WSM

WORKSHOP MANUAL
TRACTOR

L2250,L2550(GST),
L2850(GST),L3250

Kubota

KiSC issued 07, 2016 A

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA Tractor L2250, L2550, L2850 and Implements. It is divided into three parts, "Mechanism", "Disassembling and Servicing" and "Implement".

■ **Mechanism**

Information on construction and function are included for each tractor 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 tractor section, there are troubleshooting, servicing specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

■ **Implement**

On this section, explain the mechanism and servicing method for Front-end loader, Mower and Rotary tiller.

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.

December '84

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SPECIFICATIONS

Model				L2250 (2WD)	L2250 (4WD)	L2550 (2WD)	L2550 (4WD)	L2850 (2WD)	L2850 (4WD)
Maximum PTO power				15.7kW (21HP)*		17.5kW (23.5HP)*		20.1kW (27HP)*	
Engine gross H.P.				19.8kW (26.5HP)*		22.0kW (29.5HP)*		25.4kW (34HP)*	
	Model			KUBOTA D1302-DI-A		KUBOTA D1402-DI-A		KUBOTA V1702-DI-A	
	Type			Vertical, water-cooled, 4 cycle diesel engine					
	Number of cylinders			3				4	
	Bore and stroke			82 x 82mm (3.2 x 3.2in.)		85 x 82mm (3.3 x 3.2in.)		82 x 82mm (3.2 x 3.2in.)	
	Total displacement			1299cm³ (79.3cu. in.)		1395cm³ (85.1cu. in.)		1732cm³ (105.7cu. in.)	
	Rated revolution			43.3 r/s (2600 rpm)					
	Maximum torque (Net)			80.61N·m (8.22 kgf·m, 59.46 ft-lbs)		88.26N·m (9.00 kgf·m, 65.10 ft-lbs)		101.11N·m (10.31 kgf·m, 74.57 ft-lbs)	
	Combustion chamber			Direct injection					
	Fuel injection pump			Bosh K type mini pump (NP-PFR3KD 75/2 NP17)				(NP-PFR4KD 75/2 NP6)	
	Governor			Centrifugal ball mechanical governor					
	Injection nozzle			4 hole type (Stanadyne pencil nozzle)					
	Injection timing			0.31 rad. (18°) before T.D.C.					
	Injection order			1 – 2 – 3				1 – 3 – 4 – 2	
	Injection pressure			22.75 MPa (232 kgf/cm², 3300 psi)					
	Compression ratio			18					
	Lubricating system			Forced lubrication by pump					
	Cooling system			Pressurized radiator, Forced circulation with water pump					
	Starting system			Electric starting with cell starter (12V, 1.4kW)					
	Alternator			12V 420W					
	Battery			12V 80 Ah eq.				12V 110 Ah eq.	
	Fuel			Diesel fuel No. 1-D [below-10°C (15°F)] Diesel fuel No. 2-D [above-10°C (15°F)] (ASTM D975)					
	Lubricating oil			MIL-L-2104B or MIL-L-2104C, quality better than CC class (API)					
	Weight (Dry)			176.7 kg (389.6 lbs)				207.1 kg (456.6 lbs)	
Capacities	Fuel tank			29ℓ (7.7 U.S.gals., 6.4 Imp.gals.)					
	Engine crankcase			5.7ℓ (6.0 U.S.qts., 5.02 Imp.qts.)				8.5ℓ (8.9 U.S.qts., 7.48 Imp.qts.)	
	Engine coolant		A	5ℓ (5.3 U.S.qts., 4.4 Imp.qts.)				7ℓ (7.4 U.S.qts., 6.16 Imp.qts.)	
			B	4.6ℓ (4.9 U.S.qts., 4.1 Imp.qts.)				5.6ℓ (5.9 U.S.qts., 4.9 Imp.qts.)	
	Transmission case			28.5ℓ (7.5 U.S.gals., 6.3 Imp. gals.)					
	Steering gear case			0.1ℓ (0.11 U.S.qts., 0.088 Imp. qts.)					
	Steering gear box			0.2ℓ (0.21 U.S.qts., 0.176 Imp. qts.)					
	Front axle case [4WD]			6ℓ (6.3U.S.qts., 5.28Imp.qts.)		6.5ℓ (6.8 U.S.qts., 5.72 Imp.qts.)			
Dimensions	Overall length (without 3P) mm (in.)			2750 (108.3)		2770 (109.1)		2900 (114.2)	
	Overall width mm (in.)			1255 (49.4)		1305 (51.4)		1370 (53.9)	
	Overall height with muffler mm (in.)			2030 (79.9)					
	Wheel base mm (in.)			1640 (64.6)				1735 (68.3)	
	Min. ground clearance mm (in.)			345 (13.6)	305 (12.0)	370 (14.6)	345 (13.6)	355 (14.0)	345 (13.6)
	Tread	Front mm (in.)		1010 (39.8)	1010 (39.8)	960 (37.8) to 1260 (49.6)	1120 (44.1)	1150 (45.3) to 1450 (57.1)	1120 (44.1)
		Rear mm (in.)		1015 (40.0), 1135 (44.7)		1030 (40.6) to 1400 (55.1)		1050 (41.3) to 1515 (59.6)	
Travelling system	Tire size (Std.)	Front tires		4.00–15	6–14	5.00–15	7–16	5.00–15	7–16
		Rear tires		9.5–24	9.5–24	11.2–24	11.2–24	12.4–24	12.4–24
	Clutch			Dry single plate or dual stage (if equipped)				Dry twin plates or dual stage (if equipped)	
	Steering			Recirculating ball type manual steering or integral type power steering (if equipped)					
	Transmission			Mechanical shuttle, 8 forward and 7 reverse					
	Brake	Travelling		Wet disc type					
		Parking		Connected with the travelling brake					
	Differential			Bevel gear					

Tractor serial number

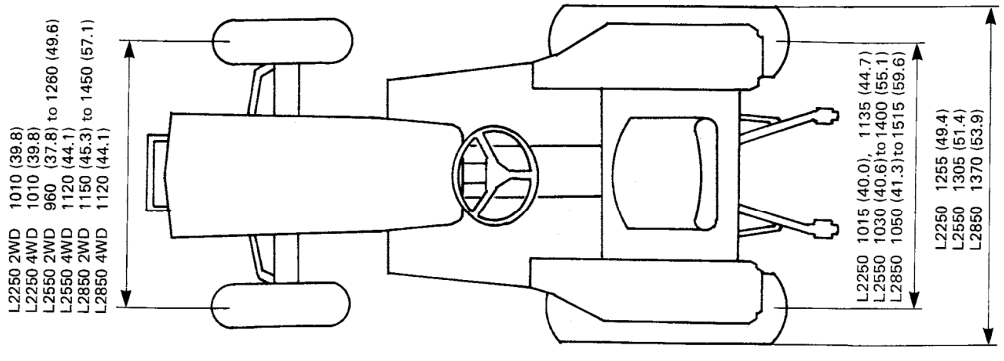
[A]	L2250 2WD: ~12830	L2550 2WD: ~12579	L2850 2WD: ~11358
	L2250 4WD: ~57288	L2550 4WD: ~57608	L2850 4WD: ~58194
[B]	L2250 2WD: 12831~	L2550 2WD: 12580~	L2850 2WD: 11359~
	L2250 4WD: 57289~	L2550 4WD: 57609~	L2850 4WD: 58195~

Model			L2250 (2WD)	L2250 (4WD)	L2550 (2WD)	L2550 (4WD)	L2850 (2WD)	L2850 (4WD)
Hydraulic system	Hydraulic control system		Position control and draft control (if equipped)					
	Pump capacity		25.4ℓ/min (6.7 GPM)				29.4ℓ/min (7.7 GPM)	
	Three point hitch		Category 1					
	Max. lifting force (24in. behind lower link end)		700kg (1540 lbs)		900kg (1980 lbs)			
Rear PTO	PTO shaft		SEA 1-3/8 6-splines (with overrunning clutch on single clutch tractor)					
	Revolution	with single stage clutch	2 speeds 9r/s (540 rpm)/engine 40.5r/s (2430 rpm), 16.7r/s (1000 rpm)/engine 40.6r/s (2438 rpm)					
		with dual stage clutch	2 speeds 9r/s (540 rpm)/engine 38.3r/s (2298 rpm), 16.7r/s (1000 rpm)/engine 40.6r/s (2438 rpm)					
Mid PTO (if equipped)	PTO shaft		USA No. 5 Involute spline					
	Revolution	with singl stage clutch	2 speeds 18r/s (1080 rpm)/engine 40.5r/s (2430 rpm), 33.3r/s (2000 rpm)/engine 40.6r/s (2438 rpm)					
		with dual stage clutch	2 speeds 18r/s (1080 rpm)/engine 38.3r/s (2298 rpm), 33.3r/s (2000 rpm)/engine 40.6r/s (2438 rpm)					
Min. turning radius m (feet)			2.3 (7.5)	2.2 (7.2)	2.3 (7.5)	2.3 (7.5)	2.4 (7.9)	2.4 (7.9)
Traction system			Fixed drawbar or Swing drawbar (if equipped)					
Weight kg (lbs)			984 (2170)	1080 (2380)	1020 (2250)	1120 (2470)	1125 (2480)	1230 (2710)

NOTE: *Manufacture's estimate.

DIMENSION
[L2250·L2550·L2850]

Unit : mm (in.)



