Timing Belt

INSPECTON

EASY

◆ **See Figure 130**

Timing belts are only used on 6 hp (128cc), 8 hp, 9.9/15 hp and 60/70 hp 4-stroke motors covered here. Of the 4-stroke motors not mentioned, the smallest instead utilize a gear driven camshaft, while the rest of the motors 25 hp and larger that weren't mentioned utilize a timing chain (or gear drive such as in the case of the 25 hp V2). One advantage of the gear or chain set-ups is that they are maintenance free and are generally considered lifetime components. Should a timing chain stretch to the point where the automatic tensioner cannot compensate you will usually hear an audible tapping and/or notice timing/performance problems which would lead you to diagnose the problem further.

The one great advantage of the timing BELT is that it can be inspected or replaced with a relatively simple procedure, compared to the gear or chain assembly (some of which are mounted on the bottom of the powerhead) which requires at least a partial disassembly of the powerhead.

That said, the timing belt is in fact a long life component that does not require much in the way or service, but we would recommend that you inspect it **at least** once every year. Also, the manufacturer provides a recommended replacement interval of about every 4 years or 800 hours of operation, whichever comes first. Keep in mind, a timing belt that breaks or even slips a tooth will likely disable the motor, possibly stranding the boat. The 60/70 hp 4-strokes are INTERFERENCE motors, meaning that a severely slipped or a broken belt could cause SEVERE engine damage. Don't play with fire.

On some versions of 9.9/15 hp motor, the timing belt is visible at one point in the manual starter cover. On most 6 hp (128cc) and 8 hp motors the belt is partially visible under the manual starter cover, but a thorough inspection is much easier once the manual starter cover and/or assembly is removed. For 60/70 hp (1298cc) models, the flywheel cover must be removed to inspect the belt.

1. For safety when working around the flywheel, disconnect the negative battery cable and/or disconnect the leads from the spark plugs, then ground the leads on the powerhead.

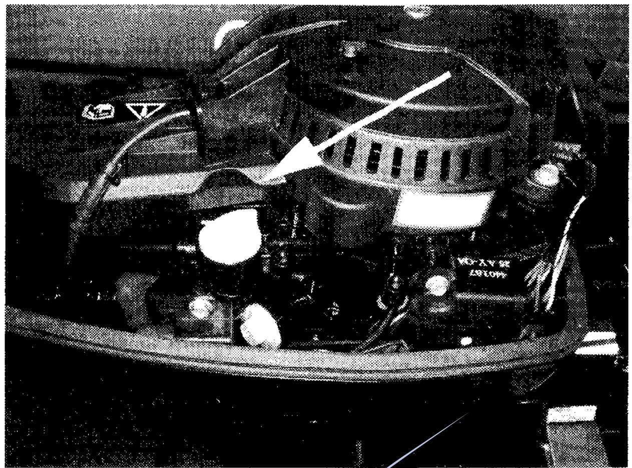

Fig. 130 Although the timing belt is partially visible on most 4-strokes, thorough inspection requires cover removal

■ **Although not absolutely necessary for this procedure, it is a good idea to remove the spark plugs at this time. Removing the spark plugs will relieve engine compression, making it easier to manually rotate the motor. Also, it presents a good opportunity to inspect, clean and/or replace the plugs.**

2. Remove the manual starter assembly or the flywheel cover, as applicable for better access to the timing belt.

3. Use low-pressure compressed air to blow debris out from under the camshaft pulley, flywheel and timing belt.

4. Visually check the belt for worn, cracked or oil soaked surfaces. Slowly rotate the flywheel (by hand) while inspecting all of the timing belt cogs.

5. Visually check the camshaft pulley and flywheel teeth for worn, cracked, chipped or otherwise damaged surfaces.

6. If the belt and or pulleys are damaged, replace them as described under Powerhead in this manual.

7. If removed, install the manual starter assembly or flywheel cover to the powerhead.

8. Install the spark plugs, then connect the leads followed by the negative battery cable and the engine cover.

BOAT MAINTENANCE

Batteries

◆ **See Figures 131 and 132**

Batteries require periodic servicing, so a definite maintenance program will help ensure extended life.

A failure to maintain the battery in good order can prevent it from properly charging or properly performing its job even when fully charged. Low levels of electrolyte in the cells, loose or dirty cable connections at the battery terminals or possibly an excessively dirty battery top can all contribute to an improperly functioning battery. So battery maintenance, first and foremost, involves keeping the battery full of electrolyte, properly charged and keeping the casing/connections clean of corrosion or debris.

If a battery charges and tests satisfactorily but still fails to perform properly in service, one of three problems could be the cause.

1. An accessory left on overnight or for a long period of time can discharge a battery.

■ **The Engine Control Unit (ECU) on fuel-injected motors will continue to draw a small amount of current from the battery, even when the motor is shut off. Although it will takes weeks to discharge a fully charged battery, periodically recharging the battery, or isolating it by disconnecting the cables or shutting off the battery switch when the boat is dockside or on the trailer will prevent this.**

2. Using more electrical power than the stator assembly or lighting coil can replace would slowly drain the battery during motor operation, resulting in an undercharged condition.

3. A defect in the charging system. A faulty stator assembly or lighting coil, defective regulator or rectifier or high resistance somewhere in the system could cause the battery to become undercharged.

