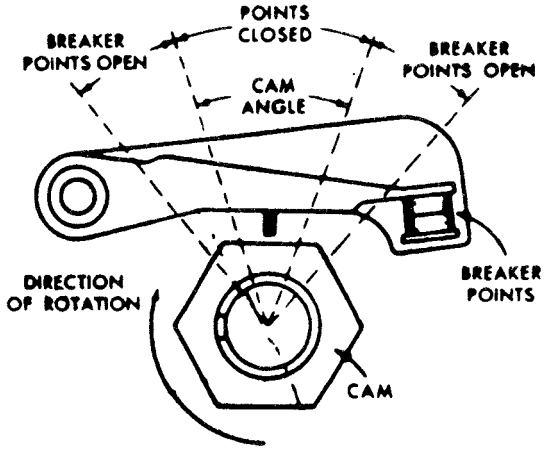
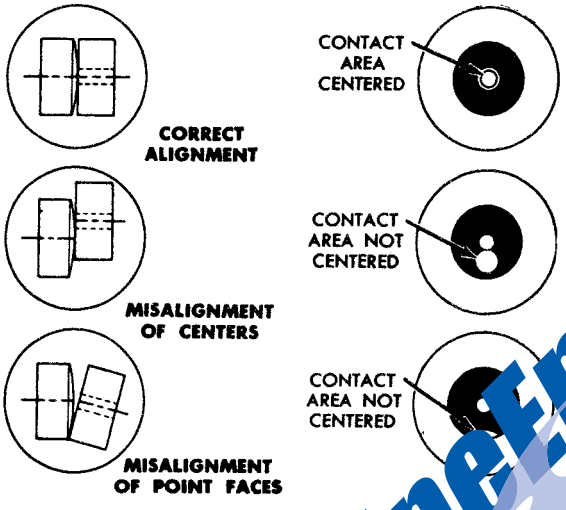


The dwell angle is directly related to the point gap.

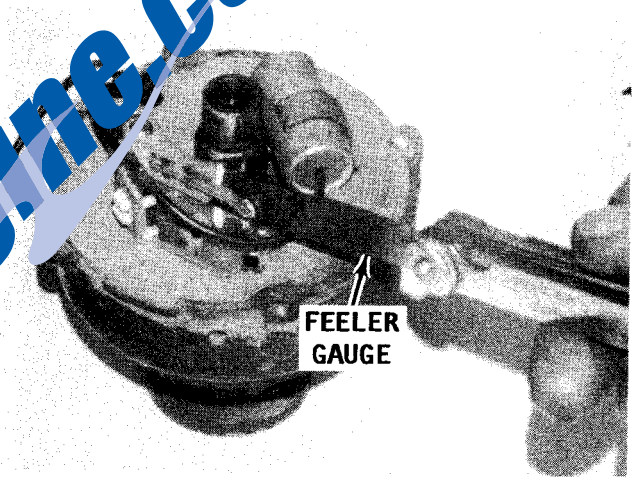


Breaker point alignment guide. Always bend the stationary point for aligning the contact point faces; otherwise, misalignment may result between the rubbing block and the cam.

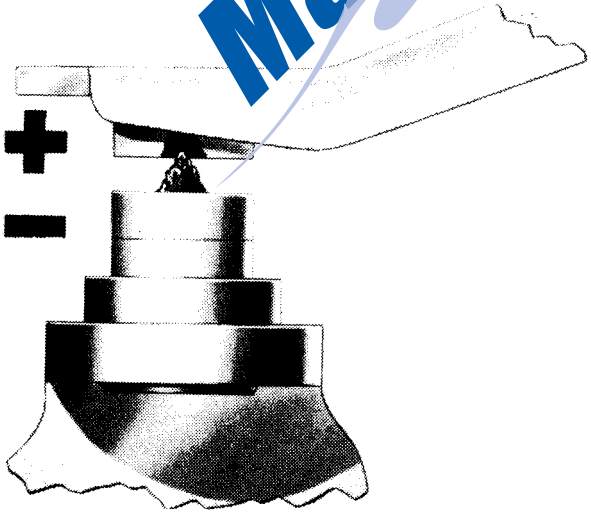
the feeler gauge blade clean, because the slightest amount of oil film will cause trouble when it oxidizes.

It is best to add 0.003" to the clearance specification when installing a new set of contact points to compensate for initial rubbing block wear. **ALWAYS** keep the contact point retaining screw **SNUG** during the adjustment to prevent the gap from changing when it is finally tightened.

