

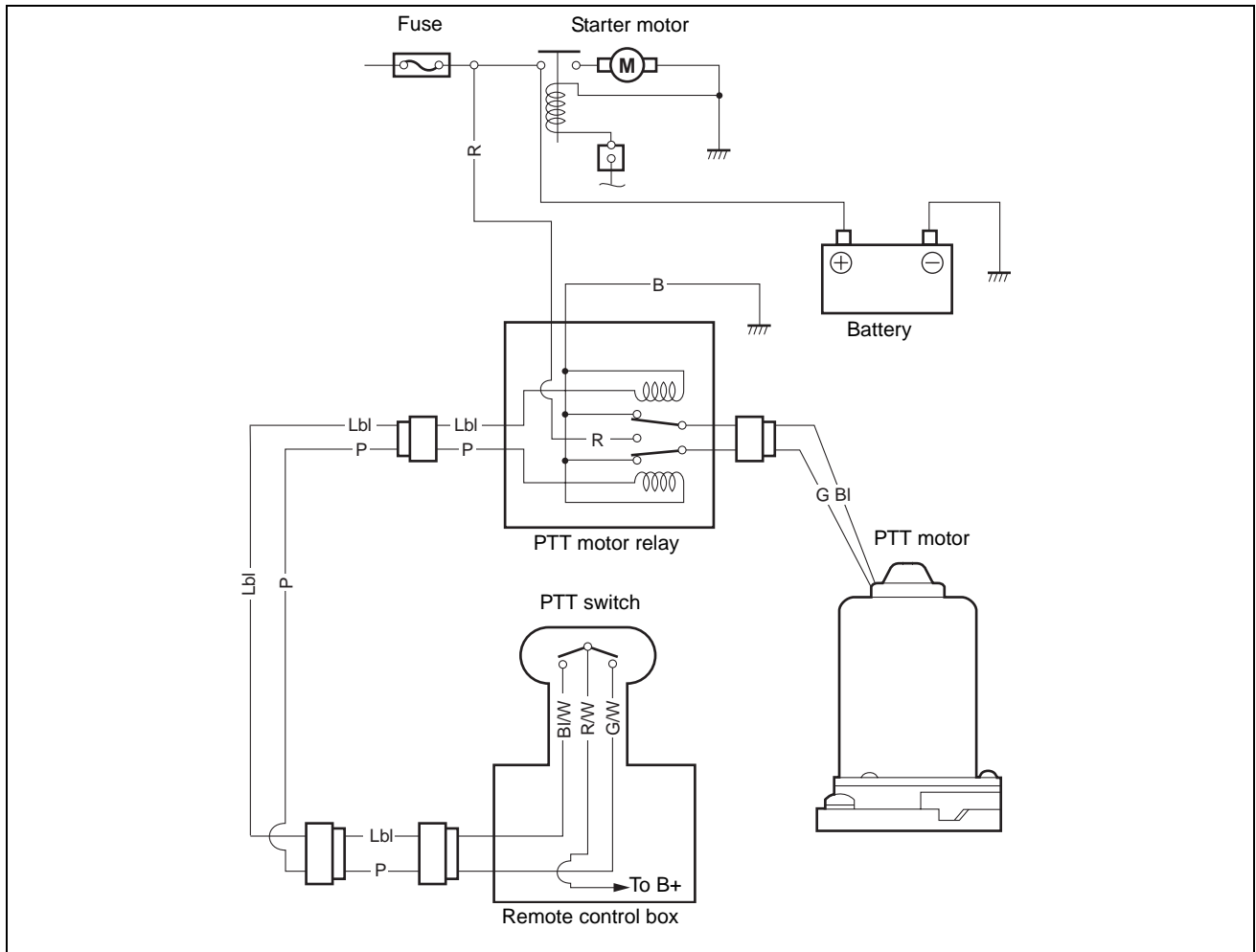
POWER TRIM AND TILT

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SYSTEM WIRING

Wiring Diagram



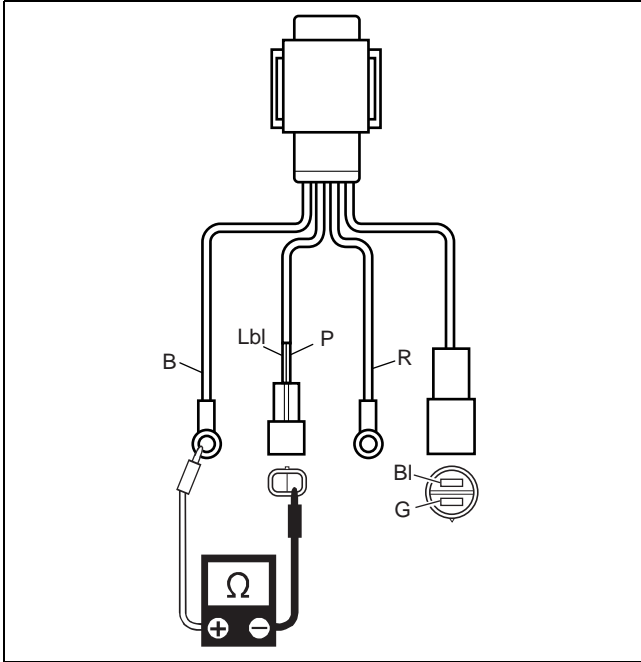
004353

Testing the PTT Motor Relay

Disconnect the battery cables at the battery.

Disconnect all cables/lead wires from PTT relay.

Use a digital tester to measure the resistance between each two leads of the relay.



00100920

Tester probe connections

Between "P" wire and "B" wire: 25 – 37 Ω

Between "Lbl" wire and "B" wire: 25 – 37 Ω

Connect "R" wire of the relay to the positive (+) terminal of a 12V battery, and "B" wire to negative (-) terminal.

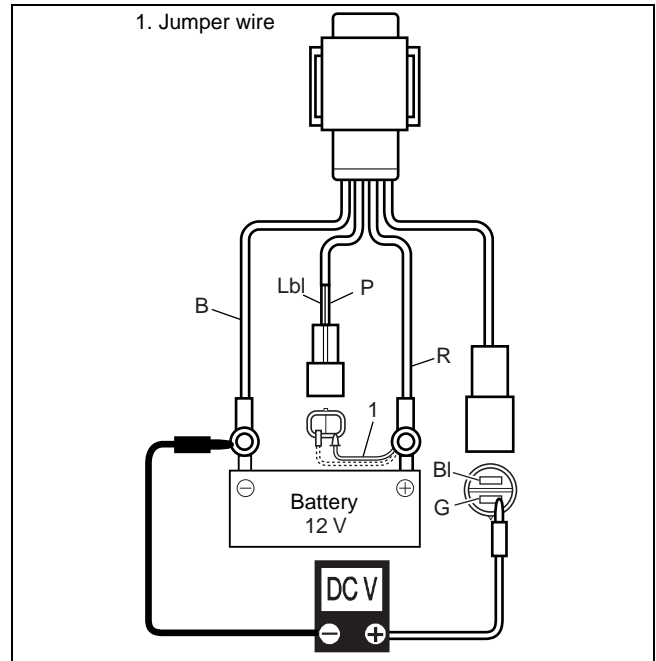
IMPORTANT: Each of the following operations must be performed within 3 – 5 seconds to avoid overheat damage to the relay coil.

Temporarily connect a jumper wire from the "P" lead wire to the battery positive (+) terminal, then check the voltage between "G" wire and "B" wire.

Between "G" wire and "B" wire: 12 V (Battery voltage)

Temporarily connect a jumper wire from the "Lbl" lead wire to the battery positive (+) terminal, then check the voltage between "BI" wire and "B" wire.

Between "BI" wire and "B" wire: 12 V (Battery voltage)



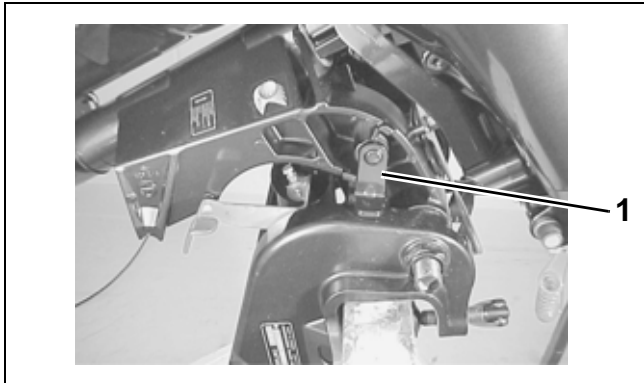
00100930

SERVICE PROCEDURES

Checking the Oil Level

Raise the engine to the full tilt position.

Lower the manual tilt lock levers.



