WSM

WORKSHOP MANUAL
TRACTOR

M7580,M8580,M9580

Kubota

KiSC issued 06, 2017 A

TO THE READER

This Workshop Manual has been prepared to provide servicing personnel with information on the mechanism, service and maintenance of KUBOTA Tractor M7580, M8580, M9580. It is divided into two parts, "Mechanism" and "Disassembling and Servicing".

■ **Mechanism**

Information on the construction and function are included for this section. This part should be understood before proceeding with trouble-shooting, disassembling and servicing.

■ **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 changers in all information at any time without notice.

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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 : Immediate hazards which **WILL** result in severe personal injury or death.

WARNING : Hazards or unsafe practices which **COULD** result in severe personal injury or death.

CAUTION : Hazards or unsafe practices which **COULD** result in minor personal 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 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.

❶ Part No. 35260—3491—3 (ROPS TRACTOR)

⚠CAUTION

TO AVOID PERSONAL INJURY:
1. Read and understand the operator's manual before operation.
2. Before strating the engine, make sure that everyone is at a safe distance from the tractor and that the PTO is OFF.
3. Do not allow passengers on the tractor at any time.
4. Before allowing othre people to use the tractor, have them read the operator's manual.
5. Check the tightness of all nuts and bolts regularly.
6. Keep all shields in place and stay away from all moving parts.
7. Lock the two brake pedals together before driving on the road.
8. Slow down for turns, or rough roads, or when applying indrividual brakes.
9. On public roads use SMV emblem and hazard lights, if required by local traffic and safety regulation.
10. Pull only from the drawbar.
11. Before dismounting, lower the implement, set the parking brake, stop the engine and remove the key.

❺ Part No. 35822—9865—2

⚠WARNING

TO AVOID PERSONAL INJURY:
1. Keep PTO shield in place at all times.
2. Before using PTO, lock swinging drawbar in center position and set distance from drawbar pin hole to PTO according to the following instructions.
   PTO Shaft Type Distance
   540 RPM — 6 spline 14 in. (355mm)
   1000 RPM — 21 spline 16 in. (406mm)
3. Do not operate the PTO at speeds faster than the speed recommended by the implement manufacturer.

❷ Part No. 35260—2979—1

⚠WARNING

TO AVOID PERSONAL INJURY:
1. Attach pulled or towed loads to the drawbar only.
2. Use the 3-point hitch only with equipment designed for 3-point hitch usage.

❶ Part No. 35870—9836—3 (CAB TRACTOR)

⚠CAUTION

TO AVOID PERSONAL INJURY:
1. Read and understand the operator's manual before operation.
2. Before starting the engine, make sure that everyone is at a safe distance from the tractor and that the PTO is OFF.
3. Do not allow passengers on the tractor at any time.
4. Before allowing other people to use the tractor, have them read the operator's manual.
5. Check the tightness of all nuts and bolts regularly.
6. Keep all shields in place and stay away from all moving parts.
7. Lock the two brake pedals together before driving on the road.
8. Slow down for turns, or rough roads, or when applying individual brakes.
9. On public roads use SMV emblem and hazard lights, if required by local traffic and safety requlations.
10. Pull only from the drawbar.
11. Before dismounting , lower the implement, set the parking brake, stop the engine, and remove the key.
12. Always use seat belt for safety when the tractor equipped with CAB or ROPS.

❹ Part No. 35820—9863—3

⚠WARNING

TO AVOID POSSIBLE INJURY OR DEATH FROM A MACHINE RUNAWAY:
1. Do not start engine by shorting across starter terminals or bypassing the safety start switch. Machine may start in gear and move if normal starting circuitry is bypassed.
2. Start engine only from operator's seat with transmission and PTO. Never start engine while standing on the ground.

❻ Part No. 35080—6528—2

⚠CAUTION

Pull the engine stop knob back and hold it until the engine stops in case of emergency.

❸ Part No. 35260—2978—2 (ROPS TRACTOR)

⚠WARNING

TO AVOID PERSONAL INJURY OR DEATH FROM ROLLOVER:
1. Kubota recommends the use of a Roll-Over Protective Structures
   (ROPS) and seat belt in almost all applications.
2. Remove the ROPS only when it substatially interferes with operation or itself presents a safety risk. (Examples include work in orchards and vineyards.)
   ALWAYS REINSTRALL IT BEFORE USING THE TRACTOR IN OTHER APPLICATIONS.
3. Never use just the seat belt or just the ROPS. They must be used together. For further details, consult your Operator's Manual or your local dealer.

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❼ Part No. 33960-9857-1

⚠ CAUTION

TO AVOID ACCIDENT:

- IC shuttle lever should not be shifted from forward to reverse position (or vice versa) at speeds exceeding 6 mph(10km/h).
- In these cases, for safety purposes, engine will shut off automatically.
  Therefore, keep sufficient space between you and other vehicles.
- If engine shuts off, move IC Shuttle Lever to neutral position and restart engine — Read operator's manual.

❽ Part No. 33966-9851-1

⚠ WARNING

BEFORE DISMOUNTING TRACTOR:
1. PARK ON LEVEL GROUND WHENEVER POSSIBLE
   If parking on a gradient, position tractor at right angles to the slope.
2. ALWAYS SET PARKING BRAKE
   Leaving transmission in gear with the engine stopped will not prevent tractor from rolling.
3. LOWER ALL IMPLEMENTS TO THE GROUND
   Failure to comply to this warning may allow the wheels to slip, and could cause injury or death.
4. STOP THE ENGINE

33966-98511Ⓓ

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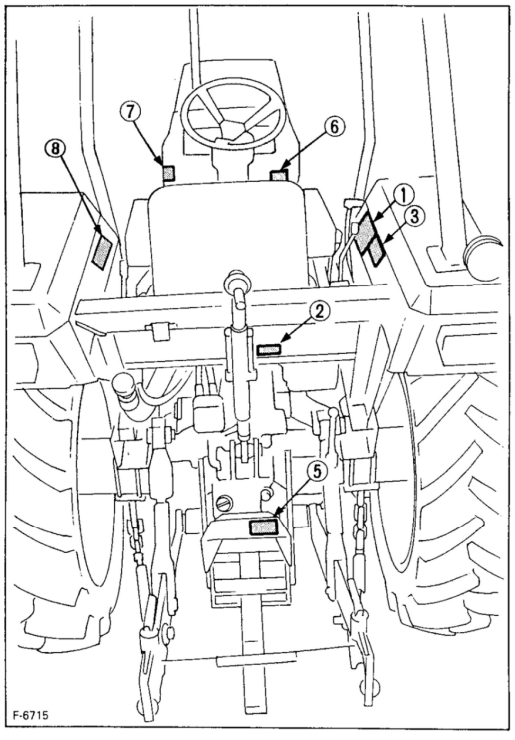

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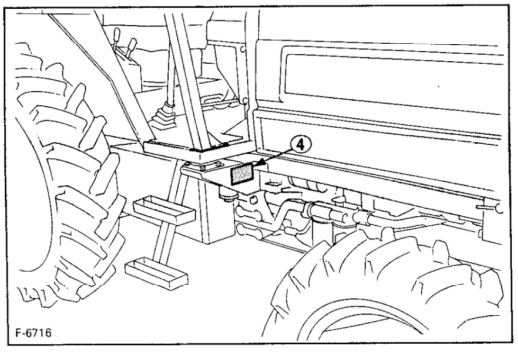

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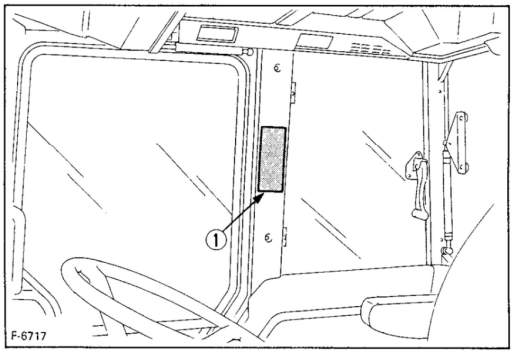

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SPECIFICATIONS

Model			M7580 (4WD) (ROPS)	M7580 (4WD) (CABIN)
PTO power (Factory observed)			72 HP (53.7 kW)*1 70 HP (52.2 kW) *2	71 HP (53.0 kW)*3
Engine	Model		V4302-A	V4302-AQ
	Type		Direct injection, vertical, water-cooled, 4-cycle diesel	
	Number of cylinders		4	
	Total displacement		4329 cm³ (264.2 cu.in.)	
	Bore and stroke		105 x 125 mm (4.13 x 4.92 in.)	
	Net power/rpm (Rated engine speed)		77 HP (57.4 kW) / 2400 rpm	
	Maximum torque		275 N·m (28 kgf·m, 203 ft-lbs)	
	Battery		12 V, 200 Ah	
	Fuel		Diesel fuel No. 1-D [below – 10 °C (15 °F)] Diesel fuel No. 2-D [above – 10 °C (15 °F)] (ASTM-D975)	
	Fuel tank capacity		105 ℓ (27.7 U.S.gal., 23.1 Imp.gal.)	
	Engine crankcase capacity		16.3 ℓ (4.3 U.S.gal., 3.59 Imp.gal.)	
	Engine coolant capacity		14.5 ℓ (3.8 U.S. gal., 3.2 Imp.gal.)	
Dimensions	Overall length		3926 mm (154.6 in.)	
	Overall width (Minimum tread)		2010 mm (79.1 in.)	
	Overall height		2624 mm (103.3 in.)	
	Wheel base		2300 mm (90.6 in.)	
	Tread	Front	1540 to 1740 mm (60.6 to 68.5 in.)	
		Rear	1520 to 2020 mm (59.8 to 79.5 in.)	
	Minimum ground clearance		470 mm (18.5 in.)	
	Crop clearnace		560 mm (22.0 in.)	
Weight			3100 kg (6834 lbs)	3370 kg (7429 lbs)
Travelling system	Tire size	Front	11.2 – 24 6PR, 12.4 – 24 6PR, 12.4 – 24 8PR, 13.6 – 24 8PR	
		Rear	18.4 – 30 6PR, 16.9 – 34 6PR, 18.4 – 34 6PR, 15.5 – 38 6PR	
	Clutch		Dry, Single plate [325 mm (12.8 in.)]	
	Steering		Full hydrostatic power steering, load reaction type	
	Transmission oil capacity		50.0 ℓ (13.2 U.S.gal., 11.0 Imp.gal.)	
	Transmission		Full synchromesh, F12 / R12 (Dual speed transmission : F24 / R24)	
	Brake	Travelling	Wet type, multiple discs (hydraulic)	
		Parking	Wet, discs	
	Minimum turning radius (with brake)		3.3 m (10.8 ft)	
	Differential		Bevel gears (with differential lock)	
Hydraulic system	Hydraulic control system		Position, draft and mix control	
	Total pump capacity		112 ℓ/min. (29.6 U.S.gal./min., 24.6 Imp. gal./min.)	
	Three point hitch		Category Ⅱ	
	Maximum lifting force		2635 kg (5809 lbs) at lower link end 2093 kg (4615 lbs) at 610 mm (24 in.) behind lifting point	
	System pressure		19.6 MPa (200 kgf/cm², 2845 psi)	
	Remote hydraulic control		Two remote valves and quick couplers	
	Max. hydraulic flow at remote outlet		80 ℓ/min. (21.1 U.S.gal./min., 17.6 Imp.gal./min.)	
	Remote hydraulic system pressure		18.1 MPa (185 kgf/cm², 2630 psi)	
PTO	Independent clutch		Wet, multiple plates (hydraulic)	
	Live PTO	Direction of turning	Clockwise, viewed from tractor rear	
		PTO speed	6 spline shaft 540 rpm (9 r/s) / Engine 2035 rpm (33.9 r/s)	
Traction system			Swing drawbar, adjustable in direction	

