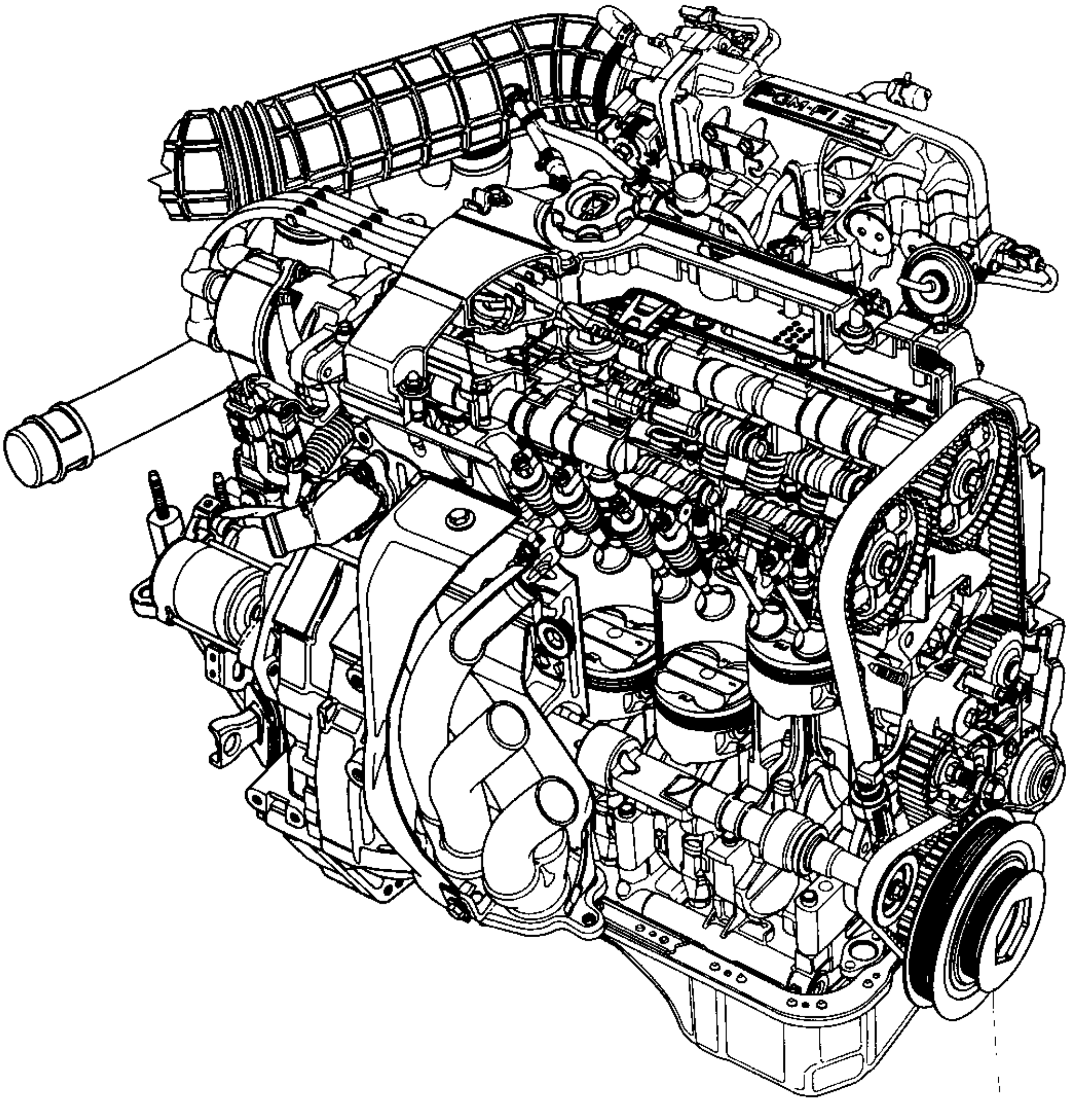
# Outline

## Description

The new H22A1 engine is an in-line 4-cylinder DOHC design displacing 2,157 cm³ (131.6 cu-in). It is water cooled and equipped with a center plug type pent-roof combustion chamber. It is specified to use premium unleaded fuel and uses a PGM-FI (Sequential Multiport Fuel Injection) system. This engine incorporates a mechanism called Honda Variable Valve Timing and Valve Lift Electronic Control (VTEC) System.
This system allows the timing and lift of the intake and exhaust valves to be changed simultaneously. The engine also includes a electronically-controlled intake manifold system that varies the volume of the intake chamber.



**Major Specifications**

| | |
|---|---|
| Type | Water cooled 4-stroke, In-line 4-cylinder gasoline engine |
| Displacement | 2,157 $cm^3$ (131.6 cu-in) |
| Bore x Stroke | 87.0 x 90.7 mm (3.43 x 3.57 in) |
| Compression Ratio | 10.0 : 1 |
| Cam, Valve Mechanism | Dual over-head camshaft, VTEC |
| Valve Train | Belt Driven |
| Fuel Supply System | Sequential Multiport Fuel Injection (SFI) |

