YANMAR

SERVICE MANUAL

MARINE DIESEL ENGINE

MODEL YSM

FOREWORD

This service manual has been compiled for engineers engaged in the sales, service, inspection and maintenance of the YSM marine diesel engines. Accordingly, descriptions of the construction and functions of the engine are emphasized in this manual while items which should already be common knowledge are omitted.

One characteristic of a marine diesel engine is that its performance in a vessel is governed by the applicability of the vessel's hull construction and its steering system.

Engine installation, fitting out and propeller selection have a substantial effect on the performance of the engine and the vessel. Moreover, when the engine runs unevenly or when trouble occurs, it is essential to check a wide range of operating conditions—such as installation to the hull and suitability of the ship's piping and propeller—and not just the engine itself. To get maximum performance from this engine, you should completely understand its functions, construction and capabilities, as well as proper use and servicing.

Use this manual as a handy reference in daily inspection and maintenance, and as a text for engineering guidance.

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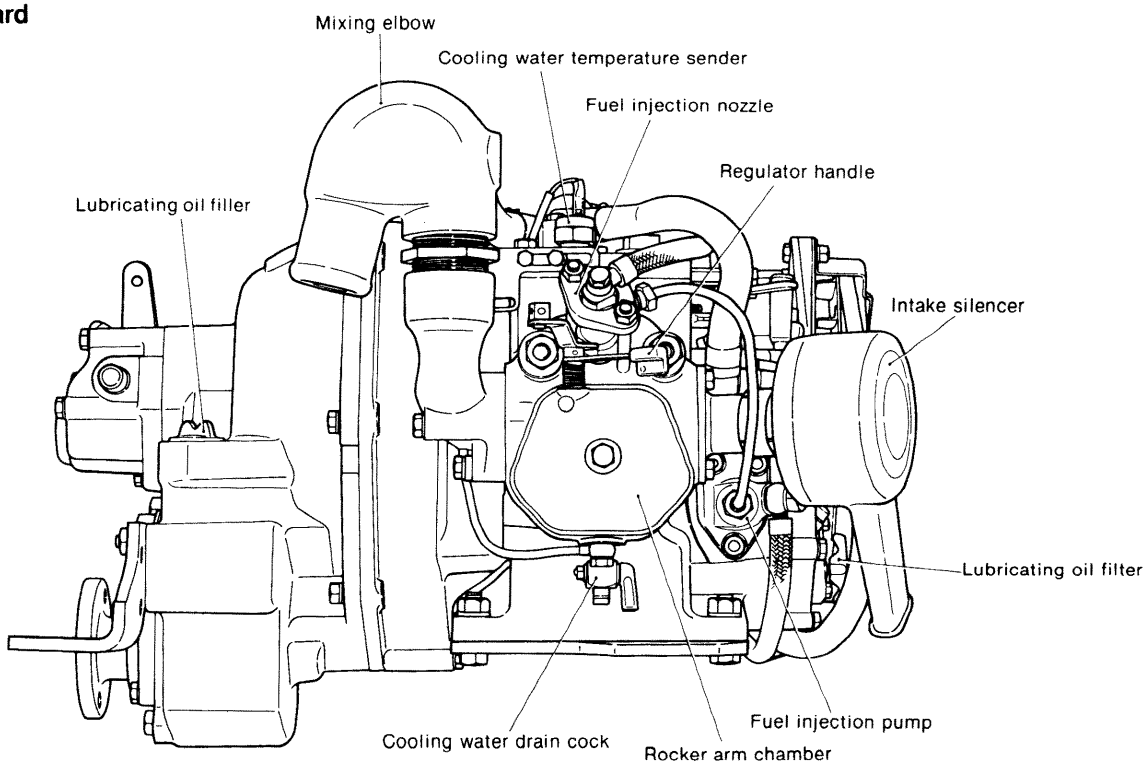
CHAPTER 1

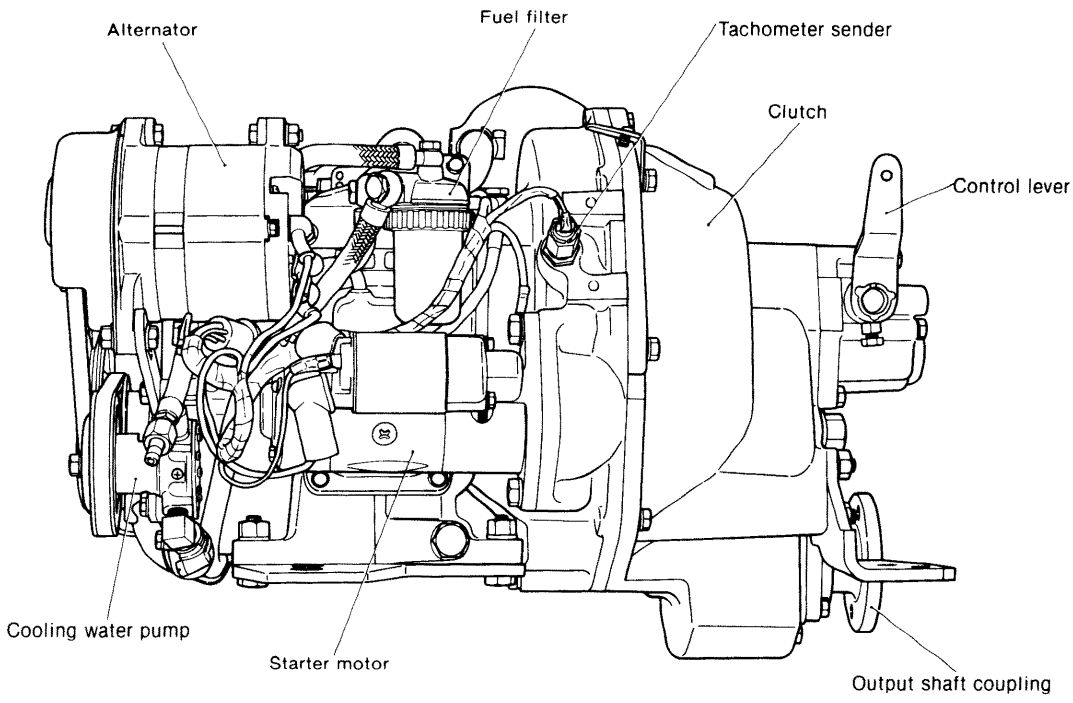
GENERAL

1. Exterior Views

1-1 Starboard



1-2 Port



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2. Specifications

Model			YSM8-R		YSM8-Y		YSM12-R		YSM12-Y	
Type			Horizontal 4-cycle water-cooled diesel engine							
Combustion chamber			Precombustion type							
Number of cylinders			1							
Bore × stroke		mm	75 × 75				85 × 90			
Displacement		ℓ	0.331				0.510			
Continuous rated output (DIN 6270A)	Output/crankshaft speed	HP/rpm	7/3200				10/3000			
	Mean piston speed	m/s	8.0				9.0			
	Propeller speed	rpm	1639	1093	1639	1093	1518	980	1518	980
One hour rating (DIN 6270B)	Output/crankshaft speed	HP/rpm	8/3200				12/3000			
	Mean piston speed	m/s	8.0				9.0			
	Propeller speed	rpm	1639	1093	1639	1093	1518	980	1518	980
Compression ratio			23:1				21:1			
Fuel injection timing		deg	bTDC 25							
Fuel injection pressure		kg/cm²	160 ±10							
Engine weight (dry)		kg	102		92		130		120	
Power takeoff position			Flywheel side							
Direction of rotation	Crankshaft		Counterclockwise (viewed from clutch side)							
	Propeller shaft		Counterclockwise (viewed from clutch side)							
Cooling system			Sea water forced cooling (rubber impeller water pump)							
Lubrication system			Closed forced lubrication							
Starting system			Electric with manual		Manual		Electric with manual		Manual	
Reduction gear system			Spur gear constant-mesh system							
Clutch			Wet single-disc mechanical type							
Reduction ratio	Ahead		1.95	2.93	1.95	2.93	1.98	3.06	1.98	3.06
	Astern		1.95	2.93	1.95	2.93	1.98	3.06	1.98	3.06
Engine size	Overall length	mm	608		598		638		628	
	Overall width	mm	602		576		673		647	
	Overall height	mm	436		544		485		591	
Lubricating oil capacity (rake angle 8°)	Crankcase Total/Effective	ℓ	1.9/0.8				3.0/1.0			
	Clutch Total/Effective	ℓ	0.7/0.2				0.7/0.2			
No-load engine speed	Maximum	rpm	3400		3400		3150		3150	
	Minimum	rpm	650		600		650		600	

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3. Principal Construction

Group	Part	Construction
Engine block	Cylinder block	Integrally-cast water jacket and crankcase
	Cylinder liner	Wet type coated with anticorrosion paint
	Main bearing	Metal housing type
Intake and exhaust systems and valve mechanism	Cylinder head	Gasket separate valve guide
	Intake and exhaust valves	Poppet type, seat angle 90°
	Intake pipe	Intake inertia type steel pipe
	Exhaust silencer	Water-cooled mixing elbow type (optional)
	Valve mechanism	Overhead valve push rod, rocker arm system
	Intake silencer	Round polyurethane sound absorbing type
Main moving elements	Crankshaft	Stamped forging
	Flywheel	Attached to crankshaft by tapered
	Piston	Oval type
	Piston pin	Floating type
	Piston rings	3 compression rings, 1 oil ring
Lubrication system	Oil pump	Trochoid pump
	Oil filter	Full-flow type, steel plate element
	Oil level gauge	Dipstick
Cooling system	Water pump	Rubber impeller type
	Thermostat	Wax pellet type
Bilge system	Bilge pump	Rubber impeller (tandem type) combined with C.W. pump (optional)
Fuel system	Fuel injection pump	Bosch PFR type
	Fuel injection valve	Semi-throttle valve
	Fuel strainer	Paper element
Governor	Governor	Centrifugal all-speed mechanical type
Starting system	Electric	Pinion ring gear type starter motor
	Manual	Over-driven chain starting
Electrical system	Charger	Alternator (with built-in IC regulator)
Reduction reversing	Reduction gear	Spur gear constant-mesh system
Clutch system	Clutch	Wet single disc mechanical type

