WSM

WORKSHOP MANUAL

G1700, G1800, G1900, G2000

Kubota

KiSC issued 12, 2017 A

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA G1700, G1800, G1900, G2000. It is divided into two parts, "Mechanism" and "Disassembling and Servicing".

■ **Mechanism**

Information on the construction and function are included in this section. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

■ **Disassembling and Servicing**

Under the heading "General" comes general precautions, check and maintenance and special tools. For each section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information, illustrations and specifications contained in this manual are based on the latest production information available at the time of publication.

The right is reserved to make changes in all information at any time without notice.

August '89

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Record of Revisions

For pdf, use search function {Search word} to find all revised locations.

Last digit of the Code No.	Issue month	Main Revised Point and Corrective Measures {Search word}	Reference Page
6	2017.12	Correction of errors	S.G-1, G-1

SPECIFICATIONS

Model			G1700		G1800	
			2WS	4WS	2WS	4WS
Engine	Model		D662-L		D662	
	Type		Vertical, liquid cooled, 4-cycle, diesel			
	Gross power		11.1 kW / 3200 rpm (15 HP / 3200 rpm)		11.9 kW / 3200 rpm (16 HP / 3200 rpm)	
	Number of cylinders		3			
	Bore and stroke		64 mm × 68 mm (2.52 in. × 2.68 in.)			
	Total displacement		655 cm³ (40.03 cu.in.)			
	Rated engine speed		3200 rpm			
	Combustion chamber		NTVCS			
	Fuel injection pump		Bosch MD mini pump			
	Governor		Centrifugal ball mechanical governor			
	Injection nozzle		Throttle type (DN4PD62)			
	Injection timing		0.33 to 0.37 rad. (19 to 21°) before T.D.C.			
	Injection pressure		13.73 MPa (140 kgf/cm², 1991 psi)			
	Direction of rotation		Counterclockwise (viewed from flywheel)			
	Compression ratio		23 : 1			
	Lubricating system		Forced lubrication by trochoid pump			
	Cooling system		Pressurized radiator, forced circulation with water pump			
	Starting system		Electric starter (12 V, 1.0 kW / 0.8 kW)			
	Charging system		AC dynamo (12 V, 150 W) or alternator (12 V, 480 W)		AC dynamo (12 V, 150 W)	
	Battery		12 V, 45 AH			
	Engine stop system		Key stop			
	Weight (Dry)		73.7 kg (162.5 lbs) [includes radiator, air cleaner and muffler]			
Capacities	Fuel tank		19 ℓ (5.0 U.S.gals., 4.2 Imp.gals.)			
	Engine crankcase		3.0 ℓ (3.2 U.S.qts., 2.64 Imp.qts.)			
	Transmission case		5.7 ℓ (6.0 U.S.qts., 5.02 Imp.qts.)			
	Radiator		3.3 ℓ (3.5 U.S.qts., 2.90 Imp.qts.)			
Dimensions	Overall length		1865 mm (73.4 in.)			
	Overall width		960 mm (37.8 in.)	1034 mm (40.7 in.)	960 mm (37.8 in.)	1034 mm (40.7 in.)
	Overall height		1110 mm (43.7 in.)			
	Wheel base		1270 mm (50.0 in.)			
	Tread	Front	740 mm (29.1 in.)			
		Rear	695 mm (27.4 in.)	820 mm (32.3 in.)	695 mm (27.4 in.)	820 mm (32.3 in.)
	Min. ground clearance		150 mm (5.9 in.)	105 mm (4.1 in.)	150 mm (5.9 in.)	105 mm (4.1 in.)
Weight (with mower)			320 kg (705.5 lbs)	340 kg (749.6 lbs)	320 kg (705.5 lbs)	340 kg (749.6 lbs)
Tire size	Front		16 × 6.50 - 8			
	Rear		23 × 10.50 - 12	23 × 8.50 - 12	23 × 10.50 - 12	23 × 8.50 - 12
Steering system			Manual			
Transmission			Hydrostatic transmission			
Brake			Internal expanding shoe type			
Traveling speed	Forward		0 to 13.0 km / h (0 to 8.1 mph)			
	Reverse		0 to 6.0 km / h (0 to 3.7 mph)			
Mower drive system			Shaft drive			
Mower clutch type			Belt tension			
Mower PTO brake			Shoe type			
Mower lift system			Hydraulic			

Model			G1900		G2000	
			2WS	4WS	2WS	4WS
Engine	Model		D722		WG750-G	
	Type		Vertical, liquid cooled, 4-cycle, diesel		Vertical, liquid cooled, 4-cycle, gasoline	
	Gross power		13.4 kW / 3200 rpm (18 HP / 3200 rpm)		15.7 kW / 3200 rpm (21 HP / 3200 rpm)	
	Number of cylinders		3			
	Bore and stroke		67 mm × 68 mm (2.64 in. × 2.68 in.)		68 mm × 68 mm (2.68 in. × 2.68 in.)	
	Total displacement		719 cm³ (43.88 cu.in.)		740 cm³ (45.16 cu.in.)	
	Rated engine speed		3200 rpm			
	Combustion chamber		NTVCS		–	
	Fuel injection pump		Bosch MD mini pump		–	
	Governor		Centrifugal ball mechanical governor			
	Injection nozzle		Throttle type (DN4PD62)		–	
	Injection timing		0.33 to 0.37 rad. (19 to 21°) before T.D.C.		–	
	Injection pressure		13.73 MPa (140 kgf/cm², 1991 psi)		–	
	Ignition system		–		Full-transistor	
	Carburetor		–		Butterfly valves	
	Spark plug		–		BCP6ES11	
	Ignition timing		–		0.35 rad. (20°) before T.D.C.	
	Direction of rotation		Counterclockwise (viewed from flywheel)			
	Compression ratio		23 : 1		9 : 1	
	Lubricating system		Forced lubrication by trochoid pump			
	Cooling system		Pressurized radiator, forced circulation with water pump			
	Starting system		Electric starter (12 V, 1.0 kW / 0.8 kW)		Electric starter (12 V, 0.7 kW)	
	Charging system		AC dynamo (12 V, 150 W) or alternator (12 V, 480 W)		AC dynamo (12 V, 150 W)	
	Battery		12 V, 45 AH		12 V, 35 AH	
	Engine stop system		Key stop			
	Weight (Dry)		73.0 kg (161.0 lbs) [includes radiator, air cleaner and muffler]		61.7 kg (136.0 lbs) [includes radiator, air cleaner and muffler]	
Capacities	Fuel tank		19 ℓ (5.0 U.S.gals., 4.2 Imp.gals.)			
	Engine crankcase		3.0 ℓ (3.2 U.S.qts., 2.64 Imp.qts.)			
	Transmission case		5.7 ℓ (6.0 U.S.qts., 5.02 Imp.qts.)			
	Radiator		3.3 ℓ (3.5 U.S.qts., 2.90 Imp.qts.)			
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Steering system			Manual			
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Traveling speed	Forward		0 to 13.0 km / h (0 to 8.1 mph)			
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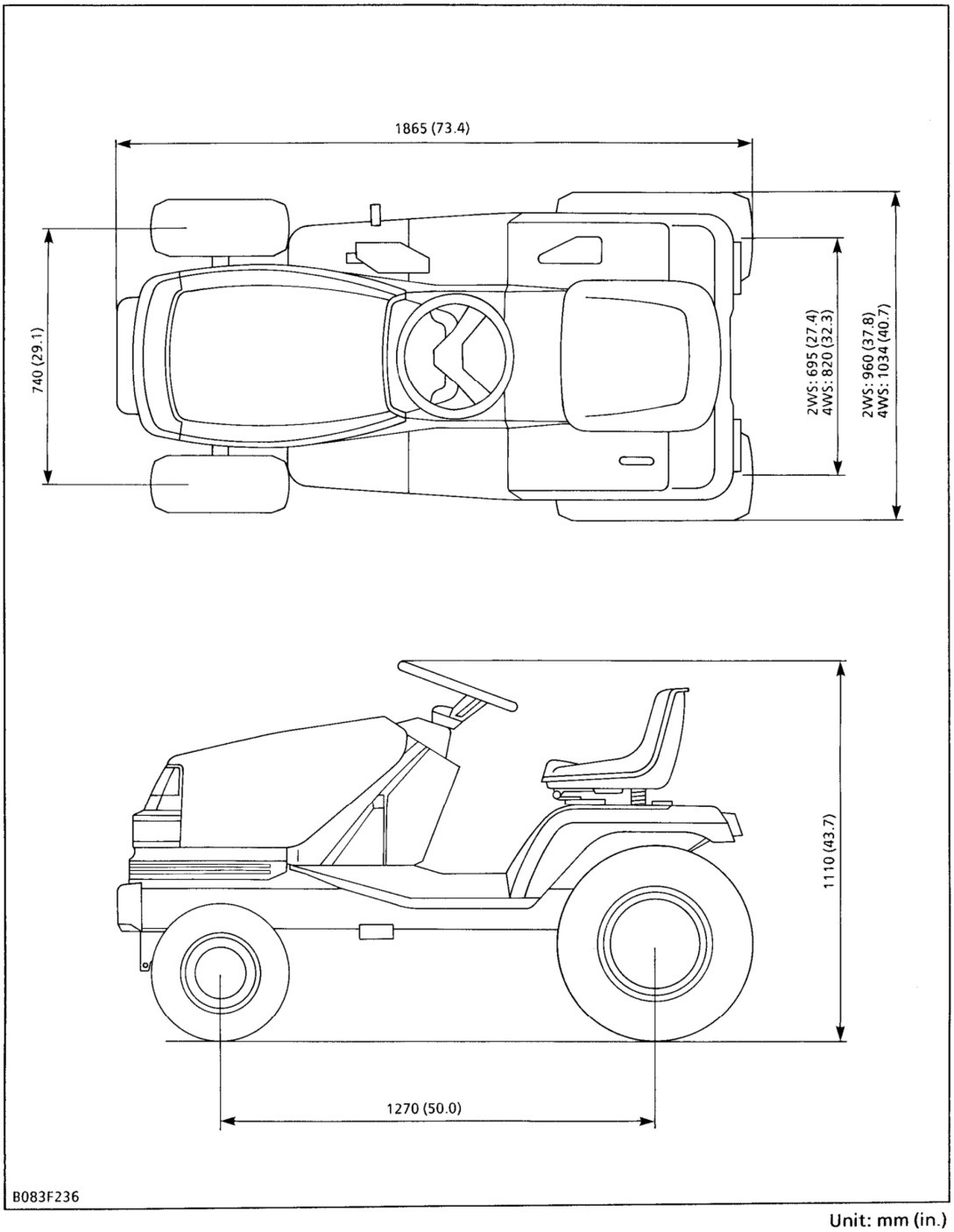
Mower drive system			Shaft drive			
Mower clutch type			Belt tension			
Mower PTO brake			Shoe type			
Mower lift system			Hydraulic			

DIMENSIONS



Unit: mm (in.)

