SERVICE MANUAL

Models

EY15-3, EY20-3 ENGINES

PUB-ES1609
Rev. 12/01

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CONTENTS

1. SPECIFICATIONS

MODEL		EY15-3D	EY20-3D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Side Valve, Gasoline Engine	
Bore x Stroke		63 x 46 mm (2.48 x 1.81 in.)	67 x 52 mm (2.64 x 2.05 in.)
Piston Displacement		143 cm^3 (8.73 cu.in.)	183 cm^3 (11.17 cu.in.)
Compression Ratio		6.3	
Output	Continuous	1.6 kW (2.2 HP) /3000 r.p.m. 2.0 kW (2.7 HP) /3600 r.p.m.	2.2 kW (3.0 HP) /3000 r.p.m. 2.6 kW (3.5 HP) /3600 r.p.m.
	Max.	2.6 kW (3.5 HP) /4000 r.p.m.	3.7 kW (5.0 HP) /4000 r.p.m.
Max. Torque		6.7 N・m (0.68 kgf・m) / 2800 r.p.m.	9.3 N・m (0.95 kgf・m) / 2800 r.p.m.
Direction of Rotation		Counterclockwise as viewed from P.T.O. shaft side	
Cooling system		Forced Air Cooling	
Valve Arrangement		Side Valve	
Lubrication		Splash Type	
Lubricant		Automobile Oil SAE #20, #30 or 10W-30 ; Class SE or higher	
Capacity of Lubricant		0.6 liters (0.156 U.S. gal.)	
Carburetor		Horizontal Draft, Float Type	
Fuel		Automobile Unleaded Gasoline	
Fuel Consumption Ratio		380 g/kW・h (280 g/HP・h) at Continuous Rated Output	
Fuel Feed System		Gravity Type	
Fuel Tank Capacity		2.8 liters (0.74 U.S. gal.)	3.8 liters (1.00 U.S. gal.)
Ignition System		Flywheel Magneto (Solid State)	
Spark Plug		NGK B6HS	
Starting System		Recoil Starter	
Governor System		Centrifugal Flyweight Type	
Dry Weight		13.2 kg (29.1 lb.)	15.0 kg (33.1 lb.)
Dimensions (L x W x H)		294 mm x 304 mm x 368 mm (11.57 in. x 11.97 in. x 14.49 in.)	303 mm x 318 mm x 392 mm (11.93 in. x 12.52 in. x 15.43 in.)

Specifications are subject to change without notice.

2. PERFORMANCE

2-1 MAXIMUM OUTPUT

The maximum output is the output of an engine with its throttle valve fully opened and considering that all the moving parts are properly broken in .

A new engine may not produce full maximum output while its moving parts are still not broken-in.

NOTE :
Power curves shown in the following charts are made in conformity with SAE internal combustion engine standard test code J1349.

2-2 CONTINUOUS RATED OUTPUT

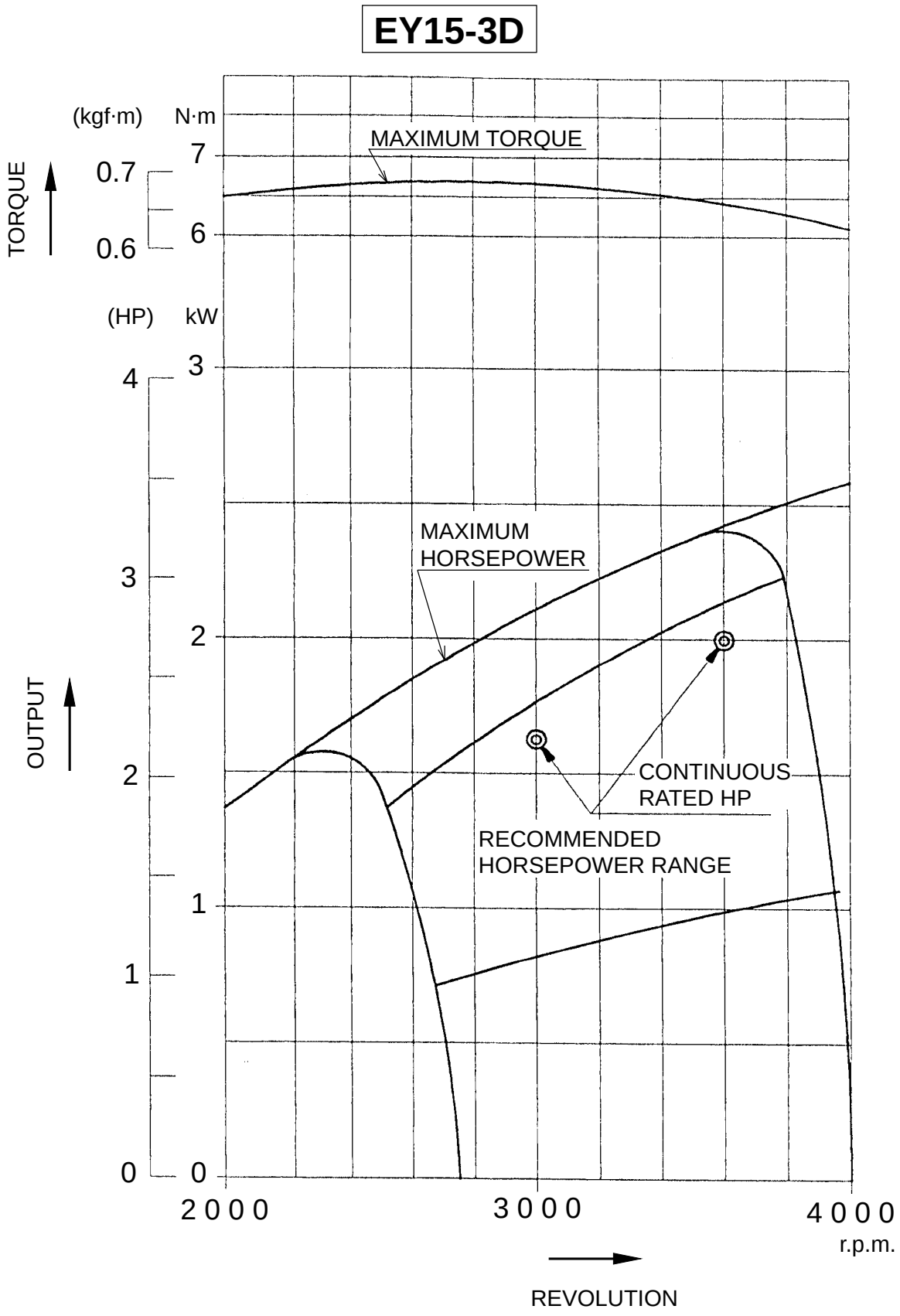
The continuous rated output is the output of an engine at optimum governed speed which is most favorable from the view point of engine's life and fuel consumption.

When the engine is installed on a certain equipment, it is recommended that the continuous output required from the equipment should be kept below this continuous rated output.

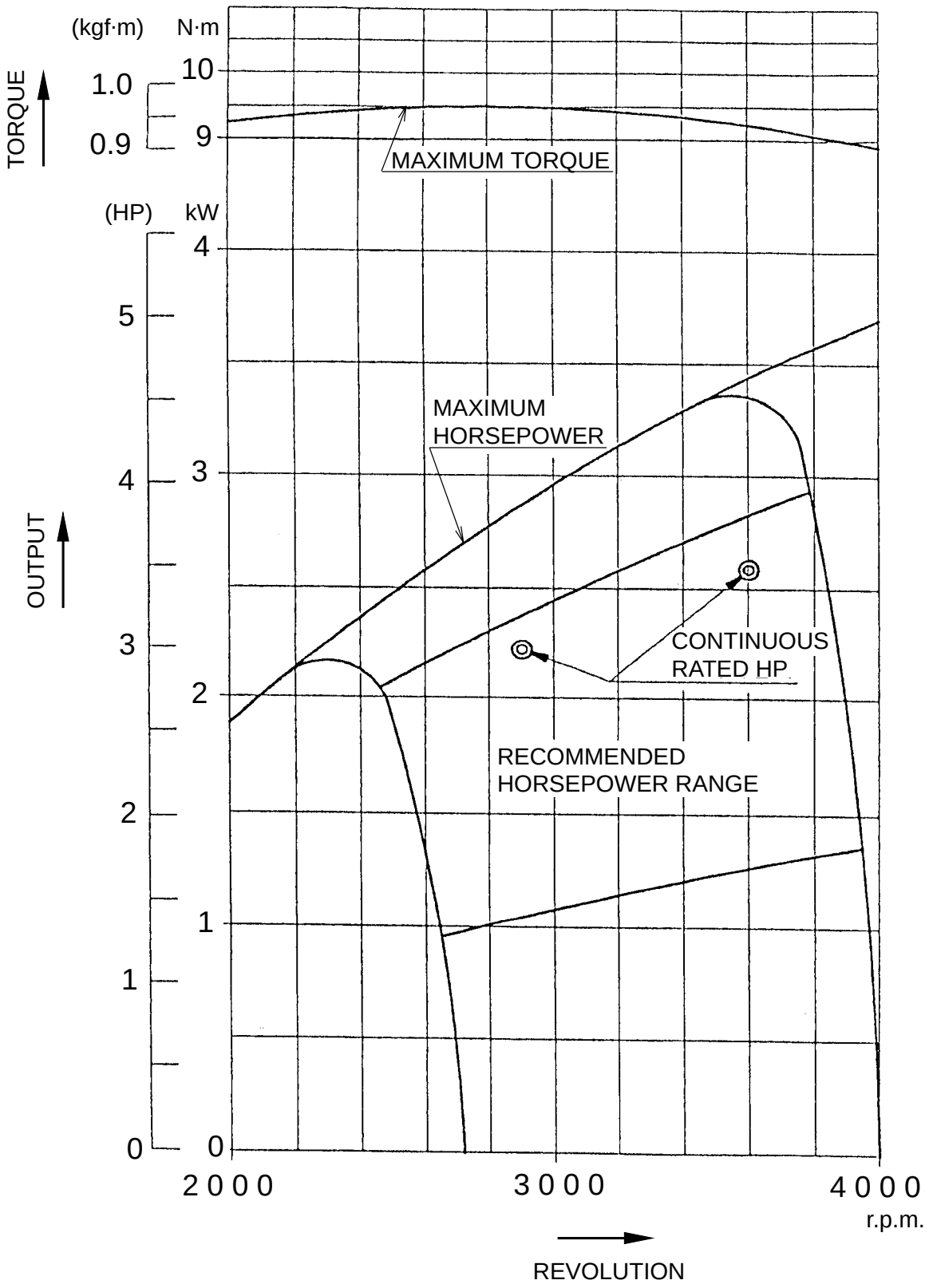
2-3 MAXIMUM TORQUE

The maximum torque is the torque at the output shaft when the engine is producing maximum output at a specified r.p.m..

2-4 PERFORMANCE CURVES



EY20-3D


(kgf·m)
N·m
TORQUE
1.0
0.9
10
9
MAXIMUM TORQUE
(HP)
kW
OUTPUT
5
4
3
2
1
0
4
3
2
1
0
MAXIMUM
HORSEPOWER
CONTINUOUS
RATED HP
RECOMMENDED
HORSEPOWER RANGE
2000
3000
4000
r.p.m.
REVOLUTION

3. FEATURES (compared with former model)

1. Re-designed outlook
   Thinner recoil starter, newly designed air cleaner and muffler are adopted.
   Also, innovate the image that express the reliability of Robin engine more by adopting new labels and new color.

2. Shorter length increased mount-ability
   Thinner recoil starter realized shorter length than former model. It eases to mount the engines to many applications.

3. Development of dust proof air cleaner
   Newly developed dual element air cleaner, which has bigger dust holding capacity, realized higher reliability in dusty condition than former model.

4. Deep consideration on human and environment
   New muffler realized quieter operation. Also, the engine meets with EPA Phase 1 exhaust emission regulation, European emission gas regulations starting from 2002, and Japanese voluntary reguations start from 2003, with dual element or cyclone type air cleaner.

5. Unchanged durability
   Durability is the same as that of former model. Robin keeps producing reliable and dependable engine.

6. Parts interchangeability
   Almost of all spare parts are interchangeable between new and former models. The air cleaner and carburetor should be exchanged at the same time.

4. GENERAL DESCRIPTION OF ENGINE COMPONENTS

4-1 CYLINDER AND CRANKCASE

The cylinder and crankcase are single piece aluminum die-casting.

The cylinder liner, made of special cast iron, is molded into the aluminum casting.

The intake and exhaust ports are located on one side of the cylinder, and are also inserted into the casting.

The crankcase has a mounting surface on the output shaft side, where the main bearing cover is attached.

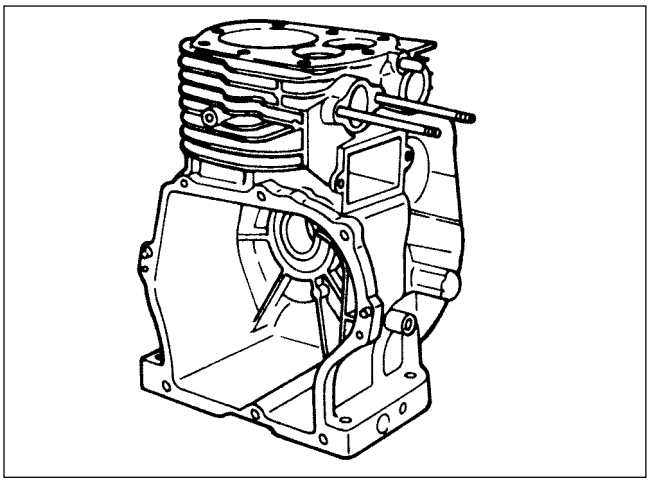


Fig. 4-1

4-2 MAIN BEARING COVER

The main bearing cover is an aluminum die-casting, which is mounted on the output shaft side of the crankcase.

Remove the main bearing cover to inspect inside of the engine.

Pilots and bosses are machined on the cover for direct mounting of the engine onto such machines as generators and pumps.

Oil gauges (fillers) are on both sides of the cover for easy maintenance.

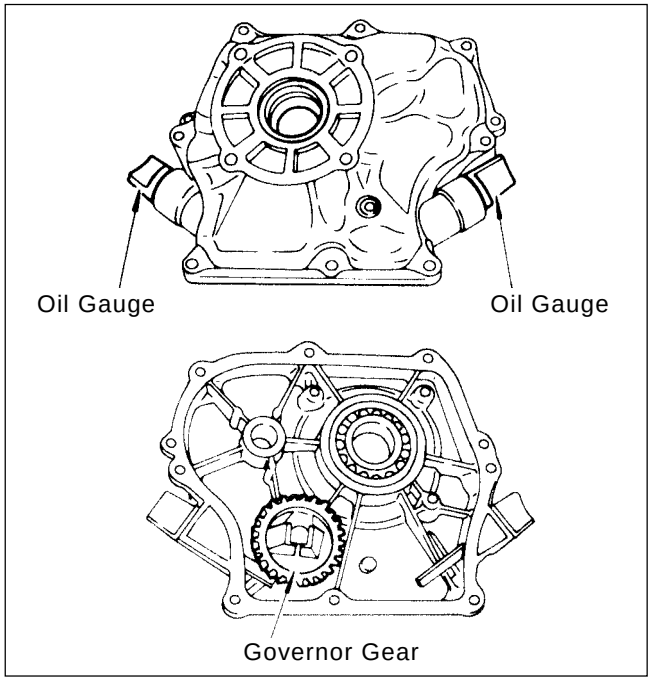


Fig. 4-2

4-3 CRANKSHAFT

The crankshaft is forged carbon steel, and the crank pin is induction-hardened.

The output end of the shaft has a crankshaft gear that is pressed into position.

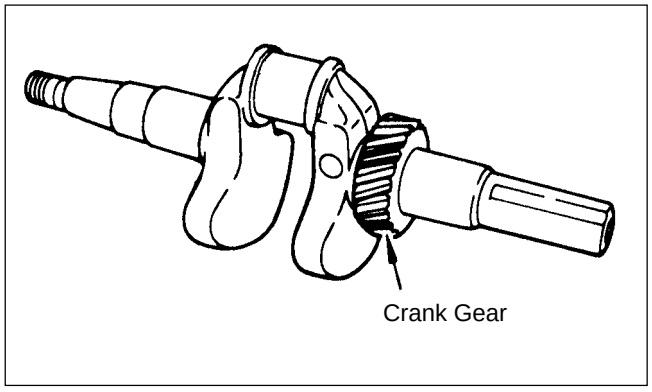


Fig. 4-3

4-4 CONNECTING ROD AND PISTON

The connecting rod is forged of aluminum alloy, and its large and small ends fanction as bearings. The large end has a built-in oil scraper for splashing the lubricating oil.

The piston is an aluminum alloy casting, and carries two compression rings and one oil ring.

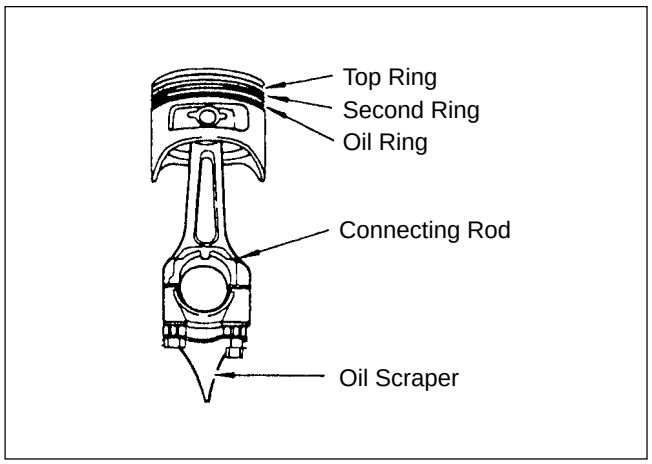


Fig. 4-4

4-5 CAMSHAFT

The camshaft is made of special cast iron, and camshaft and gear are cast together in one piece.

Both sides of the shaft fit into the plain bearings on the crankcase and main bearing cover.

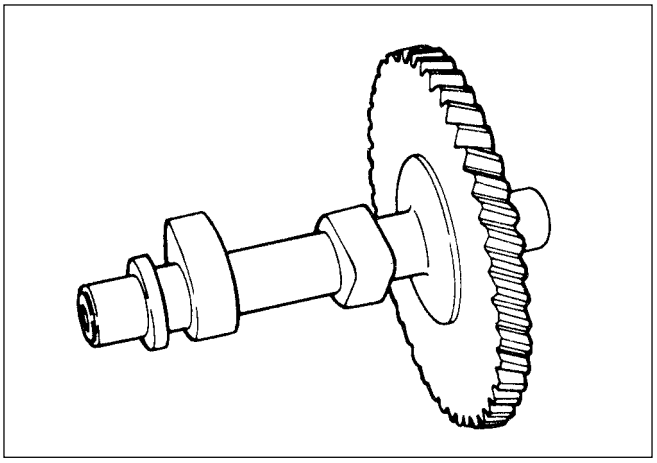


Fig. 4-5

4-6 VALVE ARRANGEMENT

The exhaust valve is located upstream of the cooling air with the result that the exhaust valve is intensively cooled for improved engine durability.

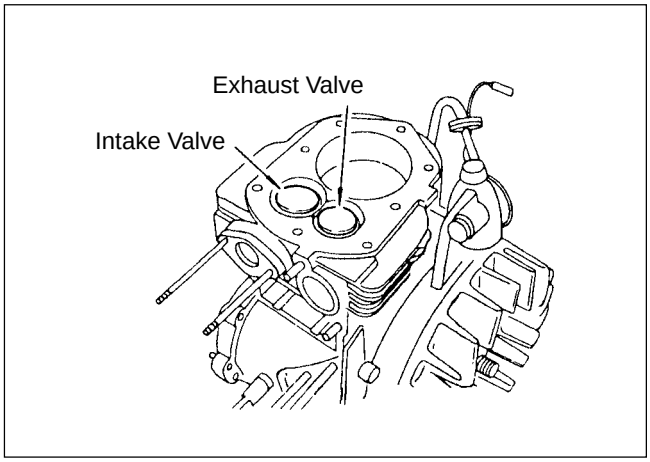


Fig. 4-6

4-7 CYLINDER HEAD

The cylinder head is an aluminum die-casting, and forms a Ricardo type combustion chamber with squish area for high combustion efficiency. The spark plug is tilted for easy mounting of the fuel tank.

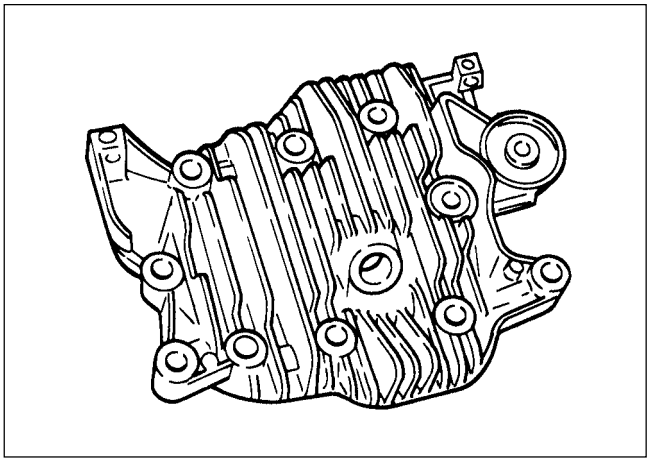


Fig. 4-7

4-8 GOVERNOR SYSTEM

The governor is a centrifugal flyweight type which ensures constant operation at the selected speed during load variations.

The governor gear with governor weights is installed on the main bearing cover.