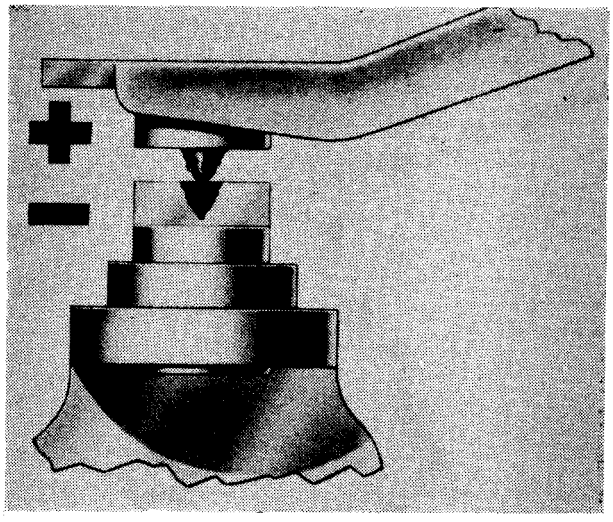
After the proper gap adjustment has been made, apply a light layer of heavy grease to coat the distributor cam. Turn the distributor shaft in the normal direction of rotation so the lubricant is wiped off against the back of the rubbing block. The grease will remain on the rubbing block as a reservoir to supply lubricant as the block wears. Wipe off any excess lubricant. Leave only the reserve stored on the rubbing block.



Adjusting the point gap.



Check the contact points for abnormal wear, burning, or pitting.



A faulty condenser will cause abnormal contact point wear and loss of engine performance.

Replace the distributor in the engine, with the rotor pointing toward the mark you scribed on the housing. Tighten the hold-down bolt. The ignition timing will be adjusted after the engine is running, as described in the following paragraphs.

Ignition Timing

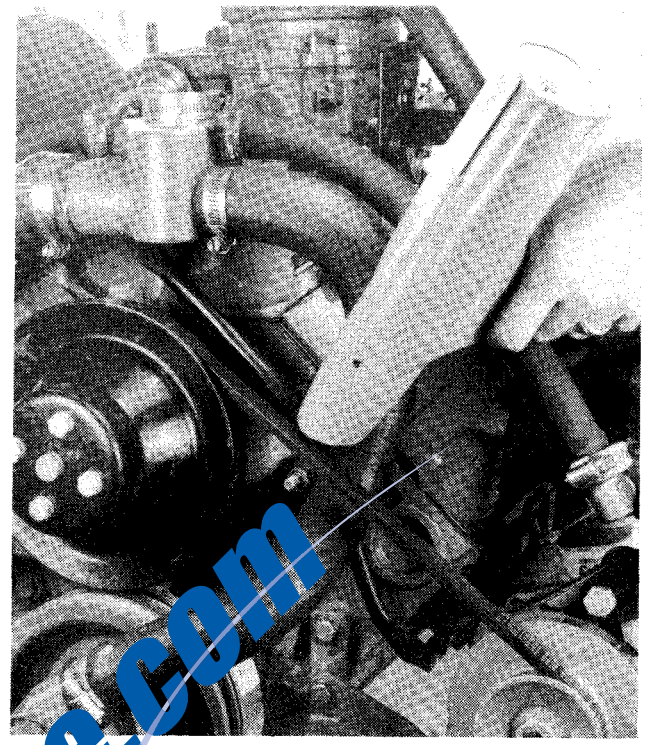
Connect a tachometer to the coil leads. Connect a power timing light to the No. 1 spark plug. Do not puncture the wire or boot when you install the timing light because a puncture could start a voltage leak and lead to problems later.

Start the engine and adjust the speed and timing to the specifications listed in the Appendix.

CAUTION: Water must circulate through the lower unit to the engine any time the engine is run to prevent damage to the water pump mounted on the engine.

