

Product: Kubota F1900 F1900E Service Manual

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WSM

WORKSHOP MANUAL
TRACTOR

F1900 F1900E

Kubota

KiSC issued 03, 2006 A

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TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA F1900E. 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.

June '93

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol", is used throughout this manual and decals on the machine itself to warn of the possibility of personal injury. Read these instructions carefully. It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

 **DANGER** : Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 **WARNING** : Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 **CAUTION** : Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

■ **IMPORTANT** : Indicates that equipment or property damage could result if instructions are not followed.

■ **NOTE** : Gives helpful information.

SAFETY SERVICING AND REPAIRING

- (1) Before working on the machine :
 - Park the machine on a firm and level ground, and set the parking brake.
 - Lower the implement or mower to the ground.
 - Stop the engine, and remove the key.
 - Disconnect the battery's ground cable.
 - Clean the work area and machine.
- (2) Do not work on the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- (3) Do not wear a necktie, scarf, necklace, loose or bulky clothing when you work near machine tools or moving parts.
- (4) Use tools appropriate to the work. Makeshift tools, parts, and procedures will not make good repairs.
- (5) When servicing is performed together by two or more persons, take care to perform all work safely.
- (6) Do not work under the machine that is supported solely by a jack. Always support the machine by safety stands.

- (7) If the engine must be running to do same work, make sure the area is well ventilated. Never run the engine in a closed area. The exhaust gas contains poisonous carbon monoxide.
- (8) Do not touch the rotating or hot parts while the engine is running.
- (9) Fuel is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.
- (10) To avoid sparks from an accidental short circuit, always disconnect the battery's ground cable first and connect it last.
- (11) Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, clothing and cause blindness if splashed into eyes. Keep electrolyte away from eyes, hands and clothing. If you spill electrolyte on yourself, flush with water, and get medical attention immediately.
- (12) Battery gas can explode. Keep sparks and open flame away from the top of battery, especially when charging the battery.
- (13) Never remove the radiator cap while the engine is running, or immediately after stopping. Otherwise, hot water will spout out from radiator. Wait for more than ten minutes to cool the radiator, before removing the cap.
- (14) Escaping fluid (fuel or hydraulic oil) under pressure can penetrate the skin causing serious injury. Relieve pressure before disconnecting hydraulic or fuel lines. Tighten all connections before applying pressure.
- (15) Do not start the engine by shorting across starter terminals.
- (16) Unauthorized modifications to the machine may impair the function and / or safety and affect machine life.
- (17) Do not alter or remove any part of machine safety system.
- (18) Keep a first aid kit and fire extinguisher handy at all times.

SAFETY OPERATION

[BEFORE OPERATION]

- (1) Read the "OPERATOR'S MANUAL" carefully. Be thoroughly familiar with the controls and the proper use of the equipment.
- (2) Do not wear loose, bulky clothing when operating the machine. Do wear safety shoes and eye protection.
- (3) Do not operate the machine while under the influence of alcohol, medication, or other substances or while fatigued.
- (4) Never allow children or inadequately trained persons to operate the machine. Keep everyone, especially children and pets, away from the area of operation.
- (5) Thoroughly inspect the area where the machine is to be used. Remove all sticks, stones, bottles, cans, wires, etc.
- (6) Remove all debris (string, wire or cords) which might wrap around blade shafts.
- (7) Keep all shields and safety devices in place. If a shield, safety device or decal is missing, defective or damaged, repair or replace it before operating.
- (8) Use only implements, attachments and accessories approved by KUBOTA.
- (9) Fuel is very flammable. Handle fuel carefully.
 - Use a properly and approved safety container.
 - Refuel the machine outdoors.
 - Shut off engine and allow it to cool before refueling.
 - Do not refuel the machine while smoking or when near open flame or sparks.
 - Do not overflow fuel while filling fuel tank.
 - Install the fuel tank cap securely, and clean up any spilled fuel before starting the engine.

[OPERATION]

- (1) Operate the machine only in daylight or in good artificial light.
- (2) Do not run the engine in a closed area without adequate ventilation.
- (3) Before starting the engine, make sure that all shift levers are in neutral positions or in disengaged positions.
- (4) Never start the engine while standing on ground. Start the engine only from operator's seat.
- (5) Be alert when operating. To prevent loss of control :
 - Watch for holes in the terrain or other hidden hazards.
 - Do not drive close to ditches, creeks, or other hazardous areas.
 - Reduce speed when making sharp turns.
 - Avoid sudden stops and starts.
 - Before backing up, look to the rear to make sure no people or obstacles are behind you or the machine.
- (6) Keep side discharge chute, mulching plate or grass catcher (option) in place.
- (7) Do not discharge clippings toward people or objects.
- (8) Do not put hands or feet near or under mower deck.
- (9) Shut the engine off and wait for all movement to stop before removing grass catcher or unlogging discharge chute.
- (10) Adjust cutting height only when engine is stopped and mower blades have stopped turning.
- (11) Mow up and down slopes, not across to avoid machine tip-over. Stay off hills and slopes too steep for safe operation.
- (12) To reduce fire hazards, keep the engine exhaust area free of grass or leaves.
- (13) Disengage power to the mower blades before crossing gravel drives, walks, or roads.
- (14) If the machine should start to vibrate abnormally, stop the engine and check immediately for the cause. Vibration is generally a warning of trouble.
- (15) After striking a foreign object, stop the engine immediately and thoroughly inspect the machine for any damage. Repair damage before restarting and operating the machine.
- (16) Before leaving the operator's position :
 - All shift levers are in neutral positions or in disengaged positions.
 - Shut off engine, and remove the key.

[TRANSPORTING]

- (1) Disengage power to the mower blades, implements and attachments before transporting the machine.
- (2) Do not tow this machine.
- (3) Do not use this machine on public roads. If you must transport it, use a pick-up truck, trailer, or other suitable vehicle and ramp.
- (4) Tie the machine down securely before transporting on public roads.

SAFETY DECALS

- The following safety decals are installed on the machine.
If a decal becomes damaged, illegible or is not on the machine, replace it. The decal part number is listed in the parts list.

① Part No. K3311-4717-2 (2WD)

DIFF LOCK



BRAKE



BRAKE LOCK LEVER

FWD.



REV.



CAUTION
TO HELP PREVENT TIPPING AND INJURY
- DO NOT DRIVE AT HIGH SPEED OR
TURN THE FRONT MOWER WHEN THE
DIFFERENTIAL IS LOCKED

PARKING BRAKE

TO LOCK: Depress brake pedal, pull and hold brake LOCK lever until pedal is latched.
TO UNLOCK: Depress brake pedal past lock and released pedal.

WARNING

TO AVOID SERIOUS INJURY OR DEATH

- DO NOT OPERATE ON STEEP SLOPES.
- GO UP AND DOWN SLOPES, NOT ACROSS.
- AVOID SUDDEN TURNS.
- IF MACHINE STOPS GOING UPHILL, STOP BLADE AND BACK DOWN SLOWLY.
- NEVER CARRY CHILDREN OR OTHERS.
- DO NOT MOW WHEN CHILDREN OR OTHERS ARE AROUND.
- LOOK DOWN AND BEHIND BEFORE AND WHILE BACKING.
- KEEP SAFETY DEVICES (GUARDS, SHIELDS AND SWITCHES) IN PLACE AND WORKING.
- REMOVE OBJECTS THAT COULD BE THROWN BY THE BLADE.

READ OPERATOR'S MANUAL.

CAUTION

TO AVOID PERSONAL INJURY

- KNOW LOCATION AND FUNCTION OF ALL CONTROLS.
- BEFORE STARTING ENGINE, MAKE CERTAIN PTO IS OFF, SHIFT INTO NEUTRAL AND EVERYONE IS AT A SAFE DISTANCE FROM MACHINE.
- DO NOT OPERATE WHERE MACHINE COULD TIP OR SLIP.
- TO REDUCE FIRE HAZARDS, KEEP THE EXHAUST WELL CLEAR OF DRY GRASS, DRY LEAVES OR OTHER COMBUSTIBLE MATERIAL.
- BEFORE DISMOUNTING, DISENGAGE PTO CLUTCH, LOWER IMPLEMENT, SHIFT INTO NEUTRAL, SET PARKING BRAKE, STOP ENGINE AND REMOVE THE KEY.
- THIS MACHINE IS NOT FOR STREET OR HIGHWAY USE.

K3311-47172英

② Part No. K3311-4721-0 (2WD)



CAUTION
THIS ARM CAN SPRING UP
UPWARD /
SEE OPERATOR'S MANUAL
WHEN DISASSEMBLING

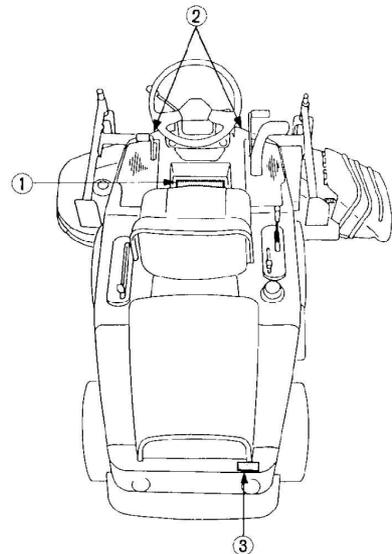
K3311-47213

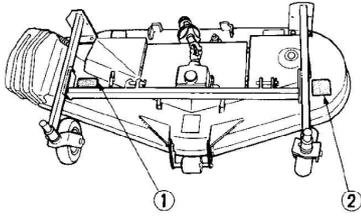
③ Part No. 18620-8806-0



CAUTION
HOT EXHAUST

18620-88061





① Part No.66071-6178-1



② Part No.66071-6179-1



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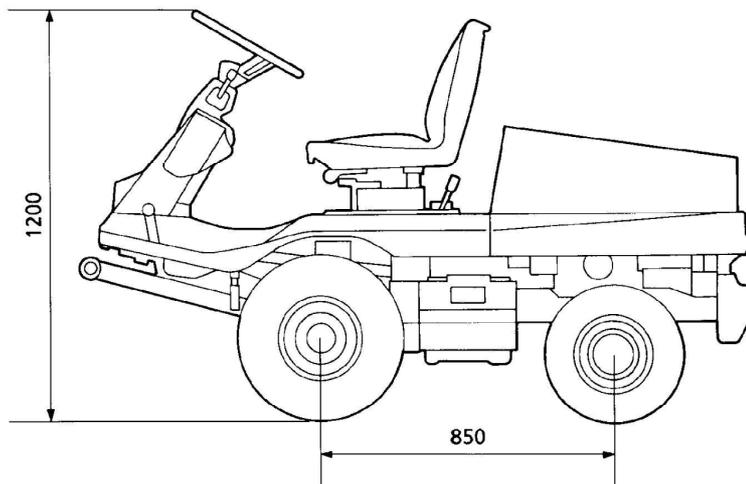
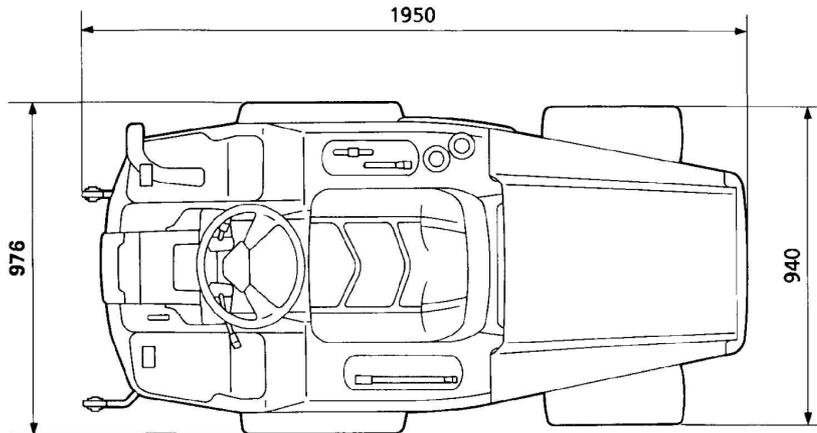
SPECIFICATIONS

