

Trim/Tilt Pump Assembly

The pump motor is a 12-volt DC bi-directional motor. The armature of the motor rests inside the field winding and is energized through brushes contacting the commutator on the end of the armature. When the up or down switches are closed, current is directed through the motor field in one of two directions causing the motor to run in one desired direction.

The opposite end of the armature is mechanically splined to the hydraulic pump. The gear rotor action of the pump causes the fluid to flow in either direction.

The motor case is sealed with O-rings and a shaft seal to prevent the entry of water or hydraulic fluid into the motor cavity.

Before going directly to the pump as a source of trouble, check the battery to be sure it is up to a full charge. Inspect the wiring for loose connections, corrosion and damaged wires. Take a good look at the control switches and connection for evidence of a problem.

The control switches may be quickly eliminated as a source of trouble by connecting the pump directly to the battery for testing purposes.

REMOVAL & INSTALLATION

◆ See Figures 20, 21, 22 and 23

■ Integrated reservoir models are identifiable because they have the motor on the bottom and the reservoir on the top. There may be some models in this year span that came through with the newer style pump; motor on top and clear plastic reservoir on the bottom.

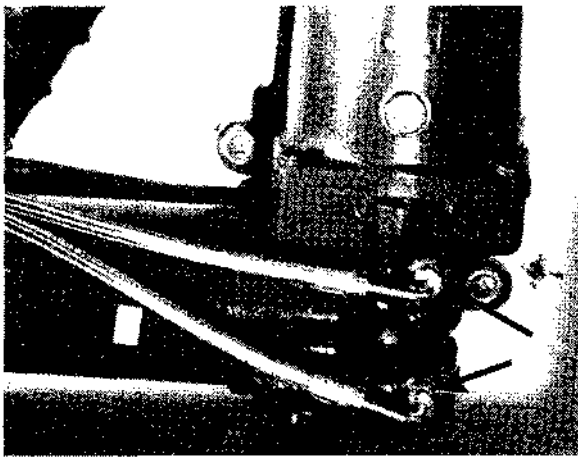


Fig. 20 Disconnect the hydraulic hoses at the pump...



Fig. 22 Unplug the trim connector

1. Using the trim switch, raise the stern drive to the full UP position and then support the bottom of the unit with a piece of wood. Remember that these models, you can raise the drive even if the system is not working by loosening the manual release valve.

2. Disconnect the battery cables from the battery terminals.

3. Relieve the pressure in the system by loosening the manual release valve one complete turn counterclockwise.

4. Mark or tag the hydraulic hoses (top or bottom) before disconnecting them from the pump. The inlet and outlet ports on the manifold should also be stamped (usually) with UP or DN markings identifying each port. Place a suitable container under the fittings and then use a line nut wrench to back the fitting out of the manifold port. Cap the hoses to prevent fluid leakage into the boat and dirt from entering the system. OMC actually sells line and port caps if you are interested, otherwise you can improvise with something from your shop like taping a baggie around them.

5. Disconnect the trim harness plug and the battery.

6. Remove the 3 lag bolts securing the trim/tilt pump assembly to the boat. Lift the assembly out and free of the boat.

7. Try to keep the assembly standing upright while out of the boat.

To Install:

8. Position the trim/tilt pump assembly in the boat. Install the lag bolts through the pump support bracket and into the transom. Tighten the bolts securely.

9. Connect the hydraulic hoses to their ports in the manifold—make sure they thread into the correct port. Tighten the line nuts securely.

10. Fill the reservoir with OMC Power Trim/Tilt and Steering Fluid to the bottom of the filler hole.

11. Connect the trim connector plug. Connect the battery cables and then cycle the stern drive Up and Down several (at least 5) times to bleed all air from the system. Check the reservoir level after each cycle and service, if needed.



Fig. 21 ...and them plug or bag them to keep out any dirt

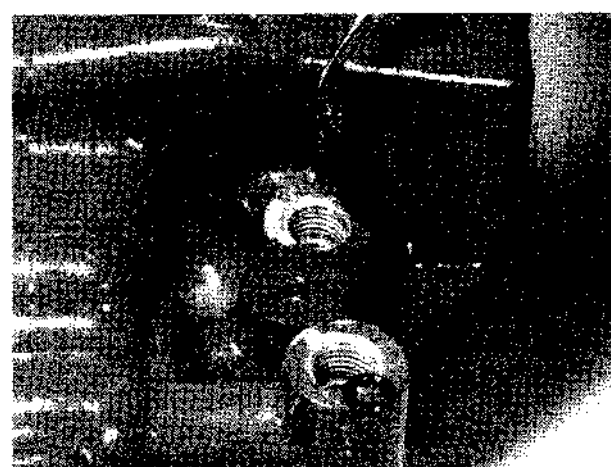


Fig. 23 Make sure that you remove the hydraulic line O-rings

13-12 TRIM AND TILT

DISASSEMBLY & ASSEMBLY

◆ See Figures 24 thru 40



1. Remove the pump assembly.
2. Drain all the remaining fluid in the reservoir into a suitable container. Discard the fluid in accordance with any local hazardous waste ordinances.
3. Remove the 4 reservoir-to-manifold mounting screws (Phillips) and then hold the assembly over a suitable container while you separate the two units. Remove the O-ring seal from the bottom of the reservoir and throw it away.
4. Turn the remaining assembly over and remove the 3 motor-to-manifold mounting screws (Phillips). Separate the motor from the manifold and then remove the O-ring and discard it.
5. Remove the oil pump filter screen from the pump surface. Clean it thoroughly and set it aside for assembly.
6. Pull the drive coupling out of the pump body and check the slotted and hex ends for wear or damage—replace as necessary. Check the rubber ball in the end of the coupling.
7. Loosen the 3 pump-to-valve body Allen bolts alternately and only ONE TURN at a time until you can lift off the gear housing (pump). There are 2 short bolts and 1 long bolt. If the pump needs to be flushed, use only new hydraulic fluid—never use solvent. Do not remove the pump assembly screws; the pump is serviced as an assembly only.

※※ WARNING

The pump housing contains pistons with springs that exert an upward pressure on the unit; it is imperative that when loosening the mounting screws, they only be turned one **complete revolution at a time, moving on to the next screw diagonally across from it each time until all spring pressure has been eliminated**. Failure to follow this procedure will result in a warped housing.

■ The mating surfaces of the pump housing and manifold are precision machined and do not use a gasket; extreme care should be exercised during removal. Be very careful not to gouge, scratch or mar either of these surfaces.

8. Working in the valve body, scrape away any visible staked metal and then pull out the filter valve and washer. Confirm that the filter is clean and undamaged. Thread in a No. 6 screw or a tap and pull up the screw to remove the valve seat. Use a small magnet to remove the check ball and check its seat for any damage. Remove the O-rings and throw them away.

9. Use a small awl or pick and pull out the 2 oil pump O-rings in the valve body.

10. Unscrew and remove the trim-in relief valve spring/valve. Check the spring, valve and seal tip for visible signs of damage. If necessary, replace the seal tip by pressing on a new tip so the flat side is against the valve and the ribbed side is against the seat.

11. Pull out the thermal expansion valve core and spring. Removing the valve body will require fabricating a special tool from a small length of extra control cable core wire (or a paper clip). Bend the wire into the shape illustrated and make sure that the end is smooth and unfrayed. Insert the tool into the valve body and pull on it until the valve pops out.

12. Use a small (No. 1) pair of circlip pliers to remove the manual release valve retaining clip and then unscrew the valve from the valve body. Pull out the O-ring and throw it away. Check the sealing surface on the tip of the valve.

13. Remove the tilt-up relief valve plug on the back side of the valve body and then pull out the spring and valve core. Removing the valve body itself will require the special tool made earlier; insert the tool (or a bent pick) into the cross-drilled holes in the body of the valve and pull out firmly.

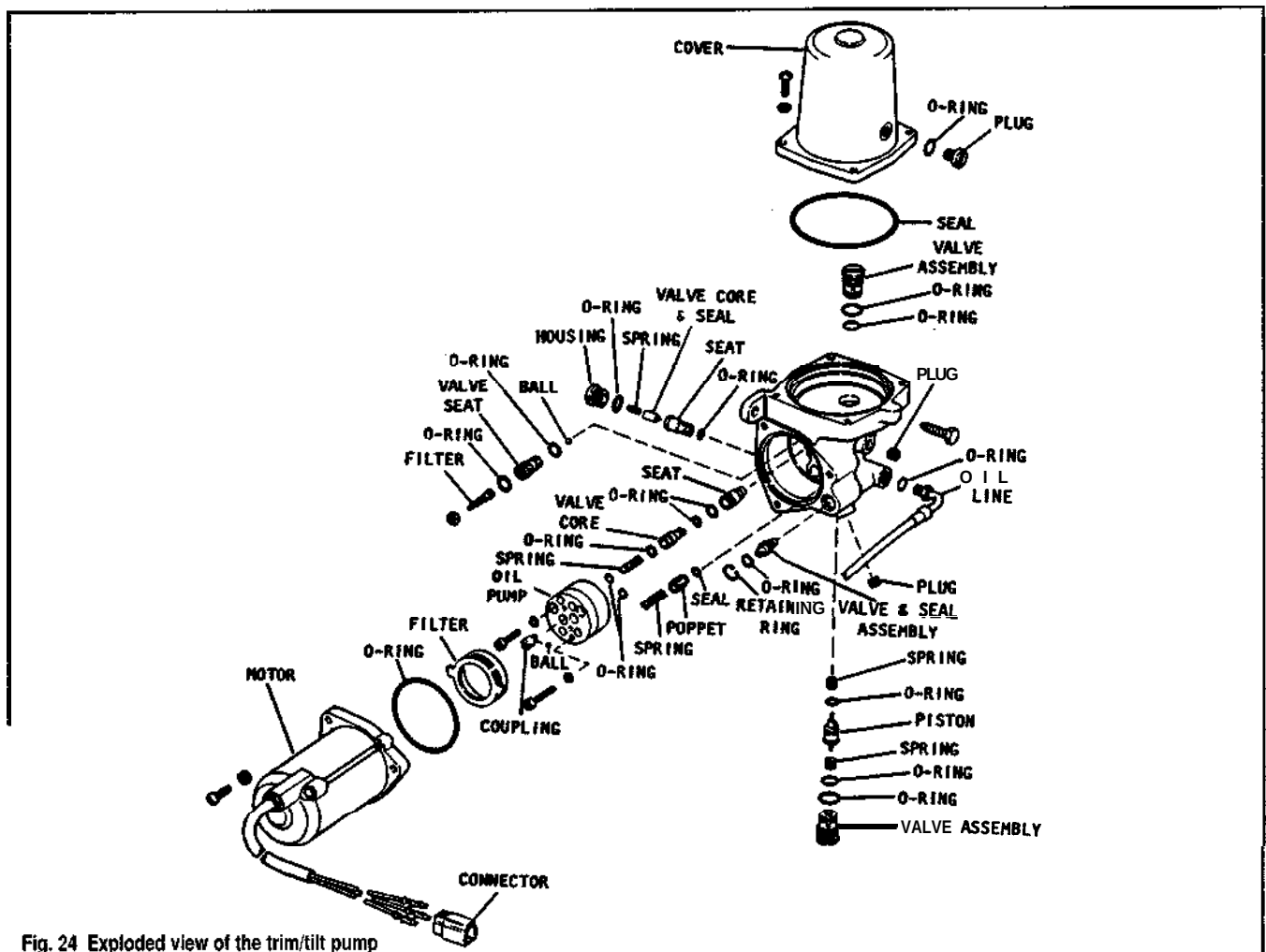


Fig. 24 Exploded view of the trim/tilt pump

14. Insert a drag link socket (or equivalent) into the trim-in/tilt-down check valve and unthread it from the valve body. Pull out the upper spring in the bore and then pull out the pump control piston with needle nose pliers. Don't forget the lower spring. Leave the 2 O-rings on the check valve for now.

15. Remove the trim-out/tilt-up check valve from the bottom (outside) of the valve body.

16. Use a small pin punch to check each check valve for freedom of operation—insert the punch into the hole in the bottom of the valve and press down on the spring, making sure that it returns freely.

To Assemble:

17. Thoroughly clean all components in solvent and blow them dry with compressed air. Pay particular attention to drying all manifold passages. Keep everything clean and lint-free.

18. Inspect the pump drive coupling for excessive wear or damage. Check all valves and bores for any sign of scoring or corrosion. Check the machined mating surfaces of the pump housing and valve body for scratches, grooves or other marring.

19. Coat all components thoroughly with Power Trim/Tilt & Steering fluid before installation—do not assemble any component dry!

20. Inspect the tilt-up relief valve seal tip and seat. Coat new O-rings with hydraulic fluid and install them on the valve seat and cap. Press the seat into the bore on the back of the valve body, insert the spring and valve core and then install the cap. Tighten to 50-60 inch lbs. (5.5-7.0 Nm).

21. Install new O-rings on the trim-out/tilt-up check valve and then thread the valve into the valve body. Tighten to 50-60 inch lbs. (5.5-7.0 Nm).

22. Insert the lower control piston spring into the bore in the valve body. Slide a new O-ring onto the piston and position it into the valve body so the end with the O-ring is down. Slide a new O-ring onto the trim-in/tilt-down check valve and then threads it into the piston assembly bore after inserting the upper piston spring. Tighten the check valve to 50-60 inch lbs. (5.5-7.0 Nm).

23. Take a look at the small O-rings on the thermal expansion valve body and core, if they were removed or look damaged in any way, replace them. Install the valve body, core and spring into the main valve body.

24. Inspect the sealing tip on the trim-in relief valve. If you haven't already replaced it, we suggest doing it now as described in the disassembly step. Install the valve and spring into the valve body.

25. Press 2 new O-rings into the filter valve body and press it into the main valve body. Install the filter and washer.

26. Position the oil pump onto the valve body mating surface without disturbing the O-rings and insert each of the screws. Tighten the screws to 25-35 inch lbs. (2.8-4.0 Nm), one full rotation at a time, in an alternating pattern.

27. Insert the drive coupling into the drive gear and rotate it slowly by hand to make sure there is no binding evident. If you are unable to turn it by hand, loosen the pump housing screws a little (remember, one turn at a time) and then try it again. If the coupling now turns, you've got a problem in the housing; check all components and start over again.



Fig. 25 Remove the motor mounting bolts...

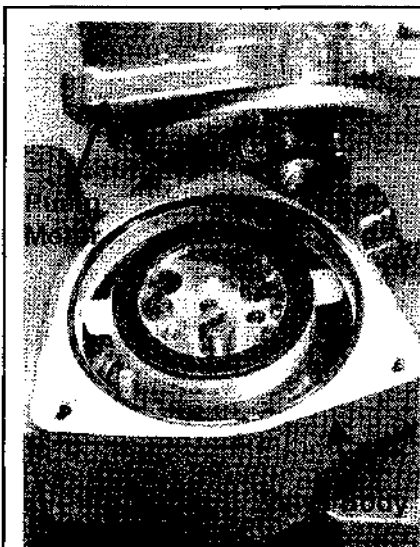


Fig. 26 ...and then lift off the motor

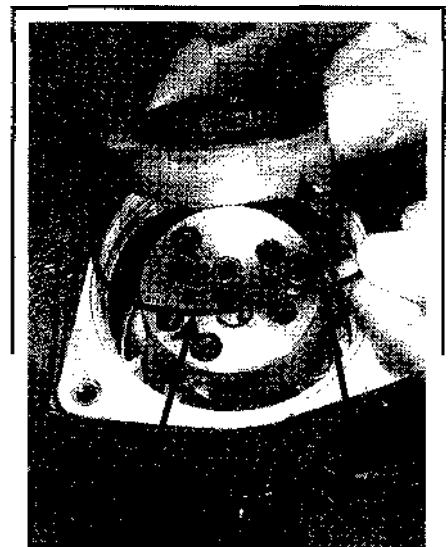


Fig. 27 Remove the oil pump filter and O-ring...

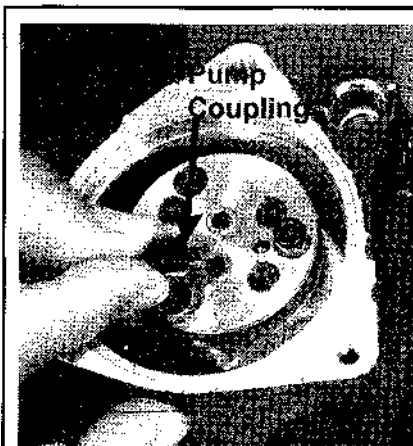


Fig. 28 ..and then lift out the pump coupling

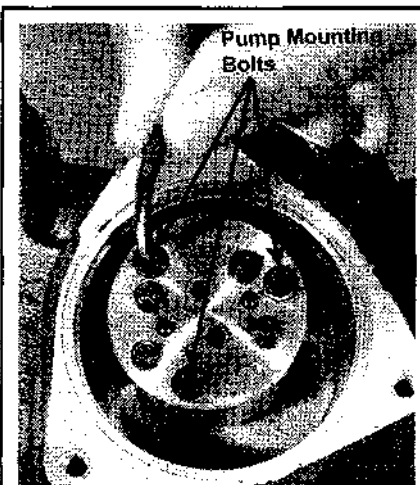


Fig. 29 Remove the 3 pump mounting bolts...

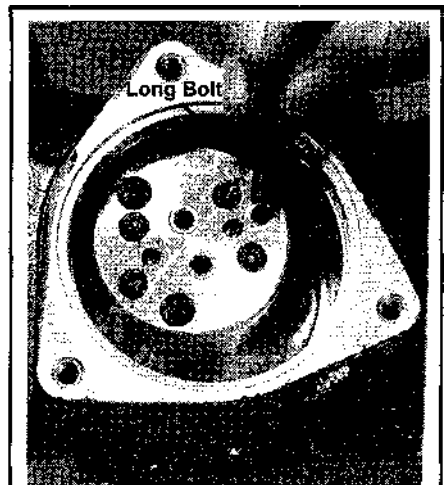


Fig. 30 ...remember that one is longer than the other two...

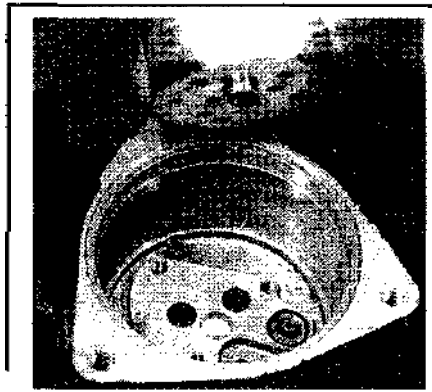


Fig. 31 ...and then lift the pump from the valve body

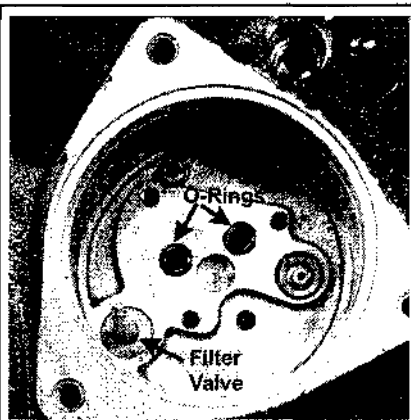


Fig. 32 Remove the filter valve and then the 2 O-rings

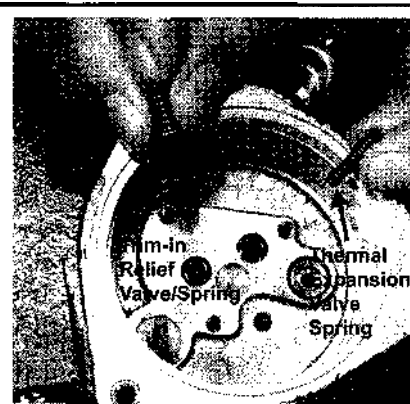


Fig. 33 Remove the trim-in relief valve and thermal expansion springs from the valve body



Fig. 34 Use a small pick or the special tool to remove the thermal expansion valve body

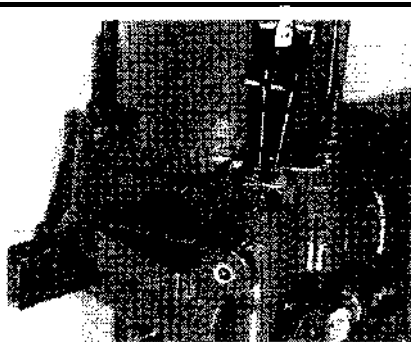


Fig. 35 Remove the release valve retaining clip

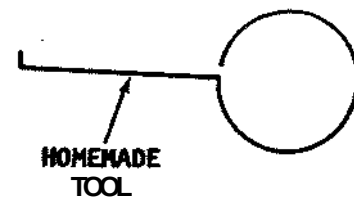


Fig. 36 Fabricate a small removal tool out of a paper clip

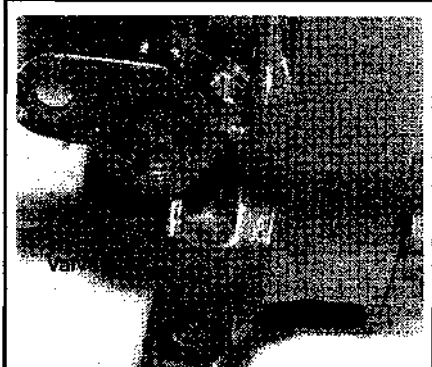


Fig. 37 A good shot of the tilt-up relief valve plug

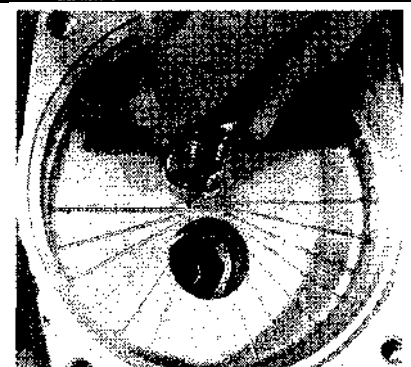


Fig. 38 Unscrew the trim-in/tilt-down check valve...

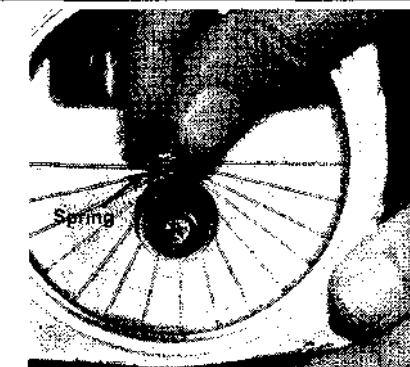


Fig. 39 ...and then remove the upper control piston spring

28. Install the round oil pump filter screen onto the pump housing.

29. Check the small seal on the inner end of the manual release valve and then install a new O-ring. Thread the valve into the bore on the outer valve body and tighten it to 45-55 inch lbs. (5-6 Nm). Install a new retaining ring with circlip pliers.

30. Install a new O-ring onto the motor and then position it to the valve body so the mounting holes line up correctly. Now rotate the coupler until the slot lines up with the blade on the motor shaft and then install the motor (it will only go on one way). Tighten the bolts to 60-84 inch lbs. (7-9 Nm).

31. Turn the assembly over and install a new O-ring on the reservoir flange. Position the reservoir on the valve body so that the bolt holes are in alignment and then tighten the bolts to 60-84 inch lbs. (7-9 Nm).

32. Install the assembly in the boat, fill with fluid and test for leaks.

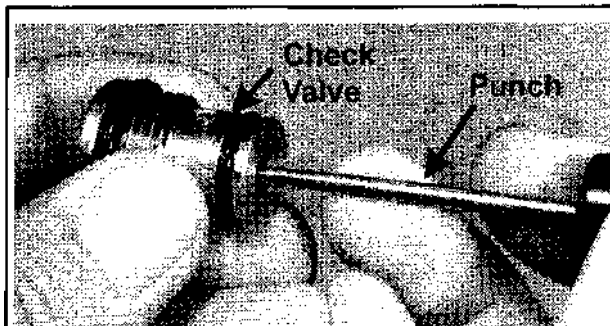


Fig. 40 Insert a small punch into the check valve to check return spring action

POWER TRIM AND TILT—1989-98 COBRA, KING COBRA, SP(SX) AND DP

Description

† See Figure 41

■ Not all models use all components in all years.

This power trim/tilt system is a hydro-mechanical, electrically controlled system allowing the stern drive to be raised when moving through the water at idle speed, when approaching the beach or shore, and when trailering the boat. The drive can also be adjusted through-out its trim range while the boat is underway and at any speed. Thus enabling the helmsman to maintain the best bow position for maximum speed, efficiency and ride for any water or throttle conditions.

An electric motor, controlled by a switch and relays, provides the power for a hydraulic pump. The pump, in turn, forces fluid through a set of hydraulic hoses to a set of hydraulic cylinders. Depending on the motor's direction, fluid will flow into one end of the cylinders to raise or lower the drive unit.

A control switch may be mounted on the remote control handle or on the control panel. When activated, the UP or DOWN relay is energized. Current to the motor rotates the motor in one of two directions, thus raising or lowering the drive unit.

The power trim/tilt system consists of a valve body (manifold), hydraulic reservoir, electric motor, up and down solenoids, trim/tilt switch, trim sending unit, trim indicator gauge, trim limit switch, two hydraulic trim cylinders, and the necessary hydraulic lines and electrical harnesses for the system to function efficiently.

The manifold, hydraulic reservoir, electric motor, and up/down solenoids make up a single unit known as the pump assembly that is mounted inside the boat. Two hydraulic trim cylinders are mounted, one on each side, of the stern drive unit. One end of the cylinder is connected to the gimbal housing and the opposite end is attached to the drive housing.

The trim sender unit is mounted on the starboard side of the gimbal ring and is connected to the trim gauge on the control panel through the wiring harness. When the stern drive is trimmed IN or OUT the gauge moves to indicate the stern drive's position.

A trim limit switch may be connected to the UP solenoid on the trim/tilt hydraulic pump. This limit switch allows the stern drive to be trimmed out only to a preset position. If the stern drive is moved out past the support brackets under high throttle setting could impose high stress loads on the boat transom and possibly loss of steering control. There may also be a 10 amp circuit breaker or fuse serving the same purpose.

The relationship of the various units in the trim/tilt system are discussed in the following paragraphs.

VALVE BODY/MANIFOLD

◆ See Figure 41

The valve body, or manifold, is the central mounting point for the pump, valves, reservoir and electric motor. The hydraulic pump is capable of creating pressure up to 3000 psi. Internal pressure relief valves set at the factory control the output pressure in the UP and DOWN circuits. A system thermal relief valve protects the pump, valves, lines, and cylinder packing from thermal expansion of the hydraulic fluid in the system when operating or sitting in the hot sun. The pump, pressure and thermal relief valves are all set at the factory and adjustments are not possible. If any of these components are found to be defective during troubleshooting or disassembly, they must be replaced with identical items. Each of the valves is color coded to ensure the correct valve is installed in the correct port. A replaceable filter is mounted on the inlet opening to the pump.

Models through 1996 utilize a manual release valve. Models after 1997 offer no provisions for a manual relief valve on the manifold. If the pump or motor fails, manually raising or lowering the stern drive would require the appropriate hydraulic line be loosened on the manifold external fitting.

□ There may be some 1996 models without a manual relief valve, and there will be some 1997 models with a manual relief valve—checking your manifold is the only way to tell for sure.

RESERVOIR

All models utilize an integrated reservoir, while some later models may use a different reservoir which is a translucent 1 1/2 quart reservoir that attaches to the bottom of the pump manifold. A MIN and MAX mark cast into the reservoir makes it easy to check the fluid quantity. A large screw-on cap and opening provides for easy servicing of the reservoir. The cap vents the reservoir to atmosphere pressure when the fill neck seal is removed inside the cap.

HYDRAULIC PUMP

The hydraulic fluid pump is a gear-type pump, very similar to an engine oil pump. The pump is attached to the manifold with four fasteners and cannot be disassembled. If the pump fails, it must be replaced as an assembly. The reservoir must be drained and removed to gain access to the pump.

MANUAL RELEASE VALVE

1989-96 Models Only

◆ See Figures 41 and 42

5 There may be some 1997 models that are still utilizing the manual release valve; conversely, there may be some 1996 models that are not equipped with this component. Simply check the valve body to be sure.

