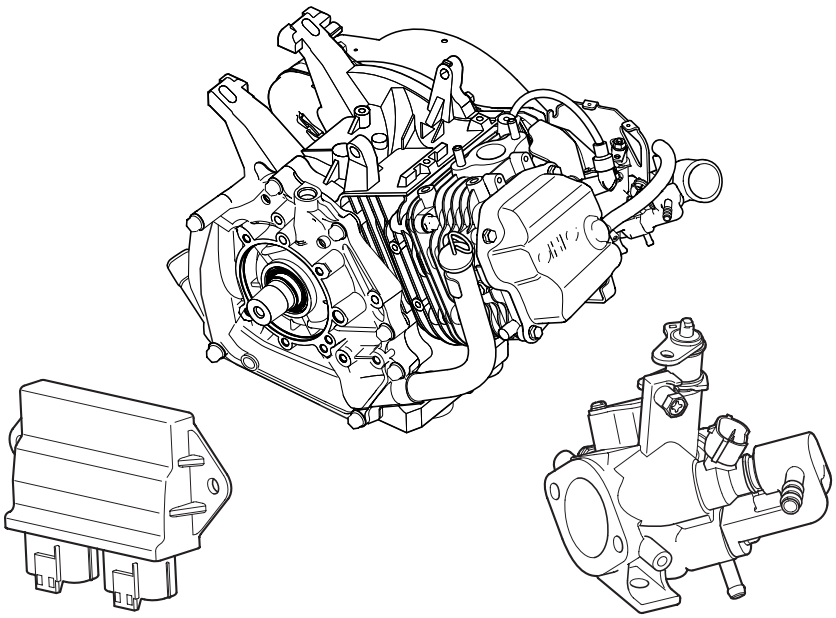
EX40 EFI Engine Service, Repair, and Rebuild Manual



Manual Number 105062943
Edition Code 0114A00000

CONTENTS

1. SPECIFICATIONS

Model		EX40D
Type		Air-Cooled, 4-Cycle, Slant Single-Cylinder, Horizontal P.T.O. Shaft, OHC Gasoline Engine
Bore & Stroke	mm (in.)	89 × 65 (3.50 × 2.56)
Piston Displacement	ml (cu.in.)	404 (24.65)
Compression Ratio		8.3
Maximum Output	kW(HP)/r.p.m.	per SAE J 1940 10.4 (14)/3600
Maximum Torque	N･m / r.p.m. (kgf･m / r.p.m.) (ft･lb. / r.p.m.)	27/2400 (2.8/2400) (19.91/2400)
Direction of Rotation		Counterclockwise as viewed from the P.T.O. shaft side
Cooling System		Forced air cooling system
Lubrication System		Splash lubrication system
Lubricant		Automobile engine oil ; Grade SE or higher (SG,SH or SJ in recomended) SAE 10W-30-----Under ordinary atmospheric temperatures SAE 5W-30-------In cold areas
Capacity of Lubricant	L	1.2 (1.3 qt.)
Fuel system		Throttle body single point injection
Fuel type		Automobile unleaded gasoline
Fuel Supply System		Regulated pressure with electric fuel pump type
Ignition System		Flywheel magneto digital C.D.I.
Spark Plug		NGK BR-6HS
Starting System		Starter / Generator
Governor System		None (Vehicle speed control)
Dry Weight	kg (lb.)	Approx. 24.4 (53.6)
Dimensions (L x W x H)	mm (in.)	351 x 451 x 340 (13.8 x 17.8 x 13.4)

∗Specifications are subject to change without notice.

2. GENERAL DESCRIPTION OF ENGINE COMPONENTS

2-1 CYLINDER AND CRANKCASE

The cylinder and crankcase are aluminum die-casting as a single piece. A special cast iron cylinder liner is molded into the aluminum die-casting.
The crankcase has a mounting surface on the output shaft side to which the main bearing cover is attached.
The cylinder is inclined to the right at an angle of 25 degrees from the horizontal as viewed from the output shaft side.

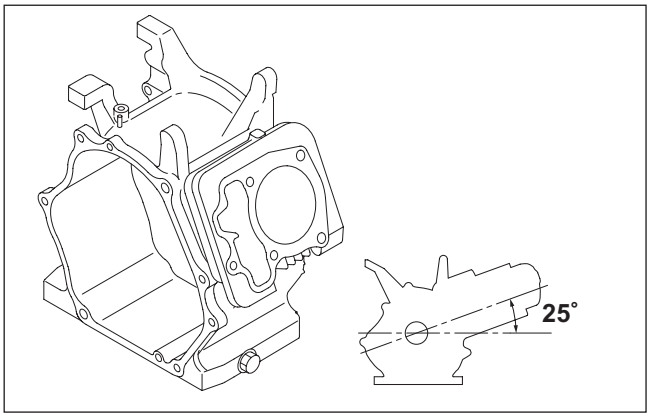


Fig.2-1

2-2 MAIN BEARING COVER

The main bearing cover is an aluminum die-casting, which is mounted on the output shaft side of the crankcase. By removing the main bearing cover, the inside of the engine can be inspected with ease.
Pilots and bosses are machined into the cover to facilitate the direct coupling of the engine with machines such as generators and pumps.
Oil gauges (fillers) are on both sides of the cover for easy maintenance.

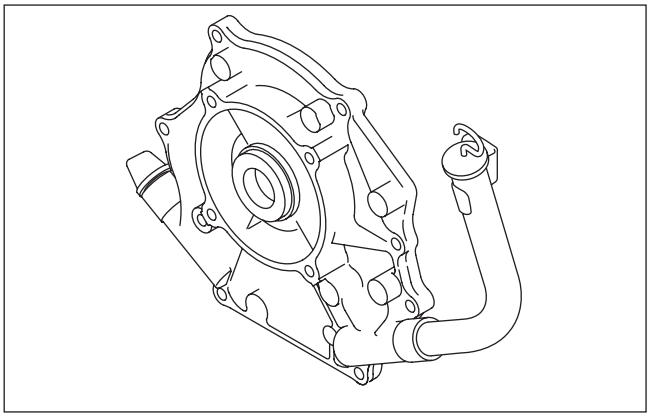


Fig.2-2

2-3 CRANKSHAFT

The crankshaft is forged carbon steel, and the crank pin is high-frequency inductionhardened.
The crank sprocket used to drive the chain and the gear used to drive the governor gear are pressed into the output end of the shaft.

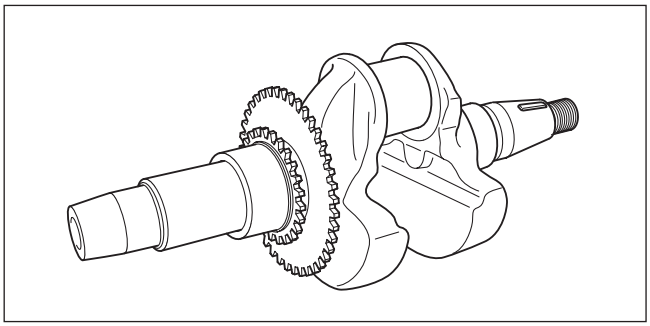


Fig.2-3

2-4 CONNECTING ROD AND PISTON

The connecting rod is a specially heat-treated aluminum alloy die-casting. Its large and small ends function as bearings. A splasher built into the connecting rod lubricates by splashing engine oil.
The piston is an aluminum alloy casting with grooves for mounting one compression ring and one oil ring.

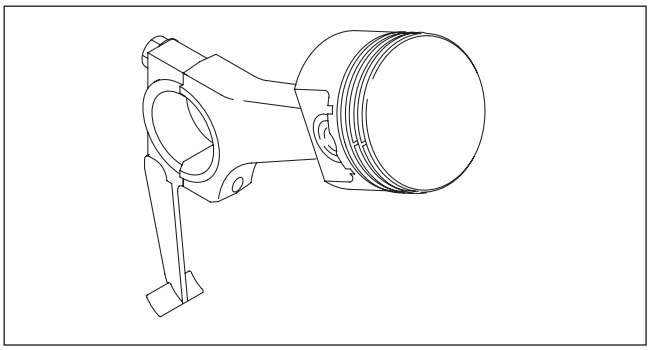
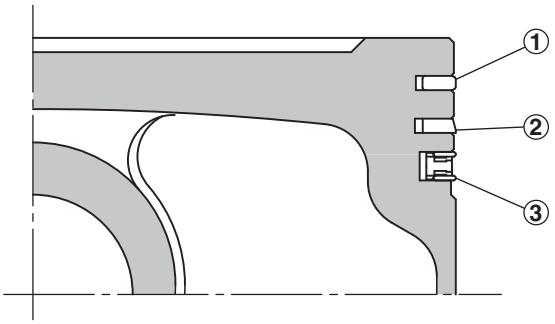


Fig.2-4

2-5 PISTON RINGS

The piston rings are made of special cast iron. The profile of the top ring is a tapered face.
The oil ring is designed for better sealing and less oil consumption, in combination with 3 pieces.



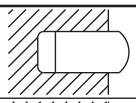
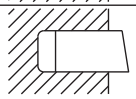
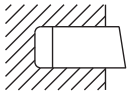
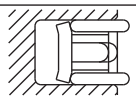
①	TOP RING	BARREL	
		TAPER	
②	SECOND RING	TAPER	
③	OIL RING	THREE-PIECE CONSTRUCTION	

Fig.2-5

2-6 CAMSHAFT

The camshaft and the sprocket are made of special sintered alloy. They are constructed as a single piece. The camshaft is provided with intake and exhaust cam, and the decompression release lever is mounted on the sprocket shaft end side.

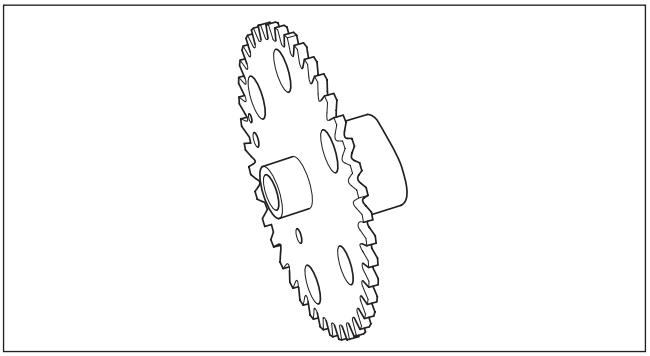


Fig.2-6

2-7 VALVE ARRANGEMENT

This engine has a chain-driven overhead cam and overhead valve construction, with a single cam which has individual profile for intake and exhaust to perform high output.

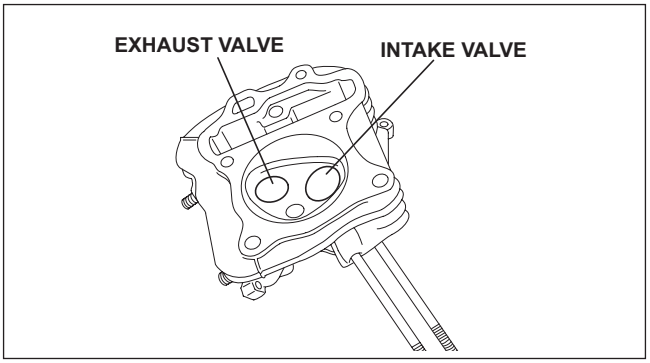


Fig.2-7

2-8 CYLINDER HEAD

The cylinder head is on aluminum die-casting with a dome-shaped combustion chamber. The intake and exhaust ports are arranged in a cross direction to improve combustion efficiency.

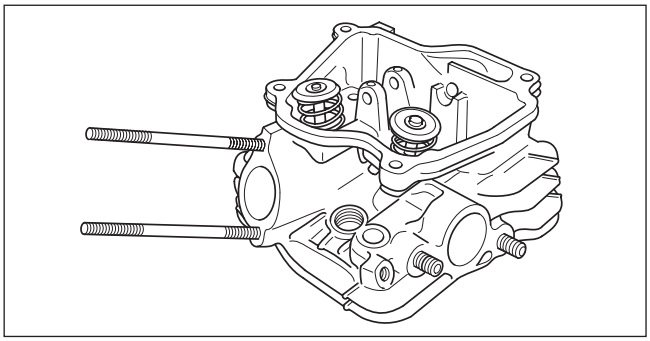


Fig.2-8

2-9 COOLING SYSTEM

The engine uses a forced air-cooling system in which a synthetic resin cooling fan (which is separate from the flywheel), reduce noise and forces cooling air into the cylinder and cylinder head.
Baffles are provided to guide the flow of cooling air.

2-10 LUBRICATION SYSTEM

The rotating parts, sliding parts and valves of the engine are lubricated with oil in the crankcase.
The oil is splashed onto the parts by the oil splasher on the connecting rod.

2-11 TIMING CHAIN

Timing chain system is adopted and designed for lubricating for the upper portion of cylinder head.
The timing chain is engaged between the sprocket portion of integrated camshaft in the cylinder head and the crankshaft gear sprocket.
The sprocket teeth in particular shape are adopted to enhance the durability and to realize low noise level.

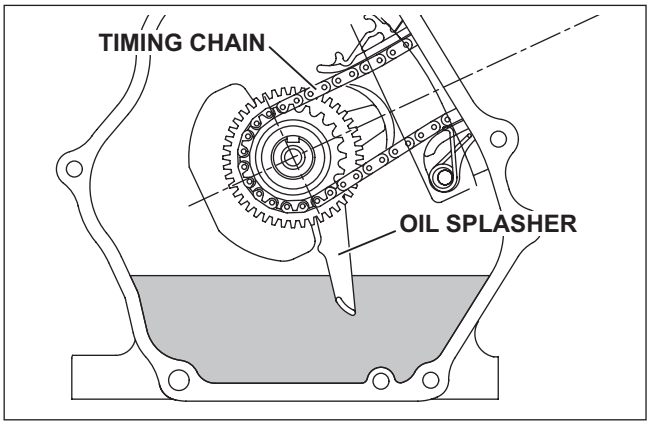


Fig.2-9

2-12 IGNITION SYSTEM

The ignition system is a flywheel magneto digital C.D.I. system. The magneto consists of a flywheel and ignition coil. The flywheel (cooling fan is separete from the flywheel) is directly mounted on the crankshaft and the ignition coil is directly mounted on the crankcase.

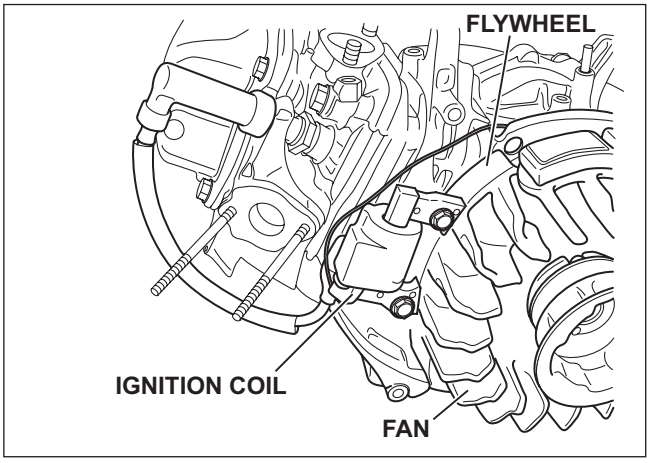


Fig.2-10

2-13 BALANCER

Unbalanced inertia force is cancelled by the balancer which rotates at the same speed as the crankshaft to effectively reduce vibration.

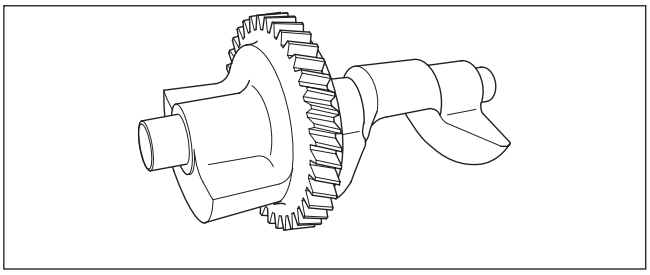


Fig.2-11

3. DISASSEMBLY AND REASSEMBLY

3-1 PREPARATIONS AND PRECAUTIONS

(1) When disassembling the engine, memorize the location of each part so that you can reassemble the engine correctly. If necessary, attach identification tags with the required assembly information to the parts.

(2) Store groups of parts in separate boxes. This will make reassembly easier.

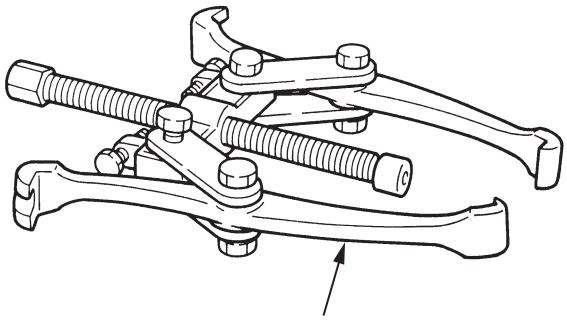
(3) To prevent parts from being mislaid, keep each group provisionally assembled after removing the parts from the engine.

(4) Handle the disassembled parts with the utmost care. Clean them with cleaning oil if necessary.

(5) Use the correct tools in the correct way when disassembling and reassembling the engine.

3-2 SPECIAL TOOLS

	Tool name	Use
Commercially available product	**Flywheel puller**	**For pulling off the flywheel**
Commercially available product	**Chain wrench**	**For locking the flywheel**



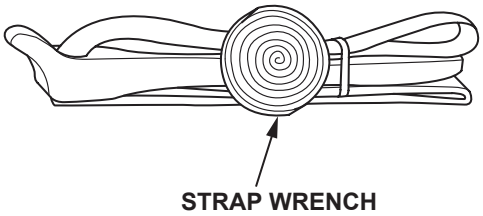


Fig.3-1

3-3 DISASSEMBLY PROCEDURE

Step	Parts to remove	Remarks and procedures	Fasteners
1	Drain the engine oill	Remove a drain plug (M14 x 12mm) located on both sides of the case. Take care not to lose the gaskets. ∗ To discharge oil quickly, remove the oil guage(M22).	14 mm spanner
2	Remove oil filler	Remove oil filler from crankcase.	M8 Bolt : 1 pc.

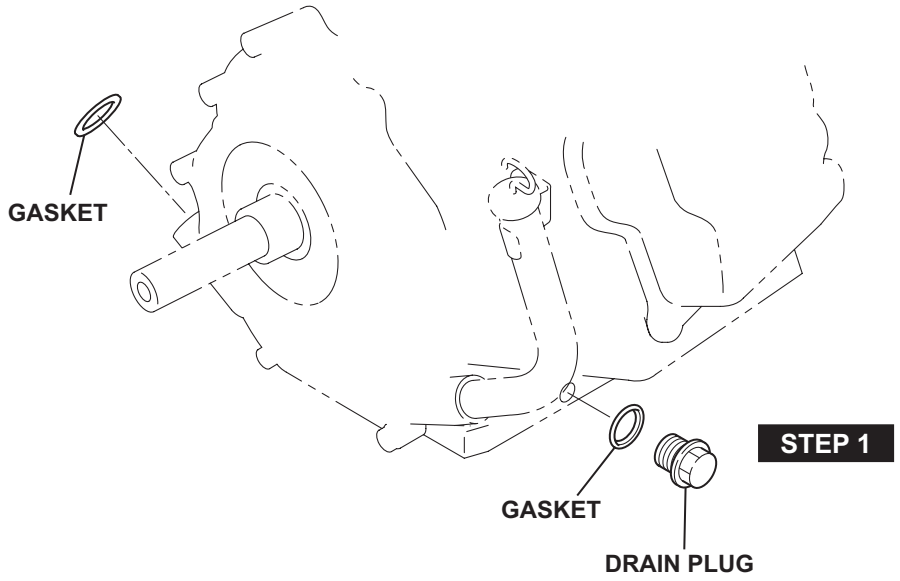


Fig.3-2

Step	Parts to remove	Remarks and procedures	Fasteners
3	Blower housing	(1) Remove the blower housing (synthetic resin) from the crankcase.	10 mm box spanner M6 x 16 mm : 5 pcs.

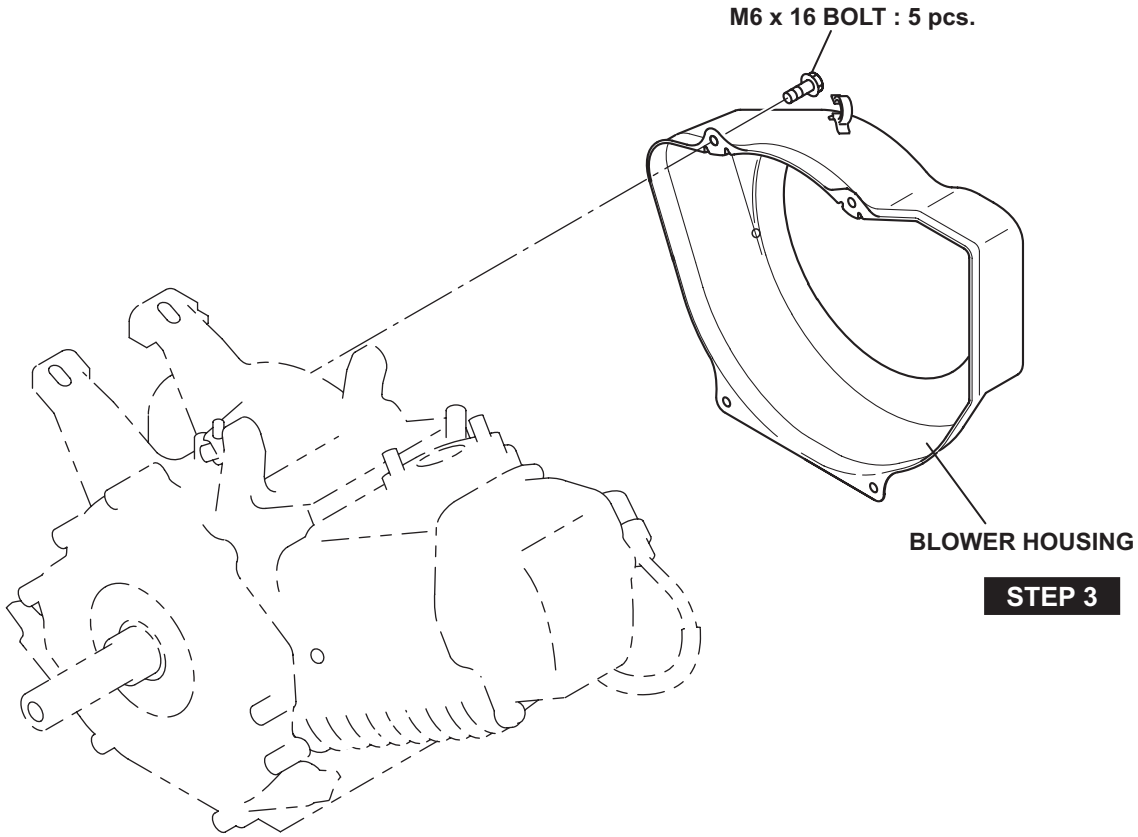


Fig.3-3

Step	Parts to remove	Remarks and procedures	Fasteners
4	Throttle body, Insulator	Remove the carburetor from the cylinder head. Remove the insulator & operation bracket.	