Model		F1900E	
Engine	Model	D722-FM	
	Type	Vertical, liquid cooled, 4-cycle, diesel	
	Gross power	13.4 kW / 3200 rpm (18 HP / 3200 rpm)	
	Number of cylinders	3	
	Bore and stroke	67 mm × 68 mm	
	Total displacement	719 cm ³	
	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/cm ²)	
	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)	
Charging system	AC dynamo (12 V, 150 W) Alternator for UK		
Battery	12 V, 45 AH		
Engine stop system	Key stop		
Capacities	Fuel tank	20.0 ℓ (4.4 Imp.gals.)	
	Engine crankcase	3.0 ℓ (2.64 Imp.qts.)	
	Transmission case	5.7 ℓ (5.02 Imp.qts.)	
	PTO gear case	0.6 ℓ (0.53 Imp.qts.)	
	Radiator	3.3 ℓ (2.90 Imp.qts.)	
Dimensions	Overall length	1950 mm	
	Overall width	976 mm	
	Overall height	1200 mm	
	Wheel base	850 mm	
	Tread	Front	724 mm
		Rear	775 mm
Min. ground clearance	102 mm		
Weight (without mower)		390 kg	
Tire size	Front	20 × 10.00 - 8	
	Rear	16 × 6.50 - 8	
Steering system		Manual	
Transmission		Hydrostatic transmission	
Brake		Internal expanding shoe type	
Traveling speed	Forward	0 to 13.5 km/h	
	Reverse	0 to 6.5 km/h	
Mower drive system		Shaft drive	
Mower clutch type		Wet multi plates	
Mower PTO brake		Wet single plate	
Mower lift system		Hydraulic	

DIMENSIONS

DIMENSIONS

ABMESSUNGEN



B143F003

Unit: mm

Unité: mm

Einheit: mm

M MECANISM

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F FEATURES



B143F007

As well as the instrument panel with its easy checker, hour meter and water temperature gauge, all switches and levers are located convenient to the operator.

Functions are easier-to-monitor and easier-to-operate.

A lighter, more compact body configuration.

Results in easier operation around tighter turns that are especially friendly to the turf.

Large torque rise from the powerful liquid-cooled vertical-type 3-cylinder Kubota Diesel Engine.

Features the unique Kubota New TVCS. Cooling air discharged to the rear.

Tilt steering.

Select the ideal operating position for greater comfort.

Foot pedal for the HST with cruise control.

Operating speed simply controlled.

The differential lock mechanism.

Makes operations on slopes easier and safer.

The hydraulic wet-type, multiple-disc PTO clutch.

Reliable durability and smoother connection.

The hydraulic mower unit lift.

This system makes lifting and lowering the mower simple and efficient.

Simplified maintenance.

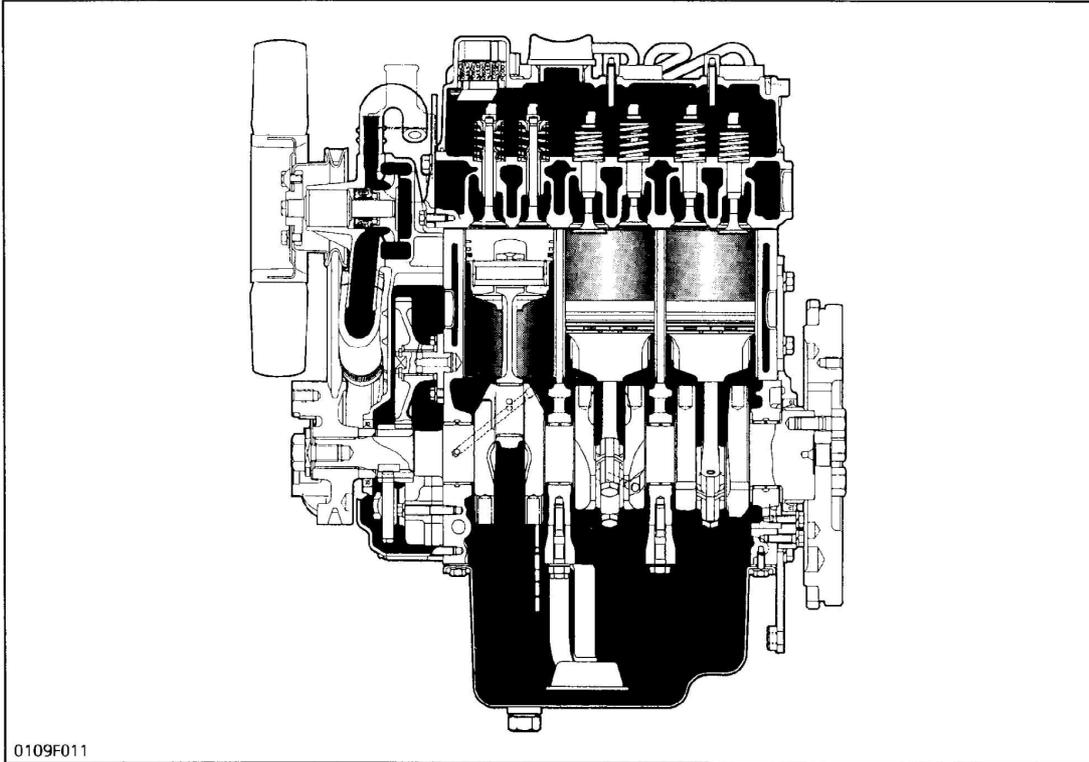
1. The mowing unit easily mounted or removed.
2. The battery easily accessed.
3. The radiator dust net easily removed.

Attention to safety a prime consideration.

1. The PTO brake.
2. The operator presence control.
3. The safety start switch.
4. Optional ROPS.

I ENGINE [D722FM]

[1] FEATURE



The D722FM is vertical, water-cooled, 4-cycle diesel engine.

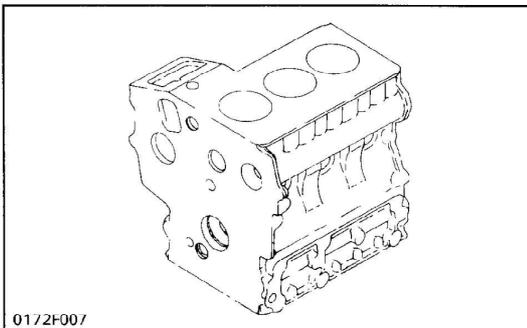
It is incorporated KUBOTA's foremost technologies.

With KUBOTA's New TVCS (Three Vortex

Combustion System), well-known Bosch MD type injection pump and the well-balanced designs, they give greater power, low fuel consumption, little vibration and quiet operation.

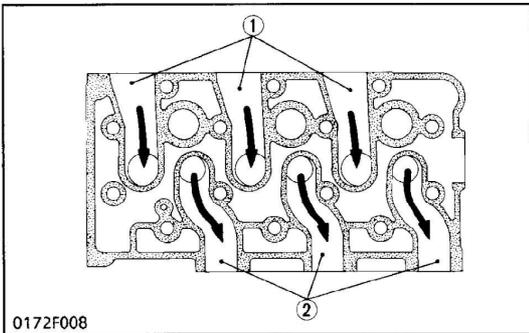
[2] ENGINE BODY

(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

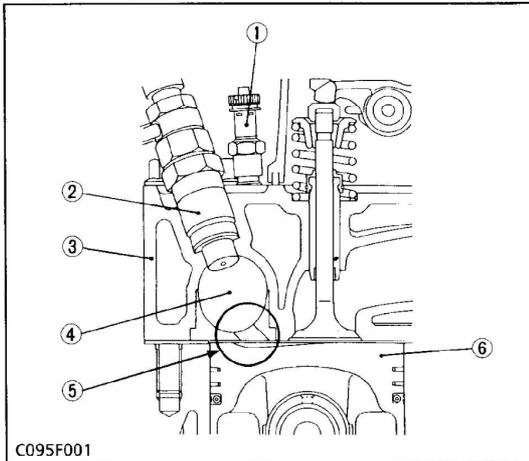


O172F008

■ 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



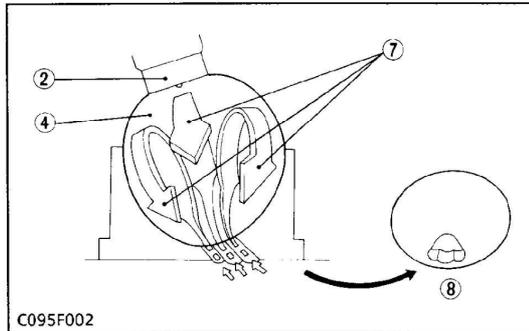
C095F001

■ Combustion System

This engine uses 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.

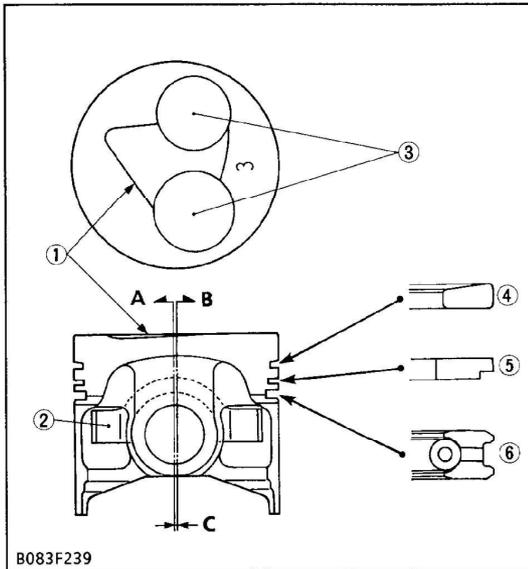
In addition, a fan-shaped concave (5) is provided on top of the piston (6) to allow a smooth ejection of the exhaust gas, offering highly efficient combustion.