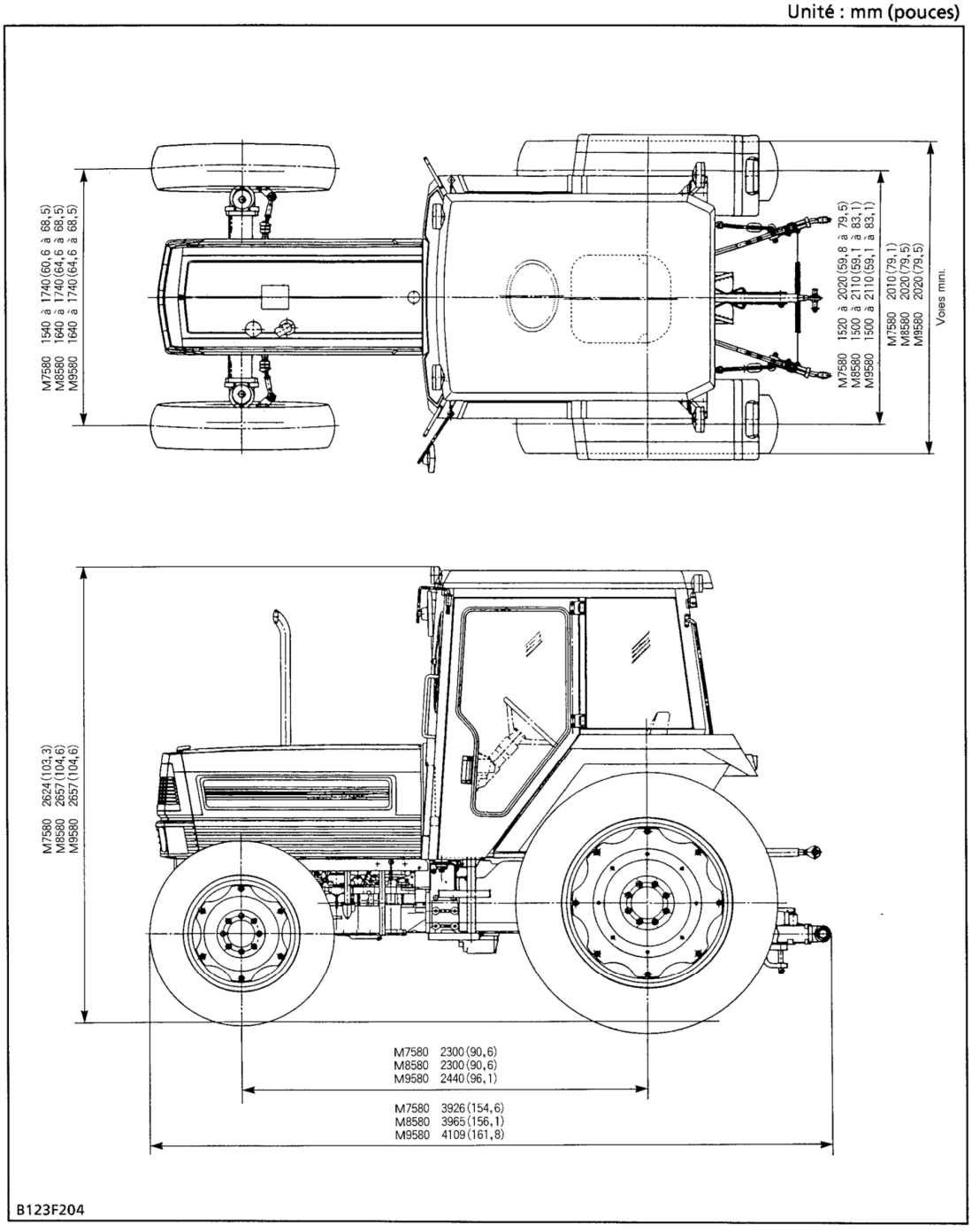
M8580 (4RM) (ROPS)	M8580 (4RM) (CABINE)	M9580 (4RM) (ROPS)	M9580 (4RM) (CABINE)
80 HP (59,7 kW)*1 78 HP (58,2 kW) *2 79 HP (58,9 kW)*3		92 HP (68,6 kW)*1	91 HP (67,9 kW)*4
V4702-A	V4702-AQ	V4702-TA	V4702-TAQ
A injection directe, vertical, refroidissement par eau, 4 temps, diesel [M9580 à turbocompresseur]			
4			
4665 cm³ (2487 pouces cubes)			
109 x 125 mm (4,29 x 4,92 pouces)			
85 HP (63,4 kW)/2400 tr/mn		100 HP (74,6 kW)/2400 tr/mn	
319 N·m (32,5 kgf·m, 235 pieds-livres)		369,7 N·m (37,7 kgf·m, 273 pieds-livres)	
12 V, 200 Ah			
Carburant diesel n° 1-D [à moins de -10 °C (15 °F)] Carburant diesel n° 2-D [à plus de -10 °C (15 °F)](ASTM-D975)			
105 ℓ (27,7 U.S.gsl., 23,1 Imp.gal.)		120 ℓ (31,7 U.S.gsl., 26,4 Imp.gal.)	
16,3 ℓ (4,3 U.S.gal., 3,59 Imp.gal.)			
14,5 ℓ (3,83 U.S.gal., 3,19 Imp.gal.)		14,1 ℓ (3,72 U.S.gal., 3,10 Imp.gal.)	
3965 mm (156,1 pouces)		4109 mm (161,8 pouces)	
2020 mm (79,5 pouces)			
2657 mm (104,6 pouces)			
2300 mm (90,6 pouces)		2440 mm (96,1 pouces)	
1640 à 1740 mm (64,6 à 68,5 pouces)			
1500 à 2110 mm (59,1 à 83,1 pouces)			
497 mm (19,6 pouces)			
590 mm (23,2 pouces)			
3800 kg (8377 livres)	4070 kg (8973 livres)	3850 kg (8488 livres)	4120 kg (9083 livres)
11,2 – 24 6PR, 12,4 – 24 6PR, 12,4 – 24 8PR, 13,6 – 24 8PR			
18,4 – 30 6PR, 16,9 – 34 6PR, 18,4 – 34 6PR, 15,5 – 38 6PR			
Type monodisque à sec [325 mm (12,8 pouces)]		Type monodisque à sec [350 mm (13,8 pouces)]	
Servodirection entièrement hydrostatique de type à réaction en charge			
50,0 ℓ (13,2 U.S.gal., 11,0 Imp.gal.)		56,0 ℓ (14,8 U.S.gal., 12,3 Imp.gal.)	
A prise entièrement syncrhonisée, 12 vitesses en marche avant et 12 vitesses en marche arrière		A prise entièrement synchronisée, 24 vitesses en marche avant et 24 vitesses en marche arrière	
Type multidisque à bain d'huile			
Disques à bain d'huile			
3,7 m (12,1 pieds)		3,8 m (12,4 pieds) [3,86 m (12,6 pieds) braquage à deux vitesses (sans frein)]	
Engrenages coniques (sans blocage du différentiel)			
Contrôle de position, contrôle d'effort et contrôle mixte			
112 ℓ/mn (29,6 U.S.gal. / mn, 24,6 Imp.gal. / mn)			
Catégorie II			
2635 kg (5809 livres) à l'extrémité du bras inférieur 2093 kg (2093 livres) à 610 mm (24 pouces) derrière le point de relevage			
19,61 MPa (200 kgf/cm², 2631 psi)			
Deux distributeurs de contrôle à distance et raccords rapides			
80 ℓ/mn (21,1 U.S.gal. / mn, 17,6 Imp.gal. / mn)			
18,14 MPa (185 kgf/cm², 2631 psi)			
Multidisque à bain d'huile			
Horaire en voyant du côté arrière du tracteur			
Arbre à 6 cannelures 540 tr/mn (9 tr/s)/moteur 2035 tr/mn (33,9 tr/s) Arbre à 21 cannelures 1000 tr/mn (16,7 tr/s)/moteur 2389 tr/mn (39,8 tr/s)			
Barre d'attelage oscillante, à direction réglable			

*1: Modèle à "inverseur de marche à prise constante", *2: Modèle à "inverseur de marche à CI", *3: Modèle à "sélection de gamme", *4: Modèle à "inverseur de marche à CI avec sélection de gamme"
La compagnie se réserve le droit de modifier les specifications sans préavis.

DIMENSIONS

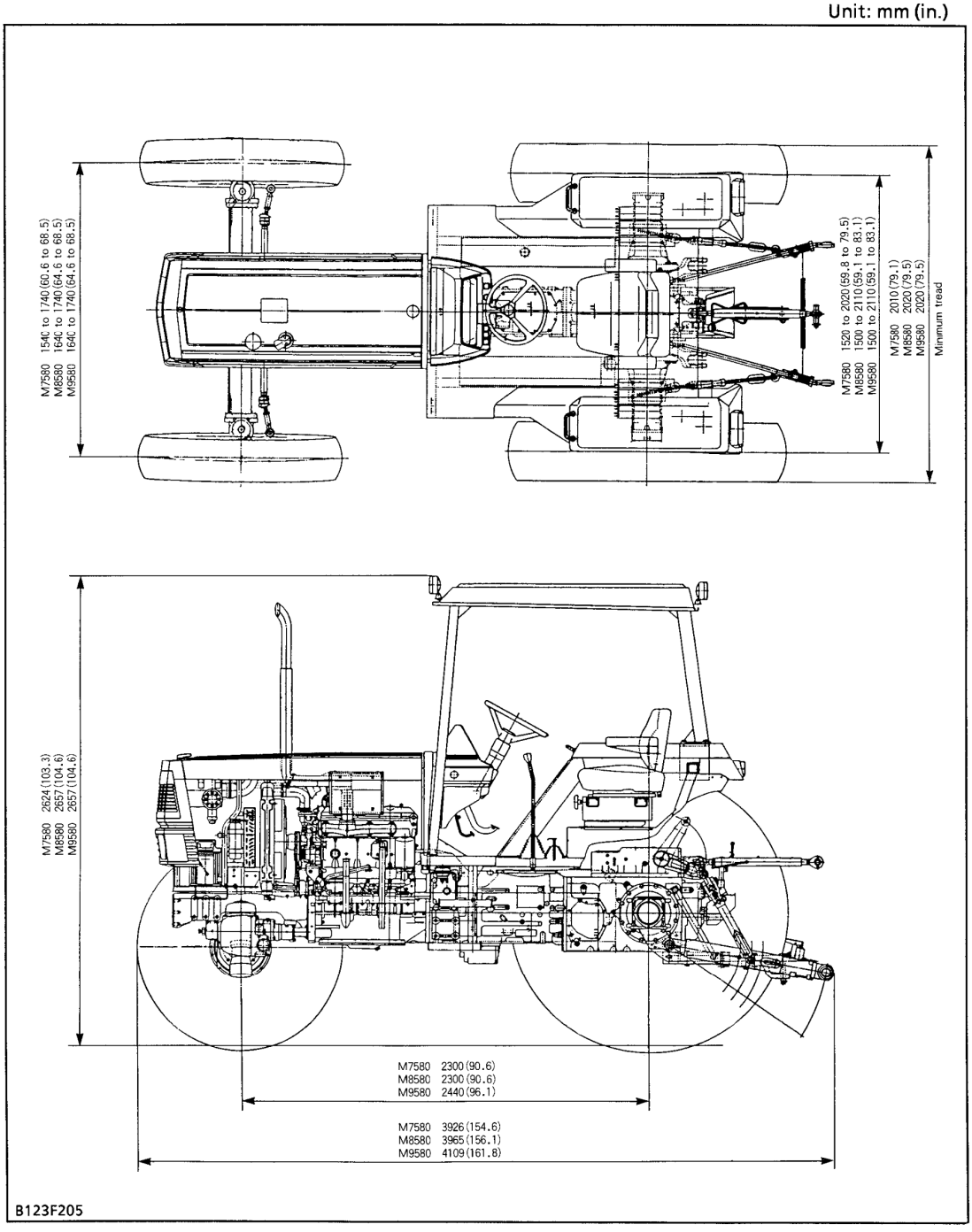
[M7580, M8580, M9580 (CABINE)]

Unité : mm (pouces)



[M7580, M8580, M9580 (ROPS)]

Unit: mm (in.)