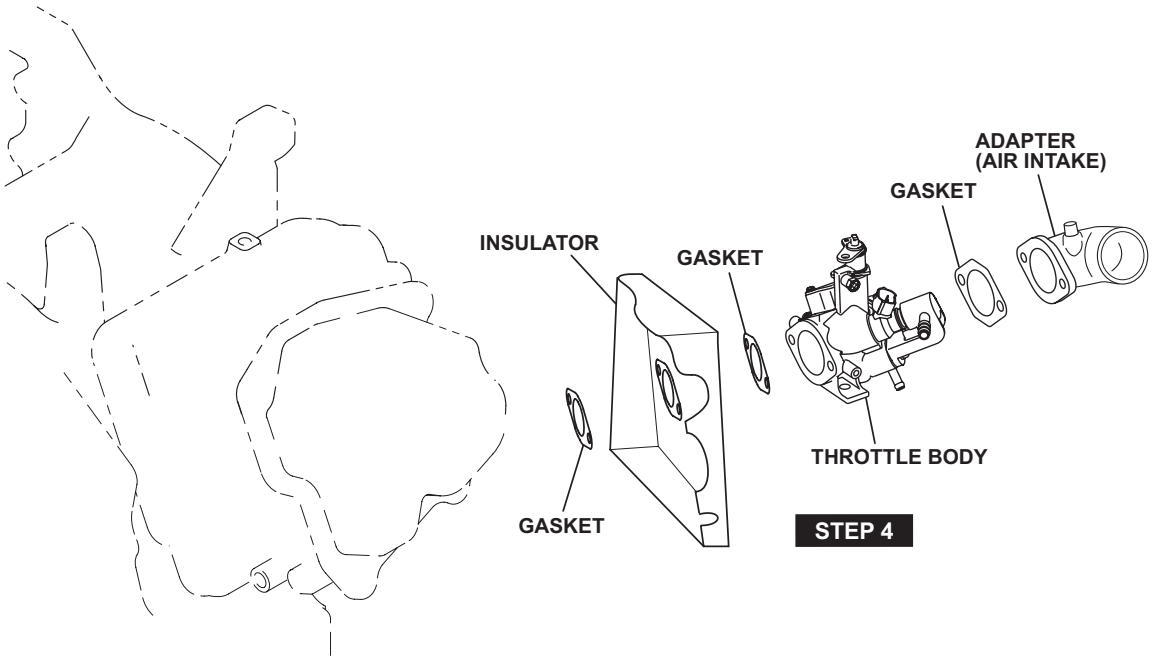


Fig.3-4

Step	Parts to remove	Remarks and procedures	Fasteners
5	Ignition coil	Remove the spark plug cap from the spark plug and remove the ignition coil from the crankcase.	10 mm box spanner M6 x 25 mm : 2 pcs.
6	Washer Cooling Blower	Remove the starting pulley and cooling Blower from the flywheel.Fit a box wrench or a socket wrench on the flywheel nut and loosen the nut by knocking the wrench sharply with a hammer. (See Fig. 3-6) NOTE: 1. Do not insert a screwdriver or other object between the flywheel blades which is a synthetic resin, otherwise the risk of damaging the blades might be occurred. 2. Knock the wrench with a hammer in a counter clockwise direction.	24 mm box spanner or socket wrench M18 nut
7	Flywheel	Remove the flywheel from the crankshaft. Leave the nut temporarily to prevent the flywheel from dropping out. Fit the flywheel puller as shown in Figure 3-7 and remove the flywheel from the crankshaft by rotating the bolt at the center in a clockwise direction. (Knock the center bolt with a hammer sometimes)	Flywheel puller

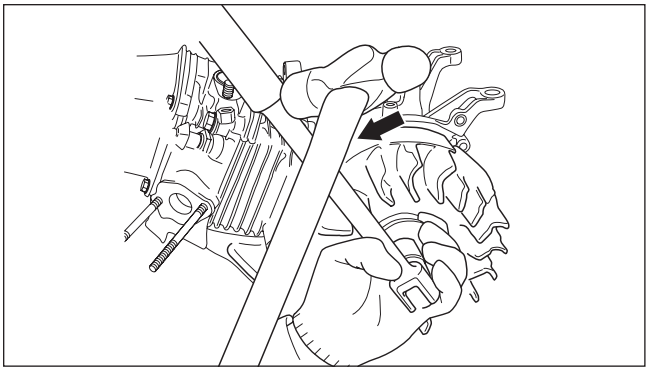


Fig.3-6

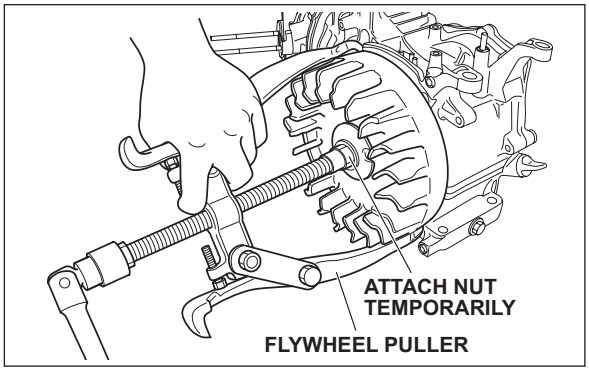


Fig.3-7

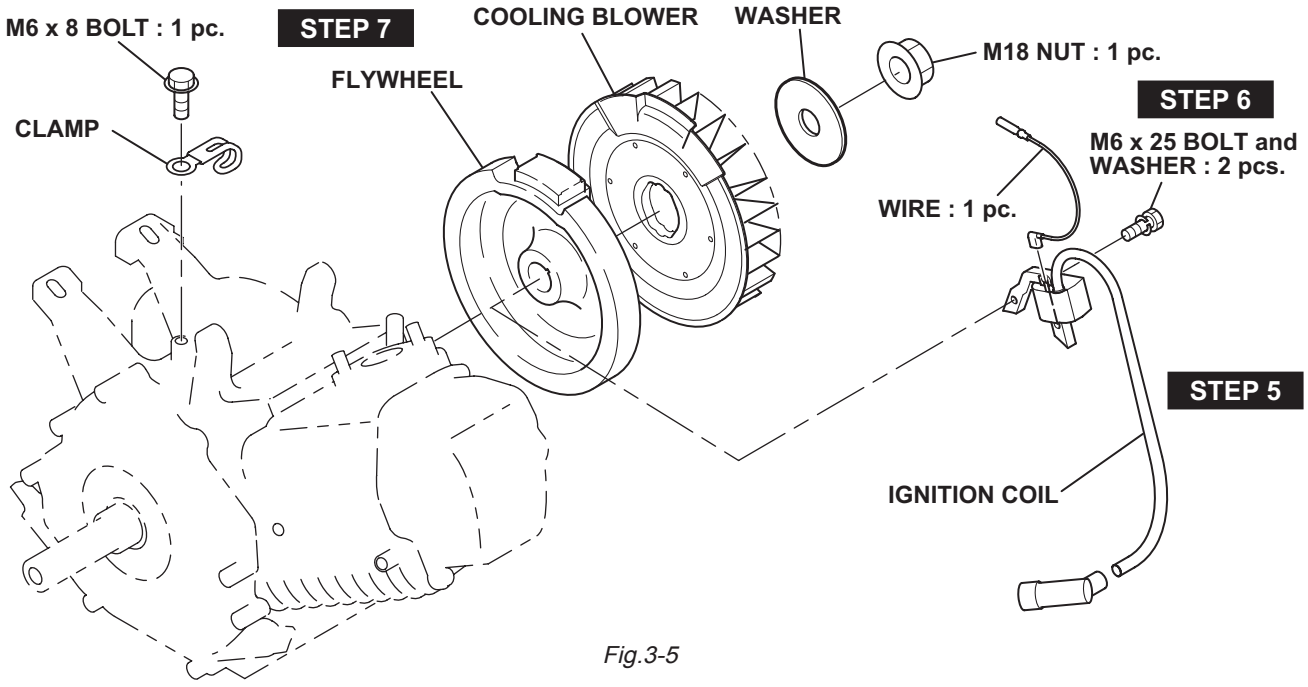


Fig.3-5

Step	Parts to remove	Remarks and procedures	Fasteners
8	Baffle 1 (Case)	Remove the Baffle 1 from the crankcase.	12 mm box spanner M8 x 12 mm : 1 pc.

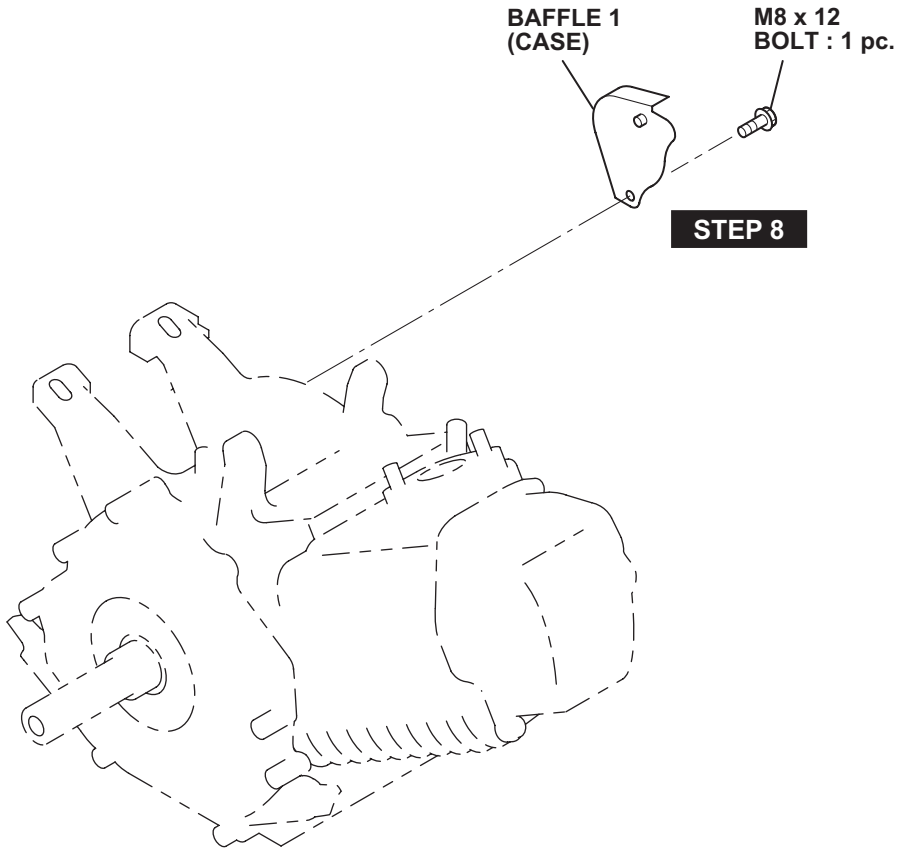


Fig.3-8

Step	Parts to remove	Remarks and procedures	Fasteners
9	Wire clamp	Disconnect the wire clamp. NOTE: Disconnect the wire clamp in this step, also an engine which has the oil sensor. However, please make sure do not damaged (cut off) the oil sensor wire after disassembly procedure.	10 mm box spanner M6 x 10 mm : 1 pc.
10	Spark plug	Remove the spark plug from the cylinder head.	21 mm plug wrench

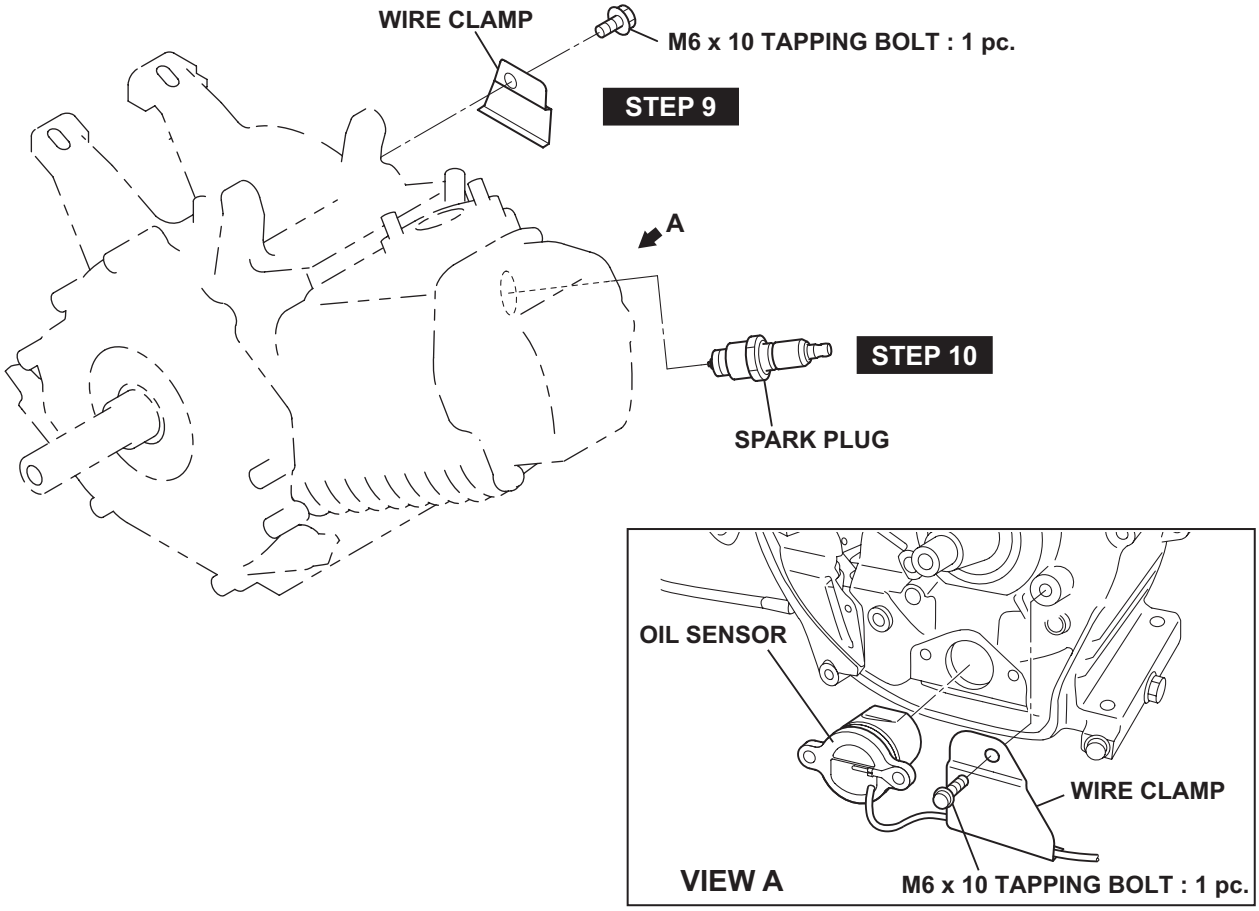


Fig.3-9

Step	Parts to remove	Remarks and procedures	Fasteners
11	Rocker cover	(1) Remove the rocker cover from the cylinder head. (2) Remove the gasket (rocker cover).	10 mm box spanner M6 x 12mm : 4 pcs.
12	Rocker arm	Remove the pin (rocker arm) and the rocker arm from the cylinder head at the compression top dead center. (See Fig. 3-12)	

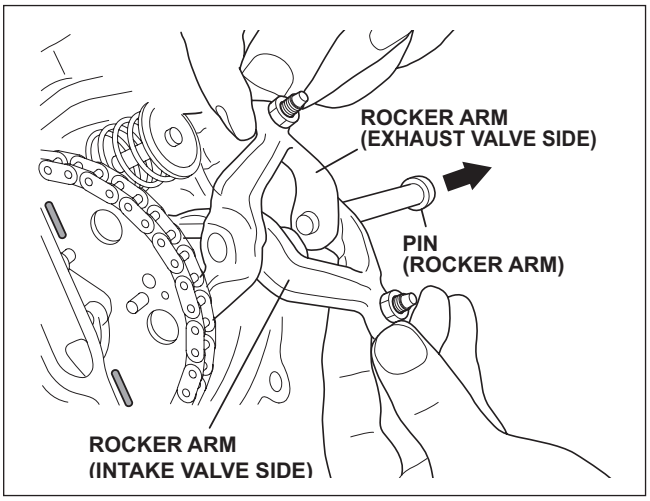


Fig.3-11

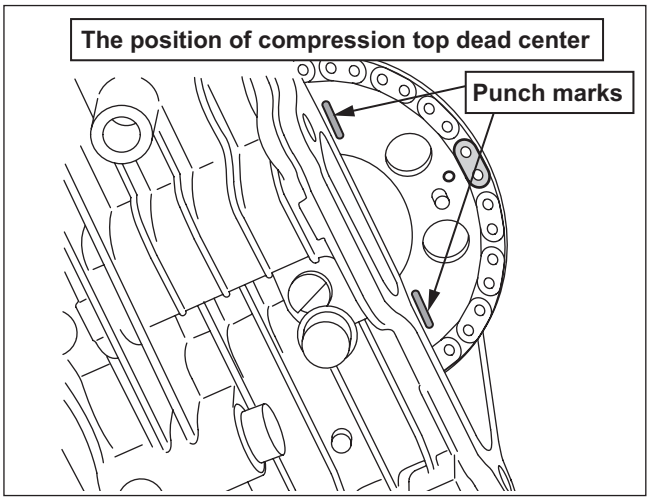
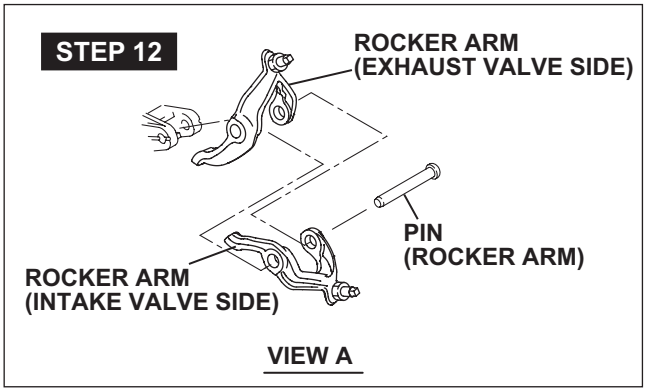


Fig.3-12



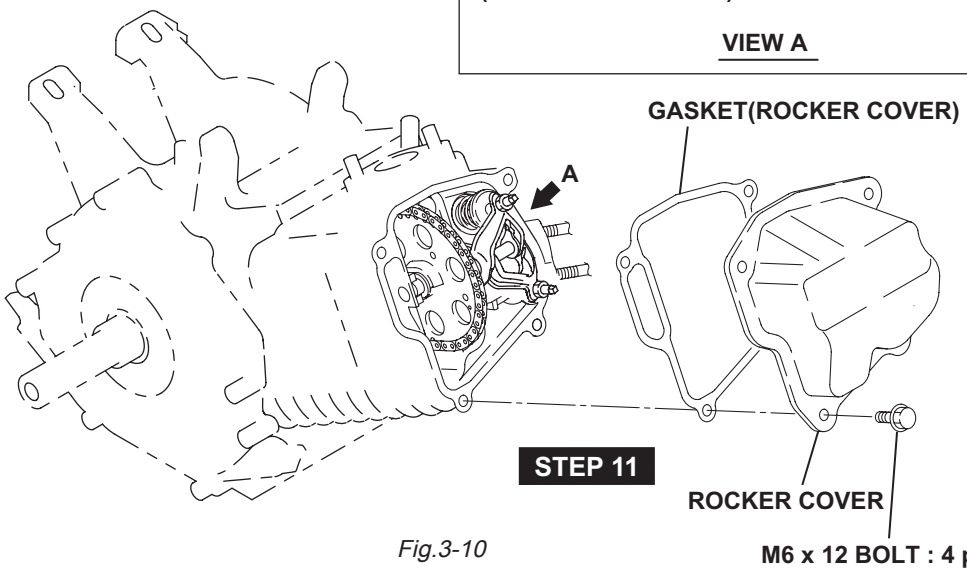


Fig.3-10

Step	Parts to remove	Remarks and procedures	Fasteners
13	Main bearing cover	Remove the flange bolts of main bearing cover from the crankcase. Remove the main bearing cover while tapping gently around the cover using a plastic hammer or similar tool. (See Fig. 3-14) Be careful not to damage the oil gauge or oil seal or not to lose the pipe knocks.	12 mm box spanner M8 x 38mm : 8 pcs.