MAINTENANCE

EASY

◆ **See Figures 132 thru 136**

Electrolyte Level

The most common and important procedure in battery maintenance is checking the electrolyte level. On most batteries, this is accomplished by removing the cell caps and visually observing the level in the cells. The bottom of each cell has a split vent which will cause the surface of the electrolyte to appear distorted when it makes contact. When the distortion first appears at the bottom of the split vent, the electrolyte level is correct. Smaller marine batteries are sometimes equipped with translucent cases that are printed or embossed with high and low level markings on the side. On some of these, shining a flashlight through the battery case will help make it easier to determine the electrolyte level.

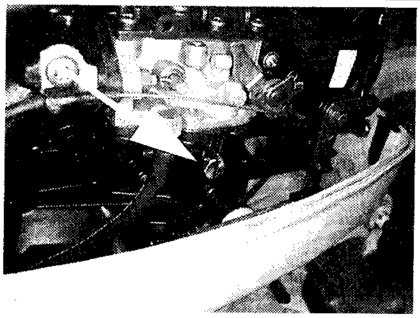
Fig. 2 Carburetor float bowls are normally equipped with a drain screw

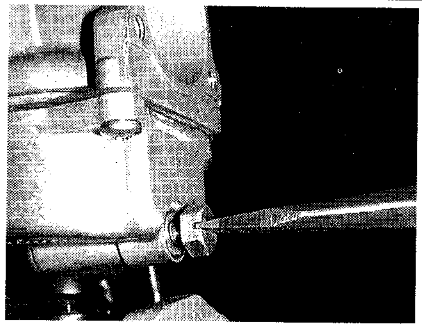
Fig. 3 To drain the carburetor, remove the drain screw. . .

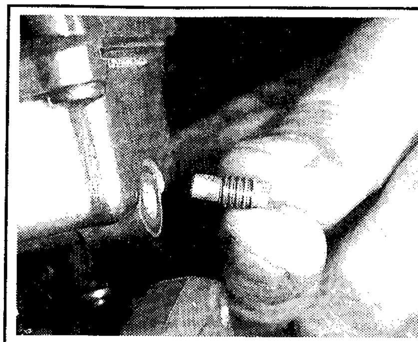
Fig. 4 . . .and, if equipped, the orifice plug from the float bowl

Fig. 5 Commercial additives, such as Sta-bil, may be used to help prevent “souring”

■ **The best method of disposing stale fuel is through a hazardous waste pickup service, automotive repair facility or marina that recycles. But, this can be a hassle. If fuel is not too stale or too badly contaminated, it may be mixed with greater amounts of fresh fuel and used to power lawn/yard equipment or even an automobile (if greatly diluted so as to prevent misfiring, unstable idle or damage to the automotive engine). But we feel that it is much less of a hassle to have a lawn mower stop running because of the fuel problem than it is to have your boat motor quit or refuse to start.**

Most carburetors are equipped with a float bowl drain screw that can be used to drain fuel from the carburetor for storage or for inspection. Some models are equipped with an orifice plug behind the drain screw and this must usually be removed as well. For EFI models, a fuel system drain is normally found on the vapor separator tank, but access to the drain may require removal of the intake manifold or other interfering components (depending upon the model).

For some motors, it may be easier to drain a fuel sample from the hoses leading to or from the low pressure fuel filter or fuel pump. Removal and installation instructions for the fuel filters are provided in the Maintenance Section, while fuel pump procedures are found in this section. To check for stale or contaminated fuel:

1. Disconnect the negative battery cable for safety. Secure it or place tape over the end so that it cannot accidentally contact the terminal and complete the circuit.

✱✱ CAUTION

Throughout this procedure, clean up any spilled fuel to prevent a fire hazard.

2. On carbureted motors, remove the float bowl drain screw (and orifice plug, if equipped), then allow a small amount of fuel to drain into a glass container.

■ **If there is no fuel present in the carburetor, disconnect the inlet line from the fuel pump and use the fuel primer bulb to obtain a sample as on EFI motors.**

3. On EFI motors, disconnect the fuel supply hose from the pump or low pressure fuel filter (as desired), then squeeze the fuel primer bulb to obtain a small sample of fuel. Place the sample in a clear glass container and reconnect the hose.

■ **If a sample cannot be obtained from the fuel filter or pump supply hose, there is a problem with the fuel tank-to-motor fuel circuit. Check the tank, primer bulb, fuel hose, fuel pump, fitting or inlet needle on carbureted models.**

4. Check the appearance and odor of the fuel. An unusual smell, signs of sediment/debris or a cloudy appearance (or even the obvious presence of water) points to a fuel that should be replaced.

5. If contaminated fuel is found, drain the fuel system and dispose of the fuel in a responsible manner, then clean the entire fuel system. On EFI models, this includes draining the vapor separator tank, then properly draining the high-pressure fuel system by relieving system pressure according to the instructions in this section.

■ **If debris is found in the fuel system, clean and/or replace all fuel filters.**

6. When finished, reconnect the negative battery cable, then properly pressurize the fuel system and check for leaks.

Fuel System Pressurization

When it comes to safety and outboards, the condition of the fuel system is of the utmost importance. The system must be checked for signs of damage or leakage with every use and checked, especially carefully when portions of the system have been opened for service.

The best method to check the fuel system is to visually inspect the lines, hoses and fittings once the system has been properly pressurized.

