MERCURY MARINER

SERVICE MANUAL

1965-1989

40-115 HP

QUICK MENU

CLICK FOR CHAPTER

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APPENDIX

2
TUNING

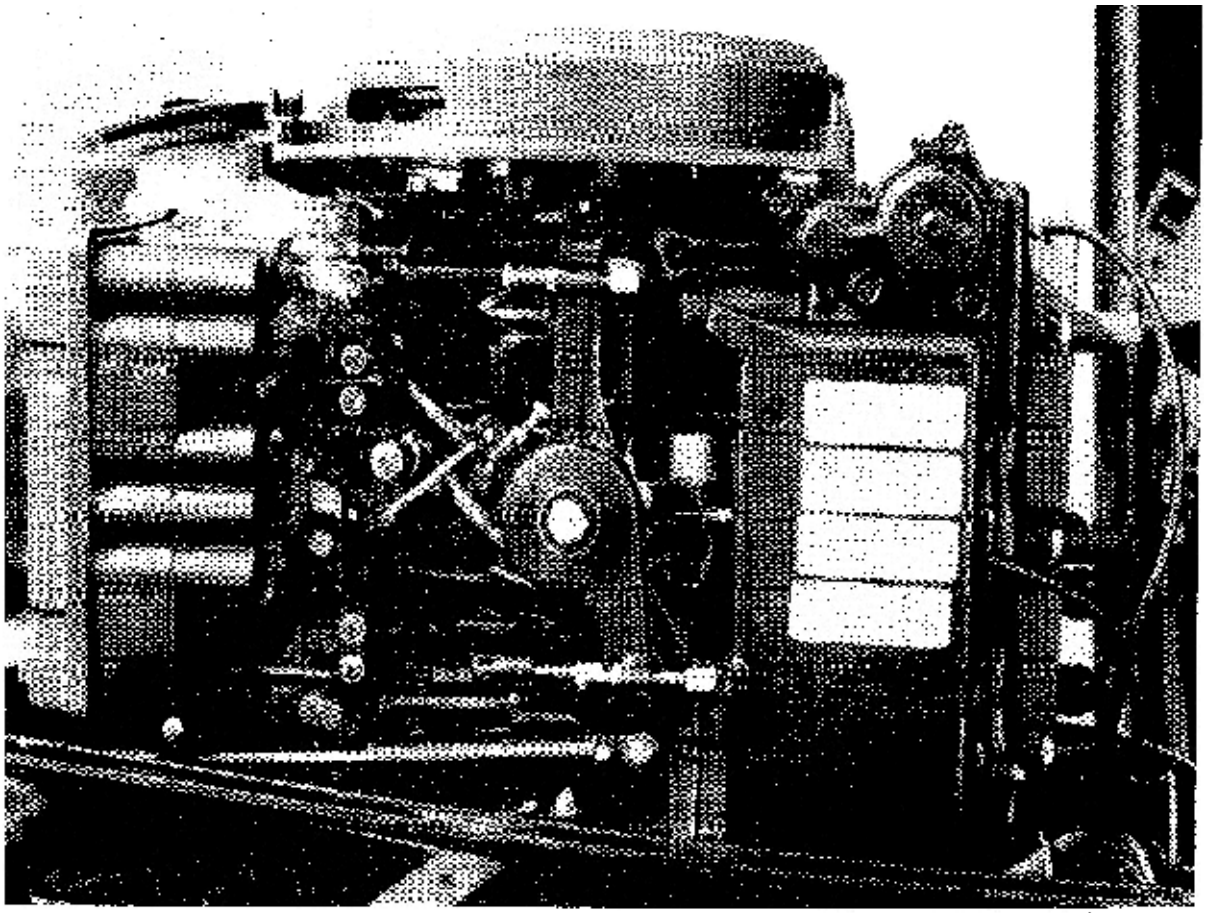
2-1 INTRODUCTION

The efficiency, reliability, fuel economy and enjoyment available from engine performance are all directly dependent on having it tuned properly. The importance of performing service work in the sequence detailed in this chapter cannot be over emphasized. Before making any adjustments, check the specifications in the Appendix. **NEVER** rely on memory when making critical adjustments.

Before beginning to tune any engine, check to be sure the engine has satisfactory compression. An engine with worn or broken piston rings, burned pistons, or scored cylinder walls, cannot be made to perform properly no matter how much time and expense is spent on the tune-up. Poor compression must be corrected or the tune-up will not give the desired results.

A practical maintenance program that is followed throughout the year, is one of the best methods of ensuring the engine will give satisfactory performance at any time.

The extent of the engine tune-up is usu-



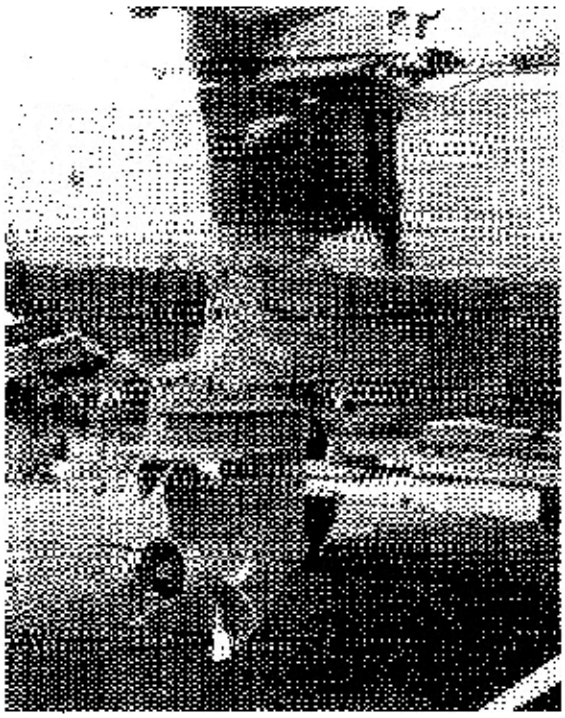
Portside of a 1991 60hp powerhead. A practical maintenance and tuning program followed throughout the year, is one of the best methods of ensuring the engine will give satisfactory performance at any time.

ally dependent on the time lapse since the last service. A complete tune-up of the entire engine would entail almost all of the work outlined in this manual. A logical sequence of steps will be presented in general terms. If additional information or detailed service work is required, the chapter containing the instructions will be referenced.

