SUBARU

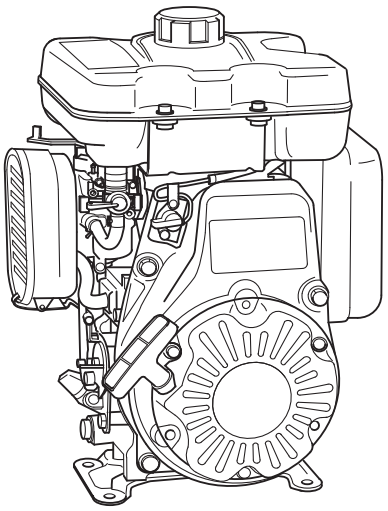
EH09-2D

SUBARU

FUJI HEAVY INDUSTRIES LTD.,
TOKYO JAPAN

Air-cooled, 4-cycle

Gasoline Engine



SERVICE MANUAL

CONTENTS

The specifications and information included in this manual were in effect at the time of printing.

1. SPECIFICATIONS

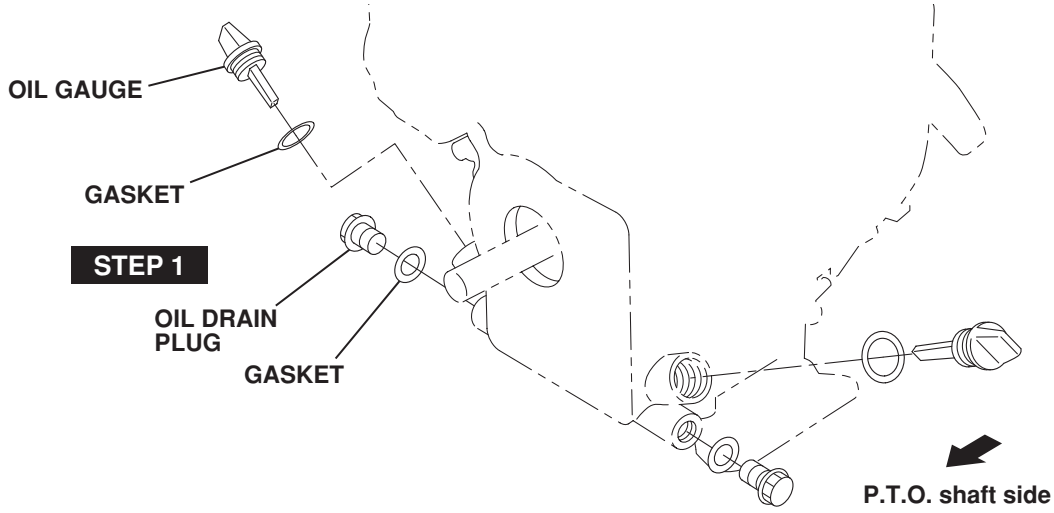
MODEL		EH09-2D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Horizontal P.T.O. Shaft, OHV, gasoline engine
Bore x Stroke	mm (in.)	51 x 42 (2.01 x 1.65)
Piston Displacement	ml (cu.in.)	86 (5.25)
Compression Ratio		8.7
Maximum Output	kW (HP) / r.p.m.	2.1 (2.9) / 4200
Continuous Output	kW (HP) / r.p.m.	1.5 (2.1) / 3600
Maximum torque	N•m (kgf•m) / r.p.m.	4.9 (0.5) / 3600
Direction of Rotation		Counter clockwise as viewed from P.T.O. shaft side
Cooling system		Forced air cooling
Valve arrangement		Over Head Valve type
Lubrication		Splashing type
Lubricant		4-stroke automotive detergent oil - SAE ; #20, #30 or 10W-30 API service class ; SE or higher (SG, SH or SJ is recommended)
Oil Capacity	liter (U.S. gal)	0.3 (0.079)
Carburetor		Horizontal draft, float type
Fuel		Automotive unleaded gasoline
Fuel feed		Gravity type
Fuel Tank Capacity	liter (U.S. gal)	1.5 (0.4)
Method of ignition		Flywheel magneto (solid state)
Spark Plug		NGK : BMR4A (CHAMPION : RCJ14)
Starting System		Recoil starter
Governor		Centrifugal flyweight type
Air Cleaner system		Semi wet type
Dry Weight	kg (lb.)	9.9 (21.8)
Dimensions (L x W x H)	mm (in.)	249 x 299 x 380 (9.8 x 11.8 x 15.0)

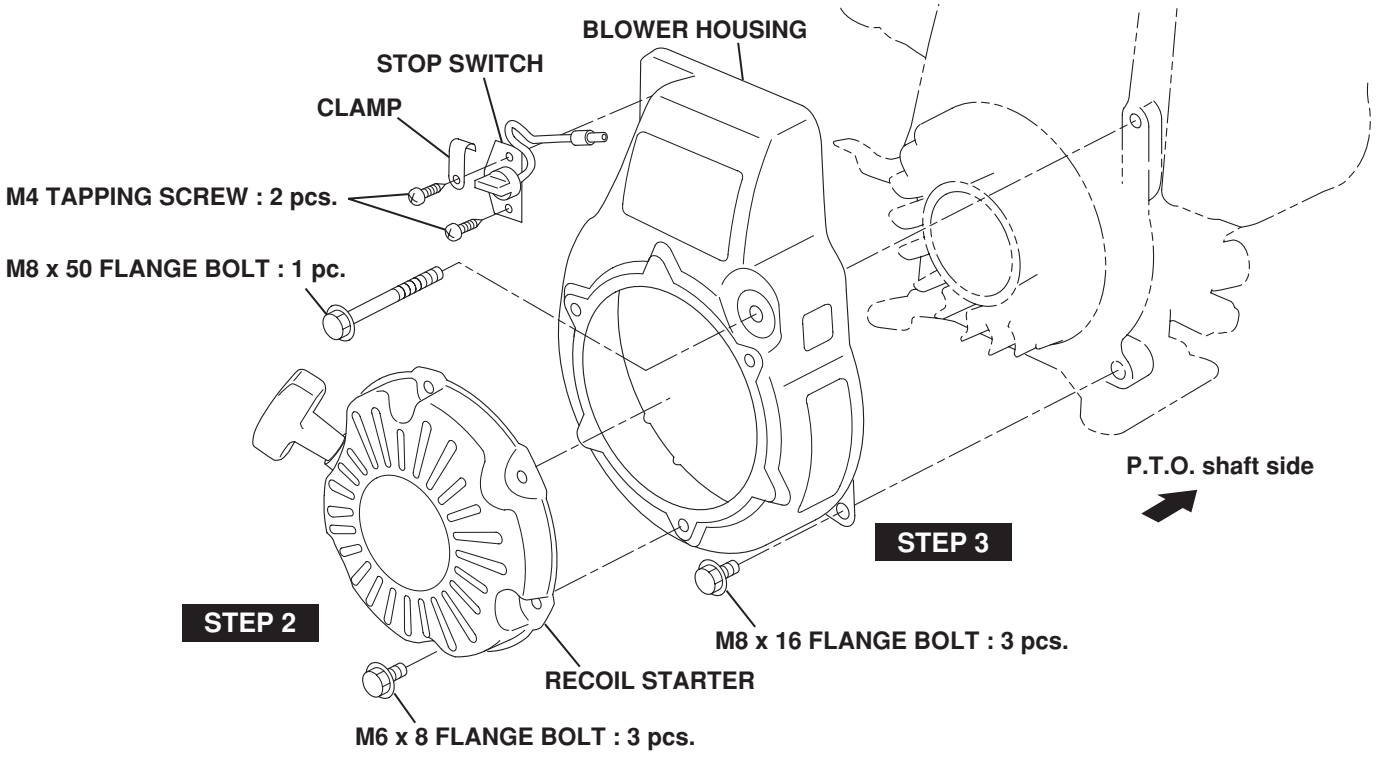
* Specifications are subject to change without notice

2. DISASSEMBLY AND REASSEMBLY

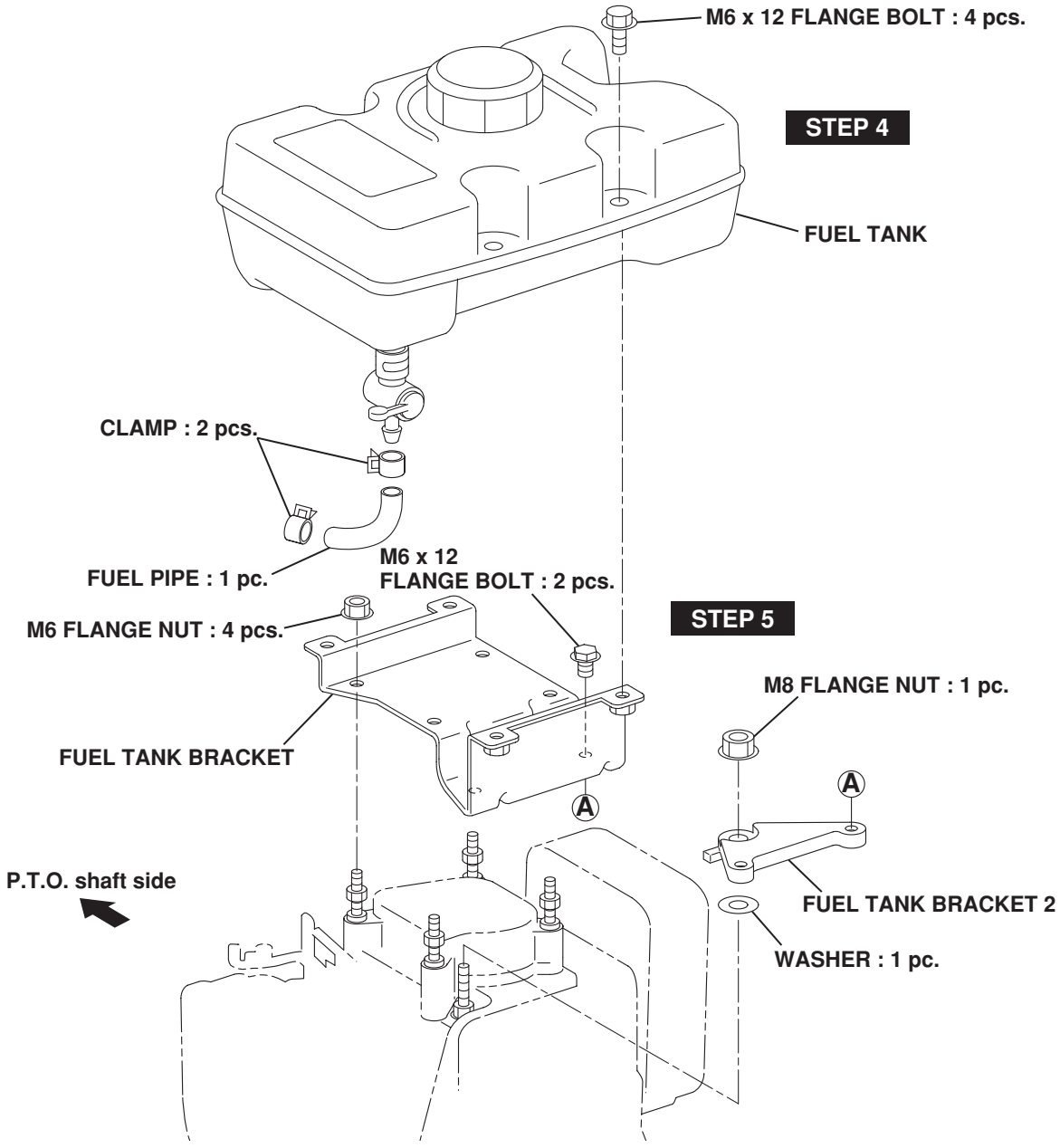
2-1 DISASSEMBLY PROCEDURES

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.	14 mm spanner
2	Recoil starter	Remove recoil starter from blower housing. Be careful of pulling direction of starter rope.	M6 x 8 : 3 pcs. 10 mm box spanner
3	Blower housing	Disconnect wire of stop switch first, then remove blower housing from crankcase.	M8 x 16 : 3 pcs. M8 x 50 : 1 pc. 12 mm box spanner

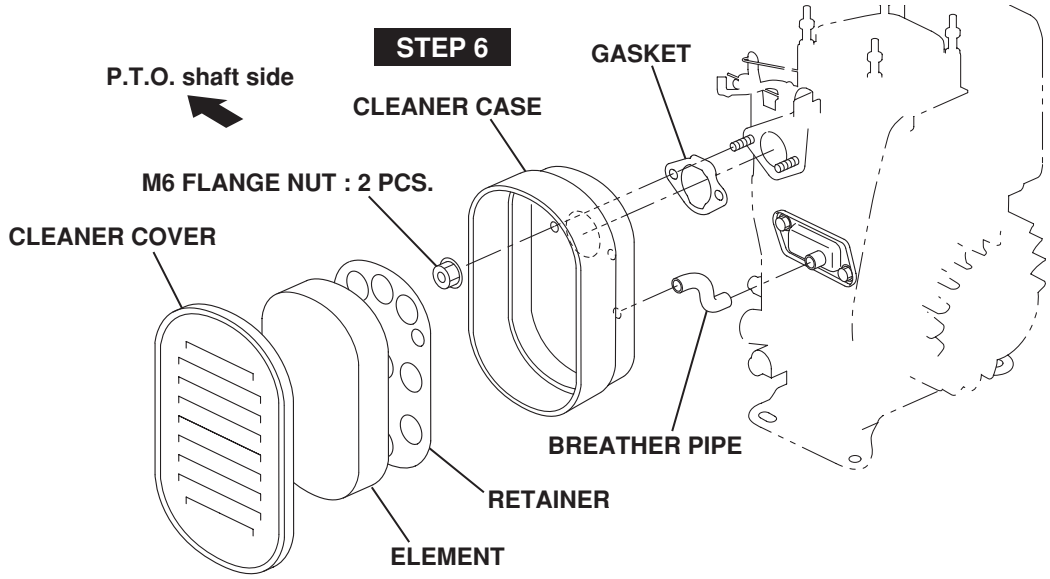


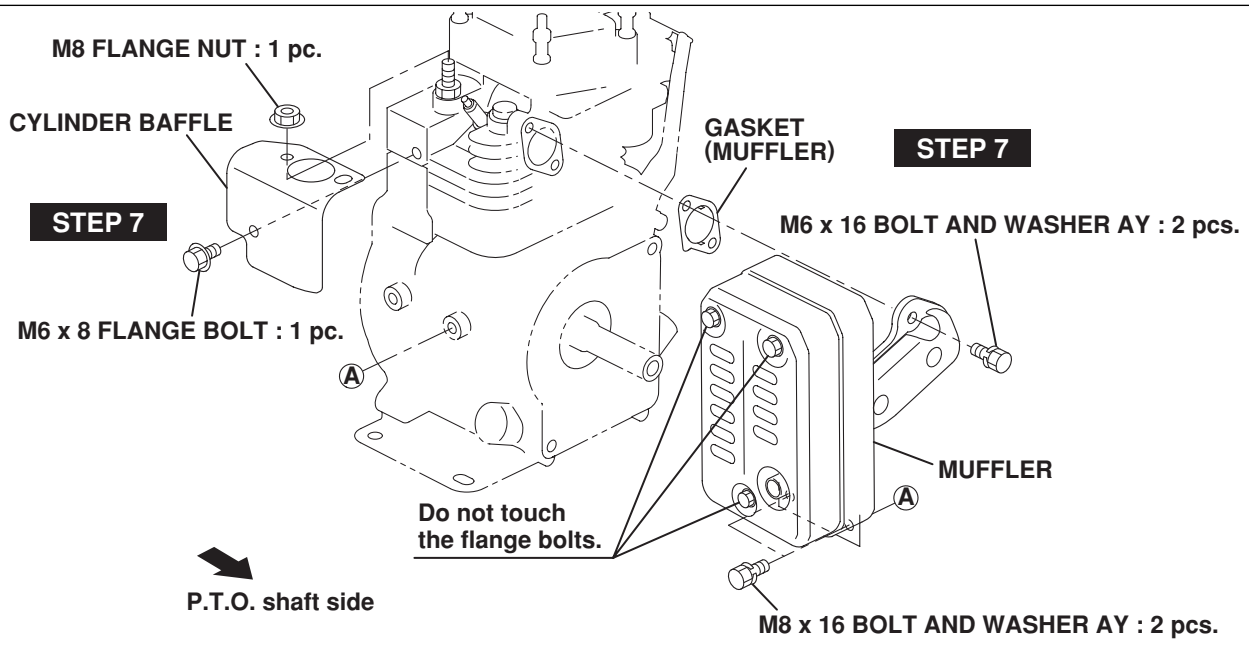


Step	Parts to remove	Remarks and procedures	Fasteners
4	Fuel tank	(1) Close the fuel cock. (2) Disconnect fuel pipe between carburetor and fuel cock from carburetor. (3) Remove the fuel tank from the fuel tank bracket.	M6 x 12 : 4 pcs. 10 mm box spanner
5	Fuel tank bracket Fuel tank bracket 2	(1) Remove the fuel tank bracket from the cylinder head and fuel tank bracket 2. (2) Remove the fuel tank bracket 2.	M6 flange nut : 4 pcs. M6 x 12 : 2 pcs. M8 flange nut : 1 pc. M8 washer : 1 pc. 10·12 mm spanner·box wrench

