SUBARU ENGINE

EK13
EK17
EK20
EK28
EK30

SERVICE MANUAL

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1. SPECIFICATIONS

Model		EK13		EK17	
		B	D	B	D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Horizontal P.T.O. Shaft, OHV Gasoline Engine			
Bore & Stroke	mm	61 × 43		67 × 48	
Piston Displacement	ml	125		169	
Compression Ratio		8.5			
Continuous Output	kW/r.p.m. (HP/r.p.m.)	2.1/1800 (2.9/1800)	2.1/3600 (2.9/3600)	3.2/1800 (4.3/1800)	3.2/3600 (4.3/3600)
Maximum Output	kW/r.p.m. (HP/r.p.m.)	3.2/2000 (4.3/2000)	3.2/4000 (4.3/4000)	4.5/2000 (6.1/2000)	4.5/4000 6.1/4000
Maximum Torque	N·m / r.p.m. (kgf·m/r.p.m.)	15.6/1400 (1.59/1400)	7.8/2800 (0.8/2800)	23.2/1300 (2.37/1300)	11.6/2600 (1.18/2600)
Direction of Rotation		Counterclockwise as viewed from the P.T.O. shaft side			
Valve Arrangement		Overhead Valve			
Cooling System		Forced air cooling system			
Lubrication System		Splash lubrication system			
Lubricant		Automobile engine oil ; Grade SE or higher (SG,SH or SJ in recommended) SAE 10W-30-----Under ordinary atmospheric temperatures SAE 5W-30-------In cold areas			
Capacity of Lubricant	L	0.55		0.6	
Carburetor		Horizontal draft, Float type			
Fuel		Automobile unleaded gasoline			
Fuel Consumption Rate	g/kW·h (g/HP·h)	313 (230)			
Fuel Supply System		Gravity type			
Fuel Tank Capacity	L	3.0		3.6	
Ignition System		Transistorized magneto			
Spark Plug		NGK BP-6HS			
Charging Capacity	V-A	12-1A (Option)		12-1A (Option)	
Starting System		Recoil starter / Electric starter (Option)			
Governor System		Centrifugal flyweight system			
Dry Weight	kg	13		15.5	
Dimensions (LxWxH)	mm	306 x 354 x 335		326 x 360 x 358	

*Specifications are subject to change without notice.

Model		EK20		EK28		EK30	
		B	D	B	D	B	D
Type		Air-Cooled, 4-Cycle, Single-Cylinder, Horizontal P.T.O. Shaft, OHV Gasoline Engine					
Bore & Stroke	mm	72 × 48		79 × 56		80 × 59	
Piston Displacement	ml	195		274		296	
Compression Ratio		8.5					
Continuous Output	kW/r.p.m. (HP/r.p.m.)	3.5/1800 (4.8/1800)	3.5/3600 (4.8/3600)	4.9/1800 (6.6/1800)	4.9/3600 (6.6/3600)	5.5/1800 (7.5/1800)	5.5/3600 (7.5/3600)
Maximum Output	kW/r.p.m. (HP/r.p.m.)	5.1/2000 (7.0/2000)	5.1/4000 (7.0/4000)	7.1/2000 (9.7/2000)	7.1/4000 (9.7/4000)	7.4/1800 (10/1800)	7.4/3600 (10/3600)
Maximum Torque	N·m / r.p.m. (kgf·m/r.p.m.)	26.4/1300 2.70/1300	13.2/2600 1.35/2600	38.2/1250 3.90/1250	19.1/2500 1.95/2500	42.0/1250 4.29/1250	21.0/2500 2.15/2500
Direction of Rotation		Counterclockwise as viewed from the P.T.O. shaft side					
Valve Arrangement		Overhead Valve					
Cooling System		Forced air cooling system					
Lubrication System		Splash lubrication system					
Lubricant		Automobile engine oil ; Grade SE or higher (SG,SH or SJ in recommended) SAE 10W-30-----Under ordinary atmospheric temperatures SAE 5W-30-------In cold areas					
Capacity of Lubricant	L	0.6		1.1			
Carburetor		Horizontal draft, Float type					
Fuel		Automobile unleaded gasoline					
Fuel Consumption Rate	g/kW·h (g/HP·h)	313 (230)					
Fuel Supply System		Gravity type					
Fuel Tank Capacity	L	3.6		6.0			
Ignition System		Transistorized magneto					
Spark Plug		NGK BP-6HS				TORCH E6TC	
Charging Capacity	V-A	12-1A (Option)		12-1A (Option)		12-1A (Option)	
Starting System		Recoil starter / Electric starter (Option)					
Governor System		Centrifugal flyweight system					
Dry Weight	kg	16		26		27	
Dimensions (L x W x H)	mm	326 x 360 x 358		353 x 418 x 420		353 x 418 x 437	

*Specifications are subject to change without notice.

2. PERFORMANCE

2-1 MAXIMUM OUTPUT

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

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

NOTE:

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

2-2 CONTINUOUS RATED OUTPUT

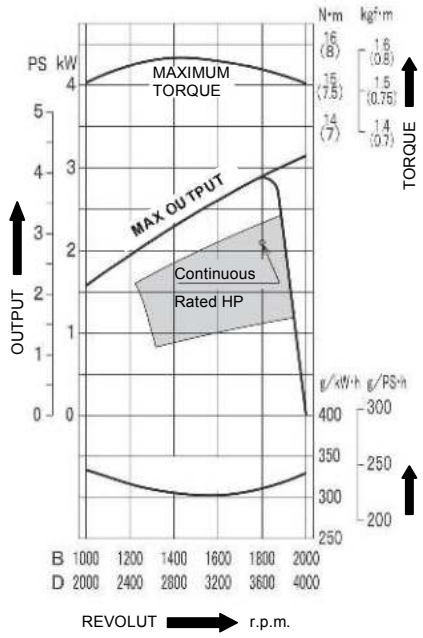
The continuous rated output is the output of an engine at optimum governed speed which is most favorable from the view point of engine's life and fuel consumption.

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

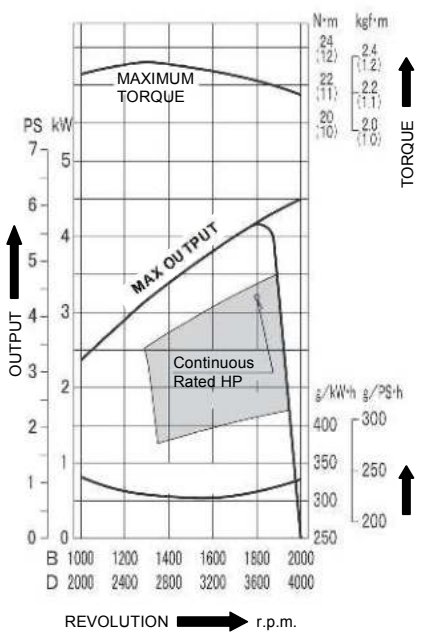
2-3 MAXIMUM TORQUE

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

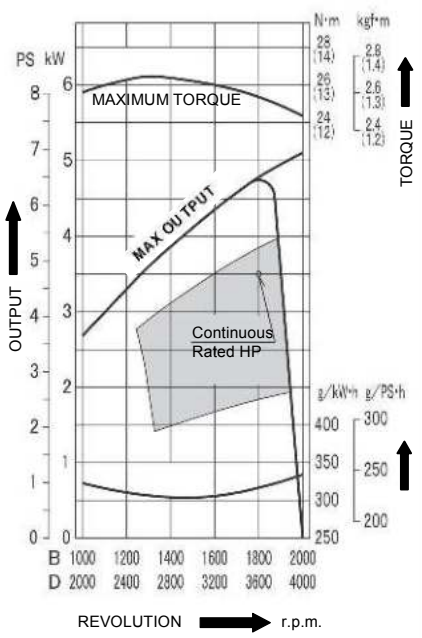
EK130−B/D



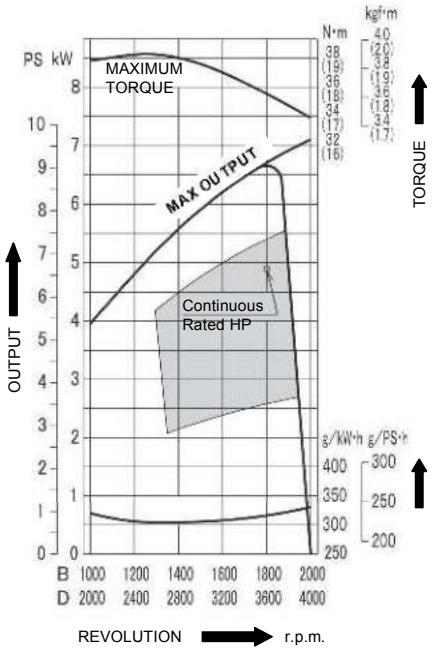
EK170−B/D



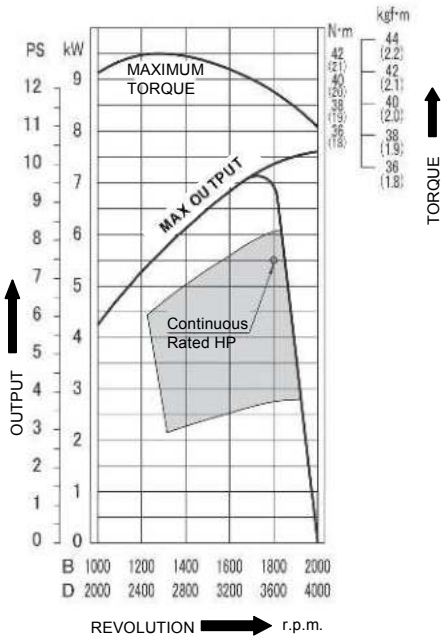
EK200−B/D



EK280−B/D



EK300−B/D



3. FEATURES

1. EK Series has newly developed combustion system and resulting in high performance. And its inclined cylinder offers compactness.
2. In addition to high output and fuel efficient, clean emission, less vibration and low noise promises environmental friendly, easiness in use and reliability.

3-1 ENVIRONMENTAL FRIENDLY

High performance with fuel efficient and less oil consumption.

Cross flow ports design enables engine's high output and

Pent-roof combustion chamber makes lean burning possible and realized fuel efficient, (EK13/17/20/28)

Lens shape combustion chamber, napier ring for second ring and optimum setting of the carburetor resulted in fuel efficient and less oil consumption. (EK30)

3-2 USER FRIENDLY

Remarkably silent among same range of engines.

Suitable clearance in between rocker arm and rocker shaft, in addition cylinder head cover with double metal sheets enables less valve noise. (EK13, 17, 20, 28)

Unlike above noted models, pivot type rocker arm is adopted as simple construction and achieving low noise. (EK30)

3-3 EXTREMELY EASY START

Mechanical automatic de-comp system and suitable combustion timing needs less starting power, ladies and seniors can start engine easily without any problem.

3-4 RUST FREE DESIGN FOR LONG LIFE

Anti – rust and anti – corrosion, suitable for agriculture machine.

This model has advanced anti-rust carburetor by considering agriculture machine which works in limited period in a year. And fuel tank has double anti – rust character, plated sheet metal and inner painting makes its life longer.

3-5 HIGH POWER MODEL EK30 (10PS)

Superior output in low to medium engine speed range

The model assures output required in low to medium engine speed for agriculture work.

It shows quick response, tough and strong in operation.

3-6 EASY INSTALLATION ON AGRICULTURE MACHINE

Low center of gravity, light weight and compact design

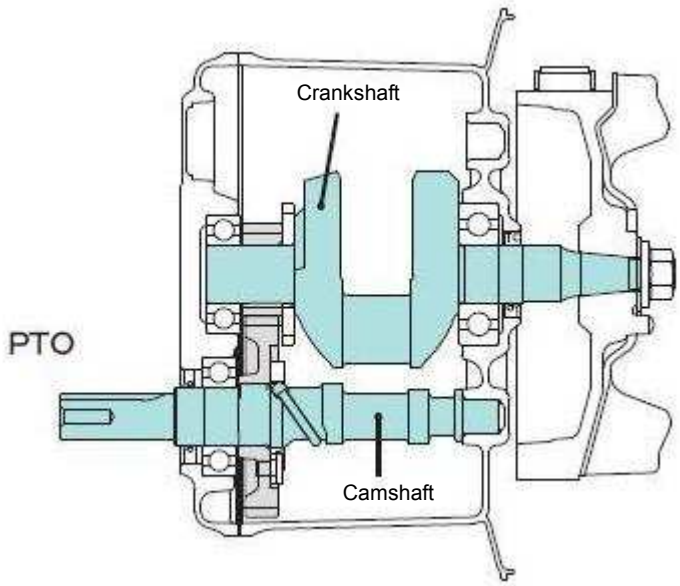
30 degrees inclined cylinder makes the model lower height and low center of gravity then achieving light weight and compactness.

(The inclined cylinder makes installing engine easier for various agriculture machine.)

Wide range of suitable specification

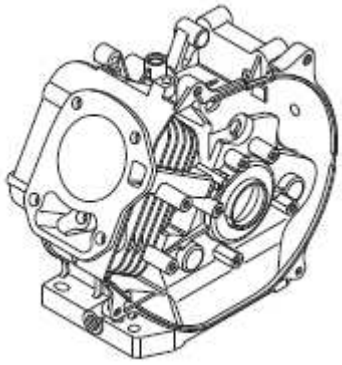
Suitable engine specification is available for variety of agriculture machines, such as cultivator, loading truck and sprayer etc.

PTO, reduction type



4. GENERAL DESCRIPTION OF ENGINE COMPONENTS

4-1 CYLINDER AND CRANKCASE



The cylinder and crankcase is aluminum die-casting as one 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 30 degrees from the horizontal as viewed from the output shaft side.

4-2 MAIN BEARING COVER

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

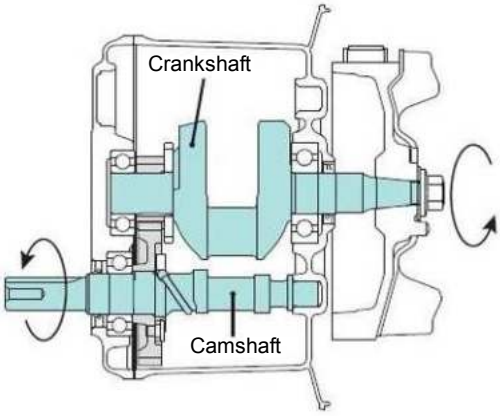
Remove the main bearing cover to inspect inside of the engine.

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

4-3 CRANKSHAFT

The crankshaft is forged carbon steel to have tough

metal structure, and the crank pin is induction-hardened.



The output side of the shaft has a crankshaft gear and balancer gear, those are pressed into position.

4-4 CAMSHAFT

The camshaft for reduction type engine is made of forged carbon steel.

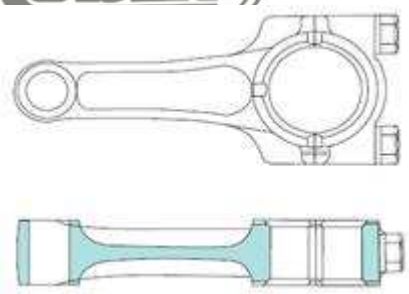
And it works as PTO shaft.

Cam gear is press fitted on the shaft, ball bearing is fixed in bearing cover to support the PTO shaft.

4-5 CONNECTING ROD AND PISTON

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

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

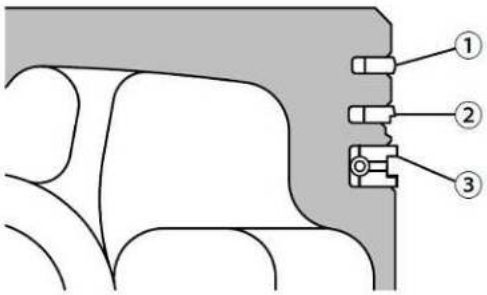


4-6 PISTON RINGS

The piston rings are made of special cast iron.

The profile of the top ring is a barrel face and the second ring has a tapered under cut face.

The oil ring is designed for better sealing and less oil consumption, in combination with 3 pieces.



①	TOP RING	EK series	BARREL
②	SECOND RING	EK13,17 EK20,28	TAPER
		EK30	TAPER UNDER CUT
③	OIL RING	EK series	THREE-PIECE

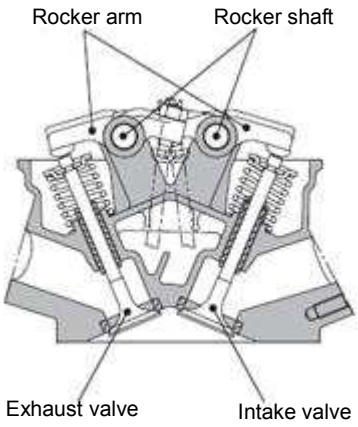
4-7 VALVE ARRANGEMENT

The intake valve is located on flywheel side of the cylinder head.

Hard alloy valve seats are molded in the cylinder head and stellite is fused to the exhaust valve face.

The cylinder baffle leads cooling air to the exhaust valve area for the optimum cooling.

EK13/17/20/28



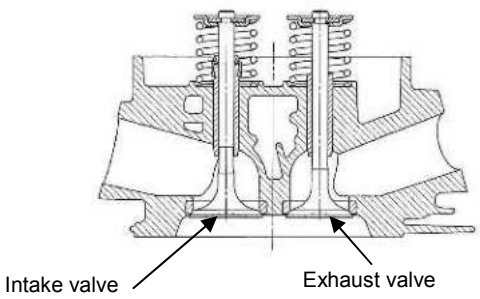
4-8 CYLINDER HEAD

The cylinder head is an aluminum die-casting with a pent roof combustion chamber construction. (EK13, 17, 20, 28)

The intake and exhaust ports are arranged in a cross direction to improve combustion efficiency.

Based on lens shaped combustion chamber and simplification of the valve components make maintenance easy. (EK30)

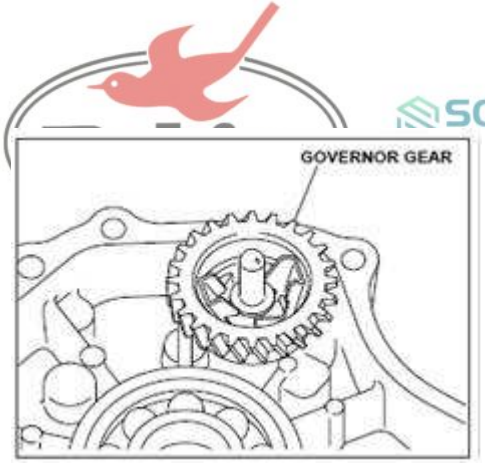
EK30



4-9 GOVERNOR SYSTEM

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

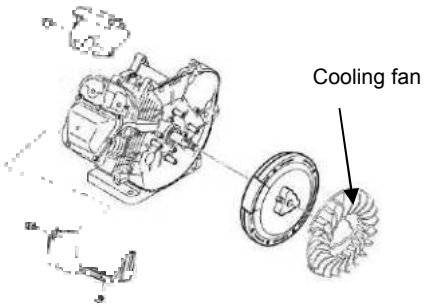
The governor gear with governor weights is installed on the main bearing cover.



4-10 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.



4-11 LUBRICATION SYSTEM

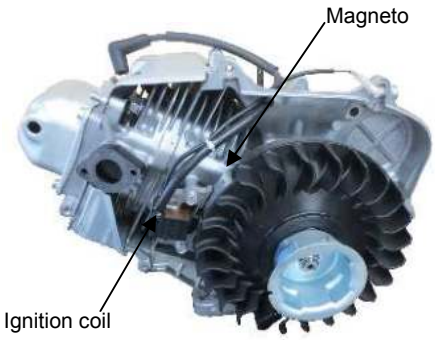
The rotating parts, sliding parts and valves of the engine are lubricated with oil in the crankcase.

Lubrication oil is splashed onto those parts in the case by the oil splasher on the connecting rod.

4-12 IGNITION SYSTEM

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

This ignition system has latest automatic ignition timing control for easy start.



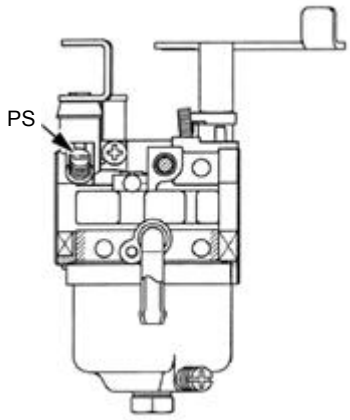
4-13 CARBURETOR

The engine is equipped with a horizontal draft carburetor.

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

Special attention is also paid to the general-purpose use of the engine.

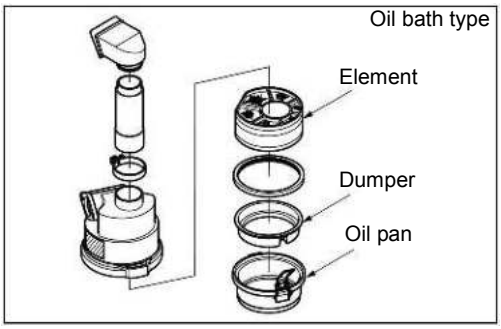
(For further information, refer to page 56, section “13. CARBURETOR”.)

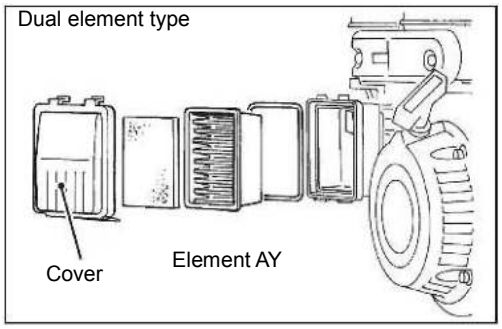


4-14 AIR CLEANER

The engine uses an air cleaner that is quieter than conventional one. A semi-wet urethane foam element is used in the STD air cleaner.

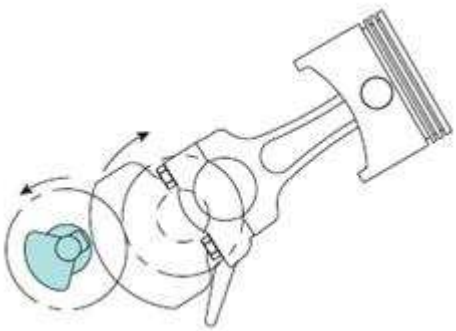
Dual element air cleaner (with a primary element of dry type sponge and secondary element of dry type paper) and other types are also provided as options.





4-15 BALANCER

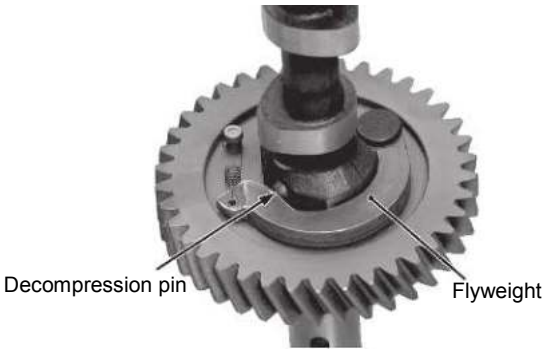
Unbalanced inertia force is cancelled by the balancer which rotates at the same speed as the crankshaft to effectively reduce vibration. (EK17 UP)



4-16 DECOMPRESSION SYSTEM

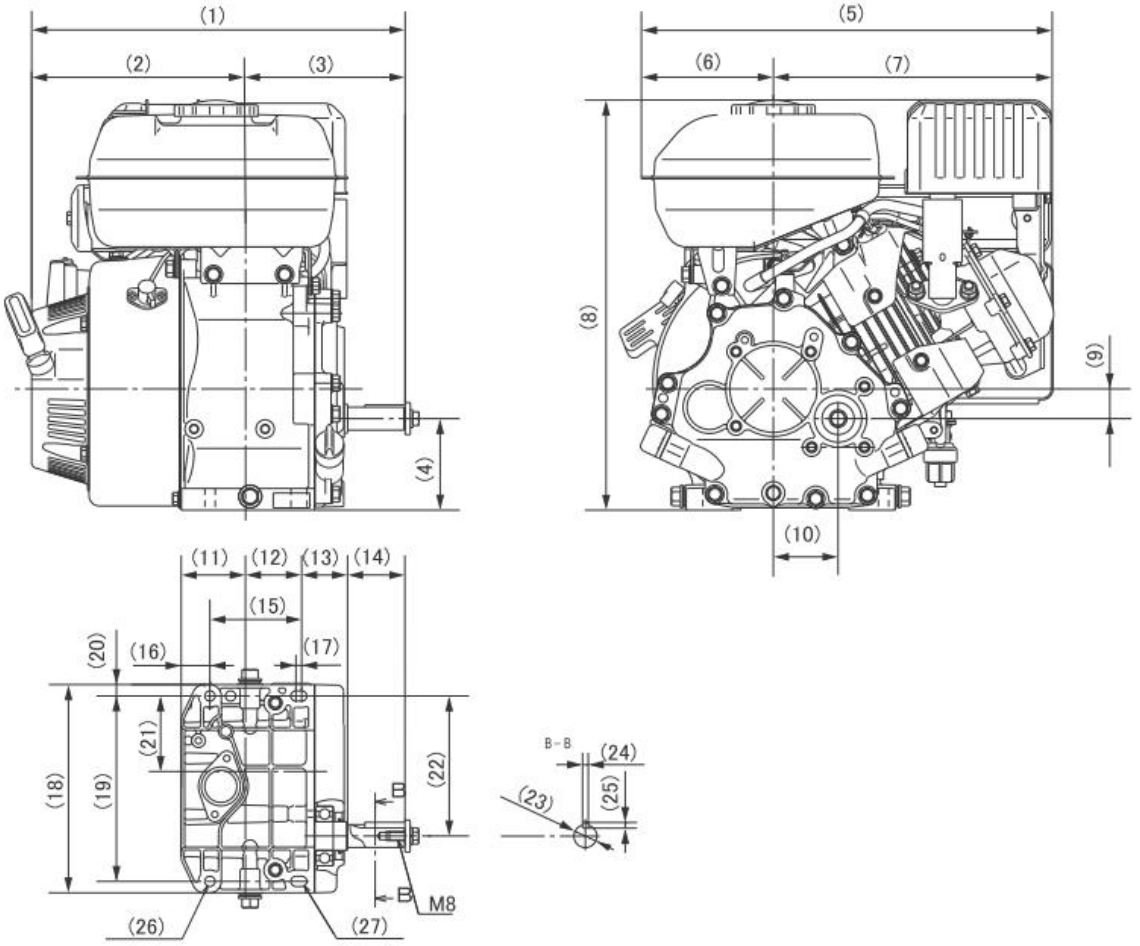
The automatic decompression system is mounted on the camshaft. It opens the exhaust valve before the compression top, thereby releasing the compression pressure and reducing the force required to pull the recoil starter.