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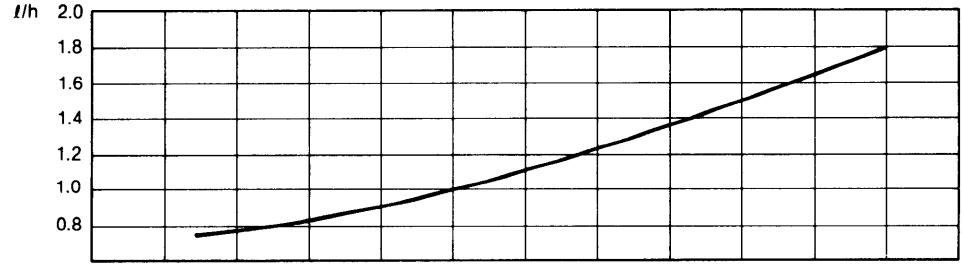
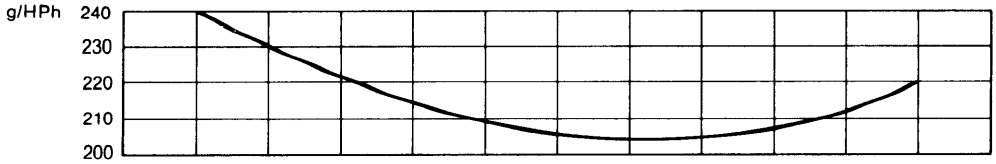
4. Performance Curves

1. YSM8-R, YSM8-Y

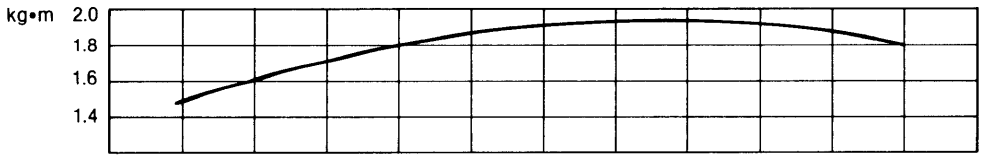
Fuel consumption at flywheel output



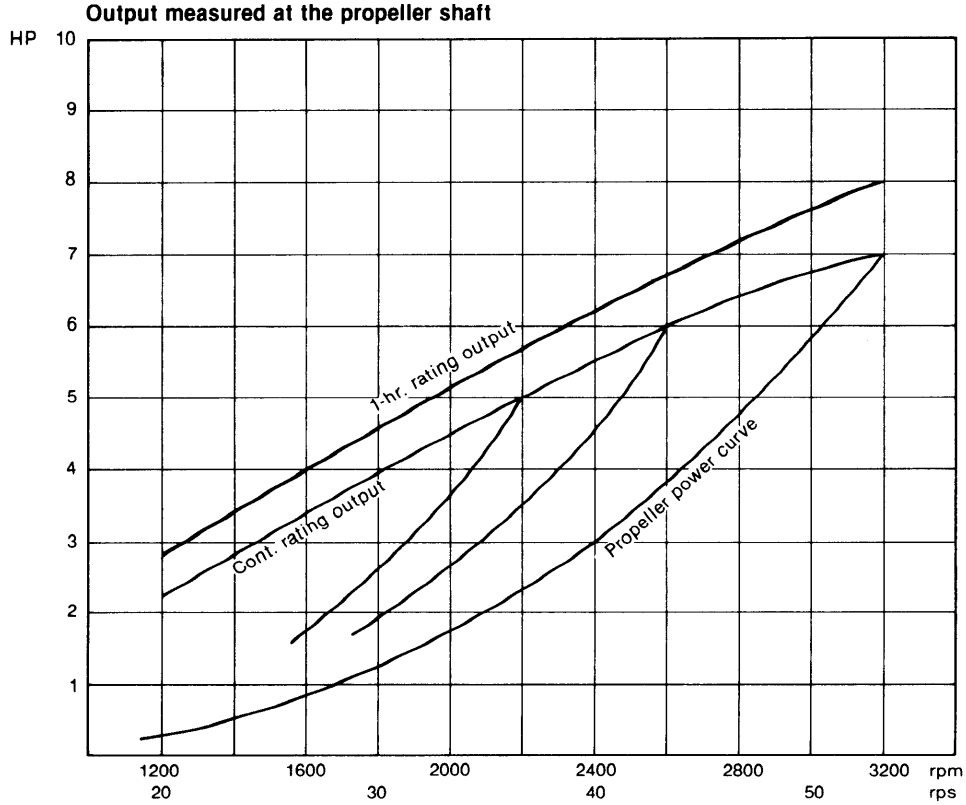
Specific fuel consumption at flywheel output



Torque measured at the flywheel



Output measured at the propeller shaft



The Engine Flywheel Output is Approx. 5% Higher.
Note: These curves show the average performance of respective engines in test operation at our plant.

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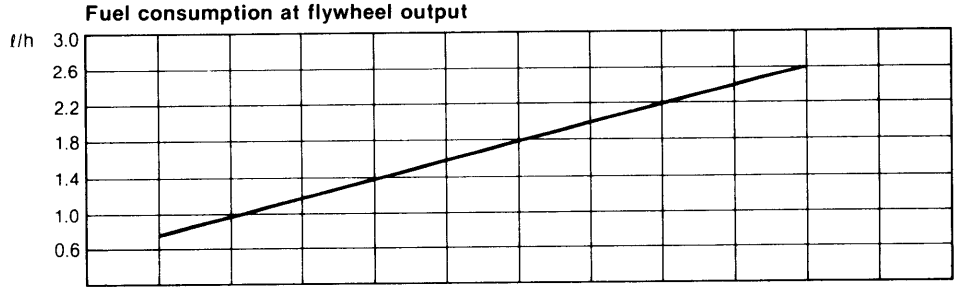
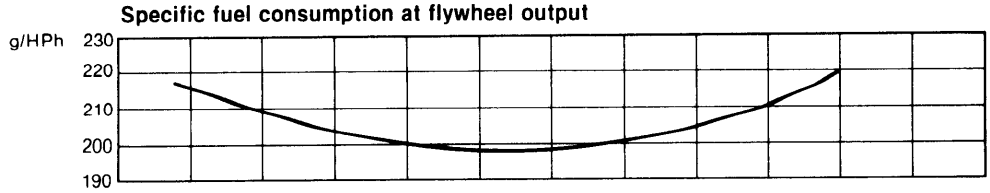
2. YSM12-R, YSM12-Y

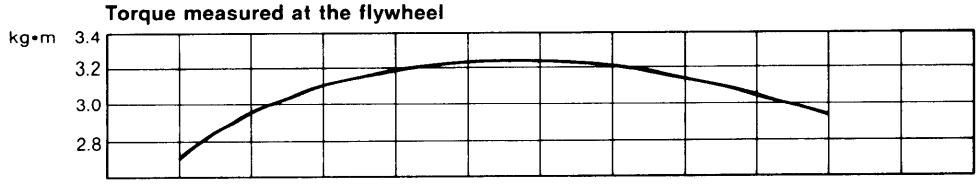
Fuel consumption at flywheel output



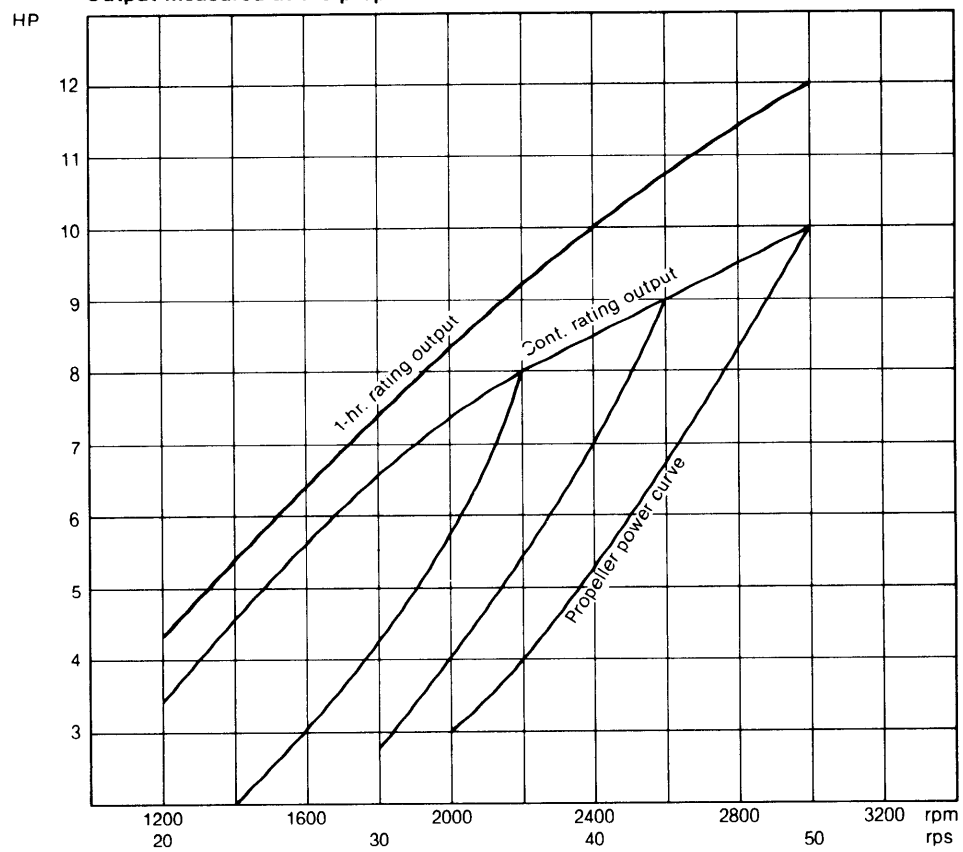
Specific fuel consumption at flywheel output



Torque measured at the flywheel



Output measured at the propeller shaft



The Engine Flywheel Output is Approx. 5% Higher.
Note: These curves show the average performance of respective engines in test operation at our plant.

5. Features

1. Superior combustion performance
The unique Yanmar swirl precombustion chamber combustion system and new cooling system display superior combustion performance in all types of operation. Low-speed, low-load combustion performance, especially demanded for marine applications, is also superb, and stable performance is maintained over a wide range of speeds. Since starting characteristics are also excellent and warm-up is fast, full engine performance can be obtained within a short time.

2. Low operating costs
Excellent combustion and low friction reduce fuel costs, while the optimized piston shape and ring configuration and improved cooling system reduce oil consumption. Continuous operating time has been extended and operating costs reduced through improved durability.

3. Reduced weight and size
Reduction of the overall length and weight of the engine has been achieved by forging the clutch case and mounting of an aluminum alloy, and by adopting a new-type, small-size reduction and reversing gear, which is coupled direction to the flywheel. Moreover, since this is a horizontal type engine, its height has been significantly reduced, leaving much more space for cargo, etc.

4. Hundreds of hours of operation without an overhaul
The main moving parts, valve mechanism and combustion chamber have adopted designs and engineering materials which are ideally suited for high-speed engines. And since the cooling water is always kept at a constant high temperature by the thermostat, liner/ring wear is limited and the heat load around the combustion chamber is low, thereby ensuring lasting quality and increased durability.

5. Quiet operation
All the machine parts which produce reciprocating motions and are the source of vibrations in the engine, have been reduced in weight and perfectly balanced, cutting vibrations to a minimum. Also, because of the adoption of an intake silencer and mixing exhaust, noise has been greatly reduced without sacrificing engine speed.