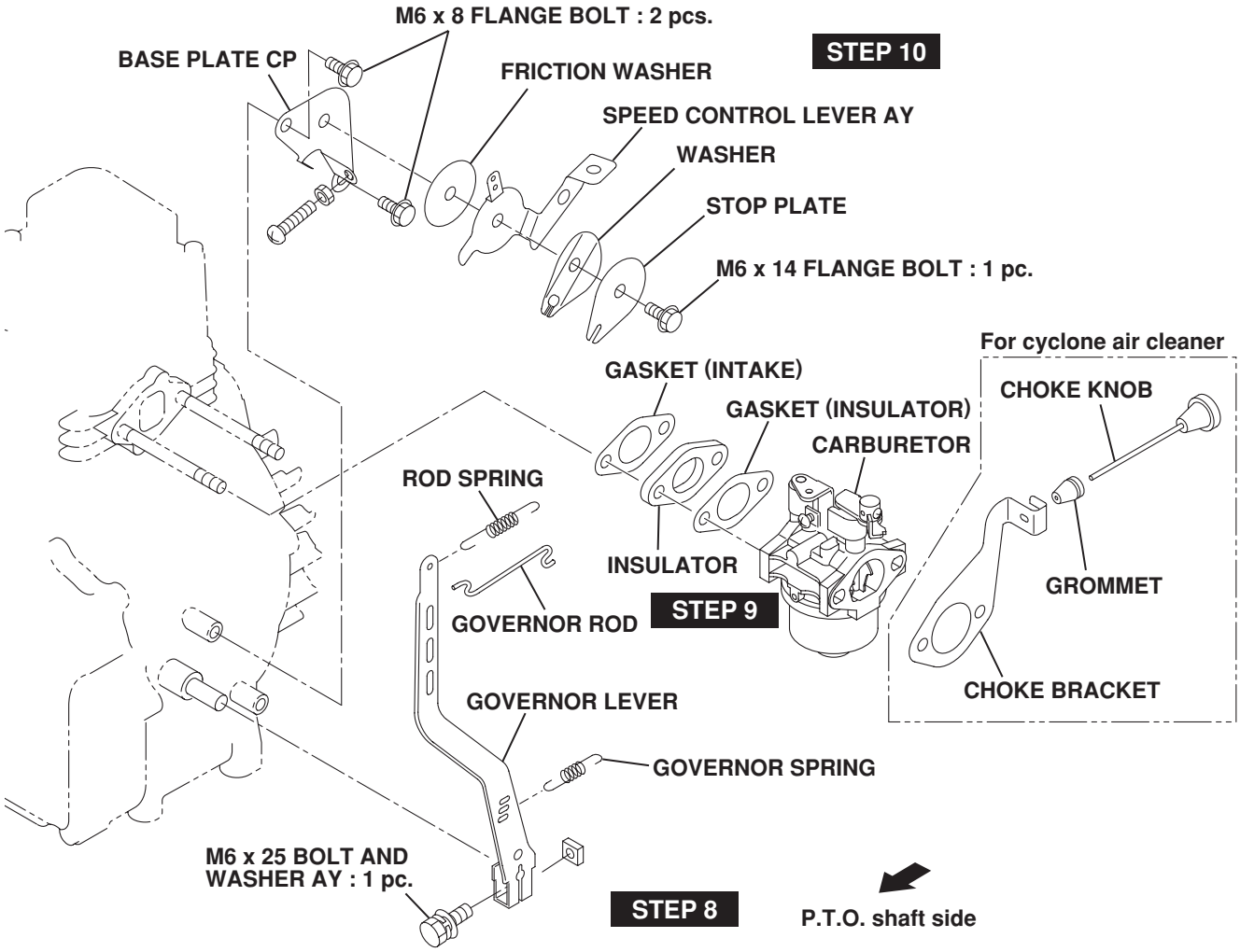


Step	Parts to remove	Remarks and procedures	Fasteners
6	Air cleaner	(1) Detach cleaner cover, and take out element and retainer. (2) Remove breather pipe from cleaner case and breather cover. (3) Remove cleaner case. Be careful not to lose air cleaner gasket.	M6 flange nut : 2 pcs. 10 mm box wrench
7	Muffler and cylinder baffle	Remove spark plug cap first from spark plug, muffler and cylinder baffle. Be careful not to lose muffler gasket.	M8 bolt and washer : 2 pcs. M6 x 16 : 2 pcs. M8 flange nut : 1 pc. M6 x 8 : 1 pc. 10·12 mm spanner·box wrench

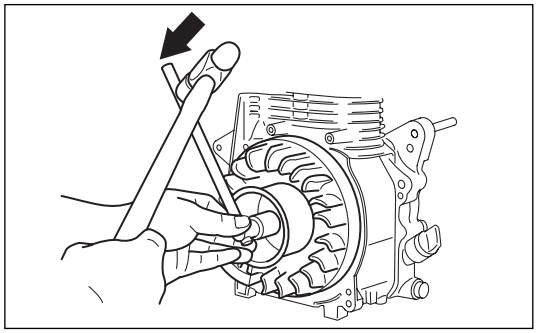


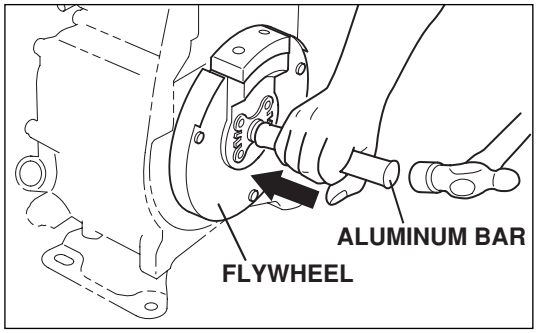


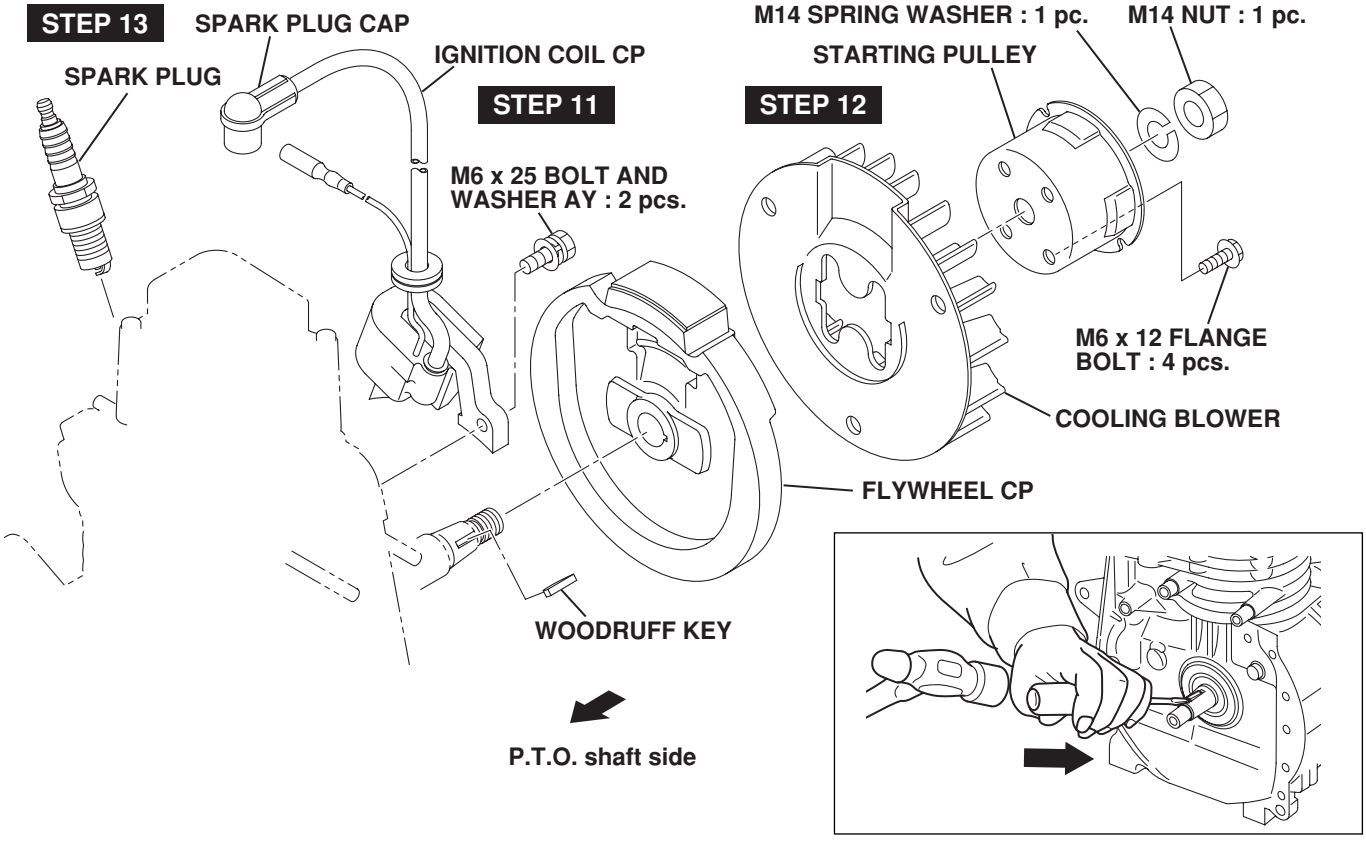
Step	Parts to remove	Remarks and procedures	Fasteners
8	Governor lever	(1) Loosen the bolt and remove governor lever. (2) Unhook governor spring from governor lever. Mark the hole on which the governor spring is hooked.	M6 x 25 : 1 pc. 10 mm box spanner
9	Carburetor	(1) Disconnect choke knob from carburetor choke lever, and remove choke bracket. (Only for cyclone air cleaner) (2) Remove carburetor carefully unhooking governor rod and rod spring from governor lever.	
10	Speed control lever and base plate		M6 x 8 : 2 pcs. M6 x 14 : 1 pc. 10 mm box spanner



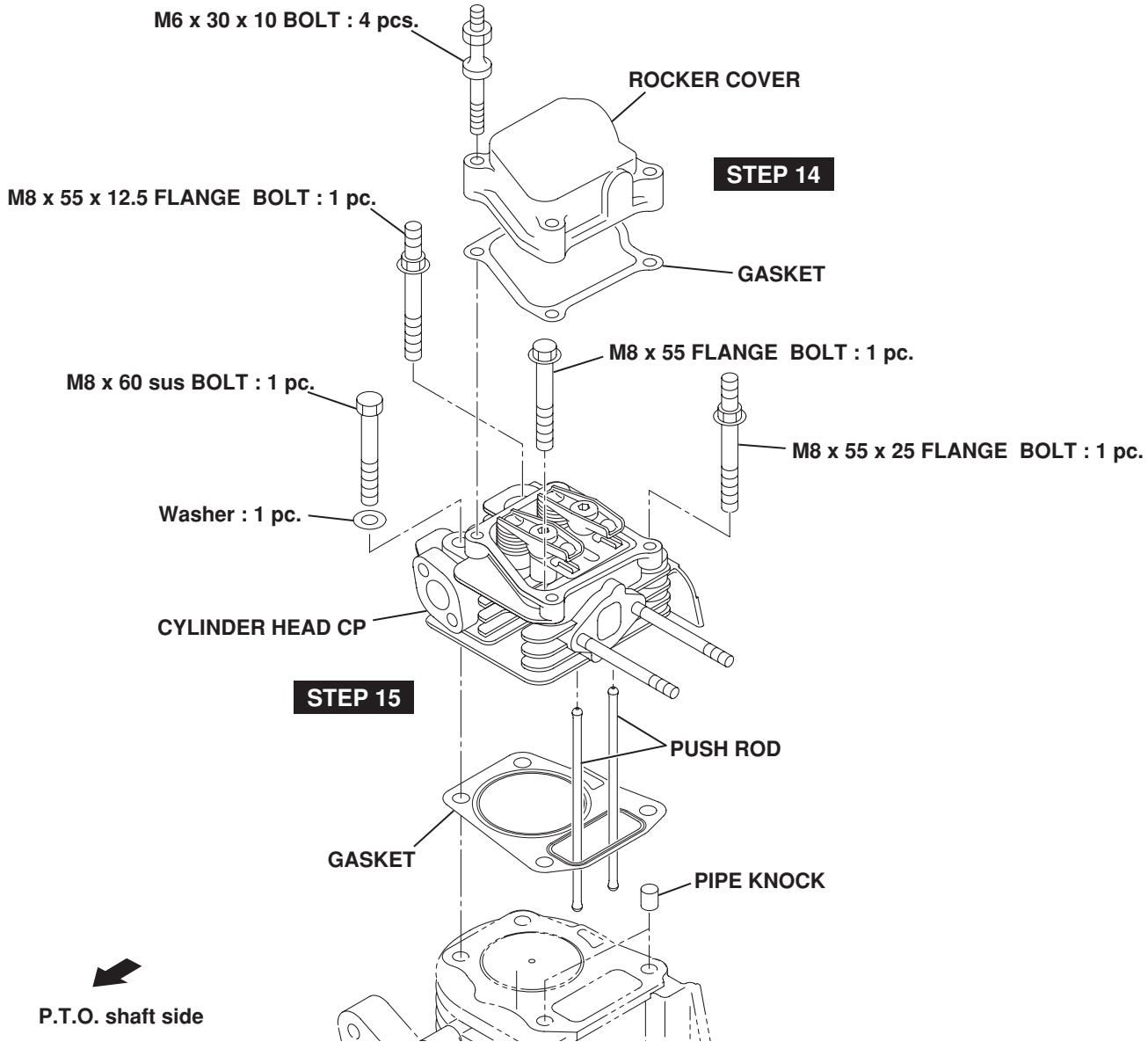
Step	Parts to remove	Remarks and procedures	Fasteners
11	Ignition coil	Remove ignition coil from crankcase.	M6 x 25 : 2 pcs. 10 mm box spanner
12	Flywheel	(1) Remove the starter pulley from flywheel. Place socket wrench on flywheel fastening nut and strike tip of the lever with hammer. (2) Remove the cooling blower. (3) Tap on flywheel end of crankshaft using aluminum bar to remove flywheel. (4) Remove the key from crankshaft.	M14 nut, springwasher : 1 pc. M6 x 12 : 4 pcs. 19 mm socket wrench 10 mm box spanner
13	Spark plug	Remove spark plug from cylinder head.	19 mm plug wrench



