■FEATURES OF 2RZ-FE, 3RZ-F AND 3RZ-FE ENGINES

Features of the 2RZ-FE, 3RZ-F and 3RZ-FE engines are as follows:

Features	Contents
High Performance and Fuel Economy	● Direct-drive DOHC with a 4-valve cross-flow layout. ● Pentroof type combustion chamber plus high compression ratio. ● EFI system with a hot-wire type mass air flow meter*1. ● Rotary solenoid type ISC system and ESA system for precision in accordance with engine operating conditions*1.
Low Noise and Vibration	● 2 balance shafts built into the cylinder block*2. ● A highly rigid full balance crankshaft assembly and cylinder block. ● A coupling fan with a 3-stage temperature-controlled fluid coupling.
Lightweight and Compact Design	● A scissors gear mechanism for the camshaft reduces the size of the cylinder head. ● An aluminum radiator core is used.
Good Serviceability and High Reliability	● Outer shim type valve lifters and adjusting shims. ● A single timing chain with superb wear resistance. ● Aluminum alloy bearings for the connecting rods and the crankshaft. ● DIS (Direct Ignition System) is used*1. ● M-OBD (Multiplex On-Board Diagnosis) system is adopted.

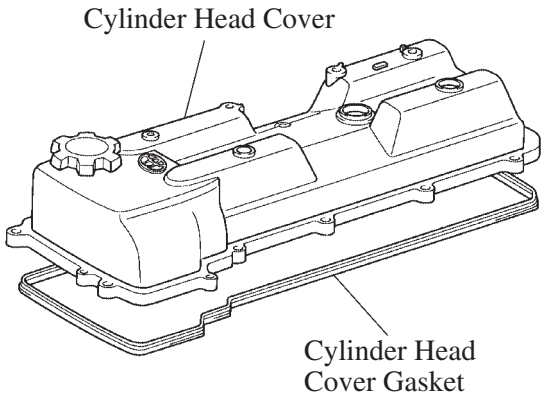
*1: Only for 2RZ-FE and 3RZ-FE Engine
*2: Only for 3RZ-FE Engine

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■ENGINE PROPER

1. Cylinder Head Cover

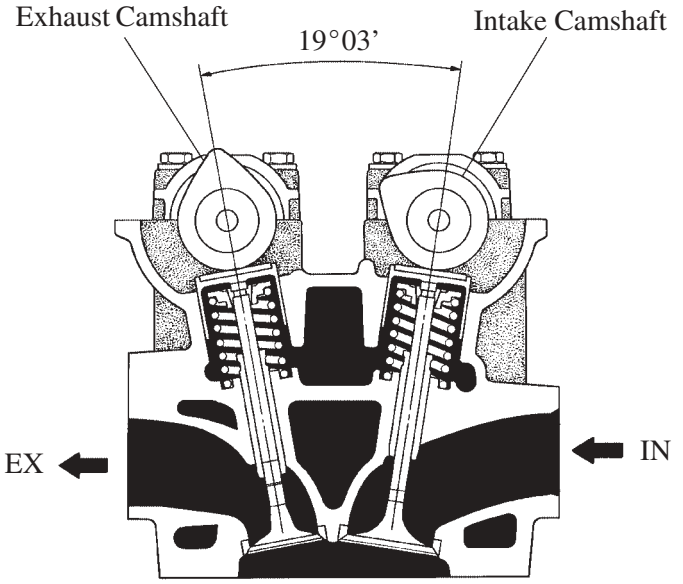
The cylinder head cover which is made of aluminum has adopted numerous curves to achieve compact design and weight reduction.



