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beml
NEW FRONTIERS. NEW DREAMS

SHOP MANUAL

BS6D125G1

DIESEL GENERATOR

BEML LIMITED

MYSORE, INDIA.

CONTENTS

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended by **beml** and decribed in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed by **beml** for the purpose.

To prevent injury to workers, the symbols and are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

SAFETY

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.

2. When carring out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.

- Always wear safety glasses when hitting parts with a hammer.
- Always wear safety glasses when grinding parts with a grinder, etc.

3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.

4. When carring out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.

5. Keep all tools in good condition and learn the correct way to use them.

6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.

8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.

9. When disassembling or assembling,support machine with blocks, jacks or stands before starting work.

10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out. Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.

12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned. Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

13. Before starting work, remove the leads from the battery. Always remove the lead from the oil or water circuits.negative (-) terminal first.

14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places.
    Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
    Do not work with any part still raised by the hoist or crane.

15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.

16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.

17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.

18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.

19. Be sure to assemble all parts again in their original places.
    Replace any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.

20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.

21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.

23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.

24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjust ments to be made at completion of the checks and repairs.

Troubleshooting charts correlating “Problems” to “Causes” are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your **beml** Regional Office for the latest information.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume : Issued for every machine model
Engine volume : Issued for each engine series.
Electrical volume : } Each issued as one volume to
Attachments volume : } cover all models

These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to **beml** Regional office. Get the most upto-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.

   Example.

   13 - 10
   - 13: Unit number (1. Engine)
   - 13: Item number (2. Testing and Function)
   - 10: Consecutive page number

3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:

REVISED EDITION MARK (① ② ③ ...)

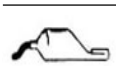
When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

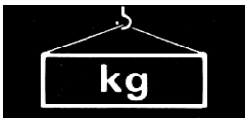
Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

SYMBOLES

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserv ing standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tighten-ing torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS



⚠ Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol 

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
- Check for removal of all bolts fastening the part to the relative parts.
- Check for existence of another part causing interference with the part to be removed.

2. Wire ropes

1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

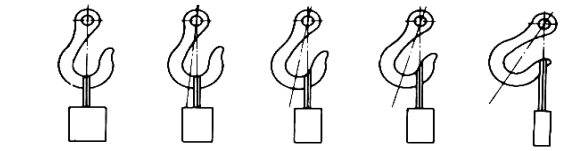
Wire ropes
(Standard "Z" or"S" twist ropes without galvanizing)

Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.
Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result.

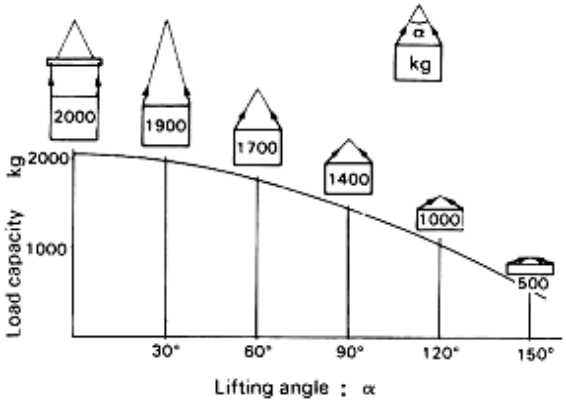
Hooks have maximum strength at the middle portion.

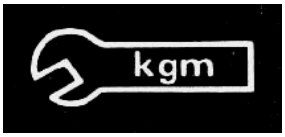


3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.
When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.





STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in section of **"Disassembly and Assembly**

Thread diameter of bolt (mm)	width across flat (mm)	 kgm	 Nm
6	10	1.35±0.15	13.2±1.4
8	13	3.2±0.3	31.4±2.9
10	17	6.7±0.7	65.7±6.8
12	19	11.5±1.0	112±9.8
14	22	18.0±2.0	177±1.9
16	24	28.5±3	279±29
18	27	39±4	383±39
20	30	56±6	549±58
22	32	76±8	745±78
24	36	94.5±10	927±98
27	41	135±15	1320±140
30	46	175±20	1720±190
33	50	225±25	2210±240
36	55	280±30	2750±290
39	60	335±35	3280±340

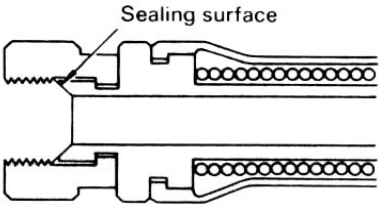
This torque table does not apply to the bolts with which nylon packings or other non-ferrous metals washers are to be used, or which require tightening to otherwise specified torque.

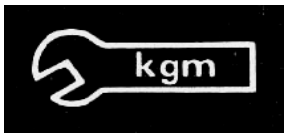
★ **Nm (newton meter): 1 Nm = 0.1 kgm**

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10	14	6.7±0.7	65.7±6.8
12	17	11.5±1	112±9.8
16	22	28.5±3	279±29

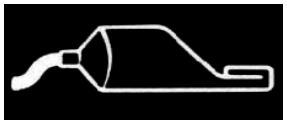




3. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared.

Thread diameter of nut part (mm)	width across flats of nut part (mm)	Tightening torque	
		kgm	Nm
14	19	2.5±0.5	24.5±4.9
18	24	5±2	49±19.6
22	27	8±2	78.5±19.6
24	32	14±3	137.3±29.4
30	36	18±3	176.5±29.4
33	41	20±5	196.1±49
36	46	25±5	245.2±49
42	55	30±5	294.2±49



COATING MATERIALS

The recommended coating materials prescribed in **beml** Shop Manuals are listed below.

Nomenclature	BEML code	Applications
Adhesives	LT-1A	Used to apply rubber pads, rubber gaskets, and cork plugs
	LT-1B	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed
	LT-2*	Preventing bolts, nuts and plugs from loosening and leaking oil.
	LT-3	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
	LT-4	Used to coat plugs (plate shaped, bowl shaped) and holes, and mating portion of shaft.
Sealant gasket	LG-1	Used with gaskets and packings to increase sealing effect.
	LG-3	Heat-resistant gasket for precombustion chambers and exhaust piping.
	LG-4	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 - 0.08 mm)
	LG-5	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
	LG-6	Silicon base type used in combination with LG-1 and LG-4.
	LG-7	Has a shorter curing time than LG-6, and is easier to peel off.
Antifriction compound (Lubricant including molybdenum disulfide)	LM-P	Applied to bearings and taper shafts to facilitate press-fittings and to prevent sticking, burning or rusting.
Grease (Lithium grease)	G2-L1 -	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline		Used for protecting battery electrode terminals from corrosion.

*LT-2 is also called LOCTITE in the shop manuals.

ELECTRIC

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: 5WB indicates a cable having a nominal number 05 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

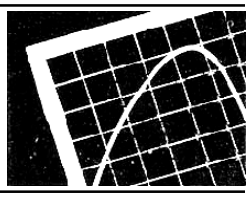
Nominal number strands	Copper Wire			Cable O.D (A)	Current rating	Applicable circuit
	Number (mm)	Dia.of strands (mm^2)	Cross section (mm)			
01	11	0.32	0.88	2.4	12	Starting,lighting,signal etc.
02	26	0.32	2.09	3.1	20	Lighting,signal etc.
05	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

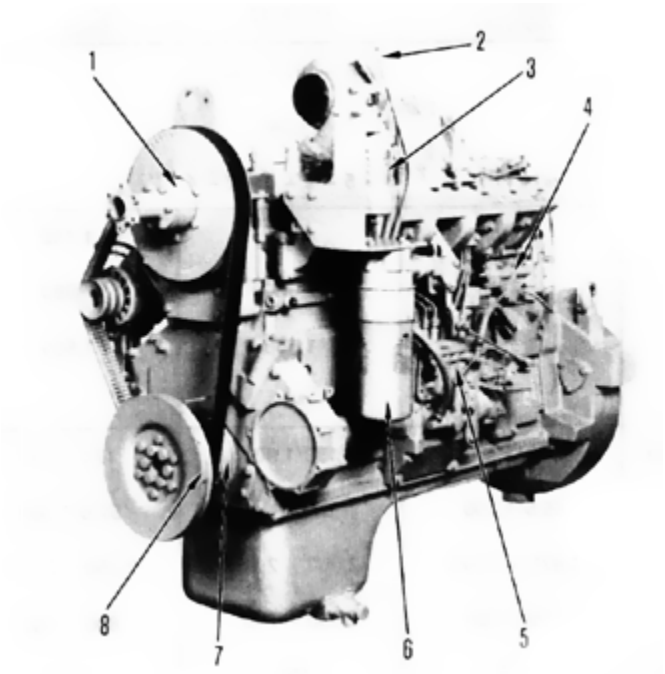
Priority	Classification \ Circuits		Charging	Ground	Starting	Lighting	Instrument	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	-	BW	RW	YR	GW	LW
		Color	White & red	-	Black & White	Red & White	Yellow &Red	Green & White	Blue & White
3		Code	WB	-	BY	RB	YB	GR	LR
		Color	White & Black	-	Black & Yellow	Red & Black	Yellow & Black	Green & Red	Blue & Red
4		Code	WL	-	BR	RY	YG	GY	LY
		Color	White & Blue	-	Black & Red	Red & Yellow	Yellow & Green	Green & Yellow	Blue & Yellow
5		Code	WG	-	-	RG	YL	(GB)	(LB)
		Color	White & Green	-	-	Red & Green	Yellow & Blue	(Green & Black)	(Blue & Black)
6		Code	-	-	-	RL	YW	(GL)	-
		Color	-	-	-	Red & Blue	Yellow & White	(Green & Blue)	-

ENGINE

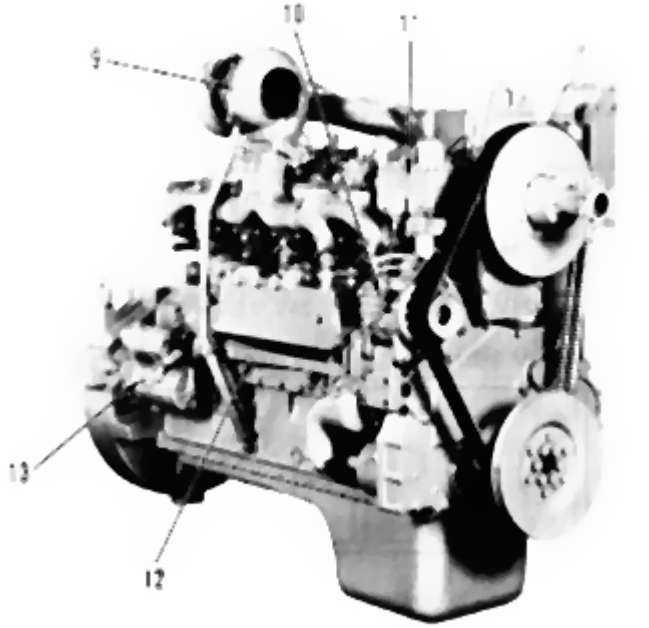
11 GENRAL



GENERAL VIEW BS6D125G1



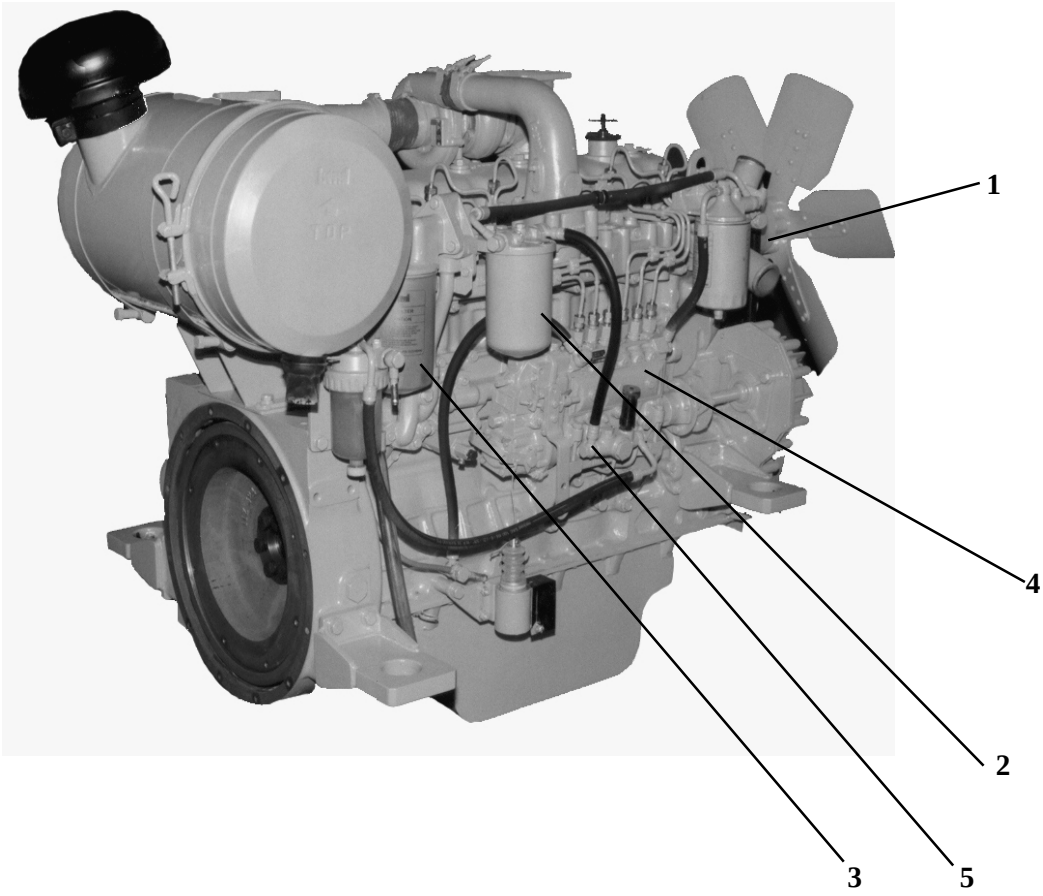
1. Fan pulley
2. Dipstick
3. Fuel filter
4. Adapter
5. Fuel injection pump
6. Oil filter
7. Crankshaft pulley
8. Vibration damper



10. Turbocharger
11. Alternator
12. Oil cooler
13. Starting motor

GENERAL VIEW

BS6D125G1 (PES100 GENSET)

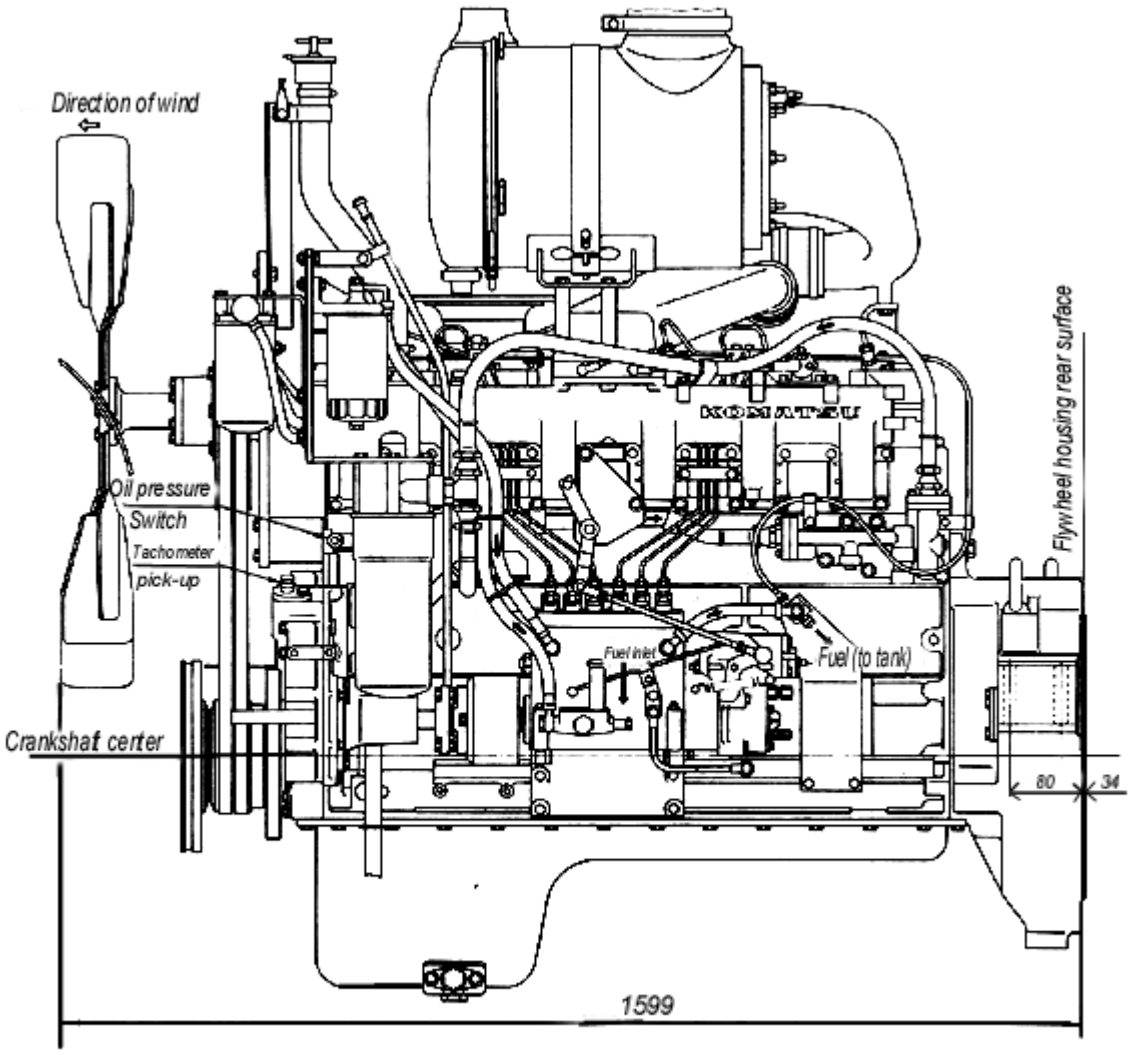


1. Fan pulley
2. Fuel filter
3. Oil filter
4. Fuel injection pump
5. Automatic timer

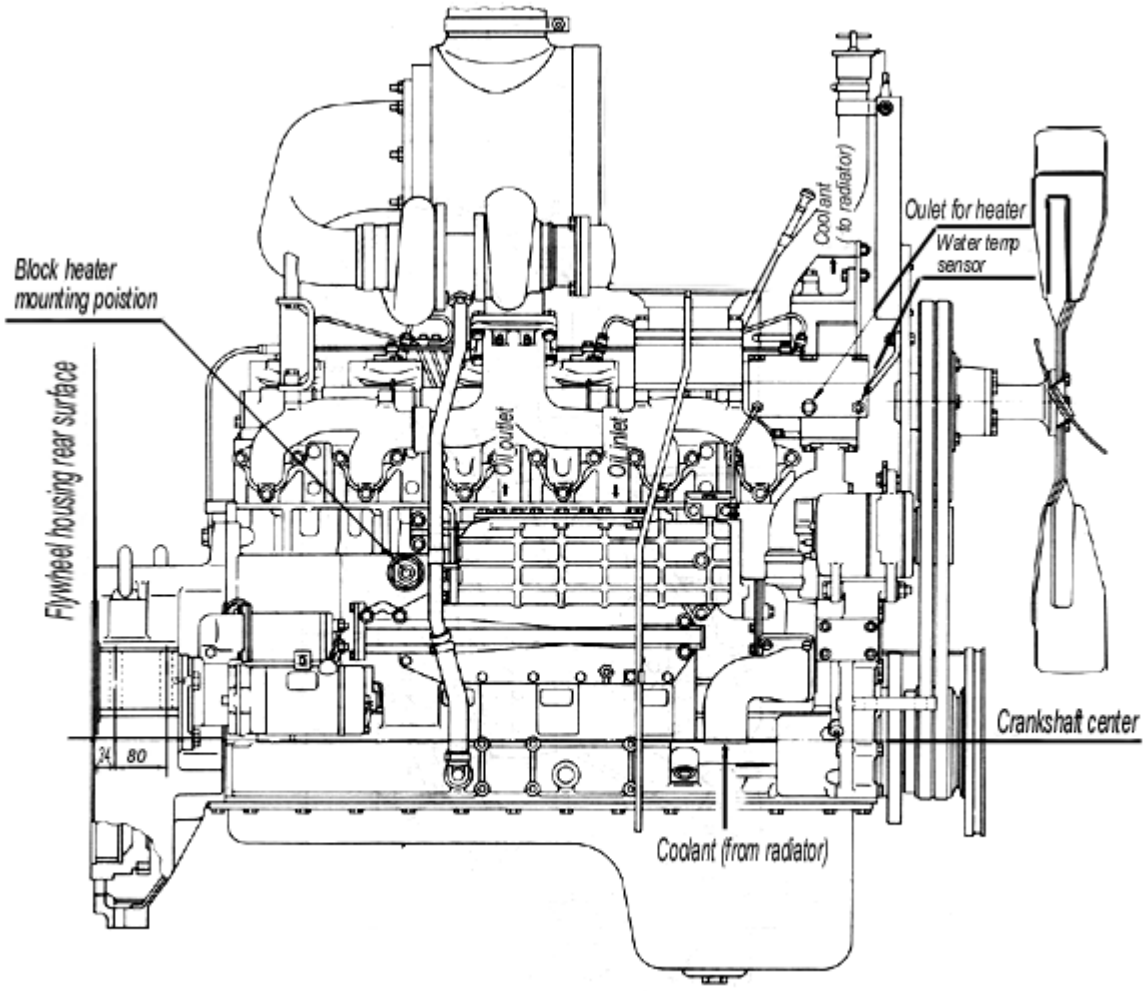
SPECIFICATION

Engine model			BS6D125G1		
Applicable machine			PES100		
Number of cylinder - Bore x Stroke		mm	6 - 125 x 150		
Total piston displacement		cc	11,040		
Firing order			1 - 5 - 3 - 6 - 2 - 4		
Dimensions	Overall length	mm	1,722		
	Overall width	mm	1,024		
	Overall height (Excluding exhaust pipe)	mm	1,175		
	Overall height (Including exhaust pipe)	mm	1,430		
Performance	Flywheel horsepower Rated	kW/r/min	118/1,500		
	10% Over Load	kW/r/min	130		
	25% Over Load	kW/r/min	147		
	High idling	r/min	Max. 1545		
	Low idling	r/min	700-750		
	Minimum fuel consumption ratio	g/kW.h	215		
Dry weight		kg	1,050±30		
Fuel pump			Bosch PE-NB type		
Governor			Bosch RSV centrifugal, all-speed type		
Lubricating oil amount (refill capacity)			32 (26)		
Coolant amount (engine only)			78.5		
Aternator			24V,30A		
Starting motor			24V, 7.5 kw		
Battery			12V, 200Ah x 2		
Turbocharger			KKK(KEL)	-	
Air compressor			-	-	-
Other			-	-	-

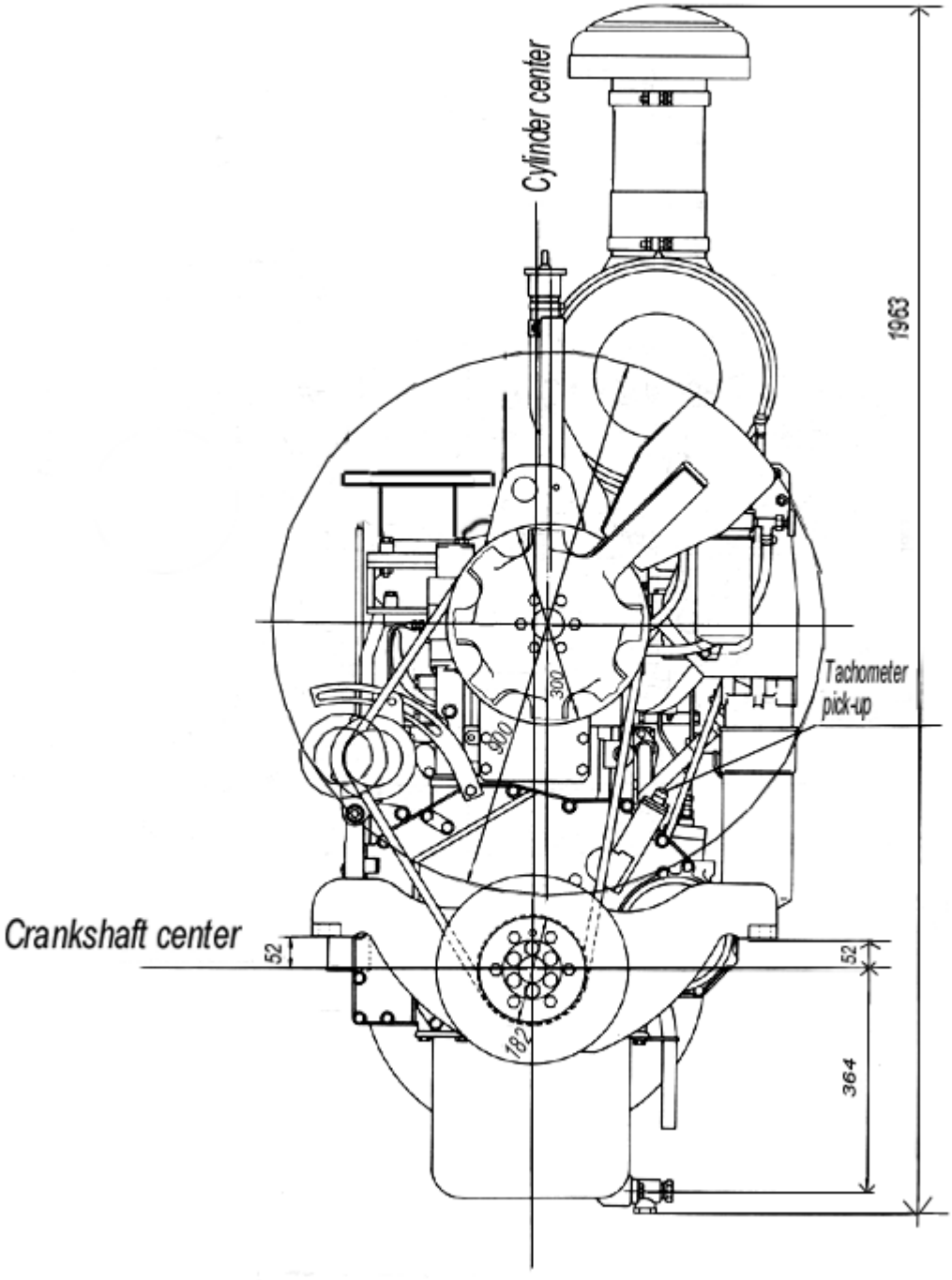
BS6D125G1 LEFT SIDE VIEW



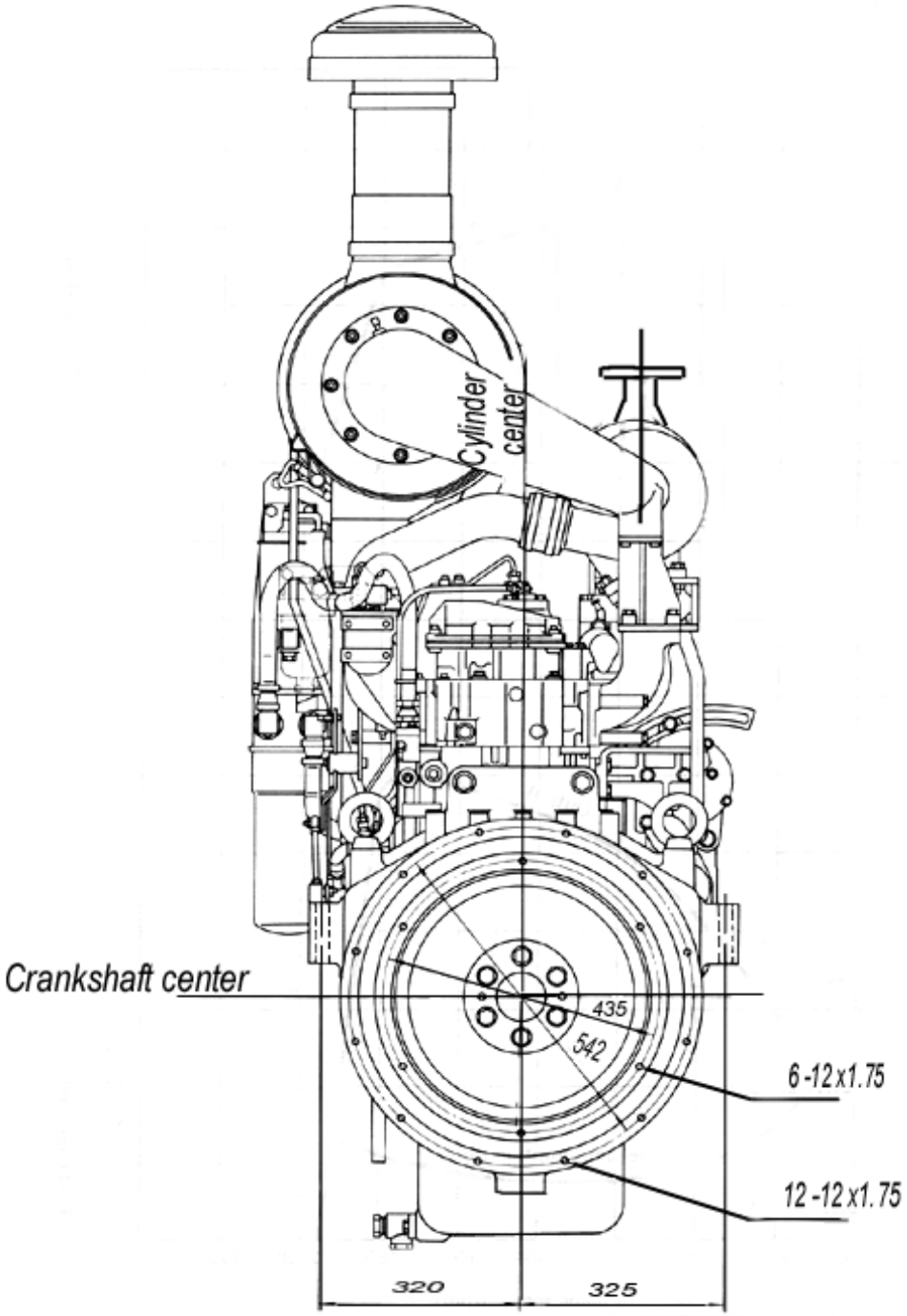
BS6D125G1 RIGHT SIDE VIEW



BS6D125G1 FRONT VIEW

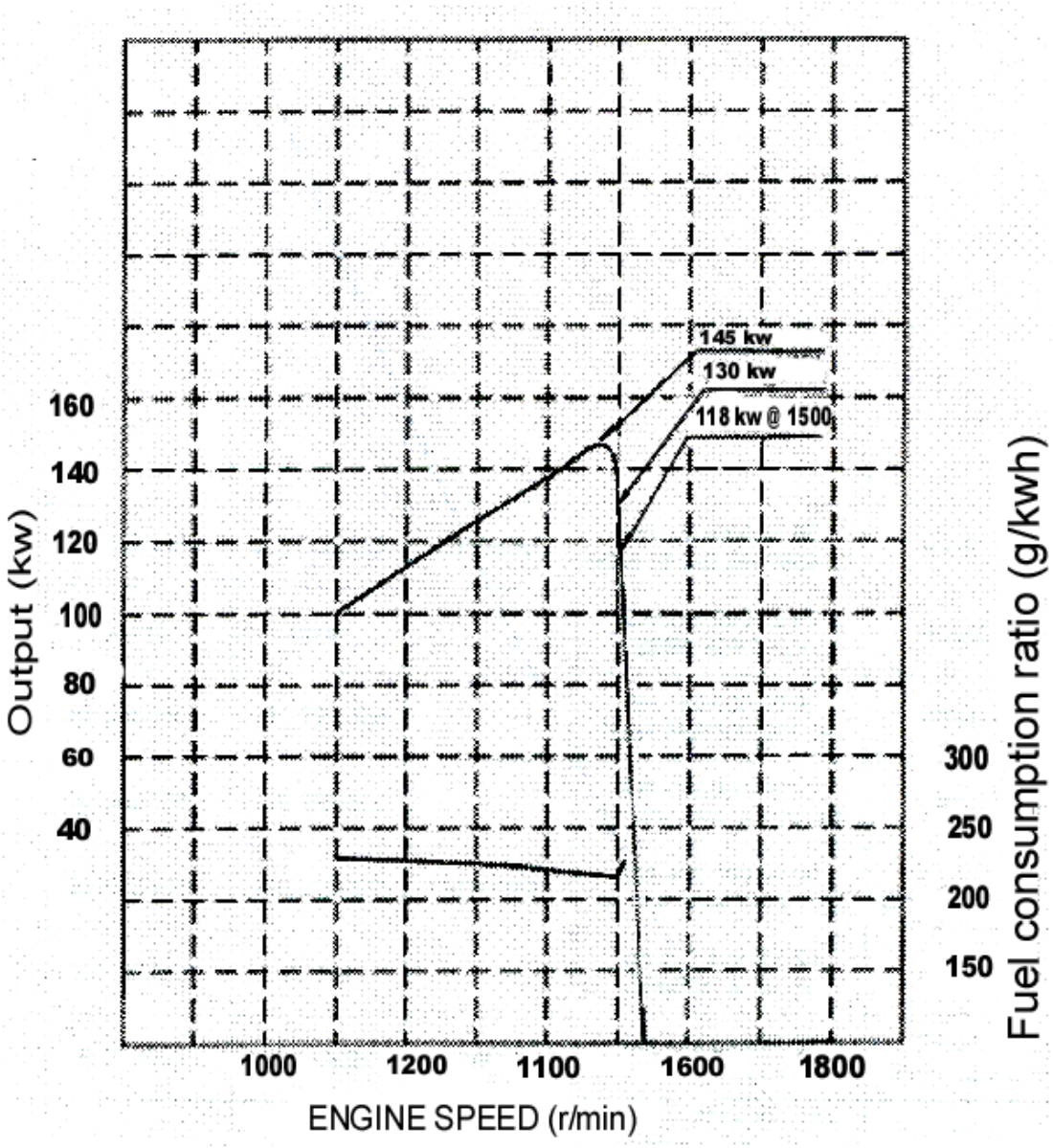


BS6D125G REAR VIEW



BS6D125G (FOR PES100)

Flywheel horsepower	:	118 kW / 1,500 rpm
Minimum fuel consumption ratio	:	215 g / kW.h



WEIGHT TABLE

This weight table is a guide for use when transporting or handling components.

Unit:Kg

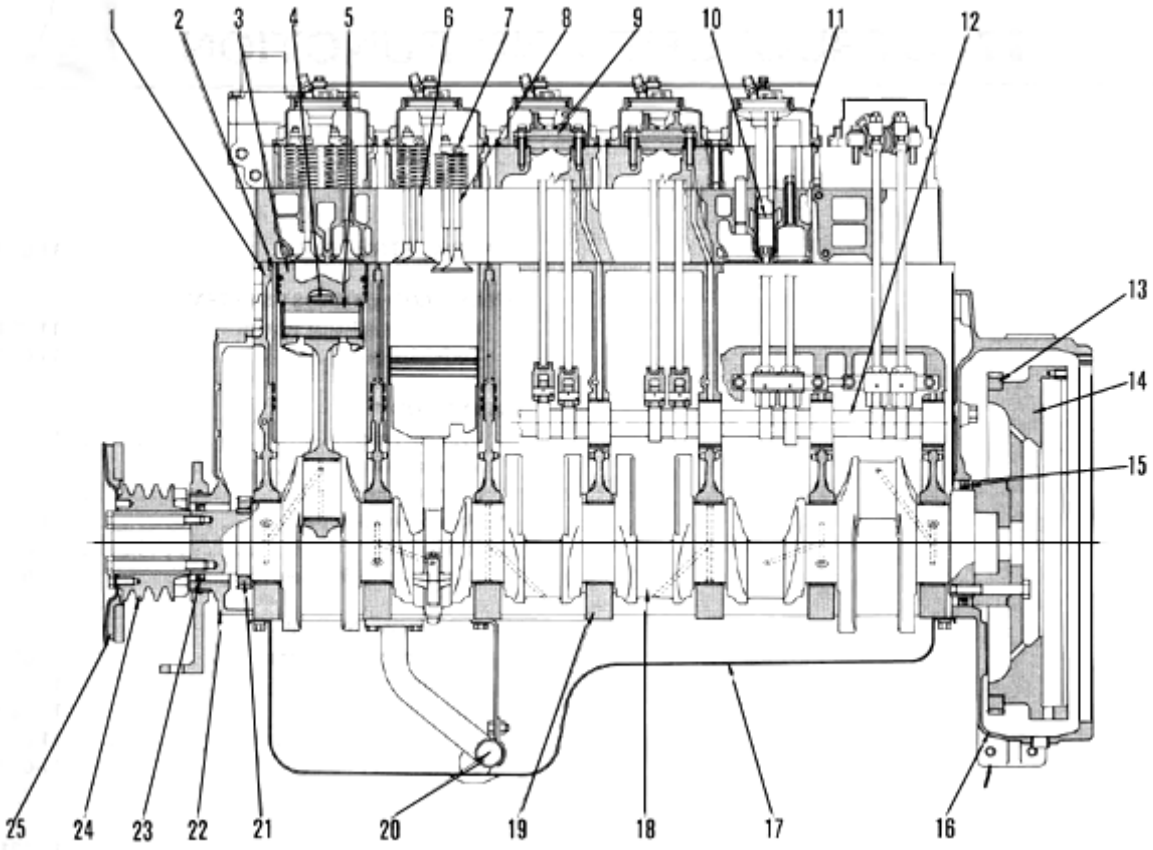
No.	ITEM	COMPONENT	BS6D 125G1
1	Turbocharger	GARRET CO. TV77- 05 GARRET CO. TV77- 05 GARRET CO. TV77- 05	17 7 15
2	Cylinder head assembly	Cylinder head, vlaue and valve spring	16 x 6
3	Cylinder block assembly	Cylinder block, Main bearing cap , Cylinder liner	223 : Except D60F - 8,8F 264 : HD205-3/280 D60F- 8, 8A
4	Front cover		19: Except D60F - 8,8A 21 : D60F- 8,8A
5	Oil pan		--
6	Flywheel assembly	Flywheel , Ring gear	35 : Except PC300-3, PC300LC-3
7	Flywheel housing		25 : Except PC300-3 PC300LC-3 50 : Except PC300-3 PC300LC-3
8	Crankshaft assembly	Crankshaft, Crankshaft gear	104
9	Camshaft assembly	Camshaft, camshaft gear and thrust plate	
10.	Piston and connecting rod assembly.	Piston, piston ring, piston pin and connecting rod.	7.8x 6
11.	Oil pump		5
12.	Fuel injection pump		26:PC300-3,PC300LC-3

No.	ITEM	COMPONENT	BS6D 125G1
13.	Wate r pump		9.5
14.	Alteranator	Without vaccum pump (24V, 13A)	7.5
		With vaccum pump (24V, 25A)	11
		24V, 35A	10.5
15.	Starting motor		18
16.	Air compressor		10

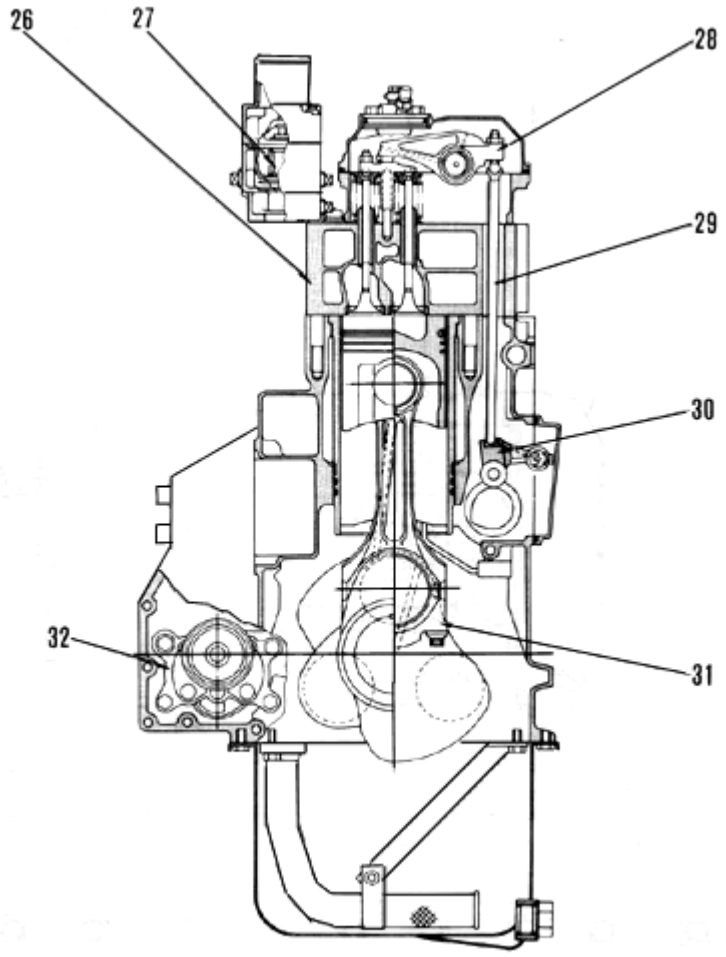
ENGINE

12 STUCTURE AND FUNCTION

GENERAL STRUCTURE



1. Cylinder block
2. Cylinder liner
3. Piston
4. Connecting rod
5. Piston pin
6. Intake valve
7. Cross head
8. Exhaust valve
9. Rocker arm shaft
10. Fuel injection nozzle
11. Cylinder head cover
12. Camshaft
13. Ring gear
14. Flywheel
15. Rear seal
16. Flywheel housing
17. Oil pan
18. Crankshaft
19. Main bearing cap
20. Oil strainer
21. Crankshaft gear
22. Front cover
23. Front seal
24. Crankshaft pulley
25. Vibration damper



26. Cylinder head

27. Thermostat

28. Rocker arm

29. Push rod

30. Cam follower

31. Connecting rod cap

32. Oil pump

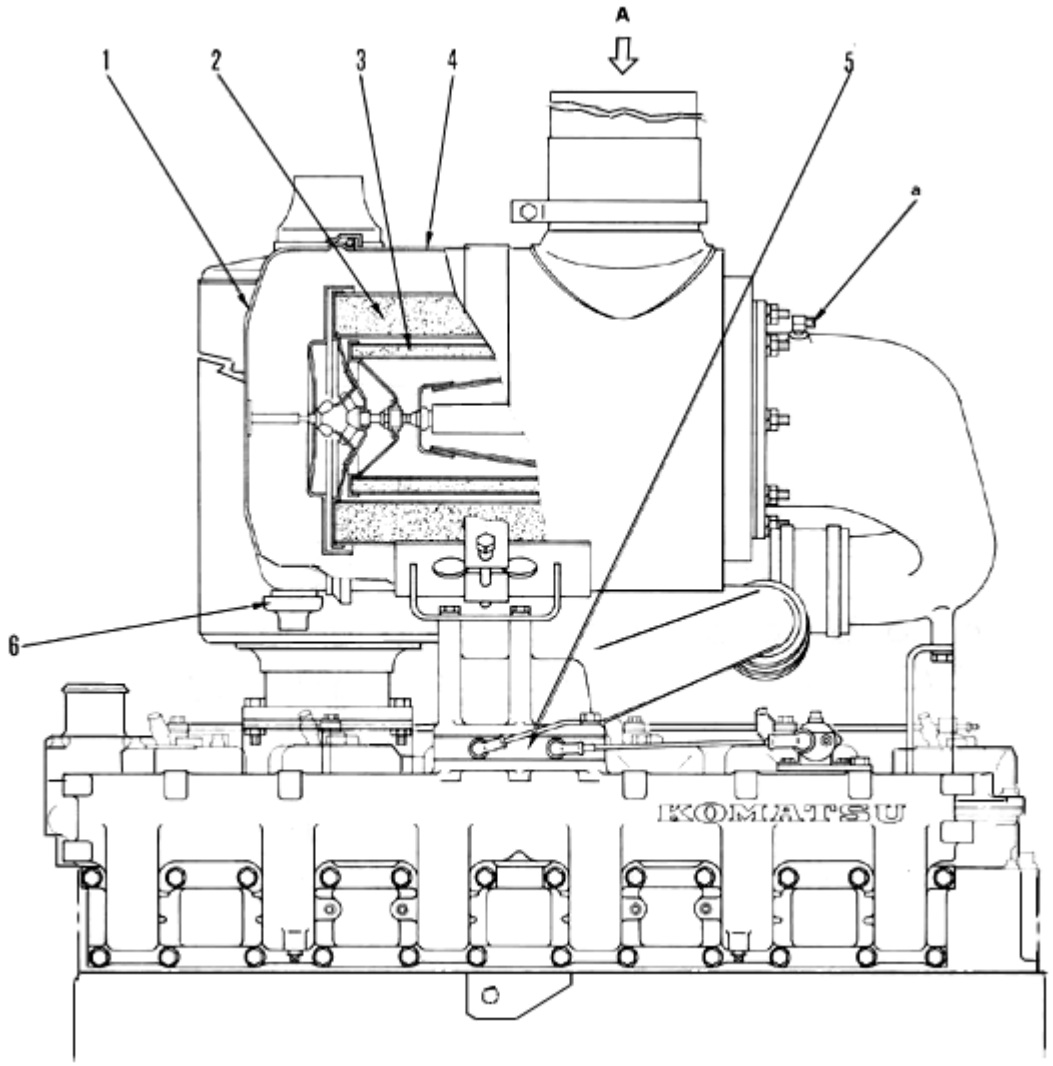
Engine: . B6D 125-1
. BS6D 125-1 (With turbocharger)
. BSA6D 125-1 (With turbocharger and after- cooler

Type:

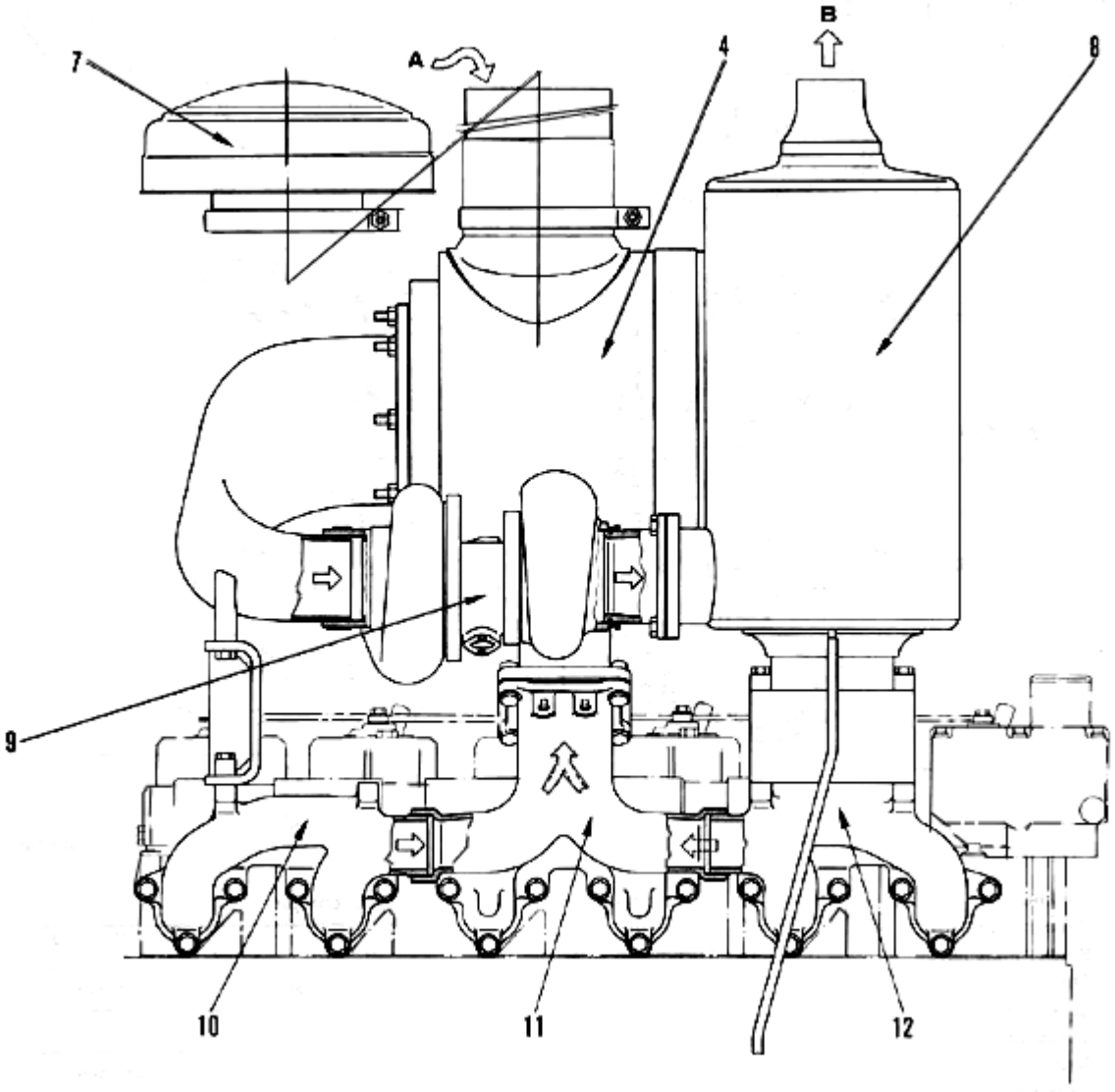
. In-line, 6-cylinders, water-cooled, direct fuel injection, 4 -cycle diesel engine.

INTAKE AND EXHAUST SYSTEM

BS6D125G1



1. Dust cap
2. Outer element
3. Inner element
4. Air cleaner body
5. Electrical intake air heater
6. Evacuator valve



7. Air cleaner cover

8. Muffler

9. Turbocharger

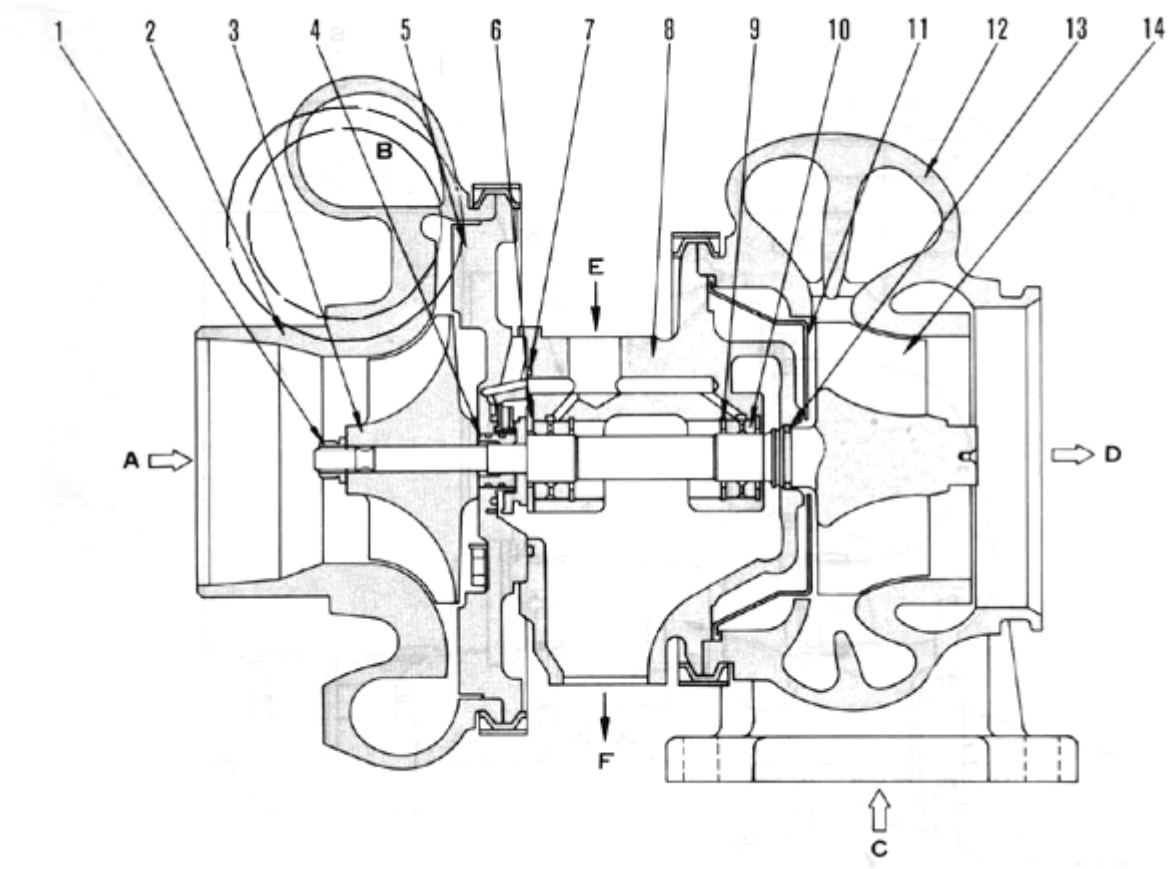
10. Exhaust manifold (Front)

11. Exhaust manifold (Center)

12. Exhaust manifold (Rear)

A. Air intake
B. Gas exhaust
a. Intake air pressure pick-up for dust indicator

TURBOCHARGER



1. Lock nut
2. Blower housing
3. Blower impeller
4. Thrust collar
5. Back plate
6. Thrust bearing
7. Seal ring
8. Center housing
9. Retaining ring
10. Journal bearing
11. Shroud
12. Turbine housing
13. Piston ring
14. Turbine impeller

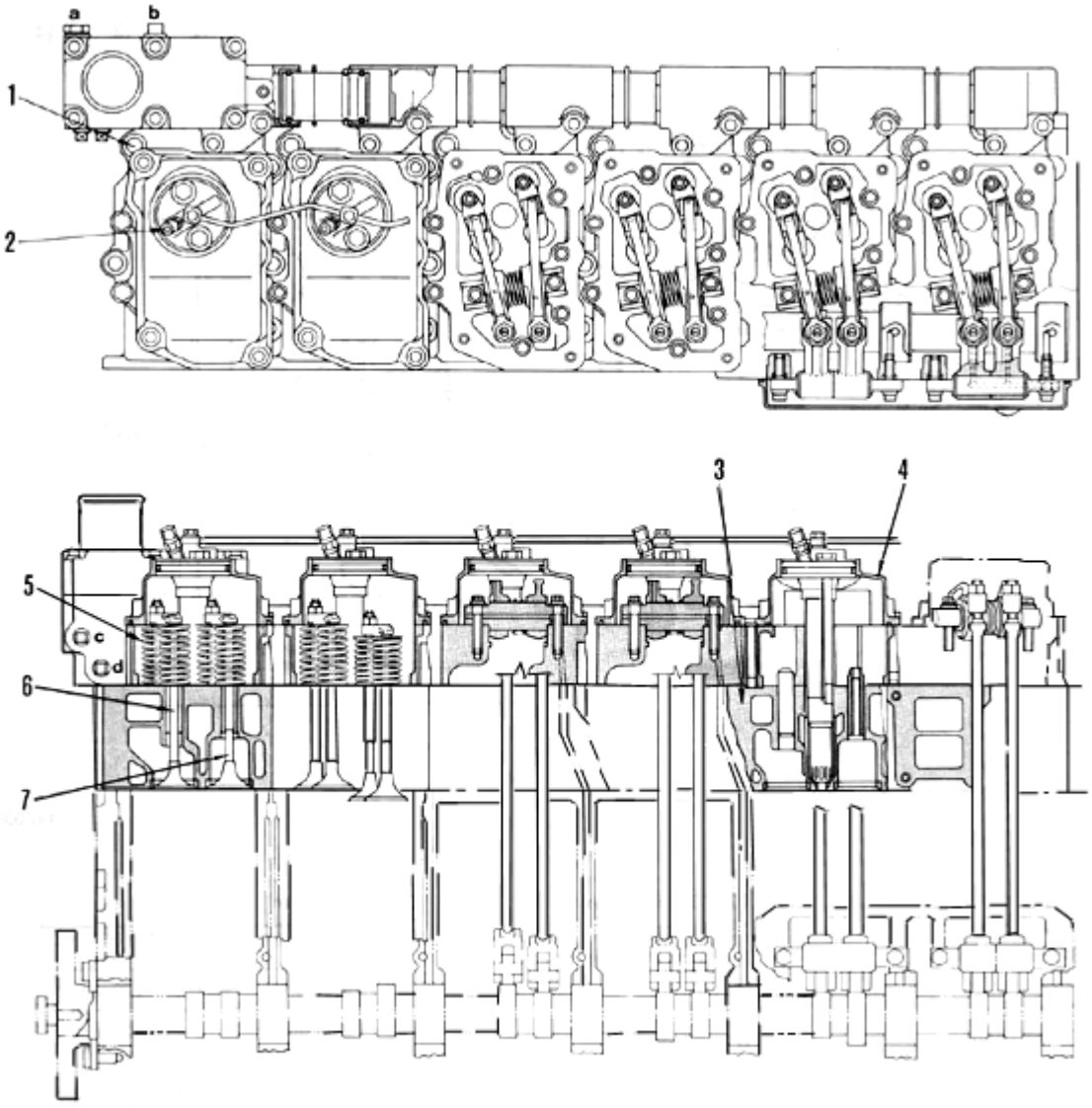
A. Air inlet
B. Air outlet
C. Gas inlet
D. Gas outlet
E. Oil inlet
F. Oil outlet

TURBOCHARGER

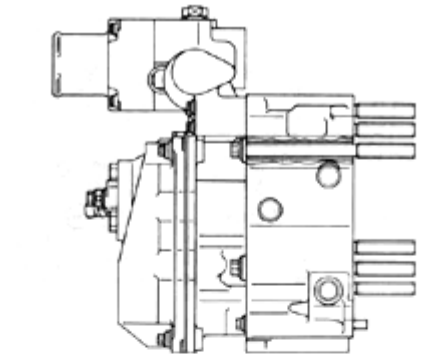
Type	GARRETT CO T04B NV
Overall length	229 mm.
Overall width	222 mm.
Overall height	185 mm.
Weight	7 kg.
Continous speed	125,000 rpm.
Applicable exhaust temp	700° C max.
Direction of rotation	Clockwise (see from the blower side)

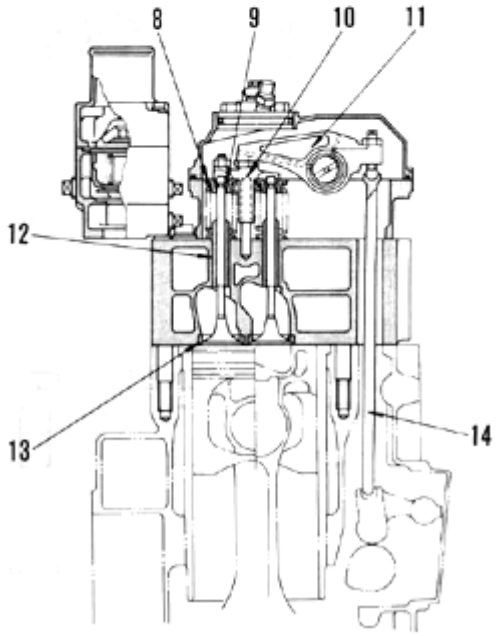
ENGINE BODY

CYLINDER HEAD



1. Cylinder head bolt
2. Nozzle holder
3. Cylinder head
4. Cylinder head cover
5. Valve spring
6. Intake valve
7. Exhaust valve





CYLINDER HEAD

. Direct fuel injection.
. 4 valve
. Injection nozzle assembled in cylinder head.
. Divided type
(1-cylinder head for 1-cylinder)

VALVE SEAT

. Press fitted insert for intake and exhaust .

