. Replace spring, O-Rings.
CONTROLLER ONLY PARTLY SHIFTED IN FIRST & SECOND GEAR	Controller stuck	Check valve and wiring
	Low pilot pressure	Reset pilot pressure, 350 psi

REAR WHEEL SKID (LOCK UP) OR ROTATE VERY SLOWLY

PROBLEM	PROBABLE CAUSE	REMEDY
LOSS OF ELECTRIC SIGNAL TO CONTROLLER WHEN IN FIRST	Wire loose or broken on first gear pressure switch	Repair
	Wire loose or broken at diode	Repair
	First gear pressure switch faulty	Replace
	Diode faulty	Replace
	Low transmission first gear clutch pressure	Check fluid level, check linkage, make sure spool is shifted properly, check Clark service manual. Check and clean suction screen.
LOSS OF ELECTRIC SIGNAL TO CONTROLLER WHEN IN SECOND	Wire loose or broken on second gear pressure switch	Repair
	Wire loose or broken at diode	Repair
	Second gear pressure switch faulty	Replace
	Diode faulty Replace	Replace
	Low transmission second gear clutch pressure	Check fluid level, check linkage, make sure spool is shifted properly, check Clark service manual. Check and clean suction screen.
SERIES/PARALLEL VALVE NOT RETURNING TO NEUTRAL IN THIRD GREAR	Drain from series/parallel solenoid valves blocked or restricted	Check lines, clean or replace.
	Series/parallel solenoid valve spool sticking in “On” position	Check solenoid and wiring.
	Faulty series/parallel valve (Sticky or broken spring)	Repair, check plunger. Replace spring and O-Rings.
LOSS OF ELECTRIC SIGNAL TO CONTROLLER IN FIRST & SECOND	Wire loose at diode	Repair
	Wire loose at controller	Repair
	Wire loose at controller	Repair
LOW PILOT PRESSURE	Wire loose at first and second pressure switches	Repair
CONTROLLER STUCK	Low Pilot Pressure	Reset, 350 psi
	Diode faulty	Replace
	Both first and second pressure switches faulty	Replace
	Controller stuck	Check pilot pressure. Repair valve.

REAR WHEELS WON'T DRIVE

PROBLEM	PROBABLE CAUSE	REMEDY
LOSS OF ELECTRIC SIGNAL TO PARALLEL SOLENOID	One hub locked out	Lock hub in.
	Loose or broken wire at first gear pressure switch	Repair
FAULTY SOLENOID IN FIRST GEAR	Loose or broken wire at parallel solenoid	Repair
	Faulty first gear pressure switch	Replace
	Sticky or faulty parallel solenoid	Check wiring, tear down and fix valve.
	Low first gear clutch pressure	Check fluid level. Check suction screen. Check shifter for full travel
	Low pilot pressure	Reset, 350 psi
LOSS OF ELECTRIC SIGNAL TO SERIES SOLENOID	Loose or broken wire at second gear pressure switch	Repair
FAULTY SOLENOID IN SECOND GEAR	Loose or broken wire at series solenoid	Repair
	Faulty second gear pressure switch	Repair
	Sticky or faulty series solenoid	Replace
	Low second gear clutch pressure	Check wiring, tear down and fix valve.
	Low pilot pressure	Reset, 350 psi.
NOT SUPPOSED TO (2 WHEEL DRIVE IN THIRD) AUTOMATIC FREE WHEEL		
LOSS OF ELECTRIC SIGNAL TO SERIES	Circuit breaker tripped	Reset
AND PARALLEL SOLENOID .	Loose ground wire at series/parallel solenoid valves	Repair
	Return line from series/parallel solenoids blocked or restricted	Repair or replace.
RETURN LINE BLOCKED IN FIRST AND SECOND GEAR	Both rear hubs locked out	Lock in hubs
CONTROLLER ONLY PARTLY SHIFTED	Controller stuck	Repair
	Low Pilot pressure	Reset - 350 psi
IN FIRST AND SECOND DRIVE, AND ONLY AT HIGH THROTTLE	Cavitation valve stuck open	Check wiring. Valve should be closed.

REAR WHEELS GOING IN WRONG DIRECTION

PROBLEM	PROBABLE CAUSE	REMEDY
ELECTRIC SIGNAL REVERSED PLUMBING WRONG	If recently serviced plumbing may be reversed at forward/reverse valve or controller	Switch plumbing
	Wires switched at forward/reverse switches	Switch wires
	One wheel has drive hoses switched. (Only if serviced recently)	Change hose

POOR INCHING

PROBLEM	PROBABLE CAUSE	REMEDY
SIGNAL OR PRESSURE TO KICK OUT TRANSMISSION	Loose or broken wire at cutoff switch operated by brake lever	Repair
	Loose or broken wire at cutoff solenoid	Repair
	Defective cutoff switch	Check wiring, or replace pressure switch
	Low pilot pressure	Reset - 350 psi
	Defective cutoff solenoid	Repair, check wiring. Replace.
IN THIRD GEAR ONLY	Not supposed to be able to	
CONTROLLER NOT BEING ACTUATED BY FOOT MOVEMENT. TRANSMISSION OUT BUT NO "FEEL"	Controller stuck	Check wiring, check operation of valve. Check all linkage.
	Inching valve not operated by foot	Check all linkage from brake pedal to all
	movement .	switches. Make adjustments in linkage as necessary.

REAR WHEELS HAVE MORE EFFORT IN SECOND THAN FIRST

PROBLEM	PROBABLE CAUSE	REMEDY
SERIES PARALLEL CIRCUIT REVERSED	Wires crossed at series/parallel valve solenoids.	Repair
	Wires crossed at first and second pressure switches	Repair

ENGINE STALLS WHEN TRYING TO STOP MACHINE

PROBLEM	PROBABLE CAUSE	REMEDY
CONTROLLER NOT BEING MOVED TO CENTER BY FOOT IN FIRST AND SECOND GEAR	Spool stuck in controller	Repair
	Inching valve linkage failed	Replace. Check linkage on pedal to switches
FIRST, SECOND & THIRD, SAME AS ABOVE, BUT FIRST OR SECOND PRESSURE SWITCH STUCK ON ALSO		Check wiring to switches if O.K. Replace switch.
SPOOL IN CONTROLLER STUCK AND SPOOL IN SERIES/PARALLEL STUCK IN THIRD GEAR ONLY		Check spools for free shifting. Repair

Trouble Shooting Information

Steering Control Units, Char-Lynn

Most steering problems can be corrected if the problem is properly defined. The entire steering system should be evaluated before removing any components. The steering control unit is generally not the cause of most steering problems. The following is a list of steering problems along with possible causes and suggested corrections.

Problem	Possible Cause	Correction
1. Slow steering, hard steering, or loss of power assist.	Worn or malfunctioning pump. Stuck flow divider piston. Malfunctioning relief valve allowing the system pressure to be less than specified. Overloaded steer axle.	Replace pump. Replace flow divider. Adjust or replace relief valve. Reduce load,
2. Wander-Vehicle will not stay in a straight line.	Air in the system due to low level of oil, cavitating pump, leaky fitting, pinched hose, etc. Worn mechanical linkage. Bending of linkage or cylinder rod. Loose cylinder piston. Severe wear in steering control unit.	Correct Repair or replace. Repair or replace. Repair or replace. Replace the steering control unit.
3. Drift-Vehicle veers slowly in one direction.	Worn or damaged steering linkage.	Replace linkage and align front end.
4. Slip-A slow movement of steering wheel fails to cause any movement of steered wheels.	Leakage of cylinder piston seals. Worn steering control unit meter.	Replace seals. Replace steering control unit.
5. Temporary hard steering or hang-up.	Thermal Shock*	Check unit for proper operation and cause of thermal shock.
6. Erratic steering.	Air in system due to low level of oil, cavitating pump, leaky fitting, pinched hose, etc. Loose cylinder piston. *Thermal shock damage. Sticking flow control spool.	Correct condition and add fluid. Replace cylinder. Replace steering control unit. Replace flow control valve.
7. “Spongy” or soft steering.	Air in hydraulic system. Most likely air trapped in cylinders or lines.	Bleed air out of system. Placing ports on top of the cylinder will help prevent air trapping. Add fluid and check for leaks.
8. Free Wheeling-Steering wheel turns freely with no feeling of of pressure and no action on steered wheels.	Low fluid level Steering column upper shaft is loose or damaged. Lower splines of column may be disengaged or broken.	Tighten steering wheel nut. Repair or replace column.

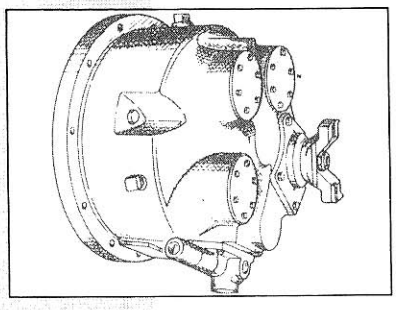
*Thermal shock definition bottom of back page.

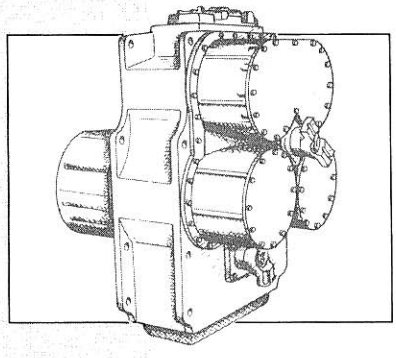
continued . . .

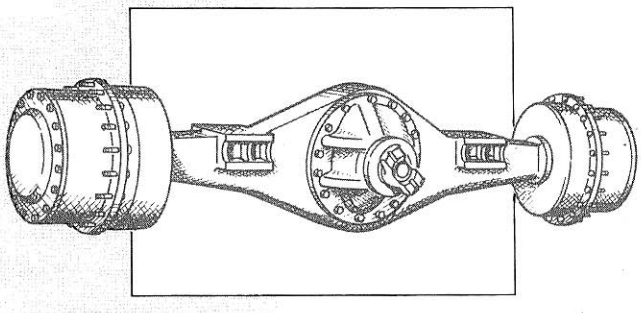
Problem	Possible Cause	Correction
	Steering control unit meter has a lack of oil. This can happen on problem. start-up, after repair, or long periods of non use.	Usually starting engine will cure problem.
	No flow to steering unit can be caused by:	
	1. Low fluid level.	Add fluid and check for leaks.
	2. Ruptured hose.	Replace hose.
	3. Internal steering control unit damage due to thermal shock*.	Replace the unit.
9. Free Wheeling-Steering wheel turns with slight resistance but results in little or no steered wheel action.	Piston seal blown out.	Determine cause. Correct and replace seal.
10. Excessive free play at steering wheel.	Loose steering wheel nut. Steering column shaft worn or damaged. There should be very little free play in the unit itself.	Repair or replace steering wheel connection or column.
11. Excessive free play at steered wheels.	Broken or worn linkage between cylinder and steered wheels.	Check for loose fitting bearings and anchor points in steering linkage between cylinder and steered wheels.
12. Binding or poor centering of steering wheel.	Leaky cylinder seals.	Replace cylinder seals.
	Binding or misalignment in steering column or splined input connection.	Align column pilot and spline to steering control unit.
	High back pressure in tank line can cause slow return to center. Should not exceed 300 psi.	Check for restriction.
	Large particles can cause binding between the spool and sleeve (in Orbitrol).	Clean the unit and filter the oil. If another component has failed generating contaminents, flush the system while bypassing the steering control unit.
13. Steering unit locks up.	Large particles in meter section.	Clean the unit.
	Severe wear and/or broken pin.	Replace the unit.
	*Thermal shock.	Replace the unit.
14. Steering wheel oscillates or turns by itself.	Parts assembled wrong. Steering unit improperly timed.	Correct timing.
	Lines connected to wrong ports.	Reconnect lines correctly.
15. Steered wheels turn in wrong direction when operator activates steering wheel	Lines connected to wrong cylinder ports.	Reconnect lines correctly.
16.Steering wheel kicks at start of steering.	Sticking check valve on steering control unit.	Clean or replace check valve.

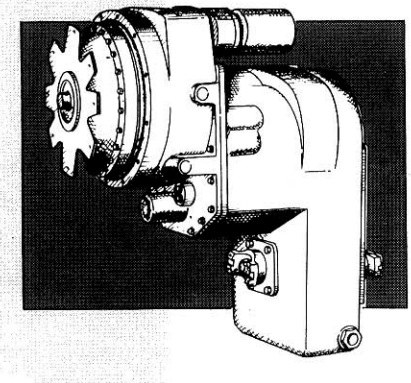
***Thermal shock-A condition caused when the hydraulic system is operated for some time without turning the steering wheel so that fluid in the reservoir and system is hot and the steering control unit is relatively cool (more than 50°F temperature differential). When the steering wheel is turned quickly the result is temp orary seizure and possible damage to internal parts of the steering control unit. The temperary seizure may be followed by total free wheeling.**

Maintenance and Service Manual









18000

Powershift Transmission

2 & 3 SPEED INLINE

CLARK-HURTH COMPONENTS

SM HR182-3 (Rev. 6-93)

Service Publications

I-77 at I-40, Rt. 18, Box 38

Statesville, NC 28677

TOWING OR PUSH STARTING

Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE: If the transmission has 4 wheel drive, disconnect both front and rear drivelines. Because of the design of the hydraulic system, the engine **cannot** be started by pushing or towing.

TABLE OF CONTENTS

NOTE: Metric Dimensions Shown in Brackets [ ].

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-HURTH COMPONENTS** product.

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 product, its principle 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-Hurth Components-**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. **Clark-Hurth Components** does not warrant repair or replacement parts, nor failures resulting from the use of parts which are not supplied by or approved by **Clark-Hurth Components. IMPORTANT: Always furnish the Distributor with the serial and model number when ordering parts.**

NOTES

HOW THE UNITS OPERATE

The transmission and hydraulic torque portion of the power train enacts an important role in transmitting 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. It is necessary to consider both units in the study of their function and operation.

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

The HR Model consists of a torque converter and powershifted transmission in one package mounted directly to the engine.

The shift control valve assembly is mounted directly on the side of the converter housing. The function of the control valve assembly is to direct oil under pressure to the desired directional and speed clutch. A provision is made on certain models to neutralize the transmission when the brakes are applied. This is accomplished through use of a brake actuated shutoff valve. The speed and direction clutch assemblies are mounted inside the transmission case and are connected to the output shaft of the converter by direct gearing. The purpose of the speed or directional clutches is to direct the power flow through the gear train to provide the desired speed range and direction.

With the engine running, the converter charging pump draws oil from the transmission sump through the removable oil suction screen and directs it through the pressure regulating valve and oil filter.

The pressure regulating valve maintains pressure to the transmission control cover for actuating the direction and speed clutches. This requires a small portion of the total volume of oil used in the system. The remaining volume of oil is directed through the torque converter circuit to the oil cooler and returns to the transmission for positive lubrication. This regulator valve consists of a hardened valve spool operating in a closely fitted bore. The valve spool is spring loaded to hold the valve in a closed position. When a specific pressure is achieved, the valve spool works against the spring until a port is exposed along the side of the bore. This sequence of events provides the proper system pressure.

After entering the converter housing the oil is directed through the stator support to the converter blade cavity and exits in the passage between the turbine shaft and converter support. The oil then flows out of the converter to the oil cooler. After leaving the cooler, the oil is directed to a lubricating fitting on the transmission and through a series of tubes and passages lubricates the transmission bearings and clutches. The oil then gravity drains to the transmission sump.

The hydraulic torque converter consists basically of three elements and their related parts to multiply engine torque. The engine power is transmitted from the engine flywheel to the impeller element through the impeller cover. This element is the pump portion of the hydraulic torque converter and is the primary component which starts the oil flowing to the other components which results in torque multiplication. This element can be compared to a centrifugal pump in that it picks up fluid at its center and discharges at its outer diameter.

The torque converter turbine is mounted opposite the impeller and is connected to the output shaft of the torque converter. This element receives fluid at its outer diameter and discharges at its center. Fluid directed by the impeller out into the particular design of blading in the turbine and reaction member is the means by which the hydraulic torque converter multiplies torque.

The reaction member of the torque converter is located between and at the center or inner diameters of the impeller and turbine elements. Its function is to take the fluid which is exhausting from the inner portion of the turbine and change its direction to allow correct entry for recirculation into the impeller element.

The torque converter will multiply engine torque to its designed maximum multiplication ratio when the output shaft is at zero RPM. Therefore, we can say that as the output shaft is decreasing in speed the torque multiplication is increasing.

The shift control valve assembly consists of a valve body with selector valve spools. A detent ball and spring in the selector spool provides 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.

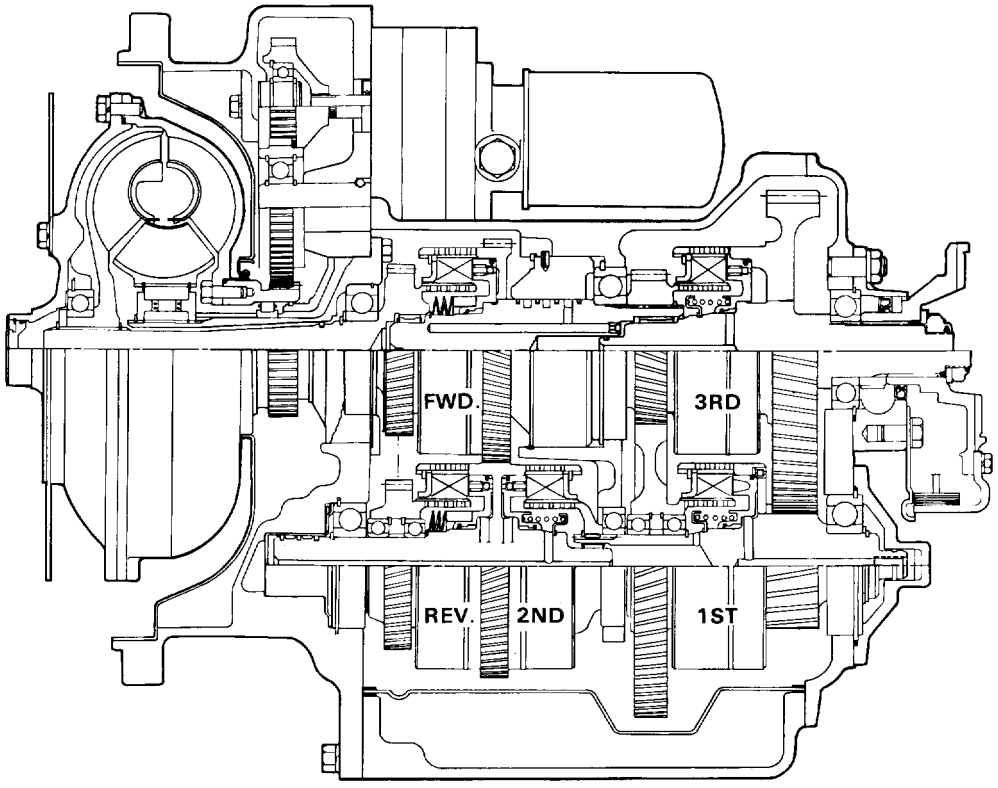
With the engine running and the directional control lever in neutral position, oil pressure from the regulating valve is blocked at the control valve, and the transmission is in neutral. Movement of the forward and reverse spool will direct oil, under pressure to either the forward or reverse direction clutch as desired.

When either directional clutch is selected the opposite clutch is relieved of pressure and vents back through the direction selector spool. The same procedure is used in the speed selector.

The direction or speed clutch assembly consists of a drum with internal splines and a bore to recieve a hydraulically actuated piston . The piston is “oil tight” by the use of sealing rings. A steel disc with external splines is inserted into the drum and rests against the piston. Next , a friction disc with splines at the inner diameter is inserted. Discs are alternated until the required total is achieved . A heavy back-up plate is then inserted and secured with a snap ring. A Hub with O.D. splines is inserted into the splines of discs with teeth on the inner diameter The discs and hub are free to increase is speed or rotate in the opposite direction as long as no pressure is present in that specific 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 valve , through a passageway, to a chosen clutcth shaft. This shaft has a drilled passageway for oil under pressure to enter the shaft. Oil pressure sealing rings are located on the clutch shaft. These rings direct oil under pressure to a desired clutch. Pressure of the oil forces the piston and discs 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 hub and clutch shaft to be locked together and allows them to drive as a unit.

There are balls or bleed orifices, depending upon the model, in the clutch piston which allow quick escape for oil when the pressure to the piston is released.



BASIC DESIGN

Figure A

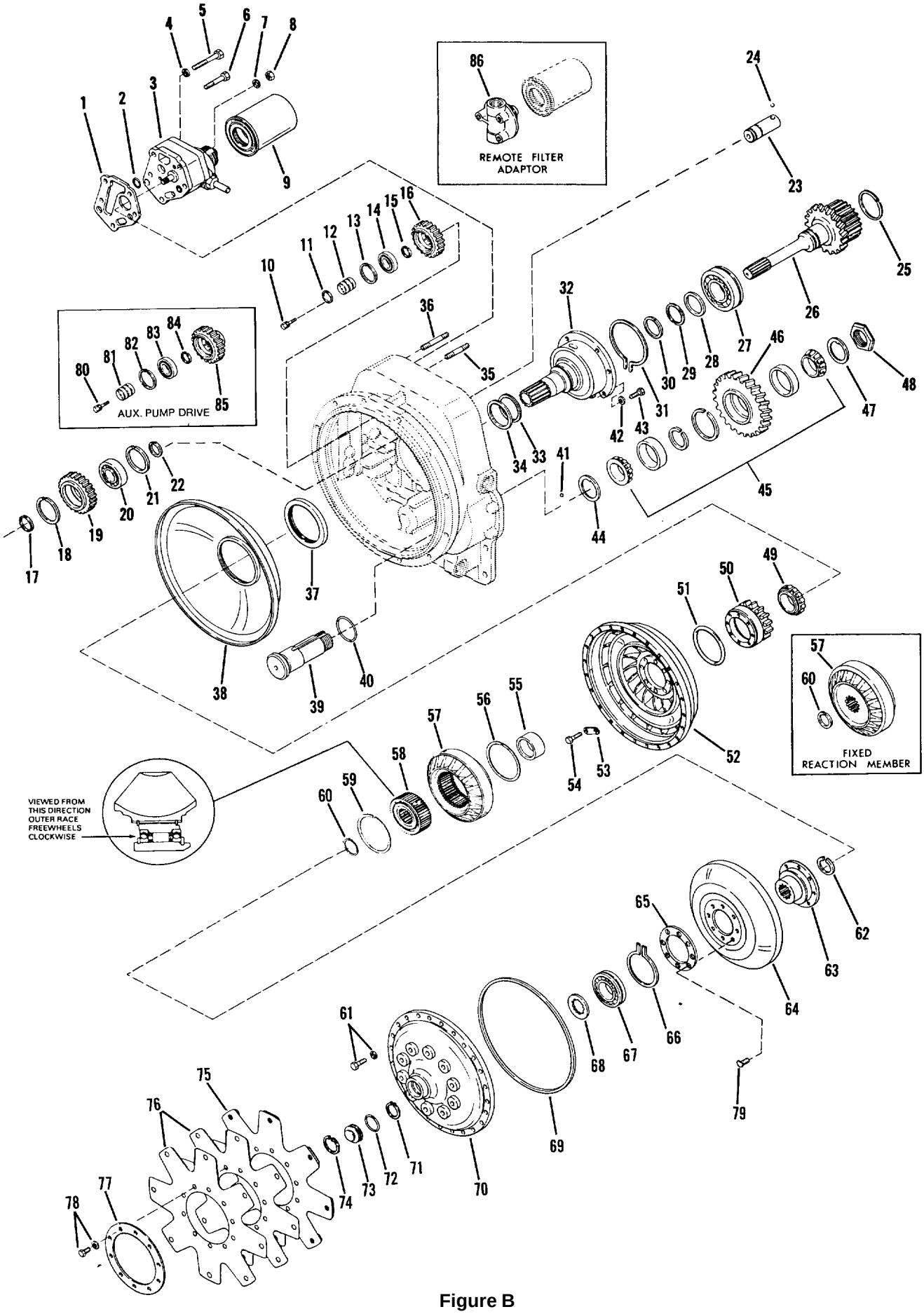

REMOTE FILTER ADAPTOR
AUX. PUMP DRIVE
FIXED REACTION MEMBER
VIEWED FROM THIS DIRECTION OUTER RACE FREEWHEELS CLOCKWISE

Figure B

HR18000 CONVERTER GROUP

ITEM	DESCRIPTION	QTY
1	Pump to Housing Gasket	1
2	“O” Ring	1
3	Charging Pump Assembly	1
4	Pump Mounting Screw Lockwasher	3
5	Pump Mounting Screw	1
6	Pump Mounting Screw	2
7	Pump Mounting Stud Lockwasher	2
8	Pump Mounting Stud Nut	2
9	Filter Assembly	1
10	Bearing Support Screw	2
11	Bearing Locating Ring	1
12	Pump Drive Bearing Support	1
13	Bearing Retaining Ring	1
14	Pump Drive Gear Bearing	1
15	Bearing Locating Ring	1
16	Pump Drive Gear	1
17	Idler Gear Bearing Locating Ring	1
18	Idler Gear Bearing Retaining Ring	1
19	Pump Drive Idler Gear	1
20	Idler Stub Shaft Bearing	1
21	Bearing Retaining Ring	1
22	Bearing Locating Ring	1
23	Idler Gear Stub Shaft	1
24	Stub Shaft Lock Ball	1
25	Baffle Ring	1
26	Turbine Shaft Disc Hub Assembly	1
27	Turbine Shaft Bearing	1
28	Bearing Locating Washer	1
29	Bearing Retaining Ring	1
30	Piston Ring	1
31	Bearing Snap Ring	1
32	Reaction Member Support	1
33	Piston Ring Expander Spring	1
34	Piston Ring	1
35	Pump Mounting Stud	1
36	Pump Mounting Stud	1
37	Oil Seal	1
38	Oil Baffle Assembly	1
39	Reverse Idler Shaft	1
40	Reverse Idler Shaft “O” Ring	1
41	Reverse Idler Shaft Lock Ball	1
42	Support Screw Washer	6
43	Reaction Member Support Screw	6

ITEM	DESCRIPTION	QTY
44	Bearing Retainer Thrust Plate	1
45	Reverse Idler Gear Bearing Assembly	1
46	Reverse Idler Gear	1
47	Bearing Retaining Thrust Plate	1
48	Retaining Plate Nut	1
49	Impeller Hub Gear Bearing	1
50	Impeller Hub Gear	1
51	Impeller Hub “O” Ring	1
52	Impeller	1
53	Impeller to Hub Screw Lock Tab	4
54	Impeller to Hub Screw	8
55	Reaction Member Spacer	1
56	Freewheel Outer Race Snap Ring	1
57	Reaction Member	1
58	Freewheel Assembly	1
59	Freewheel Outer Race Snap Ring	1
60	Reaction Member Retainer Ring	1
61	Impeller to Cover Screw and Lockwasher	18
62	Turbine Retaining Ring	1
63	Turbine Hub	1
64	Turbine	1
65	Turbine Backing	1
66	Turbine Hub Bearing Locating Ring	1
67	Turbine Hub Bearing	1
68	Bearing Retaining Washer	1
69	Impeller to Cover “O” Ring	1
70	Impeller Cover	1
71	Turbine Retaining Ring	1
72	Impeller Cover Bore Plug “O” Ring	1
73	Bore Plug	1
74	Bore Plug Retaining Ring	1
75	Drive Plate Assembly	1
76	Drive Plate	2
77	Drive Plate Backing Ring	1
78	Drive Plate Mounting Screw & Lockwasher	10
79	Turbine Hub Screw	12
80	Bearing Support Screw & Lockwasher	1
81	Auxiliary Pump Drive Bearing Support	1
82	Bearing Retaining Ring	1
83	Pump Drive Gear Bearing	1
84	Bearing Locating Ring	1
85	Auxiliary Pump Drive Gear	1
86	Remote Filter Adaptor (Optional)	1

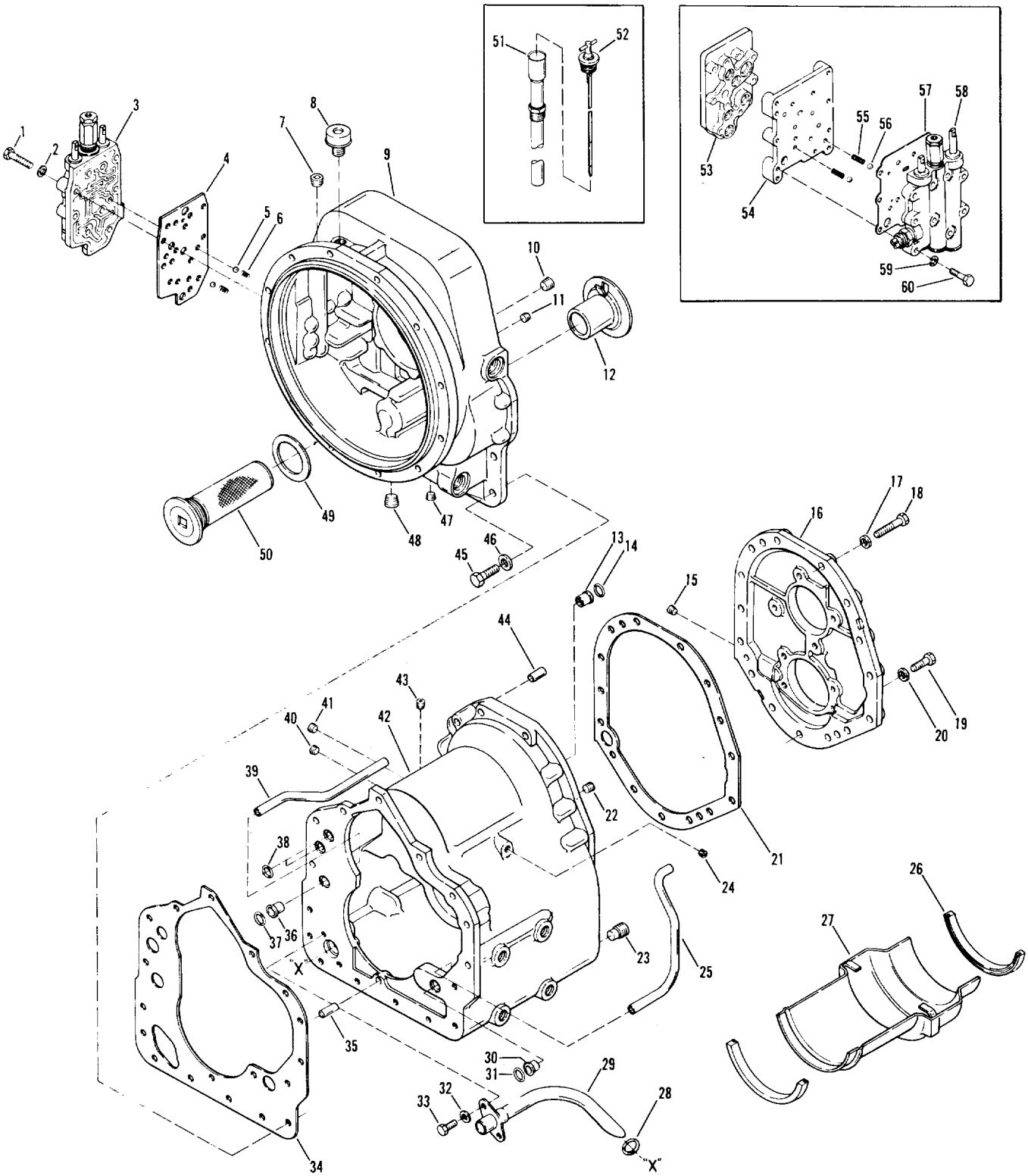

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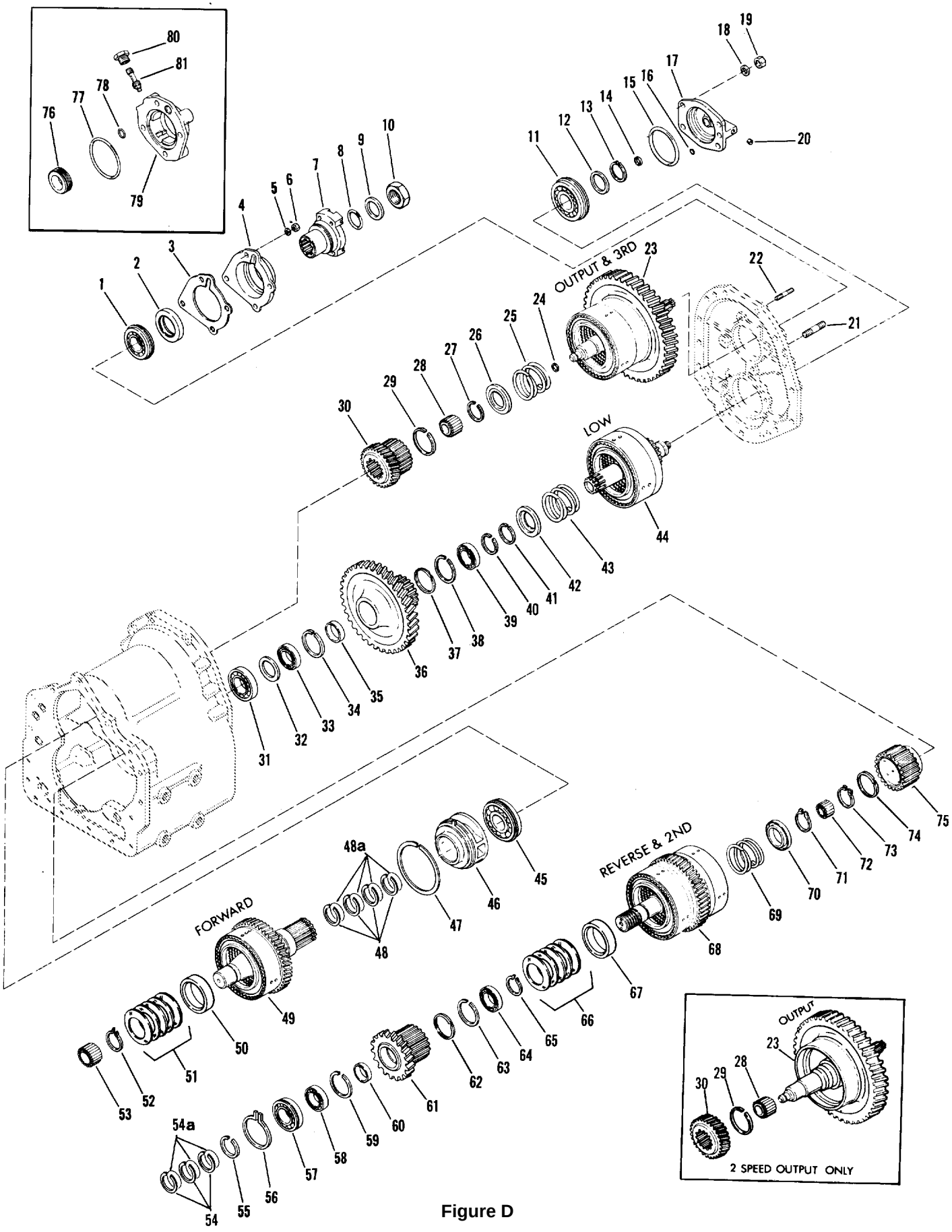
Figure C

HR 18000 CONVERTER AND TRANSMISSION CASE GROUP

ITEM	DESCRIPTION	QTY.
1	Valve to Converter Housing Screw	9
2	Valve to Converter Housing Screw Lockwasher	9
3	Control Valve Assembly	1
4	Control Valve Gasket	1
5	Detent Ball	2
6	Detent Spring	2
7	Pipe Plug	1
8	Air Breather	1
9	Converter Housing	1
10	Pipe Plug	1
11	Pipe Plug	1
12	Converter Housing Sleeve	1
13	Tube Sleeve	1
14	Pressure Tube “O” Ring	1
15	Rear Cover Pipe Plug	1
16	Rear Cover	1
17	Rear Cover to Case Screw Lockwasher	9
18	Rear Cover to Case Screw	9
19	Rear Cover to Case Screw	6
20	Rear Cover to Case Screw Lockwasher	6
21	Rear Cover to Case Gasket	1
22	Pipe Plug	1
23	Magnetic Drain Plug	1
24	Pipe Plug	1
25	Clutch Lube Tube	1
26	Oil Baffle Seal	2
27	Oil Baffle	1
28	Suction Line “O” Ring	1
29	Suction Tube Assembly	1
30	Tube Sleeve	1
31	Pressure Tube “O” Ring	1
32	Retainer Screw Lockwasher	2
33	Suction Line Retainer Screw	2
34	Converter Housing to Transmission Case Gasket	1
35	Dowel Pin	1
36	Tube Sleeve	1
37	Pressure Tube “O” Ring	1
38	Clutch Pressure “O” Ring	2
39	Low Speed Clutch Pressure Tube	1
40	Pipe Plug	1
41	Pipe Plug	1
42	Transmission Case Assembly	1
43	Pipe Plug	1
44	Case to Cover Dowel Pin	2
45	Housing to Case Screw	16
46	Housing to Case Screw Lockwasher	16
47	Pipe Plug	1
48	Pipe Plug	1
49	Screen Assembly Gasket	1
50	Screen Assembly	1
51	Dipstick Tube Assembly	1
52	Dipstick	1

Optional Remote Mounted Control Cover Valve Parts

53	Remote Control Valve Adaptor Plate	1
54	Remote Control Valve Mounting Plate	1
55	Detent Spring	2
56	Detent Ball	2
57	Control Valve to Mounting Plate Gasket	1
58	Control Valve Assembly	1
59	Valve to Mounting Plate Screw Lockwasher	9
60	Valve to Mounting Plate Screw	9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OUTPUT
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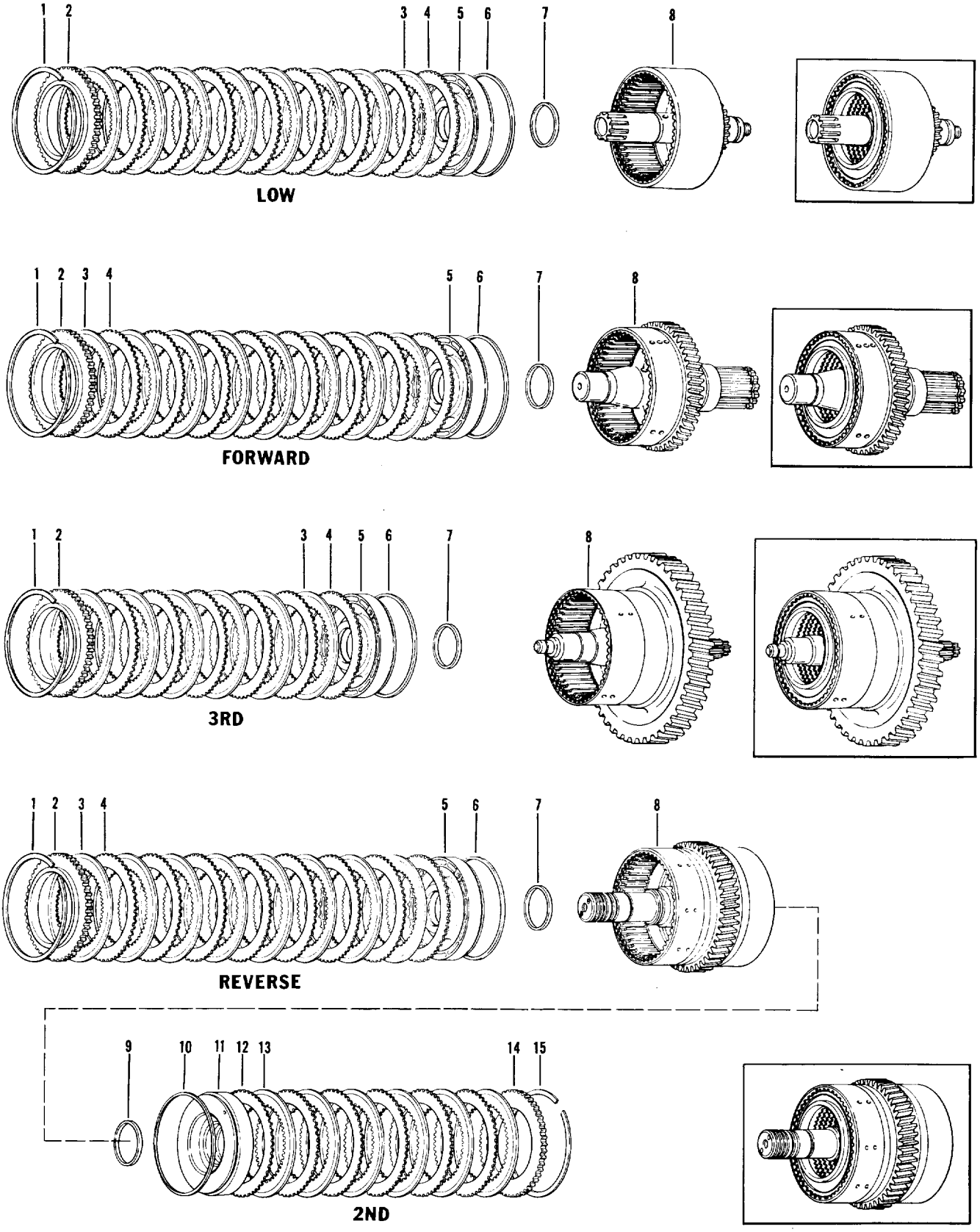
2 SPEED OUTPUT ONLY

Figure D

18000 TWO AND THREE SPEED GEAR AND CLUTCH GROUP

ITEM	DESCRIPTION	QTY
1	Output Shaft Rear Bearing	1
2	Rear Bearing Cap Oil Seal	1
3	Rear Bearing Cap Gasket	1
4	Rear Bearing Cap	1
5	Bearing Cap Stud Lockwasher	4
6	Bearing Cap Stud Nut	4
7	Companion Flange	1
8	Flange"O" Ring	1
9	Flange Washer	1
10	Flange Nut	1
11	Low Speed Shaft Rear Bearing	1
12	Rear Bearing Support Washer	1
13	Rear Bearing Retainer Ring	1
14	Low Shaft Piston Ring	1
15	Bearing Cap "O" Ring	1
16	Rear Bearing Cap "O" Ring	1
17	Rear Bearing Cap	1
18	Bearing Stud Lockwasher	4
19	Bearing Stud Nut	4
20	Pipe Plug	1
21	Bearing Cap Stud	4
22	Output Rear Bearing Cap Stud	4
23	Output Shaft and 3rd Clutch Assembly	1
24	Output Shaft Piston Ring	1
25	Piston Return Spring	1
26	Spring Retainer	1
27	Spring Retainer Snap Ring	1
28	Pilot Bearing	1
29	3rd Gear and Hub Retainer Ring	1
30	3rd Gear and Hub Assembly	1
31	Low Speed Shaft Front Bearing	1
32	Front Bearing Spacer	1
33	Low Speed Gear Bearing	1
34	Low Speed Gear Bearing Locating Ring	1
35	Low Speed Gear Spacer	1
36	Low Gear and Hub Assembly	1
37	Baffle Ring	1
38	Bearing Locating Ring	1
39	Low Speed Gear Bearing	1
40	Bearing Locating Ring	1
41	Spring Retainer Snap Ring	1
42	Spring Retainer	1
43	Piston Return Spring	1

ITEM	DESCRIPTION	QTY
44	Low Clutch	1
45	Forward Shah Rear Bearing	1
46	Piston Ring Sleeve	1
47	Piston Ring Sleeve Retainer Ring	1
48	Forward Shah Piston Ring	4
48A	Piston Ring Expander Springs	4
49	Forward Clutch	1
50	Piston Return Spring Spacer	1
51	Piston Return Disc Springs	5
	(Replace in Matched Sets)	1
52	Spring Retainer Snap Ring	1
53	Forward Shah Pilot Bearing	3
54	Reverse and 2nd Shah Piston Ring	3
54A	Piston Ring Expander Springs	1
55	Front Bearing Retainer Ring	1
56	Front Bearing Snap Ring	1
57	Reverse and 2nd Shah Front Bearing	1
58	Clutch Driven Gear Bearing	1
59	Bearing Retainer Ring	1
60	Clutch Driven Gear Bearing Spacer	1
61	Reverse Clutch Gear and Hub Assembly	1
62	Baffle Ring	1
63	Bearing Retainer Ring	1
64	Clutch Driven Gear Bearing	1
65	Spring Retainer Snap Ring	1
66	Piston Return Disc Springs	
	(Replace in matched Sets Only)	5
67	Piston Return Spring Spacer	1
68	Reverse and 2nd Clutch	1
69	Piston Return Spring	1
70	Spring Retainer	1
71	Spring Retainer Snap Ring	1
72	Reverse and 2nd Shaft Pilot Bearing	1
73	Clutch Disc Hub Retainer Ring	1
74	Baffle Ring	1
75	2nd Clutch Disc Hub	1
76	Speedometer Drive Gear	1
77	Bearing Cap "O" Ring	1
78	Bearing Cap "O" Ring	1
79	Bearing Cap	1
80	Speedometer Gear Tube Nut	1
81	Speedometer	1



18000 SERIES 3 SPEED CLUTCH ASSEMBLY

Figure E

LOW CLUTCH GROUP

ITEM	DESCRIPTION	QTY.
1	Backing Plate Snap Ring	1
2	Clutch Disc Backing Plate	1
3	Clutch Inner Disc	8
4	Clutch Outer Disc	8
5	Clutch Piston	1
6	Outer Clutch Piston Seal	1
7	Inner Clutch Piston Seal	1
8	Low Clutch Shaft Drum and Bleed Valve Assembly	1

FORWARD CLUTCH GROUP

ITEM	DESCRIPTION	QTY.
1	Backing Plate Snap Ring	1
2	Clutch Disc Backing Plate	1
3	Clutch Inner Disc	8
4	Clutch Outer Disc	8
5	Clutch Piston	1
6	Outer Clutch Piston Seal	1
7	Inner Clutch Piston Seal	1
8	Forward Shaft, Drum and Plug Assembly	1

3RD CLUTCH GROUP

(3 Speed Only)

ITEM	DESCRIPTION	QTY.
1	Backing Plate Snap Ring	1
2	Clutch Disc Backing Plate	1
3	Clutch Inner Disc	6
4	Clutch Outer Disc	6
5	Clutch Piston Assembly	1
6	Outer Clutch Piston Seal	1
7	Inner Clutch Piston Seal	1
8	Output and 3rd Clutch Shaft, Drum and Plug Assembly	1

REVERSE AND 2ND CLUTCH GROUP

ITEM	DESCRIPTION	QTY.
1	Backing Plate Snap Ring	1
2	Clutch Disc Backing Plate	1
3	Clutch Inner Disc	8
4	Clutch Outer Disc	8
5	Clutch Piston	1
6	Outer Clutch Piston Seal	1
7	Inner Clutch Piston Seal	1
8	Reverse and 2nd Shaft, Drum and Plug Assembly	1
9	Inner Clutch Piston Seal	1
10	Outer Clutch Piston Seal	1
11	Clutch Piston Assembly	1
12	Clutch Outer Disc	6
13	Clutch Inner Disc	6
14	Clutch Disc Backing Plate	1
15	Backing Plate Snap Ring	1

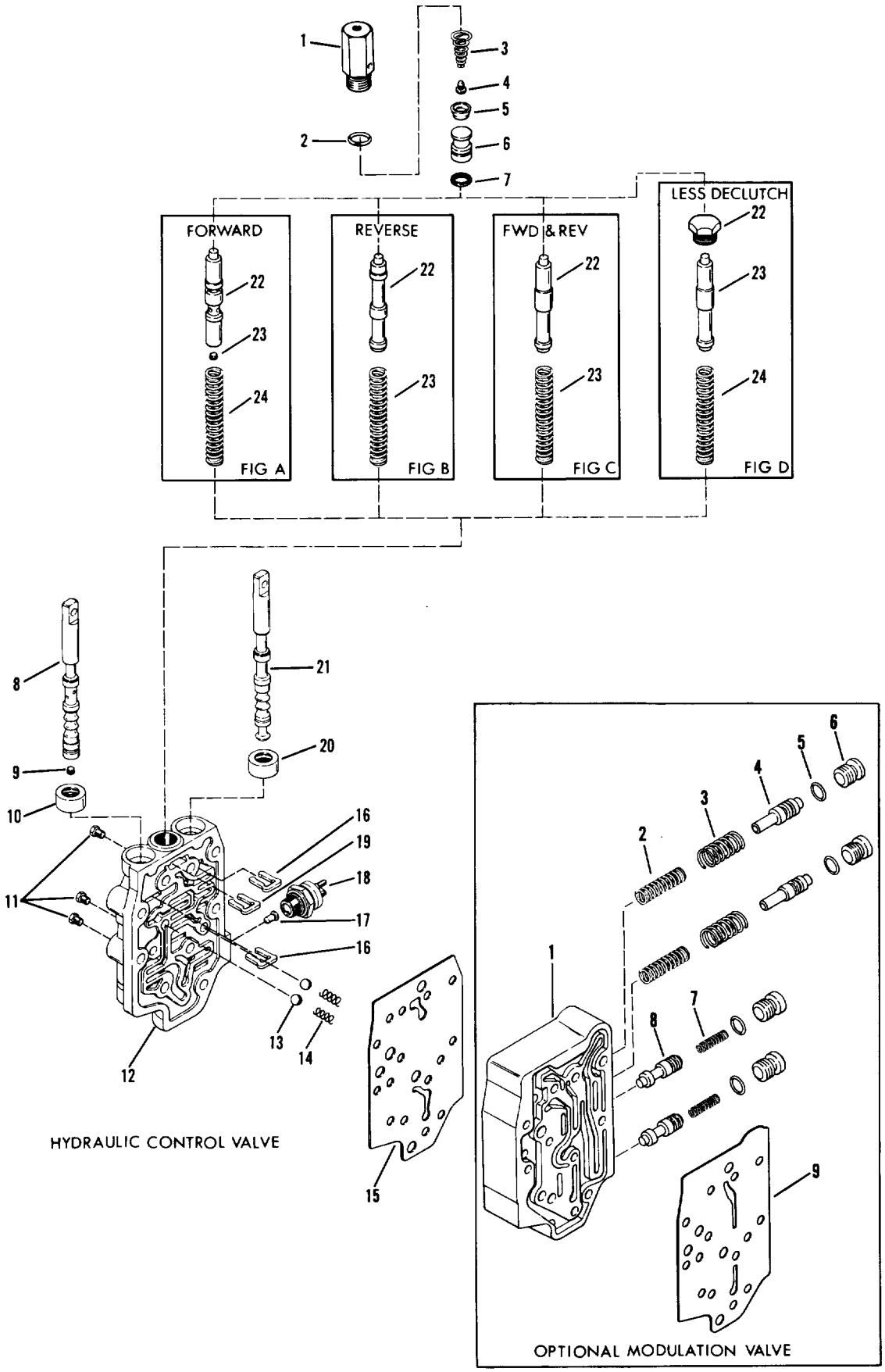

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FIG A
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HYDRAULIC CONTROL VALVE
OPTIONAL MODULATION VALVE

Figure F

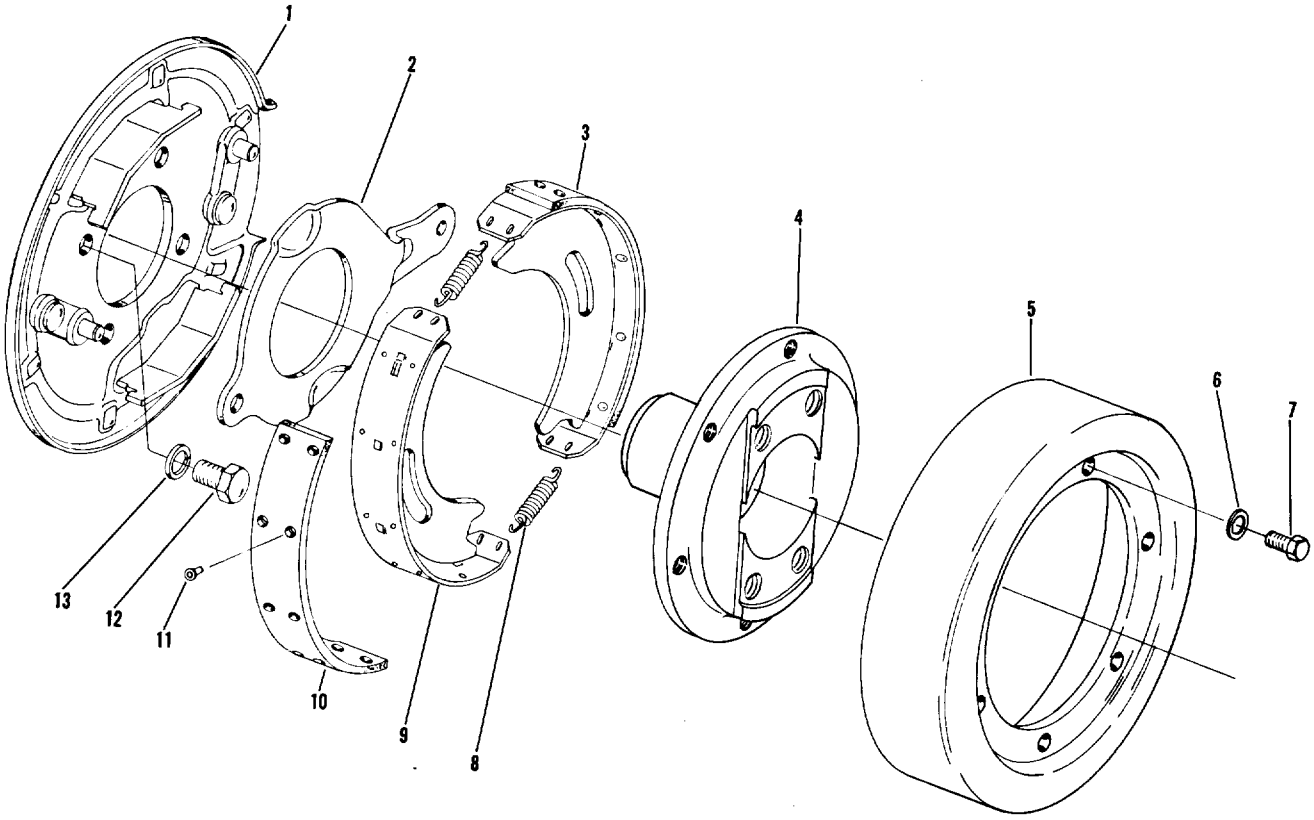
CONTROL VALVE ASSEMBLY

ITEM	DESCRIPTION	QTY.
1	Hydraulic Actuator Assembly	1
2	Piston Housing “O” Ring	1
3	Piston Balance Spring	1
4	Spring Retainer Pin	1
5	Piston Seal	1
6	Piston	1
7	Glyd Ring	1
8	Speed Selector Spool	1
9	Spool Plug	1
10	Oil Seal	1
11	Pipe Plug	3
12	Control Valve Housing	1
13	Detent Ball	2
14	Detent Spring	2
15	Control Valve Gasket	1
16	Valve Spool Stop	2
17	Neutral Switch Actuating Pin	1
18	Neutral Switch	1
19	Declutch Spool Stop	1
20	0il Seal	1
21	Forward and Reverse Valve Spool	1

NOTE: Items 22 thru 24 are various declutch options.