Furthermore, EFI motors are equipped with two inter-related fuel circuits, a low pressure circuit that is similar to the circuit that feeds carburetors on other motors and a high pressure circuit that feeds the fuel injection system. As its name implies, the high pressure circuit contains fuel under pressure that, if given the chance, will spray from a damaged/loose hose or fitting. When servicing components of the high pressure system, the fuel pressure must first be relieved in a safe and controlled manner to help avoid the potential explosive and dangerous conditions that would result from simply opening a fitting and allowing fuel to spray uncontrolled into the work area.

RELIEVING FUEL SYSTEM PRESSURE (EFI MOTORS ONLY)

2 MODERATE

Before servicing the high pressure fuel circuit or related components, including the vapor separator tank, high pressure filter, fuel rail, injector and related lines, the pressure must be released. Failure to do so in a proper manner could lead to high pressure fuel spray, excessive concentrations of vapors and an extremely dangerous, potentially explosive condition.

40/50 Hp EFI Models

1. Turn the key switch to **OFF**.
2. Tag, then disconnect the wiring (primary lead wire) from each ignition coil.
3. Disconnect the high pressure fuel pump wiring from the top of the vapor separator (just above the intake manifold and just a bit in front of the high-pressure filter) by pushing down on the connector's lock tab, then pulling the connector free.
4. Use the key switch to crank the engine in 3 second bursts for 5-10 times. This will dissipate the fuel pressure in the lines. After the first couple of bursts, start squeezing the high pressure line to determine when the pressure is released. Once the hose is soft to the touch, crank the engine a few more times to ensure pressure is gone.

■ **Even after most or all of the pressure has been dissipated, there may still be some liquid fuel left in the lines. Always wrap a shop rag around fittings before they are disconnected to catch any escaping fuel.**

5. Unless necessary for service procedures or for safety, reconnect the ignition coil primary leads.
6. Disconnect the negative battery cable for safety during service, and/or leave the fuel pump wiring disconnected until the maintenance or repairs have been completed.

■ **We still recommend disconnecting the negative battery cable, especially if any work will be one or around electrical components. Any work on or near the gearcase, propeller or other potentially hazardous moving parts is also good reason to keep the battery disconnected.**

7. After maintenance or repairs are finished, fully pressurize the high and low pressure fuel circuits and thoroughly check the system for leakage.

60/70 Hp EFI Models

1. Turn the key switch to **OFF**.
2. Disconnect the negative battery cable for safety during service and leave it disconnected until the maintenance or repairs have been completed.
3. Locate the high pressure fuel rail (fuel delivery pipe) on the side of the cylinder head. At the top of the fuel rail is a pipe plug, cover the pipe plug and then slowly and carefully loosen it 2-3 turns to gradually allow the pressure in the line to bleed off (spray into the rag). Wipe up [illegible] any fuel which is not caught by the rag.

✳✳ CAUTION

When releasing fuel pressure using the screw plug on top of the fuel rail, use extreme caution to prevent fuel from spraying uncontrolled into the work area. There must be NO open flames, sparks or other sources of ignition. It is imperative that there is proper ventilation in order to dissipate vapors. Wear safety glasses to protect your eyes, gloves to protect your skin and, finally, keep an extra rag handy, as one might not do the trick.

4. Check that fuel pressure has been released by pinching the high pressure fuel hose connected to the bottom of the rail to feel that is has softened. Back the plug out further to confirm, then tighten the plug to 29 ft. lbs. (40 Nm).

■ **Even after most or all of the pressure has been dissipated, there may still be some liquid fuel left in the lines. Always wrap a shop rag around fittings before they are disconnected to catch any escaping fuel.**

■ **We still recommend disconnecting the negative battery cable, especially if any work will be one or around electrical components. Any work on or near the gearcase, propeller or other potentially hazardous moving parts is also good reason to keep the battery disconnected.**

5. After maintenance or repairs are finished, fully pressurize the high and low pressure fuel circuits and thoroughly check the system for leakage.

90/115/140 Hp EFI Models

1. Turn the key switch to **OFF**.
2. Tag, then disconnect the wiring (primary lead wire) from each ignition coil.
3. Disconnect the high pressure fuel pump wiring from the top of the vapor separator (you should be able to access it between the top two runners of the intake manifold) by pushing down on the connector's lock tab, then pulling the connector free.
4. Use the key switch to crank the engine in 3 second bursts for 5-10 times. This will dissipate the fuel pressure in the lines. After the first couple of bursts, start squeezing the high pressure line (attached to the top of the fuel rail) to determine when the pressure is released. Once the hose is soft to the touch, crank the engine a few more times to ensure pressure is gone.

■ **Even after most or all of the pressure has been dissipated, there may still be some liquid fuel left in the lines. Always wrap a shop rag around fittings before they are disconnected to catch any escaping fuel.**

5. Unless necessary for service procedures or for safety, reconnect the ignition coil primary leads.
6. Disconnect the negative battery cable for safety during service, and/or leave the fuel pump wiring disconnected until the maintenance or repairs have been completed.

■ **We still recommend disconnecting the negative battery cable, especially if any work will be one or around electrical components. Any work on or near the gearcase, propeller or other potentially hazardous moving parts is also good reason to keep the battery disconnected.**

7. After maintenance or repairs are finished, fully pressurize the high and low pressure fuel circuits and thoroughly check the system for leakage.

200/225/250 Hp EFI Models

1. Turn the key switch to **OFF**.
2. Tag, then disconnect the wiring (primary lead wire) from each ignition coil.
3. Disconnect the high pressure fuel pump wiring from the top of the vapor separator.
4. Use the key switch to crank the engine in 3 second bursts for 5-10 times. This will dissipate the fuel pressure in the lines. After the first couple of bursts, start squeezing the high pressure line (running into the high pressure filter on top of the powerhead) to determine when the pressure is released. Once the hose is soft to the touch, crank the engine a few more times to ensure pressure is gone.