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



C095F002

(3) 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.

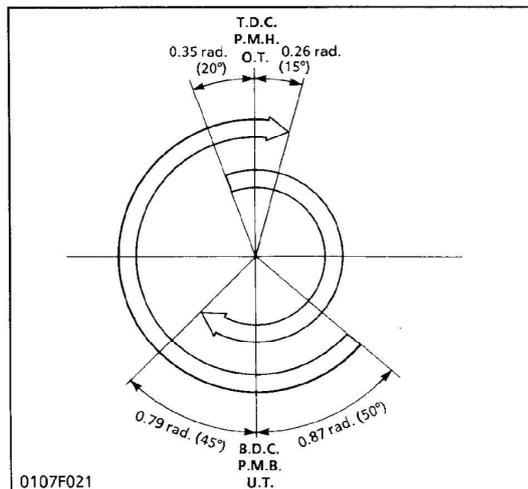
The top compression ring (4) is of the key stone type which can stand against heavy load, and the sliding surface to the cylinder wall is shaped into barrel face which is well fitted to the wall and plated with hard chrome.

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

(4) Valve Timing

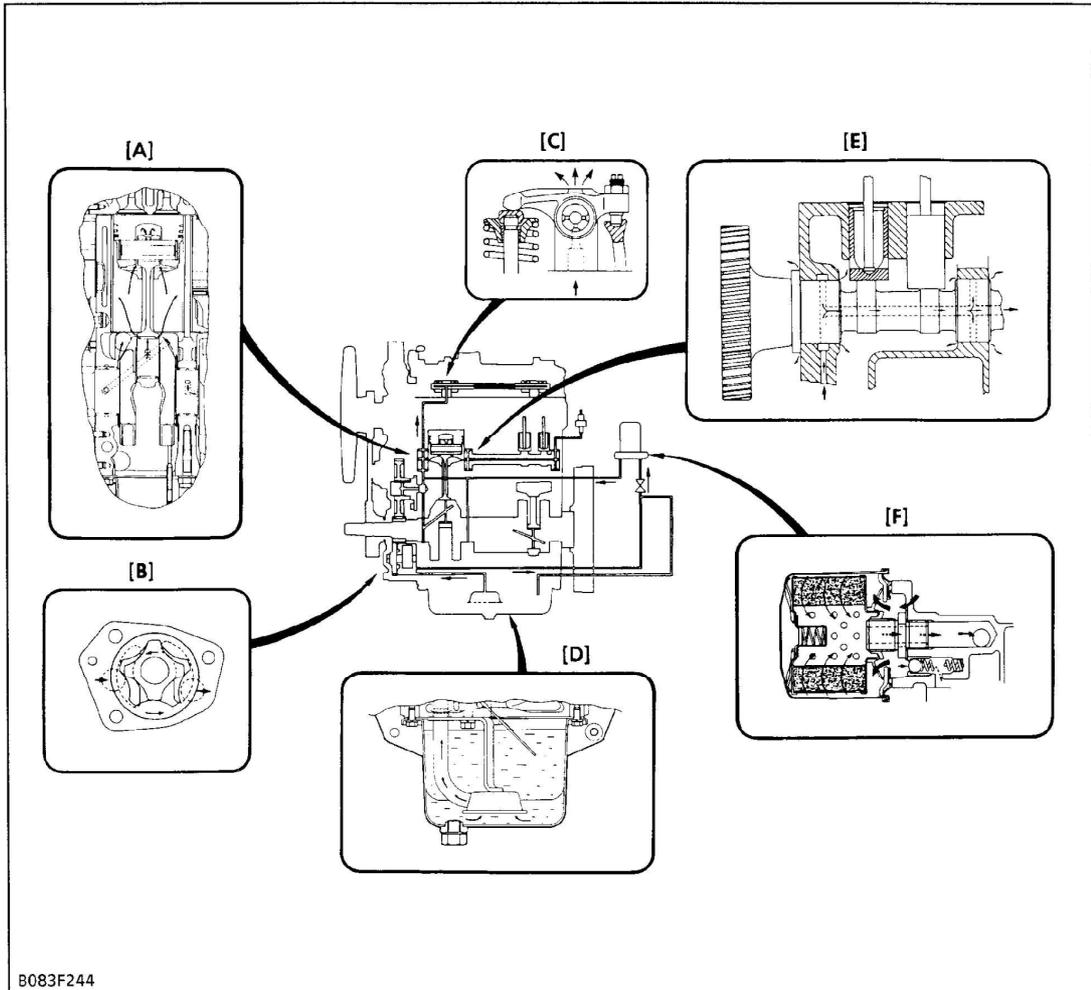


The valve opening and closing timing is extremely important for effectively intaking air into the cylinder and sufficiently exhaust gas.

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

Intake valve open ①	0.349 rad. (20°) before T.D.C.
Intake valve close ②	0.785 rad. (45°) after B.D.C.
Exhaust valve open ③	0.873 rad. (50°) before B.D.C.
Exhaust valve close ④	0.262 rad. (15°) after T.D.C.

[3] LUBRICATING SYSTEM



B083F244

[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

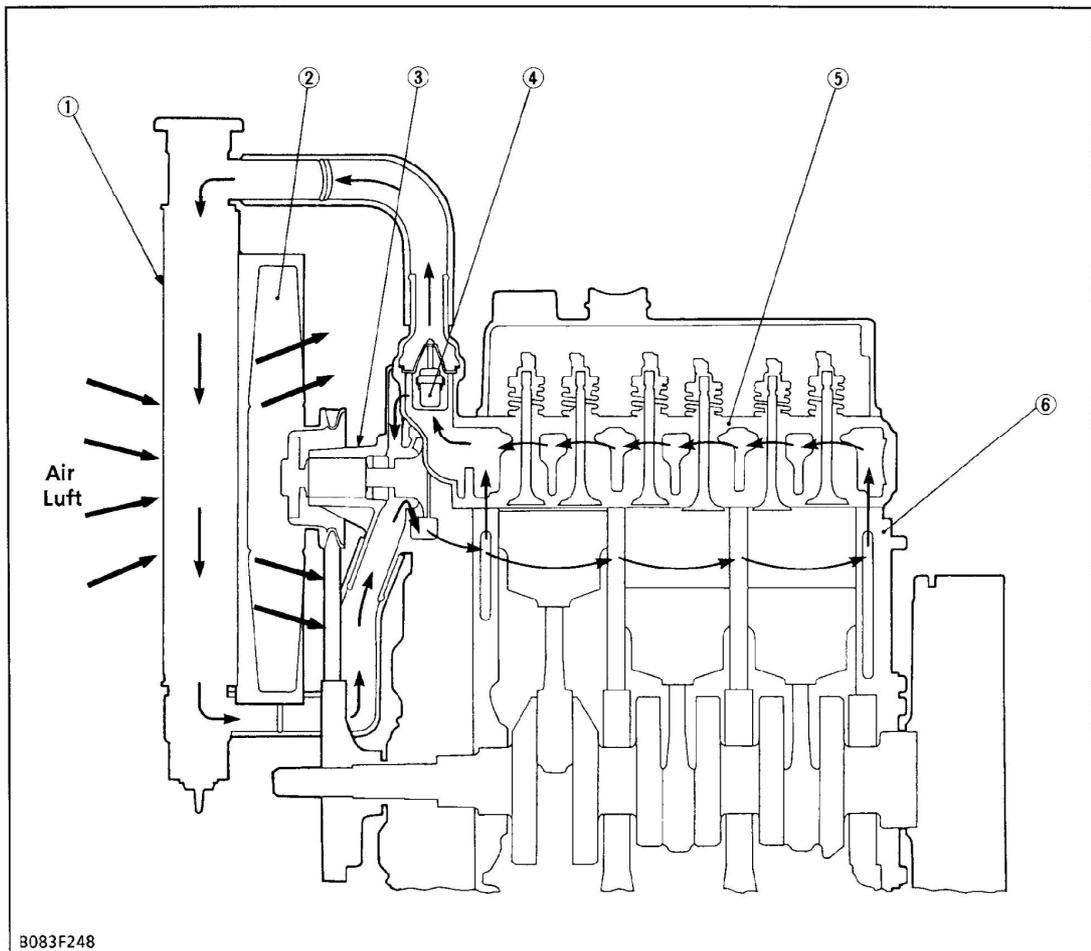
This engine lubricating system consists of oil strainer, oil pump, relief valve, oil filter cartridge and oil pressure switch.

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.

[4] COOLING SYSTEM

B083F248

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

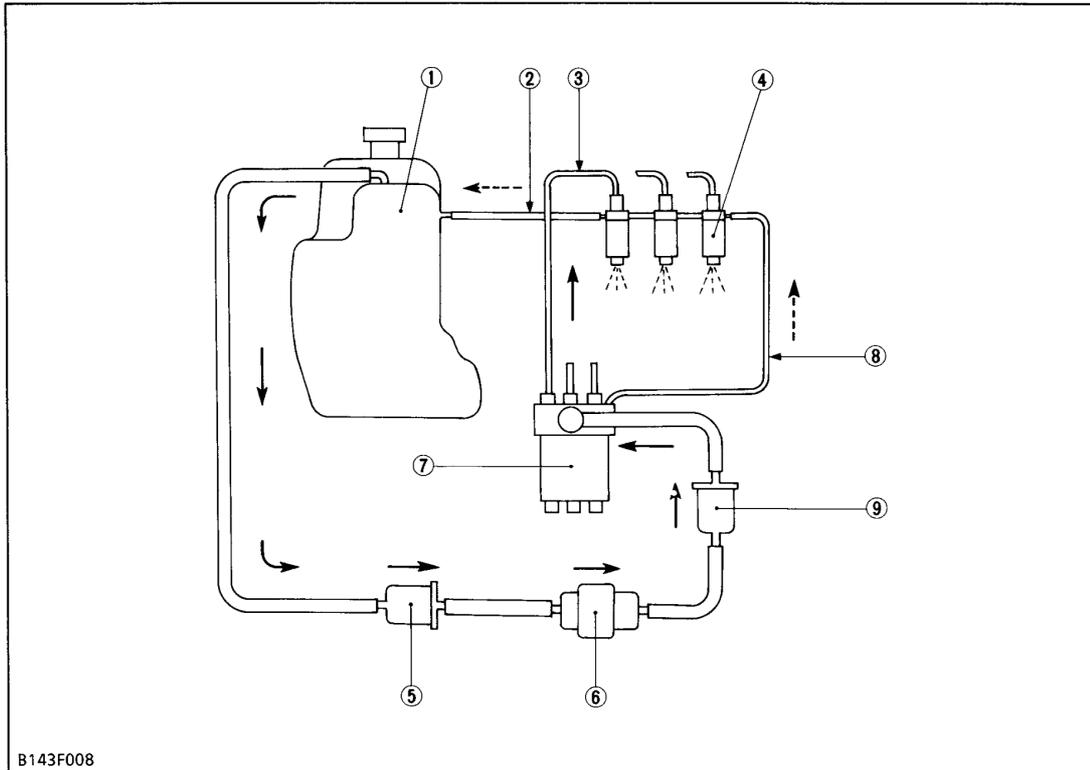
The cooling system consists of a radiator (1), centrifugal water pump (3), cooling fan (2) and thermostat (4).

