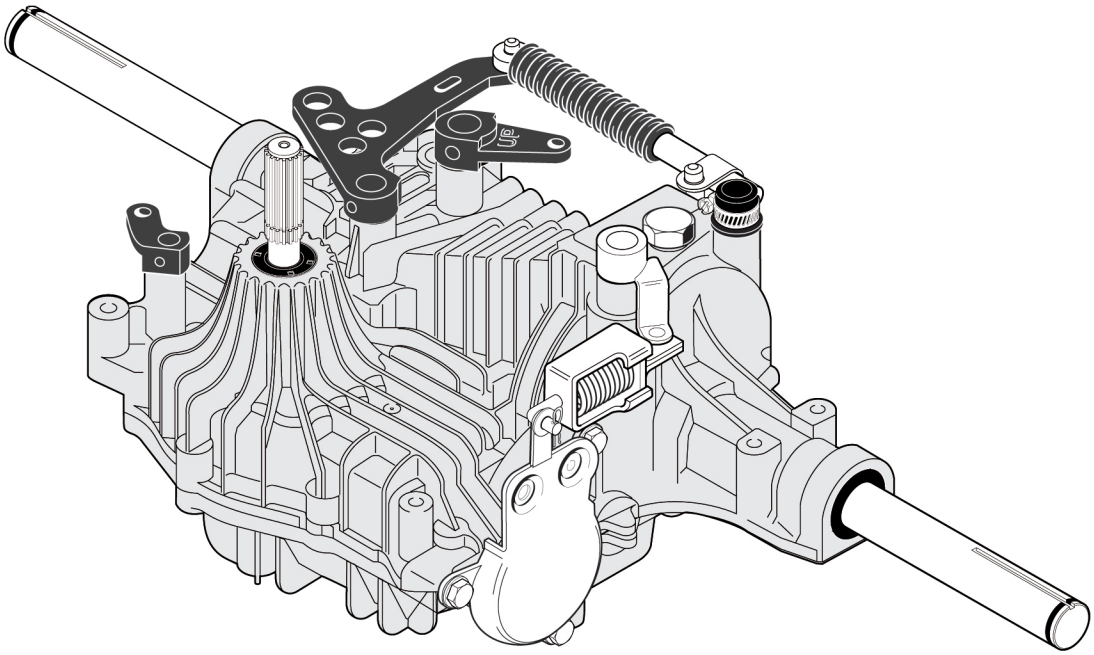
TUFF TORQ®

SERVICE MANUAL

K61



HYDROSTATIC TRANSAXLE

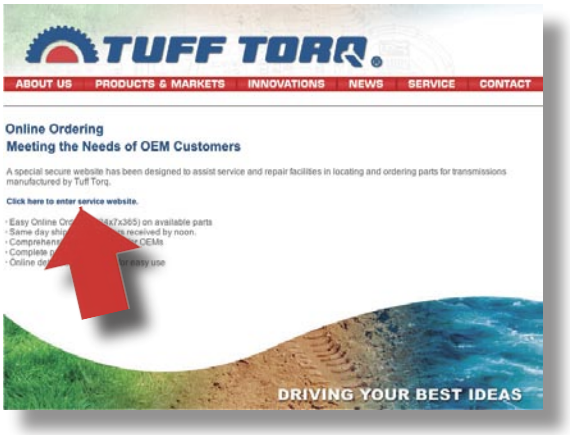
DRIVING YOUR BEST IDEAS

Table of Contents

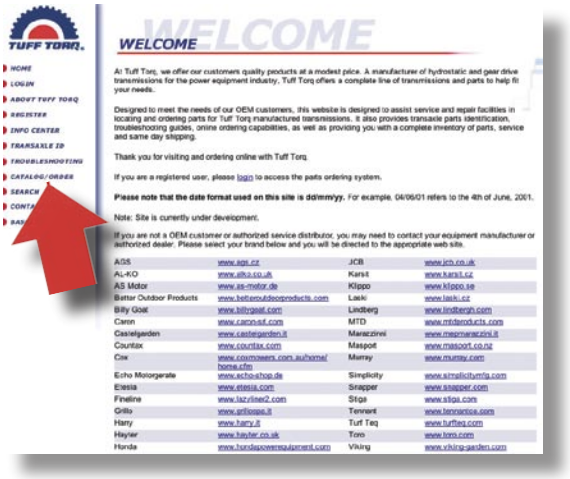
Ordering Replacement Parts Online

w w w . t u f f t o r q . c o m

Home



Page 1



Page 2

Page 3

At Tuff Torq, we offer our customers quality products at a modest price. A manufacturer of hydrostatic and gear drive transmissions for the power equipment industry, Tuff Torq offers a complete line of transmissions and parts to help fit your needs.

Designed to meet the needs of our OEM customers, this website is designed to assist service and repair facilities in locating and ordering parts for Tuff Torq manufactured transmissions. It also provides transaxle parts identification, troubleshooting guides, online ordering capabilities, as well as providing you with a complete inventory of parts, service and same day shipping.

If you are a registered user, please login (from the Welcome Page) to access the parts ordering system.

If you are not a OEM customer or authorized service distributor, you may need to contact your equipment manufacturer or authorized dealer. Select your brand (from the Welcome page) and you will be directed to the appropriate web site.

Navigating the website:

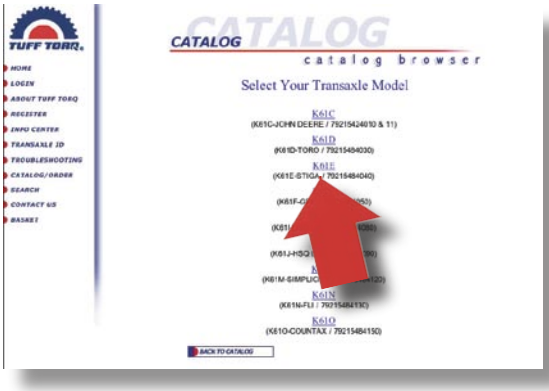
To access Tuff Torq's website, type in www.tufftorq.com from your Internet browser. From the Home page, click on "Service" to enter the Online Ordering page (Ref. Page 1)

From The Online Ordering page, click on "Click here to enter service website" to enter the Welcome page (Ref. Page 2).

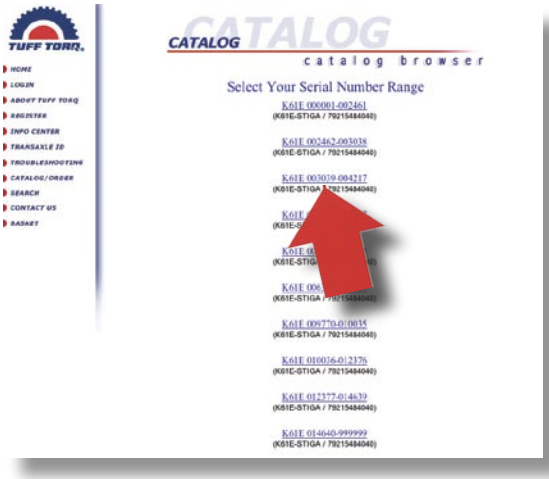
From the Welcome page, login (for register users) and follow the on screen instructions. Or, click on "Catalog/Order" to enter Store Browser (Ref. Page 3).

From the Catalog/Order page, select your transaxle model, e.g., K61. Click on "K61" to find the serial number for your model (Ref. Page 4).

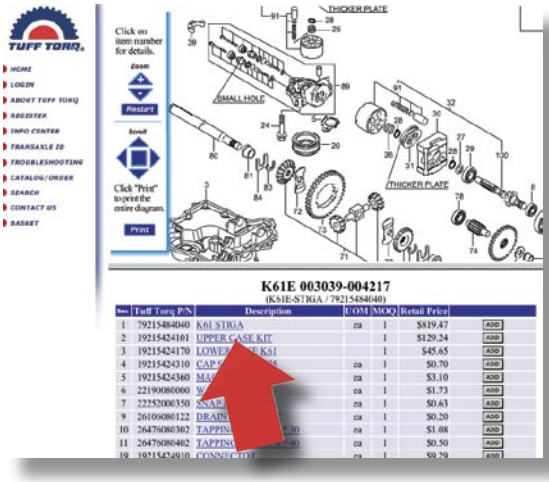
From the Model Series page, click on, your Model to enter the Serial Number Range page (Ref. Page 5).



Page 4



Page 5



Page 6

Page 7

Having your Model, and Model Series, click on the serial number to enter the Online Ordering page for you Transaxle (Ref. 6).

Navigate through the exploded parts illustration until the desired part has been identified. Take note of the part's figure number. Locate the part number in the parts listing. You can add the part to your shopping cart and return to the exploded illustration or—click on the item to go to the Product Explorer page for additional detail about the part (Ref. Page 7).

Thank you for visiting and ordering online with Tuff Torq.

Icons Used in this Manual

This symbol identifies the presents of IMPORTANT, if not critical, information.

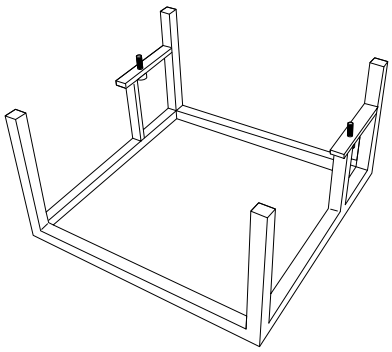
This symbol is intended to alert you of important technical information and/or maintenance procedures which will better assist you in the disassembly and reassembly of the Transaxle.

This symbol offers suggestions which will better assist you in the disassembly and reassembly of Transaxle.

This symbol indicates when an application of grease or oil is to be applied to the part prior to its assembly.

Recommended Tools and Equipment

1. Transaxle Service Stand (Part Number 1111)
2. Black Electrical Tape
3. Needle Nose Pliers
4. O.D. Retaining Ring Pliers
5. I.D. Retaining Ring Pliers
6. Neoprene Hammer
7. Ball Peen Hammer
8. Telescoping Magnetic Pickup
9. Flathead Screw Driver
10. Roll Pin Punch
11. Feeler Gauge
12. Calipers
13. Putty Knife
14. Wrench (size):
    - 8 millimeter
    - 12 millimeter
    - 14 millimeter
    - 17 millimeter
15. Sealant
16. Grease
17. Filter
18. Seal Kit (s)
19. Oil (10W 30 Class CC or CD)

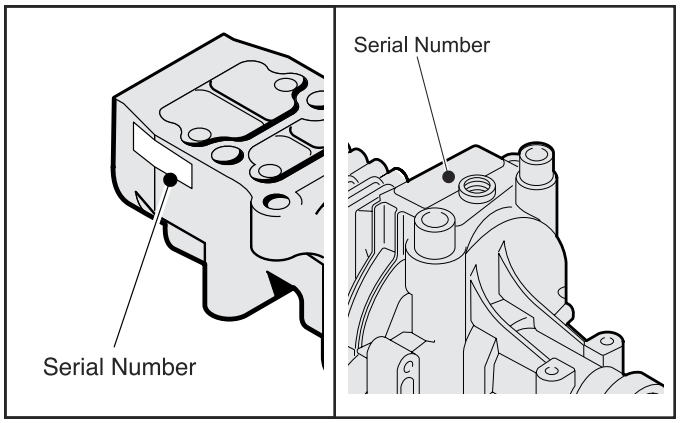


Service Stand (Part Number 1111)

This manual is applicable for repair of all (9) K61 models built and distributed by Tuff Torq.

K61C, K61D, K61E, K61F, K61I, K61J, K61M, K61N, and K61O

Serial Number Locations



Specifications:

Transaxle Torque output	217 Ft. lbs.
Maximum Input Speed	3000 RPM
Input Shaft Size	14.85 mm (0.58 in.)
Reduction Ratio	18.79 : 1 or 26.97 : 1
Axle Shaft Size	25.4 mm (1.0 in.)
Maximum Static Weight on Axle	265 kg (584 lbs.)
Weight (Dry)	17.5 kg (38 lbs.)
Brake	Dry Band
Brake Capacity	390 N-m (288 ft. lbs.) at 245 N m (55 lbs.) Brake Force
Differential	Automotive Type Bevel Gears
Gears	Heat-Treated Standard
Housing	Aluminum Die Castings
Tow Value	Std. (Brake Release)
Oil	10W 30 Class CC or CD
Oil Capacity	3.3 liters (3.5 qts.)

Disassembly of Transaxle

Drain Oil

⚠ Before beginning tear-down clean work area thoroughly and cover workbench with clean paper. This is extremely important as just one grain of sand can cause damage to the Hydrostatic Rotating Group in the Transaxle.

1. Remove the Oil Drain Plug (12 mm wrench) from the Lower Case of Transaxle and drain oil. *(Fig. 1)*
2. Remove the Connector (14 mm wrench) from the Center Case, through the Lower Case and drain the oil from the Hydrostatic Rotating Groups. *(Fig. 1)*

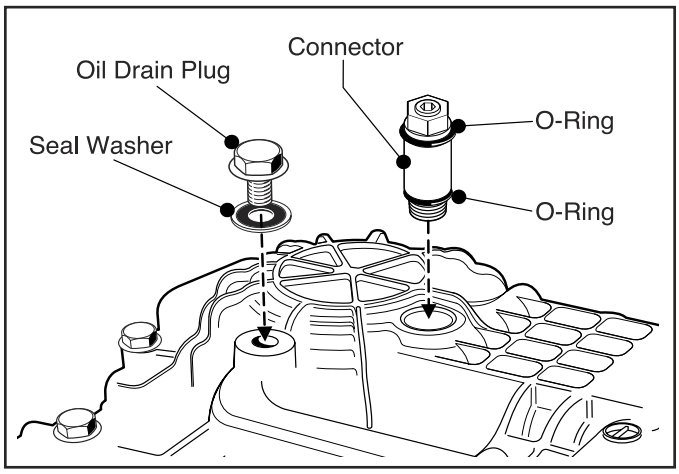


Fig. 1, Oil Drain Plug and Pressure Fill Plug removal

Always install a new Seal Washer on the Drain Plug and new O-rings on Pressure Fill Plug when reassembling.

Brake Assembly Removal

1. Remove the Cotter Pin and Washer from the Brake Rod Assembly. *(Fig. 2)*
2. Remove the Brake Rod Assembly from Brake Arm B (see Fig. 3) by pivoting 90 degrees and sliding downward. *(Fig. 2)*
3. Loosen and remove the (3) 8 mm bolts/washers (12mm wrench) and detach the Brake Assembly. *(Fig. 2)*
4. Remove Snap Ring (Snap Ring Pliers) and the Brake Drum from Brake Shaft. *(Fig. 2)*

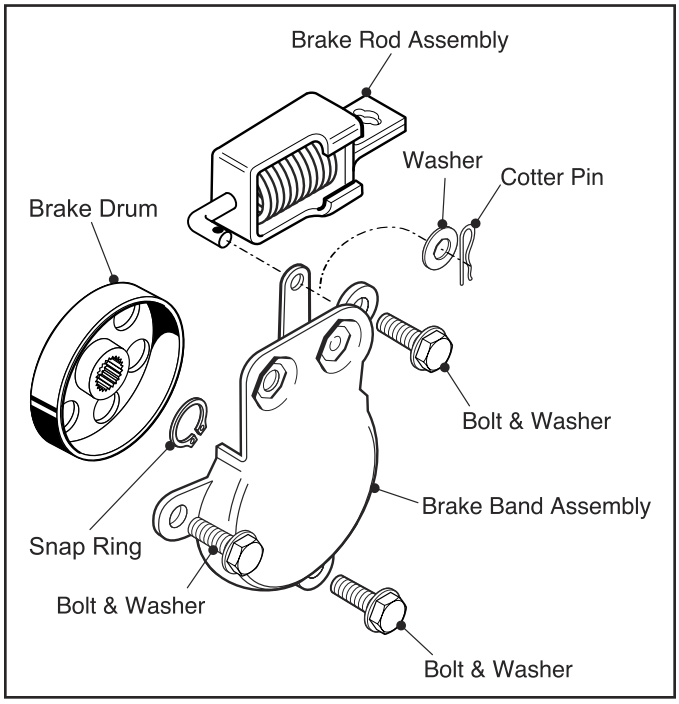


Fig. 2, Brake Assembly Removal

Inspect all brake components for wear or damage. Replace as necessary.

Brake drum and brake band are to be free from oil and dust.

Shock Absorber and Control Arms Removal (On K61 Models where applicable)

1. Remove the Shock Absorber. *(Fig. 3)*
2. Remove the Roll Pin and the H-Control Arm from the Control Shaft. *(Fig. 4)*
3. Remove the Roll Pin and the Brake Arm from the Brake Shaft. *(Fig. 4)*
4. Remove the Roll Pin and Brake Arm "B" from Brake Arm "A". *(Fig. 4)*
5. Remove the Roll Pin and the (Tow) Release Valve Arm from the Bypass Shaft. *(Fig. 4)*

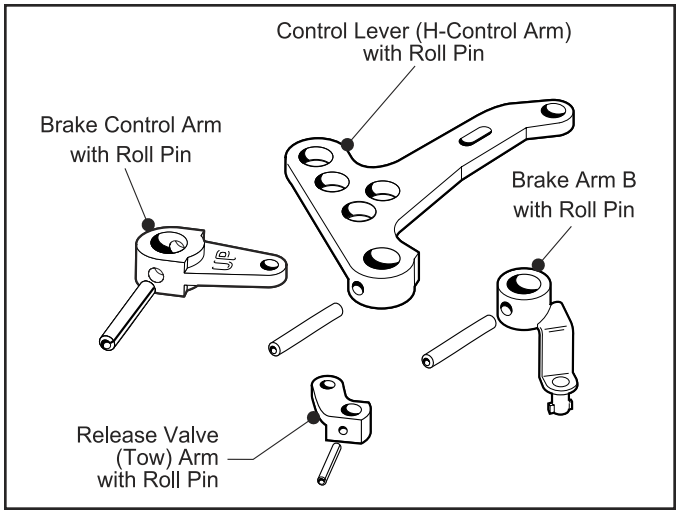


Fig. 4, Arms and Roll Pins

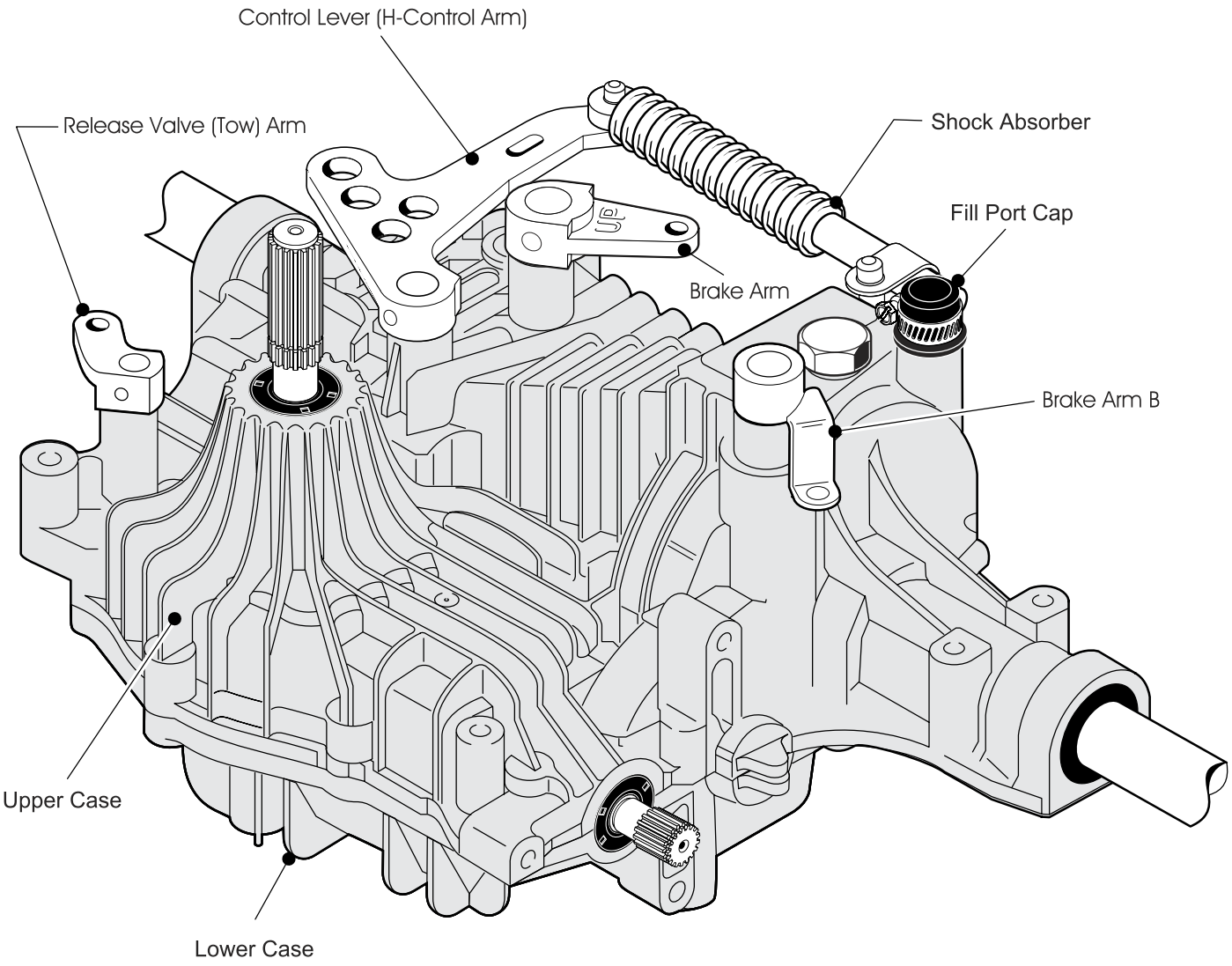


Fig. 3, Levers and Arms Removal

Lower Case Removal

1. Place the Transaxle on a Service Stand in the serviceable position (Lower Case up), to keep it steady during teardown. *(See "Recommended Tools and Equipment").*

Service Stand (Part Number 1111) can be ordered online or through your local Tuff Torq distributor. See page iv, "Recommended Tools and Equipment."

2. Remove the (14) bolts (8 mm) securing the Transaxle's Upper and Lower Cases. Lift the Lower Case away from the Upper Case, exposing the internal parts. *(Fig. 5)*

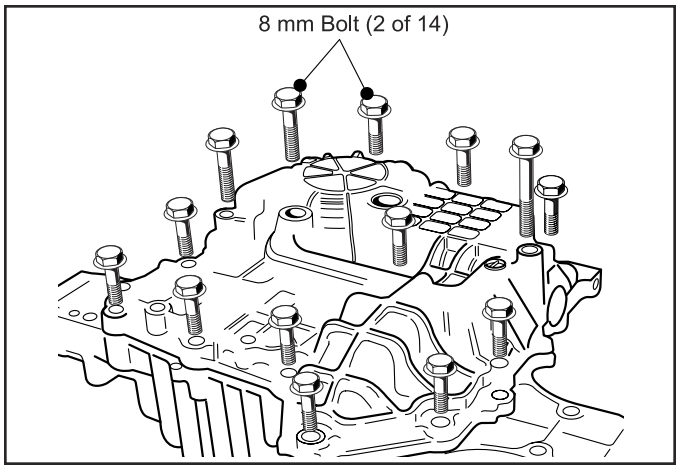


Fig. 5, Upper and Lower Housing Removal

If separation does not occur easily, a screwdriver can be inserted at any of the (4) pry points (indicated by the black arrows) *(Fig. 6)*

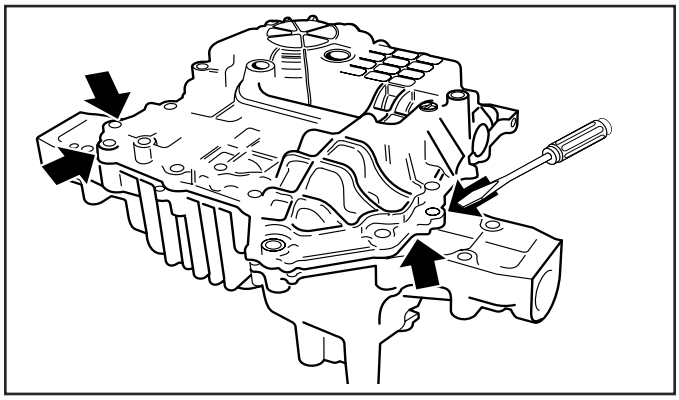


Fig. 6, Pry Points

Care should be taken not to damage the Housing Sealing lips while prying apart. Remove any old sealant residue from both case halves.

Filter Removal

1. Remove the Filter from the Center Case and discard. *(Fig. 7)*

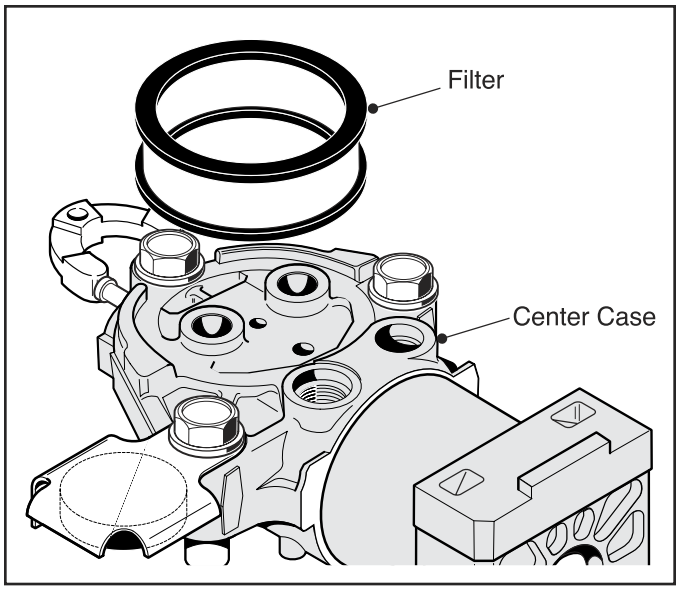


Fig. 7, Filter Removal

Install a new filter any time case halves are separated.

