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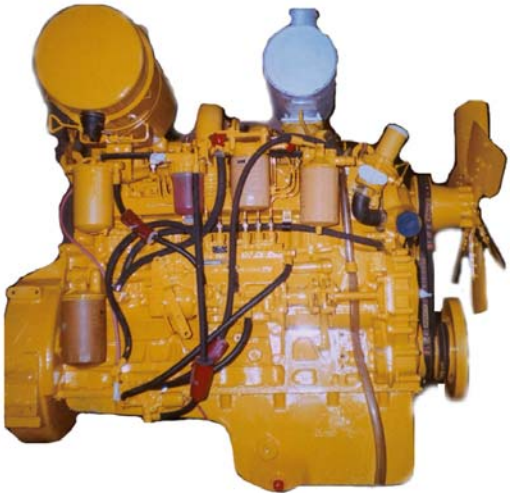
SHOP MANUAL



B(S)(A)6D105-1 SERIES DIESEL ENGINE

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 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 बी ई एम एल 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 carrying 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 carrying 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 REAIR 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, part 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 the 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 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 oi1 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 cover all models
Attachments volume : }

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 shows 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

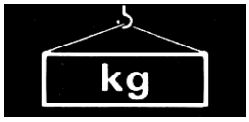
Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

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

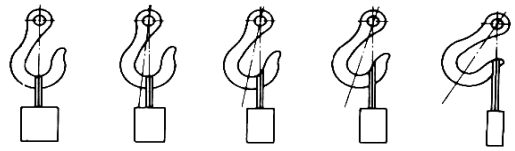
1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

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.

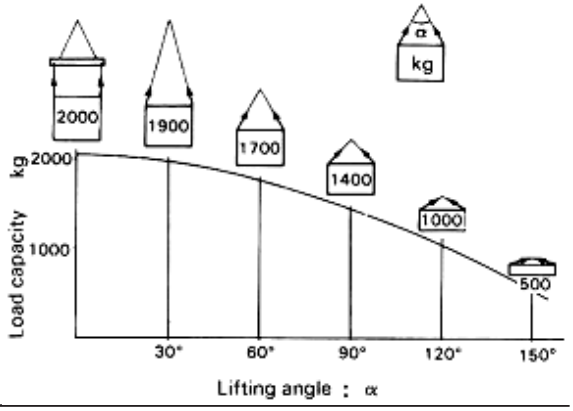
Hooks have maximum strength at the middle portion.

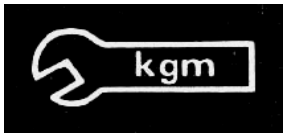


3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ 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)	bcml (T) kgm	bcml (T) 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

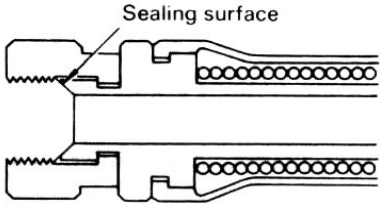
This torque table does not apply to the bolts with which nylon packings or other non-ferrous metals washers are to be used, or which require tightening to otherwise specified torque.

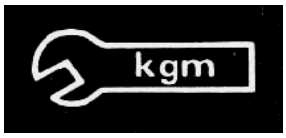
★ **Nm (newton meter): 1 Nm = 0.1 kgm**

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	Tightening torque 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

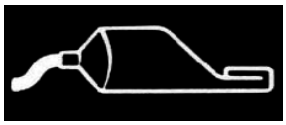




3. TIGHTENING TORQUE FOR NUTS OF FLARED

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 5 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

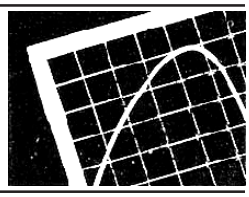
Nominal number strands	Copper Wire			Cable O.D (A)	Current rating	Applicable circuit
	Number (mm)	Dia.of strands (mm^2)	Cross section (mm)			
0.85	11	0.32	0.88	2.4	12	Starting,lighting,signal etc.
2	26	0.32	2.09	3.1	20	Lighting,signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	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	Circuits / Classification		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)	-

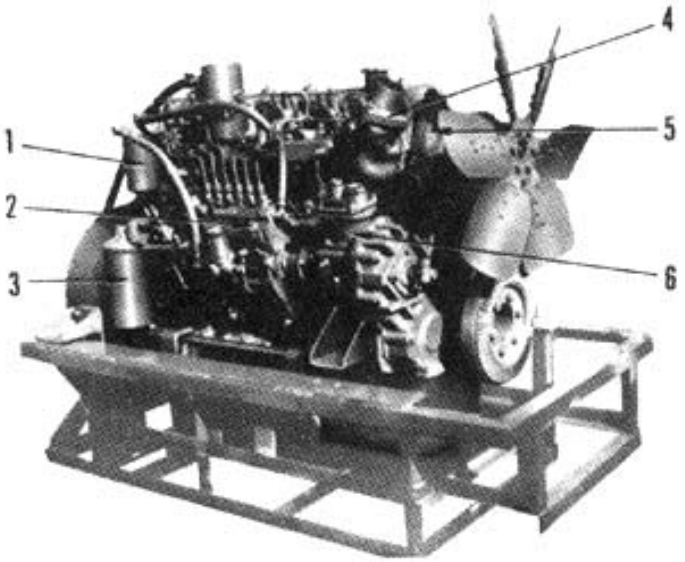
ENGINE

11 GENRAL

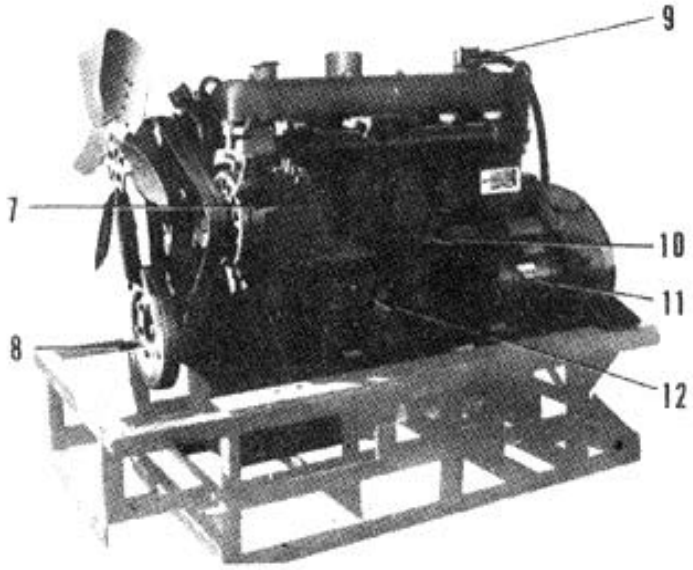


GENERAL VIEW

B6D105-1

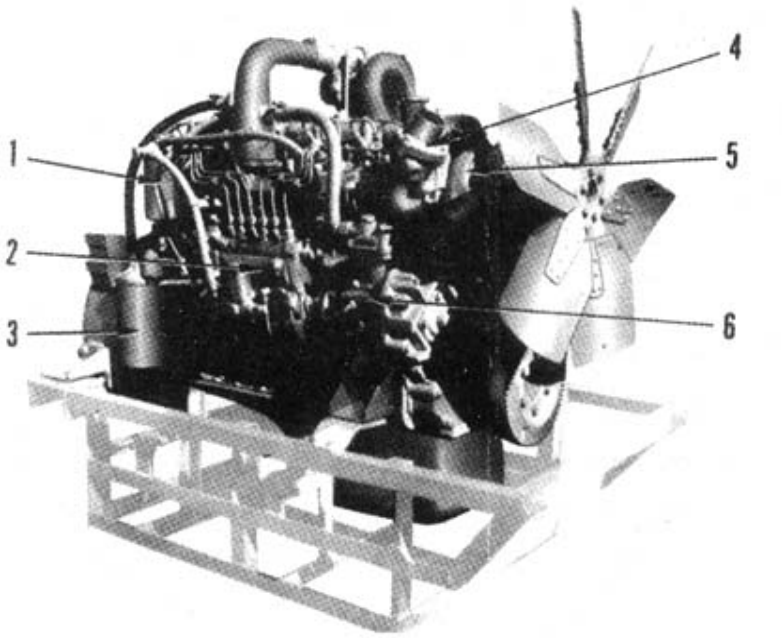


1. Fuel filter
2. Fuel injection pump
3. Oil filter
4. Thermostat housing
5. Water pump
6. Air compressor



7. Alternator
8. Vibration damper
9. Crank case breather
10. Oil filter
11. Starting motor
12. Oil level gauge

BS6D105-1



1. Fuel filter
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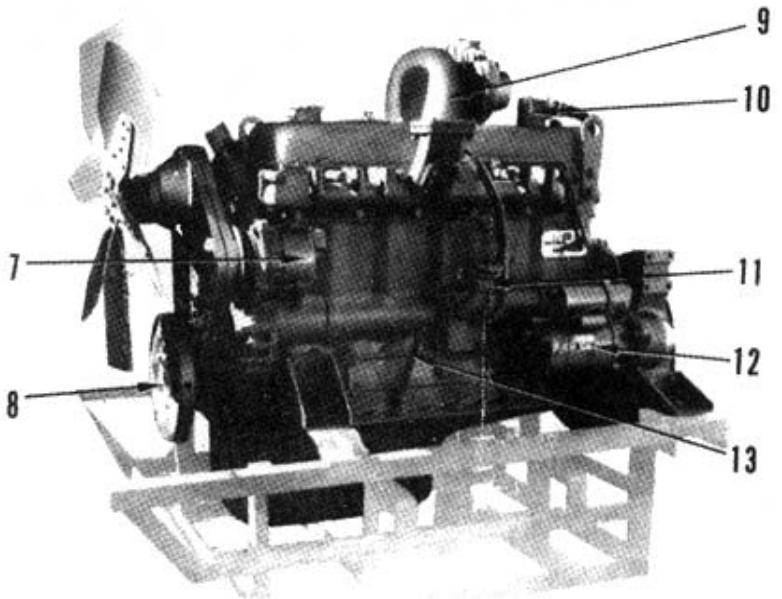


7. Aternator
8. Vibration damper
9. Turbocharger
10. Crankcase breather
11. Oil filler
12. Starting motor
13. Oil level gauge

SPECIFICATIONS

Engine model			B6D105-1	B6D105-1	BS6D105-B-1
Applicable machine			BE220-1	BE220-2 BE220LC-2	BE200-3 BE200LC-3
No. of cylinders - Bore x Stroke		mm	6 - 105 x 125		
Total piston displacement		cc	6,494		
Firing order			1 - 5 - 3 - 6 - 2 - 4		
Dimensions	Overall length (Fan to flywheel housing)	mm	1,291	1,392	1,236
	Overall width	mm	723	874	789
	Overall height (Muffler to oil pan)	mm	1,182	1,219	1,026
Performance	Flywheel horsepower	HP/rpm	105/2,350	105/2,150	116/2,100
	Max. torque	kgm/rpm	40,5/1,600	43/1,600	47/1,600
	High idling speed	rpm	2,500 - 2,600	2,300 - 2,400	2,250 - 2,350
	Low idling speed	rpm	800 - 850	800 - 900	800 - 900
	Min. fuel consumption ratio	g/HP.h	175	170	155
Dry weight		kg	620	600	620
Fuel			ASTM D975 No. 1 and No. 2		
Fuel pump			Bosch type PE - A		
Governor			Bosch RSV centrifugal, all-speed type		
Oil capacity		ℓ	24 (23)		
Coolant amount		ℓ	35	24	21
Aternator			24V, 25A		24V, 25A
Starting motor			24V, 7.5 KW		24V, 7.5 KW
Battery			24V, (12V x 2) - 150Ah		24V (12V x 2) - 140Ah
Turbocharger			-	-	T04B
Air compressor			DIESEL KIKI	-	-

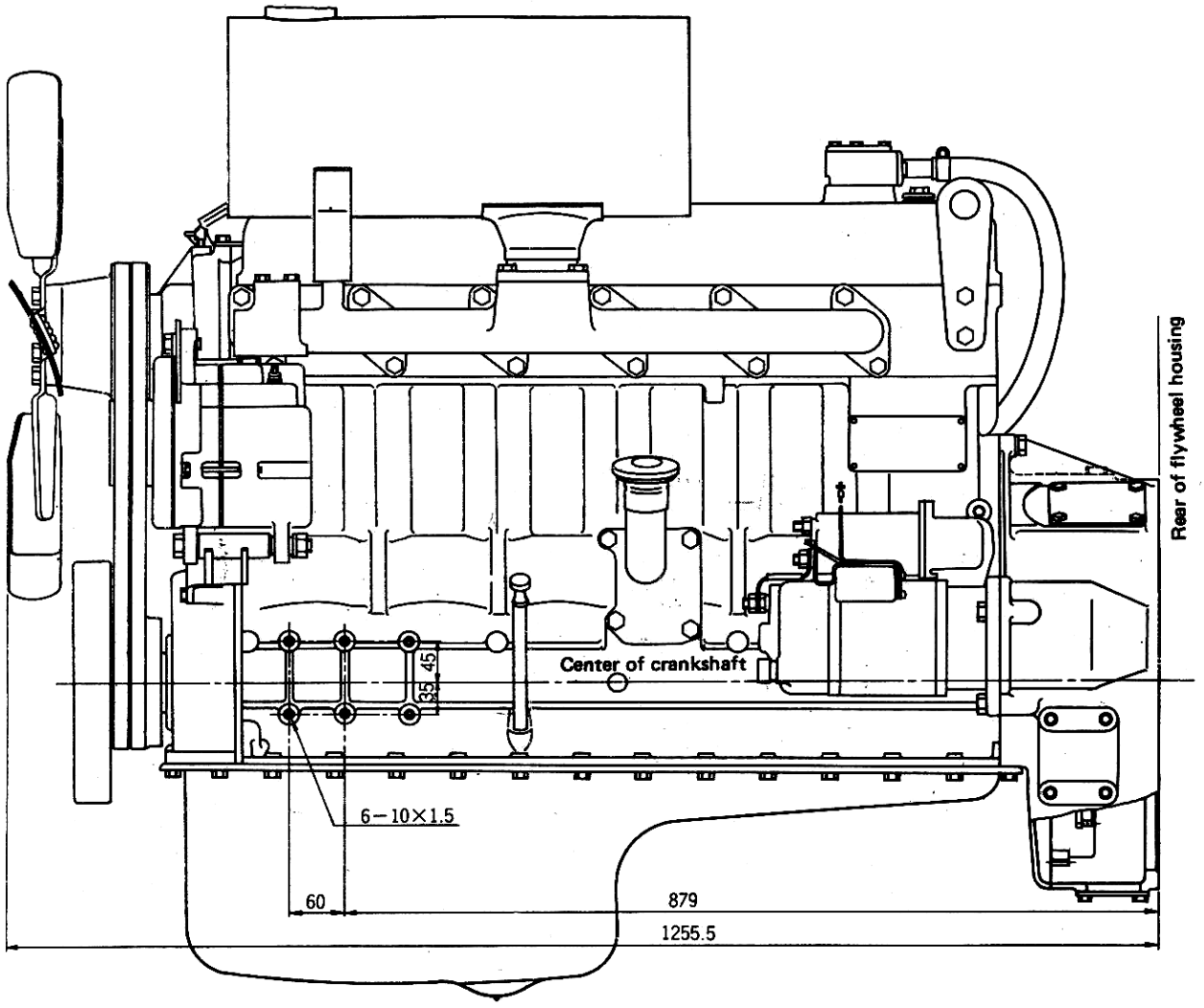
Engine model			BS6D105-1	BS6D105-1	BS6D105-1
Applicable machine			BE220-1	BE220-2 BE220LC-2	BE220-3 BE220LC-3
No. of cylinders - Bore x Stroke		mm	6 - 105 x 125		
Total piston displacement		cc	6,494		
Firing order			1 - 5 - 3 - 6 - 2 - 4		
Dimensions	Overall length (Fan to flywheel housing)	mm	1,291	1,291	1,236
	Overall width	mm	862	862	789
	Overall height (Muffler to oil pan)	mm	1,182	1,182	1,026
Performance	Flywheel horsepower	HP/rpm	136/2,350	136/2,150	146/2,100
	Max. torque	kgm/rpm	57/1,700	57/1,600	56.5/1,400
	High idling speed	rpm	2,500 - 2,600	2,300 - 2,400	2,250 - 2,350
	Low idling speed	rpm	800 - 850	800 - 900	800 - 900
	Min. fuel consumption ratio	g/HP.h	170	168	155
Dry weight		kg	640	620	620
Fuel			ASTM D975 No. 1 and No. 2		
Fuel pump			Bosch type PE - A		
Governor			Bosch RSV centrifugal, all-speed type		
Oil capacity		ℓ	24 (23)		
Coolant amount		ℓ	44	25	21
Aternator			24V, 25A		24V, 25A
Starting motor			24V, 7.5 KW		24V, 7.5 KW
Battery			24V, (12V x 2) - 150Ah		24V (12V x 2) - 140Ah
Turbocharger			T04B	T04B	T04B
Air compressor			DIESEL KIKI	DIESEL KIKI (option)	-

Engine model			BS6D105-1		BSA6D105-1
Applicable machine			BD50	100 kVA	125 kVA
No. of cylinders - Bore x Stroke		mm	6 - 105 x 125		
Total piston displacement		cc	6,494		
Firing order			1 - 5 - 3 - 6 - 2 - 4		
Dimensions	Overall length (Fan to flywheel housing)	mm	1334	1360	1360
	Overall width	mm	903	903	903
	Overall height (Muffler to oil pan)	mm	1264	1264	1264
Performance	Flywheel horsepower	kW	74.6 @ 1750	87 @ 1500	111 @ 1500
		Bhp/rpm	100 @ 1750	117 @ 1500	150 @ 1500
	Max. torque	N.m/rpm	466 @ 1100	- -	- -
		kgm/rpm	47.5 @ 1100	- -	- -
	High idling speed	rpm	1950 ~ 2050	1555 ~ 1565	1555 ~ 1565
	Low idling speed	rpm	650 ~ 700	975 ~ 1025	975 ~ 1025
	Min. fuel consumption ratio	g/kWh	208	214	212
Dry weight		kg	765 ± 20	640 ± 20	640 ± 20
Fuel pump			MICO Bosch type	MICO Bosch type	MICO Bosch type
Governor			All speed mechanical	All speed mechanical	All speed mechanical
Lubricating oil amount (refill capacity)		ℓ	24 (23)		
Coolant amount		ℓ	21		
Aternator			24V, 45A	24V, 30A	
Starting motor			24V, 7.5 kW	24V, 4.5 kW	
Battery			12V, 200Ah x 2	12V, 160Ah x 2	
Turbocharger			KKK (TEL)	KKK (TEL)	KKK (TEL)
Air compressor			- -	- -	- -

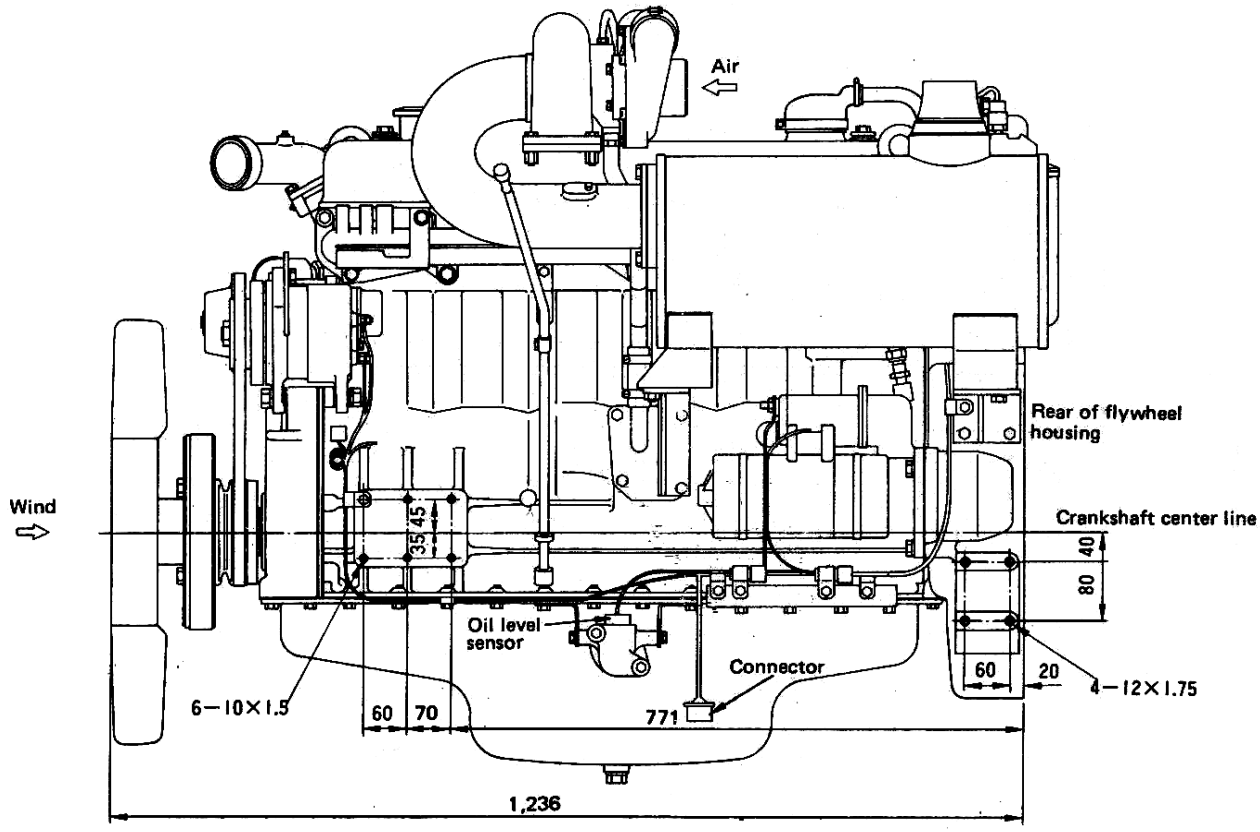
Engine model			B6D105-1		BS6D105-1	
Applicable machine			BL200	G10T (ATT)	BG605BX	G12T (ATT)
No. of cylinders - Bore x Stroke		mm	6 - 105 x 125		6 - 105 x 125	
Total piston displacement		cc	6,494		6,494	
Firing order			1 - 5 - 3 - 6 - 2 - 4		1 - 5 - 3 - 6 - 2 - 4	
Dimensions	Overall length (Fan to flywheel housing)	mm	1291			
	Overall width	mm	723			
	Overall height (Muffler to oil pan)	mm	1182			
Performance	Flywheel horsepower	kW	81 @ 2400		101 @ 2400	
		Bhp/rpm	108.6 @ 2400		135.4 @ 2400	
	Max. torque	N.m/rpm	392 @ 1600		440 @ 1700	
		kgm/rpm	40 @ 1600		44.9 @ 1700	
	High idling speed	rpm	2590 ~ 2690		2590 ~ 2690	
	Low idling speed	rpm	700 ~ 750		700 ~ 750	
	Min. fuel consumption ratio	g/kWh	234			
Dry weight		kg	620 ± 20		-	
Fuel pump			MICO		MICO	
Governor			Bosch type All speed mechanical		Bosch type All speed mechanica	
Lubricating oil amount (refill capacity)		ℓ	24 (23)		24 (23)	
Coolant amount		ℓ	21		21	
Aternator			24V, 45A		24V, 45A	
Starting motor			24V, 4.5 kW		24V, 4.5 kW	
Battery			12V, 200Ah x 2		12V, 200Ah x 2	
Turbocharger			KKK (TEL)		KKK (TEL)	
Air compressor			- -		- -	

ASSEMBLY DRAWING

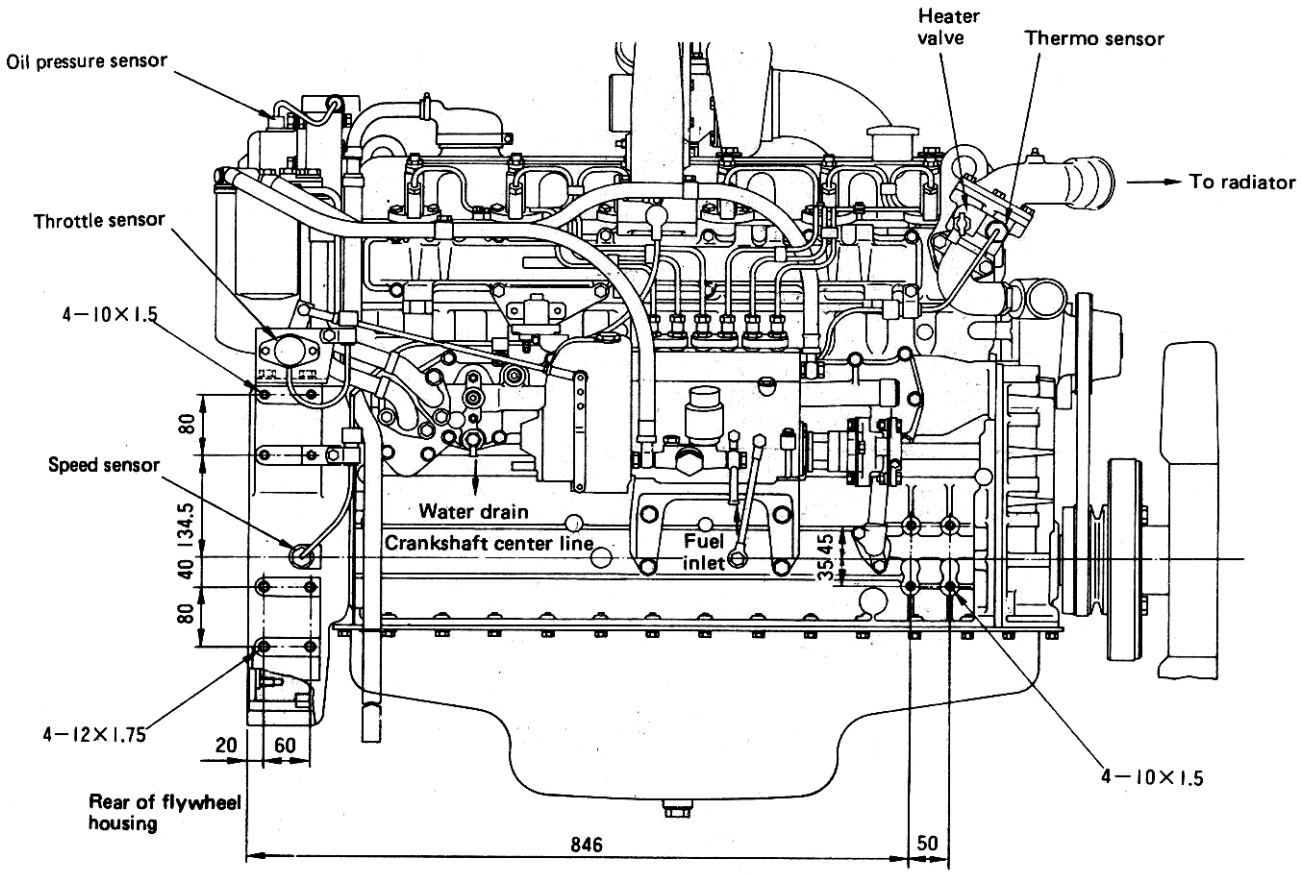
B6D105-1 LEFT SIDE DRAWING



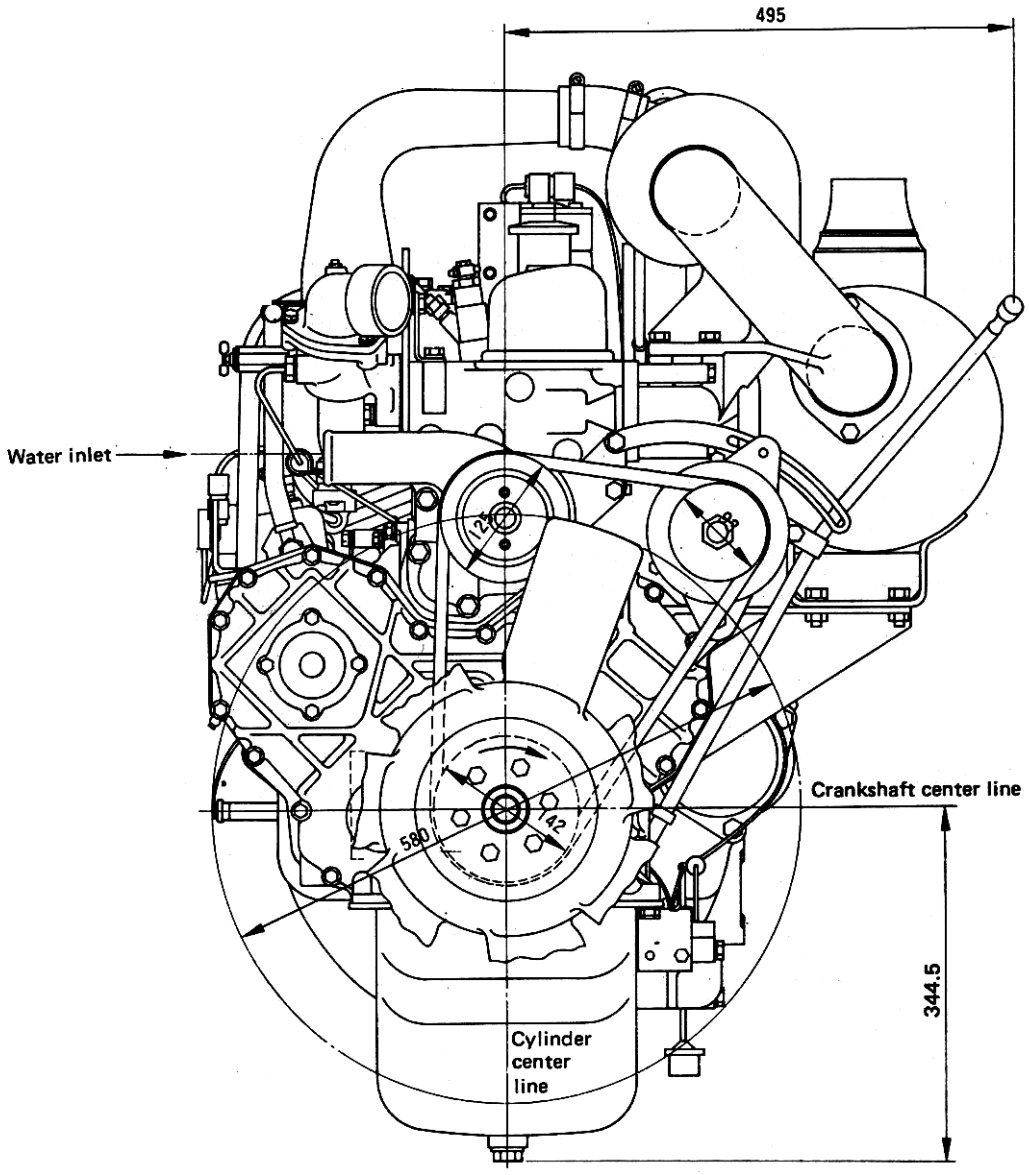
BS6D105-1 LEFT SIDE DRAWING
(For BE200-3, BE200LC-3, BE220-3, BE220LC-3)



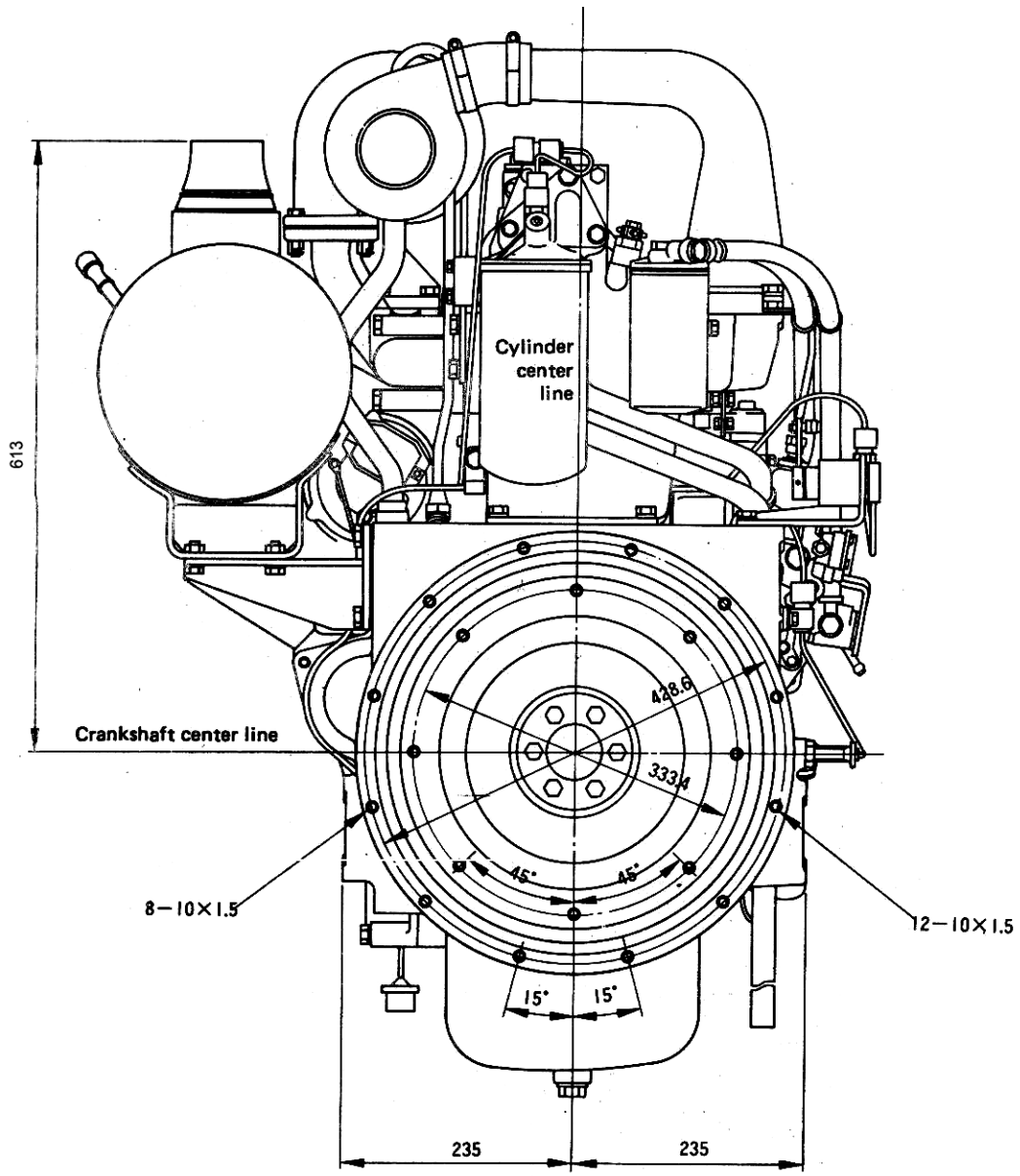
BS6D105-1 RIGHT SIDE DRAWING
(For BE200-3, BE200LC-3, BE220-3, BE220LC-3)



BS6D105-1 FRONT SIDE DRAWING
(For BE200-3, BE200LC-3, BE220-3, BE220LC-3)



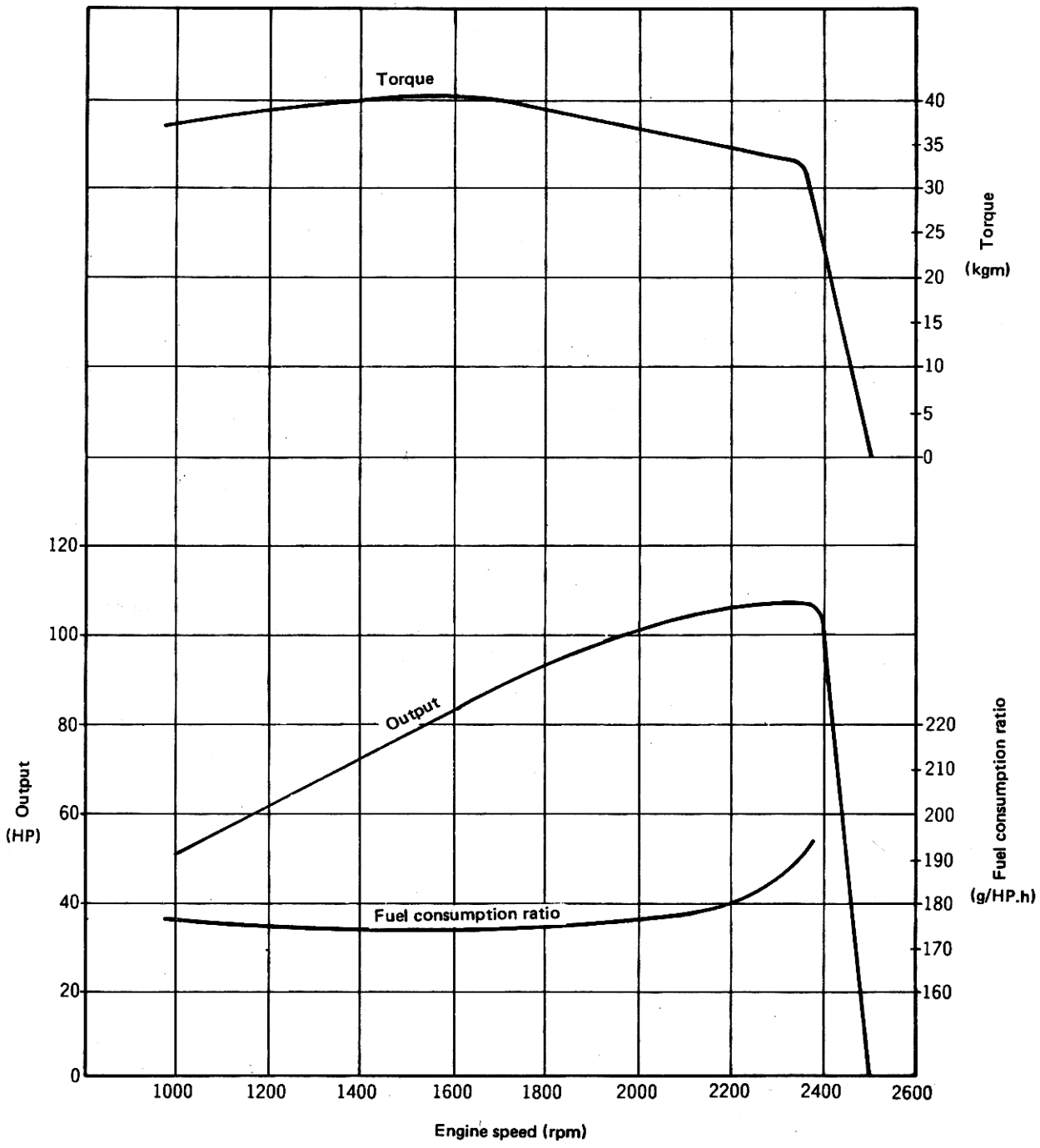
BS6D105-1 REAR SIDE DRAWING (For BE200-3, BE200LC-3, BE220-3, BE220LC-3)



PERFORMANCE CURVE

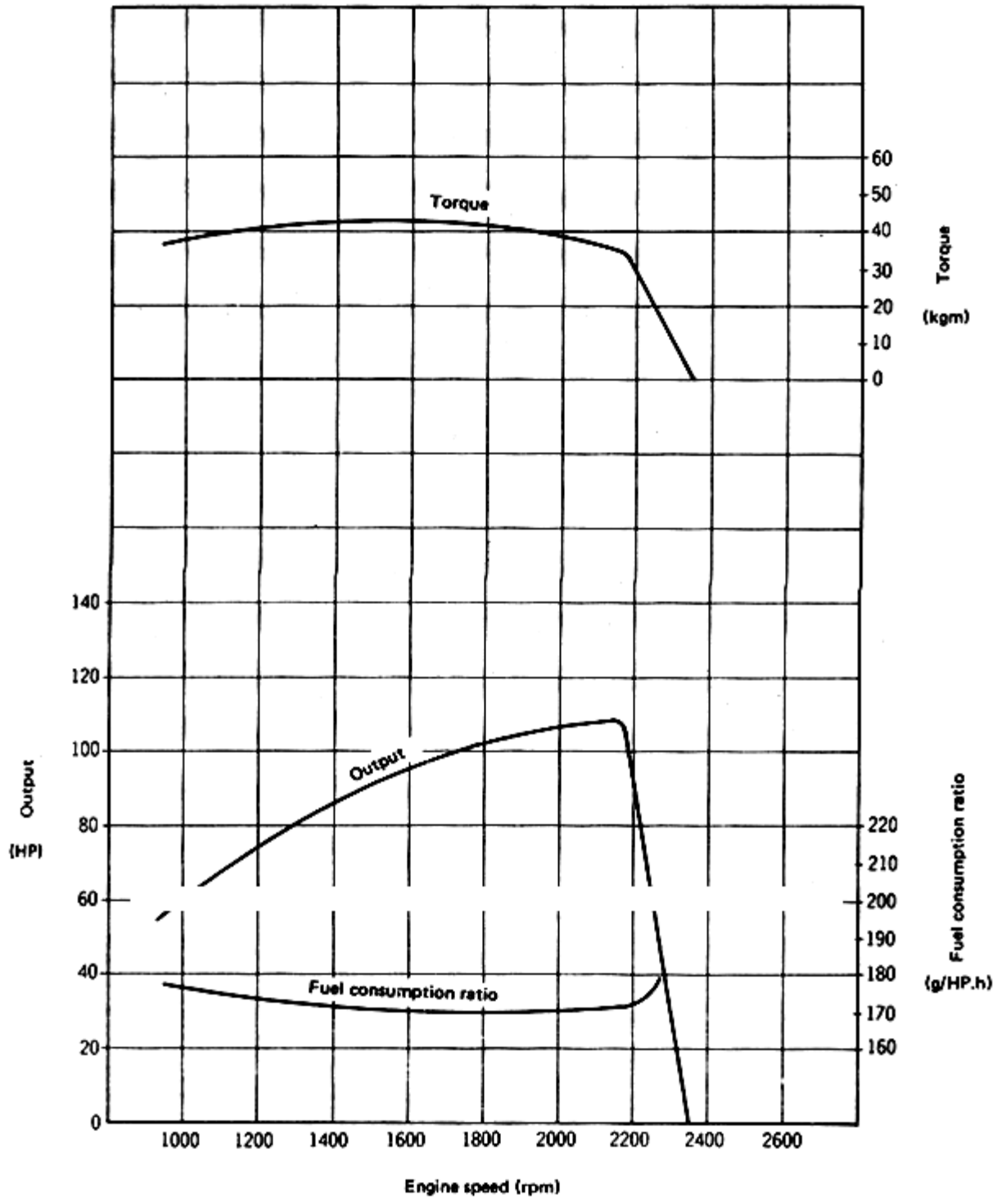
B6D105-1 For BE200-1

Flywheel horsepower : 105 HP/2,350 rpm
Max. torque : 40.5 kgm/1,600 rmp
Min. fuel consumption ratio : 175 g/HP.h



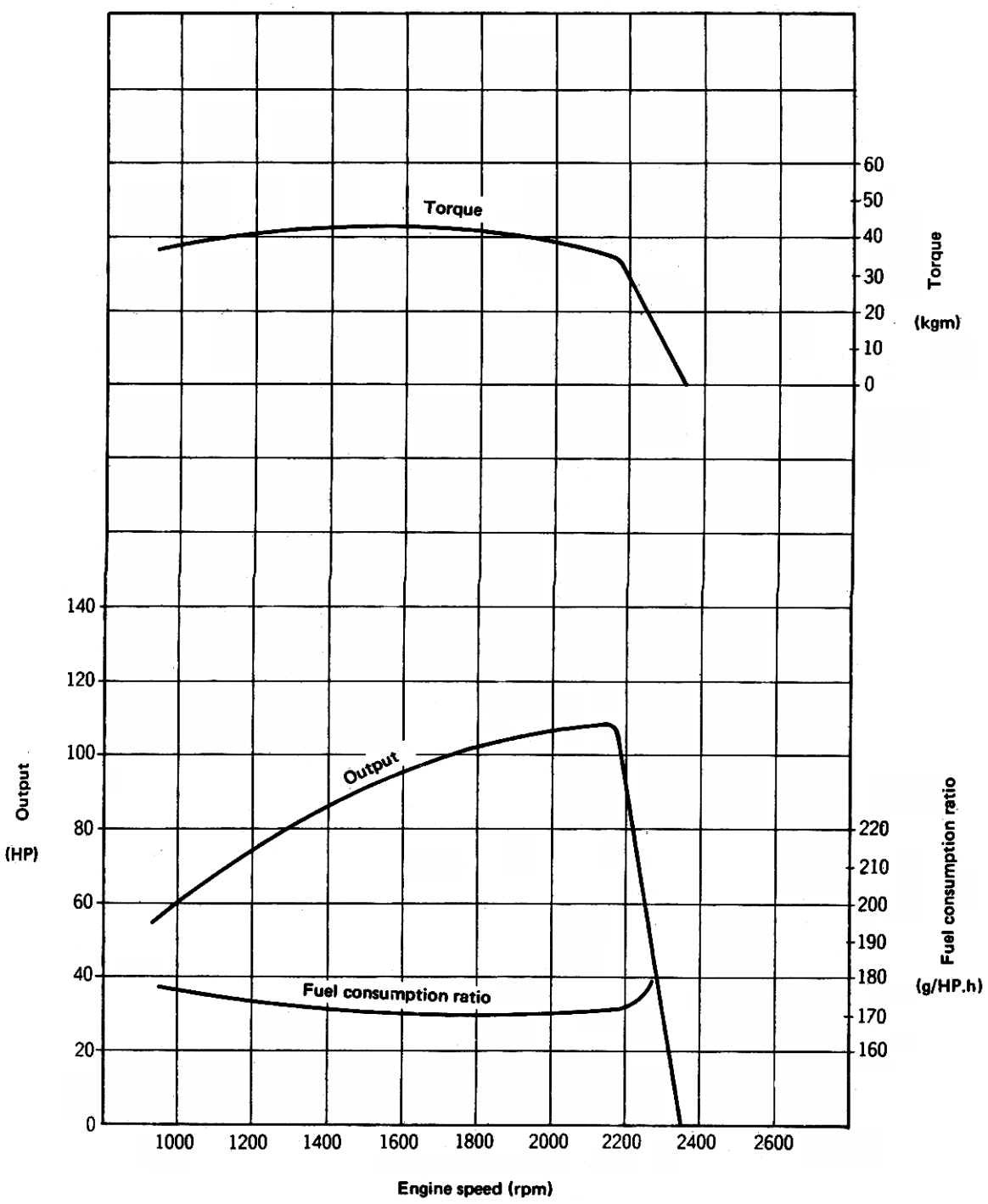
B6D105-1 For BE200-2 and BE200LC-2

Flywheel horsepower : 105 HP/2,150 rpm
Max. torque : 43 kgm/1,600 rmp
Min. fuel consumption ratio : 170 g/HP.h



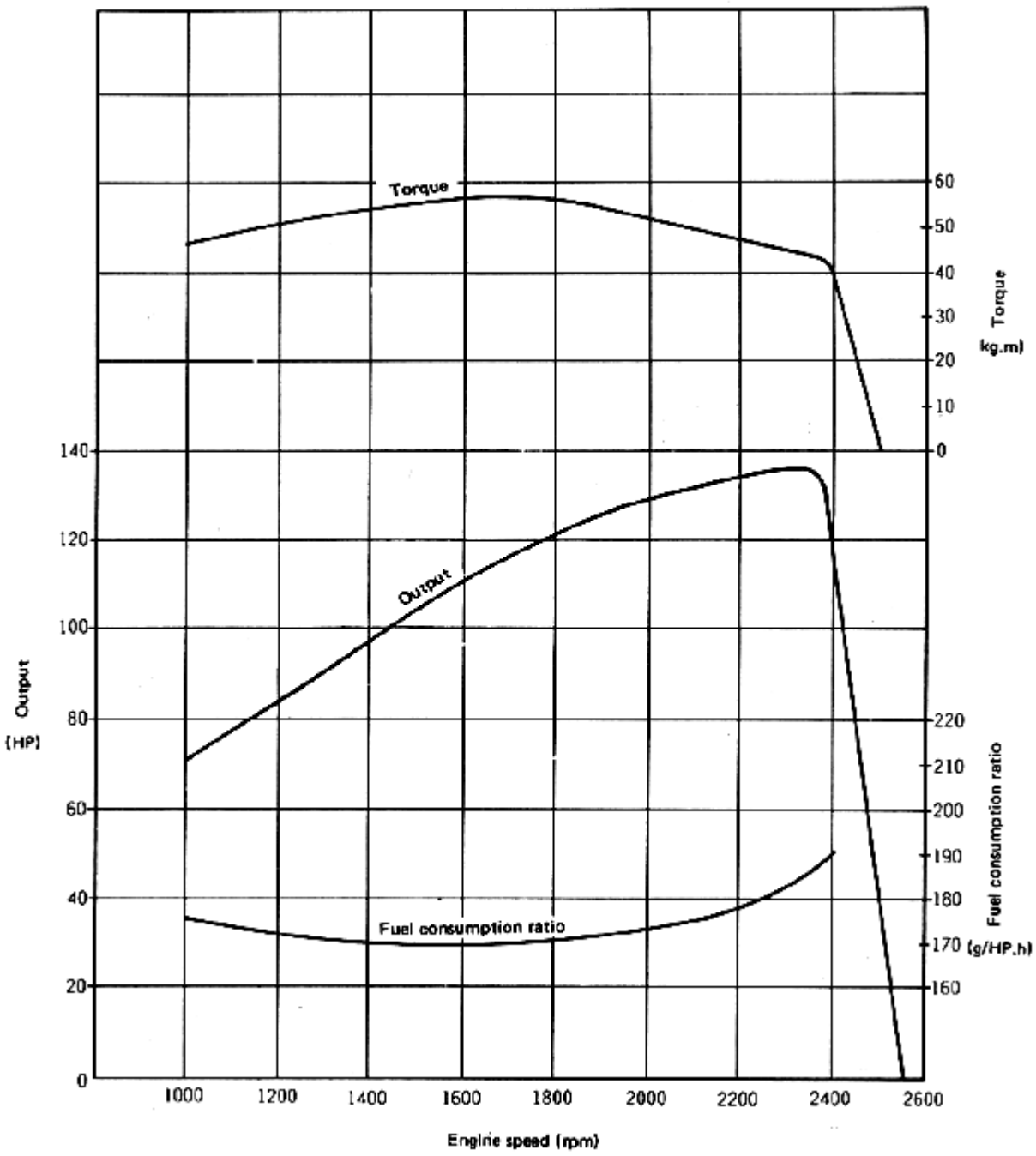
BS6D105-1 For BE200-3 and BE200LC-3

Flywheel horsepower : 118 HP/2,100 rpm
Max. torque : 47 kgm/1,600 rmp
Min. fuel consumption ratio : 155 g/HP.h



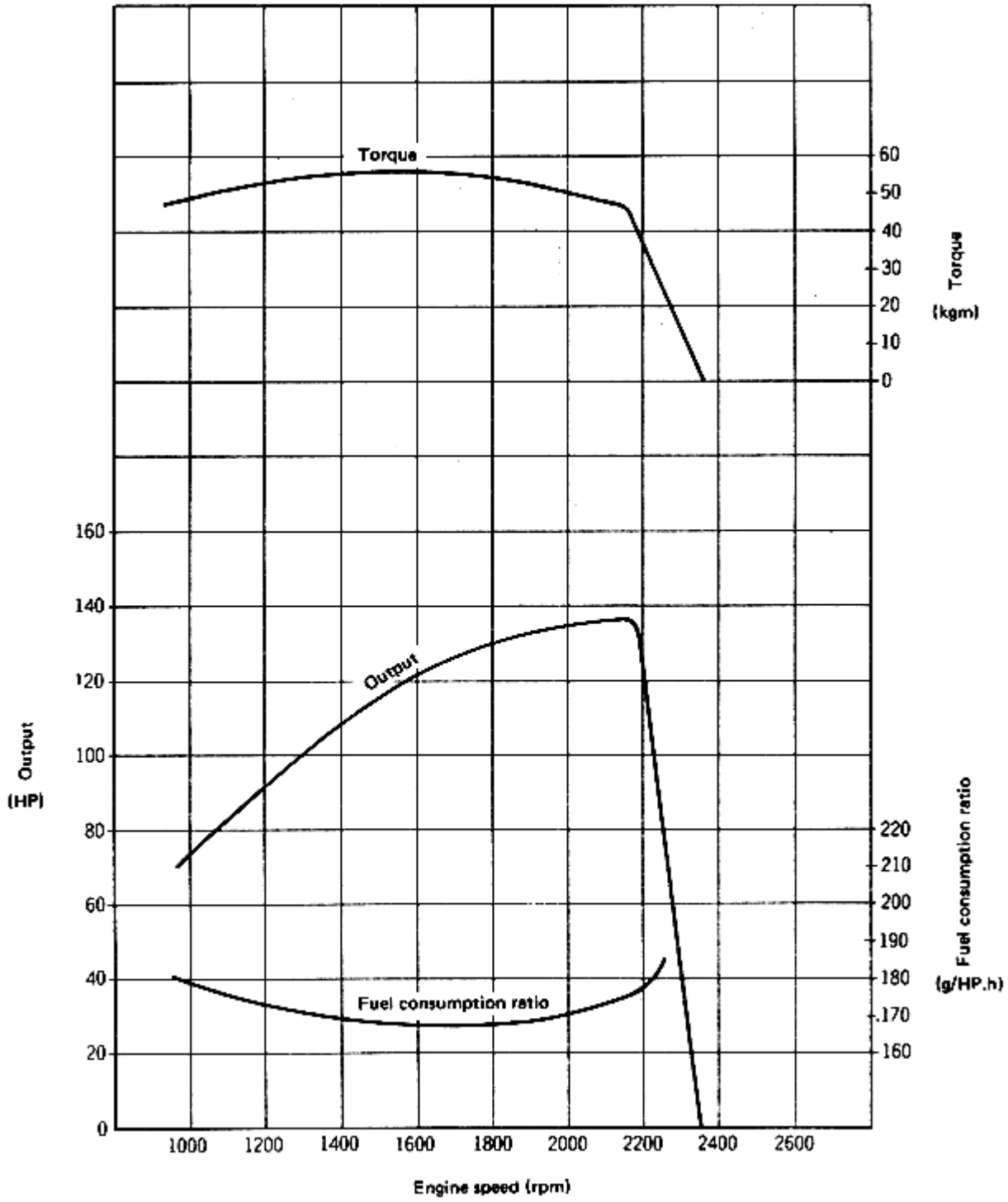
BS6D105-1 For BE200-1

Flywheel horsepower : 136 HP/2,350 rpm
Max. torque : 57 kgm/1,700 rmp
Min. fuel consumption ratio : 170 g/HP.h



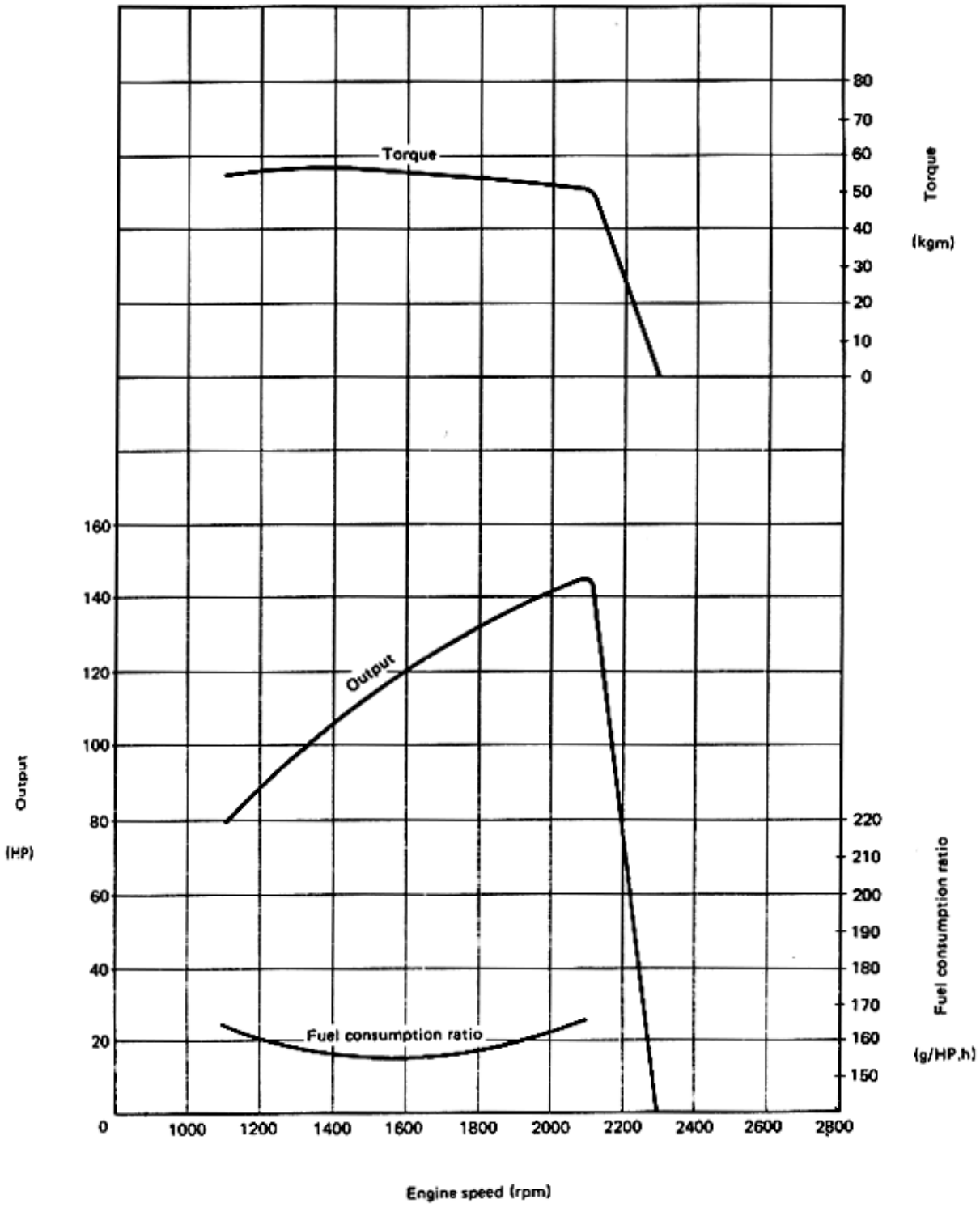
BS6D105-1 For BE200-2 and BE220LC-2

Flywheel horsepower : 136 HP/2,150 rpm
Max. torque : 57 kgm/1,600 rmp
Min. fuel consumption ratio : 168 g/HP.h



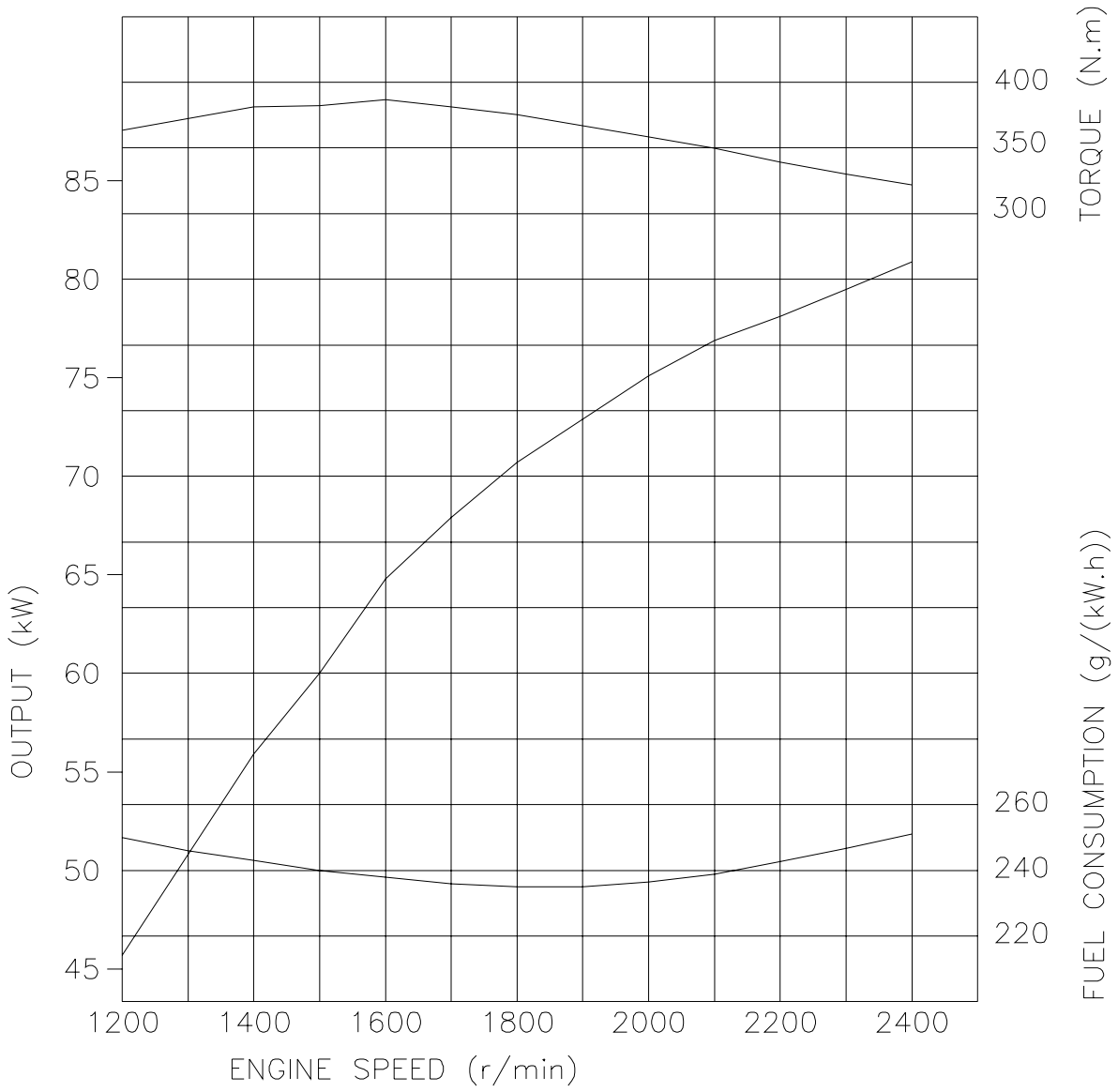
BS6D105-1 For BE220-3 and BE220LC-3

Flywheel horsepower : 148 HP/2,100 rpm
Max. torque : 56.5 kgm/1,400 rmp
Min. fuel consumption ratio : 155 g/HP.h



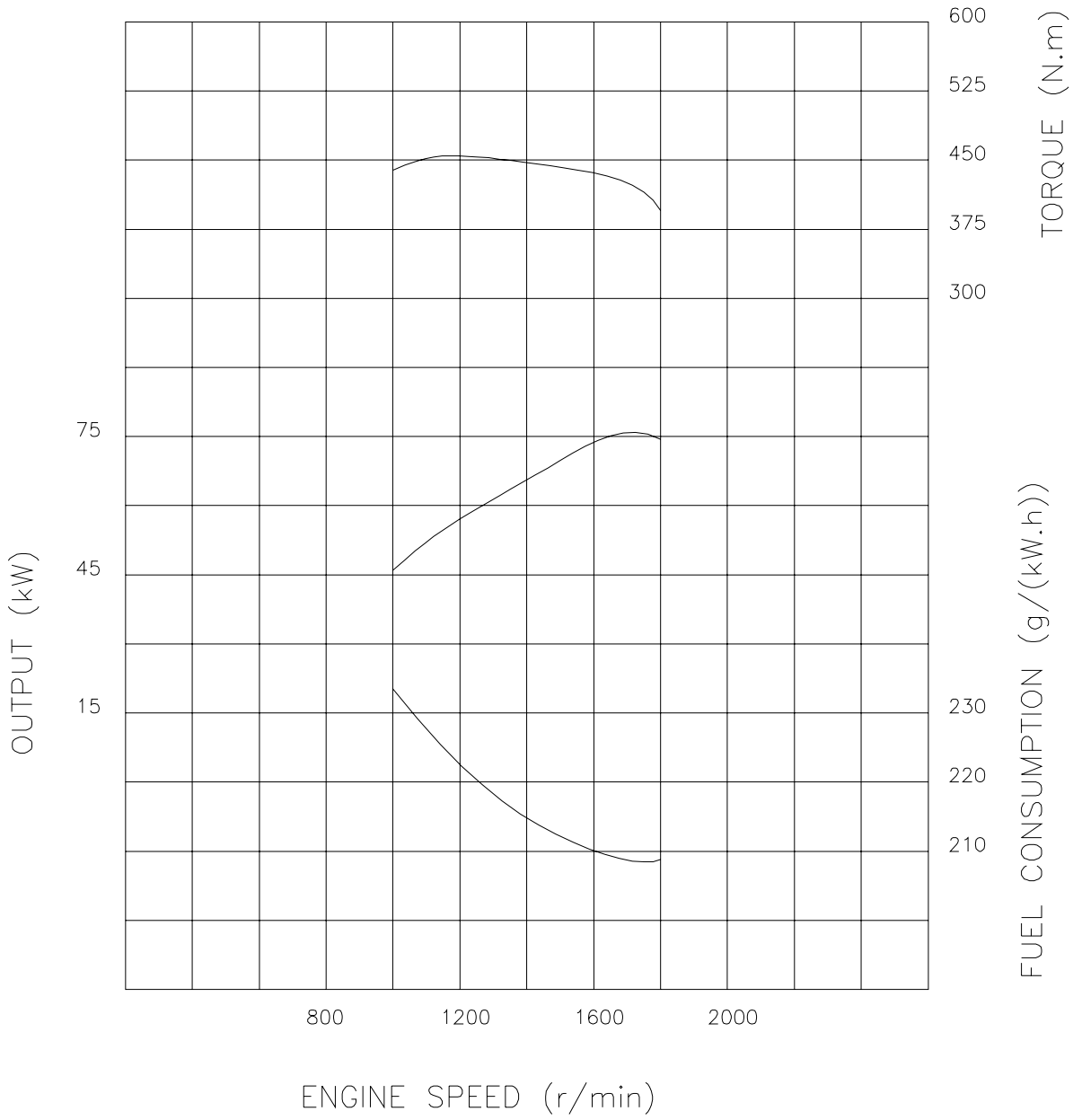
B6D105-1 For BL200 / G10T (ATT)

Flywheel horsepower	:	81 kW @ 2400 rpm
Max. torque	:	392 N.m @ 1600 rpm
Min. fuel consumption ratio	:	234 g/ (kW-hr.)
Corrected in accordance with	:	IS 13116/ISO 9249



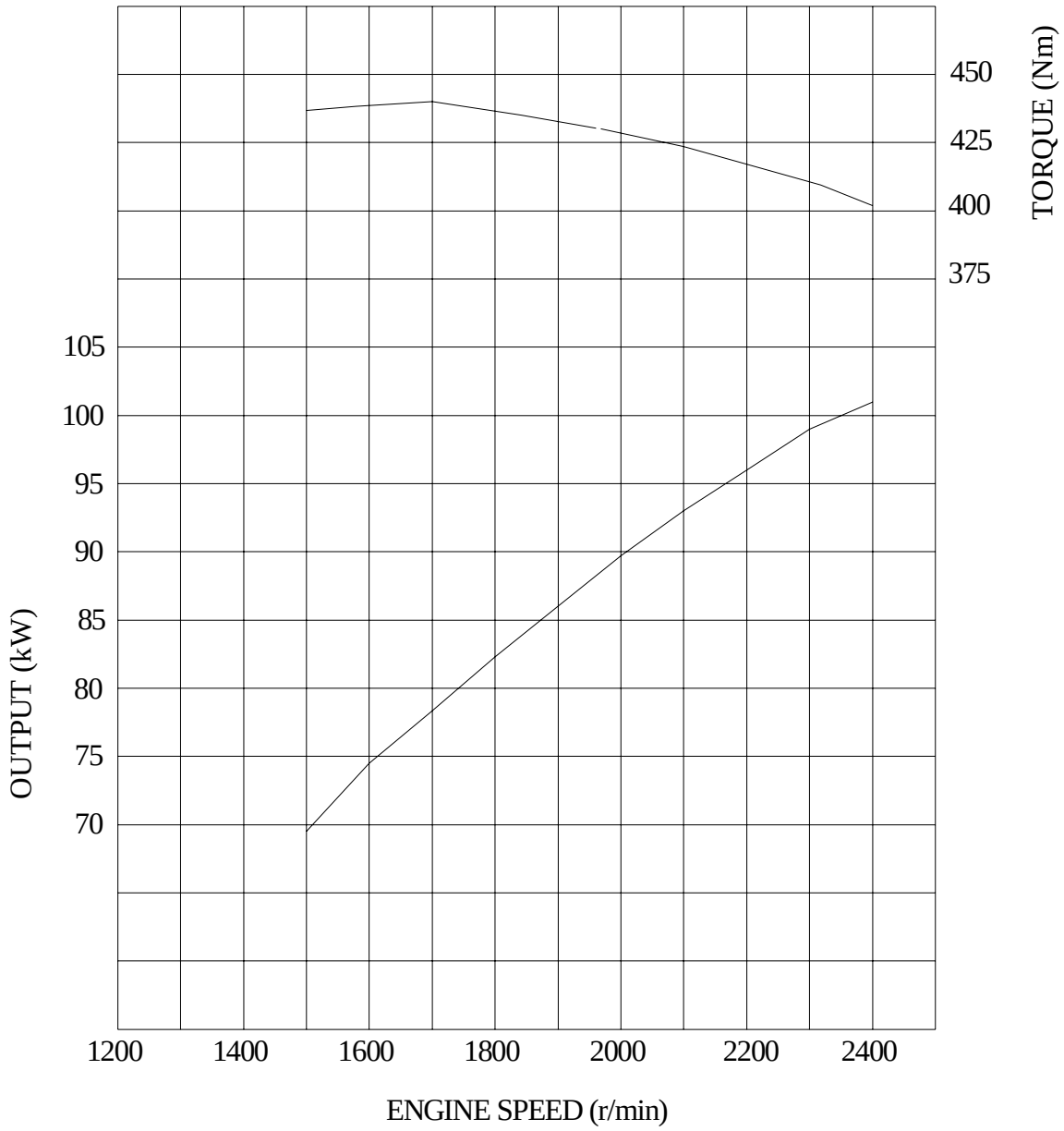
BS6D105-1 For BD50

Flywheel horsepower : 74.6 kW @ 1750 rpm
Max. torque : 466 N.m @ 1100 rmp
Min. fuel consumption ratio : 208 g/ (kW.h)



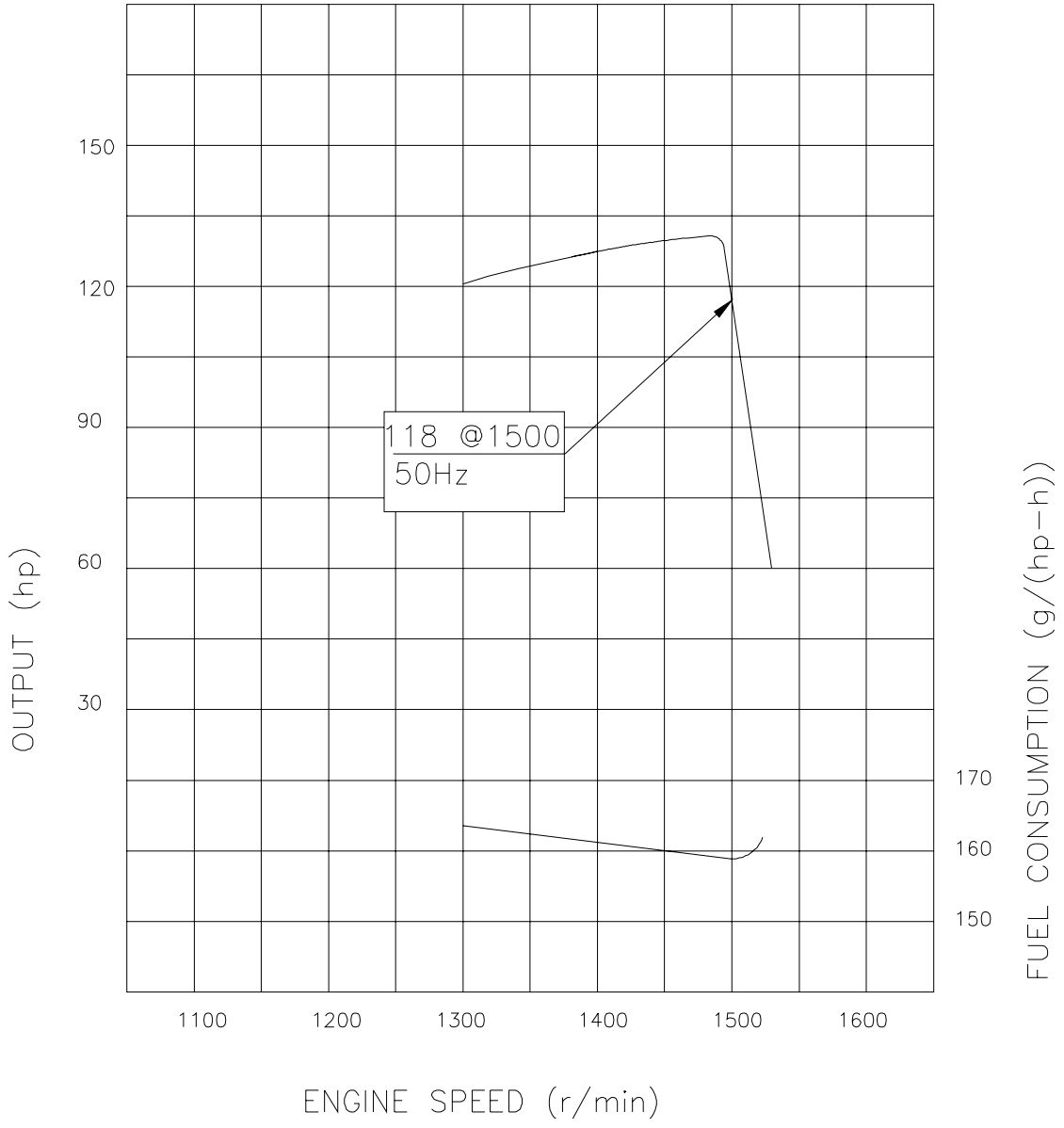
BS6D105-1 For BG605BX, G12T(ATT)

Flywheel horsepower : 101 kW @ 2400 rpm
Max. torque : 440 N.m @ 1700 rmp
Corrected in accordance with : IS 13116 / ISO 9249



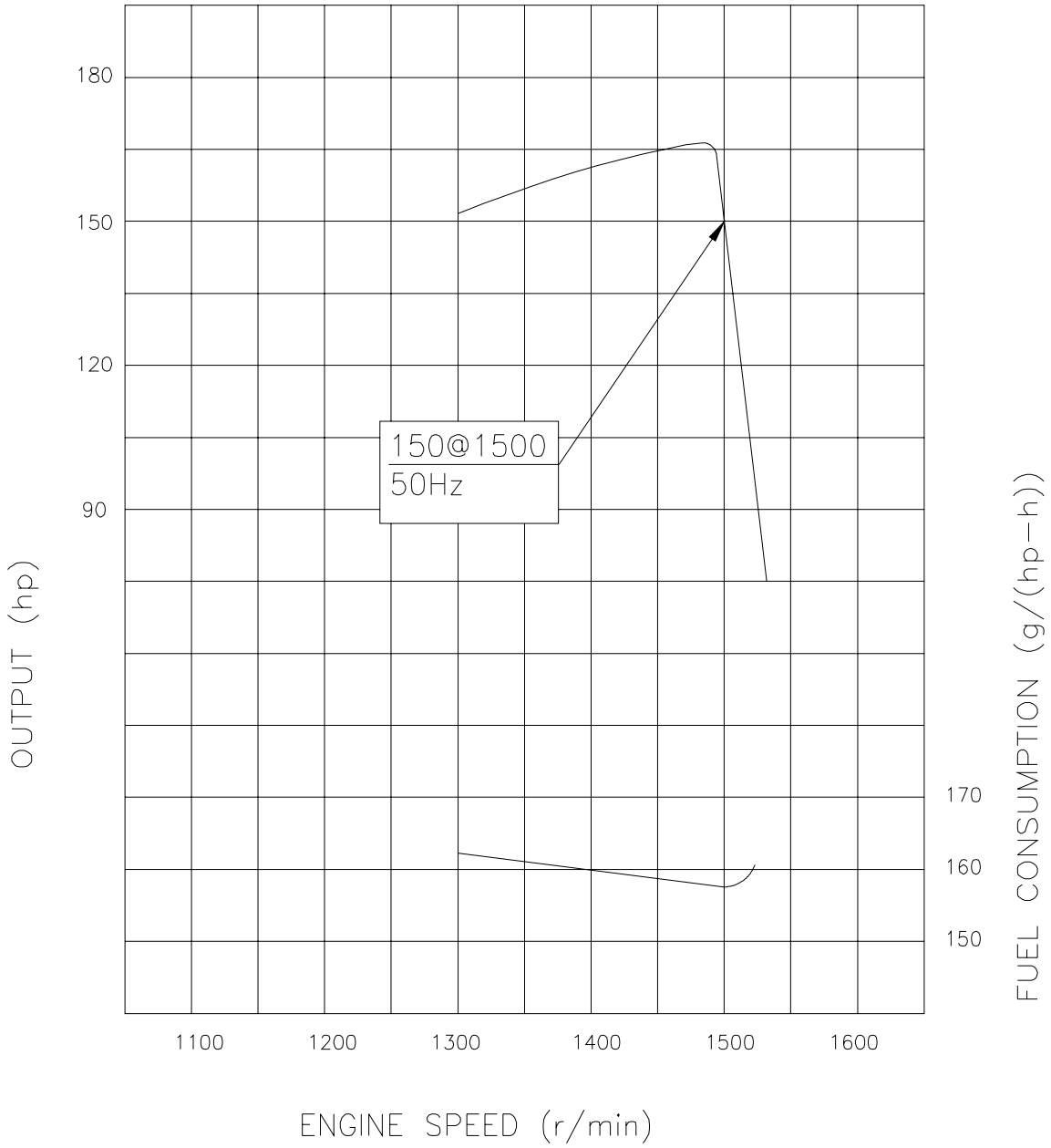
BS6D105-1 For 100 kVA

Flywheel horsepower : 118 hp @ 1500 rpm
(87 kW @ 1500 rpm
Max. torque : –
Min. fuel consumption ratio : 158 g/ hp.hr (214 g/kW-hr.)



