

# ENGINE COOLING AND LUBRICATION

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## GENERAL DESCRIPTION

### ENGINE COOLING SYSTEM

The cooling system consists of the radiator core, water pump, cooling fan, pillet type thermostat and suitable passages for water circulation through the engine (Fig. 6A-1).

#### RADIATOR

Four different type radiators are used.

These are:

Hydra-Matic Transmission Radiator.

Hydra-Matic Transmission Radiator equipped with heavy-duty oil cooler.

Synchro-Mesh Transmission Radiator.

Radiator for Cars Equipped with Air Conditioning.

Both Hydra-Matic transmission radiators have oil coolers built into the lower tank with inlet and outlet fittings for circulation of transmission fluid. The Hydra-Matic transmission radiator equipped with the heavy duty oil cooler is for use on police cars, taxicabs, etc. as optional equipment. The Synchro-Mesh transmission radiator is the conventional type, while cars equipped with air conditioning use a radiator which is more dense and has more frontal area for the greater cooling demands.

The radiators are of the down-flow tube and center type and are constructed of copper. In addition to the normal cooling system inlet and outlet, the radiators have a fitting on the lower tank for the return water from the car heating system. Front end sheet metal is designed to direct a maximum flow of air through the radiator.

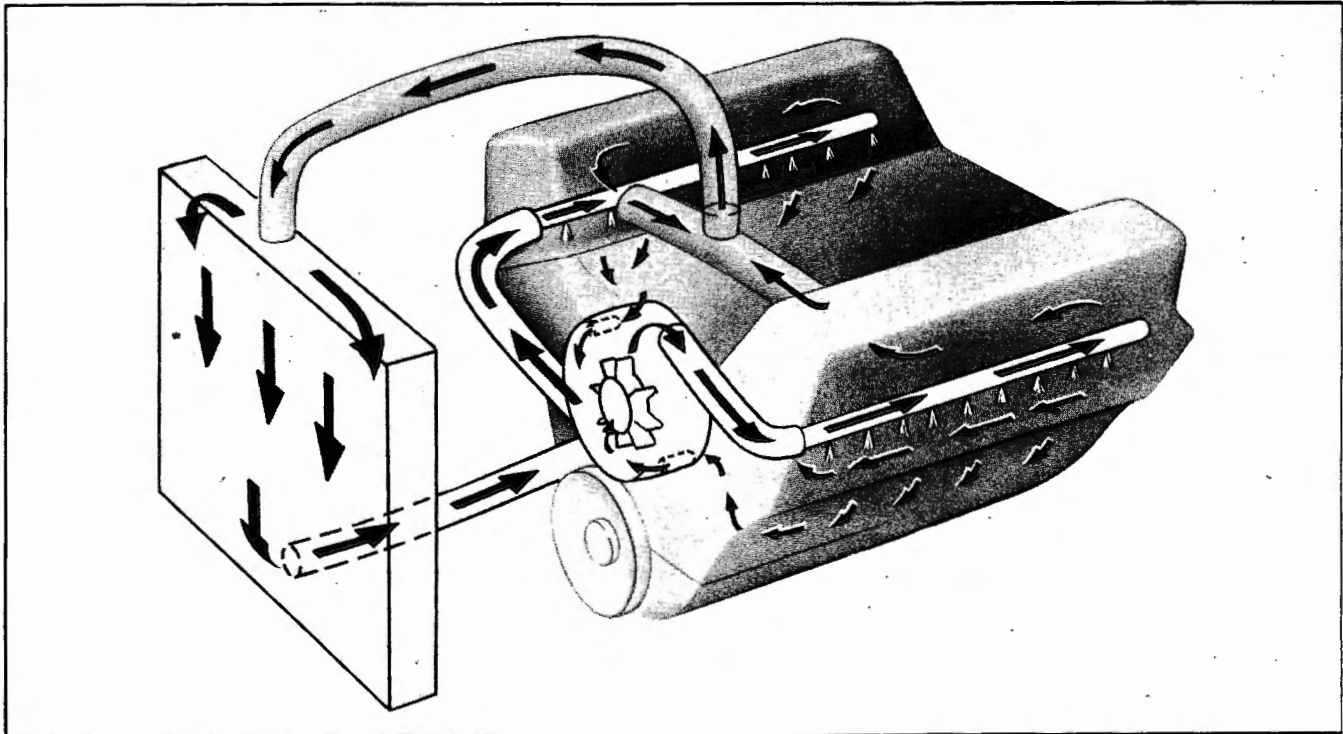


Fig. 6A-1 Engine Cooling System

A pressure-vent type cap is used on the radiator to allow a build-up of 13 psi of pressure in the cooling system. This pressure raises the boiling point of water from 212°F. to approximately 251°F. Cars equipped with Air Conditioning use a 15 psi vent type cap. The pressure raises the boiling point of water from 212°F. to approximately 257°F. **CAUTION:** As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while the engine is hot and the pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over the engine, fenders, and the person removing the cap. If the solution contains inflammable anti-freeze, such as alcohol, there is also the possibility of causing a serious fire. When removing filler cap, rotate cap toward left very slowly: if hissing of vapor is encountered, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. After pressure in the system has been relieved, turn cap more forcibly to left and remove. Turn cap all the way to the right when installing. It should not be necessary to check coolant level unless temperature gauge shows over-heating, and then not until engine is stopped and allowed to cool to normal.

#### FAN

The fan is used to increase the air flow through the radiator at low speeds. In addition it forces air into the crankcase ventilator inlets on top of the rocker arm covers to provide air flow for crankcase ventilation.

The fan has four blades which are unevenly spaced and have curled tips to provide minimum noise. A five bladed fan is used on cars with air conditioners. A fan shroud is used to prevent recirculation of air around the fan.