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.

[5] FUEL SYSTEM



B143F008

- (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

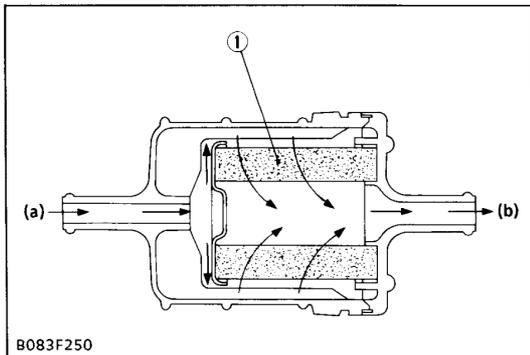
The fuel system consists of a fuel tank (1), fuel filters (5), (9), a fuel pump (6), a fuel injection pump (7) and injection nozzles (4).

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



B083F250

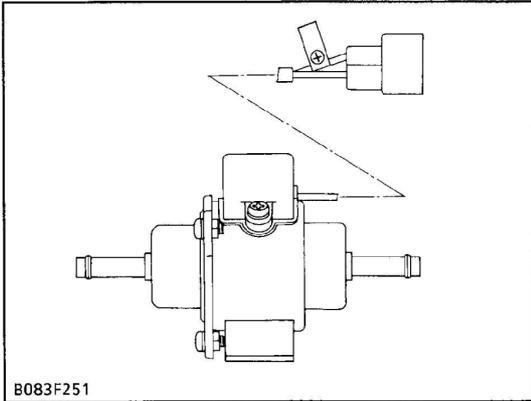
The fuel filter is installed in the fuel line between the fuel tank and fuel injection pump.

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

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

(2) Fuel Pump

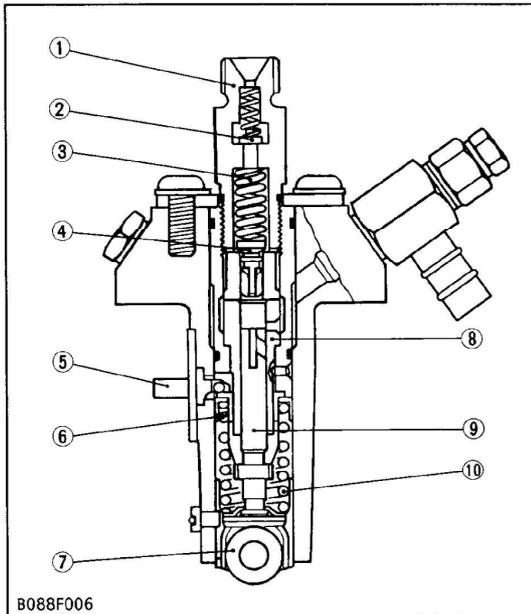


B083F251

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

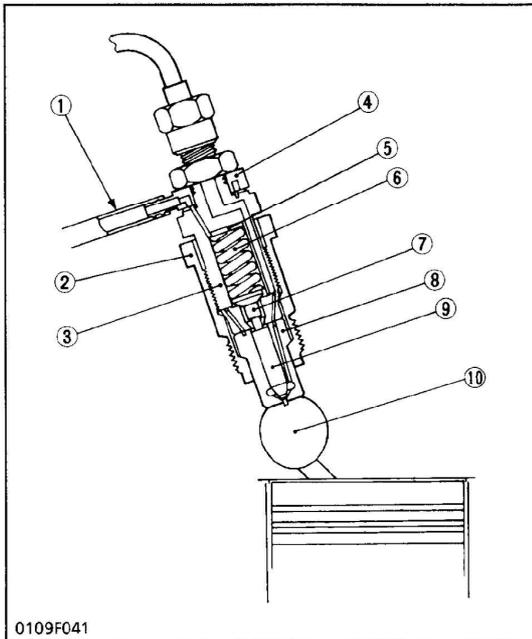


B088F006

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

(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).

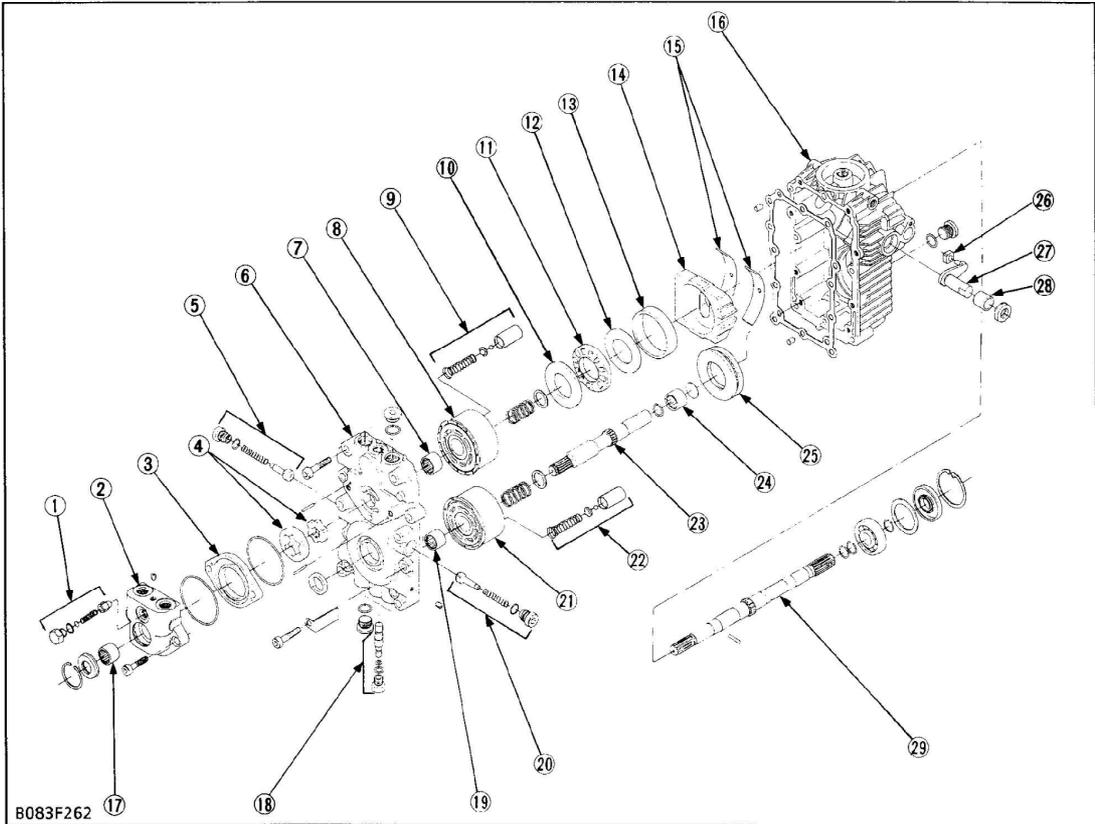
The fuel forced from the injection pump pushes up the needle valve and is injected into the sub-combustion chamber (10). The excessive fuel which is not injected returns through the center chamber of the nozzle holder (3) and the fuel overflow pipe (4) to the fuel tank.

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

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

2 TRANSMISSION AND FRONT AXLE

[1] HYDROSTATIC TRANSMISSION



B083F262

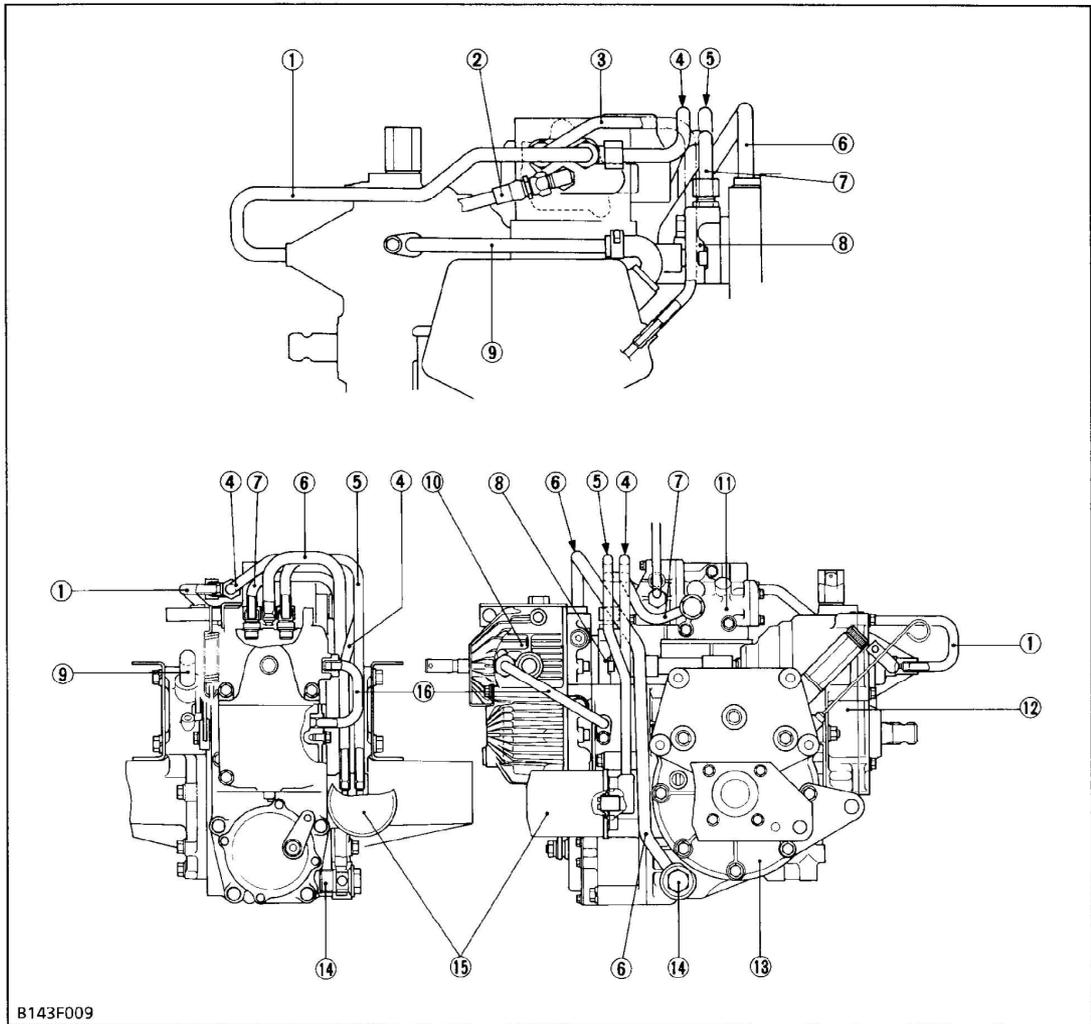
- | | | | |
|----------------------------|----------------------------|-----------------------------|--------------------------|
| (1) Charge Relief Valve | (9) Piston Assembly | (16) Housing | (23) Motor Shaft |
| (2) Auxiliary Pump Housing | (10) Thrust Plate | (17) Needle Bearing | (24) Needle Bearing |
| (3) Auxiliary Pump Spacer | (11) Thrust Roller Bearing | (18) By-pass Valve | (25) Thrust Ball Bearing |
| (4) Gerotor | (12) Thrust Washer | (19) Needle Bearing | (26) Slot Guide |
| (5) Check Valve | (13) Bearing Guide | (20) Check Valve | (27) Trunnion Arm |
| (6) Center Section | (14) Swashplate | (21) Cylinder Block (Motor) | (28) Journal Bearing |
| (7) Needle Bearing | (15) Cradle Bearing | (22) Piston Assembly | (29) Pump Shaft |
| (8) Cylinder Block (Pump) | | | |

The hydrostatic transmission consists of a variable displacement piston pump and a fixed displacement piston motor.