Each year higher compression ratios are built into modern outboard engines and the electrical systems become more complex, especially with electronic (capacitor discharge) units. Therefore, the need for reliable, authoritative, and detailed instructions becomes more critical. The information in this chapter and the referenced chapters fulfill that requirement.

2-2 TUNE-UP SEQUENCE

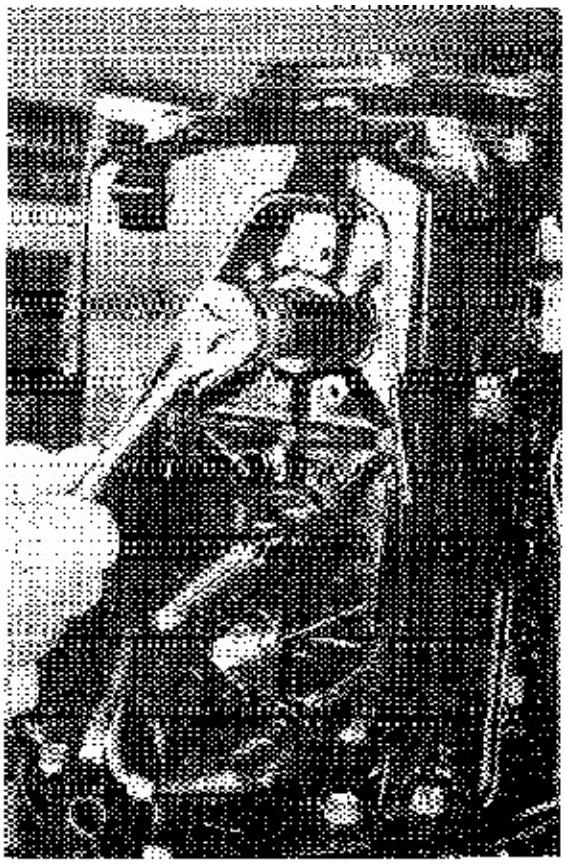
During a major tune-up, a definite sequence of service work should be followed to return the engine to the maximum performance desired. This type of work should not be confused with attempting to locate problem areas of "why" the engine is not performing satisfactorily. This work is classified as "trouble shooting". In many cases, these two areas will overlap, because many times a minor or major tune-up will correct the malfunction and return the system to normal operation.



A boat and lower unit covered with marine growth. Such a condition is a serious hinderance to performance and cannot be corrected by tuning the powerhead.

The following list is a suggested sequence of tasks to perform during the tune-up service work. The tasks are merely listed here. Generally procedures are given in subsequent sections of this chapter. For more detailed instructions, see the referenced chapter.

1- Perform a compression check of each cylinder. See Chapter 5.
2- Inspect the spark plugs to determine their condition. Test for adequate spark at the plug. See Chapter 5.
3- Start the engine in a body of water and check the water flow through the engine. See Chapter 10.
4- Check the gear oil in the lower unit. See Chapter 10.
5- Check the carburetor adjustments and the need for an overhaul. See Chapter 4.
6- Check the fuel pump for adequate performance and delivery. See Chapter 4.



Removing the spark plugs for inspection. Worn plugs are one of the major contributing factors to poor engine performance.

7- Make a general inspection of the ignition system. See Chapter 5.
8- Test the cranking motor and the solenoid. See Chapter 7.
9- Check the internal wiring.
10- Check the timing and synchronization. See Chapter 6.

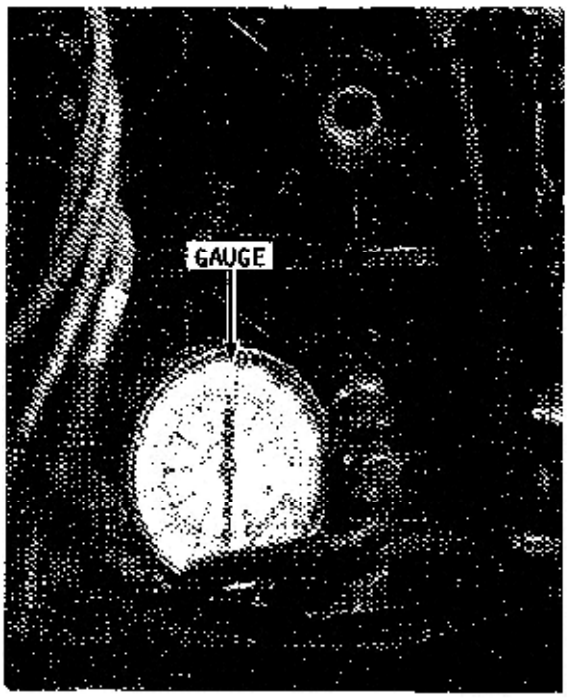
2-3 COMPRESSION CHECK

A compression check is extremely important, because an engine with low or uneven compression between cylinders **CANNOT** be tuned to operate satisfactorily. Therefore, it is essential that any compression problem be corrected before proceeding with the tune-up procedure. See Chapter 3.