M MECHANISM

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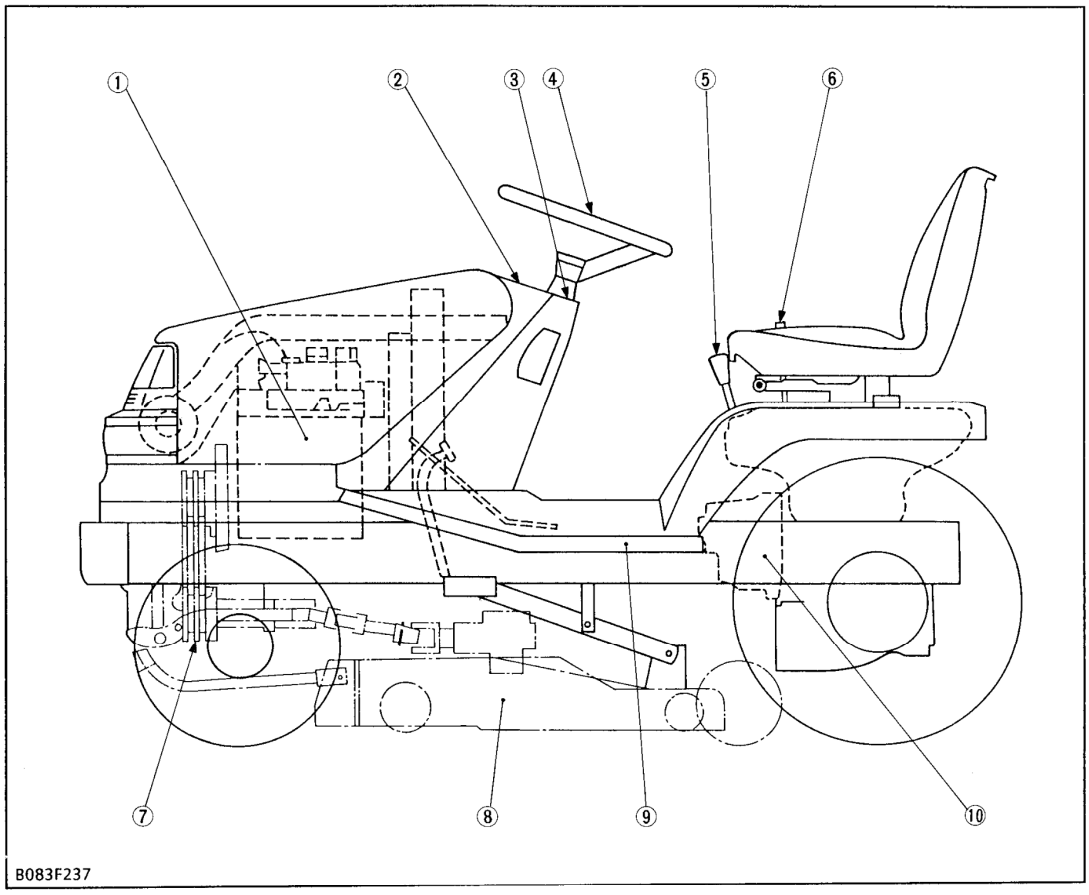
F FEATURES



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(1) New KUBOTA Engines
Models G1700, G1800 and G1900 are mounted vertical, liquid cooled, 4-cycle diesel engines.
Model G2000 is mounted vertical, liquid cooled, 4-cycle gasoline engine.
These efficient and powerful KUBOTA engines provide the harnessed power and mighty torque rise essential for handling even heavy-duty tasks.

(2) Easy Checker
To facilitate checking, the easy checker is provided.

(3) Engine Key Switch Shut-Off System
The engine can be stopped easily by key switch operation.

(4) 4 Wheel Steering System
On 4WS models, an extremely tight turning radius increases mowing efficiency.

(5) Cruise Control System
This system will provide a constant forward speed by mechanically holding the speed change pedal at the selected position.

(6) Hydraulic Lifting System
This system makes lifting and lowering the mower simple and efficient.

(7) Front PTO System
This system supplies power for the mower.

(8) Mower
To fit a variety of applications, various mower sizes are available.

(9) Semi-Flat Deck
The semi-flat deck with its ample foot space increases comfort during long operations as well as making getting on and off much easier.

(10) Hydrostatic Transmission
Easy operation by the speed change pedal without clutch operation realizes comfortable operation.

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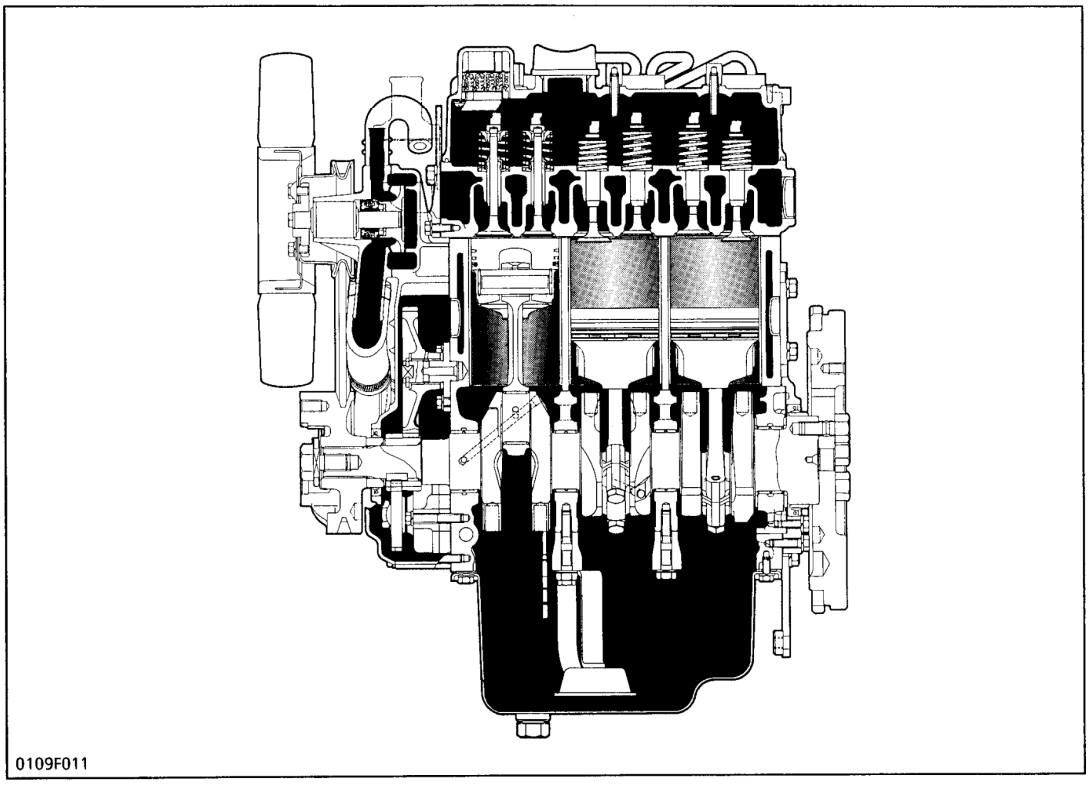
1-1 ENGINE [D662-L·D662·D722]

[1] FEATURE

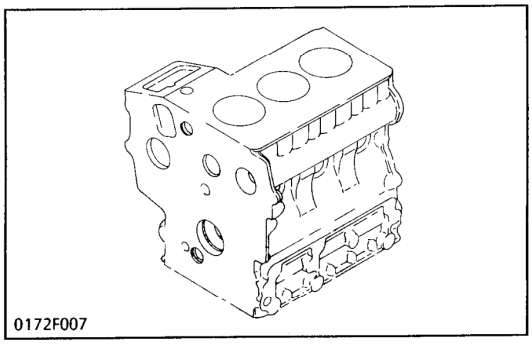


The D662-L, D662 and D722 are vertical, liquid cooled, 4-cycle diesel engines, utilizing Kubota's unique combustion system "NTVCS", special designed engine, the well-known Bosch MD type injection pump, alminum radiator for greater heat radiation, super glow for quick starting and a well-balanced design.

So these engine feature greater power, low fuel consumption, reduced vibration and quiet operation.

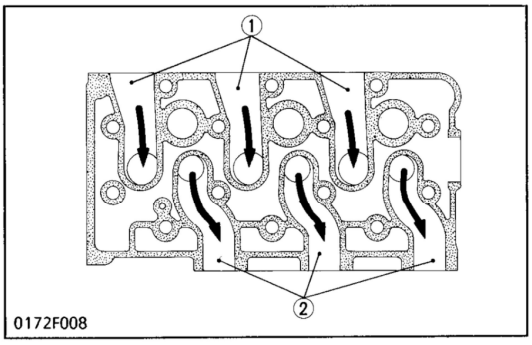
[2] ENGINE BODY

(1) Cylinder Block



The engine has a highly durable tunnel-type cylinder block in which the bearings, pistons, crankshaft and camshaft are installed.

(2) Cylinder Head



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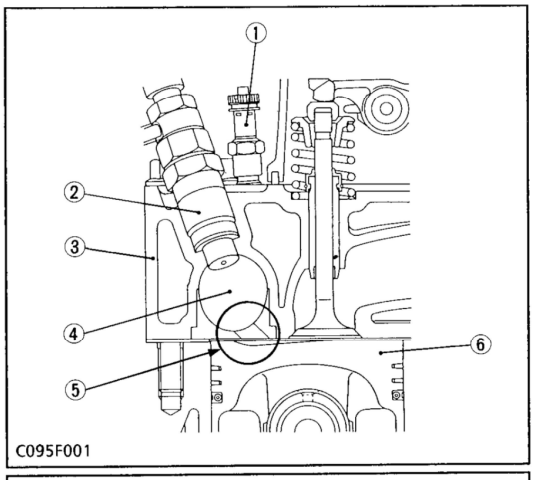
■ Intake and Exhaust Port

The cross-flow type intake / exhaust ports, which lower the heat conduction from the exhaust port to the intake port. The low heat conduction keeps the intake air from being heated and expanded by the exhaust gas.

(1) Intake Port
(2) Exhaust Port



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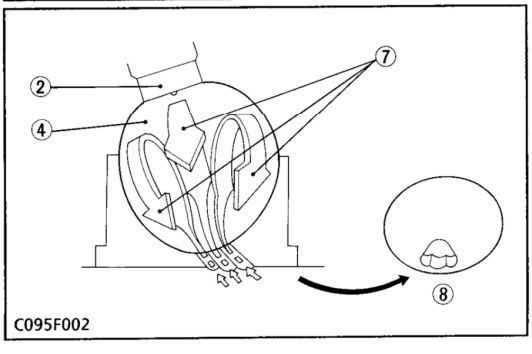
■ Combustion System

These engine use the "NTVCS" (New Three Vortex Combustion System) to achieve perfect combustion for maximum power. The NTVCS combustion system provides unique shape of throat in the air inlet (8) for combustion chamber, to produce three streams (7) of air in the chamber (4) when compressing, giving an ideal mixture of air and fuel.

In addition, a fan-shaped concave (5) is provided on top of the piston (6) to allow a smooth ejection of the exhaust gas, offering highly efficient combustion.

(1) Glow Plug
(2) Injection Nozzle
(3) Cylinder Head
(4) Combustion Chamber
(5) Fan-shaped Concave
(6) Piston
(7) Stream
(8) Air Inlet



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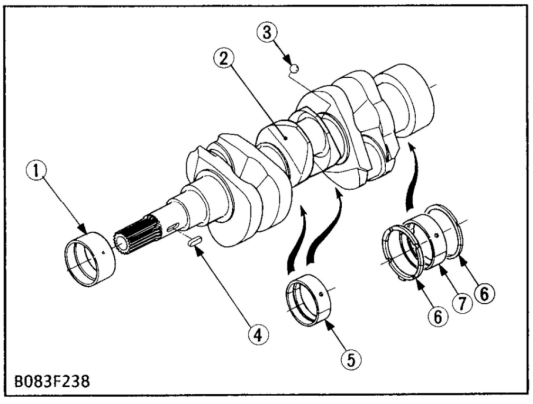
(3) Crankshaft



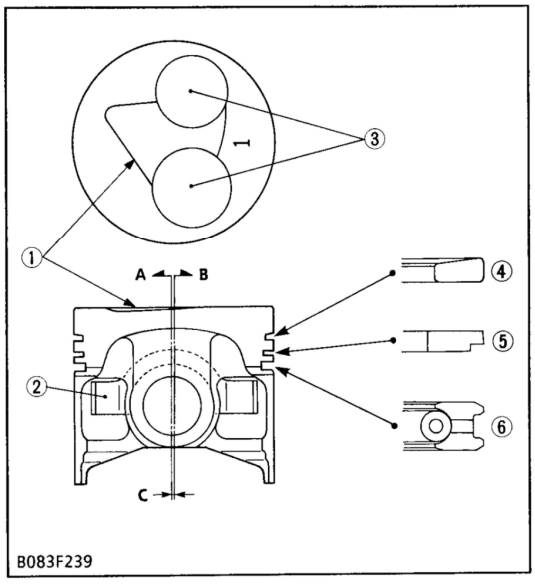
The crankshaft with the connecting rod converts the reciprocating motion of the piston into rotating motion.