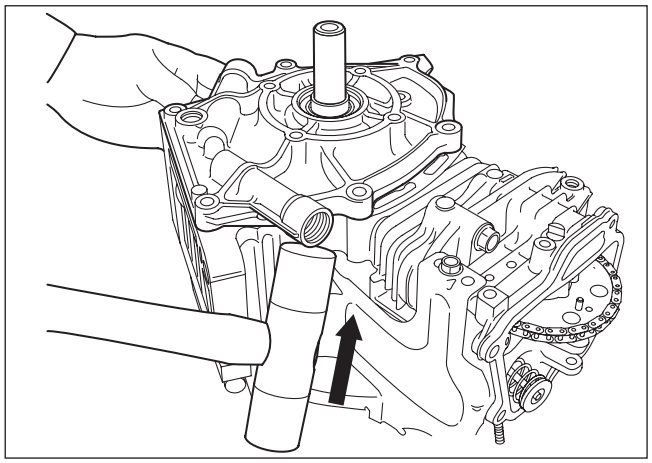


Fig.3-14

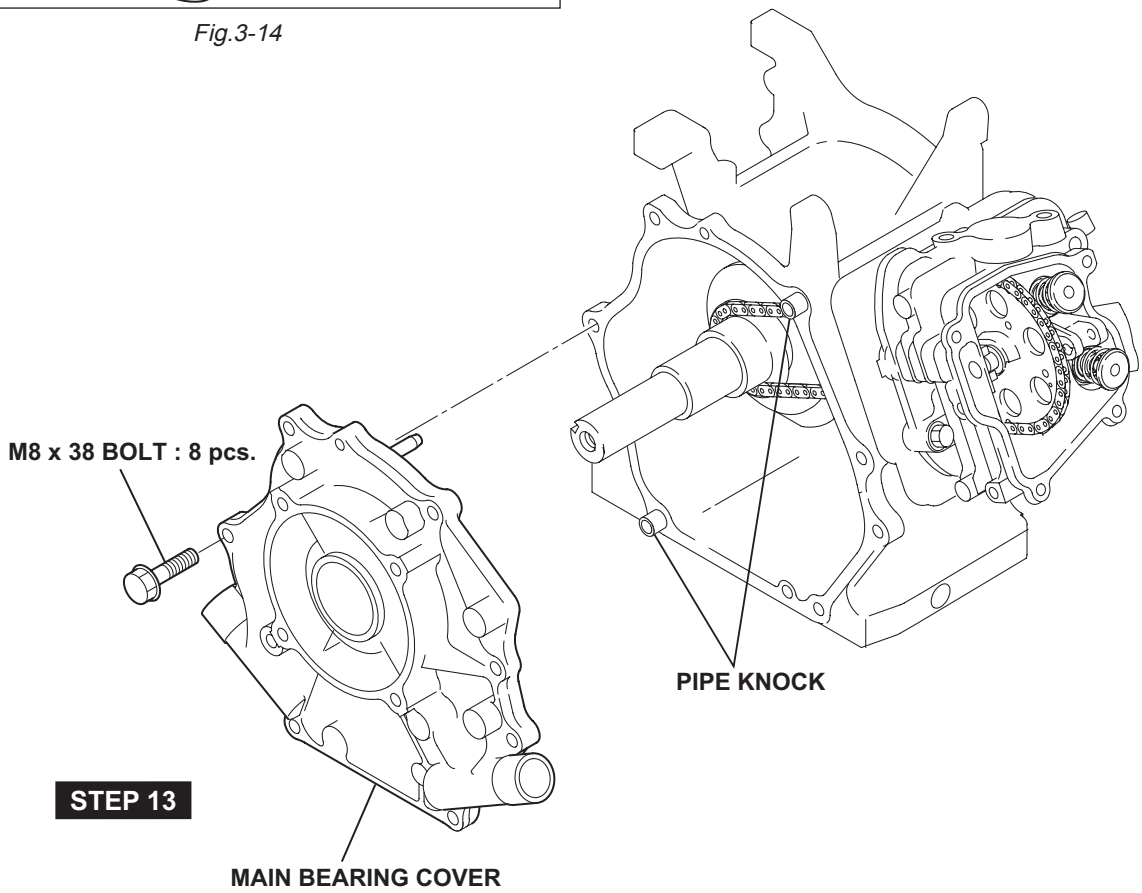


Fig.3-13

Step	Parts to remove	Remarks and procedures	Fasteners
14	Tensioner, Camshaft	(1) Remove the tensioner. (See Fig. 3-16) Do not lose the pin (tensioner). (2) Remove the retaining bolt of pin (camshaft) from the cylinder head. (See Fig. 3-17) (3) Remove the pin (camshaft), taking care not to scratch the O-ring. (4) Remove the chain from the camshaft sprocket and then take out the camshaft. (See Fig. 3-18) (5) Remove the chain from the crankshaft.	10mm box spanner or spanner M6 x 12mm : 1 pc. Pliers

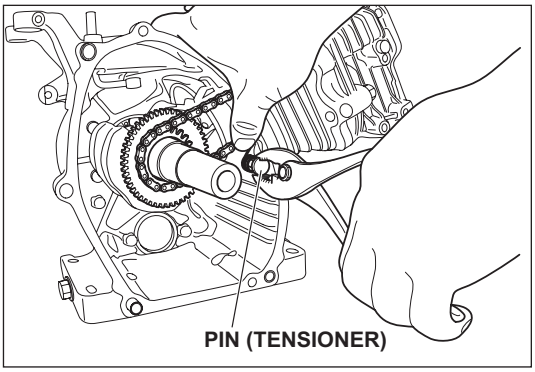


Fig.3-16

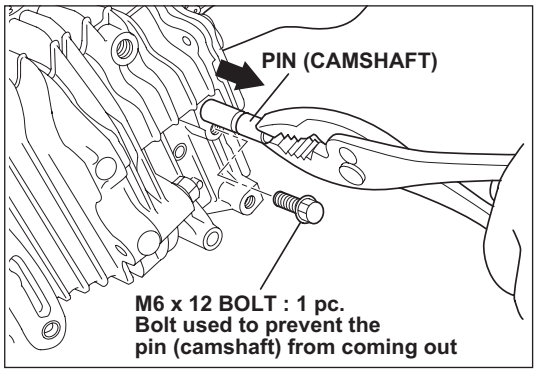


Fig.3-17

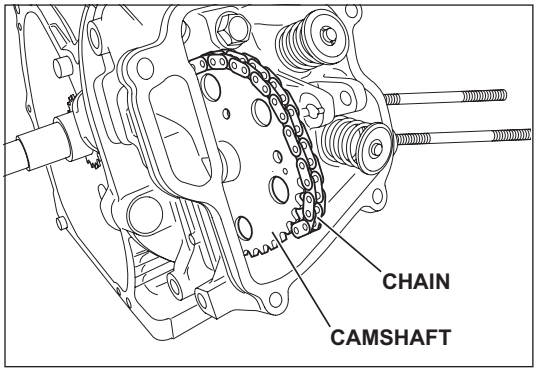


Fig.3-18

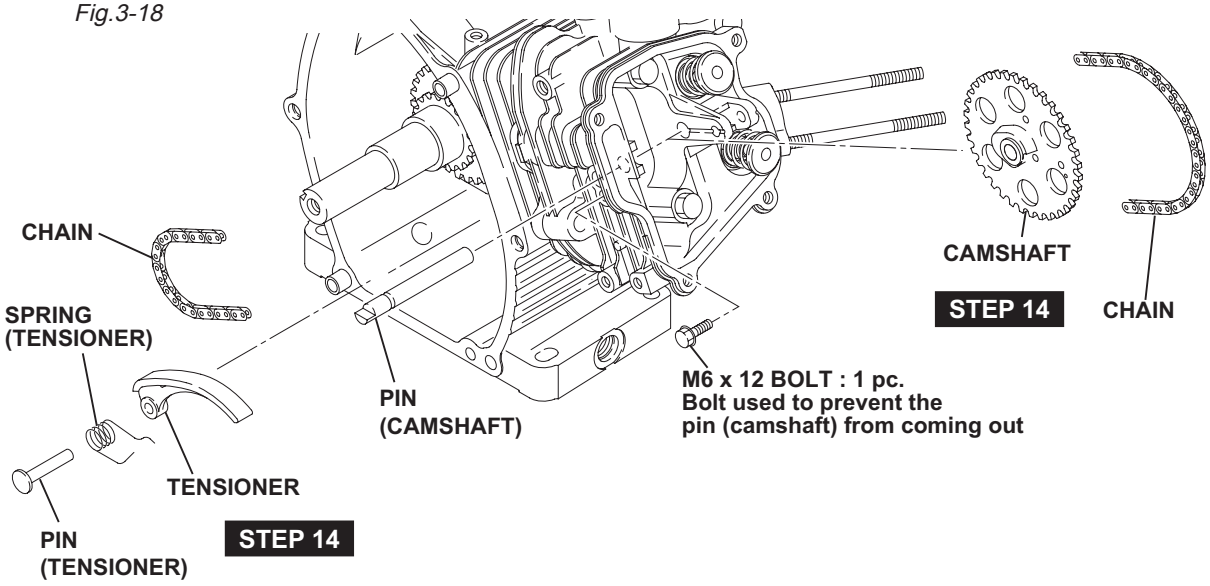


Fig.3-15

Step	Parts to remove	Remarks and procedures	Fasteners
15	Cylinder head, Chain guide	(1) Remove the cylinder head from the crankcase. (2) Remove the cylinder head gasket from the cylinder head. Take care not to lose the dowel pin. (3) Remove the chain guide from the top side of the crankcase. (If the chain guide is removed from the inner side of the crankcase, it might be damaged.)	12 mm box spanner M10 × 75mm : 4 pcs. M8 × 35mm : 2 pcs.
16	Intake and exhaust valves	(1) Remove the collet valve from the spring retainer. (See Fig. 3-20) (2) Remove the intake valve and the exhaust valve.	

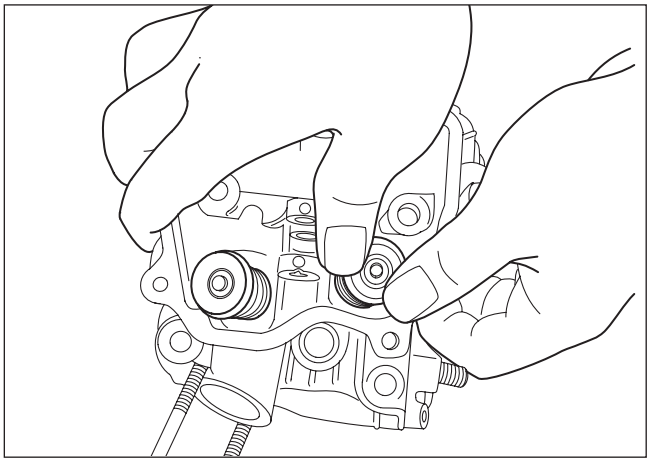


Fig.3-20

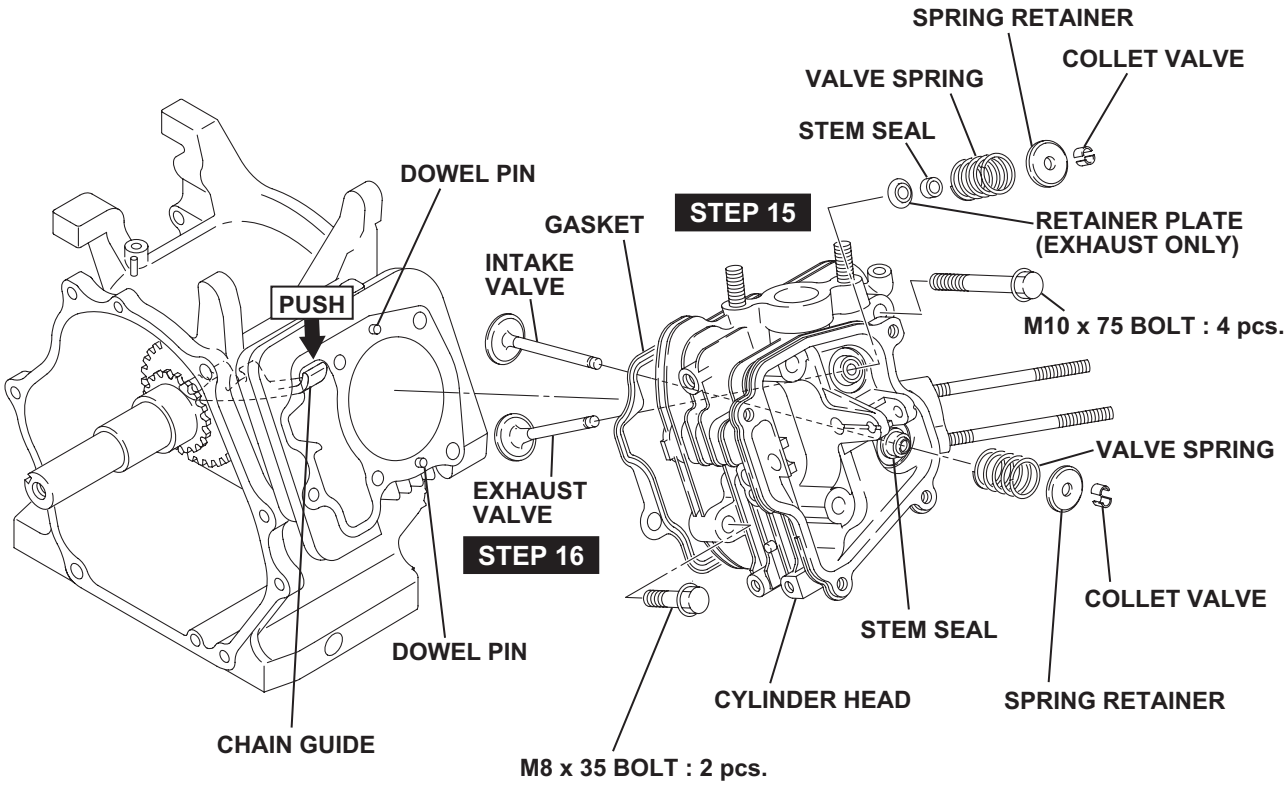


Fig.3-19

Step	Parts to remove	Remarks and procedures	Fasteners
17	Connecting rod and piston	(1) Scrape off any carbon from the cylinder and the piston head, then remove the connecting rod bolt. (2) Remove the connecting rod cap. (3) Rotate the crankshaft until the piston comes to its top position. Push the connecting rod and remove the piston from the upper part of the cylinder.	12 mm box spanner M8 x 40mm : 2 pcs.
18	Piston and piston rings	(1) Remove the piston clips (2 pcs.). Take out the piston pin and then remove the piston from the connecting rod small end, taking care not to damage the connecting rod small end. (2) Remove the piston rings from the piston by spreading them at the gap. Take special care not to damage the rings when doing this.	

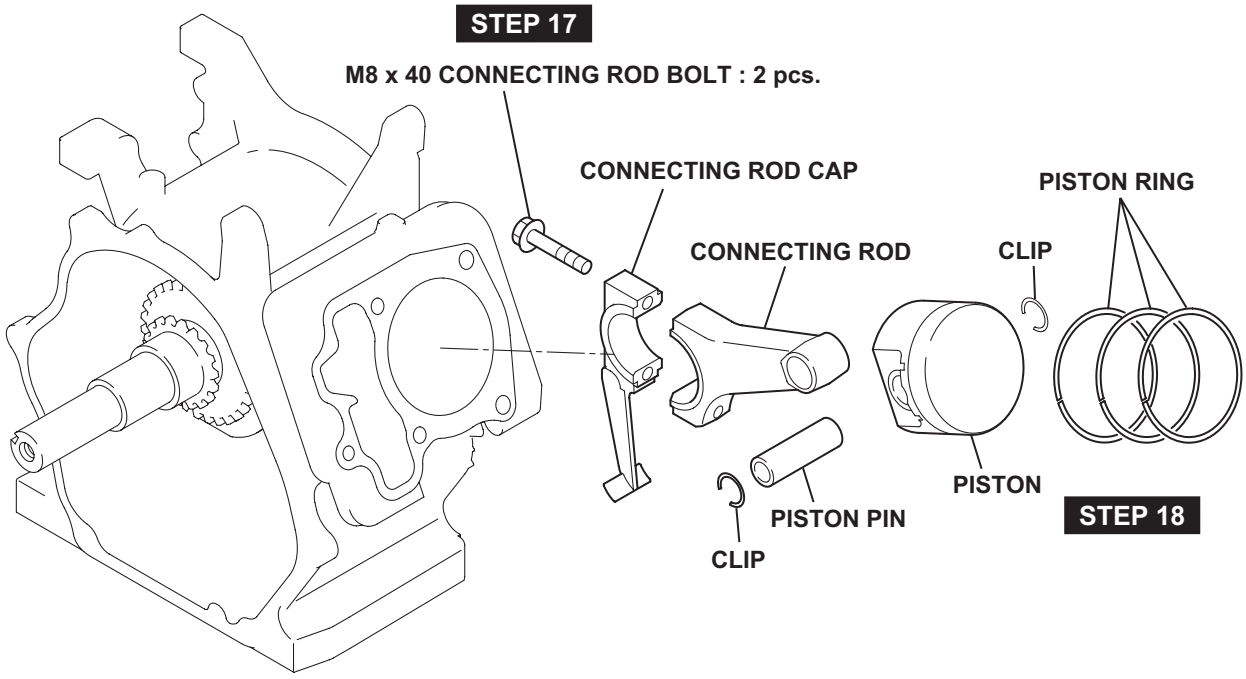


Fig.3-21

Step	Parts to remove	Remarks and procedures	Fasteners
19	Crankshaft	(1) Remove the woodruff key (for the flywheel magneto). (2) Remove the crankshaft from the crankcase by tapping its magneto side end with a plastic hammer, taking care not to damage the oil seal. (See Fig. 3-23)	Plastic hammer
20	Oil sensor	(1) Remove the clamp. (See Fig. 3-24) (2) Remove the oil sensor from the crankcase.	M6 x 10mm : 1 pc. M6 x 16mm : 2 pcs.

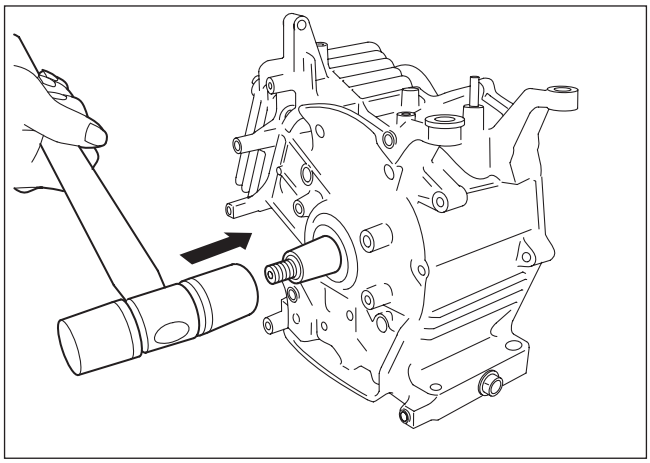


Fig.3-23

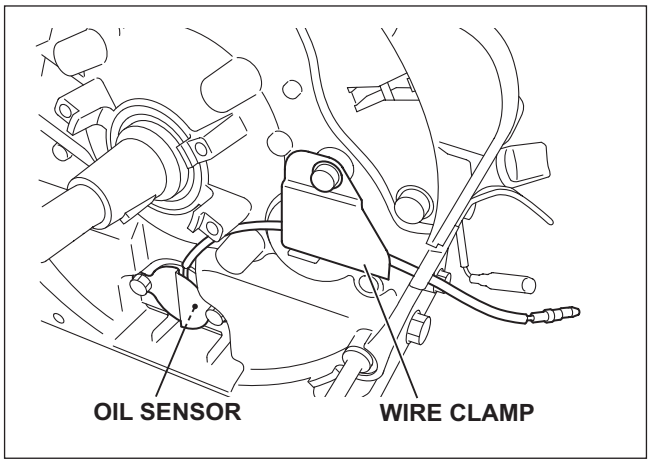


Fig.3-24

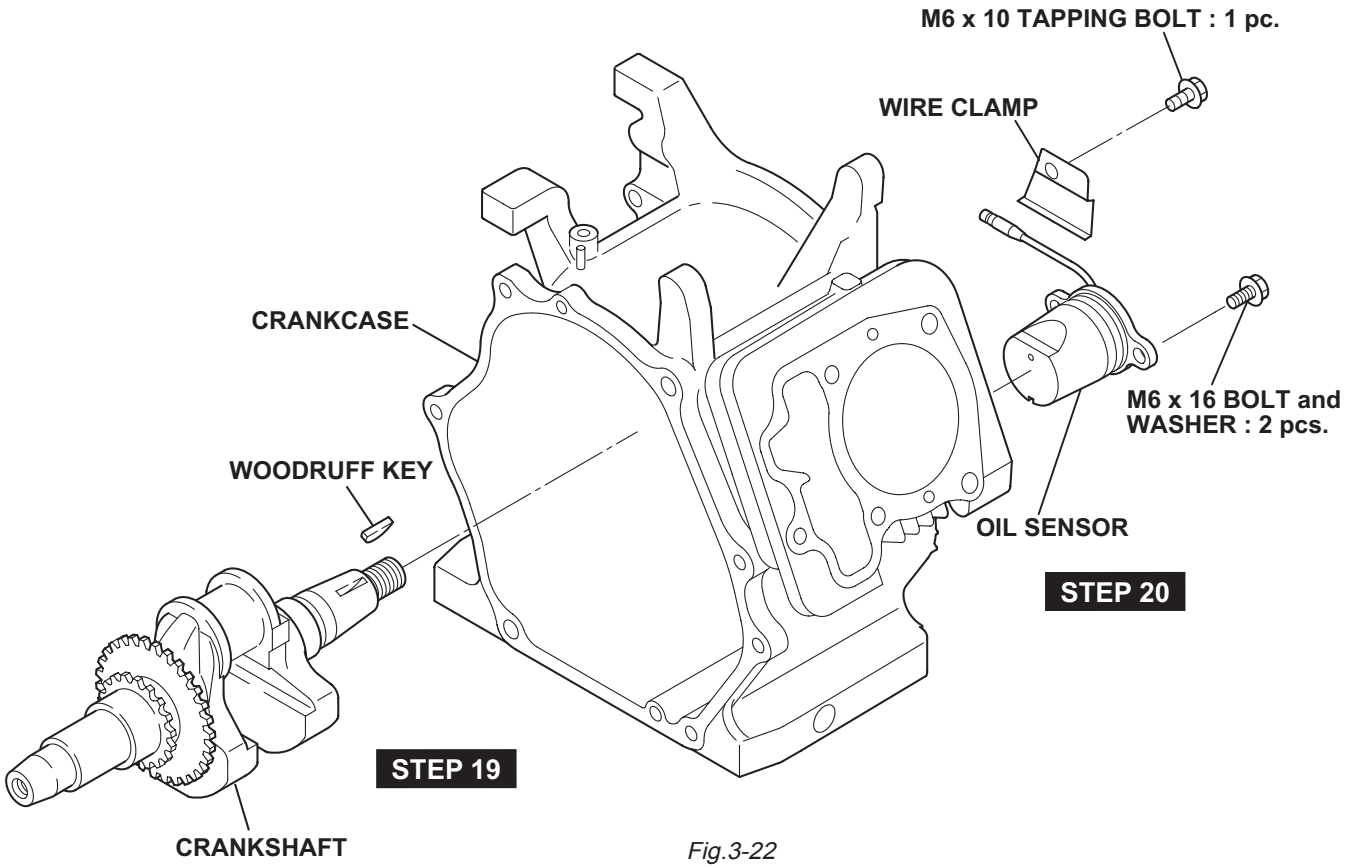


Fig.3-22

3-4 REASSEMBLY PROCEDURE

3-4-1 NOTES ON REASSEMBLY

(1) Clean the each parts carefully, taking special care with the piston, cylinder, crankshaft, connecting rod and bearings.