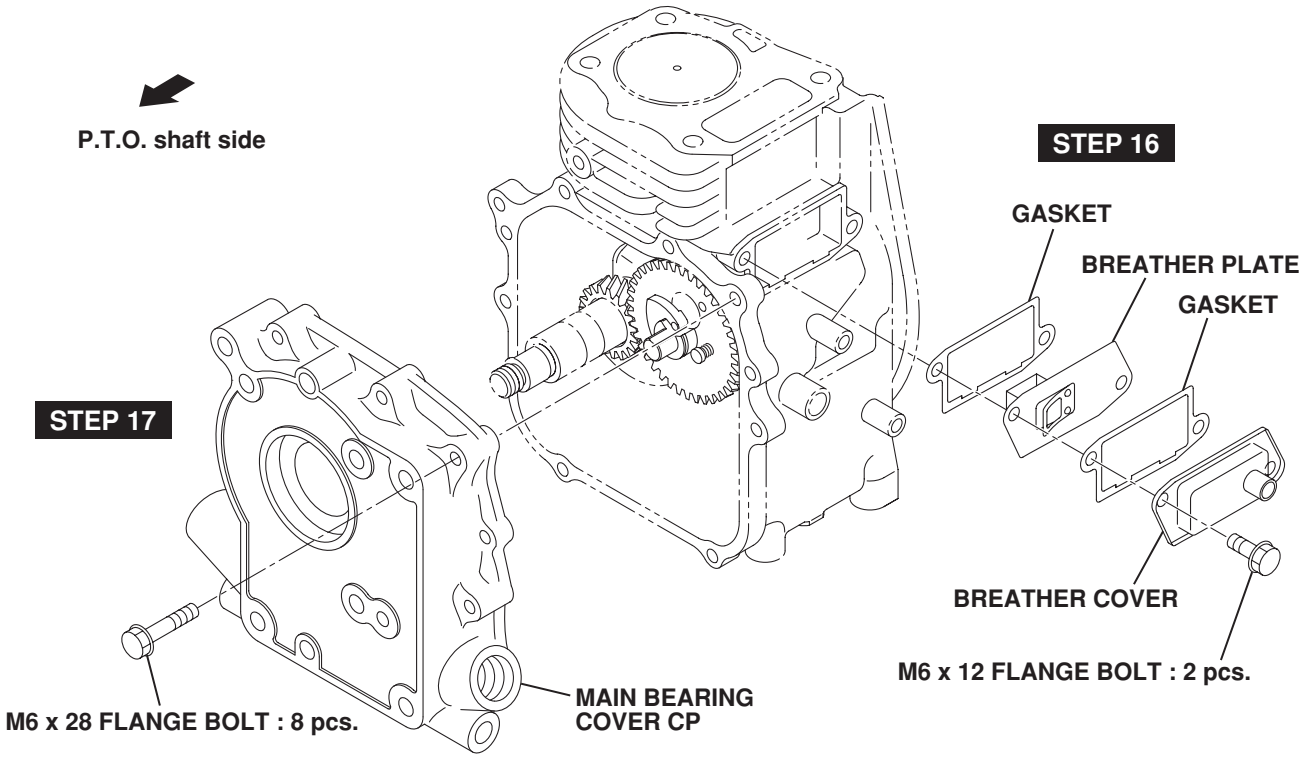


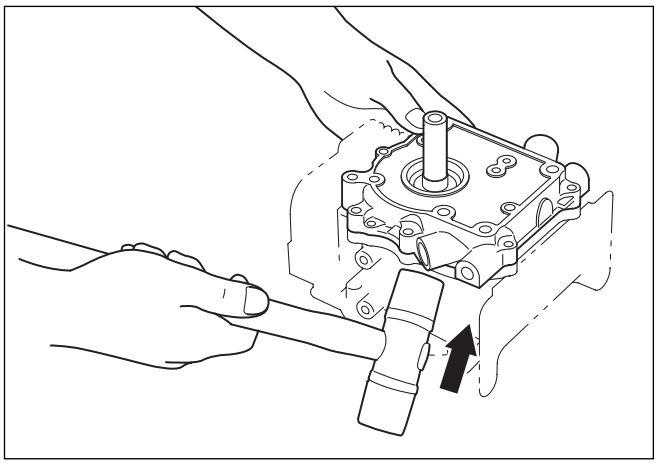


Step	Parts to remove	Remarks and procedures	Fasteners
14	Rocker cover	Remove rocker cover and gasket from cylinder head.	M6 x 30x 10 : 4 pcs. 10 mm box spanner
15	Cylinder head	(1) Remove cylinder head and gasket from crankcase. (2) Remove push rods from cylinder.	M8 x 60 : 1 pcs. M8 x 55 : 1 pcs. M8 x 55x 25 : 1 pc. M8 x 55x 12.5 : 1 pc. Washer : 1 pc. 10·12·13 mm box spanner·box wrench

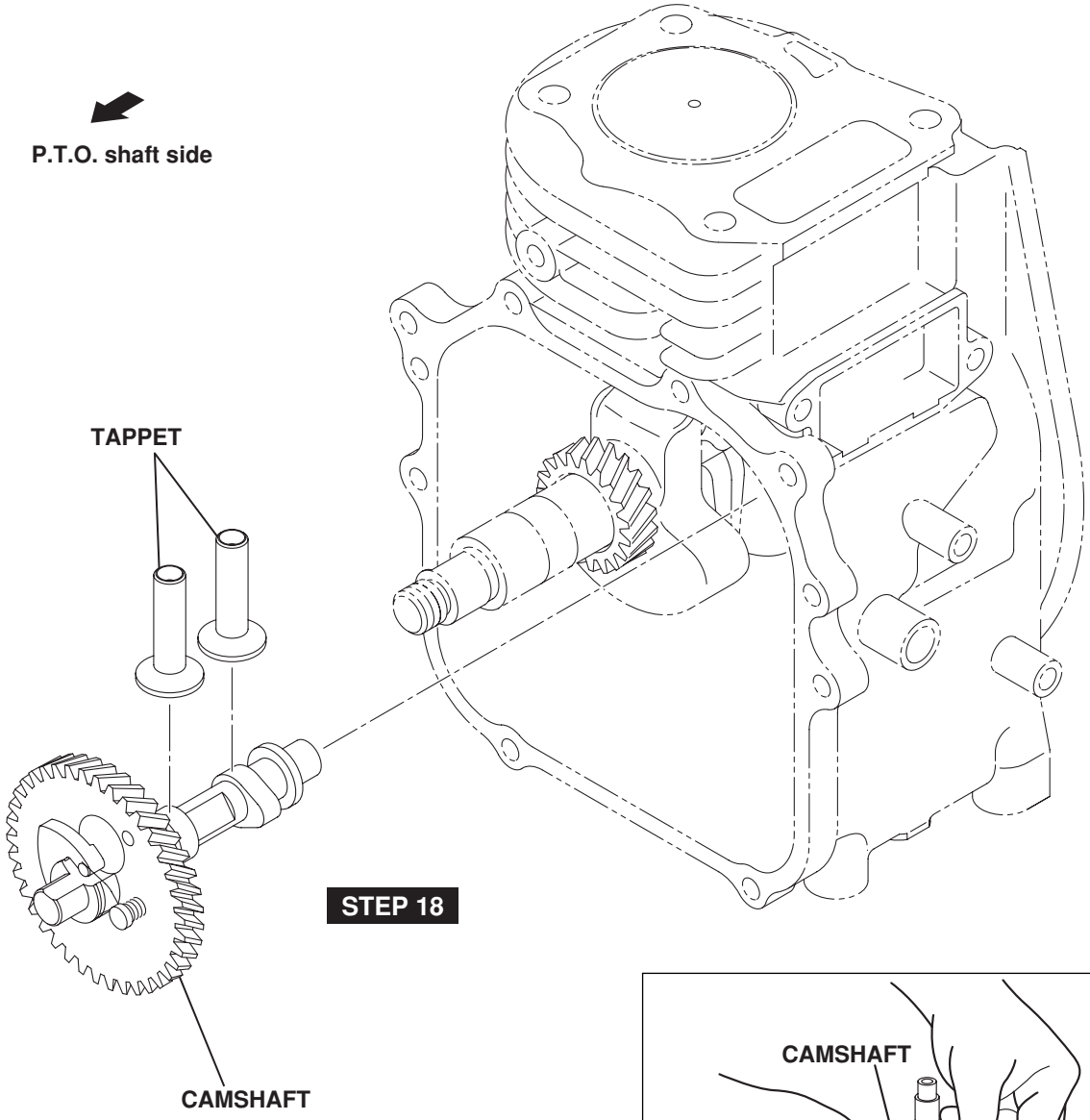


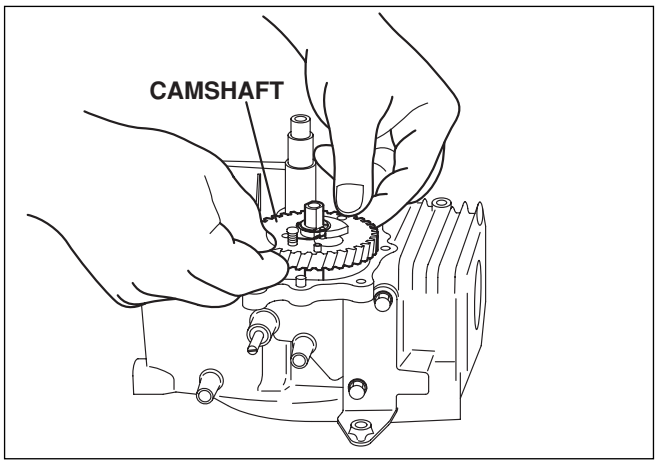
Step	Parts to remove	Remarks and procedures	Fasteners
16	Breather	Remove breather cover, breather plate, and gasket from crankcase.	M6 x 12 : 2 pcs. 10 mm box spanner
17	Main bearing cover	Be careful not to damage the oil seal. Use a soft hammer and evenly tap around outer surface of cover.	M6 x 28 : 8 pcs. soft hammer 10 mm box spanner



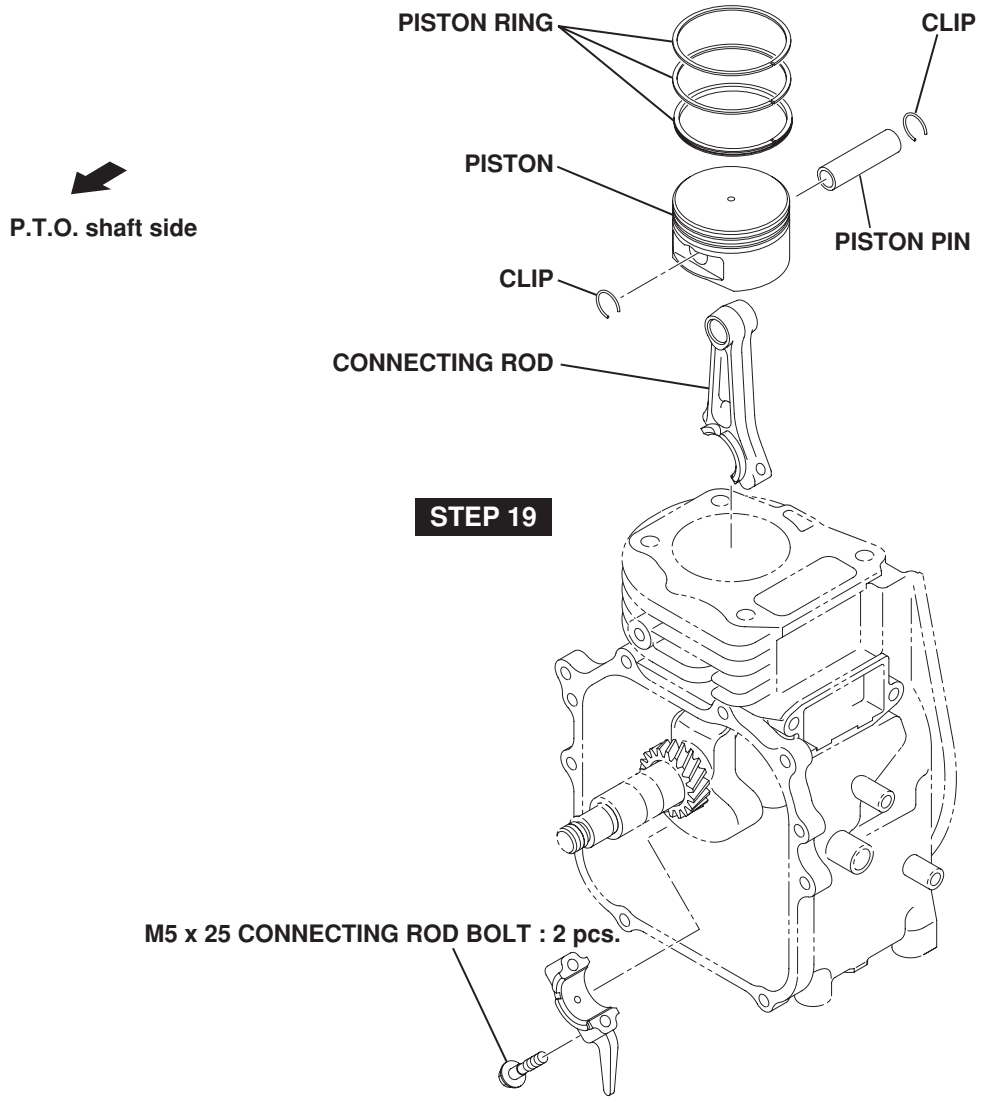


Step	Parts to remove	Remarks and procedures	Fasteners
18	Camshaft and tappets	Lay carnkcase on the flywheel side push tappets up into the block and remove camshaft. Be careful not to damage camshaft and tappets.	

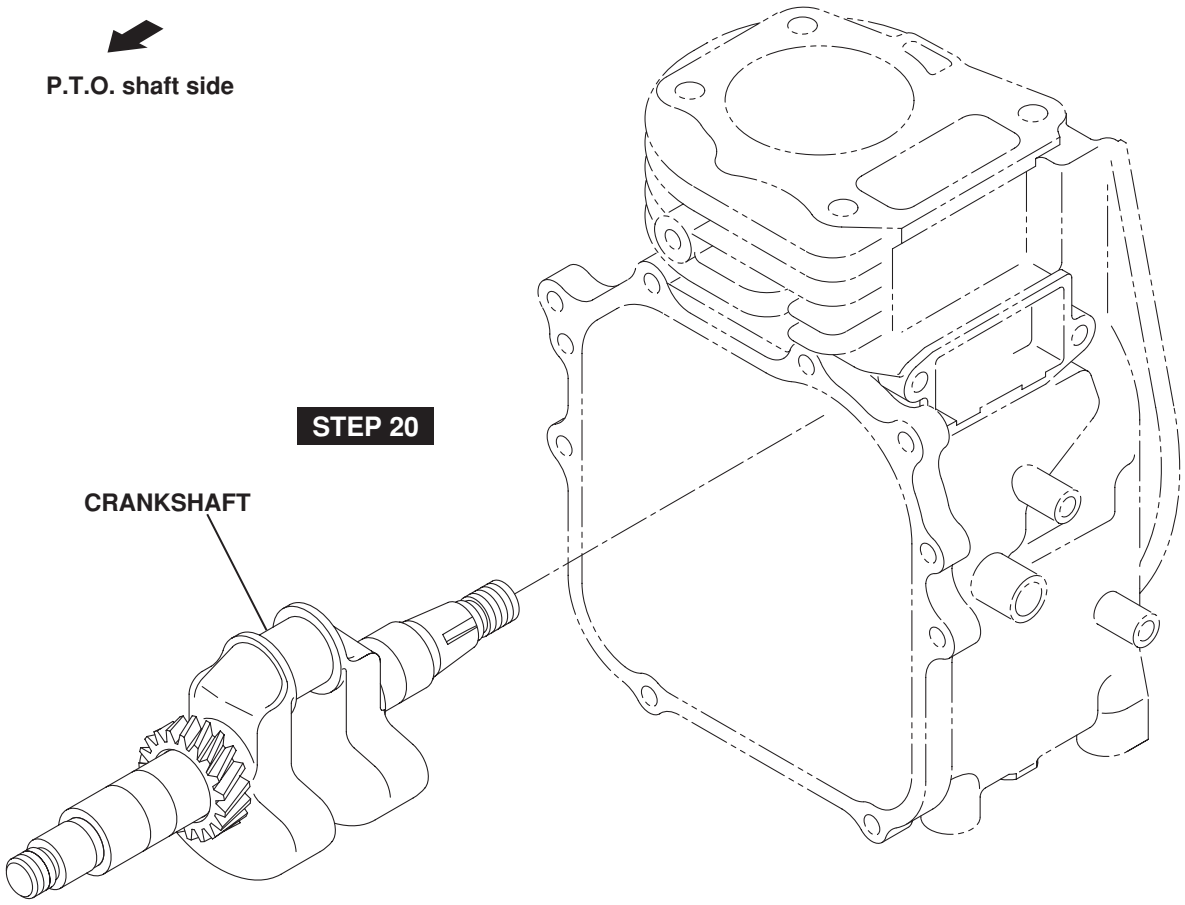


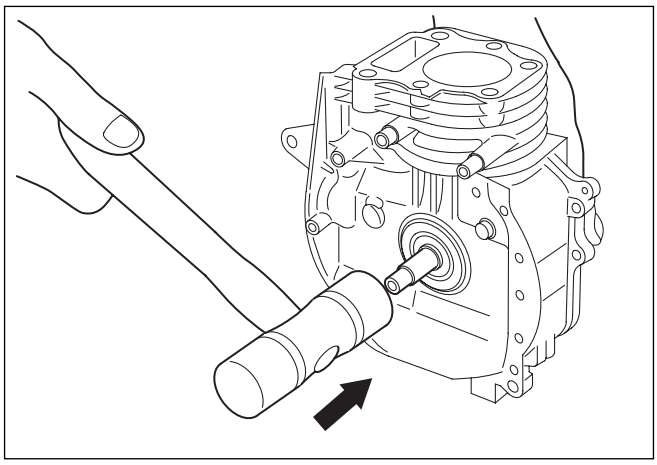


Step	Parts to remove	Remarks and procedures	Fasteners
19	Connecting rod and piston	(1) Remove connecting rod bolts and connecting rod cap. (2) Turn crankshaft until piston comes to top dead center, push out connecting rod and piston assembly through top of cylinder. * Scrape off all carbon deposits that might interfere with removal of piston from upper end of cylinder.	M5 x 25 : 2 pcs. 8 mm box spanner
	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.	