6. Easy handling and simplified operation
(1) The slope of the breather has been increased to withstand violent rollings, even up to 30°, thereby eliminating lubricating oil worries.
(2) A bracket has been mounted on the clutch so that speed-clutch control can be performed with Morse remote control device.
(3) By taking account of cabin electric power consumption, the capacity of the alternator has been increased.
(4) Because of the adoption of alarm lamps which light up when there is a rise in the temperature of the cooling water or a drop in the pressure of the lubricating oil, engine troubles are prevented.

7. Easy installation
(1) The four-point support type engine installing leg has greatly facilitated engine installation.
(2) Since the instrument panel can be installed separately it can be placed anywhere on board for easy monitoring.
(3) Rubber hoses are employed for the easy installation of on-board piping.
(4) Electrical wiring can be connected quickly and easily with connectors.

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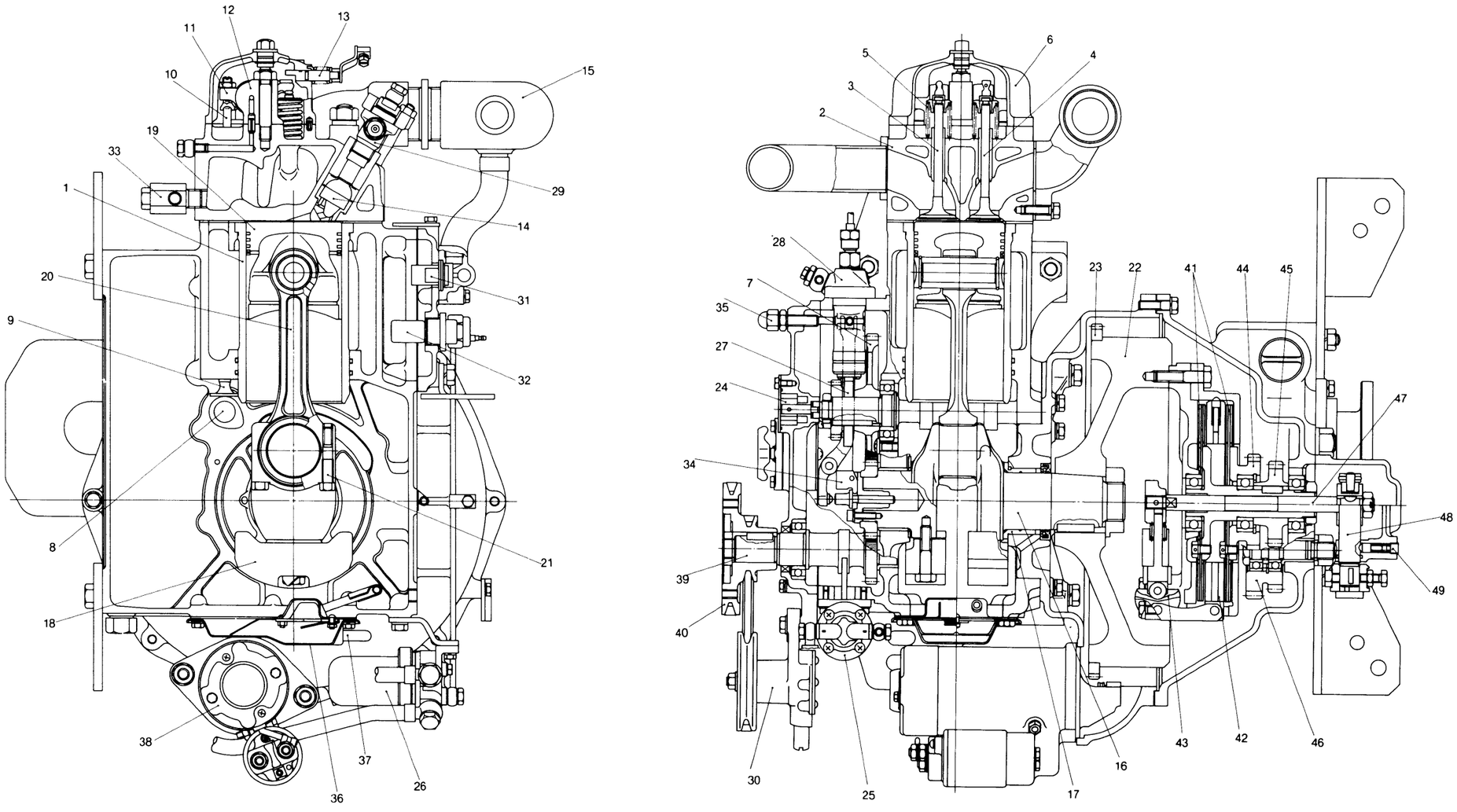
6. Engine Cross-section



1 Cylinder liner
2 Cylinder head
3 Intake valve
4 Exhaust valve
5 Valve spring
6 Valve rocker arm chamber
7 Camshaft gear
8 Camshaft
9 Tappet
10 Push rod
11 Valve rocker arm
12 Valve rocker arm support
13 Decompression shaft
14 Precombustion chamber
15 Mixing elbow
16 Crankshaft
17 Main bearing
18 Balance weight
19 Piston
20 Connecting rod
21 Connecting rod bolt
22 Flywheel
23 Ring gear
24 Lubricating oil pump
25 Fuel feed pump
26 Fuel filter
27 Fuel cam
28 Fuel pump
29 Fuel injection nozzle
30 Cooling water pump
31 Thermostat
32 Anticorrosion zinc
33 Cooling water drain cock
34 Governor weight
35 Fuel injection limiter
36 Cylinder rear cover
37 Breather pipe
38 Starter motor
39 P.T.O. shaft
40 P.T.O. shaft pulley
41 Friction disc
42 Friction plate
43 V-lever
44 Reverse gear
45 Forward gear
46 Idle gear
47 Shifting shaft
48 Fork shaft
49 Neutral point set claw

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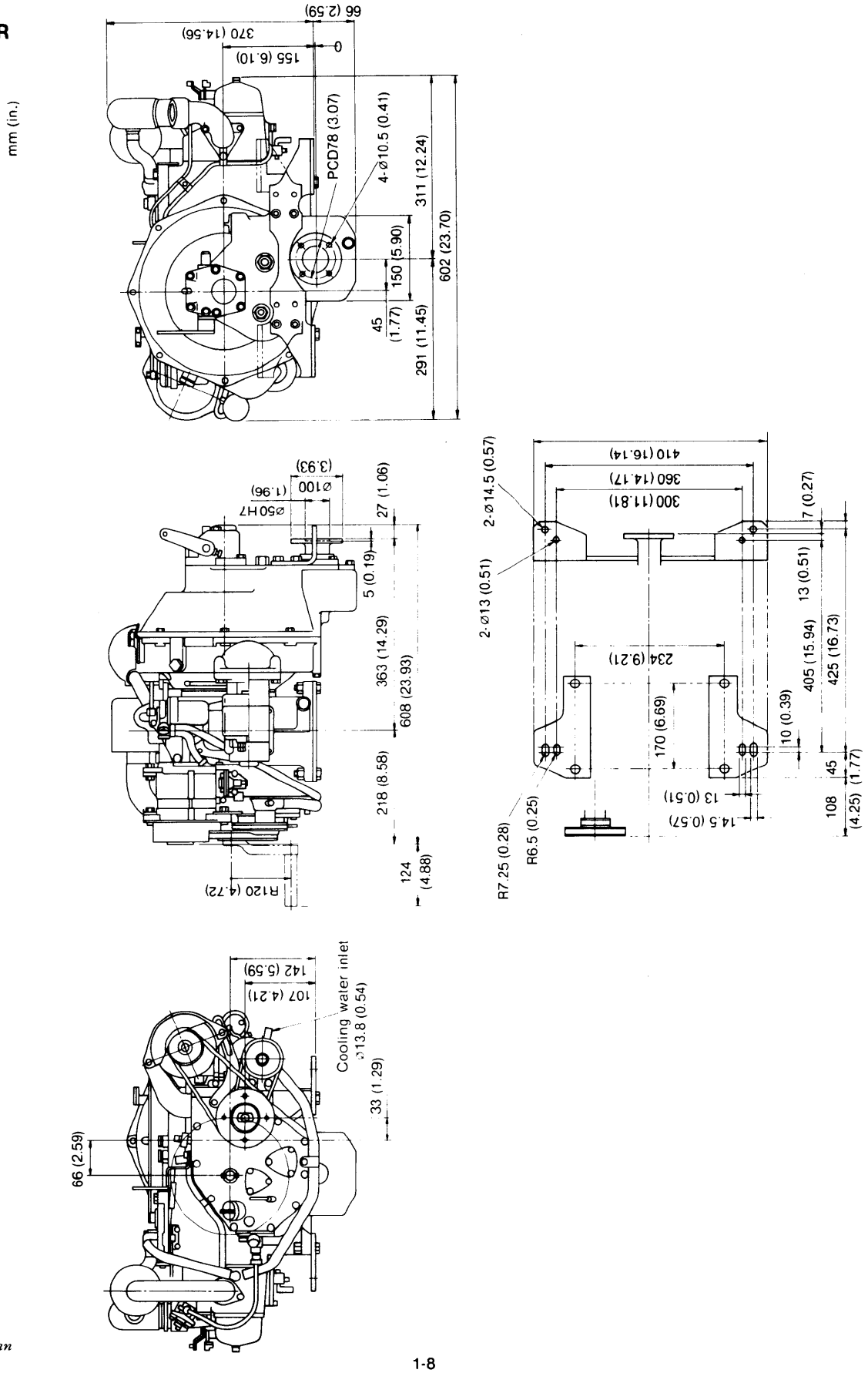
7. Exterior Views

7-1 YSM8-R

mm (in.)