If the powerhead shows any indication of overheating, such as discolored or scorched paint, inspect the cylinders visually thru the transfer ports for possible scoring. It is possible for a cylinder with satisfactory compression to be scored slightly. Also, check the water pump. The overheating condition may be caused by a faulty water pump.

Checking Compression

Remove the spark plug wires. **ALWAYS** grasp the molded cap and pull it loose with a twisting motion to prevent damage to the connection. Remove the spark plugs and keep them in **ORDER** by cylinder for evaluation later. Ground the spark plug leads to the engine to render the ignition system inoperative while performing the compression check.



A compression check should be taken in each cylinder before spending time and money on tune-up work. Without adequate compression, efforts in other areas to regain engine performance will be wasted.

Insert a compression gauge into the No. 1, top, spark plug opening. Crank the engine with the pull rope of the hand starter, thru at least 4 complete strokes with the throttle at the wide-open position, to obtain the highest possible reading. Record the highest reading. Repeat the test and record the compression for each cylinder. A variation between cylinders is far more important than the actual readings. A variation of more than 15 psi between cylinders indicates the lower compression cylinder is defective. The problem may be worn, broken, or sticking piston rings, scored pistons or worn cylinders.

Use of an engine cleaner will help to free stuck rings and to dissolve accumulated carbon. Follow the directions on the can.

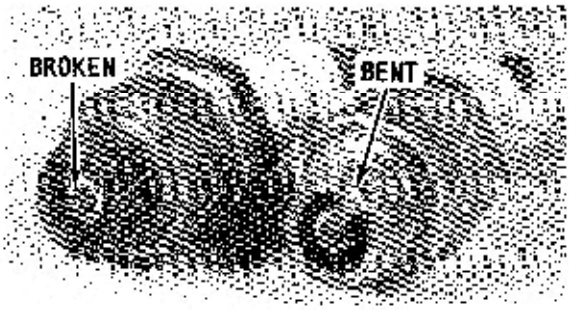
2-4 SPARK PLUG INSPECTION

Inspect each spark plug for badly worn electrodes, glazed, broken, blistered, or lead fouled insulators. Replace all of the plugs, if one shows signs of excessive wear.

Make an evaluation of the cylinder performance by comparing the spark condition with those shown in Chapter 5. Check each spark plug to be sure they are all of the same manufacturer and have the same heat range rating.

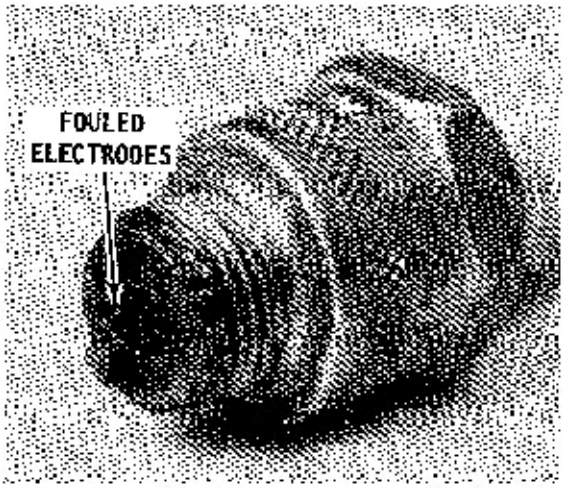
Inspect the threads in the spark plug opening of the block, and clean the threads before installing the plug.

When purchasing new spark plugs, **ALWAYS** ask the marine dealer if there has been a spark plug change for the engine being serviced.

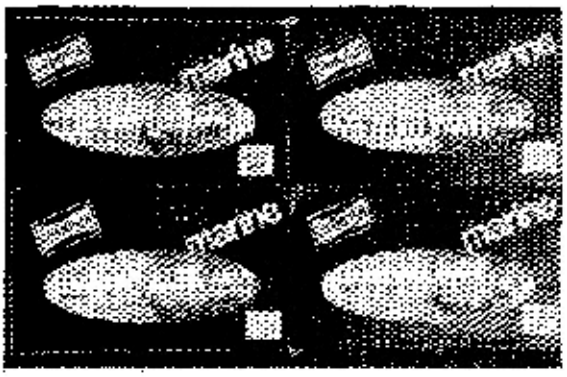


*Damaged spark plugs. Notice the broken electrode on the left plug. The broken part **MUST** be found and removed before returning the engine to service.*

2-4 TUNING



A fouled spark plug. The condition of this plug indicates problems in the cylinder which should be corrected.



*Today, numerous type spark plugs are available for service. **ALWAYS** check with the local marine dealer to be sure the proper plug is purchased for the unit being serviced.*

Crank the engine through several revolutions to blow out any material which might have become dislodged during cleaning.

Install the spark plugs and tighten them to a torque value of 20.5ft lb (27Nm). **ALWAYS** use a new gasket and wipe the seats in the block clean. The gasket must be fully compressed on clean seats to complete the heat transfer process and to provide a gas tight seal in the cylinder. If the torque value is too high, the heat will dissipate too rapidly. Conversely, if the torque value is too low, heat will not dissipate fast enough.