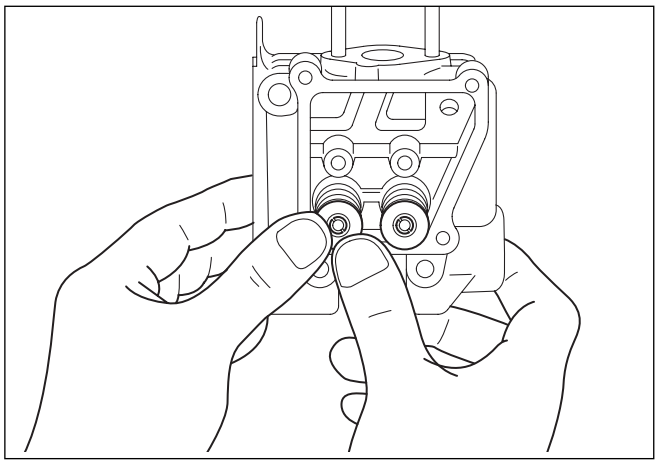


Step	Parts to remove	Remarks and procedures	Fasteners
20	Crankshaft	Tap lightly on flywheel end of crankshaft with a soft hammer to remove from crankcase. * Be careful not to damage oil seal.	soft hammer



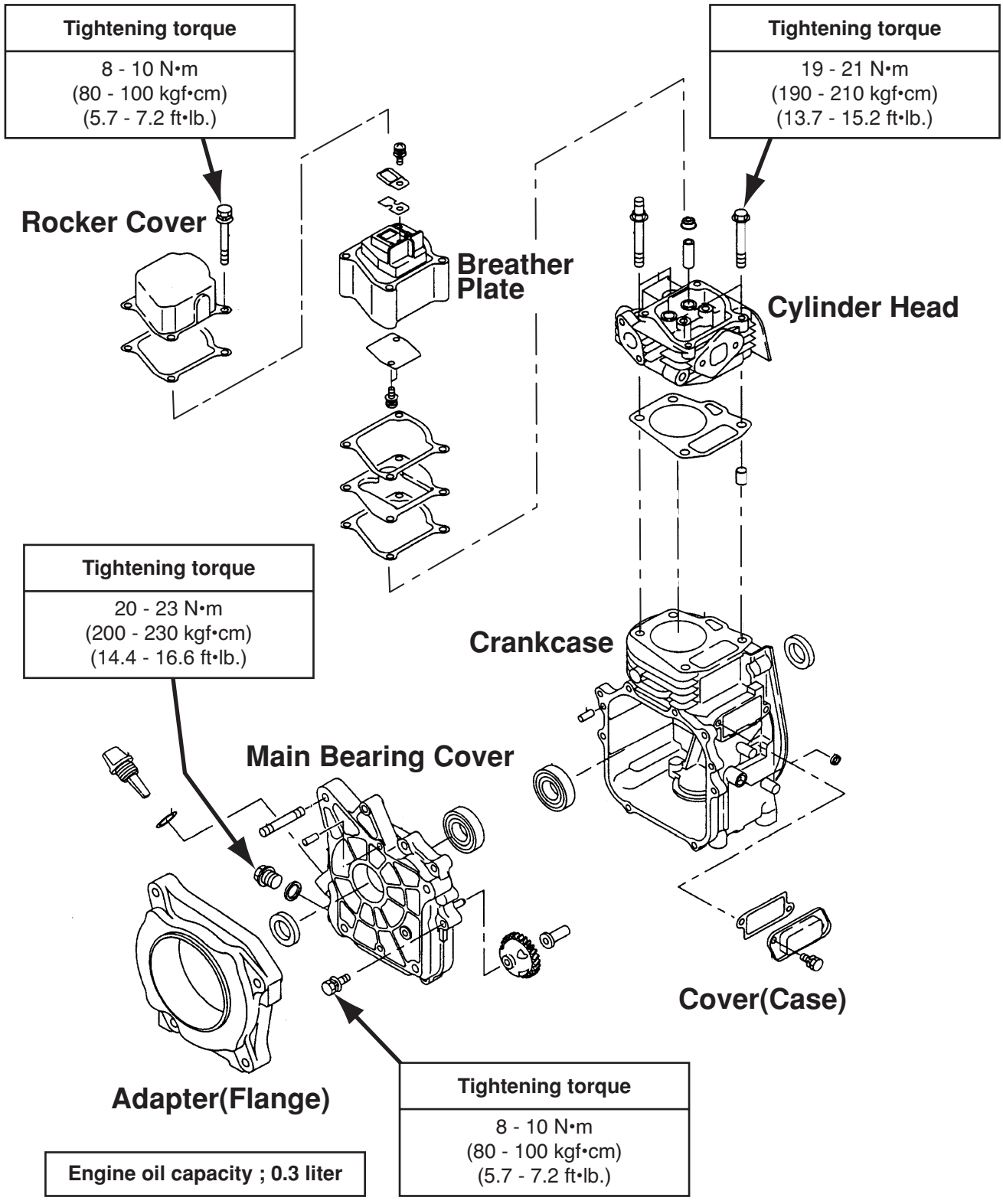


Step	Parts to remove	Remarks and procedures	Fasteners
21	Intake and exhaust valves	(1) Press down the spring retainer, take out collet valve, and then remove spring retainer and valve spring. (2) Remove intake and exhaust valves from cylinder head. * Clean carbon and gum deposit from the valves, valve seats, ports and guides. Inspect valves, valve seats and guides.	10 mm spanner Hexagon wrench