(2) Scrape off any carbon deposits on the cylinder head and the piston head. Be particularly careful when removing carbon from the piston ring grooves.

(3) Inspect the oil seals for any damage to the lip. Replace them if damaged. Apply oil to the lip before reassembly.

(4) Replace all the gaskets with new ones.

(5) Replace the keys, pins, bolts and nuts with new ones, if necessary.

(6) Tighten nuts and bolts to the specified torque settings.

(7) When reassembling the engine, apply oil to all moving parts.

(8) Check clearances and end plays and adjust, if necessary.

(9) When mounting any major part during reassembly of the engine, rotate it with your hand to check for any jamming or abnormal noise.

3-4-2 ASSEMBLY STEPS AND PRECAUTIONS

(1) OIL SENSOR

(a) Mount the oil sensor and fix the wire with the clamp.

Tightening torque
8.0 - 10.0 N·m (80 - 100 kgf·cm) (5.8 - 7.2 ft·lb.)

NOTE :
Make sure to not damaged (cut off) the oil sensor wire after assembly procedure.

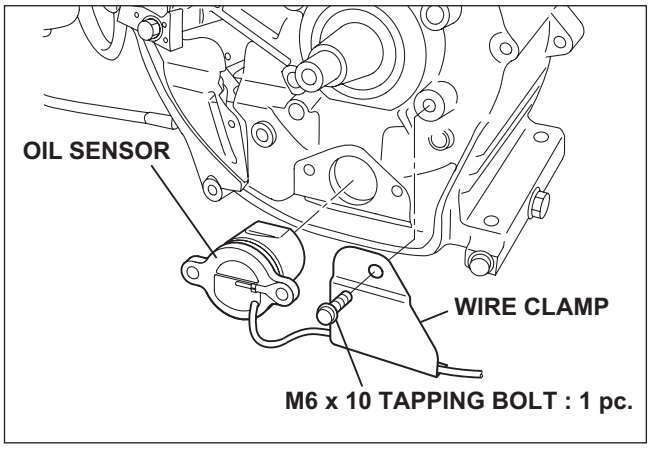


Fig.3-25

(2) CRANKSHAFT

(a) Wrap the key-way portion of the crankshaft with polyvinyl tape and insert the crankshaft into the crankcase, taking care not to damage the oil seal lip.

(b) Insert the woodruff key (for the flywheel magneto).
NOTE: Do not insert the woodruff key before inserting the crankshaft into the crankcase.

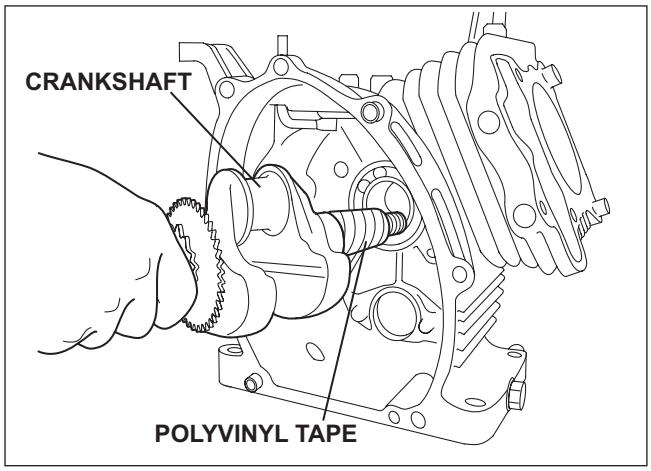


Fig.3-26

(3) PISTON AND PISTON RINGS

(a) Install each piston ring in the correct groove of the piston by widening it enough to slide it over the piston.

NOTE: Be careful not to twist the rings too much, as they may be damaged. Install the oil ring first, followed by the top ring. When installing the piston ring, make sure that the "R" mark is face up. (See Fig. 3-29)

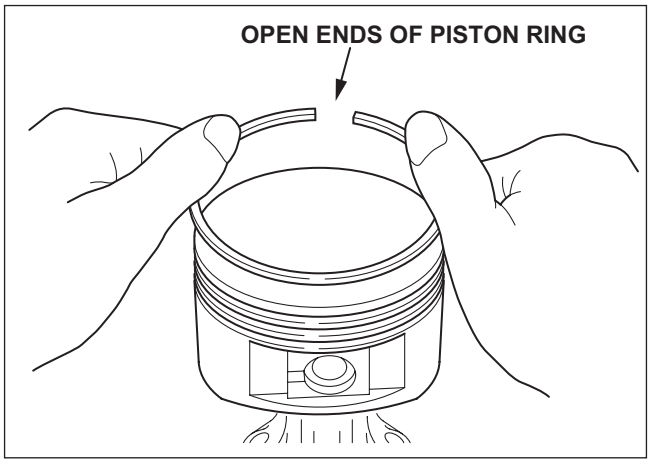


Fig.3-27

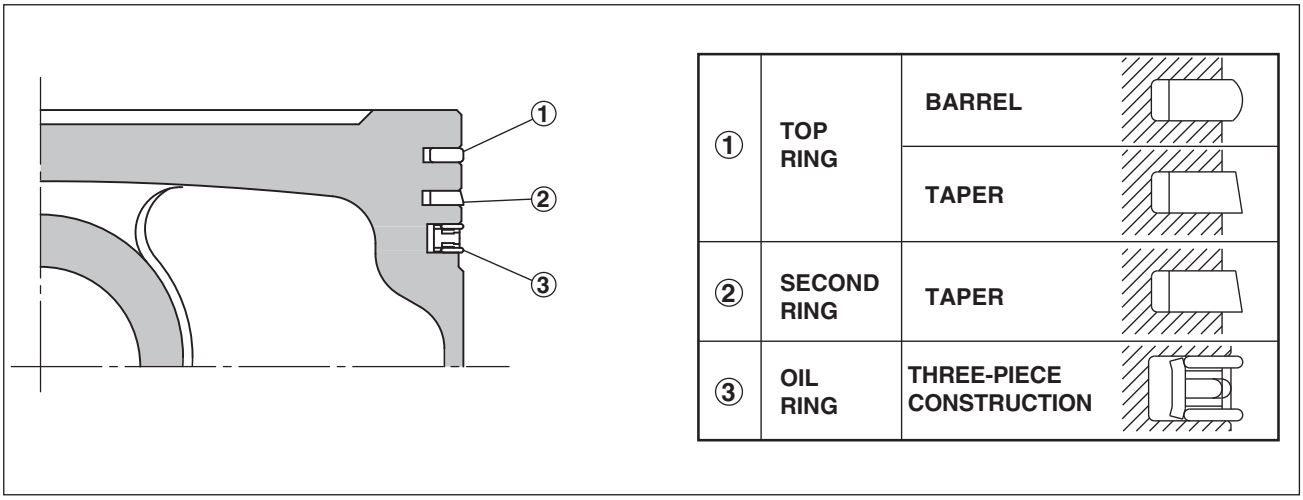


Fig.3-28

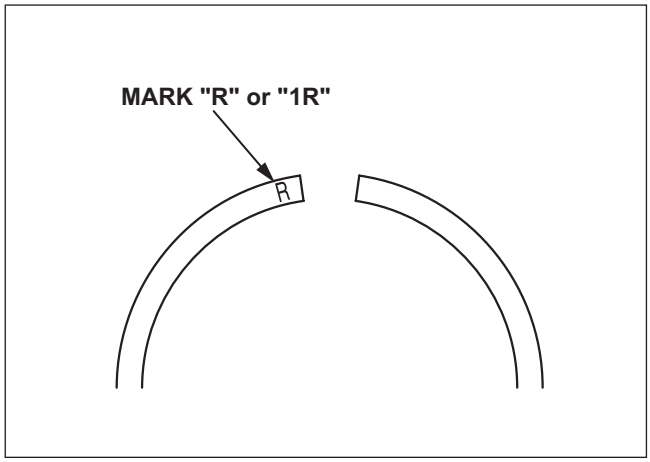


Fig.3-29

(4) PISTON AND CONNECTING ROD

The piston is attached to the connecting rod by the piston pin.

When assembling the piston and connecting rod, make sure to align the mark on the piston head with the 'MAG' mark on the connecting rod.

NOTE 1: Before assembling the connecting rod, apply oil to its small end.

NOTE 2: Be sure to insert the clips in the two ends of the piston pin and check the clips for any play.

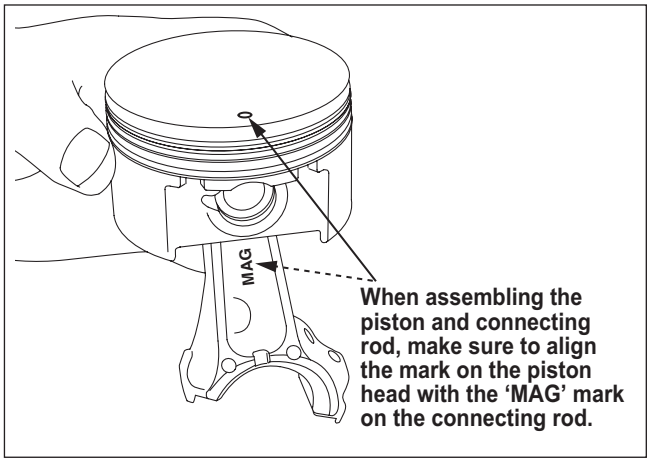


Fig.3-30

(5) CONNECTING ROD

(a) Install the piston and connecting rod assembly into the cylinder by holding the piston rings with the ring guide, with the 'MAG' mark on the connecting rod on the flywheel side. (If you do not have a ring guide, hold the piston rings with the fingers and tap the upper part of the piston with a piece of wood.)

NOTE 1: Apply oil to the piston rings, the large end of the connecting rod and cylinder before installing the connecting rod into the cylinder.

NOTE 2: The piston ring gaps should be positioned around the piston at 90-degree intervals.
(See Fig. 3-32)

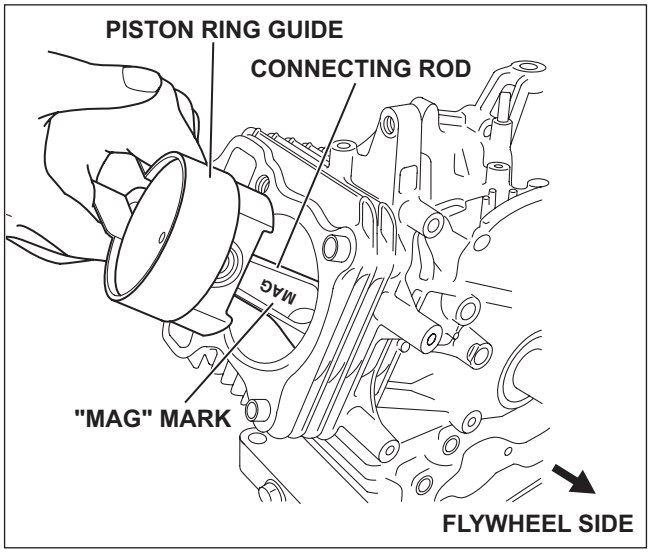


Fig.3-31

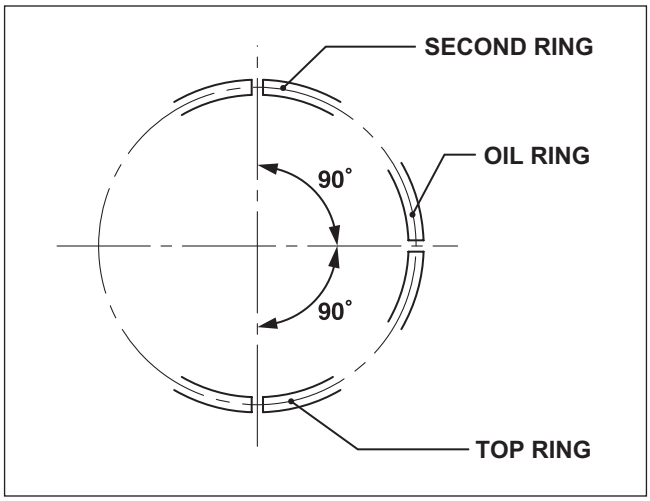


Fig.3-32

(b) Rotate the crankshaft down to the bottom dead center and lightly tap the piston head until the large end of the connecting rod touches the crank pin.

(c) To mount the connecting rod, line up the matching marks and fit the clinch portions firmly together.

M8 bolt (12mm box wrench)

Tightening torque
22.5 - 27.5 N·m (225 - 275 kgf·cm) (16.3 - 19.9 ft·lb.)

(d) Check for free movement of the connecting rod by turning the crankshaft slowly.

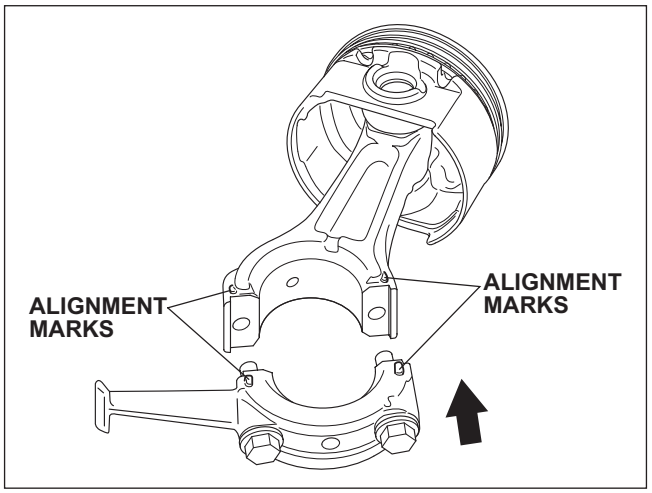


Fig.3-33

(6) INTAKE AND EXHAUST VALVES

Take the following points into account when mounting the intake and exhaust valves on the cylinder head.

NOTE 1: Replace the valve with a new one if it shows signs of wear.
(Refer to the "STANDARD REPAIR TABLES" on page 49 and 50.)

NOTE 2: Carefully scrape off any carbon deposits on the combustion chamber. Apply oil to the valve stems before mounting the intake and exhaust valves. Insert the valves in the cylinder head and place it on a level workbench. Next, mount the valve springs, the spring retainers and collet valves. (Mount the stem seal on the intake valve guide.)

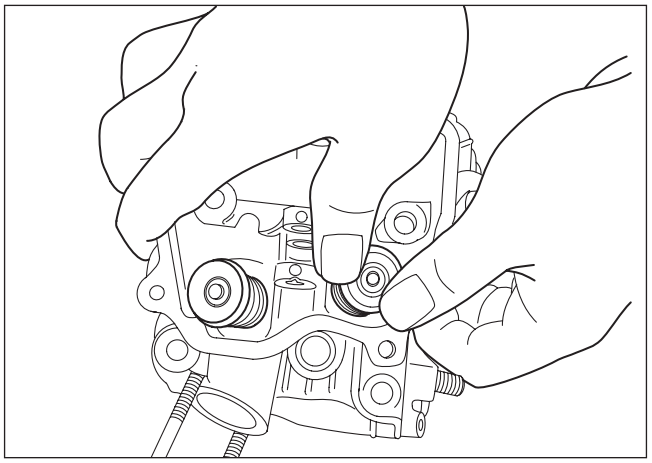


Fig.3-34

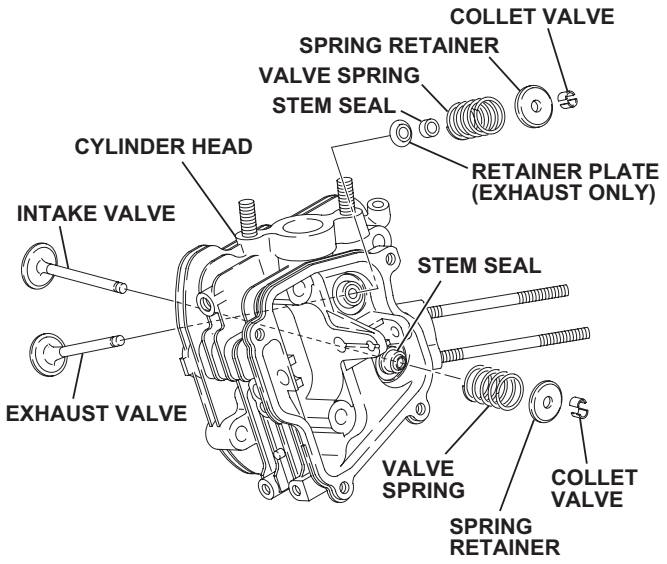


Fig.3-35

(7) CHAIN GUIDE

Mount the chain guide to the crankcase.

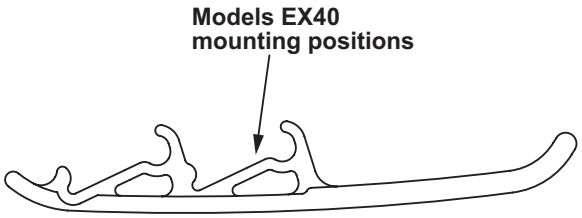


Fig.3-36

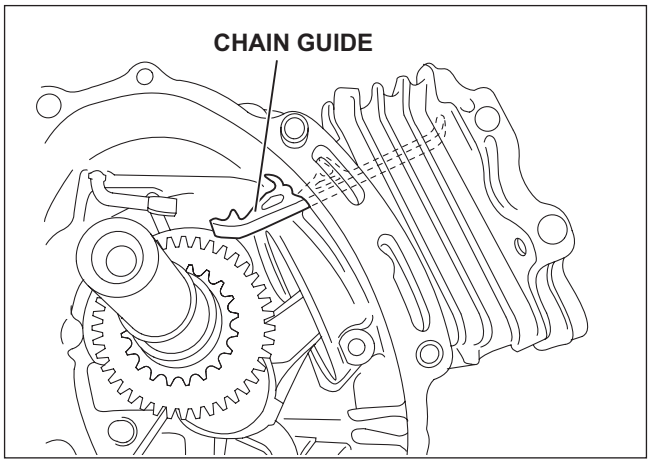
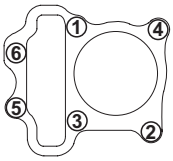
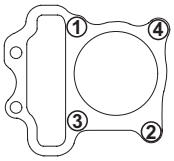


Fig.3-37

(8) CYLINDER HEAD

Inspect and repair any scratches on mounting surface and replace head gasket to new one before installing.

Cylinder head bolts	Tightening Torque		Remarks
	1st step 	2nd step 	
M10 × 75 mm : ①, ②, ③, ④, flange bolt : 4 pcs. (14mm box wrench)	17.0 - 19.0 N·m (170 - 190 kgf·cm) (12.3 - 13.7 ft·lb.)	29.0 - 31.0 N·m (290 - 310 kgf·cm) (21.0 - 22.4 ft·lb.)	Re-use
		37.0 - 39.0 N·m (370 - 390 kgf·cm) (26.7 - 28.2 ft·lb.)	When replace to new cylinder head and flange bolts
M8 × 35 mm : ⑤, ⑥ flange bolt : 2 pcs. (12mm box wrench)		—	As for ⑤and ⑥, only 1st step tightening.