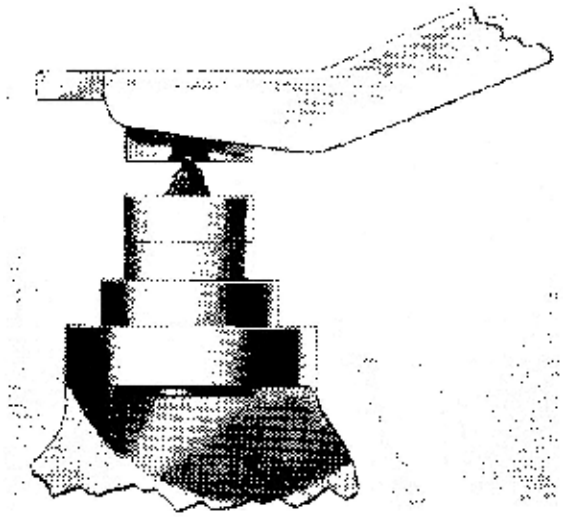
2-5 IGNITION SYSTEM

Five, yes five, different ignition systems are used on outboard engines covered in this manual. If the engine performance is less than expected, and the ignition is diagnosed as the problem area, refer to Chapter 5 for detailed service procedures. The various types are clearly identified and cross-referenced in the Appendix. Once the Type system for the powerhead being serviced is known, the work can proceed smoothly. To properly time and synchronize the ignition system with the fuel system, see Chapter 6.

Breaker Points

SOME GOOD WORDS: High primary voltage in Thunderbolt ignition systems will darken and roughen the breaker points within a short period. This is not cause for alarm. Normally points in this condition would not operate satisfactorily in the conventional magneto, but they will give good service in the Thunderbolt systems. Therefore, **DO NOT** replace the points in a Thunderbolt system unless an obvious malfunction exists, or the contacts are loose or burned. Rough or discolored contact surfaces are **NOT** sufficient reason for replacement. The cam follower will usually have worn away by the time the points have become unsatisfactory for efficient service.

Check the resistance across the contacts. If the test indicates zero resistance, the points are serviceable. A slight resistance across the points will affect idle operation. A high resistance may cause the ignition system to malfunction and loss of spark. Therefore, if any resistance across the points is indicated, the point set should be replaced.



Worn ignition points are a common problem area with units having a distributor with points.

2-6 TIMING AND SYNCHRONIZING

Correct timing and synchronization are essential to efficient engine operation. An engine may be in apparent excellent mechanical condition, but perform poorly, unless the timing and synchronization have been adjusted precisely, according to the Specifications in the Appendix. To time and synchronize the engine, see Chapter 6.

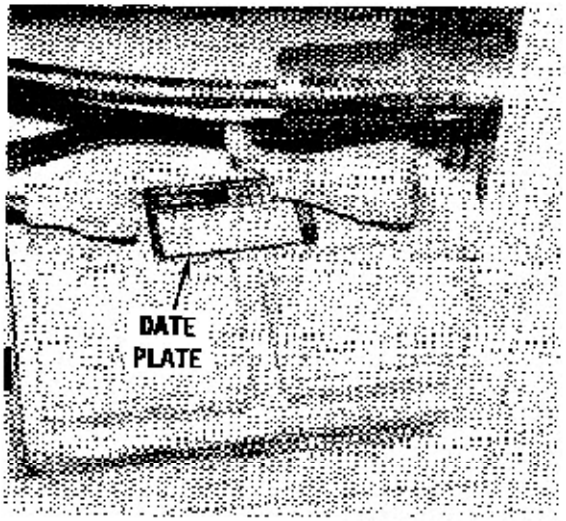
Battery Check

Inspect and service the battery, cables and connections. Check for signs of corrosion. Inspect the battery case for cracks or bulges, dirt, acid, and electrolyte leakage. Check the electrolyte level in each cell.

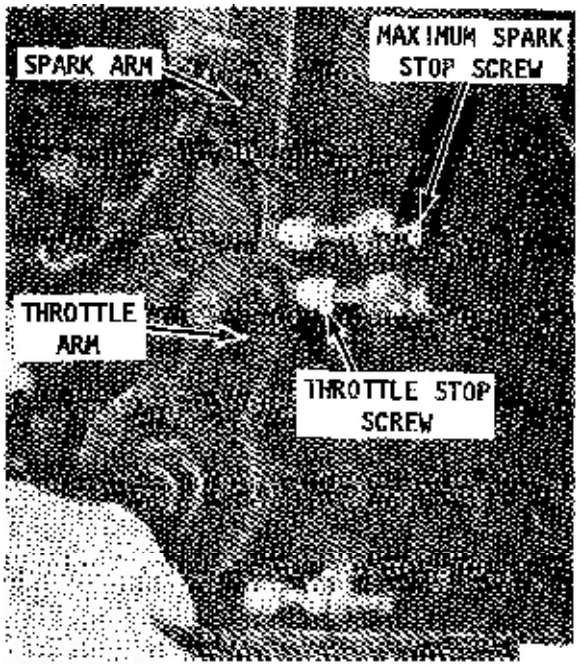
Fill each cell to the proper level with distilled water or water passed thru a demineralizer.

Clean the top of the battery. The top of a 12-volt battery should be kept especially clean of acid film and dirt, because of the high voltage between the battery terminals. For best results, first wash the battery with a diluted ammonia or baking soda solution to neutralize any acid present. Flush the solution off the battery with clean water. Keep the vent plugs tight to prevent the neutralizing solution or water from entering the cells.