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

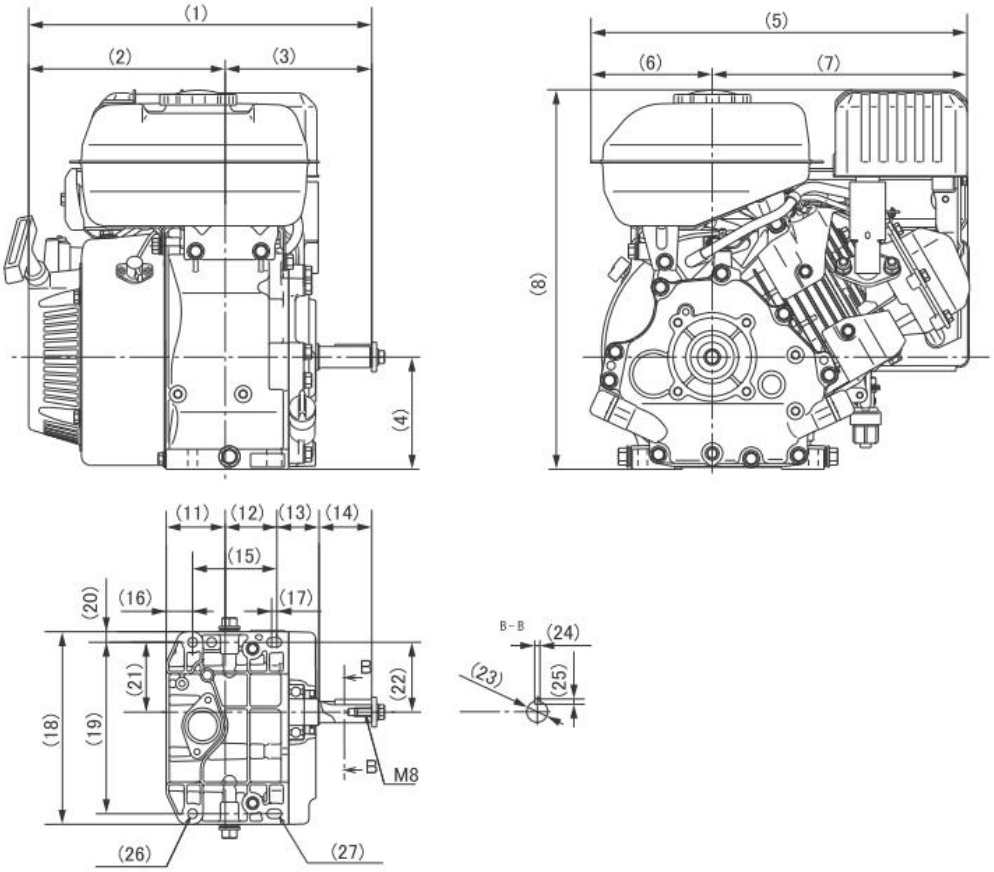


4-17 DIMENSIONS

B Type



D Type

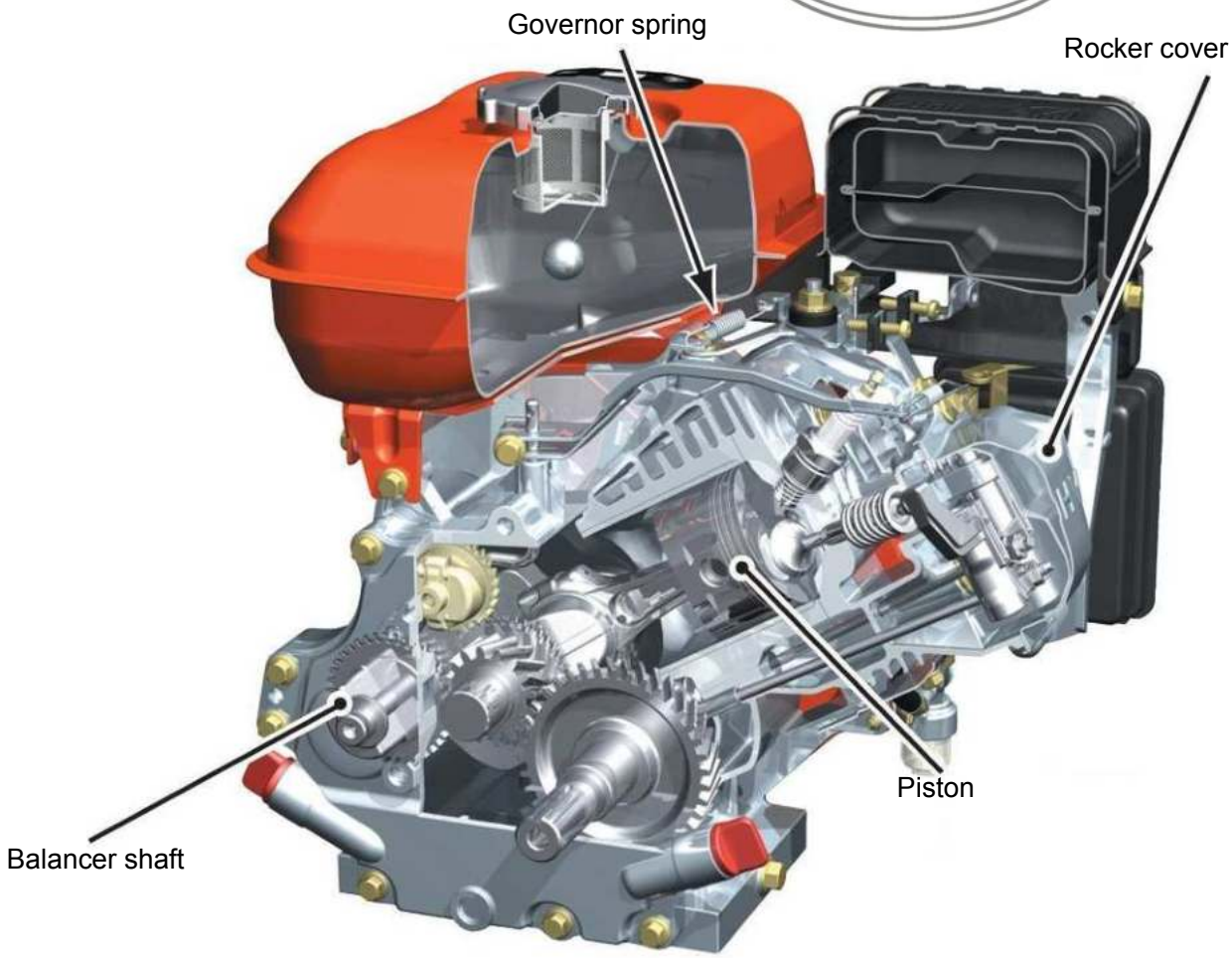


[ ] D type number in parentheses (mm)

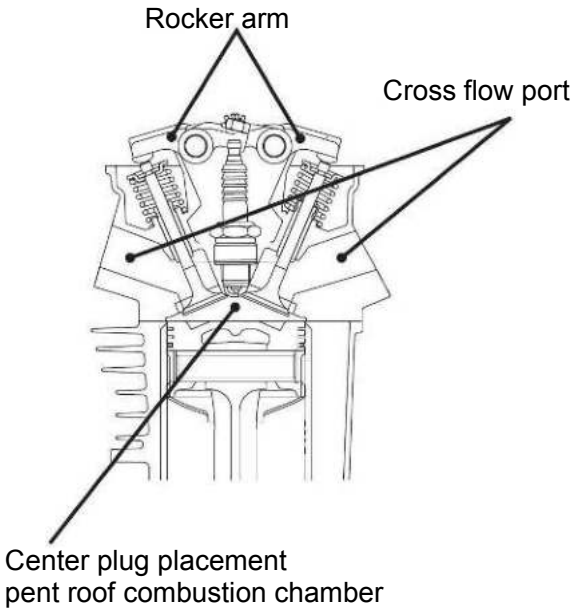
Model / Position	EK13	EK17	EK20	EK28	EK30
(1)	306	326		353 [355.2]	353
(2)	178	187		196.5	
(3)	128	139		156.5 [158.7]	156.5 [159]
(4)	80 [106]			101.5 [133.5]	
(5)	354	360		418.5	
(6)	125	116		143	
(7)	229	244		275.5	
(8)	335	358		420	437
(9)	26			32	
(10)	48.5	56.4		63.7	
(11)	56			64	
(12)	38	49		46.5	
(13)	40			50	50 [52.2]
(14)	50			60	
(15)	80			96	
(16)	14	25		14.5	
(17)	5			13	
(18)	182			219.5	
(19)	162			195.5	
(20)	10			12	
(21)	66			90.5	
(22)	114.5 [66]	122.4 [66]		154.2 [90.5]	
(23)	18	20		25	
(24)	5			7	
(25)	5			7	
(26)	2-9 hole			2-11 hole	
(27)	2-9 hole X 14 slotted hole			2-11 hole X 24 slotted hole	

The number is subject to change without notice.

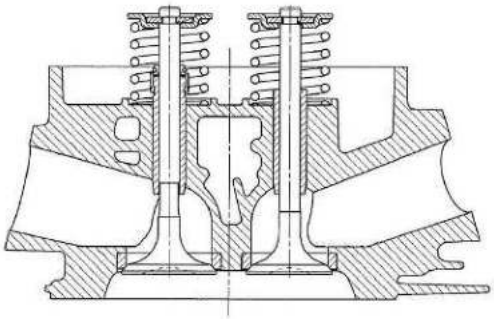
4-18 SECTIONAL VIEW OF THE ENGINE



1) EK13, 17, 20, 28



2) EK30



5. DISASSEMBLY AND REASSEMBLY

5-1 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.

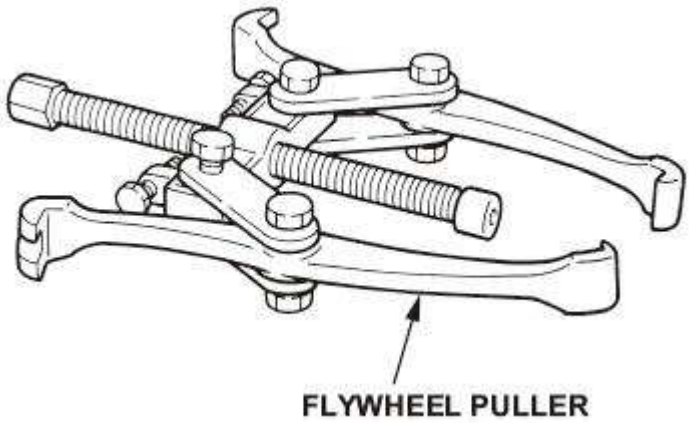
(3) To prevent parts from being mislaid, keep each group provisionally assembled after removing the parts from the engine.

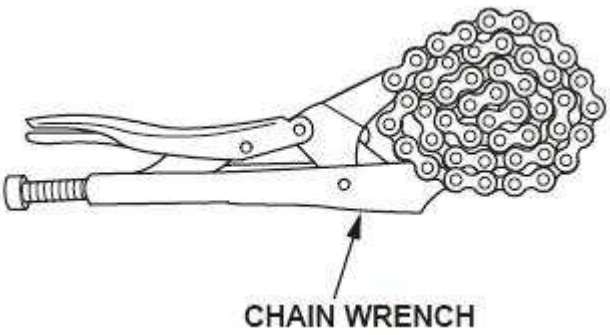
(4) Handle the disassembled parts with the utmost care. Clean them with cleaning oil if necessary.

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

5-2 SPECIAL TOOLS

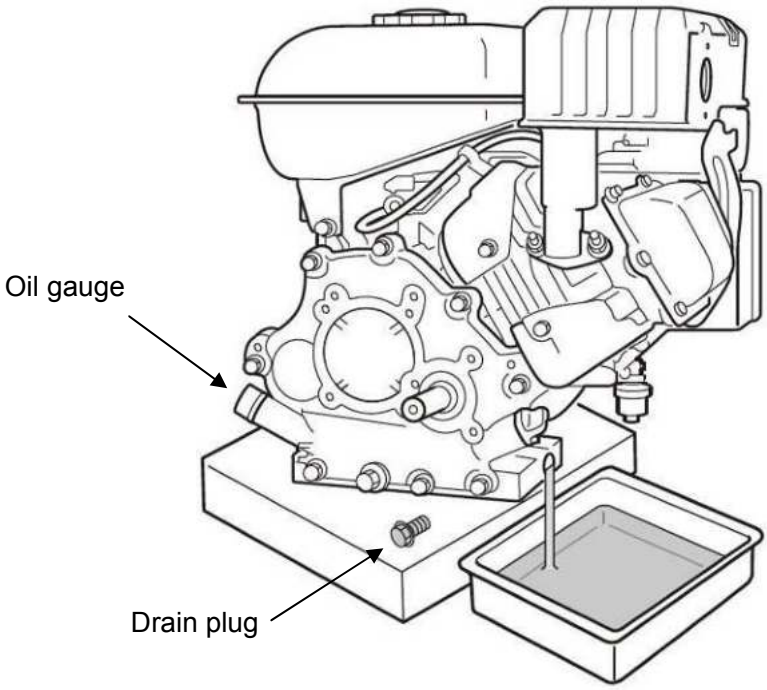
	Tool name	Purpose
Commercially available product	**Flywheel puller**	**For pulling off the flywheel**
Commercially available product	**Chain wrench**	**For locking the flywheel**

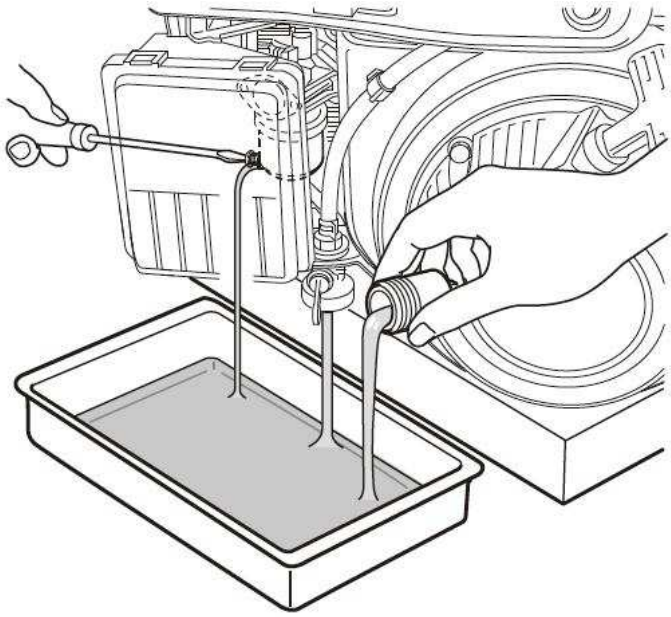




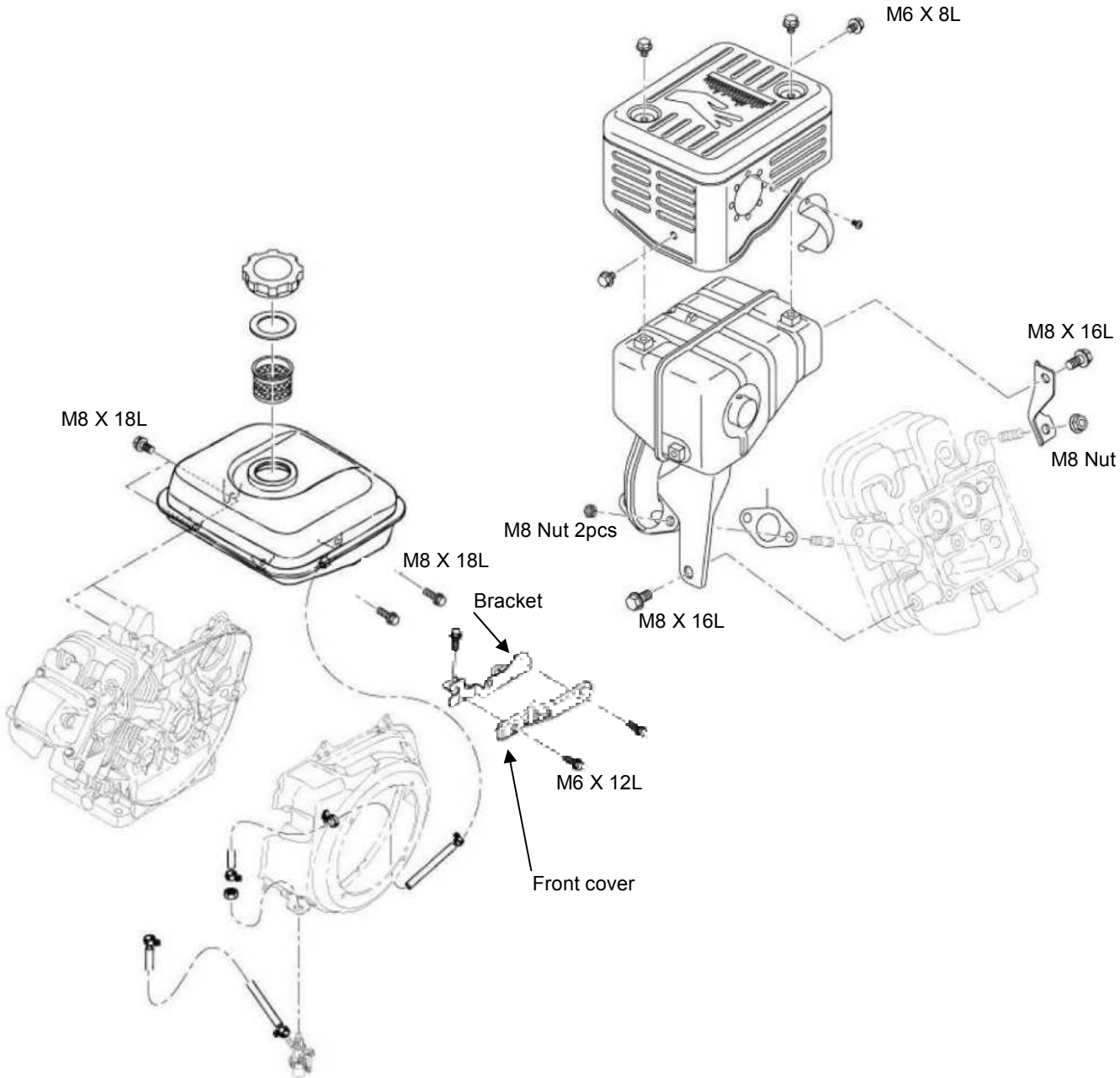
5-3 DISASSEMBLY PROCEDURE

Step	Parts to remove	Remarks and procedures	Fasteners
1	Drain the engine oil	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 gauge (M22).	14 mm spanner
2	Drain the fuel	Shut (OFF) the fuel strainer. Remove the fuel strainer cup. Open the strainer to drain fuel from fuel tank. Drain fuel from the carburetor drain.	+ or - screwdriver

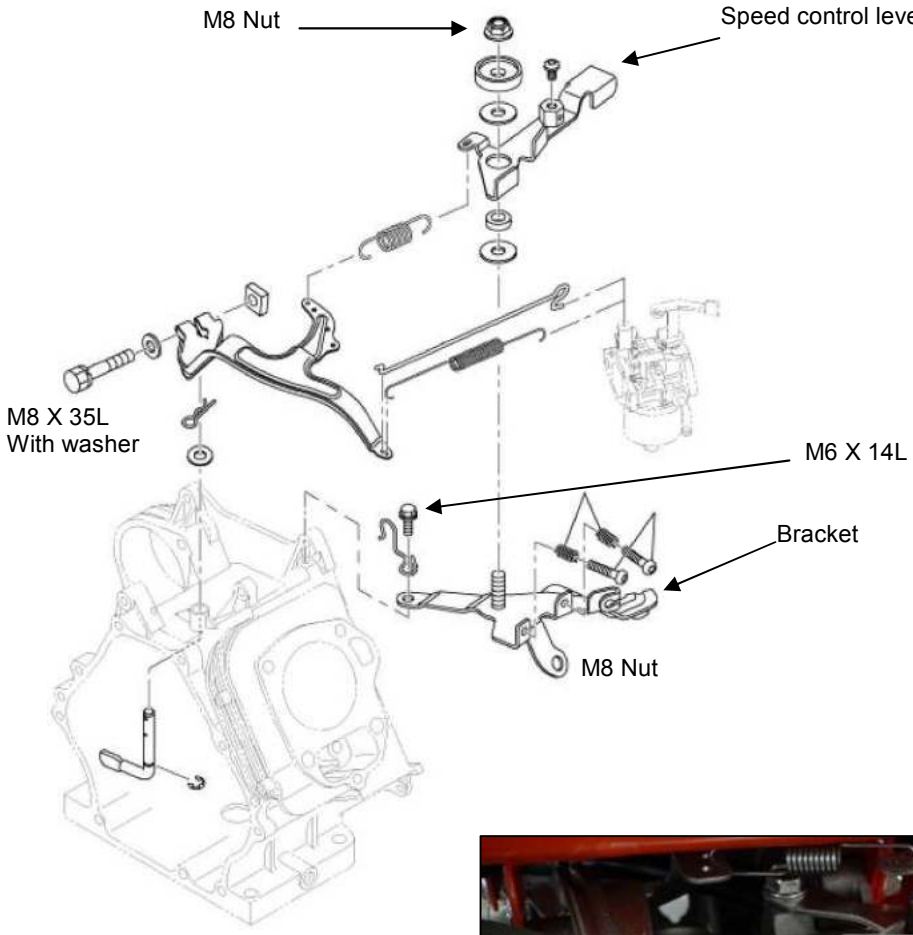




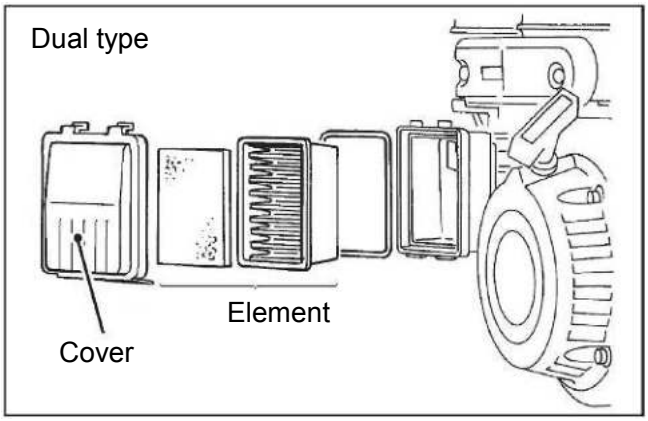
Step	Parts to remove	Remarks and procedures	Fasteners
3	Front cover	Remove the front cover from the bracket.	10 mm box spanner M6 bolt : 2 pcs.
4	Muffler and Muffler cover	(1) Remove the muffler cover from the muffler. (2) Remove the muffler from the cylinder head. Take care not to lose the gasket. * Take care not to cut your hand with the muffler gasket.	12 mm box spanner 10 mm box spanner or spanner
5	Fuel tank	(1) Remove the fuel tank mounting nuts/or and bolts from the crankcase. (2) Disconnect fuel hose from the fuel tank to strainer side. (3)Remove the fuel tank from the crankcase.	10 or 12 mm box spanner 10 or 12 mm spanner

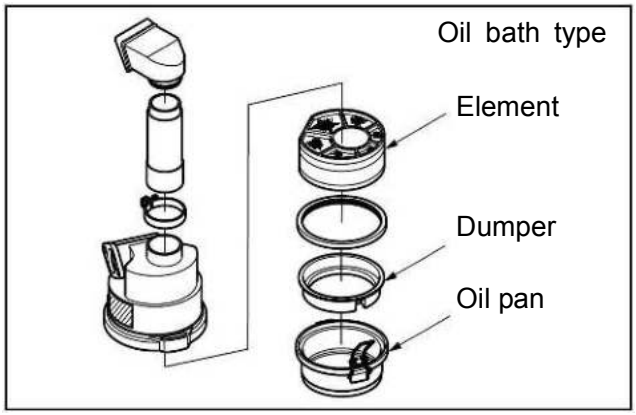


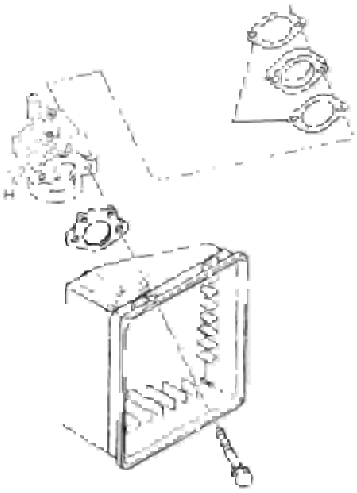
Step	Parts to remove	Remarks and procedures	Fasteners
6	Speed control lever and Bracket	Remove the speed control lever and bracket from the cylinder head. Slide to dismount the speed control lever and bracket from the cylinder head Release the bolt.	10 mm box spanner M6 x 14 mm : 1 pc.
7	Governor system	(1) Loosen the bolt and remove the governor lever from the governor shaft. There is no need to remove the bolt. (2) Remove the governor spring. (3) Remove the governor rod and the rod spring from the carburetor.	10 or 12 mm box spanner or spanner