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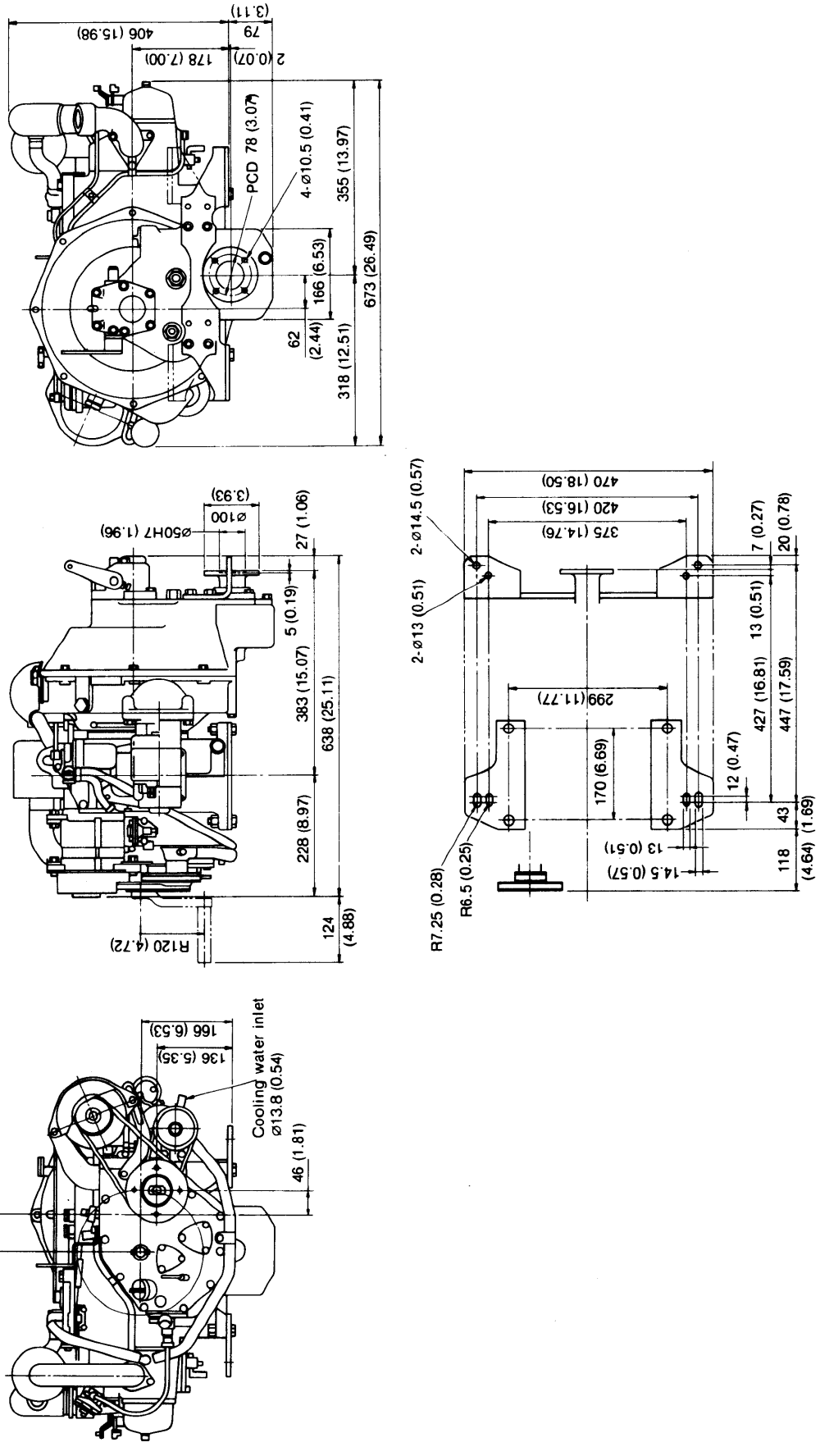
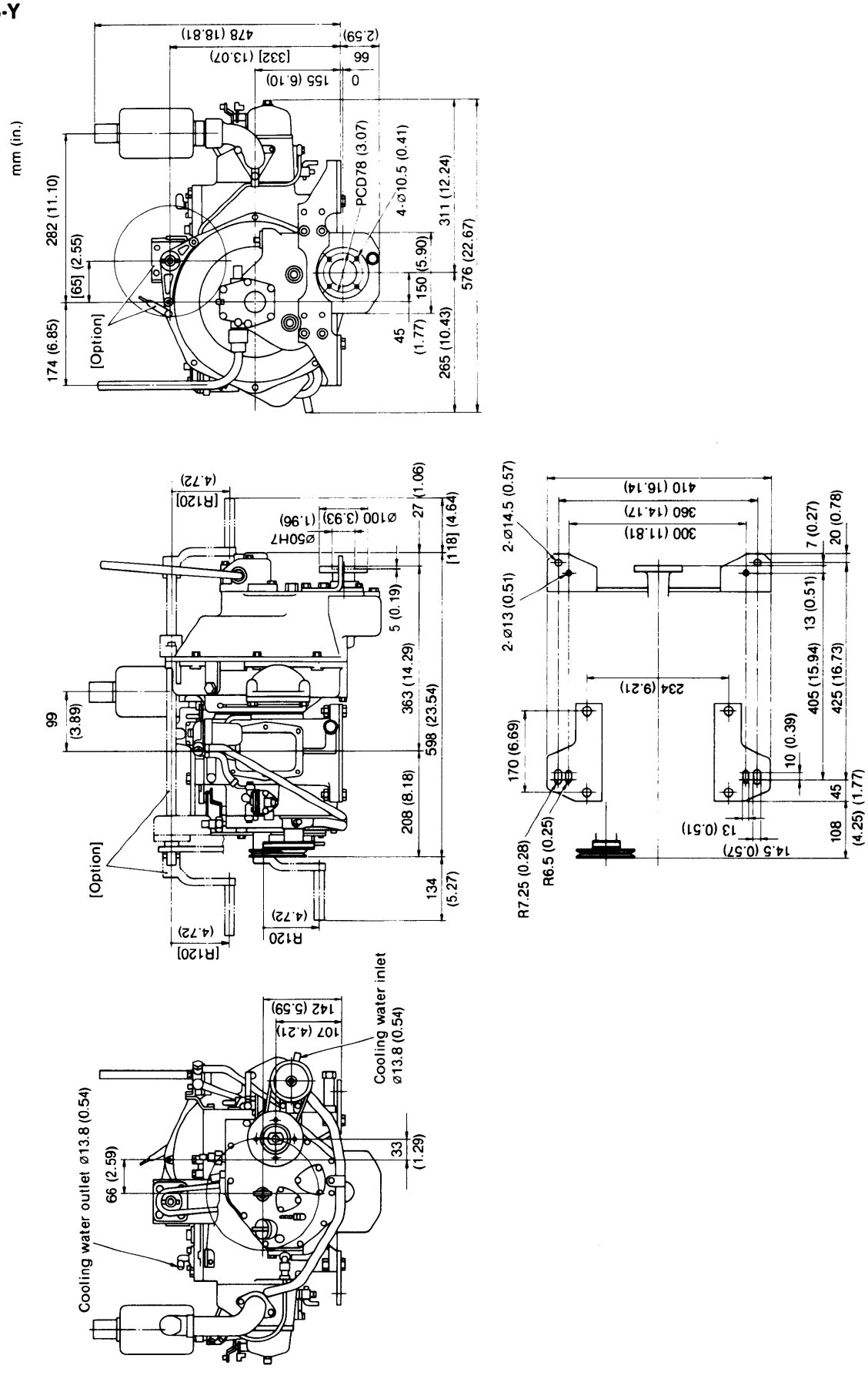
7-2 YSM12-R

mm (in.)



7-3 YSM8-Y



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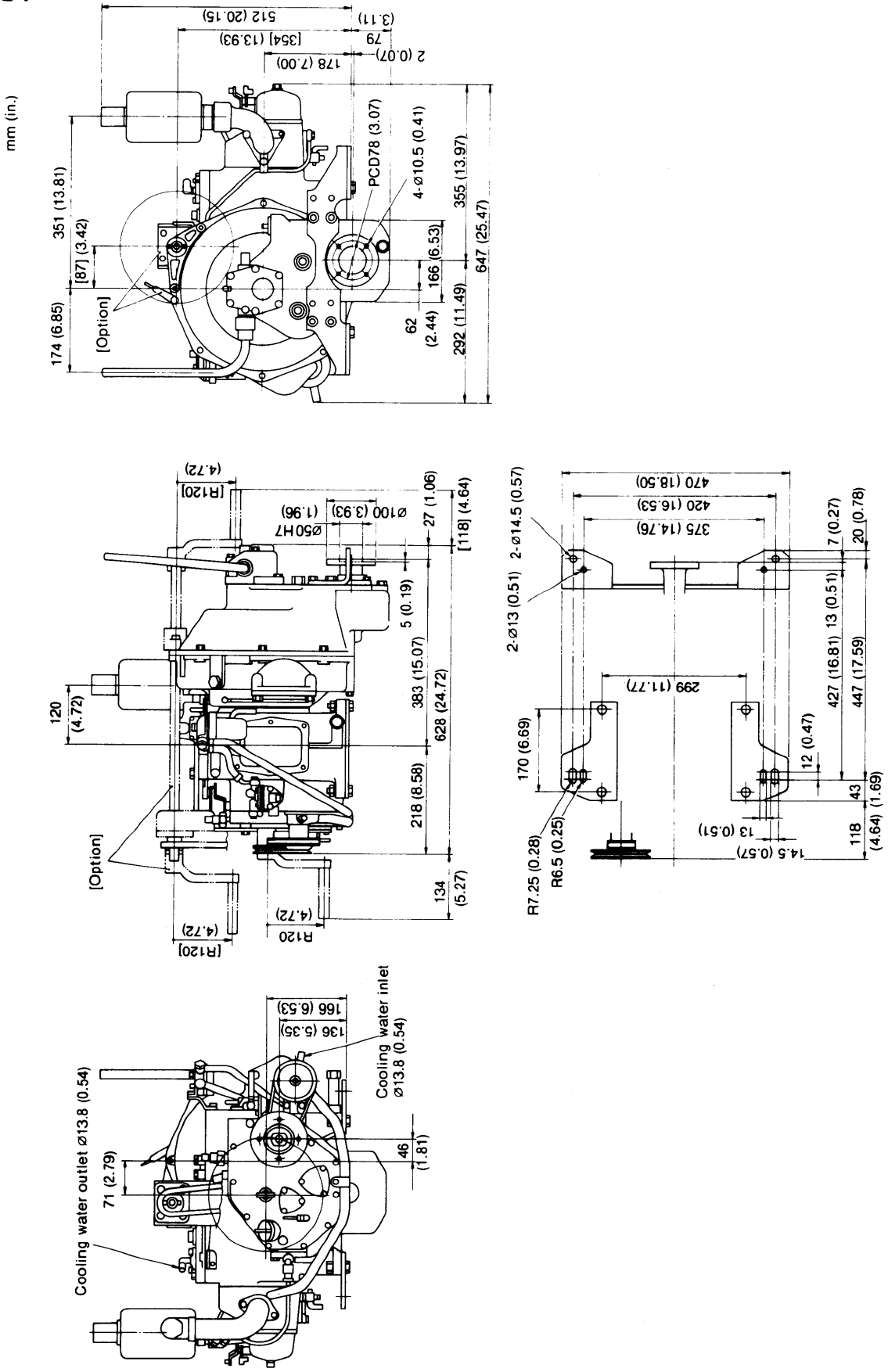
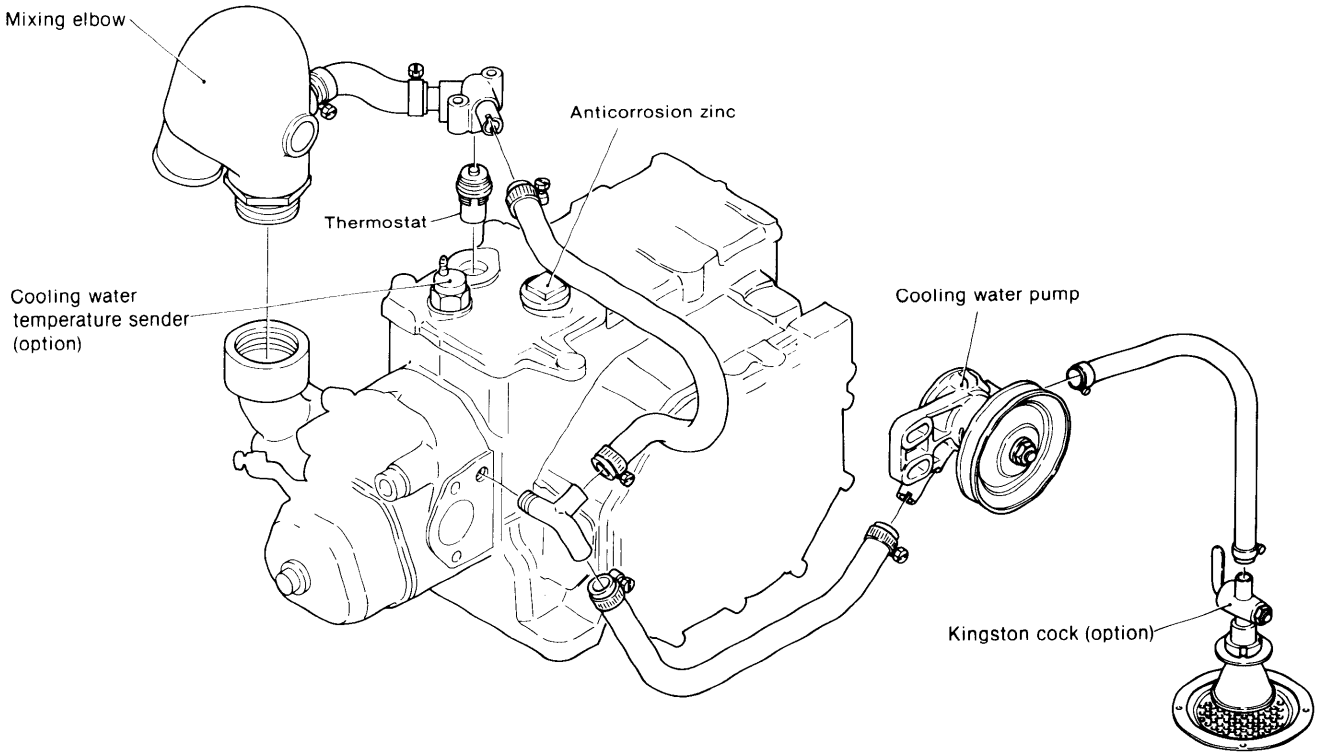
7-4 YSM12-Y