The crankshaft (2) has oil passages drilled so that oil can flow from the main bearings to the crank pin bearings.

The front journal is supported by a sleeve type bearing (crankshaft bearing 1) (1), the intermediate journal by a split type (crankshaft bearing 3) (5), and the rear by a split type (crankshaft bearing 2) (7) with thrust bearings (6).

(1) Crankshaft Bearing 1
(2) Crankshaft
(3) Steel Ball
(4) Feather Key
(5) Crankshaft Bearing 3
(6) Thrust Bearing
(7) Crankshaft Bearing 2

(4) Piston and Piston Ring



The piston is made of an aluminum alloy. Provided on top of the piston are a valve recess (3) and a fan-shaped concave (1) to allow smooth ejection of the exhaust gas from combustion chamber.

The piston pin is positioned off the center to the thrust side, which prevents a swing of the piston at the top and bottom dead centers, reducing operation noise.

The piston has a steel strut (2) inside to reduce the increase of the piston diameter.

The top compression ring (4) is of the key stone type which can stand against heavy load, and the sliding surface to the cylinder wall is shaped into barrel face which is well fitted to the wall and plated with hard chrome.

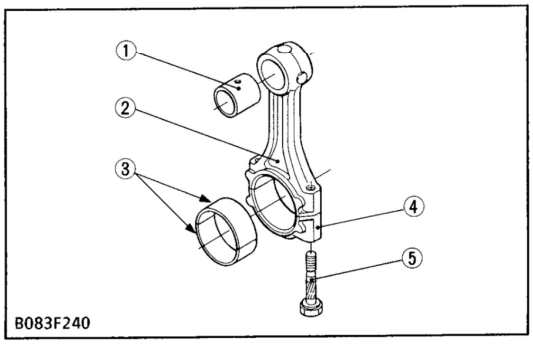
The second compression ring (5) is of the under-cut type which is effective to prevent oil rising.

Oil ring (6) is effective to scrape oil because it is closely fitted to the cylinder wall by a coil expander and the upper and lower ends of its sliding surface are cut diagonally to raise face pressure to the cylinder walls.

(1) Fan-shaped Concave
(2) Steel Strut
(3) Valve Recess
(4) Top Compression Ring
(5) Second Compression Ring
(6) Oil Ring

[A] Piston Pin Center Line
[B] Piston Center Line
[C] Piston Pin Offset

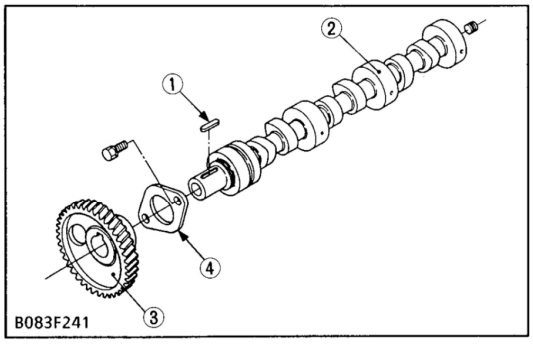
(5) Connecting Rod



The connecting rod (2) is used to connect the piston with the crankshaft. The big end of the connecting rod has a crank pin bearing (3) (split type) and the small end has a small end bushing (1) (solid type).

(1) Small End Bushing
(2) Connecting Rod
(3) Crank Pin Bearing
(4) Connecting Rod Cap
(5) Connecting Rod Screw

(6) Camshaft

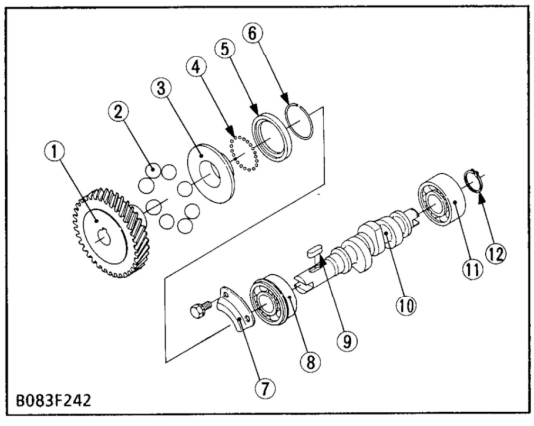


The camshaft (2) is made of special cast iron, and the journal and cam sections are chilled to resist wear.

The cams on the camshaft cause the intake and exhaust valves to open as the camshaft rotates. The bearing and journals are force-lubricated.

(1) Feather Key
(2) Camshaft
(3) Cam Gear
(4) Camshaft Stopper

(7) Fuel Camshaft

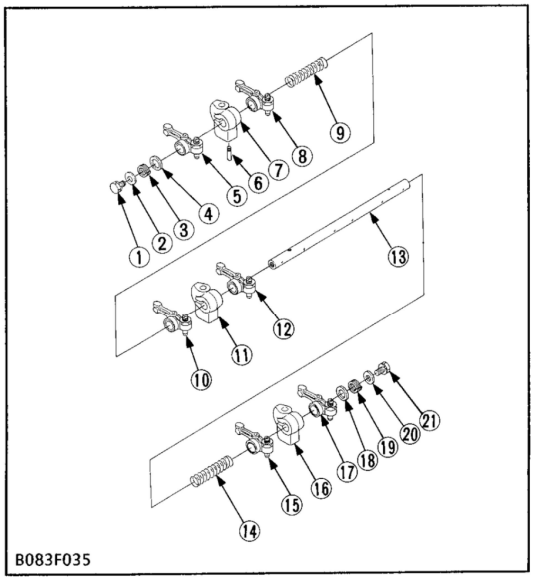


The fuel camshaft (10) controls the reciprocating movement of the injection pump, and is equipped with steel balls (2) to control the governor.

The fuel camshaft is made of carbon steel, and the cam sections are quenched and tempered to provide greater wear resistance.

(1) Injection Pump Gear
(2) Steel Ball
(3) Governor Sleeve
(4) Steel Ball
(5) Governor Ball Case
(6) Snap Ring
(7) Fuel Camshaft Stopper
(8) Ball Bearing
(9) Feather Key
(10) Fuel Camshaft
(11) Ball Bearing
(12) External Snap Ring

(8) Rocker Arm Assembly

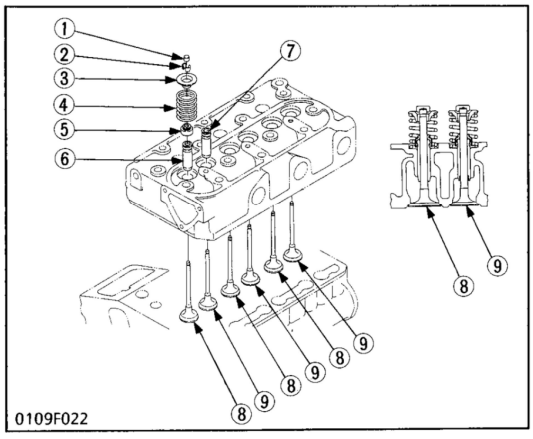


The rocker arm assembly includes the rocker arms (5), (8), (10), (12), (15), (17), rocker arm brackets (7), (11), (16) and rocker arm shaft (13) and converts the reciprocating movement of the push rods to an open / close movement of the intake and exhaust valves.

Lubricating oil is pressurized through the bracket to the rocker arm shaft, which serves as a fulcrum so that the rocker arm and the entire system are lubricated sufficiently.

(1) Screw
(2) Plain Washer
(3) Thrust Washer
(4) Washer
(5) Rocker Arm
(6) Set Screw
(7) Rocker Arm Bracket
(8) Rocker Arm
(9) Rocker Arm Spring
(10) Rocker Arm
(11) Rocker Arm Bracket
(12) Rocker Arm
(13) Rocker Arm Shaft
(14) Rocker Arm Spring
(15) Rocker Arm
(16) Rocker Arm Bracket
(17) Rocker Arm
(18) Washer
(19) Thrust Washer
(20) Plain Washer
(21) Screw

(9) Intake and Exhaust Valves

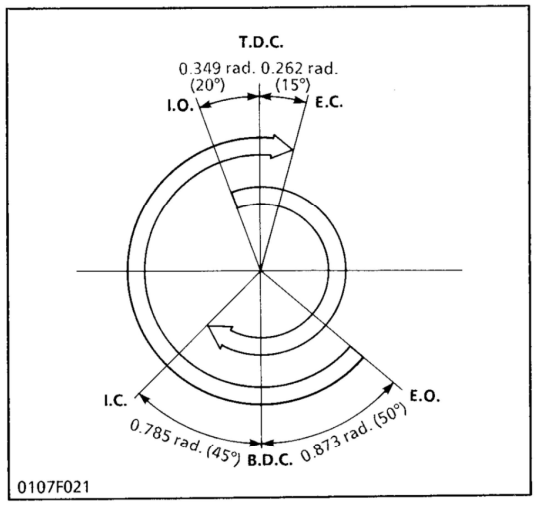


The intake and exhaust valves (8), (9) and their guides (6), (7) are different from each other. Other parts, such as valve springs (4), valve spring retainers (3), valve spring collets (2), valve stem seals (5), and valve caps (1) are the same for both the intake and exhaust valves.

All contact or sliding parts are quenched and tempered to resist wear.

(1) Valve Cap
(2) Valve Spring Collet
(3) Valve Spring Retainer
(4) Valve Spring
(5) Valve Stem Seal
(6) Intake Valve Guide
(7) Exhaust Valve Guide
(8) Intake Valve
(9) Exhaust Valve

(10) Valve Timing

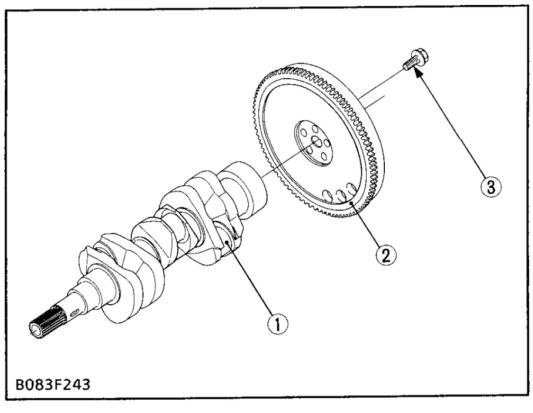


The valve opening and closing timing is extremely important for effectively intaking air into the cylinder and sufficiently exhaust gas.

An appropriate timing can be obtained by aligning the alignment marks on the crank gear and cam gear.

Intake valve open (I.O.)	0.349 rad. (20°) before T.D.C.
Intake valve close (I.C.)	0.785 rad. (45°) after B.D.C.
Exhaust valve open (E.O.)	0.873 rad. (50°) before B.D.C.
Exhaust valve close (E.C.)	0.262 rad. (15°) after T.D.C.