CYLINDER HEAD COVER

. Floating type seal

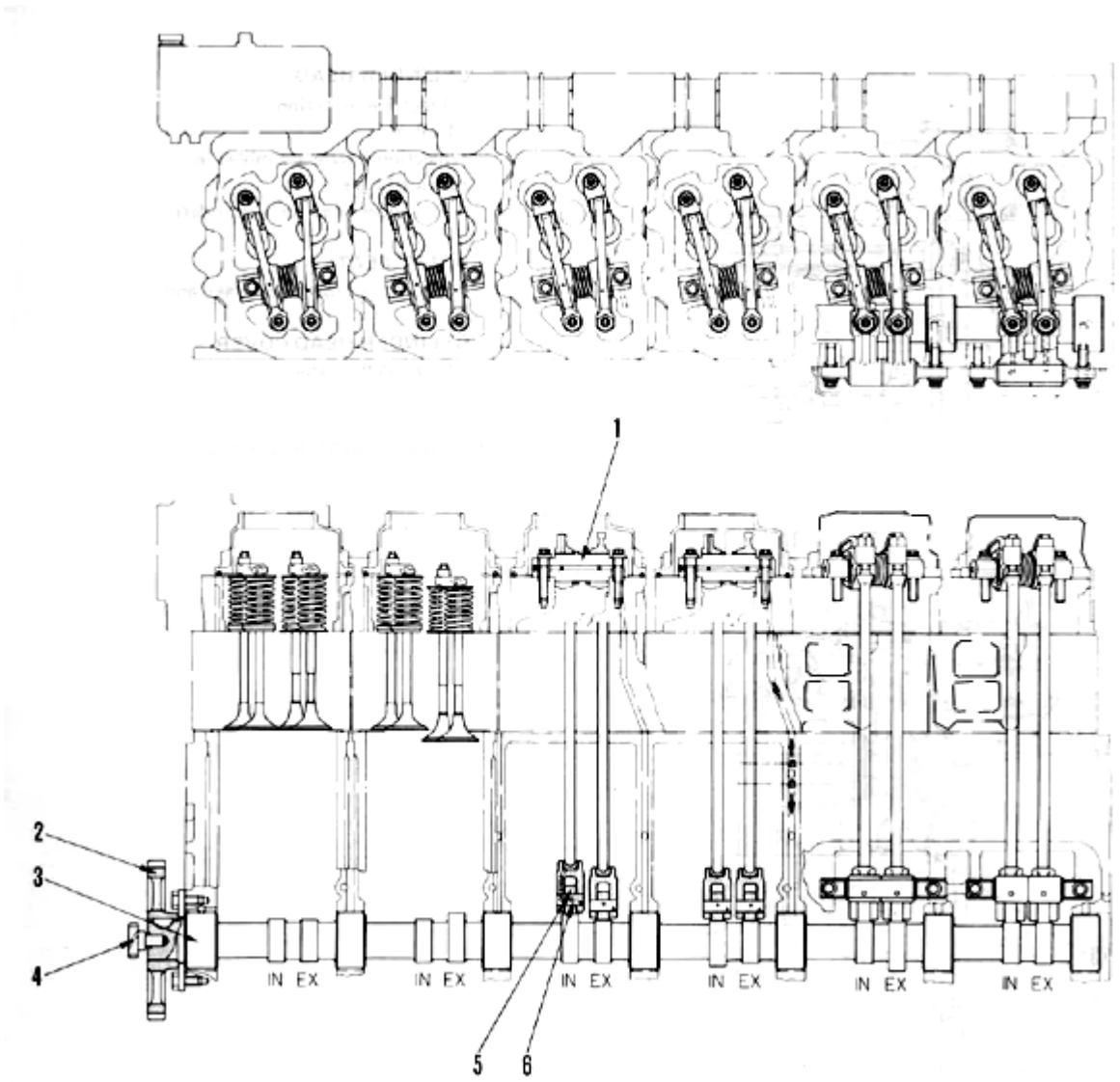
VALVE ROTATOR

. Installed BS6D125G1

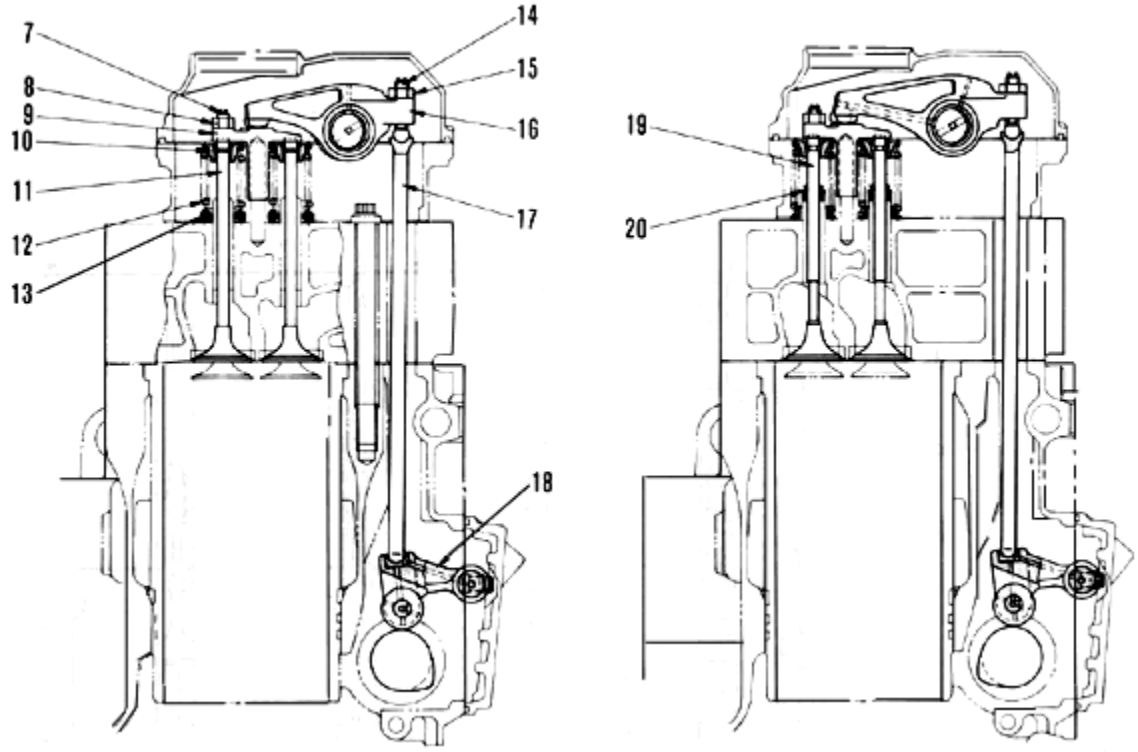
8. Valve spring seat
9. Valve cotter
10. Cross head
11. Rocker arm
12. Valve guide
13. Valve seat insert
14. Push rod

a. Water temperature pick-up
b. Outlet for heater
c. Outlet for corrosion resistor
d. Inlet for corrosion resistor

VALVE SYSTEM



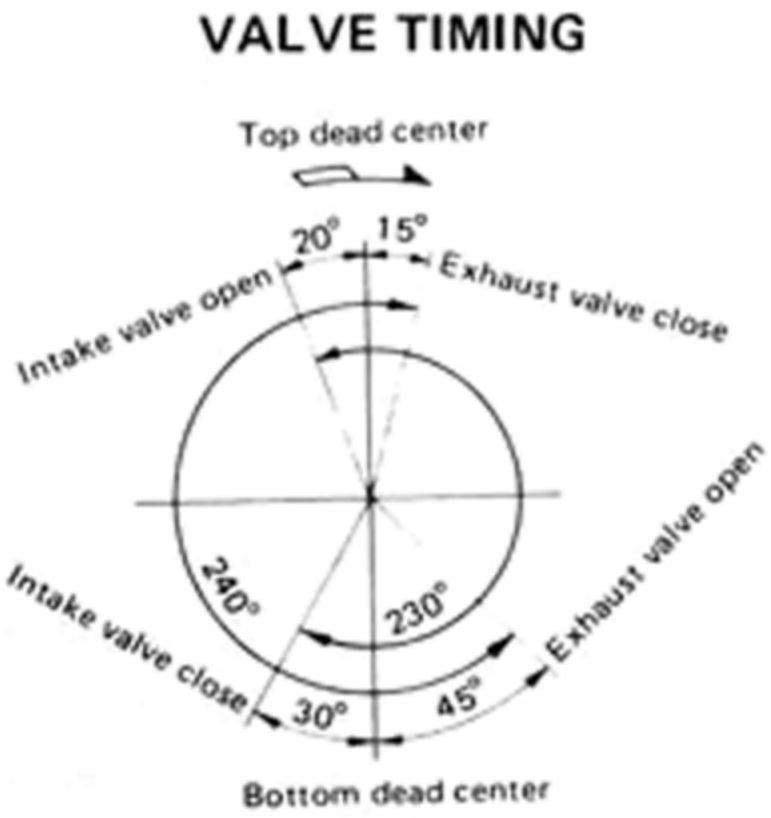
1. Rocker arm shaft
2. Camshaft gear (No. of teeth: 44)
3. Camshaft
4. Air compressor drive gear (No. of teeth: 14)
5. Cam roller
6. Cam roller pin
7. Adjustment screw
8. Locknut
9. Cross head
10. Upper valve spring seat
11. Intake valve
12. Valve spring
13. Lower valve spring seat
    B6D125-1 : Intake and exhaust
    BS6D125-1 : Exhaust only
14. Valve rotator
    (BS6D 125-1: Intake only)
    (BSA6D125-1 : Intake only)
15. Adjustment screw
16. Locknut
17. Rocker arm
18. Push rod
19. Cam follower
20. Exhaust valve
21. Valve seal (Exhaust only)



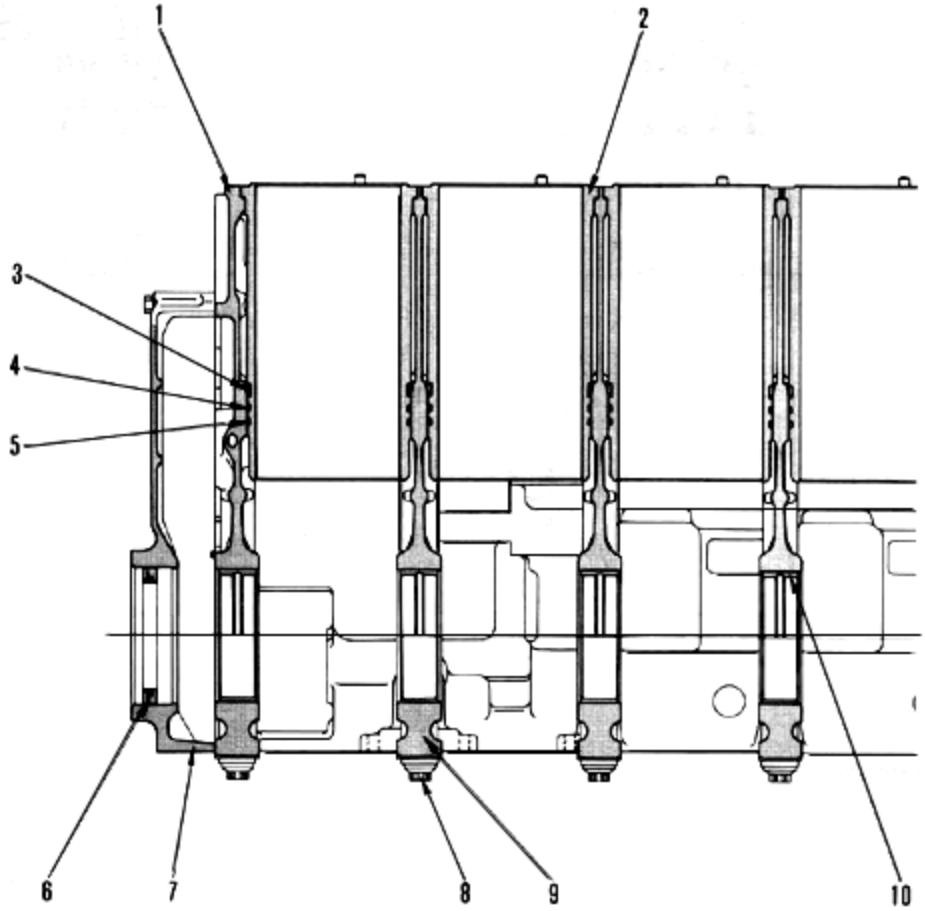
a. Oil

CAMSHAFT

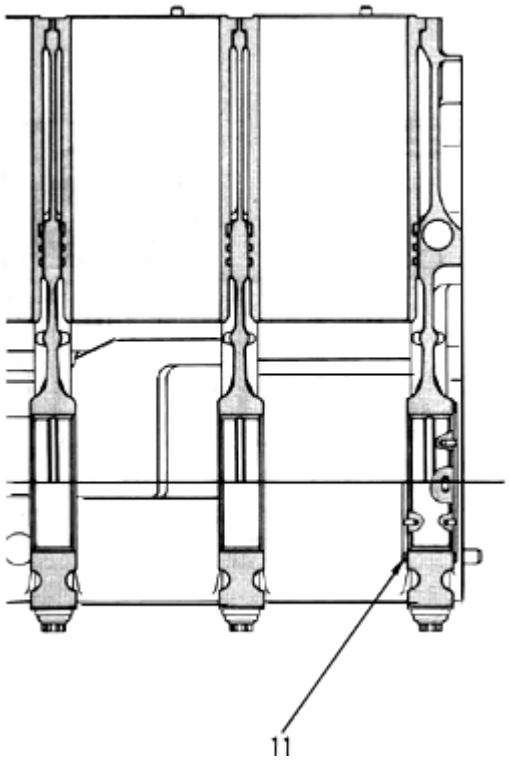
. Stamp forging
. Journal portion, cam portic

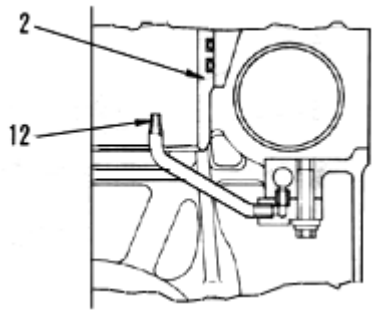


CYLINDER BLOCK



1. Cylinder block
2. Cylinder liner
3. Clevis seal
4. Liner seal (Ethylene propylene rubber)
5. Liner seal (Silicon rubber)
6. Front seal
7. Front cover
8. Main bearing cap bolt
9. Main bearing cap
10. Main bearing
11. Thrust bearing
12. Piston cooling nozzle (BS6D 125-1)





CYLINDER BLOCK :

. Crankshaft : 7 bearings
. Camshaft : 7 bearings

FRONT SEAL :

. Single lip with dust seal

PISTON COOLING :

. With piston cooling nozzle (BS6D125G1)

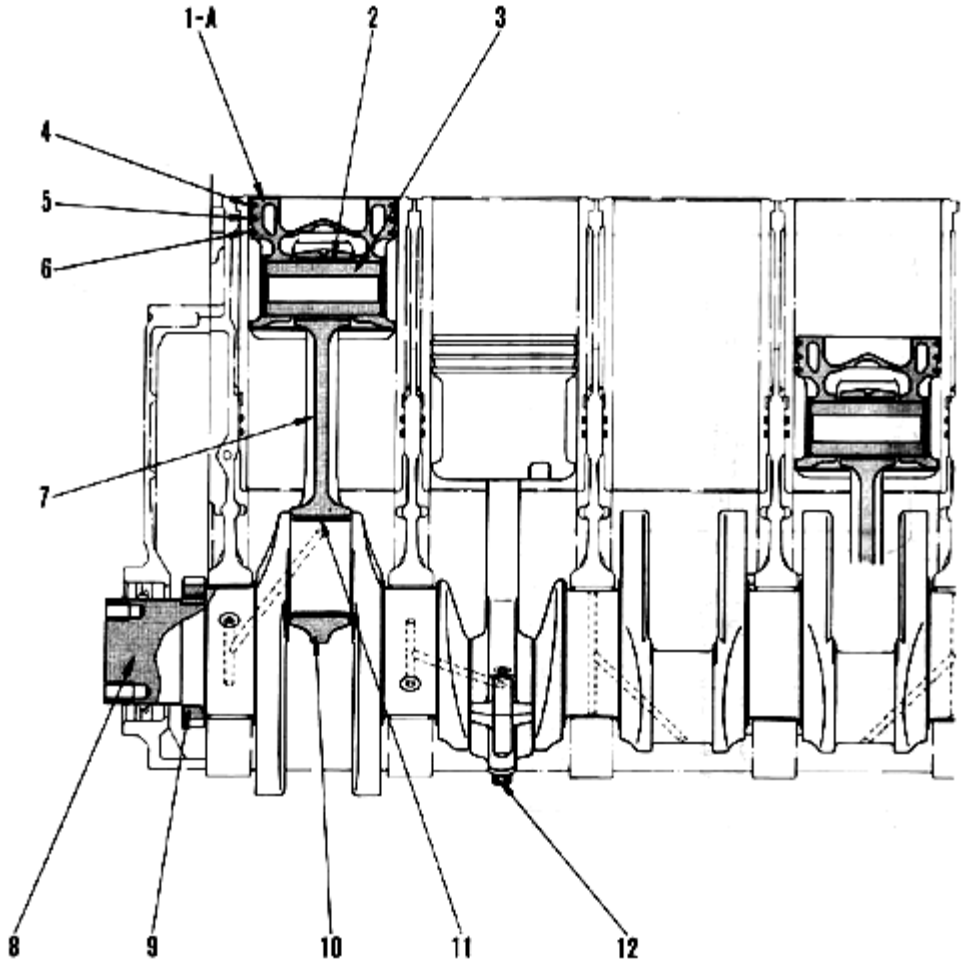
CYLINDER LINER :

. Wet type
. Treatment : Plateau honing finish
Tufftride treated (BS6D125G1)

LINER SEAL :

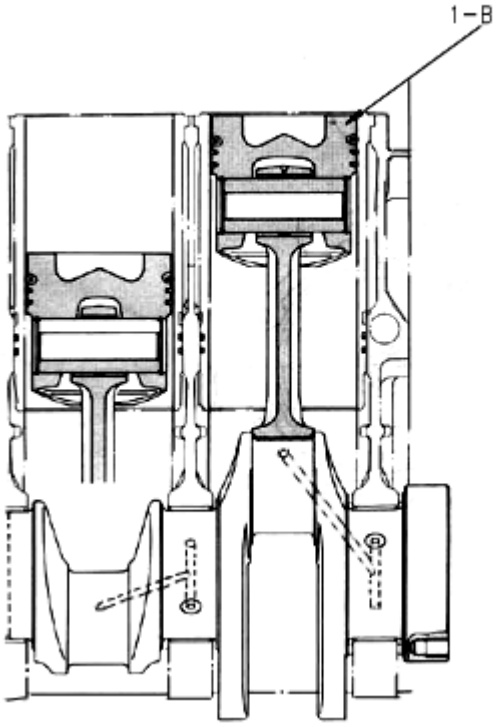
. Top : Clevis seal
. Middle : O-ring (Ethylene propylene rubber)
. Bottom : O-ring (Silicon rubber)

MAIN CIRCULATION PART



1-A. Piston (BS6D 125-1)
1-B. Piston (B6D 125-1)
2. Connecting rod bushing
3. Piston pin
4. Top ring
5. Second ring
6. Oil ring
7. Connecting rod
8. Crankshaft
9. Crankshaft gear
10. Connecting rod cap
11. Connecting rod bearing
12. Connecting rod cap bolt

* The above is a composite sectional drawing for BS6D125G1



CRANKSHAFT : Stamp forging

. BS6D 125-1 : Induction hardening on journal and fillet portions.

PISTON :

Material :
B S6D125G1 (No.1) : Ductile cast iron (FCD)/ ALUMINIUM.

Type : Elliptical taper profile thermal flow, MTCC combustion chamber.

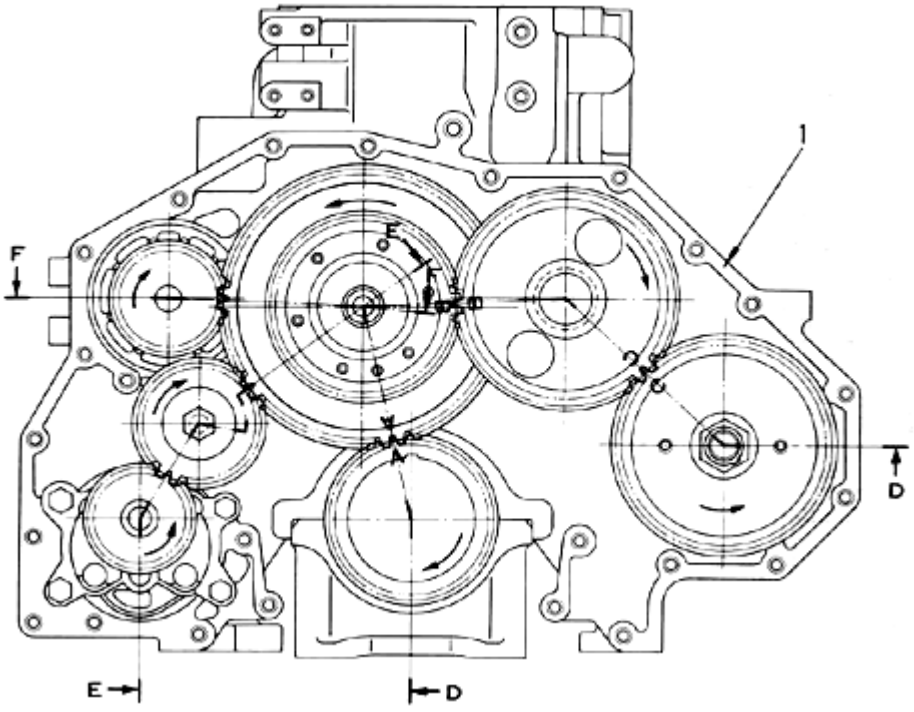
PISTON RING

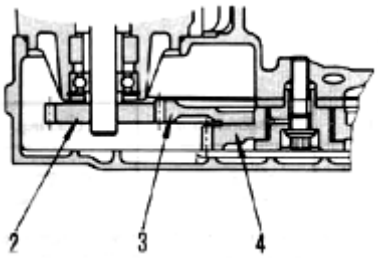
Topring	Second ring	oil ring
		
Both faces keystone barrel face Hard chrome plating	keystone inner cuttappered face Hard chrome plating	Hard chrome plating

CONNECTING ROD :

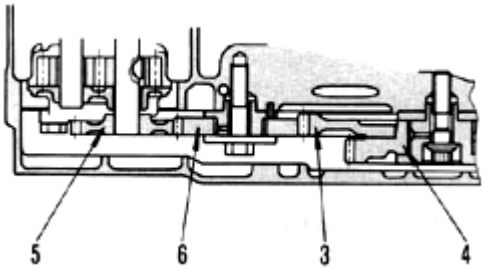
BS6D125-1: With lubrication hole

TIMING GEAR





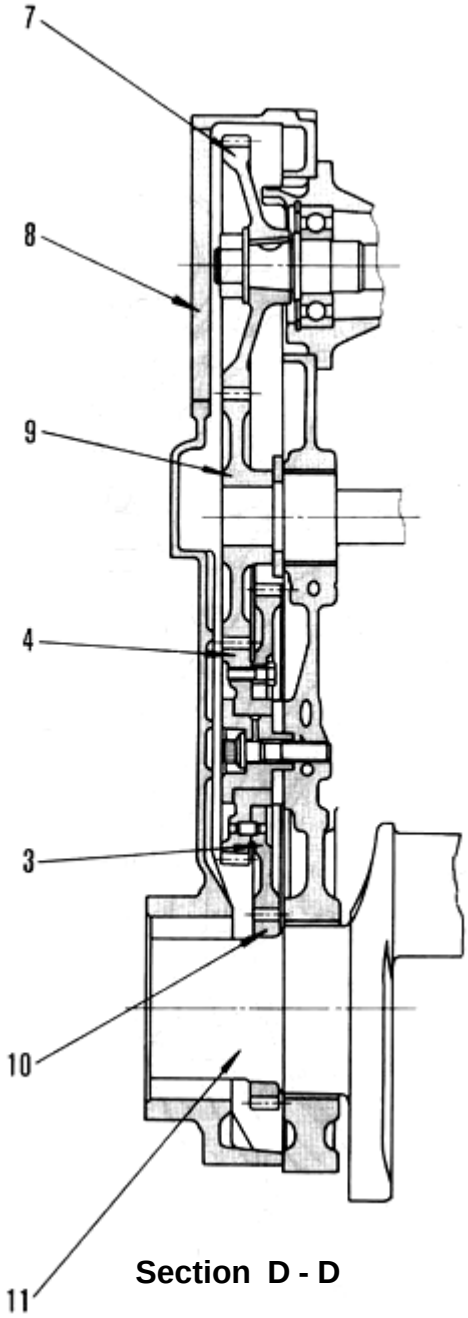
Section F - F



Section E - E

1. Cylinder block
2. Water pump drive gear (No. of teeth : 22)
3. Main idler gear (No. of teeth : 57)
4. Main idler gear (No. of teeth : 38)
5. Oil pump drive gear (No. of teeth : 21)
6. Idler gear for oil pump (No. of teeth : 25)
7. Injection pump drive gear (No. of teeth : 44)
8. Timing gear cover
9. Camkshaft gear (No. of teeth : 44)
10. Crankshaft gear (No. of teeth : 33)
11. Crankshaft

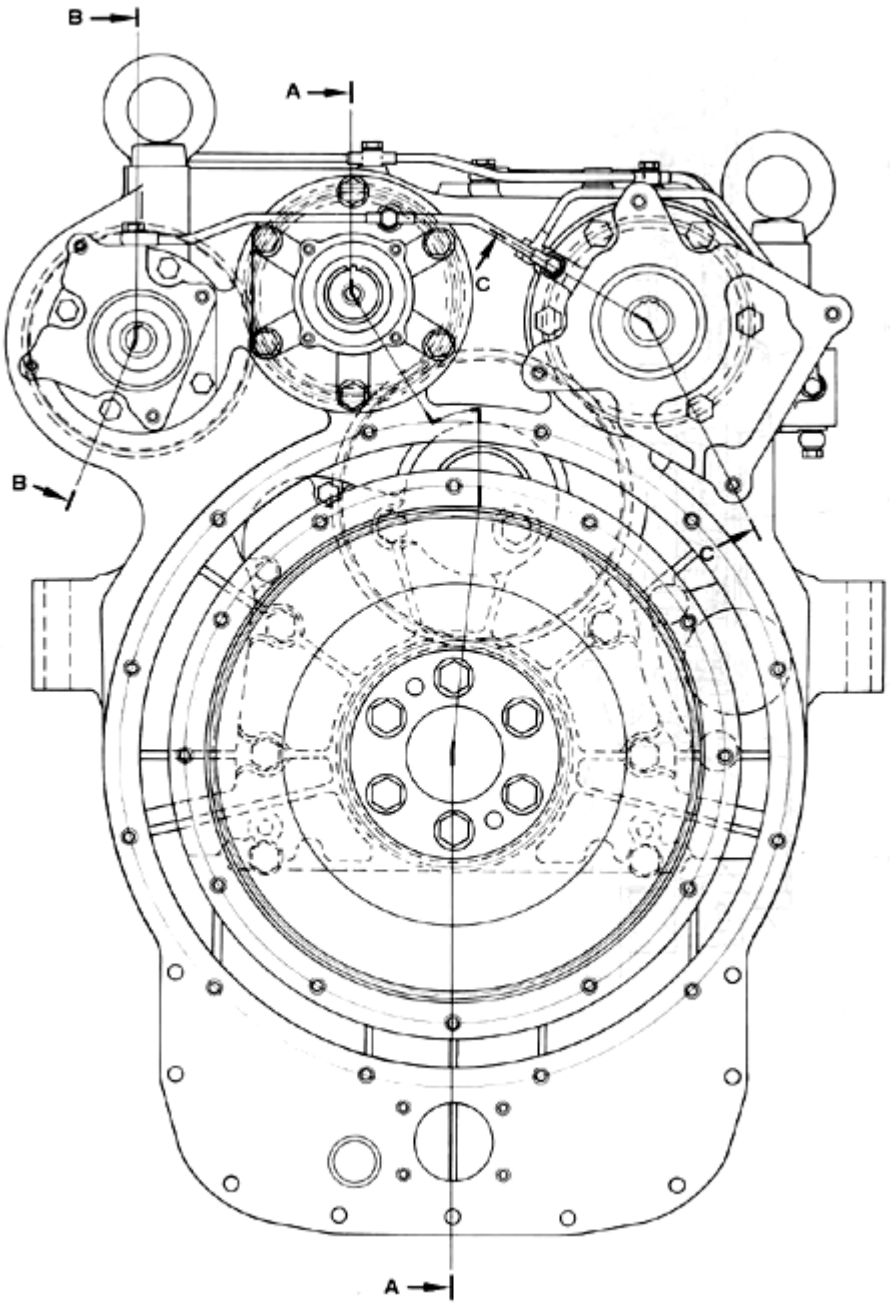
A, B, C : Match marks for timing gears.

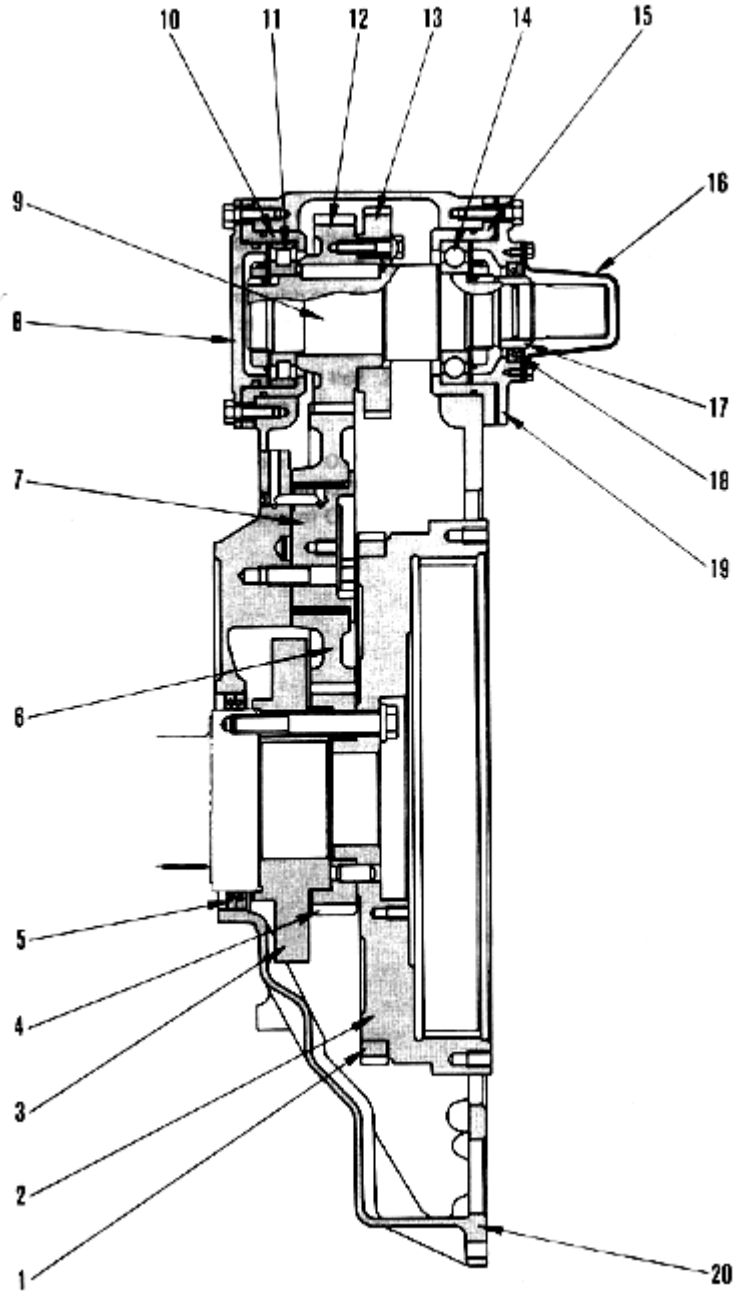


Section D - D

FLYWHEEL AND FLYWHEEL HOUSING

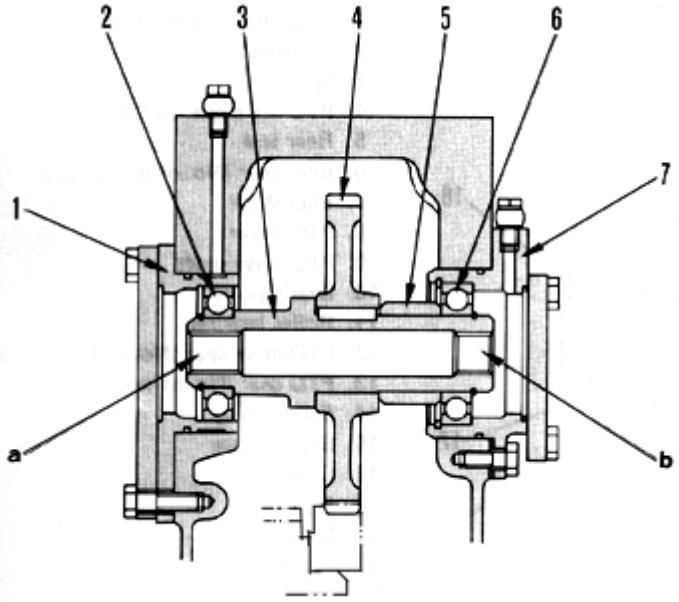
With PTO type





1. Ring gear
   No. of teeth : 137
2. Flywheel
3. Spacer
4. PTO drive gear (No. of teeth : 41)
5. Rear seal
6. Idler gear (No. of teeth: 52)
7. Idler shaft
8. PTO cover
9. PTO drive shaft
10. Bearing case
11. Roller bearing
12. PTO drive gear (No. of teeth : 35)
13. PTO gear (No. of teeth : 57)
    (Without PTO gear for HD200.205)
14. Ball bearing
15. Bearing case
16. Cover
17. Bushing
18. Oil seal
19. Cover
20. Flywheel housing

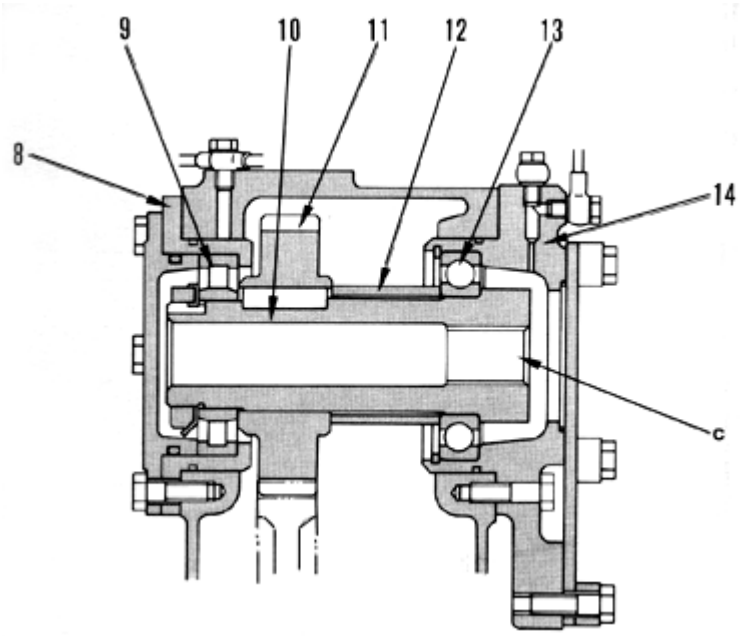
Section A - A



Section B - B

1. Bearing case
2. Ball bearing
3. Pump drive shaft
4. Pump drive gear (No. of teeth: 61)
5. Spacer
6. Ball bearing
7. Bearing case
8. Bearing case
9. Roller bearing
10. Pump drive shaft
11. Pump drive gear (No. of teeth : 35)
12. Spacer
13. Ball bearing
14. Bearing case

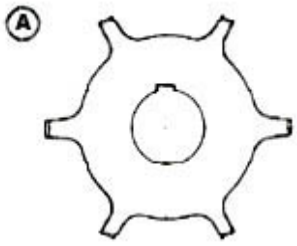
a. PTO for steering pump
b. PTO for torque converter pump
c. PTO for work equipment pump



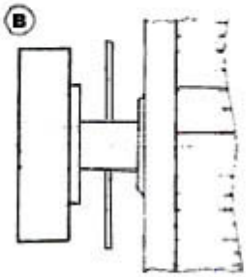
Section C - C

FLEXIBLE COUPLING (HOLESET)

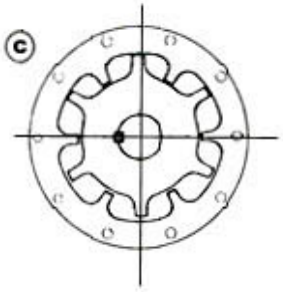
Machine The Hub (Inner Member) Bore And Key Way To Suit Alternator (Driven Machine) Shaft (Fig A)



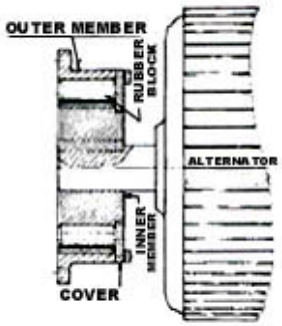
Insert Cover If Single Piece Press Fit The Hub (Inner Member) Onto The Shaft (Fig B)

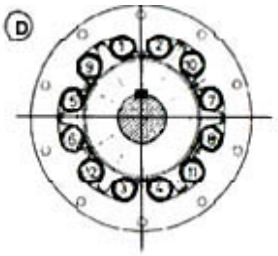


Place Outer Member In Position Resting On Inner Member (Fig C)



Assemble Two Halves Of Cover And Torque Bolts (See Table)





Insert Rubber Blocks For Easy Assembly And To Avoid Damages To The Rubber Blocks Use Lubricant

Silicone Fluid Of Viscosity Between 300 And 1000 Centistrokes Or Jelly Soap.

Do Not Use Petroleum Base Lubricants Like Grease

Apply Lubricants To Rubber Blocks And Cavities

Insert Blocks In Pairs Using A Non Metalic Hammer.

Use Sequence Shown In The Fig(D)

Fasten Outer Member To Flywheel And Torque As Per Table,

Check Alignment

NOTE:

A flexible coupling operating in correctly assembled system requires no maintenance.

It is recommended that the rubber blocks are inspected every 5000 hours.

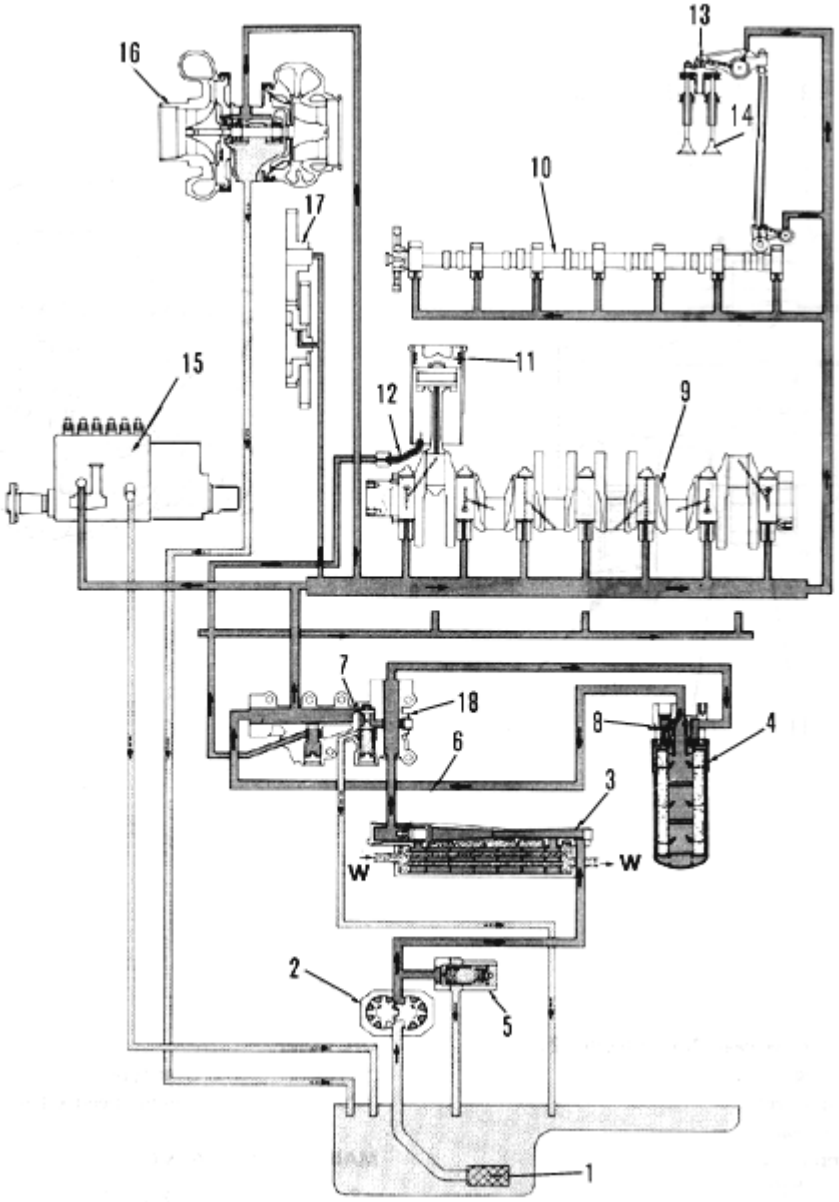
A small amount of rubber dust is normal. In initial running large quantity of dust requires inspection-on use of sufficient lubricants, damages during assembly and improper torques.

RB COUPLING SIZE	FLANGE BOLTS		COVER SETSCREW	
	GRADE	TIGHTENING TORQUE N-m	GRADE	TIGHTENING TORQUE N-m
0.12	M 8	23	M 8	23
0.20	M 8	23	M 8	23
0.24	M 10	45	M 8	23
0.37	M 10	45	M 10	45
0.73	M 12	85	M 10	45
1.15	M 12	85	M 12	85
2.15	M 12	85	M 12	85

Data : Assembly instructions for RB series flywheel mounted couplings
(Manufactured by : Poona Couplings Pvt. Ltd.)

LUBRICATION SYSTEM

LUBRICATION SYSTEM CHART

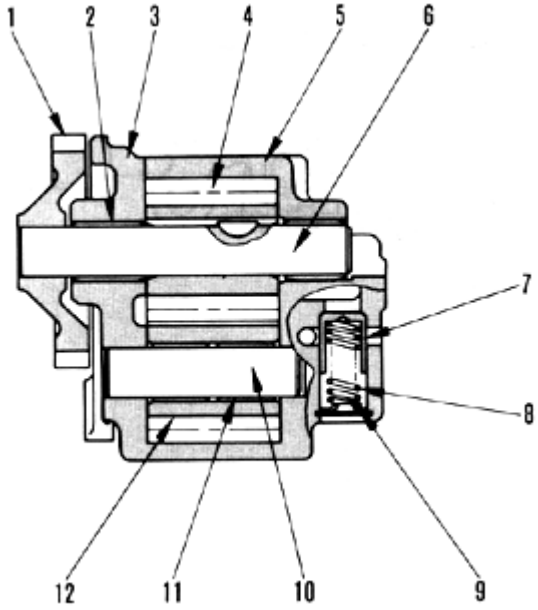


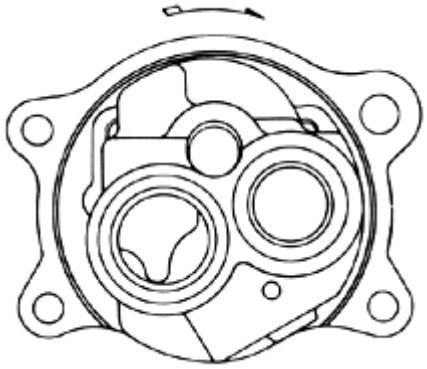
1. Oil strainer
2. Oil pump
3. Oil cooler
4. Oil filter
5. Main relief valve
6. Thermostat
7. Regulator valve
8. Safety valve
9. Crankshaft
10. Camshaft
11. Piston
12. Piston cooling nozzle (BS6D 125- 1)
13. Rocker arm
14. Intake and exhaust valve
15. Fuel injection pump
16. Turbocharger (BS6D125G1)
17. Timing gear
18. Adapter

W : Cooling water

OIL PUMP

BS6D125G1





1. Pump drive gear (No. of teeth : 21)
2. Bushing
3. Pump cover
4. Drive gear
5. Pump body
6. Drive shaft
7. Main relief valve
8. Valve spring
9. Retainer
10. Driven shaft
11. Bushing
12. Driven gear

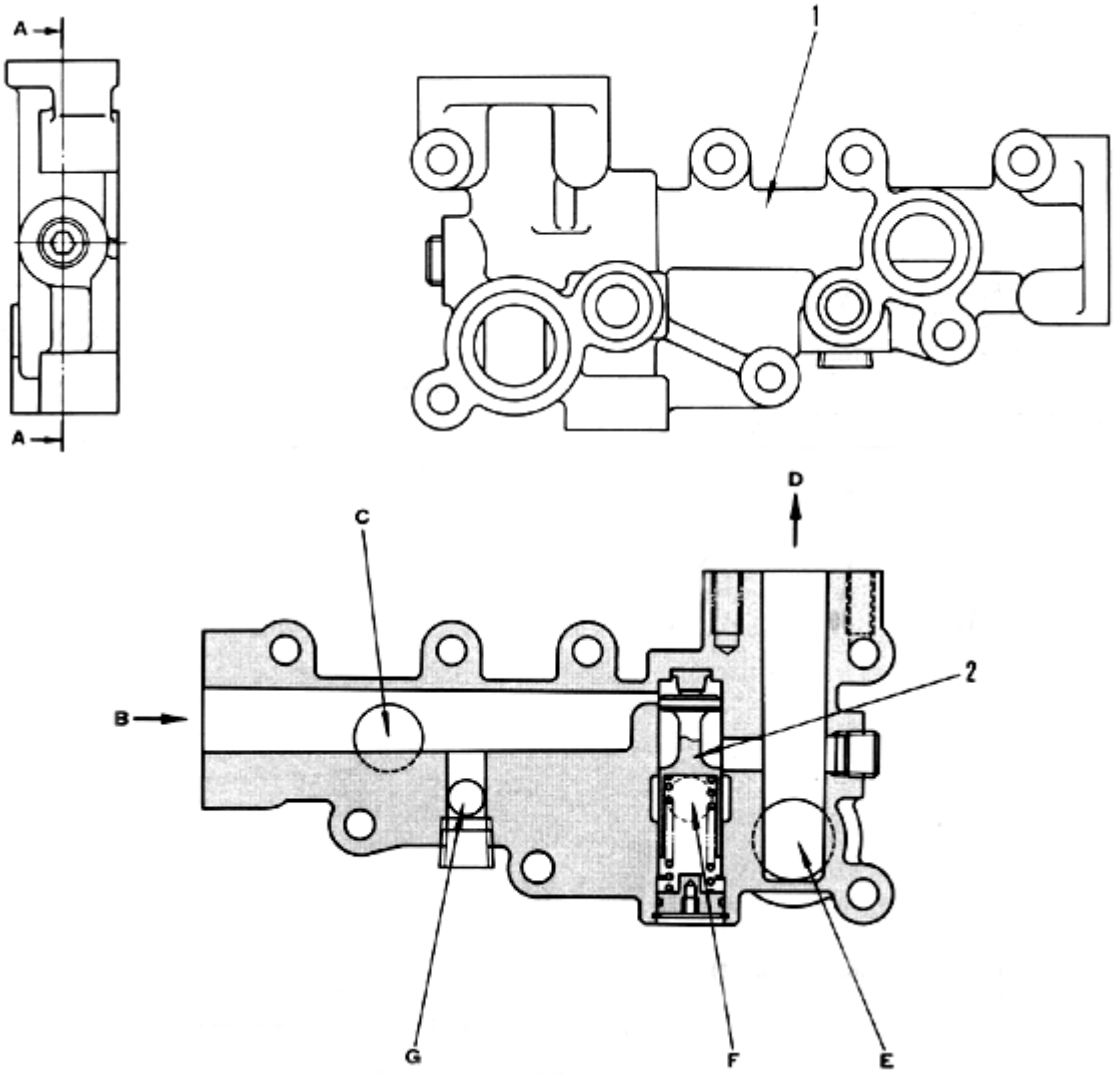
OIL PUMP :

* Type : Gear type
* Pump speed : Engine speed x 1.571

MAIN RELIEF VALVE :

* Set pressure : $7\ ^{+0.1}_{0}$ kg/cm²

REGULATOR VALVE



Section A - A

1. Adapter
2. Regulator valve

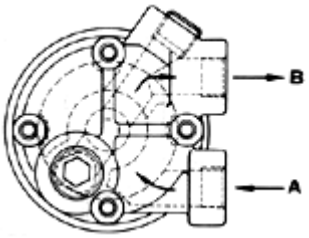
B. From oil filter
C. To engine each part
D. To oil filter
E. From oil pump
F. To oil pan
G. To piston cooling nozzle

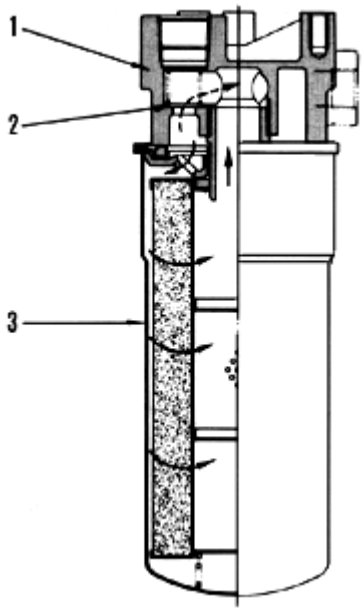
REGULATOR VALVE :

* Set pressure : 3.75 ± 0.15 kg / cm² (BS6D125G1)

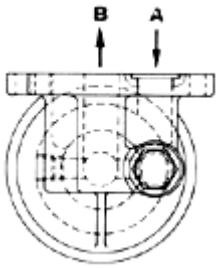
BS6D125G1

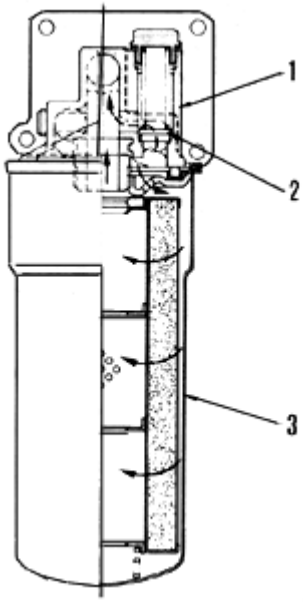
Remote mounting type





Direct mounting type





1. Bracket
2. Safety valve
3. Cartridge

A. Oil inlet

B. Oil outlet

OIL FILTER :

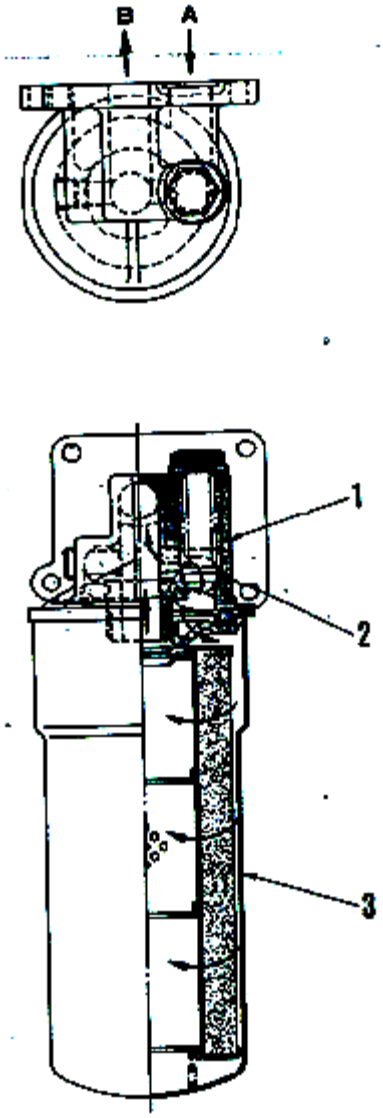
***** Filtration area : 0.84 m^2

SAFETY VALVE :

***** Set pressure : 2.0 **±** 0.2 kg / cm^2

OIL FILTER

BS6D125G1



1.Bracket
2. Safety Valve
3.Cartridge

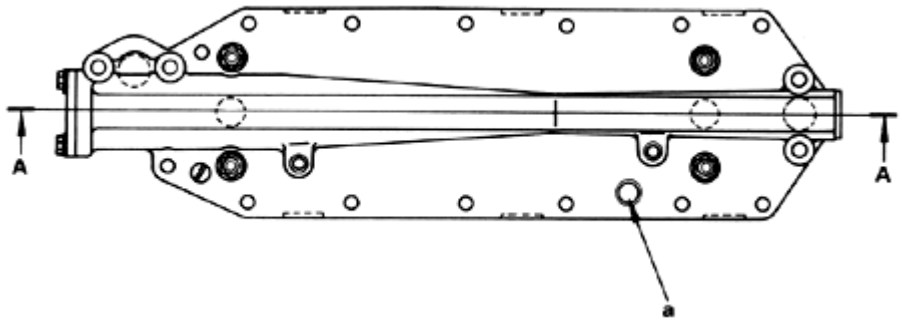
A Oil inlet
B Oil Outlet

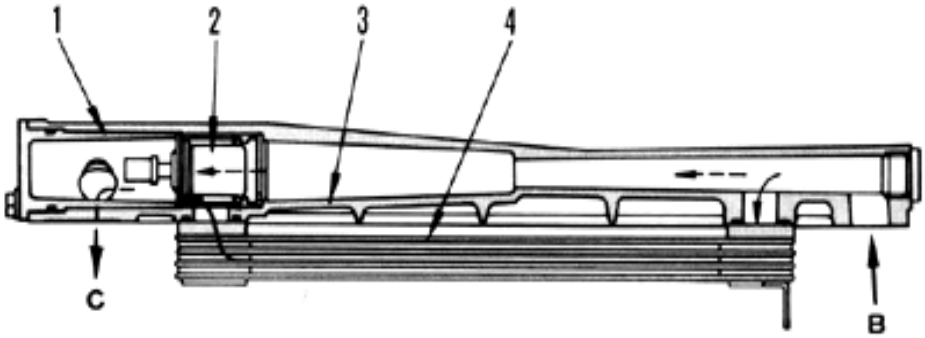
Oil Filter
* Filtration Area : 0.84 m^2

Safety Valve

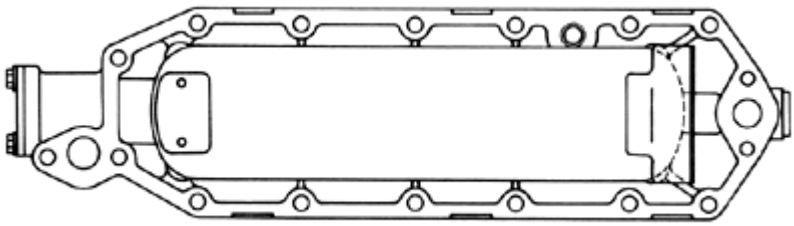
* Set Pressure : 2.0 ± 0.2 kg/cm^2

OIL COOLER





Section-AA



1. Thermostat housing
2. Thermostat
3. Cooler cover
4. Cooler Element

BS6D125G1 : 7 Cores

A. Water drain port
B. Water inlet
C. Oil inlet
D. To engine each part

THERMOSTAT FUNCTION :