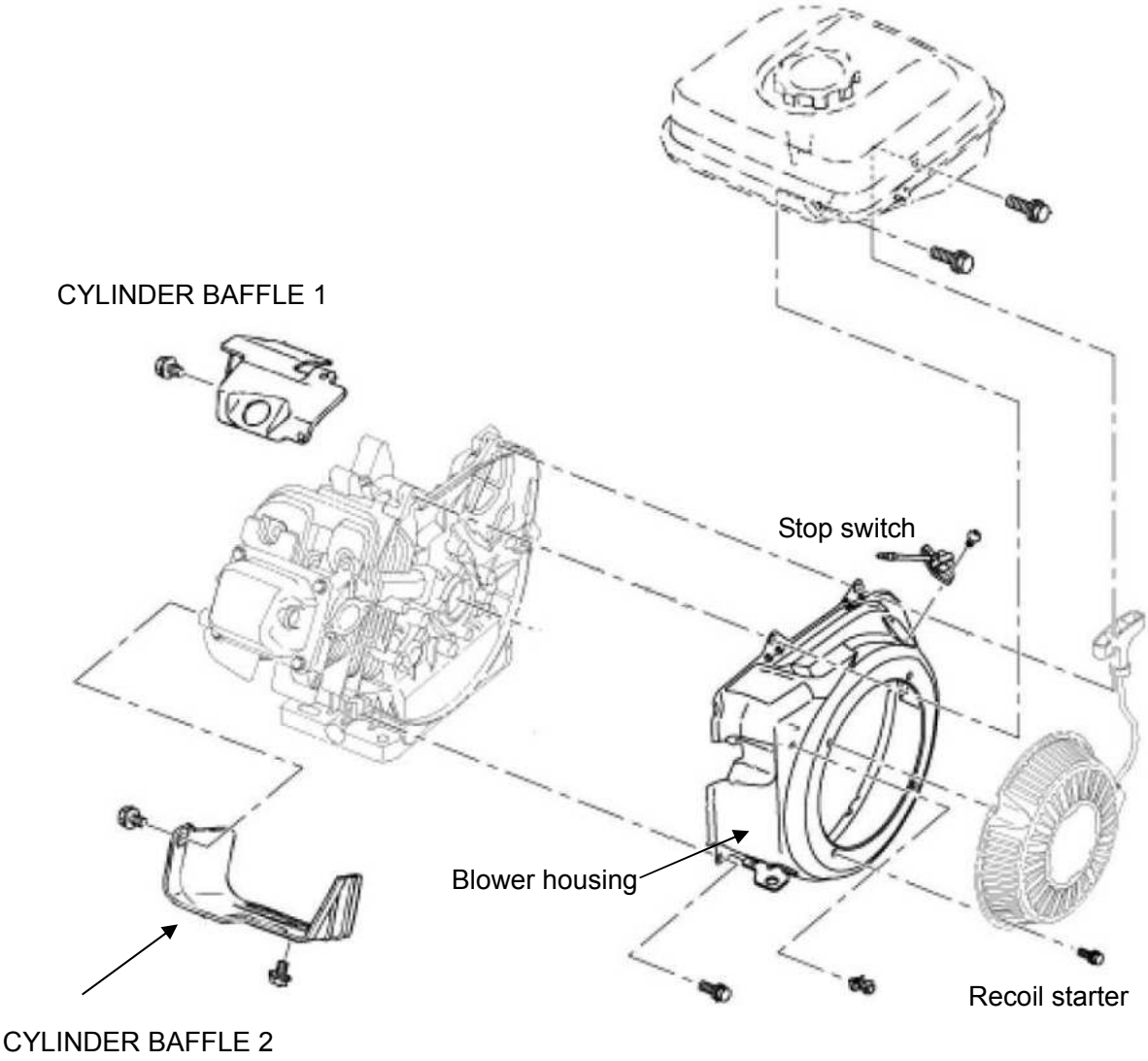
Step	Parts to remove	Remarks and procedures	Fasteners
8	Air cleaner cover	Remove the air cleaner cover and element.	
9	Air cleaner Carburetor, Insulator	Remove the air cleaner while pulling the breather pipe away from the rocker cover or cleaner base. Remove the air cleaner with carburetor together from the cylinder head. M6 bolt with washer: 2 pcs. Remove the insulator.	10 mm box spanner



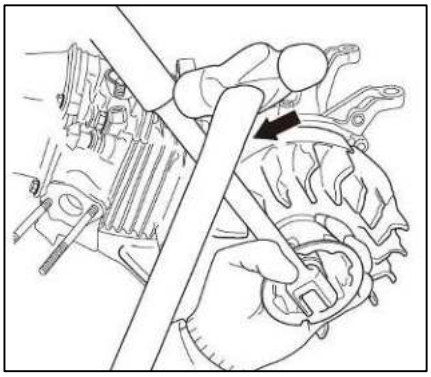


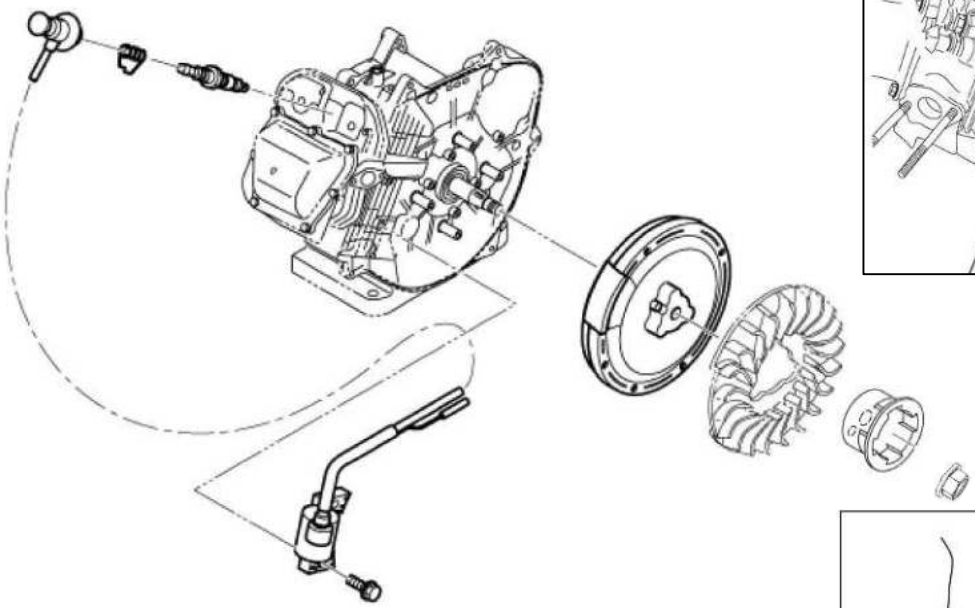


Step	Parts to remove	Remarks and procedures	Fasteners
10	Stop switch	Disconnect the wire and remove the stop switch from the blower housing.	+ screwdriver M4 x 12 mm : 2 pcs.
11	Recoil starter	Remove the recoil starter from the blower housing. 10 mm box spanner	M6 x 14 mm : 4 pcs.
12	Blower housing	Remove the blower housing from the crankcase.	10 mm box spanner M6 x 12 mm : 3 pcs.
13	Cylinder baffle	Remove the cylinder baffle 1 and 2	10 mm box spanner M6 x 12 mm : 3 pcs.

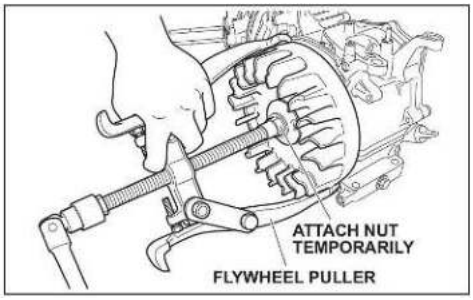


Step	Parts to remove	Remarks and procedures	Fasteners
14	Ignition coil	Remove the spark plug cap from the spark plug and remove the ignition coil from the crankcase.	10 mm box spanner M6 x 25 mm : 2 pcs.
15	Starting pulley Cooling Blower	Remove the starting pulley and cooling Blower from the flywheel. Fit a box wrench or a socket wrench on the flywheel nut and loosen the nut by knocking the wrench sharply with a hammer. 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.	EK13 17 mm box spanner or socket wrench M12 nut EK,17,20,28 and 30 19 mm box spanner or socket wrench M14 nut
16	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 5-11 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

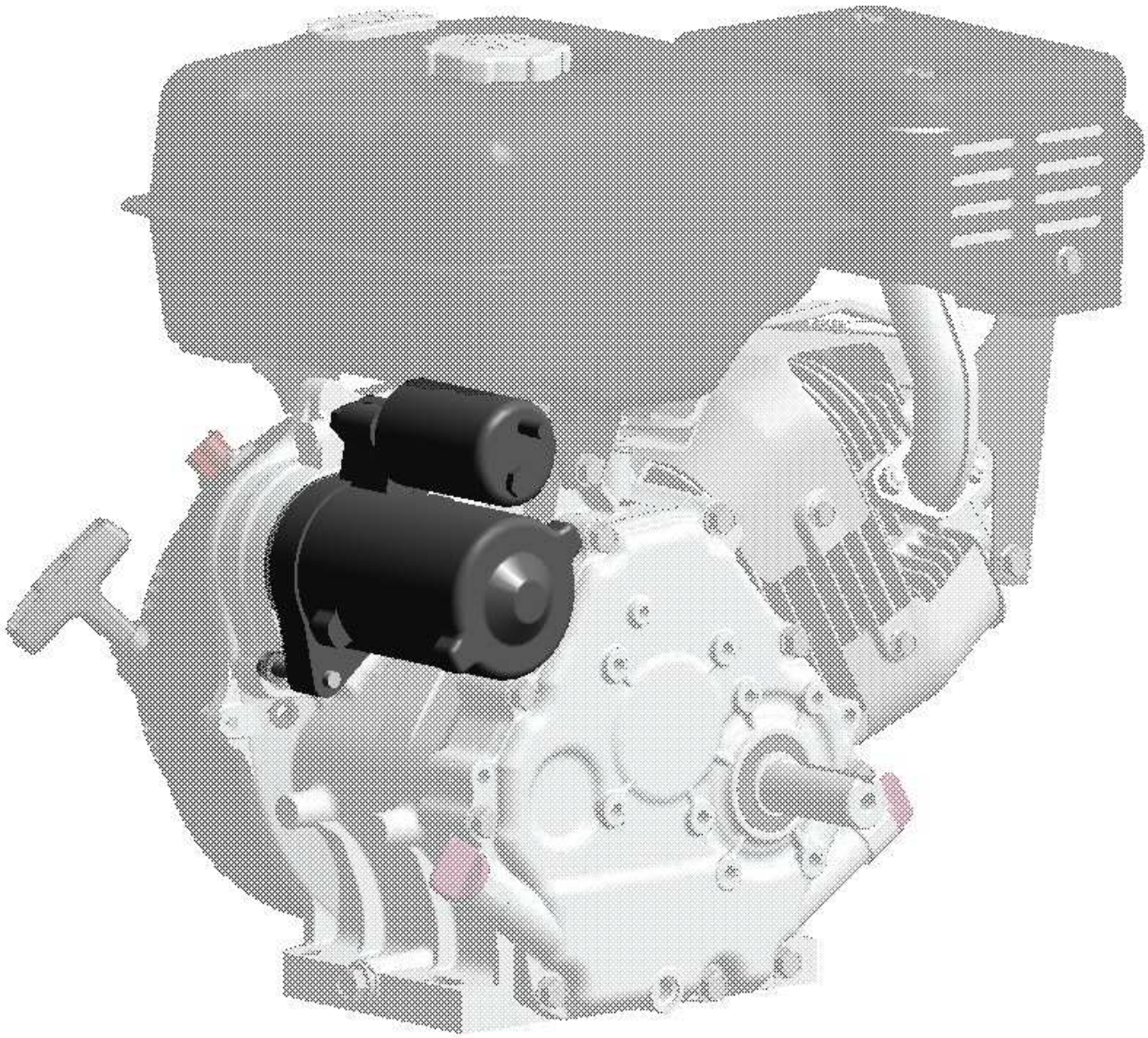




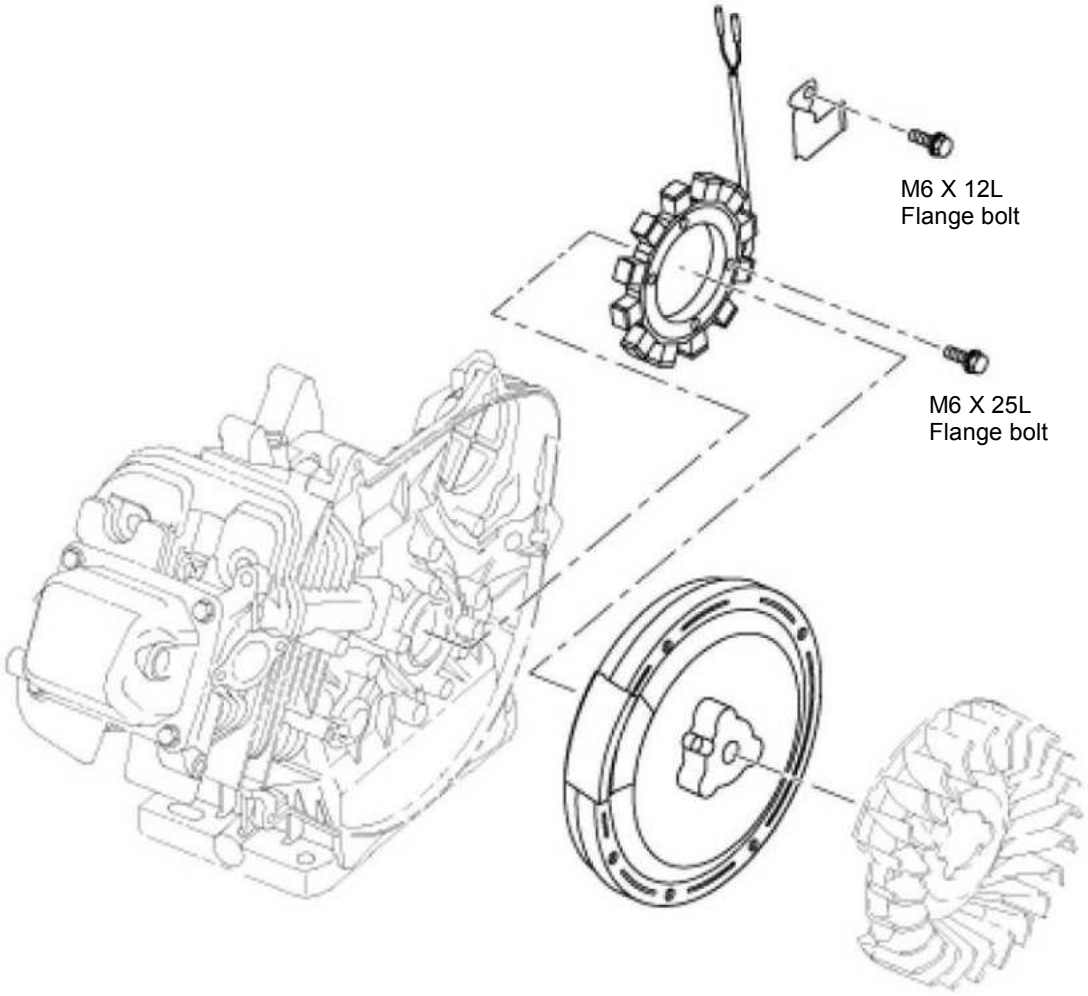
M6 X 25L
With washer



Step	Parts to remove	Remarks and procedures	Fasteners
17	**[MODEL WITH ELECTRIC STARTER TYPE]** Control box, Diode rectifier, Magnetic switch Electric starter (option)	(1) Disconnect the grounding cable from battery. (2) Disconnect the wire leading from the key switch "ST" terminal to the magnetic switch. (3) Disconnect the wire that connects the positive terminal of the battery to the magnetic switch. (4) Remove the electric starter. Remove the Baffle 1 from the crankcase.	12 mm box spanner M8 nuts 12 mm box spanner M8 x 12 mm : 1 pc.



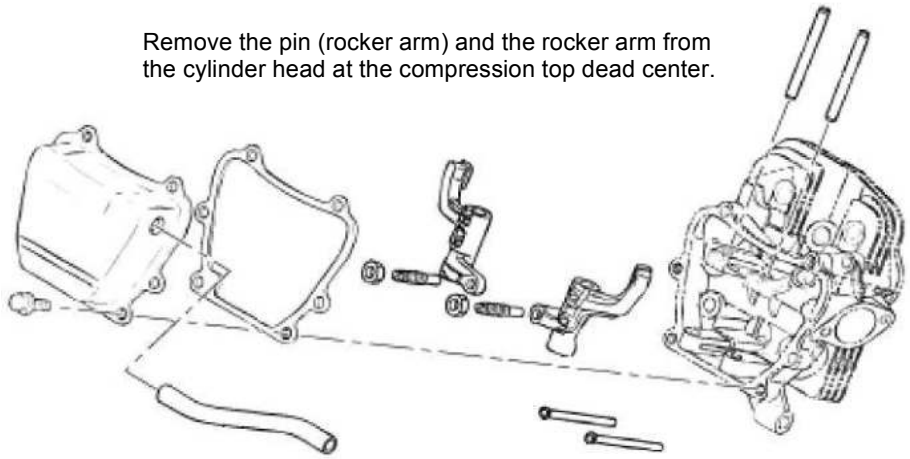
Step	Parts to remove	Remarks and procedures	Fasteners
18	**[MODEL WITH CHARGE COIL TYPE]** Wire clamp Charge coil	Disconnect the wire clamp. NOTE: Disconnect the wire clamp in this step, also an engine which has both of the charge coil and the oil sensor. However, please make sure do not damaged (cut off) the oil sensor wire after disassembly procedure. Remove the charge coil.	10 mm box spanner M6 x 10 mm : 1 pc. M6 2 to 4 pcs
19	Spark plug	Remove the spark plug from the cylinder head.	21 mm plug wrench



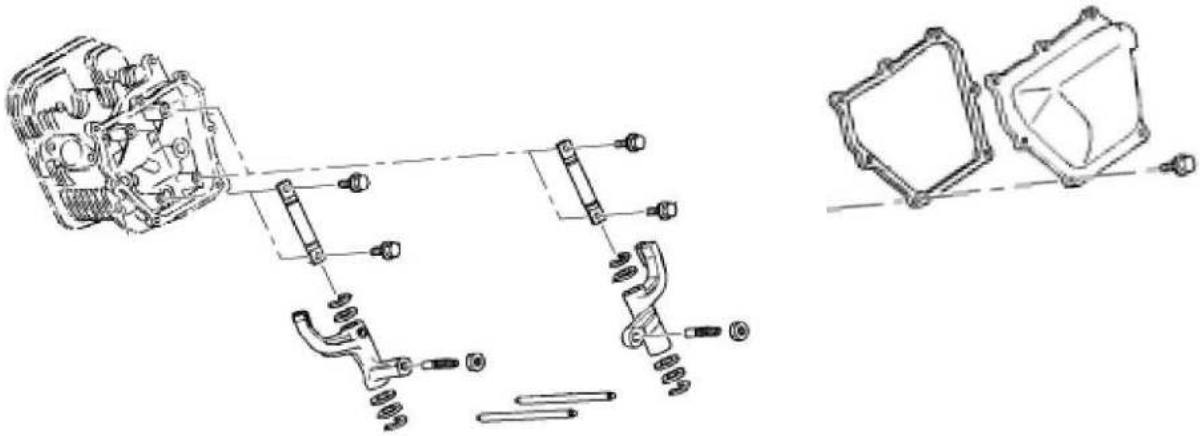
Step	Parts to remove	Remarks and procedures	Fasteners
20	Rocker cover	(1) Remove the rocker cover from the cylinder head. (2) Remove the gasket (rocker cover).	10 mm box spanner M6 x 12mm : 4 pcs.
21	Rocker arm	Remove the rocker arm.	10 mm box spanner 10 mm spanner hexagon wrench

EK13, 17, 20

Remove the pin (rocker arm) and the rocker arm from the cylinder head at the compression top dead center.

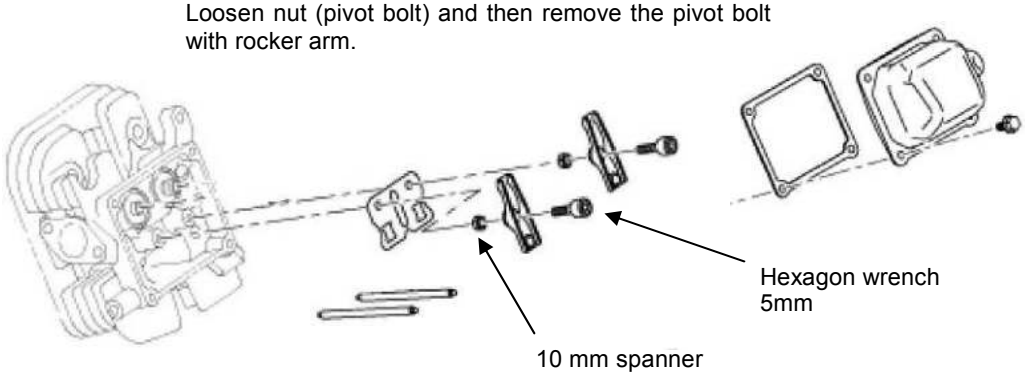


EK28



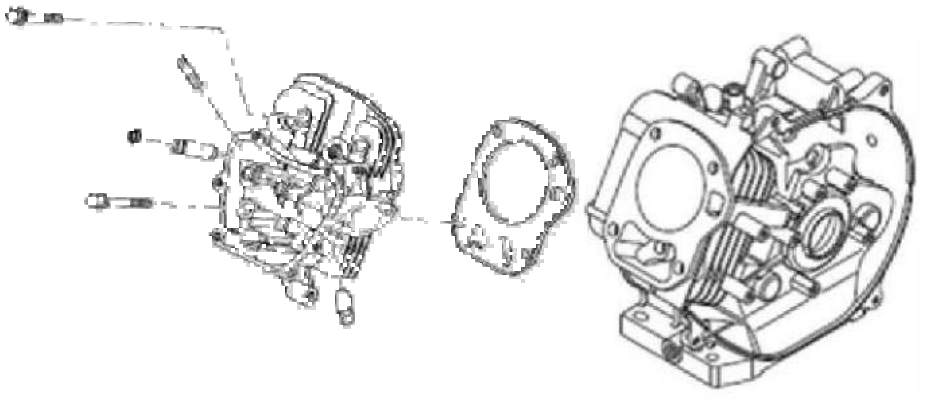
EK30

Loosen nut (pivot bolt) and then remove the pivot bolt with rocker arm.

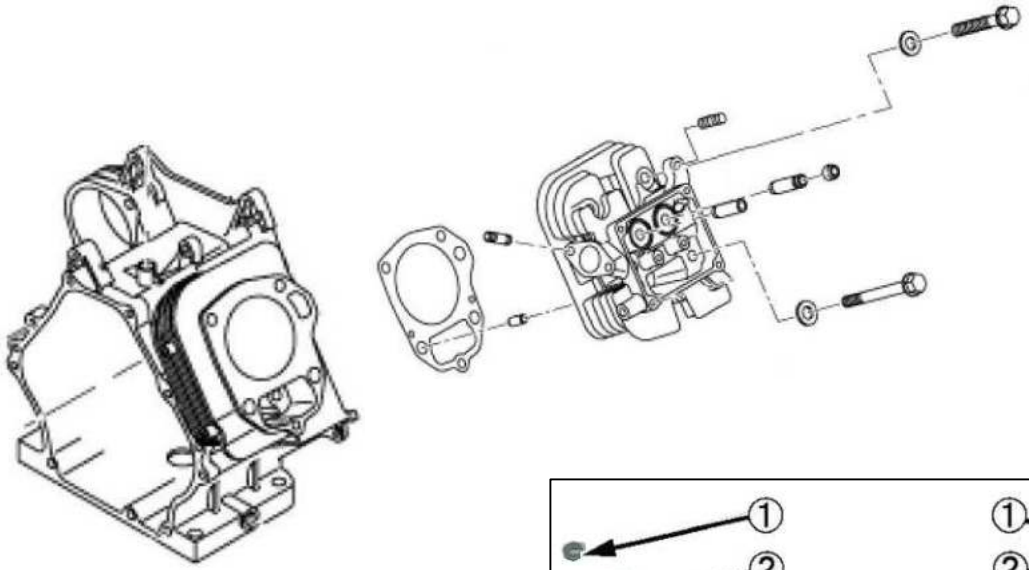


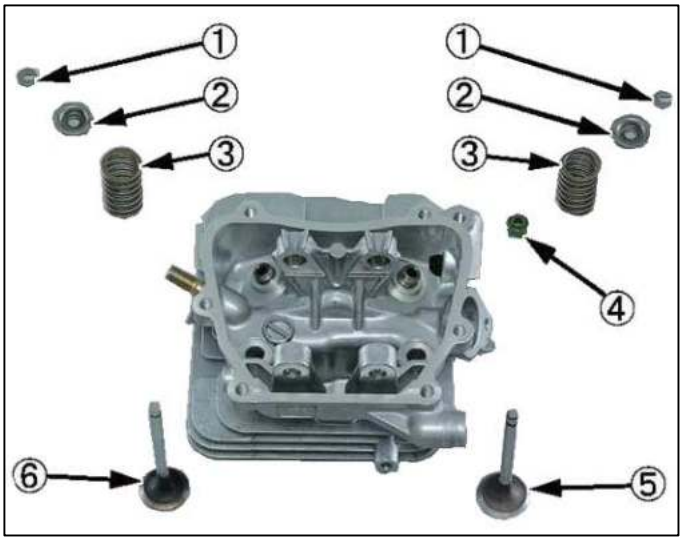
Step	Parts to remove	Remarks and procedures	Fasteners
22	Cylinder head	(1) Remove the cylinder head from the crankcase. (2) Remove the cylinder head gasket from the cylinder head. Take care not to lose the dowel pin.	box spanner 12 mm or 14 mm EK13,17,20 : M8 EK28,30 : M10
23	Intake and exhaust valves	(1) Remove the cotter from the spring retainer. (2) Remove the intake valve and the exhaust valve.	