(11) Flywheel



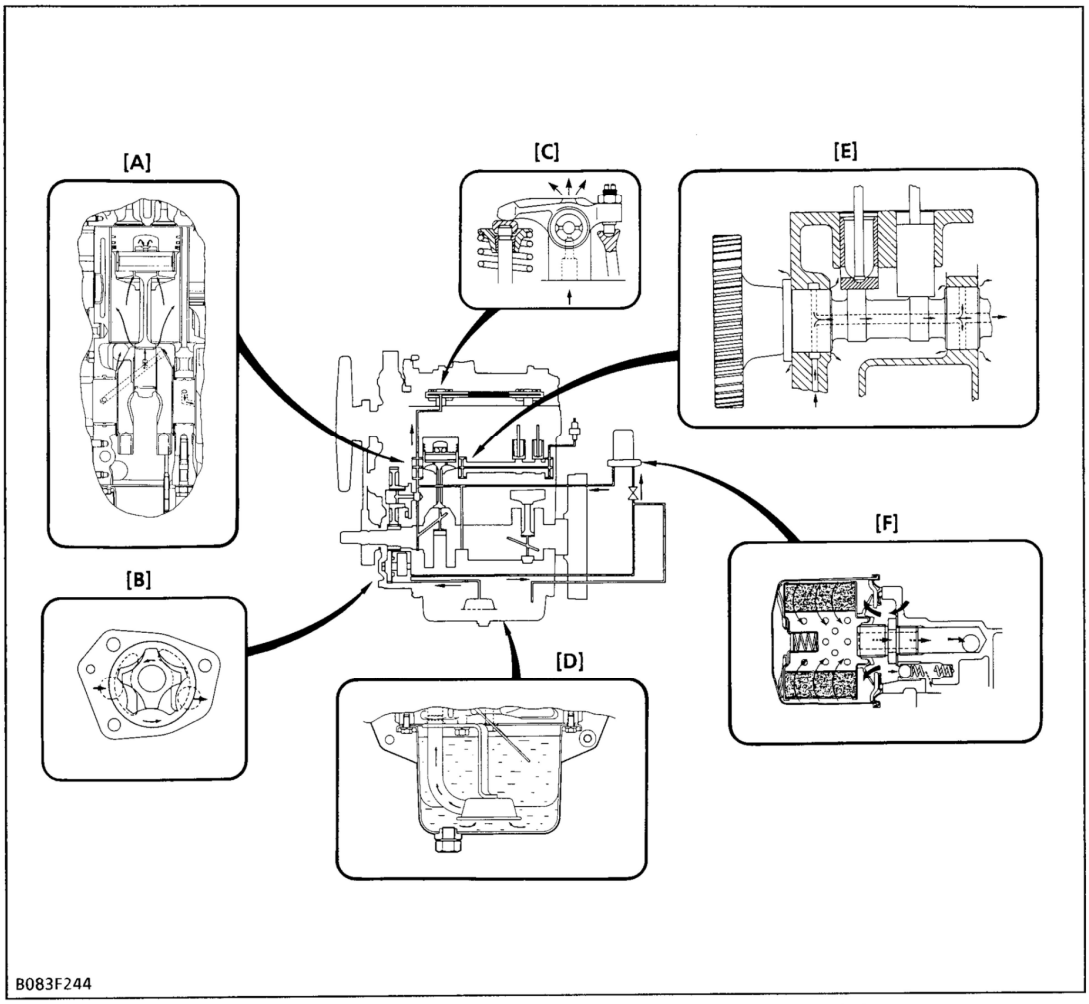
The flywheel (2) is connected with the crankshaft (1), it stores the rotating force in the combustion stroke as inertial energy to rotate the crankshaft smoothly.

The flywheel periphery is provided with marks showing fuel injection timing and top dead center.

The flywheel has gear teeth around its outer rim, which mesh with the drive pinion of the starter.

(1) Crankshaft
(2) Flywheel
(3) Flywheel Mounting Screw

[3] LUBRICATING SYSTEM



[A] Crankshaft and Piston
[B] Oil Pump
[C] Rocker Arm and Rocker Arm Shaft
[D] Oil Strainer
[E] Camshaft
[F] Oil Filter Cartridge and Relief Valve

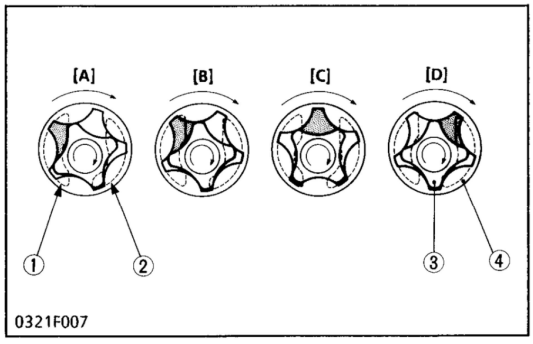
This engine lubricating system consists of oil strainer, oil pump, relief valve, oil filter cartridge and oil pressure switch.

The oil pump sucks lubricating oil from the oil pan through the oil strainer and the oil flows down to the filter cartridge, where it is further filtered.

Then the oil is force-fed to crankshaft, connecting rods, idle gear, camshaft and rocker arm shaft to lubricate each part.

Some part of oil, splashed by the crankshaft or leaking and dropping from gaps of each part, lubricates these parts: pistons, cylinders, small ends of connecting rods, tappets, push rods, intake and exhaust valves and timing gears.

(1) Oil Pump



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(1) Inlet
(2) Outlet
(3) Inner Rotor
(4) Outer Rotor

The oil pump is a trochoid pump.

Inside the pump body, the 4 lobe inner rotor (3) is eccentrically engaged with the 5 lobe outer rotor (4).

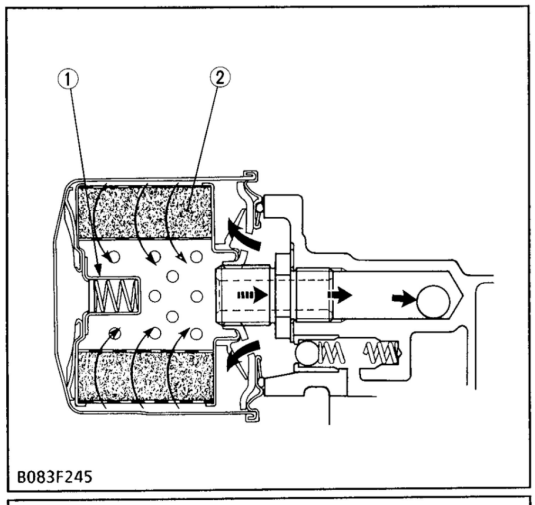
The inner rotor is driven by the crankshaft via gears, which in turn rotate the outer rotor.

When the inner rotor rotates, the outer rotor also rotates in the same direction.

The two rotors have differences in lobe number and center which generates space between lobes as shown in the figure. At position (A), there is little space between lobes in the inlet port. As the rotor rotates towards position (B), the space between the lobes becomes larger, creating a negative pressure which sucks in oil.

Outside the inlet port, as shown in position (C), the space between the lobes becomes gradually smaller, and oil pressure increases. At position (D), oil is discharged from the outlet port.

(2) Oil Filter Cartridge



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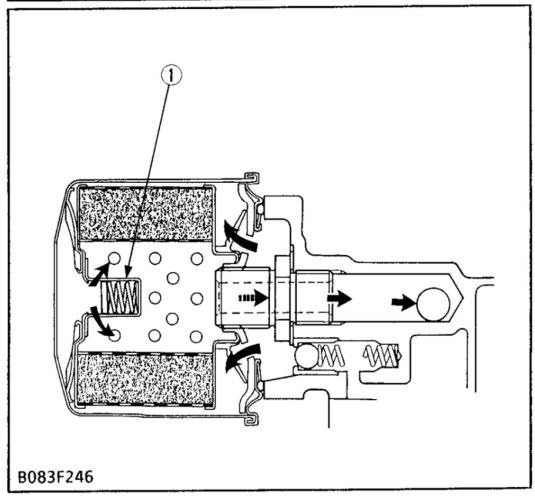


B083F246

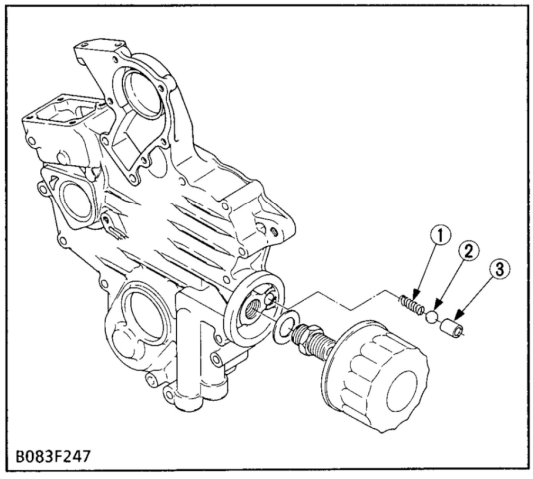
After lubricating, the lubricating oil brings back various particles of grit and dirt to the oil pan. Those particles and the impurities in the lubricating oil can cause wear or seizure of the engine parts. It may also impair the physical and chemical properties of the oil itself.

The lubricating oil, which is force-fed by the pump, is filtered by the filter cartridge with the filter element (2).

When the filter element accumulates on excessive amount of dirt and the oil pressure in the inlet line builds up by 98 kPa (1.0 kgf/cm^2, 14 psi) more than the outlet line, the by-pass valve (1) opens to allow the oil to flow from the inlet into the outlet line, by-passing the filter element.

(1) By-pass Valve
(2) Filter Element

(3) Relief Valve

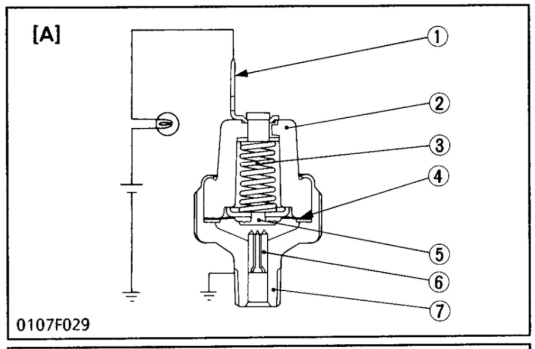


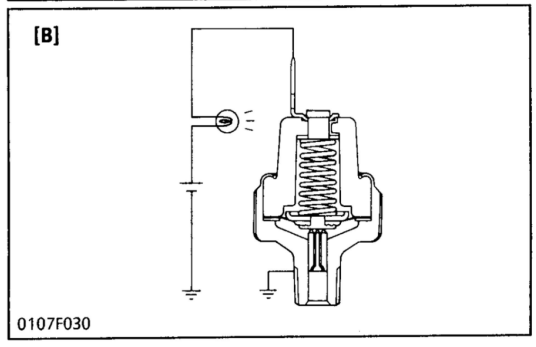
The relief valve prevents damage to the lubricating system due to high oil pressure. This relief valve is a ball type direct acting relief valve, and is best suited for low pressures.

When oil pressure exceeds the specified value, the steel ball (2) is pushed back by the pressure oil and the oil escapes.