M MECHANISM

CONTENTS

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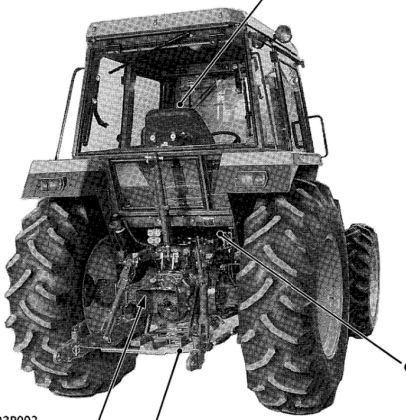
F FEATURES

- Instruments similar to those found in automobiles
- Operating controls and switches located near the seat and steering wheel
- Joy stick for front loader operation (optional)
- Hydraulic PTO clutch has automatic control modulation during engagement
- Wide piece of curved glass
- One-piece windshield for a wider forward viewing area
- Long-life heavy-duty clutch
- Direct injection engine
- Great torque rise
- Fuel economy
- Easy starting
- Built-in muffler
- Turbocharger with wast gate valve

B123P001

- Large capacity tandem pump
- High crop clearance
- Wide 80" front wheel treads (optional)
- Bi-speed Turn (M9580 only)
- 2 steps 2 doors
- IC Shuttle transmission (F12 / R12)
- Synchro-shuttle transmission (F12 / R12)
- Fast travelling speed (32.3 km/hr: with 18.4-34 rear tire)
- Cassette-type creep mechanism (field option)
- Dual speed transmission (F24 / R24)
- Small turning radius
- Bevel gear type 4WD

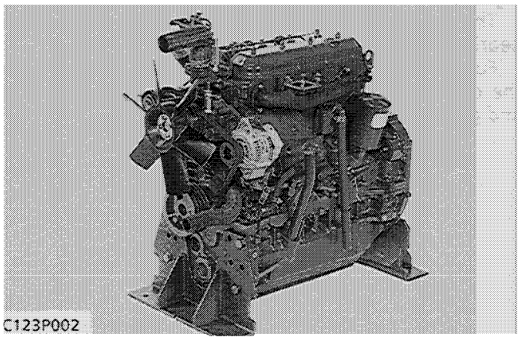
- Deluxe Kubota cabin
- 4-post type Kubota ROPS
- Full-floating type flat deck
- Tilt steering wheel
- Load reaction type full hydrostatic power steering
- Suspended pedal
- Deluxe seat
- High back deluxe seat (Cabin)


B123P002

- New hydraulic system that permits independent operation of 3-point hitch and auxiliary control hydraulic pressure
  (Auxiliary control permits the simultaneous operation of implements.)
- Third valve added to increase hydraulic capability (optional)
- Hefty 3-point hitch lift capacity
- Assist cylinder available (optional)
- Interchangeable PTO shaft (M9580, M8580 540 rpm/1000 rpm) (M7580 540 rpm)

1 ENGINE

[1] ENGINE FEATURES


C123P002

These engines have a high-output performance at a low specific fuel consumption developed as based on the current V4300-A (the stroke of 115 mm), respectively, to increase the torque by increasing the piston stroke itself.

■ **Main Improvement Items**

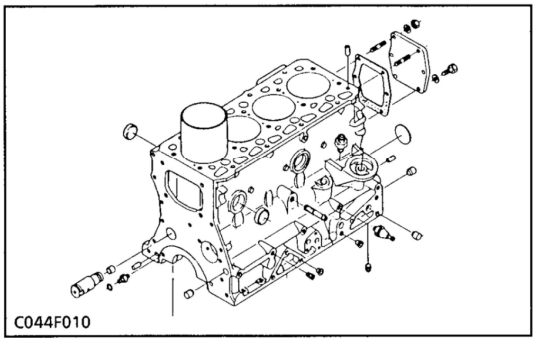
Item \ Model	V4000, V4300	V4300-T	V4302, V4702	V4702-T
Stroke	115 mm (4.53 in.)		125 mm (4.92 in.)	
Turbo charger	————	Without wast gate valve	————	With wast gate valve
Cylinder Head	————		Suction port of a cylinder head is made to have helical shape.	
Intake / Exhaust Valve	Intake valve with shroud. No valve seat. Face angle of intake valve is 0.79 rad. (45.5°).		Intake valve without shroud. Valve seat is installed. Face angle of intake valve is 1.06 rad. (60.5°).	
Valve Guide	Valve guide with a snap ring		Valve guide without a snap ring.	
Intake Cam	————		Intake valve stroke is longer.	
Balancer	Double shaft weight balancer.		Direct drive type weight balancer.	
Oil Pan	————		The four wheel drive propeller shaft is passed through the oil pan.	
Piston	A steel strut is not casted.		A steel strut is casted into the piston interior.	
Connecting Rod	The connecting rod end is divided diagonally.		The connecting rod end is divided horizontally.	
Injection Nozzle	Each nozzle has three nozzle holes.		←	
Injection Pump	DPA-pump: The maximum of fuel injection flow is fixed.		DPK-pump: The maximum of fuel injection flow is controlled automatically. It results the torque-up at low engine speed and starting performance up.	
	High pressure air venting device is not installed.		High pressure air venting device is installed.	
Oil Pump	34 ℓ/min. (9.0 U.S. gal/min, 7.5 Imp.gal/min) (Engine speed at 2400 rpm)		48 ℓ/min. (12.7 U.S. gal/min, 10.6 Imp.gal/min) (Engine speed at 2400 rpm)	
Water Pump	160 ℓ/min. (42.3 U.S. gal/min, 35.2 Imp.gal/min) (Engine speed at 2400 rpm)		200 ℓ/min. (52.8 U.S. gal/min, 44 Imp.gal/min) (Engine speed at 2400 rpm)	

■ **NOTE**

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

[2] ENGINE BODY

(1) Cylinder Block

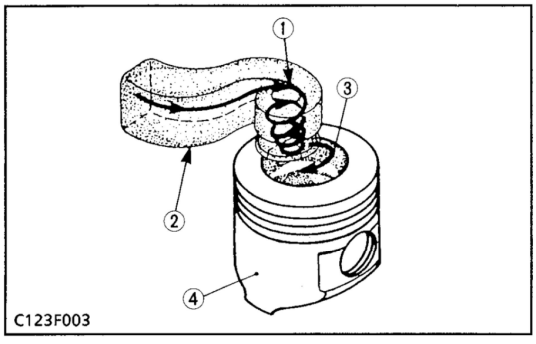

C044F010

The cylinder block is made of cast iron, containing dry liners.

The crankshaft is supported by the crankshaft bearings and the bearing cases.

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

(2) Cylinder Head



C123F003

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

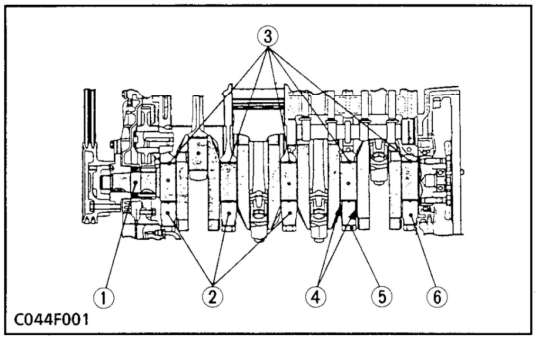
The cylinder head, in which injection nozzles and glow plugs are installed, has the air intake ports, gas exhaust ports and water jacket surrounding the valve system.

The intake port of a cylinder head is made to have helical shape which accounts for forcing to create swirl of intake air.

The V4702-T has a mark **"HT"** on the cylinder head to discriminate against the V4702

(1) Swirls
(2) Intake Port
(3) Cavity
(4) Piston

(3) Crankshaft and Bearings



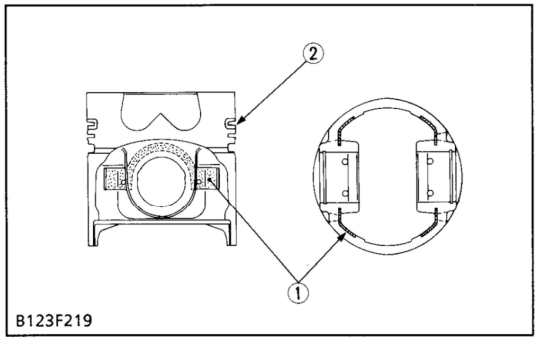
C044F001

The crankshaft is a chrominum-molybdenum steel forging. Its journals, pins and oil seal sliding surfaces are induction hardened to increase wear resistance.

The crankshaft journal is supported by the main bearing case having a bearing inside. At the both sides of the forth main bearing case (5), thrust bearings (4) are installed. The crankshaft bearings and thrust bearings are plated with a special alloy to increase the wear resistance.

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

(4) Piston

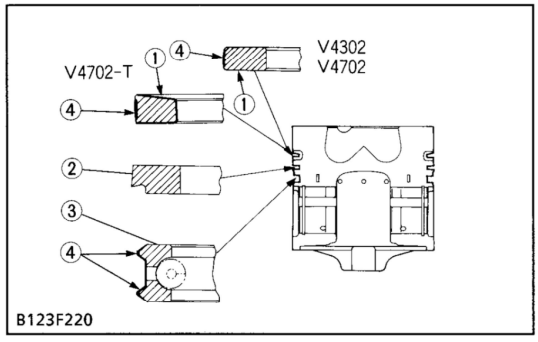


A steel strut has been casted into piston interior to hold down an increase in piston diameter to the utmost and at the same time to lessen a clearance between the piston and the cylinder liner for reducing the noise and wear prevention of a cylinder.

Only the piston of V4702-T are inserted iron alloy inserts on the top ring groove to prevent wear.

(1) Steel Strut
(2) Iron Alloy Insert (Wear resistance) [V4702-T]

(5) Piston Rings



The piston has three piston rings. The top ring is the compression one and the bottom is the oil ring.

The top ring is plain (Key stone for V4702-T) and of a round (barrel) shape which fits snugly on the sliding surface of the cylinder wall.