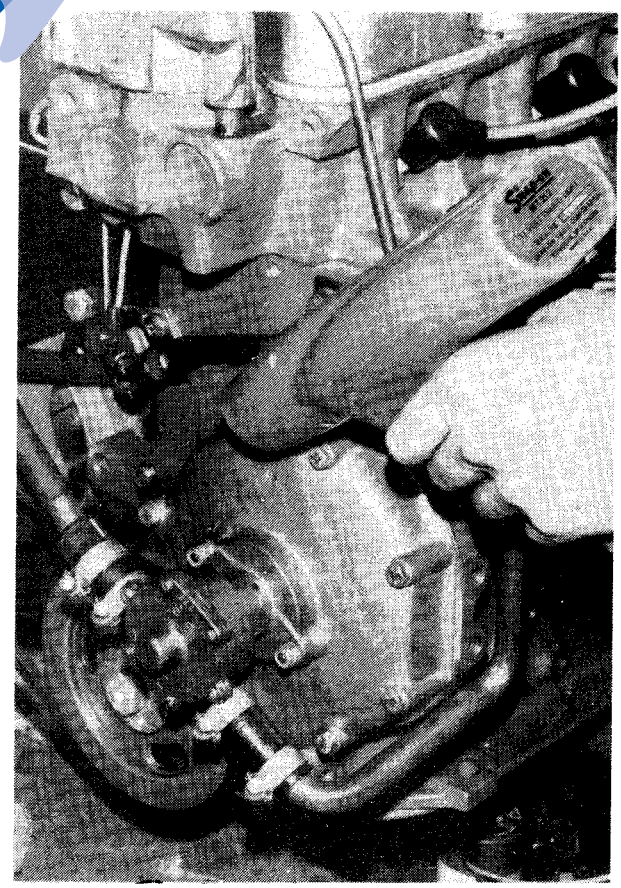
If a point adjustment is required, stop the engine, remove the cap, and make the adjustment. Remember, the dwell setting (gap) of the contact points affects the ignition timing; therefore, it is essential the dwell be set before adjusting the ignition timing.

Idle the engine at 600 rpm or less t[o] sure no centrifugal advance is takin[g] Adjust the ignition timing by rot[ating] distributor housing. Tighten the [hold-down] bolt.



Timing light aimed at the timing marks on the [damper] and on the timing chain cover — AQ200, [AQ225], AQ260, AQ280, and AQ290 engines.

Using a timing light connected to the No. 1 spark plug lead to adjust the timing.



Timing light aimed at the timing pointer and the mark on the damper — AQ130 and AQ170 engines.

the piston compresses the mixture to a fraction of its original volume; exact pressure depends principally on the compression ratio of the engine.

Power Stroke

The power stroke is produced by igniting the compressed air-fuel mixture. When the spark plug arcs, the mixture ignites and burns very rapidly during the power stroke. The resulting high temperature expands the gases, creating very high pressure on top of the piston, which drives the piston down. This downward motion of the piston is transmitted through the connecting rod and is converted into rotary motion by the crankshaft. Both the intake and exhaust valves are closed during the power stroke.

Exhaust Stroke

The exhaust valve opens just before the piston completes the power stroke. Pressure in the cylinder at this time causes the exhaust gas to rush into the exhaust manifold (blowdown). The upward movement of the piston on its exhaust stroke expels most of the remaining exhaust gas.

As the piston pauses momentarily at the top of the exhaust stroke, the inertia of the exhausting gas tends to remove any remaining gas in the combustion chamber; however, a small amount always remains to dilute the incoming mixture. This trapped gas is captured in the clearance area between the piston and the cylinder head.

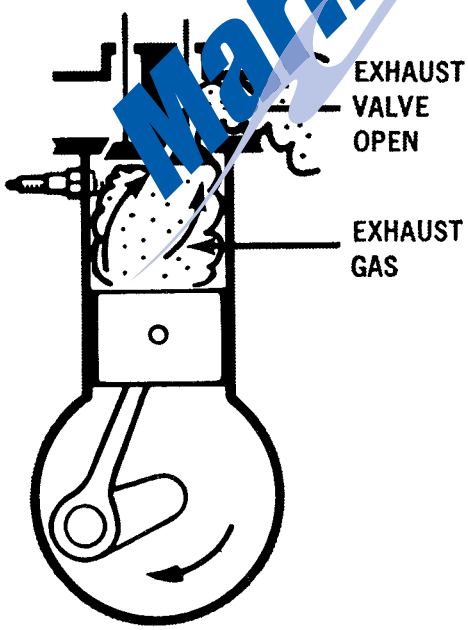
Combustion

The power delivered from the piston to the crankshaft is the result of a pressure increase in the gas mixture above the piston. This pressure increase occurs as the mixture is heated, first by compression, and then (on the down stroke) by burning. The burning fuel supplies heat that raises temperature and, at the same time, raises pressure. Actually, about 75 percent of the mixture in the cylinder is composed of nitrogen gas that does not burn but expands when heated by the burning of the combustible elements, and it is this expanding nitrogen that supplies most of the pressure on the piston.