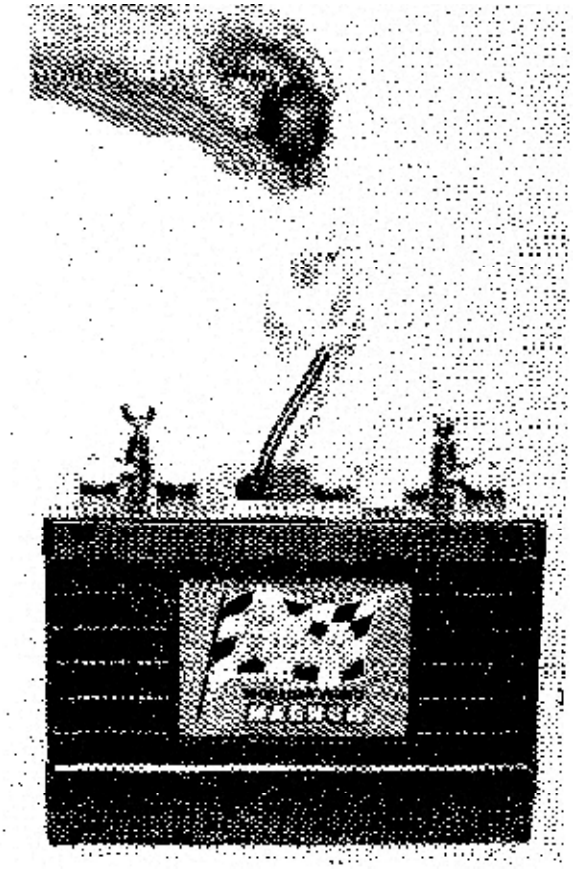
Check to be sure the battery is fastened securely in position. The hold-down device should be tight enough to prevent any movement of the battery in the holder, but not so tight as to place a strain on the battery case.



Keep an eye on the date plate affixed to the battery. Batteries seldom have a useful life the full length of their advertised life expectancy.



*The fuel and ignition systems on any engine **MUST** be properly synchronized before maximum performance can be obtained from the unit.*



A check of the electrolyte in the battery should be a regular task on the maintenance schedule on any boat.

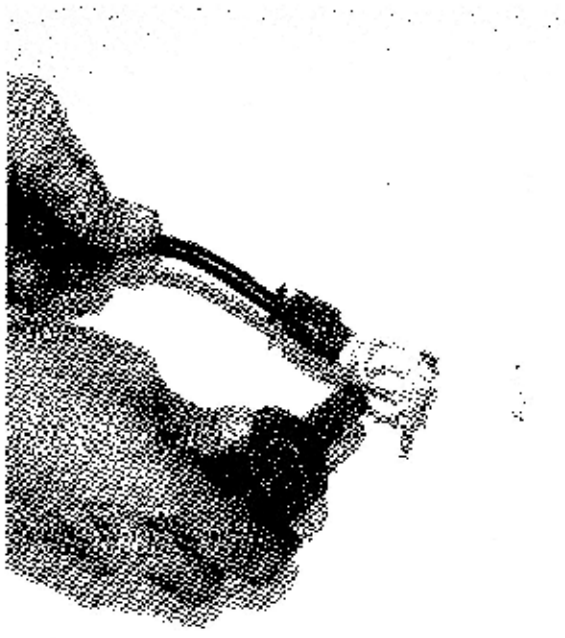
If the battery posts or cable terminals are corroded, the cables should be cleaned separately with a baking soda solution and a wire brush. Apply a thin coating of Multi-purpose Lubricant to the posts and cable clamps before making the connections. The lubricant will help to prevent corrosion.

If the battery has remained under-charged, check for high resistance in the charging circuit. If the battery appears to be using too much water, the battery may be defective, or it may be too small for the job.

Jumper Cables

If booster batteries are used for starting an engine the jumper cables must be connected correctly and in the proper sequence to prevent damage to either battery, or the rectifier diodes.

ALWAYS connect a cable from the positive terminals of the dead battery to the positive terminal of the good battery **FIRST. NEXT,** connect one end of the other cable to the negative terminals of the good battery and the other end of the **ENGINE** for a good ground. By making the ground connection on the engine, if there is an arc when you make the connection it will not be near the battery. An arc near the battery could cause an explosion, destroying the battery and causing serious personal injury.



An inexpensive brush should be purchased and used to clean the battery terminals. Clean terminals will ensure a proper connection.

DISCONNECT the battery ground cable before replacing an alternator or before connecting any type of meter to the alternator.

If it is necessary to use a fast-charger on a dead battery, **ALWAYS** disconnect one of the boat cables from the battery first, to prevent burning out the diodes in the rectifier.

NEVER use a fast charger as a booster to start the engine because the diodes in the rectifier will be **DAMAGED.**

Alternator Charging

When the battery is partially discharged, the ammeter should change from discharge to charge between 800 to 1000 rpm for all models. If the battery is fully-charged, the rpm will be a little higher.

Before disconnecting the ammeter, reconnect the red harness lead to the positive battery terminal and install the wing nut.

Most problems in the charging system can be attributed to: burnt out diodes (inside the rectifier), or burnt out stator coil connections (under the flywheel). Both these conditions will lead to an undercharged battery. A defective rectifier may cause the battery to "overcharge" or prevent the battery from being "fully charged".

