



# SERVICE MANUAL

Models

**EH09,  
EH12-2 Rammer  
ENGINES**



PUB-ES1330  
Rev. 1/01



# CONTENTS



<i>Section</i>	<i>Title</i>	<i>Page</i>
<b>1.</b>	<b>SPECIFICATIONS .....</b>	<b>1</b>
<b>2.</b>	<b>PERFORMANCE .....</b>	<b>3</b>
2-1	MAXIMUM OUTPUT .....	3
2-2	CONTINUOUS RATED OUTPUT .....	3
2-3	MAXIMUM TORQUE .....	3
2-4	PERFORMANCE CURVES .....	4
<b>3.</b>	<b>FEATURES .....</b>	<b>6</b>
<b>4.</b>	<b>GENERAL DESCRIPTION OF ENGINE COMPONENTS .....</b>	<b>7</b>
4-1	CYLINDER AND CRANKCASE .....	7
4-2	MAIN BEARING COVER .....	7
4-3	CRANKSHAFT .....	7
4-4	CONNECTING ROD AND PISTON .....	8
4-5	PISTON RINGS .....	8
4-6	CAMSHAFT .....	8
4-7	VALVE ARRANGEMENT .....	9
4-8	CYLINDER HEAD .....	9
4-9	GOVERNOR SYSTEM .....	9
4-10	COOLING SYSTEM .....	10
4-11	LUBRICATION SYSTEM .....	10
4-12	IGNITION SYSTEM .....	10
4-13	CARBURETOR .....	10
4-14	AIR CLEANER .....	11
4-15	DECOMPRESSION SYSTEM .....	11
4-16	SECTIONAL VIEW OF ENGINE .....	12
<b>5.</b>	<b>DISASSEMBLY AND REASSEMBLY .....</b>	<b>16</b>
5-1	PREPARATIONS AND SUGGESTIONS .....	16
5-2	SPECIAL TOOLS (EH12-2D) .....	16
5-3	DISASSEMBLY PROCEDURES .....	17
5-4	REASSEMBLY PROCEDURES .....	30
5-5	BREAK-IN OPERATION .....	46
<b>6.</b>	<b>MAGNETO .....</b>	<b>46</b>
6-1	OPERATION AND FUNCTION .....	46
6-2	BASIC THEORY .....	46
6-3	WIRING DIAGRAM .....	48
<b>7.</b>	<b>AUTOMATIC DECOMPRESSION SYSTEM .....</b>	<b>49</b>
<b>8a.</b>	<b>FLOAT TYPE CARBURETOR (EH09D) .....</b>	<b>50</b>
8a-1	OPERATION AND CONSTRUCTION .....	50
8a-2	DISASSEMBLY AND REASSEMBLY .....	51



<i>Section</i>	<i>Title</i>	<i>Page</i>
<b>8b.</b>	<b>FLOAT TYPE CARBURETOR (EH12-2D)</b>	<b>53</b>
8b-1	OPERATION AND CONSTRUCTION	53
8b-2	DISASSEMBLY AND REASSEMBLY	54
<b>8c.</b>	<b>DIAPHRAGM TYPE CARBURETOR (OPTION)</b>	<b>56</b>
8c-1	OPERATION AND CONSTRUCTION	56
8c-2	DISASSEMBLY PROCEDURE	59
8c-3	INSPECTION PROCEDURE	59
8c-4	REASSEMBLY PROCEDURE	60
8c-5	DIAPHRAGM CARBURETOR ADJUSTMENT METHOD	61
<b>9.</b>	<b>STARTING SYSTEM</b>	<b>62</b>
9-1	RECOIL STARTER	62
<b>10.</b>	<b>TROUBLESHOOTING</b>	<b>66</b>
10-1	STARTING DIFFICULTIES	66
10-2	ENGINE MISFIRE	67
10-3	ENGINE STOPS	67
10-4	ENGINE OVERHEAT	68
10-5	ENGINE KNOCKS	68
10-6	ENGINE BACKFIRES THROUGH CARBURETOR	68
<b>11.</b>	<b>INSTALLATION</b>	<b>69</b>
11-1	INSTALLING	69
11-2	VENTILATION	69
11-3	EXHAUST GAS DISCHARGE	69
11-4	POWER TRANSMISSION TO DRIVEN MACHINES	69
<b>12.</b>	<b>SERVICE DATA</b>	<b>70</b>
12-1	CLEARANCE DATA AND LIMITS	70
12-2	TORQUE SPECIFICATIONS	76
12-3	OIL GRADE CHART	76
<b>13.</b>	<b>MAINTENANCE AND STORAGE</b>	<b>77</b>
13-1	DAILY MAINTENANCE	77
13-2	INITIAL 20 HRS. MAINTENANCE	77
13-3	EVERY 50 HRS. (10 DAYS) MAINTENANCE	77
13-4	EVERY 100-200 HRS. (MONTHLY) MAINTENANCE	78
13-5	EVERY 300 HRS. or YEARLY MAINTENANCE	78
13-6	EVERY 500-600 HRS. MAINTENANCE	78
13-7	EVERY 1000 HRS. (YEARLY) MAINTENANCE	78
13-8	ENGINE STORAGE	78



# 1. SPECIFICATIONS

MODEL		EH09D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Horizontal P.T.O. Shaft, OHV Gasoline Engine
Bore x Stroke		51 x 42 mm (2.01 x 1.65 in.)
Piston Displacement		86 cm <sup>3</sup> (5.24 cu.in.)
Compression Ratio		9.5
Output	Continuous	1.4 kW (1.9 HP) /3600 r.p.m.
	Max.	1.8 kW (2.4 HP) /3600 r.p.m.
Max. Torque		4.8 N · m (0.49 kgf · m) /3200 r.p.m.
Direction of Rotation		Counterclockwise As Viewed From P.T.O. Shaft Side
Cooling system		Forced Air Cooling
Valve Arrangement		Overhead Valve
Lubrication		Splash Type
Lubricant		Automobile Oil SAE #20, #30 or 10W-30 ; Class SE or higher
Capacity of Lubricant		0.3 liters (0.079 U.S. gal.)
Carburetor		Horizontal Draft, Float Type or Diaphragm
Fuel		Automobile Unleaded Gasoline
Fuel Consumption Ratio		310 g/kW · h (230 g/HP · h) At Continuous Rated Output
Fuel Feed System		Gravity Type
Ignition System		Flywheel Magneto (Solid State)
Spark Plug		NGK BM6A, BMR6A
Starting System		Recoil Starter
Governor System		Centrifugal Flyweight Type
Air Cleaner		Dual Element Type
Dry Weight		9.4 kg (20.7 lb.)
Dimensions (L x W x H)		232 mm x 295 mm x 330 mm (9.1 in. x 11.6 in. x 13.0 in.)

Specifications are subject to change without notice.



MODEL		EH12-2D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Horizontal P.T.O. Shaft, OHV Gasoline Engine
Bore x Stroke		60 x 43 mm (2.36 x 1.69 in.)
Piston Displacement		121 cm <sup>3</sup> (7.39 cu. in.)
Compression Ratio		9.0
Output	Continuous	2.1 kW (2.8 HP) /3600 r.p.m.
	Max.	2.6 kW (3.5 HP) /3600 r.p.m.
Max. Torque		7.5 N · m (0.76 kgf · m) /2600 r.p.m.
Direction of Rotation		Counterclockwise As Viewed From P.T.O. Shaft Side
Cooling system		Forced Air Cooling
Valve Arrangement		Overhead Valve
Lubrication		Splash Type
Lubricant		Automobile Oil SAE #20, #30 or 10W-30 ; Class SE or higher
Capacity of Lubricant		0.4 liters (0.11 U.S. gal.)
Carburetor		Horizontal Draft, Float Type or Diaphragm
Fuel		Automobile Unleaded Gasoline
Fuel Consumption Ratio		310 g/kW · h (230 g/HP · h) At Continuous Rated Output
Fuel Feed System		Gravity Type
Ignition System		Flywheel Magneto (Solid State)
Spark Plug		NGK B6ES, BR6ES
Starting System		Recoil Starter
Governor System		Centrifugal Flyweight Type
Air Cleaner		Dual Element Type
Dry Weight		15.9 kg (35.1 lb.)
Dimensions (L x W x H)		286 mm x 330 mm x 334 mm (11.3 in. x 13.0 in. x 13.1 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 engine be kept below this continuous rated output.

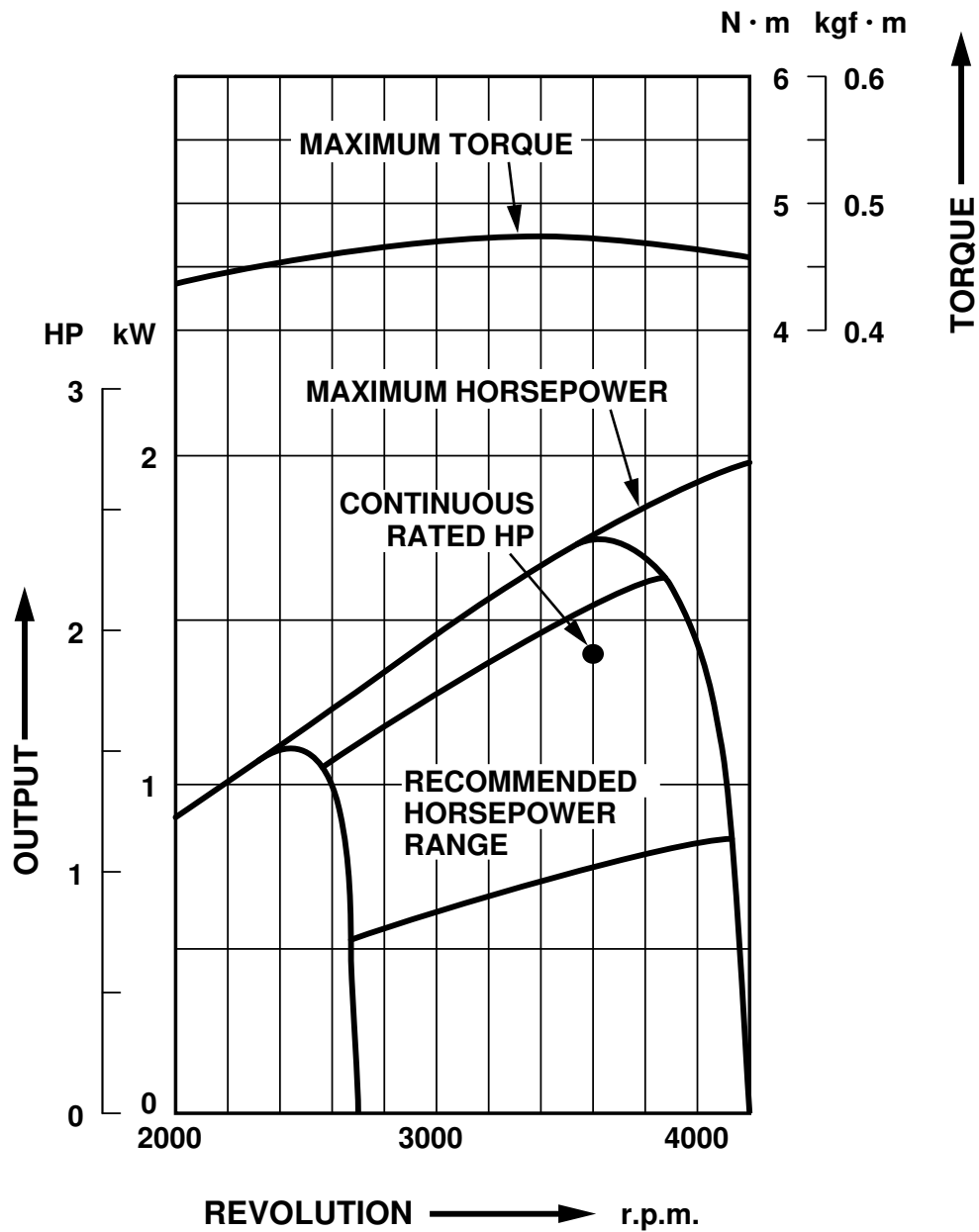
### 2-3 MAXIMUM TORQUE

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



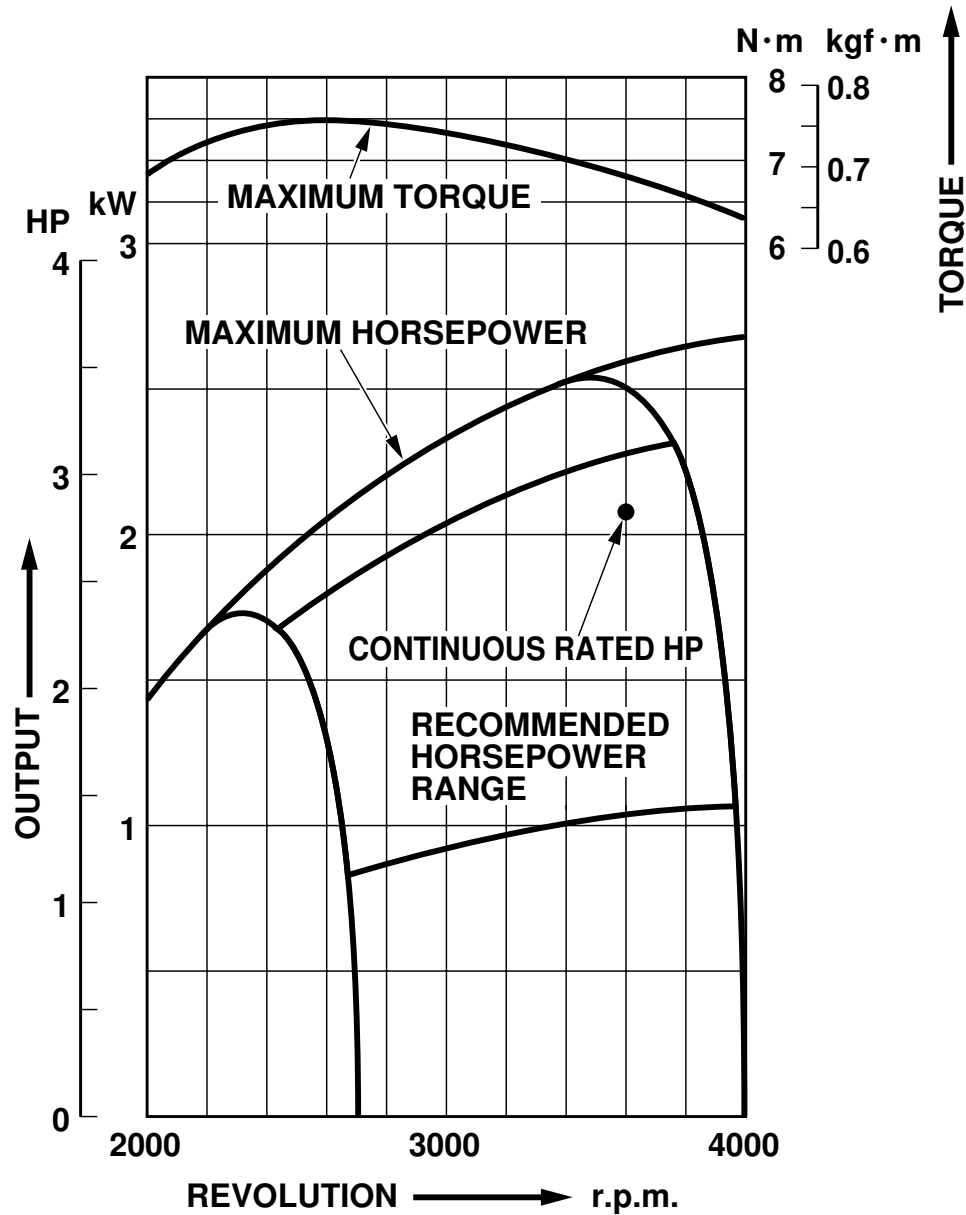
EH09D







EH12-2D



### 3. FEATURES



1. The EH09D and EH12-2D engines are designed exclusively for rammers.  
Optimum lubrication and better inclined operation are obtained thanks to upright cylinder design.
2. Easy operation  
These engines, with its upright cylinder, reduce swinging moment and achieved easier operation for rammers.  
Because the direction of vibratory force caused by reciprocating parts, such as piston and connecting rod, is the same as the jumping direction of the rammer itself. Furthermore, these engines are designed carefully to balance the weight on the rammer by locating the air cleaner and muffler symmetrically with the center line of the cylinder.
3. Improved durability  
Vibration damping and durability are greatly improved by introducing a vibration-proof breather mechanism, thick sheet metal, reinforced casting parts with thick walls and ribs, and a carburetor that prevents fuel leakage when the engine is inclined.
4. Ideal engine performance for rammer  
The overhead valve design offers ideal combustion characteristics.  
More emphasis was placed on the continuous rated power of the engine than its maximum power, considering operating characteristics when the engine is mounted on a rammer.
5. Easy starting  
Combining an ignition system with an advanced spark timing and mechanical compression release improves start-ability. Equipped with a low-speed governor, it can be started without operating the throttle.
6. Economical and clean engine  
These engines achieved fuel-efficiency and cleanliness, reducing polluting exhaust emission remarkably.



## 4. GENERAL DESCRIPTION OF ENGINE COMPONENTS

### 4-1 CYLINDER AND CRANKCASE

The cylinder and crankcase is a single piece aluminum die-casting.

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

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

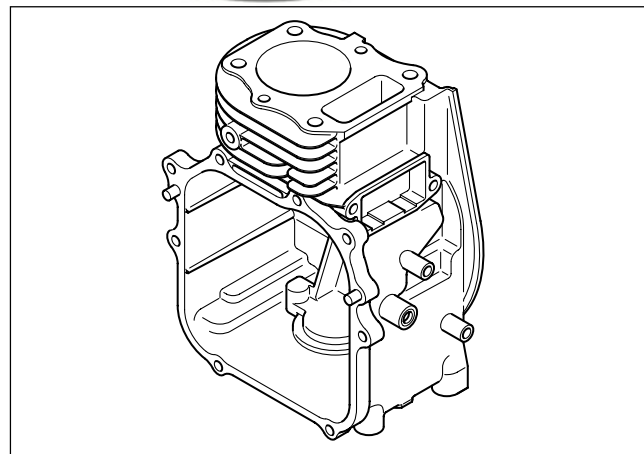


Fig. 4-1

### 4-2 MAIN BEARING COVER

The main bearing cover is an aluminum die-casting with thick reinforcing walls and ribs, which is mounted on the output shaft side of the crankcase.

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

Pilots and bosses are machined on the cover for direct mounting of the engine onto rammers.

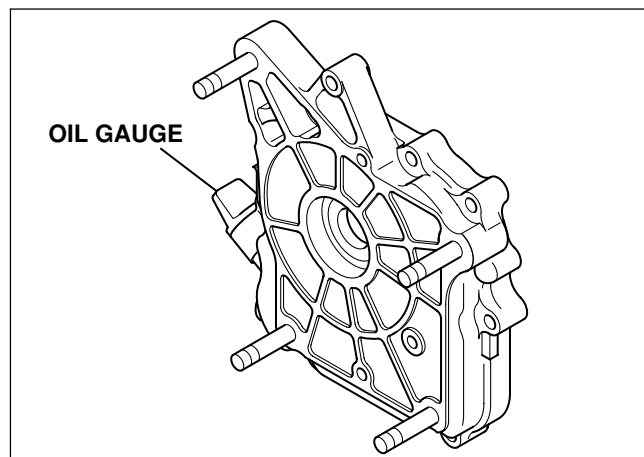


Fig. 4-2

### 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.

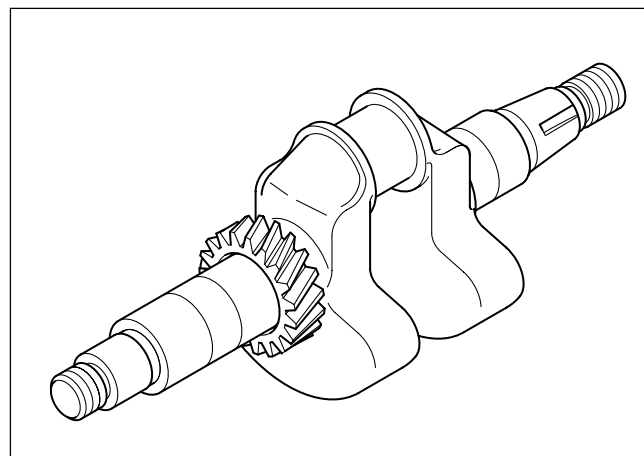


Fig. 4-3



#### 4-4 CONNECTING ROD AND PISTON

The connecting rod is an aluminum alloy die-casting and its large and small ends function as bearings.

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

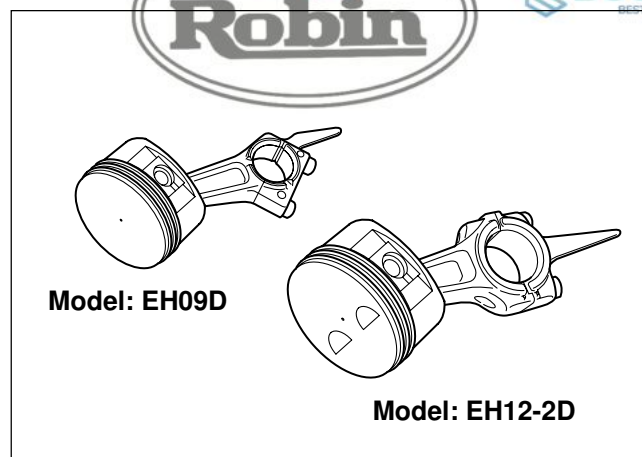


Fig. 4-4

#### 4-5 PISTON RINGS

The piston rings are made of special cast iron.

The profile of the top ring and the second ring are shown in the illustration.

The oil ring is designed for better sealing and less oil consumption.

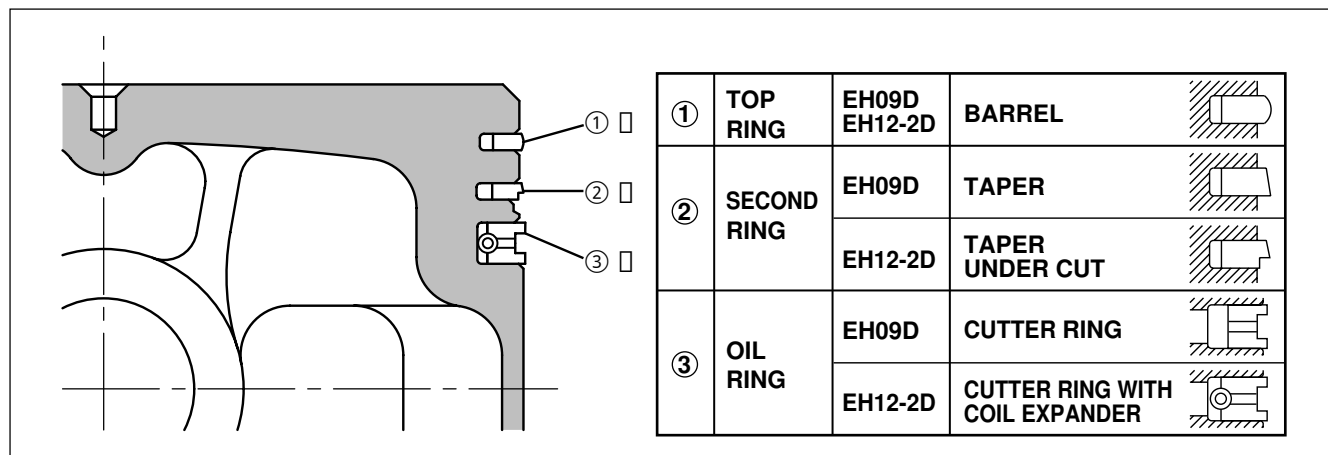


Fig. 4-5

#### 4-6 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.

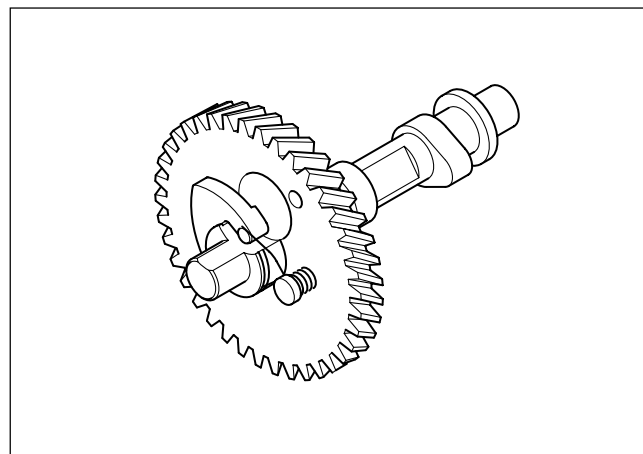


Fig. 4-6

## 4-7 VALVE ARRANGEMENT

The intake valve is located on the flywheel side of the cylinder head.  
Hard alloy valve seats are molded in the cylinder head and satellite is fused to the exhaust valve face.  
The cylinder baffle leads cooling air to the exhaust valve area for the optimum cooling.

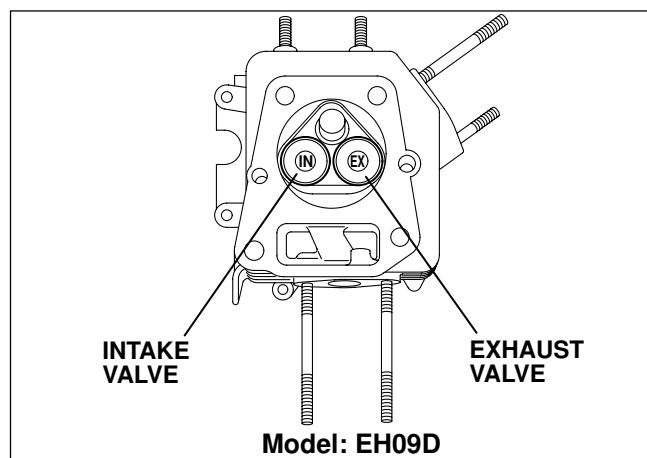


Fig. 4-7a

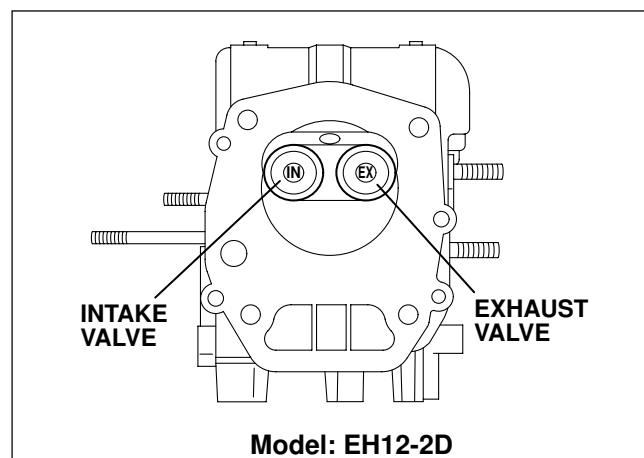


Fig. 4-7b

## 4-8 CYLINDER HEAD

The cylinder head is an aluminum die-casting which utilizes wedge type combustion chamber for the high combustion efficiency.

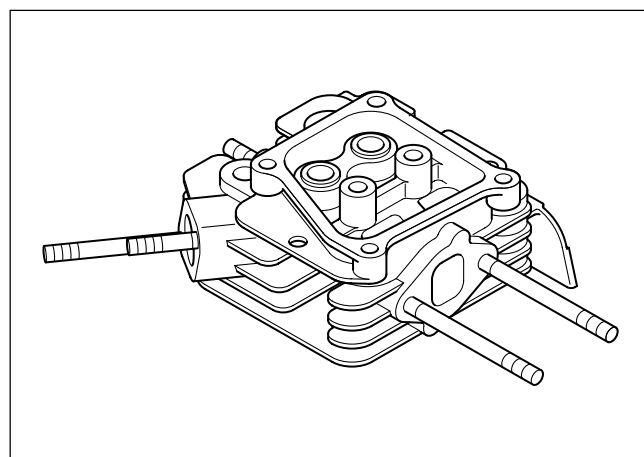


Fig. 4-8

## 4-9 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.

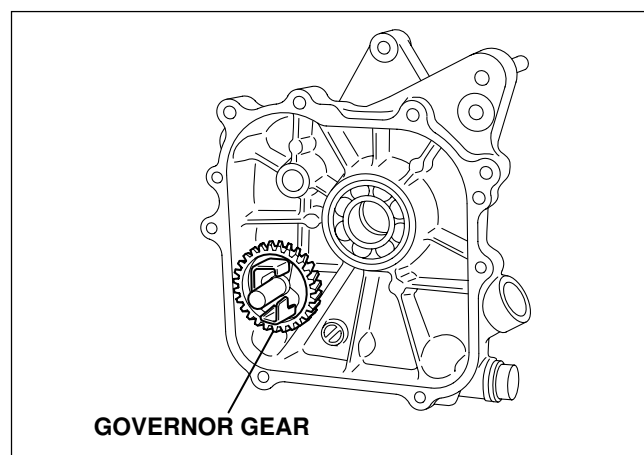


Fig. 4-9

## 4-10 COOLING SYSTEM

The large fins on the flywheel provide sufficient cooling air capacity for the inlet and exhaust area and cylinder. The cylinder baffle directs the cooling air flow efficiently.

## 4-11 LUBRICATION SYSTEM

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

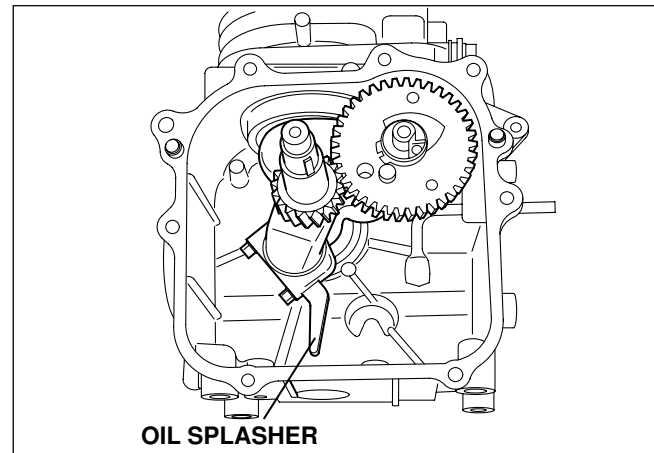


Fig. 4-10

## 4-12 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.

This system has an automatic ignition timing advance system for easy starting.