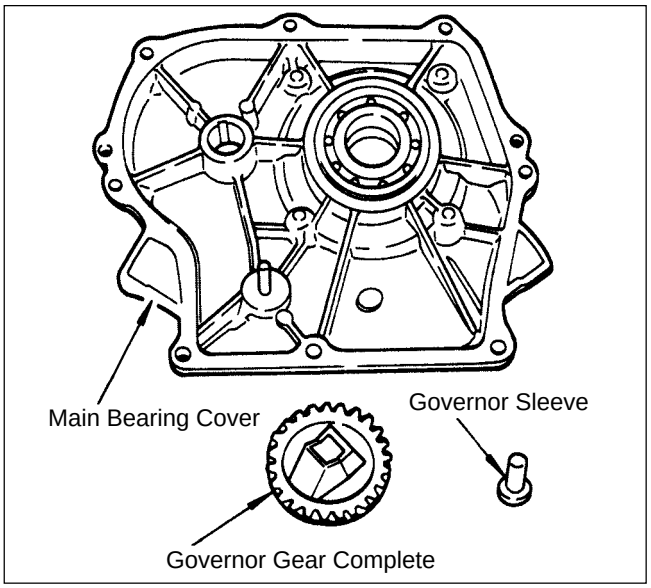


Fig. 4-8

4-9 COOLING SYSTEM

The large fins on the flywheel provide sufficient cooling air capacity for the cylinder and cylinder head. The cylinder baffle and head cover are provided for guiding the cooling air.

4-10 LUBRICATION SYSTEM

All the rotating and sliding parts are splash- lubricated by the oil scraper on the connecting rod.

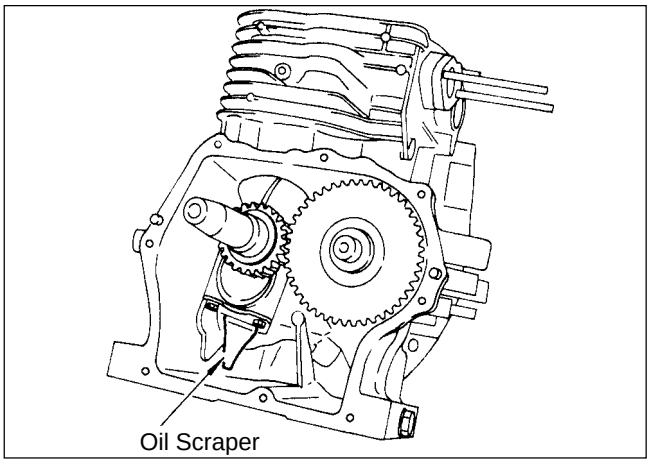


Fig. 4-9

4-11 IGNITION SYSTEM

The ignition system is a transistor controlled magneto system which consists of a flywheel and an ignition coil with a built-in transistor mounted on the crankcase.

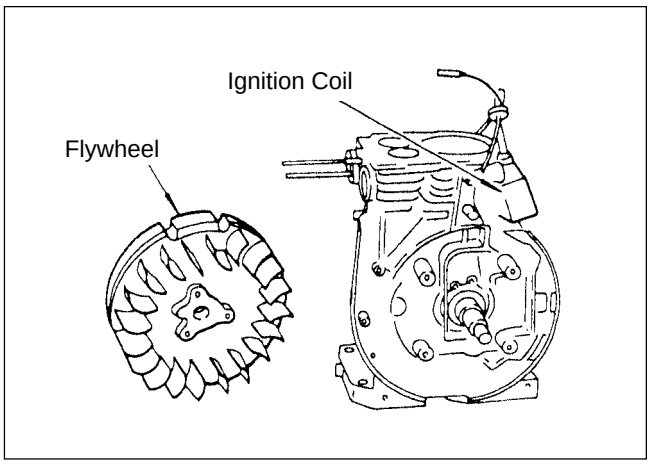


Fig. 4-10

4-12 CARBURETOR

The engine is equipped with a horizontal draft carburetor that has a float controlled fuel system and a fixed main jet.

The carburetors are calibrated carefully for sure starting, good acceleration, less fuel consumption and sufficient output.

For details, refer to page 30, section “7 CARBURETOR”.

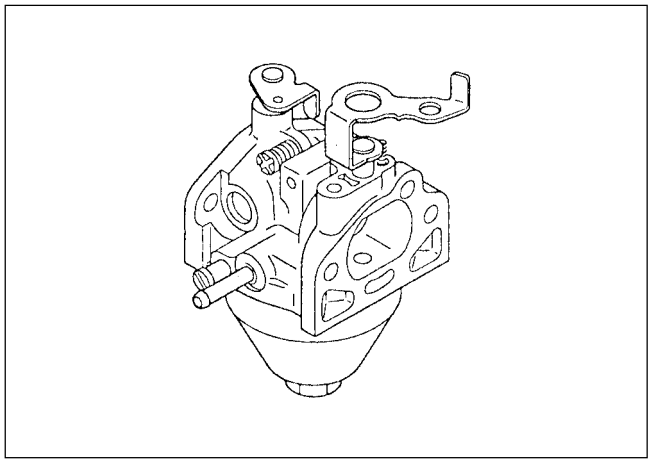


Fig. 4-11

4-13 AIR CLEANER

The air cleaner of the standard engine is an oblong type using an urethane foam(semi-wet).

As optional parts,dual-element type and cyclone chimney type are available.

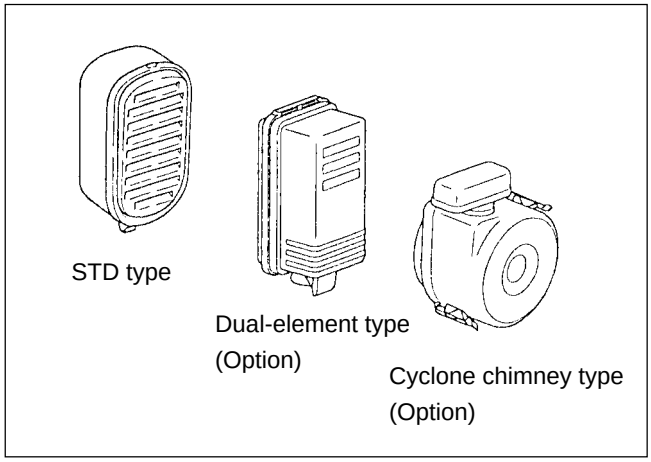


Fig. 4-12

4-14 SECTIONAL VIEW OF ENGINE

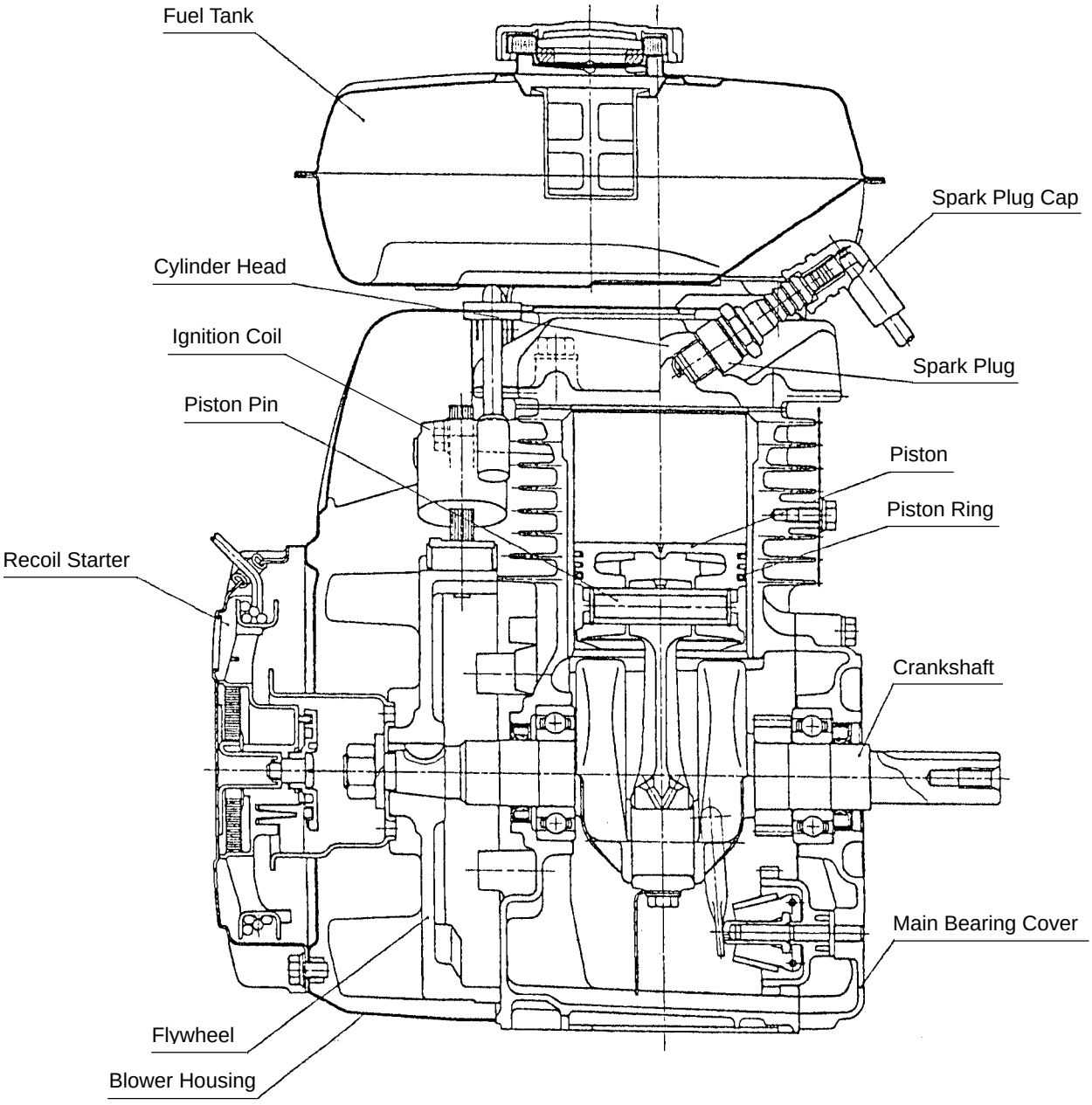


Fig. 4-13

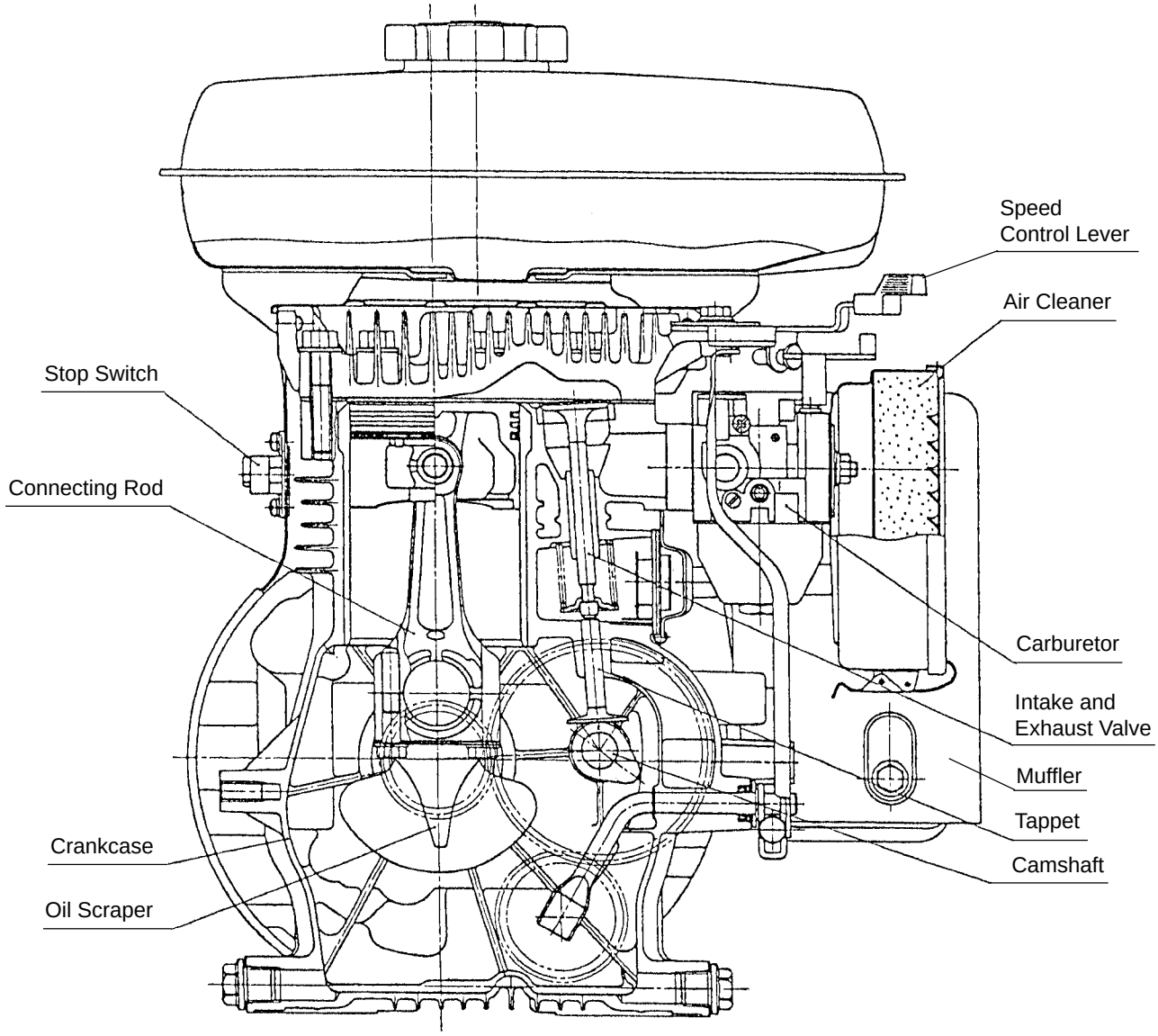

Speed
Control Lever
Air Cleaner
Stop Switch
Connecting Rod
Carburetor
Intake and
Exhaust Valve
Muffler
Tappet
Camshaft
Crankcase
Oil Scraper

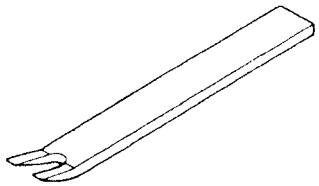
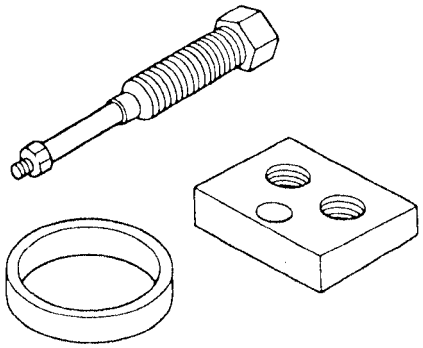
Fig. 4-14

5. DISASSEMBLY AND REASSEMBLY

5-1 PREPARATIONS AND SUGGESTIONS

1) When disassembling the engine, memorize the locations of individual parts so that they can be reassembled correctly. If you are uncertain of identifying some parts, it is suggested that tags be attached to them.
2) Have boxes ready to keep disassembled parts by group.
3) To prevent losing and misplacing, temporarily assemble each group of disassembled parts.
4) Carefully handle disassembled parts, and clean them with washing oil if necessary.
5) Use the correct tools in the correct way.

5-2 SPECIAL TOOLS

Part No.	Tool	Use	Applicable Model	Shape
227-95003-07	Valve Spring Retainer	For mounting Valve Spring Retainer and Retainer Lock	EY10,13,14 EY15,18,20 EY23,25,27 EY28	 *Fig.5-1*
227-95001-07	Valve Guide Puller	For pulling off Valve Guide	EY15,20	 *Fig.5-2*

5-3 DISASSEMBLY PROCEDURES

Step	Parts to remove	Procedures	Remarks	Tool
1	Drain Plug	(1) Drain engine oil. Drain plugs on both sides of the crankcase. M14x12 Bolt	Be careful not to lose the gasket.	14mm Box spanner
2	Recoil Starter	(1) Remove recoil starter. M6 x 8 Flange bolt : 4pcs.		10mm Box spanner

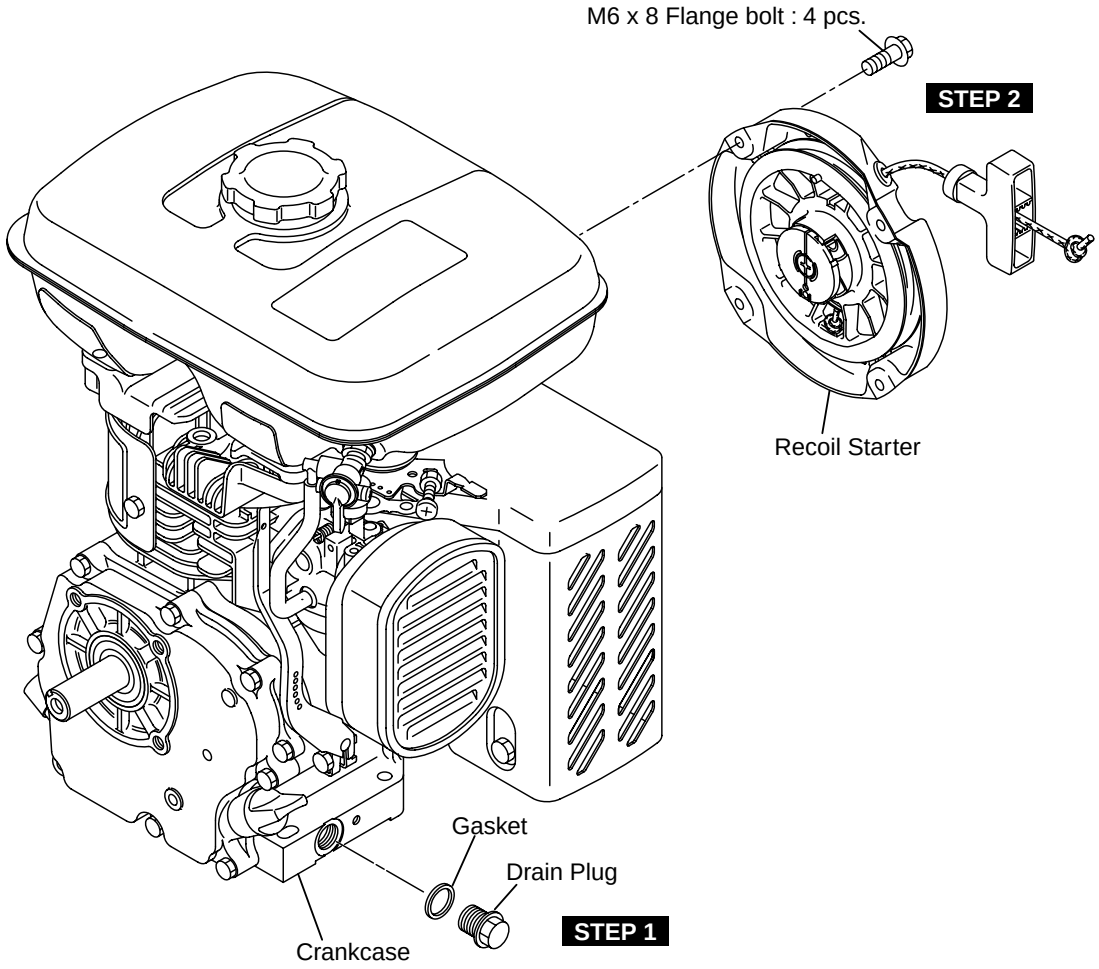


Fig. 5-3

Step	Parts to remove	Procedures	Remarks	Tool
3	Blower Housing	(1) Remove the blower housing from the crankcase and the cylinder head. M6 x 12 Flange bolt : 2 pcs. M6 x 14 Flange bolt : 2 pcs.	Blower housing is fastened together with the fuel tank.	10mm Box spanner
4	Fuel Tank and Head Cover	(1) Close the fuel cock. (2) Disconnect the fuel pipe between the fuel strainer and carburetor from the fuel strainer. (3) Remove the fuel tank from the cylinder head. M6 Nut : 2 pcs. (4) Remove the head cover from the cylinder head.		10mm Box spanner or 10mm Spanner
5	Air Cleaner	(1) Remove the air cleaner cover and element. (2) Remove the air cleaner case from the carburetor. M6 Nut : 2 pcs. (3) Disconnect the breather pipe.	Air cleaner case is fastened together with the carburetor.	10mm Box spanner
6	Muffler Cover	(1) Remove the muffler cover from the muffler. M6 x 8 Flange bolt : 3 pcs.		10mm Box spanner
7	Muffler	(1) Remove the muffler from the cylinder portion of the crankcase. M8 Nut : 2 pcs.		12mm Spanner

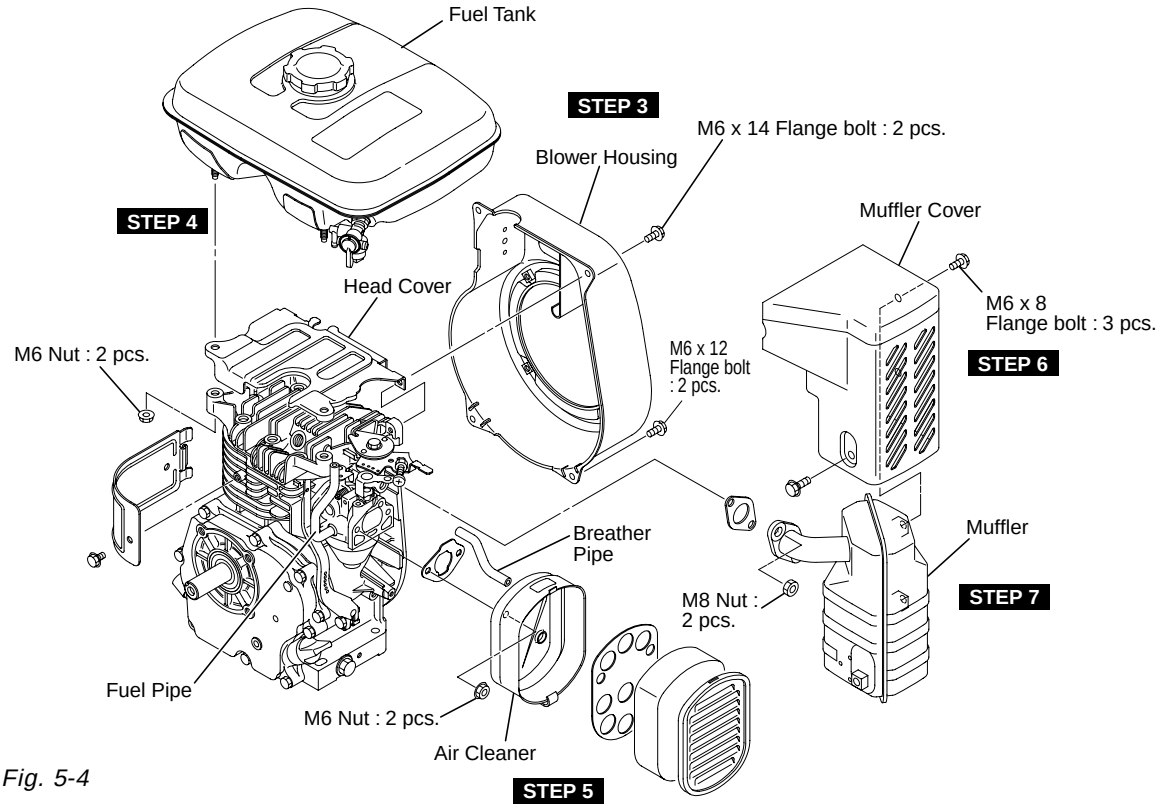


Fig. 5-4

Step	Parts to remove	Procedures	Remarks	Tool
8	Governor Lever and the relative parts	(1) Loosen the bolt and remove the governor lever from the governor shaft. M6 x 25 Bolt : 1 pc. (2) Remove the governor rod and rod spring from the carburetor.	Just loosen the bolt, unnecessary to take out the bolt.	10mm Box spanner or 10mm Spanner
9	Carburetor	(1) Remove the carburetor from the cylinder portion of the crankcase.		