BSA6D105-1 For 125 kVA

Flywheel horsepower : 150 hp @ 1500 rpm
(111 kW @ 1500 rpm
Max. torque : –
Min. fuel consumption ratio : 156 g/ hp.hr (212 g/kW-hr.)

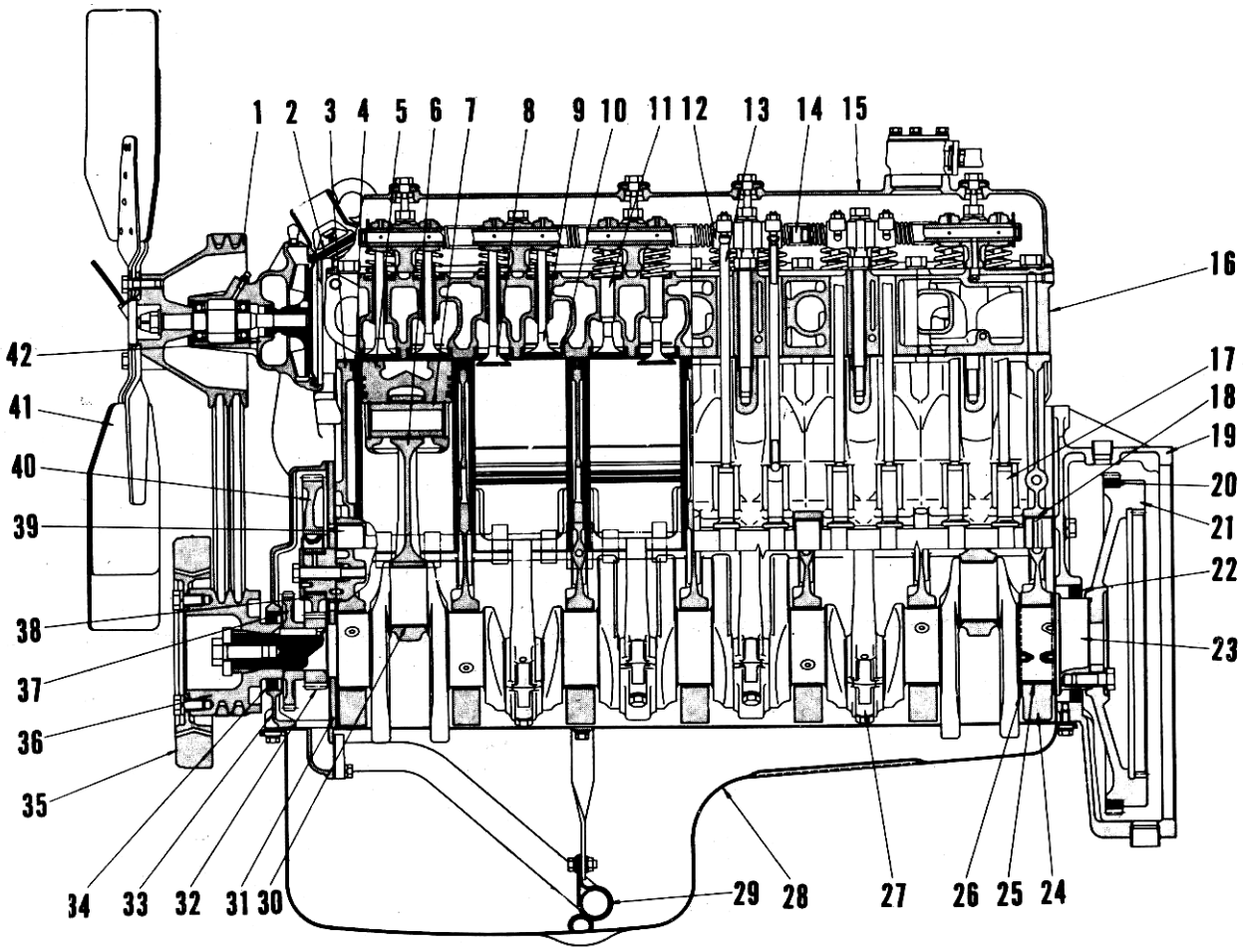


ENGINE

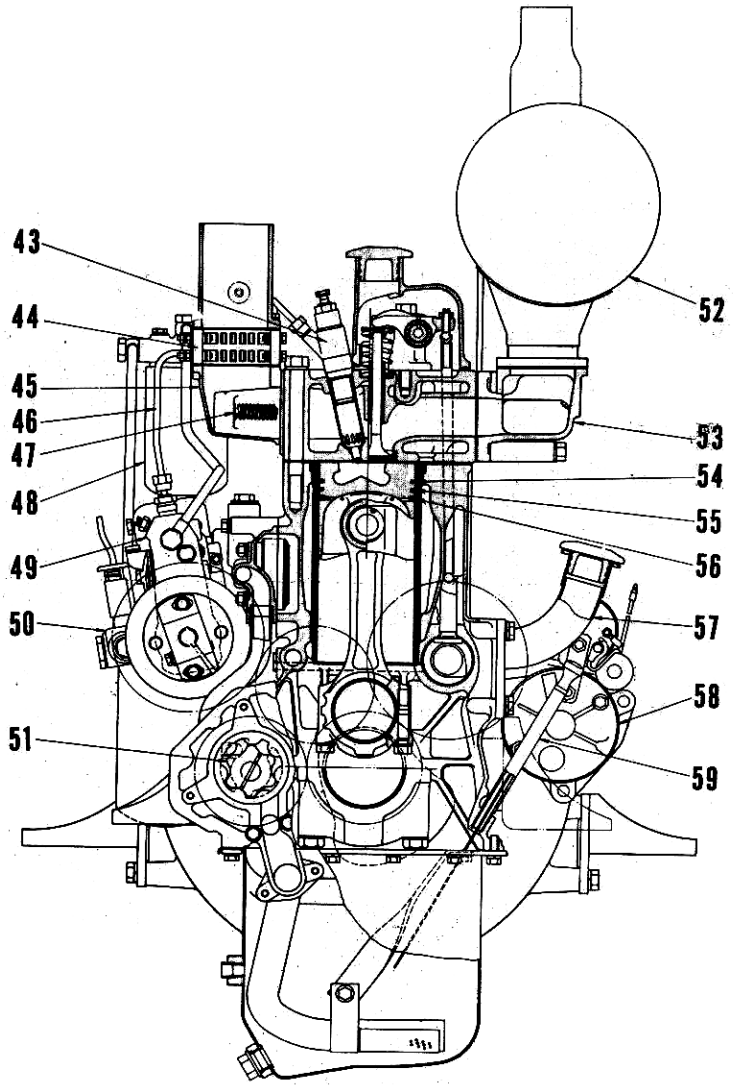
12 STUCTURE AND FUNCTION

GENERAL STRUCTURE

B6D105-1



1. Fan pulley
2. Thermostat
3. Cylinder block
4. Cylinder liner
5. Piston
6. Connecting rod
7. Piston pin
8. Exhaust valve
9. Intake valve
10. Valve seat
11. Valve guide
12. Rocker arm
13. Push rod
14. Rocker arm shaft
15. Cylinder head cover
16. Cylinder head
17. Tappet
18. Camshaft bushing
19. Flywheel housing
20. Ring gear
21. Flywheel
22. Rear seal
23. Crankshaf
24. Main bearing cap
25. Main bearing
26. Thrust bearing
27. Connecting rod cap
28. Oil pan
29. Oil strainer
30. Connecting rod bearing

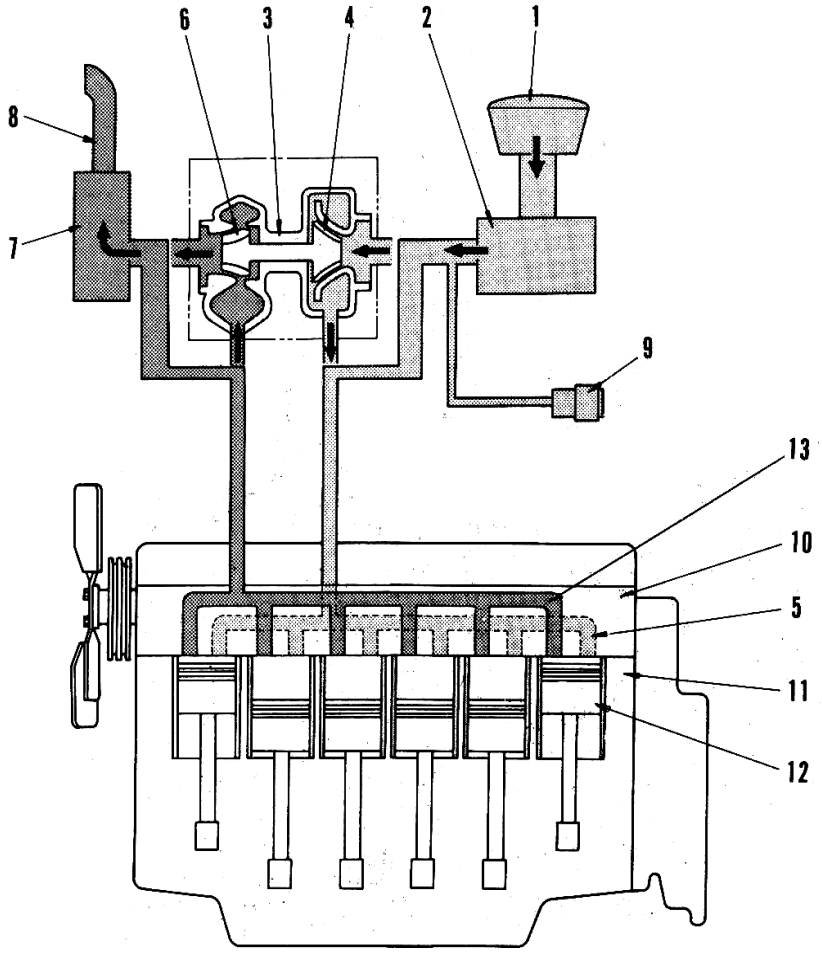


31. Front plate
32. Crankshaft gear
33. Front cover
34. Front seal
35. Vibration damper
36. Crankshaft pulley
37. Oil pump drive crank gear
38. Idler gear
39. Camshaft
40. Camshaft gear
41. Fan
42. Water pump
43. Nozzle holder
44. Ribbon heater
45. Intake manifold
46. Fuel injection pipe
47. Coil heater
48. Fuel filter
49. Fuel injection pump
50. Feed pump
51. Oil pump
52. Muffler
53. Exhaust manifold
54. Piston top ring
55. Piston second ring
56. Piston oil ring
57. Oil filter
58. Starting motor
59. Dipstick

INTAKE AND EXHAUST SYSTEM

INTAKE AND EXHAUST SYSTEM CHART

BS6D105-1



1. Precleaner
2. Air cleaner
3. Turbocharger (BS6D105)
4. Blower impeller (BS6D105)
5. Intake manifold
6. Turbine impeller (BS6D105)
7. Muffler
8. Exhaust pipe
9. Dust indicator
10. Cylinder head
11. Cylinder block
12. Piston
13. Exhaust manifold

General description

1. Structure of intake and exhaust system

- The intake and exhaust system consists of the precleaner, air cleaner, exhaust manifold, muffler and exhaust pipe. The intake manifold is built-in as a part of the cylinder head.
- BS6D105-1 ENGINE have turbocharger.

2. Circulation of intake

- The air intake is first filtered through the precleaner to remove large dust particles after which it is cleaned of fine dirt and dust by the air cleaner. The air is then charged into the engine.
- In case of turbocharger type engine, afte filter through the air cleaners, th air intake is charged into the cylinders under pressure by the blower impellers in the turbocharger.

3. Functions of dust indicator

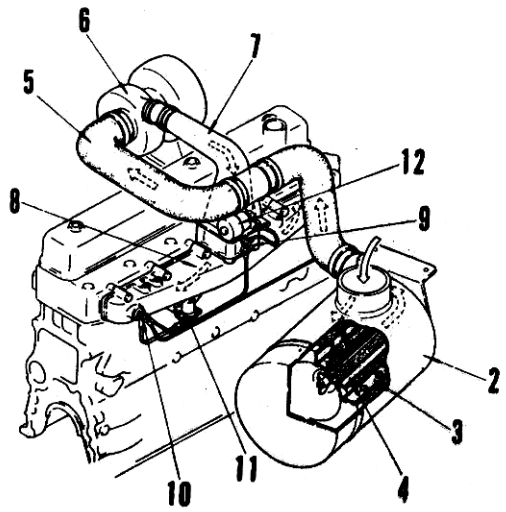
- After filtered through the air cleaner, the negative intake air pressure is transmitted to the dust indicator on the operator's instrument panel. Thereby, the clogged condition of the air cleaer can be sensed by the operator in his seat.
- **Dust indicator** is actuated (gives a red warning mark) when the negative air pressure reaches 635 mm (water column).

4. Circulation of exhaust

- Gases produced by the combusions in the cylinders pass through the exhaust manifold, silenced by muffler, and expelled from the exhaust pipe.
- In case of turbocharger type engine, gases passed through the exhaust manifold are charged into muffler after driving the turbine impellers (the blower impellers).

BS6D105-1 INTAKE SYSTEM

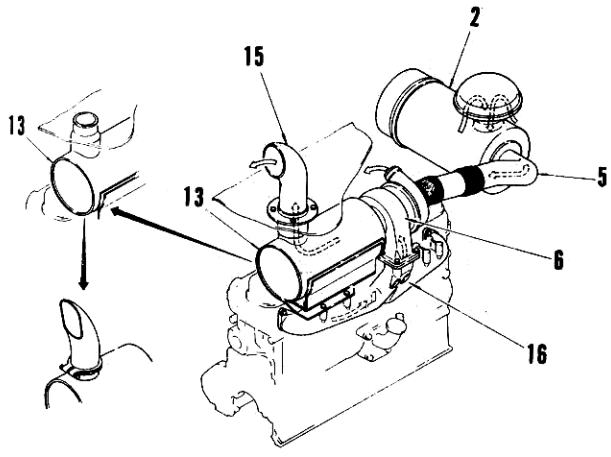
For BE220-1, BE220LC-2



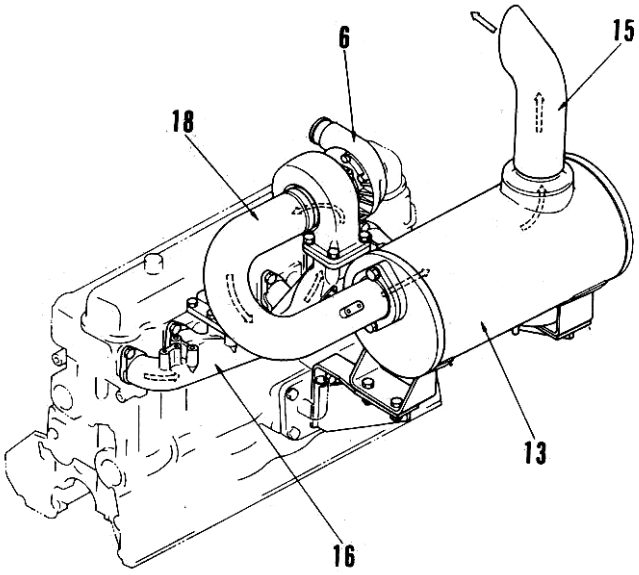
2. Air cleaner body
3. Outer element
4. Inner element
5. Intake pipe
6. Turbocharger
7. Intake pipe
8. Intake manifold
9. Electrical intake air heater
10. Coil heater
11. Relay switch
12. Dust indicator

BS6D105-1 EXHAUST SYSTEM

For BE220-1, BE220-2, BE220LC-2 BE100-2, BE125-1

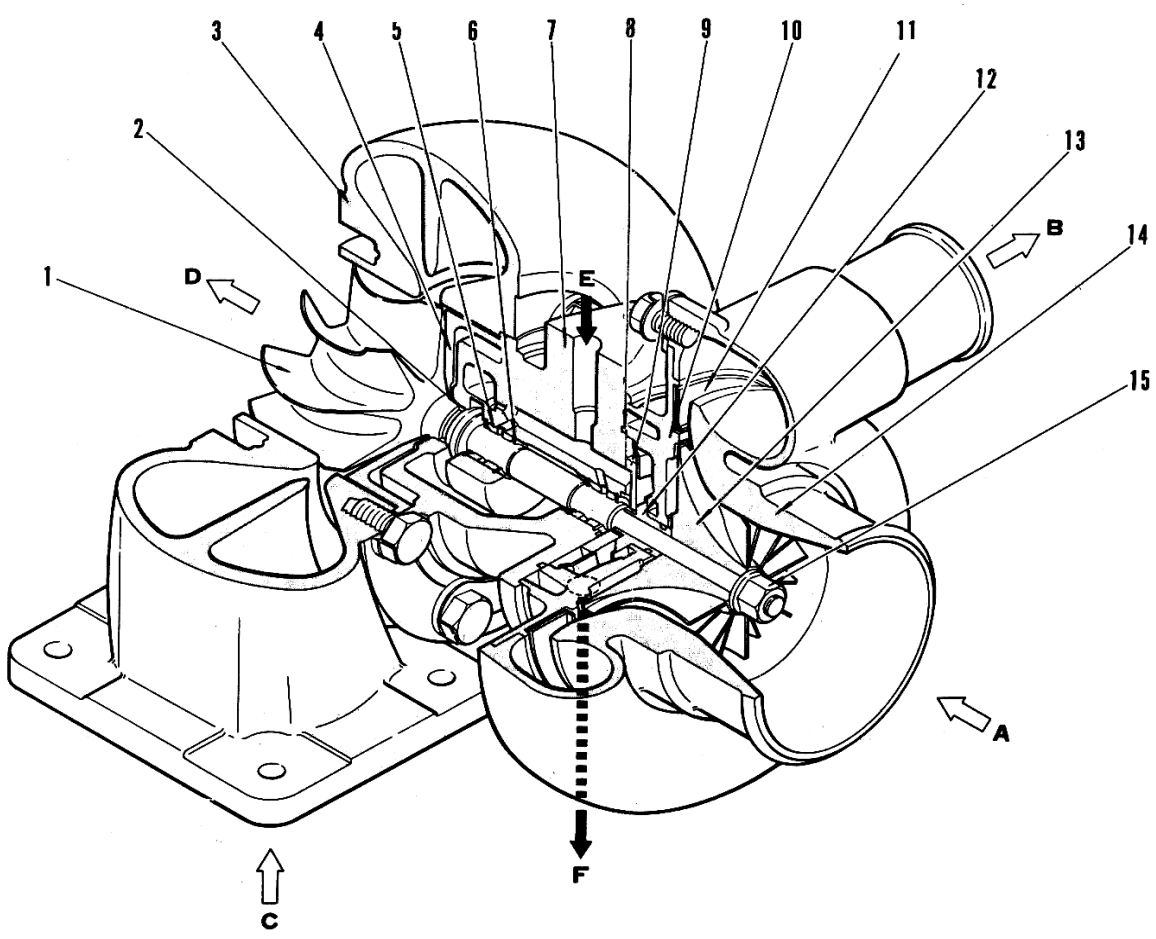


For BE200-3, BE200LC-3, BE220-3, BE220LC-3



2. Air cleaner body
5. Intake pipe
6. Turbocharger
13. Muffler
15. Exhaust pipe
16. Exhaust manifold
18. Exhaust connector pipe

TURBOCHARGER



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

A. Air inlet port
B. Air outlet port
C. Exhaust inlet port
D. Exhaust outlet port
E. Oil inlet port
F. Oil outlet port

Structure :

- The turbocharger for BS6D105 type engine is the type T04B.
- The turbocharger consists mainly of the blower housing, blower impeller, turbine housing, wheel shaft and the center housing provided with bearings and seals and forming the lubrication and support section.
- As the rotating components of a turbocharger, a wheel shaft consists of turbine impellers and a shaft integrated together, and blower impellers are forcefitted on the shaft portion opposite to the turbine impellers and fixed positively with lock nuts.
- The blower housing and the center housing and inter connected with ring type V-clamps, while the center housing and the turbine housing are mutually secured with 6 bolts.

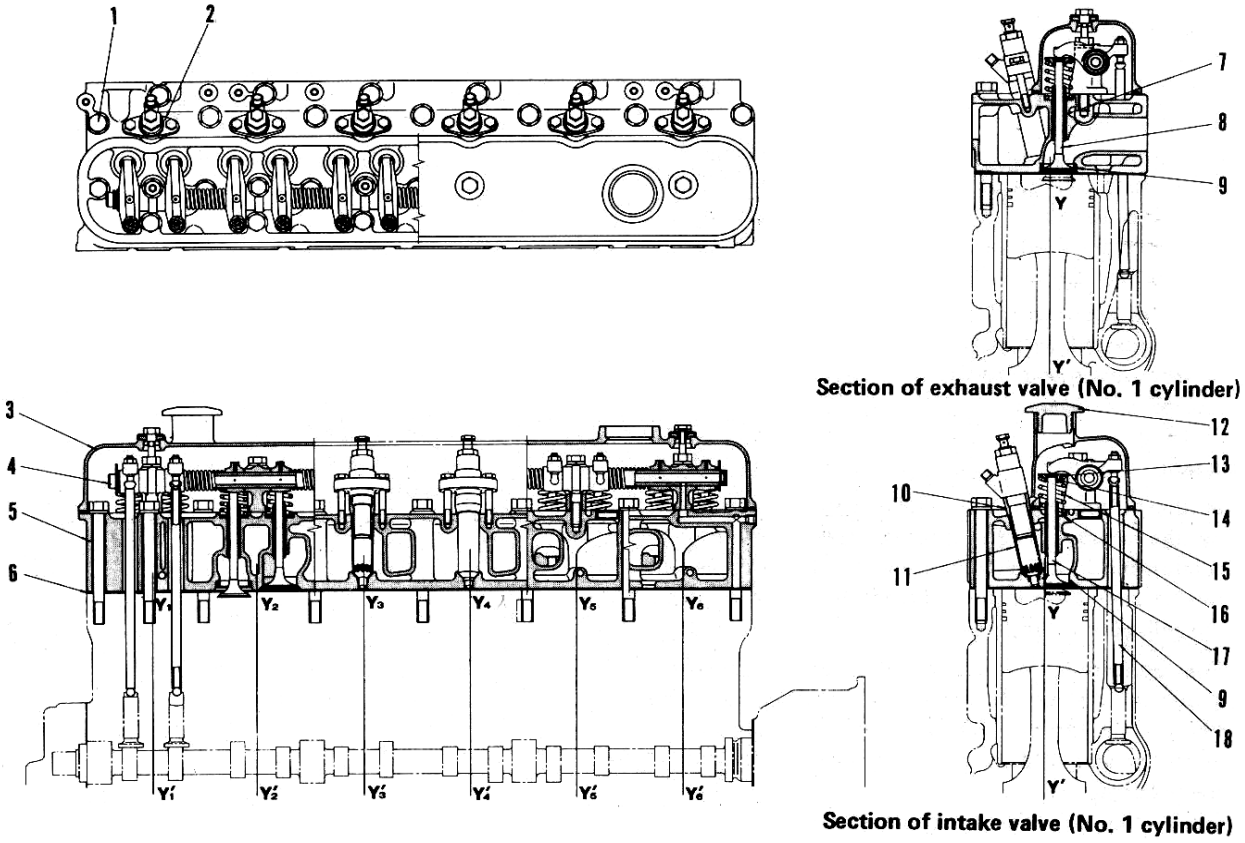
Function :

- In the turbocharger, the turbine impeller is rotated by the energy of the flowing gases poduced by combustion in the cylinders, and the blower impeller on the same shaft in turn charges the intake air into the cylindes under pressure.
- For lubrication, the engine oil is supplied through a hole in the top of the center housing. The oil flows back into the engine oil pan through a hole in the bottom of the center housing after lubricating the bearing.
  Oil in the turbocharger is prevented from leaking out by means of the seals on both sides of the center housing.

Specification :

Item		Specification
Type		NIPPON GARRETT T04B
Overall length	(mm)	225
Overall width	(mm)	195
Overall height	(mm)	150
Weight	(kg)	7.5
Continuous rotating speed	(rmp)	125,000 (max.)
Maximum charge	(kg/min.)	22
Compression ratio		3 (max.)
Appropriate (°C) exhaust temp.		675 max. (at inlet port)
Direction of rotation		Clockwise as viewed from the blower side

ENGINE BODY
CYLINDER HEAD



1. Cylinder head mounting bolt
2. Nozzle holder
3. Head cover
4. Rocker arm shaft
5. Cylinder head
6. Cylinder head gasket
7. Valve guide
8. Exhast valve
9. Valve seat
10. Nozzle holder packing
11. Nozzle holder sleeve
12. Oil filler cap
13. Valve spring guide
14. Valve cotter
15. Valve spring
16. Valve spring seat
17. Intake valve
18. Push rod

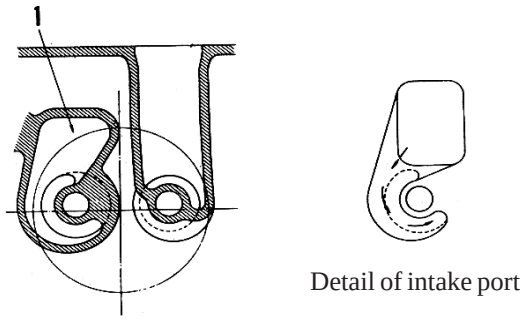
Y - Y' : Center of cylinder

Structure :

1. Cylinder head

- The cylinder head is provided with the following. features, for the smooth flow of the intake air and exhaust, as well as, for the satisfactory mixing of fuel and air;by imparting a swirling motion.

1) One intake air port and one exhaust port are provided separately for each cylinder with a large space between the valves.
2) The intake air port (1) is shaped as a spiral as shown below.



Section of intake and exhaust ports

Detail of intake port

- Furthermore, the cylinder head is designed to prevent the concentration of thermal and mechanical stresses.

1) Edges are eliminated from the machine parts.
2) The intake and exhaust valves are positioned alternately for the uniform distribution of heat on the heads underside surfacc.
3) The flow of cooling water surrounding the injection nozzles, exhaust ports, where the temperature is liable to rise a marked degree, is forced to flow fast by means of guide tubes (directors).

2. Intake and exhaust valve

- Valve inserts with high heat and wear resistant qualities are force fitted into the seats for the intake and exhaust valve.

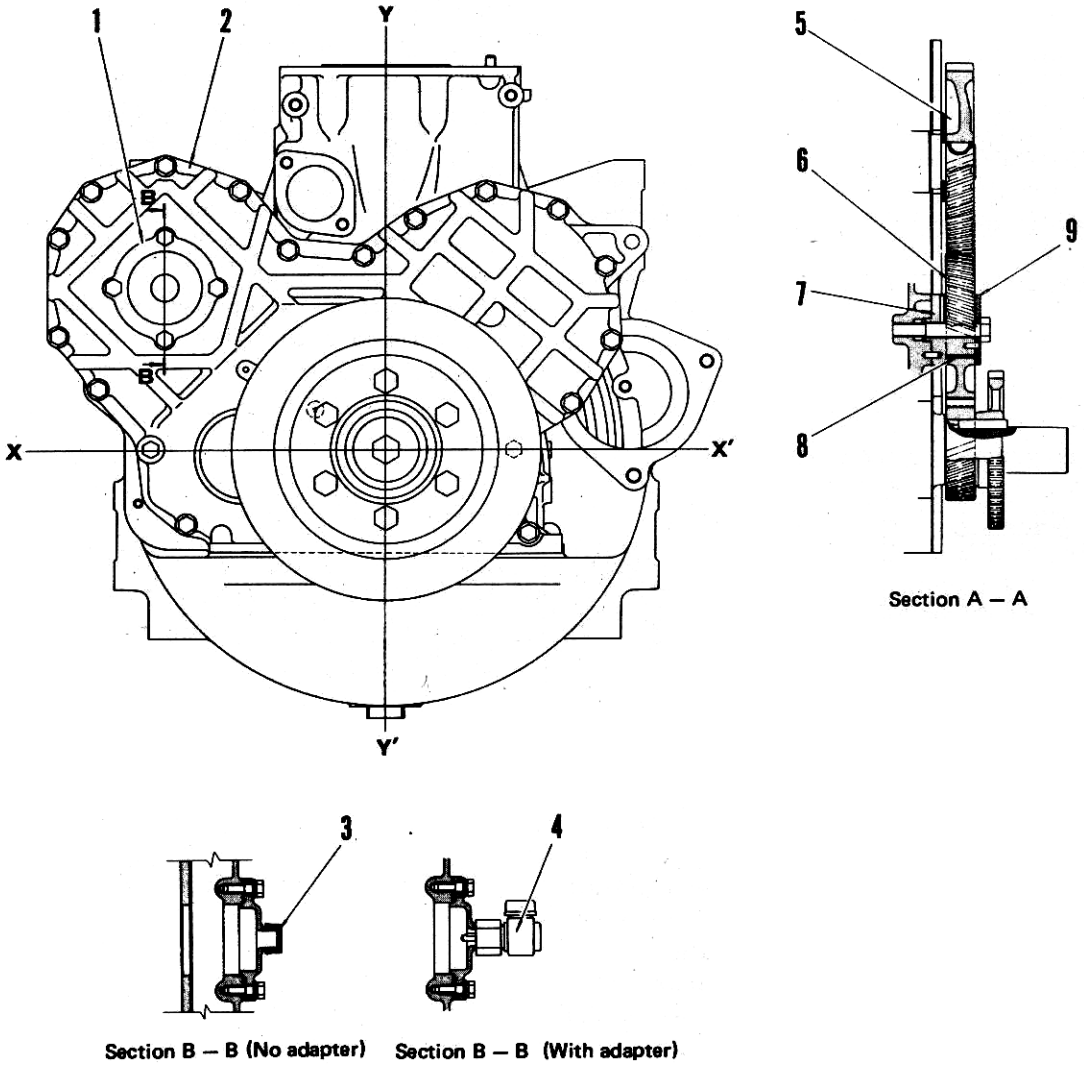
3. Valve seat insert

- When the valve seats have worn out excessively, only the inserts need to be replaced, eliminating the necessity of replacing the heads.

4. Cylinder head gasket

- The cylinder head gasket comprises top the bottom sheets of steel with interlocking claws, and containing a sheet of asbestos rubber adhered to the inside face of the sheets, to withstand the high pressure and heat.
- The areas surrounding water oil and tappet holes are treated with a special coating to increase their sealing effect.
- Steel wires are inserted around the holes in the cylinders to catch hold of the stainless steel grommets;thereby preventing gas leakage.

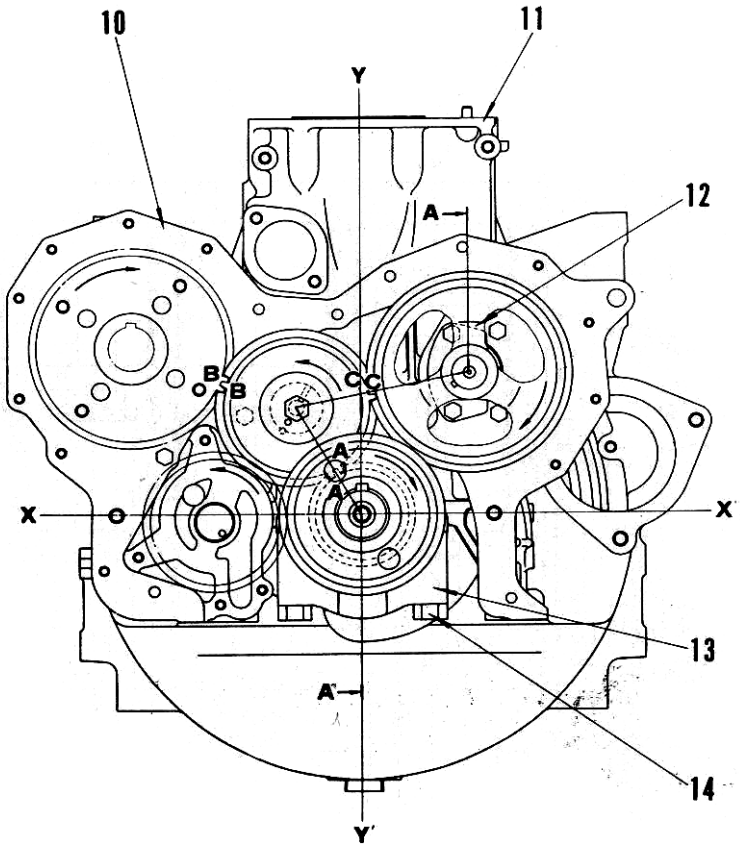
MAIN CIRCULATION PART (1/3)



1. Bearing cover
2. Front cover
3. Cap (for engine speed take out)
4. Adapter (For engine speed take out)
5. Camshaft gear (52 teeth)
6. Idler gear (40 teeth)
7. Idler gear shaft
8. Bushing
9. Thrust plate (for idler gear)
10. Front plate
11. Cylinder block
12. Thrust plate (for camshaft gear)
13. Main bearing cap
14. Main bearing cap bolt

X - X': Center of crankshaft

Y - Y': Center of cylinder



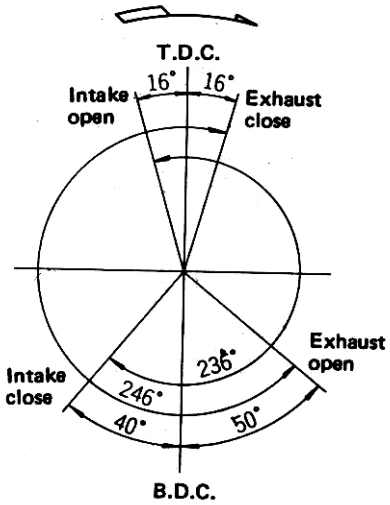
Cylinder block

Crankshaft : 7 bearings
Camshaft : 4 bearings

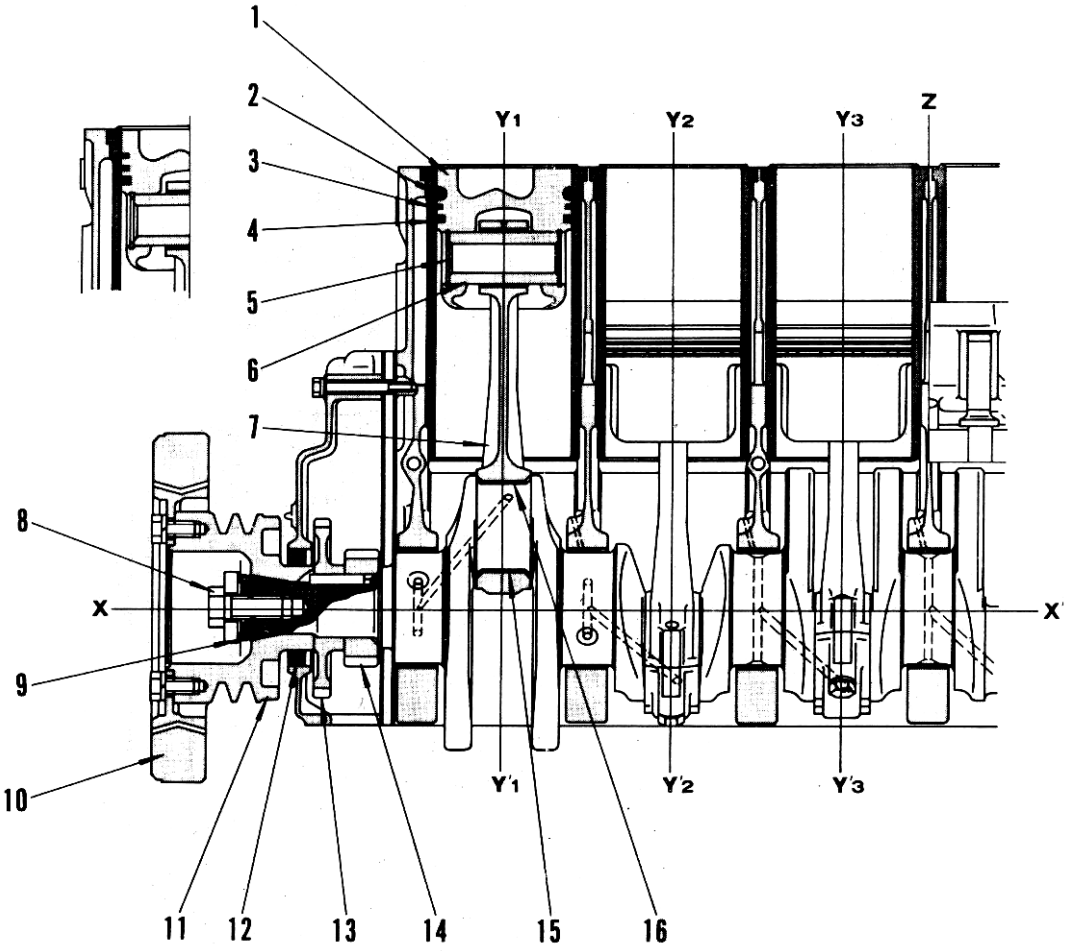
Crankshaft : Stamp forging
High frequency hardening
on journal face

Camshaft : Stamp forging
High frequency hardening
on journal face and cam face

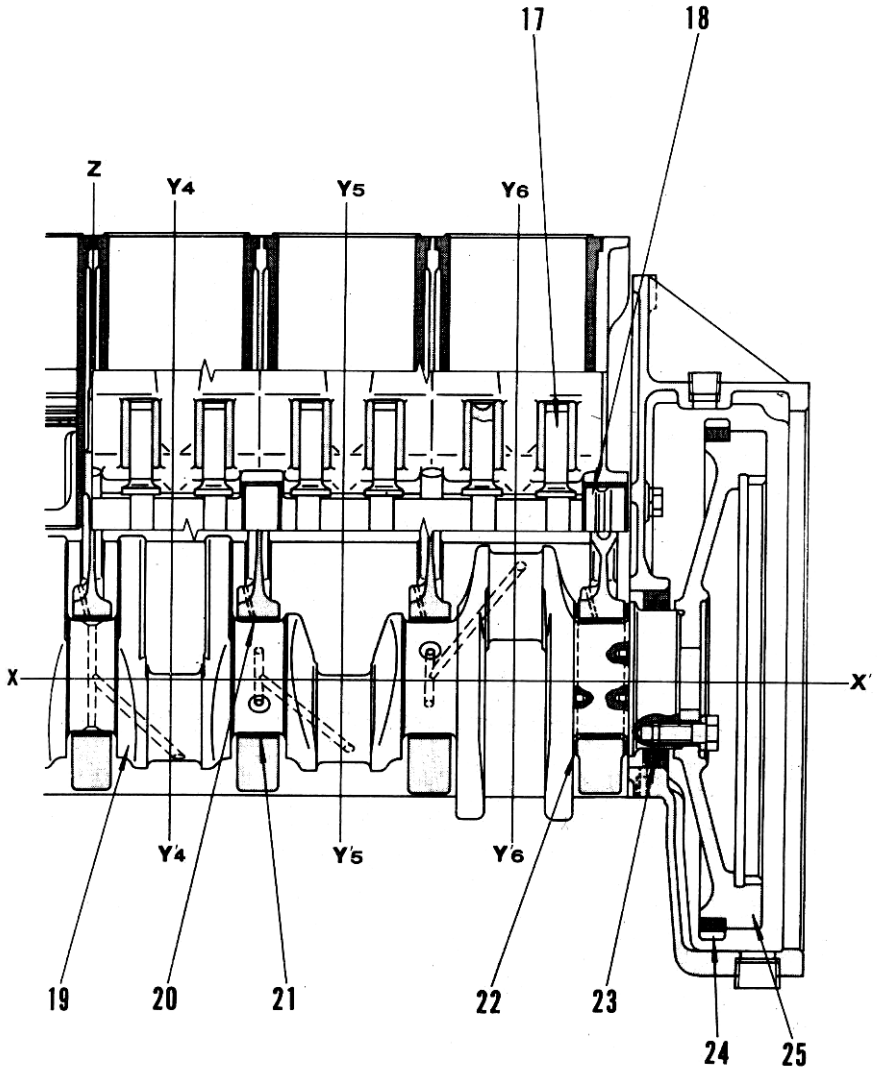
Valve timing



MAIN CIRCULATION PART (2/3)

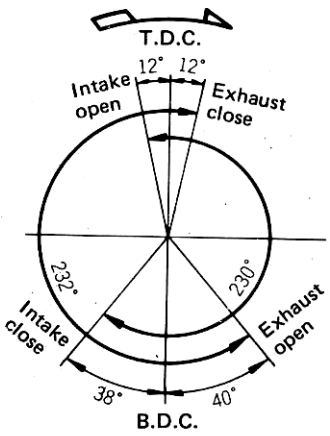


1. Piston
2. Top ring
3. Second ring
4. Oil ring
5. Snap ring
6. Piston pin
7. Connecting rod
8. Crankshaft pulley mounting bolt
9. Tapered collar
10. Vibration damper
11. Crankshaft pulley
12. Front seal
13. Oil pump drive gear (44 teeth)
14. Crankshaft gear (26 teeth)
15. Connecting rod bearing (Lower)
16. Connecting rod bearing (Upper)
17. Tappet
18. Cam shaft
19. Crankshaft
20. Main bearing (Upper)
21. Main bearig (Lower)
22. Thrust metal
23. Rear seal
24. Ring gear
25. Flywheel



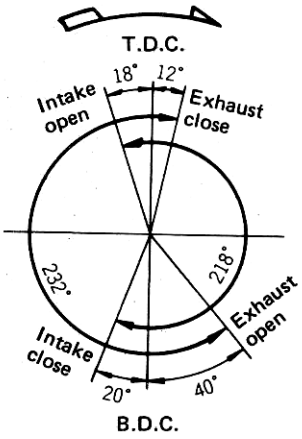
Valve timing

B6D105-1



Valve timing

BS6D105-1



Piston

. Type: Oval taper profile, thermal flow type.

Combustion chamber :
MTCC (Micro Turbulence combustion Chamber) Maelstrom-combustion chamber.

Front seal :
Single lip with dust seal.

Rear seal :
Double lip (for construction equipment)
Single lip (for generator)

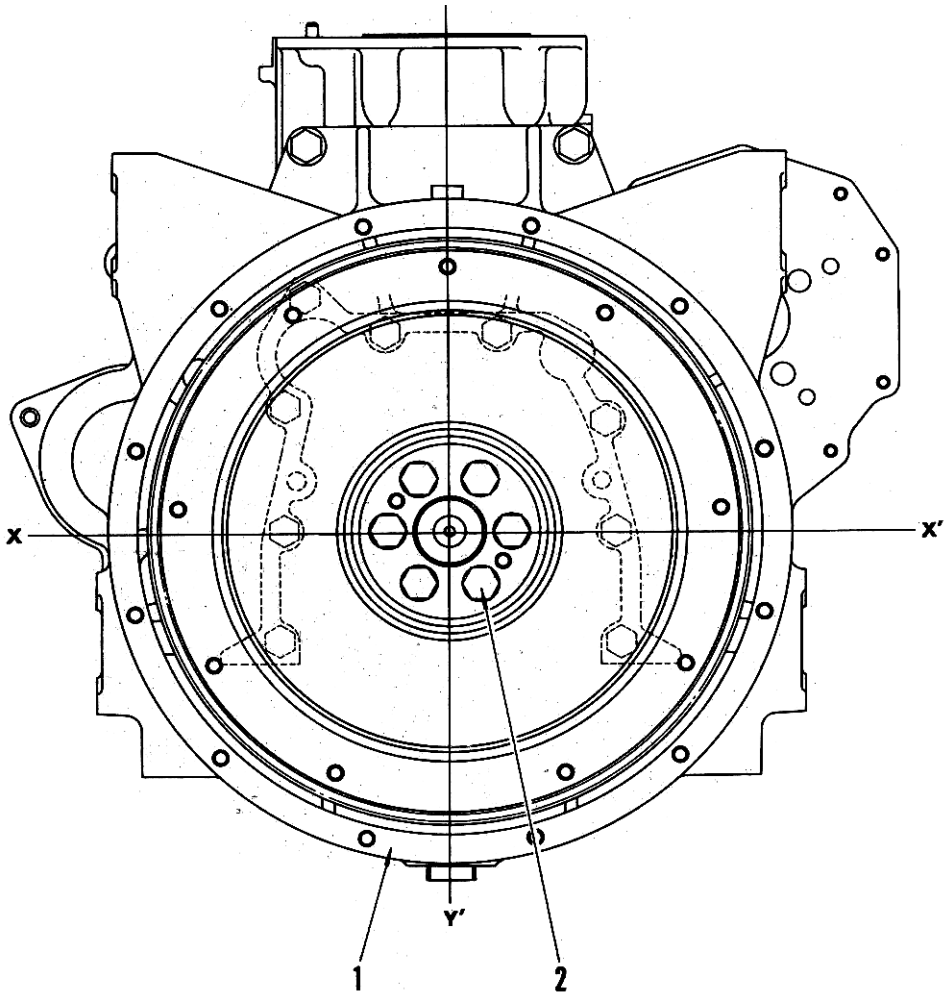
Piston cooling :
Holes on cylinder block for cooling

Piston ring

Engine	Top ring	Second ring	Oil ring
B6D105-1	Flat barrel. Hard chrome plated.	Tapered face. Inner cut.	With coil expander. Hard chrome plated.
BS6D105-1 (Engine No. — ★)	Keystone barrel. Hard chrome plated.	Single keystone tapered face.	With coil expander. Hard chrome plated.
BS6D105-1 (Engine No. ★ —)	Keystone barrel. Hard chrome plated.	Single keystone tapered face.	Coil steel type  With coil expander. Hard chrome plated.

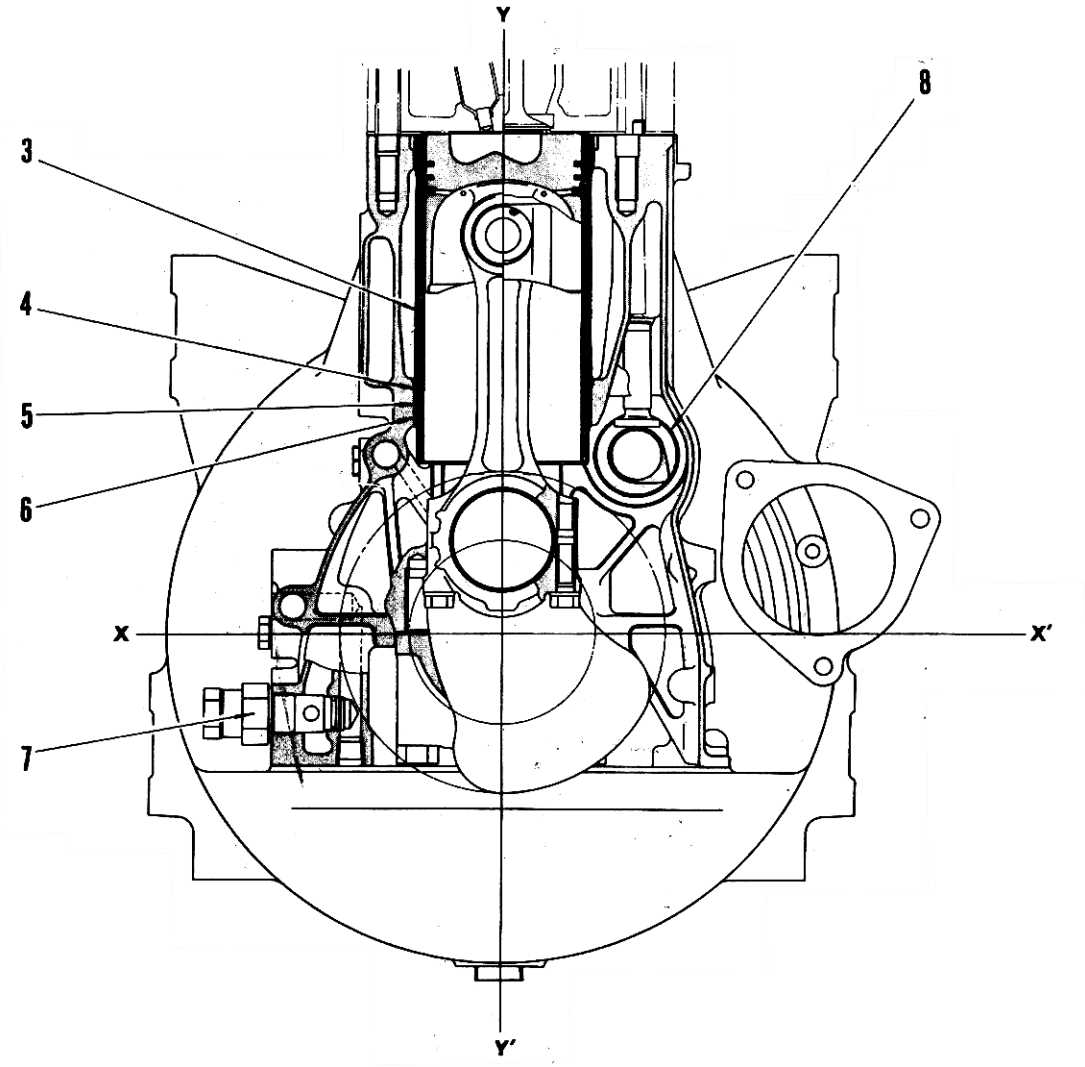
★: Refer to Parts Book for applicable Engine No.

MAIN CIRCULATION PART (3/3)



1. Flywheel housing
2. Flywheel mounting bolt
3. Cylinder liner
4. Crevice seal
5. Liner O-ring (Black)
6. Liner O-ring (Orange)
7. Oil pump regulator valve
8. Camshaft bushing

X - X' : Center of crankshaft
Y - Y' : Center of cylinder



Cylinder liner

Wet type. Inside horning

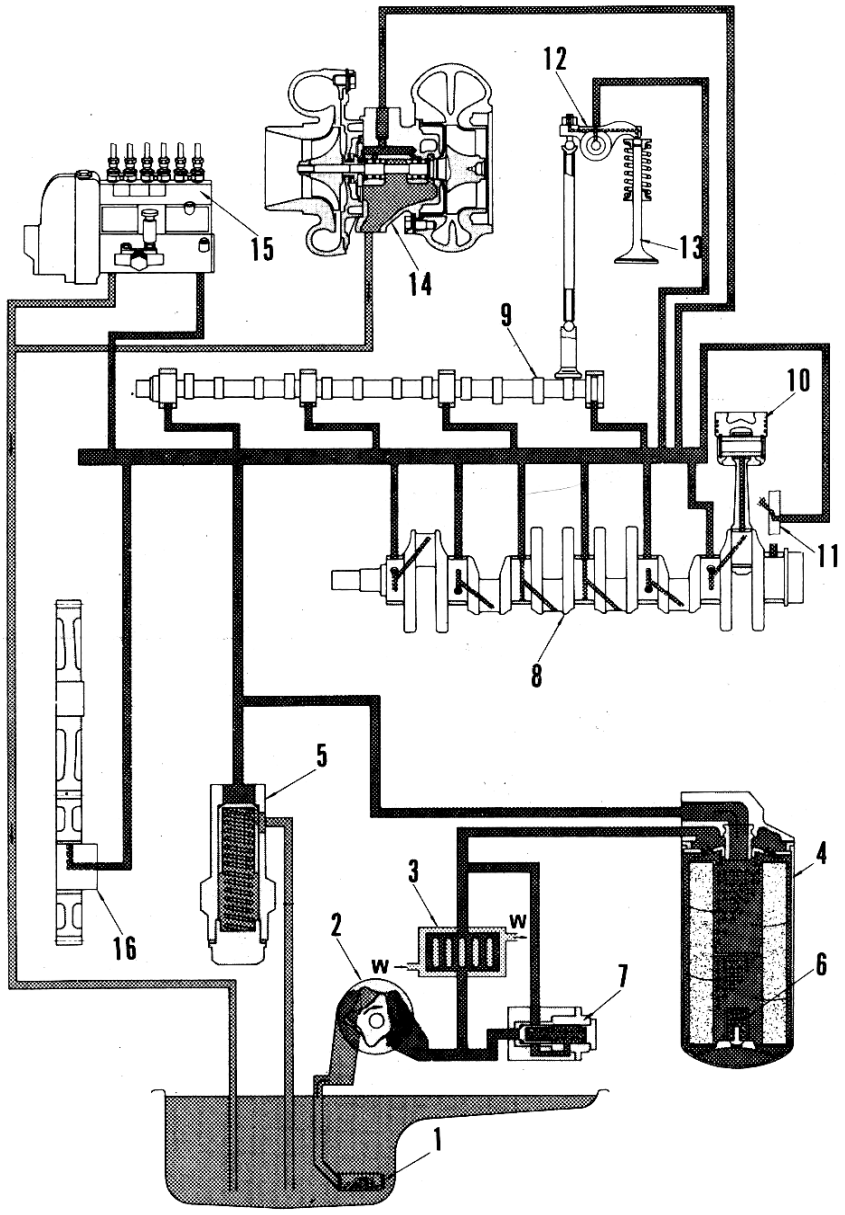
Liner ring

Top : Crevice seal
Center : O-ring (Nitrile rubber)
Lower : O-ring (Silicon rubber)

LUBRICATING SYSTEM

LUBRICATING SYSTEM CHART

B(S)6D105-1



1. Oil strainer
2. Oil pump
3. Oil cooler
4. Oil filter
5. Regulator valve
6. Oil filter safety valve
7. Oil cooler relief valve

7'. Oil cooler thermo valve

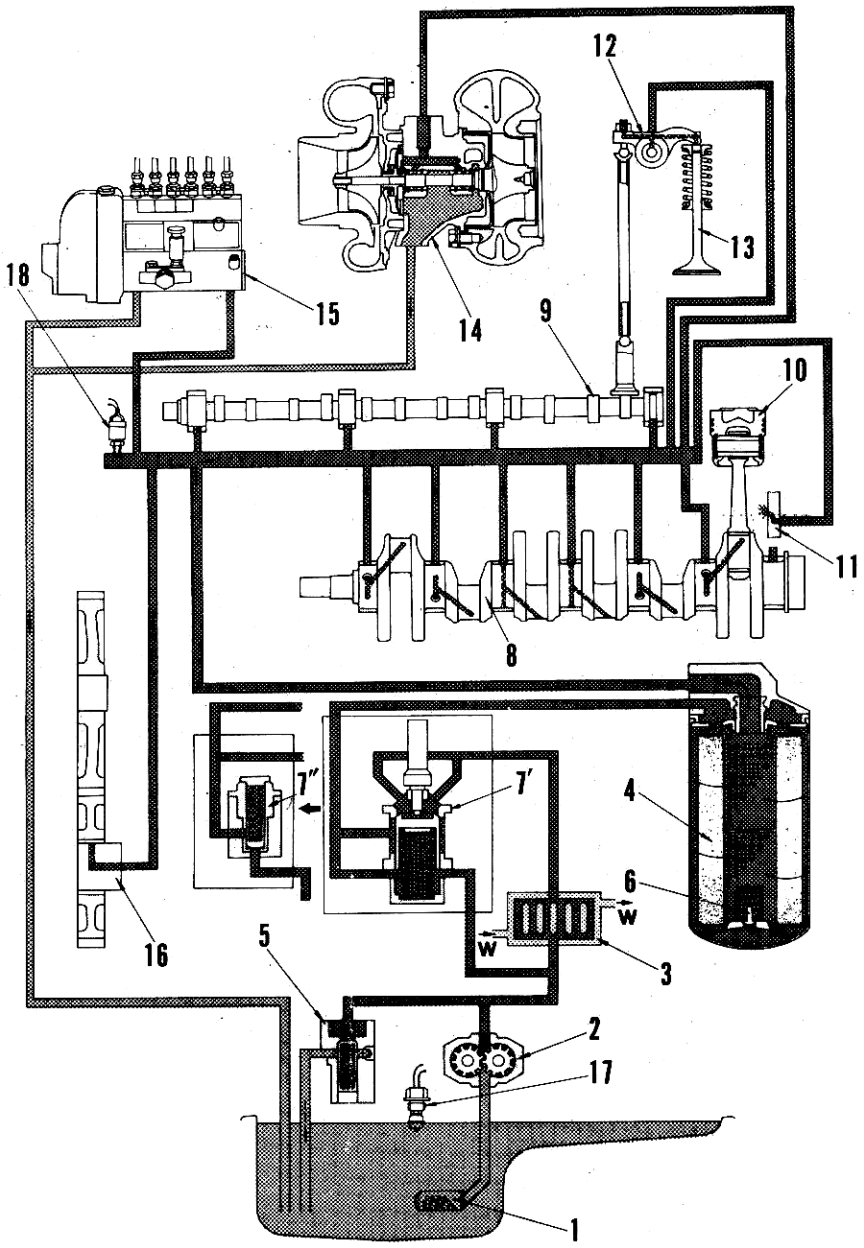
7". Oil cooler relief valve

8. Crankshaft
9. Camshaft
10. Piston
11. Piston cooling
12. Rocker arm
13. Intake or exhaust vavle
14. Turbocharger (BS6D105-1)
15. Fuel injection pump
16. Timing gear

17. Oil level sensor
(For BE200-3,CE220-C
BE200LC-3, BE220LC-3)

17. Oil Pressure sensor
(For BE200-3,CE220-C
BE200LC-3, BE220LC-3)

W. Cooling water



1. Structure of lubricating system

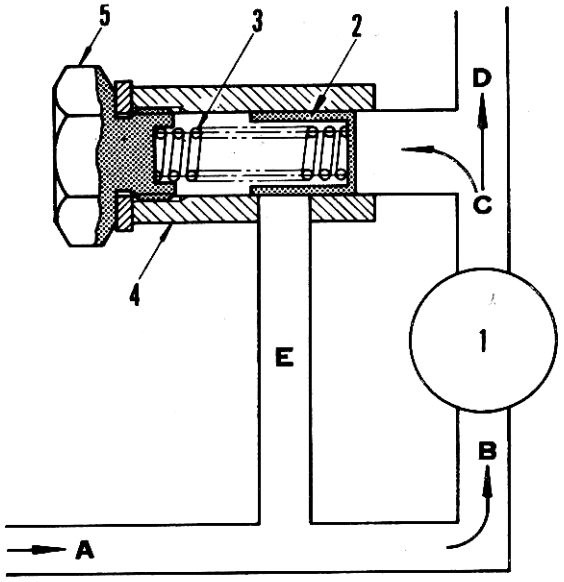
- The lubricating system consists mainly of the oil strainer, oil pump, oil pump regulato, oil coller, oil filter and safety valve to lubricate various engine parts.

2. Circulation of lubricating oil

- The lube oil flows from the oil pan to the oil pump through the oil strainer where relatively large particles of dust, dirt or foreign matter is removed from the oil. The oil pump is driven by the gear in the crankshaft cluster to such in and charge out the oil under pressure.
- The oil discharged from the pump is cleaned fully through the oil filter (**full-flow** type.)
  Thus, the oil is distributed to various lubrication points in the engine.
- The oil is cooled, through heat exchanger with the engine cooling water in the oil cooler.

FUNCTION OF THE OIL PUMP REGULATOR

- The oil pump regulator is provided in the discharge circuit of the main oil pump. To prevent excessive increase in the oil pressure in the lubrication system.
- If the oil pressure rises excessively, the oil pressure on the discharge side (C) will depress the regulator valve (2), opening the return circuit (E), which will, in turn, cause the oil to flow back the the suction side of the pump.

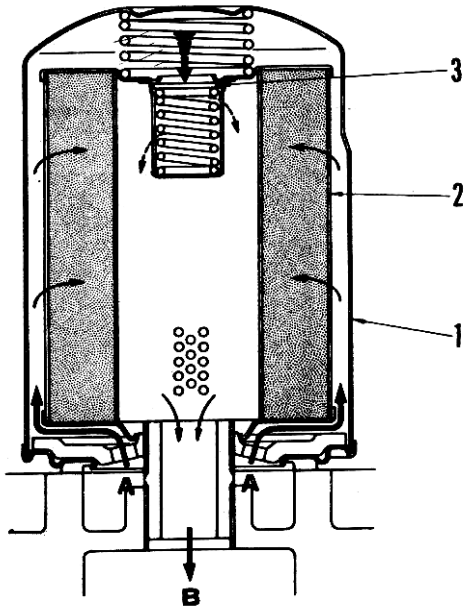


1. Oil pump
2. Regulator valve
3. Valve spring
4. Regulator case
5. Plug

A. From oil pump
B. Oil pump suction side
C. Oil pump discharge side
D. To oil filter
E. Oil return circuit

FUNCTION OF THE SAFETY VALVE

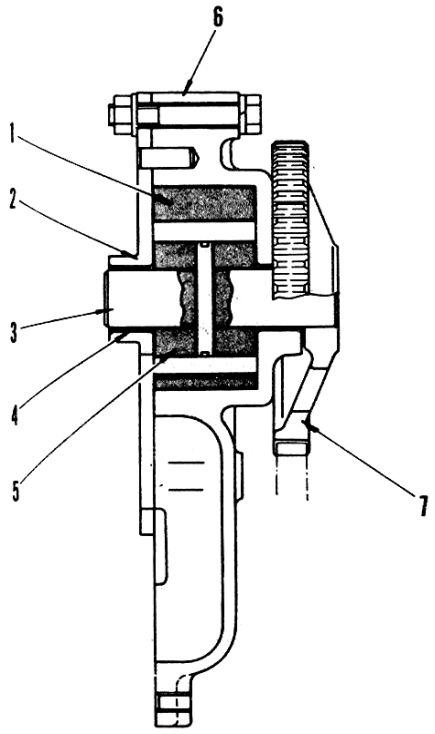
- In the lubrication circuit, a safety valve is provided in the filter in addition to the oil pump regulator to prevent the interruption of oil flow to the lubricating points due to the clogged oil filter.
- The safety valve is actuated by the pressure difference at the in and out side of the oil filter.
- In the element (2) of the oil filter (1) is clogged, the pressure deference between outside and inside of the filter element will be larger, pushing in the valve (3), which will in turn, casue the oil discharged from the oil pump (A) to flow directly to various engine parts (B), not by-passing the filter element.

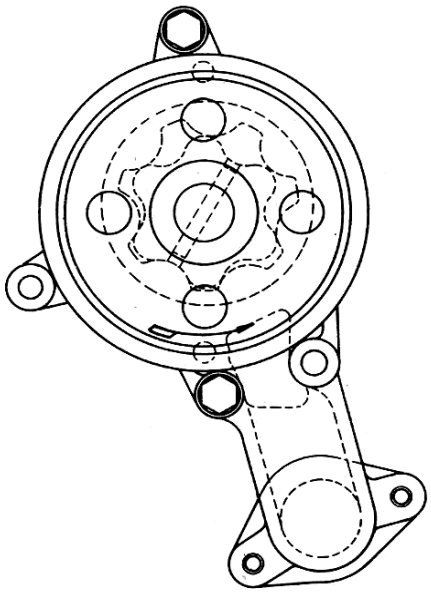


1. Oil filter
2. Filter element
3. Safety valve

A. From oil pump
B. To various engine parts

OIL PUMP





1. Outer rotor
2. Pump cover
3. Pump shaft
4. Bushing
5. Inner rotor
6. Pump body
7. Drive gear (38 teeth)

Oil pump

Type: Trochoid Pump
Pump speed: Engine speed x 1.158

Front oil seal

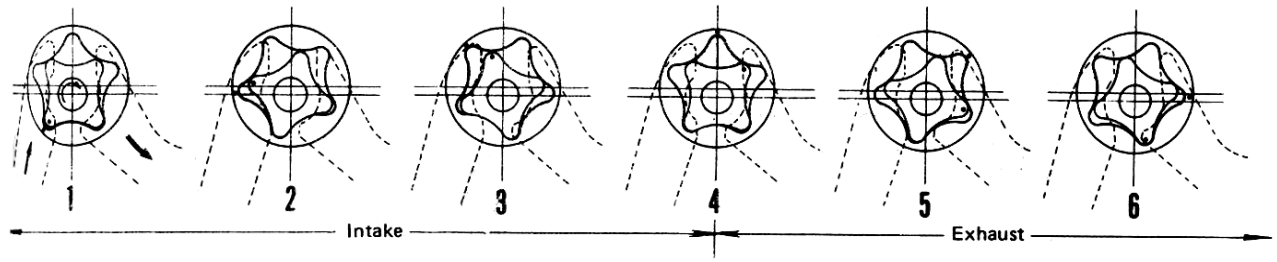
Single lip with dust seal

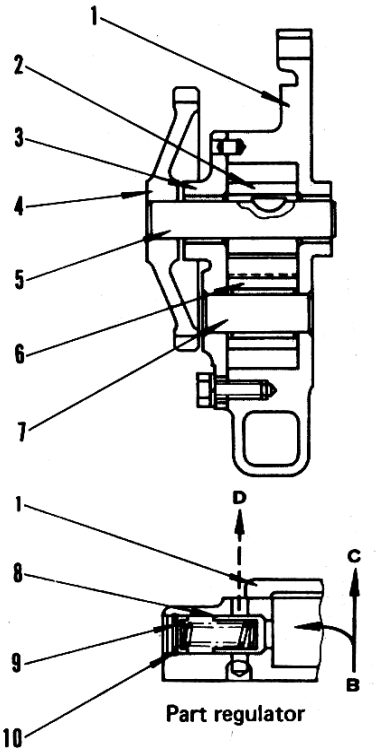
Structure

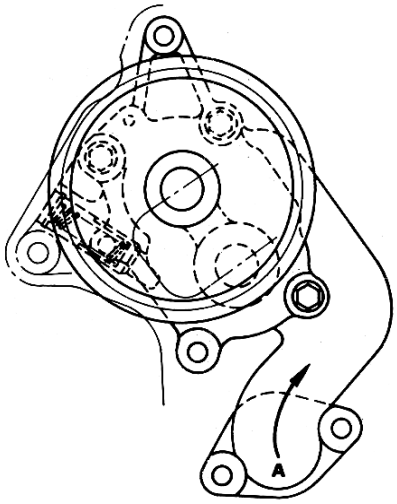
- Oil pump is installed in the engine front cover.
- The drive gear is attached at the rear end of the rotor shaft of the oil pump and is in gear with the drive gear at the front side of the crankshaft.