The manual release (or relief) valve is used on 1989-96 models and is located on the port side of the base of the manifold. This valve allows the drive unit to be raised or lowered manually without the use of electric or hydraulic power. By rotating the valve counterclockwise, the drive unit will lower under its own weight; closing the valve will stop the process. The valve must be fully open to raise the unit, and it must be tightly closed in order to hold a trim or tilt position while static or moving forward.

MANUAL RELEASE CHECK BALL & RETAINER

1989-96 Models Only

◆ See Figure 41

■ There may be some 1997 models that are still utilizing the manual release valve; conversely, there may be some 1996 models that are not equipped with this component. Simply check the valve body to be sure.

The manual release check ball and retainer is positioned in a seat next to the trim-in/tilt-down check valve. The retainer limits the check ball movement. The check ball allows fluid to flow directly from the reservoir into the manifold when the pump is not operating. This function is required to enable fluid to be drawn into the hydraulic cylinders when raising the stern drive unit manually.

TRIM-INITILT-DOWN CHECK VALVE

† See Figure 41

The trim-initilt-down check valve is located in the manifold. This valve opens under pressure to allow hydraulic fluid from the pump to the low volume side of the cylinders during the Down cycle. The cylinder chamber with the rod is identified as the low volume side.

The valve also allows fluid to return from the low volume side of the cylinder to the pump during the Up cycle, after the valve has been opened by the pump control piston.

In addition to the above, the valve prevents the drive unit from raising during operation in Reverse, acting as a reverse lock; and prevents fluid flow from the high volume side of the cylinders during a high pressure impact condition.

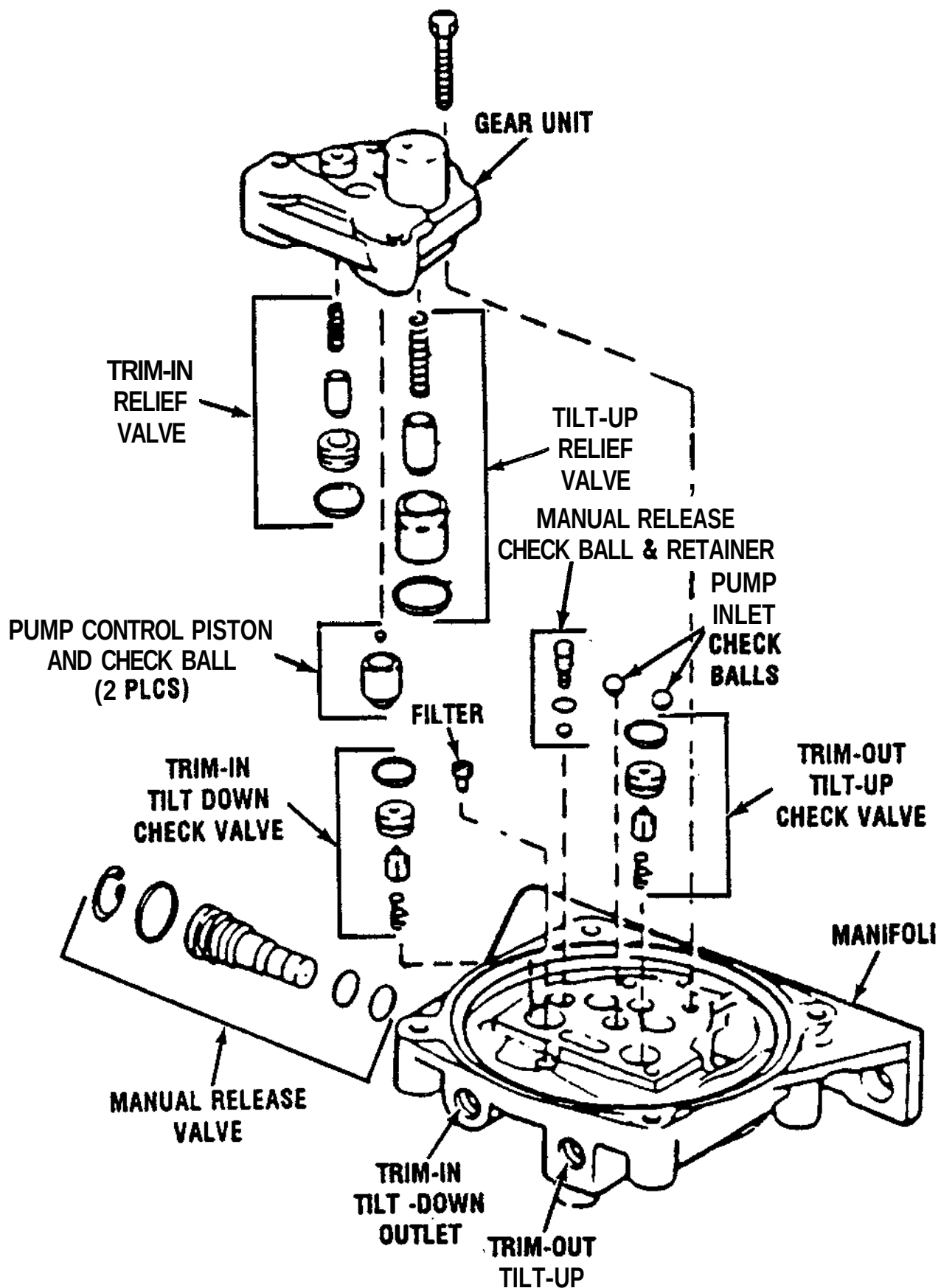


Fig. 41 Exploded view of the manifold —most models similar

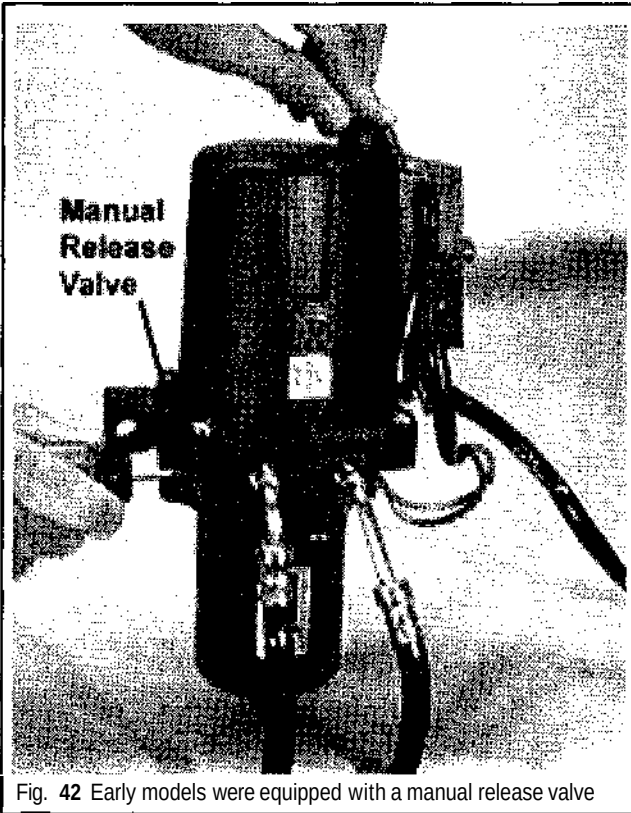


Fig. 42 Early models were equipped with a manual release valve

TRIM-IN/TILT-DOWN OUTLET PORT

◆ See Figure 41

The outlet port on the manifold is connected to the rod end (low volume) side of the trim cylinders be a combination of hydraulic hoses and lines. It is directly in line with the manual relief valve.

Hydraulic fluid, under pressure, flows through this port to both cylinders during cylinder retraction. Return fluid from both cylinders, during cylinder extension, will flow back through this port.

TRIM-OUT/TILT-UP CHECK VALVE

◆ See Figure 41

This valve is located in a seat connected to the UP port in the manifold. It opens under pressure to allow fluid flow to the high volume side of the trim cylinders during UP operation. The valve serves to maintain oil pressure in the high volume chamber of cylinder so that the drive unit will hold a particular trim or tilt position while moving forward. It will return fluid to the pump during the Down cycle after having been opened by the pump control piston.

TRIM-OUT/TILT-UP OUTLET PORT

◆ See Figure 41

This outlet port on the manifold is marked with the word **UP** and is connected to the cylinder end (high volume side) of the trim cylinders. Hydraulic fluid, under pressure, flows through this port to both cylinders during trim cylinder extension. Return fluid from each cylinder, during retraction, flows back through the port to the pump.

THERMAL EXPANSION RELIEF VALVE

◆ See Figure 41

This valve is located inside the manual release valve (1989-96) or on the gear housing (1997-98) and it prevents hydraulic lock-up when the drive is in the full tilt-up position, which can be caused by heat-related expansion of the fluid (thermal expansion). The valve will open only when it senses unusually high pressure (approx. 2250-2750 psi).

INLET CHECK BALLS

◆ See Figure 41

These check balls rest in seats on either side of the oil pump gears, allowing fluid from the reservoir into the pump when they open. When closed, obviously, they prevent fluid in the pump from returning to the reservoir.

PUMP CONTROL PISTON

◆ See Figure 41

Oil pressure in the pump moves the control pistons to open the trim-in/tilt-down check valve during the UP cycle and the trim-out/tilt-up check valve during the DOWN cycle. There are two checks balls that either allow or restrict fluid movement through the pistons depending on the cycle selection.

PUMP FILTER & COUPLER

◆ See Figure 41

A serviceable filter is located between the pump motor and the reservoir; filtering all fluid flowing into the pump from the reservoir. A coupler is used to connect the motor shaft to the oil pump drive gear.

FILTER SCREEN

1989-96 Models Only

◆ See Figure 41

Certain models may be equipped with a serviceable filter screen between the manifold and gear housing that filters fluid returning to the reservoir from the manual relief valve passage.

TILT-UP RELIEF VALVE

◆ See Figure 41

This valve is located in the gear housing, next to the Trim-in relief valve; it is noticeably larger than its companion. It functions to control maximum pressure in the circuit during the UP cycle. It also limits pressure at the full tilt-up 'stall' position to a maximum of 1200-1600 psi.

TRIM-IN RELIEF VALVE

◆ See Figure 41

As mentioned previously, this valve is located in the gear housing next to the tilt-up relief valve and is noticeably smaller than its companion. It controls pressure in the system during the DOWN cycle. Due to rod volume, more fluid returns from the high volume side of the trim cylinders than the low volume side can handle; excess fluid passes through the valve which will keep pressure on the Down side at 400-800 psi.

Troubleshooting

◆ See Figures 43 and 44

The electric pump motor must operate to drive the mechanical hydraulic pump. The hydraulic pump will convert the electrical energy into mechanical energy. The mechanical energy moves the hydraulic fluid to extend and retract the trim cylinders. Use the following troubleshooting procedures to determine if the problem is electrical or mechanical.

DETERMINE IF PROBLEM IS ELECTRICAL OR MECHANICAL



1. Verify that the battery is fully charged before continuing the troubleshooting procedure. If the battery is not fully charged, the system could give a false indication of a problem when none actually exists.
2. Verify the fluid level in the reservoir is up to the MAX mark on the side of the reservoir; or the bottom of the filler hole on earlier models.
3. Depress the **UP** or **DOWN** button on the control panel and listen for the pump motor to operate or the solenoid to click.

**Power Trim Diagnostic Chart
1989-96**

Symptom/Problem	Possible Cause
Static leak-down and/or trim-in creep in Forward gear	③ ④ ⑤ ⑥ ⑦
Trim-out/tilt-up creep in Reverse gear (no reverse lock)	⑥ ⑦ ⑧ ⑨ ⑩
Leaking, Up and Down (trim-in/out creep)	⑦
Slow or no trim-out/tilt-up while motor running	① ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬
No trim-out/tilt-up, motor does not run	⑧ ⑨ ⑩ ⑪
Slow or no trim-in/tilt-down while motor running	① ③ ⑤ ⑥ ⑧ ⑨ ⑩ ⑫
No trim-in/tilt-down, motor does not run	③ ④ ⑤ ⑥
No trim/tilt Up or Down, motor runs	① ③ ②
No trim/tilt Up or Down, motor runs fast	⑫
No trim/tilt Up or Down, motor does not run	③ ④ ⑤ ⑥
No tilt-down from full tilt-up position, motor stalls	④
Erratic operation, jumpy motion, pulsing/hissing fluid sounds	②
Continual use or loss of hydraulic fluid	⑦

- ① Air or low/no oil in reservoir. Fill reservoir and cycle pump
 ② Air in hydraulic system. Cycle pump through range 3-5 times. Fill reservoir
 ③ Manual release valve loose or leaking. Check seal ring, O-ring and seats.
 Tighten valve to 45-55 inch lbs. (5-6 Nm).
 @ Thermal expansion valve sticking or damaged spring. Dirt under check ball.
 ⑤ Trim-out/tilt-up check valve sticking, damaged seal tip, dirt under seal, leaking O-ring,
 damaged spring
 ⑥ Pump control piston sticking, dirt under check balls or in small oil passages.
 ⑦ Trim/tilt cylinder internal leak. Check for damaged piston seal impact relief valves,
 or dirt under relief valves
 ⑧ Trim-in/tilt-down check valves sticking. Damaged seal tip, dirt under seal, leaking
 O-ring or bad spring
 @ Manual release check ball leaking. Check for damaged or dirty ball or seat.
 ⑨ Trim-in relief valve leaking. Check seal tip, seat or spring. Check for sticking or dirt.
 @ Tilt-up relief valve leaking. Check sticking valve, seal tip, seal or spring. Check
 valve body O-ring.
 ⑫ Pump coupling broken.
 ⑬ 10 or 50 amp circuit breaker tripped
 ⑭ Motor inoperative, replace motor.
 ⑮ Relay control box malfunction. Replace box.
 ⑯ Switch circuit malfunction.
 ⑰ External oil leak. Check all lines, connections, cylinders and valve body.
 ⑱ Pump-to-manifold oil line attachment reversed.

**Power Trim Diagnostic Chart
1997-98**

Symptom/Problem	Possible Cause
Static leak-down and/or trim-in creep in Forward gear	③ ④ ⑤ ⑥
Trim-out/tilt-up creep in Reverse gear (no reverse lock)	⑤ ⑦ ⑧ ⑨
Leaking, Up and Down (trim-in/out creep)	⑥
Slow or no trim-out/tilt-up while motor running	① ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪
No trim-out/tilt-up, motor does not run	⑪ ⑫ ⑬ ⑭
Slow or no trim-in/tilt-down while motor running	① ③ ④ ⑤ ⑦ ⑧ ⑩
No trim-in/tilt-down, motor does not run	⑪ ⑫ ⑬ ⑭
No trim/tilt Up or Down, motor runs	008
No trim/tilt Up or Down, motor runs fast	⑫
No trim/tilt Up or Down, motor does not run	⑪ ⑫ ⑬ ⑭
No tilt-down from full tilt-up position, motor stalls	③
Erratic operation, jumpy motion, pulsing/hissing fluid sounds	②
Continual use or loss of hydraulic fluid	⑤

- ① Air or low/no oil in reservoir. Fill reservoir and cycle pump
 ② Air in hydraulic system. Cycle pump through range 3-5 times. Fill reservoir
 ③ Thermal expansion valve sticking or damaged spring. Dirt under check ball.
 ④ Trim-out/tilt-up check valve sticking, damaged seal tip, dirt under seal, leaking O-ring,
 damaged spring
 ⑤ Pump control piston sticking, dirt under check balls or in small oil passages.
 ⑥ Trim/tilt cylinder internal leak. Check for damaged piston seat impact relief valves,
 or dirt under relief valves
 ⑦ Trim-in/tilt-down check valves sticking. Damaged seal tip, dirt under seal, leaking
 O-ring or bad spring
 ⑧ Trim-in relief valve leaking. Check seal tip, seat or spring. Check for sticking or dirt.
 @ Tilt-up relief valve leaking. Check sticking valve, seal tip, seal or spring. Check
 valve body O-ring.
 ⑩ Pump coupling broken.
 ⑪ 10 or 50 amp circuit breaker tripped
 ⑫ Motor inoperative, replace motor.
 ⑬ Relay control box malfunction. Replace box.
 ⑭ Switch circuit malfunction.
 ⑮ External oil leak. Check all lines, connections, cylinders and valve body.
 ⑯ Pump-to-manifold oil line attachment reversed.

4. If the pump motor does not operate, and the solenoids do not "click," the problem is electrical.
5. If the pump motor operates, but the stern drive does not move, the problem is most likely a hydraulic or mechanical problem. Refer to hydraulic/mechanical troubleshooting.
6. On early models, check the manual release valve—it MUST be closed and tightened to 45-55 inch lbs. (5-6 Nm).

HYDRAULIC AND MECHANICAL PROBLEMS

◆ See Figure 45



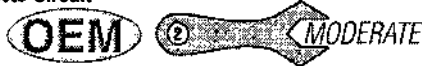
All testing procedures should be performed using a OMC Trim/Tilt In-Line Pressure Tester (# 983977) consisting of a pressure gauge, adapter, tester body, shut-off valve and hydraulic line.

To install the tester:

1. Raise the stern drive up to its full tilt-up position and block it securely with wood.
2. On early models equipped with a manual release valve, open the valve all the way for a few seconds until the pressure equalizes and then close the valve tightly. On later models without the valve, simply open the filler cap/plug for a few seconds and then close it.
3. Label the UP hydraulic line at the pump and then disconnect it; make sure you have some rags handy, safety glasses on and a suitable pan underneath the connection. Once the pressure has been released, reconnect the line.
4. The body of the tester has two ports (marked A and B). Port A is always connected to the gauge, while port B can be shut off by closing the valve on the tester. The A port must always be the one that is connected to the component or circuit thus allowing the circuit to be isolated when the vessel's line is connected to port B and the valve is closed.

Trim-Out/Tilt-Up—Complete Circuit

◆ See Figure 45



Performing this test will determine running and stall pressure for the trim out/tilt-up circuit.

1. Disconnect the UP hydraulic hose (2) at the outlet (1) on the manifold.

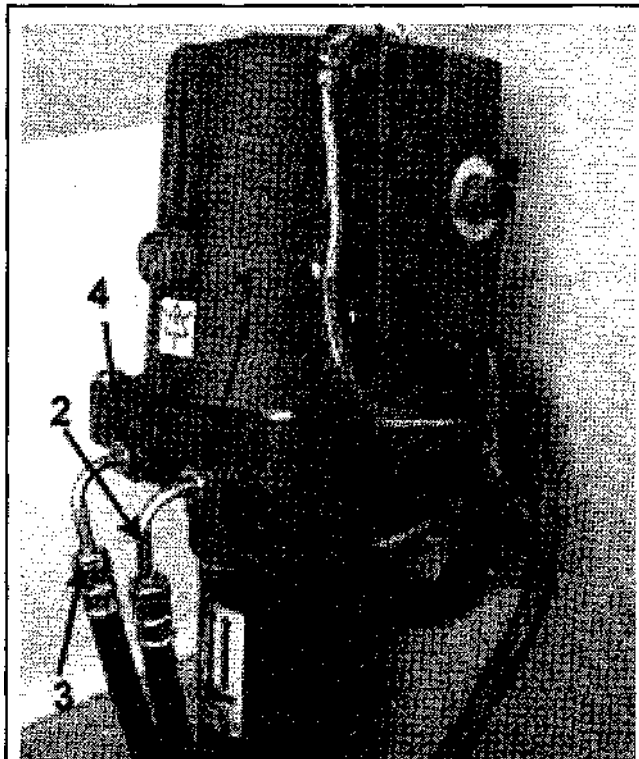


Fig. 45 Trim pump connections

2. Connect the inlet line from the tester (remember that this is connected to the A port on the tester) to the outlet (1) on the manifold.
3. Connect the UP hydraulic hose (2) to the outlet port (stamped B) on the tester and then open the shut-off valve 1-2 turns.

✖✖ WARNING

Opening the valve more than 2 turns may unseat the retaining ring and cause fluid to spray or spill.

4. Run the drive unit through a few Up and Down cycles to purge any air that may have entered the system while hooking up the tester. Check the fluid level and then move the drive unit to the full trim-out/tilt-up position and check the running and stall pressure (that point where the drive stops moving up, but the pump keeps running). Running pressure should be 225-275 psi, while the stall pressure should be 1200-1600. If within specifications, proceed to the Trim-In/Tilt-Down - Complete Circuit test; if not within specifications, move to the Trim-Out/Tilt-Up - Pump Isolation test.

Trim-Out/tilt-Up—Pump Isolation

◆ See Figure 45



Performing this test will isolate the pump manifold trim-out/tilt-up components from the trim cylinders and will determine whether the manifold or the trim cylinders have a problem.

1. Disconnect the UP hydraulic hose (2) at the outlet (1) on the manifold.
2. Connect the inlet line from the tester (remember that this is connected to the A port on the tester) to the outlet (1) on the manifold.
3. Connect the UP hydraulic hose (2) to the outlet port (stamped B) on the tester and then open the shut-off valve 1-2 turns.

✖✖ WARNING

Opening the valve more than 2 turns may unseat the retaining ring and cause fluid to spray or spill.

4. Move the drive unit up to the full tilt position and then flick the trim switch for a moment in the DOWN position to relieve pressure. Once relieved, close the shut-off valve on the tester.
5. Run the pump in the trim-out/tilt-up direction until the drive stops moving but the pump continues to run; record the pressure at the stall.
6. Release the trim switch and check the leak-down rate as the pressure drops for at least 5 minutes. Record this and record the final pressure.
7. Stall pressure should be 1200-1600 psi. Leak-down rate should not exceed 200 psi. If the stall pressure is less than specification, or the leak-down pressure is greater than the figure, check the manifold. If the leak-down rate and stall pressure is within specifications, check each of the trim cylinders for leakage.
8. Flip the trim switch to operate the drive in the opposite direction and watch the gauge until all pressure has been relieved. Disconnect the tester and reconnect the hose.

Trim-In/Tilt-Down—Complete Circuit

+ See Figure 45



Performing this test will determine running and stall pressure for the trim-in/tilt-down circuit.

1. Disconnect the DOWN hydraulic hose (3) at the outlet (4) on the manifold.
2. Connect the inlet line from the tester (remember that this is connected to the A port on the tester) to the outlet (4) on the manifold.
3. Connect the DOWN hydraulic hose (3) to the outlet port (stamped B) on the tester and then open the shut-off valve 1-2 turns.

✖✖ WARNING

Opening the valve more than 2 turns may unseat the retaining ring and cause fluid to spray or spill.

4. Run the drive unit through a few Up and Down cycles to purge any air that may have entered the system while hooking up the tester. Check the fluid level and then move the drive unit to the full trim-tilt-down position and check the running and stall pressure (that point where the drive stops moving down, but the pump keeps running). Running pressure should be 400-800 psi, while the stall pressure should be 400-800 psi. If not within specifications, move to the Trim-In/Tilt-Down - Pump Isolation test.

Trim-In/tilt-Down—Pump Isolation

◆ See Figure 45



Performing this test will isolate the pump manifold trim-in/tilt-down components from the trim cylinders and will determine whether the manifold or the trim cylinders have a problem.

1. Disconnect the DOWN hydraulic hose (3) at the outlet (4) on the manifold.
2. Connect the inlet line from the tester (remember that this is connected to the A port on the tester) to the outlet (4) on the manifold.
3. Connect the DOWN hydraulic hose (3) to the outlet port (stamped B) on the tester and then open the shut-off valve 1-2 turns.

*** WARNING

Opening the valve more than 2 turns may unseat the retaining ring and cause fluid to spray or spill.

4. Move the drive unit down to the full tilt position and then flick the trim switch for a moment in the UP position to relieve pressure. Once relieved, close the shut-off valve on the tester.
5. Run the pump in the trim-in/tilt-down direction until the drive stops moving but the pump continues to run; record the pressure at the stall.
6. Release the trim switch and check the leak-down rate as the pressure drops for at least 5 minutes. Record this and record the final pressure.
7. Stall pressure should be 400-800 psi. Leak-down rate should not exceed 200 psi. If the stall pressure is less than specification, or the leak-down pressure is greater than the figure, check the manifold. If the leak-down rate and stall pressure is within specifications, check each of the trim cylinders for leakage.
8. Flip the trim switch to operate the drive in the opposite direction and watch the gauge until all pressure has been relieved. Disconnect the tester and reconnect the hose.

Erratic Motion During Operation



Check the hydraulic fluid level and fill if necessary. Bleed the system.

Static Leak-down, Trim-In Creep in Forward

◆ See Figures 46, 47, 48 and 49



1. If equipped with a manual release valve, confirm that it is tight and not leaking. Tighten the valve to 45-55 inch lbs. (5-6 Nm). If leaking, drain the system and move the drive unit to the full Down position. Remove the valve and check the plastic seal, O-ring and seat.
2. Check the thermal expansion valve located in the end of the manual release valve (1989-96) or in the gear housing (1997-98). Look for sticking, damage to the spring or dirt under the check ball.
3. Check the trim-out/tilt-up check valve for damage. Check the seal tip, dirt under the seal, leaking O-ring or a damaged spring.
4. Check to see if the pump control piston is sticking. Check the condition of the piston and the O-ring.
5. Check for external leaks through out the system.

Trim-In/Trim-Out Creep



This condition is frequently caused by an internal leak at the trim cylinders—the internal piston seals or the impact relief valves may be dirty or damaged, causing fluid to slowly leak from one side of the piston to the other.

Trim-Out/Tilt-Out Creep In Reverse

◆ See Figure 45, 48 and 49



1. Check to see if the pump control piston is sticking. Look for dirt under the check balls or in the small oil passages in the piston itself. Check the piston and its bore for scuffing or other signs of damage. Check the ball seat for signs of wear.
2. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
3. Check the manual release check ball and seat for leakage or damage (if equipped).
4. Check all components for external leaks or damage.
5. Confirm that the UP and DOWN hydraulic hoses are connected to the correct ports on the manifold.

No Tilt-Down From Full Tilt-Up Position

◆ See Figure 47



Check the O-ring and seal on the thermal expansion valve. Confirm that the valve is not sticking and that the spring is not damaged.

No Or Slow Trim-Out/tilt-Up With Motor Running

◆ See Figures 47, 48 and 49



1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. If equipped with a manual release valve, confirm that it is tight and not leaking. Tighten the valve to 45-55 inch lbs. (5-6 Nm). If leaking, drain the system and move the drive unit to the full Down position. Remove the valve and check the plastic seal, O-ring and seat.
3. Check the thermal expansion valve located in the end of the manual release valve (1989-96) or in the gear housing (1997-98). Look for sticking, damage to the spring or dirt under the check ball.
4. Check the trim-out/tilt-up check valve for damage. Check the seal tip, dirt under the seal, leaking O-ring or a damaged spring.
5. Check to see if the pump control piston is sticking. Check the condition of the piston and the O-ring. Poor piston performance may also be affected by an internal leak in the trim cylinders—the cylinder piston seals or impact relief valves may be damaged.
6. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
7. Check the tilt-up relief valve for sticking, damaged spring or a dirty seal tip. Check that the manifold O-ring is not distorted.
8. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.
9. Check that the motor output is up to specification.

No Or Slow Trim-Out/tilt-Down With Motor Running

+ See Figures 48, 49 and 50



1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. Check the trim-out/tilt-up check valve for damage. Check the seal tip, dirt under the seal, leaking O-ring or a damaged spring.
3. Check to see if the pump control piston is sticking. Check the condition of the piston and the O-ring. Poor piston performance may also be affected by an internal leak in the trim cylinders—the cylinder piston seals or impact relief valves may be damaged.
4. The trim-in/tilt-down check valve may be sticking due to a damaged seal tip. Check for dirt under the seal, leaking O-ring or a damaged spring.
5. The filter valve, or the check valve behind it, may be damaged or leaking.
6. Check the trim-in relief valve for sticking, damaged spring or a dirty seal tip.
7. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.
8. Check that the motor output is up to specification.