*Common set of jumper cables for using a second battery to crank and start the engine. **EXTREME** care should be exercised when using a second battery, as explained in the text.*

2-7 CARBURETOR ADJUSTMENT

Fuel and Fuel Tanks

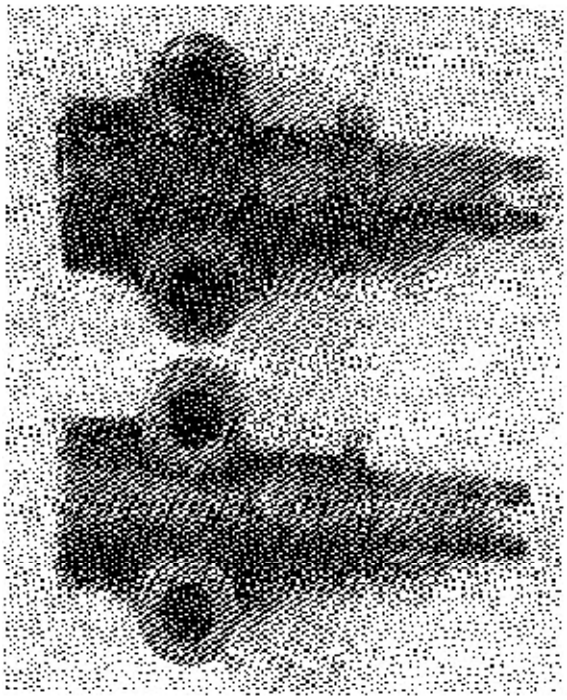
Take time to check the fuel tank and all of the fuel lines, fittings, couplings, valves, flexible tank fill and vent. Turn on the fuel supply valve at the tank. If the gas was not drained at the end of the previous season, make a careful inspection for gum formation. When gasoline is allowed to stand for long periods of time, particularly in the presence of copper, gummy deposits form. This gum can clog the filters, lines, and passageway in the carburetor.

If the condition of the fuel is in doubt, drain, clean, and fill the tank with fresh fuel.

Fuel pressure at the top carburetor should be checked whenever a lack of fuel volume at the carburetor is suspected.

Check other than Mercury fuel tank for the following:

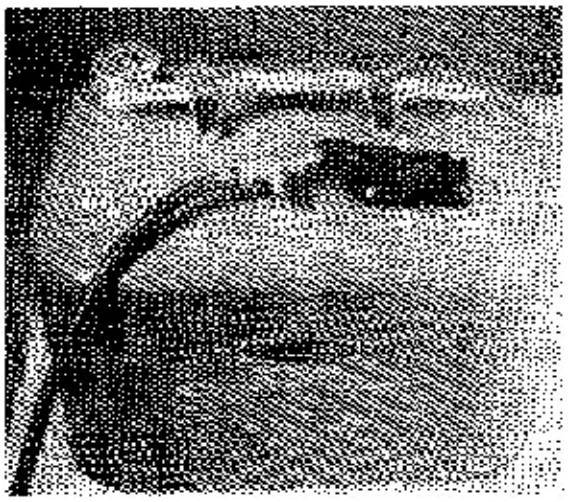
1- Adequate air vent in the fuel cap.
2- Fuel line of sufficient size, should be 5/16" to 3/8".
3- Filter on the end of the pickup is too small or is clogged.
4- Fuel pickup tube is too small.



A worn fuel coupling, bottom, compared with a new one, top. Notice how the pins on the worn coupling are smaller and tapered. For the modest cost involved and to ensure a proper connection, the coupling and line should be replaced if there is any sign of excessive wear.

High-speed Adjustment

The high-speed jet is fixed at the factory and is **NOT** adjustable. However, larger or smaller jets may be installed for different elevations.



An ideal fuel tank and fuel line arrangement for an outboard unit. The tank should be kept clean and well secured in the boat. The quick-disconnect device affords easy removal for filling and safety.

Quicksilver Gasoline Stabilizer and Conditioner may be used to keep the gasoline in the tank fresh. Such an additive will prevent the fuel from "souring" for up to twelve months.

Idle Mixture Adjustment

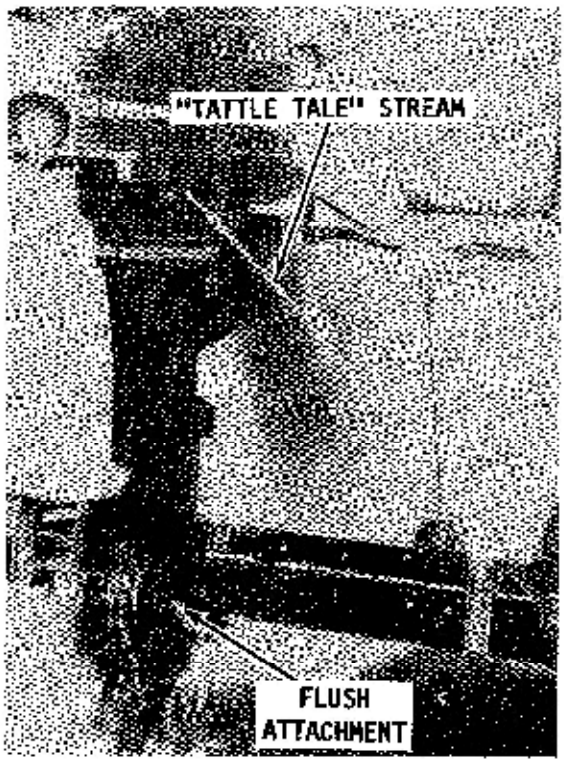
The idle mixture and idle speed are set at the factory. Due to local conditions, it may be necessary to adjust the carburetor while the engine is running in a test tank or with the boat in a body of water. For maximum performance, the idle mixture and the idle rpm should be adjusted under actual operating conditions.

Set the idle mixture screw at the specified number of turns open from a lightly seated position. In most cases this is from 1 to 1½ turns open from close.

Start the engine and allow it to warm to operating temperature.

CAUTION: Water must circulate through the lower unit to the engine any time the engine is run to prevent damage to the water pump in the lower unit. Just five seconds without water will damage the water pump.

NEVER, AGAIN NEVER, operate the engine at high speed with a flush device attached. The engine, operating at high speed with such a device attached, would **RUNAWAY** from lack of a load on the propeller, causing extensive damage.