Function

- The inner rotor (1) of a trochoid pump is rotated together with the rotor shaft (3). The number of teeth in the inner rotor is one less than the outer rotor (2). Both rotors rotates in the same direction with their respective centers set off.
- The oil is sucked into the pump when the tooth clearance between the inner and outer rotors is extended. The oil is discharged when the tooth clearance becomes smaller.







1. Oil pump body
2. Drive gear
3. Pump cover
4. Pump drive gear (38 teeth)
5. Drive shaft
6. Driven gear
7. Driven shaft
8. Regulator valve
9. Valve spring
10. Valve retainer

A. From oil strainer
B. From oil pump
C. To engine each section
D. To oil pan

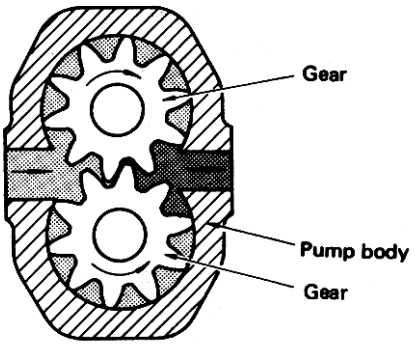
Oil pump

Type: Gear Pump
Pump speed: Engine speed x 1.158

Regulator valve

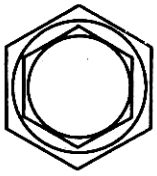
Cracking pressure : 6.5± 0.5 kg/cm²

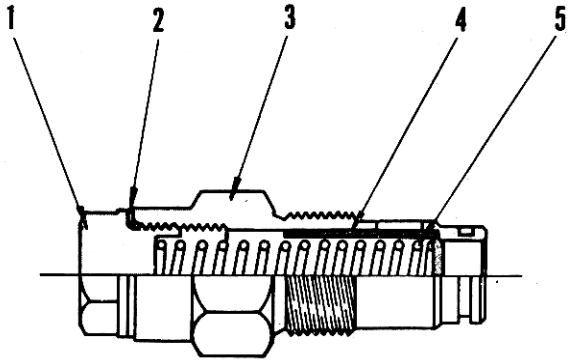
Function



- The gears rotate in the direction shown by arrow so that the vacancy enclosed with each gear and pump body is filled with oil.
- The enclosed oil is moved along the pump body wall toward the pump outlet with rotation of the gear.
- On the oil outlet side, two gear are meshed with each other to eliminate clearance, thus forcing the oil to go out of the outlet port.

REGULATOR VALVE

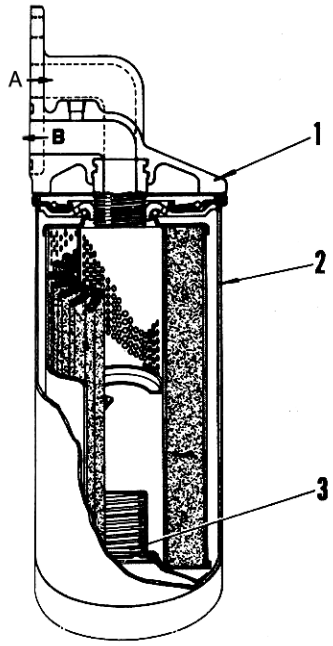


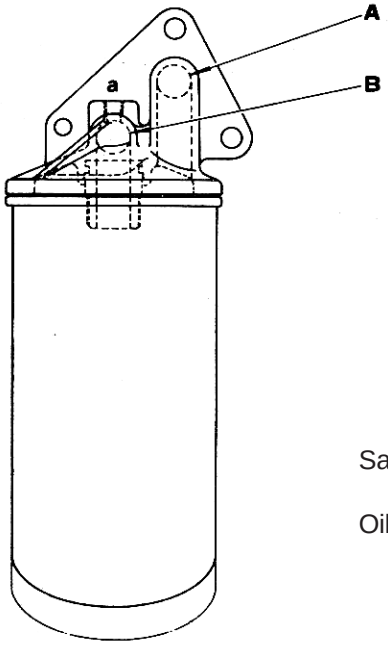


1. Nut
2. Shim
3. Valve body
4. Valve
5. Valve spring

Regulator valve
Cracking pressure: 8.25 to 8.75 kg/cm²

OIL FILTER (with safety valve)



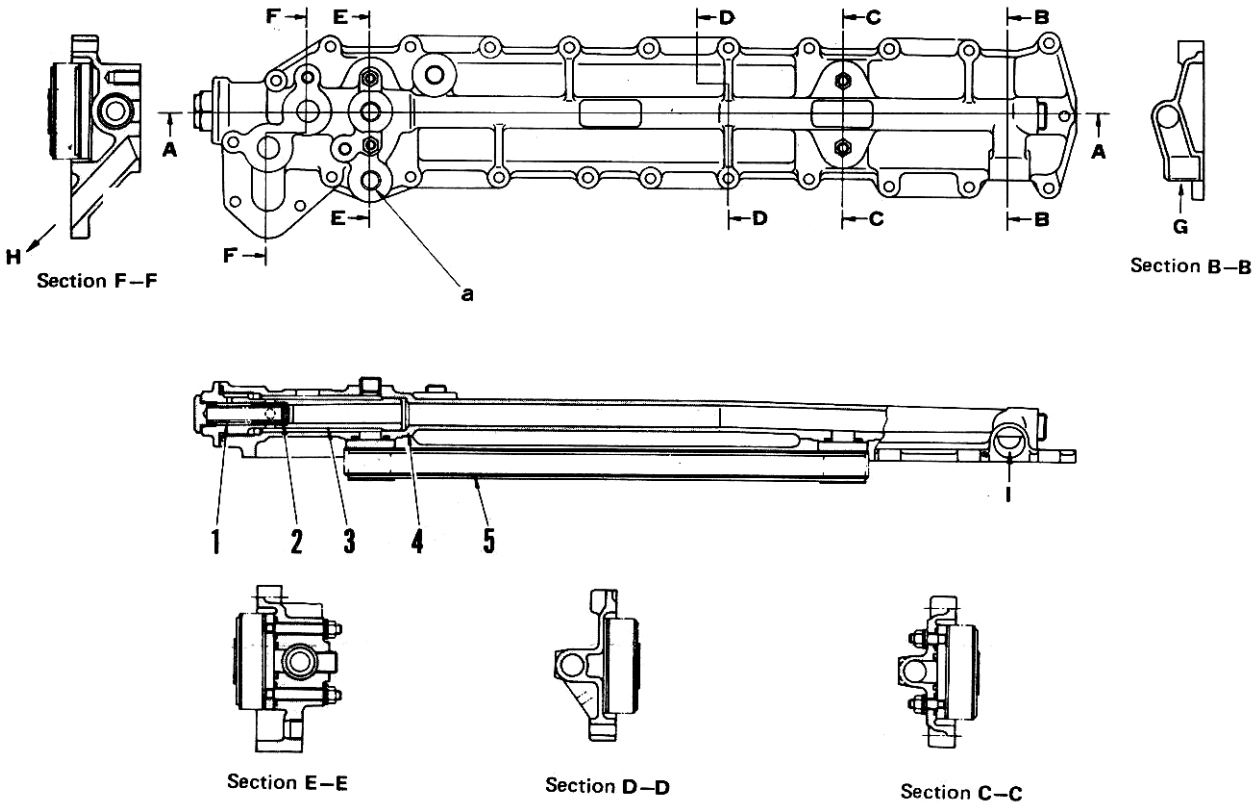


1. Filter bracket
2. Cartridge

A. From oil pump
B. To engine each section
a. Oil pressure tap

Safety valve cracking pressure
: 1± 0.2 kg/cm²
Oil filter effective area : 0.5 m²

OIL COOLER



1. Valve spring
2. By-pass valve
3. Valve case
4. Cooler cover
5. Cooler element

G. From oil pump (oil)

H. To engine each section (oil)

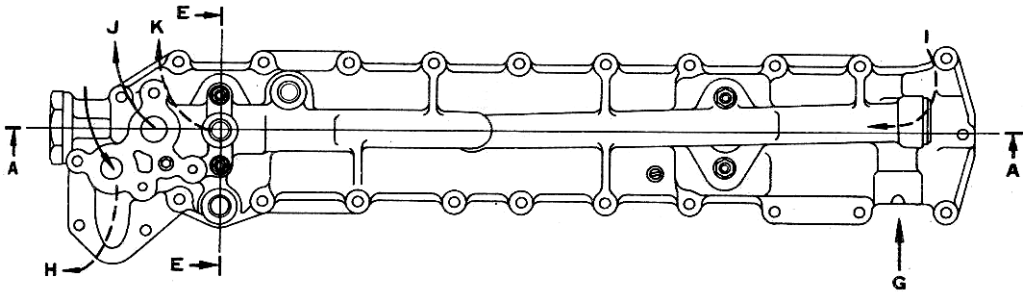
I. From water pump (Water)

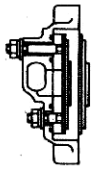
a. Water drain port

Oil cooler by-pass valve
Cracking pressure : 4± 0.2 kg/cm²

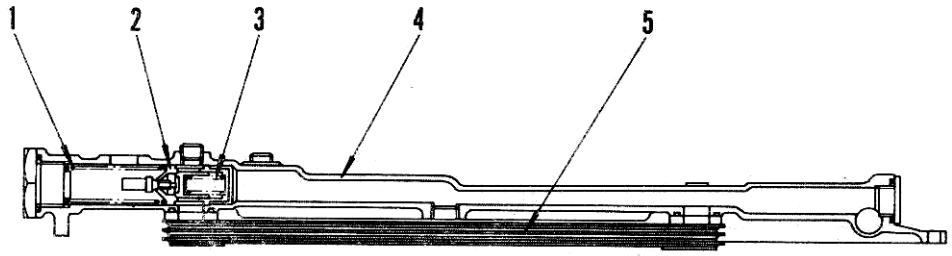
Structure and function

- The oil cooler consists of element and cover. The oil flowing through the cooler element with the cooling fin is cooled properly by the engine cooling water flowing outside the element.

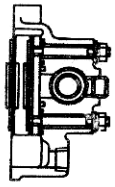




Section B–B



Section A–A



Section E–E

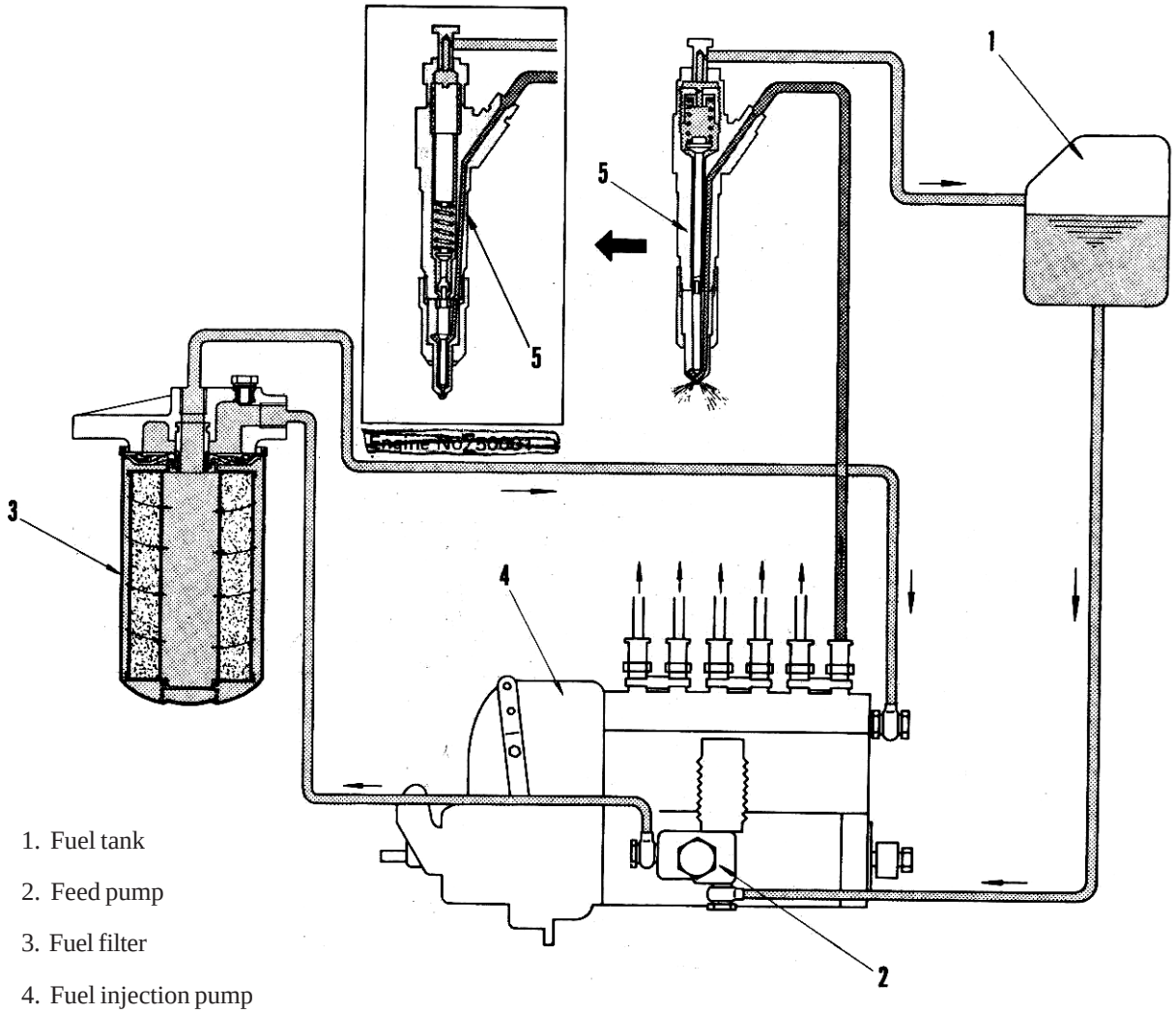
1. Spring
2. Thermo valve
3. Valve spring
4. Cooler cover
5. Cooler element

G. From oil pump (oil)
H. To engine each section (oil)
I. From water pump (Water)
J. To oil filter (Oil)
K. To engine each section (Water)

Oil cooler thermo valve

- Valve opening temperature : 104° C
- Temperature when fully open : 110° C
- Lift when fully open : 5 mm min.

FUEL SYSTEM
FUEL SYSTEM CHART



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

GENERAL DESCRIPTION

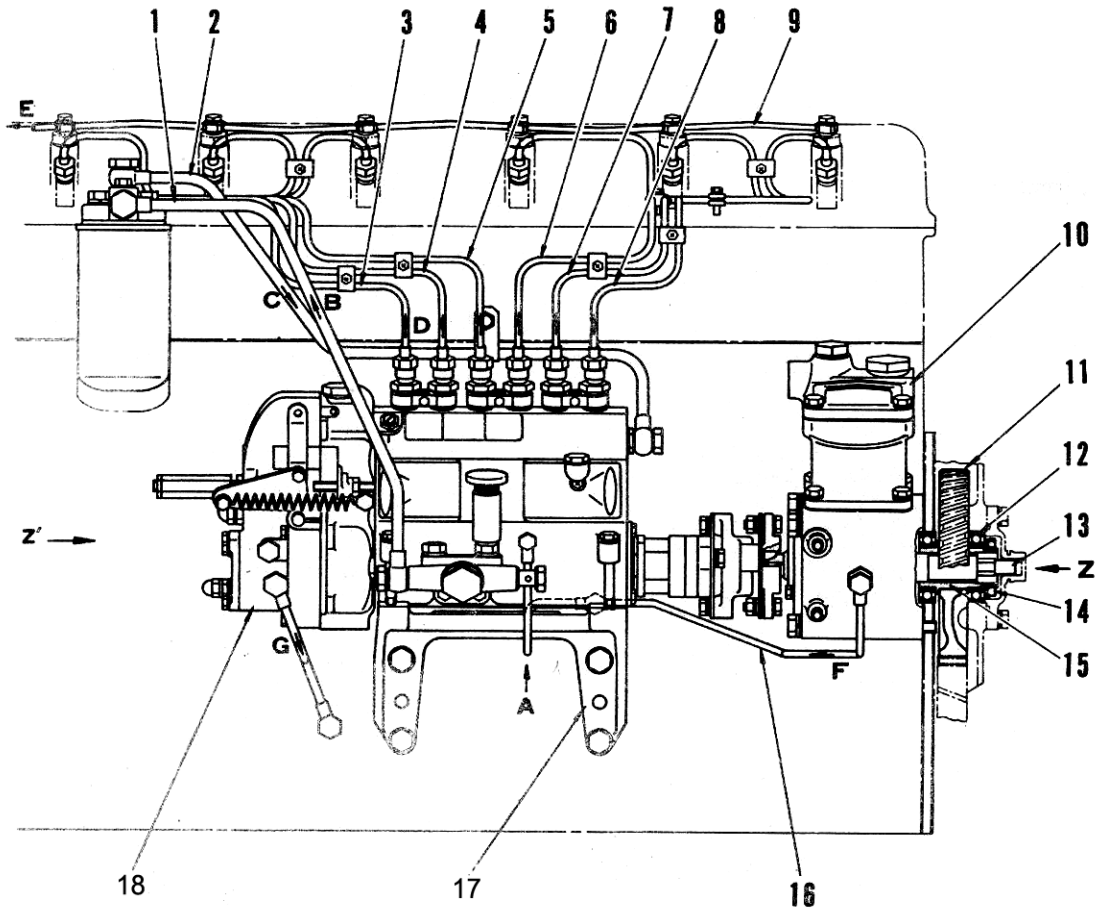
1. Structure and function

. The Fuel system consists mainly of the fuel tank, feed pump, fuel filter, fuel injection pump, fuel injection nozzles and governor (built as one unit with the fuel injection pump).

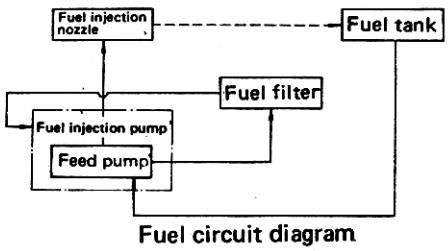
2. Circulation of fuel

1) Fuel isdelivered from the fuel tank to the injection pump though the fuel filter by the feed pump driven by the fuel injection pump cam. During the course from the tank to the injection pump, the fuel is cleaned of rough dirt through the gauge filter at the inlet to the feed pump. Then, complete dust removal and water sepa ration from the oil are accomplished through the filter.
2) Fuel entering the injection pump is pressurized by the pump plunger to that required for injection and injected into each cylinder through the injection nozzle timing for the cylinder.

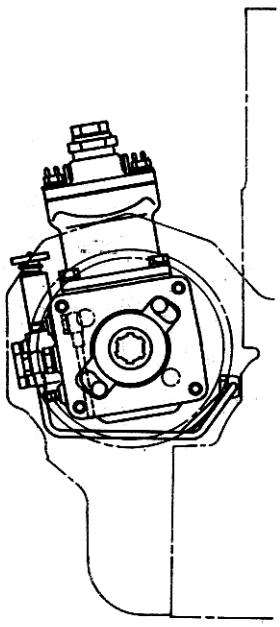
FOR CONSTRUCTION EQUIPMENT

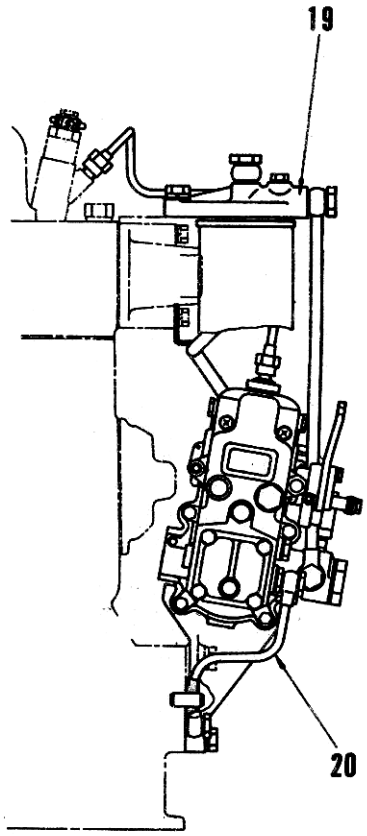


1. Fuel hose (Filter inlet)
2. Fuel hose (Filter outlet)
3. Fuel injection pipe (No. 6)
4. Fuel injection pipe (No. 5)
5. Fuel injection pipe (No. 4)
6. Fuel injection pipe (No. 3)
7. Fuel injection pipe (No. 2)
8. Fuel injection pipe (No. 1)
9. Spill tube
10. Air compressor
11. Fuel injection pump drive gear (52 teeth)
12. Ball bearing
13. Engine speed takeout shaft
14. Lock nut
15. Drive shaft
16. Oil tube (Supply)
17. Pump bracket
18. Fuel injection pump
19. Fuel filter
20. Oil tube (return)



Fuel circuit diagram


Z view



Z' view

A: Form fuel tank (Fuel)

B: From feed pump (Fuel)

C: From fuel filter (Fuel)

D: From injection pump (Fuel)

E: To fuel tank (Fuel)

F: From oil pump (Oil)

G: To oil pan (Oil)

Fuel injection pump

Type : Bosch type PE-A

Lubrication : Forced lubrication

Governor

Type : Bosch RSV, centrifugal, all speed

Fuel injection nozzle

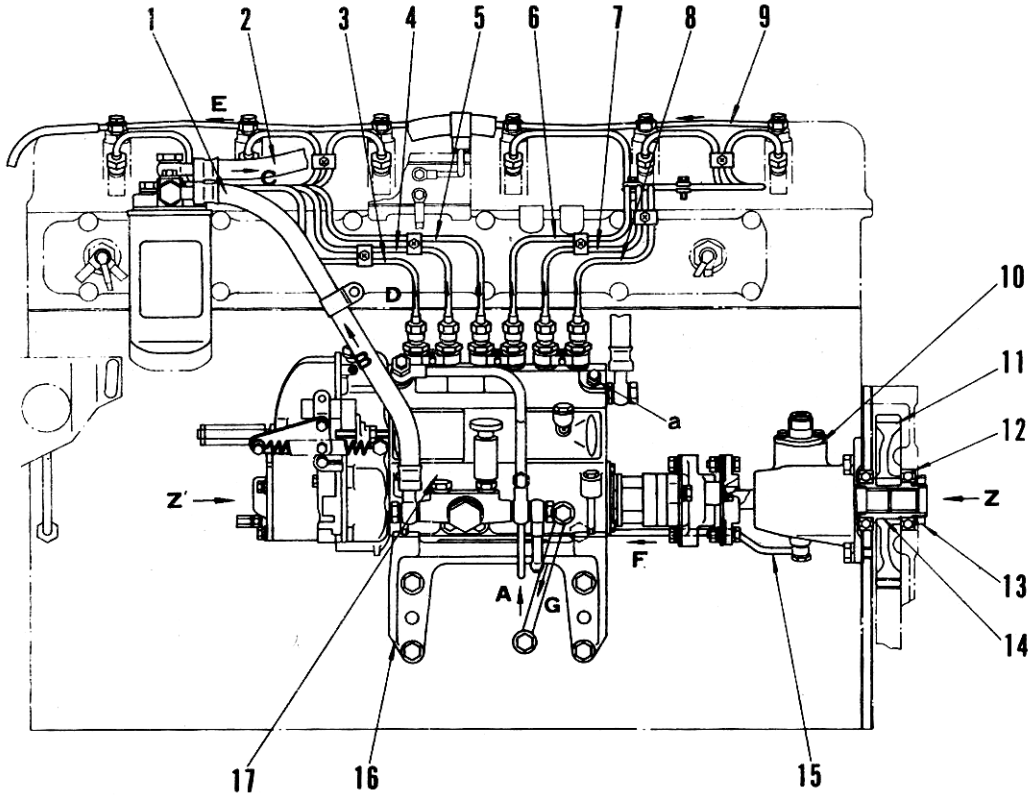
Type : Multiple hole

Injection pressure : 225 kg/cm^2

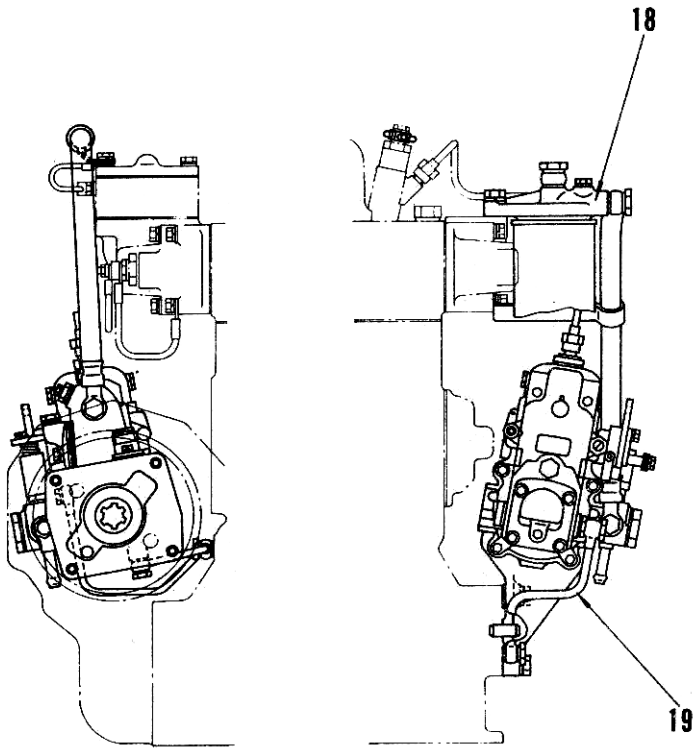
Fuel injection timing

See TESTING AND ADJUSTING DATA.

FOR GENERATOR



1. Fuel hose (Filter inlet)
2. Fuel hose (Filter outlet)
3. Fuel injection pipe (No. 6)
4. Fuel injection pipe (No. 5)
5. Fuel injection pipe (No. 4)
6. Fuel injection pipe (No. 3)
7. Fuel injection pipe (No. 2)
8. Fuel injection pipe (No. 1)
9. Spill tube
10. Injection pump drive gear
11. Fuel injection pump drive gear (52 teeth)
12. Ball bearing
13. Lock nut
14. Drive shaft
15. Oil tube (Supply)
16. Pump bracket
17. Fuel injection pump
18. Fuel filter
19. Oil tube (return)



A: Form fuel tank (Fuel)

B: From feed pump (Fuel)

C: From fuel filter (Fuel)

D: From injection pump (Fuel)

E: To fuel tank (Fuel)

F: From oil pump (Oil)

G: To oil pan (Oil)

a. Air bleeding bolt

Fuel injection pump

Type : Bosch type PE-A

Lubrication : Forced lubrication

Governor

Type : Bosch RSV, centrifugal, all speed

Fuel injection nozzle

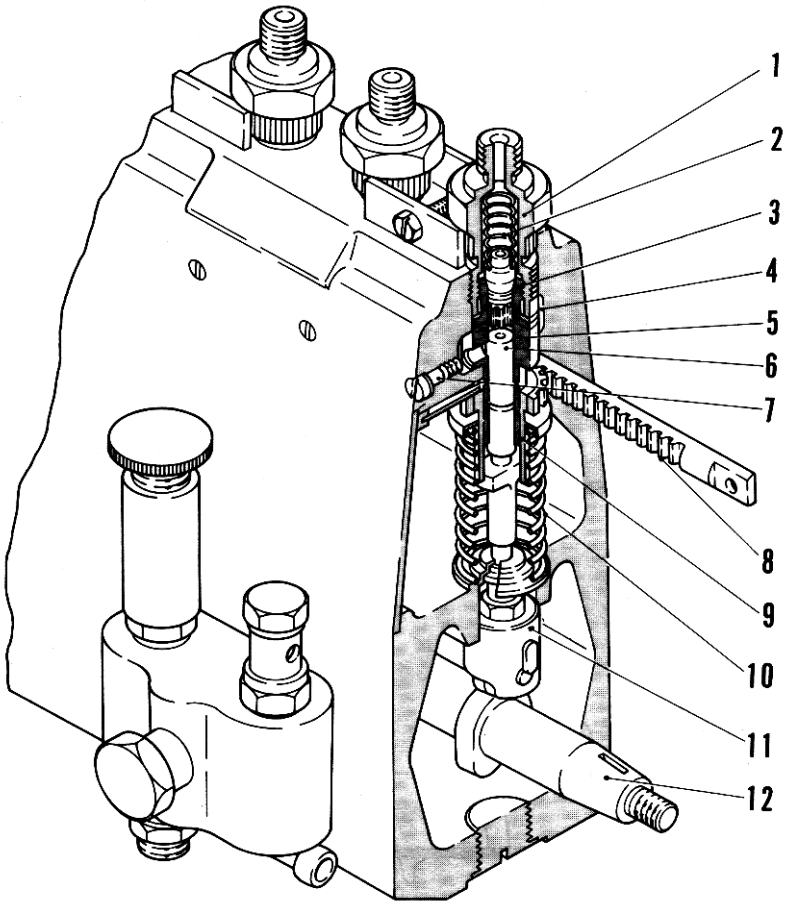
Type : Multiple hole

Injection pressure : 225 kg/cm^2

Fuel injection timing

See TESTING AND ADJUSTING DATA.

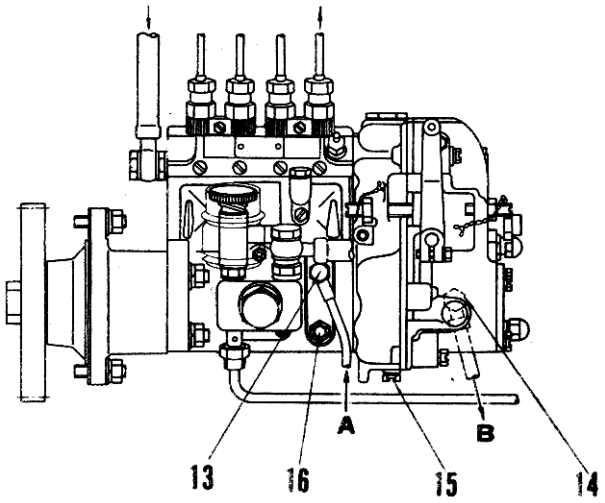
FUEL INJECTION PUMP



1. Delivery valve holder
2. Delivery valve spring
3. Delivery valve
4. Oil reservoi
5. Plunger barrel
6. Plunger
7. Deflector
8. Control rack
9. Control sleeve
10. Plunger spring
11. Tappet
12. Camshaft

GENERAL DESCRIPTION

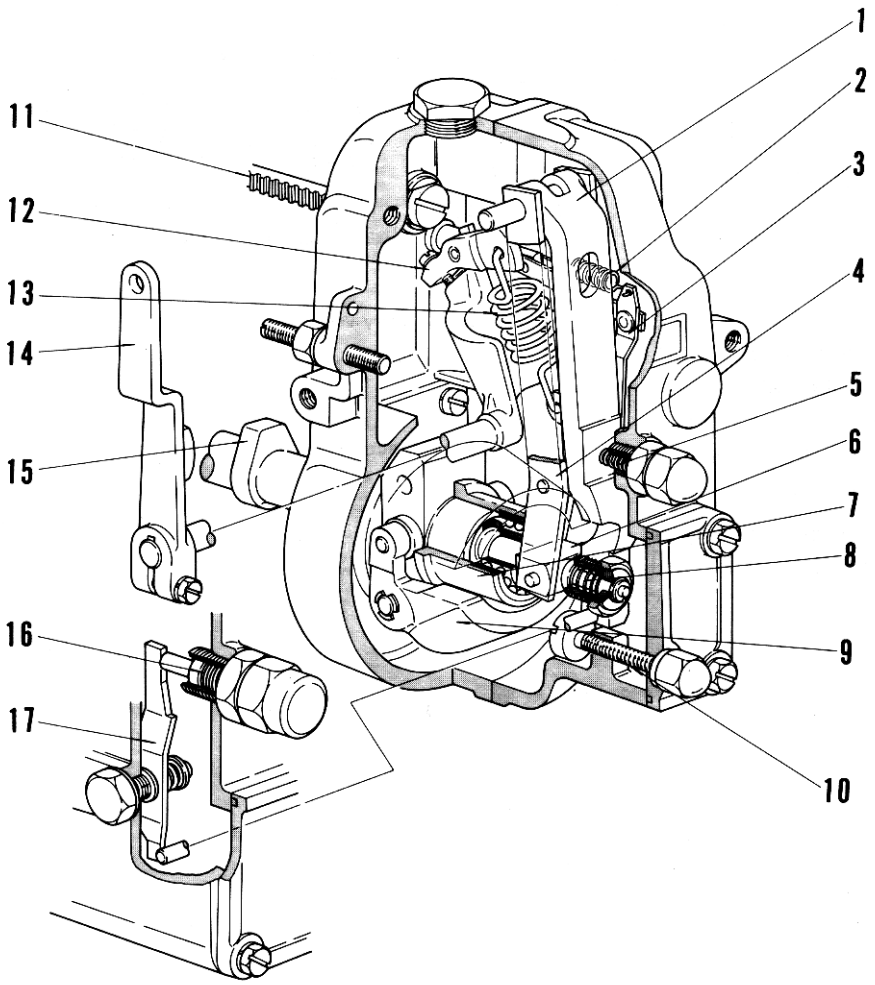
- The fuel injection pump is a Bosh type PES-A. Its pump housing, governor housing are forced lubricated with the engine oil.
- The fuel injection pmp is driven by the pump drive gear in the timing gear cluster and the direction of its rotation is clockwise as viewed from the driving (fly-wheel) side.



13. Oil inlet port
14. Oil outlet port
15. Drain plug
16. Drain plug

A. From main gallery
B. To oil pan

GOVERNOR



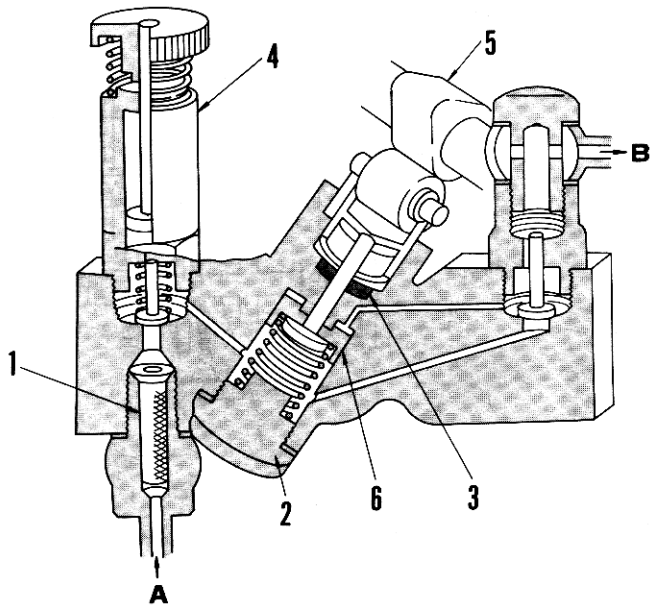
1. Tension lever
2. Start spring
3. Floating lever
4. Guide lever
5. Idling sub-spring
6. Shifter
7. Sleeve
8. Angleich spring
9. Flyweight
10. Full-load stopper
11. Control rack
12. Swivel lever
13. Governor spring
14. Control lever
15. Camshaft
16. Torque spring
17. Lever

GENERAL DESCRIPTION

1. Functions of governor

- The governor is a Bosch RSV mechanical all-speed type and serves to control the engine output power by changing the position of the control rack in the fuel injection pump (by adjusting the quantity of fuel injected).
- A flyweight actuated by the centrifugal force in the governor serves to move the sleeve depending on change in the rotational speed and adjust the move ment of control rack through the guide lever.
  On the other hand, the fuel control lever adjusts the movement of the contol rack though the tension lever for the governor spring.
- In addition to the above, the angleich unit adjusting the maximum fuel injection quantity at various rotational speeds, the torque spring unit to obtain an injection quantity corresponding to a sharp change in load during engine operation, an idling such-spring to maintain an idling speed, a start spring to as the engine starting, etc. are installed in the governor.

FEED PUMP



1. Gauze filter
2. Nut
3. Oil seal
4. Priming pump
5. Camshaft
6. Piston

A. Suction port

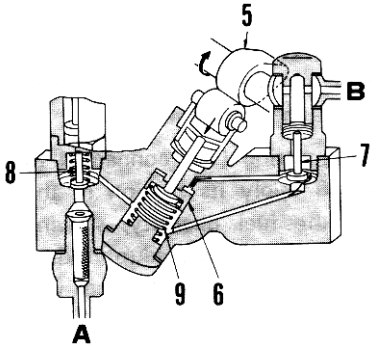
B. Discharge port

- The fuel pump is driven by the cam on the fuel injection pump camshaft and delivers fuel under pressure of approx. 1.5 kg/cm^2 . When removing the air, you can feed the fuel by pushing the priming pump by hands.

Function

1. Preparation for fuel delivery

- The piston (6) in the pump is pushed in by the cam on the camshaft (5) causing the fuel in the lower section below the piston to open the check valve (7) on the discharge side and flow into the upper section of the piston.
- At this time, the check valve (8) on the suction side is closed under the pressure of fuel pushed in by the piston, thereby preventing the reverse flow of fuel.



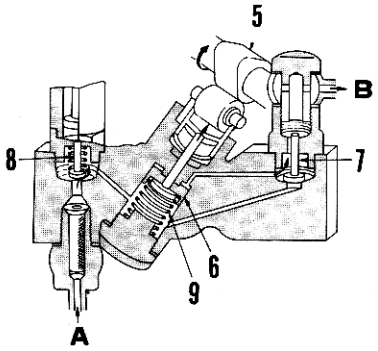
5. Camshaft
6. Piston
7. Check valve
8. Check valve
9. Piston spring

A. Suction port

B. Discharge port

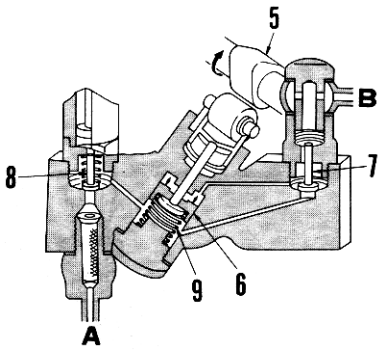
2. Suction and discharge

- If the camshaft (5) is rotated, bringing the cam out of the piston, the piston (6) will be pushed upward by the piston spring (9). The resultant fuel pressure will close the check vavle (7) on the discharge side, while fuel is delivered to the discharge port (B).
- In the section below th piston will be generated the negative prssure, causing the check vavle (A) on the suction side to open so as to draw in fuel.



3. Control fuel supply

- Fuel in the section above the piston is through directly to the passage on the discharge side. If the fuel pressure on the discharge side increases, it will becom impossible to push the piston (6) upward by the piston spring (9). Tus, the suction and discharge of fuel will be stopped until the fuel pressure on the discharge side drops by controlling the fuel quantity to be delivered.

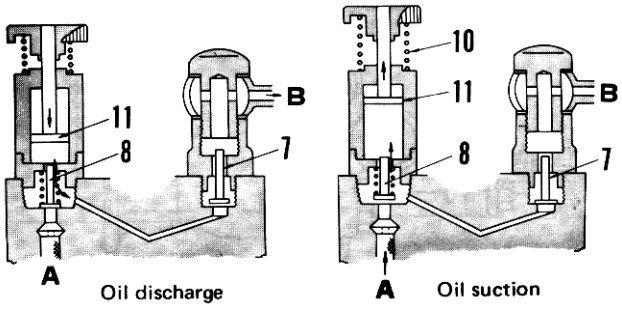


6. Piston
7. Check valve
8. Check valve
9. Piston spring

A. Suction port
B. Discharge port

4. Function of the priming pump

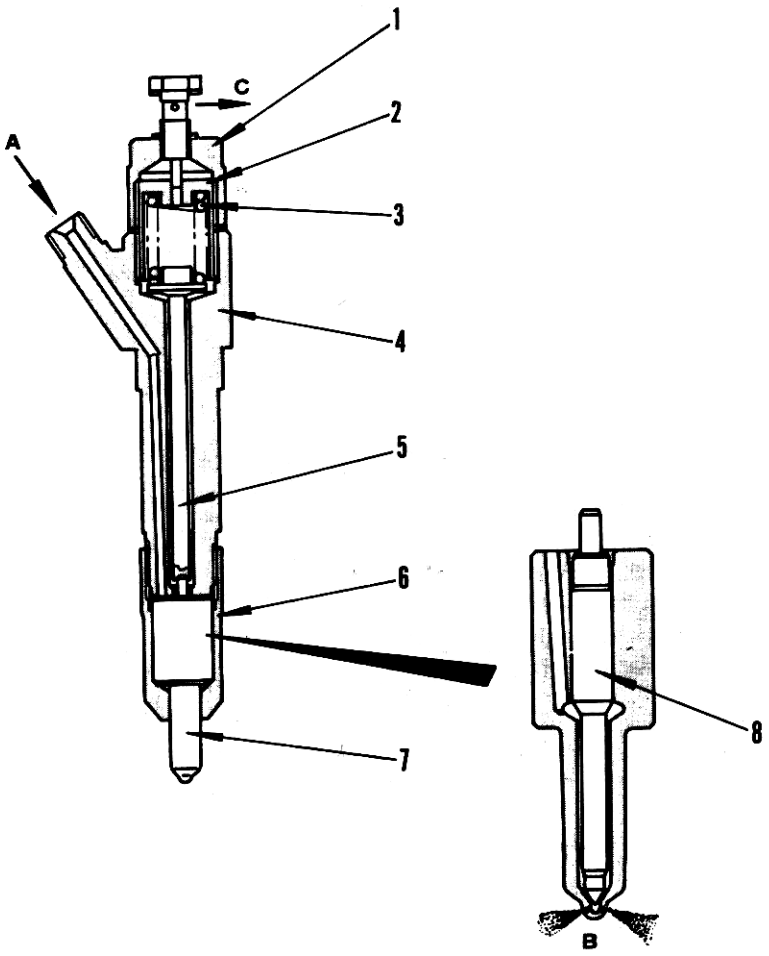
- The priming pump discharges fuel in the section below the piston when the piston (11) is pushed in by hand, and sucks in fuel when the piston is drawn up by spring (10).
- The check valves on the suction and the discharge sides (7) and (8) are used i common with those in the feed pump body. When delivery fuel, the valves on the suction side are closed and those on the discharge side are opened. When sucking in fuel, the valves on the suction sides are opened and those on th dicharge side are closed.



7. Check valve
8. Check valve
10. Spring
11. Piston

A. Suction port
B. Discharge port

FUEL INJECTION NOZZLE



1. Nozzle holder cap
2. Adjust screw
3. Nozzle spring
4. Nozzle holder body
5. Push rod
6. Nozzle cap
7. Nozzle body
8. Nozzle

A. From fuel pump
B. Fuel chamber
C. To fuel tank

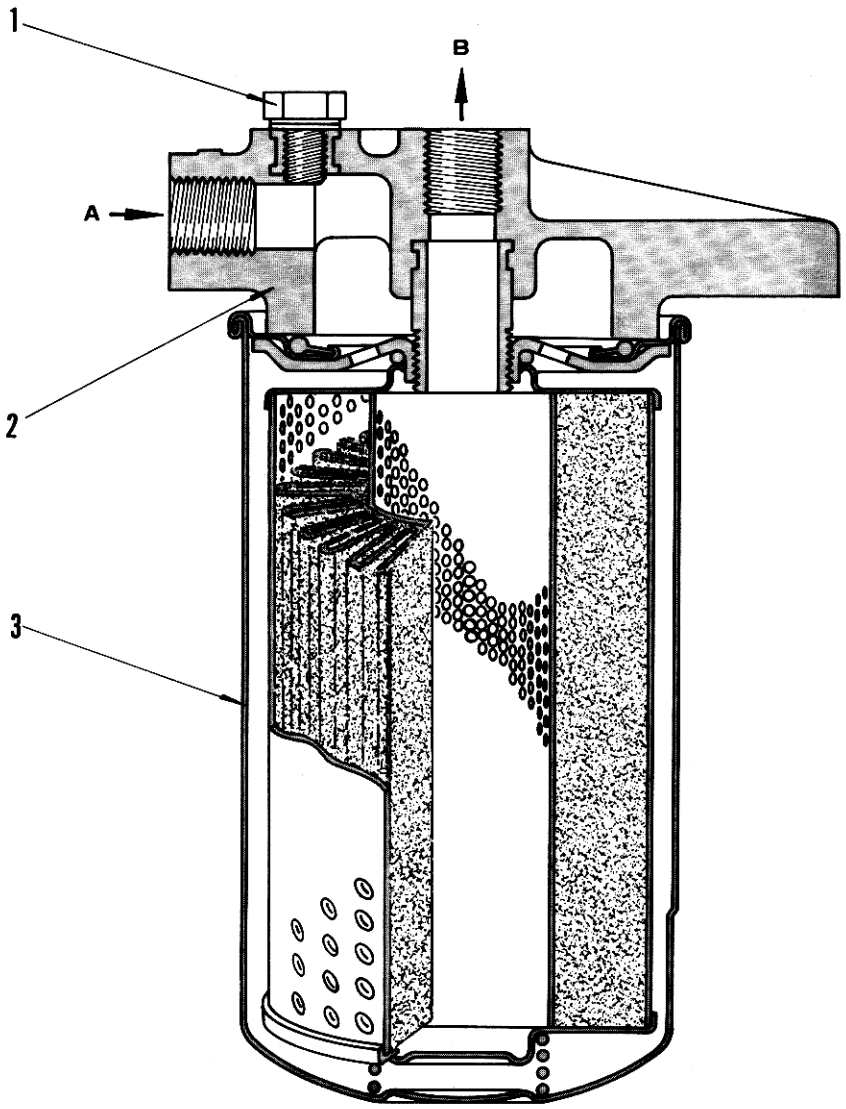
Structure and function

- The fuel injection nozzle is of a MULTIPLE HOLE type
- Fuel injection pressure: 225 kg/cm^2
- The high-pressure fuel delivered from the fuel injection pump is accumulated in the space at the tip of the nozzle. When the fuel pressure built up in the space overcome the tension of the nozzle spring compressing plunger (5), the plunger is lifted. Thus, fuel is injected into the combustion chamber through the four holes .

Specification

- Type : DIESEL KIKI
- Fuel injection presure : 225 kg/cm^2

FUEL FILTER



1. Air bleeding plug
2. Filter bracket
3. Cartridge

A. From feed pump

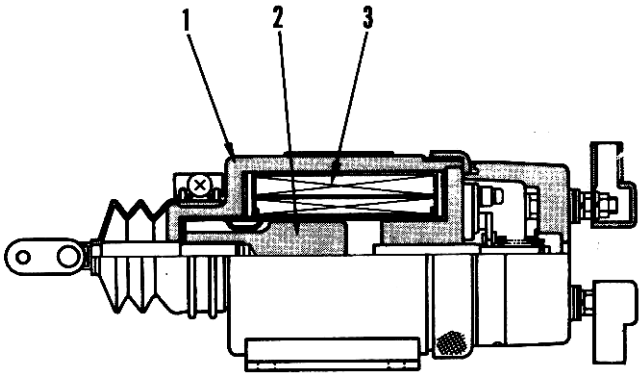
B. To fuel injection pump

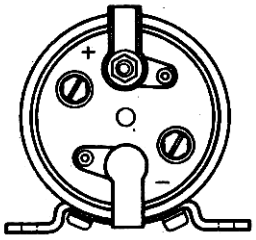
Fuel filter
Fuel filter effective area : 0.3 m^3

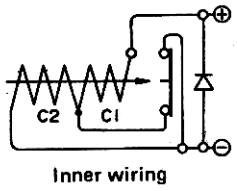
Function

- The fuel filter is a cartridge type and serves to remove dust, foreign substances of the fuel through filter paper from the feed pump.
- When fuel is contaminated with water, the wate will be separated from the fuel while flowing through the filter, resulting in accumulated water in the lower part of filter.

FUEL CUT SOLENOID







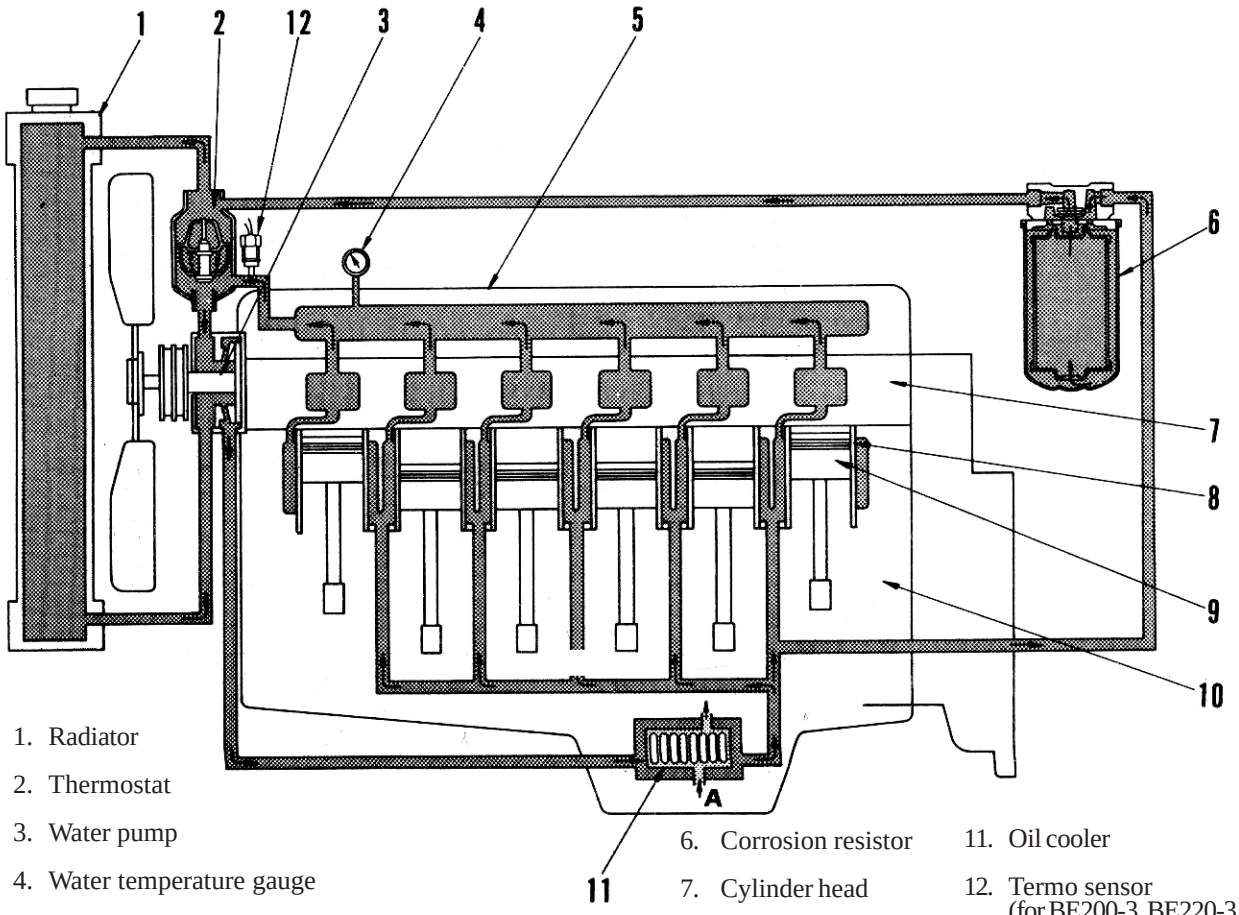
1. Case
2. Piston
3. Coil

MAGNETIC SWITCH

- Maker: NIKKO DENKI
- Type: Sealed
- Rated voltage: DC 24V
- Operating current
  - Maximum: 35A max.
  - Continuity: 0.5A max.
- Stroke: 12 ± 0.1 mm
- Weight: 2.7 kg

COOLING SYSTEM

COOLING SYSTEM CHART



1. Radiator
2. Thermostat
3. Water pump
4. Water temperature gauge
5. Water manifold (integrated with the cylinder head)
6. Corrosion resistor
7. Cylinder head
8. Cylider liner
9. Piston
10. Cylinder block
11. Oil cooler
12. Termo sensor (for BE200-3, BE220-3, (BE200LC-3,BE220LC-3
A. From oil pump (Oil)

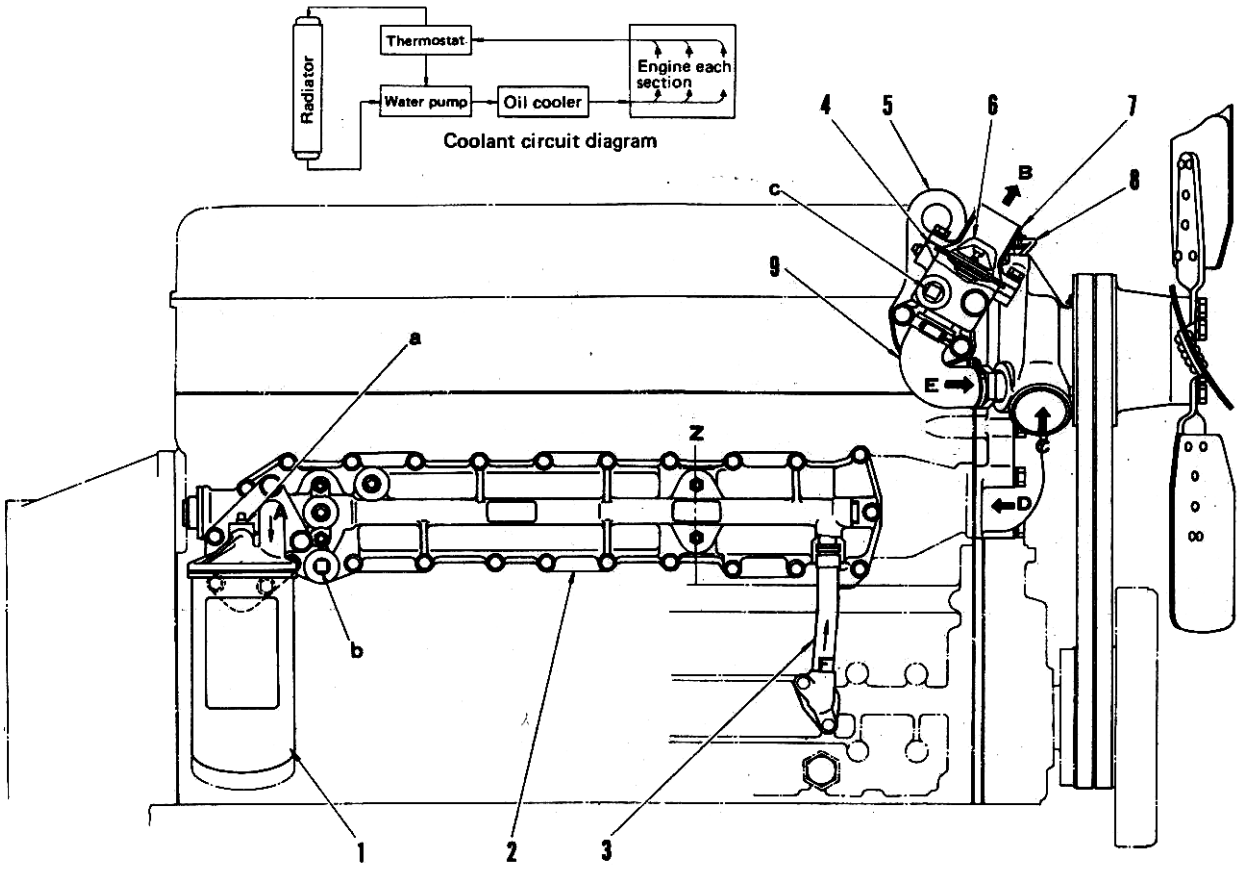
GENERAL DESCRIPTION

1. Structure of cooling system

- The cooling system consists of the water pump, thermostat, radiator, fan and water piping. It serves to cool the cylinder liners, and the areas surrounding the combustion parts in the cylinder heads.
- In addition, oil piping or oil cooler is equipped for cooling oil by the engine cooling water.

2. Circulation of cooling water

1) The cooling water is distributed under pressure from the water pump driven together with the fan through the fan belt from the crank pulley.
2) The cooling water distributed under pressure from the water pump passes through the oil cooer, cools various parts in the engine, collects in the cylinder heads, and from there flows into the thermostat.
3) The cooling water in Thermostat will flow back to the water pump, when the water temperature is below appox. 76 °C (generator: 80 to 84°C). If the water temperature is over approx. 90°C (generator: 95°C) OR SO, the thermostat will be opened fully, causing the water to flow into the radator for cooling.
4) While the water temperature ranges from 76° (generator: 80 to 84°C) to approx. 90°C (generator: 95°C), some of the water flows back to the water pump and the other to the radiator. The ratio of water flowing to the pump and the radiator depends on the degree of opening (varyling with the temperatre) of the thermostat.



1. Oil filter
2. Oil cooler
3. Oil pipe
4. Thermostat housing
5. Singer
6. Thermostat
7. Water connector
8. Water tube
9. Water hose

A. From oil cooler (oil)
B. To radiator (water)
C. From radiator (water)
D. To oil cooler (water)
E. To engine (water)
F. From oil pump (oil)

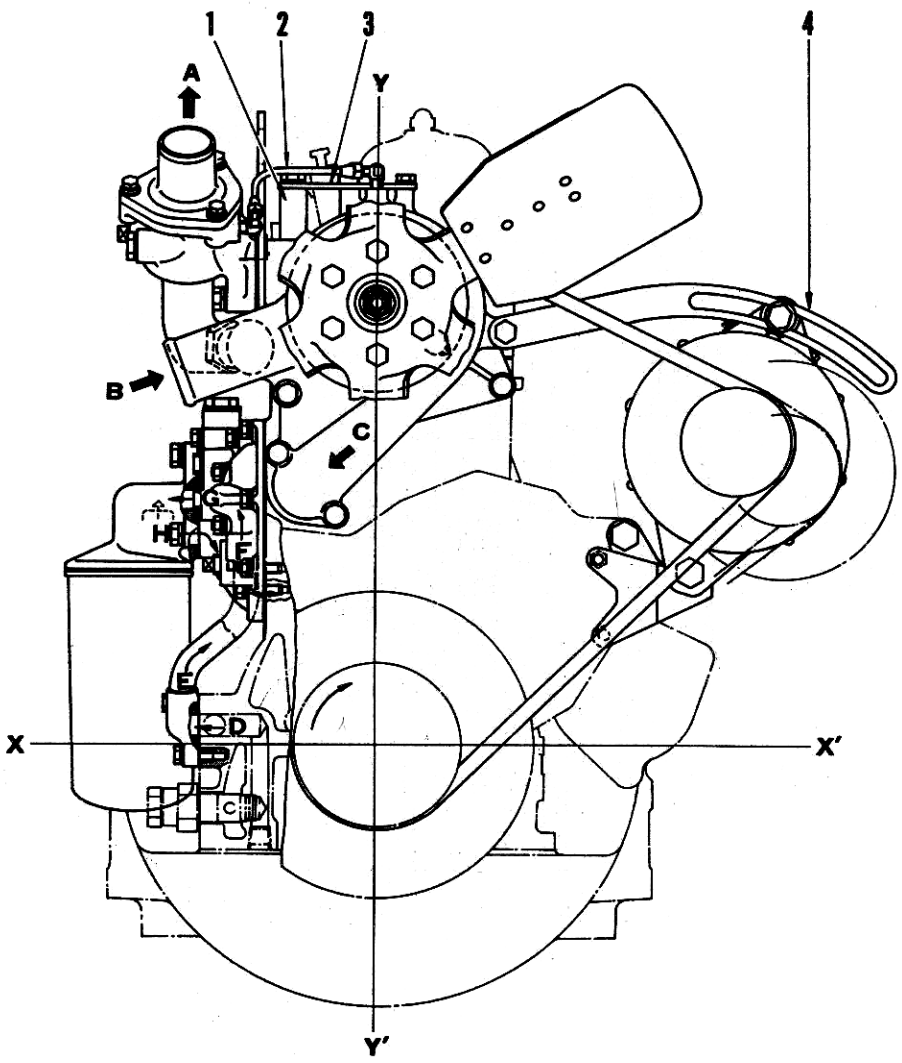
a. Oil pressure takeout port
b. Water drain plug
c. Car heater takeout port

Thermostat

Temperature when start to open : 76.5° C

Temperature when full open : 90° C

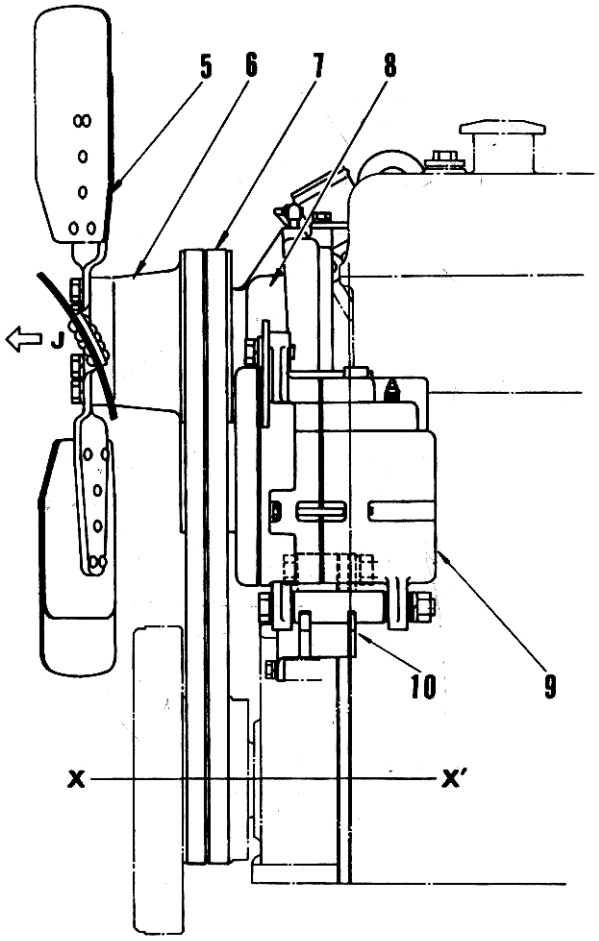
Full opening life : 10mm



1. Spacer
2. Water tube
3. Bracket
4. Adjust plate
5. Fan
6. Fan pulley
7. Fan belt
8. Water pump
9. Alternator
10. Alternator bracket

A. To radiator (water)
B. From radiator (water)
C. To engine each section (water)
D. From oil pump (oil)
E. To oil cooler (oil)
F. From oil cooling (oil)
G. To oil filter (oil)
H. From oil filter (oil)
I. To engine each section (oil)
J. To radiator

X - X': Center of crankshaft
Y - Y': Center of cylinder



Pulley diameter

Crankshaft pulley : 144 mm

Fan pulley : 156 mm

Alternator : 95 mm

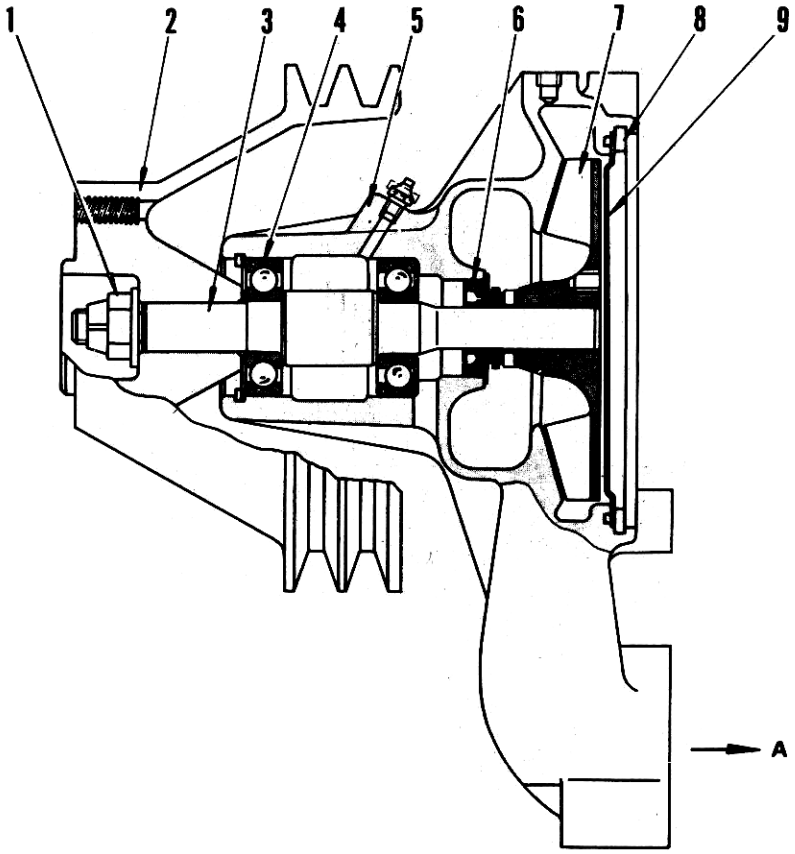
Alternator

24V, 2A

Closed with regulator type

WATER PUMP

B6D105-1, BS6D105-1 For BDG75, BDG100, BE200, BE220



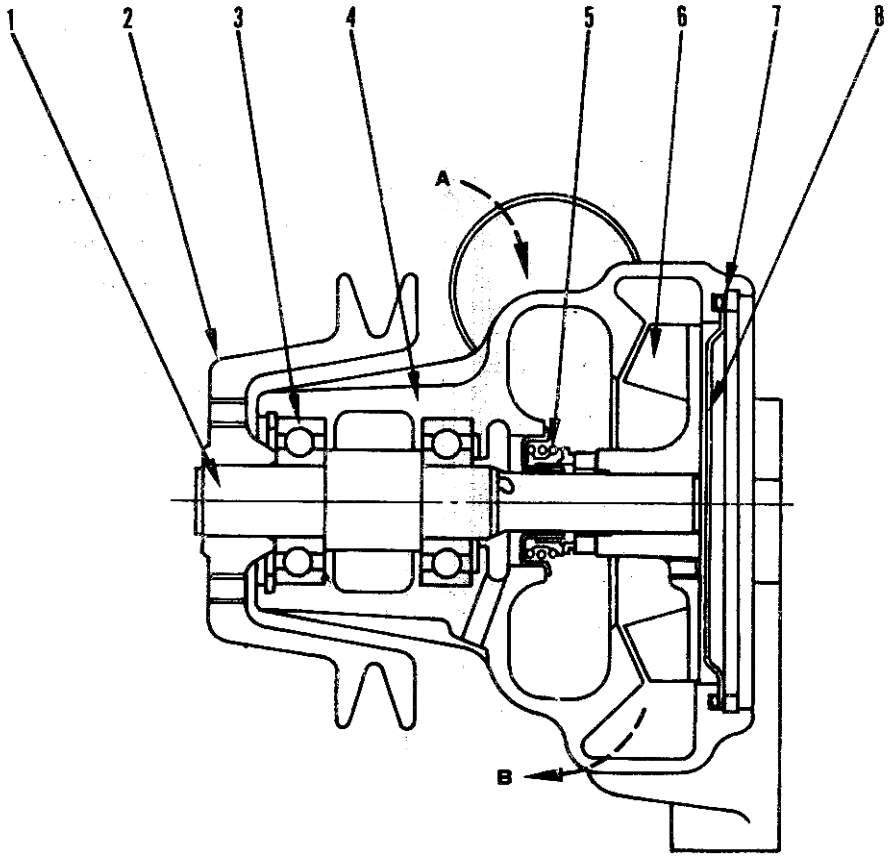
1. Lock nut
2. Pulley
3. Shaft
4. Ball bering
5. Pump body
6. Water seal
7. Impeller
8. Snap ring
9. Pump cover

A. To engine each part (water)

Fan pulley

Engine	Applicable machines	Pulley O.D. (mm)
B6D105-1	BDG75	156
	BE200-1, BE200-2, BE200LC-2	200
BS6D105-1	BDG100	156
	BE220-1,BE220-2,BE220LC-2	175
	BLW200-1	256

BS6D105-1, for BE200-3, BE200LC-3, BE220-3 AND BE220LC-3



1. Pump shaft
2. Pump pulley
3. Ball bering
4. Pump body
5. Water seal
6. Impeller
7. Snap ring
8. Pump cover

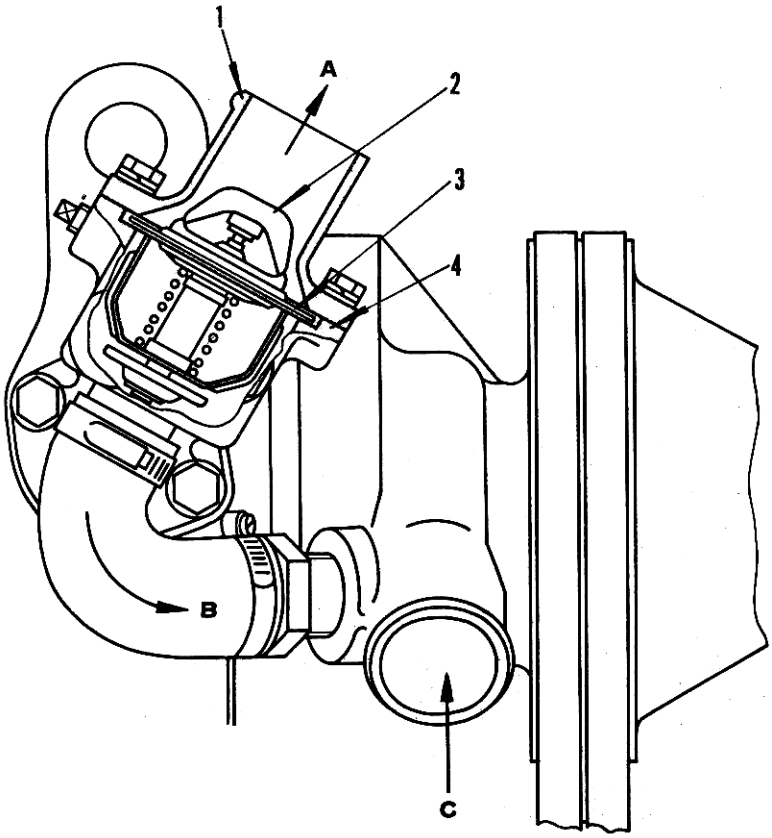
A. From radiator

B. To engine each part

Pump Pulley

Engine	Applicable machin models	O.D. Pulley (mm)
BS6D105-1	BE200-3, BE200LC-3 BE220-3, BE220lc-3	125