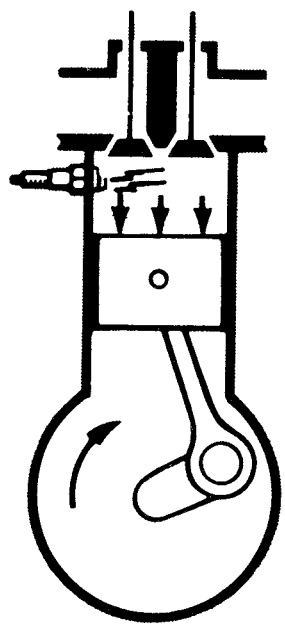
The fuel and oxygen must burn smoothly within the combustion chamber to take full advantage of its expanding effect. Maximum power would not be delivered to the piston if an explosion took place, because the entire force would be spent in one sharp hammer-like blow, occurring too fast for the piston to follow.

Instead, burning takes place evenly as the flame moves across the combustion chamber. Burning must be completed by the time the piston is about half-way down so maximum pressure will be developed in the cylinder at the time the piston applies its greatest force to the crankshaft. This will be when the mechanical advantage of the connecting rod and crankshaft is at a maximum.

At the beginning of the power stroke (as



EXHAUST



POWER

the piston is driven down by the pressure), the volume above the piston increases, which would normally allow the pressure in the cylinder to drop. However, combustion is still in progress, and this continues to raise the temperature of the gases, expanding them and maintaining a continuous pressure on the piston as it travels downward. This provides a smooth application of power throughout the effective part of the power stroke to make the most efficient use of the energy released by the burning fuel.

VALVE TIMING

On the power stroke, the exhaust valve opens before bottom dead center in order to get the exhaust gases started out of the combustion chamber under the remaining pressure (blowdown). At the end of the exhaust stroke, the intake valve opens before top dead center in order to start the air-fuel mixture moving into the combustion chamber. These processes are functions of camshaft design and valve timing.

Valves always open and close at the same time in the cycle; the timing is not variable with speed and load as is ignition timing. There is, however, one particular speed for each given engine at which the air-fuel mixture will pack itself into the combustion chambers most efficiently. This is the speed at which the engine puts out its peak torque. At low engine speeds, compression is somewhat superior due to the slight reverse flow of gases through the valves just as they open or close when the mixture is not moving fast enough to take advantage of the timing. At high speeds, the valve timing does not allow enough time during the valve opening and closing periods for effective passing of the air-fuel mixture into the cylinder.

ENGINE TYPES

The following engine manufacturers and the engine sizes or designations covered in this manual are as follows:

Volvo Penta In-Line
- Pushrod engines -- 4-cylinder
  AQ105, 115, & 130 Series (121 CID)
- Pushrod engines -- 6-cylinder
  AQ165 & 170 Series (182 CID)
- Single overhead cam **(OHC)** engines
  AQ120, 125, 131, 140, 145, & 151 Series (130, & 141 CID)
- Double overhead cam **(DOHC)** engines
  AQ171 Series (152 CID)

GMC V6
- AQ175 & 205 Series and Model 431 (229, & 262 CID)

GMC V8
- AQ200, 211, 225, 231, 240, 255, 260, 271, 280, 290, 311, & 740 Series (305, 307, 350, & 454 CID)

Ford V8
- AQ190 & 240 Series (302 & 351 CID)

CHAPTER ORGANIZATION

Many tasks can be performed while the engine remains in the boat, because the engine shroud can be dismantled for access.

THEREFORE, this chapter is divided into general areas by section as follows:

3-2 Troubleshooting
3-3 Engine removal
3-4 Engine installation
3-5 thru **3-8** Intake & exhaust manifolds
3-9 Rocker arm service
3-11 thru **3-13** Cylinder head R & I
3-14 Cylinder head reconditioning
3-15 thru **3-18** Camshaft service
3-19 thru **3-23** Valve lash adjustment
3-24 thru **3-26** Timing belt or chain
3-27 Piston, ring, & rod service
3-28 & **3-29** Crankshaft & main bearings
3-30 Oil pump service

To prevent constant repetition of procedures, the above section numbers are referenced throughout the chapter.

3-2 TROUBLESHOOTING ALL UNITS

Troubleshooting must be a well thought-out procedure. To be successful, start by accurately determining the problem; then use a logical approach to arrive at the proper solution. The common phrase, "shotgun approach" only leads to wasted time, money, and frustration. Obviously, if the instructions are to be of maximum benefit, they must be followed exactly.

When an engine does not start, the trouble must be localized to one of four general areas; starting system, ignition, fuel, or compression. Each of these areas must be systematically inspected until the trouble is located in one of them, and then detailed tests of that system must be made to isolate the part causing the starting problem.

fuel pump, or by a leak in the line from the fuel tank to the fuel pump. Would you believe, a good majority of starting troubles which are traced to the fuel system are the result of an empty fuel tank and to aged fuel.

