WORKSHOP MANUAL

MITSUBISHI MEIKI ENGINE

TYPE GM SERIES

'02-01

MITSUBISHI HEAVY INDUSTRIES, LTD.

Introduction

This workship manual provides the necessary information for checking, adjusting, disassembling, repairing reassembling and operating the Mitsubishi Meiki Engine "GM" series by the service staff. To implement rapid and correct maintenance, we recommend that you read this manual thoroughly before starting the above procedures.

The contents of this manual may not conform to your engine as a result of the change of the specifications for the purpose of improvements as this manual has been issued in accordance with the specifications as of July 1998.

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Group I	General description of engine

– 1 Features

(1) Compact size with low centre of gravity through the adoption of the inclined cylinder (OHV engine). Miniature but powerful OHV engine through the ideal combustion chamber, utilizing the results of our long time research and development. As the inclined cylinder is adopted to solve inconveniences from the heightened OHV engine, you can install the engine easily on the operation equipment and also obtain less vibration, better operability and stability with its low centre of gravity.

(2) Easy to operate and perform maintenance.
Mental and physical fatigue is minimized by:
- ▷ Reducing of power to pull the recoil through the adoption of decompression mechanism (Half compared with the conventional.)
- ▷ Centralizing of all operations (All operation from start through running to stop of the engine can be done on one side.)
- ▷ Low noise and vibration design which reduces the fatigue (Noise: 2dBA reduction from the conventional.)
- ▷ Low fuel consumption (230 gr/PS-hr · · · · · · 30% reduction from the conventional.)
- ▷ Considerable extension of lubrication interval (4 to 5 times compared with the conventional.)
- ▷ Corrosion free carburetor
- ▷ Simplified fuel and lubricant supply.
- ▷ Simplified maintenance.

(3) Economical and High Performance engine. The engine can achieve the following basic function at high level:
- ▷ Easy to start
- ▷ Acceleration.
- ▷ Output characteristics (The adoption of big volume cylinder compare with that of our competitors provides more room for a wide range of operations.)
- ▷ Torque characteristics in low/medium range of speed (Such tenacity of engine that the torque reaches maximum at around 2800 rpm.)
- ▷ Cooling characteristics (This provides more room for the installation environment, i.e., for covering.)
- ▷ Economy (Fuel and lubrication consumption, durable functional parts.)

Features of GM82, GM132, and GM182 Engines

(1) Introduction of pent-roof combustion chamber
- ▷ About 10% output increase compared to conventional OHV engine.
- ▷ Combustion efficiency is further improved and the engine clears the CARB emission control for the Year 2000 by the EPA of the United States.

(2) Realization of low noise which is at the top level of the industry
- ▷ Introduction of large muffler and air cleaner. Also, vibration noise from metal plate parts is reduced.
- ▷ Low-noise characteristics due to introduction of silent chain (low-speed type.).

(3) Large bearing is used for the output axis.
The largest bearing in the class is used which is suitable for machine the larger load in the direction of the thrust against the output axis.