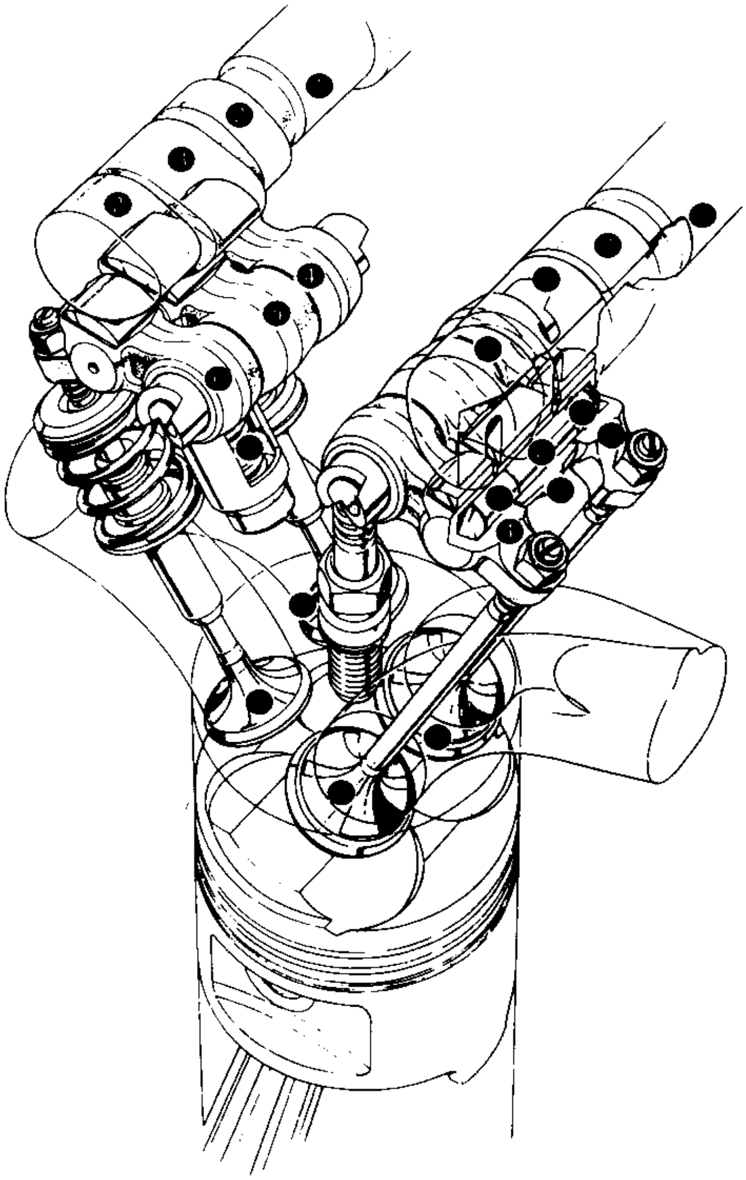
**Main Features:**

- The cylinder head is made of aluminum alloy, a center plug type, pentroof-shaped combustion chamber is used, and the 4-valve system uses 2 intake valves and 2 exhaust valves.
- The camshafts and the valve train are driven with the timing belt, and the two balancer shafts are driven by the timing balancer belt. Belt tension is automatically adjusted.
- The cylinder block is made of aluminum alloy using fiber reinforced metal (FRM) sleeves.
- The crankshaft is made by forging, the mainshaft is supported at five points and has eight balancer weights.
- The balancer shafts employ a gear-type reverse mechanism to reduce secondary engine vibration.
- The intake manifold is made of aluminum alloy, and the heat riser is used for heating the air/fuel mixture.
- The exhaust manifold is made of stainless steel.
- The electronic fuel injection system is of a sequential maltiport fuel injection type and injects fuel into all four cylinders, the throttle body is of a one-barrel side-draft type.
- The ignition system is a fully-transistorized, contactless type. The spark advance is electronic.
- The air cleaner is equipped with a resonator.
- The radiator is of a corrugated type, and the cooling fan is electrically powered.

# VTEC

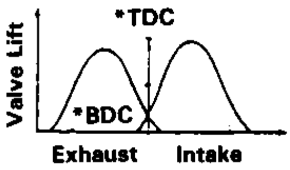
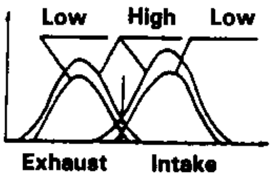
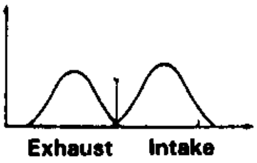
## Outline

The engine is equipped with multiple cam lobes per cylinder, providing one valve timing and valve lift profile at low speed and a different profile at high speed. Switch-over from one profile to the other is controlled electronically, and is selected by monitoring current engine speed and load.



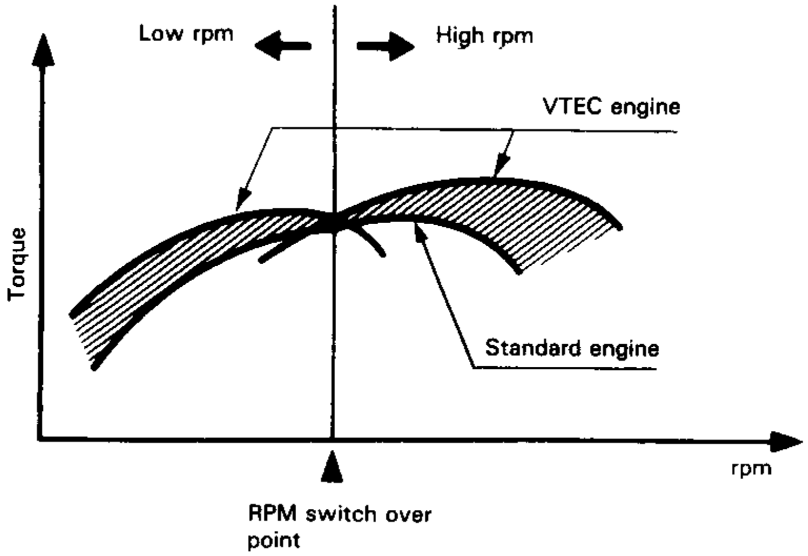
● **CAMSHAFT**
● **CAM LOBES FOR LOW RPM**
● **CAM LOBES FOR HIGH RPM**
● **PRIMARY ROCKER ARM**
● **MID ROCKER ARM**
● **SECONDARY ROCKER ARM**
● **HYDRAULIC PISTON (A)**
● **HYDRAULIC PISTON (B)**
● **STOPPER PISTON**
● **LOST MOTION ASSEMBLY**
● **EXHAUST VALVE**
● **INTAKE VALVE**

In general, it would be ideal if the high rpm performance of a racing engine and the low rpm performance of a standard passenger car engine could be combined in a single engine. This would result in a maximum performance engine with a wide power band. Two of the major differences between racing engines and standard engines are the timing of the intake/exhaust valves and the degree of valve lift. Racing engines have longer intake/exhaust timing and a higher valve lift than standard engines. The Honda Variable Valve Timing and Valve Lift Electronic Control System takes this into account. When valve actuation is set for low rpm timing and lift, low rpm torque is better than in a standard engine. When valve actuation is then switched for high rpm timing and lift, output improves to the level given by a racing engine. Until now, few variable valve timing systems have been commercialized. In those that have, only the time that both valves are open (intake/exhaust overlap) could be changed. Honda's system is the first in the world in which both the valve timing and the degree of valve lift can be changed as needed, making it the most advanced valve train mechanism available.

| | Racing Engine | VTEC Engine | Standard Engine |
|---|---|---|---|
| Valve Timing<br>(exhaust/intake)<br>Valve Lift |  |  |  |
| Max. Power | ○ | ○ | |
| Low rpm Torque | | ○ | ○ |
| Idling Stability | | ○ | ○ |

*TDC = Top Dead Center *BDC = Bottom Dead Center
○ = Optimum Characteristic

The engine is equipped with two valve timing and valve lift settings which change according to driving conditions.