A fan is used to cool the hydrostatic transmission, eliminating the need for an oil cooler.

Convenient single lever control permits simple operation of the vehicle, starting, stopping, increasing or decreasing speeds, changing direction of travel, and even going up or down hills.

(1) Oil Flow

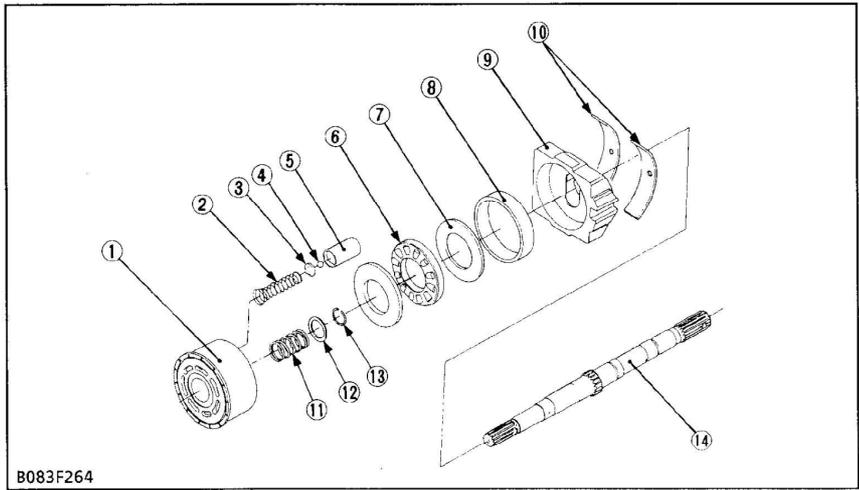


B143F009

- | | | | |
|-------------------|--------------------|--------------------|---------------------------|
| (1) PTO Pipe | (5) HST Pipe 2 | (9) Return Pipe 2 | (13) Transmission Case |
| (2) Cylinder Hose | (6) Suction Pipe | (10) HST | (14) Oil Strainer |
| (3) Return Pipe 1 | (7) Delivery Pipe | (11) Control Valve | (15) Oil Filter Cartridge |
| (4) HST Pipe 1 | (8) Auxiliary Pump | (12) PTO Gear Case | (16) Drain Pipe |

1. When the engine is started, the auxiliary pump (8) is rotated to suck oil from the transmission case (13) through the suction pipe (6).
2. When the oil is sucked, it is filtered by the oil strainer (14).
3. Filtered oil is forced out by the auxiliary pump (8) to the control valve (11) through the delivery pipe (7).
4. With the control valve in neutral position, the oil is delivered to the HST pipe 1 (4), oil filter cartridge (15) and HST pipe 2 (5).
5. The oil used to charge a leak of the closed circuit in the hydrostatic transmission. A portion of oil is drained into the transmission case (13) through the drain pipe (16) after flushing and cooling the HST cylinder blocks.

(2) Piston Pump



- (1) Cylinder Block
- (2) Piston Spring
- (3) Spring Seat
- (4) Steel Ball
- (5) Piston
- (6) Thrust Roller Bearing
- (7) Thrust Washer
- (8) Bearing Guide
- (9) Swashplate
- (10) Cradle Bearing
- (11) Spring
- (12) Washer
- (13) Snap Ring
- (14) Pump Shaft

B083F264

The piston pump consists of a cylinder block (1) having 7 pistons (5), a variable swashplate (9) to reciprocate the pistons, and a pump shaft (14) to rotate the cylinder block.

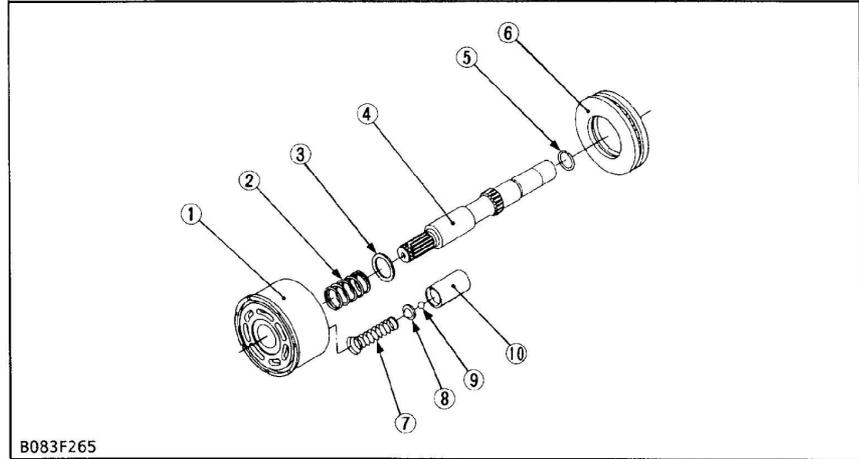
As the cylinder block rotates, the pistons follow the surface of the variable swashplate and reciprocate in their bores. Fluid is drawn from one of the closed loop ports in the center section.

The fluid is then delivered to the opposite closed loop in the center section.

Delivery flow is directly proportional to the swashplate angle. The flow is zero when the swashplate is in the neutral position.

The direction of the flow is reversed when the swashplate is tilted in the opposite position from the neutral position.

(3) Piston Motor



- (1) Cylinder Block
- (2) Spring
- (3) Washer
- (4) Motor Shaft
- (5) Snap Ring
- (6) Thrust Ball Bearing
- (7) Piston Spring
- (8) Spring Seat
- (9) Steel Ball
- (10) Piston

B083F265

The piston motor also consists of a cylinder block (1) having 7 pistons (10), a fixed swashplate (thrust ball bearing) (6), and a motor shaft (4).

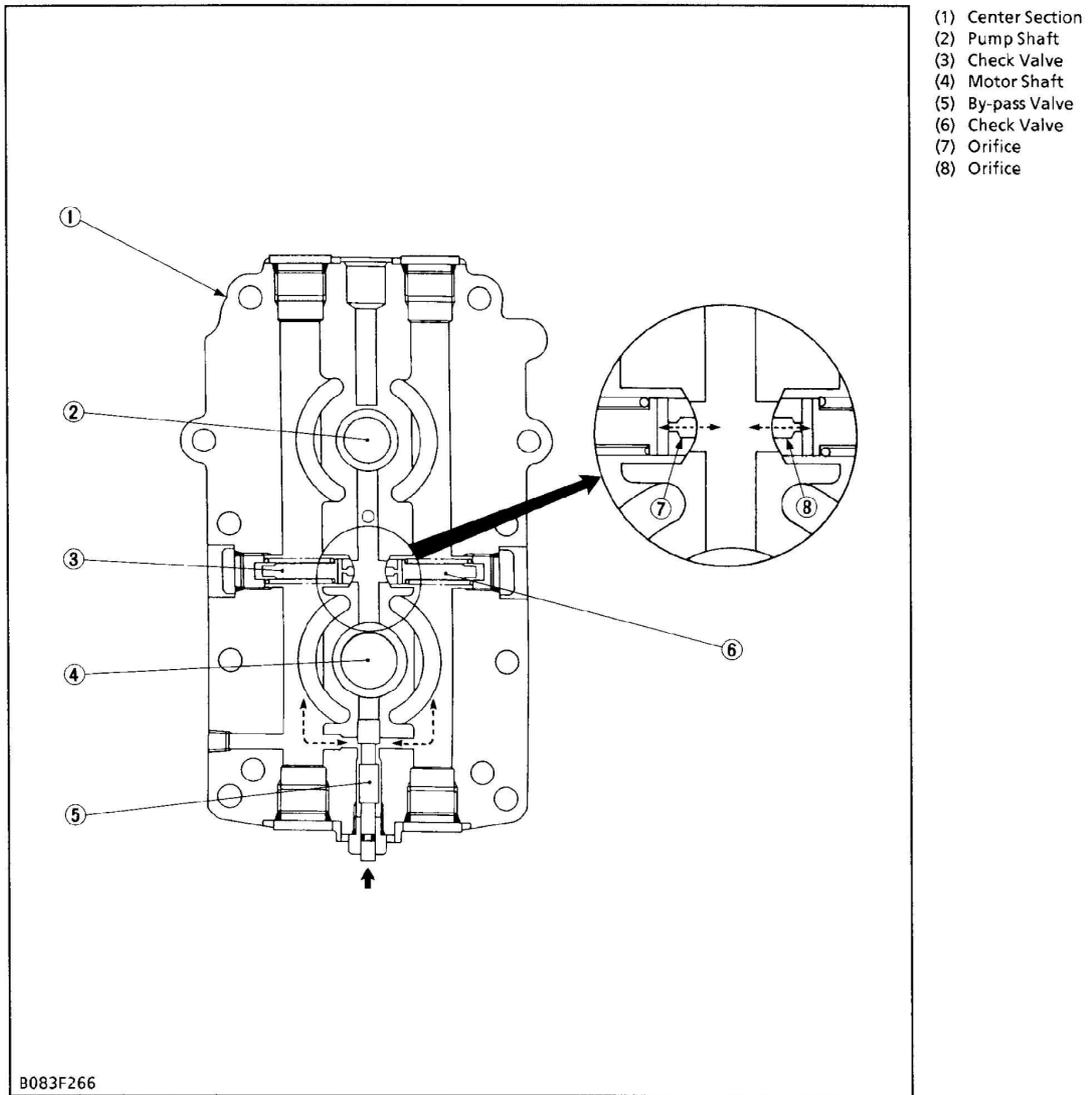
Fluid from the pump flows to the motor through the closed loop passages in the center section. The pistons on the pressurized side of the cylinder block are pushed out by the flow from the pump. As the pistons are pushed out, the pistons slide down the motor swashplate, forcing the cylinder block to

rotate the motor shaft.