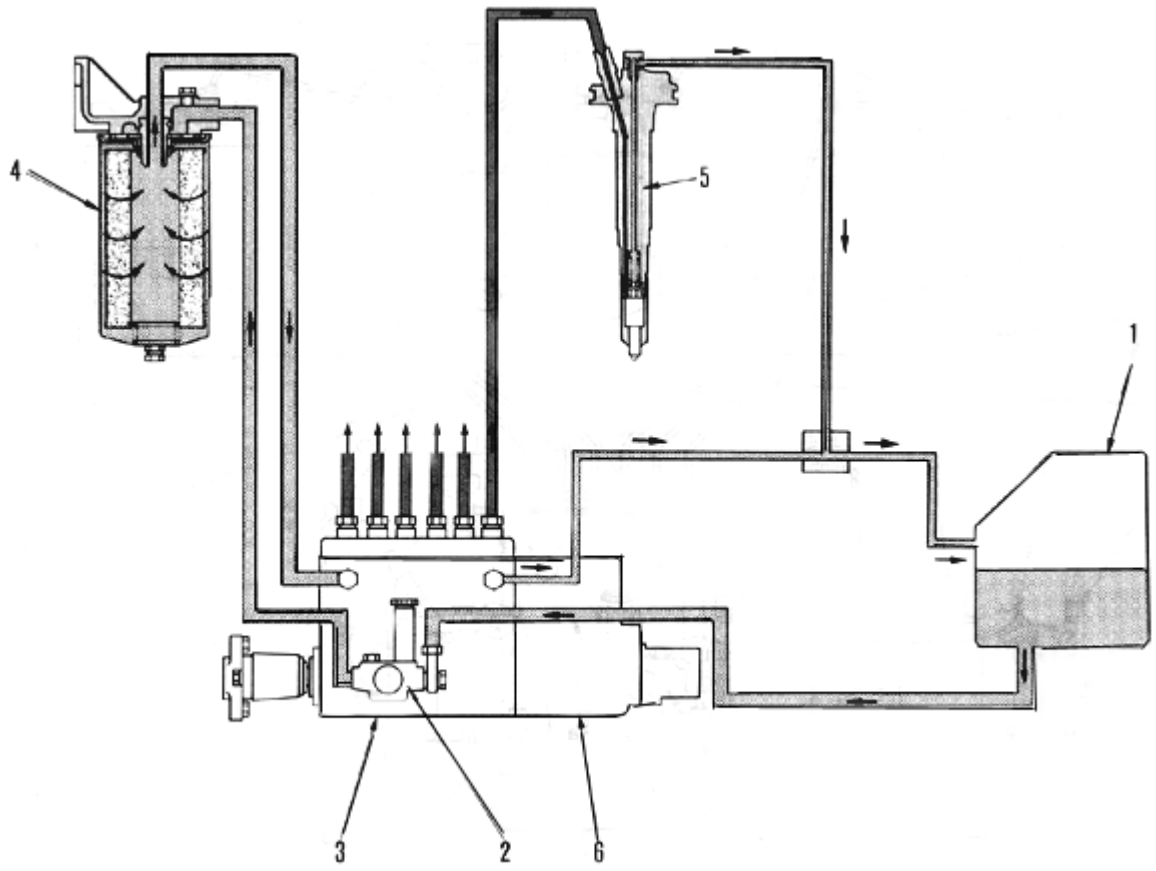
* Valve cracking temperature	: 104 ± 1.5°c
* Full opening temperature	: 115°c
* Full opening lift	: Min. 8 mm

OIL COOLER :

BS6D125G 1 : 0.504 m²

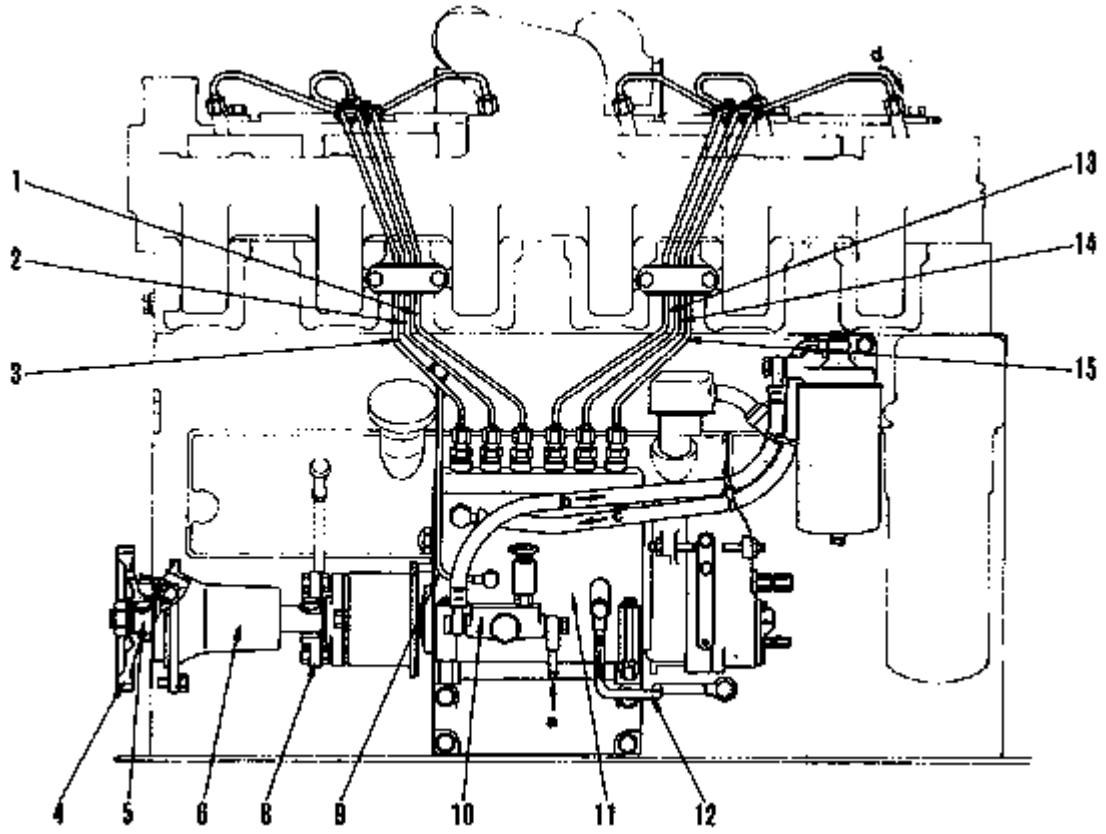
FUEL SYSTEM

FUEL SYSTEM CHART



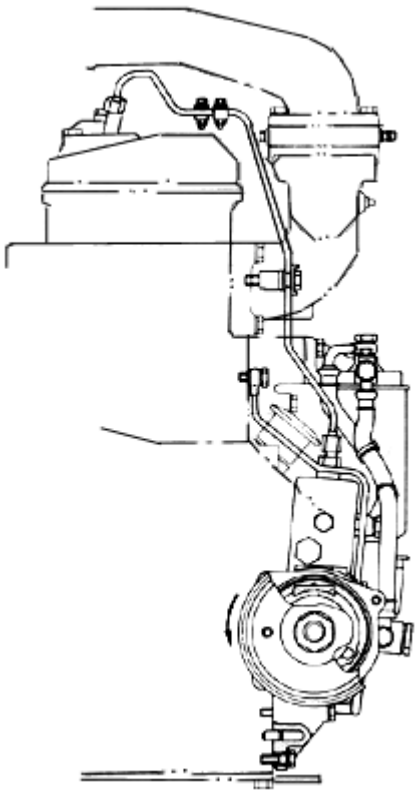
1. Fuel tank
2. Feed pump
3. Fuel injection pump
4. Fuel filter
5. Fuel injection nozzle
6. Governor

BS6D125G1



1. Fuel injection pipe (No. 3)
2. Fuel injection pipe (No. 2)
3. Fuel injection pipe (No. 1)
4. Fuel injection pump drive gear (No. of teeth : 44)
5. Drive shaft
6. Drive case
7. Coupling
8. Oil tube (inlet)
9. Feed pump
10. Fuel injection pump
12. Oil tube (outlet)
13. Fuel injection pipe (No. 4)
14. Fuel injection pipe (No. 5)
15. Fuel injection pipe (No. 6)

FUEL INJECTION PUMP



a. Fuel inlet
b. To fuel filter
c. From fuel filter
d. To fuel injection nozzle
e. To oil pan (oil)

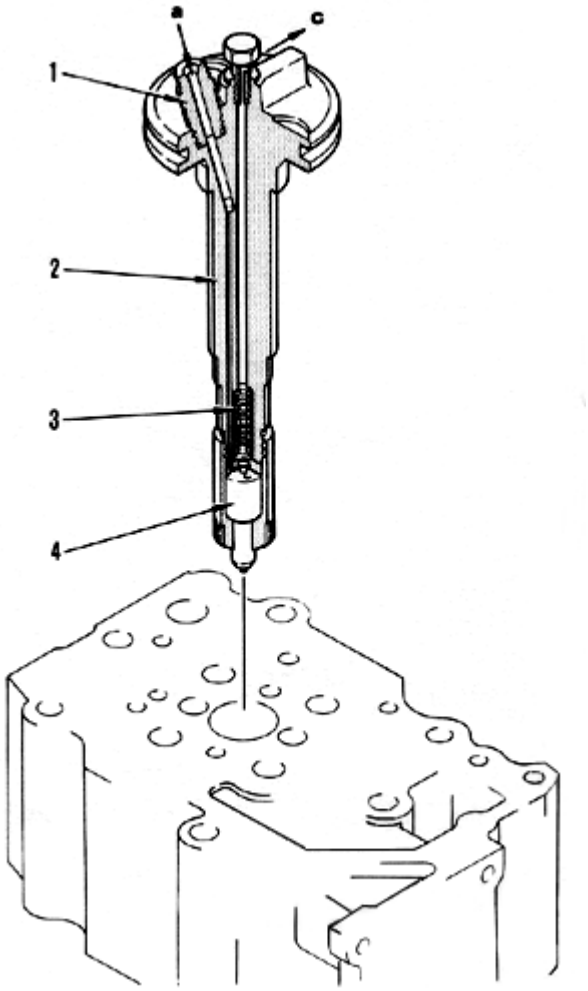
FUEL INJECTION PUMP :

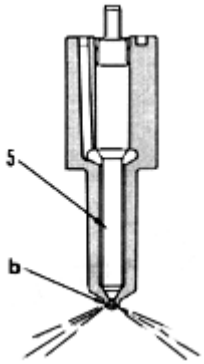
* Maker : DIESEL KIKI NIPPON DENSO
* Type : Bosch PE - P NB (EP9)
* Lubrication method : Forced lubrication with engine oil.

GOVERNOR :

* Type : RSV Centrifugal, all - speed type.

FUEL INJECTION NOZZLE





1. Inlet connector
2. Nozzle holder
3. Nozzle spring
4. Nozzle
5. Frange

FUEL INJECTION NOZZLE

* Type :

Multi - hole type
BS6D125G1 :
Made by NIPPON DENSO
Multi - hole type

a. From injection pump
b. Nozzle hole
c . to fuel tank

* Injection pressure
BS6D125G1 : 250 kg / cm²

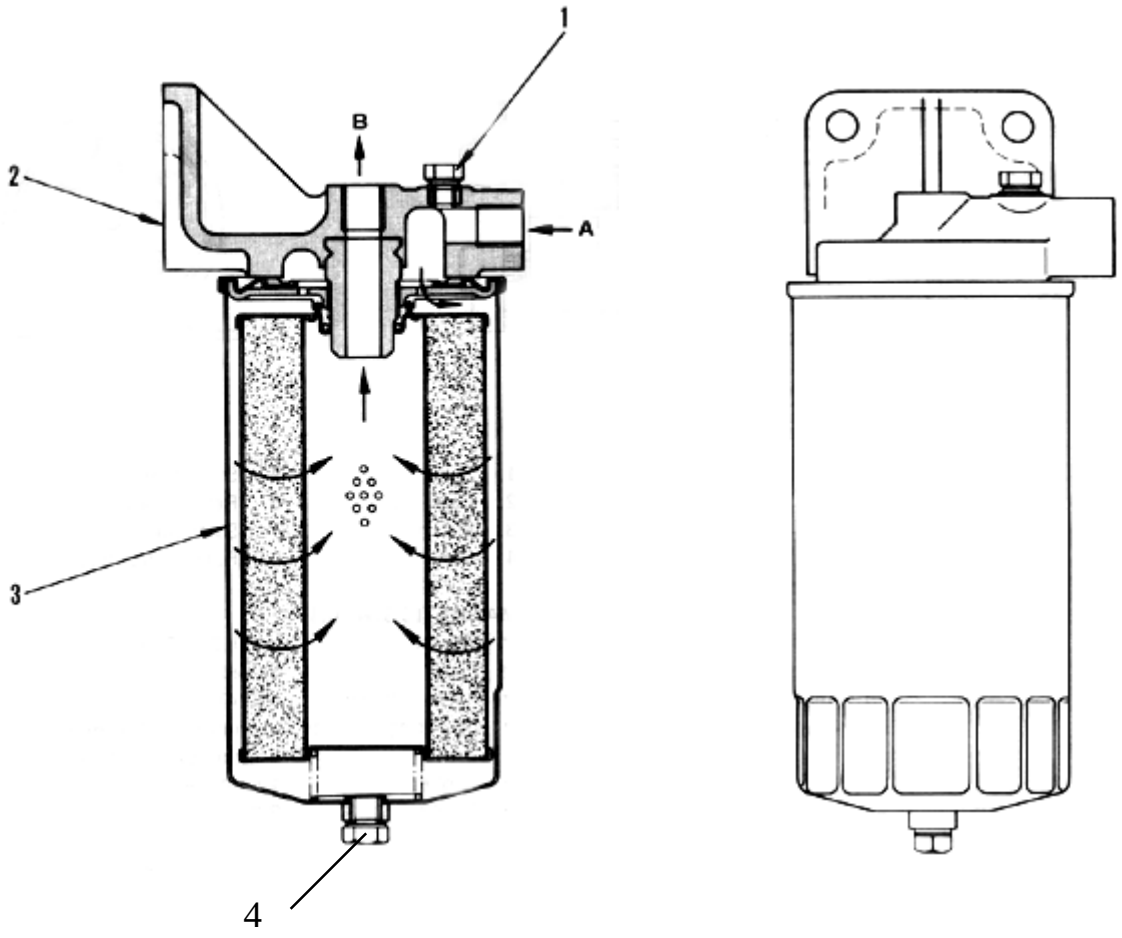
* Adjustment injection pressure :
Shim adjusting type
* Adjusting value (per shim thickness 0.1 mm)

BS6D125G1 : Approx. 14 kg / cm²

* Adjusting shims (at intervals of 0.025 mm)

BS6D 125-1 : 0.5 to 1.975 mm

FUEL FILTER



1. Air bleed plug
2. Bracket
3. Cartridge
4. Water drain plug

A. Fuel inlet

B. Fuel outlet

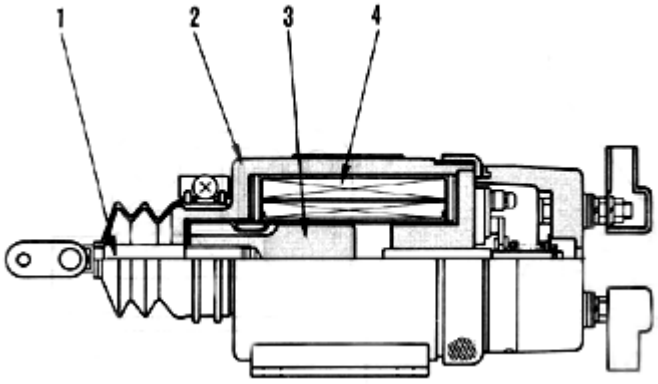
FUEL FILTER :

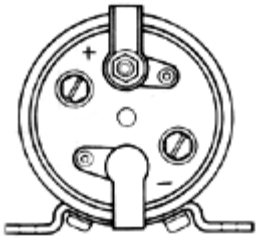
* Filtration area : 0.3 m^2

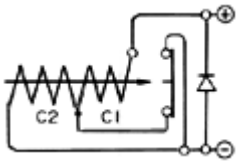
MAGENTIC SWITCH AND FUEL SOLENOID

MAGENTIC SWITCH

B contact (electricity flows in oridinary operations) method







Inner wiring

C1. Pull - in coil
C2. Holding coil

1. Shaft
2. Case
3. Piston
4. Coil
5. Stop lever
6. Return spring
7. Solenoid
8. Fuel control lever

MAGNETIC SWITCH :

* Maker	: NIKKO DENKI
* Type	: Sealed
* Rated voltage	: DC 24V
* Operating current	: Maximum : 35 A max. Continuity : 0.5 A max
* Stroke	: 12 ± 0.3 mm
* Weight	: 3.3 kg

FUNCTION :

* Starting engine :

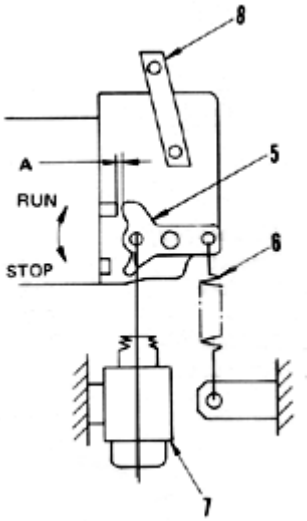
  When the starting key is turned on, the solenoid is energized.
  Solenoid shaft (1) is electrically attracted, pulling injection pump stop lever (5) and fixing it in the RUN position.

* Stopping engine :

  When the starting key is turned off, the solenoid is de - energized.
  Injection pump stop lever (5) is returned to STOP position (non - injection position) by return spring (6).

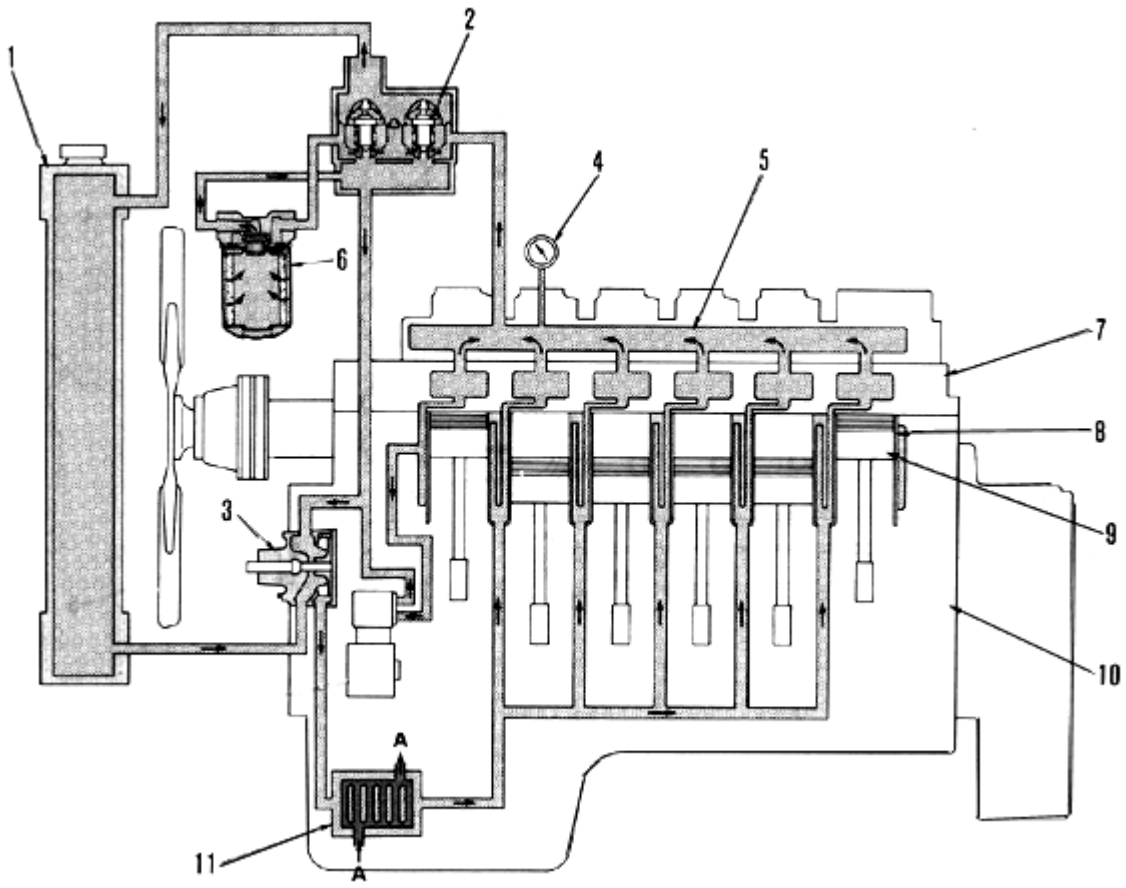
* During operation, the amount of fuel injection is controlled by fuel control lever (8).

* When installing the fuel solenoid, adjust clearance A referring to TESTING AND ADJUSTING.



COOLING SYSTEM

COOLING SYSTEM CHART

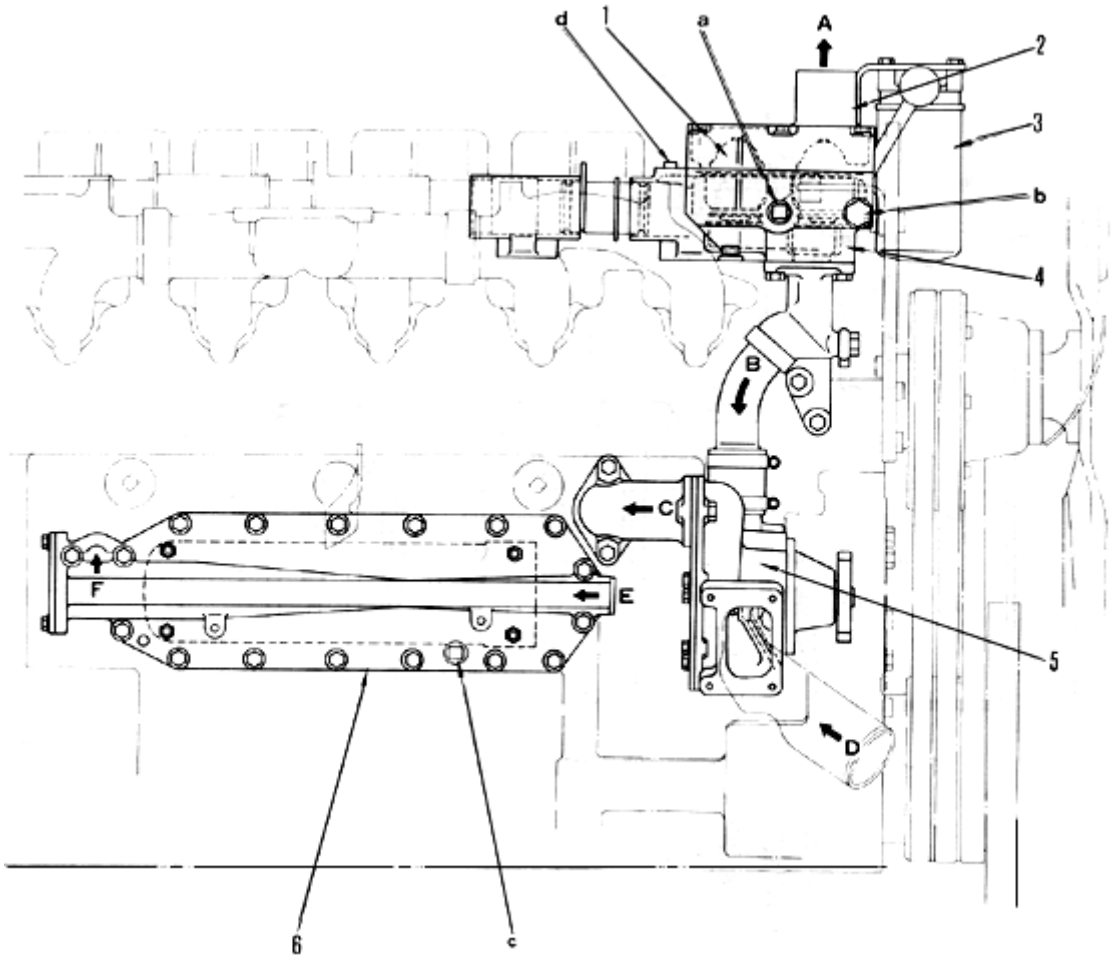


1. Radiator
2. Thermostat
3. Water pump
4. Water temperature gauge
5. Water manifold
6. Corrosion resistor (if equipped)
7. Cylinder head
8. Cylinder liner
9. Piston
10. Cylinder block
11. Oil cooler

A. Lubrication oil

WATER PUMP

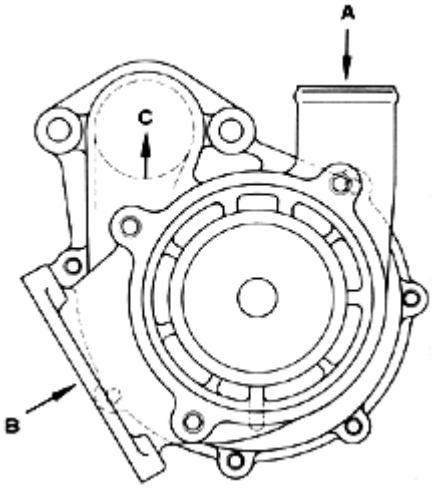
MOUNTING

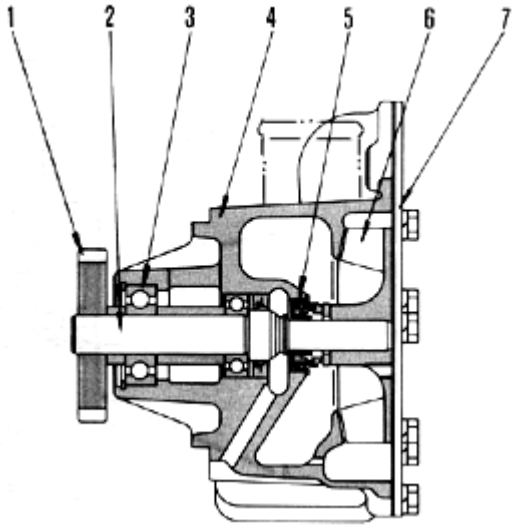


1. Thermostat
2. Housing cover
3. Corrosion resistor
4. Thermostat housing
5. Water pump
6. Oil cooler

A. To radiator (coolant)
B. From engine each part (coolant)
C. To engine each part thru oil cooler (coolant)
D. From radiator (coolant)
E. From oil pump (oil)
F. To engine each part (oil)
a. Outlet for heater
b. Water temperature gauge pick - up
c. Coolant drain plug
d. Outlet for air bleed tube

WATER PUMP





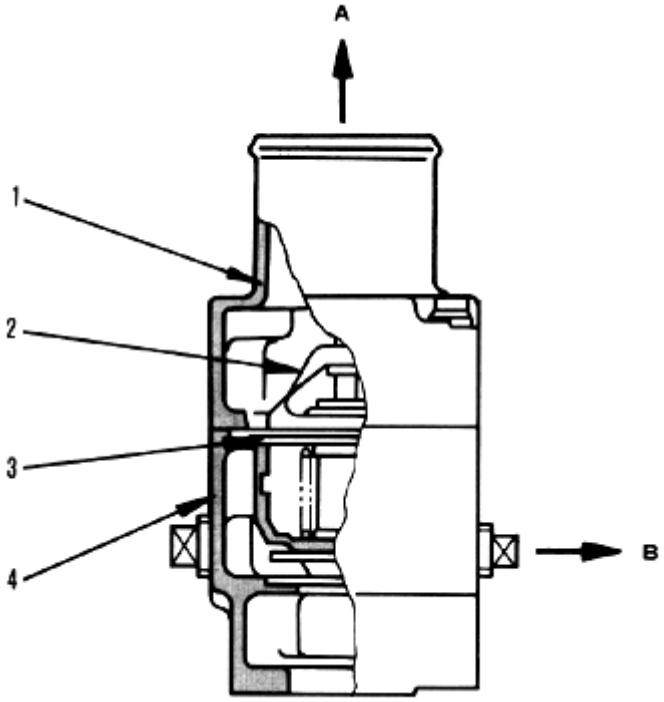
1. Water pump drive gear
   (No. of teeth : 22)
2. Pump shaft
3. Ball bearing
4. Pump body
5. Water seal
6. Impeller
7. Pump cover

A. From thermostat
B. From radiator
C. To engine each part

WATER PUMP :

***** Type : Centrifugal gear drive.
* Pump speed : Engine speed x 1.5

THERMOSTAT



1. Housing cover
2. Thermostat
3. Gasket
4. Thermostat housing

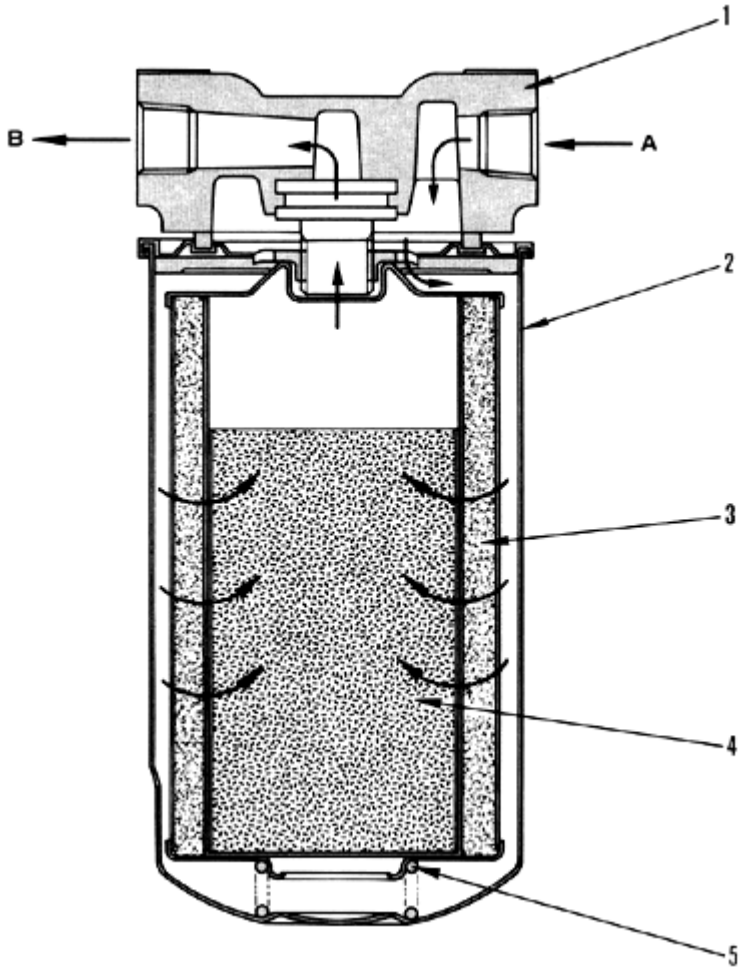
A. To radiator
B. To corrosion resistor (BS6D125G1)

THERMOSTAT :

* Valve cracking temperature	: 74.5 - 78.5° C
* Full open temperature	: 90° C
* Full open lift	: Min. 10 mm

CORROSION RESISTOR

(If equipped)



1. Head
2. Cartridge
3. Element (Paper)
4. Element (Chemicals)
5. Spring

A. Water inlet
B. Water outlet

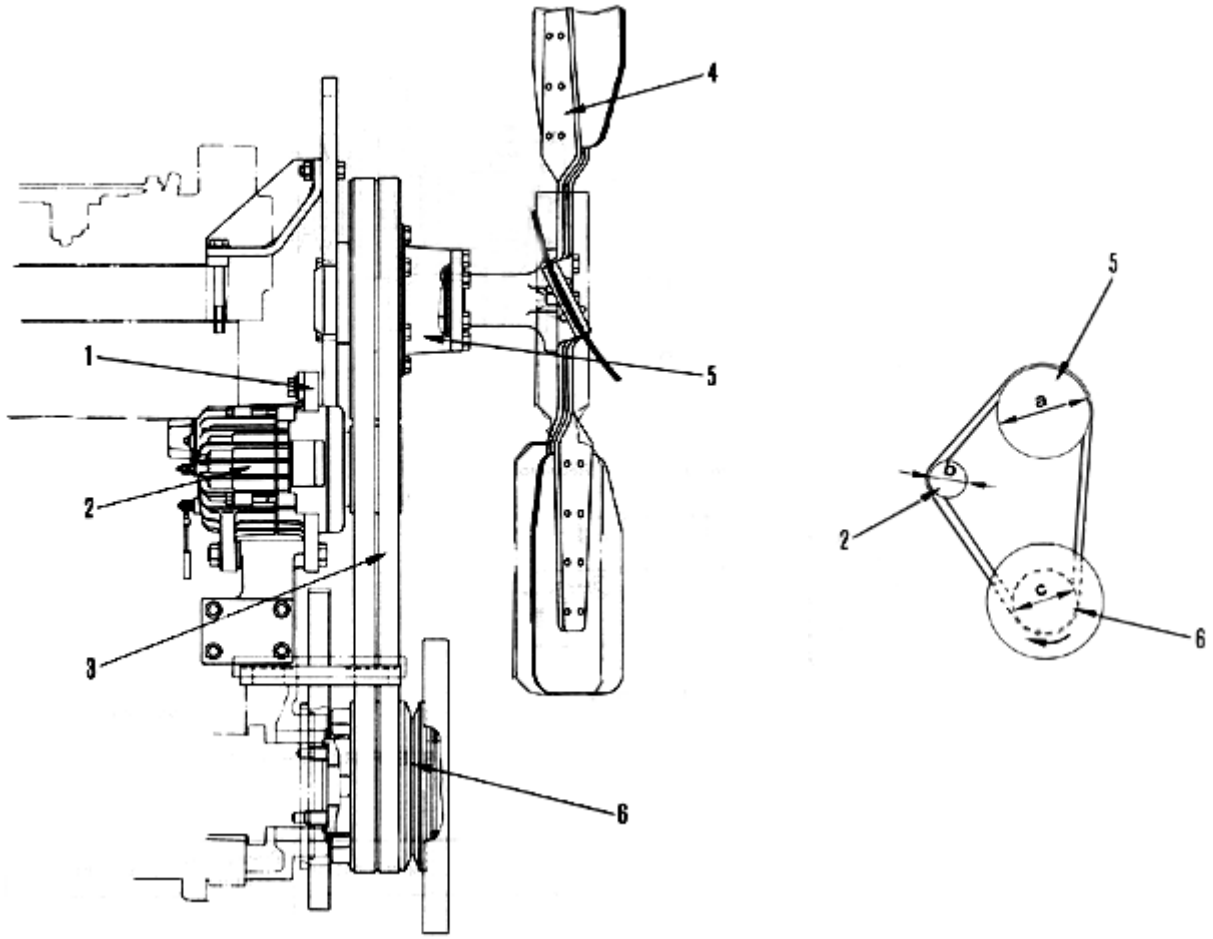
CORROSION RESISTOR :

***** Filtration area : 0.5 m^2

ELECTRICAL SYSTEM

ALTERNATOR

MOUNTING



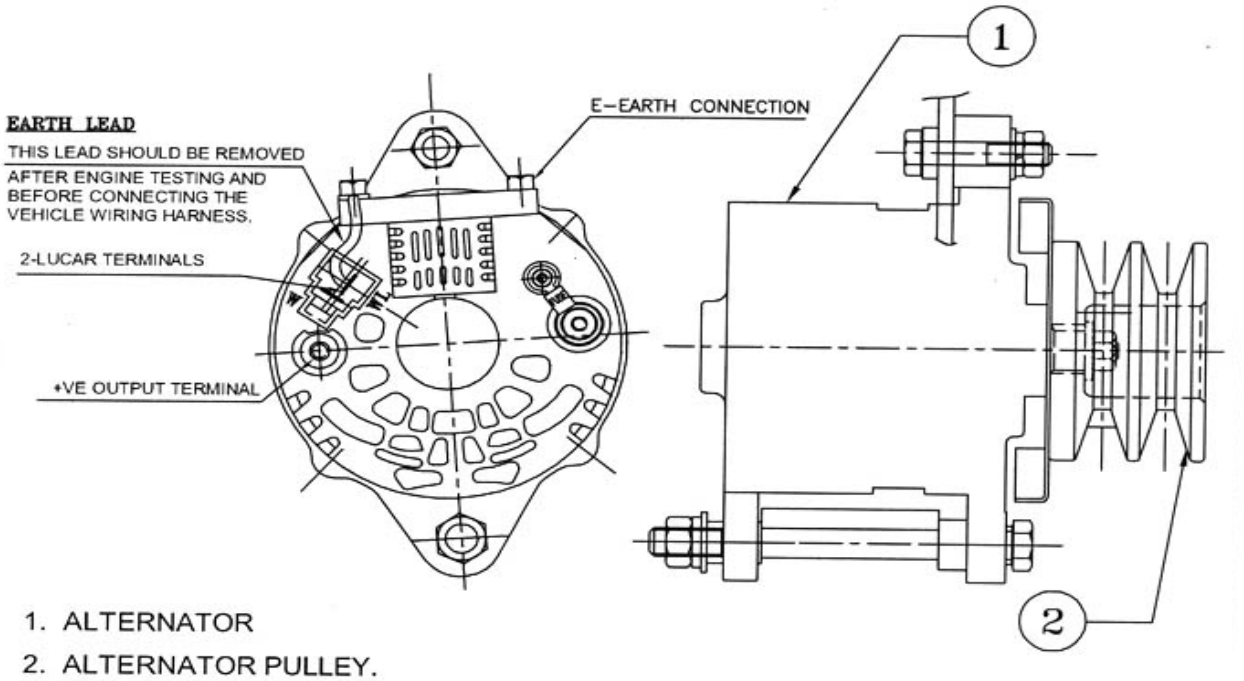
1. Adjustment plate
2. Alternator
3. Fan belt
4. Fan
5. Crankshaft pulley

a. Fan pulley O.D
b. Alternator pulley O.D
c. Crankshaft pulley O.D

* Pulley O.D

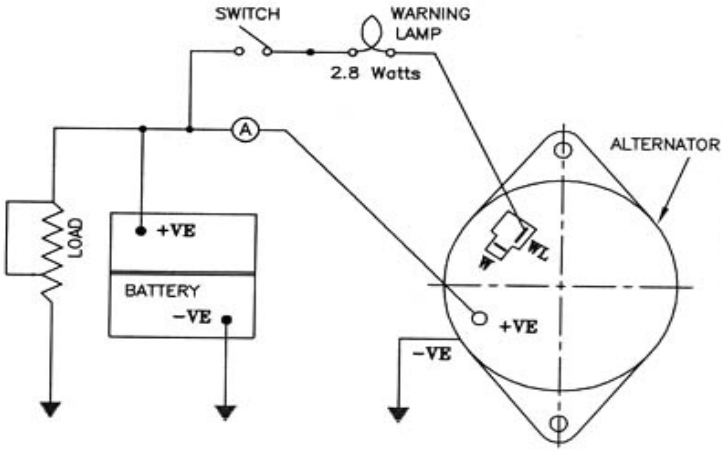
Engine model	Applicable machine	Pulley O.D (mm)		
		a	b	c
BS6D125G1	PES100	189	95	182

ALTERNATOR , PES100 GENSET



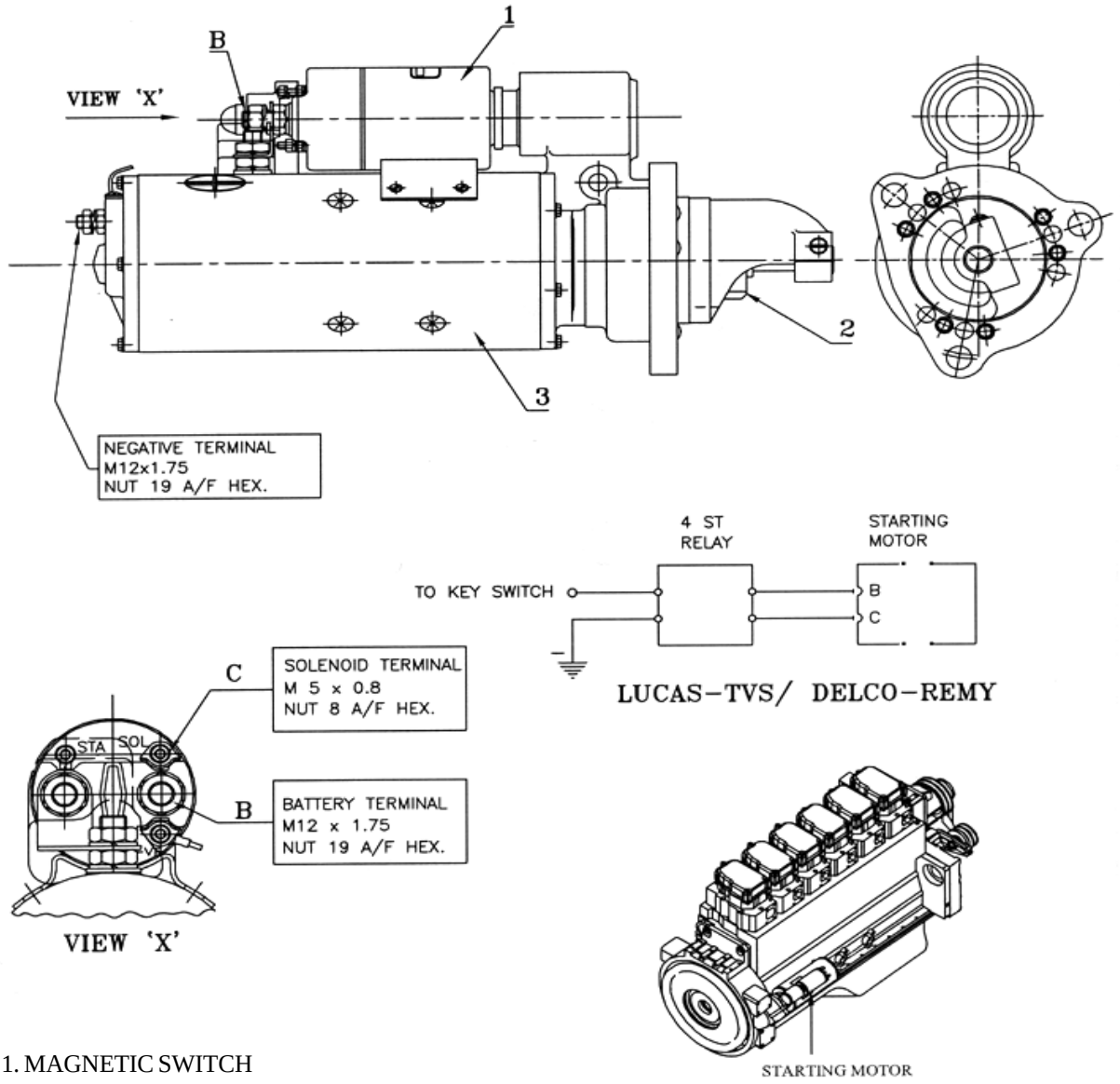
1. ALTERNATOR
2. ALTERNATOR PULLEY.

TERMINAL	SIZE	TIGHTENING TORQUE
+VE	M8x1.25	45kg.cm~55kg.cm
-VE	M6x1	25kg.cm~30kg.cm
WL	LUCAR 6.35x0.8t	—
W	—"—	—
W= A.C PHASE TAP TERMINAL (UNREGULATED VOLTAGE TERMINAL)		



ENGINE MODEL	APPLICABLE MODEL	TYPE	SPECIFICATION	PULLEY O.D (mm)	WEIGHT (kg)
BS6D125G1	PES100 GENSET	LUCAS TVS (SM 130 PE)	24V , 30A	90	5.5

STARTING MOTOR, PES100 GENSET



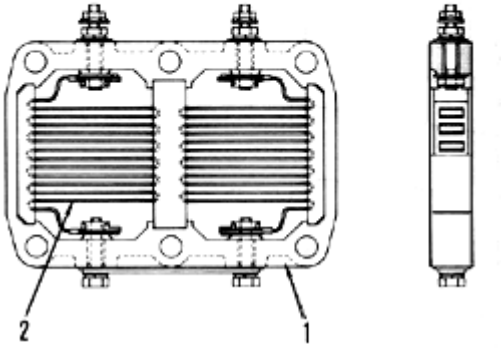
1. MAGNETIC SWITCH
2. PINION GEAR
3. STARTING MOTOR

B,C,E : TERMINALS

ENGINE MODEL	APPLICABLE MODEL	TYPE	SPECIFICATION	NUMBER OF TEETH	WEIGHT (kg)
BS6D125G1	PES100 GENSET	LUCAS TVS (SM 130 PE)	24V ,7.5 kW	12	32

ELECTRICAL INTAKE AIR HEATER

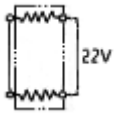
RIBBON TYPE



1. Body
2. Heater coil

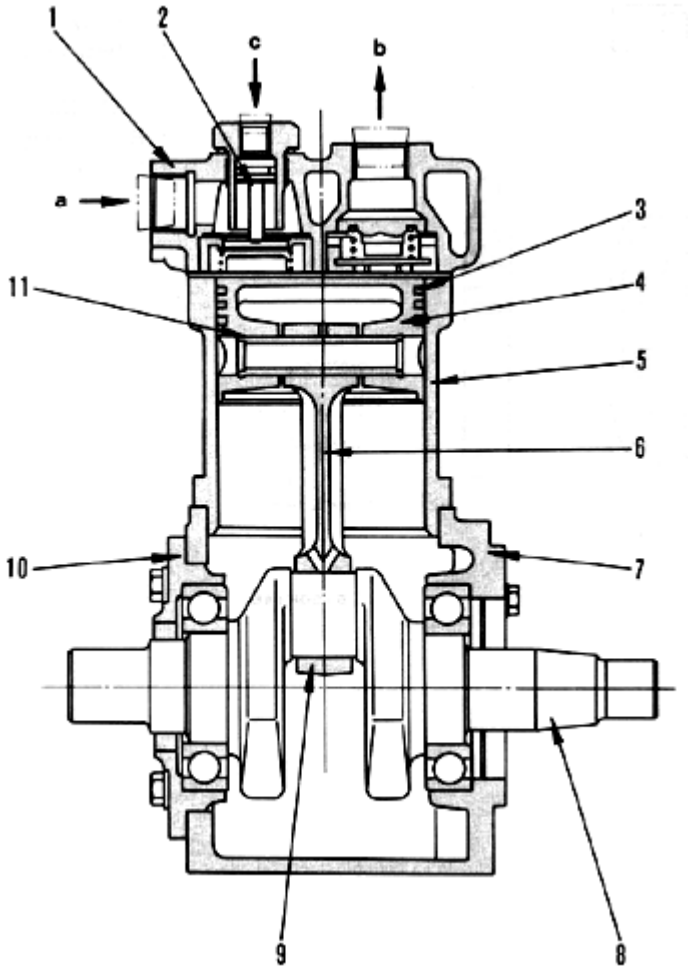
ELECTRICAL INTAKE AIR HEATER

* Rated voltage : DC24V
* Rated current : 111A



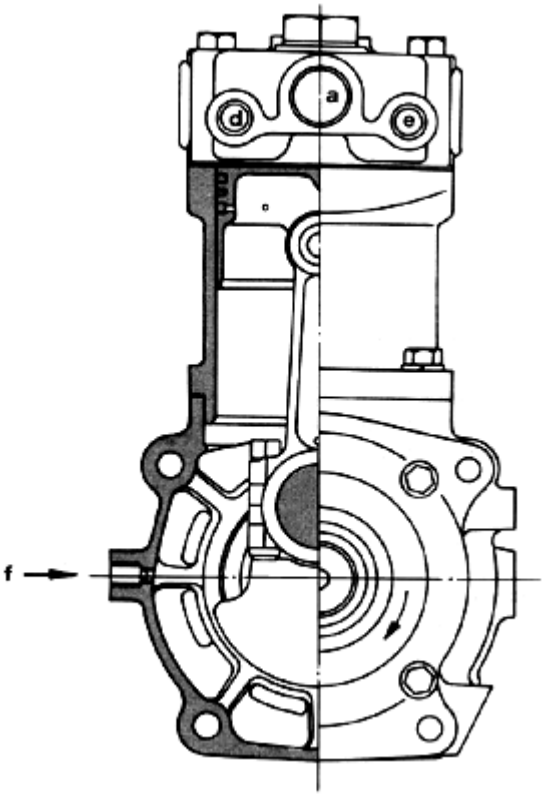
Inner wiring

ACCESSORY
AIR COMPRESSOR



1. Cylinder head
2. Unloader valve
3. Piston ring
4. Piston
5. Cylinder block
6. Connecting rod
7. Crank case
8. Crankshaft
9. Connecting rod cap
10. Bearing cover
11. Piston pin

a. Air intake
b. Air exhaust
c. Unloader
d. Cooling water inlet
e. Cooling water outlet
f. Oil inlet



AIR COMPRESSOR

* Maker	: DIESEL KIKI
* Type	: Single cylinder, double acting
* Discharge volume	: 340 cc / rev.
* Air pressure	: 8.5 kg / cm² (at full load)
* Weight	: 11 kg

UNLOADER VALVE

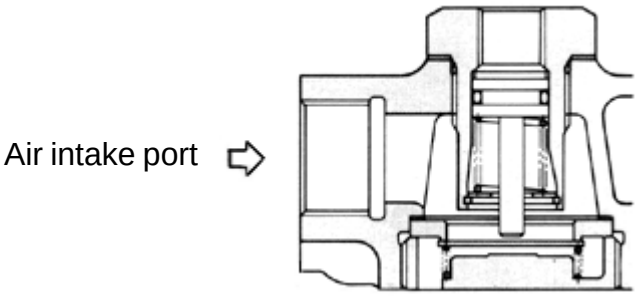
* Valve opening pressure	: 6.3 kg / cm²
* Valve shutting pressure	: 5.4 kg / cm²

OUTLINE :

The air compressor is installed between the engine timing gear and fuel injection pump, and is driven by the timing gear. It is connected directly to the engine, so the air compressor always rotates when the engine is rotating.

ACTION OF UNLOADER VALVE :

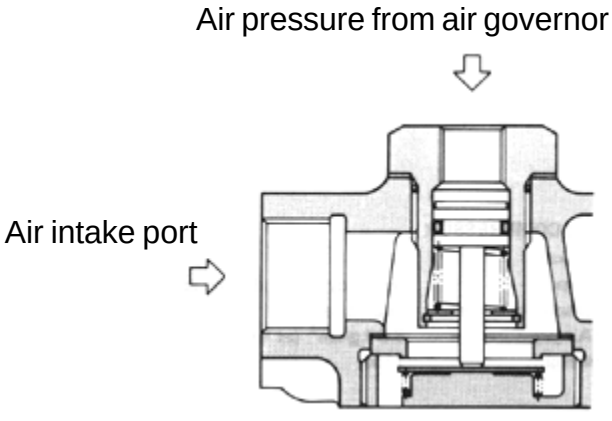
1) The intake valve and delivery valve automatically open and close according to the pressure inside the cylinder. During the piston up-stroke, the air inside the cylinder is compressed, the intake valve is closed,and the delivery valve opens to discharge the compressed air. On the down-stroke, the delivery valve closes and the intake valve opens to suck in air from the air cleaner.



When intake valve is actuated

2) An air governor is installed to control the amount of air inside the air tank. When the air pressure inside the air tank reaches the specified pressure, the compressed air inside the tank passes through the air governor, and pushes down the rod of the unloader valve to keep the intake valve open . As a result , while the unloader valve is being actuated, the intake air is not compressed.

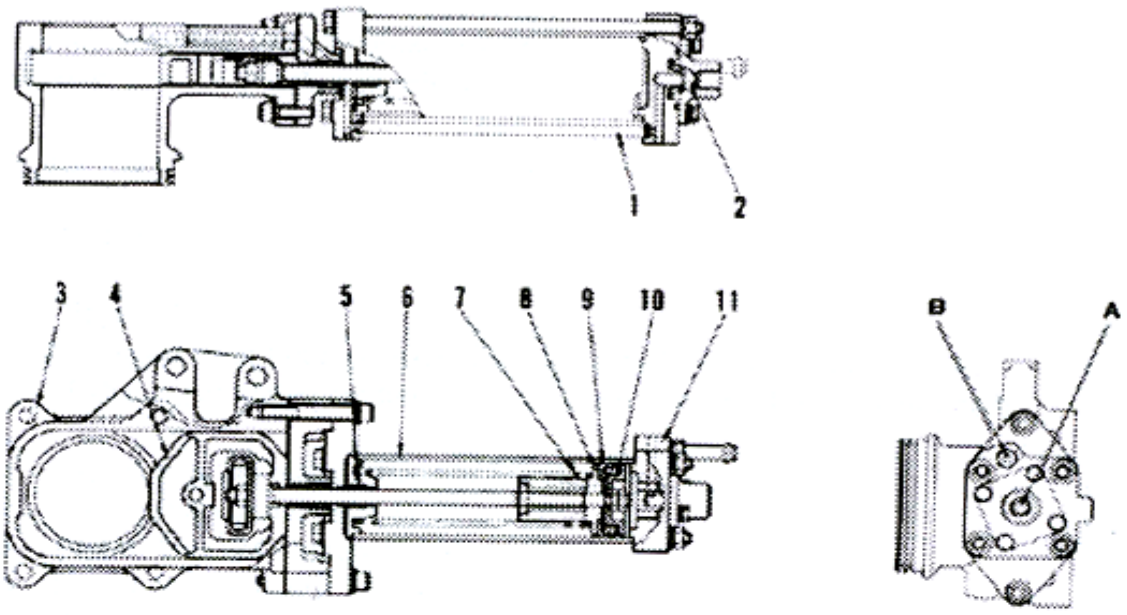
3) If the air pressure inside the air tank goes below the specified pressure of the air governor, the rod of the unloader valve returns to its original position. The intake valve then returns to its normal operation, and starts to send compressed air again.



When intake valve is kept open

EXHAUST BRAKE

For HD200D- 3, HD205- 3



1. Pipe
2. Poppet
3. Valve housing
4. Gate valve
5. Guide bushing
6. Cylinder
7. Spring
8. Piston
9. Piston packing
10. Retainer
11. Head cover

A. From solenoid valve
B. Exhaust gas exist

OUTLINE :

* Exhaust brake mounting between engine turbo-charger and muffler works due to air pressure from solenoid valve.
The exhaust brake throttles exhaust passage between turbocharger and muffler, and reduces engine speed.
The exhaust brake consists of valve mechanism and air cylinder which operates a valve.

ENGINE

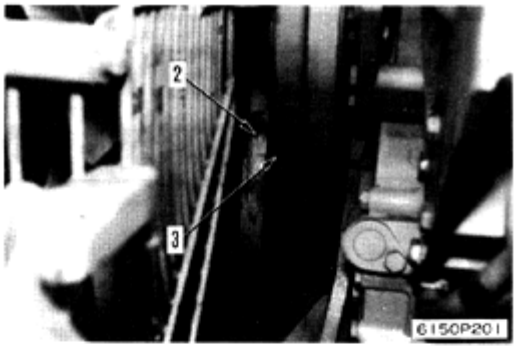
13 TESTING AND ADJUSTING

ENGINE BODY

ADJUSTING VALVE CLEARANCE

ADJUSTEMENT PROCEDURE

1. Remove the cylinder head cover.
2. Rotate the crankshaft in the normal direction. while watching the movement of the intake valve of the No.6 cylinder, bring the No.1 cylinder into the top dead center poistion of the compres sion stroke and align the "1.6 TOP" mark on vibration damper (2) with pointer(3).



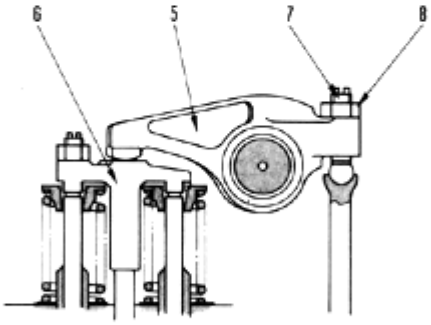
★ When the No. 1 cylinder comes near the top dead center of the compression stroke, the No.6 intake valve will start to move (open).

3. Adjust the clearance for valves ● marked in the valve arrangement chart.

● **Valve arrangement chart**

Cylinder No.	1	2	3	4	5	6
Exhaust valve		●	○	●	○	●	○
Intake valve	●	●	○	●	○	○	

4. Rotate the crankshaft in the normal direction by one revolution and adjust the valve clearance for the remaining valves ○ marked.

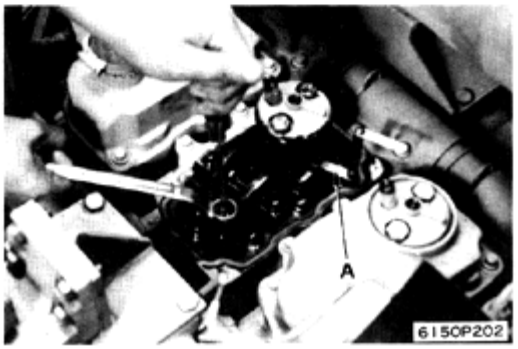


★ To adjust the valve clearance, loosen locknut (8) on adjustment screw (7), insert Feeler gauge **A** corresponding to the specified clearance between crosshead (6) and rocker arm (5), and adjust the clearance with the adjustment screw until the thickness gauge can slide lightely.