THERMOSTAT



1. Connector
2. Thermostat
3. Gasket
4. Thermostat case

A. To radiator
B. To water pump
C. From radiator

Thermostat operation

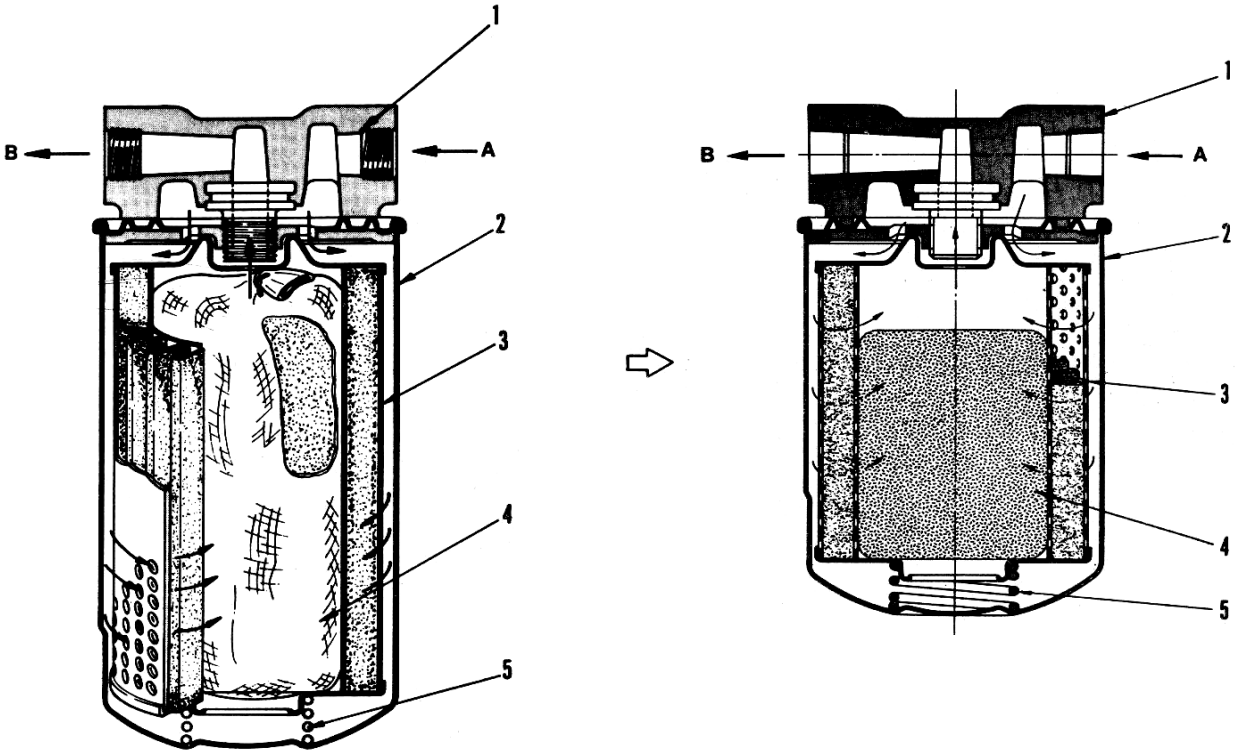
Valve cracking temperature	: 74.5 - 78.5 °C
Valve full opening temperature	: 90 °C
Full opening lift	: 8mm

Structure and function

- The thermostat opens or closes depending on the water temperature and serves to keep the cooling water temperature withi the optimum range by automatically adjusting the flow rate of the engine cooling water into the radiator.
- Within the thermostat is a cylinder containing was; with a high expansion coefficient, movement of the case opens and closes the thermostat valve.
- The optimum temperature of the engine cooling water ranges from 75° to 90° C. If the water temperature is too low, the engine will not be warmed up, resulting in poor engin performance due to improper clearances between pistons and liners. Eventually, excessive oil lubrication, oil contamination, and excessive BLOW-BY will be encountered, during engine operatio
- ★ where a thermostat is used for a generator, its operat ing temperature is set at a high degree, because a continuous operation under light load is relatively frequent and the engine is difficult to warm up.
- If the enigne cooling water temperature is too high, oil deterioration, premature deterioration of seals, O-rings, etc. and overheating will be caused.
- Function of the thermostat

Application	For construction machine	Fog generator set
Valve cracking temperature (°C)	75 - 78	80 - 84
Valve full opening temperature (°C)	90	95

CORROSION RESISTOR



1. Head
2. Cartridge
3. Element (paper)
4. Element (drug)
5. Spring

A. Inlet cooling water

B. Outlet cooling water

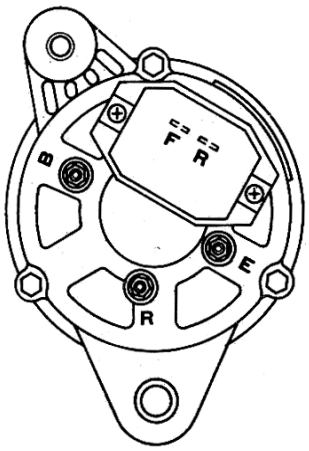
Corrosion resistor

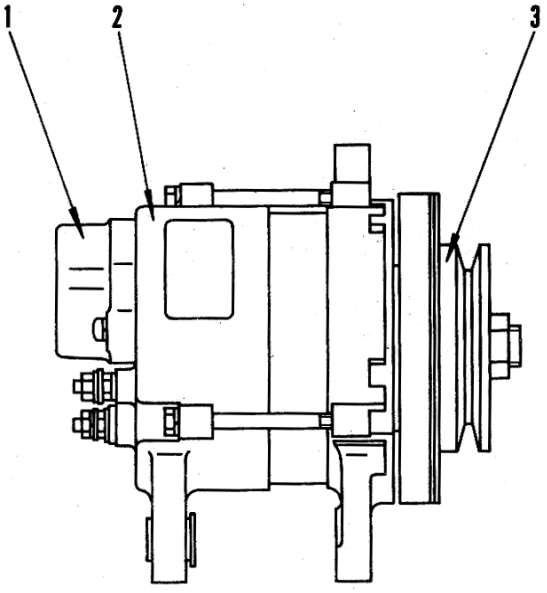
Filter area : 0.19 m^2

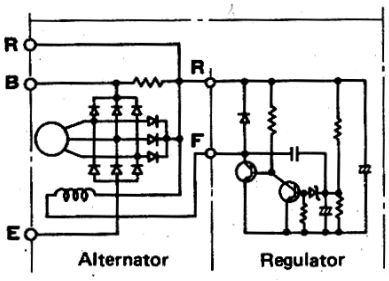
ELECTRICAL SYSTEM

ALTERNATOR

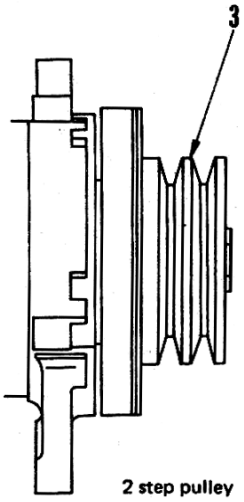
Built in regulator, open type (1)







Inner connecting diagram

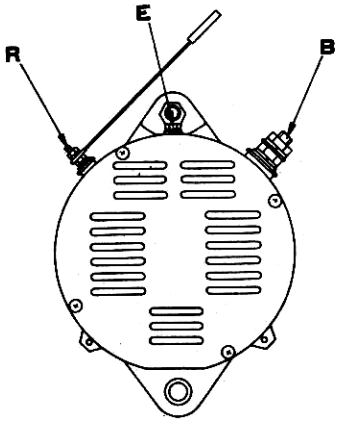


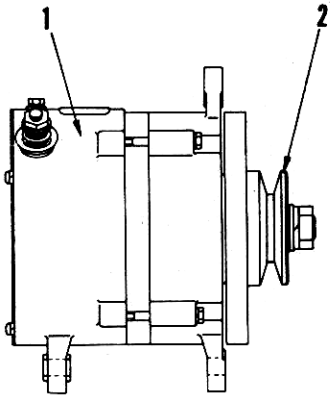
1. Regulator
2. Alternetor
3. Alternator

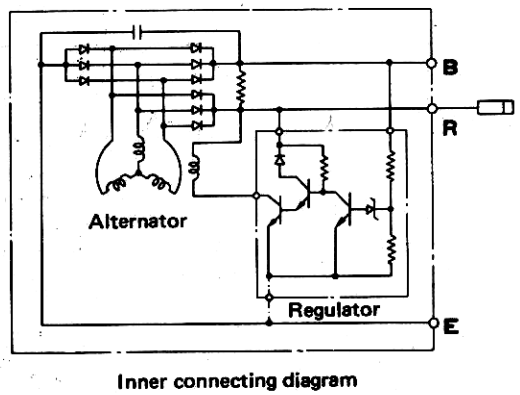
B, E, F, R : Each terminal

Engine	Applicable machine	Model	Specification	Weight (kg)	Outside diameter of pulley (mm)
BS6D105-1	BE200	Nikko Denki Open type	24V, 25A	7.3	95
BS6D105-B-1	BE220LC-3	Nikko Denki Open type	24V, 25A	7.0	95
BS6D105-1	BE200 BE220LC BE220LC-2			7.3	95
	BLW200L-1			7.0	77

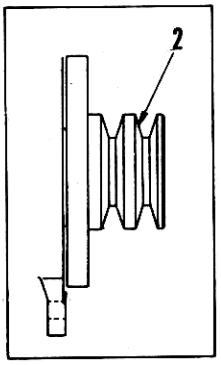
Built in regulator, open type (2)







Inner connecting diagram



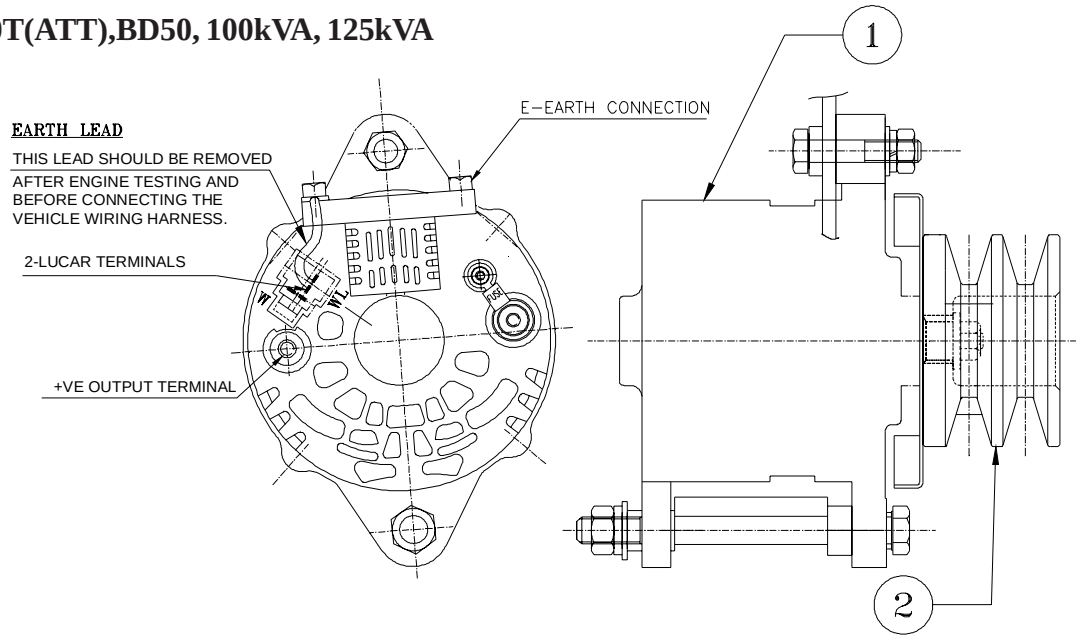
2 step pulley

1. Alternetor
2. Alternator pulley

B, E, R : Each terminal

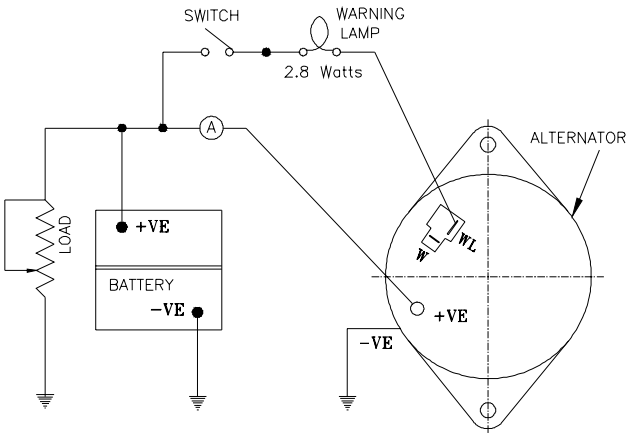
Engine	Applicable machine	Model	Specification	Weight (kg)	Outside diameter of pulley (mm)
B6D105-1	BLW200-1	Sawafuji Denki Open type	24V, 50A	12.5	85
BS6D105-1					

BL200, G10T(ATT),BD50, 100kVA, 125kVA



1. Alternetor
2. Alternator Pulley

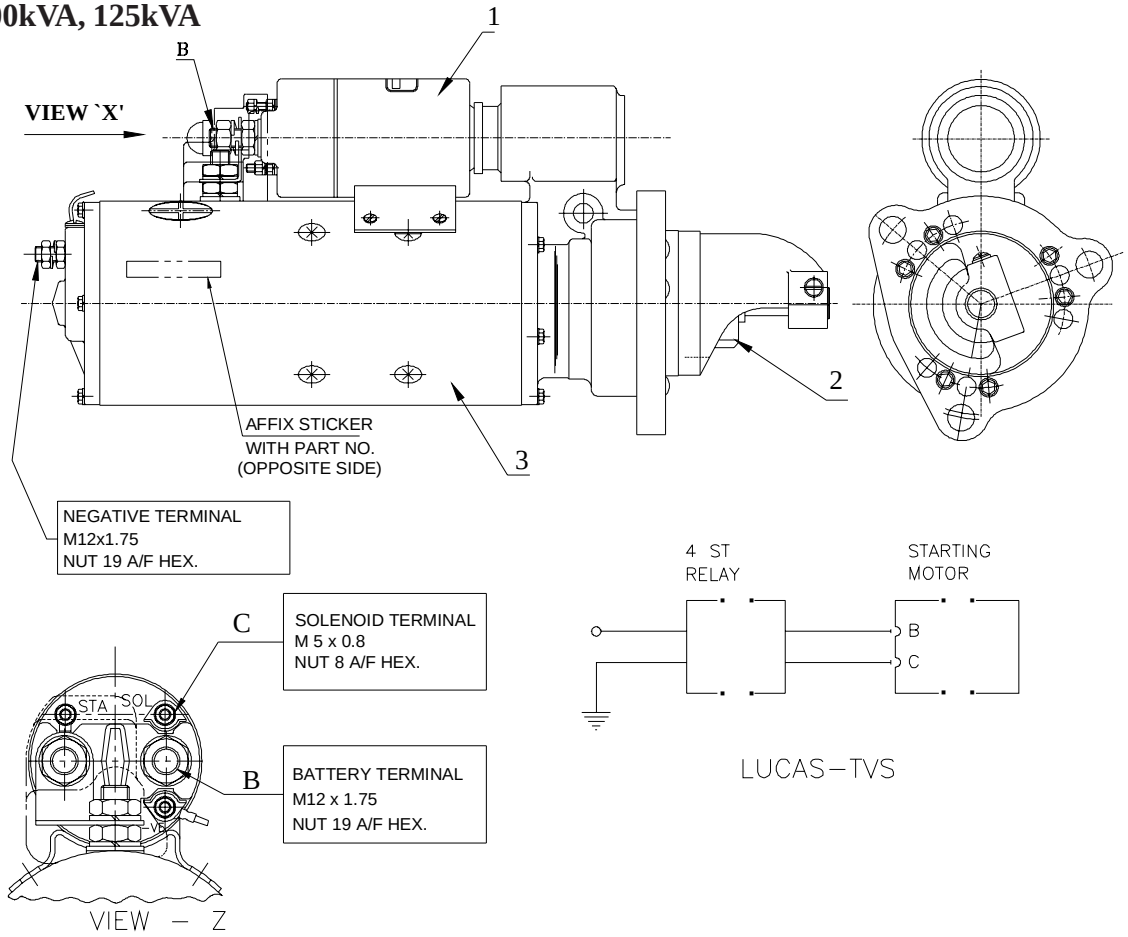
TERMINAL	SIZE	TIGHTENING TORQUE
+VE	M8 x 1.25	45kg.cm - 55kg.cm
-VE	M6 x 1	25kg.cm - 30 kg.cm
WL	LUCAR 6.35 x 0.8t	-
W	- "-	-
W = A.C PHASE TAP TERMINAL (UNREGULATED VOLTAGE TERMINAL)		



Engine Model	Applicable machine model	Type	Specification	Weight (kg)	Outside diameter of pulley (mm)
B6D105-1	BL200	LUCAS TVS	24V, 30A	10	95
	G10T (ATT)				
BS6D105-1	BD50	LUCAS TVS	24V, 45A	10	95
BS6D105-1	BG605BX / G12T(ATT)	LUCAS TVS	24V, 45A	10	95
BS6D105G	100 kVA ENGINE	LUCAS TVS	24V, 30A	10	95
BSA6D105G	125 kVA ENGINE	LUCAS TVS	24V, 30A	10	95

STARTING MOTOR

BD50, 100kVA, 125kVA



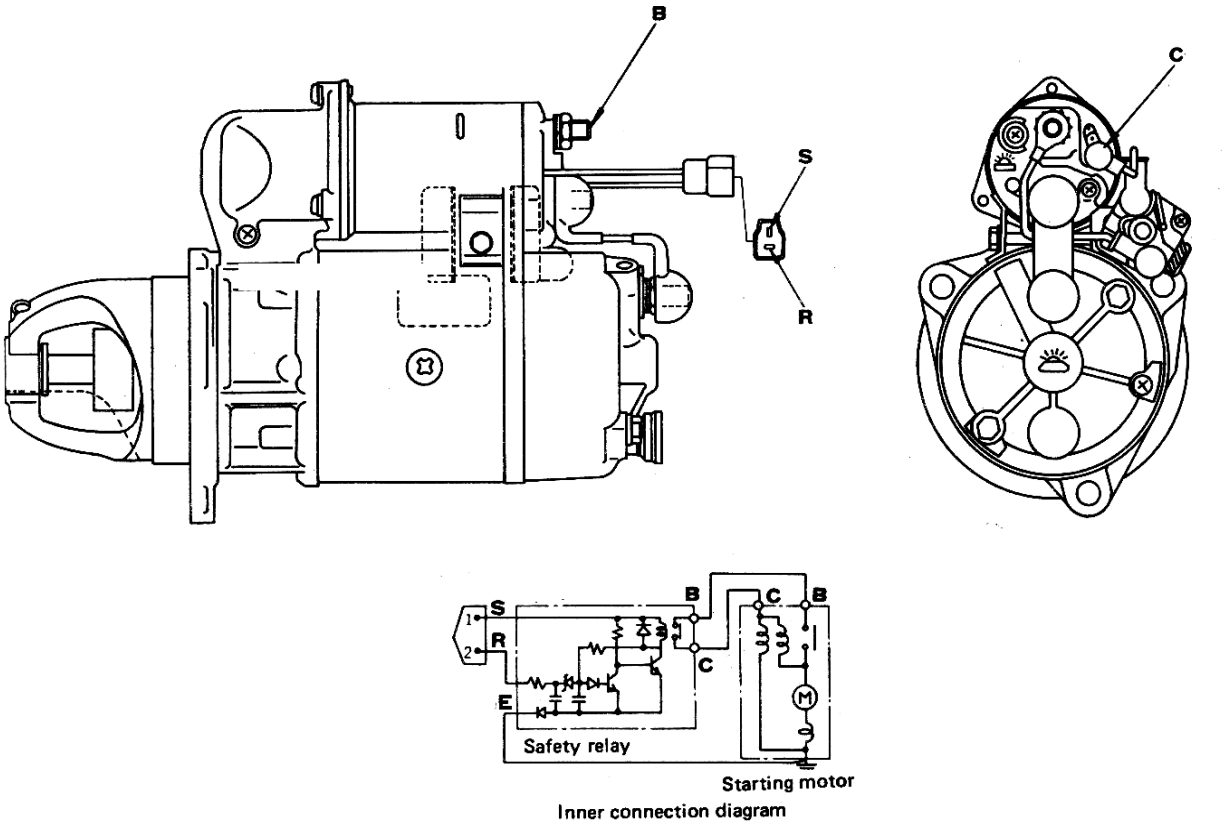
1. Magnetic Switch
2. Pinion
3. Starting Motor

B,C,E : TERMINALS

STARTING MOTOR

Engine Model	Applicable machine model	Type	Specification	Weight (kg)	No. of teeth for pinion
BS6D105-1	BD50	LUCAS TVS (SM 130 PE)	24V, 7.5 kW	32	12
BS6D105-1	BG605BX / G12T (ATT)	LUCAS TVS	24V, 4.5 kW	32	11
BS6D105G	100 kVA	LUCAS TVS	24V, 4.5 kW	32	11
BSA6D105G	125 kVA	LUCAS TVS	24V, 4.5 kW	32	11
B6D105-1	BL200	LUCAS TVS	24V, 4.5 kW	32	11
	G10T (ATT)				

Buit in safety relay



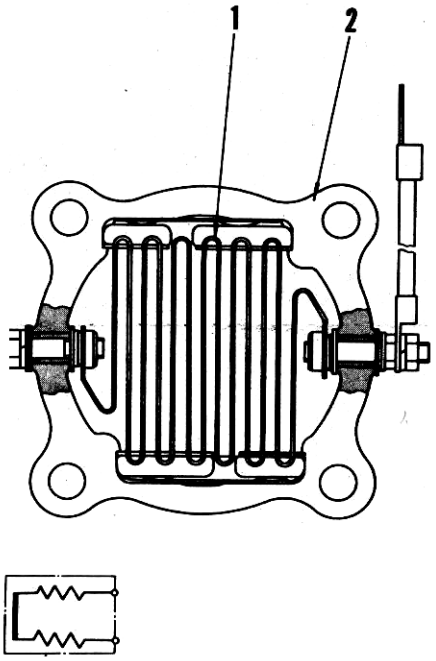
B, C, SW : Each terminal

Engine	Applicable machine	Model	Specification	Weight (kg)	No. of teeth for pinion
		Nikko Denki Sealed type	24V, 5.5 KW	16	13
B6D105-1	BE200-1, BE200-2, BE200LC-2	Nikko Denki Sealed type	24V, 7.5 KW	24	13
	BE200-1, BE200-2, BE200LC-2	Nikko Denki Sealed type	24V, 7.5 KW	18	13
BS6D105-B-1	BE200-3, BE200LC-3	Nikko Denki Sealed type	24V, 7.5 KW	18	13
		Nikko Denki Sealed type	24V, 5.5 KW	16	13
BS6D105-1	BE220-1, BE220-2, BE220LC-2	Nikko Denki Sealed type	24V, 7.5 KW	24	13
	BE220-3, BE220LC-3	Nikko Denki Sealed type	24V, 7.5 KW	18	13

STARTING AID

For easy starting in cold weather, a electrical intake air heater is attached to inlet of intake manifold and a coil heater is attached to both ends of intake manifold respectively. Pull heater switch to ON, Heater is red while starting switch is HEAT or START position to heat intake air.

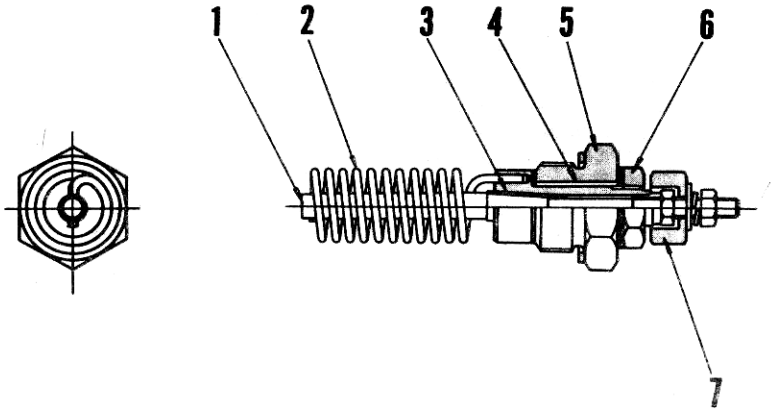
1. Electrical intake air heater



1. Heater coil
2. Housing

Rated current : 110A at 22V

2. Coil heater



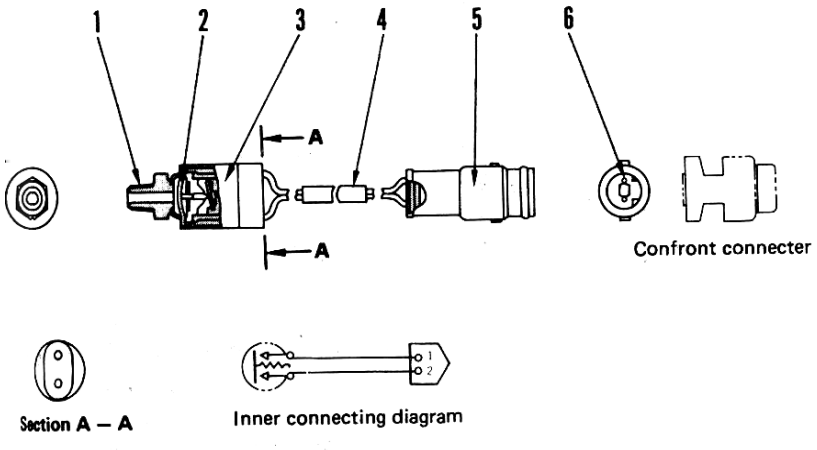
1. Inner pole
2. Heater coil
3. Outer pole
4. Insulator
5. Body
6. Nut
7. Insulator

Rated Voltage : 11.25V

Rated current : 33A

SENSOR

OIL PRESSURE SENSOR



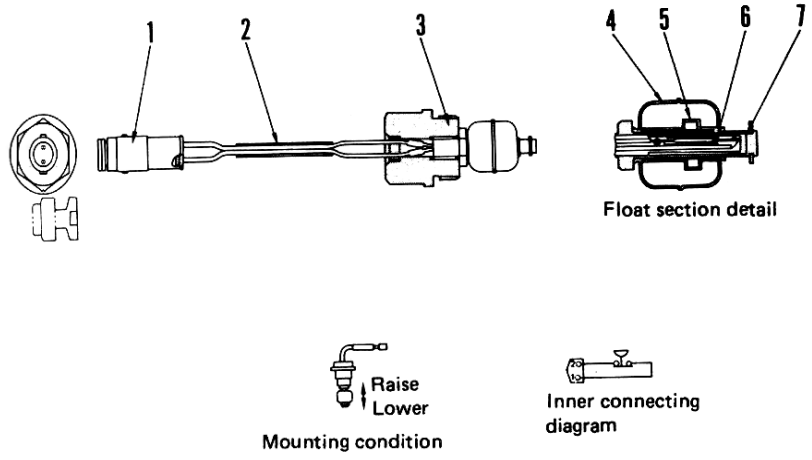
1. Port
2. Diaphragm
3. Sensor
4. Tube
5. Connector
6. Terminal

Oil pressure sensor

- Type : Daaphragm type, normally opened type (NO type)
- Operating points
  ON : 1.3 ± 0.3 kg/cm^2

  Off : $0.5^{+0.3}_{0.2}$ kg/cm^2
- When the oil pressure increses, the tip of the diaphragm comes into con tact with the terminal, turning the switch ON. When the oil pressure decreases, the switch turns OFF. Thus, you can tell wheather the oil pressure is normal or not by seeing if the switch is ON or OFF.

OIL LEVEL SENSOR

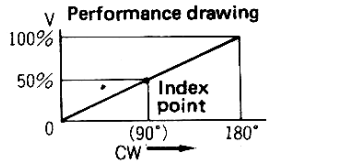


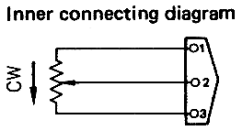
1. Connector
2. Tube
3. Plug
4. Float
5. Magnet
6. Switch
7. Case

Oil level sensor

- Type : Float type reed switch
- The float moves up and down according to the chage in the oil level, and also causes the magnet in the float to move up and down. This movement of the magnet in turn causes the switch to turn ON or OFF. Thus, you can find out the oil level by seeing if the switch is ON or OFF.

THROTTLE SENSOR





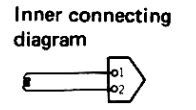
1. Throttle sensor body
2. Tube
3. Connector housing
4. Pin

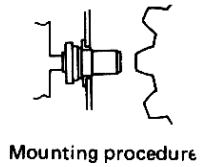
CW : Variable angle

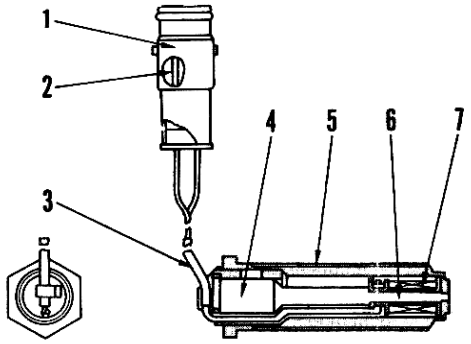
Throttle sensor

- Resistance value : 5 kΩ ± 20%
- This meter is a variable resistor. Its electric resistance varies according to the change in the lever angle and when the current flows, the voltage varies.
  This change in the voltage is detected as an electric signal.

SPEED SENSOR





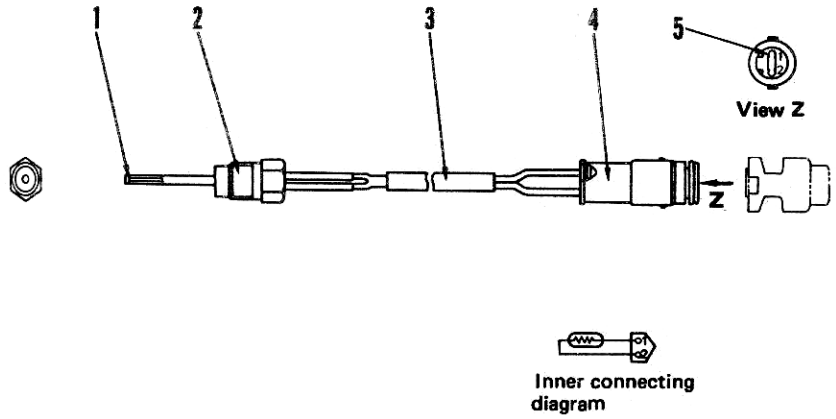


1. Connector hosing
2. Pine
3. Tube
4. Magnet
5. Case
6. Pole
7. Bobbin (coil)

Speed sensor

- This sensor is called the electromagnetic pickup. It has a built-in magnet and coil to form a magnetic field. When a piece of iron rapidly passes across the magnetic filed, the voltage builds up.
  This voltage is detected as an electric signal.

THERMO - SENSOR

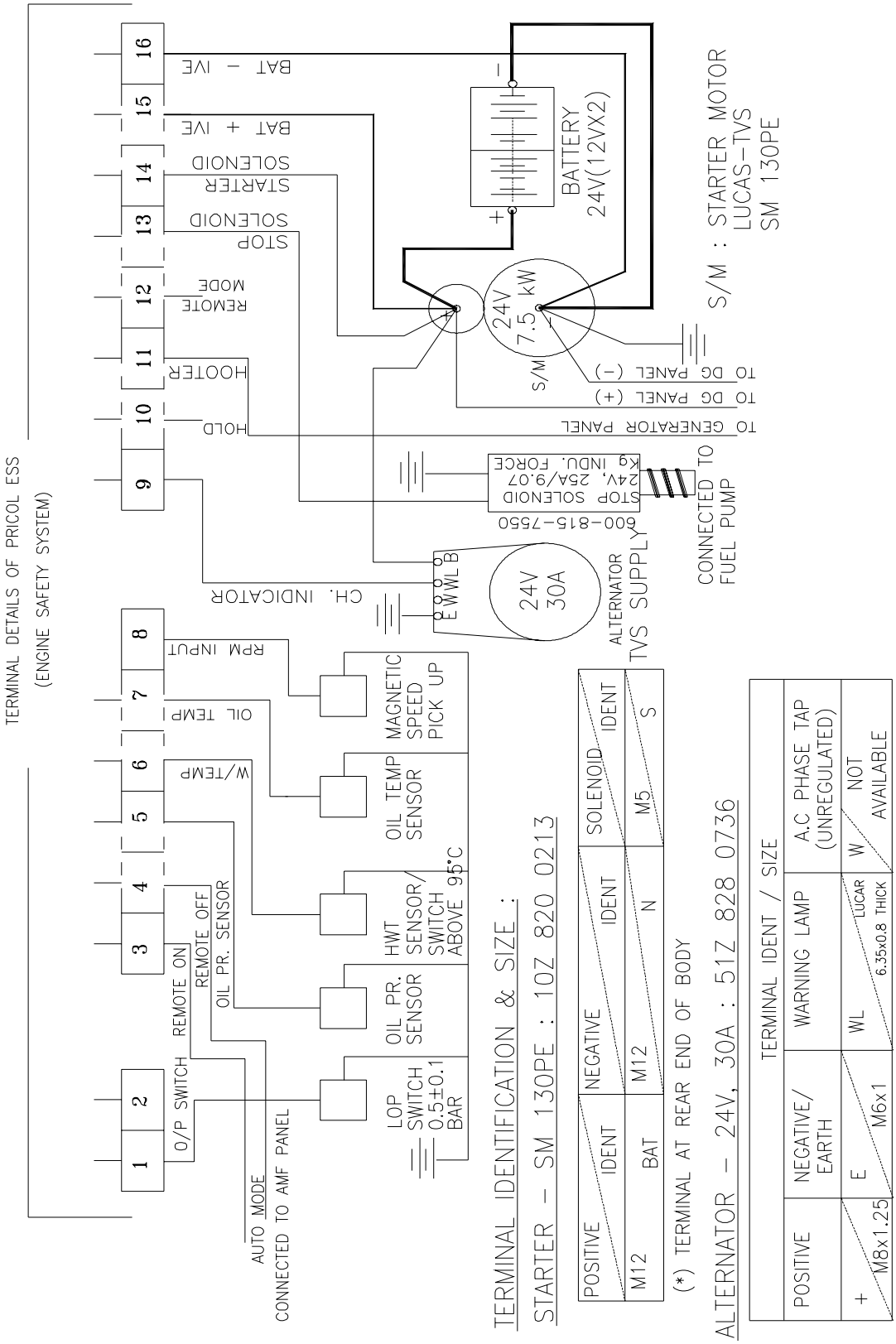


Thermo - sensor

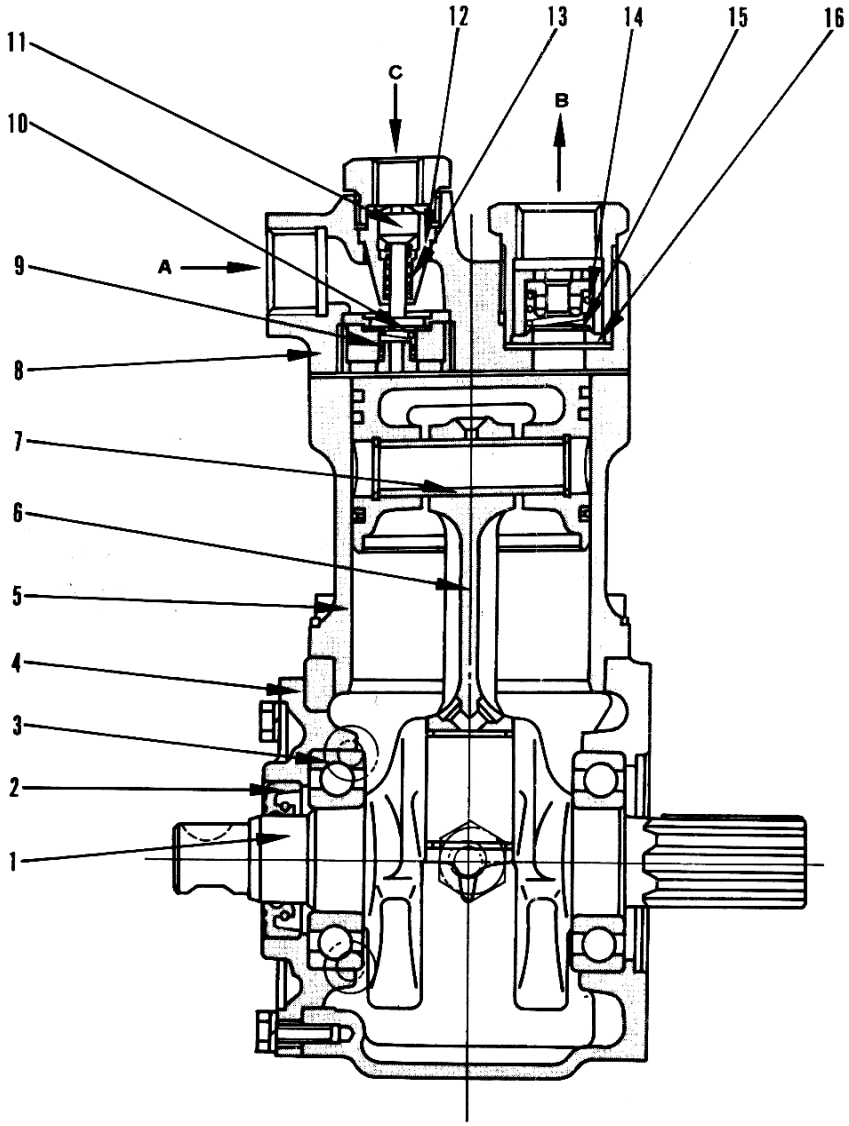
- Applicable temperature range : - 50°C to 150°C
- When the current flows to the thermistor (which change the electric resistance depending on the temperature), the magnitude of the current can be detected. In this way, you can tell whether or not the cooling water temperature is normal. The thermistor temperature gauge indicates the magnitude of the current on the teperature scael.

1. Thermistor
2. Sensor body
3. Tube
4. Connector
5. Terminal

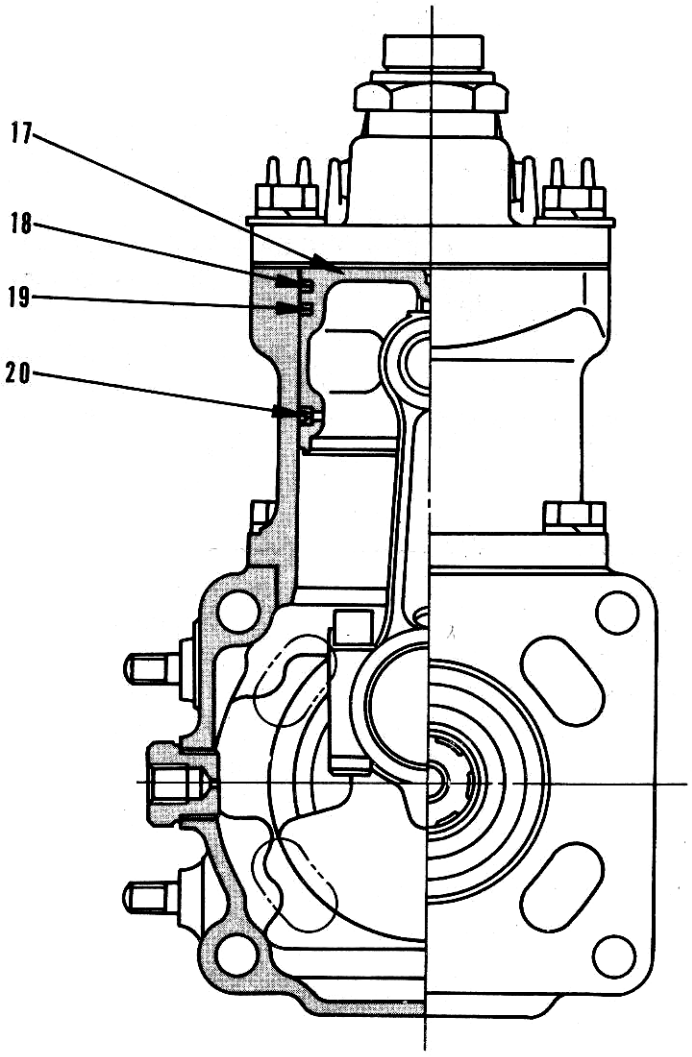
WIRING DIAGRAM FOR PRICOL ENGINE SAFETY SYSTEM
For 100kVA, 125kVA



ACCESSORY
AIR COMPRESSOR



1. Crankshaft
2. Oil seal
3. Ball bearing
4. Crankcase
5. Cylinder block
6. Connecting rod
7. Piston pin
8. Cylinder head
9. Inlet valve spring
10. Inlet valve
11. Unloader valve
12. Unloader valve guide
13. Unloader valve spring
14. Outlet valve spring
15. Outlet valve
16. Outlet valve seat
17. Piston
18. Top ring
19. Second ring
20. Oil ring



A. Air intake (inlet)
B. Air exhaust (outlet)
C. Unload

Air compressor

- Type : DIESEL KIKI
  single cylinder, double acting
- Cylinder : 70 x 40mm (Dia x stroke)
- Discharge volume : 385 l/min. (2500 rpm)
- Air pressure : 10 kg/cm^2
- Wieght : 6.5 kg

Unloader valve

- Valve opening pressure : 7.0 to 8.0 kg/cm^2
- Valve shutting pressure : 6.2 to 7.3 kg/cm^2

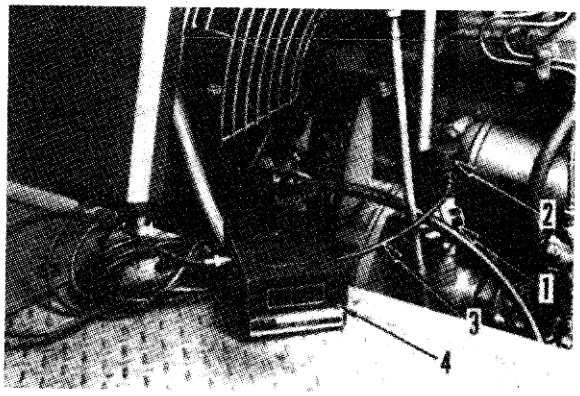
ENGINE

13 TESTING AND ADJUSTING

GENERAL OF TESTING AND ADJUSTING

MEASURING ENGINE SPEED

1. MEASUREMENT USING TACHOMETER



1. Remove the speed measuring outlet cable or cap from service meter (1).
2. Fit tachometer adaptor (2) to the speed measuring outlet and connect cable (3) to tachometer (4).
3. Turn on the power to the tachometer, and read off the speed being measured.

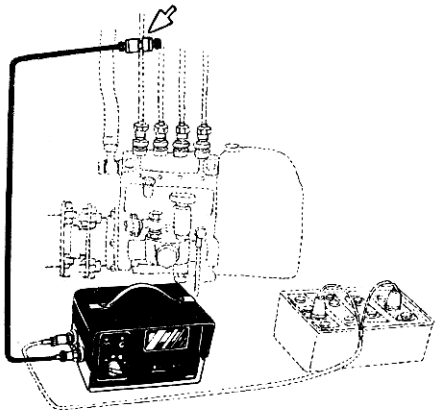
★ Before performing measurements, carefulley read the instruction manual provided with the tachometer.

★ Take care that the tachometer cable does not get tangled in the rotating part of the engine.

⚠ Keep fingers clear of rotating parts.

2. MEASUREMENT USING PIEZOELECTRIC TACHOMETER

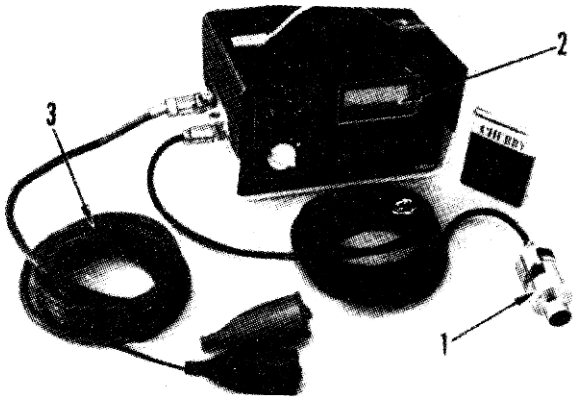
Applicable engine: Enging fitted with bosch type injection pump.



- A piezo-electric tachometer (Diesel tachom eter) detects the fuel pressure in the injection pipe during injection from the injection pump, and measures speed by counting the number of pressure pulses per minute.

1. Mount sensor (1) in the vicinity of the nozzle holder of the injection pipe and connect the connector to meter (2).
2. Connect up battery cable (3).
   Connect up
   Red clip → (+) terminal of battery
   Black clip → (-) terminal of battery
   Connector meter
3. Turn on the meter and take measurements.

★ Check that the indicator lamp flashes regularly while the engine is running.



★ Turn the sensitivity knob clockwise to the appropriate range. Do not increase the sensitivity unnecessarily.
(This is to prevent the possibility of vibration and noise being counted.)

★ If vibration damping rubber is not fitted to the clamp of the injection pipe, there is a reisk that vibration may be counted. In such a case, therefore, remove the clamp.

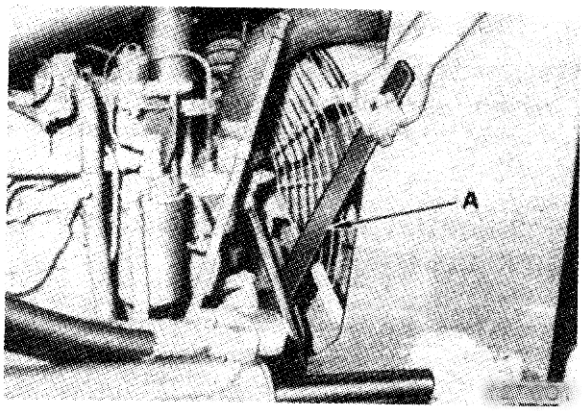
★ Carefully read the instruction manual provided with the measuring instrument.

CRANKING METHOD

1. BARRING METHOD

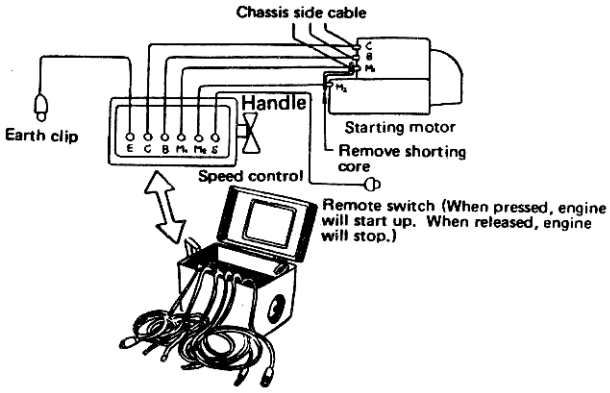
- Fit barring tool (A) to the crank pulley or accessory drive pulley, etc., and rotate it by hand.

⚠ Be carefulley that the hands do not slip or the barring tool comes away.



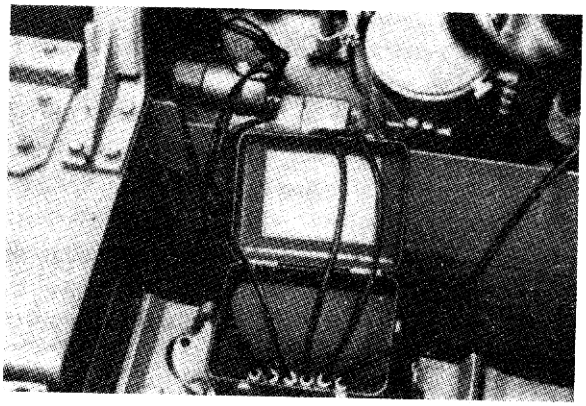
2. CRANKING KIT METHOD

1. Wiring up the cranking kit as shown in the diagram.



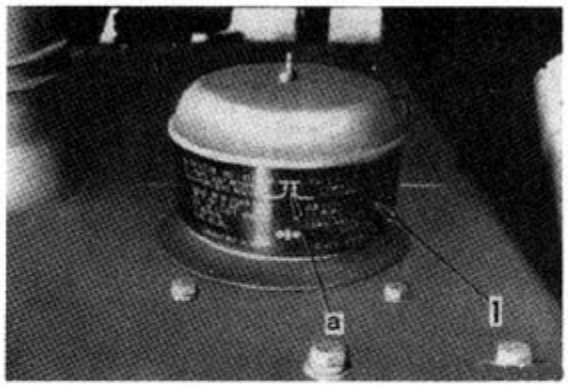
2. Put the fuel lever in the non-injection position and put the engine in aa compression releasing condition (engine fitted with compression release lever).
3. Turn the handle fully clockwise and press the remote switch.

★ Adjust the cranking speed by turning the handle.
★ It is recommended that positioning be carried out by inching in order to facilitate the positioning procedure.
★ Tighten up each terminal securely in order to ensure that the large currents involves pass through the circuit unimpeded.



INTAKE AND EXHAUST SYSTEM
CHEKING INTAKE AND EXHAUST SYSTEM

★ In tunnels and dusty locations, check the intake and exhaust system at more frequent intervals than those given in the instruction manual, in accordance with the degree of dust.



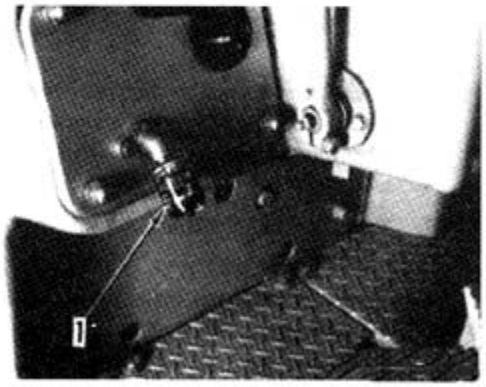
1. CHECKING AND CLEANING OF PRECLEANER (WHEN USED)

- Check the see if dust in precleaner (1) has reached the service level (a).

★ If dust in the precleaner reaches the dust level, any dust over and above this will rise up and be sucked into the air cleaner, in other words, the function of the precleaner will be lost. Accordingly, regularly check and clean the precleaner.

2 CHECKING, CLEANING AND REPLACEMENT OF AIR CLEANER

1. Inspection using dust indicator

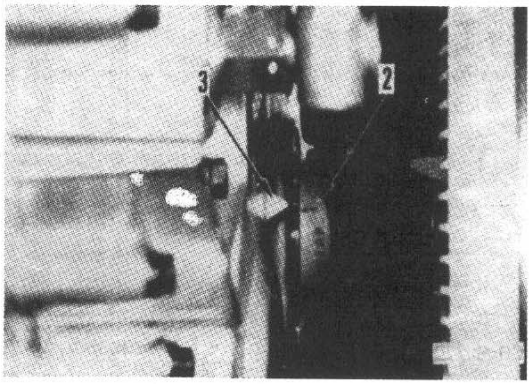


- Chek to see if dust indcator (1) is operating (red indication at service level position).
- If the air cleaner element becomes blocked up, the intake resistance will create a negative pressure which will build up and operate the dust indicator when it reaches a value of 635 mm.

- The dust indicator is connected either directly into the intake pipe line between the air cleaner and the intake manifold (or turbo-charger).

★ When the dust indicator operates, clean or replace the air cleaner element, and then press the button to restore it to the pre-operating condition.

ADJUSTING VALVE CLEARENCE



Method of adjusting valve clearance

1. Remove the cylinder head cover.

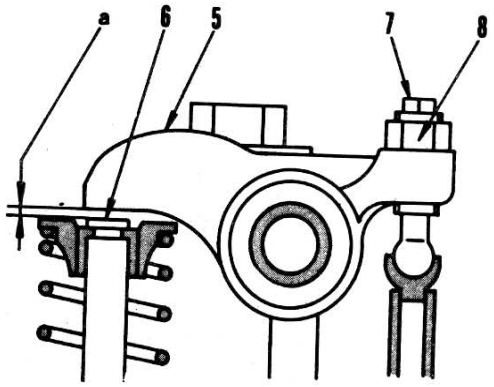
2. Rotate the crankshaft in the normal direction to align pointer (3) with the 1.6 TOP mark on vibration damper (2). When rotating,check the movement of the intake valve of No.6 cylinder. Set with No. 1 cylinder at compression top dead center.
   - ★ When No. 1 cylinder is at compression top dead center, the intake valve of No.6 cylinder can move (is open).

3. When No. 1 cylinder is at compression top dead center, adjust the valves marked ● .

4. Then rotate the crankshaft one turn in the normal direction, and adjust the valves marked ○ .

★ Adjust the valves marked ●.

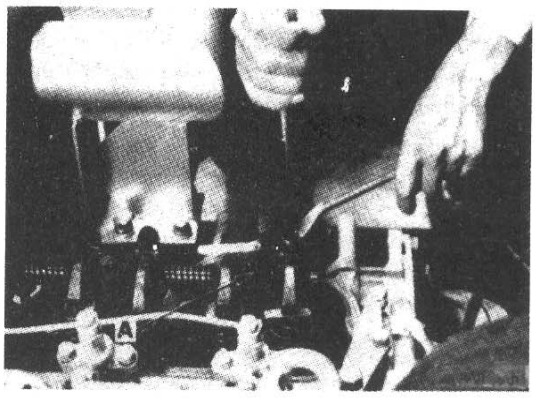
Cylinder No.	1	2	3	4	5	6
Intake valve	●	●	○	●	○	○
Exhaust valve	●	○	●	○	●	○



- ★ To adjust loosen locknut (8) of adjustment screw (7), Then insert feeler gauge **A** between valve stem (6) and rocker arm (5), and turn the adjustment screw until the clearance is a sliding fit.
  - ★ Valve clearance

5. Tighten the locknut to hold the adjustment screw in position.

kgm Locknut: 6.5 ± 1.0 kgm



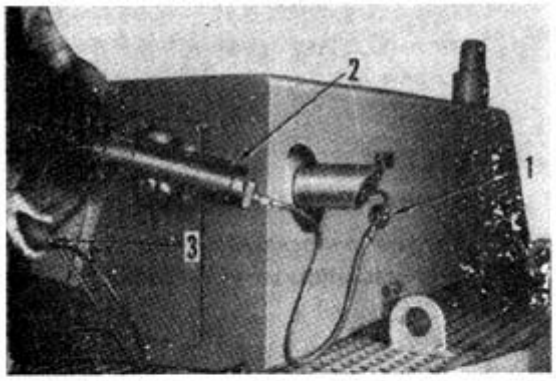
- ★ After adjusting No. 1 cylinder at compression to dead center, it is also possible to turn the crankshaft 120° each time and adjust the clearances of the intake and exhaust valves of each cylinder according to the firing order.
  - ● Firing order: 1-5-3-6-2-4
- ★ After tightening the locknut, check the clearance again.

MEASURING EXHAUST COLOR (BOSCH TYPE)

★ Adjust the exhaust color after the engine has warmed up (oil temperature at least 60° or water temperature at least 70°).

⚠ During exhaust color measurement, be carefl not to receive burns from the exhaust mani fold or muffler or get caught up in rotating parts.

1. Insert probe (1) of the measuring instrument into the outlet of the exhaust measuring pipe. Then tighten up the clip and fix it to the exhaust pipe.



2. Connect the probe and intake pump (2) by means of tubing.
3. Start up the engine, and adjust the output to the level at which measurements are to be made.
4. Fit a piece of measuring filter paper onto the front of the intake pump.
   ★ Fit the filter properly so that there is no leakage of exhaust gas.
5. Firmly grip the release (3) of the intake pump and then operate the pump (such in exhaust gas).
6. Remove the filter paper (4) from the intake pump and read off the indicated value on the measuring instrument (5).
   ★ The measuring instrument electrically converts the reflected light from the filter paper into an exhaust color indication. Accordingly, perform measurements by placing the filter paper under test on 4 or 5 sheets of unused filter paper so as to eliminate the effect of the filter paper stand.
   ★ Because the indicated value on the instrument will vary with voltage fluctuations of the dry battery contained in the instrument, be sure to calibrate the instrument before taking mea surements.

★ The method fo using the exhaust color measuring instrument will vary somewhat depending upon the maker and type. Be sure to read carefully the instruction menual provided with the instrument.

★ When the exhaust color is black, various symptoms such as insufficient output, faulty starting and oil deterioration, etc., will occur. If the engine is operated continually in this condition, such symptoms will become worse. Accordingly, remove teh cause of the trouble referring to the trouble shooting table.

★ **Exhaust gas analysis**

- When analysis the chemical constituens of the exhaust gas at the request of the customer, etc., use a simplified gas analyser.

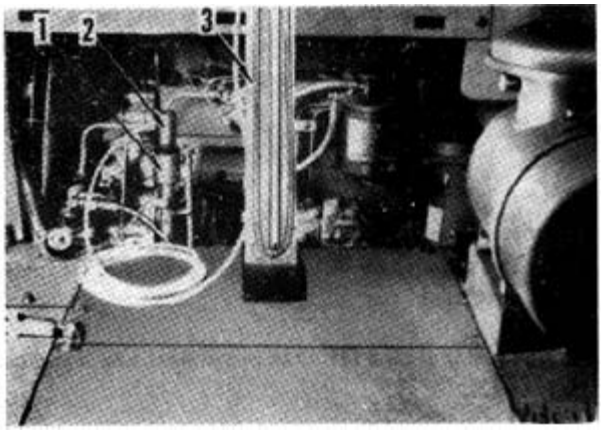
ENGINE BODY

MEASURING BLOWBY

★ Measure blowby after the engine has warmed uo (oil temperature at least 60° or water temperature at least 70°).

1. MEASUREMENT PROCEDURE

1. Mount blowby check tool (2) onto oil filter (1) or the breather port, using the adapter provided with the checj tool.
2. Connect the check tool to a U-tube manometer (3) or pressure gauge by means of tubing.
3. Block up all openings (breather, oil filter, oil the blowby check tool is mounted, in order to prevent leakage.
4. Run the engine and read off the blowby pressure.



2. DETERMINATION OF RESULTS OF BLOWBY MEASUREMENT AND REMEDY

★ The blowby standard is specified as the value obtained at the reated output of the engine. At high idling, it is possible to obtain about 80% of the blowby obtained at rated engine output. For this reason, the blowby standard is sometimes specified at high idling.

★ When it is difficult to operate the engine at rated output during field measurements, for example, take measurements under full stall operation or the previously mentioned high idling condition in order to obtain a value similar to that obtained at reated engine output.

★ The blowby standard is specified for and engine installed in a new vehicle. The actual measured value will thus vary depending upon the operating time and maintenance condition of the vehicle.

★ The measured blowby value may sometimes abruptly increase depending upon the degree of overlap of the piston ring gaps or may vary depending upon the operating condition of the vehicle. It is the blowby reference value is related to a fault in the engine.

★ If a measured blowby value is considered to be abnormal, it is necessary to throughly investigate the followig items which are related to blowby.
1. Oil consumption
2. Exhaust color
3. Starting perfomance
4. Oil deterioration

★ The main causes of bnormal blowby are:
1. Worn piston rings and liners
2. Worn valve stems and guides
3. Blocked breather
4. Abnormal combustion

Of these, it is possible to check 1 and 2 by measuring the compression presuure.

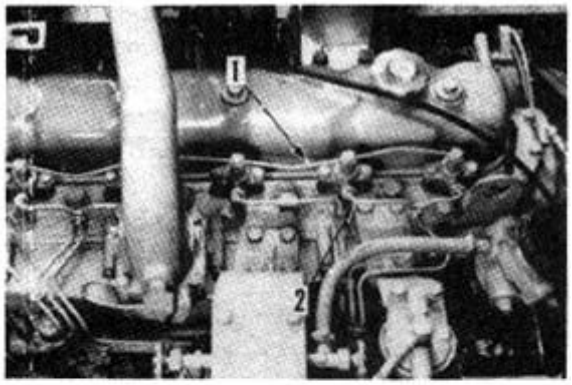
MEASURING COMPRESSION PRESSURE

⚠ When measuring the compression pressure, be careful not to touch the exhaust meanifold or muffler, or to get caught in rotatin parts.

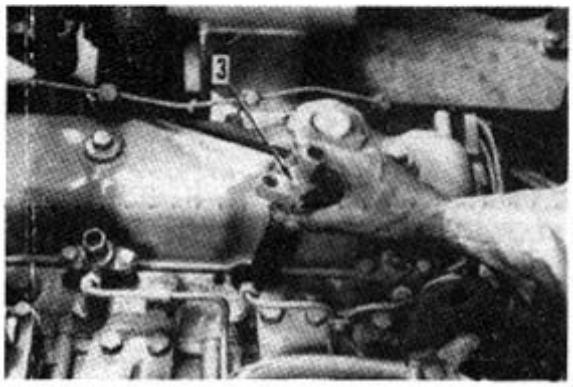
★ Warm up the engine (oil temperature: 40 ° to 60 ° C) before measuring the compression pressure.

1. Adjust Valve clearance.
   ★ For details, see ADJUSTING VALVE CLEARANCE.

2. Remove spill pipe (1), then disconnect fuel injection tube (2).

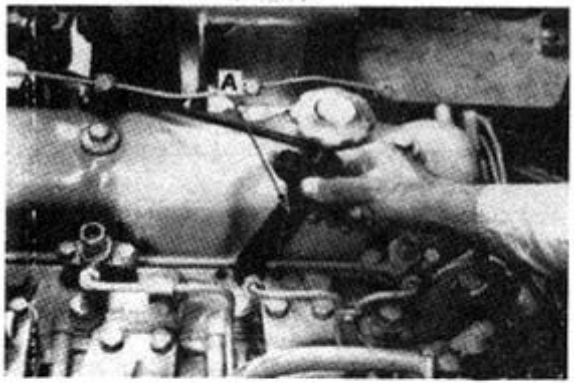


3. Remove nozzle holder assembly (3) of each cylinder.
   ★ When removing the nozzle holder, clean around the nozzle holder and fit a blind plug to prevent dust or dirt from entering.



4. Install adapter A in the place of nozzle holder assembly (3), and tighten to specified torque.

   kgm Adapter: 1.7 ± 0.2 kgm

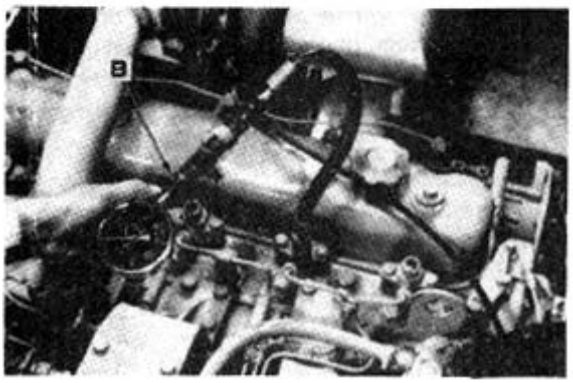


5. Connect compression gauge B to adapter.

6. Place fuel control lever in NO INJECTION position. Crank engine with starting motor and measure compression pressure.

   ⚠ If the fuel control lever is not set to the NO INJECTION position, fuel will spurt out.

   ★ If the adapter is coated with a small amount of oil, leakage is reduced.



FUEL SYSTEM

TESTING AND ADJUSTING FUEL INJECTION TIMING

Test and adjust the fuel injection timing of the fuel injection pump as follows.

- Aligning match mark.
  Use this method when the fuel injection pump is put back on the same engine without being repaired.

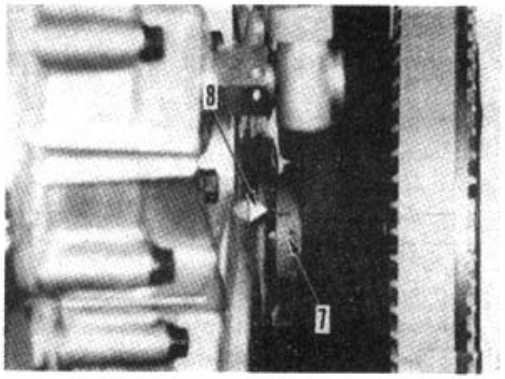
- Delivery valve check method
  Use this method when replacing or installing a repaired fuel injection pump.

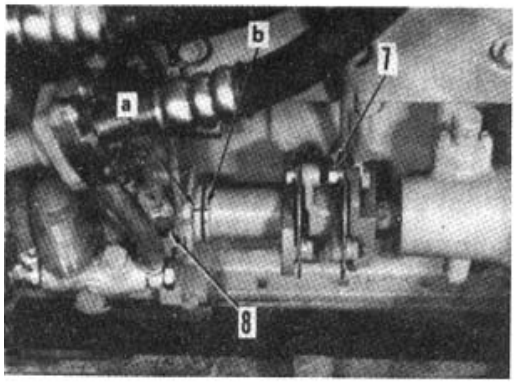
***** Set the No. 1 cylinder to compression top dead center when testing and adjusting.

***** For details, see TESTING AND ADJUSTING VALVE CLEARANCE.

Testing and adjusting by aligning match mark.

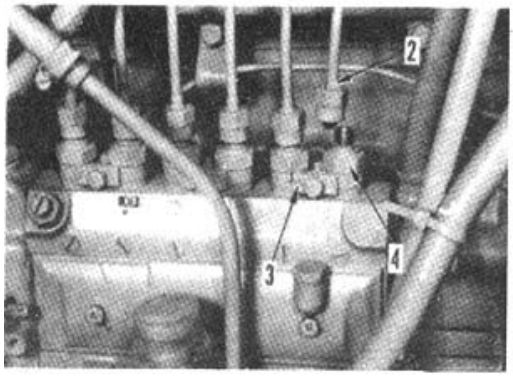
1. Set the No. 1 cylinder to top dead center, then rotate the crankshaft 30 to 40° in the reverse direction .
2. Next, rotate the crankshaft SLOWLY in the normal direction and align the fuel injection timing line on vibration damper (7) with pointer (8).





3. Check that the line “a” on the injection pump and line “b” on the coupling are aligned.
   ***** If the lines are not aligned, loosen nut (7) in the oblong hole and mounting bolt (8) of pump. Move the coupling to align the lines, then tighten the nut and mounting bolt.

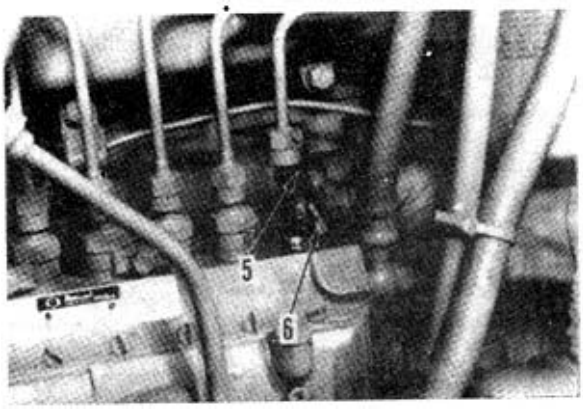
   kgm Nut : 6.2 ± 0.2 kgm



Testing and adjusting fuel injection timing by delivery valve check

1. Disconnect fuel injection tube (2) of No. 1 cyinder.
2. Remove delivery valve holder (4).

3. Remove spring (5) and delivery vlave (6) from delivery vlave holder, then install delivery valve holder again.

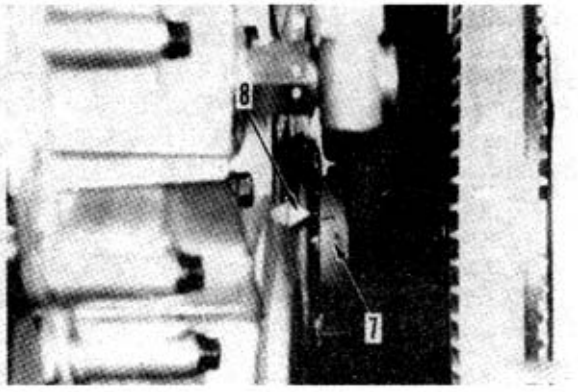


4. Place fule control lever at FULL position, then operate priming pump and rotate crankshaft slowly in normal direction. Check point where fuel stops flowing from delivery valve holder.

5. Check that fuel injection timing line on vibration damper and pointer are aligned at point where fuel stops flowing.
   * BEYOND injection timing line :
     Timing RETARDED
   * BEFORE injection timing line :
     Timing ADVANCED

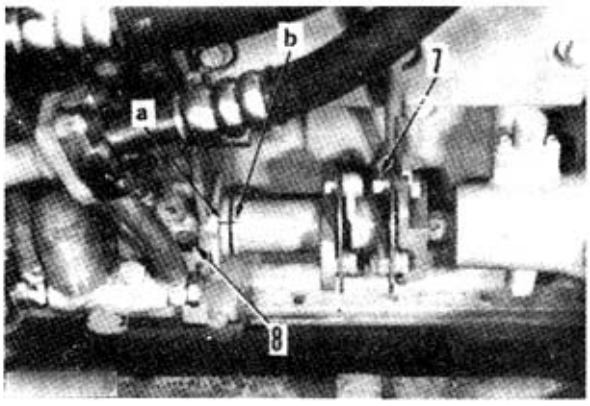
* If the test shows that the fuel injection timing is incorrect, adjust the fuel injection timing as follows.

* After testing and inspection, do not forget to assemble the spring and delivery valve again.
   1) Set the No. 1 cylinder to top dead center, then rotate the crankshft 30 to 40° in the reverse direction.



   2) Next, rotate the crankshaft in the normal direction and align the fuel injection line on damper (7) with pointer (8) correctly.

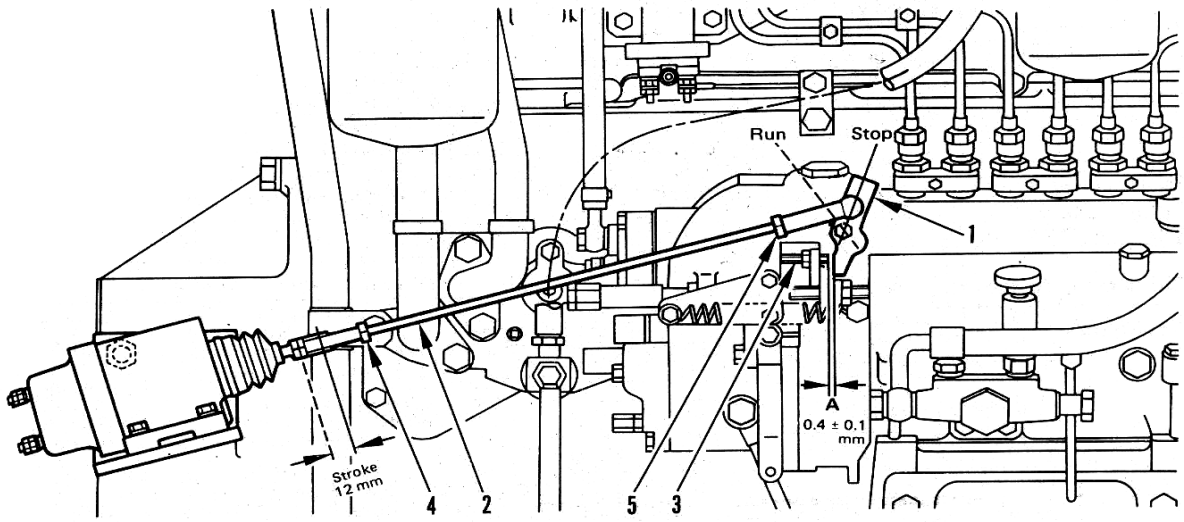
   3) Loosen nut (7) in the oblong hole of the mounting flange of the fuel injection pump, and mounting bolt (8) of the pump. Operate the priming pump and rotate the flange at pump end a little at a time. Stop at the point where the fuel stops flowing from the delivery valve holder.



   4) Tighten the nut in the oblong hole of the mounting flange of the fuel injection pump, and the mouting bolt of the pump.
      * After tightening the nut, check again that the fuel injection timing is correct.

   5) Align match mark “a” with “b” and make a mark.

ADJUSTING FUEL CUT SOLENOID (FOR WA300-1)



1. Confirm that stop lever (1) of the fuel injection pump is at the STOP position.
   (The return spring is installed to automatically position the stop lever (1) at the STOP posi -tion.)

2. Adjust rod (2) so that the solenoid has a maximum stroke of 12 mm, and so that there is clearance A of 0.4 ± 0.1 mm between stopper (3) and injection pump stop lever (1).

3. Turn on the engine starting key and confirm that the solenoid has a stroke of 12 mm, After turning on and off the key three times, recon firm the amount of the stroke of the solenoid and clearance A.