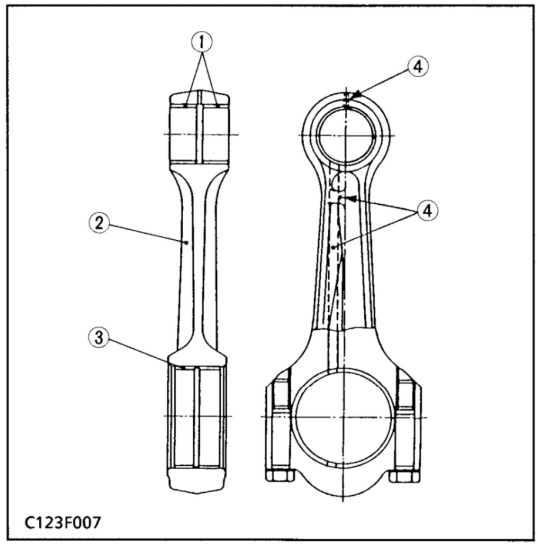
The second ring is undercut to effectively prevent oil from rising on the cylinder wall.

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

The top ring and oil ring are plated with hard chrome to increase wear resistance.

(1) Top Ring
(2) Second Ring
(3) Oil Ring
(4) Chrome Plating

(6) Connecting Rod

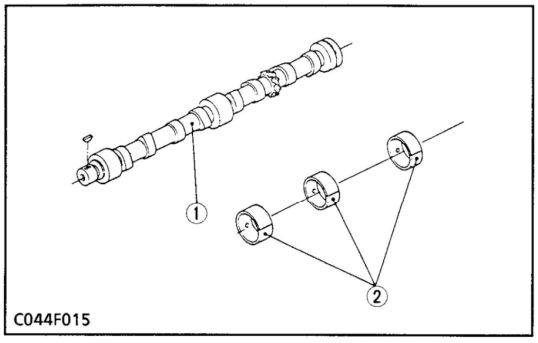


The big end of a connecting rod divided diagonally up to now has been changed to be divided horizontally.

Lubrication of the small end of a connecting rod and cooling of a piston are carried out by oil which passes through an oil hole led from the big end to the small end and then a tiny hole on the small end in the same way as before.

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

(7) Camshaft

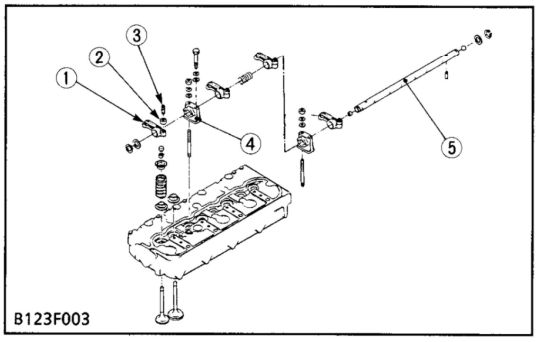


The camshaft (1) is made of special cast iron and its journal and cams are induction hardened to increase wear resistance and on its middle portion, has a screw gear machined integrally with it for driving the gear pump.

The journals and their bushings are force-lubricated.

(1) Camshaft
(2) Camshaft Bushing

(8) Rocker Arm Assembly

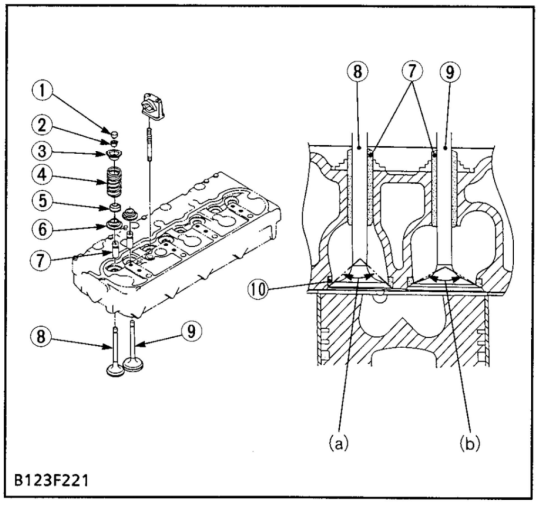


The rocker arm assembly includes the rocker arms (1) and an adjusting screw (3), which is at the end of rocker arm and rests on the push rod, rocker arm brackets (4) and rocker arm shaft (5). The rocker arms are activated by the reciprocating motion of the push rods and open or close the intake and exhaust valves.

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

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

(9) Intake and Exhaust Valves



The intake valve (9) is different from the exhaust valve (8). Other parts, such as the valve guides (7), valve washers (6), valve stem seals (only V4702-T) (5), springs (4), spring retainers (3), valve spring collets (2), and valve caps (1) are the same for both the intake and the exhaust.

The intake valve (9) are not provided with shroud which generates appropriate swirls of intake air. Because, the intake port of a cylinder head is made to have helical shape to create swirl of intake air.

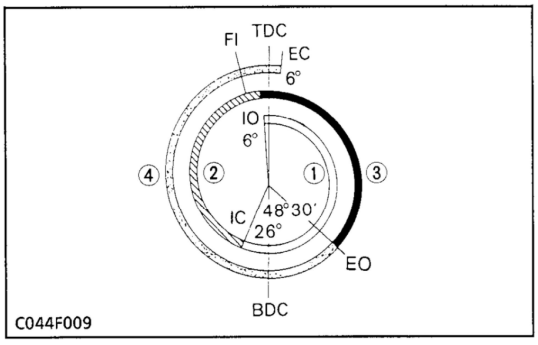
The face angle of an intake valve is increased from 0.79 rad. (45.5°) to 1.106 rad. (60.5°) and the valve lift is also increased to engage intake air volume and to improve the intake efficiency.

A valve seat (10) is inserted into the cylinder head.

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

(a) 1.57 rad. (90°)
(b) 2.09 rad. (120°)

(10) Valve Timing

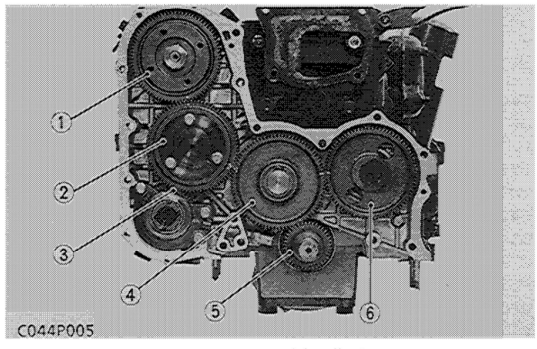


(1) Suction
(2) Compression
(3) Combustion
(4) Exhaust

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

Intake valve open (I.O.)		0.1047 rad. (6°) before T.D.C.
Intake valve close (I.C.)		0.4536 rad. (26°) after B.D.C.
Exhaust valve open (E.O.)		0.8461 rad. (48°30') before B.D.C.
Exhaust valve close (E.C.)		0.1047 rad. (6°) after T.D.C.
Fuel injection (F.I.)	V4302 V4702	0.2094 rad. (12°) before T.D.C.
	V4702-T	0.3141 rad. (18°) before T.D.C.

(11) Timing Gears

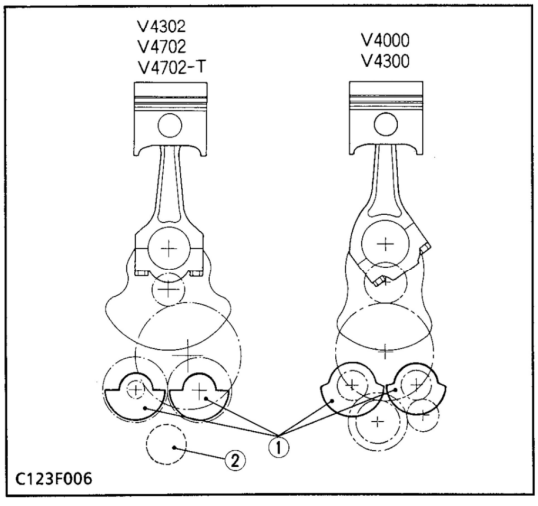


(1) Injection Pump Gear
(2) Fuel Pump Gear
(3) Hydraulic Pump Drive Gear
(4) Idle Gear
(5) Crank Gear
(6) Cam Gear

The timing gears transmit torque from the crankshaft to the hydraulic pump and the injection pump and, at the same time, correctly control fuel injection to the cylinders and valve timing.

Each gear has a alignment mark for correct and easy assembly and is spherical with teeth set obliquely to the axis of rotation to rotates smoothly and reduce noise.

(12) Weight Balancer

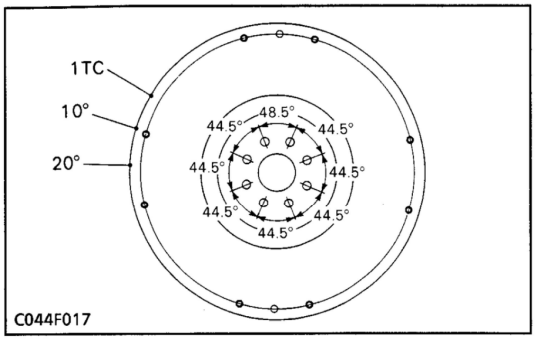


The four cylinders V4000 and V4300 are fitted with the double shaft balance weights on their lower part to absorb the second inertia and to reduce vibration.

These V4302, V4702 and V4702-T are fitted with the direct drive type balance weights on it. It results that 4 wheel drive propeller shaft can be passed through the oil pan to get the high crop clearance.

(1) Balancer
(2) 4 Wheel Drive Propeller Shaft

(13) Flywheel



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 gear teeth on its outer rim, which mesh with the drive pinion of the starter.

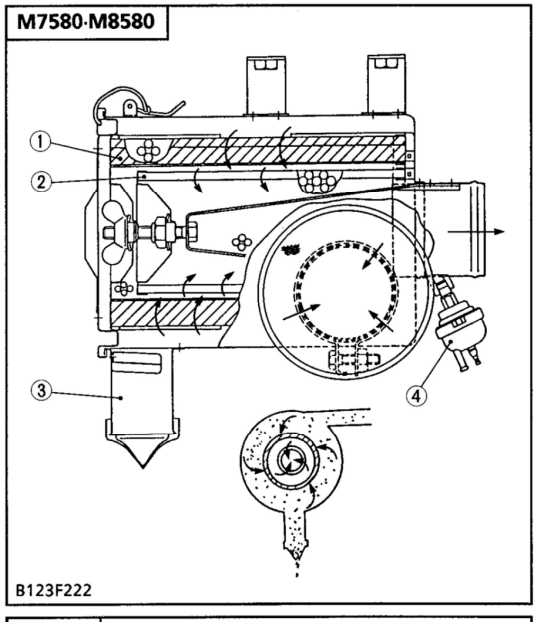
The flywheel has also marks **1TC**, 10° or 20° on its outer rim. The mark **1TC** shows the first piston's top dead center and the marks 10° and 20° show the angle on the flywheel, when they are aligned with the timing plate. The fuel injection timing is set to 0.2094 rad. (12°) (M9580 0.3141 rad. (18°)) before T.D.C.

(Reference)

	Four cylinders
Injection Order	1→3→4→2

(14) Air Cleaner

M7580·M8580



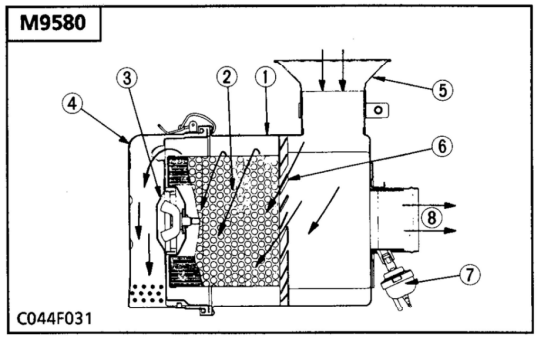
The air cleaner is of a dry type with a centrifugal cyclone, consisting of a dual structure element. This air cleaner is characterized in that sand and a relatively large dust sucked with air are put into one evacuator (3), and this valve is opened and closed with intake air pulsation caused in the compression, explosion and exhaust process, thereby discharging dust automatically. Therefore, maintenance intervals are longer than those for conventional one.