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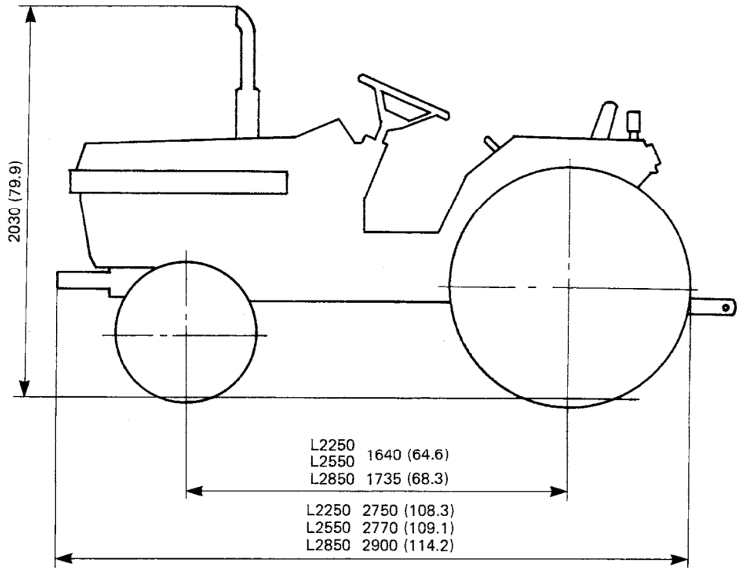

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F FEATURES

- Column shifted main shift and shuttle levers
- Integral power steering (if equipped) (M.7-3)
- Comfortable, ride-engineering seat
- Easy checker for daily inspection (if equipped) (M.9-24)
- Direct injection, water cooled diesel engine delivers more power for less fuel (M.1)
- Engine key stop

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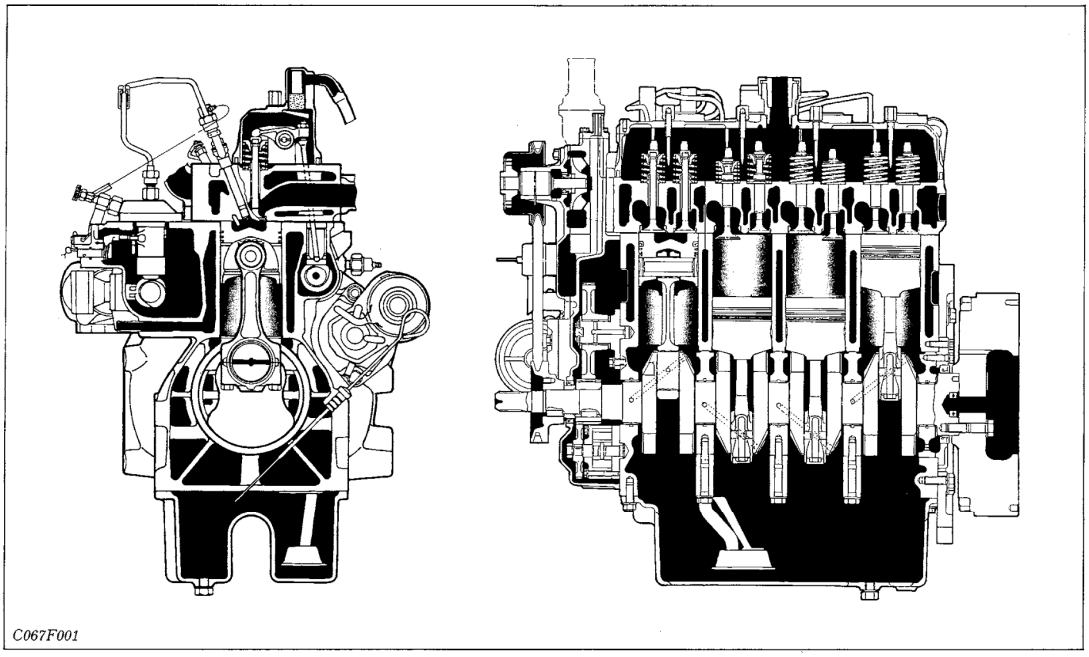
- Rops
- Position control (M.8-11) Draft control (if equipped) (M.8-13)

- Roomy platform
- 8 forward, 7 reverse speed Manual shuttle transmission (M.3-6) Partial synchromesh (3rd, 4th, 7th, 8th) (if equipped) (M.3-3)
- Mid-PTO (if equipped) (M3-9)
- Twin plates single stage clutch (for L2850) (M.2-3) Dual stage clutch (if equipped) (M.2-4)
- Smaller turning radius
- Adjustable front wheel tread (except L2250) [2WD] (M.6-1)
- Reverse fan blade
- Positive, wet disc brakes
- Two-speed PTO (M.3-8) (540 rpm, 1000 rpm)
- Category 1
- Swinging drawbar (if equipped)

1 ENGINE

[1] GENERAL

(1) Sectional View



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The D1302-DI, D1402-DI are three cylinders and V1702-DI is four cylinders, vertical, watercooled, 4-cycle diesel engines, with Bosch K type mini injection pump and direct injection system.

Their direct injection system features low fuel consumption, excellent ignition, high output at a low speed and quick response for acceration, and its low piston speed prolongs engine life.

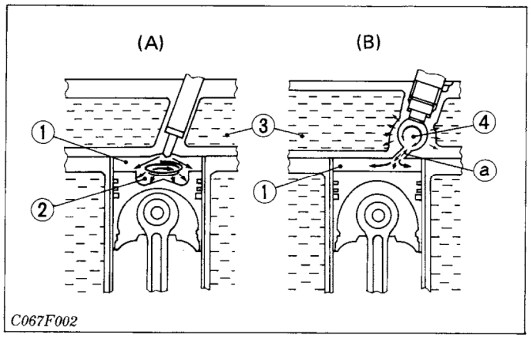
The equally divided explosion force into cylinders with improved combustion system and precisely manufactured parts lower the noise and vibration for quiet and smooth running.

The idle compensator improves the combustion at low speed while cold.

■ NOTE

- **The cylinder numbers are given in order from the gear case end.**

(2) Features



(1) Combustion Chamber
(2) Cavity
(3) Cooling Water
(4) Sub-combustion Chamber

1. Low Specific Fuel Consumption

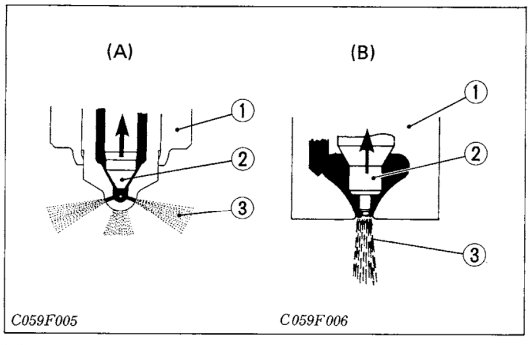
The Piston crown has a cut-out swirl cup cavity with a truncated cone at the center. The fuel is directly injected into the cavity with no throttle loss, which the sub-chamber system has at the line between the combustion chambers.

The explosion in the cavity utilizes fully its power to force down the piston and minimize the area to contacts with the cooling water, which reduce heat loss.

The low compression pressure lowers the load to the bearing and contact surfaces, which reduces friction loss.

(A) Direct injection system
(B) Sub-chamber system

(a) Line where the throttle loss is caused



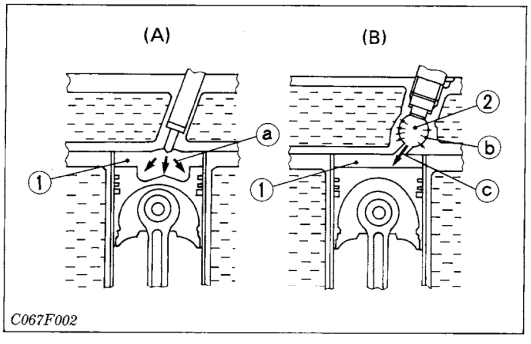
(1) Nozzle Body
(2) Valve
(3) Fuel Injected

2. Excellent Starting Performance

The hole type injection nozzle directly injects the fuel into the compressed air to atomize in the combustion chamber, which ignites the fuel more easily than the pintle type injection nozzle in the sub-combustion system. This excellent ignition assures easy starting even at −5°C (23°F) without glow plugs.

The low compression ratio facilitates passing through the top dead center.

(A) Hole Type Nozzle
(B) Pintle Type Nozzle



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

3. High Durability

The less heat transfer to the cylinder head of the direct injection system than the sub-chamber system, which has a sub-combustion chamber in the cylinder head, reduce the strain to the cylinder head, the valve seat and other parts.

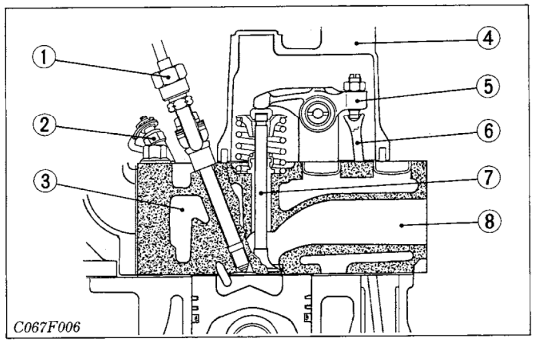
The explosion in the combustion chamber at the center of piston crown evenly forces down the piston, which minimizes the tilt of the piston and the wear of the piston, piston rings and cylinder wall. Furthermore the smaller tilt of the piston reduces the leakage of the exhaust gas to the crankcase, which keeps the lubricating oil clean and reduces the wear of moving parts.

(A) Direct injection system
(B) Sub-chamber system

(a) Combustion from the center of chamber
(b) Thermal load to cylinder head by sub-chamber
(c) Uneven force to the piston

[2] ENGINE BODY

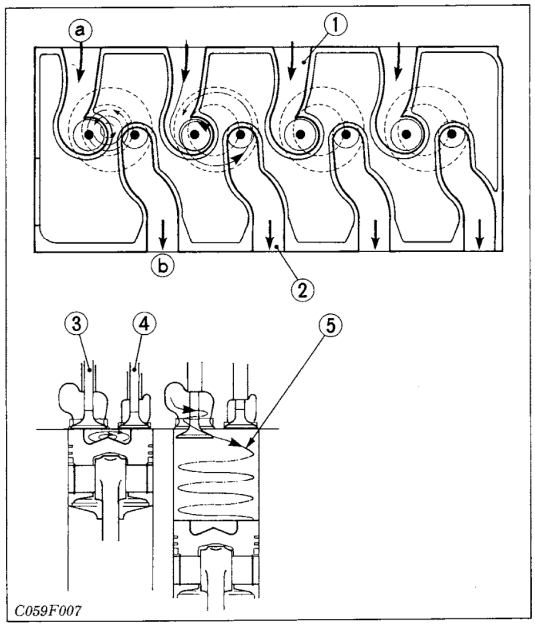
(1) Cylinder Head



The cylinder head is made of high performance cast iron which can resist high temperature and pressure caused by combustion.

The cylinder head, in which injection nozzle (1) and glow plug (2) are installed, has the air inlet ports, gas exhaust ports (8) and water jacket (3) surrounding the valve system (5), (6) and (7).

(1) Injection Nozzle
(2) Glow Plug
(3) Water Jacket
(4) Head Cover
(5) Rocker Arm
(6) Push Rod
(7) Valve
(8) Exhaust Port



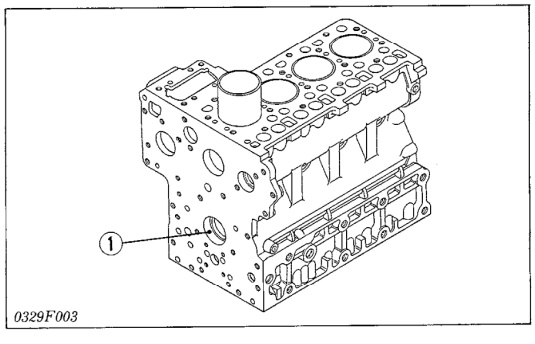
The cross-flow type inlet/exhaust ports, which are opposite and alternatively located, lower the heat conduction from the exhaust port (2) to the inlet port (1).