5. After the clearance is properly adjusted, tighten the locknut to secure the adjustment screw.

kgm

Locknut: 7 ± 0.5 kgm



★ The engine firing order: 1-5-3-6-2-4

★ Intake and exhaust valve clearances may be adjusted for each cylinder in firing order by rotating the crankshaft 120° at a time in the normal direction.

★ For details about valve clearance, see TESTING AND ADJUSTING DATA.

MEASURING COMPRESSION PRESSURE

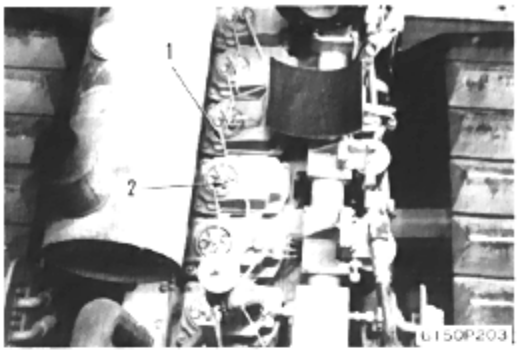
MEASUREMENT PROCEDURE

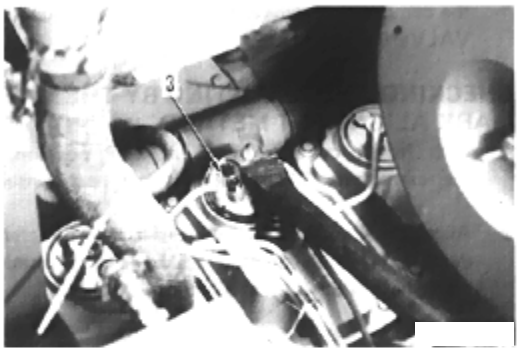
⚠ While measuring the compression pressure , take care not to burn yourself on the exhaust manifold or muffler , and be careful not to get caught in any revolving part of the engine

* Measure the compression pressure while the engine is warm.

(Oil temperature : 40-60°C)

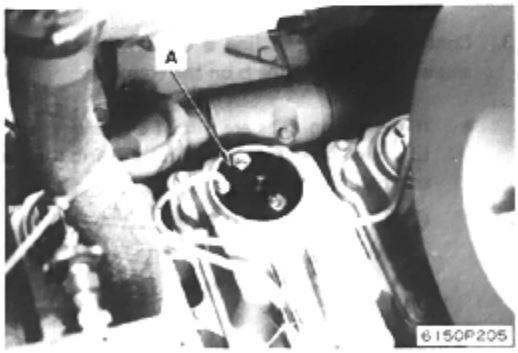
1. Adjust valve clearance properly.
   For details, see ADJUSTING VALVE CLEARANCE.
2. Remove spill tube (1) and disconnect fuel injection pipe(2).
3. Remove the nozzle holder assembly (3) for each cylinder.
   - ★ Remove the nozzle holder assembly by prying it with two mounting bolts.
   - ★ Take care not to let any dirt or foreign matter get into the cylinder.





4. Install adapter **A** the nozzle holder mounting section of the cylinder to be measured, and tighten the adapter to the specified torque.

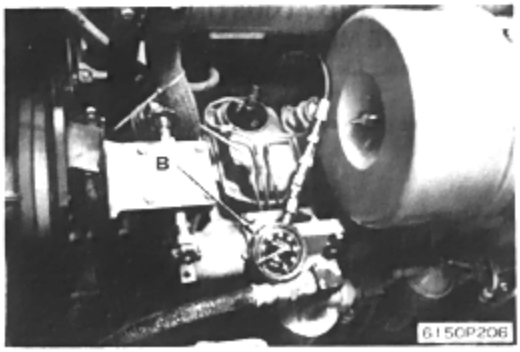
   kgm Torque: 2.2 ± 0.3 kgm



5. Connect compression gauge **B** to the adapter.

6. Place the fuel control lever in NO INJECTION position. Crank the engine with the starting motor and read the gauge when the pointer is stabilized.

   ⚠ If you do not put the fuel control lever in NO INJECTION position fuel will blow out.
   - ★ Most compression leakage can be prevented by applying a small amount of oil to the mounting section of the adapter.
   - ★ For the reference values of the compression pressure, see TESTING AND ADJUSTING DATA .



FUEL SYSTEM

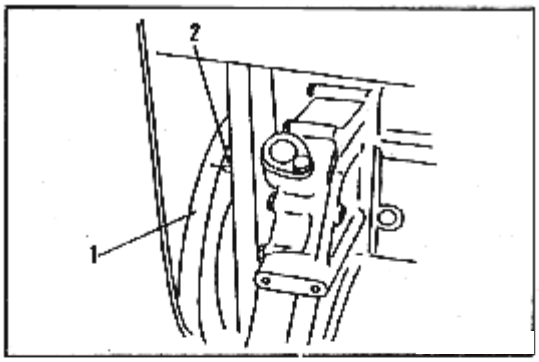
CHECKING AND ADJUSTING FUEL INJECTION TIMING

There are two methods for checking and adjusting the fuel injection timing of an injection pump.

- The " MATCH MARK ALIGNMENT " method, which is used when the injection pump is installed to the original engine and the pump is not being repaired.
- The " DELIVERY VALVE " method, which is used when a repaired or replaced injection pump is installed to the engine.

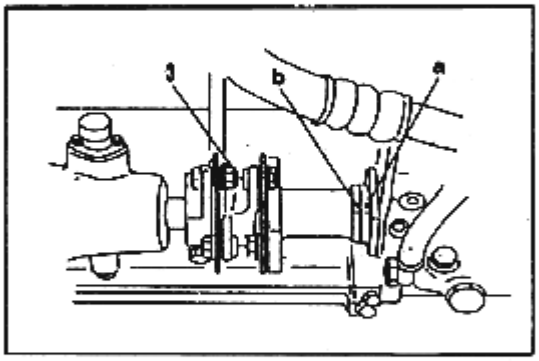
- When using the "DELIVERY VALVE " method, make preparations to replace the delivery valve copper gasket and O-ring with new parts.

★ Before inspecting and adjusting the fuel injection timing bring the No. 1 cylinder piston to the top dead center of the compression stroke.
For details, see 12 ADJUSTING VALVE CLEARANCE .



- **CHECKING AND ADJUSTING BY THE MATCH MARK ALIGNMENT METHOD.**

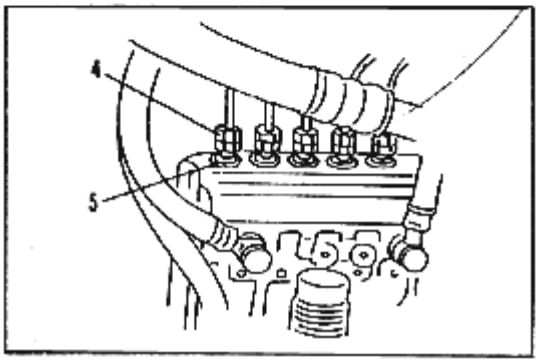
1. With No. 1 cylinder piston at TOP position, rotate the crankshaft 30° to 40° in the reverse direction.
2. Align the injection timing stamp line on crankshaft damper (1) with pointer (2) by slowly rotating the crankshaft in the normal direction.



3. Confirm that stamp line **a** on the injection pump is aligned with stamp line **b** on the coupling.

★ If the stamp line are out of alignment, loosen nut (3) align the stamp lines by shifting the coupling and tighten the nut.

kgm Nut: 6.2 ± 0.2 kgm



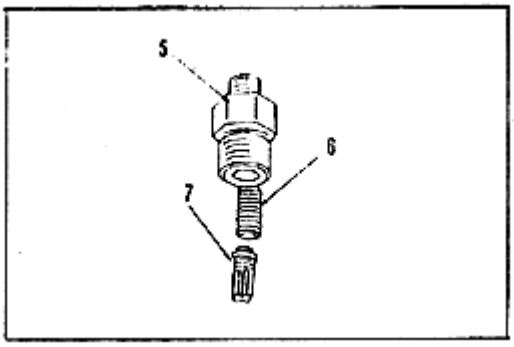
- **CHECKING AND ADJUSTING BY THE DELIVERY VALVE METHOD.**

1. Disconnect fuel injection pipe (4) for the No.1 cylinder

2. Remove delivery valve holder (5).

3. Remove spring (6) and delivery valve (7) from the delivery valve holder, and reassemble the delivery valve holder.

4. With No.1 cylinder piston at TOP position, rotate the crankshaft 30° to 40° in th reverse direction.



5. Place the fuel control lever in FULL position, slowly rotate the crankshaft in the normal direction while operating the priming pump, and observe the position when the fuel stops flowing out of the delivery valve holder.

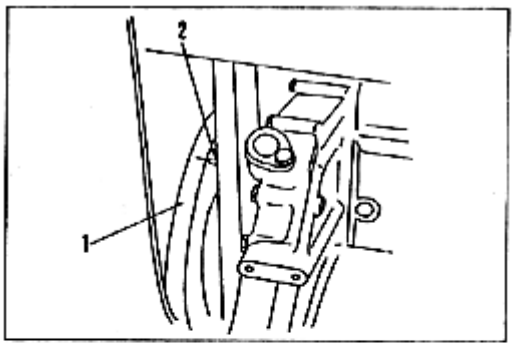
6. In the position where the outflow of fuel stops, check the injection timing stamp line on the crankshaft damper to see if it is aligned with the pointer.

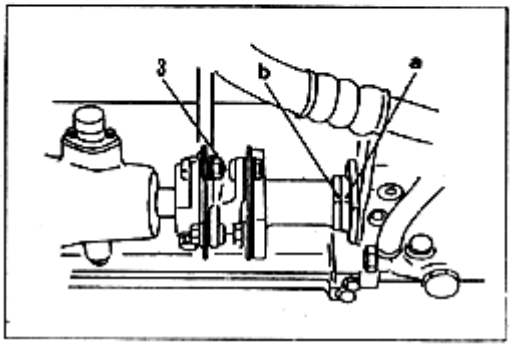
- If the injection timing stamp line passed through the pointer : The injection timing is late.

- If the injection timing stamp line did not reach the pointer : The injection timing is advanced.

★. If the inspection shows that the injection timing is out of adjustment, adjust the fuel injection timing in the following manner.

1) Rotate the crankshaft 30° to 40° in the reverse direction, starting from TOP position in No. 1 cylinder.
2) Align the injection timing stamp line on damper (1) with pointer (2) by slowly rotating the crankshaft in the normal direction.
3) Loosen nut (3) on the injection pump mounting flange slot, and rotate the flange on the pump side little by little by operating the priming pump until no fuel flows out of the delivery valve holder.
4) Tighten the nut on the injection pump mounting flange slot.
   ★ Recheck the injection timing to see if it is is properly adjusted.
5) Align match mark **a** with mark **b** and stamp the marks.



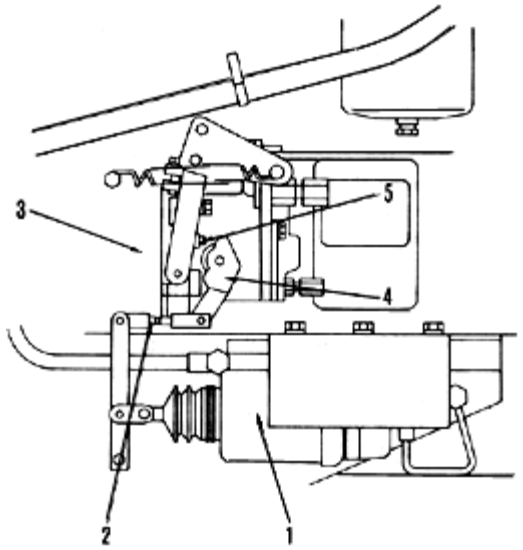


★. After the checking and adjusting, be sure to reassemble the spring and the delivery valve.

★. Always replace the delivery valve copper gasket and O-ring with new parts.

TESTING AND ADJUSTING FUEL CUT SOLENOID

1. Adjust rod (2) so that there is clearance of 0.4 ± 0.1 mm between stop lever (4) and stopper (5), while pulling rod (2) to the running direction.
2. Turn on the engine starting key and confirm that the solenoid has a stroke of 12 mm and the clearance of 0.4 ± 0.1 mm.
3. After turning on and off the key two or three times, reconfirm that solenoid works smoothly and engine runs or stops completely.
   ★ If the solenoid does not work smoothly, solenoid coil burns in the cause of excessive current or flywheel horsepower downs in the cause of dropping fuel injection volume.



1. Solenoid valve
2. Rod
3. Fuel injection pump
4. Stop lever
5. Stopper

BS6D125- 1, BSA6D125- 1 :

1. A rod forms a link between the solenoid and injection pump. At this time, when the stop lever returns 0.5 - 1.0 mm from the stop pin on the RUN side and the solenoid shaft is pushed by hand, the stop lever of the pump will be set in a position in which it has returned 0.5 - 1.0 mm from the stop pin.

2. Next, energize the solenoid and see if its movement is smooth. Turn the starting switch ON and OFF two to three times and confirm that the operation condition does not change. If the operation is not smooth, adjust the linkage and carefully observe the movement.

3. Confirmation of Functions
   After confirming that the operation is smooth, start the engine and confirm that the rated output can be obtained. Next, energize the solenoid and confirm that the engine stops. (The engine should stop within **10** sec.)

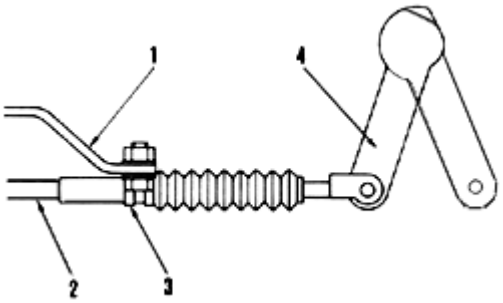
★ **Failures caused by faulty adjustment of solenoid :**

If the clearance between the stop bolt and lever is 0 when the solenoid is energized.	★ Burning of the solenoid core (when solenoid is only partially pulled). ★ Breakage or scuffing of the injection pump governor (an undue force will be applied to the lever)
When there is a large clearance between the stop lever and **RUN** side bolt when the lever is free (faulty linkage).	★ Engine power will be generated because of a decline in amount of fuel injection

.....Continue

PROCEDURE FOR ADJUSTING MOTOR CABLE

When the cable is pulled and stop lever (4) of the fuel injection pump is aligned with the STOP position, the cable will be fastened to bracket (1) with clamp (3). To give some play to the cable, remove the ball joint, turn the ball joint one revolution in the opposite (extension) direction, then reinstall it to the stop lever of the fuel injection pump.
(Note that it is also acceptable to install the ball joint from the beginning after estimating how much play the cable needs.)



1. Bracket
2. Wire
3. Clamp
4. Fuel injection pump stoplever

.....Continue

1. Stop the engine.

2. Install a ball joint to the injection pump stop lever, then temporarily fit the cable connecting the wiper motor and injection pumps.

3. Pull the injection pump stop lever by hand to the NO INJECTION postion, and temporarily fix the cable to the bracket.
   When doing this, temporarily fit the cable to the bracket using the holding nut with the stop lever contacting the ENGINE STOP stopper.

* The engine stop motor is delivered with the cable pulled (engine stopped).
* The stop lever of the fuel injection pump is at the RUN position when the lever is free. (It is pulled to the RUN position by a spring).

4. When the wiper motor is installed (engine stopped), adjust so that the clearance between the stop lever of the fuel injection pump and the STOP stopper is 0.5 - 2.5 mm. Carry out the adjustment with the nut holding the cable to the bracket, or make fine adjustments by changing the amount the ball joint is screwed in.

5. Tighten all bolts and nuts.

6. Turn the engine starting switch ON and OFF repeatedly, and check that the engine stop motor and cable move smoothly. Then check the following points again.
   (1) When the engine is running, check visually that there is slack in the engine stop motor cable, and that the stop lever of the fuel injection pump is fully returned **o** the **RUN** position.
   (2) Check again that the clearance between the stop lever and STOP stopper is 0.5 - 2.5 mm when the engine is stopped.

* The engine stop motor has limit switches built in on both sides of the cable stroke.
* Engine stop motor stroke : 35 mm
  Fuel injection pump stop lever stroke : 30 mm

* When the engine is running, there is slack in the engine stop motor cable, and the **RUN** position is maintained by the action of a spring (this is frequently built in the fuel injection pump).

* There is a loose spring inside the engine stop motor, and this absorbs the tolerance of the stop, motor when the engine is stopped. However, if it is absorbed by the loose spring of the engine stop motor, force is applied to the injecdtion pump, so depending on the model, this may be impossible.
  With such models , if the clearence between the stop lever and STOP stopper is made zero when the engine is stopped , there is a risk that problems may occur with the injection pump.

* Problems caused by defective adjustment of the engine stop motor cable.

★ When the clearance between the stop lever and STOP stopper is excessive with the engine stop motor cable pulled.	★ Engine does not stop.
★ When the clearance between the stop lever and the RUN stopper is excessive at the free position.	★ Fuel injection amount drops, causing loss of engine output power.

FUEL INJECTION PUMP CALIBRATION DATA

PES100 GENSET (NIPPON DENSO)

PUMP ASSEMBLY NUMBER

31Z 710 1682

Injection Pump Type	Pump Manufacturer
PE-6P	DIESEL KIKI

Applicable machine		Applicable engine	
PES100		BS6D125G1	

Rotating direction	: Counter Clockwise viewed from Drive End
Injection Order	: 1 - 5 - 3 - 6 - 2 - 4
Injection Interval	: 60º ± 30'
Plunger pre stroke mm	: 3.8 ± 0.05
Delivery valveRetraction volume mm³/st	: 80

ENGINE SPECIFICATION WITH FAN : (Reference Only)

Rated power	kW @ r/min	:	123 / 1500
Maximum torque N-m	@ r/min	:	--
High idling	r/min	:	1545±5
Low idling	r/min	:	700 ~ 750

CALIBRATION STANDARD

Condition					Manufacturer Standard			Service Standard
Service standard indicates data using calibration test parts	Nozzle part no.				--			--
	Nozzle holder part no.				--			--
	Injection pipe (OD x ID x L)	mm			ϕ6 x 2.2 x 650			--
Manufacturer standard is data for factory test.	Test oil				ASTM D975 No. 2 Diesel fuel			
	Oil temperature	°C			40 to 45			40 to 45
	Nozzle opening pressure	Kgf/cm²			250			250
	Transfer pump pressure	Kgf/cm²			1.6			1.6

Injection Volume					Manufacturer Standard mm³/st			Service Standard mm³/st	
Rack position are the reference when adjusting the injection volume arks * are average volumes.		Rack position (mm)	Pump speed (r/min)	Basis	allowance	Maximum variance between cylinder	Basis	allowance	Maximum variance between cylinder
	--	--	750	121	111~124	≤6	--	--	--
	--	--	360	16	14~18	≤4	--	--	--
	--	--							
	--	--							
	--	--							

PERFORMANCE TEST

RUN-IN STANDARD ★ Load are given for the case of the dynamometer arm length is 716 mm. This list shows the standard on condition that the fan is removed.

Engine model	Applicable machine	Item	Order 1	2	3	4	5	6	7
BS6D125G1	PES100	Running time (min)	5	10	15	15	15	--	
		Engine speed (r/min)	700	1,000	1,200	1,400	1,500	--	
		Load (Nm)	-	235	392	588	784	--	
		Output (kW)	-	24	67	86	123	--	
		Running time (min)							
		Engine speed (r/min)							
		Load (Nm)							
		Output (kW)							
		Running time (min)							
		Engine speed (r/min)							
		Load (Nm)							
		Output (Kw)							
		Running time (min)							
		Engine speed (r/min)							
		Load (Nm)							
		Output (kW)							
		Running time (min)							
		Engine speed (r/min)							
		Load (Nm)							
		Output (kW)							
		Running time (min)							
		Engine speed (rpm)							
		Load (kg)							
		Output (hp)							
		Running time (min)							
		Engine speed (r/min)							
		Load (kg)							
		Output (hp)							

PERFORMANCE TEST CRITIREA

Engine model	Applicable machine	Test item	Specified value (fully equipped)	Engine speed (r/min)	Dynamometer (N.m)
B(S)6D125-1	PES100 BS6D125G1	Flywheel horsepower High idling speed Low idling speed	118 kW / 1500 r/min 1,545 r/min 725±25 r/min	1,500 1,540~1550 700~750	750-810 0 0

★ The values in the table are indicated at standard conditions (Atmospheric temperature 25°C, atmospheric pressure 750 mm Hg).
★ The values given for dynamometer loads output and torque are with the fan removed, so they differ from those of the specification.
★ Values are standardized under the following conditions: Muffler; air cleaner installed; alternator idling; and air compressor (if installed) open.
★ Dynamometer loads are given for the case of the arm length is 716 mm.
★ Fuel used: ASTM D975 No. 1 or No. 2 diesel fuel.
★ Lubrication oil used: CLASS - CD SAE30.
★ Exhaust temperature column **t** : (Intake temperature - 25°C)

NOTE '*': IF THE ENGINE OPERATES AT HIGH ALTITUDE , THE FUEL DELIVERY HAS TO BE REDUCED AS PER THE **FIP** CALIBRATION CHART

Output (Hp) / (kW)	**Torque (kgm) / (Nm)**	**Fuel consumtion (sec /200 cc)**	**Coolant temperature (°C)**	**Lubrication oil temperature (°C)**	**Lubrication oil pressure (kg/cm²)**	**Exhaust temperature (°C) (t = Intake temp.25°C)**
Rated 118	--	Min. 14	70 - 95	80-110	3.0-5.0	Max. 700
10% 130	860	Min. 12	70 - 95	80-110	3.0-5.0	Max. 700
25% 147	980	Min. 10	70 - 95	80min	min 1.5	Max. 700
Hi 0	0	--	70 - 95	80-110	3.0-5.0	Max. 700
Li 0	0	--	70 - 95	80min	Min 1.5	Max. 700

TESTING AND ADJUSTING DATA :
PES100 GENERATOR SET

Engine model				BS6D125G1			
Applicable machine model				PES100			
Classification	Item	Condition,etc	Unit	Standard	Permissible Value	Standard	Tolerance
Performance	Engine speed	Highidling speed	r/min	1,545±50	--		
		Low idling speed	r/min	725^{+50}_{+0}	--		
	Necessary	0° C	r/min	Min. 100	-		
	Starting speed	- 20° C (with starting aid)	r/min	Min. 85	-		
Intake and exhaust system	Intake resistance	At all speed	mmH_2O	Max. 300	650		
	Intake pressure	At rated output	mmHg	Max. 75	--		
	Exhaust pressure						
	Exhaust temperature (Turbine inlet temp.)	All speed	° C	Max. 700	Max. 700		
	Exhaust gas colour	At rated output	Bosch	Max.7.0	Max 8.0		
	At high idling		Unit	Max. 4.0	Max 5.0		
	Valve clearance (when engine is hot or cold.)	Intake valve	mm	0.33	--		
		Exhaust valve	mm	0.71	-		
Engine body	Compression Pressure (SAE30 oil)	Oil temperature: 40° C to 60° C (Engine speed)	Kg/cm² (r/min)	Min. 32 (200 - 250)	22 (200 - 250)		
	Blow-by pressure (SAE30 oil)	At rated output Water temperature: Min. 70° C	mmH_2O	Max. 150	Max. 300		
Lubrication system	Oil Pressure (Oil temperature: Min. 80° C)	SAE30 oil At rated output	Kg/cm²	2.7 - 5.0	Min 1.9		
		SAE10W oil	Kg/cm²	2.5 - 4.5	Min 1.8		
		SAE30 oil At low idling	Kg/cm²	Min. 1.2	Min 0.7		
		SAE10W oil	Kg/cm²	Min. 1.0	Min 0.7		
	Oil temperature	All speed (oil in oil pan)	° C	80 - 110	Max 120		
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	Max 1.0		
Fuel system	Fuel injection Pressure	Nozzle tester	Kg/cm²	250^{+10}_{+3}	Min 225		
	Fuel injection timing	B.T.D.C	degree	18 ± 1	18± 1		
Cooling system	Radiator pressure valve	Opening pressure (Differential pressure)	Kg/cm²	0.75± 0.1	0.7.5± 0.1		
	Fan speed	At rated engine speed	r/min	1,395 ±42	--		
	Fan belt tension	Deflects when pushed with a force of 6 kg	mm	6.5	5-8.5		

★ The values given in the Testing and Adjusting data are NOT for adjustment of the output.
Do not use these values as a guide to change the setting of the fuel injection pump.

ENGINE

TROUBLESHOOTING

⚠ When carrying out testing and adjusting , or troubleshooting , stop the machine on level ground , fit Safety pins, block the wheels , and apply the parking brake.

⚠ When carrying out operation with two or more workers , always use signals , and do not allow any unauthorized person near the machine.

⚠ When checking the water level , if the radiator cap is removed when the engine is hot , boiling water will spurt out ad may cause burns , so always wait for the engine to cool down before checking the water level

* When using the standard values table for judgement in testing , adjusting , or troubleshooting , it is necessary to be careful of the following points.

1. The standard values for the new machines in the standard values table are values given as reference from the standards for new machines and machines shipped from the factory. They should be used as values for estimating wear during operation or as target values when carrying out repairs.
2. The failure judgement standard values in the standard value table are values using estimated values based on the results of various tests and standard values for machines shipped from the factory. Use these values for reference together with the repair and operation history of the machine when judgement failures.
3. Do not use this standard values table as a standard for judgement claims

POINTS TO REMEMBER WHEN TROUBLESHOOTING

Troubleshooting means locating the basic cause of the failure, and carrying out swift repairs, and ensuring that the failure does not occur again.

When carrying out troubleshooting, it is of course important to understand the structure and function. But to carry out the troubleshooting effectively, a quick method is to carry out troubleshooting using the problems mentioned by the operator as a guide in locating the cause.

1. **Do not disassemble the machine simply because there is a failure.**

   If the machine is disassembled immediately just because there is a failure:

   - Unrelated or unnecessary places are also disassembled
   - It becomes difficult to locate the cause of the failure

   This means that there is not only a waste of time and money on replacement parts, oil, and grease, but this action will also lose the confidence of the user and operator.

   For this reason also, it is important to carry out troubleshooting based on full investigation before starting and troubleshooting following the correct order.

2. **Questions to ask the user and operator**

   1) Are there any problems other than those already reported ?
   2) Did anything unusual happen before the failure occurred ?
   3) Did the failure occur suddenly, or had the condition of the machine been poor before the failure occurred ?
   4) What were the conditions when the failure occurred?
   5) Had any repairs been carried out before the failure occurred ?
   6) Had any similar failure occurred before ?

3. **Checks before troubleshooting**

   1) Check the oil level
   2) Check for any external leakage of oil from the piping and hydraulic equipment.
   3) Check the travel of the control levers.
   4) Other maintenance items can also be carried out visually, so carry out any check that is considered necessary.

4. **Confirming failure**

   Check the degree of the problem to judge for yourself if it is really a failure, or if there is some problem in the handling or operation of the machine.

   ★ When driving the machine and re-enacting the failure, be sure that the investigation or measurement does not make the failure worse.

5. **Troubleshooting**

   Narrow down the causes of the failure from the results of the questions and checks in the above Items 2 - 4, then follow the troubleshooting flow chart to locate the failure.

   ★ Basic procedure for troubleshooting

   1) Start from the simple places.
   2) Start from the most probable places.
   3) Investigate related parts also.

6. **Basic action to remedy cause of failure**

   Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again. To prevent this, it is necessary to investigate why the failure occurred, and to remove the root cause of the failure.

METHOD OF USING TROUBLESHOOTING CHART

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting.**
The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.
Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

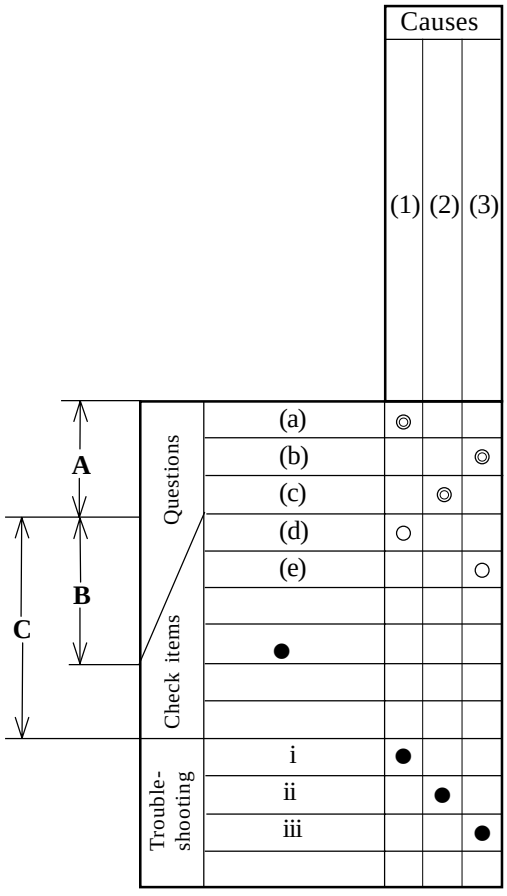
Section **A + B** in the chart on the right corresponds to the items where answers can be obtained from the user. The items in **B** are items that can be obtained from the user, depending on the user's level.

[**Check items**]

The serviceman carries out simple inspection to narrow down the causes. The items under **C** in the chart on the right correspond to this.
The serviceman narrows down the causes from information **A** that he has obtained from the user and the results of **C** that he has obtained from his own inspection.

[**Troubleshooting**]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from [**Questions**] and **[Check items].**



The basic method of using the troubleshooting chart is as follows.
Items listed for [**Questions**] and [**Check items**] that have a relationship with the cause items are marked with ○ , and of these, causes that have a high probability are marked with ◎
Check each of the [**Questions**] and [**Check items**] in turn, and marked the ○ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

❖1. For **[Confirm recent repair history]** in the **[Questions]** Section, ask the user, and mark the cause column with Δ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

❖2. Use the Δ in the cause column as reference for **[Degree of use (Operated for long period)]** in the **[Questions]** Section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to deter mine the order for troubleshooting.

			Causes					
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)
❖ 1	Confirm recent repair history							
❖ 2	Degree of use	Operated for long period		Δ	Δ	Δ		

Example of troubleshooting when exhaust gas is black :

Let us assume that[Clogged air cleaner] is taken to be the cause of black exhaust gas.Three symptoms have causal relationship with this problem: [Exhaust gas slowly become black.], [Power slowly become weaker], and [Dust indicator is red].
If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

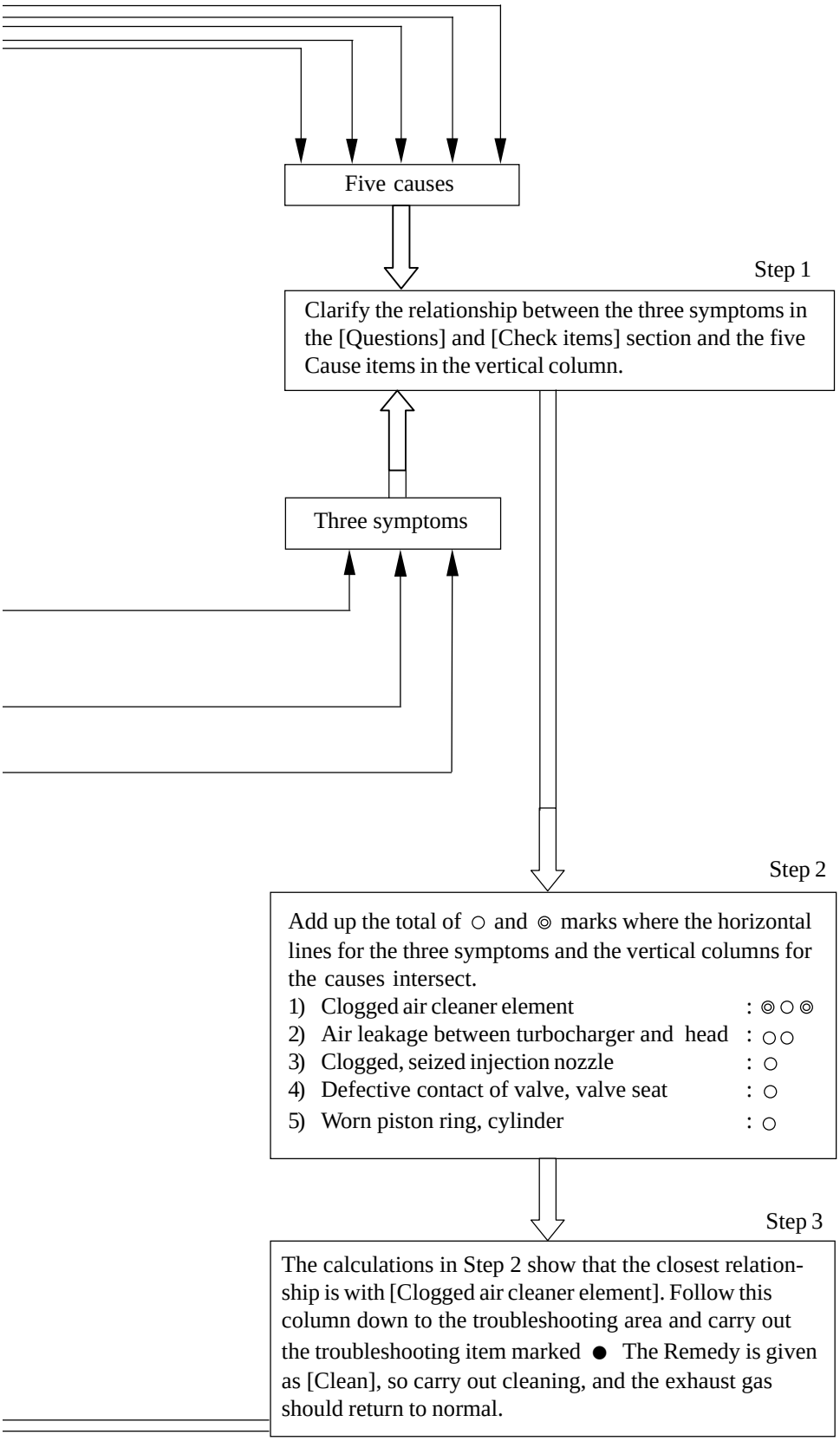
S-7 Exaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake air
- Improper condition of fuel injection
- Excessive injection of fuel

Gradually became black

			Causes											
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		Δ	Δ	Δ						Δ	
	Color of exhaust gas	Suddenly became black				○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediatly after starting engine. temperature of some cylinder is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found by heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed of some cylinders does not change when operating on reduced cylinders					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace


Five causes
Step 1
Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.
Three symptoms
Step 2
Add up the total of ○ and ◎ marks where the horizontal lines for the three symptoms and the vertical columns for the causes intersect.
1) Clogged air cleaner element : ◎○◎
2) Air leakage between turbocharger and head : ○○
3) Clogged, seized injection nozzle : ○
4) Defective contact of valve, valve seat : ○
5) Worn piston ring, cylinder : ○
Step 3
The calculations in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ● The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas should return to normal.

S-1 Starting performance is poor (Starting always takes time)

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel (At ambient temperature of -10° C use ASTM D 975 No.1 ,and -10 ^{0} C or above , use ASTMD975 No. 2 diesel fuel)
- ★ Battery charging rate

Charging rate / Ambient temperature	100 %	90 %	80 %	75 %	70 %
20° C	1.28	1.26	1.24	1.23	1.22
0° C	1.29	1.27	1.25	1.24	1.23
-10° C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the chaging rate of 70 % in the above table
- In cold weather the specific gravity must exceed the value for the charging rate of 75% in the above table

		Causes														
		Worm piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Defective APS device	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Defective injection pump (rack, plunger stuck)	Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole
Questions	Confirm recent repair history														
	Degree of use: Operated for long period			Δ	Δ	Δ				Δ					
	Ease of staritng: Gradually become black	◎	◎	○	○	○									
	Ease of staritng: Start when warm						◎			◎					
	Indicator lamp does not light up						◎								
	Engine oil must be added more frequently	◎													
	Replacement of filters has not been carried out according to operation manual			◎	◎	◎					○		○		
	Dust indicator is red			◎											
	Non-specified fuel has been used				○	○					○		○		
Check items	Battery charge lamp is ON							◎	◎						
	Starting motor cranks engine slowly									◎					
	When exhaust manifold is touched immediatly after starting engine. temperature of some cylinder is low										◎				
	Engine does not pick up smoothly, and combustion is irregular	○	○								◎				
	Blow-by gas is excessive	◎													
	Match marks on fuel injection pump are out of alignment											◎			
	Mud is stuck to fuel tank cap														○
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened												◎		
	2)Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							◎		
	Leakage from fuel piping												○	◎	
	There is hunting from engine (rotation is irregular)				○	○								◎	○
Troubleshooting	When compression pressure is measured, it is found to be low	●	●												
	When air cleaner element is inspected directly, it is found to be clogged			●											
	When fuel filter, strainer are inspected directly, they are found to be clogged				●									●	
	When feed pump strainer is inspected directly, it is found to be clogged					●									
	APS combustion portion does not become warm						●								
	Voltage is 26 - 30V between alternator terminal B and terminal E with engine at low idling: Yes							●							
	Voltage is 26 - 30V between alternator terminal B and terminal E with engine at low idling: No								●						
	Either specific gravity of electrolyte or voltage of battery is low									●					
	Speed of some cylinders does not change when operating on reduced cylinder										●				
	when check is made using delivery method , injection timing is found to be incorrect											●			
	When control rack is pushed , it is found to be heavy or does not return (when blind plug at rear of pump is removed, it can be seen that plunger control sleeve does not move)												●		
	When fuel cap is inspected directly , it is found to be clogged														●
Remedy		Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Repair	Clean

Legend

: Possible cause (judging from Questions and Check items)
○ : Most probable causes (judging from Questions and Check items)
◎ : Possible causes due to length of use (used for a long period)
Δ : Items confirm the cause
●

S-2 Engine does not start

① Engine does not turn

General causes why does not turn

- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out trouble-shooting for “Engine stops during operations”
- Failure in power train
- Defective electrical system

			Causes											
			Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective saftey relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective fuel cut solenoid valve	Defective adjustment of engine stop motor wire	Defective engine stop motor	Defective starting switch
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		Δ		Δ			○				
	Condition of horn when starting switch is turned ON	Horn does not sound	◎						○				○
		Horn sound level is low		◎									
	When starting switch is turned to START, pinion moves out,but	Rotating speed is slow		◎									
		Makes grating noise			◎	◎							
		Soon disengages again					◎						
		Makes rattling noise and does not turn		○	○		○						
Check items	When starting switch is turned to START, pinion does not move out		◎	○									○
	When starting switch is turned to ON, there is no clicking sound		Carry out troubleshooting for defective wiring of starting circuit	○				◎					
	Battery terminal is loose								◎				
	When starting switch is turned to ON, linkage does not move									◎	◎	◎	
	When battery is checked, battery electrolyte is found to be low			○									
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low			●									
	For the following conditions 1) - 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON 1) When terminal B and terminal C of starting switch are connected, engine starts												●
	2) When terminal B and terminal C of starting motor are connected, engine starts				●								
	3) When terminal B and terminal C of safety relay are connected, engine starts						●						
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts						●						
	5) There is no 24V voltage between battery relay terminal B and terminal E of battery							●					
	When ring gear is inspected directly, tooth surface is found to be chipped					●							
	Does not move even when fuel cut solenoid linkage is disconnected									●			
	Does not move even when engine stop motor linkage is disconnected										●	●	
		Remedy	-	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Replace

Legend
○ : Possible cause (judging from Questions and Check items)
◎ : Most probable causes (judging from Questions and Check items)
Δ : Possible causes due to length of use (used for a long period)
● : Items confirm the cause

② Engine turns but no exhaust gas comes out (Fuel is not being injected)

General causes why engine turns but no exhaust gas comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

Standards for use of fuel

TYPE OF FUEL	AMBIENT TEMPERATURE
	-22 -4 14 32 50 68 86 104 122°F
	-30 -20 -10 0 10 20 30 40 50° C
Diesel fuel	ASTM D975 No.2
	ASTM D975 No.1

		Causes											
		Bloken, injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump piston	Clogged fuel filter, strainer	Clogged feed pump strainer	Lack of fuel	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	Defective fuel cut solenoid	Defective engine stop motor	Improper fuel used
Questions	Confirm recent repair history											
	Degree of use / Operated for long period				Δ	Δ			Δ			
	Exhaust gas suddenly (when starting again) stopped coming out	◎	◎	◎								
	Replacement of filters has not been carried out according to operation manual				◎	◎						
	Fuel tank is found to be empty						◎					
	There is leakage from fuel piping,							◎				
	Mud is stuck to fuel tank cap								◎			
Check items	When starting switch is turned ON, linkage does not move									◎	◎	
	When fuel filter is drained, fuel does not come out											◎
	When engine is cranked with starting motor, 1) Injection pump coupling does not rotate	◎										
	2) No fuel comes out even when fuel filter air bleed plut is loosened	◎			○	○						
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	◎								
Troubleshooting												
	Check injection pump directly	●										
	When control rack is pushed, it is found to be heavy or does not return		●									
	Check feed pump directly			●								
	When fuel filter, strainer are inspected directly, they are found to be clogged				●							●
	When feed pump strainer is inspected directly, it is found to be clogged					●						
	When fuel cap is inspected directly, it is found to be clogged								●			
	Does not move even when fuel cut solenoid linkage is disconnected									●		
	Does not move even when engine stop motor linkage is disconnected										●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Add	Repair	Repair	Replace	Replace	Replace

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

③ Exhaust gas comes out but engine does not start (Fuel is being injected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel and oil

		Causes												
		Defective, broken valve system (vlave,rocker lever,etc.)	Defective injection pump (rack, plunger stuck)	Worn piston ring, cylinder liner	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Defective intake heater(ribbo typ)	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged fuel tank air breather hole	Improper fuel, oil used
Questions	Confirm recent repair history												
	Degree of use — Operated for long period			Δ	Δ	Δ					Δ		
	Suddenly failed to start	◎	◎										
	When engine is cranked, abnormal noise is heard from around cylinder head	◎											
	Engine oil must be added more frequently			◎									
	Non-specified fuel had been used		○								○		
	Replacement of filter has not been carried out according to operation manual				◎	◎	◎						
	Type of oil is not used according to operation manual												
	Rust is found when fuel is drained				◎	◎							
	Dust indicator is red						◎						
	Indicator lamp does not light up							◎					
Check items	Starting motor cranks engine slowly								◎				
	Mud is stuck to fuel tank cap											○	
	When fuel lever is placed at FULL position, it does not contact stopper		○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened		◎										
	2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							○
	There is leakage, from fuel piping									◎			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low										◎		
	When fuel filter is drained, no fuel comes out												◎
Troubleshooting	Remove head cover and inspect directly	●											
	When control rack is pushed, it is found to be heavy or does not return		●										
	When compression pressure is measured, it is found to be low			●									
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								●
	When feed pump strainer is inspected directly, it is found to be clogged					●							
	When air cleaner element is inspected directly, it is found to be clogged						●						
	Heater mout does not become warm							●					
	Either specific gravity of electrolyte or voltage of battery is low								●				
	When feed pump is opaerated, there is no response or pump is heavy									●			
	Speed of some cylinder does not change when operating on reduced cylinder										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean	Replace

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-3 Engine does not pick up smoothly (Follow-up is poor)

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Use of improper fuel

			Causes											
			Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston ring, cylinder	Seized turbocharger, interference	Improper valve clearance	Clogged fuel tank air breather hole	Clogged, leaking fuel piping	Defective contact of valve, valve seat
Questions	Confirm recent repair history												
	Degree of use	Operated for long period	Δ	Δ	Δ			Δ					Δ
	Replacement of filter has not been carried out according to operation manual		◎	◎	◎								
	Non-specified fuel has been used			◎	◎	◎	◎						
	Engine oil must be added more frequently							◎					
	Rust and water are found when fuel is drained			◎	◎								
	Dust indicator is red		◎										
	Noise of interference is heard from around turbocharger								◎				
Check items	Engine pick-up suddenly poor					○			◎		○	○	
	Color of exhaust gas	Blue under light load						◎					
		Black	◎			◎			◎				○
	Clanging sound is heard from around cylinder head									◎			
	Mud is stuck to fuel tank cap										◎		
	There is leakage, from fuel piping											◎	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						○		
	There is hunting from engine (rotation is irregular)			○	◎	○							
	When exhaust manifold is touched immediatly after starting engine, temperature of some cylinder is low					◎	○						
	Blow-by gas is excessive							◎					
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●										
	When fuel filter, strainer are inspected directly, they are found to be clogged			●									
	When feed pump strainer is inspected directly, it is found to be clogged				●								
	Some cylinders does not change engine speed when operating on reduced cylinder					●							
	When control rack is pushed, it is found to be heavy, or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
	Remedy		Clean	Clean	Clean	Repair	Replace	Replace	Replace	Adjust	Clean	Repair	Replace

Legend :
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-4 Enigne stops during operations

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating
  - ★ If there is overheating and insufficient output carry out troubleshooting for overheating.
- Failure in power train
  - ★ If the engine stops because of a failure in the power train, carry out troubleshooting for the chassis.

			Causes														
			Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken pump auxiliary equipment	Broken fuel pump drive shaft, key	Lack of fuel	Clogged fuel filter, strainer	Clogged feed pump strainer	Broken, seized feed pump piston	Clogged leaking fuel piping	Clogged fuel tank air breather hole	Defective injection pump (rack, plunger stuck)	Failure in chassis power train
Questions	Confirm recent repair history															
	Degree of use	Operated for long period								Δ	Δ					
	Condition when engine stooped	Abnormal noise was heard and engine stopped suddenly										○			○	
		Engine overheated and stopped		○			○									
		Engine stopped slowly								○	○					
		There was hunting and engine stopped								○	○			○		
	Fuel gauge lamp lights up								◎							
	Fuel tank is found to be empty								◎							
	Replacement of filters has not been carried out according to operation manual									◎	◎					
	Non specified fuel has been used									○	○	○			○	
Check items	When feed pump is operated, there is no response or it is heavy									○	○		◎			
	Mud is stuck to fuel tank cap													◎		
	Engine turns, but stops when transmission control lever is operated															◎
	Try to turn by hand using barring tool	Does not turn at all	◎	◎												
		Turns in opposite direction			◎											
		Moves amount of backlash				◎	◎									
		Shaft does not turn						◎								
	Rust and water are found when fuel is drained									◎	◎					
	Metal particales are found when oil is drained		◎	◎						○	○					
Troubleshooting	Remove oil pan and inspect directly		●	●												
	Remove head cover and inspect directly				●											
	When gear train is inspected, it does not turn					●										
	Turns when pump auxiliary equipment is removed						●									
	When fuel filter, strainer are inspected directly, they are found to be clogged									●						
	When feed pump strainer is inspected directly, it is found to be clogged										●					
	check feed pump directly											●				
	When control rack is pushed, it is found to be heavy or does not return														●	Carry out troubleshooting in chassis volume
	Remedy		Replace	Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Clean	Replace	I

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism
- Defective engine throttle controller mechanism (engine throttle controller type)

★ If there is no hunting when the engine throttle controller rod is disconnected, carry out troubleshooting for the electrical system.

			Causes										
			Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low speed is too low	Lack of fuel	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and zozzle	Clogged fuel tank air breather hole
Questions	Confirm recent repair history											
	Degree of use	Operated for long period							Δ	Δ		
	Condition of hunting	Occurs at certain speed range	◎	◎	◎	○						
		Occurs at low idling	○			◎		○	○	○	○	
		Occurs even when speed is raised	○	○	○							○
		Occurs on slopes					◎					
	Fuel tank is found to be empty						◎					
	Replacement of filters has not been carried out according to operation manual							◎	◎			
	Rust is found when fuel is drained							○	○			
Check items	Leakage from fuel piping									◎	◎	
	When feed pump is operated, 1) No response, light, return is quick									◎	◎	
	2) No response, light, return is normal									◎		
	Engine speed sometimes rises too high		◎	◎								
	Engine is sometimes difficult to stop		◎		◎							
	Seal on injection pump has come off			◎		◎						
Troubleshooting	When governor lever is moved it is found to be stiff		●		●							
	When injection pump is tested, governor is found to be improperly adjusted			●								
	When control rack is pushed, it is found to be heavy or does not return				●							
	When fuel cap is inspected directly, it is found to be clogged					●						●
	When feed pump strainer is inspected directly, it is found to be clogged							●				
	When fuel filter, strainer are inspected directly, they are found to be clogged								●			
		Remedy	Adjust	Adjust	Adjust	Adjust	Add	Clean	Clean	Repair	Repair	Clean

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-6 Engine lacks output (no power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Use of improper fuel
  (If non-specified fuel is used, output drops)
- Lack of output due to overheating
  ★ If there is overheating and Insufficient output, carry out troublshooting for overheating.

			Causes												
			Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve, valve seat	Bent fuel lever linkage, Defective adjustment	Clogged, leaking fuel piping	Clogged fuel tank air breather hole
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	Δ		Δ	Δ	Δ				Δ			
	Power was use	Suddenly		◎										
		Gradually	○		○	○	○	○			○			
	Engine oil must be added more frequently				◎									
	Replacement of filter has not been carried out according to operation manual		◎			◎	◎							
	Non-specified fuel has been used						◎	◎	◎	◎				
	Dust indicator is red		◎											
Check items	Color of exhaust gas	Black	◎	◎										
		Blue under light load			◎									
	Noise of interference is heard from around turbocharger			◎										
	Blow-by gas is excessive				◎									
	Engine pick-up is poor and combustion is irregular			◎				○					○	○
	High idling speed under no load is normal, but speed suddenly drops when load is applied					◎	◎							○
	When exhaust manifold is touched immediatly after starting engine, temperature of some cylinder is low							◎	○					
	There is hunting from engine (rotation is irregular)					○	○						○	○
	Clanging sound is heard from around cylinder head									◎				
	High idling speed of engine is low								○			◎		
	Leakage from fuel piping												◎	
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	When compression pressure is measured, it is found to be low				●						●			
	When fuel filter, strainer are inspected directly, they are found to be Clogged					●								
	When feed pump strainer is inspected directly, it is found to be clogged						●							
	Speed of some cylinders does not change when operating on reduced cylinder							●						
	When control rack is pushed, it is found to be heavy or does not return								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	When lever is placed at FULL position, it does not contact stopper											●		
	When feed pump is opaerated, operation is too light or too heavy												●	
	When fuel cap is inspected directly, it is found to be clogged													●
		Remedy	Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

			Causes											
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and cylinder head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		Δ	Δ	Δ						Δ	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pick-up is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediatly after starting engine, temperature of some cylinder is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed of cylinders does not change when operating on reduced cylinder					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly, it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-8 Oil consumption is excessive (or exhaust gas is blue)

★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- External leakage of oil
- Wear of lubrication system

			Causes													
			Broken piston ring	Worn piston ring, cylinder liner	Clogged, breather or breather hose	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan, cylinder head, etc.	Broken oil cooler	Turbocharger: Worn seal at turbine end	Turbocharger: Worn seal at blower end	Worn, broken rear seal, seal surface	Dust sucked in from intake system	Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
	Degree of use	Operated for long period		Δ							Δ	Δ			Δ
	Oil consumption suddenly increased		◎							○					
	Engine oil must be added more frequently			◎						○					
	Engine oil becomes contaminated quickly		○	◎	○										
Check items	Exhaust gas is blue under light load		◎	◎											
	Amount of blow-by gas	Abnormally excessive	◎	◎								○			○
		None			◎										
	Area around engine is dirty with oil					◎	◎	◎	◎						
	There is oil in engine cooling water									◎					
	When exhaust pipe is removed, inside is found to be dirty with oil										◎				○
	Inside of turbocharger intake pipe is dirty with oil											◎			
	Oil level in clutch or TORQFLOW transmission damper case rises												◎		
	Clamps for intake system are loose													◎	
Troubleshooting	When compression pressure is measured, it is found to be low		●	●											
	When breather element is inspected, it is found to be clogged with dirty oil				●										
	There is external leakage of oil from engine					●	●	●	●						
	Pressure-tightness test of oil cooler shows there is leakage									●					
	Excessive play of turbocharger shaft										●	●			
	Check rear seal directly												●		
	When intake manifold is removed, dust is found inside													●	
	When intake manifold is removed, inside is found to be dirty with oil														●
	Remedy		Replace	Replace	Clean	Repair	Repair	Repair	Repair	Replace	Replace	Replace	Repair	Repair	Repair

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper combustion
- Use of improper oil
- Operation under excessive load

			Causes									
			Worn piston ring, cylinder	Clogged, breather, breather tube	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety vavle	Exhaust gas is black	
Questions	Confirm recent repair history											
	Degree of use	Operated for long period	Δ			Δ			Δ			
	Engine oil must be added more frequently		◎									
	Non-specified fuel is being used				○							
Check items	Color of exhaust gas	Blue under light load	◎									
		Black									◎	
	Amount of blow-by gas	Abnormally excessive	◎			○		○	○			
		None		◎								
	Oil filter caution lamp stays on even when oil pressure rises				◎					○		
	When oil filter is inspected, metal particles are found		○		◎	○						
	When exhaust pipe is removed, inside is found to be dirty with oil					◎						
	Engine oil temperature rises quickly						◎					
Troubleshooting	When compression pressure is measured, it is found to be low		●			●						
	When breather element is inspected directly, it is found to be clogged with dirty oil, or hose is broken			●								
	When oil filter is inspected directly, it is found to be clogged				●							
	When oil cooler is inspected directly, it is found to be clogged						●					
	Turbocharger drain tube clogged							●				
	Excessive play of turbocharger shaft								●			
	When safety vavle is inspected directly, spring is found to be catching or broken									●		
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	I	

Carry out troubleshooting also for "Exhaust gas is black"

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive

- Leakage of fuel
- Impoper condition of fuel injection
- Excessive injection of fuel

			Causes							
			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
	Degree of use	Operated for long period		Δ	Δ			Δ		
	Condition of fuel consumption	More than for other machines of same model	◎			○				
		Gradually increased		○	○					
		Suddenly increased					○	○		
	Exhaust gas color	Black	◎	○		○				○
		White						○		
Check items	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low			◎	○					
	Match mark on injection pump is missaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		○					◎	◎	
	Engine low idling speed in high		○							◎
Troubleshooting	Injection pump test shows that injection amount is too high		●							
	Speed of some cylinder does not change when operating on reduced cylinder			●						
	When control rack is pushed, it is found to be heavy or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
	Remove nozzle holder and check directly							●		
	Remove feed pump and inspect directly								●	
	When engine speed is measured, low idling speed is found to be high									●
		Remedy	Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water

- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes						
			Broken oil cooler core, O-ring	Broken cylinder head, cylinder head gasket	Insufficient protrusion of cylinder liner	Broken oil cooler for power train	Brocken cylinder liner O-ring holes caused by pitting	Internal cracks in cylinder block
Questions	Confirm recent repair history							
	Degree of use	Operated for long period	Δ				Δ	
	Increase in oil level	Suddenly increased	○	○		○		
		Gradually increased					○	○
Check items	Hard water is being used as cooling water		○				○	
	Engine oil level risen, oil is cloudy, white		◎				○	○
	Excessive air bubbles inside radiator, water spurts back			◎	◎			
	Hydraulic oil, torque converter, transmission oil is cloudy white					◎		
	When hydraulic oil, torque converter, transmission oil is drained, water is found					◎		
Trouble shooting	Pressure-tightness test of oil cooler shows there is leakage		●			●		
	Pressure-tightness test of cylinder head shows there is leakage			●				
	Remove cylinder head and check directly				●			
	Remove oil pan and check directly						●	●
		Remedy	Replace	Replace	Replace	Replace	Replace	Replace

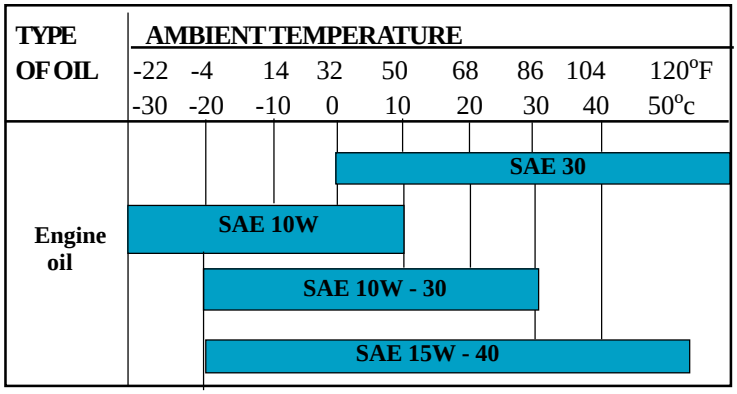
Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-12 Oil pressure lamp lights up (drop in oil pressure)

General causes why oil pressure lamp lights up

- Leakage, clogging ,wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for use of fuel



			Causes													
			Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Insufficient oil level in oil pan	Defective regulator valve	Defective relief valve	Leakage, crushed hydraulic piping	Defective oil level sensor	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history														
	Degree of use	Operated for long period	Δ	Δ				Δ							
	Replacement of filters has not been carried out according to operation manual		◎												
	Caution lamp lights up		◎								○				
	Non-specified fuel has been used		◎	○											
Check items	Condition when oil pressure lamp lights up	Lights up at low, idling		◎							○				
		Lights up at low, high idling			◎	◎	◎	◎	○	○	○				
		Lights-up on slopes							◎						
		Sometimes lights up								◎	◎		○	○	
	There is clogging, leakage from hydraulic piping (external)											◎			
	Oil level sensor lamp lights up								◎				◎		
	When oil level in oil pan is checked, it is found to be low								◎						
	Metal particles are found when oil is drained			◎											
	Metal particles are stuck to oil filter element			◎				○							
	Oil is cloudy white or smells of diesel oil														○
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●											
	Remove oil pan and check directly				●	●	●								
	Oil pump rotation is heavy, there is play							●							
	There is catching of relief valve or regulator valve,or spring or valve guide is broken									●	●				
	When oil level sensor is replaced, oil pressure sensor lamp goes out												●		
	When oil pressure is measured, it is found to be within standard value													●	Carryout Troubleshooting forOil level rises"
Remedy			Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace	I