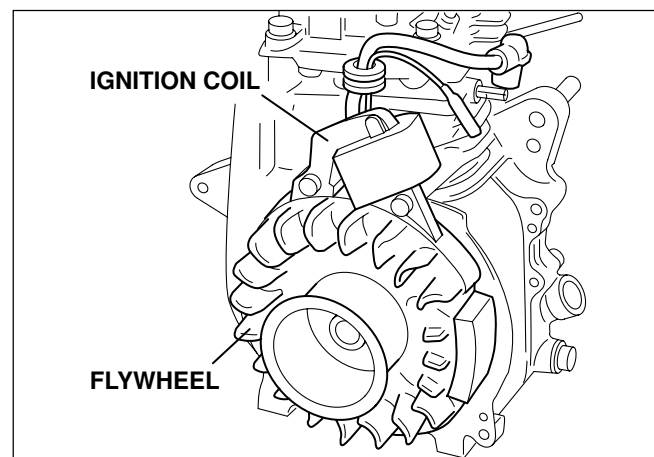


Fig. 4-11

## 4-13 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 maximum output.

For details, refer to page 50, section "8a FLOAT CARBURETOR (EH09D)" or refer to page 53, section "8b FLOAT CARBURETOR (EH12-2D)".

As an optional part, diaphragm type is available. For details, refer to page 56, section "8c DIAPHRAGM CARBURETOR (OPTION)".

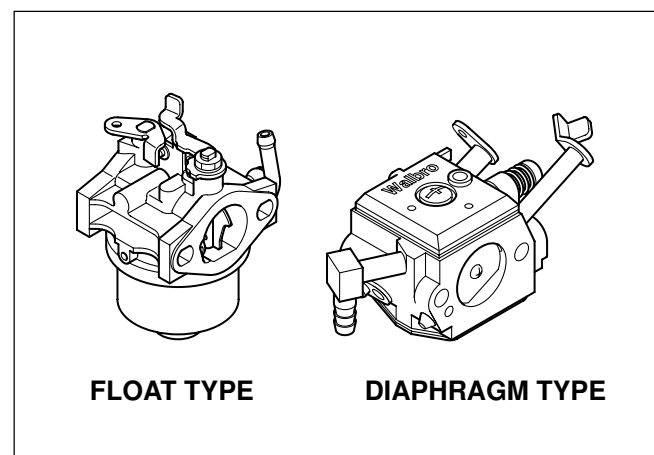


Fig. 4-12

#### 4-14 AIR CLEANER

The air-cleaner is a heavy-duty type with a dual element system ; the primary one is an urethane foam (semi-wet) and secondary one is a semi wet type element.

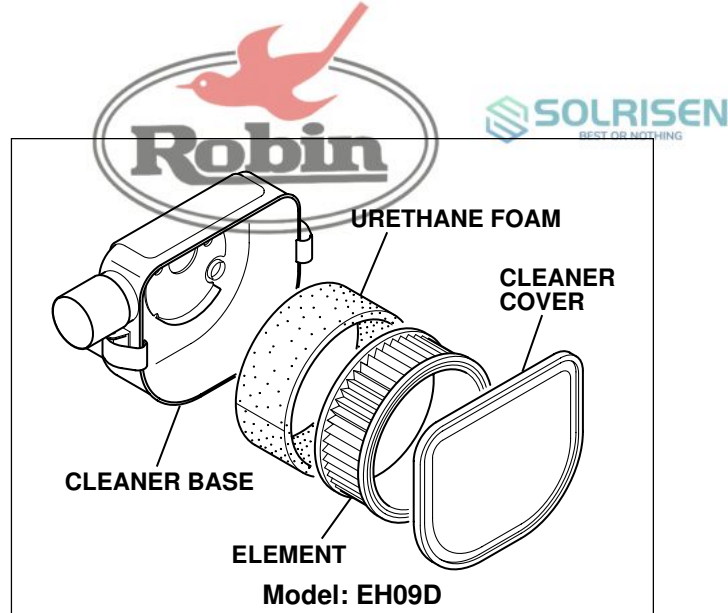


Fig. 4-13a

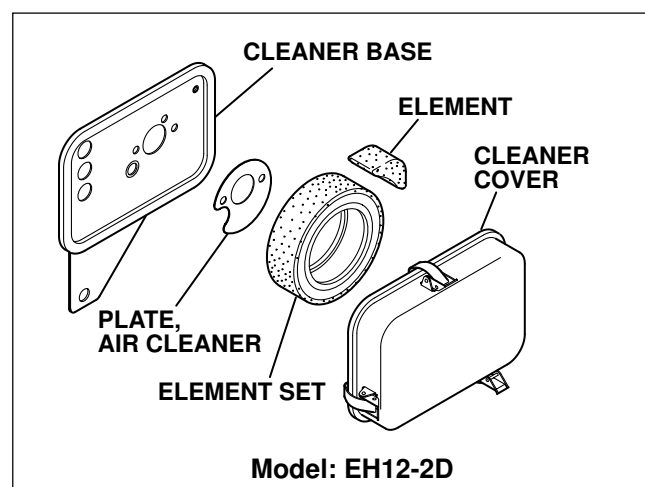


Fig. 4-13b

#### 4-15 DECOMPRESSION SYSTEM

An automatic decompression mechanism which opens the exhaust valve before the piston reaches maximum compression is assembled on the camshaft for easy starting.

During engine operation the decompression system is overpowered by centrifugal force and compression is fully utilized to produce power.

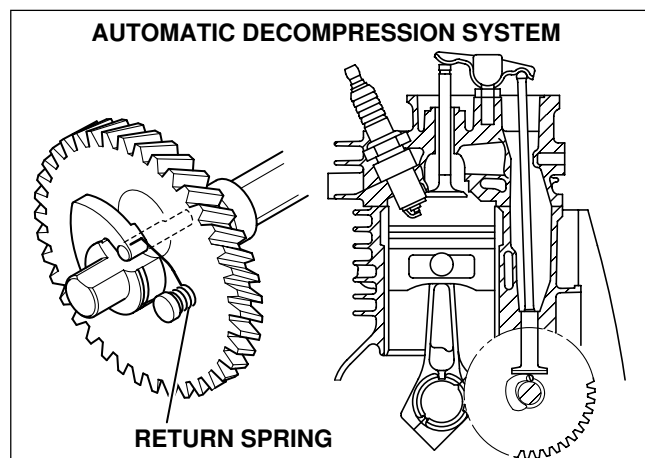


Fig. 4-14

## 4-16 SECTIONAL VIEW OF ENGINE



EH09D

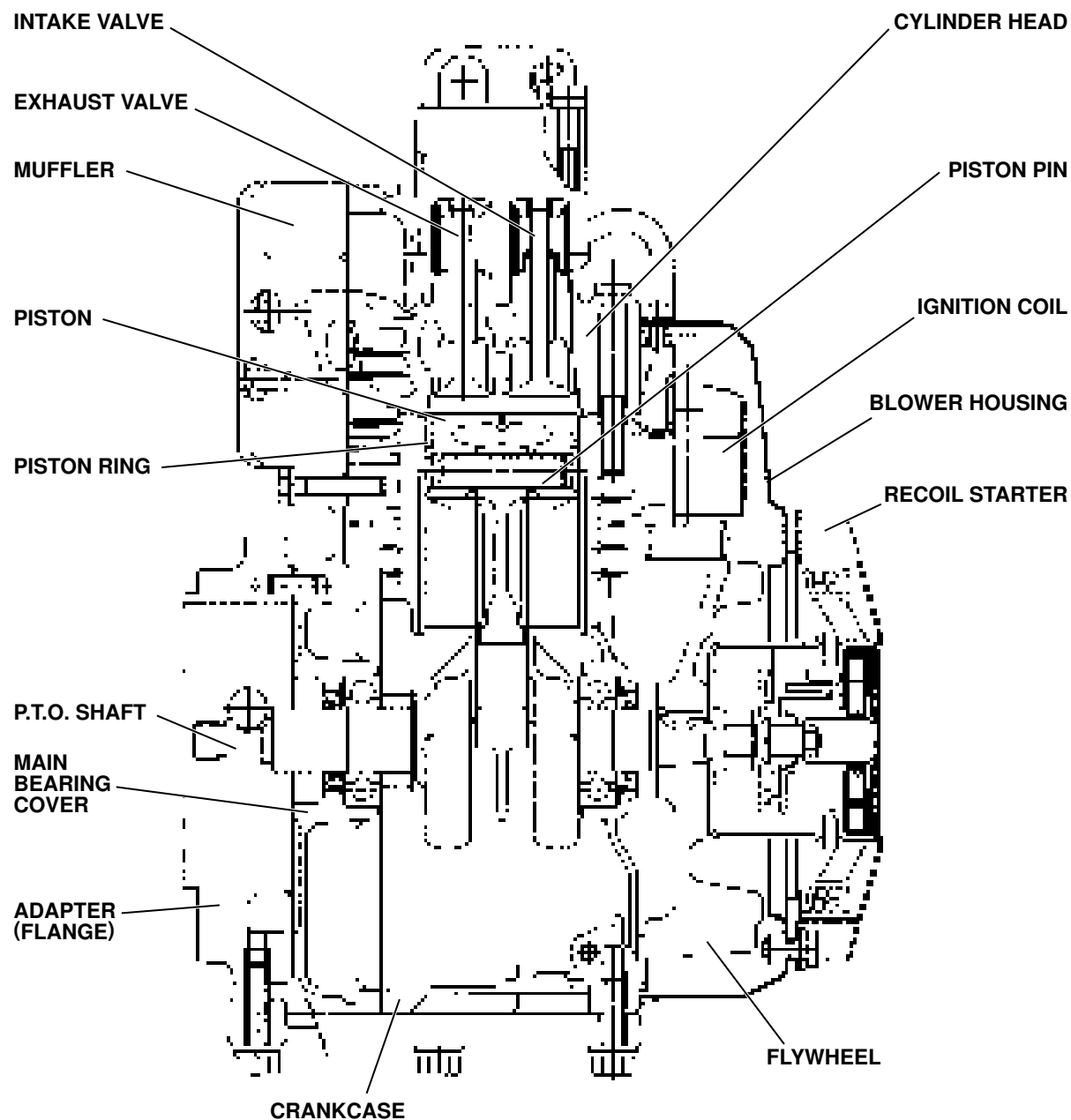


Fig. 4-15



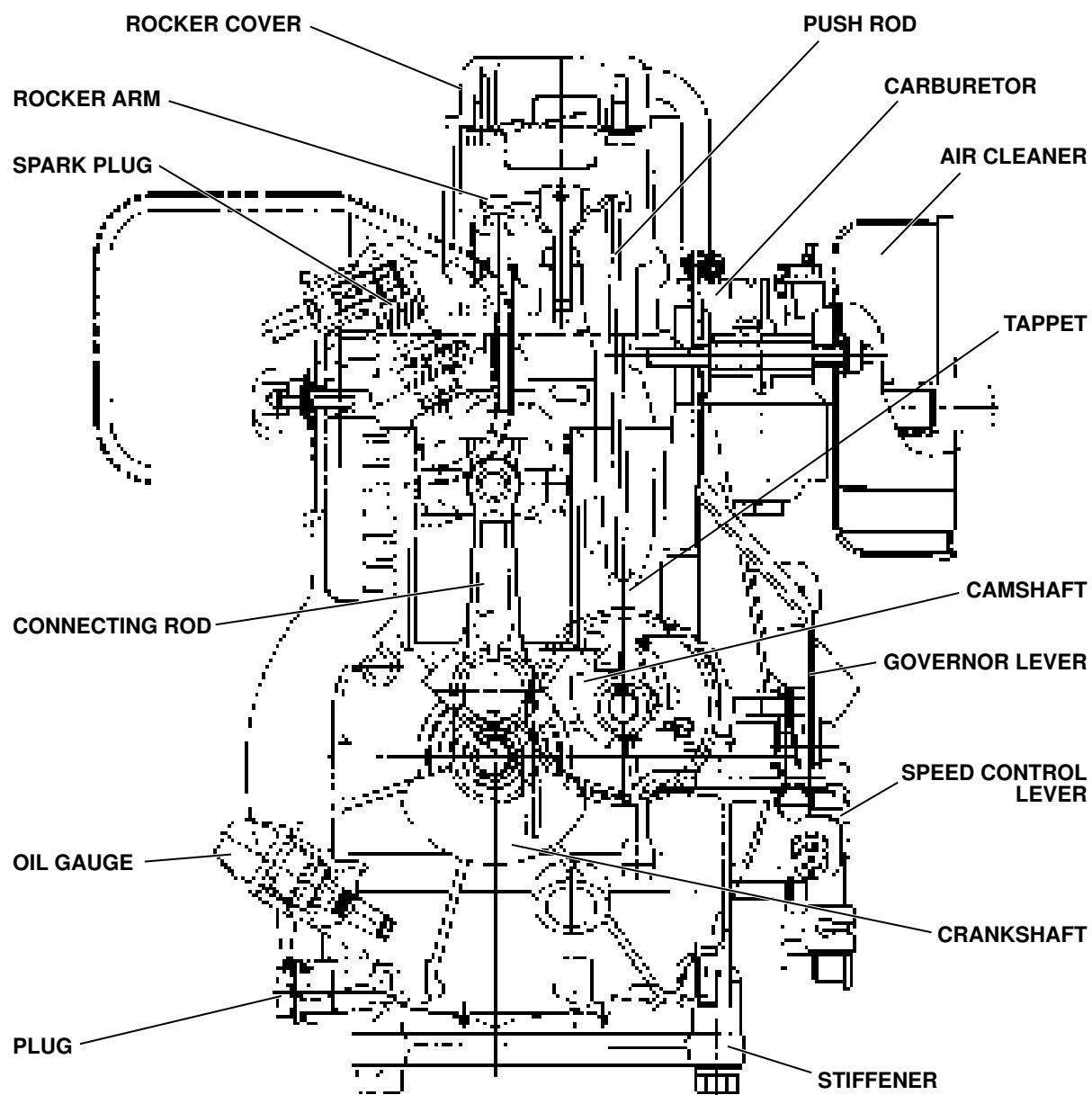


Fig. 4-16

EH12-2D

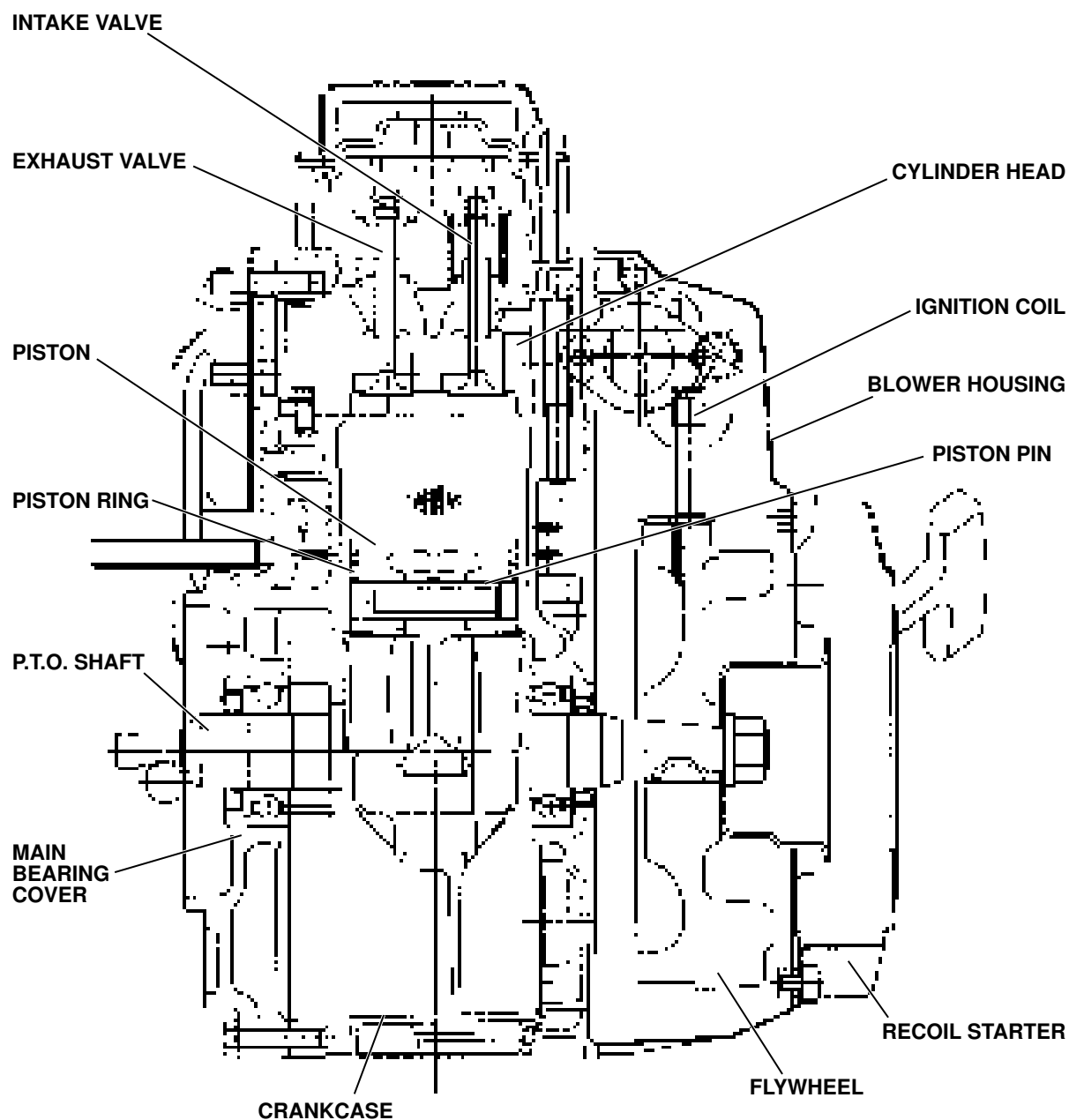


Fig. 4-17

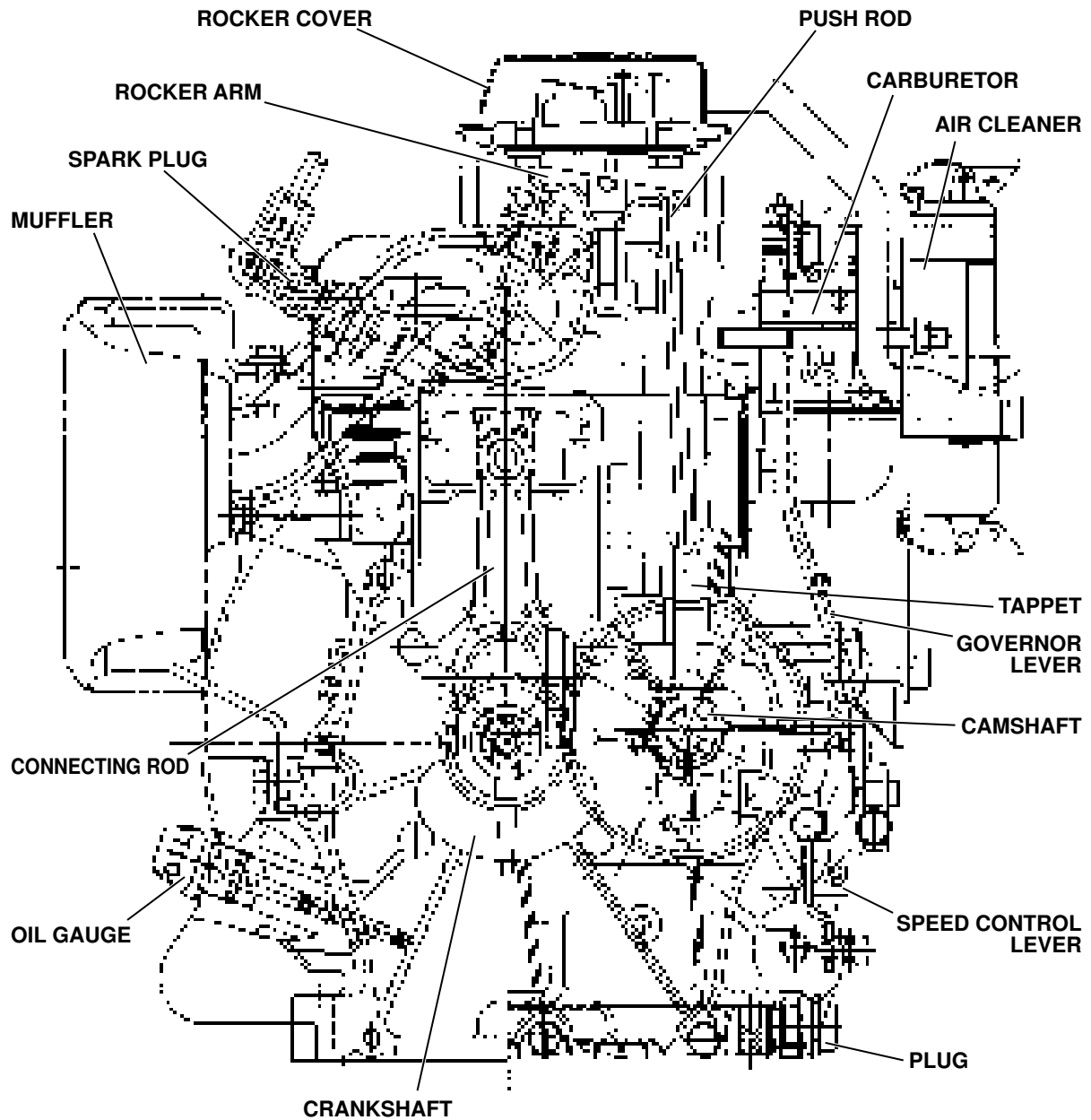


Fig. 4-18

## 5. DISASSEMBLY AND REASSEMBLY

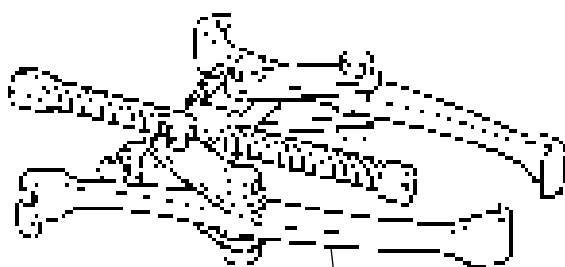


### 5-1 PREPARATIONS AND SUGGESTIONS

- 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 (EH12-2D)

Tool No.	Tool	Use
Market parts	Flywheel puller	For pulling off the flywheel



**FLYWHEEL PULLER**

*Fig. 5-1*

## 5-3 DISASSEMBLY PROCEDURES

Step	Parts to remove	Remarks and procedures	Fasteners
1	Engine oil drain	(1) Remove oil drain plug and drain oil. (2) To discharge oil quickly, remove oil gauge.	
2	<b>EH09D</b> Adapter and Stiffener		M8 x 25 : 4 pcs. M8 x 30 : 2 pcs. M8 nut, washer, spring washer : 4pcs

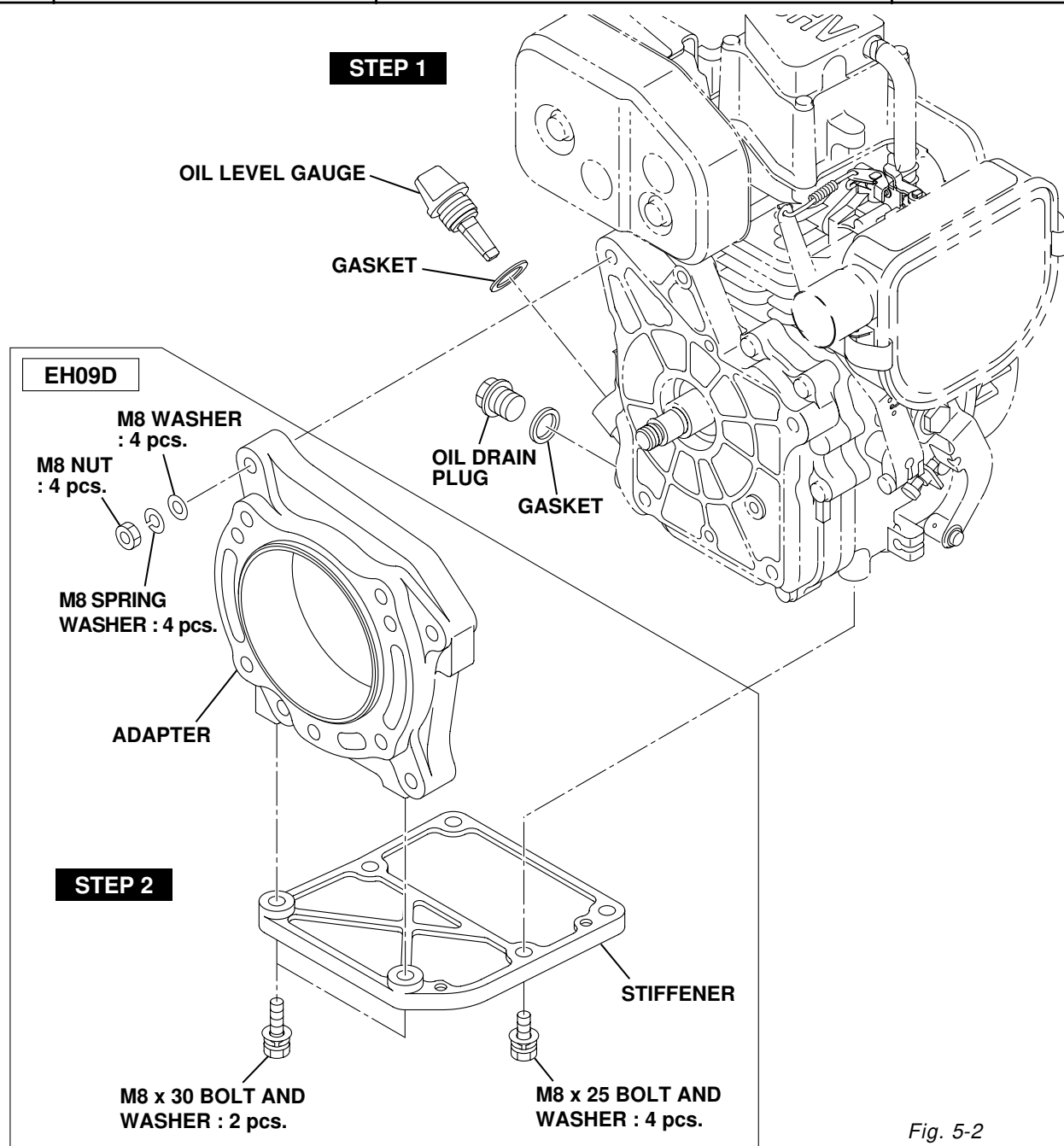
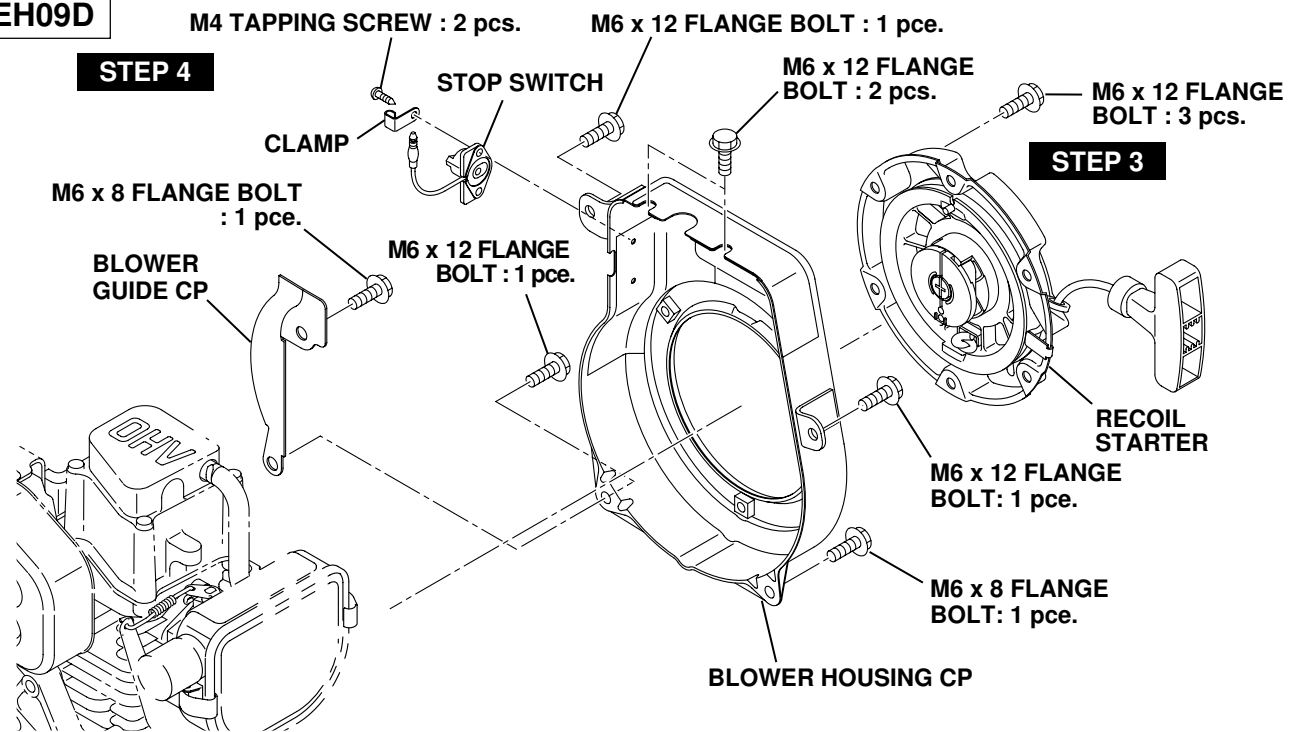


Fig. 5-2

Step	Parts to remove	Remarks and procedures	Fasteners
3	Recoil starter		M6 x 12 ; 3 pcs. (EH09D) M6 x 8 ; 4 pcs. (EH12-2D)
4	Blower housing	Disconnect wire of stop switch first, then remove blower housing from crankcase.	M6 x 12 ; 5 pcs. (EH09D) M6 x 8 ; 2 pcs. (EH09D) M6 x 55 ; 4 pcs. (EH12-2D)

### EH09D



### EH12-2D

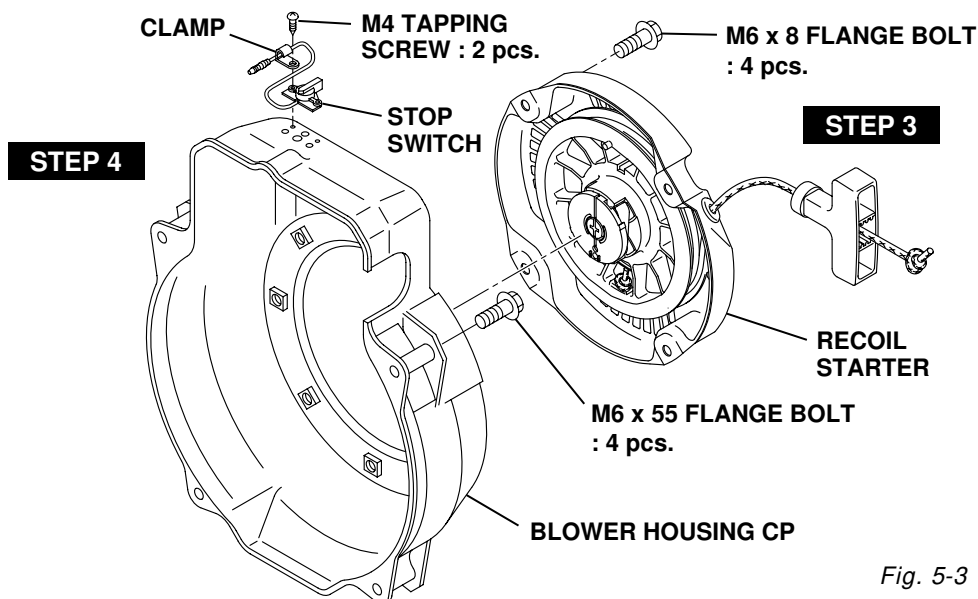
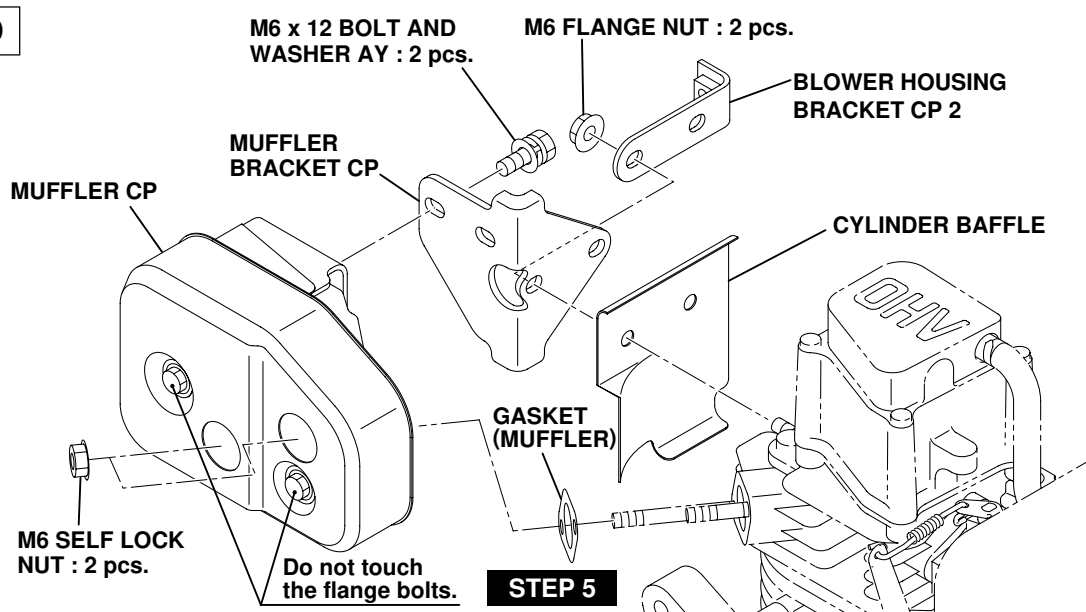


Fig. 5-3

Step	Parts to remove	Remarks and procedures	Fasteners
5	<b>EH09D</b> Muffler, muffler bracket and cylinder baffle	Be careful not to lose muffler gasket.	M6 self lock nut ; 2 pcs. M6 x 12 ; 2 pcs. M6 flange nut ; 2pcs.
	<b>EH12-2D</b> Muffler, muffler bracket and head cover	Remove spark plug cap first from spark plug. Be careful not to lose muffler gasket.	M8 self lock nut ; 2 pcs. M8 x 16 ; 4 pcs. M8 washer ; 2 pcs. M6 x 18 ; 2pcs.