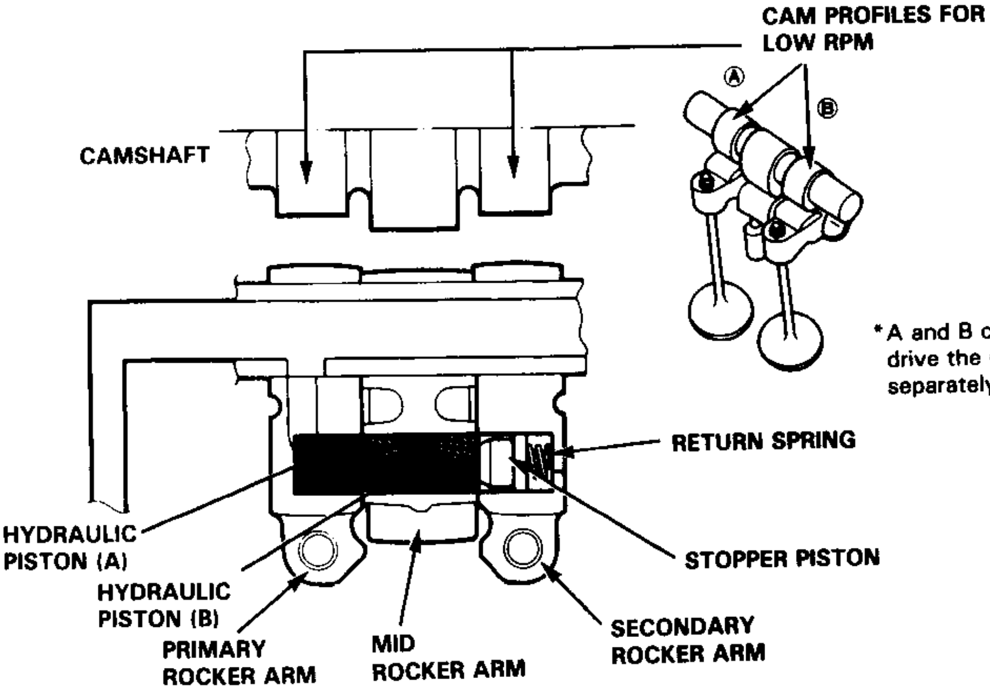


# VTEC

## Mechanism

At Low rpm:
As shown, the primary and secondary rocker arms are not connected to the mid rocker arm but are driven separately by cam lobes A and B at different timing and lift. Although the mid rocker arm is following the center cam lobe with the lost-motion assembly, it has no effect on the opening and closing of the valves in the low rpm range.

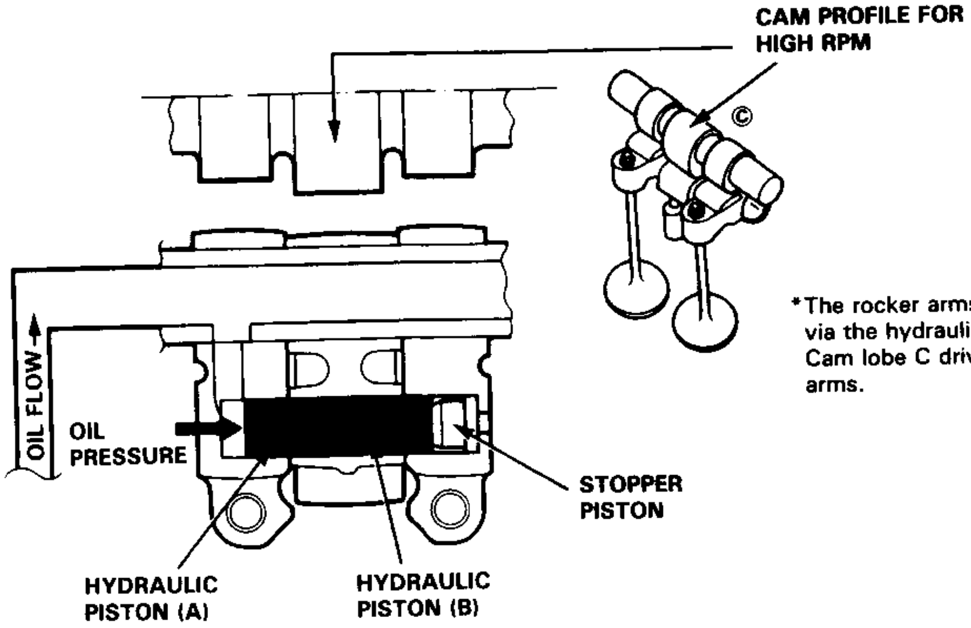
**At Low rpm:**



*A and B cam lobes drive the rocker arms separately.

At High rpm:
When driving at high rpm, piston (A) moves in the direction shown by the arrow in the figure below. As a result, the primary, secondary, and mid rocker arms are linked by 2 hydraulic pistons (like a skewer) and the 3 rocker arms move as a single unit. In this state, all the rocker arms are driven by cam lobe C, opening and closing the valves at the valve timing and valve lift set for high operation.

**At High rpm:**



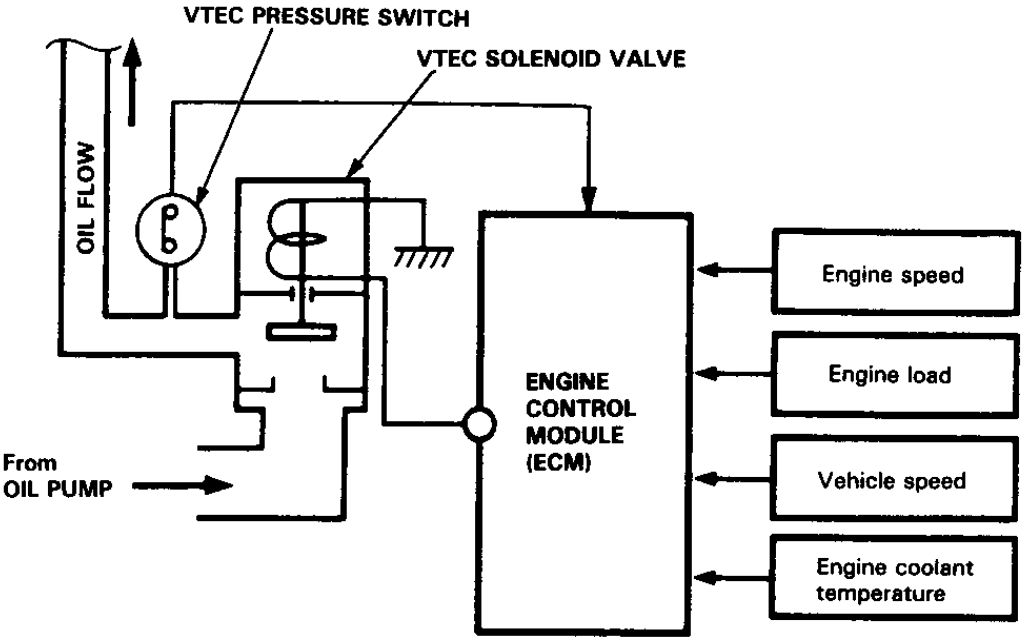
*The rocker arms are linked via the hydraulic piston. Cam lobe C drives the rocker arms.

## Control System

The control system for this mechanism, as shown below, constantly monitors the changes in engine status such as load, rpm and vehicle speed. this information is transmitted to the Engine Control Module (ECM).