EK13, 17, 20, 28



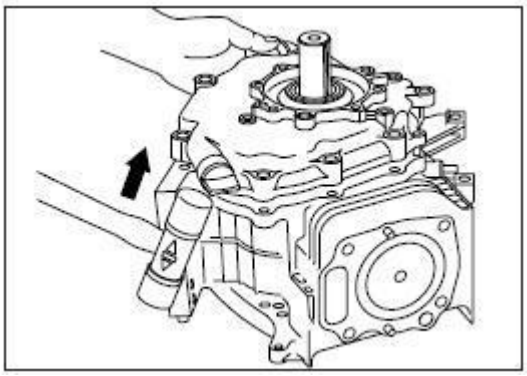
EK30



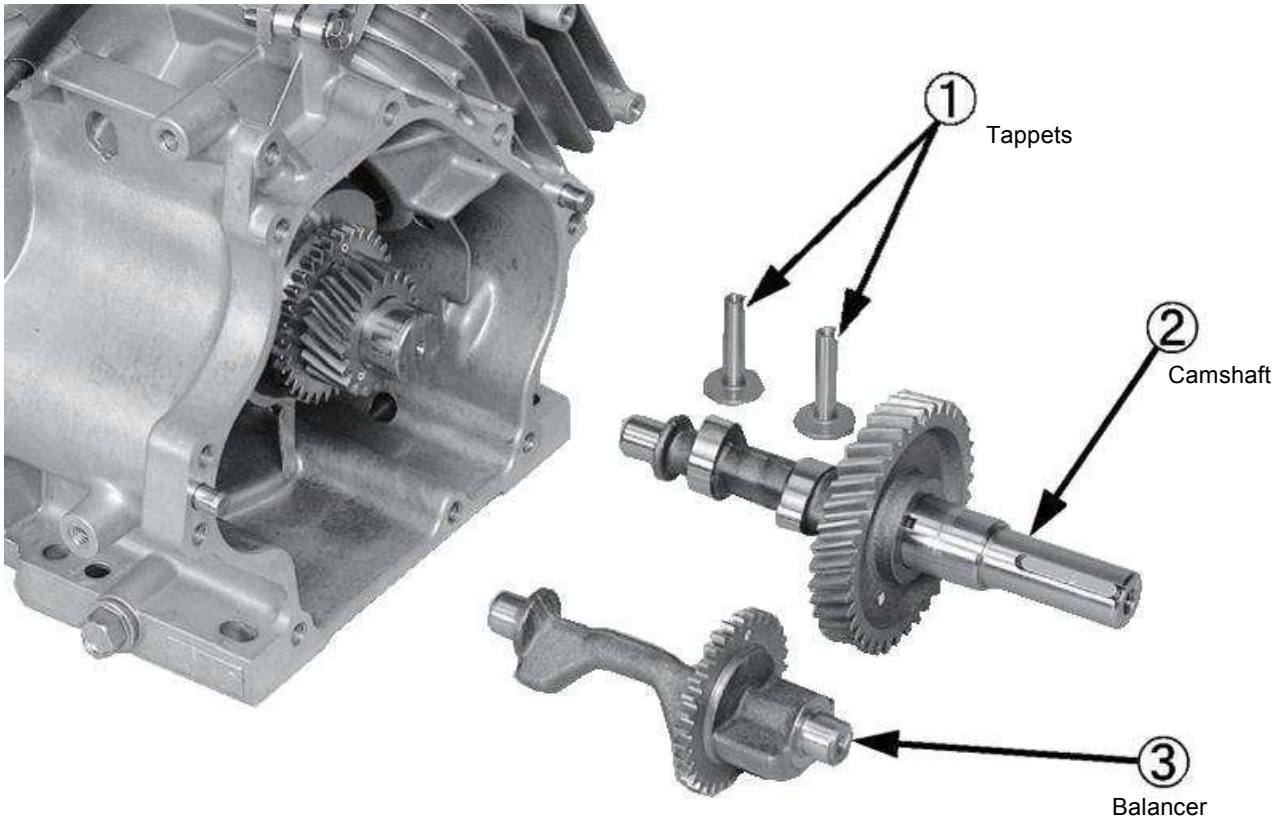


①Retainer lock
②Spring retainer
③Valve spring
④Oil seal
⑤Intake valve
⑥Exhaust valve

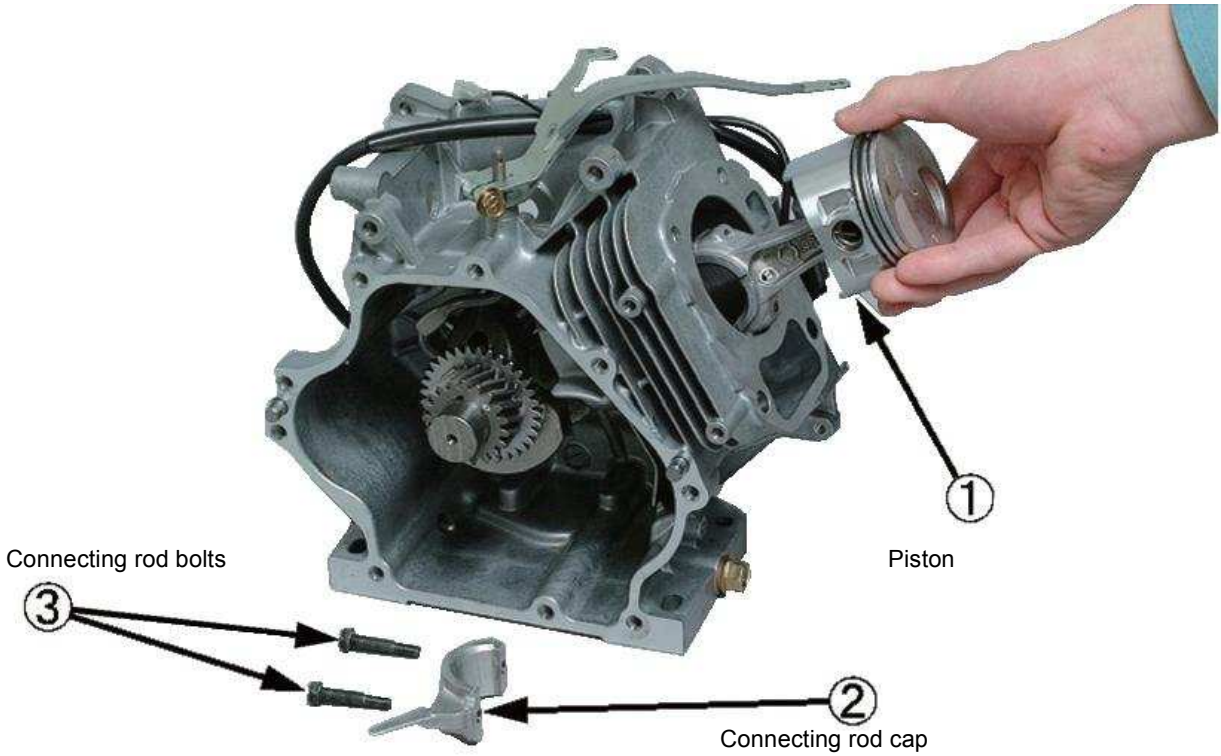
Step	Parts to remove	Remarks and procedures	Fasteners
24	Main bearing cover	Remove the flange bolts of main bearing cover from the crankcase. Remove the main bearing cover while tapping gently around the cover using a plastic hammer or similar tool. (See Fig.) Be careful not to damage the oil gauge or oil seal or not to lose the knock pins.	10 or 12 mm box spanner EK13 : M8 EK17,20,28,30: M8

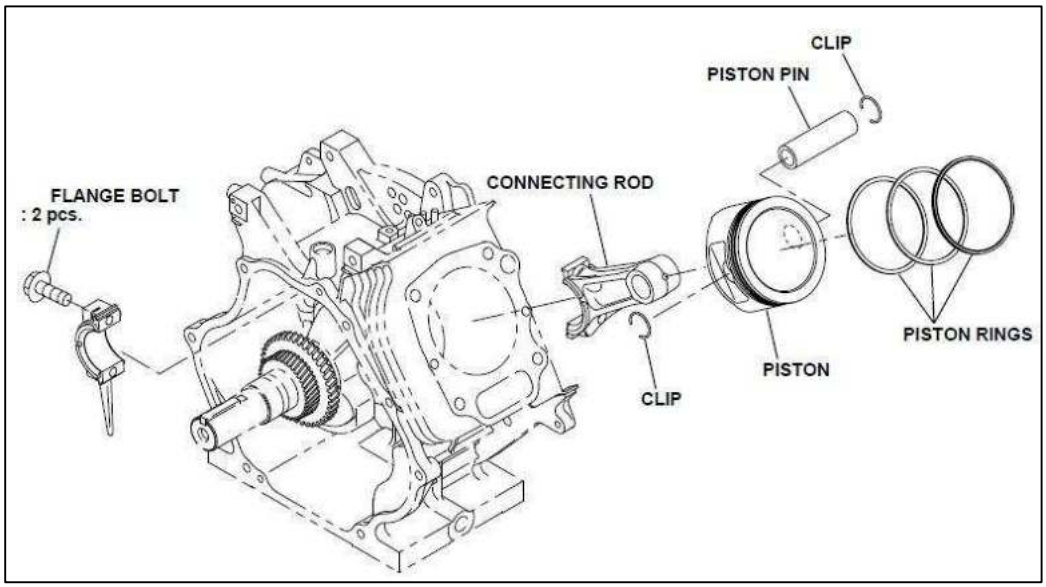


Step	Parts to remove	Remarks and procedures	Fasteners
25	Camshaft and tappets	Remove camshaft. Be careful not to damage camshaft and tappets.	
26	Balancer	Position piston at top dead center and remove balancer.	

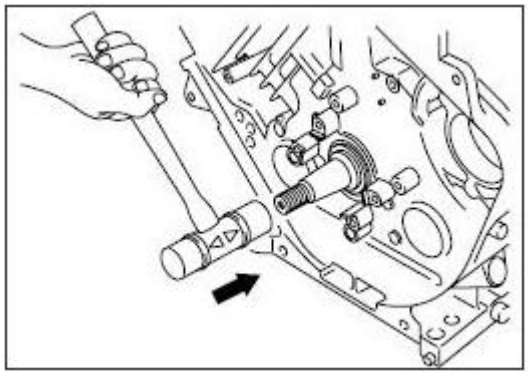


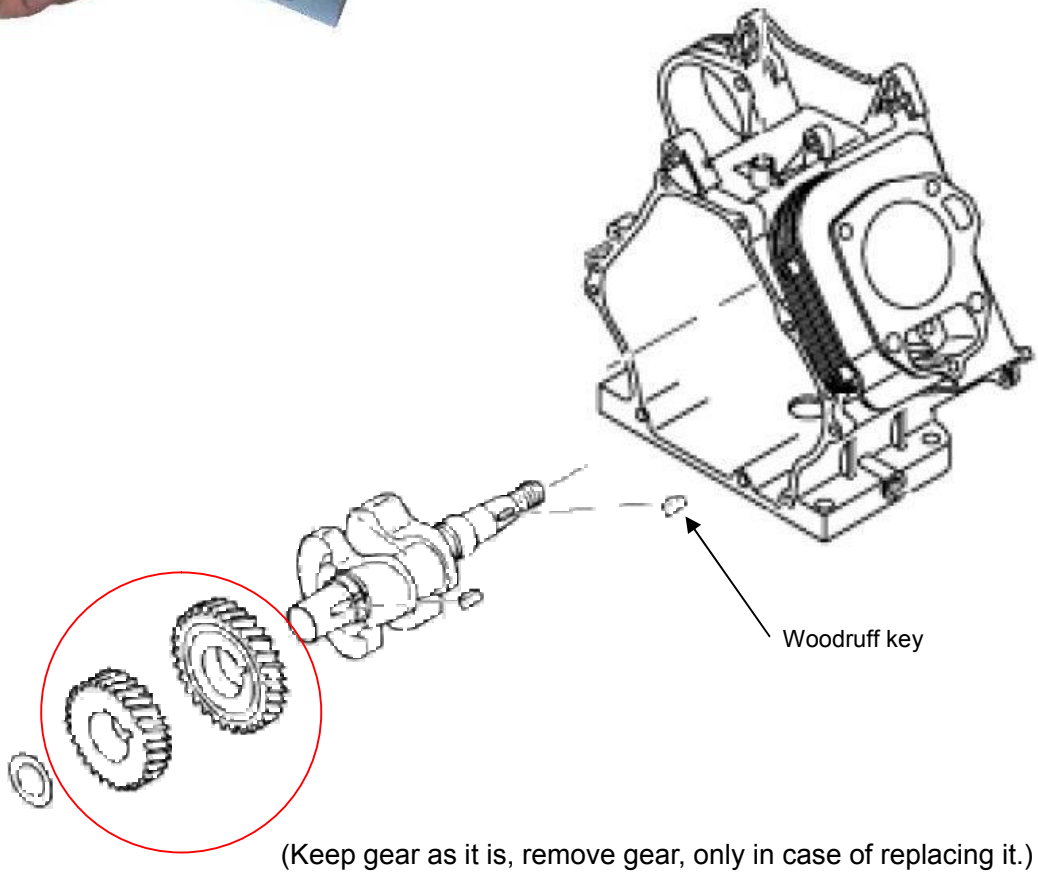
Step	Parts to remove	Remarks and procedures	Fasteners
27	Connecting rod and piston	(1) Scrape off any carbon from the cylinder and the piston head, and then remove the connecting rod bolt. (2) Remove the connecting rod cap. (3) Rotate the crankshaft until the piston comes to its top position. Push the connecting rod and remove the piston from the upper part of the cylinder.	EK13,17,20,30: 10mm box spanner EK28 : 12 mm box spanner
28	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.	





Step	Parts to remove	Remarks and procedures	Fasteners
29	Crankshaft	(1) Remove the woodruff key (for the flywheel magneto). (2) Hold the crankshaft by your hand and then remove the crankshaft from the crankcase by tapping its magneto side end with a plastic hammer, taking care not to damage the oil seal.	Plastic hammer
30	**[MODEL WITH OIL SENSOR TYPE]** Oil sensor	(1) Remove the clamp.[Model without charge coil type] (2) Remove the oil sensor from the crankcase.	





(Keep gear as it is, remove gear, only in case of replacing it.)

5-4 REASSEMBLY PROCEDURE

5-4-1 NOTES ON REASSEMBLY

(1) Clean 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.

5-4-2 ASSEMBLY STEPS AND PRECAUTIONS

(1) OIL SENSOR

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

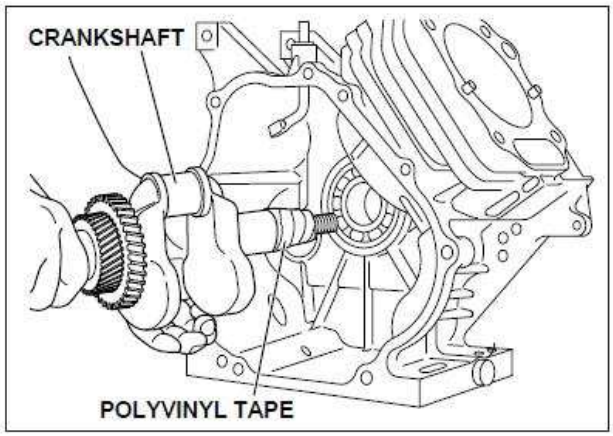
Tightening torque
8.0 - 10.0 N・m (80 - 100 kgf・cm) (5.8 - 7.2 ft・lb.)

NOTE:

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

(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:

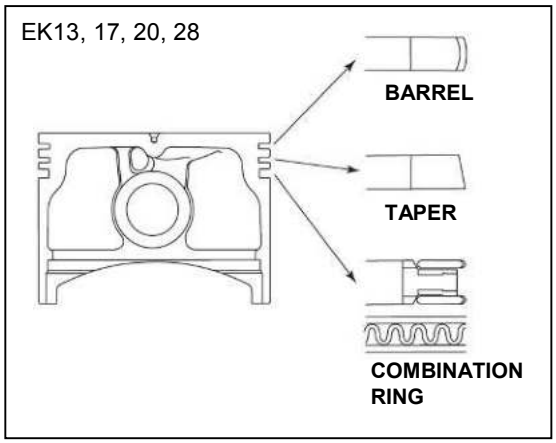
Do not insert the woodruff key before inserting the crankshaft into the crankcase.

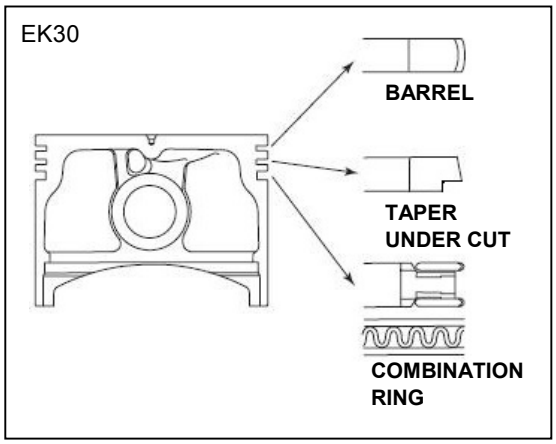
(3) PISTON AND PISTON RINGS

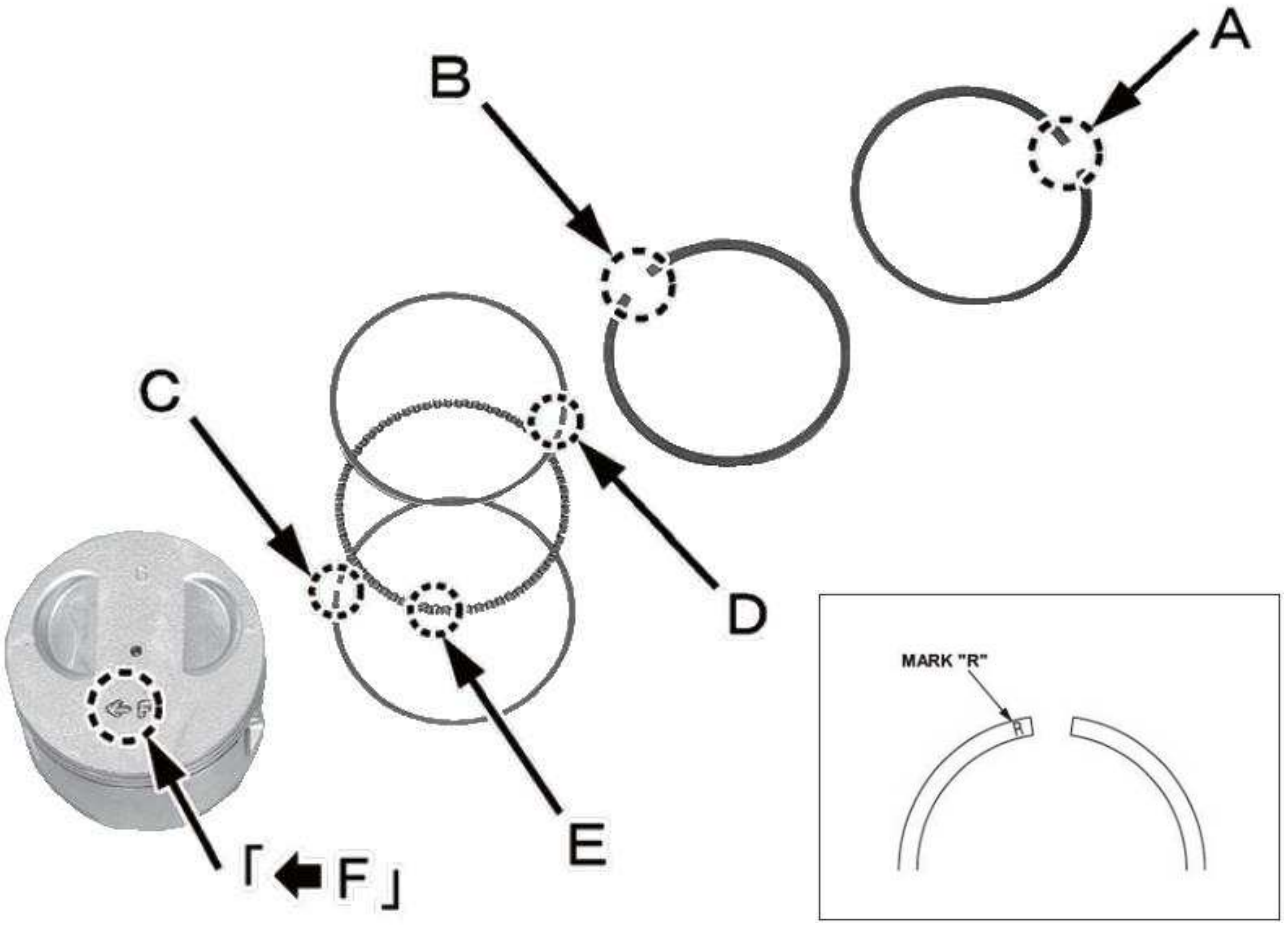
(a) Install each piston ring in the correct groove of the piston by widening it enough to slide it over the piston.

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 "1R or 2R" mark is face up.







(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 "←F" on the piston head with the 'MAG' mark on the connecting rod.

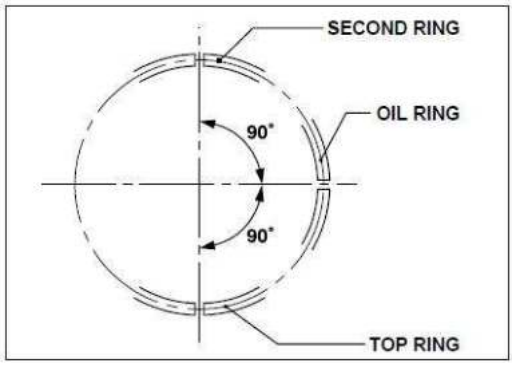
NOTE 1: Before assembling the connecting rod, apply oil to its small end.

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

(5) CONNECTING ROD

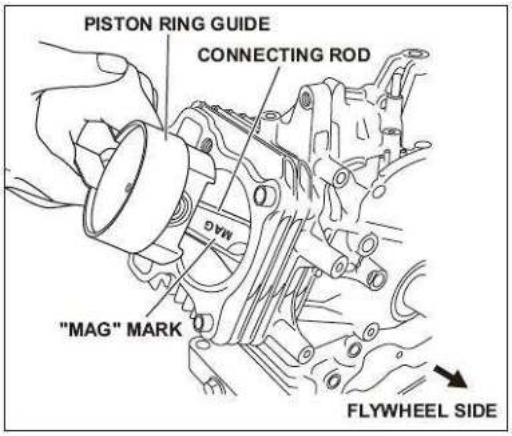
NOTE 1:
Apply oil to the piston rings, the large end of the connecting rod and cylinder before installing the connecting rod into the cylinder.

NOTE 2:
Set gaps of the piston rings 90 degrees apart from each other before assembly.



(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.)



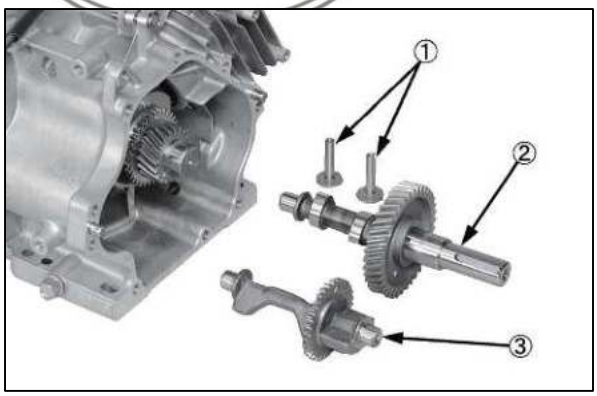
(b) Rotate the crankshaft down to the bottom dead center and lightly tap the piston head until the large end of the connecting rod touches the crank pin.

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

Model	Tightening torque	Bolt	box wrench
EK13,17,20	8.8 – 12.8 N・m (90 - 130 kgf・cm)	M6X1.0X33L	10mm
EK28	23.6 – 29.4 N・m (240 – 300 kgf・cm)	M8X1.25X42L	12mm
EK30	15.5 – 18.5 N・m (160 - 190 kgf・cm)	M7X1.0X40L	10mm

(6) BALANCER SHAFT

Install balancer shaft to crankcase aligning matching mark of balancer gear and crank gear as shown in the illustration.



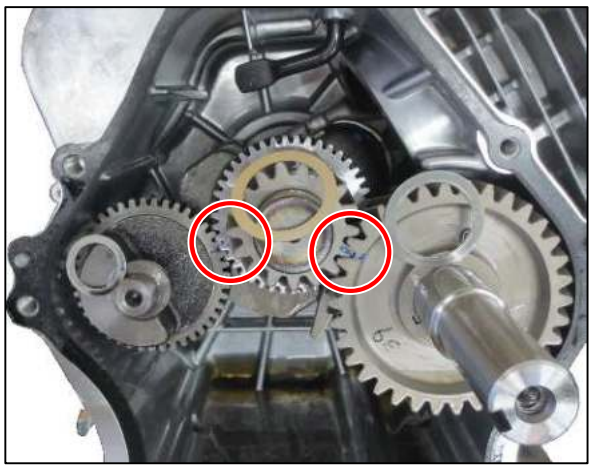
CAUTION :

Incorrect timing of the gears will cause malfunction of the engine and may results in damage due to interference of the parts.

(7) TAPPETS AND CAMSHAFT

(a) Oil the tappets and install them.
Push in fully to avoid damage during camshaft installation.

(b) Lubricate bearing surfaces of camshaft.
Align the timing mark on crankshaft gear with the timing mark on camshaft and install camshaft in the crankcase.

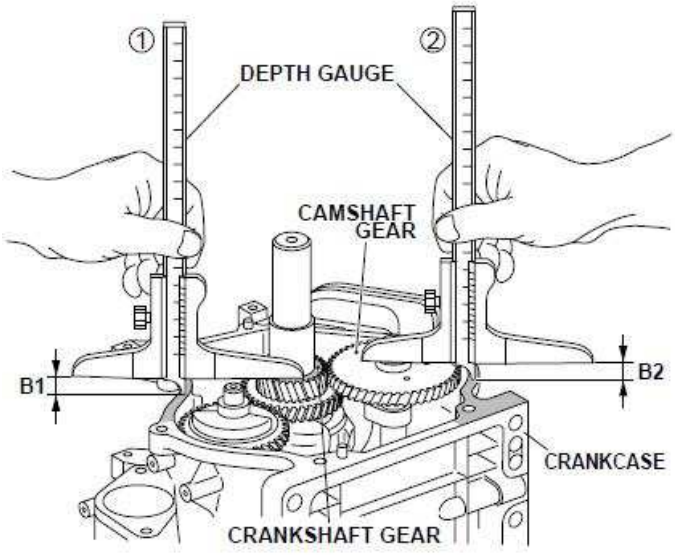


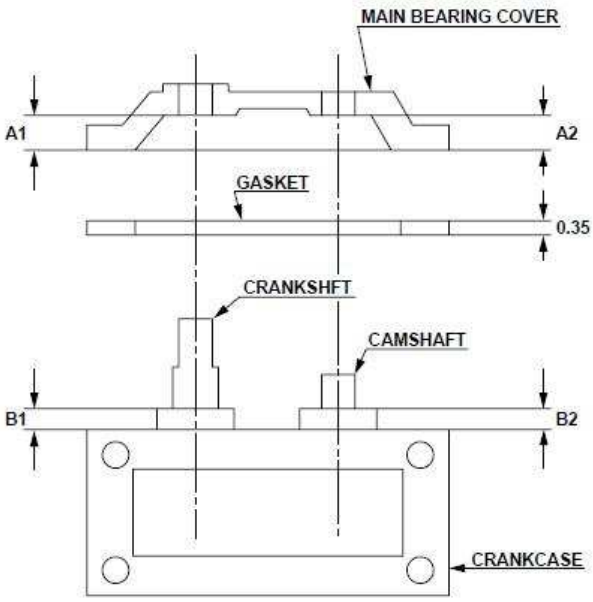
CAUTION :

Incorrect valve timing will cause malfunction of the engine.

(8) ADJUST CRANKSHAFT AND CAMSHAFT END PLAY

Adjust end play to the specified values using the proper spacer.
The proper spacer may be determined following manner.





(9) CRANKSHAFT END PLAY (For type B)

a) Measure the depth “A1” (From the mating surface to the inner race of the ball bearing.)

b) Measure the height “B1” (From the mating surface to the crank gear.)

(A1+0.35)-B1= SIDE CLEARANCE (mm)

(SIDE CLEARANCE)-0.2 mm = THICKNESS OF CRANKSHAFT SHIM (mm)

(A1+0.014)-B1= SIDE CLEARANCE (in.)