Legend

○: Possible cause (judging from Questions and Check items)

◎: Most probable causes (judging from Questions and Check items)

Δ: Possible causes due to length of use (used for a long period)

●: Items confirm the cause

S-13 Oil level rises

★ If there is oil in the cooling water, carry out troubleshooting for “Oil is in cooling water”

General causes why oil level rises

- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

		Causes											
		Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken cylinder head, head gasket (including precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump or auxiliary equipment	Leakage of fuel from piping inside head cover	Defective part inside injection pump(flange type)	Defective thermostat seat	Damaged cylinder liner O-ring, holes made by pitting	Cracks inside cylinder block
Questions / Check items	Confirm recent repair history											
	Degree of use | Operated for long period		Δ		Δ	Δ					Δ	
	There is oil in radiator cooling water	◎	○	○							○	
	Exhaust gas is white		◎					○		○		
	When engine is first started, drops of water come from muffler		◎									
	Leave radiator cap open. when engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎							○	
	Water pump breather hole is clogged with mud				◎							
	When water pump breather hole is cleaned, water comes out				◎							
	Oil level does down in clutch , TORQFLOW transmission, or damper chamber					◎						
	Oil level goes down in hydraulic tank						◎					
	Engine oil smells of diesel fuel							◎	◎	◎		
	Fuel is added more frequently							◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●										
	Pressure-tightness test of cylinder head shows there is leakage		●									
	When compression pressure is measured, it is found to be low			●								
	Remove water pump and check directly				●							
	check rear seal directly					●						
	When pump auxiliary equipment is removed, seal is found to be broken						●					
	Remove head cover and check directly							●				
	Remove injection pump and check directly								●			
	There is improper contact of thermostat seat vavle									●		
	Remove oil pan and check directly										●	●
	Remedy	Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace	Replace

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-14 Water temperature becomes too high (overheating)

General causes why water temperature becomes too high

- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature of power train

★ Carry out trubleshooting for chassis

			Causes												
			Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken cylinder head, head gasket	Damaged cylinder liner O-ring, holes made by pitting	Rise in torque converter oil temperature
Questions	Confirm recent repair history													
	Degree of use	Operated for long period		Δ	Δ							Δ	Δ	
	Condition of overheating	Suddenly overheated	◎					○	○					
		Always tends to overheat		◎	◎	○			○					
	Water temperature gauge	Rises quickly				◎		○						
		Does not go down from red range					◎							
	Radiator water level sensor lights up							◎						
Check items	Fan belt whines under sudden load								◎					
	Cloudy white oil is floating on cooling water									◎				
	Cooling water flows out from overflow hose										◎			
	Excessive air bubbles inside radiator, water spurts back											◎		
	Engine oil level has risen, oil is cloudy white									○			◎	
	There is play when fan pulley is rotated		◎											
	Radiator shroud, inside of underguard are clogged with dirt or mud			◎					◎					
	When light bulb is held behind radiator, no light passes through			◎										
	Water is leaking because of cracks in hose or loose clamps							◎						
	Belt tension is found to be slack								◎					
	Power train oil level enters red range before engine water temperature													◎
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive		●											
	Temperature difference between top and bottom radiator tanks is too slight			●										
	When water filler port is inspected , the core is found to be clogged				●									
	When a function test is carried out on the thermostat, it does not open even at the cracking temperature					●								
	When water temperature is measured, it is found to be normal						●							
	When oil cooler is inspected directly, it is found to be clogged									●				
	When measurement is made with radiator cap tester, set pressure is found to be low										●			
	When compression pressure is measured, it is found to be low											●		
	Remove oil pan and check directly												●	Carry out troubleshooting for chassis
	Remedy		Replace	Repair	Repair	Replace	Replace	Add	Repair	Replace	Replace	Replace	Replace	I

Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

S-15 Abnormal noise is made

★ Judge if the noise is an internal noise or an external noise

General causes why abnormal noise is made

- Abnormal due to defective parts
- Abnormal combustion noise
- Air sucked in from intake system

			Causes											
			Worn piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Defective injection pump (excessive injection)	Deformed fan, interference of fan belt	Improper adjustment of valve clearance	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and cylinder head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use	Operated for long period	Δ											
	Condition of abnormal noise	Gradually occurred	○						○					
		Suddenly occurred		○	○						○			
	Non-specified fuel has been used					○	○							
	Engine oil must be added more frequently		◎											
Check items	Color of exhaust gas	Blue under light load	◎											
		Black		◎						○			○	
	Metal particales are found in oil filter		◎		◎									
	Blow-by gas is excessive		○											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is irregular					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low					◎	○							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					○	○	○	○	○		○		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and cylinder head												◎	
	Vibrating noise is heard from around muffler													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and inspect directly, (flywheel housing top cover)				●							●		
	Speed of some cylinder does not change when operating on reduced cylinders					●								
	When control rack is pushed, it is found to be heavy or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, or belt is loose								●					
	When valve clearance is checked directly, it is found to be outside standard value									●				
	Remove cylinder head cover and check directly										●			
	When muffler is removed, abnormal noise disappears													●
Remedy			Replace	Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace

Legend
○ : Possible cause (judging from Questions and Check items)
◎ : Most probable causes (judging from Questions and Check items)
Δ : Possible causes due to length of use (used for a long period)
● : Items confirm the cause

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for “Abnormal noise is made”

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

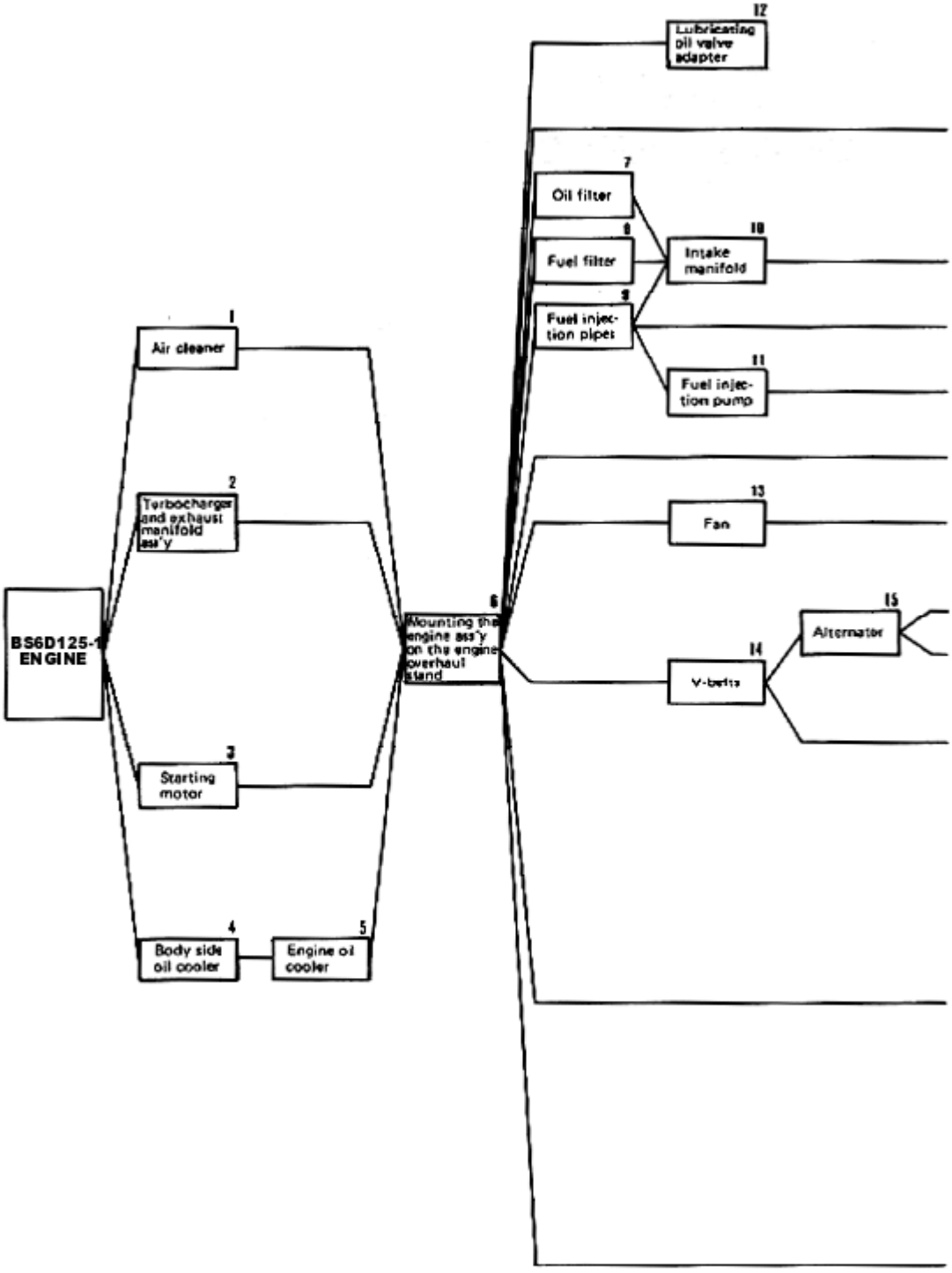
			Causes								
			Worn, seized connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Misalignment between engine and power train	Improper gear train backlash	Valve system (valve, rocker lever, etc.) stuck	Defective injection pump (excessive injection, plunger seized)
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	Δ	Δ	Δ	Δ					
	Condition of vibration	Suddenly increased					○			○	
		Gradually increased	○	○	○	○					
	Non-specified fuel has been used		○	○							
Check items	Metal particles are found in oil filter		◎	◎							
	Metal particles are found when oil is drained		◎	◎							
	Oil pressure is low at low idling		○	○							
	Vibration occurs at mid-range speed					○	○				
	Vibration follows engine speed				○	○	○	○	○		
	Exhaust gas is black									◎	○
	Seal on injection pump has come off										◎
Troubleshooting	Remove oil pan and check directly		●								
	Remove side cover and check directly			●							
	Check directly for worn support pilot, play				●						
	check directly for loose engine mounting bolts, broken cushion					●					
	Check inside of output shaft (damper) directly						●				
	When radial runout, face runout are measured, they are found to be outside standard value							●			
	Remove front cover, and check directly.								●		
	Remove head cover and check directly									●	
	Injection pump test shows that injection amount is incorrect										●
		Remedy	Replace	Replace	Replace	Replace	Replace	Repair	Repair	Replace	Adjust

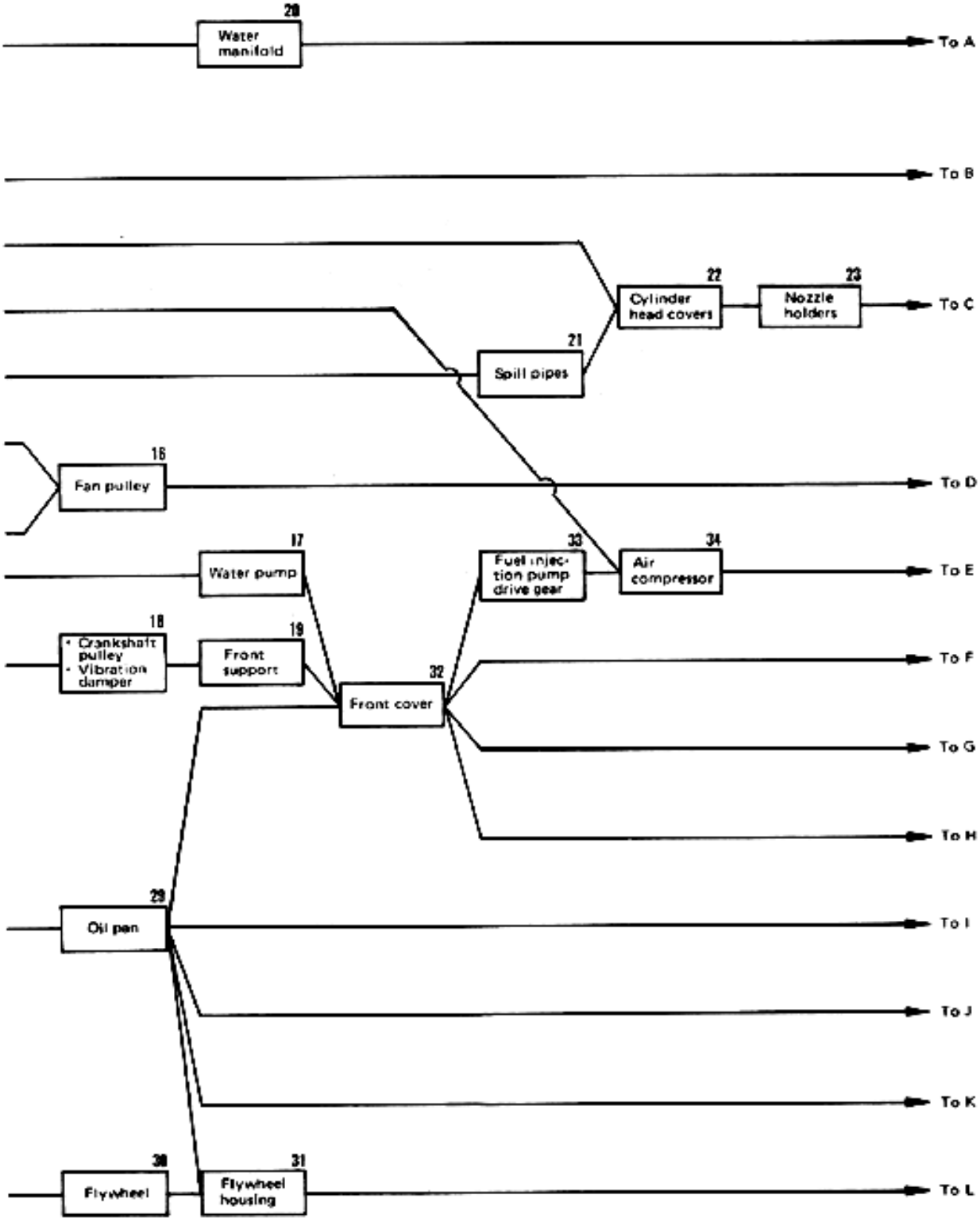
Legend
○: Possible cause (judging from Questions and Check items)
◎: Most probable causes (judging from Questions and Check items)
Δ: Possible causes due to length of use (used for a long period)
●: Items confirm the cause

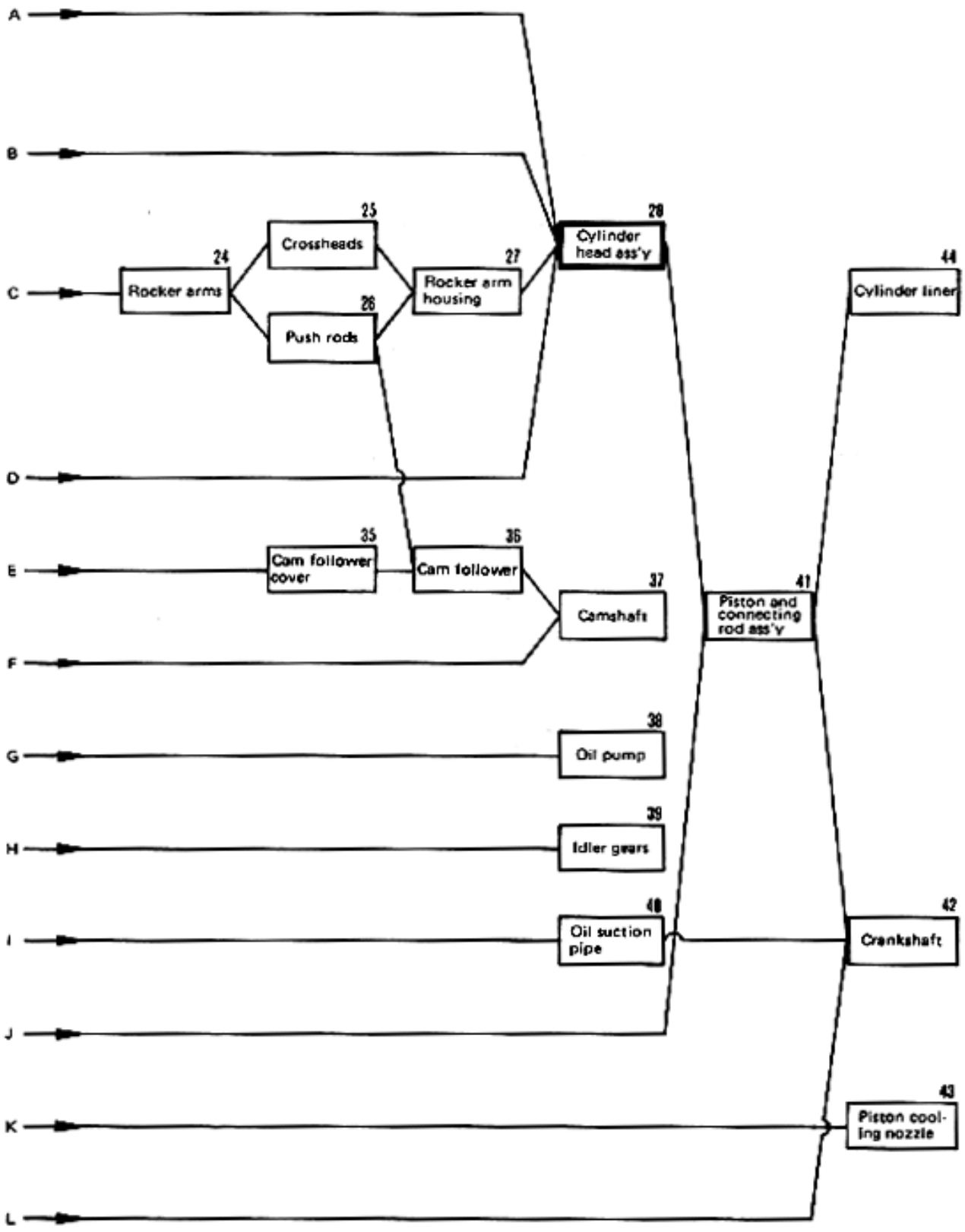
ENGINE

14 DISASSEMBLY AND ASSEMBLY

* The description of overall engine disassembly and assembly given in this section is based on the **BS6D125-1** engine,assuming the use of an overhaul stand.
* The woark procedure may differ slightly from that given here depending upon the machine in which the engine is mounted and also the particular stand used,however it is fundamentally the same.
* Use the coreect service tools when performing disassembly and assembly.


BS6D125-1
ENGINE
1
Air cleaner
2
Turbocharger and exhaust manifold ass'y
3
Starting motor
4
Body side oil cooler
5
Engine oil cooler
6
Mounting the engine ass'y on the engine overhaul stand
7
Oil filter
8
Fuel filter
9
Fuel injection pipes
10
Intake manifold
11
Fuel injection pump
12
Lubricating oil valve adapter
13
Fan
14
V-belts
15
Alternator


20
Water manifold
To A
To B
22
Cylinder head covers
23
Nozzle holders
To C
21
Spill pipes
16
Fan pulley
To D
17
Water pump
33
Fuel injection pump drive gear
34
Air compressor
To E
18
Crankshaft pulley
Vibration damper
19
Front support
To F
32
Front cover
To G
To H
29
Oil pan
To I
To J
To K
30
Flywheel
31
Flywheel housing
To L


A
B
C
D
E
F
G
H
I
J
K
L
24
Rocker arms
25
Crossheads
26
Push rods
27
Rocker arm housing
28
Cylinder head ass'y
35
Cam follower cover
36
Cam follower
37
Camshaft
38
Oil pump
39
Idler gears
40
Oil suction pipe
41
Piston and connecting rod ass'y
42
Crankshaft
43
Piston cooling nozzle
44
Cylinder liner

Special tools :

	Part No.	Part Name	QTY
A	790-901-1240	Adapter	1
B	790-501-2000	Engine overhaul stand	1
C	795-102-2102	Spring pusher	1
D	795-100-1191	Piston ring tool	1
E	795-220-1000	Liner puller	1

Preparation work :

1) Clean the engine by washing the mud and dirt off.
2) Drain the engine coolant and the engine oil.

Engine oil : approx. 30L

3) Mount the engine assembly on a stable enignes stand so that it won't fall down.

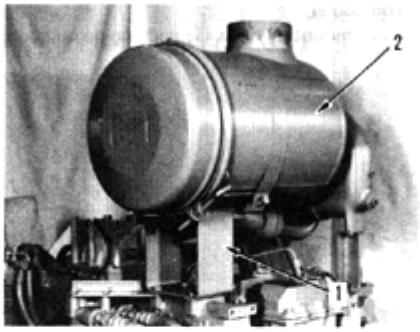
Engine assembly: approx. 1,175kg

(The engine weight differs according to machine model.)

1. Air Cleaner :

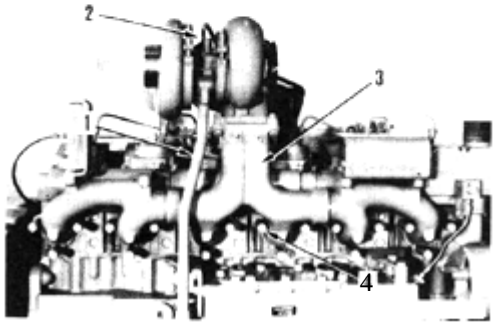
1) Disconnect the connecting hose to the turbocharger.
2) Remove the mounting bolts, and lift off air cleaner (2) together with bracket (1).

* The air cleaner and the bracket may be discon nected depending upon the machine models.

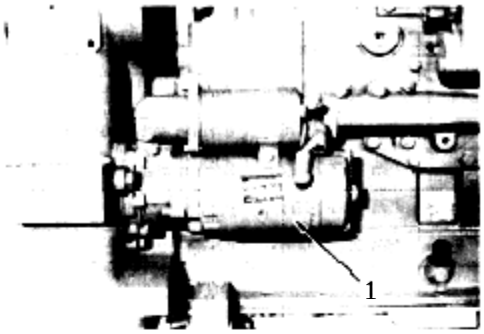


2. Turbocharger and exhaust manifold assembly :

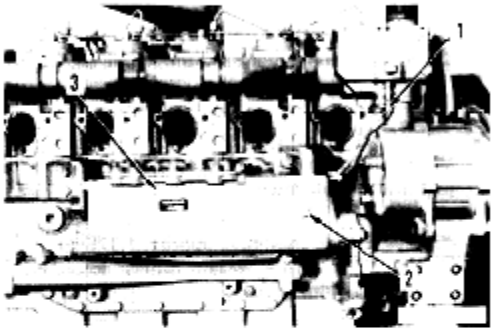
1) Remove turbocharger outlet tube (1) and inlet tube (2).
2) Disconnect the intake connector connecting hose from the turbocharger.
3) Suspend the turbocharger and exhaust manifold assembly (3), and dismount them after removing 18 mounting bolts(4).



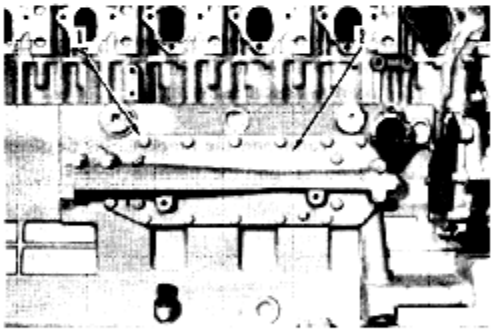
3. Starting motor :
Remove starting motor (1).



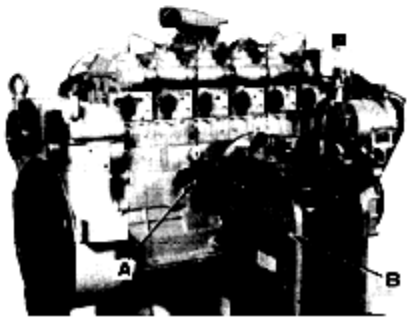
4. Body side oil cooler :
1) Remove aeration pipe (1).
2) Remove 8 mounting bolts (2) and engine side oil cooler (3).



5. Engine oil cooler :
Remove 17 mounting bolts (1) and engine oil cooler (2).

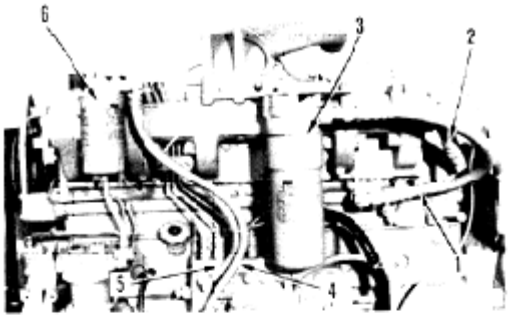


6. Mounting the engine assembly on the engine overhaul stand :
1) Install adapter A to the mounting section of the engine oil cooler.
2) Sling the engine assmbly, align engine overhaul stand B with the adapter, and secure the engine assembly to the stand.



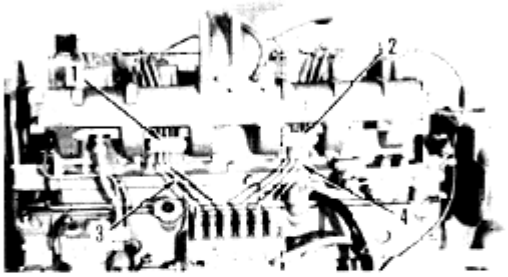
7. Oil Filter :

1) Disconnect hoses (1) and (2) between the oil filter and the adapter from the oil filter.
2) Remove 4 mounting bolts, and dismount engine oil filter (3) together with the bracket.



8. Fuel filter :

1) Disconnect hoses (4) and (5) between the fuel filter and the injection pump from the injection pump.
2) Remove 4 mounting bolts, and disconnect fuel filter (6) together with the bracket.

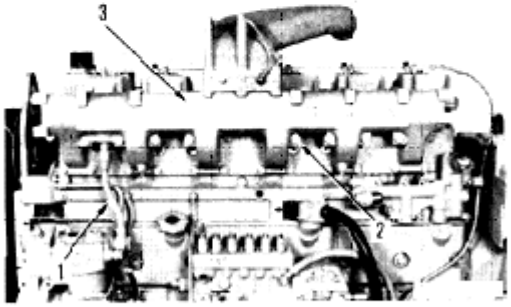


9. Fuell injection pipes :

1) Remove clamps (1) and (2).
2) Remove 6 fuel injection pipes (3) and (4).

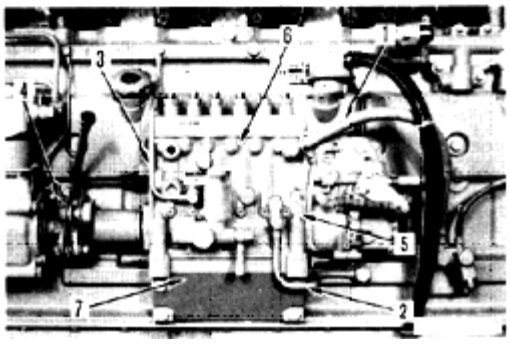
10. Intake manifold :

1) Remove tube (1) between the intake manifold and the air compressor.
2) Remove 24 mounting bolts (2) and intake manifold (3).



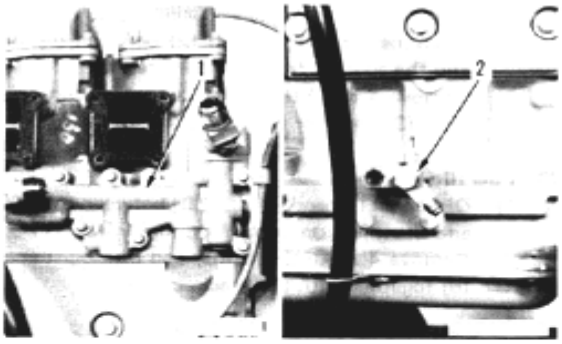
11. Fuel injection pump :

1) Disconnect overflow hose (1) at adapter end.
2) Remove lubrication tubes (2) and (3).
3) Remove 2 bolts (8) holding front laminated coupling (9) and cross coupling (10)
4) Remove 4 mounting bolts (5) remove fuel injection pump.
5) Move fuel injection pump assembly (6) to rare and remove. when doing this, leave flange coupling (11)and front laminated coupling (9) on drive shaft
6)remove bolt (4) connecting coupling and drive shaft, then remove flange shaft coupling (11) and front laminated coupling (9)
5) Remove bracket (7).



12. Lubrication oil valve adapter :

1) Remove lubricating oil valve adapter (1).
2) Disconnect the spill hose and remove fuel over flow adapter (2).

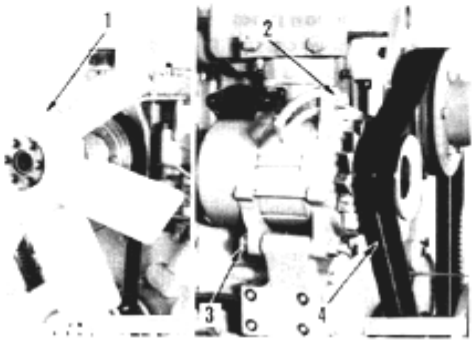


13. Fan :

Remove fan (1).

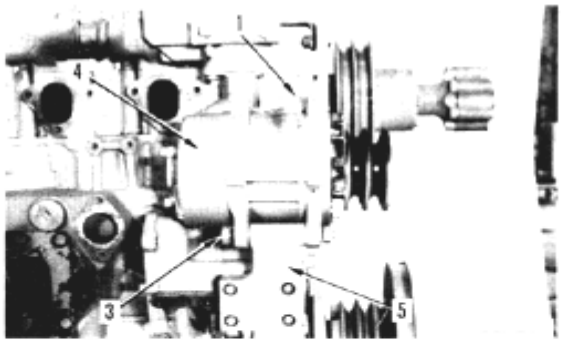
14. V-Belts :

1) Remove belt tension adjsutment bolt (2).
2) Loosen alternator fastening bolt (3), and remove V-belts (4) by pushing the alternator inward.



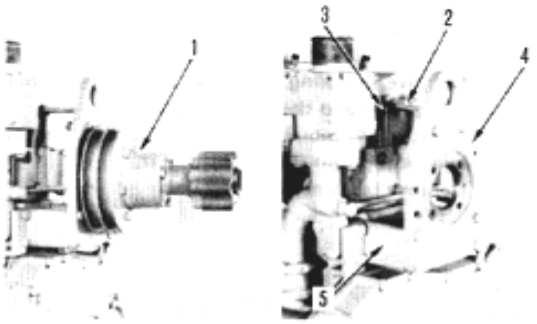
15. Alternator :

1) Remove the fastening bolts for plate (1) and alternator (4).
2) Remove fastening bolt (3) and alternator (4).
3) Remove bracket (5).



16. Fan pulley :

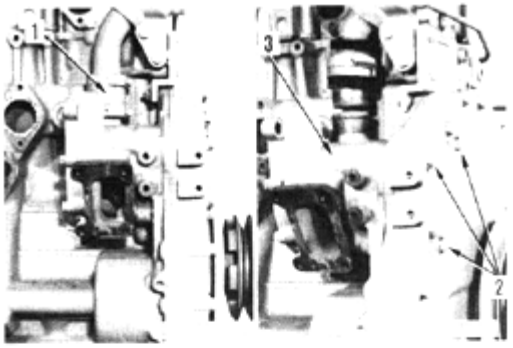
1) Remove 4 mouting bolts and fan pulley (1).
2) Remove bracket (2) and 2 spacers (3).
3) Remove hanger (4) and spacer (5).



17. Water pump :

1) Disconnect connecting hose (1) between the water pump and the thermostat housing connector, and shift the hose towards the connector.

2) Remove 3 mpunting bolts (2) and water pump (3)

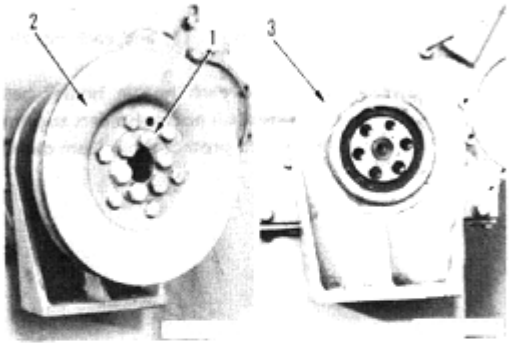


18. Crankshaft pulley - Vibration damper :

Remove 6 mounting bolts (1) and crankshaft pulley - vibration damper (2).

19. Front support :

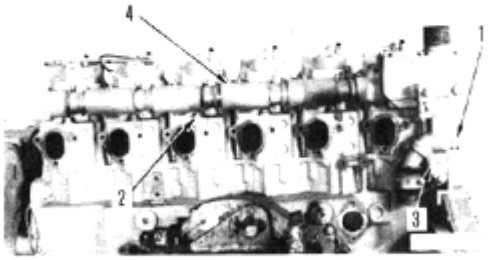
Remove front support (3).



20. Water manifold :

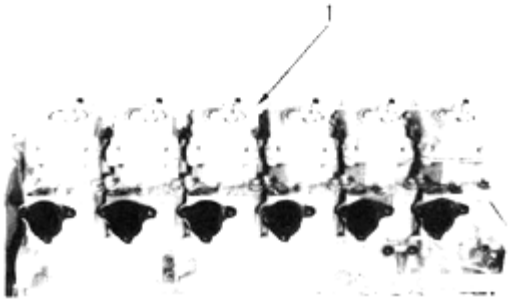
1) Disconnect tube (1) between the air compressor and the connector.

2) Remove 12 mounting bolts (2), 2 bolts (3), and water manifold (4).



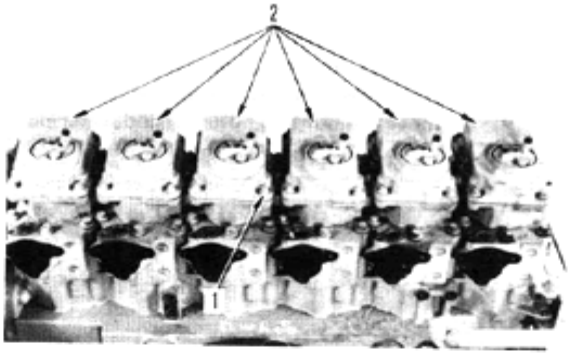
21. Spill pipes :

Remove spill pipes (1).



22. Cylinder head covers :

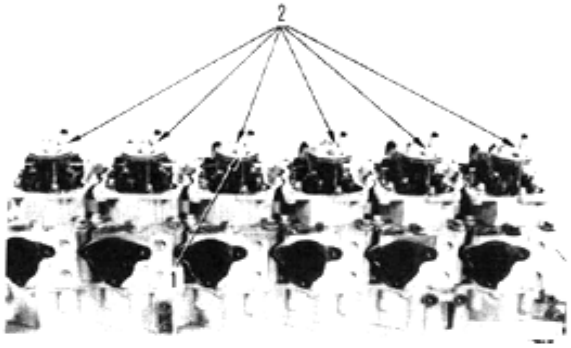
Remove 24 mounting bolts (10 and each head cover (2).



23. Nozzle holders :

Remove 12 mounting bolts (1) and each nozzle holder (2).

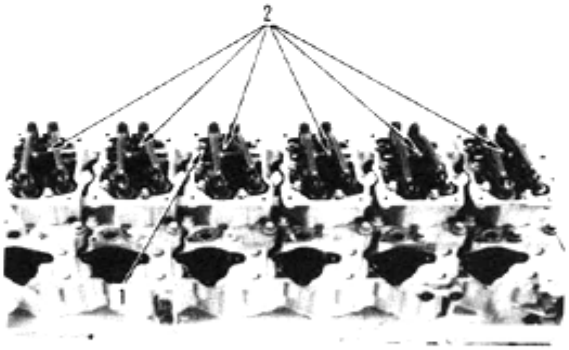
* Give a number to each nozzle holder before removing it and store all nozzle holders together in an appropriate place to protect them from damage.



24. Rocker arms :

Remove 12 mounting bolts (1) and each rocker arm (2).

* Before installing the rocker arms, loosen the lock nut and then the adjustment screw by 2 to 3 turns so that the push rod will not be subjected to undue force.

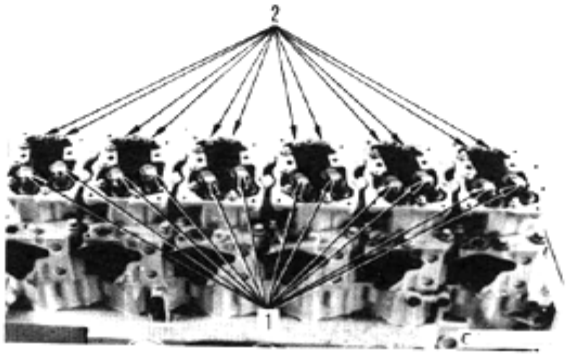


25. Crossheads :

Remove crossheads (1).

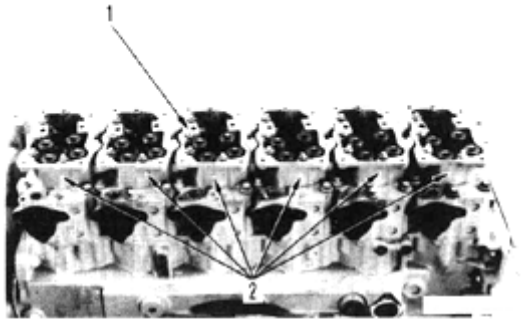
26. Push rods :

Remove push rods (2).



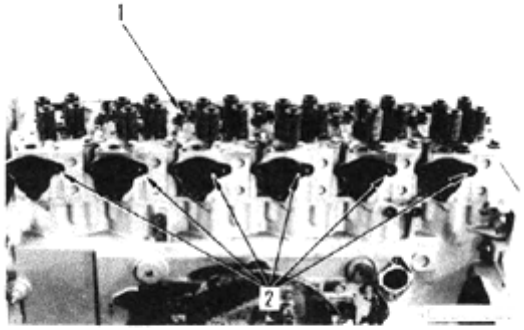
27. Rocker arm housing :

Remove 42 mounting bolts (1) and each rocker arm housing (2).



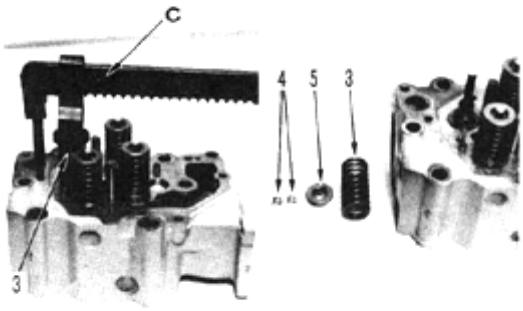
28. Cylinder head assembly :

1) Remove 42 mounting bolts (1) and each cylinder head (2).
2) Remove each cylinder head gasket.



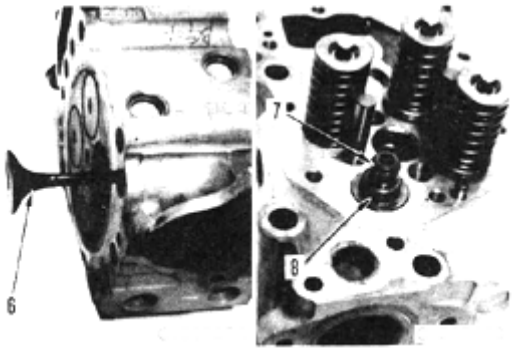
- Disassemble the cylinder head assembly as follows.

i) Compress valve spring (3) using spring pusher C and remove valve cotters (4).
ii) Remove upper seat (5) and valve spring (3).



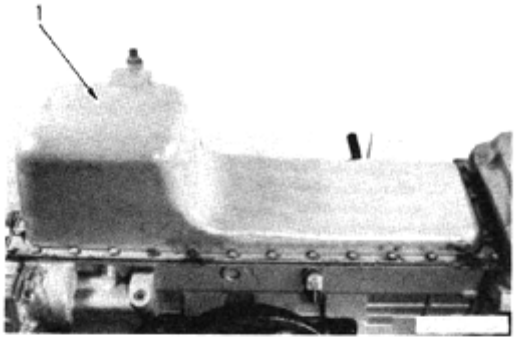
iii) Remove seal (7) and lower seat (8).
iv) Set up the cylinder head upright and remove valve (6).

* The seals are provided on the exhaust side only.



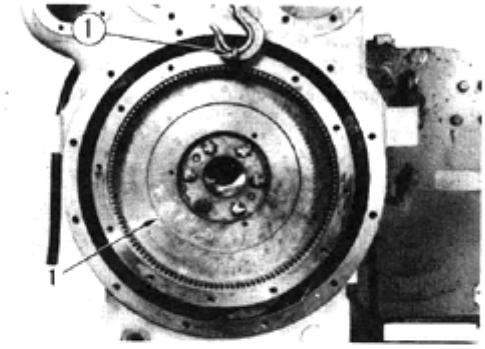
29. Oil pan :

Remove oil pan (1).



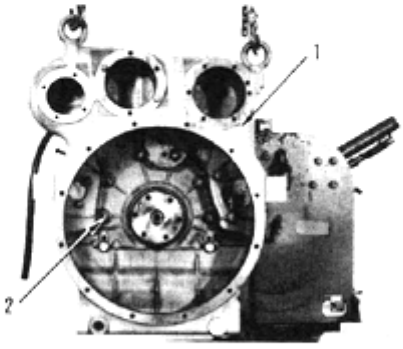
30. Flywheel :

1) Sling flywheel (1) using eye bolt ①
(Thread dia : 12 mm, pitch : 1.75 mm)
2) Remove the mounting bolts and flywheel.



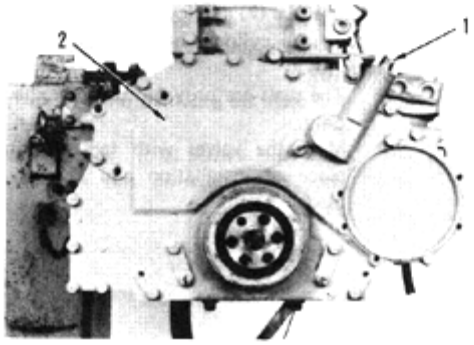
31. Flywheel housing :

1) Sling flywheel housing (1).
2) Remove mounting bolts (2) and the housing.
* When removing the housing, take care not to damage the oil seal.



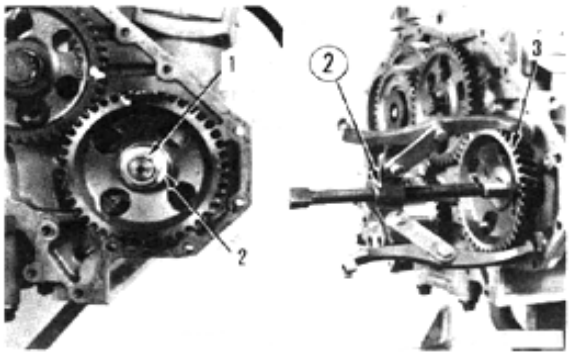
32. Front cover :

1) Remove tachometer drive assmbly (1).
2) Remove front cover (2).
* When removing the front cover, take care not to damage the oil seal.



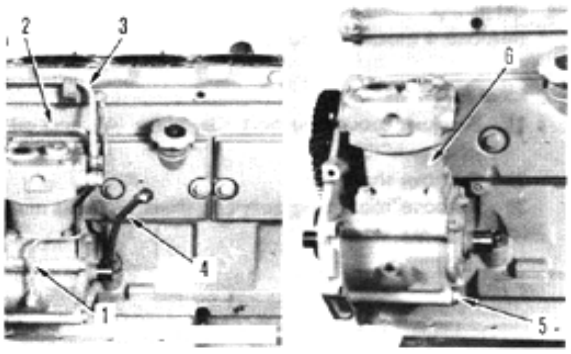
33. Fuel injection pump drive gear :

1) Remove nut (1) and washer (2).
   * Loosen the nut while holding the gear with a screwdriver.
2) Pull out fuel injection pump drive gear (3) using puller ②.



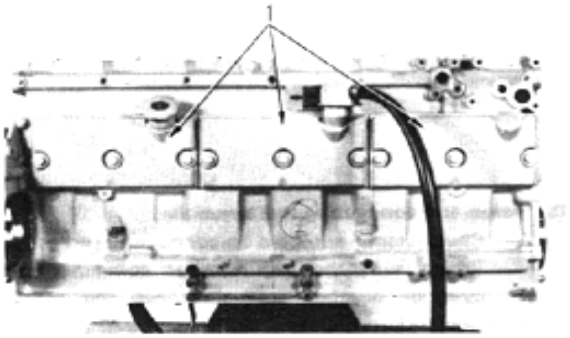
34. Air compressor

1) Remove air compressor tubes (1) and (2).
2) Remove dipstick guide (4).
3) Remove 4 mounting bolts (5) and air compressor (6).



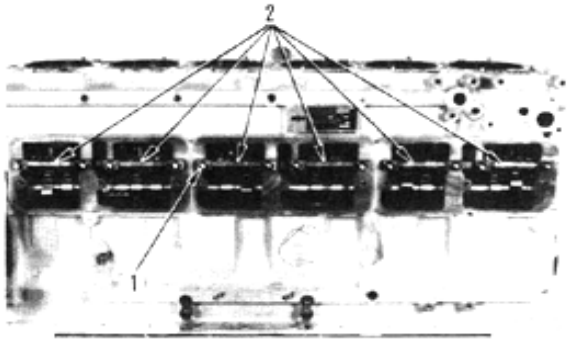
35. Cam follower cover :

Remove cam follower cover (1).



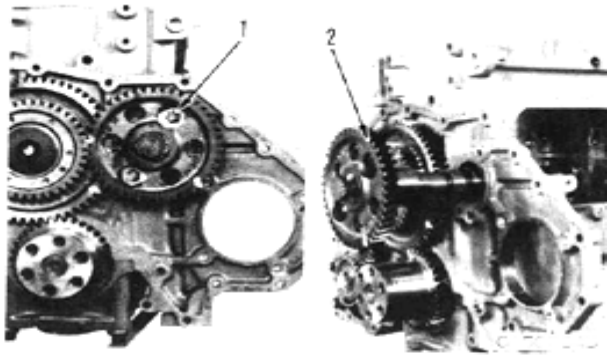
36. Cam follower :

Remove 12 mouting bolts (1) and each cam follower (2).



37. Camshaft :

1) Remove 2 mounting bolts (1).
2) Remove camshaft (2).
   * When pulling out the camshaft, turn it slowly to protect the cam bushing from damage.

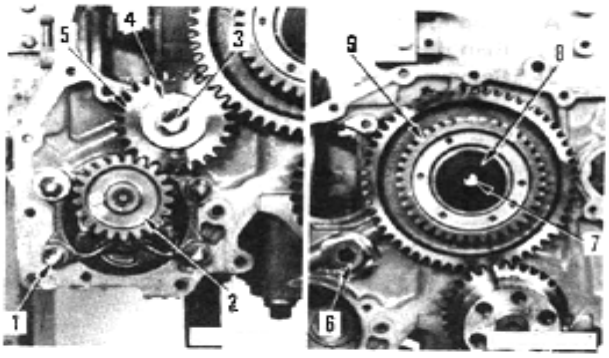


38. Oil pump :

Remove 4 mounting bolts (1) and oil pump (2).

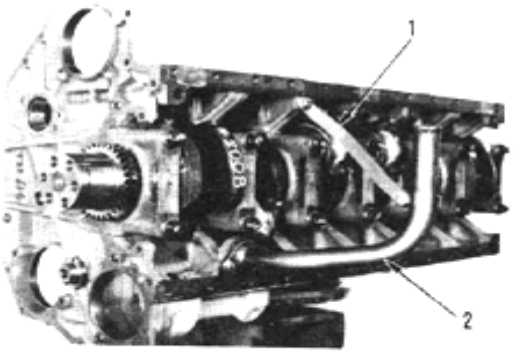
39. Idler gears :

1) Remove mounting bolt (3),plate (4), and oil pump idler gears (5).
2) Remove shaft (6).
3) Remove mounting bolt (7), shaft (8), and main idler gear (9).



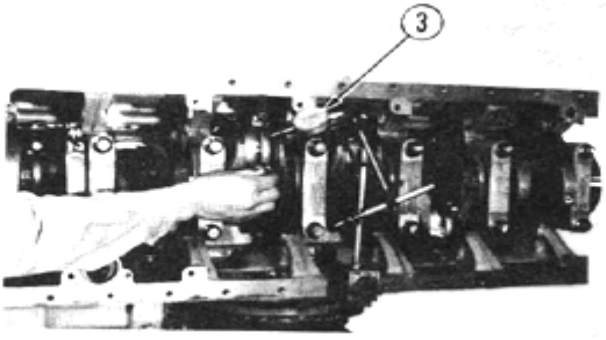
40. Oil suction pipe :

Detach bracket (1) and remove ol suction pipe (2).

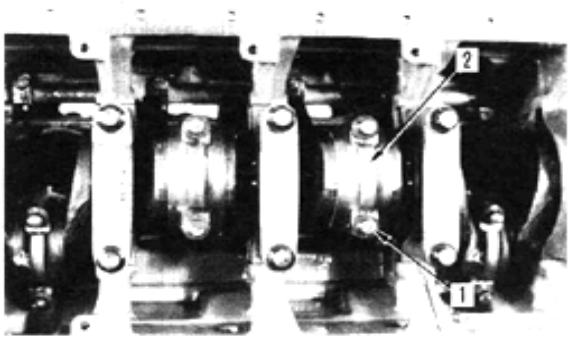


41. Piston and connecting rod assembly :

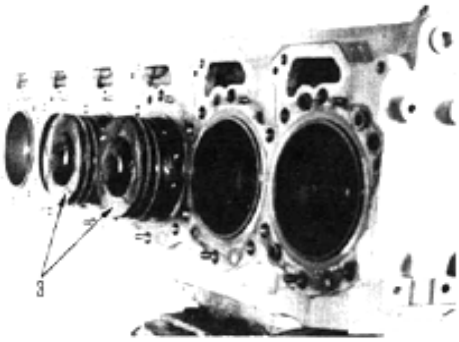
1) Check stamp numbers on connecting rod caps. (Make sure the cap number coincides with the cylinder ans also that the number is stamped on the cam side)
   * If there is no stamp number, stamp the number before the cap is removed.
2) Rotate the crankshaft so that the piston to be removed is placed in bottom dead center.
3) Removed the carbon from the liner wall using a fine sand paper.
   * If neccessary, measure the end play of the connecting rod using dial gauge ③ before removing the piston and connecting rod assembly.



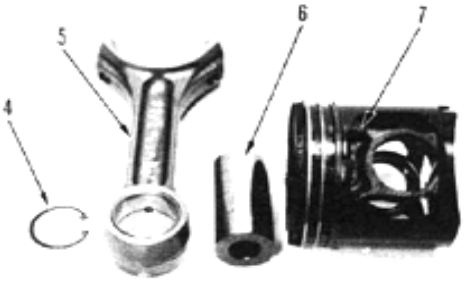
4) Remove bolt (1) from the connecting rod cap.
5) Remove connecting rod cap (2) and the connecting rod bearing as a unit by tapping the connecting rod bolt with a plastic hammer.
   * Take care not to damage the screw.



6) Push the piston and connecting rod assembly from the oil pan side with a wooden stick. Hold piston (3) in your hand and remove it from the cylinder head side.
   * Take care not to damage the piston cooling nozzle. (BS6D125-1, SA6D125-1)
   * During removal, take care not to damage the inner surface of the liner with the connecting rod.

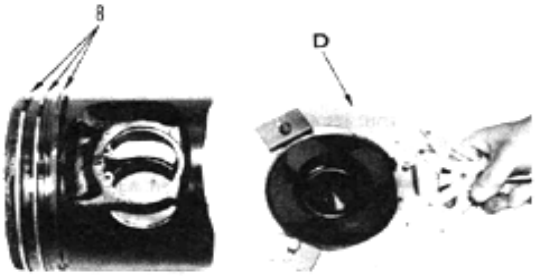


7) Remove the ramaining piston and connecting rod assemblies in the same manner.
   * When storing the piston and connecting rods, take care not to damage sliding portions of the piston and the bearing.
   * Keep the connecting rods and caps together, then store them with their corresponding bearings in order to avoid confusion during reassmebly.



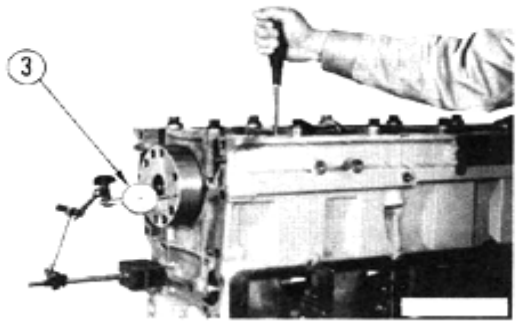
- Disassemble the piston and connecting rod assembly as follows.
  i) Remove snap ring (4).
  ii) Pull out piston pin (6) while holding connect ing rod (5) in your hand, and seperate con -necting rod from piston (7)
  iii) Remove the snap ring on the opposite side.

  iv) Remove piston rings (8) using piston ring tool D.
     * Store the piston, connecting rod, connect ing rod bearings, piston rings, and piston pin for every cylinder.

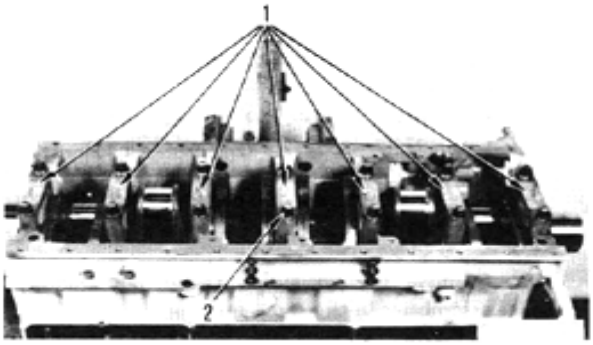


42. Crankshaft :

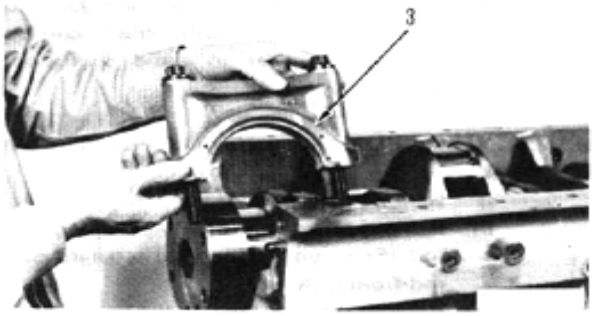
* If necessary, measure the crankshaft end play using dial gauge ③ before remving the crankshaft.



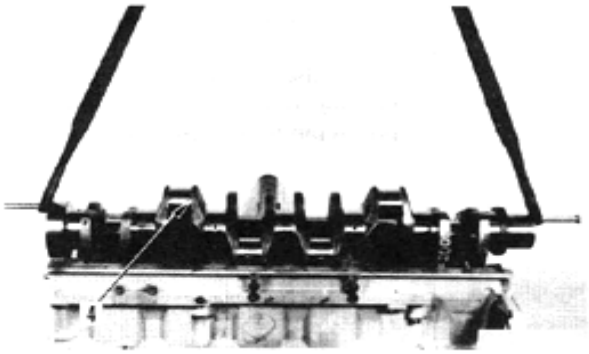
1) Remove mounting bolts (2) for main cap (1).
2) Insert a bolt into the hole on the main cap, and remove the main cap by shaking it.



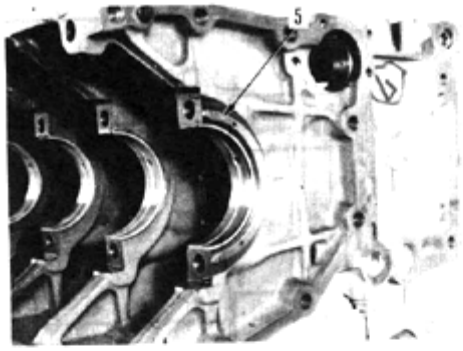
3) Since lower thrust bearing (3) is installed to main cap No. 7, mark the installation position after removing the cap.



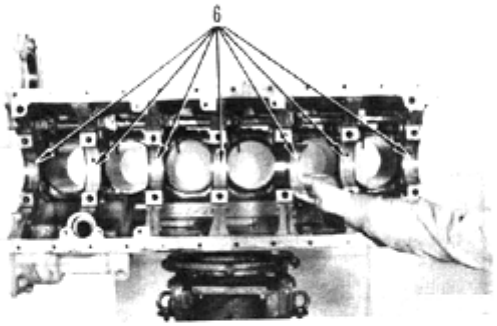
4) Using nylon slings, lift off crankshaft (4).
   * When lifting the crankshaft, take care not to let it hit against the cylinder block.
   * Store the crankshaft in an appopriate places so that its sliding portions do not get damaged.



5) Remove upper thrust bearing (5).



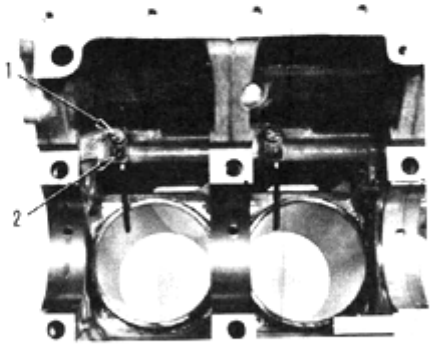
6) Remove upper bearing (6).



* Put identification tags on the main caps, main bearings, and thrust bearings or mark their installation position with a felt - tip pen, segregate them for each cap, and store then properly to protect them from damage.