Tighten the cylinder head bolts in diagonal order.

(1) Re-use (Oil the screw thread)

- Tighten all bolts (6pcs) by 18 ± 1 N·m primary, and then tighten longer ones (M10 × 75mm flange bolt: 4pcs) by 30 ± 1 N·m.

(2) When replace to new cylinder head and flange bolts (Oil the screw thread)

- Tighten all bolts (6pcs) by 18 ± 1 N·m primary, and then tighten longer ones (M10 × 75mm flange bolt: 4pcs) by 38 ± 1 N·m.

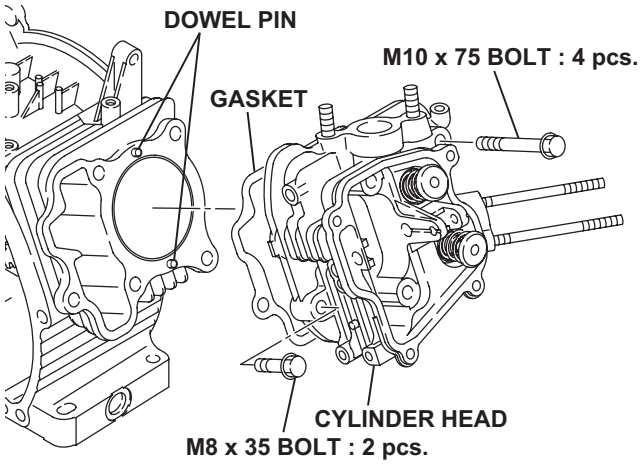


Fig.3-38

(9) SETTING THE TIMING CHAIN

(a) Align the timing mark on the crankshaft sprocket with the mark plate of the timing chain.

(b) Align the timing mark on the camshaft sprocket with the mark plate of the opposite end of the timing chain.

Number of oval steel link : 112

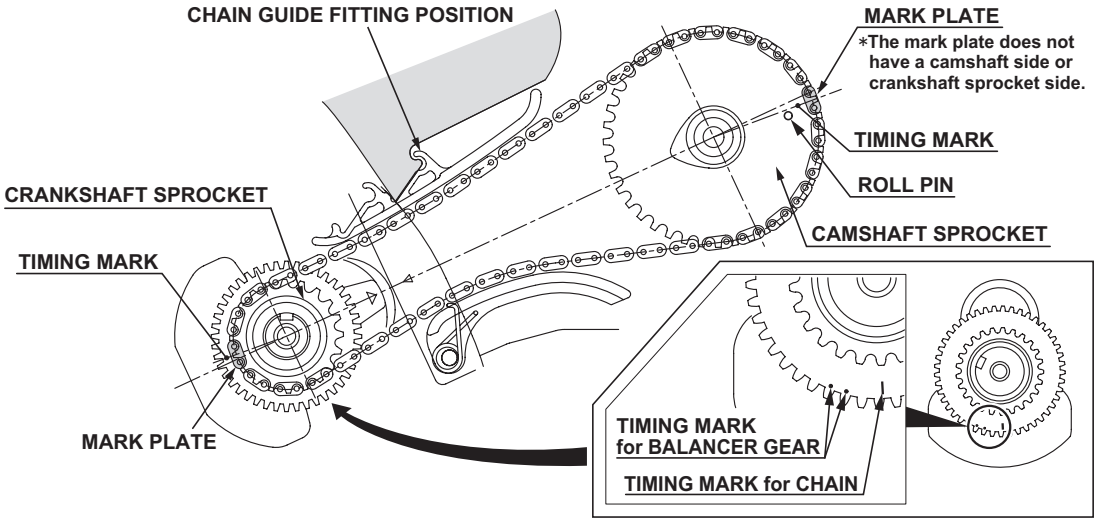
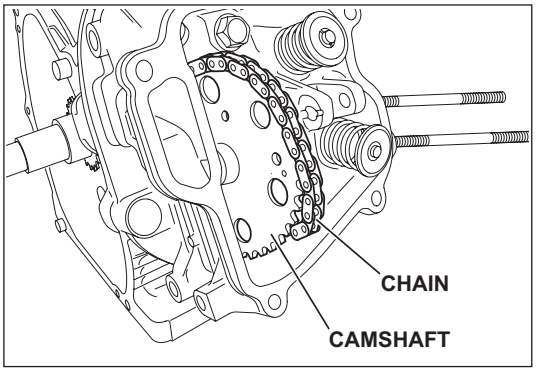


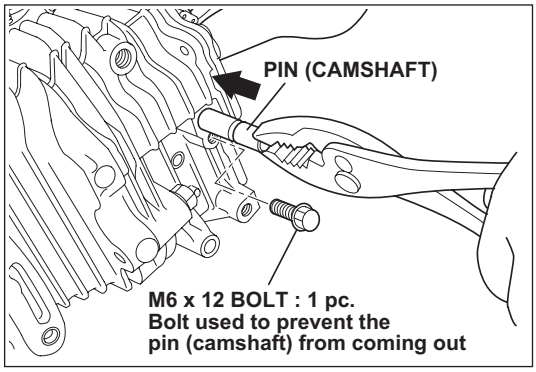
Fig.3-39

(10) MOUNTING THE CAMSHAFT ON THE CYLINDER HEAD

Mount the camshaft on the cylinder head by inserting the pin (camshaft) through the head.

Fix the bolt to prevent the pin (camshaft) from coming out.





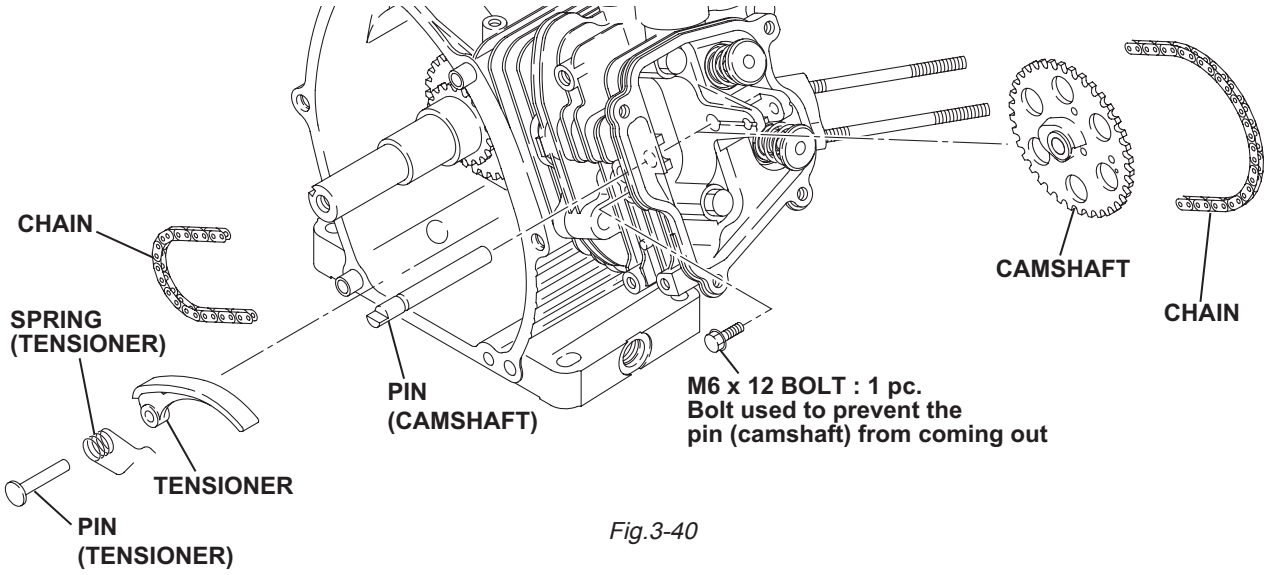


Fig.3-40

(11) MOUNTING THE TENSIONER

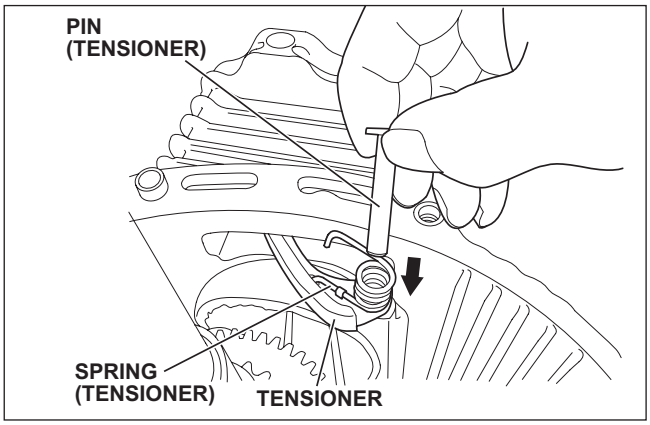


Fig.3-41

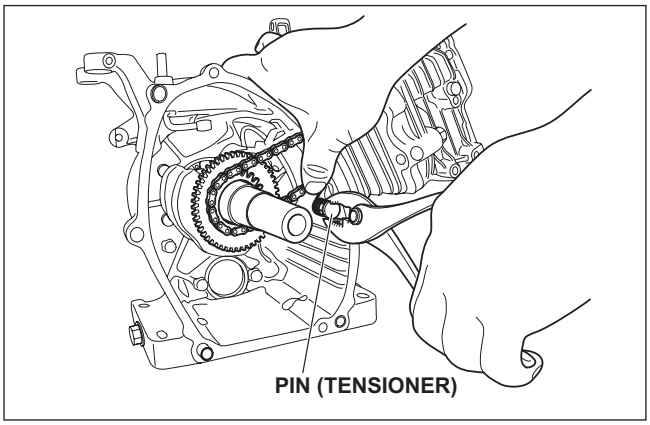


Fig.3-42

(12) BALANCER SHAFT

Mount the balancer shaft on the crankcase, align the timing marks on the balancer gear and the crankshaft gear.

NOTE: Incorrect alignment of the timing marks can result in malfunction of the engine, leading to damage due to interference of the parts.

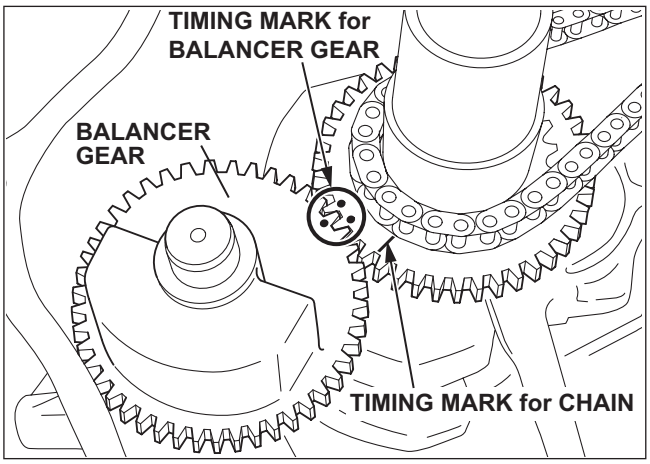


Fig.3-43

(13) MAIN BEARING COVER

Apply oil to the bearing and the oil seal lip when mounting the main bearing cover. Also apply sealant (Three Bond “1215”) to the surface of the crankcase. To avoid damaging the oil seal lip, wrap the crankshaft key-way portion with polyvinyl tape before mounting the main bearing cover.

Tightening torque
22.0 - 24.0 N･m (220 - 240 kgf･cm) (16.2 - 17.7 ft･lb.)

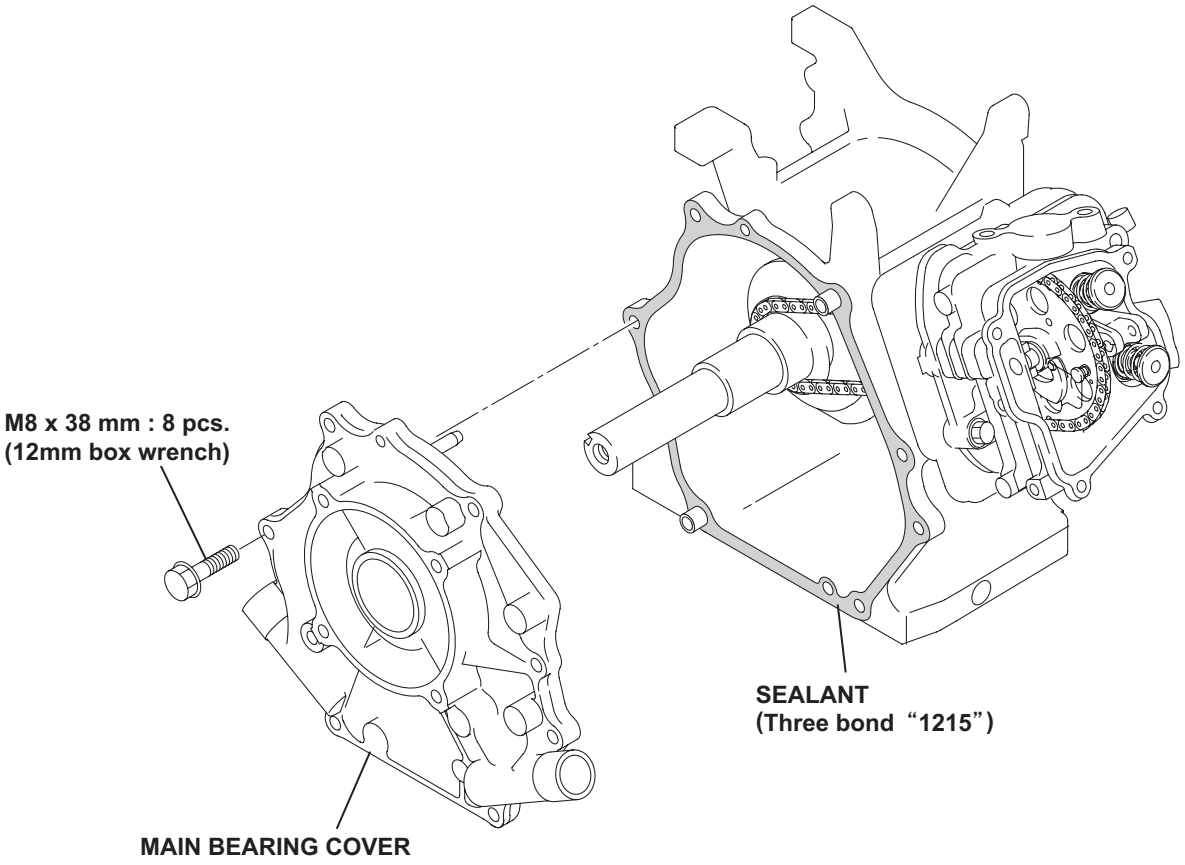


Fig.3-44

(14) Pass the pin (rocker arm) through the rocker arm and mount them on the cylinder head.

NOTE 1: Conduct this job at the compression top dead center.
(The position of two punch marks on cam sprocket is in parallel with the cylinder head surface at a time.)

NOTE 2: Make sure that the piston is at the compression top dead center by checking mutual position between the flywheel and the ignition coil or by checking that the key way is at the top. (See each Fig.3-46)

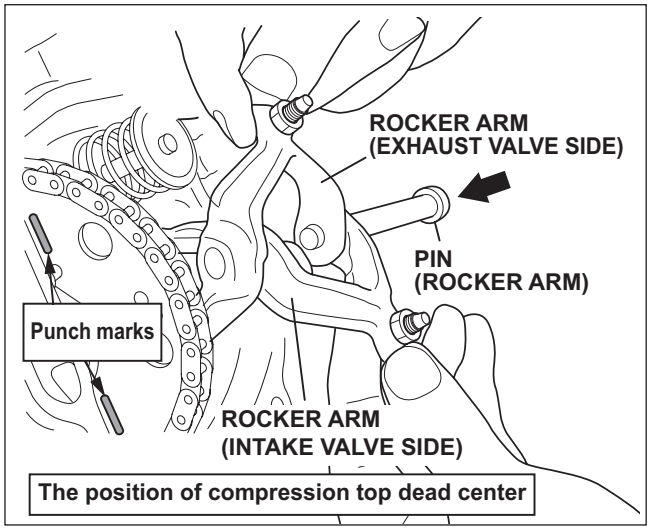


Fig.3-45

(15) VALVE CLEARANCE ADJUSTMENT

Temporarily fit the flywheel.

Rotate the crankshaft up to the compression top dead center and insert the thickness gauge between the valve and the adjusting screw of rocker arm to measure the clearance.

[Adjustment method]

Loosen the nut on the adjustment screw and turn the screw to adjust the valve clearance. When the valve clearance is correct, tighten the nut.

Valve clearance (when the engine is cold)	
Intake valve side	$0.12^{+0.03}_{0}$ mm ($0.0047^{+0.0012}_{0}$ in.)
Exhaust valve side	

Tightening torque
5.0 - 7.0 N·m (50 - 70 kgf·cm) (3.6 - 5.1 ft·lb.)

NOTE: After adjusting the valve clearances, rotate the crankshaft and check again that the intake and exhaust valve clearance are correct.

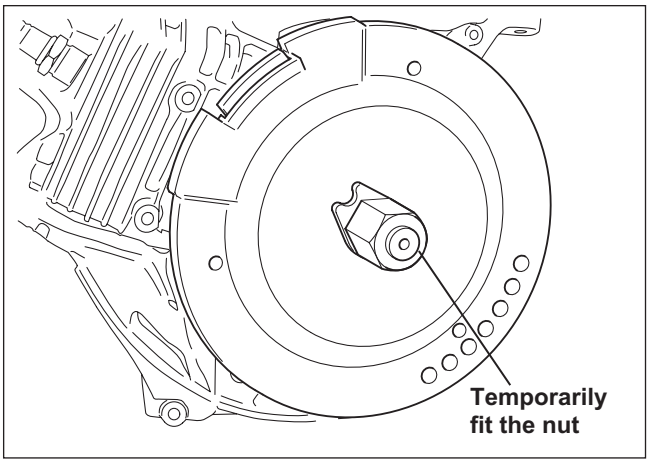


Fig.3-46

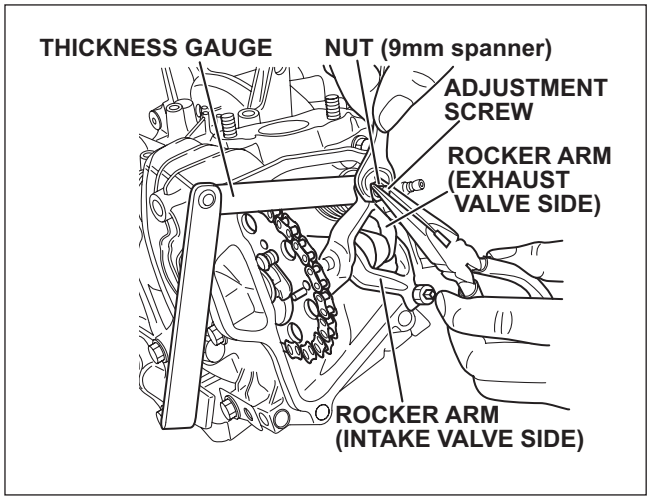


Fig.3-47

(16) ROCKER COVER

Replace the gasket with a new one, and mount the rocker cover.

M6 × 12 mm flange bolt : 4 pcs.

Tightening torque
5.0 - 7.0 N·m (50 - 70 kgf·cm) (3.6 - 5.1 ft·lb.)

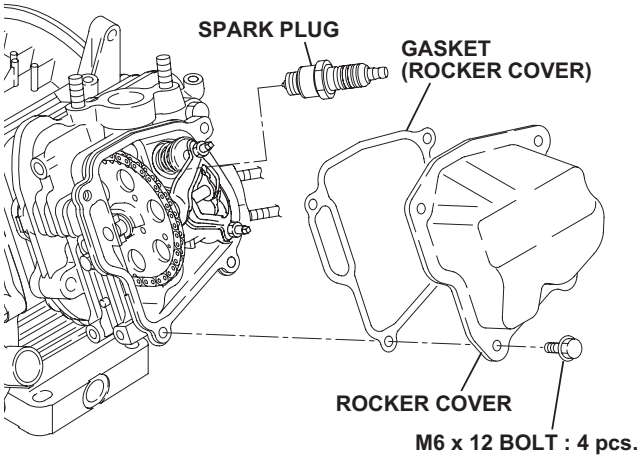


Fig.3-48

(17) SPARK PLUG

Remove any carbon deposits from the spark plug and inspect the electrode for damage before mounting. Replace with a new one, if necessary.

Spark plug : NGK BR-6HS (21 mm plug wrench)

Electrode gap	**0.6 - 0.7 mm (0.024 - 0.028 in.)**

Tightening torque	
New spark plug	Re-tightening torque
12.0 - 15.0 N·m (120 - 150 kgf·cm) (8.7 - 10.8 ft·lb.)	23.0 - 27.0 N·m (230 - 270 kgf·cm) (16.6 - 19.5 ft·lb.)

(18) BAFFLE 1 (CASE)

The projection (upper) on the baffle 1 with the crankcase and mount it (under) with the bolt.

M8 × 12 mm bolt : 1 pc.