MODULATOR VALVE ASSEMBLY (Optional)

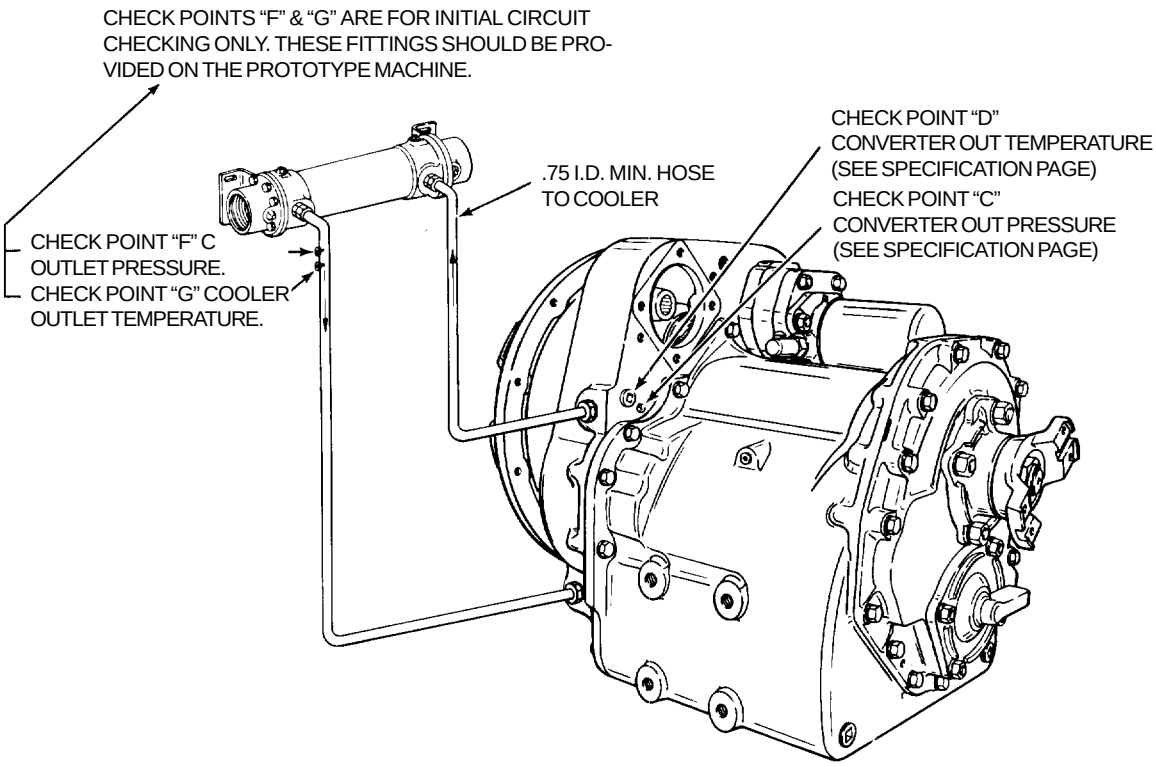
ITEM	DESCRIPTION	QTY.
1	Modulator Valve Housing	1
2	Accumulator Spring (Inner) Not Used on All Models	2
3	Accumulator Spring (Outer)	2
4	Accumulator Valve	2
5	Spool Stop Plug “O” Ring	4
6	Spool Stop Plug	4
7	Regulator Spring	2
8	Regulator Spool	2
9	Modulator Valve to Converter Housing Gasket	1



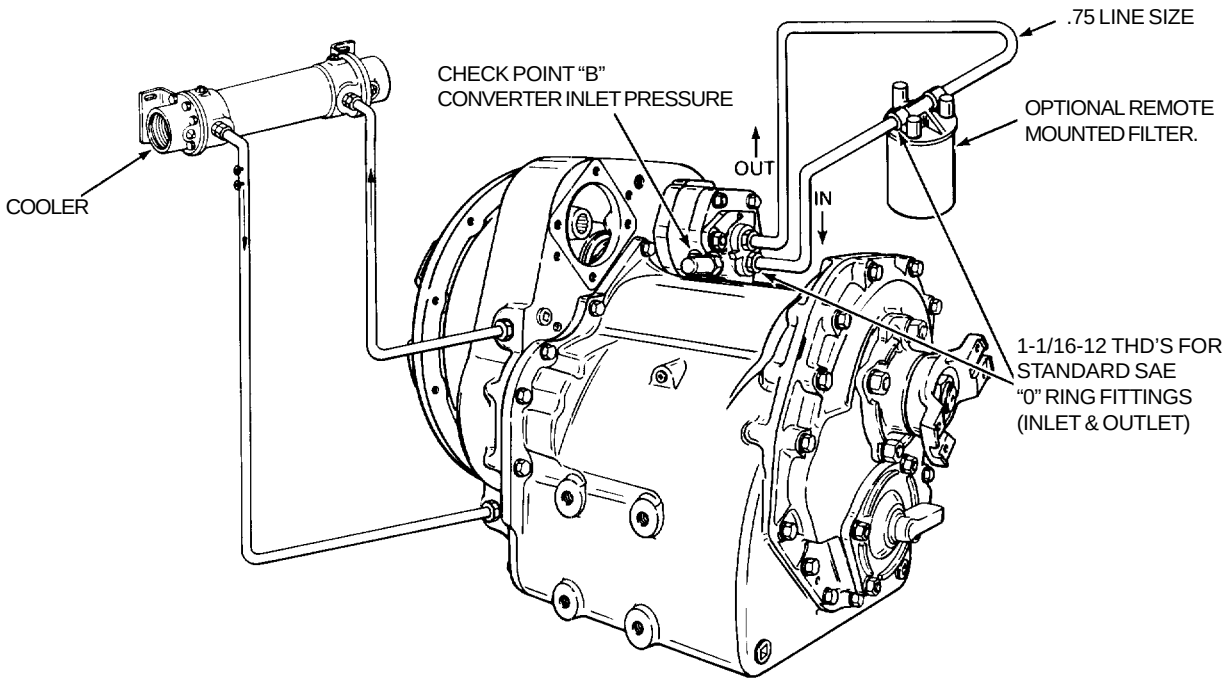
PARKING BRAKE GROUP

ITEM	DESCRIPTION	QTY.
1	Backing Plate Assembly	1
2	Actuating Lever	1
3	Brake Shoe and Lining	1
4	Brake Flange	1
5	Brake Drum	1
6	Brake Drum to Flange Screw Lockwasher	6
7	Brake Drum to Flange Screw	6
8	Return Spring	2
9	Brake Shoe, See Item 3	
10	Brake Lining	1
11	Brake Lining Rivet	20
12	Backing Plate Screw	4
13	Backing Plate Screw Lockwasher	4

Figure G

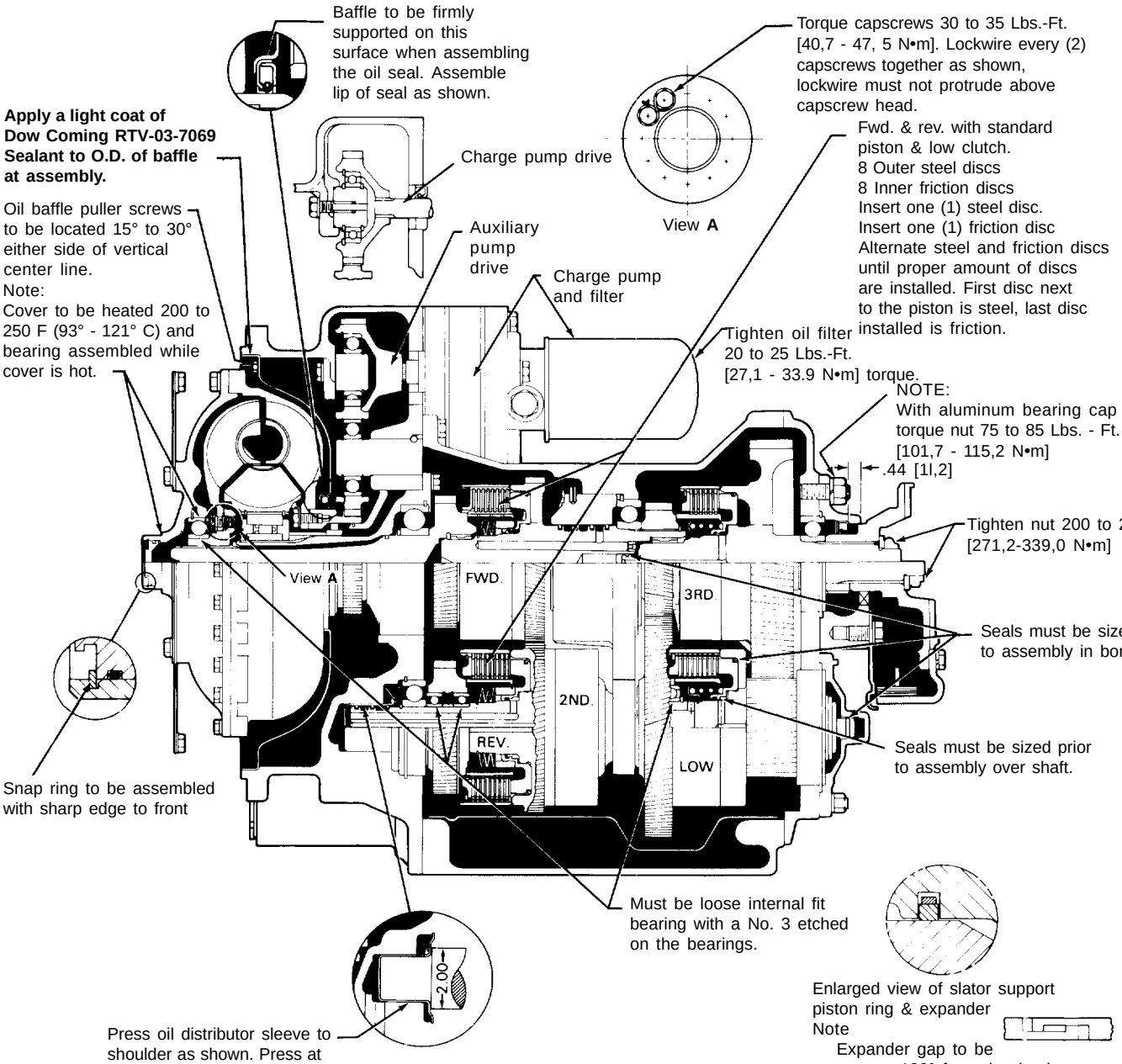


18000 PLUMBING DIAGRAM
2 AND 3 SPEED INLINE



18000 PLUMBING DIAGRAM
2 AND 3 SPEED INLINE
(WITH REMOTE FILTER)

Figure H



NOM SIZE	Grade 5 FINE THREAD LB-FT	[N·M]	Grade 5 COARSE THREAD LB-FT	[N·M]	Grade 8 FINE THREAD LB-FT	[N·M]	Grade 8 COARSE THREAD LB-FT	[N·M]
7500	223 - 245	[302,4 - 332,1]	200 - 220	[271,2 - 298,2]	315 - 347	[427,1 - 470,4]	282 - 310	[382,4 - 420 3]
6250	128 - 141	[173,6 - 191,1]	113 - 124	[153,3 - 168,1]	180 - 198	[224,1 - 268,4]	159 - 175	[215,6 - 237 2]
5625	91 - 100	[123,4 - 135,5]	82 - 90	[111,2 - 122,0]	128 - 141	[173,6 - 191,1]	115 - 127	[156,0 - 172 2]
5000	64 - 70	[86,8 - 94,9]	57 - 63	[77,3 - 85,4]	90 - 99	[122,1 - 134,2]	80 - 88	[108,5 - 119 3]
4375	41 - 45	[55,6 - 61,0]	37 - 41	[50,2 - 55,5]	58 - 64	[78,7 - 86,7]	52 - 57	[70,6 - 77 2]
3750	26 - 29	[35,3 - 39,3]	23 - 25	[31,2 - 33,8]	37 - 41	[50,2 - 55,5]	33 - 36	[44,8 - 48 8]
3125	16 - 20	[21,7 - 27,1]	12 - 16	[16,3 - 21,6]	28 - 32	[38,0 - 43,3]	26 - 30	[35,3 - 40 6]
2500	9 - 11	[12,3 - 14,9]	8 - 10	[10,9 - 13,5]	11 - 13	[15,0 - 17,6]	9 - 11	[12,3 - 14 9]

Figure I

1. All lead in chamfers for oil seals, piston rings, & “0” rings must be smooth and free from burrs. Inspect at assembly,
2. Lubricate all piston ring grooves & “0” rings with oil before assembly.
3. Apply very light coat of Permatex No. 2 to 0 D. of all oil seals before assembly.
4. After assembly of parts using loctite or Permatex there must not be any free or excess material that could enter the oil circuit.
5. Apply a light coal of #92 loctite to all pipe plugs.
6. Apply a thin coating of grease between seal lips on lip type seals prior to assembly.

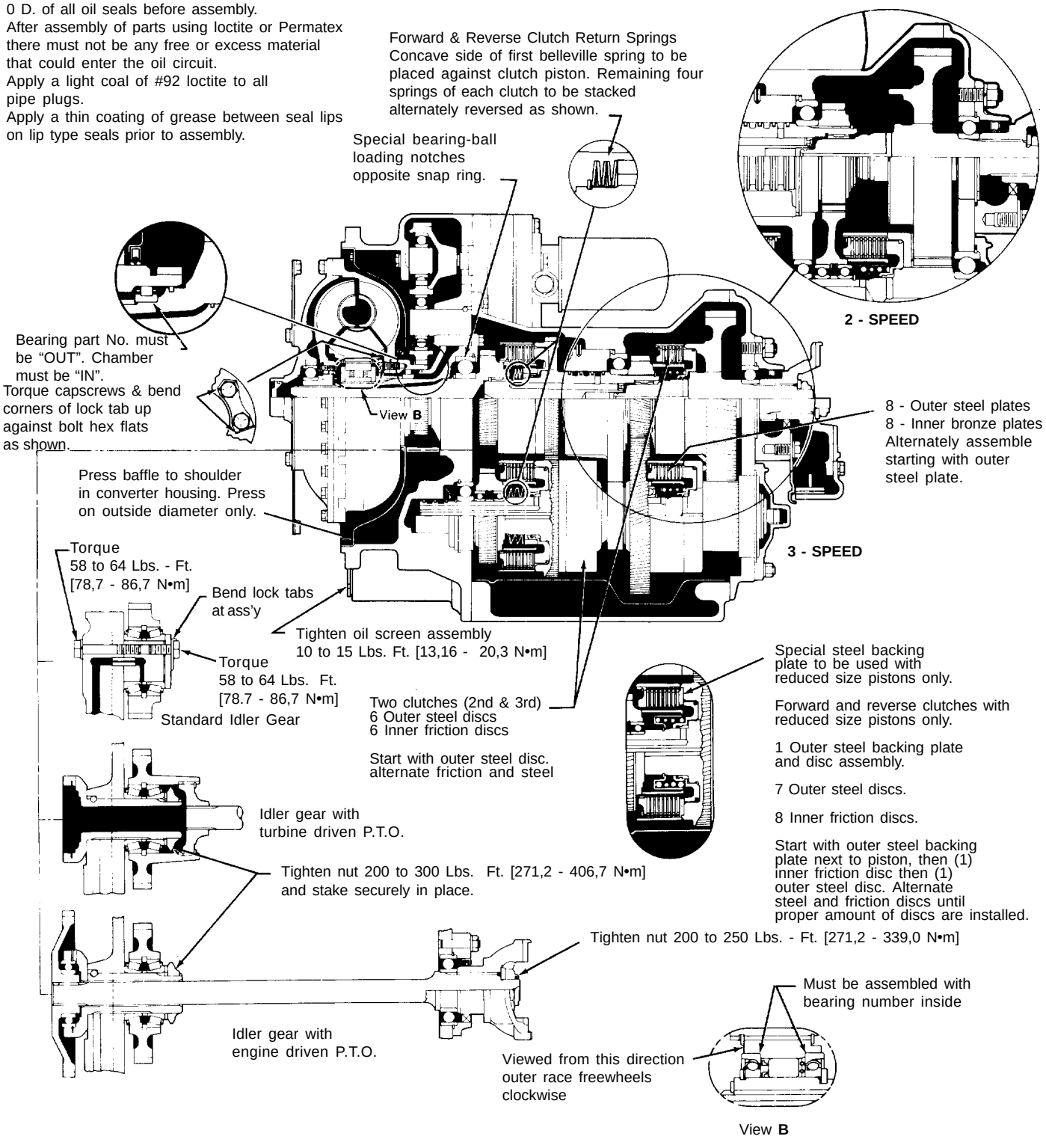
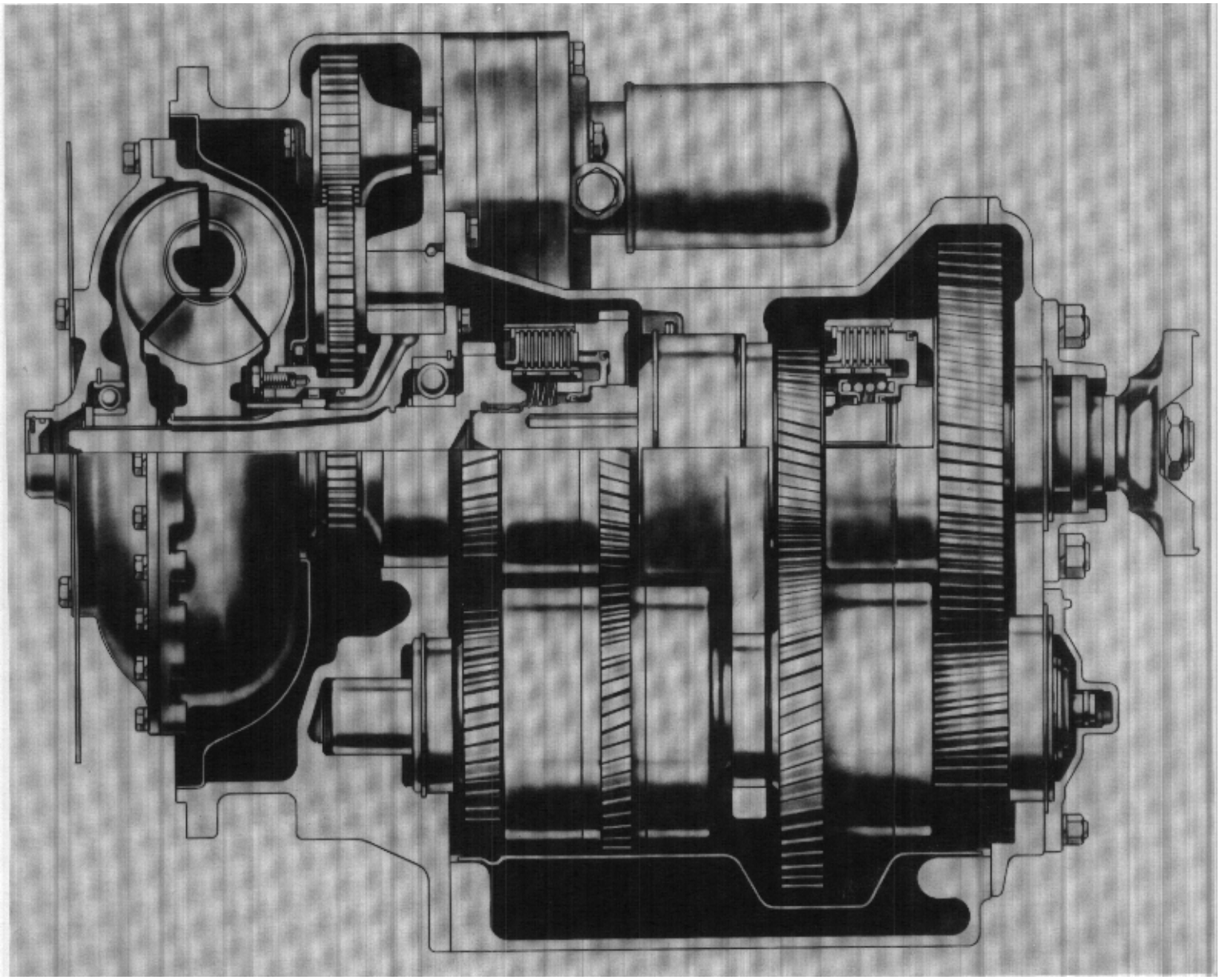


Figure I



TYPICAL 1800 CROSS SECTION

FIG. J

MAINTENANCE AND SERVICE

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 18000 transmission with many options. All 18000 transmissions 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 exterior of the unit must be thoroughly cleaned to prevent the possibility of dirt and foreign matter entering the mechanism.

DISASSEMBLY

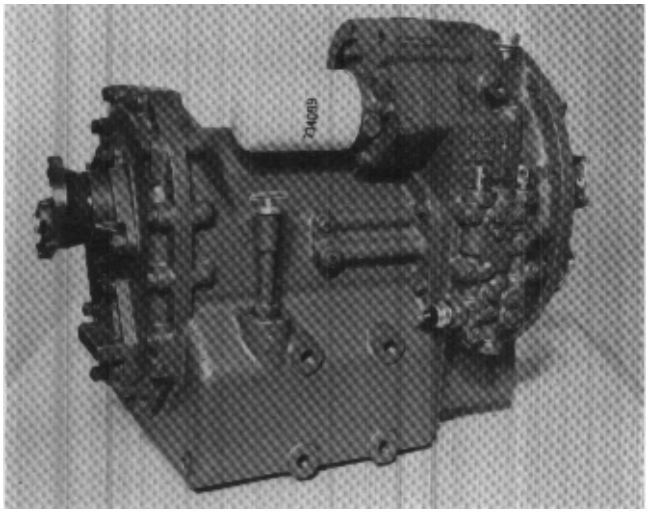


Figure 1

Side view of the 18000 inline output 2 or 3 speed transmission. The transmission being disassembled is a 3 speed.

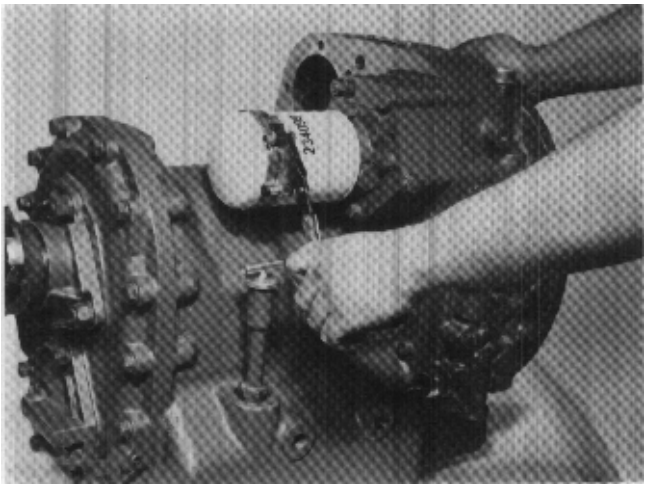


Figure 2

Loosen filter assembly.

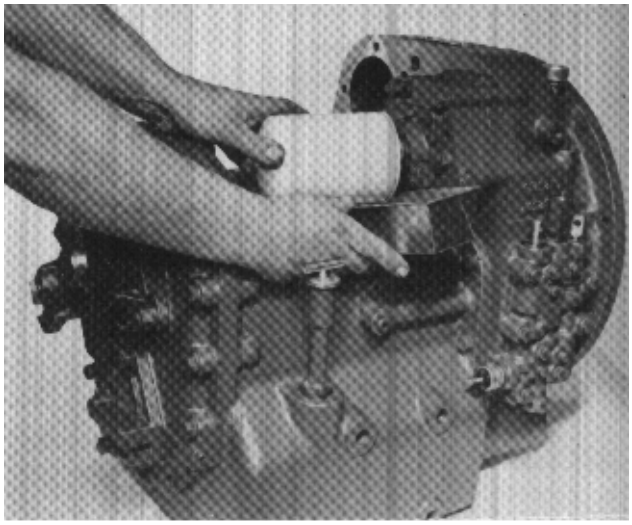


Figure 3

It is recommended a small pan be used to catch the oil left in the filter element. Remove filter assembly.

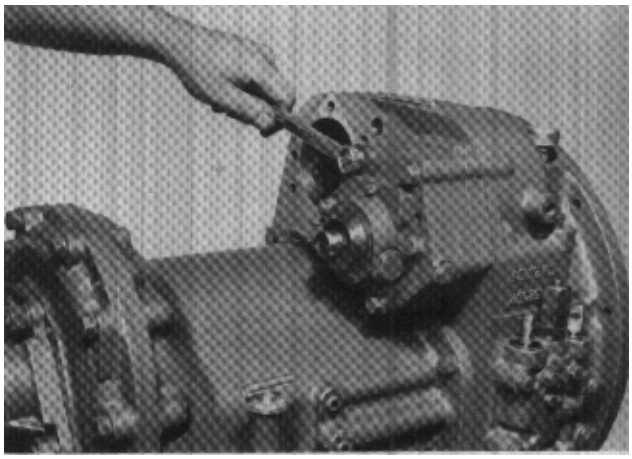


Figure 4

Remove pressure regulating valve and charging pump bolts and stud nuts.

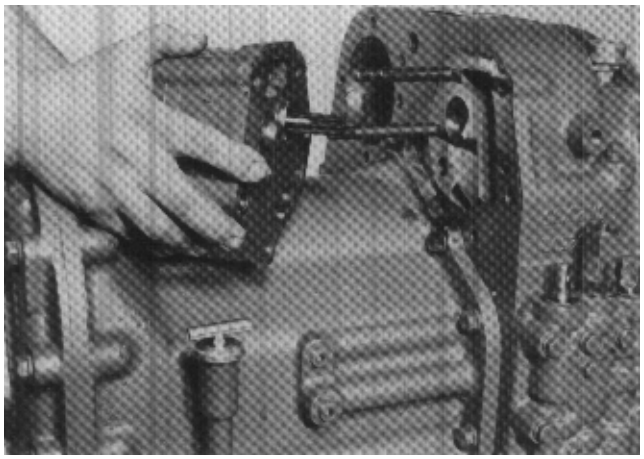


Figure 5
Remove valve and pump assembly.

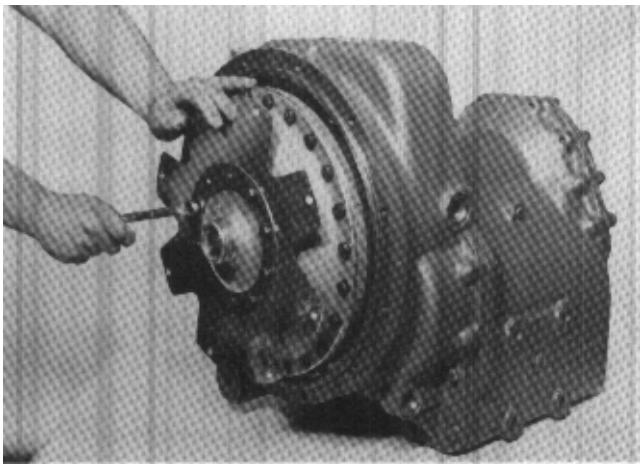


Figure 6
Remove flexplate mounting screws and washers.

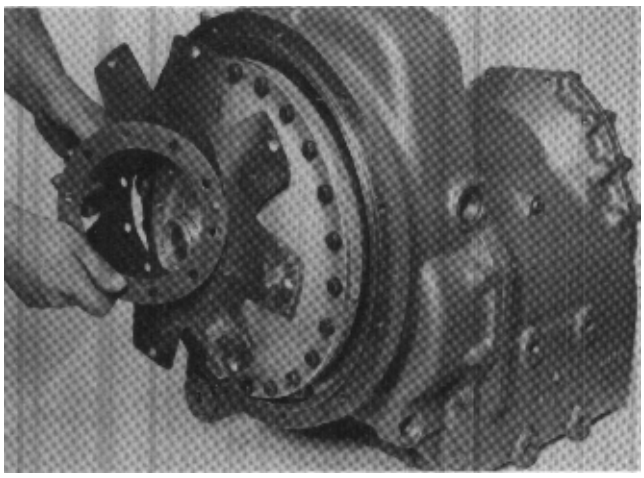


Figure 7
Remove flexplate and backing ring.

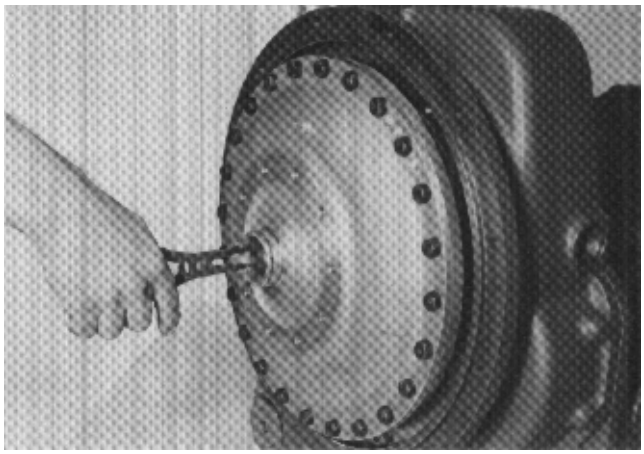


Figure 8
Remove impeller cover bore plug retainer ring.

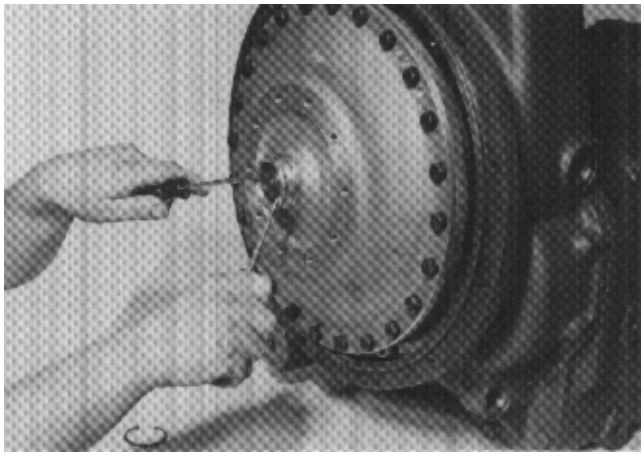


Figure 9
Using two small screw drivers as shown, remove bore plug.

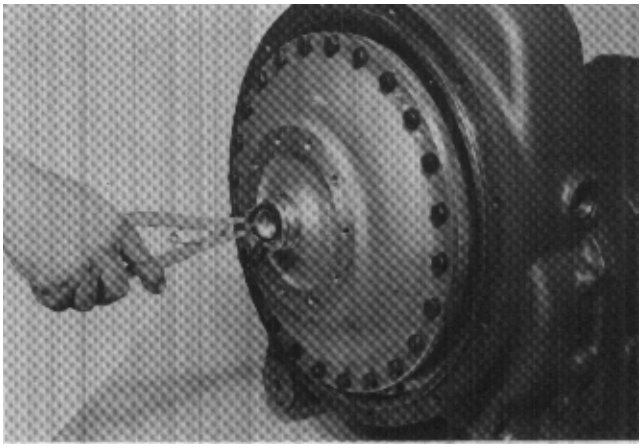


Figure 10
Through bore plug hole, remove turbine retaining ring. See Figure 10-A.

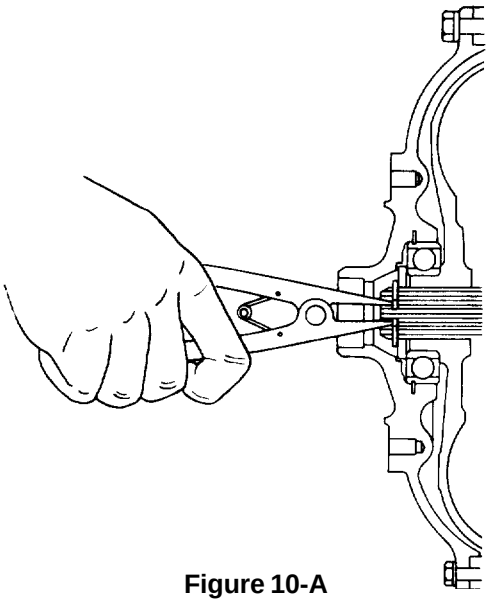


Figure 10-A

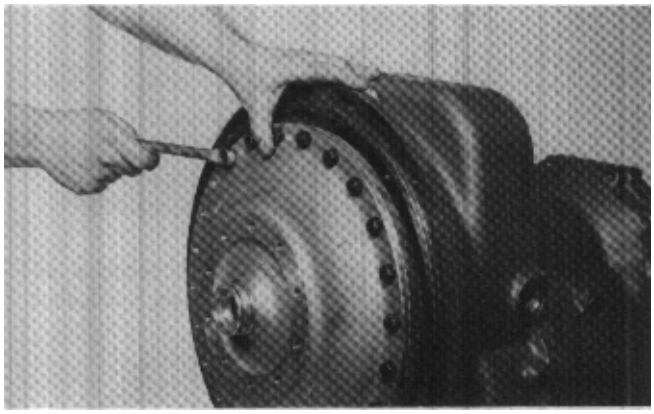


Figure 11
Remove impeller cover to impeller bolts.

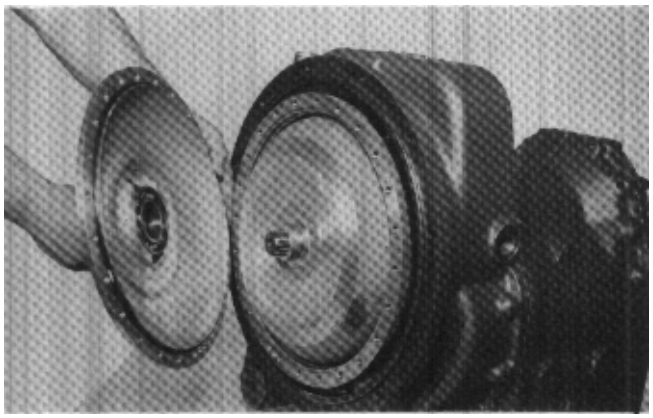


Figure 12
Remove impeller cover. **NOTE:** Turbine may remain in impeller cover bearing and will come off with impeller cover as shown in Figure 13.

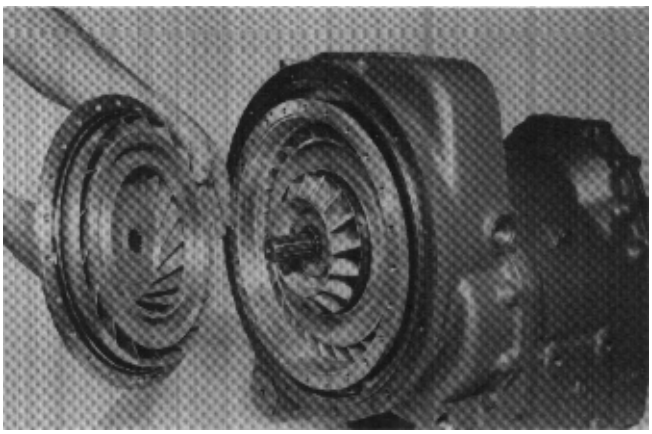


Figure 13
Impeller cover and turbine being removed as an assembly.

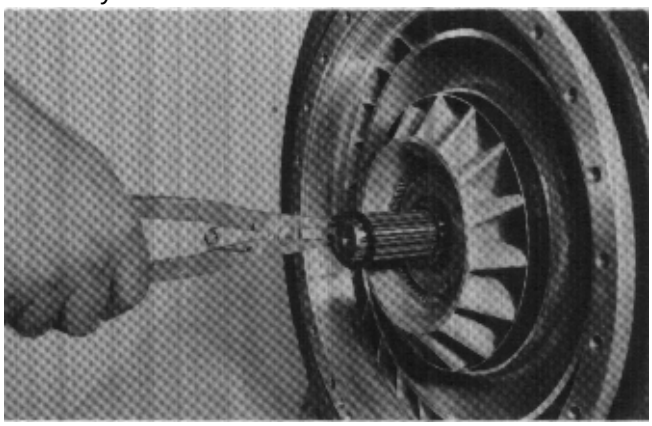


Figure 14
Remove turbine locating ring.

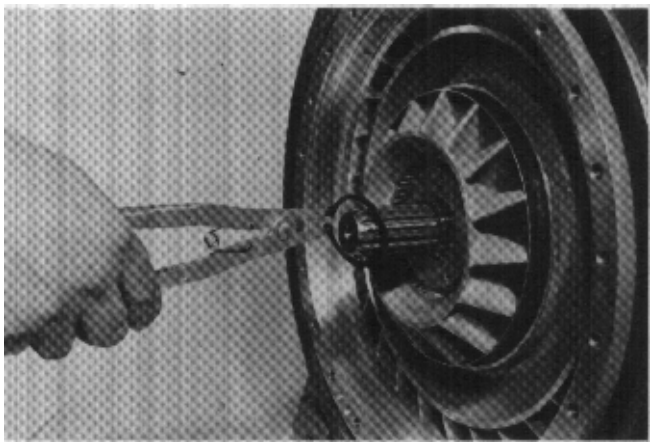


Figure 15
Remove reaction member retainer ring.
Remove reaction member and freewheel unit as an assembly.

NOTE: Some units will have a fixed reaction member and some units will have a freewheeling reaction member, the unit shown has the freewheeling type.

FREEWHEEL DISASSEMBY

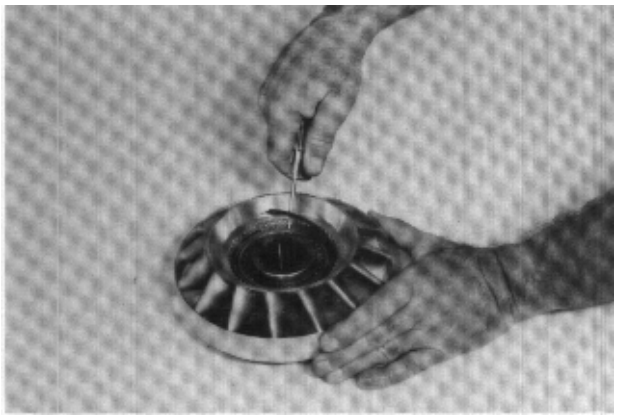


Figure 16

If either the reaction member or the reewheel assembly is to be replaced remove the front outer race to reaction member retainer ring.

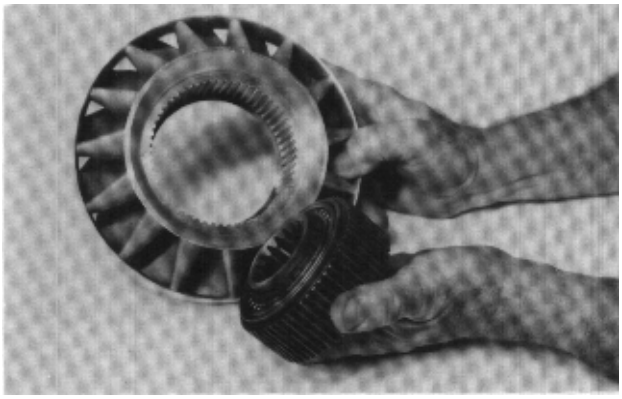


Figure 17

Remove freewheel assembly from the reaction member. **NOTE:** The freewheel assembly cannot be serviced. If the freewheel is damaged it must be replaced as an assembly.

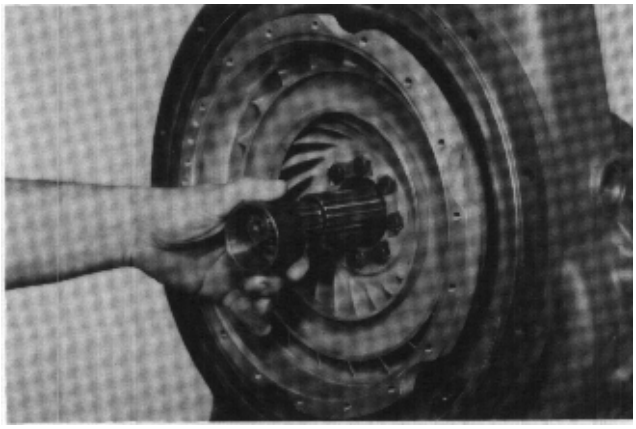


Figure 18

Remove reaction member spacer.

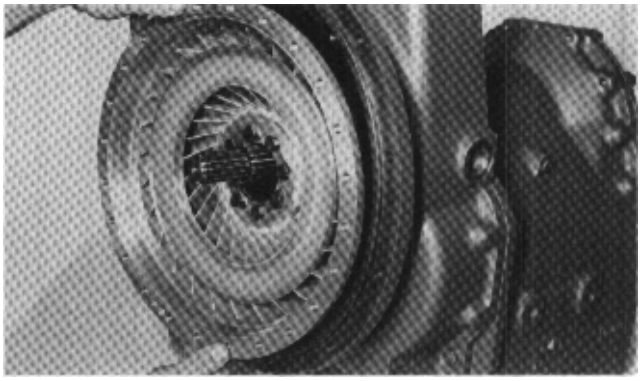


Figure 19

Remove impeller and hub assembly.

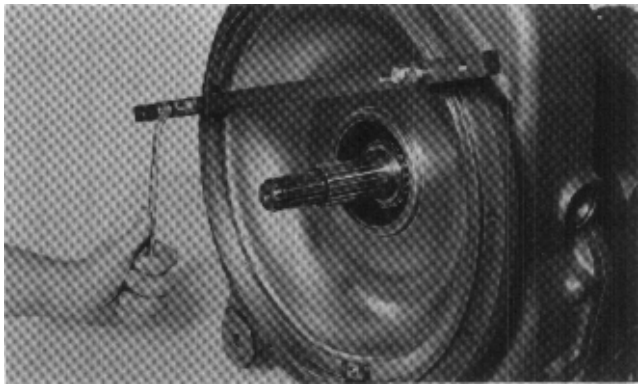


Figure 20

Using oil baffle puller holes provided, remove oil baffle. **NOTE:** Puller tool like shown can be fabricated from diagram shown in Figure 20-A.

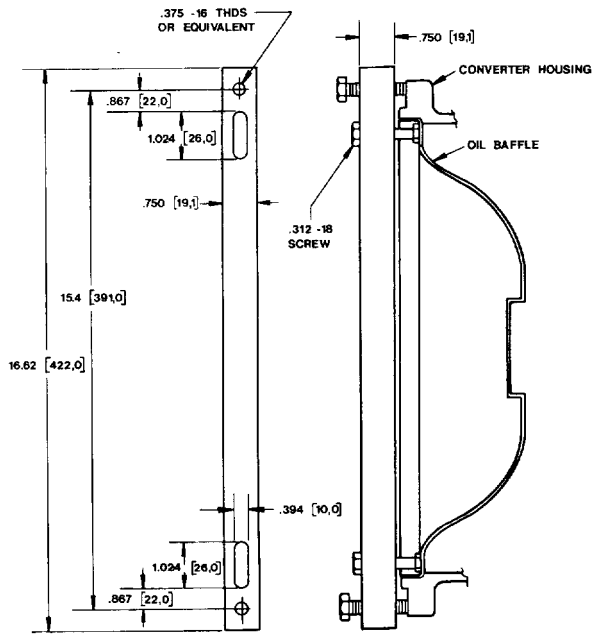


Figure 20-A

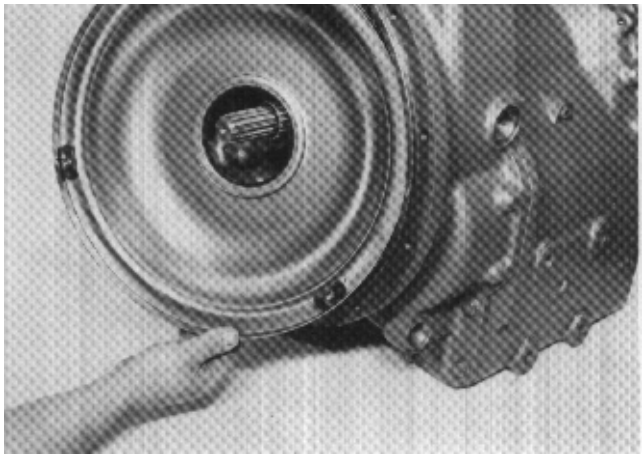


Figure 21
Oil baffle removed.

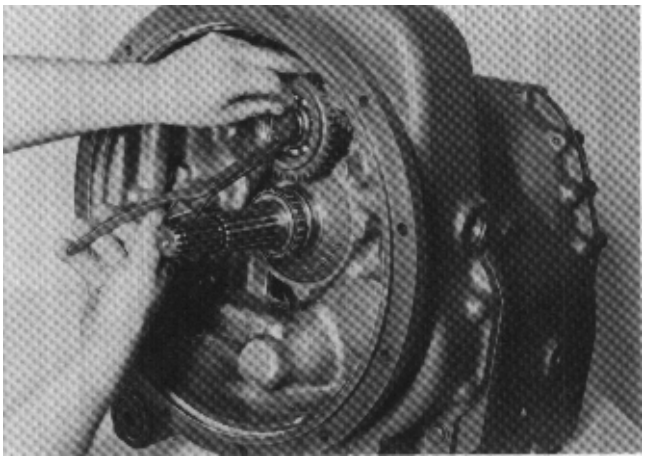


Figure 22
Remove idler gear retaining ring.

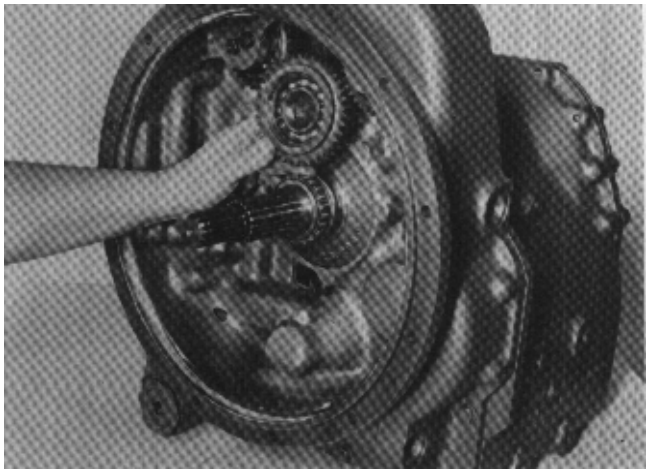


Figure 23
Remove idler gear and bearing assembly.

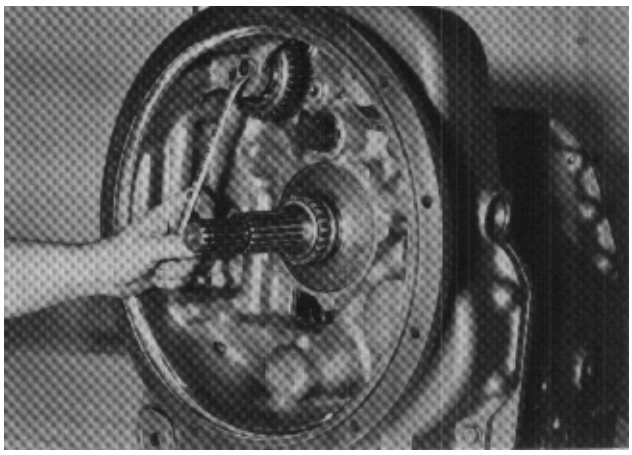


Figure 24
Remove pump drive bearing support screw and lockwasher.

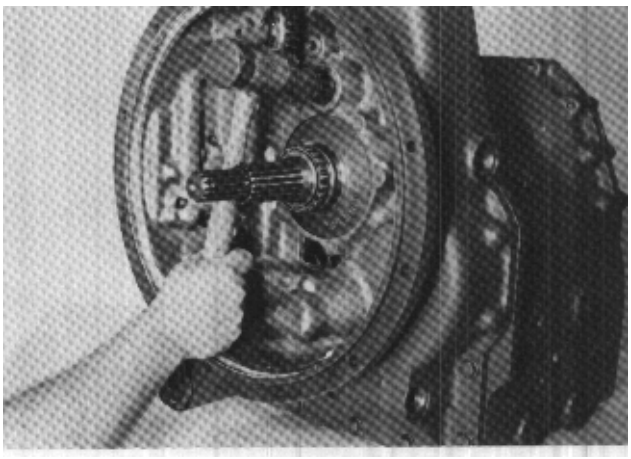


Figure 25
Using a soft hammer, tap pump drive gear and bearing support from housing.

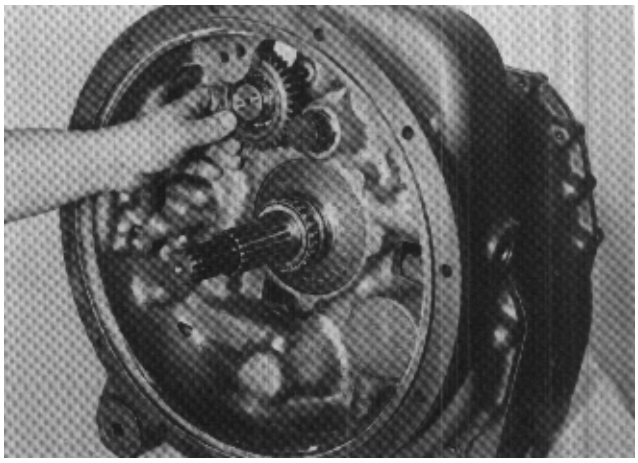


Figure 26
Remove pump drive gear assembly from housing.

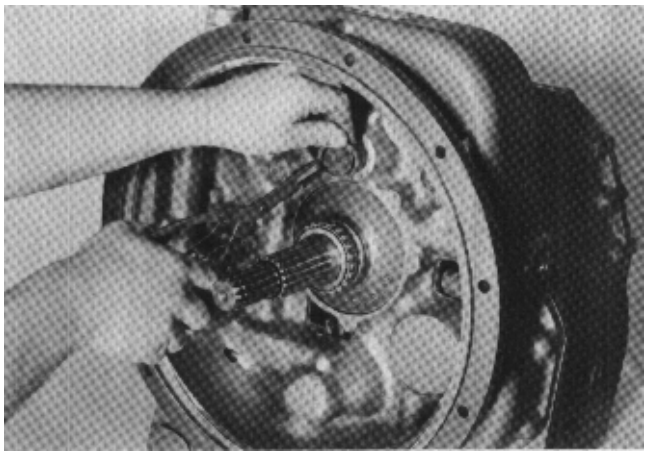


Figure 27
Remove idler stub shaft locating ring.

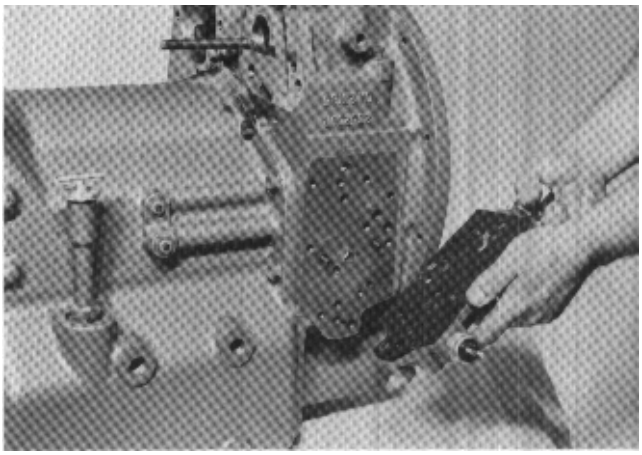


Figure 30
Remove control valve assembly. Use caution as not to lose detent springs and balls.

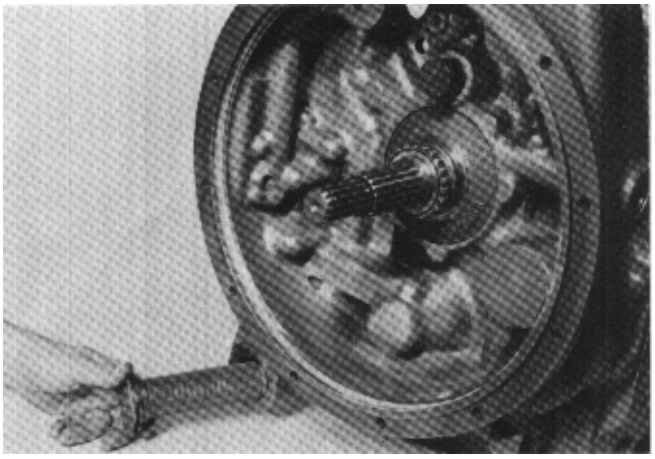


Figure 28
Remove sump screen assembly.

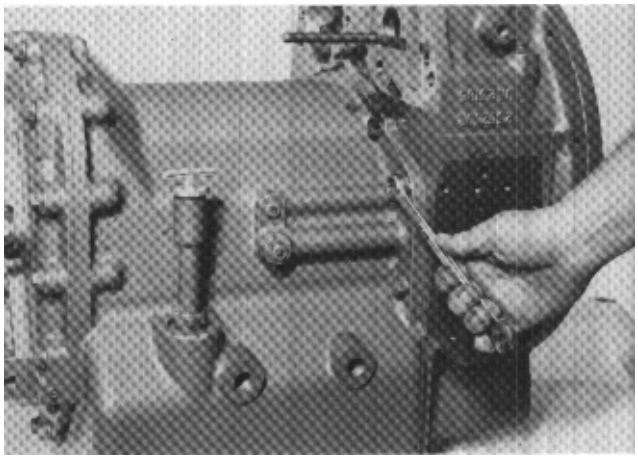


Figure 31
Remove bolts securing transmission case to converter housing.

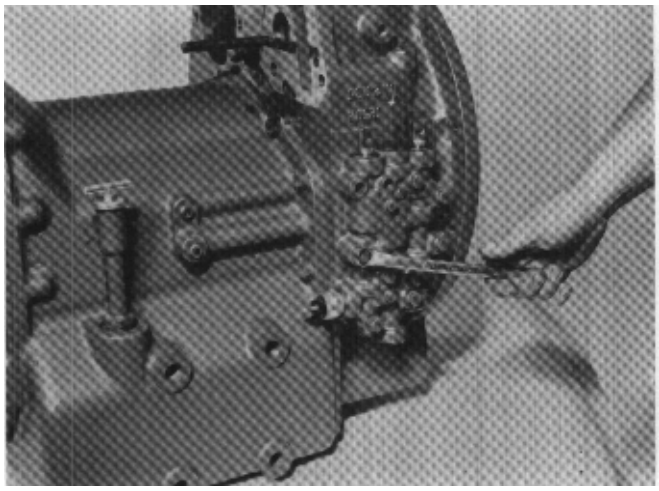


Figure 29
Remove control cover bolts and washers.