■ **Even after most or all of the pressure has been dissipated, there may still be some liquid fuel left in the lines. Always wrap a shop rag around fittings before they are disconnected to catch any escaping fuel.**

5. Unless necessary for service procedures or for safety, reconnect the ignition coil primary leads.
6. Disconnect the negative battery cable for safety during service, and/or leave the fuel pump wiring disconnected until the maintenance or repairs have been completed.

■ **We still recommend disconnecting the negative battery cable, especially if any work will be one or around electrical components. Any work on or near the gearcase, propeller or other potentially hazardous moving parts is also good reason to keep the battery disconnected.**

7. After maintenance or repairs are finished, fully pressurize the high and low pressure fuel circuits and thoroughly check the system for leakage.

PRESSURIZING THE FUEL SYSTEM (CHECKING FOR LEAKS)

① EASY

✳✳ CAUTION

Fuel leaking from a loose, damaged or incorrectly installed hose or fitting may cause a fire or an explosion. ALWAYS pressurize the fuel system and run the motor while inspecting for leaks after servicing any component of the fuel system.

Carbureted Models

Carbureted engines covered by this manual are only equipped with a low pressure fuel system, making pressure release before service a non-issue. But, even a low pressure fuel system should be checked following repairs to make sure that no leaks are present. Only by checking a fuel system under normal operating pressures can you be sure of the system's integrity.

UNDERSTANDING AND TROUBLESHOOTING ELECTRICAL SYSTEMS

Basic Electrical Theory

◆ **See Figure 1**

For any 12-volt, negative ground, electrical system to operate, the electricity must travel in a complete circuit. This simply means that current (power) from the positive terminal (+) of the battery must eventually return to the negative terminal (-) of the battery. Along the way, this current will travel through wires, fuses, switches and components. If, for any reason, the flow of current through the circuit is interrupted, the component fed by that circuit would cease to function properly.

Perhaps the easiest way to visualize a circuit is to think of connecting a light bulb (with two wires attached to it) to the battery - one wire attached to the negative (-) terminal of the battery and the other wire to the positive (+) terminal. With the two wires touching the battery terminals, the circuit would be complete and the light bulb would illuminate. Electricity would follow a path from the battery to the bulb and back to the battery. It's easy to see that with wires of sufficient length, our light bulb could be mounted nearly anywhere on the boat. Further, one wire could be fitted with a switch inline so that the light could be turned on and off without having to physically remove the wire(s) from the battery.

The normal marine circuit differs from this simple example in two ways. First, instead of having a return wire from each bulb to the battery, the current travels through a single ground wire that handles all the grounds for a specific circuit. Secondly, most marine circuits contain multiple components that receive power from a single circuit. This lessens the overall amount of wire needed to power components.

HOW DOES ELECTRICITY WORK: THE WATER ANALOGY

Electricity is the flow of electrons - the sub-atomic particles that constitute the outer shell of an atom. Electrons spin in an orbit around the center core of an atom. The center core is comprised of protons (positive charge) and neutrons (neutral charge). Electrons have a negative charge and balance out the positive charge of the protons. When an outside force causes the number of electrons to unbalance the charge of the protons, the electrons will split off the atom and look for another atom to balance out. If this imbalance is kept up, electrons will continue to move and an electrical flow will exist.

Many people find electrical theory easier to understand when using an analogy with water. In a comparison with water flowing through a pipe, the electrons would be the water and the wire is the pipe.

The flow of electricity can be measured much like the flow of water through a pipe. The unit of measurement used is amperes, frequently abbreviated as amps (a). You can compare amperage to the volume of water flowing through a pipe (for water that would be a measurement of mass usually measured in units delivered over an amount of time such as gallons or liters per minute). When connected to a circuit, an ammeter will measure the actual amount of current flowing through the circuit. When relatively few electrons flow through a circuit, the amperage is low. When many electrons flow, the amperage is high.

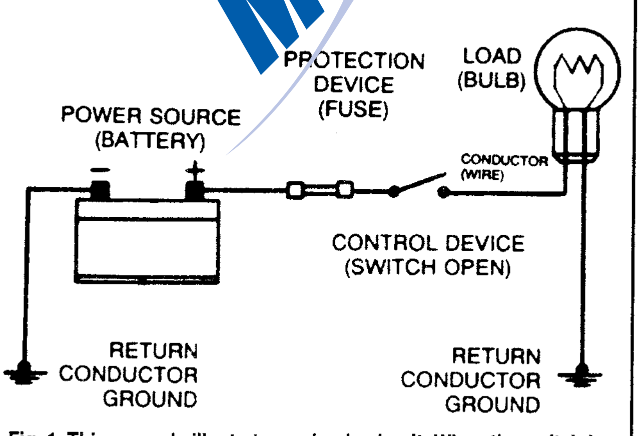

Fig. 1 This example illustrates a simple circuit. When the switch is closed, power from the positive (+) battery terminal flows through the fuse and the switch, and then to the light bulb. The electricity illuminates the bulb and the circuit is completed through the ground wire back to the negative (-) battery terminal.

Water pressure is measured in units such as pounds per square inch (psi). The electrical pressure is measured in units called volts (V). When a voltmeter is connected to a circuit, it is measuring the electrical pressure.