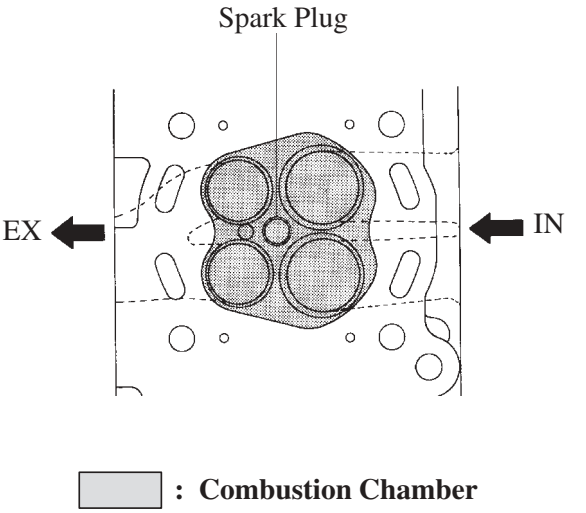
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2. Cylinder Head

- The exhaust camshaft is driven by the intake camshaft gear, and the valve angle has been narrowed to 19°03' to achieve a more compact cylinder head. Pentroof combustion chambers, which permit the spark plugs to be located in the center of the combustion chamber, are also used to improve combustion efficiency.
- An aluminum alloy cylinder head with excellent heat transmission characteristics is used. A cross-flow intake and exhaust layout is used, and 4 valves per cylinder are provided to improve intake and exhaust efficiency.
- Plastic region tightening is used for the cylinder head bolts for good axial tension.



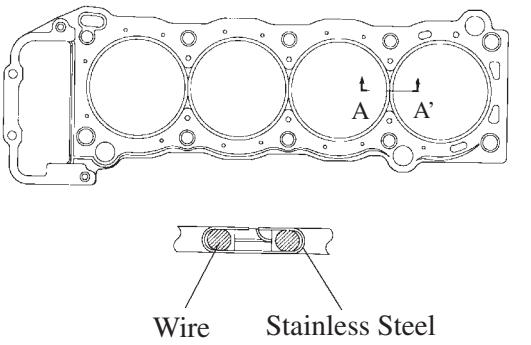
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3. Cylinder Head Gasket

A graphite gasket with stainless grommets which provides excellent pressure resistance and sealability is used for the cylinder head gasket.

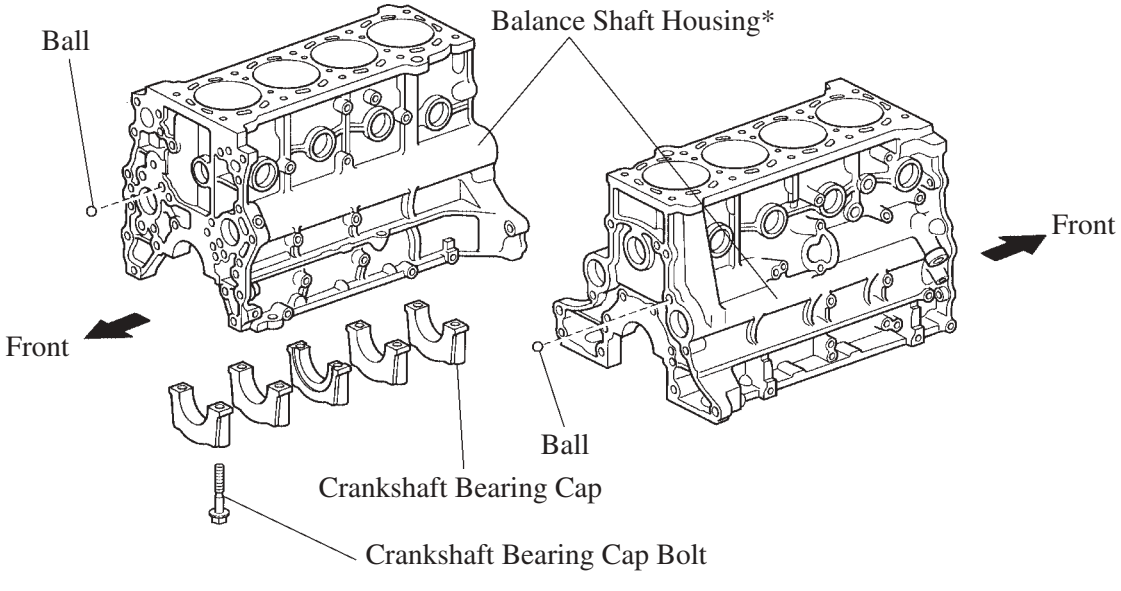


A – A' Cross Section

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4. Cylinder Block

- The cylinder block is made of cast iron. A curved surface is given to the housing for the 2 balance shafts* and the skirt to increase rigidity while reducing vibration and noise.
- Balls have been pressure inserted in the plug holes of oil passages to assure that no oil leakage occurs.
- Plastic region tightening bolts are used for the crankshaft bearing cap bolts.