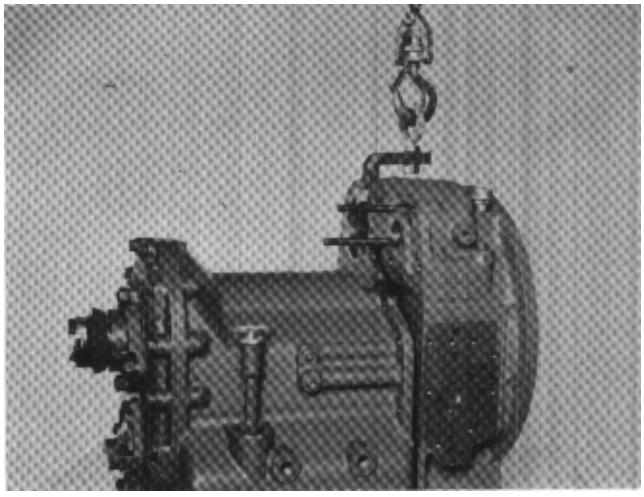


Figure 32
Support converter housing with a chain hoist

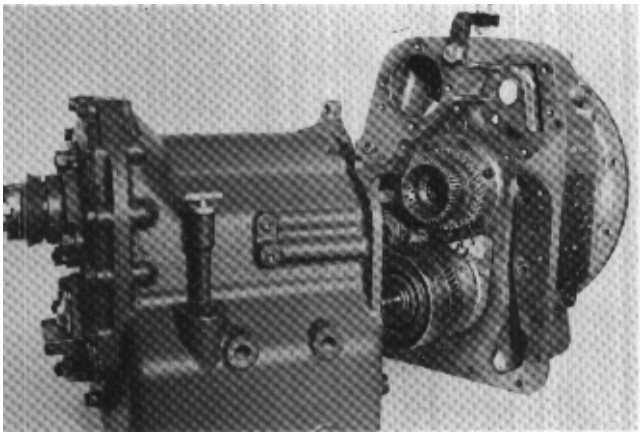


Figure 33
Separate converter housing from transmission case assembly. **NOTE:** Reverse and 2nd clutch will remain in converter housing.

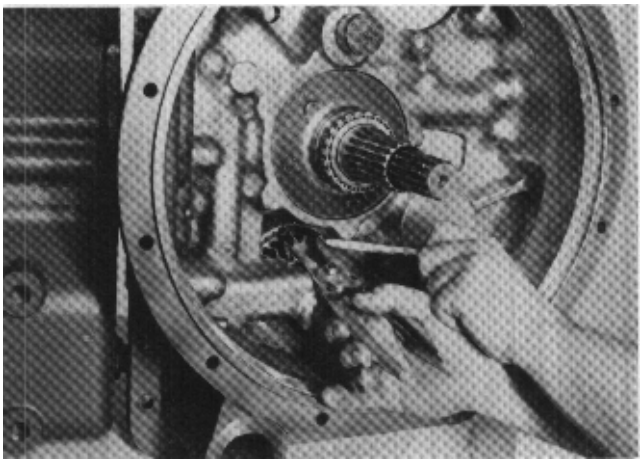


Figure 34
Using spreading type snap ring pliers, spread ears on the reverse front bearing retaining ring.

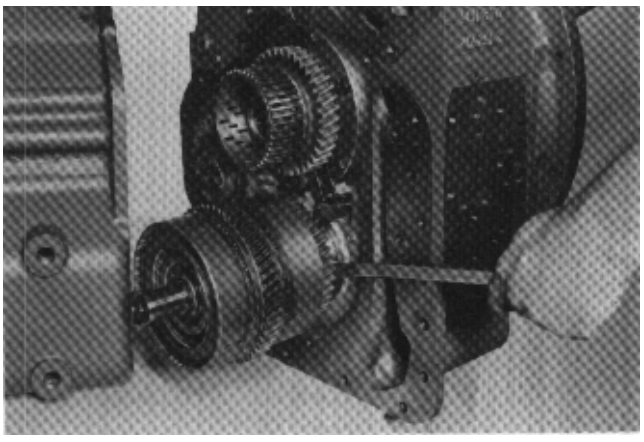


Figure 35
Holding snap ring open pry reverse and 2nd clutch assembly from converter housing.

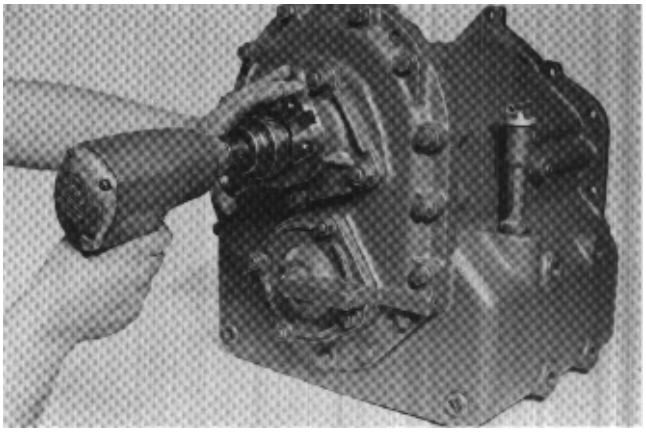


Figure 36
Using an impact wrench (if available), if not a flange retainer bar must be used to hole the companion flange from turning, loosen output flange nut.

Figure 37
Remove flange nut, washer, “O” ring and flange.

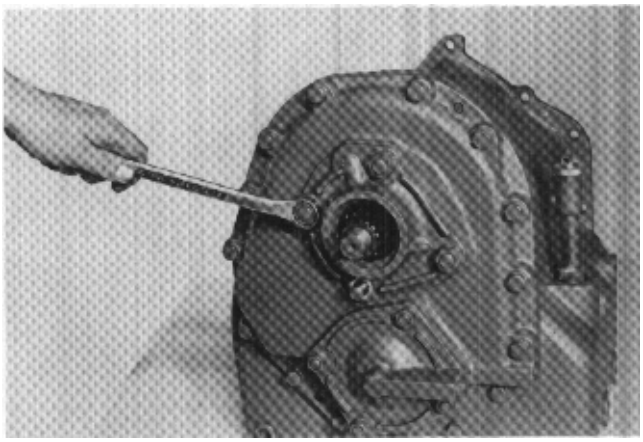


Figure 38
Remove output shaft bearing cap stud nuts and washers.

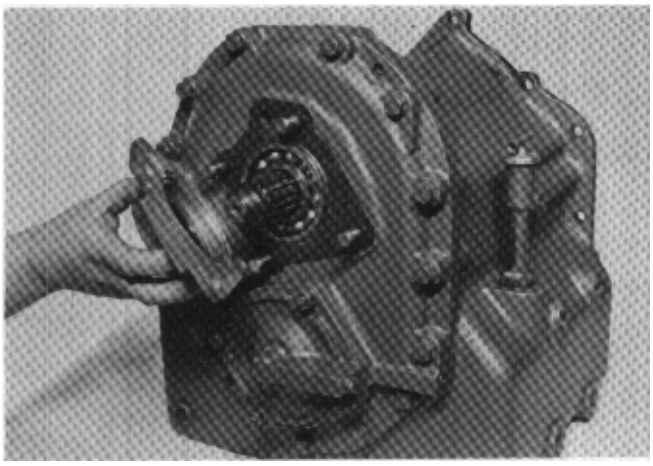


Figure 39
Remove output shaft bearing cap.

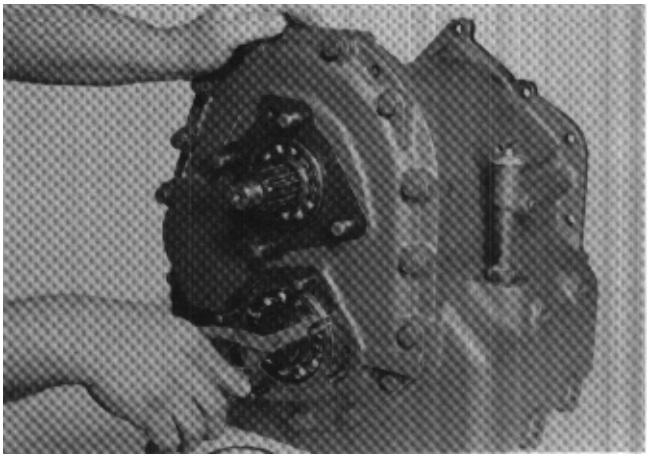


Figure 42
Remove output shaft and low clutch rear bearing locating rings.

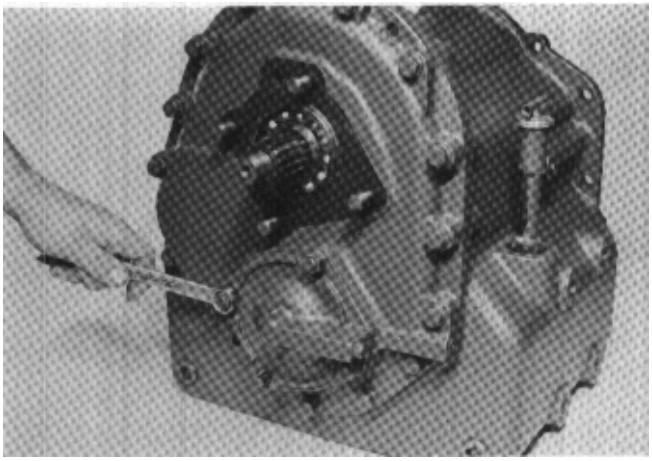


Figure 40
Remove low clutch bearing cap stud nuts and washers.

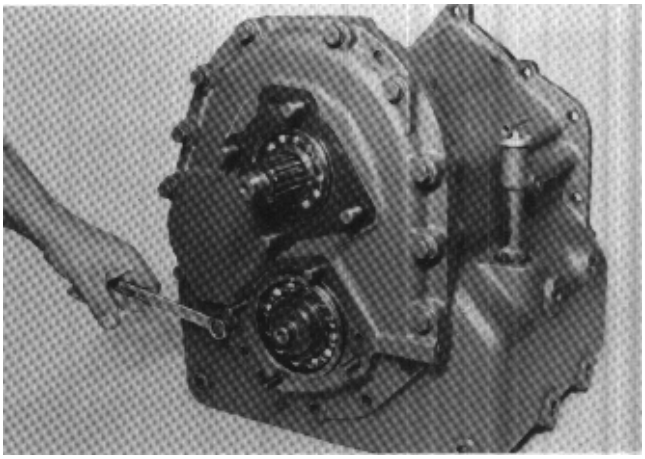


Figure 43
Remove rear cover screws and washers.

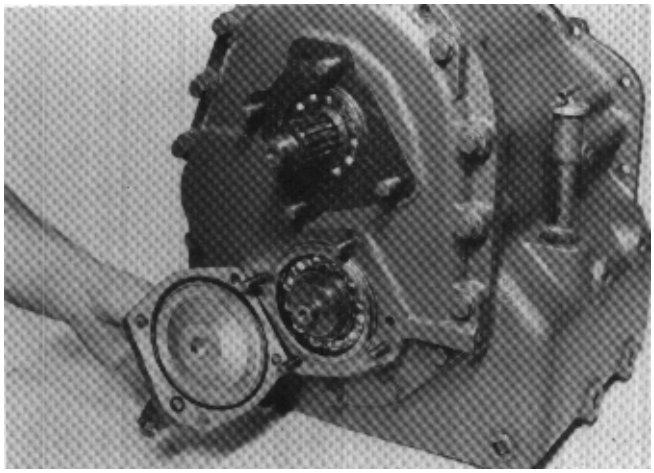


Figure 41
Remove low clutch bearing cap.

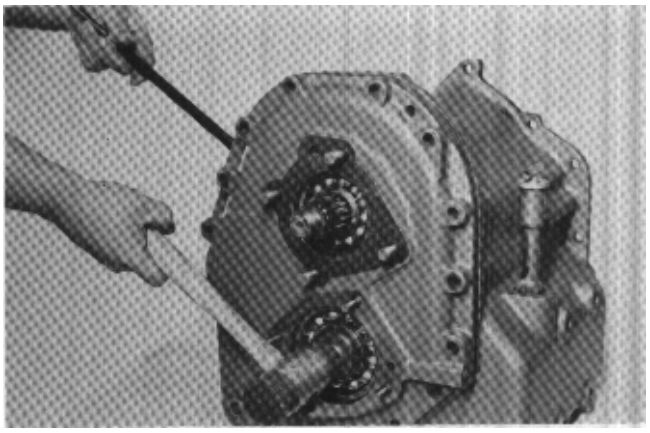


Figure 44
Using pry slots provided, pry cover from transmission housing, tapping on low clutch and output shaft to allow cover to be removed without shaft binding.

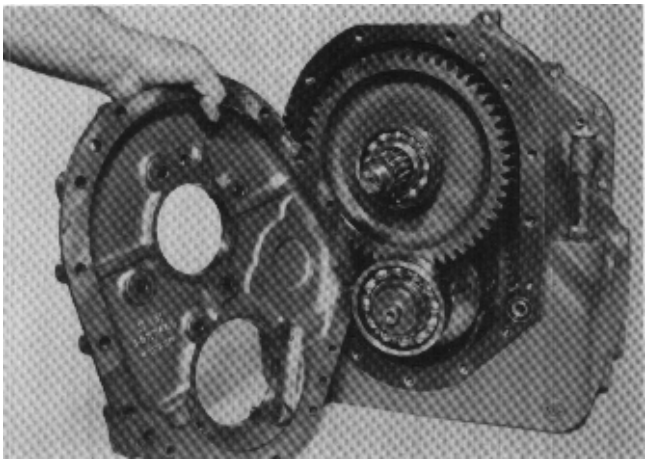


Figure 45
Rear cover removed showing low clutch (bottom) and output shaft (top).

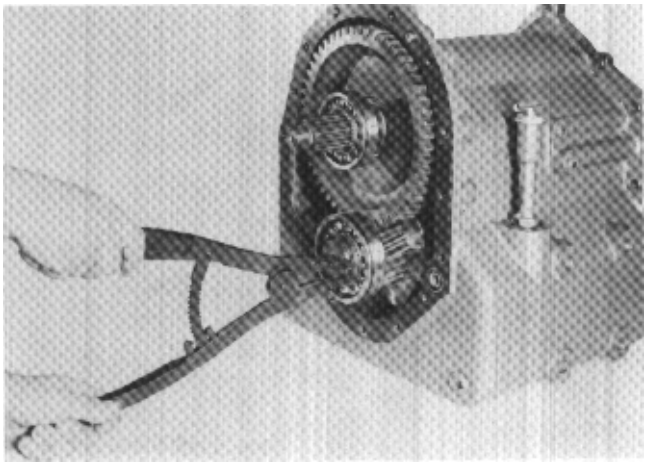


Figure 46
Remove low clutch rear bearing retainer ring.

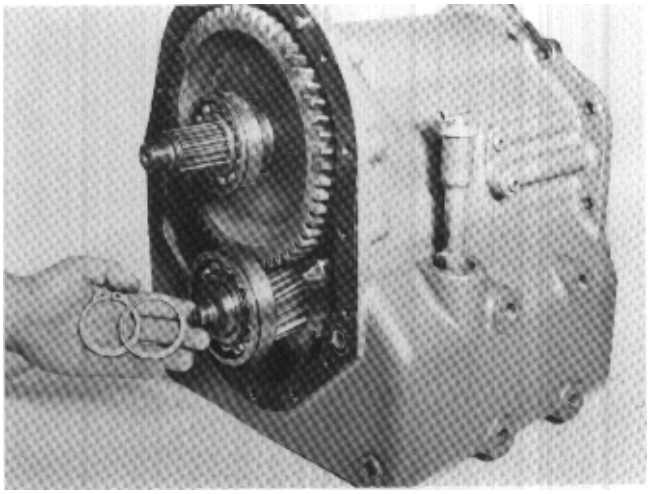


Figure 47
Low clutch rear bearing spacer and retainer ring.

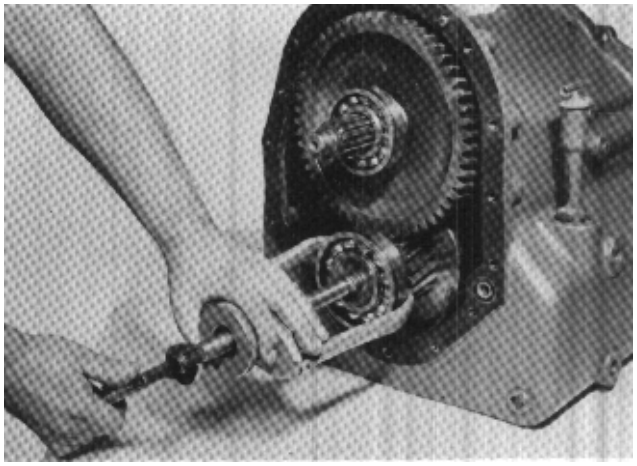


Figure 48
Remove low clutch rear bearing.

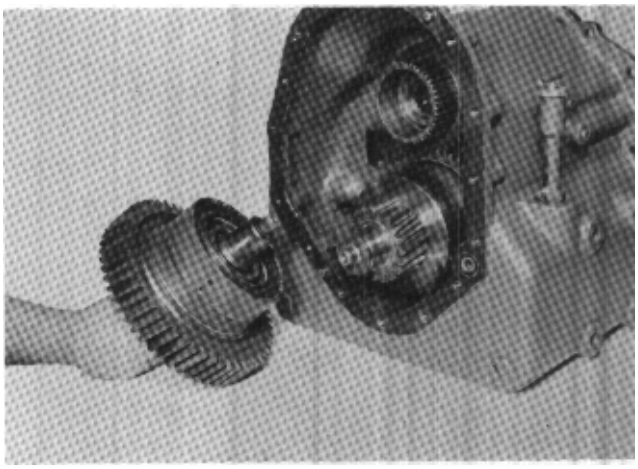


Figure 49
Remove output shaft and 3rd speed clutch assembly from housing. NOTE: The 2 speed transmission would not have a clutch on the output shaft.

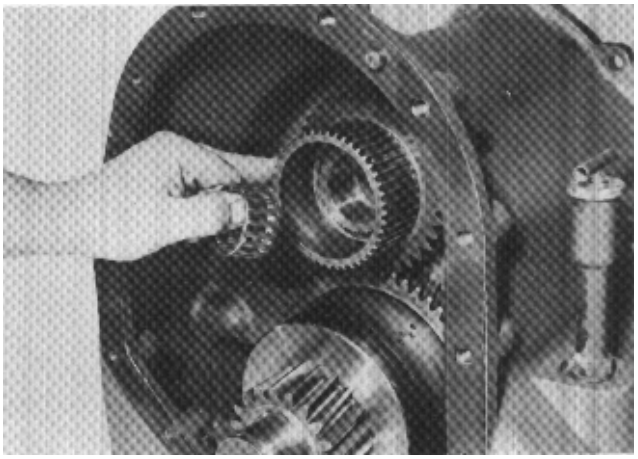


Figure 50
Remove the output shaft pilot bearing.

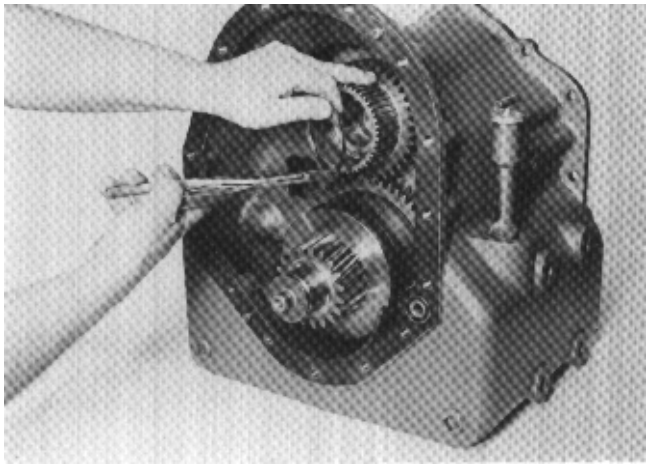


Figure 51
Remove 3rd gear and hub retainer ring.

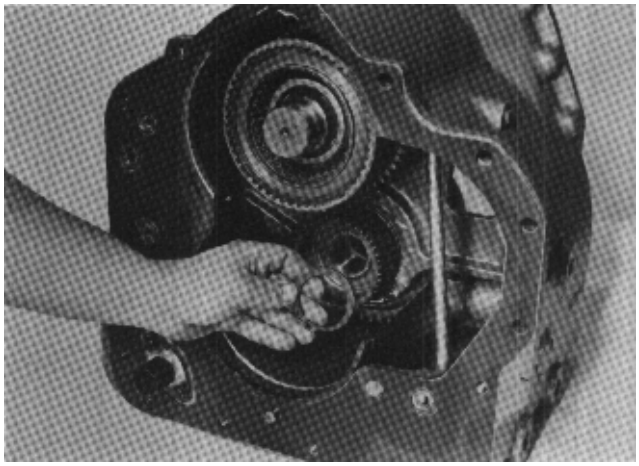


Figure 54
Remove 2nd clutch disc hub retainer ring.

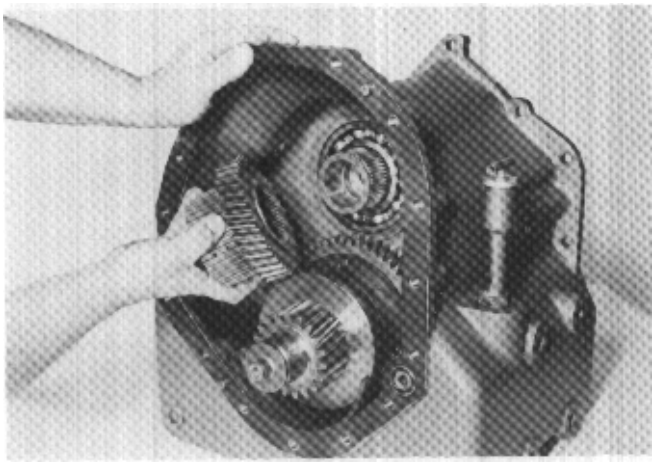


Figure 52
Remove gear and 3rd speed clutch hub. **NOTE: 2** speed would be gear only.

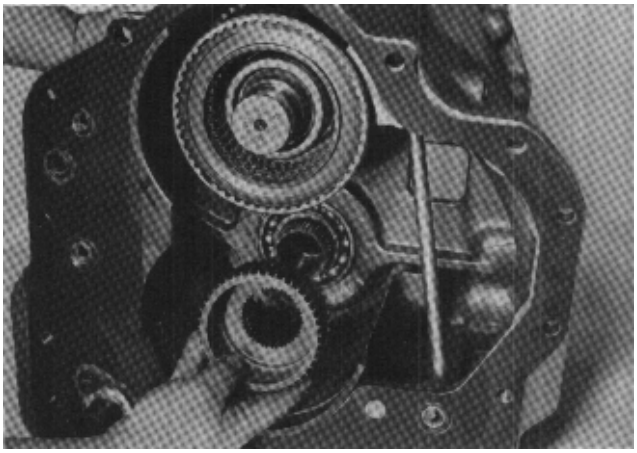


Figure 55
Remove 2nd disc hub.

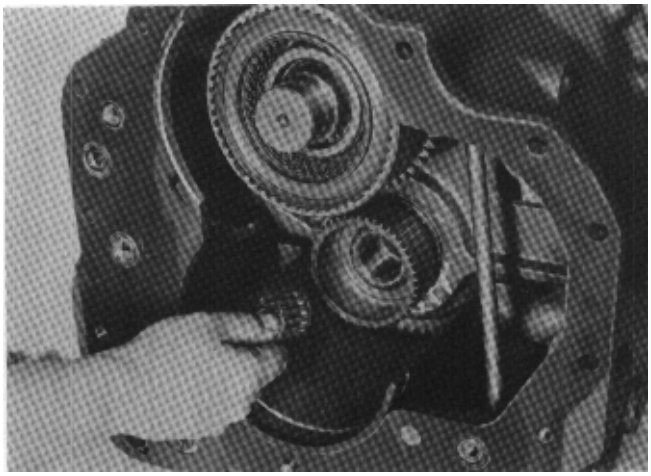


Figure 53
Remove reverse and 2nd shaft rear pilot bearing.

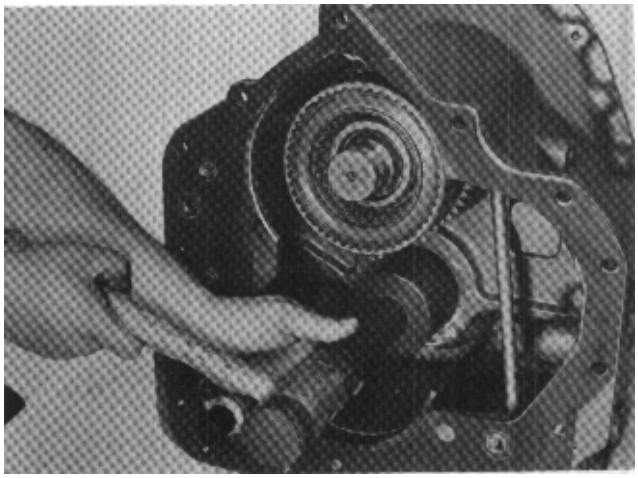


Figure 56
Tap low clutch and gear assembly from housing.

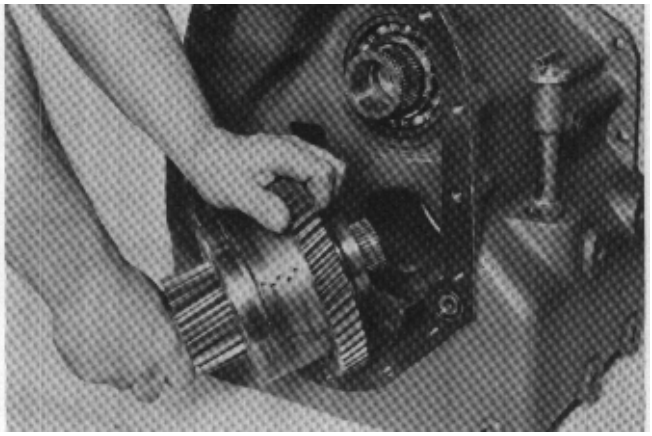


Figure 57
Low clutch assembly removed.

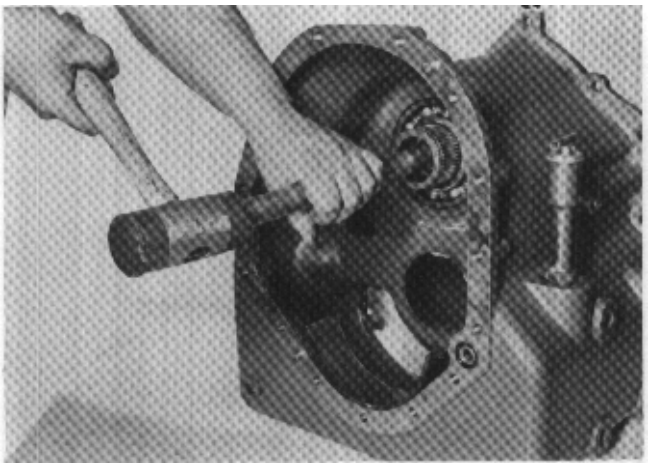


Figure 58
Tap forward clutch from housing.

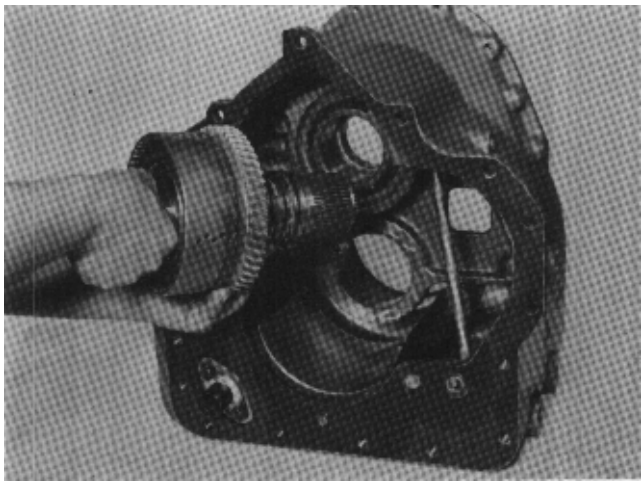


Figure 59
Forward clutch assembly removed.

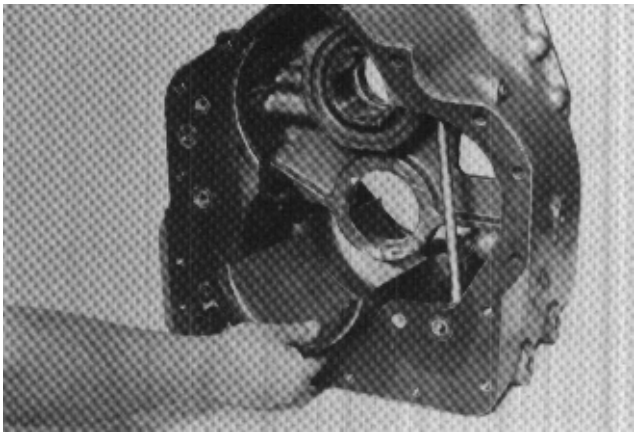


Figure 60
Remove oil baffle and baffle seals.

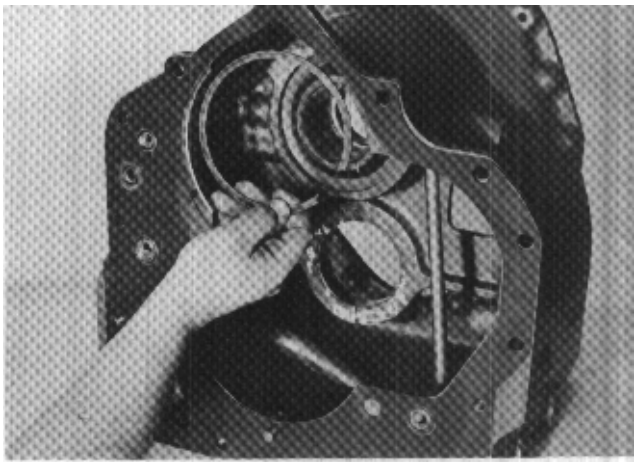


Figure 61
Remove forward clutch sealing ring sleeve retainer.

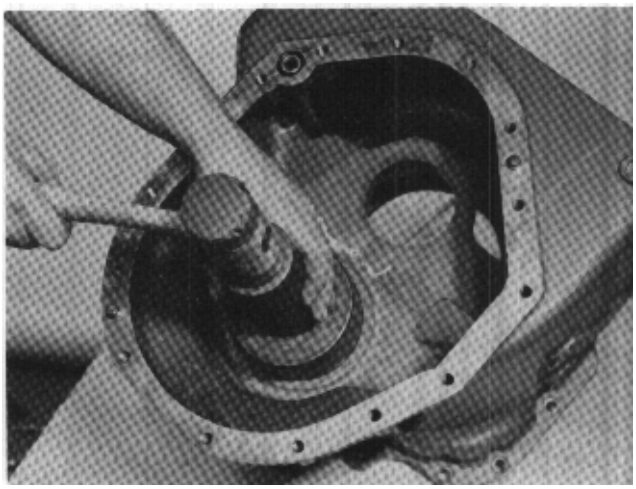


Figure 62
Tap sealing ring sleeve from housing as shown.

CLUTCH DISASSEMBLY
Low Clutch

Figure 63
Remove low gear and hub, bearing spacer and low clutch front bearing.

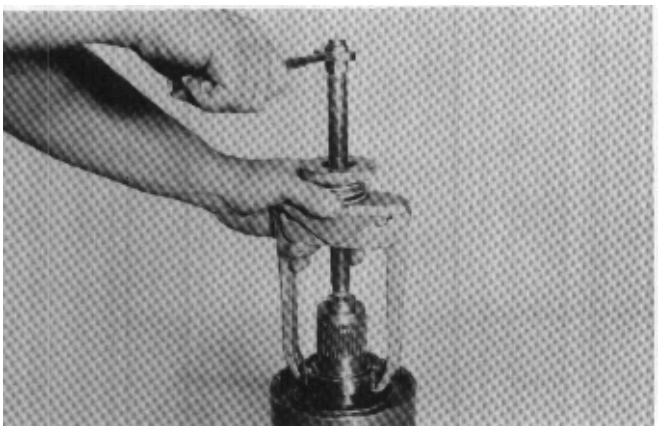


Figure 64
Remove low speed gear bearing.

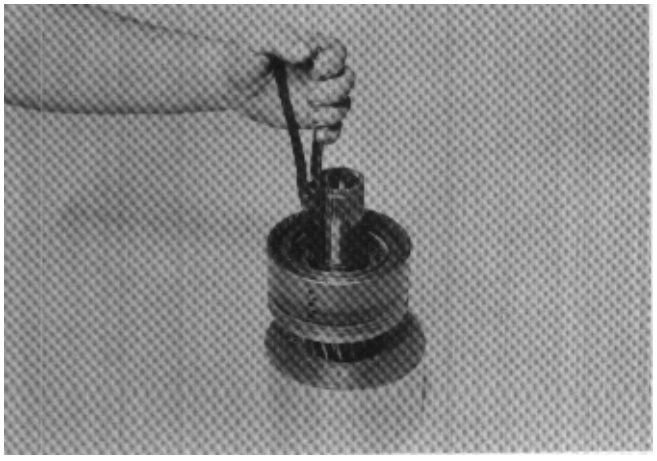


Figure 65
Remove low gear bearing locating ring.

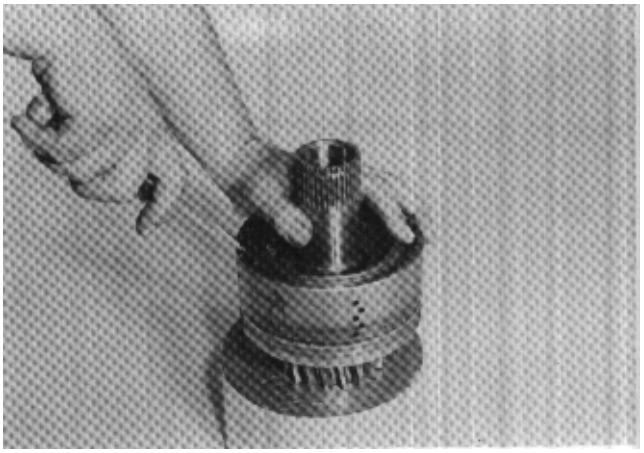


Figure 66
Remove end plate retainer ring.

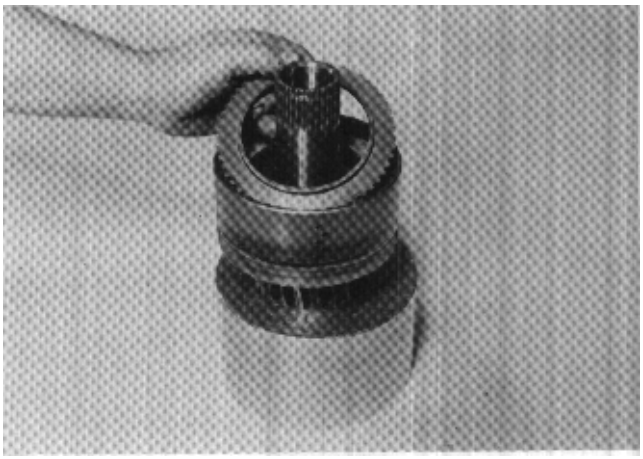


Figure 67
Remove end plate

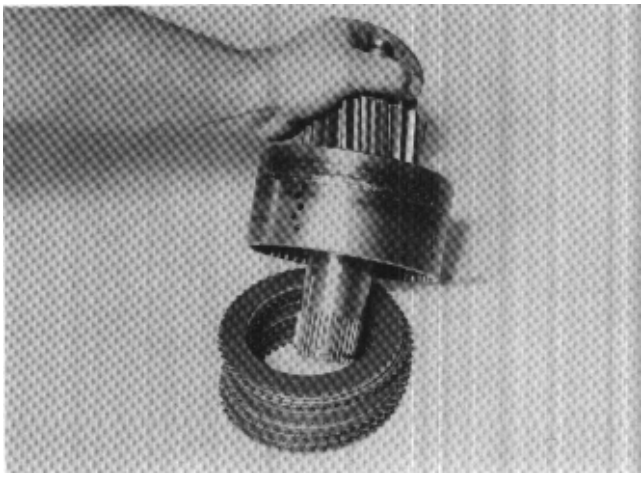


Figure 68
Turn clutch over. Remove inner and outer clutch discs.

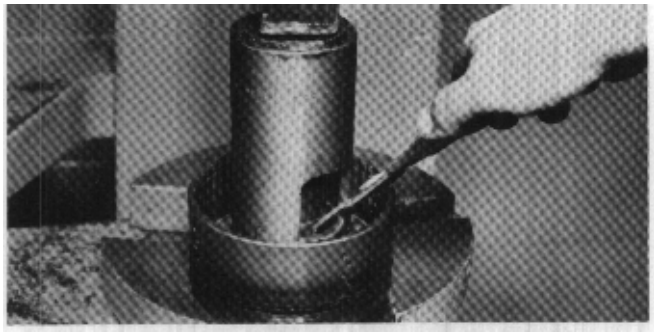


Figure 69

Remove clutch piston return spring. A sleeve with a portion removed is recommended for removing the clutch piston return spring, washer, and retainer ring. Sleeve shown is a common pipe, with a 1-1/2 x 1 [39,0x26,0mm] opening. The pipe is 6 x 3-1/4 x 2-3/4 [155,0x85,0x78,0mm]. Compress spring retainer washer. Through opening remove spring retainer snap ring. Release tension on spring retainer.

Figure 70

Remove spring retainer and spring. Turn clutch,over and tap clutch shaft on a block of wood to remove clutch piston.

LOW CLUTCH REASSEMBLY

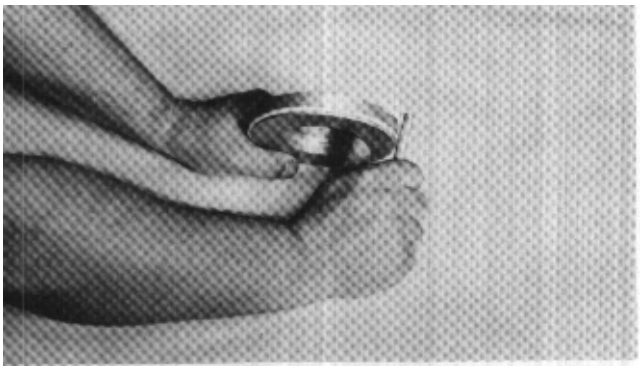


Figure 71

Install clutch piston outer seal ring. **NOTE:** Ring must be sized before installing in clutch drum. Sizing is best accomplished by rotating piston while holding a round object against the new seal ring as shown. Rotate piston until seal ring is flush with outer diameter of piston.

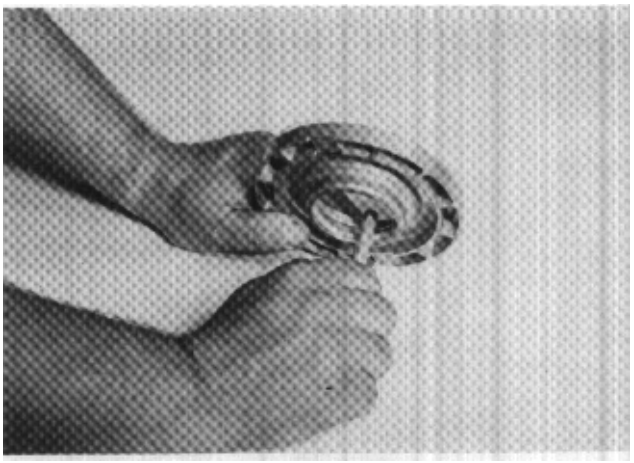


Figure 72

Install clutch piston inner seal ring and size as described in Figure 71.

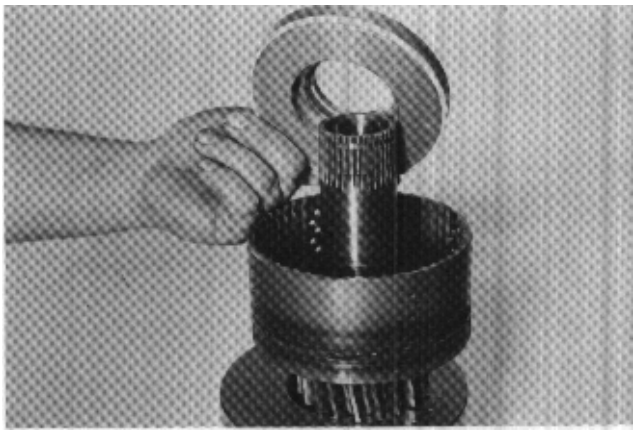


Figure 73

Position piston in low clutch drum as shown. Use caution as not to damage inner and outer piston sealing rings.

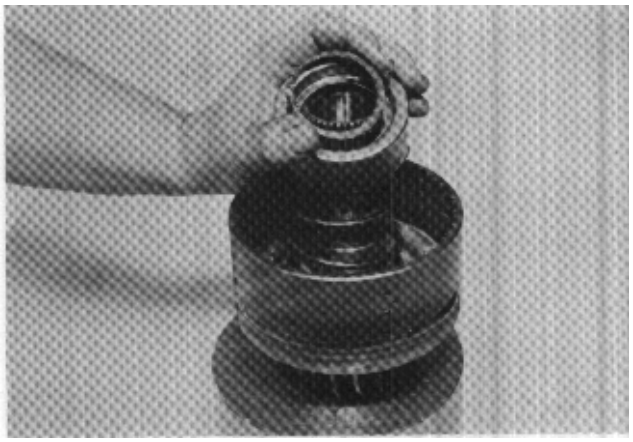


Figure 74

Position piston return spring, spring retainer, and snap ring in clutch drum.

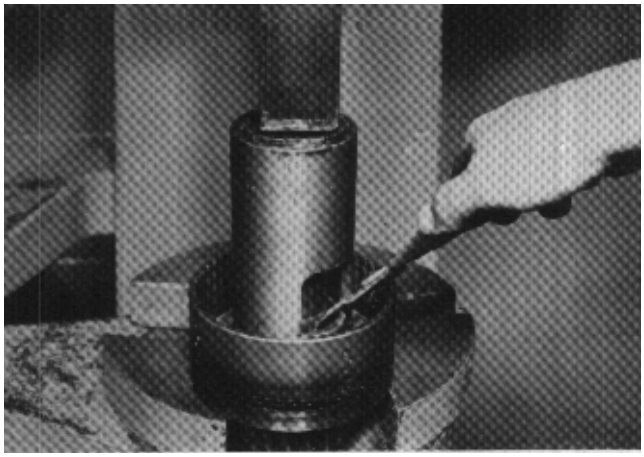


Figure 75
Compress spring and retainer. Install retainer snap ring.

Figure 76
Install clutch inner bearing locating ring.

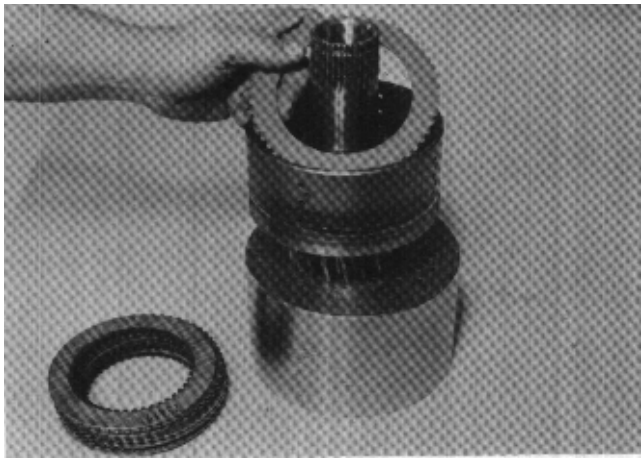


Figure 77
Install one steel disc.

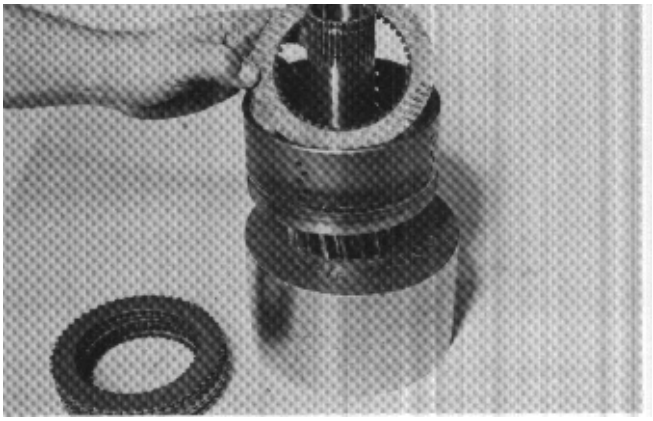


Figure 78
Install one friction disc. Alternate steel and friction discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

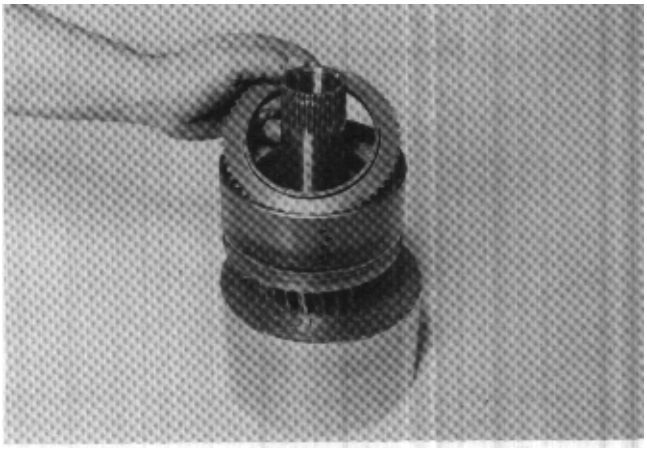


Figure 79
Install clutch disc end plate.

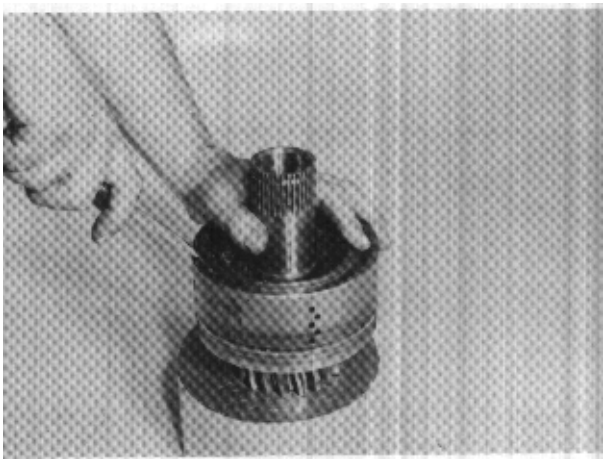


Figure 80
Install end plate retainer ring.

Figure 81
Install low speed gear inner bearing.

Figure 82
Install low speed gear bearing spacer.

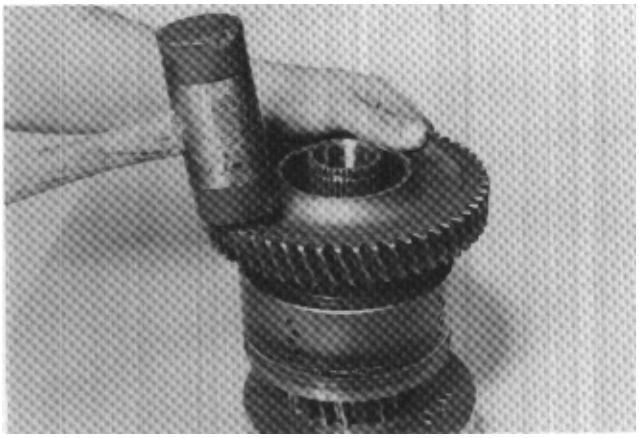


Figure 83
Install low clutch driven gear and hub into clutch drum. Align splines on clutch hub with internal teeth of friction discs. Tap gear into position. Do not force this operation. Gear splines must be in full position

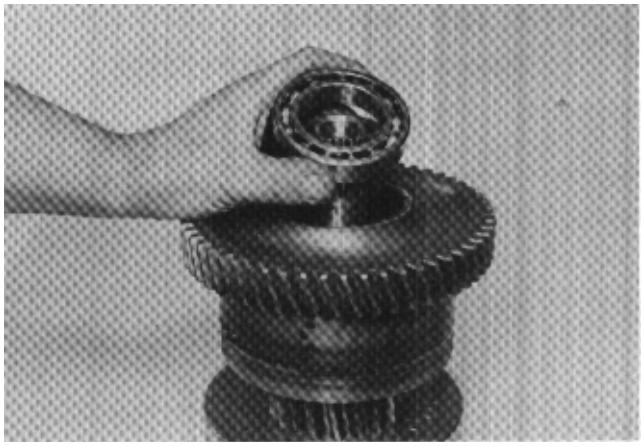


Figure 84
Install low speed gear outer bearing.

Figure 85
Position low gear front bearing spacer and bearing on clutch shaft.

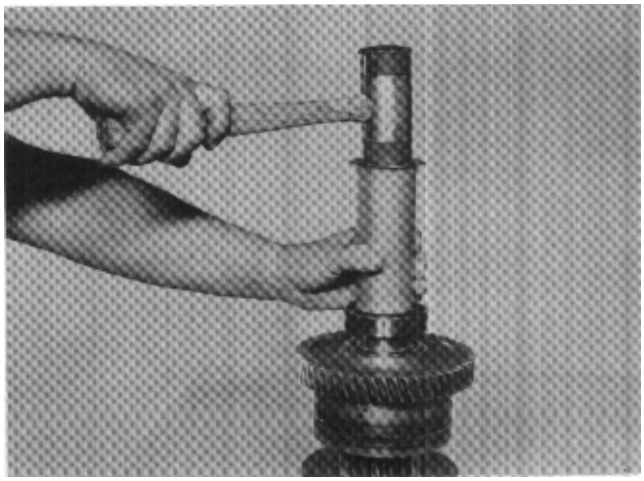


Figure 86
Tap bearing into position.

REVERSE AND 2nd CLUTCH DISASSEMBLY

(Reverse being disassembled)

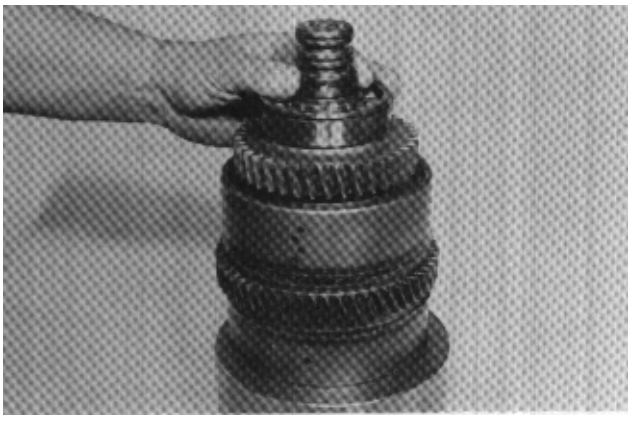


Figure 87
Remove clutch shaft piston ring and expander springs. See page 50 for proper piston ring installation.

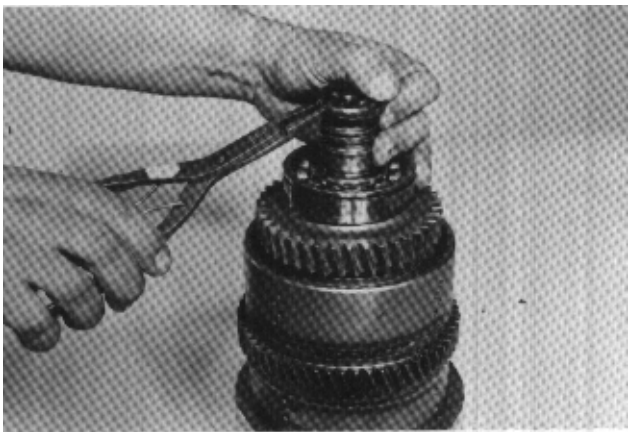


Figure 88
Remove front bearing retainer ring.

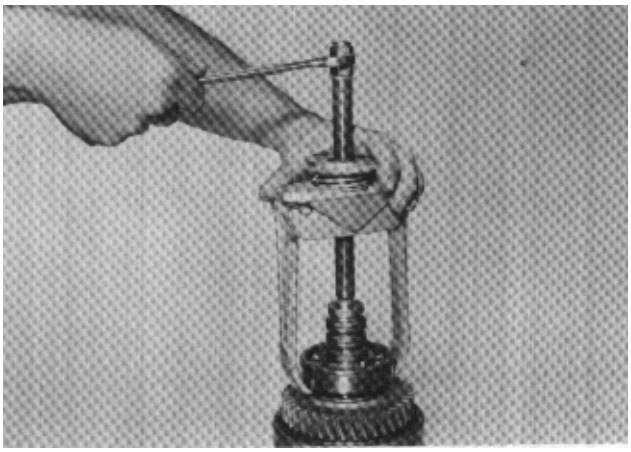


Figure 89
Remove front bearing.

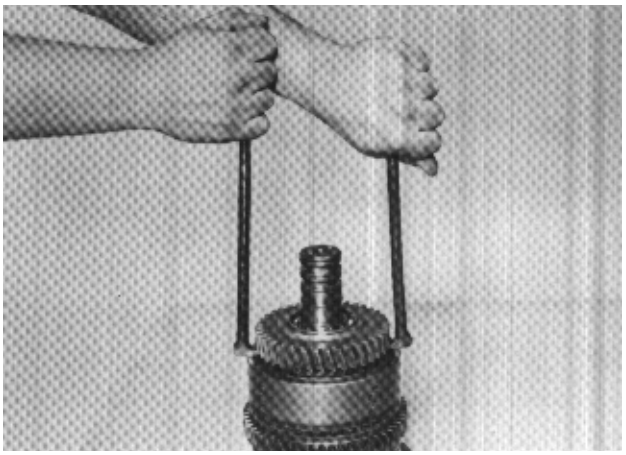


Figure 90
Pry reverse gear from clutch assembly far enough to use a gear puller.

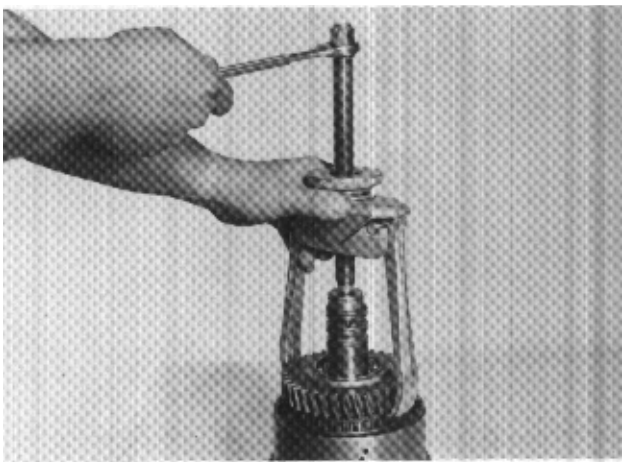


Figure 91
Remove gear as shown.