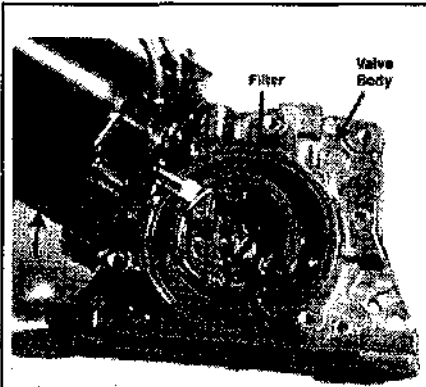


Fig. 46 Separating the pump from the manifold

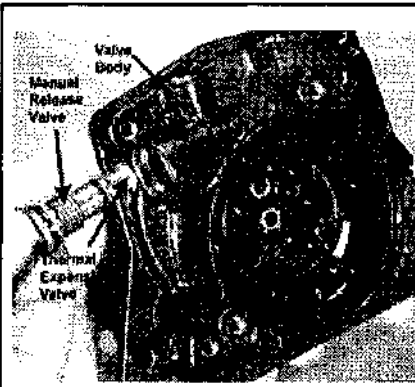


Fig. 47 On early models, the thermal expansion valve is located in the tip of the manual release valve

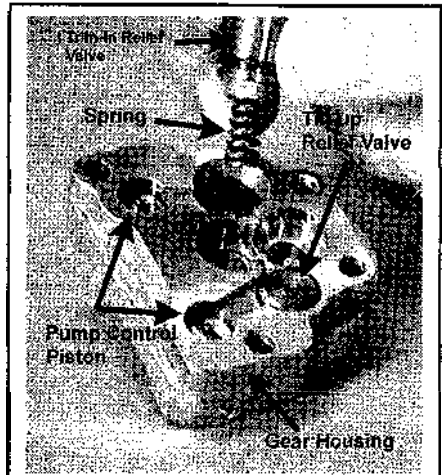


Fig. 48 Close up of the gear housing



Fig. 49 A good view of the valve body

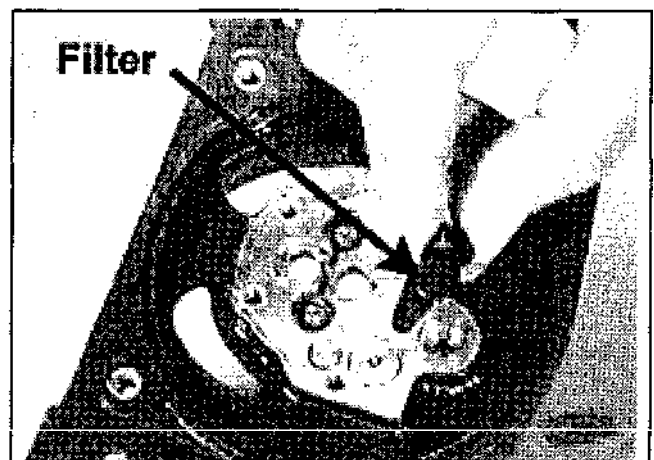


Fig. 50 Checking the filter

No Trim/Tilt, Motor Will Not Run

More times than not this condition is caused by an electrical problem in the switch circuit, relay/solenoid circuit, or with the motor. Please refer to the Electrical Problems section.

No Trim/Tilt, Motor Runs

◆ See Figure 47

1. Check the hydraulic fluid level in the reservoir. Fill if necessary and bleed the system.
2. If equipped with a manual release valve, confirm that it is tight and not leaking. Tighten the valve to 45-55 inch lbs. (5-6 Nm). If leaking, drain the system and move the drive unit to the full Down position. Remove the valve and check the plastic seal, O-ring and seat.
3. Check the thermal expansion valve located in the end of the manual release valve (1989-96) or in the gear housing (1997-98). Look for sticking, damage to the spring or dirt under the check ball.
4. Check the condition of the oil pump. Dirt can be in the pump or the coupling may have failed.

ELECTRICAL PROBLEMS



Please refer to the electrical schematics later in this section.

Before performing any electrical tests, always verify that the battery has a full charge. A low battery can always give a false indication that some other problem in the system exists.

Check the circuit breakers in the main engine electrical box and in the trim/tilt relay control box have not tripped for some reason. Push in the button and reset the breaker.

Trim/Tilt Switch



During switch operation, electrical current flows from the input terminal (red/purple wire) to the respective output terminals.

1. Check all electrical connections. Check the 50 amp trim/tilt circuit breaker and the 10 amp trim/tilt pump breaker. Check the battery.
2. Connect a test light or a multi-meter as per the manufacturer's instructions and touch the probe to the red/purple wire terminal. The tester should light or the meter should indicate battery voltage; if not, recheck the 50 amp and 10 amp circuit breakers and/or check any related electrical connections.
3. Move the probe to the green/white wire terminal and move the switch to the Down position. The tester should light or the meter should indicate battery voltage; if not, confirm that all electrical connections are OK and then replace the switch.
4. Now move the probe to the blue/white wire terminal and move the switch to the Up position. The tester should light or the meter should indicate battery voltage; if not, confirm that all electrical connections are OK and then replace the switch.
5. If all test prove to be good and the pump will still not operate, refer to the Pump Relay test later in this section.

Trim/Tilt Motor



◆ See Figures 51 and 52

A stall-torque test is the only reliable means of checking motor performance. Trim/tilt motors are not serviceable and must be replaced as a unit.

13-22 TRIM AND TILT

** WARNING

Never operate the trim/tilt motor for any longer than it takes to complete the following tests. Always allow the motor to cool sufficiently between each test. Performing the two successive tests on a hot motor will lead to inaccurate stall-torque readings.

1. Check all electrical connections. Check the 50 amp trim/tilt circuit breaker and the 10 amp trim/tilt pump breaker. Check the battery.
2. Remove the pump/motor assembly and then remove the motor from the manifold. Install it carefully in a soft-jawed vise.
3. Connect an ammeter or multi-meter in series with the **B+** terminal on the battery (make sure it's fully charged!) and the blue lead at the motor. Next connect a voltmeter (or DVOM) so the positive lead is at the motor's blue lead and the negative lead is at the motor's green lead.
4. Install an inch lb. torque wrench with a suitable adapter to the armature shaft on the pump. Have someone study the wrench while you move to the next step.
5. Now complete the circuit by running a jumper wire between the negative battery cable and the green lead and then take note of all of the readings. The ammeter should show 185 amps, the voltmeter should show 12 volts (min.) and the torque wrench should show a stall-torque of not less than 20.6 inch lbs.
6. Disconnect the 2 meters and the jumper and then reconnect the ammeter in series between the battery positive terminal and the green lead at the motor.
7. Next, make sure that the motor has cooled down and then complete the circuit by connecting the jumper wire between the negative terminal on the battery and the blue lead. This will allow you a stall-torque reading in the opposite direction; both the stall-torque reading and the ammeter reading should be the same as in the earlier step.
8. A low current reading coupled with a low torque reading indicates high resistance in the internal connections or in the brush contacts. Conversely, a high current reading and a low torque reading indicates a bad armature or field windings. Either way, the motor will have to be replaced.

Trim Sending Unit

1989-95 Models



1. Check all electrical connections. Check the 50 amp trim/tilt circuit breaker and the 10 amp trim/tilt pump breaker. Check the battery.
2. Tag and disconnect the sending unit harness at the connector.
3. Install an ohmmeter, or multi-meter, as per the manufacturer's instructions. Connect the probes to the 2 sender leads and then move the sender arm through a full Up and Down cycle while observing the meter.
4. If the meter does not read 0 to 190-210 ohms through out the cycle, the unit must be replaced.

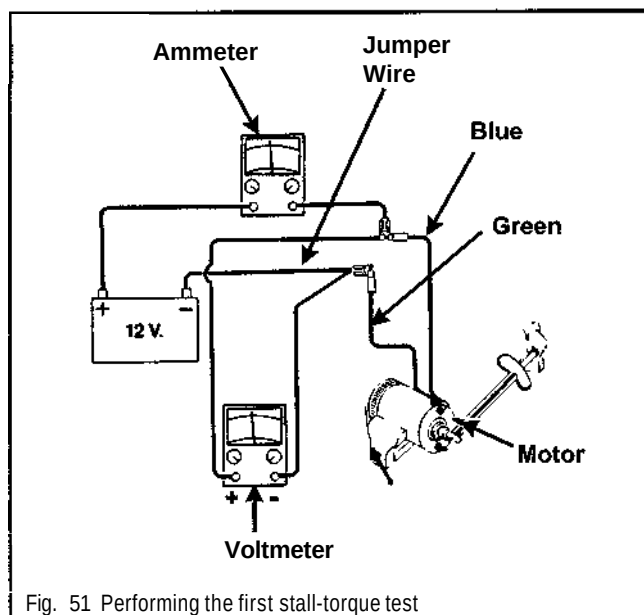


Fig. 51 Performing the first stall-torque test

1996-98 Models

1. Check all electrical connections. Check the 50 amp trim/tilt circuit breaker and the 10 amp trim/tilt pump breaker. Check the battery.
2. Remove the sending unit from the gimbal ring. Tag and disconnect the 3-pin sender connector inside the boat.
3. Install an ohmmeter as per the manufacturer's instructions. Connect the meter between the A terminal black lead in the connector and the terminal C black lead of the sender.
4. Rotate the unit control nut counterclockwise very slowly until the meter shows infinity. Continue rotating the nut and the meter will jump to 0 ohms, rotate it more until you achieve the highest reading, which should be 620-630 ohms on 1996-97 models or 575-625 ohms on 1998 models. Disconnect the meter.
5. Now, connect the meter between the C terminal black lead in the connector and the terminal B white lead of the sender. Slowly rotate the nut counterclockwise and confirm that the meter reading is steady at 620-630 ohms on 1996-97 models or 575-625 ohms on 1998 models. Disconnect the meter.
6. Finally, connect the meter between the A terminal black lead in the connector and the terminal B white lead of the sender. Slowly rotate the nut counterclockwise until the meter shows infinity. Continue rotating the nut and the meter will jump to 620-630 ohms on 1996-97 models or 575-625 ohms on 1998 models; rotate it more until you achieve the lowest reading, which should be 0 ohms. Disconnect the meter.
7. If the sending unit fails any of the preceding tests, it will require replacement.

Trim/Tilt System



◆ See Figures 53 and 54

■ On DP units, if the sender or electrical leads see a short or open condition, the needle on the trim gauge will show erratic movement.

1. Check all electrical connections. Check the 50 amp trim/tilt circuit breaker and the 10 amp trim/tilt pump breaker. Check the battery.
2. Remove the control relay box from the side of the pump.
3. Install a multi-meter as per the manufacturer's instructions. Connect the meter leads and confirm that you have battery voltage at the red/purple lead's terminal and a good ground at the black lead's terminal.

■ There are two red/purple leads, the above test involves the terminal labeled "red/purple1" in the accompanying illustration.

4. Connect the negative meter lead to a good engine ground. Connect the positive lead to the other red/purple lead terminal. If the meter shows battery voltage, the circuit breaker or the 10 amp fuse is good. If not, reset the breaker and check it again; if the meter is still not showing the correct voltage, replace the circuit breaker or the fuse.

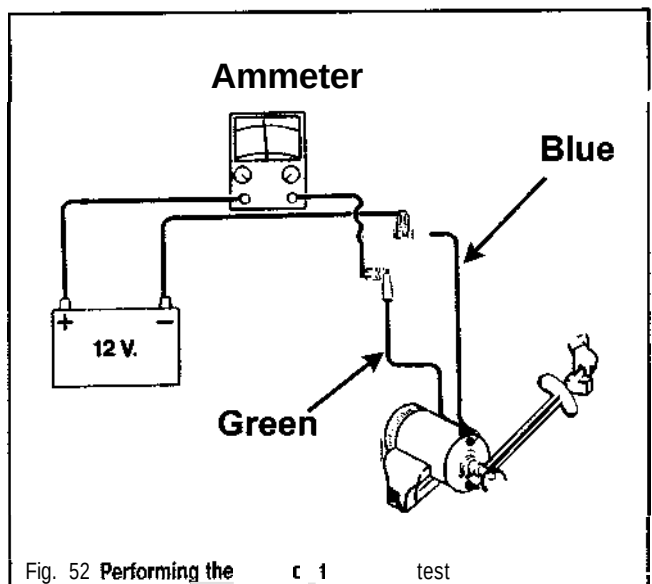


Fig. 52 Performing the second stall-torque test

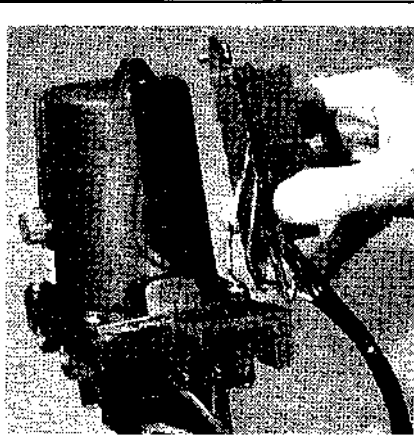


Fig. 53 Removing the control box

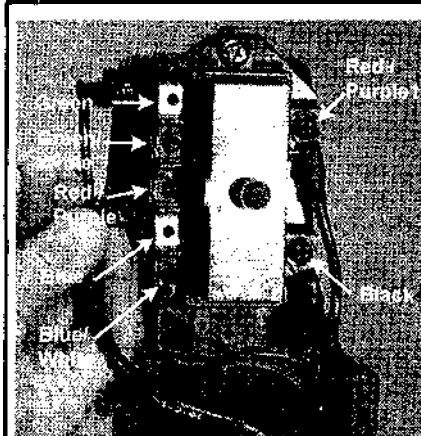


Fig. 54 Wire colors and their related terminals

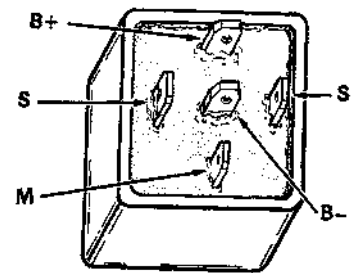


Fig. 55 Relay blade identification

Some later models may utilize a 10 amp inline fuse in place of the 10 amp circuit breaker.

5. Leave the negative lead connected to the engine ground and connect the positive lead to the green/white terminal. Move the trim switch to the Down position and check that the meter shows battery voltage. No voltage, or very low voltage, indicates you have a problem in the circuit between the switch and the box; check all wires and connections.

6. Now move the positive probe to the green terminal. Move the trim switch to the Down position and check that the meter shows battery voltage. No voltage, or very low voltage, indicates you have a bad trim-down relay. Replace the relay.

7. Leave the negative lead connected to the engine ground and connect the positive lead to the blue/white terminal. Move the trim switch to the Up position and check that the meter shows battery voltage. No voltage, or very low voltage, indicates you have a problem in the circuit between the switch and the box; check all wires and connections.

8. Now move the positive probe to the blue lead's terminal. Move the trim switch to the Up position and check that the meter shows battery voltage. No voltage, or very low voltage, indicates you have a bad trim-up relay. Replace the relay.

Relay Ohmmeter Test

◆ See Figure 55



Although the UP and DOWN relays may have different locations and orientations on different applications, the terminals will always be connected to the electrical system and the motor as follows:

- **S** blade (switch + or -)—blue/white, green/white or black wire
- **B+** blade (battery +)—red wire
- **B-** blade (battery -)—black wire
- **M** blade (motor)—blue or green wire

1. Mark each relay and remove them from their sockets.
2. Install an ohmmeter as per the manufacturer's instructions. Set the meter to the High scale.
3. Connect the meter leads between blades **B-** and **M** on the relay. The meter must show continuity.
4. Connect the meter leads between blades **B+** and **M** on the relay. The meter must show no continuity.
5. Now calibrate the meter to the appropriate scale and connect the leads between the two **S** blades on the relay. The meter must show 70-100 ohms.

6. Now connect a power source (12 V) to the **S** blades on the relay and then connect the meter leads across the **B+** and **M** blades on the relay. The meter must show continuity.

7. With the power source still connected to the **S** blades on the relay, connect the meter leads across the **B-** and **M** blades on the relay. The meter must show no continuity.

8. If the relay fails any of the preceding tests, it will require replacement

Service Precautions



The following nine points should always be observed when installing, testing, or servicing any part of the power trim/tilt system.

1. Coat the threads of all fittings and O-rings with Power Trim/Tilt or Steering Fluid, or an equivalent product.
2. Use only clean, new, Power Trim/Tilt and Steering fluid when filling the hydraulic fluid reservoir. If the Power Trim and Steering fluid is not available, substitute with SAE 10W-30 or 10W-40 motor oil in an emergency and then drain the system as soon as possible.
3. The stern drive must be in the full UP/OUT position to relieve hydraulic pressure when checking the fluid level or adding fluid to the reservoir. Normal fluid level should be maintained between the **MIN** and **MAX** marks on the side of the reservoir. If the quantity is low, add fluid until the level is up to the **MAX** mark on the side of the reservoir. Obviously, on models without the plastic reservoir, the level should be to the bottom of the filler hole.
4. If the pump stops during long use, allow the pump motor to cool at least five minutes before starting again. An internal thermal circuit protects the pump motor from overheating. If the pump still will not operate, the system breaker may have tripped or the fuse may have blown.
5. Keep the work area clean when servicing or disassembling parts. The smallest amount of dirt or lint can cause failure of the pump to operate.
6. The manifold, pump assembly, pressure relief valves, and thermal relief valves must be replaced as individual assemblies. There are no piece parts available for these components except for the O-rings that are sold in a kit.
7. The motor is protected from internal fluid leaks and external moisture by seals, O-rings, and a grommet on the field winding harness. If the motor fails due to hydraulic fluid, clean the motor thoroughly and replace the pump internal seal and O-ring. If the motor fails from moisture as evidenced by internal corrosion, the wire harness grommet is damaged or deteriorated, and the pump motor should be replaced. Sometimes liquid neoprene can be used on the wire harness grommet to seal minor cracks. Use liquid neoprene with care to prevent contaminating the electric motor or hydraulic valves.
8. Keep the trim cylinders attached to the forward anchor pin during servicing and repairs. Do not allow the trim cylinders to hang by their hydraulic hoses. Such practice may kink and damage the hoses. Use care when handling trim cylinders during removal/installation of the stern drive unit. Rough treatment of the hoses could result in a weakened hose, partial separation at the fittings, or bending of the metal tubing, any one of which could restrict the flow of fluid to the trim cylinders.
9. Always hold both fittings with a wrench when tightening or loosening hydraulic hoses and fittings. When installing flex hoses, be sure there are no twists or sharp bends in the flex hose.

13-24 TRIM AND TILT

System Testing

High pressure testing of hydraulic components requires expensive special gauges, tools and highly trained personnel to accurately interpret test results. A danger to the operator and others in the area always exists during the testing process. Therefore, it is highly recommended that the boat, with the trim/tilt system installed, be taken to a qualified repair facility having the necessary equipment to conduct the testing properly and safely.

Do not attempt to work on hydraulic hose connections without the proper tools designed for that specific purpose. The use of a common box end wrench will quite likely result in "rounding off" the flats on a hydraulic fitting. It is imperative that you have a set of "flare" or "line" wrenches that will almost guarantee the fitting will not be damaged.

System Bleeding



■ Please refer to the Maintenance section for procedures on **filling** the pump reservoir.

The power trim/tilt system is designed to be self-purging with nothing to be done other than raising and lowering the stern drive unit several times. If, during service work, components were installed already filled with hydraulic fluid, or a line was disconnected and then reconnected, the self-purging feature of the system will adequately eliminate the small amount of unwanted air. However, if components were removed and installed "dry", the following procedures must be performed to adequately purge all air from the system.

*** WARNING

Check to be sure the vent hole opening in the reservoir fill cap is free and clear. A small amount of air must be allowed to enter the reservoir tank as the fluid level drops or vacuum could develop in the tank making it difficult for the pump to draw the fluid from the reservoir.

FILLING AND BLEEDING A DRY SYSTEM

Trim Cylinders



Before installing a new or rebuilt trim cylinder:

1. Compress the trim cylinders so they are in their fully retracted (Down) position.
2. Unscrew the end caps on each cylinder (use the special spanner wrench as detailed in the Disassembly & Assembly procedure) and fill the low-volume chamber with OMC Power Trim/Tilt & Steering Fluid. Install the end caps and tighten to 25-30 ft. lbs. (34-41 Nm).
3. Install the cylinders and connect the hydraulic lines.

Hydraulic Lines & Manifold

REMOVAL & INSTALLATION



■ It will be necessary to remove the stern drive unit in order to gain access to the inner manifold line connections.

1. Loosen and remove the hydraulic line retaining clamps on each side of the gimbal housing.

2. Although not strictly necessary, we recommend removing the grease extension tube in order to gain access to the starboard hydraulic lines. Clamp a pair of vise grips onto the tube (not too tight please) as close to the gimbal bearing bore as possible. Insert a small prybar between the pliers and the bearing flange and then pry the tube out with the bar while rotating back and forth with the pliers.

3. Loosen each of the hydraulic line nuts at the manifold and carefully pull each line out of its recess. Remove each O-ring and throw them away. It's a good idea to plug the line ends with a golf tee or something similar to minimize fluid leakage.

4. Move inside the vessel and remove the 2 lines connected to the inner side of the manifold. Mark them for installation, plug them and secure them out of the way.

5. Back outside the boat, loosen and remove the mounting nut on the upper side of the manifold from the stud. The manifold is a tight fit in the housing with an O-ring—you may be able to pull it right out, but you'll probably need to position a small drift on the back (inner) side and force it through.

To Install:

6. Coat a new manifold O-ring with Gasket Sealing compound and slide it onto the manifold flange. Coat 2 new O-rings for the inner hydraulic lines with hydraulic fluid and slide them over the line tips.

7. Pull the 2 inside lines through the bore in the housing and then position the manifold near the bore so that the inner side is facing to Starboard. Route the lines to the manifold so they are parallel and then tighten the fittings to 14-18 ft. lbs. (19-24 Nm) on 1989-97 units, or 84-108 inch lbs. (9.5-12.2 Nm) on 1998 units. It is imperative that the lines get reinstalled on the port from which they were detached! As a check, once installed, the lower line should be attached to the UP inlet on the trimpump manifold.

■ Yes, we know it is unlikely that you will be able to get a torque wrench on the line **nut**—do it by feel, it's about as tight as a spark plug, just don't over-tighten them.

8. Feed the lines and through the hole in the housing until the manifold seats on it's mounting stud. Install a new locknut onto the stud and tighten it to 108-132 inch lbs. (12-15 Nm).

9. Coat 4 new O-rings with hydraulic fluid and install them on each of the outer (gimbal housing side) hydraulic line tips. Attach the lower of the 2 Port lines and then the upper. The shorter of the 2 Starboard lines should be connected to the lower of the two fittings on the starboard side of the manifold and then connect the remaining (longer) line to the upper fitting. Tighten all lines to 14-18 ft. lbs. (19-24 Nm) on 1989-97 units, or 84-108 inch lbs. (9.5-12.2 Nm) on 1998 units—see the previous Note.

10. Route each pair of lines together and install the retaining clamp on each side. Tighten the bolts securely.

11. If you removed the grease extension tube, pull the grease fitting off of the outer end of the tube. Coat the last 114 in. of the tube on the fitting side with Gasket Sealing compound and then insert the tube through the outer wall of the housing.

12. Spray the tapered end of the tube and the hole in the housing with Loctite primer and allow it to dry completely. Once dry, coat the tapered end with Loctite and then drive the end of the tube into the bearing flange. Wipe off any excess Loctite and then install the grease fitting to the opposite end of the tube.

Trim Limiter

Some DP drives utilize a trim limiter system consisting of a limiter module, override switch and associated wiring. This system has three set points which automatically limit the trim range of the drive unit. These points are set at the factory and based on a boat with an average 13 degree transom angle. Trim is limited between +5 degrees and -2 degrees, while tilt is limited to 45 degrees.

These limits, by necessity, may require changing to accommodate different transom angles or swim platforms. Although changing the parameters is not particularly difficult, it is a serious proposition with strong consequences if reset to the wrong figures.

The boat must be out of the water and in a sling when performing this procedure—the hull must be level. You must also know the transom angle—consequently, we recommend having this procedure performed at an authorized OMC service facility.

Trim Motor And Pump



1. Mount the motor/pump assembly on the transom and connect all hydraulic hoses.

2. Remove the reservoir filler plug (or cap) and fill the unit with OMC Power Trim/Tilt & Steering Fluid until the fluid level reaches the bottom of the hole (or the MAX line on the side of the reservoir if you happen to have a translucent plastic reservoir).

❑ You can also use GM Dexron II ATF fluid if necessary.

3. Press in the UP button on the trim switch, allow it to raise slightly and then stop it. Check the fluid level and add if necessary. Continue this "raise and stop" procedure, filling at each stop if necessary, until the drive is in the full UP/OUT position and the trim cylinders are fully extended.

4. Check the fluid level again and then install the filler plug of reservoir cap, tightening either on securely.

5. Run the drive unit through at least 5 Up/Down cycles to purge any residual air in the system, stop the drive in the full Up position and check the fluid level one last time; topping off if necessary.

Trim Sender

ADJUSTMENT

1989-92 Models



❑ Before adjusting the trim sender, the sender must be **installed** in the gimbal ring and the drive must be installed on the boat.

1. Turn the drive over hard to port and set it to full negative (Down) trim. Turn the ignition switch to the **ON** position; if the trim gauge shows the drive to be in the Full Down position there is no need to proceed with the adjustment, if not, move to the next step.

2. Loosen the 2 trim sender mounting screws, turn the ignition switch back to the **ON** position and then slowly rotate the sender until the trim gauge registers a Full Down position. Obviously, you'll need an assistant for this step unless you've got a long neck and great eyes.

3. Tighten the sender mounting screws to 18-24 inch lbs. (2.0-2.7 Nm) and then recheck the gauge.

1993-98 Models



◆ See Figures 56 and 57

1. Turn the drive unit over hard to port and set it to the full Down Position.

2. Loosen the 2 mounting bolts and remove the sending unit from the gimbal ring.

3. Disconnect the sending unit harness connector.

4. Install an ohmmeter as per the manufacturer's instructions and connect the probes between the **A** and **C** terminals in the connector; these will both have black wires attached to them. Slowly turn the control nut on the bottom of the sending unit until the meter reads 10-12 ohms.

5. Reinsert the sending unit into the gimbal ring and tighten the bolts finger-tight. Check the gauge again and slowly rotate the installed unit until the figure is achieved once again.

6. Tighten the bolts to 18-24 inch lbs. (2.0-2.7 Nm) and then recheck the gauge. Remove the ohmmeter and connect the sender lead.

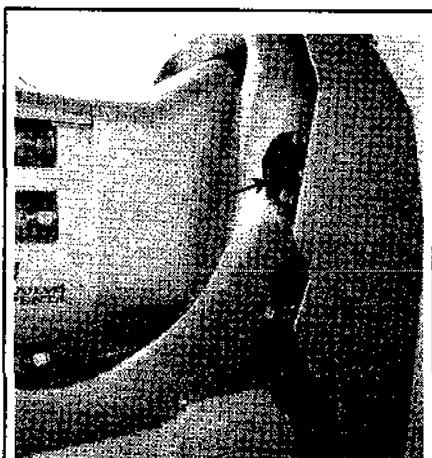


Fig. 56 Trim sender (SP shown)

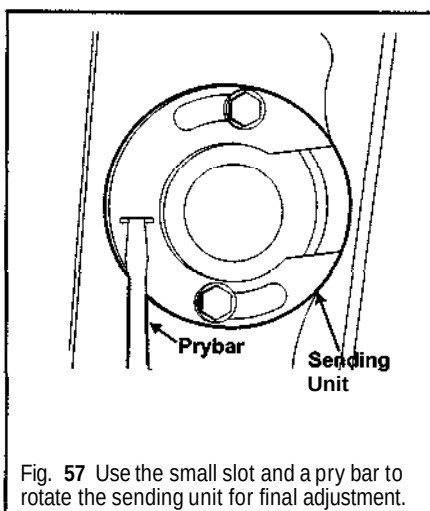


Fig. 57 Use the small slot and a pry bar to rotate the sending unit for final adjustment.

REMOVAL & INSTALLATION



◆ See Figure 58

❑ Complete removal of the sending unit will frequently damage the wiring harness, so do not remove the unit unless it is absolutely necessary.

1. Turn the drive unit over hard to port and ensure that it is in the full Down position.

2. Loosen the 2 mounting bolts and pull the sender out of the cavity in the gimbal ring.

3. Working inside the boat, disconnect the trim sender harness connector at the engine.

4. Take note of the wire positioning inside of the plug and then use a socket removal tool (# 3854350) and push the wire terminals out of the connector plug.

