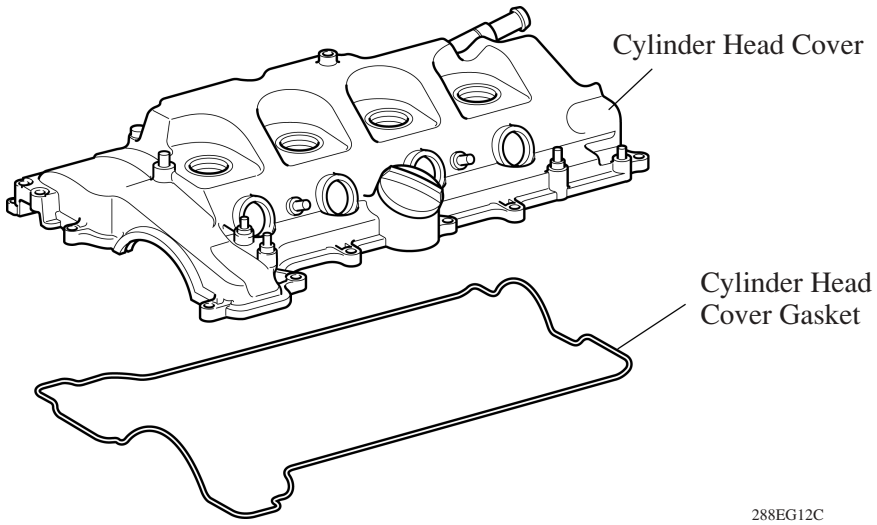
■ENGINE PROPER

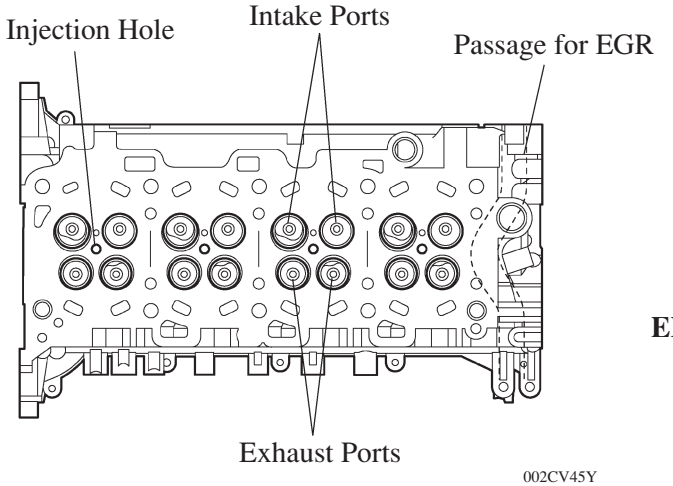
1. Cylinder Head Cover

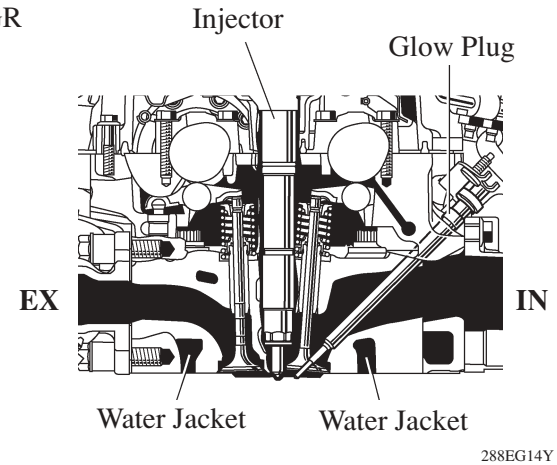
- Lightweight yet high-strength aluminum cylinder head cover is used.
- Acrylic rubber, which excels in heat resistance and reliability, is used for the cylinder head cover gasket.