"C" Arm Removal

1. Disconnect "C" Arm from the Bypass Shaft by applying slight sideward pressure to the spring loaded Push Pins. This will keep them from springing out. With the Push Pins secure, lift the "C" Arm off the Push Valve Bypass Shaft. *(Fig. 8, 9)*

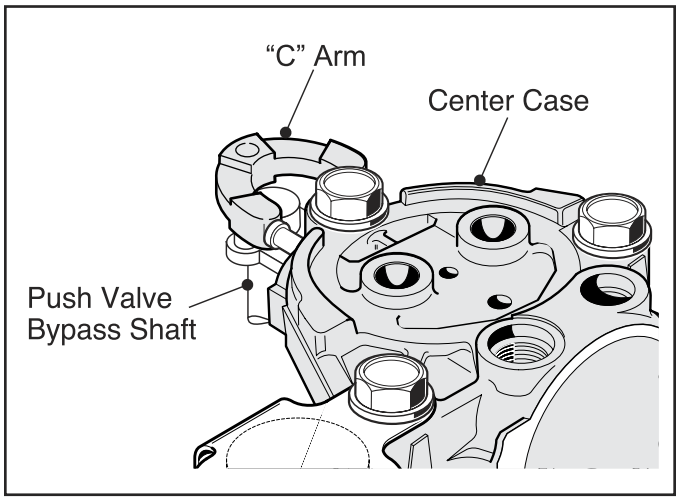


Fig. 8, "C" Arm Removal

Bypass Valve Removal

1. Remove (2) Push Pins, Springs, and Bypass Valve from the Center Case. *(Fig. 9)*

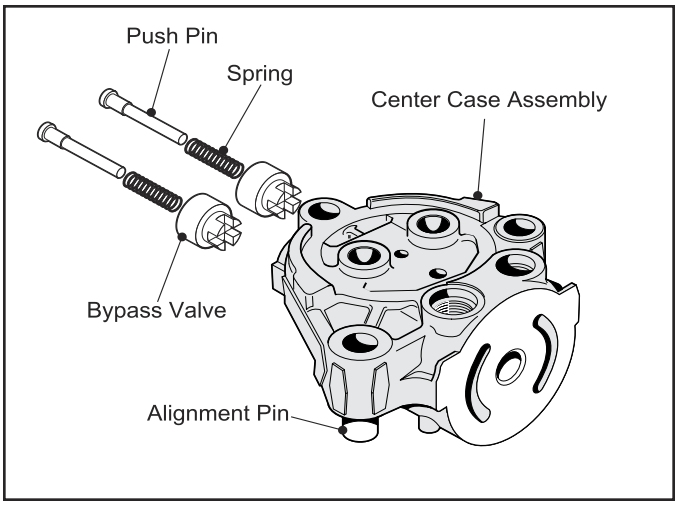


Fig. 9, Push Pin and Bypass Valve Removal

Final Pinon Assembly

1. Remove the Final Pinion Assembly from the Upper Case from its seated position. Separate the assembly, Bearing, Bushing, Washer, Final Pinon Shaft, and Reduction. *(Fig. 10, 11)*
2. Inspect the Final Pinion Shaft and the Reduction Gear for scoring, pitting, discoloration and chipped or broken teeth. *(Fig. 11)*

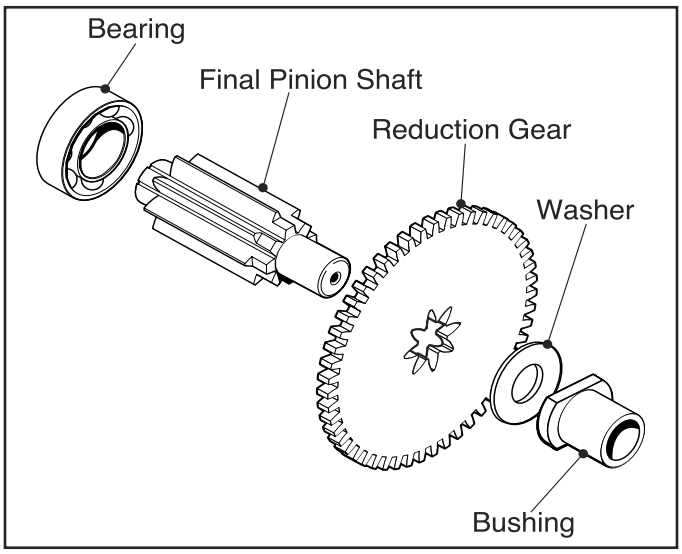


Fig. 11, Final Pinion Assembly

Final Pinion Assembly Removal

Carefully inspect all parts for wear or damage. Replace as necessary.

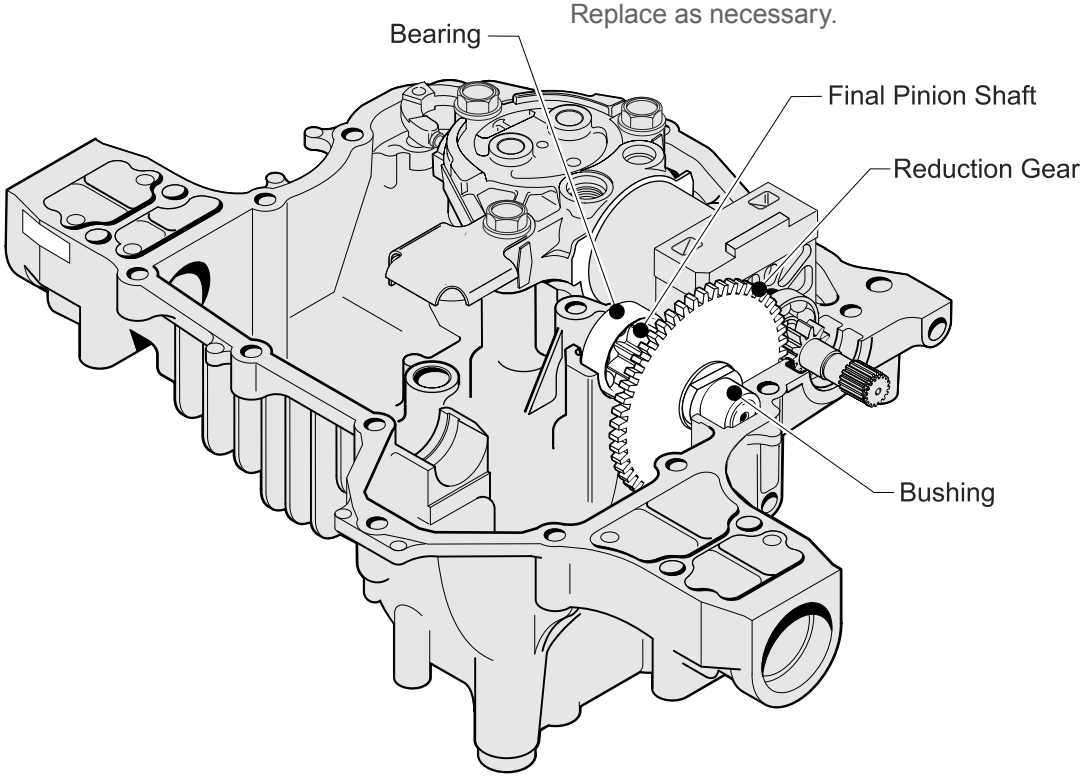


Fig 10, Final Pinon Assembly Removal

Final Pinion Shaft and Bushing Tolerances

1. Using calipers (digital recommended) measure the O. D. (X) of the Final Pinion Shaft. *(Fig. 12)*

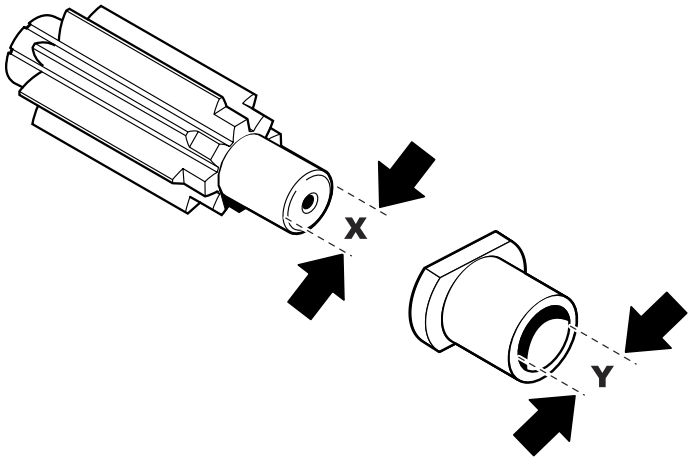


Fig. 12, Final Pinion Shaft and "Loose" Bushing Clearance

2. Measure the I. D. (Y) of the "loose" Bushing. *(Fig. 12)*
3. If the clearance (Y-X) is > 0.50 mm (.019 in), replace the Final Pinion Shaft and/or Bushing.

- ***Example of an Acceptable Tolerance:***

  Pinion Shaft O. D. (X) = 14.79 mm
  Bushing I. D. (Y) = 15.27 mm
  Y (15.27 mm) - X (14.79 mm) = 0.48 mm of clearance.

- ***Example of an Unacceptable Tolerance:***

  Pinion Shaft O. D. (X) = 14.75 mm
  Bushing I. D. (Y) = 15.29 mm
  Y (15.29 mm) - X (14.75 mm) = 0.54 mm of clearance. This is > the wear limit of 0.50 mm, replacement is necessary.

Differential Gear Assembly Removal

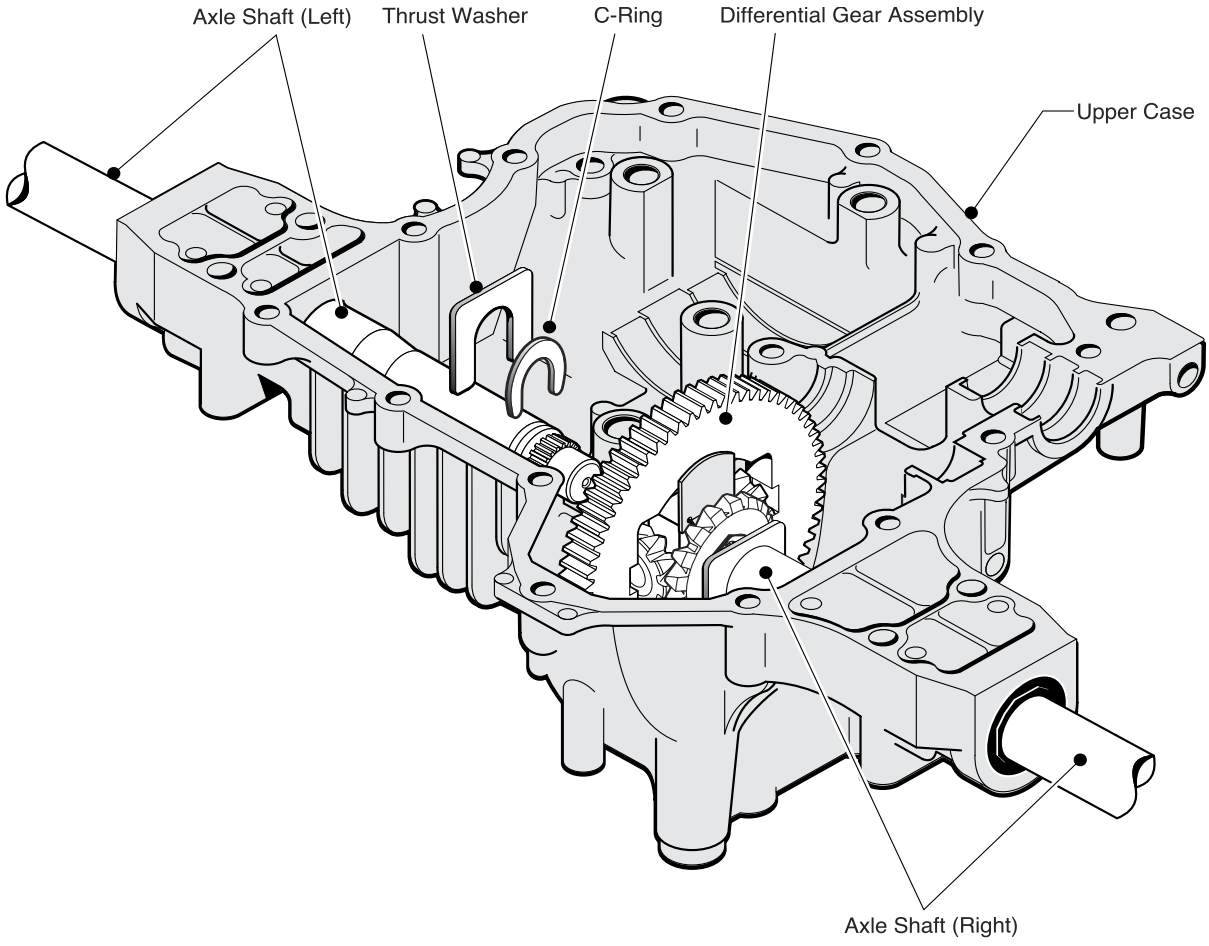


Fig 13, Differential Gear Assembly and Axle Removal

Differential Gear Assembly Removal (continued)

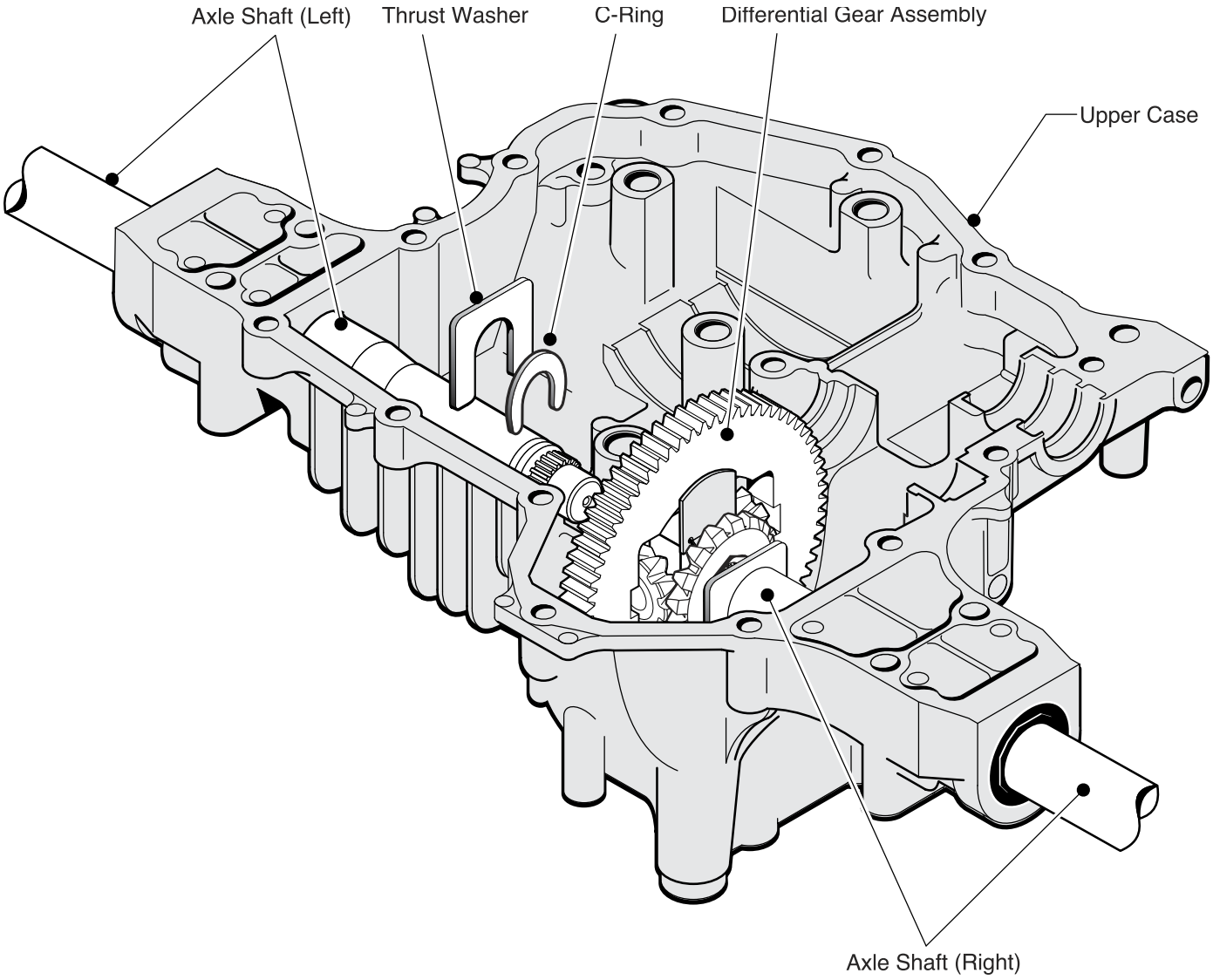


Fig 14, Differential Gear Assembly and Axle Removal

1. Remove Thrust Washer from either the Left or Right Axle. *(Fig. 14, 16)*
2. After removing the Thrust Washer, rotate the Axle until the open end of C-Ring is facing downward. Holding the Differential Side Gear stationary, slightly slide the Axle outward exposing the C-Ring. Using a Telescoping Magnet, remove C-Ring. *(Fig. 14, 16)*
3. Repeat steps 1 and 2 for opposing shaft.
4. With the Thrust Washers and C-Rings removed, hold the Gear Assembly in place. Carefully back out both Axle Shafts until the shafts splines clear the Side Gears. Remove the Gear Assembly and inspect components for wear or damage. *(Fig. 15)*

Rotating the Axle until open end of C-Ring is facing downward will prevent C-Ring from dropping into Upper Case.

5. Carefully back out and remove the Left and Right Axle Shafts. *(Fig. 14, 16)*
6. Remove (2) "loose" Bushings from the Upper Case. *(Fig. 16)*

Inspect the Axle Shafts and Bushings for scoring, pitting, discoloration, damaged ring grooves, and chipped or broken splines. Replace as necessary.

Axle Shaft and Bushing Tolerances

1. Using calipers (digital recommended) measure the O. D. (X) of the Axle Shaft. *(Fig. 15)*
2. Measure the I. D. (Y) of the "Loose" Bushing. *(Fig. 15)*
3. If the clearance (Y-X) is > 0.35 mm (0.014 in), replace the Axle Shaft and/or "loose" Bushing.

- ***Example of an Unacceptable Tolerance:***

  Axle Shaft O. D. (X) = 18.89 mm
  Bushing I. D. (Y) = 19.25 mm
  Y (19.25 mm) - X (18.89 mm) = 0.36 mm of clearance. This is > the wear limit of 0.35 mm, replacement is necessary.

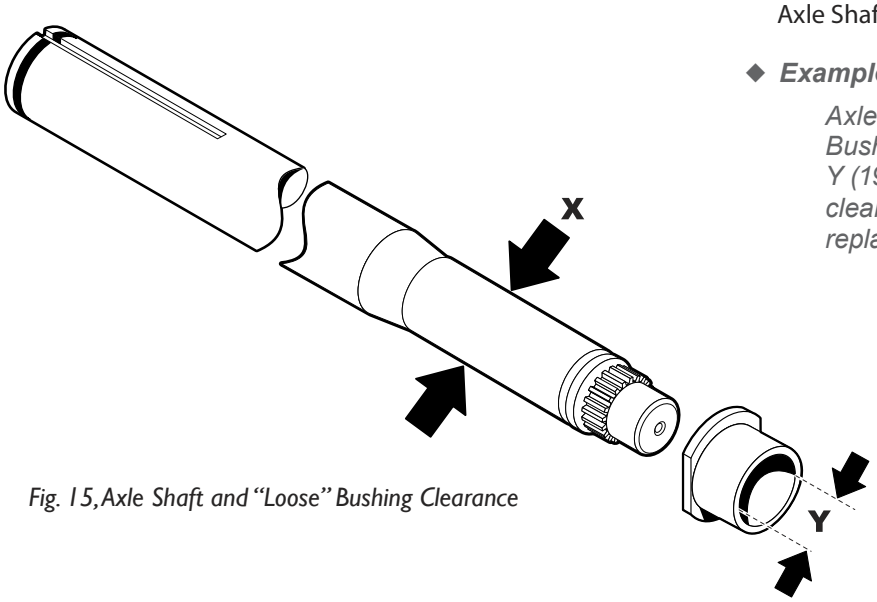


Fig. 15, Axle Shaft and "Loose" Bushing Clearance

Axel Shafts and Differential Gear Assemblies

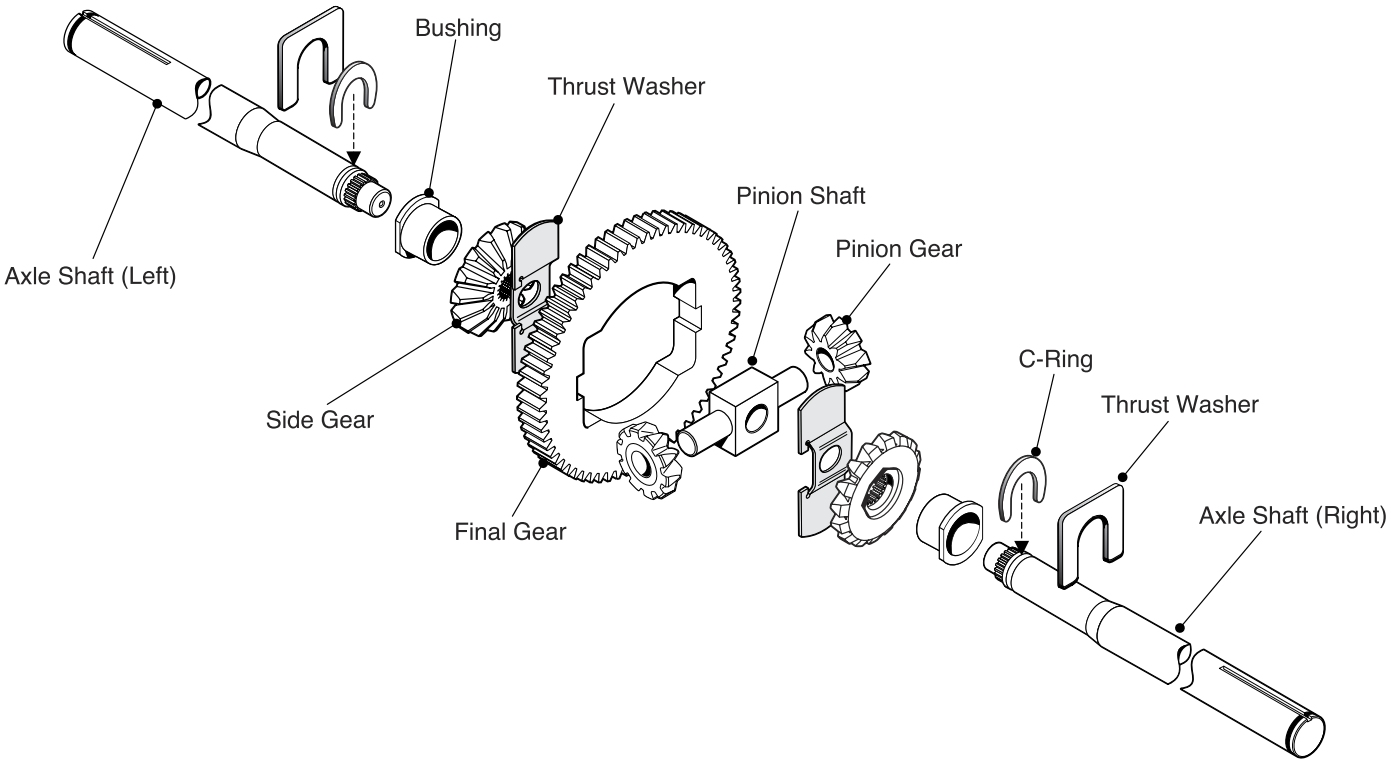


Fig. 16, Differential Gear and Axles

Differential Gear Assembly Removal

1. Remove the Differential Side Gears, Thrust Washers, Differential Pinion Gears, and the Differential Pinion Shaft from the Final Gear. *(Fig. 17)*
2. Inspect the Side and Pinion Gears and Pinion Shaft for scoring, pitting, discoloration and chipped or broken teeth.

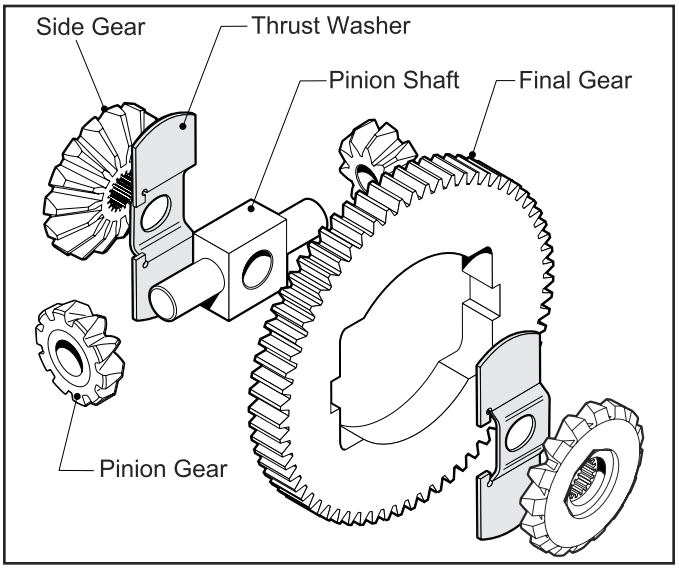


Fig. 17, Differential Gear Assembly

Axle Seal Removal

1. After the Differential Gear Assembly and Axles have been removed, take out the (2) Axle Seals at each end of the Upper Case. *(Fig. 19)*

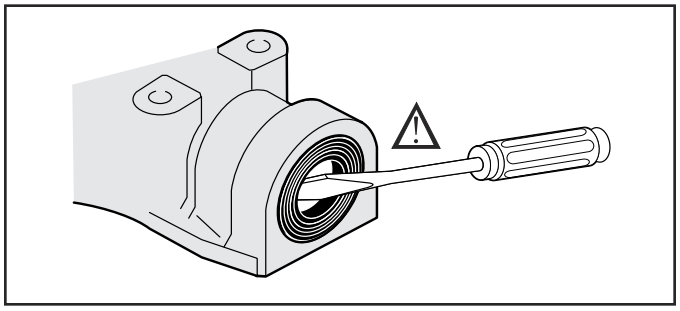


Fig. 19, Axle Seal Removal

⚠ Extreme caution should be taken when removing Seals from the Upper Case. Immediately behind each Axle Seal is a press-fit bushing. **If damaged, the Upper Case must be replaced, bushings can not be replaced separately.**

Seals should be replaced every time the Axles are removed.