The actual flow of electricity depends not only on voltage and amperage, but also on the resistance of the circuit. The higher the resistance, the higher the force necessary to push the current through the circuit. The standard unit for measuring resistance is an ohm (<omega>). Resistance in a circuit varies depending on the amount and type of components used in the circuit. The main factors that determine resistance are:

- Material - some materials have more resistance than others. Those with high resistance are said to be insulators. Rubber materials (or rubber-like plastics) are some of the most common insulators used, as they have a very high resistance to electricity. Very low resistance materials are said to be conductors. Copper wire is among the best conductors. Silver is actually a superior conductor to copper and is used in some relay contacts, but its high cost prohibits its use as common wiring. Most marine wiring is made of copper.
- Size - the larger the wire size being used, the less resistance the wire will have (just as a large diameter pipe will allow small amounts of water to just trickle through). This is why components that use large amounts of electricity usually have large wires supplying current to them.
- Length - for a given thickness of wire, the longer the wire, the greater the resistance. The shorter the wire, the less the resistance. When determining the proper wire for a circuit, both size and length must be considered to design a circuit that can handle the current needs of the component.
- Temperature - with many materials, the higher the temperature, the greater the resistance (positive temperature coefficient). Some materials exhibit the opposite trait of lower resistance with higher temperatures (these are said to have a negative temperature coefficient). These principles are used in many engine control sensors (especially those found on EFI systems).

OHM'S LAW

There is a direct relationship between current, voltage and resistance. The relationship between current, voltage and resistance can be summed up by a statement known as Ohm's law.

Voltage (E) is equal to amperage (I) times resistance ®: E=I x R

Other forms of the formula are R=E/I and I=E/R

In each of these formulas, E is the voltage in volts, I is the current in amps and R is the resistance in ohms. The basic point to remember is that if the voltage of a circuit remains the same, as the resistance of that circuit goes up, the amount of current that flows in the circuit will go down.

The amount of work that electricity can perform is expressed as power. The unit of power is the watt (W). The relationship between power, voltage and current is expressed as:

Power (W) is equal to amperage (I) times voltage (E): W=I x E

This is only true for direct current (DC) circuits; the alternating current formula is a tad different, but since the electrical circuits in most vessels are DC type, we need not get into AC circuit theory.

Electrical Components

POWER SOURCE

◆ **See Figure 2**

Typically, power is supplied to a vessel by two devices: The battery and the stator (or battery charge coil). The stator supplies electrical current anytime the engine is running in order to recharge the battery and in order to operate electrical devices of the vessel. The battery supplies electrical power during starting or during periods when the current demand of the vessel's electrical system exceeds stator output capacity (which includes times when the motor is shut off and stator output is zero).

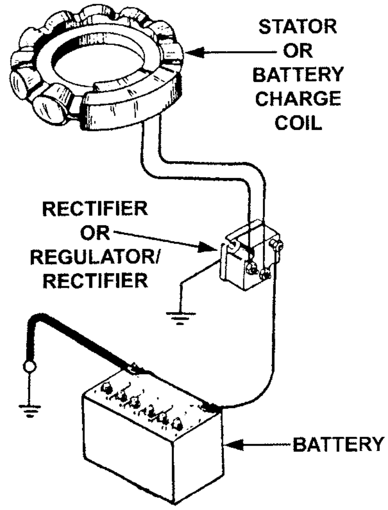

Fig. 2 Functional diagram of a typical charging circuit showing the relationship between the stator (battery charge coil), rectifier (or regulator/rectifier) and battery

The Battery

In most modern vessels, the battery is a lead/acid electrochemical device consisting of six 2-volt subsections (cells) connected in series, so that the unit is capable of producing approximately 12 volts of electrical pressure. Each subsection consists of a series of positive and negative plates held a short distance apart in a solution of sulfuric acid and water.

The two types of plates in each battery cell are of dissimilar metals. This sets up a chemical reaction, and it is this reaction which produces current flow from the battery when its positive and negative terminals are connected to an electrical load. Power removed from the battery in use is replaced by current from the stator and restores the battery to its original chemical state.

The Stator

Alternators and generators are devices that consist of coils of wires wound together making big electromagnets. The coil is normally referred to as a stator or battery charge coil. Either, one group of coils spins within another set (or a set of permanently charged magnets, usually attached to the flywheel, are spun around a set of coils) and the interaction of the magnetic fields generates an electrical current. This current is then drawn off the coils and fed into the vessel's electrical system.

■ **Some older vessels utilize a generator instead of an alternator. Although the terms are often misused and interchanged, the main difference is that an alternator supplies alternating current that is changed to direct current for use on the vessel, while a generator produces direct current. Alternators tend to be more efficient and that is why they are used on almost all modern engines.**

GROUND

Two types of grounds are used in marine electric circuits. Direct ground components are grounded to the electrically conductive metal through their mounting points. All other components use some sort of ground wire that leads back to the battery. The electrical current runs through the ground wire and returns to the battery through the ground or negative (-) cable; if you look, you'll see that the battery ground cable connects between the battery and a heavy gauge ground wire.

■ **A large percentage of electrical problems can be traced to bad grounds.**

If you refer back to the basic explanation of a circuit, you'll see that the ground portion of the circuit is just as important as the power feed. The wires delivering power to a component can have perfectly good, clean connections, but the circuit would fail to operate if there was a damaged ground connection. Since many components ground through their mounting or through wires that are connected to an engine surface, contamination from dirt or corrosion can raise resistance in a circuit to a point where it cannot operate.