STEP 8

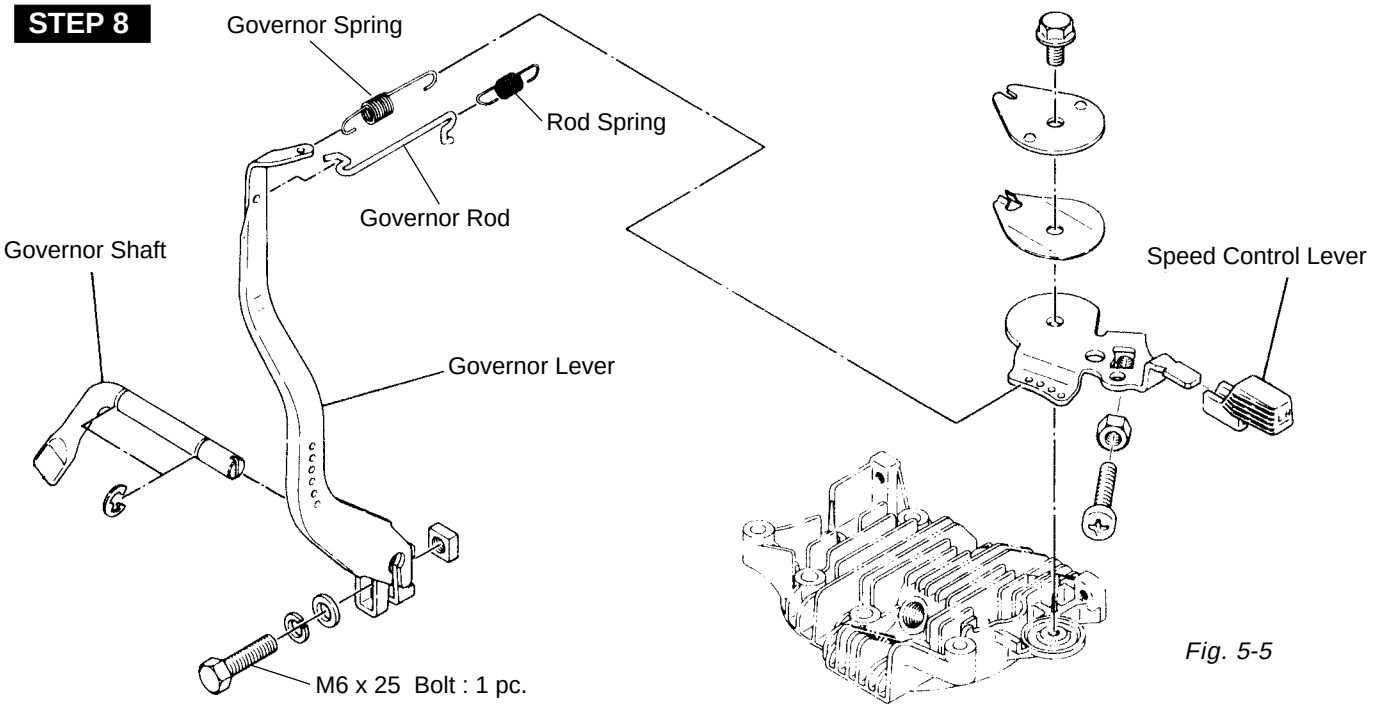


Fig. 5-5

STEP 9

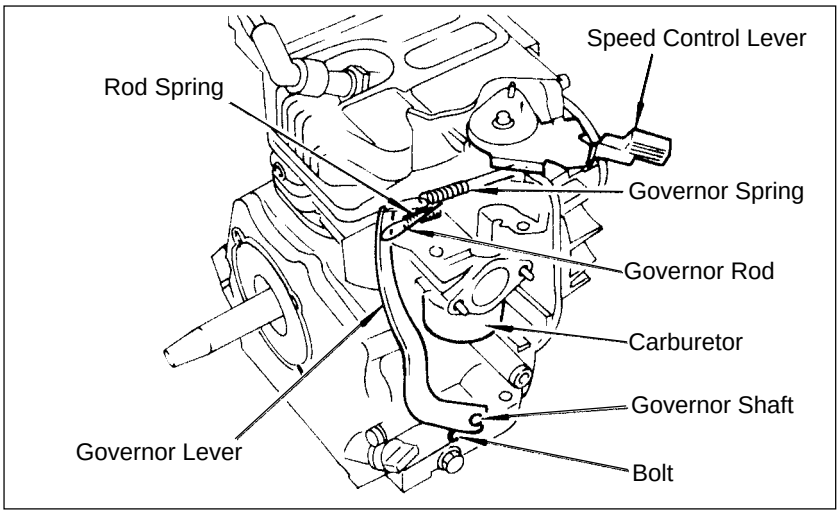


Fig. 5-6

Step	Parts to remove	Procedures	Remarks	Tool
10	Ignition Coil	(1) Remove the spark plug cap from the spark plug , and remove the ignition coil from the crankcase. M6 x 25 Bolt : 2 pcs.	Sems bolt	10mm Box spanner
11	Starting Pulley	(1) Remove the starting pulley from the flywheel. M14 Nut : 1 pc. Fit a box or socket wrench over the flywheel nut, and strike it hard with a hammer to remove the nut (14mm) and spring washer.	Be careful not to damage the blades of the flywheel with a driver and a like. Strike counterclockwise with a hammer.	19mm Box spanner or Socket wrench
12	Flywheel	(1) Temporally assemble the fixing nut to the crankshaft thread until the end face. (2) Tap the fixing nut with a Plastic hammer to remove the flywheel.	(1) Do not tap directly with a steel hammer. (2) Be careful not to damage the thread portion when using a steel hammer. Tap the fixing nut after inserting aluminum bar between the fixing nut and a steel hammer.	

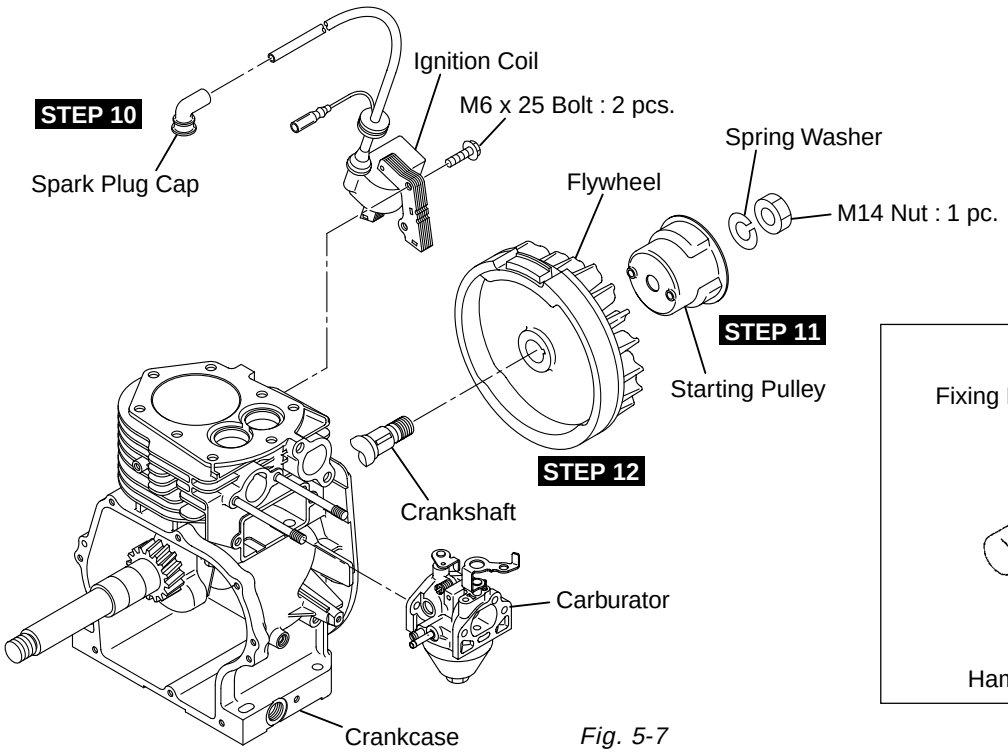


Fig. 5-7

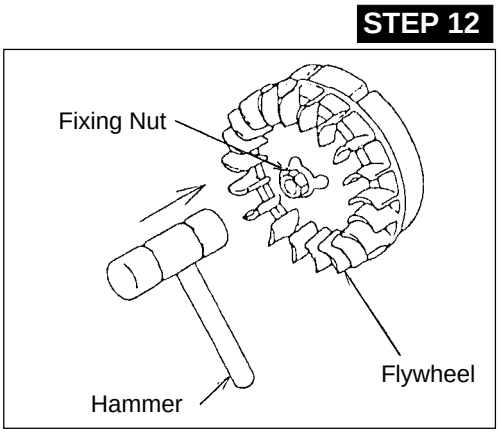
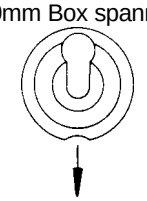


Fig. 5-8

Step	Parts to remove	Procedures	Remarks	Tool
13	Spark Plug	(1) Remove the spark plug from the cylinder head.		21mm Box spanner
14	Cylinder Head	(1) Remove the 8mm bolt and remove the cylinder head from the crankcase. M8 x 40 Bolt : 8 pcs. (2) Remove the cylinder head gasket from the crankcase.		12mm Box spanner
15	Intake and Exhaust Valve	(1) Remove the tappet cover and the breather plate from the crankcase. M6 x 12 Bolt : 2 pcs. (2) Pull out the intake and exhaust valve. (3) Remove the valve spring and the valve retainer.	Put the notch on the outer circumference of the spring retainer on this side. Hook the medium size (-) driver at the dent (lower side) of the spring retainer and pull out the valves, while pulling the spring retainer toward you.	10mm Box spanner  The front is this side. (-) Driver
16	Main Bearing Cover	(1) Remove the fixing bolt of the main bearing cover from the crankcase. M6 x 30 Bolt : 8 pcs. (2) Remove the cover, lightly tapping the cover evenly with a plastic hammer.	Be careful not to damage the oil seal.	10mm Box spanner

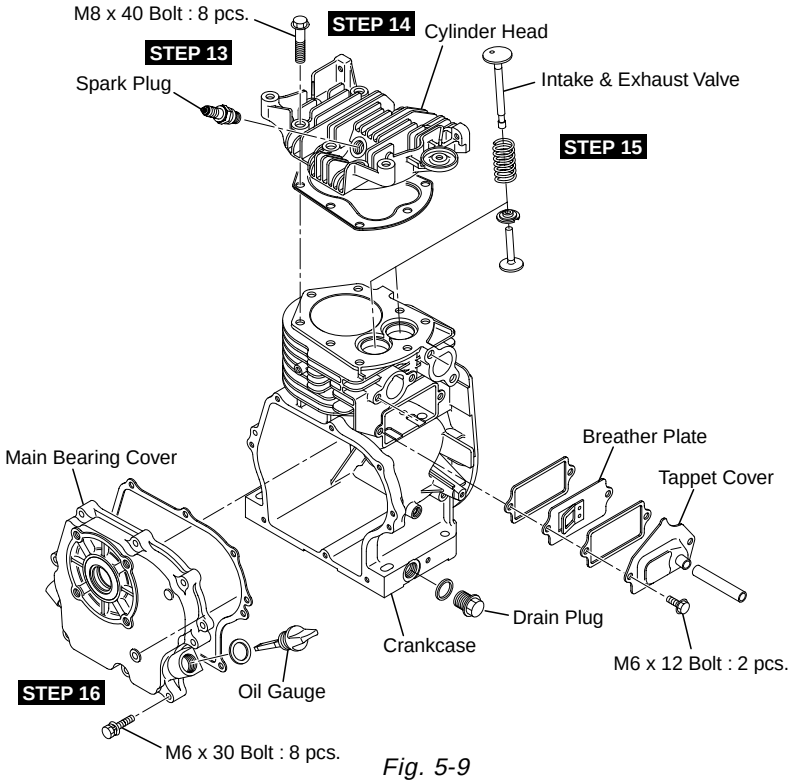


Fig. 5-9

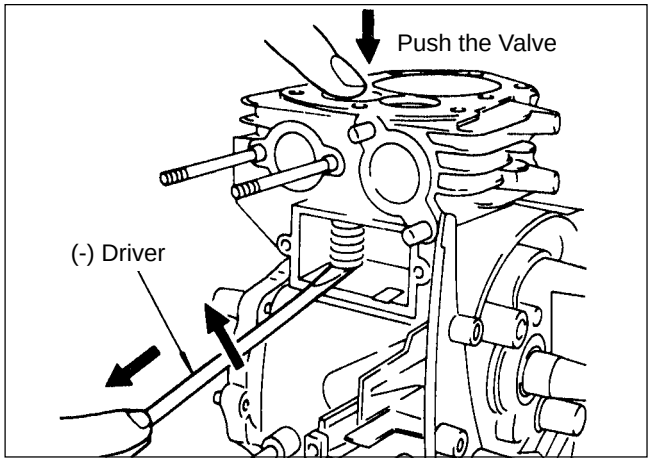


Fig. 5-10

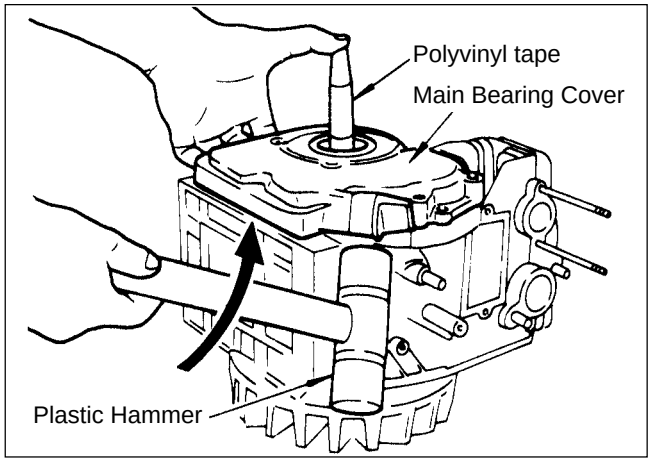


Fig. 5-11

Step	Parts to remove	Procedures	Remarks	Tool
17	Camshaft	(1) Remove the camshaft from the crankcase.	To prevent the tappets from falling or damaging, put the crankcase to the flywheel side down.	
18	Tappet	(1) Remove the tappets from the crankcase.	Before removing, put a mark of intake or exhaust on each tappet.	

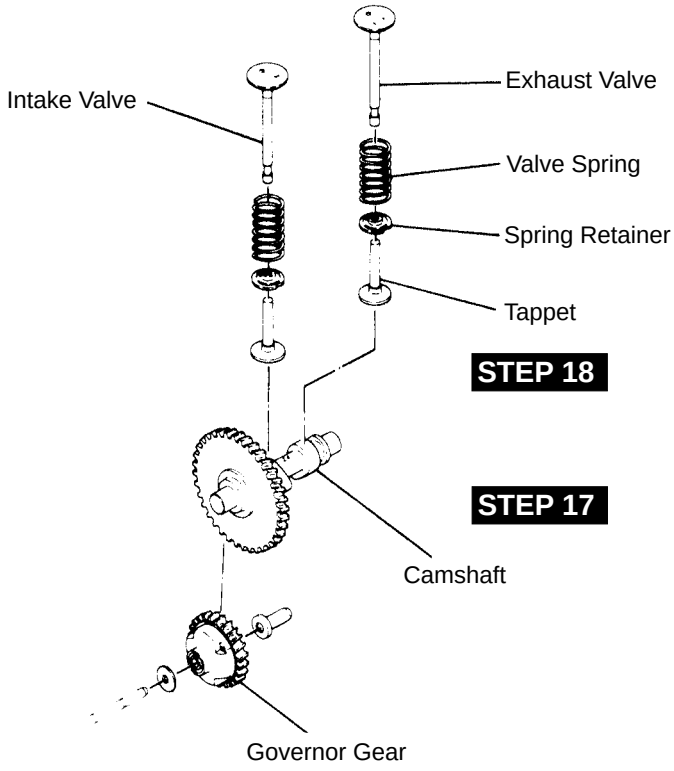


Fig. 5-12

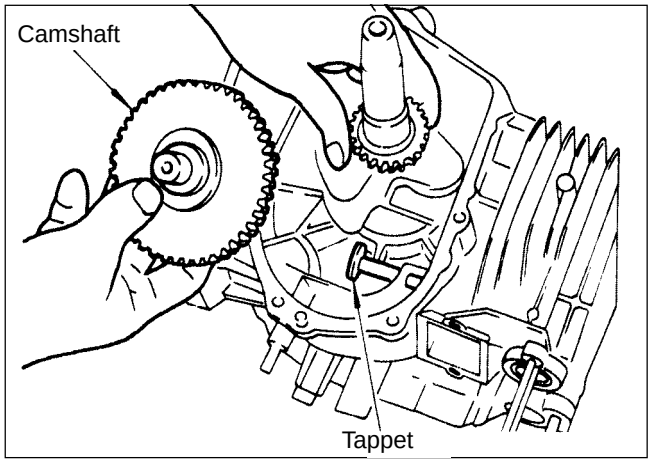


Fig. 5-13

Step	Parts to remove	Procedures	Remarks	Tool
19	Connecting Rod and Piston	(1) Scrape off carbon and other foreign deposits from the upper parts of the cylinder and piston, and then remove two pieces of connecting rod bolt. (2) Remove the oil scraper and connecting rod cap from the crankshaft. (3) Turn the crankshaft until the piston comes to top dead center,and push out connecting rod and piston assembly from the top of cylinder.		10mm Box spanner or 10mm Spanner
20	Piston and Ring	(1) Remove the two clips, pull out the piston pin, and take the piston off from the small end of the connecting rod. (2) Spread the open ends of the piston rings and remove them from the piston.	Be careful not to break the rings by spreading too much.	
21	Crankshaft	(1) Remove the woodruff key (for the magneto). (2) Tap lightly on the flywheel end of crankshaft with a soft hammer to remove it from crankcase.	Be careful not to damage the oil seal.	

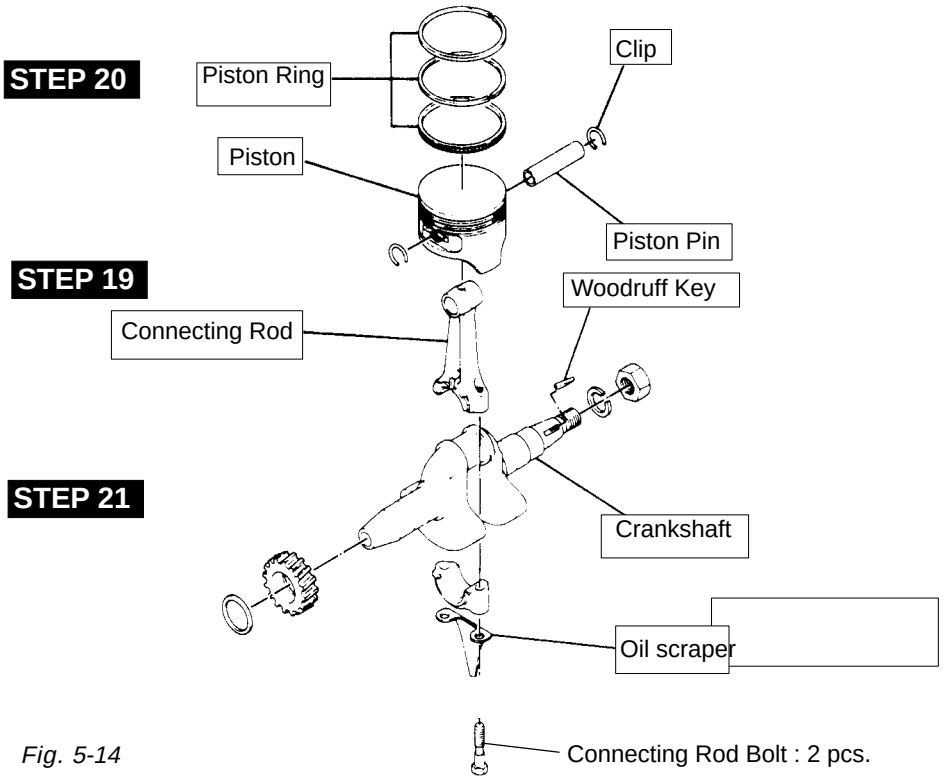


Fig. 5-14

5-4 REASSEMBLY PROCEDURES

● PRECAUTIONS FOR REASSEMBLY

1) Clean parts thoroughly before reassembly.