(SIDE CLEARANCE)-0.008 in. = THICKNESS OF CRANKSHAFT SHIM (in.)

Following are available spacer shims. (mm)

	CRANKSHAFT				BLANCER	
	EK13	EK17,20	EK28	EK30	EK17,20,EK28	EK30
SPACER SHIMS	T= 0.20 T= 0.25 T= 0.30 T= 0.35 T= 0.40 T= 0.45 T= 0.50 T= 0.55	T= 0.10 T= 0.20 T= 0.25 T= 0.30 T= 0.35 T= 0.40 T= 0.45 T= 0.50 T= 0.55 T= 0.60	T= 0.20 T= 0.25 T= 0.30 T= 0.35 T= 0.40 T= 0.45 T= 0.50 T= 0.55 T= 0.60	T= 0.20 T= 0.40 T= 0.60	T= 0.50 T= 0.60 T= 0.70 T= 0.80 T= 0.90 T= 1.00 T= 1.20	T= 0.50 T= 0.70 T= 0.90

(10) CAMSHAFT END PLAY (For type B)

a) Measure the depth “A2” (From the mating surface to the inner race of the ball bearing.)

b) Measure the height “B2” (From the mating surface to the cam gear inner boss.)

(A2+0.35)-B2 = SIDE CLEARANCE (mm)

(SIDE CLEARANCE)-0.2 mm = THICKNESS OF CAMSHAFT SHIM (mm)

(A2+0.014)-B2 = SIDE CLEARANCE (in.)

(SIDE CLEARANCE)-0.008 in. = THICKNESS OF CAMSHAFT SHIM (in.)

Following are available spacer shims. (mm)

	CAMSHAFT			
	EK13	EK17, 20	EK28	EK30
SPACER SHIMS	T= 0.20 T= 0.25 T= 0.30 T= 0.35 T= 0.40 T= 0.45 T= 0.50 T= 0.55	T= 0.10 T= 0.20 T= 0.25 T= 0.30 T= 0.35 T= 0.40 T= 0.45 T= 0.50	T= 0.20 T= 0.30 T= 0.35 T= 0.40	T= 0.20 T= 0.40

(11) MAIN BEARING COVER

Apply oil to the oil seal lip and bearing surfaces before mounting the main bearing cover. Also add a light film of oil on main bearing cover face to hold the gasket in place. Place spacers chosen at procedure (1) on crankshaft and camshaft.

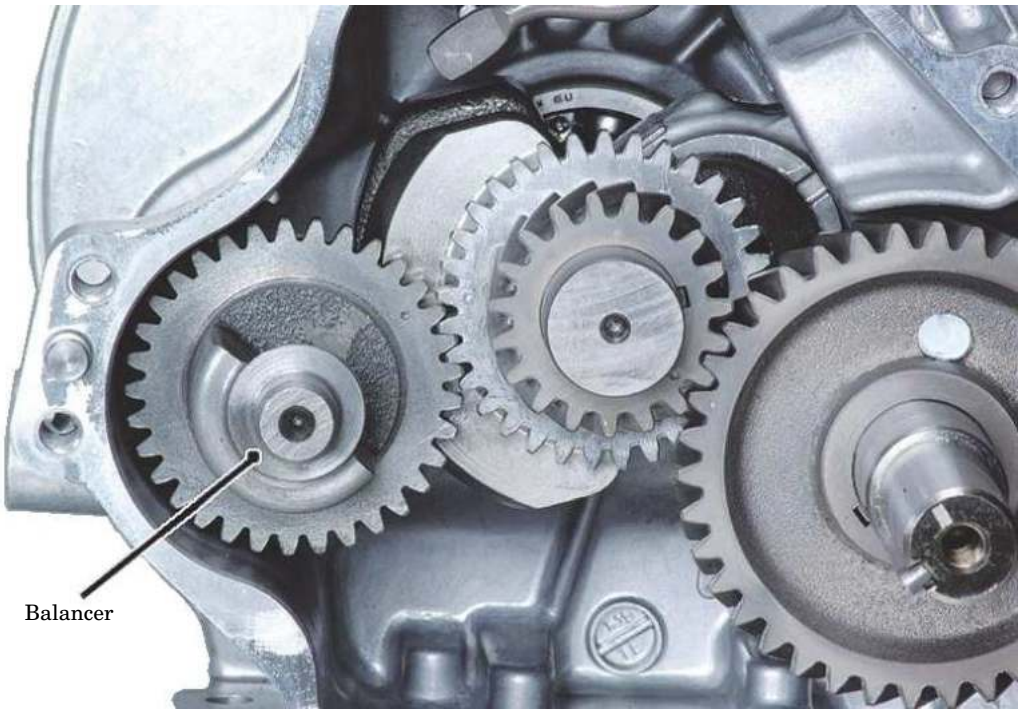
Use an oil seal guide when installing the main bearing cover to avoid damaging the oil seal lip.

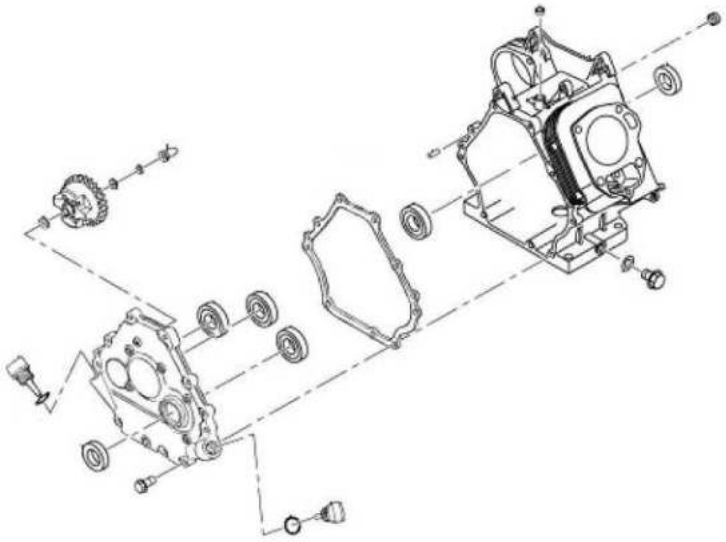
Tap the cover into place with a soft hammer.

NOTE ;

Oil the bolt threads first, and then tighten the flange bolts.

Model	Tightening torque	Bolt	box wrench
EK13	10 – 140 N・m (100 - 140 kgf・cm)	M6X1.0X33L	10mm
EK17,20,28,30	22 – 30 N・m (220 - 300 kgf・cm)	M8X1.0X40L	12mm





(12) 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 76 and 77.)

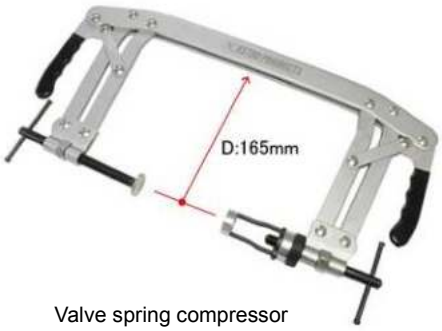
NOTE 2:

Carefully scrape off any carbon deposits on the combustion chamber.

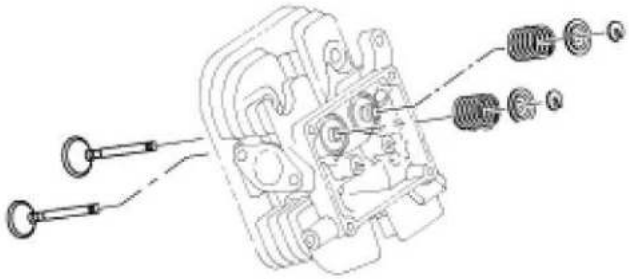
Apply oil to the valve stems before mounting the intake and exhaust valves.

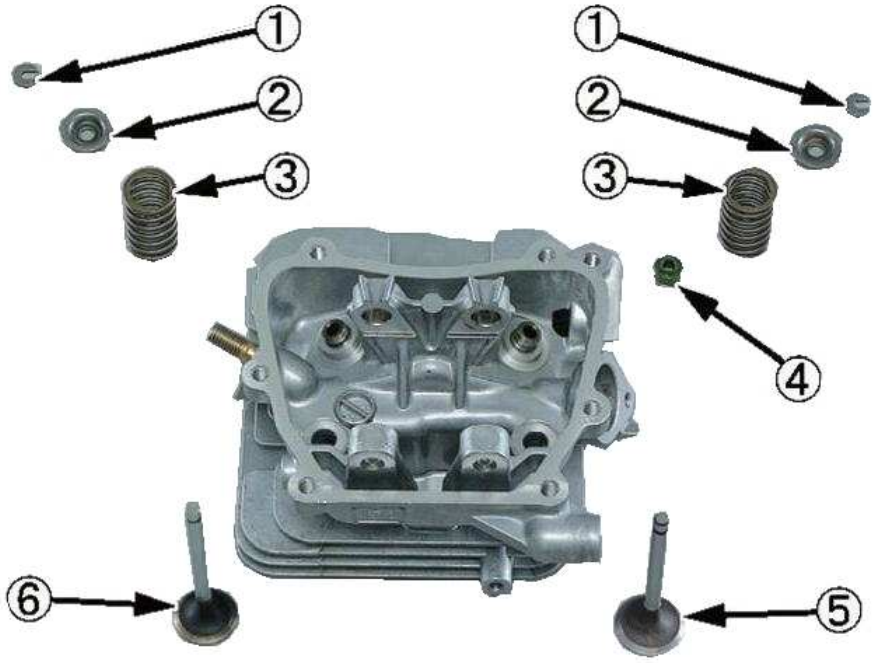
Insert the valves in the cylinder head and place it on a level workbench.

Next, mount the valve springs, the spring retainers and collets valves.
(Mount the stem seal on the intake valve guide.)



Valve spring compressor





①Retainer lock
②Spring retainer
③Valve spring
④Oil seal
⑤Intake valve
⑥Exhaust valve

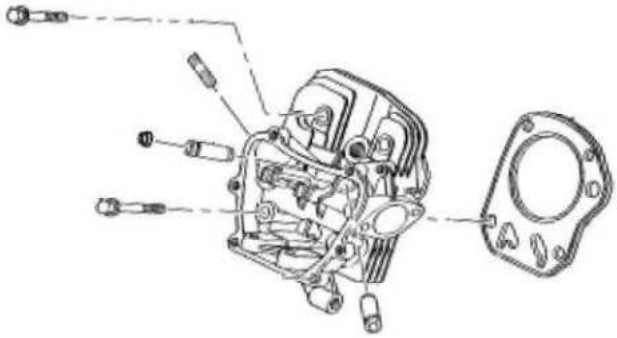
(13) CYLINDER HEAD

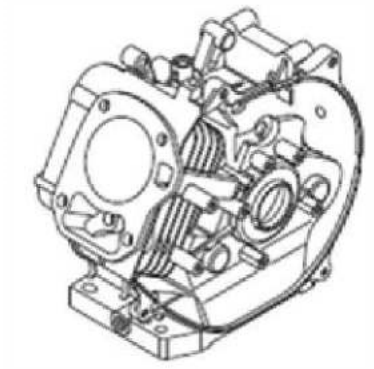
Install cylinder head to cylinder with new head gasket.

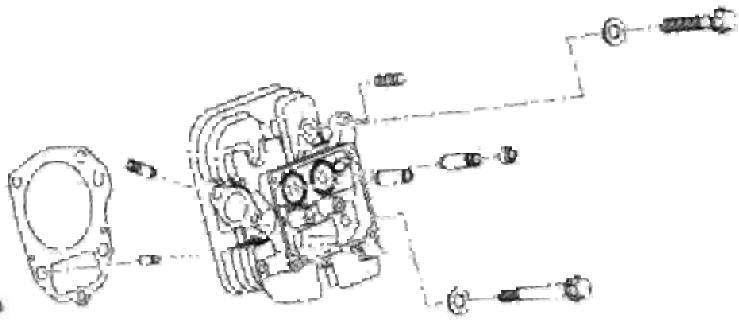
Tighten four flange bolts evenly in three steps by the following tightening torque:

Cylinder head bolt:
EK13, 17, 20; M8X1.25X60L-2pc / M8X1.25X85L-2pcs
EK28; M10X1.5X66L-2pcs / M10X1.5X100L-2pcs
EK30; M10X1.5X66L-2pcs / M10X1.5X86L-2pcs

Model	Tightening torque		
	1 st step	2 nd step	Final Step
EK13,17,20	9.8 N· m (100 kgf· cm)	19.6 N· m (200 kgf· cm)	24.5-35.3 N· m (250-360 kgf· cm)
EK28,30	9.8 N· m (100 kgf· cm)	19.6 N· m (200 kgf· cm)	41.2-50.0 N· m (420-510 kgf· cm)







EK30

EK13, 17, 20

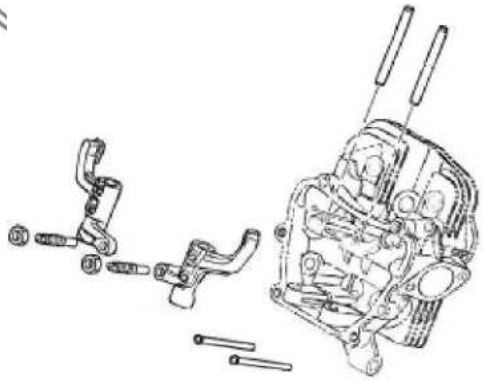
(14) ROCKER ARMS AND PUSH RODS

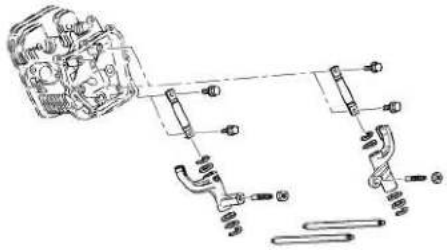
Temporally fit the flywheel in position for easy operation.

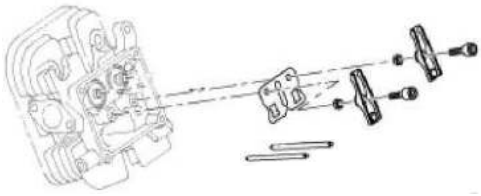
NOTE 1: Conduct this job at the compression top dead center.

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.

NOTE 3: Check and adjust valve clearance while engine is cold.







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

- EK13,17,20,28; Pass the pin (rocker arm) through the rocker arm and mount them on the cylinder head
- EK30 ; Apply oil to rocker arms and assemble them to cylinder head using pivot and nut.

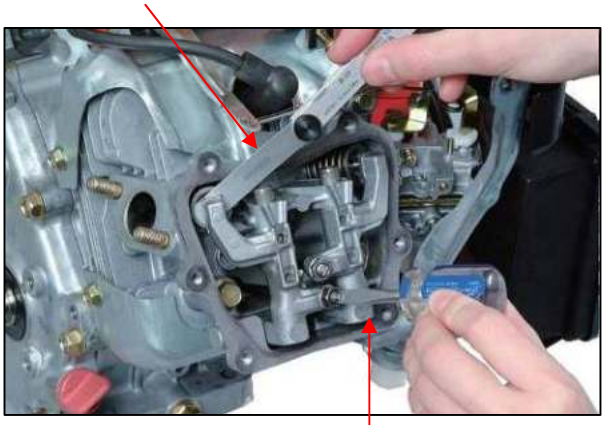
(b) Adjustment method

- EK13,17,20,28;

  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 (Intake and Exhaust)
EK13	0.15 - 0.20 mm
EK17	0.10 - 0.15 mm
EK20	0.12 - 0.17 mm
EK28	0.07 - 0.12 mm

Thickness gauge



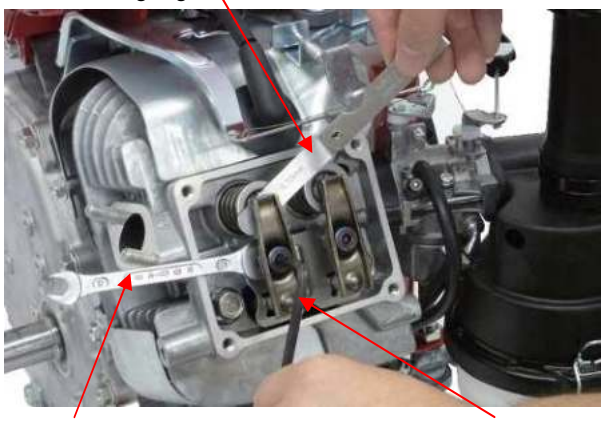
Thickness gauge Minus driver

- EK30 ;

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

  Tighten the nut on rocker arm

	Valve clearance (Intake and Exhaust)
EK30	0.07 - 0.12 mm



10 mm spanner Hexagon wrench 5mm

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

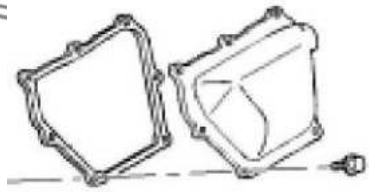
(15) ROCKER COVER

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

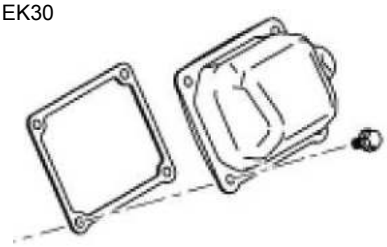
EK13, 17, 20: M6×1.0×12 mm bolt & washer AY: 6 pcs.
EK28: M6 × 1.0 × 12 mm bolt & washer AY: 7 pcs.
EK30: M6 × 1.0 × 12 mm flange bolt: 4 pcs.

Tightening torque
5.0 - 7.0 N・m (50 - 70 kgf・cm)

EK13, 17, 20, 28



EK30

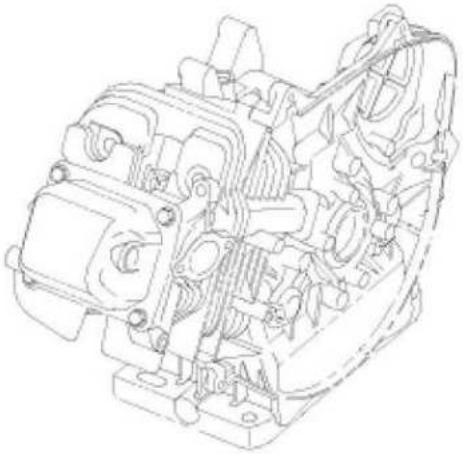


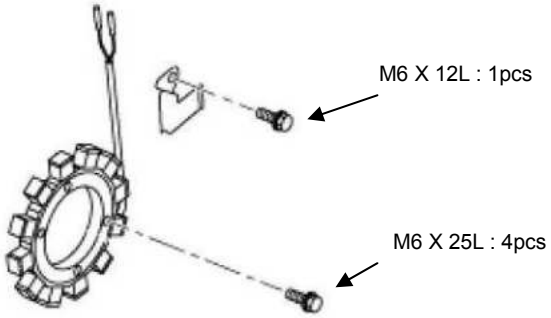
(16) FLYWHEEL, COOLING BLOWER and STARTING PULLEY

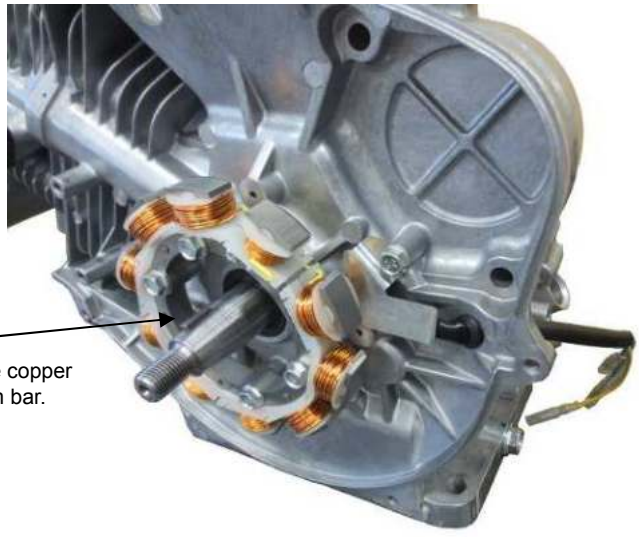
NOTE: When mounting the flywheel, be sure to wipe off any oil on the tapered part of the crankshaft and flywheel.

a) Mount the woodruff key on the crankshaft.
b) Mount the charge coil and clamp (option)

Tightening torque
6.0 - 8.0 N・m (60 - 80 kgf・cm)







c) Mount the spark plug. (21 mm plug wrench)

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

Model	EK13,17,20,28	EK30
Spark plug	NGK BP6HS	TORCH E6TC
Electrode gap	**0.6 - 0.7 mm (0.024 - 0.028 in.)**	**0.6 - 0.7 mm (0.024 - 0.028 in.)**

Tightening torque

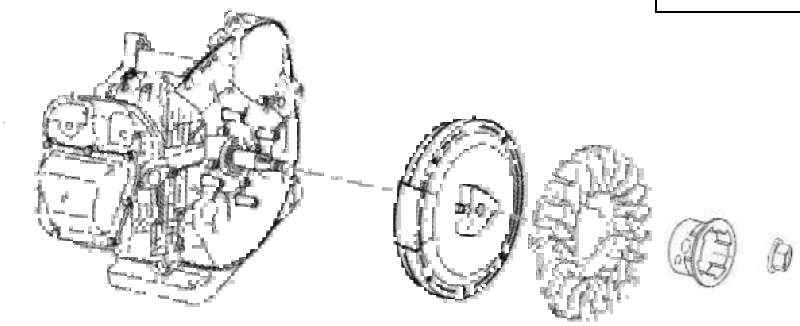
New spark plug 12.0 - 15.0 N・m (120 - 150 kgf・cm)
Re-tightening torque 23.0 - 27.0 N・m (230 - 270 kgf・cm)

d) Mount the flywheel on the crankshaft.

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

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

Model	Tightening torque	Nut	box wrench
EK13	30 – 49 N・m (300 - 500 kgf・cm)	M12	17mm
EK17,20	60 –75 N・m (600 - 750 kgf・cm)	M14	19mm
EK28,30	70 – 85 N・m (700 - 850 kgf・cm)	M14	19mm



(17) IGNITION COIL

Insert the high tension cord and primary wire from the ignition coil into the notch of the crank case so that not to pinch the cord.

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

Model	EK13,17,20,28	EK30
Air gap	**0.4 - 0.6 mm (0.016 - 0.024 in.)**	**0.3 - 0.5 mm (0.012 - 0.020 in.)**

Tightening torque

8.0 – 11.0 N・m (80 - 110 kgf・cm)
M6 X 25L : 2pcs

(18) BAFFLE (CASE)

BLOWER HOUSING, RECOIL STARTER and STOP SWITCH

The projection (upper) on the baffle 1 and 2 with the crankcase and mount it (under) with the bolt.

(a) BAFFLE
EK13, 17, 20, 28:
M6×1.0×10 mm flange bolt: 1 pc
M6×1.0×12 mm tapping bolt: 2 pcs

EK30:
M6×1.0×12 mm flange bolt: 3 pcs

(b) Attach blower housing to crankcase at the under cylinder baffle.
Tighten flange bolts : M6 × 12 mm flange bolt: 3 pcs.

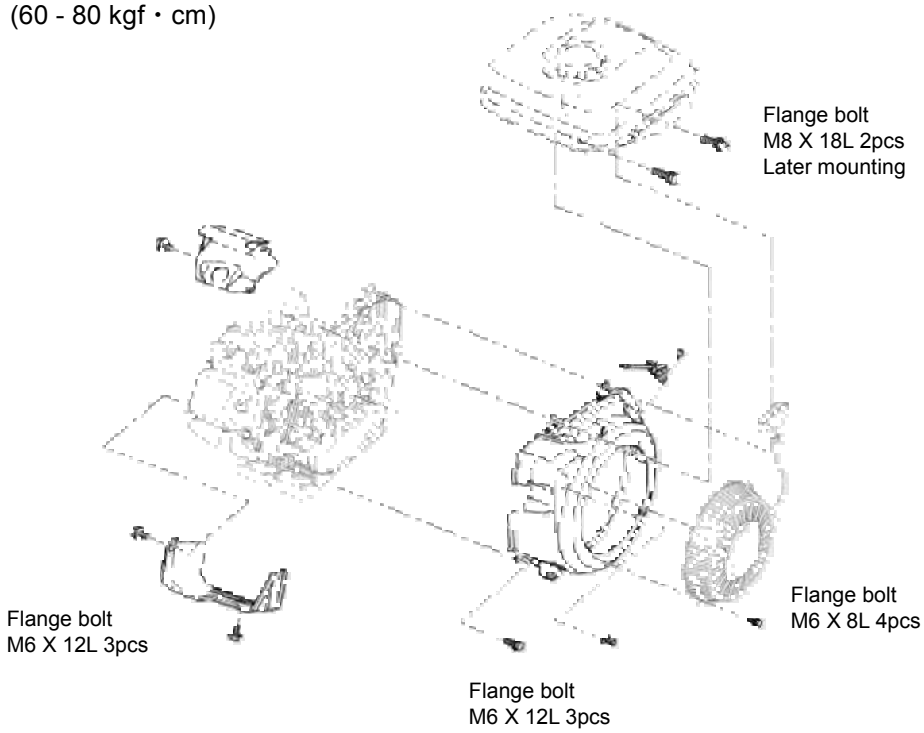
(c) Install recoil starter to blower housing: M6 × 8 mm flange bolt: 4 pcs.

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

(e) Mount the bracket UN (front cover) to the blower housing: M6 × 12 mm flange bolt: 2 pcs.

(f) Attach the muffler bracket to the cylinder head.
Temporarily fit the flange bolt : M8×1.25×16L flange bolt: 1 pc

Tightening torque
6.0 – 8.0 N・m (60 - 80 kgf・cm)



(19) INSULATOR, CARBURATOR and AIR CLEANER BASE

(a) Install bolts to cleaner base,

(b) Install gasket for cleaner base to cleaner base.

(c) Install the carburetor.

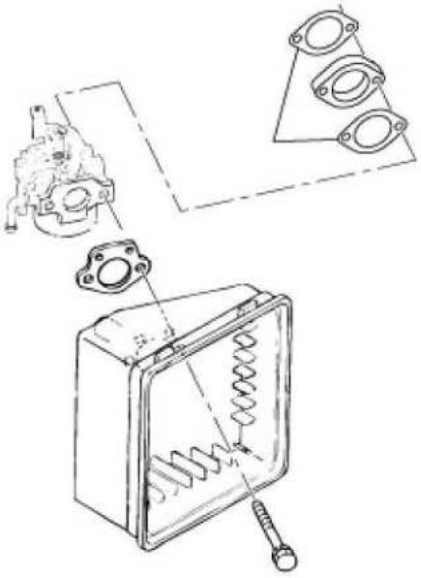
(d) Install insulator and gasket and then mount to cylinder head.