1. Manual tilt lock lever (2)

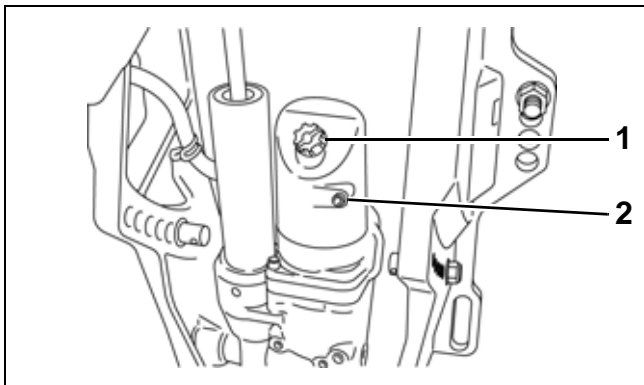
001749

Remove the reservoir plug and the oil level plug.

If oil can be seen at level plug hole, the reservoir is full. If the oil level is low, fill the reservoir with Dexron III automatic transmission fluid or an equivalent.

IMPORTANT: To ensure consistent pump operation, DO NOT mix different types of oil.

Install oil level plug and reservoir plug.

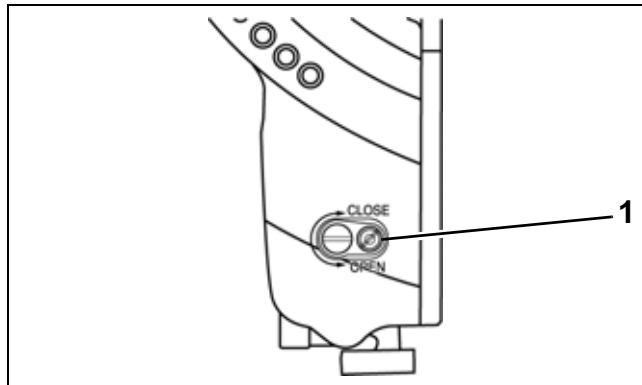


1. Reservoir plug
2. Oil level plug

001911

Bleeding the Air

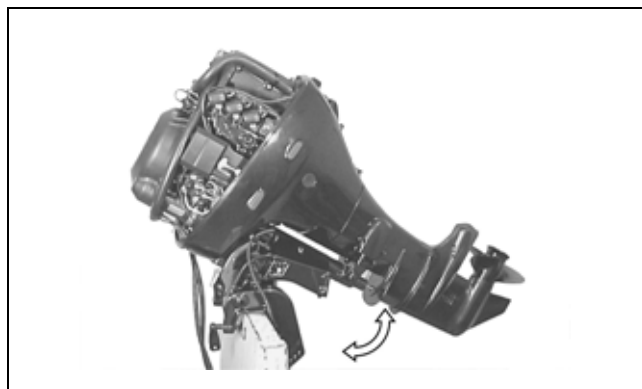
Check that the manual release valve is tightened to a torque of 16 in. lbs. (1.8 N·m). Turn the valve clockwise to close the valve. DO NOT overtighten the valve.



1. Manual release valve

001912

Raise the manual tilt lock levers. Operate the PTT switch to raise and lower the motor four or five times from the full tilt position to the full trim down position.



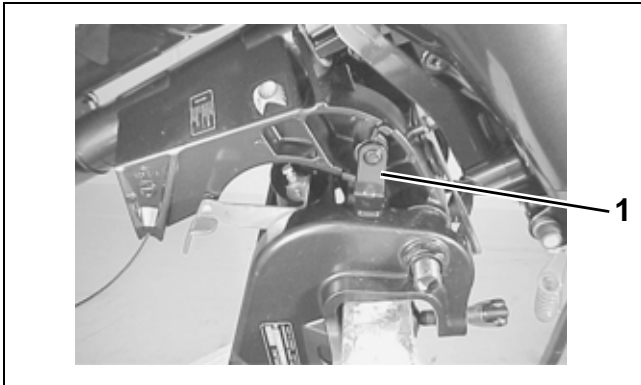
001913

Check the oil level. Top off the oil in the reservoir, if necessary. Refer to "Checking the Oil Level" on page 228.

POWER TRIM AND TILT (PTT) UNIT

Removal

Raise the engine to the full tilt position and lower the manual tilt lock levers.



1. Manual tilt lock lever (2)

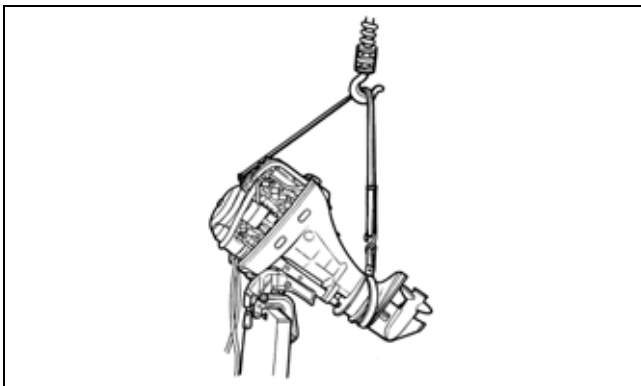
001749



WARNING



During service, the outboard may drop unexpectedly. To avoid personal injury, always support the outboard's weight with a suitable hoist.



001731

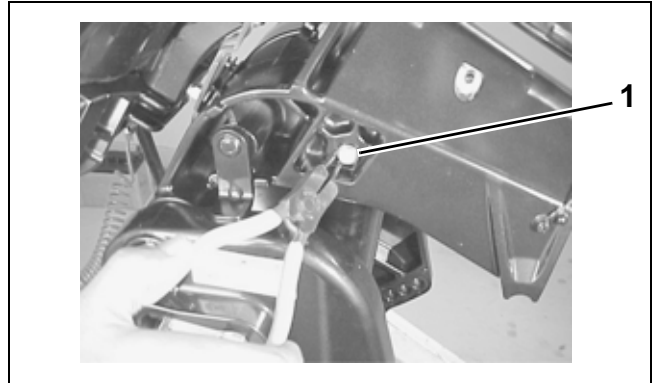


WARNING



When removing or installing any type of retaining rings, wear eye protection to avoid personal injury.

Remove the E-ring, then push out the tilt rod upper shaft.

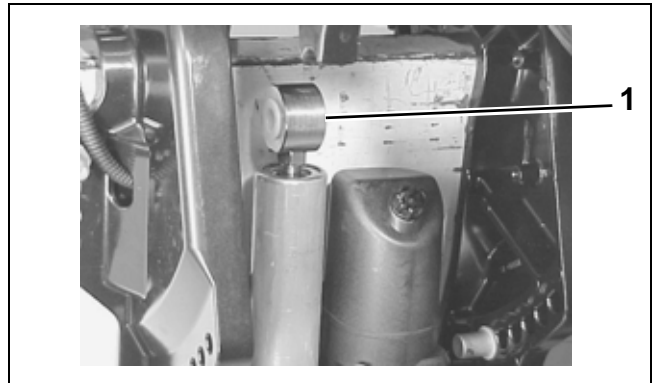


1. Tilt rod upper shaft

001750

Remove two (2) bushings from the end of the tilt cylinder rod.

Lower the tilt cylinder rod to the full down position, then disconnect the battery cable.



1. Tilt cylinder rod

001914

POWER TRIM AND TILT

POWER TRIM AND TILT (PTT) UNIT

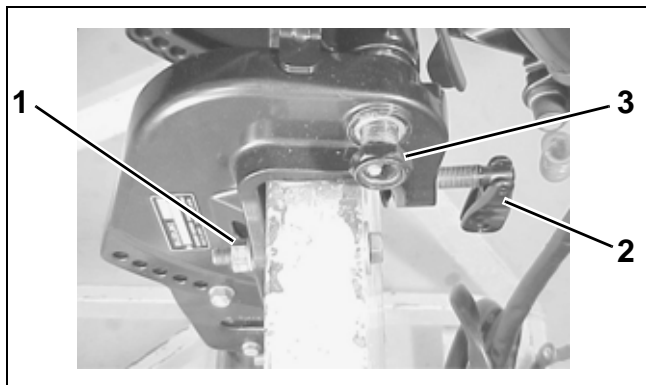
Disconnect the PTT motor cable wire leads (green and blue) from the PTT relay.

Remove the PTT motor cable from the engine lower cover.

Remove the two (2) starboard stern bracket nuts and bolts.

Loosen the starboard clamp screw and the tilt tube nut.