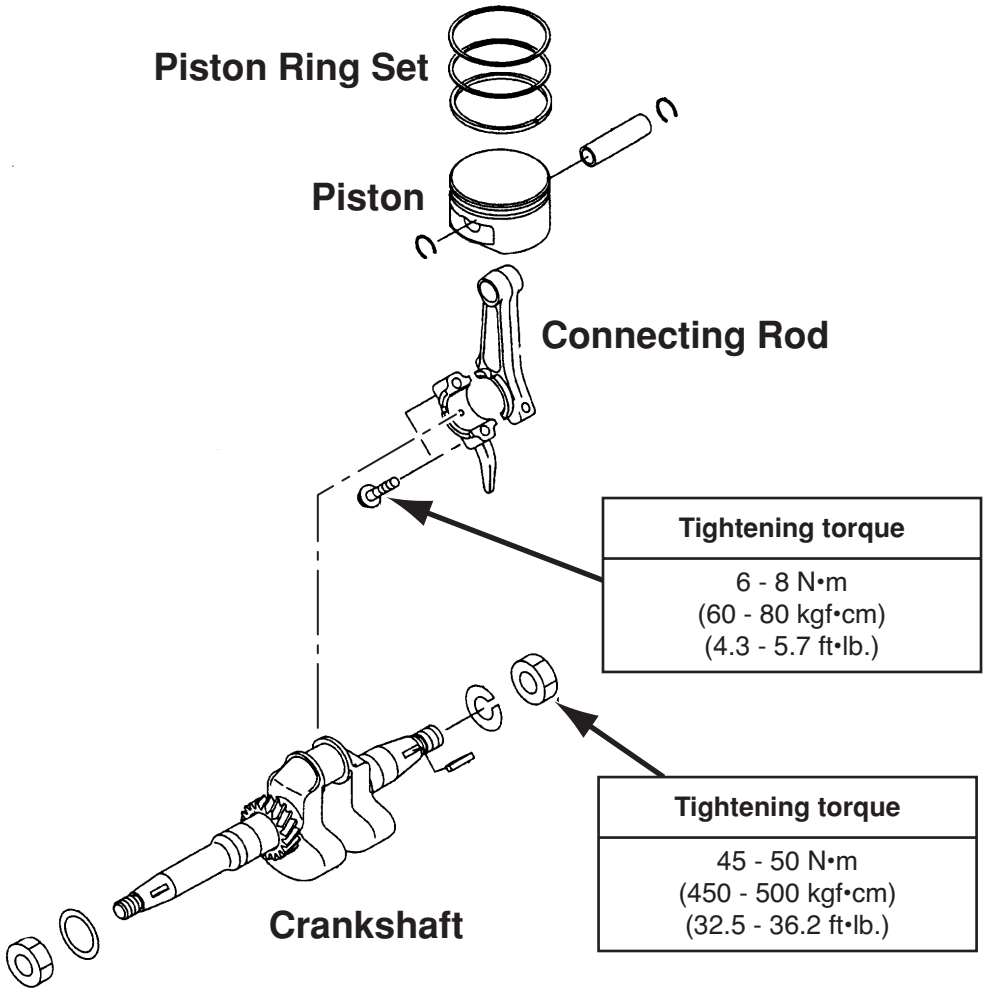


2-2 TIGHTENING TORQUE CHART

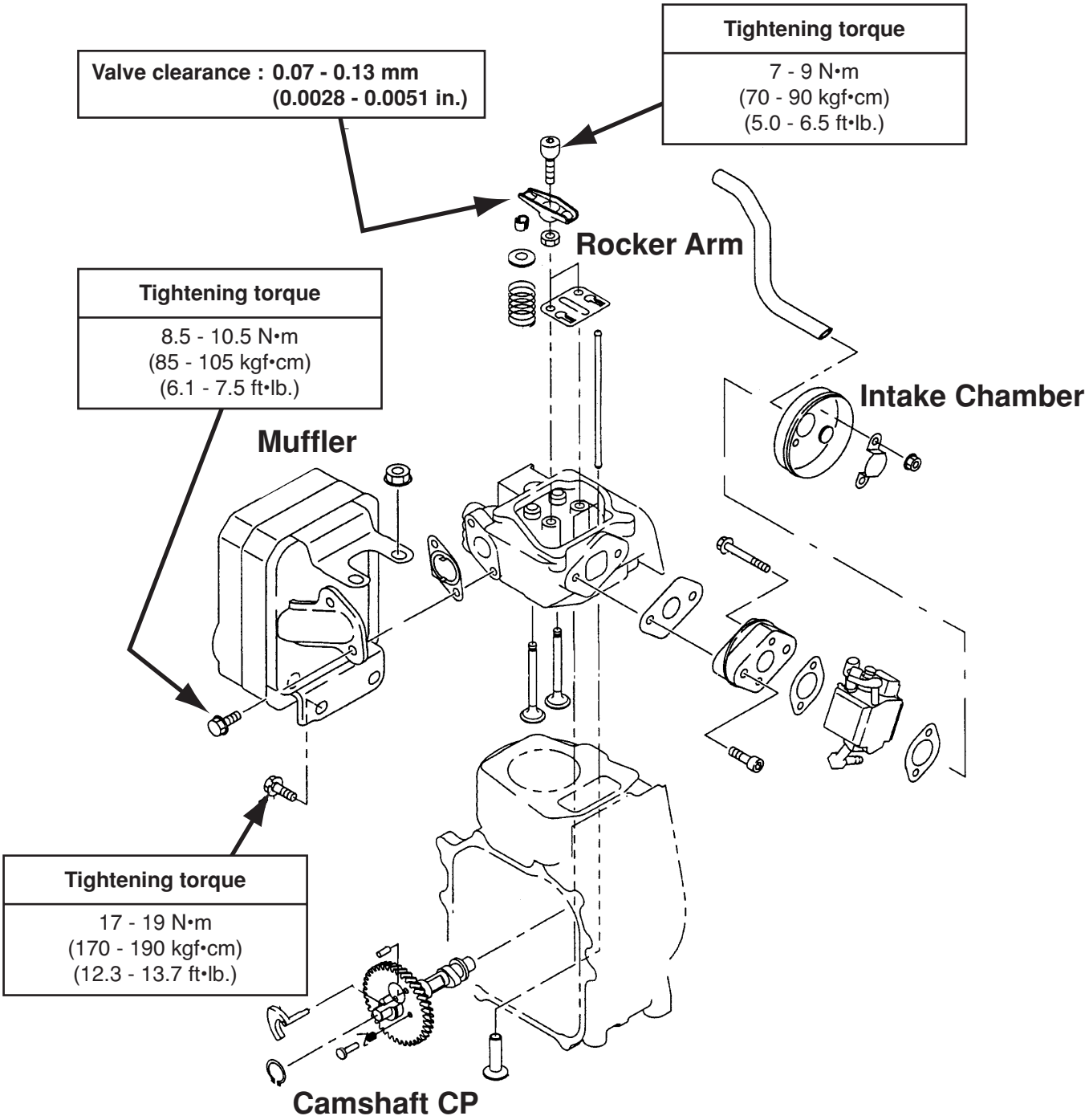
● CRANKCASE



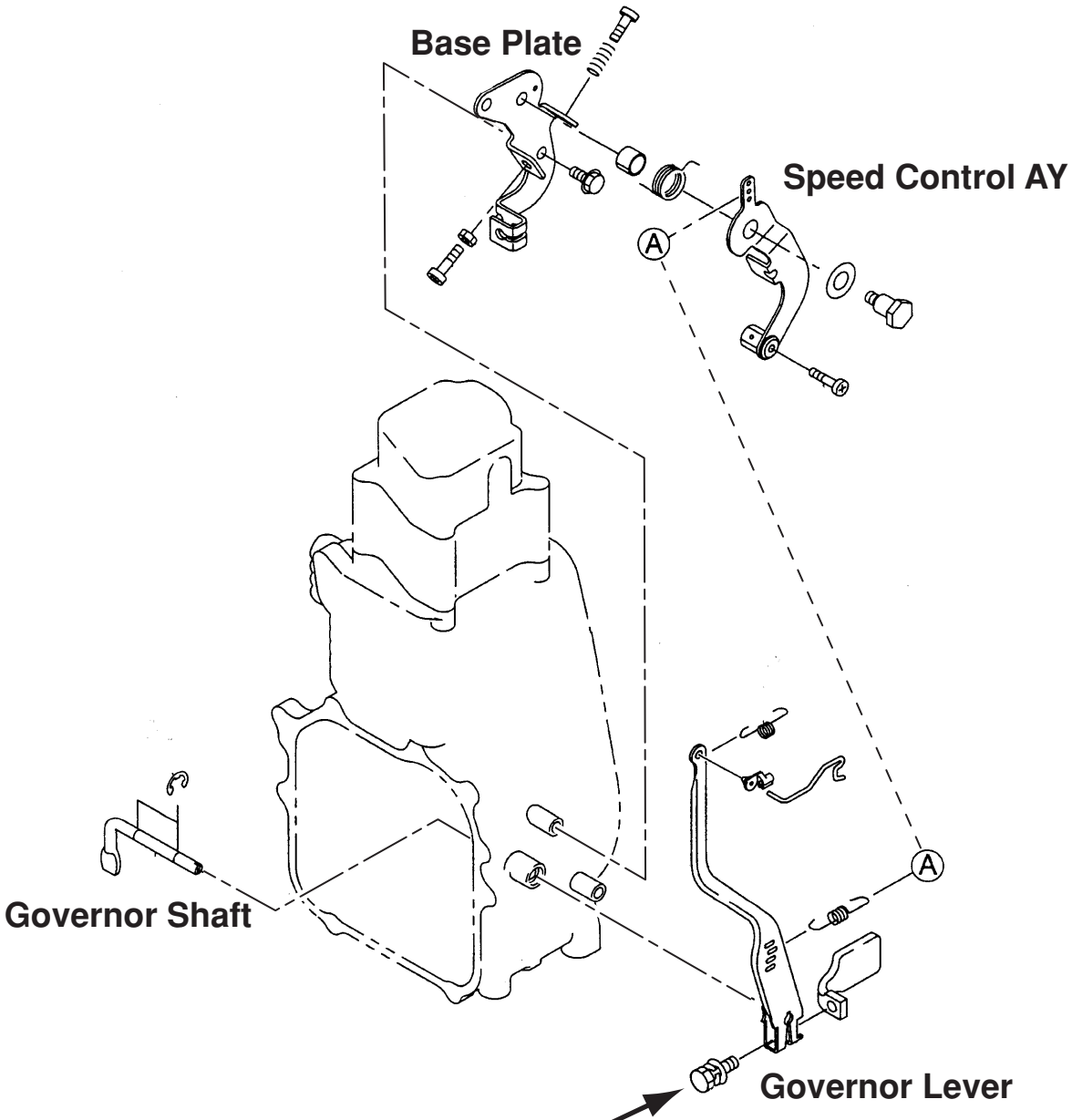
● CRANKSHAFT, PISTON



● INTAKE, EXHAUST

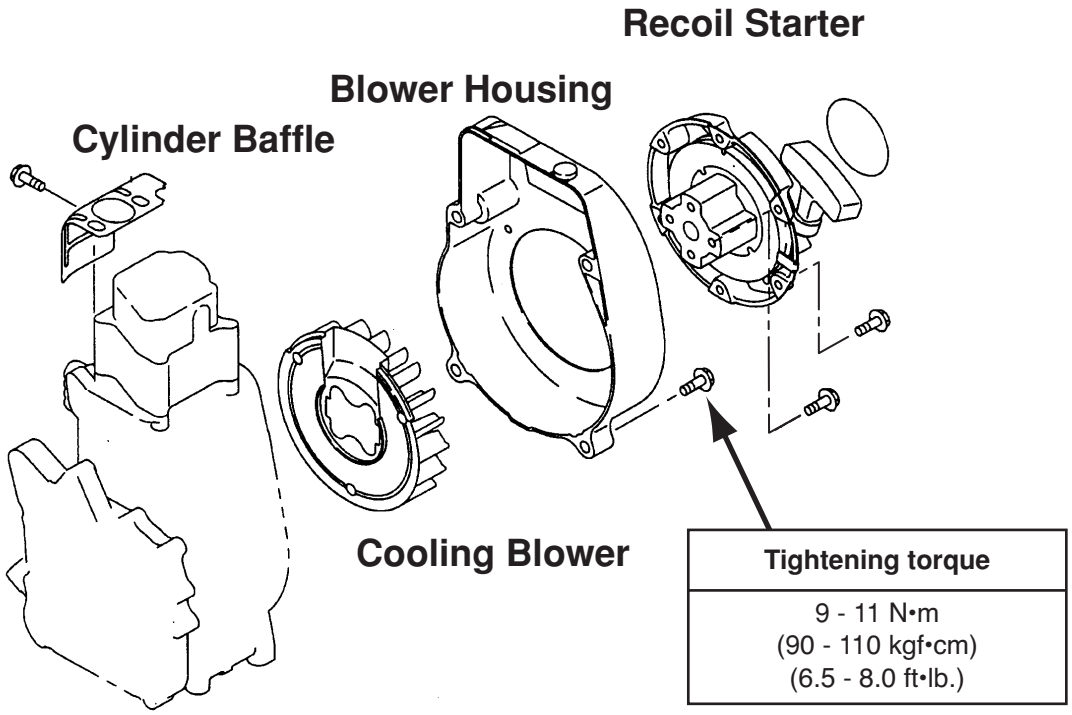


● GOVERNOR, SPEED CONTROL



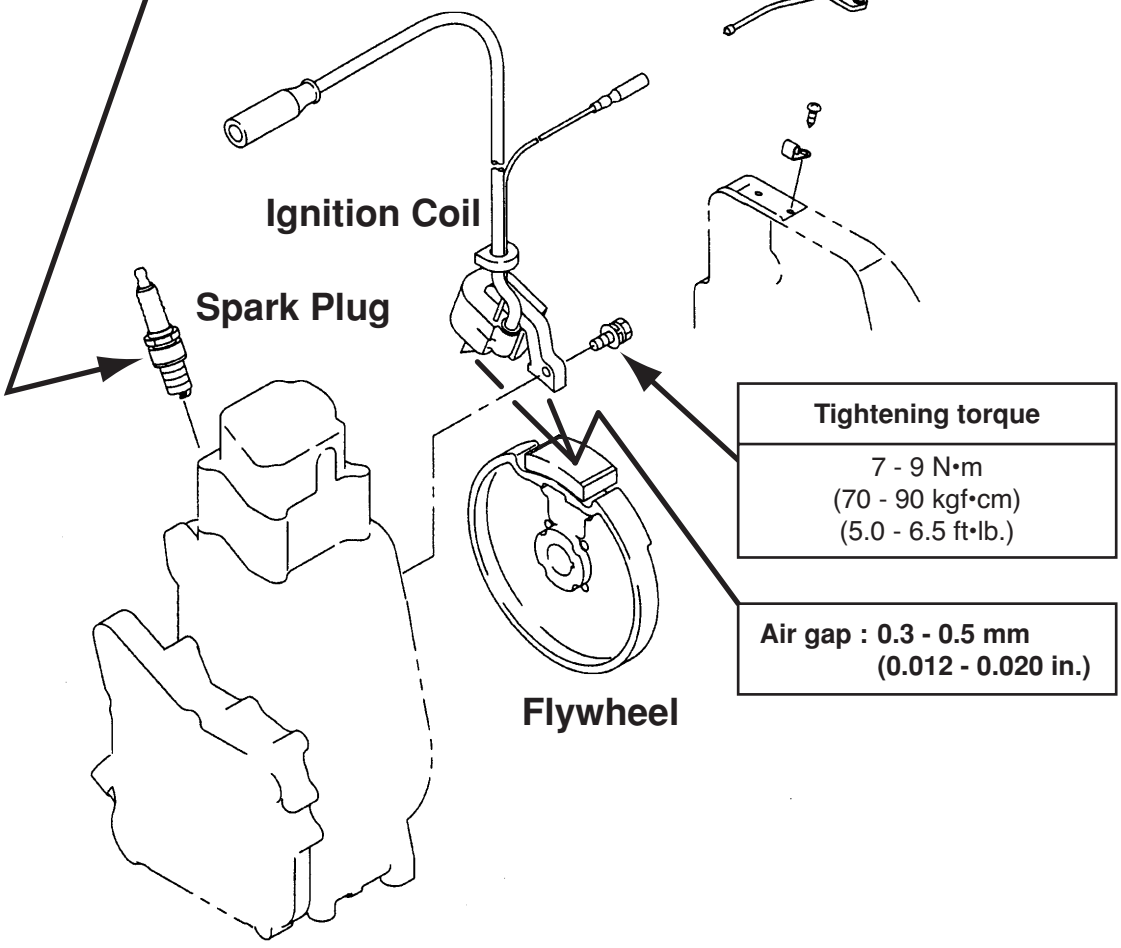
Tightening torque
7 - 9 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

● COOLING, STARTING



● ELECTRIC DEVICE

Tightening torque	
New spark plug	**Retightening**
12 - 15 N•m (120 - 150 kgf•cm) (8.7 - 10.9 ft•lb.)	23 - 25 N•m (230 - 250 kgf•cm) (16.6 - 18.1 ft•lb.)



Tightening torque
7 - 9 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

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

Recommended Spark Plug ; BMR4A(NGK)
Electrode Gap ; 0.6 to 0.7 mm

2-3 REASSEMBLY PROCEDURES

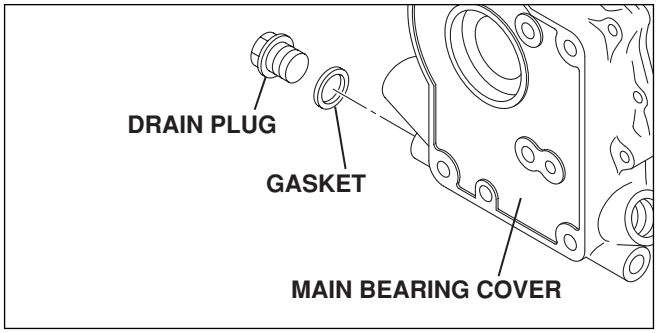
● PRECAUTIONS FOR REASSEMBLY

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 44).
7) Apply oil to rotating and sliding portions.
8) Check and adjust clearances and end plays where specified in this manual.
9) When mounting any major parts during reassembly of the engine, rotate it with your hand to check for any jamming or abnormal noise.

2-3-1 MAIN BEARING COVER

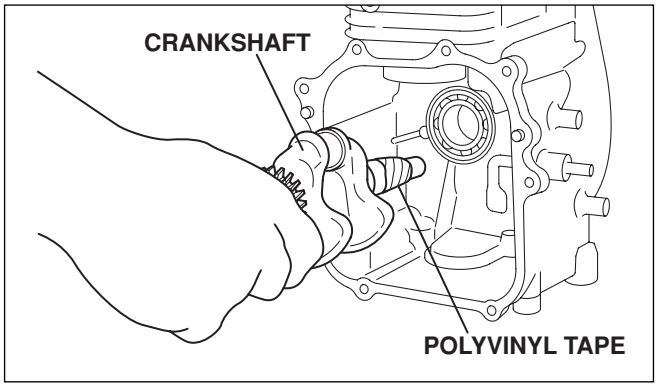
Install drain plug and gasket to main bearing cover.

Tightening torque
20 - 23 N•m (200 - 230 kgf•cm) (14.4 - 16.6 ft•lb.)



2-3-2 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.

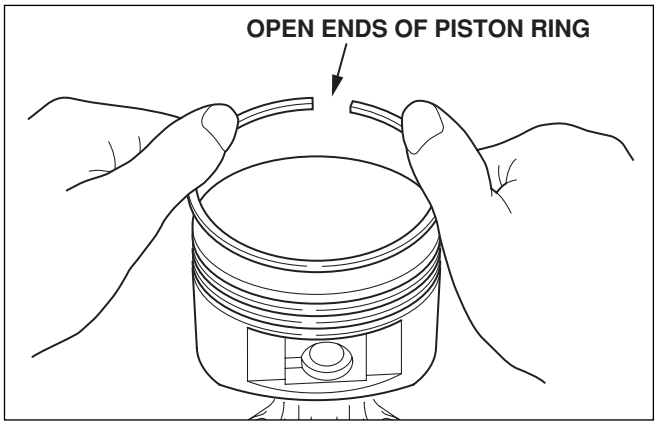


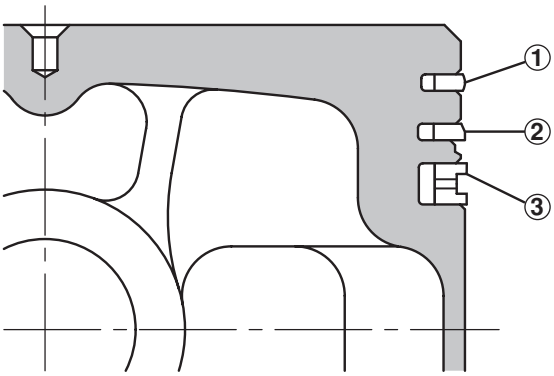
2-3-3 PISTON AND PISTON RINGS

Install oil ring first, then second ring and top ring.

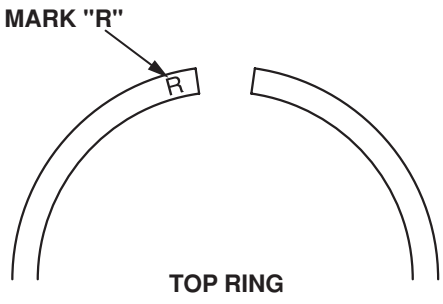
Spread ring only far enough to slip over piston and into correct groove. Use care not to distort ring.

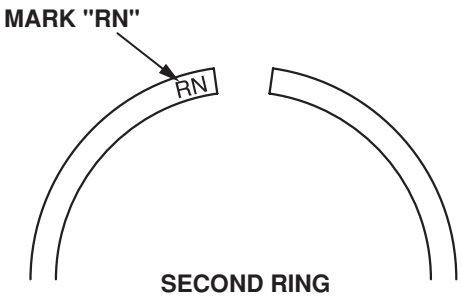
Install top and second ring with punched mark beside the gap face upward





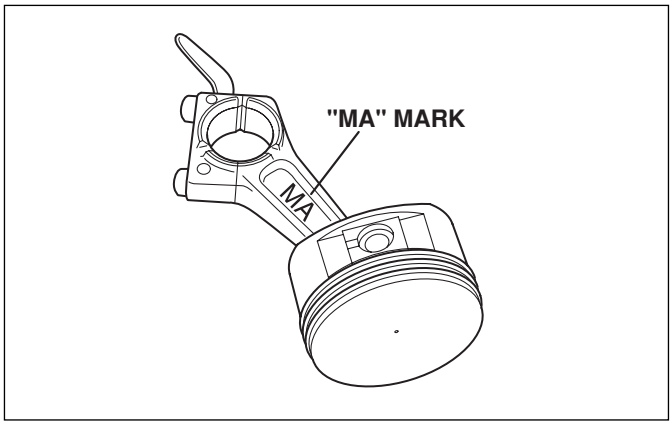
①	TOP RING	BARREL
②	SECOND RING	TAPER
③	OIL RING	THREE - PIECE CUTTER RING





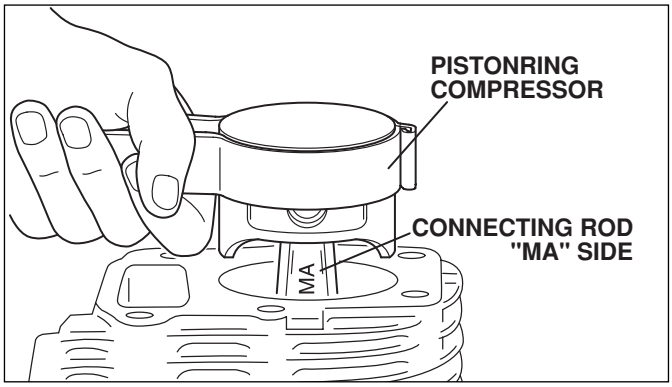
2-3-4 PISTON AND CONNECTING ROD

(1) The direction of piston on connecting rod is not specified.

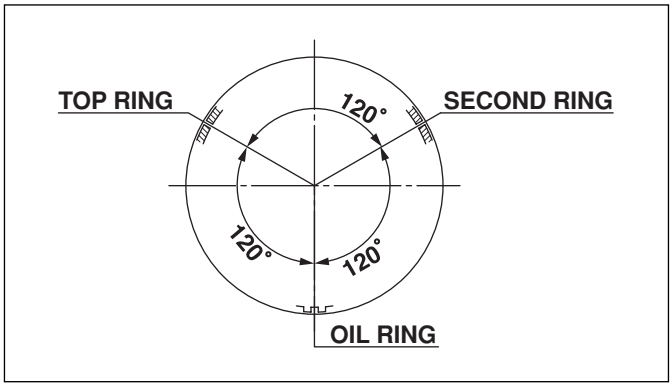


(2) Apply oil to the small end of connecting rod, piston and piston pin before assembling.
Be sure to use clips on the both side of the piston pin to secure piston pin in position.

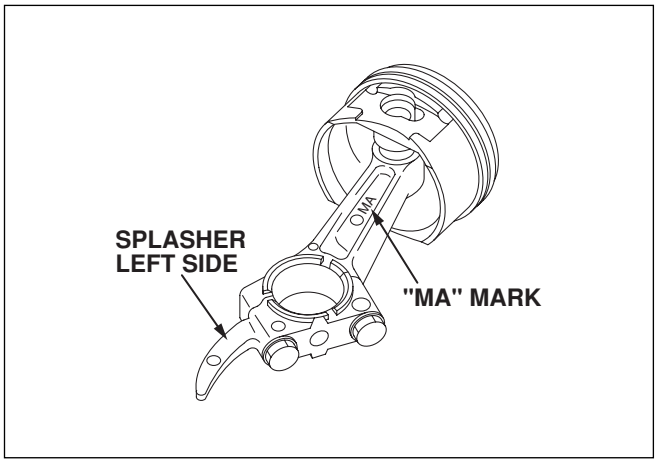
(3) Install piston and connecting rod assembly into cylinder.
Use a piston ring compressor to hold piston rings.
The “MA” mark of the connecting rod is to face the flywheel side of the engine when assembled.



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 120 degrees apart from each other before assembly.



2-3-5 CONNECTING ROD



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

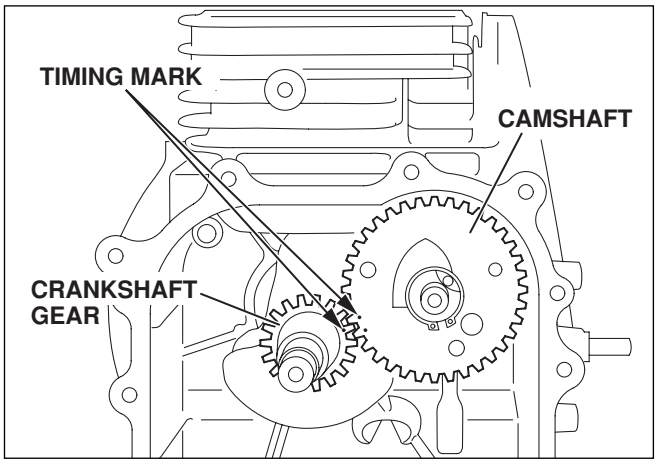
(2) Install connecting rod cap to connecting rod.
Attach connecting rod cap to connecting rod so that the "MA" marking is faced upwards and the splasher is located on the left-hand side.
Torque connecting rod bolts to specification.

M5 x 25 mm connecting rod bolt : 2 pcs.

Tightening torque
6 - 8 N•m (60 - 80 kgf•cm) (4.3 - 5.7 ft•lb.)

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

2-3-6 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.

(3) Align the timing mark on crankshaft gear with the timing mark on camshaft and install camshaft in the crankcase.

CAUTION:
Incorrect valve timing will cause malfunction of the engine.

2-3-7 MAIN BEARING COVER

(1) ADJUST CRANKSHAFT END PLAY

Adjust end play to 0.2 mm (0.008 in.) using the proper spacer.

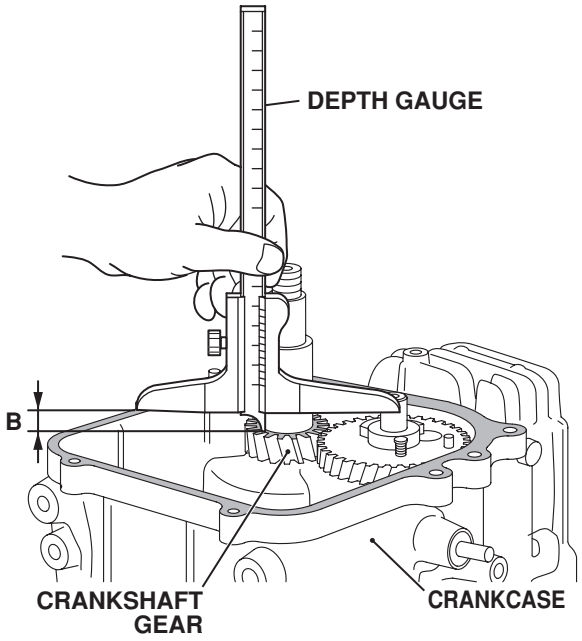
The proper spacer may be determined in the following manner.