**Valve Timing Change Conditions**
**Engine Speed: 4,900 rpm or higher**
**Vehicle Speed: 19 mph (30 km/h) or faster**
**Engine Coolant Temperature: 140°F (60°C) or higher**

Control System

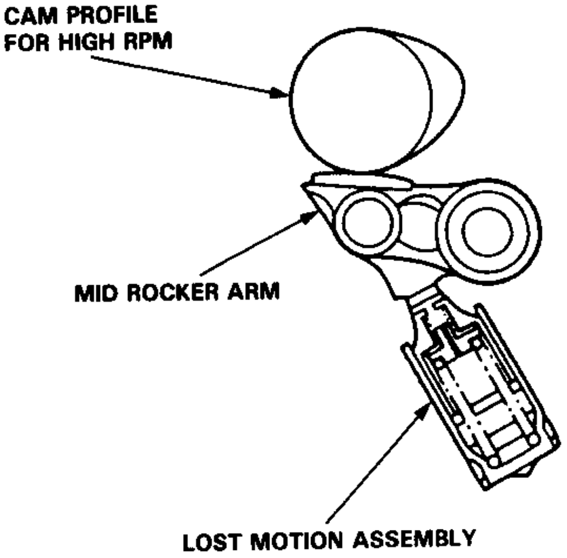


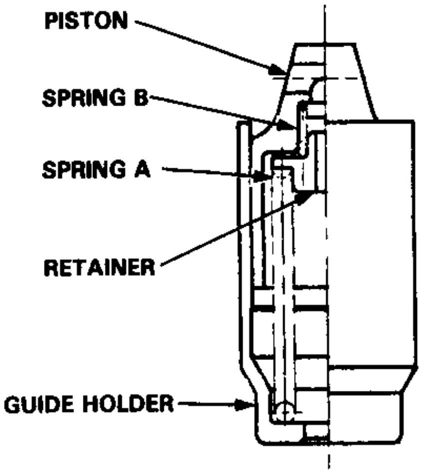
(cont'd)

## Control System (cont'd)

**Lost Motion Mechanism**

The mid rocker arm is always driven by the high-speed cam lobe, even at low speeds. At low speeds, the lost motion mechanism keeps the mid rocker arm in contact with the high-speed cam lobe. At high speeds, the lost motion mechanism acts as part of the valve spring load.



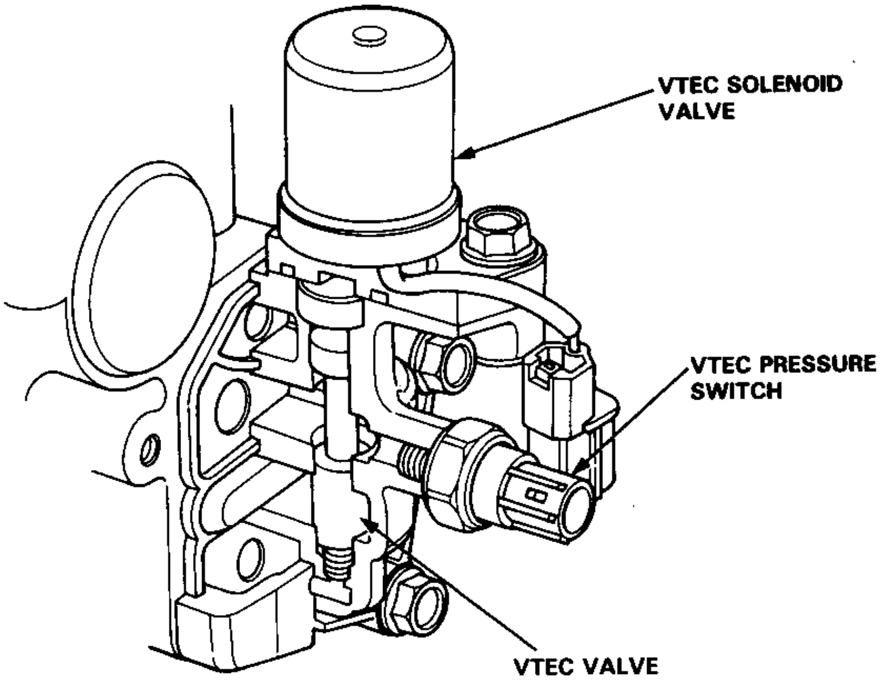


**Hydraulic Pressure Control Mechanism**

VTEC solenoid valve/VTEC pressure switch

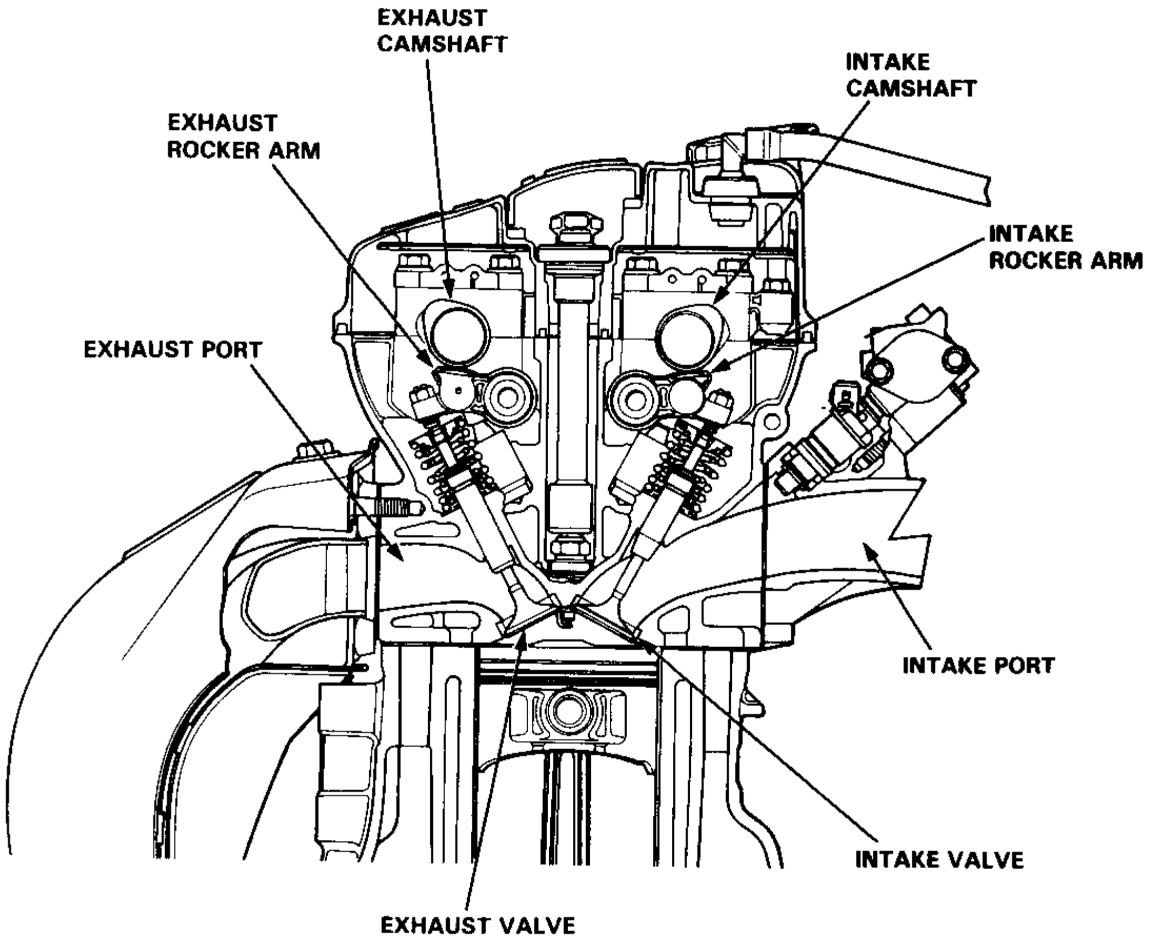
The VTEC solenoid valve, in response to a signal from the ECM, closes the oil passage to the rocker arm at low speed. This cuts oil pressure to the hydraulic pistons in the rocker arms so the arms operate independently. At high speed, the ECM opens the VTEC solenoid valve. The increased oil pressure causes the hydraulic pistons to lock the primary, secondary, and mid rocker arms together.