The spiral inlet port (1) and the valve (3) introduce the air into the cylinder, causing the air to swirl. The air swirled along the cylinder wall improves the combustion efficiency in the direct injection system.

(a) Inlet Air
(b) Exhaust Gas

(1) Inlet Port
(2) Exhaust Port
(3) Inlet Valve
(4) Exhaust Valve
(5) Swirl

(2) Cylinder Block



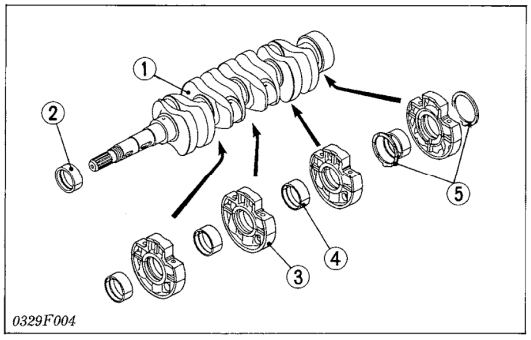
The engine has a highly durable one-piece cylinder block.

The crankshaft is supported by the crankshaft bearings and the bearing case, which are installed in the cylinder block.

Further more, dry-type cylinder liners pressed into the cylinders allow effective cooling, less distortion and greater wear-resistance.

(1) Front Bearing Bore

(3) Crankshaft and Bearing



(1) Crankshaft
(2) Crankshaft Bearing 1
(3) Main Bearing Case
(4) Crankshaft Bearing 2
(5) Thrust Bearing

The crankshaft is made of forged chrome molybdenum steel and the journals, the crankpins and the bearing surface for the oil seal are induction-hardened to increase wear resistance.

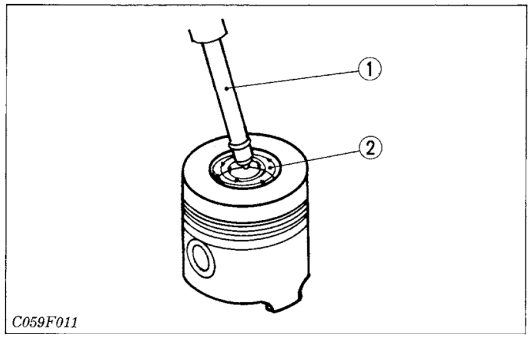
The counterweights opposite the cranks balance with their partial inertia and eliminate the vibration and lower the friction at the journals to prevent the bearing wear and lubricating oil temperature rise.

Each crankshaft journal is supported by the main bearing case (3) having a bearing inside. The front bearing – crankshaft bearing 1 (2) – is a solid type bushing. The rear and intermediate bearings – crankshaft bearing 2 (4) – are a split type. At the both sides of the rear bearing, thrust bearings (5) are installed.

The crankshaft bearings and thrust bearings are plated with a special alloy to increase the wear resistance.

The crankshaft, crankshaft bearings and main bearing cases have oil holes for lubricate flow.

(4) Piston

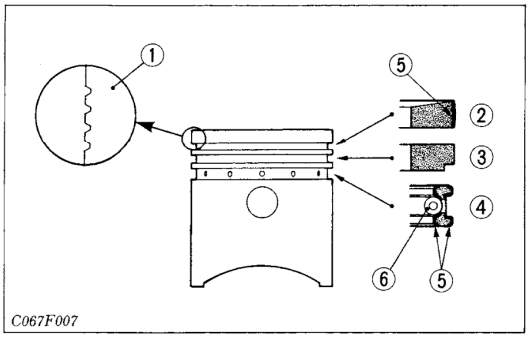


(1) Injection Nozzle
(2) Cavity

The piston is made of an aluminum alloy which is temperature and pressure resistant.

This direct injection engine has pistons with a cut-out swirl cup cavity at their head. The fuel is injected into the inlet air which is swirled and compressed in the cavity.

(5) Piston Rings



(1) Piston Top Land
(2) Top Ring
(3) Second Ring
(4) Oil Ring
(5) Chrome Plating
(6) Coil Expander Ring

The piston has three piston rings. The top (2) and the second (3) rings are the compression rings and the bottom ring (4) is the oil ring.

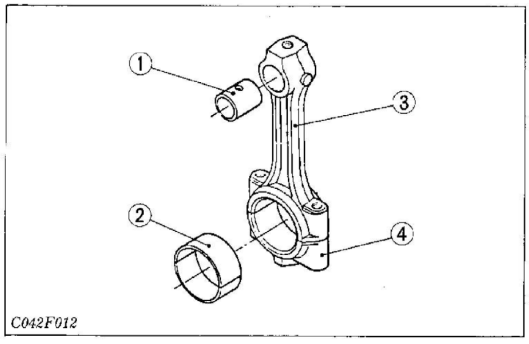
The top ring (2) is a keystone type, which can withstand heavy loads, and the barrel face on the ring fits well to the cylinder wall.

The second ring (3) is an undercut type, which prevents the oil from being carried up.

The oil ring (4) has chamfered contact faces and an expander ring (6), which increase the pressure of the oil ring against the cylinder wall to scrape the oil.

The rings are plated with hard chrome to increase wear resistance.

(6) Connecting Rod

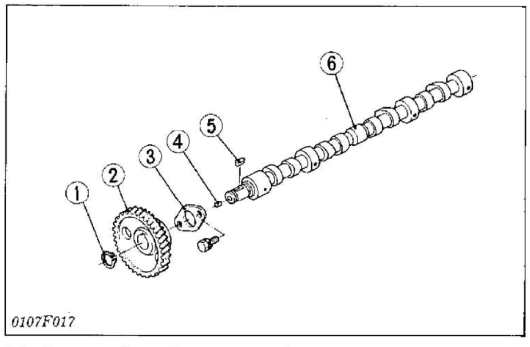


(1) Small End Bushing
(2) Connecting Rod
(3) Crankpin Bearing
(4) Connecting Rod Cap

The connecting rod (2), which converts the reciprocating motion of the pistons caused by the fuel combustion into the rotating motion of the crankshaft, is made of hard forged steel.

The connecting rod has bearings at both ends. The small end has a solid type bearing – small end bushing (1) – and the big end has a split type bearing – crankpin bearing (3).

(7) Camshaft



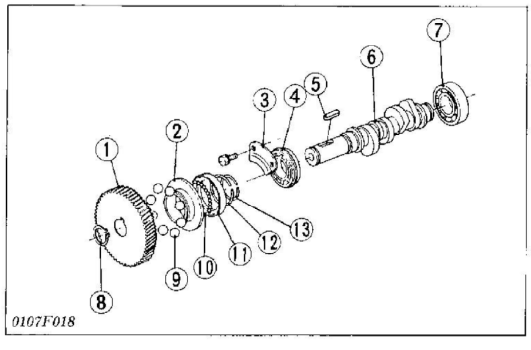
(1) External Snap Ring
(2) Cam Gear
(3) Camshaft Stopper
(4) Plug
(5) Feather Key
(6) Camshaft

The camshaft (6) is made of special cast iron and its journal and cams are hardened to increase wear resistance.

The cams on the camshaft open and close the inlet and exhaust valves with the push rods and rocker arms.

The journals and their bearings are force-lubricated.

(8) Fuel Camshaft

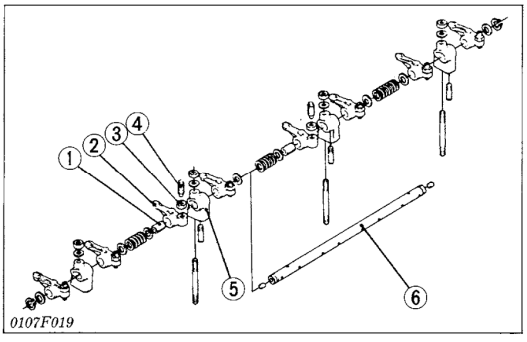


The fuel camshaft is made of carbon steel and its cams are hardened and tempered to increase wear resistance.

The cams on the fuel camshaft (6) drive the injection pump and the fuel transfer pump. The governor balls are installed on the fuel camshaft to control the engine speed.

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

(9) Rocker Arm Assembly

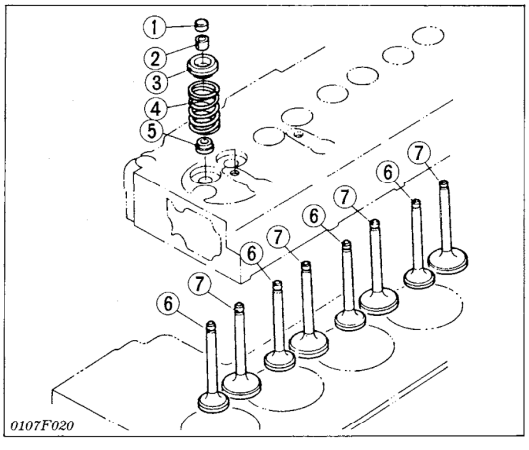


(1) Rocker Arm Bushing
(2) Rocker Arm
(3) Lock Nut
(4) Adjusting Screw
(5) Rocker Arm Bracket
(6) Rocker Arm Shaft

The rocker arm assembly includes the rocker arms (2) and an adjusting screw (4), which is at the end of rocker arm and rests on the push rod, rocker arm brackets (5) and rocker arm shaft (6). The rocker arms are activated by the reciprocating motion of the push rods and open or close the inlet and exhaust valves.

The rocker arm bushings and other parts are lubricated through the drilled holes of the brackets and the rocker arm shaft.

(10) Inlet and Exhaust Valves

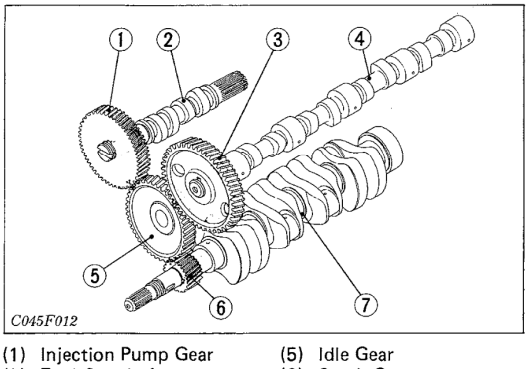


(1) Valve Cap
(2) Valve Spring Collet
(3) Valve Spring Retainer
(4) Valve Spring
(5) Valve Stem Seal
(6) Exhaust Valve
(7) Inlet Valve

The valve and its guide for the inlet are different from those for the exhaust. Other parts, such as the springs (4), spring retainers (3), valve spring collets (2), valve stem seals (5) and valve caps (1) are the same for both the inlet and the exhaust.