mm (in.)
512 (20.15)
(3.11)
[354] (13.93)
79
178 (7.00)
2 (0.07)
PCD78 (3.07)
4-ø10.5 (0.41)
355 (13.97)
647 (25.47)
351 (13.81)
[87] (3.42)
166 (6.53)
174 (6.85)
[Option]
62
(2.44)
292 (11.49)
[R120]
(4.72)
ø100 (3.93) (1.96)
ø50H7
27 (1.06)
[118] (4.64)
5 (0.19)
383 (15.07)
628 (24.72)
120
(4.72)
218 (8.58)
[Option]
134
(5.27)
R120
(4.72)
[R120]
(4.72)
470 (18.50)
420 (16.53)
375 (14.76)
2-ø14.5 (0.57)
2-ø13 (0.51)
7 (0.27)
20 (0.78)
13 (0.51)
299 (11.77)
427 (16.81)
447 (17.59)
170 (6.69)
12 (0.47)
43
(1.69)
13 (0.51)
118
(4.64)
14.5 (0.57)
R7.25 (0.28)
R6.5 (0.25)
166 (6.53)
136 (5.35)
Cooling water inlet
ø13.8 (0.54)
46
(1.81)
71 (2.79)
Cooling water outlet ø13.8 (0.54)

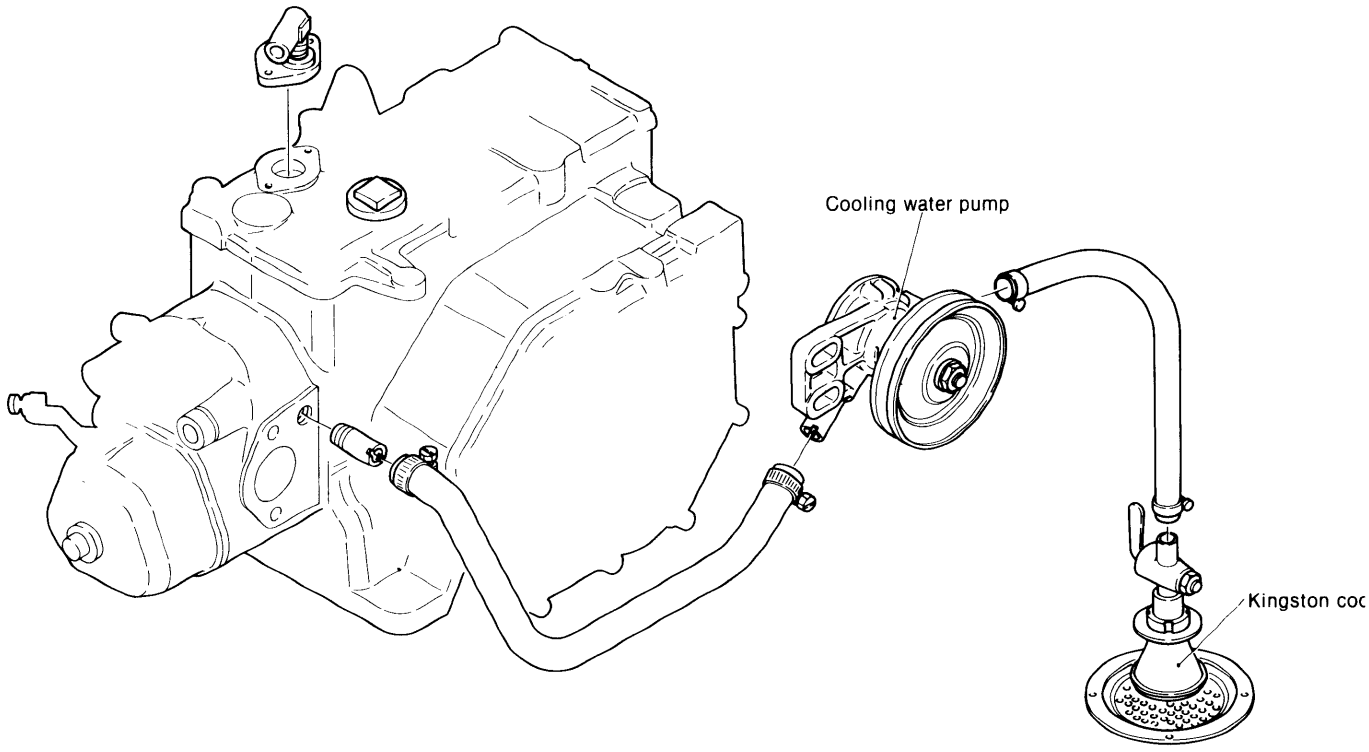
8. System Diagrams

8-1 Cooling system

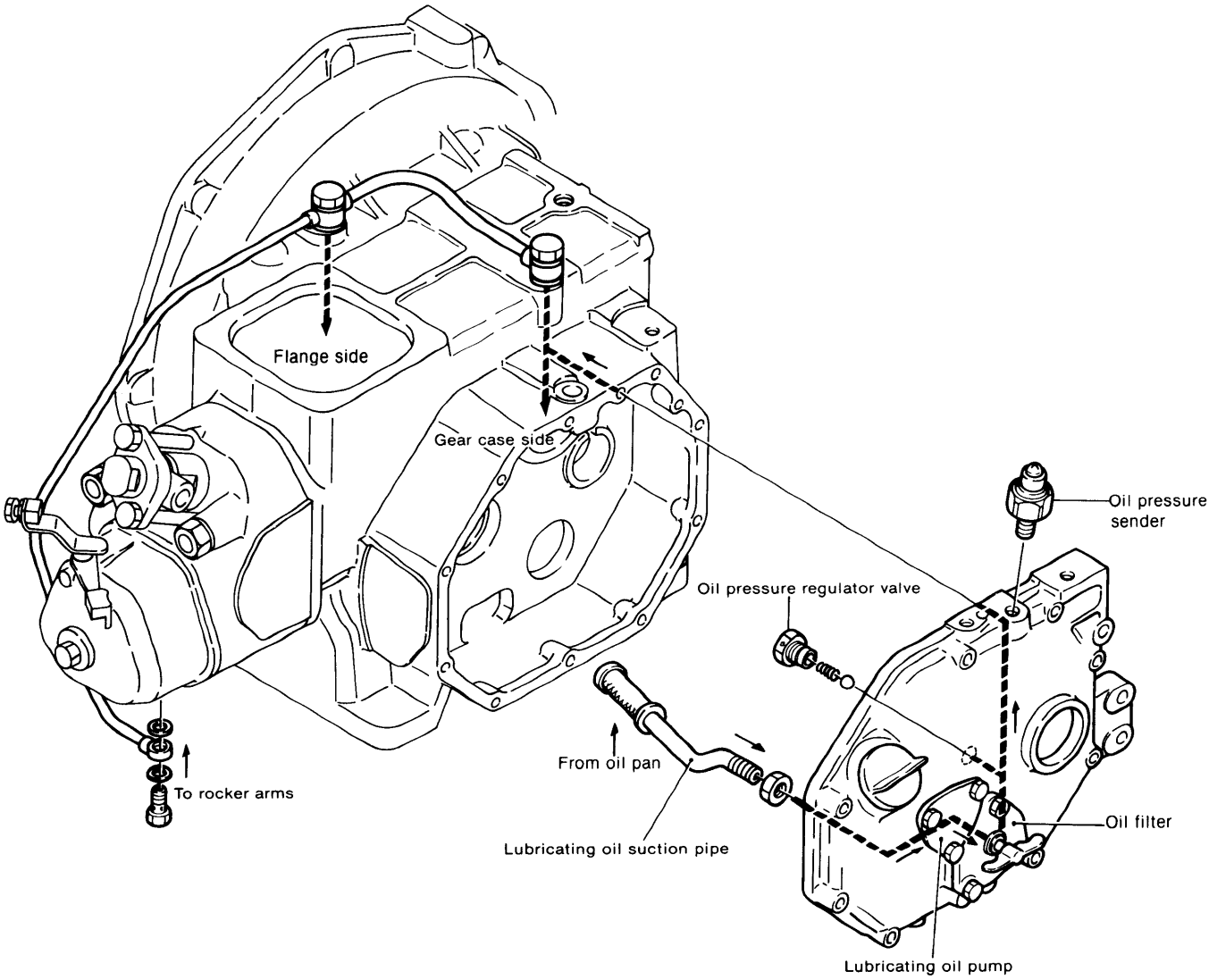
8-1.1 YSM8-R, YSM12-R



8-1.2 YSM8-Y, YSM12-Y



8-2 Lubrication system



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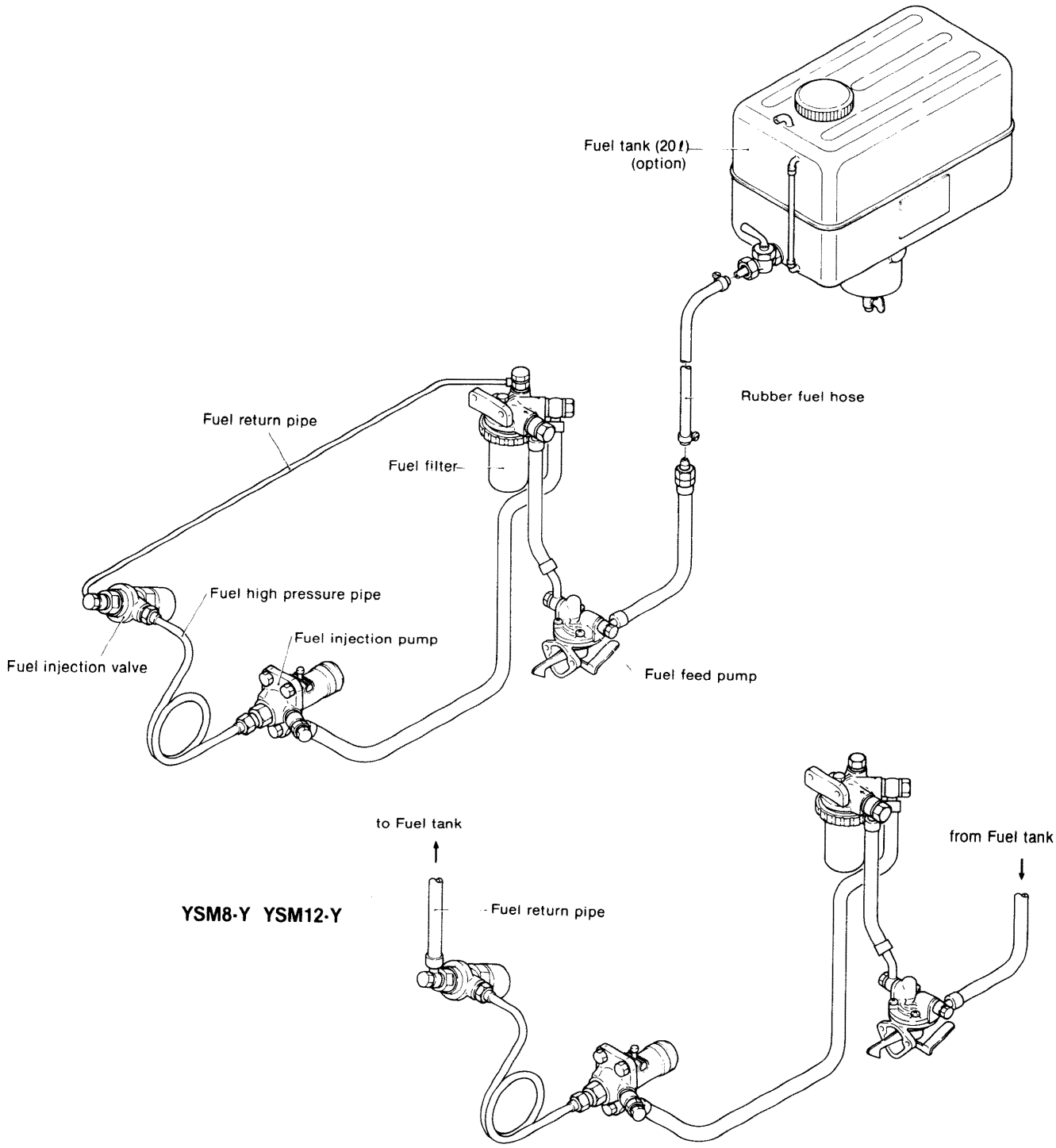
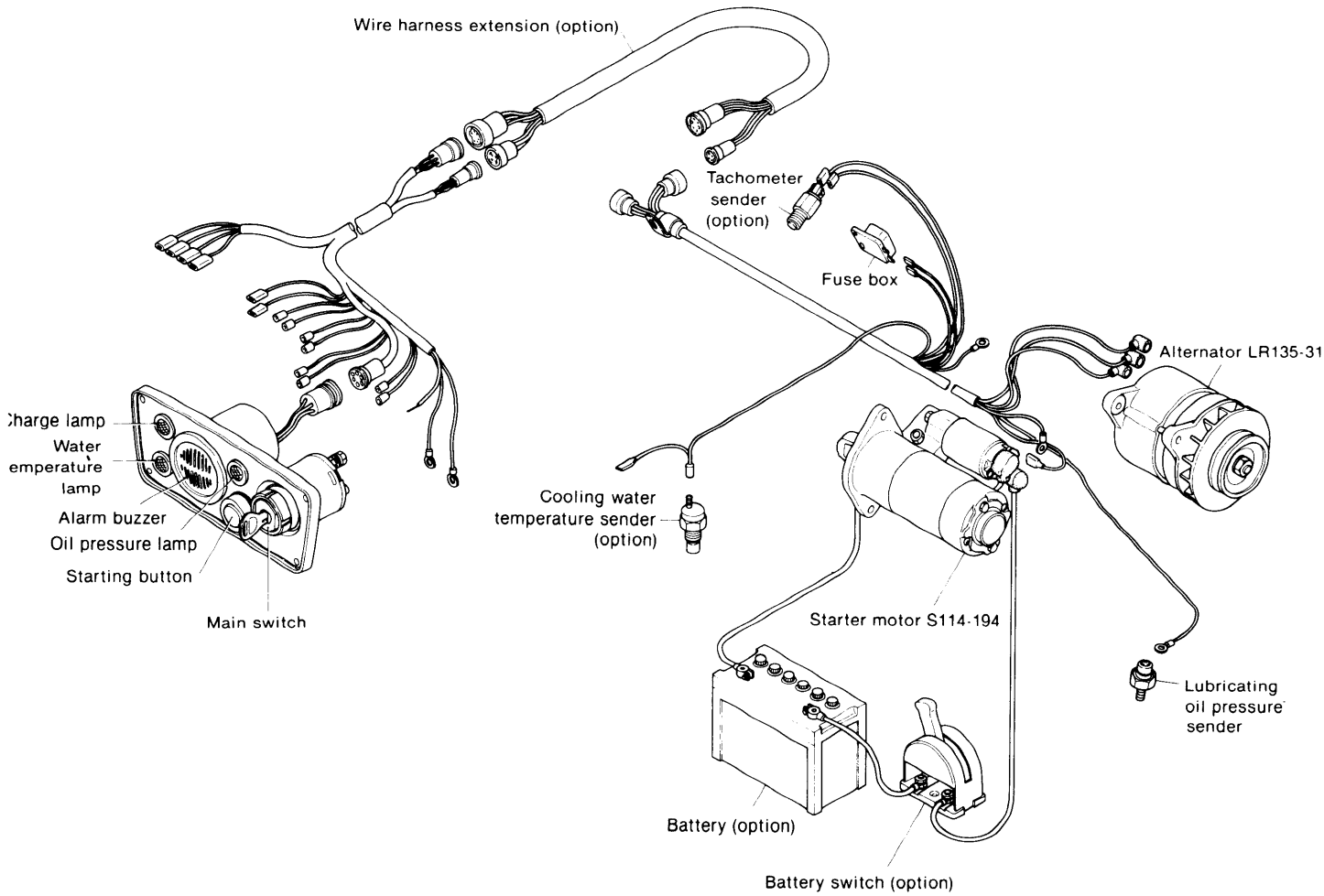
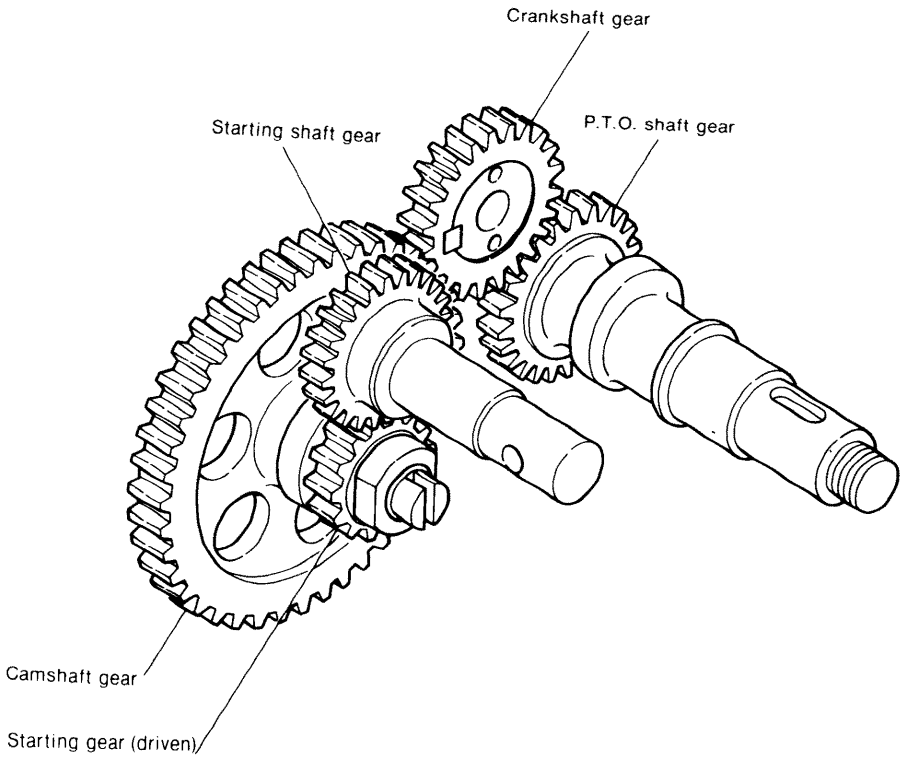
8-3 Fuel system