2. Cylinder Head

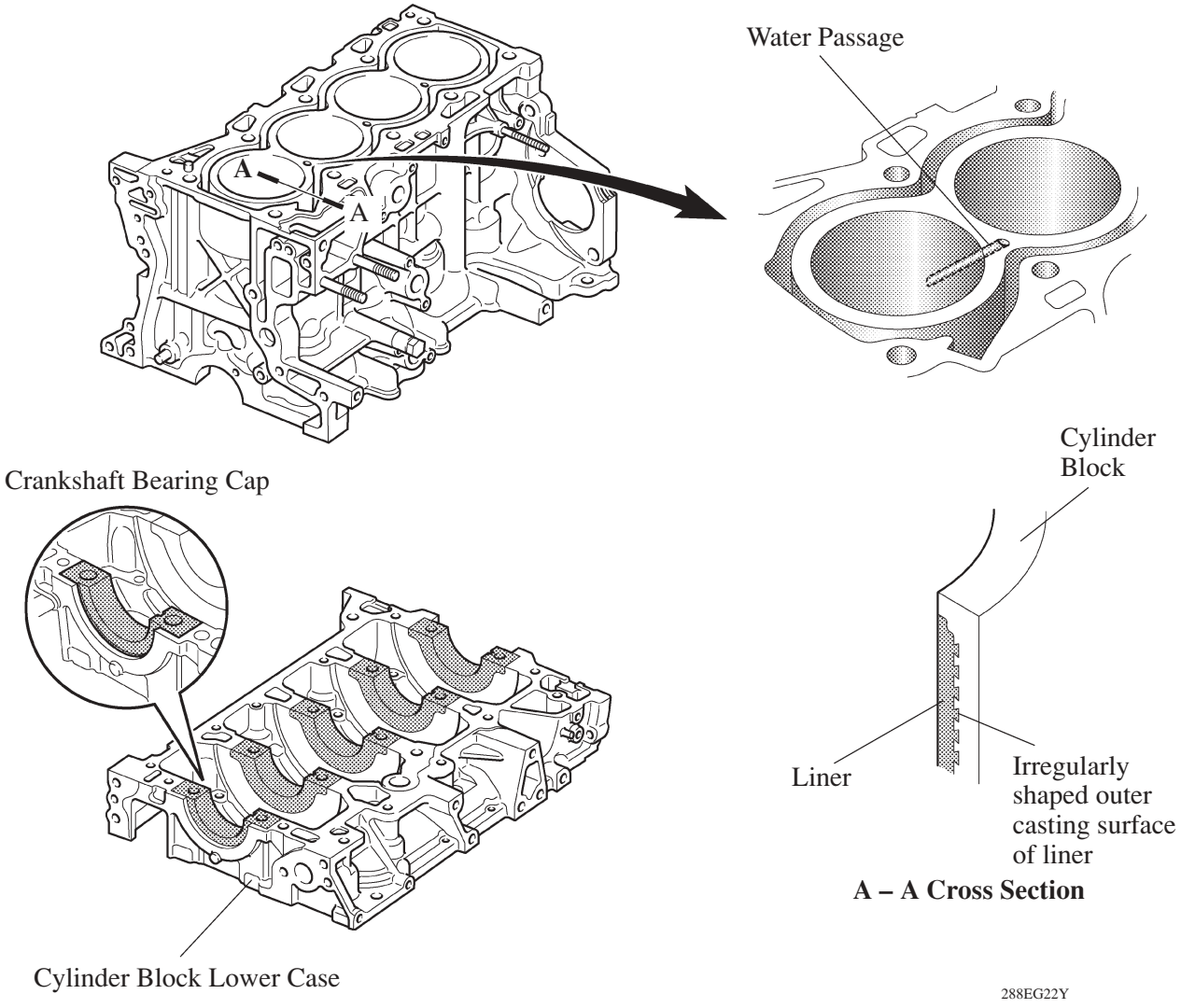
- The cylinder head is made of aluminum alloy.
- The injector is located in the center of the combustion chamber in order to improve engine performance and clean emission.
- A glow plug is placed between the intake ports of each cylinder to ensure startability.
- The passage for the EGR is provided in the cylinder head. By cooling the exhaust gas, this makes it possible to recirculate the great amount of exhaust gas.
- A water jacket is provided to the intake and exhaust ports respectively to realize excellent cooling performance.