(1) Relief Spring
(2) Steel Ball
(3) Valve Seat

(4) Oil Pressure Switch



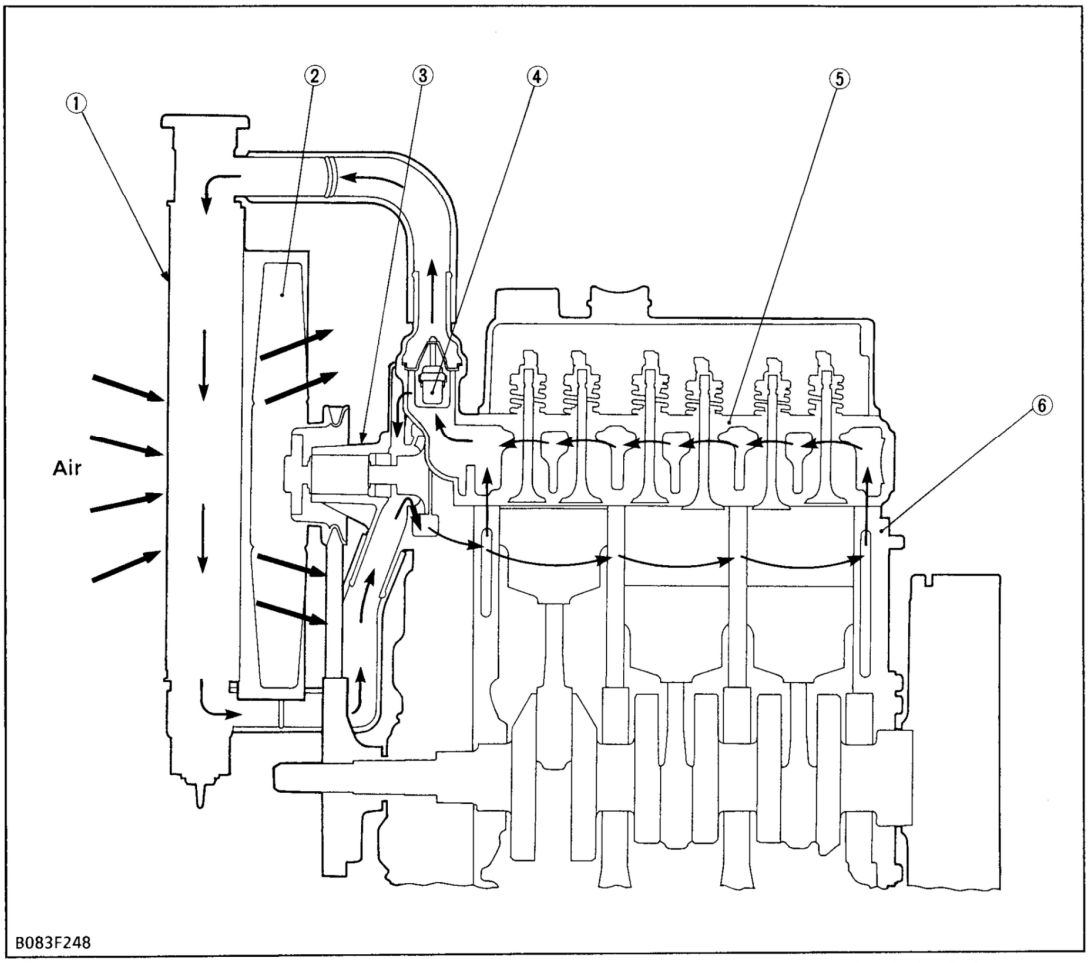


The oil pressure switch is mounted on the cylinder block, to warn the operator that the lubricating oil pressure is poor.

If the oil pressure falls below 49 kPa (0.5 kgf/cm^2, 7 psi), the oil warning lamp will light up, warning the operator. In this case, stop the engine immediately and check the cause of pressure drop.

[A] At Proper Oil Pressure
[B] At Oil Pressures of 49 kPa (0.5 kgf/cm^2, 7 psi) or Less
(1) Terminal
(2) Insulator
(3) Spring
(4) Rubber Gasket
(5) Contact Rivet
(6) Contact
(7) Oil Pressure Switch Body

[4] COOLING SYSTEM



(1) Radiator
(2) Cooling Fan
(3) Water Pump
(4) Thermostat
(5) Cylinder Head
(6) Cylinder Block

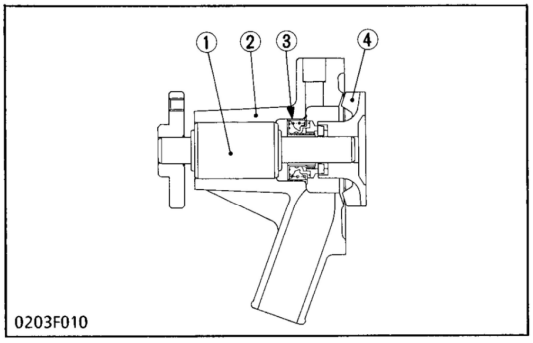
The cooling system consists of a radiator (1), centrifugal water pump (3), cooling fan (2) and thermostat (4).

The water is cooled through the radiator core, and the fan set behind the radiator pulls cooling air through the core to improve cooling.

The water pump sucks the cooled water, forces it into the cylinder block and draws out the hot water.

Then the cooling is repeated. Furthermore, to control temperature of water, a thermostat is provided in the system. When the thermostat opens, the water moves directly to radiator, but when it closes, the water moves toward the water pump through the bypass between thermostat and water pump. The opening temperature of thermostat is approx. 82 °C (180 °F).

(1) Water Pump



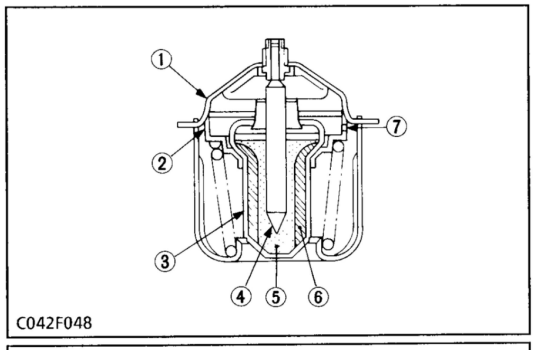
0203F010

The water pump is driven by the crankshaft via a V belt. Water cooled in the radiator is sucked into the water pump from its lower portion and is sent from the center of the water pump impeller (4) radially outward into the water jacket in the cylinder block.

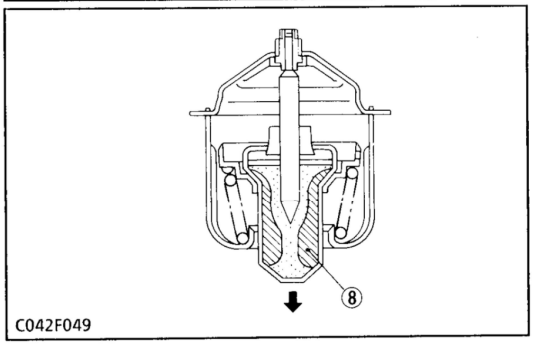
The bearing unit (1) prevents cooling water from entering by a mechanical seal (3).

(1) Bearing Unit
(2) Water Pump Body
(3) Mechanical Seal
(4) Water Pump Impeller

(2) Thermostat



C042F048



C042F049

The thermostat maintains the cooling water at correct temperature. KUBOTA's engine uses a wax pellet type thermostat. Wax is enclosed in the pellet. The wax is solid at low temperatures, but turns liquid at high temperatures, expands and opens the valve.

■ **At low temperatures (lower than 82 °C (180 °F))**

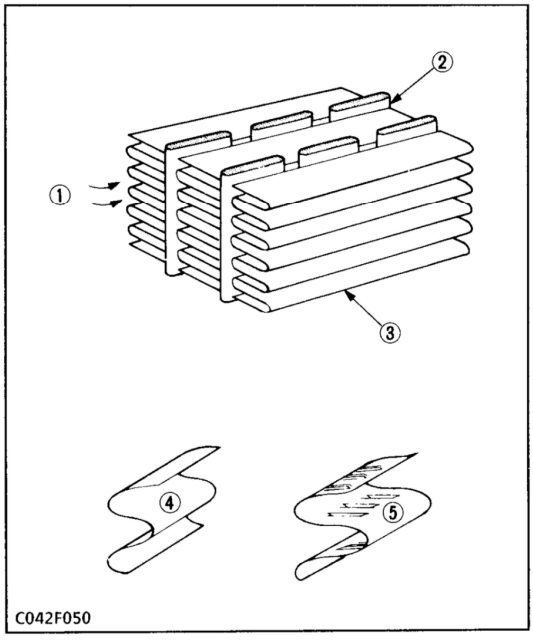
As the thermostat is closed, cooling water circulates in the engine through the water return pipe without running to the radiator. Air in the water jacket escapes to the radiator side through leak hole (7) of the thermostat.

■ **At high temperatures (higher than 82 °C (180 °F))**

When the temperature of cooling water exceeds 82 °C (180 °F), wax in the pellet turns liquid and expands. Because the spindle (4) is fixed, the pellet (3) is lowered, the valve (2) is separated from the seat (1), and then cooling water is sent to the radiator.

(1) Seat
(2) Valve
(3) Pellet
(4) Spindle
(5) Synthetic Rubber
(6) Wax (solid)
(7) Leak Hole
(8) Wax (liquid)

(3) Radiator



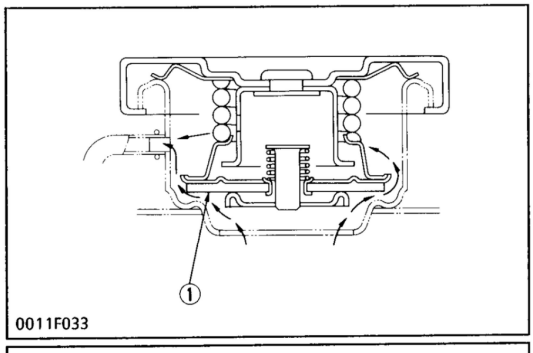
C042F050

The radiator core consists of water carrying tubes and fins (3) at a right angle to the tubes (2). Heat of hot water in the tubes is radiated from the tube walls and fins.

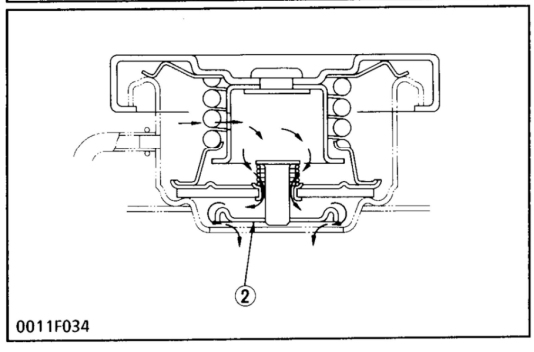
KUBOTA's engine uses corrugated fin type core which has a light weight and high heat transfer rate. Clogging is minimized by the louverless corrugated fins.

(1) Cooling Air
(2) Tube
(3) Fin
(4) Louverless Corrugated Fin
(5) Louvered Corrugated Fin

(4) Radiator Cap



0011F033



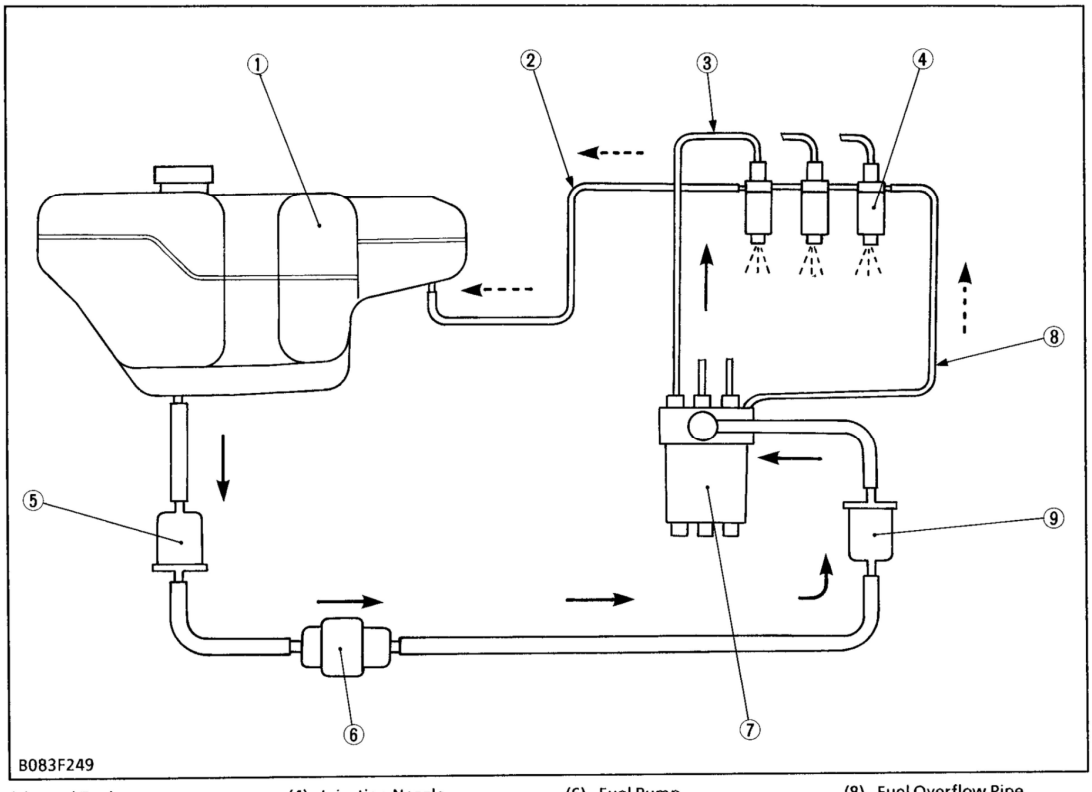
0011F034

The radiator cap is of the pressure type, which opens the pressure valve (1) to reduce internal pressure when internal pressure is increased beyond a certain point due to increase in water temperature. The normal valve actuating pressure of the radiator cap is 88 kPa (0.9 kgf/cm^2, 13 psi).