The VTEC pressure switch serves as a sensor to determine if the switch-over has taken place in response to the ECM signal.



## Outline

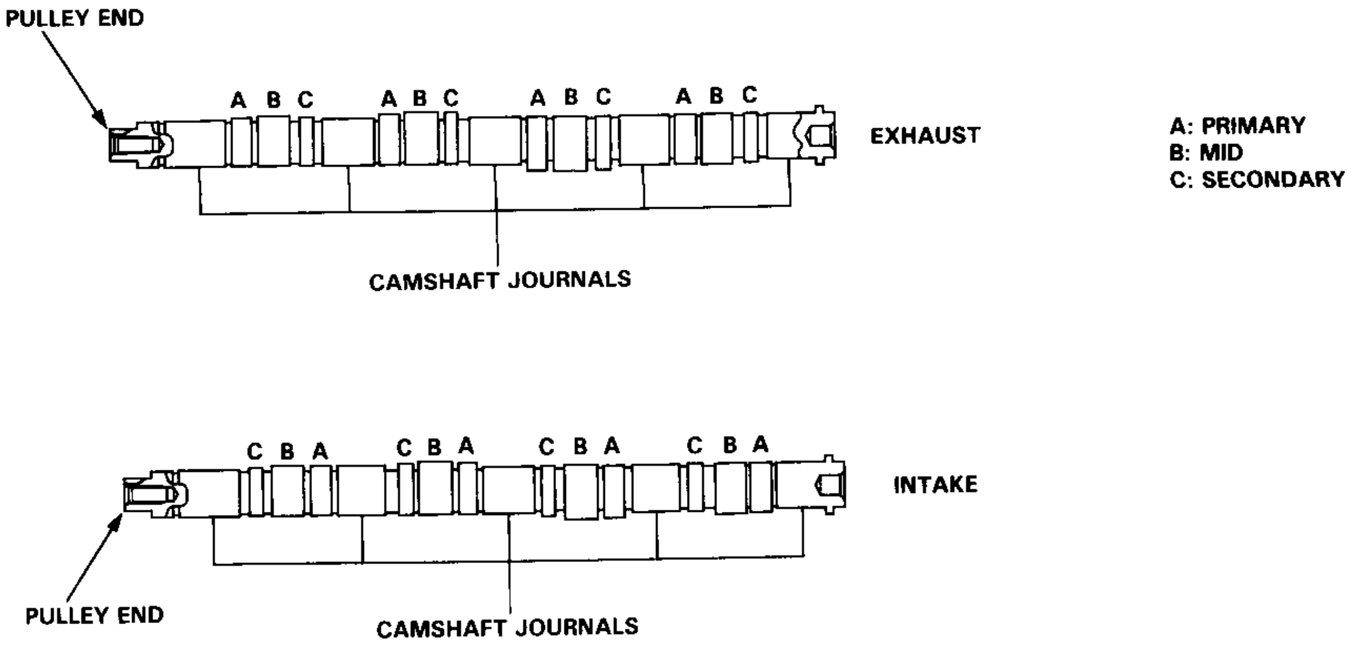
The one-piece cylinder head is made of aluminum alloy to reduce the weight while increasing efficiency.
The combustion chamber is a compact pent roof shape, center plug type. The cylinder head uses a DOHC 4-valve system with 2 intake valves and 2 exhaust valves arranged for cross flow. Combustion is stable due to the optimization of the ignition timing, compression ratio and valve timing.