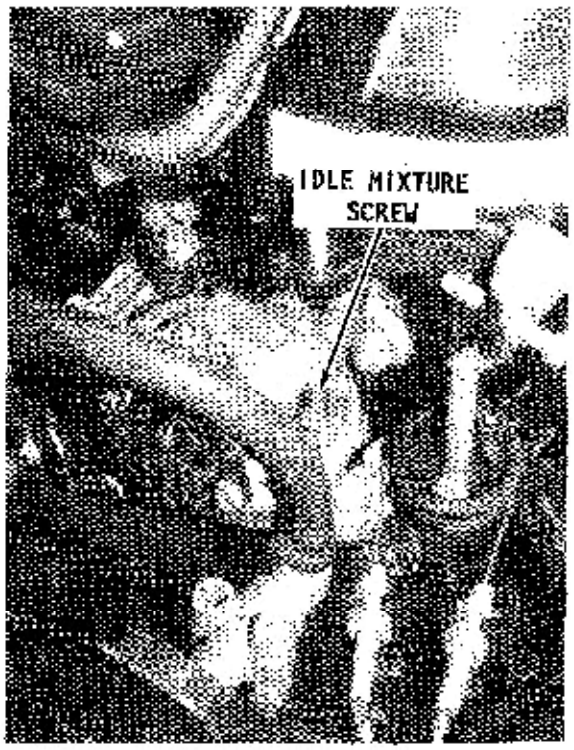


*Using a flush attachment and garden hose while operating the engine at idle speed. **NEVER** operate the engine in gear or above idle speed with such a device.*

With the engine running in forward gear, slowly turn the idle mixture screw **COUNTERCLOCKWISE** until the affected cylinders start to load up or fire unevenly, due to an over-rich mixture. Slowly turn the idle mixture screw **CLOCKWISE** until the cylinders fire evenly and engine rpm increases. Continue to slowly turn the screw **CLOCKWISE** until too lean a mixture is obtained and the rpms fall off and the engine begins to misfire. Now, set the idle mixture screw one-quarter (1/4) turn out (counterclockwise) from the lean-out position. This adjustment will result in an approximate true setting. A too-lean setting is a major cause of hard starting a cold engine. It is better to have the adjustment on the rich side rather than on the lean side. Stating it another way, do not make the adjustment any leaner than necessary to obtain a smooth idle.

If the engine hesitates during acceleration after adjusting the idle mixture, the mixture is too lean. Enrich the mixture slightly, by turning the adjustment screw inward until the engine accelerates correctly.

Loosen the locknut and adjust the idle stop screw on the stop bracket until the engine idles at the recommended rpm in



Typical idle adjustment screw found on all carburetors used on the powerheads covered in this manual.

forward gear. The manufacturer's suggested range is 550-650 rpm. Tighten the locknut to hold the adjustment.

Repairs and Adjustments

For detailed procedures to disassemble, clean, assemble, and adjust the carburetor, see the appropriate section in Chapter 4 for the carburetor type on the engine being serviced.

2-8 FUEL PUMPS

Many times, a defective fuel pump diaphragm is mistakinly diagnosed as a problem in the ignition system. The most common problem is a tiny pin-hole in the diaphragm. Such a small hole will permit gas to enter the crankcase and wet foul the spark plug at idle-speed. During high-speed operation, gas quantity is limited, the plug is not fouled and will therefore fire in a satisfactory manner.

If the fuel pump fails to perform properly, an insufficient fuel supply will be delivered to the carburetor. This lack of fuel will cause the engine to run lean, lose rpm or cause piston scoring.

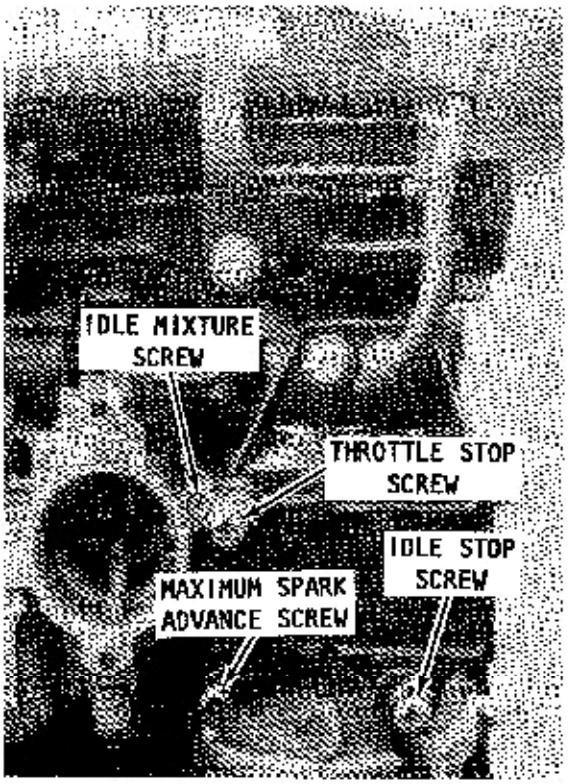
When a fuel pressure gauge is added to the system, it should be installed at the end of the fuel line leading to the upper carburetor. To ensure maximum performance, the fuel pressure must be 2 psi or more at full throttle.