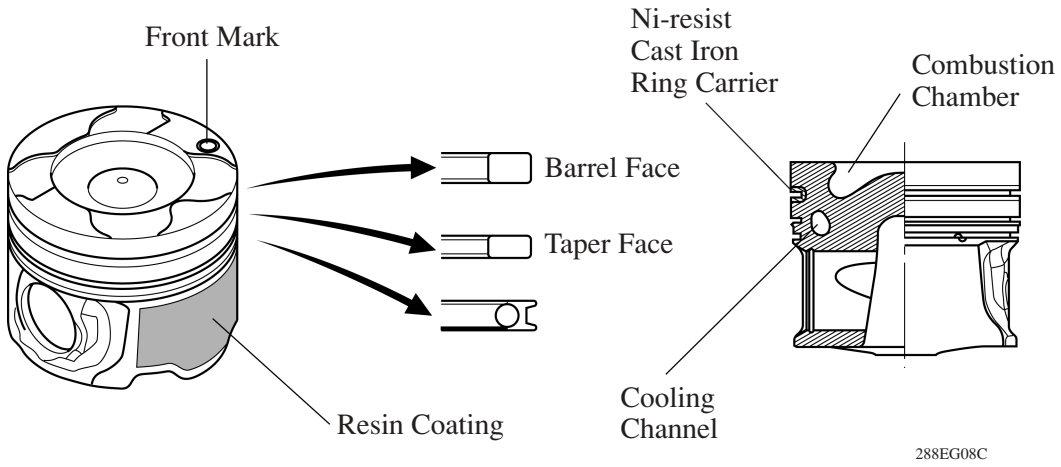
3. Cylinder Block

- The cylinder block is made of aluminum alloy.
- A water passage is provided between the cylinder bores. By allowing the engine coolant to flow between the cylinder bores, this construction enables the temperature of the cylinder walls to be kept uniform.
- The liners are the spiny-type, which are manufactured so that their casting exteriors form large irregular surfaces in order to enhance the adhesion between the liners and the aluminum cylinder block. The enhanced adhesion helps improve heat dissipation, resulting in a lower overall temperature and heat deformation of the cylinder bores.
- The crankshaft bearing caps with cylinder block lower case are used to reduce noise and to increase the coupling rigidity with the crankshaft.
- Cast iron is used as a material for part of the bearing journal of crankshaft bearing cap, and thus helps prevent deformation by high load from crankshaft.
- Plastic region tightening bolts are used for tightening the crankshaft bearing cap.
- The liner is thin, so that reboring is not possible.



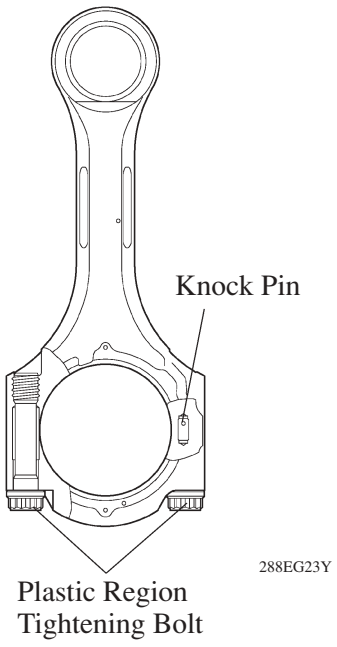
4. Piston

- The pistons are made of aluminum alloy.
- The combustion chamber is provided on the piston for direct injection.
- The shape of the combustion chamber is optimized to realize low compression ratio, high engine output, and low fuel consumption.
- A cooling channel is provided to realize excellent piston cooling performance.
- To improve the wear resistance of the top ring groove, a Ni-resist cast iron ring carrier is used.
- Along with the improved engine performance, the piston skirt is applied with resin coating to reduce friction loss.
- Full floating type piston pins are used.
- Due to increased machining precision of the cylinder bore diameter, it is not necessary to prepare pistons with different diameter.