#### WATER PUMP

A centrifugal type water pump is used to circulate the water through the system. The water pump impeller turns on a steel shaft mounted on a double-row permanently lubricated, sealed ball bearing (Fig. 6A-2). A bellows type seal is seated in the water pump body between the bearing and the impeller.

The seal surface is a graphite-lead alloy washer which is held by the spring loaded bellows against a machined surface on the impeller.

The inlet side of the pump is connected to the lower radiator tank by means of a hose. A small passage in each bank of the block also connects the block to the water pump inlet to provide recirculation of water

when the thermostat is closed. This passage also serves to control the amount of water circulated through the block at all times.

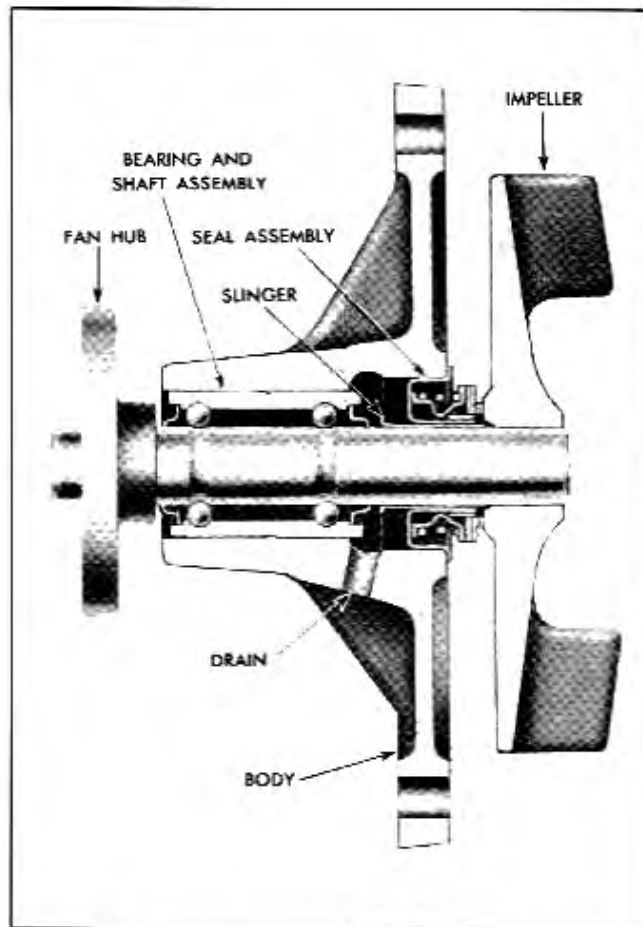


Fig. 6A-2 Cross Section of Water Pump

#### THERMOSTAT

A pellet type thermostat is used in the water outlet passage in the intake manifold. The thermostat controls the flow of coolant to provide rapid engine warm up and regulate coolant temperature. A 170° thermostat is installed as standard equipment. When desired, a higher opening thermostat is available for use with ethylene glycol (permanent type) anti-freeze.

#### COOLING SYSTEM CIRCULATION

Pontiac cooling system uses reverse flow circulation for maximum cooling efficiency. In reverse flow, cooled water from the radiator passes first to the cylinder heads, which are the hottest parts of the engine, and then to the cylinder block which is the coolest portion of the engine.

Water enters each cylinder head from the pump through a water distributing tube. Openings in the water distributing tube direct coolant in jet fashion onto valve seats and around each exhaust passage. This feature is referred to as "gusher valve cooling".

The combination of reverse flow circulation and gusher valve cooling results in relatively low operating temperature of valves and valve seats. Valve life is greatly increased, therefore, and valve seat inserts are not required.

With reverse flow circulation no cooled water is thrown directly on cylinder walls to cause cylinder distortion. Sludging of engine oil is minimized since highest temperature coolants are retained in the cylinder block, particularly during warm-up, and condensation on cylinder bores is thereby reduced.

Water circulation during warm-up (thermostat closed) is from the pump to the water distributing tubes to the cylinder heads, down into the block and back to the pump through passages from the front of each bank to the water pump inlet (Fig. 6A-1).

Water circulation after normal operating temperatures are reached (thermostat open) takes two courses. Part of the water will always recirculate through the block as outlined above. A large portion of the water, however, will pass from the pump to the water distributing tubes, to the heads, and thence directly into the top of the radiator through the water outlet passage in the front of the intake manifold.

## ENGINE LUBRICATION SYSTEM

### OIL PUMP

Oil is circulated under pressure by a helical gear type pump. The pump is mounted on the right rear bottom of the cylinder block (Fig. 6A-3) and is driven by the distributor drive gear. Maximum oil pressure is regulated by a spring loaded, ball type, pressure regulator valve. No adjustment of the pressure regulator valve is provided.

Oil is taken into the pump through a floating type oil intake. By allowing the intake to float, only the cleanest oil, which lays near the surface is pumped through the engine. All oil entering the floating intake passes through a screen. As a safety precaution a large hole is provided in the middle of the screen. During normal operation no oil can pass through this hole since the grommet around the hole is seated against the baffle. If the screen should become

plugged, however, pump suction will cause the screen to move away from the baffle, and oil will flow through the large center hole.



Fig. 6A-3 Oil Pump and Intake

### OIL FILTER

A full flow oil filter is available on Pontiac's new V-8 engine (Fig. 6A-4). The filter is mounted on a machined boss on the right rear side of the engine block.