Differential Pinion Shaft and Gears Tolerance

1. Using calipers (digital recommended) measure the O. D. (X) of the Pinion Shaft. *(Fig. 18)*

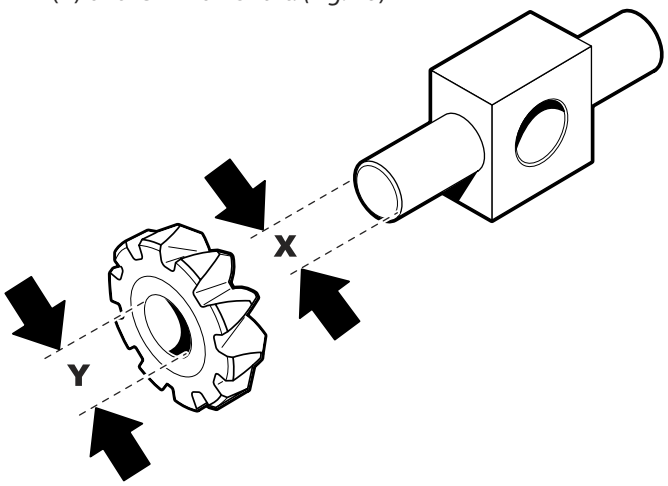


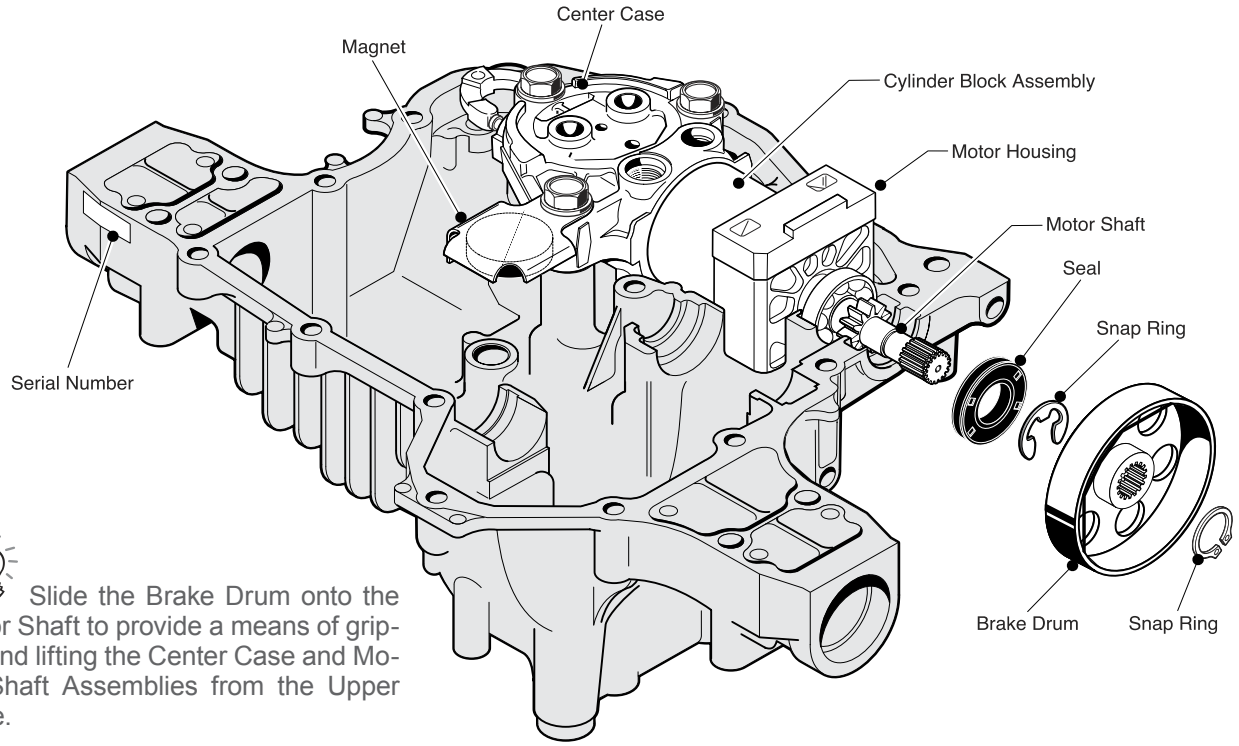
Fig. 18, Differential Pinion Shaft and Pinion Gears Clearance

2. Measure the I. D. (Y) of the Pinion Gears. *(Fig. 18)*
3. If the clearance (Y-X) is > 0.50 mm (0.019 in), replace the Pinion Shaft and/or Pinion Gears.

◆ ***Example of an Unacceptable Tolerance:***

Pinion Shaft O. D. (X) = 14.75 mm
Pinion Gear I. D. (Y) = 15.30 mm
Y (15.30 mm) - X (14.75 mm) = 0.55 mm of clearance. This is > the wear limit of 0.50 mm, replacement is necessary.

Hydrostatic Pump Removal



Slide the Brake Drum onto the Motor Shaft to provide a means of gripping and lifting the Center Case and Motor Shaft Assemblies from the Upper Case.

Fig. 20, Center Case and Motor Shaft Assemblies

Magnet Removal

1. Loosen (3) Bolts (10 mm) — removing one, on the Center Case; remove the Magnet. Clean the Magnet thoroughly before reassembling. *(Fig. 21)*

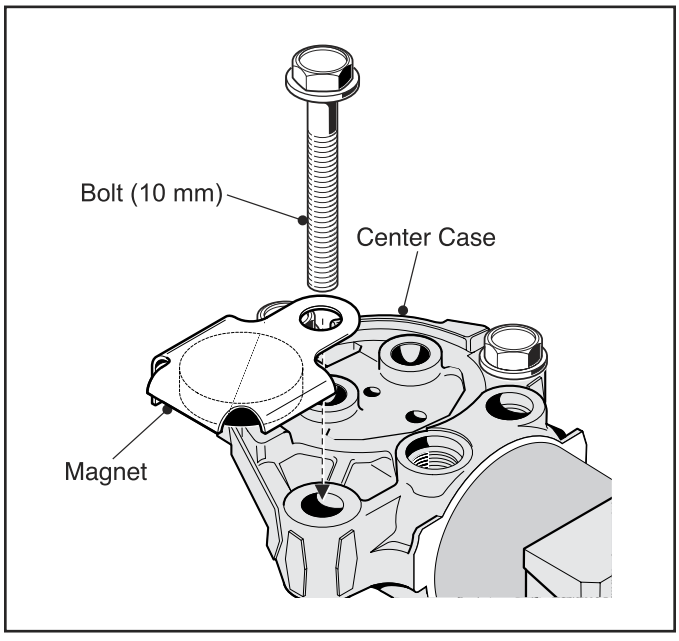


Fig. 21, Magnet Removal

Center Case & Motor Shaft Ass'y Removal

2. After removing the remaining two bolts holding the Center Case to the Upper Case, place one hand over the Motor Housing and the other hand over the Center Case. While compressing both portions together slightly, lift the entire assembly from the Upper Case. *(Fig. 22)*

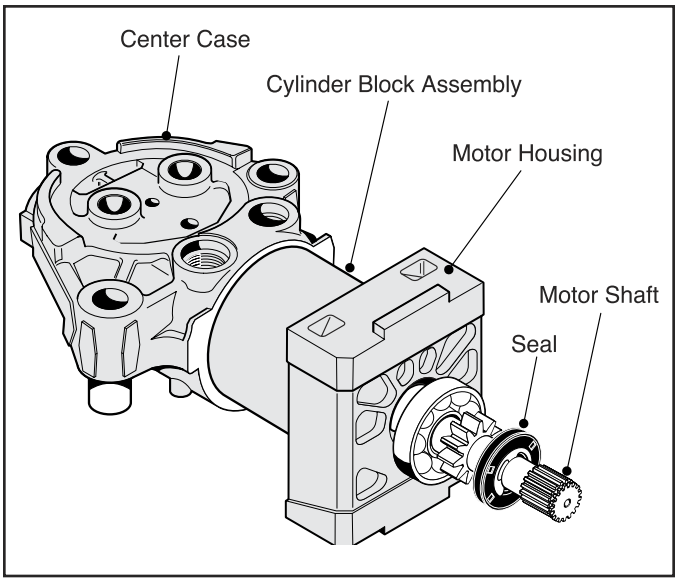


Fig. 22, Center Case and Motor Shaft Assemblies

Hydrostatic Pump Removal (continued)

Center Case Removal

3. While still maintaining pressure on the Cylinder Block Assembly and the Motor Housing, carefully separate the Center Case from the Motor Shaft Assembly. *(Fig. 23)*

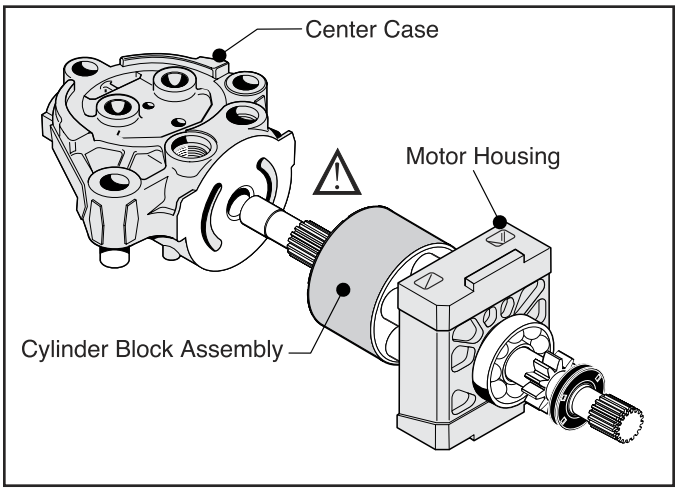


Fig. 23, Center Case and Motor Shaft Assembly

During separation, be careful not to damage contact surfaces of Center Case and Cylinder Blocks. *(Fig. 24)*

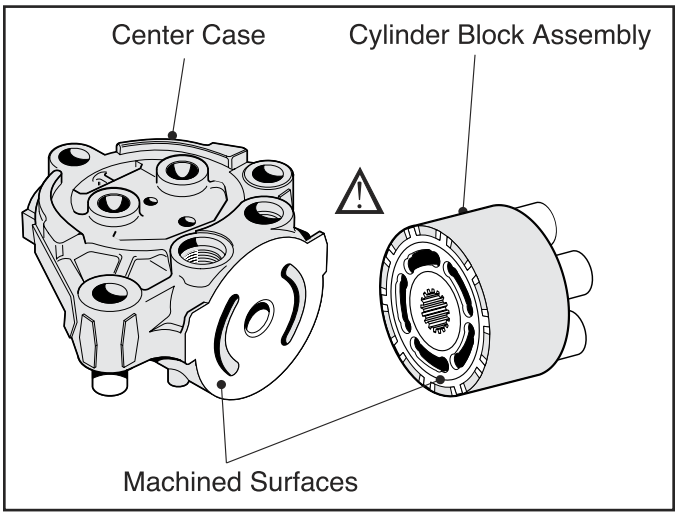


Fig. 24, Center Case and Cylinder Block, Machined Surfaces

Inspect the machined surfaces of the Center Case. If excessive scratches are detected, replace the Center Case and both Cylinder Block Assemblies, simultaneously.

Cylinder Block (Motor) Assembly Removal

4. Remove the Cylinder Block Assembly from the Motor Shaft. *(Fig. 25)*
5. Inspect each component of the Cylinder Block Assembly for burrs, scoring, pitting, discoloration, distortion, and wear.

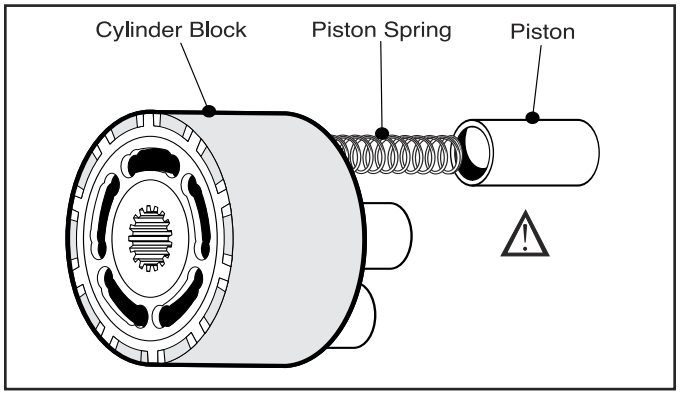


Fig. 25, Cylinder Block Assembly

If any of the components of Cylinder Block Assembly are damaged, they must be replaced with a complete Cylinder Block Assembly. Individual components are not serviced separately.

Be careful that the Pistons do not fall out of Cylinder Block. Do not set Cylinder Block down with mating surface contacting table top, as this can cause damage to the machined surfaces.

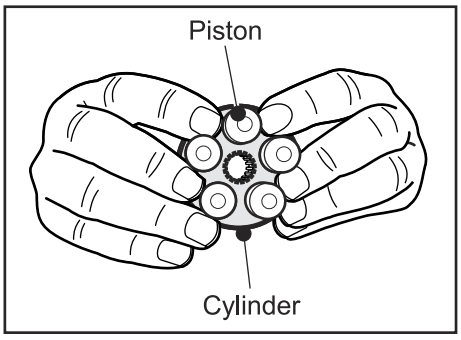


Fig. 26, Finger placement during removal

To avoid the pistons from dropping out during removal of the assembly, position fingers around the Cylinder in order to apply pressure on each of the five pistons. *(Fig. 26)*

Hydrostatic Pump Removal (continued)

Motor Housing Removal

6. Remove the Spring and Snap Ring. Next, remove the Thrust Bearing Set seated in the Motor Housing. *(Fig. 27)*
7. Inspect the press-fit Bushing in the Motor Housing for burrs, scoring, pitting, discoloration, and wear. If damaged, replace the Motor Housing. press-fit Bushings are not serviced separately.
8. Remove the Snap Ring and Seal. Discard the Seal and replace it with a new Seal during reassembly. *(Fig. 27)*

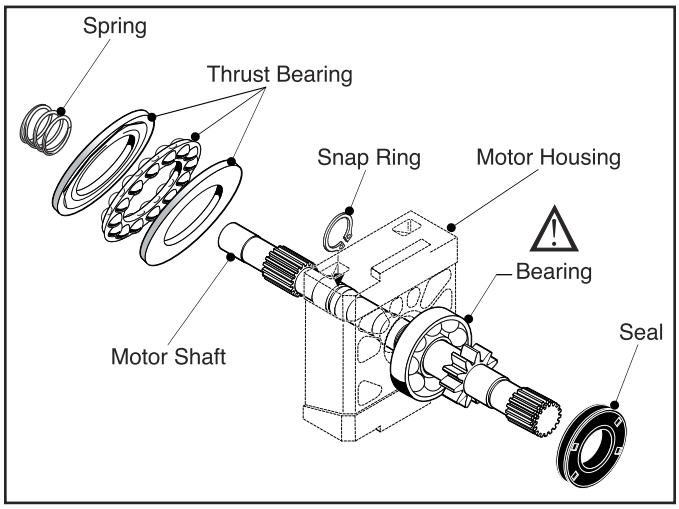


Fig. 27, Motor Shaft and Housing

Motor Shaft Removal

9. Withdraw the Motor Shaft from the Motor Housing. If the Shaft doesn't back out freely, check to see if Snap Ring was removed, see step 6. *(Fig. 29)*
10. Remove the Snap Ring and Washer. Inspect the Washer for wear or damage and replace if necessary. *(Fig. 29)*

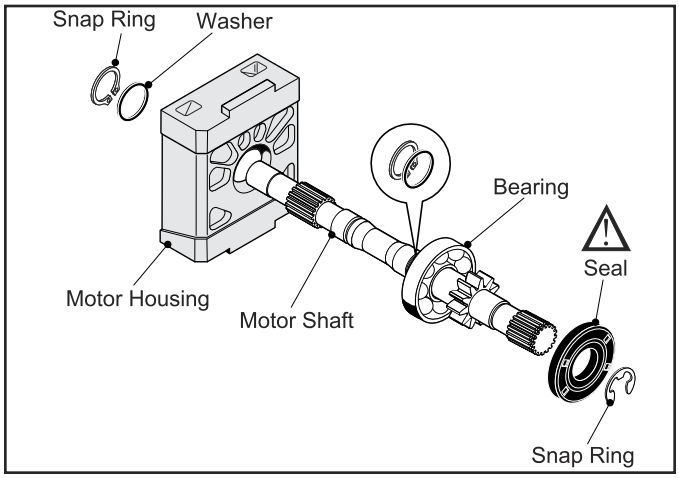


Fig. 29, Motor Shaft Removal

⚠ There is no need to remove the press-fit Bearing on the Motor Shaft, unless it is damaged or worn.

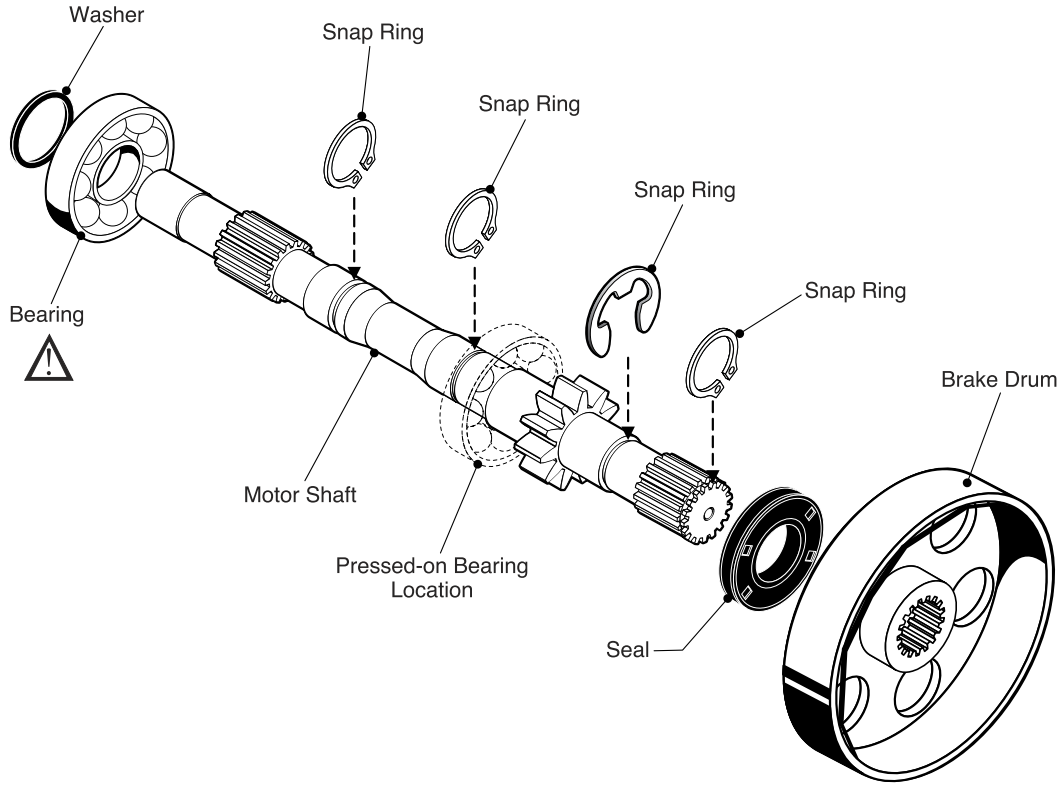


Fig. 28, Motor Shaft Assembly

Hydrostatic Pump Removal (continued)

Cylinder Block Assembly (Pump) Removal

11. Remove the Cylinder Block Assembly from the Pump Shaft. *(Fig. 30)*

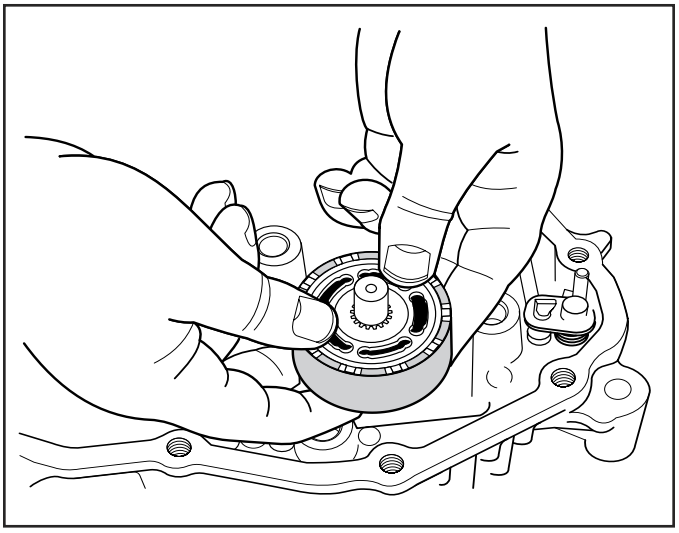


Fig. 30, Cylinder Block Removal from Pump Shaft

12. Inspect each component of the Pump Cylinder Block Assembly for burrs, scoring, pitting, discoloration, distortion, and wear. *(Fig. 31)*

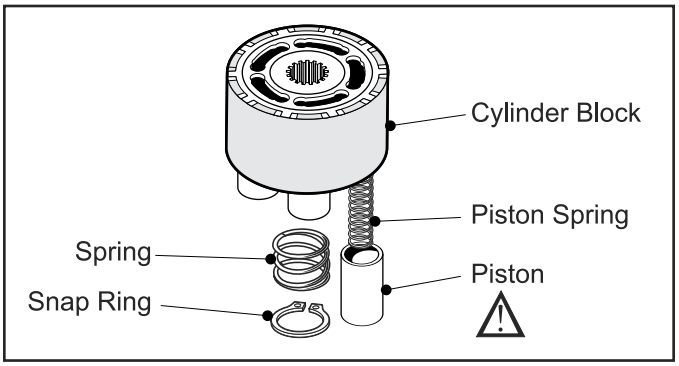


Fig. 31, Cylinder Block Removal

If any of the components of the Cylinder Block Assembly are damaged, the complete assembly must be replaced. Individual components are not serviced separately.

Take care to insure that the Pistons do not fall out of Cylinder Block. Do not set Cylinder Block down with mating surface contacting table top, as this also could cause damage.

To avoid the pistons from dropping out during removal of the assembly, position fingers around the Cylinder in order to apply even pressure to all five pistons. *(Fig. 32)*

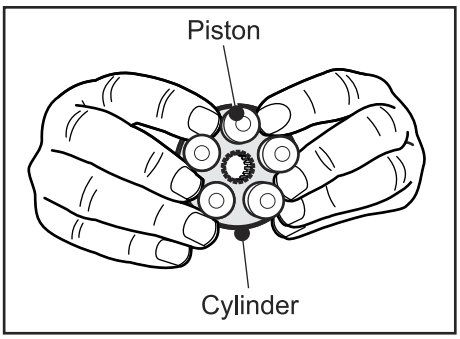


Fig. 32, Finger Placement During Removal

During separation, be careful not to damage contact surfaces of Center Case and Cylinder Blocks. *(Fig. 33)*

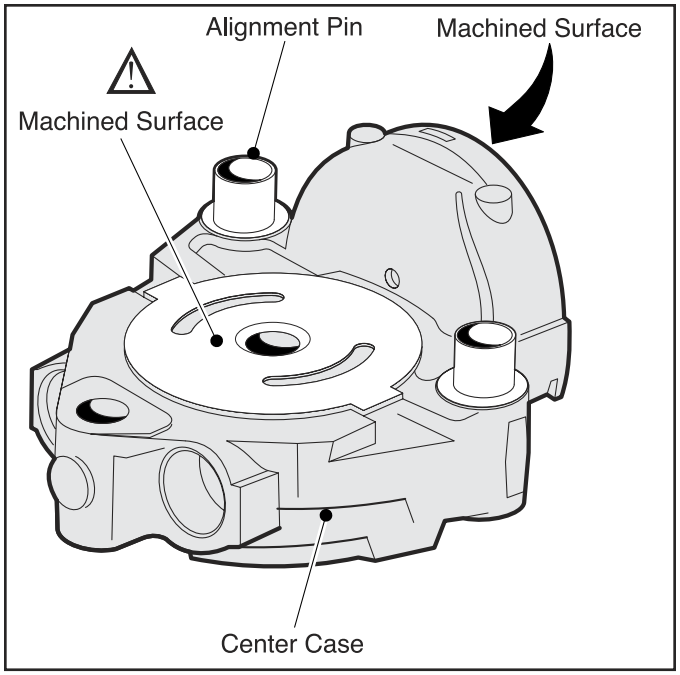


Fig. 33, Center Case Machined Surfaces

Inspect the machined surfaces of the Center Case. If excessive scratches are detected, replace the Center Case and both Cylinder Block Assemblies, simultaneously. *(Fig. 33)*

Swash Plate Removal

1. Before removing the Swash Plate Assembly measure the clearance (using Feeler gauge) between edge of Swash Plate's Slot and the Shift Blocks. If the clearance (gap) is $>$ 0.15 mm (0.005 in), replace both Shift Blocks and the Swash Plate Assembly, simultaneously. *(Fig. 34)*

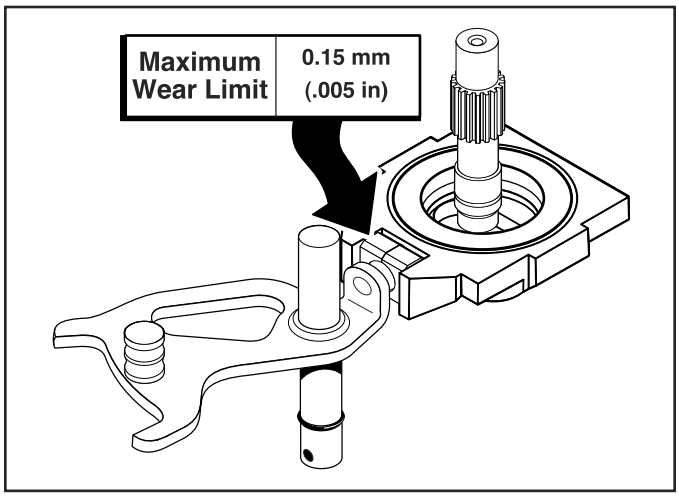


Fig. 34, Shift Blocks Clearance Tolerance

2. Remove the Spring and the Snap Ring. *(Fig. 35)*

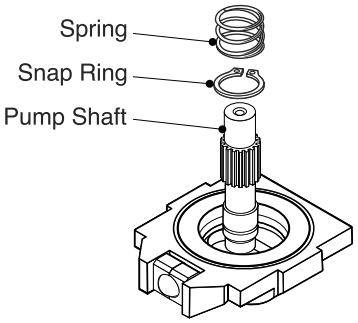


Fig. 35, Swash Plate Removal

3. Remove the Thrust Bearing seated in the Swash Plate. *(Fig. 36)*
4. Remove the Swash Plate. *(Fig. 36)*
5. Inspect the press-fit Bushing in the Swash Plate for burrs, scoring, pitting, discoloration, and wear. If damage, replace the Swash Plate. The press-fit Bushings are not serviceable separately.

⚠ Do not attempt to remove the press-fit Bushing in the Swash Plate. If damaged, replace Swash Plate Assembly (press-fit Bushing is included in the assembly).

6. Remove the (2) Thrust Metals (bearing pads) from the Upper Case. *(Fig. 36)*

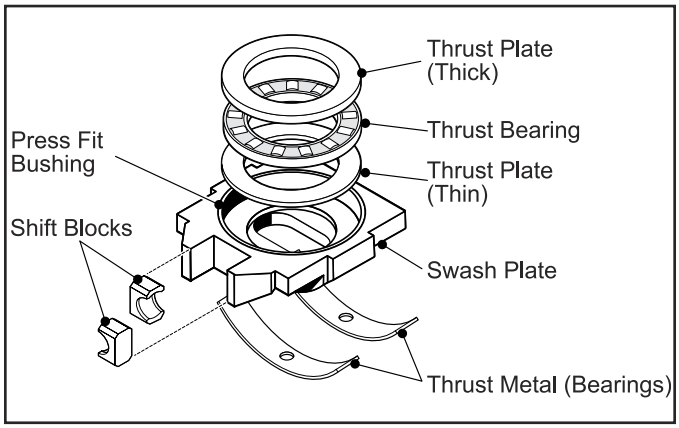


Fig. 36, Thrust Metal Bearing Removal

Inspect Thrust Bearing components for pitting, scoring, discoloration, missing rollers, and roller retainer breakage.