### EH09D



### EH12-2D

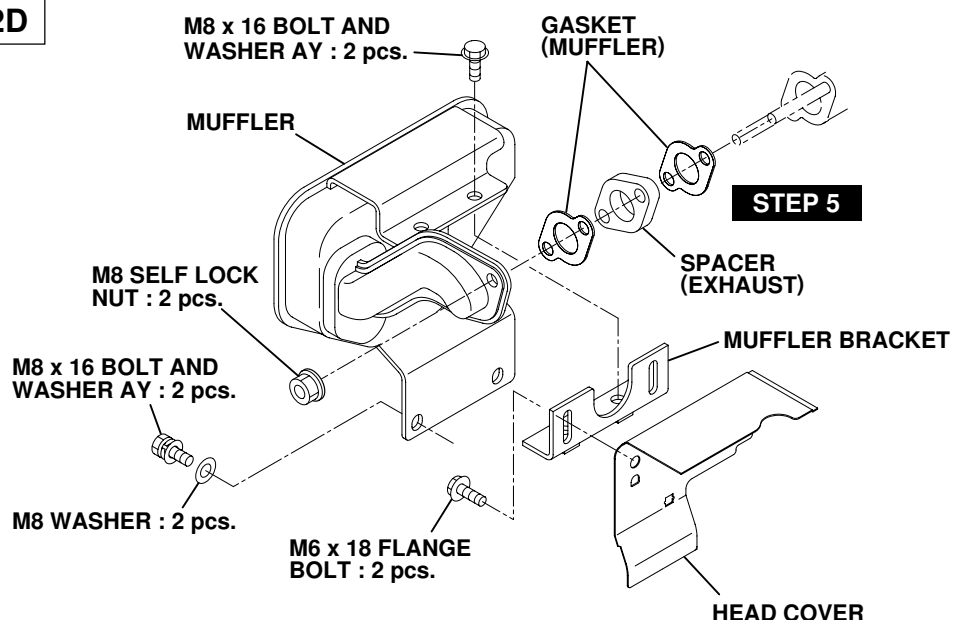
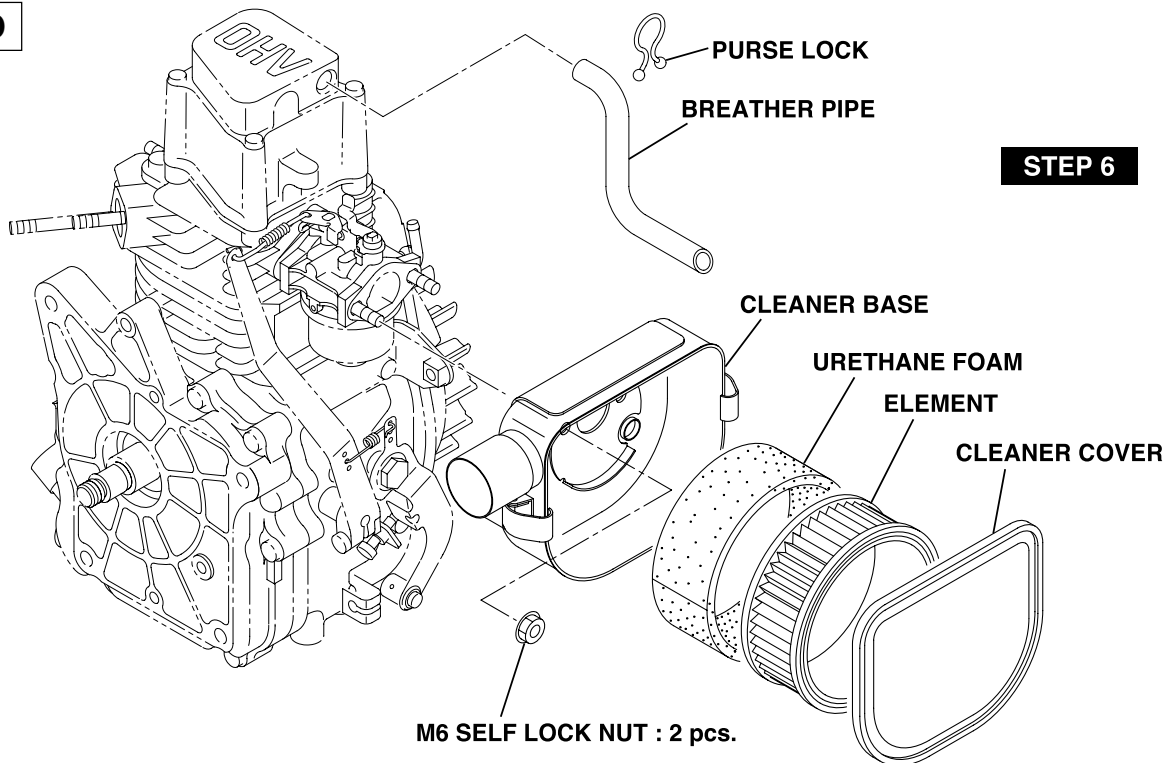


Fig. 5-4

Step	Parts to remove	Remarks and procedures	Fasteners
6	Air cleaner	Remove breather pipe from rocker cover.	M6 nut ; 2 pcs. M8 x 18 ; 1 pce. (EH12-2D)

**EH09D**



**EH12-2D**

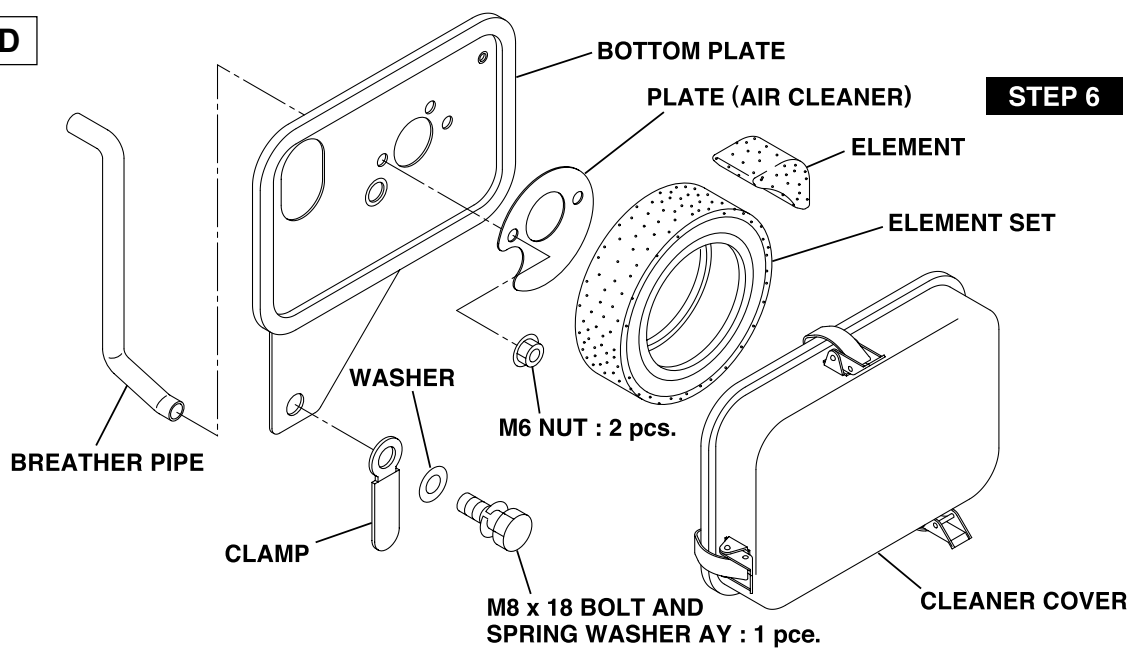


Fig. 5-5



EH09D

Step	Parts to remove	Remarks and procedures	Fasteners
7	Governor lever	(1) Loosen the bolt and remove governor lever. (2) Unhook governor spring from governor lever. Mark the hole on which the governor spring is hooked.	M6 x 25 ; 1 pce.
8	Carburetor	Remove carburetor carefully unhooking governor rod and rod spring from governor lever.	
9	Speed control lever and base plate		M6 pivot bolt ; 1 pce. M6 x 8 flange bolt ; 2 pcs.

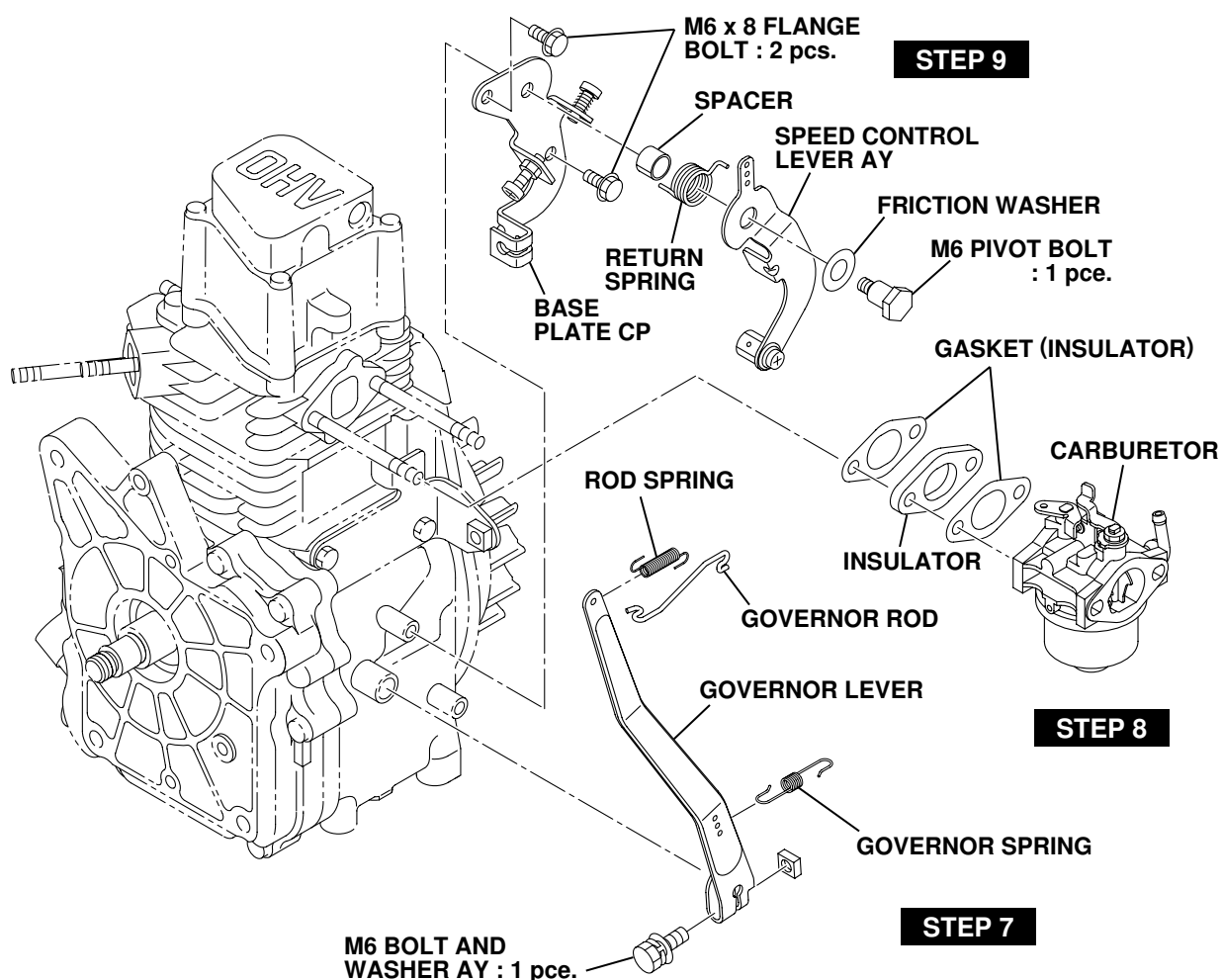


Fig. 5-6

**EH12-2D**

Step	Parts to remove	Remarks and procedures	Fasteners
7	Governor lever	(1) Remove the protector. (2) Loosen the bolt and remove governor lever. (3) Unhook governor spring from governor lever. Mark the hole on which the governor spring is hooked.	M8 x 16 ; 1 pce. M6 x 14; 1pce. M6 x 30 ; 1pce.
8	Carburetor and intake pipe	Remove carburetor carefully unhooking governor rod and rod spring from governor lever.	M6 nut ; 2 pcs. M6 x 40 ; 1 pce.
9	Speed control lever and wire bracket		M6 pivot bolt ; 1 pce. M6 x 14 flange bolt ; 1 pcs.

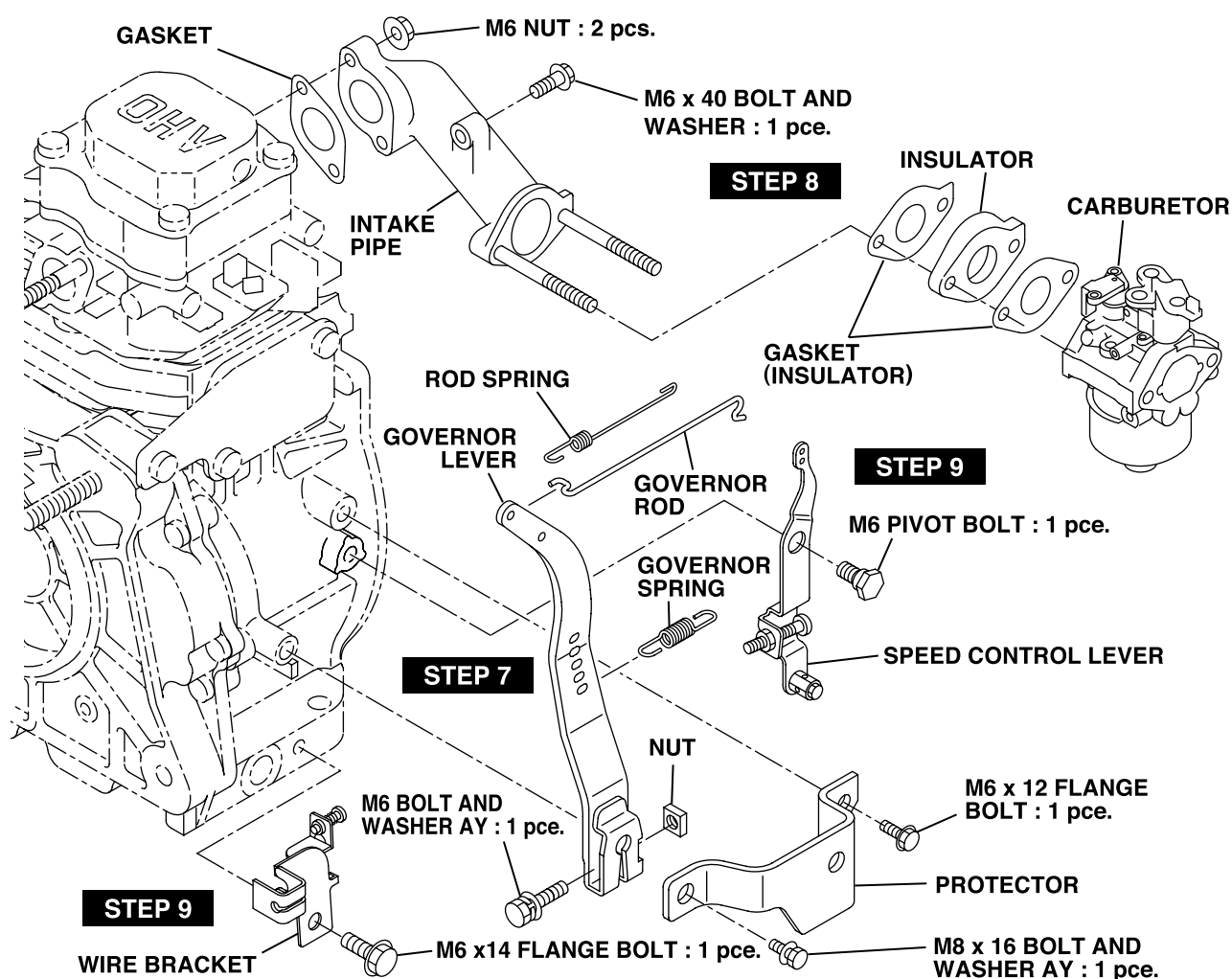


Fig. 5-7

Step	Parts to remove	Remarks and procedures	Fasteners
10	Ignition coil	(1) Remove spark plug cap from spark plug. (2) Remove ignition coil from crankcase.	M6 x 25 ; 2 pcs.
11	Flywheel	(1) Remove the starter pulley from flywheel. Place socket wrench on flywheel fastening nut and strike tip of the lever with hammer. (See Fig. 5-9.) (2) <b>EH09D</b> Tap on flywheel end of crankshaft using aluminum bar to remove flywheel. (See Fig. 5-10.) <b>EH12-2D</b> Remove flywheel using the flywheel puller. (See Fig. 5-11.) (3) Remove the key from crankshaft. (See Fig. 5-12.)	M12 nut, spring washer  M14 nut, spring washer
12	Spark plug	NGK : BM6A, BMR6A (EH09D) NGK : B6ES, BR6ES (EH12-2D)	

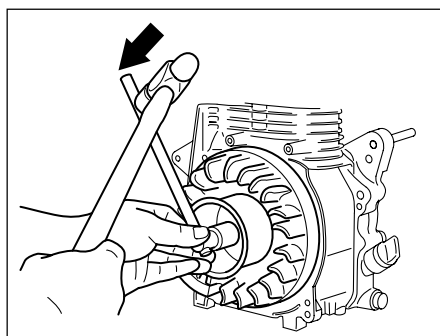


Fig. 5-9

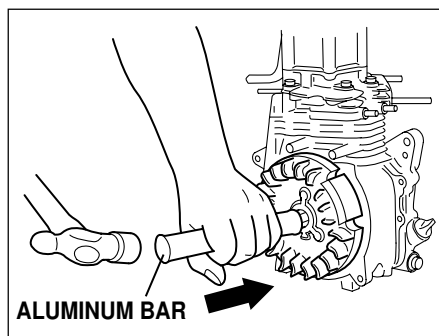


Fig. 5-10

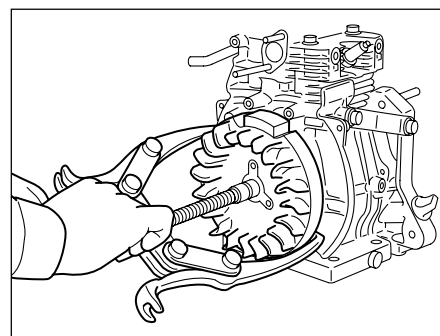


Fig. 5-11

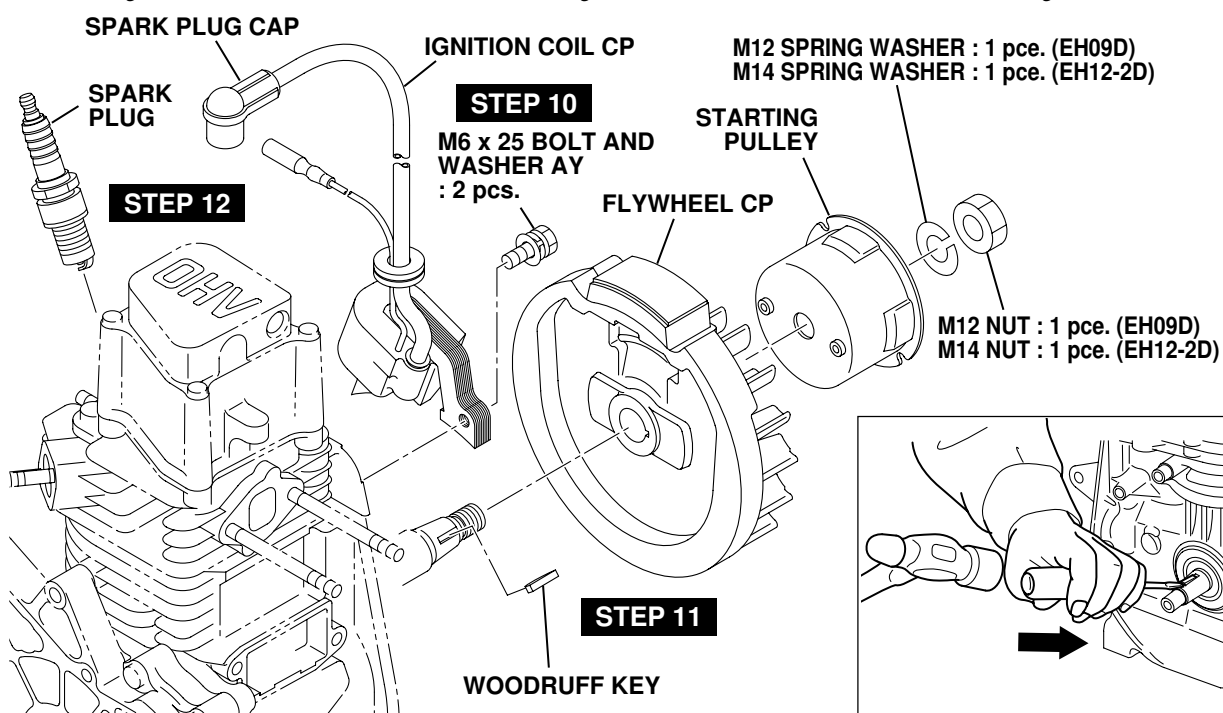


Fig. 5-8

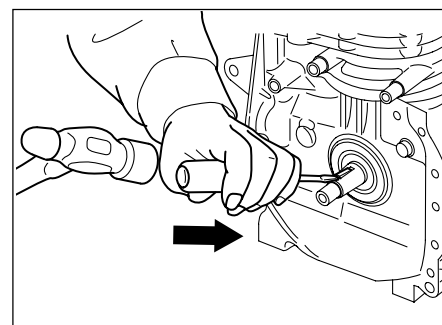
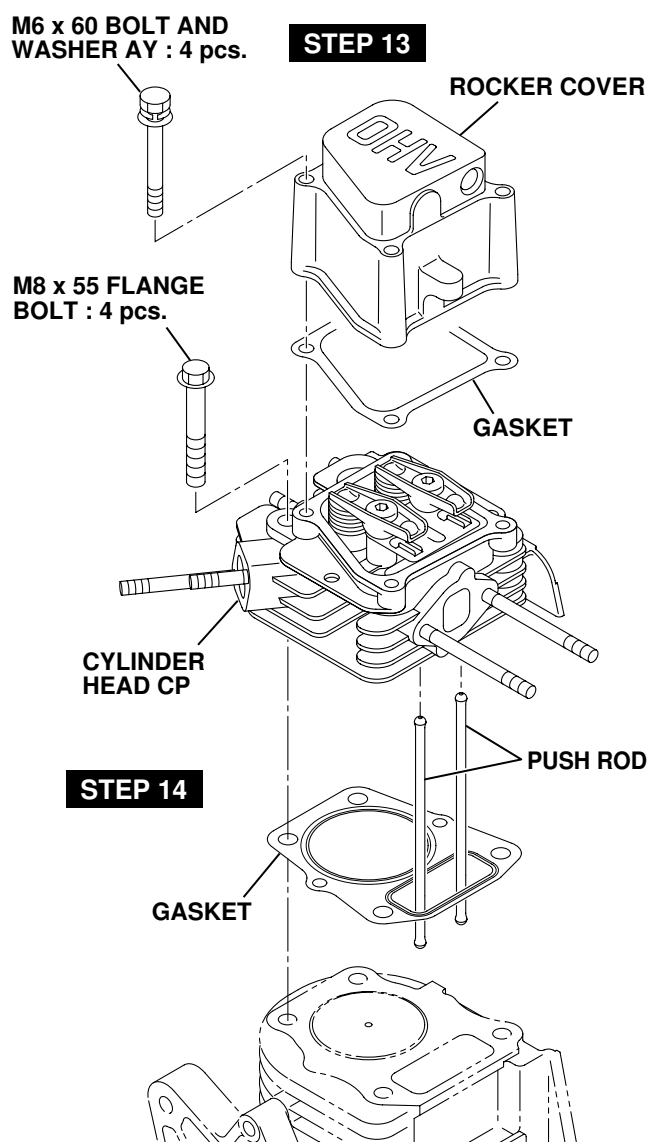


Fig. 5-12

Step	Parts to remove	Remarks and procedures	Fasteners
13	Rocker cover	Remove rocker cover and gasket from cylinder head.	M6 x 60 ; 4 pcs. (EH09D) M6 x 40 ; 4 pcs. (EH12-2D)
14	Cylinder head	(1) Remove cylinder head and gasket from crankcase. (2) Remove push rods from cylinder.	M8 x 55 ; 4 pcs. (EH09D) M8 x 65 ; 4 pcs. (EH12-2D)

### EH09D



### EH12-2D

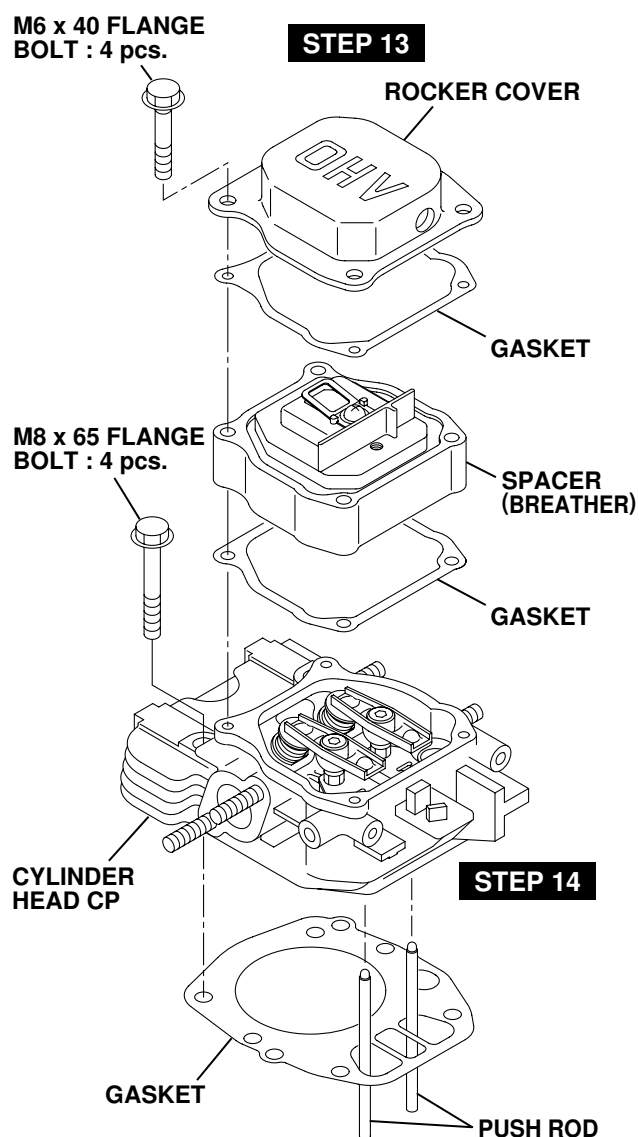


Fig. 5-13

Step	Parts to remove	Remarks and procedures	Fasteners
15	<b>EH09D</b> Main bearing cover	Be careful not to damage the oil seal. Use a soft hammer and evenly tap around outer surface of cover.	M6 x 30 ; 9 pcs.
	<b>EH12-2D</b> Bracket (M.B.C.) and main bearing cover		M8 x 16 ; 3 pcs. M6 x 16 ; 2 pcs. M6 x 30 ; 8 pcs.