*: Only for 3RZ-F and 3RZ-FE Engine

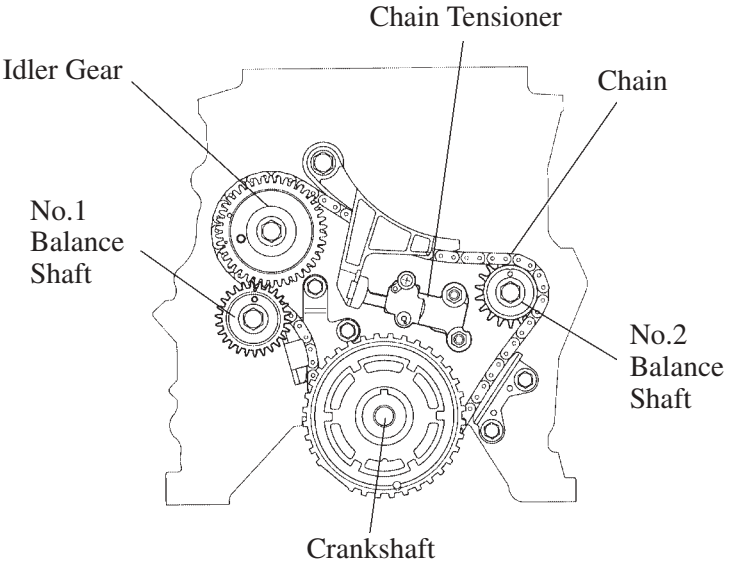
5. Balance Shaft (For 3RZ-FE Engine)

General

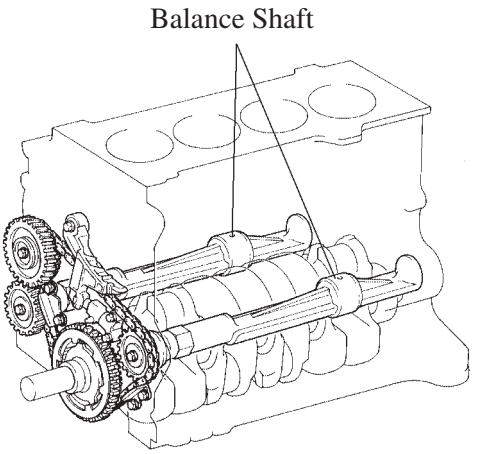
For in-line 4 cylinder engines, the main cause of vibration is imbalanced inertial force of reciprocating parts such as the pistons and connecting rods. The 3RZ-FE engine vibration has been reduced by using 2 balance shafts to cancel the imbalanced inertial force, thereby reducing engine noise (booming noise).

Construction

2 balance shafts are built into the cylinder block. Using a chain and an idler gear, both balance shafts rotate at twice the speed of the crankshaft with each balance shaft rotating in the opposite direction of the other.



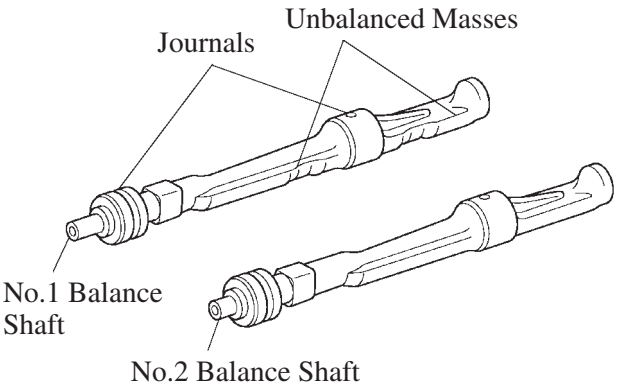
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Balance Shaft