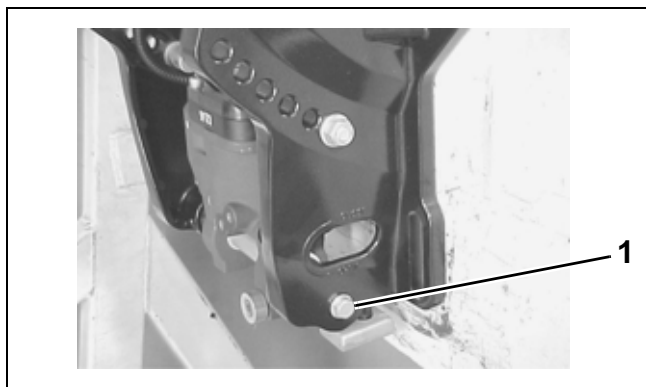
IMPORTANT: Complete removal of the tilt tube nut is not required. The nut should only be loosened as far as the end of the shaft threads to facilitate removal of the PTT unit.



1. Stern bracket nut (2)
2. Clamp screw
3. Tilt tube nut

001751

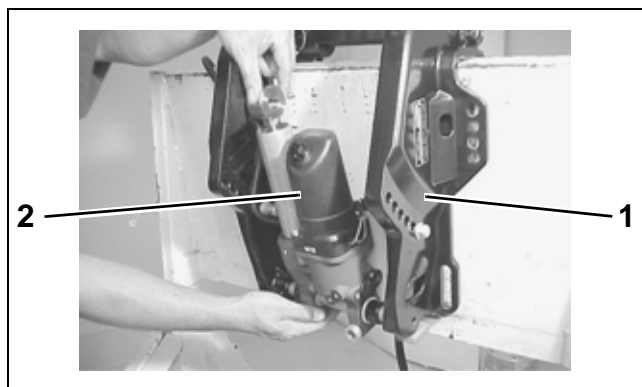
Remove the tilt cylinder shaft bolts.



1. Tilt cylinder shaft bolts (2)

001916

Slide the starboard stern bracket fully outward to the right side. Remove the PTT unit from between the stern brackets.



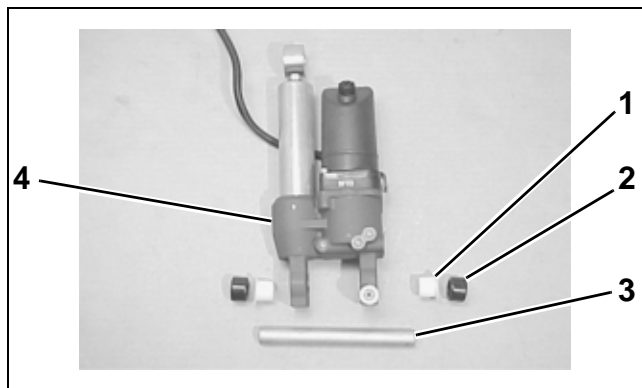
1. Stern bracket
2. PTT unit

001917

Installation

Lower the tilt rod to the full down position.

Apply *Triple-Guard* grease to the tilt cylinder lower shaft and the tilt cylinder shaft bushings. Install the bushings, shaft, and spacers on the PTT unit.

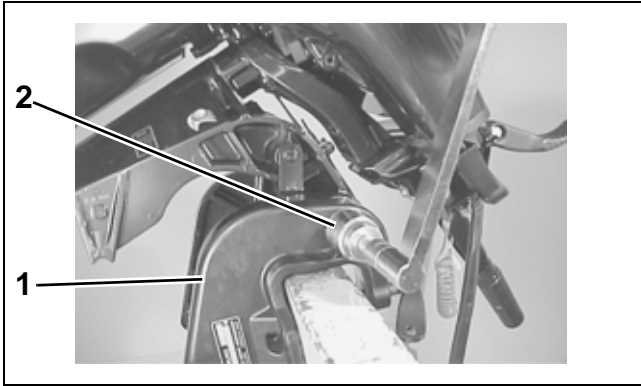


1. Bushings (2)
2. Spacers (2)
3. Tilt cylinder lower shaft
4. PTT unit

001934

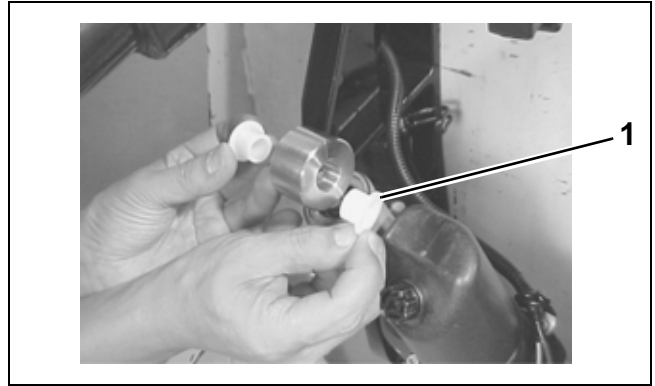
POWER TRIM AND TILT POWER TRIM AND TILT (PTT) UNIT

Position the PTT unit between the stern brackets. Install and tighten the tilt tube nut to a torque of 31 ft. lbs. (43 N·m).



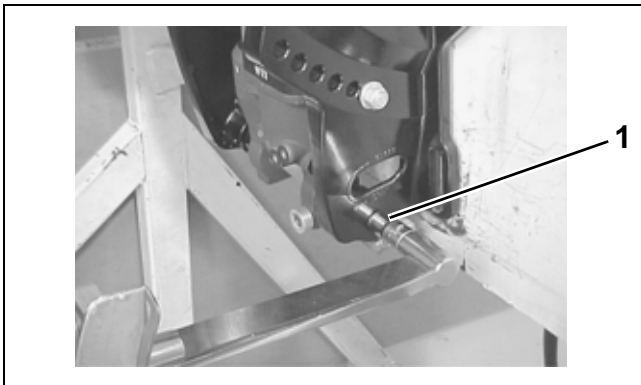
1. Stern bracket
2. Tilt tube nut
001759

Operate the PTT motor to extend the tilt cylinder rod. Align the tilt cylinder rod with the hole in the swivel bracket as the tilt rod extends.



1. Bushings (2)
001936

Apply *Nut Lock* to the threads of the tilt cylinder shaft bolts. Install and tighten the bolts to a torque of 16.5 ft. lbs. (23 N·m).



1. Tilt cylinder shaft bolts (2)
001935

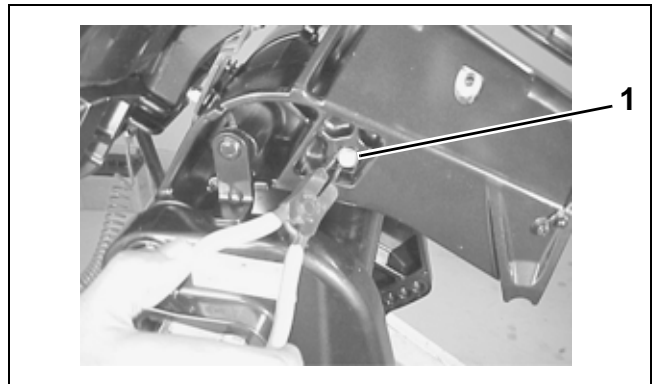
Apply *Triple-Guard* grease to the tilt rod upper bushings, then install the bushings in the end of the tilt cylinder rod.

WARNING

When removing or installing any type of retaining rings, wear eye protection to avoid personal injury.

Apply *Triple-Guard* grease to the tilt rod upper shaft, then insert the shaft through the swivel bracket and the tilt cylinder rod.

Secure the tilt rod upper shaft with the E-ring.



1. Tilt cylinder upper shaft
001750

Route the PTT motor cable through the lower cover. Refer to the **WIRE AND HOSE ROUTING** section. Connect the lead wires to the PTT relay.

PTT MOTOR

Removal

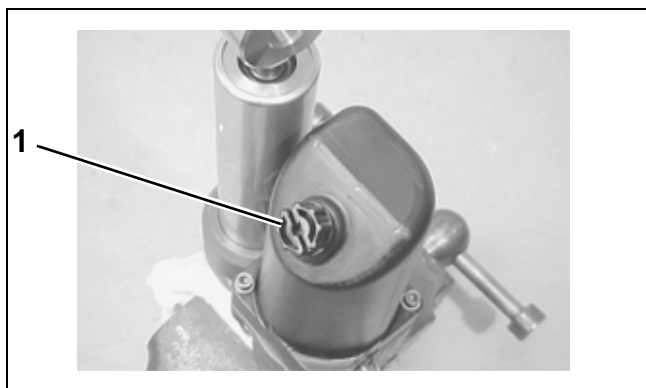
WARNING

To avoid personal injury, wear eye protection and set compressed air pressure to less than 25 psi (172 kPa).

IMPORTANT: Before removing the motor from the PTT unit, wash the outside of the unit with a stiff bristle brush and hot, soapy water to remove sand or dirt. Dry the unit with compressed air.

First, remove the PTT unit from the engine. Refer to "POWER TRIM AND TILT (PTT) UNIT" on page 229.

Unscrew the reservoir plug and drain the PTT motor oil into a suitable container.