The motor shaft speed increases when the fluid volume received from the pump increases. Motor shaft speed decreases when the fluid volume from the pump decreases. The motor shaft stops when the fluid volume from the pump decreases to zero.

The direction of the motor shaft rotation reverses when fluid flow is directed to the opposite port in the center section.

(4) By-pass Valve



The by-pass valve (5) is used to connect the two sides of the closed loop in the center section (1).

The motor shaft (4) does not rotate when the engine is stopped or pump is not driven. This means the vehicle usually can not be moved by pushing.

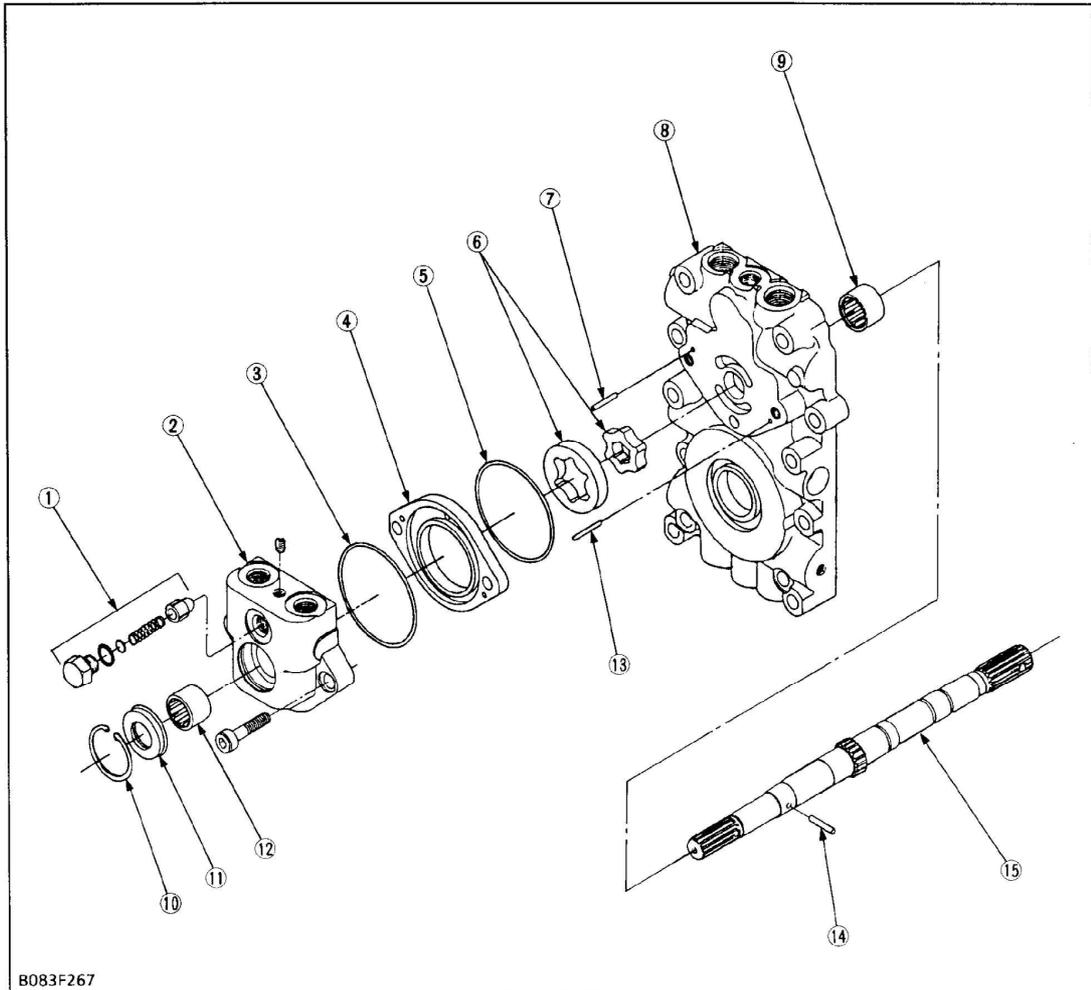
If moving the vehicle by pushing is desired, depress the by-pass valve to connect the two sides of the loop

and defeat the dynamic braking feature.

However, this hydrostatic transmission is equipped with a means of slightly bypassing higher and lower pressures all the time from the orifice (7), (8) of the check valve (3), (6).

Without having to open the by-pass valve (5), therefore, the vehicle can be moved by pushing.

(5) Auxiliary Pump



B083F267

- | | | | |
|----------------------------|--------------------|-------------------------|-----------------|
| (1) Charge Relief Valve | (5) O-ring | (9) Needle Bearing | (13) Dowel Pin |
| (2) Auxiliary Pump Housing | (6) Gerotor | (10) Internal Snap Ring | (14) Drive Pin |
| (3) O-ring | (7) Dowel Pin | (11) Oil Seal | (15) Pump Shaft |
| (4) Auxiliary Pump Spacer | (8) Center Section | (12) Needle Bearing | |

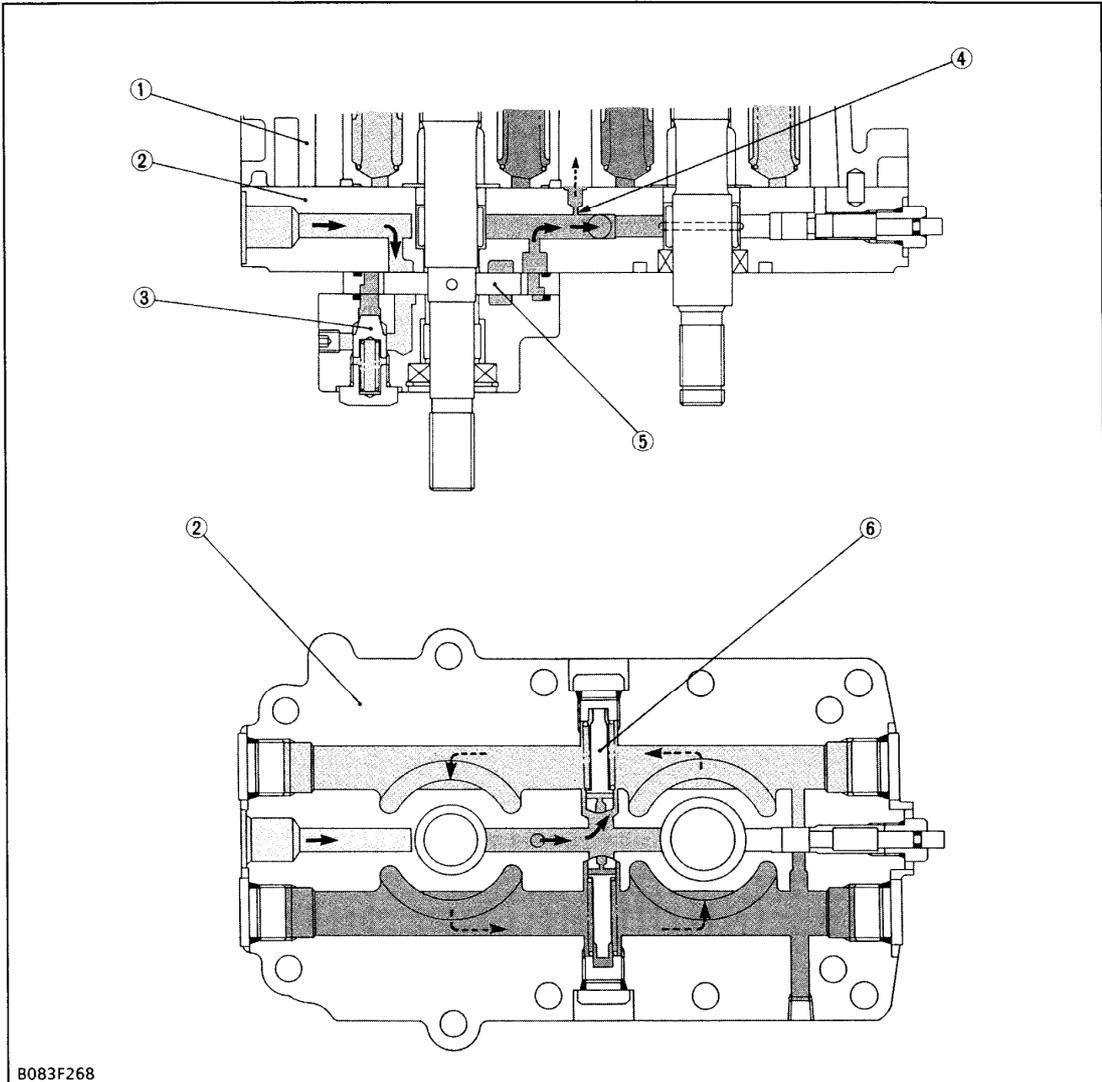
The auxiliary pump is necessary to make up for leakage from the pump and motor, preventing cavitation.

This auxiliary pump always revolves in combination with the pump shaft to draw oil from the transmission case, and feeds oil to the implement lifting circuit and charge circuit.

[Auxiliary Pump Displacement]

Displacement	Engine speed	Oil pressure	Oil temperature
2.8 to 5.1 l/min.	1800 rpm	3.43 MPa 35 kgf/cm ²	Approx. 50 °C
2.46 to 4.49 Imp.qts./min.			