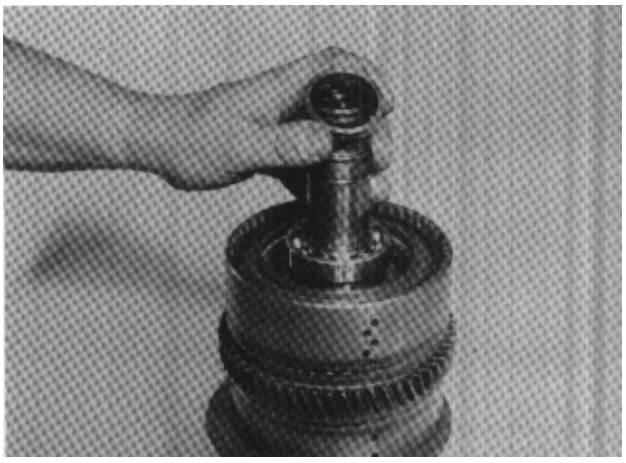


Figure 92
Remove bearing spacer.

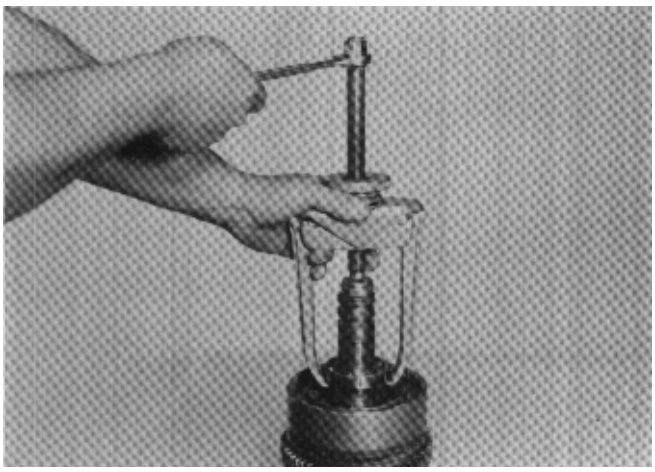


Figure 93
Remove inner bearing.

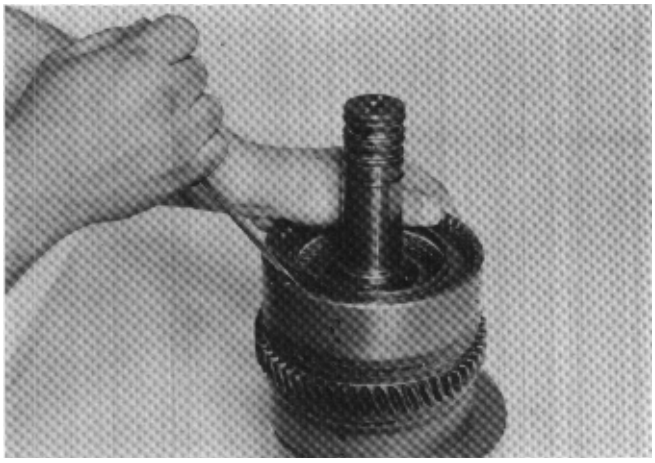


Figure 94
Remove end plate retainer ring.

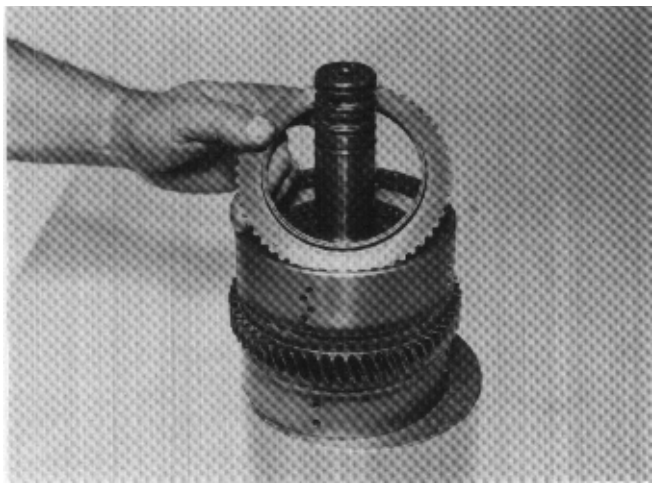


Figure 95
Remove end plate.

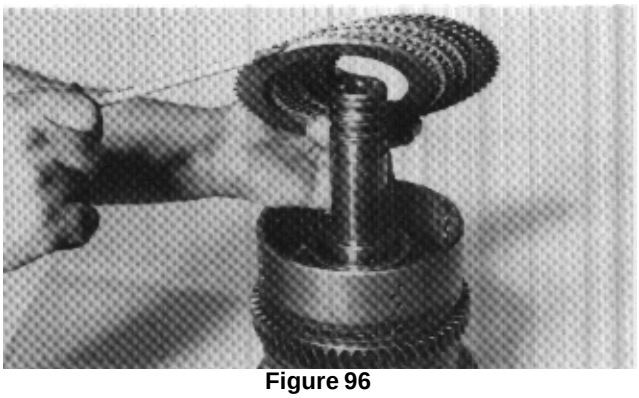


Figure 96
Remove clutch disc

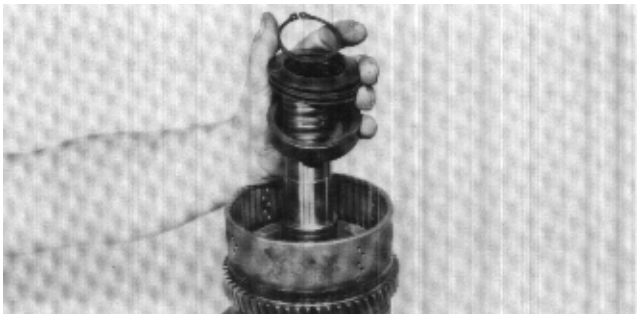


Figure 97
Refer to procedure shown in Figure 69 for removing return spring retainer ring. Remove ring, piston return spring washers and spacer. Turn clutch over and tap shaft on a block of wood to remove clutch piston. Repeat procedure for 2nd and 3rd clutch disassembly. NOTE: 2nd and 3rd clutch will not have washers for piston return. **See note on page 51.**

REVERSE AND 2ND CLUTCH DISASSEMBLY
(Reverse being assembled)

NOTE: 2nd and 3rd clutch assemblies are the same as reverse except where noted.

Figure 98
Install inner and outer clutch piston seal rings. Size rings as explained in Figure 71. Position piston in clutch drum.

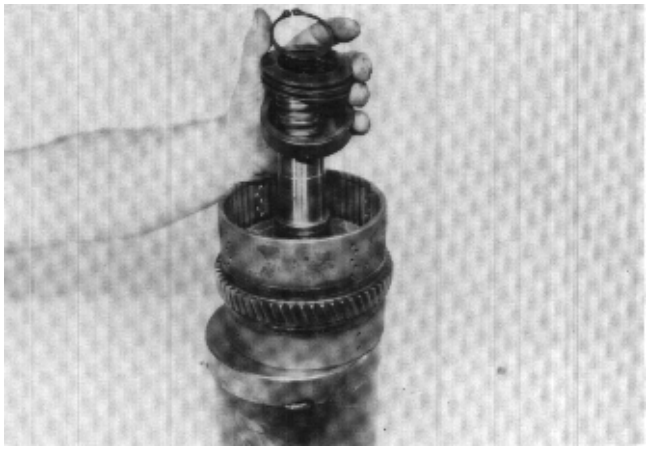


Figure 99
Install piston return spring spacer, disc spring washers and retainer ring. See note on page 51. 2nd clutch uses a return spring and not disc spring washers.

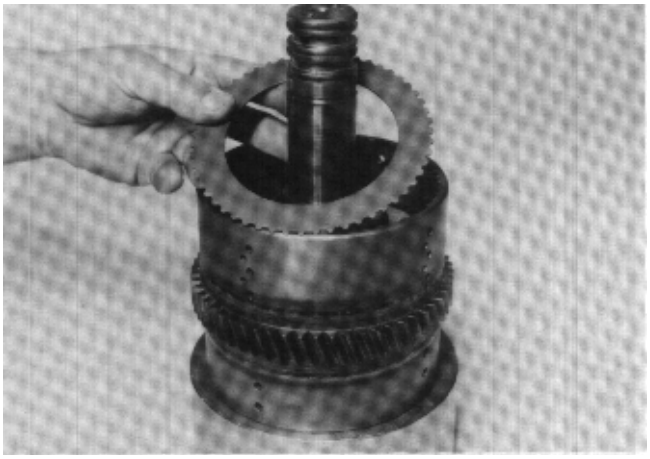


Figure 100
Install 1st steel disc.

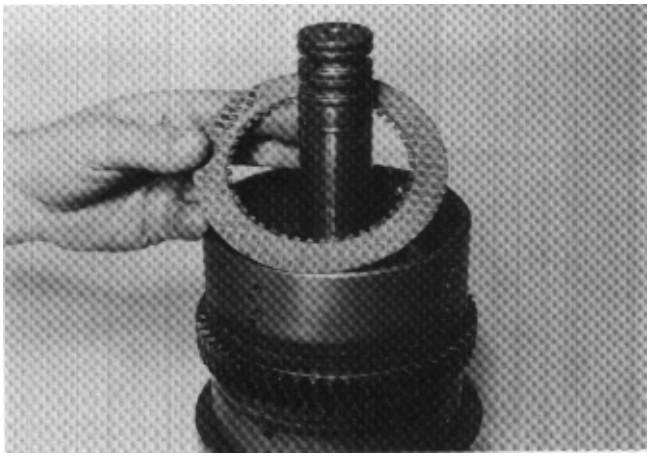


Figure 101
Install one friction disc.

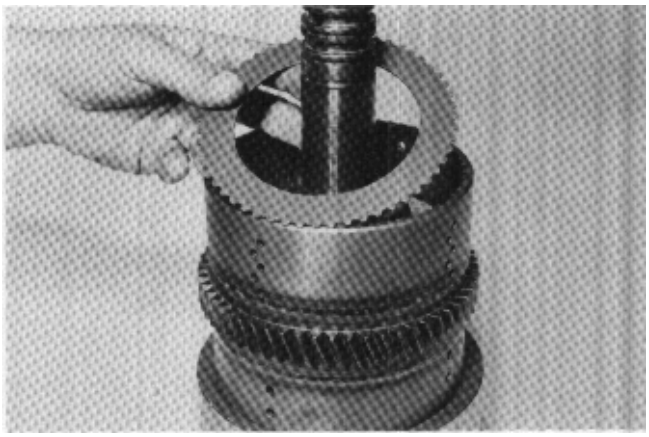


Figure 102
Install next steel disc. Alternate friction and steel discs until the proper amount of discs are installed. First disc next to the piston is steel, last disc installed is friction.

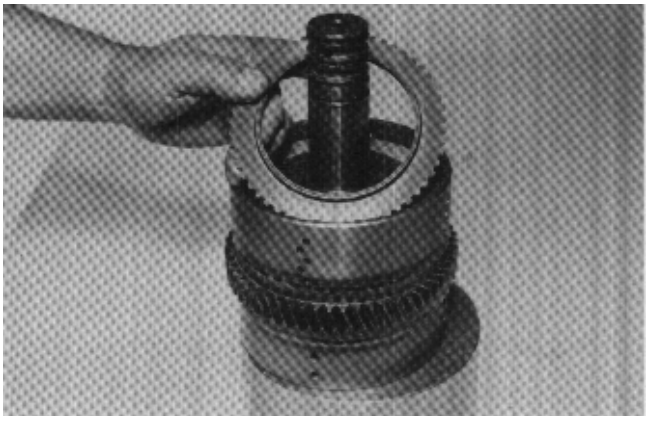


Figure 103
Install end plate.

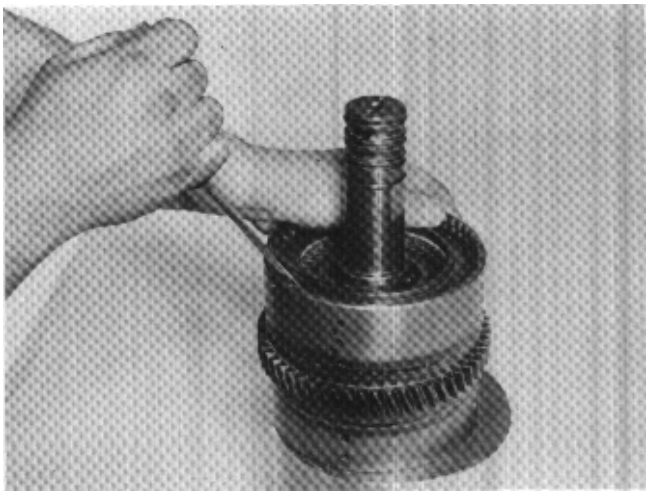


Figure 104
Install end plate retainer ring.

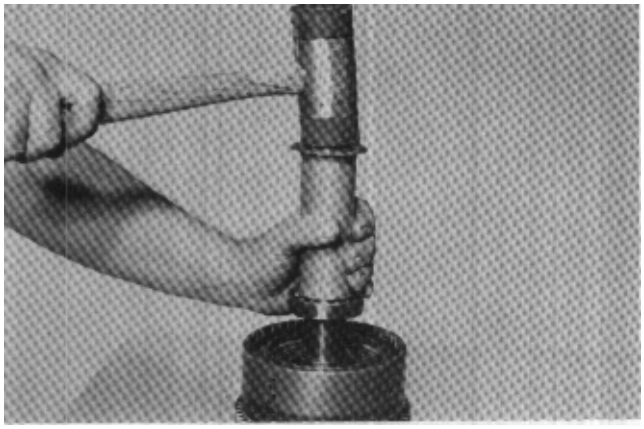


Figure 105
Install inner clutch driven gear bearing.

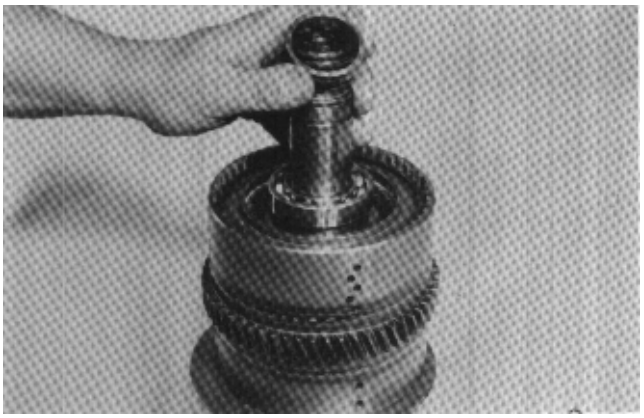


Figure 106
Install bearing spacer.

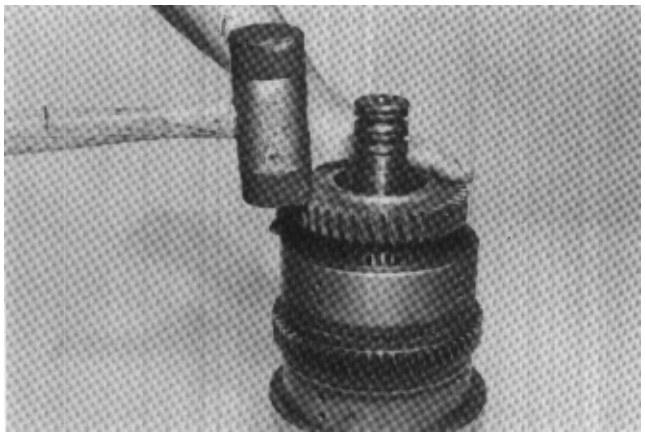


Figure 107
Install clutch driven gear into clutch drum. Align splines on clutch gear with internal teeth of friction discs. Tap gear into position. Do not force this operation. Gear splines must be in full position with internal teeth of all friction discs.

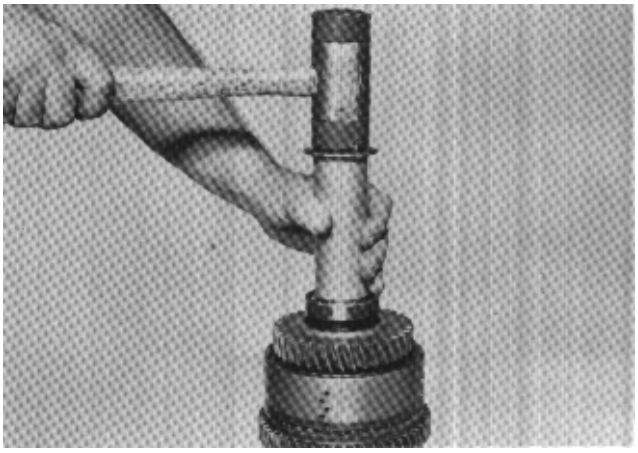


Figure 108
Install outer spacer.

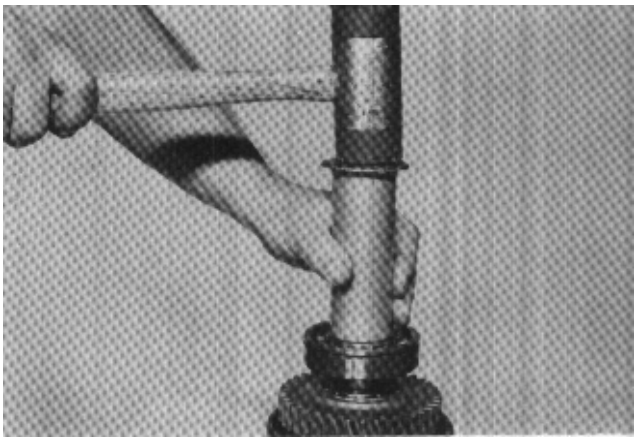


Figure 109
Install front bearing. NOTE: Snap ring groove in front bearing must be up.

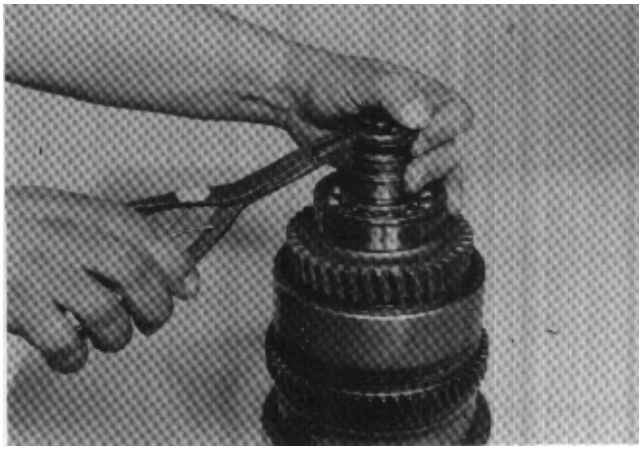


Figure 110
Install front bearing retainer ring.

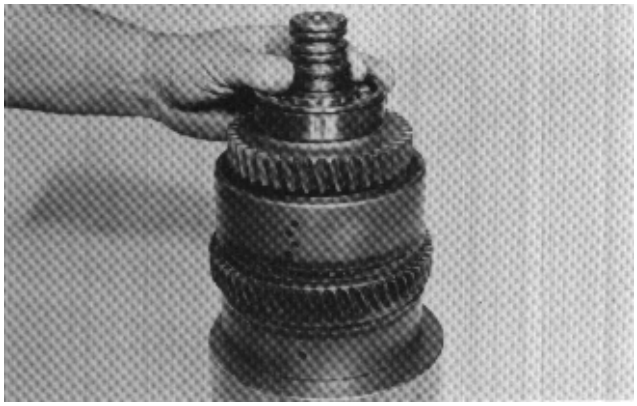


Figure 111
Install new clutch shaft piston rings and expander springs per instructions on page 50. **NOTE: 2nd and 3rd clutch uses a return spring and not disc spring washer for piston return.**

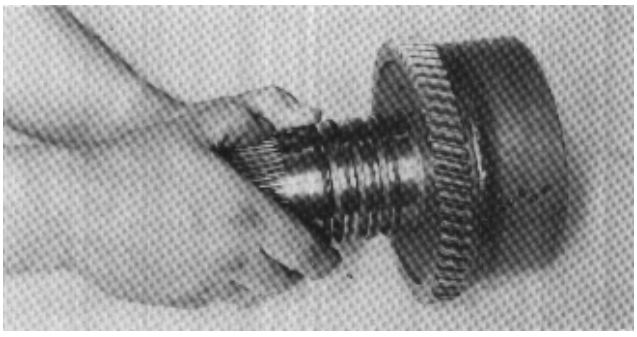


Figure 112
Forward clutch will disassemble and reassemble the same as the reverse clutch. Install new clutch shah piston rings and expander springs per instructions on page 50.

CONVERTER HOUSING DISASSEMBLY

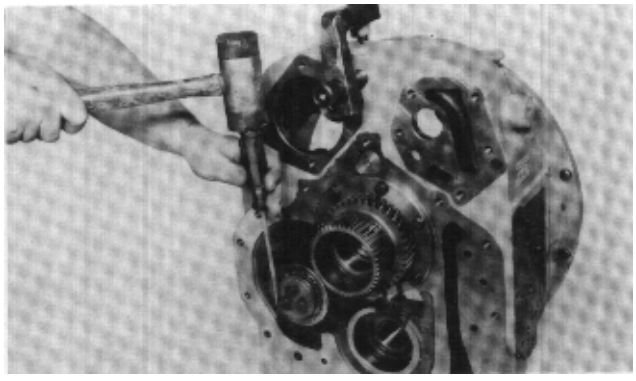


Figure 113
Straighten lockplate tabs from reverse idler capscrews.

NOTE: Some units will have a lock nut type idler gear retention. Disassembly and reassembly of this type is explained in detail starting on page 45, Figure 202.

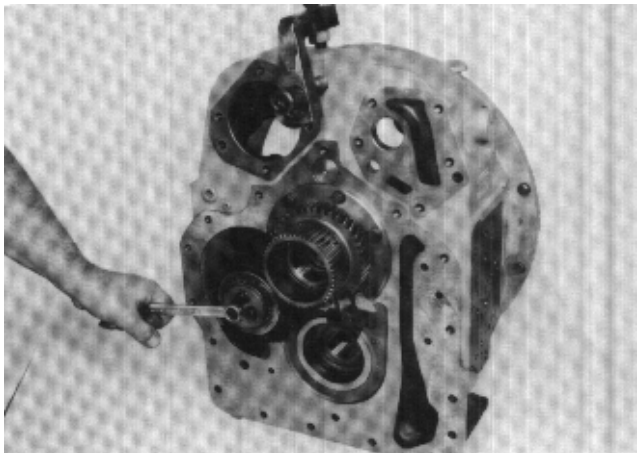


Figure 114
Remove reverse idler capscrews.

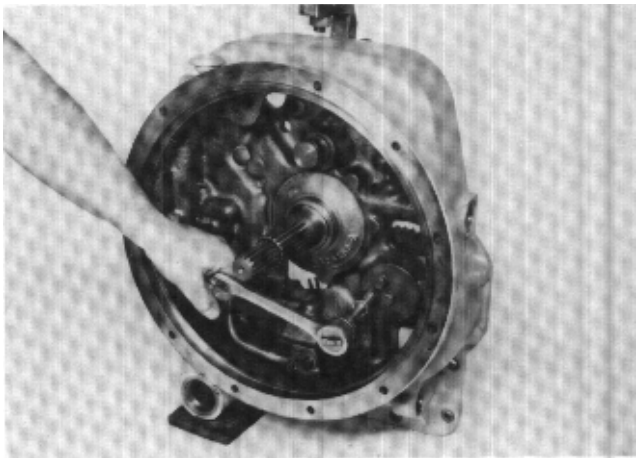


Figure 115
Remove reverse idler shaft front capscrews.

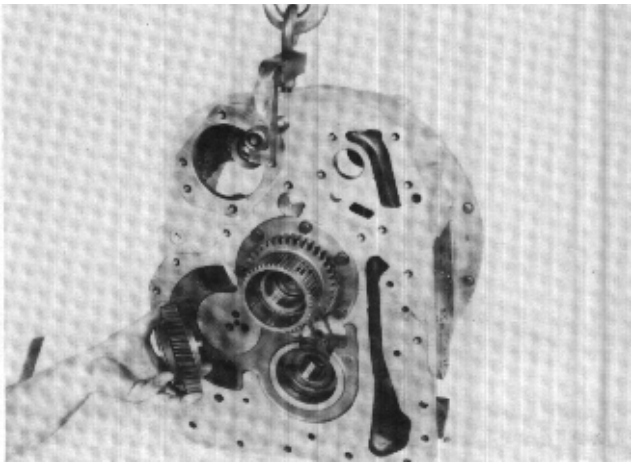


Figure 116
Remove reverse idler gear and bearing assembly.

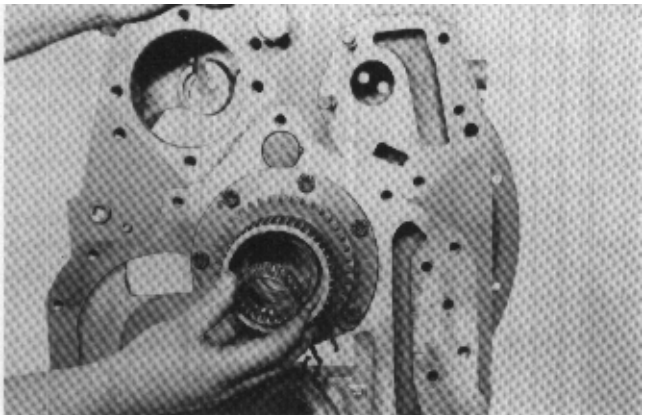


Figure 117
Remove forward shaft pilot bearing.

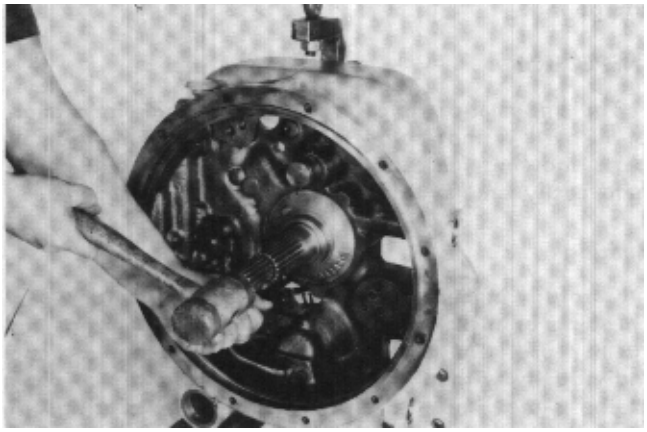


Figure 118
Using spreader type snap ring pliers spread ears on the turbine shaft bearing snap ring. Tap turbine shaft from converter housing.

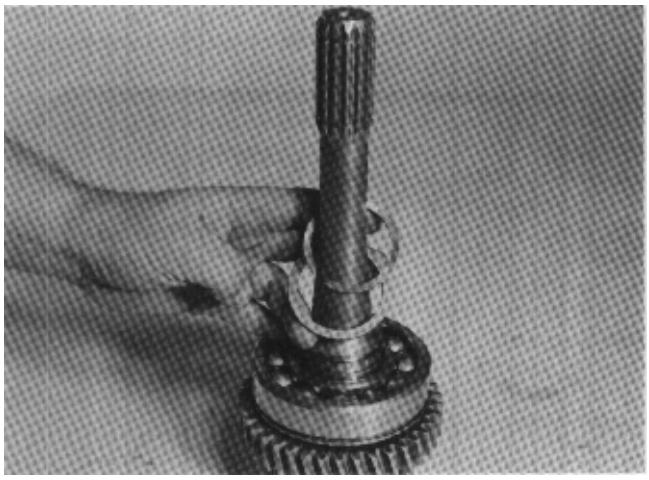


Figure 119
Remove oil sealing ring and turbine shaft bearing retainer ring and washer.

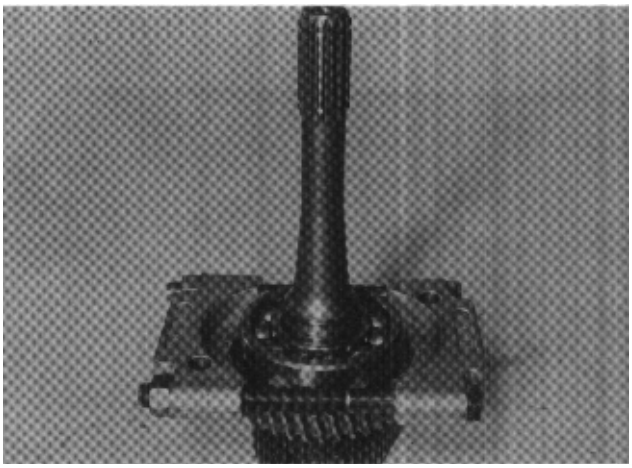


Figure 120
Recommended procedure for removing bearing.

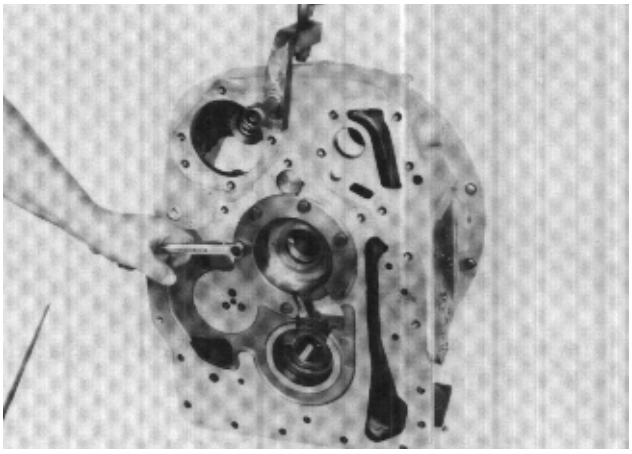


Figure 121
Remove reaction member support capscrews.

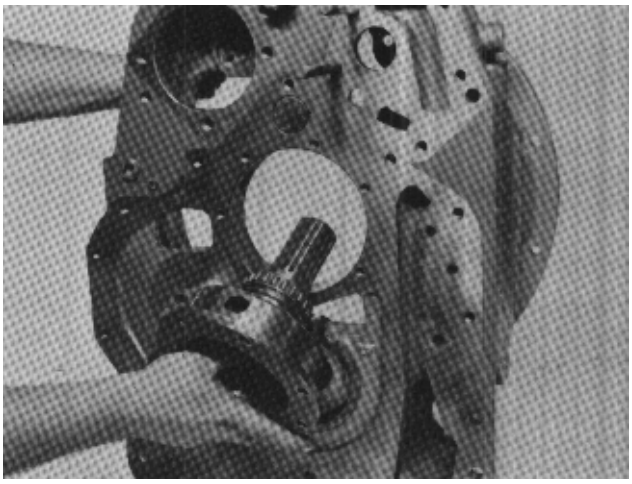


Figure 122
Tap reaction member support from housing.

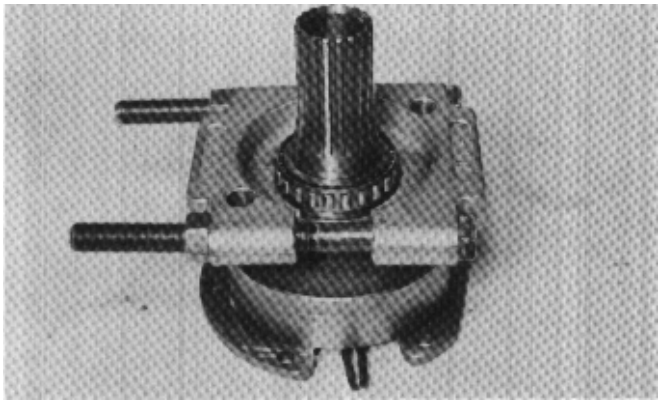


Figure 123

Remove bearing from support. Remove support oil sealing ring and sealing ring expander spring.

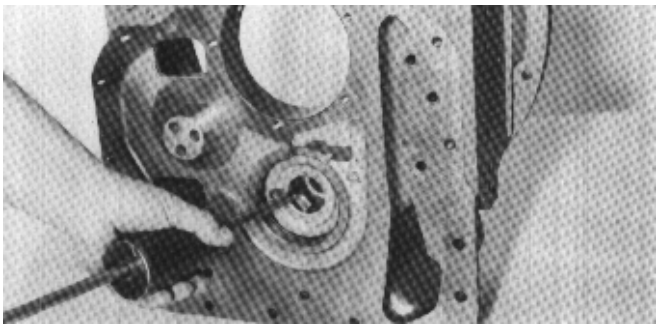


Figure 124

If reverse clutch piston ring sleeve is to be replaced, remove as shown.

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 skin rashes and inhalation of vapors 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 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 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 meeting members. Lubricate all “O” rings and seals with recommended type 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 all 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

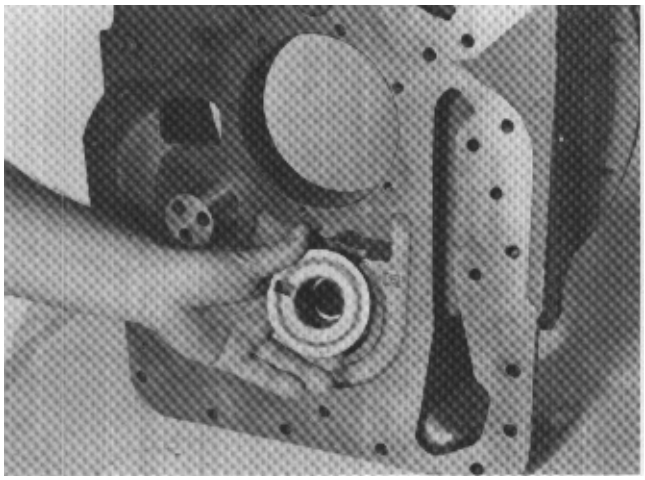


Figure 125
Install reverse clutch piston ring sleeve in housing.

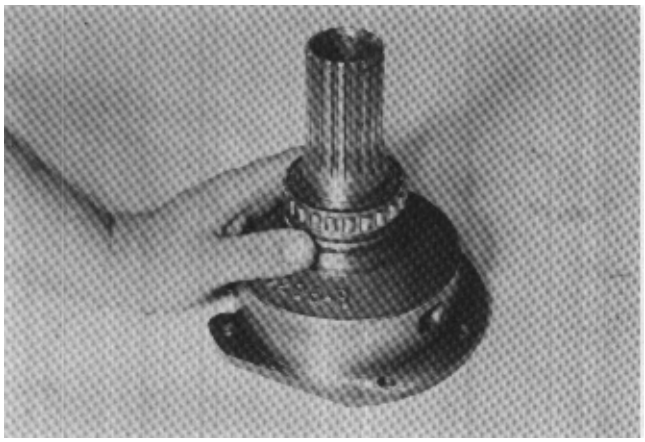


Figure 126
Install new sealing ring expander spring and oil sealing ring on support. Expander spring gap to be 180° from sealing ring hook joint. Press support bearing into position. NOTE: Bearing part number must be up.

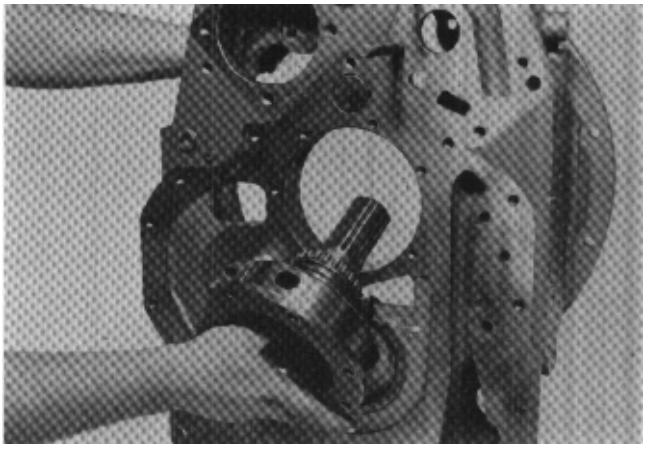


Figure 127
Position support in converter housing aligning holes of support with housing.

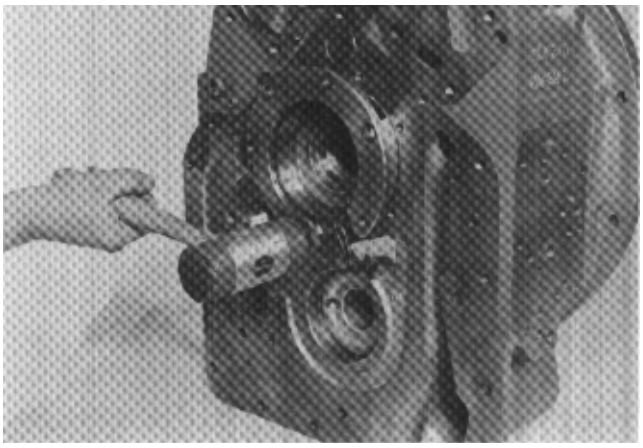


Figure 128
Tap support into position.

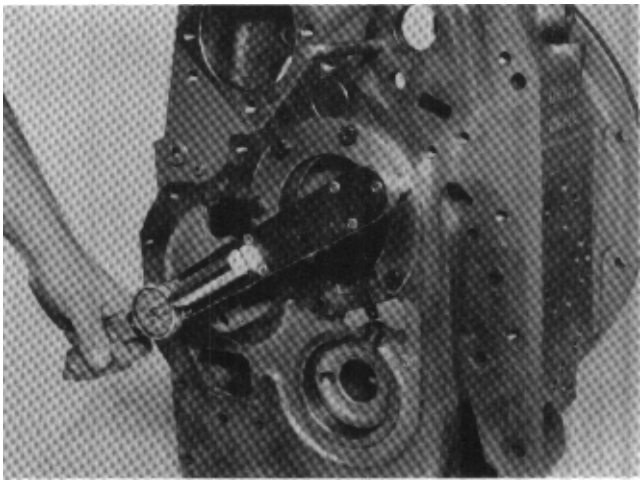


Figure 129
Tighten support bolts 23 to 25 ft. lbs. torque [31,2-33,8 N.m].

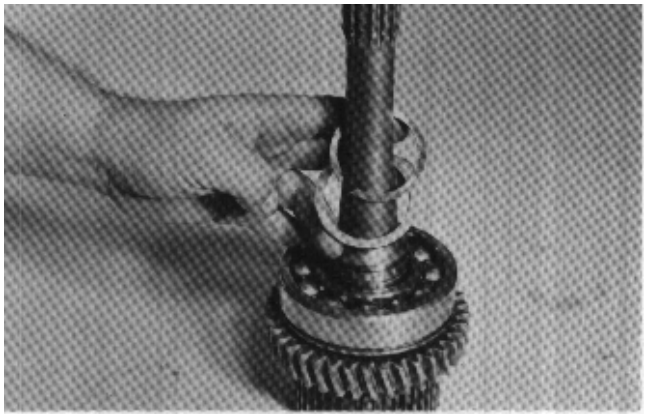


Figure 130

Press turbine shaft bearing into position. Install bearing washer and retainer ring. Install new turbine shaft oil sealing ring.

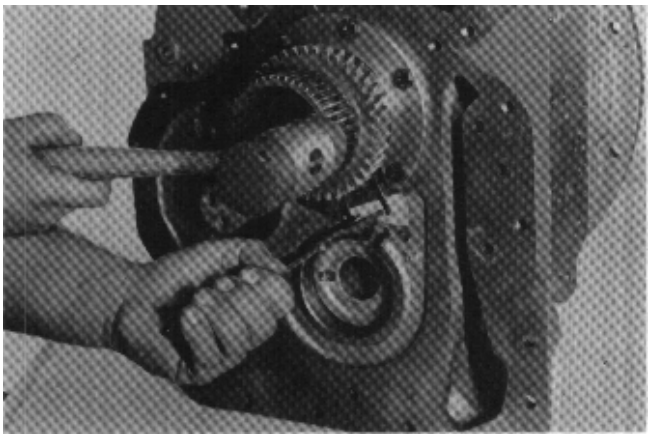


Figure 131

Spread ears on turbine shaft bearing retainer ring located in reaction member support. Tap turbine shaft into position.

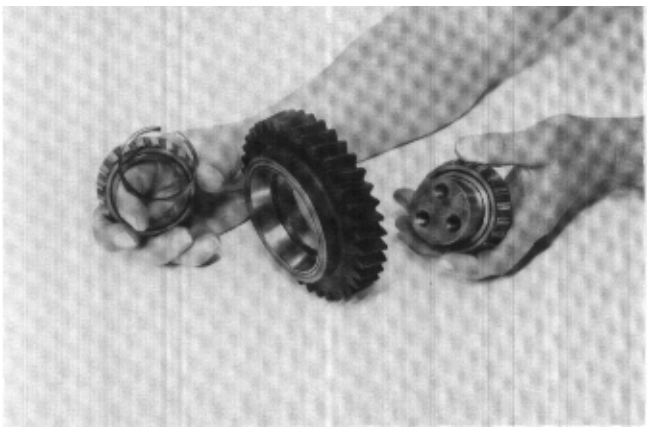


Figure 132

Press idler gear bearing on shaft. Install shah and bearing in idler gear. Position spacer on shaft, press bearing on shaft into gear. NOTE: See Figure 209 for lock nut type idler shaft retention.

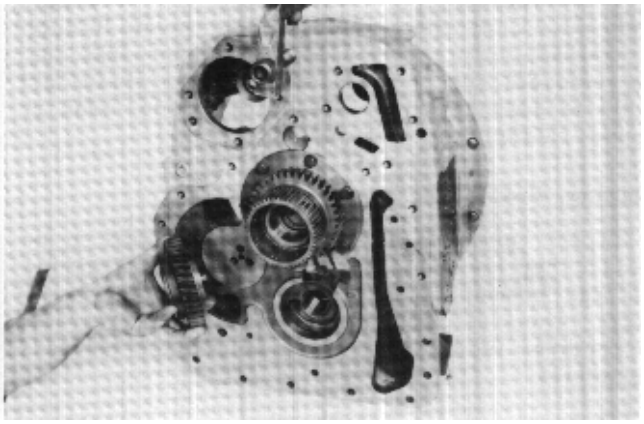


Figure 133

Position reverse idler and bearing assembly into converter housing. **NOTE:** Long hub of gear out.

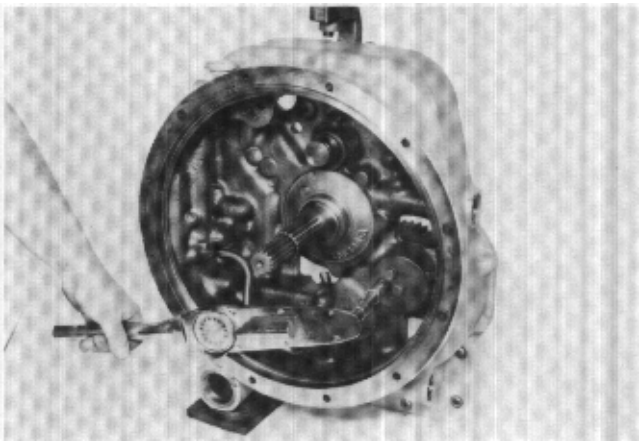


Figure 134

Install reverse idler shaft capscrews and lockwashers. Tighten 58 to 64 ft. lbs. torque [78,6 - 86,8 N.m].

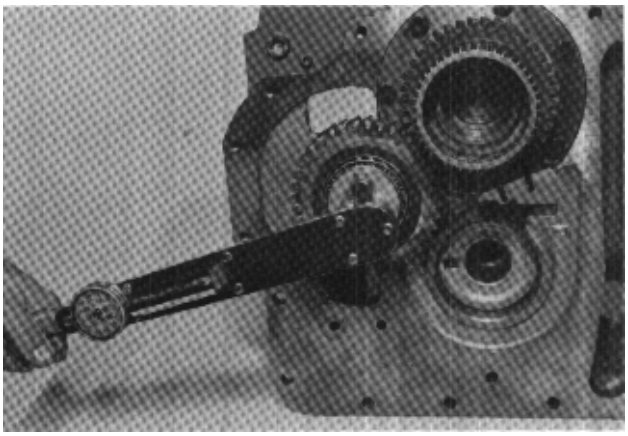


Figure 135

Install bearing retainer plate, lock plate and idler gear capscrews. Tighten capscrews 58 to 64 ft. lbs. torque [78,6 - 86,8 N.m]. Bend lockplate tabs over capscrew heads to prevent loosening.

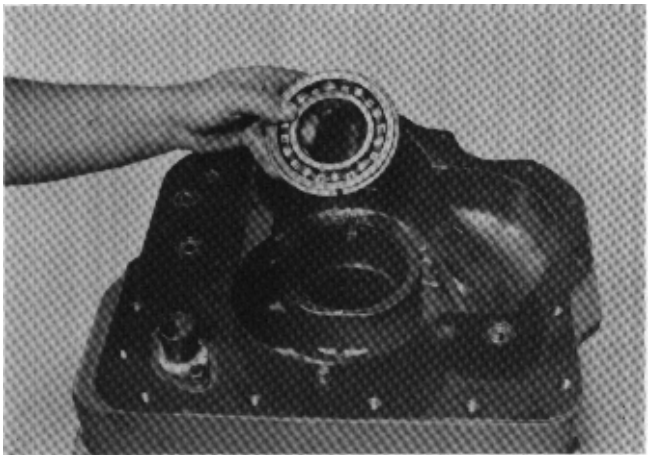


Figure 136
Tap forward shaft rear bearing into housing

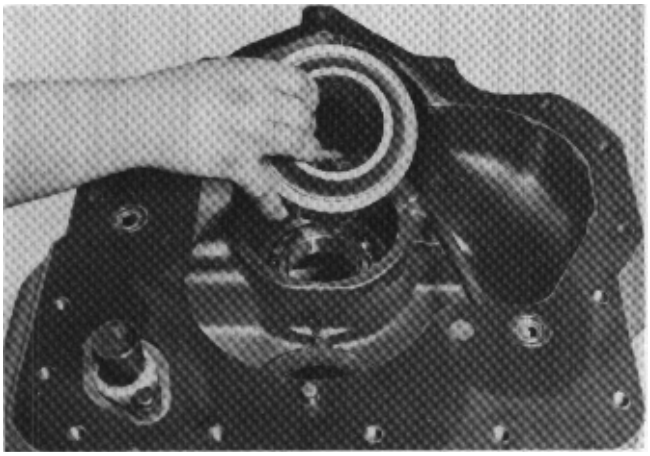


Figure 137
With roll pin in place tap forward shaft piston ring sleeve into position.

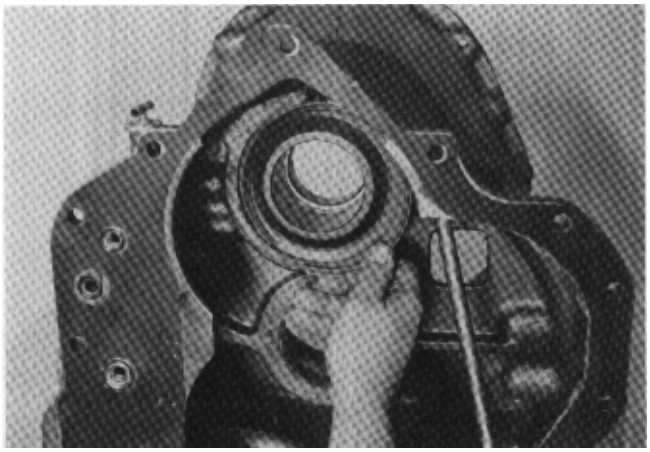


Figure 138
Install piston ring sleeve retainer ring.

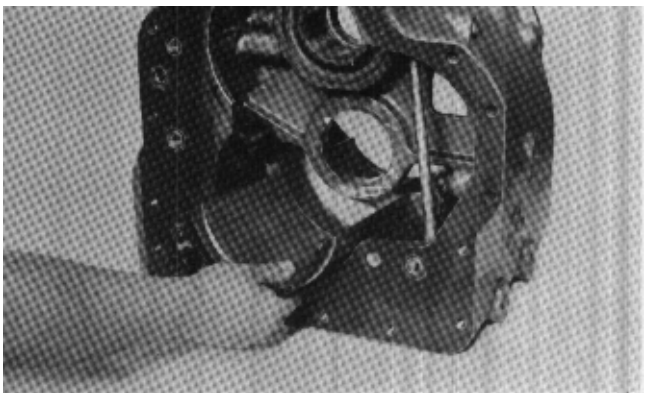


Figure 139
With front and rear baffle seals in position locate baffle in housing.

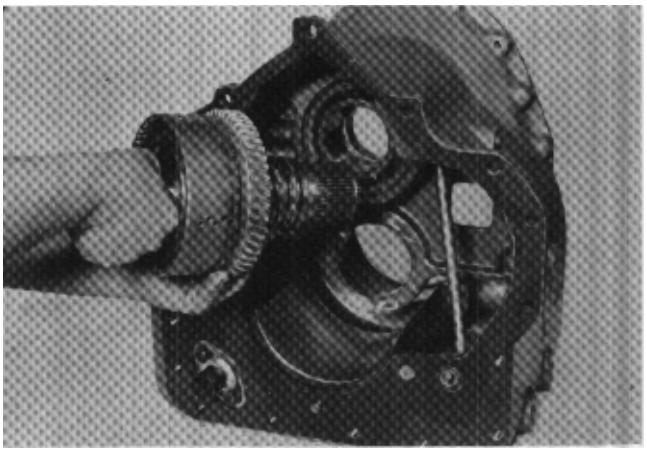


Figure 140
Position forward clutch assembly into transmission housing. Use caution as not to damage forward shaft piston rings.

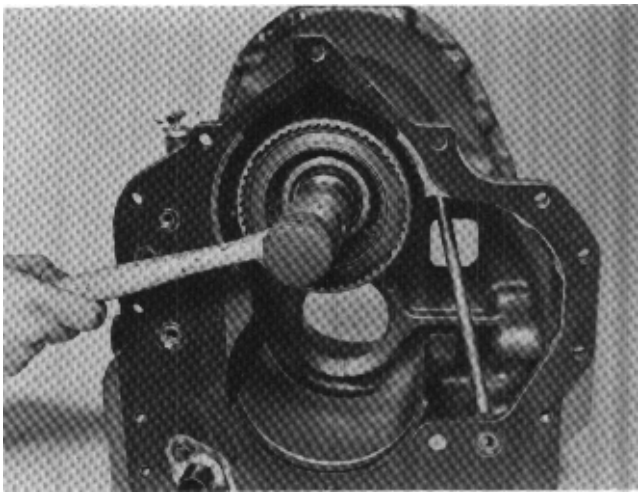


Figure 141
Tap clutch assembly into position

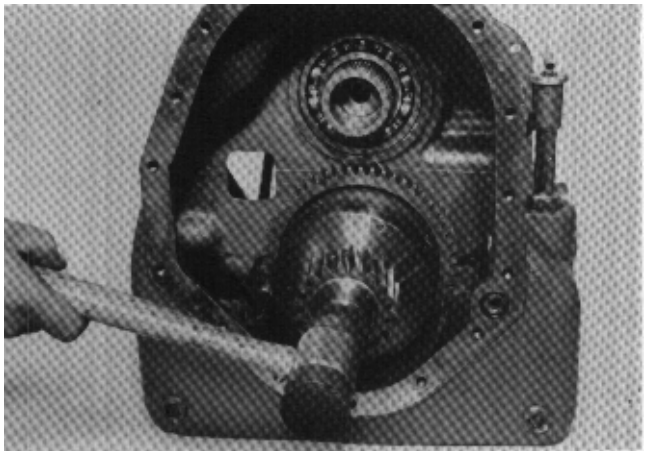


Figure 142
Locate low clutch assembly in housing. Tap into position.

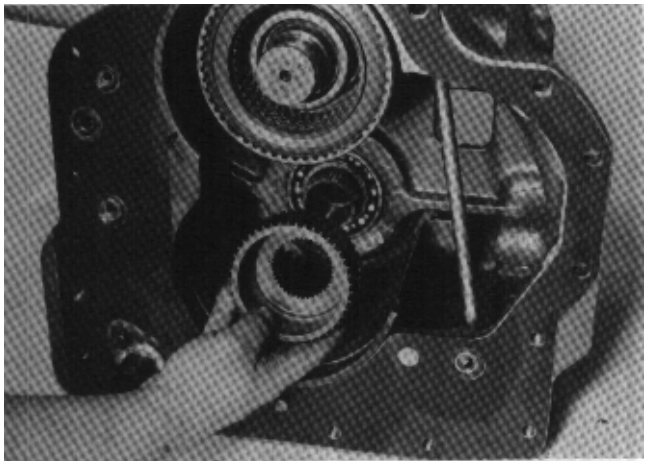


Figure 143
Install the 2nd clutch disc hub.

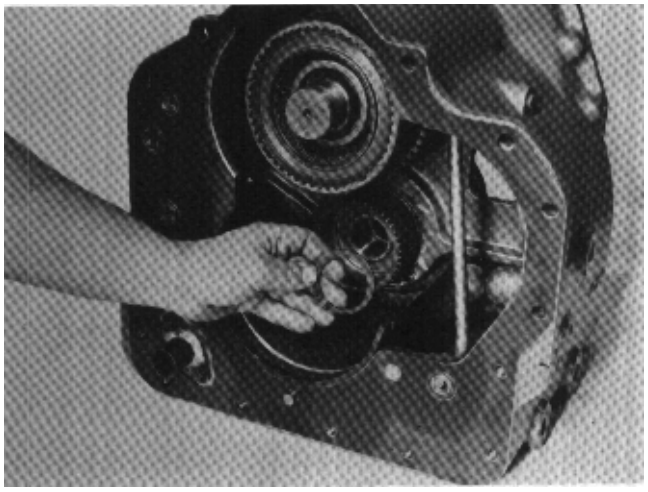


Figure 144
Install disc hub retainer ring.

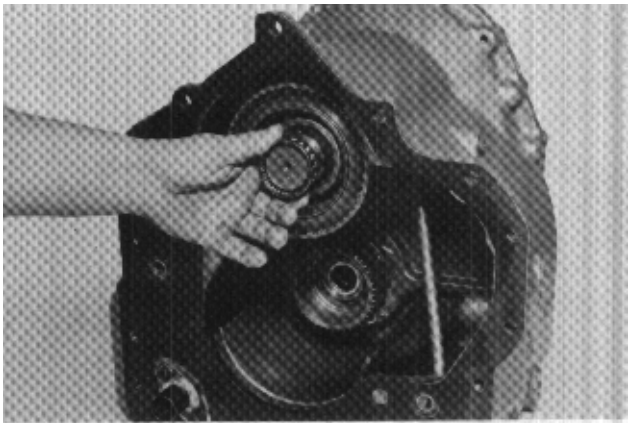


Figure 145
Locate forward shaft pilot bearing.

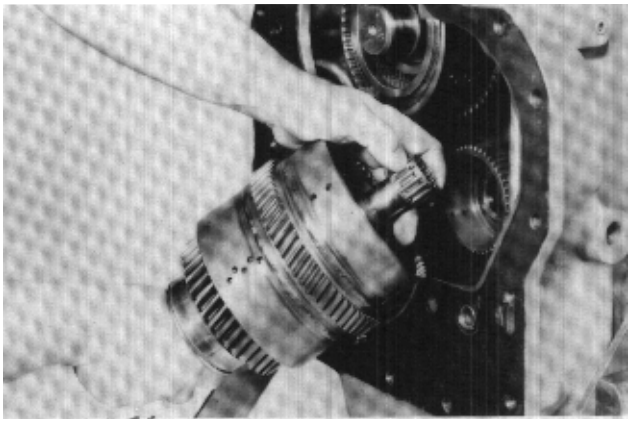


Figure 146
Install 2nd speed clutch shaft rear pilot bearing on shaft.