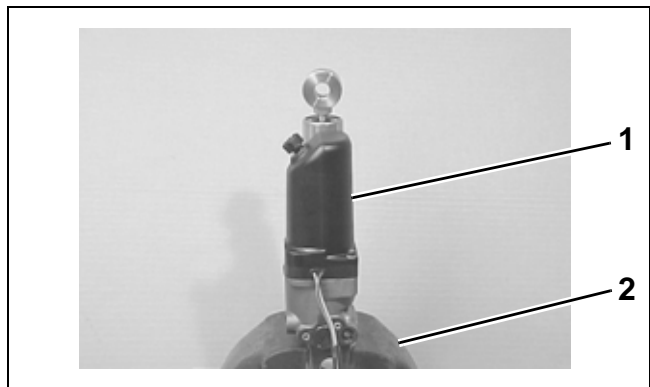


1. Reservoir plug 001918

CAUTION

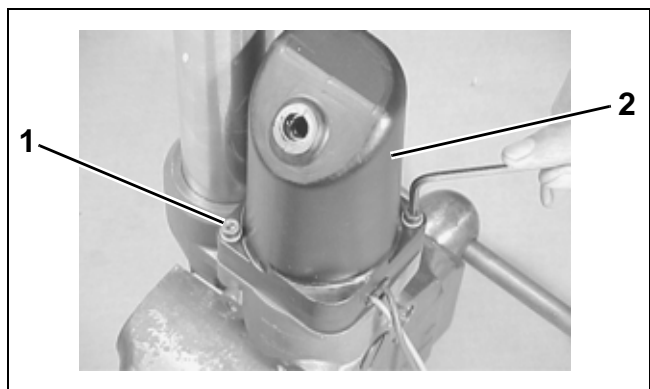
To prevent damage to the PTT unit, use wood blocks or vise jaw protectors between the vise jaws and PTT unit before tightening the vise.

Place the lower mounting eye of the PTT unit in a vise. Tighten the vise only enough to secure the PTT unit. DO NOT overtighten the vise.



1. PTT unit
2. Vise 001919

Remove two (2) screws and the reservoir.



1. Screws (2)
2. Reservoir 001920

Remove the PTT motor from the pump.

Note the positions of the drive joint and the O-ring, then remove the components.

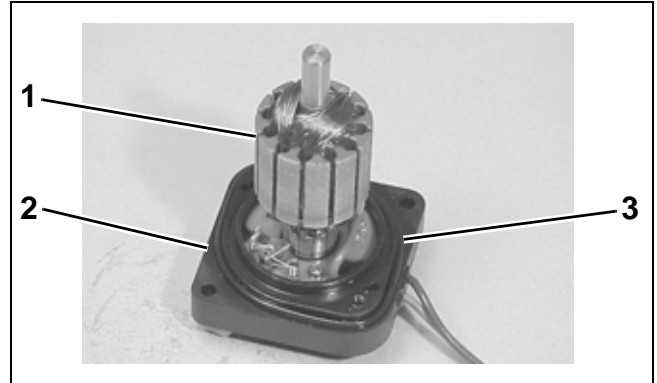
IMPORTANT: DO NOT lay out the PTT components on a rag. Dirt or lint may be transferred to

these components, which may cause system operating problems.



1. PTT motor
2. Drive joint
3. O-ring
001921

Note the position of the O-ring on the brush holder. Remove the O-ring.



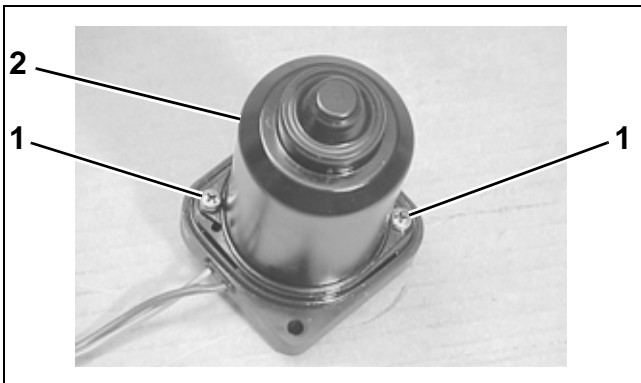
1. Armature
2. Brush holder
3. O-ring
001929

Disassembly

IMPORTANT: For correct assembly, scribe an alignment mark across the motor case and brush holder.

Remove two (2) screws that secure the motor case to the brush holder.

Use a soft face hammer to gently tap the motor case from side to side to unseat it from the brush holder. Slide the motor case upward and away from the brush holder.



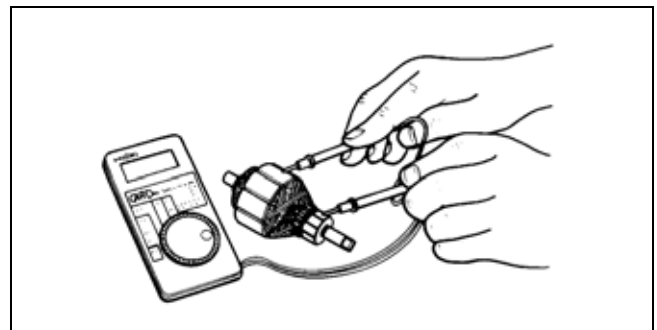
1. Screws (2)
2. Motor case
001922

Slide the armature free of the brushes.

Inspection

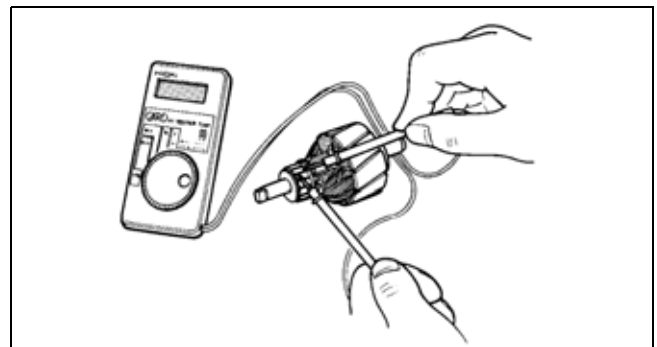
Armature and Commutator

Use a digital tester to check for continuity between the commutator and the armature core/shaft. Replace the armature if continuity is indicated.



001924

Check for continuity between the adjacent commutator segments. Replace the armature if no continuity is indicated.



001925

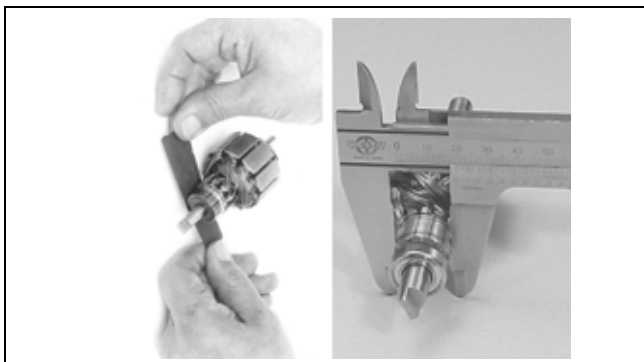
POWER TRIM AND TILT PTT MOTOR

Inspect the surface of the commutator. If the surface is gummy or dirty, clean the surface with 400 grit emery paper.

Use vernier calipers to measure the outside diameter of the commutator.

Commutator Outside Diameter	
Standard	0.77 in. (19.5 mm)
Service limit	0.73 in. (18.5 mm)

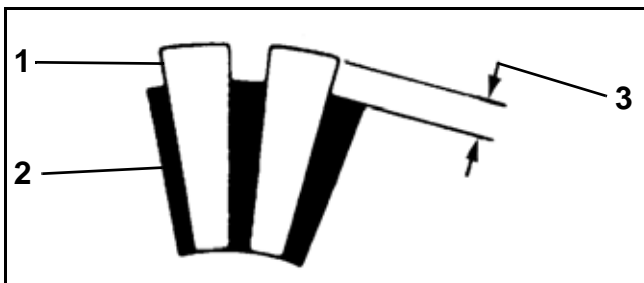
If the measurement exceeds the service limit, replace the armature.



001926

Make sure that the mica (insulator) between the segments is undercut to the correct depth.

Commutator Undercut	
Standard	0.05 to 0.06 in. (1.3 to 1.6 mm)
Service limit	0.02 in. (0.5 mm)



1. Segment
2. Mica
3. Undercut

001714

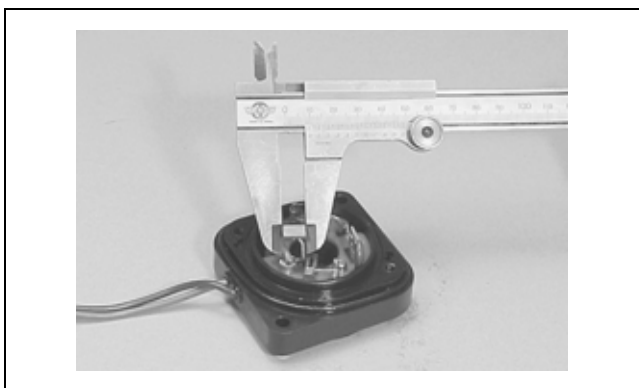
If the undercut is less than the service limit, cut the mica to the specified depth. Use compressed air to remove all particles of mica and metal.