   Pay most attention to cleanliness of piston, cylinder, crankshaft, connecting rod and bearings.

2) Scrape off all carbon deposits from cylinder head, piston top and piston ring grooves.

3) Check lip of oil seals. Replace oil seal if the lip is damaged. Apply oil to the lip before reassembly.

4) If the gasket is stuck on the mounting surface, remove it carefully by taking care not to damage the surface.

5) Replace all the gaskets with new ones.

6) Replace keys, pins, bolts, nuts, etc., if necessary.

7) Torque bolts and nuts to specification refer to the "TORQUE SPECIFICATIONS" (See page 56).

8) Apply oil to rotating and sliding portions.

9) Check and adjust clearances and end plays where specified in this manual.

10) When the main parts are assembled, check the movement and sound by rotating it manually.

5-4-1 CRANKSHAFT

(1) Insert crankshaft in ball bearing of crankcase wrapping the key-way with polyvinyl tape to avoid damage to oil seal.

(2) Install woodruff key for flywheel on crankshaft.

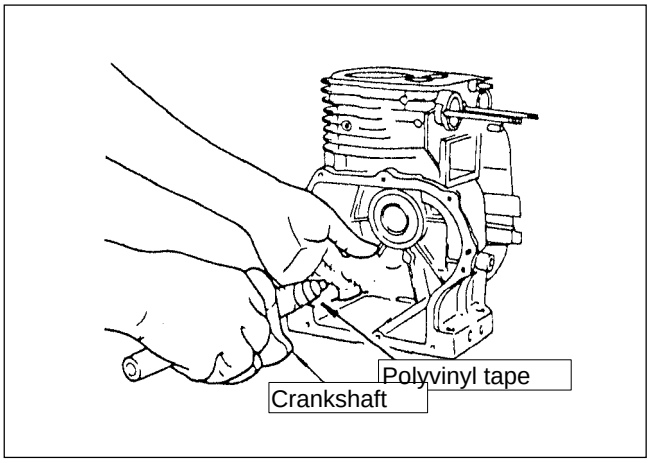


Fig. 5-15

5-4-2 PISTON AND PISTON RINGS

1) If no ring expander is available, install the ring by placing the open end over the first land of the piston, and spreading the ring only far enough to slip it over the correct ring groove.

   NOTE : Pay attention not to break the rings by twisting. Install the oil ring first followed by the second ring and then top ring. The surfaces of the second ring and the top ring with marks are to be faced up.

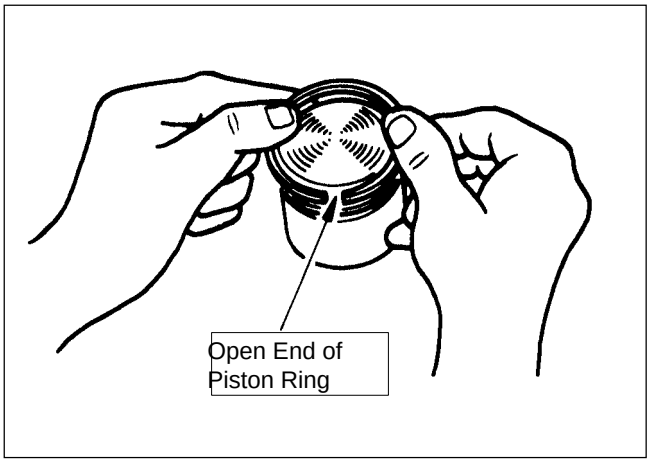
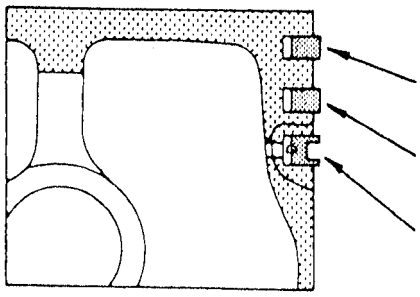


Fig. 5-17



	EY15-3	EY20-3
Top Ring	Barrel Face 	Taper and Inner bevel 
Second Ring	Taper Under Cut 	
Oil Ring	Cutter Ring with Coil Expander 	

Table. 1

2) Reassemble the piston and connecting rod with the piston pin.

NOTE :Apply enough oil to the small end of the connecting rod. Be sure to place the clips on both sides of the piston pin.

3) When installing the connecting rod assembly into the cylinder, hold piston rings with the ring guide as shown in Fig.5-18 (if no ring guide is available, keep pressing the piston rings with finger tips and gently strike the top of the piston with a plastic hummer or the like to push it in), and check that the symbol ❼ or mark MAG on the connecting rod is to face the flywheel magneto side.

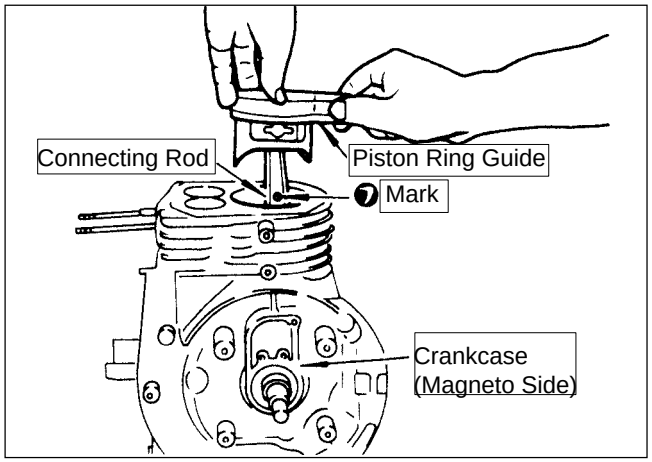


Fig. 5-18

NOTE : Apply enough oil to the piston rings, connecting rod plain bearings and cylinder bore before assembly.

NOTE : The open ends of the piston rings must be 90 ° apart from each other before assembly.

5-4-3 CONNECTING ROD

1) Turn the crankshaft to the bottom dead center, lightly tap the piston head until the large end of connecting rod contacts the crankpin.

2) When reassembling the connecting rod cap, match the alignment projection mark on the rod.

3) Oil scraper is to be set on the magneto side.

NOTE : After reassembly, confirm that the connecting rod moves lightly.

NOTE : Connecting rod cap tightening torque :

EY15-3	EY20-3
9-11.5N·m (90-115kg·cm) (6.5-8.3ft·lb)	17-22N·m (170-200kg·cm) (12.3-14.5ft·lb)

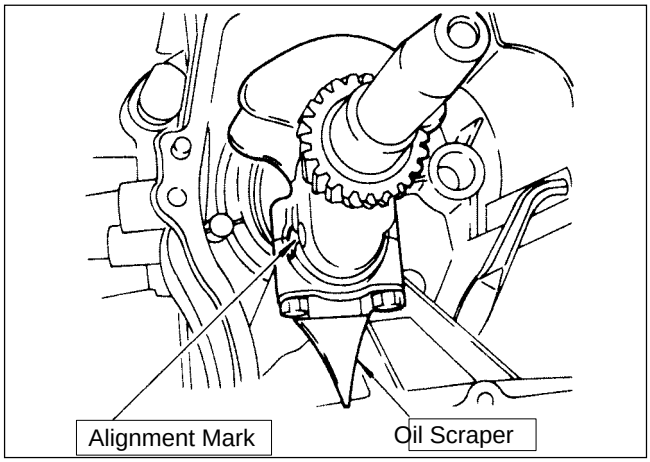


Fig. 5-19

5-4-4 TAPPET AND CAMSHAFT

Insert the tappets into the crankcase holes first, and then mount the camshaft.

NOTE : Align the timing mark on the root of the cam gear with the one on the crank gear. If the valve timing is wrong, the engine cannot operate properly or at all.

NOTE : If the intake tappet and exhaust tappet were assembled opposite each other, the tappet clearance cannot be kept correctly.

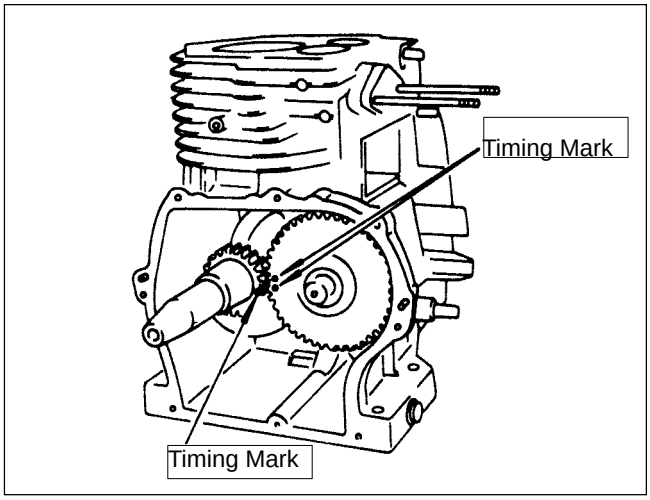


Fig. 5-20

5-4-5 MAIN BEARING COVER

Install the main bearing cover to the crankcase.

NOTE: As the governor gear is mounted on the main bearing cover side, install the main bearing cover with checking that the governor gear meshes with the cam gear. (See Fig.5-21&22.) If the oil seal needs to be replaced, press-fit a new oil seal before installing the main bearing cover.

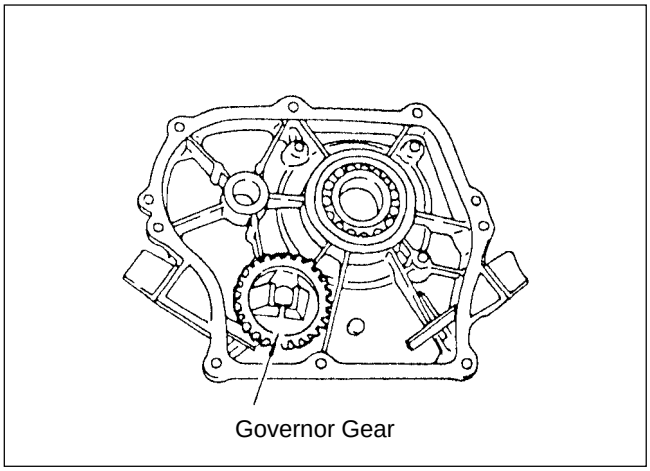


Fig. 5-21

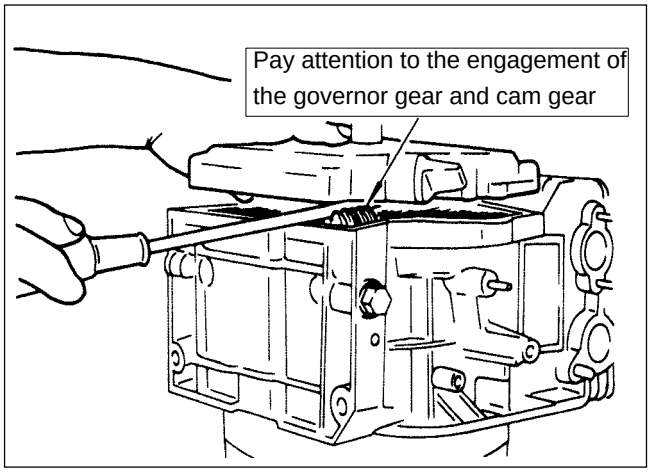


Fig. 5-22

NOTE: When installing the main bearing cover, apply oil to the bearing and oil seal lip. Wrap the keyway of crankshaft with polyvinyl tape to avoid damage to the oil seal lip. Then place the main bearing cover on.

Check that the crankshaft side clearance is 0～0.2mm; and if not, adjust it with the adjusting shims.

Main Bearing Cover Tightening torque
8-10N•m (80-100kg•cm) (5.8-7.2ft•lb)

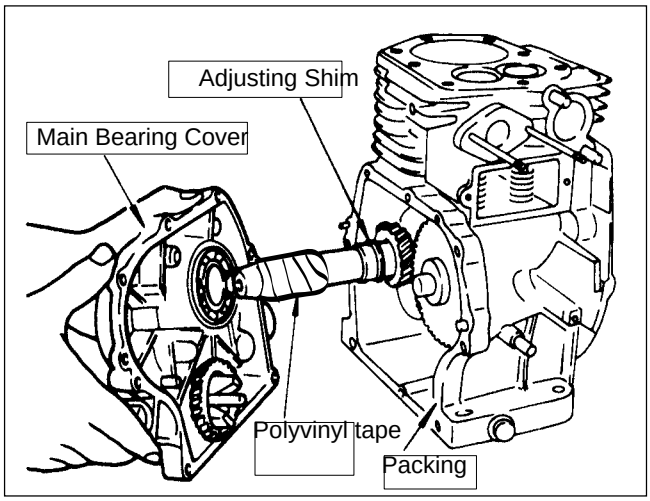


Fig. 5-23

NOTE: Fig 5-24 shows one of the methods measuring the crankshaft side clearance between the machined face of the crankcase and shims. As a paper packing is used on the machined face of the crankcase, adjust the clearance by taking this thickness of 0.22mm into account.

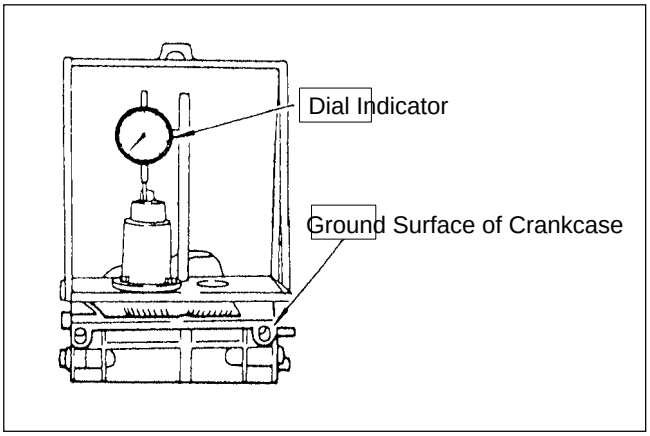


Fig. 5-24

5-4-6 INTAKE AND EXHAUST VALVES

Remove carbon and gum deposite from the valves, valve seats, intake and exhaust ports and valve guides.

NOTE: If the valve face is dinted or warped, replace the valve with new one.

NOTE: If there is an excessive clearance between the valve guide and valve stem, replace the valve guide with a spare. For replacing, pull out the valve guide, using the valve guide puller as shown in Fig. 5-26, and press fit a new valve guide into place.

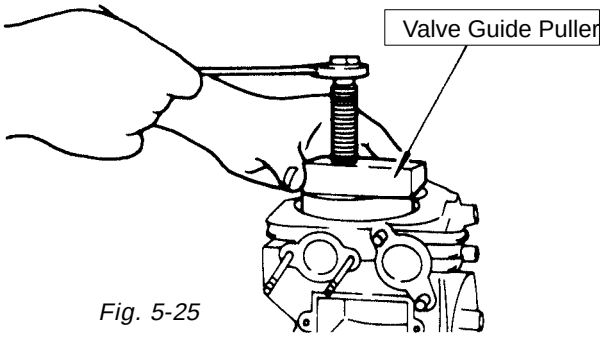


Fig. 5-25

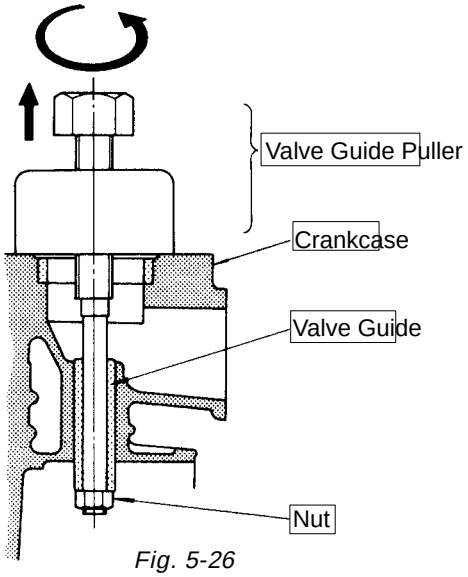


Fig. 5-26

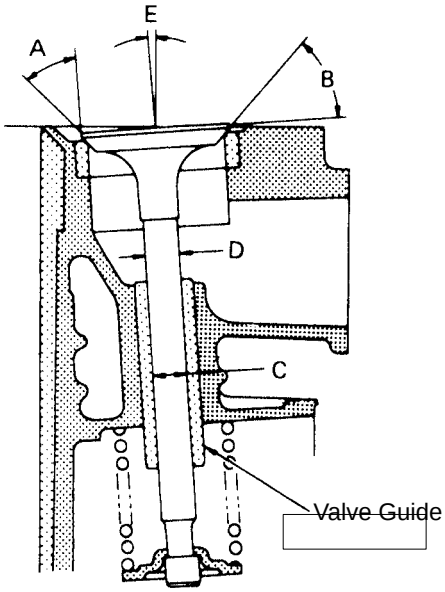


Fig. 5-27

		EY15-3 EY20-3
A-VALVE FACE ANGLE		45°
B-SEAT ANGLE		45°
C-GUIDE INSIDE DIA.		6.5 dia. +0.022 0
D-VALVE STEM OUTSIDE DIA.	INTAKE	6.5 dia. -0.025 -0.040
	EXHAUST	6.5 dia. -0.056 -0.078
MAXIMUM ALLOWABLE CLEARANCE BETWEEN C and D	INTAKE	0.025L ~ 0.062L
	EXHAUST	0.056L ~ 0.100L
E-VALVE STEM TILT ANGLE		3° 53"

Table. 2

L : LOOSE

5-4-7 TAPEET ADJUSTMENT

Lower the tappet all the way down, push the valve, and insert a thickness gauge between the valve and tappet stem to measure the clearance. (See Fig.5-28.)

NOTE: The correct tappet clearance for both intake and exhaust valves is 0.1mm ±0.02mm when the engine is cold.

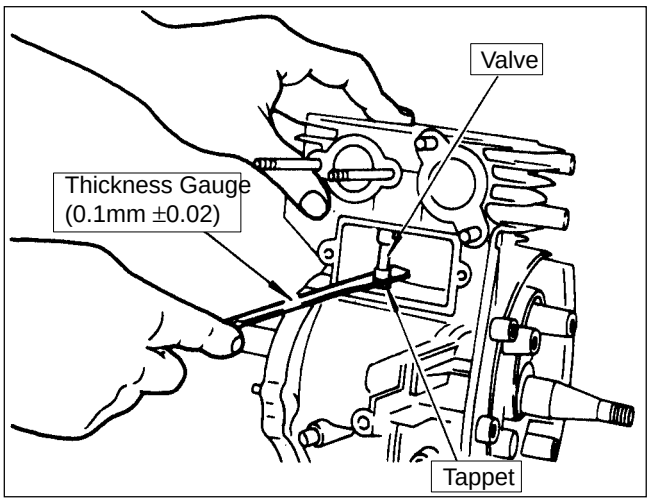


Fig. 5-28

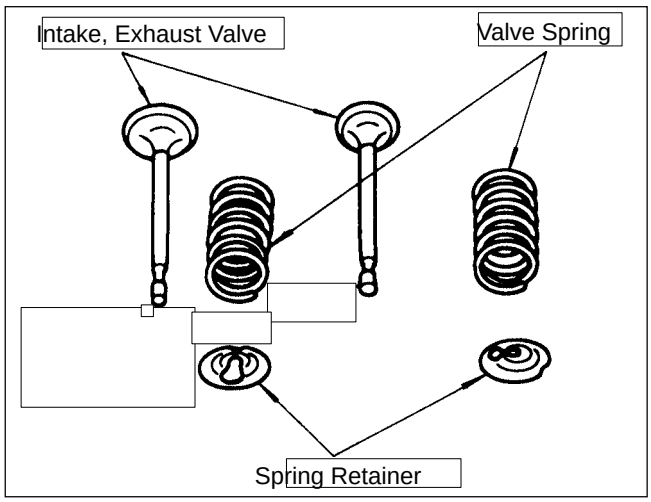


Fig. 5-29

NOTE: If the clearance is smaller than specified, slightly grind the top of the valve stem, and measure it again. On the contrary if the clearance is too large, replace the valve with new one, and polish its contact surface with a compound to obtain a good fit. Then adjust the clearance.

NOTE: After the tappet clearance adjustment, install the valve springs and spring retainers, and turn the crankshaft, and measure the tappet clearance once again if it is correct.

NOTE: INSTALLATION of SPRING RETAINERS

Place the notch on the outer circumference of the spring retainer toward this side and insert the retainer, like pushing in, using a special tool. (Valve Spring Retainer)

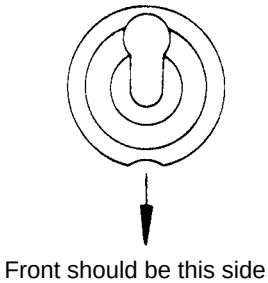


Fig. 5-30

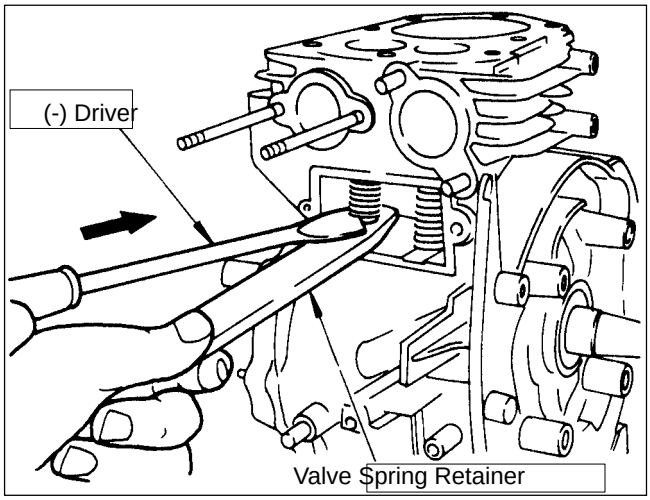


Fig. 5-31

5-4-8 CYLINDER HEAD

Remove carbon from the cylinder head, particularly its combustion chamber, and clean the cooling fins. Also check the head surface for flatness.