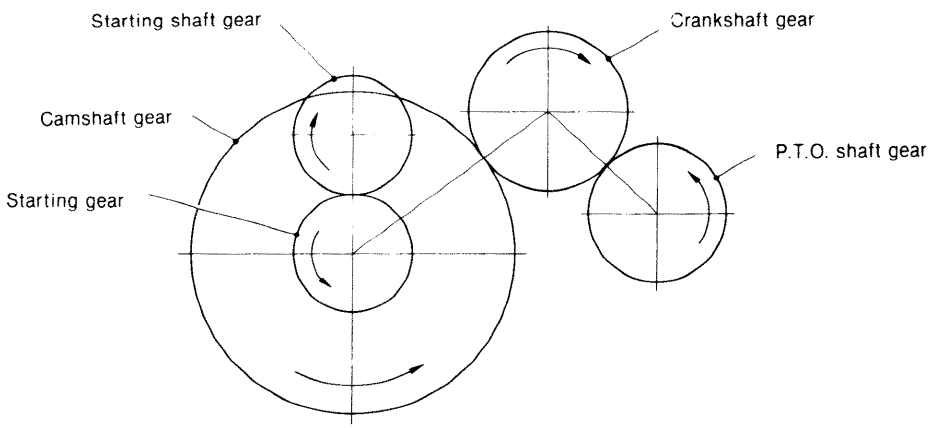


8-4 Electrical system

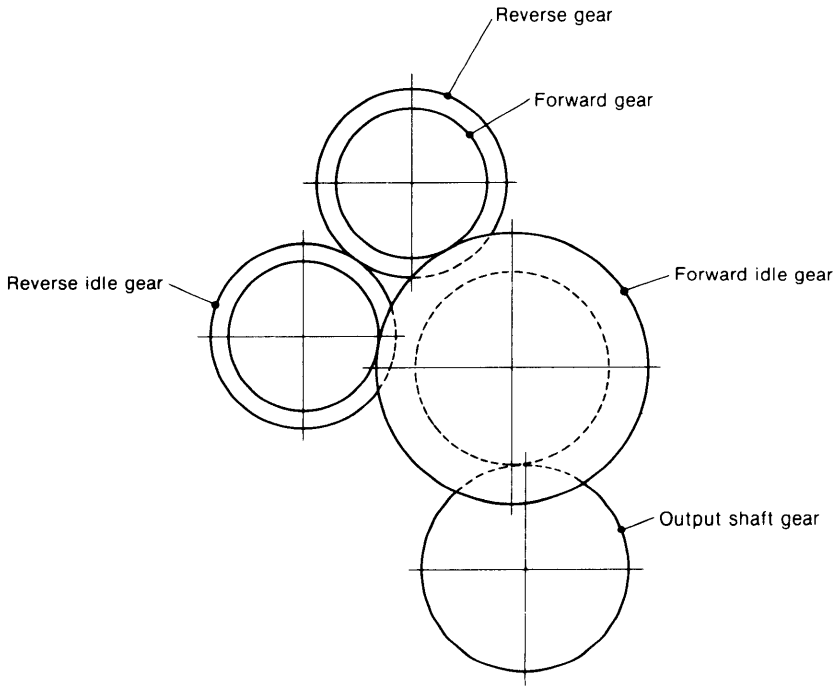


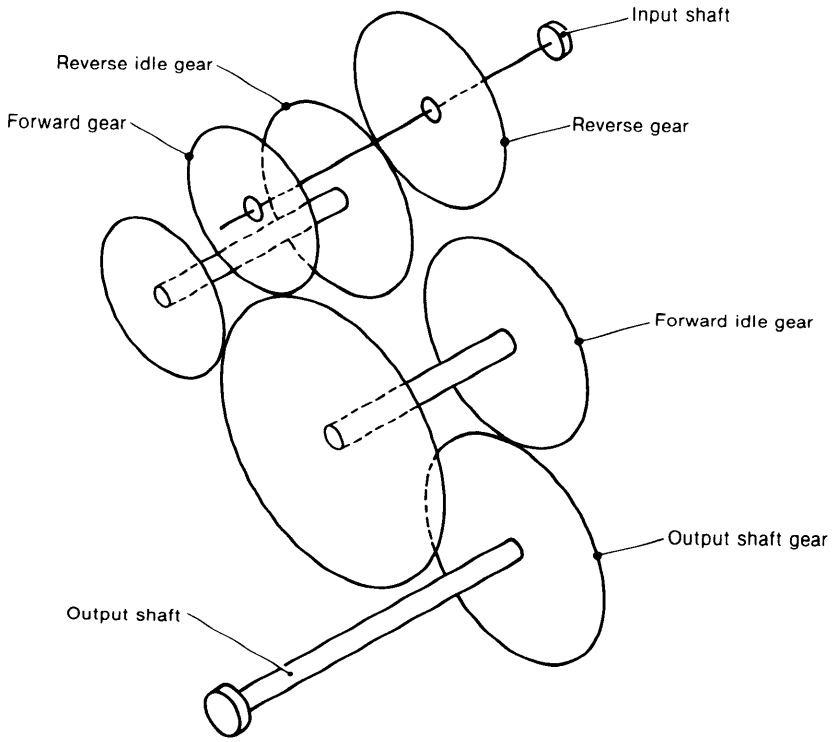
8-5 Timing gear train



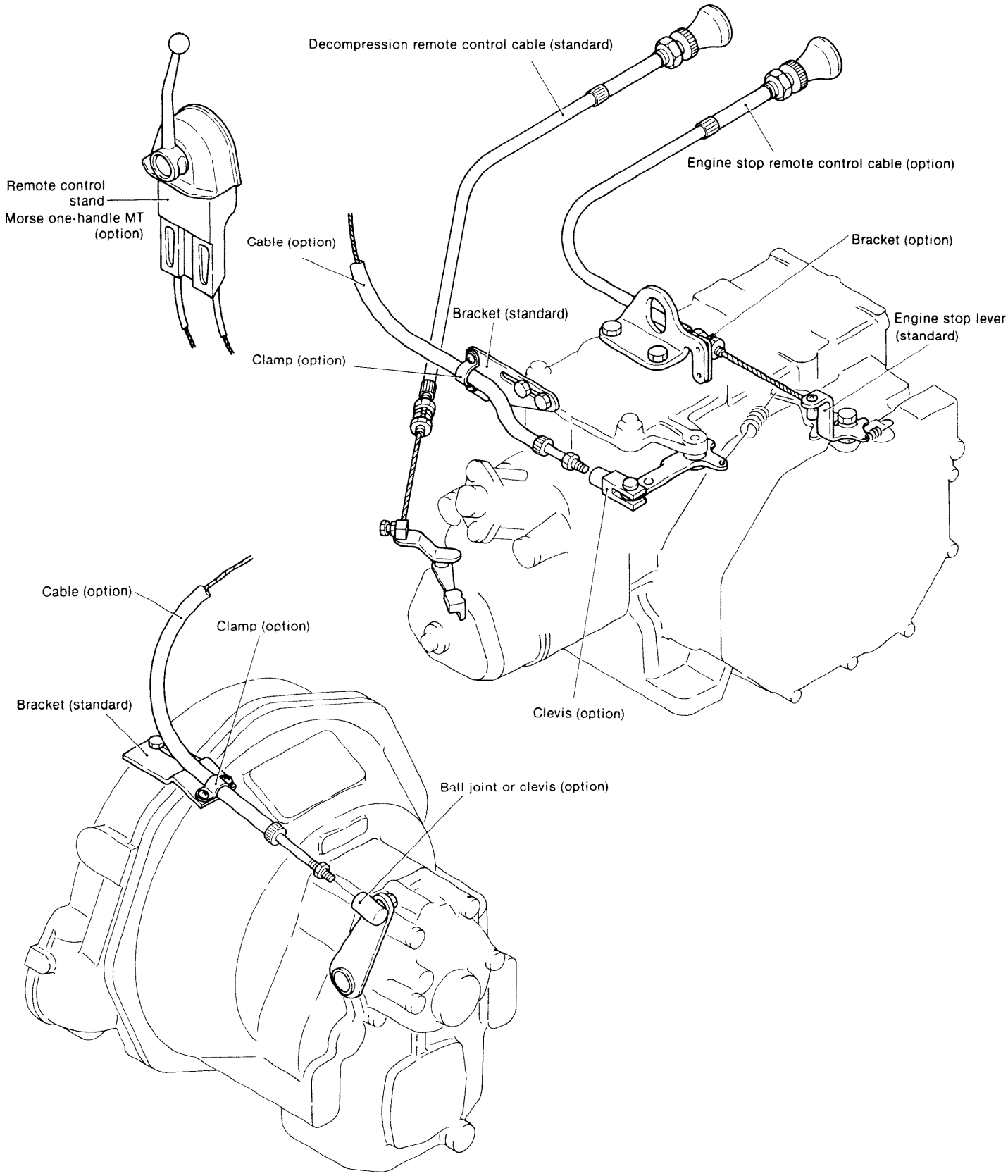


8-6 Reduction reversing power transmission system





8-7 Remote control system



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9. Accessories

○ Standard accessories packed with engine
● Standard accessories mounted on engine
△ Optional accessories packed with engine
▲ Optional accessories mounted on engine

	Part name	R-type	Y-type	Remarks
1	Dry type exhaust silencer	—	○	
2	Exhaust pipe	—	○	
3	Water mixing elbow	●	—	U-type
4	Thermostat for cooling water	●	—	
5	Fuel oil tank with rubber hose	△	△	2-meter fuel hose
6	Fuel oil feed pump (mechanical type)	●	●	
7	Fuel oil strainer	●	●	
8	Chain starting device (stern side)	▲	▲	with stern side decomp. lever
9	Lube oil evacuation pump	△	△	
10	Bilge pump (mechanical type)	▲	▲	
11	Bilge hose and strainer	△	△	
12	Kingston cock with cooling water hose	△	○	
13	Remote control cable for decompression	○	—	3-meter
14	Cable for engine stop device	△	—	3-meter
15	Speed control lever with cable	—	●	1.5-meter
16	Single lever control (Morse MT-type)	△	—	with two 4-meter cables
17	Bracket for clutch remote control cable	●	—	
18	Bracket for speed remote control cable	●	—	
19	Flywheel ring gear	●	—	
20	Starting motor	●	—	
21	A.C. generator	●	—	
22	Wireharness	●	—	
23	Dash board (with 3-meter wireharness)	○	—	
24	Fuse box	●	—	
25	Lube oil pressure sender	●	—	
26	Lube oil indicator	—	●	
27	Cooling water temperature sender	●	—	
28	Battery switch	△	—	with screws
29	Tachometer sender	△	—	
30	Tachometer	△	—	
31	Flexible mountings (fixed type)	△	—	4pcs/unit
32	Flexible mountings (adjustable type)	△	—	4pcs/unit
33	Flexible coupling	△	—	with nuts
34	Exhaust flange and elbow	△	—	
35	Propeller shaft half coupling (solid, taper bored)	△	○	with bolts and nuts
36	Propeller shaft half coupling (slit type)	△	—	with bolts and nuts
37	Wireharness coupler for open board	△	—	
38	Foundation bolts	—	○	4pcs/unit
39	On board spare parts kit	△	○	
40	Packings kit	△	△	
41	Tools	○	○	
42	Special overhauling tools	△	△	
43	Starting handle	○	○	
44	Operation manual	○	○	
45	Wireharness extension	△	—	3-meter or 6-meter
46	Intake silencer	●	—	