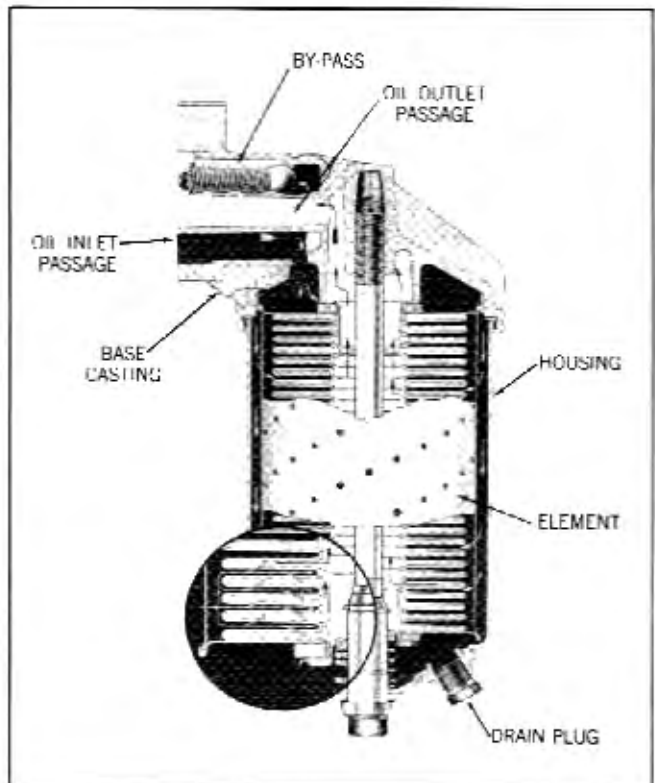


Fig. 6A-4 Oil Filter

All oil from the pump passes through the filter before going to the engine oil galleries. In the filter the oil passes through perforations in the element shell into the filtering element where all dirt and foreign particles are removed.

A by-pass valve is located in the filter base casting to insure ample lubrication in case the filter element becomes restricted. Thus, if required, oil will flow directly from the inlet through the spring loaded by-pass valve to the outlet without any possibility of washing accumulated dirt off the filter element.

#### OIL CIRCULATION

The positive pressure system delivers oil under pressure to the crankshaft, connecting rod, and camshaft bearings and to the valve train parts. Each cylinder wall is lubricated by a metered jet from the groove in the opposite connecting rod. Splash from

the jet and off the crankshaft lubricates piston pins and bushings. Timing chain and sprockets receive metered jet lubrication as do the fuel pump eccentric and rocker arm. A hole in the block from the push rod gallery through the distributor boss lubricates the distributor shaft and bushings.

Oil flow through the engine is as follows (Fig. 6A-5): Oil is first supplied by the pump and filter to two parallel oil galleries drilled in the block on each side of the camshaft. Oil travels from rear to front in the left gallery and from front to rear in the right gallery. The rear crankshaft and camshaft bearings receive oil from a hole drilled through the passage connecting the filter to the left gallery. All other crankshaft bearings receive oil from holes drilled to the left hand gallery. The remaining four camshaft bearings are supplied by a hole drilled vertically from each crankshaft bearing journal to camshaft bearing journal.