Insert the breather pipe into the rocker cover and then mount the air cleaner base.

The following are positions to insert for each type of element：

a): Urethane element type and dual element type
b): Oil bath

M6 flange bolt: 2 pcs



Bolt with washer
M6 X 80L 2pcs

Bolt with washer
M6 X 134L 1pc
M6 X 147L 1pc

(20) SPEED CONTROL LEVER and BRACKET

(a) Attach speed control lever and bracket

(b) Pass the governor rod through the rod spring, and then connect to the throttle lever of the carburetor.

(c) Attach the governor rod and rod spring to the governor lever, then mount the governor lever on the governor shaft. Do not adjust the bolt on the governor lever yet.

(d) Connect the governor lever and the speed control lever with the governor spring.

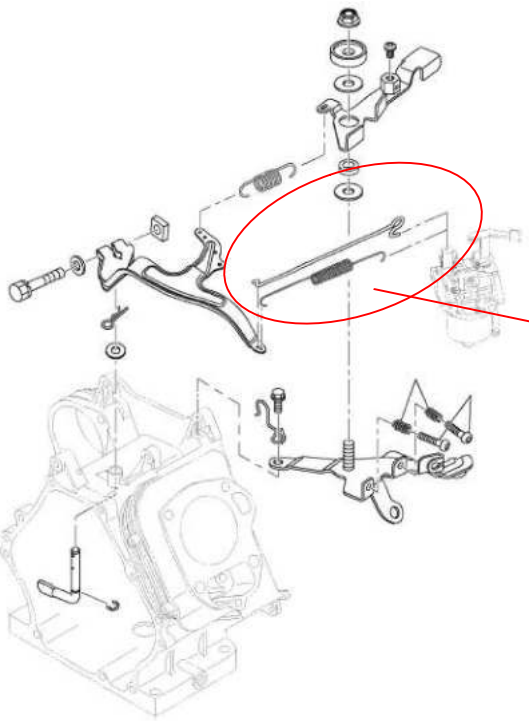
(e) Governor system adjustment method.

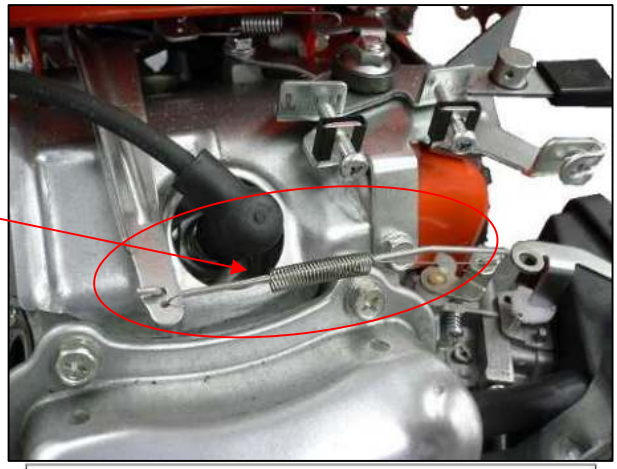
The governor unit is a centrifugal flyweight type and is installed on the governor gear.

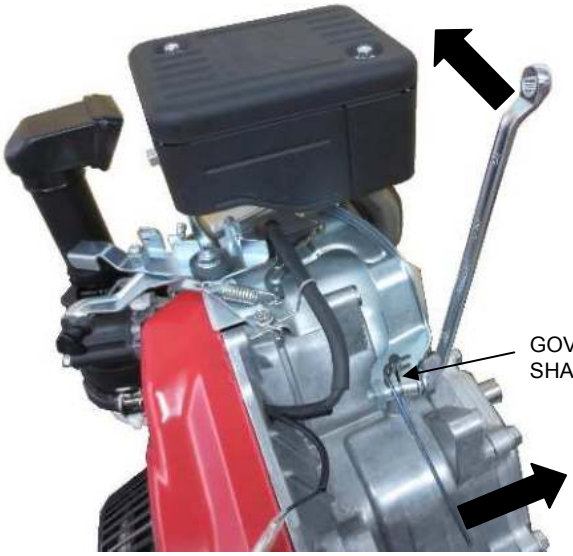
Since it automatically adjusts the throttle valve of the carburetor by means of a link mechanism, it is possible to maintain a constant engine speed, even with load variations.

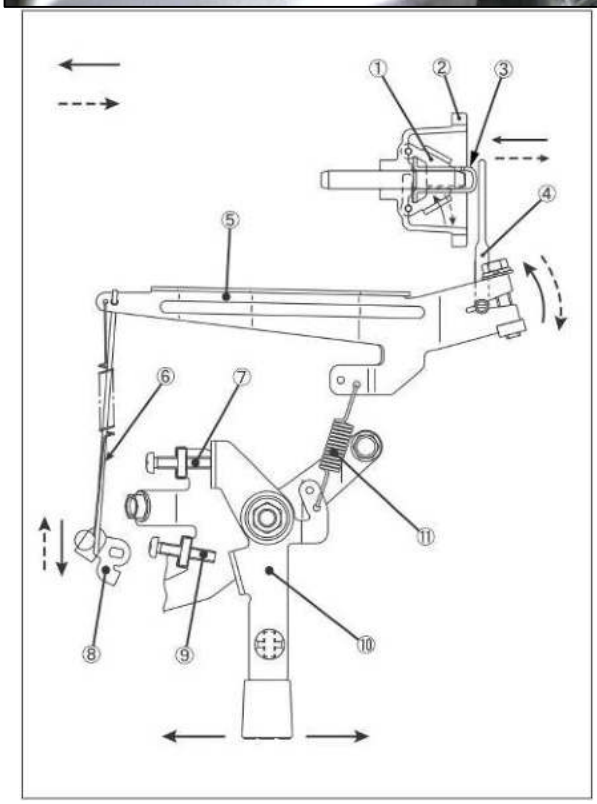
- Turn the speed control lever to the full speed position, making sure that the carburetor throttle valve is fully open.
- Hold the top of the governor shaft with the pliers and turning it **counterclockwise** as far as it will go.

Tighten the bolt on the governor lever.









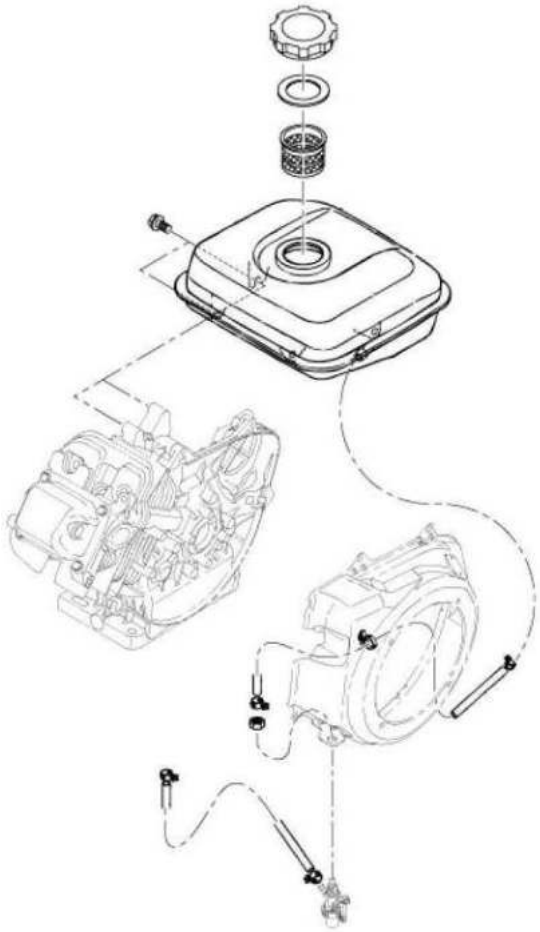
(21) FUEL TANK and FUEL STRAINER

a) Mount the fuel tank to the crankcase, and connect the fuel pipe to the fuel tank and the fuel strainer. Hold the fuel pipe with the clamp on the blower housing, and then tighten the bolts and nuts for the fuel tank.

M8 × 25 mm bolt : 4 pcs.

b) Connect the fuel pipe to the fuel strainer and the carburetor. Mount the fuel strainer to the speed control bracket.

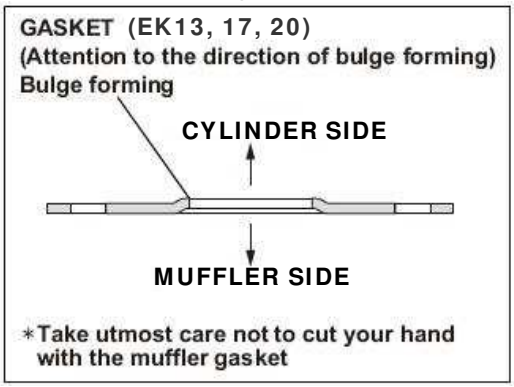
M6 × 12 mm Bolt : 1 pc.

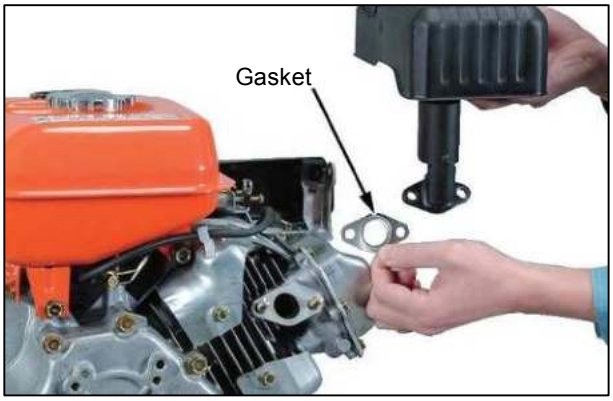


(22) MUFFLER

a) 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.



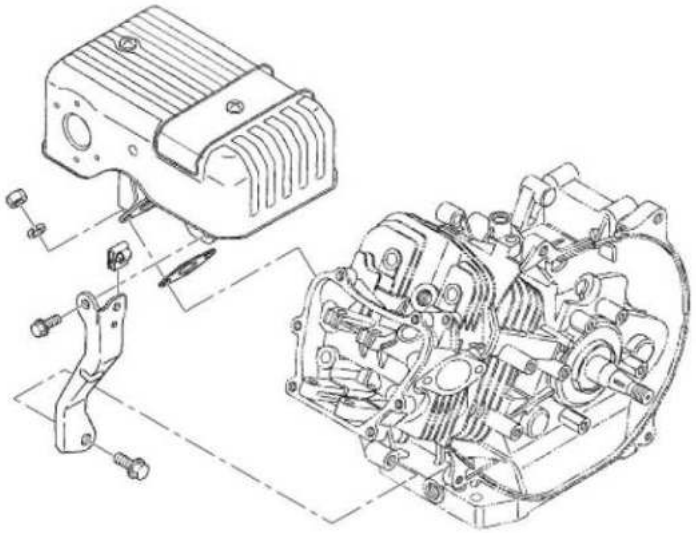


* Gasket for EK28, 30 it is not necessary to care about its direction.

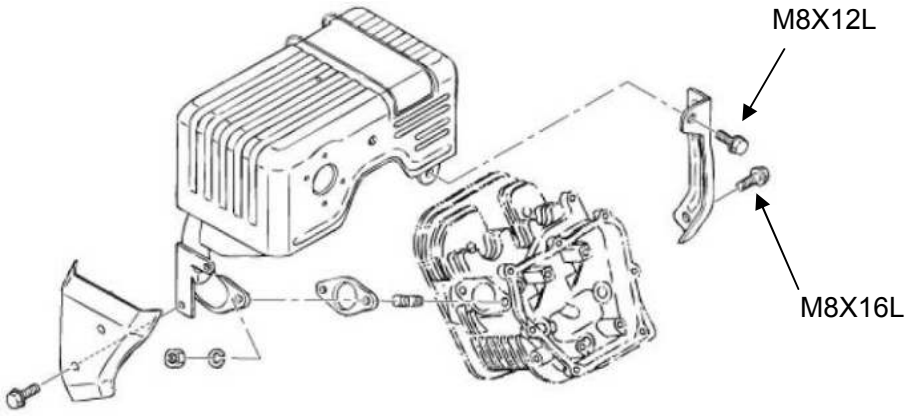
Tightening torque

M8: 18.0 - 22.0 N· m (180 - 220 kgf· cm)

EK13, 17, 20



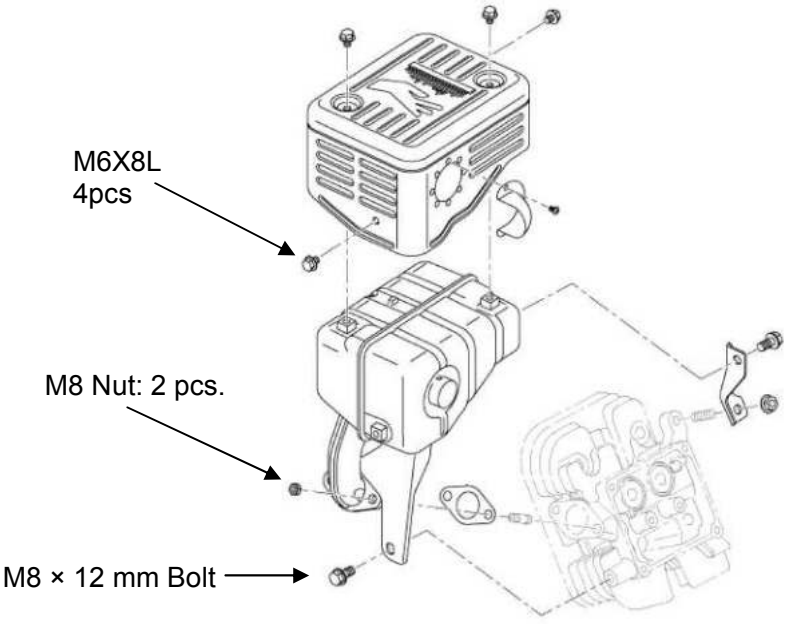
EK28



M8 Nut with SP washer 2pcs

EK30

- Mount the muffler
- Mount the muffler cover



(23) AIR CLEANER

Mount the air cleaner element and cleaner cover.

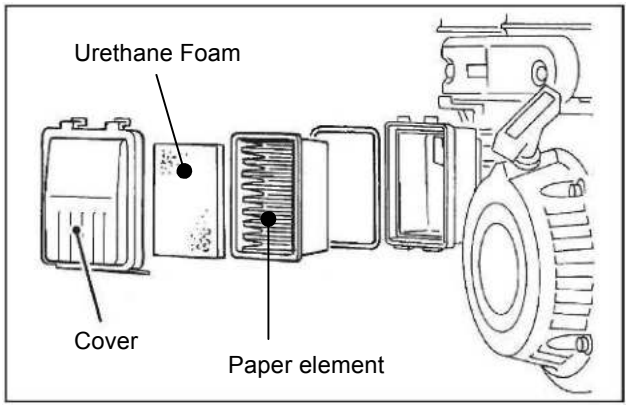
a) Urethane Foam Element Type

Remove the element and wash it in washing oil (kerosene).

Then saturate it in engine oil and squeeze it firmly before installing.

b) Dual Element Type
(Urethane Foam and Paper elements)

- For urethane foam, remove it from the paper element and wash it in washing oil (kerosene). Then saturate it in engine oil and squeeze it firmly before installing.
- For the paper element, clean by blowing on it with compressed air from the inside or tapping on it gently to remove dirt. Change the paper element when doing this fails to remove the dirt.

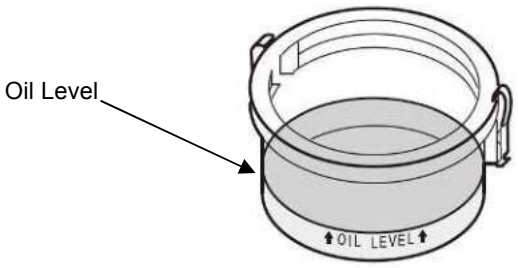


c) Oil Bath Type

Clean the urethane foam in the same way as described A Urethane Foam Element Type.

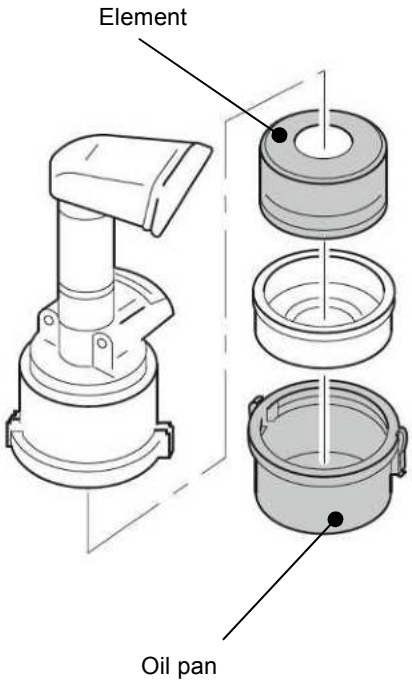
Drain the dirty oil from the oil pan and wash it in kerosene.

Then fill the new engine oil up to the specified oil level.



Oil capacity in the Oil Bath (oil pan) : (mL)

EK13/17/20 50
EK28/30 105



NOTE

Instead of washing oil (kerosene), it is possible to wash the urethane foam element in a solution of mild detergent and warm water.

Then rinse the element thoroughly in clean water.

Allow the element to dry thoroughly. Soak the element in clean engine oil and squeeze out excess oil.

NOTE

Clean and replace air cleaner elements more often when operating in dusty environments. Replace the element in case that dirt or dust can not be removed and/or that the element is deformed or deteriorated.

(24) EXTERNAL INSPECTION

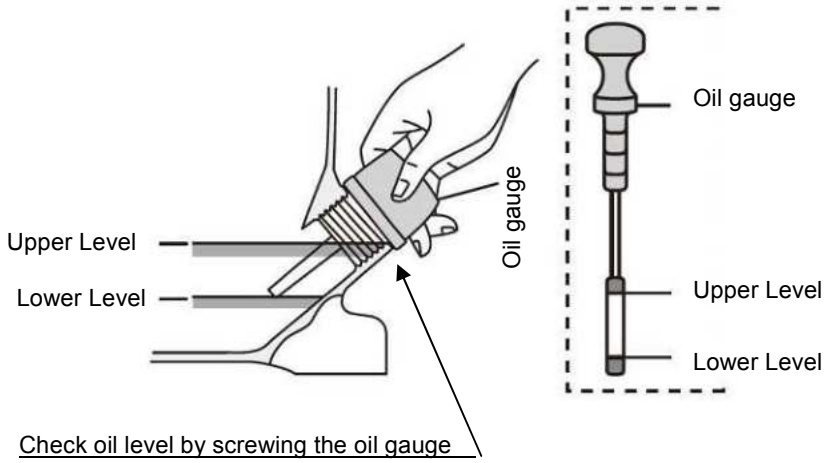
Reassembly is completed. Check that the wiring is correct and that there are no loose nuts and bolts or any other faults visible on the outside of the engine.

(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	EK13	EK17	EK20	EK28	EK30
Engine oil volume maximum : L	0.55	0.6		1.1	



(26) 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.

Model / Step	EK13	EK17	EK20	EK28	EK30	Engine Speed (r.p.m.)	Time
Step 1	No Load					2500	10 min.
Step 2	No Load					3000	10 min.
Step 3	No Load					3600	10 min.
Step 4	1.5 HP	2.2 HP	2.4 HP	3.3 HP	3.7 HP	3600	30 min.
Step 5	2.9 HP	4.3 HP	4.8 HP	6.6 HP	7.5 HP	3600	30 min.

6. 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 seizure.

6-1 CLASSIFICATION BY OIL GRADE

API (American Petroleum Institute)

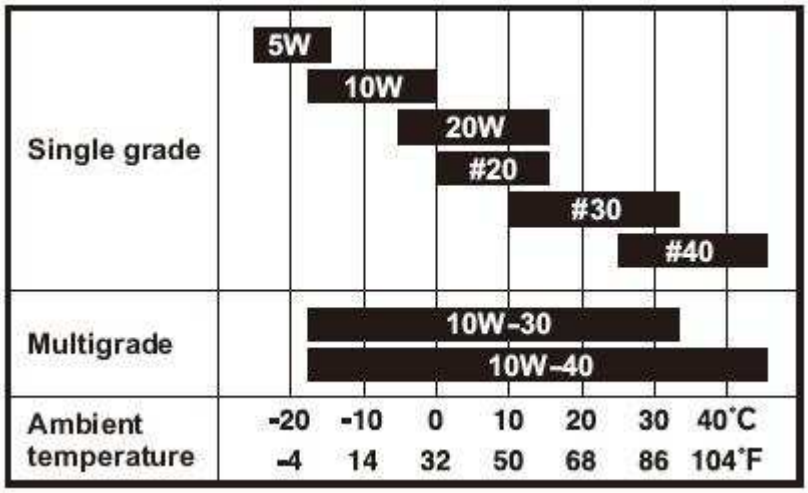
Classification	SA	SB	SC	SD	SE	SF	SG	SH	SJ	SL	SM	SN

→

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

6-2 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.

6-3 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 100 hours' use

7. MAGNETO

7-1 MAGNETO

The Subaru Engine uses a T.I.C. type breaker less magneto ignition system.

(1) T.I.C. (TRANSISTOR IGNITER CIRCUIT) has the ignition coil outside the flywheel, which is the standard
specification. A charge coil system is available as an option.

(The flywheel is a specialized piece of equipment.)

As for the lighting coil, the ignition coil is outside the flywheel and a lighting coil is inside.

7-2 INSPECTING THE MAGNETO

If the engine does not start, has difficulty starting, or does not run smoothly, check the magneto for defects according to the following procedure:

(1) Carefully check the high-tension cable for any damage or short circuiting.

(2) Check the sparking.

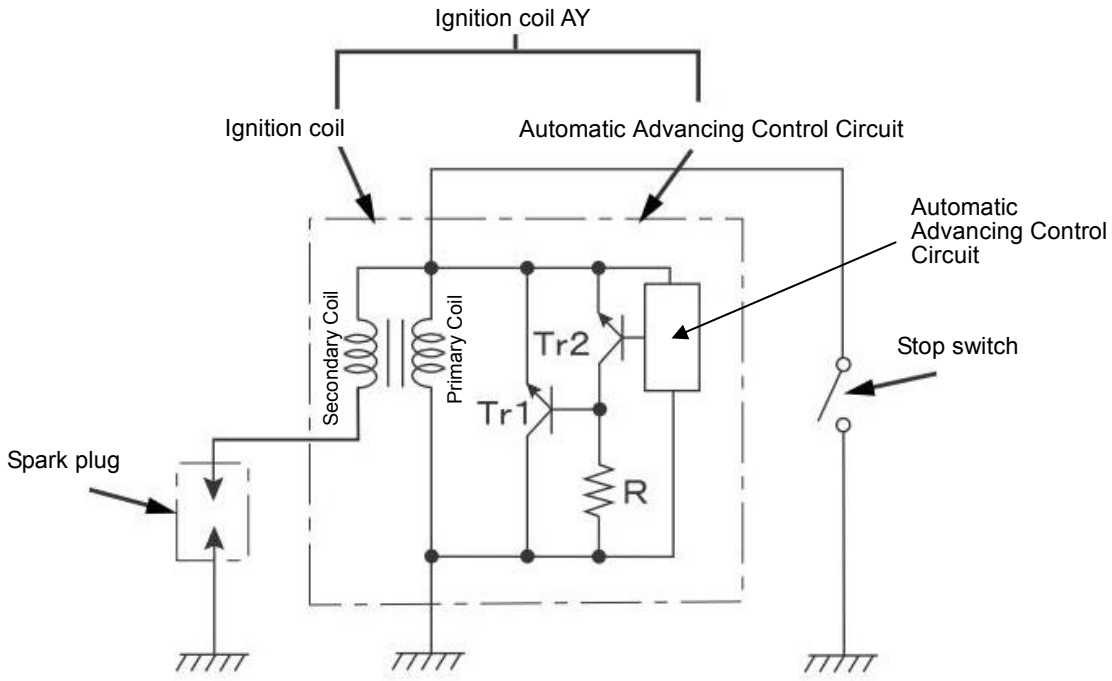
①Take the spark plug out of the cylinder head, connect the spark plug with the plug cap and ground it on the cylinder head or any other metallic part of the engine.

(The gap between the electrodes of the spark plug should be between 0.6 mm and 0.7 mm).

②Rotate the engine by pulling the recoil starter and check the spark plug gap for sparking. If the spark plug is sparking, check the intensity of the spark.

(Before checking the spark plug, disconnect the primary wire from the connector.)

③Next, disconnect the spark plug from the plug cap and check the end of the high-tension cable for sparking.



8. IGNITION SYSTEM

The ignition system is a pointless flywheel magneto with automatic advancing characteristic.

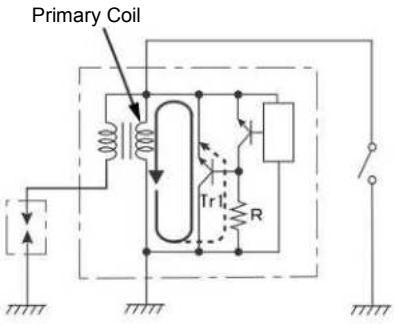
Being different from the breaker point type ignition system, this system is completely free from such troubles as starting-up failure due to dirty, burnt or corroded point surface.

8-1 IGNITION COIL INTERNAL CIRCUIT

8-2 BASIC THEORY

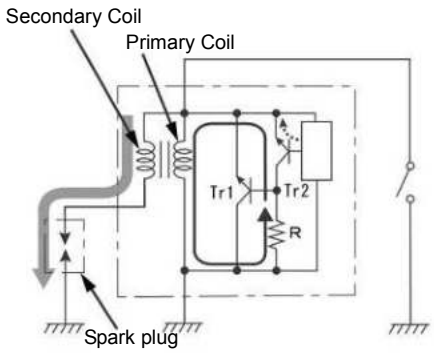
1) Revolution of the flywheel generates electricity on the primary side of the ignition coil, and the base current I1 flows to the power transistor, Tr1 .

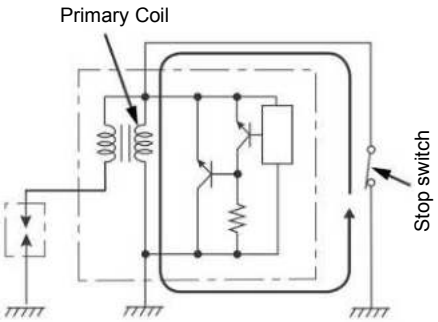
   Current I1 turns the power transistor, Tr1 “ON” and the electric current I2 flows.