5. Now, back outside the vessel, locate the harness grommet where it feeds through the transom assembly—just above the water tube in the gimbal housing. Carefully pull off the retaining clip with a pair of needle nosed pliers.

6. Grasp the grommet and pull backward on it while prying it out with a small screwdriver. Once free of the housing, pull the wires all the way through the transom assembly. Cut any plastic ties securing the harness and then remove the trim assembly.

To Install:

7. Coat the harness grommet with grease and then feed the leads through the hole in the gimbal housing and press the grommet into place until it is seated. Pop the retaining clip into position over the base of the grommet.

*** WARNING

Make sure that you do not route the harness leads under the extension tube or hydraulic lines.

8. Coat the connector plug with alcohol or solvent and then use the special tool and press the leads back into the connector plug until they seat—make sure they go back in the same positions as they were prior to removal. On certain 1998 models, the ribbed black wire goes into the **A** terminal, the white wire into the **B** terminal and the smooth black wire into the **C** terminal.

9. Reconnect the harness at the engine.

10. Use a new plastic tie and secure the harness to one of the hydraulic lines.

11. Install the sending unit into the gimbal ring and tighten the mounting bolts to 18-24 inch lbs. (2.0-2.7 Nm). Adjust the sending unit if necessary.

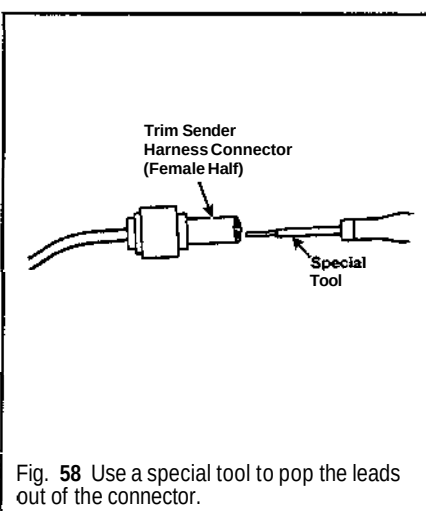


Fig. 58 Use a special tool to pop the leads out of the connector.

Trim/Tilt Cylinder

□ If troubleshooting procedures have isolated a problem to the trim/tilt cylinders, for example: a leaking oil scraper seal around the rod or a defective impact valve, it is strongly recommended that the cylinder(s) be removed and replaced with new ones, rather than attempting to disassemble the cylinders. This recommendation is based on the fact considerable difficulty may be encountered in removing the end cap from the cylinder. Even with the aid of the special tool for this purpose, the task is most difficult.

REMOVAL & INSTALLATION

◆ See Figures 59 thru 64



1. Remove the plastic cap on the aft (drive) end of each trim/tilt cylinder. Remove the elastic lock nut and flat washer; on certain 1998 units, the nut may have been replaced with an e-clip so remove the clip and flat washer from the rod.

2. Support the hydraulic cylinder and lightly tap the pivot rod out of the cylinders with a rubber mallet—tap on one side while pulling on the other side. Carefully lower the cylinders down until they rest against the spray plate.

■ If the bushings come out with the pivot rod, make sure that you keep the two grounding clips.

3. Grab the pivot ends of each cylinder and pull them out to the fully extended position. Loosen the manual release valve on models so equipped and then remove the filler plug at the reservoir to relieve any residual pressure in the system. Close the valve and install the cap. On later models without the release valve, simply loosen one of the hydraulic hoses at the pump and then remove the reservoir cap, but make sure you've got a shop towel over it and the hose connection because there may be some spray.

4. Working at the forward end of the cylinder, unscrew the bolt and disconnect the ground wire. Remove the cylinder cover retainer and lift off the cover. These models will also have a small screw and line retainer over the hydraulic line running to the aft end of the cylinder; remove them.

5. With the stern drive still in the full DOWN position, place a suitable drain pan under the hydraulic lines, tag and then disconnect the two hydraulic hoses from the end of the cylinder (cover with rag) using the correct size "Flare Nut" or "Line Wrench". These wrenches will prevent damaging the hex flats on the line or hose fittings if they are extremely tight and/or a slight amount of corrosion has built up on the fitting. Most standard open-end wrenches will flex under high torque loads, causing the wrench to slip, damaging the hex fitting on the hydraulic line.

6. Remove the O-rings on the end of each line fitting. Install plugs into the hoses and/or fittings to prevent draining the trim/tilt hydraulic system any more than necessary.

7. Pry off (or unscrew) the plastic pivot pin cap on the end of the forward pin. Remove the locknut or pull the E-Clip from the end of the pin and then slide off the flat washer and then the bushing from the pivot pin.

8. Pull the pivot pin out of the cylinder and gimbal ring, or grasp the cylinder on the inside of each pin and pull it off the anchor pins. Remove the flat washer and bushing on the inside surface of the cylinder ends or the anchor pins.

To Install:

9. Press the trim/tilt cylinder bushing into the boss on each side of the gimbal ring. Install bushings into the outer side of each cylinder. Although it is not necessary to replace the bushings unless they are worn excessively or damaged, you may want to consider replacing them anyway while you have everything apart.

10. Clean the forward pivot pin and then coat it with grease. Apply a light coat of Gasket Sealing Compound to the threaded ends of the pin and then center it in the ring.

11. Align the cylinder and then press it on to the pivot pin very carefully. You may have to give it a few taps with a rubber mallet.

12. On cylinders with lock nuts, install the washers and then the nuts (new!). Tighten the nuts until there is an equal amount of thread exposed on each side of the pin and then tighten both nuts to 32-34 ft. lbs. (43-46 Nm) on 1989-93 models, or 10-12 ft. lbs. (14-16 Nm) on all others. On models using the e-clip, install the washer and then install the e-clip into the groove on the pin. Replace the plastic caps.

13. Coat new O-rings with hydraulic fluid and then install them into the grooves on the end of each hydraulic line fitting. Remove the plugs and attach each line to its respective fitting on the cylinder. Tighten each fitting to 14-18 ft. lbs. (19-24 Nm) on 1989-93 models, or 84-108 inch lbs. (9.5-12.2 Nm) on all others, with a flare wrench.

14. Install the aft line retainer and tighten the bolt securely. Also on these models, position and install the cylinder cover.

15. Install the retainer; and then on all models, install the ground strap and tighten the bolt securely.

16. Clean the aft pivot pin thoroughly and then coat it with grease.

17. Make sure that the grounding clips are in position and then press the bushings into the end of each cylinder and into the bore boss in the drive unit. As we did with the forward end bushings, we suggest replacing the bushing as preventative maintenance, although it is perfectly acceptable to reuse the old bushing as long as they are in good shape.

18. Align the cylinder ends with the bores on each side of the drive and then insert the pivot pin into one end and press it through until it comes out the other side—you will probably have to give it a few taps with a mallet.

19. Install the flat washers and lock nuts or E-clips. On models with nuts, tighten the nuts until there is an equal amount of thread showing on each side and then tighten each nut to 32-34 ft. lbs. (43-46 Nm) on 1989-93 models, or 10-12 ft. lbs. (14-16 Nm) on all others. Install the plastic caps.

20. Fill the reservoir with Power Trim/Tilt & Steering fluid and run the drive through its full range of motion at least 5 times to purge any air in the system.

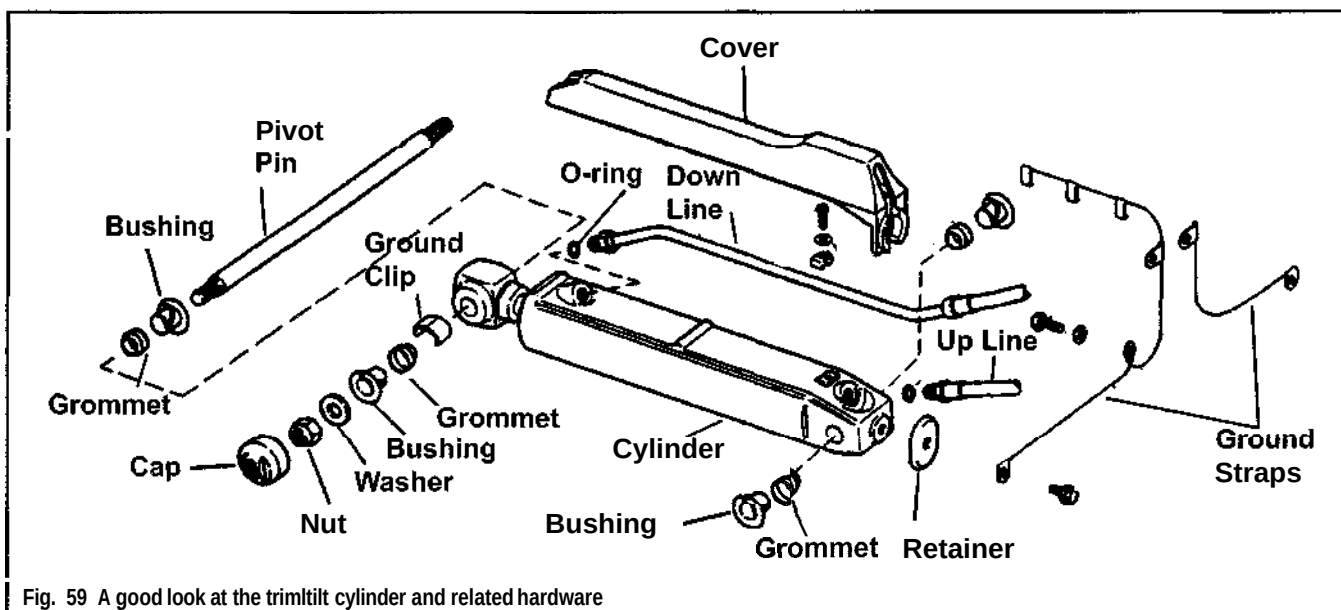


Fig. 59 A good look at the trim/tilt cylinder and related hardware

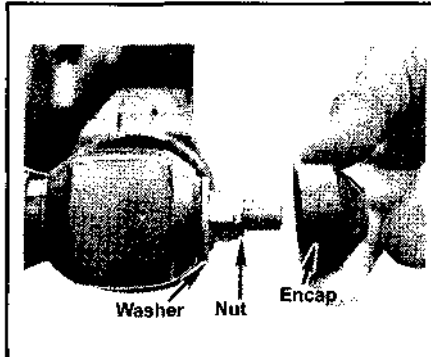


Fig. 60 Most models use a nut on the pivot pin...

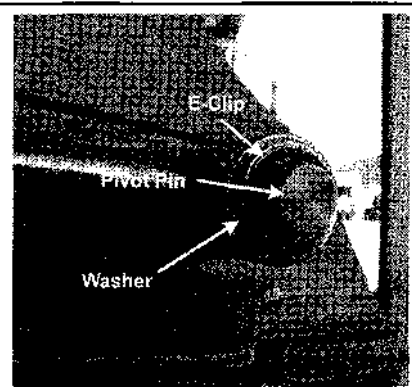


Fig. 61 ...while certain later models may use an E-clip

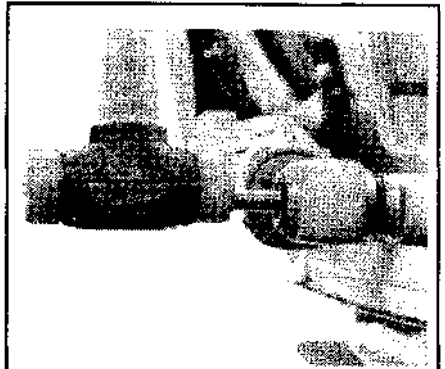


Fig. 62 Tap one end of the pivot pin lightly...

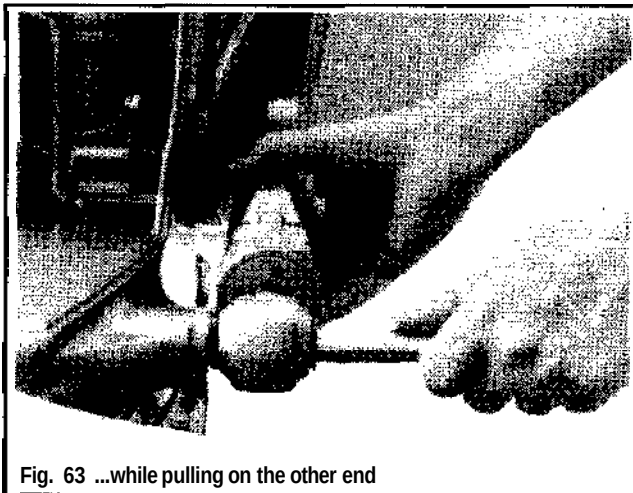


Fig. 63 ...while pulling on the other end

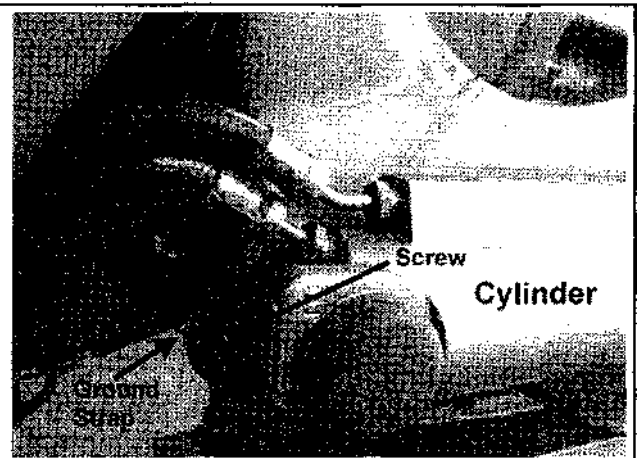


Fig. 64 A close-up of the forward end of the cylinder (later model shown)

DISASSEMBLY & ASSEMBLY



◆ See Figures 59 and 65 thru 71

1. Remove the trim cylinder(s) as previously detailed.
2. Hold the cylinder over a drain pan with the hydraulic line ports facing down and into the pan; extend, and then retract the cylinder 2-3 times to remove all fluid from the cylinder.
3. Remove the pivot pin bushings if you intend to replace them.
4. Place the cylinder in a vise equipped with soft jaws and carefully tighten it.
5. Obtain a spanner wrench (# 912084) or an equivalent tool. Removal of the end cap is difficult using the special tool so exercise care. Insert the tangs of the spanner into the holes in the end cap. If needed, slide a long breaker bar onto the tool so the bar is in the same plane as the tool. This position will provide maximum mechanical advantage. Remove the end cap. Tap the breaker bar, if necessary, but bear in mind—if the holes in the end of the cap become damaged (elongated), the cylinder might as well be given the "deep six". Continue to unscrew the end cap until it is held by a single thread. Extend the rod, and then continue to remove the end cap and piston assembly.
6. Clean and degrease the piston rod thoroughly and then install it in a vise using a rod holder (# 983213). Carefully insert the pivot pin through the hole in the end piece and spin it off the end of the rod. If you are unable to loosen the end piece, heat the shank very carefully with a torch or heat gun and then try it again.

If you find that the piston rod is slipping in the holder tool while trying to spin off the end piece, wrap a piece of paper around the rod before inserting it into the tool.

7. Pull the end cap, off of the end of the rod and then pry out the scraper with a small awl. Do the same with the 2 O-rings, one inside and one outside. Discard the scraper and the O-rings.

8. Move to the end piston and remove the 2 split rings and the O-ring; throw them all away.

9. There are no serviceable components in the assembly, so there is no service procedure. This being said though, if you suspect impact valve leakage there is a quick procedure to try before replacing everything. Install the piston rod in the holder tool again and then loosen the large bolt on the end of the piston just enough to allow the relief check balls to unseat themselves; but not too much. Clean the piston components with solvent and then blow everything dry with compressed air. Tighten the bolt securely until the balls seat themselves.

To Assemble:

10. Make an effort to keep the work area clean, because any contamination on the piston could lead to a malfunction. Inspect the interior of the cylinder for any signs of scoring or roughness. Clean all surfaces with safety solvent and blow them dry with compressed air.

11. If the piston has any signs of corrosion or damage it must be replaced with a new unit.

12. Clean the end cap threads with a wire brush until you have removed all traces of old sealant.

13. Lubricate all O-rings and interior components with Power Trim/Tilt and Steering Fluid.

14. Position a new scraper over the end cap so that the lip is facing upward and then use a small seal installer (# 326545), or an appropriately sized socket, to press the scraper into the cap.

15. Coat new O-rings with fluid and then install them into their respective grooves in side and outside the end cap.

16. Coat a new piston O-ring with fluid and roll it into place in the recess in the piston. Position new split ring retainers on each side of the O-ring so that their ends match but do not overlap. These rings are quite fragile, so be careful when installing them into the recess.

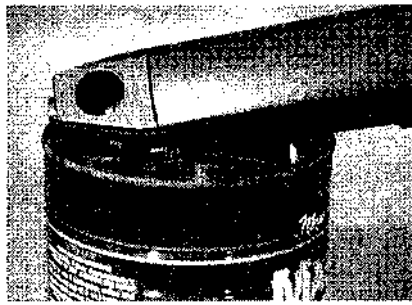


Fig. 65 Drain the cylinder into a container

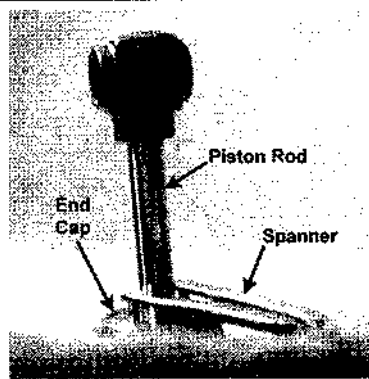


Fig. 66 Remove the end cap...

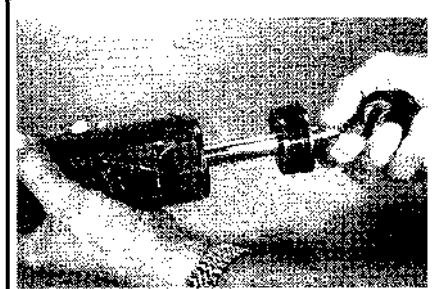


Fig. 67 ...and then pull the piston rod out of the cylinder

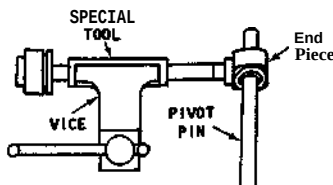


Fig. 68 Use the pivot pin to remove the end piece

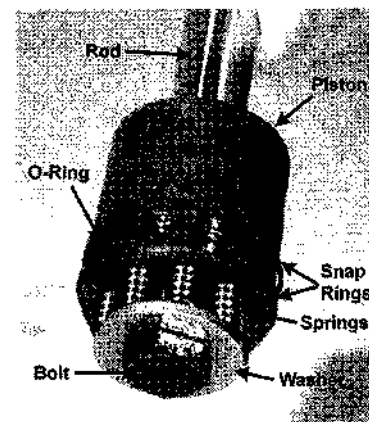


Fig. 69 A good look at the piston

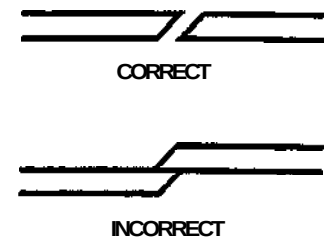


Fig. 70 Snap ring positioning

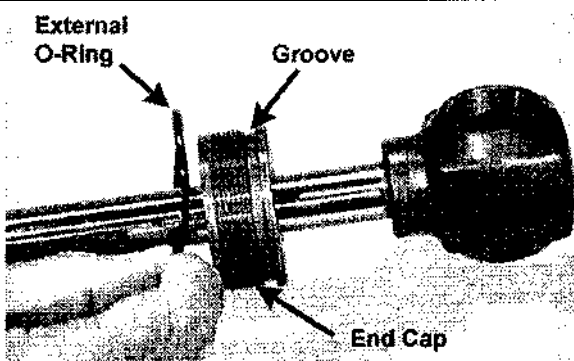


Fig. 71 Install a new O-ring on the end cap.

17. Install a seal protector tool (# 326005) over the end of the piston rod and slide on the end cap. Make sure that the rod, O-ring and cap are thoroughly lubricated with hydraulic fluid.

18. Make sure that the piston rod threads are free of all old sealant and then spray some Loctite Primer on the threads. While waiting for it to dry, secure the rod in the holding fixture again and then coat the threads with Loctite. Screw on the end piece and tighten it securely. Remove the rod and tool from the vise.

19. Re-clamp the cylinder in the vise and coat the cylinder bore and piston thoroughly with fluid. Grab the piston body so that you compress the split rings with your fingers and then feed it into the cylinder bore. Push the piston and rod all of the way into the cylinder. Once the piston is completely in, cap the hydraulic line ports and fill the cylinder with as much hydraulic fluid as possible.

20. Slide the end cap down the rod and thread it into the cylinder. Install the spanner wrench and tighten it to 25-30 ft. lbs. (34-41 Nm). Once there, continue rotating the end cap until the two holes are parallel with the pivot pin hole in the end piece.

21. Attach the cylinders, check the fluid level in the reservoir and then run the drive through its full range of motion 5 times to purge any remaining air in the system.

Trim/Tilt Pump Assembly

The pump motor is a 12-volt DC bi-directional motor. The armature of the motor rests inside the field winding and is energized through brushes contacting the commutator on the end of the armature. When the up or down switches are closed, current is directed through the motor field in one of two directions causing the motor to run in one desired direction.

The opposite end of the armature is mechanically splined to the hydraulic pump. The gear rotor action of the pump causes the fluid to flow in either direction.

The motor case is sealed with O-rings and a shaft seal to prevent the entry of water or hydraulic fluid into the motor cavity.

Before going directly to the pump as a source of trouble, check the battery to be sure it is up to a full charge. Inspect the wiring for loose connections, corrosion and damaged wires. Take a good look at the control switches and connection for evidence of a problem.

The control switches may be quickly eliminated as a source of trouble by connecting the pump directly to the battery for testing purposes.

REMOVAL & INSTALLATION

◆ See Figures 72 and 73



□ Integrated reservoir models are identifiable because they have the motor on the bottom and the reservoir on the top. There may be some models in this year span that came through with the newer style pump; motor on top and clear plastic reservoir on the bottom.

1. Using the trim switch, raise the stern drive to the full UP position and then support the bottom of the unit with a piece of wood. Remember that on early models, you can raise the drive even if the system is not working by loosening the manual release valve.

2. Disconnect the battery cables from the battery terminals.

3. Relieve the pressure in the system. If your pump is equipped with a manual release valve, loosen it a few turns; if you have a later model, carefully unscrew the reservoir cap very slowly while covered with a rag until any residual pressure has escaped.

4. Mark or tag the hydraulic hoses (right or left) before disconnecting them from the pump. The inlet and outlet ports on the manifold are also usually stamped with **UP** or **DN** markings identifying each port, but the right hose (as you face the pump) is the **UP** circuit and the left hose is for the **DOWN** circuit. Place a suitable container under the fittings and then use a line nut wrench to back the fitting out of the manifold port. Cap the hoses to prevent fluid leakage into the boat and dirt from entering the system. OMC actually sells actual line and port caps if you are interested, otherwise you can improvise with something from your shop.

5. Disconnect the green and blue wires at the terminal board on the side of the assembly. Cut the plastic tie securing the wires and the harness to the pump body and move them out of the way.

6. Remove the screw at the top of the control relay box, slide the bottom free of the lower mount and then remove the box and lay it out of the way.

7. Remove the lag bolts securing the trim/tilt pump assembly to the boat. Lift the assembly out and free of the boat.

8. Try to keep the assembly standing upright while out of the boat.

To Install:

9. Position the trim/tilt pump assembly in the boat. Install the lag bolts through the pump support bracket and into the transom. Tighten the bolts securely.

10. Insert the lower end of the control box into the notch on the pump and then secure it with the Phillips screw. Reconnect the blue and green leads and secure the harness to the bracket with a new plastic tie. Don't forget to coat the screws and terminals with liquid Neoprene.

11. Connect the hydraulic hoses to their ports in the manifold—make sure they thread into the correct port. Tighten the line nuts securely.

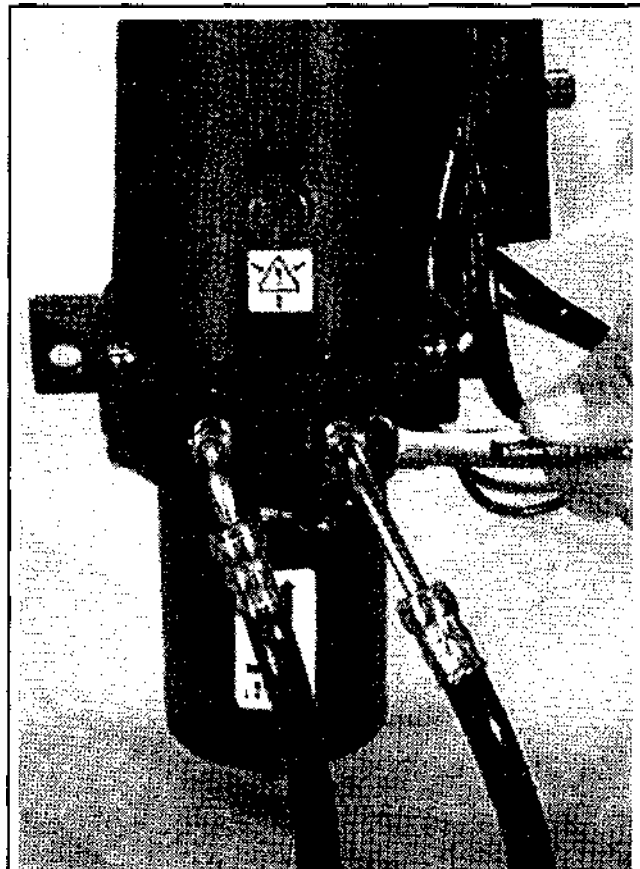


Fig. 72 Disconnect the hydraulic hoses at the pump

12. Fill the reservoir with OMC Power Trim/Tilt and Steering Fluid to the bottom of the filler hole.

13. Connect the battery cables and then cycle the stern drive Up and Down several (at least 5) times to bleed all air from the system. Check the reservoir level after each cycle and service, if needed.

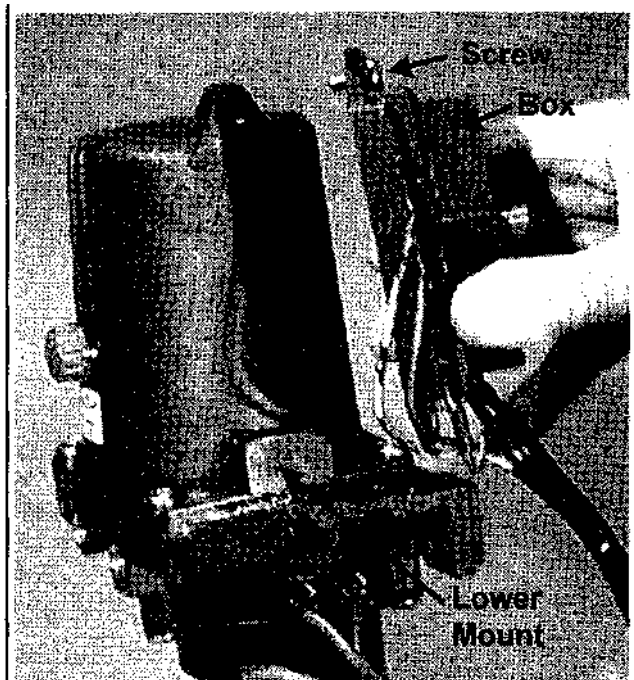


Fig. 73 Remove the control box

IS

& ASSEMBLY



◆ See Figure 41 and 74 thru 93

1. Remove the pump assembly.

2. Drain all the remaining fluid in the reservoir into a suitable container. Discard the fluid in accordance with any local hazardous waste ordinances.

3. Remove the 4 reservoir-to-manifold mounting screws (Phillips) and then hold the assembly over a suitable container while you separate the two units. Remove the O-ring from the bottom of the reservoir and throw it away.

4. Turn the remaining assembly over and remove the 3 motor-to-manifold mounting screws (Phillips). Separate the motor from the manifold and then remove the O-ring and discard it.