In addition to the above, this air cleaner is provided with servicing indicator (4) so as to check that element servicing (cleaning and replacement) is required since ventilation resistance increases if the element becomes clogged.

Dust or dirt flows spirally inside main unit with respect to the air cleaner main unit, entering the evacuator. Air free from dust or dirt passes through elements (1), (2), and flows into the inlet manifold after filtration and cleaning.

(1) Outer Element
(2) Inner Element
(3) Evacuator
(4) Service Indicator

M9580

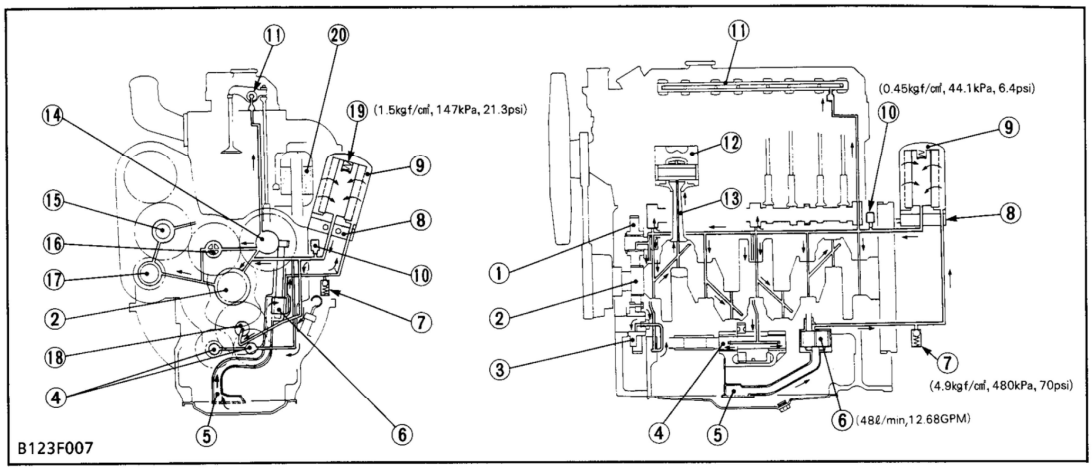


The air cleaner is of a dry type with a centrifugal cyclone. Sucked air is caused to flow in a whirling way with fins (6), gets relatively large dust in it to accumulate in dust pan (4) and minute dust to be removed with element (2). The cleaned air flows toward the inlet manifold. If the element is clogged, flow resistance increases. To indicate this, an air cleaner indicator (7) is provided, whereby the necessity of servicing (cleaning, replacement) can be known.

(1) Body
(2) Element
(3) Baffle Cover
(4) Dust Pan
(5) Cap
(6) Fin
(7) Air Cleaner Indicator
(8) To Inlet Manifold

[3] LUBRICATING SYSTEM

(1) Lubricating Oil Flow

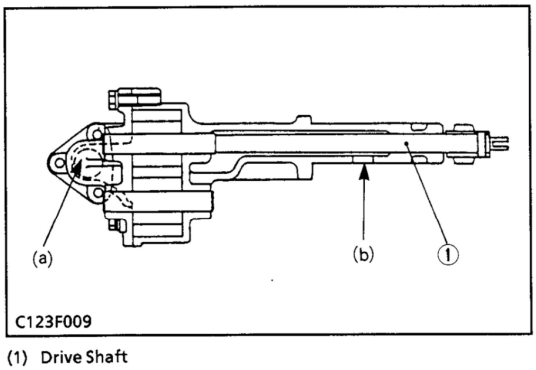


(1) Idle Gear 1
(2) Crankshaft
(3) Idle Gear 2
(4) Balancer Shaft
(5) Oil Strainer
(6) Oil Pump
(7) Relief Valve
(8) Oil Cooler (Except M7580)
(9) Oil Filter
(10) Oil Pressure Switch
(11) Rocker Arm Shaft
(12) Piston
(13) Connecting Rod
(14) Camshaft
(15) Fuel Pump Gear Shaft
(16) Idle Gear Shaft 1
(17) Hydraulic Pump Gear Shaft
(18) Idle Gear Shaft 2
(19) By-pass Valve
(20) Breather

The lubricating system consists of an oil pump (6), oil strainer (5), oil filter (9) (cartridge type), relief valve (7), oil pressure switch (10) and etc. The oil pump is driven by the oil pump drive gear on the camshaft (14). Engine oil in the oil pan is sucked in by the oil pump (6) through oil strainer (5) where it is pressurized and discharged to oil filter. There, the tiny impurities in the engine oil has been further filtered out before it passes through the oil gallery (oil line in the crankcase).

Then, the oil is force-fed to crankshaft (2), connecting rods (13), idle gear 1, 2 (1) (3), camshaft (14) and rocker arm shaft (11) to lubricate each part. Some part of oil, splashed by the crankshaft or leaking and dropping from gaps of each part, lubricates the following parts: pistons (12), cylinders, small ends of connecting rods (13), tappets, push rods, intake and exhaust valves and timing gears.

(2) Oil Pump



(1) Drive Shaft

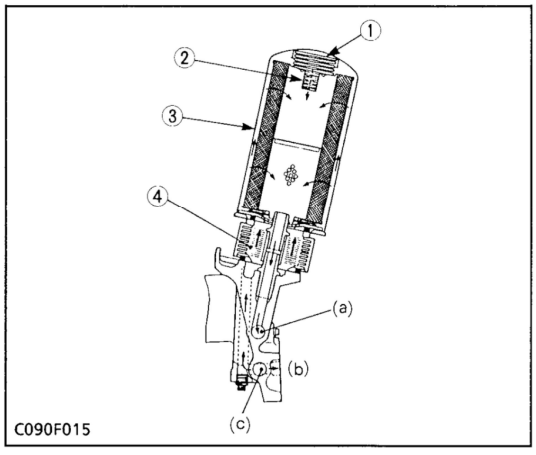
(a) From oil filter 1 **(b) To oil filter 2**

The oil pump is a gear pump that consists of a pump cover, a pump body and two spur gears (drive and driven gears) engaging in the body, and is driven by the oil pump drive gear on the camshaft.

By changing its direction of rotation with a screw gear, the camshaft operates the oil pump drive gear via the drive shaft (1). Then, the driven gear meshed with the drive gear rotates in the opposite direction and oil in the oil pump inlet is carried through to the outlet between the body and the gears, leaving a negative pressure at the inlet. This negative pressure sucks oil from the oil pan.

The delivery of an oil pump has been increased from 34 ℓ/min. (8.98 U.S. gal/min., 7.48 Imp. gal/min.) (in 115 mm stroke engine having 2,400 rpm available up to now) to 48 ℓ/min. (12.68 U.S. gal/min., 10.56 Imp. gal/min.) (in this engine having 2,400 rpm).

(3) Oil Filter (Cartridge type)



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

The lubricating oil, which is force-fed by the pump, is filtered by the filter cartridge with the filter element (3).

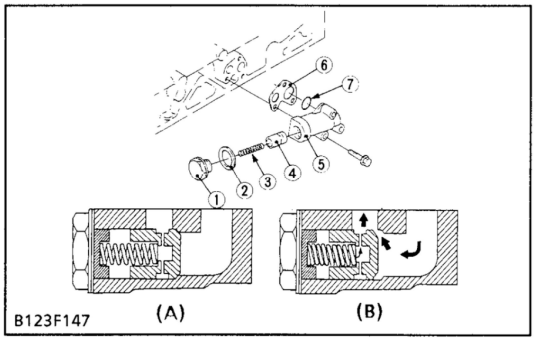
When the filter element accumulates on excessive amount of dirt and the oil pressure in the inlet line builds up by 147 kPa (1.5 kgf/cm^2, 21.3 psi) move than the outlet line, the by-pass valve (1) opens to allow the oil to flow from the inlet into the outlet line, by-passing the filter element.

The water cooled oil cooler is installed between the filter and engine crank case. (Except M7580)

(a) To oil gallery
(b) To relief valve
(c) From oil pump

(1) By-pass Valve
(2) By-pass Adjusting Spring
(3) Filter Element
(4) Oil Cooler

(4) Relief Valve



The relief valve in the inlet line allows oil to flow into the oil pan to prevent damage to the lubricating system, when the oil pressure rises more than 441 to 520 kPa (4.5 to 5.3 kgf/cm^2, 64.0 to 75.4 psi).

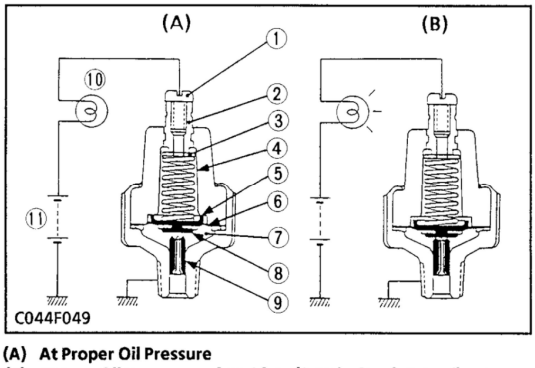
The relief valve consists of a valve (4), a coil spring (3) pressuring the valve, relief valve bodies (1) and (5), and a gasket (2) and is installed halfway above the oil line.

When the right quantity of oil is supplied, the by-pass is closed by coil spring (3) and valve (4). However, in excessive quantities, force-fed oil pressure rises gradually and finally defeats the spring pressure, opening valve (4) and returning excessive oil to the oil pan through the by-pass.

(A) In Normal Times
(B) Activated

(1) Relief Valve Body 2
(2) Gasket
(3) Spring
(4) Valve
(5) Relief Valve Body 1
(6) Gasket
(7) O-ring

(5) Oil Pressure Switch



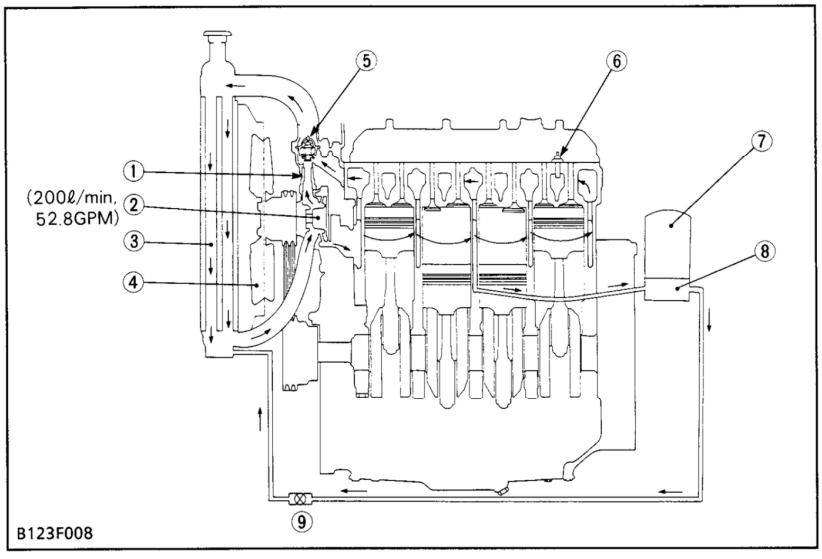
(A) At Proper Oil Pressure
(B) At Low Oil Pressures of 44.1 kPa (0.45 kgf/cm^2, 6.4 psi) or Less

The oil pressure switch is installed on the cylinder block to detect reduced oil pressure in the lubricating system. If oil pressure falls below 44.1 kPa (0.45 kgf/cm^2, 6.4 psi), a bulb connected to the switch lights up, cautioning the operator. In this case, the engine must be stopped immediately and diagnosed the cause of oil reducing repaired. At oil pressures above 44.1 kPa (0.45 kgf/cm^2, 6.4 psi), the force acting on oil seat (7) overcomes that of the spring, separating contact rivet (8) on oil seat (7) form contact (9). At pressures of 44.1 kPa (0.45 kgf/cm^2, 6.4 psi), or less, contact rivet (8) is touched contact (9).