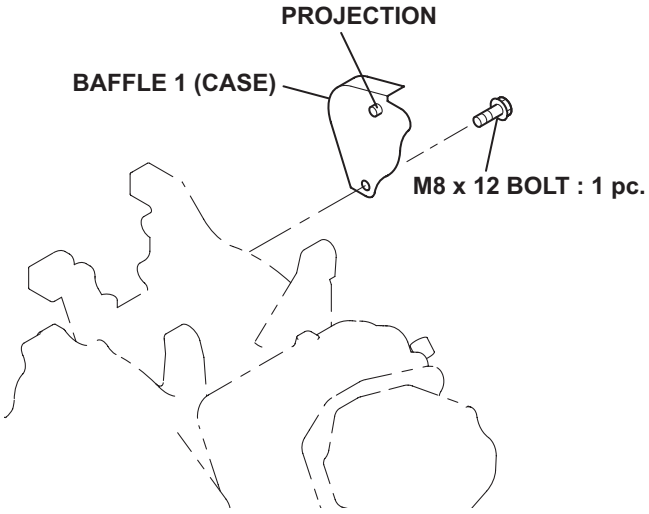


Fig.3-49

(19) FLYWHEEL, COOLING BLOWER and STARTING PULLEY

NOTE: When mounting the flywheel, be sure to wipe off any oil on the tapered portion of the crankshaft and flywheel.

a) Mount the flywheel on the crankshaft.

b) Install cooling blower and starting pulley to the crankshaft.

c) Tighten crankshaft nut with a strap wrench adopted as shown in the illustration.

Tightening torque
100.0 - 120.0 N·m (1000 - 1200 kgf·cm) (72.3 - 86.8 ft·lb.)

M18 Nut : 1 pc. (24mm box wrench)

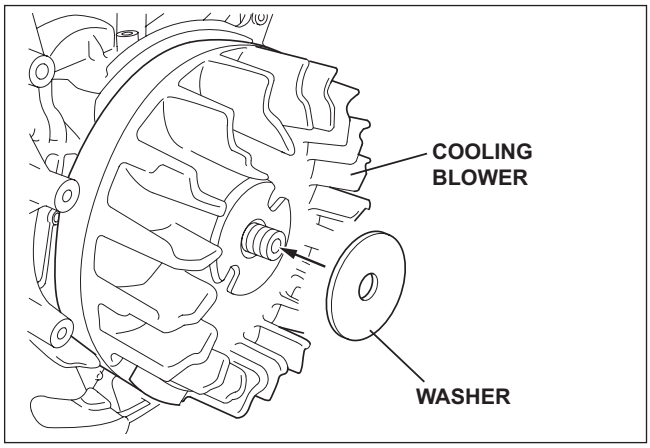


Fig.3-50

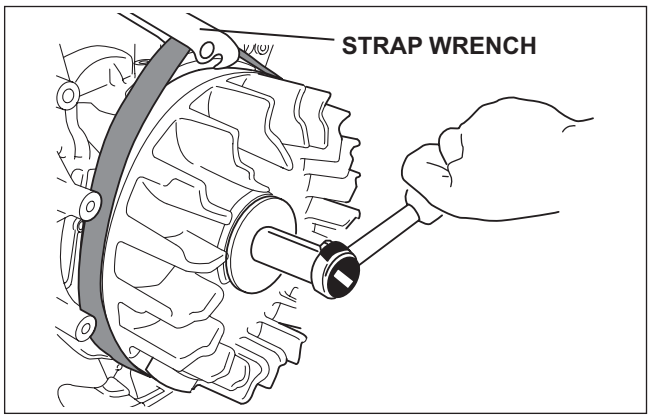


Fig.3-51

(20) IGNITION COIL

When mounting the ignition coil, insert a thickness gauge between the ignition coil and the flywheel to check the air gap.

Air gap	0.3 - 0.5 mm (0.012 - 0.020 in.)

Tightening torque
7.0 - 9.0 N·m (70 - 90 kgf·cm) (5.1 - 6.5 ft·lb.)

M6 × 25 mm bolt and washer : 2 pcs.

Make sure to put in the wire 1 to the notch on the crankcase, and tighten it with the clamp. (M6×8 mm bolt : 1 pc.)

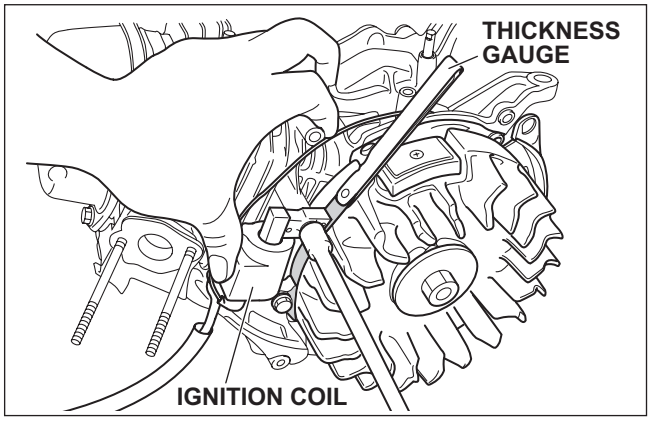


Fig.3-52

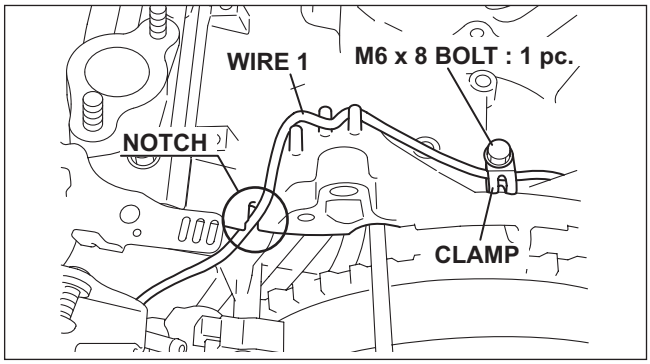


Fig.3-53

(21) BAFFLE2, RECOIL BRACKET, BLOWER HOUSING, RECOIL STARTER and STOP SWITCH

(1) Mount the stop switch to the blower housing. (M4 × 12 mm screw and washer : 2 pcs.)

∗Tighten the wire 2 (ground) with the stop switch. (See Detail C)

(2) Mount the blower housing on the crankcase.（M6 × 16 mm bolt : 5 pcs.）

∗Tighten the wire 2 (ground) with the blower housing. (See View D)

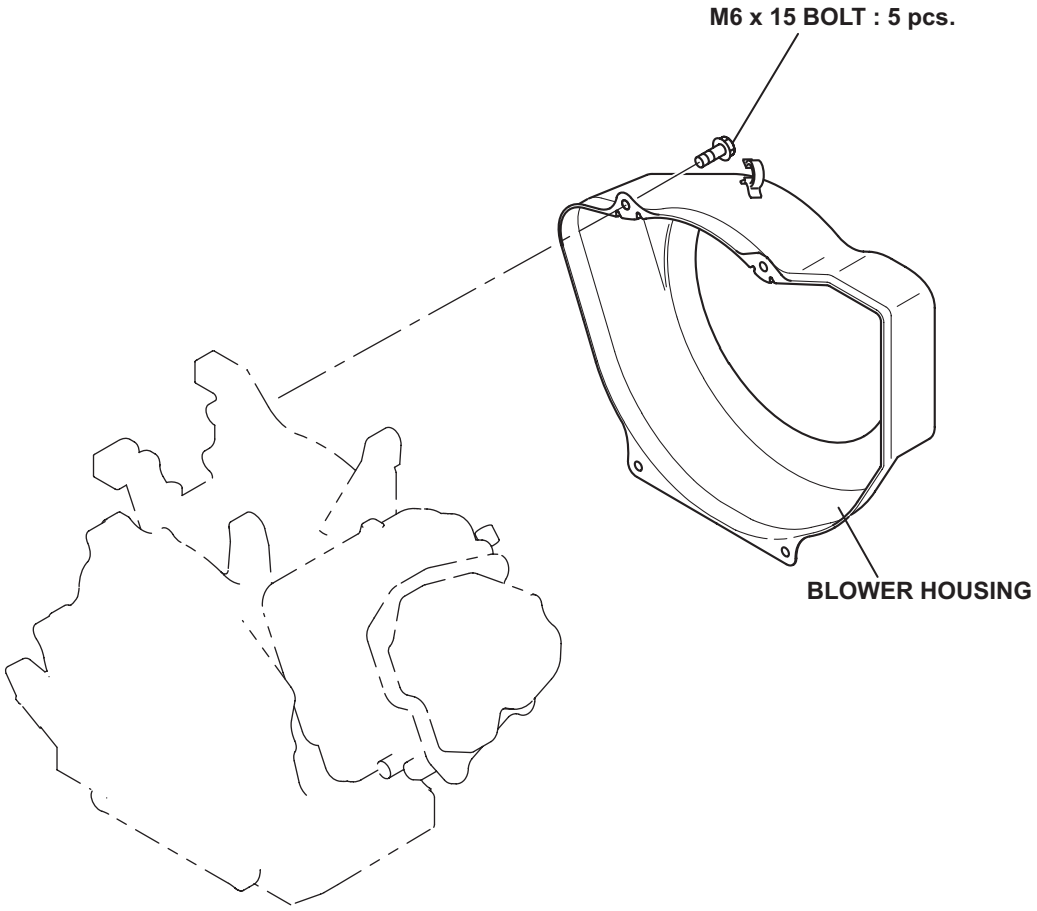


Fig.3-54

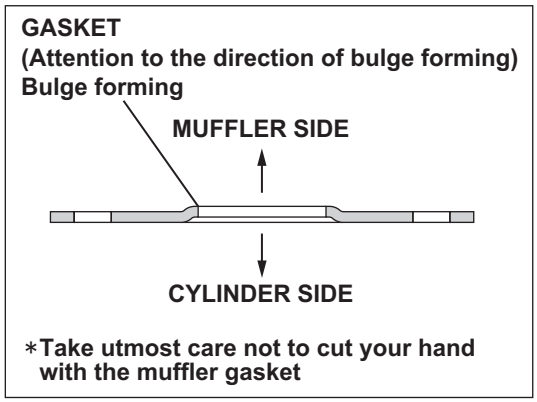
(22) WIRING

Refer to the wiring diagram (See page 48 and 49) for wiring details.

(23) MUFFLER

(1) Mount the muffler and the gasket on the cylinder head.

NOTE : Be sure to remove any tape or cloth used to cover the exhaust port when the engine was disassembled.



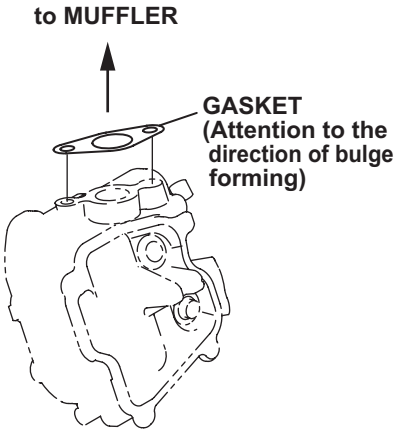


Fig.3-55

M8 × 12 mm Bolt : 1 pc.

M8 Nut : 2 pcs.

Tightening torque (Recommend)
18.0 - 22.0 N·m (180 - 220 kgf·cm) (13.0 - 16.2 ft·lb.)

(24) EXTERNAL INSPECTION

Reassembly is completed. Check that the wiring is correct and that there are no loose nuts and bolts o any other faults visible on the outside of the engine.

(25) FILLING WITH ENGINE OIL

Use the automobile engine oil of API service class SE or higher grade.

The amount of oil, refer to the table below.

	Model EX40
Engine oil volume (maximum)	1.2L

4. ENGINE OIL

Using engine oil of the correct grade and viscosity greatly lengthens engine life and improves performance. Too much or too little oil can also result in serious problems, including engine damage.

4-1 CLASSIFICATION BY OIL GRADE

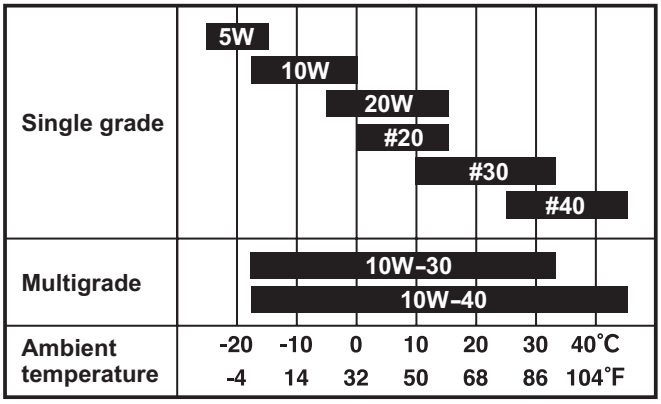
API (American Petroleum Institute)

Classification	SA	SB	SC	SD	SE	SF	SG	SH	SJ

Grades suited for Robin Engine: SE or higher (SG,SH or SJ in recomended)

4-2 CLASSIFICATION BY OIL VISCOSITY

SAE (Society of Automotive Engineers)



Be sure to use automobile engine oil of the viscosity shown in the table above, depending on environmental air temperature.

When the air temperature falls below –20℃ or rises above 40℃, be sure to choose engine oil of appropriate viscosity and grade, according to the prevailing conditions.

∗Care must be taken when using multi-grade engine oil, because the oil consumption rate tends to increase when the air temperature is high.

4-3 ADDING AND CHANGING ENGINE OIL

○ Engine oil inspection and filling up . . . Every time you use the engine
(add engine oil up to the designated maximum level)

○ Engine oil change . . . . . First time . . . . . After 20 hours' use
Thereafter . . . . . Every 200 hours' use

5. IGNITION SYSTEM

The ignition system is controlled by the digital CDI, and the ignition timing is variable according to engine speed. The flywheel (cooling fan is separate from the flywheel) is directly mounted on the crankshaft and the ignition coil is directly mounted on the crankcase.

6. WIRING DIAGRAM

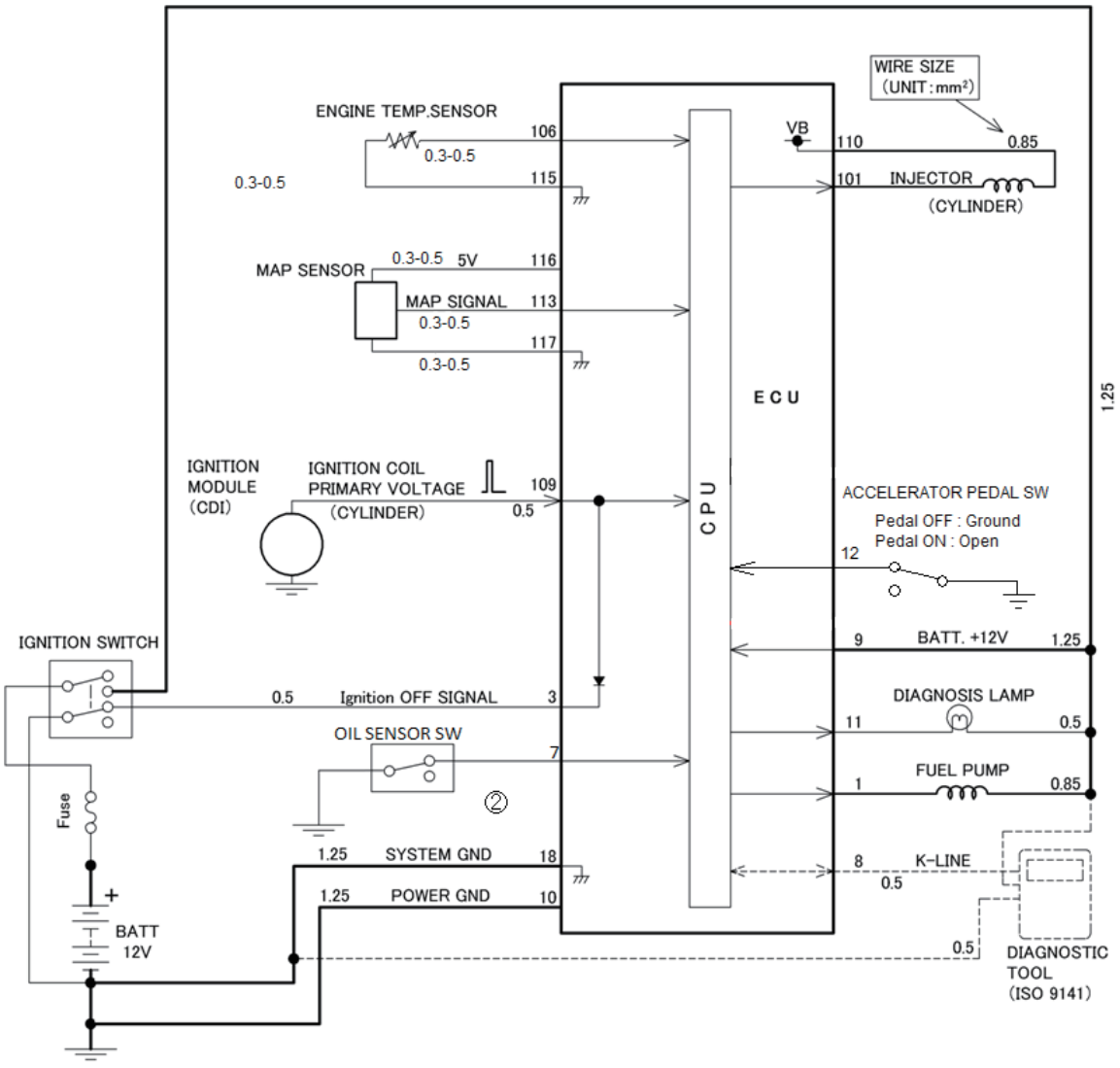


Fig.6-1

7. OIL SENSOR

7-1 SPECIFICATIONS

Type	Float type (with lead switch incorporated)
Resistance (at FULL oil level)	100 M ohms or over
Operating Temperature	-30 to +180 degree Celsius

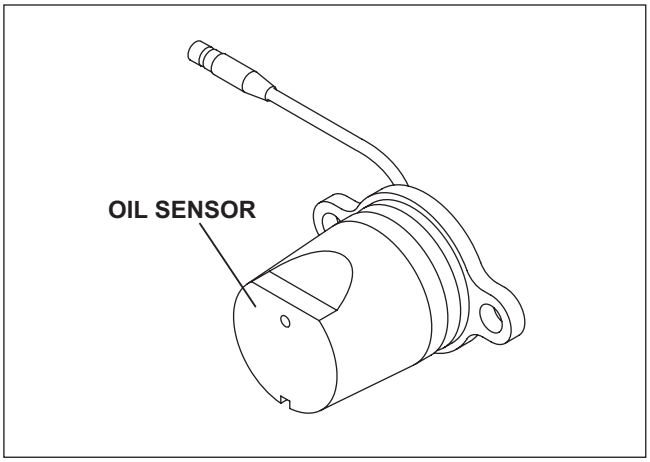


Fig.7-1

7-2 CONSTRUCTION AND OPERATION

The oil sensor is composed of the float, permanent magnet incorporated into the float and the lead switch.
In accordance with the oil level, the float moves up and down.
When the oil level is upper level, the float moves up.

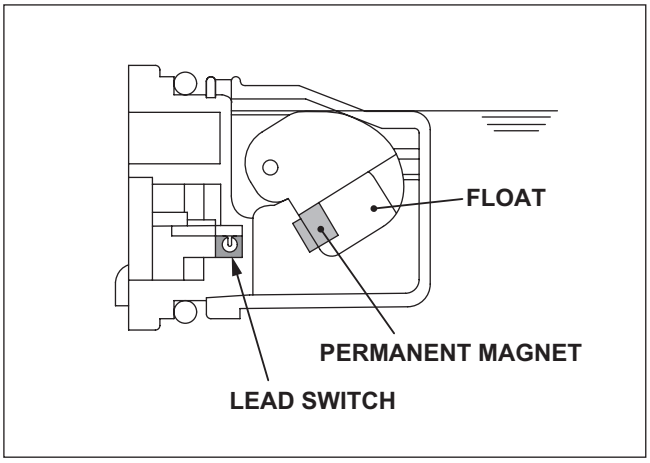


Fig.7-2

When the oil level is lower level, the float moves down.
The permanent magnet is close to the lead switch, and the lead switch is activated by the magnetic force.

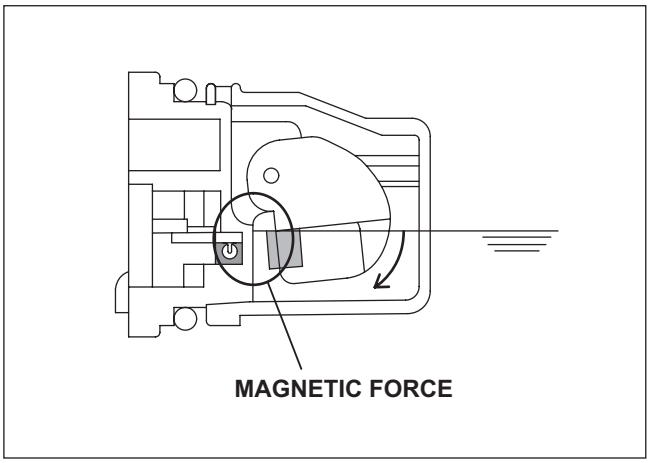


Fig.7-3

NOTE : With regards to the wiring diagram, please refer to the section 9-3 (page49).