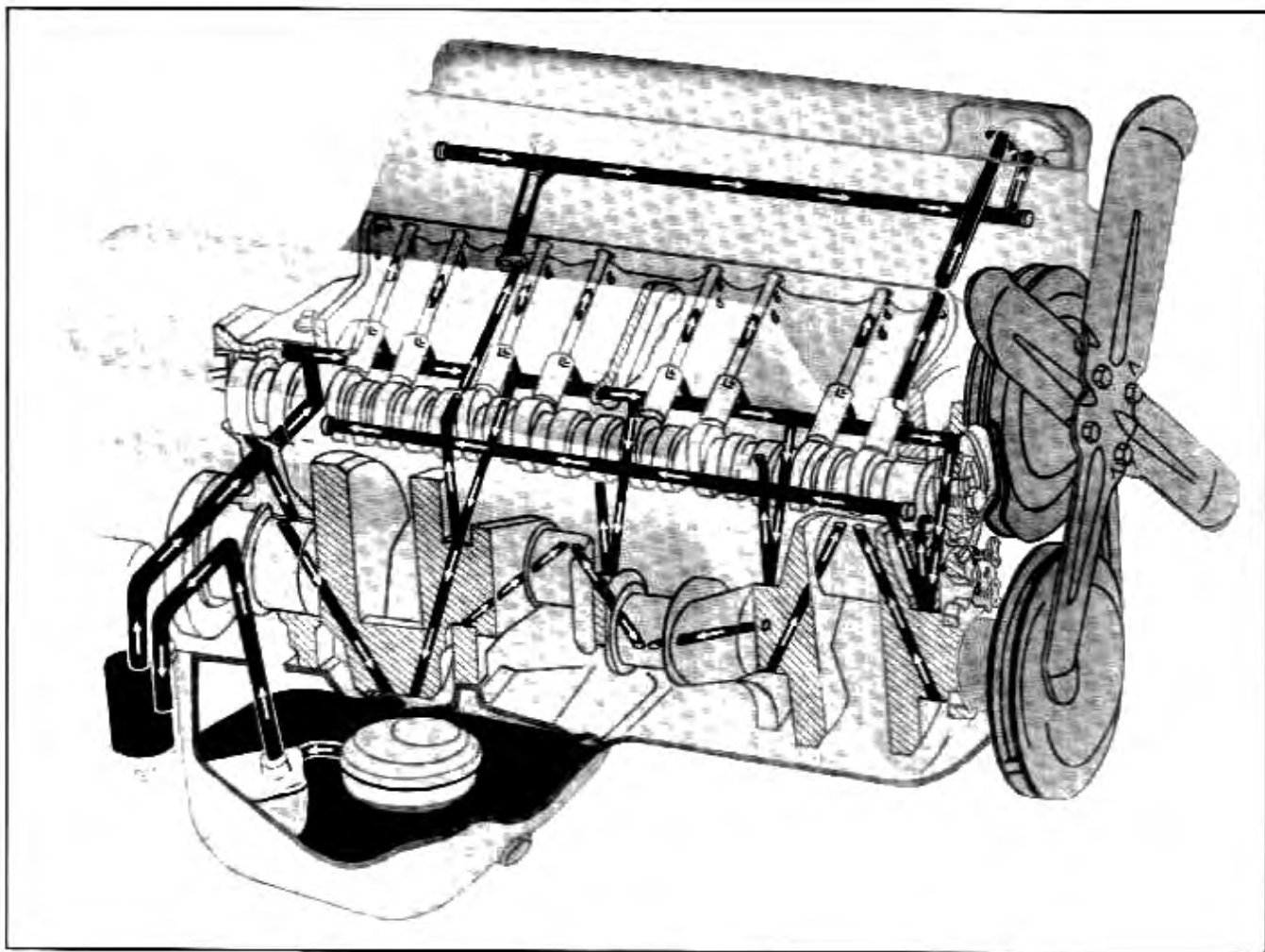


Fig. 6A-5 Engine Lubrication

Hydraulic valve lifters are fed by holes drilled from each lifter boss to the oil galleries (Fig. 6A-5). Oil is fed under pressure from a hole in the push rod seat of the valve lifter up through the hollow push rod to provide pressure lubrication of both ends of the push rod.

Oil is also positively fed to the cylinder head to lubricate all valve train surfaces. An oil gallery in the right hand cylinder head is fed intermittently by a line leading from the front center camshaft bearing journal, while the gallery in the left hand head is fed from the rear center camshaft journal. Oil from cylinder head galleries flows up holes in each rocker arm ball stud and out through a 1/16" hole drilled into the side of the stud to index with the ball. This oil lubricates the ball seat and also flows out through grooves in the top of the ball to fill the rocker arm with oil. Overflow from the rocker arm passes over the end onto the valve stem to lubricate the contact area between the rocker arm and the end of the valve stem.

Lubrication of the camshaft thrust plate, timing chain and sprockets, and fuel pump eccentric and rocker arm is provided for by a passage in the front of the camshaft. A lateral hole in the front bearing journal indexes with the camshaft bearing oil supply hole in the block once each revolution. An oil jet then squirts out of the horizontal hole in the end of the camshaft toward the front of the engine. Part of this oil is projected straight forward, against the camshaft thrust plate. Another part of the oil is projected downward through the grooves in the block and thrust plate to the crankshaft timing chain sprocket (Fig. 6A-6). Oil passing down the groove also is forced out the hole in the thrust plate. The jet of oil from this hole is timed to pass through one of the openings in the camshaft sprocket and strike the fuel pump eccentric and rocker arm.

The oil pan has been made as deep as possible to provide the maximum depth of oil. This minimizes splashing and foaming which would be detrimental to the operation of hydraulic lifters. It also insures a constant supply of oil during rapid acceleration and sharp turns. Additional protection against splashing and foaming is provided by the oil pan baffle. The baffle extends across the entire sump area of the oil pan preventing oil which is thrown off the crankshaft from churning that in the sump.

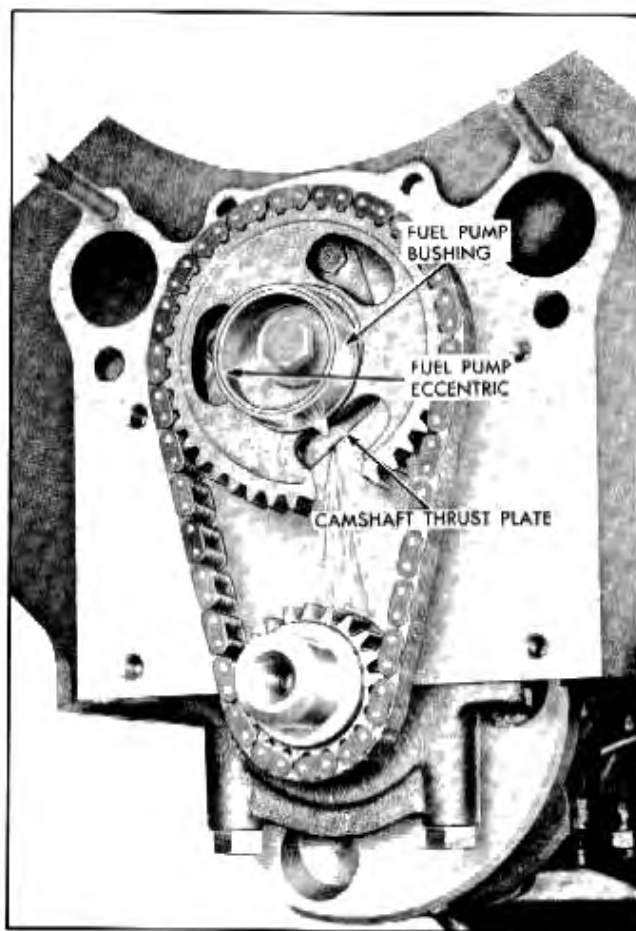


Fig. 6A-6 Timing Chain and Sprocket, Camshaft Thrust Plate, and Fuel Pump Eccentric and Rocker Arm Lubrication

## CRANKCASE VENTILATION

When gasoline is burned in the cylinders of any internal combustion engine, one of the by-products is water vapor. Actually, more than one gallon of water is produced for every gallon of gasoline burned. Most of this water vapor is blown out through the exhaust system. Some of it, however, leaks down into the crankcase where it can have very destructive effects through the formation of sludge and acid. The acid is formed when the water combines with sulphur dioxide which is another product of combustion.