(1) Screw
(2) Terminal
(3) Spring Plate
(4) Insulator
(5) Spring Retainer
(6) Rubber Gasket
(7) Oil Seat
(8) Contact Rivet
(9) Contact
(10) Bulb
(11) Battery

[4] COOLING SYSTEM

(1) Cooling Water Flow



(1) By-pass Pipe
(2) Water Pump
(3) Radiator
(4) Cooling Fan
(5) Thermostat
(6) Water Temperature Sensor
(7) Oil Filter
(8) Oil Cooler
(9) Drain Cock

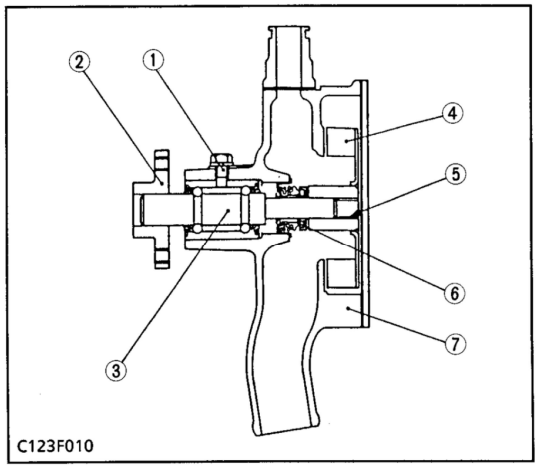
The cooling system is of forced-circulation cooling type used an impeller type centrifugal water pump (2). The system consists of a radiator (3), a centrifugal water pump (2), a cooling fan (4) and a thermostat (5). The water is cooled as it flows through the radiator core, and the fan behind the radiator pulls the cooling air through the core. The water pump receives water from the radiator or from the cylinder head and forces 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 closes to flow the water only to the water pump.

The opening temperature of the thermostat is approx. 79 °C (174 °F).

A port of cooling water flows to the oil cooler (8), which is set under the oil filter (7), to cool engine oil. And the drain cock (9) for draining cooling water is located between the oil cooler and radiator.

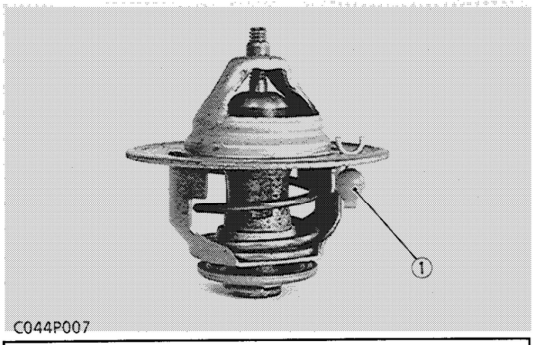
(2) Water Pump



The delivery of a water pump has been increased from 160 ℓ/min. (42.3 U.S. gal/min., 35.2 Imp. gal/min.) (at 2400 rpm engine speed) to 200 ℓ/min. (52.8 U.S. gal/min., 44.0 Imp.gal/min.) (at same speed). Besides, the pump shaft and bearings that had been individual parts are made to be an integral bearing unit (3). This unit is fixed with a setting screw (1).

(1) Setting Screw
(2) Pulley Flange
(3) Bearing Unit
(4) Impeller
(5) Screw Thread for Drawing-out Impeller
(6) Mechanical Seal
(7) Body

(3) Thermostat



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

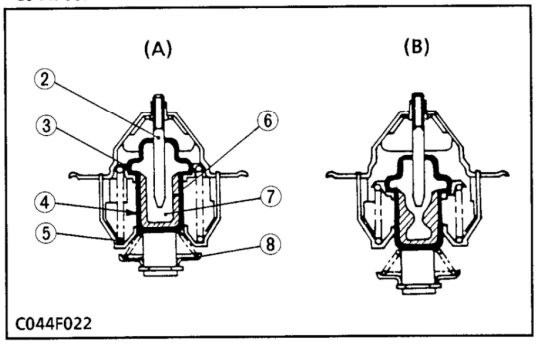
The case has a seat and the pellet has a valve (3). The spindle attached to the case is inserted into the synthetic rubber in the pellet. The pellet is charged with was.

(A) At Low Temperature (lower than 79 °C (173 °F)

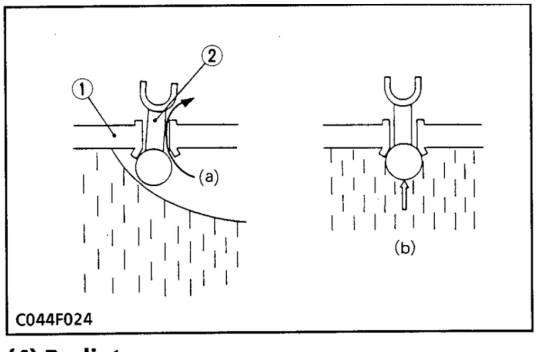
The valve (3) is seated by the spring (5) and the cooling water circulates in the engine through the water return pipe, but does not enter the radiator.

(B) At High Temperature (higher than 79 °C (173 °F)

As the water temperature rises, the wax in the pellet (4) turns liquid and expands, repelling the spindle, which causes the pellet to lower. The valve (3) is opened to send the cooling water to the radiator.



(1) Jiggle Valve
(2) Spindle
(3) Valve
(4) Pellet
(5) Spring
(6) Wax
(7) Synthetic Rubber
(8) By-pass Valve



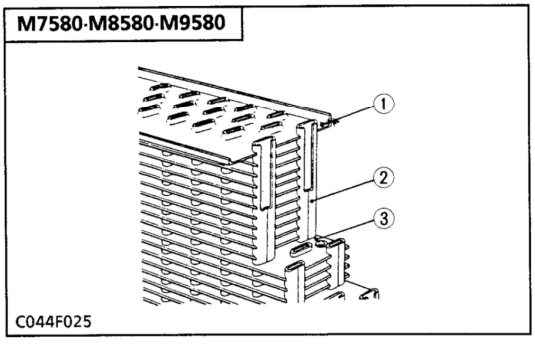
■ Jiggle Valve

The jiggle valve (2) is mounted on the thermostat to prevent air from remaining in the circulating system. If air remains in the circulating system, it flows out through the vent which is opened by gravity. When no air remains, the valve is pressed against the seat by cooling water pressure which closes the vent.

(a) Air
(b) Cooling water
(1) Thermostat Housing
(2) Jiggle Valve

(4) Radiator

M7580·M8580·M9580

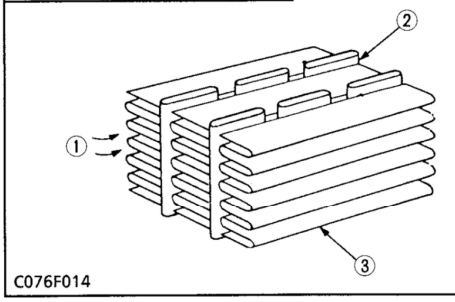


The radiator is of a plate fine type which is durable and resistant to pressure, and has good heat transfer properties. As it passes through the radiator core, cooling water is cooled by air from outside, and is circulated again to the engine body by the water pump.

The radiator core consists of water carrying tubes (2) with fins (3) at a right angle to it. Both of the components are formed of thin copper plate, etc. which gives good heat transfer. Cooling air passed between the fins helps cooling water in the tube to give off heat.

(1) Top Header
(2) Water Carrying Tube
(3) Fin

M9580 (Serial No. ~ 60079)



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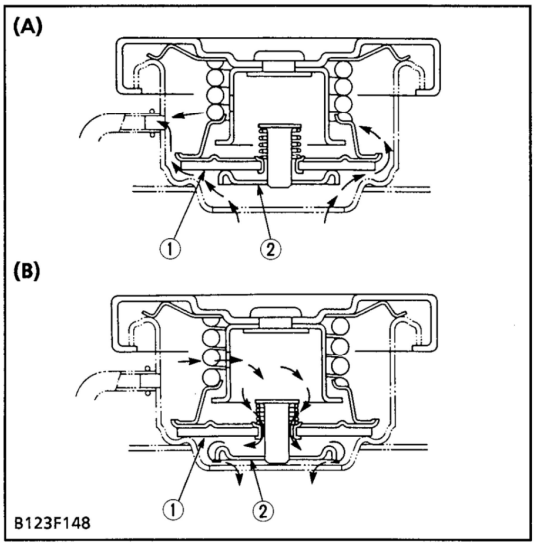
The radiator core consists of water carrying tubes (2) with fins (3) at a right angle to it.

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.

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

(5) Radiator Cap



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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 88 kPa (0.9 kgf/cm², 13 psi))

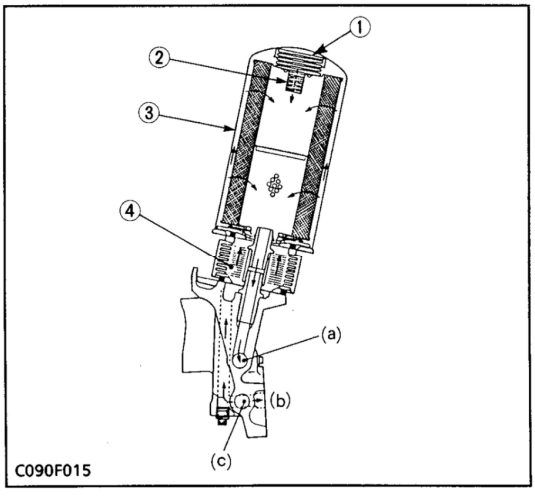
When the water temperature rises and the pressure in the radiator increases above the specified pressure, the pressure valve (1) is opened to reduce the internal pressure.

(B) At Low Pressure

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

(1) Pressure Valve
(2) Vacuum Valve

(6) Oil Cooler (Except M7580)



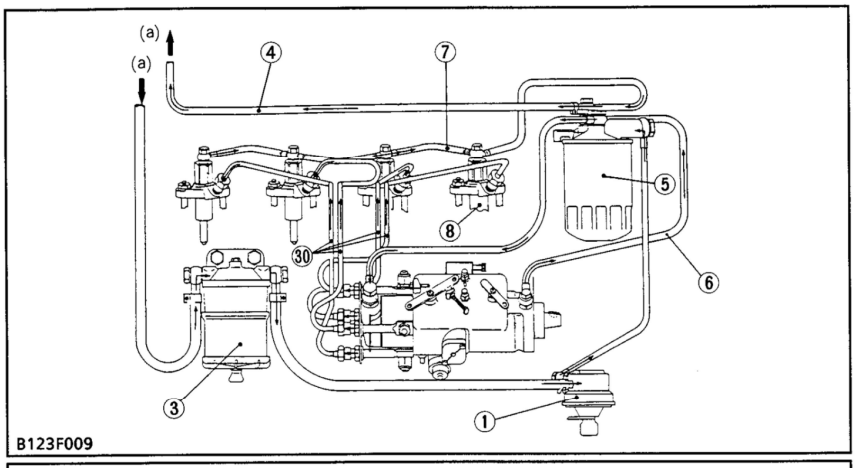
C090F015

Engine oil passes the oil cooler (4) before entering the oil filter (3). This oil cooler is water-cooled type and cools engine oil by the cooling water from the radiator.