4. Tighten up nuts (4) and (5).

FIP CALIBRATION DATA :

Machine Model	Engine Model	Injection Pump Type	Pump Manufacture
BE200-1	**B6D105-1F**	PE6A	DIESEL KIKI

Pump Assembly Number
6136-71-1310(101602-3130)...2

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60°	59°30' to 60° 30'
Plunger pre-stroke	mm	3.5	3.45 to 3.55
Delivery valve Retraction volume	mm^3	59	

Specification engine with fan :

Rated horsepower	HP/rpm	105/2350
Maximum torque	kgm/rpm	40.5/1600
High idling	rpm	2450 to 2550
Low idling	rpm	800

Calibration Standard :

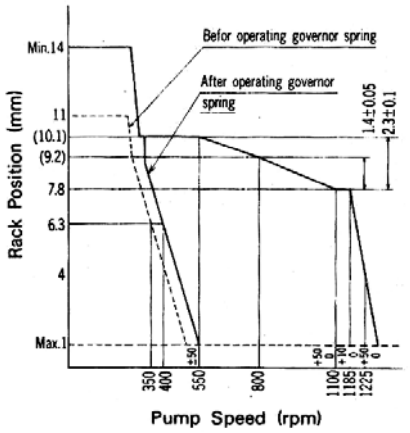
		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Conditions	Nozzle part no.		(105015-2860)	(105780-0000)
	Nozzle holder part no.		(105031-3390)	(105780-2080)
	Injection pipe (O/D × I/D × length)	mm	6 x 2 x 600	6 × 2 × 600
	Test oil		ASTM D975 No. 2 diesel fuel or equivalent	
	Oil temperature	℃	43 to 47	43 to 47
	Nozzle opening pressure	kg/cm^2	200	170
	Transfer pump pressure	kg/cm^2	1.6	1.6

Specifications

- Rack positions B to F are the reference volume when adjusting the injection volume.
- Marks ⋆ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
Calibration basic point	7.8	1175	53	Each cylinder 52 to 54	± 1.06	39.7	Each cyl 38.7 to37.7	± 0.79
B	6.3	400	18	⋆ 16.2 to 19.8	± 1.80	8.3	⋆ 6.5 to 10.1	± 0.83
C				⋆			⋆	
D				⋆			⋆	
E				⋆			⋆	
F				⋆			⋆	

Governor performance :



Machine Model	Engine Model	Injection Pump Type	Pump Manufacture
BE200-2 BE200LC-2	**B6D105-1F**	PE6A	DIESEL KIKI

Pump Assembly Number
6136-72-1310(101602-3460)... 0

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60°	59°30' to 60° 30'
Plunger pre-stroke	mm	3.5	3.45 to 3.55
Delivery valve Retraction volume	mm^3	59	

Specification engine with fan :

Rated horsepower	HP/rpm	108/2150
Maximum torque	kgm/rpm	43/1600
High idling	rpm	2300 to 2400
Low idling	rpm	800 to 900

Calibration Standard :

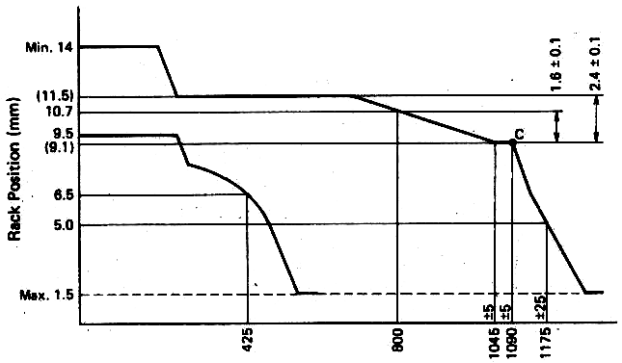
		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Conditions	Nozzle part no.			(105780-0000)
	Nozzle holder part no.			(105780-2080)
	Injection pipe (O/D × I/D × length)	mm	6 × 2 × 600	
	Test oil		ASTM D975 No. 2 diesel fuel or equivalent	
	Oil temperature	℃	43 to 47	
	Nozzle opening pressure	kg/cm²	175	
	Transfer pump pressure	kg/cm²	1.6	

Specifications

- Rack positions B to F are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
Calibration basic point	10.7	800		Each cylinder		56.5	Each cyl 55.5 to57.5	± 1.1
B	7	425		★ 16.2 to 19.8	± 1.80	8.3	★ 6.2 to 9.8	± 0.8
C				★			★	
D				★			★	
E				★			★	
F				★			★	

Governor performance :



Print C:
- Never raise pump speed over 1180 rpm.

Machine Model	Engine Model	Injection Pump Type	Pump Manufacture
BE220-1	B6D105-1F	PE6A	DIESEL KIKI

Pump Assembly Number
6136-71-1310(101602-3150)...2

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60°	59°30' to 60° 30'
Plunger pre-stroke	mm	3.3	3.25 to 3.35
Delivery valve Retraction volume	mm^3	59	

Specification engine with fan :(reference only)

Rated horsepower	HP/rpm	139/2350
Maximum torque	kgm/rpm	55.3/1700
High idling	rpm	2450 to 2550
Low idling	rpm	800

Calibration Standard :

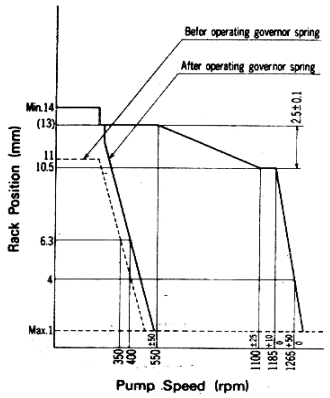
		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Conditions	Nozzle part no.		(105015-2860)	
	Nozzle holder part no.		(105031-3390)	
	Injection pipe (O/D × I/D × length)	mm	6 x 2 x 600	
	Test oil		ASTM D975 No. 2 diesel fuel or equivalent	
	Oil temperature	℃	43 to 47	
	Nozzle opening pressure	kg/cm^2	200	
	Transfer pump pressure	kg/cm^2	1.6	

Specifications

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
Calibration basic point	10.5	1175	74	Each cylinder 73 to 75	± 1.48		Each cyl	
B	6.3	400	18	★ 16.2 to 19.8	± 1.80		★	
C				★			★	
D				★			★	
E				★			★	
F				★			★	

Governor performance :



Machine Model	Engine Model	Injection Pump Type	Pump Manufacture
BE200-2 BE200LC-2	**B6D105-1F**	PE6A	DIESEL KIKI

Pump Assembly Number
6136-72-1310(101602-3560)...0

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60°	59°30' to 60° 30'
Plunger pre-stroke	mm	3.3	3.25 to 3.35
Delivery valve Retraction volume	mm^3	59	

Specification engine with fan: (reference only)

Rated horsepower	HP/rpm	140/2150
Maximum torque	kgm/rpm	57/1600
High idling	rpm	2300 to 2400
Low idling	rpm	800 to 900

Calibration Standard :

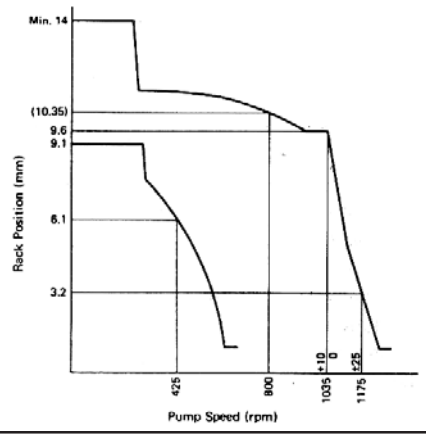
		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Conditions	Nozzle part no.		(105015-5020)	(105780-0000)
	Nozzle holder part no.		(105031-4480)	(105780-2080)
	Injection pipe (O/D × I/D × length)	mm	6 x 2 x 600	6 × 2 × 600
	Test oil		ASTM D975 No. 2 diesel fuel or equivalent	
	Oil temperature	℃	43 to 47	43 to 47
	Nozzle opening pressure	kg/cm^2	225	175
	Transfer pump pressure	kg/cm^2	1.6	1.6

Specifications

- Rack positions B to F are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
Calibration basic point	9.6	1075	64	Each cylinder 63 to 65	± 1.3		Each cyl	
B	6.3	400	8	★ 7 to 9	± 0.8		★	
C				★			★	
D				★			★	
E				★			★	
F				★			★	

Governor performance :



PUMP ASSEMBLY NUMBER
F002 A0 Z1098

Injection Pump Type	Pump Manufacture
PE-6A	MICO

Applicable Machine	Applicable Engine
BL200 G10T(ATT)	**B6D105-1**

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60° ± 30'	
Plunger pre-stroke	mm	3.25 ± 0.05	
Delivery valve Retraction volume	mm^3	90	

Specification engine:(reference only)

Rated horsepower	HP/rpm	108.4 @ 2400
Maximum torque	kgm/rpm	40 @ 1600
High idling	rpm/min	2590 to 2690
Low idling	rpm/min	700 to 750

Calibration Standard :

Conditions		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Service standard indicates data using calibration test parts	Nozzle part no.		EA43123500	-
	Nozzle holder part no.		F002 C70 200	-
	Injection pipe (O/D × I/D × length)	mm	⌀6 x 2 x 600	-
	Test Fuel		ASTM D975 No. 2 diesel fuel	
Manufacturer standard data for factory test.	Fuel temperature	℃	-	-
	Nozzle opening pressure	kg/cm^2	-	-
	Transfer pump pressure	kg/cm^2	-	-

Injection Volume

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ⋆ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis (Each cylinder)	Allowance (Each cylinder)	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
A	-	-	-		-	-	-	-
B	-	-	-		-	-	-	-
C	-	-	-		-	-	-	-
D	-	-	-		-	-	-	-
E	-	-	-		-	-	-	-

PUMP ASSEMBLY NUMBER

11Z7100555

Injection Pump Type	Pump Manufacture
PE-6A	MICO

Applicable Machine	Applicable Engine
BD50	**BS6D105-1**

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60° ± 30'	
Plunger pre-stroke	mm	3.5 ± 0.05	
Delivery valve Retraction volume	mm^3	90	

Specification engine : (reference only)

Rated horsepower	HP/rpm	74.6 @ 1750
Maximum torque	kgm/rpm	466 @ 1100
High idling	rpm/min	1950 to 2050
Low idling	rpm/min	650 to 700

Calibration Standard :

Conditions		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Service standard indicates data using calibration test parts	Nozzle part no.		F002C30207	-
	Nozzle holder part no.		11Z7101843	-
	Injection pipe (O/D × I/D × length)	mm	⌀6 x 2 x 600	-
	Test Fuel		ASTM D975 No. 2 diesel fuel	
Manufacturer standard data for factory test.	Fuel temperature	℃	38 to 42	-
	Nozzle opening pressure	kg/cm^2	180	-
	Transfer pump pressure	kg/cm^2	1.0	-

Injection Volume

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard (Each cylinder) Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard Basis	Allowance	Maximum variance between cylinder
A	10	750	88.5 ± 2 ★		4	-	-	-
B	11± 0.5	720	101 ± 2 ★		≤4	-	-	-
C	6.6	500	12 ± 2 ★		≤4	-	-	-
D	-	-	-		-	-	-	-
E	-	-	-		-	-	-	-

PUMP ASSEMBLY NUMBER

F002 A0 Z1098

Injection Pump Type	Pump Manufacture
PE-6A	MICO

Applicable Machine	Applicable Engine
BG605BX G12T(ATT)	**BS6D105-1**

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60° ± 30'	
Plunger pre-stroke	mm	3.25 ± 0.05	
Delivery valve Retraction volume	mm^3	90	

Specification engine: (reference only)

Rated horsepower	HP/rpm	135.4 @ 2400
Maximum torque	kgm/rpm	44.9 @ 1700
High idling	rpm/min	2590 to 2690
Low idling	rpm/min	700 to 750

Calibration Standard :

Conditions		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Service standard indicates data using calibration test parts	Nozzle part no.		EA43123500	-
	Nozzle holder part no.		F002 C70 200	-
	Injection pipe (O/D × I/D × length)	mm	6 x 2 x 600	-
	Test Fuel		ASTM D975 No. 2 diesel fuel	
Manufacturer standard data for factory test.	Fuel temperature	℃	-	-
	Nozzle opening pressure	kg/cm^2	-	-
	Transfer pump pressure	kg/cm^2	-	-

Injection Volume

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard (Each cylinder) Basis	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard Basis	Allowance	Maximum variance between cylinder
A	-	-	-		-	-	-	-
B	-	-	-		-	-	-	-
C	-	-	-		-	-	-	-
D	-	-	-		-	-	-	-
E	-	-	-		-	-	-	-

FIP CALIBRATION CHART

PUMP ASSEMBLY NUMBER

11Z7100555

Injection Pump Type	Pump Manufacture
PE-6A	MICO

Applicable Machine	Applicable Engine
100 kVA	**BS6D105G**

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60° ± 30'	
Plunger pre-stroke	mm	3.25 ± 0.05	
Delivery valve Retraction volume	mm^3	90	

Specification engine: (reference only)

Rated horsepower	HP/rpm	117 @ 1500
Maximum torque	kgm/rpm	-
High idling	rpm/min	1555 to 1565
Low idling	rpm/min	975 to 1025

Calibration Standard :

Conditions

Service standard indicates data using calibration test parts

Manufacturer standard data for factory test.

	Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Nozzle part no.		F002C30207	-
Nozzle holder part no.		11Z7101843	-
Injection pipe (O/D × I/D × length)	mm	⌀6 x 2 x 600	-
Test Fuel		ASTM D975 No. 2 diesel fuel	
Fuel temperature	℃	38 to 42	-
Nozzle opening pressure	kg/cm^2	235	-
Transfer pump pressure	kg/cm^2	1.0	-

Injection Volume

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis (Each cylinder)	Allowance	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
A	10	750	88.5 ± 2 ★		4	-	-	-
B	11± 0.5	720	101 ± 2 ★		≤4	-	-	-
C	6.6	500	12 ± 2 ★		≤4	-	-	-
D	-	-	-		-	-	-	-
E	-	-	-		-	-	-	-

FIP CALIBRATION CHART

PUMP ASSEMBLY NUMBER

11Z7100555

Injection Pump Type	Pump Manufacture
PE-6A	MICO

Applicable Machine	Applicable Engine
125 kVA	**BSA6D105G**

Injection Timing :

	Unit	Basis	Allowance
Rotating direction		clockwise viewed from drive end	
Injection order		1 - 5 - 3 - 6 - 2 - 4	
Injection interval		60° ± 30'	
Plunger pre-stroke	mm	3.25 ± 0.05	
Delivery valve Retraction volume	mm^3	90	

Specification engine: (reference only)

Rated horsepower	HP/rpm	150 @ 1500
Maximum torque	kgm/rpm	-
High idling	rpm/min	1555 to 1565
Low idling	rpm/min	975 to 1025

Calibration Standard : Conditions		Unit	Manufacture standard (with nearly the same actual machine parts)	Service standard (with calibration test parts)
Service standard indicates data using calibration test parts	Nozzle part no.		F002C30207	-
	Nozzle holder part no.		11Z7101843	-
	Injection pipe (O/D × I/D × length)	mm	⌀6 x 2 x 600	-
	Test Fuel		ASTM D975 No. 2 diesel fuel	
Manufacturer standard data for factory test.	Fuel temperature	℃	38 to 42	-
	Nozzle opening pressure	kg/cm^2	235	-
	Transfer pump pressure	kg/cm^2	1.0	-

Injection Volume

- Rack positions B to E are the reference volume when adjusting the injection volume.
- Marks ★ are avg volumes.

	Rack Position (rpm)	Pump Speed (rpm)	Injection volume (cc/1000st) for manufacturer standard: Basis (Each cylinder)	Allowance (Each cylinder)	Maximum variance between cylinder	Injection (cc/1000st) for service standard: Basis	Allowance	Maximum variance between cylinder
A	10.4	750	120 ± 2 ★		4	-	-	-
B	11.6	720	133 ± 2 ★		≤4	-	-	-
C	6.5	500	12 ± 2 ★		≤4	-	-	-
D	-	-	-		-	-	-	-
E	-	-	-		-	-	-	-

PERFORMANCE TEST
TESTING METHOD OF PERFORMANCE

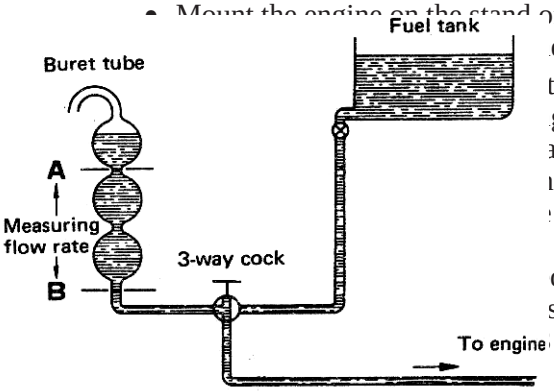
★ When the engine was overhauled or was given an extensive repair, this test is done to check the enigne for performance and pressnece of abnormal ties after assembly.

1. OIL SUPPLY

- Supply the engine oil, CLASS-CD SAE30 (CLASS-CD SAE10W if temperature is 0° within) until it goes as far as to the making H of the oil level gauge.
- When the injection pump was removed and repaired, supply about 200 cc of the same oil to the governor room of the pump and about 60 cc to the cam room.

2. INSTALLATION TO THE DYNOMOMETER

- Mount the engine on the stand of the
- Check the dynamometer for levelling and functions.



e saucer to the
than 6 (10 ,
gine on the stand
ard to all direction,
d backward.Then,
engine to the

d at the engine
should be, if the
mm of full deflec-

3. WIRING AND PIPING

- Make all connections to the cooling system using the pipe.
- Make all connections to the fuel system, and pour the fuel to the fuel filter.
- Install the startup switch, set-motor, and thermostat to the 24V 120AH2 battery, and distribute all wires between them.
- Install the exhaust pipes in a manner that they do not affect the intake air temperature as much as possible.
- Install the fuel control lever.

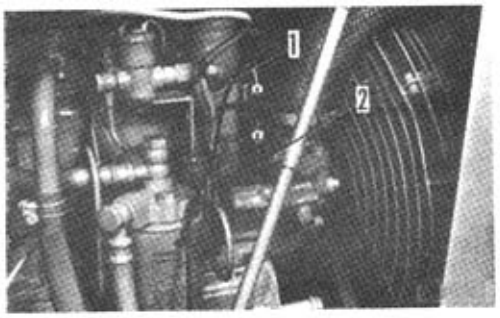
4. INSTALLATION OF MEASURE DEVICES

- **Engine tachometer**
  The tachometer equipped with a dynamometer gives, in general, relatively large error in measurements because of its wide speed range. Therefore, advisable to take measurement by placing the clocktype tachometer (Hussier tachometer, minimum graduation : 5 rpm) on the edge of the dynamometer, or by installing to the shaft of the dynamometer the electromagnetic pickup which is connected to the counter.

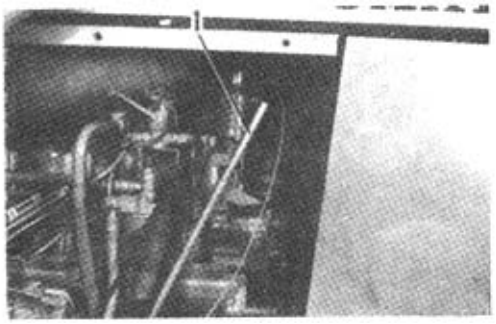
- **Measurement apparatus for fuel consumption**
  Connect the 3-way cock and burret tube between engine and the fuel tank as follows. (Measuring accuracy : 1%)

- **Thermostat for intake air**
  Install the bar thermostat or thermistor thermometer at the inlet of the air cleaner. (Minimum graduation: 1° C)
- **Thermostat for exhasut air**
  Install the termcouple on the exhaust pipe approximately 50 mm from the flange of the exhaust manifold outlet. If cold junction is not provided for the thermocouple, measurements are subject to the effect of room temperature.
  As thermometer, Alumel-chromel thermo couple is recommended. (Minimum graduation: 1° C).
- **Thermometer for coolant**
  Install the bar thermostat (adapter is neccessary) or the thermistor thermometer to the outlet for water temperature gauge provided on the top of the cylinder head.(Minimum graduation: 10° C).

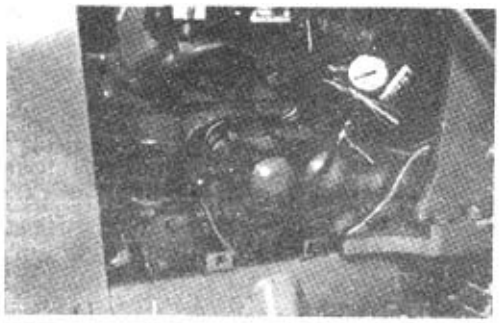
- **Oil temperature gauge**
  Install the thermistor thermometer (adapter (2) is neccesary) on the main gallery of the engine. (Minimum graduation : 1° C).



- **Oil pressure gauge**
  Install the pipe to the outlet for oil pressure provided on the oil filter bracket, and connect the oil pressure gauge.
  The oil pressure gauge must be installed so as not to be affected directly by the vibration of the engine. (Measuring accuracy : 0.2 kg/cm²)



- **RUN-IN**
  After the engine has been repaired, perform the Run-in according to the standard proce dure so that the piston and piston ring can get good familiarity with sliding areas such as cylinder liner and bearings for smooth running of the engine.



1) Before starting engine, make sure the followings.

- Each part of the engine, and tightness of the engine seatbolts
- Tension of the fan-belt.
- Replacement of the engine oil and coolant.
- Oil supply to each part of the dynamameter injection timing.

* The fan must be removed.

- When starting up the engine, place the lever in NO INJECTION position, and idle with the starting motor for 15 - 20 seconds during which make sure the following.
  1. The dial of the oil pressure gauge deflects.
  2. The engine runs smoothly without any abnormal sound.
     Do not idle the starting motor for more than 20 seconds.

2) During running of the engine, make sure the followings.

- **Lube oil**

1. Oil level is between H and L of the dipstick.
2. Oil pressure is between 1.0 and 6.0kg/cm².
3. Coolant is not entered in the oil.

- **Coolant**

1. After startup of the engine, replenish the coolant as neccessary to as th fill the cooling system with coolant.
2. Temperature of the coolant is maintained at 70 - 80°C.

- **Exhaust color**
- **Presenece of leakage of coolant, oil and compressed gases.**
- **Abnormal sound on each part**
- **Tightness of each part installed**
- **Abnormality of blowby**

3) After Run-in, make sure the following.

- Check the oil. If badly dirted, replace with new oil.
- Adjust the valve clearance.

6. POWER ADJUSTMENT AND PER FORMANCE TEST

1. Standard performance test

The flywheel horsepower is the valve of the measured power multiplied by (JIS) modification factor. This valve should exceed 96% of the lower limit specified in the Standard Performance Test.

- (JIS) modification factor is shown on table 1. 2 (page 12-084, 085).
- Make sure the engine performance trans fers smoothly, refering to the performance curve at shipment from the factory (See PERORMANCE CURVE.)
- According to the degree of overhaul or adjustment, the engine performance may be below the standard values.
- The vlaues shown in the standard peroformance test differs from those in the specifications, because the standard test is done without the fan.

2. Conditions for performance test

- **Alternator : No load**
- **Air cleaner : Installed**
- **Fuel injection timing : 21° before the top dead center**
- **Fuel used : ASTM D975 No.2 diesel fuel**
- **Lubrication oil used : Engine oil CLASS-CD SAE30**

RUN-IN CRITERIA

(B6D105-1)

***** Loads are given for the case of the dynamometer arm length : 716 mm
Tolerance for load shall be ± 1 kg of the dynamometer scale.

Engine model	Item		1	2	3	4	5	6
B6D105-1 (For BE200-1)	Running time	(min)	5	10	10	15	15	5
	Engine speed	(rpm)	800 ± 25	1180	1480	1860	2140	2350
	Load	(kg)	0	6	12	24	36	48.5
	Output	(HP)	0	6.8	13.6	43.2	74.7	110.6
B6D105-1 (For BE200-1) BE200LC-2	Running time	(min)	5	10	10	15	15	5
	Engine speed	(rpm)	850 ± 50	1080	1350	1700	1960	2150
	Load	(kg)	0	6	13	26	39	52.1
	Output	(HP)	0	6.3	17.0	42.7	74.7	108.6

RUN-IN CRITERIA

(BS6D105-1)

***** Load are given for the case of the dynamometer arm length : 716 mm
Tolerance for load shall be ± 1 kg of the dynamometer scale.

Engine model	Item		1	2	3	4	5	6
BS6D105-B-1 (For BE200-3, BE200LC-3)	Running time	min	5	10	10	50	15	5
	Engine speed	r/min	800+50 0	1050	1260	1680	1890	2100
	Load	kg	0	7	15	30	46	59
	Output	hp	0	7.3	18.4	48.5	84.4	137.7
BS6D105-1 (For BE220-1)	Running time	min	5	10	10	15	15	5
	Engine speed	r/min	800+50 0	1180	1480	1680	2140	2350
	Load	kg	0	8	16	30	47	62
	Output	hp	0	9.2	18.4	55.8	97.5	141.1
BS6D105-1 (For BE220-2, BE220LC-2)	Running time	min	5	10	10	15	15	5
	Engine speed	rpm	800+50 0	1080	1350	1700	1960	2150
	Load	kg	0	9	17	34	51	68
	Output	hp	0	9.7	22.3	56.3	97.0	141.6
BS6D105-1 (For BE220-2) BE220LC-2)	Running time	min	5	10	10	15	15	5
	Engine speed	r/min	850+50 0	1050	1260	1680	1890	2100
	Load	kg	0	9	18.5	37.5	58	75
	Output	hp	0	9.2	22.8	61.1	106.7	152.3

BD50, 100kVA, 125kVA

***** Load are given for the case of the dynamometer with 954.9 mm arm length.

***** The values shown below are at standard condition and without fan.

Engine model	Item		Order 1	2	3	4	5	6
BS6D105-1 (For BD50)	Running time	min	5	10	20	20	5	-
	Engine speed	r/min	LI	1200	1400	1600	1750	-
	Load	Nm	-	106	212	318	422	-
	Output	kW	-	13	31	53	77	-
BS6D105G (For 100 kVA)	Running time	min	5	5	20	20	5	-
	Engine speed	r/min	LI	1100	1200	1300	1400	1500
	Load	Nm	-	80	155	310	465	560
	Output	kW	-	9	19	42	68	88
BSA6D105G (For 125 kVA)	Running time	min	5	5	10	10	15	15
	Engine speed	r/min	LI	1100	1200	1300	1400	1500
	Load	Nm	-	100	210	350	525	660
	Output	kW	-	12	26	48	77	104
B6D105-1 (For BL200 & G10T)	Running time	min	5	10	10	15	15	5
	Engine speed	r/min	LI	1100	1500	1800	2100	2400
	Load	Nm	-	42	84	168	252	308
	Output	kW	-	5	13	32	55	77
BS6D105-1 (For BG605BX & G12T (ATT)	Running time	min	5	10	10	15	15	5
	Engine speed	r/min	LI	1200	1500	1900	2200	2400
	Load	Nm	-	52	105	209	314	405
	Output	kW	-	7	16	42	72	102

PERFORMANCE TEST CRITERIA

B6D105-1

* In this list, the axial torque and output are different from the specified valve, because they are obtained wihtout the fan .
* This list shows the standard on condition that the air cleaner is installed, the dynamo is no-load and air compressor is no - load.
* The load on the dynamometer is for the case of dynamometer arm length : 716 mm.
* Marine engine rated flywheel horsepower $^{0}_{-5}$% is standard of engine output.

Engine model	Test Item	Specified Value	Enigne Speed (rpm)	Dynamometer (kg)	Axial output
B6D105-1 (For BE200-1)	Flywheel horsepower	105 HP/2350 rpm	2350 ± 5	47.2 - 49.8	107.5 - 113.7
	Maximum Torque	40.5 kgm/1600 rpm	1600 ± 100	56.0 - 59.3	-
	High idling speed	2550 ± 50 rpm	2550 ± 50	0	0
	Low Idling speed	825 ± 25	825 ± 25	0	0
B6D105-1 (For BE200-2) BE200LC-2	Flywheel horsepower	105 HP/2150 rpm	2150 ± 5	50.6 - 53.6	105.5 - 113.7
	Maximum torque	43 kgm/1600 rpm	1600 ± 100	59.2 - 62.8	-
	High idling speed	2350 ± 50 rpm	2350 ± 50	0	0
	Low idling speed	850 ± 25	850 ± 50	0	0

Torque (kgm)	Fuel comsumption (sec./300 cc)	Coolant Temperature(°C)	Lube oil temp--erature (°C)	Lube oil prssure (kg/cm²)	Exhaust temp (°C) (t: Air Intake temp.20°C)
-	Min. 28.2	70 - 80	90 - 110	3.5 - 5.5	Max. 650 + 3t
40.1 - 42.5	Min. 36.0	70 - 80	90 - 110	-	Max. 650 + 3t
0	-	70 - 80	90 - 110	-	-
0	-	70 - 80	Min. 80	Min. 1.5	-
-	Min. 30.4	70 - 80	90 - 115	3.5 - 5.5	Max. 650 + 3t
42.4 - 45.0	Min. 34.5	70 - 80	90 - 115	-	Max. 650 + 3t
0	-	70 - 80	90 - 115	-	-
0	-	70 - 80	Min. 80	Min. 1.5	-

BS6D105-1

Engine model	Test Item	Specified Value	Enigne Speed (rpm)	Dynamometer (kg)	Axial output
BS6D105-1 (For BE220-1)	Flywheel horsepower	136 HP/2350 rpm	2350 ± 5	60.5 - 63.8	137.7 - 145.5
	Maximum Torque	57 kgm/1700 rpm	1600 ± 100	78.4 - 83.9	-
	High idling speed	2550 ± 50 rpm	2550 ± 50	0	0
	Low Idling speed	825 + 50 rpm	825 ± 25	0	0
		0			
BS6D105-1 (For BE200-2) BE200LC-2	Flywheel horsepower	105 HP/2150 rpm	2150 ± 5	66.0 - 70.0	137.7 - 145.9
	Maximum torque	43 kgm/1600 rpm	1600 ± 100	78.8 - 83.5	-
	High idling speed	2350 ± 100 rpm	2350 ± 50	0	0
	Low idling speed	800 ± 50 rpm	850 ± 50	0	0
BS6D105-1 (For BE200-3) BE200LC-3	Flywheel horsepower	105 HP/2100 rpm	2100 ± 5	57.0 - 60.4	147.7 - 156.8
	Maximum torque	56.5 kgm/1400 rpm	1400 ± 100	66.6 - 70.8	-
	High idling speed	2300 ± 50 rpm	2300 ± 50	0	0
	Low idling speed	850 ± 50 rpm	850 ± 50	0	0
BS6D105-1-B-1 (For BE200-3) BE200LC-3	Flywheel horsepower	118 HP/2100 rpm	2100 ± 5	53.7 - 60.9	116.9 - 124.1
	Maximum torque	47 kgm/1600 rpm	1600 ± 100	64.8 - 68.8	-
	High idling speed	2300 ± 50 rpm	2300 ± 50	0	0
	Low idling speed	850 ± 50 rpm	850 ± 50	0	0

Torque (kgm)	Fuel comsumption (sec./200 cc)	Coolant Temperature(°C)	Lube oil temp--erature (°C)	Lube oil prssure (kg/cm²)	Exhaust temp (°C) (t: Air Intake temp 20°C)
-	28.2 - 24.1	70 - 80	90 - 110	3.5 - 5.5	Max. 650 + 3t
56.1 - 60.0	27.5 - 29.5	70 - 80	90 - 110	-	Max. 650 + 3t
0	-	70 - 80	90 - 110	-	-
0	-	70 - 80	Min. 80	Min. 1.5	-
-	Min. 23.9	70 - 80	90 - 110	3.5 - 5.5	Max. 650 + 3t
56.4 -59.8	Min. 27.4	70 - 80	90 - 110	-	Max. 650 + 3t
0	-	70 - 80	90 - 110	-	-
0	-	70 - 80	Min. 80	Min. 1.5	-
		70 - 80	90 - 110	3.5 - 5.5	Max. 650 + 3t
		70 - 80	90 - 110	-	Max. 650 + 3t
	-	70 - 80	90 - 110	-	-
	-	70 - 80	Min. 80	Min. 1.5	-
-		70 - 80	90 - 110	3.5 - 5.5	Max. 650 + 3t
46.4 - 49.3		70 - 80	90 - 110	-	Max. 650 + 3t
0	-	70 - 80	90 - 110	-	-
0	-	70 - 80	Min. 80	Min. 1.5	-

BD50, 100 kVA, 125 kVA, BL200, G10T(ATT)

Engine model	Test Item	Specified Value	Enigne Speed (rpm)	Dynamometer (kg)
B6D105-1 (For BL200 / G10T(ATT)	Flywheel horsepower	81 kW/ 2400 rpm	-	-
	Maximum Torque	392Nm @ 1600 rpm	-	-
	High idling speed	2640 ± 50 rpm	2590 ~ 2690	0
	Low Idling speed	700 $^{+50}_{-0}$ rpm	700 ~ 750	0
BS6D105-1 (For BD50)	Flywheel horsepower	74.6 kW/ 1750 rpm	1745 ~ 1755	43.8 ~ 46.7
	Maximum Torque	466 Nm/ 1100/rpm	1000 ~ 1200	48.3 ~ 51.2
	High idling speed	2000 ± 50 rpm	1950 ~ 2050	0
	Low Idling speed	650 $^{+50}_{-0}$ rpm	650 ~ 700	0
BS6D105-1 (For BG605BX/ G12T(ATT)	Flywheel horsepower	101 kW/ 2400 rpm	2400	-
	Maximum Torque	440 Nm/ 1700/rpm	1600 ~ 1800	-
	High idling speed	2640 ± 50 rpm	2590 ~ 2690	0
	Low Idling speed	700 $^{+50}_{-0}$ rpm	650 ~ 750	0
BS6D105G (For 100 kVA)	Flywheel horsepower	87 kW/ 1500 rpm	1498 ~ 1503	58.5 ~ 61.5
	Maximum Torque	-	-	-
	High idling speed	1560 ± 5 rpm	1555 ~ 1565	0
	Low Idling speed	1000± 25 rpm	975 ~ 1025	0
BSA6D105G (For 125 kVA)	Flywheel horsepower	111 kW/ 5000 rpm	1498 ~ 1503	73 ~ 77
	Maximum Torque	-	-	-
	High idling speed	1560 ± 5 rpm	1555 ~ 1565	0
	Low Idling speed	1000± 25 rpm	975 ~ 1025	0

* The values in the table are indicated at standard condition (atmospheric temperature 25°C, and atmospheric pressure 743 mm Hg.).
* The values given for the 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 and air cleaner installed: alternator and air compressor (if installed) under no load.
* Dynamometer loads are given for the case of the arm length is 954.9 mm.
* Fuel : ASTM D975 No. 2 diesel fuel.
* Lubrication oil : CLASS-CD SAE30.

Output (kW)	Torque (Nm)	Fuel comsumption (sec./300 cc)	Coolant Temperature(°C)	Lube oil temp--erature (°C)	Lube oil prssure (kg/cm²)	Exhaust temperature (°C)
-	-	-	70 - 80	80 - 110	3.0 - 5.0	Max. 650
-	-	-	70 - 80	80 - 110	-	Max. 650
0	0	-	70 - 80	80 - 110	-	-
0	0	-	70 - 80	Min. 80	Min. 1.5	-
71 ~ 79	-	-	70 - 80	80 - 110	3.0 - 5.0	Max. 650
-	443 ~ 489	-	70 - 80	80 - 110	-	Max. 650
0	0	-	70 - 80	80 - 110	-	-
0	0	-	70 - 80	Min. 80	Min. 1.5	-
-	-	-	70 - 80	80 - 110	3.0 - 5.0	Max. 650
-	-	-	70 - 80	80 - 110	-	Max. 650
0	0	-	70 - 80	80 - 110	-	-
0	0	-	70 - 80	Min. 80	Min. 1.5	-
87 ~ 89	-	-	70 - 80	80 - 110	3.0 - 5.0	Max. 650
-	550 ~ 567	-	70 - 80	80 - 110	-	Max. 650
0	0	-	70 - 80	80 - 110	-	-
0	0	-	70 - 80	Min. 80	Min. 1.5	-
111 ~ 114.5	-	-	70 - 80	80 - 110	3.0 - 5.0	Max. 650
-	706 ~ 730	-	70 - 80	80 - 110	-	Max. 650
0	0	-	70 - 80	80 - 110	-	-
0	0	-	70 - 80	Min. 80	Min. 1.5	-

NOTE: "*" If the engine operates at high altitude, the power and torque to be derated as follows

For 10,000 ft to 13,000 ft : -10%
For 13,000 ft and above : -15%

AS SPECIFIED IN PUMP ASSY. (SHEET No.029)

TESTING AND ADJUSTING DATA
B6D105-1 , BS6D105-1

Classification	Item	Condition,etc	Unit	B6D105-1		BS6D105-1	
				Standard Value	Permissible Value	Standard Value	Permissible Value
Intake and exhaust system	Necessary Starting engine speed (with starting aid)	At ambient temperature of 0° C	rpm	Min. 150	-	Min. 150	-
		At ambient temperature of -20° C (with starting aid)		Min. 100	-	Min. 100	-
	Intake resistance	At flywheel horse power	mmH_2O	Max. 380	635	Max. 380	635
	Exhaust temperature	When intake air temp is 20° C)	° C	Max. 650	Max. 650	Max. 650	Max.650
	Exhaust gas color	At abrupt acceleration	Bosch Index	Max. 5.5	6.5	Max. 5.5	6.5
		At high idling		Max. 1.0	2.0	Max. 1.0	2.0
	Valve clearance (when engine is cold.)	Intake valve	mm	0.25	-	0.25	-
		Exhaust valve	mm	0.45	-	0.45	-
body	Compression Pressure	Oil temperature: 40° C to 60° C, Engine speed 320 to 360 rpm	Kg/cm^2	Min. 32.0	22.0	Min. 29.0	20.0
	Blow-by pressure	At high idling , oil temperature: Min. 60° C	mmH_2O	Max.100	200	Max. 100	200
Lubrication system	Oil pressure, (SAE30 ,Min. 80° C)	At high idling	Kg/cm^2	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5
		At low idling	Kg/cm^2	Min. 1.0	0.7	Min. 1.5	0.7
	Oil temperature	In oil pan	° C	80 - 110	120	80 - 110	120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	1.0	Max. 0.5	1.0
	Injection pressure	-	Kg/cm^2	225 ± 10	180	225 ± 10	180
Fuel	Injection timing					:15 :16 BE220 - 2 :18 BE200 - 3 : 20 BE220 - 3	-
Cooling system	Coolant temperature	Engine outlet water temp.	° C	70 - 80	100	70 - 80	100
		Valve opening temperature	° C	74.5 - 78.5	74.5 - 78.5	74.5 - 78.5	74.5 - 78.5
		Temperature when fully open	° C	90	-	90	-
		Lift when fully open	mm	10 ± 0.5	10 ± 0.5	10 ± 0.5	10 ± 0.5
	Fan belt tension	Sag at 6 kg finger pressure	mm	10	5 - 15	10	5 - 15

TESTING AND ADJUSTING DATA
BD50, 100kVA, 125kVA

	Engine model			BS6D105-1		BS(A)6D105G	
	Applicable machine model			BD50		100 kVA / 125 kVA	
Classification	Item	Condition,etc	Unit	Standard Value	Permissible Value	Standard Value	Permissible Value
Performance	Engine speed	High idling speed	rpm	2000 ± 50	-	1560 ± 5	-
		Low idling speed	rpm	675 ± 25	-	1000 ± 25	-
	Necessary Starting engine speed	@ 0° C	rpm	Min.150	-	Min.150	-
		@ -20° C (with starting aid)	rpm	Min.100	-	Min.100	-
Intake and exhaust system	Intake resistance	At all speed	mmH_2O	Max. 300	Max. 635	Max. 150	Max. 635
	Allowable Ex.back pressure	At roted output	mmH_2O	Max. 75	-	Max. 75	-
	Exhaust temperature (Turbine inlet temp.)	At all speed	° C	Max. 650	Max. 650	Max. 650	Max.650
	Exhaust gas color	At rated output	Bosch	Max. 3.0	-	Max. 3.0	-
		At high idling	Unit	Max. 1	-	Max. 1	-
	Valve clearance (when engine is hot or cold.)	Intake valve	mm	0.25	-	0.25	-
		Exhaust valve	mm	0.45	-	0.45	-
Engine body	Compression Pressure	Oil temperature: 40° C to 60° C, (Engine speed)	Kg/cm^2 rpm	Min. 29 (320-360	20 (320-360)	Min. 29 (320-360)	20 (320-360)
	Blow-by pressure (SAE30 OIL)	At rated ouput Water temper. Min. 70° C	mmH_2O	Max.100	Max.100	Max. 100	Max.100
Lubrication system	Oil pressure, (Oil temperature Min. 800° C)	At rated output SAE30 Oil	Kg/cm^2	3.0 - 5.0	Min.2.1	3.0 - 5.0	Min.2.1
		SAE10W Oil	Kg/cm^2	2.5 - 4.5	Min. 1.8	2.5 - 4.5	Min. 1.8
		At low idling SAE30 Oil	Kg/cm^2	Min.1.5	Min. 0.7	Min.1.5	Min. 0.7
		SAE10W Oil	Kg/cm^2	Min.1.0	Min. 0.7	Min.1.0	Min. 0.7
	Oil temperature	All speed (oil in oil pan)	° C	80 - 110	Max.120	80 - 110	Max.120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	Max.1.0	Max. 0.5	Max.1.0
Fuel	Fuel injection pressure	Nozzle tester	Kg/cm^2	225 ± 10	Max.180	225 ± 10	Max.180
	Fuel injection timing	B.T.D.C	degree	22 ± 1	22 ± 1	22 ± 1	22 ± 1
Cooling system	Radiator pressure Value	Opening pressure (Differential pressure)	Kg/cm^2	0.75 ± 0.1	0.75 ± 0.1	0.75 ± 0.1	0.75 ± 0.1
	Fan speed	At rated engine speed	rpm	1733 ± 50	1733 ± 50	1733 ± 50	1733 ± 50
	Fan belt tension	Deflection when pushed with a force of 6kg	mm	10	5-15	10	5-15

* The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output. Donot use these values as a guide to change the setting of the fuel injection pump.

TESTING AND ADJUSTING DATA
BL200, G10T, BG605BX, G12T(ATT)

	Engine model			B6D105-1		BS6D105-1	
	Applicable machine model			BL200 / G10T (ATT)		BG605BX / G12T (ATT)	
Classification	Item	Condition,etc	Unit	Standard Value	Permissible Value	Standard Value	Permissible Value
Performance	Engine speed	High idling speed	rpm	2640 ± 50	-	2640 ± 50	-
		Low idling speed	rpm	700 $^{+50}_{0}$	-	700 $^{+50}_{0}$	-
	Necessary Starting engine speed	@ 0° C	rpm	Min.150	-	Min.150	-
		@ -20° C (with starting aid)	rpm	Min.100	-	Min.100	-
Intake and exhaust system	Intake resistance	At all speed	mmH_2O	Max. 380	Max. 635	Max. 380	Max. 635
	Allowable Ex.back pressure	At roted output	mmH_2O	-	-	-	-
	Exhaust temperature (Turbine inlet temp.)	At all speed	° C	Max. 650	Max. 650	Max. 650	Max. 650
	Exhaust gas color	At rated output	Bosch	Max. 5.5	6.5	Max. 5.5	6.5
		At high idling	Unit	Max. 1	2.0	Max. 1	2.0
	Valve clearance (when engine is hot or cold.)	Intake valve	mm	0.25	-	0.25	-
		Exhaust valve	mm	0.45	-	0.45	-
Engine body	Compression Pressure	Oil temperature: 40° C to 60° C, (Engine speed)	Kg/cm^2 rpm	Min. 32.0 (320-360	22.0 (320-360)	Min. 29.0 (320-360	20.0 (320-360)
	Blow-by pressure (SAE30 OIL)	At rated ouput Water temper. Min. 70° C	mmH_2O	Max.100	Max.200	Max.100	Max.200
Lubrication system	Oil pressure, (Oil temperature Min. 800° C)	At rated output SAE30 Oil	Kg/cm^2	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5	3.5 - 5.5
		SAE10W Oil	Kg/cm^2	-	- -	-	
		At low idling SAE30 Oil	Kg/cm^2	Min.1.	Min. 0.7	Min.1.5	Min. 0.7
		SAE10W Oil	Kg/cm^2	-	-		
	Oil temperature	All speed (oil in oil pan)	° C	80 - 110	Max.120	80 - 110	Max.120
	Oil consumption ratio	At continuous rated output (Ratio of fuel consumption)	%	Max. 0.5	Max.1.0	Max. 0.5	Max.1.0
Fuel	Fuel injection pressure	Nozzle tester	Kg/cm^2	225 ± 10	Max.180	225 ± 10	Max.180
	Fuel injection timing	B.T.D.C	degree	20	20	-	-
Cooling system	Radiator pressure Value	Opening pressure (Differential pressure)	Kg/cm^2	-	-	-	-
	Fan speed	At rated engine speed	rpm	-	-	-	-
	Fan belt tension	Deflection when pushed with a force of 6kg	mm	10	5-15	10	5-15

* The values given in the TESTING AND ADJUSTING DATA are NOT for adjustment of the output.
Donot use these values as a guide to change the setting of the fuel injection pump.

TESTING AND ADJUSTING TOOL LIST

No.	Inspection and measuring item	Tool	Part No.	Remarks
1	Engine speed	Tachometer	799-203-8000	Digital reading 60 ~ 2,000 rpm
2	Battery Specific Gravity	Battery, coolant tester	795-500-1000	1.100 ~ 1.300
3	Coolant Freezing temperature			-5- - 50° C
4	Water temperature, oil temperature, air intake temperature	Thermistor temperature gauge	790-500-1300	0 - 200° C
5	Exhaust temperature			0 - 1000° C
6	Lubrication oil pressure	Engine pressure measuring kit	799-203-2002	0 - 10 kg/cm²
7	Fuel pressure			0 - 20 kg/cm²
8	Intake pressure, exhaust pressure			0 - 1500 mmHg
9	Blow-by pressure			0 - 1000 mmH_2O
10	Intake resistance			- 1000 - 0 mmH_2O
11	Compression pressure	Compression gauge	795-502-1203	0 - 70 kg/cm²
12	Blow-by pressure	Blow-by checker	799-201-1503	0 - 500 mmH_2O
13	Valve clearance	Feeler gauge	795-116-1330 795-125-1330	0.35, 0.65 mm 0.25, 0.45 mm
14	Exhaust gas color	smoke checker	799-201-9000	Bosch index 0 - 70
15	Fuel or water mixed in oil	Engine oil checker	799-201-6000	Water content 0.1 ,0.2% in standard sample
16	Fuel injection pressure Nozzle injection condition	Nozzle tester	Commercially available	0 - 300 kg/cm²
17	Coolant quality	Water quality tester	799-202-7001	PH, nitrous acid concentration
18	Pressure valve performance Leakage from cooling system	Radiator cap tester	799-202-9001	0 - 2 kg/cm²
19	Radiator blockage	Anemometer (Air speed gauge)	799-202-2001	1 - 40 m/s
20	Engine cranking	Cranking kit	795-610-1000	DC24V starting motor
21	Electrical circuit	Tester	Commercially available	Current, voltage, resistance

Before performing inspection, adjustment or troubleshooting, park the machine on level ground and check that the safety pins and blocks are installed properly.

⚠ When performing joint work, follow the fixed signals and allow only authorized personnel near the machine.

⚠ When checking the water level, allow the engine to cool down before removing the radiator cap. Hot water may spurt out if the engine is hot.

⚠ Take great care to avoid getting caught in rotating parts such as the fan, etc.

TROUBLESHOOTING

CONTENTS

POINTS TO REMEMBER WHEN TROUBLESHOOTING

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

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 disas sembled
- 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 READING TROUBLESHOOTING TABLE

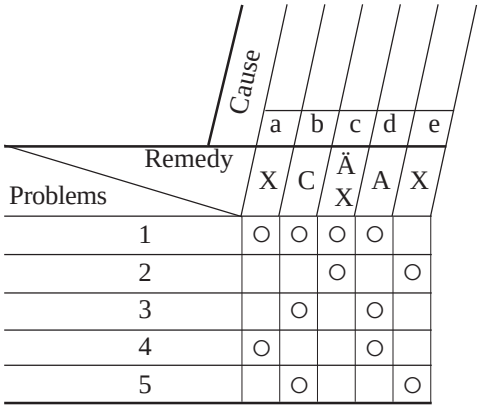
DESCRIPTION OF SYMBOLS USED IN TROUBLESHOOTING TABLE

The following symbols are used in the " Remedy " column to indicate the method of eliminating the cause of a fault.

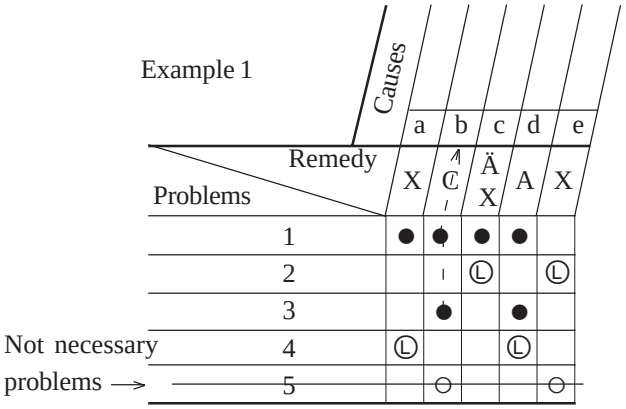
X : Replace ; Ä : Repair
A : Adjusting; C : Clean

METHOD OF READING TROUBLE-SHOOTING TABLE

- The symbol ○ in the table is inserted only for causes which can be diagnosed. If a casuse can not be diagnosed, the corresponding box is left blank.
- If the result of problems 1 using the troubleshooting table shown at right is abnormal, the cause of the trouble can be assumed to lie between a and d. because it is not possible to make a problems regarding e, it is necessary to perform the next problems (owing to the possibility of a multiple fault).
  If the result of problems 1 is normal, the cause of the fault does not lie between a and d. In such a case, before diagnosing the cause as e, however, carry out a check by means of problems 2 or 5.
- If now the result of problems 1 is abnormal and the result of problems 2 normal, the cause is one of a, b or d. To determine which of b or d is the actual cause, perform problems 4.
- If the result of problems is abnormal, blacken out the corresponding ○ in the table and then perform the next problems on these causes in order to narrow the likely causes.



Example 1



Example 1:

Problems 1→ Abnormal
Problems 2→ Normal
Problems 3→ Abnormal
Problems 4→ Normal

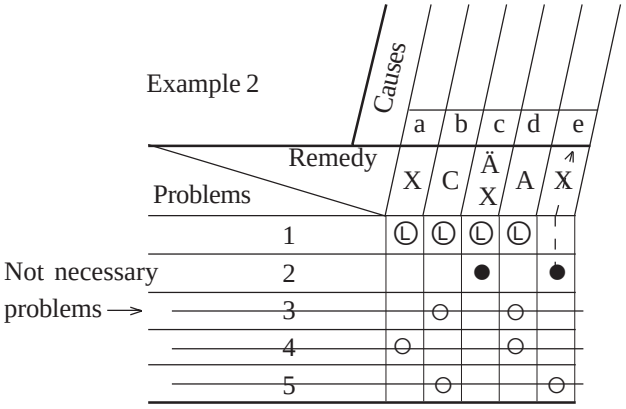
} From the table of example 1, the cause of the fault is b.

Example 2 :

Problems 1→ Normal
Problems 2→ Abnormal

From the table of example 2, the cause of the fault is e.

Example 2



★ In example 2, it is evident that the cause is e without carrying ot problems 2 however problems 2 is performed by way of an additional check.

Example 3 :

Problems 1→Abnormal
Problems 2→Normal
Problems 3→Normal

From the table of example 3, the cause is one of a, c and e.

Continue problems

Problems 4→Normal
Problems 5→Normal

From the table of example 3-1, the cause is c.

Example 3

Problems \ Causes / Remedy	a	b	c	d	e
	X	C	ÄX	A	X
1	●	●	●	●	
2			●		●
3		Ⓛ		Ⓛ	
4	○			○	
5		○			○

Example 3-1

Problems \ Causes / Remedy	a	b	c	d	e
	X	C	ÄX	A	X
1	●	●	●	●	
2			●		●
3		Ⓛ		Ⓛ	
4	Ⓛ			Ⓛ	
5		Ⓛ			Ⓛ

Example 4 :

Problems 1→Abnormal
Problems 2→Normal

From the table of example 4, the cause is one of a, b or d.

Continue problems

Problems 3→Abnormal
Problems 4→Abnormal
Problems 5→Normal

From the table of example 4-1, the cause is a or d.

As can be seen from the above examples, it is not necessary to perform all of the problems.

Also, looking at a particular cause, no matter how many marks there are in the column corresponding to that cause, it will cease to be an actual cause if there is even one Ⓛ mark in the same column.

Example 4

Problems \ Causes / Remedy	a	b	c	d	e
	X	C	ÄX	A	X
1	●	●	●	●	
2			Ⓛ		Ⓛ
3		○		○	
4	○			○	
5		○			○

Example 4-1

Problems \ Causes / Remedy	a	b	c	d	e
	X	C	ÄX	A	X
1	●	●	●	●	
2			Ⓛ		Ⓛ
3		●		●	
4	●			●	
5		Ⓛ			Ⓛ

TROUBLESHOOTING TABLE

1. Starting defective or badness.

1) Engine does not turn.

Questions to ask operator before starting trouble-shooting

1. Did machine stop suddenly during operation ? → Damage or seizure of internal parts.
2. Did machine make abnormal noise during operation ? → Damage parts.

★ **Cause h:** battery charging rate

Temperature \ Charging rate	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

- Specific gravity should be at least figure for 70% charging rate.
- In cold weather, specific gravity must be at least figure for 75% charging rate.

No.	Problems \ Remedy	Cause: Stopping piston from moving by foreign matter in cylinder. (a)	Damage to connecting rod or crankshaft (b)	Bushing and metal biting into each other (c)	Intake and exhaust valves are blocked in cylinder (d)	Damage to pump or supply system (e)	Failure in power train (f)	Seizure of moving parts (g)	Battery insufficiently charged → See No. 20 (h)	Damage to pinion or ring gear (i)	Pinion movement force insufficient, wrong meshing position (j)	Battery terminal connection defective, wiring defective (k)	Electrical system defective → See No. 20 (l)
		X	X	X	X	X	X	X	X	X Ä	Ä X	–	
1	When setting the starting switch to START; 1) No sound of pinion moving out.											○	
	2) Pinion grates.									○			
	3) pinion engages but does not turn.	○	○	○	○	○	○						
2	When checking battery, electrolyte level or specific gravity is low.						○						
3	When cranking engine with barring tool; 1) Does not move.					○							
	2) Moves backlash only.				○								
	3) Can be turned in reverse direction.	○	○	○									
4	Remove head cover. When checking valve cotter, it is out of place.			○									
5	Remove oil pan. When checking internal parts, they are abnormal.		○										
6	Remove cylinder head. When checking internal parts, forein matter appears.	○											

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair

A : Adjusting; C : Clean

2) Engine turns but no exhaust gas is emitted.

Check before troubleshooting

1. Is there any fuel in fuel tank ?
2. Is fuel feed valve open ?
3. Is fuel piping leaking or damaged between fuel tank and injection pump ?
4. Is there any leak from fuel filter ?
5. Is there any water, rust or sludge mixed with fuel drained from fuel tank or fuel filter ?
   (Injection pump or nozzle are frequent causes of failure.)

No.	Problems / Remedy / Cause	a b	c	d		
			Injection pump plunger seized, rack rusted	*Feed pump piston seized*	*Fuel filter element clogged*	*Fuel piping clogged between fuel tank and injecton pump*
			XC	X	X	C
1	No fuel comes out even if injection pump bleed plug is loosened and priming pump operated.					○
2	When cranking engine with starting motor; 1) Injection pump (coupling) does not rotate.				○	
	2) No fuel comes out even if injection pump bleed plug is loosened.			○	○	
	3) No fuel spurts out even if injection pump pipe sleeve nut is loosened.		○	○	○	
3	When removing injection pump tappet cover, control rack does not move.		○			

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

3) Exhaust gas in emitted but engine does not start.

If there is always great difficulty in starting, lack of output power is a possible cause, so perform this troubleshooting.

Check before troubleshooting

1. Is dust indicator red ? →Air cleaner element clogged.
2. Is SAE30 oil being used at temperature below 0° C? (Oil viscosity is too high) → At temperature below 0℃,use SAE10W oil.
3. Is ASTM D975 No. 2 diesel fuel being used at temperatures below - 10℃? (Clogging caused by precipitated parafin)→ Use ASTM D975 No. 1 at temperature below - 10℃.
4. Is fuel control lever bent? Is there any play? Is the pin out of place?

No.	Problems / Remedy	Cause	a	b	c	d	e	f	g	h	i	j	k
			Foreign matter causing block between cylinder head and air cleaner	Injection timing defective (rarely sole cause of failure)	Valve clearance defective (rarely sole cause of failure)	Piston, rig or liner worn	Injector nozzle clogged or seized	Injection pump plunger sized or worn	Injection pump rack function defective	Air cleaner elements clogged	Battery charge too low → See No. 20	Electrical intake air heater wiring broken	Electrical intake air heater wiring defective
			C	A	A	X	CX	X	XÄ	CX	AX	X	XÄ
1	When turning starting switch to HEAT. (At cold weather operation). 1) Heater signal lamp does not light.												○
	2) Heater mount does not become warm.											○	
2	Rotating speed of starting motor is too slow to start engine.										○		
3	When checking battery, electrolyte level or specific gravity is too low.										○		
4	Engine starts if air cleaner element is removed.								○				
5	When removing injection pump tappet cover, control rack and pluger do not move.							○					
6	When checking injector nozzle with nozzle tester, it does not inject.						○						
7	Compression pressure is too low; blow-by is high.					○							
8	Valve clearance is not proper value.				○								
9	Injection timing is not proper position.			○									
10	Air cleaner does not aspirate air. (After maintenance)	○											

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair

A : Adjusting; C : Clean

2. Engine stopped during operation.

Questions to ask operator before troubleshooting.

1. Did engine stop slowly?→ Fuel supply cut.
2. Did engine stop suddenly?→ Internal parts damaged or seized.
3. Did engine make abnormal noise?→parts damaged.

Check before troubleshooting

1. Is there any fuel in fuel tank?
2. Is fuel control lever bent? Is there any play? Is the pin out of place?
3. Is fuel piping leaking or damaged between fuel tank and injection pump.
4. Is beed hole of fuel tank cap clogged?

No.	Problems / Remedy / Cause	Injection pump plunger seized (a)	Feed pump piston seized (b)	Injection pump drive shaft damaged (c)	Fuel filter element clogged (d)	Fuel piping clogged between fuel tank and injection pump (e)	Part of intake or exhaust valve blocking cylinder (f)	Pump or other auxiliary mechanism seized (g)	Piston or bearing (metal) seized (h)	Failure of machine power train (i)
	Remedy	X	X	X	XC	C	X	X	X	XÄ
1	Starting motor cranks engine, but engine stops if gear shift lever is moved to any speed position.									○
2	Starting motor does not crank engi 1) engine does not turn when cranking engine with barring tool.								○	
	2) Engine turns backlash distance only.						○			
	3) Engine can be turned in reverse direction.					○				
3	No fuel comes out even if injection pump bleed plug is loosened and priming pump operated.				○					
4	When cranking engine with starting motor; 1) Injection pump (coupling) does not rotate.			○						
	2) No fuel comes out even if injection pump bleed plug is loosened.		○	○						
	3) No fuel spurts ut even if injection pump pipe sleeve nut is loosened.	○	○	○						
5	When removing injection pump tappet cover, control rack does not move.	○								

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

3. Engine runs abnormally.

1) Engine speed is too high.

	Cause	Remedy
a	Governor function defective	XA△
b	Governor adjustment defective	

2) Engine does not stop.

	Cause	Remedy
a	Fuel control lever linkage is bent; there is too much play; pin is out of position; something is catching.	△
b	Injection pump control rack function defective	X△
c	Injection pump function defective (part other than rack)	XA△
d	Governor function defective	XA△

3) Hunting.

	Cause	Remedy
a	Air sucking into system between fuel tank and feed pump	X△
b	Governor function defective	XA△
c	Governor adjustment defective	A
d	Injection pump control rack function defective	X△

★ Set injection pump and governor on test stand when adjusting.
★ Making up fuel pump by injecting more fuel than standing may damaged engine.

4. Fuel consumption too high.

. Before starting the troubleshooting, ask the operator why he noticed the fuel consumption was too high.

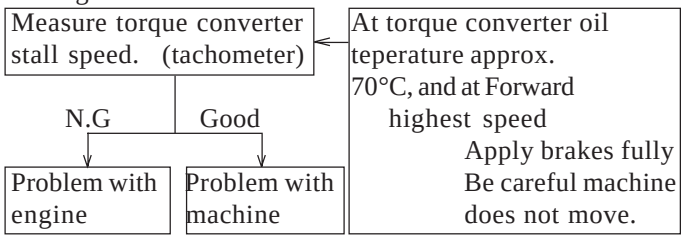
	Cause	Remedy
a	External leakage of fuel; Fuel tank, injection pump, fuel filter and piping. (Common cause when fuel consumption increases suddenly)	X△
b	Excessive fuel injection, poor fuel combustion ratio (in this case exhaust gas is black).	Follow "6. Exhaust gas is black".
c	Internal leakage of fuel; Leakage from fuel tube inside cylinder head cover (In this case, oil level rises and oil smells of kerosene)	△ Change oil

The following symbols are used to indicate the action to be taken when a cause of failure is locked.
X : Replace ; Ä : Repair
A : Adjusting; C : Clean

5. Lack of power.

★ If lack of power is accompanied by black exhaust gas, follow problems "6. Black exhaust smoke."

★ First troubleshoot whether the cause is in the engine or in the chassis as follows.



. Judge mainly checking for track tension, brake function, acceleration and engine high idling speed when mounting DIRECT transmission.

Check before troubleshooting

1. Is fuel piping damaged or fuel leaking between fuel tank and injection pump?
2. Is bleed hole of fuel tank cap clogged?
3. Is tube damaged or leaking between injection pump and nozzle holder?
4. Is incorrect fuel being used?
5. Is there any water, rust or sludge mixed with fuel drained from fuel tank?
   (Injection pump or nozzle are frequent causes of failure.)
   (Check strainer clogged when no fuel comes out.)

No.	Problems / Remedy	Cause: Injection pump control rack function defective (a)	Injection pump plunger seized (b)	Injection nozzle seized or clogged (c)	Fuel filter element clogged (d)	Fuel piping clogged between fuel tank and injection nozzle (e)	Fuel tube leaking between fuel tank and feed pump (f)	Fuel piping leaking between feed pump and injector nozzle (g)	Fuel control lever linkage bent, loose or out of adjustment (h)
	Remedy	XÄ	X	XC	X	C	XÄ	XÄ	ÄA
1	Even with fuel control lever at FULL position, injection pump lever does not contact to the full-stopper.								○
2	When operating priming pump; 1) No reaction or slight reaction and quick return.							○	○
	2) No reaction or slight reaction with normal return.							○	
3	No fuel comes out even if injection pump bleed plug is loosened and priming pump operated.				○	○			
4	Improper engine-running happens by hunting.				○				
5	When checking with nozzle tester, injection spray is defective or injection pressure is low.			○					
6	No fuel spurts out even if injection pump pipe sleeve nut is loosened.		○	○					
7	Some cylinder little or no pulse when injection pipe is held between fingers.		○						
8	When removing injection pump tappet cover and checking movement of plunger, piston does not move up and down.		○						
9	When removing injection pump tappet cover and checking movement of control rack, does not move smoothly.	○							

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

6. Exhaust gas is black.

Check before troubleshooting

1. Is dust indicator red?→Air cleaner element clogged.
2. Is injection pump seal out of position?→Pump out of ad justment (excessive injection).
3. Is air leaking between turbocharger and cylinder head?
4. Is standard spec. machine operating at high altitude?

No	Problems / Remedy	XΔ	XΔ	ΔC	A	ΔX	X	A	CX	XC
	Cause	a	b	c	d	e	f	g	h	i
		Injection pump defective	Turbocharger seized	Muffler, exhaust pipe damaged or clogged	Valve clearance defective	Defective contact between valve and valve seat	Piston, ring or liner worn	Improper injection timing	Injector nozzle blocked, spray defective	Air cleaner elements clogged
1	Exhaust gas color improves when air cleaner element is removed.									○
2	When checking with nozzle tester, defective injection spray is defective or injection pressure is low.								○	
3	Match marks of injection pump plunger and coupling or drive case are not properly aligned. Checking injection timing by delivery method shows timing is out of adjustment.							○		
4	Blow-by is excessive.						○			
5	Compression pressure is lack.					○	○			
6	Valve clearance is too large or too small.				○					
7	Exhaust gas color improves when muffler is removed.			○						
8	Turbocharger is sluggish when turned by hands. (For engines with turbocharger)		○							
9	Exhaust gas color improves when injection pump is replaced.	○								

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

7. Exhaust gas is blue. (Combustion of engine oil)

Check before troubleshooting

1. Has engine continued to run for over 20 mins at low idling?→ Oil coming up into cylinder, oil leak from seal at turbocharger turbine side.
2. Has engine continued to run for over 20 mins at high idling?→ Oil coming up or down into cylinder, oil leak from seal at turbocharger blower side.
3. Is turbocharger oil return pipe damaged?→ oil leak from seal turbocharger seal.

No.	Problems / Remedy	Cause: Intake valve, valve guide worn (oil coming down into cylinder) (a)	Breather element clogged (b)	Piston, ring or liner worn (oil coming up into cylinder) (c)	Seal worn at turbocharger tubine side (d)	Seal worn at turbocharger blower side (e)
		X	C	X	X	X
1	Inside of turbocharger intake pipe is coated with oil.					○
2	Turbocharger shaft play is excessive.				○	○
3	Compression pressure is lack.			○		
4	Blow-by is excessive.			○		
5	When checking breather element, it is clogged with oil.		○			
6	Remove cylinder head. When checking intake valve and valve guide, the clearance of them is big.	○				

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

8. Oil Consumption too high.

Before starting the problems, ask the operator why he noticed the fuel consumption was too high.

★ If answer is: “Oil consumption was high and exhaust gas was blue”, follow problems “7. Exhaust gas is blue”.

Check before troubleshooting

- Is engine or engine lower part coated with oil. (Remove earth and sand and check.)

No.	Problems / Remedy	Cause a: Rear seal or seal contact face worn or damaged	b: Oil cooler damaged	c: Oil leaking from oil drain plug	d: Oil leaking from cylinder head, oil pan, gear case, flywheel housing and mounts	e: Oil leaking from oil piping	f: Oil leaking from oil filter or oil cooler	g: Oil leaking from turbocharger
	Remedy	XΔ	X	Δ	XΔ	ΔX	ΔX	ΔX
1	Oil leaking out of engine (check around engine).				○			
2	Cooling water is mixed with engine oil.		○					
3	Oil in main clutch or TORQFLOW transmission or damper increases.	○						

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

9. Oil level rises. (Mixed water or fuel)

Check before troubleshooting

- Is the cooler of engine oil dirt - white?→ Mixed water.

No.	Problems / Remedy	Cause a: Failure in hydraulic pump for machine	b: Rear seal or seal contact face worn or damaged	c: Oil leaking inside injection pump	d: Fuel leaking from tube inside cylinder head cover	e: Nozzle holder defective	f: Liner O-ring damaged	g: Cylinder block or cylinder liner damaged	h: Cylinder head gasket damaged	i: Oil cooler pipe or O-ring damaged
	Remedy	XΔ	XΔ	XΔ	XΔ	X	X	X	X	X
1	Water mixed with engine oil.						○			
2	Fuel mixed with engine oil.			○						
3	Oil in main clutch or TORQFLOW transmission or damper decreases.		○							
4	Seal or seal contact face of hydraulic pump drive shaft is worn or damaged.	○								

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

10. Oil quickly becomes dirty.

Before starting the troubleshooting, ask the operator the following questions.

1. Were oil and oil filter changed in accordance with the "Operation and Maintenance Manual"?

No.	Problems / Remedy	Cause: Leak of exhaust gas through seal on turbocharger turbine side (a)	Cause: Piston, ring or liner worn (b)	Cause: Valve or valve guide worn (c)
		XΔ	X	XΔ
1	Exhaust gas is blue when engine is run at high speed with light load.		○	○
2	Compression pressure is lack.		○	○
3	Blow-by is excessive.		○	
4	After running at high idling for approx. 10 mins., oil can be seen leaking from turbocharger turbine outlet.	○		
5	Turbocharger shaft play is excessive.	○		

★ If the above problems does not reveal the cause, a common secondary cause of dirt oil is carbon from incomplete combustion mixing with the oil. In this case follow problems in "6. Exhaust gas is black".

The following symbols are used to indicate the action to be taken when a cause of failure is locked.
X : Replace ; Ä : Repair
A : Adjusting; C : Clean

11. Engine oil pressure gauge indicator fluctuates abnormally.

No.	Problems / Remedy	Regulator valve defective (a) A, ΔX	Instrument panel loose (b) Δ	Engine oil pressure gauge defective (c) X	Lack of oil in oil pan (fluctuation occurs particularly when operating on slopes) (d) A
1	Oil level in oil pan is too low. (Check whether oil consumption is excessive.)				○
2	Fluctuation stops when gauge is replaced.			○	
3	Mounts in instrument panel are loose. (Check directly)		○		
4	Regulator valve is catched, spring is fatigued, valve or valve guide is damaged. (Check directly)	○			

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair

A : Adjusting; C : Clean

12. Lack of oil pressure.

(At enigne speed of over 700 rpm, indicator of engine oil pressure gauge is to left of “green range”.)

Question to be asked before starting troubleshooting.

Is 10W oil being used at temperature above 0°C?

No.	Problems / Remedy	Cause: Oil pump defective (a)	Regulator valve function defective (b)	Oil strainer in oil pan clogged (c)	Oil pipe in oil pan damaged or clogged (d)	Bearing or journal worn (e)	Oil filter element clogged and bypass valve function defective (f)	Oil hose, tube clogged or damaged (g)	Engine oil pressure gauge tube clogged or damaged (h)	Gauge defective (i)	Lack of oil in oil pan (particularly with lack of oil when operating on slopes) (j)	Water or fuel mixed with oil → see No. 9 (k)	Oil leaking from connection of oil hose and tube (l)	Oil leaking from tube or connections of engine oil pressure gauge (m)
	Remedy	Δ X	Δ XA	C	X C	X	X ΔA	C XΔ	C XΔ	X	A	–	X Δ	X Δ
1	Oil is leak from hose or tube. (Check for signs of external oil leakage).												○	
2	Water or fuel mixed with fuel.											○		
3	Oil in oil pan is lack (no sign of external oil leakage).										○			
4	Engine oil pressure is normal if gauge is replaced.								○					
5	Oil hose, tube are clogged or damaged. (Check directly)							○						
6	Oil filter is clogged and bypass valve function is defective. (Check directly)					○								
7	Metal particles are caught in oil filter element. K.O.W.A (oil analysis) shows abnormality.				○									
8	Remove oil pan. When checking oil, strainer is clogged or oil pipe is damaged.			○										
9	Regulator valve is catching, spring is fatigued, valve or valve guide is damaged. (Check directly)		○											
10	Oil pump does not rotate smoothly and oil pump shaft play is excessive.	○												

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair

A : Adjusting; C : Clean

13. Oil in cooling system.

	Cause	Remedy
a	Pipe broken in oil cooler, O-ring damaged	X
b	Head gasket damaged	X
c	Cylinder head cracked	X
d	Cylinder block cracked	X

14. Water temperature does not rise.

Water temperature gauge indicator is to left of “green range”

★ In cold weather operation, if reversible fan and radiator shutters are not fitted, the engine may not warm up.