Adequate crankcase ventilation evaporates the moisture and carries it, as well as the combustion gasses, out of the engine. Pontiac's crankcase ventilation system provides positive ventilation of the complete engine, even during idling. This system functions as follows (Fig. 6A-7):

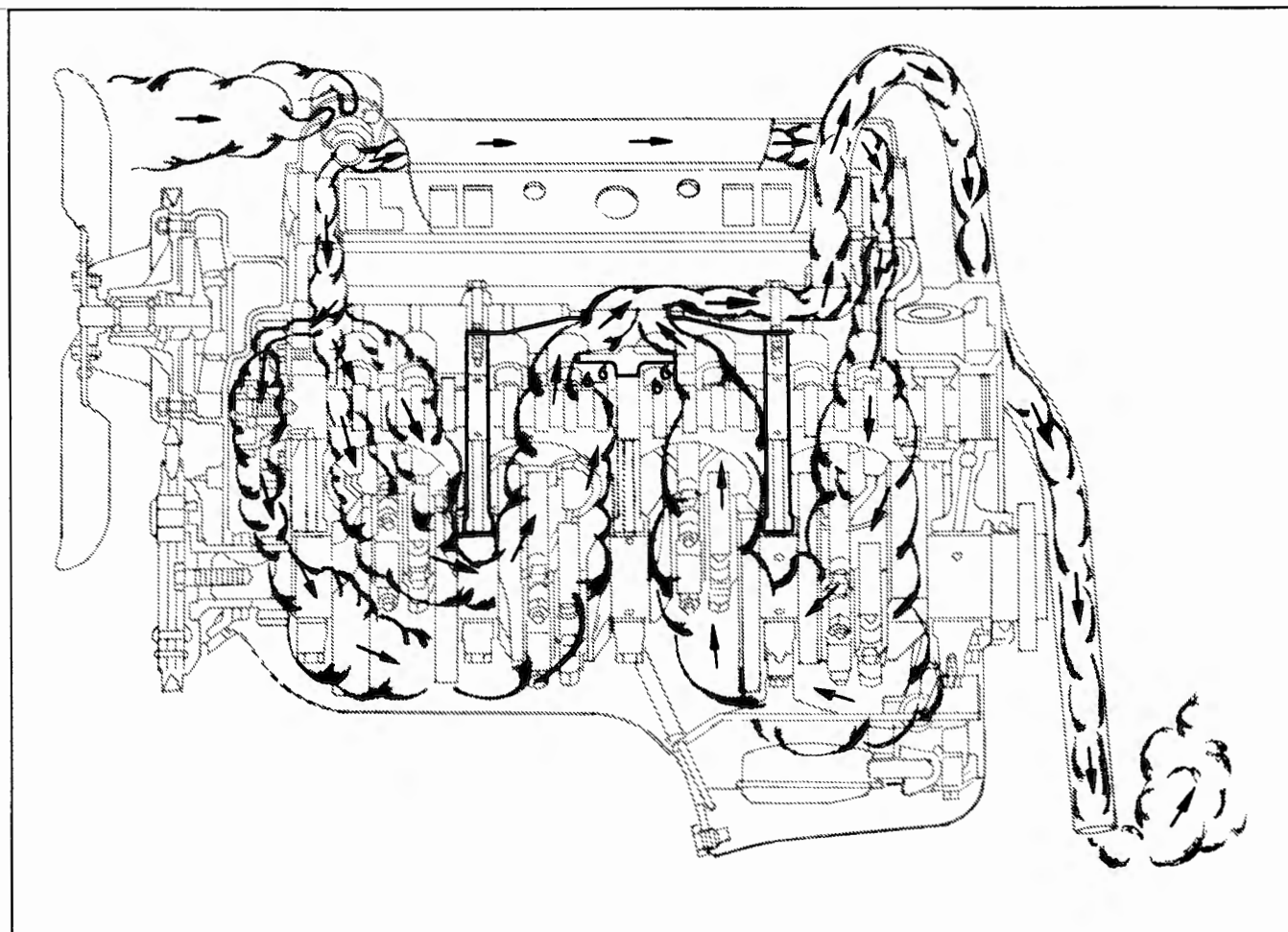


Fig. 6A-7 Crankcase Ventilation System

Air is forced into the engine through an air inlet in each rocker arm cover. The inlets, which also serve as oil filler caps, are located at the front of the rocker arm covers where they receive direct blasts of air from the fan. Filter elements in the air inlet insure the circulation of clean air through the engine.

The flow of air through the crankcase is aided by the suction type air outlet which exhausts vapors and fumes beneath the car.

Air entering the inlets circulates along the top of the cylinder head inside the rocker arm covers. Cast openings at the front and rear of each cylinder head allow air to be forced down into the area of the block below the push rod cover. This area is sealed from the crankcase in the center by the crankcase ventilator lower baffle. At the front and rear of this chamber, however, the air passes down into the crankcase. The solid transverse members for the front center and rear center main bearings serve as baffles, forcing the air to pass all the way

down into the crankcase. The air then passes under these transverse members and up through the middle of the block into an opening in the crankcase ventilator lower baffle. From the lower baffle the air passes through a passage inside the push rod cover and out the outlet pipe.

Air passing down into the block at the front circulates into the timing chain cover through a hole near the top of the block. The ventilating air then circulates down around the timing chain and sprockets and into the crankcase.

Cast fins in the block in the path of the exhausting air serve to precipitate oil which has been picked up and carried in the air. An oil separator or baffle chamber inside the push rod cover further insures against excessive oil being carried out of the engine with the ventilating air. To guard against dirt entering the ventilator outlet pipe due to reverse air circulation when the engine is stopped a cleaner is available for the outlet pipe.

## PERIODIC SERVICE

### ENGINE OIL

See General Lubrication Section.