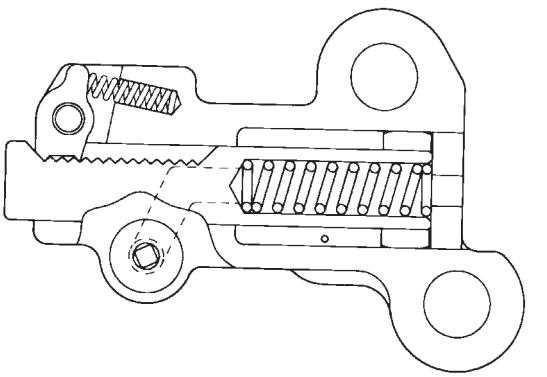
- Each balance shaft has 2 journals and 2 unbalanced masses.
- Both balance shafts are made of forged iron.



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Chain Tensioner

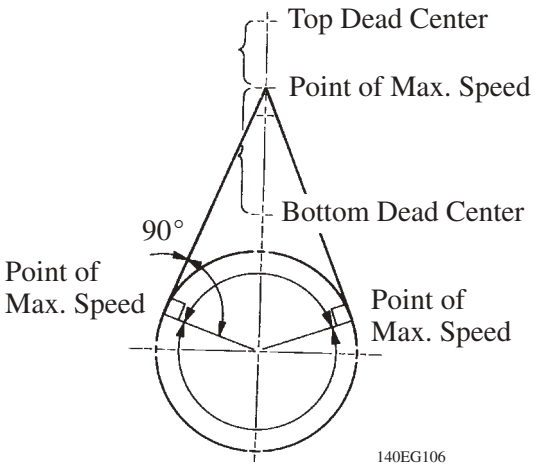
The chain tensioner uses a spring and oil pressure to maintain proper chain tension at all times. A ratchet type non-return mechanism is also included.