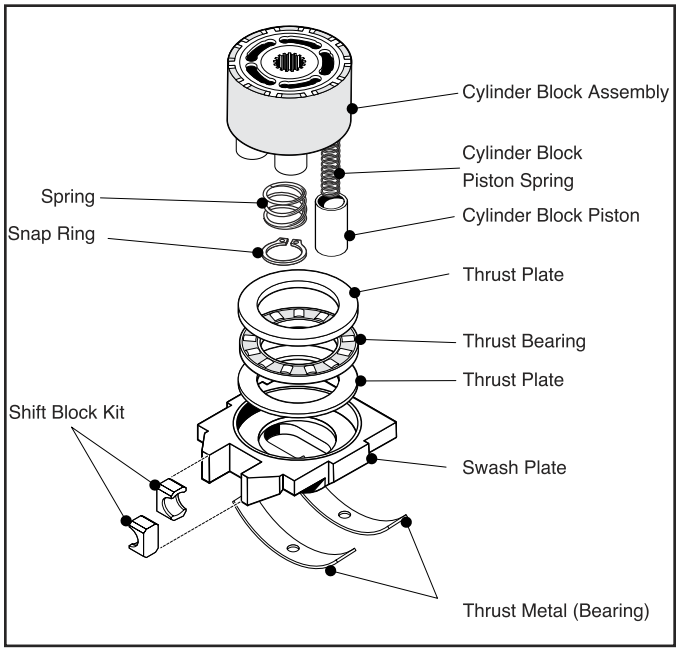


Fig. 37, Cylinder Block Assembly & Swash Plate

Swash Plate Removal (continued)

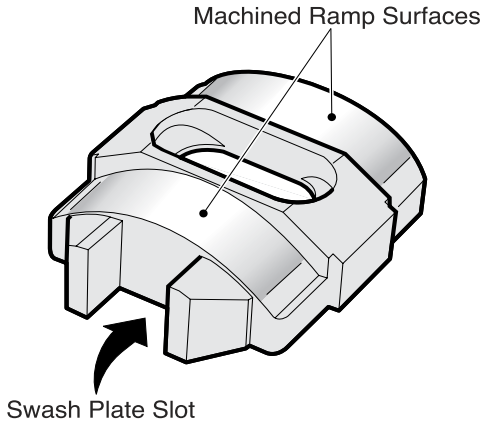


Fig. 38, Swash Plate's Machined Ramps

Inspect the Swash Plate's machined ramp surfaces and Press-Fit Bushings for scoring, pitting, discoloration, and wear. If the Swash Plate and/or Bushings are damaged, they must be replaced as a group.

7. Using calipers (digital recommended) measure the thickness of both Thrust Metals for wear. If the clearance is < 1.30 mm (0.051 in), replace Thrust Metals as a set. *(Fig. 39)*

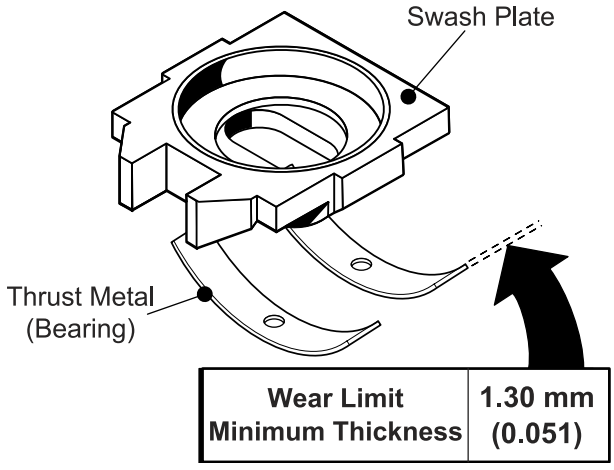


Fig. 39, Thrust Metals Tolerance

Always replace the Thrust Metals worn beyond wear limits as a group.

Fulcrum Removal

1. Remove the Nut (17mm) and Washer from the Fulcrum (Neutral Adjust Eccentric). *(Fig. 40)*

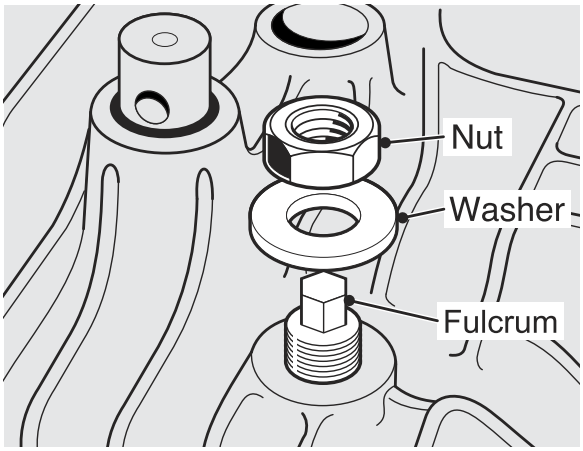


Fig. 40, Fulcrum Removal, from top of Upper Case

2. Return the Upper Case to its service position (Flange side up) and remove the Fulcrum. *(Fig. 41)*
3. Inspect the Fulcrum Cam for wear or damage, replace if required.
4. Remove and discard (2) O-rings and replace with a fresh pair. *(Fig. 41)*

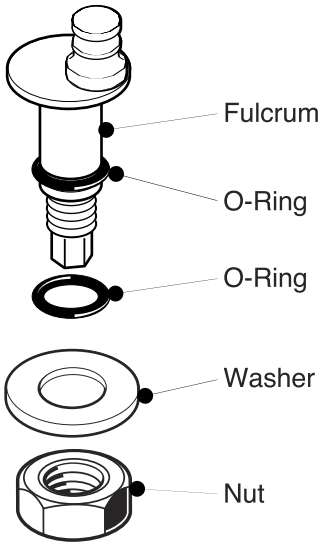


Fig. 41, Fulcrum

Pump Shaft Removal

1. Remove the Seal and discard. Replace with new a Seal during reassembly. *(Fig. 42)*
2. Remove the large internal Snap Ring and lift the Pump Shaft from the Upper Case. *(Fig. 43)*

Inspect the Shaft and its components for scoring, pitting, discoloration, and other wear. Replace if damage or worn. Inspect the Pump Shaft splines for chipped or broken teeth.

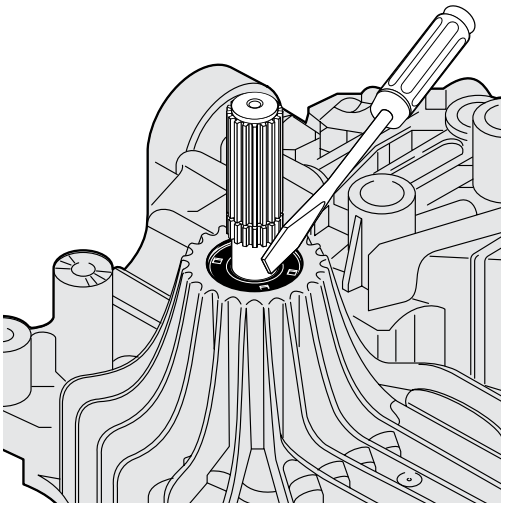


Fig. 42, Pump Shaft Seal Removal

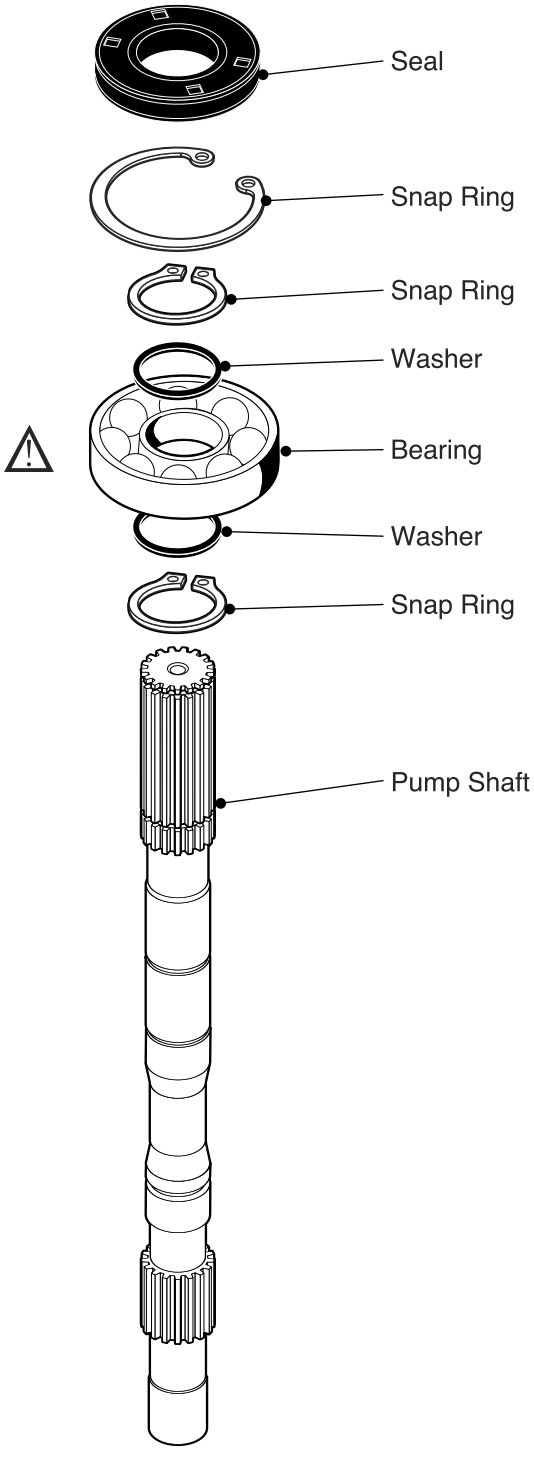


Fig. 43, Pump Shaft

Do not attempt to remove the press-fit Bearing on the Pump Shaft unless it is damage or worn. Removal could result in damage to the Bearing.

Levers (Shafts) and Linkage Removal (If Applicable)

1. Remove the Control Shaft Assembly.
2. Remove the Fulcrum. Refer to page 14 for more details.
3. Disconnect Snap Pin from the Brake Rod (see arrow 1) and remove Washer. *(Fig. 44)*
4. Disengage the Brake Rod from Brake Arm "A" (see arrow 2) and remove the Brake Rod. *(Fig. 44)*
5. Remove Brake Arm "A." *(Fig. 44)*
6. Disengage the Brake Return Spring from the Brake Shaft and the Upper Case, remove the Spring after steps 8 and 9.
7. Disengage the Bypass Rod from the slot on the Brake Shaft. Remove the Bypass Rod. *(Fig. 45)*
8. Remove the Brake Shaft. *(Fig. 45)*
9. Remove the Bypass Shaft and Spring. *(Fig. 45)*

Remove and discard O-rings on Shafts. Replace with new O-rings before reassembly. Refer to the Assembly section for further information.

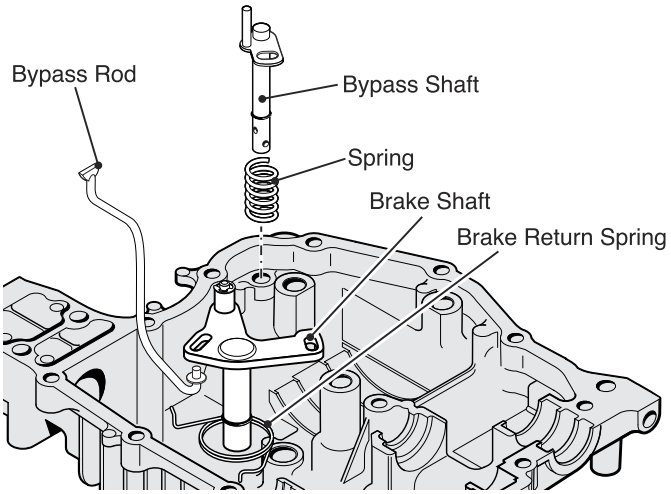
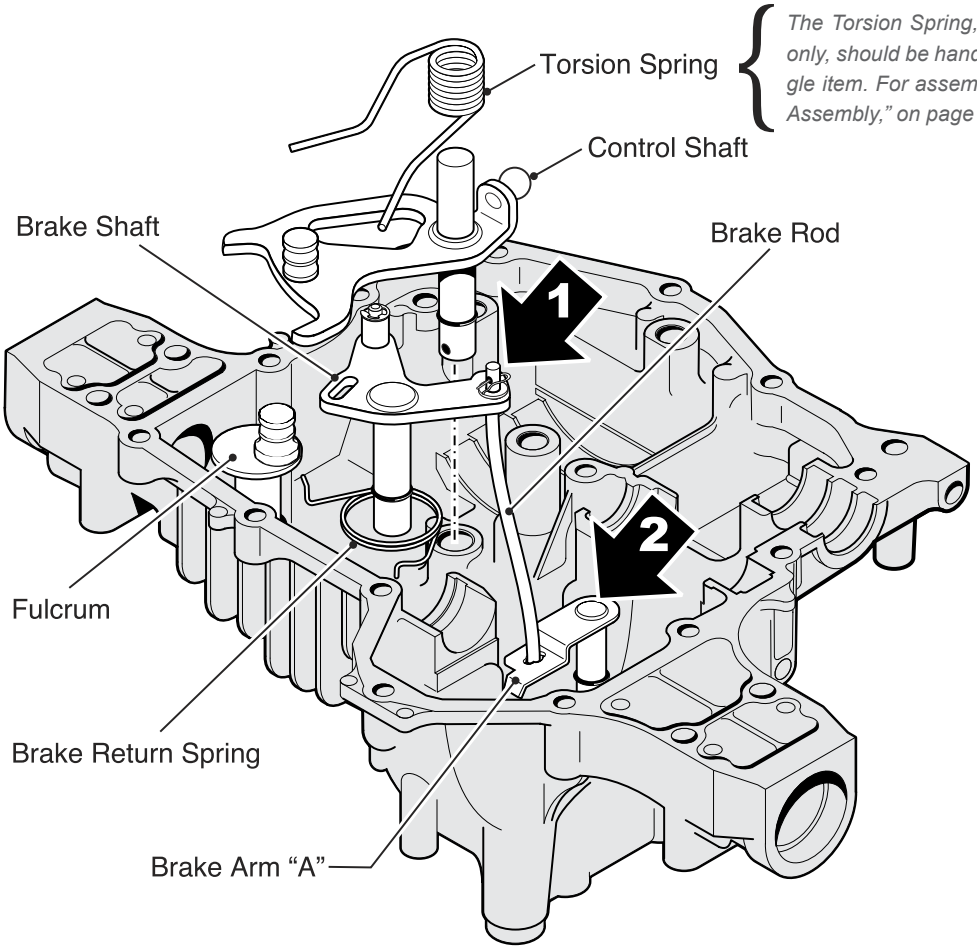


Fig. 45, Bypass Shaft and Spring

Inspect all Levers and Linkage for scoring, pitting, discoloration, or any other visual damaged. Replace as necessary.

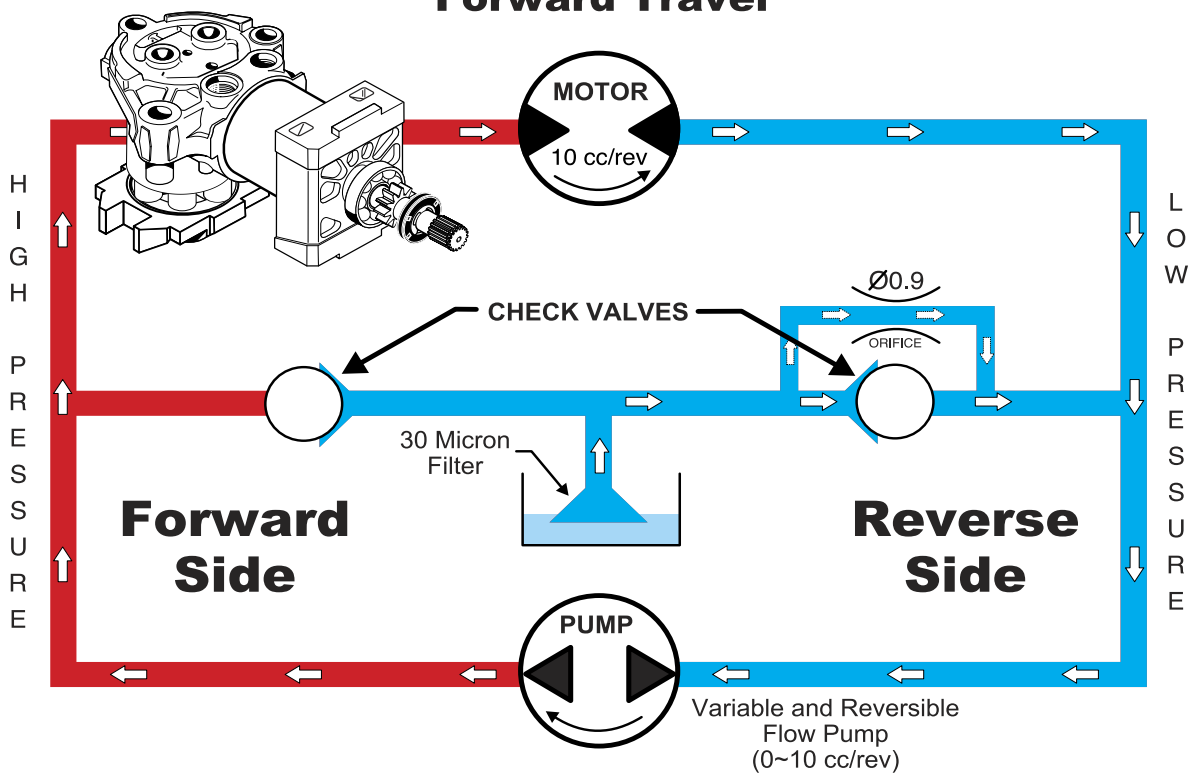


The Torsion Spring, shown here disassembled for clarity only, should be handled (removing and installing) as a single item. For assembly refer to " Control Shaft & Fulcrum Assembly," on page 21.

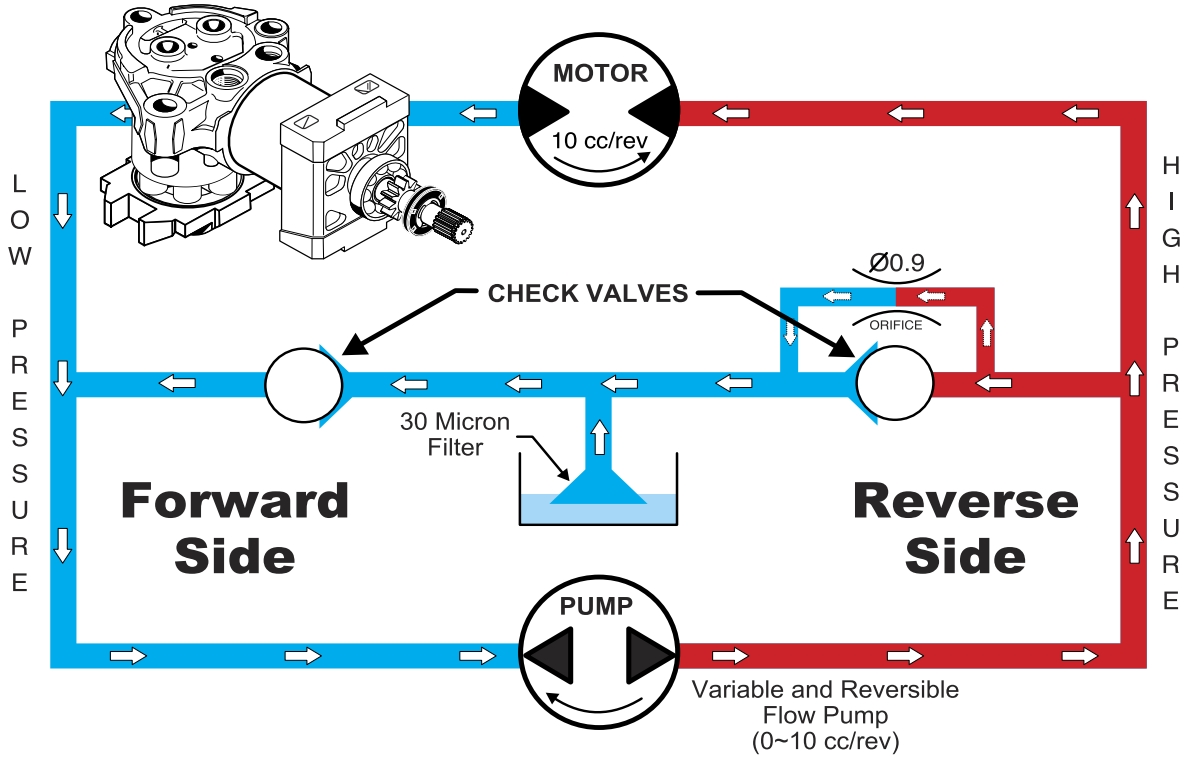
Fig. 44, Levers and Linkage Removal

K61 Hydraulic Flow Diagram

Forward Travel



Reverse Travel



Assembly of Transaxle

Before Starting Assembly

Before starting the assembly of the Transaxle check all parts to ensure that they are clean and free of any foreign debris, this includes your work area and tools.

Have on hand a new Seal Kit (19215499150). Check contents of kit for possible defects before installation. Note that the kit is designed to cover all K61 models. You may or may not use all the items, in the kit, on your particular model. The Seal Kit, as well as other parts necessary for replacement, can be ordered on-line by visiting Tuff Torq's Web Site at: www.tufftorq.com (See "Ordering Replacement Parts", page ii).

Bypass Shaft Assembly

1. Place the Upper Case on a service stand in the service position (flange side up).
2. Install a new O-ring onto the Bypass Shaft.
3. Install the Spring onto the Bypass Shaft.
4. Install the Spring and Bypass Shaft into the hole on the Upper Case. *(Fig. 1)*

Apply a light coating of grease to the surface of the O-ring. Also, apply a small amount of grease into mating hole of Upper Case.

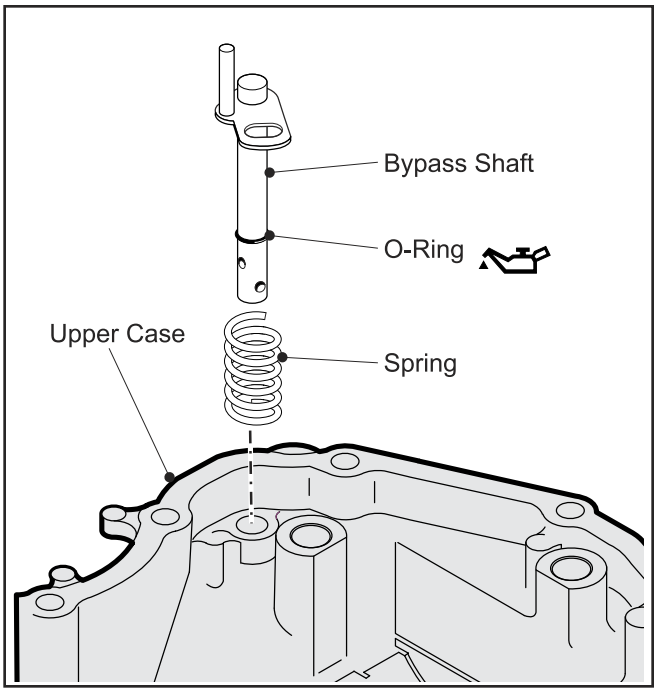


Fig. 1, Bypass Shaft Assembly

Rather than lubricating packing items (O-rings and Seals) in advance, apply a light coating of grease just prior to their installation. This will minimize the possibility of debris collecting of packing items while waiting to be installed.

5. Since the Bypass Shaft is spring loaded it is recommended that the Release Valve (Tow) Arm be connected before proceeding.

   ◆ From the reverse side of the Upper Case, mount the Release Valve Arm onto the Bypass Shaft; then, align and secure with Roll Pin. *(Fig. 2)*

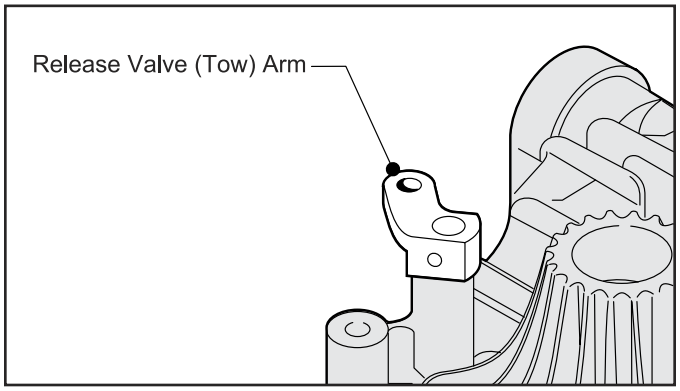


Fig. 2, Release Valve Arm Assembly

◆ Always install Roll Pins with the slit on a horizontal plane. This will enable the pin greater holding ability.

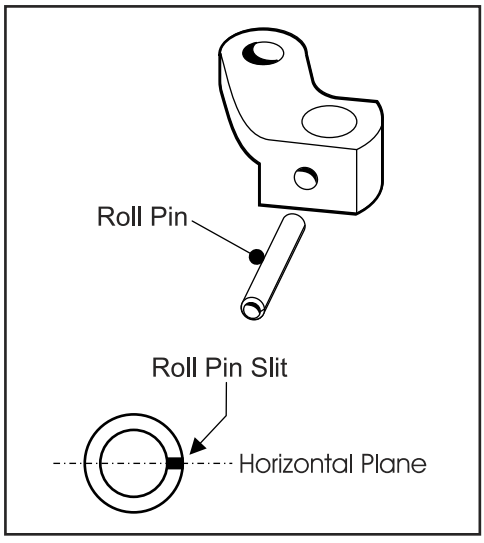


Fig. 2a, Roll Pin Installation

Interlock Linkage (If Applicable)

1. Place the Upper Case back to the Service Position; then, attach the Bypass Rod to the Bypass Shaft. *(Fig. 3)*

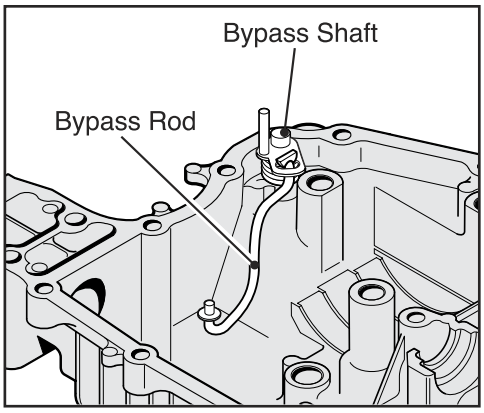


Fig. 3, Bypass Rod Assembly

Brake Shaft Assembly (If Applicable)

1. Install a new O-ring onto the Brake Shaft. *(Fig. 4)*
2. Check Bushing for damage or exceptionable wear; replace if necessary. *(Fig. 4)*

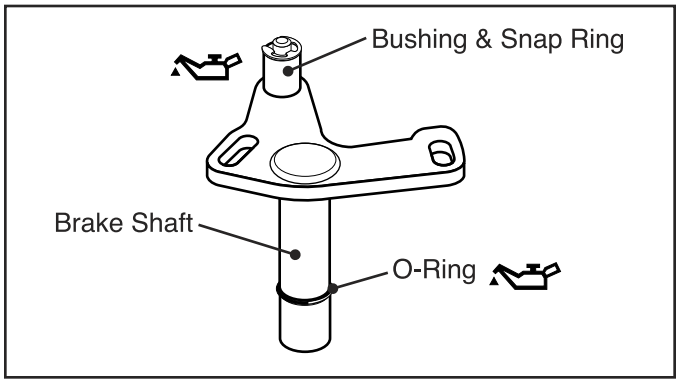


Fig. 4, Brake Shaft Assembly

Apply a light coating of grease to the surface of the new O-ring and Bushing. Also, apply a small amount of grease into mating hole of the Upper Case.