If the gasket is stuck on the upper surface of crankcase and on the cylinder head, separate it carefully by taking care not to damage the mating surface.

NOTE: Replace the cylinder head gasket with a new one.

NOTE: DISTINGTION between the GASKET of EY 15-3 and EY20-3

The pitch of the mounting holes and the outer circumference dimensions of the gasket for EY15-3 and EY20-3 are same. However, the inner dimensions are different each other.

Furthermore, the marking is provided at the position shown below for identification.

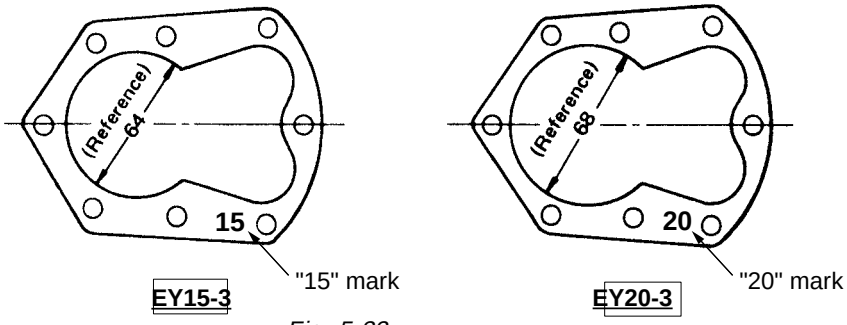


Fig. 5-32

With 8 pieces of 8mm bolt fasten the cylinder head.

Cylinder Head Tightening torque
22-26N•m
(220-260kg•cm)
(15.9-18.8ft•lb)

NOTE: DISCRIMINATION of CYLINDER HEAD

As stated above, the pitch of the holes of cylinder head is common to both EY15-3 and EY20-3. For enabling to discriminate the cylinder head of EY15-3 from that of EY20-3, an embossed mark 15 is given to the EY15-3 cylinder head, while no embossed mark is given to the EY20-3 cylinder head.

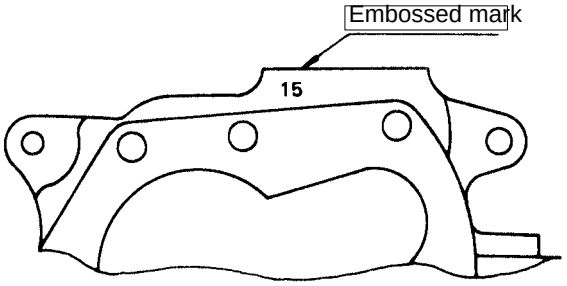


Fig. 5-33

NOTE: Embossed mark for

EY15-3 Kerosene engine is 15-K, and

EY20-3 Kerosene engine is 20-K.

5-4-9 SPARK PLUG

Install spark plug to cylinder head.

Spark plug : NGK B6HS or BR6HS

NEW SPARK PLUG	RETAIGHTENING
12-15N•m (120-150kg•cm) (8.7-10.8ft•lb)	23-27N•m (230-270kg•cm) (16.6-19.5ft•lb)

5-4-10 IGNITION COIL, FLYWHEEL AND STARTER PLLEY

Fit the flywheel on to the crankshaft.
Also, fasten the starter pulley together with the flywheel.

NOTE: Before installing, wipe out oil from the crankshaft and the tapered portion of the flywheel.

Flywheel Tightening torque
60-65N•m
(600-650kg•cm)
(43.4-47.0ft•lb)

Fasten the ignition coil to the crankcase temporarily and adjust air gap between the ignition coil and the flywheel, then fasten the ignition coil tightly.

Air gap: 0.3 ~ 0.5mm

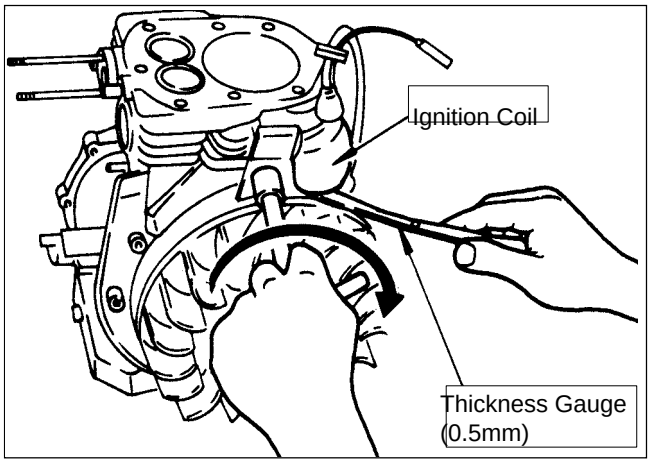


Fig. 5-34

5-4-11 CARBURETOR

To the cylinder portion of the crankcase, install the gasket, insulator, gasket and carburetor in order, and then mount the air cleaner case and fasten them with two pieces of 6mm nut.

5-4-12 GOVERNOR LEVER

When reassembling, refer to the 6. GOVERNOR ADJUSTMENT.

5-4-13 MUFFLER AND MUFFLER COVER

If the muffler gasket is stuck to the crankcase and to the muffler flange surface, remove it carefully by taking care not to damage the surfaces.

Be sure to replace the muffler gasket with a new gasket.

Install the muffler to the cylinder with 2 pieces of stainless steel nuts, then mount the muffler cover.

5-4-14 HEAD COVER, FUEL TANK AND BLOWER HOUSING

Install the head cover, fuel tank and blower housing in order.

NOTE: If these parts are installed in the order of the head cover, blower housing and fuel tank, removal of the blower housing would be impossible.

5-4-15 RECOIL STARTER

Fasten the recoil starter with 4 pieces of M6 x 8 mm bolt.

NOTE: It is feared that the bolt longer than 8mm may damage the blades.

Install the plastic recoil for the pump specification of model EY15-3 with 4 pieces of M6 x 12 mm bolt.

5-5 BRAKE-IN OPERATION OF REASSEMBLED ENGINE

An overhauled engine must be operated at low speed to break-in the parts. A thorough break-in is indispensable particularly when the cylinder, piston, piston rings or valves are replaced with new ones.

The recommended break-in schedule is shown below.

Step	Load		Engine Speed	Time
Step 1	No Load		2,500rpm	10min.
Step 2	No Load		3,000rpm	10min.
Step 3	No Load		3,600rpm	10min.
Step 4	EY15-3	1.0kW(1.35HP)	3,600rpm	30min.
	EY20-3	1.3kW(1.75HP)		
Step 5	EY15-3	2.0kW(2.7HP)	3,600rpm	60min.
	EY20-3	2.6kW(3.5HP)		

Table. 3

6. GOVERNER ADJUSTMENT

Models EY15-3 and EY20-3 employ a centrifugal flyweight type governor. The governor is mounted on the governor gear and the throttle valve of the carburetor is automatically regulated by a lever which is connected to the governor in order to maintain constant engine speed against load variations.
The adjustment procedure of the governor is as follows (See Figs. 6-1 and 6-2.):

1) Connect the carburetor throttle lever to the governor lever with the governor rod and rod spring, and mount the governor lever onto the governor shaft.
2) Install the speed control lever to the cylinder head.
3) Connect the governor lever to the speed control lever with the governor spring.

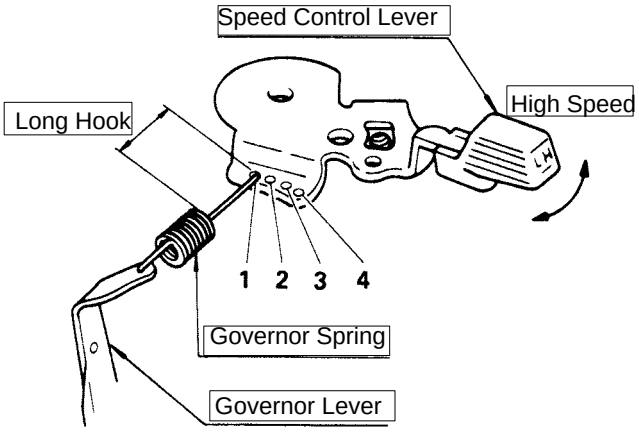


Fig. 6-3

*The hole where the governor spring is to be hooked :

For EY15-3 the governor spring is to be hooked to the hole 1, while it is to be hooked to the hole 2 for EY20-3.

4) Turn the speed control lever towards high speed, and confirm that the carburetor throttle valve is fully opened.
5) Insert a (–) screwdriver in the groove of the governor shaft, turn it clockwise fully until the governor shaft no longer moves, and then lock the governor lever to the governor shaft with the governor lever tightening bolt.
(See Fig.6-4)

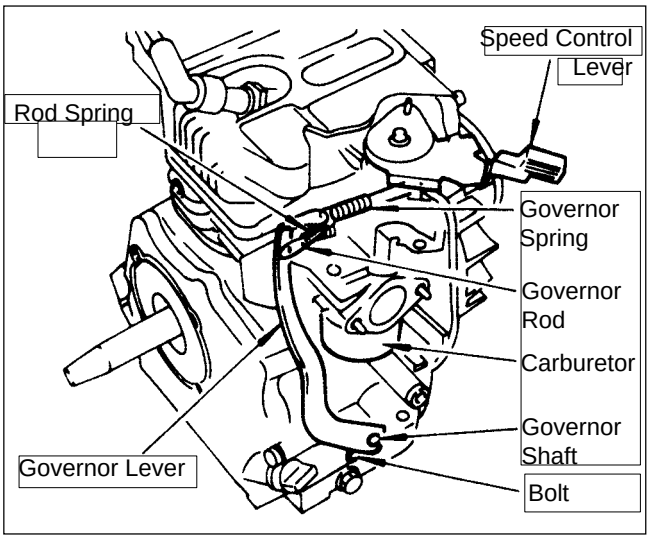


Fig. 6-1

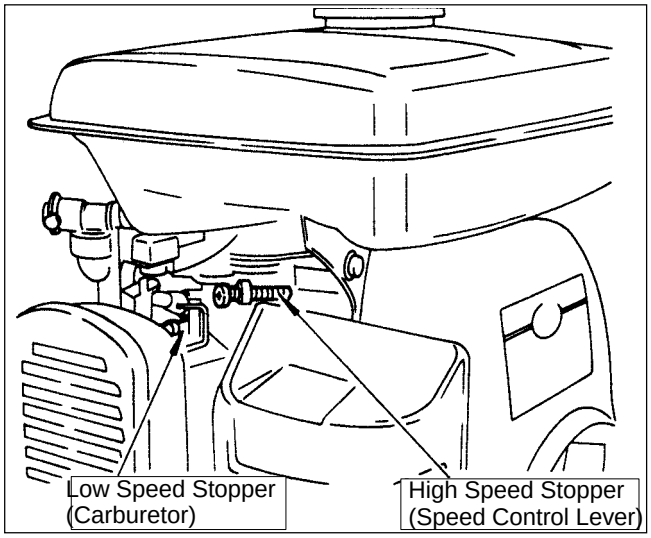


Fig. 6-2

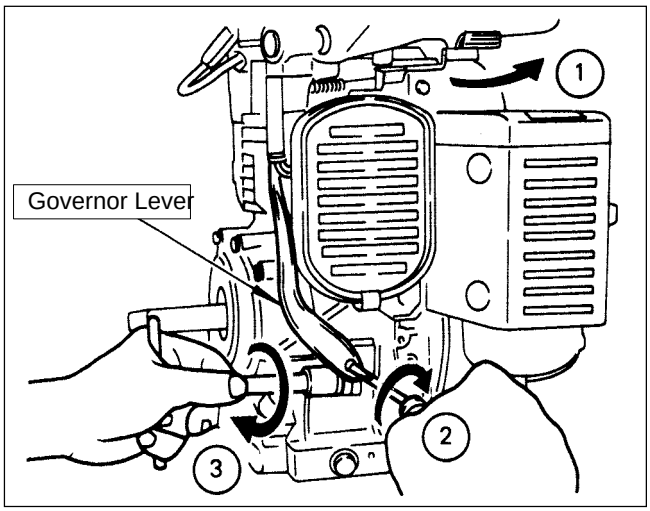


Fig. 6-4

*Dimensions of the governor spring for the engine to be connected to the generator:

The dimensions of the governor spring to be used are different each other according to the Hz. The governor spring for the standard engine is same as that for the engine to be connected to the 60Hz generator.

Discrimination according to the dimensions:

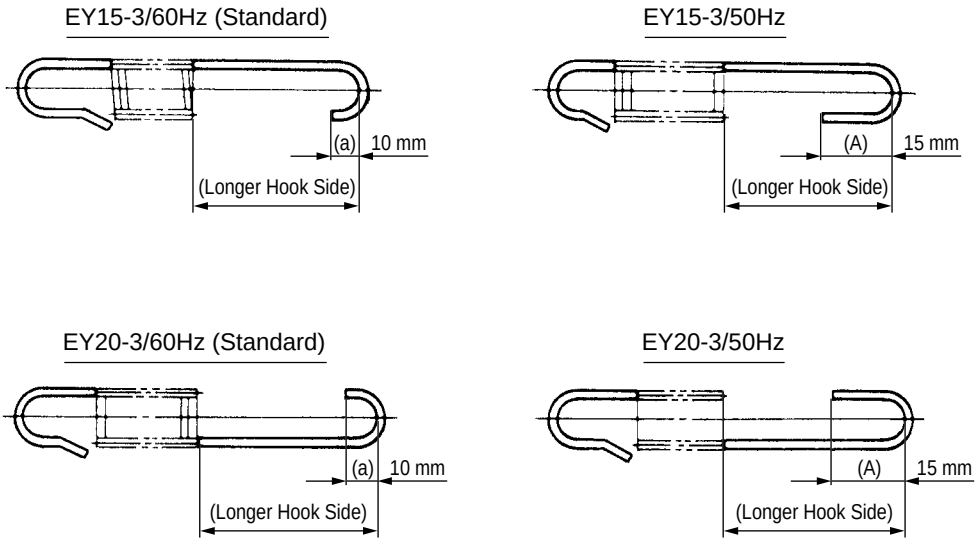


Fig. 6-5

*For EY15-3 and EY20-3, the governor spring longer in the length of (A) is for 50 Hz.
*Both ends of the spring for EY15-3 are bended to the same direction, while both ends of the spring for EY20-3 are bended to contrary directions.

7. CARBURETOR

7-1 OPERATION AND CONSTRUCTION (See Fig.7-1)

7-1-1 FLOAT SYSTEM

The float chamber is located just below the carburetor body, and the float (F) and the float valve (F.V) maintain a constant fuel level during engine operation.

The fuel flows from the fuel tank into the float chamber through the float valve. When the fuel rises to a specific level, the float (F) rises; and when its buoyancy and fuel pressure are balanced, the float valve (F.V) close to shut off the fuel, thereby keeping the fuel at the reference level.

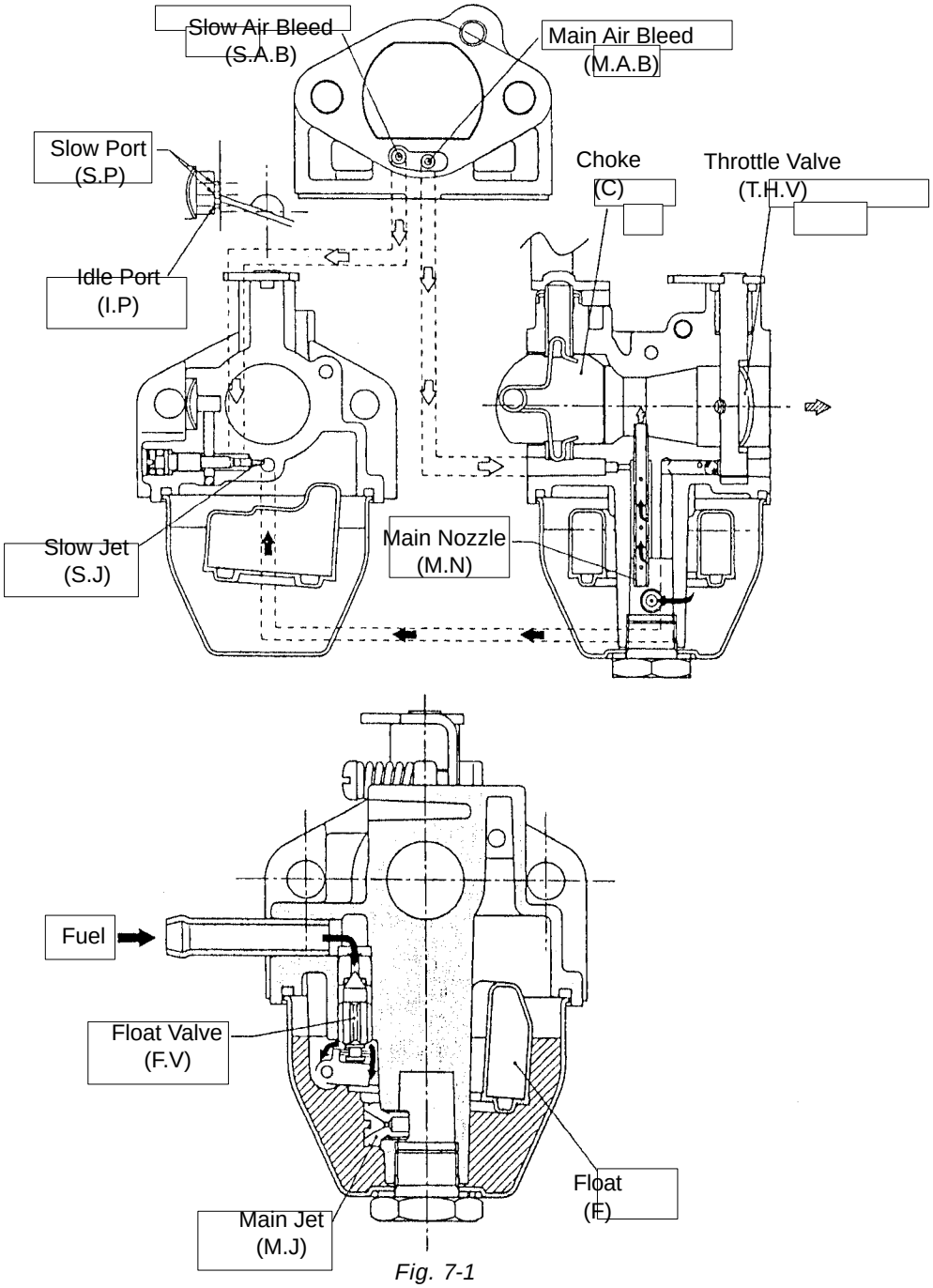


Fig. 7-1

7-1-2 SLOW SYSTEM

The pilot system feeds the fuel to the engine during idling and low-speed operation.

The fuel is fed through the main jet (M.J) to the slow jet (S.J), where it is metered, and mixed with the air metered by the slow air bleed (S.A.B).

The fuel-air mixture is fed to the engine through the idle port (I.P) and slow port(S.P).

During engine idling, the fuel is mainly fed from the idle port (I.P).

7-1-3 MAIN SYSTEM

The main system feeds the fuel to the engine during medium and high-speed operation.

The fuel is metered by the main jet (M.J) and fed to the main nozzle (M.N). The air metered by the main air bleed (M.A.B) is mixed with the fuel through the bleed holes in the main nozzle (M.N), and the mixture is atomized out of the main bore. It is mixed again with the air taken through the air cleaner into an optimum fuel-air mixture, which is supplied to the engine.

7-1-4 CHOKE

The choke (C) is used for easy start in the cold season. When the recoil starter is pulled with a closed choke (C), the negative pressure applied to the main nozzle increases and draws much fuel accordingly; thus easily start up the engine.

7-2 DISASSEMBLY AND REASSEMBLY (See Fig.7-2)

Apart from mechanical failures, most of carburetor troubles are caused by an incorrect mixing ratio, which may arise mainly due to a clogged up air or fuel passage in jets, or fuel level variations. In order to assure proper flow of air and fuel, the carburetor must be kept clean at all times. The carburetor disassembly and reassembly procedures are as follows.

7-2-1 THROTTLE SYSTEM

(1) Remove the Philips screw (-2) and throttle valve (-1), and pull out the throttle shaft (-11).

When reassemble the throttle valve, apply a screw-lock agent to philips screw and tighten it with a tightening torque of 0.39~1.47 N • m (4~15 kg•cm) (0.3~1.1ft•lb).

(2) The spring (-41) can be taken out by removing the throttle stop screw (-40).

*Exercise care not to damage throttle valve edge.

7-2-2 CHOKE SYSTEM

(1) Remove the clip (-4) and choke valve (-3), and pull out the choke shaft (-8).

(2) When mounting the choke valve, mark sure that the cutout of the choke valve locates on the right side when viewed from the outside.

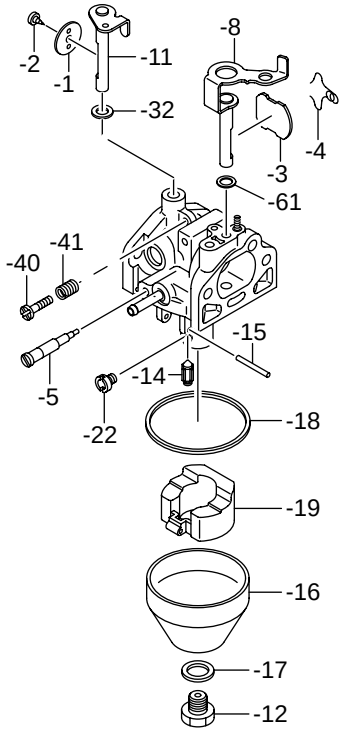


Fig. 7-2

7-2-3 SLOW SYSTEM

(1) Remove the slow jet (-5), using correct tool to avoid damage to it.