### EH09D

#### STEP 15

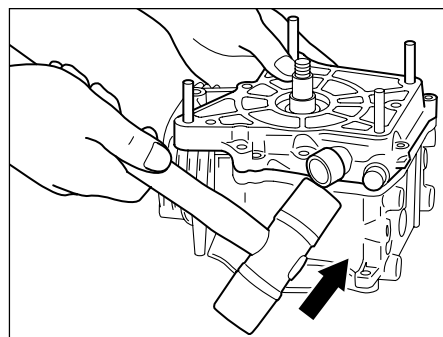
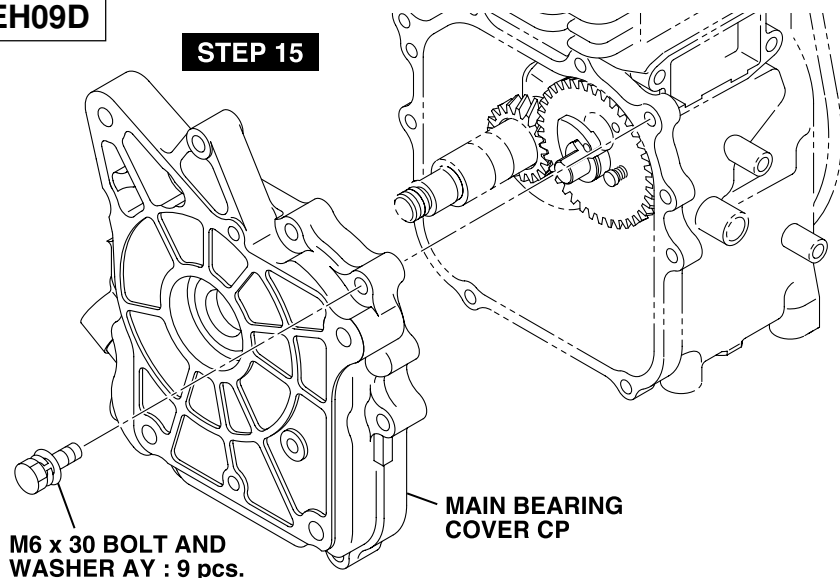


Fig. 5-15

### EH12-2D

#### STEP 15

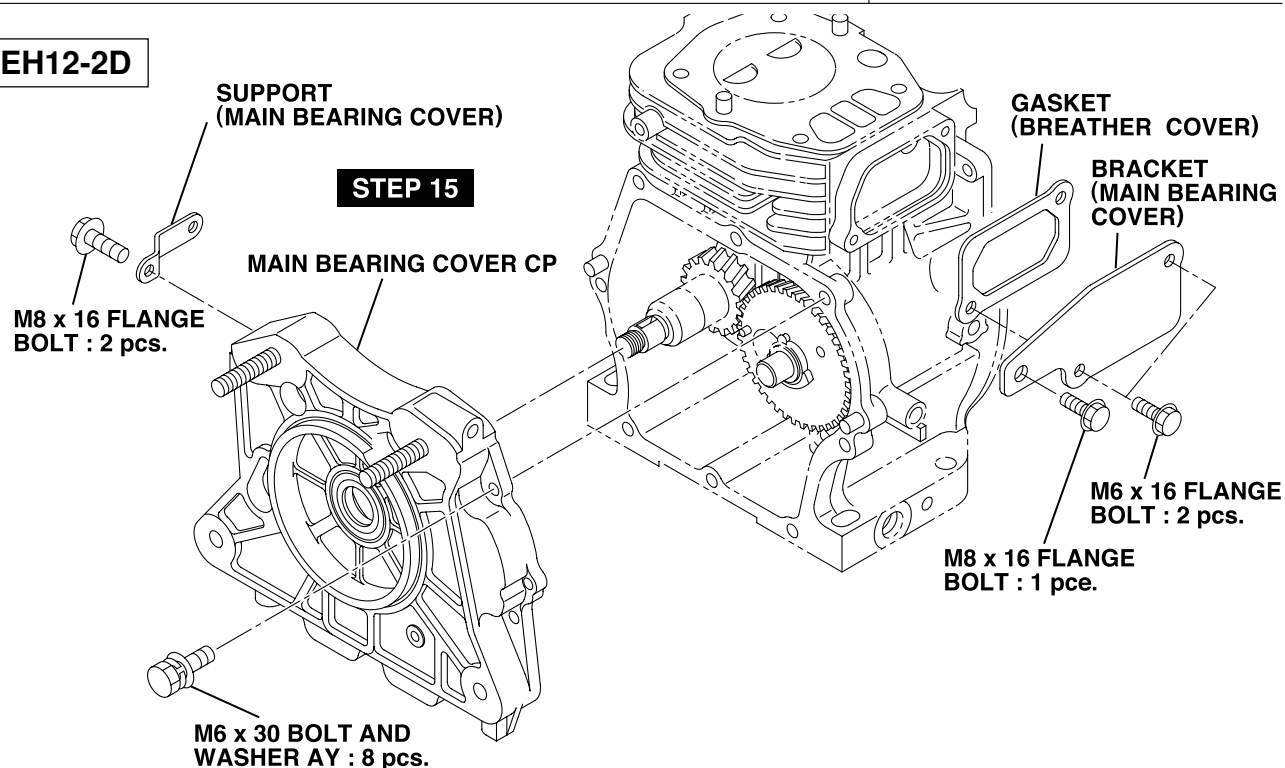


Fig. 5-14

Step	Parts to remove	Remarks and procedures	Fasteners
16	Camshaft and tappets	Lay camcase on the flywheel side push tappets up into the block and remove camshaft. Be careful not to damage camshaft and tappets.	

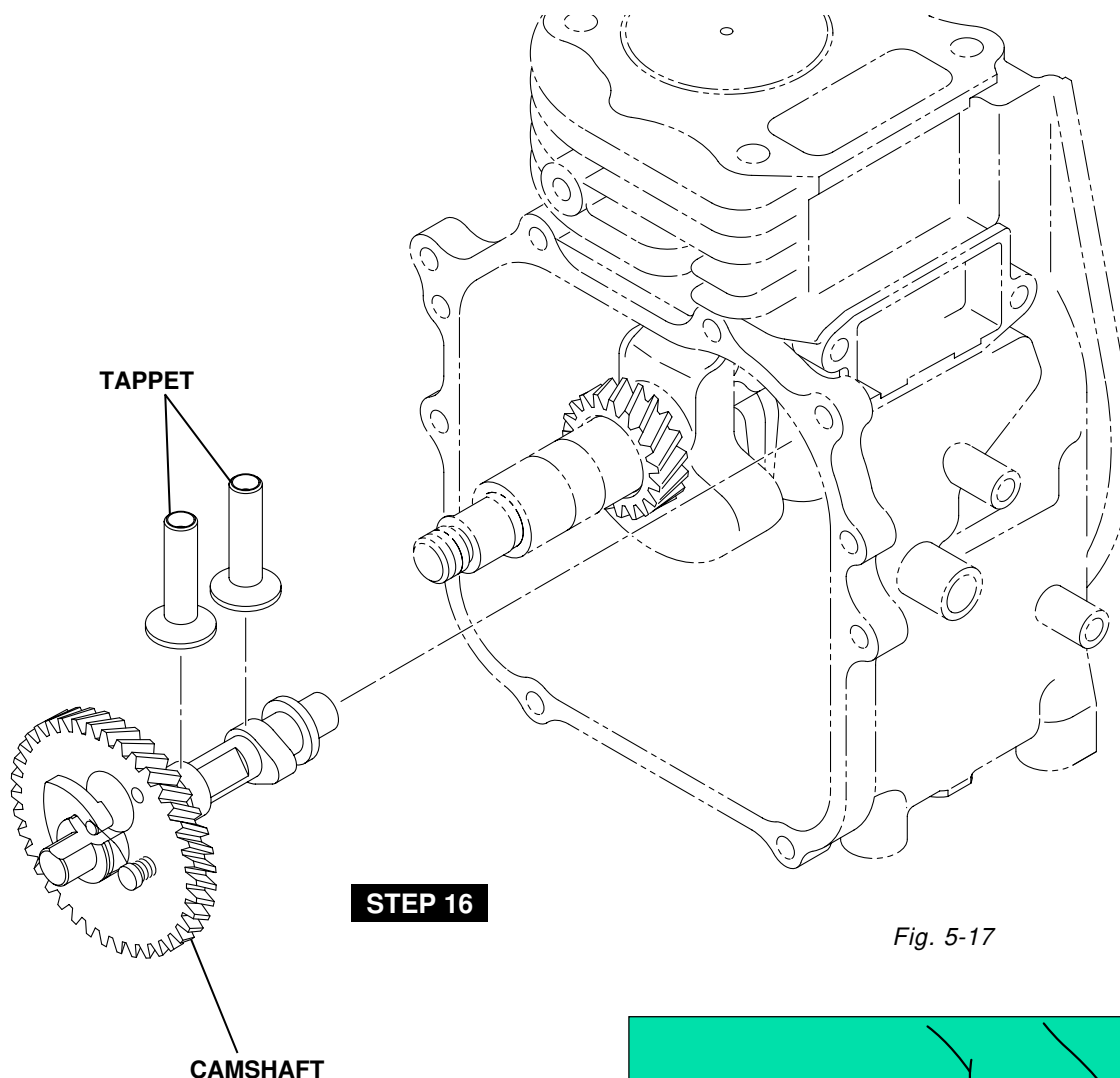


Fig. 5-17

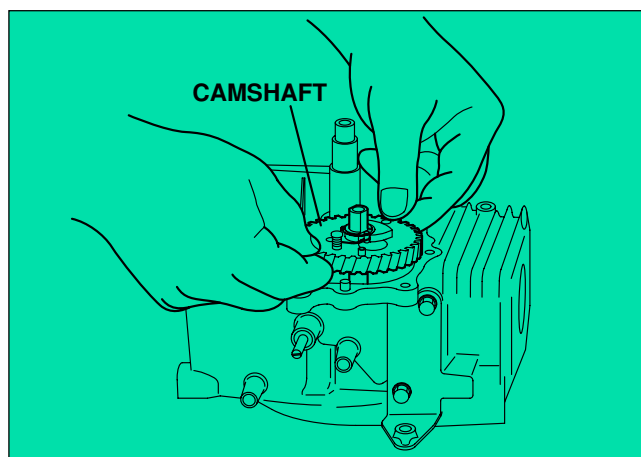
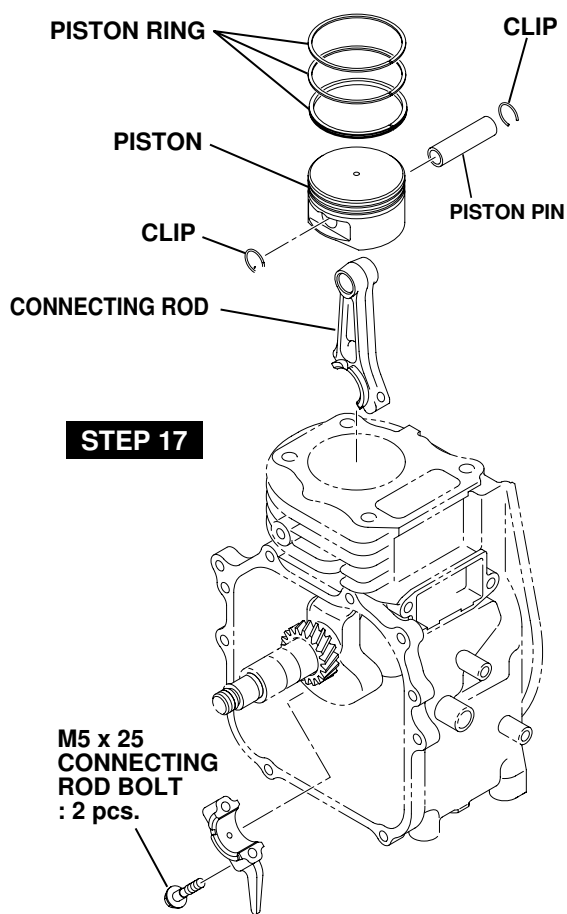


Fig. 5-16



Step	Parts to remove	Remarks and procedures	Fasteners
17	Connecting rod and piston	(1) Remove connecting rod bolts and connecting rod cap. (2) Turn crankshaft until piston comes to top dead center, push out connecting rod and piston assembly through top of cylinder. *Scrape off all carbon deposits that might interfere with removal of piston from upper end of cylinder.	M5 x 25 ; 2 pcs (EH09D) M6 x 34 ; 2 pcs (EH12-2D)
	Piston and piston pin	(1) Remove clips and piston pin to remove connecting rod from piston. (2) Remove piston rings from piston. *Be careful not to damage the piston and connecting rod. Be careful not to break rings by spreading too much or twisting.	

#### EH09D



#### EH12-2D

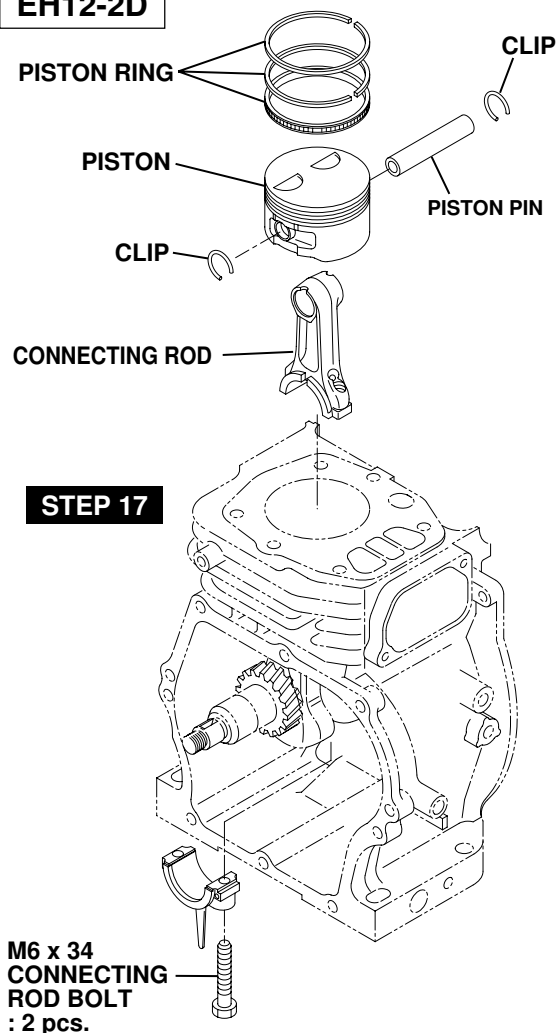


Fig. 5-18

Step	Parts to remove	Remarks and procedures	Fasteners
18	Crankshaft	Tap lightly on flywheel end of crankshaft with a soft hammer to remove from crankcase. *Be careful not to damage oil seal.	

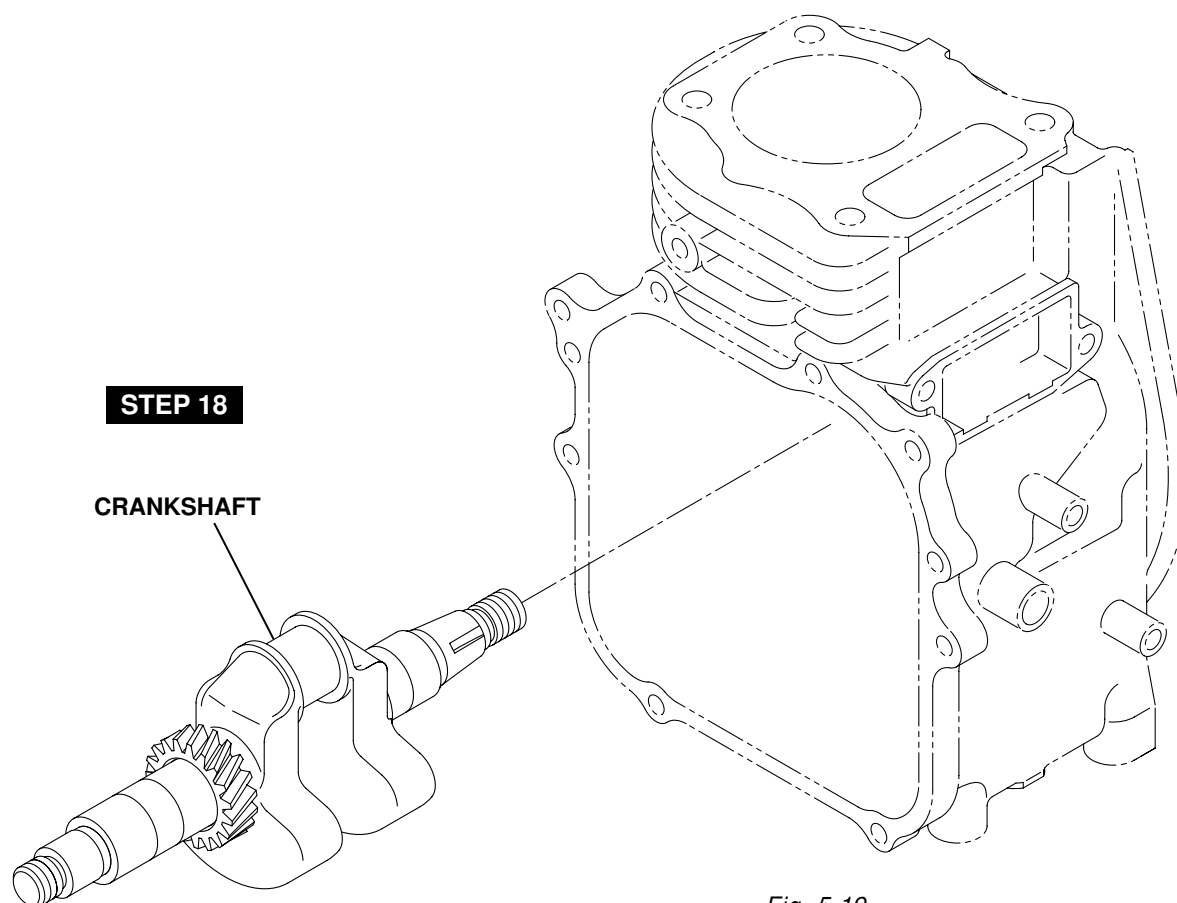


Fig. 5-19

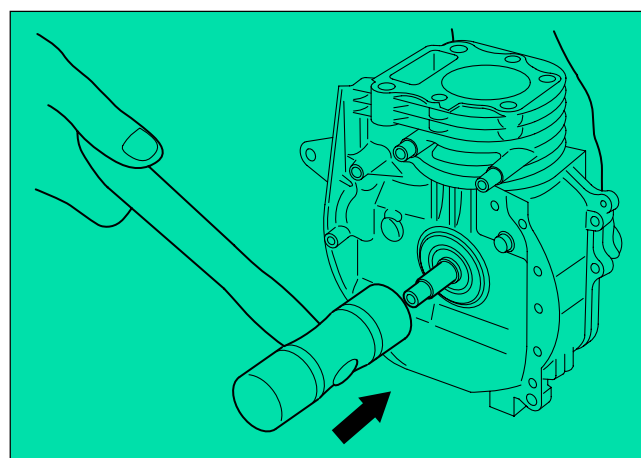


Fig. 5-20



Step	Parts to remove	Remarks and procedures	Fasteners
19	Intake and exhaust valves	<p>(1) Press down the spring retainer, take out collet valve, and then remove spring retainer and valve spring.</p> <p>(2) Remove intake and exhaust valves from cylinder head.</p> <p>* Clean carbon and gum deposit from the valves, valve seats, ports and guides.</p> <p>Inspect valves, valve seats and guides.</p>	

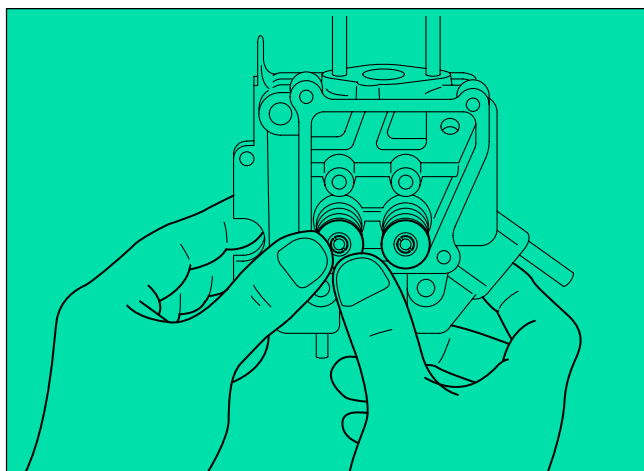


Fig. 5-22

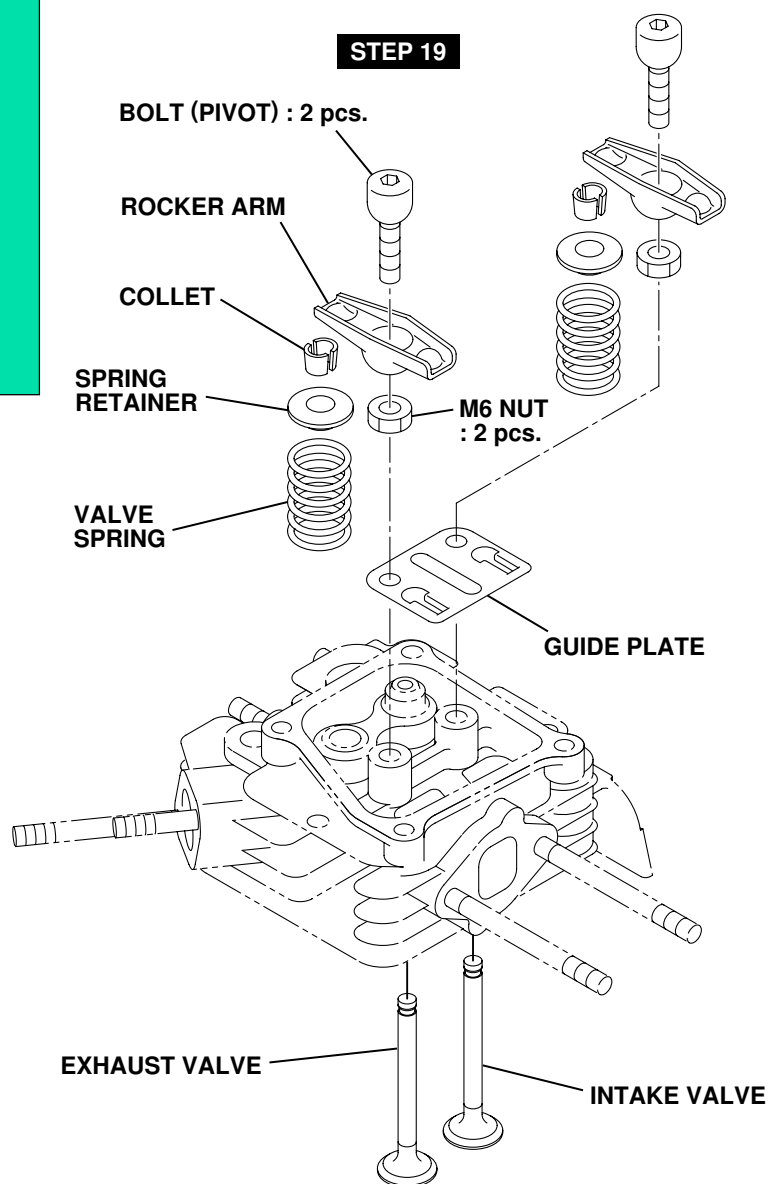


Fig. 5-21

## 5-4 REASSEMBLY PROCEDURES

### • PRECAUTIONS FOR REASSEMBLY

1) Clean parts thoroughly before reassembly.

Pay close attention to the 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) Replace all the gaskets with new ones.

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

6) Torque bolts and nuts to specification refer to the "TORQUE SPECIFICATIONS" (See page 76).

7) Apply oil to rotating and sliding portions.

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

### 5-4-1 CRANKSHAFT

(1) Install crankshaft in crankcase wrapping the keyway with polyvinyl tape to avoid damage to oil seal.

(2) Install woodruff key for flywheel on crankshaft.

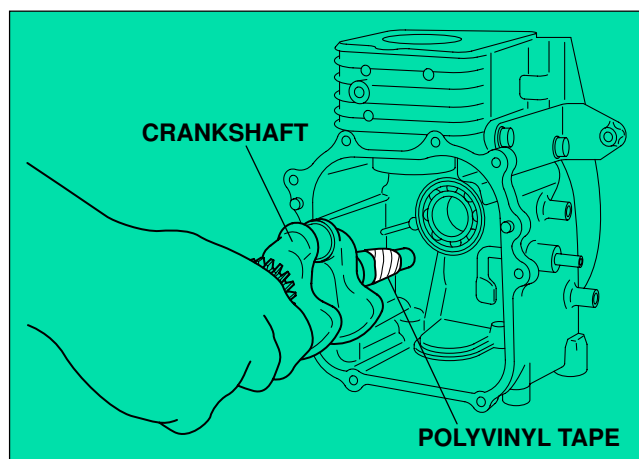


Fig. 5-23

### 5-4-2 PISTON AND PISTON RINGS

(1) Install oil ring first, then second ring and top ring.

Spread ring only far enough to slip over piston and into correct groove. Use care not to distort ring.

Install second ring with punched mark beside the gap face upward. (See Fig. 5-26a, 26b)



Fig. 5-24

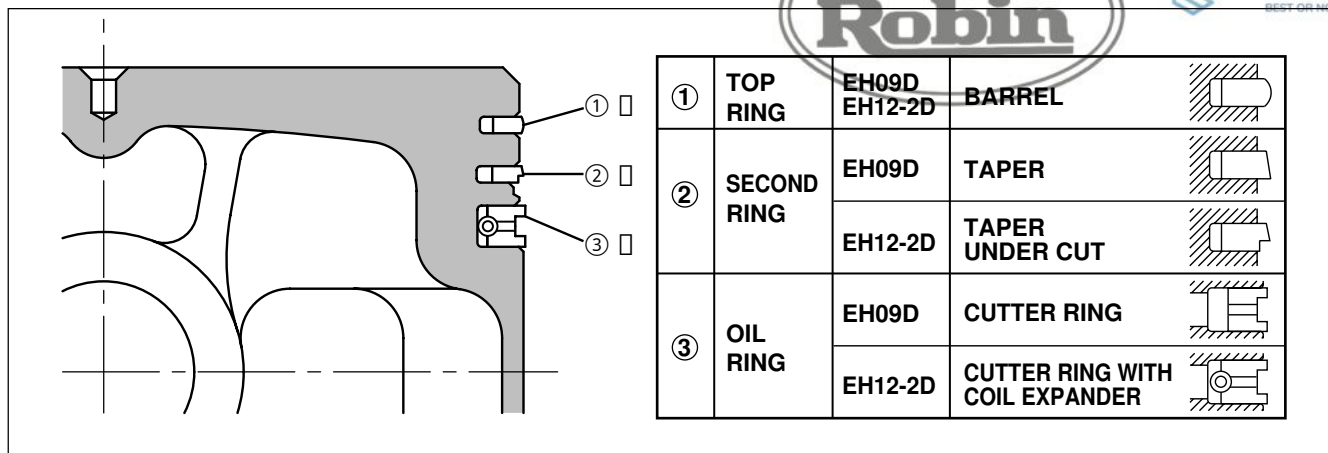


Fig. 5-25

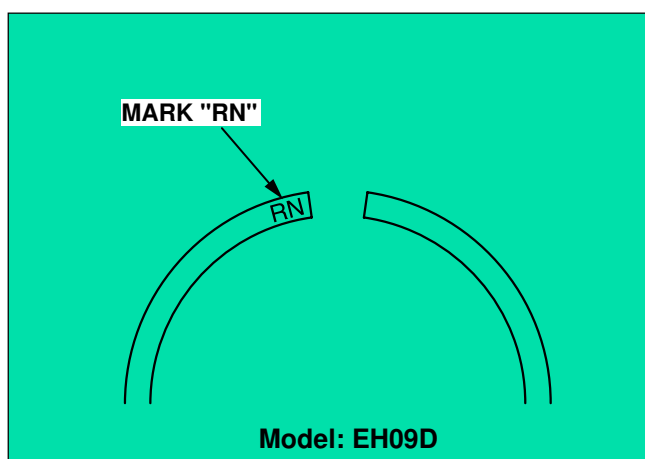


Fig. 5-26a

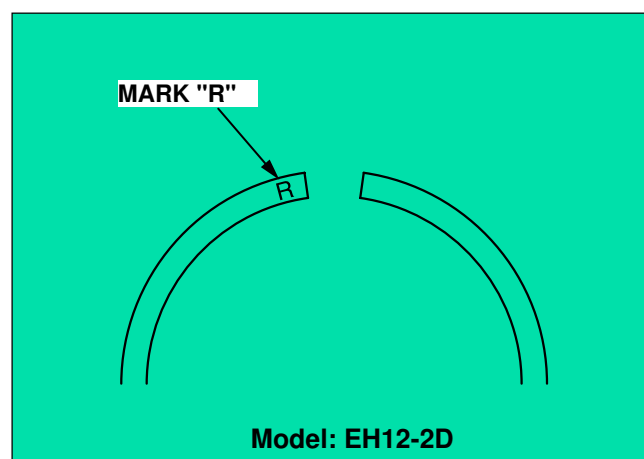


Fig. 5-26b

### 5-4-3 PISTON AND CONNECTING ROD

#### (1) EH09D

The direction of piston on connecting rod is not specified.

#### EH12-2D

When installing the piston on the connecting rod, place the valve recess of the piston crown as shown in the illustration to the "MAG" side of the connecting rod.

#### (2) Apply oil to the small end of connecting rod, piston and piston pin before assembling.

Be sure to use clips on the both side of the piston pin to secure piston pin in position.

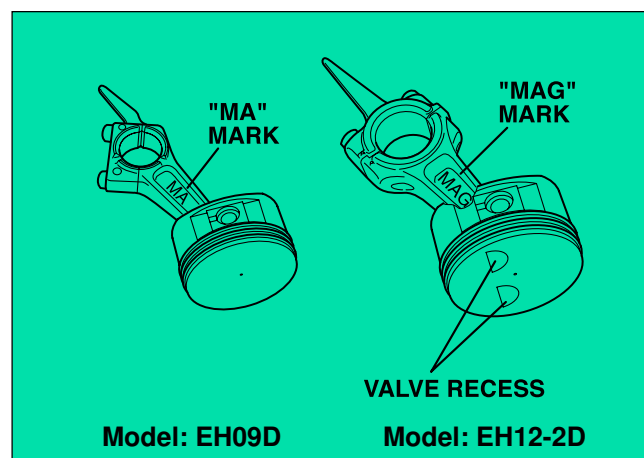


Fig. 5-27

- (3) Install piston and connecting rod assembly into cylinder.

Use a piston ring compressor to hold piston rings.

The **"MA"** mark (EH09D) , **"MAG"** mark (EH12-2D) of the connecting rod is to face the fly-wheel side of the engine when assembled.

**Note:**

- (1) Apply enough oil to lubricate the piston rings, connecting rod bearings and cylinder bore before assembly.
- (2) Set gaps of the piston rings 90 degrees apart from each other before assembly.