When water temperature is reduced (and its volume is reduced), pressure in the radiator becomes negative, and the vacuum valve (2) opens and introduces air into the radiator to prevent distortion of the radiator.

(1) Pressure Valve
(2) Vacuum Valve

[5] FUEL SYSTEM



(1) Fuel Tank
(2) Fuel Return Pipe
(3) Injection Pipe
(4) Injection Nozzle
(5) Fuel Filter
(6) Fuel Pump
(7) Fuel Injection Pump
(8) Fuel Overflow Pipe
(9) Fuel Filter

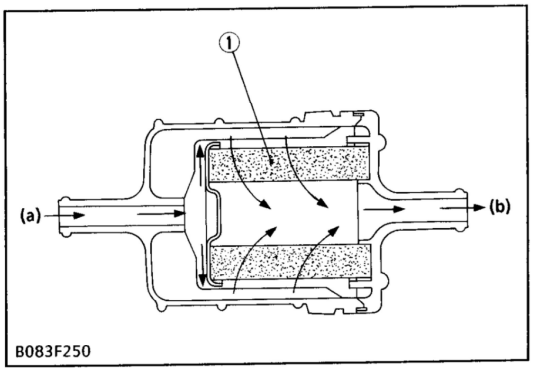
The fuel system consists of a fuel tank (1), fuel filters (5), (9), a fuel pump (6), a fuel injection pump (7) and injection nozzles (4).

When the main switch is turned **"ON"**, the fuel pump starts to feed the fuel to the fuel injection pump through the filters.

While the engine is running, the fuel injection pump pressure-feeds the fuel to the injection nozzles through the injection pipe, then the fuel is injected to the combustion chamber.

Any fuel leaking from the nozzles returns to the fuel tank through the fuel return pipe (2).

(1) Fuel Filter



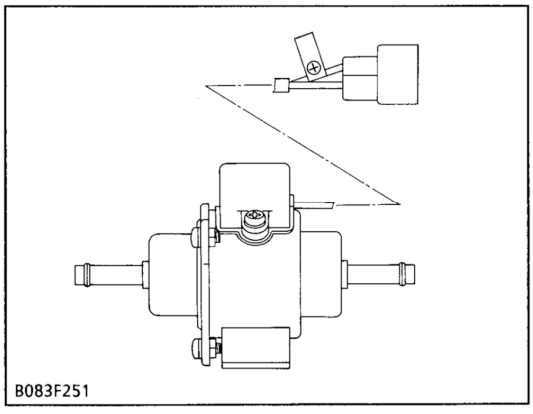
The fuel filter is installed in the fuel line between the fuel tank and fuel injection pump.

As the fuel flows from the inlet **(a)** through the filter element (1), the dirt and impurities in the fuel are filtered, allowing only clean fuel to enter the inside of the filter element. The cleaned fuel flows out from the outlet **(b)**.

Type of filter element	Accordion-pleated paper type
Material of filter element	Cotton fiber
Filter mesh	15 µm (0.00059 in.)

(1) Filter Element
(a) Inlet
(b) Outlet

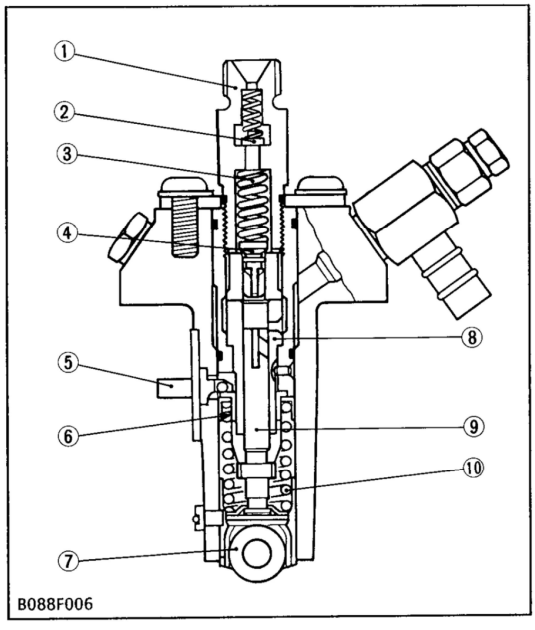
(2) Fuel Pump


B083F251

An electro magnetic fuel pump uses a transistor that causes the pump to start pumping fuel when the main switch is turned to the **"ON"** position.

Therefore, fuel is supplied to the fuel injection pump regardless of engine speed. This pump is driven by the battery. It can therefore be operated even with the engine being stopped.

(3) Fuel Injection Pump

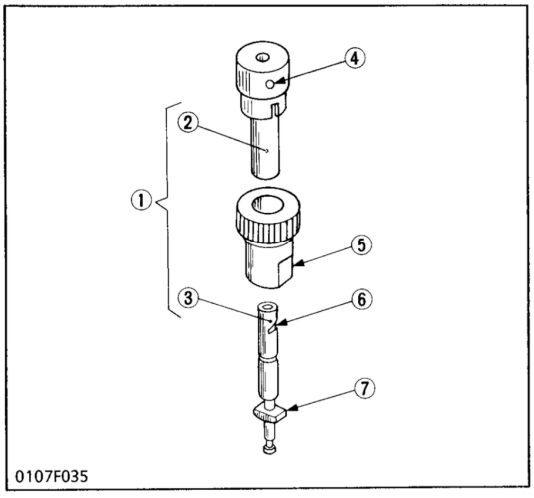


B088F006

The injection pump is a Bosch MD type mini-injection pump, which gives high injection quality even at low engine speed. The plunger (9) is reciprocated by the fuel camshaft through the tappet (7).

The control rack (5) is pushed or pulled by the fork lever of the governor and rotates the control sleeve (6) and the plunger, which has a left-hand lead control groove, to vary the amount of fuel forced into the injection nozzle.

(1) Delivery Valve Holder
(2) Damping Valve
(3) Delivery Valve Spring
(4) Delivery Valve
(5) Control Rack
(6) Control Sleeve
(7) Tappet
(8) Cylinder
(9) Plunger
(10) Spring



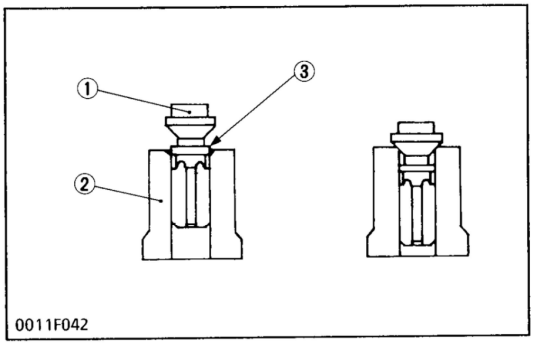
0107F035

■ Pump Element

The pump element (1) consists of the plunger (3) and cylinder (2). Their sliding surfaces are super precision machined to maintain the injection pressure at idle speed.

Since the driving face (7) fits in the control sleeve (5), the plunger is rotated by the movement of the control rack. The cylindrical surface of the plunger has a helix groove, which is called the control groove (6).

(1) Pump Element
(2) Cylinder
(3) Plunger
(4) Feed Hole
(5) Control Sleeve
(6) Control Groove
(7) Driving Face



0011F042

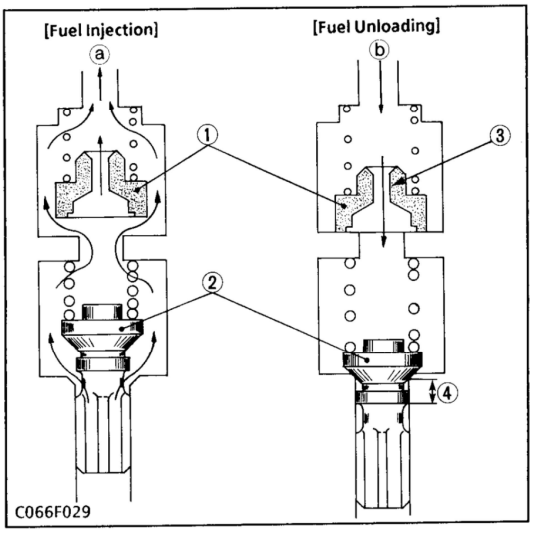
■ Delivery Valve

The delivery valve consists of the valve (1) and the valve seat (2).

The delivery valve prevents the fuel from flowing back into the delivery chamber through the injection pipe. It also prevents the fuel from dribbling at the injection nozzle.

When the delivery stroke ends the relief plunger (3) moves into the bore of the valve seat and seals the delivery line from the delivery chamber. The relief plunger lowers further until the valve seat sucks back the fuel to prevent dribbling at the injection nozzle.

(1) Valve
(2) Valve Seat
(3) Relief Plunger



C066F029

■ Damping Valve

The damping valve (1) with a orifice (0.4 mm dia., 0.016 in. dia.) (3) is provided above the delivery valve (2) to prevent rapid pressure drop at the delivery stroke ends.

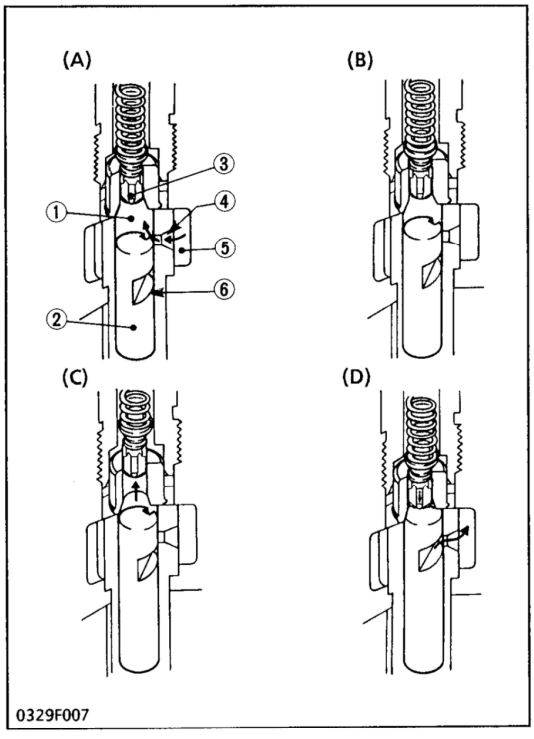
In the fuel injection state, the damping valve rises against the spring force and the fuel is forcibly fed to the nozzle through around the damping valve and its orifice.