43. Piston cooling nozzle (BS6D125-1, SA6D125-1) :

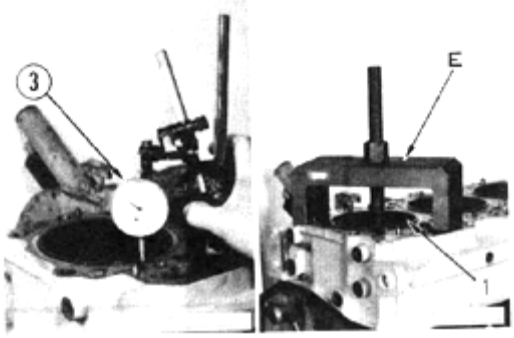
Remove mounting bolts (1) and each piston cooling nozzle (2).



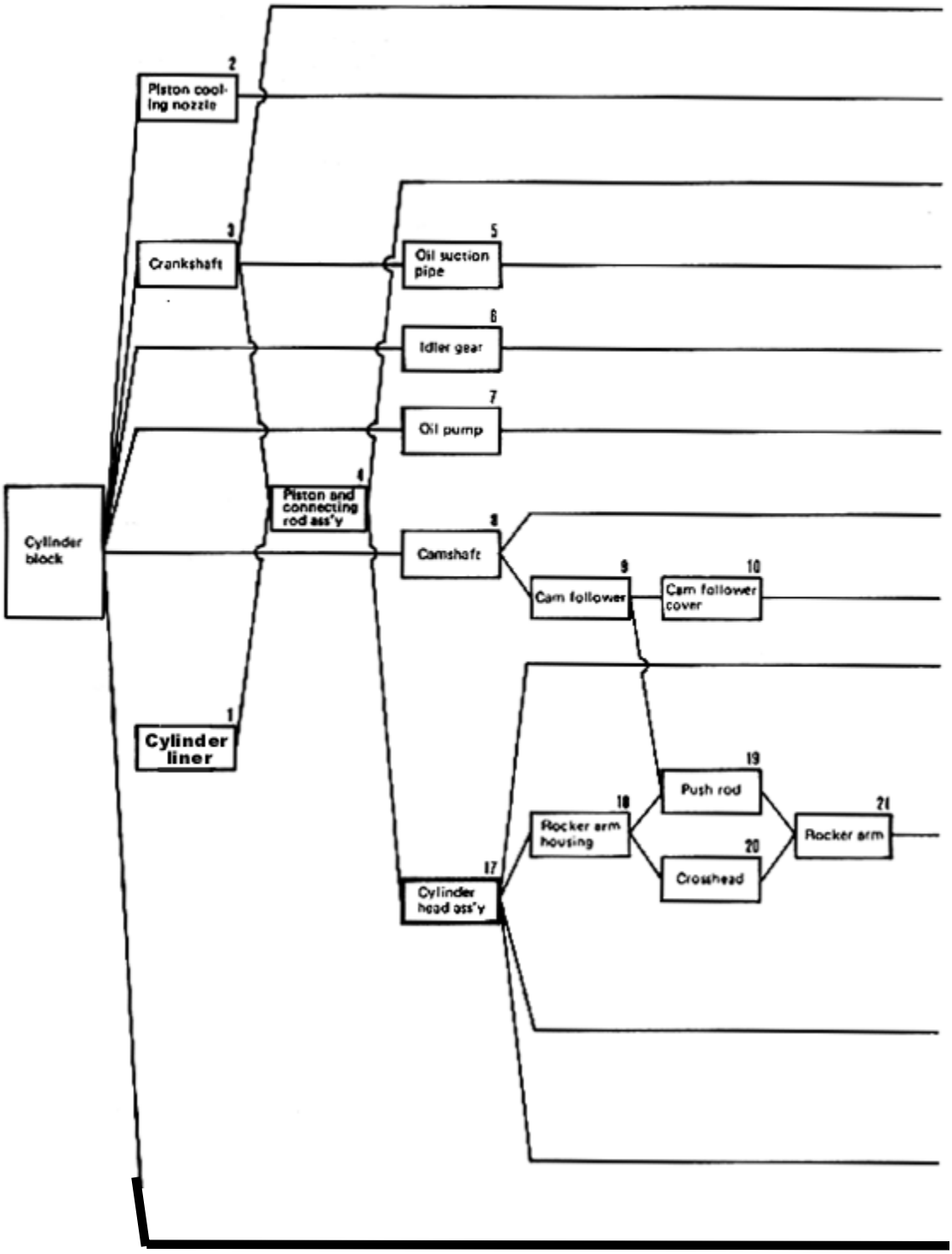
44. Cylinder liner :

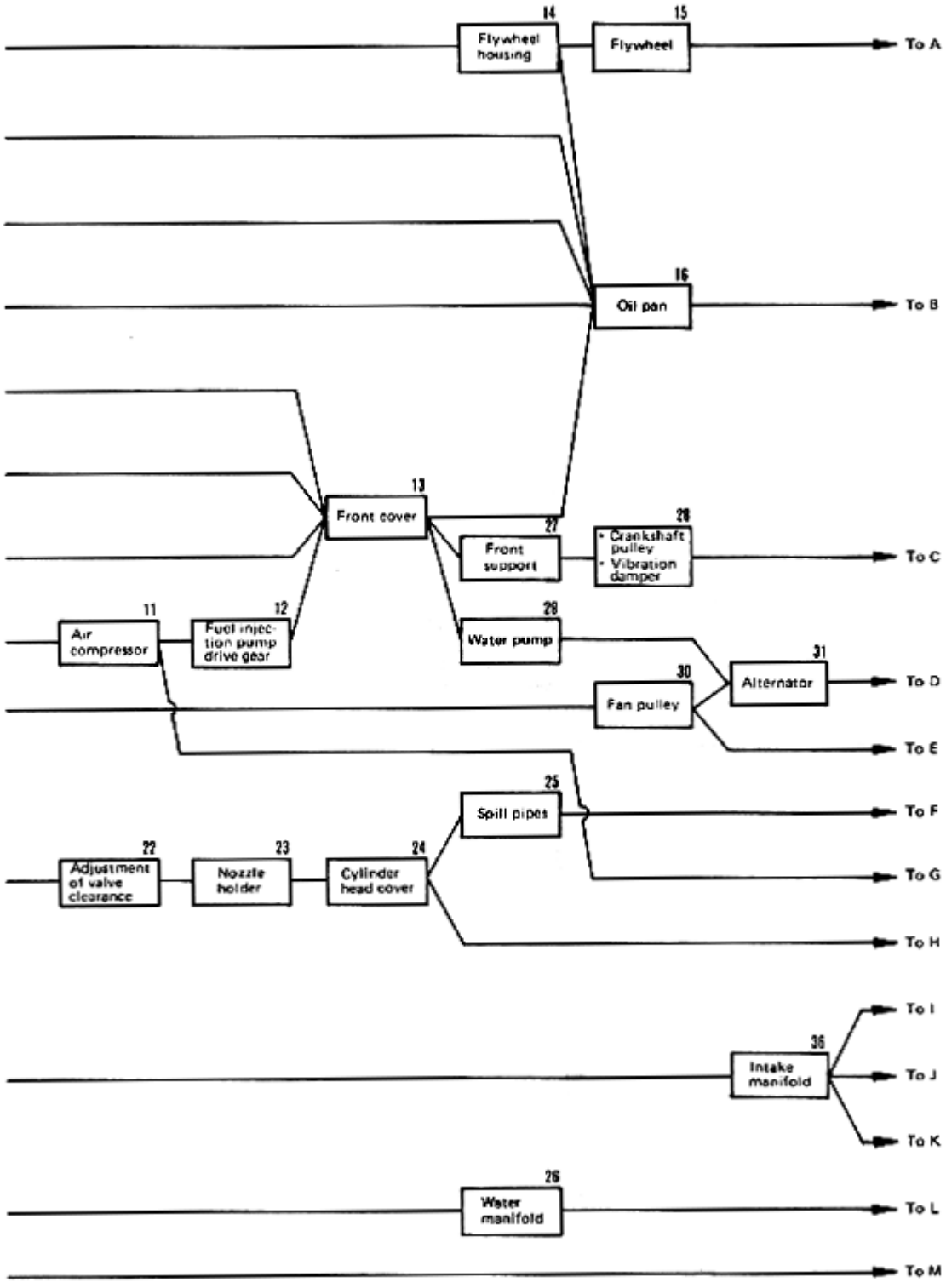
* If necessary, measure the cylinder liner protrusion using dial gauge (3) before removing the cylinder liners.

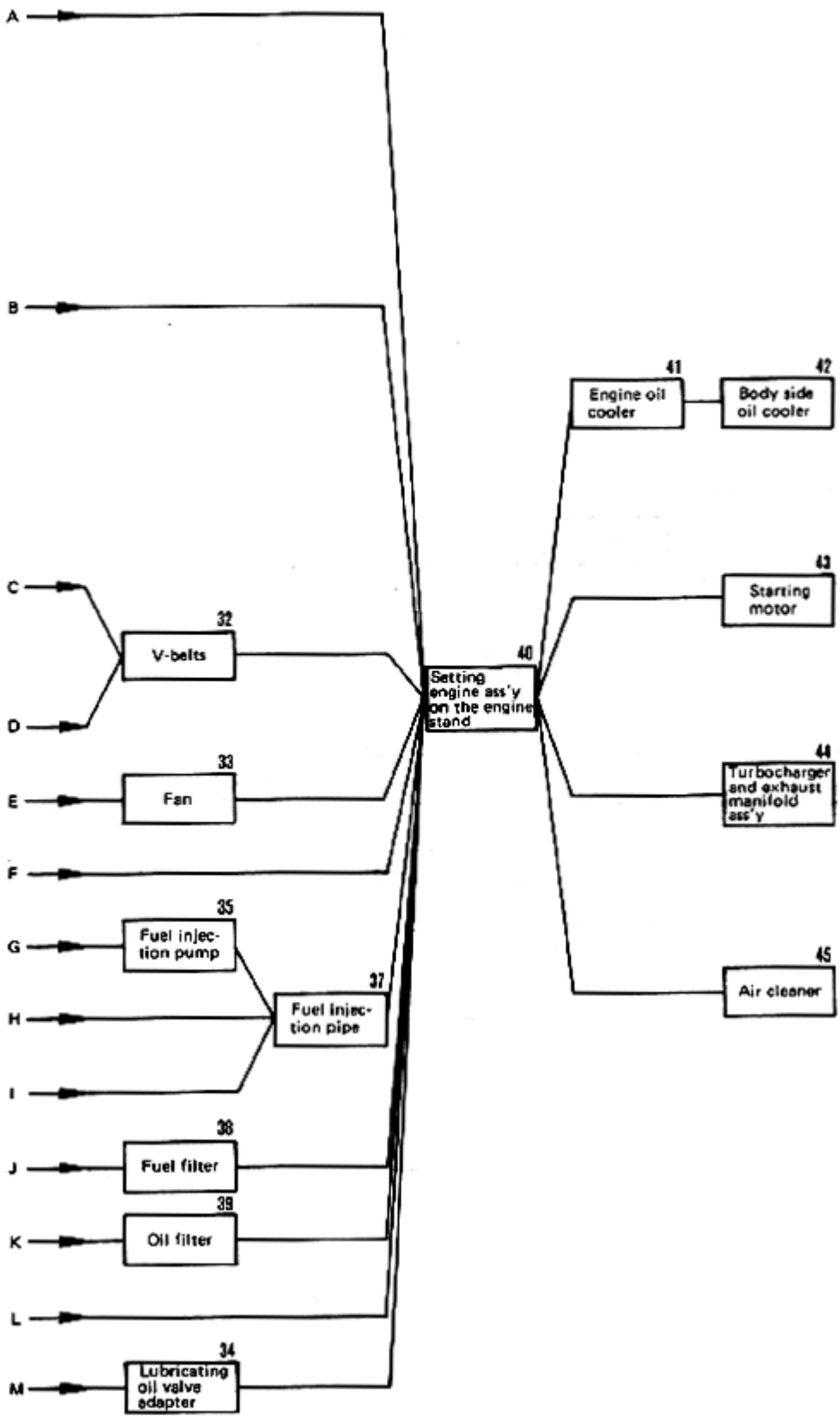
Pull out cylinder liners (1) using liner puller E.



GENERAL ASSEMBLY

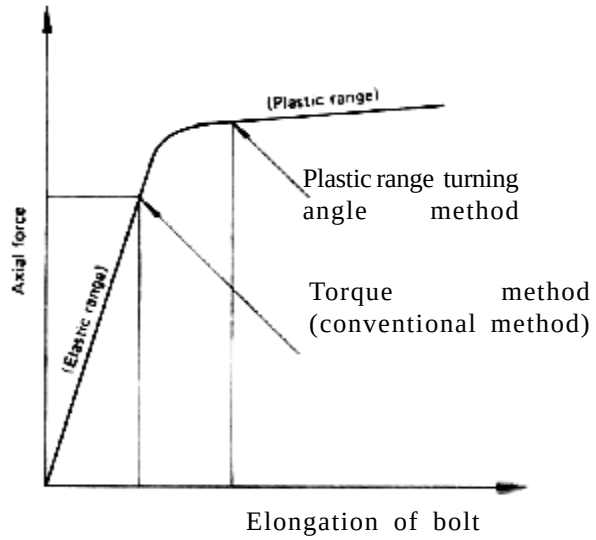



14
Flywheel housing
15
Flywheel
To A
16
Oil pan
To B
13
Front cover
27
Front support
28
• Crankshaft pulley
• Vibration damper
To C
11
Air compressor
12
Fuel injection pump drive gear
29
Water pump
31
Alternator
30
Fan pulley
To D
To E
25
Spill pipes
To F
To G
To H
22
Adjustment of valve clearance
23
Nozzle holder
24
Cylinder head cover
To I
36
Intake manifold
To J
To K
26
Water manifold
To L
To M


A
B
C
D
E
F
G
H
I
J
K
L
M
32
V-belts
33
Fan
35
Fuel injection pump
37
Fuel injection pipe
38
Fuel filter
39
Oil filter
34
Lubricating oil valve adapter
40
Setting engine ass'y on the engine stand
41
Engine oil cooler
42
Body side oil cooler
43
Starting motor
44
Turbocharger and exhaust manifold ass'y
45
Air cleaner

TIGHTENING BOLT BY THE PLASTIC RANGE TURNING ANGLE METHOD

- Important bolts in the 125 Series engines are tighten ing by the plastic range turning angle method. In this method, special bolts are used. By being tightened to the load (Plastic range) at which they begin to be permanently deformed , accurate and high tightening force can be on obtained. The most common method for tightening bolts is the torque control method. In this method, however, it is difficult to accurately control the tightening force because of the coefficient of friction.
- The plastic range turning angle method is based on the initial tightening torques and the turning angle.



* Elongation exceeding the elastic range results in permanent deformation.

- Bolts to be tightened by the plastic range turning angle method in the 125 series engines.
  1) Cylinder head mounting bolts.
  2) Main cap mounting bolts.
  3) Connecting rod cap mounting bolts.
  4) Crank pulley mounting bolts (only in D60P, S-8 machines)

* In the plastic range turning angle method, the permanent strain remains in bolts after they are tightened. Therefore, the number of times that each bolt can be reused is limited. Observe the following precautions.

1) After tightening put one punch mark on the bolt.Do not reuse any bolt which has 5 or more punch marks.
2) If a bolt has been tightened in excess of the specified turning angle,loosen the bolt completely and retighten it.(In this case,put two punch marks on the bolt.)
3) The tightening angle should be targeted at the standard value plus or minus tolerance.

Special tools :

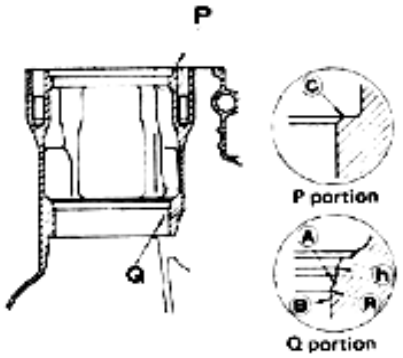
	Part No.	Part Name	QTY
A	790-901-1240	Adapter	1
B	790-501-2000	Engine overhaul stand	1
C	795-102-2102	Spring pusher	1
D	795-100-1191	Piston ring tool	1
F	795-225-1520	Liner driver	1
G	795-102-3900	Piston holder	1
H	795-502-1121	Gauge	1
I	795-125-1360	Feeler gauge	1

* Clean every part throughly and check the part for dents, flaws, and blowholes.When assembling the parts, make sure that none of the oil and water pas sages are blocked.

Preparation work :

- Install adapter A to the cylinder block, hten raise it and place it on engine overhaul stand B.
- Reapair the cylinder block as follows before inserting the cylinder liners.
  1) Remove rust and scale from surfaces Ⓐ and Ⓑ with sandpaper untill the machined surface is ex -posed.
  2) Polish portion Ⓡ with No. 60 sandpaper to make surface Ⓡ smooth.
  3) Polish portions Ⓡ and ⓗ with No. 60 sandpape to make them smooth.
     If portion Ⓡ is square or burred, polish it with sandpaper or a scraper.
     Finish this portion to an especially smooth surface to protect the O-ring from damage.
  4) If the pitting in surface Ⓑ is so rough that it cannot be repaired, replace the cylinder block.

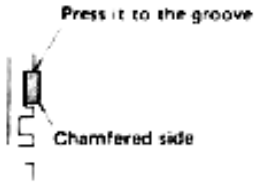
5) If surface Ⓐ and portion Ⓡ are roughened with pitting, finish them smooth.
6) Inspect the counterbore section and remove any burrs.Chips and dirt on surface Ⓒ will cause poor contact of the liner, which will lead to water leakage or improper liner projection.
   * Repair the counterbore section if there is any drooping, corrosion, or pitting.

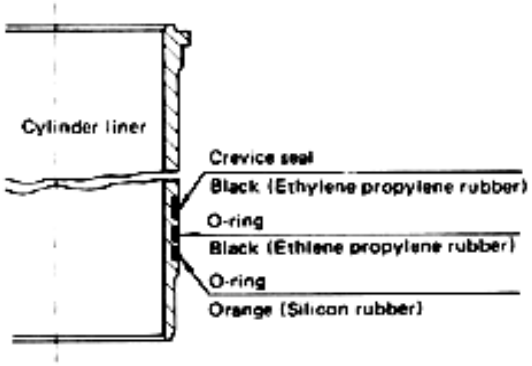


1. Cylinder liner :

* Replace the liner O-ring and clevis seal with new parts just before assembling the liner.

- Method of installing liner O-rings and clevis seal
  1) Confirm that the cylinder liner O-ring grooves and the circumference of the liner are free from rust and pitting.
     * If there surfaces are roughened with pitting , replace the liner to remove the cause of water leakage
  2) Coat liner O-rings and clevis seals with SAE No. 30 engine oil.
     * The clevis seal and black O-ring will become swollen and degraded because of oil. To prevent this, do not leave these parts immersed in oil.
     * Apply a little oil with a brush just before assembling the parts.
  3) After fitting the O-ring on the cylinder liner, check that it is not twisted. If it is twisted, use a smooth bar (approx. 10 mm O.D.) to remove the twist from the O-ring.
  4) To prevent the clevis seal from twisting, continue to press the whole circumference until it is intalled properly in the groove.
  5) Install the liner O-ring and clevis seal as shown in the diagram.
     * Install the clevis seal with the chamfered side down.





2) Insert the cylinder liners

i) Coat the liner O-rings and cylinder block O-ring grooves with SAE No. 30 engine oil

ii) Insert the liner into the cylinder block with mark A and B stamped on the liner top facing the front, taking care not to damage the O-ring.

iii) Insert the liner by pushing with both hands and all your weight.

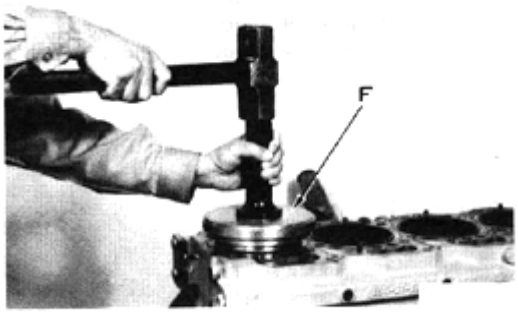
* If the liner fails to go into the cylinder block smoothly when pushed with your weight, the O-ring may get damaged. Confirm that there are no burrs on the cylinder block.

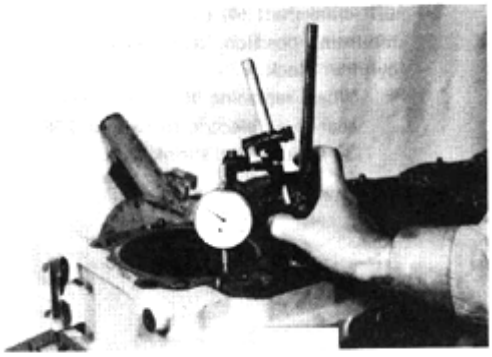
iv) Press-fit cylinder liners (1) into the cylinder block using liner driver F.

v) Measure the cylinder liner protrusion using dial gauge ③ after press-fitting the cylinder liner.

* Before measuring the liner protrusio, press the liner with a plate to elimininate the raising of the liner caused by the O-ring.

* Cylinder liner protrusion : 0.07 - 0.15 mm

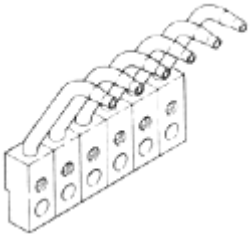


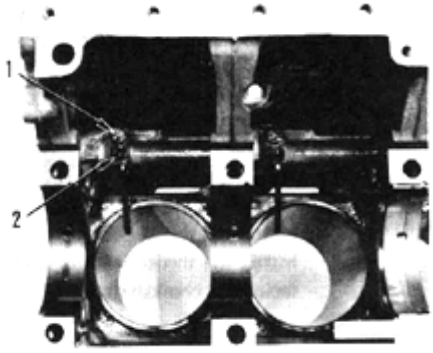


2. Piston cooling nozzle

Install each piston cooling nozzle (2) and tighten mounting bolts (1).

* Before setting nozzles in place, put them side by side and make sure that they are free from bends and other defects.

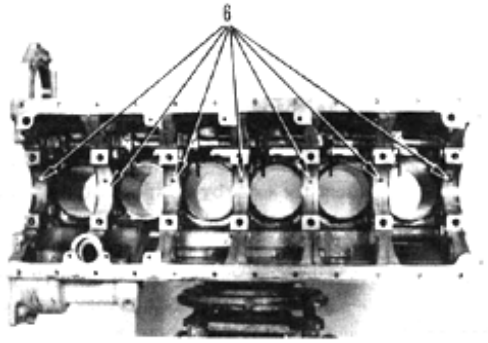




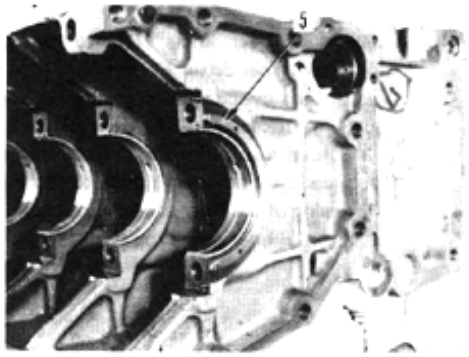
* After the piston and connecting rod assembly is installed, recheck the mounting position.

3. Crankshaft

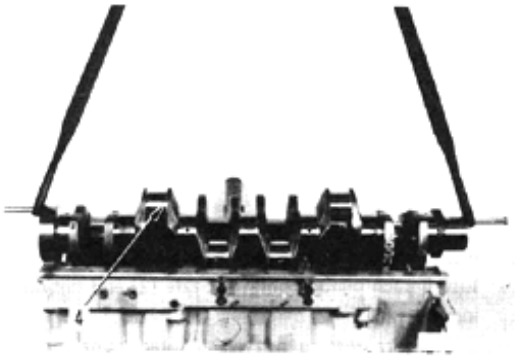
1) Install upper main bearing (6) to the cylinder block with the projected part of the bearing aligned with the groove on the cylinder block.
   * Before installing the bearing,see if any foriegn matter is adhering to the back of the bearing. Coat the inner surface of the bearing with SAE No. 30 engine oil.



2) Drive the roll pin untill its protrusion reaches 1.5 to 1.9 mm from the end of the cylinder block, then install upper side thrust bearing (5).
   * Install the thrust bearing with the grooved surface facing the crankshaft.

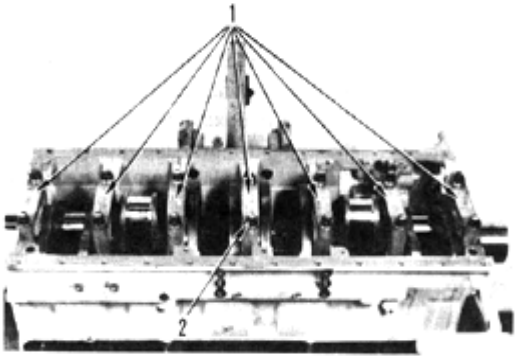


3) Lift crankshaft (4) using nylon slings.Place it in the mounting position, taking care not to let it hit the cylinder block.
   * When replacing the crank gear, heat the new gear in an electric furnace at 200°C for at least 30 minutes and shrink fit it.



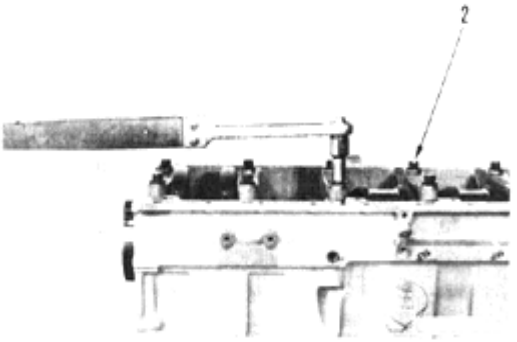
4) Install lower main bearing (7) with the projected part of the bearing aligned with the groove on the main cap.
   * Before installing the bearing, make sure that no foriegn matter is stuck on the back of the bearing.
5) Drive the rolll pin into the No. 7 cap until its protrusion reaches 1.5 to 1.9 mm from the end of the cap, and install thrust bearings (3) to both sides.
   * Install the thrust bearings with the grooved side facing the crankshaft.

6) Coat the crankshaft journal with SAE No. 30 engine oil, confirm that the stamp No. on main cap (1) coincides with the number on the cylinder block, and install the main cap.
   * Installl the main cap with the cast number facing the engine front.
7) Coat the threads of the mounting bolts and the washers for the main cap with SAE No. 30 enigne oil and secure the main cap by tightening the bolts.
8) Tighten main bearing cap mounting bolts (2) as follows.
   * Starting from the center to the outside, tighten the bolts to the specified tightening torque as follows.
   kgm Main bearing cap mounting bolts

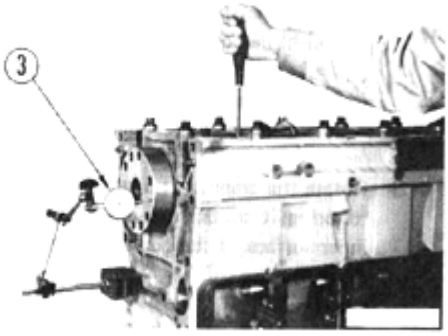


Unit : kgm

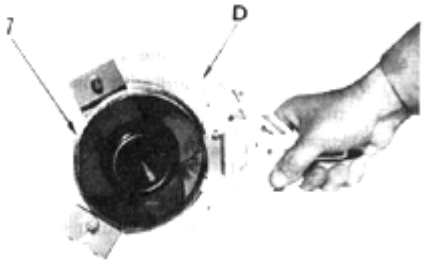
Order	Target	Range
1st step	10	9 - 11
2nd step	20	19.5 - 20.5
3rd step	Mark the bolts and the cap with a felt-tip pen, and turn the bolts with following degree	
	90°	90°-120°



Mark the bolt and the cap



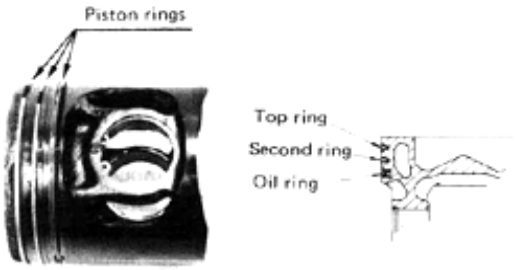
* Afer tightening the bolts, put one punch mark on the head of each bolt. do not reuse a bolt which has 5 punch marks. Replace it with a new one.
9) After tightening the bolts, confirm that the crank shaft rotates smoothly.
10) Measure the end play of the crankshaft using dial gauge ③.
    * End play : 0.14 - 0.315 mm



4. Piston and connecting rod assembly

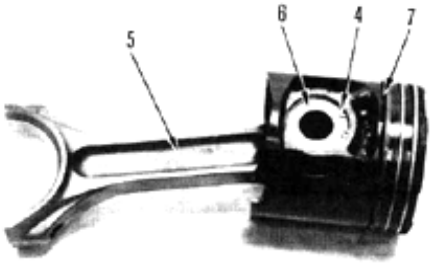
1) Assemble the piston and connecting rod assem bly as follows.
   i) Install piston rings (7) to the piston using piston ring tool D.

* Install each piston ring as shown in the drawing.
* Install each piston ring to the piston with the stamped surface facing upward.
* Remove the expander from the oil ring, fit the expander into the groove, then install the oil ring. Make sure that the expander fits snugly into the ring groove.

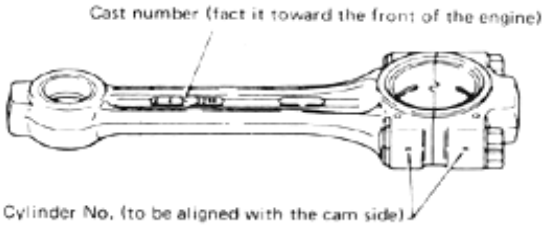


ii) Connect the piston to the connecting rod.
* Align the cylinder No. on the piston top with the stamp No. on the connecting rod, and install piston (7) to connecting rod (5) by inserting piston pin (6) with the numbers facing in the same directions.

iii) Secure the piston pin by fitting snap rings (4) on both sides.

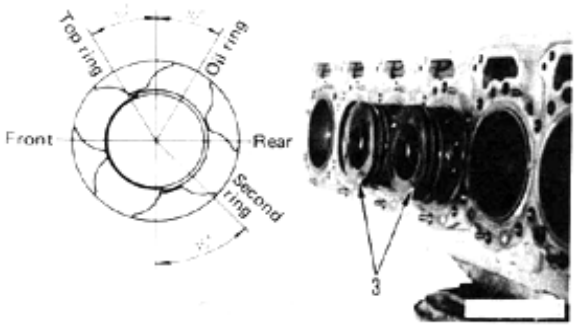


iv) Install the upper bearing to the connecting rod with the projected part on the bearing aligned with the notch on the rod.
* Make sure the back of the bearing is free from any foriegn matter before installing the bearing.

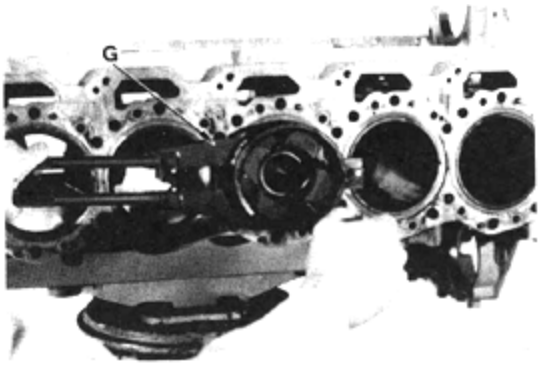


2) Rotate the crankshaft of the cylinder to be installed to bring it to bottom dead center, and coat the inner surface if the connecting rod bearing and the inner surface of the cylinder with SAE No. 30 engine oil.

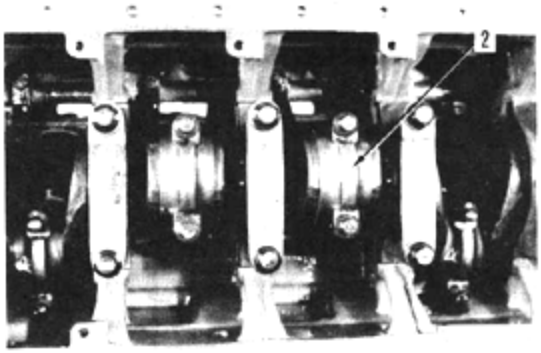
3) Insert piston and connecting rod assembly (3) into the cylinder with the cast number on the rod facing the engine front (the stamp No. should be on the camshaft side), and with the relative position of the piston ring openings arranged as shown in the drawing.
* For BS6D125G1
Take care not to damage the piston cooling nozzle when inserting the piston and connecting rod assembly.



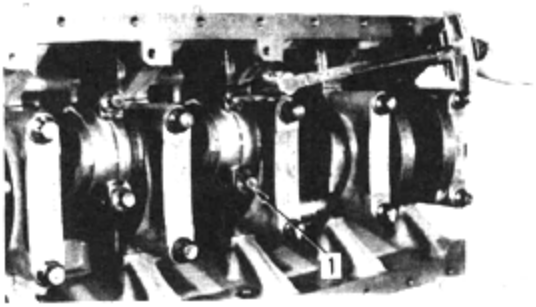
4) Contract the piston rings using piston holder G, and push the piston head into the cylinder with a wooden stick.
   * For BS6D125G1
     Take care not to damage the piston cooling nozzle when inserting the piston. Make sure also that the nozzle is located in the center of the notched part on the piston.



5) Install the lower bearing to the connecting rod cap with the projected part on the bearing aligned with the notch on the cap, and install connecting rod cap (2) in alignment with the stamped mark on the connecting rod.
   * Make sure the back of the bearing is free from any foriegn matter before installing it.
   * Coat the sliding surface of the connecting rod with SAE No. 30 engine oil.



6) Coat the threads and seating surface of connecting rod bolts (1) with SAE No. 30 engine oil and tighten them as follows.
   Connecting rod cap mounting bolts
   kgm

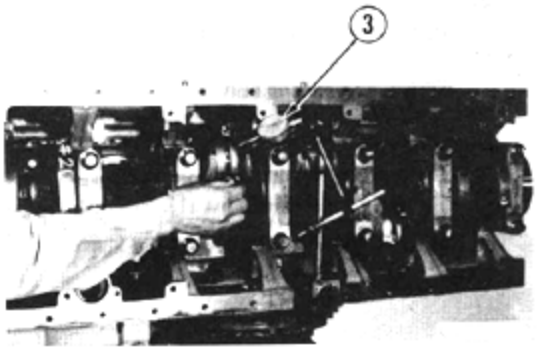


Unit : kgm

Order	Target	Range
1st step	10	9.5 - 10.5
2nd step	Mark the bolts and the cap with a felt-tip pen, and turn the bolts with following degree	
	90°	90°-120°

* After tightening the bolts, put one punch mark on the head of each bolt, Do not reuse a bolt which has 5 punch marks. Replace it with a new one.

7) After the piston and connecting rod assembly is installed, make sure the crankshaft rotates smoothly.

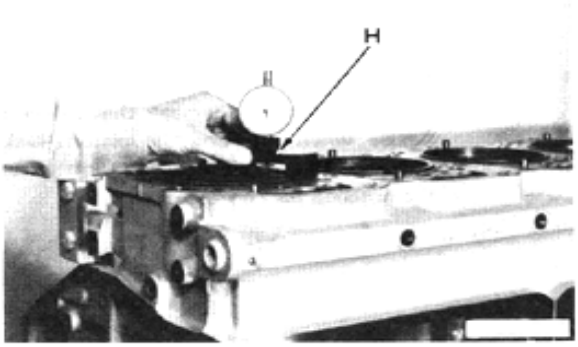


8) Measure the side clearance of the connecting rod with dial gauge ③.
   * Standard side clearance : 0.20 - 0.375 mm

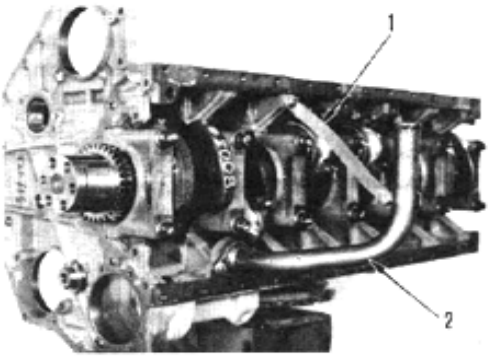
9) Measure the protrusion of piston top from cylinder block top face using gauge H.
* Protrusion of piston :

Unit : mm

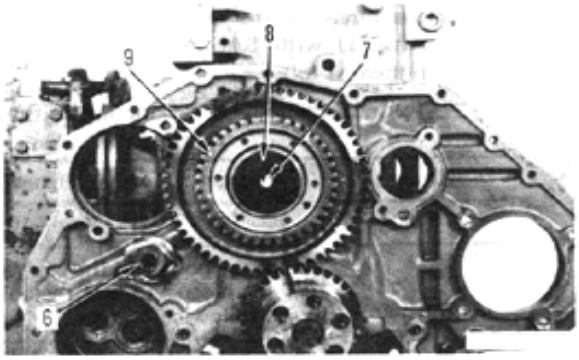
(Aluminium piston)	(FCD piston)
0.806 - 1.151	0.984 - 1.335



5. Oil suction pipe
1) Fit an O-ring and install oil suction pipe (2).
2) Install bracket (1) to secure the pipe.

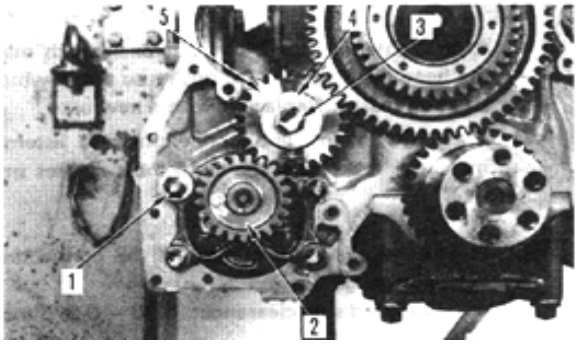


6. Idler Gear
1) Align mark A on the crankshaft gear with mark A on main idler gear (9), install shaft (8), and tighten mounting bolt (7).
kgm Mounting bolt :
16.5 ± 1.5 kgm (For M : 14 mm)
27.5 ± 2.5 kgm (For M : 16 mm)
2) Drive in the pin and install shaft (6).



3) Install oil pump idler gear (5), fit plate (4) and tighten mounting bolt (3).
kgm Mounting bolt : 16.5 ± 1.5 kgm

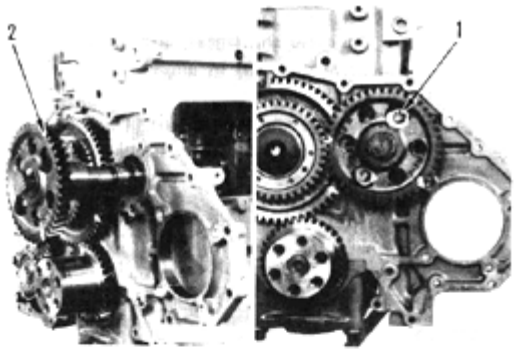
7. Oil pump
1) Fit O-ring and install oil pump (2).
2) Tighten 4 mounting bolts (1).
kgm Mounting bolt : 7 ± 0.5 kgm



8. Camshaft

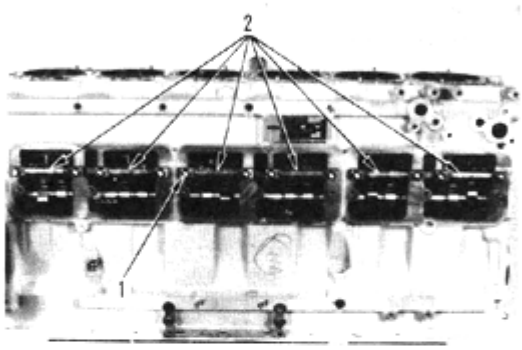
1) Coat the camshaft journal with SAE No. 30 engine oil.
2) Install camshaft (2) by aligning mark B on the camshaft gear with mark B on the main idler gear.
3) Tighten mounting bolts (1).
   kgm Plate mounting bolts : 3.75 ± 0.75 kgm

   * When installing the camshaft, turn it to prevent damage to the cambushing.
   * When replacing the cam gear, heat the gear in an electric furnace at 200 - 240°C for 30 minutes and shrink fit it.



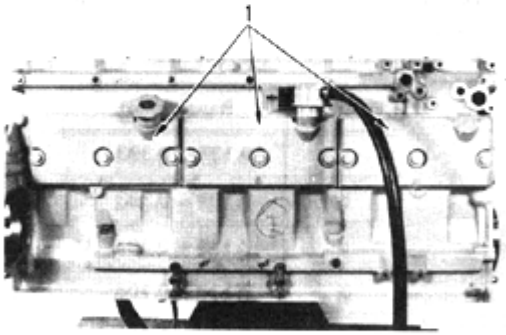
9. Cam follower

Install cam follower (2) in alignment with the pin, and tighten mounting bolts (1).
kgm Mounting bolts : 5.25 ± 0.75 kgm



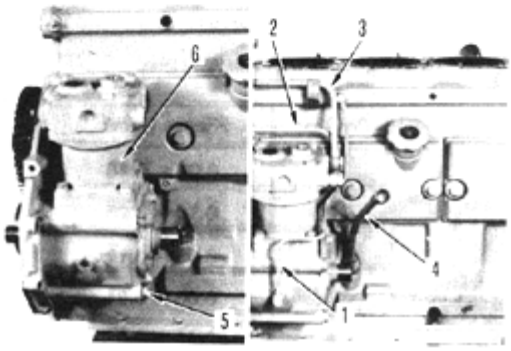
10. Cam follower cover

Fit an O-ring and install cam follower cover (1).
kgm Mounting bolt : 1.5 ± 0.15 kgm



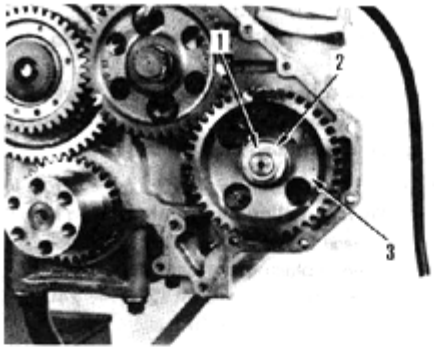
11. Air compressor

1) Fit an O-ring and install air compressor (6), and tighten 4 bolts (5).
2) Install dipstick guide (4).
3) Fit gasket on both sides and install air compressor tubes (3), (2), and (1).

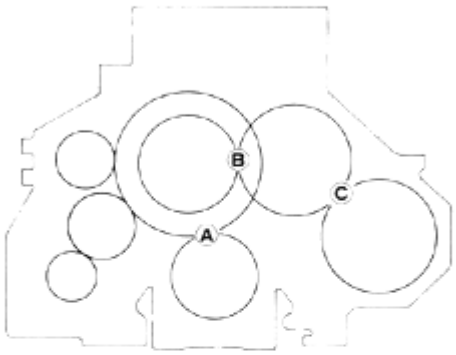


12. Fuel injection pump drive gear

1) Drive the drive shaft gear, and install fuel injection pump drive gear (3) in alignment with mark C on the camshaft gear.
2) Fit washer (2) and tighten nut (1).
   * Tighten the nut while holding the gear with a screwdriver.
   kgm Nut :24.5 ± 1.5 kgm

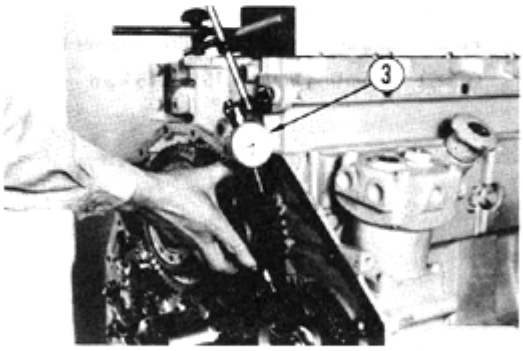


* Make sure match marks on each drive gear and on the idler gear are aligned with eash other.



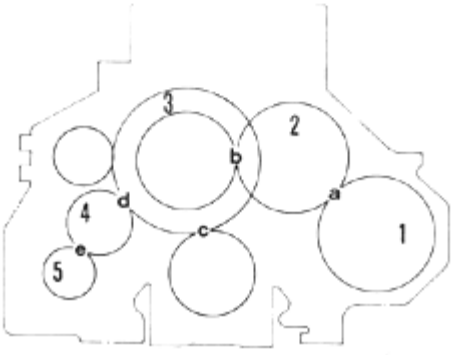
* Measure the backlash and the end play of each gear with dial gauge ③.
  - Standard value of gear backlash

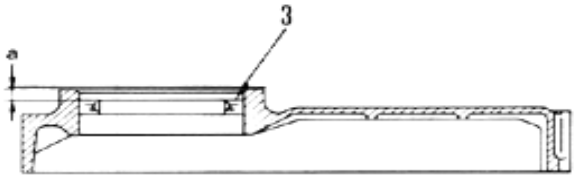
Position	Range (mm)
a	0.125 - 0.395
b	0.125 - 0.395
c	0.140 - 0.425
d	0.130 - 0.405
f	0.080 - 0.390



  - Standard value of gear END PLAY

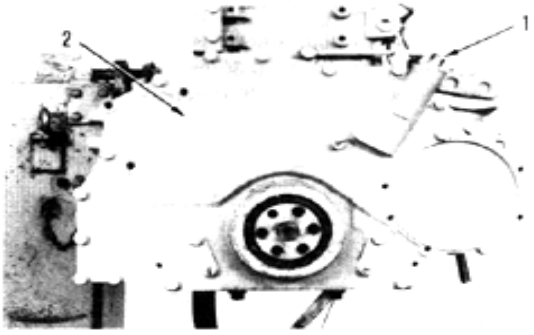
Position	Range (mm)
1	0.09 - 0.48
2	0.10 - 0.25
3	0.05 - 0.17
4	0.05 - 0.21
5	0.03 - 0.09





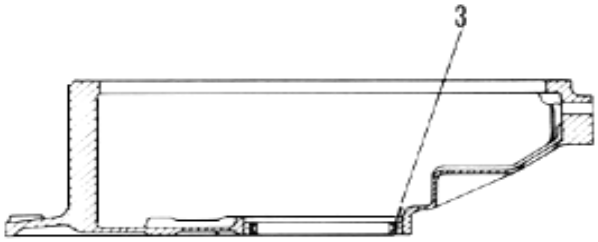
13. Front cover

1) Press fit oil seal (3) into the cover using a push tool (outside diameter : 120 mm).
   * Insertion allowance (a) for oil seal : 11 +1 mm
     0
   Oil seal lip : G2-L1 (Coat 50 to 80% of the lip clearance)



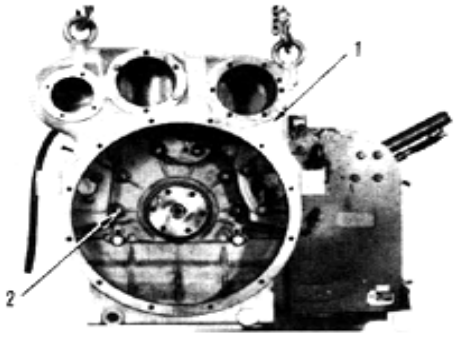
2) Coat the mounting surface with liquid gasket and install front cover (2).
   * Take care not to damage the oil seal when installing the cover (2).
   Mounting surface : Liquid gasket (LG-7)

3) Fit an O-ring and install tachometer drive assembly (1).
4) Measure the difference between the cylinder block lower face and the front cover using dial gauge.
   * Difference : 0 - 0.275 mm



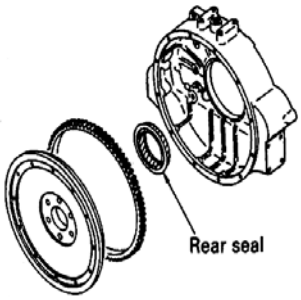
14. Flywheel housing

1) Press fit oil seal (3) into the housing using a push tool (outside diameter : 180 mm).
   Oil seal lip : Engine oil

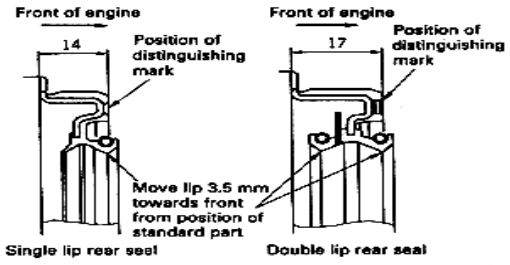


2) Coat mounting surface of cylinder block with liqiuid gasket.
   Mounting surface : Liquid gasket (LG-7)
3) Sling flywheel housing (1), install the housing to cylinder block and tighten mounting bolts (2).
   * Take care not to damage the oil seal when installing the housing.
   Bolt thread and washers : SAE No. 30 Engine oil

*If the oil seal lip contact surface of the crank shaft is worn (enough for your fingernail to catch:0.1 mm or more), assemble a rare seal to correct the wear (assemble it 3.5 mm to the front of the engine the lip position).



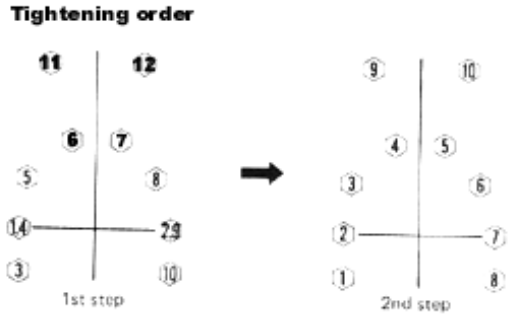
B6D125 SERIES



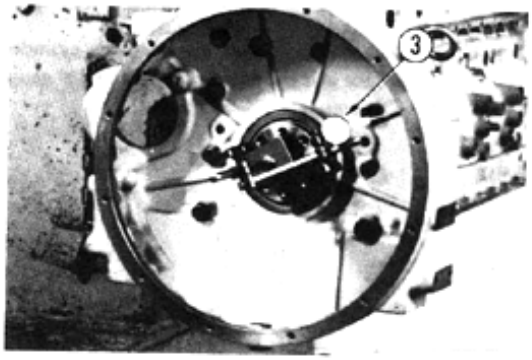
* Tighten flywheel housing mounting bolts as follows and in the order shown in the drawing.
  kgm Flywheel housing mounting bolts

Unit : kgm

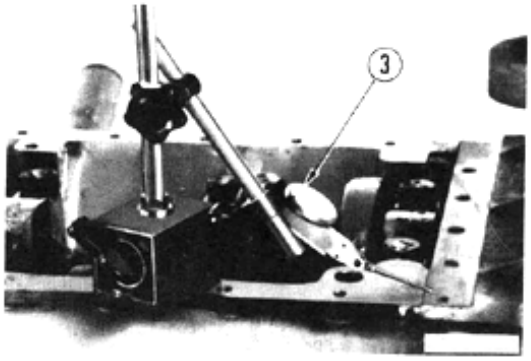
Order	Target	Range
1st step	19	15 - 24
2nd step	28	25 - 31.5



3) After flywheel housing is installed, measure the face runout and radial runout using dial gauge ③.
   * Radial runout : 0.20 mm max.
   * Face runout : 0.20 mm max.



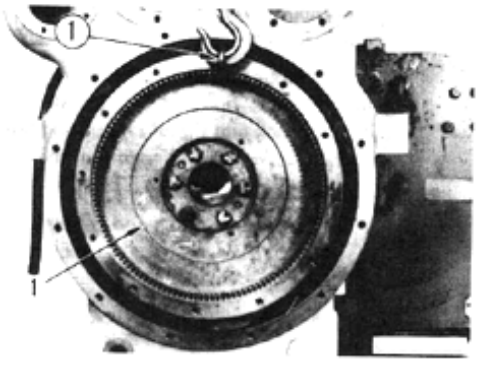
4) Measure the difference between the cylinder block and the flywheell housing using dial gauge ③.
   * Difference : 0 - 0.35 mm



15. Flywheel

1) Sling flywheel (1) with eye bolt ① (Thread dia : 12 mm, pitch : 1.75 mm), install the flywheel to the crankshaft, and tighten the mounting bolts.

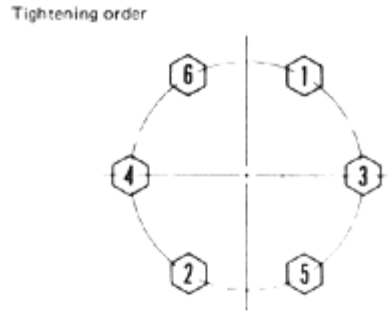
   Bolt threads and washers : SAE No. 30 engine oil.



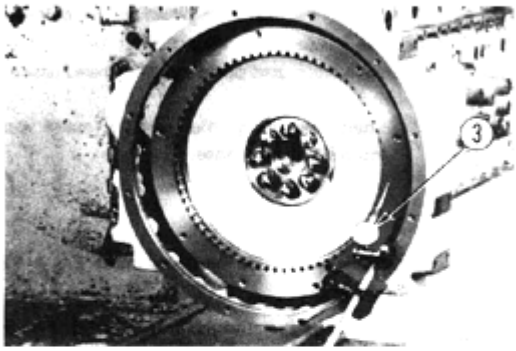
* Tighten flywheel housing mounting bolts as follows and in the order shown in the drawing.
kgm Flywheel housing mounting bolts

Unit : kgm

Order	Target	Range
1st step	15	13 - 17
2nd step	29.5	27.5 - 31.5

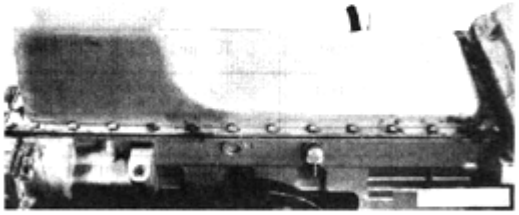


2) After flywheel housing is installed, measure the face runout and radial runout using dial gauge ③.
* Radial runout : 0.20 mm max.
* Face runout : 0.15 mm max.

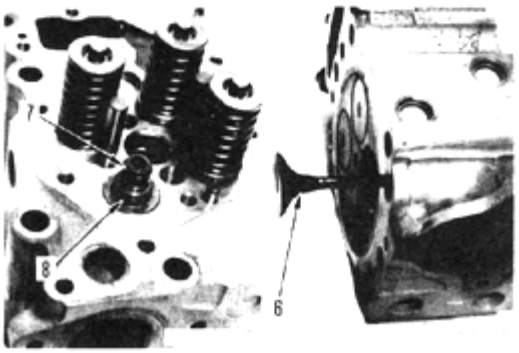


16. Oil pan
Fit a gasket and install oil pan (1).

17. Cylinder head assembly
1) Assemble the cylinder head assembly as follows.
i) Fit lower seat (8) and install seal (7).
* The seals are provided on the exhuast side only.
ii) Coat the valve stems and the inner surface of valve guides with SAE No. 30 engine oil and install vlave (6).



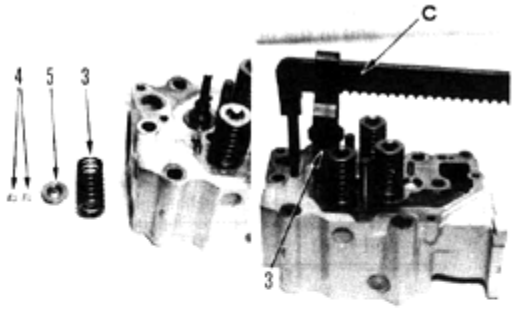
* The valve rotator is installed in BS6D125 engine, instead of the lower seat.
* The free length of the valve springs are different between B6D125 and BS6D125.



iii) Set the cylinder head upright, and install valve spring (3) and upper seat (5).

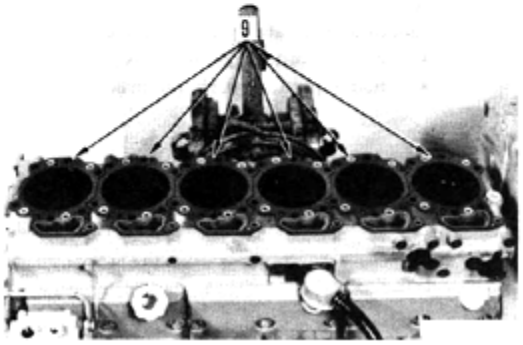
iv) Contract the valve spring using spring pusher **C**,and install valve cotters (4).

* Tap the valve stem lightly with a plastic hammer to make sure the cotters are securely installed in the valve stem groove.



2) Make sure the mounting surface of cylinder head and the inside of cylinders are free from dust and foriegn matter, and place cylinder head gasket (9) in position.

* When installing the gasket, make sure the grommet is not loose.

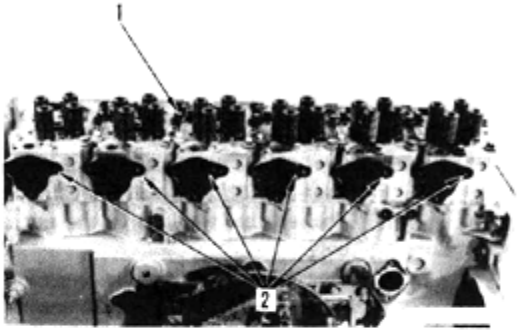


3) Install each cylinder head assembly (2) and tighten mounting bolts (1).

Coat the threads and lower side of the bolt head before tightening the mounting bolts with lubricant (LM-P).

* First screw in the mounting bolts two or three revolutions by hand, then tighten the bolts as follows.