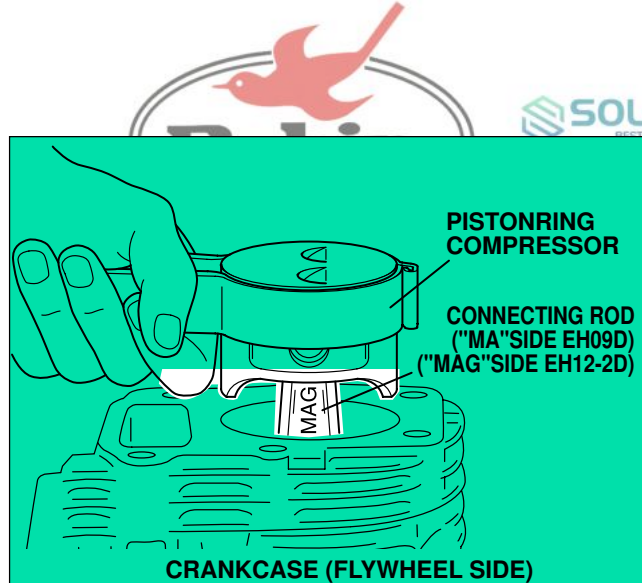


Fig. 5-28

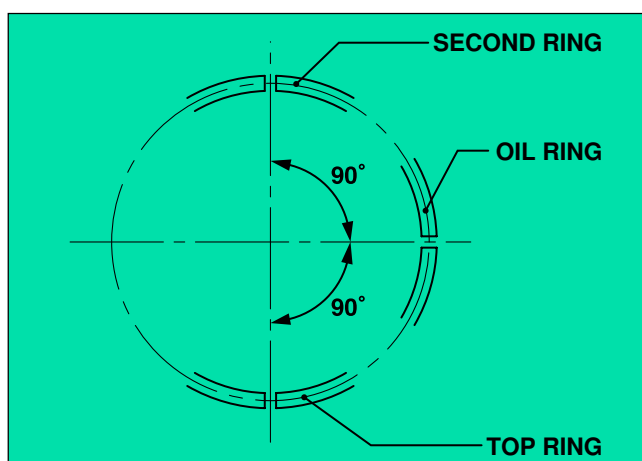


Fig. 5-29

#### 5-4-4 CONNECTING ROD

- (1) Turn crankshaft to bottom dead center, lightly tap top of the piston until large end of the rod meet crank pin.

- (2) Install connecting rod cap to connecting rod. Make sure to match the alignment marks on the rod caps.

Torque connecting rod bolts to specification.

M5 x 25 mm connecting rod bolt : 2 pcs. (EH09D)

M6 x 34 mm connecting rod bolt : 2 pcs. (EH12-2D)

Tightening torque	
EH09D	EH12-2D
5.9 - 7.8 N · m (60 - 80 kg · cm) (4.3 - 5.7 ft · lb.)	8.8 - 11 N · m (90 - 115 kg · cm) (6.5 - 8.3 ft · lb.)

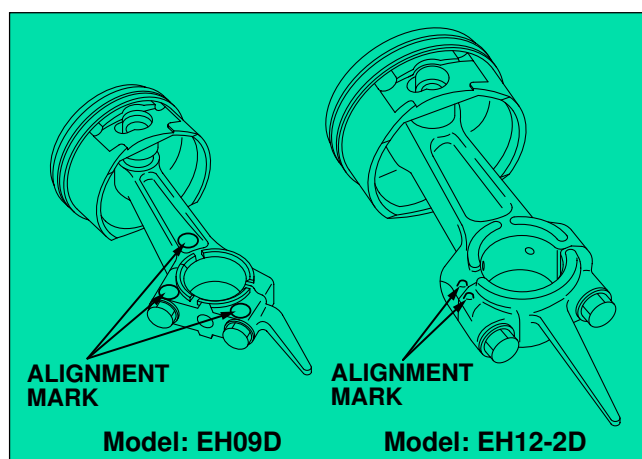


Fig. 5-30

- (3) Check for free movement of connecting rod by turning crankshaft slowly.

### 5-4-5 TAPPETS AND CAMSHAFT

- (1) Oil the tappets and install them.  
Push in fully to avoid damage during camshaft installation.
- (2) Lubricate bearing surfaces of camshaft.  
Align the timing mark on crankshaft gear with the timing mark on camshaft and install camshaft in the crankcase. (See Fig. 5-31a)

#### CAUTION :

**Incorrect valve timing will cause malfunction of the engine.**

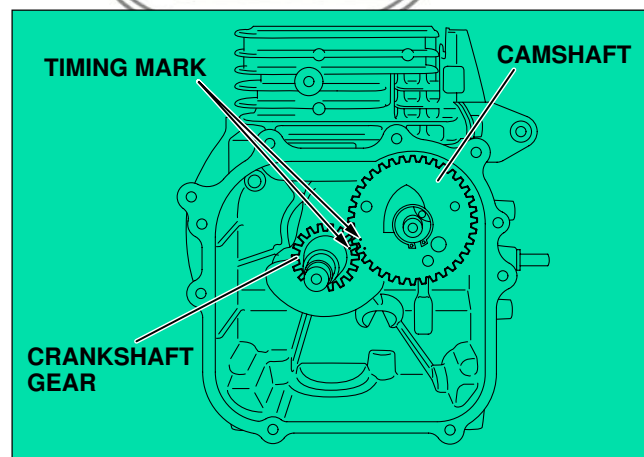


Fig. 5-31a

### 5-4-6 ADJUST CRANKSHAFT END PLAY

- (1) Adjust end play to 0.2 mm (0.008") using the proper spacer.

The proper spacer may be determined in the following manner.

- 1) Measure the height "A" (From the mating surface to the inner race of the ball bearing.)

- 2) Measure the depth "B" (From the mating surface to the crank gear.)

$B - A = \text{SIDE CLEARANCE (mm)}$

$(\text{SIDE CLEARANCE}) - 0.2 \text{ mm} = \text{THICKNESS OF CRANKSHAFT SHIM (mm)}$

$B - A = \text{SIDE CLEARANCE (in.)}$

$(\text{SIDE CLEARANCE}) - 0.008 \text{ in.} = \text{THICKNESS OF CRANKSHAFT SHIM (in.)}$

Following are available spacer shims.

	CRANKSHAFT
SPACER SHIMS	T= 0.6 mm (0.024 in.) T= 0.8 mm (0.031 in.) T= 1.0 mm (0.039 in.)

Table. 5-1

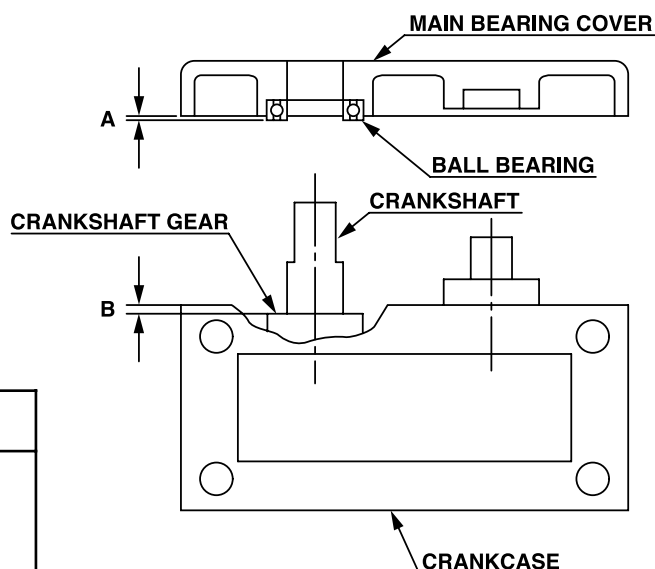
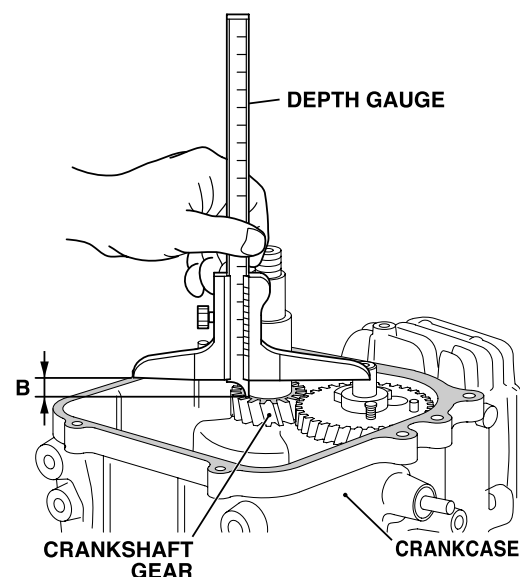


Fig. 5-31b

(2) Lubricate the oil seal and bearing surfaces.

Coat the surface of the main bearing cover with sealant (Three bond 1216).

Place spacer chosen in step (1) on crankshaft.

Use an oil seal guide when installing the main bearing cover to avoid damaging the oil seal .

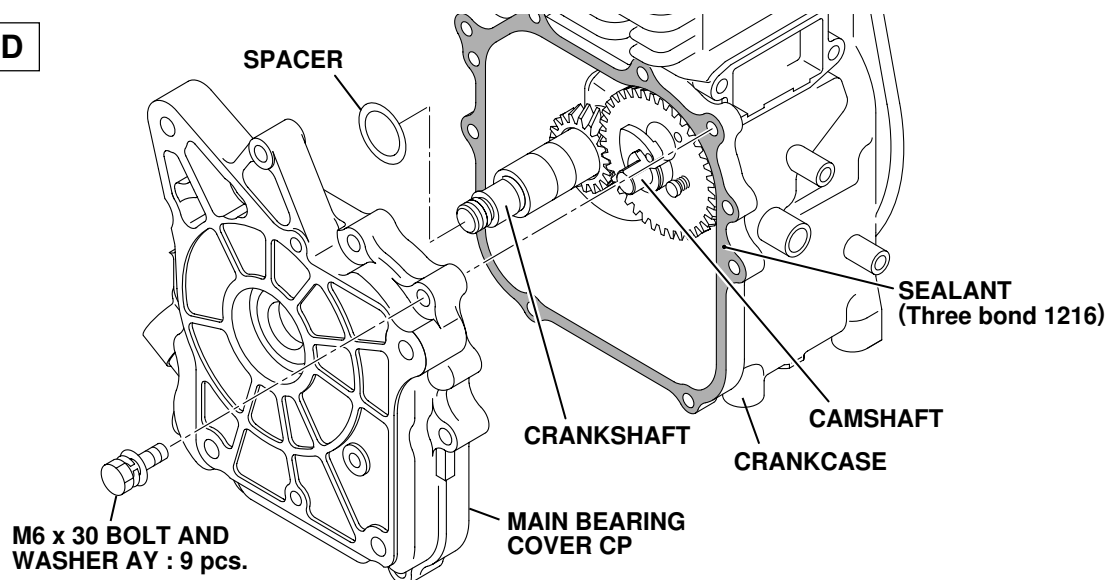
Tap the cover into place with a soft hammer.

Main bearing cover EH09D M6 x 30 mm bolt and washer : 9 pcs.

EH12-2D M6 x 30 mm bolt and washer : 8 pcs.

Tightening torque
EH09D, EH12-2D
9.8 - 11.8 N · m (100 - 120 kg · cm) (7.2 - 8.7 ft · lb.)

### EH09D



### EH12-2D

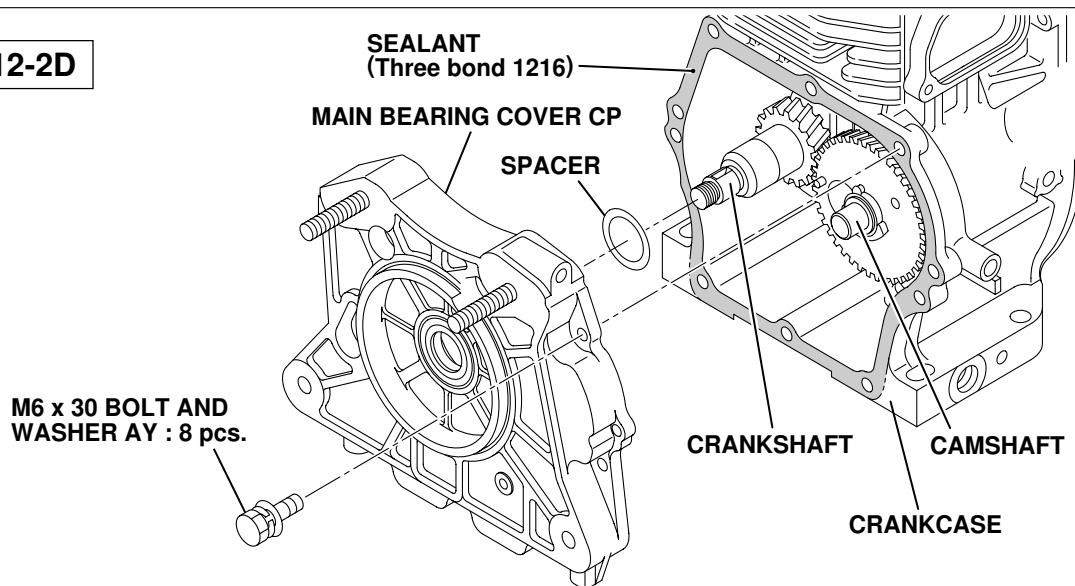


Fig. 5-32



## 5-4-7 CYLINDER HEAD

(1) Clean carbon and gum deposits from the valves, seats, ports and guides. Inspect valves, valve seats and valve guides.

(2) Replace valves that are badly burned, pitted or warped.

(3) When installing valves in cylinder head, oil the valve stems and insert them into valve guide.

Then place cylinder head on flat table, install valve spring and spring retainer.

(4) Valve guides should be replaced when valve stem clearance exceeds specifications (See “SERVICE DATA”).

Draw valve guides out and press new guides in.

Refer to “SERVICE DATA” for clearance specifications.

After replacing valves and guides, lap valves in place until a uniform ring shows around the face of the valve. Clean valves and wash cylinder head thoroughly.

(5) Install cylinder head onto cylinder with new head gasket.

Tighten four flange bolts evenly in three steps by the following tightening torque:

Cylinder head M8 x 55 mm bolt : 4 pcs. (EH09D)

Tightening torque (EH09D)		
1 st step	2 nd step	Final Step
5.0 N · m (50 kg · cm) (3.6 ft · lb.)	9.8 N · m (100 kg · cm) (7.2 ft · lb.)	18.6-20.6 N · m (190-210 kg · cm) (13.7-15.2 ft · lb.)

Cylinder head M8 x 65 mm bolt : 4 pcs. (EH12-2D)

Tightening torque (EH12-2D)		
1 st step	2 nd step	Final Step
5.0 N · m (50 kg · cm) (3.6 ft · lb.)	9.8 N · m (100 kg · cm) (7.2 ft · lb.)	23.0-26.0 N · m (230-270 kg · cm) (17.0-30.0 ft · lb.)



## 5-4-8 ROCKER ARMS AND PUSH RODS

- (1) Insert push rods into crankcase.  
Put push rod tip in the hollow of tappet top.

### Note:

An oil return slot is located next to the tappet boss. If you do not put the push rod in the tappet properly, the push rods will fall into the crankcase.  
Removal of the main bearing cover is necessary to get them out.

- (2) Apply oil to rocker arms and assemble them to cylinder head using pivot bolt and nut.

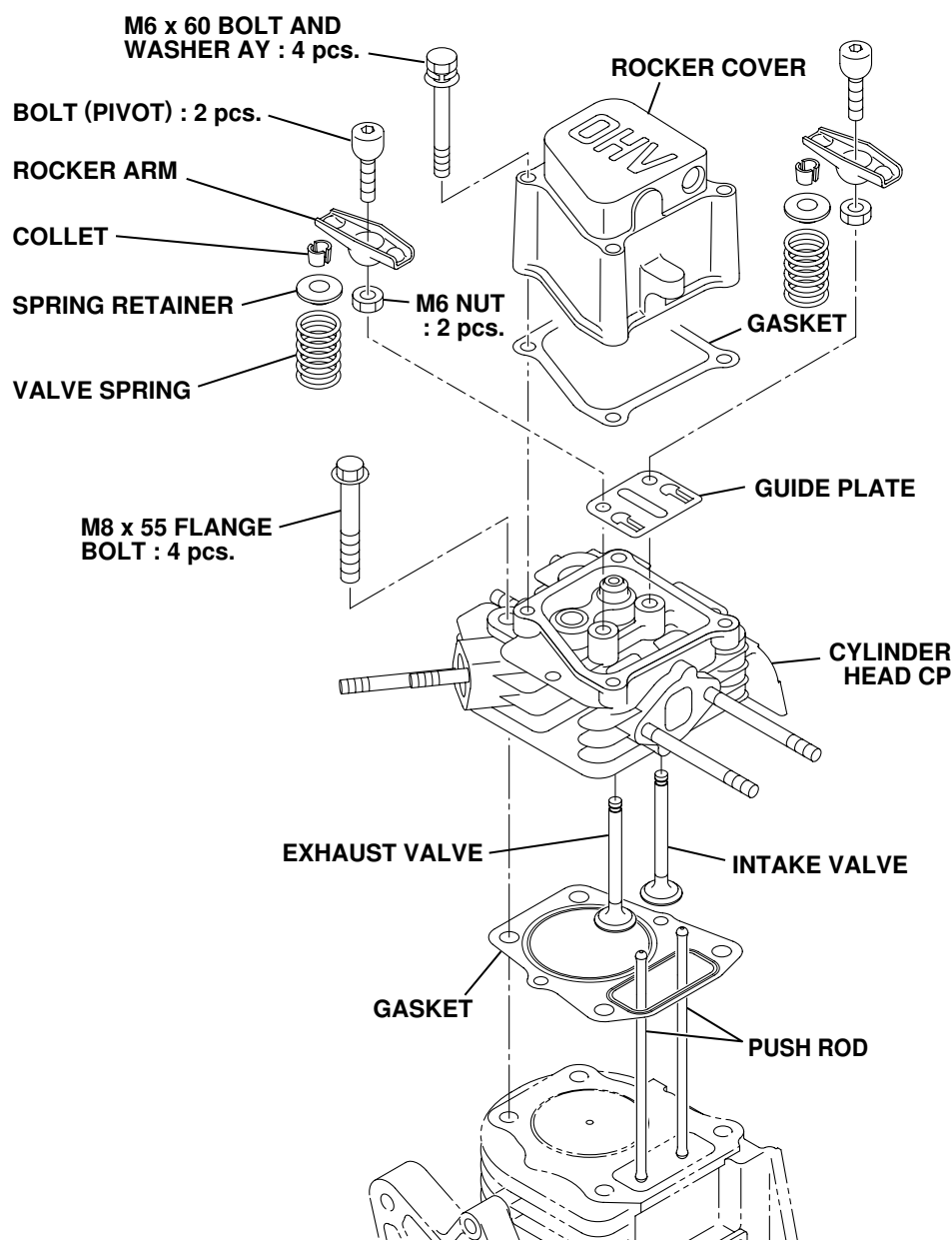


Fig. 5-33



## 5-4-9 VALVE CLEARANCE ADJUSTMENT

**Note:**

**Temporally fit the flywheel in position for easy operation.**

**(1) EH09D**

Position the piston at the top dead center of compression stroke by matching the alignment mark of flywheel with the alignment mark of crankcase.

**EH12-2D**

Position the piston at the top dead center of compression stroke. The top dead center may be obtained by placing the key slot on the power take off shaft to 10 o'clock position. (See Fig. 5-34b)

- (2) Loosen the nut under the rocker arm and turn the bolt (pivot) to adjust the clearance between rocker arm and valve stem end.

Tighten the nut on rocker arm.

**Valve clearance : 0.07 - 0.13 mm  
(0.0028 - 0.0051 in.)**

**Note:**

**Check and adjust valve clearance while engine is cold.**

**Check operation of valves by turning crankshaft. Then recheck the valve clearance.**

- (3) Install rocker cover and gasket.

Rocker cover M6 x 25 mm bolt : 4 pcs.

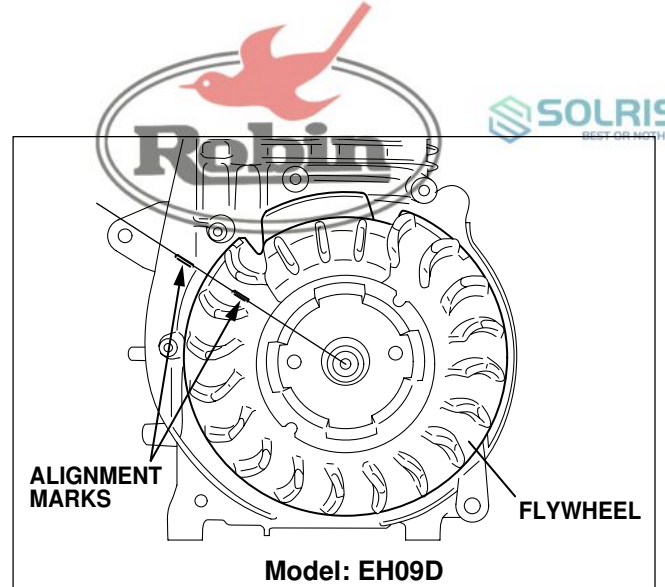


Fig. 5-34a

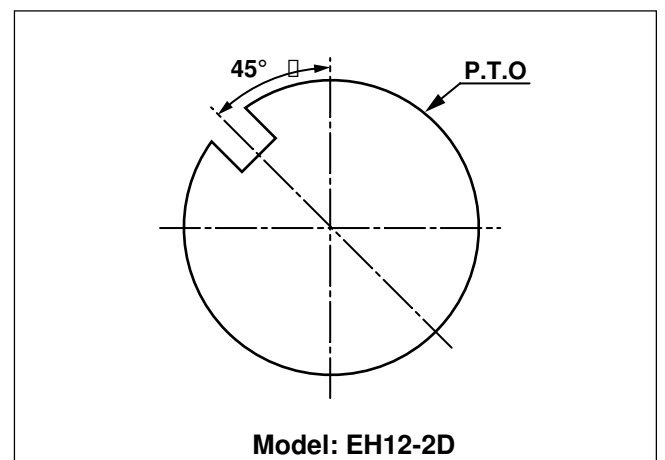


Fig. 5-34b

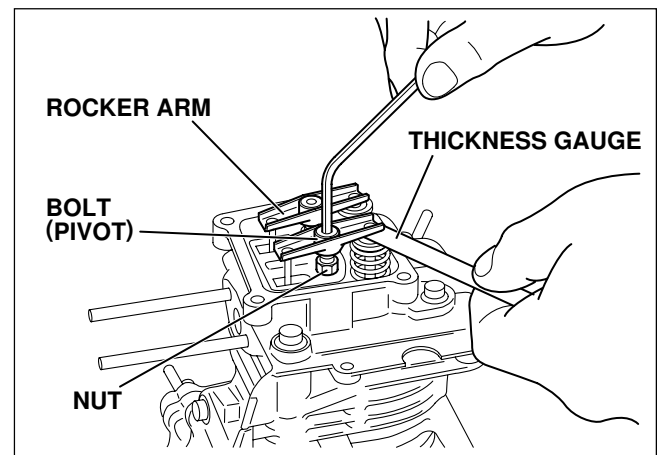


Fig. 5-35

## 5-4-10 SPARK PLUG

Install spark plug to cylinder head.

**Spark plug : NGK BM6A, BMR6A (EH09)**

**: NGK B6ES, BR6ES (EH12-2D)**

Tightening torque (EH09D)	
New spark plug	Retightening
11.8 - 14.7 N · m (120 - 150 kg · cm) (8.7 - 10.9 ft · lb.)	22.6 - 24.5 N · m (230 - 250 kg · cm) (16.6 - 18.1 ft · lb.)

Tightening torque (EH12-2D)	
New spark plug	Retightening
11.8 - 14.7 N · m (120 - 150 kg · cm) (8.7 - 10.9 ft · lb.)	22.6 - 26.5 N · m (230 - 270 kg · cm) (16.6 - 19.5 ft · lb.)

## 5-4-11 FLYWHEEL MAGNETO

- (1) Put the woodruff key in the keyway of crankshaft. Wipe off oil and grease thoroughly from the tapered portion of crankshaft and flywheel center hole.

- (2) Install the flywheel to crankshaft.

Tighten the flywheel nut with the starter pulley.

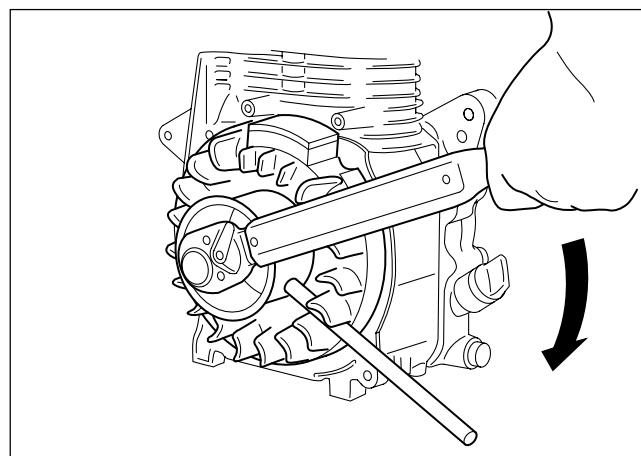


Fig. 5-36

Tightening torque	
EH09D	EH12-2D
44.2 - 49.1 N · m (450 - 500 kg · cm) (32.5 - 36.2 ft · lb.)	59.0 - 63.0 N · m (600 - 650 kg · cm) (43.0 - 47.0 ft · lb.)

### 5-4-12 IGNITION COIL

Install ignition coil to crankcase.

Pay attention the direction of ignition coil and the location of code.

Adjust air gap between ignition coil and flywheel using a thickness gauge and tighten bolts.

M6 x 25 mm bolt and washer : 2 pcs.

<b>Air gap : 0.3 - 0.5 mm (0.012 - 0.020 in.)</b>
---

<b>Tightening torque</b>
--------------------------

8.8 - 10.8 N · m (90 - 110 kg · cm) (6.5 - 8.0 ft · lb.)
--

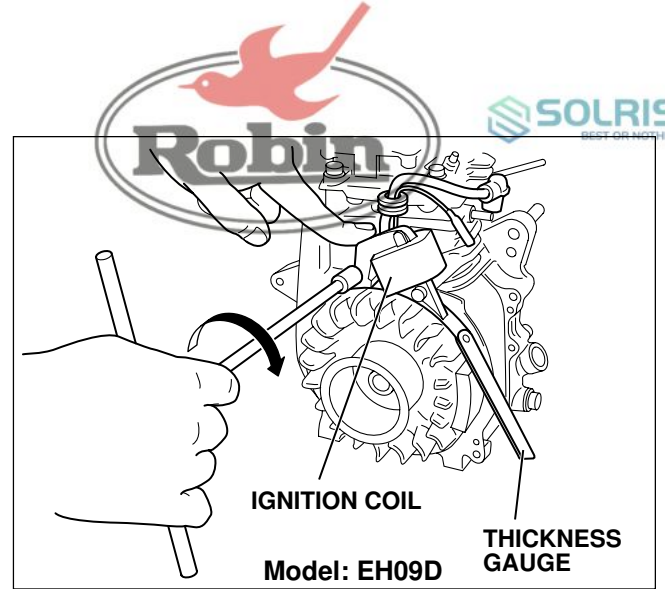


Fig. 5-37a

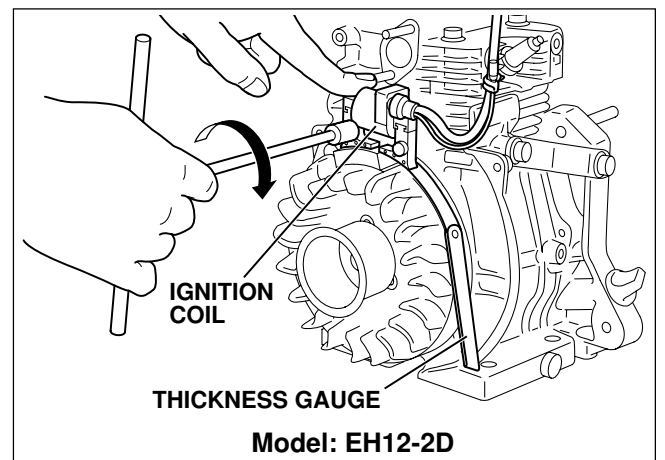


Fig. 5-37b

### 5-4-13 INTAKE PIPE, INSULATOR (EH12-2D)

(1) Install the intake pipe to the cylinder head with gasket.

M6 flange nut : 2pcs.

M6 x 40 mm bolt and washer : 1pce.

<b>Tightening torque : 9.8 - 13.7 N·m (100 - 140 kg·cm) (7.2 - 10.1 ft·lb.)</b>
---

Then put the gasket and insulator on the intake pipe.

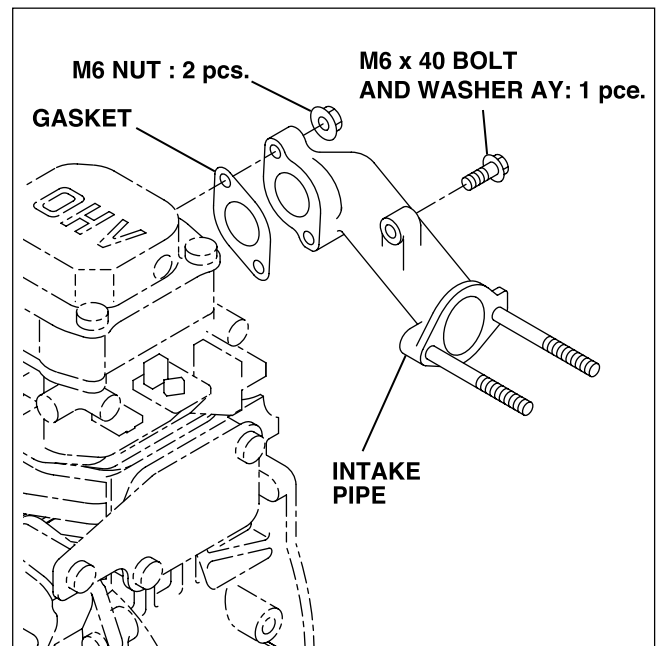


Fig. 5-38

## 5-4-14 GOVERNOR, SPEED CONTROL SYSTEM AND CARBURETOR

### EH09D

- (1) Install governor lever to governor shaft, then tighten the locking bolt temporarily.
- (2) Install base plate to crankcase.
- (3) Install speed control lever, friction washer, pivot bolt, etc. to base plate as shown in illustration.
- (4) Hook governor spring to proper holes of governor lever and speed control lever. (See Fig. 5-40a)
- (5) Install insulator and gaskets for carburetor to cylinder head.
- (6) Install carburetor to cylinder head hooking governor rod to governor lever and throttle lever of carburetor. Hook rod spring over governor rod.
- (7) Attach air cleaner base to carburetor. Tighten two flange nuts and a bolt. Connect breather pipe from rocker cover to cleaner base.