When the delivery valve sucks back the fuel after the end of injection, the fuel passes through the orifice only.

Therefore, the pressure drop in the sucks back process is retarded for perfect prevention of secondary injection caused by rapid pressure drop and to improve the nozzle durability.

(1) Damping Valve
(2) Delivery Valve
(3) Orifice
(4) Sucking Back Stroke

(a) To Injection Pipe
(b) From Injection Pipe



0329F007

■ Operation of Pump Element

(A) Before delivery

As the tappet lowers, the plunger (2) lowers and fuel is drawn into the delivery chamber (1) through the feed hole (4) from the fuel chamber (5).

(B) Beginning of delivery

When the plunger is pushed up by the cam of fuel camshaft and the head of the plunger closes the feed hole, the pressure in the delivery chamber rises to push the delivery valve (3) open.

Fuel is then force-fed into the injection pipe.

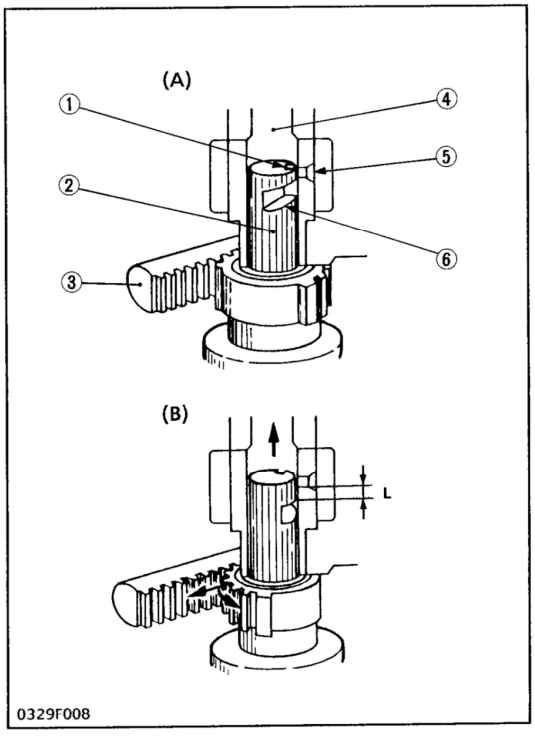
(C) Delivery

While the plunger is rising, delivery of fuel continues.

(D) End of delivery

When the plunger rises further and the control groove (6) on its periphery meets the feed hole, the fuel returns to the fuel chamber from the delivery chamber through the control groove and the feed hole.

(1) Delivery Chamber
(2) Plunger
(3) Delivery Valve
(4) Feed Hole
(5) Fuel Chamber
(6) Control Groove



0329F008

■ Positions of Pump Element

(A) No fuel delivery

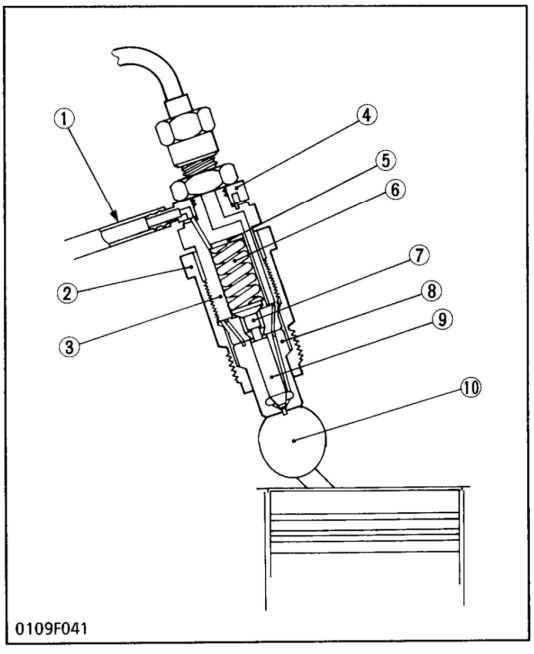
At the engine stop position of the control rack (3), the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). The delivery chamber (4) is led to the feed hole during the entire stroke of the plunger, and no fuel is forced to the injection nozzle.

(B) Fuel delivery

The plunger is rotated (see figure) by the control rack and the feed hole is not aligned with the lengthwise slot. When the plunger is pushed up, the feed hole is closed by the plunger. The pressure in the delivery chamber builds up and forces the fuel to the injection nozzle until the control groove (6) meets the feed hole. The amount of the fuel to be forced into the nozzle corresponds to the distance "**L**".

(1) Slot
(2) Plunger
(3) Control Rack
(4) Delivery Chamber
(5) Feed Hole
(6) Control Groove

(4) Injection Nozzle



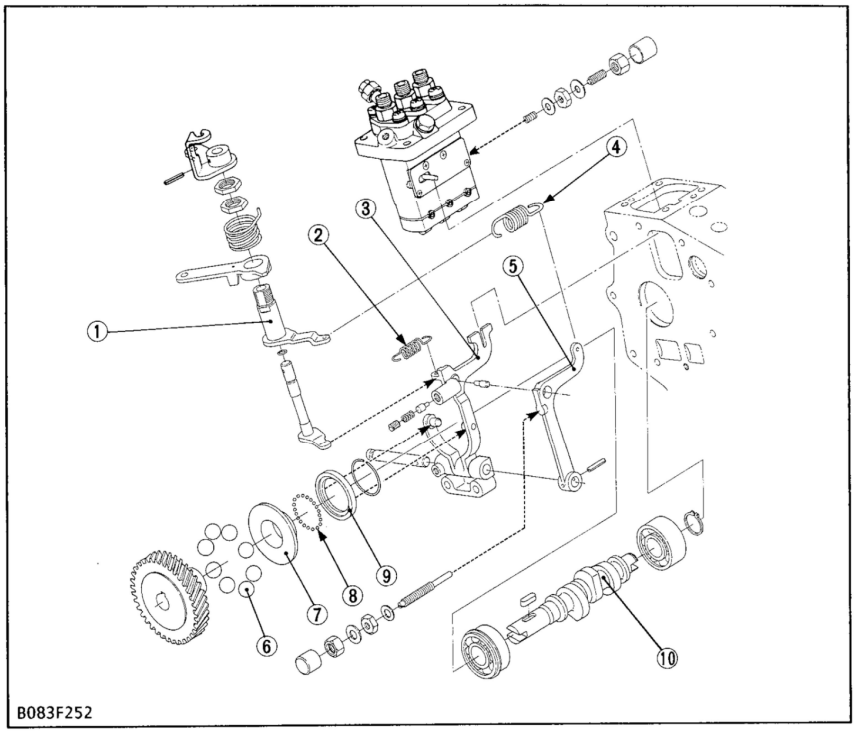
The injection nozzle is of the throttle type. The needle valve (9) is pushed against the nozzle body (8) by the nozzle spring (6) with the push rod (7).

The fuel forced from the injection pump pushes up the needle valve and is injected into the sub-combustion chamber (10). The excessive fuel which is not injected returns through the center chamber of the nozzle holder (3) and the fuel overflow pipe (4) to the fuel tank.

The injection pressure can be adjusted with the adjusting washer (5).

(1) Fuel Return Pipe
(2) Nozzle Retaining Nut
(3) Nozzle Holder
(4) Fuel Overflow Pipe
(5) Adjusting Washer
(6) Nozzle Spring
(7) Push Rod
(8) Nozzle Body
(9) Needle Valve
(10) Sub-combustion Chamber

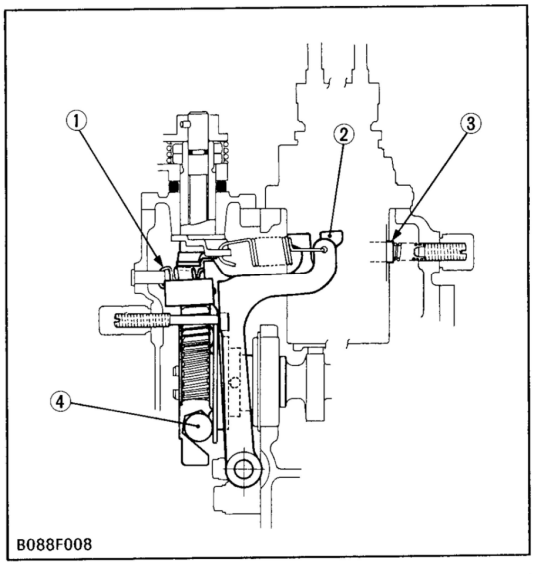
(5) Governor



(1) Governor Lever
(2) Start Spring
(3) Fork Lever 1
(4) Governor Spring
(5) Fork Lever 2
(6) Steel Ball
(7) Governor Sleeve
(8) Steel Ball
(9) Governor Ball Case
(10) Fuel Camshaft

The governor controls the amount of the fuel to be fed in the entire speed range to prevent the engine from changing its speed according to the load.

The fork lever 1 (3) is held where two forces on it are balanced. One is the force that fork lever 2 (5) pushes, which is caused by the tension of the governor spring (4) between the governor lever (1) and fork lever 2 (5). Another is the component of the centrifugal force produced by the steel balls (6) which are rotated by the fuel camshaft (10).

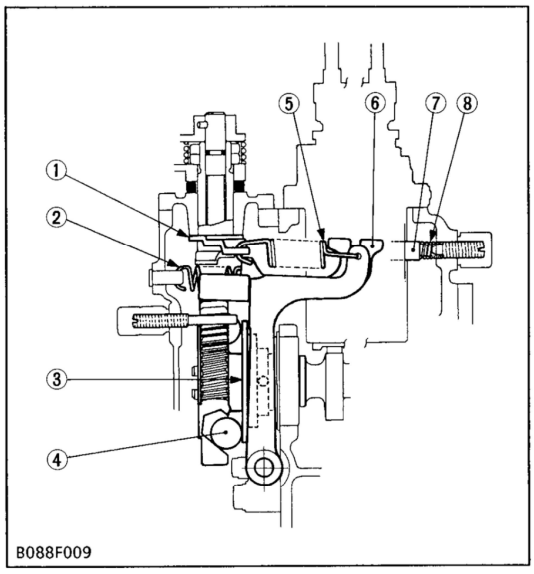


■ At Start

The steel ball (4) has no centrifugal force.

Fork lever 1 (2) is pulled by the start spring (1) and the control rack (3) moves to the maximum injection position for easy starting.

(1) Start Spring
(2) Fork Lever 1
(3) Control Rack
(4) Steel Ball



B088F009

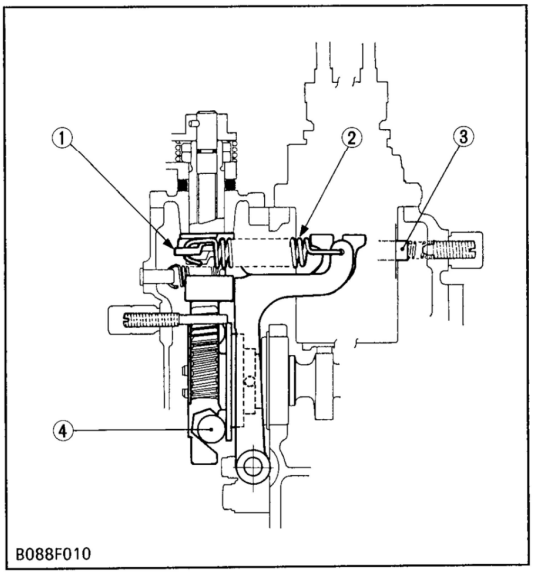
■ **At Idling**

When the speed control lever (1) is set at the idling position, the governor spring (5) is pulled slightly.

As the camshaft rotates, the steel balls (4) increase their centrifugal force and push the governor sleeve (3). Fork lever 1 (6) pushed by the governor sleeve, pushes the control rack (7) and the control rack compresses the idling adjust spring (8).