8. 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:

8-1 STARTING DIFFICULTIES

Phenomenon	Possible causes	Remedy
1. Low engine speed at starting	1) Battery discharged	Charge battery
	2) Poor connection between battery and starter motor	Clean or repair
	3) Poor connection between battery and ground	Clean or repair
	4) Electric starter faulty	Repair or replace
	5) Improper engine oil	Replace with recommended engine oil
2. Ignition system malfunction	Spark plug * Improper spark plug gap * No insulation * Carbon deposits	 Adjust Replace Clean
	Ignition coil * No insulation or discontinuity * Poor connection or discontinuity of ignition code	Check with failure diagnosis system Replace Repair or replace
	Improper air gap between ignition coil and flywheel	Adjust
3. Fuel system malfunction	1) No fuel in fuel tank	Refill
	2) Fuel pump clogged	Clean or replace
	3) Fuel hose clogged or pinched	Clean or replace
	4) Air mixing into fuel lines	Check and adjust connecting portion
	5) Improper gasoline or water infiltration	Replace
	6) Throttle body * Poor connection or discontinuity of throttle body (ECU). * Clogged or damaged * Improper operation of throttle valve	 Repair or replace. Check with failure diagnosis system Clean or replace Check and adjust or replace
	7) Poor connection of fuel pump wiring	Check with failure diagnosis system
	8) Improper pulsation damper	Replace
	9) Improper temperature sensor	Check with failure diagnosis system and replace
4. Engine core components malfunction	1) Insufficient tightening of cylinder head bolts	Check and retighten
	2) Wear of piston, piston ring and/or cylinder	Repair or replace
	3) Improper contact of valve and seat	Repair
	4) Valve seizure	Repair
	5) Improper valve clearance	Adjust
	6) Intake manifold gasket leakage	Retighten intake manifold bolts or replace gasket
	7) Throttle body gasket leakage	Retighten cleaner adapter flange nut or replace gasket
	8) Insufficient tightening of spark plug	Retighten

8-2 INSUFFICIENT OUTPUT

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

8-3 OVERHEAT

Phenomenon	Possible causes	Remedy
Overheating	1) Cooling air flow obstructed at inlet or cylinder baffle portion	Clean
	2) Improper engine oil	Replace
	3) Lean air/fuel mixture	Check and replace throttle body, and pulsation damper
	4) Excessive back pressure of exhaust system	Check, clean or replace
	5) Over-load	Change to rated load
	6) Loosen or missing spark plug cap	Check and connect properly

8-4 ROUGH IDLING

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

8-5 HIGH ENGINE OIL CONSUMPTION

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

8-6 HIGH FUEL CONSUMPTION

Phenomenon	Possible causes	Remedy
1. Fuel system	1) Throttle body faulty	Check or replace
	2) Pulsation damper faulty	Check or replace
	3) Fuel pump faulty	Check or replace
2. Engine core components	1) Low compression	Check or repair
	2) Over cooling	Check and adjust load and/or engine speed

8-7 DETONATION

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

8-9 ENGINE MISFIRE

Phenomenon	Possible causes	Remedy
1. Ignition system	1) Improper spark plug gap or damaged electrode	Cealn, adjust or replace
	2) Ignition coil faulty	Replace
	3) Damaged ignition system wirings	Check with failure diagnosis system and replace
	4) Poor connection of ignition system wirings	Check with failure diagnosis system and connect properly
2. Fuel system	1) Lean or rich air/fuel mixture	Check and replace throttle body
	2) Clogged throttle body	Check and replace
	3) Throttle body faulty	Check and replace
	4) Fuel pump faulty	Check and replace
	5) Improper gasoline or water infiltration	Replace
3. Engine core componets	1) Valve heat deterioration or improper valve adjustment	Adjust or replace
	2) Valve spring deterioration	Replace
	3) Low compression	Check, adjust or replace

9. ELECTRIC FUEL INJECTION SYSTEM

This engine is equipped with Electronic Fuel Injection system (FI system) Integrated with ECU (Engine Control Unit).

The FI system consists of throttle body, ECU, MAP (Manifold Absolute Pressure) sensor, injector, engine case temperature sensor, electric fuel pump.

The fuel system is calibrated after careful testing for optimum all-round performance (including starting, acceleration, fuel consumption, output power characteristics).

The throttle body monitors air and engine temperature at start up and performs the choke function automatically.

While the engine is in operation, the throttle body monitors engine speed, manifold absolute pressure, and engine temperature to ensure proper engine performance.

Failure diagnosis is made by the diagnosis lamp on the panel.

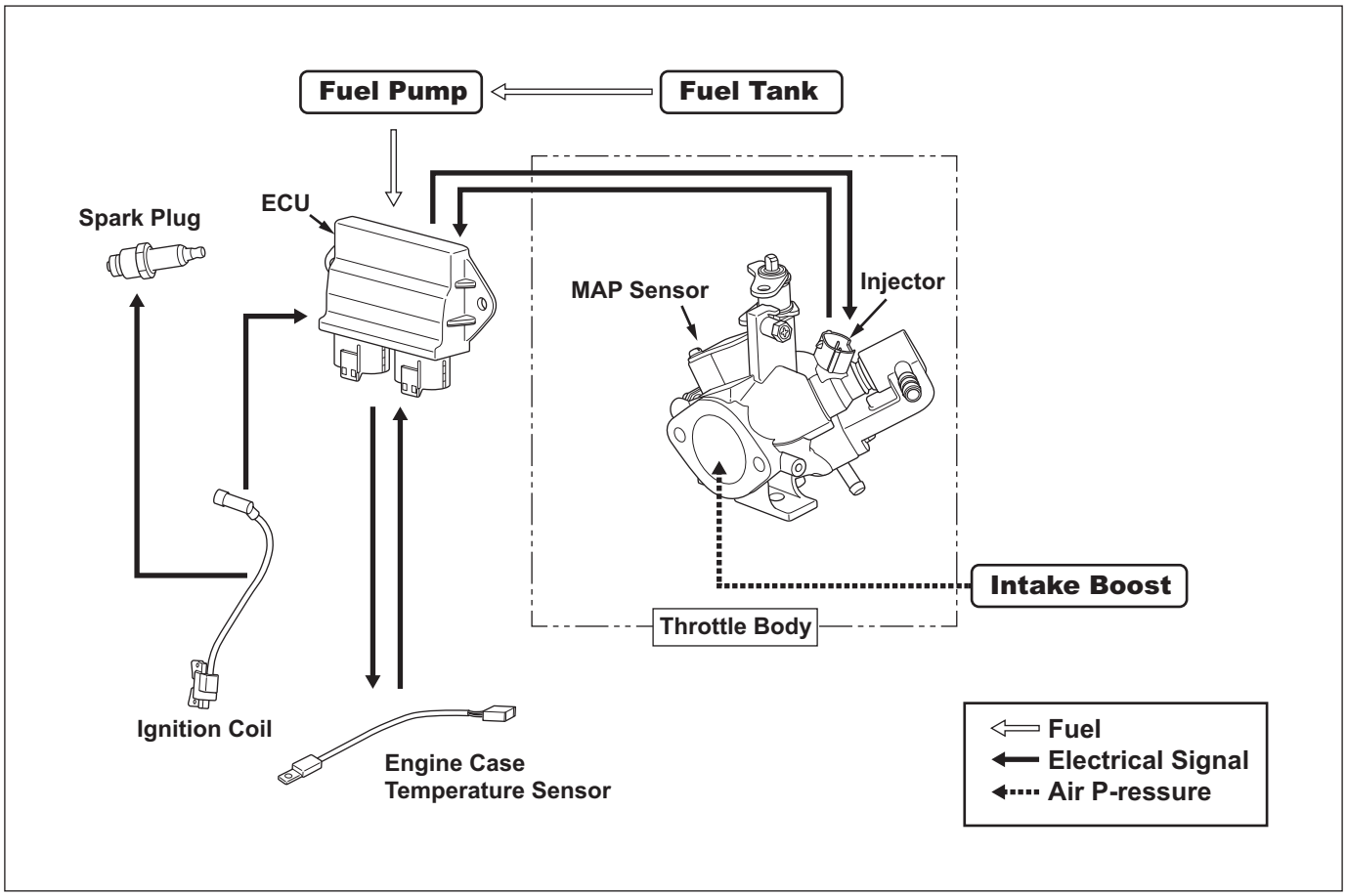


Fig.9-1

9-1 FUNCTIONS AND CONSTRUCTION

9-1-1 FUEL INJECTOR

Fuel is metered by the fuel injector that is actuated electronically by ECU.

The fuel is injected into the throttle bore and mixed with air from the air cleaner.

9-1-2 ENGINE CONTROL UNIT (ECU)

The ECU (engine control unit) on bottom of the throttle body is powered by DC battery. The ECU monitors engine conditions such as engine speed, air pressure, and engine temperature.

With these inputs, the ECU actuates the fuel injector to ensure the fuel/air mixture is of optimum concentration and is fed into the combustion chamber of the engine at the correct timing. When engine speed reached to 4,400 rpm, the ECU cuts fuel to prevent over speed.

The ECU also controls the low oil sensor system and monitors voltage of DC battery, and each wiring whether disconnecting or electrical short circuit.

9-1-3 CHOKE SYSTEM

The throttle body monitors air pressure and engine temperature at start up and performs the choke function automatically.

The choke system automatically adjusts for easier start of the engine in all weather conditions.

9-2 FUEL SYSTEM TESTING AND DIAGNOSIS

Most fuel system malfunctions occur when the fuel/air ratio of the mixture is not correct.

This is usually caused by clogged fuel filters, air passages, fuel passages, or by variations in the fuel level.

To get the best possible performance from the throttle body, make sure that the fuel feed and air feed passages are free so air and fuel can flow freely through them.

The procedure for inspecting the fuel system is described below.

Run all system tests with a full tank of fresh, clean fuel.

9-3 EFI SYSTEM

9-3-1 CHECKING ECU CONNECTOR

1. Disconnect the connector, and check their terminals for contamination and deformation.
2. Check to see that cable is not broken or terminals are not shelled off.
3. If any damaged parts are found, repair or replace them.

NOTE ;
When replacing the ECU, the throttle body also needs to be replaced.

IMPORTANT ;
Connect connectors surely after checking.

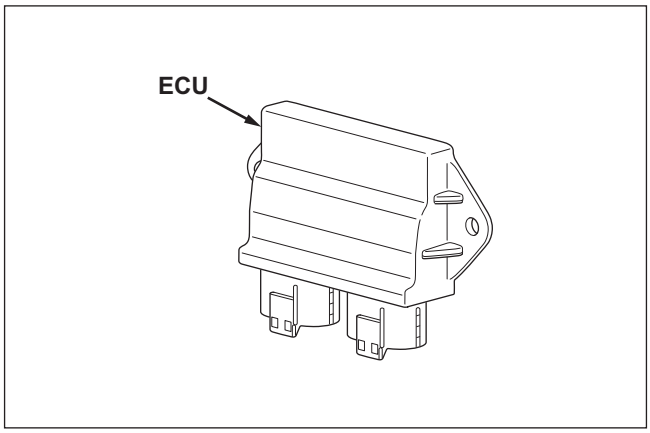
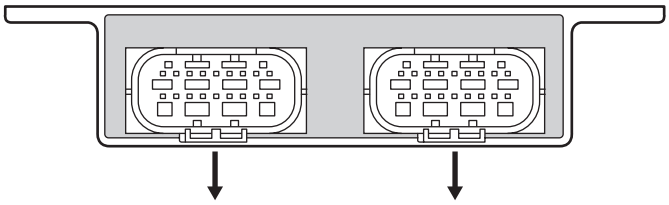


Fig.9-2

PIN ASSIGNMENT OF ECU CONNECTOR



110	111	112	113	114	115	116	117	118
101	102	103	104	105	106	107	108	109

JAPAN AVIATION ELECTRONIC INDUSTRY
PARTS No.MX23A18NFG
COLOR : GRAY

101	INJECTOR CONTROL
102	N.C.
103	N.C.
104	N.C.
105	N.C.
106	ENGINE TEMP. SENSOR
107	N.C.
108	N.C.
109	IGNITION SIGNAL
110	INJECTOR (VB+)
111	N.C.
112	N.C.
113	M.A.P. SENSOR
114	N.C.
115	SENSOR GND (ENG.TEMP.)
116	5V ref.
117	SENSOR GND(M.A.P.)
118	N.C.

10	11	12	13	14	15	16	17	18
1	2	3	4	5	6	7	8	9

JAPAN AVIATION ELECTRONIC INDUSTRY
PARTS No.MX23A18NF1
COLOR : BLACK

1	FUEL PUMP
2	N.C.
3	IGNITION GND
4	N.C.
5	N.C.
6	N.C.
7	OIL SENSOR SWITCH
8	K-LINE
9	BATT. +12V
10	POWER GND
11	DIAGNOSIS LAMP
12	ACCELERATOR PEDAL SWITCH
13	N.C.
14	N.C.
15	N.C.
16	N.C.
17	N.C.
18	SYSTEM GND

9-3-2 ECU CONNECTOR VOLTAGE

(Main Circuit)

1. Turn on the main switch. (Do not start engine.)
2. Measure the voltage between terminal **9** (+)and terminal **10** (**–**).
3. It is OK if the voltage equals to the battery voltage.

(Sensor Voltage)

1. Turn on the main switch. (Do not start engine.)
2. Measure the voltage between terminal **116** (+)and terminal **117** (**–**).
3. It is OK if the voltage is approx. 5 V.

Voltage	Terminal 9 to 10	Approx. battery voltage
	Terminal 116 to 117	Approx. 5 V

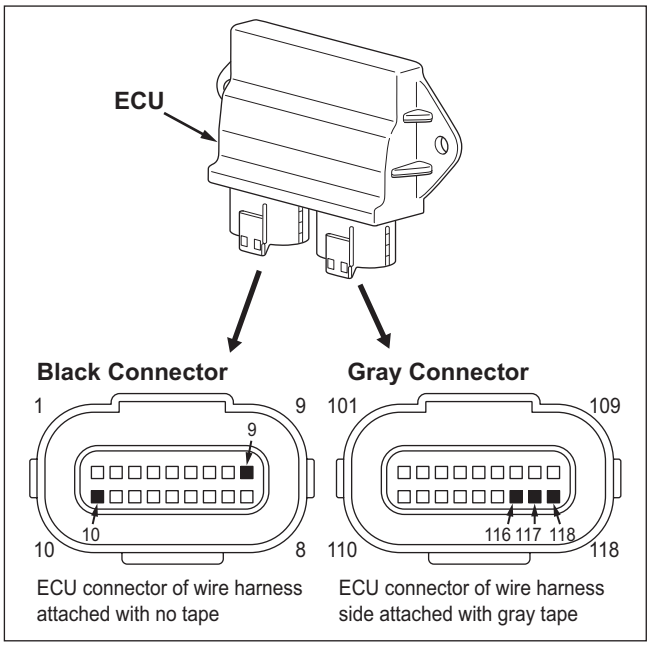


Fig.9-3

9-3-3 WIRING HARNESS OF ENGINE CASE TEMPERATURE SENSOR

1. Disconnect the engine case temperature sensor connector (2P).
2. Check the state of the harness and if it is abnormal, replace it.
3. Turn the key switch to the **ON** position.
4. Measure the voltage between the terminals of the connector with voltage range of circuit tester.
5. When the measurements are the table value below, the ECU is normal.
   The engine case temperature sensor is damaged, then replace it.
6. When the measurements are out of the table value below, the ECU is failure, then replace it.

Wiring harness voltage	Terminal 1- Terminal 2	5V

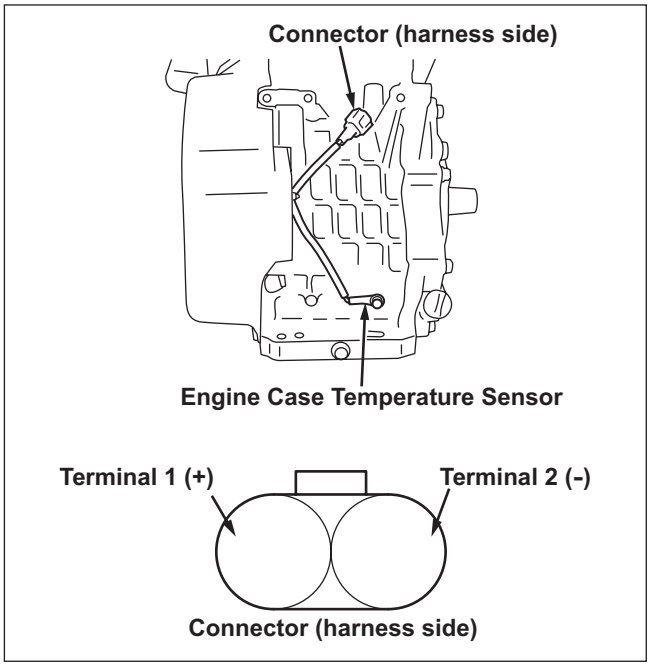


Fig.9-4

9-3-4 ENGINE CASE TEMPERATURE SENSOR

1. Disconnect the connector from the engine case temperature sensor.
2. Measure the resistance with an ohmmeter across the terminal **1** and **2** of engine case temperature sensor
3. If the measurement is not indicated, the sensor is faulty.

Resistance (Sensor terminal **1** - terminal **2**)	Reference value	Approx. 10 kΩ at 25°C (77°F)

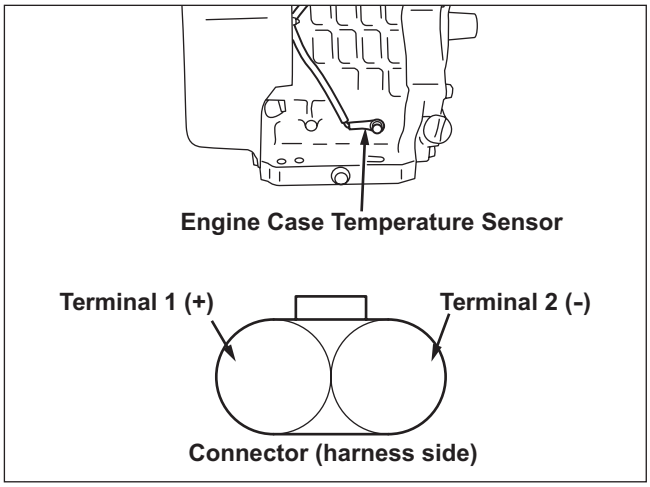


Fig.9-5

9-3-5 INJECTOR

1. Disconnect the connector of injector (2P).
2. Measure the resistance between the terminals of the injector with resistance range of circuit tester.
3. If the measurement is not within factory specification, replace the injector.

Injector resistance	Factory specification	Approx. 11.5 to 12.5 Ω

4. Check the state of the harness and if it is abnormal, replace it.
5. Turn the key switch to the ON position.
6. Measure the voltage between the terminal 2 of injector connector and body earth with voltage range of circuit tester (harness side).
7. Measure the resistance between the terminal 1 of injector connector and ECU terminal 101 with resistance range of circuit tester (harness side).

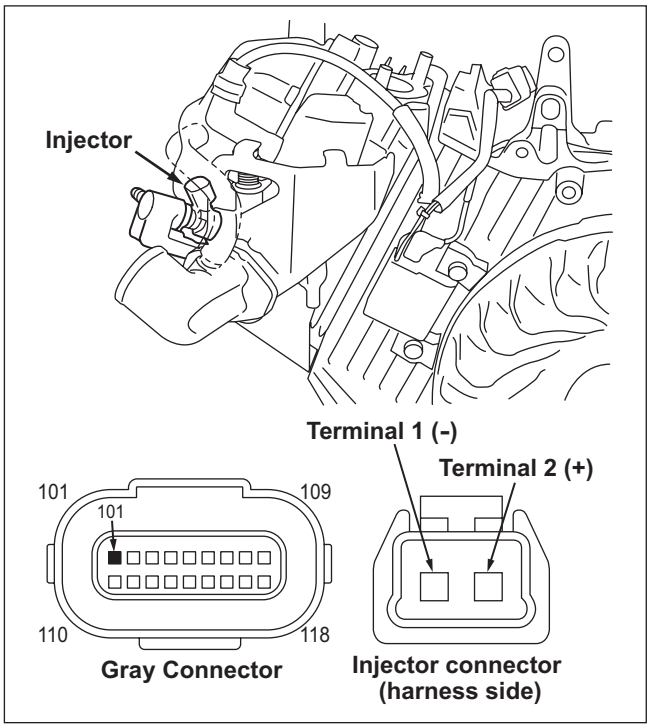


Fig.9-6

8. When the measurements are the table value below the ECU is normal. The injector is damaged, then replace it.
9. When the measurements are out of the table value below, the ECU is damaged, then replace it.

NOTE ;
- **The injector can not be replaced separately.**
- **When the injector is in failure, replace throttle body.**
- **When replacing the throttle body, the ECU also needs to be replaced.**

Harness voltage	Terminal 1- Body earth	Approx. 5 V
Harness resistance	Terminal **2**- ECU terminal **101**	0Ω

9-3-6 MAP SENSOR

1. Connect the connector of MAP sensor (3P).
2. Turn the key switch to the ON position.
3. Measure the voltage between the terminal 3 and body earth with voltage range of circuit tester.
4. If the measurement is not within factory specification, replace the throttle body with ECU or wiring harness.
5. Check .the state of the harness and if it is abnormal, replace it.
6. Turn the key switch to the OFF position.
7. Disconnect the connector of MAP sensor (3P).
8. Turn the key switch to the ON position.
9. Measure the resistance between the terminal 1 and ECU terminal 117 earth with resistance range of circuit tester (harness side).