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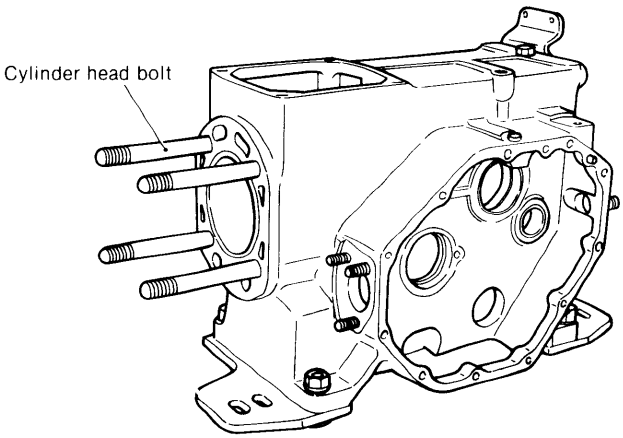
CHAPTER 2

BASIC ENGINE

1. Cylinder Block

1-1 Construction of cylinder block

The cylinder, crank case and gear case are housed in a monoblock type cylinder block cast of high-grade cast iron. On the basis of stress analysis tests, the shape and thickness of each part have been optimized, and special ribs have been effectively arranged for increased rigidity and strength.



1-2 Cylinder block inspection

1-2.1 Inspecting each part for cracks

If the engine has been frozen or dropped, visually inspect it for cracks and other abnormalities before disassembling. If there are any abnormalities or the danger of any abnormalities occurring, make a color check.

1-2.2 Inspecting the water jacket of the cylinder for corrosion

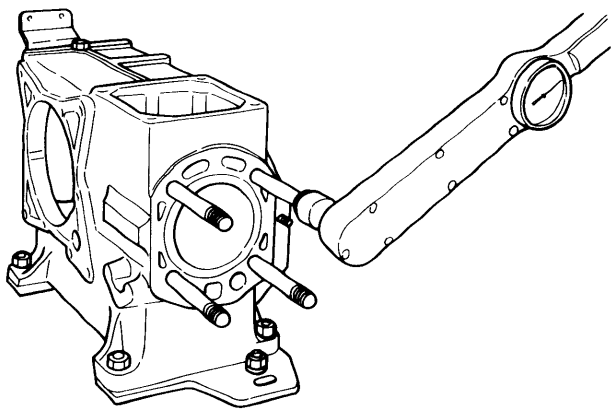
Inspect the cooling water passages and cylinder liner contact parts for sea water corrosion, scale, and rust. Replace the cylinder body if corrosion, scale or rust is severe.

Cylinder body jacket corrosion depth limit: 1.5mm

1-2.3 Cylinder head bolts

Check for loose cylinder head bolts and for cracking caused by abnormal tightening, either by visual inspection or by a color check.

Replace the cylinder block if cracked.



kg•cm (ft-lb)

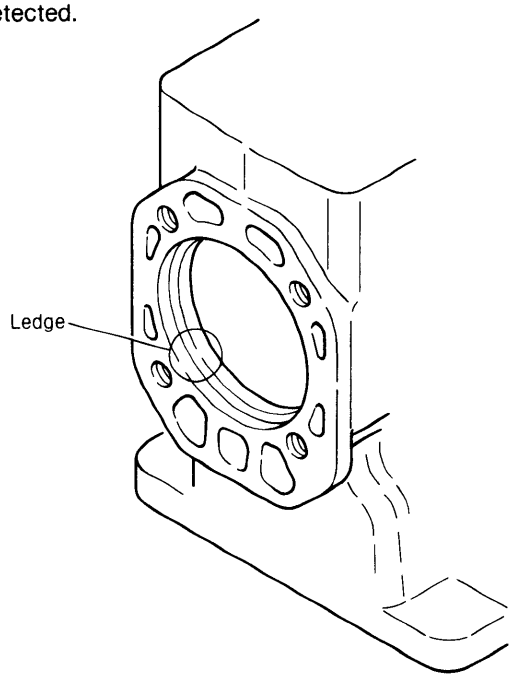
	YSM8	YSM12
Stud bolt tightening torque	450 (32.55)	450 (32.55)

1-2.4 Oil and water passages

Check the oil and water passages for clogging and build-up of foreign matter.

1-2.5 Cylinder bore and ledge

Perform a color check on the ledge at the top of the cylinder head bore, and replace the cylinder if any cracks are detected.



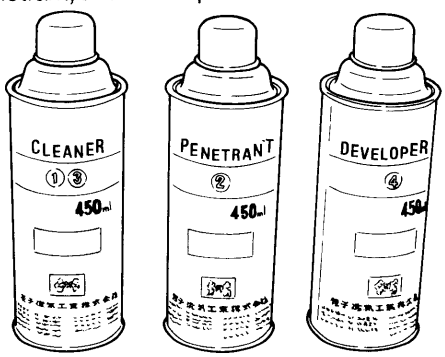
1-2.6 Inspection of oil hole and cooling water hole

Check each oil hole and cooling water hole for continuity. When disassembling, also check each fitting surface for impressions, etc.

1-2.7 Color check flaw detection procedure

(1) Clean the inspection point thoroughly.

(2) Procure the dye penetration flaw detection agent. This agent comes in spray cans, and consists of a cleaner, penetrant, and developer in one set.



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(3) Pretreat the inspection surface with the cleaner. Spray the cleaner directly onto the inspection surface, or wipe the inspection surface with a cloth moistened with the cleaner.
(4) Spray the red penetration liquid onto the inspection surface. After cleaning the inspection surface, spray the red penetrant (dye penetration flaw detection agent) onto it and allow the liquid to penetrate for 5-10 minutes.
If the penetrant fails to penetrate the inspection surface because of the ambient temperature or other conditions, allow it to dry and respray the inspection surface.
(5) Spray the developer onto the inspection surface. After penetration processing, remove the residual penetrant from the inspection surface with the cleaner, and then spray the developer onto the inspection surface. If the inspection surface is flawed, red dots or lines will appear on the surface within several minutes. When spraying the developer onto the inspection surface, hold the can about 30—40cm from the surface and sweep the can slowly back and forth to obtain a uniform film.
(6) Reclean the inspection surface with the cleaner.

NOTE: Before using the dye penetration flaw detection agent, read its usage instructions thoroughly.

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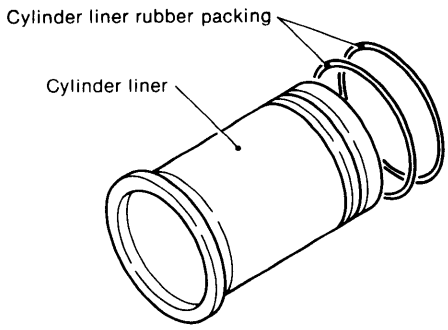
2. Cylinder Liner

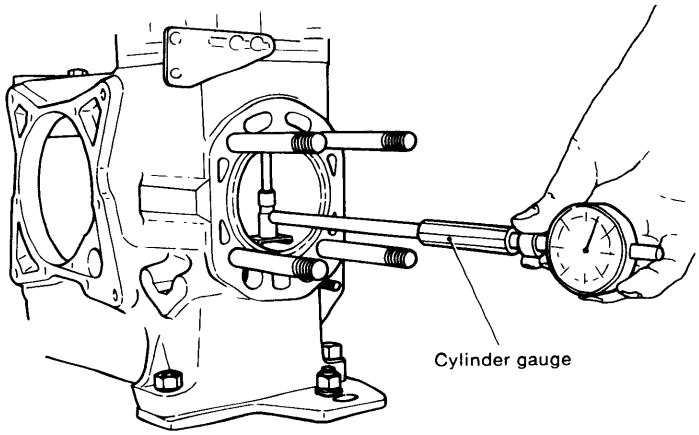
2-1 Construction of cylinder liner

The cylinder liner is made of a special, highly wear-resistant cast iron. Its inner surfaces are finished by precision honing, thereby holding lubricating oil properly and greatly improving the wear-resistant properties of the piston rings and the cylinder liner itself. Two grooves for O-rings are cut into the outer surface of the cylinder liner. The two O-rings prevent the deformation and distortion of the cylinder liner, and at the same time, maintain maximum water tightness between the cylinder block and the cooling water jacket.



2-2 Inspection

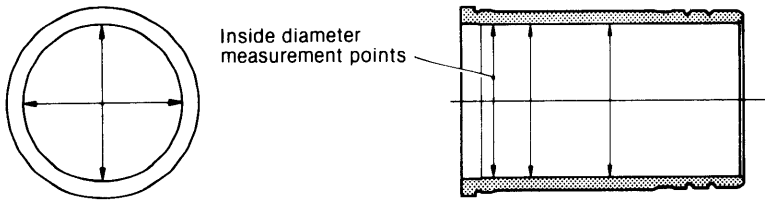
Since the piston and piston rings constantly slide against the cylinder liner while the engine is in operation, and side pressure is applied to the cylinder liner by the movement of the crankshaft, eccentric wear occurs easily.
Moreover, if lubrication and cooling are insufficient, the inner surface will be damaged or rusted. Inspect the inner surface and replace the cylinder liner if the surface is noticeably damaged or rusted.



2-3 Cylinder liner bore diameter measurement

Measure the bore diameter of the cylinder liner with a cylinder gauge at the positions shown in the figure.

Replace the cylinder liner when the measured value exceeds the wear limit.



mm (in.)

		Maintenance standard	Maximum allowable clearance	Wear limit
YSM8	Cylinder liner diameter	$\varnothing 75\ ^{+0.03}_{0}$ ($2.9528\ ^{+0.00118}_{0}$)	0.3 (0.0118)	ø75.17 (2.9594)
	Piston outside diameter	ø75 (2.9528)		
	Cylinder liner circularity	0.02 (0.0008)	—	0.1 (0.0039)
YSM12	Cylinder liner diameter	$\varnothing 85\ ^{+0.035}_{0}$ ($3.3465\ ^{+0.00137}_{0}$)	0.3 (0.0118)	ø85.19 (3.3539)
	Piston outside diameter	ø85 (3.3465)		—
	Cylinder liner circularity	0.02 (0.0008)	—	0.1 (0.0039)

Thank you very much for your reading.

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