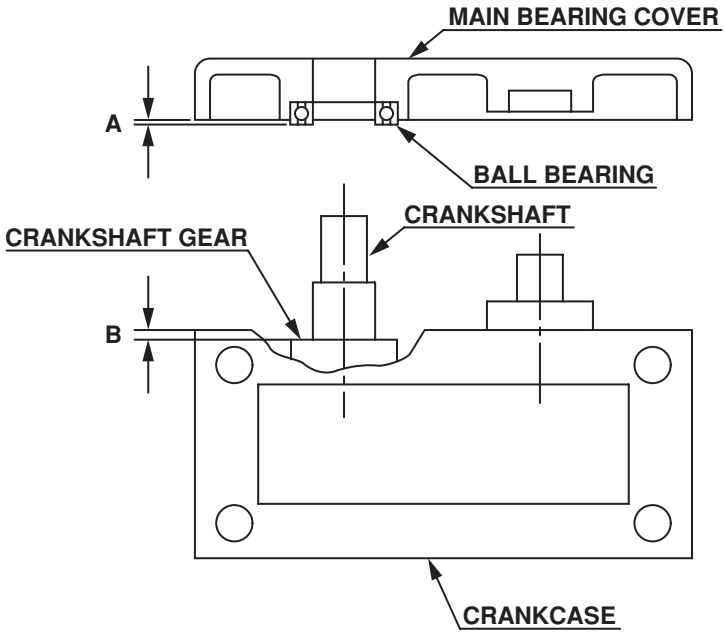
1) Measure the height "A" (From the mating surface to the inner race of the ball bearing.)
2) Measure the depth "B" (From the mating surface to the crank gear.)
   B – A = SIDE CLEARANCE (mm)
   (SIDE CLEARANCE) – 0.2 mm = THICKNESS OF CRANKSHAFT SHIM (mm)

   B – A = SIDE CLEARANCE (in.)
   (SIDE CLEARANCE) – 0.008 in. = THICKNESS OF CRANKSHAFT SHIM (in.)

Following are available spacer shims.

	CRANKSHAFT
SPACER SHIMS	T = 0.8 mm (0.031 in.) T = 1.0 mm (0.039 in.) T = 1.2 mm (0.047 in.)





(2) MAIN BEARING COVER

Lubricate the oil seal and bearing surfaces.

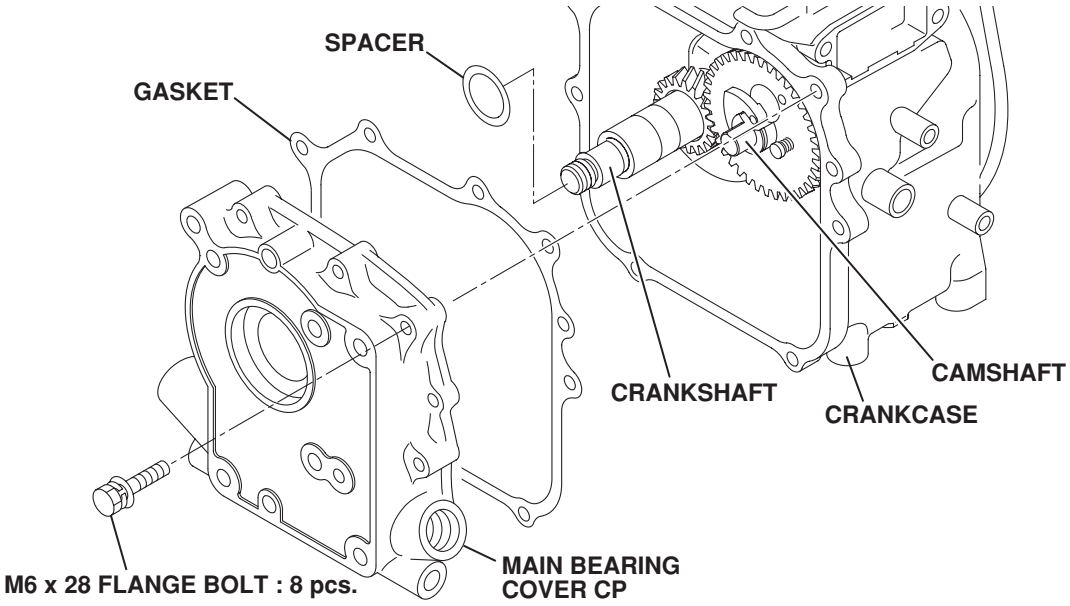
Place spacer chosen in STEP (1) on crankshaft.

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.

M6 x 28 mm Flange bolt : 8 pcs.

Tightening torque
8 - 10 N•m (80 - 100 kgf•cm) (5.7 - 7.2 ft•lb.)



2-3-8 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 60 mm sus bolt + washer : 1 pc.
M8 x 55 mm flange bolt : 1 pc.
M8 x 55 x 25 mm flange bolt : 1 pc.
M8 x 55 x 12.5 mm flange bolt : 1 pc.

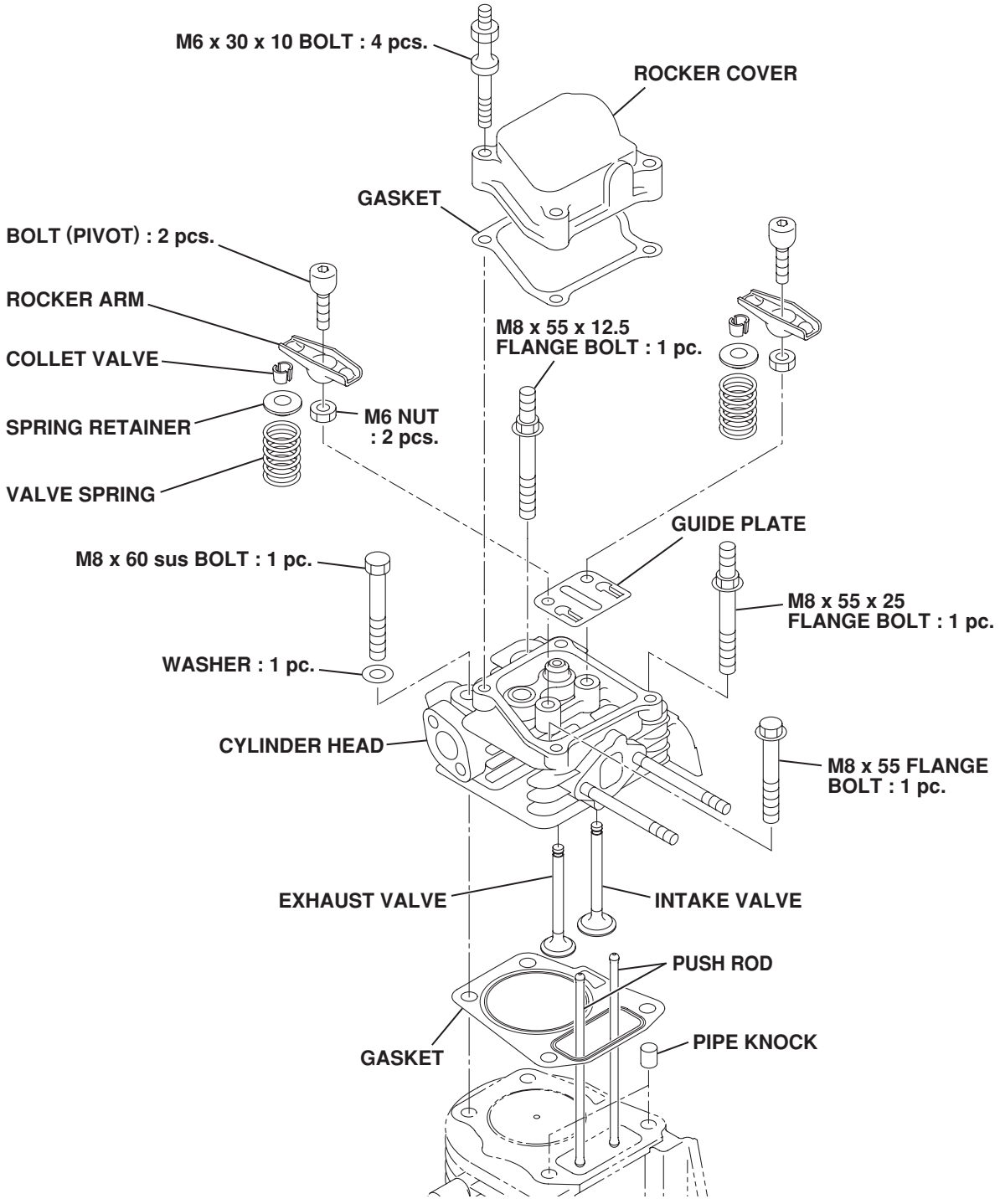
Tightening torque		
1 st step	**2 nd step**	**3 rd step**
5.0 N•m (50 kgf•cm) (3.6 ft•lb.)	10 N•m (100 kgf•cm) (7.2 ft•lb.)	19 - 21 N•m (190 - 210 kgf•cm) (13.7 - 15.2 ft•lb.)

2-3-9 ROCKER ARMS AND PUSH RODS

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

* 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.

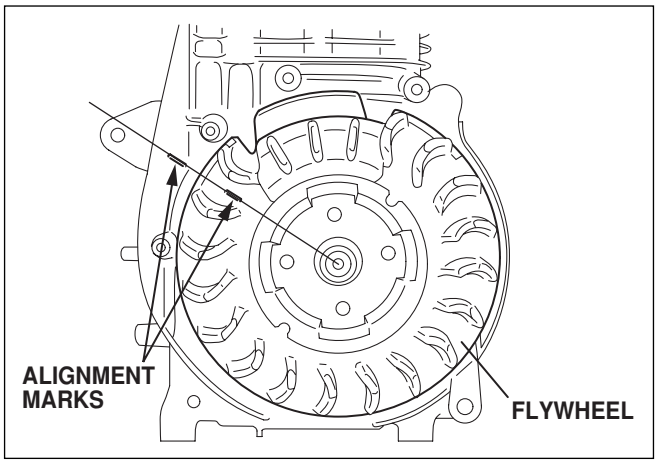
(2) Apply oil to rocker arms and assemble them to cylinder head using pivot bolt and nut.



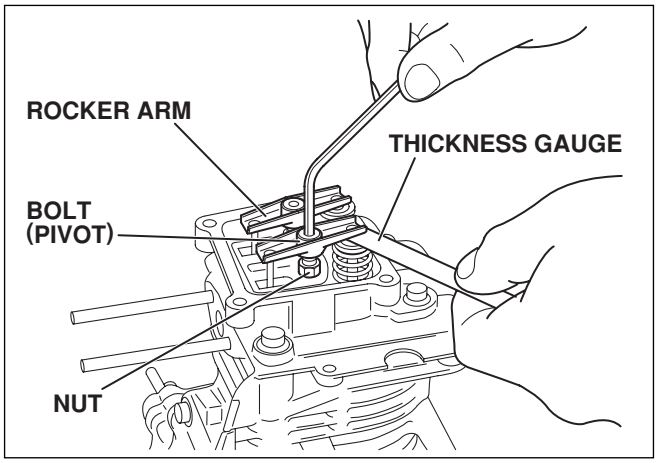
2-3-10 VALVE CLEARANCE ADJUSTMENT

Note:
Temporally fit the flywheel in position for easy operation.

(1) Position the piston at the top dead center of compression stroke by matching the alignment mark of cooling blower with the alignment mark of crankcase.



(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.



Tightening torque
7 - 9 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

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.
M6 x 30 x 10 mm bolt : 4 pcs.

Tightening torque
8 - 10 N•m (80 - 100 kgf•cm) (5.7 - 7.2 ft•lb.)

2-3-11 SPARK PLUG

Install spark plug to cylinder head.

Spark plug : NGK BMR4A

(CHAMPION : RCJ14)

Tightening torque	
New spark plug	**Retightening**
12 - 15 N•m (120 - 150 kgf•cm) (8.7 - 10.9 ft•lb.)	23 - 25 N•m (230 - 250 kgf•cm) (16.6 - 18.1 ft•lb.)

2-3-12 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 cooling blower and starter pully to crank shaft.

M6 x 12 mm flange bolt : 4 pcs.

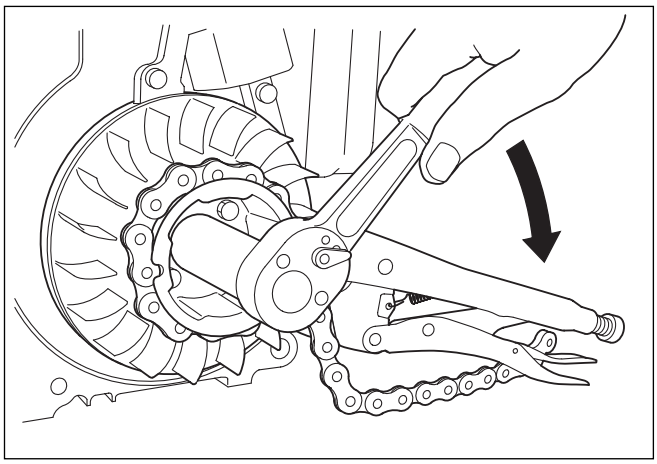
Tightening torque
4 - 6 N•m (40 - 60 kgf•cm) (2.8 - 4.3 ft•lb.)

Note:
Attach cooling blower to flywheel with three projections on flywheel adjusted to three holes on cooling blower.

(3) Tighten crankshaft nut with locking pliers adopted as shown in the illustration.

M14 nut : 1 pc.

Tightening torque
45 - 50 N•m (450 - 500 kgf•cm) (32.5 - 36.1 ft•lb.)



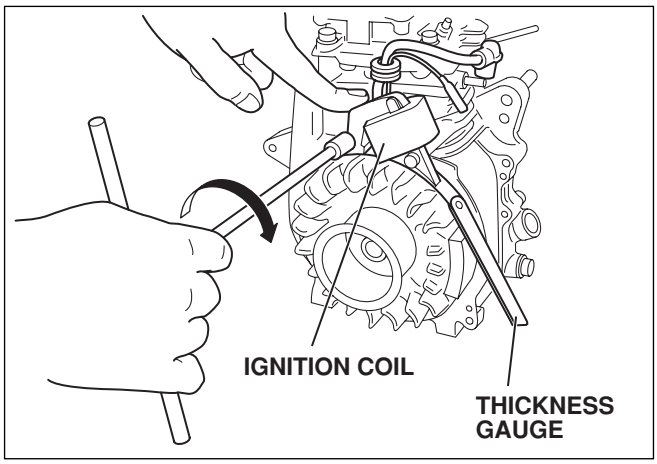
2-3-13 IGNITION COIL

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.

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

Tightening torque
7 - 9 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

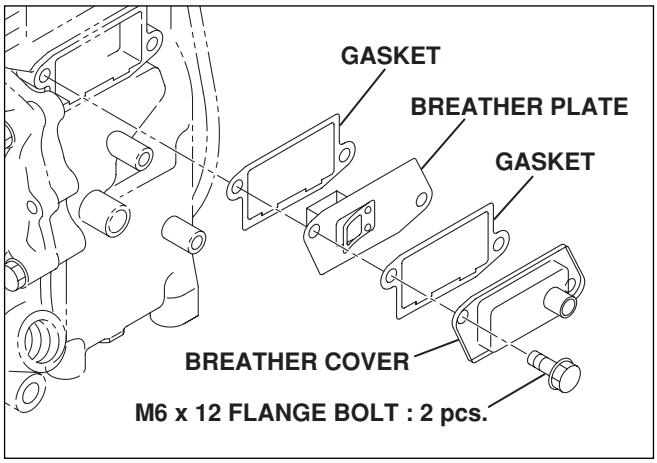


2-3-14 BREATHER

Install breather plate, breather cover, gasket in position.
M6 x 12 mm flange bolt : 2 pcs.