Tune-up Task

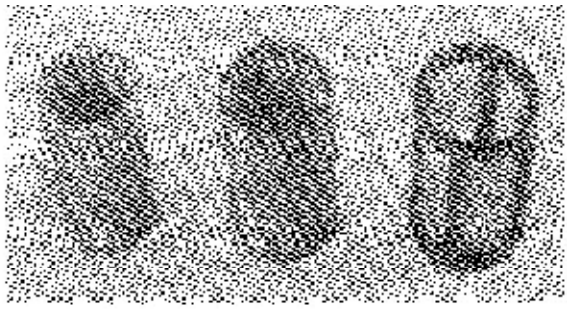
Remove the fuel filter on the carburetor. Wash the parts in solvent and then dry them with compressed air. Install the clean element. A fuel pump pressure test should be made any time the engine fails to perform satisfactorily at high speed.

NEVER use liquid Neoprene on fuel line fittings. Always use Permatex when making fuel line connections. Permatex is available at almost all marine and hardware stores.

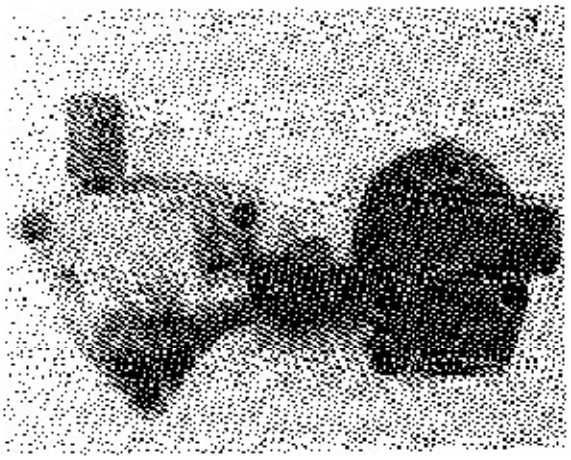
To service the fuel pump, see Chapter 4.



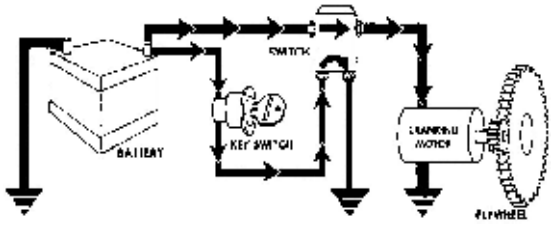
Convenient tuning adjustment points for synchronizing the fuel and ignition systems.



Filters used with the side-bowl carburetor. The two on the left are obsolete and should be replaced with the new type on the right.



Typical separate fuel pumps installed on the powerheads covered in this manual.



Functional diagram of a typical cranking circuit.

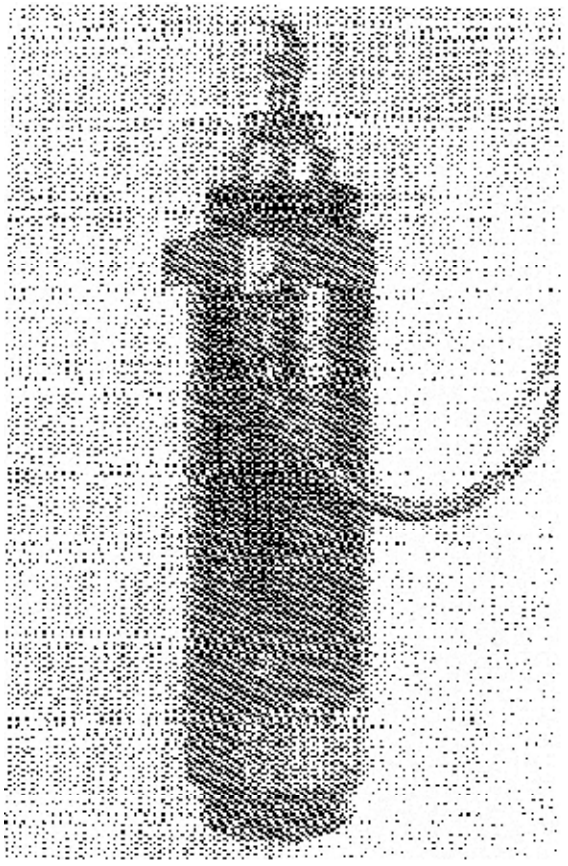
2-9 CRANKING MOTOR AND SOLENOID

Cranking Motor Test

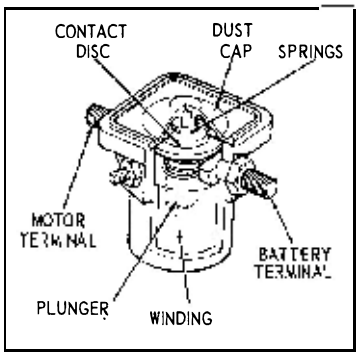
Check to be sure the battery has at least a 90-ampere rating and is fully charged. Would you believe, many cranking motors are needlessly disassembled, when the battery is actually the culprit.

Lubricate the pinion gear and screw shaft with No. 10 oil.

Connect one lead of a voltmeter to the positive terminal of the cranking motor. Connect the other meter lead to a good ground on the powerhead. Check the battery voltage under load by turning the ignition switch to the **START** position and observing the voltmeter reading.



Cranking motor used on marine outboard installations.



Exploded view of a cranking motor solenoid.

If the reading is 9-1/2 volts or greater, and the cranking motor fails to operate, repair or replace the unit. See Chapter 7.

Solenoid Test

A magneto analyzer is required for this test. Turn the selector switch of the magneto analyzer to position No. 2 (distributor resistance). Clip the small red and black leads together. Turn the meter adjustment knob for Scale No. 2 until the meter pointer aligns with the set position on the left side of the **OK** block on Scale No. 2. Separate the red and black leads. Connect the small red test lead to one large terminal of the solenoid. Connect the small black test lead to the other large terminal.

Testing the terminals of a side-mounted electrical connector with a volt/ohm/amp meter.