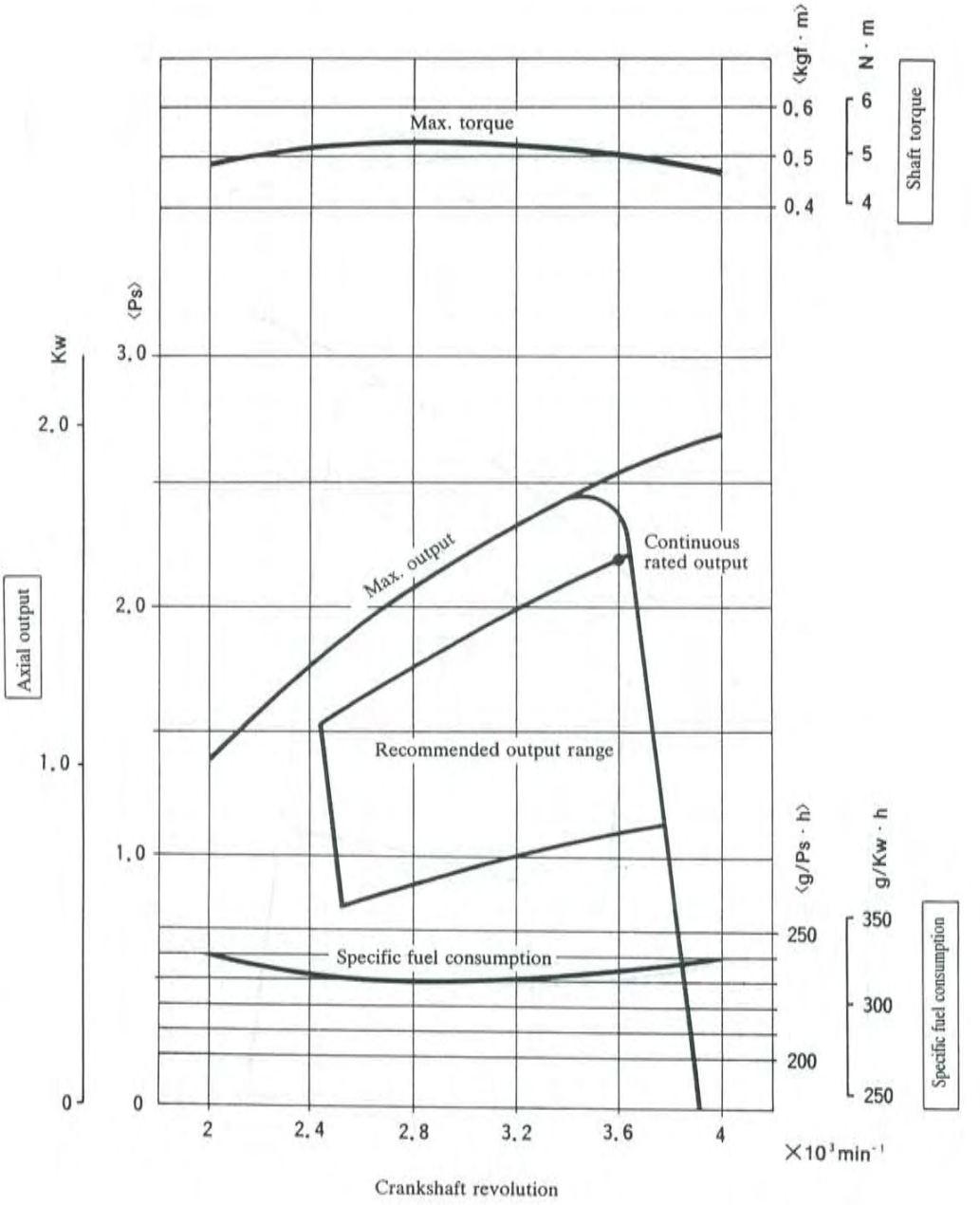
– 2 Specifications

Type		Air-cooled 4 stroke cycle overhead valve gasoline engine with cylinder inclined by 30 degrees																
Model		GM90	GM130	GM180	GM220	GM290	GM300	GM91	GM131	GM181	GM221	GM231	GM291	GM301	GM391	GM401	GM82	GM132	GM182
No. of cylinders-Bore × Stroke	(mm)	1 – 52×42	1 – 62×42	1 – 68×50	1 – 72×53	1 – 80×59		1 – 52×42	1 – 62×42	1 – 68×50	1 – 72×53		1 – 80×59		1 – 89×63		1 – 52×38	1 – 62×42	1 – 68×50
Displacement	(cm^3)	89	126	181	215	296		89	126	181	215		296		391		80	126	181
Continuous rated output	(kW/rpm)	1.6/3600	2.1/3600	3.3/3600	3.7/3600	4.4/3600	5.5/3600	1.6/3600	2.1/3600	3.3/3600	3.7/3600		4.4/3600	5.5/3600	5.9/3600	6.6/3600	1.3/3600	2.1/3600	3.3/3600
	(PS/rpm)	2.2/3600	2.8/3600	4.5/3600	5.0/3600	6.0/3600	7.5/3600	2.2/3600	2.8/3600	4.5/3600	5.0/3600		6.0/3600	7.5/3600	8.0/3600	9.0/3600	1.8/3600	2.8/3600	4.5/3600
Max. output	(kW/rpm)	2.0/4000	2.9/4000	4.4/4000	5.1/4000	5.9/4000	7.4/4000	2.0/4000	2.9/4000	4.4/4000	5.1/4000		5.9/4000	7.4/4000	8.1/4000	9.6/4000	1.8/4000	2.9/4000	4.4/4000
	(PS/rpm)	2.7/4000	4.0/4000	6.0/4000	7.0/4000	8.0/4000	10.0/4000	2.7/4000	4.0/4000	6.0/4000	7.0/4000		8.0/4000	10.0/4000	11.0/4000	13.0/4000	2.4/4000	4.0/4000	6.0/4000
Max. torque	(N·m/rpm)	5.20/2800	7.65/2800	11.6/2800	13.7/2800	17.7/2800	19.3/2800	5.20/2800	7.65/2800	11.6/2800	13.7/2800		17.7/2800	19.3/2800	23.5/2800	26.5/2800	4.31/3000	7.65/2800	11.57/2800
	(kgf·m/rpm)	0.53/2800	0.78/2800	1.18/2800	1.40/2800	1.80/2800	1.97/2800	0.53/2800	0.78/2800	1.18/2800	1.40/2800		1.80/2800	1.97/2800	2.4/2800	2.7/2800	0.44/3000	0.78/2800	1.18/2800
Engine rotation		Counterclockwise facing to output shaft																	
Fuel		Lead-free automobile gasoline																	
Fuel tank capacity	(ℓ)	2.2	3.0	4.0		6.0		3.0		4.0		4.5	6.0		7.0		1.6	2.5	4.0
Lubricatig Oil		Engine Oil SD class or higher, SAE standard #30 (In winter, #20)																	
Lubricating Oil Volume	(ℓ)	0.6		0.7		1.2		0.6		0.7		0.9	1.4		1.2		0.4	0.6	0.6
Carburetor		Float (butterfly valve transverse suction type)																	
Starting system		Recoil starter or Self-starting motor																	
Spark plug		NGK, BP5ES													CHANPION RC12YC		NGK, BP6HS		
Ignition system		Breaker-less ignition type, flywheel magnet (MTI)																	
Governor		Conical pendulum system																	
Lubrication		Splash lubrication				Splash lubrication paralelled with oil pump		Splash lubrication					Splash lubrication paralelled with oil pump				Splash lubrication		
Reduction system		L type=1/2 Cam reduction system													1/2 external reduction system		L type=1/2 Chain reduction system		
Air cleaner element		Oil wet polyurethane or oil bath system			Oil wet polyurethane foam	Oil wet polyurethane or oil bath system		Oil wet polyurethane or oil bath system			Oil wet polyurethane foam	Oil wet polyurethane or oil bath system							
Lighting capcity	(V – W)	6 – 15 (Option)																	
Charging capacity	(V – A)	12 – 2 or 12 – 4 (Option)																	
Dry weight	(kg)	14.5	15.0	17.5	18.0	25.0	26.0	15.5		18.5		21.5	26.0	27.0	35.0		9.5	P: 12.7, L: 13.7	P: 14.95, L: 15.8
Dimensions (Length×Width ×Height)	(mm)	304×337 ×326	304×337 ×336	326×362 ×363	336×362 ×363	370×426×426		308×345×336		326×363×368		339×375 ×418	370×431×431		462.5×463×466		275×304 ×284	297×340 ×320	304×357 ×350

Note:

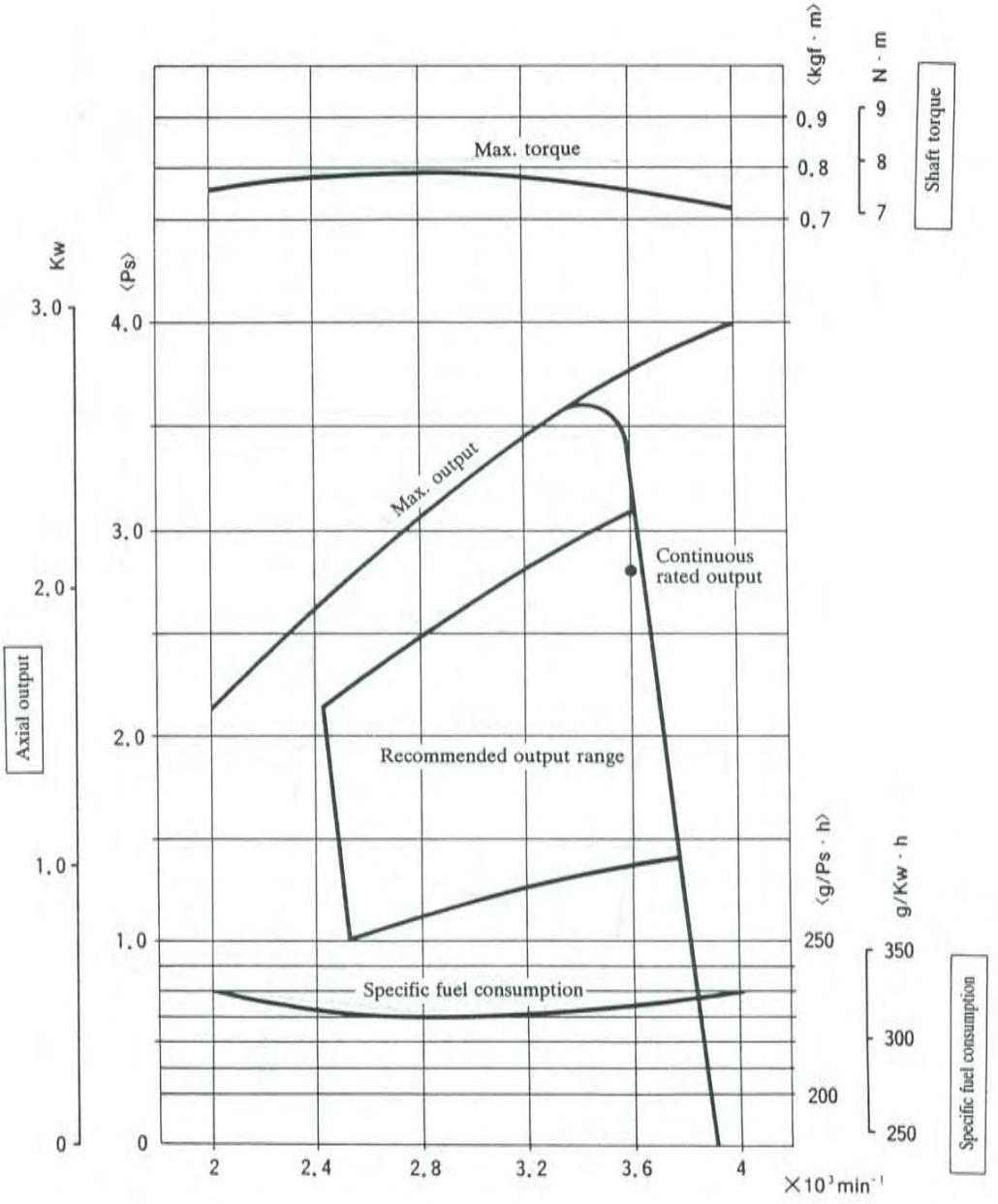
1) **Indicated revolution is at the crankshaft.**
2) **The above specifications are subject to change without prior notice by the manufacturer for the purpose of improvement.**
3) **Indicated dimensions and weights are based on LN type specifications.**