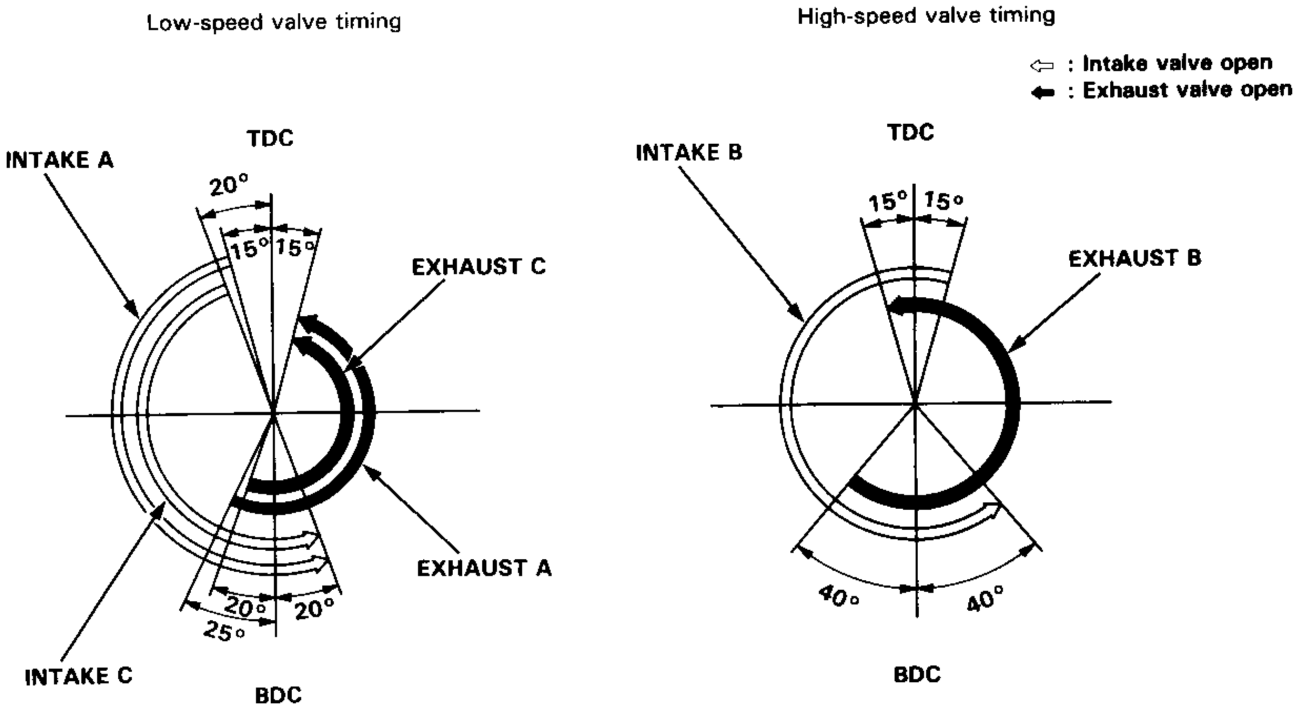


# Cylinder Head

## Camshafts

The camshaft is a cast piece. By improving dimensional accuracy, it became possible to achieve minimum space between cams, thus allowing a more compact cylinder head. Each camshaft is supported on five bearing journals with forced lubrication. On the left end of each camshaft is a driven pulley. The exhaust and intake cycles require a total of 24 cam lobes to open and close the valves.





TDC: Top dead center
BDC: Bottom dead center

## Valves and Valve Springs

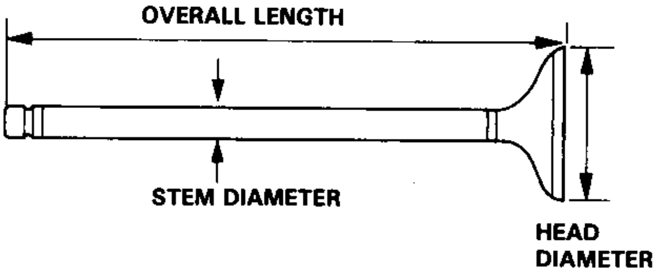
The valves are opened and closed by rocker arms driven by the camshaft.
Light weight and large diameter valves made of a high strength metal with small diameter stems are used. The air resistance is decreased by the slender stems and the intake efficiency is increased by inlet ports that match with large diameter valves.

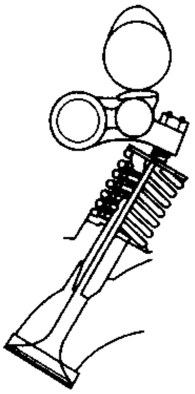
**Valve specifications**

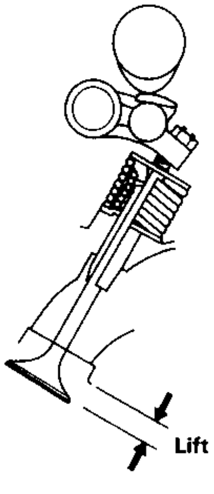
Unit: mm (in)

| ITEM \ VALVE | INTAKE | EXHAUST |
|---|---|---|
| HEAD DIAMETER | 35.0 (1.38) | 30.0 (1.18) |
| STEM DIAMETER | 5.5 (0.22) | 5.5 (0.22) |
| OVERALL LENGTH | 106.75 (4.203) | 106.95 (4.211) |
| VALVE LIFT | Secondary: 8.0 (0.31)<br>Mid: 11.5 (0.45)*<br>Primary: 6.5 (0.26) | Secondary: 7.5 (0.30)<br>Mid: 10.5 (0.41)*<br>Primary: 6.0 (0.24) |

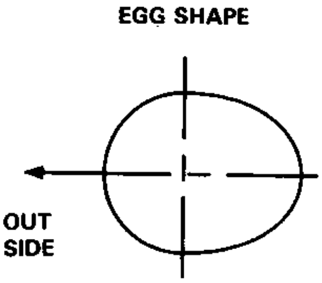
*Indicates high-speed valves

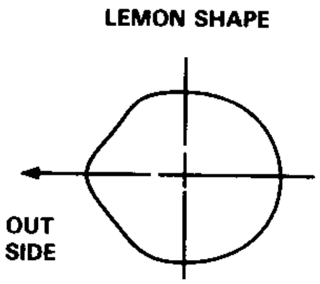






The valve spring wire uses a modified cross-section to valve lift in a limited space.