No.	Problems / Remedy	Cause: Thermostat defective (stays open) (a)	Cause: Water temperature gauge defective (b)
		X	X
1	Water temperature rises if gauge is replaced.		○
2	When thermostat is removed, it is found to stay open; or performance test shown cracking temperature is too low.	○	

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

15. Water temperature rises excessively.

(Water temperature gauge indicator goes to right of "green range". engine overheats)
Never remove the radiator cap when the temperature is still high. Boiling water may spurt out and cause serious burns.

★ When the engine overheats, stopping the engine immediately means water is no longer sent out by the water pump. As a result the temperatre of the parts being cooled rises sharply and this may cause cracking or other damag to the engine.

Before starting the troubleshooting, ask the operator the following questions.

1. Is anti-freeze being used in summer?
2. Is water being supplied according to the "Operation and maintenace Manual".

Check before troubleshooting

1. Is machine being operated under excessive load?
2. Is fan damaged or deformed?
3. Is belt groove of fan pulley or crank pulley worn?
4. Are radiator shutter and reversible fan being used properly ?

No.	Problems / Remedy	a	b	c	d	e	f	g	h	i	j	k	l	m	n
	Cause	Excessive use of machine with torque converter stalled	Torque converter damaged	Water temperature gauge defective	Thermostat seal defective (dose not open)	Thermostat defective (does not open)	Water pump defective	Radiator core fins clogged or damaged	Fan belt tension incorrect	Cylinder block or head cracked, sleeve damaged	Head gasket, precombustion chamber gasket damaged	Cylinder liner or piston ring damaged, oil cooler pipe damaged	Water leaking from water tube or hose	Water leaking from radiator	Water leaking from water pump or oil cooler
	Remedy	A	ΔX	X	X	X	XΔ	CX	A	X	X	X	XΔ	XΔ	XΔ
1	Coolant level is too low.									○			○		
2	Cooling water mixed with oil.									○					
3	Fan belt loosens.								○						
4	Radiator core is damaged or clogged with mud or dust.							○							
5	Difference in temperature between upper and lower tanks is extreme.						○								
6	Radiator is only slightly warm.				○	○									
7	Valve opens when testing thermostat only.				○										
8	If water temperature gauge is replaced, it returns t `ormal.			○											
9	Torque converter oil temperature is too high. (with TORQFLOW transmission)	○													

★ If exhaust smoke is black, follow problems "6. Exhaust gas is black".

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

16. Too much vibration.

No.	Problems \ Remedy	a ΔX	b X	c X	d X	e X	f XΔ	g X	h A	i CX	j X	k Δ AX	l ΔX	m X	n Δ
	Cause	a Wear of front support pilot	b Tappet stuck	c Intake or exhaust valve stuck	d Intake or exhaust valve broken	e Bushings or bearings (main bearing, connecting rod bearing, balancer bushing, cam bushing, etc.) worn	f Injection pump plunger seized; function defective	g Injector nozzle seized	h Injection pump out of adjustment (excessive injection)	i Injector nozzle clogged, spray defective	j Thermostat defective (stays open)	k Governor defective	l Air in fuel piping between fuel tank and feed pump	m Vibration damper defective	n Engine mounting bolts loose
1	Engine mounting bolts are loose. (Check directly)														○
2	Vibration damper is not warm to touch after operation, during operation, gear noise is also excessive.													○	
3	Air is mixed in fuel system.												○		
4	Engine runs abnormally at low idling. (No air in fuel line; exhaust gas color normal)					○					○				
5	Exhaust gas is black.							○	○	○					
6	Water temperature does not rise or rises slowly.									○					
7	When checking injector nozzle with nozzle tester, injection spray is defective or injection pressure is low.						○		○						
8	Injection pump seal is out of position, injection pump is out of adjustment. (Check directly with pliers)							○							
9	When loosening injection pipe sleeve nuts in order at low idling, speed of some cylinders does not change.					○	○								
10	Oil pressure is low at low idling.				○										
11	Remove cylinder head when checking it, the tappet or intake and exhaust valves are abnormal.		○	○											
12	The wear and clearance of front support pilot is large.	○													

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair

A : Adjusting; C : Clean

17. Abnormal noises emitted.

★ When noises indicating internal damage are being emitted continuing to operate machine may make the damage worse.

★ As far as possible, classify the abnormal noise to make location of the cause easie Type of noise;

- Interface
- Abnormal combustion
- Gear
- Internal, external
- Engine, power train

No.	Problems \ Remedy	X	X	X	ΔX	XΔ	CX	X	X	A	X	X	X	A	ΔX
	Cause	Valve or piston broken	Valve stem or tappet stuck or worn	Timing gear or oil pump gear or P.T.O. gear broken or worn	Bolt missing from connecting rod cap or main cap	Camshaft bushing or balancer bushing out of place	Injector nozzle clogged	Injector nozzle seized	Piston, ring or liner worn	Valve clearance defective	Injection pump plunger defective	Vibration damper defective	Thermostat defective	Injection pump out of adjustment (excessive injection)	Interference of fan or fan belt; fan deformed
		a	b	c	d	e	f	g	h	i	j	k	l	m	n
1	External or interference engine noise occurs.														○
2	Exhaust gas is black.					○		○	○			○	○		
3	Combustion noise is abnormal.					○	○		○	○		○	○		
4	Seal is broken. (Check injection volume on test stand.)												○		
5	Water temperature does not rise.											○			
6	Vibration damper is not warm to touch after operation; during operation, gear noise is also excessive.										○				
7	When loosening injection pipe sleeve nut and setting engine to low idling, engine speed does not change.									○					
8	Valve clearance is too large or too small.								○						
9	Compression pressure is lack; blow-by is excessive.							○							
10	When checking injector nozzle with nozzle tester, injection spray is defective or injection pressure is low.					○	○								
11	Remove oil pan. When checking it, internal engine noise is excessive.			○											
12	Remove gear cover. Gear noise is occured.		○												
13	When removing cylinder head, Internal engine noise is excessive.	○													

Other causes of abnormal noise (direct check)

	Cause	Remedy
o	PTO gear damaged or worn	X
p	Air compressor damaged	X
q	Turbocharger damaged	X

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
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18. Excessive wear of engine parts.

Before starting the troubleshooting, ask the operator the following questions.

1. Is the specified oil being used?
2. Is the specified fuel being used?
3. Is the ai cleaner element cleaned and replaced according to the “Operation and Maintenance Manul”?
4. Is the fuel filter element cleaned and replaced according to the “Operation and Maintenance Manul”?
5. Are the engine oil and oil filter element replaced according to the “Operation and Maintenance Manul”?
6 Has there been repeated rapid acceleration or repid gear shifting?
7. Is the machine warmed up before operation and left idlig before stopping engine according to the “Operation and Maintenance Manul”?

No.	Problems / Remedy	a	b	c	d	e	f	g	h	i
	Cause	Fuel filter element damaged or clogged	Dirt or water mixed with fuel	Dirty oil	Water mixed with oil	Fuel mixed with oil	Abnormal combustion	Air leaking into system between precleaner and cylinder head	Air cleaner element damaged	Precleaner damaged or improperly cleaned
		X	C	–	–	–	–	ΔX	X	XC
1	Dirt gets into engine. (Check directly)							○		
2	Exhaust gas is black. (See problems “6. Exhaust gas is black”)						○			
3	Fuel is mixed with oil. (See problems “9. Oil level rise”)					○				
4	Water is mixed with oil. (See problems “9. Oil level rise”)				○					
5	Oil is dirty. (See problems “10. Oil quickly becomes dirty”)			○						
6	Dirt or water drains out when fuel tank drain plug is removed.		○							
7	Fuel filter is dirty or damaged.	○								

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

19. Engine does not start because of fault in electrical system. (Chek starting circuit)

When checking, take care not to be caught in fan or other rotating parts if engine statrs.

Check before troubleshooting

1. Is battery electrolyte level or specific gravity too low?
2. Check starting circuit for broken or disconnected wires, loose terminals or short circuits (Visual check)
   Battery ↔ Safety relay ↔ Starting switch ↔ Battery relay switch ↔ Battery
3. Immediately after repair, mistaken wiring connection is possible cause.
4. When problems (1-1) “Engine does not turn”, use this problems.

No.	Problems / Remedy	Cause: Starting motor defective	Internal wiring or performance of safety relay defective	Internal wiring or performance of safety switch defective	Internal wiring or performance of battery relay switch defective	Internal wiring or performance of starting switch defective
		a	b	c	d	e
		XΔ	Δx	Δx	Δx	Δx
1	If terminals (B) and (C) of starting motor are connected, pinion moves out. ★ Sparks are produced by this test. ⚠ When pinion movement is confirmed, disconnect-terminals immediately.		○	○	○	○
2	If terminals (B) and (C) of starting switch are connected, engine will start.					○
3	If terminals (b) and (E) of battery relay switch are connected, engine will start.				○	
4	If plug terminal of safety switch is connected to terminal (B) or (+) of starting motor, engine will start.			○		
5	If terminals (B) and (C) of safety relay are connected, engine will start.		○			
6	Starting motor does not turn even if No. 1 starting motor terminals (B) and (C) are connected.	○				

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

20. Battery does not charge. (Chek starting circuit)

When checking, take care not to be caught in fan or other rotating parts if engine statrs. Take care also to cause short circuits.

Before starting the troubleshooting, ask the operator if the battery is old (in se for 2 or more years).

Check before troubleshooting

1. Is alternator drive belt loose?
2. Check starting circuit for broken or disconnected wires, loose terminals or short circuits. (Visual check, continuity check)
   Battery ↔ Safety switch ↔ Ammeter ↔ Regulator ↔ Starting motor↔ Alternator↔ Battery relay switch ↔ Battery
3. Do lamps or heater exceed specified limit? Are they left on?
   ★ When engine is stopped and charged lamp stays on, or ammeter indicator deflects to one side, lamps are still on, or there is a short circuit.
4. Following repairs, mistaken wiring connection is possible cause.

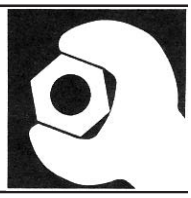
No.	Problems / Remedy	Cause: Alternator defective (a)	Internal wiring or performance of regulator defective (b)	Internal wiring or performance of ammeter or charging lamp defective (c)	Internal wiring or performance of starting switch defective (d)	Battery defective (e)
		xΔ	Δx	Δx	Δx	x
1	During operation, deflection of ammeter and charging lamp are normal.					○
2	Continuity test using tester shows; 1) Little or no continuity when terminals (AC) and (B) of starting switch are connected. (with switch ON)				○	
	2) When the starting switch is ON, continuity between them above 1) is proper, but when being OFF, no continuity.				○	
	3) Little or no continuity between (+) terminal and (—) terminal of ammeter or charging lamp.			○		
3	Run engine at medium speed (1,000 — 1,500 rpm) and measure charging voltage with tester. 1) Tester does not show charging voltage (26 — 30V) between terminal (E) of alternator and terminal (N) of regulator.	○	○			
	2) Tester shows charging voltage between terminals (B) and (E) of alternator, but does not shown with above.		○			
	3) Tester shows charging voltage with 2) only.	○				

The following symbols are used to indicate the action to be taken when a cause of failure is locked.

X : Replace ; Ä : Repair
A : Adjusting; C : Clean

ENGINE

14 DISASSEMBLY AND ASSEMBLY

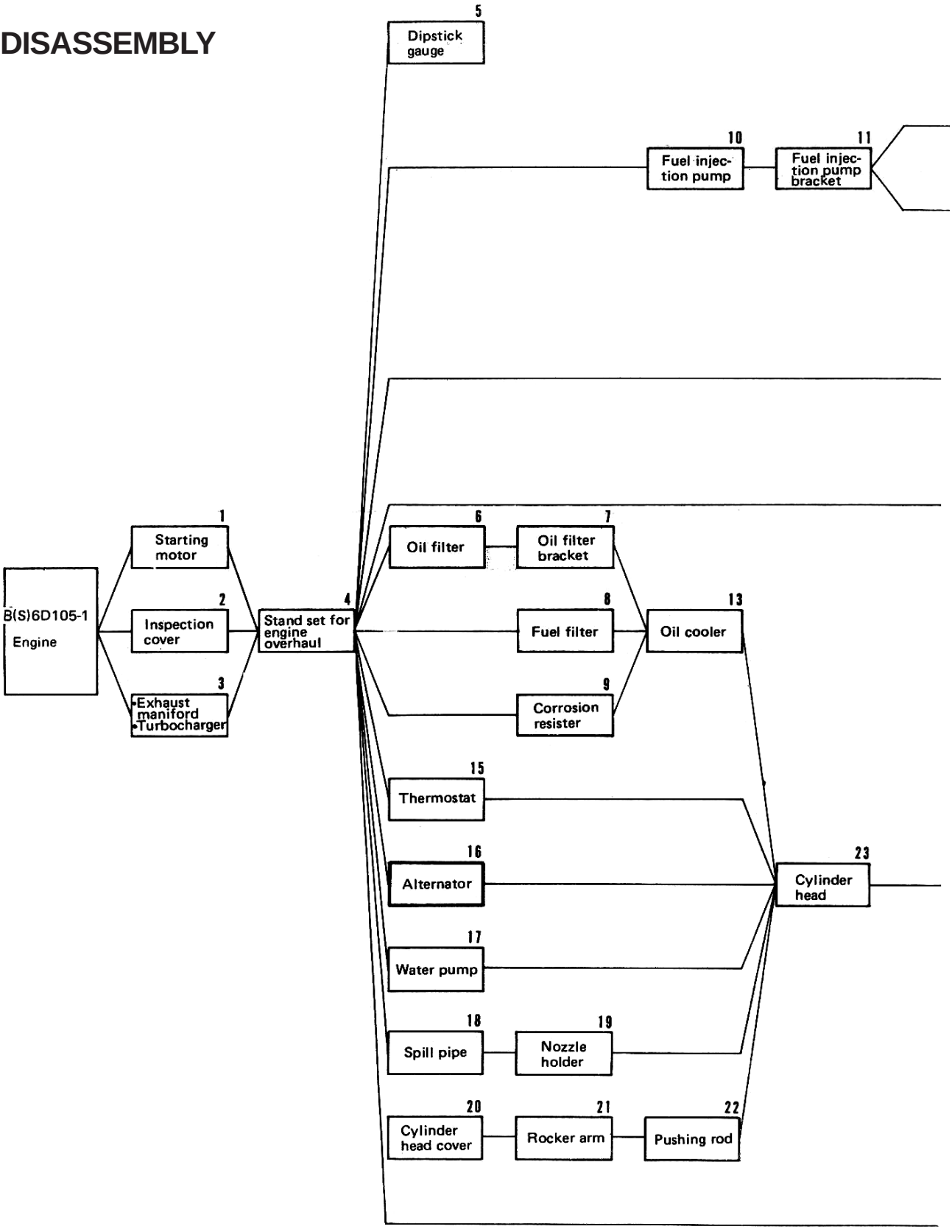


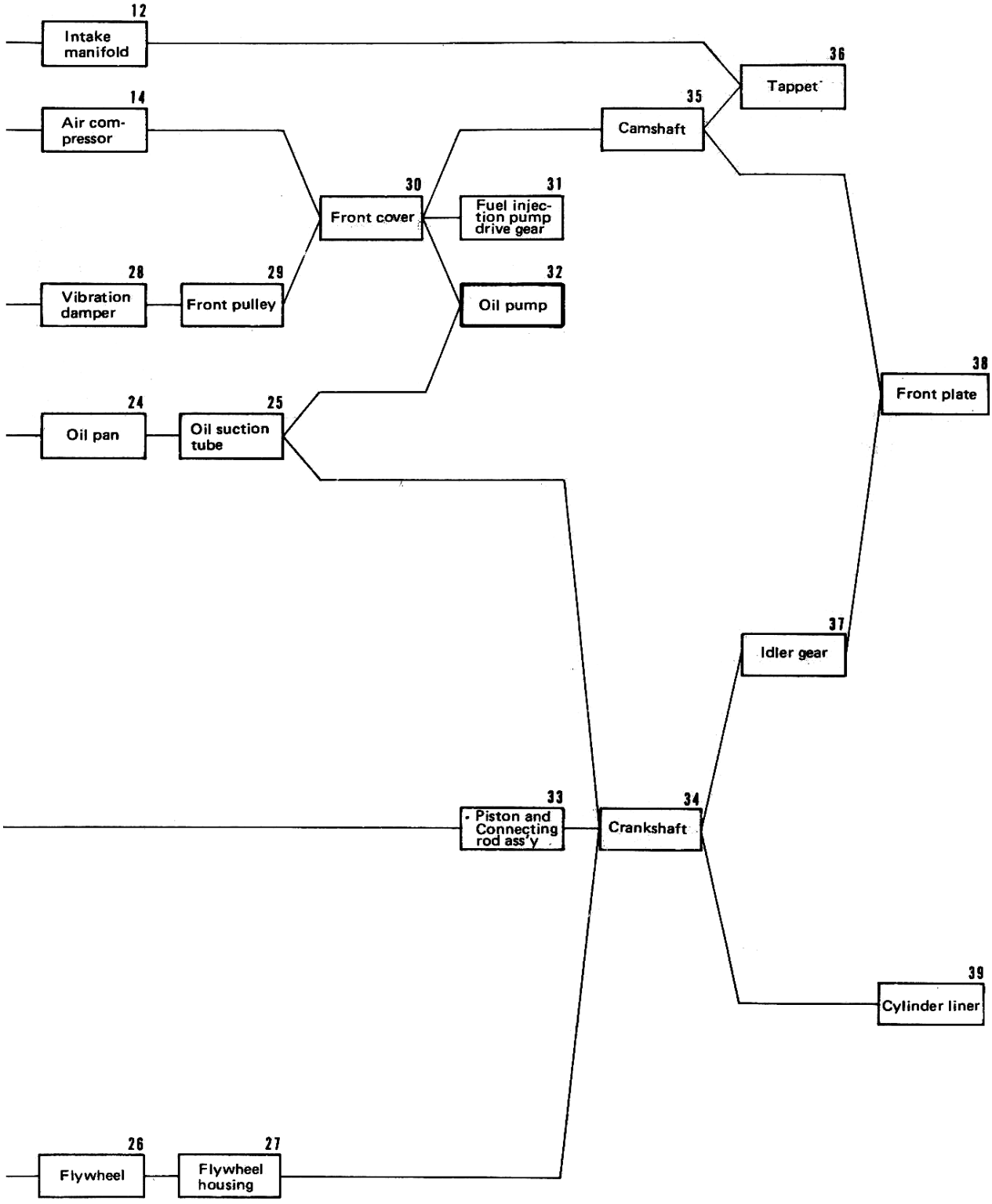
* This chapter deals with procedures both for general disassembly and assembly putting emphasis on B6D105-1 engine in case overhaul stand is used.

* When machine serial numbers and/or engine bases are different, or when engine with turbocharger is handled, some of procedures mentioned here may differ in detailed part, but the essentials of the procedures are the same.

GENERAL

DISASSEMBLY




12
Intake manifold
14
Air compressor
28
Vibration damper
29
Front pulley
30
Front cover
31
Fuel injection pump drive gear
32
Oil pump
24
Oil pan
25
Oil suction tube
35
Camshaft
36
Tappet
38
Front plate
37
Idler gear
33
Piston and Connecting rod ass'y
34
Crankshaft
39
Cylinder liner
26
Flywheel
27
Flywheel housing

NECESSARY TOOLS

Tool No.	Tool	A	B	C	D
790-501-2000	Stand for engine overhaul	1			
790-901-1106	Bracket for engine overhaul stand	1			
795-102-2101	Valve spring pusher		1		
795-100-2800	Piston ring tool			1	
795-215-1000	Liner puller				1

Preparatory work

- Clean the by removing the dust, mud, sand, etc. thor oughly.
- Drain the coolant and lubrication oil.

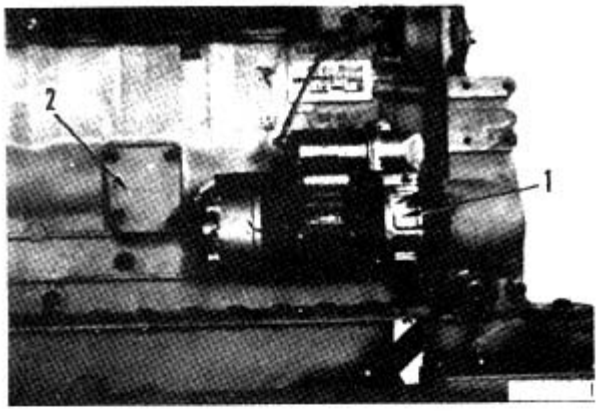
Engine oil : approx. 24l

- Stabilize the engine stand so that the engie will not fall down.
- Rest the engine on the stand and fasten it firmly.

Engine assembly: approx. 650 kg

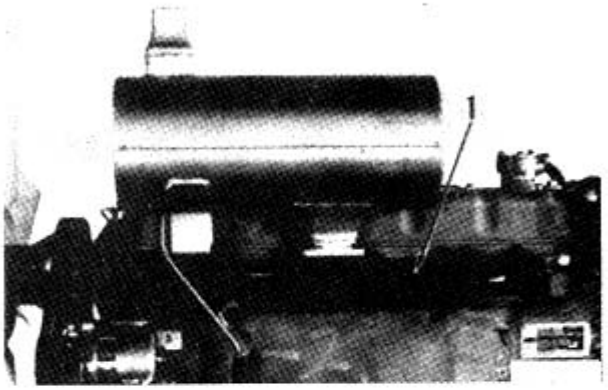
1. Starting motor
- Remove starting motor (1).

2. Inspection cover
- Remove inspection cover (2).



3. Exhaust manifol, turbocharger

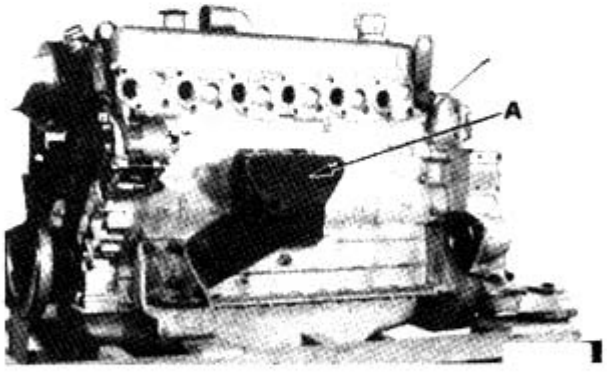
* In a turbocharged engine, remove the exhaust manifold and turbocharger as one unit after removing the oil feed pipe and drain tube.
- Remove exhaust manifold (1).



4. Stand set for engine overhaul

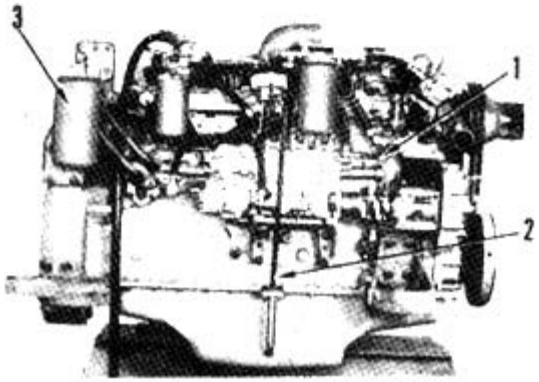
1) Attach bracket A to engine (1).
2) Sling the engine and rest it on engine over haul stand A.

kg Engine assembly : 650 kg

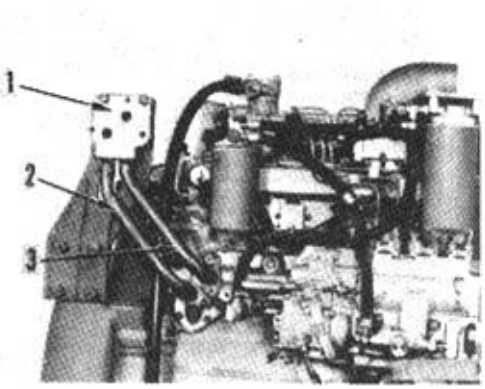


5. Dipstick gauge
- Remove dipstick gauge (2).

6. Oil filter
- Remove oil filter (3).

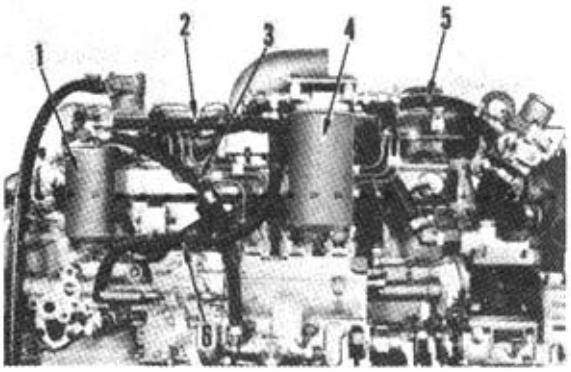


7. Oil filter bracket
1) Remove tubes (2) and (3).
2) Remove oil filter bracket (1).

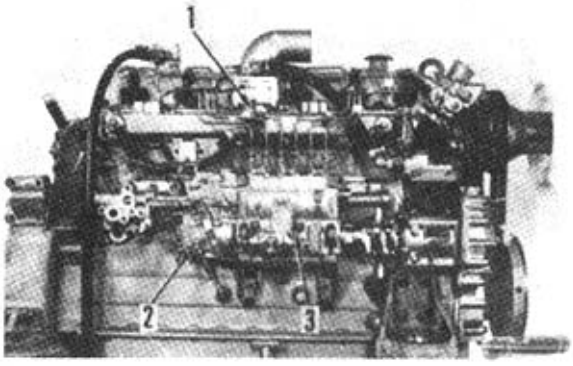


8. Fuel filter
1) Remove hose (2) and (3).
2) Remove fuel filter (1).

9. Corrosion resister
1) Remove hose (5) and (6).
2) Remove corrosion resister (4).

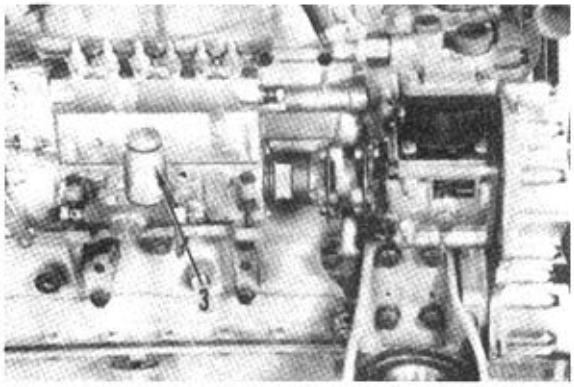


10. Fuel injection pump
1) Remove tube (1) between the nozzle holder and the pump.
2) Remove tube (2).
3) Remove tube (3) between the compressor and the pump.



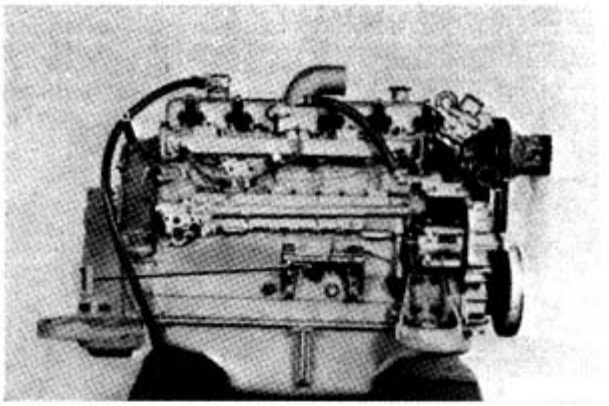
***** Make sure there are match marks on the fuel inejction pump and coupling before removing them. If not marks, punch the match marks on them.

4) Remove fuel injection pump assembly (3) together with the coupling.
   ***** Tightly close the fuel and oil outlet ports with tape to keep out dust and other foriegn particles.



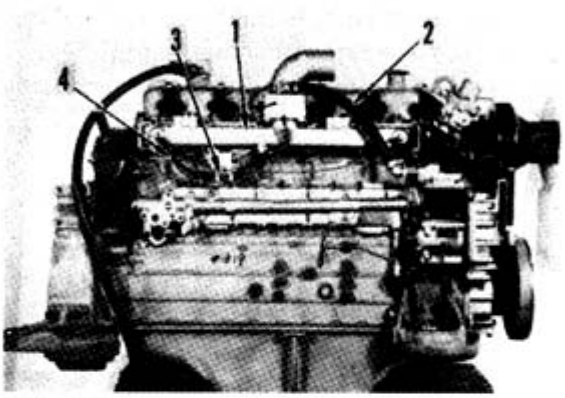
11. Fuel injection pump bracket

- Remove fuel injection pump bracket (1).



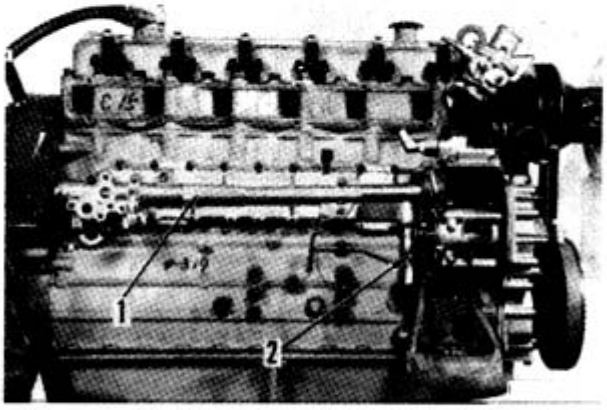
12. Intake manifold

1) Remove bracket (3).
2) Remove wiring (4).
3) Remove hose (2) between the intake manifold and the compressor.
4) Remove intake manifold (1).



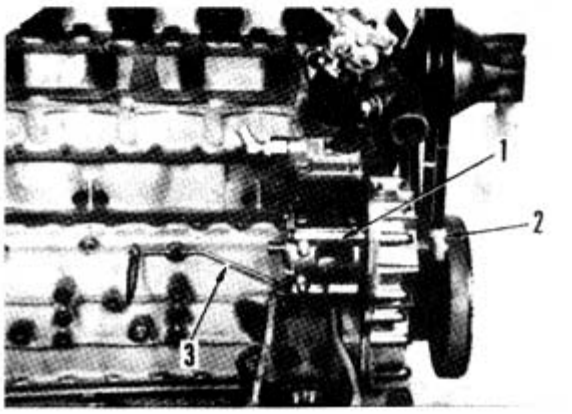
13. Oil cooler

1) Remove tube (2).
2) Remove oil cooler (1).



14. Air compressor

1) Remove tube (3).
2) Remove the service meter tap (2).
3) Remove air compressor (1).

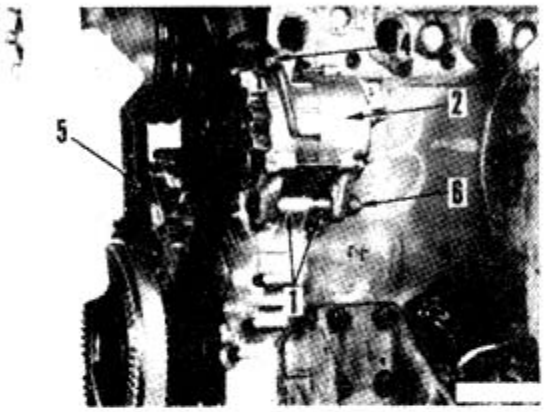


15. Thermostat

1) Remove tube (4).
2) Remove hose (3) between the water pump and thermostat.
3) Remove the thermostat together with case (2).
4) Attach hanger (1) to the head.

16. Alternator

1) Remove adjusting bolt (4).
2) Loosen alternator mounting bolt (6).
3) Force the alternator into place and remove fan belt (5).
4) Remove spacer (1) and alternator (2).



17. Water pump

- Remove water pump (1).

18. Spill pipe

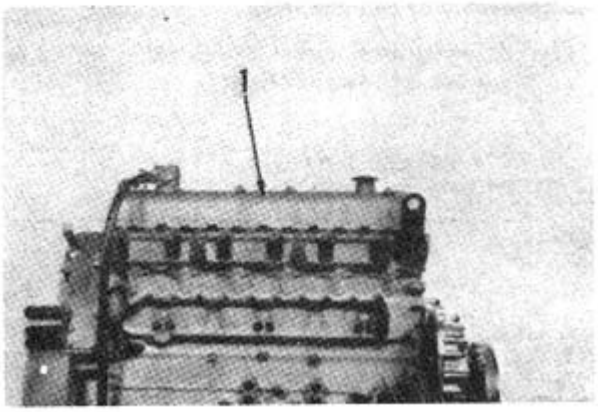
- Remove spill pipe (1).

19. Nozzle holder

- Remove nozzle holder (1).
  - * Be careful not to let the nozzle holder tip hit anything.

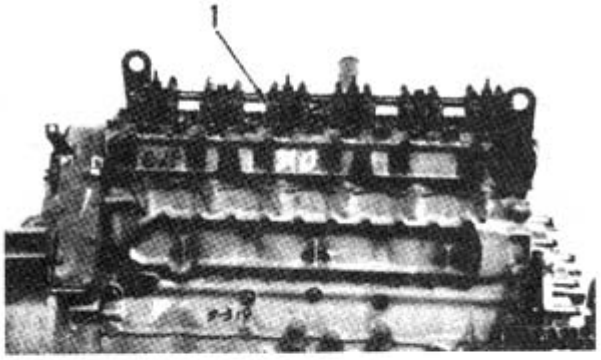
20. Cylinder head cover

- Remove cylinder head cover (1).



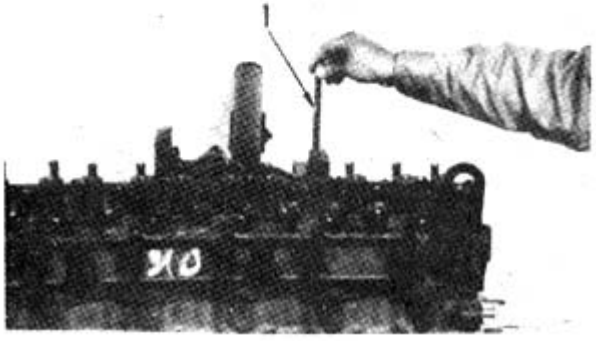
21. Rocker arm

- Remove rocker arm (1).



22. Push rod

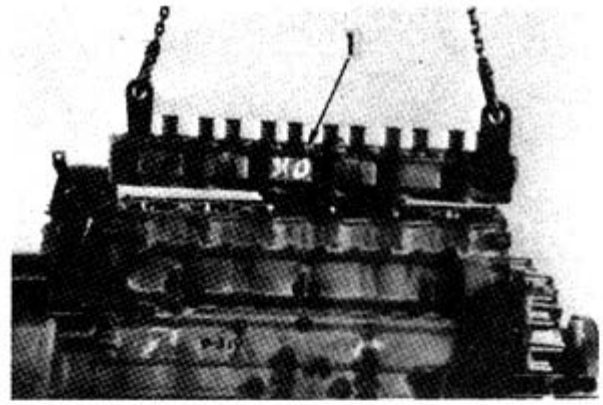
- Remove push rod (1).



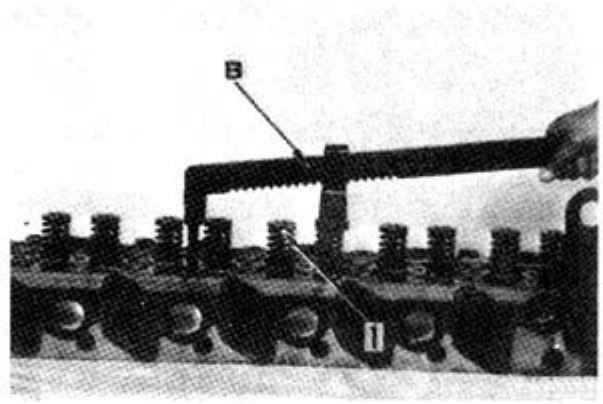
23. Cylinder head

- Remove cylinder head (1).

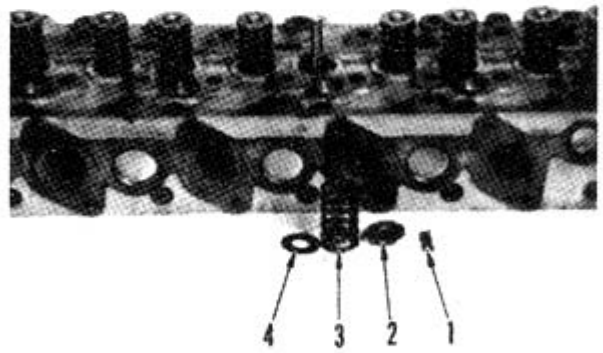
kg Cylinder head : 57 kg



- **Disassembly of cylinder head**
  1) Compress each valve spring, using spring pusher B.
     Remove each valve cotter (1).

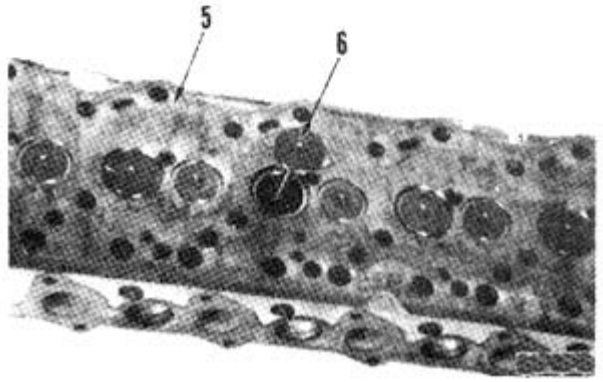


  2) Gently release the compression on the spring, and remove each spring guide (2), valve spring (3) and spring seat.



  3) Stand cylinder head (5) upright and remove each valve (6).

     * Valve spring
       Unequal pitch of spring

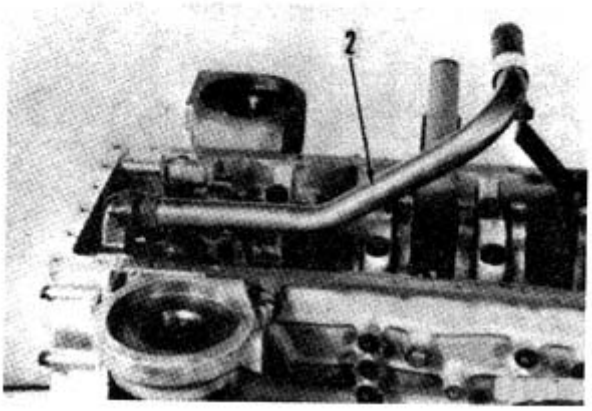


24. Oil pan

- Turn the engine overhaul stand so that oil pan (1) faces upward, and remove it.

25. Oil suction tube

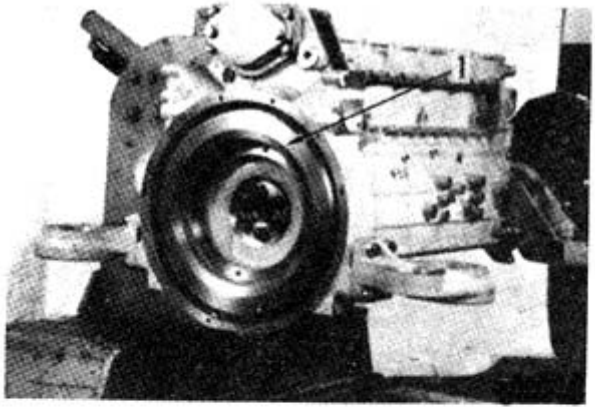
- Remove oil suction tube (2).



26. Flywheel

- Remove the flywheel while tapping around it with a plastic hammer.

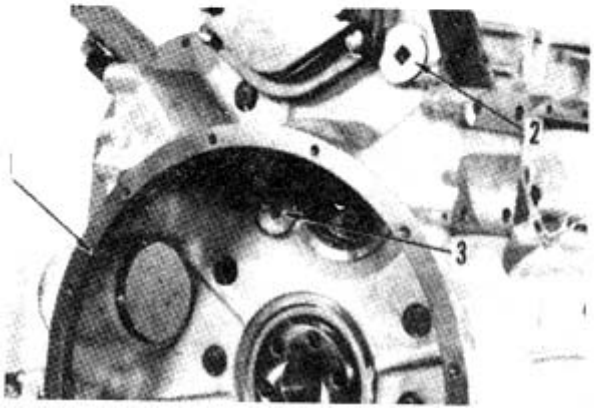
kg Flywheel : 40 kg



27. Flywheel housing

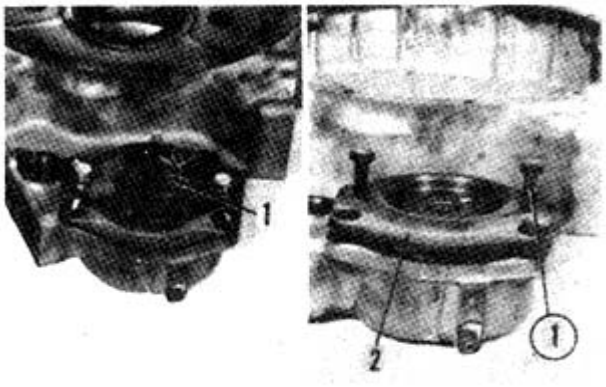
1) Remove the flywheel housing mounting bolts after removing plugs (2) and (3).
2) Remove flywheel housing (1).

kg Flywheel housing assembly :80 kg

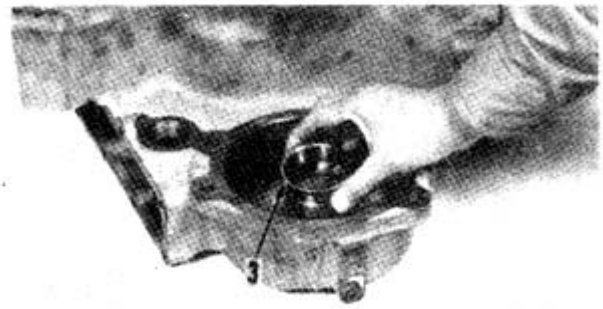


*** Disassembly of flywheel housing assembly**

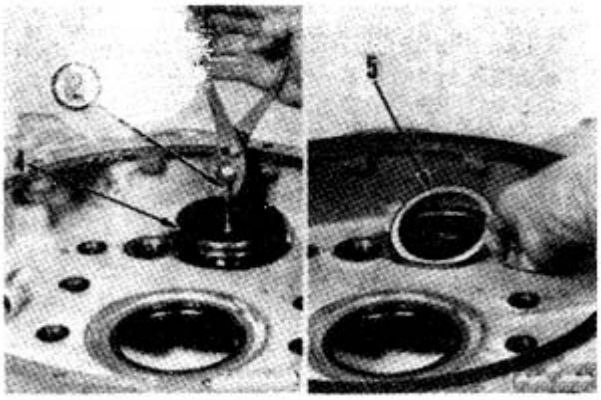
1) Remove cover (1).
2) Remove cover (2) by forcing bolt ①.



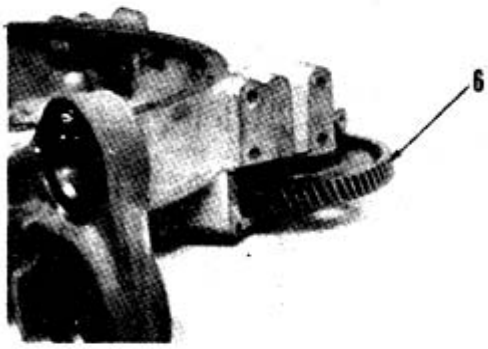
3) Remove bearing inner race (3).



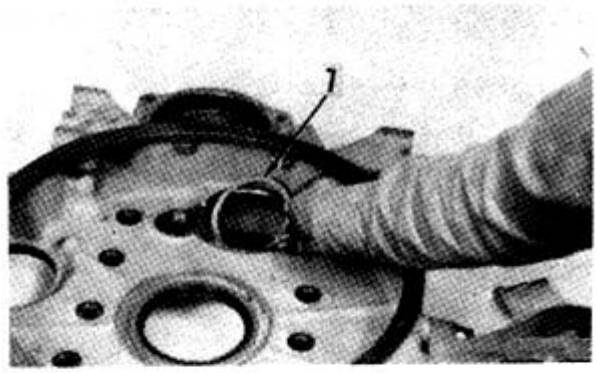
4) Install hook bolt ② and draw shaft (4) out of place with a pair of pliers.
5) Remove wahser (5).



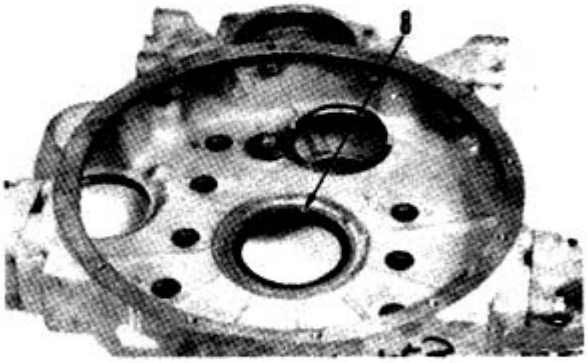
6) Remove gear (6).



7) Remove thrust washer (7).



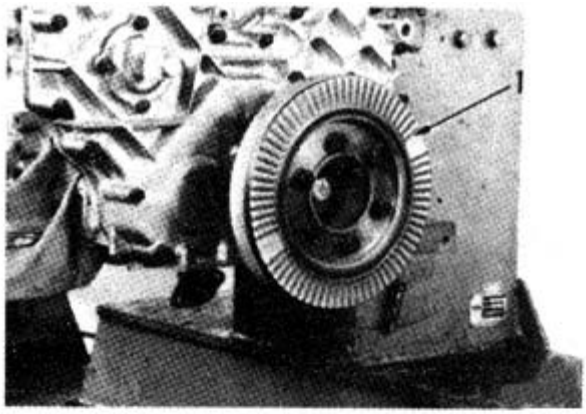
8) Remove oil seal (8).



9) Remove nuts (9), then remove cover (2).

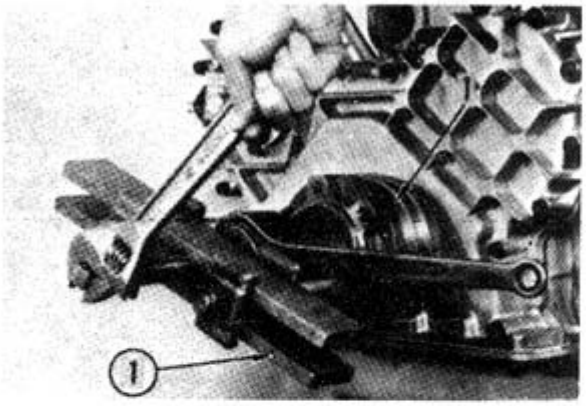
28. Vibration damper

- Remove vibration damper (1).



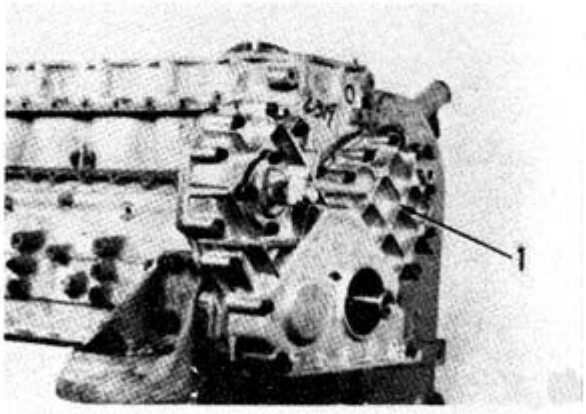
29. Front pulley

- Take front pulley (1) out of places with puller ① . Then, remove the taper collar.
  - * If a puller is not available, remove the front pulley by tapping around it with a plastic hammer.



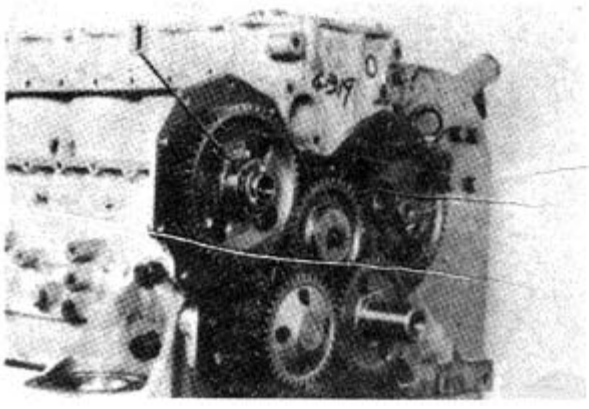
30. Front cover

- Remove front cover (1).



31. Fuel injection pump drive gear

- Remove fuel injection pump drive gear (1).

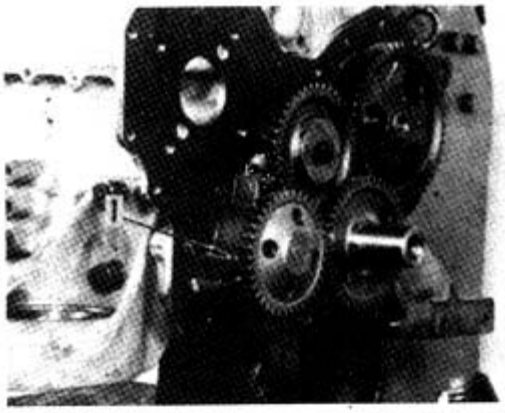


32. Oil pump

- Remove oil pump (1).

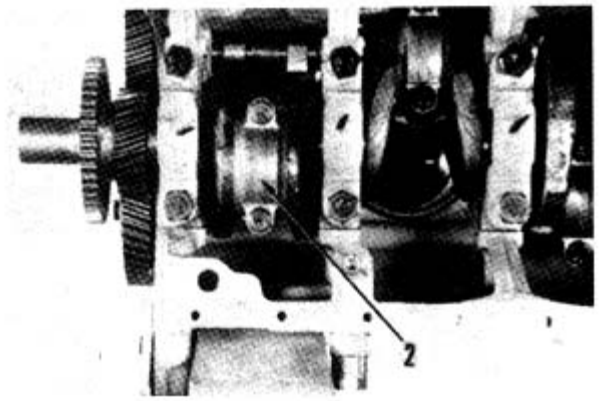
* **When disassembling the oil pump, see to section "DISASSEMBLY AND ASSEMBLY".**

Gear pump

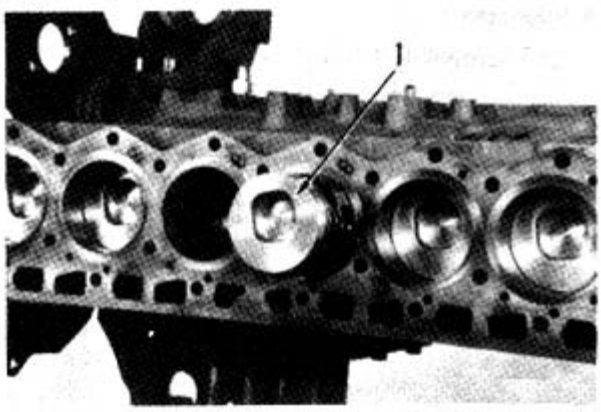


33. Piston and connecting rod assembly

1) Turn the engine overhaul stand so that the engine faces sideways.
2) Remove each connecting rod cap (2).

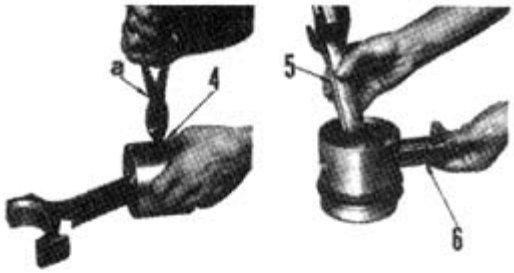


3) Remove piston (1).
   ***** Store each connecting rod cap and piston as a pair.



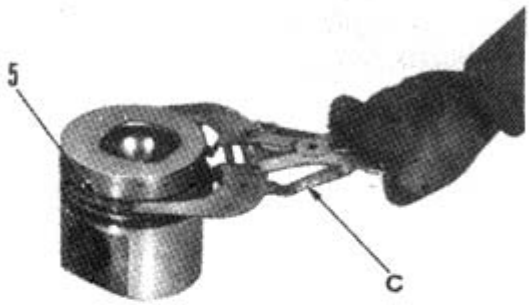
Disassembly of piston and connecting rod assembly

1) Using piller (a), remove one side snap ring (4).
2) Hold connecting rod (5) with a hand, and slowly draw off piston pin (6).
3) Separate connecting rod from piston.
4) Remove another snap ring.



5) Remove the piston rings in sequence by piston ring tool C, begining with top ring (5).

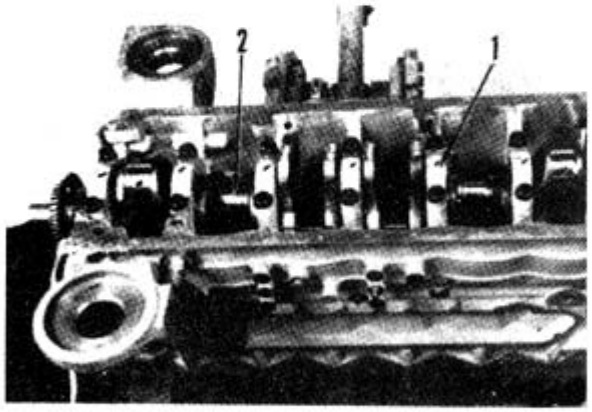
* Arrange pistons, connecting rods, bearings, piston rings, and piston pins in the order of cylinder numbers.



34. Crankshaft

1) Remove main caps (1).
2) Remove crankshaft (2).

kg Crankshaft : 67 kg

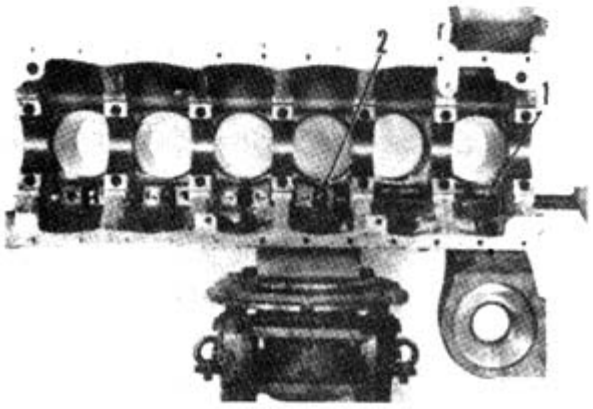


35. Camshaft

Remove camshaft ass'y (1) turning it.

36. Tappet

Remove tappet (2).



37. Idler gear

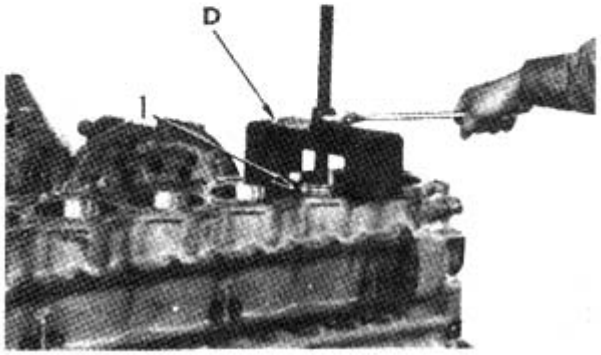
- Remove idler gear.

38. Front plate

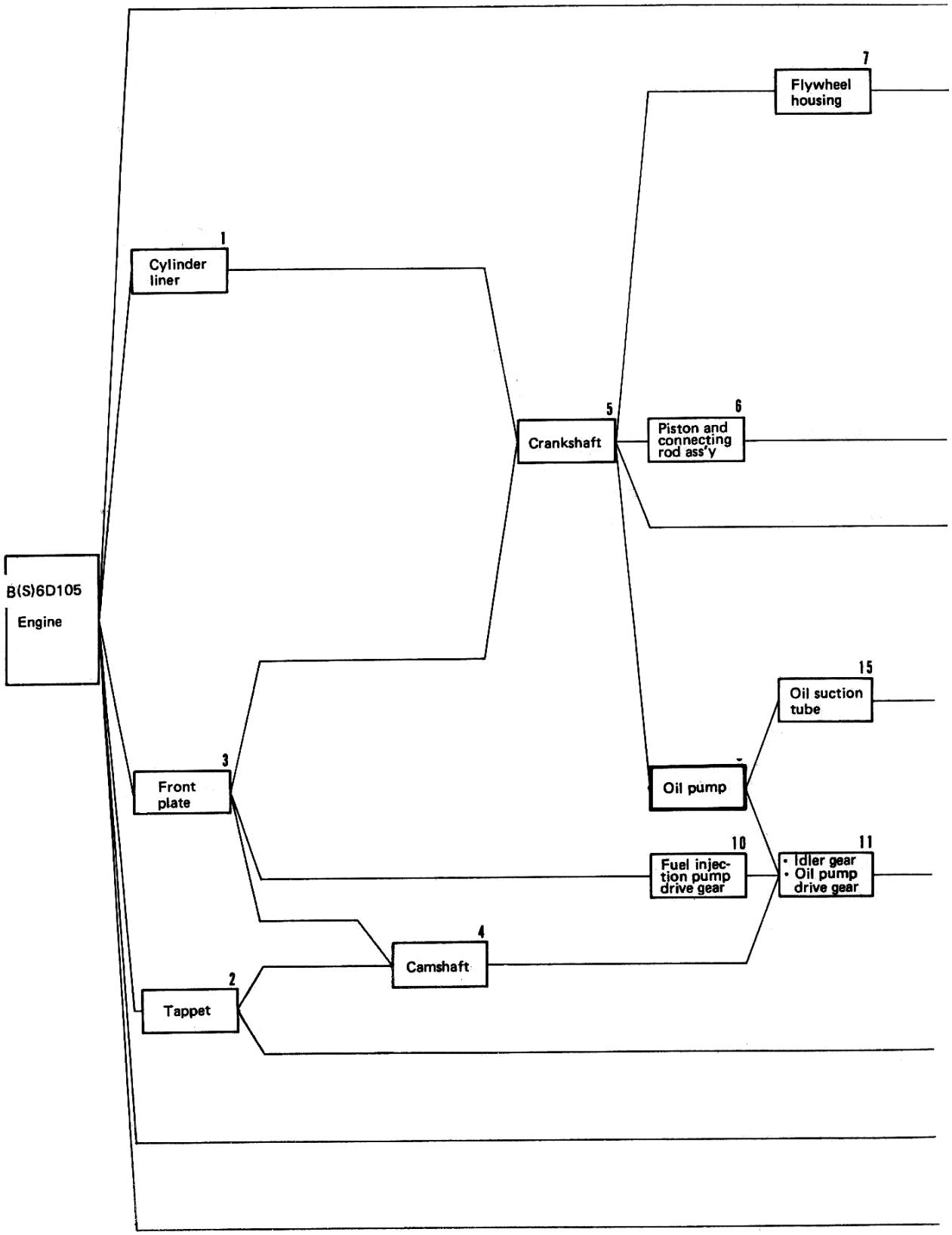
1) Remove idler shaft (2).
2) Remove front plate (1).

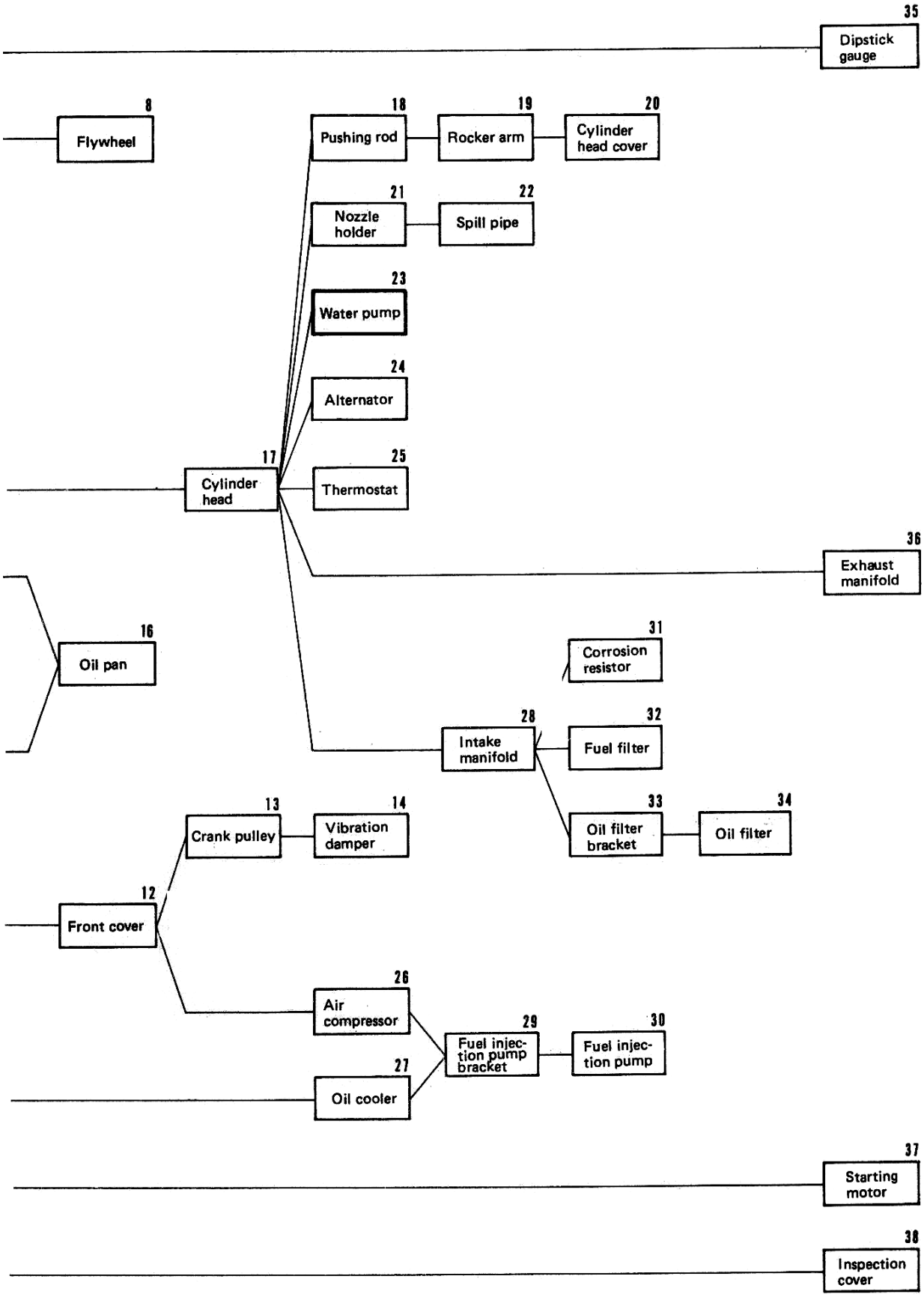
39. Cylinder liner

- Remove liner (1) using liner - puuler D.



ASSEMBLY


B(S)6D105
Engine
1
Cylinder liner
2
Tappet
3
Front plate
4
Camshaft
5
Crankshaft
6
Piston and connecting rod ass'y
7
Flywheel housing
10
Fuel injection pump drive gear
11
• Idler gear
• Oil pump drive gear
15
Oil suction tube
Oil pump

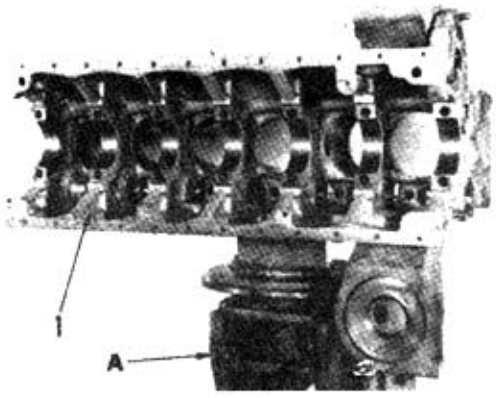

35
Dipstick gauge
8
Flywheel
18
Pushing rod
19
Rocker arm
20
Cylinder head cover
21
Nozzle holder
22
Spill pipe
23
Water pump
24
Alternator
17
Cylinder head
25
Thermostat
36
Exhaust manifold
16
Oil pan
31
Corrosion resistor
28
Intake manifold
32
Fuel filter
13
Crank pulley
14
Vibration damper
33
Oil filter bracket
34
Oil filter
12
Front cover
26
Air compressor
29
Fuel injection pump bracket
30
Fuel injection pump
27
Oil cooler
37
Starting motor
38
Inspection cover

NECESSARY TOOLS

Tool No.	Tool	A	B	C	E	F	G	H	I	J
790-501-2000	Stand for engine overhaul	1								
790-901-1106	Bracket for engine overhaul stand	1								
795-102-2101	Valve spring pusher		1							
795-100-2800	Piston ring tool			1						
795-215-1710	Liner driver				1					
795-216-1300	Cam bushing pushing tool					1				
795-215-1900	Piston holder						1			
795-215-1800	Real seal guide							1		
795-116-1410	Valve guide pushing tool								1	
795-116-1330	Filler gauge									1

Preparatory works

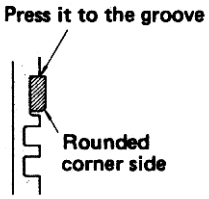
- Wash each part and make sure there are no rust, sharp edges, and defects.
- Attach an adapter plate to cylinder block (1) and install the cylinder block on engine overhaul stand A.



1. Cylinder liner

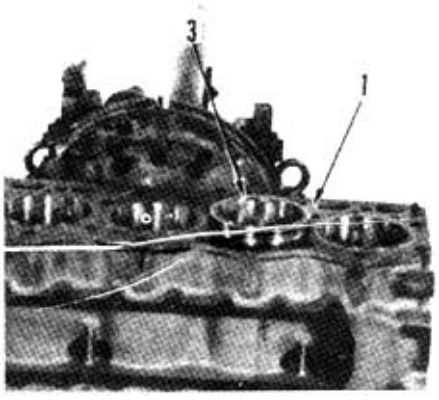
★ Check that there is no rust or pitting on the surface of the cylinder block where the liner is inserted. If there is any rust or pitting, polish the surface with No. 100 sandpaper or use metal compound to remove the pitting.

1) Install an O-ring on each cylinder liner.
   i) Coat the O-ring grooves on the cylinder liner and the surface of the cylinder block which will contact the O-ring with engine oil, Class-CD, SAE30.
   ii) Apply engine oil to the O-ring, and fit it completely into the O-ring grooves of the cylinder block using the finger tips.
   iii) 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.



2) Clevis seal
   i) Coat clevis seal grooves on the cylinder liner with engine oil, Class-CD, SAE30.
   ii) Coat clevis seals with engine oil, Class-CD, SAE30. Set them in grooves on the liner with your fingers.

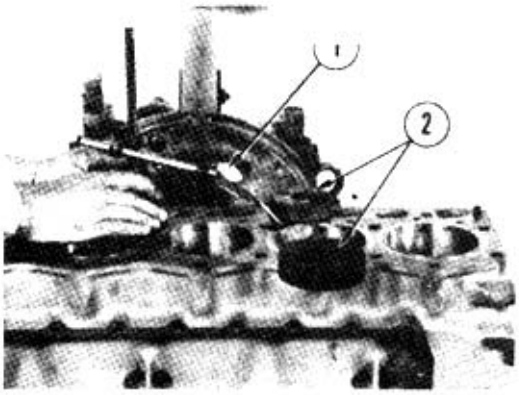
★ When installing a clevis seal, be sure to keep its chamfered edge on the lower side.



3) Cylinder liner
Coat machined surface which will be in contact with O-ring with engine oil, Class-CD SAE30 and insert cylinder liner carefully. Use hands and body weight to push in liner until O-ring contacts machined surface.

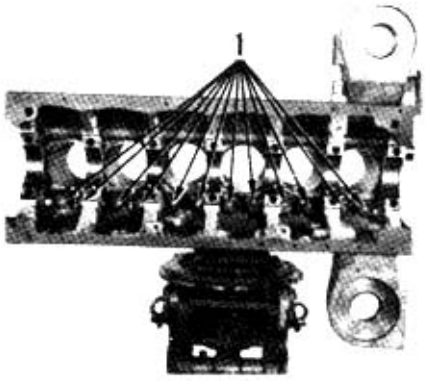
ii) Using liner driver E, force fit cylinder liner completely.

★ After force-fitting the liner measure the protrusion.
★ Before measuring the protrusion, using plates 2 to press in liner toremove protrusion caused by O-ring.
★ Clinder liner protrusion
Permissible range : 0.05 to 0.13 mm



2) Tappet

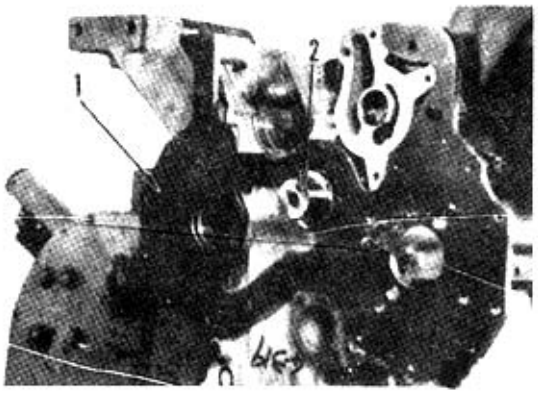
1) Turn the overhaul stand so that the crankshaft faces upwards.
2) Set each tappet (1) in place. Then, make sure that tappets move up and down smoothy.



3. Front plate

1) Attach a gasket to front plate (1) and install the front plate.
★ When installing a timing gear cover, coat the gasket so that the bolt holes are in correct alignment.

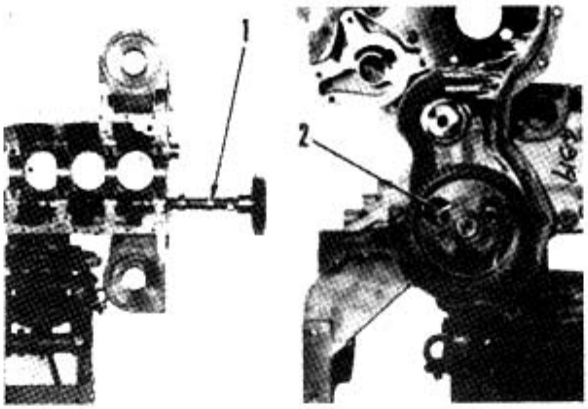
2) Install idler shaft (2).
★ Tighten the gear cover mounting bolts before installing the shaft.



4. Camshaft

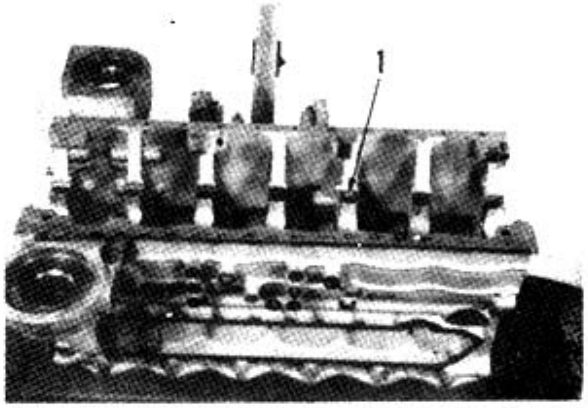
★ Install bushings, if removed, with bushing tool F,

1) Install camshaft (1) and the cam gear as one unit.
   - ★ Slowly install the camshaft and gear while pushing the shaft center, taking care not to damage the cam bushing.
   - ★ Do not hit on the gear by hammer.
2) Install thrust plate (2)

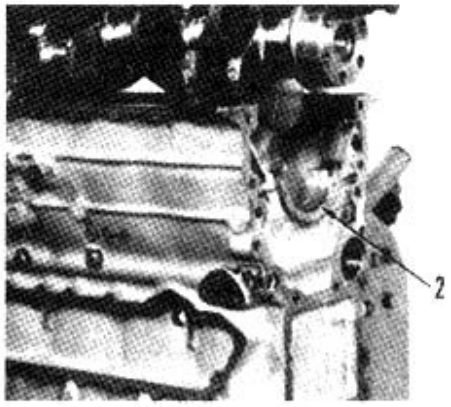


5) Crankshaft

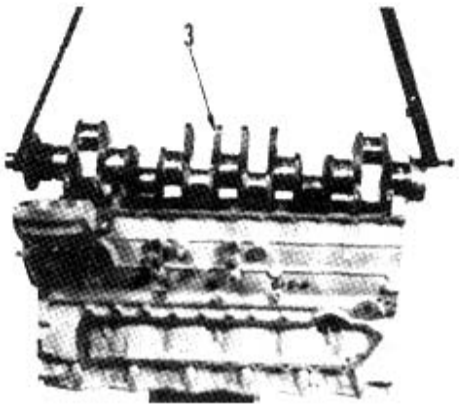
1) Install upper bearing (1). Make sure to align its protrusion and the notch of the cylinder block with each other.
   - ★ Make sure that the oil holes are in line with each other.
   - ★ After installing the upper bearing, coat its sliding surface with engine oil, Class-CD SAE30.