(6) Charge Circuit



B083F268

- (1) Housing
- (2) Center Section
- (3) Charge Relief Valve
- (4) Orifice
- (5) Auxiliary Pump
- (6) Check Valve

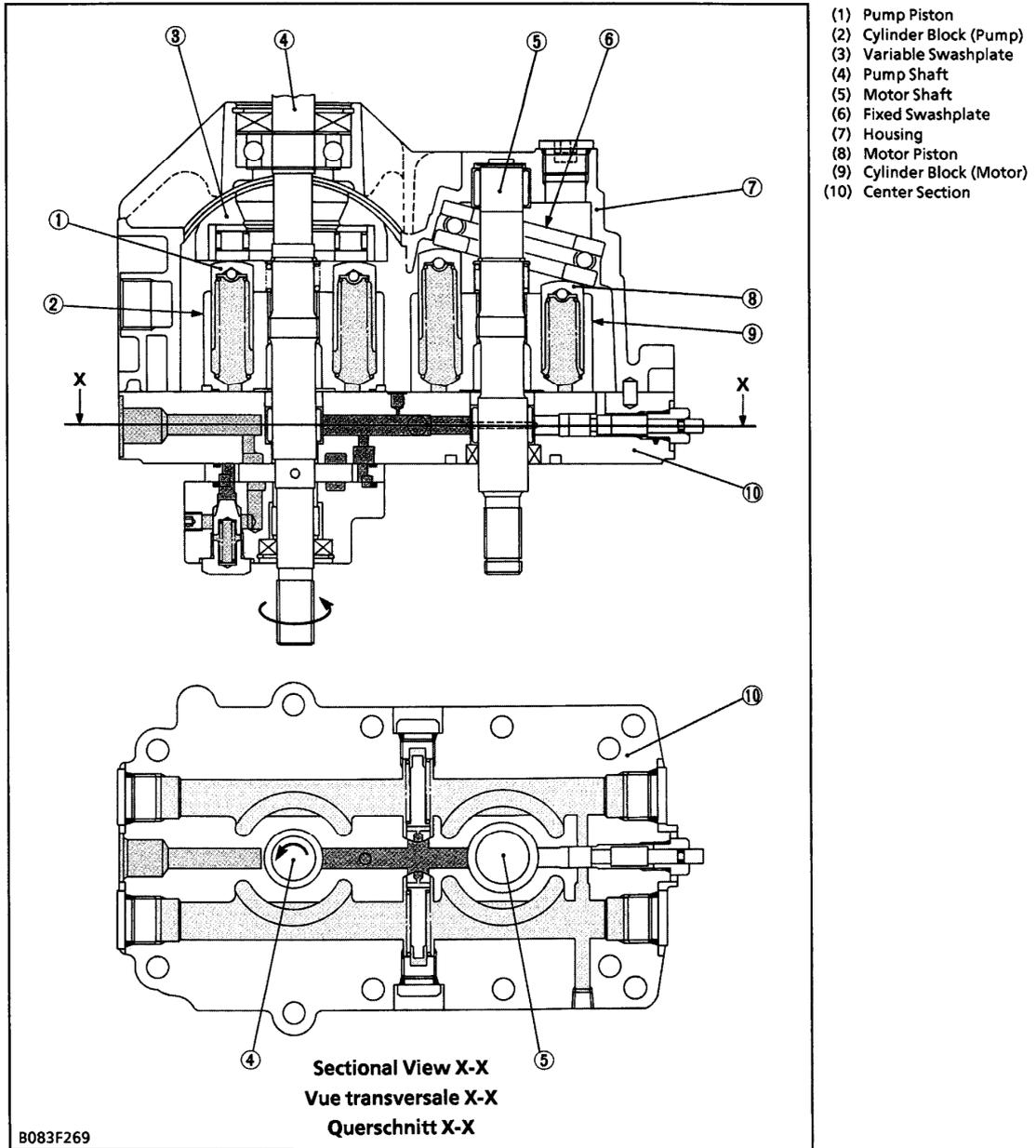
Oil that is sucked from the transmission case by the auxiliary pump (5) is fed through the discharge port to the implement lifting circuit, activating the hydraulic cylinder, and PTO.

The return oil from the implement lifting circuit is used to charge a leak of the closed circuit from the low-pressure side of the check valve (6).

About 1.5 *l*/min. (1.32 Imp.qts./min.) of oil in this charging stream flows through the orifice (4) of the center section (2) into the housing (1), thereby flushing and cooling the cylinder blocks. Excess oil is returned through the charge relief valve (3) back to the suction side of the auxiliary pump (5).

(7) Operation

■ Neutral

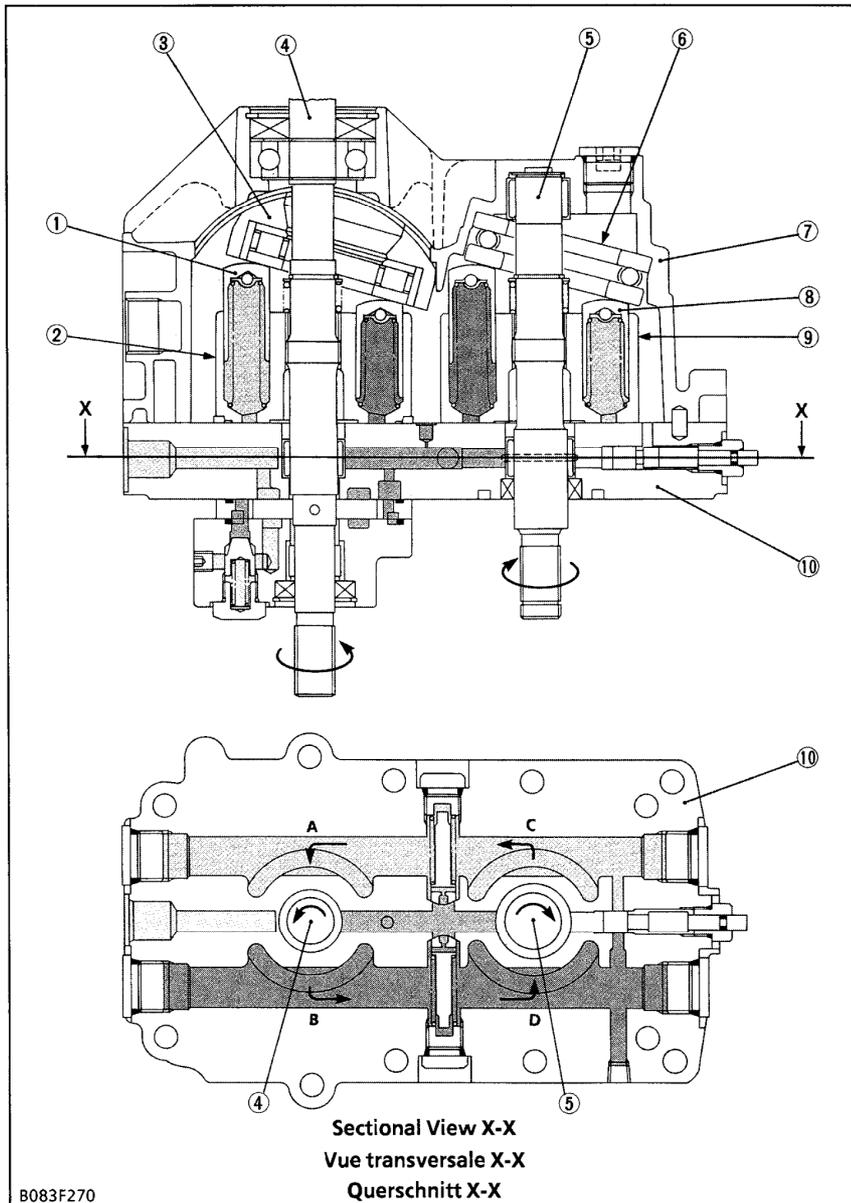


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When the speed change pedal is in neutral, the variable swashplate (3) is at right angles to the pump pistons (1) and they only rotate with cylinder block (Pump) (2) without reciprocating.

Since the oil is not being pumped to the piston motor, the cylinder block (Motor) (9) in the piston motor is stationary and the motor shaft (5) does not rotate.

■ Forward



- (1) Pump Piston
- (2) Cylinder Block (Pump)
- (3) Variable Swashplate
- (4) Pump Shaft
- (5) Motor Shaft
- (6) Fixed Swashplate
- (7) Housing
- (8) Motor Piston
- (9) Cylinder Block (Motor)
- (10) Center Section
- A : Pump Kidney Port "A"
- B : Pump Kidney Port "B"
- C : Motor Kidney Port "C"
- D : Motor Kidney Port "D"

B083F270

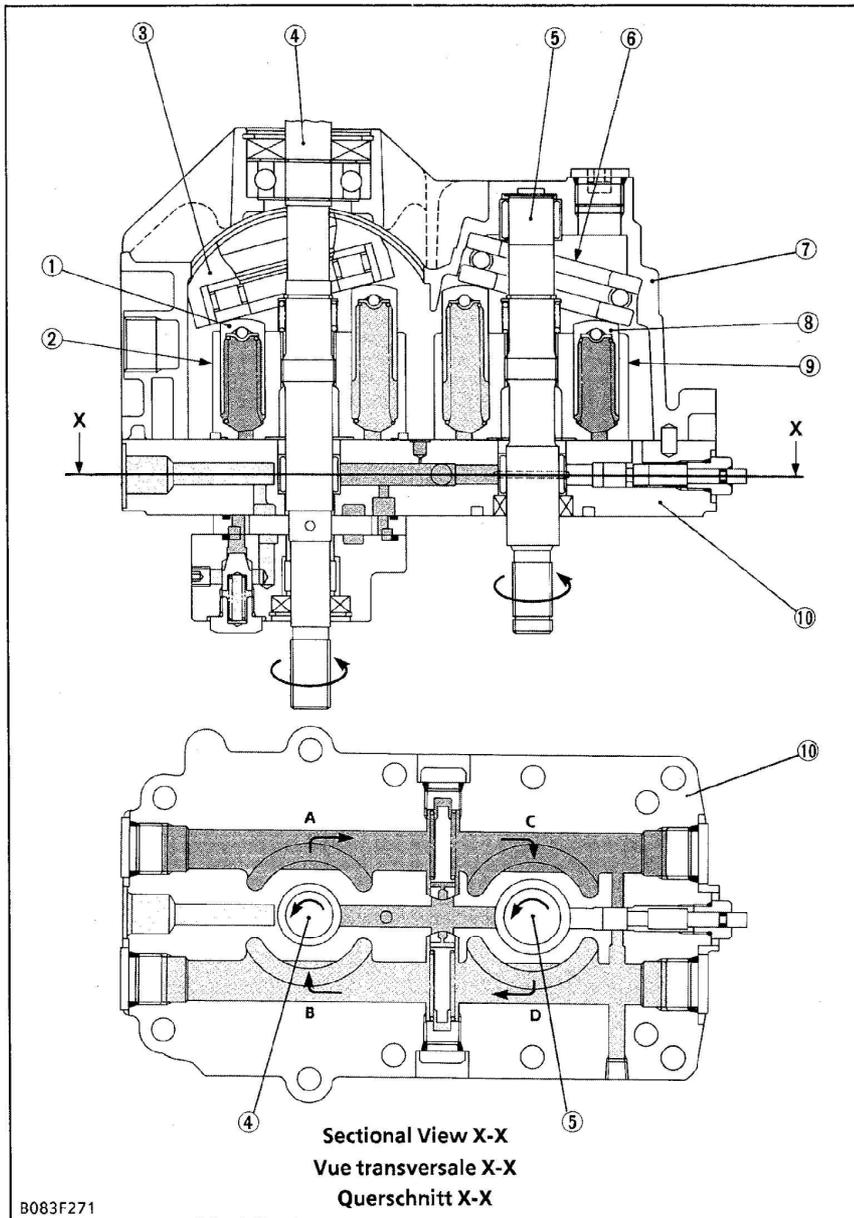
When the speed change pedal is stepped on and in forward, the variable swashplate (3) is tilted as shown in the figure above.

As the cylinder block (Pump) (2) rotates with the pump shaft (4), oil is forced out of pump kidney port "B" at high pressure. As pressure oil enters motor kidney port "D", the pistons (8), which align with port "D", are pushed against the fixed swashplate (6) and slide down the inclined surface.