Fuel will begin to sour in three to four months and will cause engine starting problems. A fuel additive such as Sta-Bil may be used to prevent gum from forming during storage or prolonged idle periods.

If the automatic choke should stick in the open position, the engine would have trouble starting. This condition can be quickly corrected by rapid movement of the accelerator which will discharge fuel into the intake manifold and the engine will start.

If the automatic choke should stick in the closed position, the engine will flood making it very difficult to start. To correct this condition, move the fast idle or warm up lever to the wide-open position as the engine is cranked. This action will activate the unloader linkage to open the choke valve and help the flooded engine to start.

Mike Basso, driving this boat equipped with a high performance engine and standard Volvo Penta stock Model 280 stern drive, averaged 110 mph (177 kph) for two runs over a measured course. Imagine the demand on the complete fuel system to deliver the quantity of fuel required by such performance.

When the engine is hot, the fuel system can cause starting problems. After a hot engine is shut down, the temperature inside the fuel bowl may rise to 200°F and cause the fuel to actually boil. All carburetors are vented to allow this pressure to escape to the atmosphere. However, some of the fuel may percolate over the high-speed nozzle and overflow into the intake manifold.

In order for this raw fuel to vaporize enough to burn, considerable air must be added to lean out the mixture. Therefore, the only remedy is to open the throttle as wide as possible and to crank the engine until enough air is drawn in to provide the proper mixture for the engine to start. **NEVER** move the throttle lever back-and-forth in an attempt to start a hot engine. This action will only compound the problem by adding more fuel to an already too-rich mixture.

If the needle valve and seat assembly is leaking, an excessive amount of fuel may enter the intake manifold in the following manner. After the engine is shut down, the pressure left in the fuel line will force fuel past the leaking needle valve. This extra fuel will raise the level in the fuel bowl and cause fuel to overflow into the intake manifold.

A continuous overflow of fuel into the intake manifold may be due to a sticking or defective float which would cause an extra high level of fuel in the bowl and overflow into the intake manifold.

ROUGH ENGINE IDLE

If an engine does not idle smoothly, the most reasonable approach to the problem is to perform a tune-up to eliminate such areas as: defective points; faulty spark plugs; and timing out of adjustment.

Other problems that can prevent an engine from running smoothly include: An air leak in the intake manifold; uneven compression between the cylinders; and sticky valves.

Of course any problem in the carburetor affecting the air-fuel mixture will also prevent the engine from operating smoothly at idle speed. These problems usually include: Too high a fuel level in the bowl; a heavy float; leaking needle valve and seat; a dirty flame arrestor; defective automatic choke; and improper adjustments for idle mixture or idle speed.

EXCESSIVE FUEL CONSUMPTION

Excessive fuel consumption can be the result of any one of three conditions, or a combination of all three.

1- Inefficient engine operation.

2- Faulty condition of the hull, including excessive marine growth.

3- Poor boating habits of the operator.

If the fuel consumption suddenly increases over what could be considered normal, then the cause can probably be attributed to the engine or boat and not the operator.

Marine growth on the hull can have a very marked effect on boat performance. This is why sail boats always try to have a haul out as close to race time as possible. While you are checking the bottom take note of the propeller condition. A bent blade or other damage will definitely cause poor boat performance.

If the hull and propeller are in good shape, then check the fuel system for a leak. Check the line between the fuel pump and the carburetor while the engine is running and the line between the fuel tank and the pump when the engine is not running. A leak between the tank and the pump may sometimes will not appear when the engine is operating because the suction created by the pump sucking fuel will not allow the fuel to leak. Once the engine is turned off and the suction no longer exists, fuel will begin to leak.

If a minor tune-up has been performed and the spark plugs, points, and timing are properly adjusted, the problem most likely is in the carburetor and an overhaul is in order. Check the power valve and the needle valve and seat for leaking. Use extra care when making any adjustments affecting the fuel consumption, such as the float level, automatic choke, vacuum-control, and the power valve. Any time the automatic choke is checked, **BE SURE** the heat tube is open and the vacuum system is operating properly.

The flame arrester should be cleaned at regular intervals.

ENGINE SURGE

If the engine operates as if the load on the boat were being constantly increased and decreased even though you are attempting to maintain a constant engine speed, the problem can most likely be attributed to the fuel pump.

The next few paragraphs briefly describe operation of the fuel pump. This description is followed by detailed procedures for testing the pressure; testing the volume; removing; and installing the fuel pump.