▶ GM90, GM91



GM90, GM91

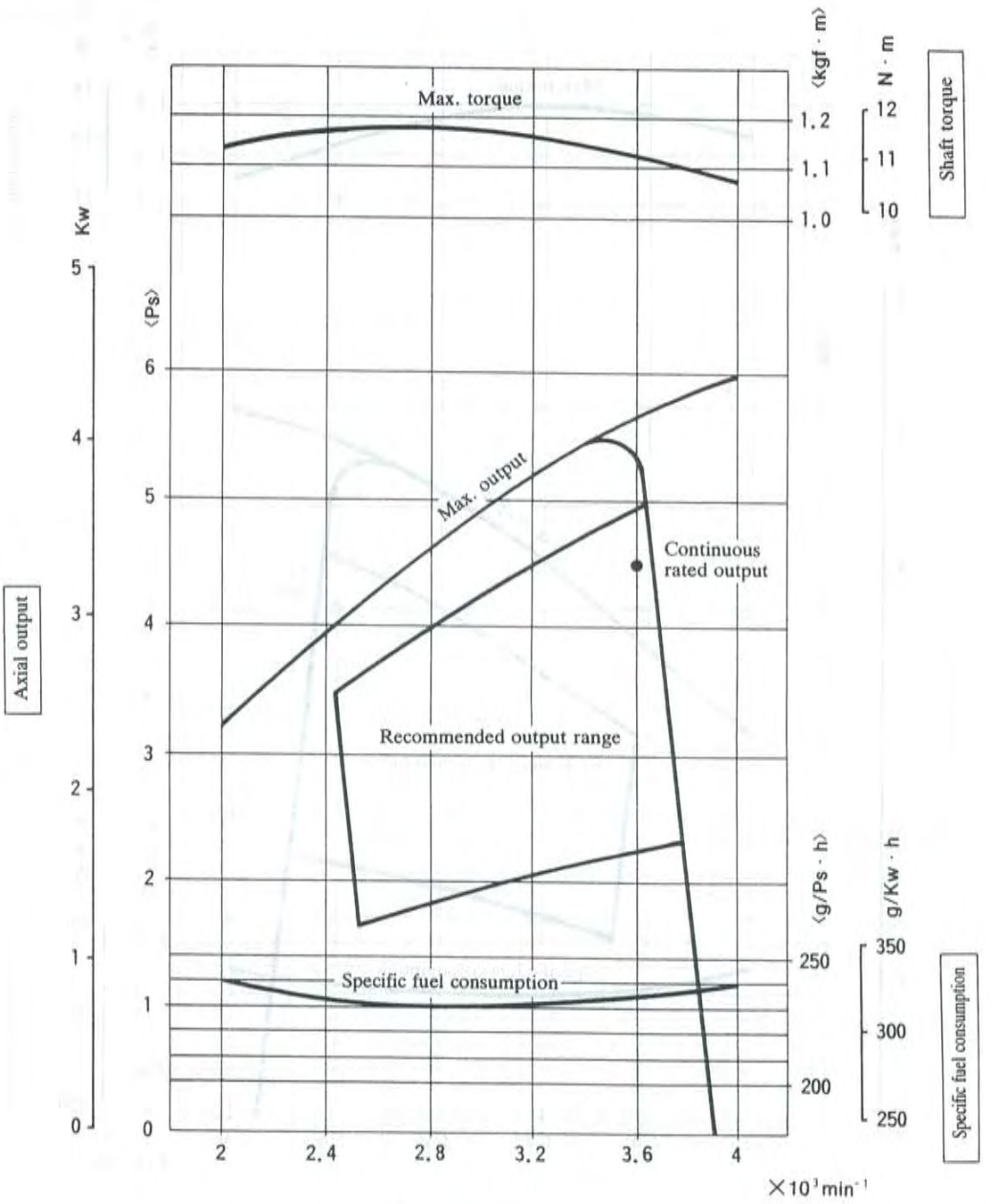
▶ GM130, GM131



Crankshaft revolution

GM130, GM131

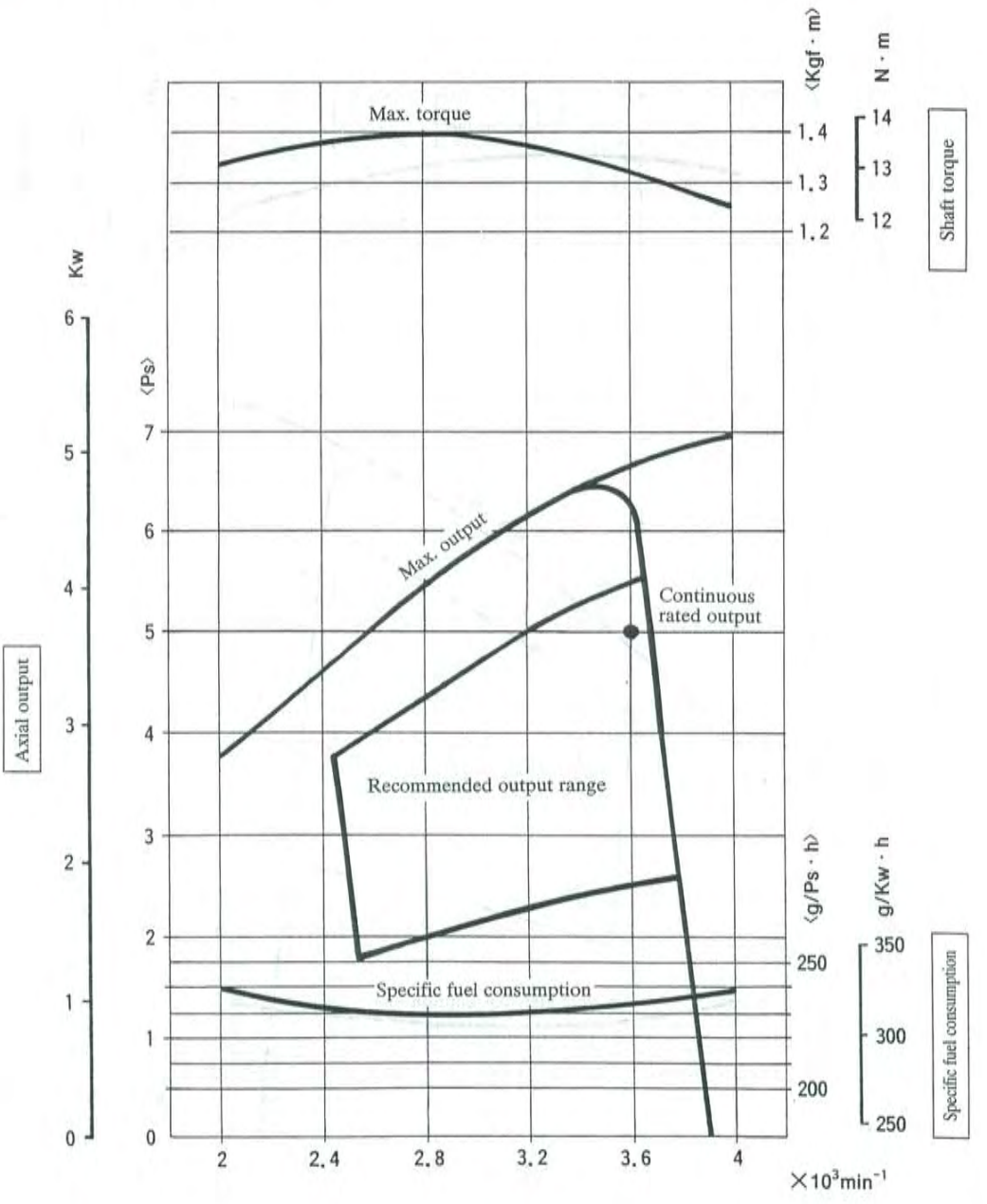
▶ **GM180, GM181**



GM180, GM181