All contact or sliding surfaces are hardened to increase wear resistance.

(11) Timing Gears



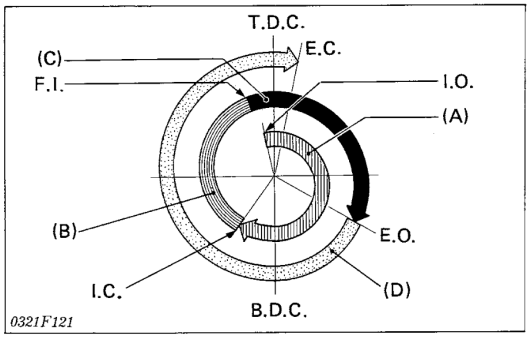
(1) Injection Pump Gear
(2) Fuel Camshaft
(3) Cam Gear
(4) Camshaft
(5) Idle Gear
(6) Crank Gear
(7) Crankshaft

The crankshaft drives the oil pump, injection pump and valves with the timing gears.

The timings for opening and closing the valve are extremely important to achieve effective air intake and sufficient gas exhaust.

The appropriate timing can be obtained by aligning the mark on the crank gear (6) with one on the idle gear (5), when assembling.

(12) Valve and Injection Timing

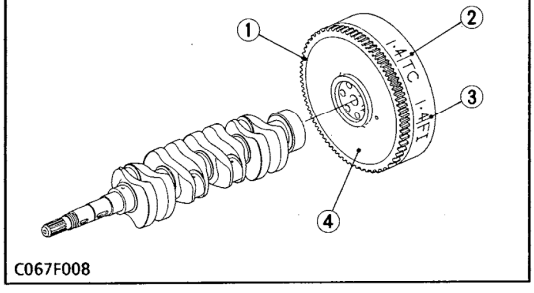


I.O. : Inlet valve open
0.21 rad (12°) before T.D.C.
I.C. : Inlet valve close
0.63 rad (36°) after B.D.C.
E.O. : Exhaust valve open
1.05 rad (60°) before B.D.C.
E.C. : Exhaust valve close
0.21 rad (12°) after T.D.C.
F.I. : Fuel injection
0.31 rad (18°) before T.D.C.
T.D.C. : Top Dead Center
B.D.C. : Bottom Dead Center

(A) Suction
(B) Compression
(C) Combustion
(D) Exhaust

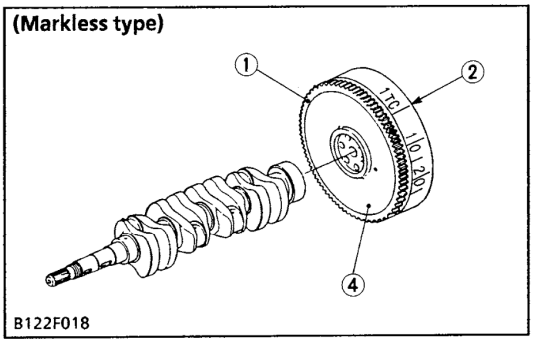
(13) Flywheel

(FI mark type)



(1) Ring Gear
(2) Piston Top Dead Center Mark
(3) Fuel Injection Timing Mark
(4) Flywheel

(Markless type)



The flywheel is installed on the rear end of the crankshaft. Its inertia keeps the flywheel turning at a constant speed, while the crankshaft tends to speed up during the power stroke and to slow down during other strokes.

The flywheel has a ring gear (1) , which mesh with the drive pinion of the starter.

The flywheel has also mark **1TC** (2) on its outer rim.

The mark **1TC** shows the piston's top dead center of 1st cylinder, when it is aligned with the mark of window on the clutch housing.

■ NOTE

- **(FI mark type): This type has marks TC and FI for each cylinder.**
  (Markless type): This type has mark TC only for 1st cylinder and does not have mark FI.

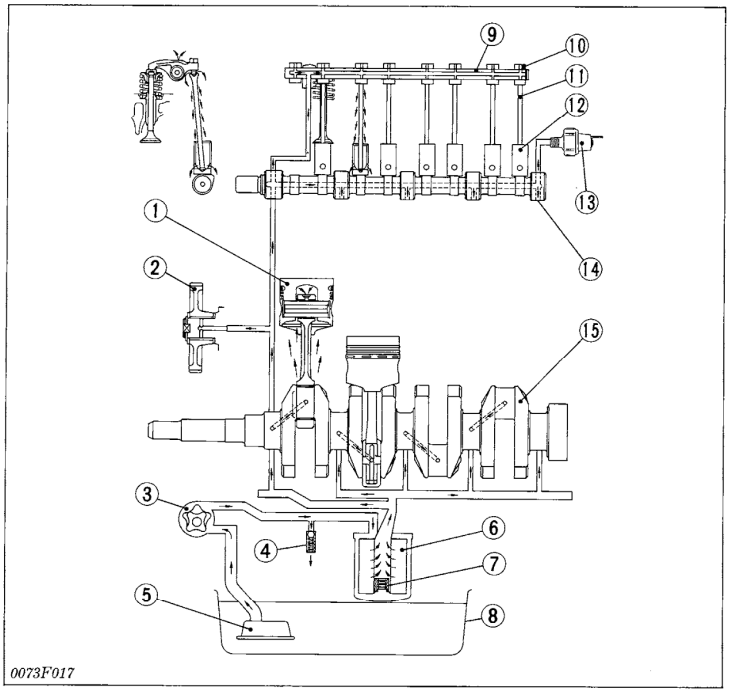
(Reference)

- Injection Sequence

Three Cylinders: 1 → 2 → 3
Four Cylinders: 1 → 3 → 4 → 2
(The cylinder number is given in order from the gear case end.)

[3] LUBRICATING SYSTEM

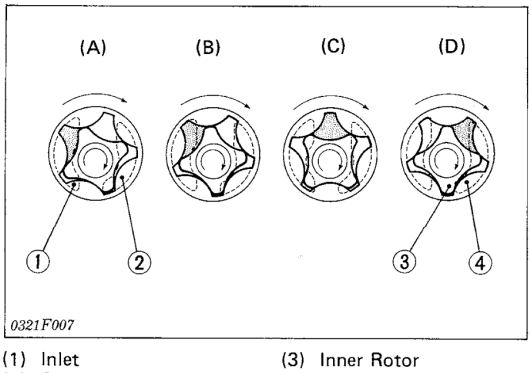
(1) Flow of Lubricating Oil



(1) Piston
(2) Idle Gear
(3) Oil Pump
(4) Relief Valve
(5) Oil Filter
(6) Oil Filter Element
(7) Bypass Valve
(8) Oil Pan
(9) Rocker Arm Shaft
(10) Rocker Arm
(11) Push Rod
(12) Tappet
(13) Oil Pressure Switch
(14) Camshaft
(15) Crankshaft

The lubricating oil is forced to each journal through the oil passages of the cylinder block, cylinder head and shafts. The oil, splashed by the crankshaft or thrown off from the bearings, lubricates other engine parts such as the push rods (11), tappets (12), piston pins and timing gears.

(2) Oil Pump



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

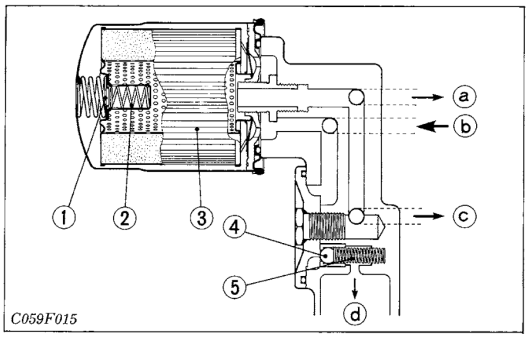
The oil pump is a gear pump, whose rotors have trochoid lobes. The inner rotor (3) has 4 lobes and the outer rotor (4) has 5 lobes, and they are eccentrically engaged with each other. The inner rotor, which is driven by the crankshaft through the gears, rotates the outer rotor in the same direction, varying the space between the lobes.

While the rotors rotate from (A) to (B), the space leading to the inlet port increases, which causes the oil to flow through the inlet port.

When the rotors rotate to (C), the port to which the space leads is changed from inlet to outlet.

At (D), the space decreases and sucked oil is discharged from the outlet port.

(3) Oil Filter and Relief Valve



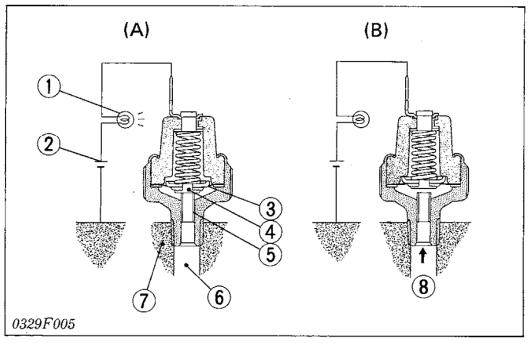
(1) Bypass Valve
(2) Bypass Adjusting Spring
(3) Filter Element
(4) Relief Valve Ball
(5) Relief Adjusting Spring

The lubricating oil force-fed by the pump is filtered by the filter cartridge, passing through the filter element from the outside to the inside. When the filter element accumulates dirt and the pressure difference between the inside and outside rises more than 98 kPa (1.0 kgf/cm^2, 14 psi), the bypass valve (1) opens to allow the oil to flow from the inlet line to outlet line, bypassing the filter element.

The relief valve (4) in the inlet line allows oil to prevent damage to the lubricating system, when the oil pressure rises more than 441 kPa (4.5 kgf/cm^2, 64 psi).

(a) To Idle Gear, Camshaft and Rocker Arm
(b) From Oil Pump
(c) To Crankshaft Journal and Crankpin
(d) Drain of Relief Valve

(4) Oil Pressure Switch



(1) Warning Lamp
(2) Battery
(3) Rubber Gasket
(4) Contact Rivet
(5) Contact
(6) Oil Passage
(7) Cylinder Block
(8) Oil

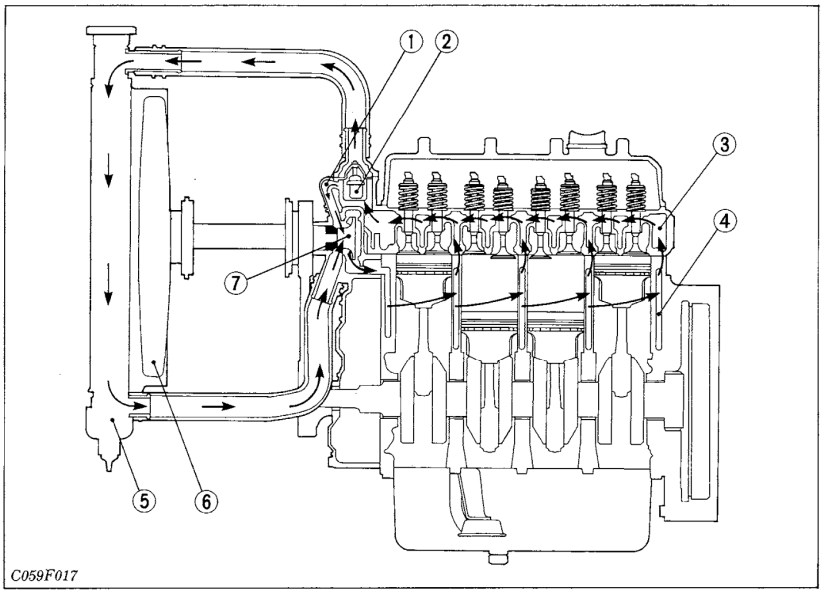
The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil.