5. Remove the round mesh filter screen from the manifold. Clean it thoroughly and set it aside for assembly.

6. Pull the drive coupling out of the manifold and check the slotted and hex ends for wear or damage—replace as necessary.

7. Loosen the 4 pump-to-manifold Allen bolts alternately and only ONE TURN at a time until you can lift off the gear housing (pump). Make sure that both pump control pistons and their check balls stay in the housing. If equipped with an oil filter, pull it out of the manifold.

*** WARNING

The pump housing contains pistons with springs that exert an upward pressure on the unit; it is imperative that when loosening the mounting screws, they only be turned one complete revolution at a time, moving on to the next screw diagonally across from it each time until all spring pressure has been eliminated. Failure to follow this procedure will result in a warped housing.

The mating surfaces of the pump housing and manifold are precision machined and do not use a gasket extreme care should be exercised during removal. Be very careful not to gouge, scratch or mar either of these surfaces.

13-30 TRIM AND TILT

8. Turn the pump housing over and mark the exposed end of each pump gear with an indelible marker so that you know which end of which gear goes where. Lift the two gears out of the housing. The gears may not always be in the housing as they frequently stay in the manifold after lifting off the housing.

9. Use a pair of needle-nosed pliers and pull the two pump control pistons out of their bores in the housing. Reach in and remove the check balls.

10. Turn the housing back over and insert a small piece of stock through the hole in the tilt-up relief valve bore. Press the valve out of the bore, remove the inner spring and then pull out the O-ring from the groove on the valve. If the housing in your application has no hole in the back of the bore, carefully drill a $\frac{1}{8}$ in. hole in the housing as indicated in the illustration. Inspect the valve, spring and check ball for wear, scoring or other damage, replacing as necessary.

11. Repeat the previous step for the trim-in relief valve (smaller diameter).

12. Although you have probably already done so, remove the pump gears from the manifold if this is where they stayed after lifting off the housing. Either way, check the excessive wear or chipped teeth. Remove the check balls.

13. On 1989-96 models, insert a small metal pin into the manual release valve check ball hole on the valve body and force out the check ball and retainer. Pull the O-ring off of the retainer and discard it.

14. On 1989-96 models, remove the small inner snap ring in the release valve bore and unscrew the valve. Throw away all O-rings.

The thermal expansion valve is located inside the tip of the manual release valve on most **1989-96** models and cannot be serviced separately.

15. On 1997-98 models, remove the thermal expansion valve and then pull out the O-ring from the groove in the bore.

16. Squeeze some grease into the hydraulic line opening adjacent to the trim-in or tilt-out check valve until the bore is about $\frac{1}{2}$ full. Install a $\frac{1}{4}$ in. fine thread bolt into the opening and slowly tighten it slowly until the check valve pops out of the bore. Lift out the valve, seat and spring. If the valve does not come out all the way, remove the bolt and squeeze in some more grease; then attempt tightening the bolt again.

To Assemble:

17. Thoroughly clean all components in solvent and blow them dry with compressed air. Pay particular attention to drying all manifold passages. Keep everything clean and lint-free.

18. Inspect the pump drive coupling for excessive wear or damage. Check both gears for wear and chipped or damaged teeth. Check all valves and bores for any sign of scoring or corrosion. Check the machined mating surfaces of the pump housing and manifold for scratches, grooves or other marring.

19. Coat all components thoroughly with Power Trim/Tilt & Steering fluid before installation--do not assemble any component dry!

20. On 1989-96 models, coat new O-rings and the nylon sealing ring with hydraulic fluid and install them onto the manual release valve. Coat the valve thoroughly and thread it into the bore in the manifold, tightening it to 45-55 inch lbs. (5-6 Nm). Do not over-tighten the valve. Install the inner snap ring into the groove in the valve bore.

21. On 1989-96 models, drop the manual release valve check ball into the oil passage. Install a new O-ring on the retainer, coat them with hydraulic fluid thoroughly and then press the retainer into the bore until it is flush with the surface of the manifold. Make sure that you do not push the retainer in any further than flush or it will restrict check ball movement and affect release valve functions.

22. On 1997-98 models, install the thermal expansion valve after inserting a new O-ring into the bottom of the bore and tighten it to 45-57 inch lbs. (5-6 Nm).

23. Position a check valve spring into each bore in the manifold and insert the check valve over the spring so that the tip is facing upward. Install a new O-ring into the groove in the seat and then carefully install the seat over the valve so it is centered, pressing it in until it is fully seated. If you encounter difficulty, position an appropriately sized socket over the seat and lightly tap it into place.

24. Install a new O-ring into the groove on the trim-in relief valve seat (piston) and coat them, and the valve with hydraulic fluid. Invert the pump housing and insert the valve spring into the bore, followed by the valve itself. Position the seat over the valve and press it in until it seats itself. Repeat this procedure for the tilt-up relief valve.

25. Insert the check balls for each pump control piston into its bore in the manifold. Position the piston over the ball and press it into the bore.

26. Coat the teeth of the two drive gears, and their bores, with grease and then insert them into their respective bores. Remember the markings that you made on each gear during disassembly—the marks must be facing away from the housing.

If you removed the drive gears from the manifold instead of the housing during disassembly, then your mark would be facing away from the manifold and NOT the pump housing.

27. Insert a check ball into each of the reservoir inlet passages.

28. Install the small oil filter into the manifold if your pump was equipped with one.

29. Position the pump housing onto the manifold mating surface and insert each of the screws. Tighten the screws to 35 inch lbs. (4 Nm), one full rotation at a time, in the sequence illustrated.

30. Insert the drive coupling into the drive gear and rotate it slowly by hand to make sure there is no binding evident. If you are unable to turn it by hand, loosen the pump housing screws a little (remember, one turn at a time) and then try it again. If the coupling now turns, you've got a problem in the housing; check all components and start over again.

31. Install the round reservoir filter screen onto the manifold so that the foam gasket is facing toward the motor.

32. Pour hydraulic fluid into the cavity surrounded by the filter screen until it reaches the top of the casting. Insert a screwdriver into the drive coupler and rotate it until you no longer see air bubbles coming out of the check ball opening. The pump is now primed.

33. Install a new O-ring onto the motor and then position it to the manifold so the mounting holes line up correctly. Now rotate the coupler until the slot lines up with the blade on the motor shaft and then install the motor. Tighten the bolts to 35-52 inch lbs. (4.0-5.9 Nm).

34. Turn the assembly over and install a new O-ring on the reservoir flange. Position the reservoir on the manifold so that the bolt holes are in alignment and then tighten the bolts to 35-52 inch lbs. (4.0-5.9 Nm).

35. Install the assembly in the boat, fill with fluid and test for leaks.

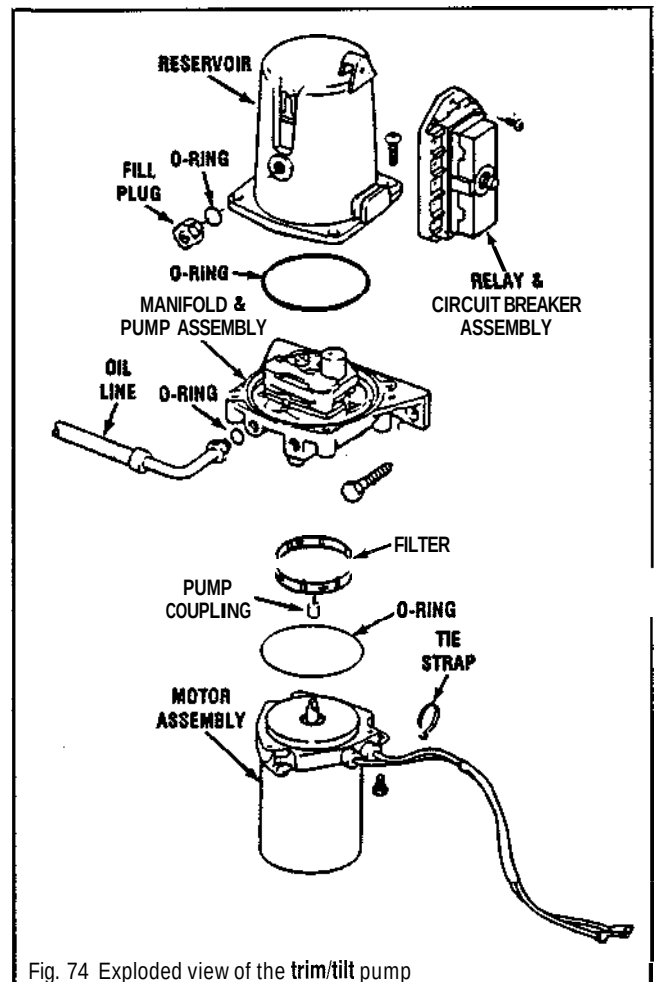


Fig. 74 Exploded view of the trim/tilt pump

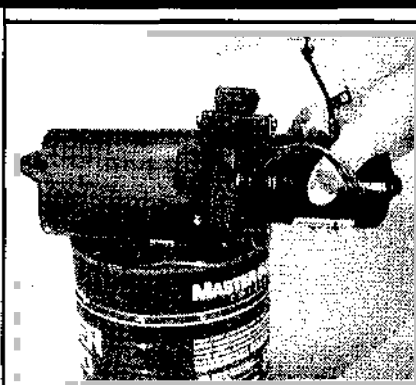


Fig. 75 Drain any residual fluid into an appropriate container...

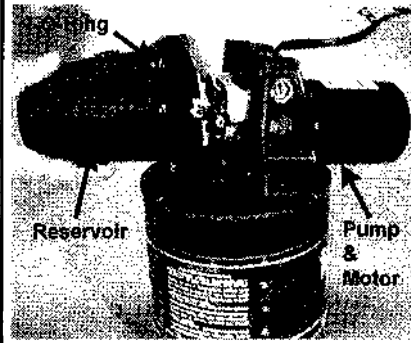


Fig. 76 ...keeping the assembly over the container when separating the reservoir

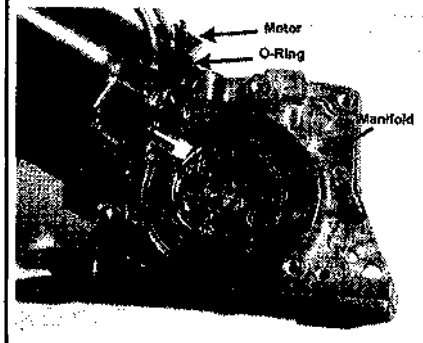


Fig. 77 Separate the motor from the manifold..

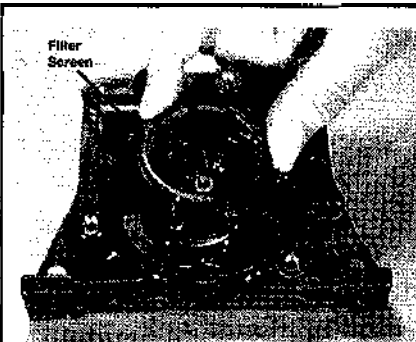


Fig. 78 ...remove the filter screen...

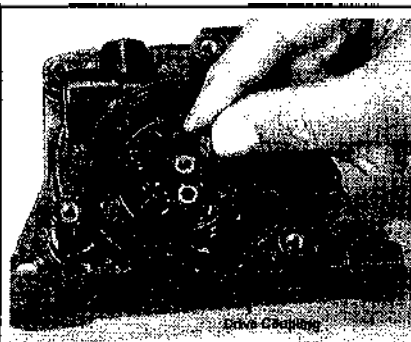


Fig. 79 ...and then lift out the coupling

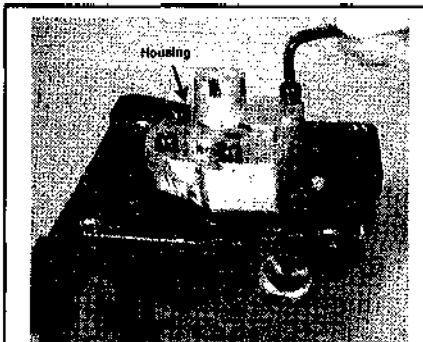


Fig. 80 Loosen the pump housing bolts **ONE TURN** at a time...



Fig. 81 ...and then lift the housing from the manifold

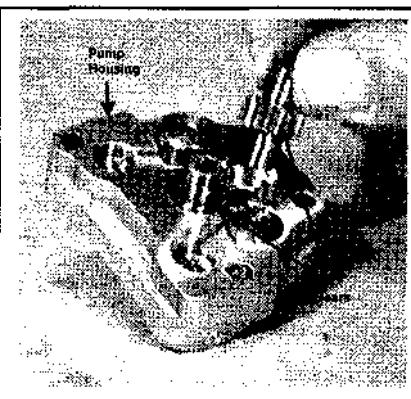


Fig. 82 Pull the drive gears out of the housing after they have been marked...

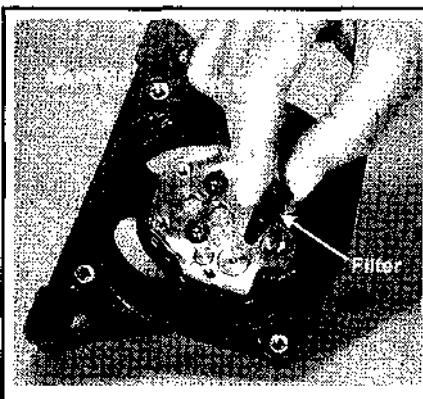


Fig. 83 ...and then remove the small oil filter from the manifold (if equipped)

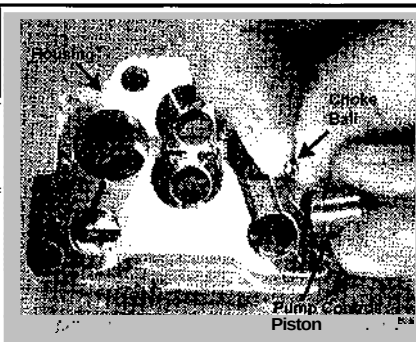


Fig. 84 Remove the pump control pistons



Fig. 85 Removing the relief valves

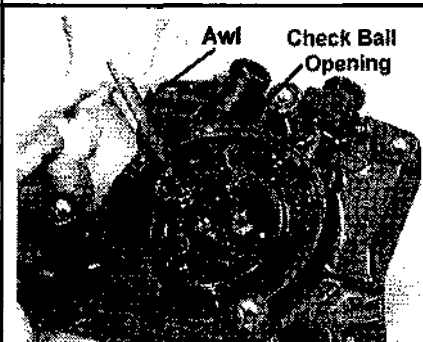


Fig. 86 Press out the manual release valve check ball and retainer (1989-96)

13-32 TRIM AND TILT

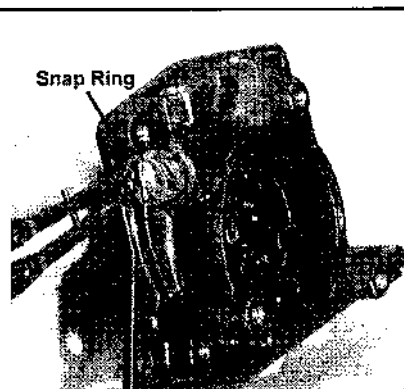


Fig. 87 Remove the manual release valve snap ring on 1989-96 models...

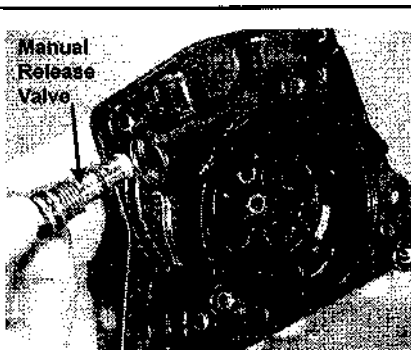


Fig. 88 ...and then unscrew the valve



Fig. 89 Thread a bolt into each bore...

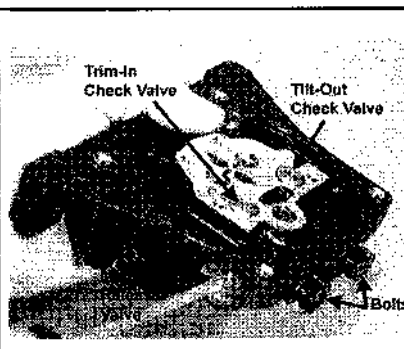


Fig. 90 ...and then turn the release valve (early models only)

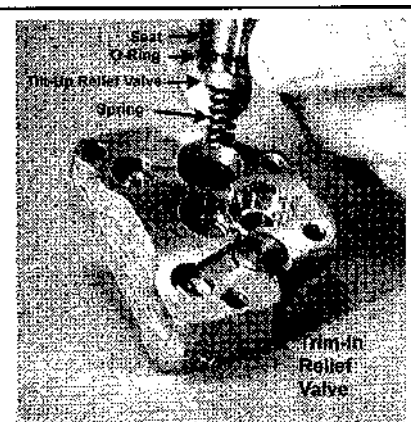


Fig. 91 Installing the relief valve

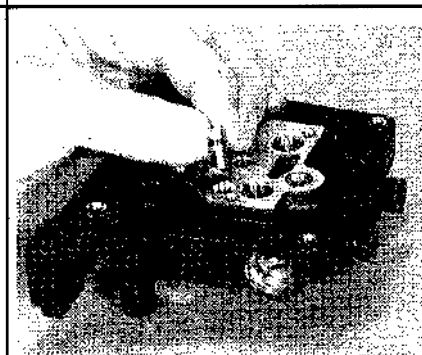


Fig. 92 Installing the manual release check valve ball retainer

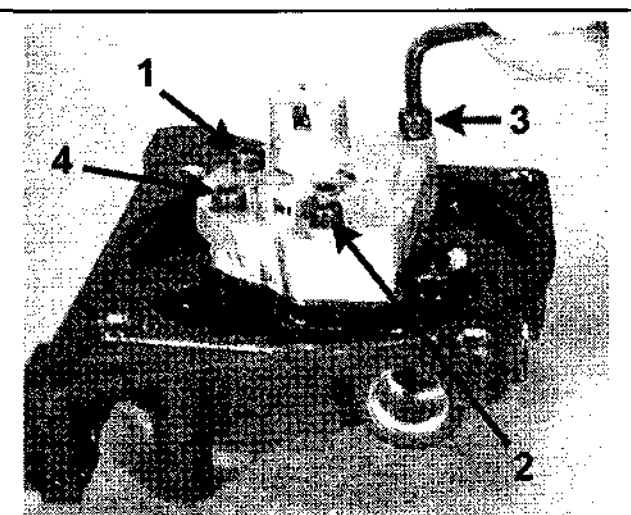
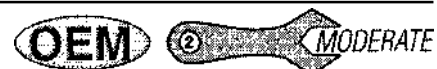


Fig. 93 Pump-to-manifold tightening sequence

PRESSURE TESTING THE MANIFOLD



1. Thread a 10132 x 112 in. screw with a 5132 in. flat washer into the pump housing mounting bolt hole nearest the trim-out-tilt-up check valve, making sure that the washer does not cover the small hole in the center of the valve seat.
2. Connect a pressure tester adapter (# 914459) to a Stevens Pressure Tester S-34. Lubricate an hydraulic hose O-ring and install it into the groove on the end of the adapter.
3. Thread the adapter end into the UP port on the manifold. Brush some soapy water onto the top of the manifold or submerge it in a container of Power Trim/Tilt & Steering fluid and then apply 30 psi to the manifold and check for any leaks.
4. Repeat Steps 1-3 for the trim-in/tilt-down check valve and manual release check ball retainer.
5. Replace any component showing a leak during the test.

WIRING SCHEMATICS

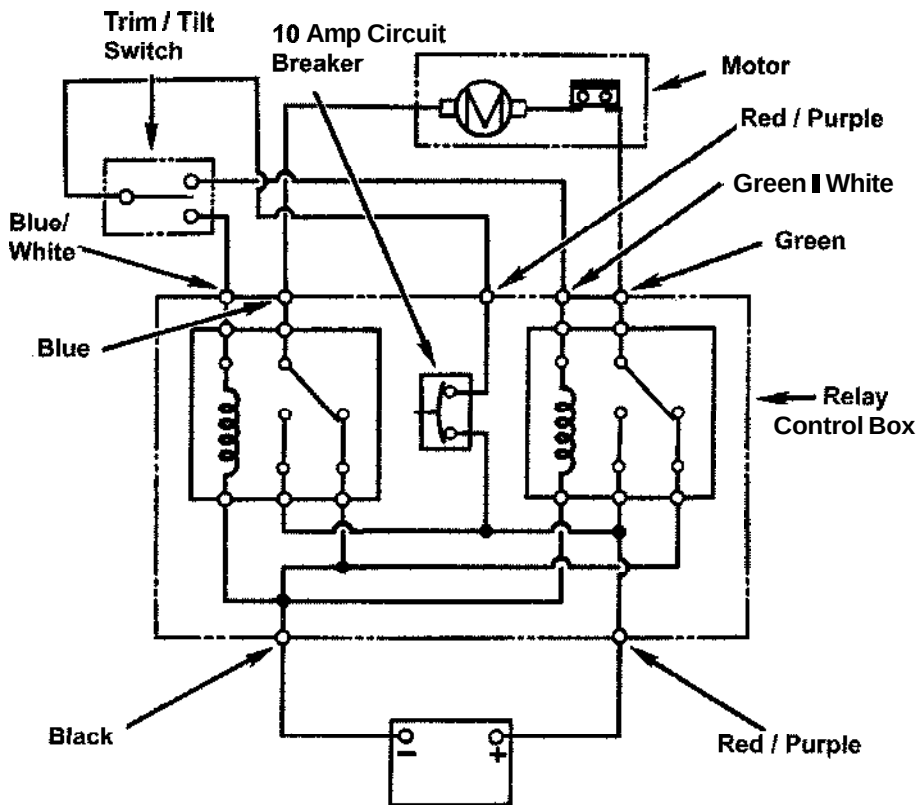


Fig. 94 Relay control box

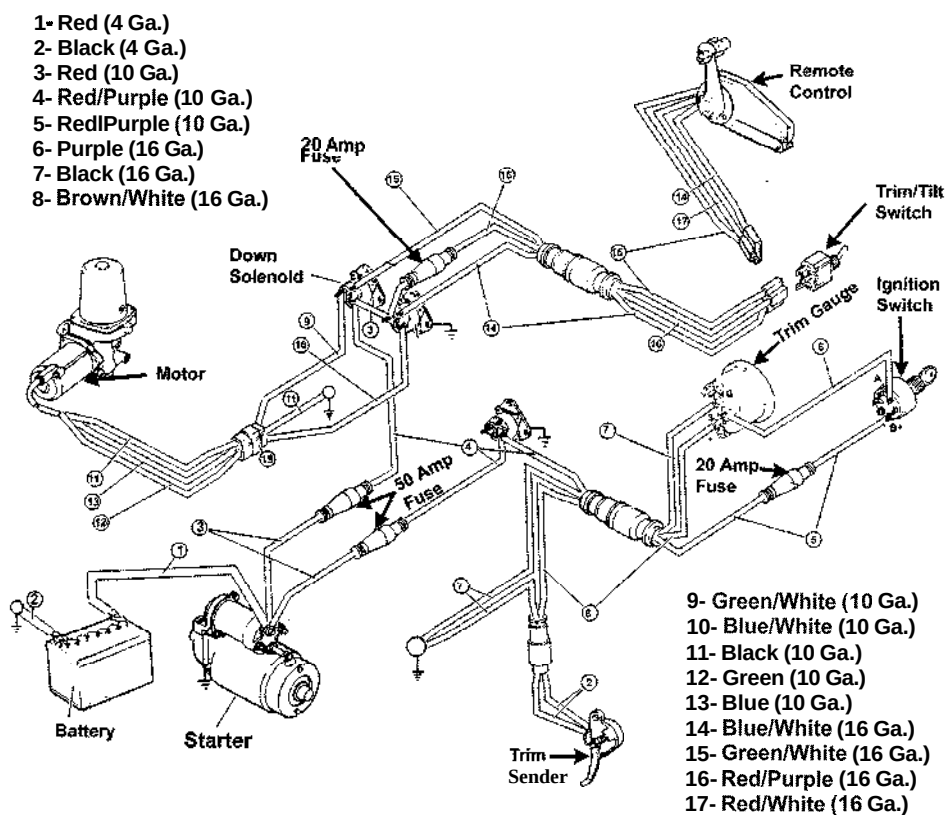


Fig. 95 Power trim/tilt—1986-88 models w/GM engines

13-34 TRIM AND TILT

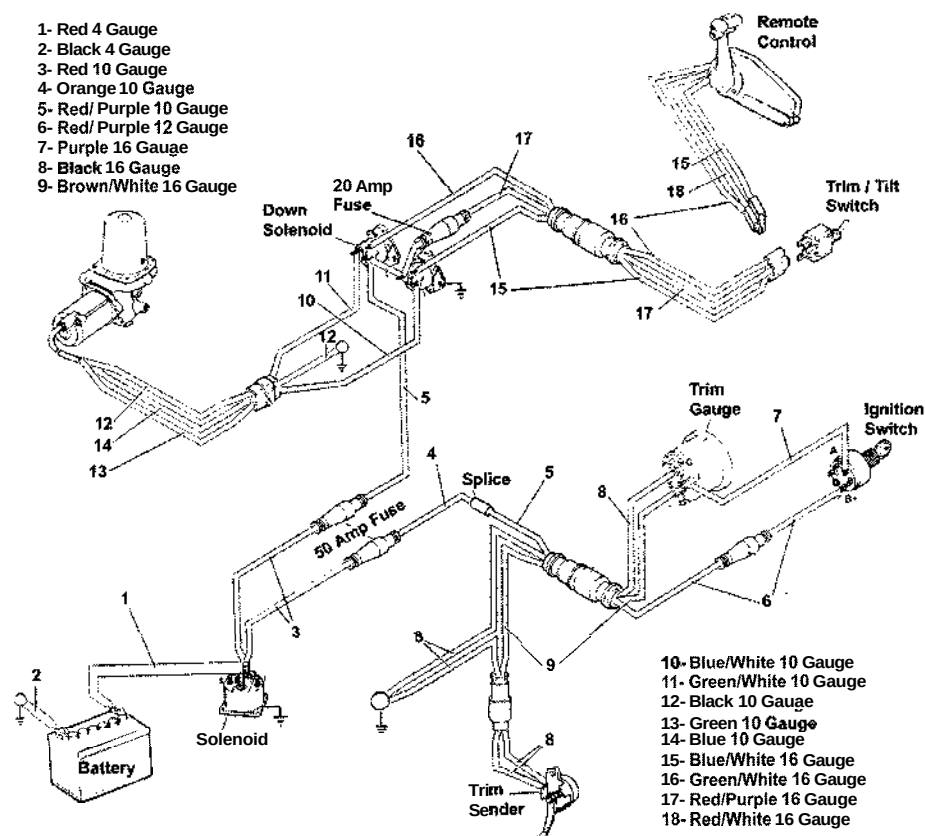


Fig. 96 Power trim/tilt—1987-88 models w/Ford engines

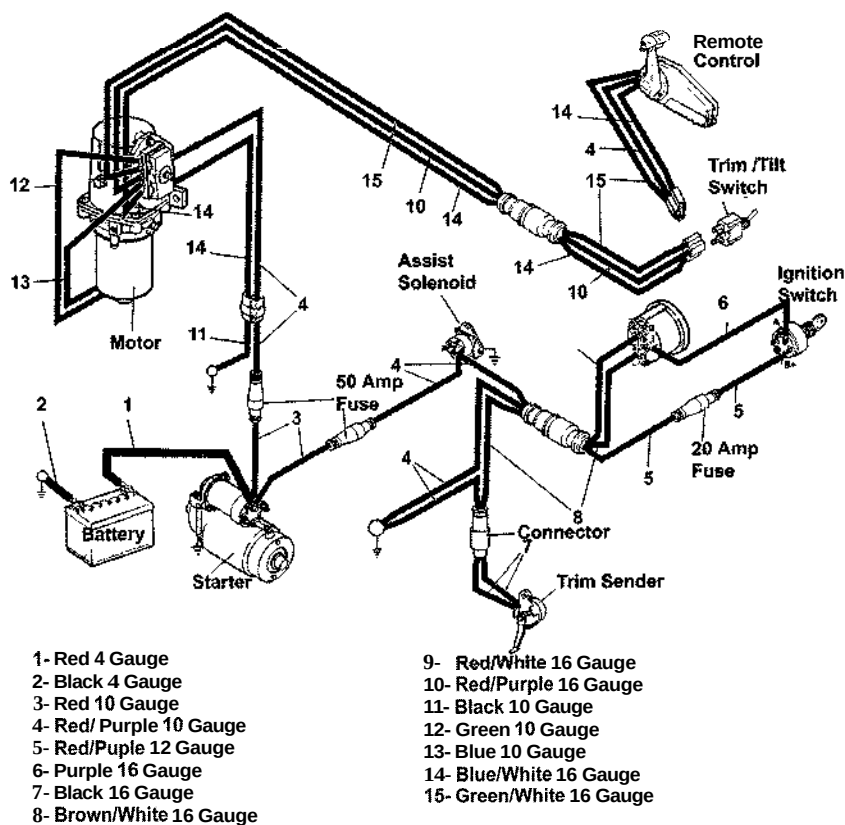


Fig. 97 Power trim/tilt—1989 models w/GM engines

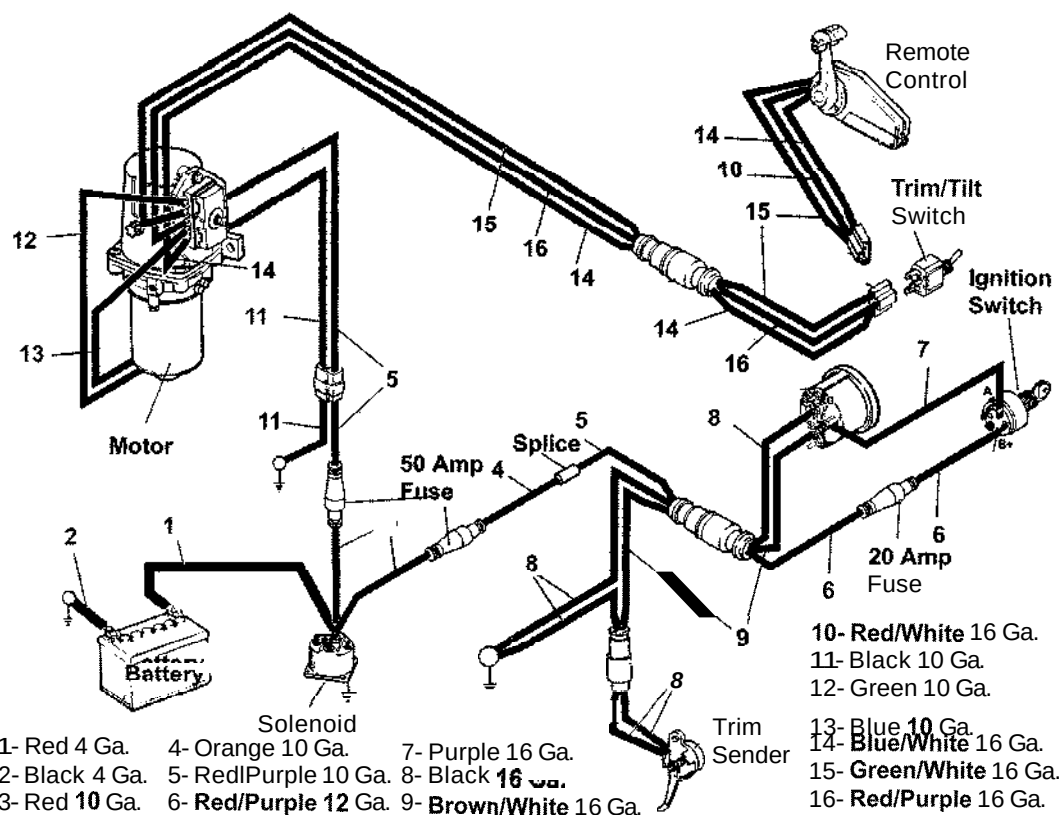


Fig. 98 Power trim/tilt—1989 models w/Ford engines and 1990 Cobra models w/Ford engines