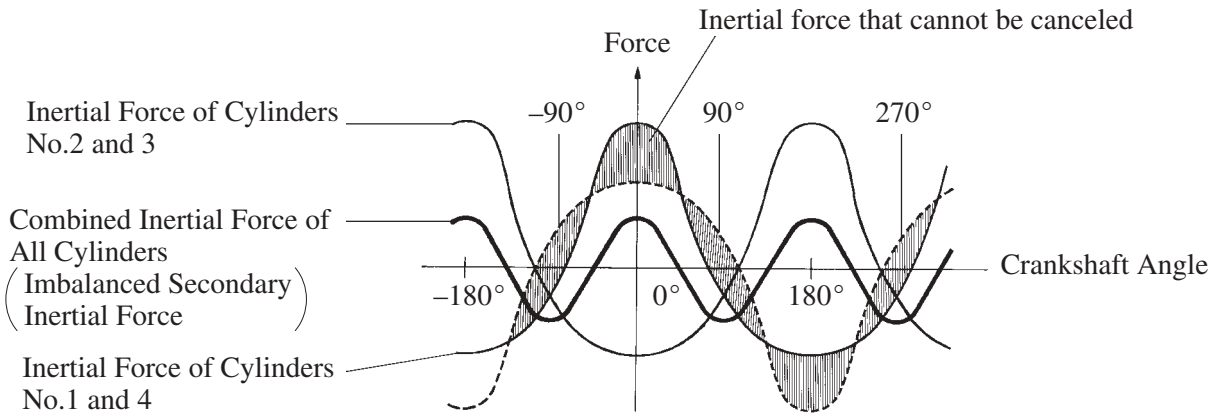


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Operation

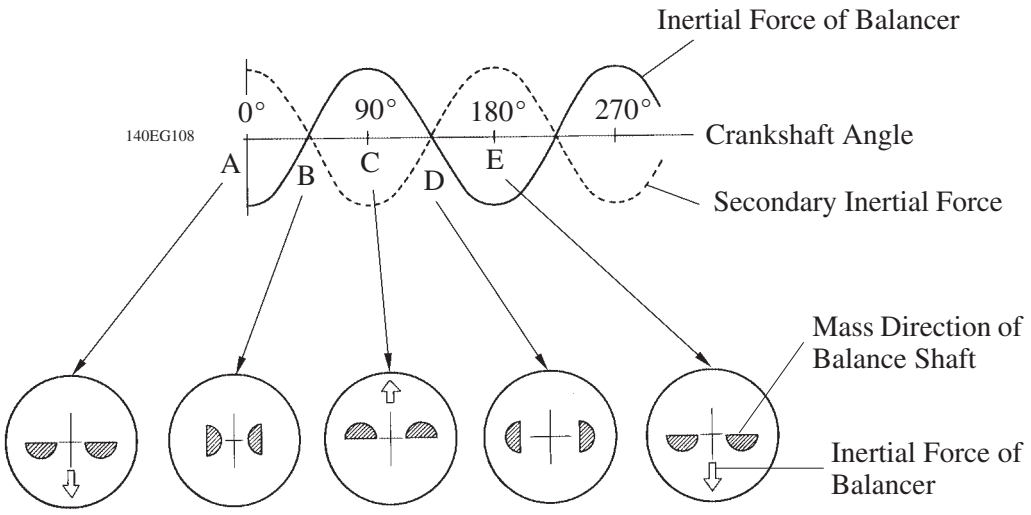
In the in-line 4-cylinder engine, the crankshaft angle for cylinders No.1 and 4 are exactly at the opposite (180°) position of cylinders No.2 and 3. Therefore, the inertial force of the pistons and the connecting rods of the former 2 cylinders and of the latter 2 cylinders almost cancel each other. However, as the position at which the piston reaches its maximum speed is located toward the top-dead-center from the center of the stroke, the upward inertial force is greater than the downward inertial force. This imbalanced secondary inertial force is generated at twice the crankshaft speed.





Inertial Force Generated by In-Line 4 Cylinders

To cancel the imbalanced secondary inertial force, 2 balance shafts are rotated at twice the crankshaft speed and generate inertial force in the opposite direction. Also, in order to cancel the inertial force generated by the balance shaft itself, the balance shaft actually consists of 2 shafts rotating in opposite directions.



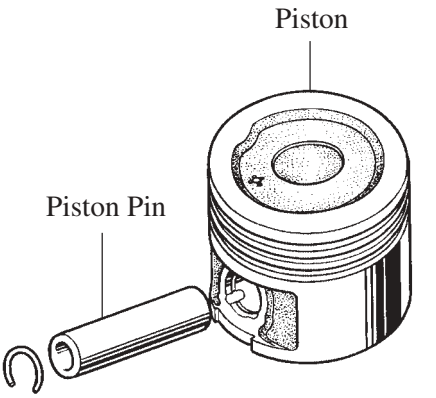
Mass Direction of Balance Shaft at Crankshaft Angle

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6. Piston

- The piston is made of aluminum alloy and the skirt area has been coated with resin to reduce friction.
- The piston pin is made of chrome steel and is the full-floating type.