3. Align the Bypass Rod with the slot on the Brake Shaft. *(Fig. 5, 7)*
4. Place the Brake Return Spring under the Brake Shaft. *(Fig. 5, 7)*
5. Hook the Brake Return Spring to the Brake Shaft (see arrow 1); then, hook the opposite end of the spring to the Upper Case housing (see arrow 2). *(Fig. 6)*

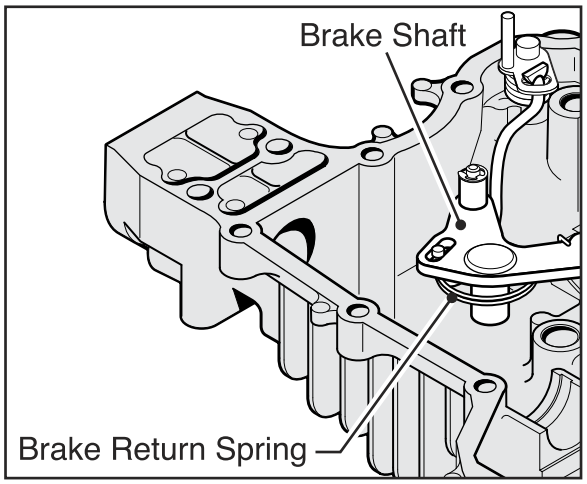


Fig. 5, Brake Shaft & Return Spring Assembly

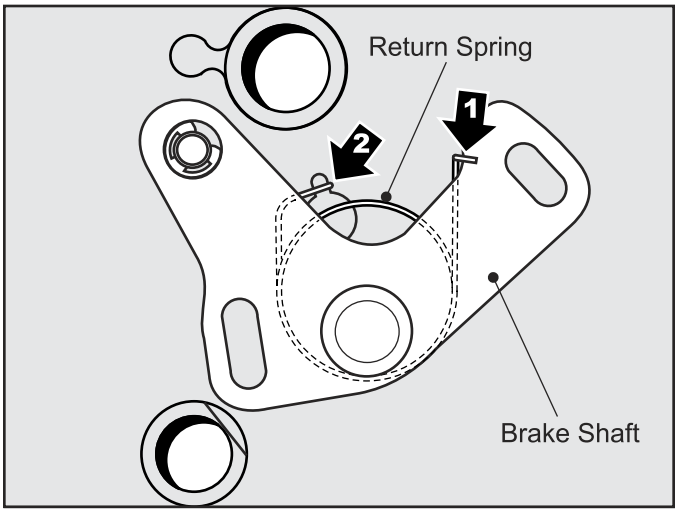


Fig. 6, Brake Shaft & Return Spring Assembly

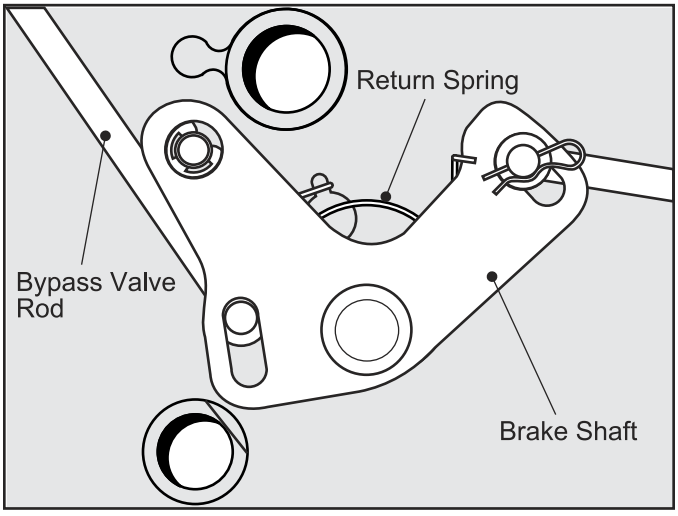


Fig. 7, Brake Shaft—Bypass Rod Assembly

Brake Arm "A" Assembly

1. Install a new O-ring onto the Brake Arm. *(Fig. 8)*
2. Attach the Brake Rod to the Brake Arm; then, to the Brake Shaft. *(Fig. 8, 9)*

Apply a light coating of grease to the surface of the new O-ring and Bushing. Also, apply a small amount of grease into mating hole of Upper Case.

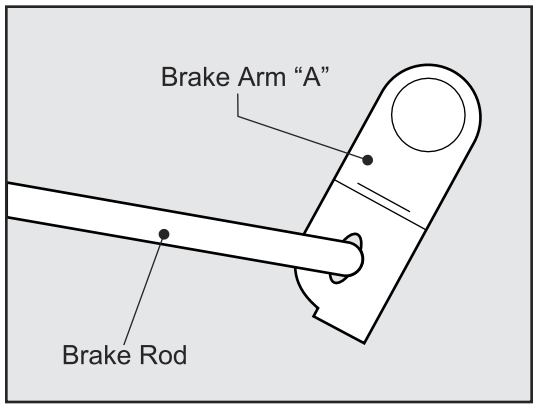


Fig. 8, Brake Arm Assembly

3. Secure the Brake Rod to the Brake Shaft with a Washer and Cotter Pin. *(Fig. 9)*

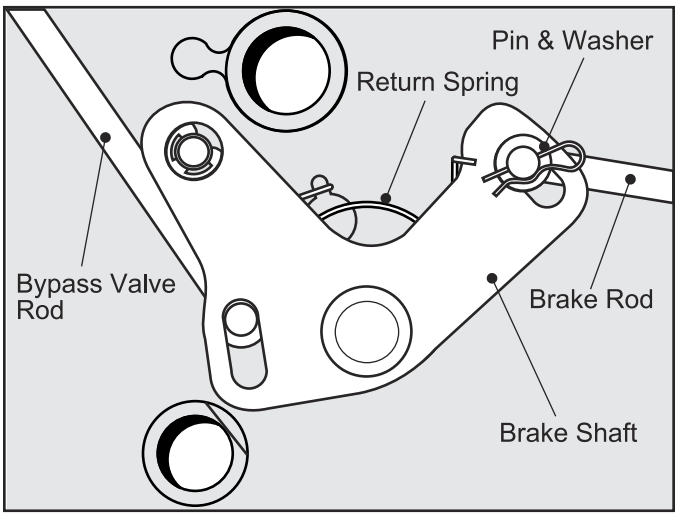


Fig. 9, Brake Rod Assembly

With the Brake Linkage in place, seat the Brake Shaft and the Brake Arm to their lowest position – **In order for the Roll Pin and the Brake Arm to align properly *(Fig. 10)*, the Return Spring must not hinder the full positioning of the Brake Shaft.** Check linkage for proper operation, adjust if necessary.

4. From the reverse side of the Upper Case, mount the Brake Arm onto the Brake Shaft. The side of the Brake Arm with the word "UP" should be visible; then, align and secure with Roll Pin. *(Fig. 10)*

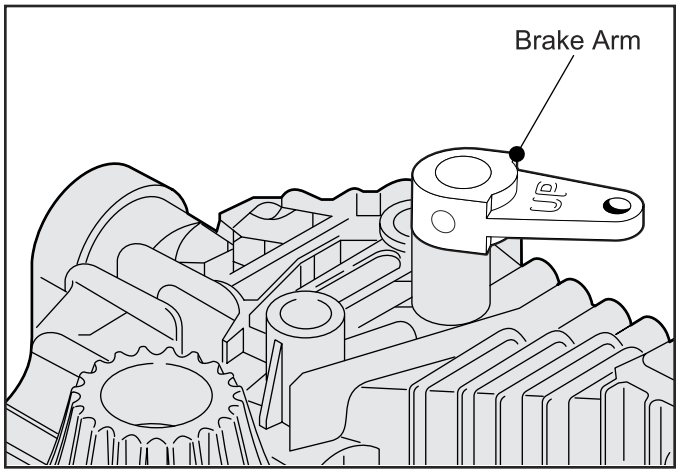


Fig. 10, Brake Arm Assembly

5. Mount the Brake Arm "B" onto the Brake Arm "A"; then, align and secure with Roll Pin. *(Fig. 11)*

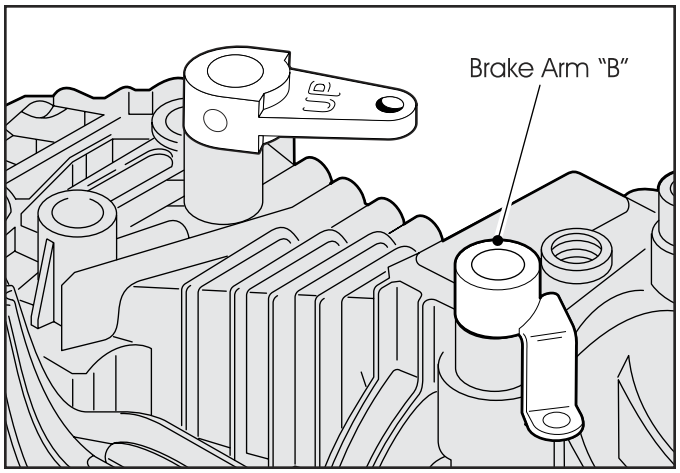


Fig. 11, Brake Arm "B" Assembly

6. Place the Upper Case back to the Service Position and continue with the assembly of Transaxle.

Control Shaft & Fulcrum Assembly

1. Install a new O-ring onto the Control Shaft. *(Fig. 12)*

Apply a light coating of grease to the surface of the new O-ring. Also, apply a small amount of grease around the mating hole of Upper Case.

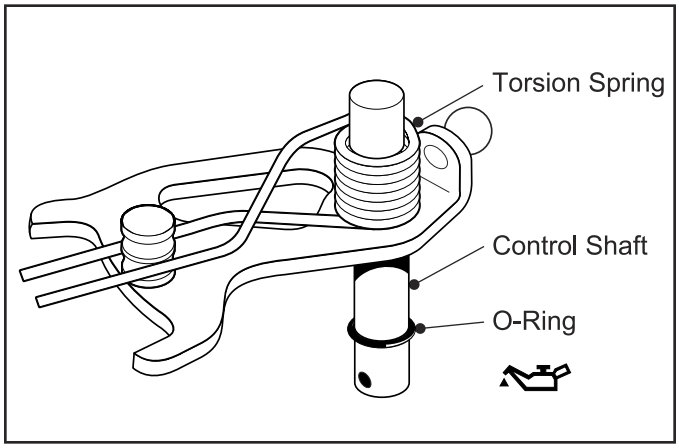


Fig. 12, Control Shaft/Torsion Spring Assembly

2. Install a new O-ring onto the Fulcrum (If applicable for your model). *(Fig. 13)*

Apply a light coating of grease to the surface of the new O-ring. Also, apply a small amount of grease around the mating hole of Upper Case.

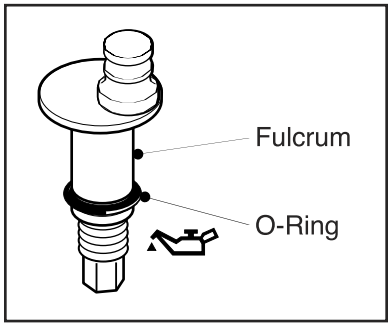


Fig. 13, Fulcrum

3. Place the head of the Fulcrum between the legs of the Torsion Spring. *(Fig. 14)*

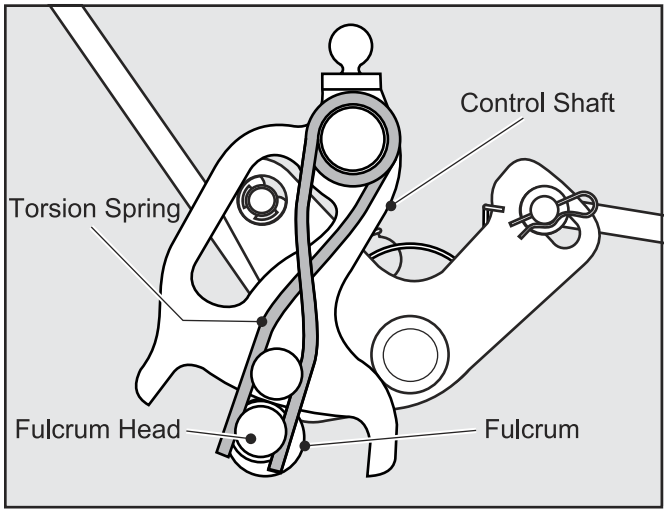


Fig. 14, Fulcrum –Control Shaft Assembly

4. Apply an ample amount of grease to the inside surface of the Shift Blocks and to the pivot ball; then, press the Shift Blocks to the pivot ball. The grease will help retain the Shift Blocks in position during installation and alignment of the Swash Plate Assembly. See "Swash Plate Assembly" step 3 on page 24. *(Fig. 15)*
5. Align the Fulcrum and Control Shaft Assembly with mating holes on the Upper Case; then, press into place.
6. Rotate the Fulcrum until maximum distance is achieved between the Fulcrum head and the Control Shaft Spool. *(Fig. 15)*

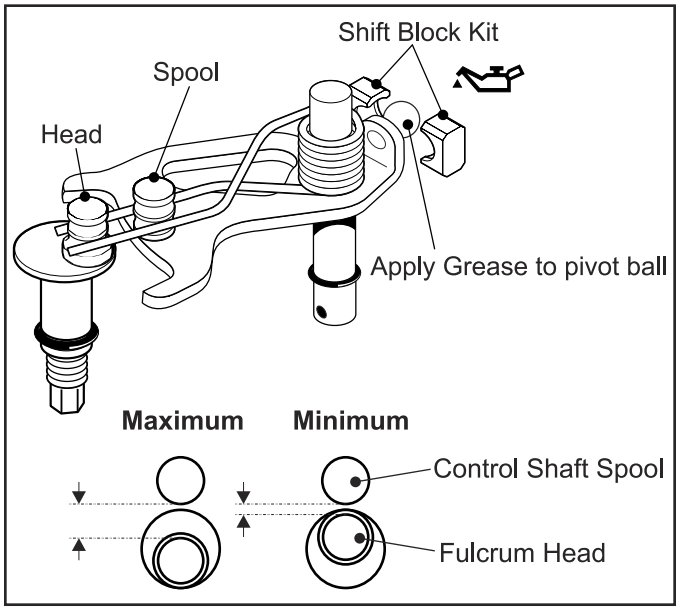


Fig. 15, Shift Blocks – Fulcrum Assembly

Control Shaft & Fulcrum Ass'y (continued)

7. From the reverse side of the Upper Case; Using a 17 mm wrench, install washer and nut to the Fulcrum. *(Fig. 16)*

Tightening torque: *2.5 ~ 3.3 kg–m*
24.6 ~ 32.5 N–m
18 ~ 24 ft. lbs.

- To adjust the Neutral Eccentric, use a 8 mm wrench.

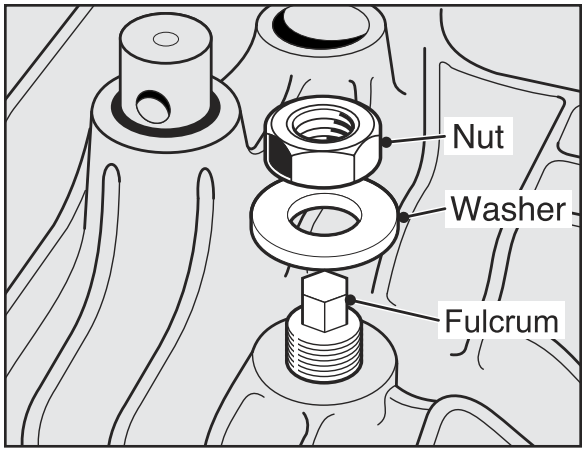


Fig. 16, Fulcrum Assembly

8. Mount the Hydrostatic Control Arm onto the Control Shaft; then, align and secure with Roll Pin. *(Fig. 17)*

◆ On some K61 models a Snap Ring must be installed on the Control Shaft before the OEM's Control Lever is installed.

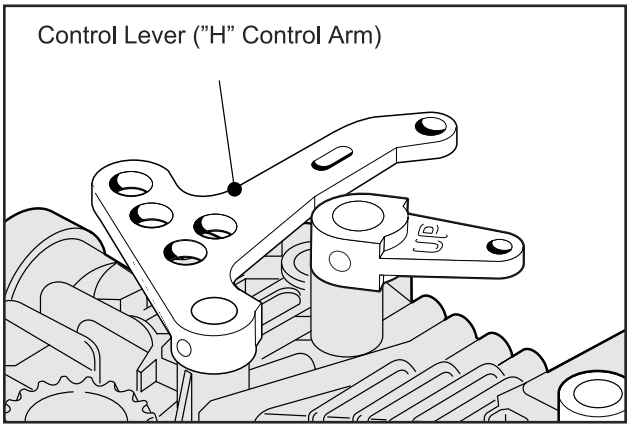


Fig. 17, Hydrostatic Control Arm Assembly

To avoid possible damage to the splines of the Pump Shaft; first, install all levers and control arms. The driving in of the respective Roll Pins could result in the unintentional contact with the shaft. If shaft is already present, place a protective covering over spline, e.g., electrical tape.

Pump Shaft Assembly

1. Install a new Bearing onto the Pump Shaft, if required.
2. Lubricate Bearing with clean oil, (old or new).
3. Installation involving a new Bearing: *(Fig. 18)*
   - Seat Snap Ring in the Pump Shafts groove.
   - Install Washer.
   - Press Bearing into position.
   - Install Washer.
   - Seat Snap Ring in the Pump Shafts groove.

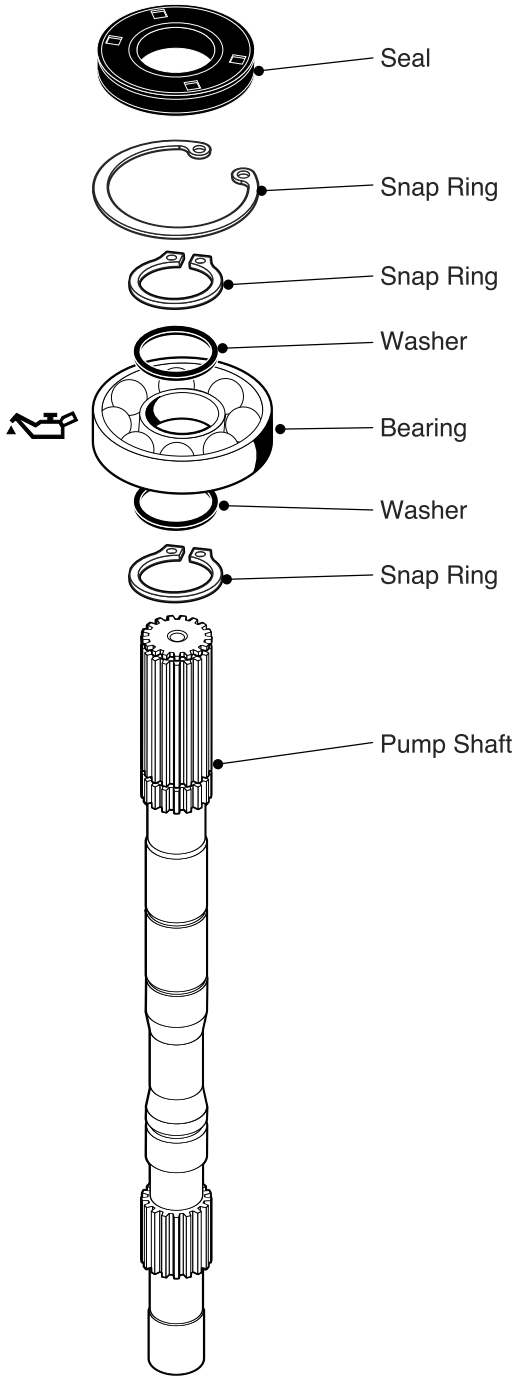


Fig. 18, Pump Shaft Assembly

Pump Shaft Assembly (continued)

4. Insert the Pump Shaft Assembly into the Upper Case. *(Fig. 19)*
5. Install Internal Snap Ring.
6. Install a new Seal.

To avoid possible damage to the Seal lip, during installation, cover the splines of the Pump Shaft with tape.

Apply a light coating of grease to the surface of all Seals and O-rings. Also, apply a small amount of grease around the mating hole of the Upper Case. For Bearings and other machined parts, apply a coating of oil.

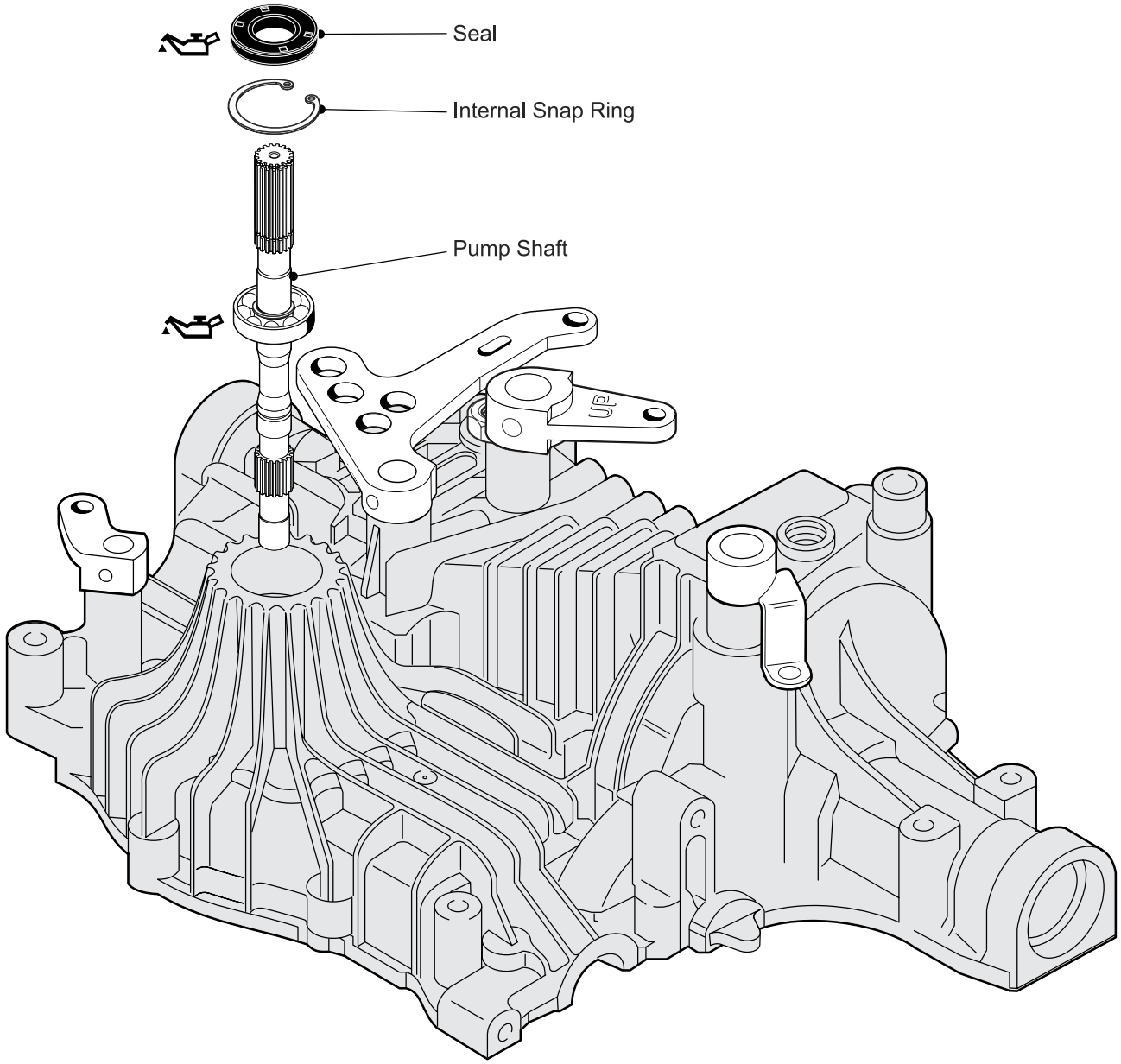


Fig. 19, Pump Shaft Assembly

Swash Plate Assembly

1. Install Thrust Metals into the Upper Case (forming a cradle for the Swash Plate). *(Fig. 20)*
2. Install the Thrust Bearing Group into the Swash Plate.