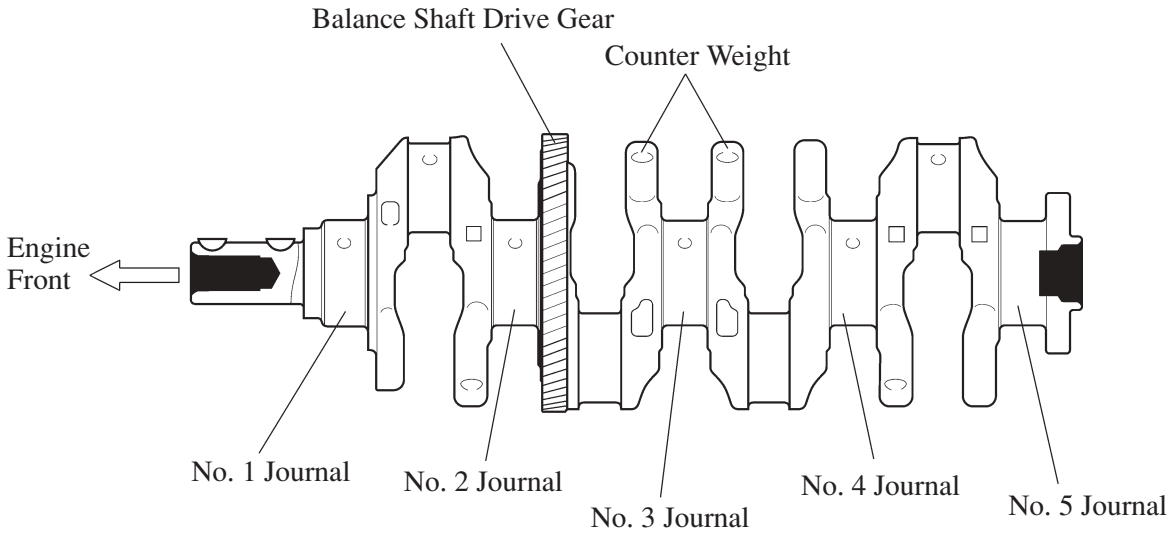
5. Connecting Rod and Connecting Rod Bearing

- The connecting rods and caps are made of high-strength steel for weight reduction.
- Knock pins are used at the matching surfaces of the bearing caps of the connecting rod to minimize the shifting of the bearing caps during assembly.
- Nutless-type plastic region tightening bolts are used on the connecting rods for a lighter design.
- The connecting rod bearings are reduced in width to reduce friction.



6. Crankshaft

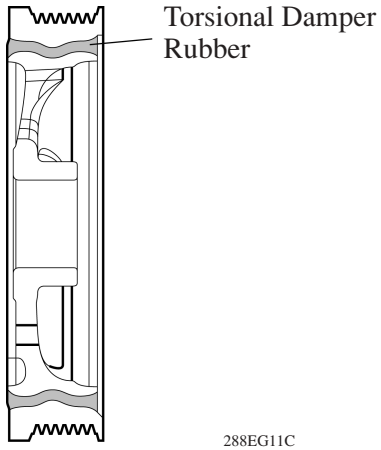
- A crankshaft made of forged steel, which excels in rigidity and wear resistance, is used.
- The crankshaft has 5 journals, 4 connecting rod pins, 7 counter weights and a balance shaft drive gear.



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7. Crankshaft Pulley

The rigidity of the crankshaft pulley with its built-in torsional damper rubber reduces noise.