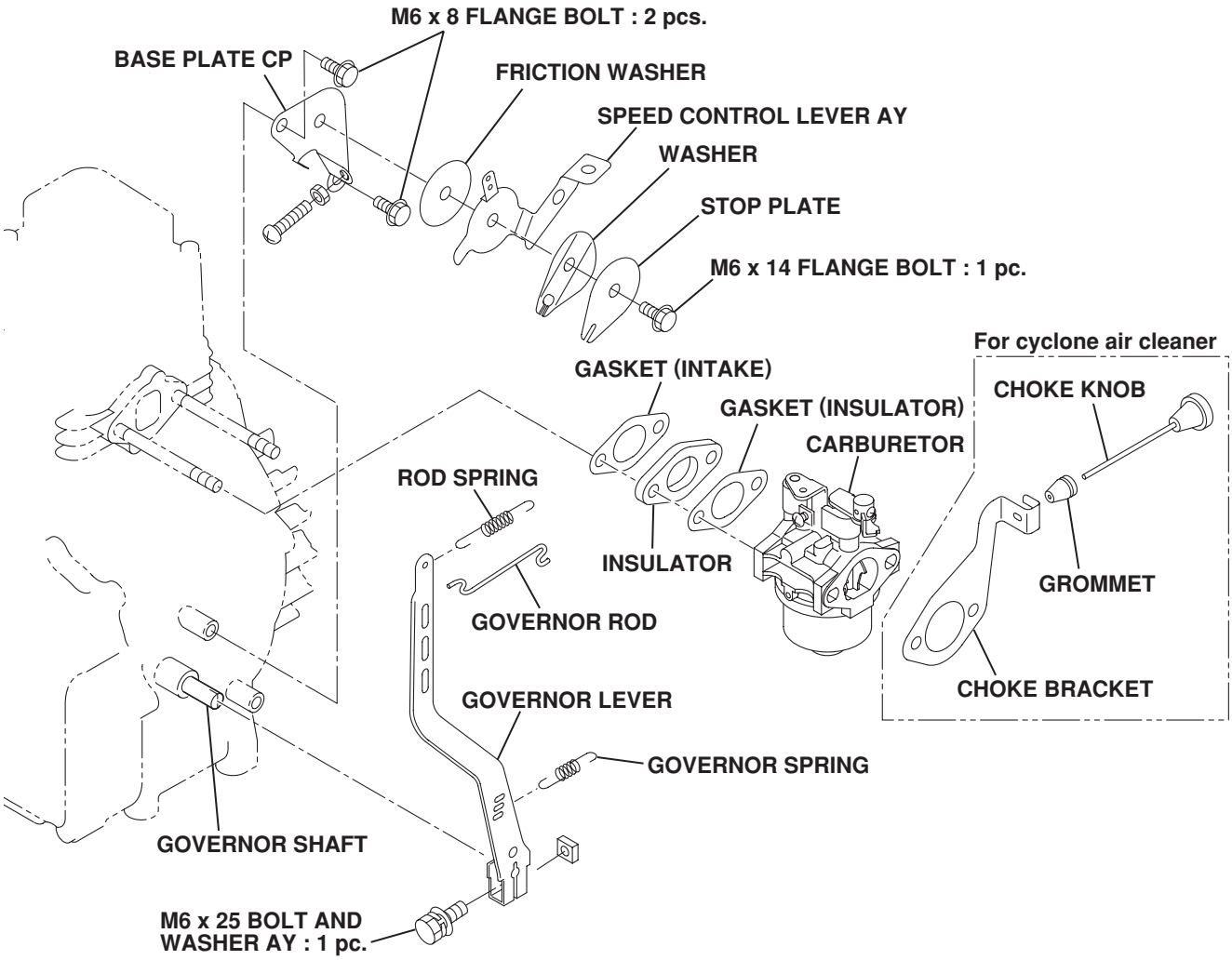
Tightening torque
4 - 6 N•m (40 - 60 kgf•cm) (2.8 - 4.3 ft•lb.)

※ Connect breather pipe after installing air cleaner.



2-3-15 GOVERNOR, SPEED CONTROL SYSTEM AND CARBURETOR

(1) Install governor lever to governor shaft, then tighten the locking bolt temporarily.
(2) Install base plate to crankcase.
(3) Install speed control lever, washer, bolt, etc. to base plate as shown in illustration.
(4) Hook governor spring to proper holes of governor lever and speed control lever.
(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.



2-3-16 AIR CLEANER

(1) Install the air cleaner gasket and the cleaner base and tighten them.
M6 flange nut : 2 pcs.

Tightening torque
8 - 10 N•m (80 - 100 kgf•cm) (5.7 - 7.2 ft•lb.)

(2) Install the element and the cleaner case.

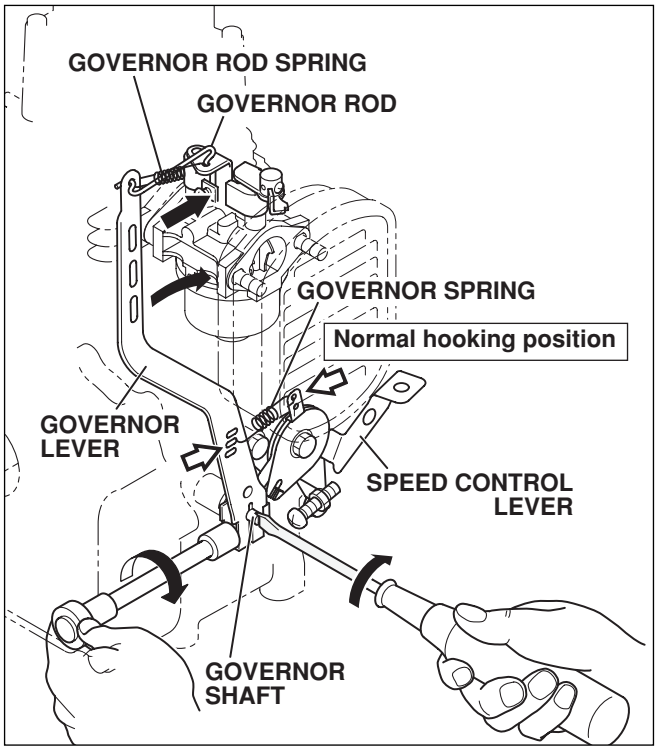
(3) Then connect breather pipe from breather cover to cleaner base.

2-3-17 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.
Check that the governor lever is pulled by the governor spring and carburetor throttle valve is fully open.

(2) Turn the governor shaft clockwise all the way using a screw driver, and tighten lock bolt to secure the lever on the shaft.
M6 x 25 mm bolt and washer : 1 pc.

Tightening torque
7 - 9 N•m (70 - 90 kgf•cm) (5.0 - 6.5 ft•lb.)

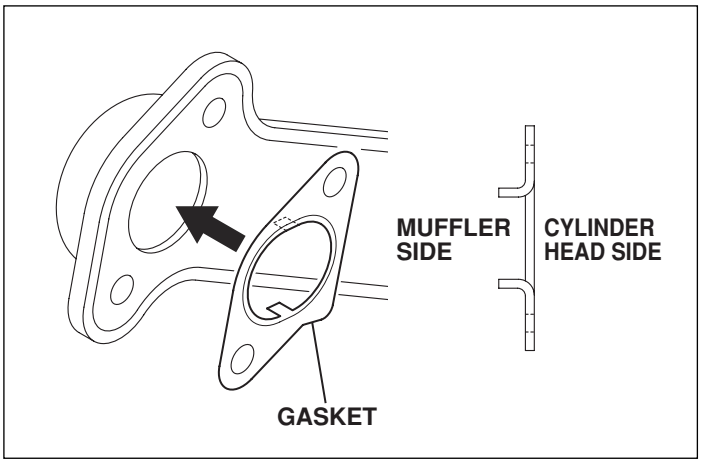


2-3-18 CYLINDER BAFFLE AND MUFFLER (step 1; temporarily fitting)

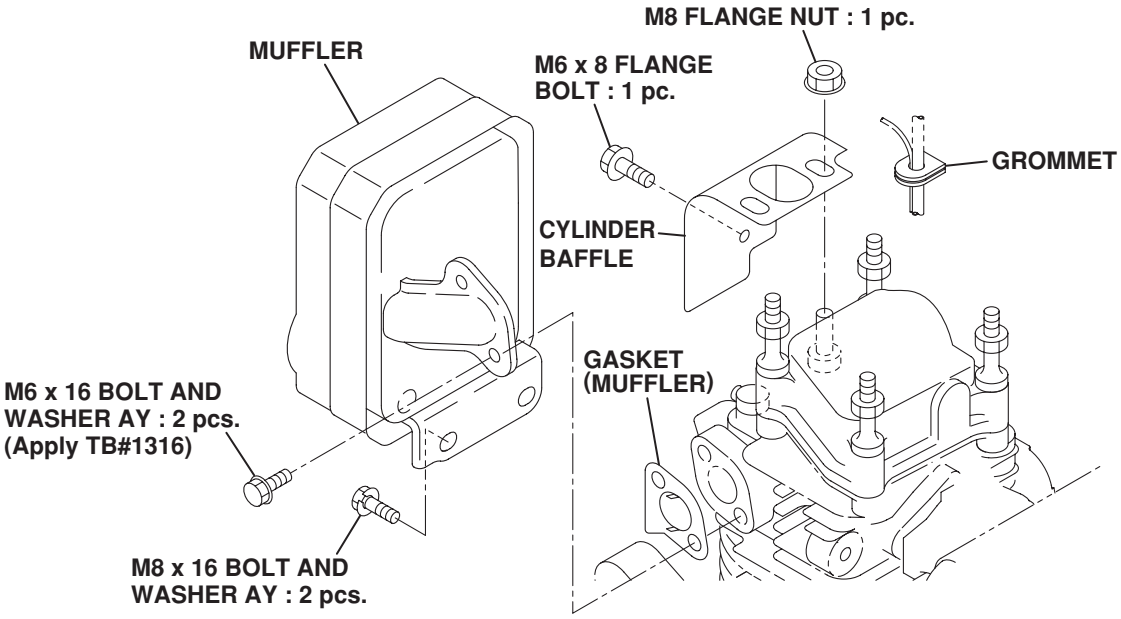
(1) Attach gasket with the crows faced inside of muffler.

(2) Temporarily attach cylinder baffle and muffler onto cylinder head.

(3) Fit grommet, holding ignition code and stop switch wiring, into the cutting portion of cylinder baffle.



Note:
In order to install blower housing in position, do not tighten bolts and nuts for cylinder baffle and muffler securely.



2-3-19 BLOWER HOUSING AND RECOIL STARTER

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

M8 x 16 mm flange bolt : 3 pcs.

M8 x 50 mm flange bolt : 1 pc.

Tightening torque
9 - 11 N•m (90 - 110 kgf•cm) (6.5 - 8.0 ft•lb.)

(2) Install recoil starter to blower housing.

M6 x 8 mm flange bolt : 3 pcs.

Note :
Be careful of pulling direction of starter rope.

2-3-20 CYLINDER BAFFLE AND MUFFLER (step 2; finally fixing)

Finally tighten bolts and nuts for cylinder baffle and muffler securely.

M6 x 8 mm flange bolt : 1 pc. (cylinder buffle)

Tightening torque
4 - 6 N•m (40 - 60 kgf•cm) (2.8 - 4.3 ft•lb.)

M8 nut : 1 pc. (cylinder buffle)

Tightening torque
17 - 19 N•m (170 - 190 kgf•cm) (12.3 - 13.7 ft•lb.)

M8 x 16 mm bolt and washer : 2 pcs. (crankcase boss)

Tightening torque
17 - 19 N•m (170 - 190 kgf•cm) (12.3 - 13.7 ft•lb.)

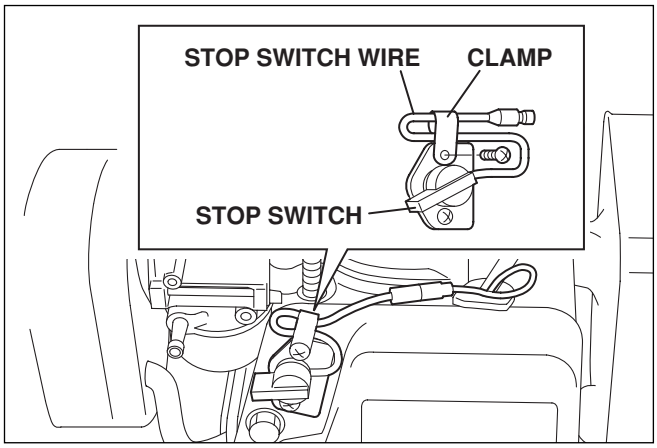
M6 x 16 mm bolt and washer : 2 pcs. (exhaust port)

Tightening torque
8.5 - 10.5 N•m (85 - 105 kgf•cm) (6.1 - 7.5 ft•lb.)

2-3-21 STOP SWITCH

(1) Install stop switch to blower housing.

(2) Connect wires referring to the wiring diagram.



2-3-22 FUEL TANK BRACKET 2

Attach washer (t=1.2) in position and then install fuel bracket 2.

M8 flange nut : 1 pc.

Tightening torque
17 - 19 N•m (170 - 190 kgf•cm) (12.3 - 13.7 ft•lb.)

2-3-23 FUEL TANK BRACKET

Set fuel tank bracket onto rocker cover installing bolts.

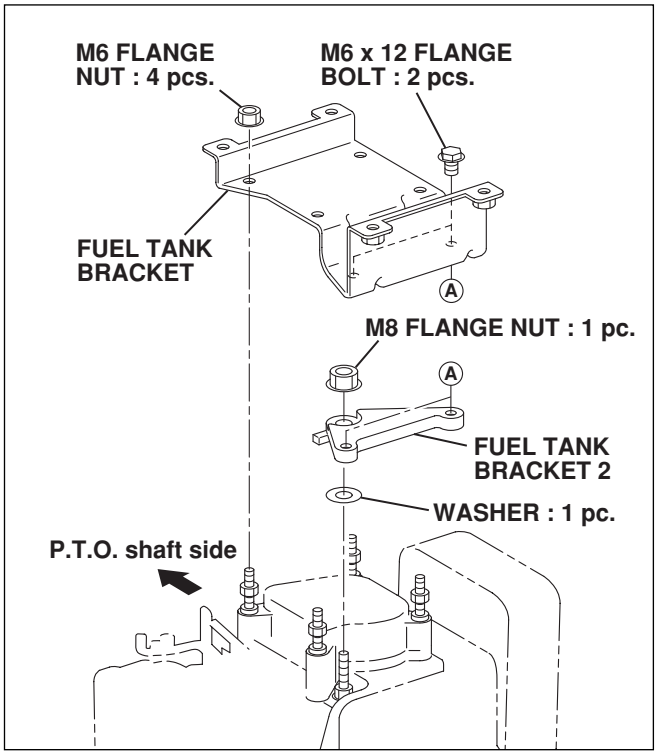
M6 flange nut : 4 pcs.

Tightening torque
6 - 8 N•m (60 - 80 kgf•cm) (4.3 - 5.7 ft•lb.)

Tighten flange bolts with fuel tank bracket 2.

M6 x 12 mm flange bolt : 2 pcs.

Tightening torque
6 - 8 N•m (60 - 80 kgf•cm) (4.3 - 5.7 ft•lb.)



2-3-24 FUEL TANK

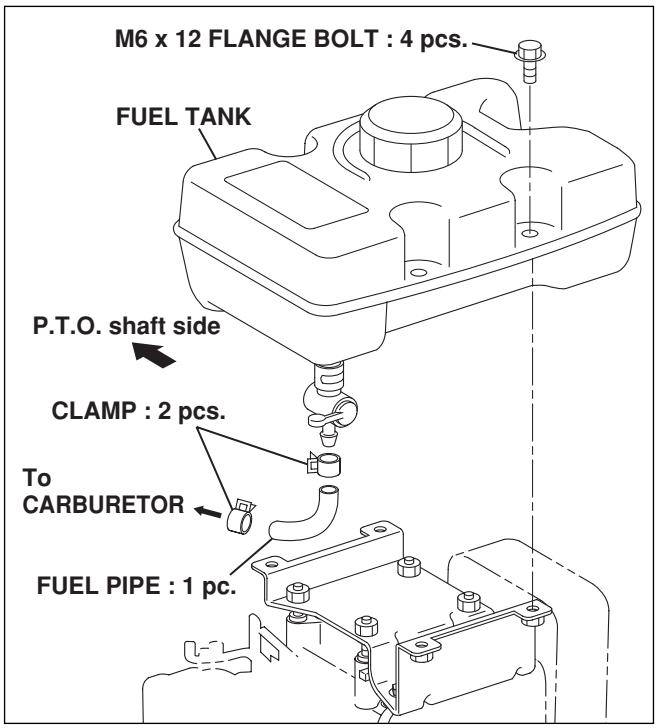
Attach fuel tank to fuel tank bracket.

Fix fuel tank with flange bolts.

M6 x 12 mm flange bolt : 4 pcs.

Tightening torque
6 - 8 N•m (60 - 80 kgf•cm) (4.3 - 5.7 ft•lb.)

Connect fuel hose with fuel cock and carburetor, and secure with clamps.



- End of the reassembly -

2-4 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.

2-5 ENGINE SPEED ADJUSTMENT

High-speed side ; Engine speed is varied by the equipment, so adjust the speed to the specified one indicated on the equipment.

Low-speed side ; Adjust the engine speed to 1,400 rpm by the carburetor idle screw, and then adjust to 1,600 rpm by adjusting screw of governor base plate.

3. TROUBLESHOOTING

If the engine shows any sign of malfunction, the cause should be determined immediately and appropriate countermeasures should be taken to prevent the problem from worsening. This section describes certain known problems, their possible causes and appropriate countermeasures. Note, however, that the list of problems presented here is not all. Generally speaking, since there is the possibility of multiple causes for a single problem, please use your experience and common sense when deciding on what action to take.