   ◆ Comprising of (2) Thrust Plates and (1) Thrust Bearing, the Thrust Bearing Group should be oiled and placed into the Swash Plate. Starting with the "thin" Thrust Plate followed by the Thrust Bearing and, finally; the "thick" Thrust Plate. *(Fig. 20)*
3. If not previously done, apply an ample amount of grease to the inside surface of the Shift Blocks and to the pivot ball; then, press the Shift Blocks to the pivot ball. The grease will help retain the Shift Blocks in position during installation and alignment of the Swash Plate Assembly. See "Control Shaft and Fulcrum Assembly" step 4 on page 21. *(Fig. 20)*
4. Coat the exposed surfaces of the Thrust Metals with oil.
5. Place the Swash Plate Assembly over the Pump Shaft; then, into cradle, align with Shift Blocks. *(Fig. 20)*

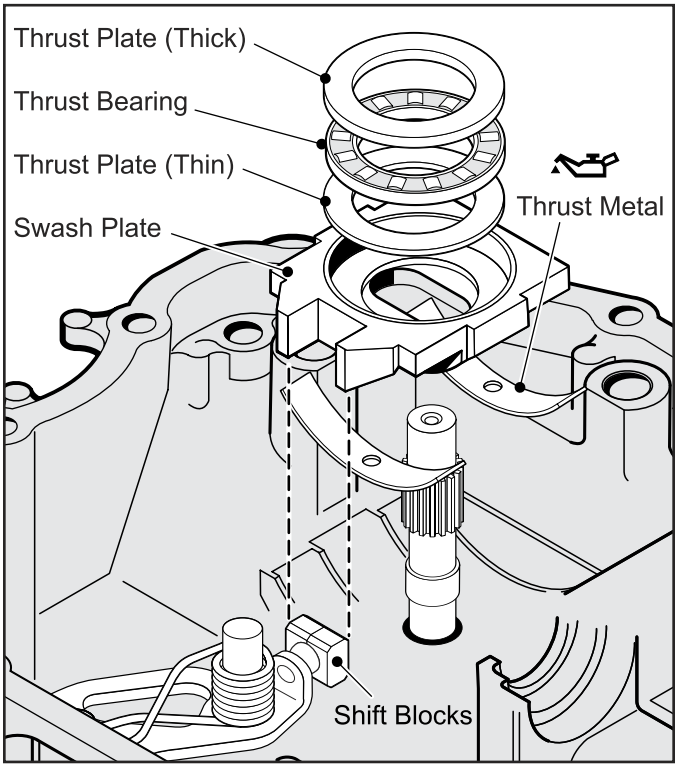


Fig. 20, Pump Shaft Assembly

6. Using feeler gauge, check the distance between the Swash Plate and the Shift Blocks.

Clearance should be: *0.01 ~ 0.11 mm*
.0003 ~ .004 in

Cylinder Block (Pump) Assembly

1. Apply a coating of oil to each of the Pistons. *(Fig. 21)*
2. Place the (5) Washers, Springs and Pistons into the Cylinder Block. *(Fig. 21)*
3. Install Snap Ring and Spring onto Pump Shaft. *(Fig. 22)*
4. Install Cylinder Block Assembly onto Pump Shaft. *(Fig. 24)*

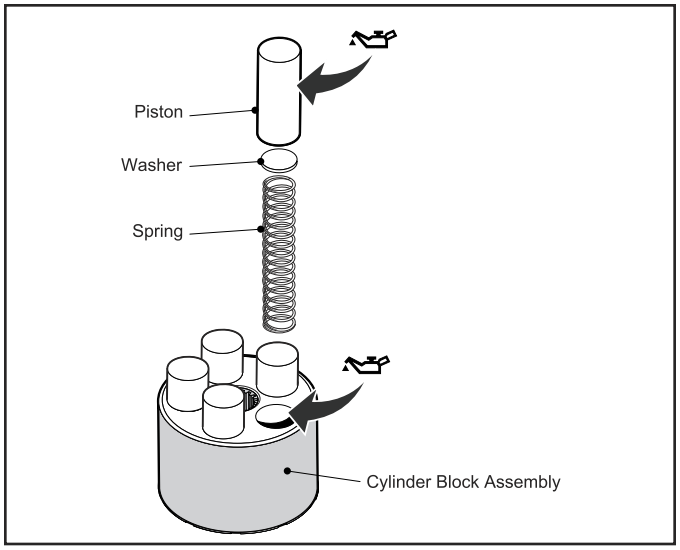


Fig. 21, Cylinder Block Assembly

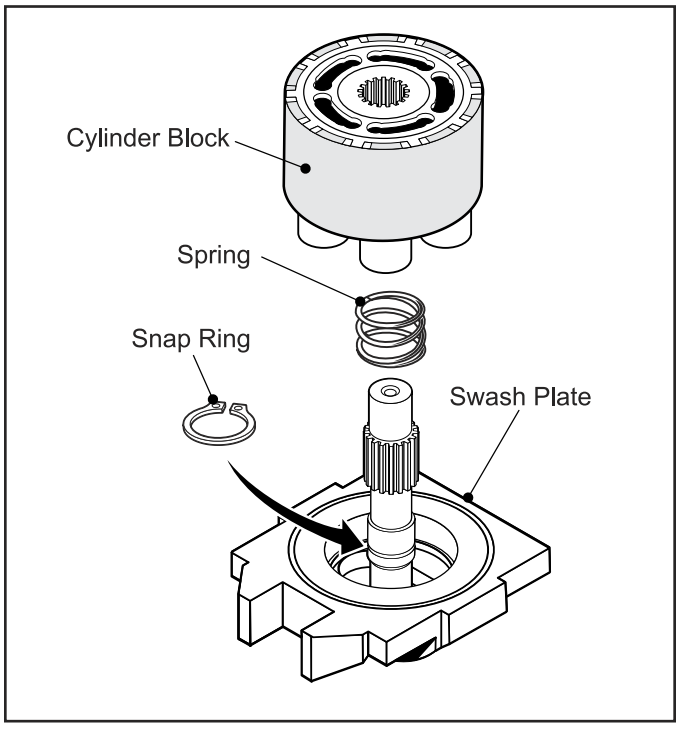


Fig. 22, Cylinder Block Assembly

Be careful that the Pistons do not fall out of Cylinder Block. Damage to any component of the assembly will result in the replacement of the entire assembly.

To avoid the pistons from dropping out during assembly, position fingers around the cylinder in order to apply pressure on each of the five pistons. (Fig. 23)

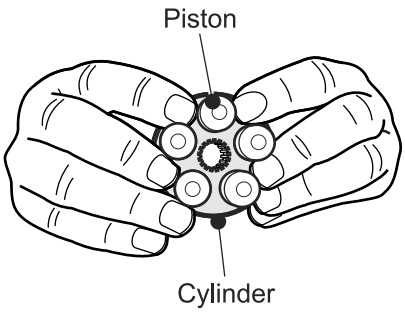


Fig. 23, Finger Placement During Assembly

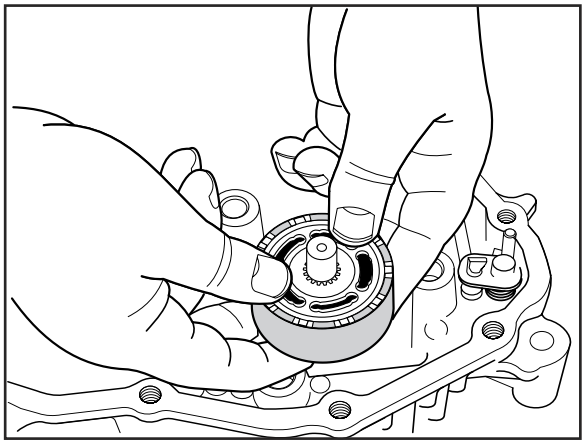


Fig. 24, Cylinder Block Assembly Installation

If any of the components of Cylinder Block Assembly are damaged, they must be replaced with a complete Cylinder Block Assembly. Individual components are not serviced separately.

Motor Shaft Assembly

1. Install a new Bearing onto the Motor Shaft, if required.
2. Lubricate Bearing with clean oil, (old or new).
3. Installation involving a new Bearing: *(Fig. 25)*
   - Press Bearing into position.
   - Install Washer.
   - Seat Snap Ring in the Motor Shafts groove.
4. Install a new Seal onto the Motor Shaft. *(Fig. 25)*
5. Install Snap Ring in front of new Seal. *(Fig. 25)*

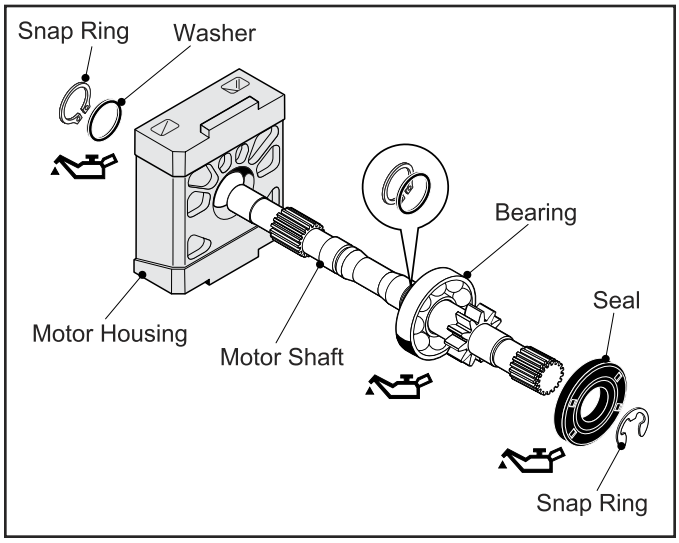


Fig. 25, Motor Shaft Assembly

Apply a light coating of grease to the surface of all Seals and O-rings. Also, apply a small amount of grease around the mating hole of the Upper Case. For Bearings and other machined parts, apply a coating of oil.

Motor Shaft Assembly (continued)

6. Install the Thrust Bearing Group into the Motor Housing.

   ◆ Comprising of (2) Thrust Plates and (1) Thrust Bearing, the Thrust Bearing Group should be oiled and placed into the Motor Housing. Starting with the "thin" Thrust Plate followed by the Thrust Bearing and finally, the "thick" Thrust Plate. (Fig. 26)

Apply a light coating of oil to the Motor Housing machined surfaces for Thrust Bearings.

7. Install Motor Shaft Assembly through hole in Motor Housing. *(Fig. 26)*
8. Install Snap Ring and Spring onto Motor Shaft. *(Fig. 26)*

Apply a light coating of grease to the surface of all Seals and O-rings. Also, apply a small amount of grease around the mating hole of the Upper Case. For Bearings and other machined parts, apply a coating of oil.

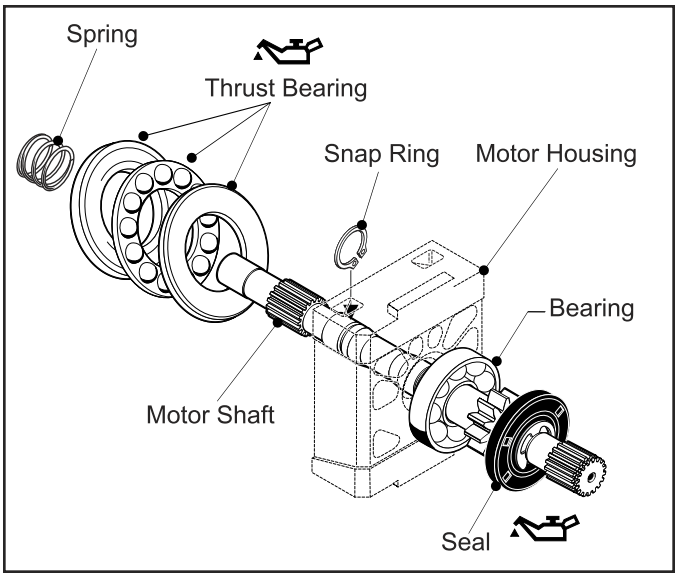


Fig. 26, Motor Shaft – Housing Assembly

9. Place the (5) washers, springs and pistons into Motor Cylinder Block. *(Fig. 27)*

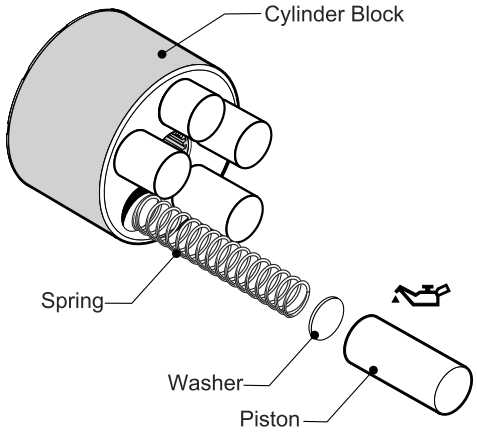


Fig. 27, Motor Cylinder Block

10. Align splines of the Cylinder Block Assembly and the Motor Shaft; then, press together until pistons are positioned against Motor Housing Thrust Bearing. *(Fig. 28)*

Motor Housing Assembly is installed so that dimples are showing (facing up). *(Fig. 28)*

If Motor Housing Assembly is oriented 180° opposite (dimples facing downward) during installation, axles will rotate in opposite direction, i.e., axles will rotate forward when they should be rotating in reverse.

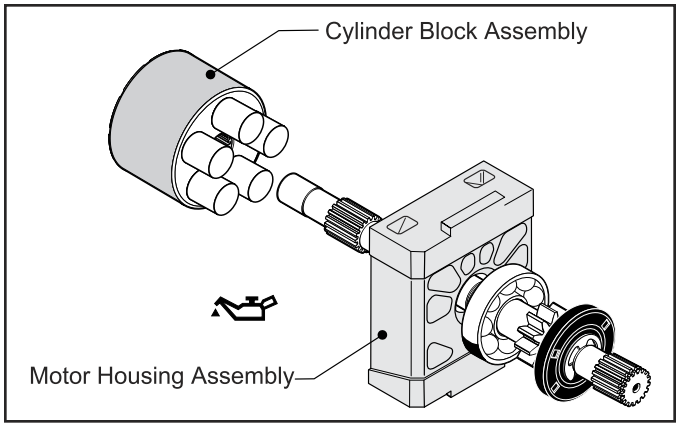


Fig. 28, Motor Cylinder Block Assembly

Center Case Assembly

The Center Case Assembly is comprised of several internal parts (Sleeve Assembly) that are not serviced separately. Other unserviceable parts include the Push Pins, Springs and Valves. Although, these parts are also considered to be internal, they will, unlike the Sleeve Ass'y, eject during handling. So, great care should be taken not to lets components get away during the handling of the Center Case. *(Fig. 29)*

⚠ Care should be taken when handling the Center Case Assembly. Any damage to its machined surfaces or internal components will result in the necessity to replace the entire assembly. *(Fig. 29, 31)*

Center Case Assembly:

- (2) Shaft Bushings
- (2) Alignment Pins
- (2) Push Pin Assemblies
- (2) Sleeve Assemblies

Sleeve Assembly (Not Illustrated):

- (2) Pin Holders
- (2) Ball Springs
- (2) Ball Holders
- (2) Balls
- (2) Back-Up Rings
- Sleeve "A1" (with orifice)
- Sleeve "A2"

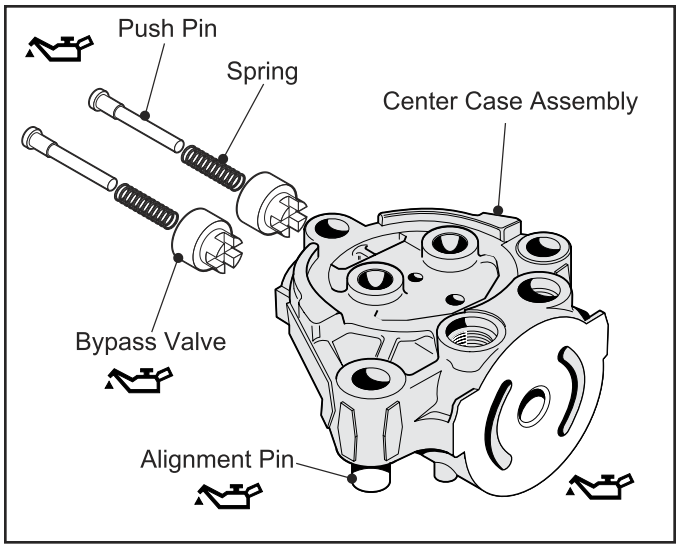


Fig. 29, Center Case Assembly

Apply a light coating of oil to the Push Pins, Valves, Alignment Pins, and the Machine surfaces of the Center Case. *(Fig. 29, 30)*

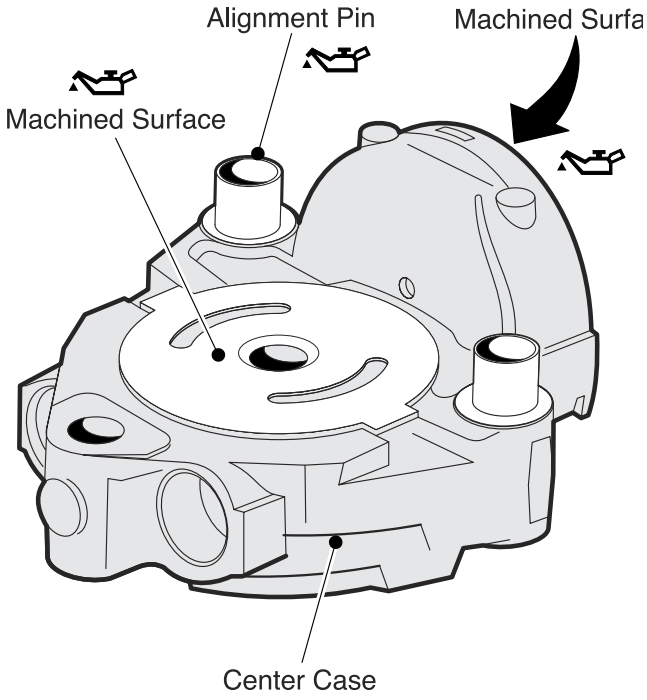


Fig. 30, Center Case Machined Surfaces

⚠ If Sleeves are removed, it is important that the Sleeve with the orifice be reinstalled in the same valve port it was removed from. Failure to install Sleeves in their correct location will result in the improper operation of the Transaxle. *(Fig. 31)*

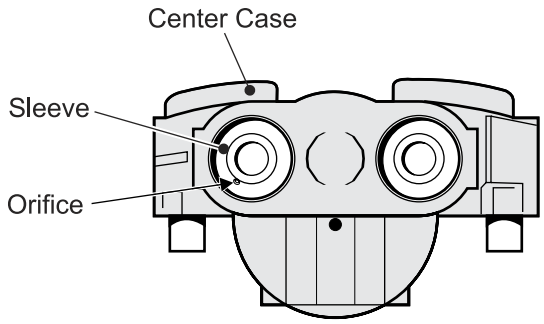


Fig. 31, Center Case Sleeve Placement

To avoid possible damage to the Push Pins, Springs, and/or Bypass Valves, these components should be installed after the Center Case has been secured into the Upper Case. To do otherwise could result in the items ejecting from valve causing their loss or damage.

Motor Shaft/Center Case Assembly

1. Apply a film of clean oil to the machined surface of the Center Case and to the mating surface of the Cylinder Block. *(Fig. 32)*

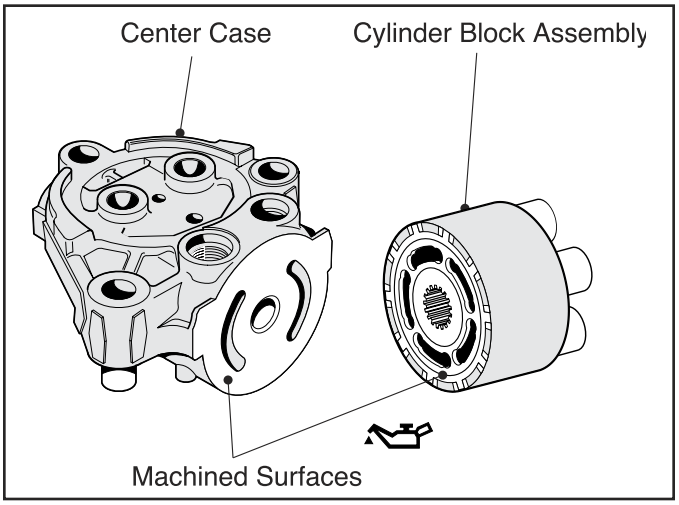


Fig. 32, Machined Surfaces–Center Case/Cyl. Blk

2. Align the Motor Shaft with the bushing in the Center Case and press together. *(Fig. 33)*

⚠ Care should be taken when handling the Center Case to avoid any possibility of damage. Also,care should be taken while compressing pistons in the Cylinder Block. If pressure is relaxed during assembly, the pistons may eject from the Cylinder Block. Thus, causing damage to the pistons and making it necessary to replace the entire assembly.

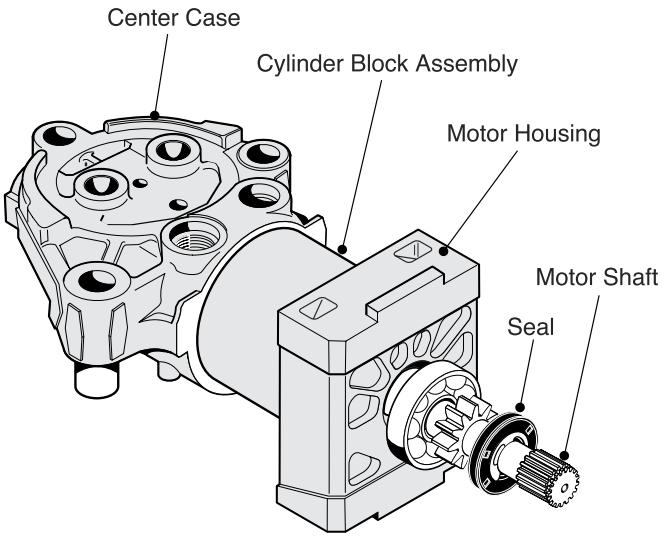


Fig. 33, Hydrostatic Motor Assembly

3. Install the Motor Shaft and Center Case assemblies into Upper Case as a single unit. *(Fig. 35)*

⚠ This may be the most difficult procedure in the entire assembly of the Transaxle, if not the most critical. For this assembly to go smoothly several things need to occur simultaneously;

◆ Pay particular attention to install motor housing in same orientation that it was removed with recesses (dimples) facing up. Incorrect installation will result in improper operation of transaxle.

◆ Align Seal, Bearing and Motor (Swash Plate) Housing with Upper Case grooves.

◆ Align the (2) Center Case Alignment Pins with Upper Case mounting holes as the Motor Shaft and Center Case Assemblies are squeezed together. Verify that tab on bottom of Motor Housing slips into slot of Upper Case. Press down on Center Case until Alignment Pins are securely seated.

A Pilot Hole on Center Case aids in the aligning of Center Case and the Pump Shaft.

4. Install (2) 10 mm Bolts and tighten with fingers. *(Fig. 34)*

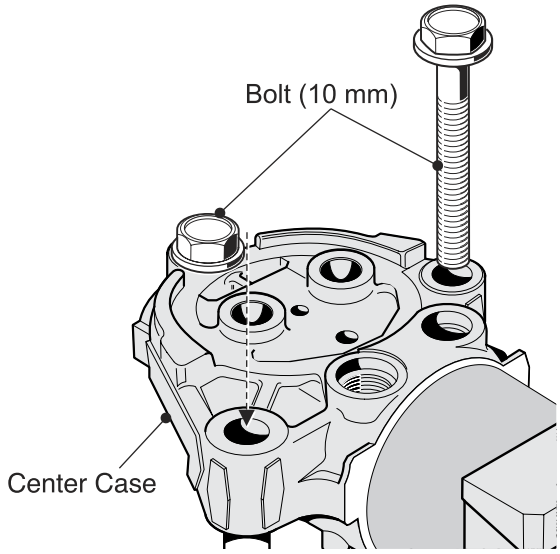


Fig. 34, Center Case Mounting

Motor Shaft/Center Case Assembly (continued)

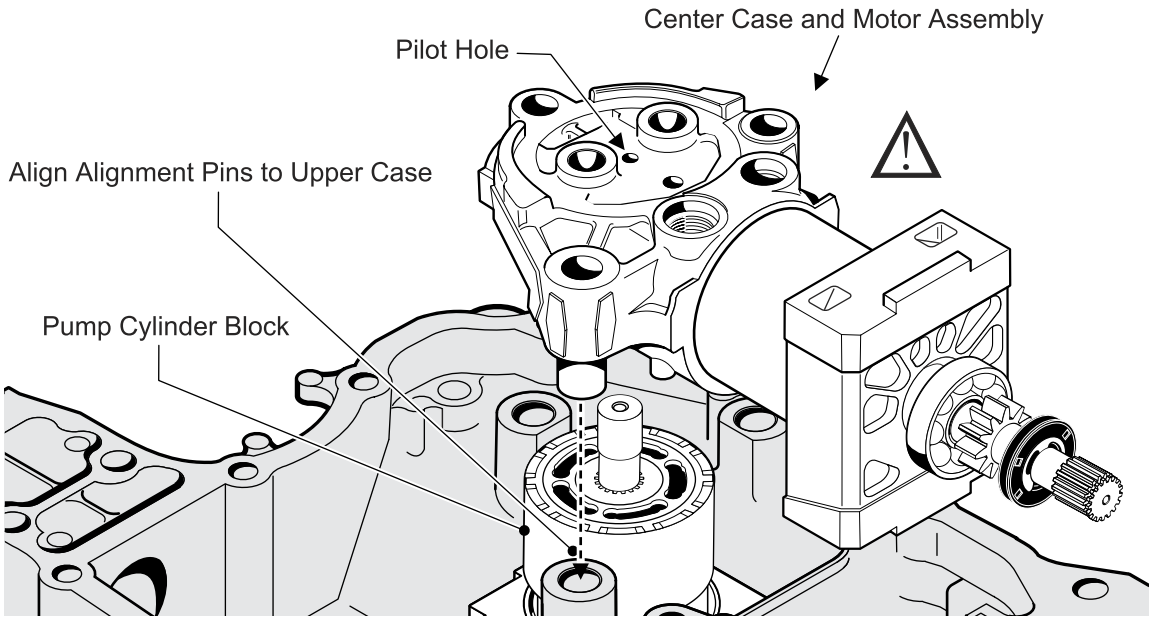


Fig. 35, Hydrostatic Pump and Motor Assembly

5. Install Magnet and Bolt in third hole of Center Case. *(Fig. 36)*

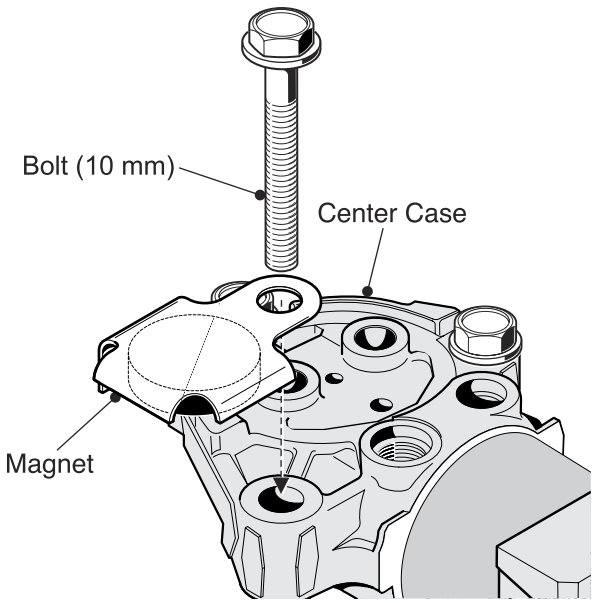


Fig. 36, Magnet Mounting

Magnet must be oriented, by rotating clockwise against Center Case side, while tightening Bolts. The Lower Case will not mate properly with Upper Case if Magnet is not correctly located.

4. Tighten the (3) 10 mm Bolts (14 mm wrench) evenly to draw Center Case Assembly into place.

Tightening torque: *4.5 ~ 6.5 kg-m*
44.3 ~ 63.9 N-m
33 ~ 47 ft lbs.