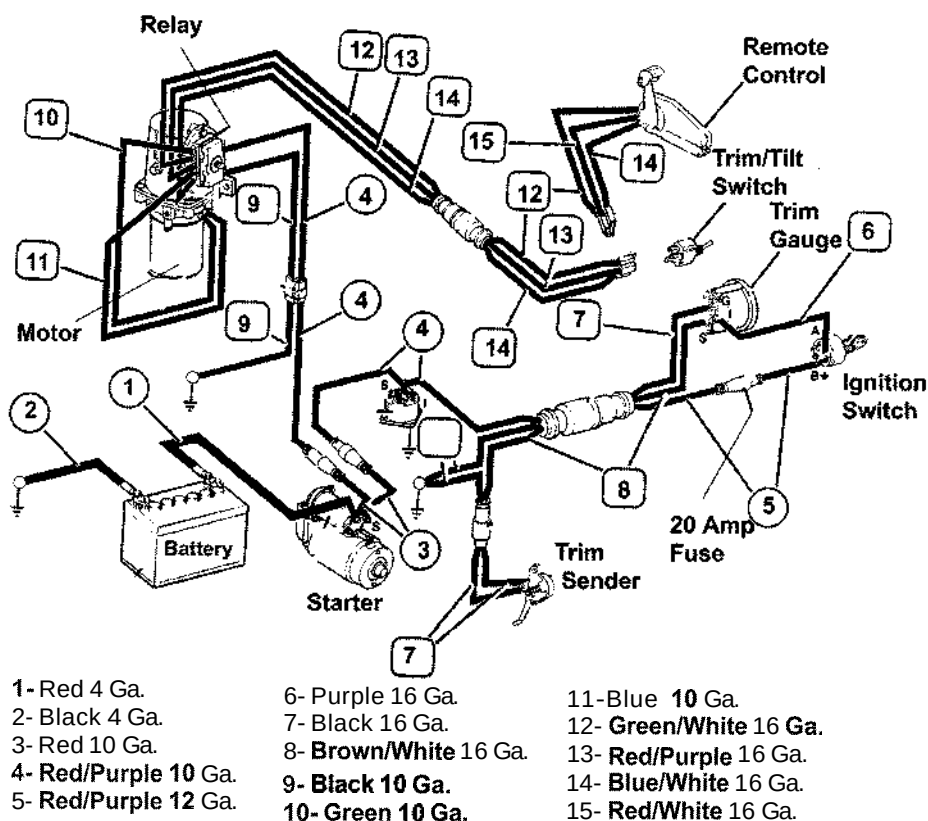
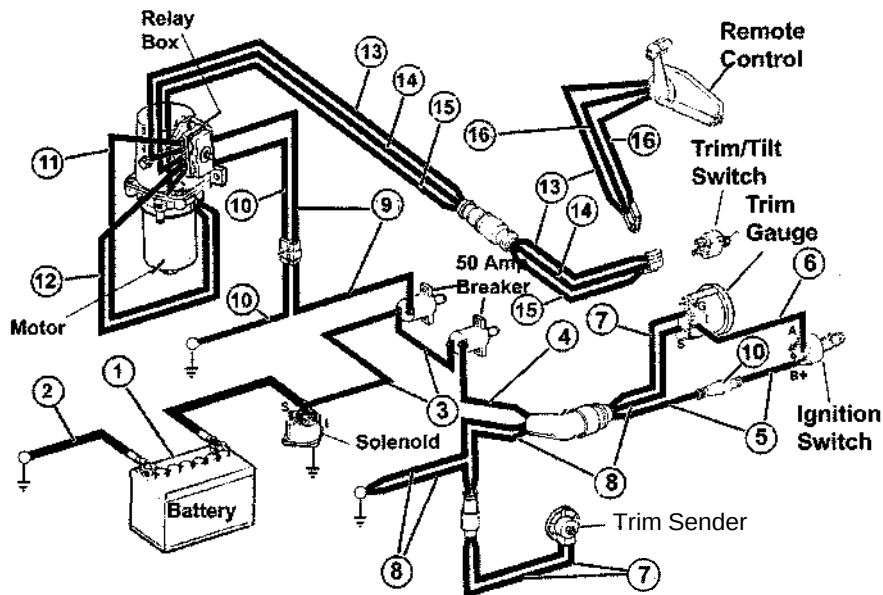


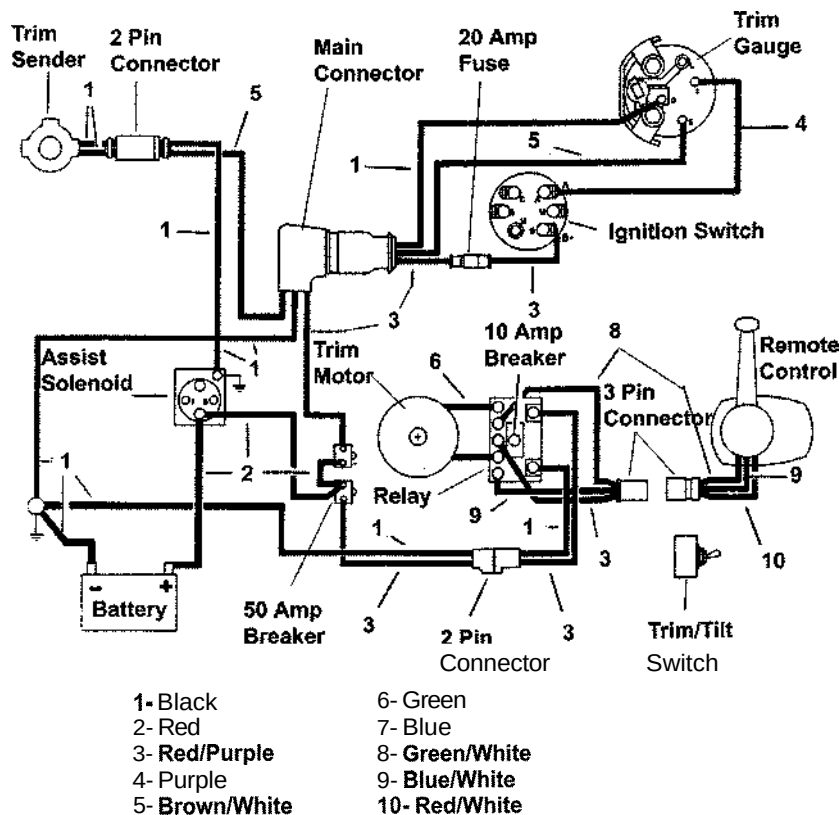
Fig. 99 Power trim/tilt—1990 Cobra models w/GM engines

13-36 TRIM AND TILT



- | | | |
|----------------------|-----------------------|------------------------|
| 1- Red 4 Ga. | 7- Black 16 Ga. | 13- Green/White 16 Ga. |
| 2- Black 4 Ga. | 8- Brown/White 16 Ga. | 14- Red/Purple 16 Ga. |
| 3- Red 10 Ga. | 9- Red 10 Ga. | 15- Blue/White 16 Ga. |
| 4- Red/Purple 10 Ga. | 10- Black 10 Ga. | 16- Red/White 16 Ga. |
| 5- Red/Purple 12 Ga. | 11- Green 10 Ga. | |
| 6- Purple 16 Ga. | 12- Blue 10 Ga. | |

Fig. 100 Power trim/tilt—1990 King Cobra models, all engines



- | | |
|----------------|----------------|
| 1- Black | 6- Green |
| 2- Red | 7- Blue |
| 3- Red/Purple | 8- Green/White |
| 4- Purple | 9- Blue/White |
| 5- Brown/White | 10- Red/White |

Fig. 101 Power trim/tilt—1991-92 models, 1993 GM models and 1994-95 7.4GL GM models

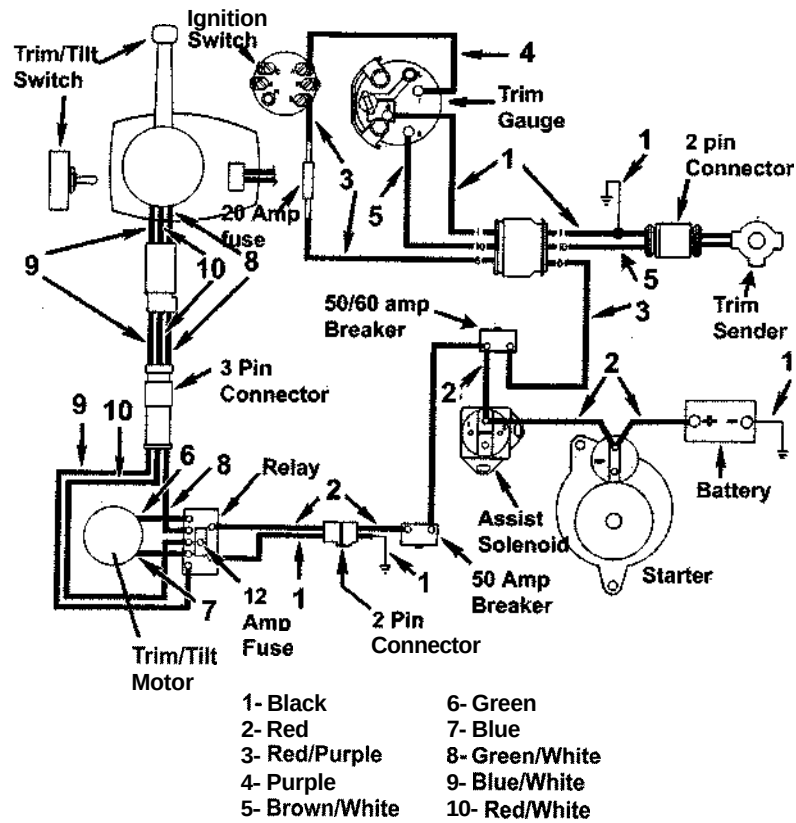


Fig. 102 Power trim/tilt—1993-95 Ford models

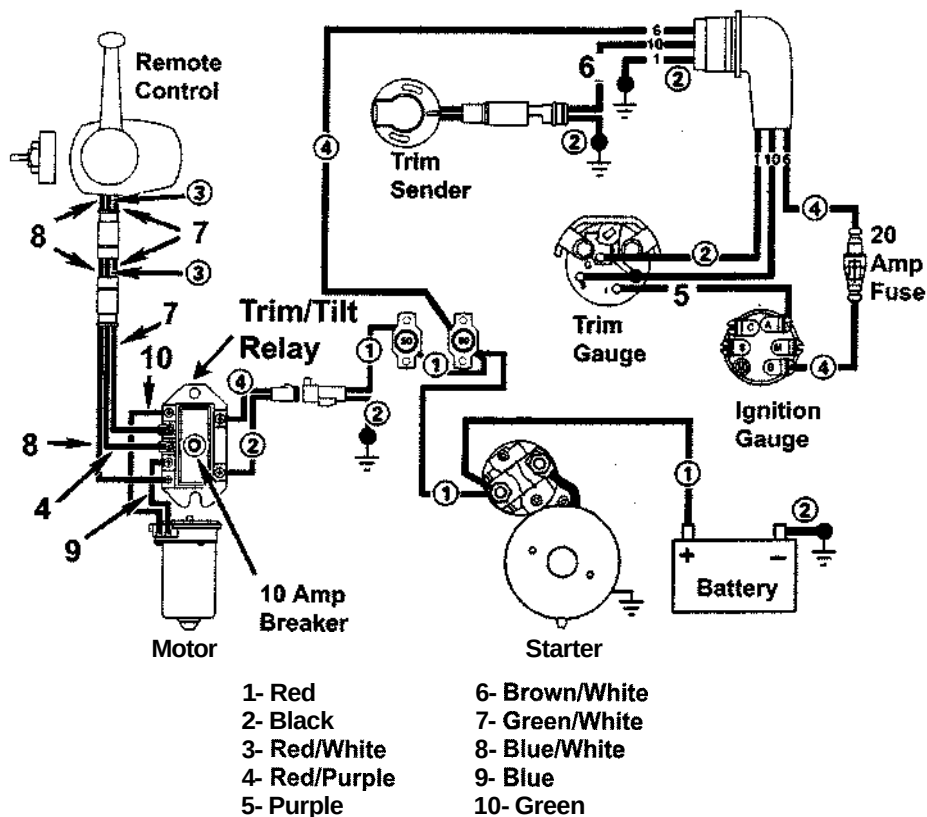


Fig. 103 Power trim/tilt—1995 7.4L EFI GM models

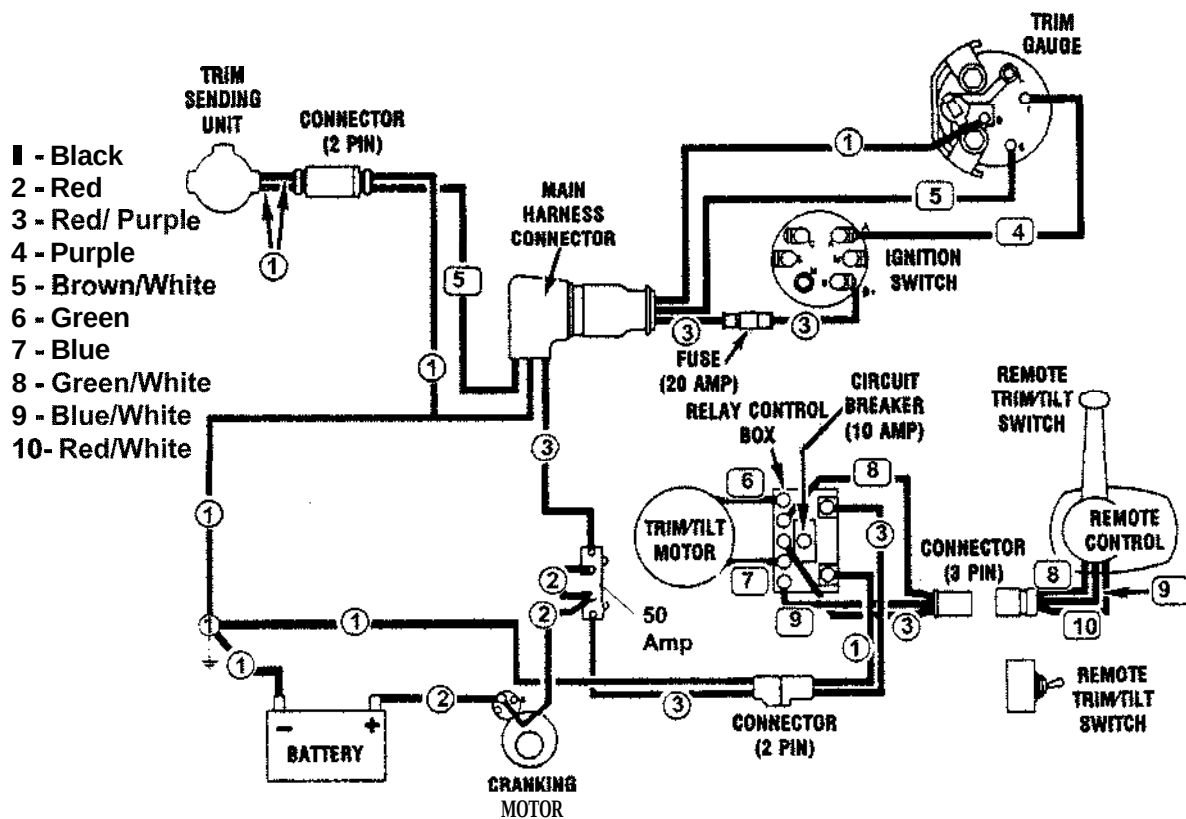


Fig. 104 Power trim/tilt—1994-95Cobra models w/GM engines

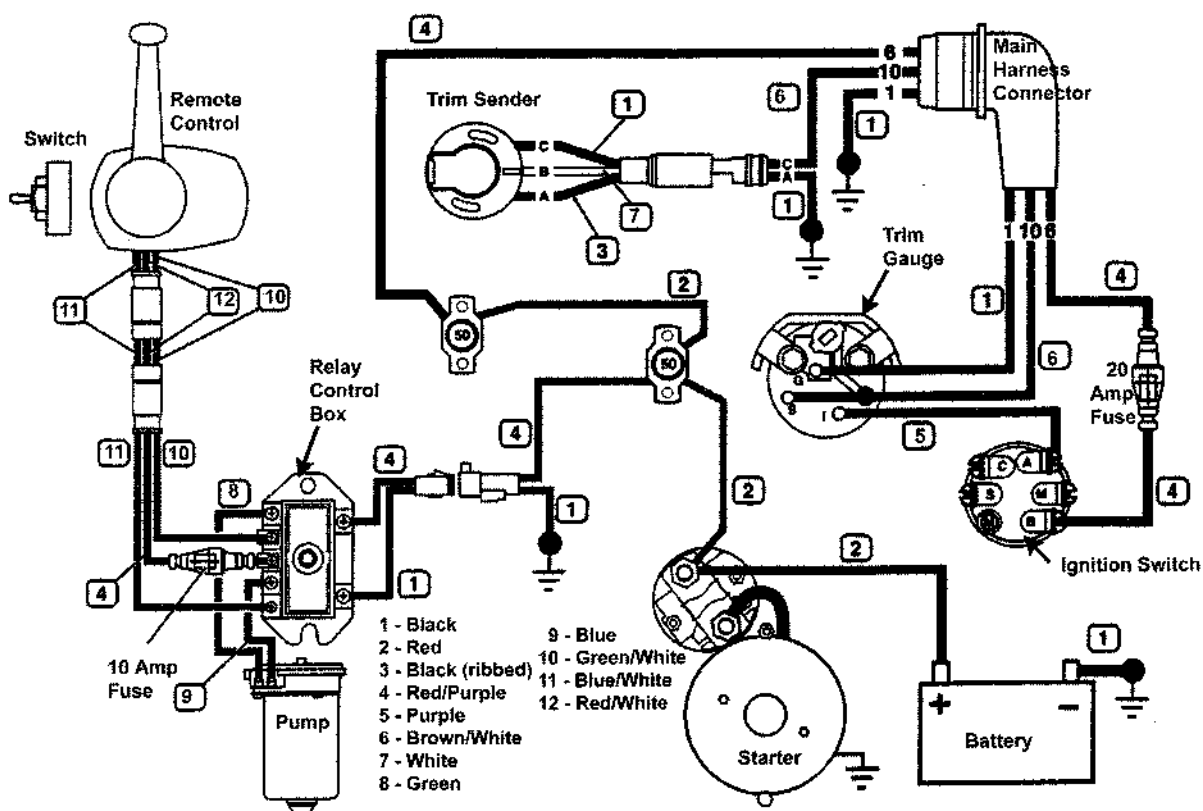


Fig. 105 Power trim/tilt—1996-98 SP models w/3.0GS, 4.3GL/GS, 5.0GL and 5.7GL/GS GM engines

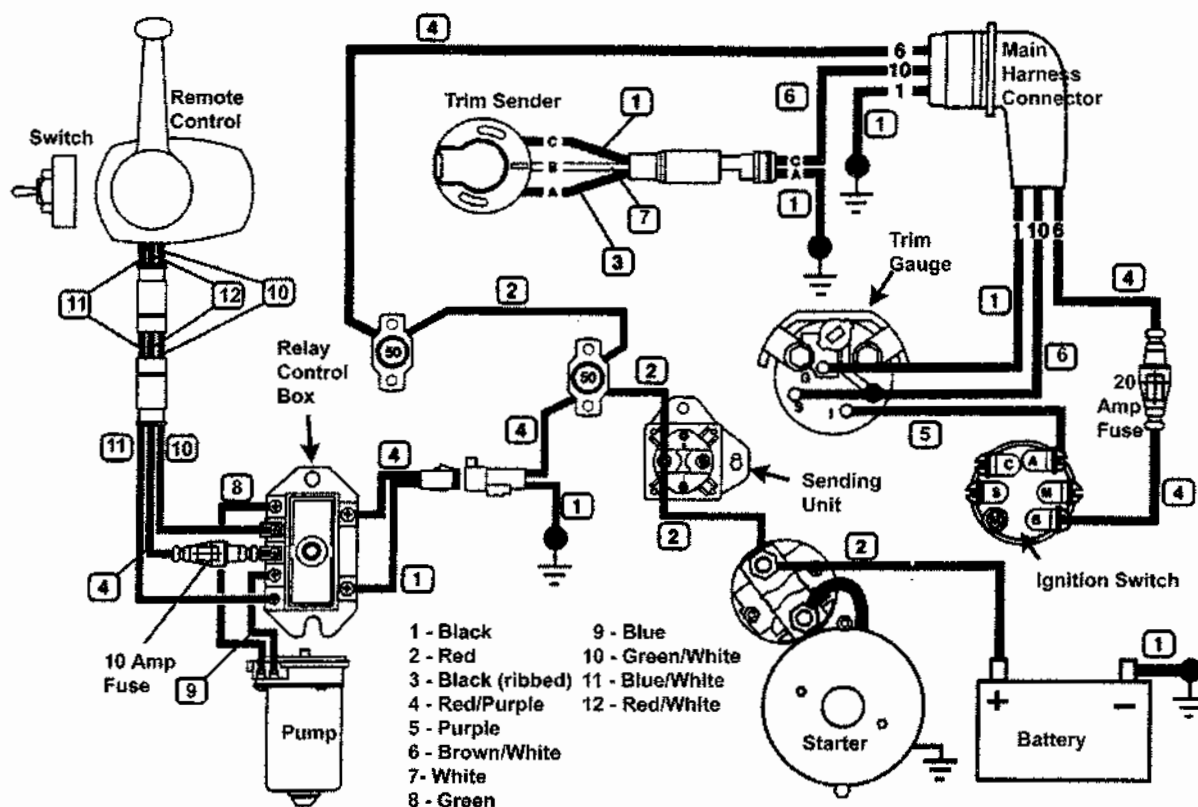


Fig. 106 Power trim/tilt—1996 SP models w/5.0/5.8L FL Ford engines and 7.4GL GM engines