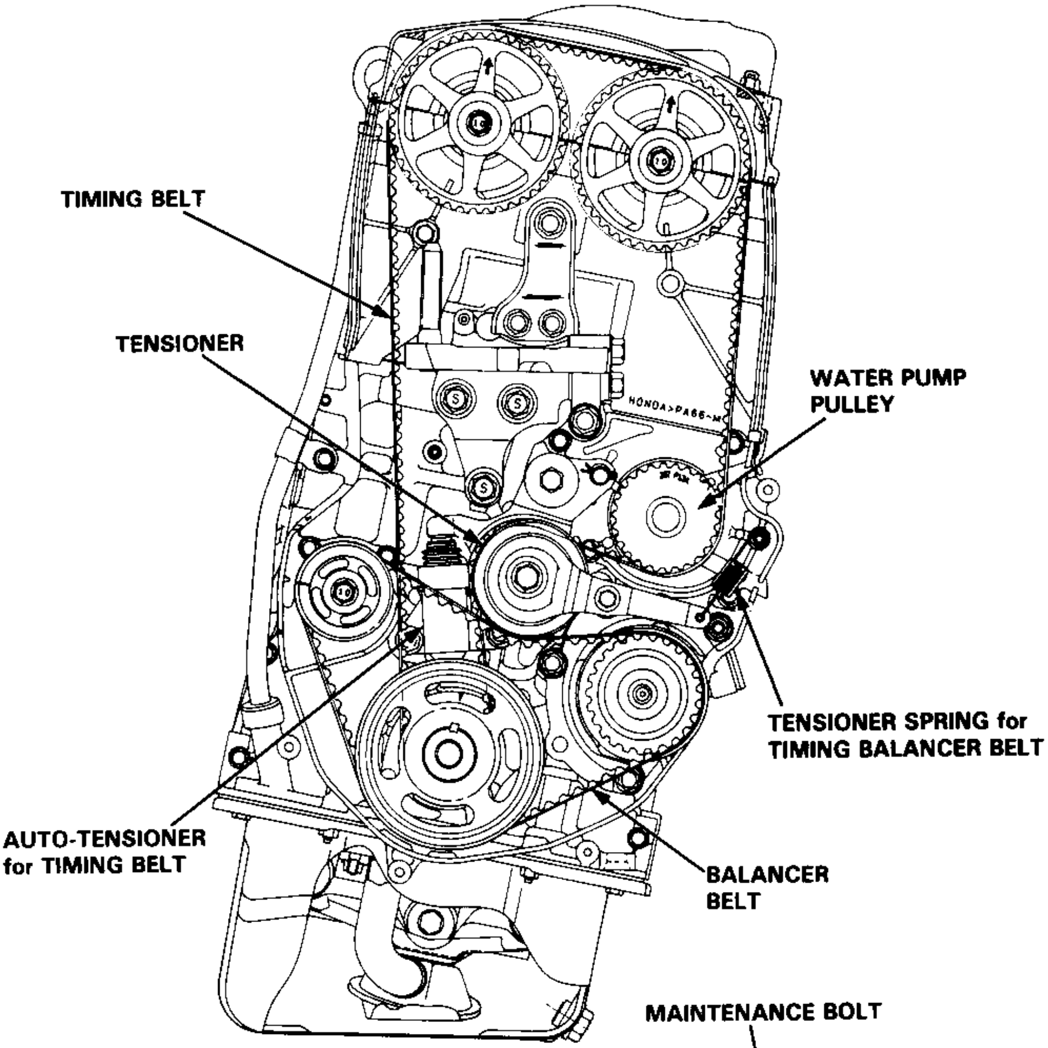


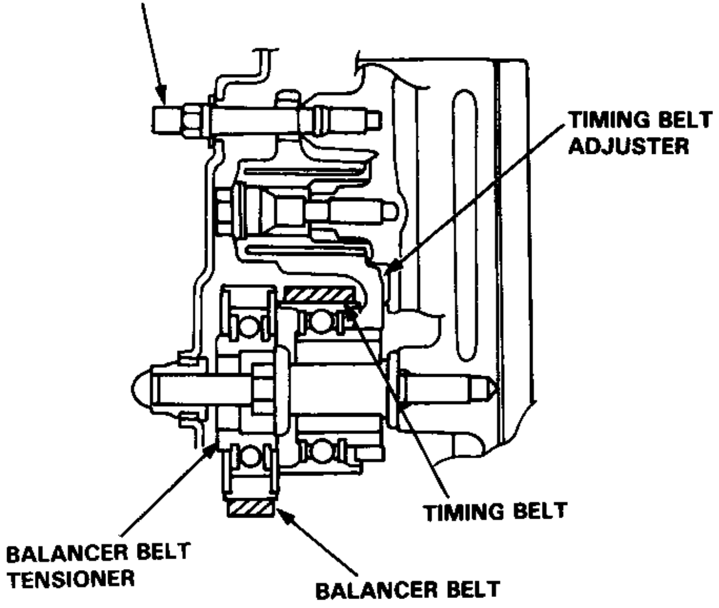


# Belt Tensioner

## Outline

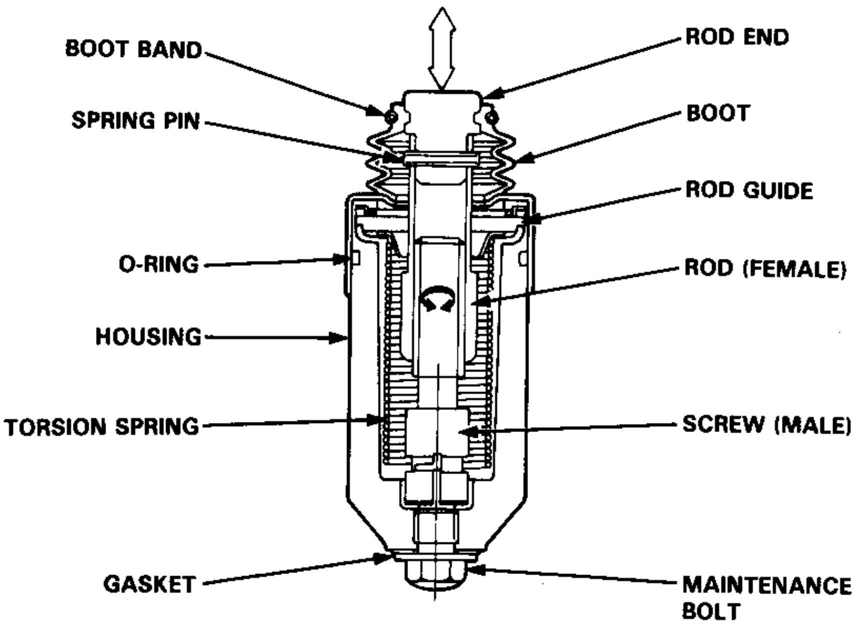
The tensioners for the balancer shaft drive belt and the timing belt are arranged in parallel on a single axis for a more compact configuration. This tensioner allows easy belt maintenance.



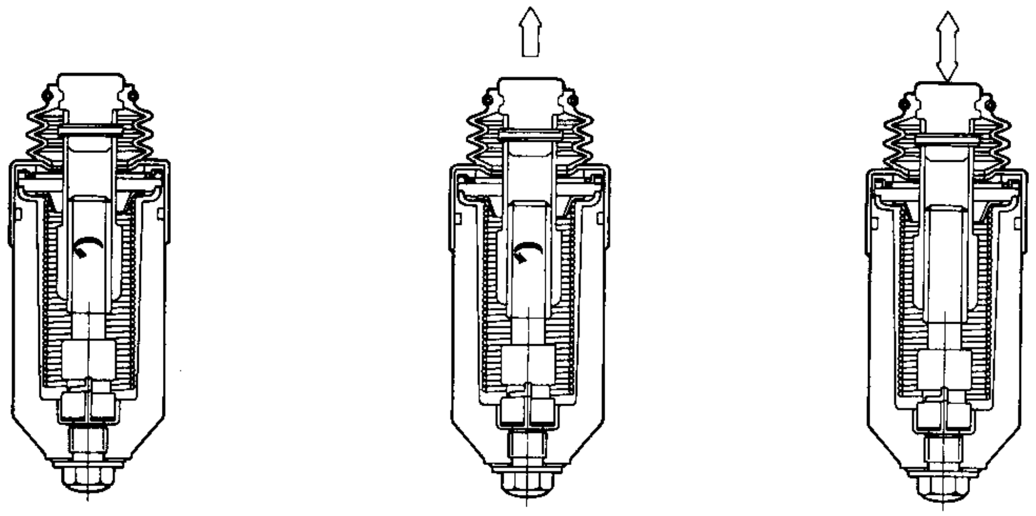


## — Auto-tensioner

The auto-tensioner uses a torsion spring to regulate the timing belt tension. The main components are the torsion spring, a male screw and a female rod. The assembly is filled with oil and sealed. The spring turns the male screw, which pushes the female rod out against the belt. The design is such that the rod cannot be pushed back into the housing by belt tension. To pull the female rod back into the assembly, the male screw must be turned with a screwdriver.



**Mechanism:**



① The male screw is rotated by the torsion spring.

② The female rod is pushed out as the rod rotates.