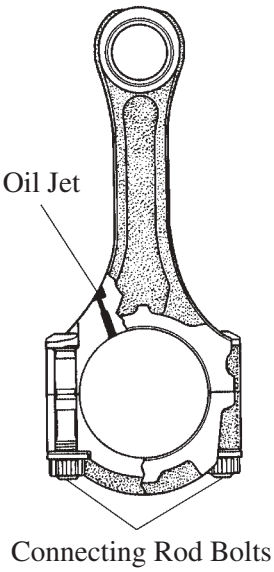
▶ For 3RZ-FE Engine ◀



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7. Connecting Rod

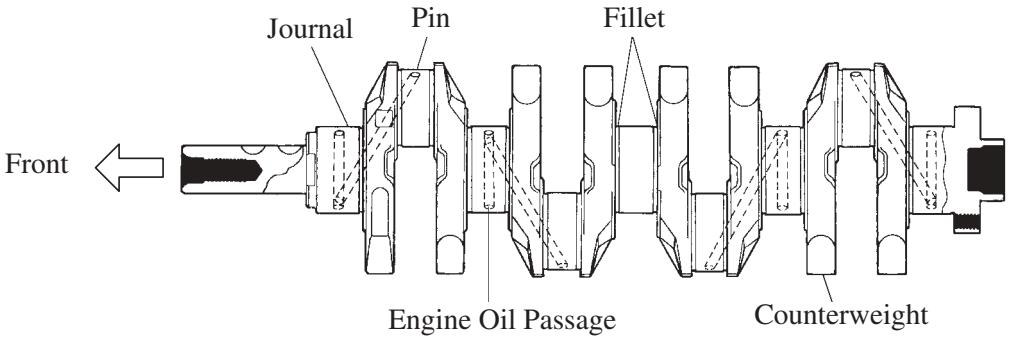
- The connecting rod is made of a lightweight carbon steel that withstand higher speed and high output operation.
- An oil jet is provided in the large end for cooling the piston.
- Plastic region tightening is used for the connecting rod bolts.



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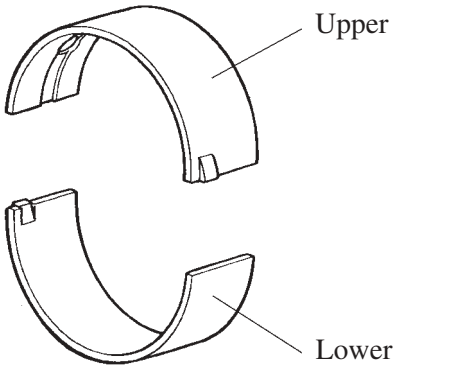
8. Crankshaft

- In the 2RZ-FE and 3RZ-F engines, the crankshaft is made of cast iron, and in the 3RZ-FE engine, the crankshaft is made of vanadium steel.
- The crankshaft has 5 journals and 8 counterweights.
- Pin and journal have been quenched through a high-frequency process for enhanced reliability, and both the fillets have been roll-finished.



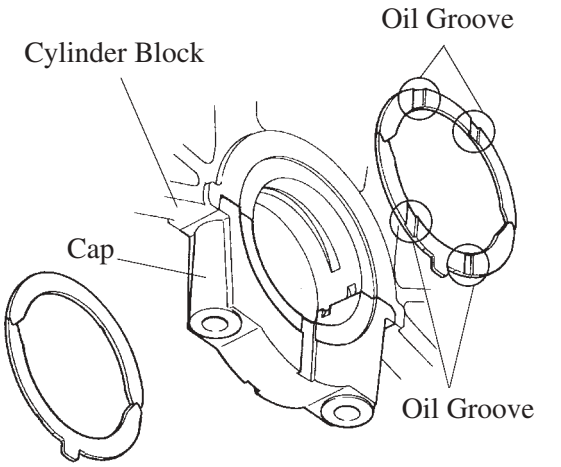
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- The crankshaft bearing is made of aluminum alloy.



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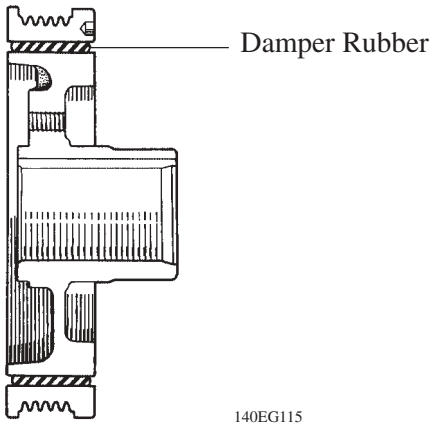
- The thrust washer of the center journal receives the force in the crankshaft's thrust direction.



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9. Crankshaft Pulley

A torsional damper pulley is used and the use of damper rubber which is inserted under high pressure improves reliability.



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