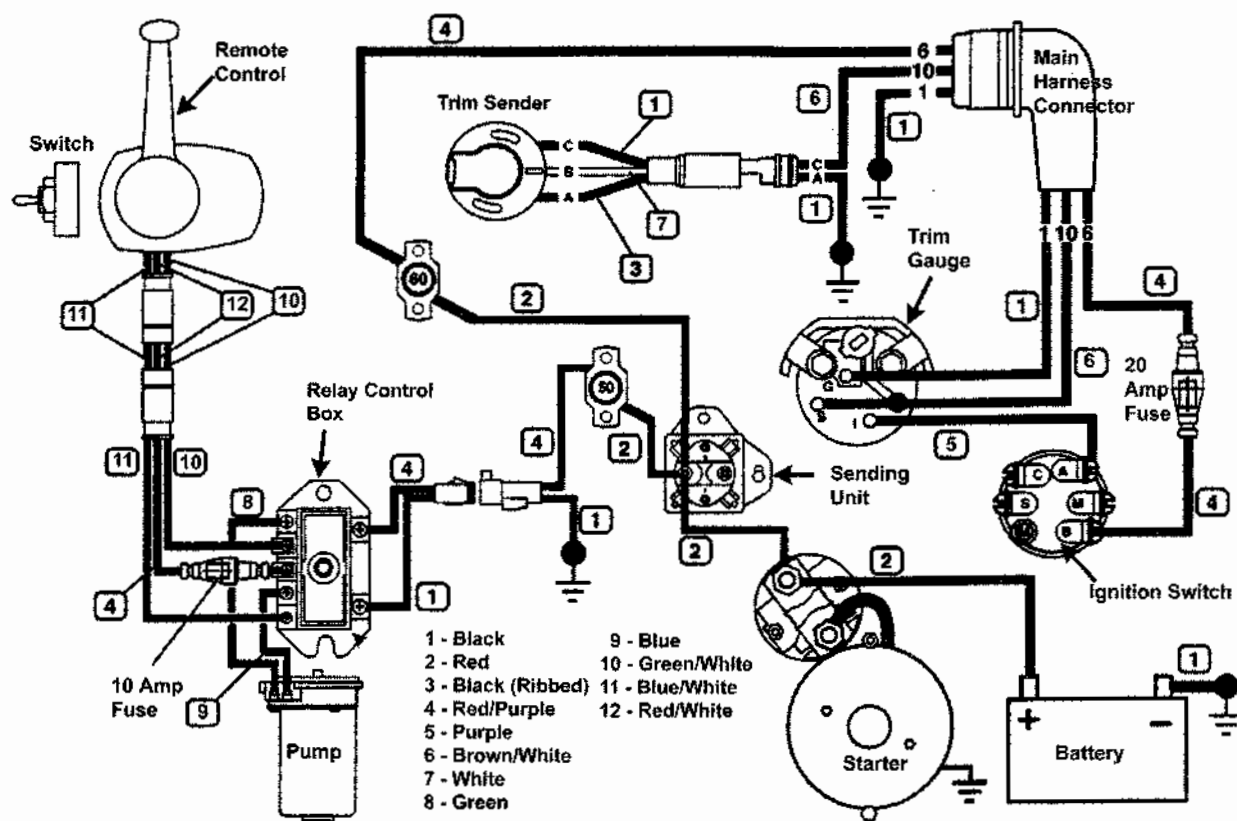


Fig. 107 Power trim/tilt—1996 SP models w/5.0Fi and 5.8FSI Ford engines

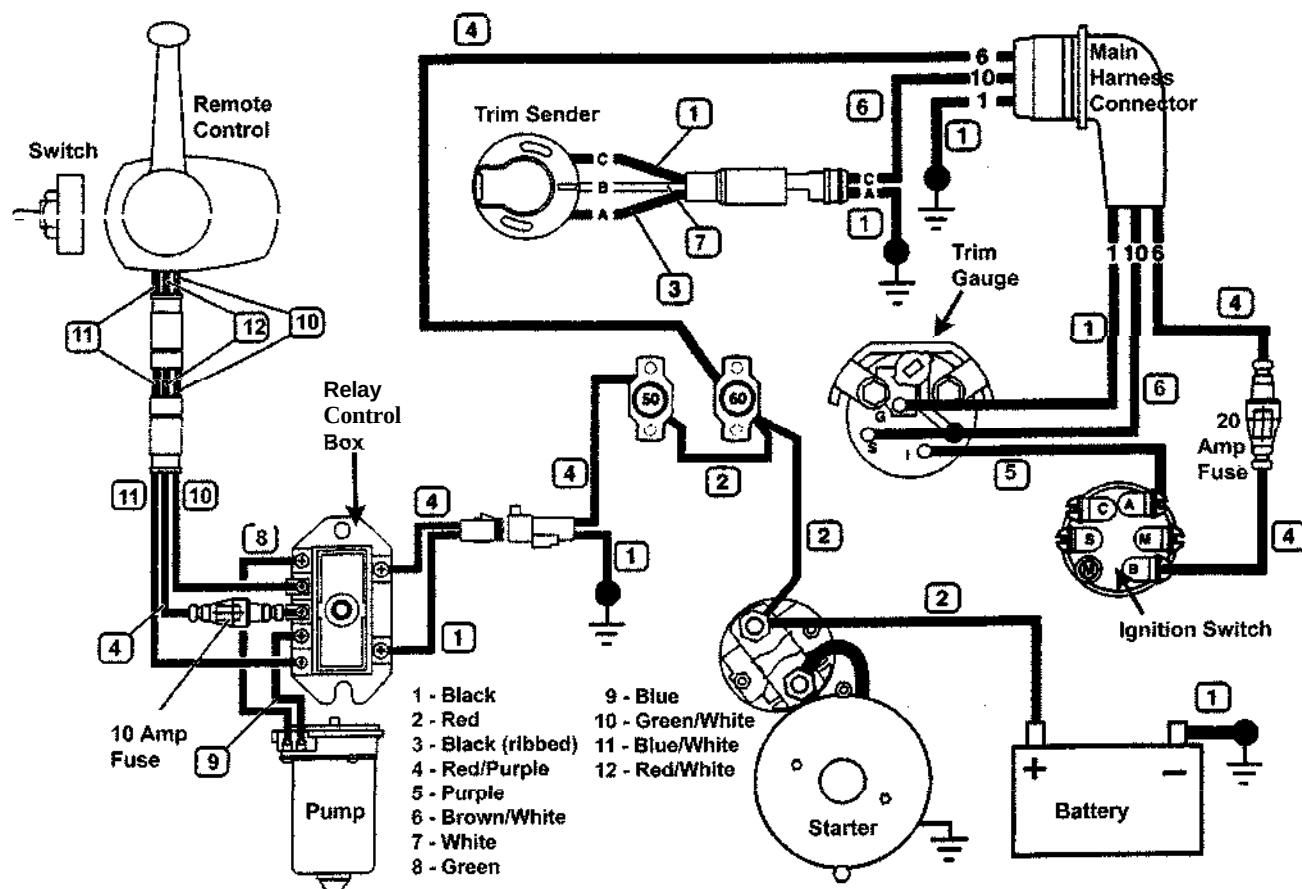


Fig. 108 Power trim/tilt—1996-98 SP models w/4.3Gi, 5.7Gi/GSi, 7.4Gi/GSi and 8.2GSi GM engines

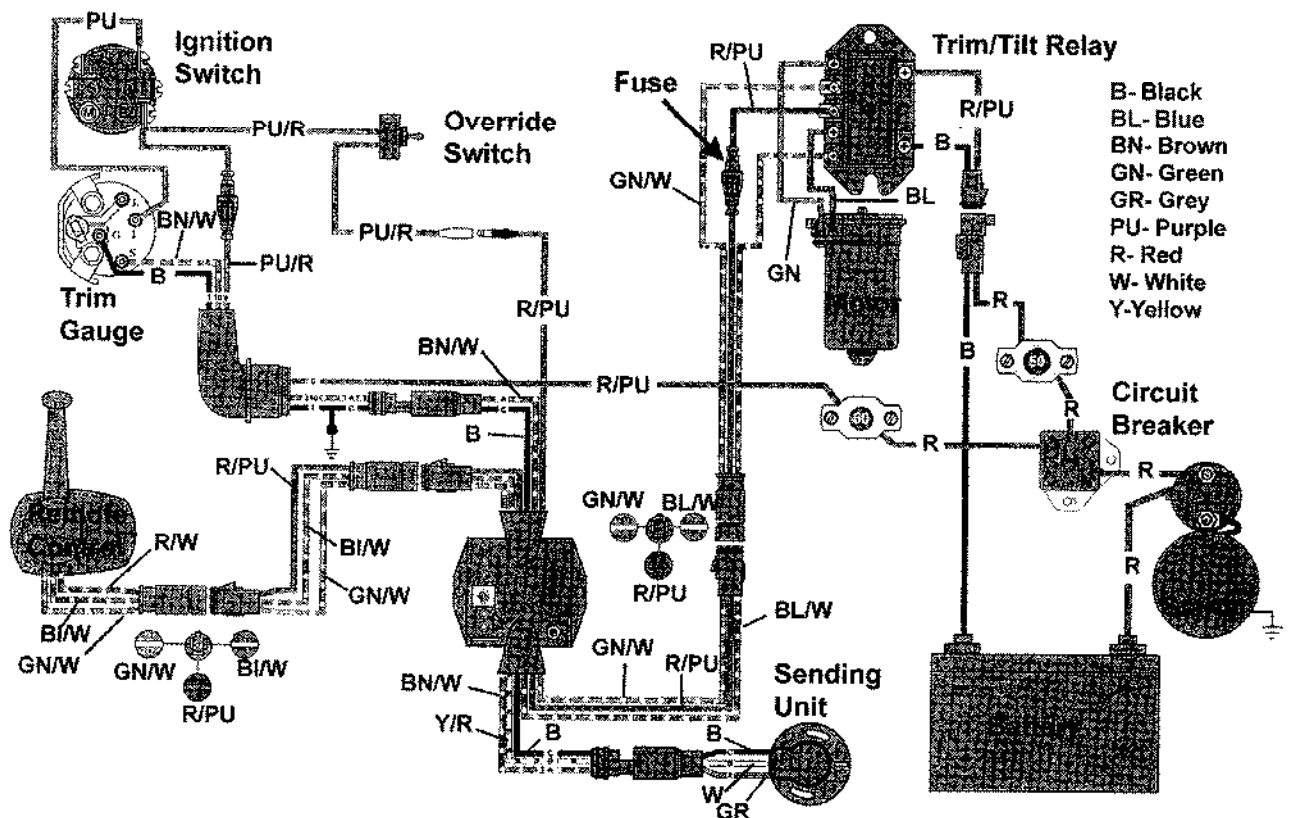


Fig. 109 Power trim/tilt—1996-98DP models w/GM engines

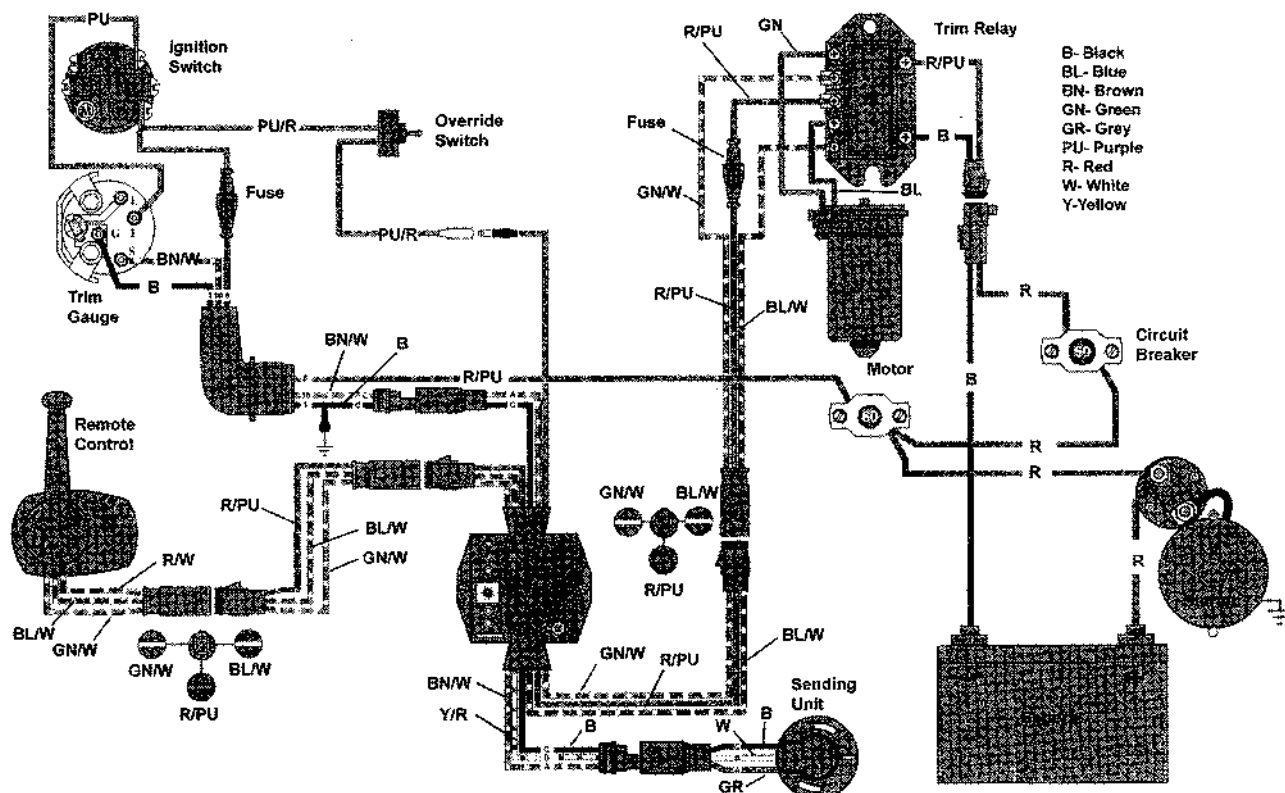


Fig. 110 Power trim/tilt—1996 DP models w/Ford engines

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STEERING SYSTEMS

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14-2 STEERING SYSTEMS

MANUAL STEERING SYSTEM

The manual steering system on your boat is very simple—a steering wheel, a steering cable and a steering tube/lever in the stern drive unit. Please refer to the Drive Systems sections for Steering Lever procedures.

The jacketed steering cable is connected on the one end to the helm (steering wheel) rack and pinion assembly. The opposite end of the outer jacket is connected to the steering tube at the transom plate. The inner cable passes through the tube and is connected to the steering arm coming from the stern drive unit. The tube and cable are connected to the transom via an anchor block, which provides the mechanical adjustment capabilities for centering of the steering system. When the steering wheel is rotated, the inner cable extends or retracts, moving the drive unit to port or starboard.

An adjustable trim tab on most models is located on the lower unit and is positioned to off-set the torsional steering (centered position) when operated at mid-range and full power settings.

Steering Cable

REMOVAL & INSTALLATION

1986 Models



◆ See Figures 1, 2 and 3

■ The steering cable is serviced as an assembly only.

1. Locate the end of the steering cable at the transom. Pull out the cotter pin securing the bottom of the clevis pin holding the cable ram to the steering lever (arm). Remove the steering arm clevis and disconnect the cable ram from the steering lever. On dual engine installations, support the tie bar and then repeat the procedure on the opposite side.

2. Remove the steering lever bushings (if equipped).

3. Turn the helm hard over to port until it reaches the full lock position and then loosen the cable anchor nut at the steering tube. Disconnect the cable.

4. Disconnect the cable at the helm and remove it.

■ The steering tube position in the anchor block is preset at the factory—do not loosen the jam nut or attempt to change the centering position of the steering tube.

To Install:

5. Clean the steering tube and steering lever thoroughly and inspect carefully for cracks, wear or other damage.

6. Connect the new cable to the helm as per the cable manufacturer's instructions and run it back through the boat.

7. Turn the steering wheel until the steering cable ram is extended to its full length and then coat the ram liberally with OMC Triple Guard Grease over its entire length.

8. Retract the steering cable ram completely while turning the steering wheel. Count the exact number of turns (yes, of the steering wheel) it takes until the ram is fully retracted.

9. Feed the cable ram through the steering tube and then position the steering lever at its center position of travel.

10. Now, turn the steering wheel in the other direction exactly half of the amount of turns you noted in the previous step—this will center the steering cable ram.

11. Position the steering cable end against the steering tube, loosen the lock nut and then turn the steering tube until the hole in the cable ram is lined up with the hole in the steering arm. Use your hand, not pliers or vise grips!

12. Move the steering tube jam nut so that it is next to the anchor block. Attach a 1-5/16 in. (34mm) 90 deg. crows foot wrench to a torque wrench and then tighten the jam nut to 20-25 ft. lbs. (27-34 Nm).

13. Position the steering ram in the steering lever so the holes line up and then insert the clevis pin from the top. Install a new cotter pin and bend over the arms.

14. Turn the steering wheel from lock-to-lock, extending and retracting the cable ram. The steering lever should move from stop-to-stop without coming in contact with the cut-out in the transom. Check that the steering arm has equal clearance at each stop and that it is centered when the wheel is centered.

1987-98 Models



◆ See Figures 1, 2 and 3

The steering cable is serviced as an assembly only.

1. Locate the end of the steering cable at the transom. Pull out the cotter pin securing the bottom of the clevis pin holding the cable ram to the steering lever (arm). Remove the steering arm clevis and disconnect the cable ram from the steering lever. On dual engine installations, support the tie bar and then repeat the procedure on the opposite side.

2. Remove the steering lever bushings.

3. Turn the helm hard over to port until it reaches the full lock position and then loosen the cable anchor nut at the steering tube. Disconnect the cable.

4. Disconnect the cable at the helm and remove it.

The steering tube position in the anchor block is preset at the factory—do not loosen the jam nut or attempt to change the centering position of the steering tube.

To Install:

5. Clean the steering tube and steering lever thoroughly and inspect carefully for cracks, wear or other damage.

6. Connect the new cable to the helm as per the cable manufacturer's instructions and run it back through the boat.

7. Turn the steering wheel until the steering cable ram is extended to its full length and then coat the ram liberally with OMC Triple Guard Grease over its entire length.

8. Feed the cable ram through the steering tube and then thread on the anchor nut (while holding the cable in the tube) until it bottoms against the end of the tube. Attach a 90 deg. crows foot wrench to a torque wrench and then tighten the anchor nut to 120 inch lbs. (14 Nm).

9. Install the steering lever bushings into the lever. It is not necessary to replace these bushings unless they are worn or damaged; we recommend replacing them anyway as preventative maintenance although it is by no means imperative.

10. Position the steering ram in the steering lever so the holes line up and then insert the clevis pin from the top. Install a new cotter pin and bend over the arms.

11. Turn the steering wheel from lock-to-lock, extending and retracting the cable ram. The steering lever should move from stop-to-stop without coming in contact with the cut-out in the transom. Check that the steering arm has equal clearance at each stop and that it is centered when the wheel is centered.

MAINTENANCE



The steering cable should be lubricated with water repellent grease (OMC Triple Guard) every 60 days during your boating season, although depending on your particular local conditions it may be necessary to shorten the interval.

Steering Tube

REMOVAL & INSTALLATION



◆ See Figures 4 and 5

The steering tube position in the anchor block is preset at the factory—although we are providing the appropriate service procedures here, we do not recommend removing the assembly unless you are a skilled technician.

1. Disconnect the steering cable from the steering tube as detailed in the previous section.

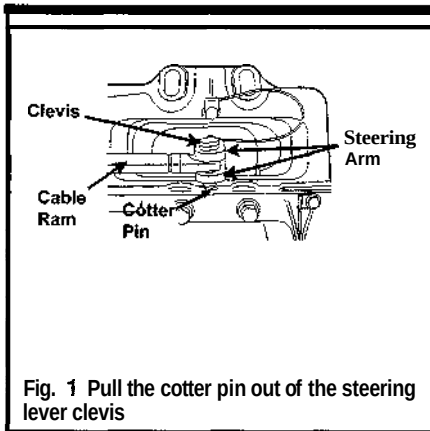


Fig. 1 Pull the cotter pin out of the steering lever clevis

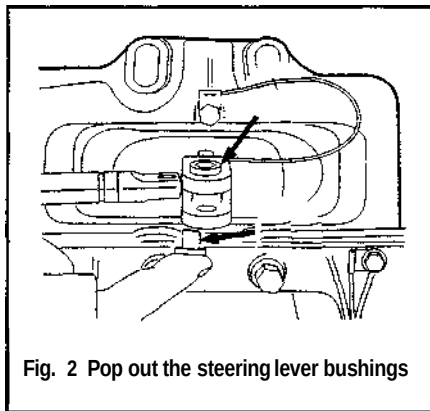


Fig. 2 Pop out the steering lever bushings

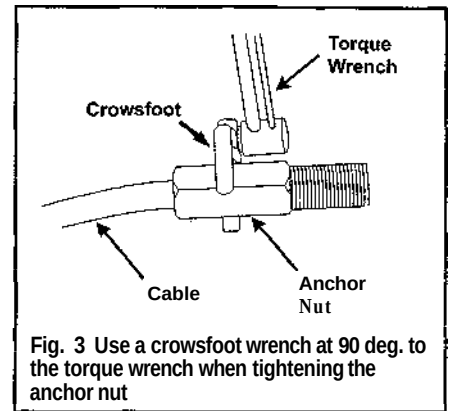


Fig. 3 Use a crowsfoot wrench at 90 deg. to the torque wrench when tightening the anchor nut

2. Locate the anchor block at the transom, loosen the jam nut and thread the steering tube out of the block. Remove the jam nut from the tube.

3. Remove the cotter pins (if equipped) and then the 2 mounting bolts and lift the anchor block out of the transom plate.

To Install:

4. Clean the anchor block and steering tube thoroughly.

5. Thread the jam nut all of the way onto the steering tube. Measure 3 1/4 in. (82.55mm) in from the threaded end of the tube. Now measure in an additional 1 1/4 in. (31.80mm) from that mark and spray Loctite primer on the 1 1/4 inch area of threads. Allow the primer to dry completely and coat the same area of threads with Loctite sealer or OMC Nut Lock.

6. Thread the anchor block onto the tube until the outer edge of the block is 3-5/32 in. (80.2mm) from the end of the tube. This should position the steering tube for accurate centering of the system.

7. Thread the jam nut up against the anchor block and then tighten it to 35-40 ft. lbs. (47-54 Nm). It is very important that the anchor block does not change position during the final tightening of the jam nut!

8. Coat the bushings LIGHTLY with grease and position the assembly into the transom bracket. Install the original mounting bolts and tighten them to 40-45 ft. lbs. (54-61 Nm). Insert new cotter pins into the holes and bend over the arms.

WARNING

It is imperative that when greasing the bushings, you squeeze only a little grease into them—filling the bushing can cause the bolts to hydraulically lock and break the transom plate bracket.

9. Reconnect the steering cable to the steering tube.

Trim Tab

ADJUSTMENT

See Figure 6

The trim tab should be pre-set at the factory and should normally require no adjustment. To confirm the setting, measure from the very end of the trim tab directly over to the port side of the anti-cavitation plate so that you measurement is taken at a point perpendicular to the centerline of the drive unit. Left-hand rotation units should measure 3 1/4 in. (83mm) (5 degrees to port of the centerline), while right-hand units should measure 2 1/4 in. (57mm) (30 degrees to port of the centerline).

If the measurement is not within specifications, loosen the trim tab bolt and re-position the tab to meet the correct dimension. Tighten the bolt to 28-32 ft. lbs. (38-43 Nm) on drives through 1994; for 1995-98 drives, tighten the bolt to 14-16 ft. lbs. (19-22 Nm).

In spite of the fact that the tab is pre-set at the factory, the boat may still steer more easily in one direction or another. If this is the case, confirm that the tab setting is correct as per factory recommendations and then perform the following test while running the boat in a straight line, with a balance load, in an area where current and wind will be as little a factor as possible.

10. While running the boat in a straight line, turn the wheel in one direction and then the other direction a few times while determining which direction requires the least amount of effort to complete the turn.

11. The trim tab will need to be moved SLIGHTLY in the direction that requires the LEAST effort. If boat is easier to turn to port, loosen the tab mounting bolt and move the tab just a bit toward the port side. If the boat turns easier to starboard, do the same, but move the tab to the starboard side. Tighten the trim tab bolt to 28-32 ft. lbs. (38-43 Nm) on drives through 1994; for 1995-98 drives, tighten the bolt to 14-16 ft. lbs. (19-22 Nm).

On boats with twin engines, the trim tab on each engine must be moved the same amount and in the same direction.

12. Recheck the steering effort after making the adjustment. Repeat the procedure until you are confident that the boat steers with the same amount of effort in each direction.

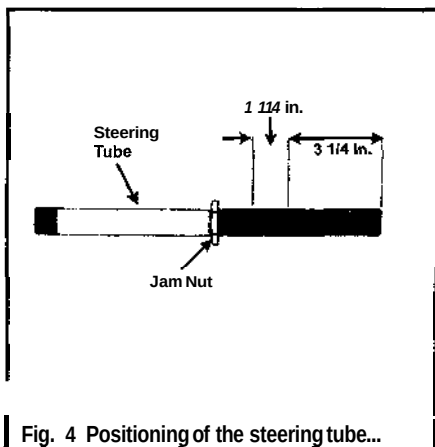


Fig. 4 Positioning the steering tube...

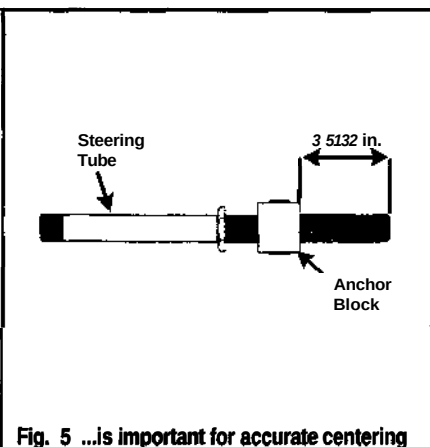


Fig. 5 ...is important for accurate centering

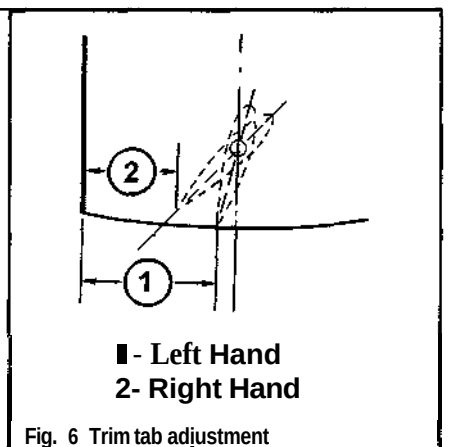


Fig. 6 Trim tab adjustment

14-4 STEERING SYSTEMS

POWER STEERING SYSTEM

Description

+ See Figure 7

All OMC power steering systems utilize an engine-driven, vane-type hydraulic pump supplying fluid and pressure, via hoses, to a control or servo valve. The valve controls flow and pressure to a steering cylinder, the two of which make up the power steering assembly. There are three basic power steering modes: Neutral, left turn and right turn. The control valve, activated by the steering wheel via a steering cable controls all three modes.

The hydraulic pump is mounted on the front of the engine and is belt-driven by the crankshaft pulley. Some models have a separate fluid reservoir, but most utilize a reservoir contained within the pump housing. On the integrated models, the fill cap has a dipstick attached.

The control valve and steering cylinder are usually a single unit and are mounted to the transom plate at the back of the boat. This assembly is connected to the pump by means of hydraulic lines, with an oil cooler being incorporated into the low pressure return line. The assembly is also connected to the helm by means of a standard mechanical steering cable, which along with the steering ram, is connected to the steering arm on the drive unit.

When there is no steering input from the helm, the control valve is kept centered by a spring. Hydraulic fluid from the pump enters the valve at the pressure point, flows by each of the cylinder ports with almost no restriction and then through the return port, oil cooler and back to the pump reservoir.

When the helm is turned over to port, the system pulls the steering arm to starboard. The casing on the steering cable pushes the valve spool to port, fluid enters the valve and is routed to the rod-end outlet and then on to the low volume side of the cylinder. Pump pressure then moves the piston and steering arm to starboard. Fluid in the high volume side of the cylinder is forced through the valve, out the return port and back to the pump reservoir.

When the helm is turned over to starboard, the system pushes the steering arm to port. The casing on the steering cable pulls the valve spool to starboard, fluid enters the valve and is routed to the piston-end outlet and then on to the high volume side of the cylinder. Pump pressure then moves the piston and steering arm to port. Fluid in the low volume side of the cylinder is forced through the valve, out the return port and back to the pump reservoir.

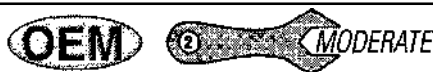
Even when the power assist is not working for the steering system, the boat may still be steered, albeit not quite so easily. When turned to port at the wheel, the steering cable will still move the steering arm to starboard. This, in turn, causes the cable casing to press against the valve spool to port and against the stop at about 0.125 in. (3.18mm). The cable is now transmitting full manual effort to the steering arm. Fluid ahead of the piston is manually forced out of the cylinder through the outlet and into the valve, then through the return port and back to the pump reservoir. Additionally, fluid will be drawn out of the reservoir through the pressure inlet and back to the opposite side of the piston.

During normal operation, dual intake ports in the pump draw fluid from the reservoir. Pump output is also via ports. Vanes on the pump are held against the pump bore by pressure against the back of the vanes. Pump output should always be sufficient to perform quick boating maneuvers at idle. Pump output, flow-restricted to a maximum of 2.3 gallons/min., is always determined by resistance to flow found in the system. With no steering input, pressure should be 50-100 psi. Steering input increases the pressure, dependant upon boat attitude, trim position, throttle position and speed of maneuver.

A pressure relief valve located in the body of the pump protects against exceedingly high pressure and limits output pressure to 1000-1100 psi.

Testing

PUMP LEAKAGE



◆ See Figures 8, 9 and 10

Over-filling the pump reservoir is frequently the cause of leaks. Hydraulic fluid expands as it heats up during usage and the level then rises in the reservoir. Excess fluid is expelled through the breather hole in the filler cap where it can then be sprayed over the engine by the drive belt.

When using a torque wrench on line fittings, you will need the use of a 90° crowfoot wrench.