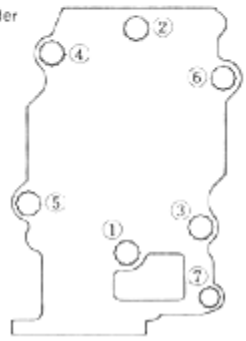
kgm Cylinder head mounting bolts



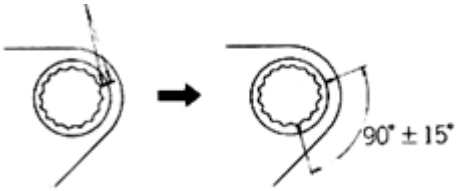
Unit : kgm

Bolt No.	Order	Target	Range
① l ⑥	1st step	10	9 - 11
	2nd step	14	13.5 - 14.5
	3rd step	Mark the bolts and the cylinder head with a felt-tip pen, and turn the bolts with following degrees.	
		90°	75° - 105°
⑦	-	6.75	6.0-7.5

Tightening order



Put mark on the bolt and cylinder head

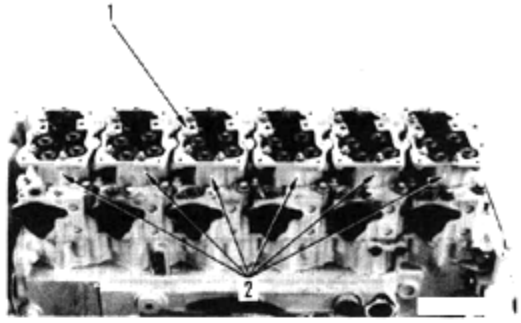


* After tightening the bolts, put one punch mark on the head of each bolt. Do not reuse a bolt which has 5 punch marks. Replace it with a new one.

18. Rocker arm housing

Fit gaskets and install rocker arm housing (2) to the cylinder heads, then tighten 42 mounting bolts (1).

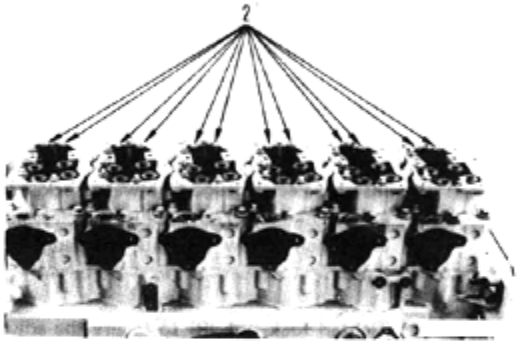
kgm Mounting bolts : 6.75 ± 0.75 kgm



19. Push rod

Install push rods (2).

* Make sure the push rods are securely positioned in the cam follower lever holes.

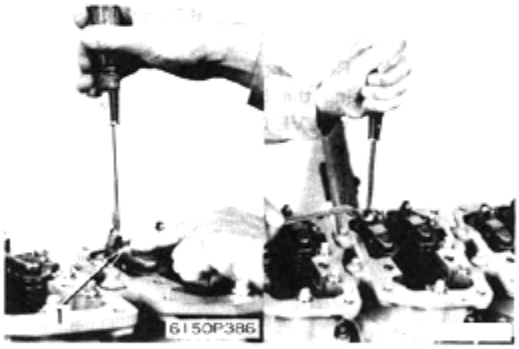


20. Crosshead

Install crosshead (1).

* Adjust the crosshead as follows.
  - i) Loosen the lock nut and the adjustment screw.
  - ii) Hold down the upper surface of the crosshead lightly wih a finger, and screw the adjustment screw.
  - iii) After the adjustment screw comes into contact with the valve stem, screw the adjustment screw 20 degrees.
  - iv) Tighten the lock nut in this position.

kgm Lock nut : 6.5 ± 0.5 kgm



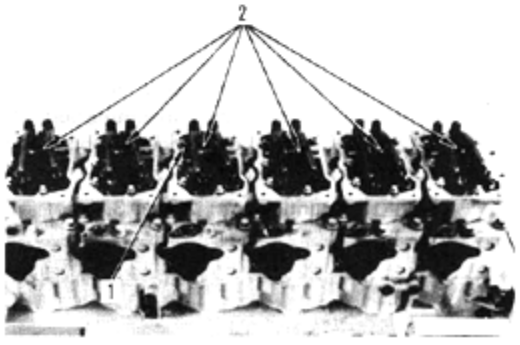
21. Rocker arm

Fit gaskets and install rocker arm (2), then tighten 12 mounting bolts (1).

* Make sure the ball portion of the adjustment screws are securely placed in the socket portion of the push rods before tightening the bolts.
* Clean oil holes onthe bolts and tighten the bolts.

kgm Mounting bolt : 6.75 ± 0.75 kgm

* Set a rocker arm shaft in place so that the portion having a large hole (13 mm dia.) is on the lower side and that having a blind ball plug is on the front side.

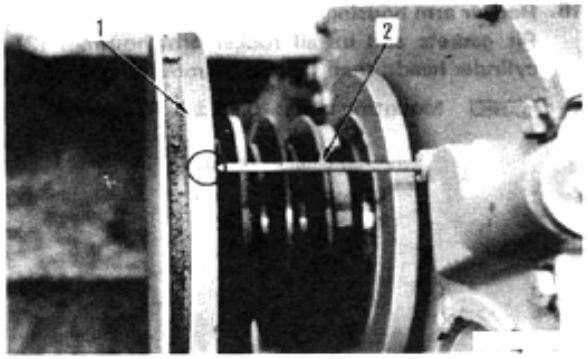


22. Adjustment of valve clearance

Adjust the valve clearance in the following procedure.

* Adjust the vlave clearance to obtain the following clearance between the crosshead and the rocker arm.
* Valve clearance (when engine is cold)

Intake valve	Exhaust valve
0.33	0.71



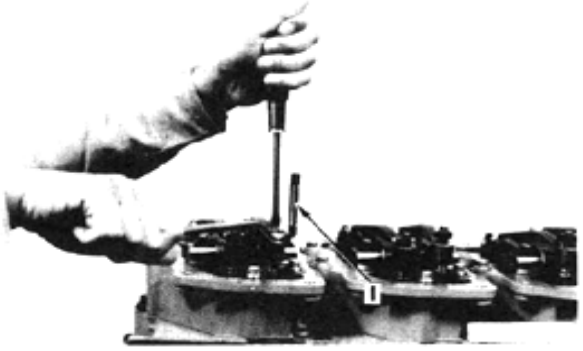
* With the engine cranking in firing order 1-5-3-6-2-4, adjust the valve clearance for each cylinder.
  1) Rotate the crankshaft in the normal direction. while watching the movement of the valve, align stamped line "1.6 TOP" on vibration damper (1) with pointer (2).

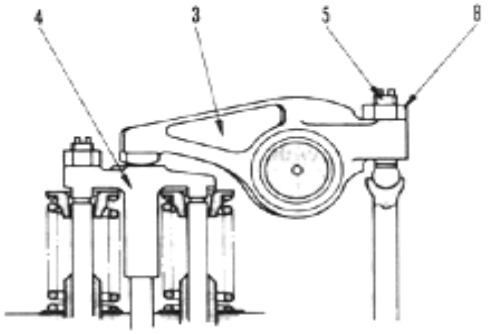
  2) Insert a feeler gauge **l** between rocker arm (3) and crosshead (4), and adjust the clearance with adjustment screw (5) until the gauge can slide lightly.

  3) Tighten lock nut (8) to secure the adjustment screw.

  kgm Lock nut : 6.75 ± 0.75 kgm

* Recheck the valve clearance after tightening the lock nut. Refer 12 ADJUSTING VALVE CLEARANCE.

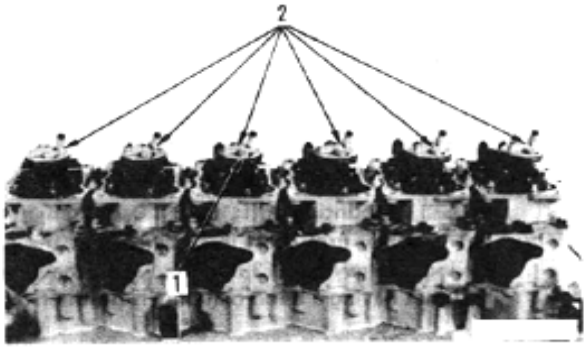




23. Nozzle holder

* Make sure the inside of nozzle holder sleeve is free from dust and foreign matter.
  Fit O-rings and install nozzle holders (2) to the cylinder head, then tighten mounting bolts (1).
* Tighten the nozzle holder mounting bolts equally to achieve even tightening.

kgm Mounting bolt : 2.2 ± 0.3 kgm

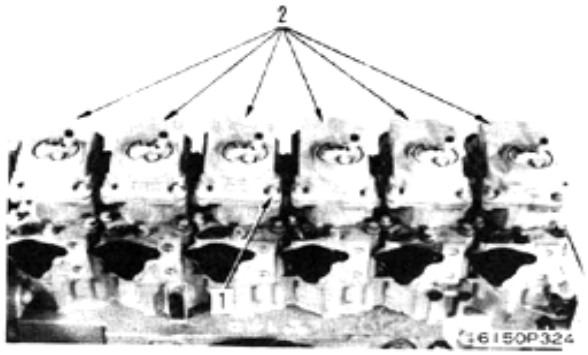


24. Cylinder head cover

Fit O-rings and install cylinder head covers (2), then tighten 24 mounting bolts (1).

* Apply adhesive to the O-rings so that they can be installed without causing twisting.

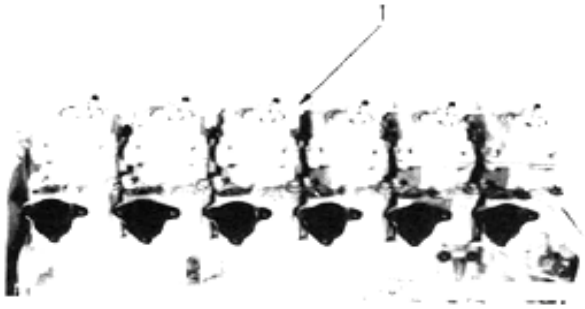
kgm Cylinder head cover mounting bolts : 1 ± 0.1 kgm



25. Spill pipes

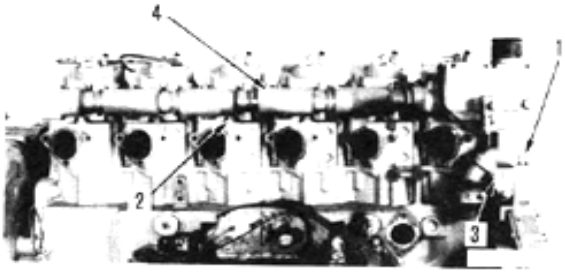
Fit gaskets on both sides and install spill pipes (1).

kgm Joint bolt : 1.25 ± 0.25 kgm



26. Water manifold

1) Fit gaskets and install water manifold (4), then tighten 12 bolts (2) and 2 bolts (3).
2) Fit gaskets on both sides, and connect tube (1) between the air compressor and connector.



27. Front suppoprt

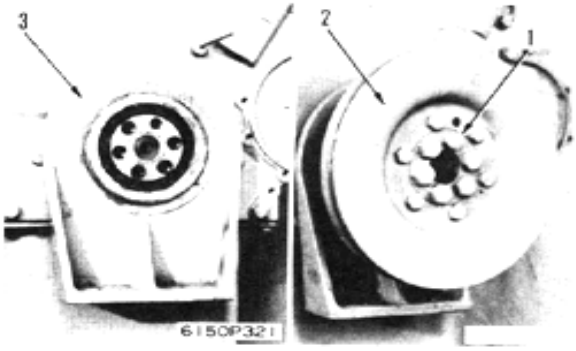
Install front support (3).

28. Crankshaft pulley and vibration damper

Install crankshaft pulley and vibration damper (2), then tighten 6 mounting bolts (1).

kgm Mounting bolts : 28 ± 3 kgm (Threads dia. : 16 mm, Pitch : 1.5 mm)

18 ± 2 kgm (Thread dia. : 14 mm, Pitch : 1.5 mm)

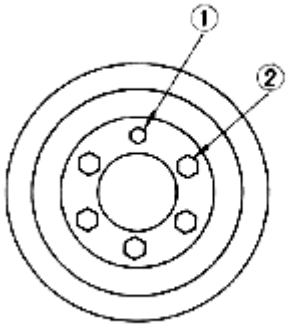


28-1. Crankshaft pulley (for D60P-8 and D60S-8)

1) Install crankshaft pulley.
2) Coat bolts with the engine oil, then tighten the bolts as follows.

kgm Bolt ①: 18 ± 2 kgm
Bolt ②:
1st step : 15 ± 1 kgm
2nd step : 30 ± 1 kgm
3rd step : Mark the bolts and the pulley with a felt-tip pen, and turn the bolts 90° - 120°.

* Bolt ①: Thread dia. : 14 mm, Pitch : 1.5 mm
Bolt ②: Thread dia. : 16 mm, Pitch : 1.5 mm

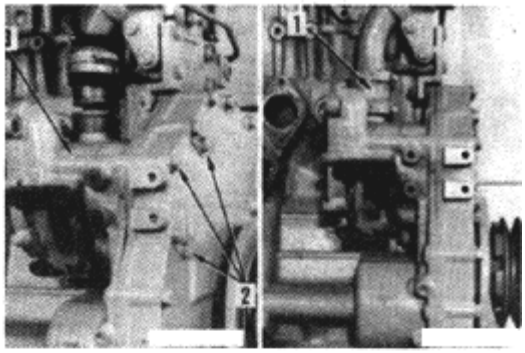


29. Water pump

1) Fit O-ring and install water pump (3), then tighten 3 mounting bolts.

kgm Mounting bolts : 6.75 ± 0.75 kgm

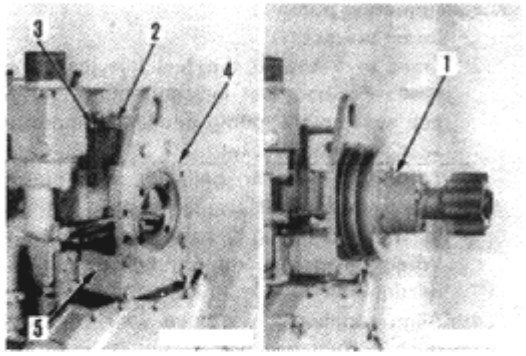
2) Connect hose (1) between the water pump and the thermostat housing.



3) Install spacer (5) and hanger (4).
4) Install 2 spacers (3) and bracket (2).

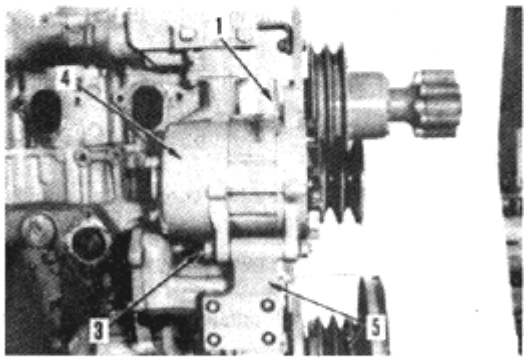
30. Fan pulley

Install fan pulley (1) and tighten the 4 mounting bolts.



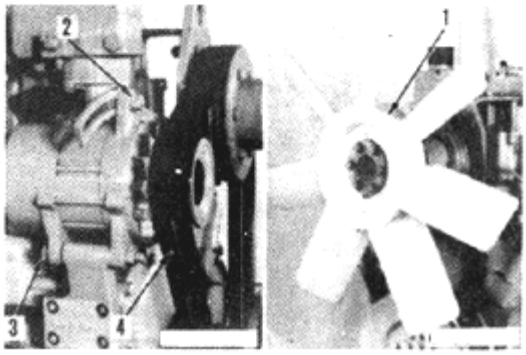
31. Alternator

1) Install bracket (5).
2) Set alternator (4) on the bracket, and loosly tighten fastening bolt (3).
3) Install plate (1).



32. V-belts

1) Install V-belts (4) to the pulley grooves, and install the belt tension adjustment bolt (2).
2) Adjust the belt tension by raising the alternator with a bar until the belt deflects about 13 mm when the center of the belt is depressed with a force of 6 kg then tighten bolts (3) and (2).
PC300-3, PC400-3
Standard belt tension : about 6 - 7 mm

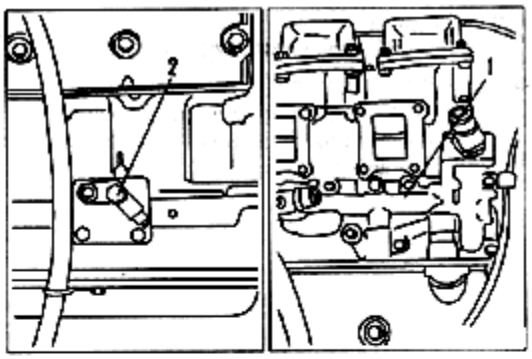


33. Fan

Install fan (1).

34. Lubricating oil valve adapter

1) Install adapter (2) for the fuel overflow, and connect the spill hose.
2) Fit O-ring and install lubricating oil valve adapter (1).



35. Fuel injection pump

1) Install bracket (7).
2) Drive in a key to the fuel injection pump drive shaft. Position fuel injection pump (6) with the key seat on the pump coupling aligned with pin section on the bracket.
3) Remove 2 couplling bolts (8) from fuel injection pump, then install flange coupling (11) and front laminated coupling (9) tko engine drive shaft.
When doing this, do nt tighten coupling connection bolt (4).
4) Align coupling key groove with drive shaft key, push in fuel injection pump assembly (6), align with pin portion of bracket, and set in position.
5) Tighten 4 mounting bolts (5). of fuel injection pump.

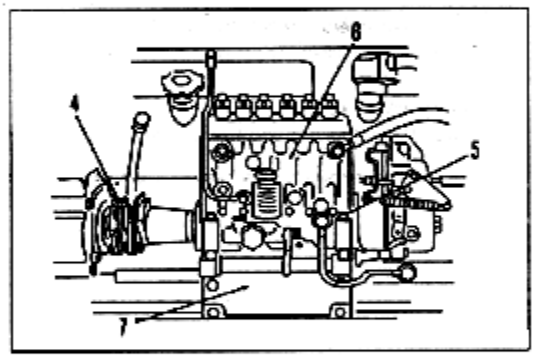
kgm Mounting bolts :
3.2 ± 0.3 kgm (B6D125-1)
6.75 ± 0.75 kgm (BS6D125-1)
6.75 ± 0.75 kgm (BSA6D125-1)

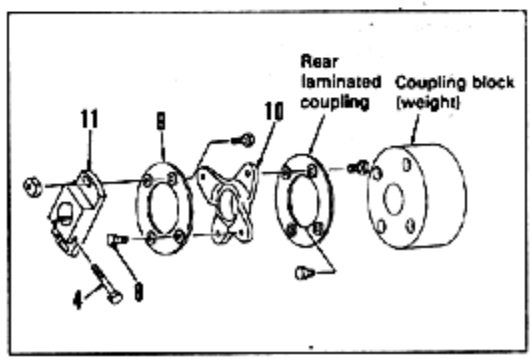
6) Tighten 2 bolts (8) connecting coupling and drive shaft.

kgm Connecting bolts : 6.25 ± 0.25 kgm

7) Tighten bolts (4) connecting coupling and drive shaft.

kgm Mounting bolt :
9 + 0.5 kgm (B6D125-1)
0
8 ± 0.5 kgm (BS6D125-1)
8 ± 0.5 kgm (BSA6D125-1)





8) Check the injection timing as follows.
i) Rotate the crankshaft in the normal direction and align the injection timing stamp line on vibration damper (8) with pointer (9).
* If the stamp line on the injection pump coupling is invisible from the front, rotate the crankshaft one more revolution.
ii) In the condition described in step i), confirm that stamp line **a** on the injection pump side is aligned with stamp line **b** on the coupling side.
* If the stamp lines are out of alignment, loosen nut (10), turn the coupling until one stamp line is aligned with the other, and tighten the nut to the specified torque.

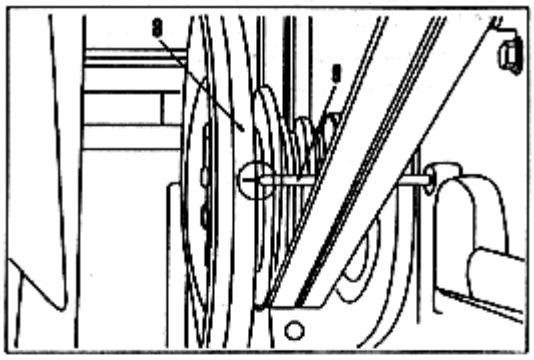
kgm Nut : 6.2 ± 0.2 kgm

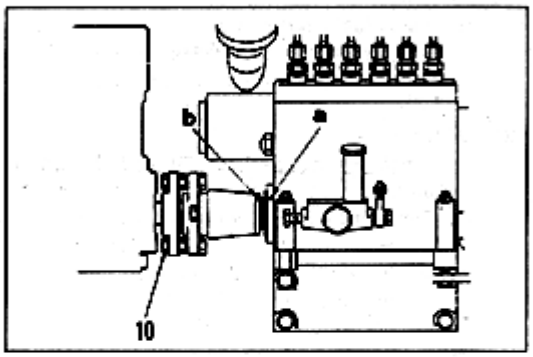
* When the fuel injection pump is repaired or replaced, or if the stamp line is missing, adjust the injection timing by the delivery valve method. See 12 CHECKING AND ADJUSTING FUEL INJECTION TIMING.

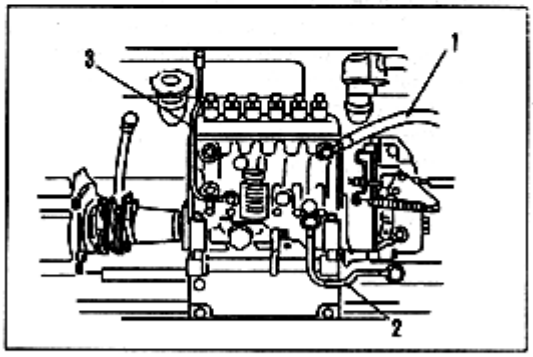
9) Fit gaskets to both sides and install lubrication tubes (3) and (2).

kgm Joint bolt for tube (2) : 2.5 + 0.5 kgm
0
Joint bolt for tube (3) : 1.5 + 0.5 kgm
0

10) Fit gasket to both sides and connect overflow hose (1)



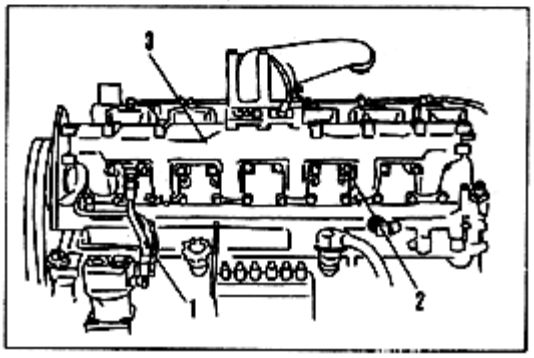




36. Intake Manifold

1) Fit a gasket , install intake manifold (3) , and tighten 24 mounting bolts (2)

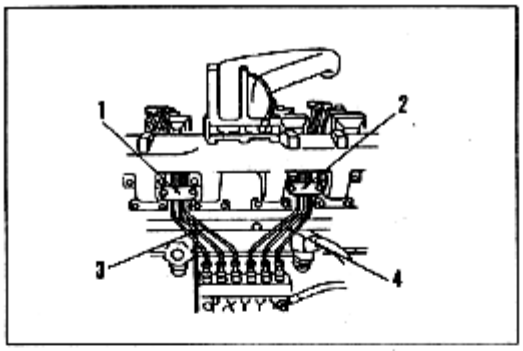
2) Install tube (1) between the intake manifold and the air compressor.



37. Fuel injection pipe

Install fuel injection pipes (4) and (3), and secure the pipes with clamps (2) and (1).

kgm Sleeve nut : 2.4 ± 0.1 kgm

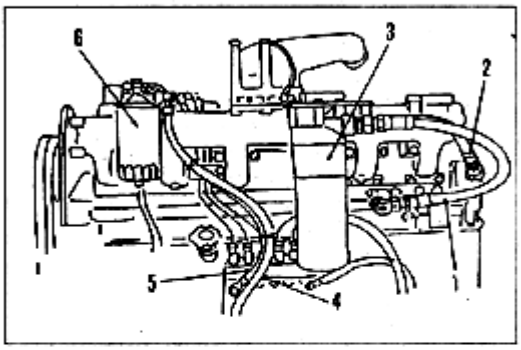


38. Fuel filter

1) Install fuel filter (6) and the bracket as a unit.
2) Fit gaskets to both sides and install hoses (5) and (4) between the filter and the pump.

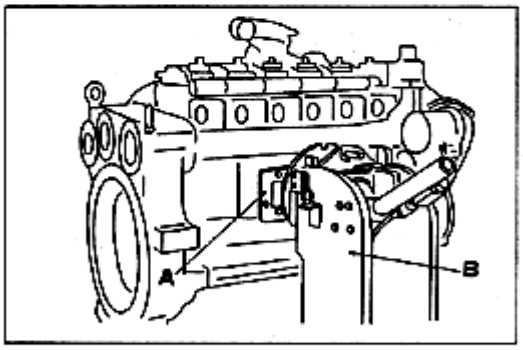
39. Oil filter

1) Install engine oil filter (3) and the bracket as a unit.
2) Connect hoses (2) and (1) between the filter and the adapter.
   * Install the hoses without twisting or interference.



40. Setting engine assembly on the engine stand

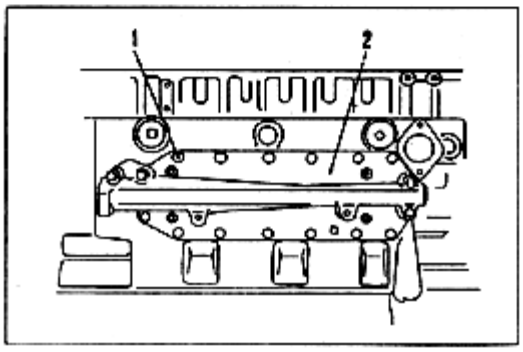
1) Sling the engine assembly, remove the connecting bolts between adapter **A** and engine overhaul stand **B,** to seperate the engine assembly from overhaul stand.
2) Set the engine assembly on the engine stand.
3) Remove adapter **A**.



41. Engine oil cooler

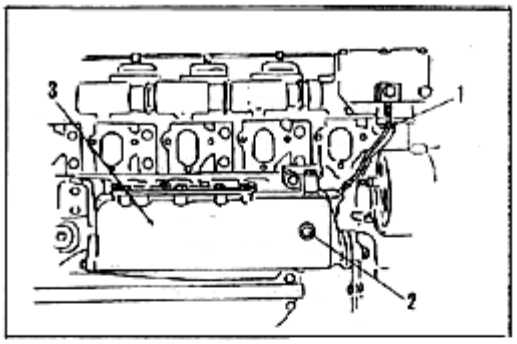
Fit a gasket and install engine oil cooler (2), then tighten 17 bolts (1).

kgm Mounting bolt : 6.75 ± 0.75 kgm



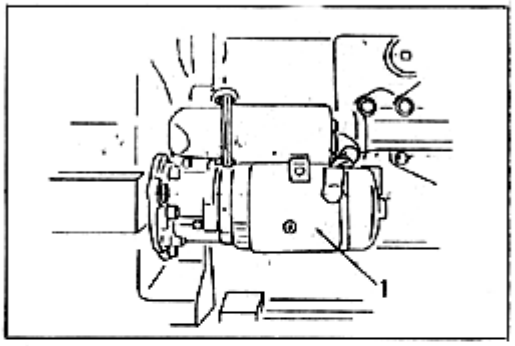
42. Body side oil cooler

1) Fit a gasket and install body side oil cooler (3), then tighten 8 bolts (2).
2) Install aeration pipe (1).



43. Starting motor

1) Fit a gasket and install starting motor (3),



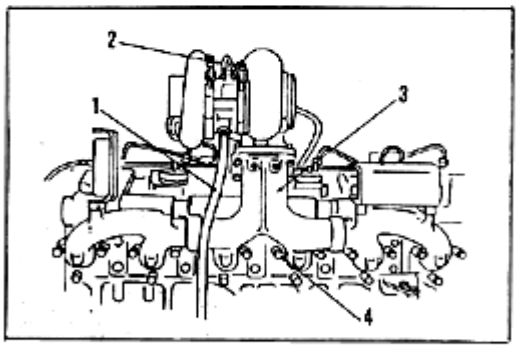
44. Turbocharger and exhaust manifold assembly

1) Sling turbocharger and exhaust manifold assem bly (3), fit gaskets, and tighten 18 mounting bolts (4).
   * Fit the gasket with the marked side facing outward.

   kgm Mounting bolt : 6.75 ± 0.75 kgm

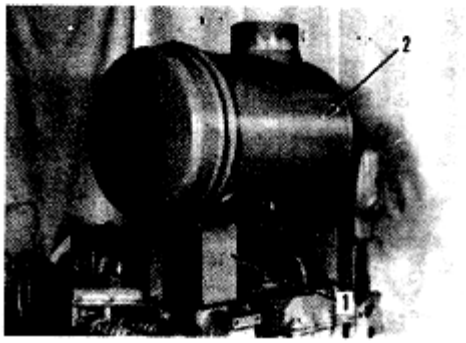
2) Assemble exhaust brake.
   * To prevent any excessive force from being brought to bear on the turbocharger when assembling the exhaust brake , position it first and then tighten all the bolts.

3) Fit gaskets and install turbocharger inlet tube (2) and outlet tube (1).
4) Connect the intake connector hose to the turbocharger.



45. Air cleaner

Install air cleaner (2) and bracket (1) as a unit, and connect the hose to the turbocharger.

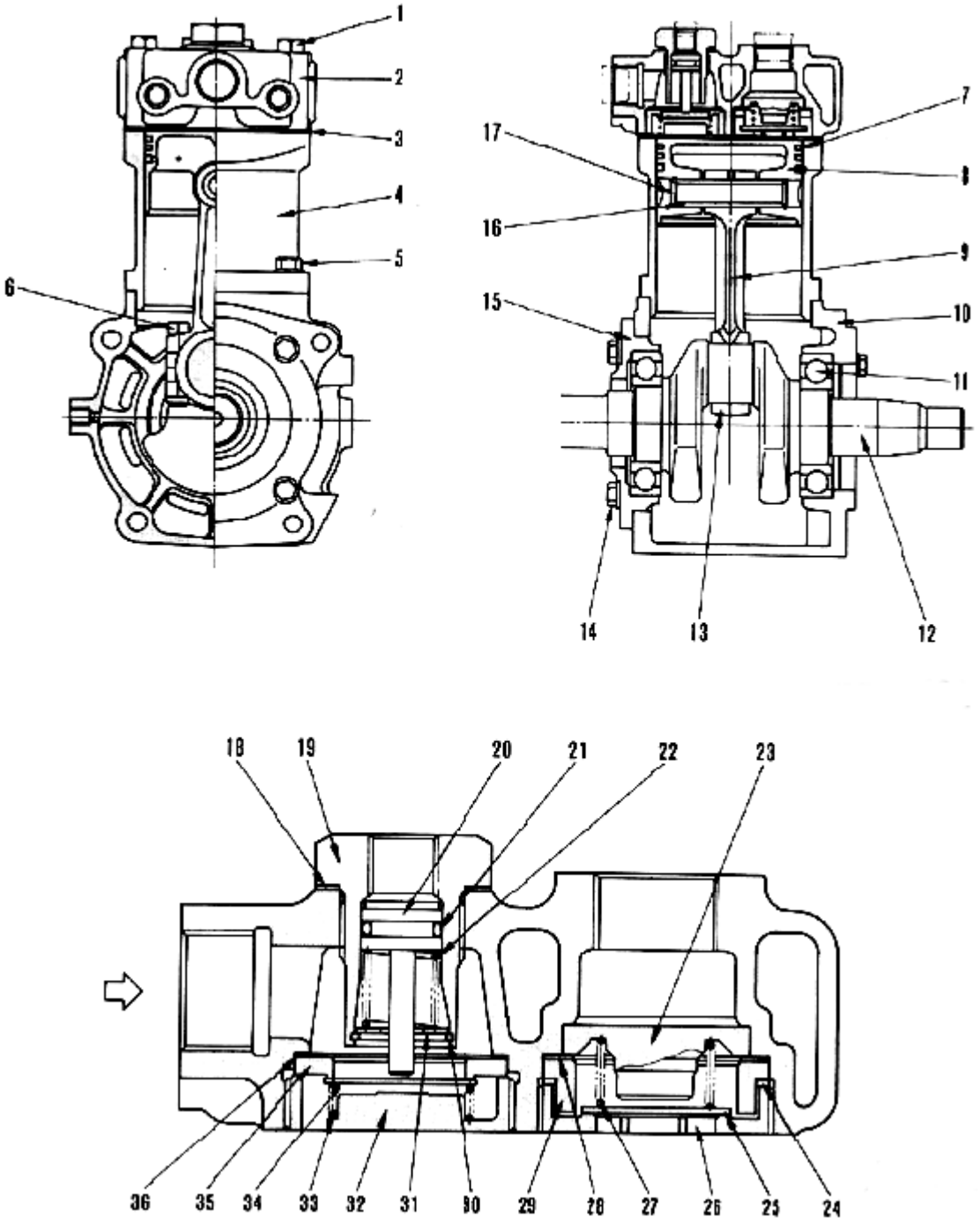


Refilling with the engine oil

1) Make sure the engine drain plug is tightened.
2) Add engine oil through the oil filter to the specified level.

Engine oil pan : about 26ℓ

DISASSEMBLY OF AIR COMPRESSOR



OVERALL ASSEMBLY

1. Cylinder head

1) Remove 4 cylinder head mounting bolts (1).
2) Tap with a wooden hammer from under cylinder head, and remove cylinder head (2).
3) Remove gasket (3) inserted between cylinder and cyinder head.

2. Cylinder, connecting rod, piston

1) Remove 4 cylinder mounting bolts (5), then remove cylinder (4) from crankcase (10).
2) Remove 2 bolts (6) holding big end of connecting rod.
3) Remove piston (8) and connecting rod (9) from crankcase.

3. Bearing cover

1) Remove 4 mounting bolts (4) of bearing cover installed to crankcase, then remove cover (15) from crankcase together with oil seal.
2) Remove oil seal from bearing cover (15).

4. Crankshaft

1) Pull out crankshaft (12) in direction of mounting surface of bearing cover (15) with 2 ball bearing (11) stil installed.
2) Using a press, remove ball bearings (11) from crannkshaft (12).

FINE DISASSEMBLY

1. Piston, connecting rod

1) Remove snap ring (17), then pull out piston pin (16), and remove piston (8).
2) Remove piston rings (7) from piston.

2. Unloader valve assembly

1) Remove unloader valve body (19) installed on top of cylinder head.
2) Remove snap ring (30) from inside unloader valve body (19), then take out washer (31), spring (22), and rod (20).

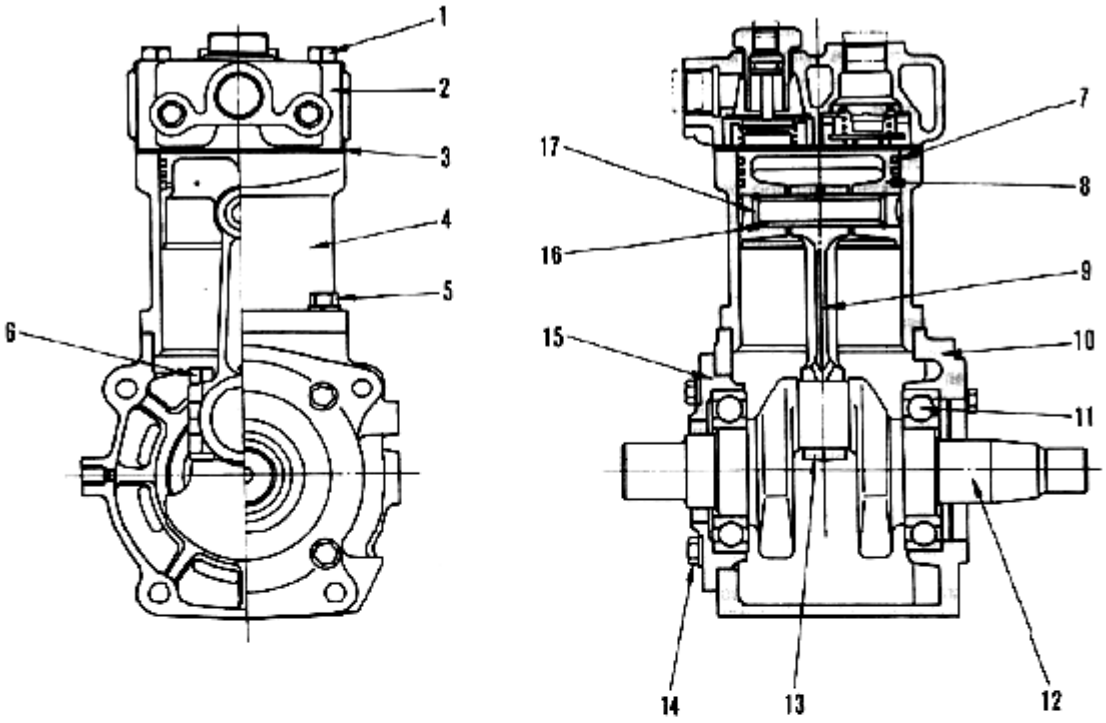
3. Delivery valve assembly

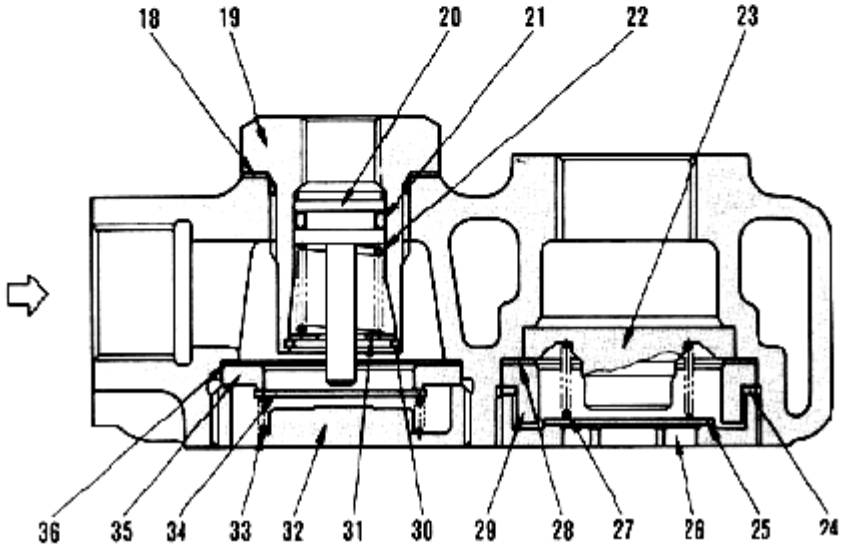
1) Seat (26) is screwed in and installed to bottom of cylinder head, and thread is caulked, so remove caulking.
2) Remove seat (26), then remove guide (23), spring (27), valve plate (25), guide (29), and gasket (28) from inside.

4. Intake valve assembly

1) Guide (32) is screwed in to bottom of cylinder head, and thread is caulked, so remove caulking.
2) Remove guide (32), then remove spring (33), valve plate (34), seat (35), and gasket (36) at the same time.

ASSEMBLY OF AIR COMPRESSOR





FINE ASSEMBLY

1. Intake valve

1) Assmeble gasket (36), seat (35), valve plate (34), and spring (33) in turn to cylinder head (1), then temporarily tighten guide (32).
2) Check that valve plate and spring move smoothly, then tighten guide (32) to the specified torque.
   kgm Guide : 10 kgm

   * If the guide is protruding from the bottom surface of the cylinder head, it will interfere with the piston, so check the condition.
3) Caulk guide at three places with a punch.

2. Delivery valve

1) Assembe guide (23), spring (27), valve plate (25), gasket (28), guide (29), and gasket (24) in turn to cylinder head (1), then temporarily tighten seat (26).
2) Check that the plate moves smoothly, then tighten seat (26) to the specified torque.
   kgm Seat : 15 kgm

   * If the seat is proturding from the bottom surface of the cylinder head, it will interfere with the piston, so check the condition.
3) Caulk seat at three places with a punch.

3. Unloader valve

1) Fit O-ring (21) to rod (20), then assemble in body (19).
   O-ring : Grease (LM-G)
2) Install spring (22) and washer (31) to rod (20), then install snap ring (30).
3) Install gasket (18), then assemble unloader valve assembly to cylinder head (1), and tighten to the specified torque.
   Unloader valve : 5 kgm
   * Push rod (20) with a screwdriver, and check that the valve moves.

4. Piston, connecting rod

1) Set piston (8) to connecting rod (9), then insert piston pin (16), and install snap ring (17).
2) Assemble piston rings (7) to piston (8).
   * Install the top ring and second ring with the stamped mark at the top, and make sure the end gaps are not aligned.

OVERALL ASSEMBLY

1. Crankshaft

1) Press fit bearings (11) to both ends of crankshaft (12).
2) Insert crankshaft (12) from installation side of bearing cover (15) of crankcase.
3) Press fit oil seal to bearing cover (15), and fit O-ring, then install to case and tighten bolts (14).
   kgm Bolt : 2.5 kgm

2. Cylinder, connecting rod, piston

1) Insert connecting rod from top of crankcase, then tighten cap (13) with bolts (6).
   kgm Connecting rod bolt : 2.5 kgm

   * Check that the connecting rod match marks are aligned.
2) Fit O-ring to cylinder mounting surface, then compress piston ring while inserting piston in to cylinder (4), and tighten bolts (5).
   kgm Bolt : 3 kgm

3. Cylinder head

1) Install gasket (3) to cylinder.
2) Install cylinder head (2), then tighten bolts (1) uniformly.
   kgm Cylinder head bolt : 5 kgm

PERFORMANCE TEST AFTER ASSEMBLY

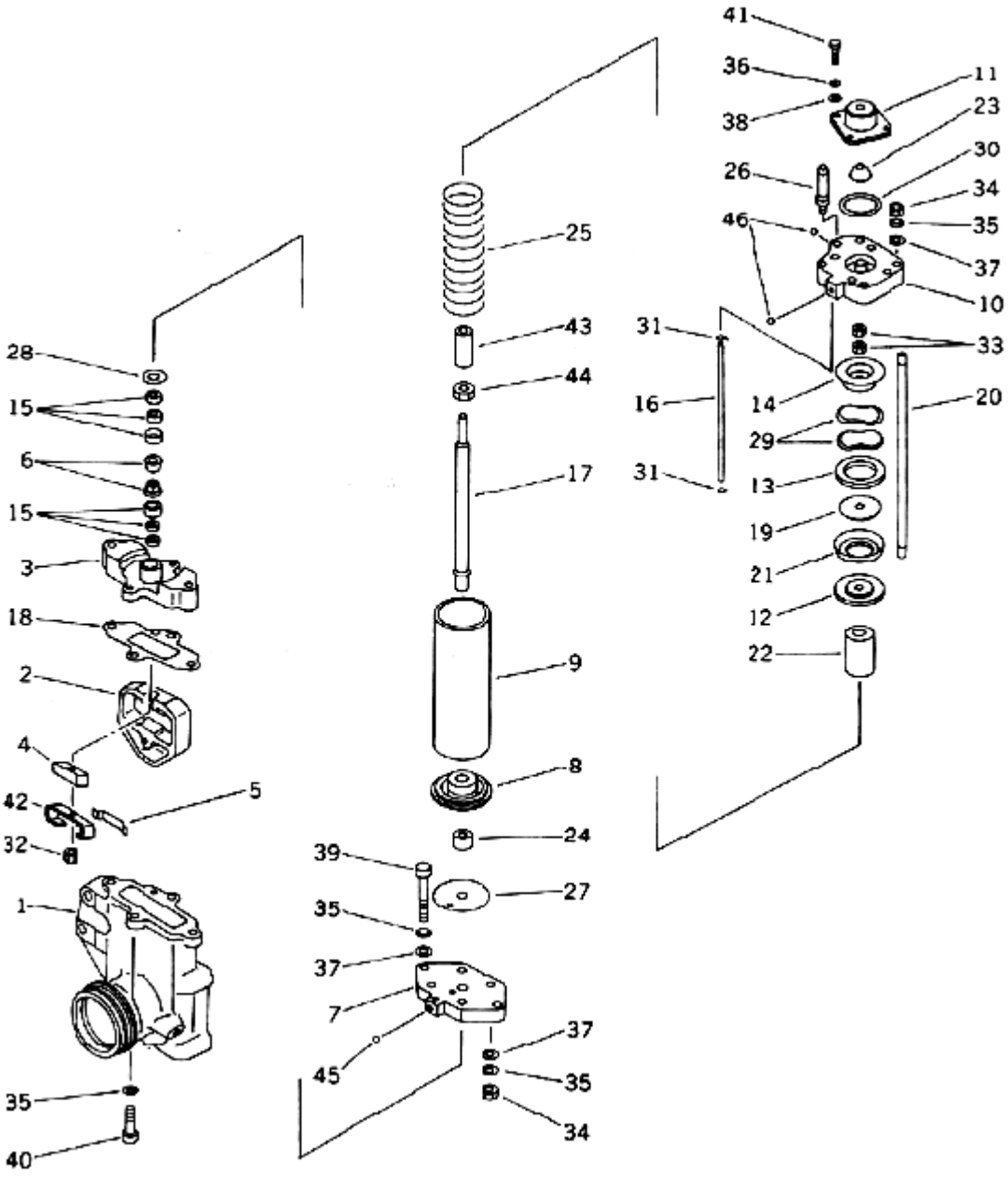
After disassmbling, inspecting, and assembling, carry out an air-tighteness test and perfoemance test as follows.

1) Air tightness test
   Apply an air pressure of 7 kg/cm² at the same time to the discharge port and unloader valve, and measure the amount of leakage from the intake port.
   Standard for leakage : Max. 450 cc/min
2) Filling performance
   With a tank capacity of 30 litres, the time taken to raise the tank pressure from 0 --> 8 kg/cm² must be as follows.

Speed (rpm)	Filling time (sec)
250	Max. 220
1,500	Max. 40

3) Oil leakage up
   Remove the pipe of the discharge port in the cylinder head, and check the operation. Check that there is no abnormal spray of oil from the discharge port.

DISASSEMBLY AND ASSEMBLY OF EXHAUST BRAKE



1. Exchange O-ring (30) and poppet (23)

1) Remove bolt (41) after fixing body.
2) Exchange O-ring (30) and poppet (23).


poppet (23) : Silicon grease


Bolt : 0.8 kgm

2. Exchange liner (5), gate valve (2), gasket (18) and valve housing (1).

1) Remove socket head cap screw (39), (40) after fixing valve housing (1).
2) Remove valve housing (1).
3) Connect air piping to PT 1/4 of poppet cover, raise air pressure to approx. 1 -- 2 kg/cm² and float T block (4).
4) Remove gate valve (2), liner (5), and gasket (18) in order, and install replacment parts in regular order.
5) Remove air piping after reducing air pressure to 0 kg/cm²
6) Install valve housing (1) and socket head cap screws (39) and (40).


Cap screw : Antifriction compound


Cap screw : 3 kgm

3. Exchange cylinder tube (9), piston portions (12), (13), (14), (15), (19), (21), (29) and spring (25).

1) Fix valve housing (1).
2) Remove head cover (10) after removing nut (34).
3) Remove socket head cap screws (39) and (40) fixing valve housing (1).
4) Remove valve housing (1) after pushing retainer (14).
5) Remove liner (5) and gasket (18).
6) Fix hexagonal nuts (32) holding T block.
7) Remove two hexagonal nuts (33) holding piston portion.
8) Remove retainer (14), wave washer (29), taper washer (13), washer (19), and piston packing (21).
9) After removing cylinder tube (9) and setting piston (12) on vice, top piston rod (17) with rubber mallet and remove piston (12).
10) Remove spring (25).
11) Apply silicon grease to one side only of the exchanged cylinder tube (9) to a surrounding width of 40 mm, install the tube turning the grease upward, into spring holder (8).


Cylinder tube : Silicon grease

12) Install spring (25) into spring holder (8).
13) Apply LOCK-TIGHT to surrounding groove of piston (12).


Piston : Adhesive (LT-2)

14) Place piston packing (21) on piston (12) and place the burrless side of wahser (19) to the packing (21).
15) Apply silicon grease lightly to the edge of packing (21).


Packing : Silicon grease

16) Apply silicon grease to the region surrounding retainer (14) and position two web washers (29) and taper washer (13).


Retainer : Silicon grease

17) Place sub-assembly of piston (12), packing (21) and washer (19) into piston rod (17), while pressing packing (21) with the tapered portion of washer (13).
18) Push in sub-assembly of (13), (29), (14) and install them using two nuts (33).


1st nut : 2 kgm
2nd nut : 2 kgm

19) Remove fixing nut (32).
20) Install gasket (18) and liner (5).
21) Install gate valve (2) while pushing in retainer (14).
22) Install valve housing (1) and tighten socket head cap screws (39) and (40).


Cap screw : 3 kgm

* Install head cover (10) and tighten nut (34).


Nut : 2.5 kgm

4. Exchange guide bushing (24) and insulating packings (27) and (28).

1) Remove spring (25) using similar method to that of item 3.
2) Loosen nut (44) holding sleeve (43) after removing (22), and remove (43) and (44) from rod (17).
3) Remove fixing nut (32) and draw out rod (17) from base plate (3) and adapter plate (7).
4) Remove seal packing sub-assembly (15), relief spacer (6) and guide bushing (24) from plate (3) in that order, and install the exchanged parts in regular order.
   * Face the wider side of spacer (6) to packing sub-assembly (15) side.
5) Fix plate (7) by vice and remove (8) and (24), while tapping bushing (24) slightly with bar (a little smaller than hole diameter of plate) from the opposite hole of spring holder (8).
   * When (8) is difficult to remove, turn (8) using a pipe wrench then remove it.
   * In this case, exchange (8) with new part.
6) Make a hole (5mm) in plate (7) , then apply thread tightener and position packing (27) so that the hole of packing (27) is aligned with the hole of plate (7). Ø
   plate : Thread tightener (LT-2)
7) Place bushing (24) in spring holder (8), then apply thread tightener to pilot portion of plate (7) and align holes of packing (27) and spring holder (8) to install spring holder (8).
   plate : Thread tightener (LT-2)
8) Place insulating packing (28) in to plate (7).
9) ıe pilot of plate (7) to align with base plate (3), and install rod (17) from plate (3) side.
10) Place nut (44) onto rod (17) so that the flat face of the nut meets sleeve (43).
11) Adjust the distance from the rod (17) end to sleeve (43) to approx. 27 mm, by use of nut (44).
12) Fix sleeve (43) by vice and tighten the nut (44).
   Nut : 2.5 kgm
13) Place collar (22) on sleeve (43) and apply LOCK-kgm Γ to 8 mm screw and 8 mm diameter portions of rod (17).
   Screw, rod : Adhesive (LT-2)
14) After this, assemble using similar method to item

5. Exchange piston rod (17)

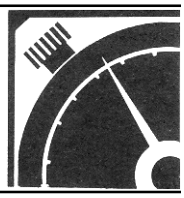
1) Remove rod (17) using similar method to item 4.
2) Place T block (4) and guide (42) onto exchanged rod (17).
3) Tighten nut (32) so that the chamfered side of nut (32) faces guide (42).
   Nut : 5.5 kgm
4) Calk the nut at three places using a punch to avoid kgm ing .
5) After this, assemble using similar method to item 4.

6. Matters to be attended to before assembly housing (1) when carryin g out items 3, 4 and 5.

1) Install air piping to PT 1/4 of poppet cover, raise air pressure to approx. 1 - 2 kg/cm² , float T block (4) and remove gate valve (2).
   * When reducing air pressure to 0 kg/cm² , position an approx. 10 mm block so that T block (4) does not contact base plate (3) directly.
2) Then reduce air pressure to 0 kg/cm² .
3) Adjust by turning T block (4) so that the seat side of gate vlave (2) for liner guide (42) is approxi mately parallel with the longitude direction of base plate (3).
4) If operation is smooth after carrying out the operation of T block several times, float T block (4) and remove block.
5) After this, assemble using similar method to item 2.
   * Silicon grease.
     Pertinent brand : SHINETSU KAGAKU (FG721A) or equivalent.
   * Antifriction compound
     Pertinent brand : LC-G MORI court 1000 or equivalent.