Brushes

Use vernier calipers to check the length of each brush.

Brush Length	
Standard	0.39 in. (9.8 mm)
Service limit	0.19 in. (4.8 mm)

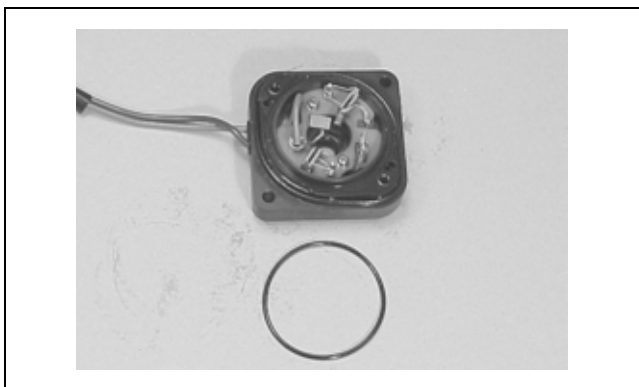
If the brushes are worn down to the service limit, replace the brushes.



001927

O-ring

Inspect the O-ring between the PTT motor and the pump. If there are any cuts, nicks, or tears, replace the O-ring.



001928



WARNING

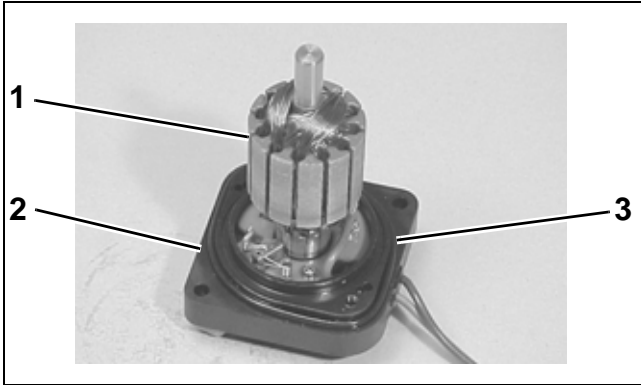


To avoid personal injury, wear eye protection and set compressed air pressure to less than 25 psi (172 kPa).

Assembly

Install the O-ring on the brush holder. Make sure that the O-ring is positioned correctly

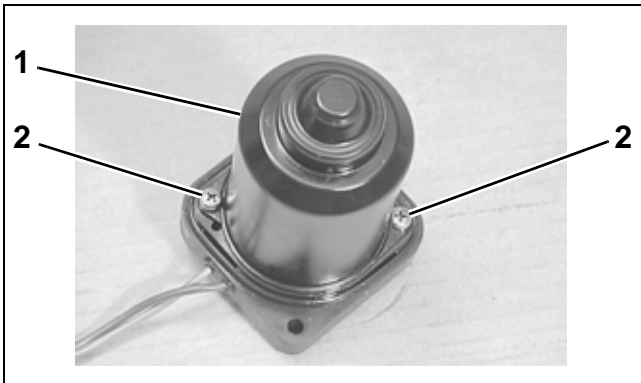
Carefully slide the armature onto the brush holder to avoid breaking any of the brushes.



- 1. Armature
 - 2. Brush holder
 - 3. O-ring
- 001929

Install the motor case over the brush holder. Make sure that the alignment marks on the case and the holder are aligned.

Install and tighten two (2) screws that secure the motor case to the brush holder.

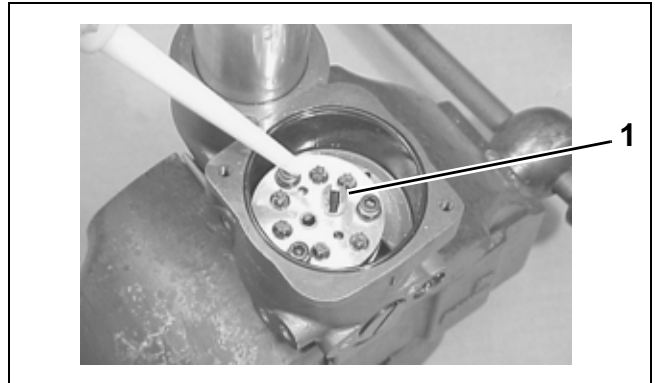


- 1. Motor case
 - 2. Screws (2)
- 001922

Installation

Make sure that the drive joint is aligned and firmly inserted into the gear pump assembly.

Check the level of PTT oil in the pump. If the level is low, add the recommended PTT oil until the oil is level with the mating surface of the PTT motor.

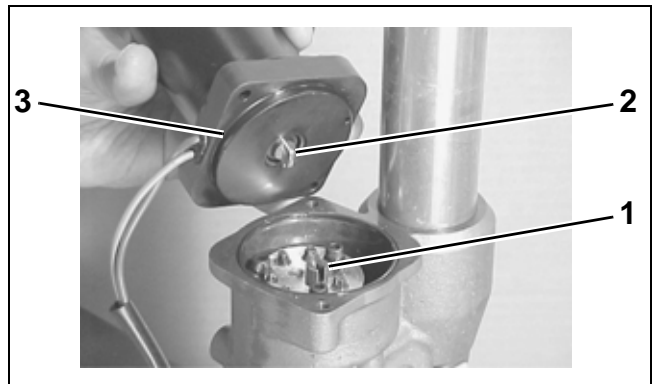


- 1. Drive joint
- 001931

Make sure the mating surfaces of the PTT motor and the reservoir are free of dirt or debris.

Install the O-ring on the bottom of the PTT motor.

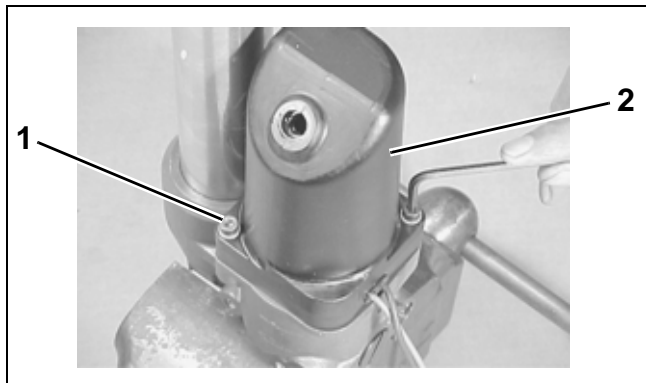
Install the PTT motor on the pump. Make sure that the tip of armature shaft fits firmly into the drive joint.



- 1. Drive joint
 - 2. Armature shaft
 - 3. O-ring
- 001932

POWER TRIM AND TILT PTT MOTOR

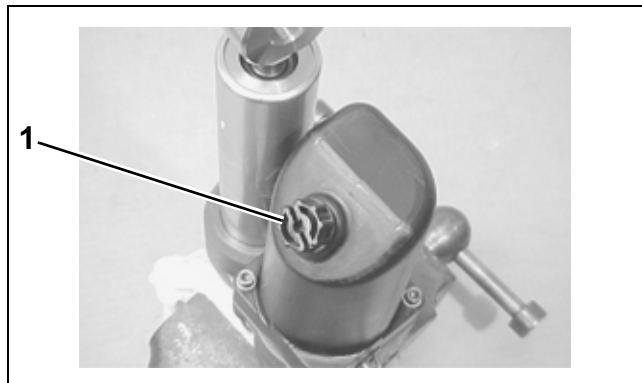
Install the reservoir. Install and tighten two (2) screws to a torque of 40 in. lbs. (4.5 N·m).



1. Screws (2)
2. Reservoir

001920

Pour the recommended PTT oil into the reservoir to the specified level. Install the reservoir plug.