1. Remove the lower hose fitting (1) with a flare wrench and install a new O-ring. Make sure you have opened the filler cap and have plenty of rags on hand. Tighten the fitting to 40 ft. lbs. (54 Nm) on 1986-89 models or 15-26 ft. lbs. (20-32 Nm) on 1990-98 models. If leakage continues, replace the hose or pump as necessary.

2. Check the torque on the lower fitting port nut (2). If the port is already tightened to 35 ft. lbs. (48 Nm) on 1986-89 models or 37-75 ft. lbs. (50-102 Nm) on all others, replace the pump; otherwise tighten the port to bring it into specifications.

3. Check the fluid level in the reservoir. If leakage continues with the fluid at the correct level and the cap on tightly, replace the cap or the pump.

4. Refer to the illustration for other likely areas of leakage. If detected in any of these areas, replace the pump.

PUMP PRESSURE



+ See Figures 10 and 11

This test will require the use of a power steering system pressure gauge kit.

1. Ensure the power steering fluid is at the correct level in the reservoir(s).

2. Turn off the engine and connect a pressure gauge (Kent Moore #J-5176) to the high pressure hose. Disconnect the lower hose at the rear of the pump with a flare wrench. Connect the end of the hose to the pressure gauge on the shut-off valve side and then connect a spare hose between the other side of the gauge and the rear pump connection port. Open the shut-off valve.

The shut-off must be downstream from the gauge,

3. Remove the filler cap from the pump reservoir and check the fluid level, making sure the fluid is at the **FULL** line on the dipstick.

4. Start the engine and turn the wheel hard over (either way) until it is at full lock. Check the connections at the tool for any leaks.

5. Bleed the system as detailed in the Maintenance section.

6. Insert a thermometer (Kent Moore # J-5421) into the filler opening on the reservoir. Start the engine and move the steering wheel back and forth from lock-to-lock several times until the thermometer indicates a temperature of 150-190° F (65-88 °C); this is normal operating temperature.

7. Check the fluid level and add if necessary. While the fluid is at normal operating temperature, the pressure with the valve open should be 80-125 psi on 1986-89 models or 50-100 psi on 1990-98 models. If pressure is higher, check all hoses for obstructions.

8. Close the shut-off valve momentarily and read the gauge. Open the valve immediately once you have noted the pressure. Relief valve pressure should be 1000-1100 psi.

9. Remove the gauge and spare hose. Connect the high pressure hose to the pump and tighten the fitting nut to 40 ft. lbs. (54 Nm) on 1986-89 models or 15-26 ft. lbs. (20-32 Nm) on 1990-98 models.

10. Replace the pump if the specified temperature or either of the pressures were outside of their ranges.

Maintenance Procedures

Please refer to the Maintenance section for fluid level checking, system bleeding and drive belt adjustment procedures.

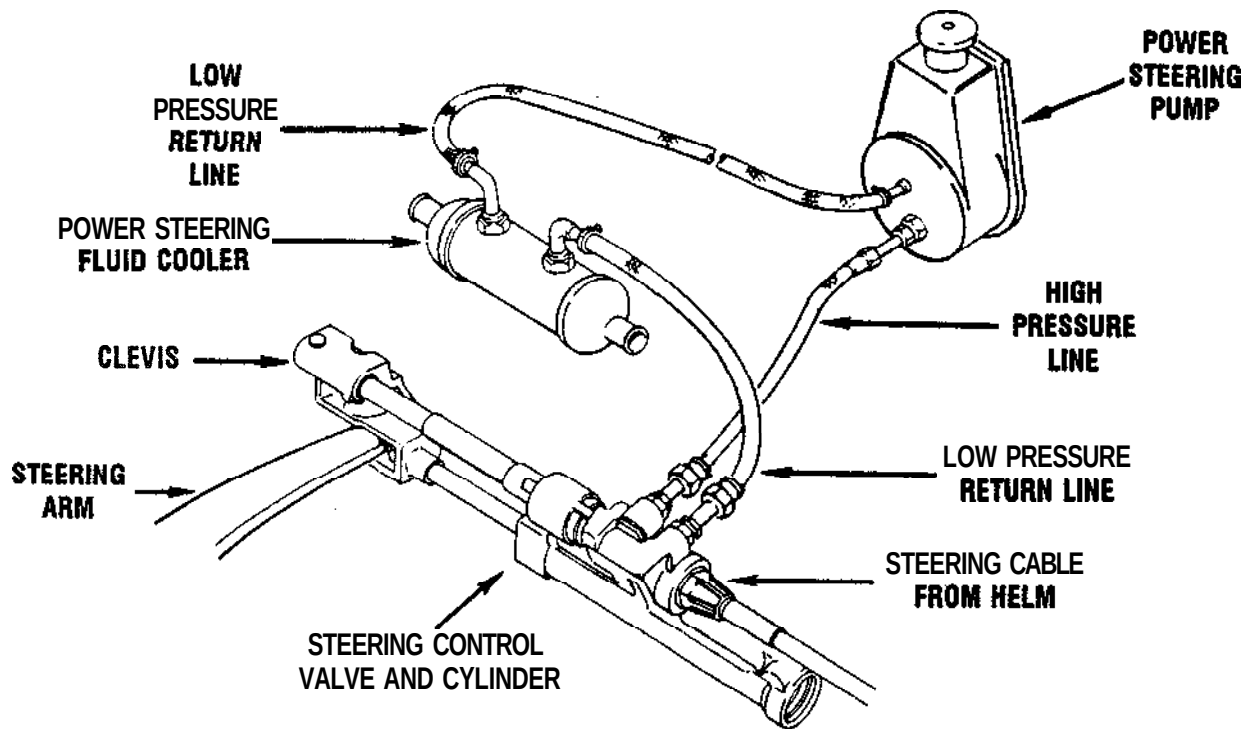


Fig. 7 Exploded view of the power steering cylinder—1990-98 models

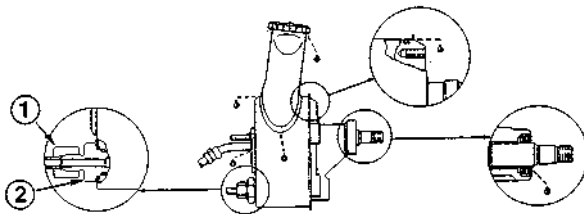


Fig. 8 Common fluid leak points on the hydraulic pump—1986-89 models

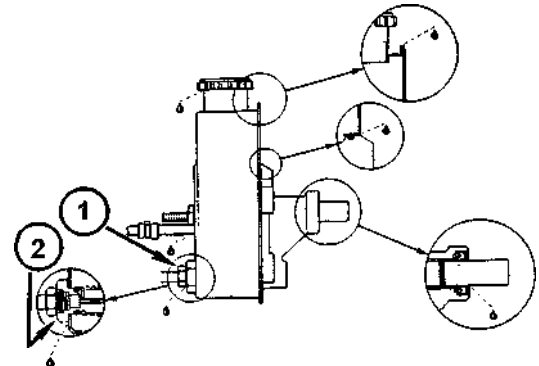


Fig. 9 Common fluid leak points on the hydraulic pump—1990-98 models

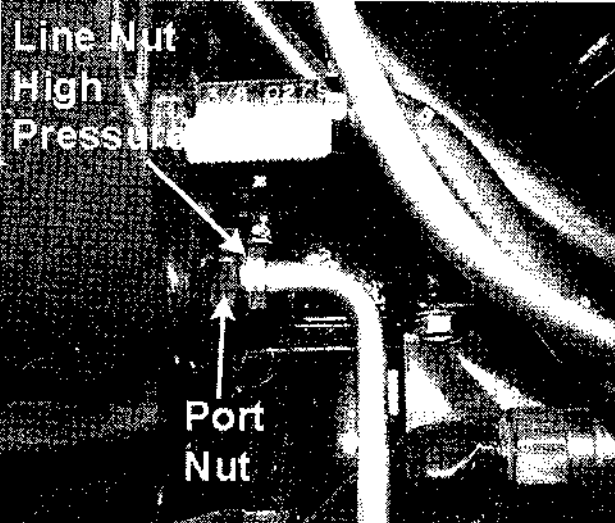


Fig. 10 Close look at the lower (high pressure) line connections (later models shown)

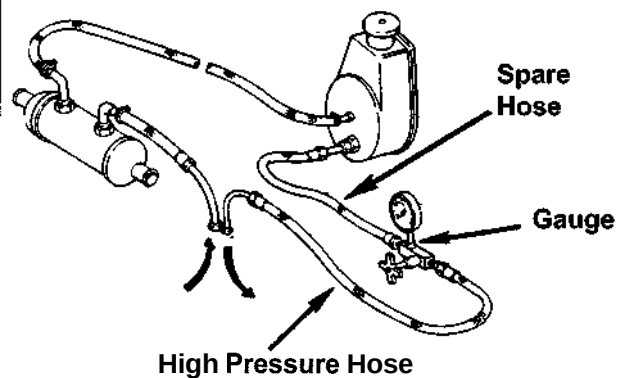


Fig. 11 Pressure test gauge hook-up

14-6 STEERING SYSTEMS

Actuator Valve And Cylinder Assembly

REMOVAL & INSTALLATION

1986-89 Models Only

◆ See Figure 12



1. Remove the steering cylinder as detailed elsewhere in this section.
 2. Loosen and remove the guide lock nut and washer. Lift off the valve guide and steering tube as an assembly.
 3. Carefully clamp the assembly in a soft-jawed vise and remove the bracket-to-valve bolt (and washer).
 4. Spin two 1/2-13 nuts onto the bracket-to-valve bolt and then thread it into the bracket bushing. Tighten the inner nut against the bushing (firmly) and then cinch the other nut up against the inner nut. Remove the bushing clamp bolt and throw it away. Now turn the bracket-to-valve bolt counterclockwise and remove the bushing.
 5. Aside from removal of the grease fitting nipple on the housing, no further service is possible on the actuator valve.
 6. Bend a piece of cardboard around the cylinder rod so that it butts up against the inner edge of the clevis fork and then clamp a pair of Vise Grips around the cardboard and rod. Working inside the fork in the clevis, remove the cylinder lock nut and washer while holding the rod with the pliers.
 7. Remove the cotter pin on the bracket and then remove the 2 cylinder trunnion pins by threading in a 2 in. long bolt—the pins have internal 10-24 threads.
 8. Separate the bracket and the cylinder. Remove the remaining cotter pin on the bracket and pull out the cylinder bushing. The cylinder is serviced as an assembly, no further service is possible.
- To Install:**
9. Clean all components thoroughly and inspect everything for cracks and other visible signs of damage.
 10. Press the cylinder rod bushing into the bracket so that the grooved end lines up with the cotter pin hole. Insert the pin and bend over the ends.
 11. Slide the bracket onto the power cylinder so that the hydraulic line ports are exposed and then install the trunnion pins so the threaded end is on the outer side. Slide in a new cotter pin for the lower trunnion.
 12. Slide the clevis over the end of the cylinder rod and then grasp the rod with Vise Grips as detailed in the removal procedure. Tighten the lock nut to 23-28 ft. lbs. (31-38 Nm).
 13. Thread the bushing into the valve until the outer edge of the bushing is 1116-3132 in. BELOW the outer edge of the bore in the valve—this will allow the clamp bolt to pass through the groove between the bushing threads. Install a new clamp bolt and tighten it to 24-30 ft. lbs. (33-41 Nm).
 14. Position the bracket against the valve assembly so that the slot on the valve mating surface lines up with the small rise on the bracket mating surface. Install the bracket bolt and tighten it to 50-60 ft. lbs. (68-81 Nm).
 15. Install the steering tube and valve guide as an assembly. If the tube lock nut was removed, or even loosened, position the tube so that 718 in. (22mm) of thread is protruding on the cylinder end. Tighten the lock nut to 25-30 ft. lbs. (34-40 Nm).
 16. Position the steering tube over the power cylinder and set the guide on the actuator stud. Slide a new internal toothed lock washer onto the nut and thread it onto the stud. Tighten the nut to 40-50 ft. lbs. (54-68 Nm).
 17. Install the cylinder as detailed elsewhere in this section.

Power Steering Cooler

All engines covered here utilize a raw-water cooled steering cooler on the low pressure (return) side of the power steering system; located in-line between the control valve and the power steering pump.

REMOVAL & INSTALLATION

◆ See Figures 13, 14, 15, 16 and 17



1. Locate the cooler. It can generally be found at the rear of the engine, although certain engines will have it tucked in at the front of the engine on the port side. If it's not readily visible, just follow the lines from the pump.
2. Drain the cooling system as detailed in the Maintenance section.
3. Loosen the hose clamps and wiggle off the cooling hoses on each end of the unit. Have some rags and a container handy as there will still be some residual water in the cooler and lines. Tie the hoses up and out of the way.

■ Although not absolutely necessary, we recommend draining the power steering system before attempting this procedure.

4. Loosen the hydraulic lines running into and out of the cooler unit. Most will simply use a hose clamp, but a few applications will use a screw-in fitting. Have some rags and a container handy as there will still be some residual fluid in the cooler and lines. Tie the hoses up and out of the way. Plug the openings to prevent contamination.

5. Loosen and remove the mounting brackets—usually just hose clamps, and lift out the cooler.

To Install:

6. Clean the cooler thoroughly and inspect it for cracks, wear or other damage.
7. Position the cooler and tighten the mounting hardware.
8. Slide the cooling hoses over the end flanges and tighten the hose clamps securely. Check the hose ends for cracks, crimping or bulges.
9. Install the hydraulic lines onto their original fitting and tighten the hose clamps or nuts securely.
10. Refill the cooling and power steering systems.

Power Steering Pump

REMOVAL & INSTALLATION



+ See Figures 14, 15, 16, 17 and 18

1. Relieve drive belt tension as detailed in the Maintenance section and remove the belt. Loosen the mounting adjusting brackets and swivel the pump in so you can pull the belt off.

■ On certain engine applications you may have to remove the pump before disconnecting the hydraulic lines.

2. Make sure to have a suitable container and some rags available. Loosen the pressure line fitting (lower) on the rear of the pump housing with a flare wrench and remove the line. Plug the line and tie it up so the plugged end is facing upward. Drain the fluid reservoir and then plug the port. Remove and discard the O-ring.

3. Loosen the hose clamp on the return line (upper) and pull the line off the fitting on the pump housing. Plug the line and secure it somewhere with the plugged end facing up. Plug the port on the pump.

4. Loosen the pump-to-brace bolt (if you haven't already) and disconnect the pump from the engine brace. If necessary, remove the brace from the engine.

5. Remove the two pump bracket mounting bolts and lift out the pump assembly.

■ On dual engine installations there may be a remote reservoir connected by hoses to the top of each pump reservoir. Remove the hose if necessary.

6. Remove the pump pulley with the appropriate puller (# 982270) and then remove the mounting bracket if necessary.

7. With the exception of the pump pulley, the power steering pump is a non-serviceable item and is replaced as a unit; overhaul is not possible.

To Install:

8. Install the mounting bracket and pulley if removed (use installer tool #982271 if necessary).

■ On certain engines applications you may have to connect the hydraulic lines prior to installing the pump.

9. Install the pump and bracket assembly onto the brace and tighten the bolts just tight enough to hold the pump in position.

10. If removed, attach the pump brace to the engine and tighten it to 30 ft. lbs. (41 Nm).

11. Connect the pump to the engine brace (if equipped) and tighten the bolt securely.

12. Connect the pressure line to the lower fitting and tighten it to 40 ft. lbs. (54 Nm) on 1986-89 models and 15-26 ft. lbs. (20-35 Nm) on all others; be sure to use a new O-ring coated with power steering fluid. Slide the return line over the pump fitting and tighten the hose clamp to 12-17 inch lbs. (1.4-2.0 Nm).

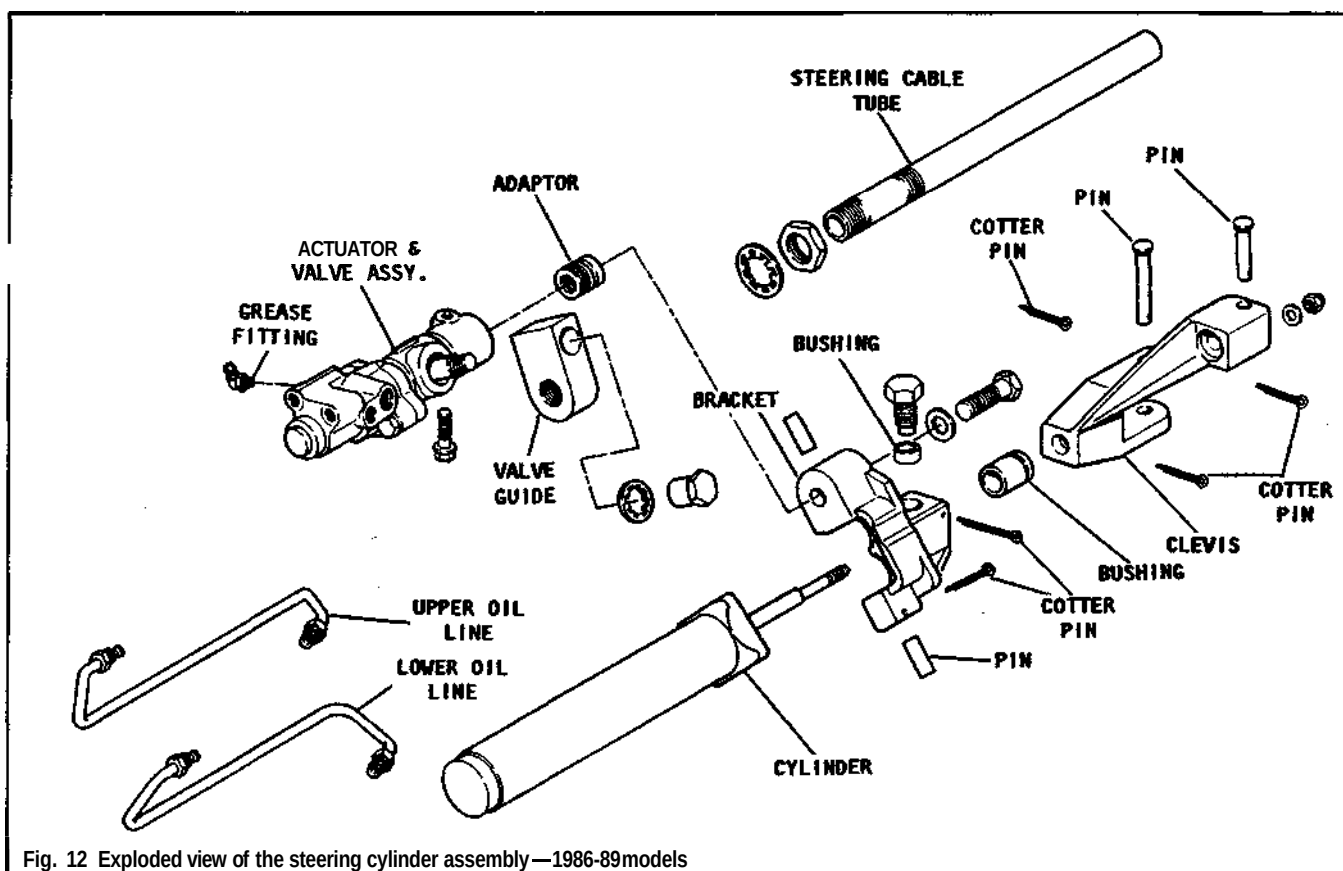


Fig. 12 Exploded view of the steering cylinder assembly—1986-89 models

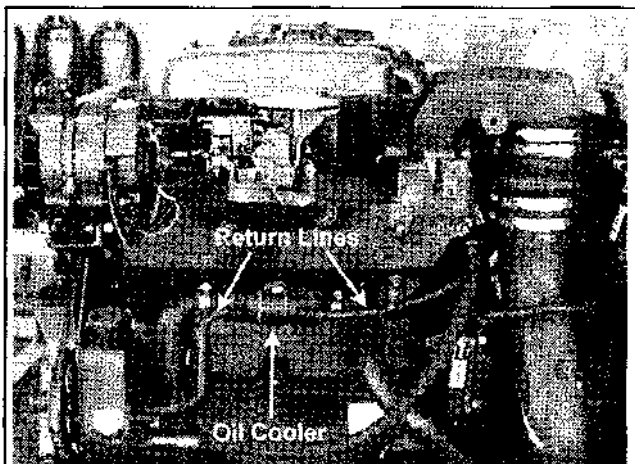
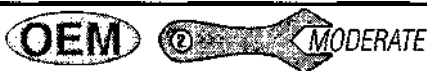


Fig. 13 Power steering cooler

13. Install and adjust the drive belt.
14. Fill the reservoir with power steering fluid and bleed the system.

Steering Cable

REMOVAL & INSTALLATION



- ◆ See Figures 19, 20 and 21

The steering cable is serviced as an assembly only.

1. Turn the steering wheel hard over to port until it reaches full lock.
2. Locate the end of the steering cable at the control valve/cylinder on the transom. Pull out the cotter pin securing the bottom of the clevis pin holding the cable ram to the guide tube. Remove the clevis pin.

There are two clevis pins in the guide clevis—the larger one in the center cut-out is for the steering arm, while the smaller one on the port side end is for the cable ram.

3. Secure the steering tube with a wrench (22mm) and then loosen the cable anchor nut at the control valve. Disconnect the cable and pull it out of the valve.

4. Disconnect the cable at the helm and remove it.

To Install:

5. Clean the control valve assembly thoroughly and inspect carefully for cracks, wear or other damage.

6. Connect the new cable to the helm as per the cable manufacturer's instructions and run it back through the boat.

7. Turn the steering wheel until the steering cable ram is extended to its full length and then coat the ram liberally with OMC Water Repellent Grease over its entire length.

8. Now retract the ram into the cable casing, feed the end of the ram through the valve while holding the anchor nut back so that the cable seats into the end of the valve.

9. Press the cable tightly against the valve and then thread on the anchor nut until it bottoms against the end of the tube.

10. Hold the cable guide tube at the flat near the valve with a 22mm wrench. Attach a 90 deg. crow'sfoot wrench to a torque wrench and then tighten the anchor nut to 120 inch lbs. (14 Nm).

On 1986-89 models hold the jam nut, not the tube itself.

11. Position the steering ram eyelet so it lines up with the hole in the assembly and then insert the clevis pin from the top. Install a new cotter pin and bend over the arms.

12. Turn the steering wheel from lock-to-lock, extending and retracting the cable ram. The steering lever should move from stop-to-stop without coming in contact with the cut-out in the transom. Check that the steering arm has equal clearance at each stop and that it is centered when the wheel is centered.

13. Center the steering wheel and confirm that the steering lever is centered in the drive unit.

14. Check the fluid level and bleed the system.

14-8 STEERING SYSTEMS

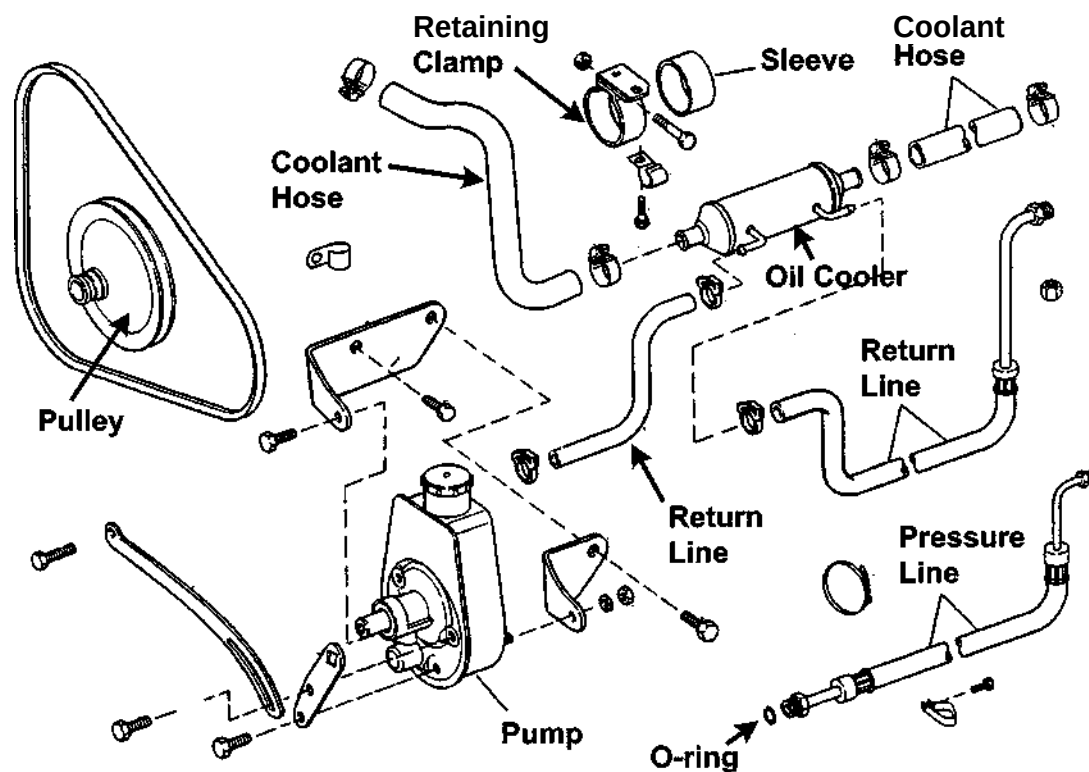


Fig. 14 Power steering pump and related components—3.0L engines (typical)

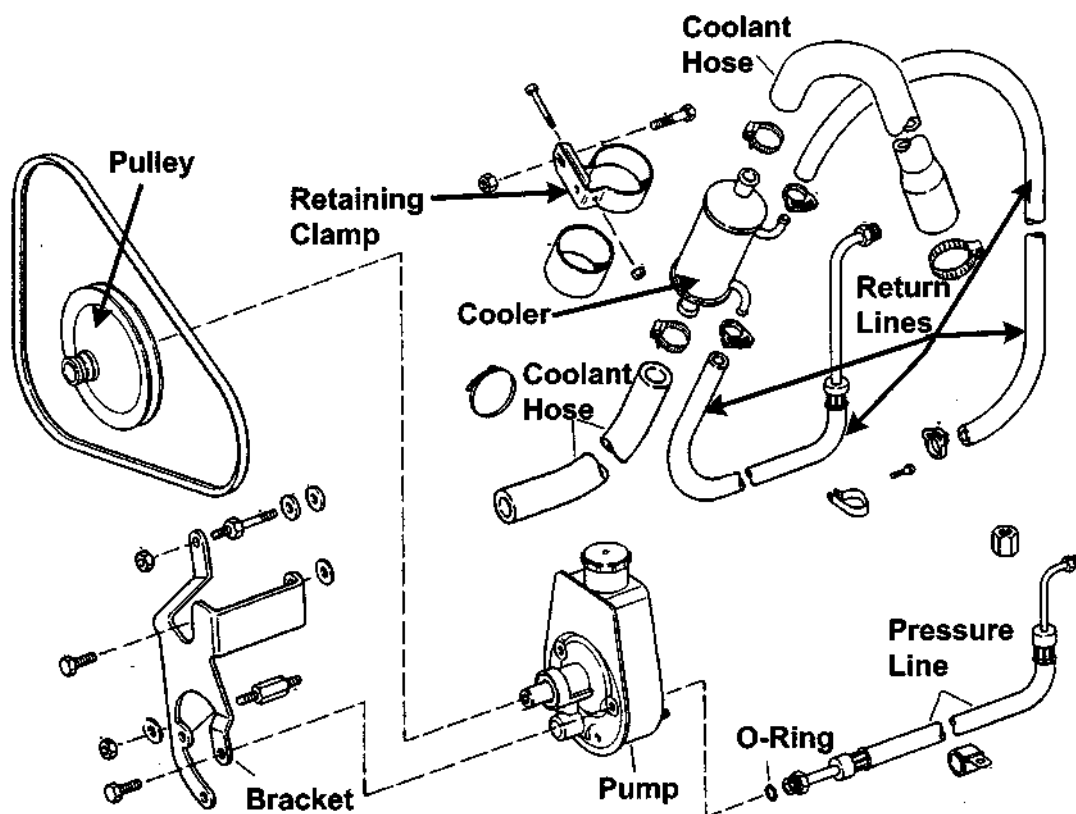


Fig. 15 Power steering pump and related components—V6/V8 GM engines (typical)