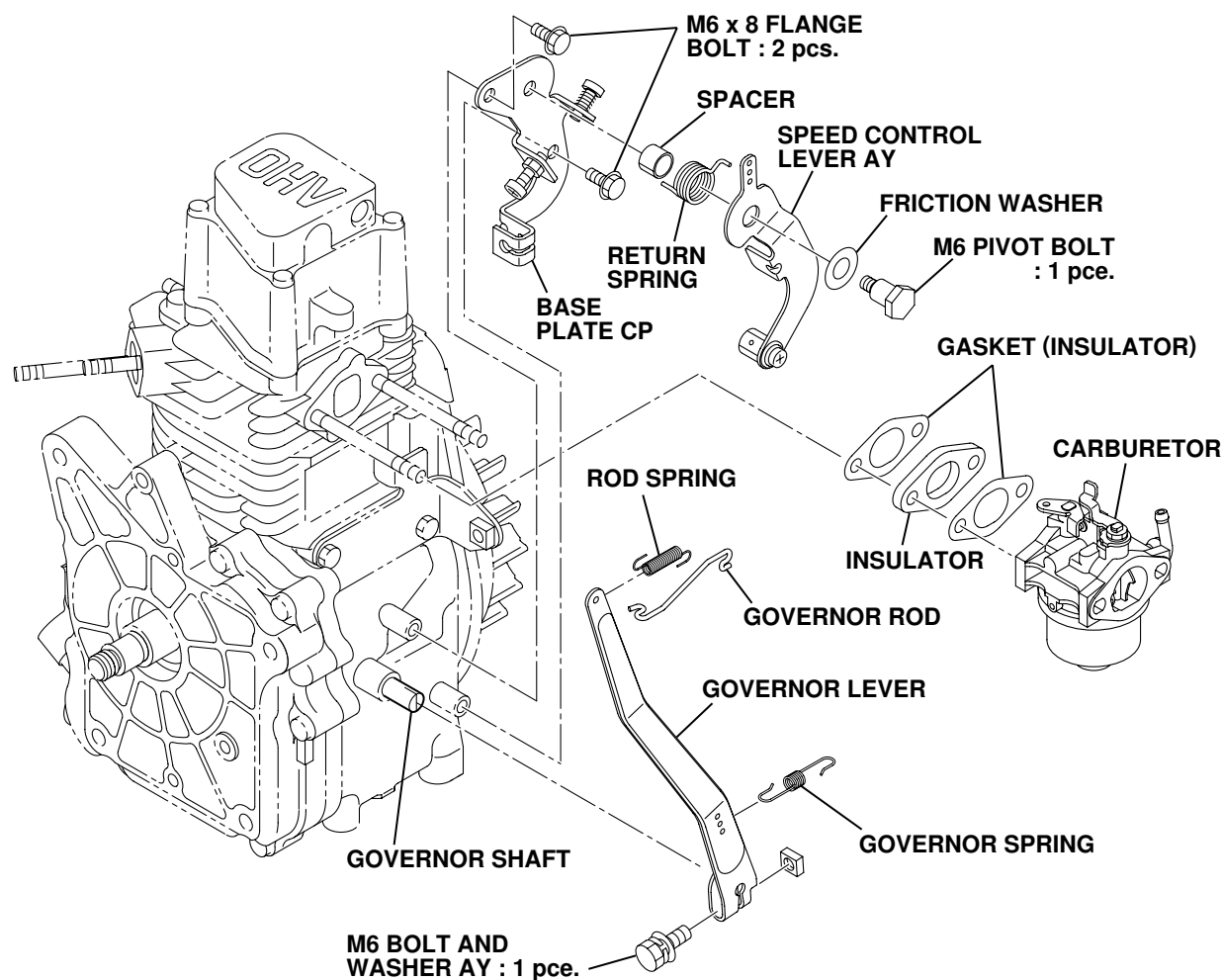


Fig. 5-39a

# EH12-2D

- (1) Install governor lever to governor shaft, then tighten the locking bolt temporarily.
- (2) Install speed control lever, pivot bolt, etc. as shown in illustration.
- (3) Hook governor spring to proper holes of governor lever and speed control lever. (See Fig. 5-40b)
- (4) Install insulator and gaskets for carburetor to intake pipe.
- (5) Install carburetor to intake pipe hooking governor rod to governor lever and throttle lever of carburetor. Hook rod spring over governor rod.
- (6) Attach air cleaner base to carburetor. Tighten two flange nuts and a bolt. Connect breather pipe from rocker cover to cleaner base.

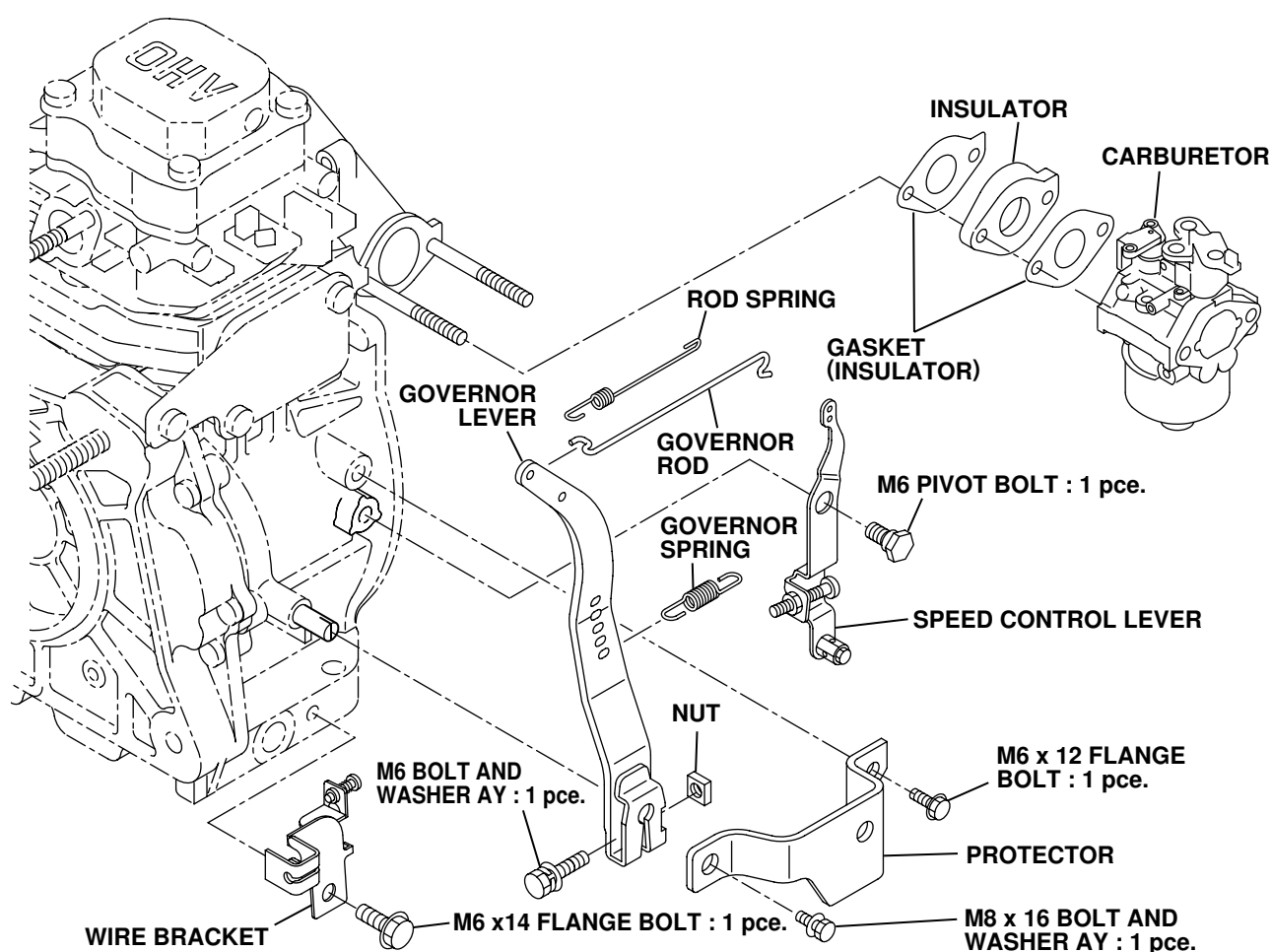


Fig. 5-39b

## 5-4-15 AIR CLEANER

Install the air cleaner gasket and the cleaner base and tighten them with 2-M6 flange nuts.

Then install the element and the cleaner case.

## 5-4-16 ADJUST GOVERNOR SYSTEM

- (1) Turn the speed control lever all the way toward the high speed position and fix it by tightening self lock nut.
- (2) Check that the governor lever is pulled by the governor spring and carburetor throttle valve is fully open.
- (3) Turn the governor shaft clockwise all the way using a screw driver, and tighten lock bolt to secure the lever on the shaft.
- (4) Loosen the self lock nut to allow the speed control lever to move freely.

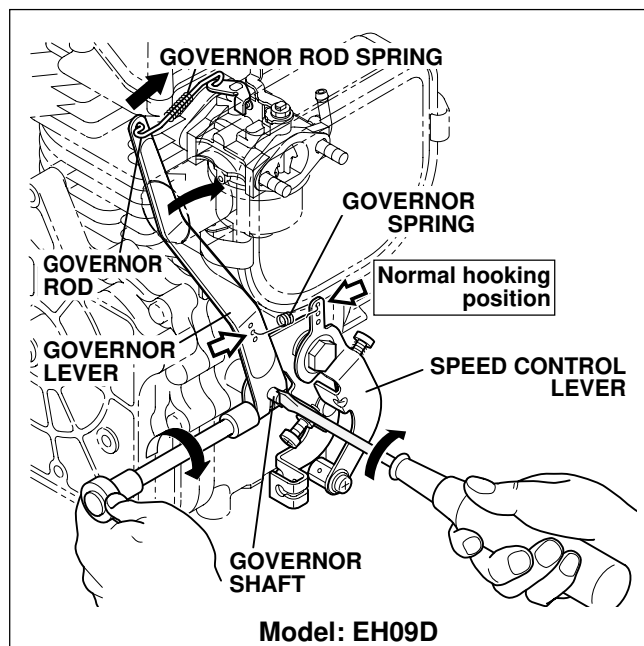


Fig. 5-40a

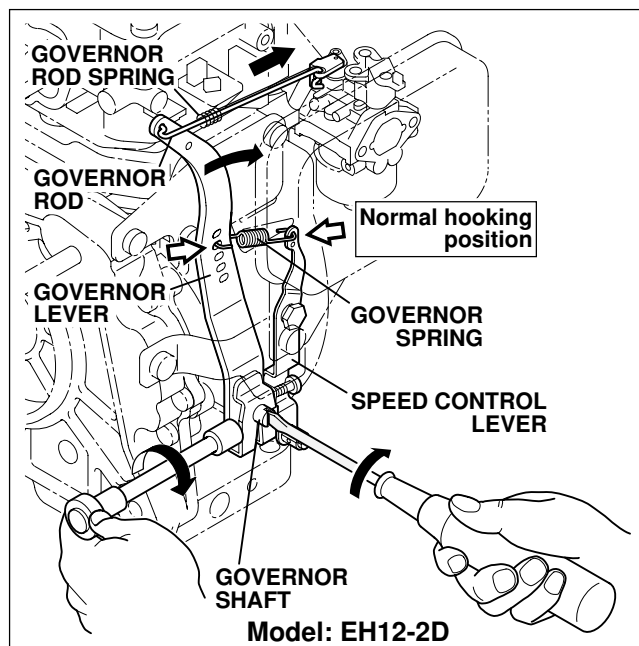


Fig. 5-40b



## 5-4-17a CYLINDER BAFFLE, MUFFLER BRACKET and MUFFLER (EH09D)

- (1) Temporarily install cylinder baffle, muffler bracket and blower housing bracket 2 to the cylinder head.

: M6 flange nut : 2 pcs.

Do not tighten the flange nut fully.

- (2) Temporarily install muffler and gasket to cylinder head.

: M6 self lock nut : 2 pcs.

: M6 x 12 mm bolt and washer : 2 pcs.

- (3) Finally, tighten the self lock nut etc. fully, according to the following priority.

① M6 self lock nut : 2 pcs.

② M6 x 12 mm bolt and washer : 2 pcs.

③ M6 flange nut : 2 pcs.

Tightening torque
8.8 - 10.8 N · m (90 - 110 kg · cm) (6.5 - 8.0 ft · lb.)

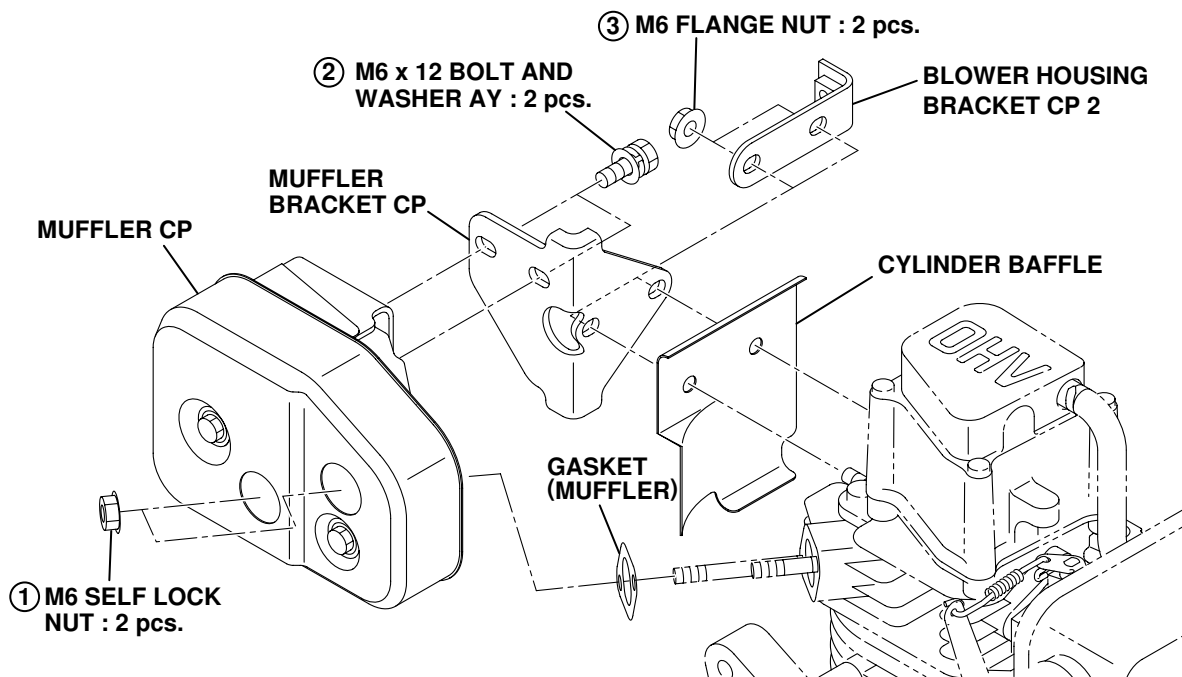


Fig. 5-41a



## 5-4-17b HEAD COVER, MUFFLER BRACKET and MUFFLER (EH12-2D)

(1) Temporarily install head cover and muffler bracket to cylinder head.

: M6 x 18 mm flange bolt : 2 pcs.

(2) Temporarily install muffler, gasket (muffler) and spacer (exhaust) to cylinder head.

: M8 self lock nut : 2 pcs.

: M8 x 16 mm bolt and washer : 4 pcs.

(3) Finally, tighten the self lock nut etc. fully, according to the following priority.

① M8 self lock nut : 2 pcs.

② M8 x 16 mm bolt and washer : 2 pcs.

③ M8 x 16 mm bolt and washer : 2 pcs.

④ M8 x 18 mm flange bolt : 2 pcs.

### Tightening torque (M8)

22.5 - 26.5 N · m  
(230 - 270 kg · cm)  
(16.5 - 19.5 ft · lb.)

### Tightening torque (M6)

8.8 - 10.8 N · m  
(90 - 110 kg · cm)  
(6.5 - 8.0 ft · lb.)

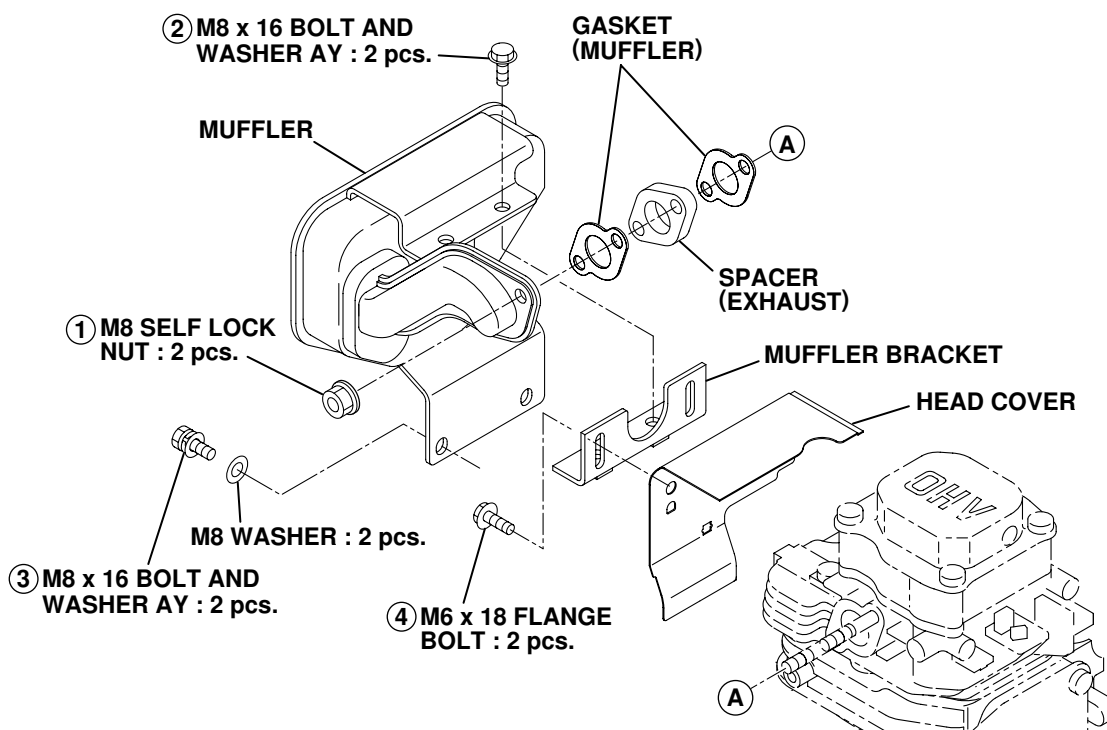


Fig. 5-41b





### 5-4-18 BLOWER HOUSING AND RECOIL STARTER

- (1) Attach blower housing to crankcase. Tighten five flange bolts.

M6 x 12 mm flange bolt : 5 pcs.

Insert the high tension cord from the ignition coil into the notch of the blower housing so as not to pinch the cord.

- (2) Install recoil starter to blower housing.

M6 x 8 mm flange bolt : 4 pcs.

**Note:**

**Be careful of pulling direction of starter rope.**

### 5-4-19 STOP SWITCH

- (1) Install stop switch to blower housing.
- (2) Connect wires referring to the wiring diagram.

– End of the reassembly –

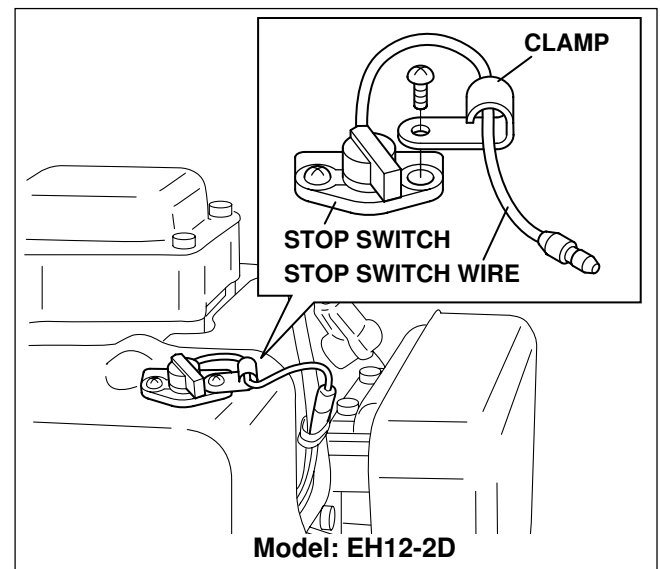


Fig. 5-42



## 5-5 BREAK-IN OPERATION

A new engine or an engine that has been completely overhauled by being fitted with a new piston, rings, valves and connecting rod should be thoroughly RUN-IN before being put back into service.

Good bearing surfaces and running clearances between the various parts can only be established by operating the engine under reduced speed and loads for a short period of time.

While the engine is being tested, check for oil leaks.

Make final carburetor adjustment and regulate the engine operating speed.

Step	Load		Engine Speed	Time
Step 1	No Load		2,500 rpm	10 min.
Step 2	No Load		3,000 rpm	10 min.
Step 3	No Load		3,600 rpm	10 min.
Step 4	EH09D	0.7 kW (1.0 HP)	3,600 rpm	30 min.
	EH12-2D	1.0 kW (1.4 HP)		
Step 5	EH09D	1.4 kW (1.9 HP)	3,600 rpm	60 min.
	EH12-2D	2.1 kW (2.8 HP)		

Table. 5-2

## 6. MAGNETO

### 6-1 OPERATION AND FUNCTION

The ignition system of the EH09D and EH12-2D is a breakerless flywheel magneto with an automatic advancing system.

Being different from the breaker point type ignition system, this system is completely free from such troubles as starting-up failure due to dirty, burnt or corroded point surface.

The electronic automatic advancing ensures extremely easy starts and stable high performance at operating speed by advancing the ignition timing to the most suitable point.

### 6-2 BASIC THEORY

(1) Revolution of the flywheel generates electricity on the primary side of the ignition coil, and the base current  $I_1$  flows to the power transistor.

Current  $I_1$  turns the power transistor "ON" and the electric current  $I_2$  flows.

- (2) At lower engine revolution, when the flywheel reached the ignition point the low speed ignition timing control circuit operates to run the base current  $I_3$  to turn the signal transistor A "ON" allowing the current  $I_1$  to bypass as current  $I_4$ .

At this moment the power transistor turns "OFF" and the current  $I_2$  is abruptly shut off resulting in the high voltage generated in the secondary coil which produces sparks at the spark plug.

- (3) At higher engine revolution, the advancing control circuit operates at the ignition timing to run the base current  $I_5$  to turn the signal transistor B "ON" allowing the current  $I_1$  to bypass as current  $I_6$ .

At this moment the power transistor turns "OFF" and the current  $I_2$  is abruptly shut off resulting in the high voltage generated in the secondary coil which produces sparks at the spark plug.

The operating timing of the advancing control circuit advances in accordance with the increase of engine speed resulting in the advancing of ignition timing as shown in Fig. 6-1(b).

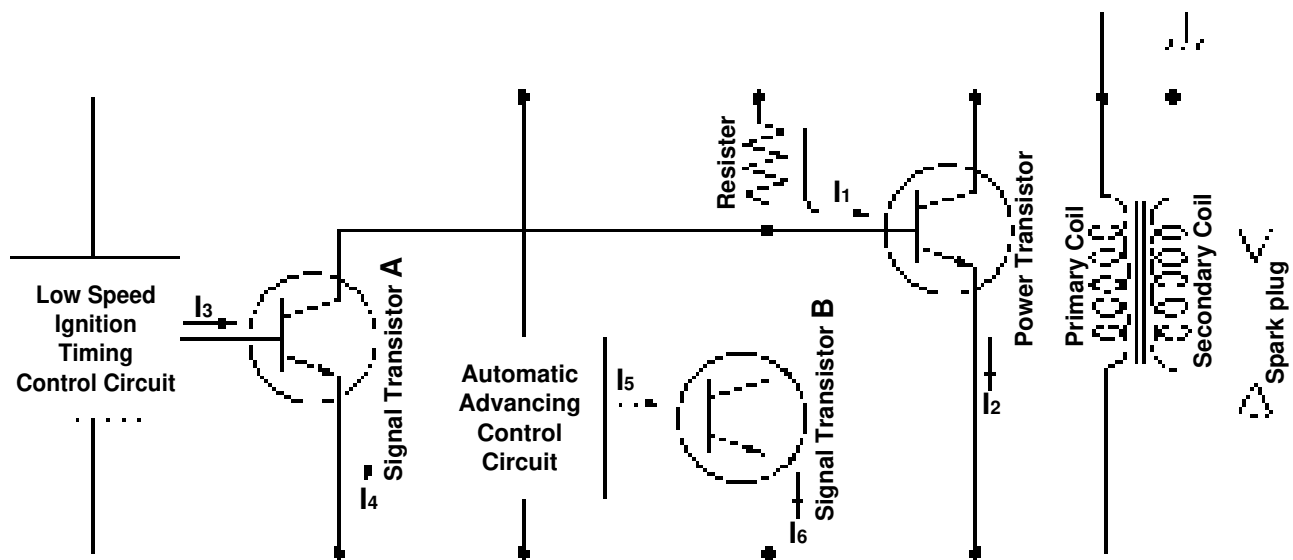


Fig. 6-1a

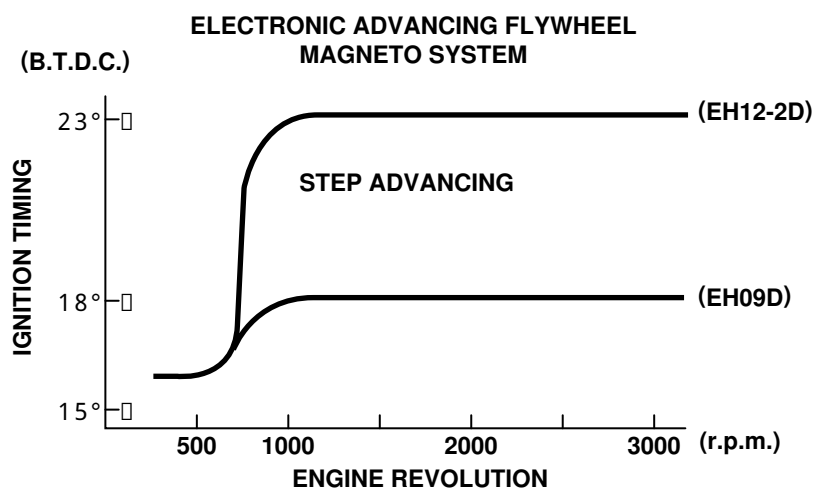


Fig. 6-1b



## 7. AUTOMATIC DECOMPRESSION SYSTEM



EH09D and EH12-2D engines employ an automatic decompression system as a standard feature. This enables easy starting of the engine, with lighter recoil pull.

The automatic decompression system releases the compression of the engine by lifting up the exhaust valve at cranking speeds. The following is the explanation of how the system works.

At the end of the compression process, the release lever lifts up the tappet which in turns opens up the exhaust valve slightly to release the compression. The release lever has a flyweight on its end and another end of the lever is a crescent cam.

When the engine is cranked, the crescent cam projects above the cam profile and lifts up the tappet because the gravity force on the weight is larger than the centrifugal force on the weight.

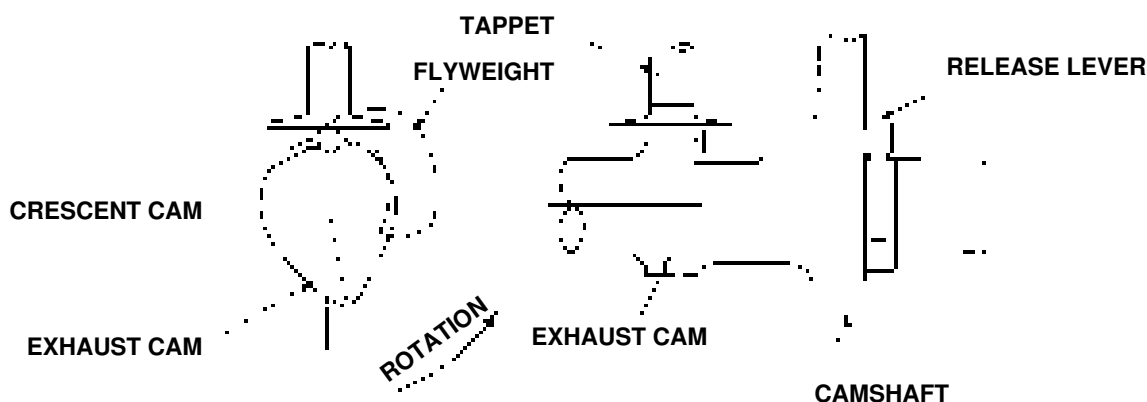


Fig. 7-1

When the cranking speed reaches a specified r.p.m., the crescent cam is retracted under the cam profile because the centrifugal force applied to the flyweight becomes larger than the force of gravity on the weight and thus it is shifted to the position shown in the illustration below.

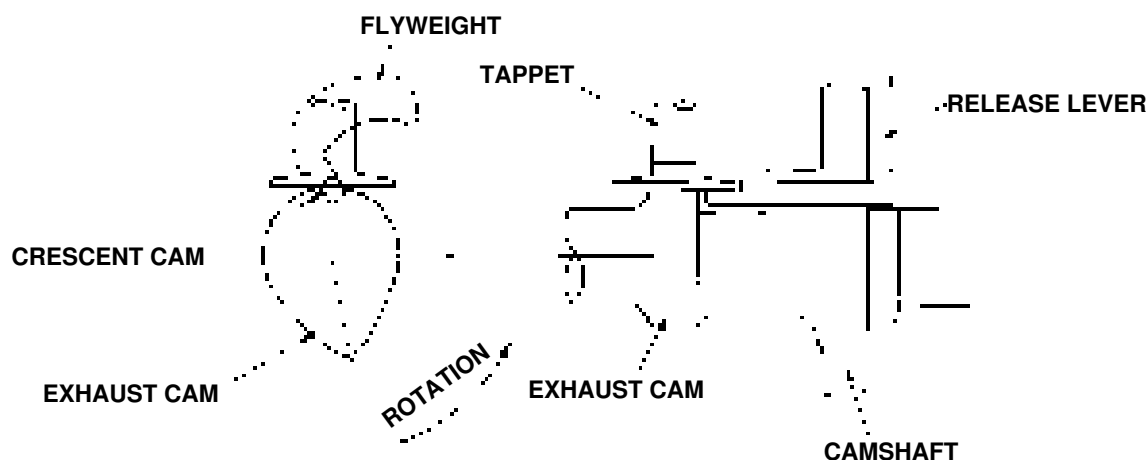


Fig. 7-2

## 8a. FLOAT TYPE CARBURETOR (EH09D)



### 8a-1 OPERATION AND CONSTRUCTION

#### 8a-1-1 FLOAT SYSTEM

The float chamber is located below the carburetor body and, with a float and a needle valve, maintains a constant fuel level during engine operation.