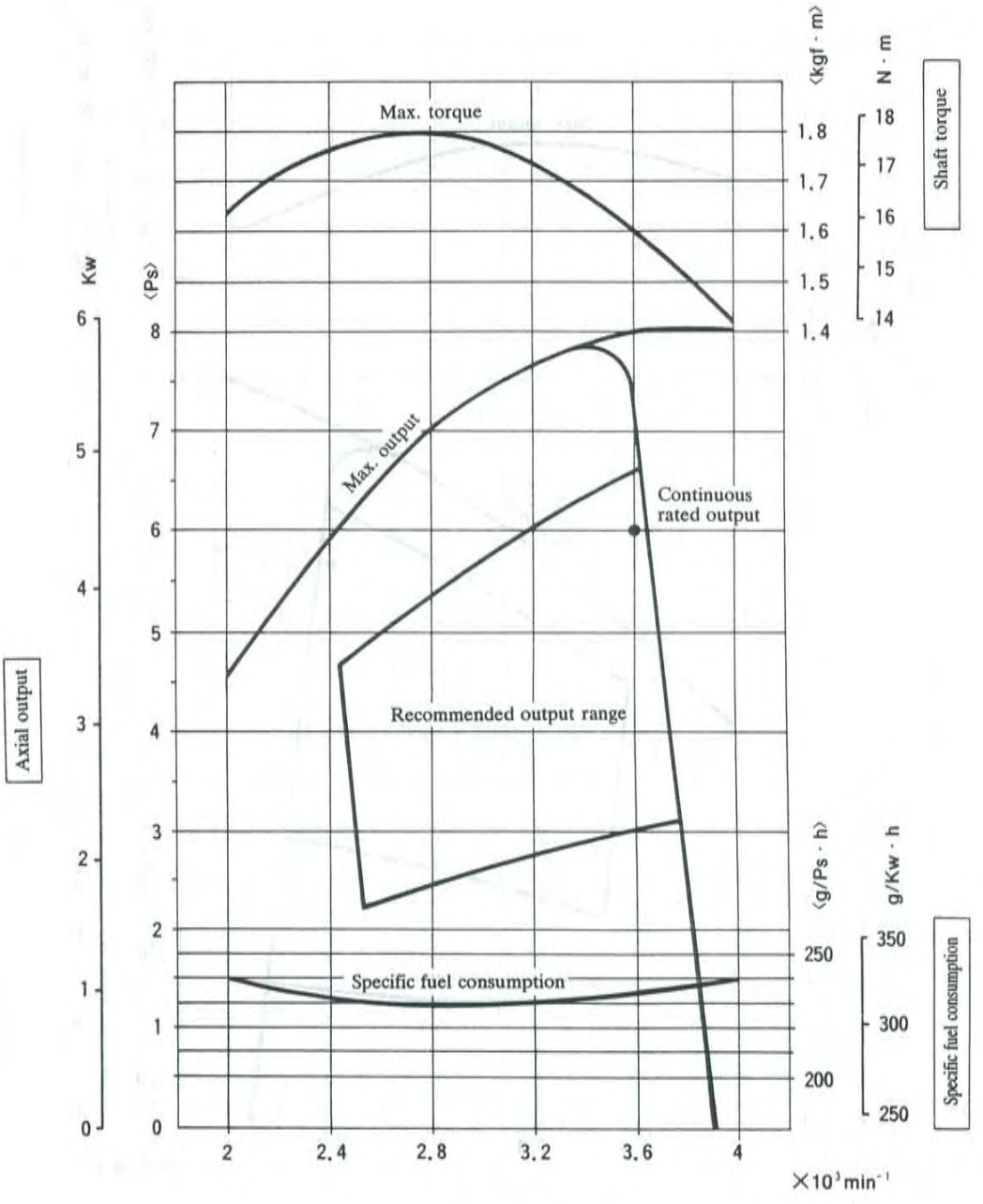
– 3 Performance curve

▶ **GM220, GM221, GM231**



GM220, GM221, GM231

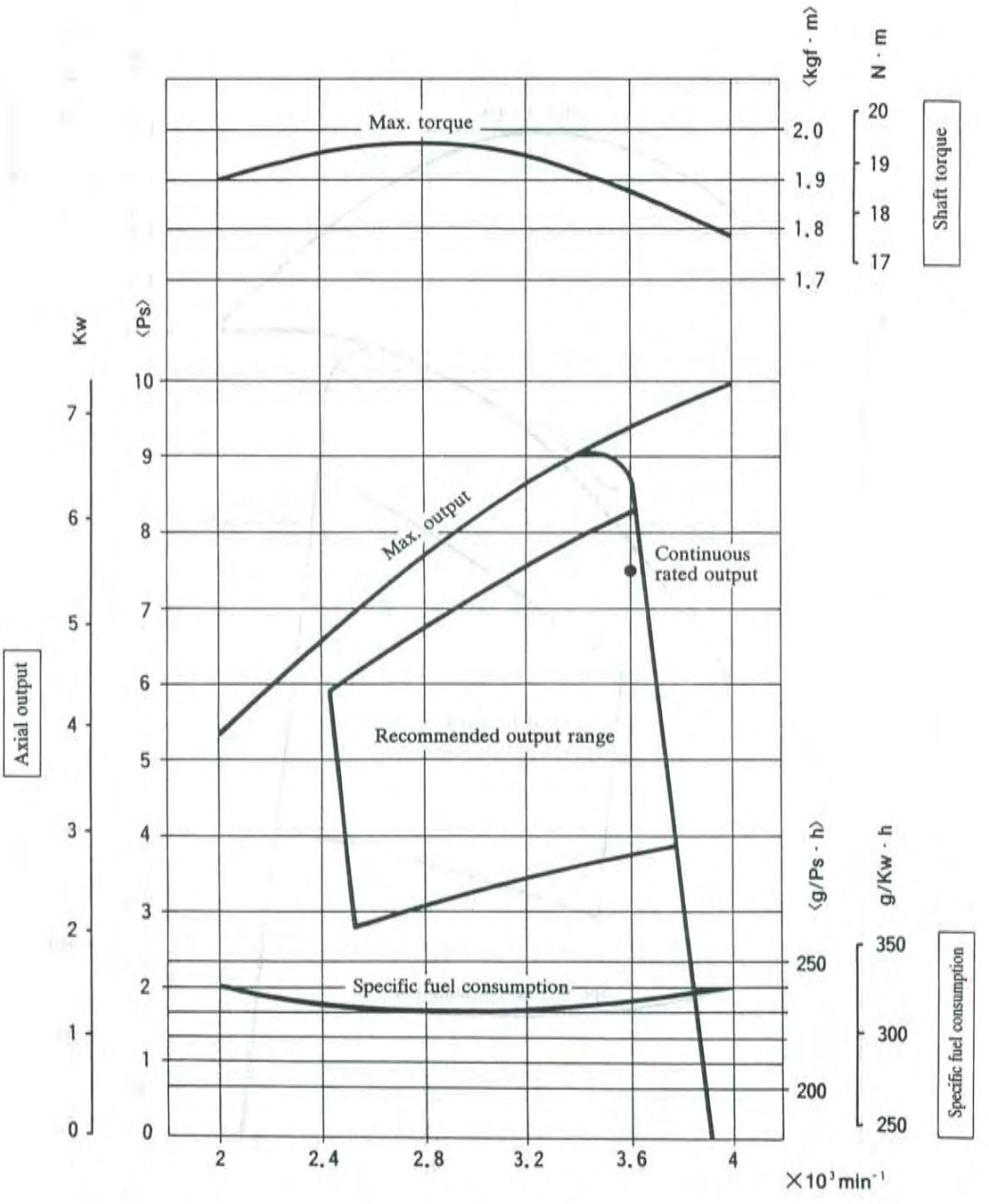
▶ **GM290, GM291**



GM290, GM291