When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp (1).

(A) At Lower Oil Pressure
(49 kPa (0.5 kgf/cm^2, 7 psi) or less)
(B) At Proper Oil Pressure

[4] COOLING SYSTEM

(1) Flow of Cooling Water



(1) Water Return Pipe
(2) Thremostat
(3) Cylinder Head Water Jacket
(4) Cylinder Block Water Jacket
(5) Radiator
(6) Cooling Fan
(7) Water Pump

The cooling system consists of a radiator (5), a centrifugal water pump (7), a fan (6) and a thermostat (2).

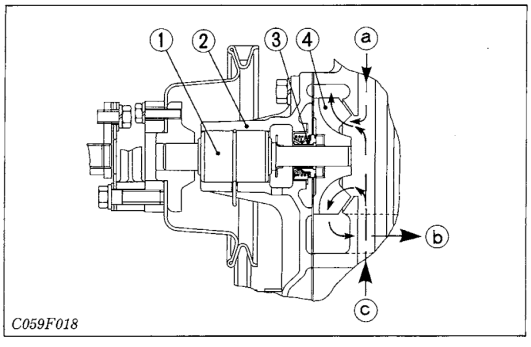
The water is cooled as it flows through the radiator core, and the fan behind the radiator pulls the cooling air through the radiator core.

The water pump receives water from the radiator or from the cylinder head and force it into the cylinder block.

The thermostat opens or closes according to the water temperature. When the water temperature is high, the thermostat opens to allow the water to flow from the cylinder block to the radiator. When the water temperature is low, the thermostat close to flow the water only to the water pump.

The opening temperature of the thermostat is approx. 82°C (180°F).

(2) Water Pump



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

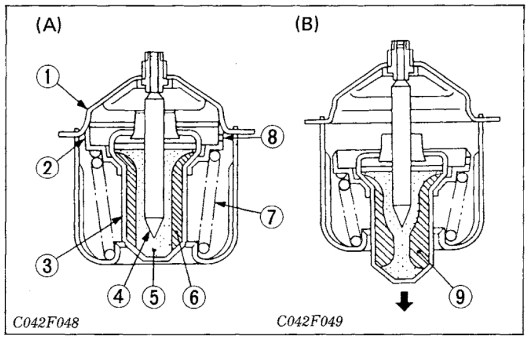
The water pump is driven with the fan drive pulley, which is on the water pump shaft and driven by the crankshaft with a belt.

The rotating impeller (4) in the water pump receives cool water from the bottom of the radiator and the water jacket of cylinder head, and sends it into the water jacket in the cylinder block.

The mechanical seal (3) prevents the water from entering the bearing (1).

(a) From Thermostat
(b) To Cylinder Block
(c) From Radiator

(3) Thermostat



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

The thermostat is wax pellet type, which controls the flow of the cooling water to the radiator to keep the proper temperature.

The case has a seat (1) and the pellet has a valve (2). The spindle attached to the case is inserted into the synthetic rubber in the pellet. The pellet is charged with wax.

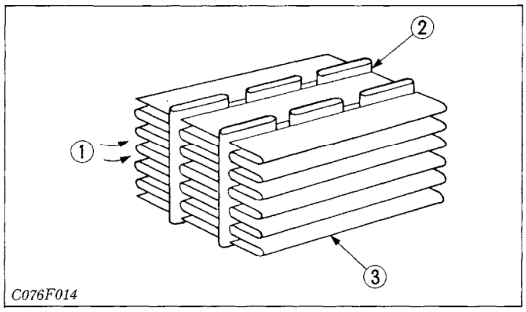
(A) At low temperature (lower than 82°C (180°F))

The valve (2) is seated by the spring (7) and the cooling water circulates in the engine through the water return pipe but does not enter the radiator.

(B) At high temperature (higher than 82°C (180°F))

As the water temperature rises, the wax in the pellet (3) turns liquid and expands, repelling the spindle. The pellet lowers and the valve (2) opens to send the cooling water to the radiator.

(4) Radiator



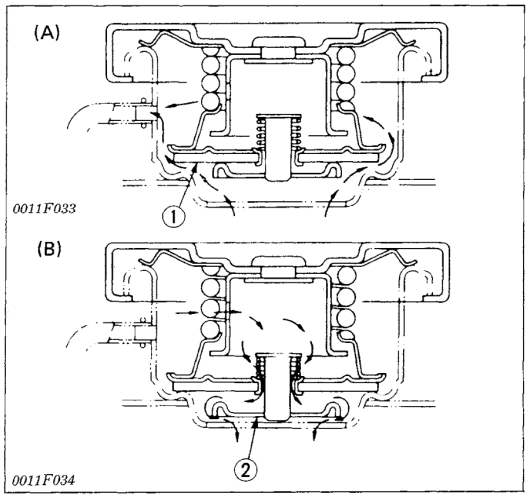
(1) Cooling Air
(2) Tube
(3) Fin

The radiator core consists of water carring tubes (2) with fins (3) at a right angle to it.

The water in the radiator is cooled by the air flowing through between the tube wall and the fin.

The louverless corrugated fins are light in weight, high in heat exchange ratio and less in clogging by the dust.

(5) Radiator Cap



The pressure type cap is installed on the radiator, which prevents the pressure difference between the inside and the outside of the radiator from deforming the radiator.

(A) At high pressure
(higher than 88kPa (0.9kgf/cm², 13 psi))

When the water temperature rises and the pressure in the radiator increase above the specified pressure, the pressure valve (1) opens to reduce the internal pressure.

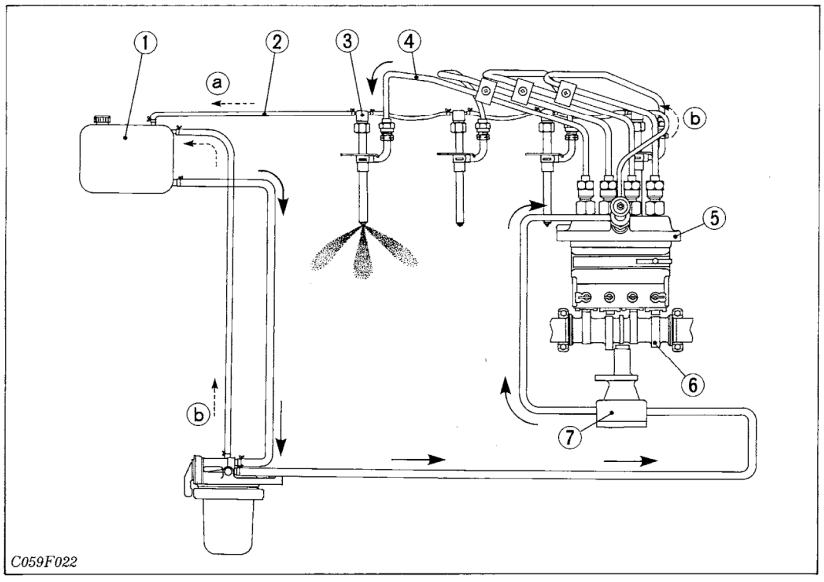
(B) At low pressure

When the water temperature falls and a vacuum is formed in the radiator, the vacuum valve (2) opens to allow the air to enter the radiator.

(1) Pressure Valve
(2) Vacuum Valve

[5] FUEL SYSTEM

(1) Flow of Fuel



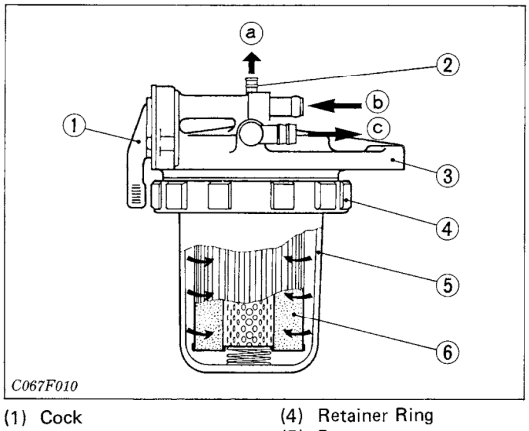
(a) Over Flow
(b) Air

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

The fuel is fed from the tank (1) through the fuel filter (6) to the injection pump (5) by the fuel transfer pump (7). The injection pump force-feds the fuel through the injection nozzles (3), which inject the fuel into the cylinders for combustion.

The excessive fuel from the injection pump to the injection nozzles is collected in the fuel overflow pipes (2) and returns to the fuel tank.

(2) Fuel Filter



(1) Cock
(2) Air Vent
(3) Filter Body
(4) Retainer Ring
(5) Pot
(6) Filter Element

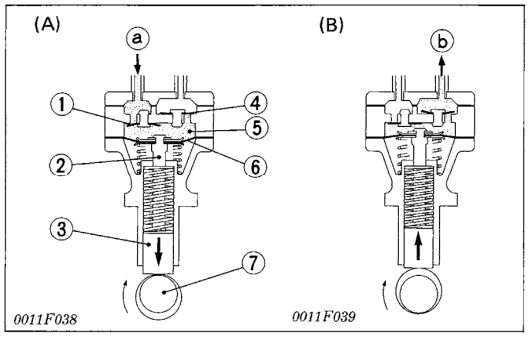
The fuel filter removes dirt and water with its fine filter paper, which collects particles of 15 microns (0.00059 in.) at 20 kPa (0.2 kgf/cm^2, 3 psi).

The fuel from the fuel tank is filtered by the filter element (6), while flowing through the filter element from its outside to inside.

The filter body (3) has an air vent (2) to return the air in the fuel to the fuel tank to prevent the engine from stopping or running irregularly.