2) When flywheel reached the ignition timing, timing control circuit transmit signal to turn on Tr2 and Tr1 turn off at the same time, at the particular moment current in primary coil cut off abruptly then high voltage is generated in secondary coil and make spark in the spark plug.

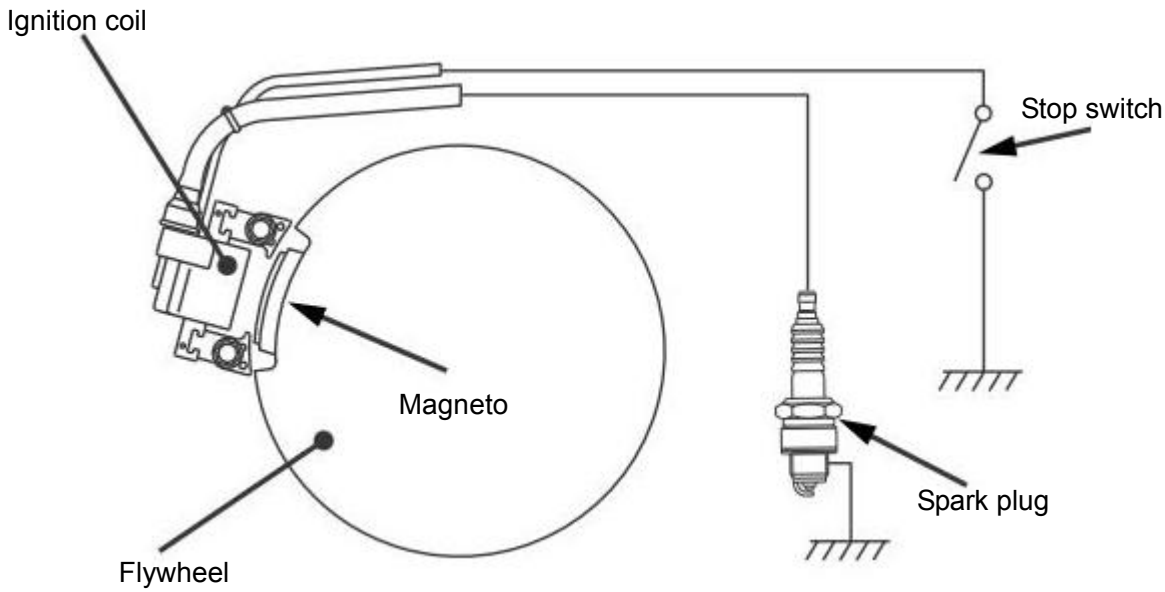
3) Stop switch is to ground the primary current not to generate current in secondary coil.





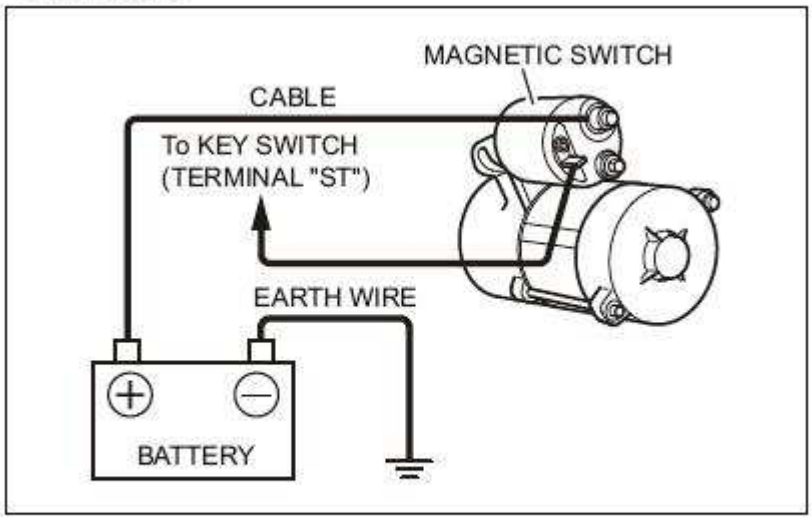
9. WIRING DIAGRAM

9-1 MODEL WITHOUT ELECTRIC STARTER



10. ELECTRIC STARTER

4. WIRING



(1) Connect positive (+) terminal of the magnetic switch and positive (+) terminal of the battery with battery cable.

11. OIL SENSOR

Not available

12. AUTOMATIC DECOMPRESSION SYSTEM

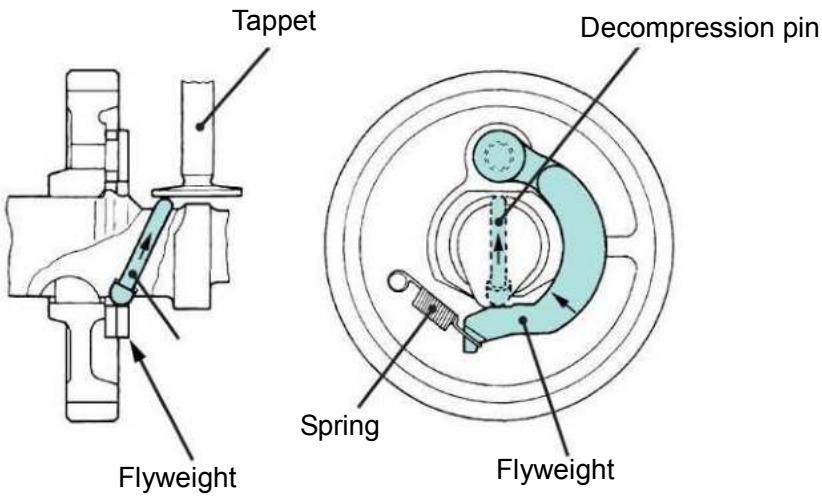
12-1 FUNCTIONS AND CONSTRUCTION

EK series engines employ an automatic decompression system as a standard feature. This enables easy starting of the engine, with lighter recoil pulling force.

The automatic decompression system releases the compression of the engine by lifting up the tappet for exhaust valve at cranking speed. The following is the explanation of the function.

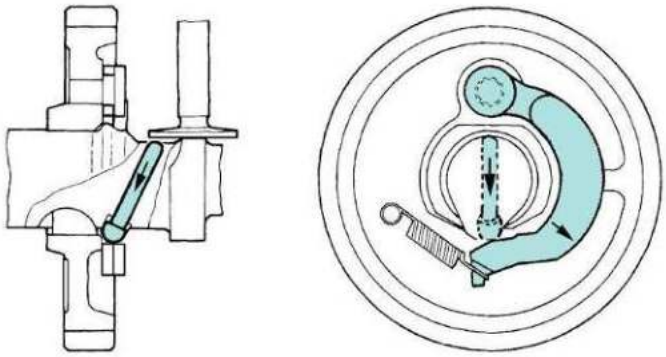
When starting engine, the flyweight is pulled by spring and lifts up the decompression pin.

Then, tappet (exhaust) which in turn opens up the exhaust valve slightly to release the compression, accordingly recoil pulling force become lighter.



When the cranking speed reaches specified r.p.m., flyweight move to outer against spring force because the centrifugal force applied to the flyweight and the decompression pin coming down.

Then ,Tappet coming down to normal position to follow the cam profile not to release compression.



12-2 INSPECTION

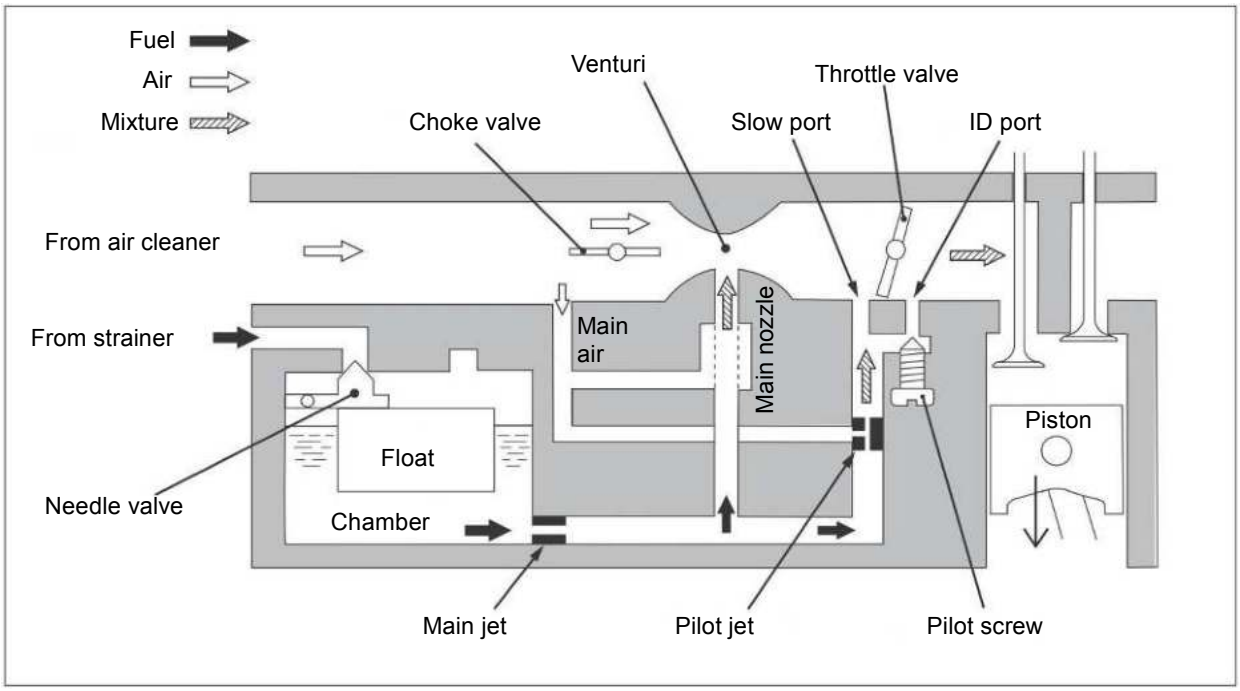
When assembling the release lever, make sure that it works smoothly.

13. CARBURETOR

13-1 SPECIFICATIONS (STD)

Model	EK13	EK17	EK20	EK28	EK30
A/C Type	STD	Oil bath	Oil bath	Oil bath	Oil bath
Main Jet	66.3	75	80	102.5	102.5
Pilot Jet	40	48.8	47.5	57.5	51.3
Venturi Bore - Throttle Bore	φ 12-18	14-20	15-20	16-24	16-24

13-2 FUNCTIONS AND CONSTRUCTION



13-2-1 FLOAT SYSTEM

The float chamber is located below the carburetor body. Through the operation of the float and the needle valve, the float chamber maintains a constant fuel level while the engine is working.

The fuel flows from the tank into the float chamber through the needle valve. When the fuel rises to a specific level, the float rises. When the buoyancy of the float is balanced with the fuel pressure, the needle valve shuts off the fuel passage, thereby maintaining the fuel at the predetermined level.

13-2-2 SLOW SYSTEM

The slow system supplies fuel to the engine during idling and low-speed operation.

Fuel is initially metered by the main jet and then metered once again by the slow jet.

The fuel / air mixture is fed to the engine through the pilot outlet and the bypass.

During idling, fuel is fed to the engine mainly through the pilot outlet.

13-2-3 MAIN SYSTEM

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

Fuel is metered by the main jet and flows into the main nozzle. Air metered by the main air jet is mixed with fuel through the bleed holes of the main nozzle.

The fuel/air mist is injected into the Venturi and mixed once again with air from the air cleaner.

This fuel/air mixture is now of optimum concentration and is fed into the combustion chamber of the

engine.

13-2-4 CHOKE SYSTEM

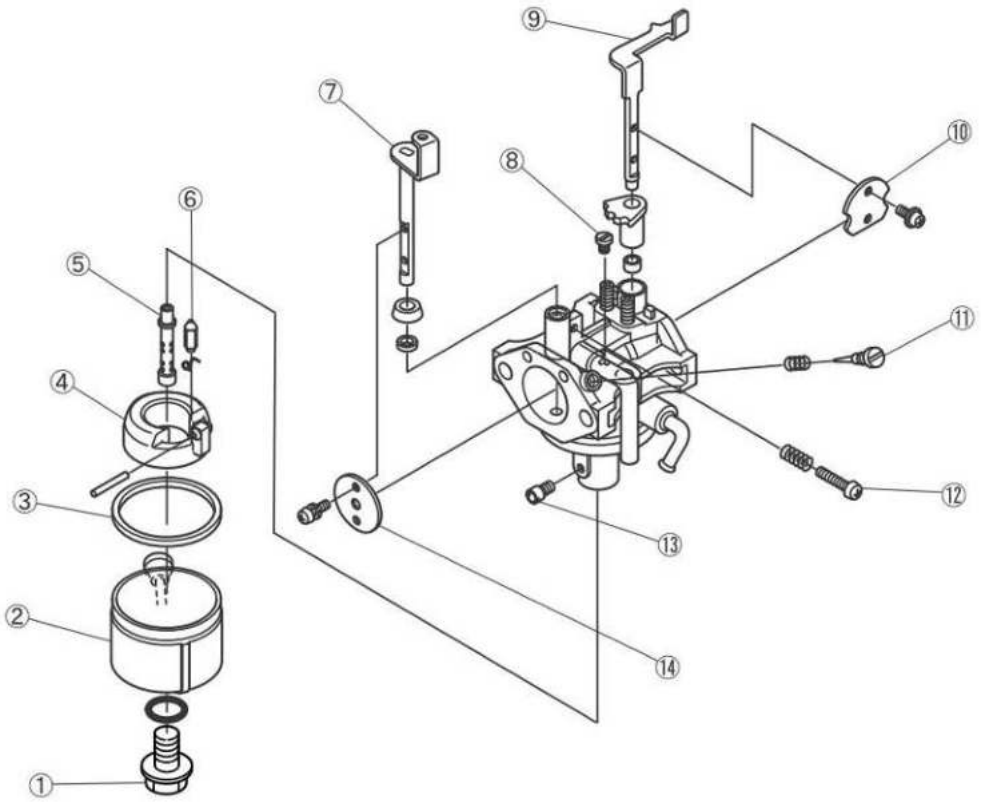
The choke system is for easier start of the engine in cold weather conditions.

When the engine is started with a closed choke, the negative pressure applied to the main nozzle increases. This causes a larger amount of fuel to be drawn into the carburetor, which in turn makes it easier to start the engine.

13-3 DISASSEMBLY AND REASSEMBLY

Mechanical failures aside, most carburetor malfunctions occur when the fuel/air ratio of the mixture is not correct. This is usually caused by clogged jets, air passages and fuel passages, or by variations in the fuel level.

To get the best possible performance from the carburetor, ensure that the each passages are kept clean so that air and fuel can flow freely through them.



The procedures for overhauling the carburetor are described below.

13-3-1 THROTTLE SYSTEM

(1) When the throttle stop screw⑫ is removed, the spring can be taken out.

(2) Remove the Phillips screw and the throttle valve⑭, then take out the throttle shaft⑦ .
When removing the throttle valve, take care not to damage the valve edge.

13-3-2 CHOKE SYSTEM

(1) Remove the choke valve ⑩. Then pull out the choke shaft ⑨.

(2) When reassembling the choke shaft, be sure to position the cutout on the choke valve facing the pilot air jet.

13-3-3 SLOW SYSTEM

(1) Remove the pilot jet ⑧. Use the correct tool so as to avoid damaging the jet.

(2) When reassembling the pilot jet, be sure to firmly tighten it, otherwise fuel may leak, leading to engine malfunction.

13-3-4 MAIN SYSTEM

(1) Remove the bolt ① and remove the float chamber body ②.

(2) Remove the main jet ⑬ from the body.

(3) Remove the main nozzle ⑤ from the body.

(4) When reassembling the main system, be sure to fasten the main jet and main nozzle firmly to the body, otherwise the fuel concentration in the fuel/air mixture may become too rich, leading to engine malfunction.

(5) The tightening torque of the bolt ① is 9 N・m (90 kgf・cm / 6.5 ft・lb.). Be sure not to forget to mount the washer.

13-3-5 FLOAT SYSTEM

(1) Take out the float pin and then remove the float ④ and the needle valve ⑥

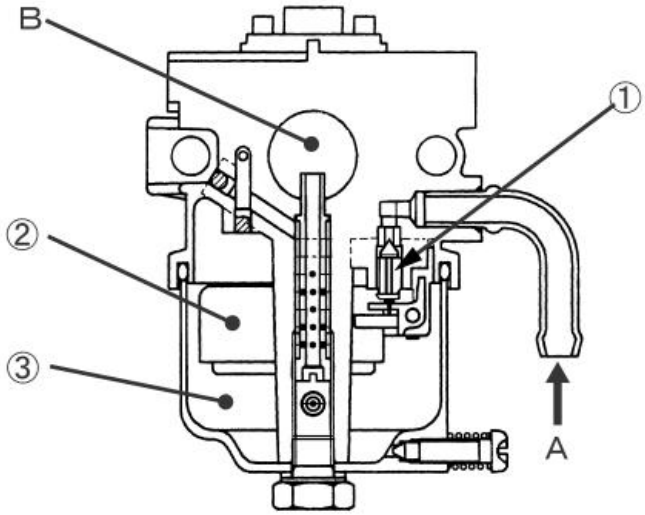
*Since the needle valve ⑥ is linked to the float ④, take care when assemble.

* Do not use drill or similar objects for cleaning the jets, as these are likely to damage the orifices, which in turn can impair fuel flow. Use compressed air to clean the jets.

* The float pin is pressed into the carburetor body. When removing the needle valve and the float, a rod or a similar tool slimmer than the float pin should be used. Tap the reverse side gently and remove.

13-3-6 Sectional view of the carburetor

① Needle valve
② Float
③ Float chamber
A Fuel Inlet
B Venturi



14. RECOIL STARTER

14-1 RECOIL STARTER

Tools required: Screwdriver, pliers and protective glasses

14-1-1 DISASSEMBLY PROCEDURE

(1) Remove the recoil starter from engine.

(2) Pull the starter knob to draw out the starter rope by about 30 cm and tie a tentative knot.

(3) Untie the knot inside the knob to remove the knob.

(4) Hold the starter case and the reel firmly with your left hand and untie the tentative knot with your right hand.

Continue to hold the case and the reel with your left hand and hold the reel center with your right hand then loosen both hands alternately to allow the reel gradually to turn to the arrow direction until the spring is completely released.

(Do this carefully to avoid dangers caused by spring-back.)

CAUTION

Since the spring is stored in the reel, make sure not to drop or shake the reel after removing it. Place it on a level surface such as a table.

- Disassembly is completed.

14-1-2 REASSEMBLY PROCEDURE

CAUTION

Put on the protective glasses prior to start reassembly.

(1) Put the reel back into the case

-Adjust the position of the inner end of the spring in the reel.

-Hold the reel in such a way that the inner end of the spring hooks onto the shaft hook and then place the reel carefully back into the case.

-Turn the reel gently counterclockwise to confirm that the spring is hooked

-Mount the ratchet into the reel

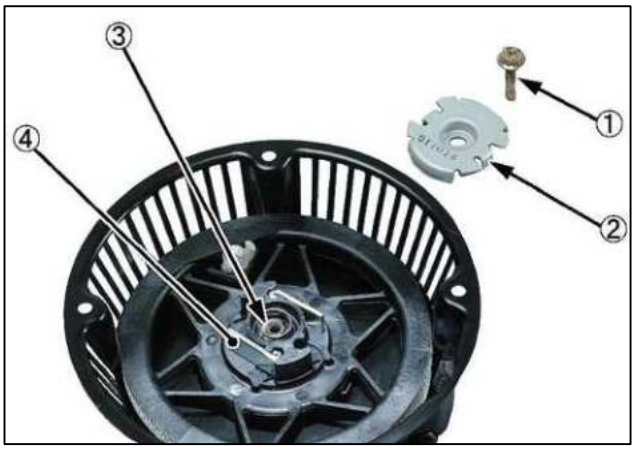
-Mount the ratchet guide assembly, taking care not to move the ratchet.

-Tighten the set screw

Hold the ratchet guide gently by your hand to prevent it from rotating, and then tighten the set screw.

Tightening torque (M6)

5.5 N・m
(55 kgf・cm)
(4.0 ft・lb.)



Tension the reel spring

-1 Grip the case and turn the reel 6 times counterclockwise.

-2 Fix the reel so that the rope hole in the reel is aligned with the rope guide.

14-1-3 OTHER GUIDES

(1) If the spring escapes from the reel during disassembly

(a) Hook the outer end of the spring onto the gap in the reel, and rewind the spring, holding the spring with your fingers so as to prevent it from springing out of the housing unit.

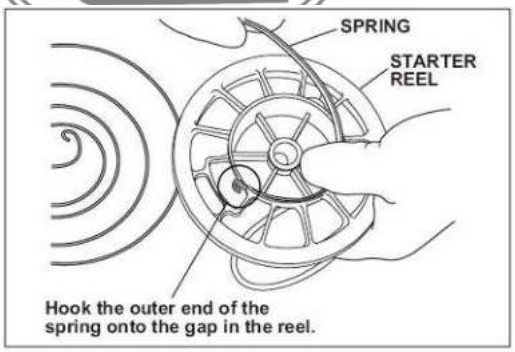
(Wear protective gloves when doing this.)

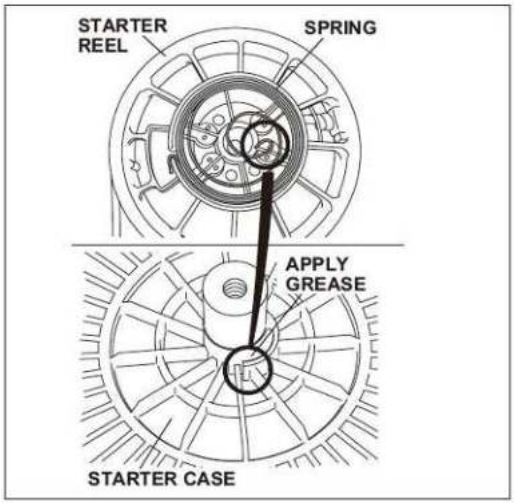
(b) Hook the inner end of the spring onto the projection on the starter case.

* Refer to the assembly procedure for more details.

(2) About lubrication

Lubricate the rotating and frictional parts and the spring with grease (heat-resistant grease recommended) or engine oil when the starter is disassembled and prior to long term storage.





15. TROUBLE SHOOTING

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.

15-1 ENGINE

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.

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
		3) Hunting after engine stop	Check or replace O-ring (spacer)
	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

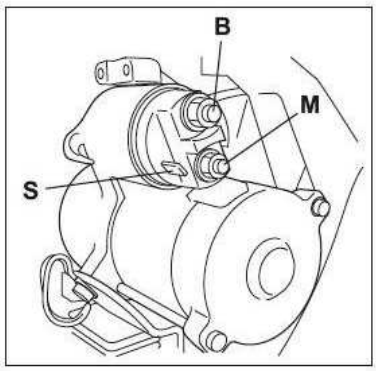
Problem and possible cause			Remedy
Excessive engine oil consumption	1. Oil leakage	1) Loose oil drain plug	Tighten
		2) Faulty oil drain gasket	Replace
		3) Loose main bearing cover bolts	Tighten
		4) Faulty main bearing cover gasket	Replace
		5) Crankshaft oil seal (front, rear) defect	Replace
	2. 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 inflow 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

Engine does not start

- Does the crank run? — NG → Does the starter run? — NG → Check battery charged state and battery terminal connection or corrosion for any abnormality. — NG → • Charge or replace the battery. • Repair connection or corrosion of battery terminals.
- Check battery charged state and battery terminal connection or corrosion for any abnormality. — OK → Operation sound of magnetic switch of starter — NG → • Key switch • Connected state • Check/repair wiring to the starter magnetic switch. • Repair or replace starter magnetic switch.
- Does the starter run? — OK → Check engagement of pinion and ring gear — NG → • Check settling of spring and sliding of pinion. • Replace if pinion/ring gear end face is worn. • Correction of pinion gap
- Operation sound of magnetic switch of starter — OK → With starter alone, connect the battery (+) terminal and the M or K terminal of the starter and check if motor runs. — NG → Replace motor (brush holder or armature).
- Does the crank run? — OK → Normal rotation? — NG (Too slow) → Check battery charged state and battery terminal connection or corrosion for any abnormality. — NG → • Charge or replace the battery. • Repair connection or corrosion of battery terminals.
- Normal rotation? — OK → Check ignition system and fuel system.
- Check battery charged state and battery terminal connection or corrosion for any abnormality. — OK → Check viscosity of engine oil for any abnormality. — NG → Change the engine oil.
- Check viscosity of engine oil for any abnormality. — OK → Replace the starter with a new one and check if it runs. — NG → Check the engine interior.
- Replace the starter with a new one and check if it runs. — OK → Repair or replace the starter.

※ When the starter continuously runs
(Immediately remove the (-) terminal of the battery)

Motor does not stop even when the key switch is turned off. → Repair or replace the key switch or starter magnetic switch.



16. STANDARD REPAIR TABLES

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

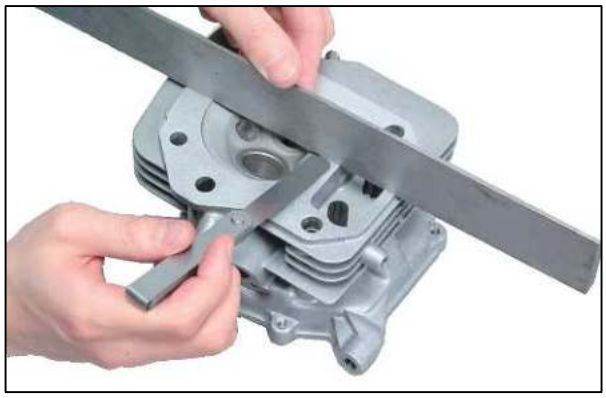
Whereas, "Limit" shows the maximum allowance for the parts to be used on the engine.