Then the motor shaft (5) rotates with the cylinder block (Motor) (9). This drives the vehicle forward and the angle of variable swashplate determines the motor shaft speed.

As the cylinder block (Motor) continues to rotate, oil is forced out of motor kidney port "C" at low pressure and returns to the pump through pump kidney port "A".

■ Reverse



- (1) Pump Piston
- (2) Cylinder Block (Pump)
- (3) Variable Swashplate
- (4) Pump Shaft
- (5) Motor Shaft
- (6) Fixed Swashplate
- (7) Housing
- (8) Motor Piston
- (9) Cylinder Block (Motor)
- (10) Center Section
- A : Pump Kidney Port "A"
- B : Pump Kidney Port "B"
- C : Motor Kidney Port "C"
- D : Motor Kidney Port "D"

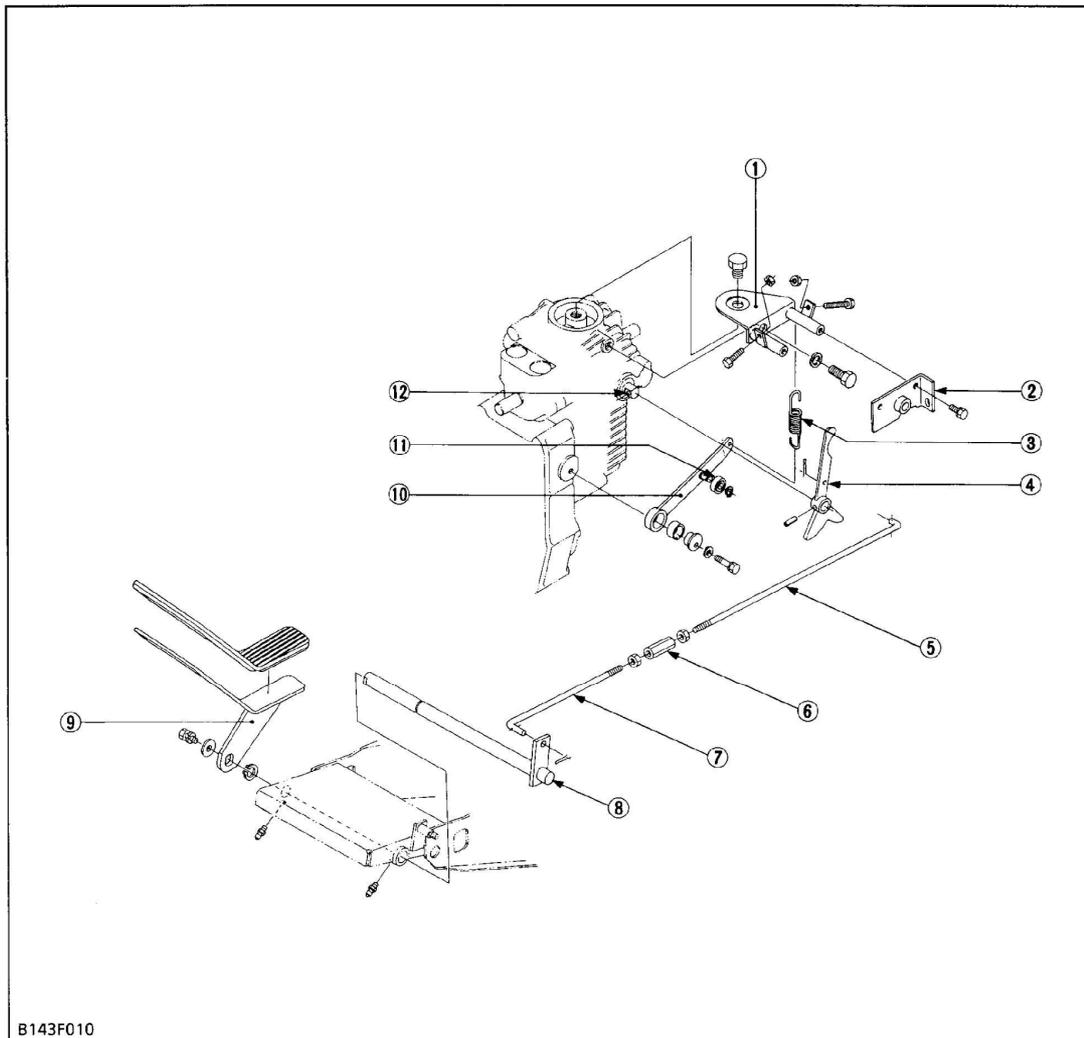
B083F271

When the speed change pedal is stepped on and in reverse, the variable swashplate (3) is tilted as shown in the figure above.

As the cylinder block (Pump) (2) rotates with the pump shaft (4), oil is forced out of pump kidney port "A" at high pressure. As pressure oil enters motor kidney port "C", the pistons (8), which align with port "C", are pushed against the fixed swashplate (6) and slide down the inclined surface.

Then the motor shaft (5) rotates with the cylinder block (Motor) (9). This drives the vehicle and the angle of variable swashplate determines the motor shaft speed.

As the cylinder block (Motor) continues to rotate, oil is forced out of motor kidney port "D" at low pressure and returns to the pump through pump kidney port "B".

(8) Control Linkage

B143F010

- | | | | |
|-------------------------------|------------------------|------------------------|-------------------|
| (1) Control Panel Plate | (4) Speed Change Arm | (7) Speed Change Rod 2 | (10) Neutral Arm |
| (2) Cruise Control Plate | (5) Speed Change Rod 1 | (8) HST Pedal Shaft | (11) Ball Bearing |
| (3) Neutral Arm Return Spring | (6) Turnbuckle | (9) Speed Change Pedal | (12) Trunnion Arm |

The speed change pedal (9) and the trunnion arm (12) are linked with HST pedal shaft (8), speed change rod 2 (7), turnbuckle (6), speed change rod 1 (5) and speed change arm (4).

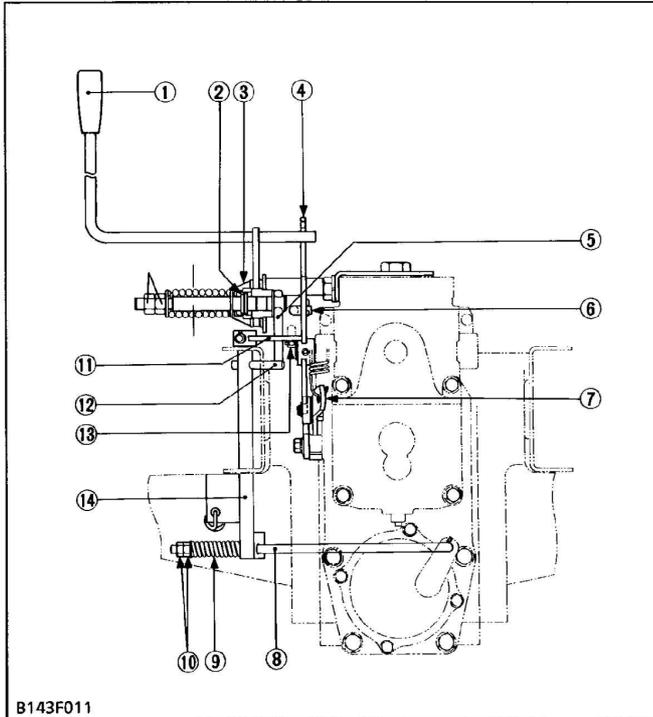
As the front footrest of the pedal is depressed, the washplate rotates and forward traveling speed increases. Depressing the rear footrest increases

reverse speed.

The ball bearing (11) on the neutral arm (10) hanged with the return spring (3) seats the detent of the speed change arm (4) so that the speed change arm returns to neutral.

Then, the washplate is returned to neutral with the speed change arm, when the pedal is released.

(9) Cruise Control System



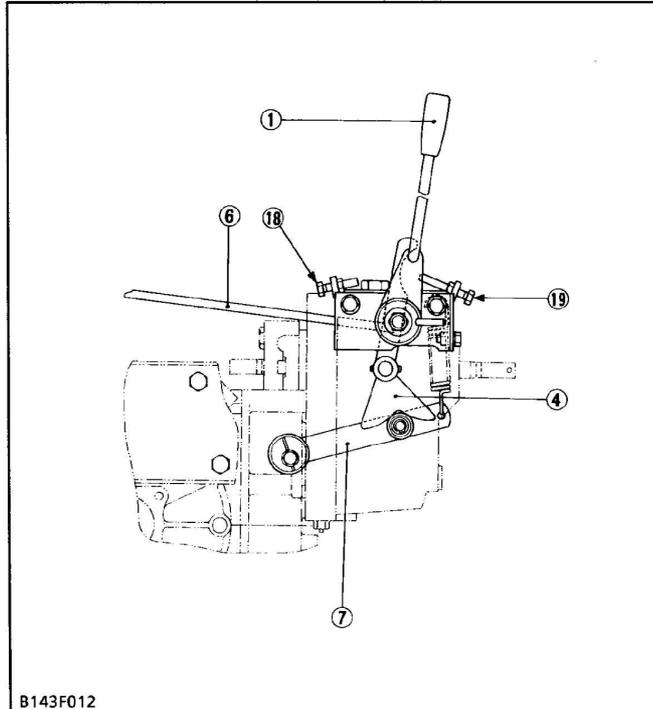
The cruise control system provides a constant forward speed by mechanically holding the speed change pedal at the selected position.

When the cruise control lever (1) is set to desired speed, the speed change arm (4) is tilted to the forward by the cruise control lever. As the speed change pedal and speed change arm are linked with the speed change rod (6), the pedal is hold in the desired speed.

When the cruise control lever is set to "RELEASE" position, the speed change arm (4) is returned to neutral position by the neutral arm (7).

When the brake pedal is depressed, the brake rod (12) is pulled. Then the brake arm (14), brake shaft (11) and spring pin (5) start turning. The spring pin (5) is now pressing the spring pin (13) to rotate the latter too.

In so doing, the cam 1 (2) pushes up the cam 2 (3), and the cruise control lever (1) is automatically released from the friction disc (back to "RELEASE" position). If the speed control pedal feels heavy when the machine moves backward, pull the cruise control lever (1) all the way down by hand to clear the cruise control completely.



- (1) Cruise Control Lever
- (2) Cam 1
- (3) Cam 2
- (4) Speed Change Arm
- (5) Spring Pin
- (6) Speed Change Rod 1
- (7) Neutral Arm
- (8) Brake Rod 2
- (9) Spring
- (10) Adjusting Nut
- (11) Brake Shaft
- (12) Brake Rod 1
- (13) Spring Pin
- (14) Brake Arm
- (15) Cruise Control Shaft
- (16) Adjusting Nut
- (17) Cruise Control Spring
- (18) Speed Set Screw (Forward)
- (19) Speed Set Screw (Reverse)