(a) To Fuel Tank
(b) From Fuel Tank
(c) To Fuel Transfer Pump

(3) Fuel Transfer Pump



(1) Inlet Valve
(2) Push Rod
(3) Tappet
(4) Outlet Valve
(5) Chamber
(6) Diaphragm
(7) Fuel Camshaft

The filtered fuel is fed to the injection pump by the fuel transfer pump.

The diaphragm is linked to the tappet (3) with the push rod (2). The tappet is reciprocated by the eccentric cam on the fuel camshaft (7).

(A) Inlet Stroke

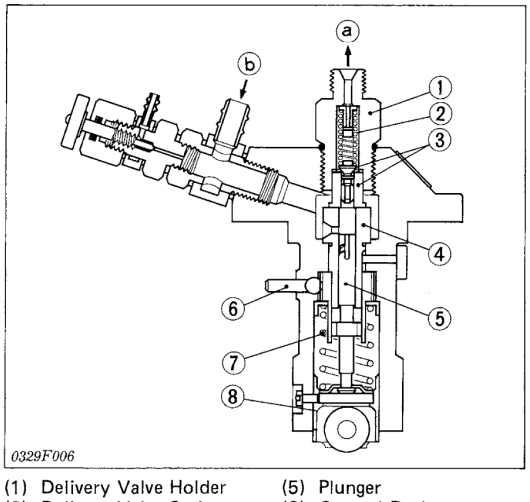
When the diaphragm is pulled down by the spring, vacuum in the chamber (5) causes the outlet valve (4) to close and the atmospheric pressure in the fuel tank to force the fuel into the chamber, opening the inlet valve (1).

(B) Discharge Stroke

When the diaphragm is pushed up by the cam, the pressure in the chamber causes the inlet valve to close and forces out the fuel, opening the outlet valve.

(a) From Fuel Filter
(b) To Injection Pump

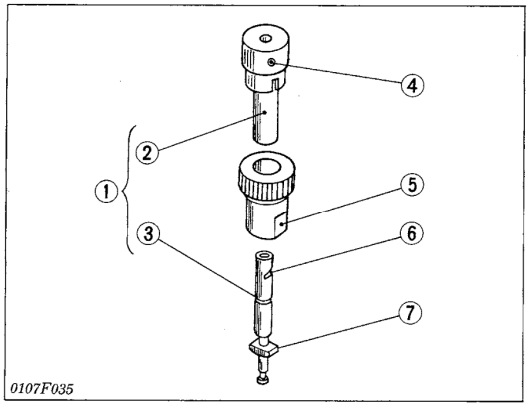
(4) Fuel Injection Pump



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

The injection pump is Bosch K type mini injection pump. It features a compact and lightweight design.

(a) To Injection Nozzle
(b) From Fuel Transfer Pump

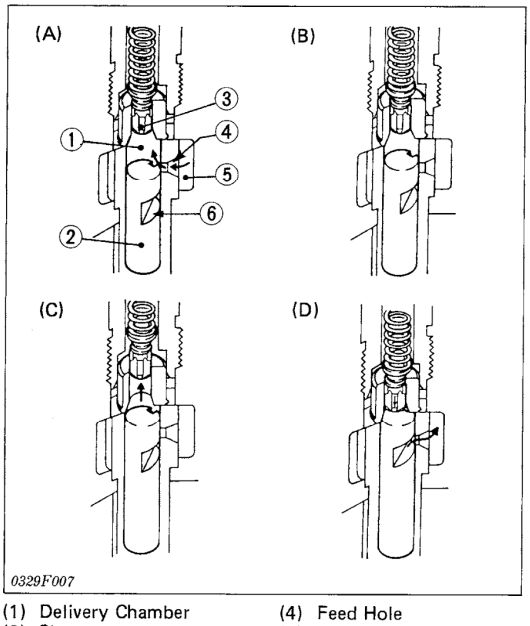


(1) Pump Element
(2) Cylinder
(3) Plunger
(4) Feed Hole
(5) Control Sleeve
(6) Control Groove
(7) Driving Surface

1. Pump Element

The pump element (1) consists of a plunger (3) and cylinder (2), their sliding surfaces are precision-machined to maintain fuel tightness.

The plunger (3) fits in the control sleeve (5) at the driving face (7). The sleeve is engaged with the control rack, which rotate the plunger in the cylinder to control the amount of fuel delivery.



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

2. Operation of Pump Element

(A) Before delivery

As the tapper 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

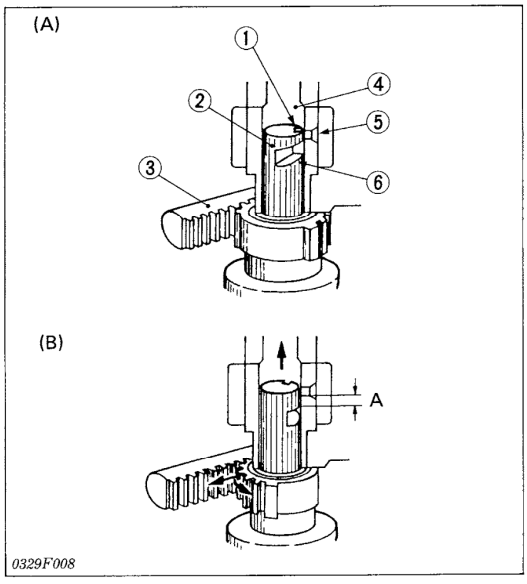
When the plunger is pushed up by the cam and the head of the plunger closes the feed hole, the pressure in the delivery chamber rises to push the relief plunger (3) open.

(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 peryphery meets the feed hole, the fuel returns to the fuel chamber from the delivery chamber through the control groove and the feed hole.



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

3. Amount of fuel delivery

(A) No fuel delivery

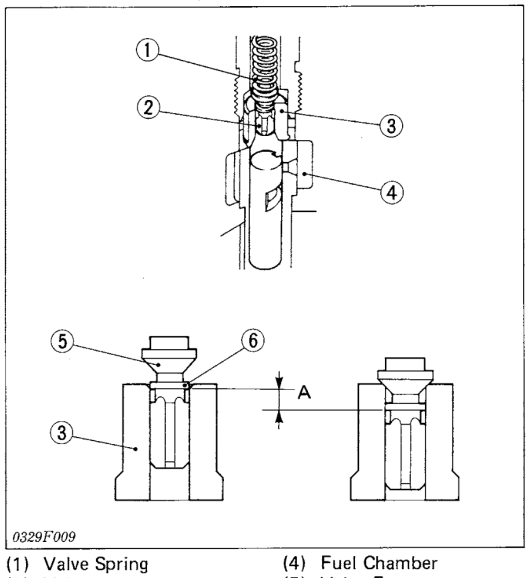
At the engine stop position of the control rack (3), the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). The delivery chamber (4) is led to the feed hole during the entire stroke of the plunger.
The pressure in the delivery chamber does not build up and no fuel is forced to the injection nozzle.

(B) Fuel delivery

The plunger is rotated 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 distance A.



(1) Valve Spring
(2) Valve
(3) Valve Seat
(4) Fuel Chamber
(5) Valve Face
(6) Relief Plunger

4. Delivery Valve

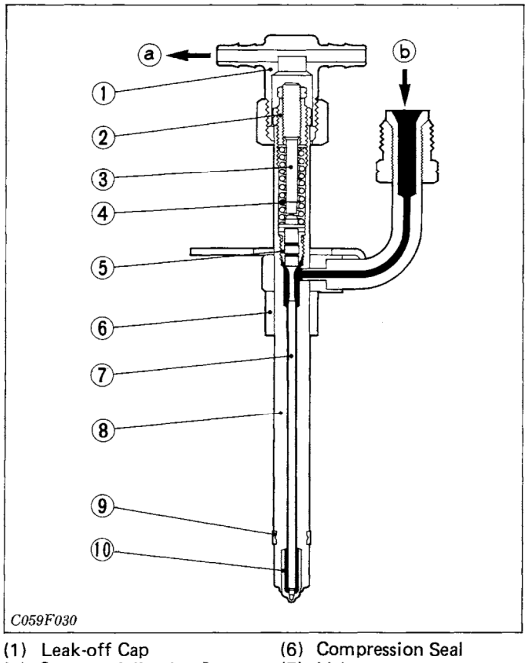
The delivery valve consists of a valve (2) and a valve seat (3).

The delivery valve prevents the fuel in the injection pipe from flowing back into the delivery chamber and the fuel in the injection nozzle from dribbling after injection.

When the delivery stroke ends, the relief plunger (6) moves down into the bore of the valve seat (3) and seals the delivery line from the fuel chamber (4).

The relief plunger (6) lowers further A until the valve face (5) seats the valve seat (3), reducing pressure in the injection line to pevent dribbling at the injection nozzle.

(5) Fuel Injection Nozzle



(1) Leak-off Cap
(2) Pressure Adjusting Screw
(3) Lift Adjusting Screw
(4) Spring
(5) Valve Guide
(6) Compression Seal
(7) Valve
(8) Valve Body
(9) Carbon Dam Seal
(10) Nozzle Tip

The nozzle is a pencil type, which is suitable for the direct injection system.

When the fuel is not delivered from the injection pump, the valve (7) is tightly closed against the nozzle tip (10) by the pressure spring (4).

As the injection pump force feeds the fuel to the injection nozzle through the delivery pipe, the fuel pressure in the closed chamber is increases. When the fuel pressure raises and overcomes the tension of the pressure spring (4), the valve is pushed up and the fuel is sprayed through four 0.25 mm (0.00984 in.) diameter holes into the cylinder, where the fuel is ignited by the high-temperature and high-pressure air.

The excessive fuel from the injection pump flows through the space between the valve (7) and the valve guide (5) to the leak-off cap (1), cooling and lubricating the nozzle.