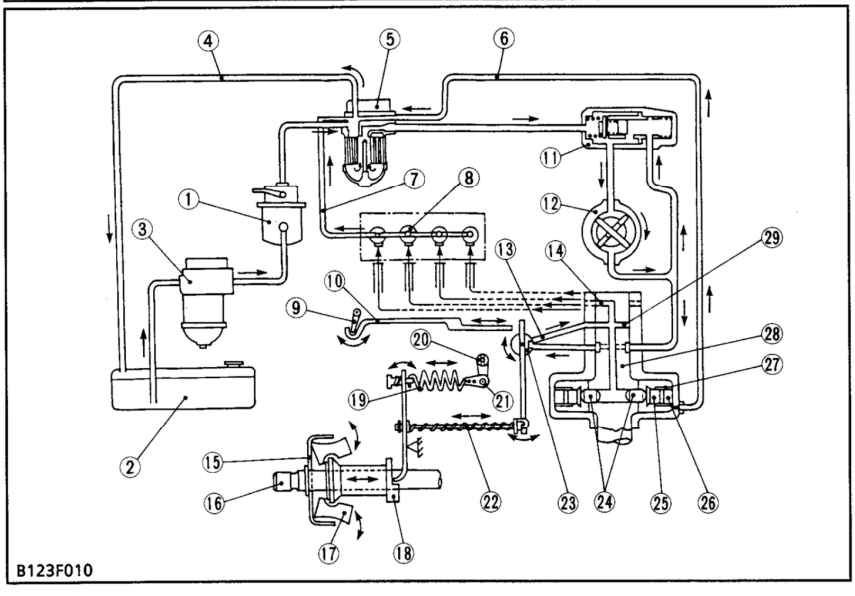
(1) By-pass Valve
(2) By-pass Adjusting Spring
(3) Filter Element
(4) Oil Cooler
(a) To oil gallery
(b) To relief valve
(c) From oil pump

[5] FUEL SYSTEM

(1) Fuel Flow



B123F009



B123F010

(1) Fuel Feed Pump
(2) Fuel Tank
(3) Sedimenter
(4) Return Line
(5) Fuel Filter
(6) Return Pipe
(7) Return Line
(8) Injection Nozzle
(9) Shut-off Lever
(10) Shut-off Bar
(11) Regulating Valve
(12) Transfer Pump
(13) Metering Port
(14) Distributor Port
(15) Weights Retainer
(16) Drive Shaft
(17) Governor Weight
(18) Thrust Sleeve
(19) Control Spring
(20) Throttle Arm
(21) Throttle Arm
(22) Link Arm
(23) Metering Valve
(24) Plungers
(25) Roller Shoe
(26) Cam Ring
(27) Scroll Plate
(28) Rotor
(29) Inlet Port
(30) Injection Pipe

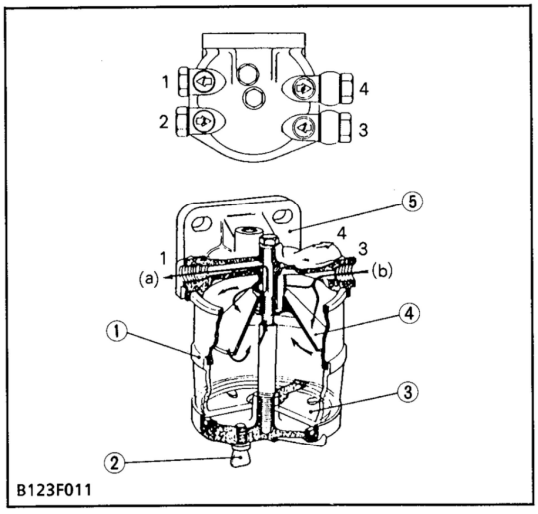
(a) To / From fuel tank

Fuel is drawn from the tank (2) by the feed pump (1), driven by the engine and provided with a manual priming device. Fuel enters the sedimenter (3) provided with a water drain bowl and then the fuel filter (5) at feed pressure; air bubbles, if any, are eliminated through the return line (4). The clean fuel reaches now the sliding vane pump (12) (transfer pump) The function of the transfer pump is to raise the pressure further; this pressure, through the action of the regulating valve (11), rises practically in direct ratio with the engine revolution.

Another function of the valve (11) is to provide means of by-passing the transfer pump during the phase of fuel priming. The fuel leaving the transfer pump reaches the metering valve (23) which regulates the fuel flow which enters the rotor through the metering port (13). The metering valve is controlled by the speed governor, the functions of which are described later.

During the feeding phase fuel flows in the rotor through the inlet ports (29) which are equally spaced and as many as there are engine cylinders. These ports register with a fuel passage which on one side conveys the fuel to the plungers (24) and on the other to the distributor port (14) which delivers the fuel to the injection nozzles (8). A return line (7) collects the fuel leaks at the injection nozzles and conveys it back to the fuel tank. The pipe (6) conveys the excessive flow of fuel back from pump to filter.

(2) Sedimenter

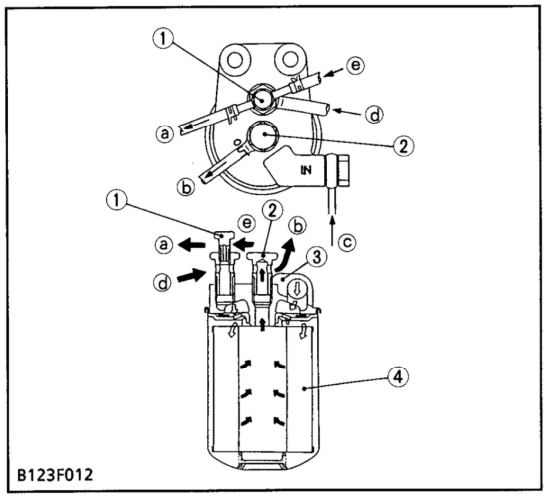


Fuel entering through the inlet connections (2 or 3) flows over and around the conical section, which acts as a diffuser of the fuel flow, and passes through a narrow gap around the periphery. It then flows radially towards the center and out via the outlet connections (1 or 4). During this period of radial flow, water and the heavier abrasive particles are separated out by gravity and are settled into the collecting bowl. No. 1 and 3 of these connections are used for the fuel system of this tractor.

The sedimenter mainly removes all large droplets of water and solid particles from fuel.

(1) Transparent Bowl
(2) Drain Plug
(3) Sedimenter Chamber
(4) Conical Diffuser
(5) Sedimenter Head
(a) Out
(b) In

(3) Fuel Filter

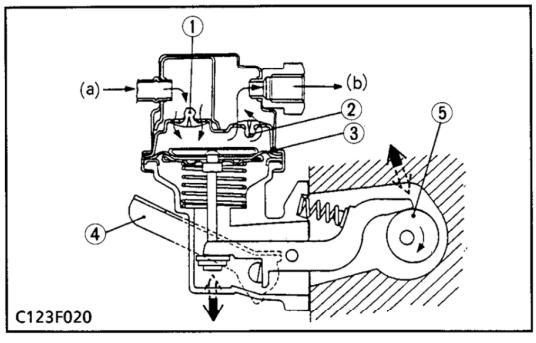


Fuel entering through the inlet connection **IN** (c) flows out through **OUT**. The excessive fuel supplied to the injection pump is again fed into the filter through the connection (d). The vent (1) is an air vent.

The paper filter element (4) is so constructed that fuel passing through it is throttled once at its lower end. Because of this structure, when fuel containing water has passed through the element, water falls in large drops from the throttling end and settles down on base, and particles remain in the paper element.

(1) Vent
(2) Eye Joint Bolt
(3) Filter Head
(4) Paper Element
(a) To tank
(b) To injection pump
(c) From fuel feed pump
(d) From injection pump
(e) From injection nozzle

(4) Fuel Feed Pump

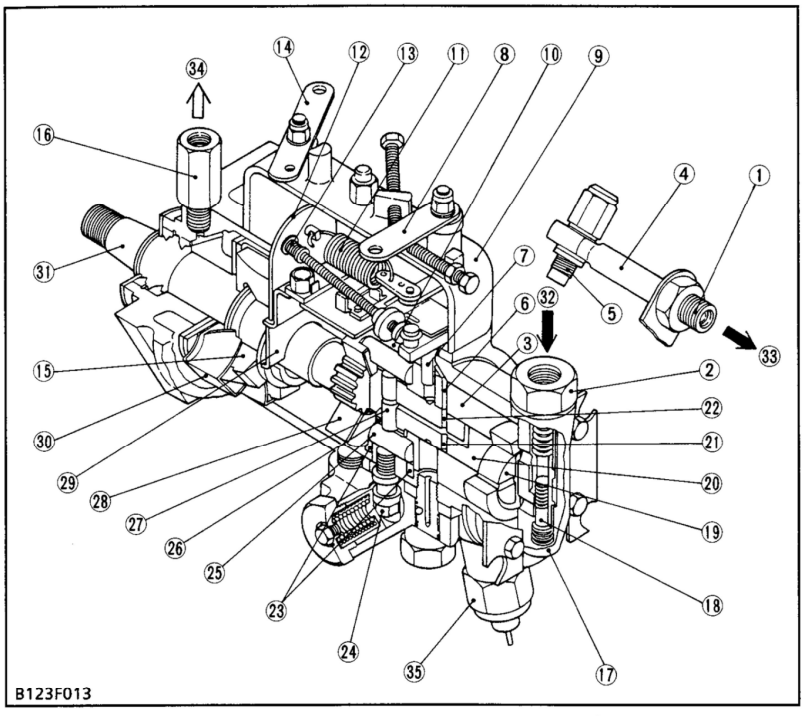


Generally, an injection pump can supply itself with fuel only to a small content, but it requires another pump to feed it from the tank. Therefore fuel is fed to the injection pump by the fuel feed pump.

➡ **Intake Stroke** ⇢ **Discharge Stroke**

(a) Fuel from the fuel tank
(b) Fuel to the fuel filter
(1) Suction Valve
(2) Discharge Valve
(3) Diaphragm
(4) Lever for Hand Priming
(5) Fuel Cam

(5) Fuel Injection Pump



(1) Banjo Bolt
(2) Fuel Inlet Connection
(3) Pump Body
(4) Hydraulic Head
(5) Outlet Port
(6) Inlet Port
(7) Metering Valve
(8) Throttle Arm
(9) Governor Cover
(10) Cam Ring
(11) Governor Spring
(12) Governor Arm
(13) Governor Link
(14) Shut-off Lever
(15) Governor Weight
(16) Non-return Valve
(17) End Plate
(18) Regulating Valve
(19) Transfer Pump
(20) Rotor
(21) Distributor Port
(22) Inlet Port
(23) Scroll Plate
(24) Cam Advance Screw
(25) Roller
(26) Roller Shoe
(27) Plungers
(28) Splined Drive Plate
(29) Thrust Sleeve
(30) Weights Retainer
(31) Drive Shaft
(32) Fuel Inlet (From Filter)
(33) High Pressure Fuel Outlet (to Injection Nozzles)
(34) Excess Fuel (Returning to Filter)
(35) Fuel Cut-off Solenoid

SDPK distributor type fuel injection pump, made by CAV, forms a compact unit. It is relatively simple in design and contains no ball or roller bearings, gear or highly stressed springs. The number of working parts remains the same regardless of the number of engine cylinders. The pump is required to serve. The pump embodies a mechanical fly-weight, all-speed governor and an automatic advance mechanism.