Problem and possible cause			Remedy
Starting difficulties	1. Ignition system problems	1) Spark plug • Improper spark plug gap • Insulation defect • Carbon deposits	 Adjust the gap Replace Clean
		2) Ignition coil • Insulation defect or discontinuity • Poor contact or broken wire	 Replace Repair or replace
		3) Improper air gap between ignition coil and flywheel	Adjust
	2. Fuel system problems	1) No fuel in fuel tank	Refill
		2) Fuel hose clogged or pinched	Clean or replace
		3) Air in fuel lines	Check and retighten joints
		4) Poor quality gasoline or water in gasoline	Replace
		5) Carburetor • Overflow • Clogged or damaged • Throttle valve malfunction (does not close fully)	 Adjust Overhaul Check and adjust
	3. Engine core components problems	1) Insufficient tightening of cylinder head bolts	Check and retighten
		2) Wearing of piston, piston rings and/or cylinder	Repair or replace
		3) Improper contact of valve and seat	Repair
		4) Valve sticking	Repair
		5) Improper valve clearance	Adjust
		6) Leakage from intake manifold gasket	Retighten; replace gasket
		7) Leakage from carburetor gasket	Retighten; replace gasket
		8) Insufficient tightening of spark plug	Retighten

Problem and possible cause			Remedy
Poor output	1. Insufficient compression	1) Loosen spark plug	Retighten; replace gasket
		2) Leakage from cylinder head gasket	Retighten; replace gasket
		3) Piston ring 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 problems	1) Faulty spark plug	Replace
		2) Faulty ignition coil	Replace
		3) Improper air gap between ignition coil and flywheel	Adjust
		4) Demagnetization (flywheel magneto)	Replace
	3. Fuel system malfunction	1) Carburetor clogged	Overhaul, clean
		2) Fuel strainer and/or hose clogged	Clean or replace
		3) Air in fuel lines	Check and retighten joints
		4) Poor quality gasoline or water in gasoline	Replace
	4. Low air intake volume	1) Air cleaner clogged	Clean or replace
		2) Throttle valve malfunction	Repair or replace
Overheat	1. Engine	1) Cooling air flow obstructed at inlet or cylinder baffle portion	Clean
		2) Poor quality engine oil	Replace
		3) Lean fuel/air mixture	Check and adjust carburetor
		4) Excessive back pressure of exhaust system	Check and clean or replace
		5) Overloading	Adjust to rated load
Rough Idling	1. Carburetor system	1) Low idling speed	Adjust
		2) Slow system passage clogged	Check and clean
	2. Intake system	1) Air mixing from air intake system joints	Check and tighten; replace gasket
	3. Cylinder head	1) Gasket faulty (blow-by)	Replace
	4. Valve system	1) Improper valve clearance	Adjust
		2) Leakage from valve seat	Repair
		3) Excessive clearance between valve stem and guide	Replace
	5. Ignition system	1) Weak spark	Check; adjust or replace plug

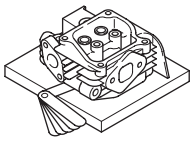
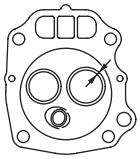
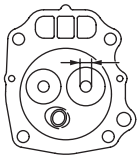
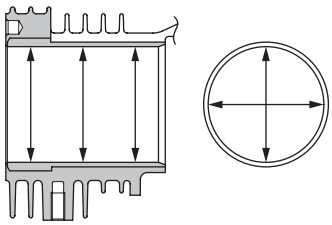
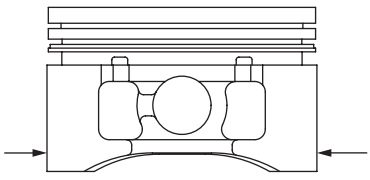
Problem and possible cause			Remedy
Exessive engine oil consumption	1. Oil leakage	1) Loose oil drain plug	Tighten
		2) Faulty oil drain gasket	Replace
		3) Loose main bearing cover bolts	Tighten
		4) Faulty main bearing cover gasket	Replace
		5) Crankshaft oil seal (front, rear) defect	Replace
	2. Oil up	1) Faulty piston oil ring	Replace
		2) Piston ring seizure, wear or poor contact	Replace
		3) Excessive wear of piston and/or cylinder	Replace
		4) Faulty stem seal	Replace
		5) Excessive oil level	Adjust oil level
		6) Breather defect	Repair or replace
High fuel consumption	1. Fuel system	1) Clogged air cleaner	Clean or replace
		2) Faulty needle valve and/or high fuel level in float chamber	Repair or replace
		3) Choke does not open fully	Repair or replace
	2. Engine core components	1) Low compression	Check and repair
		2) Overcooling	Check and adjust load and/or engine speed
Abnormal engine noise	1. Ignition system problems	1) Loose ignition system wiring	Inspect and tighten
		2) Improper or faulty spark plug	Clean or replace
	2. Fuel system problems	1) Lean or rich fuel/air mixture	Clean, adjust or replace carburetor
		2) Carburetor contamination	Overhaul or clean
		3) Dirty or clogged fuel lines	Clean or replace
		4) Air mixing from air intake system joints	Tighten; replace gasket
	3. Cylinder head	1) Carbon deposit in combustion chamber	Clean
		2) Leakage from cylinder head gasket	Replace
	4. Valve system problems	1) Improper valve clearance	Adjust
		2) Valve heat deterioration	Replace
		3) Worn or broken valve spring	Replace
		4) Improper valve timing	Adjust

4. SERVICE DATA

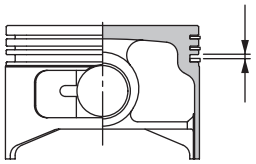
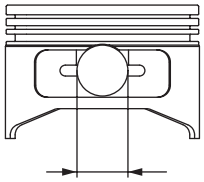
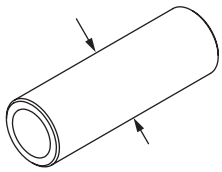
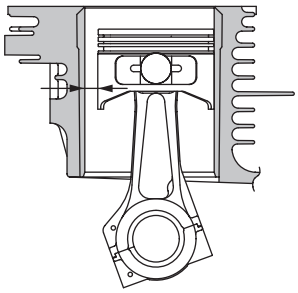
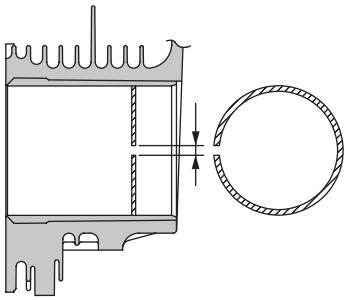
"STD" in the following table is the parts dimension from the brand new engine or the spare parts.
Whereas, "Limit" shows the maximum allowance for the parts to be used on the engine.
If the measurement exceeds beyond the "Limit" the part needs to be replaced and/or repaired.

4-1 CLEARANCE DATA AND LIMITS

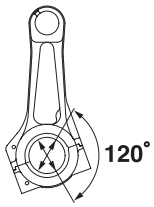
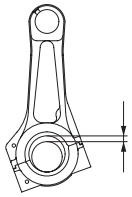
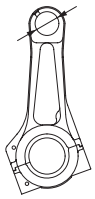
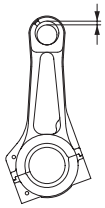
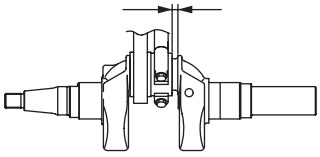
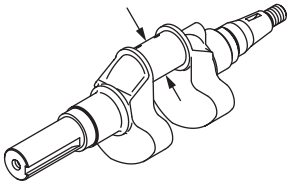
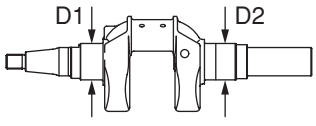
Unit : mm (in.)

ITEM		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)
CYLINDER * 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)
	1st reboring	51.250 - 51.269 (2.0177 - 2.0185)	Ditto
	2nd reboring	51.500 - 51.519 (2.0276 - 2.0283)	—
* Roundiness after reboring.		LESS THAN 0.01 (0.004)	—
* Cylindricity after reboring.		LESS THAN 0.015 (0.0006)	—
PISTON * Piston size (At skirt in thrust direction) 	STD	50.97 - 50.99 (2.0067 - 2.0075)	50.88 (2.0031)
	1st o / s	51.22 - 51.24 (2.0165 - 2.0173)	51.13 (2.0123)
	2nd o / s	51.47 - 51.49 (2.0264 - 2.0272)	51.38 (2.0228)

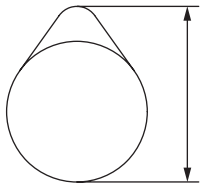
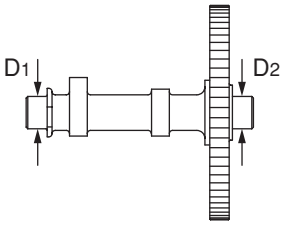
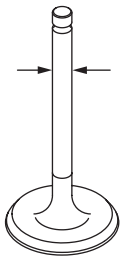
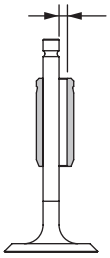
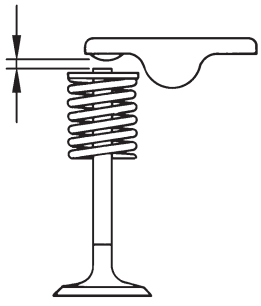
Unit : mm (in.)

ITEM		STD	Limit
PISTON * Ring groove side clearance 	Top	0.035 - 0.080 (0.0014 - 0.0031)	0.15 (0.006)
	2nd	0.035 - 0.080 (0.0014 - 0.0031)	0.15 (0.006)
	Oil ring	Three - piece 0.010 - 0.065 (0.0004 - 0.0026)	—
		Cutter ring 0.010 - 0.065 (0.0004 - 0.0026)	0.15 (0.006)
* Piston pin hole 		10.991 - 11.035 (0.4327 - 0.4344)	11.035 (0.4344)
* Piston pin outside dia. 		10.992 - 11.000 (0.4328 - 0.4331)	10.960 (0.4315)
* Clearance between piston and cylinder at skirt area. 		0.010 - 0.049 (0.0004 - 0.0019)	0.25 (0.010)
* Piston ring end gap 	Top 2nd	Top 0.15 - 0.35 (0.006 - 0.014) 2nd 0.35 - 0.55 (0.014 - 0.022)	1.5 (0.0591)
	Oil ring	Cutter ring 0.05 - 0.25 (0.002 - 0.010)	1.5 (0.0591)

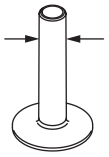
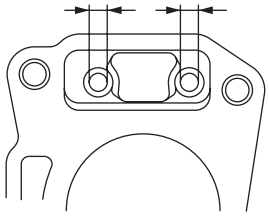
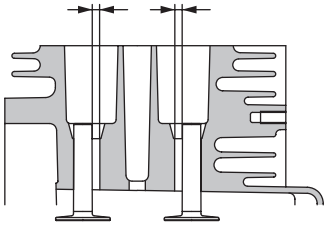
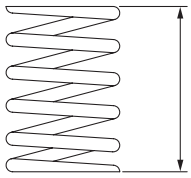
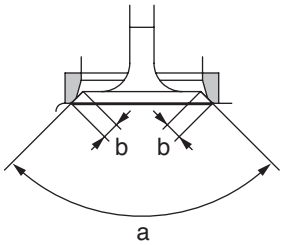
Unit : mm (in.)

ITEM	STD	Limit
CONNECTING ROD * Big end inside dia. 	21.0 - 21.013 (0.8268 - 0.8273)	21.1 (0.8307)
* Clearance between big end and crankpin 	0.02 - 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)
* Clearance between small end and piston pin 	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)
CRANKSHAFT * Crankpin outside dia. 	20.967 - 20.980 (0.8255 - 0.8259)	20.85 (0.821)
* Journal dia. 	D1, D2 19.988 - 19.997 (0.7869 - 0.7873)	

Unit : mm (in.)

ITEM		STD	Limit
CAMSHAFT * Cam height (IN. and EX.) 		18.3 - 18.5 (0.720 - 0.728)	18.15 (0.715)
* Journal outside dia. "D" type 	D_1	9.972 - 9.987 (0.3926 - 0.3932)	9.95 (0.3917)
	D_2	9.972 - 9.987 (0.3926 - 0.3932)	9.95 (0.3917)
VALVE * Valve stem outside dia. 	IN.	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)
* Clearance between valve stem dia. and valve guide. 	IN.	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)
* Valve clearance (cold) 	IN. / EX.	0.06 - 0.10 (0.0024 - 0.0039)	

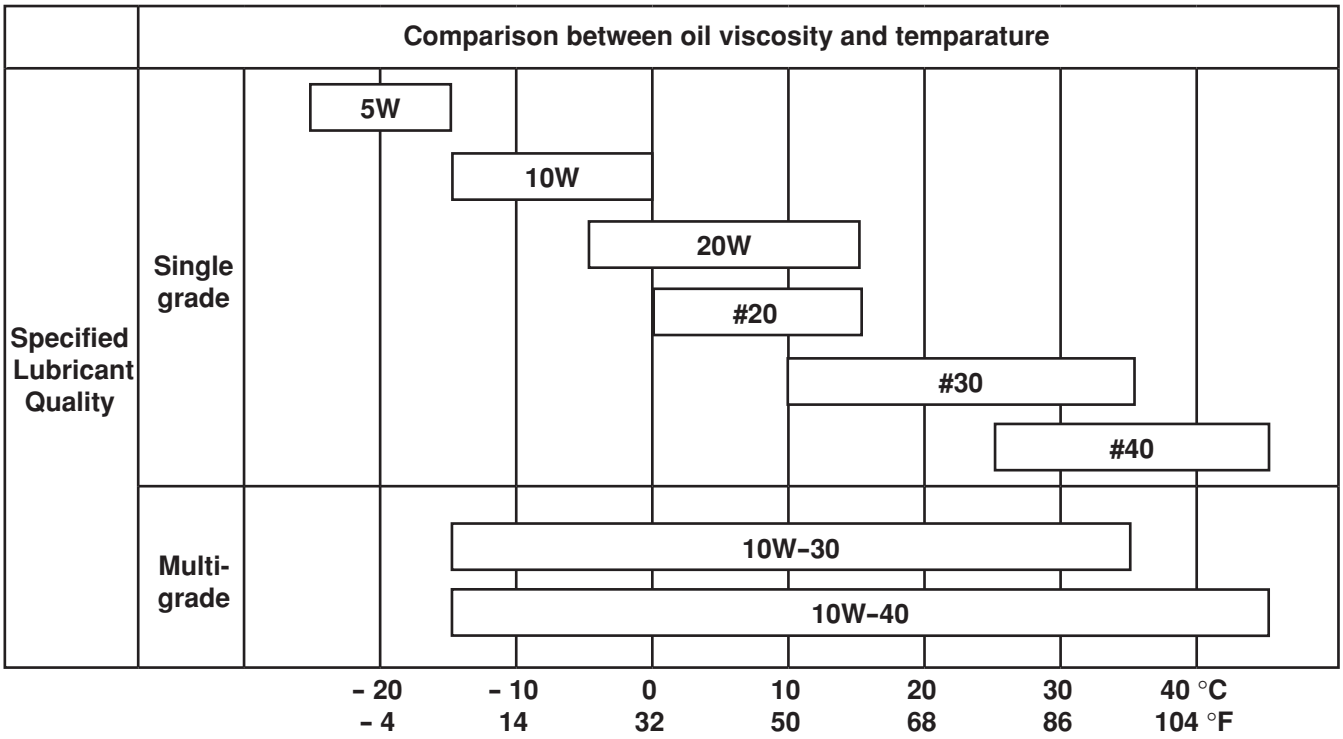
Unit : mm (in.)

ITEM	STD	Limit
TAPPET * Stem outside dia. 	7.960 - 7.975 (0.3134 - 0.3140)	
* Guide inside dia. 	8.000 - 8.015 (0.3150 - 0.3156)	
* Tappet guide clearance 	0.025 - 0.055 (0.0010 - 0.0022)	
VALVE SPRING FREE LENGTH 	26.7 (1.05)	
VALVE SEAT ANGLE (IN. and EX.) * Valve cutter angle (a) * Valve contact width (b) 	a : 90° b : 0.8 - 1.1 (0.031 - 0.043)	2.0 (0.079)

4-2 TORQUE SPECIFICATIONS

ITEMS			Tightening torque		
			N·m	kgf·cm	ft·lb.
Cylinder head bolts			19 - 21	190 - 210	13.7 - 15.2
Connecting rod cap bolts			6 - 8	60 - 80	4.3 - 5.7
Flywheel nut			45 - 50	450 - 500	32.5 - 36.2
Main bearing cover bolts			8 - 10	80 - 100	5.7 - 7.2
Spark plug		New one	12 - 15	120 - 150	8.7 - 10.9
		Retightening	23 - 25	230 - 250	16.6 - 18.1
Muffler nut	Cylinder head EX. port (Bolt & washer)		8.5 - 10.5	85 - 105	6.1 - 7.6
	Crankcase boss (Bolt & washer)		17 - 19	170 - 190	12.3 - 13.7

4-3 OIL GRADE CHART



Use oil classified as SE or higher. (SG, SH, or SJ is recommended)

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

ISSUE EMD-ES2121

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