(2) When fitting the slow jet, screw it in fully and turn it back, accurately by the rotation specified in the table of correction standards.

7-2-4 MAIN SYSTEM

(1) Remove the bolt (-12) and take out float chamber body (-16).

(2) Remove the main jet (-22) from the body.

(3) Fasten the main jet securely to the body. Otherwise, the fuel may become too rich and cause engine malfunction.

Main jet Tightening torque
0.98-2.94N•m (10-30kg•cm) (0.7-2.1ft•lb)

(4)

Bolt(-12) Tightening torque
7.85-11.77N•m (80-120kg•cm) (5.8-8.7ft•lb)

7-2-5 FLOAT SYSTEM

(1) Pull out the float pin (-15) and remove the float (-19) and float valve (-14).

CAUTION :

When cleaning the jets, use neither a drill nor a wire (because of possible damage of the orifice which will adversely affect fuel flow). Be sure to use compressed air to blow them clean.

NOTE ; Check that the gasket (float chamber) is correctly fitted before mounting the float chamber body.

8. MAGNETO

8-1 FEATURES

Ignition system of the model EY15-3 and EY20-3 is a maintenance-free electronic pointless magneto system.

The electronic circuit is based on the cut off of the electric current by power transistor, and employs U.T.C.I. (Universal Transistor Control Ignition) circuit which always controls the ignition voltage to maximum.

Thanks to the U.T.C.I., the ignition performance is always stable against environmental changes such as temperature, etc..

8-2 BASIC PRINCIPLE OF U.T.C.I.

ROBIN electronic ignition system consists of the ignition coil with built-in U.T.C.I. circuit and the flywheel magnet.

(1) When the flywheel rotates and the magnet passes the ignition coil, magnetic flux changes to induce voltage across the primary ignition coil.

Resultant electric current in the primary coil is switched by power transistor in the circuit.

(2) When the flywheel rotates further to the ignition timing, ignition timing detection circuit is activated to turn on the thyristor which cut off the current to the power transistor suddenly.

The U.T.C.I. controls to cut off the current induced in the primary always at around the maximum level.

(3) Sudden cut off of primary current induces a high voltage across the secondary coil to spark the spark plug.

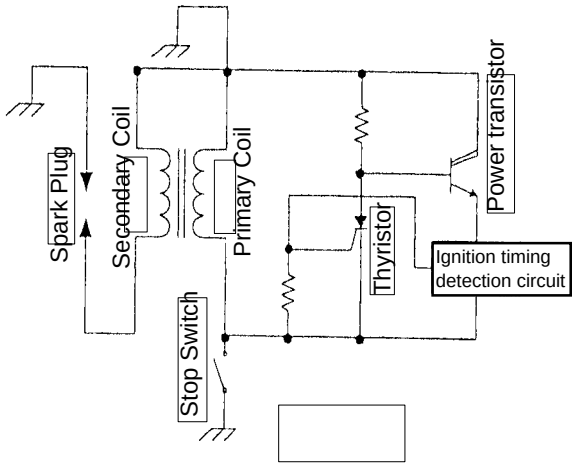


Fig. 8-1

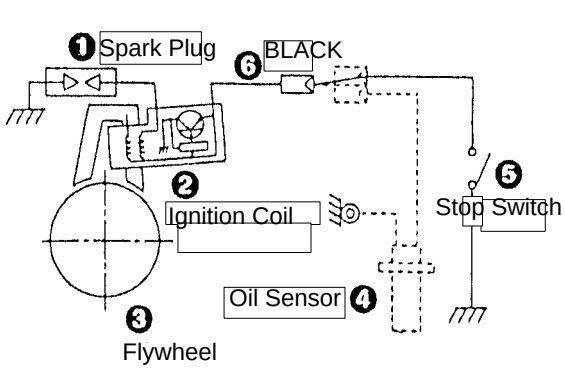


Fig. 8-2

8-3 MAGNETO TROUBLESHOOTING

When the engine does not start or starts with difficulty, or when its operation is unstable, the following checks will clarify if they are caused by a defect of the magneto.

(1) Check ignition cable for possible damage, worn insulator or loose connection.

(2) Check the spark.

1) Remove the spark plug from the cylinder head and connect the spark plug to the plug cap, then ground it to the cylinder head or the like (The correct gap of electrodes is 0.6 ~ 0.7mm).

2) Pull the recoil starter to rotate the flywheel to check the spark of the spark plug and spark intensity (disconnect primary wiring at the connector before the test).

3) If no spark is found between the plug electrodes, remove both the plug and the plug cap and place the tip of ignition (high voltage) cable a few mm away from the cylinder head to check the spark from the cable tip when the recoil starter is pulled.

9. OIL LEVEL SENSOR (OPTION)

9-1 FUNCTION

When the oil level sensor detects the insufficient level of engine oil, it halts engine for warning and protection of engine.

9-2 PRINCIPLE

(1) Though it is very little, engine oil has electrical conductivity, while air is completely nonconductive. Utilizing this difference, presence of oil is identified by the current between electrodes of the sensor.

(2) On the basis of this principle the sensing elements are merely fixed electrodes without mobile part, hence, it is possible to conduct reliable measurement without influence of vibration. And it is also shockresistant and free of deterioration.

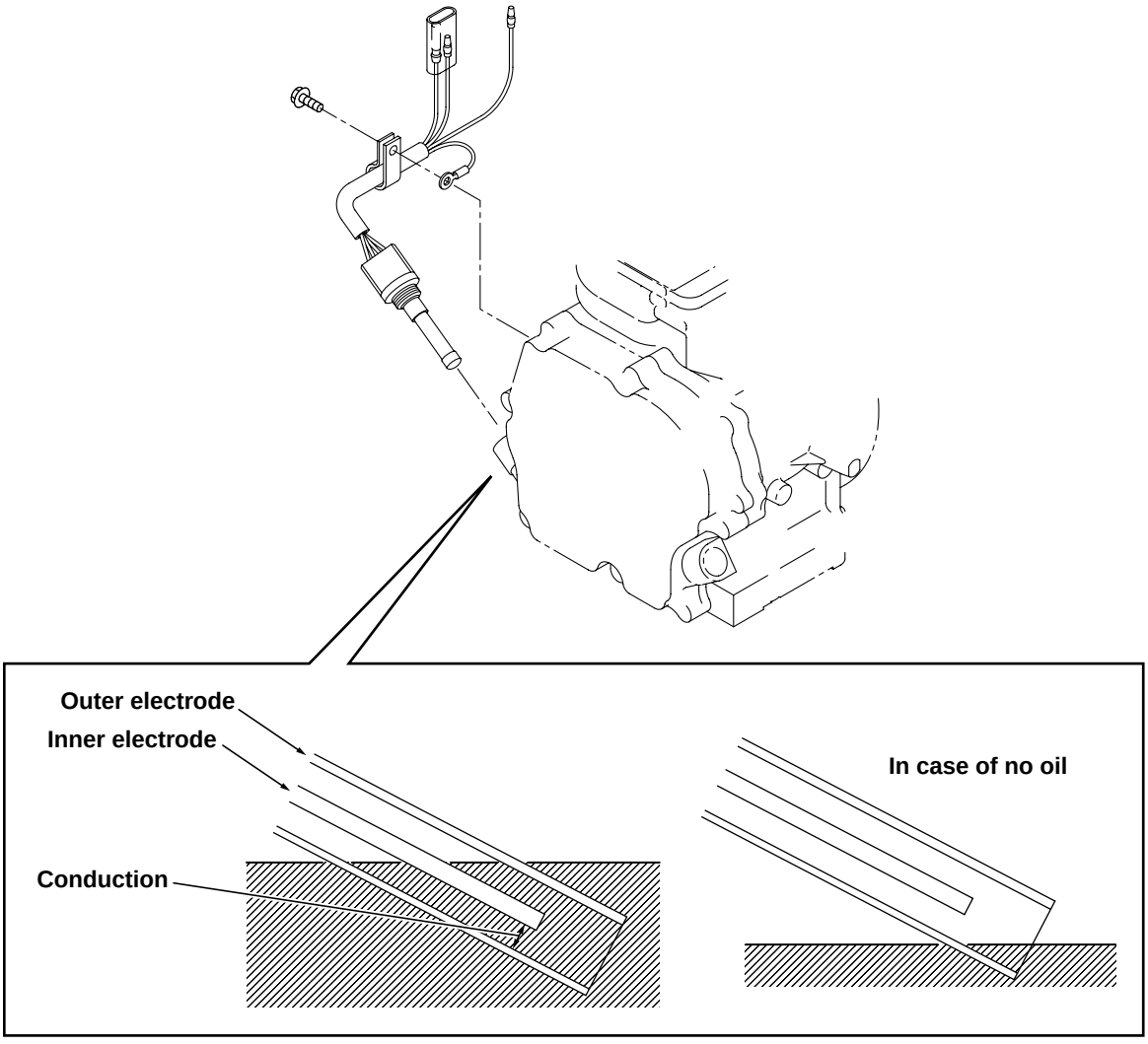


Fig. 9-1

10. RECOIL STARTER

10-1 RECOIL STARTER (STEEL)

Tools to be prepared: Driver, Pinchers (Pliers) and Protective Glasses

WARNING

Before starting the disassembly, make sure to wear the protective glasses.

10-1-1 DISASSEMBLY STEPS

(1) Relieve the spring power

-1: Hold the starter knob and extract the starter rope.

-2: Extract the rope fully and hold the rope so that the knot of the rope in the reel makes a straight line with the rope guide.

-3: Hold the reel with the thumbs of both hands firmly so that the rope will not be wound back. (Fig.10-1)

-4: Pull out the knot of the rope out of the reel, and unfasten the knot and pull it out toward the starter knob. (2 people required)

-5: By controlling the reel with the thumbs of both hands, unwind the reel gently until the rotation of the reel stops.

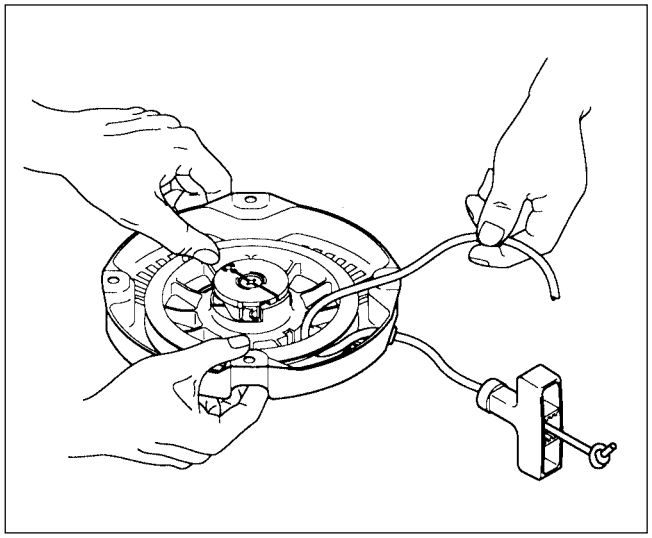


Fig. 10-1

WARNING

The spring power is at its maximum when the rope is fully extracted. Do not put off your hand nor loosen the pressure of your finger suddenly.

(2) Remove the component parts (Fig.10-2)

-1: Loosen the set-screw.

-2: Remove the set-screw, the latchet guide, the friction spring and the latchet.

(3) Remove the reel (Fig.10-2)

-1: Hold the reel lightly so that it will not float. Move the reel clockwise and counter-clockwise about a quarter circle for several times until it moves smoothly.

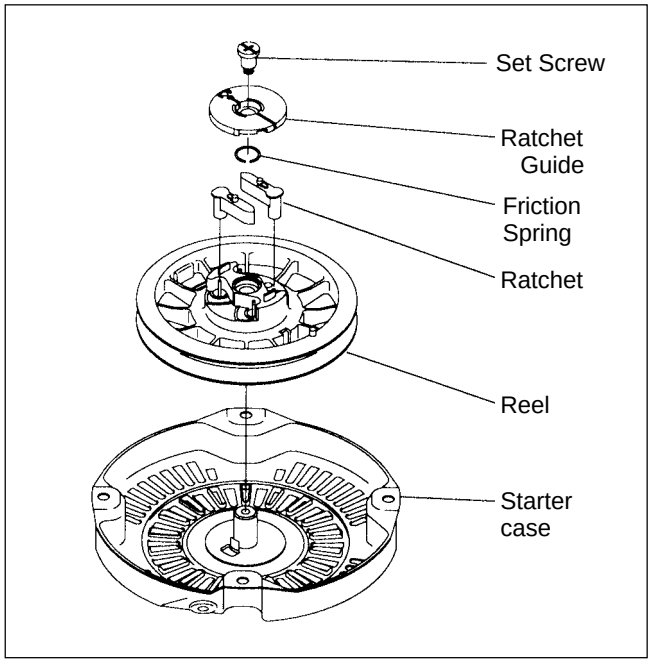


Fig. 10-2

-2: Hold up the reel gradually and slowly and remove it from the case.

-3: If the spring in the reel likes to jump out, redo the steps of (3)-1 and (3)-2 again.

WARNING

Do not drop nor shake the reel. Put it on a level table because the spring is set in the disassembled reel.

Disassembly is completed.

WARNING

Before starting the assembly, make sure to wear the protective glasses.

10-1-2 ASSEMBLY STEPS

(1) Setting the reel into the case.

-1: Apply grease to the case. (Fig.10-3)

-2: Adjust the position of the inner end of the spring, which is set in the reel. (Fig.10-3)

-3: Hold the reel so that the hook and the inner end of the spring are hooked together. Set the reel gently from the above into the case.

-4: Move the reel slightly counter-clockwise and make sure the spring is hooked.

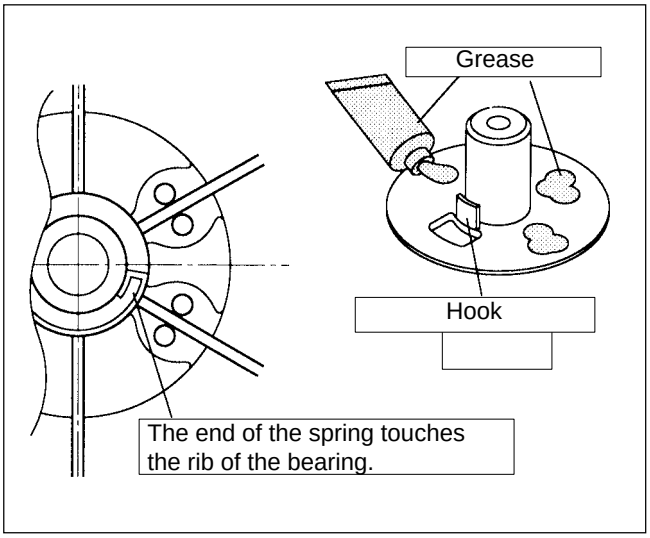


Fig. 10-3

(2) Assemble the component parts.

-1: Set the latchet into the reel. (Fig.10-4)

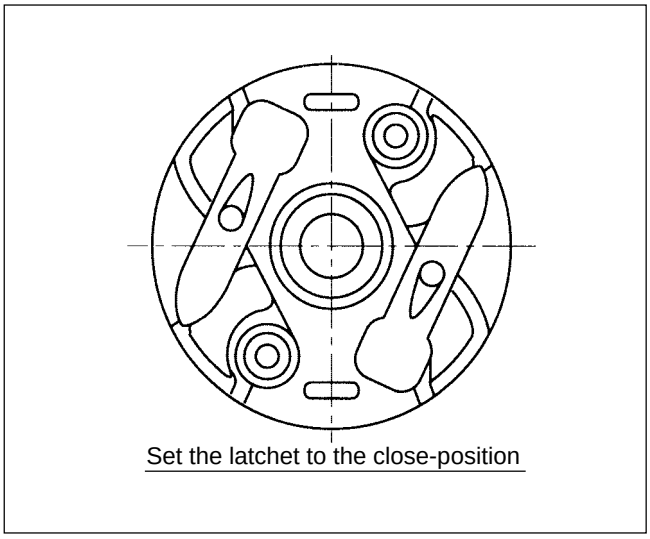


Fig. 10-4

-2: Holding the latchet position, mount the latchet-guide sub-assembly. (Fig.10-5)

(3) Tightening the set-screw.

-1: Push the latchet-guide lightly by hand so that the latchet guide won't move and tighten the set-screw.

(4) Storing the spring-power.

-1: Hold the case tightly and wind up the reel counter-clockwise 6 times by both hands.

-2: Hold the reel at the position where the rope hole of the reel and the rope guide make a straight line. (Fig.10-6)

WARNING

The spring power is at its maximum when the reel is being wound. Do not put off your hand nor loosen the pressure of your finger unintentionally.

(5) Setting the rope. (2 people required)

-1: Pass the rope end through the rope guide and the rope hole of the reel and pull the end about 20cm out of the reel. (Fig.10-6)

-2: Fasten the rope end. (Fig.10-7)

-3: Put the rope end into the reel, whereby make sure that the rope end will not float. (Fig.10-8)

-4: Hold the rope firmly with the hand at the position about 50 cm from the rope guide and keep the rope slightly pull so that the rope will not be wound in.

-5: Release the hand of the reel gently and wind the rope slowly by the winding power of the spring until the knob reaches the rope guide.

Assembly is completed.

*The disassembly and the reassembly have been completed, however carry out the following to check if the necessary components have surely been assembled.

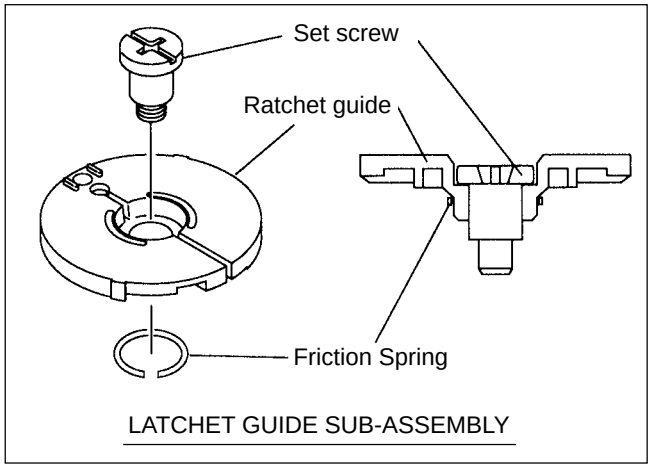


Fig. 10-5

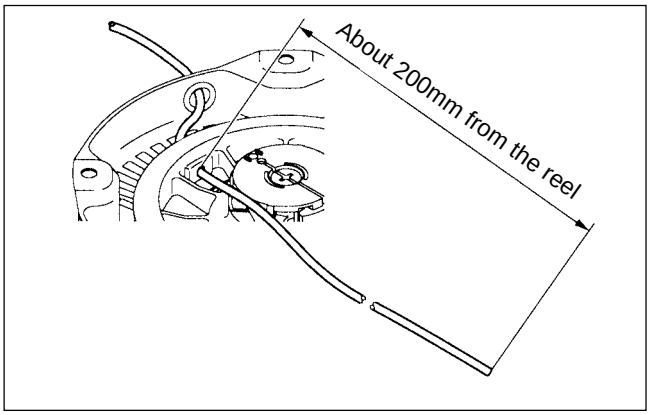


Fig. 10-6

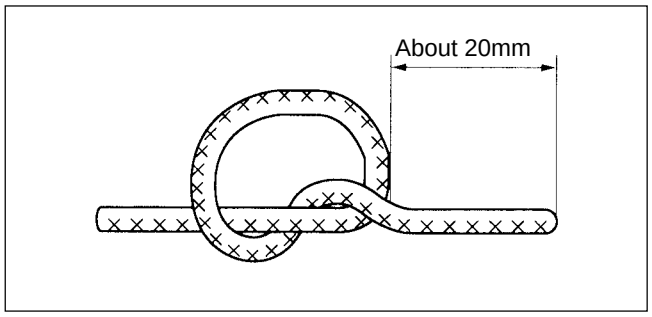


Fig. 10-7

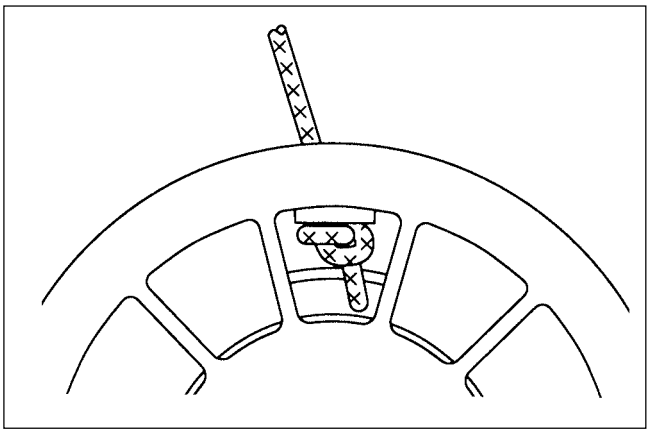


Fig. 10-8

10-1-3 CHECK AFTER REASSEMBLY

(1) Pull the starter knob a few times to check if :

A. The starter knob is too heavy to pull, check that each part has been assembled as specified.

B. The ratchet does not function, check if parts such as friction spring have been missing.

(2) Pull the starter knob and pull out the rope fully to see if:

A. If the starter rope remains in the groove of the reel, immoderate strain is imposed to the spiral spring. Pull out the rope by approx. 30 cm, and pull it out toward inner side of the recoil starter with holding the reel firmly with your thumb.

Then rewind the reel 1 to 2 turns while applying a brake with your thumb.

B. The return power of the rope is weak or the starter knob droops on the way, apply grease or mobile oil to the rotating and the frictional parts.

If the problem is not solved, wind the reel 1 to 2 turns. (In this case, check that the spring is not over-stressed.)