1. Reservoir plug

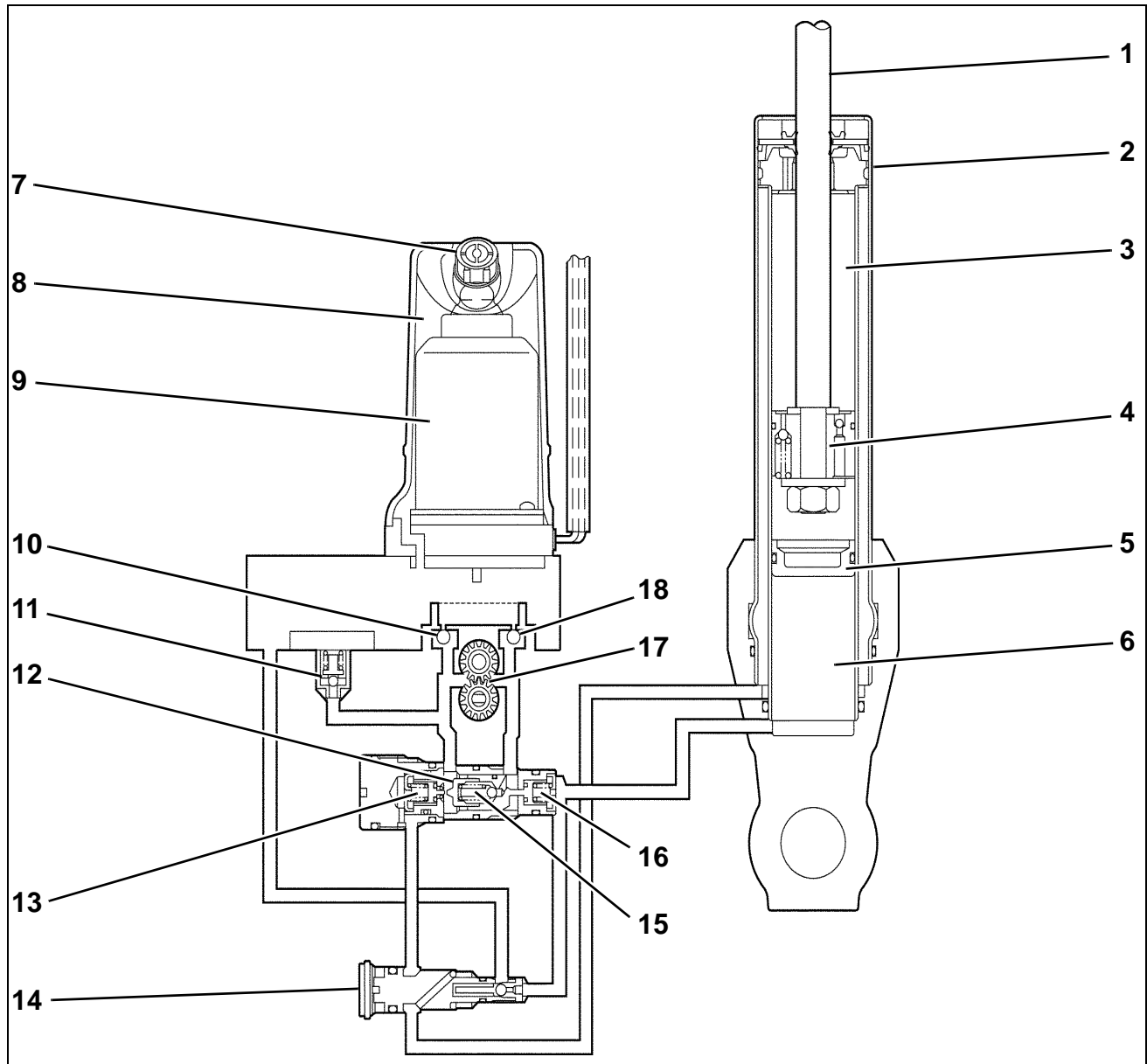
001918

Bleed the air from the reservoir. Refer to “Bleeding the Air” on page 228.

OPERATION

The power trim and tilt (PTT) system is operated by a “rocker” type switch (protected by a rubber thumb pad) on top of the remote control box handle.

When the switch is depressed, power is delivered to the electric motor via the relay. The relay with the blue wire connected to the pump is for trim/tilt “up”. The relay with the green wire is for trim/tilt “down”.



- | | |
|---------------------------|------------------------------------|
| 1. Tilt rod | 10. Check valve "A" |
| 2. PTT cylinder | 11. DOWN relief valve |
| 3. Upper cylinder chamber | 12. Spool valve |
| 4. Piston | 13. DOWN pressure main check valve |
| 5. Free piston | 14. Manual release valve |
| 6. Lower cylinder chamber | 15. UP relief valve |
| 7. Oil filler cap | 16. UP pressure main check valve |
| 8. Oil reservoir | 17. Gear pump |
| 9. PTT motor | 18. Check valve "B" |

001941

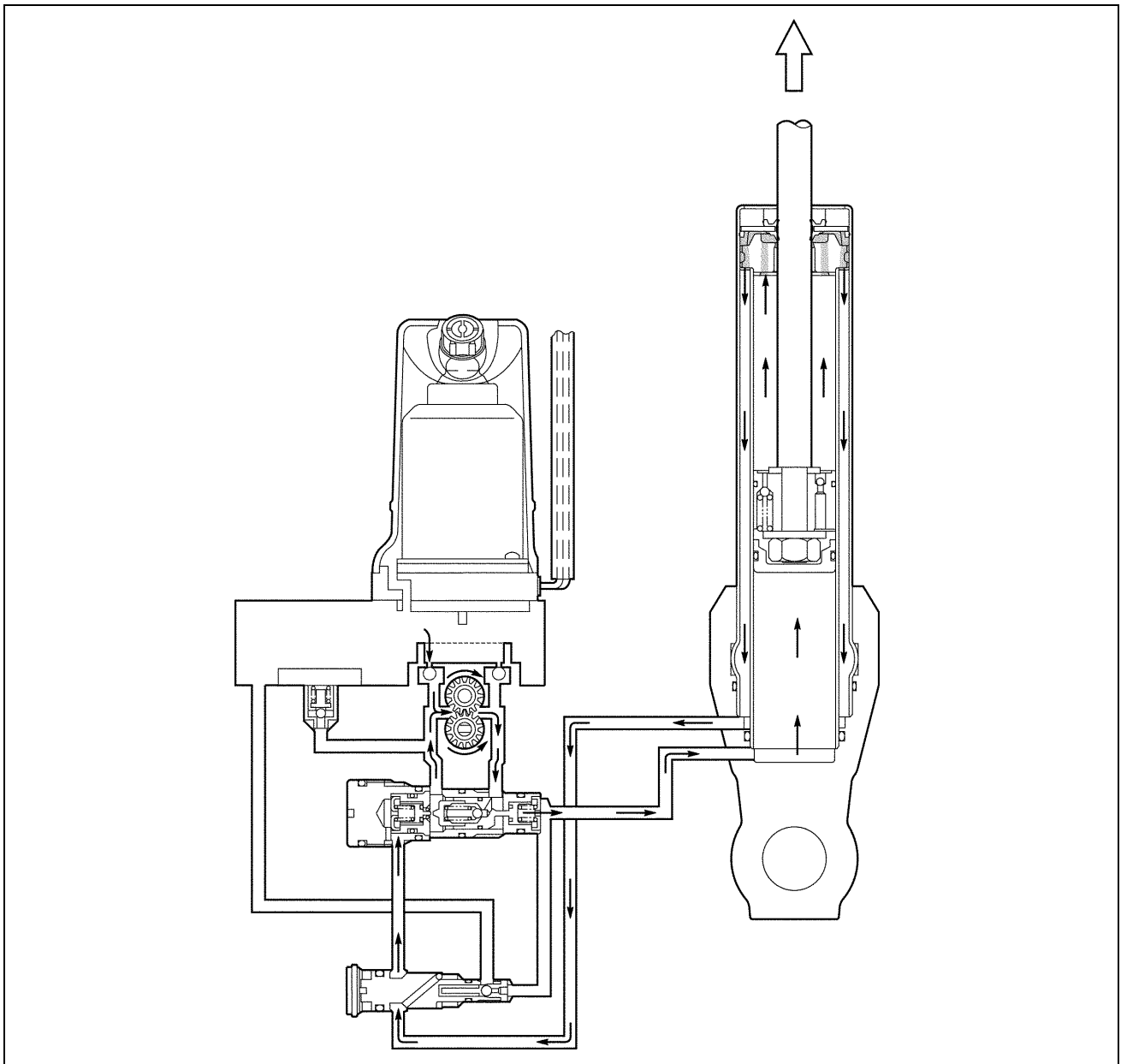
POWER TRIM AND TILT OPERATION

Trim Tilt “UP” Circuit

The electric motor is operating in a clockwise direction. Check valve “A” will open, allowing oil to flow from the reservoir to the pump. Oil flow from the pump enters the spool valve and moves it to the left, opening the “down” pressure main check valve and returning oil from the upper cylinder chamber (and oil from the reservoir) to the pump. Pressure built up by the pump will then open the “up” pressure main check valve and oil will enter the lower cylinder chamber.

When the trim motor stops, both the “down” pressure main check valve and the “up” pressure main check valve will close to retain tilt/trim position.

When full trim/tilt “up” position is attained, sustained operation of the “up” relay will have no effect, as pump oil flow will be returned to the reservoir through the “up” relief valve.