The fuel flows from the fuel tank into the float chamber through the needle valve. When the fuel rises to a specific level, the float rises, and when its buoyancy and fuel pressure are balanced, the needle valve closes to shut off the fuel, thereby keeping the fuel at the predetermined level.

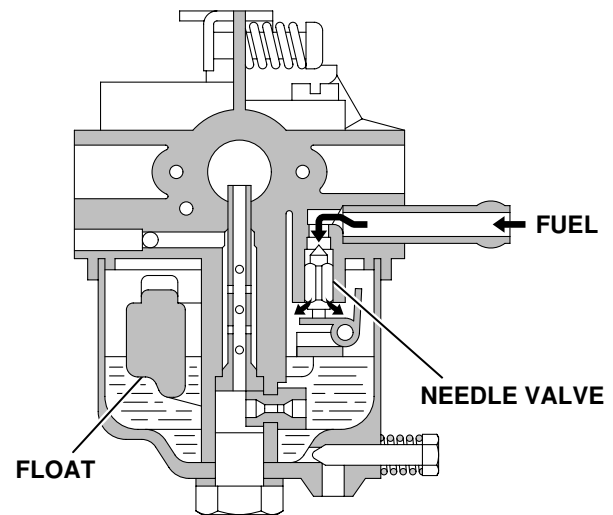


Fig. 8-1

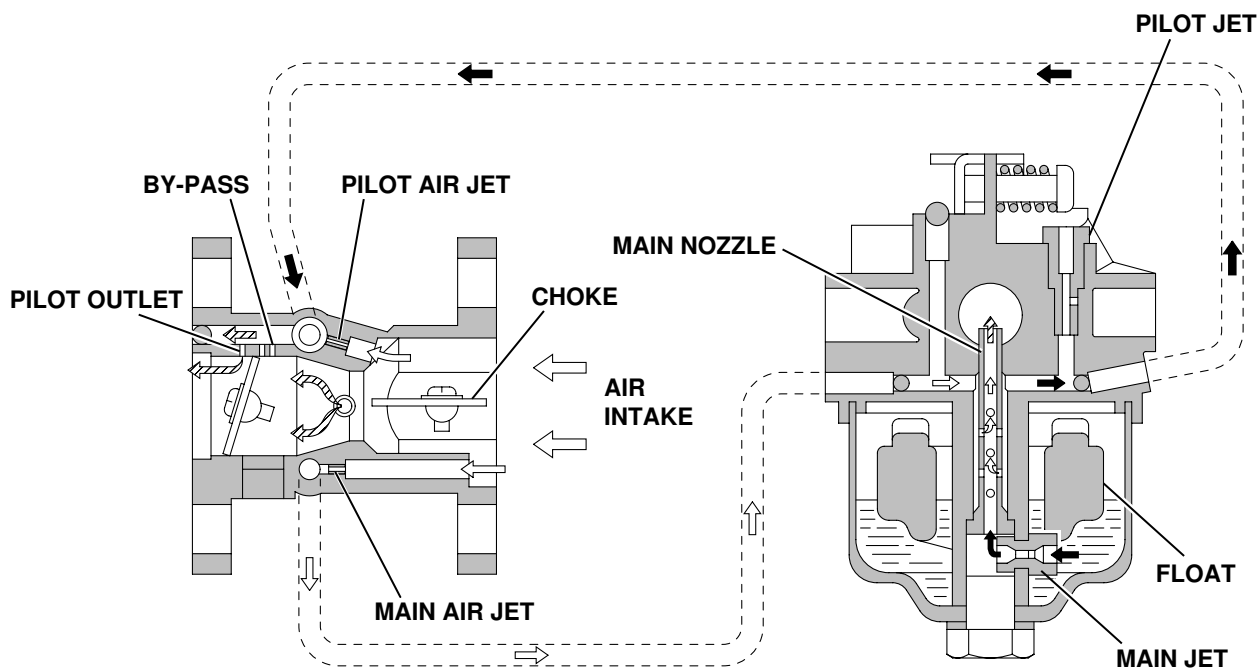


Fig. 8-2

## 8a-1-2 PILOT SYSTEM

The pilot system feeds the fuel to the engine during idling and low-speed operation. The fuel is fed through the main jet to the pilot jet, where it is metered, and mixed with the air metered by the pilot air jet. The fuel-air mixture is fed to the engine through the pilot outlet and the bypass. At idling speed, the fuel is mainly fed from the pilot outlet.

## 8a-1-3 MAIN SYSTEM

The main system feeds the fuel to the engine at medium and high-speed operation. The fuel is metered by the main jet and fed to the main nozzle. The air metered by the main air jet is mixed with the fuel through the bleed holes in the main nozzle, 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.

## 8a-1-4 CHOKE

The choke is used for easy starting when the engine is cold. When the starter is operated with a closed choke, the negative pressure applied to the main nozzle increases and draws more fuel ; thus richening the mixture and making starting the engine easier.

## 8a-2 DISASSEMBLY AND REASSEMBLY

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.

### 8a-2-1 THROTTLE SYSTEM

- (1) The spring ④ can be taken out by removing the throttle stop screw ⑤.
- (2) Remove the philips screw ① and throttle valve ②, and pull out the throttle shaft ③.

\*Be careful not to damage throttle valve rim.

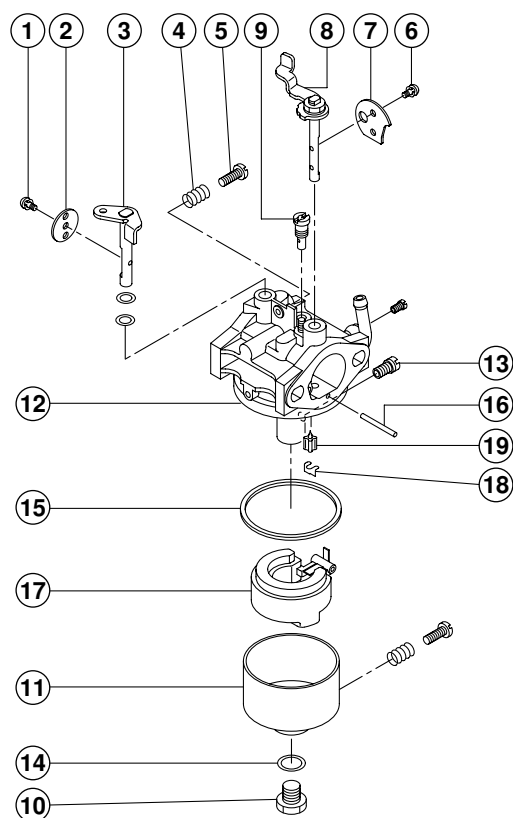


Fig. 8-3



### 8a-2-2 CHOKE SYSTEM

- (1) Remove the philips screws ⑥ and choke valve ⑦, and pull out the choke shaft ⑧.
- (2) When reassembling the choke shaft, make sure that the cutout in the choke valve faces the pilot air jet.

### 8a-2-3 PILOT SYSTEM

- (1) Remove the pilot jet ⑨, using correct tool to avoid damage to it.
- (2) Reassembly  
Tighten the pilot jet securely. Otherwise, the fuel may leak, causing engine malfunction.

### 8a-2-4 MAIN SYSTEM

- (1) Remove the bolt ⑩ and take out float chamber body ⑪.
- (2) Remove the main jet ⑬ and guide holder from the body ⑫ .
- (3) Reassembly
  - a) Fasten the main jet securely to the body. Otherwise, the fuel may become too rich and cause engine malfunction.
  - b) The bolt ⑩ tightening torque is 90 kg-cm. Be sure to set the gasket ⑮ and washer ⑭ for chamber ⑪.

### 8a-2-5 FLOAT SYSTEM

- (1) Pull out the float pin ⑯ and remove the float ⑰ and then remove the clip ⑱ and needle valve ⑲. If the needle valve needs to be replaced, replace it with rubber needle.

#### **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.**

- (2) When removing the needle valve and float, gently tap the reverse side of the float pin ⑯ using a rod more slender than the float pin and remove, since the float pin is pressed into the carburetor body.



## 8b. FLOAT TYPE CARBURETOR (EH12-2D)



### 8b-1 OPERATION AND CONSTRUCTION

#### 8b-1-1 FLOAT SYSTEM

The float chamber is located below the carburetor body and, with a float and a needle valve, maintains a constant fuel level during engine operation.

The fuel flows from the fuel tank into the float chamber through the needle valve. When the fuel rises to a specific level, the float rises, and when its buoyancy and fuel pressure are balanced, the needle valve closes to shut off the fuel, thereby keeping the fuel at the predetermined level.

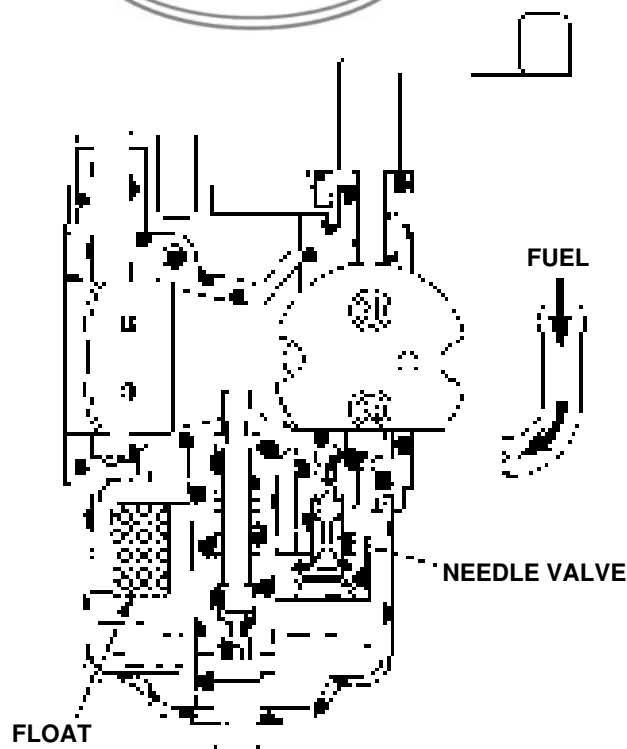


Fig. 8-4

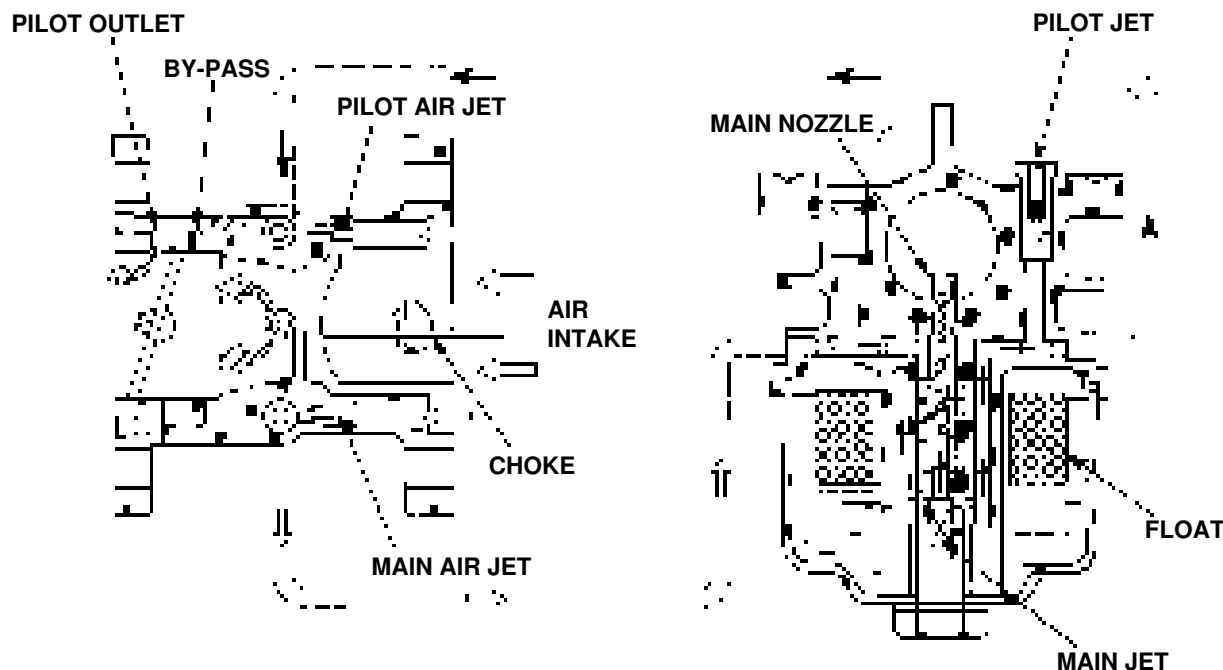


Fig. 8-5

## 8b-1-2 PILOT SYSTEM

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

The fuel is fed through the main jet to the pilot jet, where it is metered, and mixed with the air metered by the pilot air jet. The fuel-air mixture is fed to the engine through the pilot outlet and the bypass. At idling speed, the fuel is mainly fed from the pilot outlet.

## 8b-1-3 MAIN SYSTEM

The main system feeds the fuel to the engine at medium and high-speed operation. The fuel is metered by the main jet and fed to the main nozzle. The air metered by the main air jet is mixed with the fuel through the bleed holes in the main nozzle, 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.

## 8b-1-4 CHOKE

The choke is used for easy starting when the engine is cold. When the starter is operated with a closed choke, the negative pressure applied to the main nozzle increases and draws more fuel ; thus richening the mixture and making starting the engine easier.

## 8b-2 DISASSEMBLY AND REASSEMBLY

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.

### 8b-2-1 THROTTLE SYSTEM

- (1) Remove the philips screw ① and throttle valve ②, and pull out the throttle shaft ③.
- (2) The spring ④ can be taken out by removing the throttle stop screw ⑤.

\*Be careful not to damage throttle valve rim.

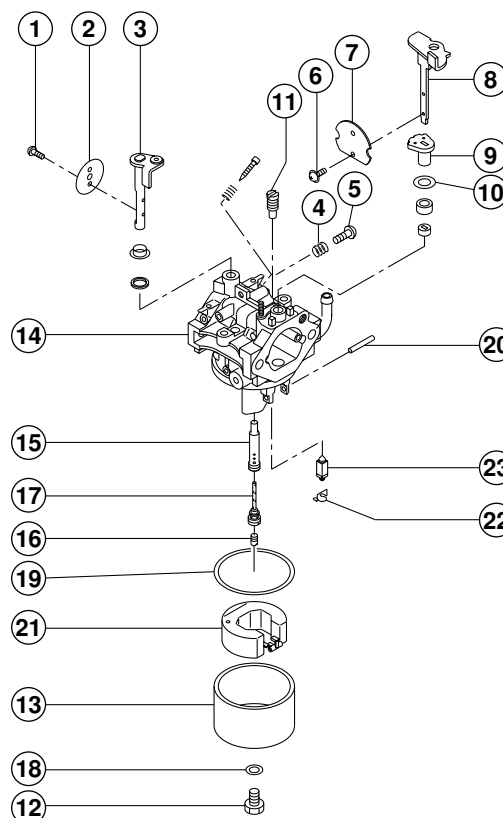


Fig. 8-6



### 8b-2-2 CHOKE SYSTEM

- (1) Remove the philips screws ⑥ and choke valve ⑦, and pull out the choke shaft ⑧.
- (2) When reassembling the choke shaft, make sure that the cutout in the choke valve faces the pilot air jet. Meanwhile, when reassembling set the rings ⑨ and ⑩ at the right position.

### 8b-2-3 PILOT SYSTEM

- (1) Remove the pilot jet ⑪, using correct tool to avoid damage to it.
- (2) Reassembly  
Tighten the pilot jet securely. Otherwise, the fuel may leak, causing engine malfunction.

### 8b-2-4 MAIN SYSTEM

- (1) Remove the bolt ⑫ and take out float chamber body ⑬.
- (2) Remove the main jet ⑮ and guide holder ⑰ from the body ⑭. And then remove the main nozzle ⑮.
- (3) Reassembly
  - a) Fasten the main jet and main nozzle securely to the body. Otherwise, the fuel may become too rich and cause engine malfunction.
  - b) The bolt ⑫ tightening torque is 70 kg-cm. Be sure to set the gasket ⑲ and washer ⑱ for chamber ⑬.

### 8b-2-5 FLOAT SYSTEM

- (1) Pull out the float pin ⑳ and remove the float ㉑ and then remove the clip ㉒ and needle valve ㉓. If the needle valve needs to be replaced, replace it with rubber needle.

#### **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.**

- (2) When removing the needle valve and float, gently tap the reverse side of the float pin ㉑ using a rod more slender than the float pin and remove, since the float pin is pressed into the carburetor body.

## 8c. DIAPHRAGM TYPE CARBURETOR (OPTION)



### 8c-1 OPERATION AND CONSTRUCTION

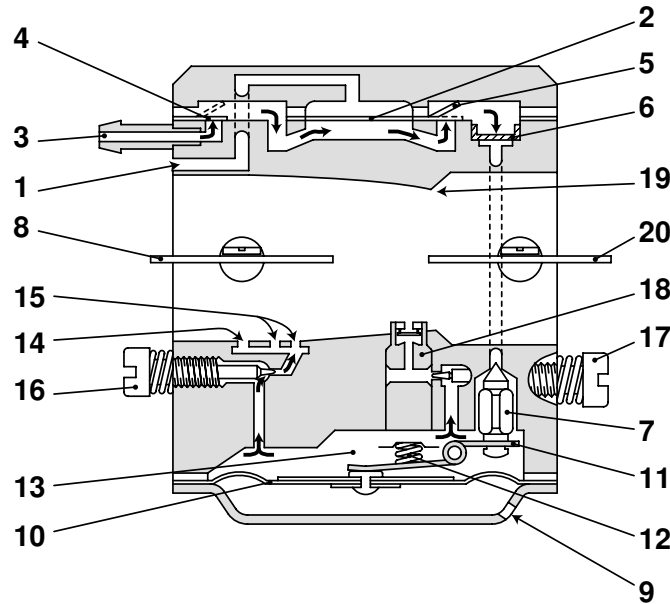


Fig. 8-7

#### 1. ENGINE IMPULSE

The alternating action of the positive pressure and negative pressure inside the engine crankcase operates the fuel pump diaphragm.

#### 2. FUEL PUMP DIAPHRAGM

The fuel pump diaphragm undulates in response to the engine impulse and as a result of that movement it feeds the fuel through the fuel pump valve.

#### 3. FUEL INLET

The fuel inlet is the opening through which fuel is sucked from the fuel tank.

#### 4. INLET VALVE

The inlet valve opens when the diaphragm is submitted to the action of a negative pressure in response to the movement of the pump diaphragm and the inlet valve shuts when it is submitted to a positive pressure.

#### 5. OUTLET VALVE

Oppositely to the inlet valve, the outlet valve shuts when it is submitted to the action of a negative pressure and opens when submitted to a positive pressure.



## **6. INLET SCREEN**

The inlet screen filters the fuel that is sucked from the fuel tank to the carburetor.

## **7. INLET NEEDLE VALVE**

The inlet needle valve controls the fuel that is fed from the fuel pump to the metering chamber.

## **8. THROTTLE VALVE**

The throttle valve controls the volume of air sucked into the engine, thereby changing the engine speed.

## **9. AIR VENT HOLE**

The air vent hole is open to the atmosphere, with the purpose of allowing smooth operation of the metering diaphragm.

## **10. METERING DIAPHRAGM**

The metering diaphragm has the function of operating the metering lever, which is pulled up by the variations in the negative pressure of the engine.

## **11. METERING LEVER**

The metering lever has the function of opening/shutting the inlet needle valve by transmitting the movements of the metering diaphragm to that valve.

## **12. METERING LEVER SPRING**

The metering lever spring has the function of pushing up the metering lever, thereby shutting the needle valve when the engine is stopped and when the metering chamber is full of fuel.

## **13. METERING CHAMBER**

The metering chamber is the fuel storage compartment that has the function of supplying fuel to the nozzle holes and other parts.

## **14. FIRST IDLE HOLE**

The first idle hole is the only fuel supply hole that is available when the engine is idling.

## **15. SECOND AND THIRD IDLE HOLES**

The second and the third idle holes have the function of supplying fuel when the throttle is at an intermediate opening state between the idling state and the fully open state.



## **16. IDLE NEEDLE**

The idle needle has the function of controlling the fuel when the engine is at idling speeds and when the throttle is at a low speed position.

## **17. HIGH SPEED NEEDLE**

The high speed needle has the function of controlling the fuel when the engine is operating at high speed and when the throttle is at a high speed position.

## **18. MAIN NOZZLE**

The main nozzle is the hole through which fuel is ejected when the engine is operating at high speed and when the throttle is at a high speed position.

## **19. VENTURI**

The venturi has the function of increasing the air flow at the nozzle section, thereby improving the atomization of the fuel.

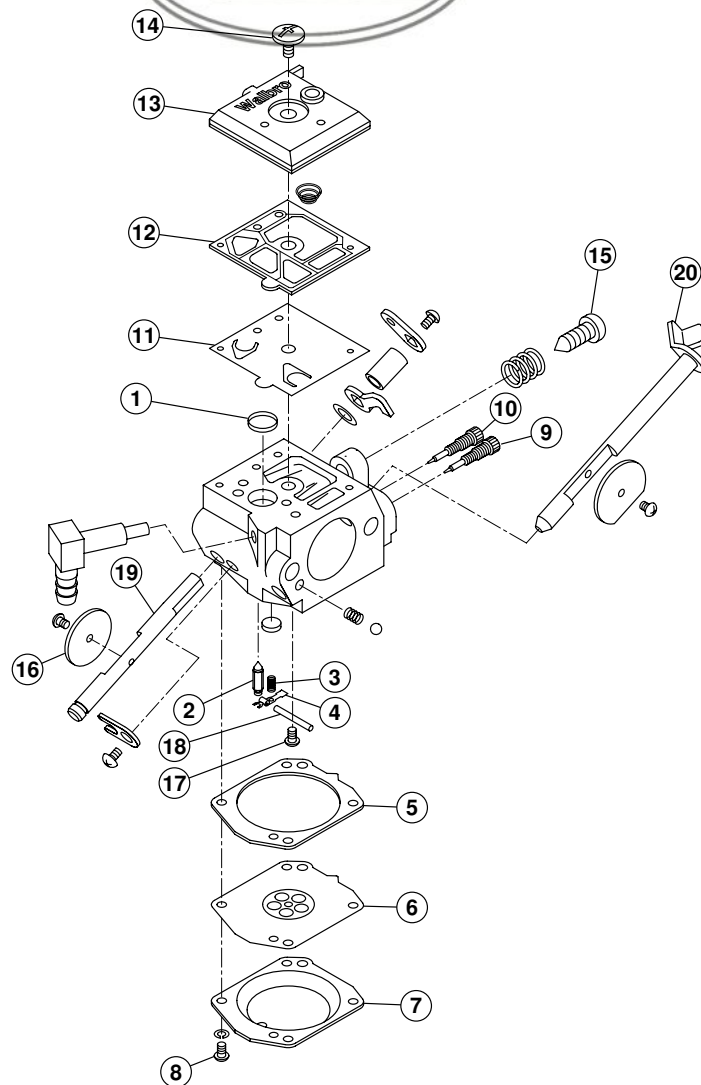
## **20. CHOKE VALVE**

The choke valve has the function of shutting the suction of air when the engine is started at cold state, thereby securing the temporary supply of a rich fuel/air mixture.

## 8c-2 DISASSEMBLY PROCEDURE

Prior do disassembling the carburetor, make sure to wash it with clean gasoline, washing oil or the like.

- (1) Loosen the pump cover screw ⑭ and remove the screw and the pump cover ⑬.
- (2) Remove the pump gasket ⑫ and the diaphragm ⑪.
- (3) Next, place the carburetor with the metering side up and remove the metering cover screws ⑧ (4 screws).
- (4) Remove the metering cover ⑦, the diaphragm ass'y ⑥ and the gasket ⑤.
- (5) Loosen the metering lever pin screw ⑰ and remove the lever ④, pin ⑱, spring ③, needle valve ②, etc.
- (6) Remove the high-speed needle ⑨ and the idle needle ⑩.



## 8c-3 INSPECTION PROCEDURE

- (1) Wash the carburetor body with gasoline or the like and blow it with compressed air. However, make sure not to blow compressed air into the check valve unit of the carburetor equipped with primer pump.
- (2) Check the gaskets for any deformation and/or damage. If a gasket is deformed or damaged, make sure to replace it with a new one.
- (3) Make sure that the pump diaphragm ⑪ is not damaged and make sure that the inlet valve and outlet valve are flat and not bent.
- (4) Make sure that the metering diaphragm ⑥ is not damaged and that the plate is not bent.
- (5) Check the throttle shaft ⑲ and the choke shaft ⑳ for smooth operation.
- (6) Check the inlet screen ① for sticking of foreign matter. If there is any particle of foreign matter stuck on the inlet screen, wash it and blow it out with compressed air.
- (7) Check the inlet needle valve ② for abnormal wearing. If the inlet needle valve is worn, change it with a new one.

Fig. 8-8



## 8c-4 REASSEMBLY PROCEDURE

- (1) Mount the inlet screen ① on the body.
  - (2) Mount the inlet needle valve ②, metering lever spring ③, metering lever ④ and other related parts. After mounting these parts, adjust the metering lever ④ position at the specified height. Be particularly careful when carrying out this adjustment, because the metering lever height depends on the model.
  - (3) Next, mount the metering gasket ⑤, metering diaphragm ⑥ and cover ⑦ in this order and then tighten the four cover screws ⑧.
  - (4) Mount the high-speed needle ⑨ and the idle needle ⑩, turn them gently clockwise to the fully shut position and then adjust them to the specified opening by returning them counterclockwise from that position. Be particularly careful when carrying out this adjustment, because the opening depends on the model, both for the H and L positions.
  - (5) Next, mount the pump diaphragm ⑪, pump gasket ⑫ and pump cover ⑬ in this order and then tighten the pump cover screw ⑭.
- Refer to the figure at the Fig. 8-8 for the procedure for mounting the parts of the carburetor.

By the way, when the idle needle ⑩ and the high-speed needle ⑨ require a considerable amount of adjustment and when large amounts of foreign matter is stuck on the inlet screen ① when the carburetor is disassembled, be sure to clean the interior of the fuel tank and change the tank filter.





## 8c-5 DIAPHRAGM CARBURETOR ADJUSTMENT METHOD

In the first place, set the idle needle ⑩ and the high-speed needle ⑨ at their standard return openings and then carry out the adjustment according to the following steps of procedure.

### 8c-5-1 IDLING ADJUSTMENT

- (1) Start the engine and then carry out the adjustment of the idle adjust screw ⑮ for the engine to operate at a speed slightly lower than the speed at which the clutch engages.
- (2) Turn the idle needle ⑩ clockwise/counterclockwise so as to find the position where the engine operates most smoothly.
- (3) By means of the idle adjust screw ⑮, adjust the engine at a speed approximately 500 r.p.m. higher than the specified idling speed.
- (4) Next, turn the idle needle ⑩ counterclockwise for the engine to operate at the specified idling speed.

### 8c-5-2 HIGH-SPEED ADJUSTMENT

- (1) Set the throttle valve ⑮ at the fully open state and check whether the engine rotates at the speed specified by the manufacturer.
  - 1) If the engine speed is too high, turn the high-speed needle ⑨ counterclockwise so as to adjust the engine revolution speed at the specified value.
  - 2) If the engine speed is too low, turn the high-speed needle ⑨ clockwise so as to adjust the engine revolution speed at the specified value.

\*The idle needle ⑩ and the high-speed needle ⑨ are set at the correct adjustments through the execution of the steps of procedure described above.

At that time, the adjustment is regarded as correct and normal if the needle return opening is within 1/2 of the standard return opening.

## 9. STARTING SYSTEM



### 9-1 RECOIL STARTER

Tools required: Driver, Pinchers (Pliers) and Protective Glasses

**WARNING :**

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

#### 9-1-1 Disassembly Steps

(1) Setting off 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 knob of the rope in the reel makes a direct line with the rope guide.
- 3 : Push and hold the reel with the thumbs of both hands firmly so that the rope will not be wound back. (Fig. 9-1)
- 4 : Pull off the knot of the rope out of the reel, unfasten the knot and pull it off to the direction of the starter knob. (2 persons required)
- 5 : By controlling the reel with the thumbs of both hands, unwind the rope gently until the rotation of the reel Stops.

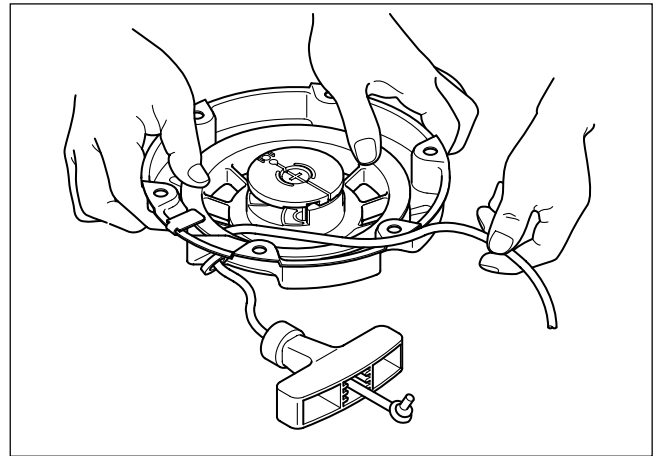


Fig. 9-1

**WARNING :**

**The spring power is at its most when the rope is fully extracted. Therefore, do not abruptly put off your hand nor loosen the pressure of your finger unintentionally.**

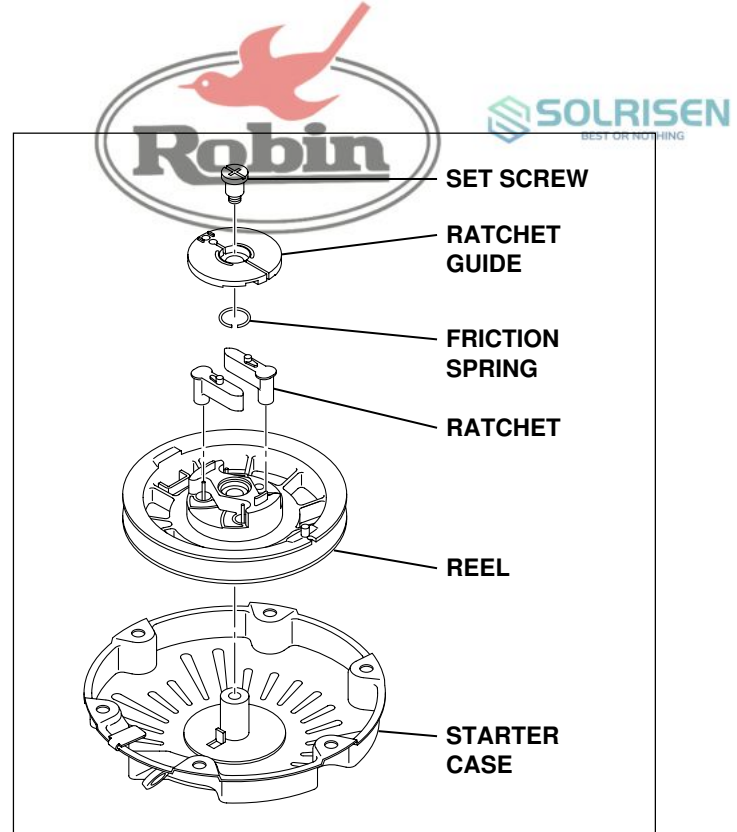


Fig. 9-2

- (2) Setting the attachments off (Fig. 9-2)
- 1 : Fix the case and loosen the set-screw.
  - 2 : Put off the set-screw, the ratchet guide, the friction spring and the ratchet in the same order from above.
- (3) Setting the reel off (Fig. 9-2)
- 1 : Push the reel lightly so that it will not float up. Move the reel clockwise and counter-clockwise about a quarter circle for several times until it moves smoothly.
  - 2 : Pull up the reel gradually and slowly and put it off from the case.
  - 3 : In case the spring in the reel is close to pop up, redo the steps of (3)-1 and (3)-2 again.