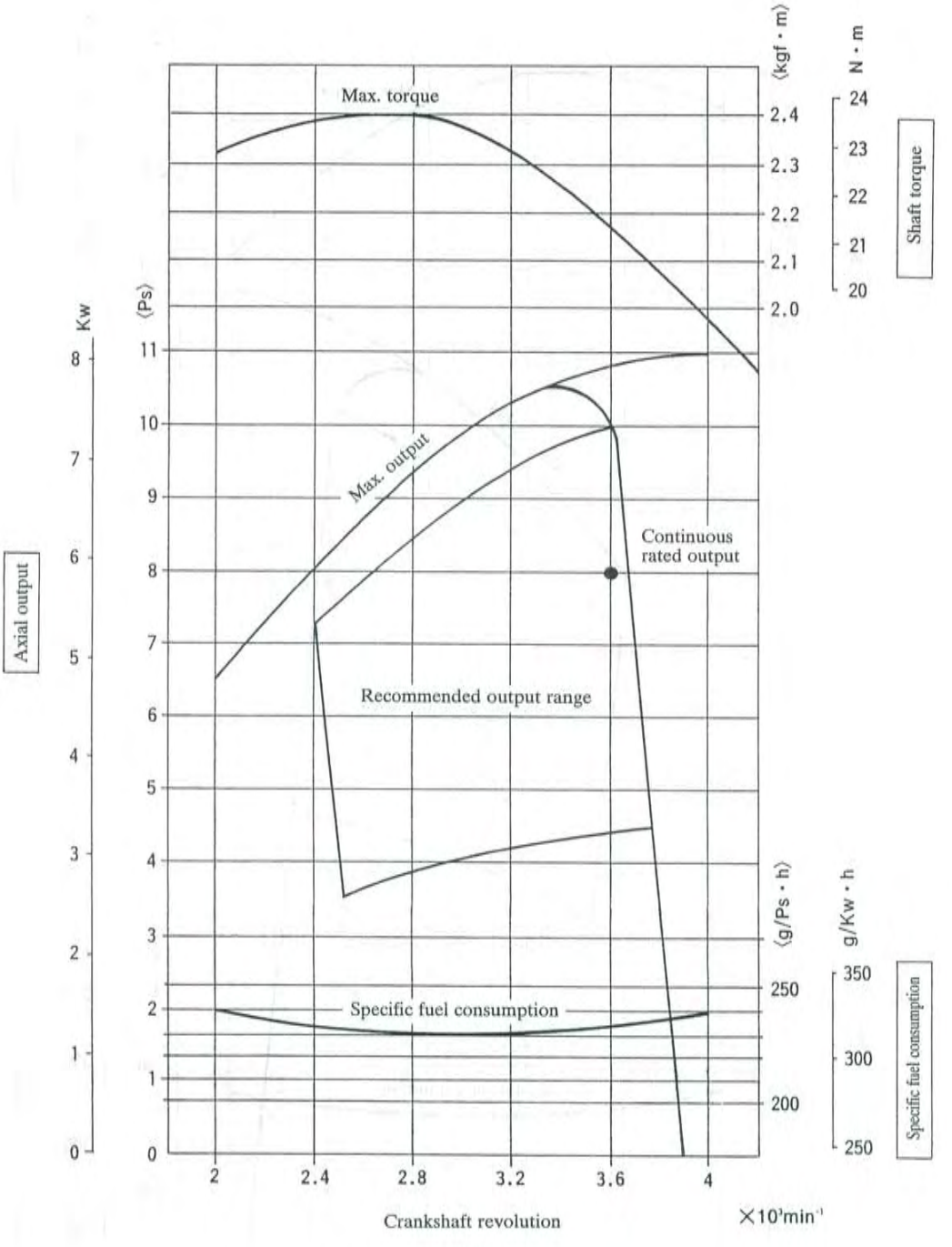
– 3 Performance curve

▶ GM300, GM301



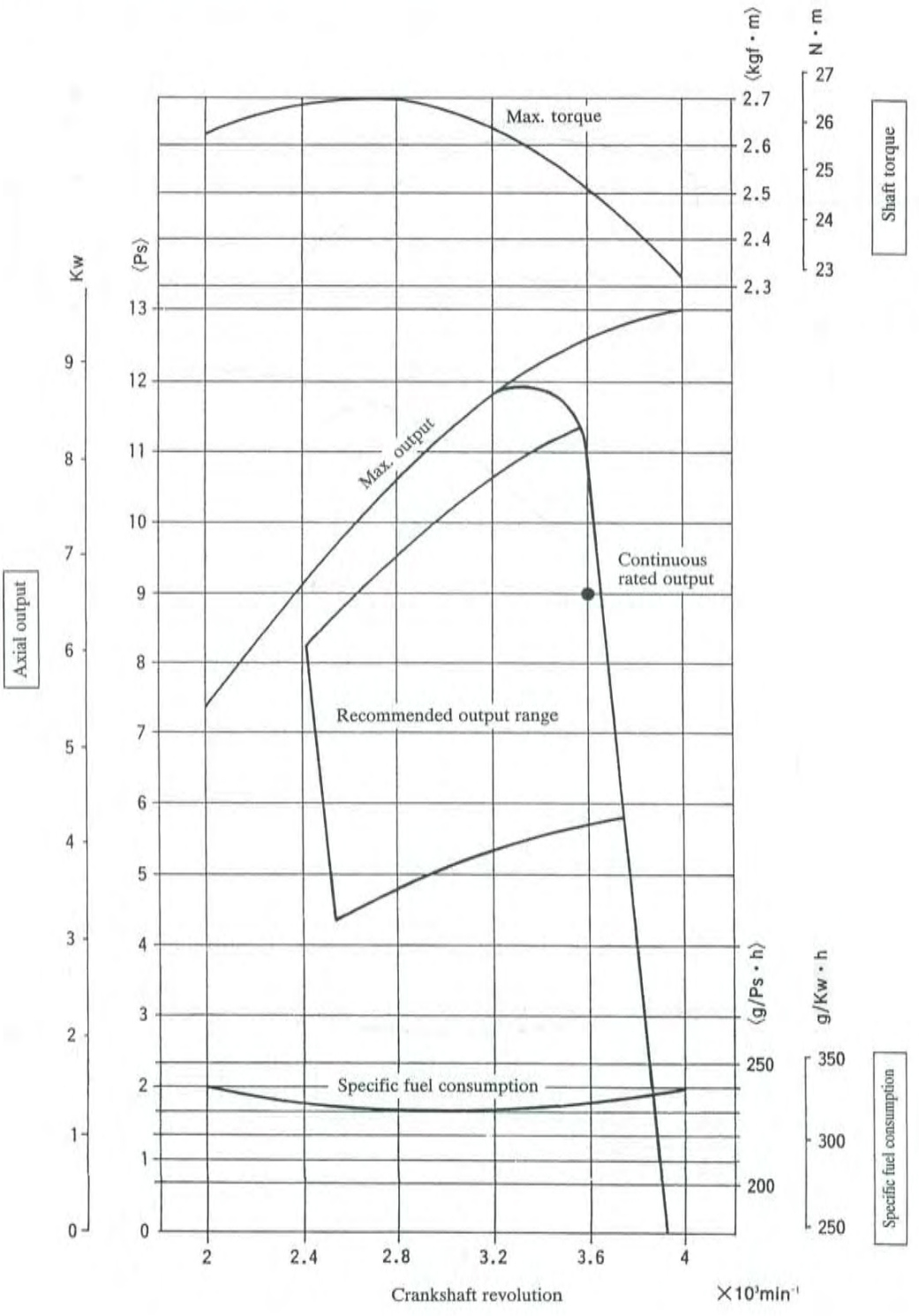
GM300, GM301

▶ **GM391**


Max. torque
Max. output
Continuous rated output
Recommended output range
Specific fuel consumption
Axial output
Kw
(Ps)
(kgf · m)
N · m
Shaft torque
(g/Ps · h)
g/Kw · h
Specific fuel consumption
Crankshaft revolution
×10³min⁻¹
2
2.4
2.8
3.2
3.6
4