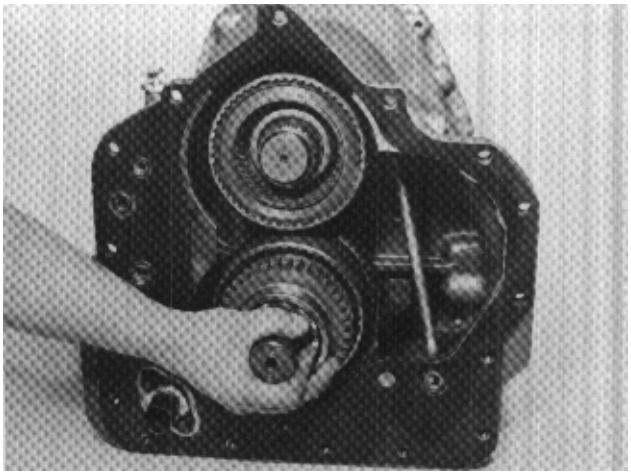


Figure 147
Position reverse and 2nd speed clutch on disc hub aligning splines of disc hub with internal teeth of 2nd speed clutch friction discs. Disc hub must be in full position with friction discs. Do not force this operation.

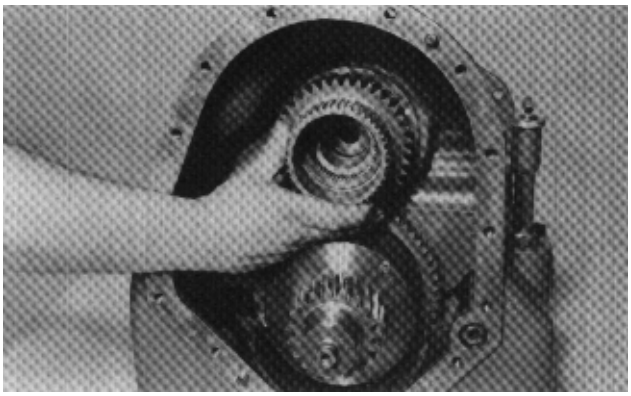


Figure 148

Locate gear and clutch disc hub on forward clutch shaft. **NOTE:** The 2 speed transmission will have Only a gear and not a clutch disc hub on it.

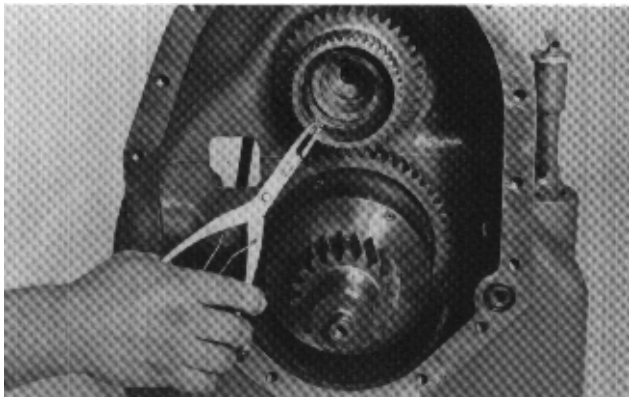


Figure 149
Install gear retainer ring

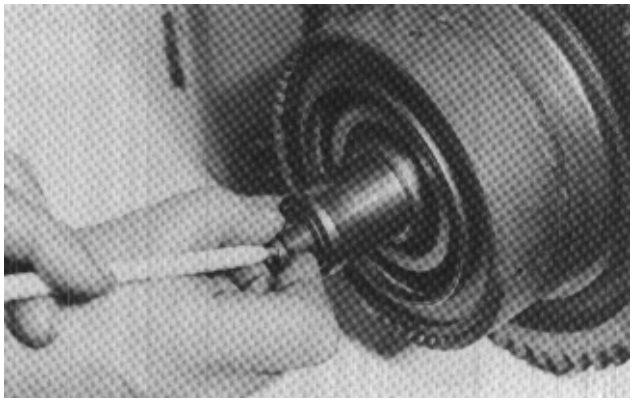


Figure 150

Install new oil sealing ring on output shaft. **NOTE:** New ring must be sized before shaft can be assembled in transmission housing.

A sizing tool can be made for ease of sizing oil seal ring. See Figure **151**.

The 2 speed trasmission will not have a clutch on the output shaft.

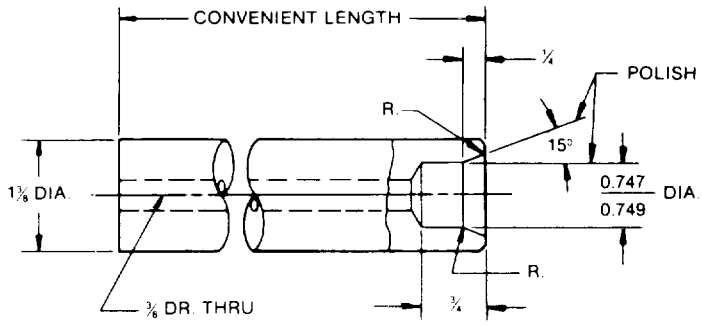


Figure 151
Oil sealing ring tool.

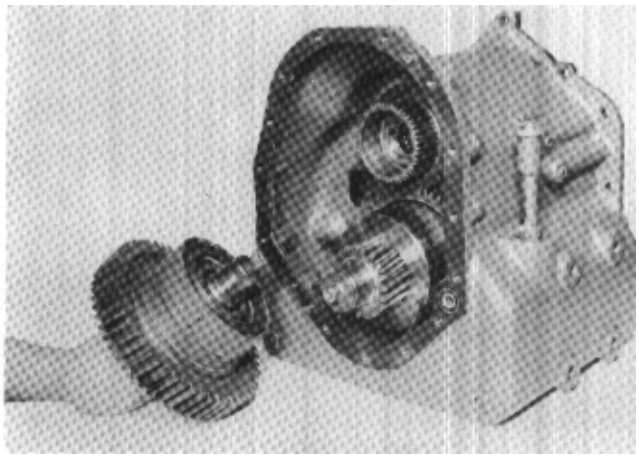


Figure 152
Install output shaft and 3rd speed clutch.

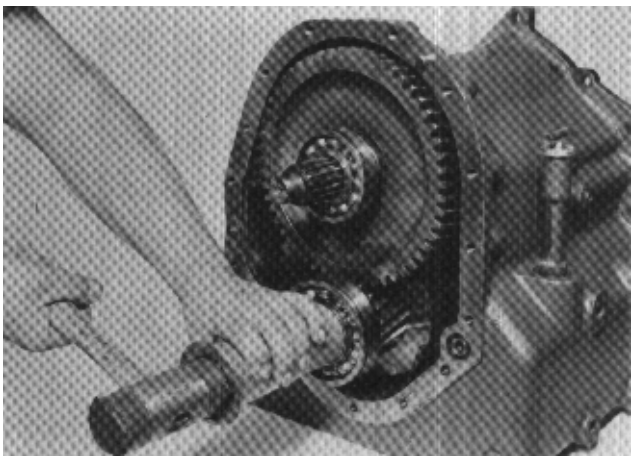


Figure 153
Install low clutch rear bearing.

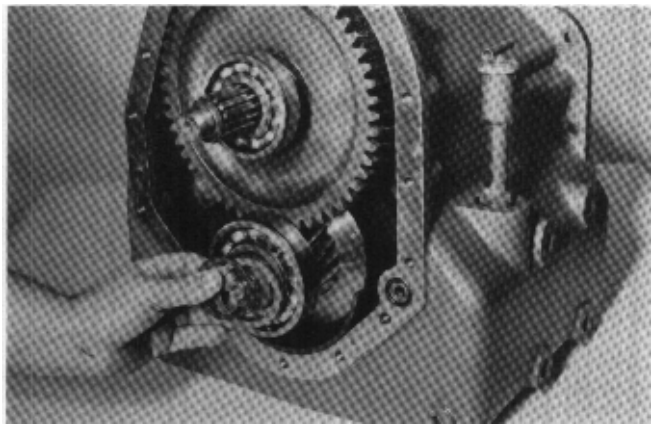


Figure 154

Install low clutch rear bearing washer and retainer ring.

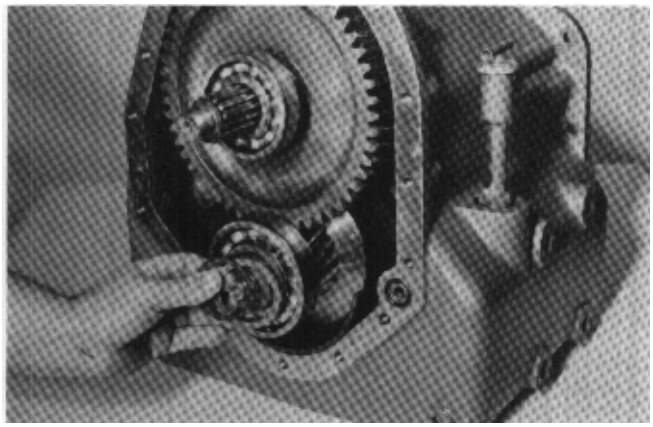


Figure 155

Install new oil sealing ring on low clutch shaft.

NOTE: New ring must be sized before installing low shaft bearing cap.

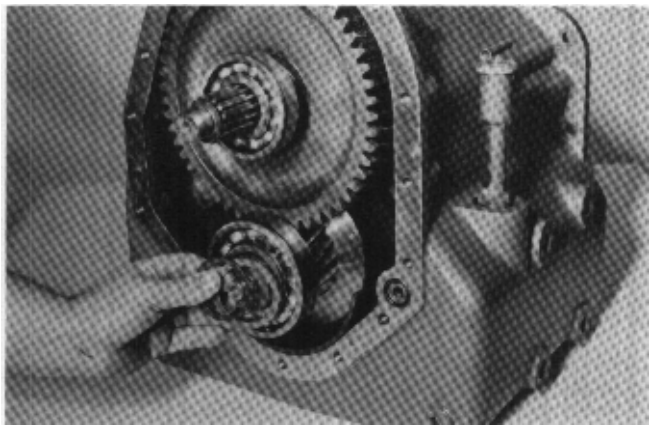


Figure 156

Position new gasket and “O” ring on rear of transmission housing. A thin coat of chassis grease will hold the gasket and “O” ring in place.

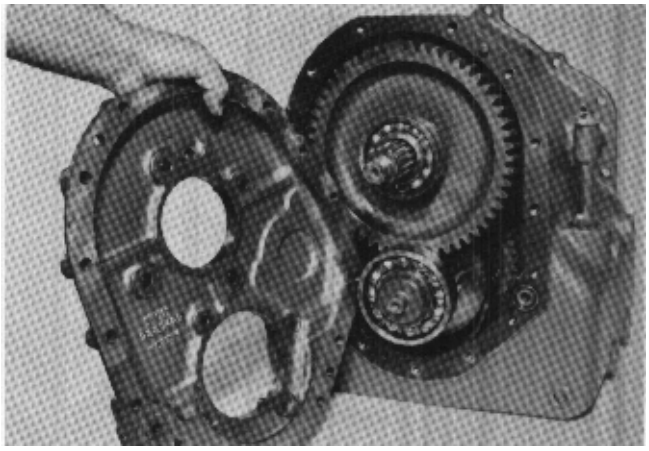


Figure 157

Install rear cover, bolts and lockwashers.

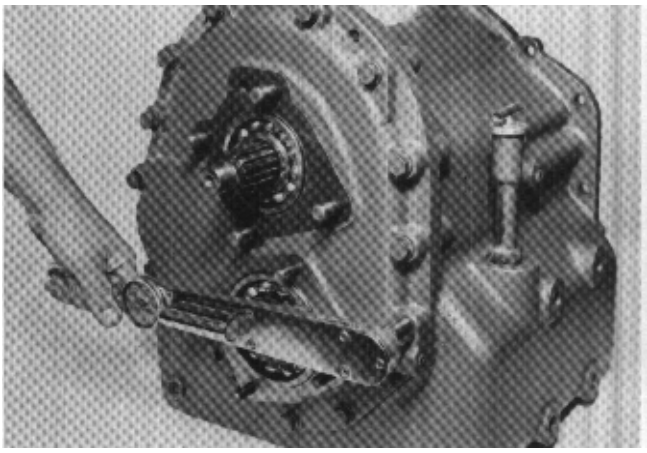


Figure 158

Tighten bolts 37 to 41 ft. lbs. torque [50,2 - 55,5 N.m].

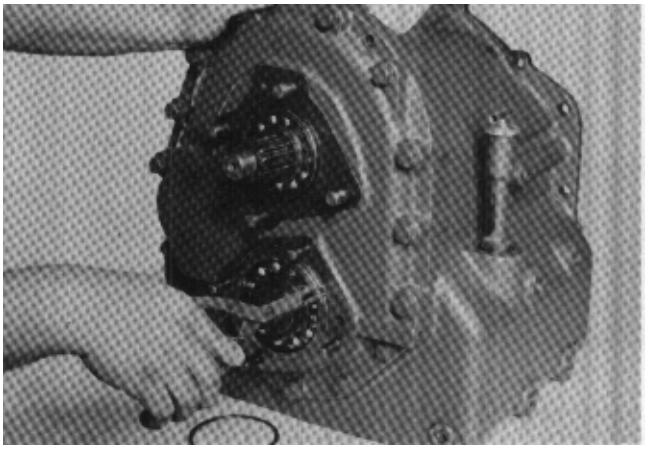


Figure 159

Tap output and low clutch shaft to the rear. Install rear bearing locating rings.

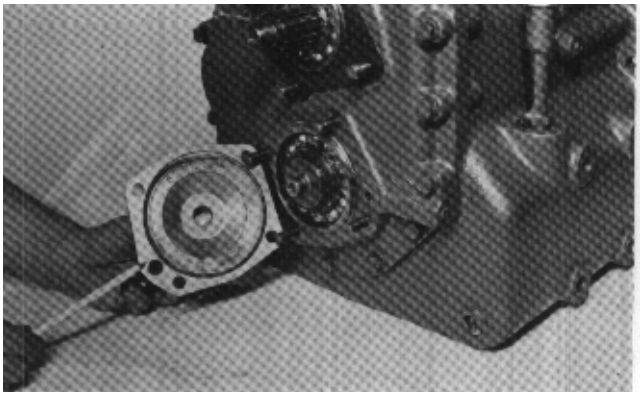


Figure 160

Install new bearing cap and low clutch pressure port “O” rings on low shaft bearing cap. Position bearing cap onlow shaft. Install washers and stud nuts.

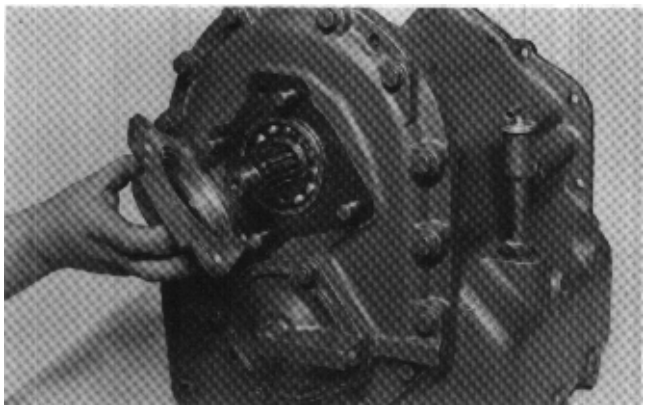


Figure 161

Position new gasket on output shaft studs. Install bearing cap. Install washers and nuts.

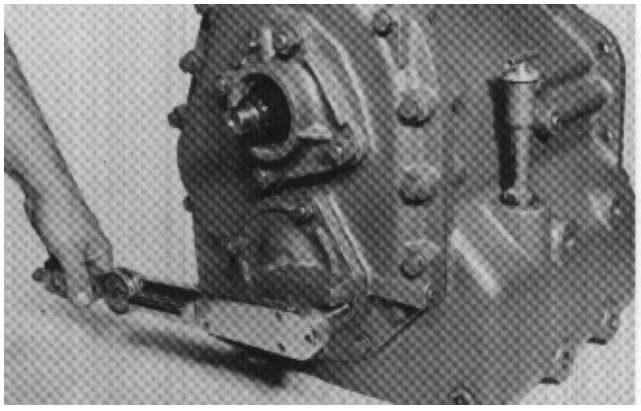


Figure 162

Tighten low shaft bearing cap stud nuts 41-45 ft. lbs. torque [55,6 - 61,0 N.m.]. Tighten output shaft stud nuts 91-100 ft. lbs. torque [123,4 - 135,5 N.m].

Figure 163

Install output flange “O” ring, washer and flange nut. Block flange to prevent turning. Tighten flange nut to 200 to 250 ft. lbs. torque [271 ,2 - 339,0 N.m].

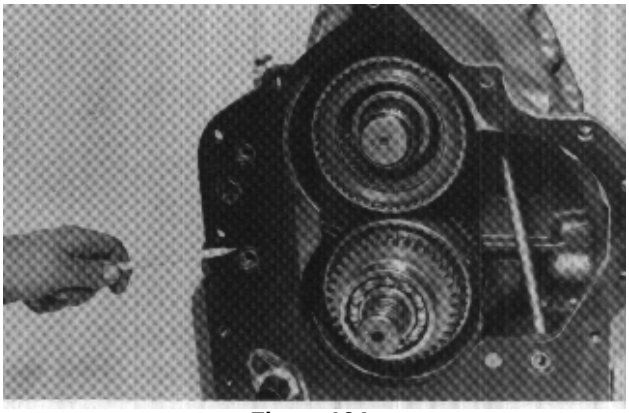


Figure 164

Position a new gasket and “O” rings on front of transmission housing. A thin coat of chassis grease will hold the gasket and “O” rings in place.

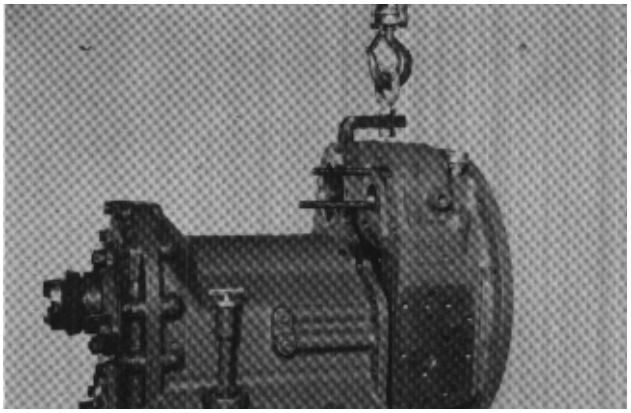


Figure 165

Position converter housing assemble on transmission case. Use caution as not to disturb housing “O” rings or gasket.

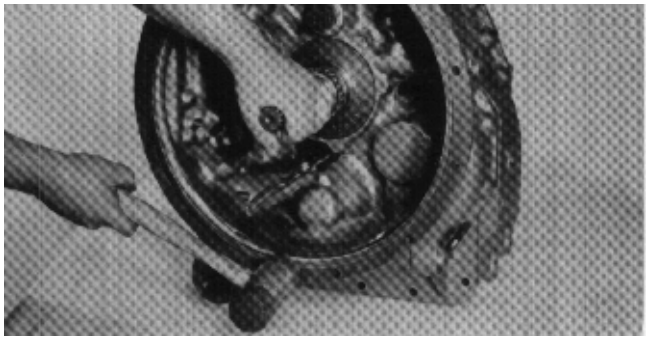


Figure 166

Spread ears on the reverse clutch front bearing snap ring. Lock pliers open to hold snap ring open. Tap converter housing in place. Use caution as not to damage reverse clutch front piston ring. Note aligning stud.

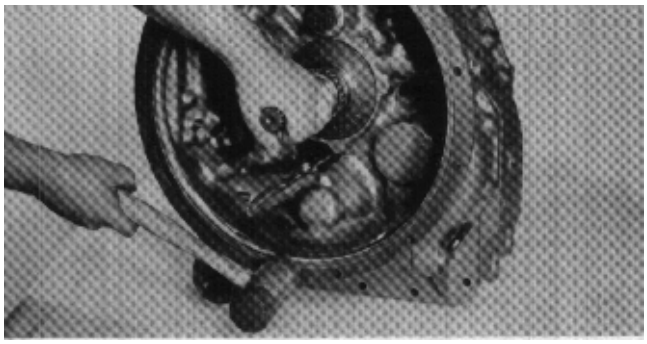


Figure 167

Install a cap screw in the front and one in the rear of the converter housing and snug up but do not tighten. This will hold the converter housing to the transmission housing. Using a hook type hammer puller as shown pull the reverse clutch gear toward the front of the converter housing. This will move the reverse and 2nd clutch assembly forward to align the snap ring groove in the bearing with the snap ring is in full position in snap ring groove, remove pliers.

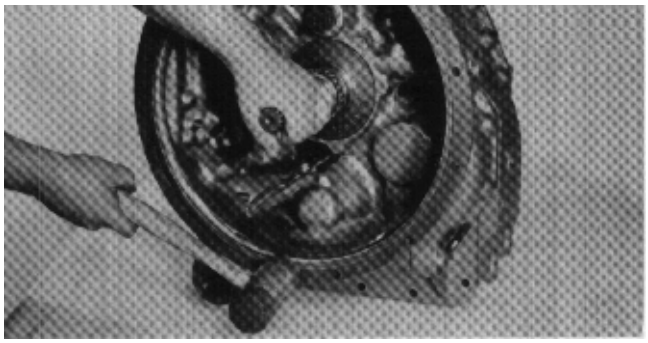


Figure 168

Remove converter housing alignment stud. Install converter housing and transmission housing capscrews. Tighten 37 to 41 ft. lbs. torque [50,2-55,5 N.m].

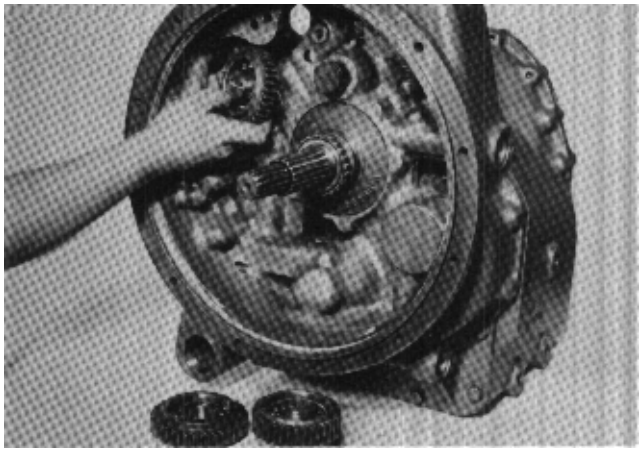


Figure 169

Install charging pump drive gear. Snug capscrews to hold gear in place

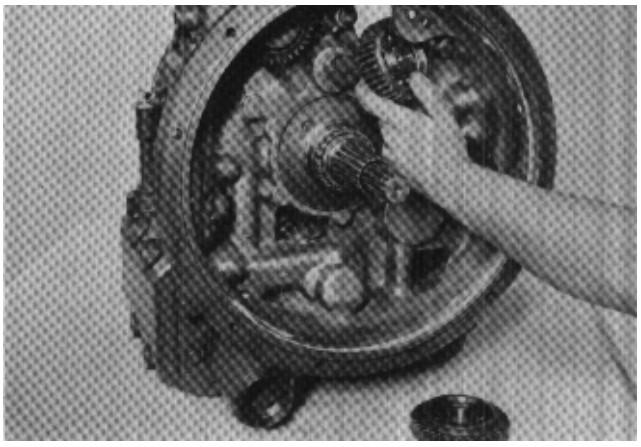


Figure 170

Install auxiliary pump drive gear. Snug capscrews.

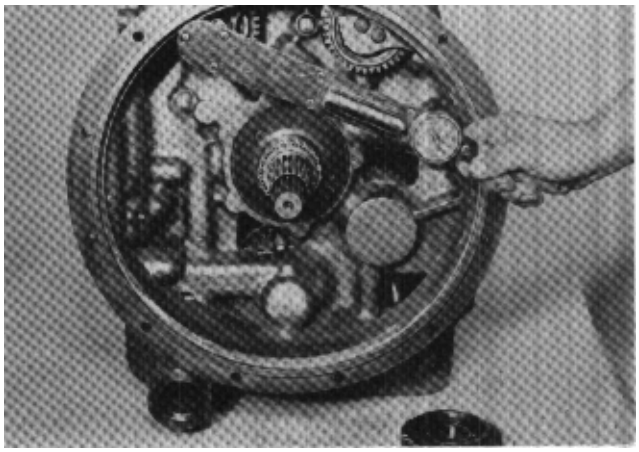


Figure 171

Tighten pump drive gear capscrews 23 to 25 ft. lbs. torque [31,2 - 33,8 N.m].

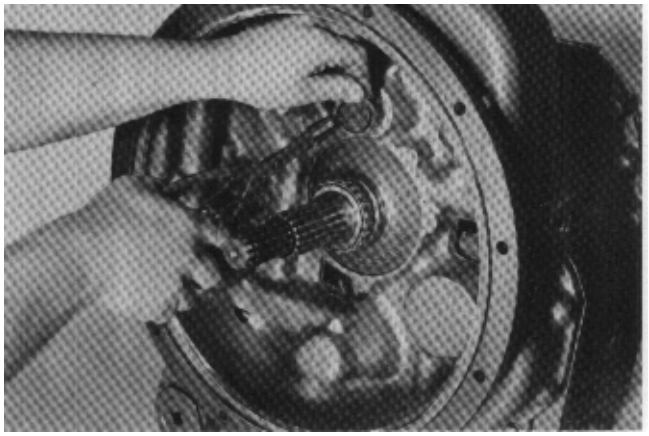


Figure 172

If fidler shaft bearing locating ring was removed, install new ring on stub shaft.

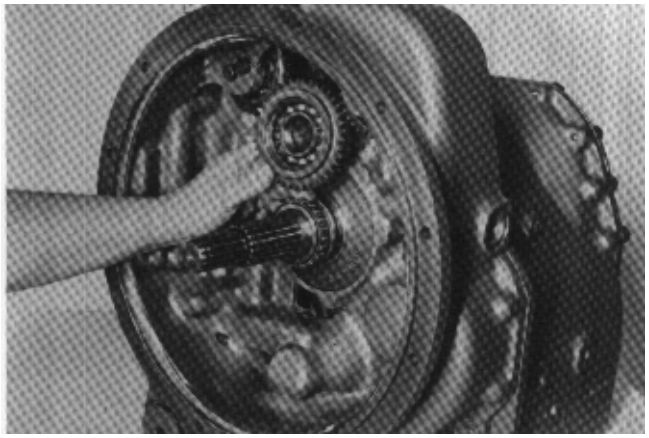


Figure 173

Position pump idler gear and bearing on stub shaft.

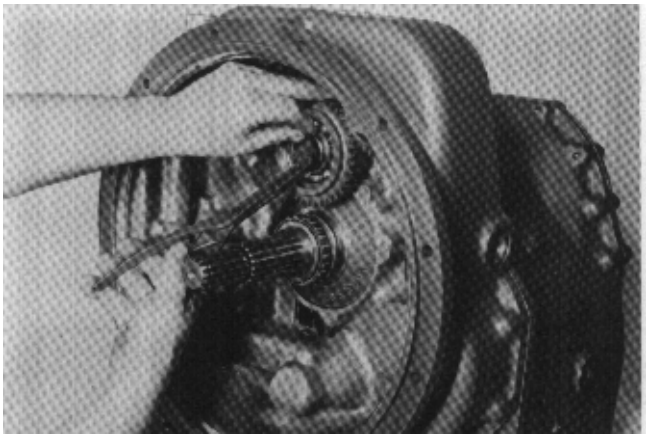


Figure 174

Install idler gear bearing locating ring.

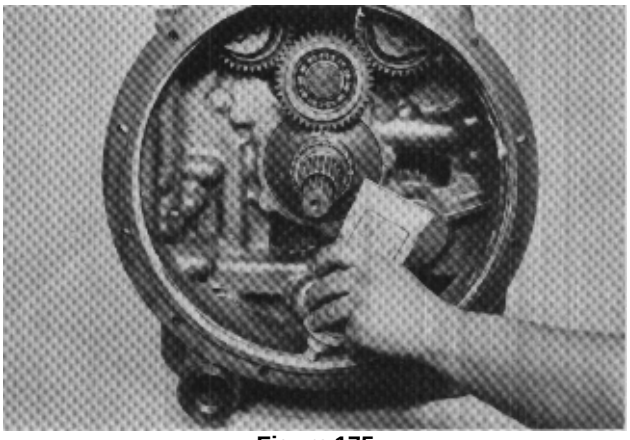


Figure 175

Apply a light coat of Dow Corning RTV-03-7069 to O.D. of oil baffle or counter bore in converter housing. Remove immediately any excess sealant that could enter the oil circuit.

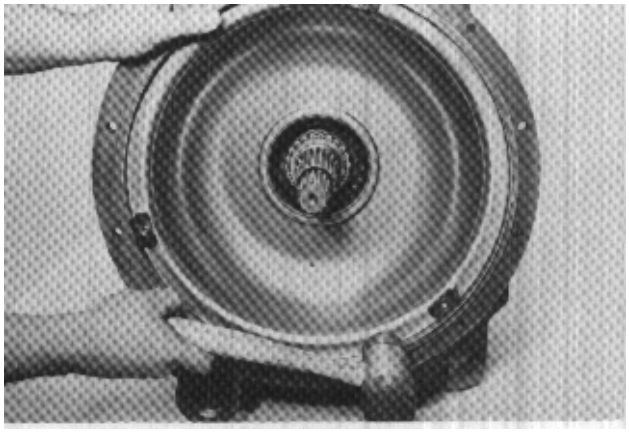


Figure 176

Assemble new oil baffle oil seal in baffle. Position oil baffle puller screw holes 15° to 30° either side of vertical center line. Tap baffle into position until baffle shoulders in converter housing.

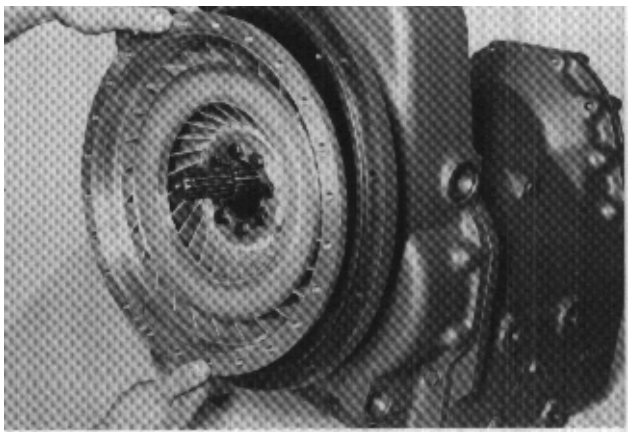


Figure 177

Install impeller and hub assembly using caution as not to damage the oil baffle oil seal.

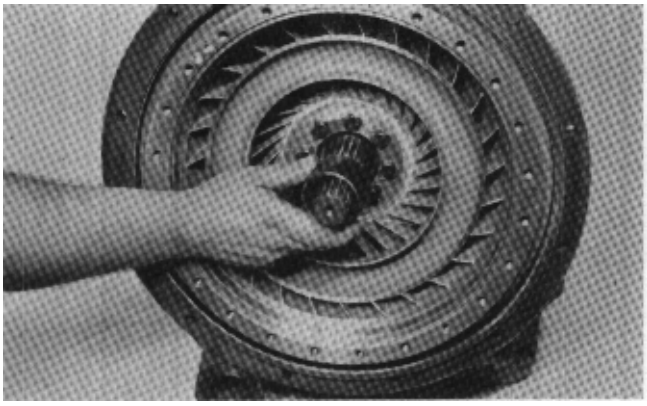


Figure 178

Position reaction member to impeller hub gear spacer on reaction member support.

NOTE: If a fixed reaction member is used, install reaction member on support with thick side of blades out and proceed with Figure 183.

FREEWHEEL REASSEMBLY

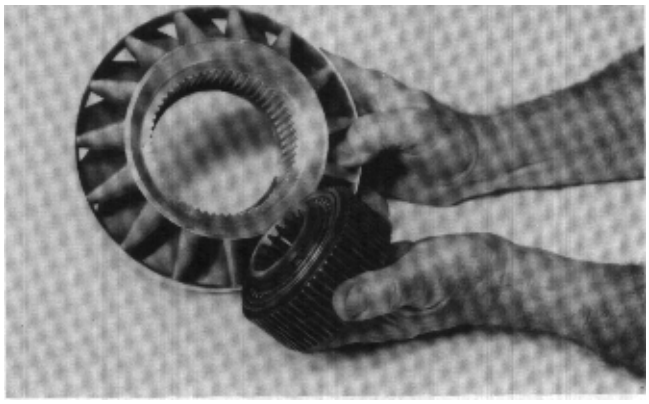


Figure 179

Install outer race and sprag assembly in reaction member **NOTE:** Undercut shoulder of race must go toward the rear of the reaction member.

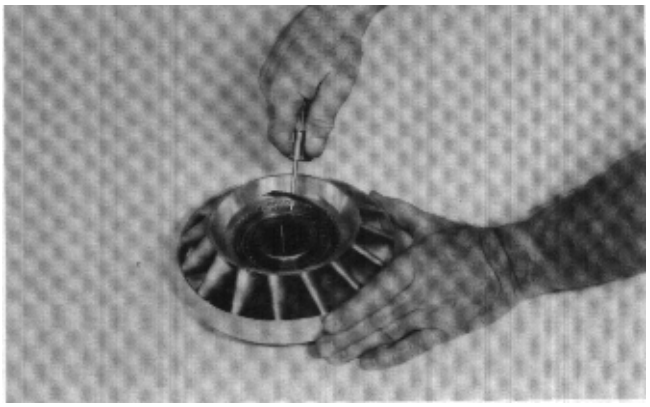


Figure 180

Install outer race to reaction member retainer ring.

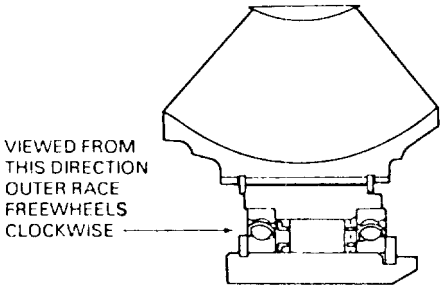


Figure 181

MUST FREEWHEEL IN CLOCKWISE ENGINE ROTATION

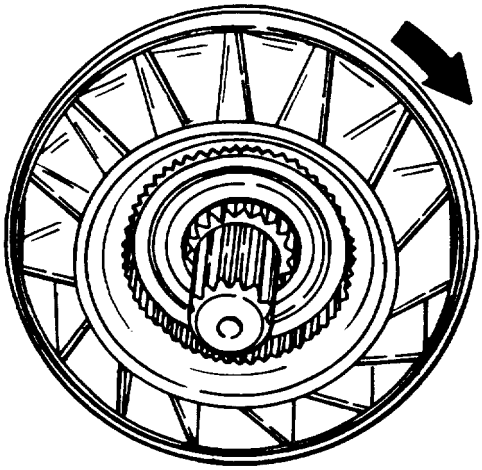


Figure 182

NOTE: Some units have a bolted on turbine hub. If either the turbine or hub is replaced see page 36 for reassembly.

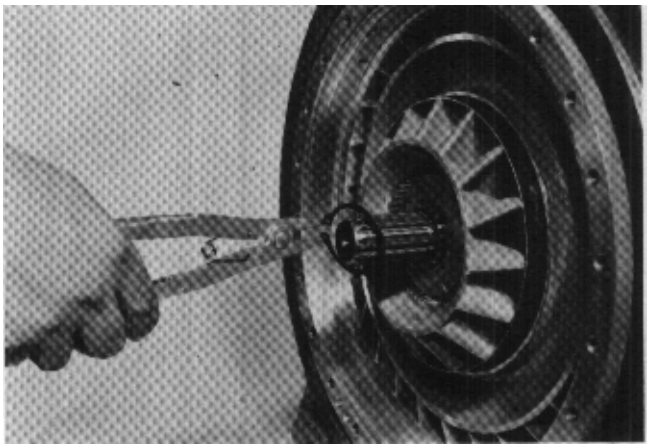


Figure 183

Install reaction member to support retainer ring.

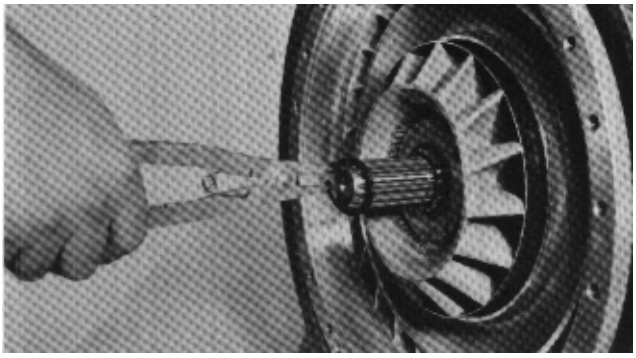


Figure 184

Position inner turbine locating ring on turbine shaft. Install turbine on shaft.

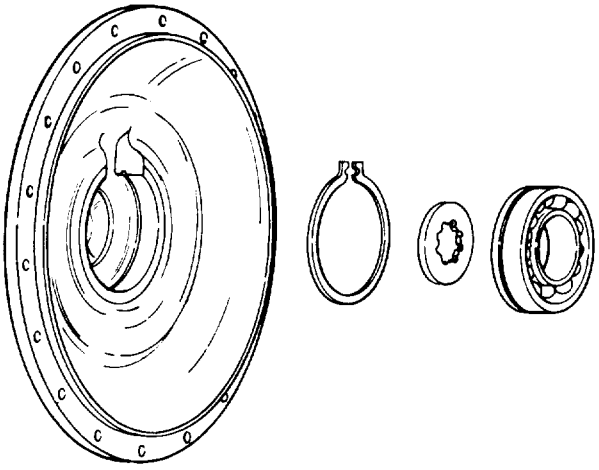


Figure 185

If the impeller cover bearing retaining washer or bearing was replaced, use the following procedure for reassembly. Heat cover 200° to 250° F [93°- 121° C]. Position snap ring in groove. Place bearing retainer washer in cover. While cover is hot press bearing into position spreading ears on snap ring at the same time. Align snap ring groove in bearing with snap ring. Release snap ring. Check ring to be certain it is in full position in groove.

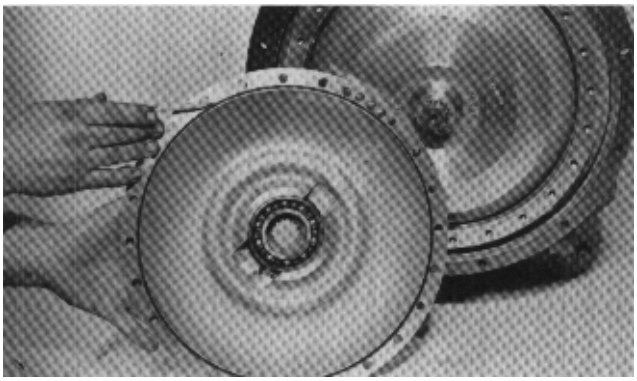


Figure 186
Position new “O” ring on impeller cover.

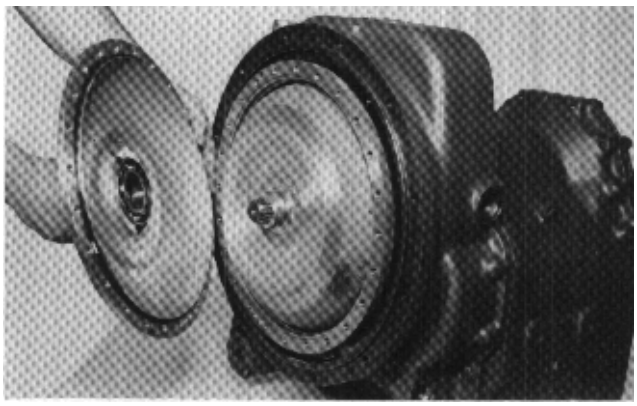


Figure 187

Install impeller cover assembly on impeller. Use caution as not to damage “O” ring. Bearing retainer plate must be aligned with the turbine shafts.

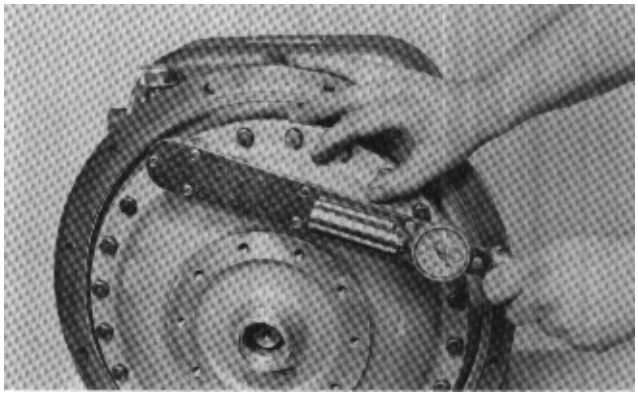


Figure 188

Install impeller cover to impeller capscrews and washers.

Tighten 11" impeller cover capscrews 12 to 16 ft. lbs. torque [16,3 - 21,6 N.m].

Tighten 12" impeller cover capscrews 23 to 25 ft. lbs. torque [31,2 - 33,8 N.m].

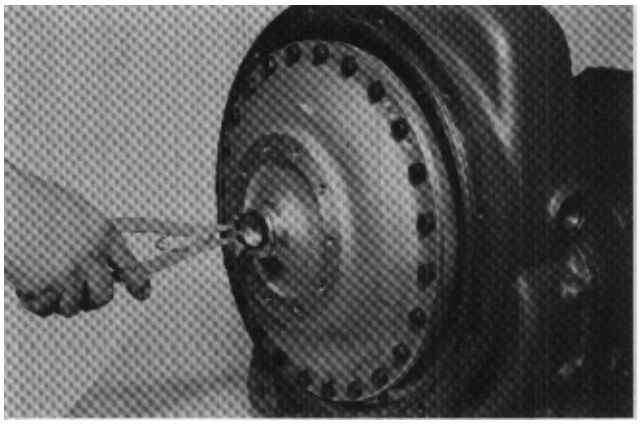


Figure 189
Install turbine retainer ring. See Figure 189-A.

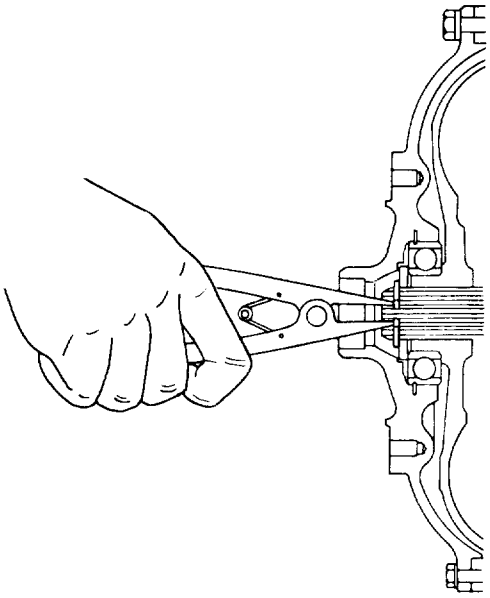


Figure 189-A

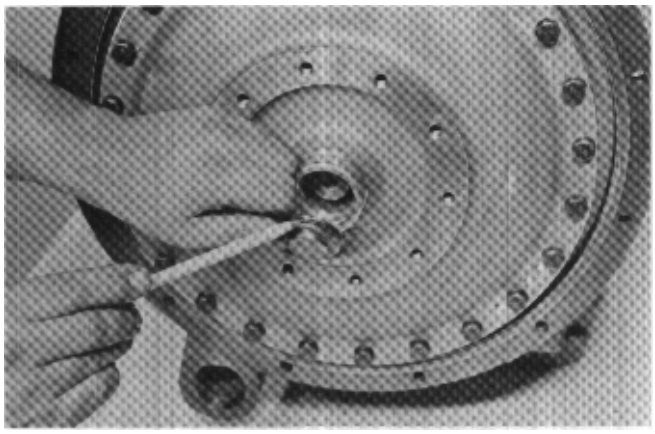


Figure 190

Position new “O” rinq on impeller cover bore plug. Lubricate ring to facilitate reassembly. Install plug in cover.

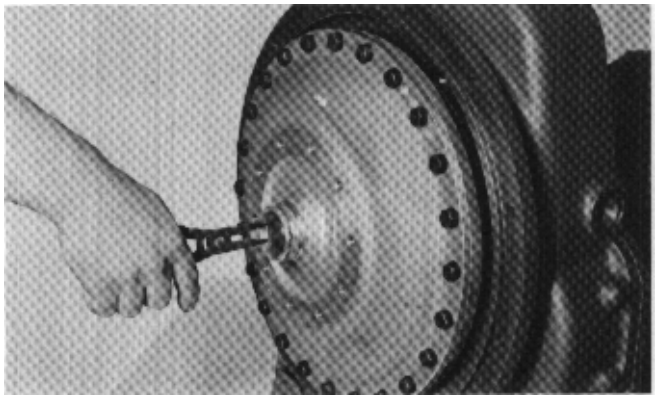


Figure 191

Install bore plug retainer ring.

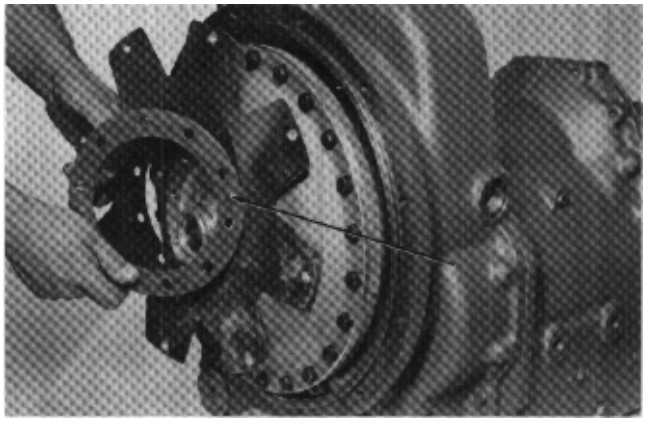


Figure 192

Position flexplate and weld nut assembly on impeller cover with weld nuts toward cover. Align intermediate flex plate backing ring with holes impeller cover. **NOTE:** Two dimples 180° apart in backing ring must be out (toward engine flywheel). Install capscrews and washers.

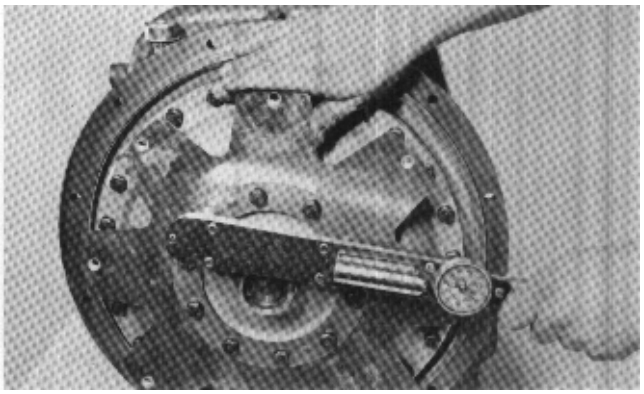


Figure 193

Tighten flex plate capscrews 23 to 25 ft. lbs. torque [31,2 - 33,8 N.m].

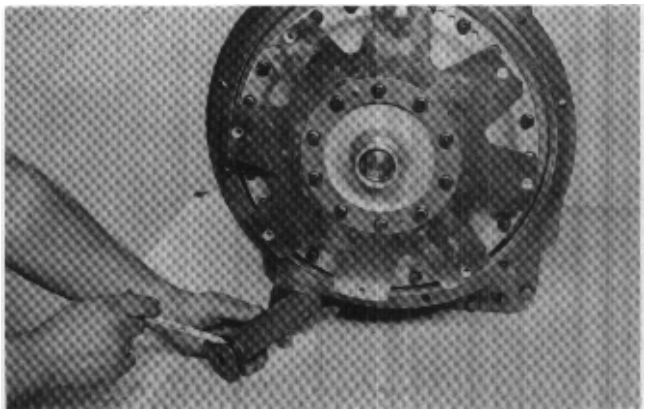


Figure 194

Position new gasket on sump screen, install screen assembly and tighten 10 to 15 ft. lbs. torque [13,6 - 20,3 N.m].

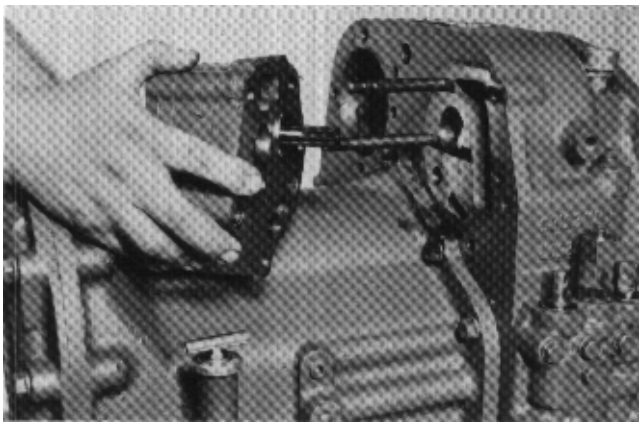


Figure 195

Using a new gasket and “O” ring, position charging pump assembly on studs. Install washers, nuts and capscrews.

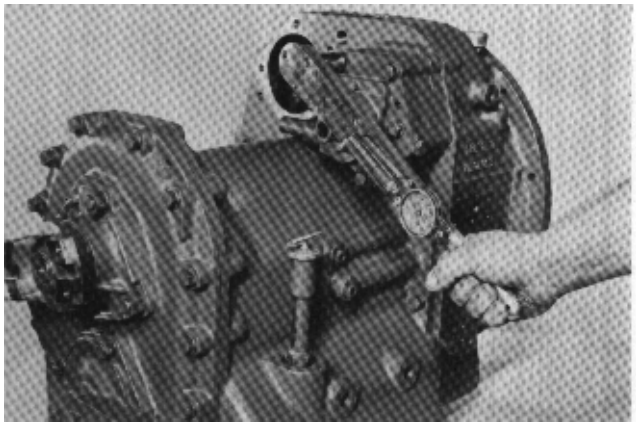


Figure 196

Tighten capscrews 37 to 41 ft. lbs. torque [50,2 - 55, 5 N.m]. Tighten stud nuts 41 - 45 ft. lbs. torque [55,6 - 61,0 N.m].

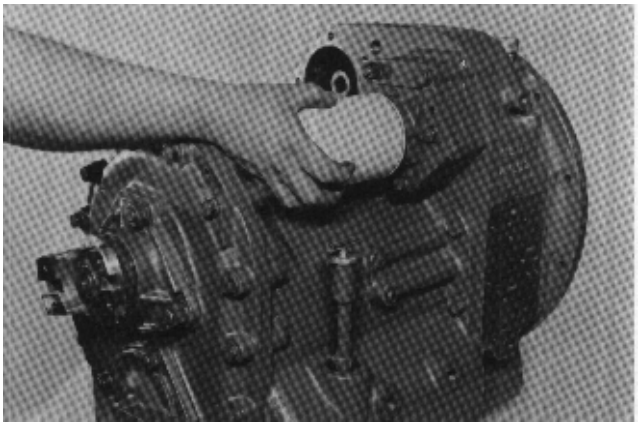


Figure 197

Install new oil filter. Tighten 20 to 25 ft. lbs. torque [27,1 - 33,9 N.m].

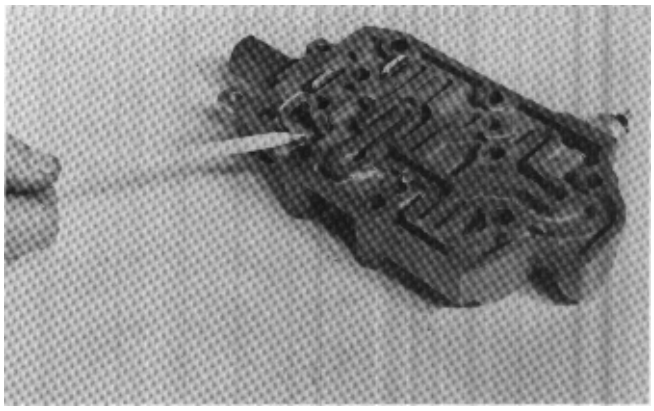


Figure 198

If the control cover valve spools are to be inspected or the spool oil seals changed, remove the valve spool stops as shown and pull spools out of oil seals. Always replace oil seals if valve spools are removed for inspection. Sharp edges on valve spool will cut lip of oil seal. When replacing oil seal, pick old seal out of housing using caution as not to damage oil seal bore.

Install new seal in control valve. **NOTE:** When installing speed and direction selector spools through oil seal use extreme caution as not to cut lip of oil seal.

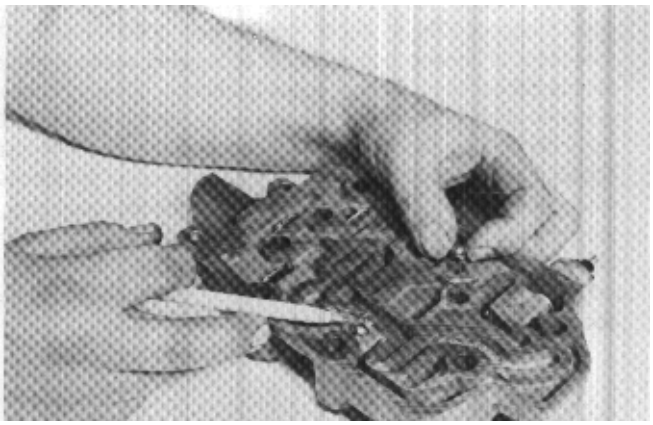


Figure 199

Position detent balls in housing.

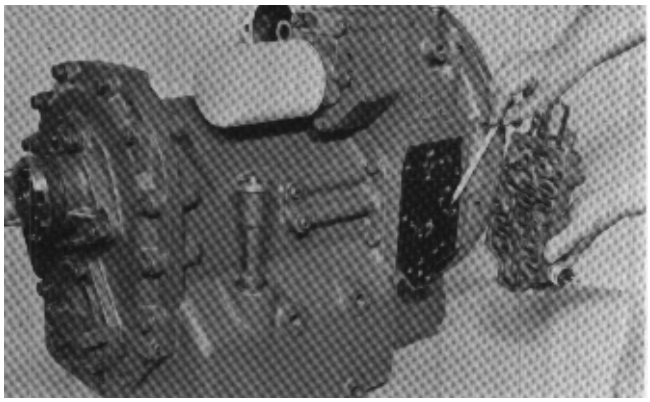


Figure 200

Position new gasket and detent springs on converter housing. Install control cover and cover to housing capscrews and washers.