The pump housing is completely filled with fuel oil under pressure so that all parts are adequately lubricated and cooled, airlocks are prevented and so is the ingress of dust, water or other foreign matter.

The employment of a single pumping element ensures uniformity of delivery to each of the engine cylinders and obviates the need to balance the deliveries to each injection nozzle.

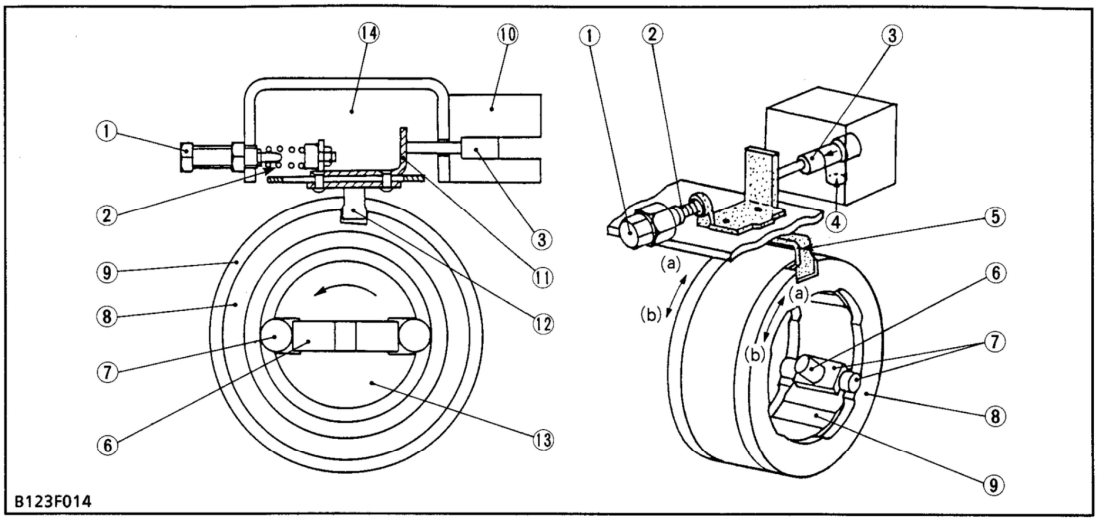
The torque performance of SDPK distributor type is better than that of DPA type, which is used for D3000 and V4300, specially under the low engine speed. Main modification items are as follows.

(1) Automatic advance and delay device
The automatic advance device only is available for D3200 and V4000, but automatic advance and delay device is available for V4302, V4702 and V4702-T. As a result, the starting performance at cold is much better.

(2) High pressure air venting device
The air venting device is mounted on V4302, V4702 and V4702-T to bleed easily air in a plunger.

(3) Adjustable maximum fuel injected amount
The maximum fuel injected amount of DPA is not adjustable, but that of DPK is adjusted automatically. (Except SDPK Type)

■ Maximum Fuel Adjustment (DPK Type)



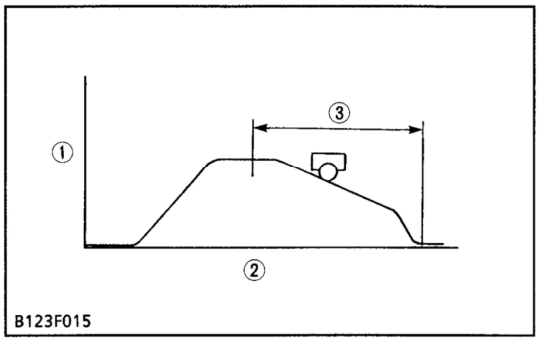
(1) Torque Screw
(2) Torque Spring
(3) Piston
(4) Transfer Pressure
(5) Scroll Plate Link
(6) Plunger
(7) Cam Roller
(8) Scroll Plate
(9) Cam Ring
(10) Control Block
(11) Slide Plate
(12) Scroll Plate Link
(13) Rotor
(14) Cam Box

(a) When engine revolution is decreased

(b) When engine revolution is increased

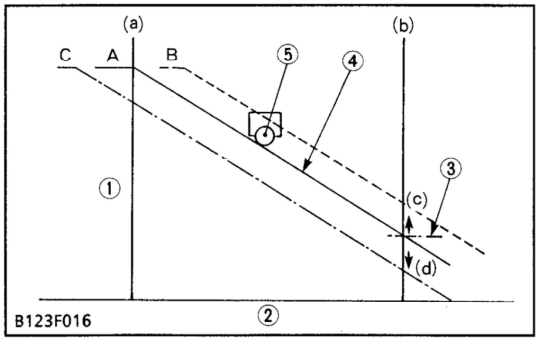
The upper figure shows fuel adjustment mechanism.

The maximum fuel setting is made by limiting the outwards movement of the pumping plungers (6) by a pair of scroll plate (8). The scroll plates are a internal cam and have the same number of lobes as the cam ring (9).



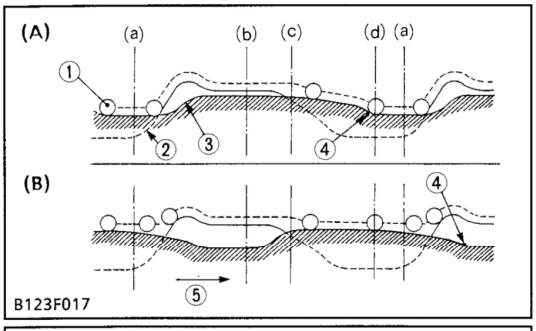
- **Lift Curve of Scroll Plate**
  The left figure shows the principle of fuel adjustment by the scroll plates. When the hydraulic rotor (13) rotates, the cam roller (7) moves to right hand side. As the inlet port opens, fuel enters the rotor and separates the plungers. The plungers follow to natural filling curve at the initial stage of filling, and cam roller contacts the scroll plate then follows to scroll plate profile.

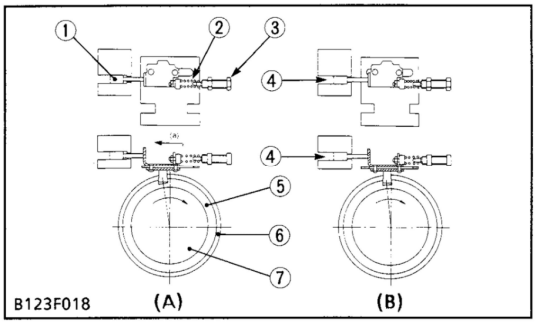
(1) Lift
(2) Angle
(3) Available Sphere

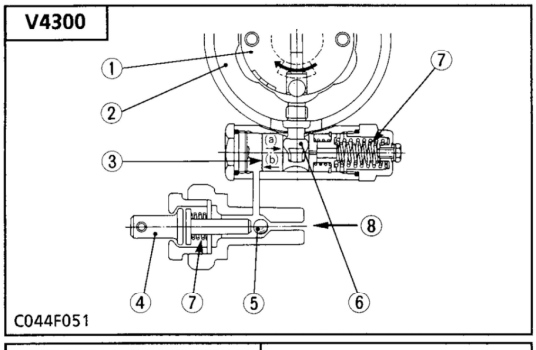


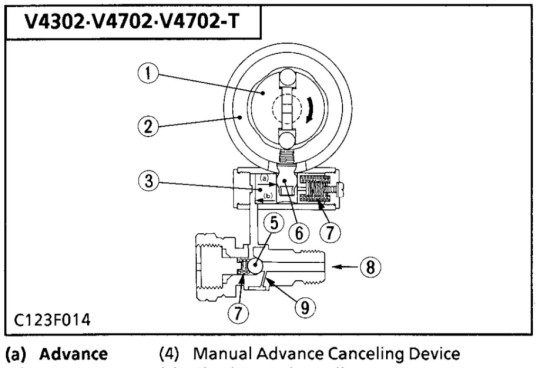
- **Maximum Fuel Adjustment**
  As the rotor rotates further and inlet port closes, then fuel no more enters to the rotor.
  As the scroll plate moves from (A) to (B), fuel delivery decreases, and moves from (A) to (C), fuel delivery increases.

(1) Lift
(2) Pump Rotation Angle
(3) Fuel Delivery
(4) Scroll Plate Lift
(5) Cam Roller
(a) Inlet port opens
(b) Inlet port closes
(c) Decrease
(d) Increase









(a) Advance
(b) Delay

(1) Rotor
(2) Cam Ring
(3) Piston
(4) Manual Advance Canceling Device
(5) Checking Valve Ball
(6) Cam Screw
(7) Spring
(8) Fuel
(9) Orifice

■ Excess Fuel (DPK Type)

- **Schematic Diagram of Scroll and Cam Phasing**

Excess fuel at cranking speed is obtained by controlling the scroll plate position. The figure shows the excess fuel position of the scroll plate and normal fuel position.

(a) Outlet port opens
(b) Outlet port closes
(c) Inlet port opens
(d) Inlet port closes

(A) Excess Fuel Position
(B) Max. Fuel Position

(1) Roller
(2) Cam Profile
(3) Scroll Plate Profile
(4) Beginning of Excess Fuel Position
(5) Pump Rotation

- **Scroll Plate Control Mechanism**

The figure shows one of the scroll plate control mechanism. When engine is at rest or cranking speed, the scroll plate (5) is kept at excess fuel position by the torque spring (2). After engine starts, the transfer pressure (4) is increased, then the transfer pressure pushes the piston (1) against the return spring and scroll plates will be in normal fuel position.

(1) Torque Piston
(2) Torque Spring
(3) Torque Screw
(4) Transfer Pressure
(5) Scroll Plate
(6) Cam Ring
(7) Rotor

(a) Delivery increase

(A) Torque Control Position
(B) Max. Fuel Position

■ Automatic Advance and Delay Device

- **START AT COLD**

To improve the cold starting performance of an engine, it is generally better to set back the injection timing in time of cranking. In the conventional type, the injection timing can be delayed by operating the angle-of-lead remove lever manually to shut off a passage to the angle-of-lead device by pushing the check ball to the passage so that the transfer pressure doesn't act on.

On the other hand, in this pump, this remover lever has been removed, and a hydraulic passage is shut off by a spring and a check ball all the while extending from cranking to just before starting so as to set the angle of lag automatically.

- **AFTER STARTING**

Since a certain time is infallibly needed for fuel to burn, it is desirable to advance the injection timing as the engine RPM raises.

1. Following a rise of engine RPM, the transfer pressure rises to push the check ball to open a passage and to move the angle-of-lead piston to the right as shown in the following figure so that the piston causes the cam ring to move around in the direction (a) of leading the angle. This controls the injection timing in match with engine RPM.
2. As the engine RPM begins to come down, the transfer pressure also drops, and fuel which is pushing the piston comes out of the devices through the orifice. Consequently, the piston moves to the left, and the cam ring moves around in the direction (b) of lagging the angle.