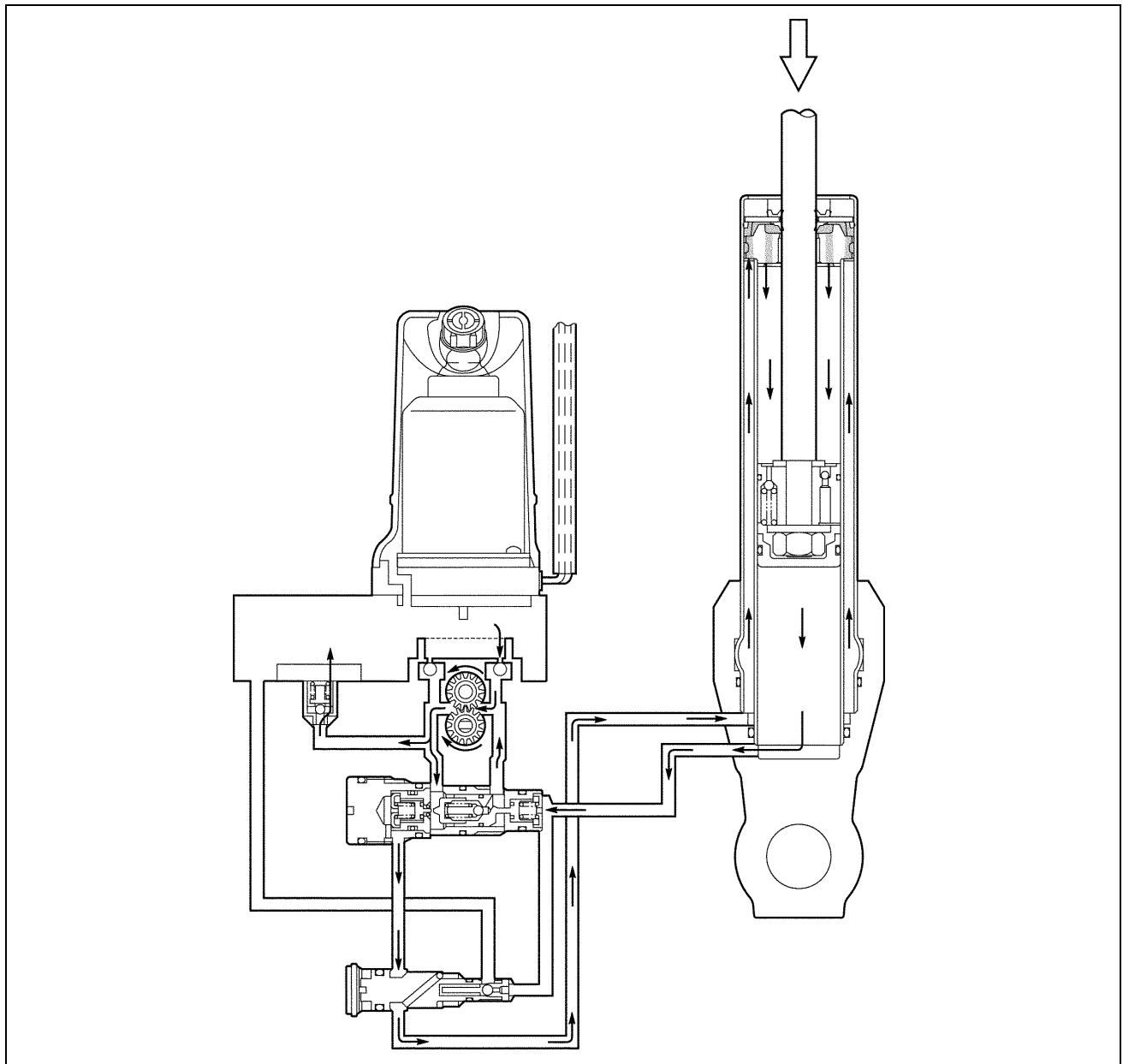
001942

Trim/Tilt “DOWN” Circuit

The electric motor is operating in a counterclockwise direction. Check valve “A” will open, allowing oil to flow from the reservoir to the pump. Oil flow from the pump enters the spool valve and moves it to the right, opening the “up” pressure main check valve. Oil from the lower cylinder chamber will go through the “up” pressure main check valve to the pump.

Pressure built up by the pump will open the “down” pressure main check valve and oil will enter the upper cylinder chamber. The piston will retract (move inward), which will tilt the outboard down. Oil in the lower cylinder chamber is returned to the pump through the “up” pressure main check valve.

When full “down” position is reached, continued operation of the “down” relay will have no effect, as pump oil flow will be returned to the reservoir through the “down” relief valve.



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POWER TRIM AND TILT OPERATION

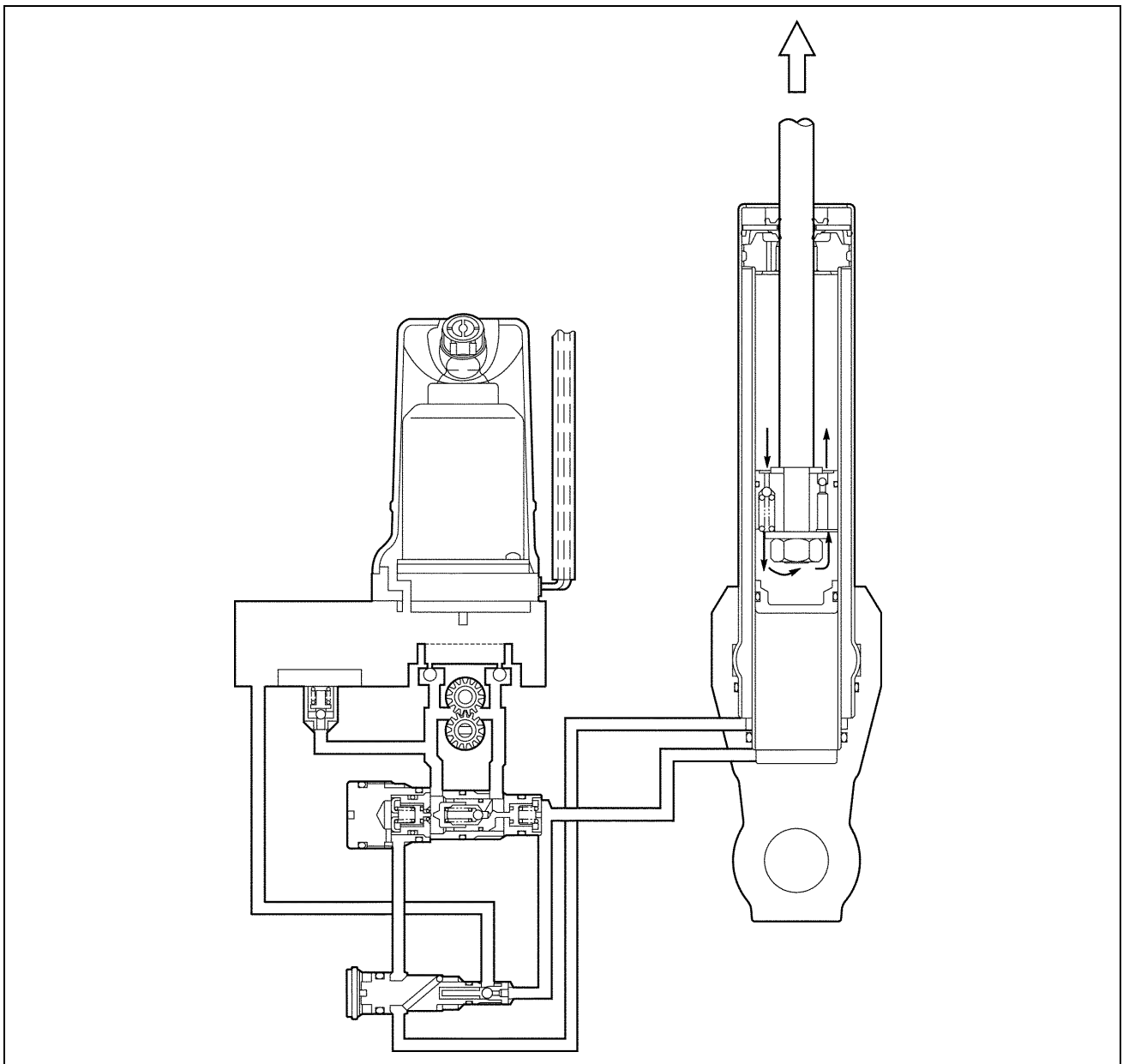
Shock Absorber Circuit

Shock valve

Should the lower unit strike an underwater object while in motion, the piston will rise abruptly, creating a sudden high impact pressure in the upper cylinder chamber. The shock valve will then open, allowing oil to flow into the area between the tilt ram piston and the free piston, thereby dampening (absorbing) the impact.

Return valve

When the point of impact has passed, propeller thrust and motor weight will force the tilt ram piston back downwards. The oil from between the ram piston and the free piston is then expelled through the return valve before flowing into the upper cylinder chamber.