C. The spring comes off with a sound and the starter rope cannot be wound in the reel, reassemble the starter from the beginning.

10-1-4 OTHER GUIDES

(1) When the spring jumps out of the reel:

With a thin wire, make a ring whose diameter is smaller than spring housing.

Hook the outer end of the spring to the ring and re-wind the spring into the wire ring as shown in Fig. 10-9, then put it into the spring housing of the reel.

Remove the ring slowly while holding down the spring with fingers so as not to come out of place.

The ring can easily be removed by prying it with the tip of a screwdriver.

If the wire ring is not available, re-wind the spring directly into the housing.

(2) Lubricate the rotating and frictional parts with grease (If possible, heat-resistant type is preferable) or mobile oil when the starter is disassembled or prior to long term storage.

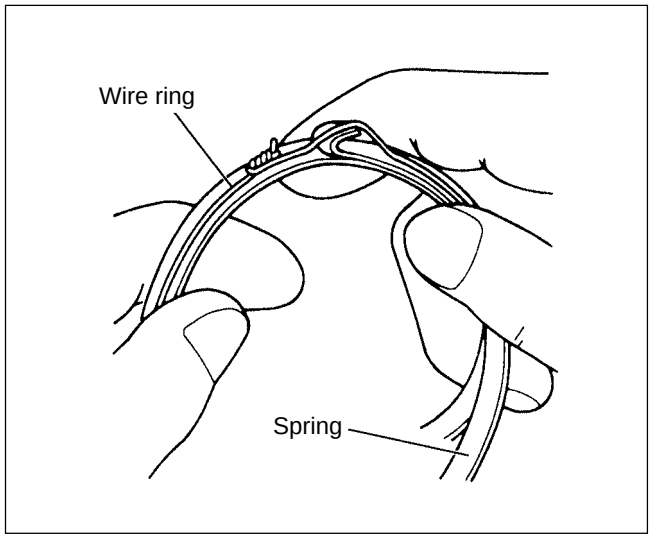


Fig. 10-9

10-2 RECOIL STARTER (SYNTHETIC RESINS)

Tools to be prepared: Driver, Pinchers (Pliers) and Protective Glasses

WARNING

Before starting the disassembly, make sure to wear the protective glasses.

10-2-1 DISASSEMBLY STEPS

(1) Relieve the spring power

-1: Hold the starter knob and extract the starter rope.

-2: Extract the rope fully and hold the rope so that the knot of the rope in the reel makes a straight line with the rope guide.

-3: Hold the reel with the thumbs of both hands firmly so that the rope will not be wound back. (Fig.10-10)

-4: Pull out the knot of the rope out of the reel, and unfasten the knot and pull it out toward the starter knob. (2 people required)

-5: By controlling the reel with the thumbs of both hands, unwind the reel gently until the rotation of the reel stops.

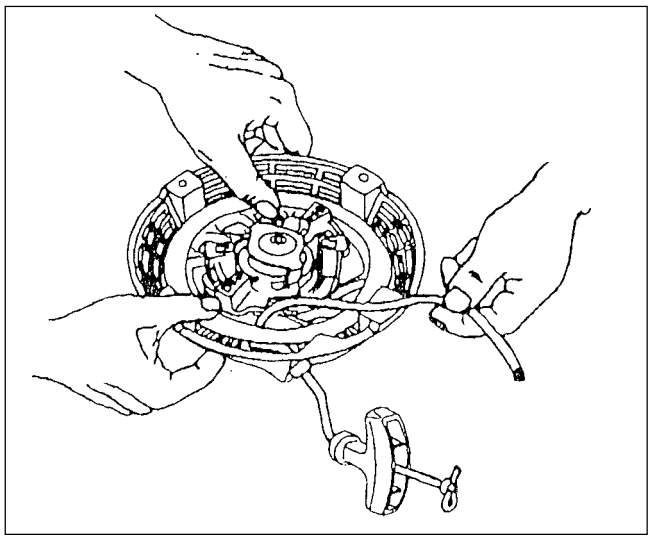


Fig. 10-10

WARNING

The spring power is at its maximum when the rope is fully extracted. Do not put off your hand nor loosen the pressure of your finger suddenly.

(2) Remove the component parts (Fig.10-11)

-1: Fix the case and loosen the set-screw.

-2: Remove the set-screw, the friction plate, the friction spring and the latchet in the order from the above.

(3) Remove the reel. (Fig.10-11)

-1: Hold the reel lightly so that it will not float. Move the reel clockwise and counter-clockwise about a quarter circle for several times until it moves smoothly.

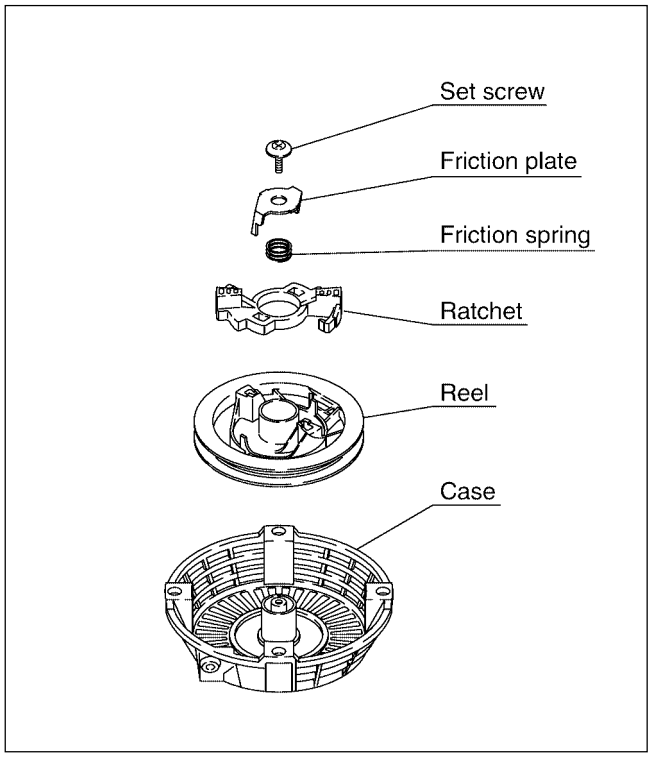


Fig. 10-11

-2: Hold up the real gradually and slowly, and remove it from the case.

-3: If the spiral spring in the reel likes to jump out of the reel, stop the procedure and push the reel against the case to redo the step of section (3)-1 and (3)-2.

WARNING

Since the spiral spring is set in the reel, do not drop or shake it. Put it on a flat place.

Disassembly is completed.

WARNING

Before starting the assembly, make sure to wear the protective glasses.

10-2-2 ASSEMBLY STEPS

(1) Setting the reel into the case.

-1: Peep at the boss of reel to check the inner end of the spring.

-2: Hook the inner end of spring to the hook of case and put the reel into the case. (Fig.10-12)

(2) Assemble the component parts.

-1: Put the ratchet in the reel so that the receiving area of the reel is within the area illustrated in Fig.10-13.

-2: Assemble the friction spring to the shaft in the case.

-3: Insert the legs of friction plate (2 places) in ratchet holes. (Fig.10-14)

(3) Tighten the center screw. (2 people required for this step.)

-1: Adjust the tip of center shaft to the hole of friction plate and compress the friction spring by pushing the friction plate with your fingers.

-2: Tighten the center screw counterclockwise (as it is reverse screw).

WARNING

Wear work gloves during operation to avoid a possible injury by a sharp edge of the friction plate.

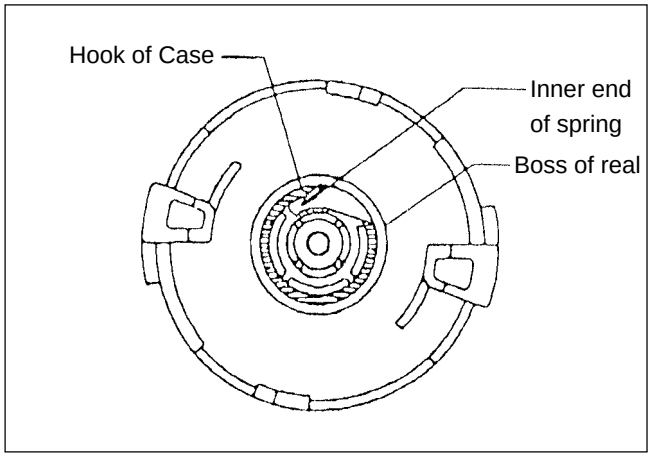


Fig. 10-12

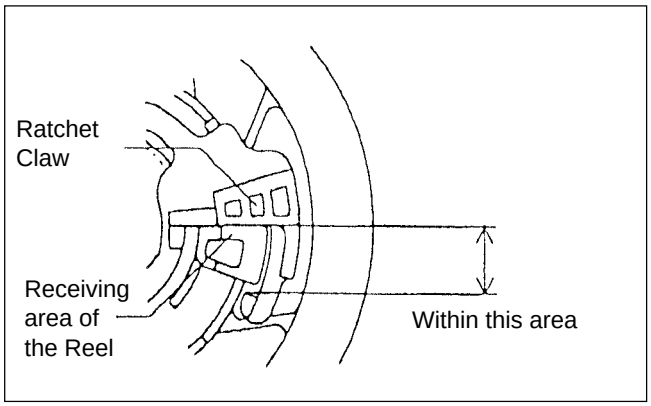


Fig. 10-13

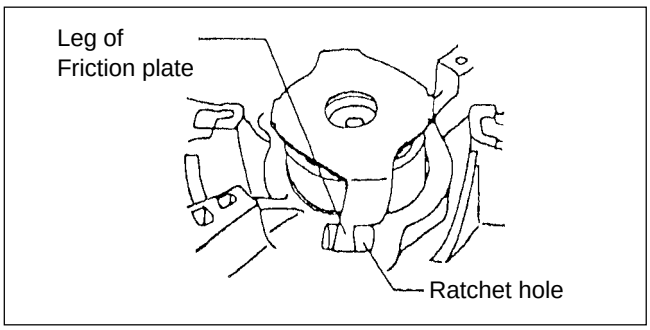


Fig. 10-14

(4) Wind the spiral spring.

-1: Hold the case tightly and rotate the reel counterclockwise until it stops. (It stops when it is wound approx. 6 turns.)

-2: Turn back the reel slowly by approx. 3/4 turns and hold the reel at the position where the rope hole of the reel and the rope guide of the case are aligned.

WARNING

The spring power is at its maximum when the reel is being wound. Do not put off your hand nor loosen the pressure of your finger unintentionally.

(5) Setting the rope. (2 people required)

-1: Pass the rope end through the rope guide to the rope hole on the reel and make a knot as shown in Fig.10-15.

-2: Put the rope-end-knot in the reel paying attention that it will not touch the case. (Fig.10-16)

-3: Hold the rope firmly with the hand at the position about 50cm from the rope guide and keep the rope slightly pull so that the rope will not be wound in.

-4: Release the hand of the reel gently and wind the rope slowly by the winding power of the spring until the knob reaches the rope guide.

Assembly is completed.

*The disassembly and the reassembly have been completed, however carry out the following to check if the necessary components have surely been assembled.

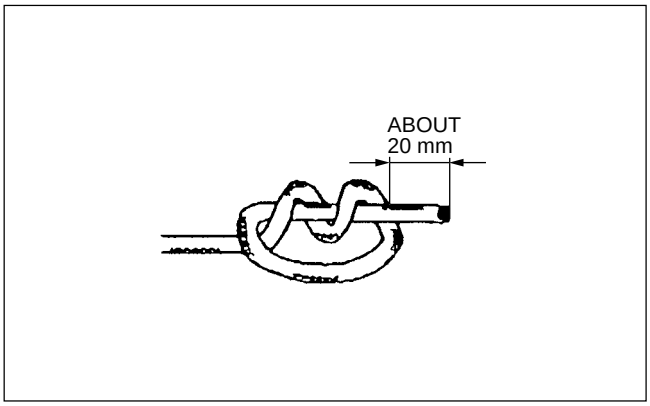


Fig. 10-15

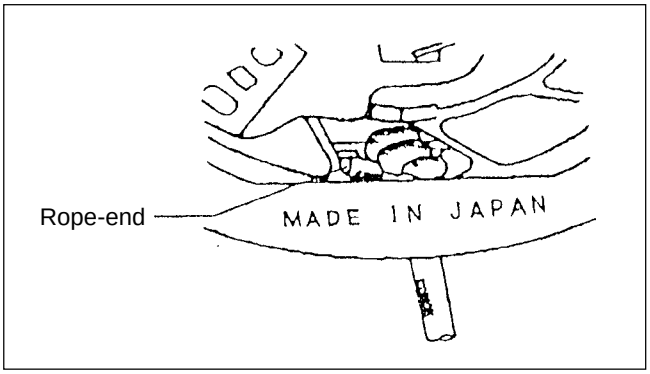


Fig. 10-16

10-2-3 CHECK AFTER REASSEMBLY

(1) Pull the starter knob a few times to check if :

A. The starter knob is too heavy to pull, check that each part has been assembled as specified.

B. The ratchet does not function, check if parts such as friction spring have been missing.

(2) Pull the starter knob and pull out the rope fully to see if:

A. If the starter rope remains in the groove of the reel, immoderate strain is imposed to the spiral spring. Pull out the rope by approx. 30 cm, and pull it out toward inner side of the recoil starter with holding the reel firmly with your thumb.

Then rewind the reel 1 to 2 turns while applying a brake with your thumb.

B. The return power of the rope is weak or the starter knob droops on the way, apply grease or mobile oil to the rotating and the frictional parts.

If the problem is not solved, wind the reel 1 to 2 turns. (In this case, check that the spring is not over-stressed.)

C. The spring comes off with a sound and the starter rope cannot be wound in the reel, reassemble the starter from the beginning.

10-2-4 OTHER GUIDES

(1) When the spring jumps out of the reel:

With a thin wire, make a ring whose diameter is smaller than spring housing.

Hook the outer end of the spring to the ring and re-wind the spring into the wire ring as shown in Fig. 10-17, then put it into the spring housing of the reel.

Remove the ring slowly while holding down the spring with fingers so as not to come out of place.

The ring can easily be removed by prying it with the tip of a screwdriver.

If the wire ring is not available, re-wind the spring directly into the housing.

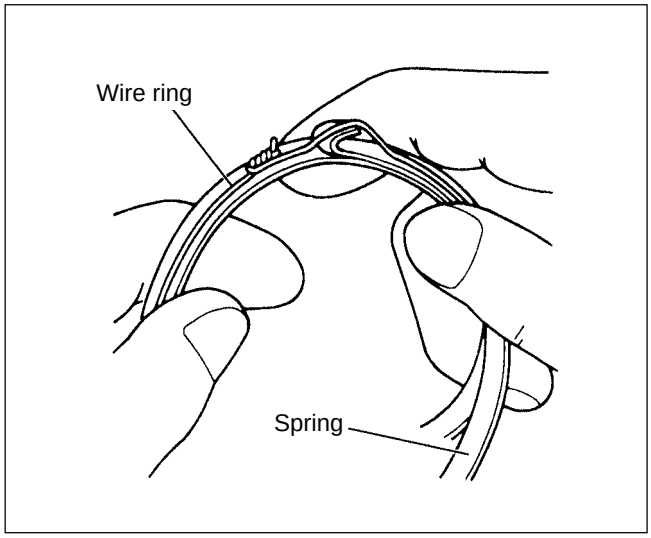


Fig. 10-17

(2) Lubricate the rotating and frictional parts with grease (If possible, heat-resistant type is preferable) or mobile oil when the starter is disassembled or prior to long term storage.

11. INSTALLATION

Engine life, ease of maintenance and inspection, frequency of checks and repairs, and operating cost are all depend on the way in which the engine is installed. Review the following instructions carefully for installing the engine.

11-1 INSTALLING

When mounting the engine, carefully examine its position, the method of connecting it to a machine, the foundation, and the method of supporting the engine.
When determining its mounting position, in particular, make sure that gasoline and oil can easily be supplied and checked, the spark plug can easily be checked, the air cleaner can easily be serviced, and that the oil can easily be discharged.

11-2 VENTILATION

Fresh air is necessary for cooling the engine and burning the fuel.
In the case the engine is operated under a hood or in a small room, temperature rise in the engine room can cause vapor lock, oil deterioration, increased oil consumption, loss of power, piston seizure, shorter engine life, etc., making it impossible to operate the engine properly. It is necessary, therefore, to provide a duct or baffle to guide cooling air to the engine to prevent recirculation of he hot air used for engine cooling, and temperature rise of the machine. Keep the engine room temperature below 50 ℃ even in the hottest period of the year.

11-3 EXHAUST GAS DISCHARGE

Exhaust gas is noxious. When operating the engine indoors, be sure to discharge the exhaust gas outdoors. If a long exhaust pipe is used in such a case, the internal resistance increases causing loss of engine power. Thus pipe inside diameter must be increased in proportion to exhaust pipe length.
Exhaust pipe : Less than 3 m long, pipe inside diameter 30 mm,
Less than 5 m long, pipe inside diameter 33 mm.

NOTE:Fit safety covers to the exhaust pipe and to the muffler.

11-4 FUEL SYSTEM

If the fuel tank removed from the engine, set the height of the bottom of fuel tank and the fuel joint of carburetor to a level between 5 cm and 50 cm.Pay attention that the too low level of fuel tank allows fuel not to be supplied and the too high may cause the carburetor overflow.
When piping, in addition, pay attention to the pipe for its heat transfer thickness, bend and leaking in joints to prevent air-lock and vapour-lock.And length of the pipe should be as short as possible.

11-5 POWER TRANSMISSION TO DRIVEN MACHINES

11-5-1 BELT DRIVE

Take the following notes into consideration.

* V-belts are preferable to flat belts.

* The driving shaft of the engine must be parallel to the driven shaft of the machine.

* The driving pulley of the engine must be in line with the driven pulley of the machine.

* Install the engine pulley as close to the engine as possible.

* If possible, span the belt horizontally.

* Disengage the load when starting the engine.

If no clutch is used, use a belt tension pulley or the like.

11-5-2 FLEXIBLE COUPLING

When using a flexible coupling, runout and misalignment between the driven shaft and engine shaft must be minimized. Runout and misalignment tolerance are specified by the coupling manufacturer.

12. CHECKS AND CORRECTIONS

After disassembling and cleaning the engine, check and repair, if necessary, according to the correction table. The correction table applies whenever the engines are repaired. It is important for the servicemen to be familiar with the contents of this table. Correct maintenance is recommended by observing the correction standards specified.

The meanings of the terms used in the correction table are as follows:

1) Correction
   Repair, adjustment or replacement of any engine parts.

2) Correction Limit
   The limit on wear, damage or functional deterioration of engine parts beyond which normal engine performance cannot be expected without repairing such parts.

3) Use Limit
   The limit beyond which parts can no longer be used in respect of performance or strength.

4) Standard Dimensions
   The design dimensions of new parts minus tolerance.

5) Correction Tolerance
   Tolerance on the dimensions of engine parts refinished or adjusted.

13.TROUBLESHOOTING

13-1 STARTING DIFFICULTIES

If a sign of malfunction is found on the engine it is necessary to find out the cause immediately and take proper measures to prevent it from spreading.

The section can not cover all the cause and measures to be taken for the faults but covers them only for possible faults.

Generally speaking, one cause of trouble can overlaps with the other, so you are requested to take complete measures by exerting experience and judgment accumulated so far.