### OIL FILTER

The filter element should be replaced every 15,000 miles or once per year to insure best filter performance. To replace filter element, raise car and proceed as follows:

1. Remove filter drain plug (Fig. 6A-8) and allow oil to drain out of housing.



Fig. 6A-8 Oil Filter Drain Plug

2. Loosen filter element housing bolt and remove housing by unscrewing the bolt. Let the housing turn with bolt for convenience.

3. Remove filter element from housing and wash housing thoroughly. Make sure gasket surface at top of housing is free of dirt or burrs which could cause a leak.

4. Replace gasket in base with a new one.

5. Install new AC Type PF-122 filter element in housing and install housing on filter base with drain plug away from engine. Tighten housing bolt securely.

6. Fill crankcase with six quarts of oil, start engine, and check to see that there are no leaks around top of filter housing.

### CRANKCASE VENTILATOR INLETS AND OUTLET

See "General Lubrication", page 0-1.

### CHECKING AND FILLING COOLING SYSTEM

No periodic check of coolant level is necessary or desirable. The coolant level should be considered

correct as long as the temperature gauge does not indicate overheating.

Always allow the cooling system to cool to normal before removing the cap. When removing filler cap, rotate cap toward left very slowly; if there is pressure in the system, tighten cap immediately and wait for system to cool sufficiently to allow removal of cap. See "CAUTION", page 6A-2.

When filling radiator do not bring level above three inches from the top of the filler neck. This air space is required for expansion and contraction and if the space is not left, coolant will be lost out the overflow.

### FLUSHING COOLING SYSTEM

1. Drain radiator and block by opening drain cocks on radiator lower tank and on both sides of engine block.

2. After system is empty and with drains open, run water into radiator. Engine should be running and should be occasionally accelerated as this will aid in circulating water and dislodging rust and scale. **CAUTION:** Do not introduce cold water into a hot engine or block may be cracked. Allow engine to cool, then add water with engine running.

3. Where there is difficulty in getting water to run clear or there is an excessive amount of rust and scale, the cooling system should be cleaned with a cleanser supplied for that purpose by a reputable source. If force flushing equipment is used it should be used on the **RADIATOR ONLY** (engine to radiator inlet and outlet hoses removed) as any reverse flushing of the block with the water pump in place may cause the water pump seal to leak, if flushing pressure is excessive.

4. After flushing and refilling cooling system with water, add rust inhibitor unless anti-freeze containing rust inhibitor is to be added to cooling water.

### PREPARING COOLING SYSTEM FOR ANTI-FREEZE

The cooling system should be properly prepared for the addition of anti-freeze each fall.

To properly prepare cooling system:

1. Bring engine up to operating temperature.
2. Flush out cooling system as instructed previously.

3. Tighten all hose connections on radiator, heater and defroster. Replace any deteriorated hose. Check to see that radiator hold down bolts are tightened properly.

4. Fill system with water and operate engine, checking for water leaks at radiator core, hose connections, water pump seal and gaskets, heater and defroster connections, and head to block joint.

5. Drain sufficient water to allow addition of proper quantity of anti-freeze.

### ADDING ANTI-FREEZE TO COOLING SYSTEM

**CAUTION:** Salt solutions, such as calcium or magnesium chloride, sodium silicate, etc., honey, glucose, and sugar solutions, and oils or kerosene are not satisfactory for use as anti-freeze compounds in automotive cooling systems.

In selecting anti-freeze for winter operation, the local conditions and type of service should be considered. Pontiac has released two types of anti-freeze, Methanol (volatile type) and Ethylene-Glycol (non-volatile type).

The volatile type (synthetic methanol) is for the owner who can satisfy his requirements with a low priced volatile anti-freeze. It is subject to some evaporation on heavy runs on warmer days so that the solution must be periodically checked and replenished if loss by evaporation has occurred. Volatile anti-freeze will damage car finish if it should contact the same. **CAUTION:** If volatile anti-freeze compound is accidentally spilled on the car finish, it should be immediately flushed off with a large quantity of clear, cold water.

The pressure cap used on the Pontiac cooling system largely overcomes the difficulty of evaporation with volatile anti-freeze except under high temperature driving or where the high opening thermostat is used. With the pressure cap, evaporation is retarded due to raising the boiling point of the solution and it becomes possible to use volatile anti-freeze under most driving conditions.

Non-volatile Anti-Freeze is non-evaporating. For this reason it will not be boiled away by the higher temperatures resulting from very hard drives on warm days or from use of the high opening thermostat.

Non-volatile Anti-Freeze, although not subject to loss by evaporation, should not be left in the cooling system indefinitely inasmuch as the rust inhibitor in the anti-freeze will become exhausted and rusting in the cooling system will result.

### TESTING ANTI-FREEZE

In using a hydrometer to determine the freezing point of radiator solution, make sure the correct hydrometer markings are read. Unless hydrometer is provided with means for temperature correction, test should be made at the temperature at which hydrometer is calibrated, for if the solution is warmer or colder large errors may result (in some cases as much as 30°F.). Most good hydrometers are equipped with a thermometer and temperature correction scale which allows an accurate test of freezing point over a range of temperatures. **NOTE:** It is especially important to flush and check the cooling system for leaks when anti-freeze is used because of the possibility of damage to engine parts should it reach the interior of the engine.

## MINOR REPAIRS

### REMOVE AND INSTALL THERMOSTAT

1. Drain radiator, disconnect upper hose and remove water outlet fitting from intake manifold.
2. Remove thermostat. Before replacing thermostat with new one, test it unless obviously defective.
3. Install thermostat with pillet or cartridge projecting down into water passage in intake manifold.
4. Using new gasket, install water outlet fitting.
5. Connect upper radiator hose.
6. Refill radiator to approximately three inches from top and check for leaks.