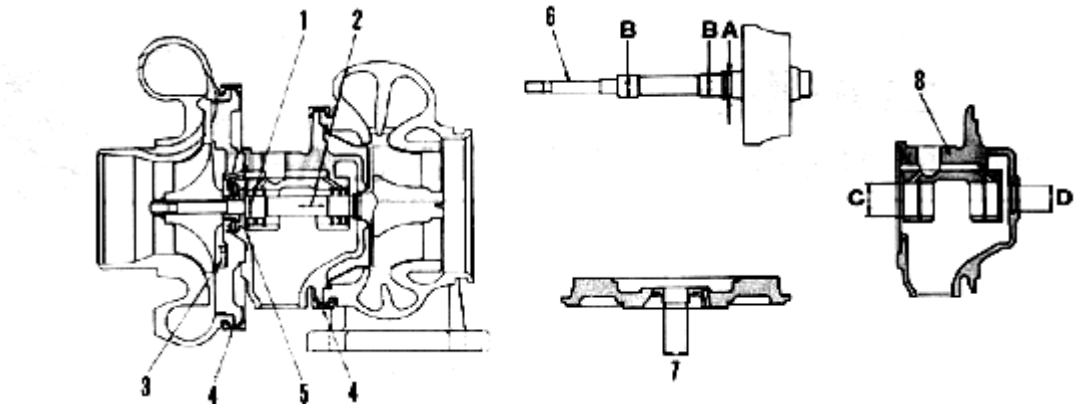
ENGINE

15 MAINTENANCE STANDARD



TURBOCHARGER

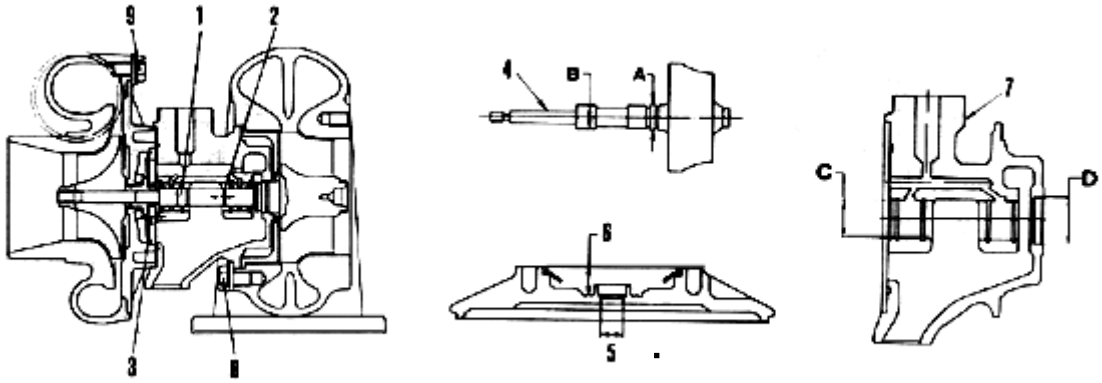
TV77



Unit: mm

No.	Item	Criteria			Remedy
1	Radial play of rotor	Standard	Repair limit		
		0.08 - 0.18	0.18		Replace
2	End play of rotor	0.08 - 0.25	0.25		
3	Tightening torque of back plate mounting bolt	Target (kgm)	Range (kgm)		
		1.25	1.15 - 1.38		
4	Tightening torque of V-band locknut	Order	Target (kgm)	Range (kgm)	Retighten
		1st step	1.8	1.6 - 2.0	
		2nd step	0	Loosen completely	
		3rd step	1.4	1.27 - 1.50	
5	Thickness of thrust bearing	Standard	Repair limit		Replace
		2.315	2.29		
6	Outer diameter of wheel shaft	Measuring point	Standard	Repair limit	
		A	17.53	17.48	
		B	15.88	15.88	
	Bend of wheel shaft	Repair limit: 0.010 (Total indicated runout)			
7	Inside diameter of back plate	Standard	Repair limit		
		17.47	17.49		
8	Inside diameter of center housing	Measuring point	Standard	Repair limit	
		C	20.90	20.93	
		D	24.97	24.97	

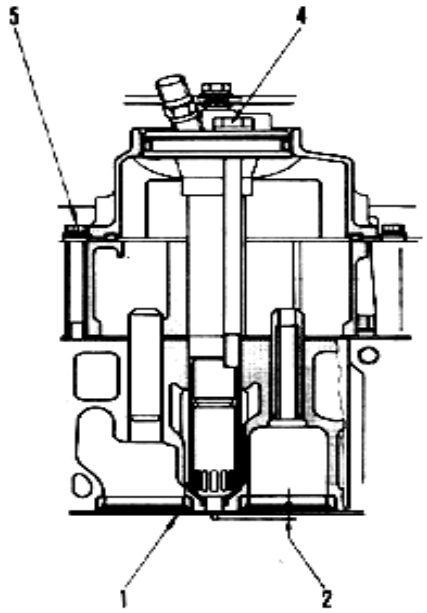
(For BE300-3 AND BE300LC-3)

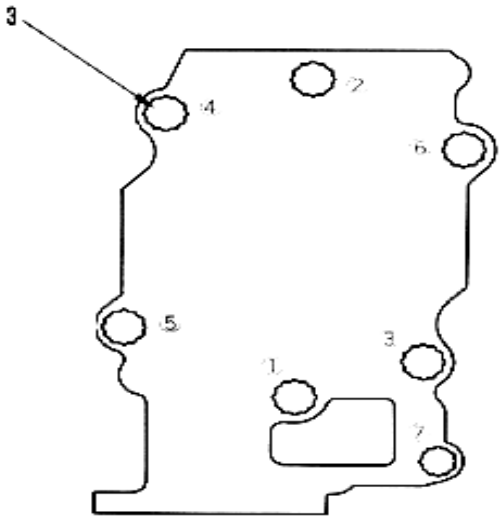


Unit: mm

No.	item	Criteria			Remedy
1	Radial play of rotor	Standard		Repair limit	Replace
		0.075 - 0.150		0.180	
2	End play of rotor	0.025 - 0.075		0.10	
3	Thickness of thrust bearing	4.36		4.35	
4	Outer diameter of wheel shaft	Measuring point	Standard	Repair limit	
		A	17.34	17.25	
		B	10.16	10.15	
	Bend of wheel shaft	Repair limit: 0.010 (Total indicator reading)			
5	Inside diameter of back plate	Standard		Repair limit	
		12.70		12.73	
6	Depth of back plate	11.66		11.68	
7	Inside diameter of center housing	Measuring point	Standard	Repair limit	
		C	15.80	15.81	
		D	18.03	18.08	
8	Tightening torque of turbine housing bolt	Target (kgm)		Range(kgm)	Retighten
		2.0		1.8 - 2.2	
9	Tightening torque of blower housing bolts	1.3		1.15 - 1.5	

CYLINDER HEAD

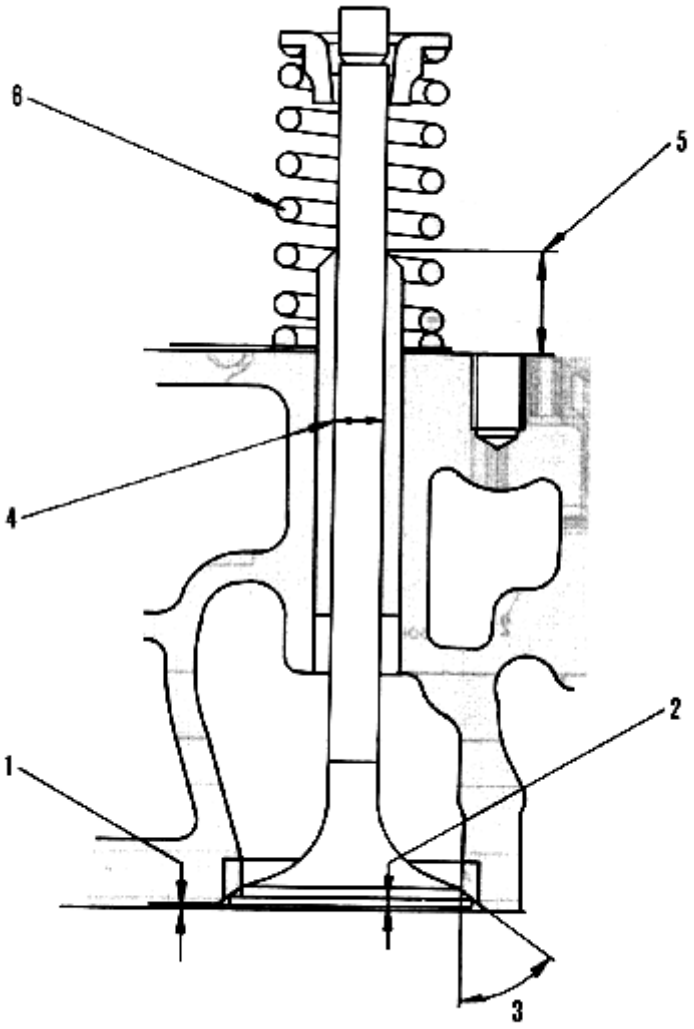




Uunit: mm

No.	Item	Criteria				Remedy
1	Distortion of cylinder head mounting surface	Standard			Repair limit	Repair by grinding or replace
		0 - 0.06			0.09	
2	Protrusion of nozzle	Applicable model			Standard	Replace Sleeve
	B6D125-1	S.T.D			4.90 - 5.70	
		S.T.D			3.35 - 4.25	
	BS6D125-1	D75S-5 (23193 and up) D85E.P-1 BE300-3 (23689 and up) HD205-3 GD705A-4 (23599 and up)			4.90 - 5.70	
		S.T.D			4.90 - 5.70	
	BSA6D125-1	D135A-1			3.35 - 4.25	
3	Tightening torque of cylinder head mounting bolts (Coat the thread areas with molybdenum disulfide or engine oil)	Bolt No.	Order	Target (kgm)	Range(kgm)	Tighten bolts in accordance with bolts No.
		① - ⑥	1st step	10	9 - 11	
			2nd step	14	13 - 15	
			3rd step	Retighten with 90°	90°-120°	
		⑦	-	7	6 - 7.5	
4	Tightening torque of nozzle holder mounting bolt	2.2 ± 0.3 kgm				Retighten
5	Tightening torque of rocker arm housing	6.75 ± 0.75 kgm				

VALVE AND VALVE GUIDE



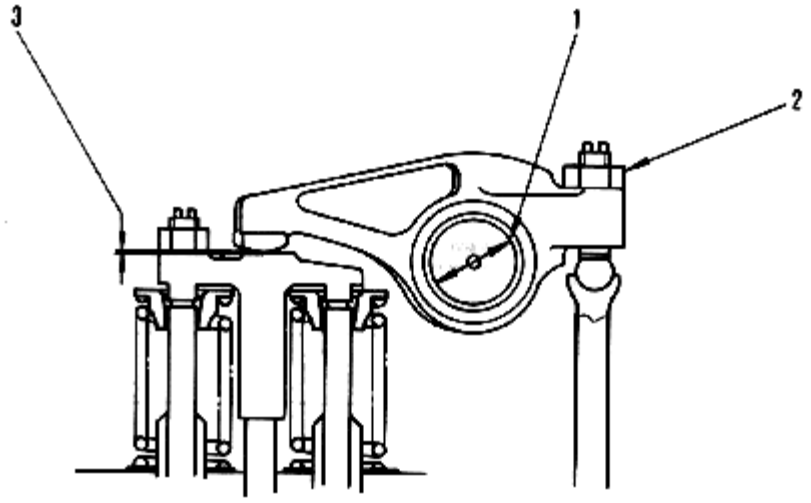
unit: mm

No.	Item	Criteria				Remedy
		Valve	Standard	Tolerance	Repair limit	
1	Amount of valve sinking	Intake	0	±0.10	0.63	Replace valve or valve seat
		Exhaust	0	±0.10	0.70	

Unit: mm

No.	Item	Criteria			Remedy
2	Thickness of valve lip	Valve	Standard	Repair limit	Replace
		Intake	2.10	1.7	
		Exhaust	1.50	1.2	
3	Valve seat angle	Valve	Standard	Tolerance	Repair or replace
		Intake	30°	± 0°15’	
		Exhaust	45°	± 0°15’	
4	Outside diameter of valve stem	Valve	Standard	Tolerance	Replace
		Intake	9	-0.045 -0.065	
		Exhaust	9	-0.050 -0.070	
	Inside diameter of valve guide	Before inserting	9	+0.015 -0.005	Replace
		After inserting	9	±0.010	
	Clearance between valve guide and valve stem	Valve	Standard	Clearance limit	Replace
		Intake	0.035 - 0.075	0.22	
		Exhaust	0.040 - 0.080	0.24	
	Bend of valve stem	Repair limit: 0.02 (Total indicator reading for 100 mm)			Replace
5	Protrusion of valve guide	Standard		Tolerance	Repair
		20		±0.2	
6	Freee length of Valve spring	Engine	Valve	Color code	Free length	Repair limit	Replace
		B6D125-1	Intake	Yellow	66.9	64.7	
			Exhaust	Yellow	66.9	64.7	
		BS6D125-1	Intake	Purple	61.3	58.9	
			Exhaust	Yellow	66.9	64.7	
	Installed load of valve spring	Engine	Valve	Color code	Installed length	Installed load	Repair limit	
		B6D125-1	Intake	Yellow	56.0	30.0± 1.5kg	27.0 kg	
			Exhaust	Yellow	56.0	30.0± 1.5kg	27.0 kg	
		BS6D125-1	Intake	Purple	49.5	40.0± 2.0kg	36.0 kg	
			Exhaust	Yellow	56.0	30.0± 1.5kg	27.0 kg	
	Squarence of valve spring		Repair limit : 2° (For both end)					

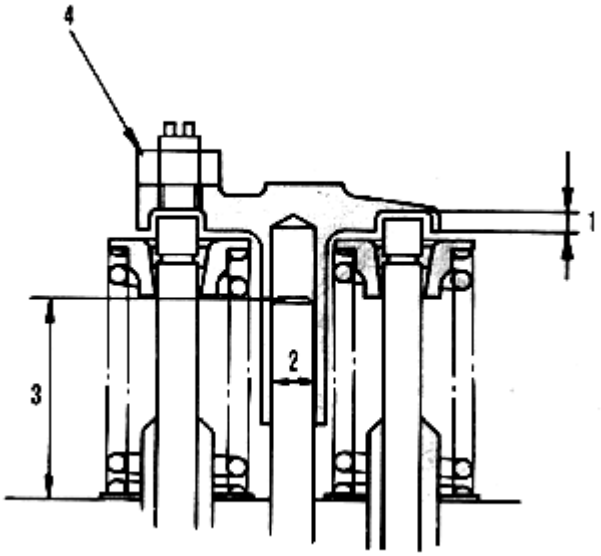
ROCKER ARM SHAFT



unit: mm

No.	Item	Criteria			Remedy
1	Outside diameter of rocker arm shaft	Standard: 28.6	Tolerance: –0.055 -0.065		Replace rocker arm shaft
	Inside diameter of rocker arm shaft hole	28.6	+0.035 - 0.025		Replace rocker arm
	Clearance between rocker arm and rocker arm shaft	Standard clearance: 0.025 - 0.100	Clearance limit: 0.130		Replace rocker arm or rocker arm shaft
	Bend of rocker arm shaft	Repair limit : 0.20 (Total indicator reading)			Replace rocker arm shaft
2	Tightening torque of rocker arm adjustment nut	6.75 ± 0.75 kgm			Retighten
3	Valve clearance (at cold)	Valve	Standard	Tolerance	Adjust
		Intake	0.33	± 0.02	
		Exhaust	0.71	± 0.02	

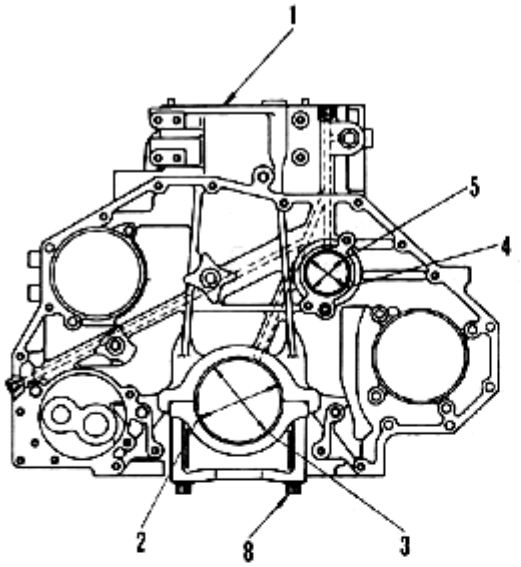
CROSSHEAD

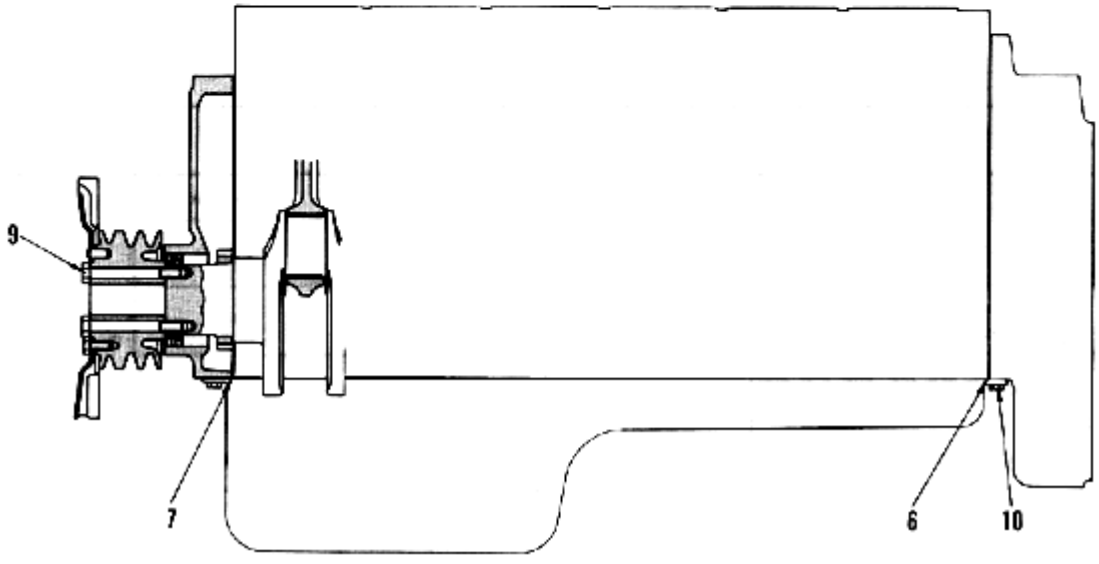


unit: mm

No.	Check item	Criteria			Remedy
		Standard	Tolerance	Repair limit	
1	Depth of crosshead stem	3	+0.56 -0.46	3.67	Replace
2	Inside diameter of crosshead	11	+0.075 +0.025	11.18	
	Outside diameter of crosshead guide	11	+0.010 0	10.95	
3	Protrusion of crosshead guide	45.5	± 0.25	-	Repair
4	Tightening torque of crosshead lock nut	6.75 ± 0.75 kgm			Retighten

CYLINDER BLOCK

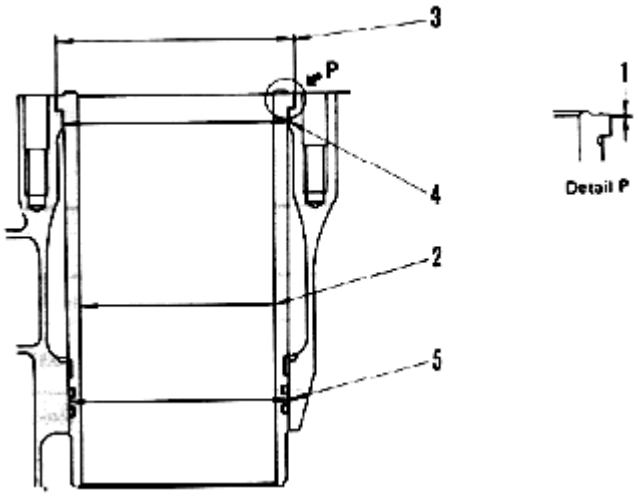




unit: mm

No.	Item	Criteria			Remedy
1	Distorsion of cylinder head mounting surface	Standard: 0 - 0.080		Repair limit: 0.120	Repair by grinding or replace
2	Inside diameter of main bearing hole	Standard: 116		Tolerance: +0.022 0	Repalce main bearing cap
	Thickness of main bearing	3		-0.003 -0.013	Replace
	Roundness of main bearing hole	Repair limit : 0.005 bearing			
3	Inside diameter of main bearing	Standard: 110	Tolerance: +0.040 -0.010	Repair limit: 110.15	Replace bearing
4	Inside diameter of cam bushing mounting hole	63	+0.030 0		Repair or replace
5	Inside diameter of cam bushing	60	+0.070 0	60.30	Replace
6	Difference between lower face of cylinder block & flywheel housing	Repair limit : 0.35			Repair
7	Difference between lower face of cylinder block and front cover	Repair limit : 0.28			
8	Tightening torque of main bearing cap bolt (Coat thread area with engine oil)	Order	Target(kgm)	Range (kgm)	Tighten
		1st step	10	9 - 11	
		2nd step	20	19 - 21	
		3rd step	Retighten with 90°	90° - 120°	
9	Tightening torque of crankshaft pulley mounting bolt	M16 (5 bolts), for BD60P-8, BD60S	1st: 15	14 - 16	
			2nd: 30	29 - 31	
			3rd: Retighten with 90°	Retighten with 90° - 120°	
		M14 (1 bolt)	18	16 - 20	
10	Tightening torque of oil pan mounting bolt	5.5 ± 2.0 kgm			

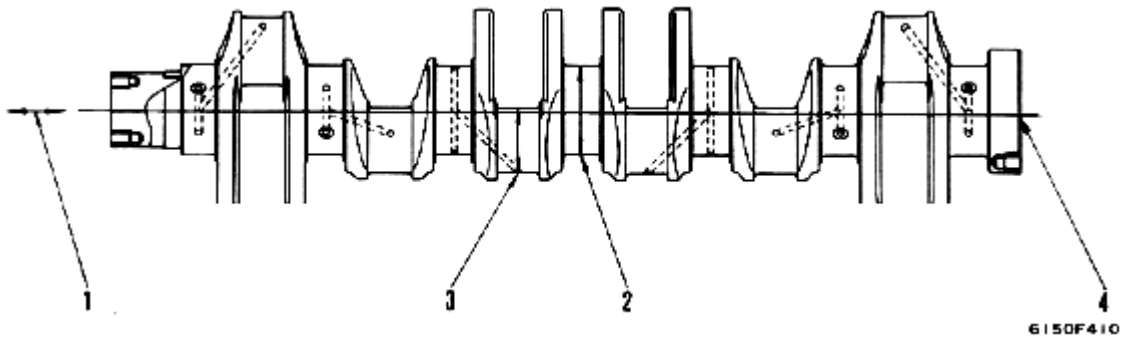
CYLINDER LINER



unit: mm

No.	Item	Criteria			Remedy
1	Protrusion of cylinder liner	Repair limit : 0.07 to 0.15			Replace liner or block
2	Inside diameter of cylinder liner	Standard	Tolerance	Repair limit	
		125	+0.040 0	125.20	
	Roundness of cylinder liner	Repair limit: 0.08			
	Cylindricity of cylinder liner	Repair limit: 0.08			Replace liner
3	Outside diameter of cylinder liner(Counter bore)	Standard	Tolerance		
		153	± 0.025		
	Interference between cylinder liner and block (Counter bore)	Standard : 0 - 0.115			Replace liner liner block
4	Outside diameter of cylinder liner(Counter bore bottom)	Standard	Tolerance		Replace liner
		145	+0.090 +0.040		
	Interference between cylinder liner Standard Interference limit	Replace liner			
	& block(Counter bore bottom)	0.01 - 0.12	0.01		block
5	Outside diameter of cylinder liner (O-ring)	Standard	Tolerance		Replace or liner
		141	+0.385 +0.360		
	Clearance between cylinder liner and block (O-ring)	Standard : 0.015 - 0.080			Replace liner or block

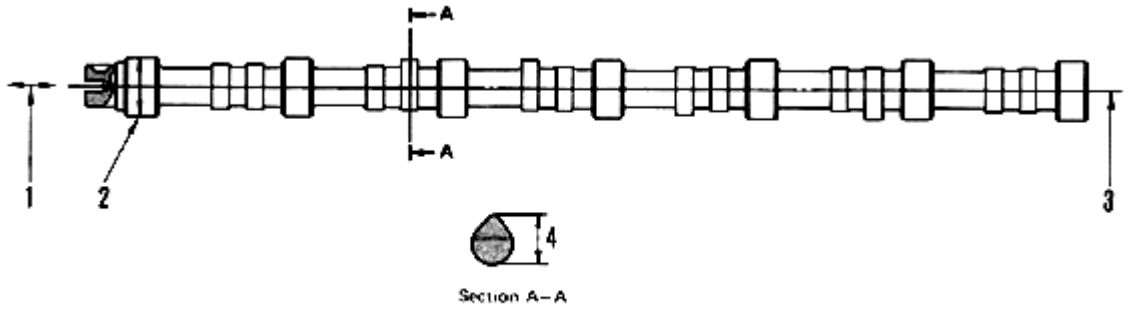
CRANKSHAFT



unit: mm

No.	Item	Criteria				Remedy
1	End play	Standard: 0.0140 - 0.320		Repair limit: 0.50		Repair by using over size thrust-bearing/replace
2	Outside diameter of main journal		Standard	Tolerance	Repair limit	Repair by using under size main bearing or replace
		S.T.D.	110	-0.050 -0.070	109.88	
		0.25US			109.63	
		0.50US			109.38	
		0.75US			109.13	
		1.00US			108.88	
	Roundness of main journal	Standard: 0 - 0.010		Repair limit: 0.020		
	Clearance of main journal	Standard: 0.060 - 0.105		Clearance limit: 0.27		Replace main bearing
3	Outside diameter of crank pin journal		Standard	Tolerance	Repair limit	Repair by using under size bearing or replace
		S.T.D	80.00	-0.050 -0.070	79.88	
		0.25US	79.75		79.63	
		0.50US	79.50		79.38	
		0.75US	79.25		79.13	
		1.00US	79.00		78.88	
	Roundness of crankpin journal	Standard: 0 - 0.010		Repair limit: 0.020		
	Clearance of crankpin journal	Standard: 0.045 - 0.090		Clearance limit: 0.24		Replace connecting rod bearing
4	Bend of crankshaft	Standard: 0 - 0.090		Repair limit: 0.20		Repair by using under size bearing or replace

CAMSHAFT

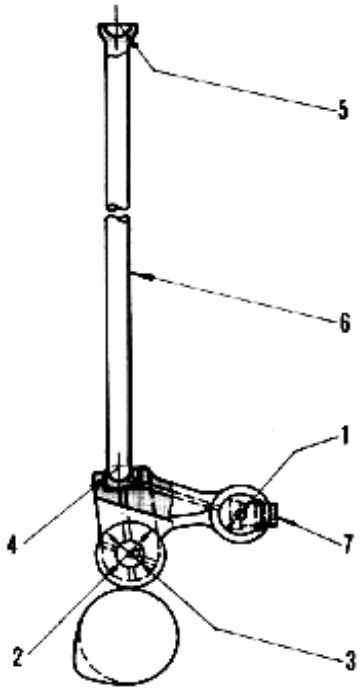


unit: mm

No.	Item	Criteria			Remedy
1	End play	Standard 0.15 - 0.35		Repair limit 0.50	Replace thrust plate
2	Outside diameter of camshaft journal	Standard 60		Tolerance -0.080 -0.110	Replace camshaft
	Clearance of camshaft journal	Standard 0.080 - 0.180		Clearance limit 0.28	Replace cam bushing
3	Bend of camshaft	Repair limit: 0.03 (Total indicator reading)			
4	Cam height	Standard 52	Tolerance + 0.395 + 0.195	Repair limit 51.73	Replace

CAM FOLLOWER AND PUSH ROD

B6D125-1
BS(A)6D125-1

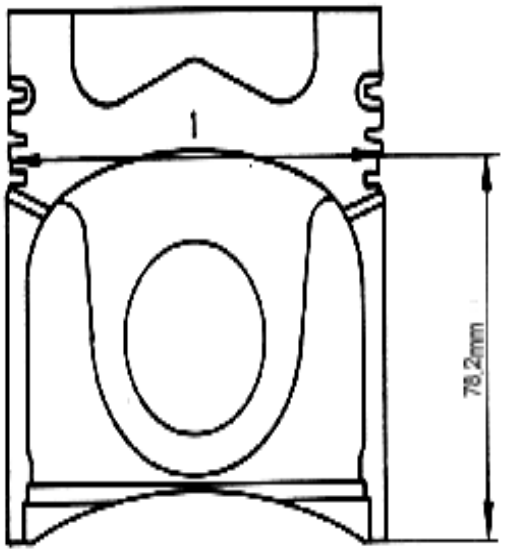


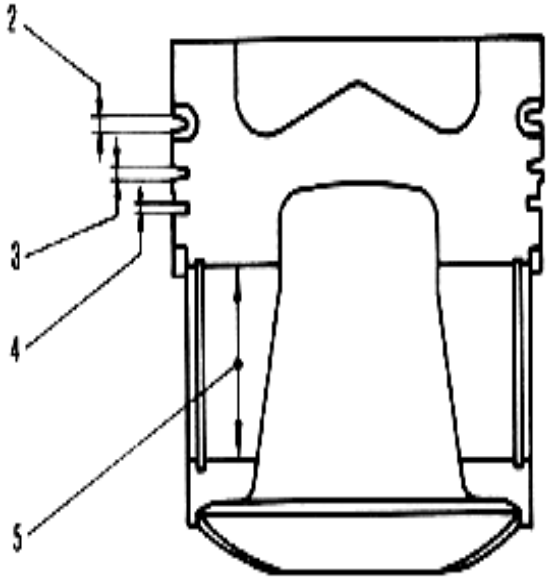
Unit : mm

No.	Item	Criteria			Remedy
1	Outside diameter of cam follower shaft	Standard	Tolerance	Repair limit	Replace
		19.8	-0.040 -0.050	19.73	
	Inside diameter of cam follower shaft hole	19.8	+0.020 0		
2	Outside diameter of cam roller	32	- 0.250 - 0.280	31.71	
3	Inside diameter of cam roller	13	- 0.260 - 0.285	12.78	
	Outside diameter of cam roller pin	13	- 0.365 -0.375	12.62	
4	Radius of push rod ball end	Standard size	Tolerance		
		12.7	0 -0.20		
5	Radius of push rod socket end	12.7	0 -0.20		
6	Bend of push rod	Repair limit : 0.50 (Total indicator reading)			
7	Tightening torque of cam follower housing mounting bolt	5.25 ± 0.75 kgm			

PISTON, PISTON RING AND PISTON PIN

B6D125-1 (Aluminum alloy)



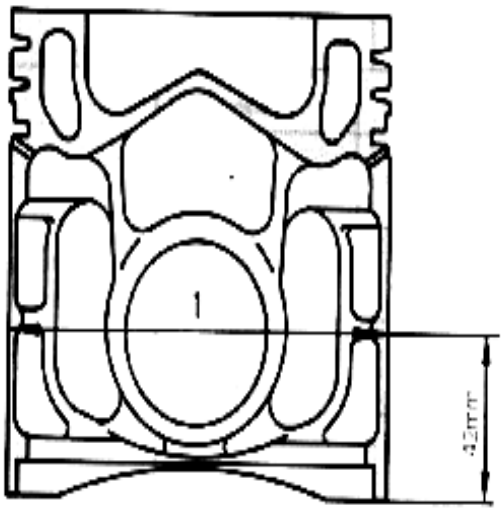


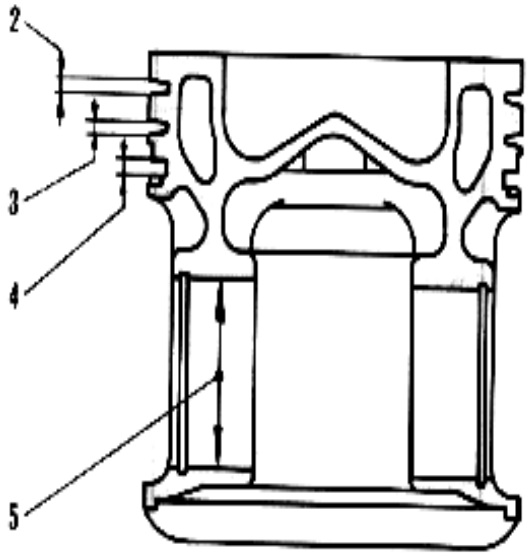
B6D125-1 (Aluminum alloy)

unit: mm

No.	Item	Criteria				Remedy
1	Outside diameter of piston (Aluminum piston)	Standard: 125	Tolerance: -0.295 -0.325	Repair limit: 124.59		Replace piston
2 3 4	Thickness of piston ring	No. 2	Measuring point: Top ring	Standard: 2.4	Tolerace: -0.015 -0.035	Replace piston ring
		3	Second ring	2.4	-0.010 -0.030	
		4	Oil ring	4.0	-0.010 -0.030	
	Width of piston ring groove	2	Top ring	Judge using groove wear gauge		Replace piston
		3	Second ring			
		4	Oil ring	4.0	+0.025 +0.010	
	Clearance between piston ring and ring groove	No. 2	Measuring point: Top ring	Standard: Judge using groove wear gauge	Clearance limit	Replace piston or piston ring
		3	Second ring			
		4	Oil ring	0.020 - 0.055	0.15	
	Piston ring gap	2	Top ring	0.37 - 0.52	2.0	Replace pis piston ring or cylinder liner
		3	Second ring	0.50 - 0.62	1.5	
		4	Oil ring	0.28 - 0.43	1.0	
5	Outside diameter of piston pin	Standard: 48	Tolerance: 0 -0.006			Replace piston pin
	Inside diameter of piston pin hole	48	+0.012 +0.004			Replace piston
	Clearance between piston pin and piston	Standard: 0.004 - 0.018	Clearance limit: 0.030			Replace piston or piston pin

BS6D125-1, BSA6D125-1 (Ductile cast iron (FCD))



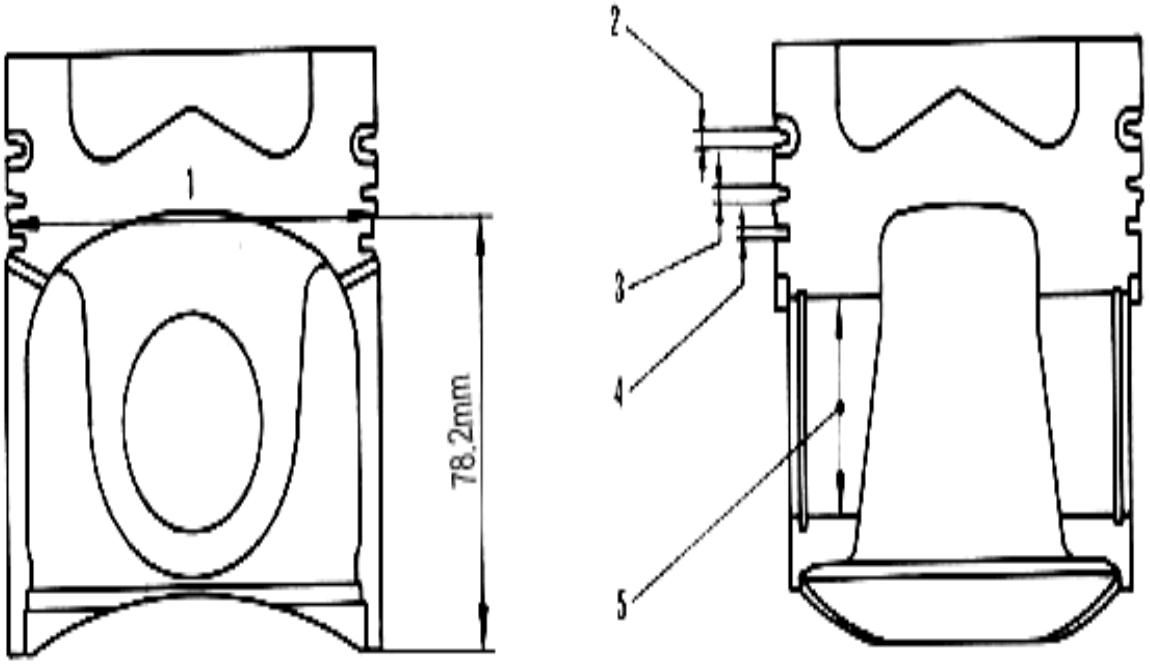


BS6D125-1, BSA6D125-1 (Ductile cast iron (FCD))

unit: mm

No.	Item	Criteria				Remedy
1	Outside diameter of piston	Standard: 125		Tolerance: -0.075 -0.105	Repair limit: 124.80	Replace piston
2 3 4	Thickness of piston ring	No.	Measuring point	Standard	Tolerace	Replace piston ring
		2	Top ring	2.4	-0.015 -0.035	
		3	Secong ring	2.4	-0.010 -0.030	
		4	Oil ring	4.0	-0.010 -0.030	
	Width of piston ring groove	2	Top ring	Judge using groove wear gauge		Replace piston
		3	Second ring			
		4	Oil ring	4.0	+0.040 +0.020	
	Clearance between piston ring and ring groove	No.	Measuring point	Standard	Clearance limit	Replace piston or piston ring
		2	Top ring	Judge using groove wear gauge		
		3	Second ring			
		4	Oil ring	0.03- 0.07	0.15	
	Piston ring gap	2	Top ring	0.37 - 0.52	2.0	Replace pis piston ring or cylinder liner
		3	Second ring	0.50 - 0.62	1.5	
		4	Oil ring	0.28 - 0.43	1.0	
5	Outside diameter of piston pin	Standard size: 48		Tolerance: 0 -0.006		Replace piston pin
	Inside diameter of piston pin hole	48		- 0.045 - 0.035		Replace piston
	Clearance between piston pin and piston	Standard: 0.035 - 0.051		Repair limit: 0.063		Replace piston or piston pin

BS6D125-1 (Aluminum alloy)

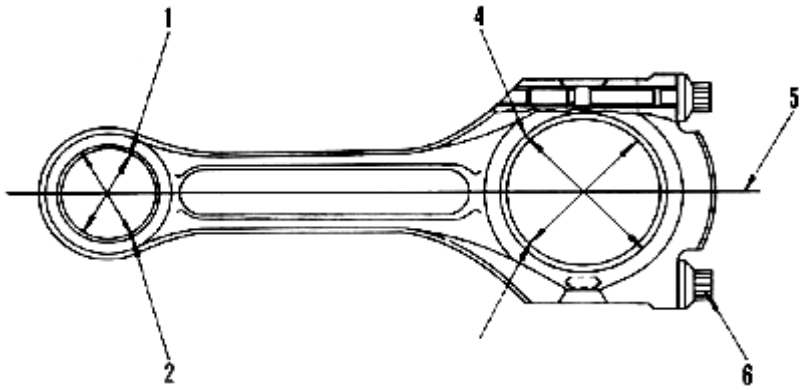


BS6D125-1 (Aluminum alloy)

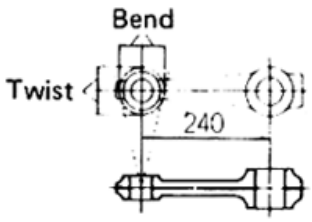
unit: mm

No.	Item	Criteria				Remedy
1	Outside diameter of piston	Standard		Tolerance	Repair limit	Replace piston
		125		-0.255 -0.285	124.59	
2 3 4	Thickness of piston ring	No.	Measuring point	Standard	Tolerace	Replace piston ring
		2	Top ring	2.4	-0.015 -0.035	
		3	Secong ring	2.4	-0.010 -0.030	
		4	Oil ring	4.0	-0.010 -0.030	
	Width of piston ring groove	2	Top ring	Judge using groove wear gauge		Replace piston
		3	Second ring			
		4	Oil ring	4.0	+0.025 +0.010	
	Clearance between piston ring and ring groove	No.	Measuring point	Standard	Clearance limit	Replace piston or piston ring
		2	Top ring	Judge using groove wear gauge		
		3	Second ring			
		4	Oil ring	0.020- 0.055	0.15	
	Piston ring gap	2	Top ring	0.37 - 0.52	2.0	Replace piston ring or cylinder liner
		3	Second ring	0.50 - 0.62	1.5	
		4	Oil ring	0.28 - 0.43	1.0	
5	Outside diameter of piston pin	Standard		Tolerance		Replace piston pin
		48		0 -0.006		
	Inside diameter of piston pin hole	48		+0.012 +0.004		Replace piston
	Clearance between piston pin and piston	Standard		Clearance limit		Replace piston or piston pin
		0.004 - 0.018		0.030		

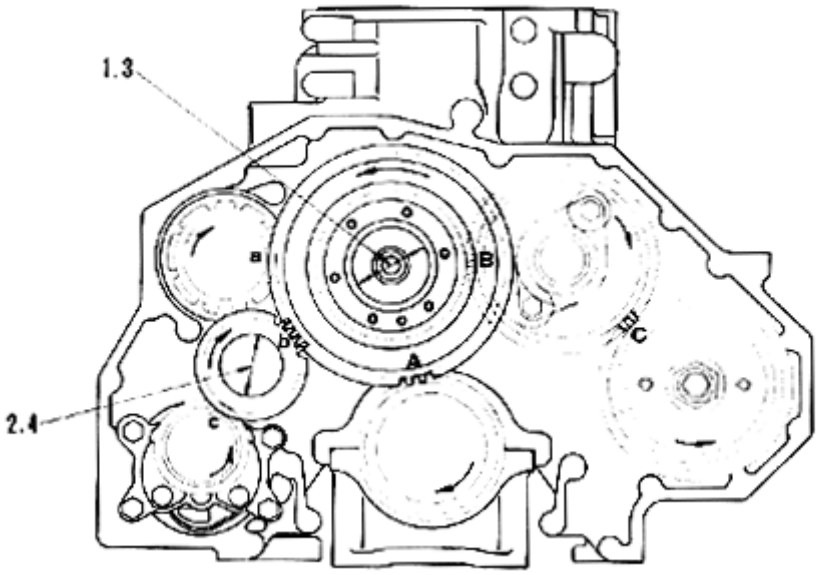
CONNECTING ROD



unit: mm

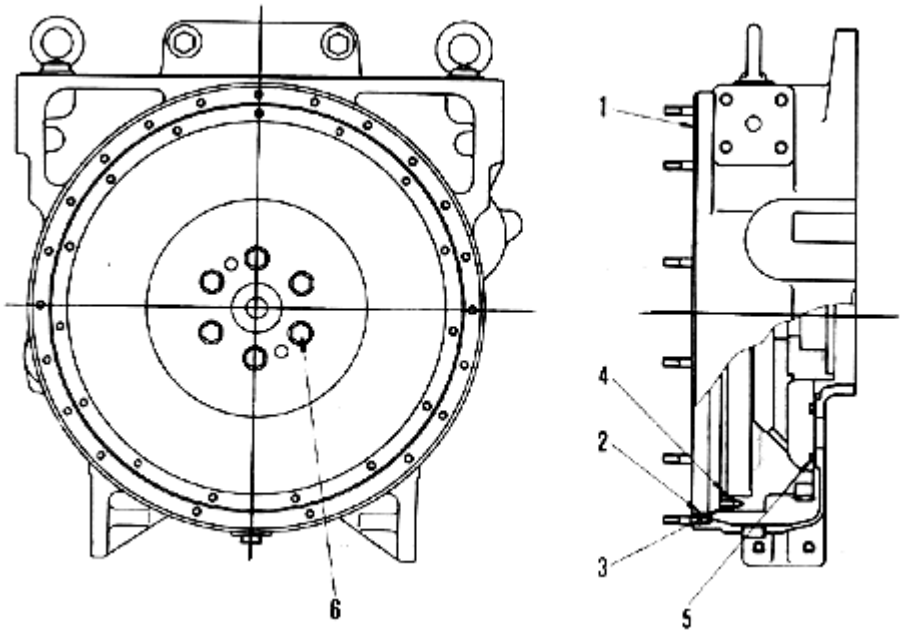
No.	Item	Criteria			Remedy
1	Inside diameter of bushing at connecting rod small end	Standard 48	Tolerance +0.041 +0.025	Repair limit 48.08	Replace bushing
	Clearance between bushing at connecting rod small end piston pin	Standard 0.025 - 0.047		Clearance limit 0.10	Replace bushing or piston pin
2	Inside diameter of bushing hole at connecting rod small end.	Standard size 53		Tolerance +0.030 0	Replace connecting rod
3	Inside diameter of bearing at connecting rod big end	Standard size 80	Tolerance +0.020 -0.010	Repair limit 80.12	Replace bearing
4	Inside diameter of bearing at connecting rod big end	85	+0.022 -0.004	-	Replace connecting
		Measure after tightening connecting rod cap with specified torque			
	Thickness of connecting rod	2.5	+0.005 -0.005		Replace bearing
5	Bend and twist of conneting rod			Standard / Repair limit Bend: 0 - 0.20 / 0.25 Twist: 0 - 0.30 / 0.35	Replace connecting rod
6	Tightening torque of connecting rod cap mounting bolt (Coat bolt threads & nut seats with engine oil)	Order 1st step 2nd step	Target (kgm) 10 Retightening with 90°	Range (kgm) 9.5 - 10.5 90° - 120°	Retighten

TIMING GEAR

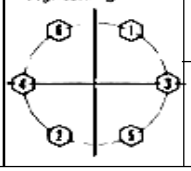


No.	Check item	Criteria				Remedy
1	Backlash of each gears	Measring point	Gears	Standard Size	Repair limit	Replace
		A	Crankshaft gear and main idler gear (Large)	0.140-0.425	0.6	
		B	Main idler gear (small) and camshaft gear	0.125-0.395		
		C	Camshaft gear and fuel injection pump drive gear	0.125-0.395		
		a	Main idler gear (Large)and water pump drive gear	0.155-0.440		
		b	Main idler gear(Large) and oil pump idler gear	0.130-0.405		
		c	Oil pump idler gear and oil pump drive gear	0.080- 0.390		
2	Clearance between main idler gear bushing and shaft	Standard size	Tolerance: Shaft	Tolerance: Hole	Standard Clearance	Clearance limit	Replace bushing
		47.5	+0.165 +0.140	+0.115 +0.100	0.025 - 0.060	0.20	
3	Clearance between oil pump idler gear and shaft	35	-0.025 -0.040	+0.065 0	0.025 - 0.105	0.20	
4	End play of main idler gear	Standard		Repair limit		Replace thrust bearing
		0.05 - 0.07		0.4		
5	End play of oil pump idler gear	0.05 - 0.21		0.4		

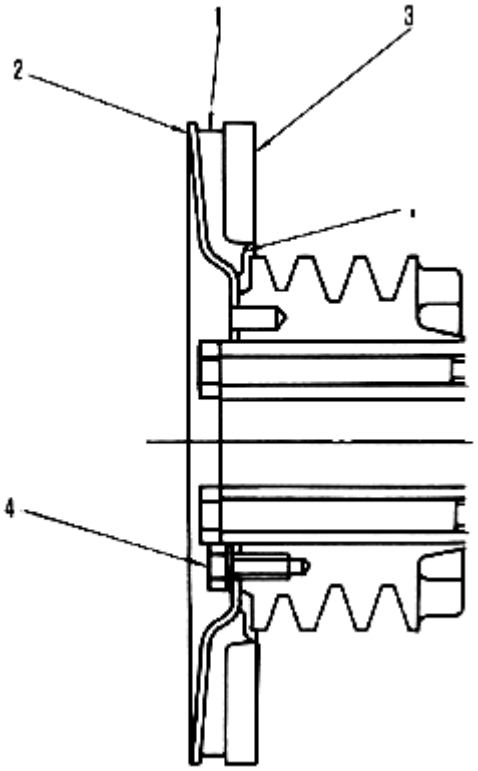
FLYWHEEL AND FLYWHEEL HOUSING



unit: mm

No.	Item	Criteria				Remedy
1	Face runout of flywheel housing	Repair limit : 0.35				Replace
2	Radial runout of flywheel housing	Repair limit : 0.30				
3	Face runout of flywheel	Repair limit : 0.20				
4	Radial runout of flywheel	Repair limit : 0.15				
5	Tightening torque of flywheel housing mounting bolts	Bolt	Order	Targer(kgm)	Range (kgm)	Retighten
		M16	1st step	14.5	8.5 - 20	
			2nd step	28.5	25 - 31.5	
		M10	-	7	6 - 7.5	
6	Tightening torque of flywheel mounting bolts (Coat the bolt threads with engine oil)	Tightening order 	1st step	15	13 - 17	
			2nd step	29.5	27.5 - 31.5	

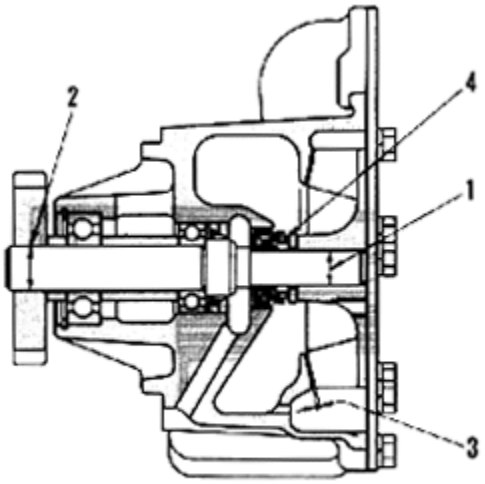
VIBRATION DAMPER

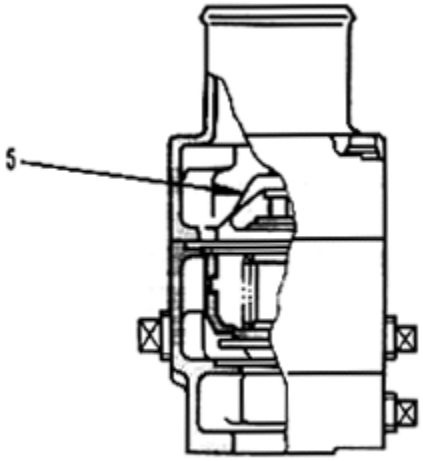


unit: mm

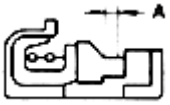
No.	Item	Criteria			Remedy
1	Visual check	Not appear any cracks on the rubber part.			Replace
2	Face runout of vibration damper(For D60P -17)	Repair limit : 0.80			Replace
3	Radial runout of vibration damper (For D60P-17)	Repair limit : 0.80			Replace
4	Tightening torque of vibration damper mounting blot	Bolt	Target (kgm)	Range (kgm)	Retighten
		M12 (Except D60P-17)	11.3	10 - 12.5	
		M14 (For D60p-17)	18	16 - 20	

WATER PUMP AND THERMOSTAT

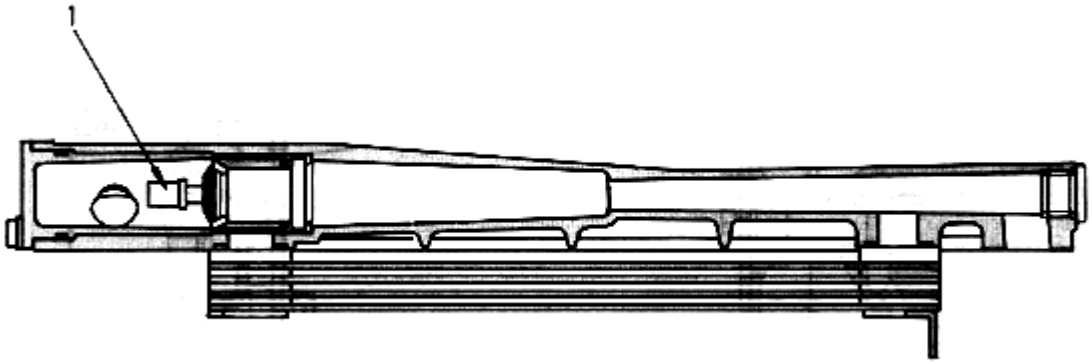




unit: mm

No.	Item	Criteria					Remedy
		Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
1	Interference between impeller and shaft	15.9	+0.020 +0.005	-0.020 -0.050	0.025 - 0.070	-	Replace impeller
2	Interference between drive gear and shaft	20	+0.015 0	-0.025 -0.055	0.025 - 0.070	-	Replace impeller
3	Clearance between impeller and body	Standard clearance : 0.30 - 1.10 (Include end play)					Replace
4	Abrasion of seal ring in water seal	 Repair limit A: 1.5					
5	Lift of thermostat valve	Min. 10 (Check after immersion in a hot water bath of 90°C for 4 or 5 minutes.)					Replace
	Opening and closing of valve in thermostat	Valve must be close fully when immersed in a hot water bath (71° C) for 4 or 5 minutes after being immersed in a hot water bath (90°C) to fully open the valve.					

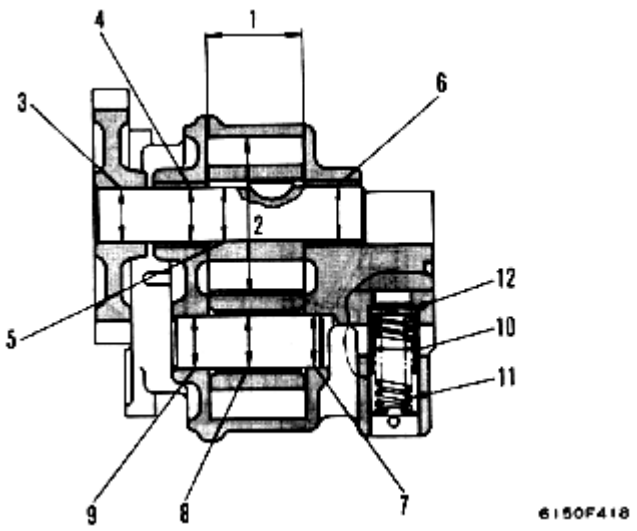
OIL COOLER



unit: mm

No.	Item	Criteria		Remedy
1	Lift of thermostat valve	B6D125-1 BS6D125-1	Min. 8 (check after immersion in a hot oil bath of 115°C for 4 or 5 minutes.)	Replace
	Opening and closing of valve in thermostat	Valve must be close fully when immersed in a hot oil bath (104° C) for 4 or 5 minutes after being immersed in a hot oil bath (115°C) to fully open the valve.		

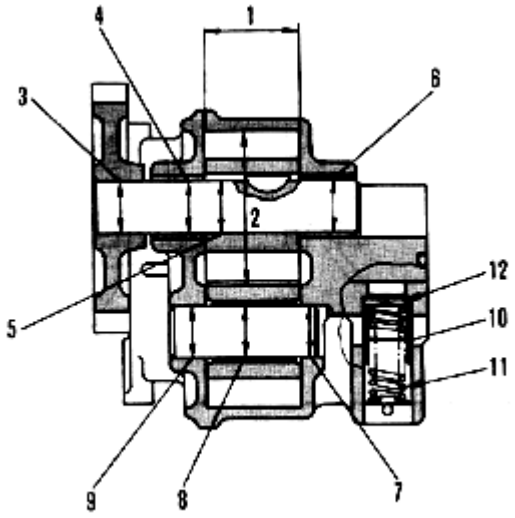
OIL PUMP



unit: mm

No.	Item	Criteria						Remedy
		Engine	Standard size	Tolerance: Gear thickness	Tolerance: Body depth	Standard clearance	Clearance limit	
1	Axial clearance of pump gear	B6D125-1	23	0 -0.021	+0.065 +0.040	0.03 - 0.09	0.10	Replace gear
		BS6D125-1	47	0 -0.025	+0.065 +0.040	0.03 - 0.09	0.10	
		Standard size	Tolerance: Gear O.D	Tolerance: Gear I.D	Standard clearance	Clearance limit		
2	Radial clearance of pump gear	51.4	-0.15 -0.21	+0.06 0	0.03- 0.10	0.13		
		Standard size	Tolerance: Shaft	Tolerance: Hole	Standard clearence or interference	Clearance or interference limit		
3	Interference between pump drive gear and drive shaft	18	+0.105 +0.090	+0.065 +0.045	0.025- 0.060	-		Replace
4	Clearance between drive shaft and cover bushing	18	-0.005 -0.025	+0.060 +0.035	0.040- 0.085	-		Replace bushing
5	Inteference between pump gear and drive shaft	18	+0.105 +0.090	+0.065 +0.030	0.025- 0.080	-		Replace
6	Clearance between drive shaft and body bushing	18	+0.105 +0.090	+0.175 +0.145	0.040- 0.085	-		Replace bushing
7	Clearance between driven shaft and body	18	+0.090 +0.070	+0.130 +0.100	0.010 - 0.060	-		Replace
8	clearance between driven shaft and gear bushing	18	+0.090 +0.070	+0.145 +0.120	0.030 - 0.080	-		Replace bushing
9	Interference between driven shaft and cover	18	+0.090 +0.070	+0.040 +0.020	0.030 - 0.070	-		Replace

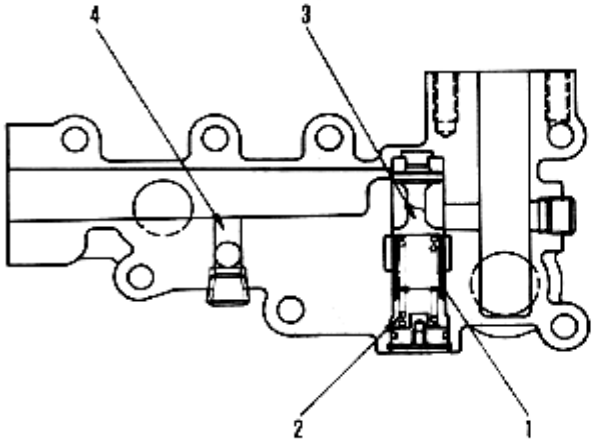
MAIN RELIEF VALVE

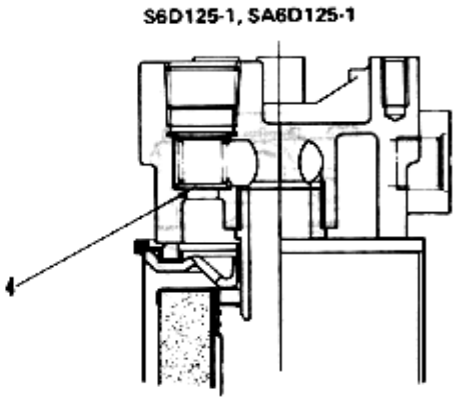


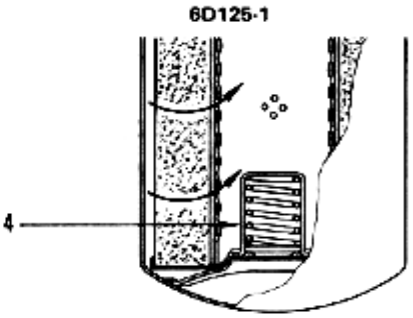
unit: mm

No.	Item	Criteria					Remedy
1	Clearance between valve and body	Standard size	Tolerance		Standard Clearance	Clearance limit	Replace
			Shaft	Hole			
		16	-0.040 -0.060	+0.045 0	0.040 - 0.105		
2	Relief valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		49.1	34.8	10.8kg	46.2	9.8 kg	
3	Relief valve set pressure	$7\ ^{+0.1}_{0}$ kg/cm^2					

REGULATOR VALVE AND SAFETY VALVE



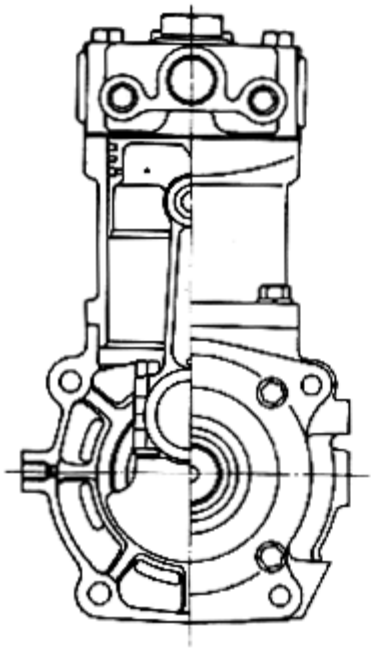


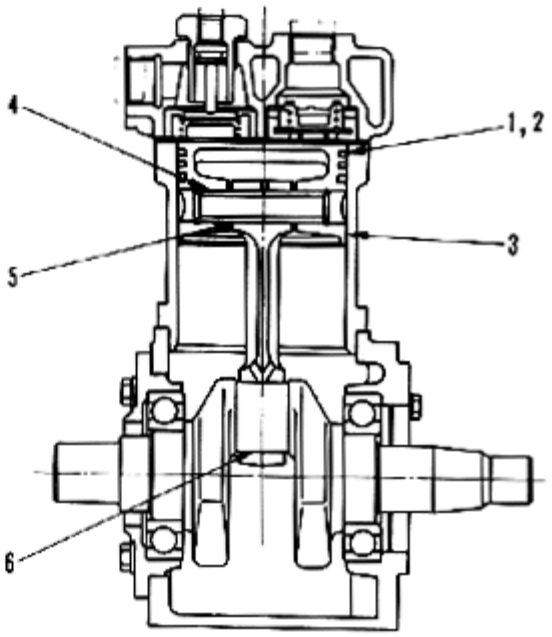


unit: mm

No.	Item		Criteria					Remedy
			Standard size	Tolerance		Standard Clearance	Clearance limit	
				Valve	Body			
1	Clearance between regulator valve and body		22	+0.15 +0.12	+0.28 +0.22	0.07 - 0.16		
			Standard size			Repair limit		Replace
	Regulator valve spring		Free length	Installed length	Installed load	Free length	Installed load	
2	Remote mounting type	Outer spring	65.0		8.63 kg			
		Innser spring	56.3	42.3	4.248 kg			
	Direct mounting type		106.2	75.5	11.02 kg			
3	Regulator valve set pressure		B6D125-1: 3.0 +0.1 -0.2 kg/cm² BS6D125-1 : 3.75 ± 0.15kg/cm² BSA6D125-1					
4	Safety valve set pressure		2.0 ± 0.2 kg/cm²					

AIR COMPRESSOR





unit: mm

No.	Item		Criteria			Remedy
1	Piston ring gap	1st,2nd ring	Standard clearance: 0.1 - 0.3		Repair limit: 2.0	Repair or Replace
		Oil ring	0.2 - 0.6		1.5	
2	Clearance between piston ring and ring groove	1st,2nd ring	Standard size: 3	Standard clearance: 0.015 - 0.050	Repair limit: 0.15	
		Oil ring	4	0.035 - 0.110	0.20	
3	Clearance between piston and cylinder		85	0.090 - 0.150	0.25	
4	Clearance between piston pin and piston		16	0.006 - 0.026	0.1	
5	Clearance between piston pin and connecting rod small end		16	0.006 - 0.026	0.1	
6	Clearance between crankpin metal and crankpin		35	0.034 - 0.075	0.15	