If the turbine or turbine hub was replaced or disassembled, this procedure must be used for reassembly.

TURBINE HUB ASSEMBLY WITH BACKING RING AND SPECIAL SELF LOCKING SCREWS

1. Clean hub mounting surface and tapped holes with solvent. Dry thoroughly being certain tapped holes are dry and clean.

2. Install backing ring and special screws to approximately .06 [1,5] of seated position. With a calibrated torque wrench, tighten screws 37 to 41 lbs. ft. torque [50,2 - 55,6 N.m]. **NOTE:** Assembly of turbine hub must be completed within a fifteen minute period from start of screw installation. The screws are prepared with a coating which begins to harden after installation in the hub holes. If not tightened to proper torque within the fifteen minute period, insufficient screw clamping tension will result. The special screw is to be used for one installation only. If the screw is removed for any reason it must be replaced. The compound left in the hub holes must be removed with the proper tap and cleaned with solvent. Dry hole thoroughly and use a new screw for reinstallation.

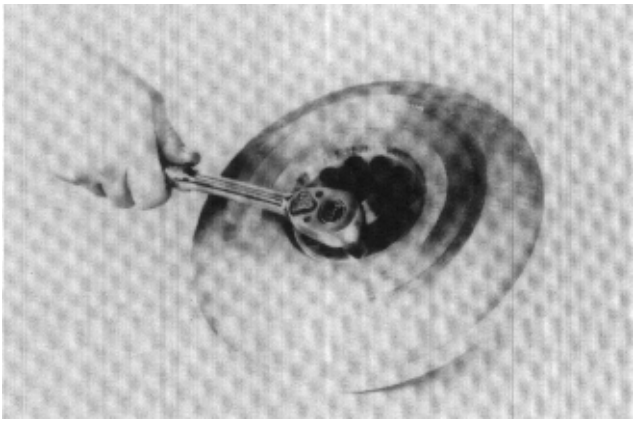


Figure A

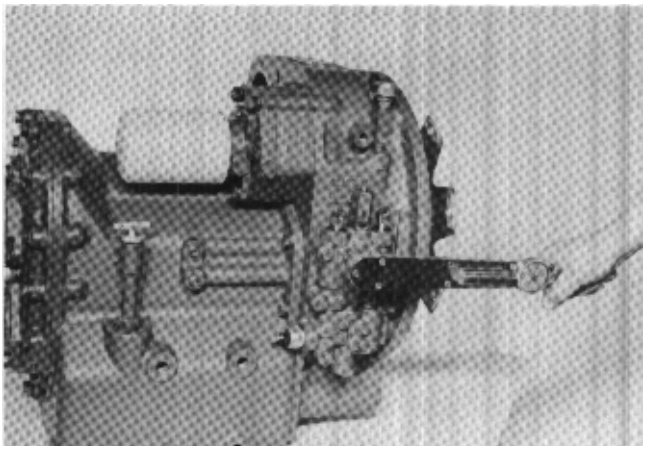


Figure 201

Tighten capscrews 23 to 25 ft. lbs. torque [31,2 - 38.8 N.m].

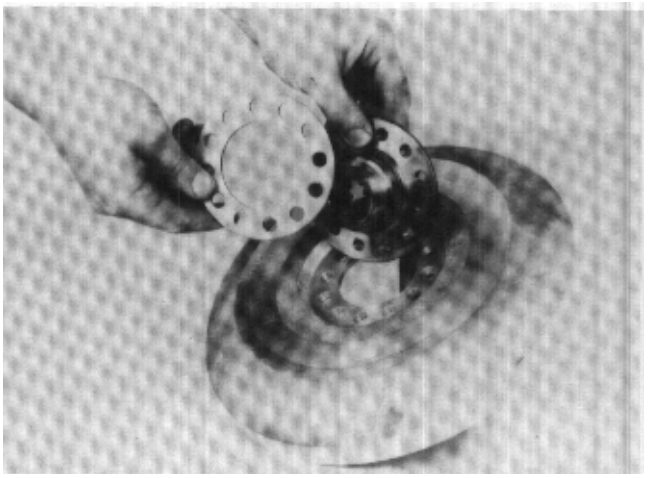


Figure B

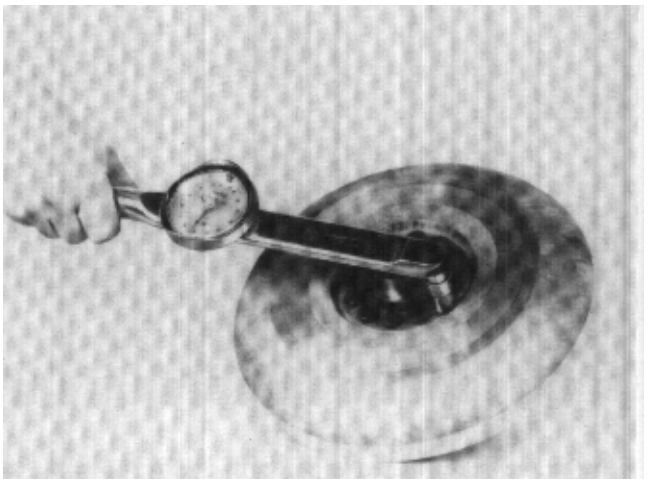


Figure C

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 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 transmission has been installed in the machine, the oil cooler, 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 engine 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.

   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, 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. On remote mounted torque converters remove drain plug from torque converter and inspect interior of converter housing, gears, etc. If presence of considerable foreign material is noted, disassembled and cleaned thoroughly. It is realized this entails extra labor however such labor 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 use only type oil recommended in lubrication section. Fill transmission through filler opening until fluid comes up to **LOW** mark on transmission dipstick.

   Run engine two minutes at 500-600 RPM to prime torque converter and hydraulic lines. Re check level of fluid in transmission with engine running at idle (500-600 RPM).

   Add quantity necessary to bring fluid level to **LOW** mark on dipstick. Recheck with hot oil (180-200° F.) [82, 2-93, 3° C].

   Bring oil level to **FULL** mark on dipstick.

7. Recheck all drain plugs, lines, connections, etc., for leaks and tighten where necessary.

TOWING OR PUSH STARTING

Before towing the vehicle, be sure to lift the rear wheels off the ground or disconnect the driveline to avoid damage to the transmission during towing.

NOTE: If the transmission has 4 wheel drive, disconnect both front and rear drive lines. Because of the design of the hydraulic system, the engine **cannot** be started by pushing or towing.

SPECIFICATIONS AND SERVICE DATA-POWER SHIFT TRANSMISSION AND TORQUE CONVERTER

CONVERTER OUT PRESSURE Converter outlet oil temp. 180° - 200° F. 82.3° - 93,3° C].
Transmission in **NEUTRAL**.
Operating specifications:
25 P.S.I. [172,4 kPa] minimum pressure at 2000 R.P.M. engine speed **AND** a maximum of 70 P.S.I. [482,6 kPa] outlet pressure with engine operating at no-load governed speed.

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 Friction.

CLUTCH OUTER DISC Steel.

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

CLUTCH PRESSURE 180-220 psi [1241,1 - 1516,8 kPa] - With parking brake set (see note), oil temperature 180° - 200° F. [82,2°-93,3°C], engine at idle (400 to 600 RPM). shift thru direction and speed clutches. All clutch pressure must be equal within 5 psi psi, [34,5 kPa] If, clutch pressure varies in any one clutch more than 5 psi, [34,5 kPa] repair clutch.

NOTE: Never use service brakes while making clutch pressure checks. Units having brake actuated declutching in forward and/or reverse will not give a true reading.
ALWAYS USE PARKING BRAKE WHEN MAKING CLUTCH PRESSURE CHECKS.

LUBRICATION

RECOMMENDED LUBRICANTS FOR CLARK POWER SHIFTED TRANSMISSION AND TORQUE CONVERTERS

Prevailing Ambient Temperature

TYPE OF OIL See Lube 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° to 200° F. 82.2 -93,3° C]. Maintain oil level to FULL Mark.

NORMAL* DRAIN PERIOD Every 500 hours, change oil filter element
Every 1000 hours, drain and refill system as follows Drain with oil at 150 ° to 200° F. [65,6 -93° C].

NOTE: It is recommended that filter elements be changed after 50 and 100 hours of operation on new and rebuilt or repaired units.

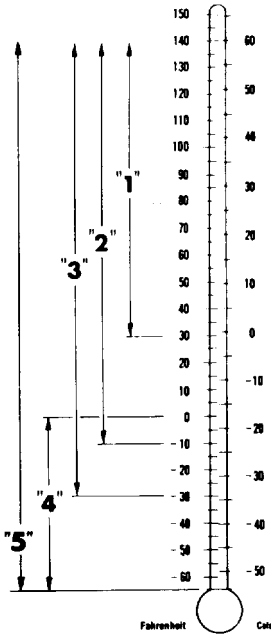
(a) Drain transmission and remove sump screen. clean screen thoroughly and replace, using new gaskets.

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

(c) Refill transmission to LOW mark.

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

(e) Recheck level with engine running at 500-600 RPM and add oil to bring level to LOW mark. When oil temperature is hot (180-200° F.) [82,2-93,3° C] make final oil level check. BRING OIL LEVEL TO **FULL MARK.**



*Dextron is a registered trademark of General Motors Corporation

Temperature Range "1"
C-2 Grade 30
C-3 Grade 30
Engine OIl: - Grade 30 API-CD/SE or CD/SF
MIL-L-2104C-Grade 30
MIL-L-2104D-Grade 30
MIL-L-2104C-Grade 10
MIL-L-2104D-Grade 10

Temperature Range "2"
C-2 Grade 10
C-3 Grade 10
Engine Oil:-Grade 10 API-CD/SE or CD/SF
Quintolubric 822-220 (Non Phosphate Ester Fire Resistant Fluid)

Temperature Range "3"
*Dexron
*Dexron II D - **See Caution Below**

Temperature Range "4"
MIL-L-46167
MIL-L-46167 A

Temperature Range "5"
Conoco High-Performance Synthetic Motor Oil - Spec. NO. 6718

PREFERRED OIL VISCOSITY: Select highest oil viscosity compatible with prevailing ambient temperatures and oil application chart. Temperature ranges "2" and "3" may be used to lower ambient temperatures when sump preheaters are used. Temperature range "4" should be used only in ambient temperature range shown.

MODULATED SHIFT TRANSMISSIONS: T12000, 18000, 24000, 28000 & 32000 series transmissions with modulated shift use only C-3 or temperature range 3 items (a) & (b) *Dexron or *Dexron II D. **SEE CAUTION BELOW.** 3000, 4000, 5000, 6000, 8000, 16000, 34000 series transmissions with modulated shift use only C-3 or temperature range 3 item (a) only *Dexron. Do **NOT** use *Dexron II D. **SEE CAUTION BELOW.**

CAUTION: *Dexron II D is not compatible with graphitic clutch plate friction material UNLESS IT MEETS THE APPROVED C-3 SPECIFICATIONS. *Dexron II D cannot be used in the 3000, 4000, 5000, 6000, 8000, 16000, or 34000, series power shift transmission, or the HR28000 & HR32000 series having converter lock-up, or the C270 series converter having lock-up UNLESS IT MEETS THE APPROVED C-3 SPECIFICATIONS.

Any deviation from this chart must have written approval from the application department of the Clark-Hurth Components

Normal drain periods and filter change intervals are for coverage environmental and duty-cycle conditions. Severe or sustained high operating temperatures or very dusty atmospheric conditions will cause accelerated deterioration and contamination. For extreme conditions judgment must be used to determine the required change intervals.

TROUBLE SHOOTING GUIDE
For The
HR Model. 18000 Transmission

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 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 operations 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 control valve, if full engage- 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:

Check oil level in transmission. This should be done with oil temperatures of 180 to 200° F. [82,2-93,3° C]. 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 A EXCESSIVE LENGTH OF TIME WILL OVERHEAT THE CONVERTER.

LOW CLUTCH PRESSURE

Cause	Remedy
1. Low oil level.	1. Fill to proper level.
2. Clutch pressure regulating valve spool stuck open.	2. Clean valve spool and housing.
3. Faulty charging pump.	3. Replace pump.
4. Broken or worn clutch shaft or piston sealing rings.	4. Replace sealing rings.
5. Clutch piston bleed valve stuck open.	5. Clean bleed valves thoroughly.

LOW CONVERTER CHARGING PUMP OUTPUT

1. Low oil level.	1. Fill to proper level.
2. Suction screen plugged.	2. Clean suction screen.
3. Defective oil pump.	3. Replace pump.

OVERHEATING

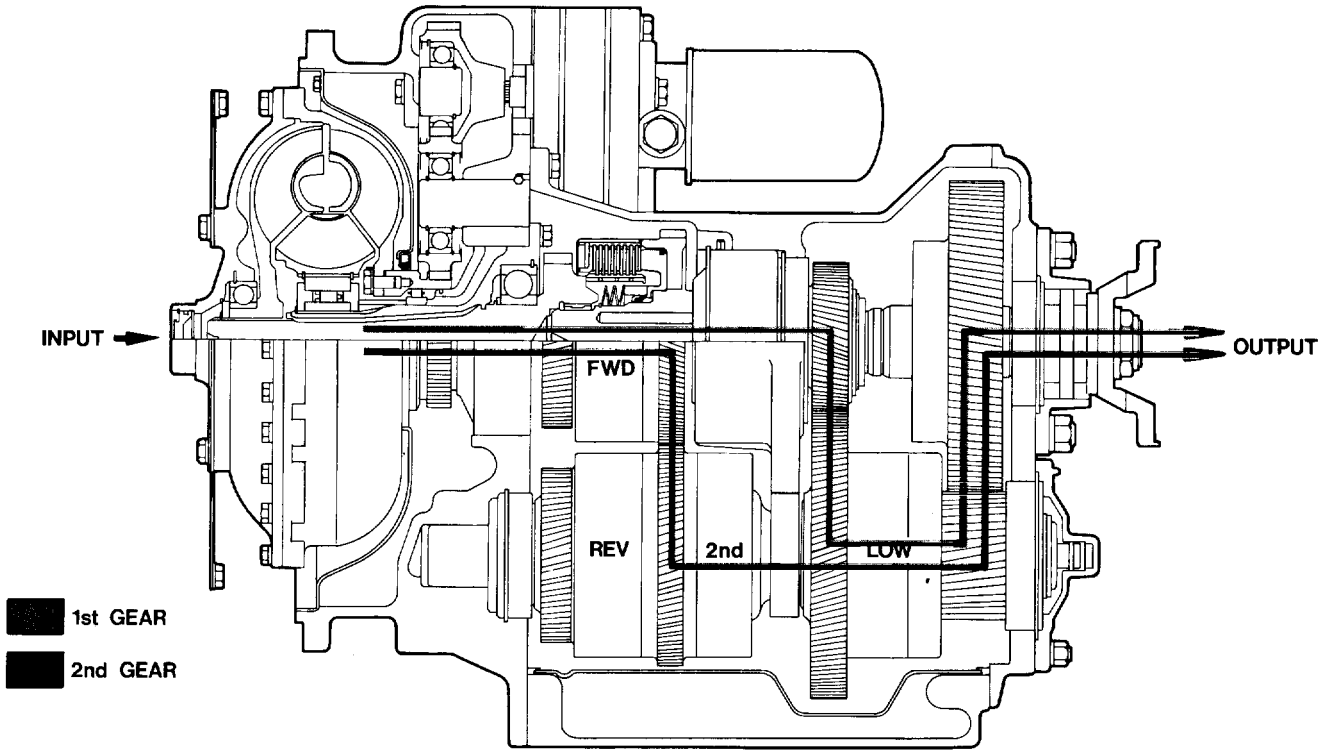
1. Worn oil sealing rings.	1. Remove, disassemble, and rebuild converter assembly.
2. Worn oil pump.	2. Replace.
3. Low oil level.	3. Fill to proper level.

NOISY CONVERTER

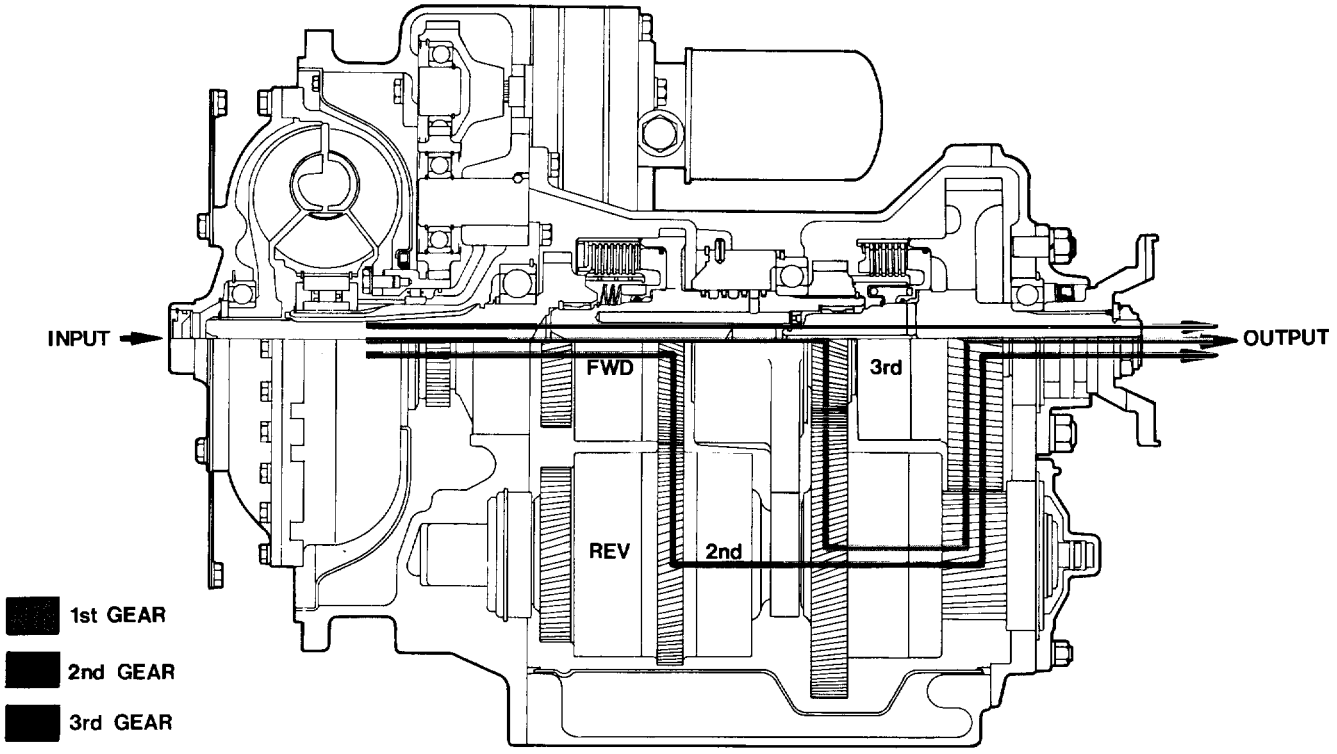
1. Worn oil pump.	1. Replace.
2. Worn or damaged bearings.	2. A complete disassembly will be necessary to determine what bearing is faulty.

LACK OF POWER

1. Low engine RPM at converter stall.	1. Tune engine check governor.
2. See “Overheating” and make same checks.	2. Make corrections as explained in “Overheating.”

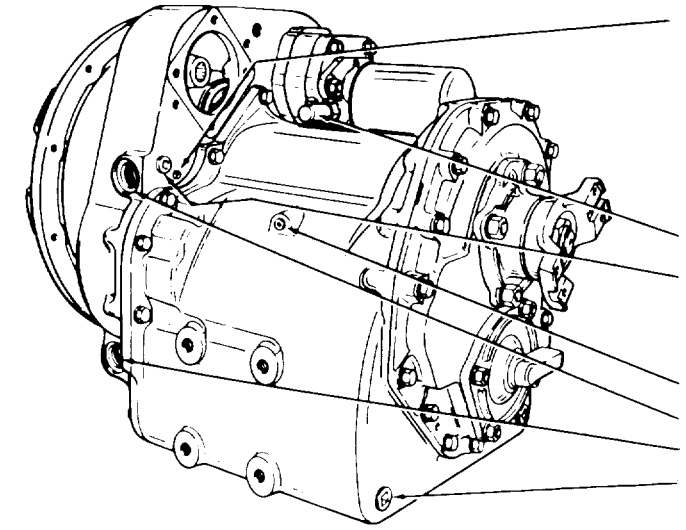


18000 2 SPEED TRANSMISSION
POWER FLOW



18000 3 SPEED TRANSMISSION
POWER FLOW

PRESSURE CHECK POINTS



CHECK POINT "C" CONVERTER OUTLET PRESSURE 25 P.S.I. [173 kPa] MINIMUM PRESSURE AT 2000 R.P.M. ENGINE SPEED AND A MAXIMUM OF 70 P.S.I. [483 kPa] OUTLET PRESSURE WITH ENGINE OPERATING AT NO LOAD GOVERNED SPEED.

PRESSURE REGULATOR VALVE

CHECK POINT "D" CONVERTER OUTLET TEMPERATURE RED LINE 250° F. [121° C] ½ N.P.T.F. PORT SIZE – MAY USE CLARK NO. 234033 (REF.) OR SAE NO. 2 TEMPERATURE PICKUP.

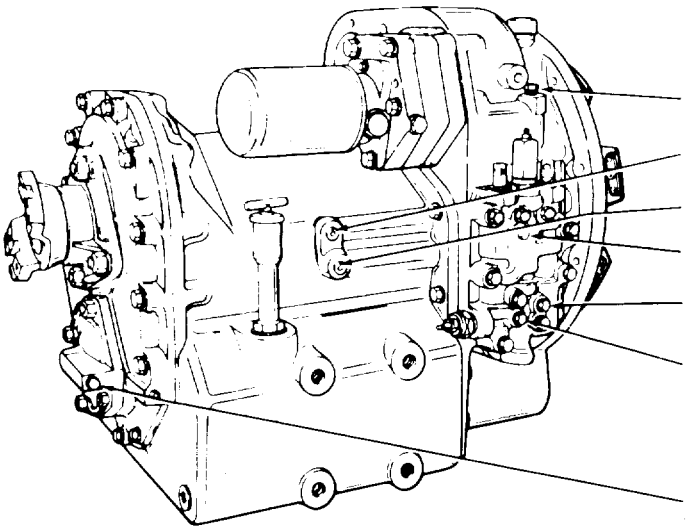
LUBE (CONSTRUCTION HOLE ONLY)

CONVERTER OUT

TO LUBE FROM COOLER

DRAIN

CHECK POINTS A & D SHOULD BE MONITORED BY GAUGES LOCATED IN OPERATOR'S COMPARTMENT.



CHECK POINT "A" CLUTCH PRESSURE ¼ N.P.T.F. CLUTCH PRESSURE 180 to 220 P.S.I. [1241-1516 kPa].

CHECK POINT FOR FORWARD MODULATED CLUTCH PRESSURE 180 to 220 P.S.I. [1241-1516 kPa]

3RD

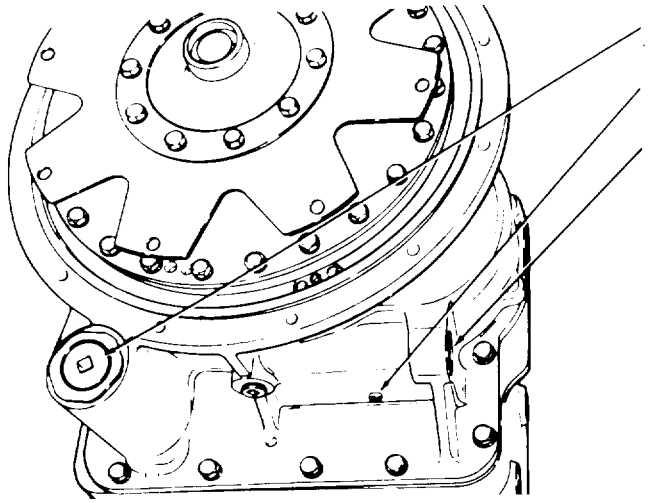
TRANSMISSION FWD. CLUTCH PRESSURE PORT (1/8 N.P.T.F.)

2ND

TRANSMISSION REV. CLUTCH PRESSURE PORT (1/8 N.P.T.F.)

THESE PORTS ARE PROVIDED FOR INSTALLATION OF BACK-UP WARNING LIGHT PRESSURE SWITCH OR HORN.

1ST (LOW)



SUMP SCREEN

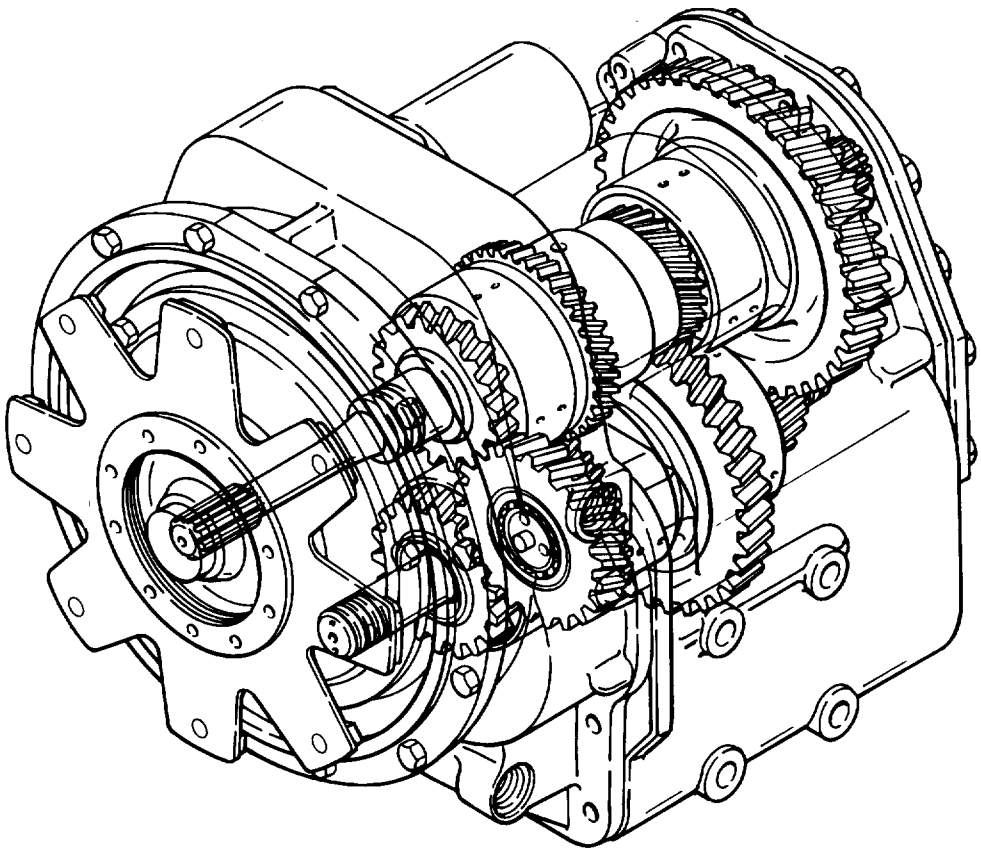
CHECK POINT "H" LUBE PRESSURE 1/8 N.P.T.F. 15-25 P.S.I. [103-172 kPa] @ 2000 RPM & 180°-200° F. [82,2-93,3° C] AT CONVERTER OUTLET.

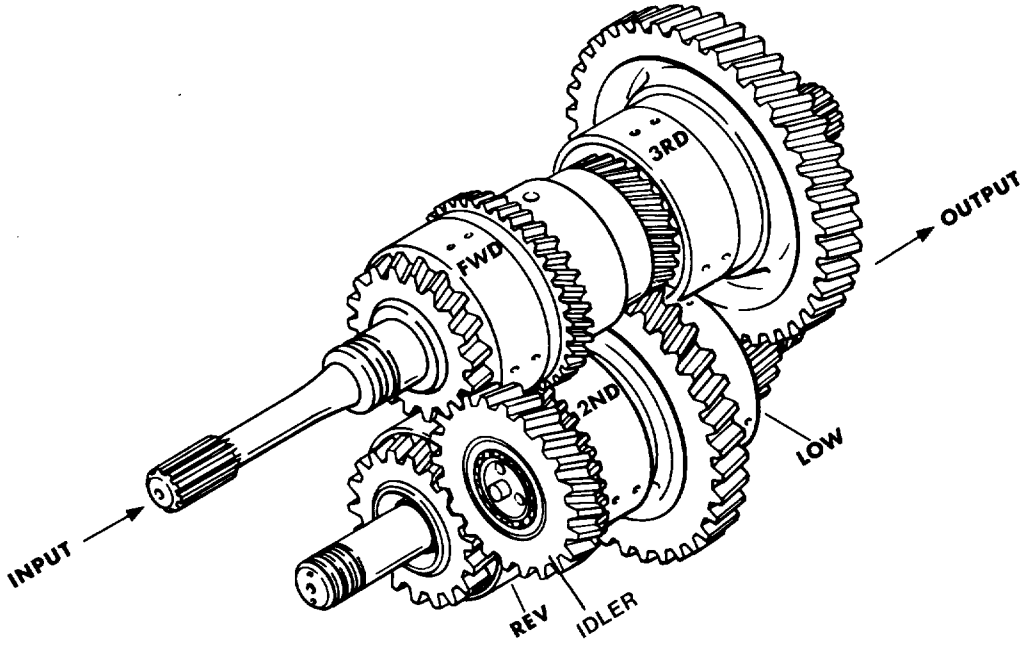
TO LUBE FROM COOLER

HOSE LINE OPERATING REQUIREMENTS:

1. PRESSURE LINES

   AMBIENT TO 250° F [121° C] FOR CONTIMUOUS OPERATION. MUST WITHSTAND 300 P.S.I. [2068 kPa] CONTINUOUS OPERATION WITH 600 P.S.I. [4137 kPa] SURGE PRESSURE REF. SAE 100RI HYDRAULIC HOSE.
2. OIL SPECIFICATIONS: SEE LUBRICATION SECTION.
3. ALL HOSE LINES USED MUST CONFORM TO SAE SPEC NO. SAE J1019 TESTS & PROCEDURES FOR HIGH-TEMPERATURE TRANSMISSION OIL HOSE, LUBRICATING OIL HOSE & HOSE ASSEMBLIES.



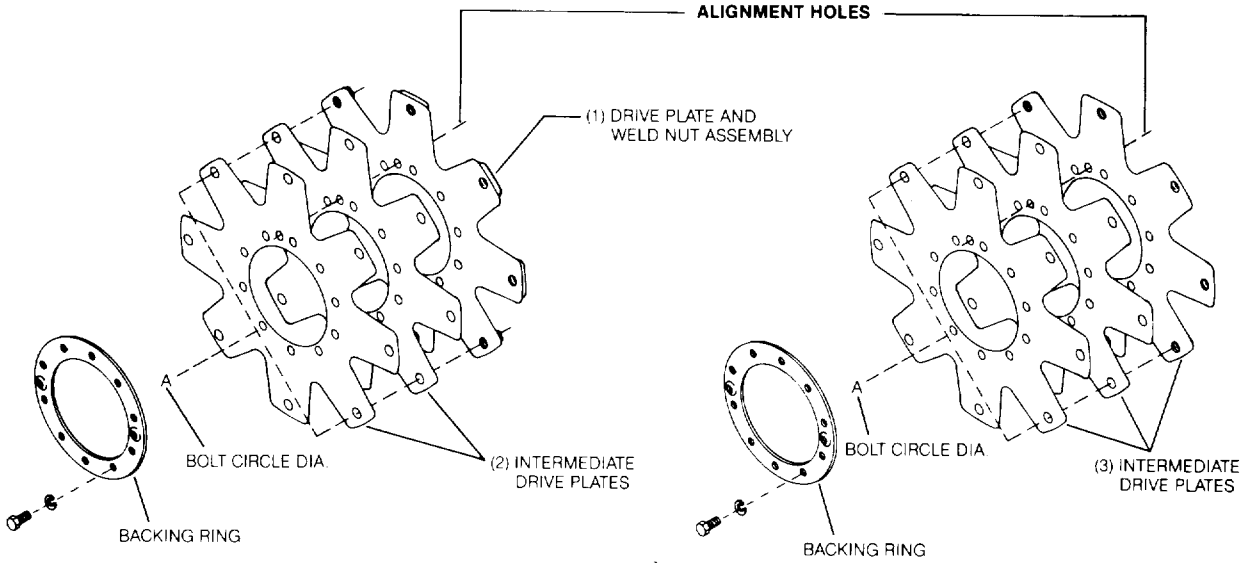


18000 SERIES - 3 SPEED INLINE
CLUTCH & GEAR ARRANGEMENT

18000 SERIES TRANSMISSION CONVERTER DRIVE PLATE KITS

Proper Identification by Bolt Circle Diameter

Measure the “A” dimension (Bolt Circle diameter) and order Drive Plate Kit listed below.
Note four (4) kits have two (2) intermediate drive plates and one (1) drive plate and weld nut assembly. Two (2) kits with three intermediate drive plates.



“A” Dimension (Bolt Circle Diameter)

11.38" [288,900 mm] Diameter
Kit No. 802229
13.12" [333,375 mm] Diameter
Kit No. 802230
13.50" [342,900 mm] Diameter
Kit No. 802231
17.00" [431.800 mm] Diameter
Kit No. 802356

Each Kit will include the following parts:

2 Intermediate Drive Plates.
1 Drive Plate and Weld Nut Assembly.
1 Backing Ring.
10 Screw and Lockwasher Assembly.
1 Instruction Sheet.

“A” Dimension (Bolt Circle Diameter)

11.38" [288,900 mm] Diameter
Kit No. 802494

13.12" [333,375 mm] Diameter
Kit No. 802393

13.50" [342,900 mm] Diameter
Kit No. 802232

Each Kit will include the following parts:

3 Intermediate Drive Plates.
10 Screw and Lockwasher Assembly.
1 Instruction Sheet.

NOTE: Some drive plates and backing rings will have fourteen (14) mounting holes. Only ten (10) mounting holes will be used.

TO FACILITATE ASSEMBLY, ALIGN SMALL HOLES IN DRIVE PLATES-SEE ILLUSTRATION ABOVE.

Position drive plate and weld nut assembly on impeller cover with weld nuts toward cover. Align intermediate drive plate and backing ring with holes in impeller cover. **NOTE:** Two dimples 180° apart in backing ring must be out (toward engine flywheel). Install capscrews and washers. Tighten 23 to 25 lbf.ft torque [31,2 - 33,8 N.m.].

TRANSMISSION TO ENGINE INSTALLATION PROCEDURE

1. Remove all burrs from flywheel mounting face and nose pilot bore. Clean drive plate surface with solvent.

2. Check engine flywheel and housing for conformance to standard S.A.E. #3 - S.A.E. J-927 tolerance specifications for pilot bore size, pilot bore runout and mounting face flatness. Measure and record engine crankshaft end play.

3. Install two 2.50 [63, 50 mm] long transmission to flywheel housing guide studs in the engine flywheel housing as shown. Rotate the engine flywheel to align a drive plate mounting screw hole with the flywheel housing access hole.

*4. Install a 4.00 [101,60 mm] long drive plate locating stud .3750-24 fine thread in a drive plate nut. Align the locating stud in the drive plate with the flywheel drive plate mounting screw hole positioned in step No. 3.

5. Locate transmission on flywheel housing aligning drive plate to flywheel and transmission to flywheel housing. **NOTE:** Fig. 4 installation, align drive plate holes with flywheel studs.

*6. Install transmission to flywheel housing screws. Tighten screws to specified torque. Remove transmission to engine guide studs. Install remaining screws and tighten to specified torque.

Remove drive plate locating stud.

7. Install drive plate attaching screw and washer. Snug screw but do not tighten. **NOTE**: Fig. 4 installation, install drive plate attaching washers and nuts. Tighten each nut 28 to 30 ft. lbs. torque [38,0- 40,6 N.m]. Some engine flywheel housings have a hole located on the flywheel housing circumference in fine with the drive plate screw access hole. A screwdriver or pry bar used to hold the drive plate against the flywheel will facilitate installation of the drive plate screws. Rotate the engine flywheel and install the remaining seven (7) flywheel to drive plate attaching screws. Snug screws but do not tighten. After all eight (8) screws are installed torque each one 25 to 30 ft. lbs. torque [33,9 -40,6 N.m]. This will require torquing each screw and rotating the engine flywheel until the full amount of eight (8) screws have been tightened.

8. Measure engine crankshaft end play after transmission has been completely installed on engine flywheel. This value must be within .001 [0,025mm] of the end play recorded in step No. 2.

*Does not apply to units having 3 intermediate drive plates. See Fig. 4.

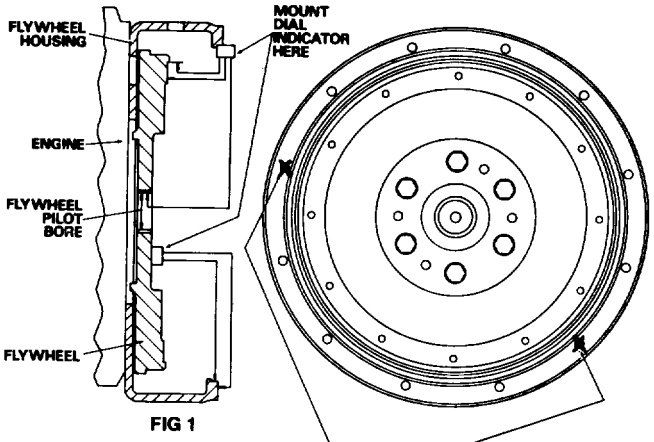


FIG 1

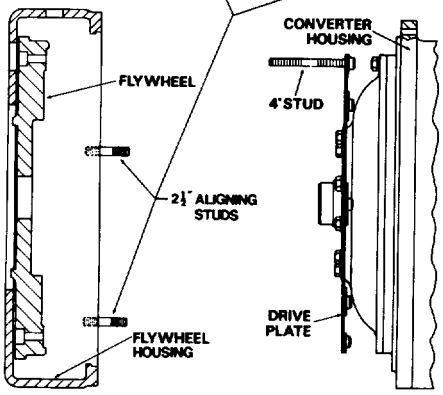


FIG 2

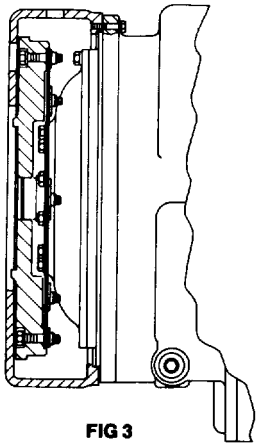


FIG 3

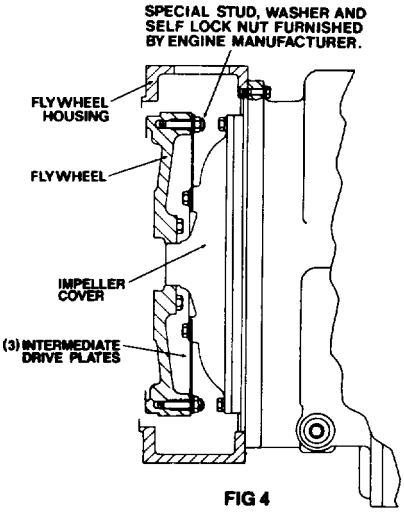
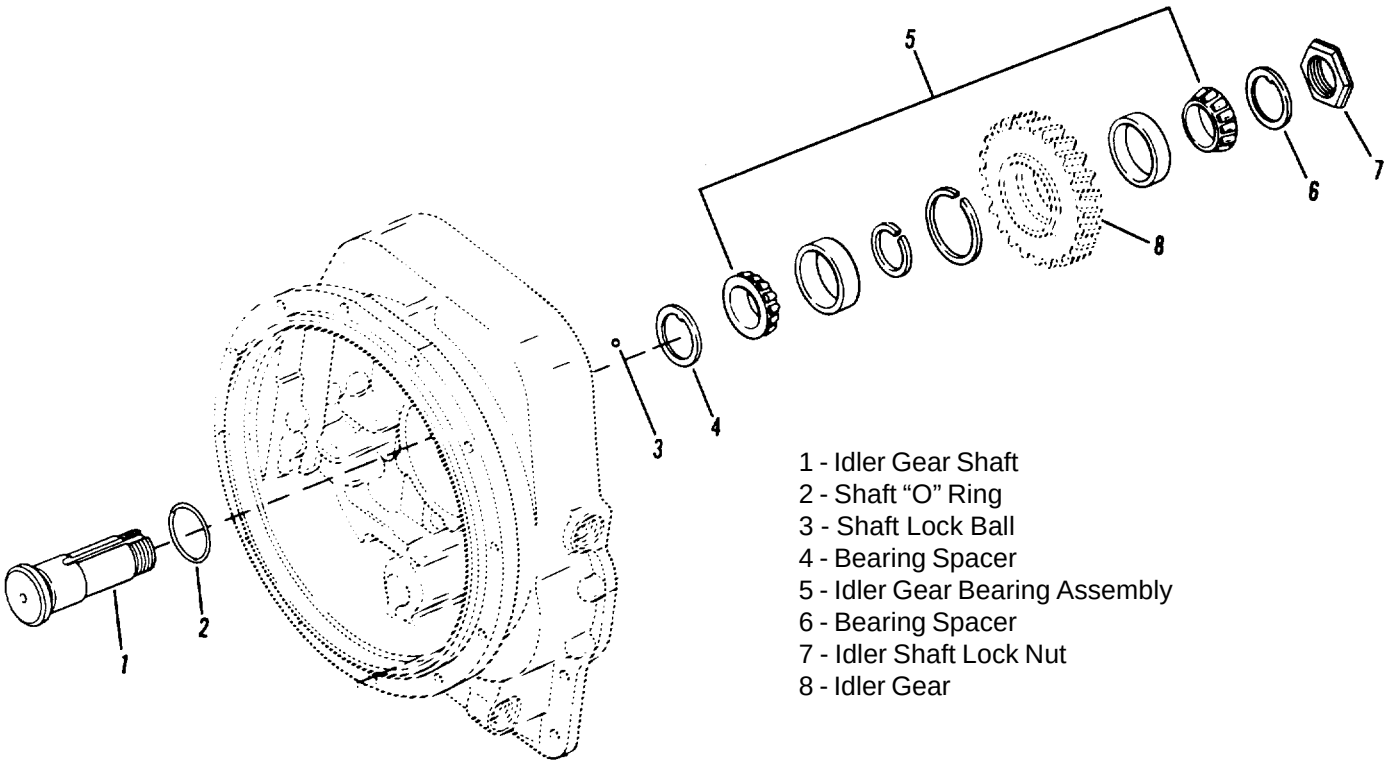


FIG 4



1 - Idler Gear Shaft
2 - Shaft “O” Ring
3 - Shaft Lock Ball
4 - Bearing Spacer
5 - Idler Gear Bearing Assembly
6 - Bearing Spacer
7 - Idler Shaft Lock Nut
8 - Idler Gear

DISASSEMBLY AND REASSEMBLY OF LOCK NUT TYPE IDLER SHAFT

DISASSEMBLY

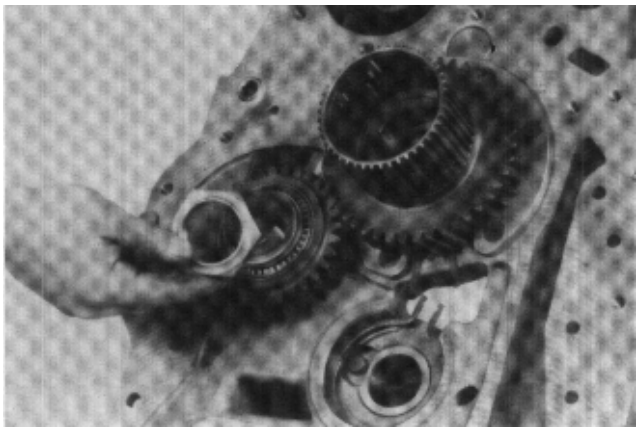


Figure 202

Unclinch lock nut by straightening upset metal in notch in idler shaft. Remove idler shaft nut.

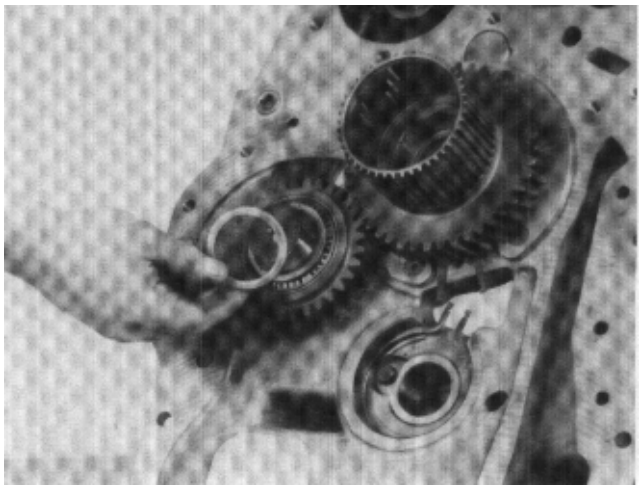


Figure 203

Remove nut spacer.

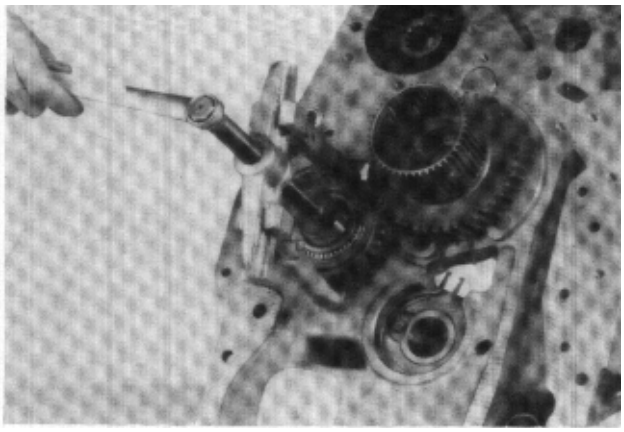


Figure 204
Remove idler gear and outer taper bearing from idler shaft.

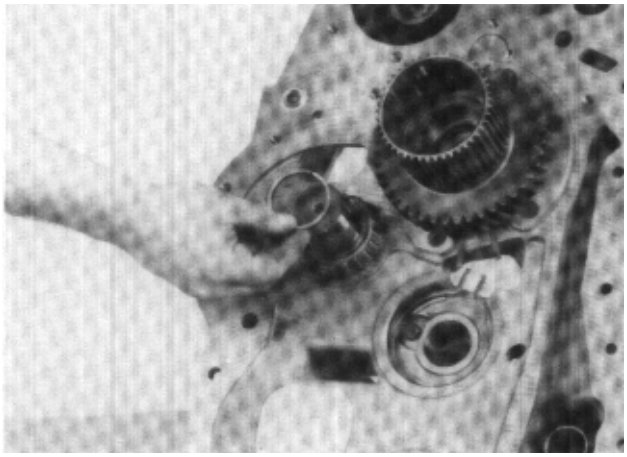


Figure 205
Remove bearing spacer.

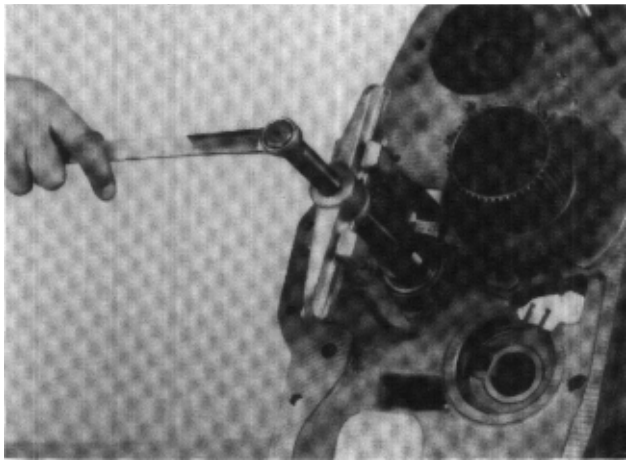


Figure 206
Remove inner taper bearing.

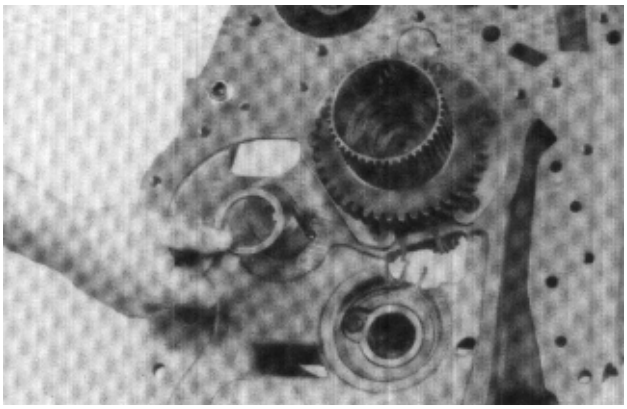


Figure 207
Remove bearing spacer.

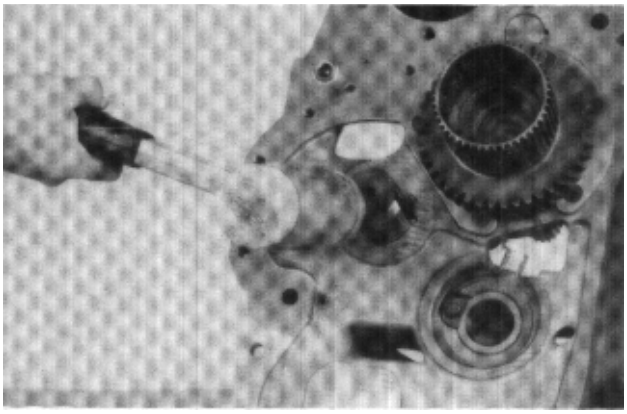


Figure 208
Remove idler shaft, use caution as not to lose shaft lock ball. Refer to page 21 for further disassembly.

REASSEMBLY OF LOCKNUT TYPE IDLER SHAFT

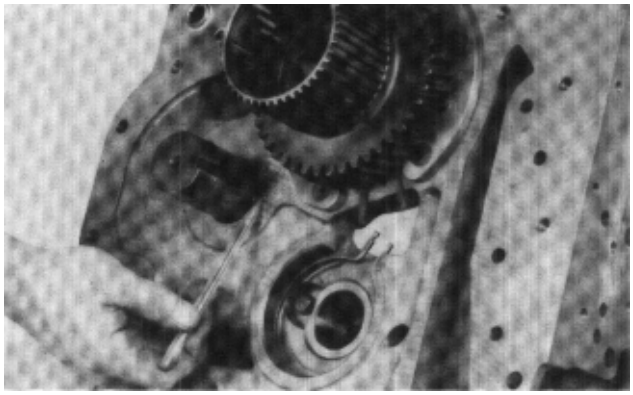


Figure 209
With new “O” ring on shaft, position idler shaft and lock ball in converter housing. Tap shaft into position. Note lock ball.

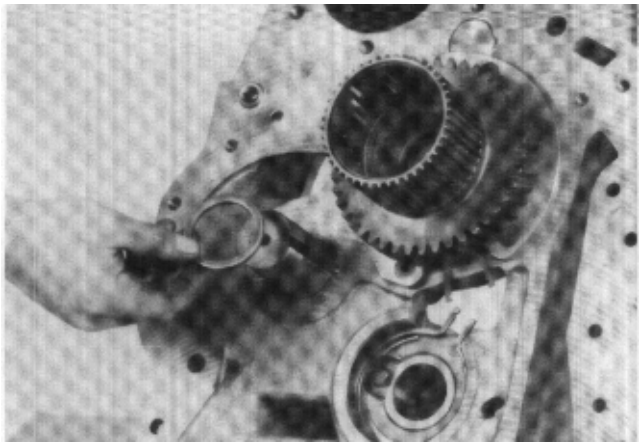


Figure 210
Install reverse idler shaft spacer.

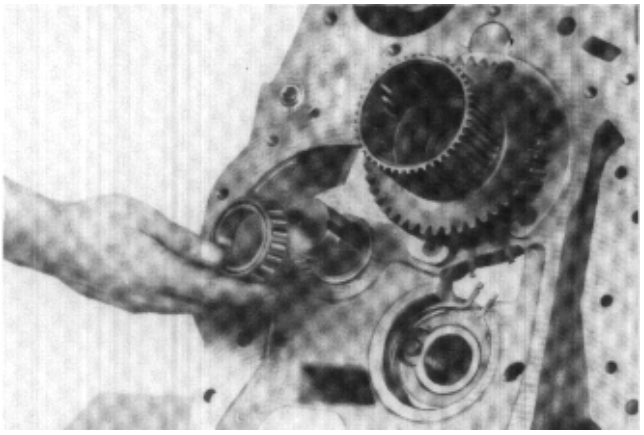


Figure 211
Install inner taper bearing on shaft with large diameter of taper down.

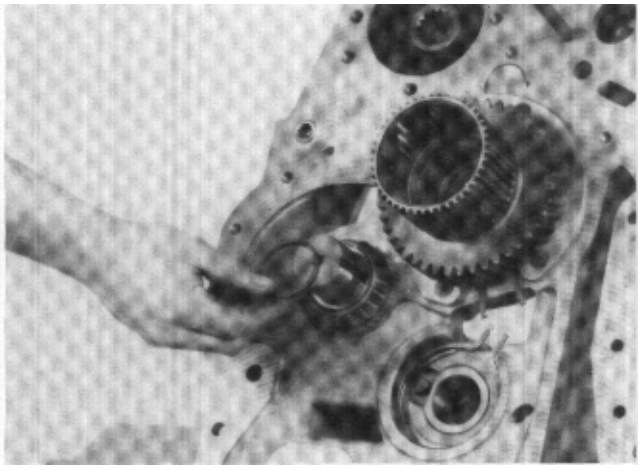


Figure 212
Position bearing spacer on shaft.

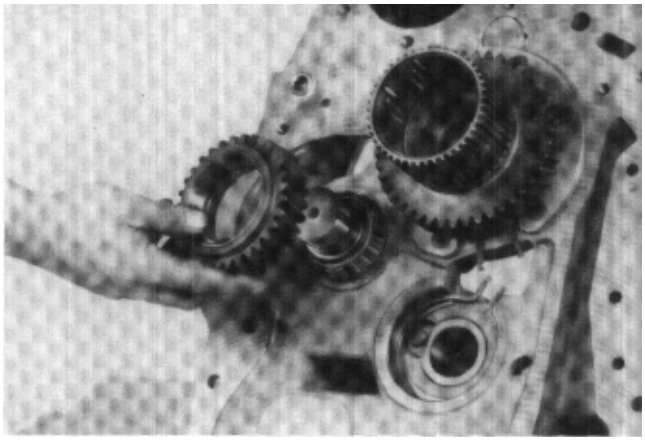


Figure 213
Position idler gear on bearing with hub of gear up.