5. Install Push Pins, Springs, and Bypass Valves in Center Case; then, while depressing Push Pin Assemblies, place "C" Arm onto Bypass Shaft. *(Fig. 37)*

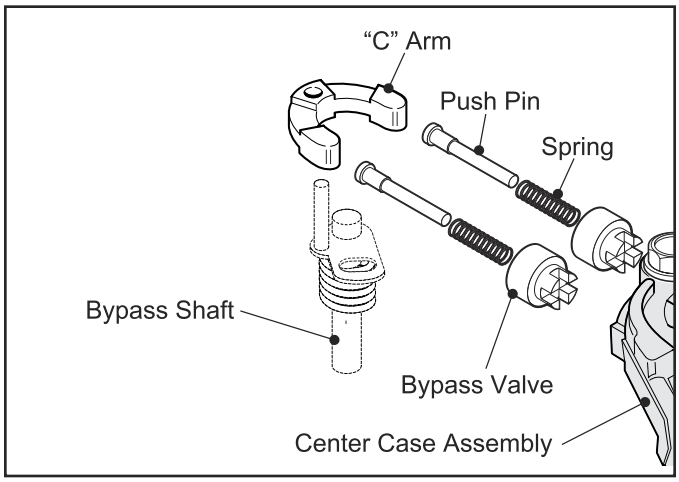


Fig. 37, Actuating Valve Assembly

Differential Gear Assembly

1. Install the (2) Differential Pinion Gears to Differential Pinion Shaft. *(Fig. 38)*
2. Install the Differential Pinion Assembly (Pinion Shaft and (2) Pinion Gears) within the Final Gear. *(Fig. 38)*
3. Position the (2) Thrust Washers aginist Pinion Shaft body and Final Gear. *(Fig. 38)*
4. Position the (2) Differential Side Gears next to Thrust Washers. *(Fig. 38)*

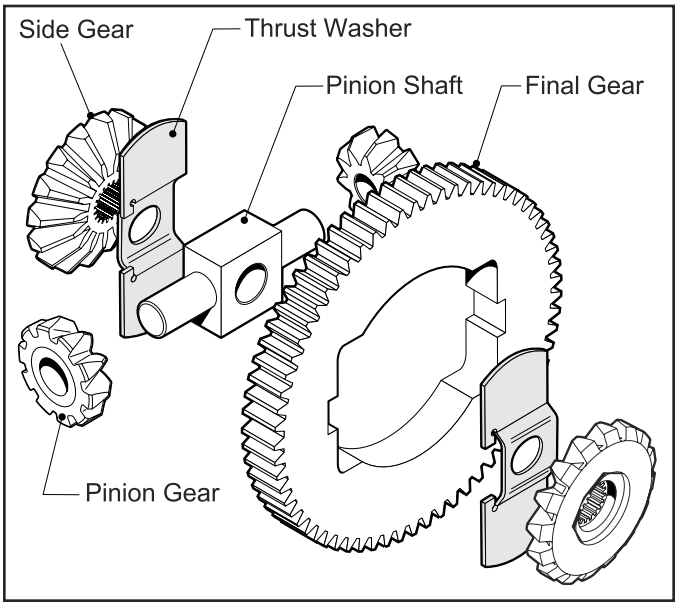


Fig. 38, Differential Gear Assembly

Axle Shafts and Differential Gear Assembly

1. Place new Seals onto Left and Right Axle Shafts. *(Fig. 39)*

Apply a light coating of grease to Seal before installation. Also, apply a small amount of grease to the chamfer of bore.

Install Seals from internal (splined) side of Axles to avoid cutting Seal lip on sharp edge of ring groove and keyway, However, if Axle Shafts are already in place, apply tape over ring groove and keyway to protect Seal lip.

2. Install Left and Right Axle Shafts into Upper Case.
3. Place the (2) "loose" Axle Bushings into corresponding grooves in Upper Case; then, push Axle Shafts through Bushings.

Install Bushings with the flat surfaces perpendicular to the surface of the Upper Case. *(Fig. 39)*

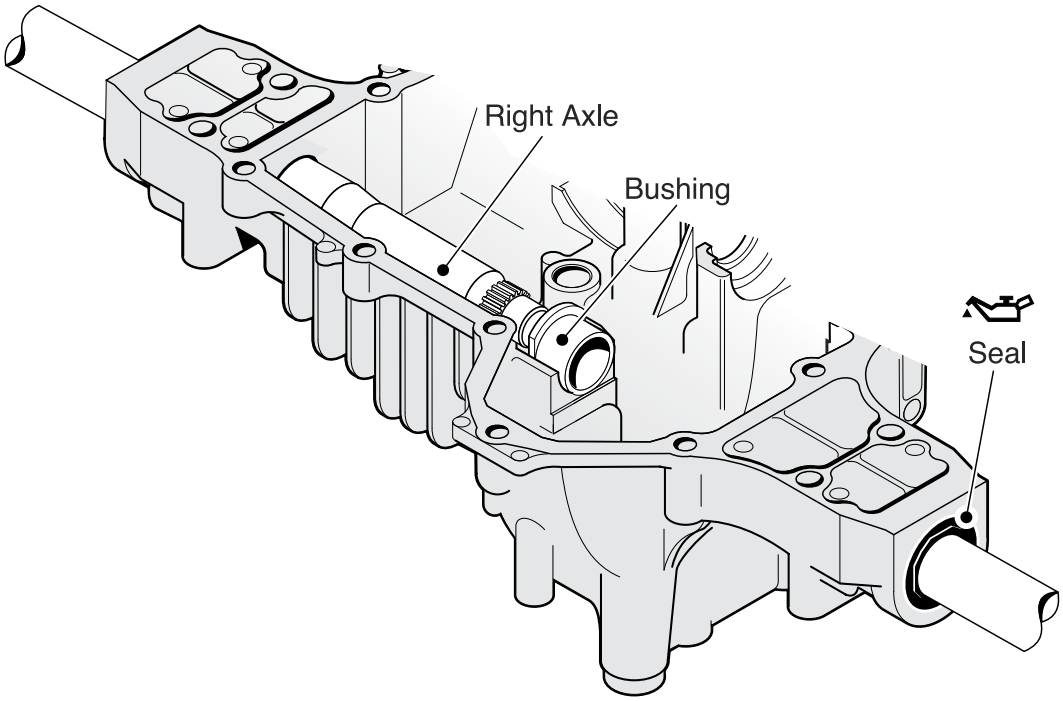


Fig. 39, Axle Bushing Assembly

Axle Shafts and Differential Gear Assembly (continued)

4. Install the Differential Gear Assembly to the Left and Right Axle Shafts. *(Fig. 40, 41)*
5. Install the (2) C-Rings onto the Left and Right Axle Shafts; then, push Shafts inward until each C-Ring is captured within the Side Gear's recess. *(Fig. 41)*
6. Install the (2) Thrust Washers to the Left and Right Axle Shafts. *(Fig. 41)*

Axle Shafts should rotate freely; turn by hand to check for ease of rotation. Also, verify that the C-Rings and Thrust Washers are properly seated by pulling outward on both Axle Shafts —There should be very little travel, confirming that Axles are secure.

7. Press both Axle Shaft Seals squarely into case, beyond chamfer of bore.

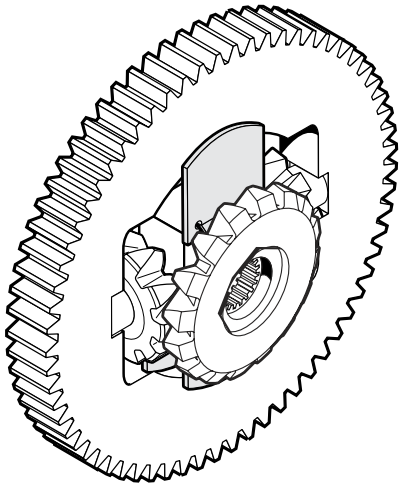


Fig. 40, Differential Gear Assembly

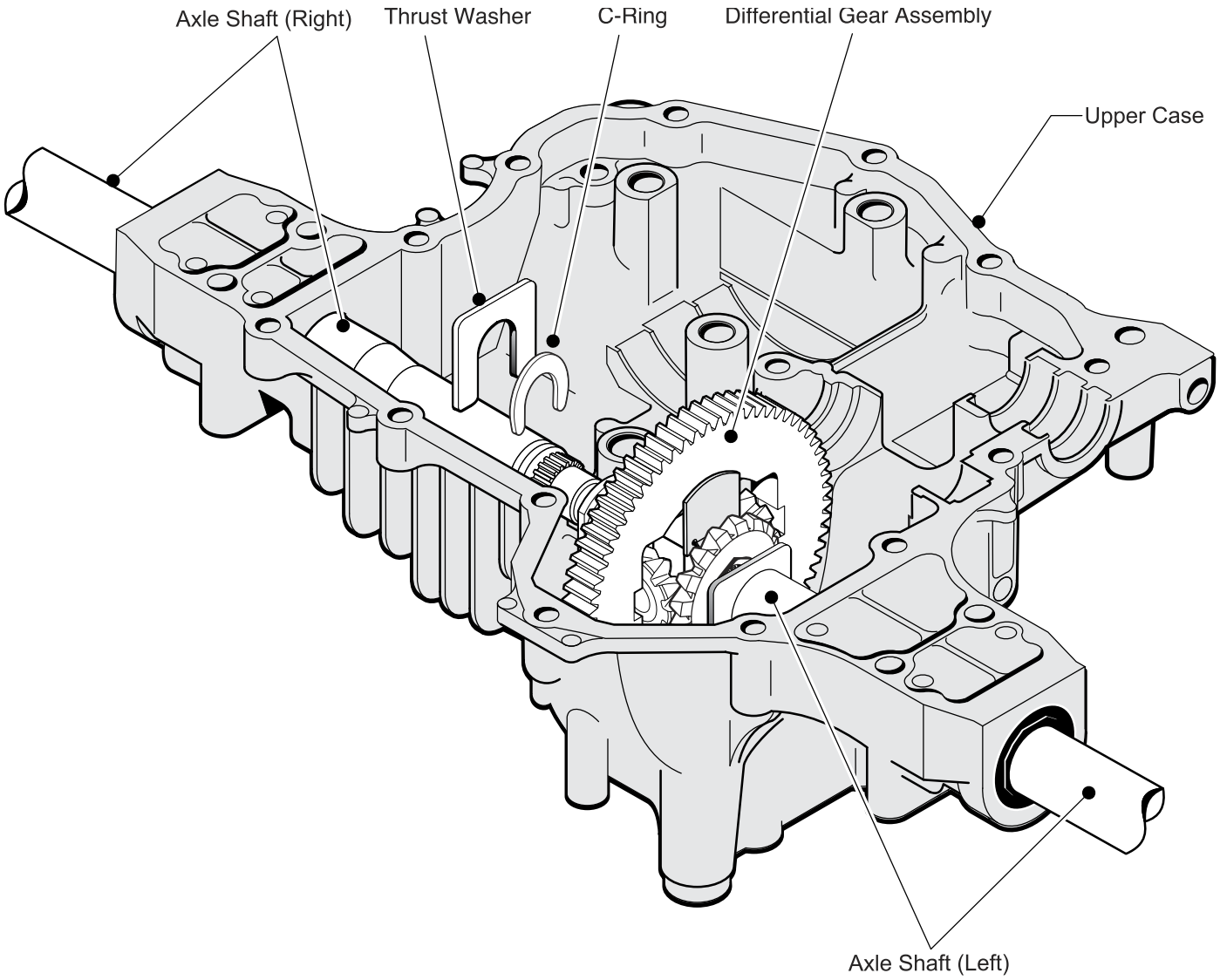


Fig. 41, Differential Gear Installation

Final Pinon Shaft Assembly

1. Install Bearing onto Final Pinion Shaft. *(Fig. 42)*
2. Install Final Shaft Gear, Washer and Bushing onto Final Pinion Shaft. *(Fig. 42)*
3. Install Final Pinion Shaft Assembly into Upper Case. *(Fig. 43)*

Install Bushing with flat surface parallel to the surface of the Upper Case. Lower Case will not mate properly with Upper Case if Bushing is improperly installed.

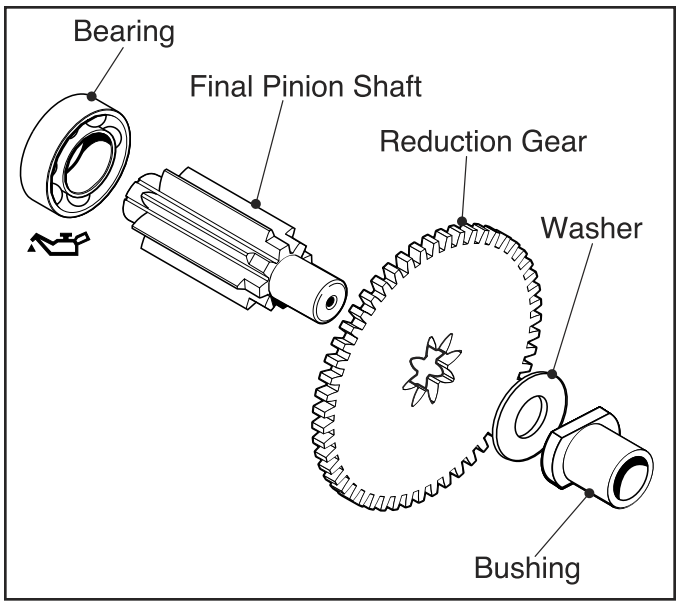


Fig. 42, Pinion Gear Assembly

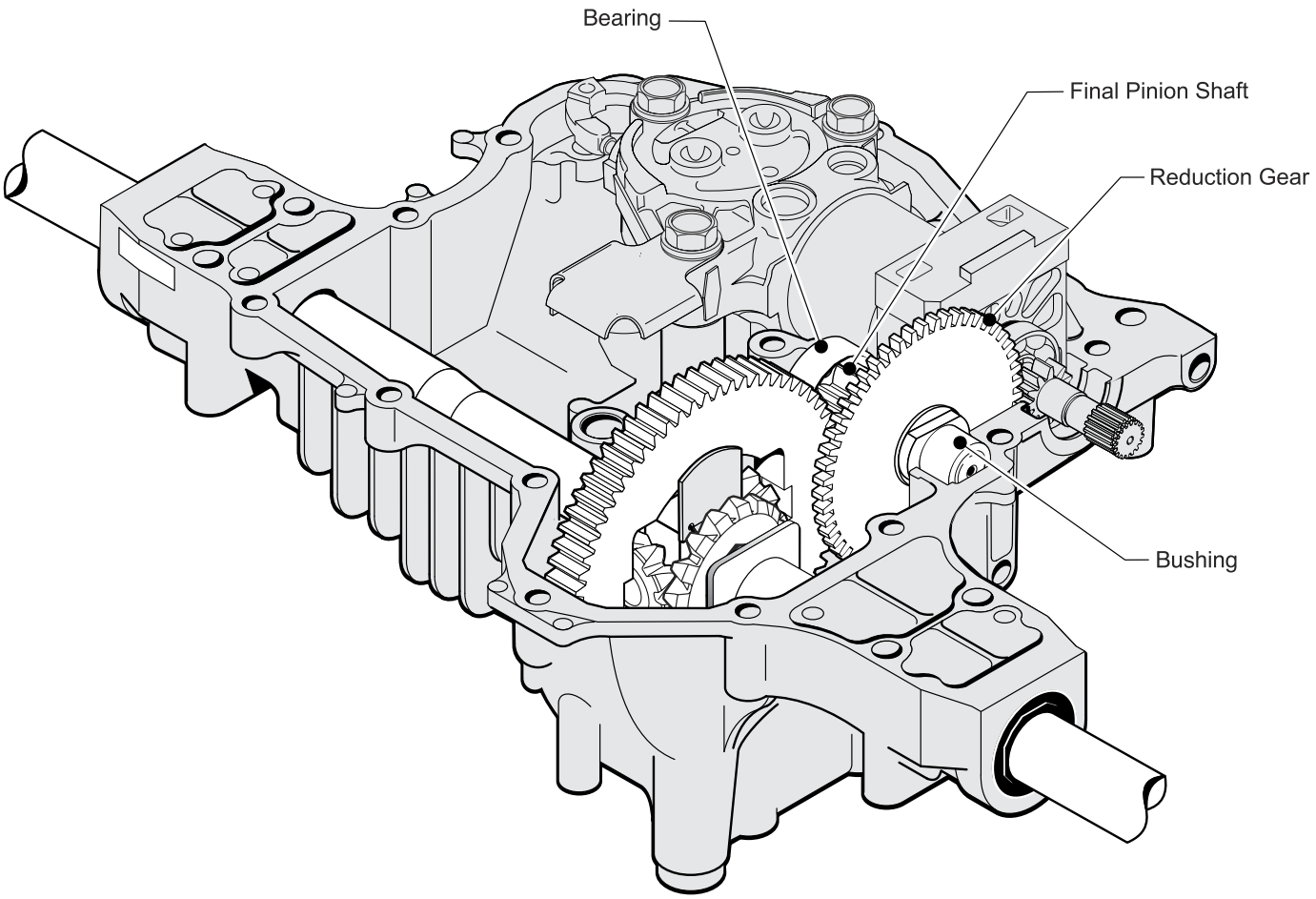


Fig. 43, Final Pinion Shaft Assembly

Lower and Upper Case Assembly

1. Place a new Filter over groove of Center Case.

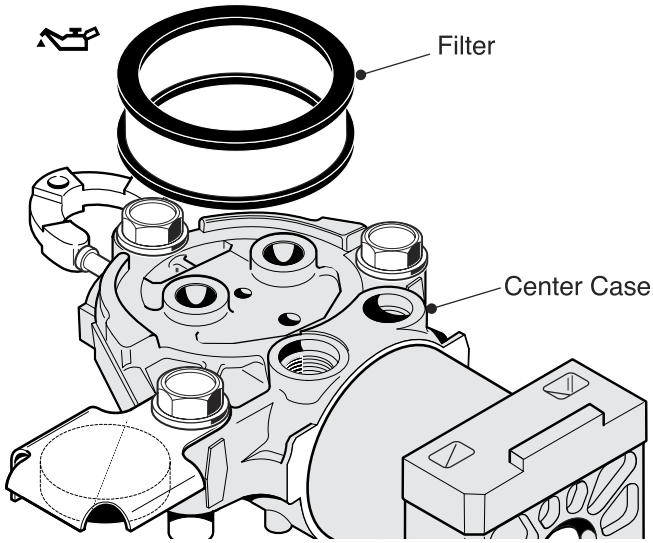


Fig. 44, New Filter Install

When installing a new Filter, apply a film of clean oil onto the rubber seals. *(Fig. 44)*

2. Apply a thin even bead of sealant to mating surface of Lower Case, following along the inside surface of bolt holes — Be sure to apply sealant aroung center bolt hole. *(Fig. 45)*

Clean mating surfaces of Transaxle thoroughly before applying sealant.

◆ Activate the Bypass Linkage so that "C" Arm (Fig. 43) retracts, providing additional clearance for the positioning of the Lower Case onto the Upper case.

3. Position Lower Case onto Upper Case — Press together.

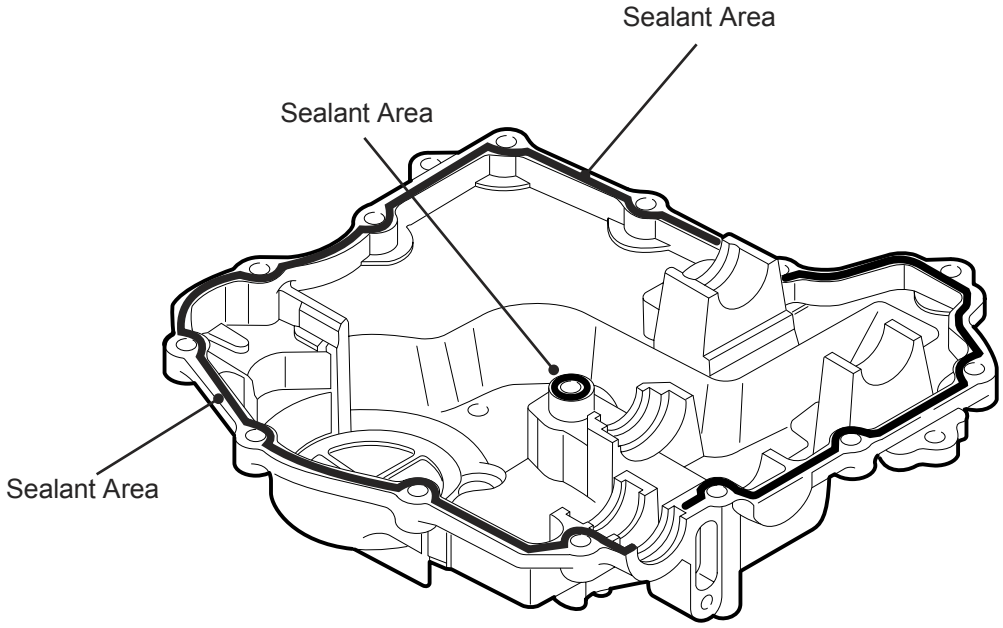


Fig. 45, Sealant Application to Lower Case

Lower and Upper Case Ass'y (continued)

4. Install (1) M8x75 Bolt (**arrow 14**), (2) M8x40 Bolts (**arrows 8 & 10**) and (11) M8x30 Bolts (**arrows 1–13**) to Lower Case/Upper Case. *(Fig. 46)*

5. Torque Bolts (12 mm wrench) utilizing the tightening sequence diagram. *(Fig. 46)*

Tightening torque: *2.3 ~ 2.5 kg-m*
22.6 ~ 24.6 N-m
17 ~ 18 ft lbs.

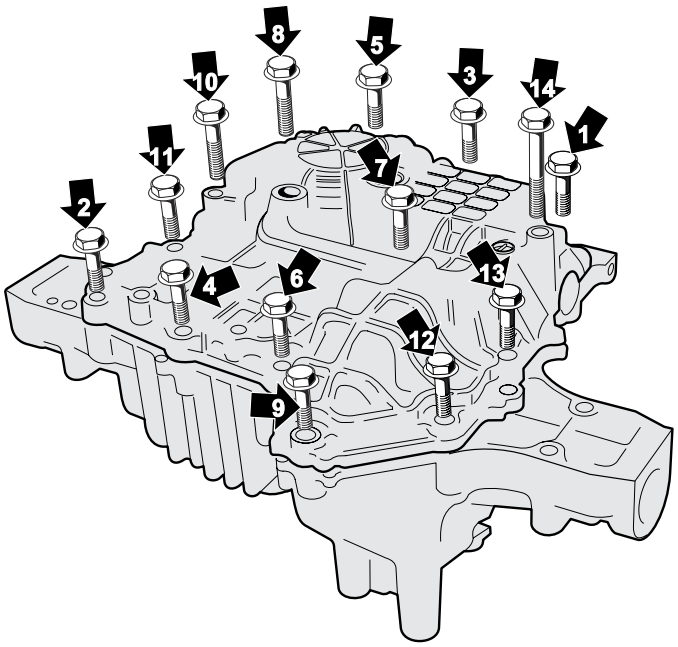


Fig. 46, Torque Sequence for Upper & Lower Case

6. Install Oil Drain Plug (12 mm wrench) with new Seal Washer into Lower Case.

Tightening torque: *1.3 ~ 1.7 kg-m*
12.8 ~ 16.7 N-m
113 ~ 148 in. lbs.

7. Install (2) new O-rings and the 1/8" plug (5 mm hex wrench) onto Connector (Pressure Fill Plug).

Apply grease to surface of O-rings.

If 1/8 inch Pressure Plug was removed apply Teflon tape to threads of plug before reinstalling. *(Fig. 47)*

8. Install Connector through Lower Case's opening into Center Case port.

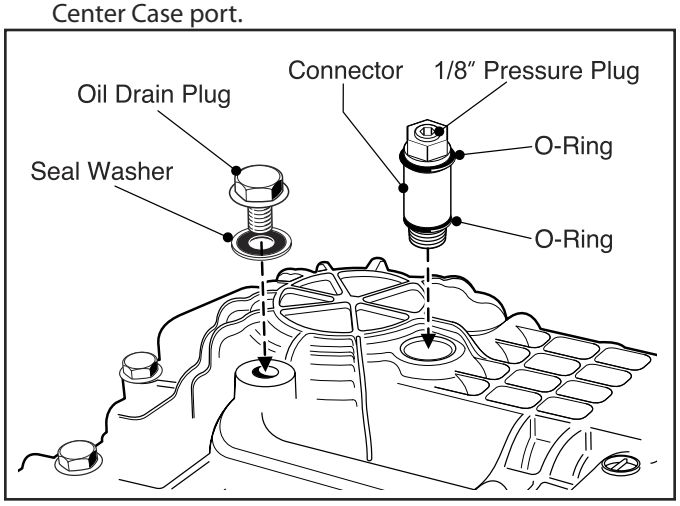


Fig. 47, Oil Plug & Connector Install

Before installing the Connector, fill transmission rotor groups with new oil through the connector port of Center Case while hand rotating Motor Shaft using Brake Drum for gripping assistance. This procedure is effective for quick air bleeding.

Brake Assembly

1. Install the Brake Drum and Snap Ring onto Motor Shaft. *(Fig. 49)*
2. Install the Brake Band Assembly; tighten (3) Bolts by hand. *(Fig. 48, 49)*

Clean oil and dust from the Brake Band and Brake Drum before installing.

3. Center the Brake Band around the Brake Drum by manually activating (left to right) the Engagement Lever. While maintaining pressure to the Engagement Lever, tighten (using a 12 mm wrench) the (3) Bolts.

Tightening torque: *2.3 ~ 3.0 kg-m*
22.6 ~ 29.5 N-m
17 ~ 21 ft. lbs.

4. Attach the Brake Rod Assembly to the Brake Arm.
5. Adjust the Brake Rod to align with the Engagement Lever and connect.
6. Connect the Washer and Cotter Pin.
7. Confirm that the Band Brake is properly aligned and working smoothly.
8. **(If Applicable)** Connect one end of the Shock Absorber to the Control Arm and the opposite end to the stud on Upper Case, using the appropriate hardware, i.e., Spring Clips or Cotter Pin. *(Fig. 49)*

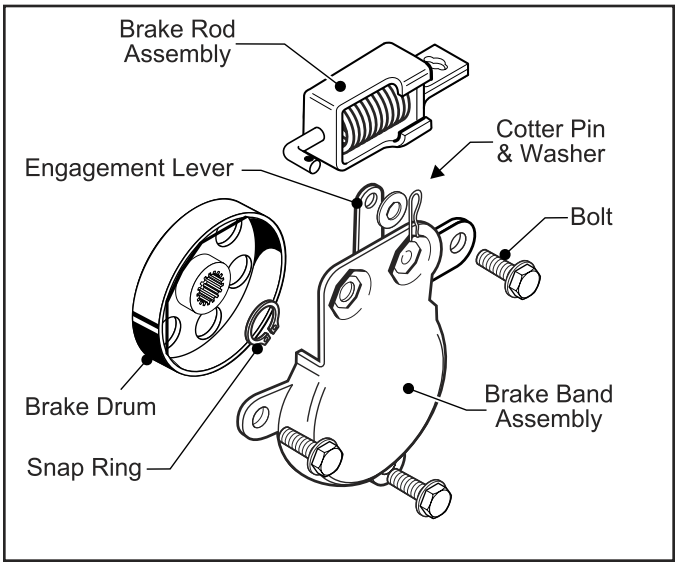


Fig. 48, Brake Band Assembly

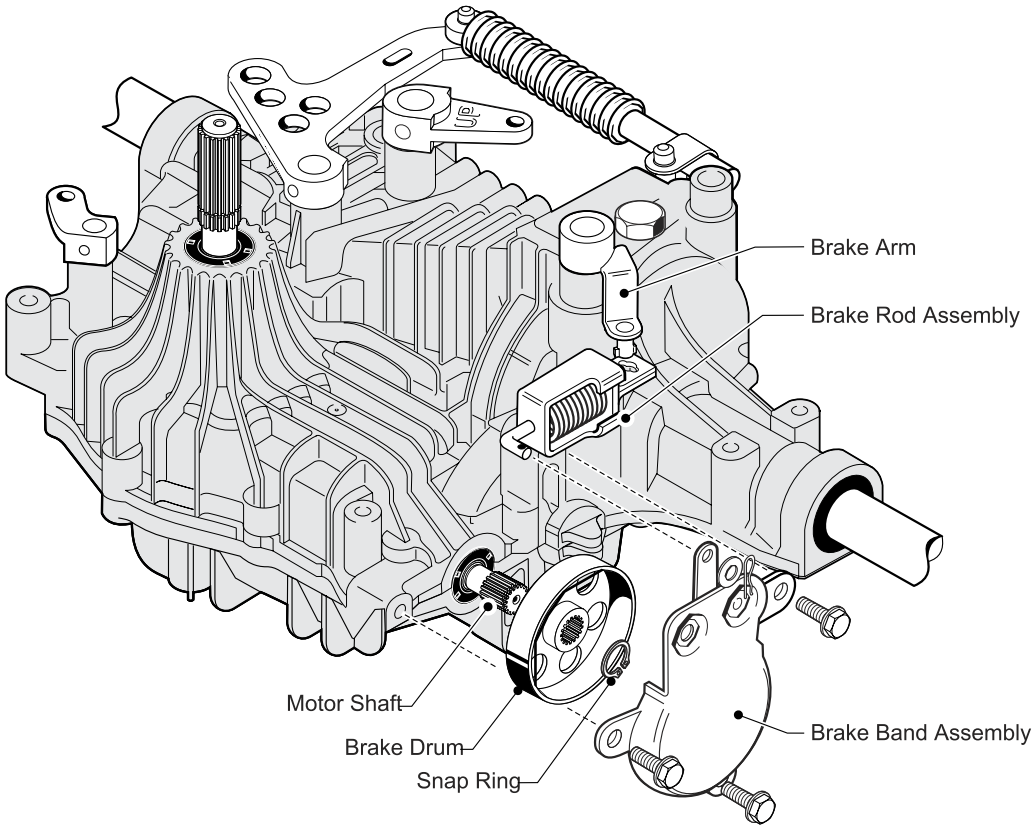


Fig. 49, Brake Band Installation

Post Assembly Procedures

1. Pour new SAE 10W30, Class CC or CD engine oil, approx. 2.5 L (2.65 qt.), into the Transaxle until oil level reaches the top of the fill port.