Phenomenon		Possible causes	Remedy
1	Ignition system malfunction	1) Spark plug * Improper spark plug gap * No insulation * Carbon deposits	 Adjust Replace Clean
		2) Ignition coil * No insulation or discontinuity * Poor connection or discontinuity of ignition code	 Replace Repair or replace
		Improper air gap between ignition coil and flywheel	Adjust
2	Fuel system malfunction	1) No fuel in fuel tank	Refill
		2) Fuel hose clogged or pinched	Clean or replace
		3) Air mixing into fuel lines	Check and adjust connecting portion
		4) Improper gasoline or water infiltration	Replace
		5) Carburetor * Overflow * Clogged or damaged * Improper operation of throttle valve	 Adjust Disassembly and clean Check and adjust
3	Engine core components malfunction	1) Insufficient tightening of cylinder head bolts	Check and retighten
		2) Wear of piston, piston ring and/or cylinder	Repair or replace
		3) Improper contact of valve and seat	Repair
		4) Valve seizure	Repair
		5) Improper valve clearance	Adjust
		6) Intake manifold gasket leakage	Retighten intake manifold bolts or replace gasket
		7) Carburetor gasket leakage	Retighten carburetor bolts or replace gasket
		8) Insufficient tightening of spark plug	Retighten

13-2. INSUFFICIENT OUTPUT

Phenomenon		Possible causes	Remedy
1	Low compression	1) Loosen spark plug	Retighten or replace gasket
		2) Cylinder head gasket leakage	Retighten or replace gasket
		3) Piston ring(s) seizure or wear	Replace
		4) Piston or cylinder wear	Repair or replace
		5) Incorrect valve and seat contact	Repair or replace
		6) Valve stem seizure	Repair or replace
		7) Improper valve clearance	Adjust
2	Ignition system malfunction	1) Spark plug faulty	Replace
		2) Ignition coil faulty	Replace
		3) Improper air gap between ignition coil and flywheel	Adjust
		4) Magneto demagnetization	Replace
3	Fuel system malfunction	1) Carburetor clogged	Disassembly and clean
		2) Fuel strainer or fuel hose clogged	Clean or replace
		3) Air mixing into fuel lines	Check and adjust connecting portion
		4) Improper gasoline or water infiltration	Replace
4	Low intake air volume	1) Air cleaner clogged	Clean or replace
		2) Throttle valve faulty	Repair or replace

13-3. OVERHEAT

Phenomenon	Possible causes	Remedy
Overheating	1) Cooling air flow obstructed at inlet or cylinder baffle portion	Clean
	2) Improper engine oil	Replace
	3) Lean air/fuel mixture	Check and adjust carburetor
	4) Excessive back pressure of exhaust system	Check, clean or replace
	5) Over-load	Change to rated load

13-4. ROUGH IDLING

Phenomenon		Possible causes	Remedy
1	Carburetor	1) Low idling speed	Adjust
		2) Carburetor slow system passage clogged	Check and clean
2	Intake system	1) Air mixing from connecting portion of air intake system	Check , tighten or replace gasket
3	Cylinder head	1) Cylinder head gasket faulty (blow-by)	Replace
4	Valve system	1) Improper valve clearance	Adjust
		2) Leakage from valve seat	Adjust valve seat contact
		3) Excessive clearance between valve stem and guide	Replace
5	Ignition system	1) Weak ignition spark	Check and replace spark plug

13-5. HIGH ENGINE OIL CONSUMPTION

Phenomenon		Possible causes	Remedy
1	Oil leakage	1) Loosen drain plug	Tighten
		2) Drain plug gasket damaged	Replace
		3) Loosen main bearing cover bolts	Tighten
		4) Main bearing cover gasket damaged	Replace
		5) Crankshaft oil seal damaged	Replace
2	Oil dilution	1) Piston oil ring faulty	Replace
		2) Piston rings seizure, wear or poor contact	Replace
		3) Excessive wear of piston and cylinder	Replace
		4) Excessive wear of valve stem	Replace
		5) High oil level	Adjust oil level
		6) Breather faulty	Repair or replace

13-6. HIGH FUEL CONSUMPTION

Phenomenon		Possible causes	Remedy
1	Fuel system	1) Air clcaner clogged	Crean pr replace
		2) Needle valve faulty and/or high fuel level in float chamber	Adjust or replace
		3) Chock valve does not open fully.	Repair or replace
2	Engine core components	1) Low compression	Check or repair
		2) Over cooling	Check and adjust load and/or engine speed

13-7. DETONATION

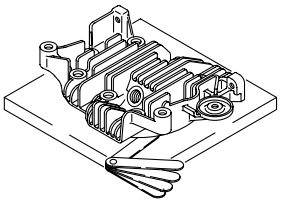
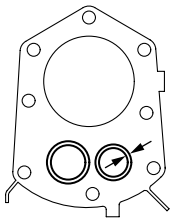
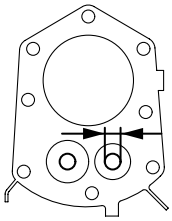
	Phenomenon	Possible causes	Remedy
1	Ignition system malfunction	1) Poor connection of ignition system wirings	Check and connect properly
		2) Improper or damaged spark plug	Clean or replace
2	Fuel system malfunction	1) Lean or rich air/fuel mixture	Clean, adjust or replace
		2) Carburetor damaged	Disassembly and clean
		3) Fuel lines clogged or damaged	Clean or replace
		4) Air mixing from connecting portion of air intake system	Connect properly or replace gasket
3	Cylinder head	1) Carbon deposit in combustion chamber	Clean
		2) Cylinder head gasket faulty (blow-by)	Replace
4	Valve system	1) Improper valve clearance	Adjust
		2) Valve heat deterioration	Replace
		3) Valve spring deterioration	Replace
		4) Improper valve timing	Adjust

14. SERVICE DATA

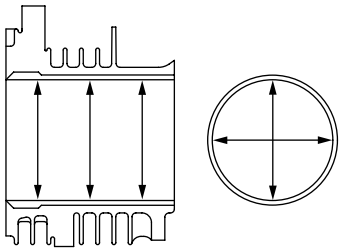
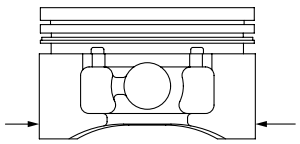
"STD" in the following table is the parts dimension from the brand new engine or the spare parts.
Whereas, "Limit" shows the maximum allowance for the parts to be used on the engine.
If the measurement exceeds beyond the "Limit", the part needs to be replaced and/or repaired.

14-1 CLEARANCE DATA AND LIMITS

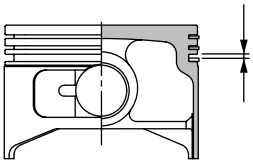
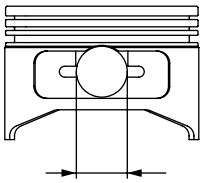
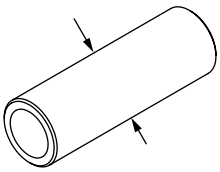
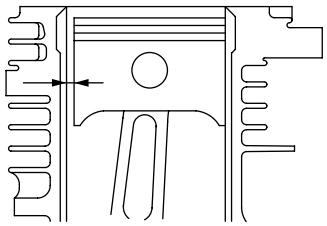
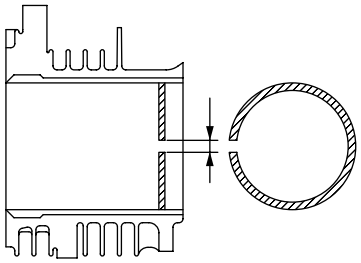
Unit : mm (in.)

ITEM		EY15-3, EY20-3	
		STD	**Limit**
CYLINDER HEAD * Flatness 		LESS THAN 0.1 (0.004)	0.15 (0.006)
* Valve seat contact width 	IN. EX.	1.2 - 1.5 (0.0472 - 0.0591)	2.5 (0.098)
* Valve guide inside dia. 		6.500 - 6.522 (0.2559 - 0.2568)	6.65 (0.2618)

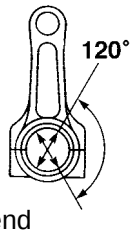
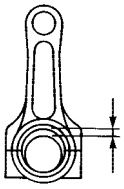
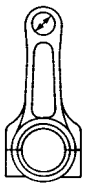
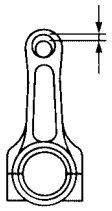
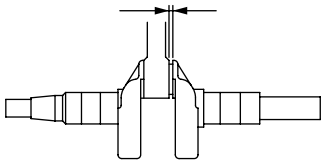
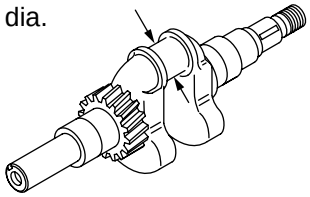
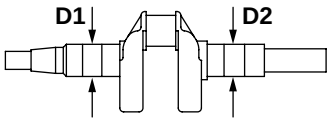
Unit : mm (in.)

ITEM		EY15-3		EY20-3	
		STD	**Limit**	**STD**	**Limit**
CYLINDER * Inside dia. 	STD	63.0 - 63.019 (2.4803 - 2.4811)	To be rebored when the difference between max. and min. of diameter reached to 0.1 (0.004).	67.000 - 67.019 (2.6378 - 2.6385)	To be rebored when the difference between max. and min. of diameter reached to 0.1 (0.004).
	1 st reboring	63.250 - 63.269 (2.4902 - 2.4909)	Ditto	67.250 - 67.269 (2.6476 - 2.6484)	Ditto
	2 st reboring	63.500 - 63.519 (2.4803 - 2.5007)	———	67.500 - 67.519 (2.6575 - 2.6582)	———
* Roundiness after reboring.		LESS THAN 0.01 (0.004)	———	LESS THAN 0.01 (0.004)	———
* Cylindricity after reboring.		LESS THAN 0.015 (0.0006)	———	LESS THAN 0.015 (0.0006)	———
PISTON * Piston size (At skirt in thrust direction) 	STD	62.96 - 62.98 (2.4787 - 2.4795)	62.88 (2.4756)	66.96 - 66.98 (2.6362 - 2.6370)	66.88 (2.6331)
	1 st o / s	63.21 - 63.23 (2.4886 - 2.4894)	63.13 (2.4854)	67.21 - 67.23 (2.6461 - 2.6469)	67.13 (2.6429)
	2nd o / s	63.46 - 63.48 (2.4984 - 2.4992)	63.38 (2.4953)	67.46 - 67.48 (2.6559 - 2.6567)	67.38 (2.6528)

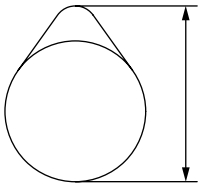
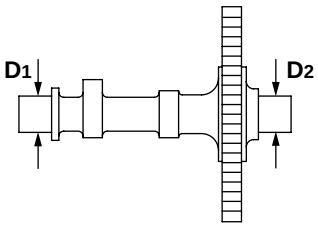
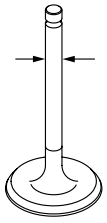
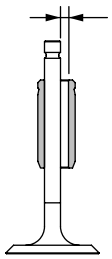
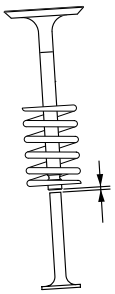
Unit : mm (in.)

ITEM		EY15-3		EY20-3	
		STD	Limit	STD	Limit
PISTON * Ring groove side clearance 	Top	0.09 - 0.135 (0.0035 - 0.0053)	0.15 (0.0059)	0.05 - 0.095 (0.0020 - 0.0037)	0.15 (0.0059)
	2nd	0.06 - 0.105 (0.0024 - 0.0041)	0.15 (0.0059)	0.01 - 0.055 (0.0004 - 0.0022)	0.15 (0.0059)
	Oil ring	0.010 - 0.065 (0.0004 - 0.0026)	0.15 (0.0059)	0.010 - 0.065 (0.0004 - 0.0026)	0.15 (0.0059)
* Piston pin hole 		13.991 - 14.002 (0.5508 - 0.5513)	14.035 (0.5526)	13.991 - 14.002 (0.5508 - 0.5513)	14.035 (0.5526)
* Piston pin outside dia. 		13.992 - 14.000 (0.5509 - 0.5512)	13.960 (0.5496)	13.992 - 14.000 (0.5509 - 0.5512)	13.960 (0.5496)
* Clearance between piston and cylinder at skirt area. 		0.020 - 0.059 (0.0008 - 0.0023)	0.25 (0.010)	0.020 - 0.059 (0.0008 - 0.0023)	0.25 (0.010)
* Piston ring end gap 	Top 2nd	0.2 - 0.4 (0.003 - 0.016)	1.5 (0.0591)	0.5 - 0.25 (0.002 - 0.010)	1.5 (0.0591)
	Oil ring	0.1 - 0.3 (0.004 - 0.012)	1.5 (0.0591)	0.5 - 0.25 (0.002 - 0.010)	1.5 (0.0591)

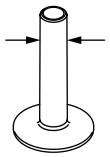
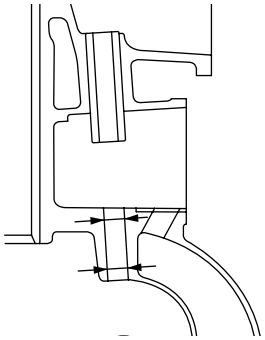
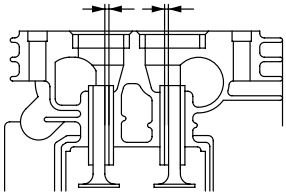
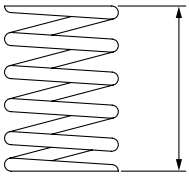
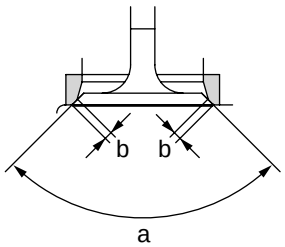
Unit : mm (in.)

ITEM	EY15-3		EY20-3	
	STD	Limit	STD	Limit
CONNECTING ROD * Large end inside dia. 	24.000 - 24.013 (0.9449 - 0.9454)	24.1 (0.9488)	26.000 - 26.013 (1.0236 - 1.0241)	26.1 (1.0276)
* Clearance between rod large end inside dia. and crankpin 	0.037 - 0.063 (0.0015 - 0.0025)	0.2 (0.008)	0.037 - 0.063 (0.0015 - 0.0025)	0.2 (0.008)
* Small end inside dia. 	14.010 - 14.021 (0.5516 - 0.5520)	14.08 (0.5543)	14.010 - 14.021 (0.5516 - 0.5520)	14.08 (0.5543)
* Clearance between small end inside dia. and piston pin 	0.010 - 0.029 (0.0004 - 0.0011)	0.12 (0.0047)	0.010 - 0.029 (0.0004 - 0.0011)	0.12 (0.0047)
* Large end side clearance 	0.1 - 0.3 (0.004 - 0.039)	1.0 (0.040)	0.1 - 0.3 (0.004 - 0.039)	1.0 (0.040)
CRANKSHAFT * Crankpin outside dia. 	23.950 - 23.963 (0.9429 - 0.9434)	23.5 (0.9252)	25.950 - 25.963 (1.0217 - 1.0222)	25.5 (1.004)
* Journal dia. 	D1, D2 24.988 - 24.997 (0.9838 - 0.9841)	D1, D2 24.95 (0.9823)	D1, D2 24.988 - 24.997 (0.9838 - 0.9841)	D1, D2 24.95 (0.9823)

Unit : mm (in)

ITEM		EY15-3		EY20-3	
		STD	Limit	STD	Limit
CAMSHAFT * Cam height (IN. and EX.) 		24.85 - 25.05 (0.978 - 0.986)	24.7 (0.972)	28.7 - 28.9 (1.130 - 1.138)	28.55 (1.124)
* Journal outside dia. "D" type  	D_1	14.973 - 14.984 (0.5895 - 0.5899)	14.95 (0.5886)	14.973 - 14.984 (0.5895 - 0.5899)	14.95 (0.5886)
	D_2	14.973 - 14.984 (0.5895 - 0.5899)	14.95 (0.5886)	14.973 - 14.984 (0.5895 - 0.5899)	14.95 (0.5886)
VALVE * Valve stem outside dia. 	IN.	6.460 - 6.475 (0.2543 - 0.2549)	6.35 (0.2500)	6.460 - 6.475 (0.2543 - 0.2549)	6.35 (0.2500)
	EX.	6.422 - 6.444 (0.2528 - 0.2537)	6.35 (0.2500)	6.422 - 6.444 (0.2528 - 0.2537)	6.35 (0.2500)
*Clearance between valve stem dia. and valve guide. 	IN.	0.025 - 0.062 (0.0010 - 0.0024)	0.3 (0.012)	0.025 - 0.062 (0.0010 - 0.0024)	0.3 (0.012)
	EX.	0.056 - 0.100 (0.0022 - 0.0039)	0.3 (0.012)	0.056 - 0.100 (0.0022 - 0.0039)	0.3 (0.012)
* Valve clearance 	IN. / EX. (cold)	0.08 - 0.12 (0.0031 - 0.0047)	below 0.05 (0.002) above 0.25 (0.010)	0.08 - 0.12 (0.0031 - 0.0047)	below 0.05 (0.002) above 0.25 (0.010)

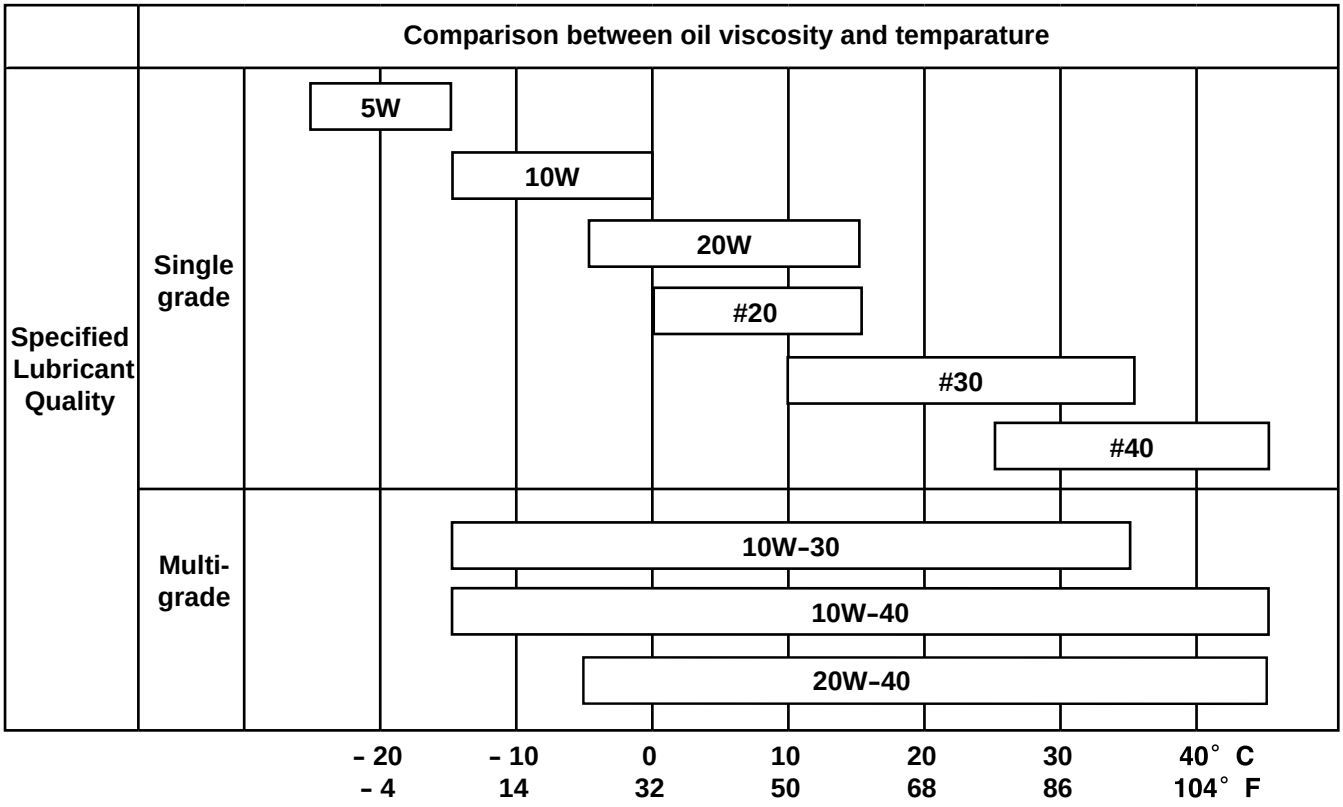
Unit : mm (in)

ITEM	EY15-3		EY20-3	
	STD	Limit	STD	Limit
TAPPET * Stem outside dia. 	6.978 - 6.987 (0.2747 - 0.2751)	6.878 (0.2709)	6.978 - 6.987 (0.2747 - 0.2751)	6.878 (0.2709)
* Guide inside dia. 	7.000 - 7.015 (0.2756 - 0.2762)	7.1 (0.2795)	7.000 - 7.015 (0.2756 - 0.2762)	7.1 (0.2795)
* Clearance between stem and guide 	0.013 - 0.037 (0.0005 - 0.0015)	0.2 (0.0079)	0.013 - 0.037 (0.0005 - 0.0015)	0.2 (0.0079)
VALVE SPRING FREE LENGTH 	37.0 (1.46)	35.5 (1.40)	37.0 (1.46)	35.5 (1.40)
VALVE SEAT ANGLE (IN. and EX.) * Valve cutter angle (a) * Valve contact width (b) 	a : 90 ° b : 0.8 - 1.1 (0.031 - 0.043)	2.0 (0.079)	a : 90 ° b : 0.7 - 1.0 (0.028 - 0.039)	2.0 (0.079)

14-2 TORQUE SPECIFICATIONS

ITEM		Tightening Torque		
		N.m	kg-cm	ft-lb
Cylinder head bolts		22-26	220-260	15.9-18.8
Connecting rod cap bolts	EY15-3	9-11.5	90-115	6.5-8.3
	EY20-3	17-20	170-200	12.3-14.5
Flywheel nut		60-65	600-650	43.4-47.0
Main bearing cover bolts		8-10	80-100	5.8-7.2
Spark plug	New one	12-15	120-150	8.7-10.8
	Retightening	23-27	230-270	16.6-19.5

14-3 OIL GRADE CHART



15. MAINTENANCE AND STORAGE

The following maintenance jobs apply when the engine is operated correctly under normal conditions. The indicated maintenance intervals are by no means guarantees for maintenance free operations during these intervals.

For example, if the engine is operated in extremely dusty conditions, the air cleaner should be cleaned every day instead of every 50 hours.

15-1 DAILY MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Clean away dust and chaff from engine.	Governor linkage is especially sensitive to dust.
2) Check fuel leakage from fuel system. If any, retighten fasteners or replace necessary parts.	
3) Inspect for loose hardware and retighten if necessary.	Loose bolts and nuts may come off and result in breakage of other parts.
4) Check oil level and add to full mark.	

15-2 INITIAL 20 HRS. MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Replace crankcase oil.	To remove sludge from run-in operation.

15-3 EVERY 50 HRS. (10 DAYS) MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Change crankcase oil.	Contaminated oil quickens wear.
2) Clean air cleaner.	
3) Check and clean spark plug.	If dirty, wash in gasoline or polish with emery paper.

15-4 EVERY 100–200 HRS. (MONTHLY) MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Clean fuel filter and fuel tank.	
2) Inspect cooling system and remove dirt and chaff.	Remove blower housing and clean up between fins and housing.

15-5 EVERY 500–600 HRS. MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Remove carbon from cylinder head.	Carbon deposits in combustion chamber causes lack of power.
2) Disassemble and clean carburetor.	

15-6 EVERY 1000 HRS. (YEARLY) MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Overhaul engine.	Clean and correct parts. Replace piston rings and other necessary parts.
2) Replace fuel lines once a year.	Avoid hazards caused by fuel leakage.

15-7 ENGINE STORAGE

(1) Perform the above 13-1 and 13-2 maintenance jobs.

(2) Drain fuel from the fuel tank and carburetor float chamber.

(3) To prevent rust in the cylinder bore, apply oil through the spark plug hole and turn the crankshaft several turns by hand. Reinstall the plug.

(4) Turn the starting pulley by hand and leave it where the resistance is the heaviest.

(5) Clean outside of the engine with oiled cloth.

(6) Put a plastic cover or the like over the engine and store the engine in dry place.

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