PROTECTIVE DEVICES

◆ **See Figure 3**

Problems can occur in the electrical system that will cause large surges of current to pass through the electrical system of your vessel. These problems can be the fault of the charging circuit, but more likely would be a problem with the operating electrical components that causes an excessively high load. An unusually high load can occur in a circuit from problems such as a seized electric motor (like a damaged starter) or the excessive resistance caused by a bad ground (from loose or damaged wires or connections). A short to ground that bypasses the load and allows the battery to quickly discharge through a wire can also cause current surges.

If this surge of current were to reach the load in the circuit, the surge could burn it out or severely damage it. It can also overload the wiring, causing the harness to get hot and melt the insulation. To prevent this, fuses, circuit breakers and/or fusible links are connected into the supply wires of the electrical system. These items are nothing more than a built-in weak spot in the system. When an abnormal amount of current flows through the system, these protective devices work as follows to protect the circuit:

- Fuse - when an excessive electrical current passes through a fuse, the fuse blows (the conductor melts) and opens the circuit, preventing current flow.
- Circuit Breaker - a circuit breaker is basically a self-repairing fuse. It will open the circuit in the same fashion as a fuse, but when the surge subsides, the circuit breaker can be reset and does not need replacement. Most circuit breakers on marine engine applications are self-resetting, but some that operate accessories (such as on larger vessels with a circuit breaker panel) must be reset manually (just like the circuit breaker panels in most homes).
- Fusible Link - a fusible link (fuse link or main link) is a short length of special, high temperature insulated wire that acts as a fuse. When an excessive electrical current passes through a fusible link, the thin gauge wire inside the link melts, creating an intentional open to protect the circuit. To repair the circuit, the link must be replaced. Some newer type fusible links are housed in plug-in modules, which are simply replaced like a fuse, while older type fusible links must be cut and spliced if they melt. Since this link is very early in the electrical path, it's the first place to look if nothing on the vessel works, yet the battery seems to be charged and is otherwise properly connected.

⁂ CAUTION

Always replace fuses, circuit breakers and fusible links with identically rated components. Under no circumstances should a component of higher or lower amperage rating be substituted. A lower rated component will disable the circuit sooner than necessary (possibly during normal operation), while a higher rated component can allow dangerous amounts of current that could damage the circuit or component (or even melt insulation causing sparks or a fire).

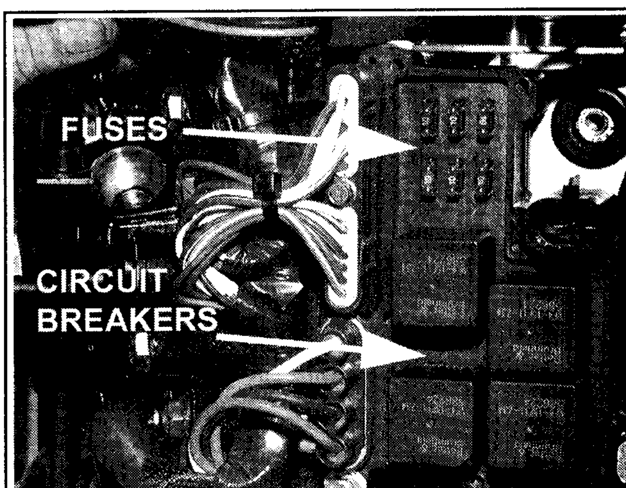

Fig. 3 Fuses and circuit breakers may be found in a central location, or mounted to individual holders in the wiring harness

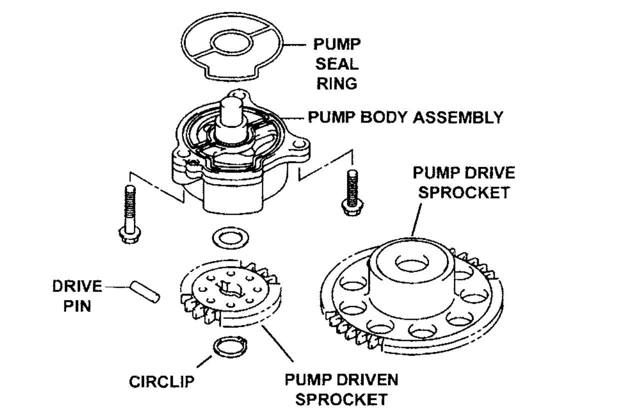

Fig. 56 Exploded view of the oil pump assembly - 90/115/140 hp EFI models

11. Install the oil pump drive sprocket to the exhaust cam. Tighten the retaining bolt to 56.5 ft. lbs. (78 Nm) while holding the camshaft from turning using the hex provided.

12. Finish installing the powerhead, but before installing the lower engine covers, connect the negative battery cable and install an oil pressure gauge, then perform a pressure test to ensure the pump is working properly.

13. After repairs and testing is completed, install the lower engine covers as detailed in the Engine Maintenance section.

200/225/250 Hp Models

③ DIFFICULT

◆ **See Figures 53, 54 and 57**

The oil pump assembly on 200/225/250 hp motors is not unlike th[illegible] on many other models with regards to mounting, basic design [illegible] For starters it is bolted to the underside of the powerhead and i[illegible] one of the camshafts. However, unique to the 90 hp and lar[illegible] motors is a configuration where in fact the pump is driven [illegible] mounted to one of the camshafts and not off the end [illegible] Additionally, just as with most other motors, the oil [illegible] that the powerhead must be removed for acce[illegible] de[illegible]gn itself uses a shaft to drive inner and outer rotors. B[illegible] much where the similarities end.