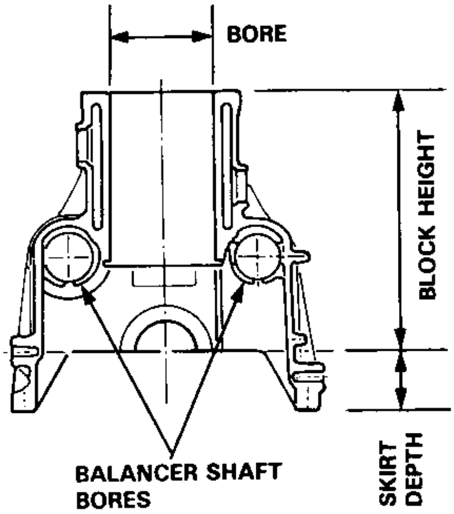
③ The rod stops when the force of the torsion spring and the timing belt equalize.

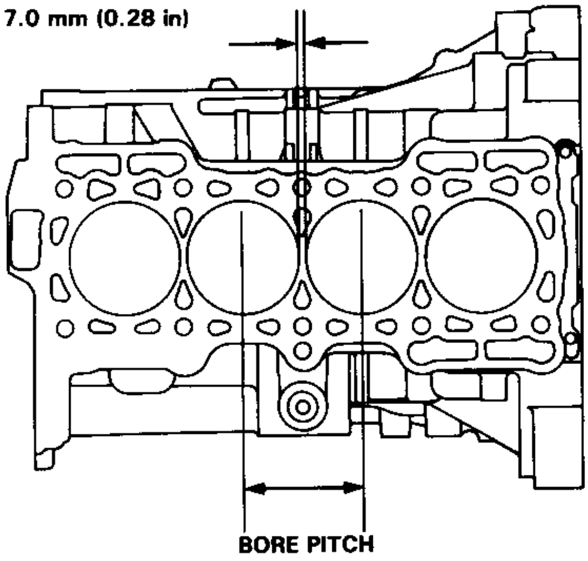
# Cylinder Block

The cylinder block is a closed deck design made of aluminum alloy . The cylinder sleeves are made of FRM, a composite material of aluminum, alumina fiber and carbon fiber. The bores in the cylinder block for the balancer shafts and the deep skirt design improve the rigidity of the block.

**Cylinder specifications**

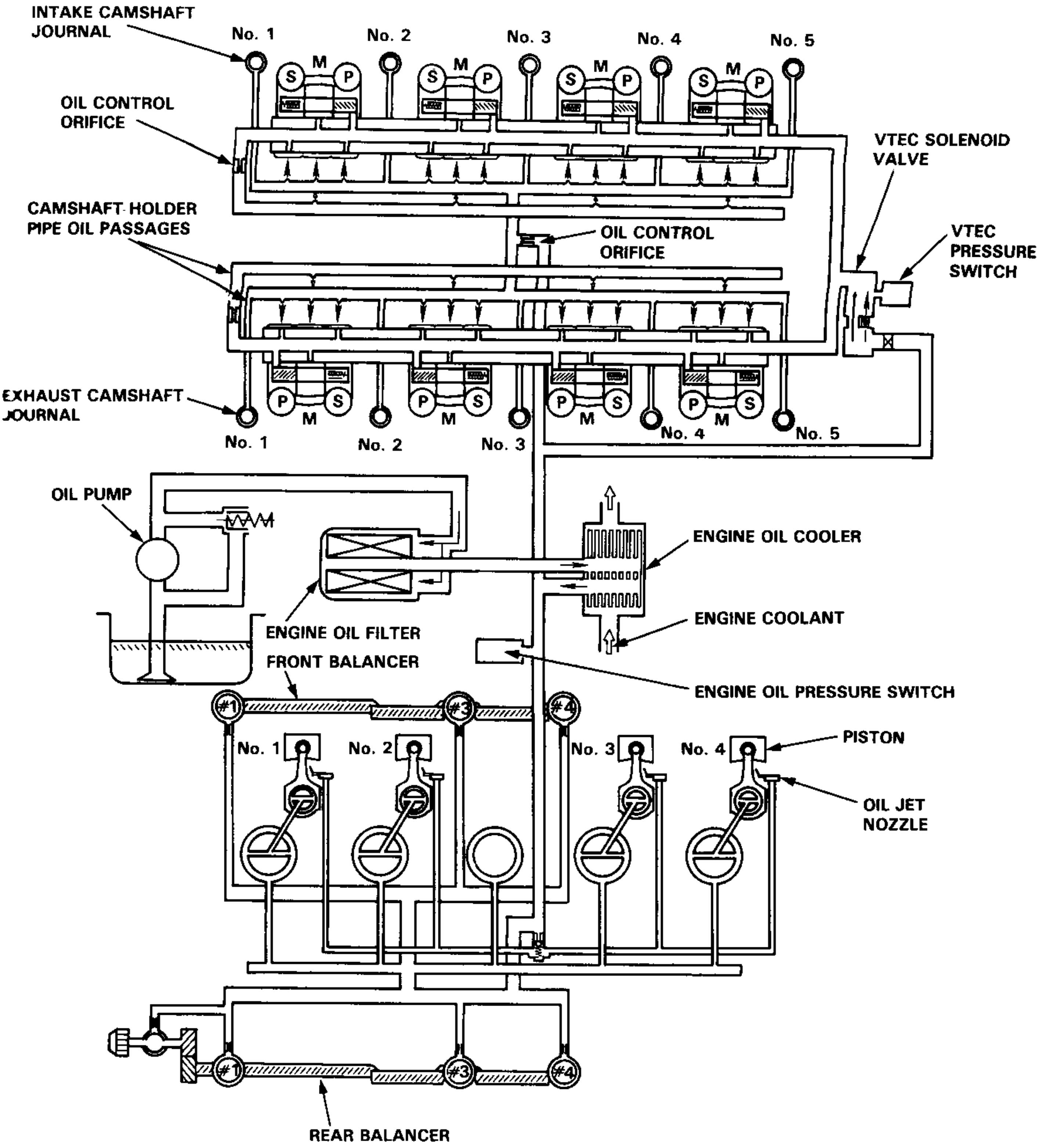
| | |
|---|---|
| Bore x Stroke | 87.0 x 90.7 mm (3.43 x 3.57 in) |
| Bore Pitch | 94.0 mm (3.70 in) |
| Block Height | 219.52 (8.643 in) |
| Skirt Depth | 50.0 mm (1.97 in) |
| Displacement | 2.157 $cm^3$ (131.6 cu-in) |





# Oil Flow

Lubrication of the crankshaft and connecting rod bearings is done by oil pumped through the main bearing caps and into passages in the crankshaft. The pistons and cylinder walls are lubricated by oil spray nozzles mounted on the cylinder block.



(cont'd)

# Oil Flow

## (cont'd)

Oil pumped to the cylinder head serves two purposes; to lubricate the components and to operate the VTEC. Oil is pumped into the camshaft holder to lubricate the journals, and it sprays from orifices in the holder to lubricate the rocker arms and valves. Oil is also supplied to the VTEC solenoid valve. At high RPM, this valve opens and oil is pumped at high pressure through the rocker arm shafts to operate the VTEC.