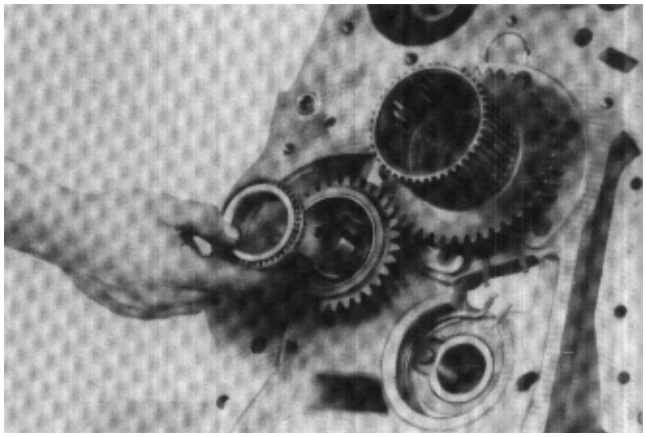


Figure 214
Install idler gear outer taper bearing with large diameter of taper up.

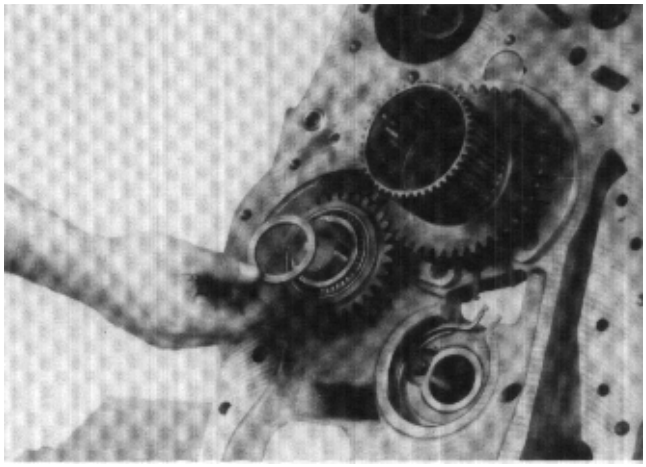


Figure 215
Position outer spacer on shaft.

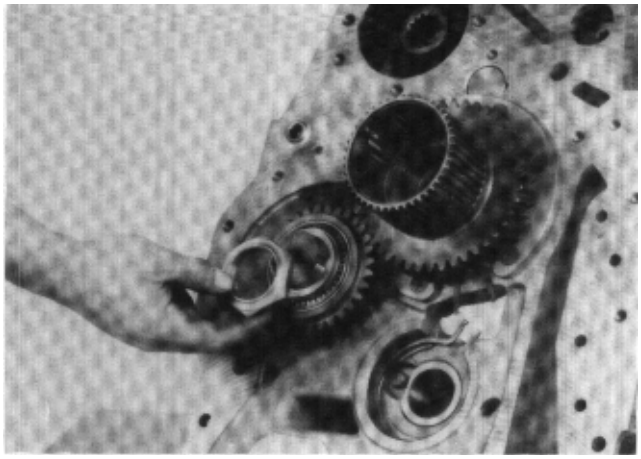


Figure 216

Install retainer nut.

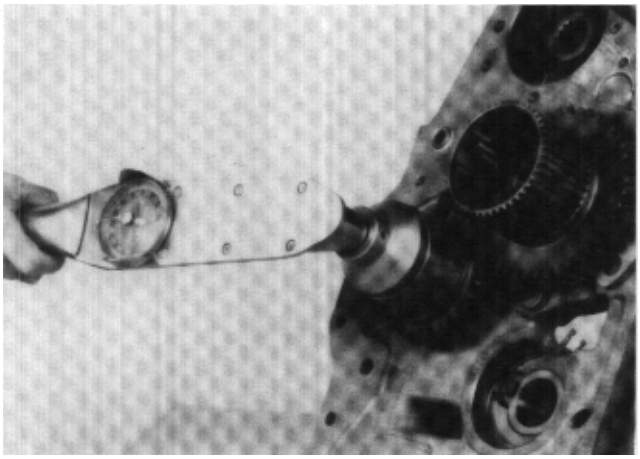


Figure 217

Tighten nut 200-250 ft. lbs. torque [271,2-338,8 N.m].

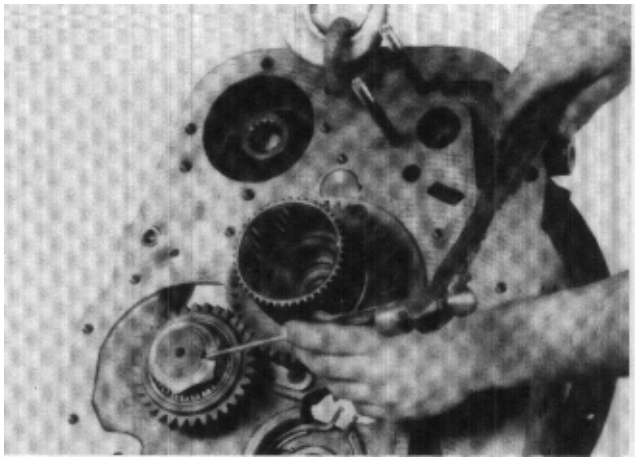
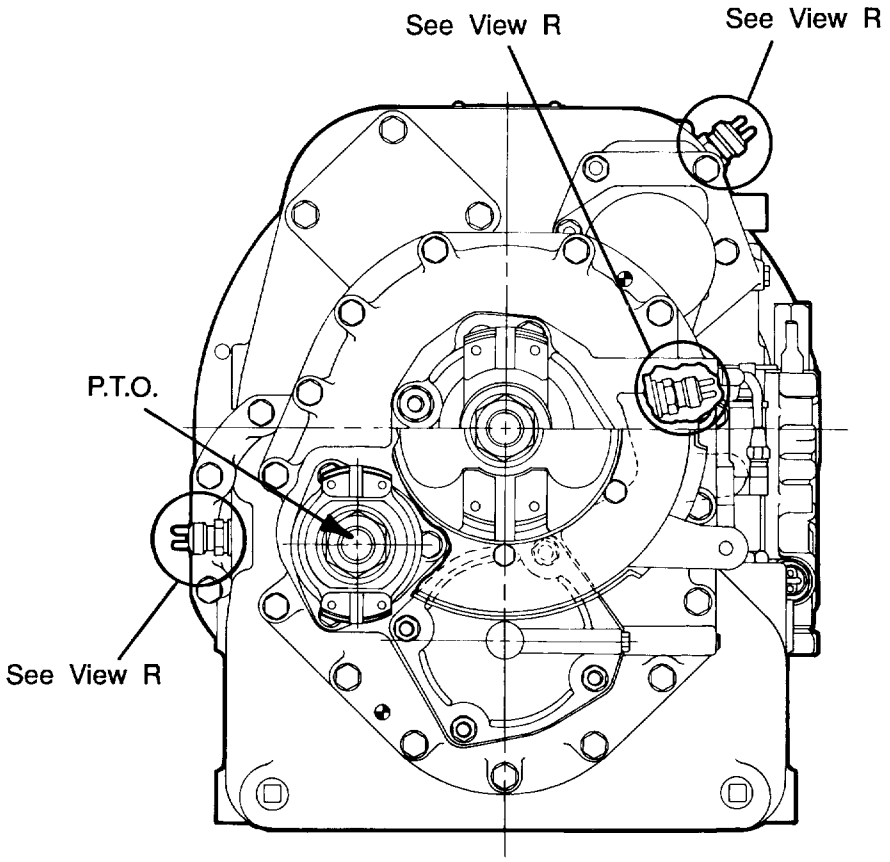
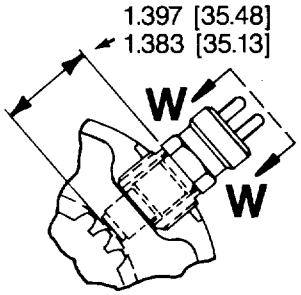


Figure 218

Stake nut securely in shaft notch.



Assemble speed sensor bushing in housing to specified dimension with Loctite 262 or 270 and stake 3 places.



VIEW R

Stake 3 places approx. equally spaced — orientation not critical

VIEW W-W
Typical 3 Places

PROPER INSTALLATION OF TEFLON PISTON RING AND PISTON RING EXPANDER SPRINGS

NOTE: NOT ALL TRANSMISSIONS WILL HAVE TEFLON PISTON RINGS AND EXPANDER SPRINGS

1. Fill the oil sealing ring grooves with a good grade of grease, this will help stabilize the teflon ring and expander spring in the ring groove for installation.

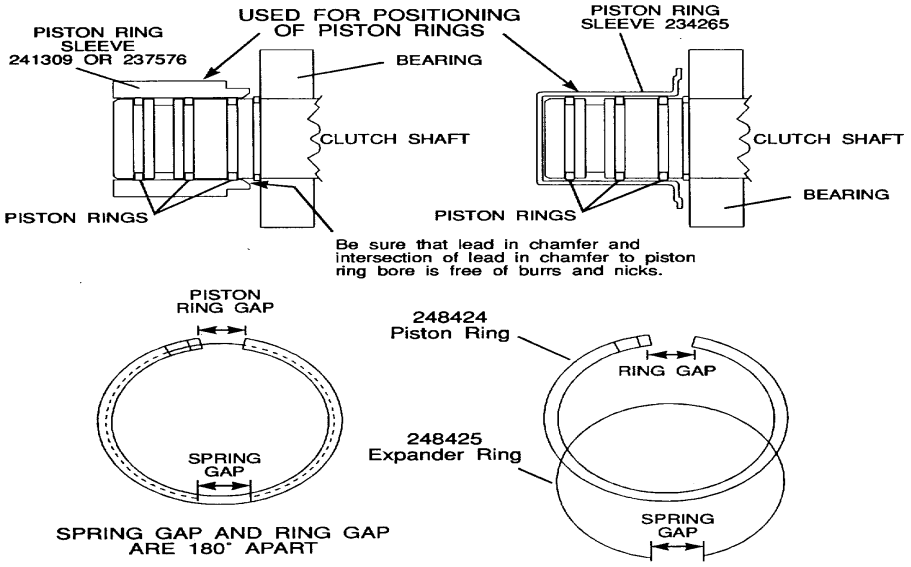
2. Position the expander spring in the inner groove of the new piston ring, with the expander spring gap 180° from the hook joint gap of the piston ring.

3. Carefully position the piston ring and expander spring on the clutch shaft in the inner most ring groove. Hook the piston piston ring joint.

4. Repeat steps 1, 2 and 3 for the remaining ring or rings making certain all hook joints are fastened securely.

5. Apply a heavy coat of grease to the outer diameter of the rings and clutch shaft. Center the piston ring's in the ring groove.

6. Before installing the clutch assembly in the front cover or converter housing it is recommended a piston ring sleeve P/N's 241309, 237576 or 234265 be used to center all of the piston rings in their respective ring grooves. Use extreme caution to not damage piston rings when installing the clutch shaft in the front transmission cover or converter housing.



NOTE: Clutch return disc spring packs are certified according to compression weight specifications and are pre-packed in quantities to repair one (1) specific clutch.

The disc spring packs are to be used as complete assemblies and care should be taken not to intermix the individual disc springs with disc springs in another clutch or disc spring pack.

Each disc spring assembly is made up of selected springs to precisely match each part within this assembly. Failure to replace all piston return springs can result in unequal deflection within the spring pack. The result of this imbalance may adversely affect overall life of springs.

N O T E S

NOTES

CLARK-HURTH
COMPONENTS

Statesville, North Carolina

Brugge, Belgium

Arco, Italy

Sao Paulo, Brazil

Price on request

59-905-0013
PRINTED IN U.S.A.

Important rim and wheel safety precautions

NOTICE!

An inflated tire and rim can be very dangerous if misused or worn-out. Many accidents, some fatal, have resulted from improper handling and operation of truck rims and wheels. It is, therefore, of the utmost importance that the precautions outlined on this page be carefully followed by all persons servicing truck rims and wheels to avoid personal injuries and costly damage.

How to prevent rim accidents during tire mounting

Always inflate tire in safety cage or use a portable lock ring guard. This is a safeguard against improper assembly, inadvertently mismatched parts, and other assembly errors. Remember, an inflated tire contains potentially explosive energy that can blow improperly assembled rings loose. In emergency situations, where a safety cage or portable safety device is not available, use a clip-on type air chuck so that the operator can stand clear during tire inflation. **Important,** when clip-on air chuck is used, line pressure must be restricted to maximum inflation capacity of tire.

Use properly matched parts only. Rim base and rings must be matched according to size and type. This information is stamped on each Firestone part.

Replace damaged parts. Abuse during road operations or in mounting the tire can cause dents, cracks, or distortions which weaken the parts. Inspect for and replace damaged parts.

Periodically inspect and remove rust and other foreign matter. Accumulation of such material in the rim gutter can prevent the proper fitting of rings. Parts that are excessively corroded are weakened and should be replaced. Use of a rust preventative compound (not containing water) during mounting will minimize rusting.

Do not use over-size or over-inflated tires. Use only recommended size rims for tires and do not exceed maximum inflation pressure for the rim.

Follow manufacturer's recommended mounting procedures.

ADDED PRECAUTION: **Re-check assemblies just prior to inflation, particularly if they have been rolled across the floor or have received rough handling between mounting and inflation.**

During tire demounting

Completely deflate tire prior to demounting. The tire should be deflated prior to removal of the tire and rim assembly from the vehicle. Remove the valve core to insure complete deflation.

DO NOT STAND IN FRONT OF RIM/TIRE DURING DEFLATION.

Follow recommended demounting procedures.

Check for damaged or worn parts. Mark defective parts for destruction to preclude their future use.

During vehicle operation

Before putting new vehicles into service, clamps and wheel nuts should be checked for proper torque.

Do not overload rims or wheels. Insure that the combination of load and vehicle weight does not exceed the rated load of the rims or wheels used. Rims and wheels are designed to sustain their rated load using the maximum tire size recommended for that rim width by the Tire & Rim Association.

Inspect rims and wheels for damage during tire checks and at periodic maintenance intervals. Remove and replace defective parts.

Do not exceed maximum inflation pressures. This is determined by the size and ply rating of the tire, but is not to exceed the maximum inflation listed for the rim or wheel. It is also important to maintain uniform inflation in both tires of a dual assembly so that weight is equally sustained.

Do not run vehicle on one tire of dual assembly. When there is loss of air in a dual tire the carrying capability is reduced and the load must be sustained by the other tire and rim. Both tires should be inflated to balanced, recommended pressures before further operation.

Never re-inflate a tire that has been run flat or seriously underinflated without first breaking rim down and reassembling rim. It is especially important to make sure the lock ring is secure in the gutter and has not been damaged prior to re-inflation.

After first 50 to 100 miles of service re-check clamp and wheel nut torque. Loose wheel nuts can cause excessive wear around bolt holes, dangerous wheel vibration, and metal fatigue failure. Excessive torque is also dangerous in that it can cause stud or wheel breakage.

THE GRADALL COMPANY
406 Mill Ave., S.W. New Philadelphia, Ohio 44663

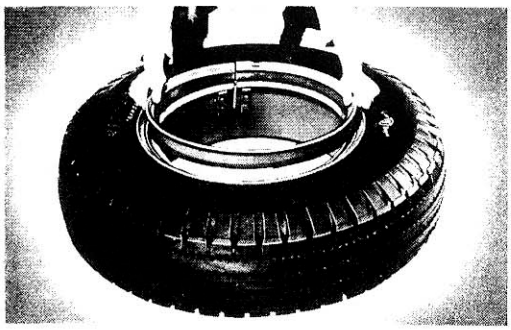
Form No. 0009

How to mount and demount ACCU-RIDE 5° Commander and 3-piece convertible rims

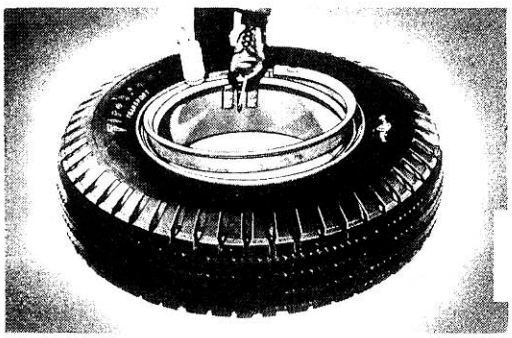
(Procedure applies to tires on both demountable rims and disc wheels)

Tools required: 1 rim mallet / 1 rim tool

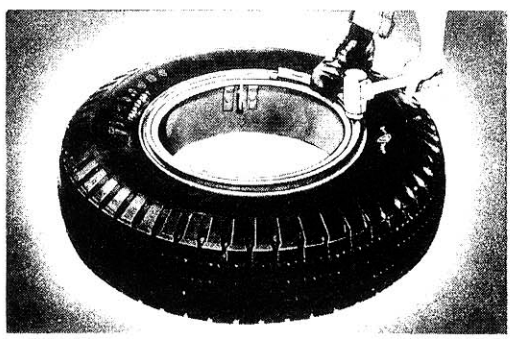
MOUNTING



After applying tire and tube in usual manner, place removable side ring (flange) on bead of tire. Then insert tapered toe of lock ring between side ring and rim base.

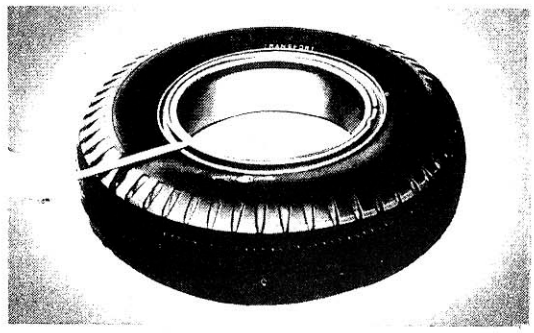


To fasten lock ring, hold with foot at one end of split and hammer end of ring into place with rim mallet.

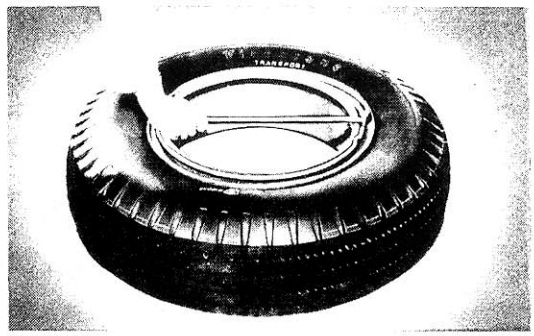


Continue progressively around the rim, holding ring with foot and hammering until entire ring is seated. Check seating of rings and inflate tire to recommended pressure.

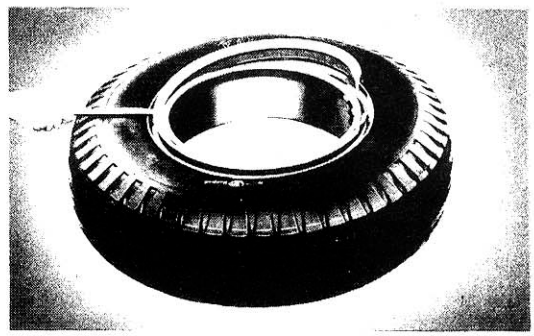
DEMOUNTING



Standing clear of rim, completely deflate tire by removing valve core or using deflator cap. Place tapered end of rim tool in depression in lock ring, or between rings, and press down on side ring to free bead. Continue downward pressure on side ring progressively around the tire until the bead is completely freed from the bead seat.



To disengage lock ring from the gutter, insert rim tool in removing notch, near split in the ring, and push downward. If desired, a second similar tool may be used to facilitate removal.



Insert the rim tool between the lock ring and side ring and press downward to pry ring up. Move progressively around the rim until lock ring is free, then lift off lock and side rings. Turn assembly over, unseat tire bead, stand tire up and remove rim base.

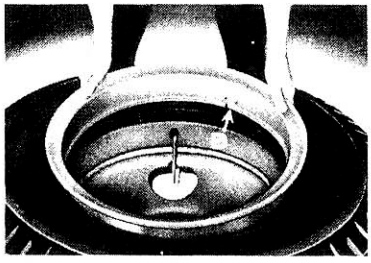
SAFETY PRECAUTIONS

1. **Use only parts free from damage or heavy rust.**
2. **Insure that lock ring is completely installed before inflating tire. Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand clear during inflation.**
3. **Insure that tire is completely deflated prior to removal of rings.**
4. **Split lock rings used with continuous side rings must not butt.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

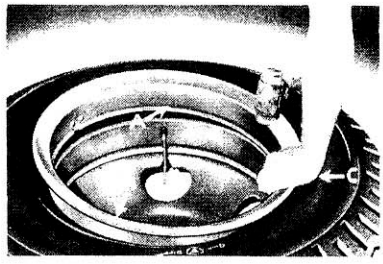
How to mount and demount ACCU-RIDE RH5° rims

Tools Required: 1 Rim Mallet
1 Rim Tool

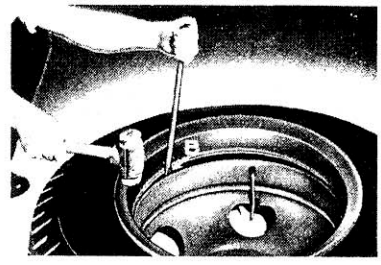
MOUNTING



Place disc portion of wheel on floor with rim gutter up. Apply tire with valve pointing in direction desired. Place side ring in position with operating notch located between two embossings (point B) approximately three inches from valve, on either side.

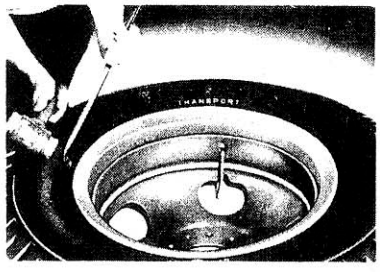


The two cutaway portions opposite each other in the inner diameter of the ring (points A) are placed so as to span the rim gutter. At point C, opposite valve, force half of ring into the gutter as far as possible using hand and rim mallet.

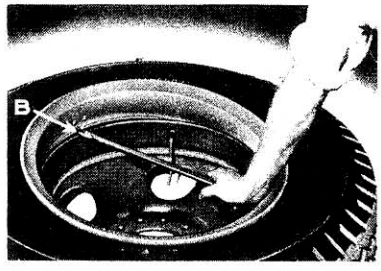


Insert straight end of rim tool in operating notch (point B), then pull in direction indicated by arrow. Retain pressure with tool and strike ring downward with mallet at point between tool slot and cutaway portion, thereby engaging ring over rim gutter at that point. Remove tool and strike additional blows progressively toward other cutaway portion until entire toe of ring has passed over the rim gutter. Check seating of ring as shown below and inflate tire to recommended pressure.

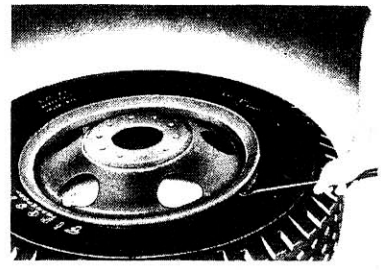
DEMOUNTING



CAUTION: Staying clear of rim, make certain tire is completely deflated. To loosen tire bead from side ring, drive curved bead-loosening end of above recommended rim tool, or a larger tire tool, between ring and bead. Pry downward on bead and repeat this operation around the ring until bead is loose.



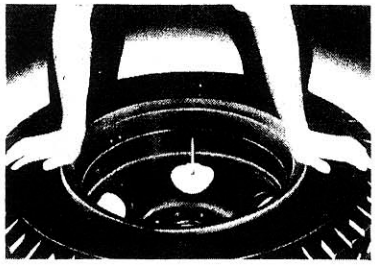
Remove ring by putting straight end of rim tool into notch in ring located between embossings (point B). Push ring downward at point opposite operating notch. Force tool handle downward as illustrated, causing ring to disengage from rim gutter. Continue operation, prying away from rim gutter with flat end of tool until free.



Turn assembly over and unseat tire bead from back flange in same manner as loosening bead from side ring in first step. Stand tire up and remove rim base.

NOTE: It is unnecessary to free the side ring from the tire bead if tire is to be removed for tube repair and immediately replaced. Simply loosen bead from back (permanent) flange as in third demounting step. Then turn the assembly over and remove ring, with tire attached, as in second demounting step.

IMPORTANT: RH-5° side rings are not interchangeable on other size RH-5° bases. Make certain side ring is right size for the rim base you are using.



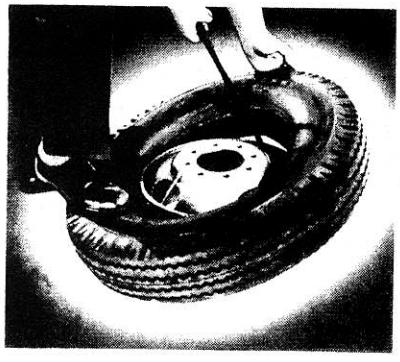
SAFETY PRECAUTIONS:

1. **Before inflating tire, be certain side ring has completely cleared the gutter of rim base. In this position, the side ring can be depressed by hand. This can be easily felt and seen. DO NOT INFLATE IF SIDE RING DOES NOT MOVE FREELY.**
2. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
3. **Use only parts free from damage or heavy rust, especially at the area of contact between the rim base and side ring.**
4. **Insure that tire is completely deflated prior to removal of side ring.**
5. **Do not inflate a flat or seriously underinflated tire while tire is on vehicle. Remove and make sure all parts are serviceable and fully reassemble before reinflating tire.**

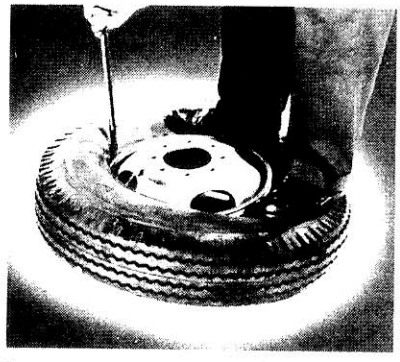
How to mount and demount ACCU-RIDE RHP rims

Tools required: 2 rim tools
1 rim mallet
1 tire tool (thin end)

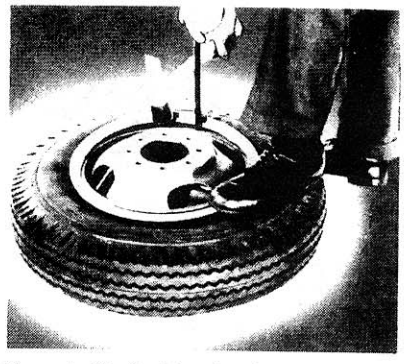
MOUNTING



Place tire on rim so that valve is in line with valve hole and insert valve through valve hole. Force first bead down into well of rim just to side of valve with foot. Mount first bead over rim gutter with rim tool progressing from each side of foot to point approximately opposite foot.

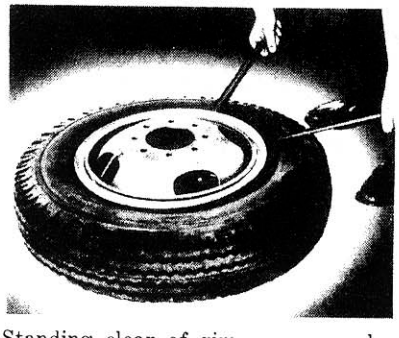


To apply second bead, start at point opposite valve and press bead toe over rim gutter and into rim well with foot pressure. Mount remainder of bead over rim gutter by means of thin tire tool, being careful not to pinch tube.

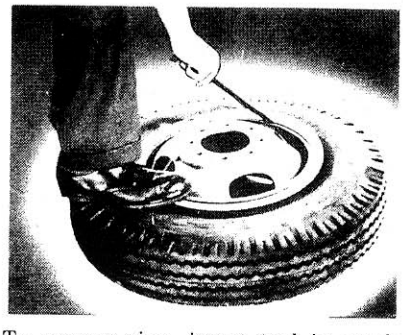


Place half of side ring in rim gutter with cutaway portions in position as shown. Insert thin end of rim tool or heavy screw driver and pull ring outward toward centered position. Strike with mallet, forcing rim into gutter.

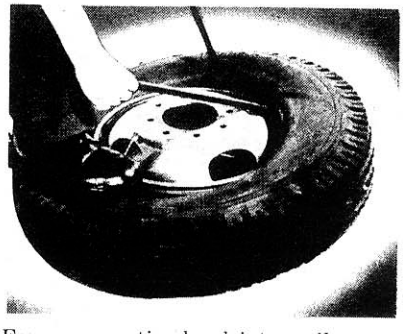
DEMOUNTING



Standing clear of rim, remove valve core to completely deflate tire. Place tire and wheel on floor with side ring up. To loosen first bead, drive hooked end of rim tool between tire and rim flange and press downward on bead. Progress around rim, using 2 tools, as shown.



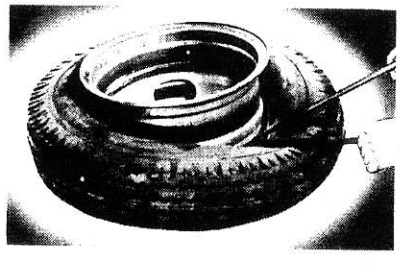
To remove ring, insert tool in notch and force ring opposite of notch into gutter, then pry off. Pry out and up on side ring, carefully but firmly. (Be careful not to bend side ring.)



Force upper tire bead into well opposite the valve slot and with tire tool pry opposite portion of bead over edge of rim.

Turn tire over and by means of rim tools, loosen bead on opposite bead seat. This can be further aided by using foot pressure.

Make sure one portion of second bead is still in the rim well, then pry opposite portion of bead over edge of rim. This will free the tire from the rim.



SAFETY PRECAUTIONS:

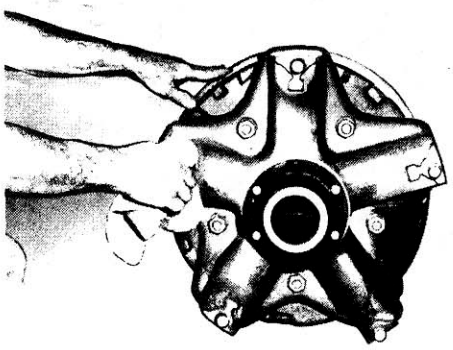
1. **Use only parts free from damage or heavy rust.**
2. **Insure that side ring is completely seated before inflating tire.**
3. **Inflate tire in safety cage or use a lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck so that operator may stand aside during inflation.**
4. **Insure that tire is completely deflated prior to removal of rings.**
5. **Do not mount 16.5 diameter tubeless tires on 16" diameter rims.**

How to properly install ACCU-RIDE rims and wheels

Proper installation of rims and wheels on a vehicle is essential to safe, economical, trouble-free service. Use only the specified sizes of studs, nuts and clamps.

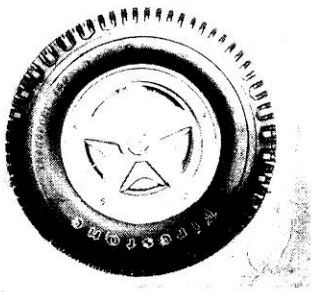
RECOMMENDED INSTALLATION PROCEDURE

DEMOUNTABLE RIMS



Make sure that all parts, including rims, rings, spacer bands and cast wheel studs are free from damage, dirt or rust. Replace any defective parts.

Place rims and spacer band on wheel. Secure clamps evenly in position and draw up nuts alternately in the sequence shown at right. Do **not** tighten them fully, however. This procedure will permit the inside rim to properly align itself on the 28° mounting bevel on the back of the cast wheel, thus avoiding damaging wheel wobble.



Then, tighten nuts fully, using same alternate sequence. Be sure to tighten these nuts **only** to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

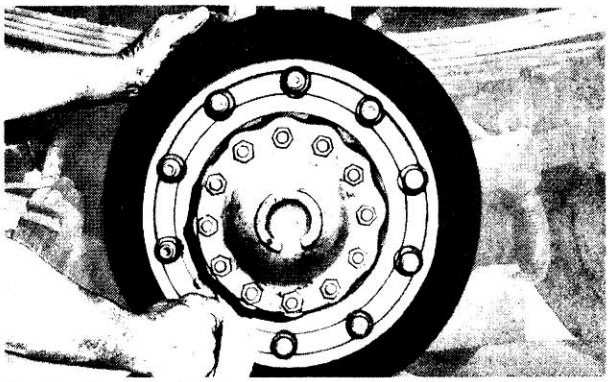
SPOKE WHEELS*	
Thread Size	Torque Ft.-Lbs. (Dry)
5/8 - 11	150 - 175
3/4 - 10	200 - 250
1 - 8	400 - 450
1 - 14	400 - 450

CAUTION: *Insufficient* mounting torque can cause rim slippage, resulting in broken valves, worn parts and damaged tires. *Excessive* mounting torque can cause damage by stripping studs, collapsing spacer bands or forcing rims into an out-of-round condition.

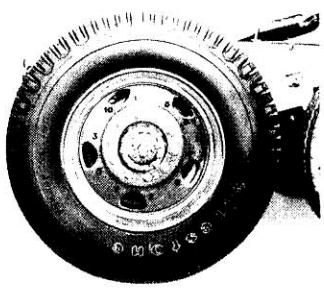
Wrenches for Demountable Rims and Disc Wheels: Double-end socket wrenches for rims and disc wheels normally are adequate to install and remove Accu-Ride rims and wheels, when used with a 3-foot bar. A 150-pound man, exerting his entire weight, 2.5 feet out on a bar, can apply 375 foot-pounds of torque to a wrench (150 x 2.5). Air wrenches, however, sometimes are used to save time and labor. The torque they deliver depends on the air line pressure from which they operate. Periodic checks by torque wrench, or other means, should be made to insure accuracy of these air wrenches.

***NOTE: After first 50 to 100 miles of service re-check clamp & wheel nut torque.**

DISC WHEELS



Check all parts for damage, including wheels and rings. Insure that studs, nuts and mounting faces of hub and wheels are clean and free from grease. Replace any defective parts.



Mount single wheel or inner dual wheel (also, outer dual wheel for hub - type mounting) over studs, being careful not to damage stud threads. Draw up nuts alternately in the sequence shown at left. Do **not** tighten them fully, however. This procedure will permit the uniform seating of nuts and insure the even, face-to-face contact of wheels and hub.

Tighten nuts fully, using the same alternate sequence. Mount the outer wheel (for double cap mounting) and repeat the entire procedure. In each case, be sure to tighten wheel nuts only to the torque level recommended in the table below and to maintain them at that level through planned, periodic checks.

Note: When inner cap nuts are re-tightened, be sure first to loosen outer cap nuts several turns; then, re-tighten them.

DISC WHEELS*		
Application	Thread Size	Torque Ft.-Lbs. (Dry)
Passenger Type Mtg.	7/16-20	80-90
	1/2-20	80-90
	9/16-18	110-120
	5/8-18	125-140
In-Out Coined Mtg.	9/16-18	175-200
	5/8-18	175-200
		1-pc. nut / 2-pc. nut
Piloted Mtg.	11/16-16	300-350 / 200-250
	3/4-16	450-500 / 300-350
	7/8-14	..... / 350-400
Ball Seat Mtg.	3/4-16	450-500
	1-1/8-16	450-500
Heavy Duty Ball Seat Mtg.	15/16-12	750-800
	1-5/16-12	750-800

CAUTION: *Insufficient* mounting torque can cause wheel shimmy, resulting in damage to parts and extreme tire tread wear. *Excessive* mounting torque can cause studs to break and discs to crack in the stud hole area.

Proper maintenance of ACCU-RIDE rims and wheels

Accu-Ride rims and wheels are thoroughly tested in Firestone laboratories, on Firestone test tracks and by both small and large fleets on the highways of America. All these tests, plus a rigid quality-control program, insure maximum performance of all Accu-Ride rims and wheels. In order, however, to maintain their built-in quality and to insure maximum service and safety a continuous maintenance program is advisable. Maintenance procedures should be carried out during all tire inspections and changes and at periodic maintenance intervals depending upon road and environmental conditions of operation.

RIM AND WHEEL MAINTENANCE DURING TIRE INSPECTIONS

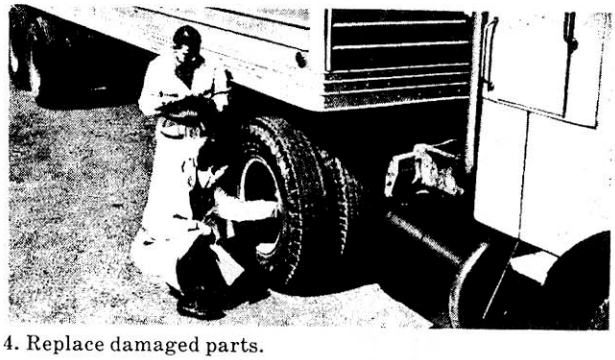
1. Check all metal surfaces thoroughly while making tire inspections, including areas between duals and on inboard side of wheel. Watch for:

excessive rust or corrosion build-up
cracks in metal
bent flanges, resulting from road obstructions
deep rim tool marks on rings or in gutter areas
loose, missing or damaged nuts or clamps
bent or stripped studs
damaged or missing rim drive plates
matched rim parts

2. Pull damaged rims or wheels.

CAUTION: Excessively corroded or cracked rims or rings can be dangerous. Deflate tires prior to the removal of rims or wheels from the vehicle.

3. Mark damaged or hazardous areas with chalk so that part will be removed from service.



4. Replace damaged parts.

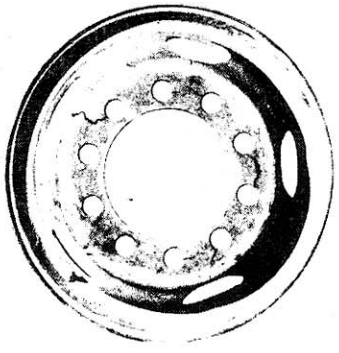
CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

5. Inflate tires only to recommended air pressures.

RIM AND WHEEL MAINTENANCE DURING TIRE CHANGES

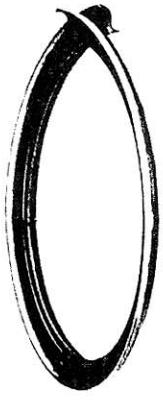
1. Check all metal surfaces as in No. 1, above. A more thorough check may be made, however, after the tire has been demounted. Watch particularly for the damages illustrated below and refer to recommendations in this section of the catalog if corrective measures are required.

Cracks in the rim base, in the back flange and gutter areas. These are caused by deep rim tool marks, overloading and overinflating tires and using larger than recommended tire sizes.



Cracks in the wheel disc, between stud holes or hand holes. These are caused by loose wheel nuts, improper installation procedures and use of incorrect sizes or types of attaching parts.

Cracks through side ring, spreading laterally through the entire section. These are caused by improper mounting and demounting techniques, impact with road obstructions, and excessive clamping torques.



Sprung side ring, resulting from improper mounting procedures.

Erosion and chipping of bead seat of lock ring, resulting from excessive corrosion. This may occur with this part as well as others if protective measures described on following page are not taken.

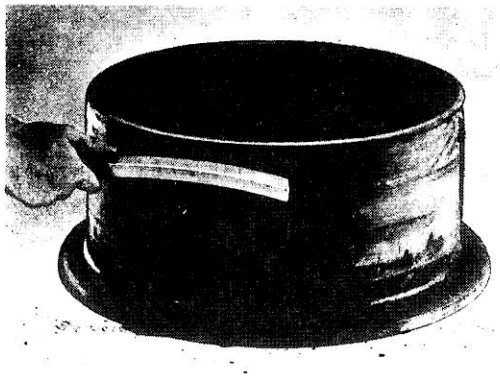
2. Replace damaged parts.

CAUTION: Insure that replacements are made with the proper sizes and types of rims and rings.

NOTE: Openings between ends of split side rings must not be less than 3/32" except where the ring design calls for an abutting condition, or more than 5/16" after ring is seated-in during operation. Split lock rings used with endless side rings must not butt.

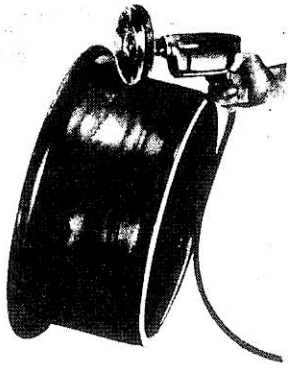
(Continued)

Proper maintenance of ACCU-RIDE rims and wheels
(continued)

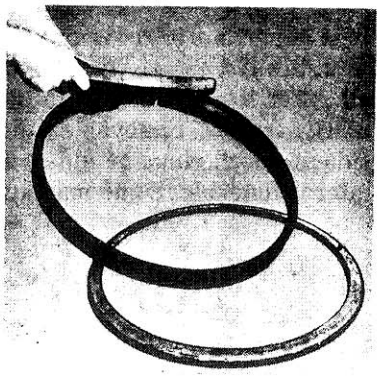


3. Thoroughly remove rust, dirt and other foreign materials from all surfaces. Hand or electric wire brushes, sand blasting or chemical baths may be used.

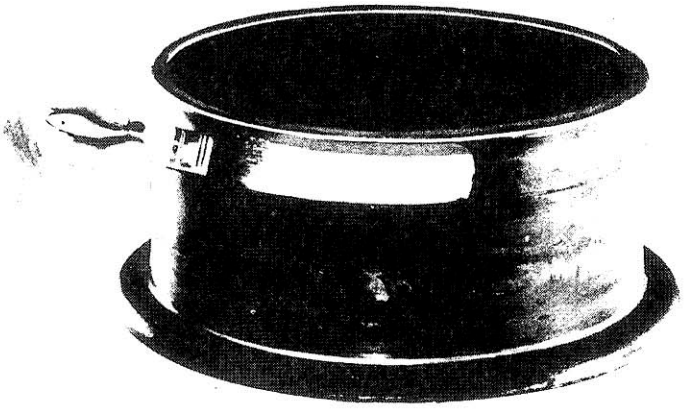
Gutter of rim base should be cleared of rust and other materials obstructing safe, positive seating of rings.



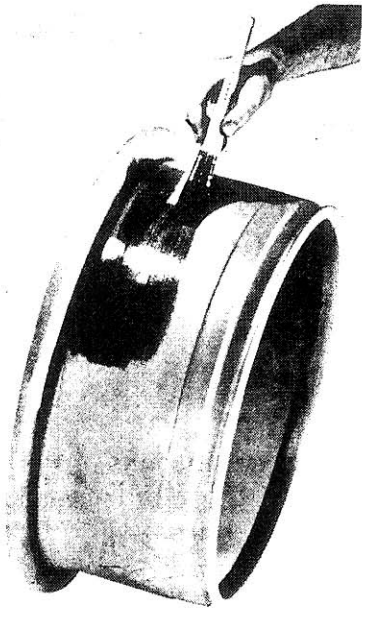
Bead seat areas of rim should be free of rust and rubber deposits. This is especially important for drop-center tubeless rims, because the 15° bead seat is the air-sealing element.



Rings should be cleaned with wire brush. Pay particular attention to seating surfaces and bead seat areas.



4. Paint rim by brush or spray with a fast-drying metal primer. Surfaces should be clean and dry prior to painting. Insure that bare metal areas on outside or tire side of rim are covered. This is especially important on drop-center tubeless rims, because warm and sometimes moist air is in constant contact with the metal surface on the tire side of the rim.

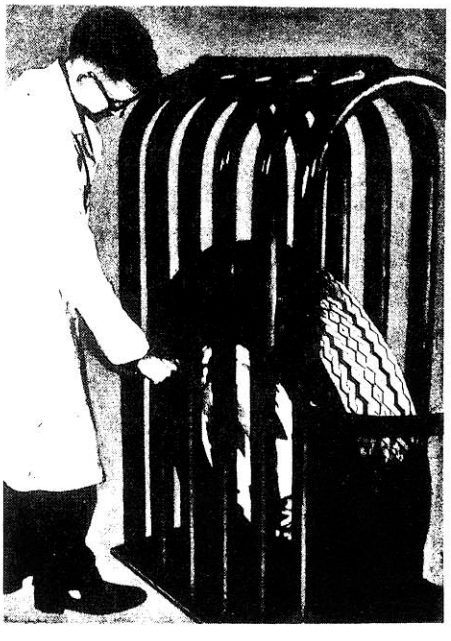


5. Lubricate tire side of rim base just prior to mounting tire. Avoid the use of any lubricant which contains water or solvent that is injurious to rubber. A combination lubricant and rust-preventive compound is preferable. This protective measure is of particular importance with drop-center tubeless rims as the air in the tire is contained by the tire-side rim surface.

6. Inflate tire only to recommended air pressure.

SAFETY PRECAUTIONS

1. **Insure that rings are properly seated, prior to inflation.**
2. **Use safety cage or lock ring guard. In emergency situations where a safety cage or portable safety device is not available, use clip-on type air chuck, so that operator may stand aside during inflation. When clip-on air chuck is used, pressure must be restricted to max. inflation capacity of tire or rim, whichever is lower.**
3. **Air tank should incorporate moisture trap when used with drop-center tubeless rims in order to reduce the moisture in contact with the metal rim surfaces.**



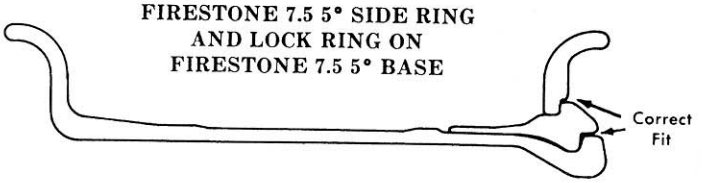
How to Insure Greater Safety and Service by Properly Matching Side and Lock Rings

It is important to recognize that the various types of highway rims produced by their manufacturers all differ to some degree in design. This is particularly true of removable rings and, as a result, side and lock rings of different rim types are not interchangeable. Some may appear to be, but they actually do not fit properly on the rim base. Serious accidents to personnel have resulted from the use of mismatched rings.

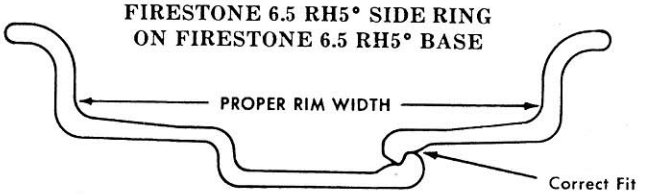
The drawings below illustrate a few of the potentially dangerous conditions which can result from the mismatching of rings and bases.

CORRECT

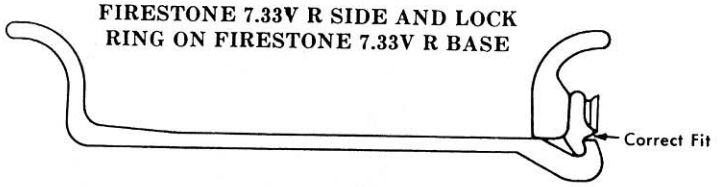
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.5 5° BASE



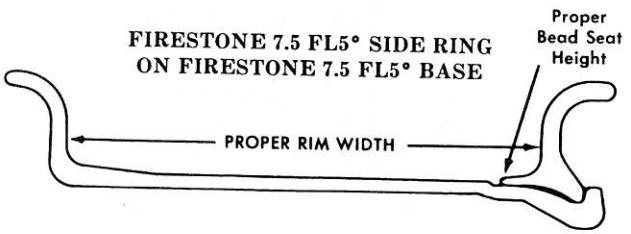
FIRESTONE 6.5 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.33V R BASE

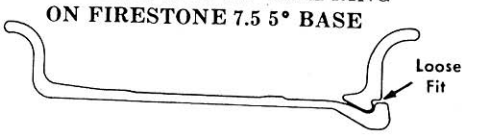


FIRESTONE 7.5 FL5° SIDE RING ON FIRESTONE 7.5 FL5° BASE

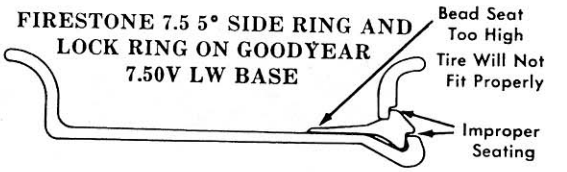


INCORRECT

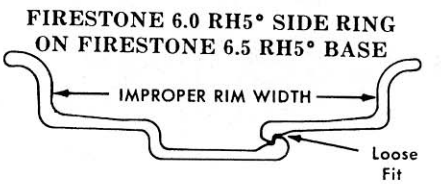
GOODYEAR 7.50V LW SIDE RING ON FIRESTONE 7.5 5° BASE



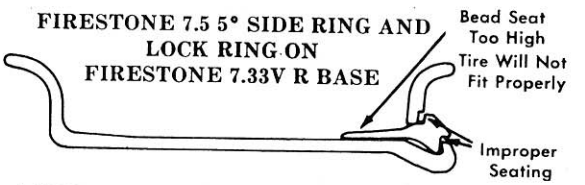
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON GOODYEAR 7.50V LW BASE



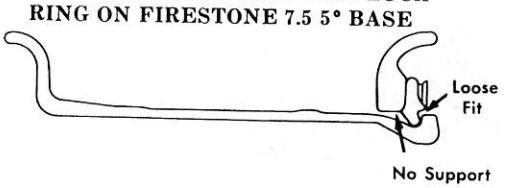
FIRESTONE 6.0 RH5° SIDE RING ON FIRESTONE 6.5 RH5° BASE



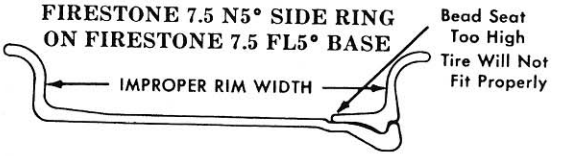
FIRESTONE 7.5 5° SIDE RING AND LOCK RING ON FIRESTONE 7.33V R BASE



FIRESTONE 7.33V R SIDE AND LOCK RING ON FIRESTONE 7.5 5° BASE



FIRESTONE 7.5 N5° SIDE RING ON FIRESTONE 7.5 FL5° BASE



NOTE: When in doubt of component compatibility, refer to the U.S. Department of Transportation, National Highway Traffic Safety Administration's Multipiece Rim / Wheel Matching Chart. Chart is available from D.O.T. NHTSA Office of Defect Investigation, all rim and wheel distributors and all Firestone Sales Offices.

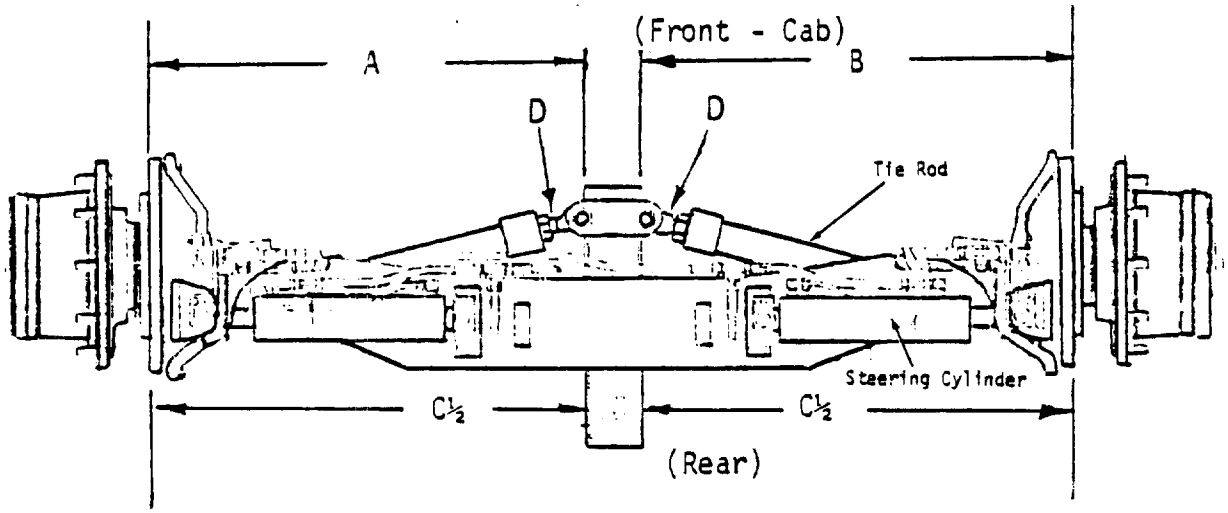
TOE-IN PROCEDURE FOR GRADALL/LOED Model 534B
(Rear Steer)

The correct toe-in adjustment is 5/16" for each rear tire. Incorrect toe-in will cause the rear wheels to drift or float erratically.

How to check for toe-in:
With wheels straight, measure A and B. They should be equal (1/16").

C½ + C½ = 2

Correct adjustment is: A + B + 5/8" = C



HOW TO ADJUST:

1. Turn rear wheels full left and sway machine 8 for easy removal of tie rod bolt. Turn engine off.
2. Remove tie rod bolt.
3. Swing out tie rod and loosen locknut (D).
4. Turn tie rod eye to shorten or lengthen rod.
5. Tighten locknut and replace bolt.

Repeat procedure for opposite tie rod.

MAKE SURE THAT A EQUALS B AFTER ADJUSTMENT IS MADE.

TORQUE-HUB®

Final Drives

ASSEMBLY-DISASSEMBLY MANUAL

FOR THE

W3-P
"A"
DRIVE

UNIT

FAIRFIELD

THE FORCE BEHIND THE FUTURE

Introduction

This Service Manual is a step-by-step guide designed for the customer or shop mechanic who is servicing or repairing a particular model of Torque-Hub Final Drive. (The model covered by this copy of the Manual is specified on the Manual cover.)

Included are—

1. **assembly and exploded view drawings**
2. **disassembly procedure**
3. **main assembly procedure (assuming all sub-assemblies to be intact)**
4. **sub-assembly procedures.**

At the time of printing, this Manual was complete for the specific Torque-Hub model designated. However, Fairfield Manufacturing Co., Inc., reserves the right to update and improve its products at any time. All specifications and procedures are therefore subject to change without notice.

Safety

Standard safety practices should be followed during the disassembly and assembly procedures described. Safety glasses and safety shoes should be worn; heavy, heat resistant gloves should be used when heated components are handled. Be especially alert when you see a caution symbol (). This symbol indicates that a particular operation could cause personal injury if not performed properly or if certain safety procedures are not followed.

W3-P “A” Drive
Disassembly Procedure

1. Loosen all 12 Cover Bolts and drain the oil from the unit.

2. Remove the 12 Cover Bolts and lift off the Cover Sub-Assembly. Discard the ‘O’ ring Seal from the Cover counterbore.

3. Lift out the Carrier Sub-Assembly and Thrust Bearing Set. A Thrust Washer may stick inside the Cover.

4. Pry the Ring Gear loose and remove it. Discard the ‘O’ ring Seal from the Hub counterbore.

5. Remove the Input Shaft. Input Gear, and the Thrust Spacers that are on the Input Shaft.

6. Lift out the Internal Gear and Thrust Bearing Set. A Thrust Washer may stick to the bottom of the Carrier.

7. Remove the Retaining Ring from the Spindle and discard; then lift the hub off the Spindle.
   Eye protection should be worn during Retaining Ring removal.