The pump is driven by a drive/driven [illegible] but not directly as with the 90 hp and larger inline [illegible] this motor uses a dedicated pump drive chain. Th[illegible] unique shape, designed specifically for use with thes[illegible] unlike most of the 4-strokes covered here Johns[illegible] time to provide specifications for pump overhaul, including [illegible] side clearances (just like they provide the same data for the 4[illegible] hp motors.

1. Disconnect the negative battery cable for safety.

2. For access, remove the powerhead from the gearcase. For details refer to the procedures in the Powerhead section.

3. On the Port side cylinder bank of 250 hp motors, remove the 4 bolts that secure the oil control valve (OCV), then remove the OCV and gasket.

4. On all models, loosen and remove the 11 bolts that secure the valve cover to the cylinder head, then remove the cover.

5. Remove the 5 bolts that secure the oil pump, then remove the pump keeping track of the shim washer that is mounted between the pump and driven gear, as it is free to fall away when the pump is removed.

6. If necessary, remove the drive gear and chain assembly as follows:

a. Remove the bolt that secures the tensioner assembly, then remove the oil pump chain tensioner and tensioner spring.

b. With the tensioner removed the pump driven gear can be freed from the drive chain.

✳✳ CAUTION

The oil pump DRIVE gear retaining bolt is LEFT-HAND THREADED! You must turn it CLOCKWISE to loosen it, and COUNTERCLOCKWISE to tighten it.

c. Using a wrench to hold the hex on the camshaft (located just inboard of the lobe closest to the sprockets) use a large wrench or suitable ratchet or breaker bar and socket to loosen the LEFT-HAND THREAD drive sprocket bolt. Remove the sprocket and drive chain.

d. Clean all parts in a suitable solvent. Check the sprocket teeth, the drive chain and the tensioner all for signs of excessive wear or damage.

7. If necessary, disassemble the pump as follows:

a. Remove the single Phillips head screw that secures the oil pump rotor plate to the back side of the oil pump case, then lift the plate for access to the rotors.

b. Check for the presence of the punch marks that should be on the rotors and, if you cannot locate them place matchmarks on the rotors to ensure they are reinstalled facing the same direction (i.e. with the same side facing the rotor plate). Lift out the [illegible]r and outer rotor from the pump case for cleaning and inspection.

c. To separate the inne[illegible] the shaft, remove the drive pin and slide the shaft free of t[illegible]

d. Use a suitable [illegible] clean the rotors and, if removed, the pressure relief va[illegible]nts. Use a lint free shop rag soaked in solvent to wipe the cove[illegible] case clean.

■ **Be ca[illegible]l no[illegible]emove the rotor matchmarks when cleaning or keep th[illegible]r and remark them once dry.**

[illegible] the rotors and the oil pump housing for worn, discolored or [illegible] surfaces.

[illegible] the inner and outer rotor into the oil pump housing, positioned [illegible] punch marks or matchmarks.

[illegible]sing a feeler gauge, measure the clearance between the outer rotor an[illegible] oil pump case (radial clearance). The rotors and case must be re[illegible]aced if clearance is greater than 0.0122 in. (0.31mm).

■ **Remember that when measuring clearance with a feeler gauge, the specified size (or smaller) gauge must pass through with a slight drag. A larger sized gauge must not fit or clearance is excessive.**

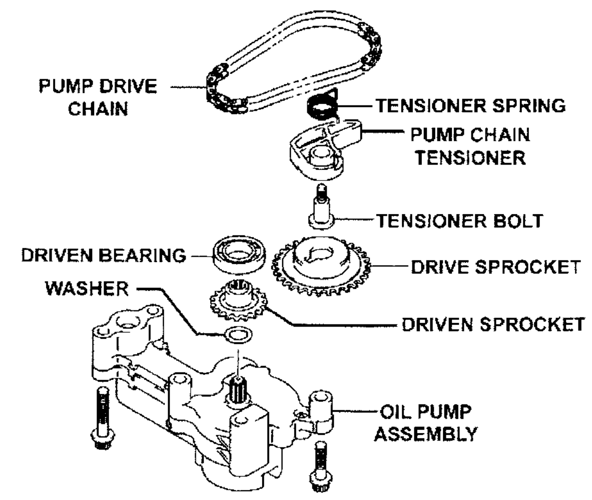

Fig. 57 Exploded view of the oil pump assembly - 200/225/250 hp EFI models

h. Measure the rotor-to-cover (plate) side clearance using a precision straightedge. Position the straightedge across the case and both rotors, then, while pushing downward on the straightedge, measure clearance between the straightedge and the outer rotor. The rotors and pump case must be replaced if clearance is greater than 0.0059 in. (0.15mm).

To install:

8. If the pump housing was disassembled, prepare it for installation as follows:

a. Coat the inner and outer rotors, as well as the inside of the pump case with clean 4-stroke engine oil.

b. Place the oil pump shaft through the inner rotor and install the drive pin.

c. Position the inner and outer rotors into the oil pump case making sure either the punch marks that were already there and/or your matchmarks made earlier are facing the rotor plate.

d. If removed, install the dowel pins, then install the rotor plate and tighten the screw securely.

e. Turn the rotors by hand using the pump shaft and ensure they turn freely without binding. If you feel any binding remove the plate again and check for misaligned or damaged components.

f. Locate the large oil passage at the far end of the pump from the rotor plate screw (surrounded by two bosses for pump mounting bolts) and pour about 1.7 oz (50ml) of fresh, clean 4-stroke engine oil into the pump case for initial lubrication.