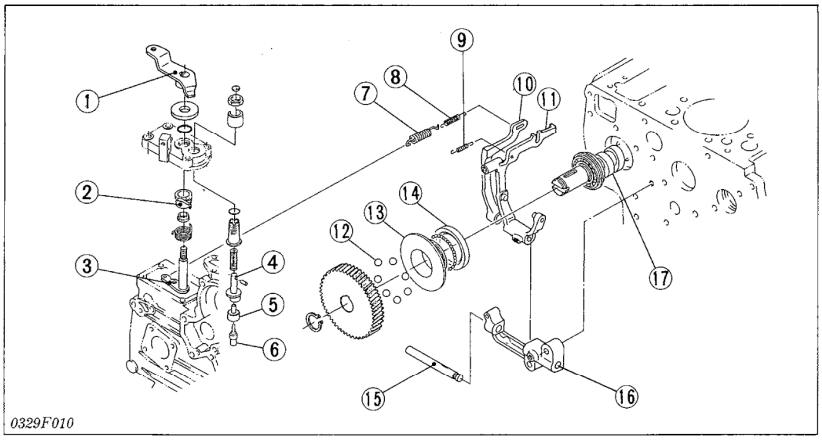
(a) To Tank
(b) From Injection Pump

(6) Governor and Idle Compensating

Model \ Idle compensator	Mounted	None
D1302-DI	up to S/N 17625	above S/N 17626
D1402-DI	up to S/N 18590	above S/N 18591
D1702-DI	up to S/N 16517	above S/N 16518

S/N : Serial Number

1. Disassembled View



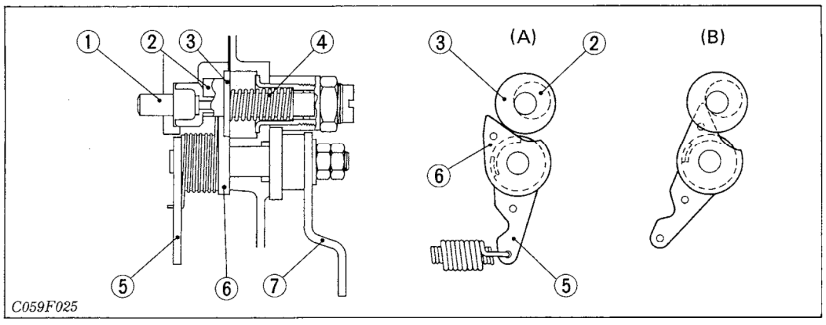
(1) Speed Control Lever
(2) Compensating Lever
(3) Governor Lever
(4) Idle Compensator
(5) Thermostat Housing
(6) Thermostat
(7) Governor Spring 1
(8) Governor Spring 2
(9) Start Spring
(10) Fork Lever 2
(11) Fork Lever 1
(12) Steel Ball
(13) Governor Sleeve
(14) Governor Ball Case
(15) Fork Lever Shaft
(16) Fork Lever Holder
(17) Fuel Camshaft

The governor controls the amount of fuel delivery over the entire speed range to prevent the engine from changing its speed as the load changes and to maintain the stable running.

The governor is composed of steel balls (12), which produce the centrifugal force according to the rotating speed of the fuel camshaft (17), governor springs (7) (8), fork levers (10) (11), idle compensator (4) and thermostat (6).

Fork lever 1 (11), which holds the control rack, is positioned where two opposite forces on it are balanced. One is the tension of the start spring (9) and the force that fork lever 2 (10) pushes, which is caused by the tension of governor spring 1 (7) and governor spring 2 (8). Another is the component of the centrifugal force of the steel balls (12).

2. Idle Compensator



(A) Higher Idling
(B) Rated Idling

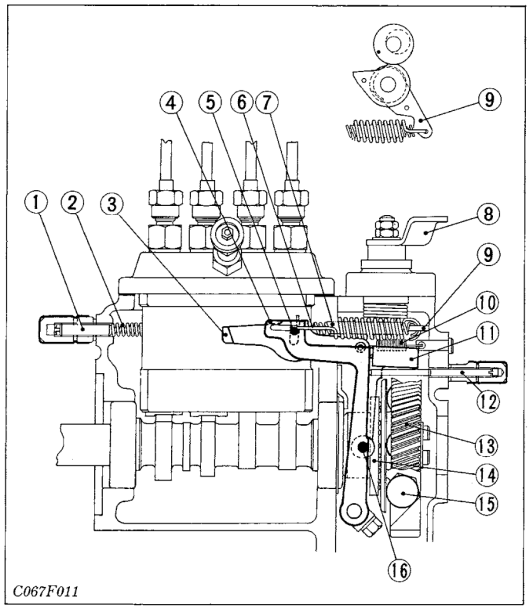
(1) Thermostat
(2) Smaller Cam
(3) Larger Cam
(4) Spring
(5) Governor Lever
(6) Compensating Lever
(7) Speed Control Lever

Direct injection engines tend to exhaust blue smoke at idling, while they are not sufficiently warmed up.

The idle compensator prevents this, by raising the idling speed until the engine is sufficiently warmed up, and lowers the idling speed when the oil is warmed to the specified temperature. The idle compensator is composed of a larger cam (3), a smaller cam (2) and a thermostat (1), which expands according to the oil temperature and pushes the cams.

While the oil temperature is low, the thermostat is compressed. The cams are shifted by the spring (4), so that the larger cam (3) contacts with the compensating lever (6). The speed control lever (7), which moves with the compensating lever (6), sets the engine speed to slightly higher idling speed (approx. 1400 rpm) rather than the rated idling speed.

When the engine is warmed up and the oil temperature is raised (more than 27°C (81°F)), the thermostat (1) expands and shifts the idle compensator, so that its smaller cam (2) contacts with the compensating lever (6). The speed control lever sets the engine speed to the rated idling speed (approx. 850 rpm).



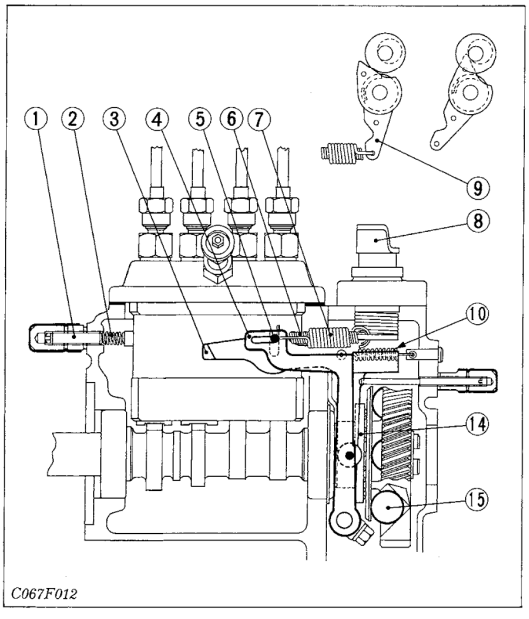
3. Operation of Governor

(A) At Start

The steel ball (15) has no centrifugal force.

As the fork lever 1 (3) is pulled by the start spring (10), the control rack pin (5) moves to the maximum injection position. At start, the sufficient injection of the fuel enables easy starting.

(1) Idling Adjusting Screw
(2) Idling Adjusting Spring
(3) Fork Lever 1
(4) Fork Lever 2
(5) Control Rack Pin
(6) Governor Spring 1
(7) Governor Spring 2
(8) Speed Control Lever
(9) Governor Lever
(10) Start Spring
(11) Torque Spring
(12) Adjusting Screw
(13) Injection Pump Gear
(14) Governor Sleeve
(15) Ball
(16) Fork Lever Pin



(B) At Idling

At the idling position of the speed control lever (8), the governor spring 1 (6) is free and the governor spring 2 (7) pulls the fork lever 2 (4).
Fork lever 1 (3) is pulled by the fork lever 2 (4) and the start spring (10).

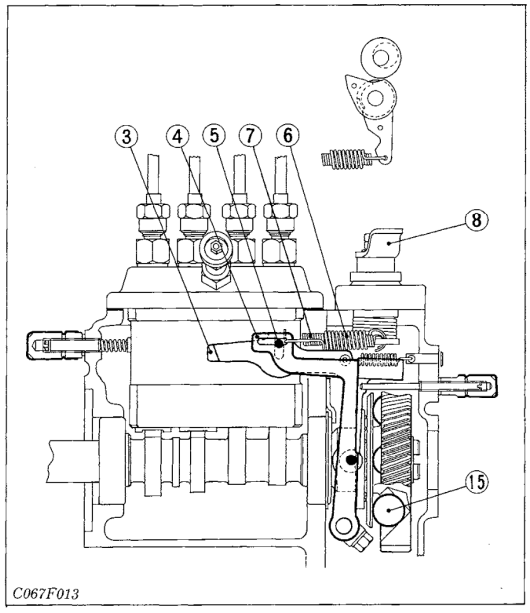
As the camshaft rotates, the balls (15) increase their centrifugal force to push the governor sleeve (14), which in turn pushes the fork lever 1 (3).

The control rack, which is pushed by the idle adjusting spring and the fork lever 1 (3), is kept at a position where these forces are balanced, providing stable idling.

■ IMPORTANT

- **The idling speed has been factory-set. The idling adjusting screw (1) and spring (2) should not be disassembled and readjusted.**

(1) Idling Adjusting Screw
(2) Idling Adjusting Spring
(3) Fork Lever 1
(4) Fork Lever 2
(5) Control Rack Pin
(6) Governor Spring 1
(7) Governor Spring 2
(8) Speed Control Lever
(9) Governor Lever
(10) Start Spring
(14) Governor Sleeve
(15) Ball



C067F013

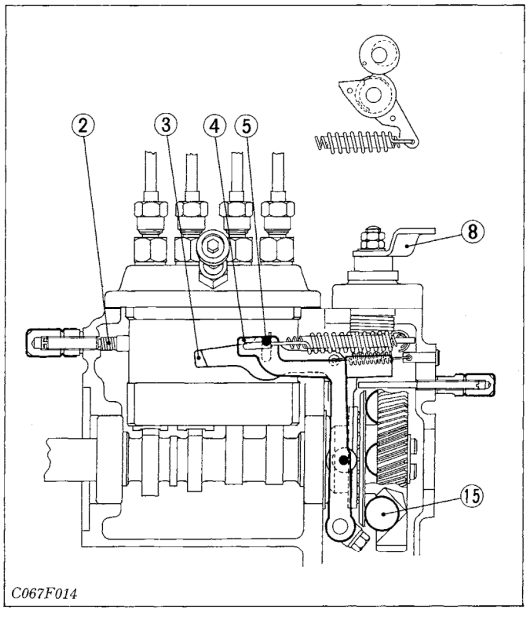
(C) At Medium Speed with Load

When the speed control lever (8) is turned further than the idling position, the governor spring 1 (6) and the governor spring 2 (7) pull fork lever 2 (4), which in turn pull fork lever 1 (3) to increase the engine speed.

The balls (15) increase their centrifugal force to push fork lever 1 (3) until the forces on fork lever 1 (3) and control rack pin (5) are balanced, so that stable running is maintained.

When the engine speed is dropped due to the increase of the load, the centrifugal force of the balls (15) decreases and the control rack pin (5) is pulled. The amount of the fuel to the injection nozzle is increased to produce a higher torque required for the load.