Because the fuel pump diaphragm is moved downward only by the diaphragm spring, the pump delivers fuel to the carburetor only when the pressure in the outlet line is less than the pressure exerted by the diaphragm spring. This lower pressure condition exists when the carburetor float needle valve is unseated and the fuel passages from the pump into the carburetor float chamber are open.

When the needle valve is closed and held in place by the pressure of the fuel on the float, the pump builds up pressure in the fuel chamber until it overcomes the pressure of the diaphragm spring. This pressure almost stops movement of the diaphragm until more fuel is needed in the carburetor float bowl.

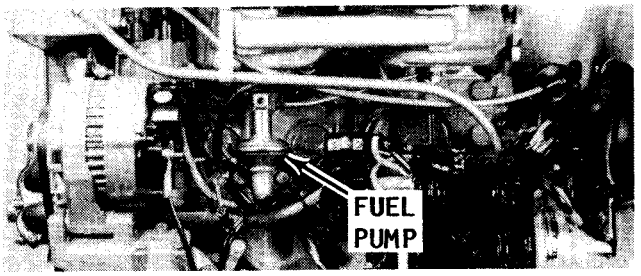
From this description you can appreciate why the fuel pump diaphragm and the carburetor float must be in good condition at all times for proper engine performance.

4-3 FUEL LINE AND FUEL PUMP TESTS

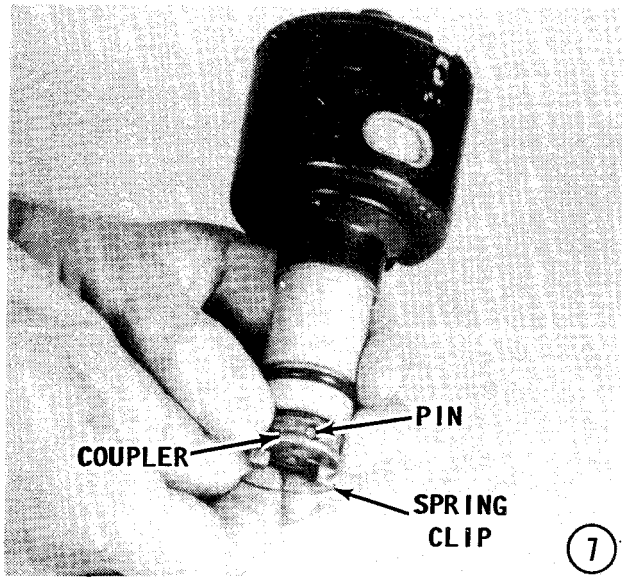
CAUTION: Gasoline will be flowing in the engine compartment during this test. Therefore, guard against fire by grounding the high-tension wire to prevent it from sparking.

The high tension wire between the coil and the distributor can be grounded by either pulling it out of the distributor cap and grounding it, or by connecting a jumper wire from the primary (distributor) side of the igniton coil to a good ground.

Disconnect the fuel line at the carburetor. Place a suitable container over the end of the fuel line to catch the fuel discharged, and then crank the engine. If the



Fuel pump installed on a 4-cylinder OHC engine.



cutouts in the plate are aligned with the humps on the inside surface of the distributor housing. Lift the breaker plate out of the housing.

SPECIAL WORDS

Under normal conditions and only **RARELY** do the centrifugal weights need to be removed. If it is not possible to get any centrifugal advance from the distributor, the weights may be at fault. If a spring is broken, a weight is corroded so badly that it fails to function, then this area will require service.