### REMOVE AND INSTALL OIL PUMP

1. Remove engine oil pan.
2. Remove oil pump attaching screws while holding oil pump in place. Carefully lower oil pump away from block with one hand while removing oil pump drive shaft with other hand.



3. To install pump, position drive shaft into position in distributor and oil pump drive gear; then position oil pump in place on block using new gasket between pump and block and indexing drive shaft with pump drive gear shaft. Install two attaching screws with lock washers and tighten securely. **NOTE:** Removal and installation of pump does not affect distributor timing since the oil pump and distributor drive gear is mounted on the distributor shaft.

4. Install oil pan.

#### REMOVE AND INSTALL OIL FILTER ASSEMBLY

1. Remove oil pressure gauge line from fitting on filter base, remove three attaching screws with lockwashers and flatwashers, and remove filter assembly and gasket.

2. If new filter base is to be installed, transfer gauge fitting elbow from old to new base.

3. Position gasket and filter assembly on engine. (Replace gasket if damaged.)

4. Install three attaching screws with flatwashers and lockwashers, and tighten securely.

5. Attach oil pressure gauge line.

#### REMOVE AND INSTALL RADIATOR

1. Drain water from radiator.

2. Remove attaching screws which fasten fan shroud to radiator and move fan shroud out of way.

3. Disconnect upper and lower radiator hose and heater hose from radiator, using Tool J-5284.

4. Remove radiator to support attaching screws.

5. Remove radiator by pulling up and out of radiator support. **NOTE:** If removing Hydra-Matic transmission radiator, disconnect the inlet and outlet oil hose and plug openings with a cork or similar plug.

6. Install radiator by reversing above steps, and after refilling radiator run engine for a short period of time and check for leaks. If Hydra-Matic transmission radiator, recheck transmission oil level.

#### REMOVE AND INSTALL WATER PUMP

**NOTE:** Water pump is serviced only as an assembly.

1. Drain radiator and engine block.

2. Loosen generator at adjusting strap and remove fan belt from fan pulley.

3. Remove fan and pulley.

4. Remove water pump retaining nuts and lockwashers and remove pump.

5. Install pump by reversing above steps. When pump is installed on engine, drain hole will be at bottom. Tighten water pump attaching nuts to 15 lb. ft. torque.

## OVERHAUL

### OIL PUMP AND SCREEN

#### DISASSEMBLY

1. Remove cotter pin which retains floating screen to oil pump inlet, and remove screen (Fig. 6A-9).

2. Remove pressure regulator spring retainer, spring, and pressure regulator ball.

3. Remove screws retaining cover to oil pump body and remove cover.

4. Remove driven gear and drive gear with shaft.

#### CLEANING AND INSPECTION

1. Clean all parts thoroughly. Screen must be thoroughly cleaned by using Gulf Motor Flush, Bendix Cleaner, or equivalent.

2. Inspect pressure regulator spring (Fig. 6A-9) for distortion, cracks, and wear on sides.

3. Inspect pressure regulator ball to see that it is not nicked or otherwise damaged.

4. Visually inspect pump body, driven gear shaft and cover for evidence of wear.

5. Inspect pump gears and end of drive gear shaft for wear.

6. Inspect oil pump drive shaft (distributor to pump shaft) for evidence of wear and cracks.

#### ASSEMBLY

1. Install drive and driven gears.

2. Install cover and turn driveshaft by hand to insure that it turns freely and has a slight amount of end play.

3. Install pressure regulator ball, spring and retainer. **CAUTION:** Do not attempt to change oil pressure by varying length of pressure regulator valve spring.