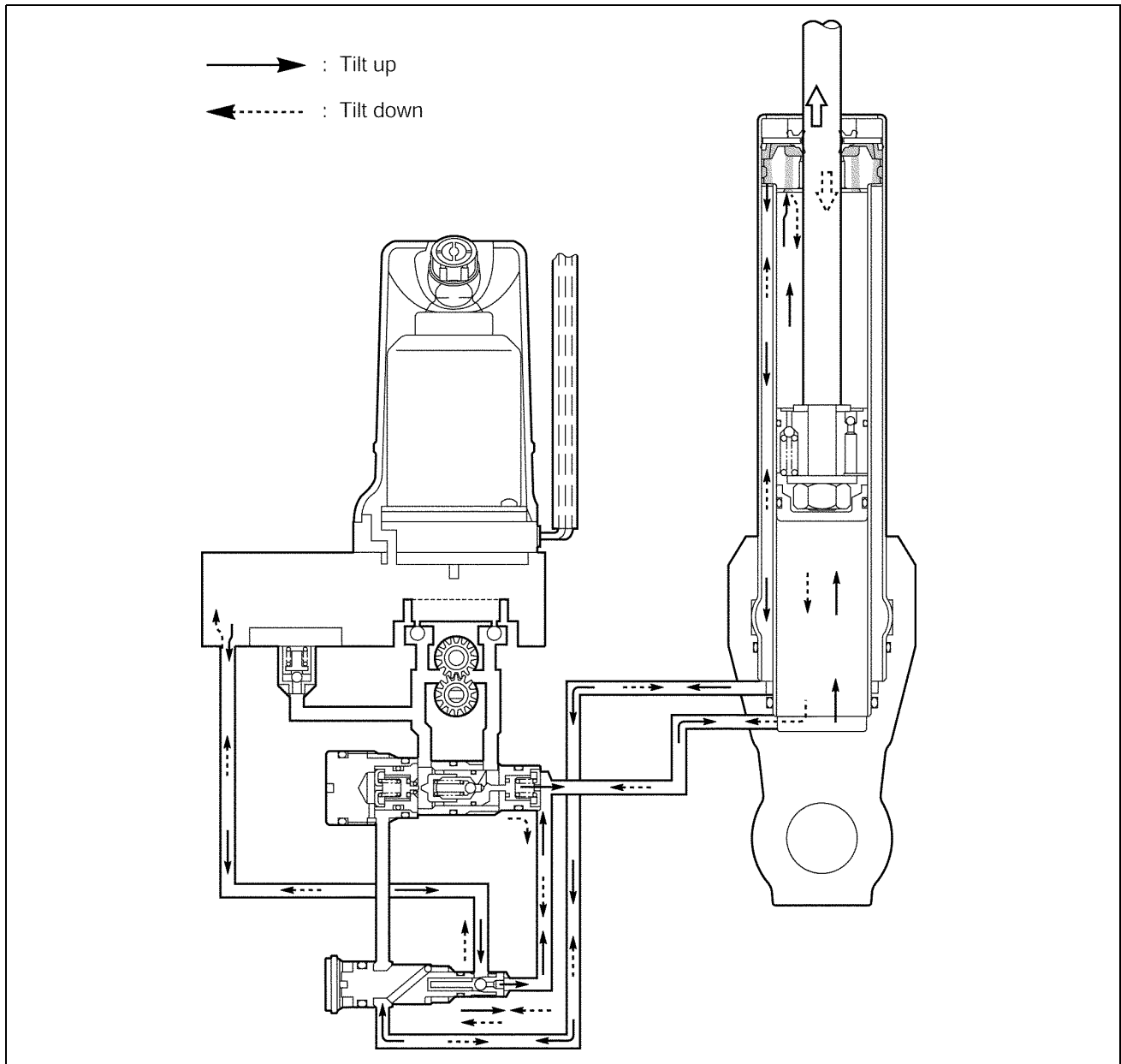


001944

Manual Release Circuit (Manual Valve)

Turn the manual valve a maximum of three full counterclockwise turns.

When the manual valve is loosened, oil will flow unimpeded (without resistance) through the internal pump tubes, thereby facilitating manual tilting or lowering of the outboard. To hold the engine in a selected position, the manual valve must be closed again.



001945

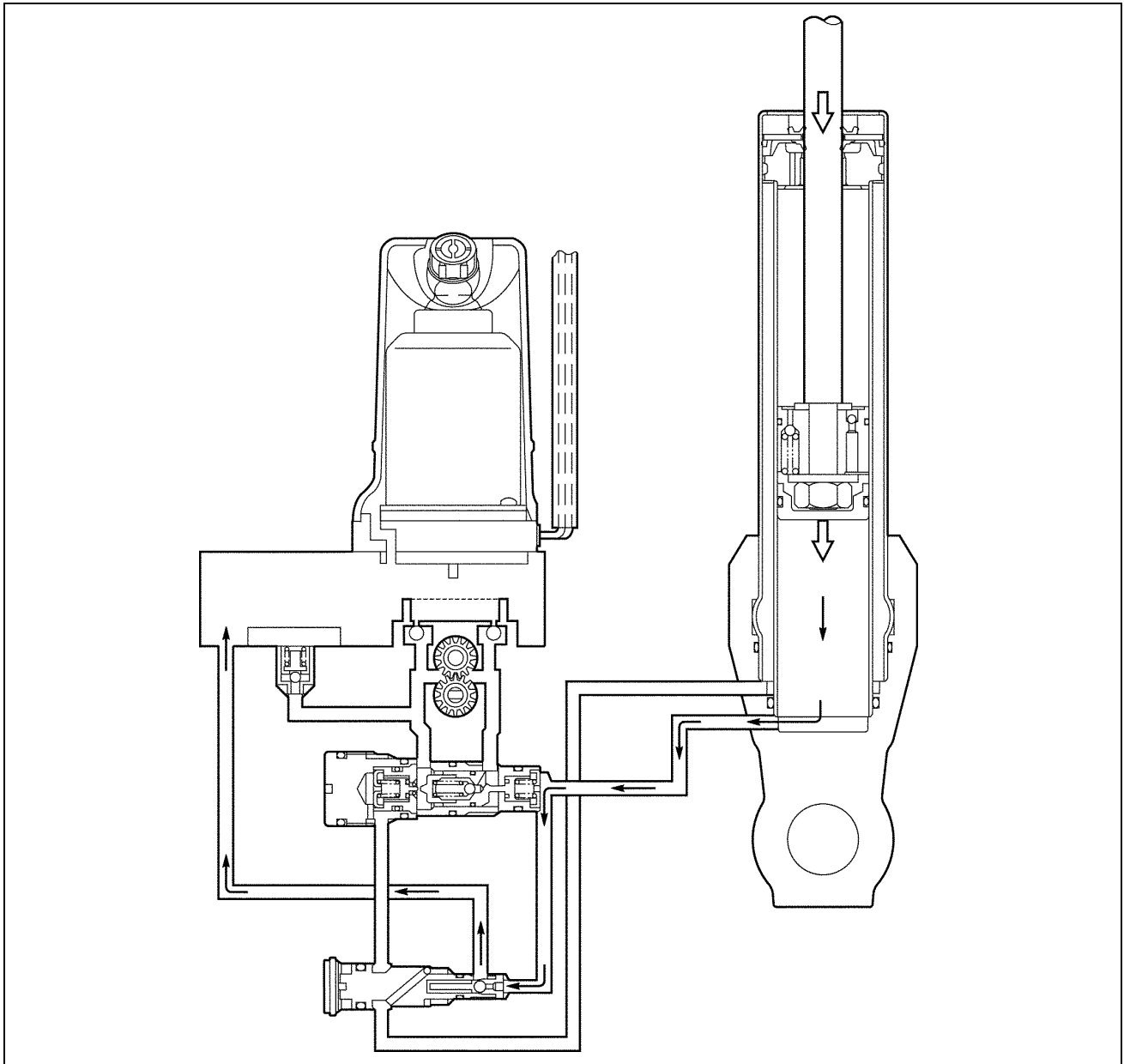
POWER TRIM AND TILT OPERATION

Thermal Valve

The PTT system incorporates a thermal valve for protection of the internal components if excessive downward force is exerted on the lower unit with the motor in a tilted position or, in the case of an impact in reverse gear, the stern clamp/swivel brackets and the transom.

Should the propeller strike an underwater object while in reverse gear, a build up of pressure will be induced in the lower cylinder chamber and the brackets and/or the transom may sustain damage. To prevent this, the thermal valve will open to relieve the oil pressure, thereby softening the impact.

Internal PTT circuits are protected, as the thermal valve will open to reduce oil pressure caused by either hot climate or abnormally heavy usage.



001946