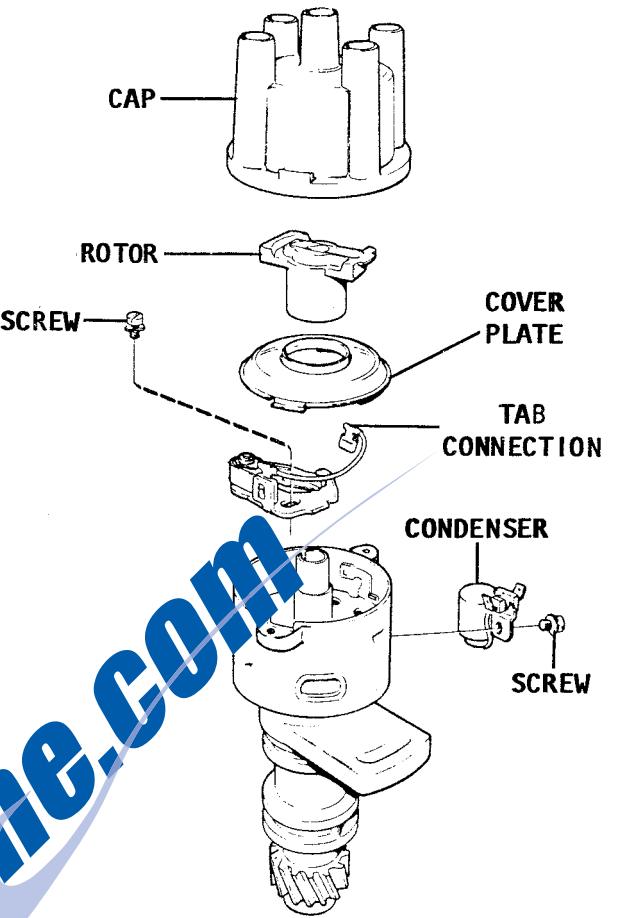
7- SELDOM is it necessary to remove the drive coupling from the distributor shaft. Remove the spring clip. This clip serves as a retainer for the pin on the distributor drive coupling. Next, drive the pin out, and then remove the coupler. Slide the distributor shaft out of the housing. The bushing can be replaced, if necessary. When the shaft and bushing are removed, a seal, and a stainless steel washer, will also come free.

CLEANING AND INSPECTING

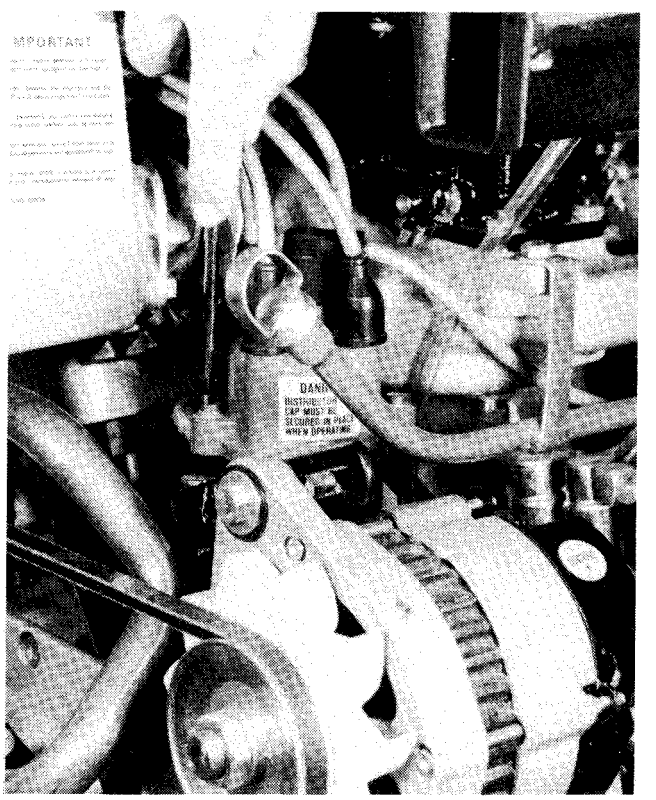
NEVER wash the distributor cap, rotor, condenser, or breaker plate assembly, of a distributor in any type of cleaning solvent. Such compounds may damage the insulation of these parts or, in the case of the breaker plate assembly, saturate the lubricating felt.

ALWAYS replace the points with a new set during a distributor overhaul.

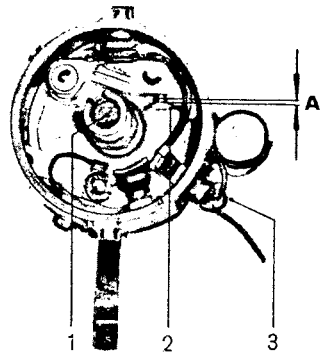
The condenser seldom gives trouble, but good shop practice a few years ago called