4. Install screen assembly on oil pump and install new cotter pin retainer.

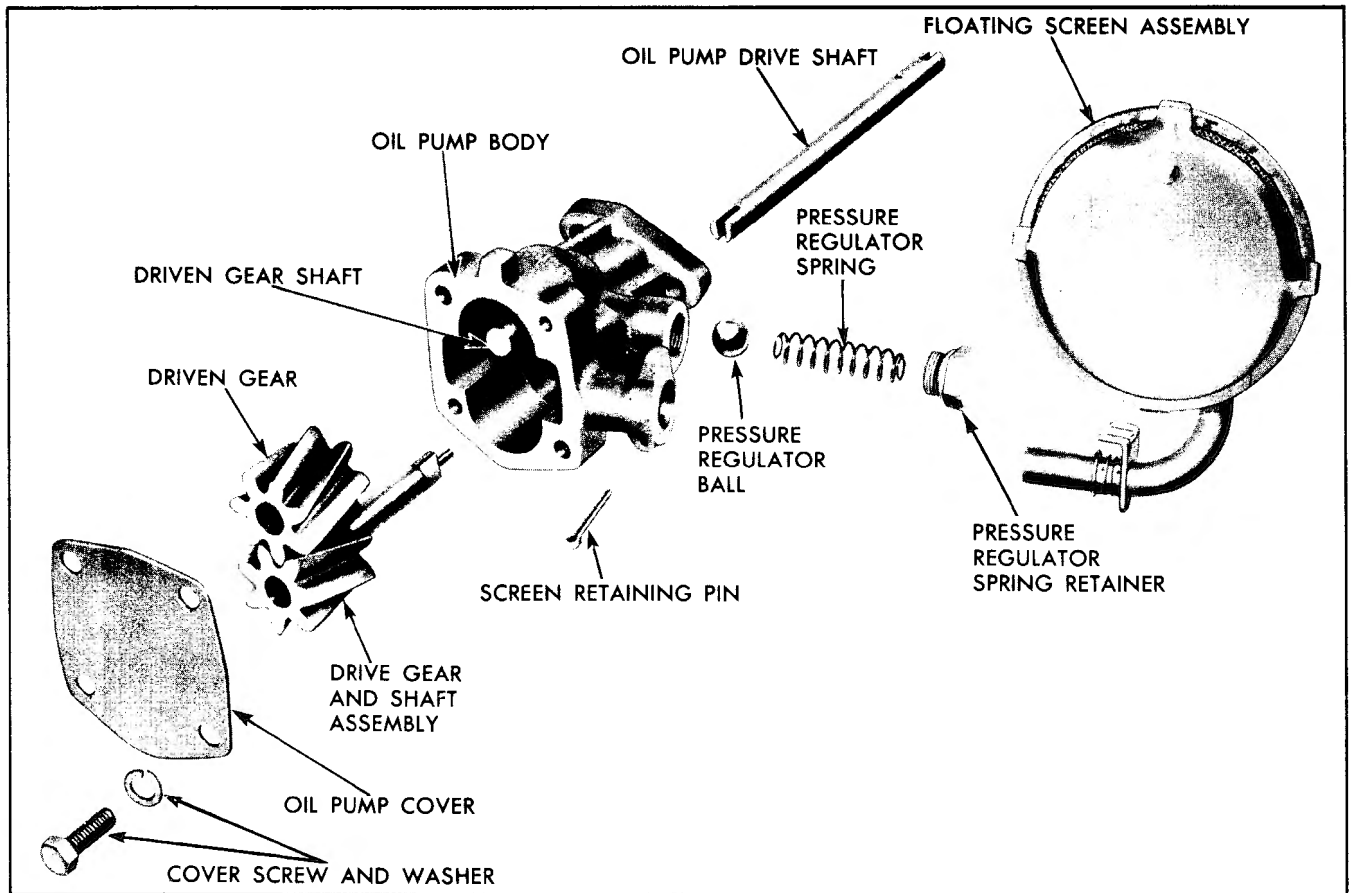


Fig. 6A-9 Exploded View of Oil Pump

## TROUBLE DIAGNOSIS

### SYMPTOM

- High temperature for short time after warm-up.
- Temperature indicator shows "Hot" during normal driving.
- Cooling system loses water.

### CAUSE

- Normal pressure build-up in cooling system during warm-up.
- Test actual temperature of water in radiator with a thermometer. If temperature is normal check for defective gauge as outlined in Section 12.

  1. Make sure owner is not trying to keep radiator filled to top, and is not filling while cold. The expansion and contraction of water during operation will cause level to drop to several inches below the top of the filler neck. Once the level becomes stabilized it will not change appreciably during operation.
  2. Check for leaks from radiator or hose connections, including heater.
  3. Check for crack in block. Pull engine oil dipstick to check for water in crankcase.
  4. Remove rocker arm covers and check for cracked cylinder head.
  5. Remove cylinder heads and check gaskets. While heads are off, check for cracks in heads or block.

**SYMPTOM**

**CAUSE**

Buzzing noise from radiator cap.

This is caused by the relieving of excessive pressure when radiator boils. Check causes of overheating.

Overheating (coolant actually boils).

1. Check engine thermostat.
2. Check for driving conditions which may cause overheating. Prolonged idling, start and stop driving in long lines of traffic on hot days, climbing steep grades on hot days, etc. will occasionally cause coolant to boil.
3. Check engine operation to make sure tune-up is not needed. Timing retarded past TDC may cause overheating.
4. Check fan belt for excessive looseness.
5. Clean bugs from radiator.
6. Clean cooling system as outlined on page 6A-7.
7. Remove cylinder heads and check water passages in heads and block for obstructions.

**SPECIFICATIONS**

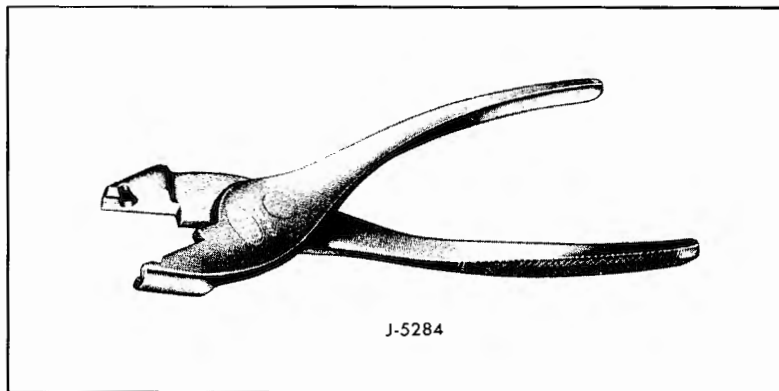
**COOLING SYSTEM**

Type .....	Pressure with vent
Operating Pressure (Except Air Conditioning) .....	13 psi
Operating Pressure (Air Conditioning) .....	15 psi
Pump Type .....	Centrifugal
Pump and Fan Drive .....	V-Belt
Pump Bearings .....	Sealed Ball Bearings
Radiator Type .....	Tube and Center
Core Area Standard .....	389 sq. in.
Core Area w/Air Conditioning .....	429 sq. in.
Core Thickness .....	1¾"
Thermostat .....	170°
Fan Diameter Standard .....	19"
Fan Diameter w/Air Conditioning .....	20.5"

Number of Blades Standard .....	4
Number of Blades w/Air Conditioning .....	5
Belt Adjustment .....	Generator link
Capacity of System All Models .....	21½ qts.
Capacity of System w/Underseat Heater .....	23 qts.
Capacity of System w/Air Contioning .....	22¼ qts.
Capacity of System w/Air Conditioning and Underseat Heater .....	23¾ qts.

**LUBRICATION SYSTEM**

Type .....	Pressure
Pressure at 40 mph .....	35-45 psi
Lubricant Capacity When Refilling .....	5 qts. (6 qts. if filter element is changed)
Pump Type .....	Helical Gear



J-5284

**SPECIAL TOOLS**

J-5284 Corbin Hose Clamp Pliers