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

16-1 STANDARD DIMENSIONS AND LIMITS OF USE

1) CYLINDER HEAD

・Flatness
Limit 0.05 mm



・Intake/exhaust valve seat contact width
Intake and Exhaust
STD
EK13, 17 20 1.1 – 1.4 mm
EK28, 30 1.0 – 1.3 mm
Contact rate to those valve seat 85% and more

a) Scrape the valve seat face by valve seat cutter (45 degree), slightly

b) Put ink marker on valve face and fit it on the seat face then check contact position

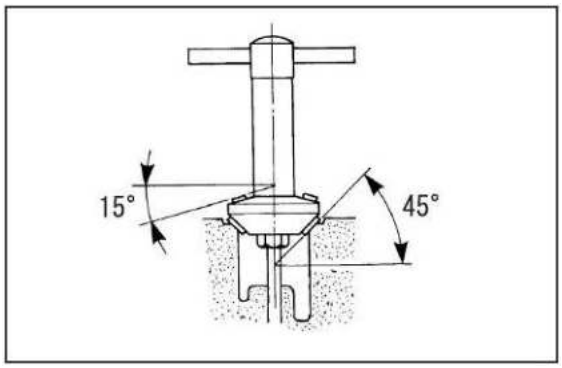
c) Scrape the face by valve seat cutter (15 degree),

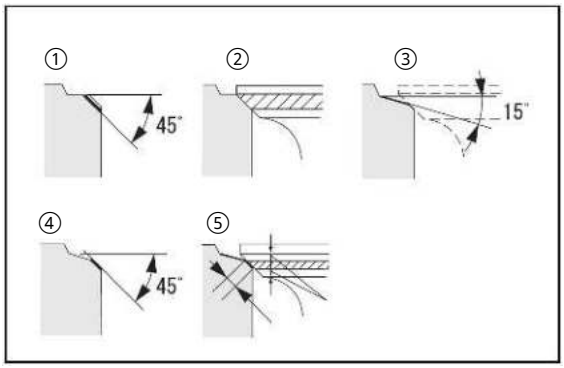
d) Scrape the face again by the cutter (45 degree) slightly, and recheck contact rate

e) Repeat 3 and 4, to make contact position normal

f) Make adjustment to make contact rate more than 85%

g) After adjustment of valve face, check valve clearance and adjust it





・Intake/exhaust valve guide inner diameter (mm)

Model		STD	Limit
EK13, 17, 20	Intake Exhaust	5.500-5.512	5.65
EK28, 30		6.500-6.515	6.65

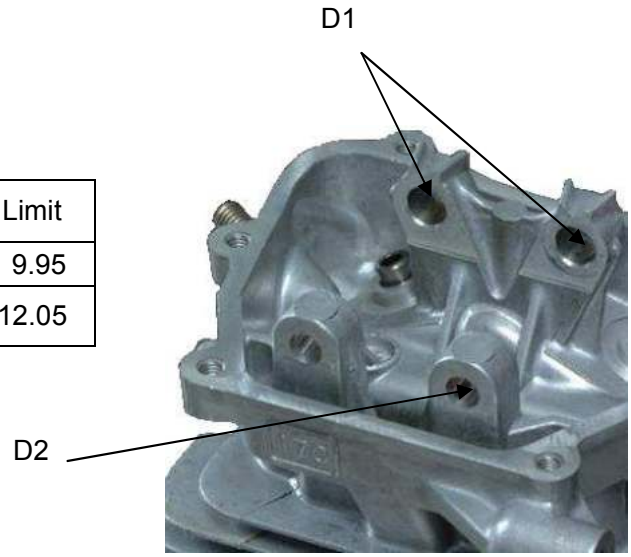
・Rocker arm pin support inner diameter (mm)

Pin outer diameter

D1, D2

Model		STD	Limit
EK13, 17, 20	Intake Exhaust	9.975-9.900	9.95
EK28		12.000-12.018	12.05

*EK13 is nothing

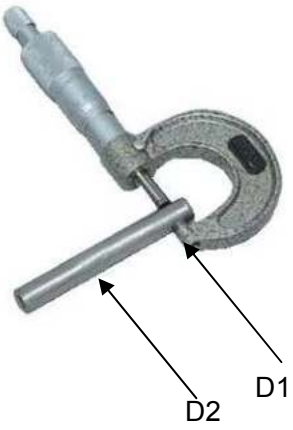


・Rocker arm pin outer diameter (mm)

D1, D2

Model		STD	Limit
EK13, 17, 20	Intake Exhaust	9.960-9.970	9.9
EK28		11.973-11.984	11.9

*EK30 is nothing



・Rocker arm inner diameter for pin (mm)

Model		STD	Limit
EK13, 17, 20	Intake Exhaust	10.000-10.015	10.05
EK28		12.000-12.018	12.05

*EK30 is nothing

2) CYLINDER

・Inner diameter (mm)

Model	STD	Limit
EK13	61.000-61.015	61.115
EK17	67.000-67.015	67.115
EK20	72.000-72.015	72.115
EK28	79.000-79.015	79.115
EK30	80.000-80.015	80.115

Model	First re-boring (0.25)	Limit
EK13	61.250-61.265	61.365
EK17	67.250-67.265	67.365
EK20	72.250-72.265	72.365
EK28	79.250-79.265	79.365
EK30	80.250-80.265	80.365

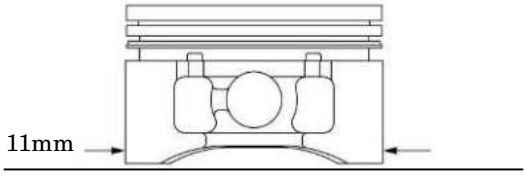
Model	Second re-boring (0.50)	Limit
EK13	61.500-61.515	61.615
EK17	67.500-67.515	67.615
EK20	72.500-72.515	72.615
EK28	79.500-79.515	79.615
EK30	80.500-80.515	80.615

* Roundness after re-boring Less than 0.01 mm
* Cylindricity after re-boring Less than 0.015 mm

3) PISTON

・Outer diameter at skirt in thrust direction (mm)

Model	STD	Limit
EK13	60.965-60.980	60.865
EK17	66.965-66.980	66.865
EK20	71.965-71.980	71.865
EK28	78.965-78.980	78.865
EK30	79.975-79.985	79.875

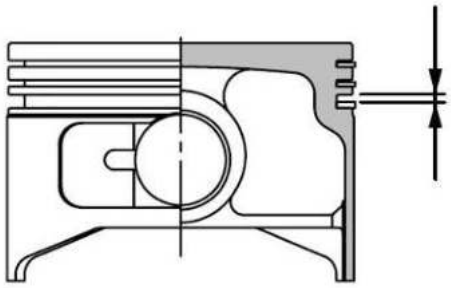


Model	Oversize +0.25	Limit
EK13	61.215-61.230	61.115
EK17	67.215-67.230	67.115
EK20	72.215-72.230	72.115
EK28	79.215-79.230	79.115
EK30	80.225-80.235	80.125

Model	Oversize +0.50	Limit
EK13	61.465-61.480	61.365
EK17	67.465-67.480	67.365
EK20	72.465-72.480	72.365
EK28	79.465-79.480	79.365
EK30	80.475-80.485	80.375

・Ring groove side clearance (mm)

a) Top ring



Model	STD	Limit
EK13	0.02-0.06	0.10
EK17 EK20 EK28 EK30	0.04-0.08	0.12

b) Second ring

Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	0.02-0.06	0.10

c) Oil ring

Model	STD	Limit
EK13	0.01-0.18	0.22
EK17 EK20 EK28	0.06-0.15	0.19
EK30	0.04-0.12	0.16

・Piston pin hole (mm)

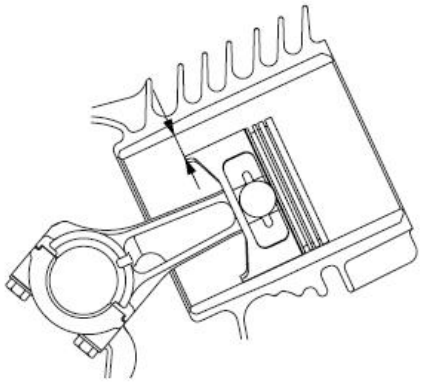
Model	STD	Limit
EK13	13.003-12.995	13.035
EK17 EK20	15.003-14.995	15.035
EK28	18.002-17.994	18.035
EK30	18.008-18.000	18.035

・Piston pin outer diameter (mm)

Model	STD	Limit
EK13	13.000-13.005	12.960
EK17 EK20	15.000-15.005	14.960
EK28 EK30	18.000-18.005	17.960

・Clearance between piston and cylinder at skirt (mm)

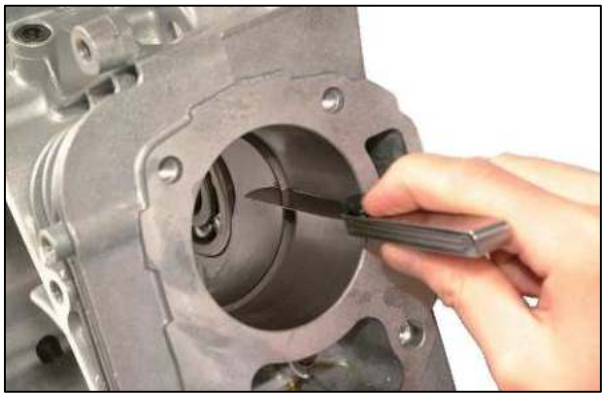
Model	STD	Limit
EK13 EK17 EK20 EK28	0.020-0.050	0.25
EK30	0.015-0.040	0.25



・Piston ring end gap (mm)

a) EK13 / EK17 / EK20 / EK28

	STD	Limit
Top ring	0.2-0.4	0.9
2nd ring	0.2-0.4	0.9
Oil ring	0.2-0.7	0.9



b) EK30

	STD	Limit
Top ring	0.10-0.25	0.7
2nd ring	0.08-0.28	0.7
Oil ring	0.1-0.6	0.8

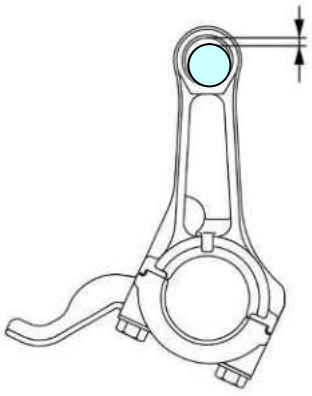
4) CONNECTING ROD

・Small end inner diameter (mm)

Model	STD	Limit
EK13	13.015-13.025	13.080
EK17 EK20	15.015-15.025	15.080
EK28 EK30	18.015-18.025	18.080

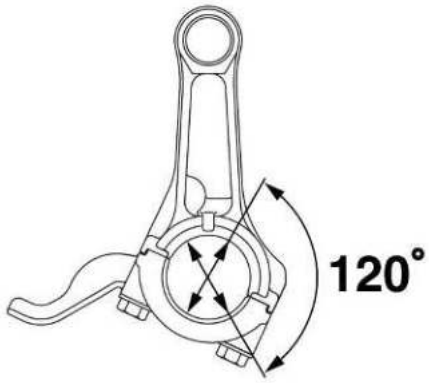
・Clearance between small end and piston pin (mm)

Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	0.01-0.003	0.12



・Large end inner diameter (mm)

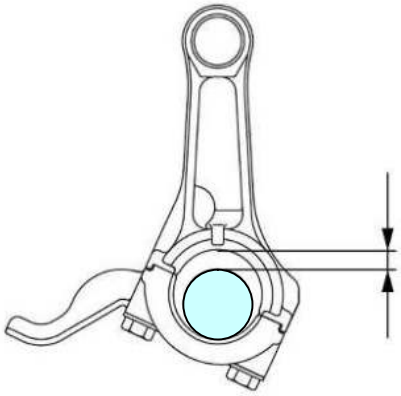
Model	STD	Limit
EK13	25.500-25.515	25.6
EK17 EK20	30.000-30.015	30.1
EK28 EK30	33.500-33.515	33.6



*Connecting rod bolt tightening torque
EK13/17/20: 11 N・m
EK28: 26 N・m
EK30: 17 N・m

・Clearance between large end and crank pin (mm)

Model	STD	Limit
EK13 EK17 EK20	0.015-0.040	1.1
EK28 EK30	0.020-0.045	1.1



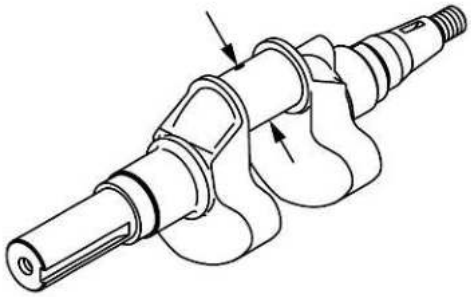
・Large end side clearance (mm)

Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	0.4-1.1	1.3

5) CRANKSHAFT

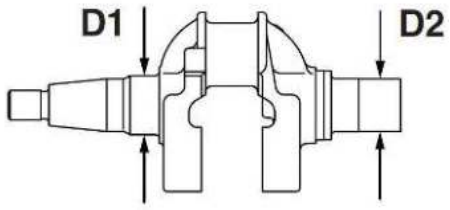
・Crank pin outer diameter (mm)

Model	STD	Limit
EK13	25.475-25.485	25.37
EK17 EK20	29.975-29.985	29.87
EK28 EK30	33.470-33.480	33.37



・Journal outer diameter (mm)

Model	STD	
	D1	D2
EK13	19.990-20.000	19.985-19.995
EK17 EK20	24.985-24.995	24.985-24.995
EK28 EK30	29.985-29.995	29.985-29.995



6) CAMSHAFT

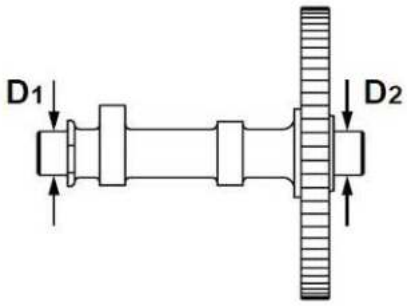
・Cam peak height (intake and exhaust) (mm)

Model	STD	Limit
EK13	23.885-23.915	23.785
EK17 EK20	28.080-28.120	27.980
EK28 EK30	32.780-32.820	32.680

・Journal outside dia. (mm)

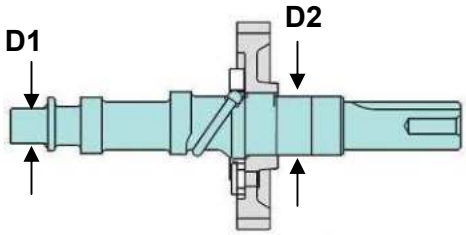
"D" type

Model	STD		Limit
	D1	D2	
EK13	13.966-13.984		13.95
EK17 EK20	14.966-14.984		14.95
EK28 EK30	17.966-17.984		17.95



"B" type

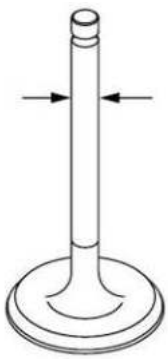
Model	STD		Limit	
	D1	D2	D1	D2
EK13	13.966-13.984	19.980-19.993	13.95	19.95
EK17 EK20	14.966-14.984	24.980-24.993	14.95	24.95
EK28 EK30	17.966-17.984	29.980-29.993	17.95	29.95



7) VALVE

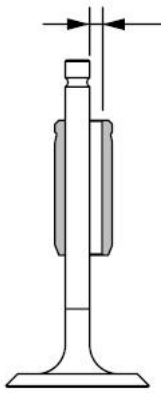
・Valve stem outside dia. (mm)

Model		STD	Limit
EK13, 17, 20	Intake	5.442-5.460	5.30
EK28, 30		6.443-6.455	6.30
EK13, 17, 20	Exhaust	5.440-5.460	5.30
EK28, 30		6.440-6.460	6.30



・Clearance between valve stem and valve guide (mm)

Model		STD	Limit
EK13, 17, 20	Intake	0.040-0.070	0.1
EK28, 30		0.045-0.072	0.1
EK13, 17, 20	Exhaust	0.040-0.072	0.1
EK28, 30		0.040-0.075	0.1



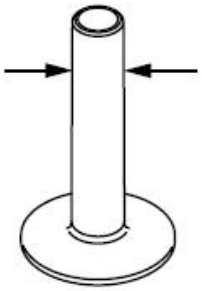
・Valve clearance (in cold state) (mm)

Model	STD	Limit
EK13	0.15-0.20	0.25
EK17	0.10-0.15	0.25
EK20	0.12-0.17	0.25
EK28 EK30	0.07-0.12	0.25

8) TAPPET

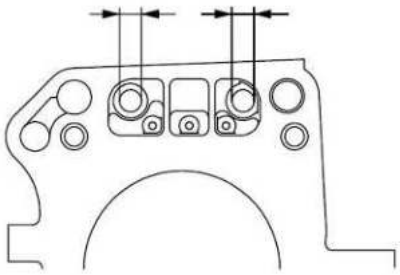
・Stem outside dia. (mm)

Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	7.960-7.975	7.93



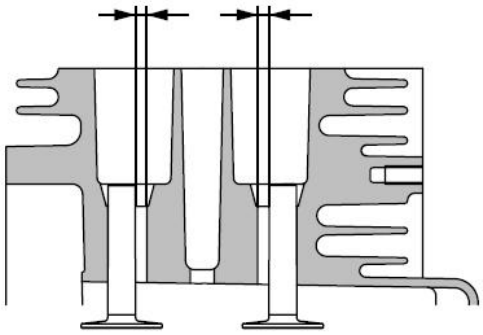
・ Tappet guide inside dia. (mm)

Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	8.010-8.035	8.08



・Tappet guide clearance (mm)

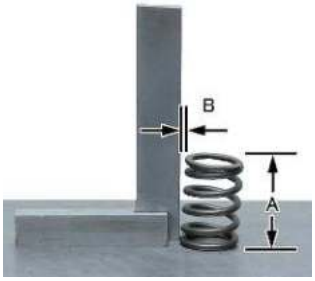
Model	STD	Limit
EK13 EK17 EK20 EK28 EK30	0.035-0.075	0.1



9) VALVE SPRING FREE LENGTH (mm)

Model	STD	Limit
EK13 EK17 EK20	31.8-32.3	31.5
EK28 EK30	36.5-37.0	36.2

* B : Limit 1.5



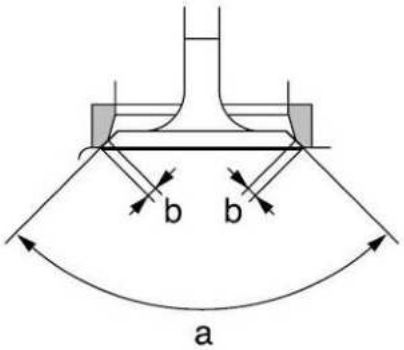
10) VALVE SEAT ANGLE (INTAKE AND EXHAUST)

・Valve cutter angle (a)

・Valve contact width (b)

Model	STD	Limit
EK13 EK17 EK20	a: 90° b: 1.1 - 1.4	2.0
EK28 EK30	a: 90° b: 1.1 - 1.3	2.0

* More than 85%



16-2 SERVICE DATA (The following are only for your reference.)

			EK13	EK17	EK20	EK28	EK30
Compression pressure	kPa (kgf/cm^2)/ 500 rpm		300	300	350	400	800
Fuel consumption	Continuous load / 3600 rpm	(L / Hr)	1.2	1.6	1.7	3.0	3.3
Lubricant	Capacity	(L)	0.55	0.6	0.6	1.1	1.1
	Effective Capacity	(L)	0.25	0.26	0.26	0.55	0.55
	Consumption	(mL / Hr)	5	5	5	5	7

※ Oil consumption has been measured under-following condition :
- Good break-in operation has been finished.
- Oil : 10W-30 (Grade SE)
- Load : Continuous load / 3600 rpm

16-3 AIR GAP AND CLEARANCE

ITEM		Clearance (mm)				
		EK13	EK17	EK20	EK28	EK30
Valve clearance	(Intake, Exhaust)	0.15-0.20	0.10-0.15	0.12-0.17	0.07-0.12	0.07-0.12
Air gap	(Ignition and flywheel)	0.4-0.6				0.3-0.5
Electrode gap	(Spark plug)	0.6-0.7				

16-4 TIGHTENING TORQUE

ITEM			Tightening Torque [N·m (kgf·cm)]		
			STD	Range	Remarks
Spark plug	EK13,17 EK20,28	New	15 (150)	10-20 (100-200)	
		Re-use	25 (250)	23-27 (230-270)	
	EK30	New	13.5 (138)	12-15 (120-150)	
		Re-use	25 (250)	23-27 (230-270)	
Rocker arm rock nut (EK13,17,20,28)			10 (100)	8-13 (80-130)	oil the screw thread
Pivot bolt (EK30)			8 (80)	7-9 (70-90)	oil the screw thread
Cylinder head	EK13,17,20	M8	30 (300)	25-36 (250-360)	
	EK28,30	M10	45 (450)	42-51 (420-510)	
Connecting rod	EK13,17,20		11 (110)	9-13 (90-130)	oil the screw thread
	EK28		27 (270)	24-30 (240-300)	oil the screw thread
	EK30		17 (170)	16-19 (160-190)	oil the screw thread
Flywheel	EK13		40 (400)	30-50 (300-500)	
	EK17,20		67 (670)	60-75 (600-750)	
	EK28,30		76 (760)	70-85 (700-850)	
Rocker cover (head cover)			6 (60)	5-7 (50-70)	
Main bearing cover (Crankcase cover)	EK13		12 (120)	10-14 (100-140)	
	EK17,20,28,30		26 (260)	22-30 (220-300)	
Drain plug	M10		12 (125)	10-15 (100-150)	
	M12		25 (250)	20-30 (200-300)	
	M14		22 (220)	20-23 (200-230)	

STD Tightening Torque

ITEM		Tightening Torque N·m (kgf·cm)		
		STD	Range	Remarks
Normal type bolt	M6 (4T)	7 (70)	6-8 (60-80)	
	M6 (7T)	11 (110)	9-12 (100-115)	
	M8 (4T)	20 (200)	18-21 (180-210)	
	M8 (7T)	25 (250)	24-28 (240-280)	
Tapping screw	M6	13 (130)	10-15 (100-150)	except muffler cover

17. MAINTENANCE AND STORAGE

The maintenance jobs described below apply to correct use of the engine under normal conditions.

The maintenance intervals mentioned in this section are not a guarantee that no maintenance is required during those intervals.

For example, when the engine is used in dusty conditions, the air cleaner should be cleaned every day, rather than every 100 hours.

17-1 DAILY MAINTENANCE (EVERY 8 HOURS OF USE)

MAINTENACE ITEMS	REASON / REMARKS
(1) Clean dust from engine. (2) Check for fuel leakage. Tighten or replace parts, if necessary. (3) Check all parts are securely fastened. Tighten, if necessary. (4) Check oil level and add up to full mark. (5) Check that the air cleaner element is clean. Clean or replace, if necessary.	(1) Dust can impair operation of various parts. Governor linkage is especially sensitive to dust. (2) Uneconomical and dangerous. (3) Looseness can result in vibration and accidents. (4) Running the engine with insufficient oil can result in serious problems, including engine seizure. (5) A clogged air cleaner can cause power loss and malfunction.

17-2 INSPECTION AND MAINTENANCE AFTER THE FIRST 20 HOURS

MAINTENACE ITEMS	REASON / REMARKS
(1) Change the crankcase oil.	(1) Sludge is deposited during running-in.

17-3 INSPECTION AND MAINTENANCE EVERY 100 HOURS (EVERY 10 DAYS)

MAINTENACE ITEMS	REASON / REMARKS
(1) Change the crankcase oil. (2) Clean the air cleaner. (3) Inspect the spark plug. Clean with gasoline or polish with sandpaper if dirty.	(1) Contaminated oil quickens wear. (2) A clogged air cleaner can cause engine malfunction. (3) A faulty spark plug can cause low power output and poor starting performance.

17-4 INSPECTION AND MAINTENANCE EVERY 100 TO 200 HOURS (EVERY MONTH)

MAINTENACE ITEMS	REASON / REMARKS
(1) Clean the fuel strainer and fuel tank. (2) Change the air cleaner element. (3) Clean and adjust the spark plug electrode.	(1) Contaminated fuel can cause engine malfunction. (2) A clogged air cleaner can cause engine malfunction. (3) Cause low power output and poor starting performance.

17-5 INSPECTION AND MAINTENANCE EVERY 300 HOURS

MAINTENACE ITEMS	REASON / REMARKS
(1) Inspect the intake and exhaust valve clearance. Adjust if necessary.	(1) Incorrect clearance can cause low power output and engine malfunction.

17-6 INSPECTION AND MAINTENANCE EVERY 500 TO 600 HOURS (EVERY 6 MONTHS)

MAINTENACE ITEMS	REASON / REMARKS
(1) Remove the cylinder head and remove any carbon. (2) Disassemble and clean the carburetor. (3) Inspect and fitting the intake and exhaust valve and the seats of them.	(1) Carbon deposits can cause engine malfunction. (2) A faulty carburetor can cause engine malfunction. (3) Unfitting can cause low power output and engine malfunction.

17-7 MAINTENANCE EVERY 1,000 HOURS (ANNUAL MAINTENANCE)

MAINTENACE ITEMS	REASON / REMARKS
(1) Overhaul the engine. Clean and correct the engine parts, replacing if necessary. (2) Replace the piston rings. (3) Replace the fuel hose.	(1) Dirty, misaligned or worn parts can cause low power output and engine malfunction. (2) Faulty piston rings can cause low output power and engine malfunction. (3) To prevent fuel leakage and attendant dangers.

17-8 SPARK ARRESTER AND TAIL SCREEN (OPTION)

Check and clean the spark arrester and the tail screen, which are mounted on the tail of the exhaust muffler every 100 hours.

Clogged the spark arrester or the tail screen can cause prevents the flow of exhaust gas, reduces engine output, increases fuel consumption and makes starting difficult.

CAUTION

If the engine has been running, the muffler, the spark arrester and the tail screen will be very hot.

Allow the muffler to cool before checking or cleaning the spark arrester and the tail screen.

HOW TO REMOVE THE SPARK ARRESTER AND TAIL SCREEN

(1) Remove the tapping screw, the spark arrester (screw: 1pc.) and the tail screen (screw : 3ps.).

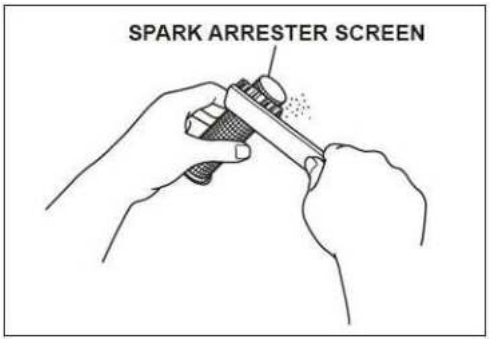
CLEAN THE SPARK ARRESTER AND TAIL SCREEN

(1) Use a brush to remove carbon deposits from the spark arrester screen. Be careful to avoid damaging the screen.

(2) The spark arrester must be free of breaks and holes.

Replace the spark arrester if it is damaged.

(3) Install the spark arrester, and muffler protector in the reverse order of disassembly.



17-9 ENGINE STORAGE

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

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

(3) To prevent rust in the cylinder bore, inject oil through the spark plug hole, pull the recoil starter knob gently 2 or 3 times and then put back the spark plug.

(4) Pull the recoil starter knob until the resistance is heavy. Leave it in that position.

(5) 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.