K61E Only:

2. Place,–(Cap, Sleeve & Hose Clamp) over the fill port. *(Fig. 50)*

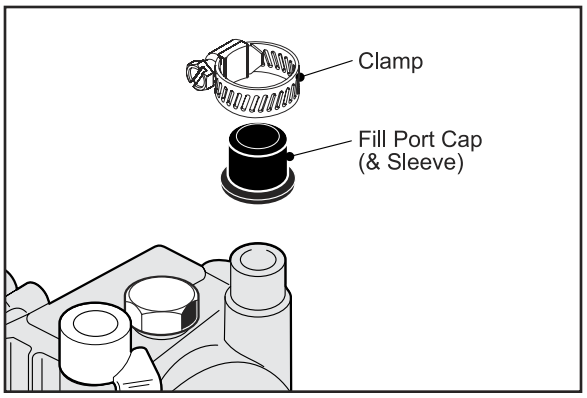


Fig. 50, Oil Port Cap

3. During the warranty period, the serial number of the Transaxle is required when applying for reimbursement of appropriate repairs. Serial number is also beneficial to the dealer in providing the proper parts for the series transaxle being repaired. (See page ii for Serial Number location)

Purging Air from Hydrostate Oil Circuit

1. Check oil level.
2. Place vehicle's drive axle on jack stands with wheels off floor.
3. Start engine and operate at low idle.
4. Repeat opening and closing of bypass valve while alternately depressing forward and reverse pedals.
5. When vehicle starts to move, increase engine speed to high idle.
6. Repeat quick starts and panic stops until transaxle gives full response.
7. Recheck and top-off oil level.

For immediate air bleeding, fill transmission's Center Case with new oil into the connector port in Center Case through connector hole of transaxle's Lower Case while rotating Motor Shaft by hand via the Brake Drum. (Refer to Fig. 47)

Adjusting Neutral

1. Complete air bleeding on the Transaxle.
2. Place the tractor's rear axle on a jack stands with wheels off the floor.
3. Remove necessary components from vehicle to access (brass colored) Fulcrum on Transaxle for adjustment.
4. Start engine and adjust the throttle for high idle speed (full throttle).
5. Turn the Fulcrum Shaft clockwise until the Axle Shafts rotate in reverse.
6. Mark the top of the Fulcrum.
7. Turn the Fulcrum Shaft counterclockwise slowly until the Axle Shafts stop rotating in reverse. Mark the Transaxle Case. *(Fig. 51)*
8. Turn the Fulcrum Shaft counterclockwise slowly until the Axle Shafts rotate forward.
9. Turn the Fulcrum Shaft clockwise slowly until the Axle Shaft stops and mark the Transaxle Case. *(Fig. 51)*
10. Rotate mark on the Fulcrum clockwise to a position one third (1/3) distance from the forward stop point. *(Fig. 51)*
11. Hold the Fulcrum Shaft with a (8 mm) wrench, and tighten the (17 mm) Lock Nut. *(Fig. 51)*

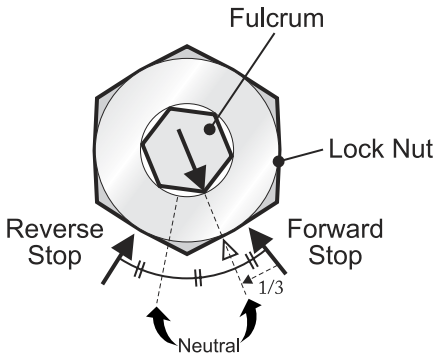


Fig. 51, Neutral Adjustment 1

12. Confirm no rotation of the Axle Shaft in neutral by slowly returning the Control Lever to neutral from forward and reverse.

Oil Change Frequency

For consumer use in yard tractor and riding mower applications oil changing is not emphasized as most homeowners are not equipped or in the habit of changing transmission oil. For most consumers, the transaxle will outlast the life of the vehicle. It must be said that changing oil will extend the life of the transmission.

However, in commercial and heavy usage applications oil changing is recommended after the first 50 hours of operation and every 200 hours thereafter.

The filter should never require changing unless the transaxle is removed from the tractor or riding mower and opened for repairs.

Oil Requirement

Approximately 3.3 liters of SAE 10W30, Class CC or CD engine oil.

K61 Hydrostatic Transaxle

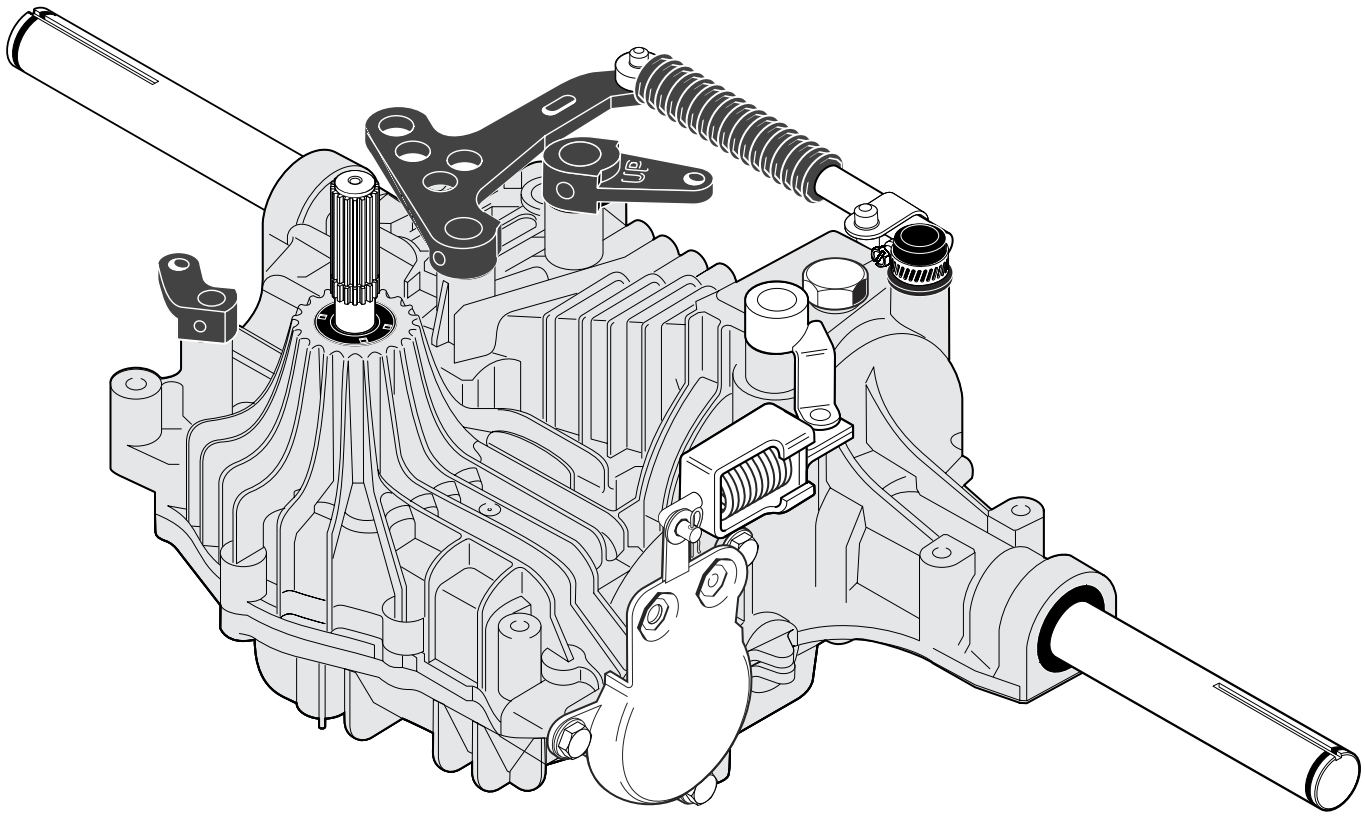


Fig. 52, K61 Hydrostatic Transaxle

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Note: If your specific problem and/or solution is not listed below, consult a qualified Tuff Torq Distributor.	
Transaxle Noise	
◆ DEBRIS INTERFERING WITH MOVING PARTS	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ INCORRECT OIL/OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ BRAKE DRAGGING OR PARTIALLY ENGAGED	◆ BRAKE LINKAGE BROKEN, BENT, BINDING, OR OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ TRANSAXLE DRIVE BELT OUT OF ADJUSTMENT, RUBBING SOMEWHERE OR FRAYED	◆ MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ FAN CRACKED, BROKEN OR STRIKING SOMETHING	◆ INSPECT FAN FOR DAMAGE - CHECK FOR FAN BLADE INTERFERENCE - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ BEARING ON IDLER PULLEY WORN EXCESSIVELY	◆ INSPECT IDLER PULLEY COMPONENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENT
◆ INPUT SHAFT PULLEY, LOOSE OR DAMAGED	◆ INSPECT PULLEY, PULLEY SPLINES, SNAP RINGS AND INPUT SHAFT SPLINES FOR DAMAGE - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ BY-PASS VALVE ORIFICE LOCATED IN WRONG PORT	◆ CENTER CASE REPLACEMENT REQUIRED
◆ HYDROSTATIC OIL FILTER PLUGGED	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
◆ INTERNAL DAMAGE TO ROTATING GROUPS AND DIFFERENTIAL ASSEMBLY	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Brakes Malfunction	
◆ BRAKE LINKAGE BROKEN, BENT, BINDING, OR DISCONNECTED	◆ CLEAN AND INSPECT TRANSAXLE FOR ACCUMULATED DEBRIS AND WORN LINKAGE COMPONENTS
◆ BRAKES OUT OF ADJUSTMENT	◆ SEE PROCEDURE FOR PROPER ADJUSTMENT
◆ BRAKE DRUM AND BRAKE BAND ASSEMBLY COATED WITH OIL	◆ CLEAN BRAKE COMPONENTS WITH BRAKE CLEANER
Transaxle Overheating	
◆ POOR AIR CIRCULATION - FAULTY AND/OR DAMAGED FAN PULLEY	◆ INSPECT FAN/PULLEY FOR DAMAGE - CHECK MOUNTING HARDWARE - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ INCORRECT OIL/OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ ACCUMULATION OF GRASS AND OTHER DEBRIS IN COOLING FINS OF TRANSAXLE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ TRANSAXLE DRIVE BELT OUT OF ADJUSTMENT OR DAMAGED	◆ MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ BRAKE DRAGGING OR PARTIALLY ENGAGED	◆ BRAKE LINKAGE BROKEN, BENT, BINDING OR OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ BY-PASS VALVE ORIFICE LOCATED IN WRONG PORT	◆ CENTER CASE REPLACEMENT REQUIRED
Creeps In Neutral	
◆ SPEED (SHIFT) CONTROL LINKAGE BENT OR BINDING	◆ REMOVE ACCUMULATED DEBRIS - REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST PER PROPER PROCEDURE
◆ TRANSAXLE SHIFT CONTROL ARM (LEVER) FAILED. SHIFT CONTROL ARM ROLLPIN (O.D. AND LENGTH) UNDERSIZED OR MISSING	◆ REPLACE DAMAGED OR MISSING COMPONENTS - ADJUST SHIFT LINKAGE PER PROPER PROCEDURE
◆ SHOCK ABSORBER (DAMPER), BENT, RUSTY, WORN OR MISSING	◆ REPLACE SHOCK ABSORBER
◆ NEUTRAL SETTING OUT OF ADJUSTMENT	◆ MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ INTERNAL DAMAGE TO SHIFT CONTROL SHAFT, SWASH PLATE AND COMPONENTS, THRUST METALS (BEARING PADS) AND NEUTRAL RETURN SPRING	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Hard Shifting	
◆ SPEED (SHIFT) CONTROL LINKAGE BELT, BINDING AND/OR WORN	◆ REMOVE ACCUMULATED DEBRIS - REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST PER PROPER PROCEDURE
◆ INCORRECT OIL/OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ SHOCK ABSORBER (DAMPER), BENT, RUSTY, WORN OR MISSING	◆ REPLACE SHOCK ABSORBER
◆ INTERNAL DAMAGE TO SHIFT CONTROL SHAFT, SWASH PLATE AND COMPONENTS, THRUST METALS (BEARING PADS) AND NEUTRAL RETURN SPRING	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
Oil Leakage	
◆ EXCESSIVE RUST PREVENTATIVE APPLIED AT MANUFACTURER'S FACILITY ◆ EXCESSIVE OIL IN TRANSAXLE (DUE TO OVERFILL) LEAKING FROM EXPANSION TANK DUE TO HEAT EXPANSION ◆ TRANSAXLE OVERHEATING (DUE TO EXCESSIVE LOADING) - LEAKING FROM EXPANSION TANK DUE TO EXCESSIVE RISE IN OIL TEMPERATURE.	◆ THESE CASES APPEAR TO BE LEAKING, BUT DO NOT REQUIRE REPAIR. ALL LEAKS SHOULD BE INVESTIGATED TO DETERMINE SOURCE OF LEAKAGE. ADJUST OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL CONFIRM THAT TRANSAXLE IS NOT OVERHEATING WASH ALL EXCESS OIL AND ACCUMULATED DEBRIS OFF OF TRANSAXLE OPERATE MOWER UNTIL OPERATING TEMPERATURE BECOMES NORMAL CHECK AGAIN FOR OIL LEAKAGE TO FIND EXACT SOURCE
◆ EXPANSION TANK AND CONNECTION COMPONENTS	◆ MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ INPUT SHAFT SEAL	◆ SEE INPUT SHAFT SEAL REPLACEMENT PROCEDURE
◆ AXLE SHAFT SEAL	◆ SEE AXLE SHAFT SEAL REPLACEMENT PROCEDURE
◆ DRAIN PLUG LOWER CASE	◆ REMOVE INSPECT, AND REPLACE SEAL WASHER - REPLACE TEFLON TAPE ON ALLEN PLUG - TORQUE PLUG TO 1.5 KG-M (130 IN-LBS) - CHECK OIL LEVEL
◆ FITTING (CONNECTOR) AND ALLEN PLUG	◆ REMOVE, INSPECT, REPLACE INNER AND OUTER "O" RINGS IF REQUIRED - TORQUE FITTING AND PLUG TO 2.0-2.5 KG-M (15-18 FT-LBS) - CHECK OIL LEVEL
◆ CASE BOLTS	◆ RESEAL AND TORQUE BOLTS TO 2.3~2.8 KG-M (17~20.6 FT-LBS)

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Oil Leakage (continued)	
◆ CASE HALVES IF TORQUE MEETS SPECIFICATIONS • MOTOR OUTPUT SHAFT SEAL (BRAKE) • BY-PASS (TOW) CONTROL SHAFT "O" RING • SPEED (SHIFT) CONTROL SHAFT "O" RING • FULCRUM "O" RING EITHER BRAKE SHAFT "O" RING	◆ REPLACE SEALS AND O-RINGS AS REQUIRED
Input (Pump) Shaft/Pulley Will Not Turn	
◆ TRANSAXLE DRIVE BELT OUT OF ADJUSTMENT, WORN, FRAYED OR MISSING	◆ INSPECT DRIVE BELT, REPLACE AND/OR ADJUST PER PROPER PROCEDURE
◆ IDLER PULLEY SEIZED, BINDING OR WORN	◆ INSPECT IDLER PULLEY COMPONENTS - MAKE NECESSARY CORRECTIONS
◆ GRASS OR OTHER DEBRIS INTERFERENCE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ INPUT (PUMP) SHAFT SPLINES DAMAGED EXTERNALLY OR INTERNALLY	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
◆ INTERNAL DAMAGE TO ROTATING GROUPS, CENTER CASE, AND DIFFERENTIAL ASSEMBLY	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
No Drive	
◆ AXLE/WHEEL HUB KEYS MISSING OR DAMAGED	◆ CHECK KEYS FOR PROPER INSTALLATION
◆ INCORRECT OIL LEVEL OR OIL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ TRANSAXLE DRIVE BELT OUT OF ADJUSTMENT, WORN, FRAYED, OR MISSING	◆ INSPECT DRIVE BELT - REPLACE AND/OR ADJUST PER PROPER PROCEDURE
◆ SPEED (SHIFT) CONTROL SHAFT ROLL PIN SHEARED OR MISSING ON TRANSAXLE	◆ REPLACE MISSING OR DAMAGED ROLL PIN
◆ PARKING BRAKE ENGAGED	◆ REMOVE ACCUMULATED DEBRIS - REPAIR AND/OR REPLACE DAMAGED OR MISSING COMPONENTS
◆ SPEED (SHIFT) CONTROL LINKAGE BROKEN, BENT, DISCONNECTED OR BINDING	◆ DISENGAGE PARKING BRAKE
◆ ENGINE OR TRANSAXLE PULLEY TURNING ON ATTACHED SHAFT	◆ INSPECT KEYS OR SPLINES ON ENGINE AND TRANSAXLE PULLEYS - REPLACE DAMAGED OR MISSING COMPONENTS

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
No Drive (continued)	
◆ BY-PASS (TOW) VALVE ACTIVATED	◆ CHECK BY-PASS (TOW) VALVE CONTROL FOR BENT, BROKEN, DISCONNECTED OR BINDING LINKAGE
◆ INPUT SHAFT SPLINES DAMAGED ◆ BY-PASS (TOW) VALVE COMPONENTS DAMAGED ◆ INPUT SHAFT NOT ROTATING PUMP COMPONENTS ◆ INTERNAL DAMAGE TO ROTATING GROUPS, CENTER CASE, AND DIFFERENTIAL ASSEMBLY ◆ HYDROSTATIC OIL FILTER PLUGGED	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
No Drive - One Direction	
◆ GRASS OR OTHER DEBRIS INTERFERENCE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ SPEED (SHIFT) CONTROL LINKAGE BENT OR BINDING	◆ REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST SHIFT LINKAGE PER PROPER PROCEDURE
◆ TRANSAXLE SHIFT CONTROL ARM (LEVER) FAILED OR WORN	◆ REPLACE SHIFT CONTROL ARM (LEVER) AND NEW ROLL PIN ADJUST SHIFT LINKAGE PER PROPER PROCEDURE
◆ BRAKE DRAGGING OR PARTIALLY ENGAGED	◆ BRAKE LINKAGE BROKEN, BENT, BINDING, OR OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ FITTING (CONNECTOR - NOT OIL PLUG) LOOSE AT BOTTOM OF CASE	◆ TORQUE FITTING AND ALLEN PLUG TO 2.0-2.5 KG-M (15-18 FT-LBS)
◆ INTERNAL BINDING DAMAGE TO SHIFT CONTROL SHAFT, SWASH PLATE AND COMPONENTS, THRUST METALS (BEARING PADS), ROTATING GROUPS, OR CENTER CASE	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Slows Down Under Heavy Load...	
High Operating Temperature..."Stall" Condition	
◆ INCORRECT OIL/OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ TRANSAXLE DRIVE BELT OUT OF ADJUSTMENT, WORN OR FRAYED	◆ INSPECT DRIVE BELT, REPLACE AND/OR ADJUST PER PROPER PROCEDURE
◆ INADEQUATE (INSUFFICIENT) COOLING	◆ SEE TRANSMISSION OVERHEATING PROBLEM
◆ BRAKE DRAGGING OR PARTIALLY ENGAGED	◆ BRAKE LINKAGE BROKEN, BENT, BINDING, OR OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ TRANSAXLE IS OVERLOADED	◆ REDUCE LOAD - ALLOW TRANSAXLE TO COOL
◆ LOSS OF ENGINE RPM'S	◆ REPAIR ENGINE
◆ INTERNAL DAMAGE TO ROTATING GROUPS OR CENTER CASE	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
Lower Power - Both Directions	
◆ AXLE/WHEEL HUB SLIPPING	◆ CHECK KEYS FOR PROPER INSTALLATION - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ GRASS OR OTHER DEBRIS INTERFERENCE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ INCORRECT OIL/OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ ENGINE RPM NOT MAXIMUM	◆ ADJUST ENGINE SPEED
◆ PARKING BRAKE ENGAGED	◆ DISENGAGE PARKING BRAKE
◆ BRAKE DRAGGING OR ENGAGED	◆ OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ SPEED (SHIFT) CONTROL LINKAGE BENT OR BINDING	◆ REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST SHIFT LINKAGE PER PROPER PROCEDURE
◆ CONNECTOR FITTING (NOT OIL PLUG) LOOSE AT BOTTOM OF CASE	◆ TORQUE FITTING AND ALLEN PLUG TO 2.0-2.5 KG-M (15-18 FT-LBS)
◆ ENGINE OR TRANSAXLE PULLEY LOOSE OR DAMAGED ON RESPECTIVE SHAFTS	◆ INSPECT PULLEYS, PULLEY SPLINES, AND SNAP RINGS - MAKE NECESSARY CORRECTIONS ***NOTE: IF INPUT SHAFT SPLINES ARE DAMAGED OR WORN, INPUT SHAFT REPLACEMENT MAY BE REQUIRED.***

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
Lower Power - Both Directions (continued)	
◆ BY-PASS (TOW) VALVE PARTIALLY ACTIVATED	◆ CHECK BY-PASS (TOW) VALVE CONTROL FOR BENT, BROKEN, DISCONNECTED OR BINDING LINKAGE
◆ INTERNAL DAMAGE TO ROTATING GROUPS, SWASH PLATE AND COMPONENTS, CENTER CASE OR DIFFERENTIAL ASSEMBLY	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED
◆ HYDROSTATIC OIL FILTER PLUGGED	◆ FILTER REPLACEMENT REQUIRED
Low Power - One Direction	
◆ AXLE/WHEEL HUB SLIPPING	◆ CHECK KEYS FOR PROPER INSTALLATION AND MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ GRASS OR OTHER DEBRIS INTERFERENCE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ INCORRECT OIL OR OIL LEVEL IN TRANSAXLE	◆ CHECK OIL LEVEL IN EXPANSION TANK - SAE 10W30 MOTOR OIL
◆ PARKING BRAKE ENGAGED	◆ DISENGAGE PARKING BRAKE
◆ BRAKE DRAGGING OR PARTIALLY ENGAGED	◆ BRAKE LINKAGE BROKEN, BENT, BINDING, OR OUT OF ADJUSTMENT - MAKE NECESSARY CORRECTIONS/ADJUSTMENTS
◆ SPEED (SHIFT) CONTROL LINKAGE BROKEN, BENT OR BINDING	◆ REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST SHIFT LINKAGE PER PROPER PROCEDURE
◆ CONNECTOR FITTING (NOT OIL PLUG) LOOSE AT BOTTOM OF CASE	◆ TORQUE FITTING AND ALLEN PLUG TO 2.0-2.5 KG-M (15-18 FT-LBS)
◆ BY-PASS (TOW) VALVE PARTIALLY ACTIVATED	◆ CHECK BY-PASS (TOW) VALVE CONTROL FOR BENT, BROKEN, DISCONNECTED OR BINDING LINKAGE
◆ BY-PASS (TOW) VALVE ORIFICE LOCATED IN WRONG PORT	◆ CORRECT LOCATION IS INDICATED BY CREEP OF TRACTOR'S WHEEL WHEN PUSHED FORWARD AND LOCKED UP WHEN TRACTOR IS PUSHED REARWARD
◆ INTERNAL DAMAGE TO ROTATING GROUPS, SWASH PLATE AND COMPONENTS, CENTER CASE, BY-PASS VALVE COMPONENTS, OR DIFFERENTIAL ASSEMBLY	◆ TRANSAXLE REPLACEMENT OR REPAIR REQUIRED

Troubleshooting and Diagnosis Guides

POSSIBLE CAUSE	POSSIBLE SOLUTION
By-Pass (Tow) Valve Does Not Operate Correctly	
◆ ACCUMULATION OF GRASS AND/OR OTHER DEBRIS INTERFERENCE	◆ CLEAN TRANSAXLE/TRACTOR OF ACCUMULATED DEBRIS
◆ BY-PASS (TOW) VALVE CONTROL LINKAGE BENT, BROKEN, DISCONNECTED, OR BINDING	◆ REPAIR OR REPLACE DAMAGED COMPONENTS - ADJUST FOR PROPER OPERATION
◆ BY-PASS (TOW) VALVE PARTIALLY ACTIVATED	◆ CHECK BY-PASS (TOW) VALVE CONTROL FOR BENT, BROKEN, DISCONNECTED OR BINDING LINKAGE
◆ BY-PASS (TOW) VALVE ACTIVATED	◆ CHECK BY-PASS (TOW) VALVE CONTROL FOR BENT, BROKEN, DISCONNECTED OR BINDING LINKAGE
◆ BY-PASS (TOW) ORIFICE LOCATED IN WRONG PORT	◆ CORRECT LOCATION IS INDICATED BY CREEP OF TRACTOR'S WHEEL WHEN PUSHED FORWARD AND LOCKED UP WHEN TRACTOR IS PUSHED REARWARD CENTER CASE REPLACEMENT REQUIRED
◆ BINDING, BROKEN, OR MISSING INTERNAL COMPONENTS (PUSH PIN, SPRING, POPPETS, ETC) OR INTERNAL LEAKAGE IN BY-PASS (TOW) VALVE	◆ TRANSAXLE REPAIR REQUIRED