**WARNING :**

**Do not drop or shake the reel and put it on a level table because there is a spring set in the disassembled reel.**

Disassembly is complete.

**WARNING :**

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

## 9-1-2 Assembly Steps

- (1) Setting the reel into the case.
- 1 : Paste grease on the case. (Fig. 9-3)
  - 2 : Adjust the position of the inner end of the spring, which is set in the reel. (Fig. 9-4)
  - 3 : Hold the reel so that the shaft/hook part and the inner-end of the spring are hooked together. Drop the reel gently from above into the case.
  - 4 : Move the reel slightly counterclockwise and make sure the spring is hooked.

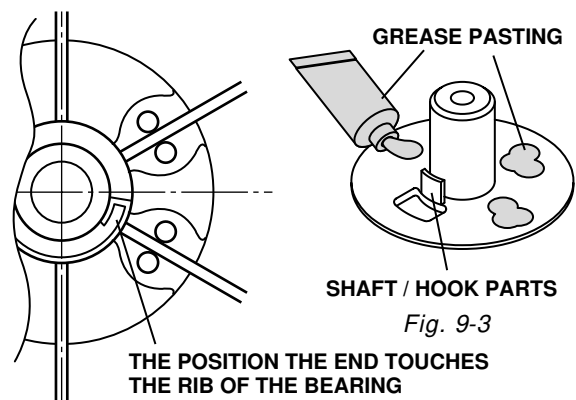


Fig. 9-3

Fig. 9-4

## (2) Setting the attachments

-1: Set the ratchet into the reel. (Fig. 9-5)

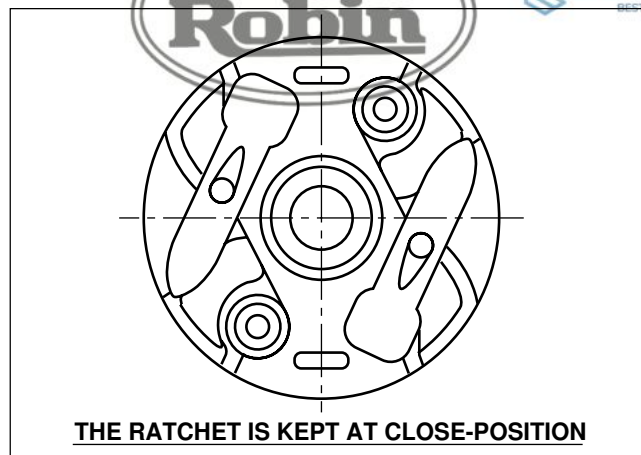


Fig. 9-5

-2: Holding the ratchet, set the ratchet-guide subassembly. (Fig. 9-6)

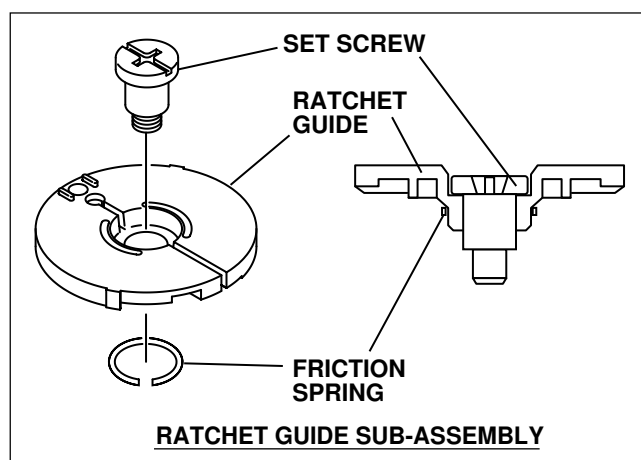


Fig. 9-6

## (3) Tightening the set-screw.

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

## (4) Storing the spring-power.

-1 : Hold the case tight and using both hands, wind up the reel counterclockwise 6 times.

-2 : Set the reel to keep the position, whereby the rope hole of the reel and the rope guide make a direct line. (Fig. 9-7)

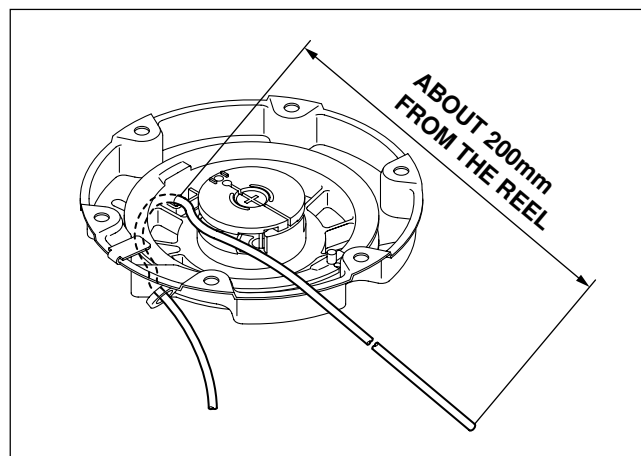


Fig. 9-7

### **WARNING :**

The spring power is at its most when the reel is being wound. Therefore, do not abruptly put off your hand nor loosen the pressure of Your finger unintentionally.

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

-1 : Set the end of the rope through the rope guide and the rope hole of the reel and pull the end about 20 cm out of the reel.

(Fig. 9-7)

-2 : Fasten the end of the rope.

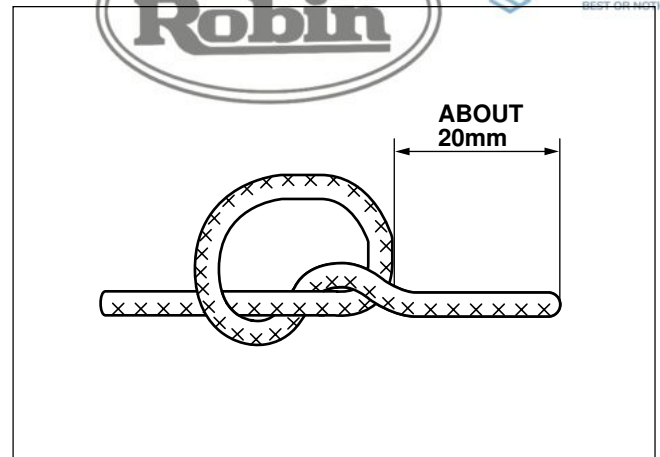


Fig. 9-8

-3 : Put the rope into the reel, whereby make sure that the rope will not float up.

(Fig. 9-9)

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

-5 : Take your hand off the reel gently and release the rope slowly checking the winding power of the spring until the knob reaches the rope guide.

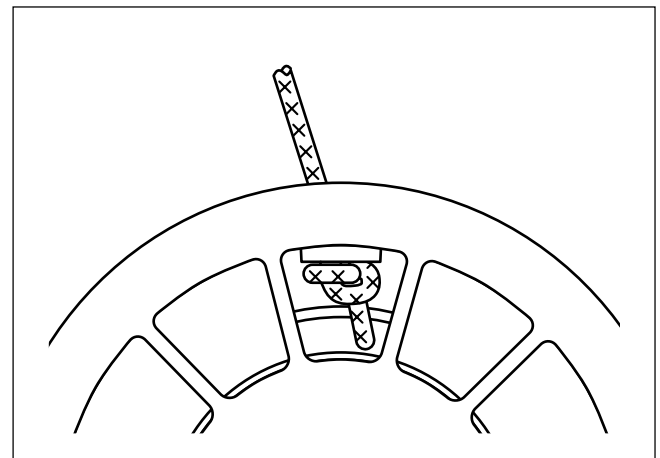


Fig. 9-9

Assembly is complete.

(6) Test the operation of the recoil starter to see if the rope recoils satisfactorily and the ratchets extend and retract properly. Mount the recoil starter to the engine.

(7) If the spring escapes from the reel when disassembling the recoil, hook the outer end of the spring onto the notch of the reel and rewind the spring into the housing.

(8) Lubricate the rotating parts, sliding parts and spring with heat resistant grease before reassembling the recoil and prior to long term storage.



## 10. TROUBLESHOOTING

The following three conditions must be fulfilled for satisfactory engine start.

1. The cylinder filled with a proper fuel-air mixture.
2. Good compression in the cylinder.
3. Good spark, properly timed, to ignite the mixture.

The engine cannot be started unless these three conditions are met. There are also other factors which make engine start difficult, e. g., a heavy load on the engine when it is about to start at low speed, and a high back pressure due to a long exhaust pipe.

The most common causes of engine troubles are given below :

### 10-1 STARTING DIFFICULTIES

#### 10-1-1 FUEL SYSTEM

- (1) No gasoline in the fuel tank, or the fuel cock closed.
- (2) The carburetor is not choked sufficiently especially when the engine is cold.
- (3) Water, dust or gum in the gasoline interfering with the fuel flow to the carburetor.
- (4) Inferior grade gasoline or poor quality gasoline not vaporized enough to produce the correct fuel-air mixture.
- (5) The carburetor needle valve is held open by dirt or gum. This trouble can be detected as the fuel flows out of the carburetor when the engine is idling. (Overflow)

This trouble may be remedied by lightly tapping the float chamber with the grip of a screwdriver or the like.

- (6) If the carburetor overflows, excessive fuel runs into the cylinder when starting the engine, making the fuel-air mixture too rich to burn. If this happens, remove the spark plug, and turn the starting pulley a few turns in order to let the rich fuel-air mixture out of the spark plug hole and into the atmosphere. Keep the choke valve open during this operation.  
Dry the spark plug well, screw it into place, and try to start again.

#### 10-1-2 COMPRESSION SYSTEM

If starting difficulties and loss of power are not due to the fuel system or ignition system, the followings must be checked for possible lack of compression.

- (1) Engine inside is completely dried up because of a long period of storage.
- (2) Loose or broken spark plug. This causes a hissing noise made by air/fuel mixture running out of cylinder in compression stroke during cranking.
- (3) Damaged head gasket or loose cylinder head. A similar hissing noise is produced during compression stroke.



(4) Incorrect Valve clearance

If the correct compression is not obtained even after remedying the above, disassemble the engine and check further as follows :

- a) Valve stuck open due to carbon or gum on the valve stem.
- b) If the piston rings are stuck on the piston, remove the piston and connecting rod from the engine. Clean or replace the parts.

### 10-1-3 IGNITION SYSTEM

Check the followings for lack of sparks.

- (1) Wires of the ignition coil, spark plug or contact breaker disconnected.
- (2) Ignition coil damaged and shorted.
- (3) Spark plug cable wet or soaked with oil.
- (4) Spark plug dirty or wet.
- (5) Spark plug electrode gap incorrect.
- (6) Spark plug electrodes are connected or bridged.
- (7) Incorrect spark timing.
- (8) Proper connection of all wires.

### 10-2 ENGINE MISFIRES

- (1) Incorrect spark plug electrode gap. Adjust it to anywhere between 0.7 and 0.8 mm.
- (2) Ignition cable worn and leaking.
- (3) Sparks weak.
- (4) Ignition wire connections loose.
- (5) Water in gasoline.
- (6) Insufficient compression.

### 10-3 ENGINE STOPS

- (1) Fuel tank empty. Water, dirt, gum, etc. in gasoline.
- (2) Vapor lock, i. e., gasoline evaporating in the fuel lines due to overheating of the engine.
- (3) Vapor lock in the fuel lines or carburetor due to the use of too volatile (winter) gas in the hot season.
- (4) Air vent hole in the fuel tank cap plugged.
- (5) Bearing parts seized due to lack of oil.
- (6) Magneto or ignition coil faulty.



## **10-4 ENGINE OVERHEATS**

- (1) Crankcase oil level low. Add oil immediately.
- (2) Spark timing incorrect.
- (3) Low grade gasoline is used, or engine is overloaded.
- (4) Cooling air circulation restricted.
- (5) Cooling air path misdirected causing loss of cooling efficiency.
- (6) Cylinder head cooling fins clogged up with dirt.
- (7) Engine operated in an enclosed space without sufficient cooling air.
- (8) Exhaust gas discharge restricted, or carbon deposits in the combustion chamber.
- (9) Engine running on low-octane gasoline detonates due to heavy load at low speed.

## **10-5 ENGINE KNOCKS**

- (1) Poor quality gasoline.
- (2) Engine operating under heavy load at low speed.
- (3) Carbon or lead deposits in the cylinder head.
- (4) Spark timing incorrect.
- (5) Loose connecting rod bearing due to wear.
- (6) Loose piston pin due to wear.
- (7) See causes of engine overheat.

## **10-6 ENGINE BACKFIRES THROUGH CARBURETOR**

- (1) Water or dirt in gasoline, or low-grade gasoline.
- (2) Intake valve stuck.
- (3) Valves overheated, or hot carbon particles in the combustion chamber.
- (4) Engine cold.





## 11. INSTALLATION

Engine life, ease of maintenance and inspection, frequency of checks and repairs, and operating cost 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 the hot air used for engine cooling, and temperature rise of the machine. Keep the engine room temperature below 50°C 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.

### 11-4 POWER TRANSMISSION TO DRIVEN MACHINES

#### 11-4-1 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.

#### 11-4-2 FLEXIBLE COUPLING

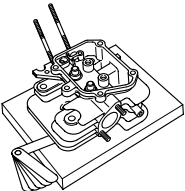
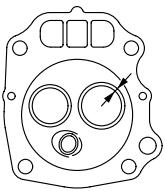
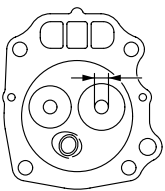
When using a flexible coupling, run out and misalignment between the driven shaft and engine shaft must be minimized. Run out and misalignment tolerance are specified by the coupling manufacturer.

## 12. SERVICE DATA

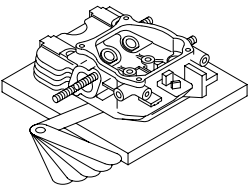
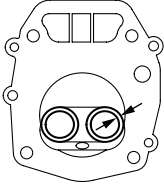
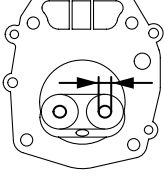
“STD” in the following table is the parts dimension from the brand new engine or the spare parts. Whereas, “Limit” shows the maximum allowance for the parts to be used on the engine. If the measurement exceeds beyond the “Limit”, the part needs to be replaced and/or repaired.

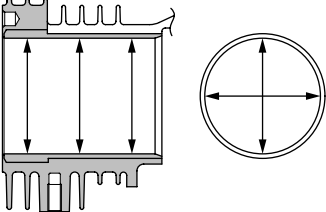
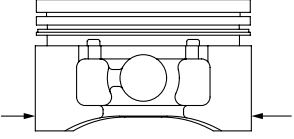
### 12-1 CLEARANCE DATA AND LIMITS

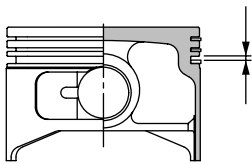
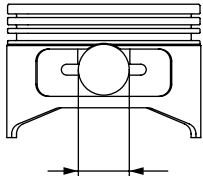
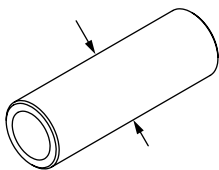
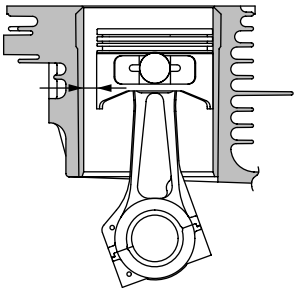
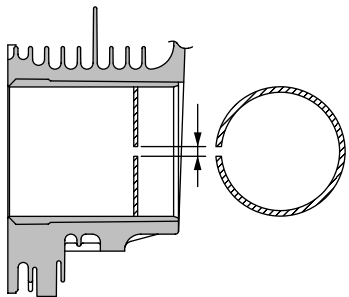
Unit : mm (in.)

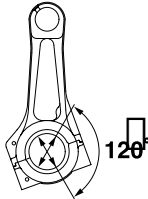
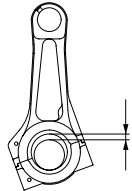
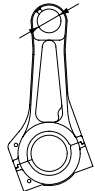
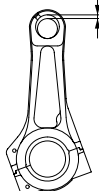
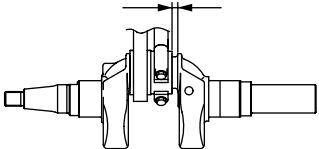
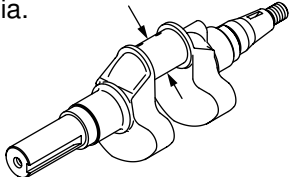
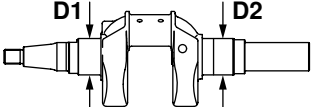
ITEM		EH09D	
		STD	Limit
CYLINDER HEAD * Flatness 		LESS THAN 0.05 (0.002)	0.1 (0.004)
* Valve seat contact width 	IN. EX.	0.8 - 1.1 (0.0315 - 0.0433)	2.0 (0.079)
* Valve guide inside dia. 		5.500 - 5.518 (0.2165 - 0.2172)	5.65 (0.2224)

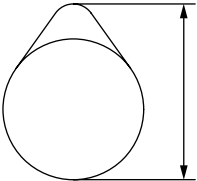
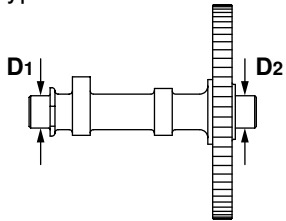
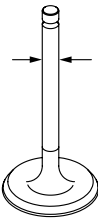
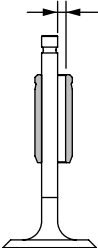
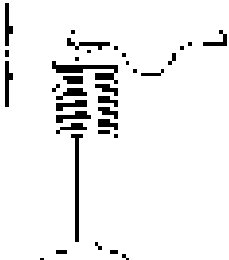
Unit : mm (in.)

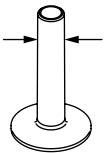
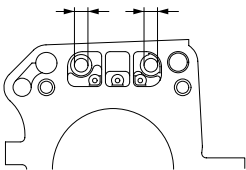
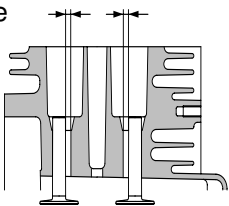
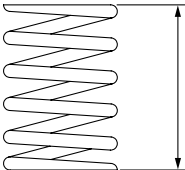
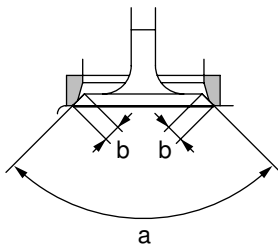
ITEM		EH12-2D	
		STD	Limit
CYLINDER HEAD * Flatness 		LESS THAN 0.05 (0.002)	0.1 (0.004)
* Valve seat contact width 	IN. EX.	0.7 - 1.0 (0.028 - 0.039)	2.0 (0.079)
* Valve guide inside dia. 		5.500 - 5.518 (0.2165 - 0.2172)	5.65 (0.2224)

ITEM		EH09D		EH12-2D	
		STD	Limit	STD	Limit
<b>CYLINDER</b> * Inside dia. 	STD	51.0 - 51.019 (2.008 - 2.009)	To be rebored when the difference between max. and min. of diameter reached to 0.1 (0.004).	60.000 - 60.019 (2.3622 - 2.3630)	To be rebored when the difference between max. and min. of diameter reached to 0.1 (0.004).
	1 st reboring	51.250 - 51.269 (2.0177 - 2.0185)	Ditto	60.250 - 60.269 (2.3720 - 2.3728)	Ditto
	2 st reboring	51.500 - 51.519 (2.0276 - 2.0283)	—	60.500 - 60.519 (2.3819 - 2.3826)	—
	* Roundness 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)	—
<b>PISTON</b> * Piston size (At skirt in thrust direction) 	STD	50.97 - 50.99 (2.0067 - 2.0075)	50.88 (2.0031)	59.96 - 59.98 (2.3606 - 2.3614)	59.87 (2.3571)
	1 st o / s	51.22 - 51.24 (2.0165 - 2.0173)	51.13 (2.0123)	60.21 - 60.23 (2.3705 - 2.3713)	60.12 (2.3669)
	2nd o / s	51.47 - 51.49 (2.0264 - 2.0272)	51.38 (2.0228)	60.46 - 60.48 (2.3803 - 2.3811)	60.37 (2.3768)

ITEM		EH09D		EH12-2D	
		STD	Limit	STD	Limit
<b>PISTON</b> * Ring groove side clearance   * Piston pin hole   * Piston pin outside dia.   * Clearance between piston and cylinder at skirt area.   * Piston ring end gap 	Top	0.035 - 0.080 (0.0014 - 0.0031)	0.15 (0.006)	0.030 - 0.075 (0.0012 - 0.0030)	0.15 (0.006)
	2nd	0.035 - 0.080 (0.0014 - 0.0031)	0.15 (0.006)	0.030 - 0.075 (0.0012 - 0.0030)	0.15 (0.006)
	Oil ring	0.010 - 0.065 (0.0004 - 0.0026)	0.15 (0.006)	0.020 - 0.075 (0.0008 - 0.0030)	0.15 (0.006)
		10.991 - 11.009 (0.4327 - 0.4334)	11.035 (0.4344)	12.991 - 13.002 (0.5115 - 0.5119)	13.035 (0.5132)
		10.992 - 11.000 (0.4328 - 0.4331)	10.960 (0.4315)	12.992 - 13.000 (0.5115 - 0.5118)	12.960 (0.5102)
		0.010 - 0.049 (0.0004 - 0.0019)	0.25 (0.010)	0.015 - 0.074 (0.0006 - 0.0029)	0.25 (0.010)
	Top 2nd	Top 0.15 - 0.35 (0.006 - 0.014)  2nd 0.35 - 0.55 (0.014 - 0.022)	1.5 (0.0591)	0.2 - 0.4 (0.008 - 0.016)	1.5 (0.0591)
	Oil ring	0.05 - 0.25 (0.002 - 0.010)	1.5 (0.0591)	0.2 - 0.4 (0.008 - 0.016)	1.5 (0.0591)

ITEM	EH09D		EH12-2D	
	STD	Limit	STD	Limit
<b>CONNECTING ROD</b> * Big end inside dia. 	20.000 - 20.013 (0.7874 - 0.7879)	20.1 (0.7913)	26.000 - 26.013 (1.0236 - 1.0241)	26.1 (1.0276)
* Clearance between big end and crankpin 	0.037 - 0.063 (0.0015 - 0.0025)	0.2 (0.008)	0.020 - 0.046 (0.0008 - 0.0018)	0.2 (0.008)
* Small end inside dia. 	11.010 - 11.021 (0.4335 - 0.4339)	11.08 (0.4362)	13.010 - 13.021 (0.5122 - 0.5126)	13.08 (0.5150)
* Clearance between small end 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)
* Big end side clearance 	0.1 - 0.7 (0.004 - 0.028)	1.0 (0.040)	0.1 - 0.7 (0.004 - 0.028)	1.0 (0.040)
<b>CRANKSHAFT</b> * Crankpin outside dia. 	19.950 - 19.963 (0.7854 - 0.7859)	19.85 (0.7815)	25.967 - 25.980 (1.0223 - 1.0228)	25.85 (1.0177)
* Journal dia. 	D1, D2 19.988 - 19.997 (0.7869 - 0.7873)		D1, D2 24.988 - 24.997 (0.9839 - 0.9841)	

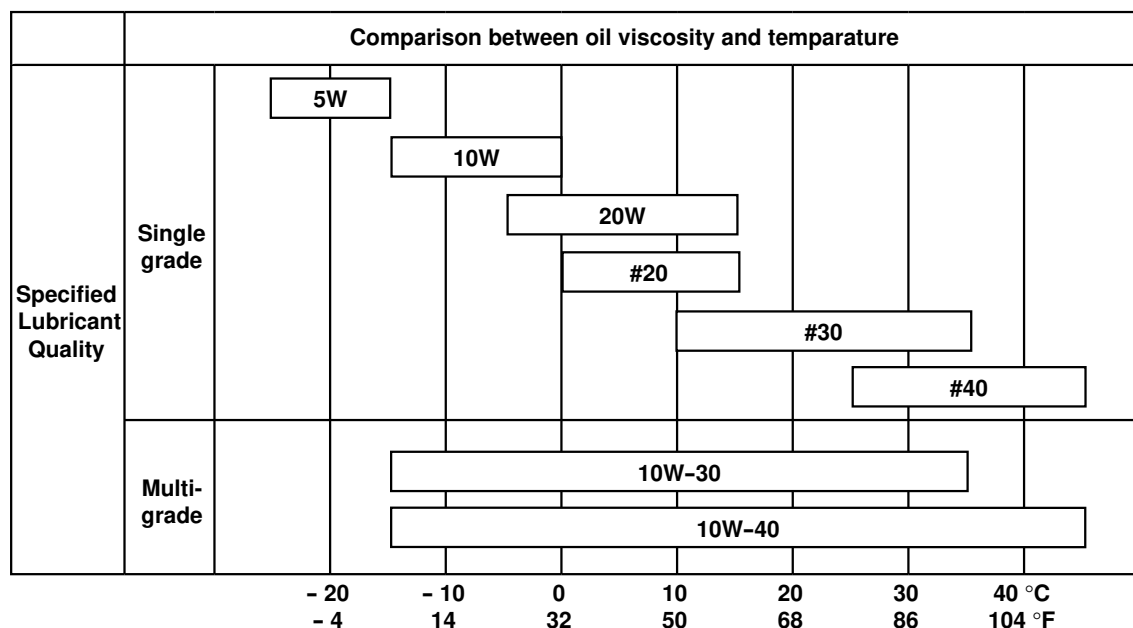
ITEM		EH09D		EH12-2D	
		STD	Limit	STD	Limit
<b>CAMSHAFT</b> * Cam height (IN. and EX.)  * Journal outside dia. "D" type 		18.3 - 18.5 (0.720 - 0.728)	18.15 (0.715)	29.6 - 29.8 (1.165 - 1.173)	29.45 (1.159)
	D <sub>1</sub>	9.972 - 9.987 (0.3926 - 0.3932)	9.95 (0.3917)	16.973 - 16.984 (0.6682 - 0.6687)	16.95 (0.6673)
	D <sub>2</sub>	9.972 - 9.987 (0.3926 - 0.3932)	9.95 (0.3917)	14.973 - 14.984 (0.5895 - 0.5899)	14.95 (0.5886)
<b>VALVE</b> * Valve stem outside dia.  *Clearance between valve stem dia. and valve guide.  * Valve clearance 	IN.	5.440 - 5.455 (0.2142 - 0.2148)	5.35 (0.2106)	5.440 - 5.455 (0.2142 - 0.2148)	5.35 (0.2106)
	EX.	5.426 - 5.444 (0.2136 - 0.2143)	5.35 (0.2106)	5.426 - 5.444 (0.2136 - 0.2143)	5.35 (0.2106)
	IN.	0.045 - 0.078 (0.0018 - 0.0031)	0.3 (0.012)	0.045 - 0.078 (0.0018 - 0.0031)	0.3 (0.012)
	EX.	0.056 - 0.092 (0.0022 - 0.0036)	0.3 (0.012)	0.056 - 0.092 (0.0022 - 0.0036)	0.3 (0.012)
	IN. / EX. (cold)	0.07 - 0.13 (0.0028 - 0.0051)		0.07 - 0.13 (0.0028 - 0.0051)	

ITEM	EH09D		EH12-2D	
	STD	Limit	STD	Limit
<b>TAPPET</b> * Stem outside dia. 	7.960 - 7.975 (0.3134 - 0.3140)		7.960 - 7.975 (0.3134 - 0.3140)	
* Guide inside dia. 	8.000 - 8.015 (0.3150 - 0.3156)		8.000 - 8.015 (0.3150 - 0.3156)	
* Tappet guide clearance 	0.025 - 0.055 (0.0010 - 0.0022)		0.025 - 0.055 (0.0010 - 0.0022)	
<b>VALVE SPRING FREE LENGTH</b> 	26.7 (1.05)	—	30.5 (1.2)	—
<b>VALVE SEAT ANGLE (IN. and EX.)</b> * 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)

## 12-2 TORQUE SPECIFICATIONS

ITEMS		Tightening torque		
		N • m	Kg • cm	ft • lb.
Cylinder head bolts	(EH09D)	18.6 - 20.6	190 - 210	13.7 - 15.2
	(EH12-2D)	23.0 - 26.0	230 - 270	17.0 - 30.0
Connecting rod cap bolts	(EH09D)	5.9 - 7.8	60 - 80	4.3 - 5.7
	(EH12-2D)	8.8 - 11.0	90 - 115	6.5 - 8.3
Flywheel nut	(EH09D)	44.2 - 49.1	450 - 500	32.5 - 36.2
	(EH12-2D)	59.0 - 63.0	600 - 650	43.0 - 47.0
Main bearing cover bolts	(EH09D)	9.8 - 11.8	100 - 120	7.2 - 8.7
	(EH12-2D)	9.8 - 11.8	100 - 120	7.2 - 8.7
Spark plug (EH09D)	New one	11.8 - 14.7	120 - 150	8.7 - 10.9
	Retightening	22.6 - 24.5	230 - 250	16.6 - 18.1
Spark plug (EH12-2D)	New one	11.8 - 14.7	120 - 150	8.7 - 10.9
	Retightening	22.6 - 26.5	230 - 270	16.6 - 19.5
Intake pipe (EH12-2D)		9.8 - 13.7	100 - 140	7.2 - 10.1
Muffler nut	(EH09D)	8.8 - 10.8	90 - 110	6.5 - 8.0
	(EH12-2D)	22.5 - 26.5	230 - 270	16.5 - 19.5

## 12-3 OIL GRADE CHART



Use oil classified as SE or higher.

Multi-grade oil tends to increase its consumption at high ambient temperature.



## 13. 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.

### 13-1 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.	

### 13-2 INITIAL 20 HRS. MAINTENANCE

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

### 13-3 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.

#### 13-4 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.

#### 13-5 EVERY 300 HRS. or YEARLY MAINTENANCE

MAINTENANCE ITEMS	REMARKS
1) Check and adjust valve clearance	

#### 13-6 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.	

#### 13-7 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.

#### 13-8 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.