9. If the pump drive chain and sprocket assembly was removed, install them now as follows:

a. Position the oil pump drive sprocket and chain to the exhaust camshaft. Hold the camshaft from turning and tighten the LEFT-HAND THREAD NUT COUNTERCLOCKWISE to 56 ft. lbs. (78 Nm).

b. Install the oil pump driven gear into the drive chain, then install the tensioner spring and chain tensioner to the assembly. Tighten the chain tensioner bolt securely.

10. Place the shim washer over the oil pump drive shaft and hold in position with a pair of needle-nose pliers or small screwdriver as you slide the oil pump into position on the powerhead. Make sure the pump shaft splines with the drive gear, then seat the pump and install the retaining bolts. Tighten the bolts to 17 ft. lbs. (23 Nm).

11. Install the cylinder head cover, as detailed in the powerhead section.

12. On 250 hp motors, install the OCV using a new gasket and tighten the retaining bolts securely.

13. Finish installing the powerhead, but before installing the lower engine covers, connect the negative battery cable and install an oil pressure gauge, then perform a pressure test to ensure the pump is functioning properly.

14. After repairs and testing is completed, install the lower engine covers as detailed in the Engine Maintenance section.

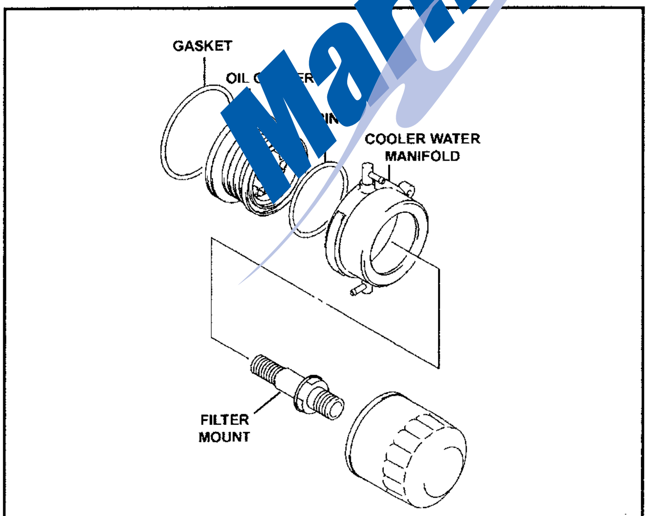

Fig. 58 Exploded view of the oil cooler assembly - 140 hp models

Oil Cooler

◆ **See Figures 58 and 59**

REMOVAL & INSTALLATION

The 140 hp EFI motor is equipped with an oil cooler integrated into the oil filter mount assembly. The purpose of the cooler is to minimize engine oil temperature while optimizing engine performance. Cooling water flow is directed from passages inside the engine holder through the cooler and back out to the return water hose.

1. Disconnect the negative battery cable for safety.

2. Remove the Starboard side lower engine cowling, as detailed in the Maintenance and Tune-Up section.

3. Remove the oil filter.

4. Tag and disconnect the outlet and inlet water hoses from the oil cooler.

5. Using a large socket and breaker bar over the hex of the oil filter mount, loosen and remove the oil filter mount and oil cooler assembly.

To install:

6. Install a new se[illegible] into the back of the oil cooler assembly.

7. Place the oil cooler assembly loosely on the cylinder block. Position a locating pin at the face of the rib in the cylinder block (just a hair above the 3 o'clock position relative to the oil cooler, then install the oil filter mount to secure the assembly. Tighten the oil filter mount hex to 29 ft. lbs. (40 Nm).

8. Reconnect the inlet and outlet water hoses to the fittings on the oil cooler (the inlet hose connects to the bottom of the assembly, while the [illegible] hose goes on top).

9. Install a new oil filter.

10. Connect the negative battery, provide a suitable source of cooling water and test run the powerhead looking for water or oil leaks.

11. Shut the powerhead down and install the Starboard engine cover.

Oil Pressure Switch and Warning System

For information on testing the oil pressure switch and warning LED and/or horn/buzzer circuitry, please refer to Warning System in the Ignition and Electrical System section.

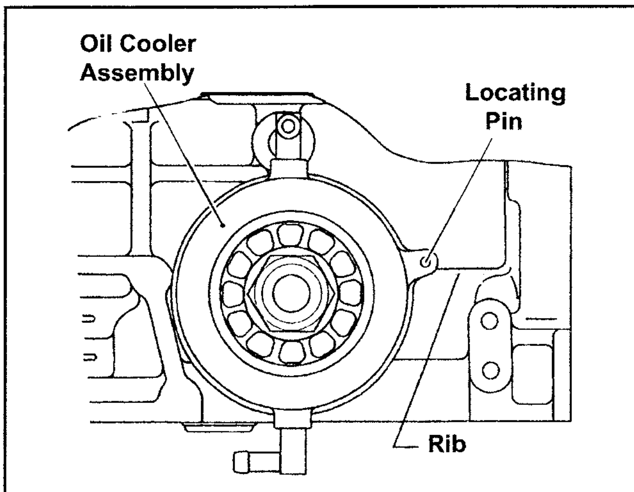

Fig. 59 During installation put a locating pin at the face of the block rib