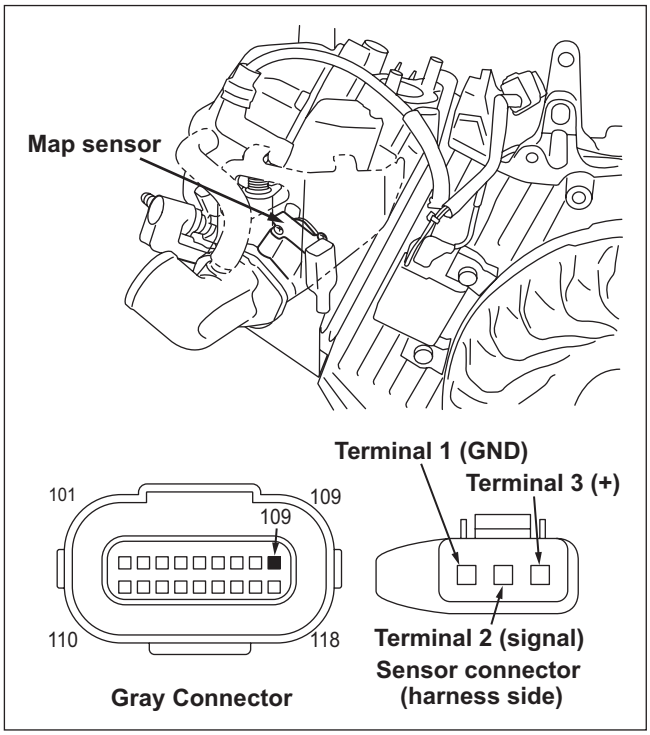


Fig.9-7

10. Measure the resistance between the terminal 2 and ECU terminal 113 with resistance range of circuit tester (harness side).
11. Measure the resistance between the terminal 3 and ECU terminal 116 earth with resistance range of circuit tester (harness side).
12. When the measurements are the table value below the wiring harness is normal. The MAP sensor is damaged, then replace it.
13. When the measurements are ot.it of table value below, the wiring harness is damaged, then replace it.

NOTE ;
- **The MAP sensor can not be replaced separately.**
- **When the injector or MAP sensor is in failure, replace throttle body.**
- **When replacing the throttle body, the ECU also needs to be replaced.**

Harness voltage	Terminal **3**- Body earth	Approx. 5 V
Harness resistance	Terminal **1**-ECU terminal **117**	0Ω
	Terminal **2**-ECU terminal **113**	0Ω
	Terrninal **3**-ECU terminal **116**	0Ω

9-3-7 IGNITION COIL

NOTE ;

- **When the diagnosis lamp is flashing, check the procedures below in order.**
- **If the result is within factory specification, there is a problem with ECU. Replace the ECU and throttle body.**

1. Measure the resistance between the terminal **C** and terminal **B** of the primary coil with resistance range of circuit tester at 20°C (68°F).
2. Measure the resistance between the terminal **C** and terminal **A** of the secondary coil with resistance range of circuit tester at 20°C (68 °F).
3. If the measurements are not within factory specification, replace the ignition coil.

Ignition coil resistance	Factory specitication	Primary coil (Terminal **C**- Terminal **B**)	6.0 to 15Ω
		Secondary coil (Terminal **C**- Terminal **A**)	5.0 to 12 kΩ

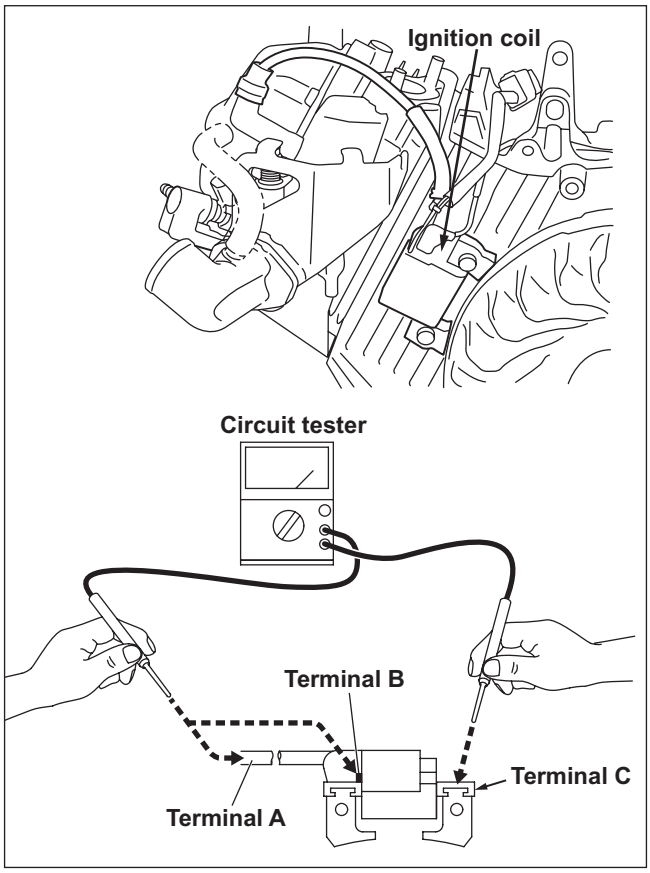


Fig.9-8

4. Check the state of the harness and if it is abnormal, replace it.

9-4 FAILURE DIAGNOSIS MODE TABLE

This engine has the failure diagnosis system to know that low voltage of DC battery and each wiring whether disconnecting or electrical short circuit.

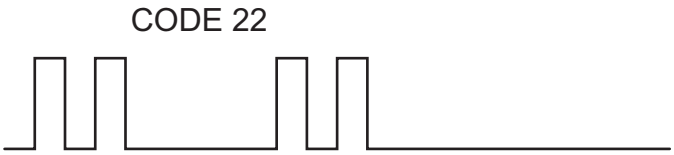
The ECU monitors engine various conditions for the system when turn the key to the “RUN”(ON) position.

DISPLAY MODE (WHEN IGNITION SWITCH ON)

DISPLAY MODE	CONDITION	LAMP CONTROL
BLINK CODE	NO FAILURE	STEP1. LAMP ON TWO SECONDS STEP2. LAMP OFF FOUR SECONDS STEP3. LAMP OFF
	DETECT FAILURE	STEP1 AND 2 IS SAME AS "NO FAILURE" STEP3. DISPLAY BLINK CODE IF MORE THAN ONE FAILURE OCCURED, BLINK CODE WILL BE DISPLAYED IN ORDER (FROM 21 TO 51) FOLLOWED BY A PAUSE.

DISPLAY MODE (AFTER IGNITION SWITCH ON)

DISPLAY MODE	CONDITION	LAMP CONTROL
BLINK CODE	NO FAILURE	STEP1. LAMP OFF
	DETECT FAILURE	STEP1. LAMP OFF FOUR SECONDS STEP2. DISPLAY BLINK CODE IF MORE THAN ONE FAILURE OCCURED, BLINK CODE WILL BE DISPLAYED IN ORDER (FROM 21 TO 51) FOLLOWED BY A PAUSE.



BLINK CODE	FAILURE DESCRIPTION
21	BATTERY VOLTAGE LOW
22	MAP SENSOR OPEN CONNECTION OR SHORTED CONNECTION
23	TEMP SENSOR OPEN CONNECTION OR SHORTED CONNECTION
31	FUEL PUMP OPEN CONNECTION
41	INJECTOR OPEN CONNECTION
51	IGNITION PULSE OPEN CONNECTION

10. STANDARD REPAIR TABLES

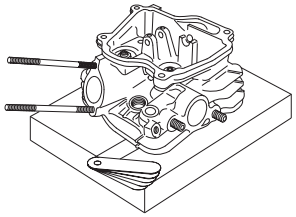
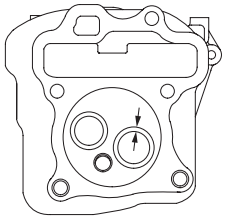
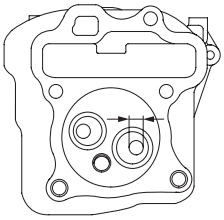
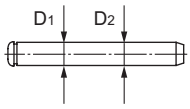
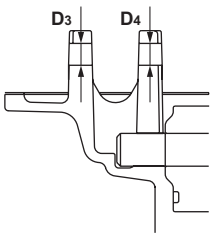
"STD" in the following table is the parts dimension from the brand new engine or the spare parts.

Whereas, "Limit" shows the maximum allowance for the parts to be used on the engine.

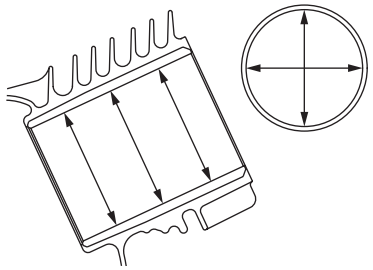
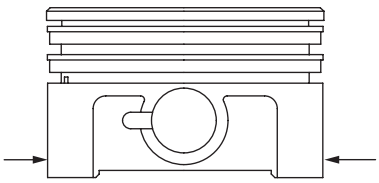
If the measurement exceeds beyond the "Limit", the part needs to be replaced and/or repaired.

10-1 STANDARD DIMENSIONS AND LIMITS OF USE

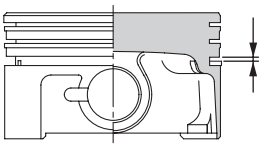
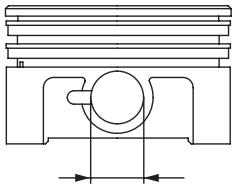
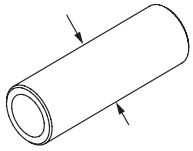
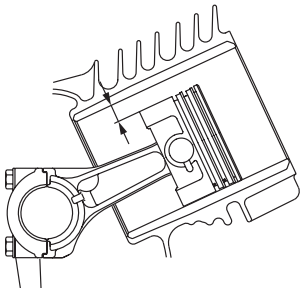
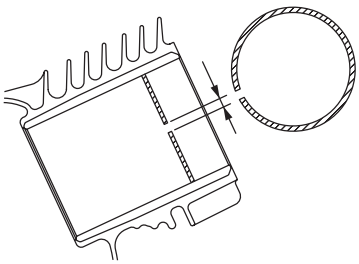
Unit: mm (in.)

ITEM		STD	Limit
CYLINDER HEAD * Flatness 		0.05 (0.002)	0.1 (0.004)
* Intake/exhaust valve seat contact width 	Intake Exhaust	0.7 - 1.0 (0.0276 - 0.0394)	———
* Intake/exhaust valve guide inner diameter 	Intake Exhaust	6.035 - 6.053 (0.2376 - 0.2383)	———
* Rocker arm pin outer diameter 	Pin outer diameter D1, D2	7.970 - 7.980 (0.3138 - 0.3142)	7.9 (0.3110)
* Rocker arm pin support inner diameter 	Support inner diameter D3, D4	8.00 - 8.018 (0.3150 - 0.3157)	8.05 (0.3169)

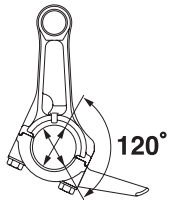
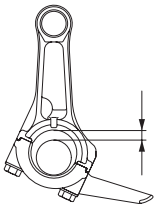
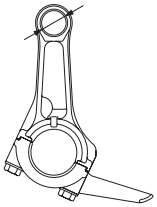
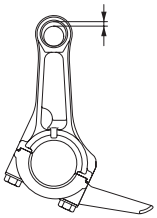
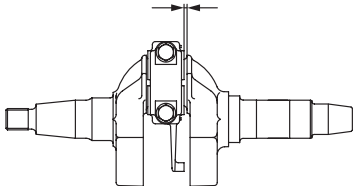
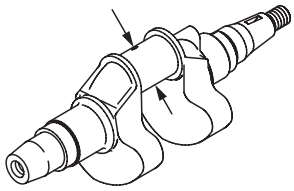
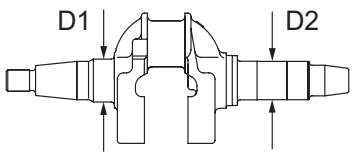
Unit: mm (in.)

ITEM		STD	Limit
CYLINDER * Inner diameter 	Standard	89.000 - 89.022 (3.5039 - 3.5040)	To be rebored when the difference between max. and min. of diameter reached to 0.1 (0.004).
	First reboring	89.250 - 89.272 (3.5138 - 3.5147)	Ditto
	Second reboring	89.500 - 89.522 (3.5236 - 3.5245)	Ditto
* Roundness after reboring		Less than 0.01 (0.0004)	
* Cylindricity after reboring		Less than 0.015 (0.0006)	
PISTON * Outer diameter at skirt in thrust direction 	Standard	88.980 - 89.000 (3.5032 - 3.5039)	88.89 (3.4996)
	Oversize +0.25	89.230 - 89.250 (3.5130 - 3.5138)	89.14 (3.5095)
	Oversize +0.50	89.480 - 89.500 (3.5228 - 3.5236)	89.39 (3.5193)

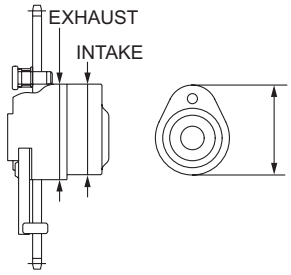
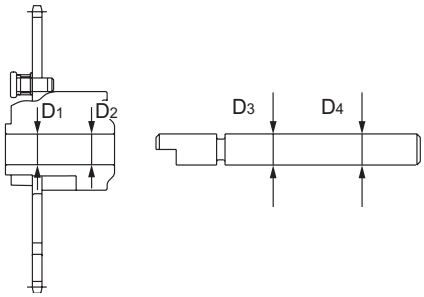
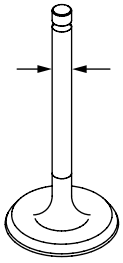
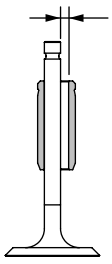
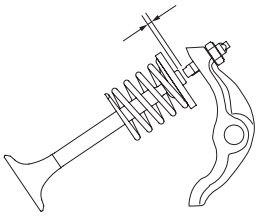
Unit: mm (in.)

ITEM		STD	Limit
PISTON * Ring groove side clearance 	Top	0.050 - 0.090 (0.0020 - 0.0035)	0.15 (0.0059)
	Oil ring (three-piece)	0.030 - 0.125 (0.0012 - 0.0049)	———
* Piston pin hole 		20.989 - 21.022 (0.8263 - 0.8276)	21.045 (0.82854)
* Piston pin outer diameter 		20.992 - 21.000 (0.8265 - 0.8268)	20.960 (0.8252)
* Clearance between piston and cylinder at skirt 		0.065 - 0.107 (0.0026 - 0.0042)	0.25 (0.0098)
* Piston ring end gap 	Top	0.10 - 0.25 (0.0039 - 0.0098)	1.5 (0.0591)
	Oil ring (three-piece)	0.15 - 0.55 (0.0059 - 0.0217)	1.5 (0.0591)

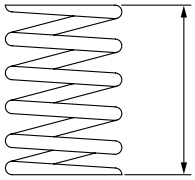
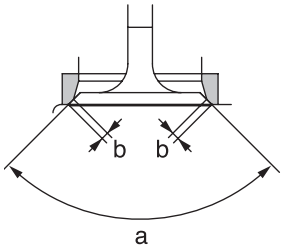
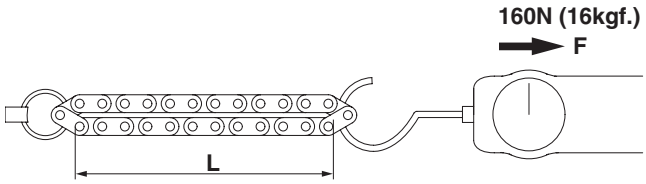
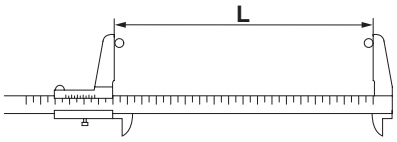
Unit: mm (in.)

ITEM		STD	Limit
CONNECTING ROD * Large end inner diameter 		38.000 - 38.016 (1.4961 - 1.4967)	38.1 (1.5000)
* Clearance between large end and crank pin 		0.030 - 0.060 (0.0012 - 0.0024)	0.2 (0.0079)
* Small end inner diameter 		21.010 - 21.023 (0.8272 - 0.8277)	21.08 (0.8299)
* Clearance between small end and piston pin 		0.010 - 0.032 (0.0004 - 0.0013)	0.12 (0.0047)
* Large end side clearance 		0.100 - 0.780 (0.0039 - 0.0307)	1.0 (0.0394)
CRANKSHAFT * Crank pin outer diameter 		37.956 - 37.970 (1.49433 - 1.4949)	37.85 (1.4902)
* Journal outer diameter 	D1	34.986 - 34.997 (1.3774 - 1.3778)	
	D2	34.986 - 34.997 (1.3774 - 1.3778)	

Unit: mm (in.)

ITEM			STD	Limit
CAMSHAFT * Cam peak height (intake and exhaust)  	Cam peak height	Intake	35.658 - 35.758 (1.4039 - 1.4078)	35.61 (1.4020)
		Exhaust	39.408 - 39.508 (1.5515 - 1.5554)	39.36 (1.5496)
	Cam inner diameter D_1,D_2		10.0 - 10.036 (0.3937 - 0.3951)	10.05 (0.3957)
* Cam sprocket inner diameter * Pin (cam sprocket) outer diameter  	Pin outer diameter D_3,D_4		9.953 - 9.975 (0.3919 - 0.3927)	9.95 (0.3917)
INTAKE/EXHAUST VALVES * Valve stem outer diameter 	Intake		5.970 - 5.985 (0.2350 - 0.2356)	5.85 (0.2303)
	Exhaust		5.970 - 5.985 (0.2350 - 0.2356)	5.85 (0.2303)
* Clearance between valve stem and valve guide 	Intake		0.050 - 0.083 (0.0197 - 0.0033)	0.3 (0.0118)
	Exhaust		0.050 - 0.083 (0.0197 - 0.0033)	0.3 (0.0118)
* Valve clearance (in cold state) 	Intake		0.12 - 0.15 (0.0047 - 0.0059)	0.25 (0.0098)
	Exhaust		0.12 - 0.15 (0.0047 - 0.0059)	0.25 (0.0098)

Unit: mm (in.)

ITEM		STD	Limit
VALVE SPRING FREE LENGTH 		36.5 (1.4370)	
VALVE SEAT ANGLE (INTAKE AND EXHAUST) * Valve cutter angle (a) * Valve contact width (b) 	Intake Exhaust	a: 90° b: 0.7 - 1.0 (0.0276 - 0.0394)	2.0 (0.0787)
CHAIN LENGTH  		346.20 (13.6299)	349.0 (13.7402)

10-2 SERVICE DATA (The following are only for your reference.)

			EX40
Compression pressure	(Mpa / 500 rpm)		1.15 Mpa
Lubricant	Capacity	(L)	1.2
	Effective Capacity	(mL)	600
	Consumption	(mL/Hr)	7~11

Above numbers may change under each operating conditions

10-3 TIGHTENING TORQUE

ITEM			Tightening Torque		
			N·m	kgf·cm	ft·lb
Cylinder head bolts	M10×75 flange bolt	Re-use	29.0 - 31.0	290 - 310	21.0 - 22.4
		When replace to new cylinder head and flange bolts	37.0 - 39.0	370 - 390	26.7 - 28.2
	M8×35 flange bolt		17.0 - 19.0	170 - 190	12.3 - 13.7
Connecting rod cap bolts			22.5 - 27.5	225 - 275	16.3 - 19.9
Flywheel nut			100.0 - 120.0	1000 - 1200	72.3 - 86.8
Main bearing cover bolts			22.0 - 24.0	220 - 240	16.2 - 17.7
Spark plug	New		12.0 - 15.0	120 - 150	8.7 - 10.8
	Re-tightening		23.0 - 27.0	230 - 270	16.6 - 19.5
Muffler nut			18.0 - 22.0	180 - 220	13.0 - 16.2
Ignition coil			7.0 - 9.0	70 - 90	5.1 - 6.5
Oil sensor			8.0 - 10.0	80 - 100	5.8 - 7.2

10-4 AIR GAP AND CLEARANCE

ITEM		Clearance	
		mm	in.
Valve clearance	(Intake, Exhaust)	0.12 - 0.15	0.0047 - 0.0059
Air gap	(Ignition and flywheel)	0.3 - 0.5	0.012 - 0.020
Electrode gap	(Spark plug)	0.6 - 0.7	0.024 - 0.028

11.PERIODIC MAINTENANCE

18-1 PERIODIC MAINTENANCE SCHEDULE TABLE

Maintenance Items	Every 8 hours (Daily)	Every 50 hours (Weekly)	Every 200 hours (Monthly)	Every 500 hours	Every 1000 hours
Clean engine and check bolts and nuts	● (Daily)				
Check and refill engine oil	● (Refill daily up to upper level)				
Change engine oil (*Note : 1)	● (Initial 20 hours)		● (Every 200 hours)		
Replace engine oil filter (*Note 1)	● (Initial 20 hours)		●		
Clean spark plug		●			
Clean air cleaner		●			
Clean spark arrester (Optional part)		● (Every 100 hours)			
Replace air cleaner element			●		
Clean fuel strainer			●		
Clean and adjust spark plug and electrodes			●		
Replace spark plug				●	
Remove carbon from cylinder head				●	
Clean throttle body				●	
Check and adjust valve clearance				●	
Overhaul engine (*Note : 2)					●

*Note : 1. Initial oil change and oil filter replacement should be performed after 100 hours of operation.
Thereafter change oil every 200 hours and replace oil filter 200 hours.
Before changing oil, check for a suitable way to dispose of old oil.
Do not pour it down into sewage drains, onto garden soil or into open streams.
Your local zoning or environmental regulations will give you more detailed instructions on proper disposal.

*Note : 2. As to the procedures, please refer to the Service Manual or consult your nearest service dealer.

*Note : 3. More frequent oil changing, oil filter replacement and air cleaner service on replacement may be necessary depending on operating conditions.
This would include dusty environment, high ambient temperature, heavy engine loading.

18-2 ENGINE STORAGE

(1) Carry out the maintenance jobs described in step 18-1 above.

(2) To prevent rust in the cylinder bore, inject 5cc oil through the spark plug hole, run motor 1~2 seconds and then put back the spark plug.

(3) Clean the exterior of the engine with an oiled cloth. Place a plastic cover or similar over the engine, and store the engine in a dry place.

NOTES

Ingersoll Rand
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