(3) Fork Lever 1
(4) Fork Lever 2
(5) Control Rack Pin
(6) Governor Spring 1
(7) Governor Spring 2
(8) Speed Control Lever
(15) Ball



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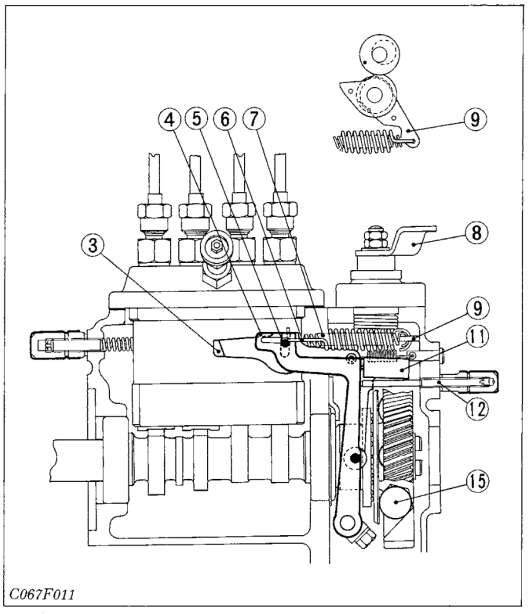
(D) At High Speed Running without Load

When the speed control lever (8) is set to the high speed position, the tensions of the governor springs are at their maximum. The centrifugal force of the balls (15) is also at its maximum when the load is least.

The control rack pin (5) is pushed against the idling adjusting spring (2) and is held at a position to keep a stable high speed with a small amount of fuel.

(2) Idling Adjusting Spring
(3) Fork Lever 1
(4) Fork Lever 2
(5) Control Rack Pin
(8) Speed Control Lever
(15) Ball



C067F011

(3) Fork Lever 1
(4) Fork Lever 2
(5) Control Rack Pin
(6) Governor Spring 1
(7) Governor Spring 2
(8) Speed Control Lever
(9) Governor Lever
(11) Torque Spring
(12) Adjusting Screw
(15) Ball

(E) At High Speed Running with Overload

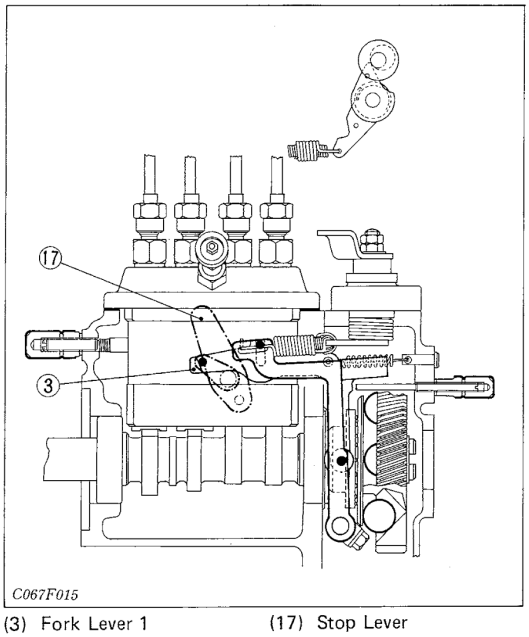
The fork lever 2 (4) is pulled by governor spring 1 (6) and the govenror spring 2 (7) at their maximum tension. The overload to the engine lowers the engine speed,which decreases the centrifugal force of the balls (15).

The control rack (5) is moved and held at the position where the decreased centrifugal force and the spring tensions are balanced, to increase the amount of fuel.

As the load increases further, the centrifugal force of the balls decrease and fork lever 2 (4) is moved until it contacts the adjusting screw (12). The torque spring (11), which is built in the fork lever 1 (3), pushes fork lever 2 (4) to pull the control rack and to increase the amount of fuel further. This enables the high torque performance at high speeds with overload.

■ IMPORTANT

- **The Adjusting Screw (12) has been factory-set. It should not be disassembled and readjusted.**



C067F015

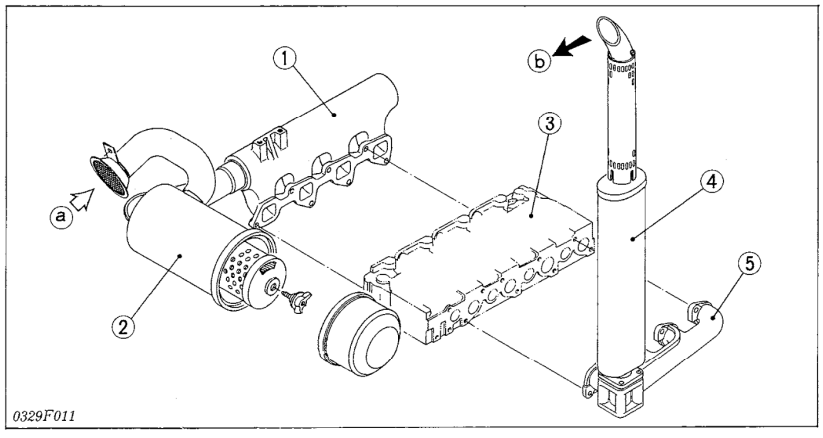
(3) Fork Lever 1
(17) Stop Lever

(F) To Stop Engine

When the stop lever (17) is moved to the stop position, fork lever 1 (3) is pushed to move the control rack to stop fuel injection.

[6] INLET AND EXHAUST SYSTEM

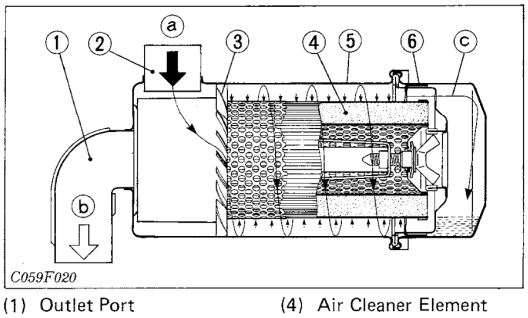
(1) Flow of Inlet Air and Exhaust Gas



(a) Inlet Air
(b) Exhaust Gas

(1) Inlet Manifold
(2) Air Cleaner
(3) Cylinder Head
(4) Muffler
(5) Exhaust Manifold

(2) Air Cleaner



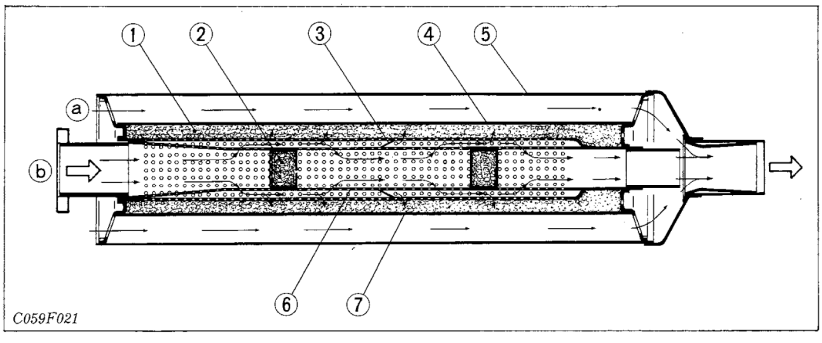
(1) Outlet Port
(2) Inlet Port
(3) Fin
(4) Air Cleaner Element
(5) Body
(6) Dust Cup

The air cleaner is dry-cyclone type and easy to maintain.

The air from the inlet port (2) circulates along the fin (3) and around the air cleaner element (4) and the heavier dust is carried to the dust cup (6), where the dust accumulates. The fine dust in the air is filtered with the air cleaner element (4), and the filtered air flows to the outlet port (1).

(a) Inlet Air
(b) To Inlet Manifold
(c) Heavier Dust

(3) Muffler



(a) Cooling Air
(b) Exhaust Gas

(1) Glass Wool
(2) Partition
(3) Baffle
(4) Inner Body
(5) Outer Body
(6) Inner Tube
(7) Outer Tube

The exhaust noises are absorbed and dumped, while the gas pass through a series of holes on the inner tube (6) and outer tube (7), and glass wool (1).

The exhaust gas and the outer tube (7) are cooled by the air flow between the outer body (5) and inner body (4).

2 CLUTCH

The clutch is located between the engine and transmission and is operated by stepping on the clutch pedal.

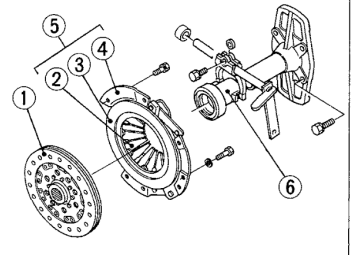
When the clutch pedal is depressed, the clutch is disengaged and when it is released, the clutch is engaged and power from the engine is transmitted to the transmission.

L2250 and L2550 tractors are equipped with either dry single plate type clutch or dual stage type clutch.

L2850 tractor is equipped with either dry twin plates type clutch or dual stage type clutch.

Tractors equipped with dual stage type clutch have a live PTO function which enables stoppage of the power transmission to the travelling system while the PTO is in rotation.

Single Plate Clutch
[L2250・L2550]



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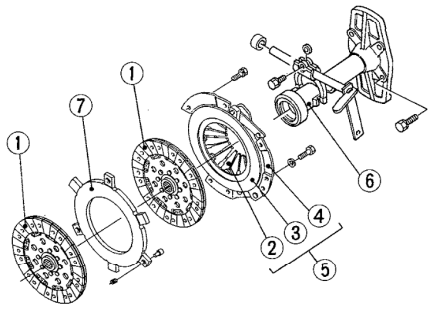
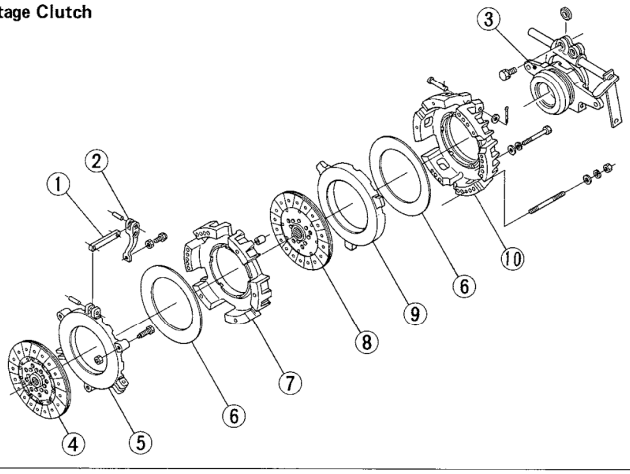
Twin Plates Clutch
[L2850]



0329F012

(1) Clutch Disc
(2) Diaphragm Spring
(3) Pressure Plate
(4) Clutch Cover
(5) Pressure Plate Assembly
(6) Release Hub
(7) Center Plate

Dual Stage Clutch



0301F006

(1) Release Rod
(2) Release Lever
(3) Release Hub
(4) Clutch Disc 1 (Travelling)
(5) Pressure Plate 1
(6) Belleville Spring
(7) Clutch Cover 1
(8) Clutch Disc 2 (PTO)
(9) Pressure Plate 2
(10) Clutch Cover 2