8. The inside Bearing Cone and the Bearing Shim can now be removed.

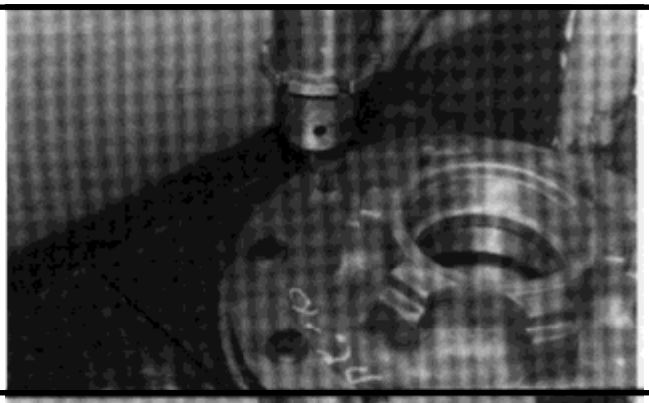
9. The Seal can be pried out of the Hub with screw driver or pry bar. This will also allow the outside Bearing to be removed.

   Note: If bearing replacement is necessary, the Bearing Cups can be removed with a “slide hammer puller” or driven out with a punch.

10. To remove the Cluster Gears from the Carrier, drive the anti-roll pin into the Planet Shaft of the Cluster Gear. After the Planet Shaft is removed the roll pin should be driven out of the Planet Shaft.

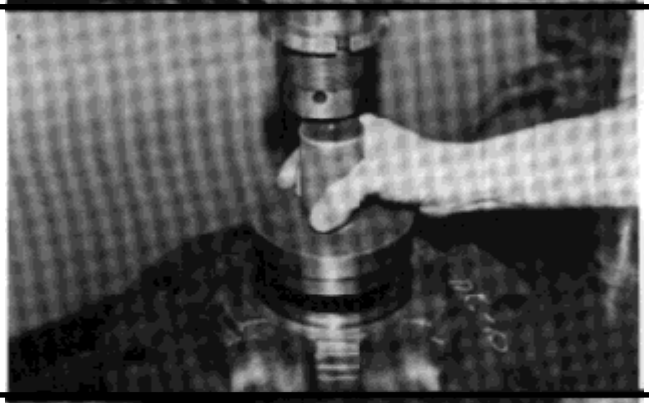
WARNING: When rebuilding the unit, the ‘O’ rings and Retaining Rings should always be

Main Assembly Procedure

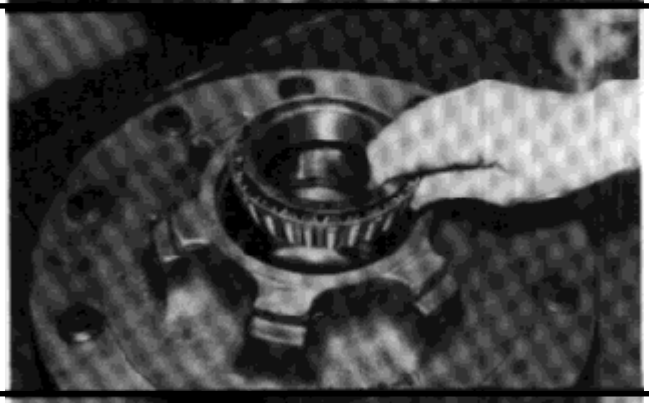


1. Using an arbor type press if available. (if not, a hammer may be used), install the wheel studs. The hub flange should be supported from the underside during this operation.

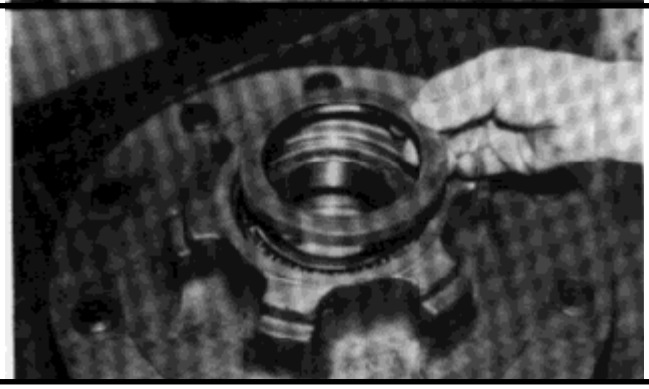
   Note: Wheel studs are optional.



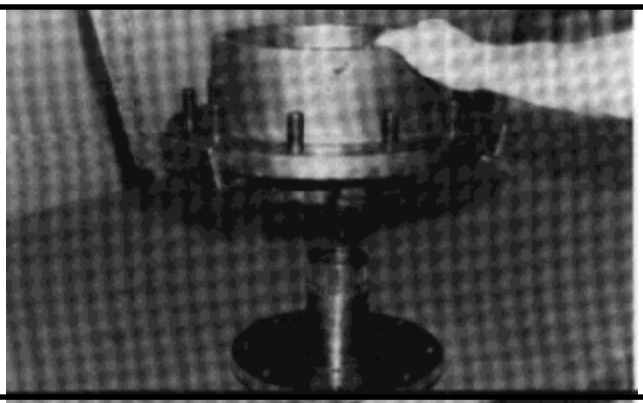
2. Using an arbor type press if available, press Bearing Cups with large inside diameters facing out, into Hub counterbores. Cup #JM716610 will go into small end of Hub, and Cup #JM515610 will go into large end of Hub.



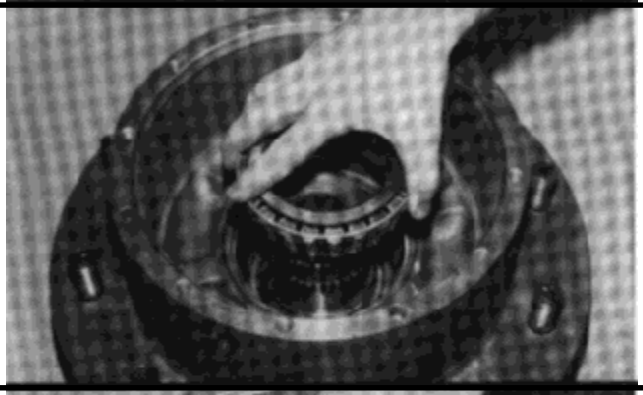
3. Place Bearing cone #JM716649 into Bearing Cup in small end of Hub.



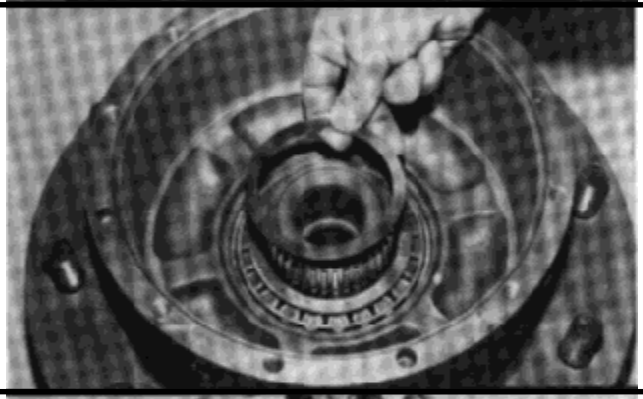
4. Press Seal into Hub counterbore with flat metal side facing in. Use a flat object to assure that Seal is pressed evenly and is flush with Hub face.



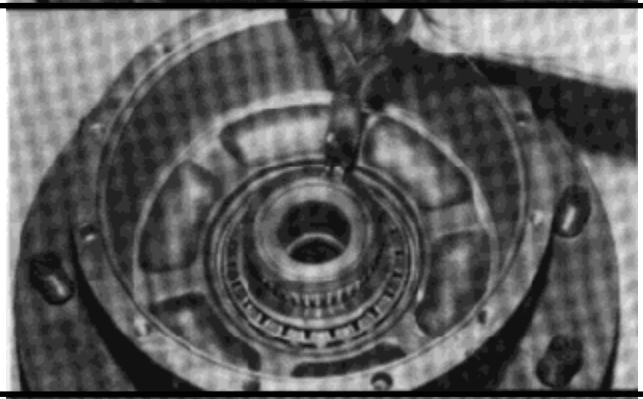
5. Lower Hub onto Spindle with large open end up.



6. Place Bearing cone #JM515649 over end of Spindle and into Bearing Cone.

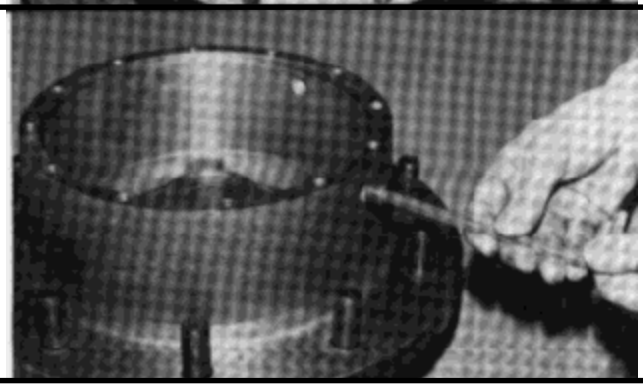


7. Place Bearing Shim over end of Spindle and against Bearing Cone.

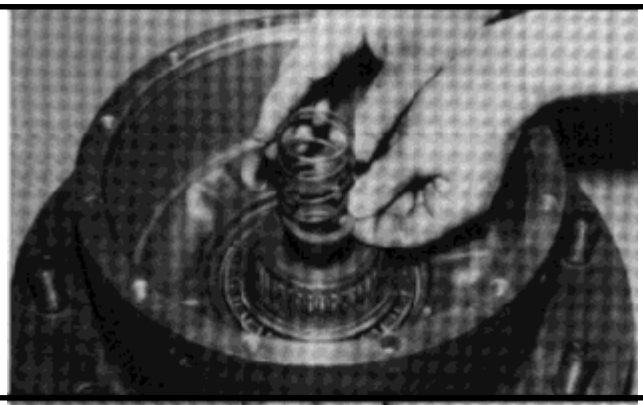


8. Secure Retaining Ring completely into Spindle groove and against Bearing Shim. Be sure that Retaining Ring is entirely in groove.

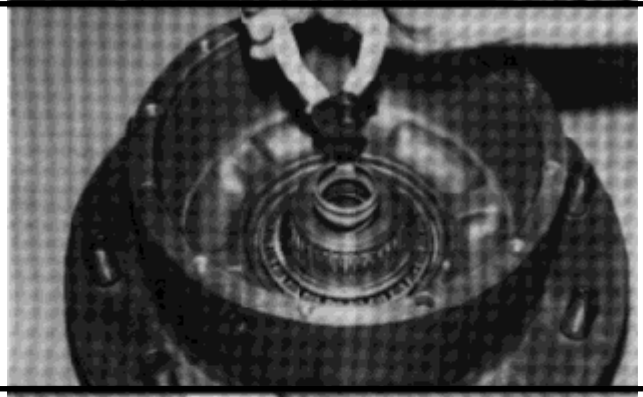
⚠ Eye protection should be worn during Retaining Ring installation.



9. The pipe plugs are installed in the Hub. The us of lub-seal is recommended on the pipe plug.

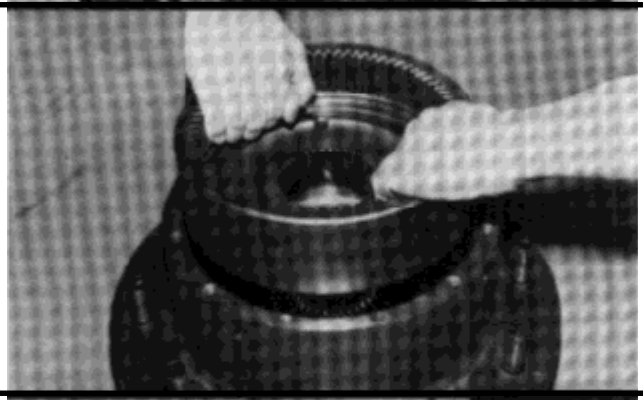


10. The disengage spacer and spring are installed into the co'bore of the Spindle.

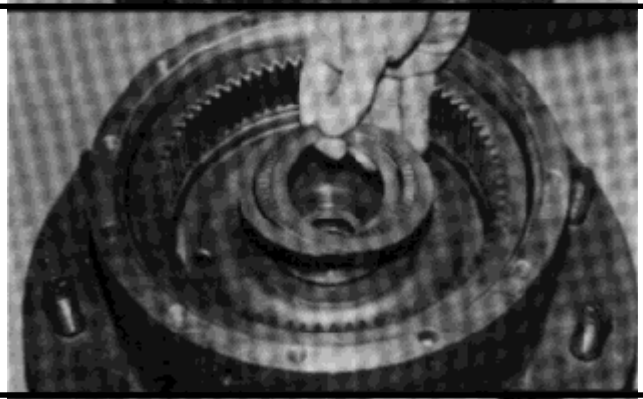


11. Another spacer and the correct Retaining Ring are installed into the Spindle co'bore and Retaining Ring groove provided.

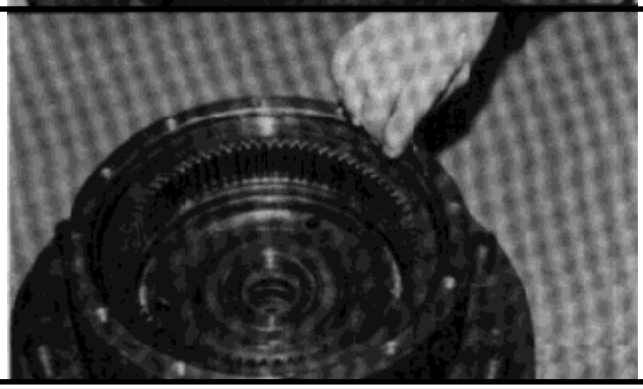
⚠ Eye protection should be worn during Retaining Ring installation.



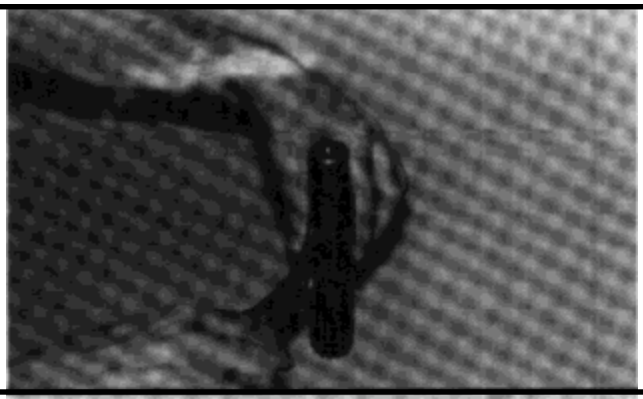
12. The internal gear is installed matching the Bore Spline the Spindle Spline.



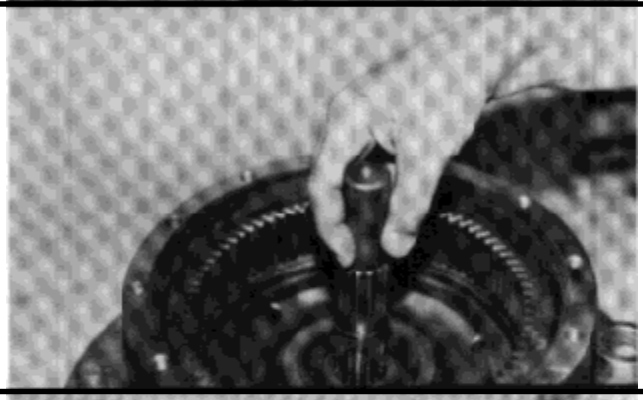
13. The thrust washer/thrust bearing set is installed on the portion of the Spindle which extends into the internal gear.



14. The O'Ring is placed into the counterbore provided in the Hub. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

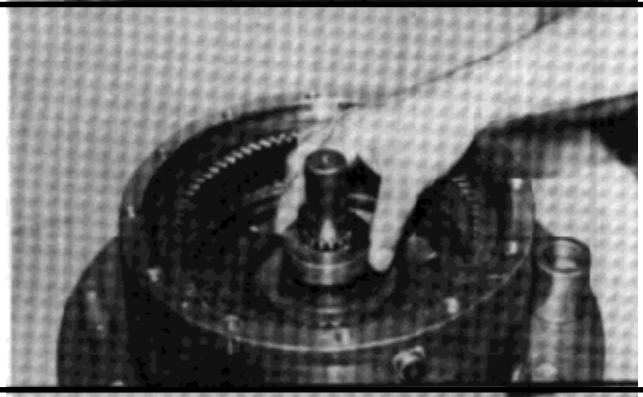


15. Install retaining ring into input shaft retaining ring groove.

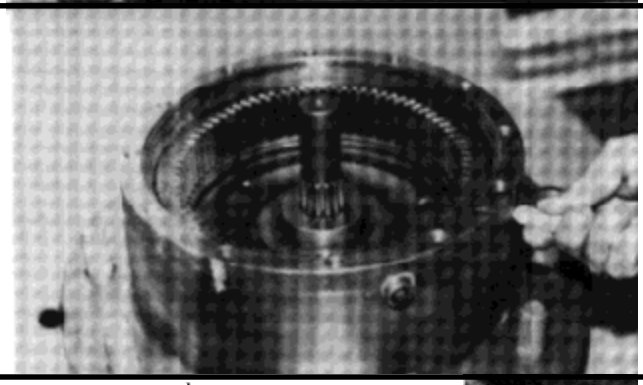


16. The input shaft is installed into the spindle.

    The action of the spring should be checked at this point.

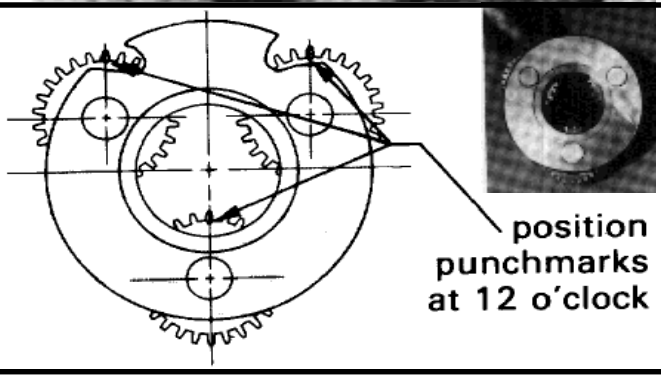


17. The thrust spacer is installed on the input shaft.

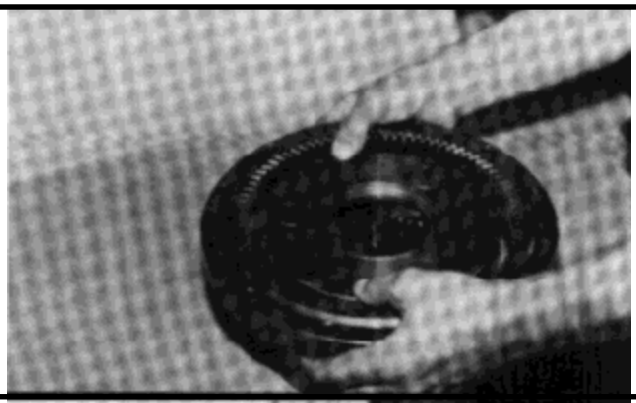


18. Locating the four counter reamed holes in the face of the hub, mark them for later identification.

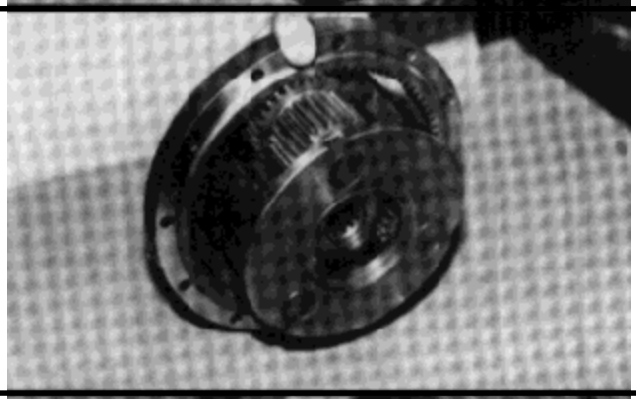
    These holes are reamed to accept the shoulder bolts.



19. Place Carrier Assembly on a flat surface with the large gears up and positioned as shown. Find the punch marked tooth on each large gear and locate at 12 o'clock (straight-up) from each planet pin. Marked tooth will be located just under the Carrier on upper two gears.



20. With shoulder side of Ring Gear facing down, place Ring Gear over (into mesh with) large gears. Be sure that punch marks remain in correct location during Ring Gear installation. The side of the Ring Gear with an “X” stamped on it should be up.

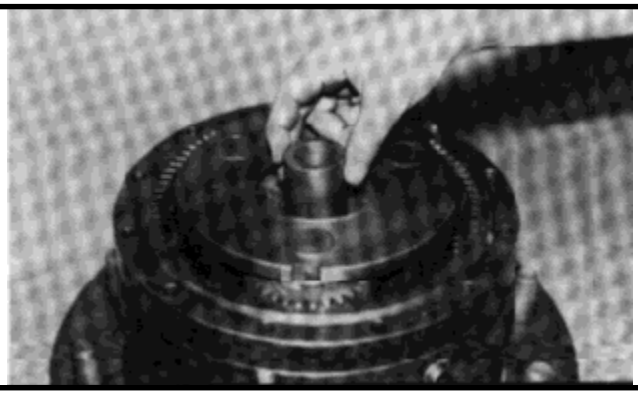


21. The input gear is now installed into the carrier, meshing with the small diameter cluster gear.

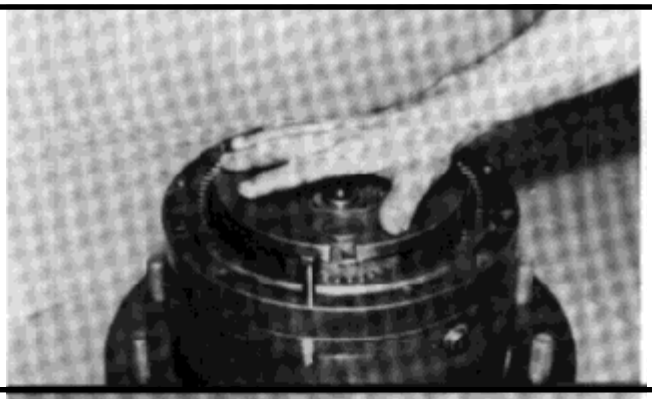
    The counterbore in the bore of the input gear must be to the outside of this assembly.

22. While holding Ring Gear and Cluster Gears in mesh, place small side of Cluster Gear into mesh with the Internal Gear On the Ring Gear locate the hole marked “X” over one of the marked counterbored holes in Hub.

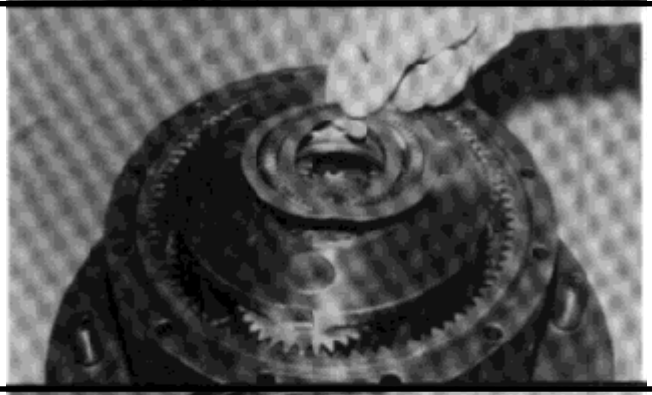
Note: If gears do not mesh easily or Carrier Assembly does not rotate freely, then remove the Carrier and Ring Gear and check the Cluster Gear timing.



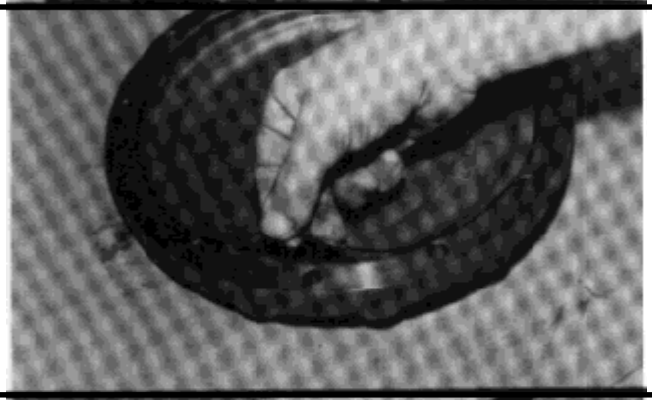
23. Another thrust spacer is installed onto the input shaft.



24. After inserting at least one shoulder bolt in the proper location, rotate the carrier. This is to check freedom of rotation and recheck timing.

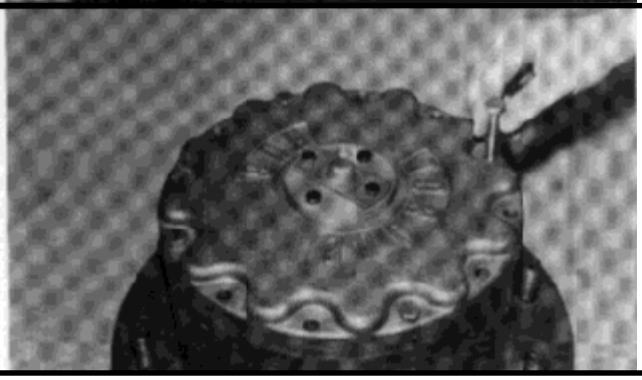


25. Another thrust washer/thrust bearing set is now installed into the counterbore in the face of the carrier.



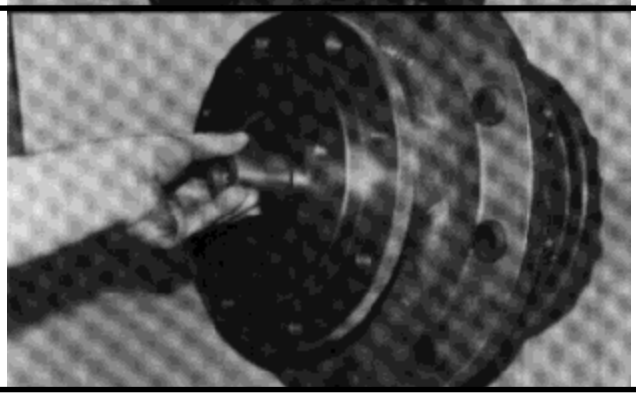
26. Place O'Ring into cover assembly counterbore. Slight stretching may be necessary. Use sufficient grease or petroleum jelly to hold in place.

27. Place cover assembly on Ring Gear with oil level, check plug in cover located approximately 90° from oil fill plug in Hub.



28. Locate four shoulder bolts 90° apart into counterbored hole in Hub which were marked in step 17. Torque each bolt to 47 ft. lbs.

29. Install grade eight bolts into the remaining eight holes and torque all bolts to 47 ft. lbs. Use the 180° to 90° method in torqueing all bolts.

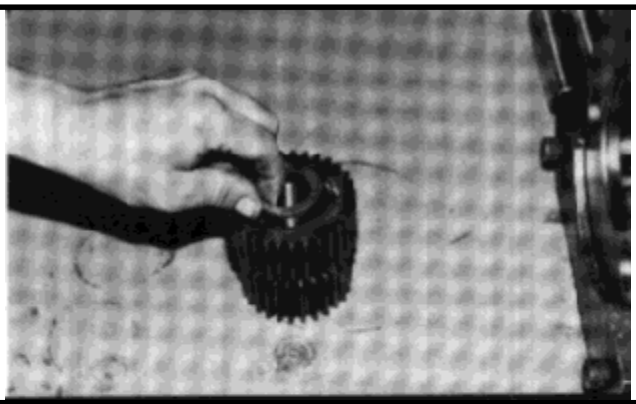


30. Place Coupling into the Spindle and onto the Input Shaft.

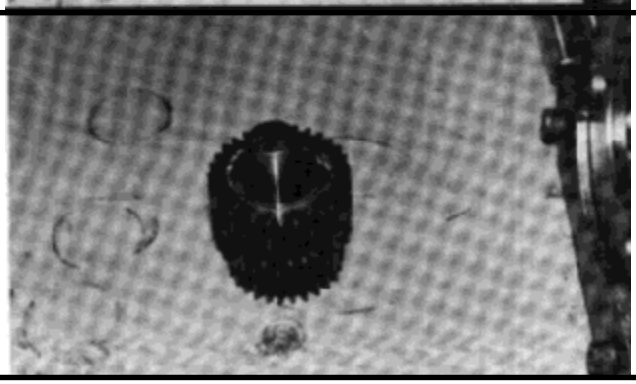
    Note: W3C units must have one external and one internal Snap Ring installed. All units with an “X” on the end of the model number must have two internal Snap Rings with a spacer between them installed in the Coupling.

This completes the assembly. The unit must be filled one-half full of EP 90 lubricant before operation.

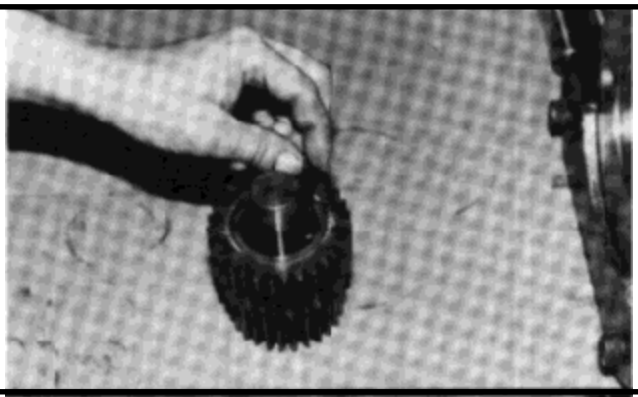
Carrier Sub-Assembly (Bronze Washers)



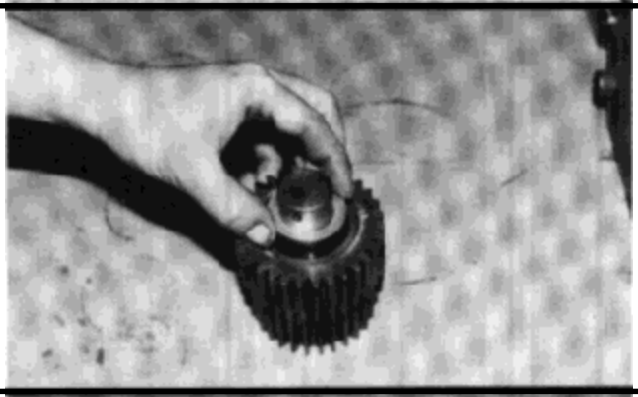
1. To aid in centering Planet Pin (3E) use an extra Spacer (3D) inserted into the bore of Cluster Gear (3F) which has been positioned on a flat surface, small diameter Cluster Gear down.



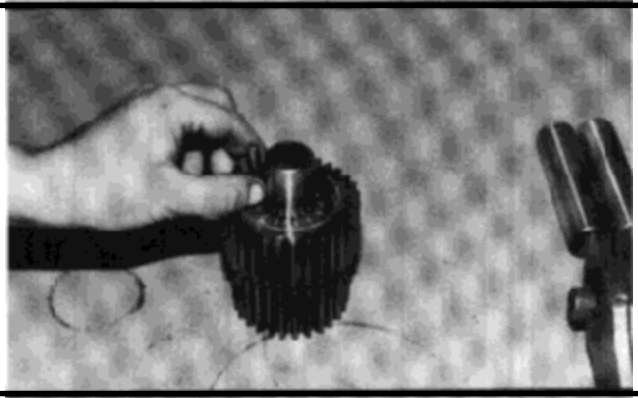
2. Position Planet Pin (3E) in the bore of Cluster Gear (3F) locating in Spacer (3D).



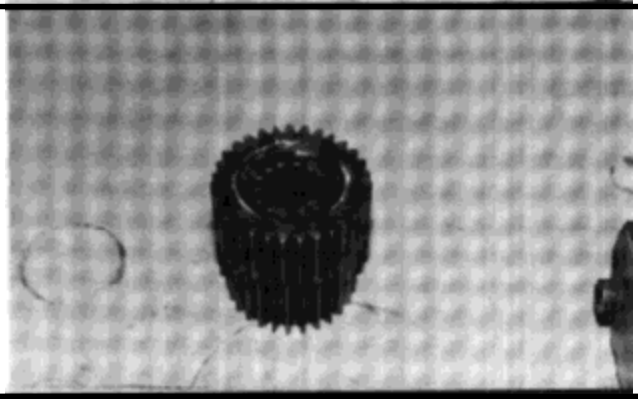
3. Install 14 Needle rollers (3C) into lower half of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding Needle Rollers (3C).



4. Install Spacer (3D) onto Planet Pin (3E) locating on inboard end of Needle Rollers (3C).

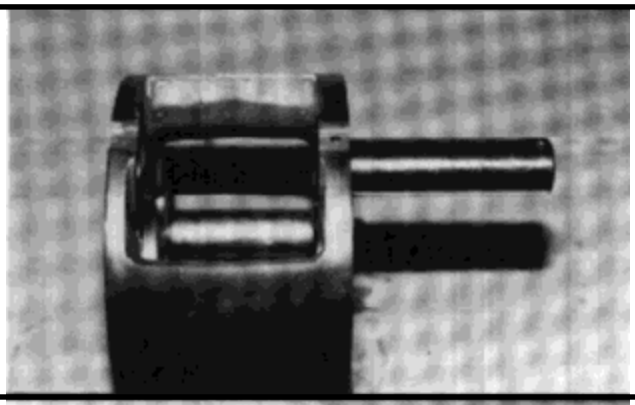


5. Install another 14 Needle Rollers (3C) into the remaining half of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding Needle Rollers (3C) in place once Planet Pin (3E) is removed.

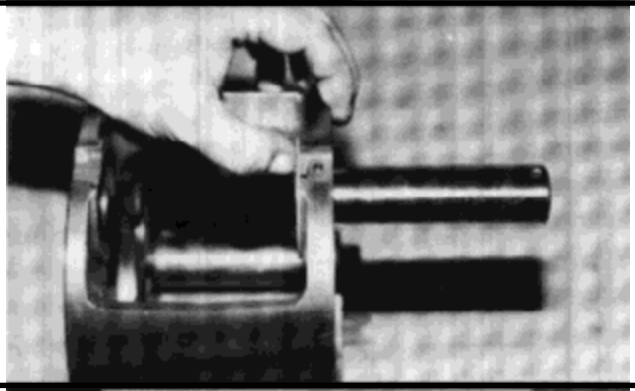


6. Planet Pin (3E) may be removed from the bore of Cluster Gear (3F).

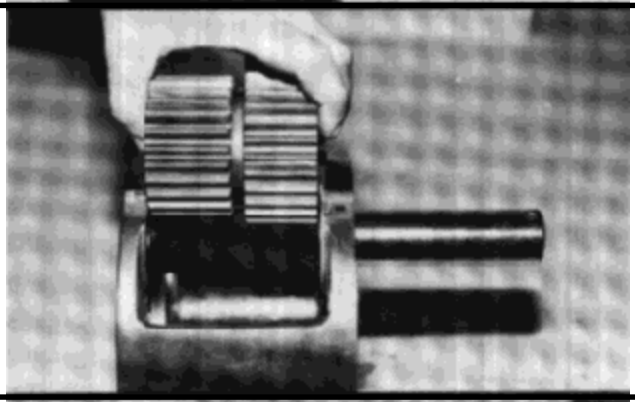
7. Thrust Washer (3H) are installed into the counterbores of each end of the Cluster Gear (3F). Care is to be taken to install the smooth side of Thurst Washer (3H) into the counterbore of Cluster Gear (3F).



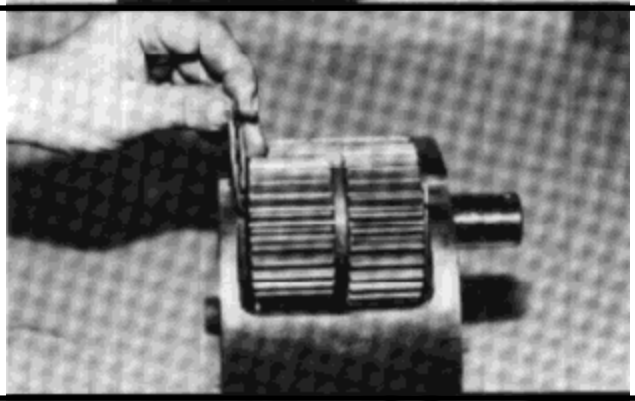
8. Insert Planet Pin (3E) into the Planet Pin hole of Carrier (3A) from the Roll Pin hole side. Care is to be taken to align Planet Pin (3E) with the chamfered end of the Roll Pin hole up. This chamfered hole is to assist in aligning the Roll Pin holes in the Carrier (3A) and Planet Pin (3E) as Roll Pin (3G) is tapped into location.



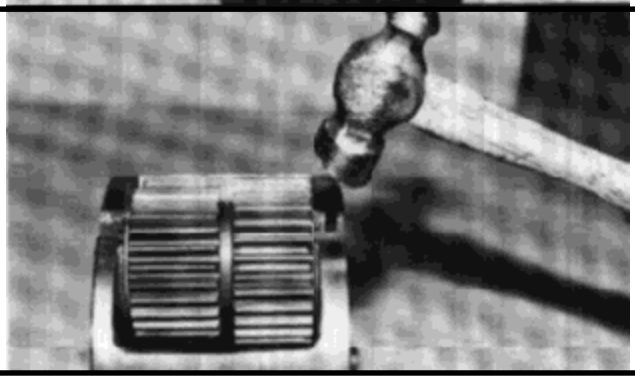
9. Using sufficient grease or petroleum jelly to assist in holding in position. Thrust Washer (3B) is installed onto Planet Pin (3E). Care is to be taken to install Thrust Washer (3B) with the tang positioned in the slot provided.



10. Cluster Gear (3F) with Thrust Washers (3H), Needle Rollers (3C) and Spacer (3D) installed is positioned into Carrier (3A) and aligned with Planet Pin (3E). Care is to be taken to insure Cluster Gear (3F) is installed with the large diameter end to the Roller Pin (3G) side of Carrier (3A).

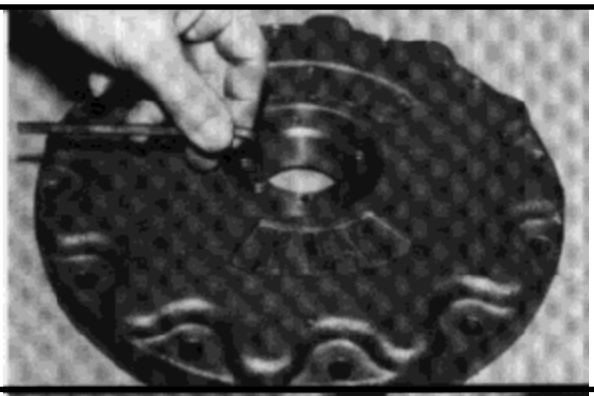


11. A second Thrust Washer (3B) is installed on the small diameter end of Cluster Gear (3F) using sufficient grease or petroleum jelly to assist in holding position as Planet Pin (3E) fully extended through Carrier (3A).

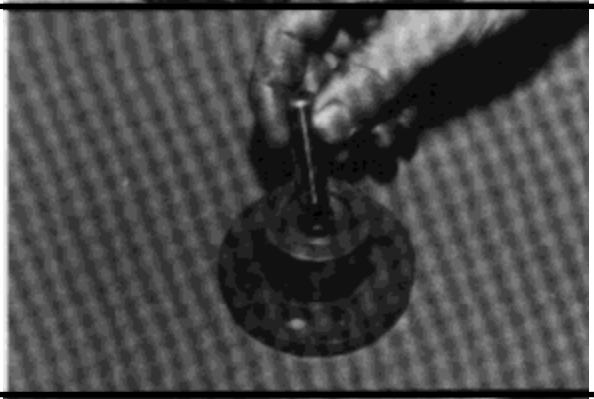


12. Upon checking alignment of the Roll Pin holes in Carrier (3A) and Planet Pin (3E), Roll Pin (3G) is tapped into location. Care is to be taken to insure that the external end of Roll Pin (3G) is below the outer diameter of Carrier (3A).

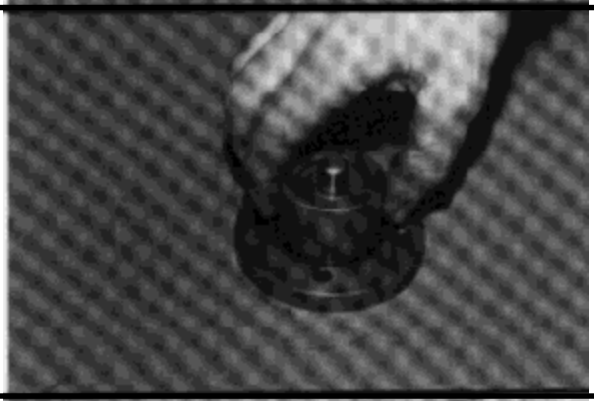
Cover Sub-Assembly



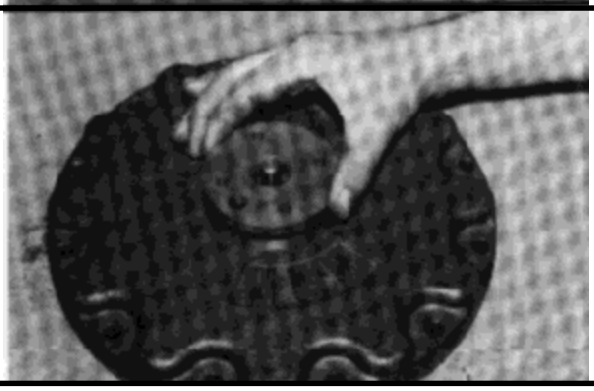
1. Screw Pipe Plug into Cover.



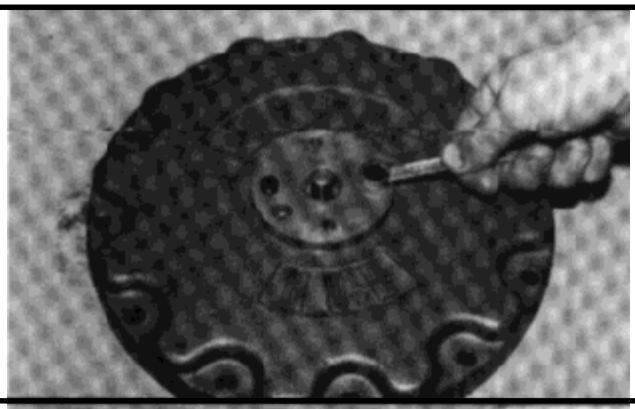
2. Place ‘O’ Ring into Cover Cap internal groove. The Disconnect Rd may be used to push ‘O’ Ring into groove. Rod will be held in place by friction from the ‘O’ Ring.



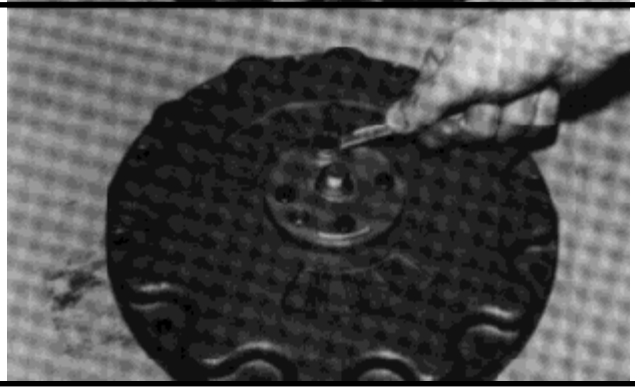
3. Slip ‘O’ Ring over Cover Cap and against face.



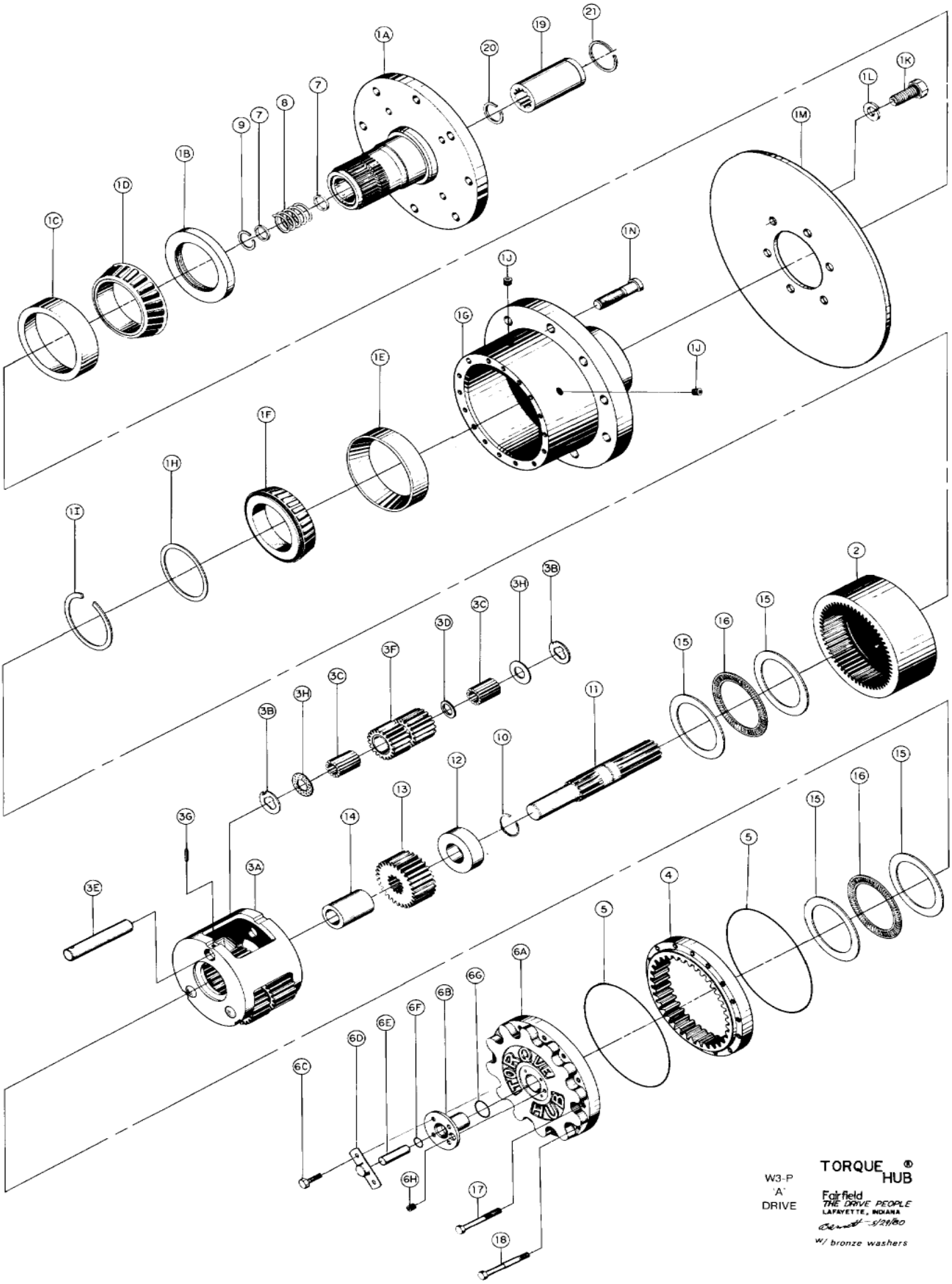
4. Place Cover Cap into Cover with large hole located over Pipe Plug.



5. Install two 1/4 x 20 x 3/4 bolts 180° apart and torque to 70 - 80 in. lbs.



6. Place disconnect cap over cover cap with nipple facing out and align with two open holes. Secure disconnect cap to cover with two 1/4 x 20 x 3/4 and 70 - 80 in. lbs.



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Rev. 6/95

Cyclopac® Service Procedures

Proper air cleaner servicing results in maximum engine protection against the ravages of dust. Proper servicing can also save time and money by maximizing filter life and dust cleaning efficiency.

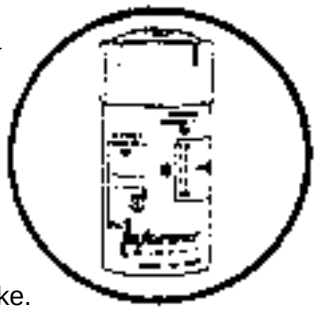
Two of the most common problems:

A) Over Servicing. New filter elements increase in dust cleaning efficiency as dust builds up on the media. Don't be fooled by filter appearance.... the filter should look dirty. By using proper filter measurement tools you will use the full life of the filter at maximum efficiency.

B) Improper Servicing. Your engine is vulnerable to abrasive dust contaminants during servicing. The most common cause of engine damage is careless servicing procedures. By following the steps shown, you can avoid unnecessary risk to the engine.

Measure Restriction

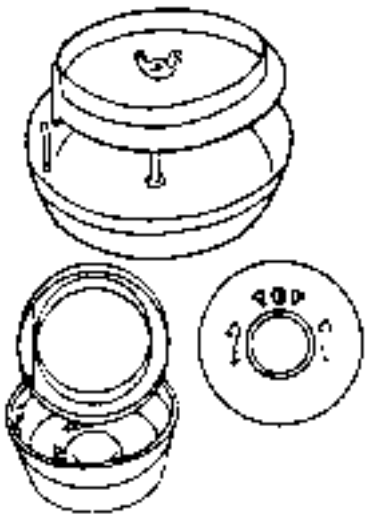
Measure the restriction of the air cleaner with a Donaldson restriction indicator, such as The Informer, a service gauge, or water manometer at the restriction tap provided in the air cleaner, the transfer pipe, or the blower intake.



One of two conditions will exist
(1) If the reading indicates the maximum restriction (per engine manufacturer's recommendations), change out the filter.
(2) If the reading shows below the maximum, the filter still has life left and should not be touched.

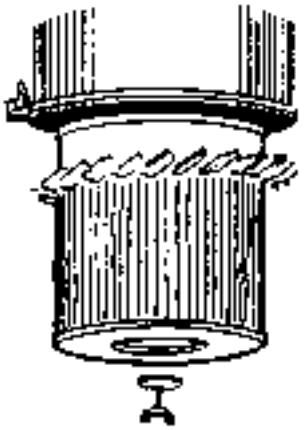
Empty the Dust Cup

Dust should not be allowed to build up closer than one inch from the baffle. On models equipped with a Donaldson Vacuator valve, dust cup service is cut to a minimum; all that is necessary is a quick check to see that the Vacuator valve is not inverted, damaged, or plugged.



Filter Servicing

When restriction indicates that filter servicing is required, loosen the wingnut and remove the primary filter. Before installing new filter, inspect the filter and gasket for shipping or storage damage. (See service tips on reverse side of this document.) Carefully install new element and wingnut.



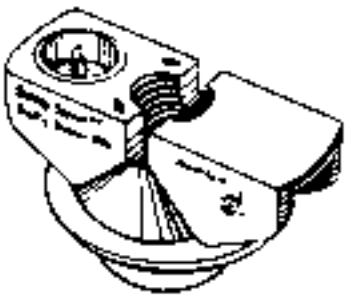
Always use authentic replacement Donaldson filters, which have been engineered to fit the air cleaner and engine intake system exactly.

Cover the Inlet

Don't leave the air inlet exposed! If the new filter won't be installed immediately, cover the opening to prevent stray contaminant from entering the induction system.

Safety Element Service

For Maximum engine protection and air cleaner service life, replace the safety filter **every third** primary filter change or cleaning, or as indicated by the Donaldson Safety Signal service indicator. Note that the safety element is not intended to be cleaned.



Reinstall the Dust Cup

Be sure the dust cup is sealed 360° around the air cleaner body. Reset the restriction indicator to green.

Check Connections

Ensure that all connections between the air cleaner and the engine are tight and leak-free.

Air Filter Service Tips

7 Important Steps to Follow

(1) Remove the old element gently to prevent knocking dust off of it.

2) Always clean the inside of the housing carefully

3) Always clean the gasket sealing surfaces of the housing

4) Check for uneven dirt patterns in your old filter that indicate gasket leakage

5) Press your fresh gasket to see that it springs back

6) Make sure the gasket seats evenly

7) Ensure an airtight fit on all connections and ducts

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The Important "Don't"

<u>Don't</u> remove filter for inspection.

Never rap a filter to clean it. Rapping only damages the filter.

<u>Never</u> judge the filter's life by looking at it. Measure how restricted its airflow is.

<u>Never</u> leave an air cleaner open longer than necessary.

<u>Don't</u> ignore a worn or damaged gasket in the housing....replace it!

Don't use a damaged or bunched filter.

Never use a warped cover on a housing.

Never substitute an incorrect filter model number.

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For more Information, Contact:

Donaldson

P.O. Box 1299
Minneapolis, MN 5544-1399 USA
Tel: 800-374-1374
FAX: (612) 887-3716

Interleuvenlaan, 1
B-3001 Leuven, Belgium
Tel. (32)-(16)-383811
Telefax: (32)-(16)-400077
Telex: 23205 Beldo B

Corporate Office
JLG Industries, Inc.
1 JLG Drive
McConnellsburg PA. 17233-9533
USA
Phone: (717) 485-5161
Fax: (717) 485-6417

JLG Worldwide Locations

JLG Industries (Australia)
P.O. Box 5119
11 Bolwarra Road
Port Macquarie
N.S.W. 2444
Australia
Phone: (61) 2 65 811111
Fax: (61) 2 65 810122

JLG Industries (UK)
Unit 12, Southside
Bredbury Park Industrial Estate
Bredbury
Stockport
SK6 2sP
England
Phone: (44) 870 200 7700
Fax: (44) 870 200 7711

JLG Deutschland GmbH
Max Planck Strasse 21
D-27721 Ritterhude/lhlpohl
Bei Bremen
Germany
Phone: (49) 421 693 500
Fax: (49) 421 693 5035

JLG Industries (Italia)
Via Po. 22
20010 Pregnana Milanese - MI
Italy
Phone: (39) 02 9359 5210
Fax: (39) 02 9359 5845

JLG Latino Americana Ltda.
Rua Eng. Carlos Stevenson,
80-Suite 71
13092-310 Campinas-SP
Brazil
Phone: (55) 19 3295 0407
Fax: (55) 19 3295 1025

JLG Europe B.V.
Jupiterstraat 234
2132 HJ Foofddorp
The Netherlands
Phone: (31) 23 565 5665
Fax: (31) 23 557 2493

JLG Industries (Norge AS)
Sofeimyrveien 12
N-1412 Sofienyr
Norway
Phone: (47) 6682 2000
Fax: (47) 6682 2001

JLG Polska
Ul. Krolewska
00-060 Warsawa
Poland
Phone: (48) 91 4320 245
Fax: (48) 91 4358 200

JLG Industries (Europe)
Kilmartin Place,
Tannochside Park
Uddingston G71 5PH
Scotland
Phone: (44) 1 698 811005
Fax: (44) 1 698 811055

JLG Industries (Pty) Ltd.
Unit 1, 24 Industrial Complex
Herman Street
Meadowdale
Germiston
South Africa
Phone: (27) 11 453 1334
Fax: (27) 11 453 1342

Plataformas Elevadoras
JLG Iberica, S.L.
Trapadella, 2
P.I. Castellbisbal Sur
08755Castellbisbal
Spain
Phone: (34) 93 77 24700
Fax: (34) 93 77 11762

JLG Industries (Sweden)
Enkopingsvagen 150
Box 704
SE - 175 27 Jarfalla
Sweden
Phone: (46) 8 506 59500
Fax: (46) 8 506 59534