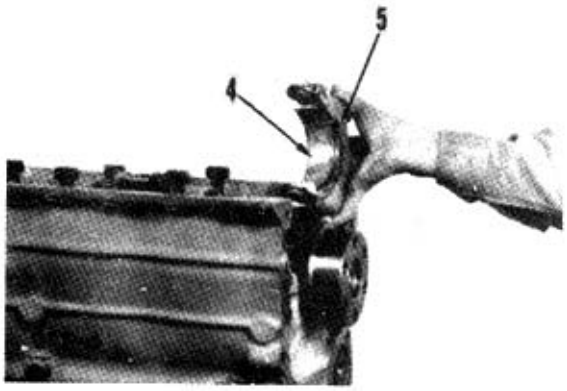
2) Install thrust bearing (2).
   - ★ Face the groove outwards
   - ★ After installing the thrust bearing, coat its sliding surface with engine oil, Class-CD SAE30.

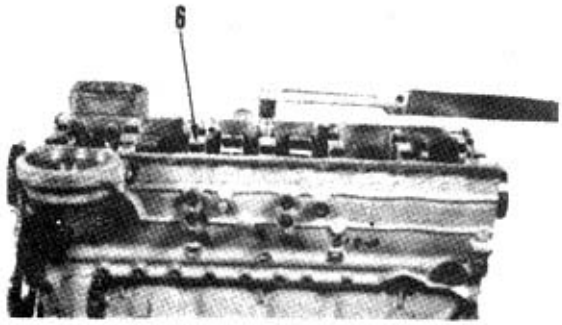


3) Using nylon sling, raise crankshaft assembly (3) and install it carefully, taking care not to damage journal.
   - ★ Coat surface of crankshaft journal with engine oil (Class-CD SAE30).



4) Install lower bearing (4). Make sure to align its protrusion and the notch of the main cap.
5) Set a thrust bearing (5) on each side of No. 7 main cap.
   - ★ Set each thrust bearing with its grooved portion facing outwards.
   - ★ Make sure that the roll pin protrudes 1.5 to 1.9 mm.
6) Install main cap (6).
   - ★ Install each bearing by coating its sliding surface with engine oil, Class-CD SAE30.
   - ★ Set the main cap marked ``F'' facing the engine front, referring to the matching cylinder block and bearing numbers.
7) Coat lock plate and thread of main metal cap mounting bolts with engine oil Class-CD SAE30. Tighten bolts little by little in turn to fit main metal cap (9) completely. Tighten mounting bolts of main metal cap in the following order.
   - ★ Bend lock plate securely.
   - ★ Tighten the cap bolts in steps and in order from the center outwards.





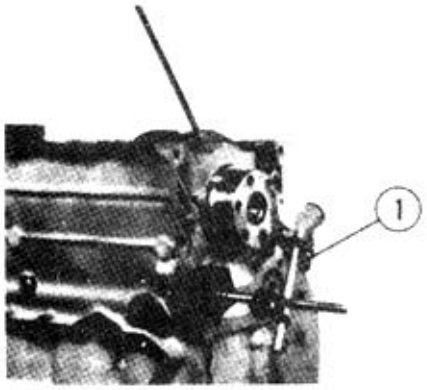
kgm Main metal cap mounting bolts

Unit : kgm

Procedure	Target	Range
Step 1	7	6 - 8
Step 2	20	19 - 21
Step 3	Loosen off completely	
Step 4	7	6 - 8
Step 5	14	13 - 15
Step 6	20	19 - 21

★ **After tightening the bolts, see the crankshaft rotates smoothly.**

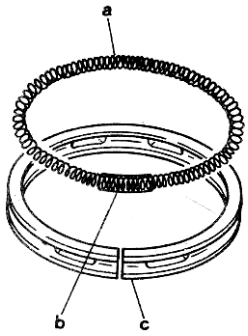
8) Measure end play of crankshaft
   - • Place the dial gauge① probe against the end of the crankshaft and read the dial to measure the in and out movement of the crankshaft.
   - ★ Crankshaft end play: 0.14 to 0.315 mm If the end play exceeds the permissible limit, replace the thrust metal with an oversize metal and correct the crankshaft to oversize.



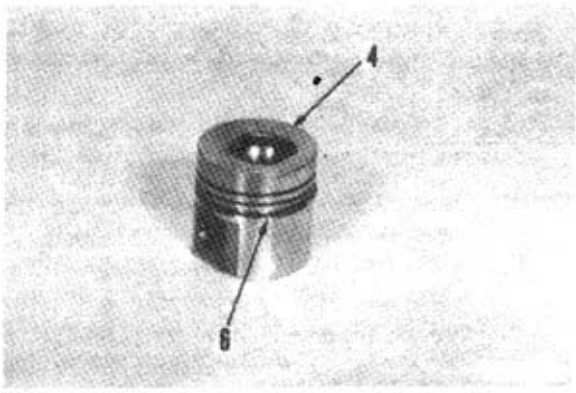
6. Piston and connecting rod assembly

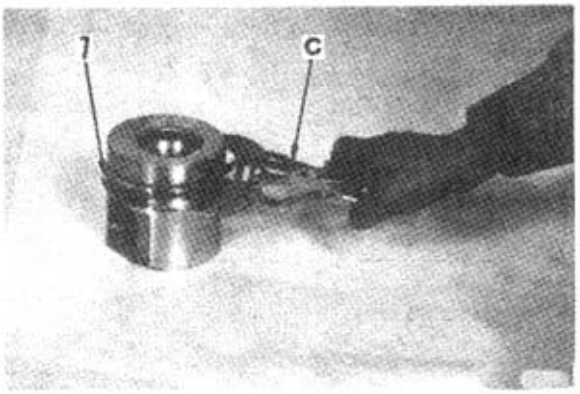
★ **Assembly piston and connecting rod assembly**

1) Install expander (6) to piston (4)
2) Using piston ring tool C, assemble top ring, 2nd ring and oil ring on piston (1) with stamped mark faceing up.
   - ★ After installing the piston ring, check that the piston ring moves smoothly in the piston ring grooves.
   - ★ Relative positions between expander and ring are shown in Fig. 6136F304.

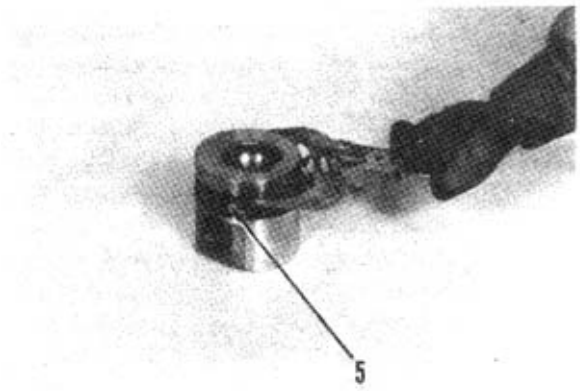


a. Coil joint part
b. Teflon tube
c. Gap

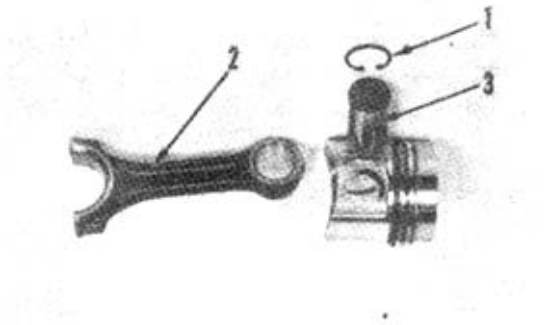




3) Install compression ring (5).



4) Letting the direction of FRONT marked on piston head and the casted part number of connecting rod be in same side (i.e., cylinder serial number comes to cam side), insert piston pin (3) and set piston to connecting rod (2).
   - ★ If piston pin is difficult to be inserted, dip piston in hot water expand it.
   - ★ Set each piston and connecting rod by referring to their matching cylinder numbers.
   - ★ The cylinder number is marked on the connecting rod with an electric pen.
5) Install snap rings (1) on each side.

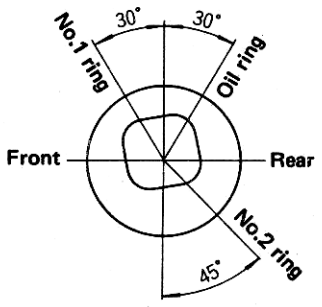


- Turn the overhaul stand so that the cylinder block faces sideways.

★ Place a crank pin the top dead center position in the cylinder to which a piston connecting rod assembly is-to be fitted.

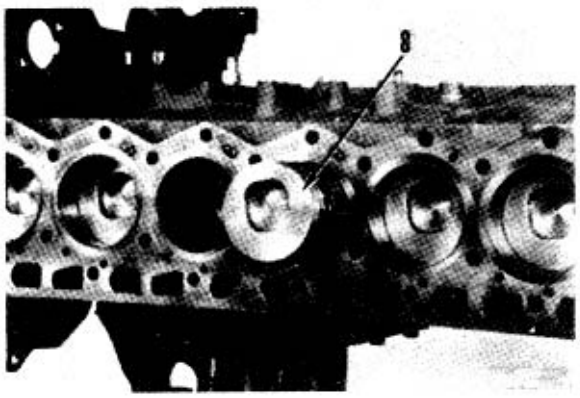
★ Coat the internal surface of the cylinder, the piston rings, and connecting rod bearings surface with engine oil.

1) Insure the relative locations of the each piston ring mating faces shown in the figure at right.



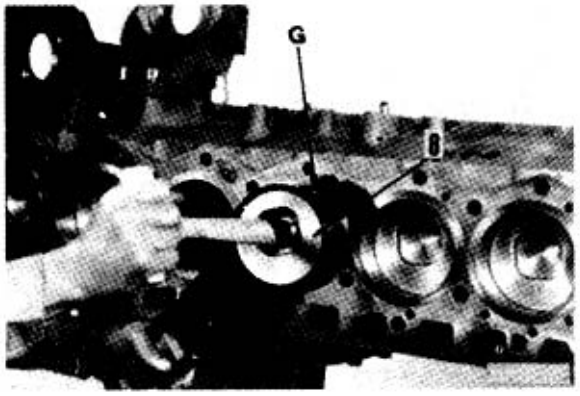
2) Direct casted part number of connecting rod (direction of FRONT marked on top of piston) to adhead of engine (cylinder serial number comes to cam side), and insert piston connecting rod assembly from cylinder head side.

★ Install the piston connecting rod assembly with its marked cylinder number on the cam side.



3) After wringing the piston rings with piston holder G, thrust in piston head with wooden bar and pull larger end of connecting rod to allow rod to fit in crankshaft.

4) Install the lower connecting rod bearing to the connecting rod cap by aligning the notch of the connecting rod cap with the protrusion of the lower connecting rod bearing.



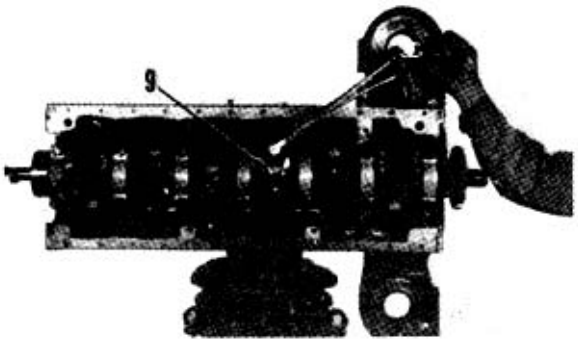
5) Install connecting rod caps (9) so that the marked numbers are on the cam side, by aligning the number marked on the con necting rod.

★ Coat the connecting rod bearings with engine oil.

6) Install the connecting rod cap in the following manner.

★ Coat the threads of the connecting rod bolt and the seat surfaces of the nuts with engine oil.

★ Tighten the bolts alternately in the following way :

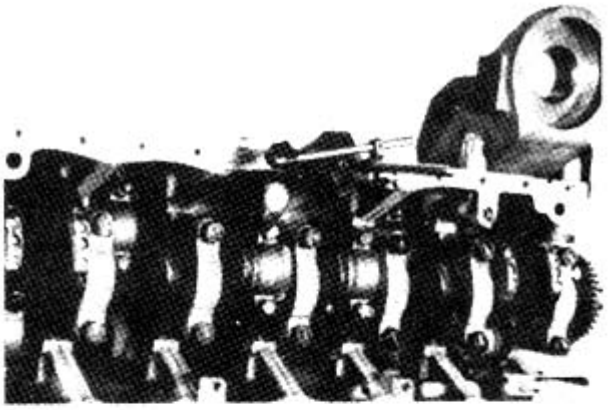


kgm Tightening torque for connecting rod cap

Unit: kgm

Procedure	Target	Range
Step 1	6	5 - 7
Step 2	11	10 - 12
Step 3	Loosen off completely	
Step 4	6	5 - 7
Step 5	11.2	10.6 - 11.7

★ **After installation of the piston connecting rod assembly, turn the crankshaft to see if the shaft rotates smoothly.**



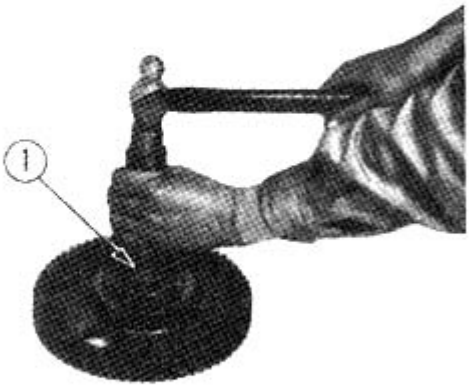
Measure side clearance of connecting rod

- Place the dial gauge probe aganist the connecting rod cap and read the dial to measure the movement backwards and forwards of the connecting rod.
- ★ Connecting rod side clearance :0.16 to 0.33 mm. If the connecting rod does not move, disassemble and check for incorrect assembly or foreign matter.

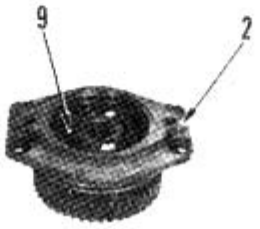
7. Flywheel housing

★ **Assembly Flywheel housing**

1) Press fit the bearing using pushing tool 1 (outside dia. : 100 mm)



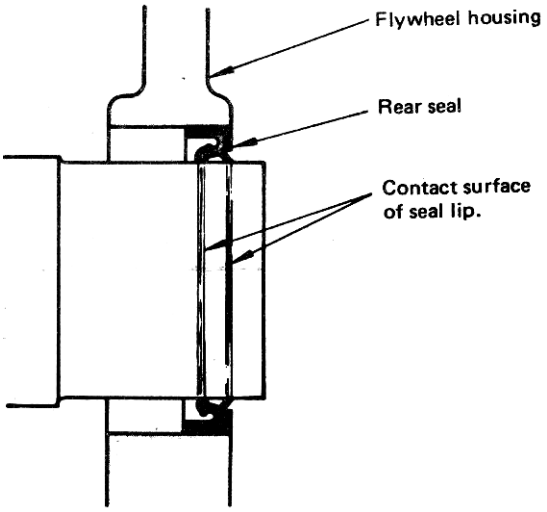
2) Install the gear to cover (2).
3) Tighten nuts (9).
   - ★ Bend the lock washer certainly.



4) Press-fit rear seal to the flywheel housing using push rod ②tool
(outside diameter : 135 mm)

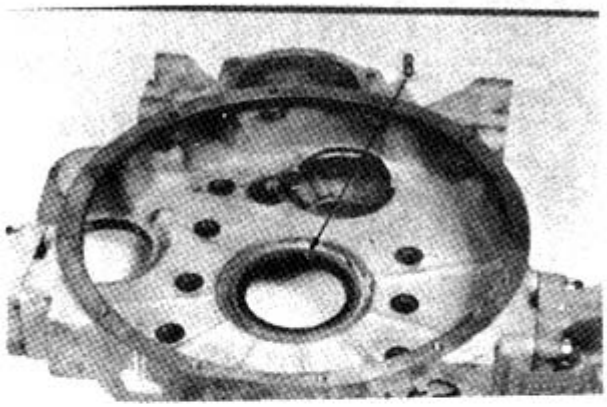
Apply thinly gasket sealant (LG-2) on circumferences of rear seal.

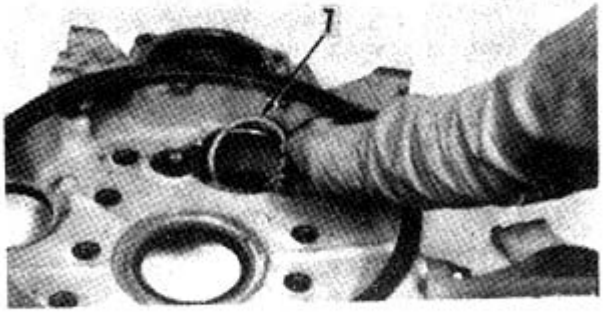
★ Keep rear seal end face even with the surface of the flywheel housing.
★ If the surface of the crankshaft which is in contact with the seal lip has scratches (approx. 0.1 mm deep) or if it is smooth like a mirror surface, shift the rear seal approx. 3.0 mm forward.

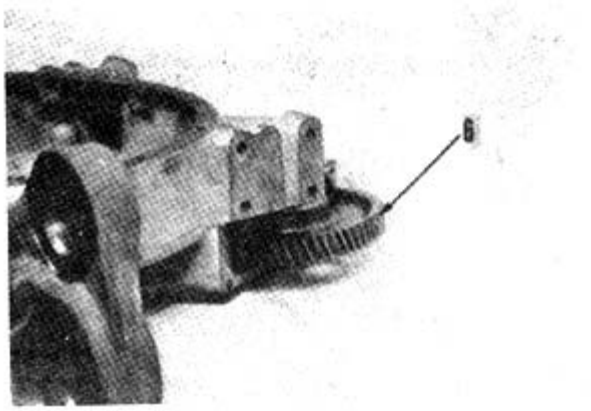


5) Install thrust washer (7).
★ Face the grooves toward the gear.

6) Install gear (6).

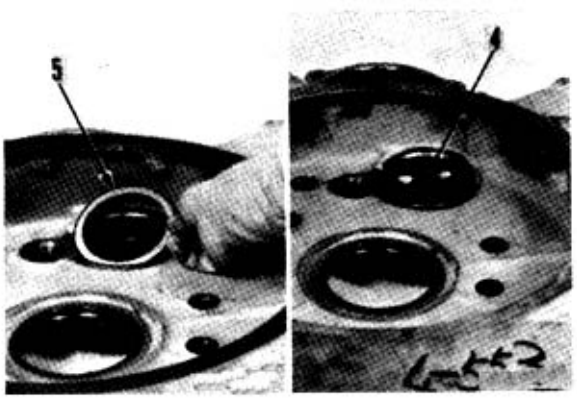




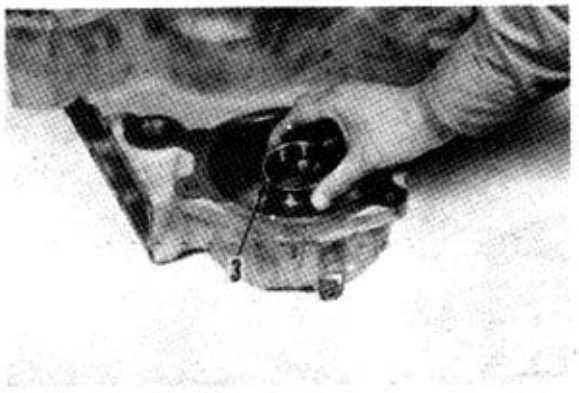


7) Install thrust washer.

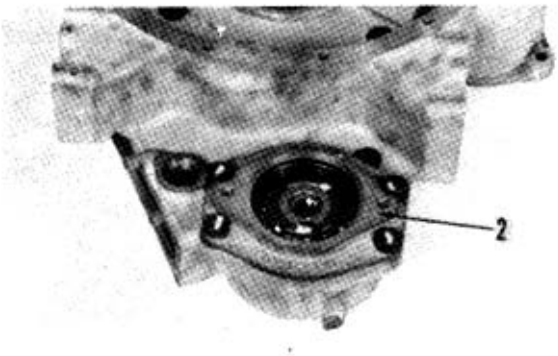
8) After fitting O-ring to shaft (4), and install shaft (4).



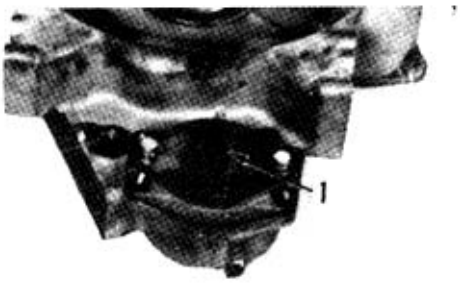
9) Install bearing inner race (3).



10) Install cover (2) after fitting the O-ring to it

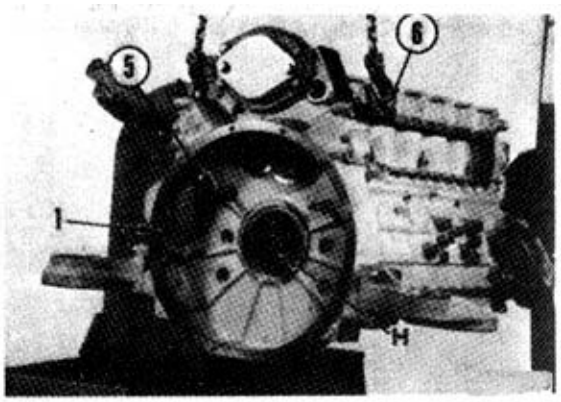


11) Install cover (1) after fitting the O-ring to it



★ **Installing the flywheel housing**

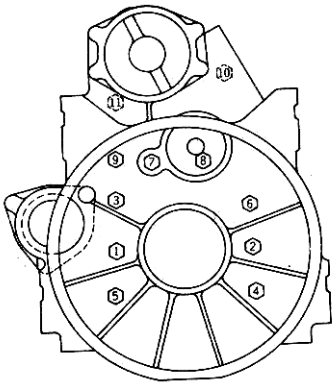
1) Attach rear seal guide H to the end of crankshaft.
2) Install guide bolt 5 (dia. 10 mm, pitch 1.25 mm, length 100 mm).
3) Lift flywheel housing (1) using eye bolt 6 (dia. 12 mm, pitch 1.75 mm). Align the flywheel housing dowel pin hole with cylinder block dowel pin hole and install the flywheel housing, after installing the gasket to the cylinder block.



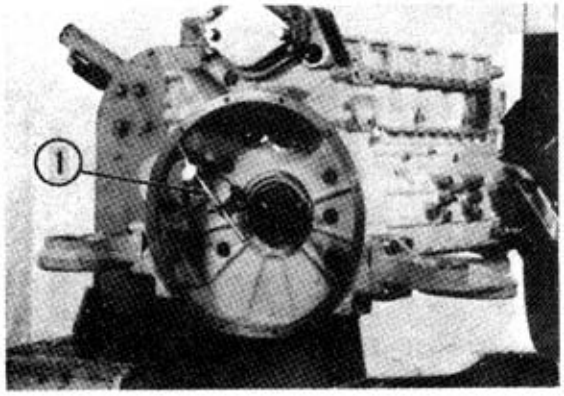
Apply grease (G2-LI) so that about 50% to 80% of space of seal lip is fitted with.

★ Tighten these bolts in order to right figure.

kgm Flywheel housing : 11 ± 1.5 kgm

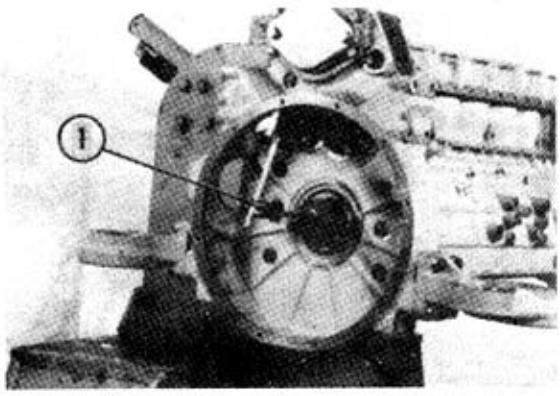


4) Measure face runout of flywheel housing
   - Place the dial gauge probe 1 against the rear face of the flywheel housing. Rotate the crankshaft one turn and check that the difference between the maximum measurement and the minimum measurement is within the permissible range.



   ★ Permissible face runout : max. 0.35 mm
   ★ When turning the crankshaft one turn, the dial needle should return to the same position. If it does not, take the measurement again.

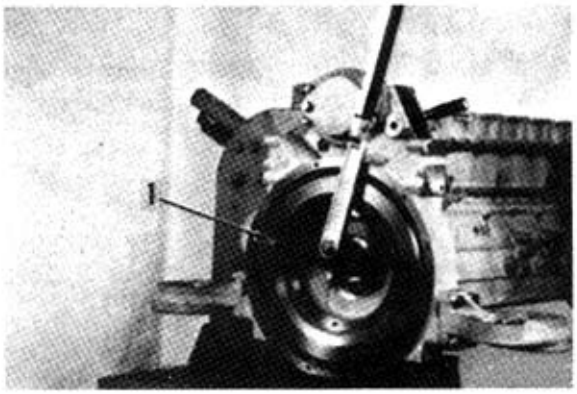
5) Measure radial runout of flywheel housing
   - Place the dial gauge probe 1 against the pilot bore of the flywheel housing. Rotate the crankshaft one turn and check that the difference between the maximum measurment and minimum measurment is within the permissible range.



   ★ Permissible radial runout: max.0.30 mm
   If the difference exceeds the permissible range, adjust the mounting position of the housing assembly.

8. Flywheel

1) Install the guide bolt (dia. 14 mm, pitch 1.5 mm) to crankshaft of flywheel surface.
2) Install flywheel (1)

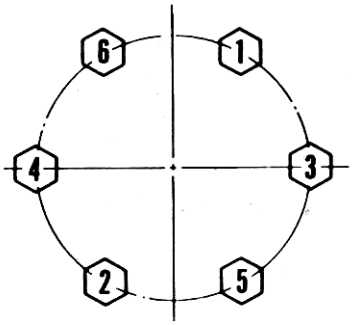


★ Apply engine oil on threads of flywheel mounting bolts, and washer surface.
★ Tighten flywheel mounting bolts according to the following procedure.

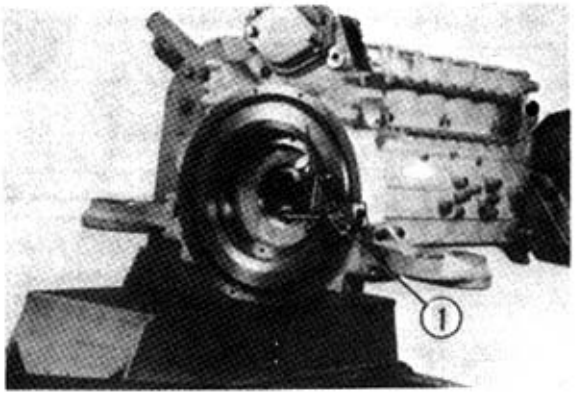
kgm Tightening torque for flywheel

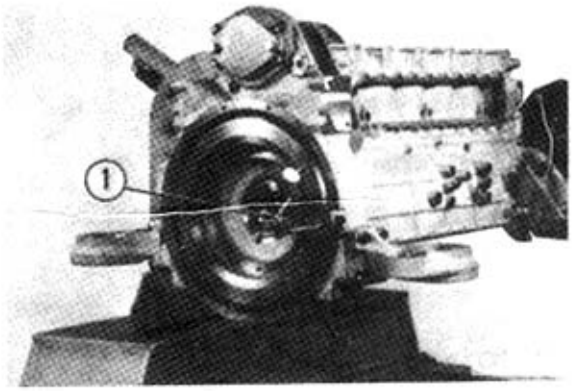
Unit: kgm

Procedure	Target	Range
Step 1	9	6 - 12
Step 2	18	16 - 20



3) Measure face runout of flywheel housing
   - Place the dial gauge probe 1 against the rear face of the flywheel housing. Rotate the crankshaft one turn and check that the difference between the maximum measurement and the minimum measurment is within the permissible range.
   ★ Permissible face runout : max. 0.20 mm
   ★ When turning the crankshaft one turn, the dial needle should return to the same position. If it does not, take the measurement again.
4) Measure radial runout of flywheel housing
   - Place the dial gauge probe 1 against the pilot bore of the flywheel housing. Rotate the crankshaft one turn and check that the difference between the maximum measurement and the minimum measurement is with in the permissible range.
   ★ Permissible radial runout: max. 0.15mm If the difference exceeds the permissible range, adjust the mounting position of the housing assembly.





9. Oil pump

- Install oil pump (1)
  - ★ Torchoid pump
    Gear pump

  Regarding to assembling the oil pump, refer to page 13-051

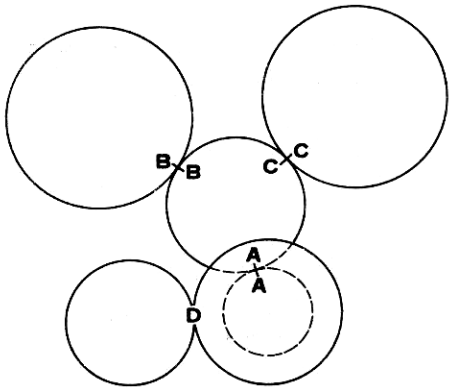
10. Fuel injection pump drive gear

- Install fuel injection pump drive gear (2).

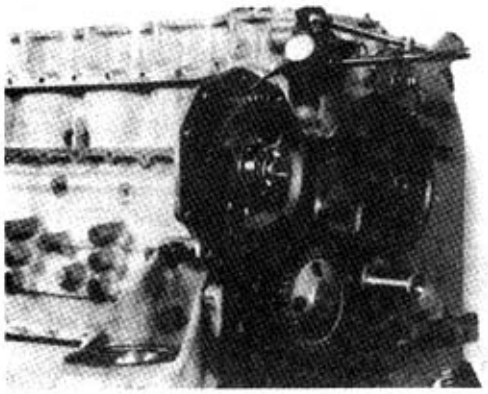
11. Idler gear, oil pump drive gear

1) Set idler gear (3) in place and install thrust plate (4) with the roll pin in the correct pisition.

   kgm Thrust plate mounting bolt: 11 ± 1.5 kgm

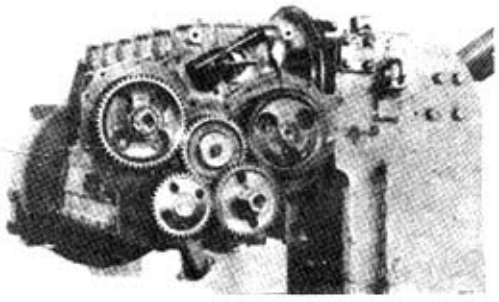


2) Install oil pump drive gear (5).
   - ★ Make sure that each drive gear and idler gear is correctly mated according to their match marks.
   - ★ Measure the backlash between each drive gear and idler gear and the end play at the camshaft and idler gear.



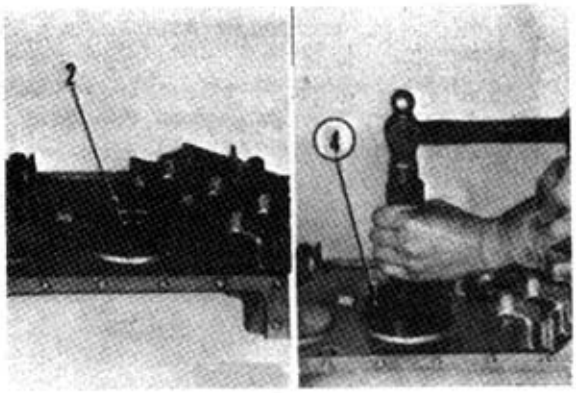
Position	Measuring point	Backlash range (mm)
A	Between crank gear and idlergear	0.105-0.370
B	Between injection pump gear and idler gear	0.025-0.425
C	Between cam gear and idler gear	0.110-0.410
D	Between pump gear and idler gear	0.120-0.370

- ★ Camshaft end play: 0.15 - 0.35 mm
- ★ Idler gear end play: 0.05 - 0.21 mm



12. Front cover :

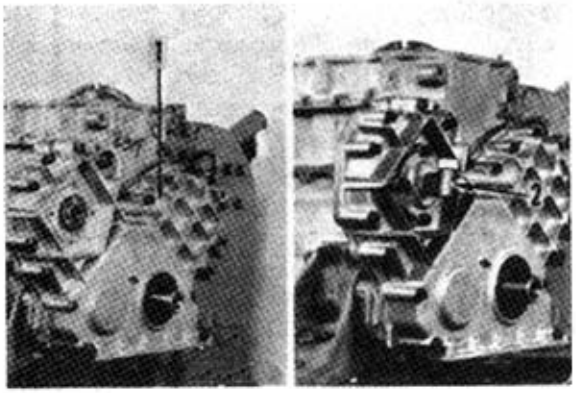
1) Press-fit front seal (2) into the front cover using pushing tool ④ (outside diameter 90 mm).



2) Fit the gasket to the cylinder block, and install front cover (1).

Gasket sealant : LG - 1

Apply grease (G2 - L1) so that about 50 to 80% of space of seal lip is filled with.

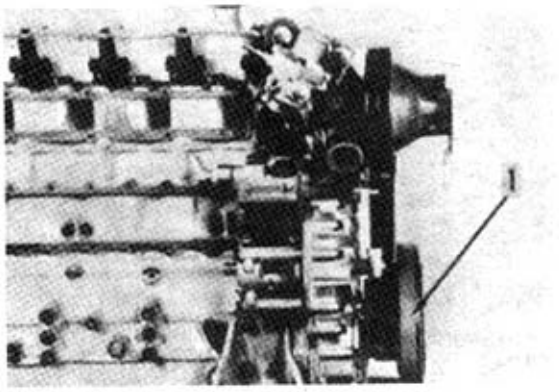


3) Install service meter cover (2).

13. Crank pulley :

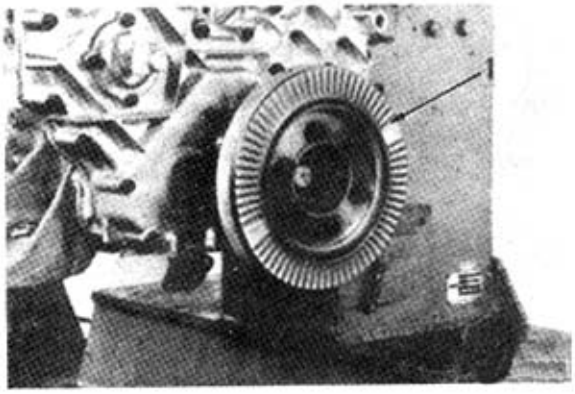
1) Install crank pulley (1).
2) Install the taper-collar.
3) Tighten the bolds after attaching the plates.

kgm Crank pulley : 38 ± 3 kgm.



14. Vibration damper :

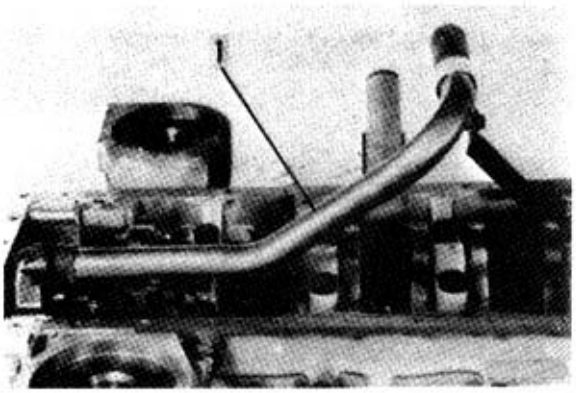
- Install vibration damper (1).



15. Oil suction tube :

- Turn the engine overhaul stand so that the oil pan faces upwards.
- Attach O-ring to oil suction tube (1) and connect it.

* When connecting the tube, tighten the clamp, without putting too much force on the tube.



16. Oil pan :

1) Measure the differences in even between the cylinder block and front cover, front plate and flywheel housing, using a dial gauge (1).

* Stand differences in even

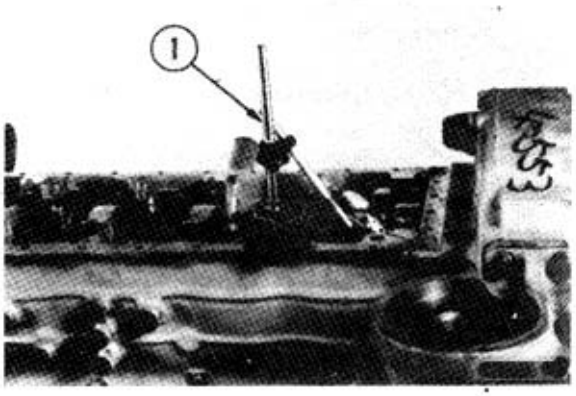
Between the cylinder block and front plate.

Protrusion of plate : 0.04 mm

Retraction of plate : 0.22 mm

Between the cylinder block and front cover : 0.11mm

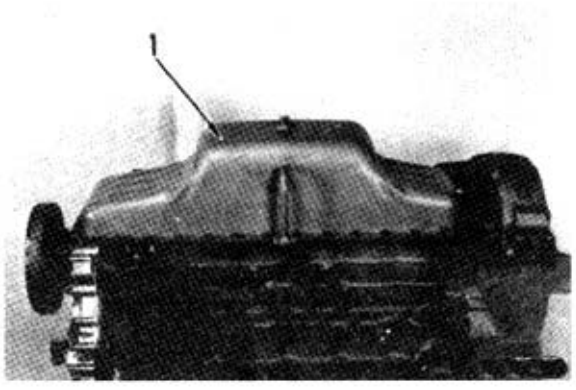
Between the cylinder block and flywheel housing : 0.13 mm



Coat the mating surfaces of the front cover, front plate, and flywheel housing with liquid gasket (LG - 1).

2) Put a gasket on oil pan (1). Then install it on the cylinder block.

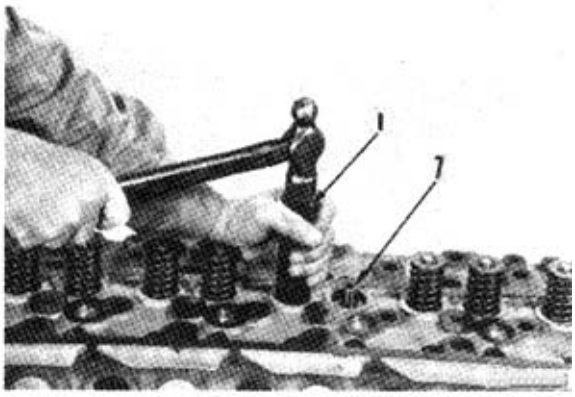
* Attach a split type gasket to the oil pan so that the whole hot-rolled surface (glossy surface) faces the cylinder block.



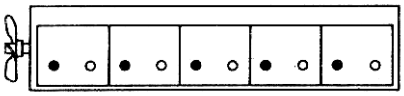
kgm Oil pan mounting bolt : 25 ± 1 kgm.

17. Cylinder head :

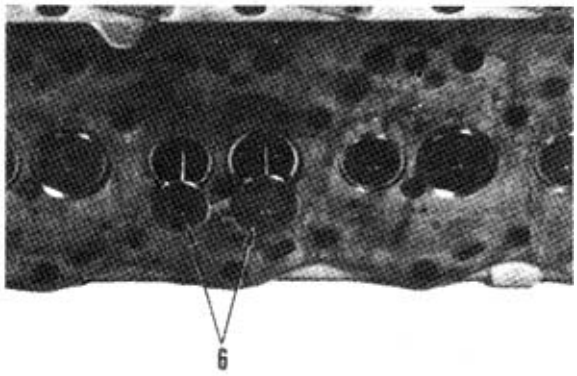
★ Cylinder head assembly
★ When removing the valve guide, install valve guide (7) using pusher tool I.



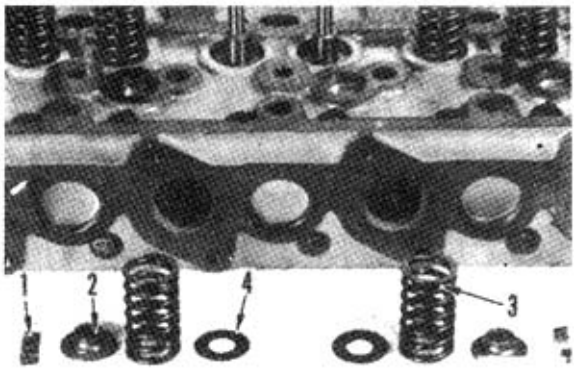
1) Install valves (6).
   ★ Cost the stem of valve with engine oil of CLASS - CD SAE 30.
   ★ Intake and exhaust valves are arranged as shown below.



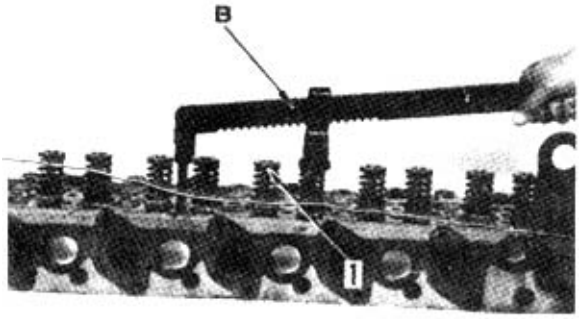
● Exhaust valve
○ Intake valve
(Viewed from top)



2) Install in spring seats (4), valve springs (3) and ring guides (2).
   ★ Use a varied pitch valve spring, so be sure to install with the tight coils at the bottom (cylinder head end).

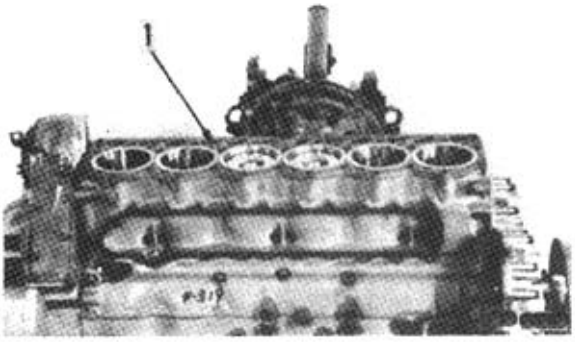


3) Compress each valve spring and set valve cotter (1) on the valve stem, using valve pusher B.
   ★ Remove valve pusher **B**. Tap the valve stem lightly with a plastic hammer to make sure that the cotter is set completely on the valve stem.

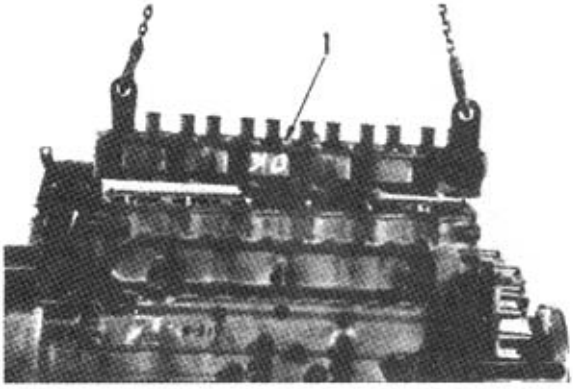


★ Cylinder head material differs according to whether or not the engine is turbo-charged. Be sure to use the right kind of cylinder head when replacing or repairing.

1) Install head gasket (1) with word TOP facing up.
   - ★ Be careful not to danage the bottom face of the cylinder head and the mounting surface of the cylinder block. Also check that there is no dust or dirt on these surface.



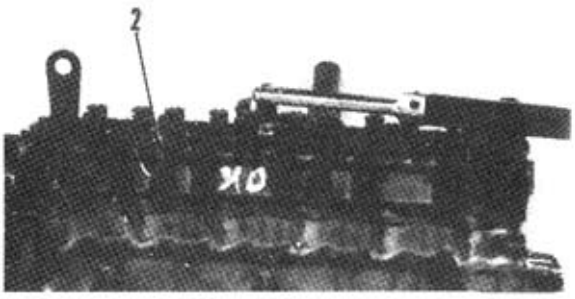
2) Install cylinder head (2).



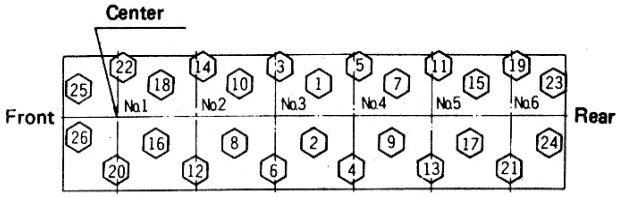
3) Cost thread of mounting bolts with anti-friction compound or engine oil, and then tighten bolts as shown in diagram.

kgm Cylinder head mounting bolts (kgm)

Producere	With anti-frication compound		With engine oil	
	Target	Range	Target	Range
Step 1	9	8 - 10	9	8 - 10
Step 2	13	12 - 14	13	12 - 14
Step 3	18	17.5-18.5	20	19.5 - 20.5

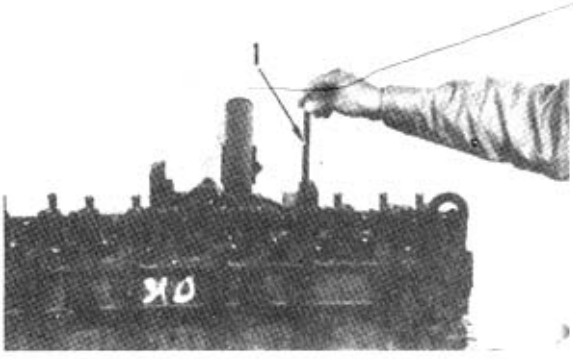


- ★ Tightening order of cylinder head bolt



18. Push rod :

- Install push rod (1).
  - ★ The pushing rods for air intake and exhaust are identical.
  - ★ Make sure that pushing rod is certainly in the tappet.



19. Rocker arm :

1) Install rocker arm assembly (1).

★ After installing, if tension of valve spring is applied on rocker arm, return adjustment screw until no tension is present so as to avoid compulsory force on push rod during tightening.

★ Install rocker arm assembly mounting bolts (6) and tighten them alternately. While tightening these bolts, make sure adjustment screw ball is seating in push rod socket.

2) Adjust the valve clearance using feeler gauge **J**.

★ Valve clearance (when engine is cold).

Intake valve	0.25 mm
Exhaust valve	0.45 mm

★ Engine firing order : 1-5-3-6-2-4.

3) Rotate crankshaft one rotation at clock wise to align 1.6 TOP marked line (2) of crank pulley with pointer (3) while looking at the No.6 cylinder intake valve.

★ When alignment has been obtained, 1st cylinder is just in upper compression dead point.

★ With the B6D105-1 engine there is a #1.6 TOP mark on the drive shaft of the injection pump. Use this as a guide when adjusting the valve clearnce.

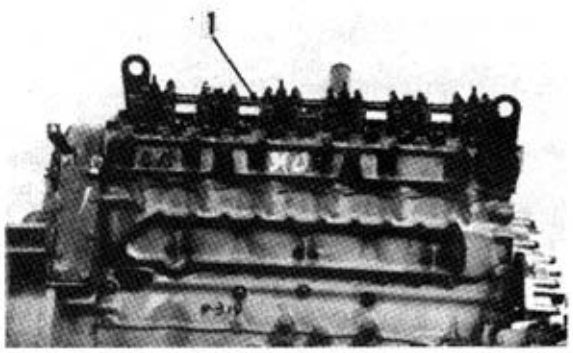
4) Adjust clearances for valves marked ●. Valve arrangement

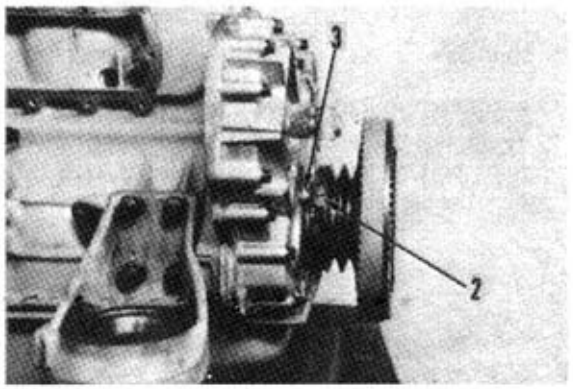
Cylinder No.	1		2		3		4		5		6	
Intake valve		●		●		○		●		○		○
Exhaust valve	●		○		●		○		●		○	

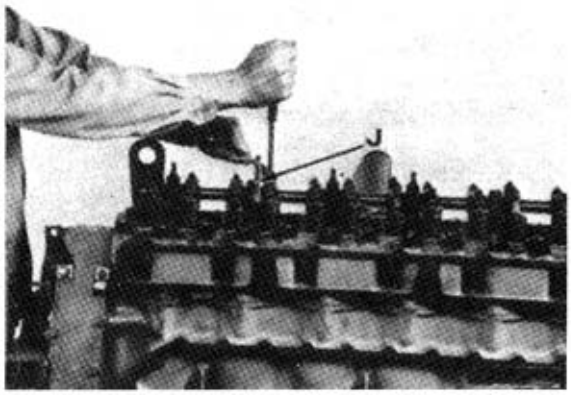
5) Turn the crankshaft one rotation in the normal direction and adjust the clearance of valves marked ○.

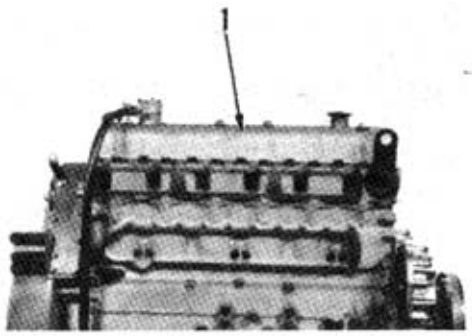
20. Cylinder head cover :

• Attach the gasket, and then install cylinder head cover (1).







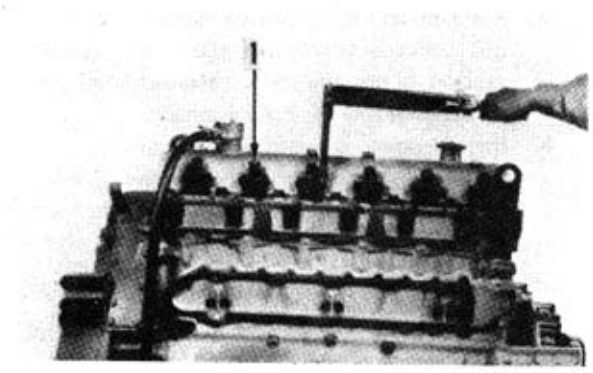


21. Nozzle holder :

1) Install nozzle holder (1).

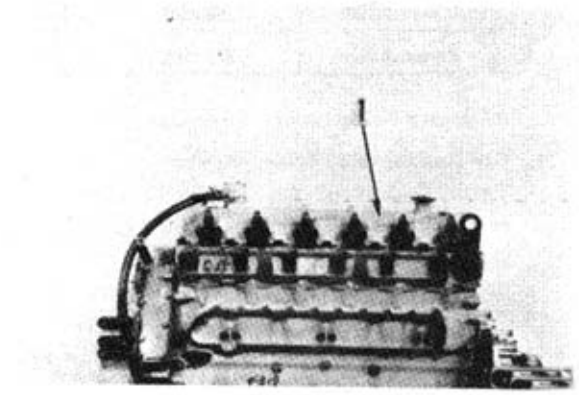
kgm Nozzle holder : 1.75 ± 0.25 kgm

★ Make sure that each nozzle holder mounting hole is free from dirt, dust, etc. Be careful not to hit the holder tip against anything.
★ Tighten the nozzle holder mounting bolts uniformly and alternately.



22. Spill pipe

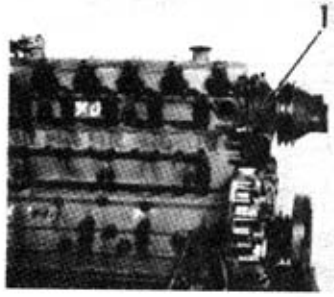
• Connect each spill pipe with a gasket attached.
★ When installing spill pipes, be careful not to let the joint bolt gaskets fall out of place. It is difficult to pick the gasket out of the cylinder head.



23. Water pump

• Attach the gasket to water pump (1), and install it.

Gasket: Liquid gasket (LG-1)

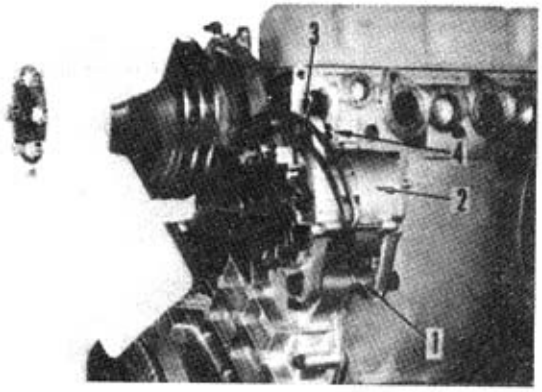


24. Alternator

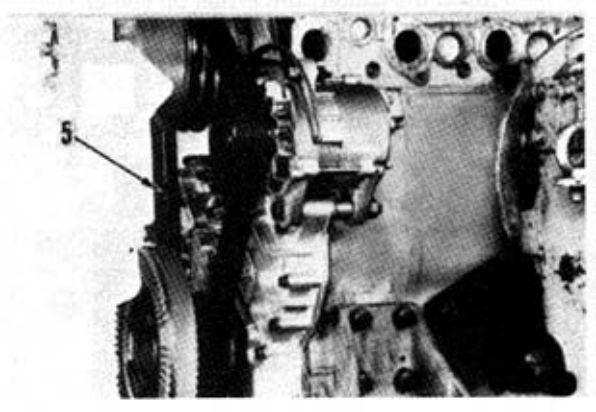
1) Install alternator assembly (2) with spacer (1) attached.

★ Spacer and alternator have been tightened together.

2) Install adjust plate (3).
3) Temporarily tighten adjustment bolts (4).



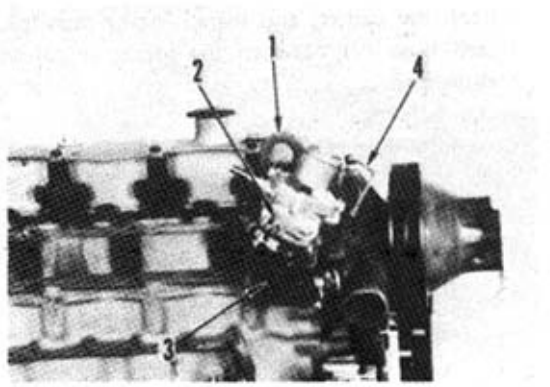
4) Install fan belts (5).
5) Using bar to raise alternator to front, adjust belt tension.
   - ★ The belts should sag about 10 mm under 6 kg of finger pressure at mid-- point between pulley and alternator pulley.
   - ★ After adjusting, tighten plate bolt (2) and alternator bolt (3).

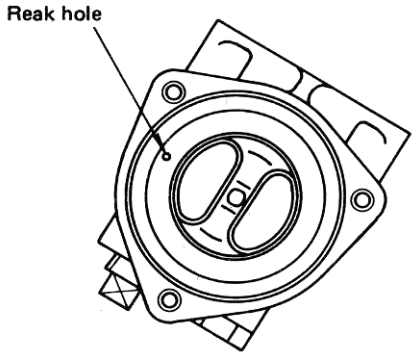


25. Thermostat :

1) Remove hanger (1).
2) Attach a gasket to the thermostat and install with case (2) as a unit.
3) Install hanger (1) through a hole in the case. Tighten hanger (1).
4) Connect a hose (3) between the water pump and thermostat.
5) Install tube (4).

★ Set the thermostat in place so that the water leak hole is positioned as shown in the figure.





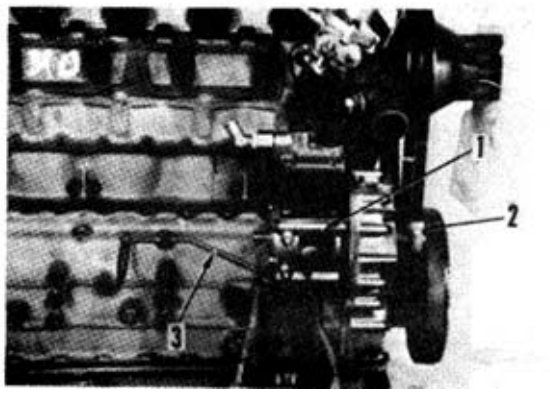
26. Air compressor

1) Remove the service meter tap.
2) Align the air compressor spline shaft in line with the match mark on the spline and install air compressor (1).

kgm Compressor mounting bolt : 25 ± 1.0 kgm

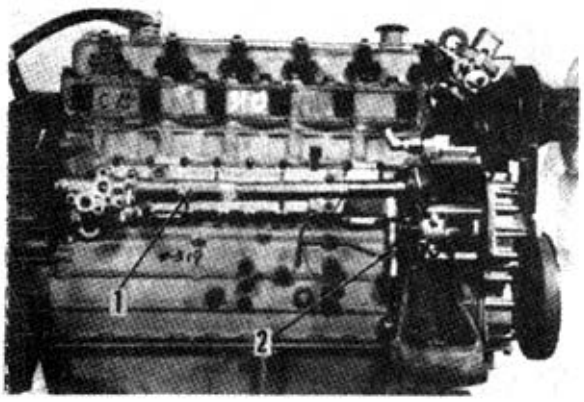
Mounting bolt : Coat wtih adhesive (LT - 2)

3) Install service meter tap (2).
4) Attach a gasket to tube (3) and connect it.



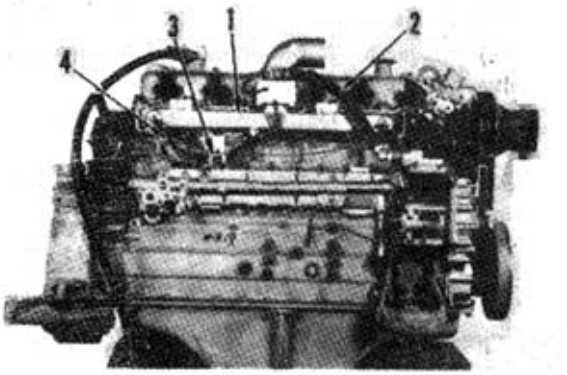
27. Oil cooler :

1) Attach the gasket, and install oil cooler (1).
2) Attach the O-ring to tube (2), and install tube (2).



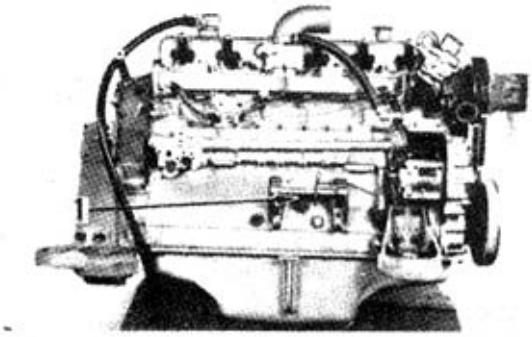
28. Intake manifold :

1) Attach the gasket, and install intake manifold (1).
2) Install hose (2) between the intake manifold and compressor.
3) Install bracket (3).
4) Connect wiring (4).



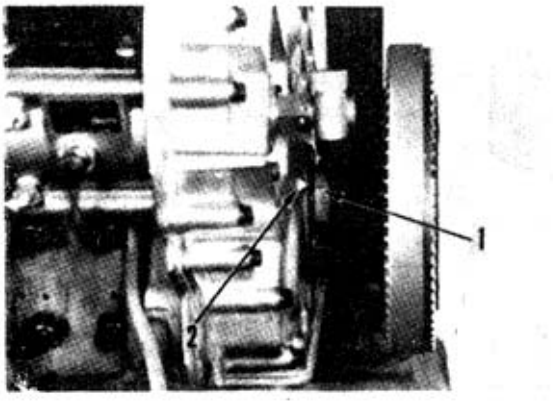
29. Fuel injection pump bracket :

- Install fuel injection pump bracket (1).



30. Fuel injection pump :

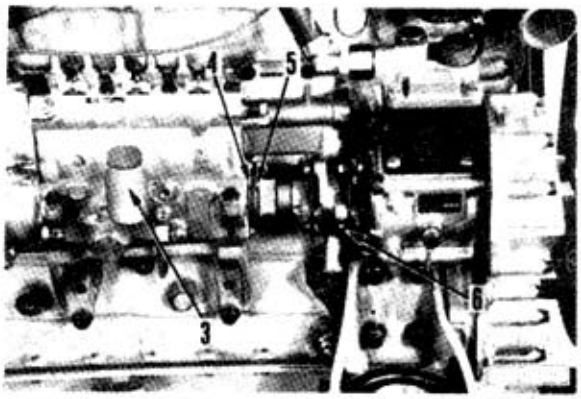
1) Make sure that pump mounting key is up. Align the marked line (1) of the crank pulley with pointer (2).



2) Install fuel injection pump (3).
3) Make sure that the marked line (4) on the injection pump and that (5) on the coupling are aligned with each other.
   - ★ If both marked lines are out of alignment, loosen bolt (6) in the oblong hole in the coupling. Move the coupling until both marked lines are aligned.

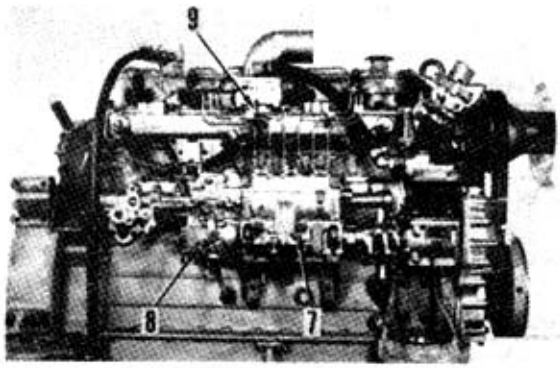
     kgm Coupling bolt : 3.25 ± 0.25 kgm

   - ★ After adjustment or replacement of pump has been made, adjust the fuel injection timing by the delivery method.

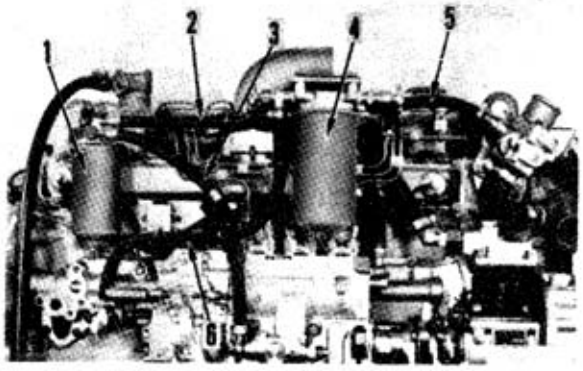


4) Connect tube (7) between the air compressor and pump.
   - ★ Be careful not to let the comet packings fall out of place.
5) Attach the gasket to tube (8), and install tube.
6) Install six injection pipes (9) between the nozzle holer and pump.

   kgm Tube mounting nuts : 25 kgm max.

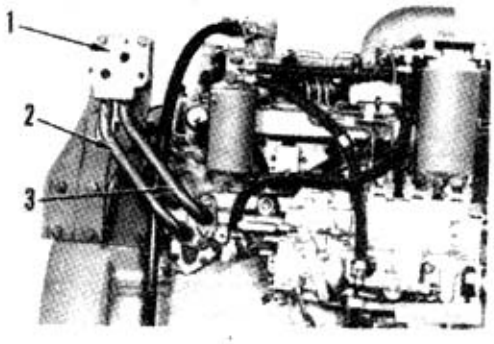


31. Corrosion resistor :
1) Install corrosion resistor (4).
2) Install hose (5) and (6).



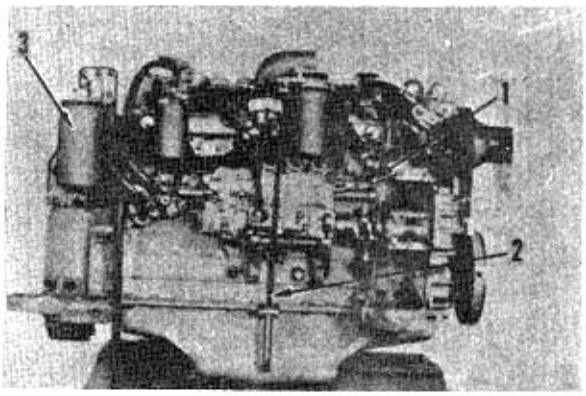
32. Fuel filter :
1) Install fuel filter (4).
2) Connect hose (2)
3) Attach the gasket and connect hose (3)

33. Oil filter bracket :
1) Install oil filter bracket (1).
2) Attach the O-rings, and connect tubes (2) and (3).



34. Oil filter

- Install oil filter (3).



35. Dipstick gauge

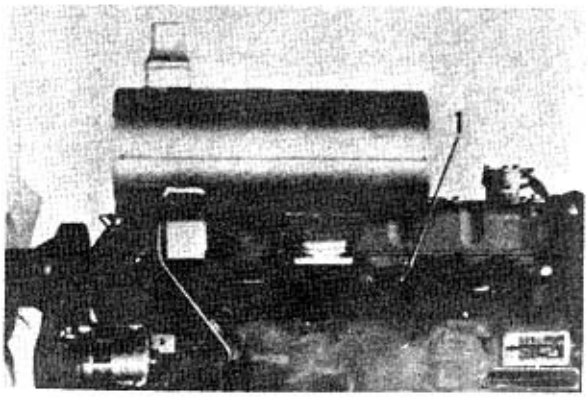
- Install dipstick gauge (2) after attaching the gasket.

★ Remove engine (1) from the engine overhaul stand.

36. Exhaust manifold, turbocharger (For BS6D105 -1)

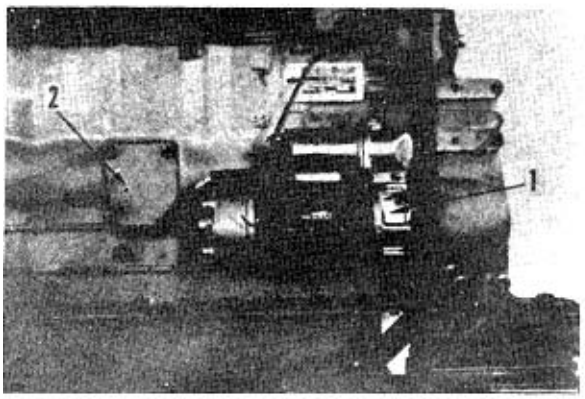
★ When connecting turbocharger outlet and inlet pipes, the oil feed tube and drain tubes, be careful not to impose too much force on them. This will prevent distortions or kinks.

1) Attach the gasket and install exhaust manifold (1).
2) Pass hose (2) through the clamp.



37. Starting motor

- Attach the O-ring to starting motor (1) and install them.



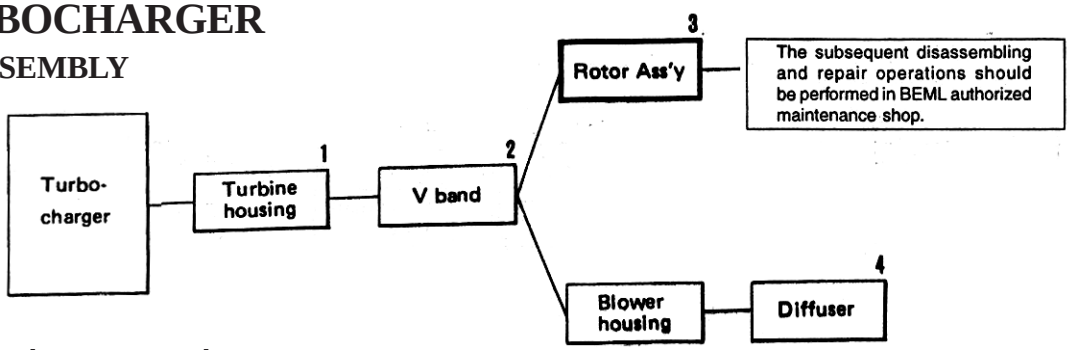
38. Inspection cover

- Attach the gasket to inspection cover (2) and install them.

DISASSEMBLY AND ASSEMBLY OF ACCESSORIES

TURBOCHARGER

DISASSEMBLY



Tools to be prepared

Japan Gallet	p/n Part Name		A	B	C	D
801067	Penetrating oil	-				
801051	Deep socket		1			
801090	Cartridge holder			1		
801059	T-wrench				1	
801058	Retaining ring remover					1

1. Turbine housing

1) Spray penetrating oil on the turbine housing mounting bolts and leave the housing as sprayed for about 15 minutes.

★ Since the mounting bolts are often found in burnt or seized state by high heat, be sure the oil penetrates to their thread areas.

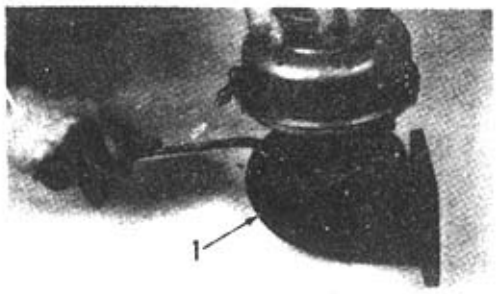
2) Give matching marks to the turbine housing mating or contacting parts.

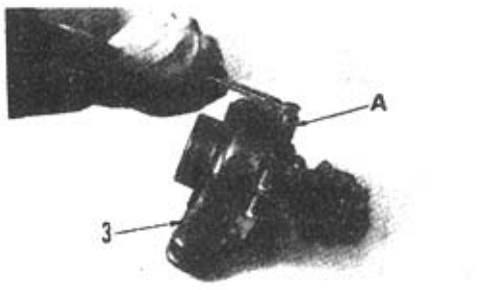
★ These matching marks are given to prevent erroneous locations of parts in reassembling the turbine housing.

3) Straighten lock plates and loosen bolts.

4) Remove the turbine housing.

★ At this time, be careful not to damage the turbine housing. If the housing is stuck in position, remove the housing gently, giving light blows to the outer circumference with a plastic - face hammer.





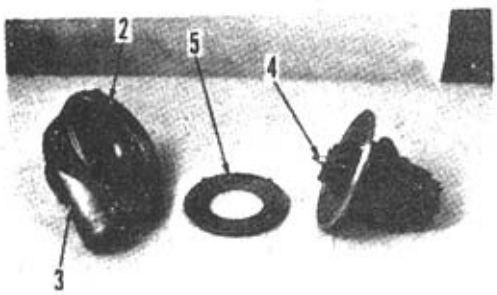
2. V-band

- Remove V band (2), using a deep socket A.

3. Rotor ass'y

- Remove rotor ass'y from compressor housing (3).