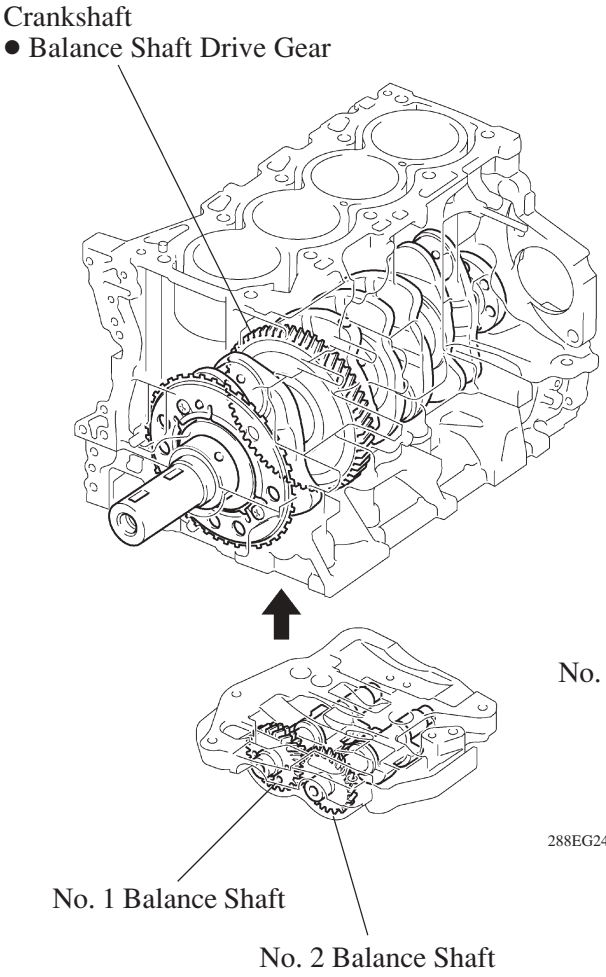


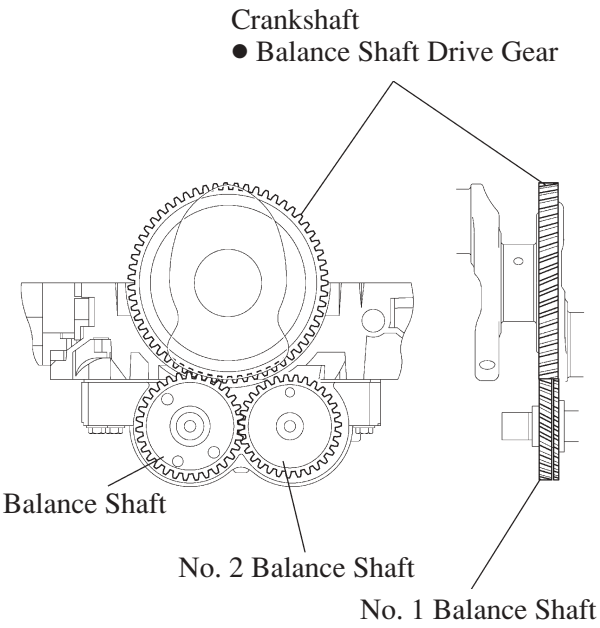
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8. Balance Shaft

General

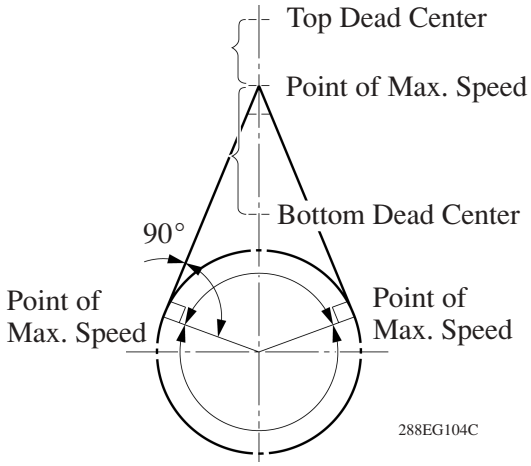
- Two balance shafts are used to reduce vibration.
- The crankshaft directly drives the No. 1 balance shaft.
- A scissors gear is used for the No. 1 balance shaft to reduce gear noise.
- The No. 2 balance shaft is driven by the No. 1 balance shaft.