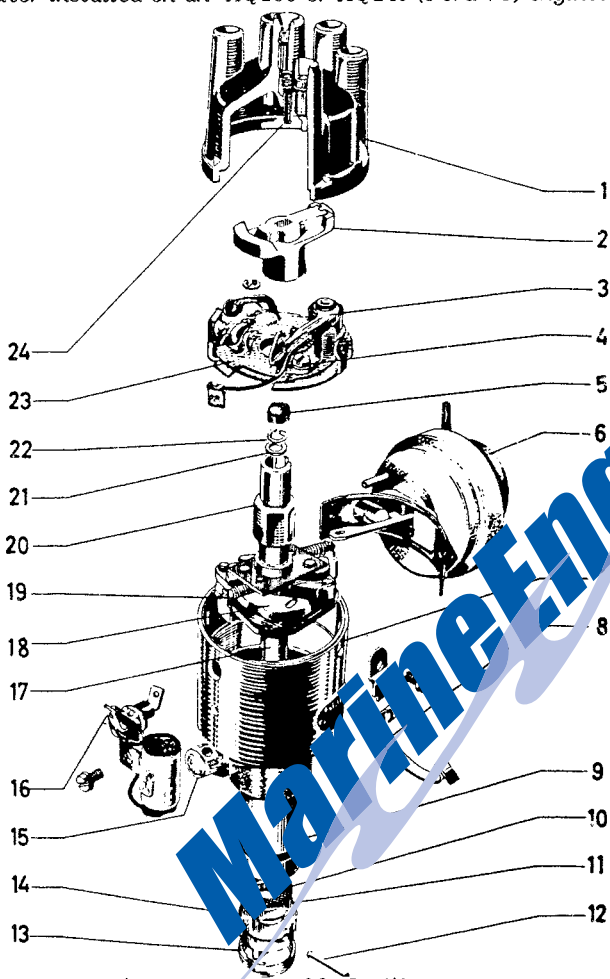
Exploded drawing of the distributor installed on the AQ125 and AQ145 engines, with principle parts identified.



Securing the distributor cap on an AQ145 engine.

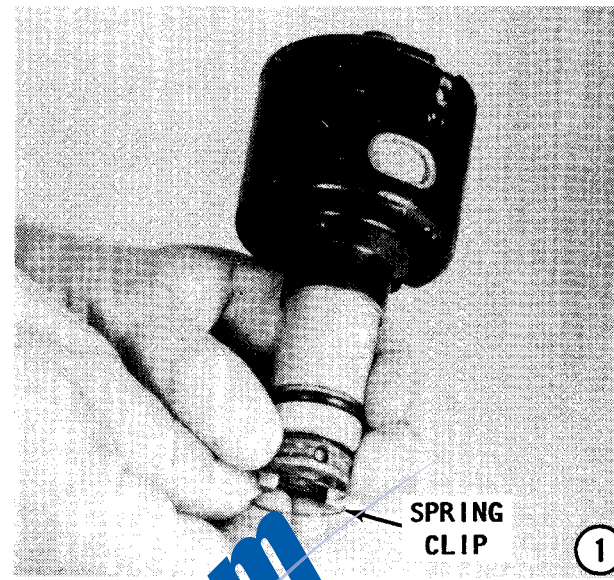


Arrangement of principle parts of a Mallory distributor installed on an AQ190 or AQ240 (Ford V8) engine.



1. Distributor cap
2. Distributor arm
3. Contacts
4. Lock screw for breaker contacts
5. Lubricating felt
6. Vacuum regulator (AQ 165)
7. Distributor housing
8. Cap clasp
9. Rubber seal
10. Fibre washer
11. Steel washer
12. Lock pin
13. Resilient ring
14. Driving collar
15. Lubricator
16. Primary connection
17. Distributor shaft
18. Centrifugal governor weight
19. Centrifugal governor spring
20. Breaker cam
21. Washer
22. Circlip
23. Breaker plate
24. Rod brush (carbon)

Exploded drawing of the Bosch distributor installed on the AQ105, AQ115, AQ130, AQ165, and AQ170 engines.



for a new [illegible]er with a new set of points. S[illegible]oint sets still include a condens[illegible] package. If you have paid for a [illegible] condenser, you might as well inst[illegible] it [illegible]d be free of concern over that par[illegible]

[illegible]ect the distributor cap for cracks or [illegible]age. Check the spark plug wires.

If the centrifugal weights were not re-[illegible]ed, check their action to be sure they [illegible]l extend and retract properly.

ASSEMBLING

1- Install the distributor shaft into the housing. Install the bushing, seal, and stainless steel washer onto the lower end of the shaft. Push the pin through, and then secure it with the spring clip.

Check the end play on the shaft. The end play should not be less than 0.004" and not more than 0.010".

2- Slide the breaker plate into the distributor housing with the cutouts in the plate aligned with the humps on the inside surface of the housing. After the plate is seated, rotate it until the scribe mark on the plate is aligned with the scribe mark on the inside surface of the housing. Secure the plate in position with the two screws attaching the two distributor cap retaining spring clips.

3- Install a **NEW** set of breaker points and secure them with the retainer screw.

4- If servicing a 4-cylinder engine, set the breaker points at 0.016" to 0.020". If servicing a 6-cylinder engine, set the points at 0.010" to 0.014". This is the open distance when the high side of the cam on the