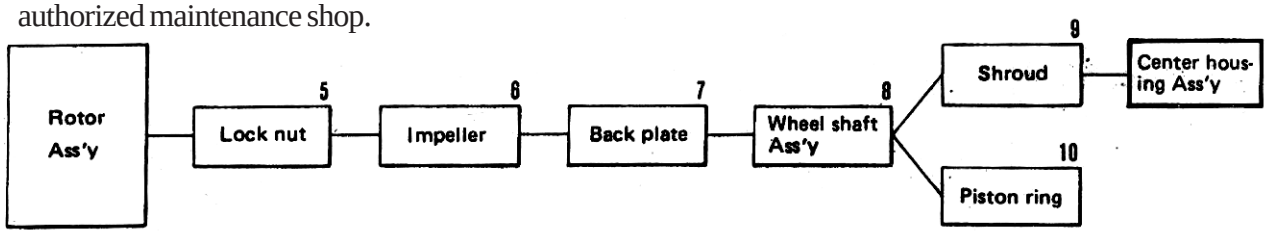
★ Impeller and turbine wheel are in the state of high-precision, dynamic balance, requiring extreme care in their handling . If damaged or deformed, they cannot be reconditioned.

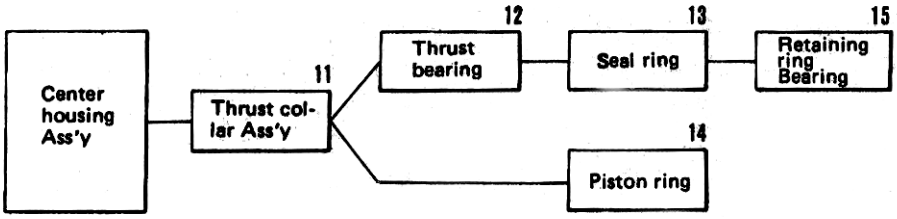


4. Diffuser

Remove diffuser (5) from the compressor housing.

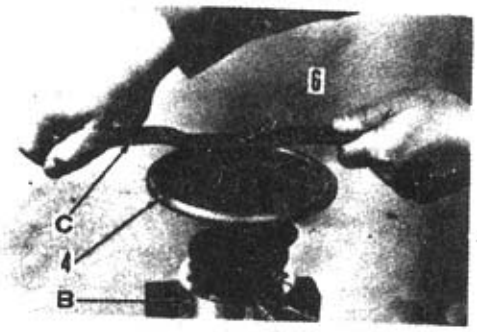
★ The subsequent disassembly and reassembly operations should be performed in a बेमल authorized maintenance shop.





5. Lock nut

1) Secure cartridge holder with a vice. Put rotor ass'y (4) in the holder and keep it so that the end of wheel shaft is set in socket.
2) Remove lock nut (6), using T wrench C.
   ★ If the lock nut is removed, the wheel shaft ass'y will fall out of the rotor ass'y. Therefore, when carrting the rotor ass'y, be sure to support the wheel and center housing sections by two hands.



6. Impeller

1) Remove rotor ass'y (4) from the cartridge holder and rest it on blower housing (3).
2) Remove back plate (7) mounting bolts.
3) Remove impeller (8) out of place.

7. Back plate

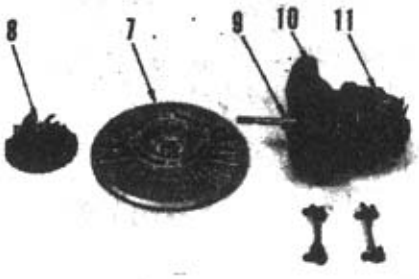
- Remove back plate (7) out of place.

8. Wheel shaft ass'y

- Remove wheel shaft ass'y (9) from center housing (10).

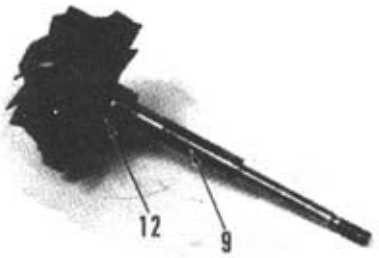
9. Shroud

- Remove shroud (11) from the center housing.



10. Piston ring

- Remove piston ring (12) from wheel shaft assembly but separating the mating parts wide by fingers.

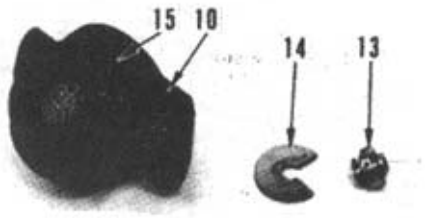


11. Thrust collar ass'y

- Remove thrust collar ass'y (13) from center housing (10).

12. Thrust bearing

- Remove thrust bearing (14) from center housing (10).

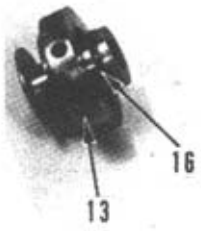


13. Seal ring

- Remove seal ring (15) from center housing (10).

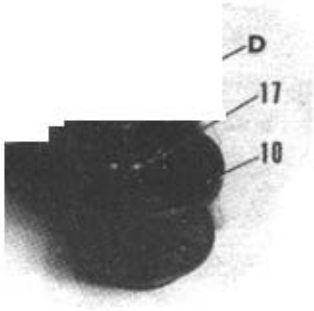
14. Piston ring

- Remove piston ring (16) from thrust collar ass'y (13).

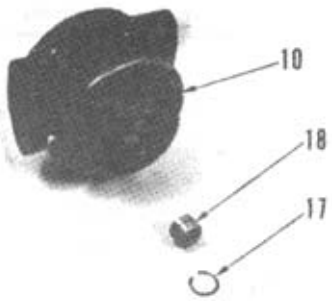


15. Retaining ring and bearing

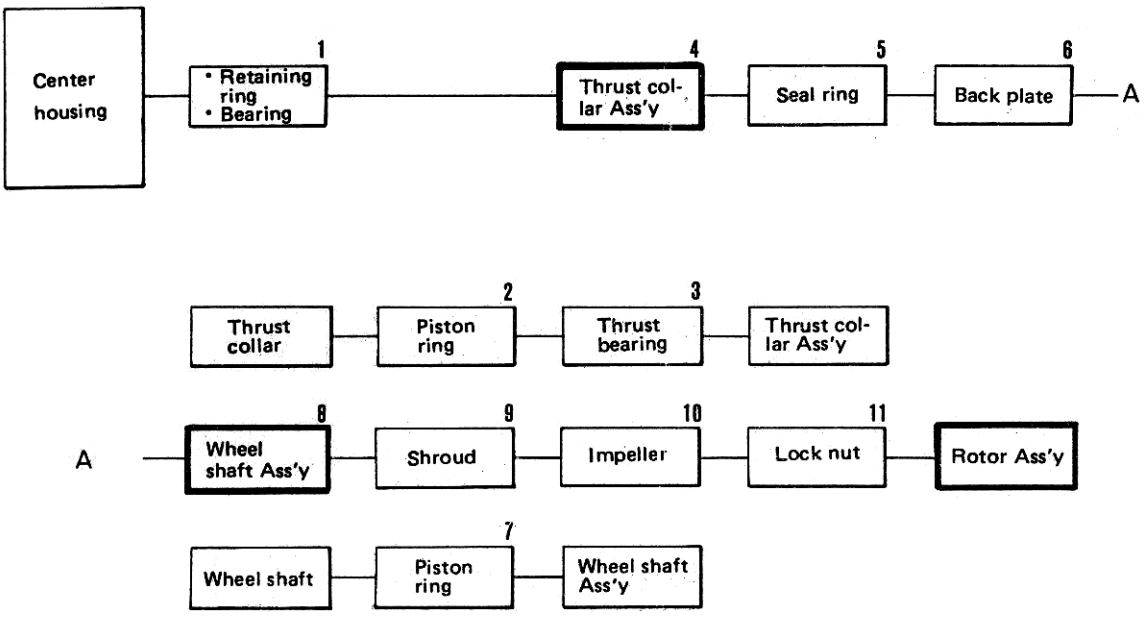
1) Remove outer retaining ring (17) from the blower side of center housing (10), using a retaning ring remover D.



2) Remove bearing (18) from the blower side of center housing (10).
3) Remove inner retaining ring from the center housing in the same manner as described in 1) above.
4) Remove retaining ring (17) and bearing (18) from the turbine side of center housing (10) in the same manner as described in 1), 2) and 3) above.



ASSEMBLY

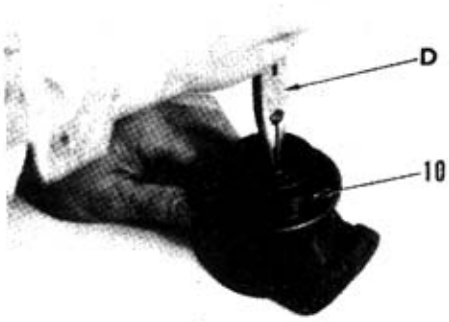


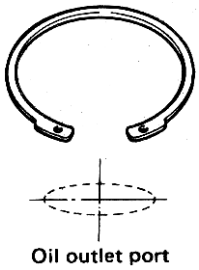
Tools to be prepared

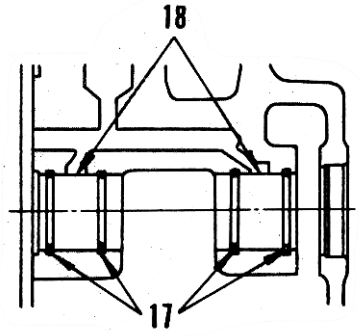
Japan Gallet P/N	Part Name	-	A	B	C	D	E	F	G	H
801066	Lubriplate	1								
801051	Deep socket		1							
801090	Cartridge holder			1						
801059	T-wrench				1					
801058	Retaining ring remover					1				
801050	Piston ring guide						1			
801052	Pig							1		
801056	Radial play measuring instrum.								1	
801057	Radial play measuring instum.								1	
801055	End play measuring instrument									1
801054	End play measuring instrument									1

1. Retaining ring and bearing

1) Insert retaining ring (17) into center housing (10), using retaining ring remover D.
   * Make sure that the mating ends of ring are in a correct contact with each other with oil outlet side up.
2) Coat the inner and outer surfaces of bearing with engine oil.
3) Set bearing (18) in the center housing.
4) Insert the outer retaining ring in the same manner as described in 1).

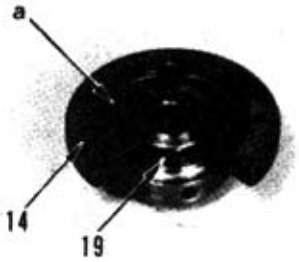






2. Piston ring

- Install piston ring (16) on thrust collar (19).

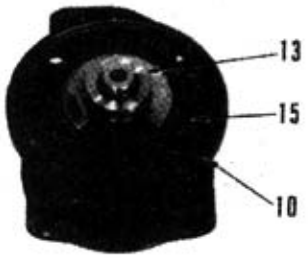


3. Thrust collar ass'y

1) Coat thrust bearing (14) with engine oil.
2) Install the thrust bearing in groove in thrust collar (19).
   * At this time oil groove (a) in the thrust collar should face outside.

4. Thrust collar ass'y

- Install thrust collars ass'y in center housing (10).

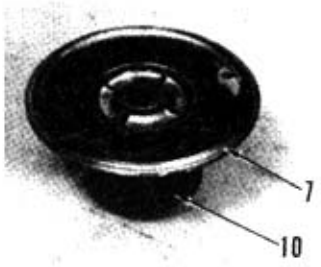


5. Seal ring

- Install seal ring (15) in the groove on the circumference of center housing (10).

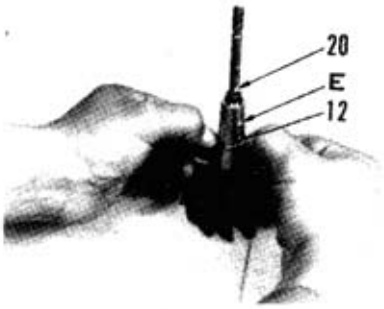
6. Back plate

1) Coat the inside hole of back plate with engine oil.
2) Install back plate (7) with threaded hole in plate and drilled hole in center housing (10) aligned with each other.
   * Provide a space for name plate away from oil hole in the housing.

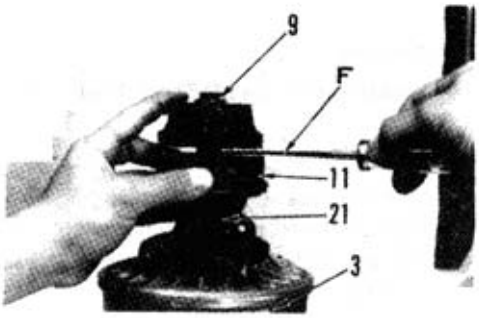


3) Hold the center housing and back plate by hands, taking care not to allow the set parts to get out of place, and turn them with the back plate down.
4) Tighten the back plate (7) mounting bolts.
kgm Tightening torque of the back plate mounting bolts : 0.95 ± 0.1 kgm

7. Piston ring
- Install piston ring (12) on wheel shaft (20), using piston ring guide E.

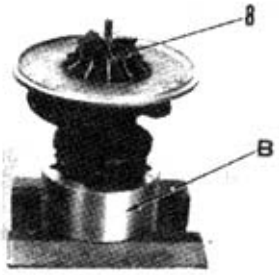


8. Wheel shaft ass'y
1) Rest center housing ass'y (21) on blower housing (3) used as support.
2) Coat a bearing section in wheel shaft ass'y (9) with oil.
3) Contract piston ring in the wheel shaft ass'y, using pig F and insert wheel into the center housing, rotating the wheel gently.

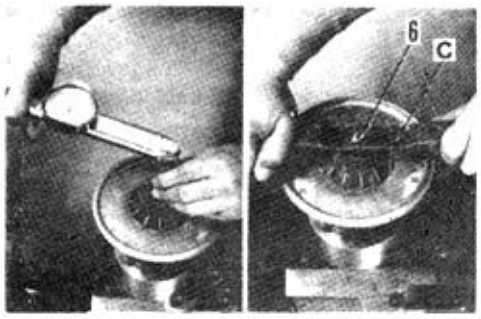


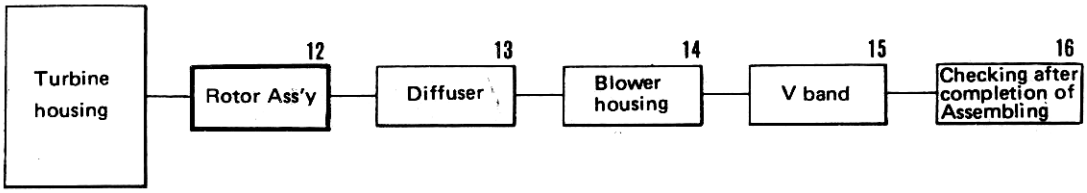
9. Shroud
- Install shroud (11) in center housing ass'y (21).

10. Impeller
1) Remove the center housing wheel shaft ass'y from the blower housing and set it in cartridge holder B, taking care not to pull out the wheel shaft assembly.
2) Coat the impeller mounting shaft and the lock but installing thread area with lubriplate (to prevent seizure).
3) Install impeller (8).



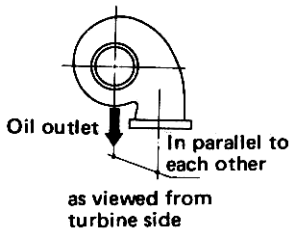
11. Lock nut
1) Tighten lock nut (6).
kgm Lock nut tightening torque : 0.02 ± 0.01 kgm
2) Retightening the lock nut further by 90°, using T-wrench C.





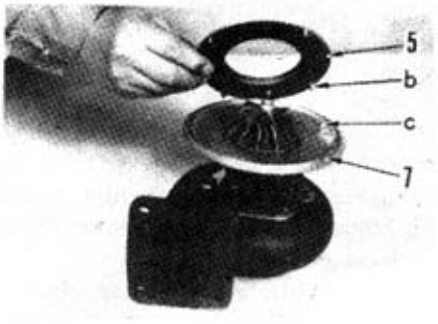
12. Rotor ass'y

1) Install rotor ass'y (4) in turbine housing (1).
   * Install the rotor ass'y gently, taking care not to impair parts.
   * Install the turbine housing in place as shown in schematic drawing.
   * Locate drilled holel in shroud so as to face an oil inlet side.
2) Coat turbine housing mounting bolt holes with antrifriction compound.
   * Antifriction compounds : NICHIMOLI PG paste or MOLI COAT AST compound
3) Tightening the turbine housing mounting bolts.
   kgm Tightening torque of turbine housing mounting bolts : 1.7 ± 0.1 kgm
4) Bend lock plates.



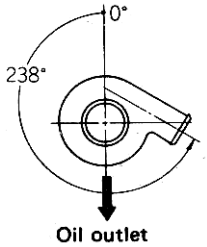
13. Diffuser

- Install diffuser (5) on back plate (7).
  * Bring protrusion (b) of the diffuser to the right side of protrusion (c) of the back plate to prevent the diffuser from turning clockwise.
  * If the diffuser has three protrusion, bring these protrusions in holes in the back plate.



14. Blower housing

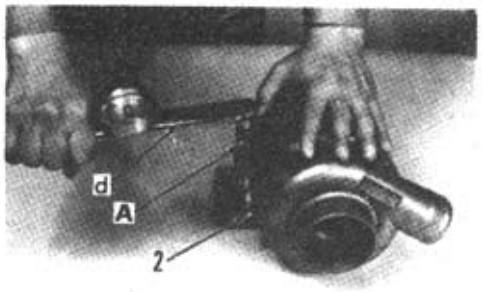
Install blower housing in place as shown in schemetic drawing below.



- Tighten the blower housing mounting bolts.
  kgm Tightening torque : 1.35 ± 0.15 kgm

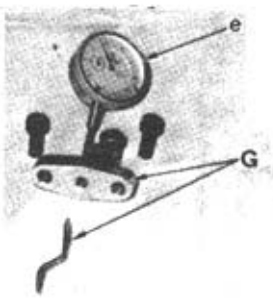
15. V band

- Attach and tighten V band (2), using deep socket A and torque wrench (d).
  V band tightening torque : 0.8 ± 0.1 kgm

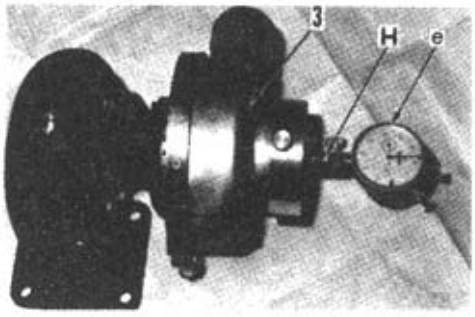


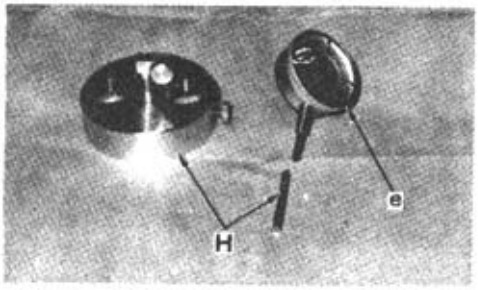
16. Checks after completion of assembling

1) Make sure that the rotor ass'y rotates smoothly by giving light push thereto.
2) Check play of rotor in the radial direction (radial play).
   i) Attach a measuring instrument G to oil outlet of center housing (10) and set a dial gauge so that its probe comes into contact with shaft.
   ii) Hold the rotor by hands on both ends and move it in parallel in the direction to measure play.
   * Rotor radial play (allowable range : 0.075 to 0.150 mm)



3) Check play of rotor in the axial direction. (End play)
   i) Set dial gauge in end play measuring instrument H and replace the gauge probe with an exclusive one for this measurement.
   ii) Attach the measuring instrument to inlet port in blower housing (3) and set the dial gauge so that a probe comes into contact with the shaft end.
   iii) Measure end play by moving the rotor in its axial direction.
   * Play of rotor in axial direction (End play)
   Allowable range : 0.025 to 0.075 mm





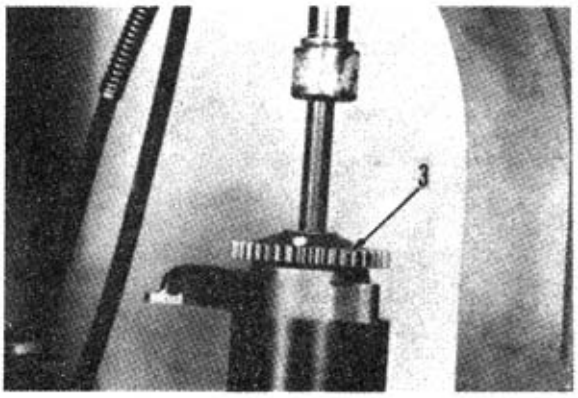
OIL PUMP

DISASSEMBLY

1. Remove cover (1).

2. Remove outer - rotor (2).

3. Separate gear (3) from inner - rotor (4).

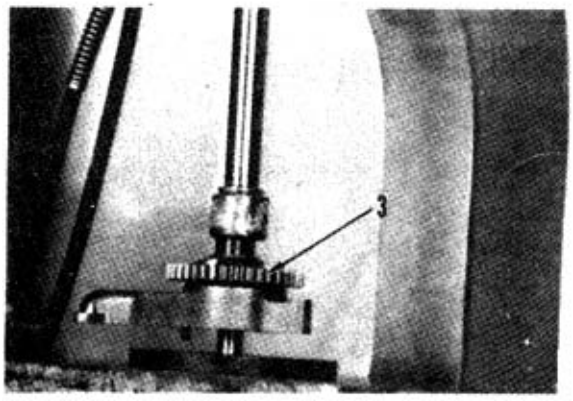


4. Remove bushing (5).
5. Remove dowel pin (6).

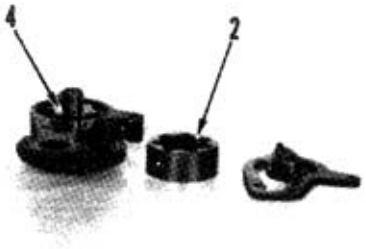
ASSEMBLY

1. Install bushing (5).
2. Strike in dowel pin (6).

3. Press fit gear (3) to inner rotor (4).



4. Install outer rotor (2).

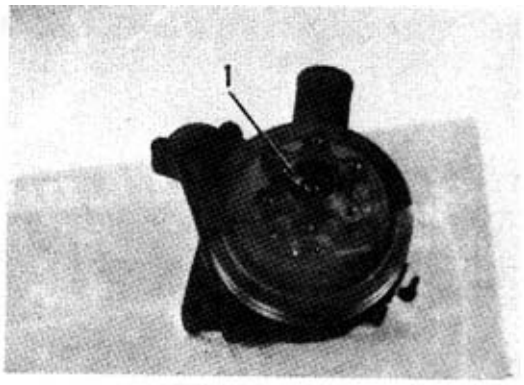


5. Align the dowel pin hole in case with the dowel pin, and install cover (1).

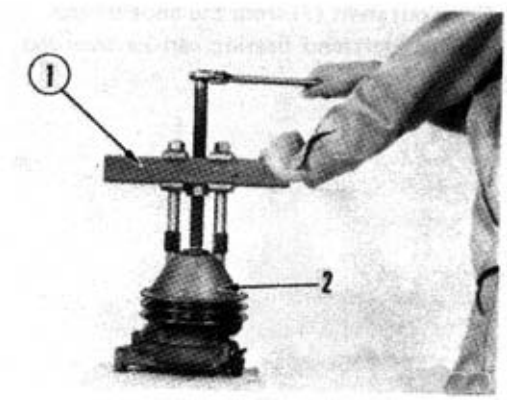
WATER PUMP

DISASSEMBLY

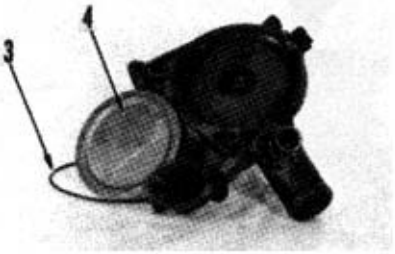
1. Remove nut (1).



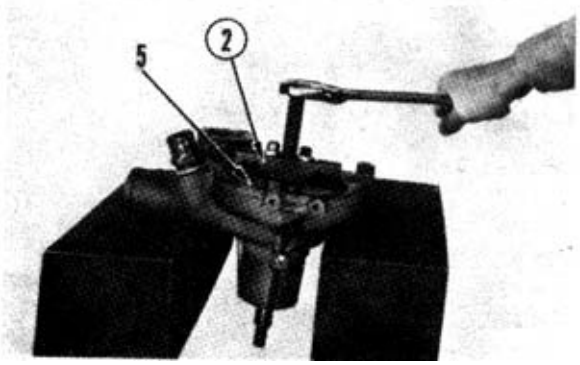
2. Remove fan pulley (2) using puller (1).



3. Remove snap ring (3), and remove cover (4).

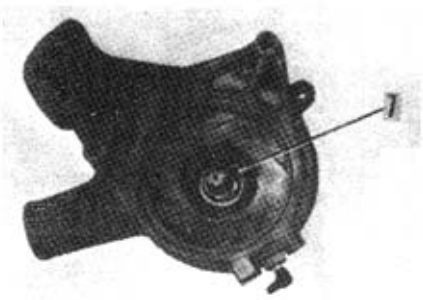


4. Remove impeller (5) using puller (2).

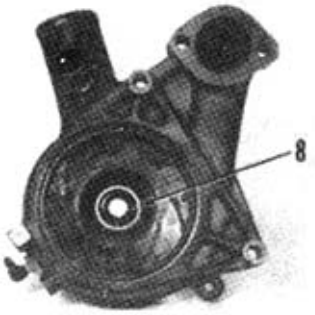


5. Remove snap ring (6).

6. Draw out shaft (7) from the impeller side.
   * The shaft and bearing can be removed as one unit.



7. Remove water seal (8).



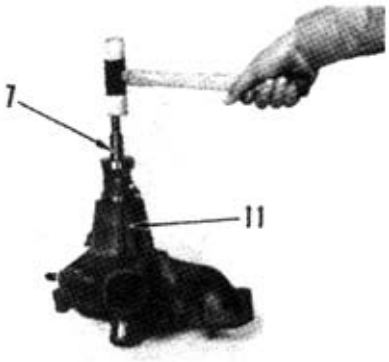
8. Remove bearings (9) and (10) from the shaft.

ASSEMBLY

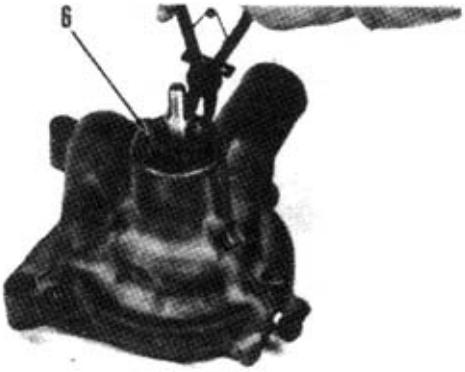
1. Install bearings (9) and (10) on the shaft.
   * Install two bearings to that the sides where the balls can be seen face inside.

2. Install shaft assembly (7) to water pump case (11) from the pulley side.

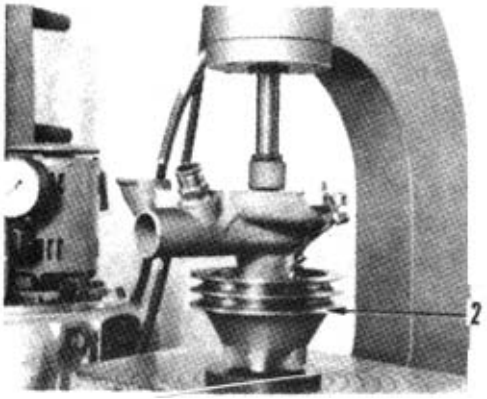
   Grease between two bearings : Grease (G2-L1)



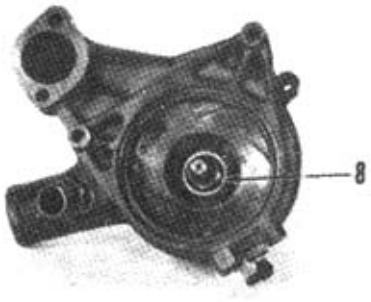
3. Install snap ring (6) to fix the shaft assembly.



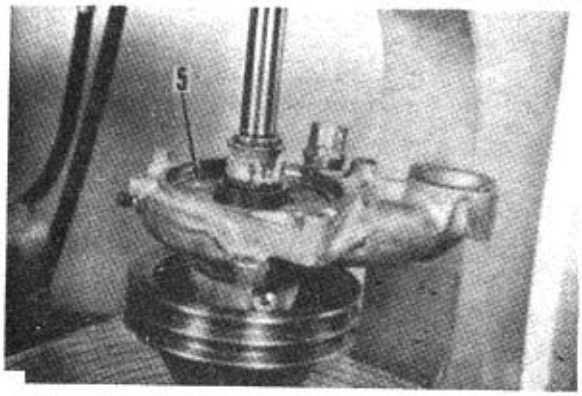
4. Press-fit fan pulley (2).
5. Tighten the nut.



6. Install water seal (8).

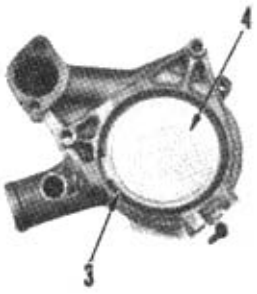


7. Press - fit impeller (5) into place:



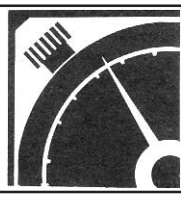
8. Attach the O-ring to cover (4), and then install cover (4).

9. Attach snap ring (3) and fix cover (4) in place.



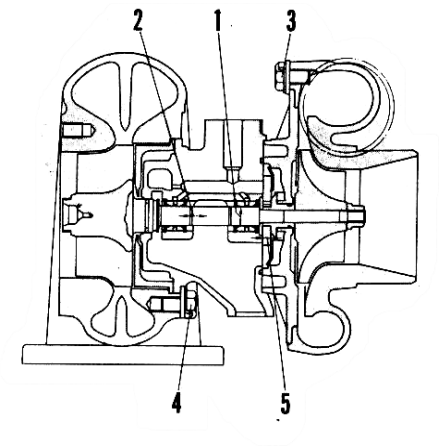
ENGINE

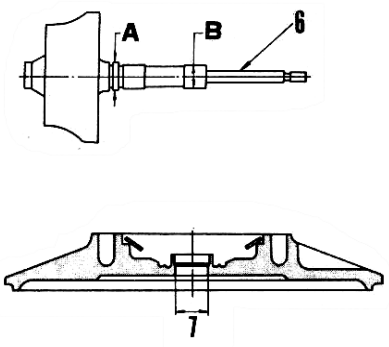
15 MAINTENANCE STANDARD

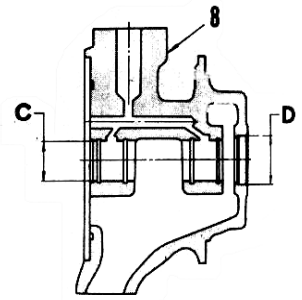


INTAKE AND EXHAUST SYSTEM

TURBOCHARGER





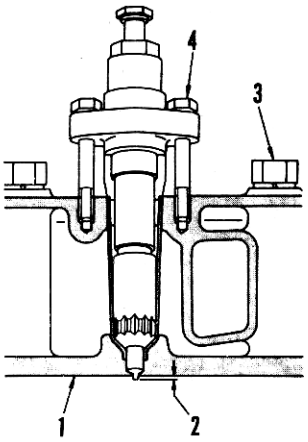


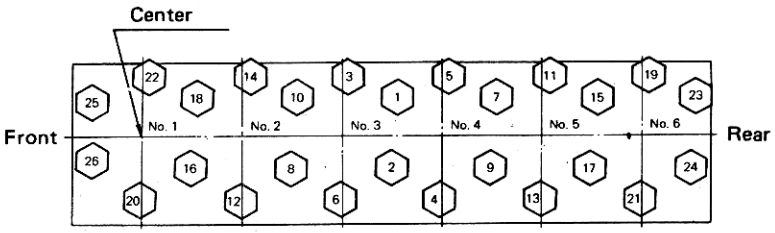
Unit: mm

No.	Item	Criteria			Remedy
1	Radial play of rotor	Standard	Repair limit		
		0.75 - 0.150	0.18		Replace or repair
2	Axial play of rotor	0.025 - 0.075	0.10		
3	Tightening torque of blower housing bolt	Target (kgm)	Range (kgm)		
		1.3	1.15 - 1.5		
4	Tightening torque of turbine housing bolt	1.7	1.6 - 1.85		Tightening
5	Thickness of thrust bearing	Standard	Repair limit		
		4.36	4.35		
6	O.D or bending of wheel shaft	*O.D. posotion	Standard size	Repair limit	
		A portion	10.155	10.13	
		B portion	17.340	17.29	
		*Bending Repair limit : 0.010 (T.I.R)			Replace
7	Inside diameter of back plate	Standard size	Repair limit		
		12.70	12.73		
8	Inside diameter of center housing	Position	Standard size	Repair limit	
		C porton	15.80	15.81	
		D portion	18.03	18.08	

ENGINE BODY

CYLINDER HEAD





Unit: mm

No.	Check item	Criteria				Remedy
1	Distortion of cylinder head mounting surface	Tolerance		Repair limit		Repir by grinding or replace
		0 - 0.09		0.12		
2	Protrusions of nozzles	Engine No.		Standard		Replace nozzle sleeves
				0.79-1.71		
3	Tightening torque of cylinder head mounting bolts (Coat the thread areas with molybdenum disulfide or engine oil)	Order	When coat with MoS_2		When coat with engine oil		Tighten in sequence as indicated above
			Target (kgm)	Range (kgm)	Target (kgm)	Range (kgm)	
		1st	9	8 - 10	9	8 - 10	
		2nd	13	12 - 14	13	12 - 14	
		3rd	18	17.5 - 18.5	20	19.5 - 20.5	
4	Tightening torque of nozzle holder mounting bolt	Target value (kgm)		Range (kgm)		Retighten
		1.75		1.5 - 2.0		

CHECKING AND INSPECTION

A. Cracks in the cylinder heads

After cleaning, inspect the cylinder heads for cracks

- By combined use of the water pressure test method and the penetration flaw detecting method.
- By combined use of the hydraulic test method and the magnetic flow detecting method.

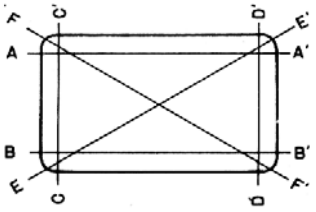
Hydraulic test

Apply water pressure at 3.5 kg/cm^2 (max.) through one water hole in the top for ten minutes to check for water leak.

During test, be careful not to peep into the cylinder heads to prevent accidental injuries, because there is a possibility of loose plugs and sleeves to pop out of place under excessive water pressure.

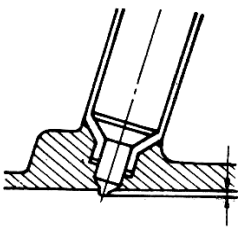
B. Distortion of the cylinder head mounting surface

Place a straightedge on the mounting surface in the six positions, shown below, then measure the gap between the edge and the head surface with a thickness gauge.



C. Protrusion of a nozzle

Measure the protrusion of a nozzle at its tip with a dial gauge.



VALVES AND VALVE GUIDES

CHECKING AND INSPECTION

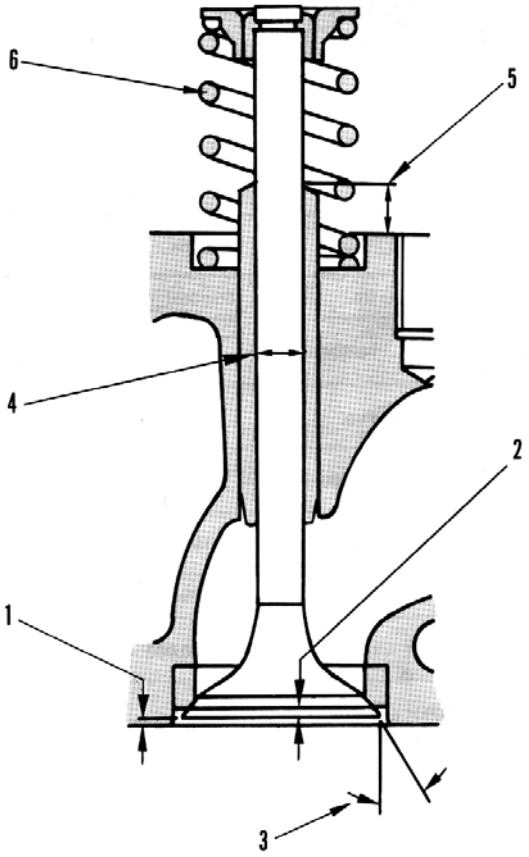
A. Amount of valve sinking

Place a strightedge on the cylinder head mounting surface and measure the amount of valve sinking with a thickness gauge.

B. Abnormal valve conditions

Mark the valve seat surface with a pencial at 20 positions and turn it by approximate 10° . Check the surface.

If some marks remain on the surface correct the surface by grinding the valve to the valve seat.



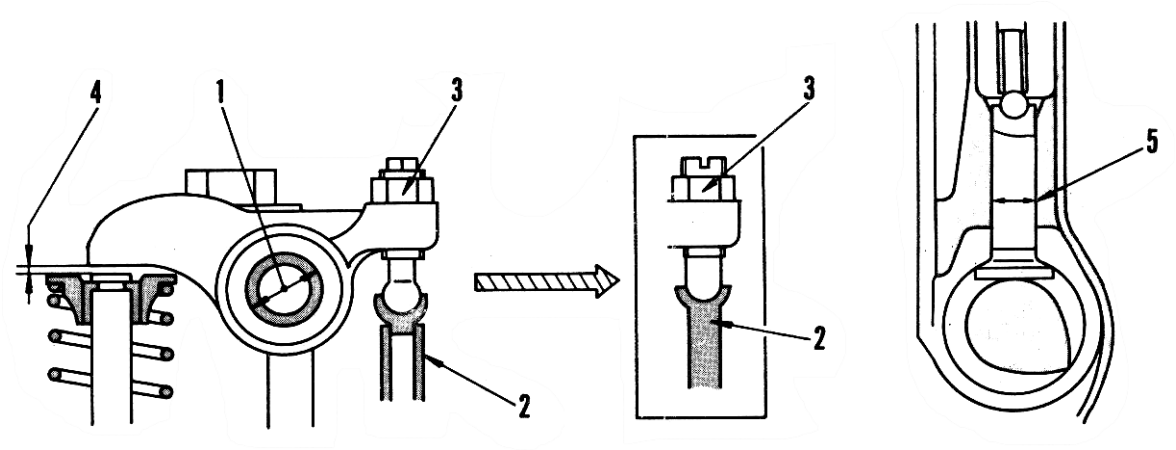
Unit: mm

No.	Check item	Criteria					Remedy
		Engine No.	Valve	Standard	Tolerance	Repair limit	
1	Sinking of valve		ntake	0	±0.1	1.1	Replace valve or valve seat
			Exhaust				

Unit: mm

No.	Check item	Criteria				Remedy
2	Thickness of valve lip	Valve	Standard	Repair limit		Replace valves
		intake	2.10	1.7		
		Exhaust	1.50	1.2		
3	Angle of vavle seat	Intake	30°	–		Replace valve and valve seat or repair
		Exhaust	45°	–		
4	Outside diameter of valve stem	Engine No.	Valve	Standard	Tolerance	Replace valve
			Intake and Exhaust	9	-0.030 -0.045	
	Inner dia.of valve stem		Intake and Exhaust	9	+0.030 -0.010	Replace valve guide
	Valve stem-to-valve guide clearance	Engine No.	Valve	Standard clearance	Clearance limit	Replace valve or valve guide
			Intake and Exhaust	0.040 - 0.075	0.20	
	Bend of valve stem	Repair limit: 0.02 (Total indicator reading for 100 mm)				Replace
5	Height of valve guide when knocked in	Engine No.	Standard	Tolerance		Repair
			25.9	±0.25		
6	Free length of valve spring	Engine No.	Standard size	Repair limit		Replace valve spring
			63.8	62.4		
	Installed load of valve spring	Engine No.	Installed length	Standard size	Repair limit	
			50.1	29.0 ± 1.3 kg	26.0 kg	
	Squareness of valve spring	Repair limit: 2° (for both end)				

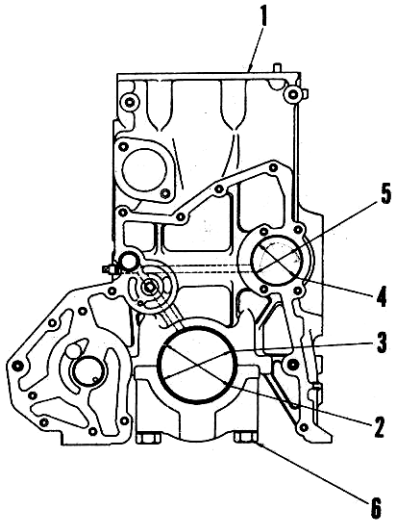
ROCKER ARM SHAFT, PUSH ROD AND TAPPET



Unit: mm

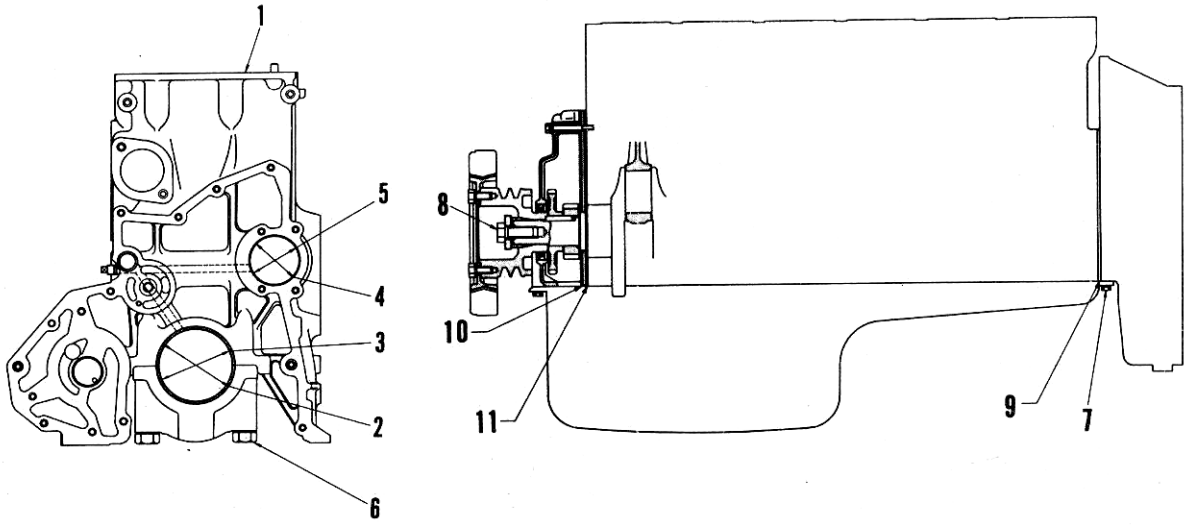
No.	Check item	Criteria				Remedy
1	Outside diameter of rocker arm shaft	Engine No.	Standard	Tolerance		Replace rocker arm shaft
			19	-0.010 -0.030		
	Inside diameter of rocker arm shaft hole		19	+0.020 0		Replace rocker arm
	Clearance between rocker arm shaft and rocker arm	Engine No.	Standard clearance	Clearance limit		Replace rocker arm shaft or rocker arm
			0.020 - 0.060	0.13		
	Bend of rocker arm shaft	Repair limit : 0.20 (Total indicator reading)				Replace rocker arm shaft
2	Bend of push rod	Repair limit : 0.30 (Total indicator reading)				Replace push rod
3	Tightening torque of rocker arm adjusting screw locknut	Target value (kgm)		Range (kgm)		Tighten
		3.15		2.8 - 3.5		
4	Valve clearance (when cold)	Engine No.	Valve	Standard	Tolerance	Adjust
			Intake	0.25	± 0.02	
			Exhaust	0.45		
5	Outside diameter of tappet	Standard		Tolerance		Replace tappet
		18		-0.015 -0.035		
	Inside diameter of tappet hole	18		+0.020 0		Replace cylinder head
	Clearance between tappet and tappet hole	Standard clearance		Clearance limit		Replace tappet or cylinder head
		0.015 - 0.055		0.20		

CYLINDER BLOCK



Unit: mm

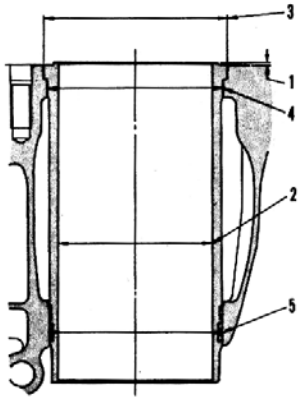
No.	Item	Criteria			Remedy
1	Distorsion of cylinder head mounting surface	Standard		Repair limit	Correct by grinding or replace
		0 - 0.008		0.120	
2	Inside diameter of main bearing mounting hole	Standard		Tolerance	Replace main bearing cap
		91		+0.020 0	
	Straightness of mounting hole	Repair limits : 0.010			
	Roundness of mounting hole	Repair limit : 0.005			
3	Inside diameter of bearing mounting hole	Standard size	Tolerance	Repair limit	Replace main bearing
		85	+0.130 -0.060	85.16	
4	Inside diameter of cam bushing mounting hole	Standard size		Tolerance	Repair or replace
		57.5		+0.030	
				0	
5	Inside diameter of cam bushing	Standard size	Tolerance	Repair limit	Replace cam bushing
		54.5	+0.070 0	54.78	



Unit: mm

No.	Item	Criteria			Remedy
6	Tightening torque values of main bearing cap (Coat thread area with oil)	Sequence	Target value	Range (kg.m)	
		1st	7	6-8	
		2nd	20	19-21	
		Loosen	0	0	
		3rd	7	6 - 8	
		4th	14	13 - 15	
		5th	20	19 - 21	
7	Tightening torque of oil pan mounting bolts	-	2.5	1.5 - 3.5	
8	Tightening torque of crank pulley mounting bolt	-	38	35 - 41	
9	Uneven mounting surfaces between cylinder block and flywheel housing	Repair limits : 0.13			
10	Uneven mounting surfaces between cylinder block and front cover	Repair limits : 0.11			
11	Uneven mounting surfaces between cylinder block and front cover	Repair limits : 0.11 Protrusion of plate : 0.04 Retreat of plate : 0.22			

CYLINDER LINER



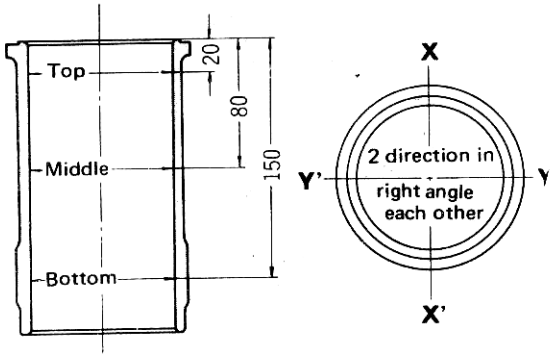
Unit: mm

No.	Item	Criteria			Remedy
1	Protrusion of cylinder liner	Permissible range : 0.05 - 0.13 Difference among cylinder : 0.05 max.			Replace liner or block
2	Inside diameter of cylinder liner	Standard size	Tolerance	Repair limit	
		105	+0.035 0	105.20	
	Roundness of cylinder liner	Repair limit: 0.08			Replace Cylinder liner
	Cylindricity of cylinder liner	Repair limit: 0.08			
3	Outside diameter of cylinder liner(Counter bore)	Standard size	Tolerance		
		127	+ 0.115 + 0.075		
	Cylinder liner to block interference (Counter bore)	Standard interference	Interference limit		Replace cyl. liner or block
		0.015 - 0.115	0.01		
4	Outside diameter of cylinder liner(Counter bore bottom)	Standard size	Tolerance		Replace cylinder liner
		121	+0.120 +0.170		
	Cylinder liner to block cleaearace (Counter bore bottom)	Standard clearance :0.165 - 0.280			Replace cyl. liner or block
5	Outside diameter of cylinder liner(O-ring)	Standard size	Tolerance		Replace cyl. liner
		118.7	-0.010 +0.035		
	Cylinder liner to block cleaearace (O-ring)	Standard clearance : 0.010 - 0.-070			Replace cyl. liner or block

CHECKING AND INSPECTION

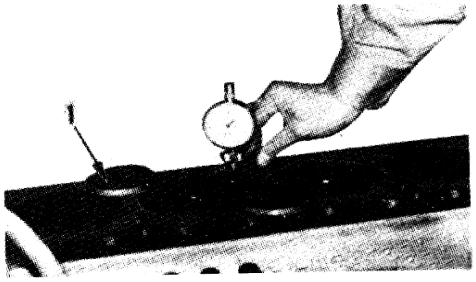
A. I.D. of the cylinder liner

Measure the I.D, at the points indicated with a cylinder gauge or an inside micrometer



B. Protrusion of the cylinder liner

Measure the protrusion at 4 points around the cylinder with a dial gauge.



★ Where a liner has been reset in place, use a lock plate (1) to hole down the liner flange then tighten the bolts to prevent the liner from being pushed up by the surface pressure on the O-ring, after which, measure the protrusion.

CRANKSHAFT

Unit: mm

No.	Item	Criteria				Remedy
1	End play	Standard: 0.140 - 0.315		Repair limit: 0.40		Replace a thrust bearing or correct oversize
2	Outside diameter of main journal		Standard size	Tolerance	Repair limit	Correct under size or replace
		S.T.D.	85.00	-0.050 -0.070	84.86	
		0.25US	84.75		84.61	
		0.50US	84.50		84.36	
		0.75US	84.25		84.11	
		1.00US	84.00		83.86	
	Roundness of main journal	Repair clearance : 0 - 0.20				
	Clearance of main journal	Standard clearance: 0.060 - 0.130		Clearance limit: 0.30		Replace main bearing
3	Outside diameter of crank pin journal		Standard size	Tolerance	Repair limit	Correct under size or replace
		S.T.D	66.00	-0.050 -0.070	65.91	
		0.25US	65.75		65.66	
		0.50US	65.50		65.41	
		0.75US	65.25		65.16	
		1.00US	65.00		64.91	
	Roundness of crankpin journal	Repair limit : 0.020				
	Clearance of crankpin journal	Standard: 0.040 - 0.105		Clearance limit: 0.30		Replace connecting rod bearing
4	Bend of crankshaft	Repair limit : 0.09 (Total indicator reading)				Correct undersize or replace

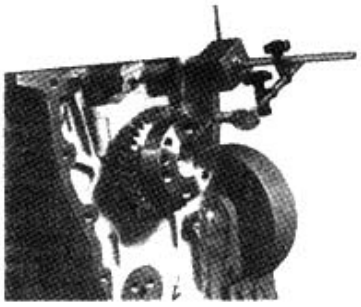
CHECKING AND INSPECTION :

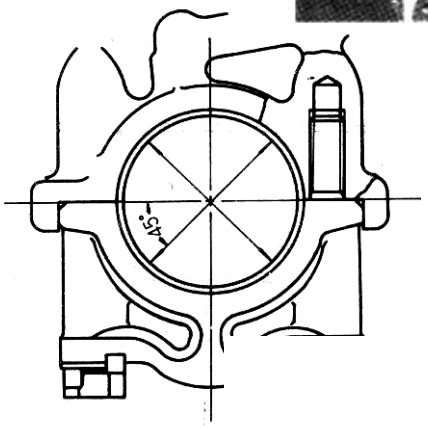
A. Crankshaft end play :

- Before removing the main bearing caps when disassembling, measure the main bearing and play to check for its proper value. After reassembly, measure the end play again.
- To measure the end play, use any of the following two methods.

  Measurement with a dial gauge

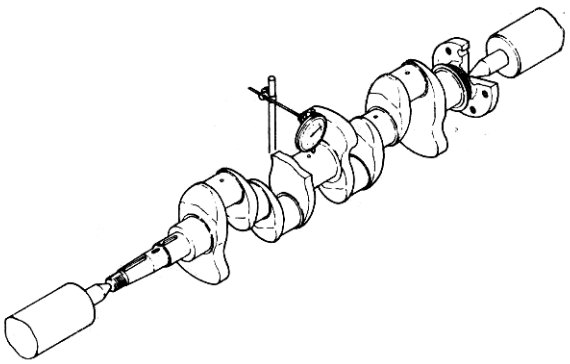
  Hold a dial gauge vertically against the flange end surface at the rear of the crankshaft and take readings of the movement when the crankshaft is shifted back and fortth with a crowbar.





kshaft :

shaft at the center of each
a lathe or on a centerless
dial gauge vertically to the
point of the crankshaft.
ankshaft one revolution,
lial gauge.



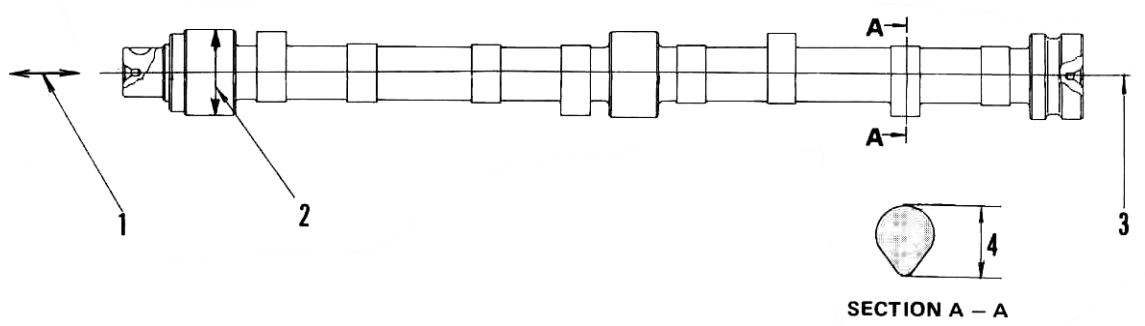
★ Checking the crankshaft for bending with both of its ends supported by V-blocks is not made because of errors due to eccentric wear of the journals.

C. Clearance at the bearings :

- Main journal the main cap to a specified torue, measure the I.D. in two perpendicular directions (excluding the cut-out), by using a cylinder gauge, and obtain the difference from the corresponding crankshaft bearing O.D
- Crank pin journal

  After tightening the connecting rod cap, measure the I.D. in two perpendicular directions (excluding the cut-out) and obtain the difference from the corresponding crankshaft bearing O.D. If the clearance exceeds the service limits, replace the bearing.

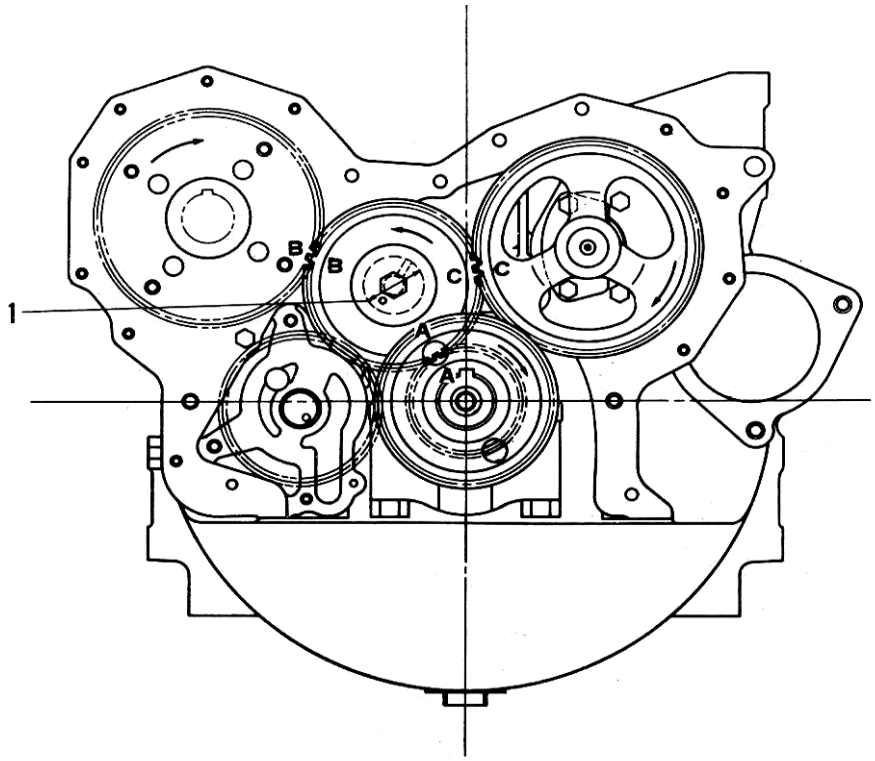
CAMSHAFT



Unit: mm

No.	Check item	Criteria					Remedy
1	End play	Standard size: 0.15 - 0.35			Repair limit: 0.50		Replace thrust plate
2	Outside diameter of camshaft journal	Standard size: 54.5			Tolerance: -0.080 -0.110		Replace camshaft
	Clearance of camshaft journal	Standard size: 0.080 - 0.180			Clearance limit: 0.28		Replace camshaft bushing
3	Bend of camshaft	Repair limit: 0.03 (Total indicator reading)					
4	Cam height	Engine: BS6D105-1	Cam: For intake and exhaust	Standard size: 45.74	Tolerance: ± 1.0	Repair limit: 45.24	Replace

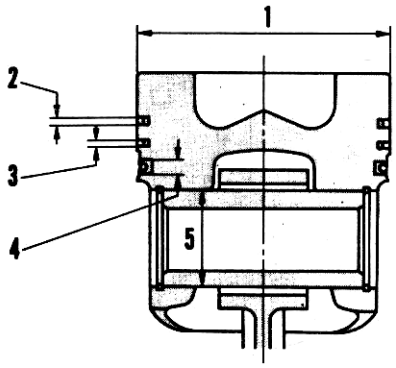
TIMING GEAR



Unit : mm

No.	Check item	Criteria			Remedy
		Inspection points	Standard clearance	Service limit	
A	Gear backlash	A. Crankshaft gear and idler gear	0.105 to 0.370	0.6	Replace bushing or gear
B		B. Idler gear and injection pump	0.025 to 0.425		
C		C. Camshaft gear and camshaft gear	0.110 to 0.410		
1	O.D of idler gear shaft	Standard size	Tolerance		Replace shaft
		44	-0.025 -0.050		
	I.D. of idler gear bushing	44	+0.075 +0.010		Replace bushing
	Clearance between idler gear bushing and shaft	Standard clearance	Service limit		
		0.035 - 0.125	0.20		
	Idler gear end play	Standard size	Service limit		Replace thrust plate
		0.05 - 0.21	0.4		

PISTON, PISTON RING AND PISTON PIN (B6D105-1)



Unit: mm

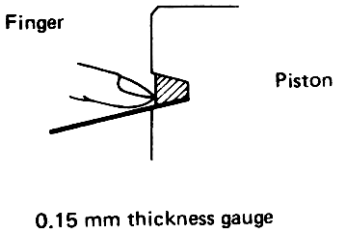
No.	Item	Criteria				Remedy
1	Outside diameter of piston	Standard size		Tolerance	Repair limit	Replace piston
		105		-0.160 -0.200	104.80	
2	Thickness of piston ring	No.	Measuring point	Standard	Tolerance	Replace piston ring
		2	No. 1 ring	3	-0.01 -0.03	
		3	No. 2 ring	2.5	-0.04 -0.06	
		4	Oil ring	5	-0.01 -0.03	
3	Width of piston ring groove	2	No. 1 ring	3	+0.05 +0.03	Replace piston
		3	No. 2 ring	2.5	+0.04 +0.02	
		4	Oil ring	5		
4	Clearance between piston ring and ring groove	No.	Measuring point	Standard	Clearance limit	Replace piston or piston ring
		2	No. 1 ring	0.04 - 0.08	0.15	
		3	No. 2 ring	0.06 - 0.10	0.17	
		4	Oil ring	0.03 - 0.07	0.15	
	Piston ring gap	2	No. 1 ring	0.3 - 0.5	2.0	Repl.piston ring or cyl. liner
		3	No. 2 ring	0.3 - 0.5	1.5	
		4	Oil ring	0.3 - 0.45	1.0	
5	Outside diameter of piston pin	Standard size		Tolerance		Replace piston pin
		40		0 -0.005		
	Inside diameter of piston pin hole	40		+0.015 0		Replace piston
	Clearance between piston pin and piston	Standard		Clearance limit		Replace piston or piston pin
		0 - 0.020		0.05		
-	Weight of piston			1141±1.5 (g)		Repl.piston

PISTON, PISTON RING AND PISTON PIN (BS6D105-1)

★ **Check item is same as B6D105-1**

CHECK METHOD OF PISTON GROOVE

This method apply only top and second ring of BS6D105-1
Perform the inspection of the top ring groove and the second ring groove using a new piston ring and a feleer gauge.



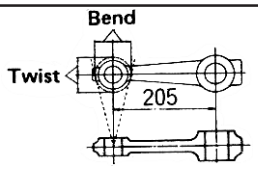
1. Completely remove the carbon in the piston ring groove and after cleaning insert a new ring into the ring groove.
2. After pressing the ring with your fingers until ring reaches bottom of piston groove as shown in the figure at right, check to see whether or not a 0.15 mm gauge fits in.
3. If the gauge easily fits in without applying any strength, the wear of the piston ring groove has exceeded the allowance and so the piston must be changed.
4. If the gauge does not fit in without applying any strength, the piston can be reused for this ring groove.

Unit: mm

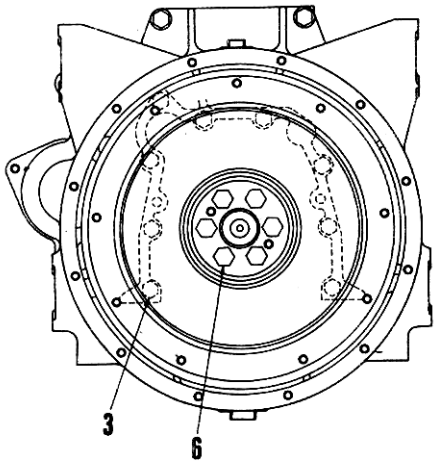
No.	Item	Criteria				Remedy
1	Outside diameter of piston	Standard size		Tolerance	Repair limit	Replace piston
		105		-0.160 -0.200	104.80	
★ 2	Thickness of piston ring	No.	Measuring point	Standard	Tolerance	Replace piston ring
		2	No. 1 ring	3	-0.01 -0.03	
		3	No. 2 ring	2.5		
		4	Oil ring	5		
3	Width of piston ring groove	2	No. 1 ring	Measure feeler gauge (Refer to figure)		Replace piston
		3	No. 2 ring			
		4	Oil ring	5	+0.04 -0.02	
4	Clearance between piston ring and ring groove	No.	Measuring point	Standard	Clearance limit	Replace piston or piston ring
		2	No. 1 ring	Measure feeler gauge		
		3	No. 2 ring			
		4	Oil ring	0.03 - 0.07	0.15	
	Piston ring gap	2	No. 1 ring	0.3 - 0.5	2.0	Repl.piston ring or cyl. liner
		3	No. 2 ring	0.3 - 0.45	1.5	
		4	Oil ring	0.3 - 0.45	1.0	
5	Outside diameter of piston pin	Standard size		Tolerance		Replace piston pin
		40		0 -0.005		
	Inside diameter of piston pin hole	40		+0.015 0		Replace piston
	Clearance between piston pin and piston	Standard		Clearance limit		Replace piston or piston pin
		0 - 0.020		0.05		
-	Weight of piston			1,191±1.5 (g)		Repl.piston

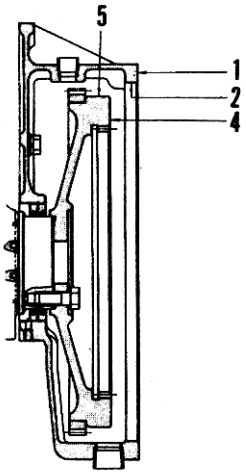
CONNECTING ROD

Unit: mm

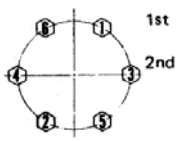
No.	Item	Criteria			Remedy
1	Inside diameter of bushing at connecting rod small end	Standard size	Tolerance		
		40	+0.040 +0.025		Replace bushing
	Clearance between bushing at connecting rod small end piston pin	Standard clearance	Clearance limit		Replace bushing or piston pin
		0.025 - 0.050	0.10		
2	I.D. of bushing securing hole at small end of connecting rod	Standard size	Tolerance		
		43	+0.035 +0.010		Replace conng. rod
3	I.D. of bearing at big end of connecting (crank pin journal)	Standard size	Tolerance	Repair limit	
		66	+0.030 -0.010	66.15	Replace bearing
4	I.D. of bearing mounting hole at big end of connecting rod	70	+0.025 0	70.04	Replace connecting
		Measure after tightening connecting rod cap with specified torque			
5	Bend and twist of conneting rod	 Bend (Repair limit): 0.08 Twist (Repair limit): 0.30			Replace connecting rod
6	Tightening torque of connecting rod cap securing bolts (Coat the bolt threads and nut seats with engine oil)	Order	Target (kgm)	Range (kgm)	
		1st step	6	5 - 7	
		2nd step	11	10 - 12	
		Loosen	0	0	Tighten
		3rd	6	5 - 7	
		4th	11.2	10.6 - 11.7	
-	Connecting rod weight	Standard size : 2087 ± 70 (g)			Repl.connecting rod

FLYWHEEL AND FLYWHEEL HOUSING





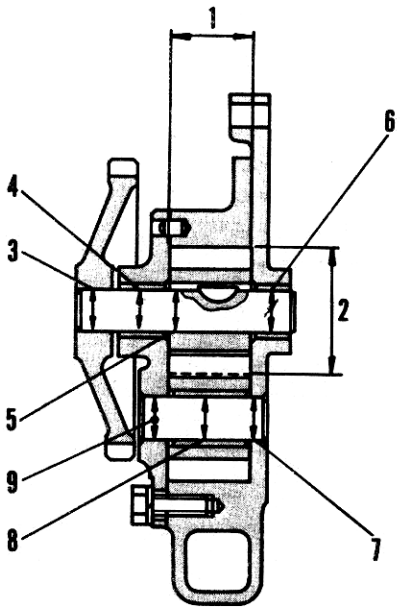
Unit: mm

No.	Item	Criteria			Remedy
1	Face runout of flywheel housing	Repair limit : 0.35			Correct by re-assembly
2	Radial runout of flywheel housing	Repair limit : 0.30			
3	Tightening torque of the fly-wheel housing mounting bolts	Target value (kg.m)	Range (kg.m)		Tighten
		11	9.5 - 12.5		
4	Face runout of flywheel	Repair limit : 0.20			Correct by assembly
5	Radial runout of flywheel	Repair limit : 0.15			
6	Tightening torque of flywheel housing mounting bolts	Tightening sequence	Target value (kg.m)	Range (kg.m)	Tighten
			9 18	6 - 12 16 - 20	

LUBRICATING SYSTEM

OIL PUMP

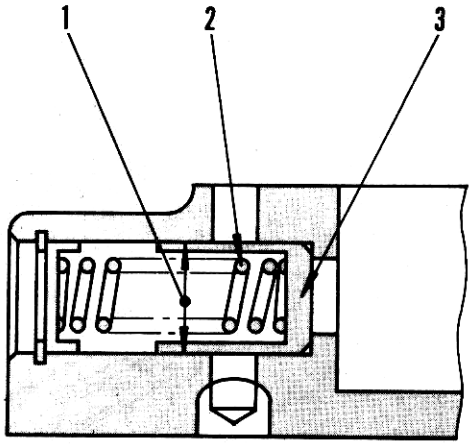
Engine No. 50001 and up



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Gear thickness	Depth of body			
1	Axial clearance of pump gear	32	0 -0.025	+0.065 +0.040	0.03 - 0.09	0.10	Replace gear
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Gear O.D	I.D of body			
2	Radial clearance of pump gear	51.4	-0.15 -0.21	+0.06 0	0.03 - 0.10	0.13	
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
3	Interference between pump drive gear and drive shaft	18	+0.105 +0.090	+0.060 +0.045	0.030 - 0.060	-	Replace
4	Clearance between driven shaft and driven gear bushing	18	+0.105 +0.090	+0.175 +0.145	0.040 - 0.085		Replace bushing
5	Interference between pump gear and drive shaft	18	+0.105 +0.090	+0.065 +0.045	0.025 - 0.060	-	Replace
6	Clearance between drive shaft and body bushing	18	-0.005 -0.025	+0.060 +0.035	0.040 - 0.085		Replace bushing
7	Clearance between driven shaft and body	18	+0.080 +0.065	+0.130 +0.100	0.020 - 0.065	-	Replace
8	Clearance between driven shaft and body bushing	18	+0.080 +0.065	+0.145 +0.120	0.040 - 0.080		Replace bushing
9	Interference between drive shaft and cover	18	+0.080 +0.065	+0.040 +0.020	0.025 - 0.060	-	Replace

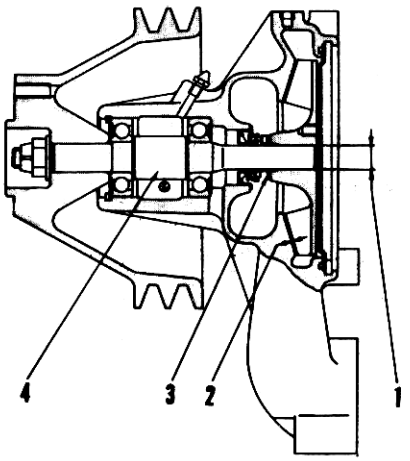
REGULATOR AND SAFETY VALVE

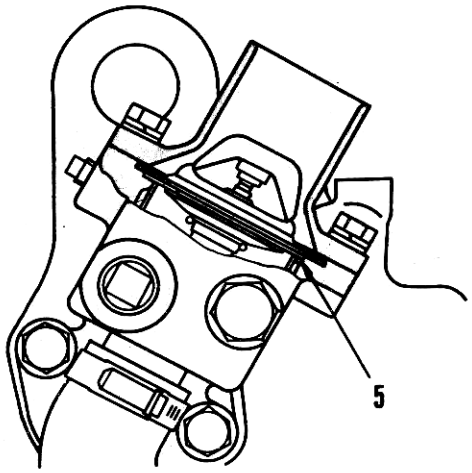


Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Clearance between valve and valve body</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard Clearance</td><td rowspan="2">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td></td><td></td><td>22</td><td>+0.15
+0.12</td><td>+0.28
+0.22</td><td>0.07 - 0.105</td><td></td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Regulator valve spring</td><td colspan="4">* Free length :
Standard size : 49.1
* Installed load :</td><td rowspan="3">Replace</td></tr>
<tr><td>Installed length</td><td colspan="2">Standard load (kg)</td><td>Repair limit (kg)</td></tr>
<tr><td>34.8</td><td colspan="2">10.8</td><td>9.8</td></tr>
<tr><td>3</td><td>Regulator valve actuating pressure</td><td colspan="4">Standard : 6.5 ± 0.5 kg/cm²</td><td>Repair or Replace spring</td></tr>
</table>

COOLING SYSTEM
WATER PUMP AND THERMOSTAT





Unit: mm

No.	Check item	Criteria				Remedy
		Standard size	Tolerance		Standard interference	
			Shaft	Hole		
1	Interference between impeller bore and shaft	15.9	+0.020 +0.005	-0.020 -0.050	0.025 - 0.070	Replace impeller
2	Clearance between impeller and body	Standard clearance : 0.18 - 1.47 (Include end play)				Replace
3	Abrasion of seal ring in water seal	 Dimension A : Repair limits : 0				
4	Bend of shaft	Repair limit : 0.1 mm (Specified as face runout at 40 mm radius of pulley)				
5	Thermostat full - opening lift	10 min. Dip in hot water bath at 90c or 5 minutes. Then, inspect it.				Replace
	Thermostat open and shut	First, dip in 90c hot water bath for 4 or 5 minutes. (The valve will open fully). Then dip in 71 c hot water for 4 or 5 minutes. The valve should close fully.				