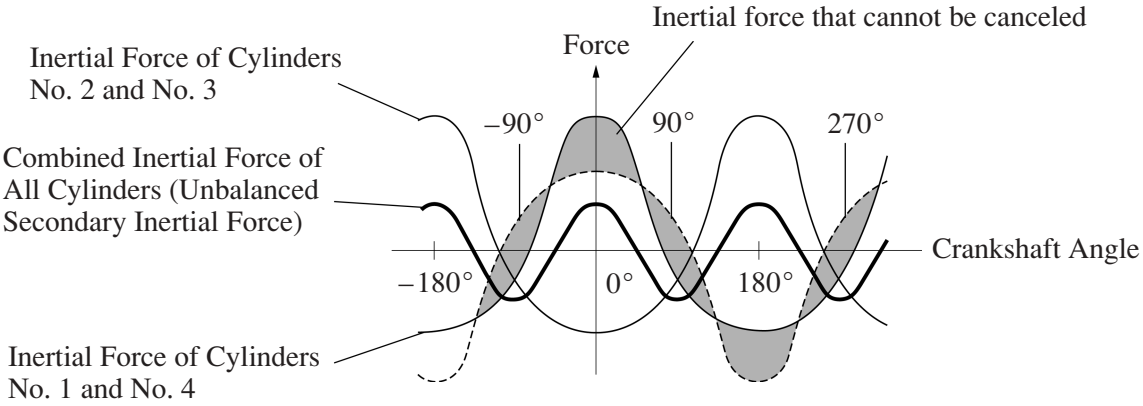




Operation

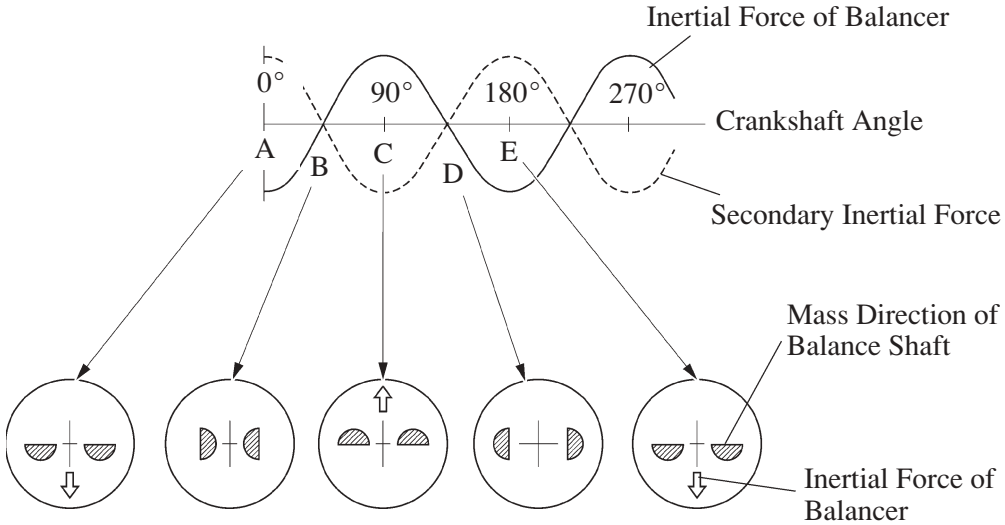
In the in-line 4-cylinder engine, the crankshaft angle for cylinders No. 1 and No. 4 are exactly at the opposite (180°) position of cylinders No. 2 and No. 3. Therefore, the inertial force of the pistons and the connecting rods of the former 2 cylinders and of the latter 2 cylinders almost cancel each other. However, because 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 unbalanced secondary inertial force is generated twice for each rotation of the crankshaft.





Inertial Force Generated by In-line 4 Cylinders

To cancel the unbalanced secondary inertial force, 2 balance shafts are rotated twice for each rotation of the crankshaft 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