The control rack is kept at a position where the centrifugal force is balanced with the spring tension on the control rack providing stable idling.

(1) Speed Control Lever
(2) Start Spring
(3) Governor Sleeve
(4) Steel Ball
(5) Governor Spring
(6) Fork Lever 1
(7) Control Rack
(8) Idling Adjust Spring



B088F010

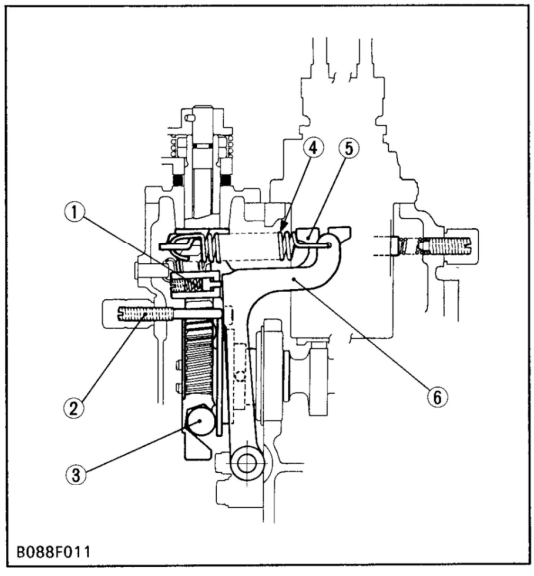
■ **At Medium or High Speed Running**

When the speed control lever (1) is turned further, the governor spring (2) increases the tension and the control rack (3) is pulled to increase the engine speed.

The steel balls (4) increase their centrifugal force and the control rack is pushed, decreasing the engine speed, until the centrifugal force and the spring tension are balanced.

When the engine speed is dropped with the increase of the load, the centrifugal force of the steel ball decreases and the control rack is pulled. The amount of the fuel to the injection nozzle is increased to produce a higher engine torque required for the load.

(1) Speed Control Lever
(2) Governor Spring
(3) Control Rack
(4) Steel Ball



B088F011

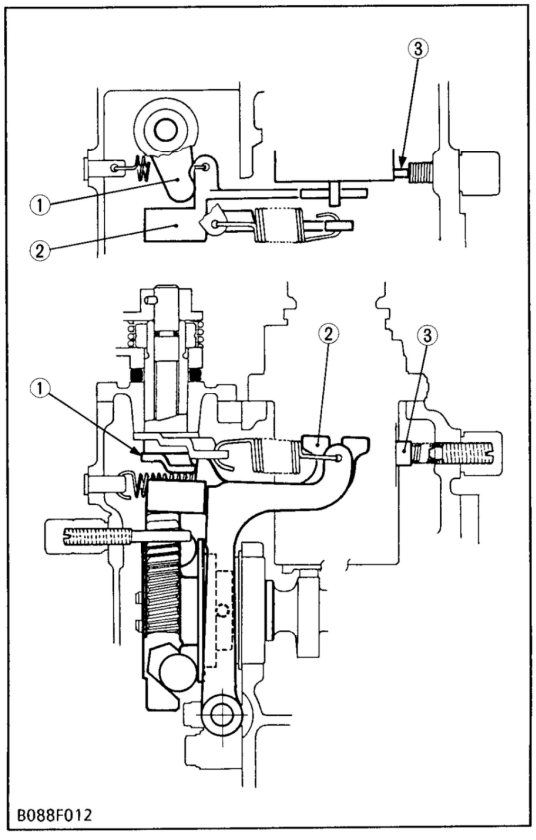
■ **At Maximum Speed Running with Overload**

When the engine is overloaded at the high speeds and the engine speed drops, the centrifugal force of the steel balls (3) decreases and the governor spring (4) pulls fork lever 1 (5) and 2 (6).

When fork lever 2 contacts the adjusting screw (2), the spring (1) which is built in fork lever 2 begins to push the fork lever 1 to pull the control rack.

The fuel to the injection nozzle is increased to run the engine at high speed and torque.

(1) Spring
(2) Adjusting Screw
(3) Steel Ball
(4) Governor Spring
(5) Fork Lever 1
(6) Fork Lever 2



B088F012

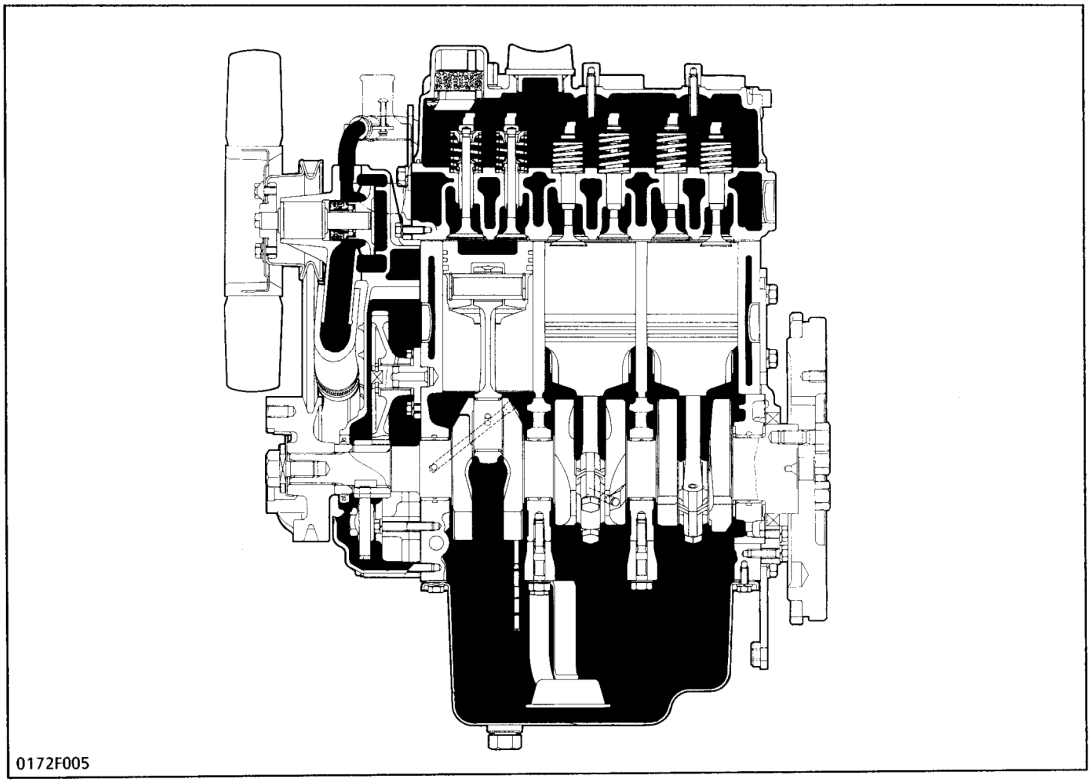
■ **To Stop the Engine**

When the stop lever (1) is moved to the stop position, fork lever 1 (2) is pushed and the control rack (3) is moved to stop the fuel injection.

(1) Stop Lever
(2) Fork Lever 1
(3) Control Rack

1-2 ENGINE [WG750-G]

[1] FEATURE

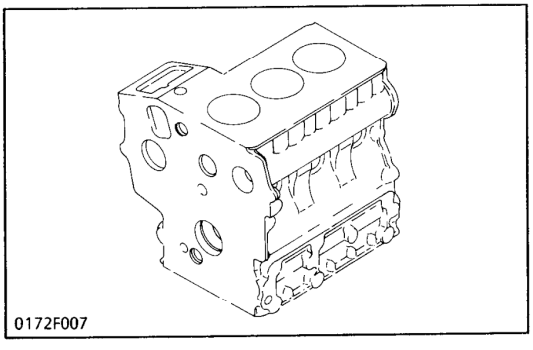


The WG750-G is vertical, liquid cooled, 4-cycle gasoline engine. It incorporates Kubota's most advanced technology.

With special ignition system, famous fully-transistorized ignition, and well-balanced design, the WG750-G delivers tremendous power, excellent fuel consumption, little vibration, quiet operation, and durability equal to that of Kubota's diesel engines.

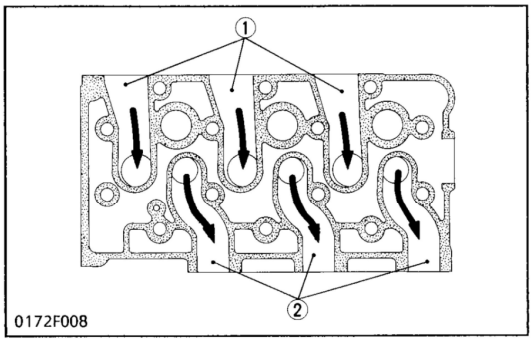
[2] ENGINE BODY

(1) Cylinder Block



The engine has a highly durable tunnel-type cylinder block in which the bearings, pistons, crankshaft and camshaft are installed.

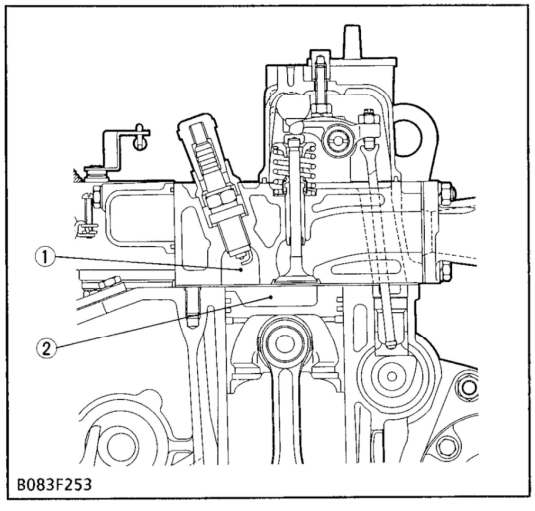
(2) Cylinder Head



■ Intake and Exhaust Port

The cross-flow type intake / exhaust ports, which lower the heat conduction from the exhaust port to the intake port. The low heat conduction keeps the intake air from being heated and expanded by the exhaust gas.

(1) Intake Port (2) Exhaust Port

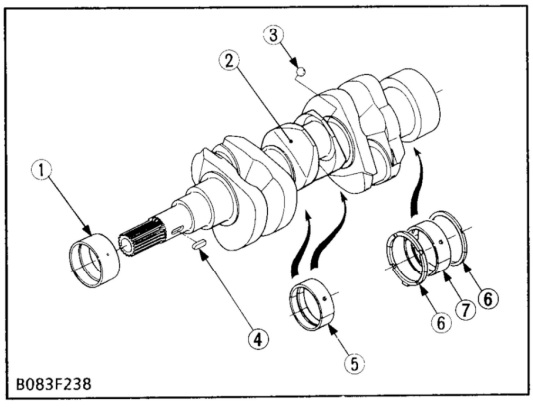


■ Combustion System

The gas in the sub-combustion chamber (1) forms a vortex in the main combustion chamber (2), which improves combustion efficiency.

(1) Sub-combustion Chamber (2) Combustion Chamber

(3) Crankshaft



The crankshaft with the connecting rod converts the reciprocating motion of the piston into rotating motion.

The crankshaft (2) has oil passages drilled so that oil can flow from the main bearings to the crank pin bearings.

The front journal is supported by a sleeve type bearing (crankshaft bearing 1) (1), the intermediate journal by a split type (crankshaft bearing 3) (5), and the rear by a split type (crankshaft bearing 2) (7) with thrust bearings (6).

(1) Crankshaft Bearing 1
(2) Crankshaft
(3) Steel Ball
(4) Feather Key
(5) Crankshaft Bearing 3
(6) Thrust Bearing
(7) Crankshaft Bearing 2