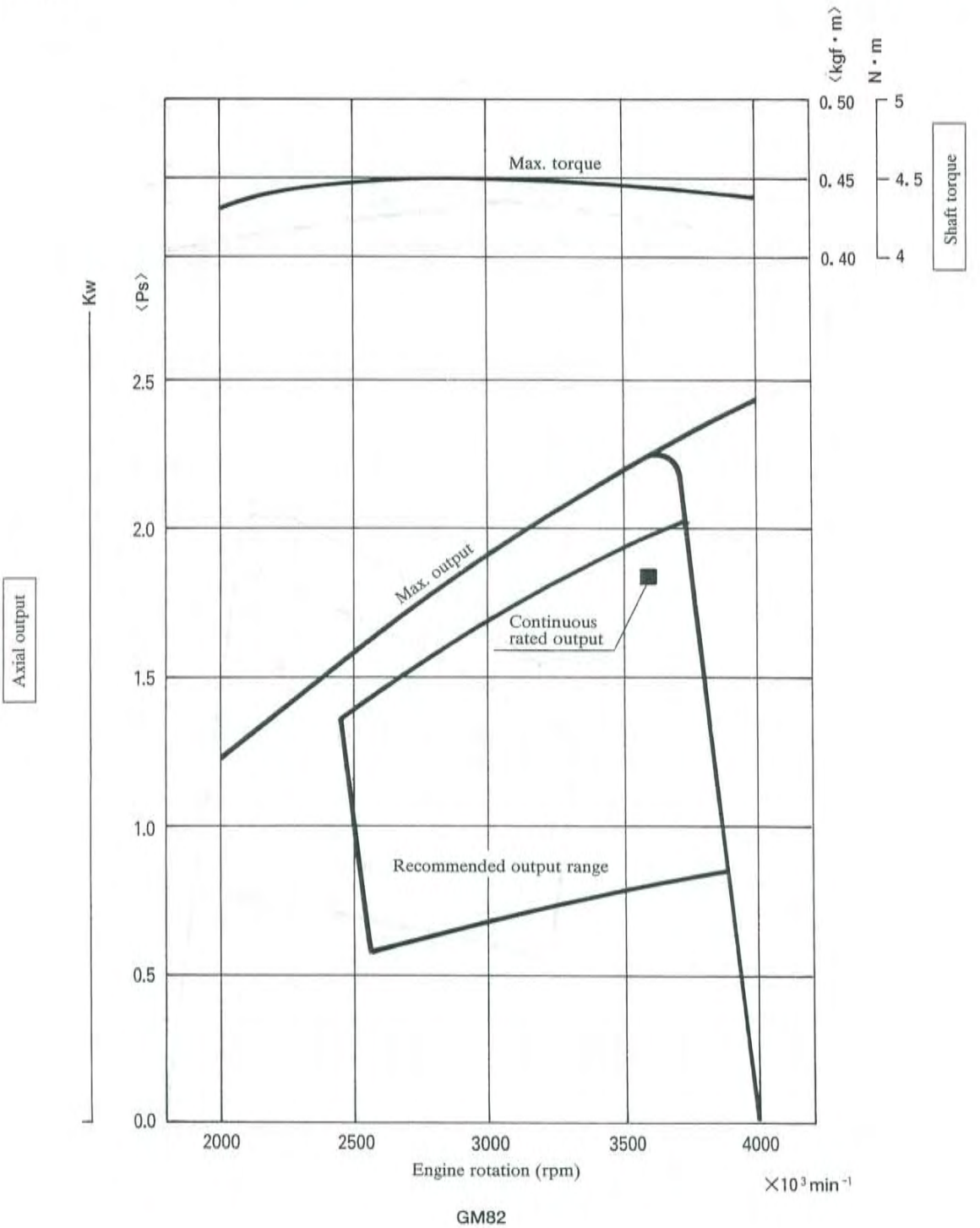
GM391

▶ **GM401**


Max. torque
Max. output
Continuous rated output
Recommended output range
Specific fuel consumption
Axial output
Kw
〈Ps〉
〈kgf・m〉
N・m
Shaft torque
〈g/Ps・h〉
g/Kw・h
Specific fuel consumption
Crankshaft revolution
×10³min⁻¹
2
2.4
2.8
3.2
3.6
4

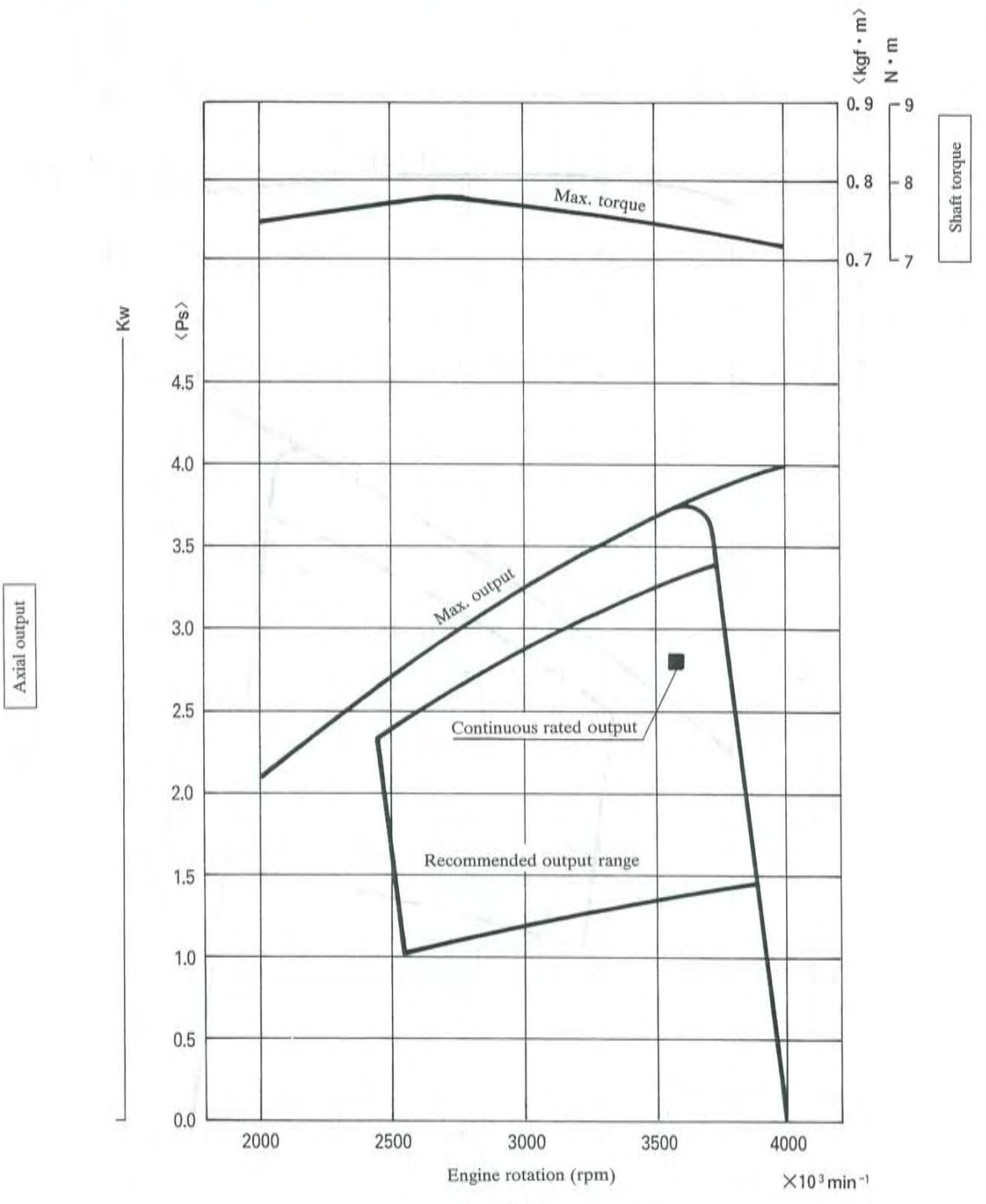
GM401

▶ **GM82**


〈kgf・m〉
N・m
0.50
0.45
0.40
5
4.5
4
Shaft torque
Max. torque
Kw
〈Ps〉
2.5
2.0
1.5
1.0
0.5
0.0
Axial output
Max. output
Continuous rated output
Recommended output range
2000
2500
3000
3500
4000
Engine rotation (rpm)
×10³min⁻¹

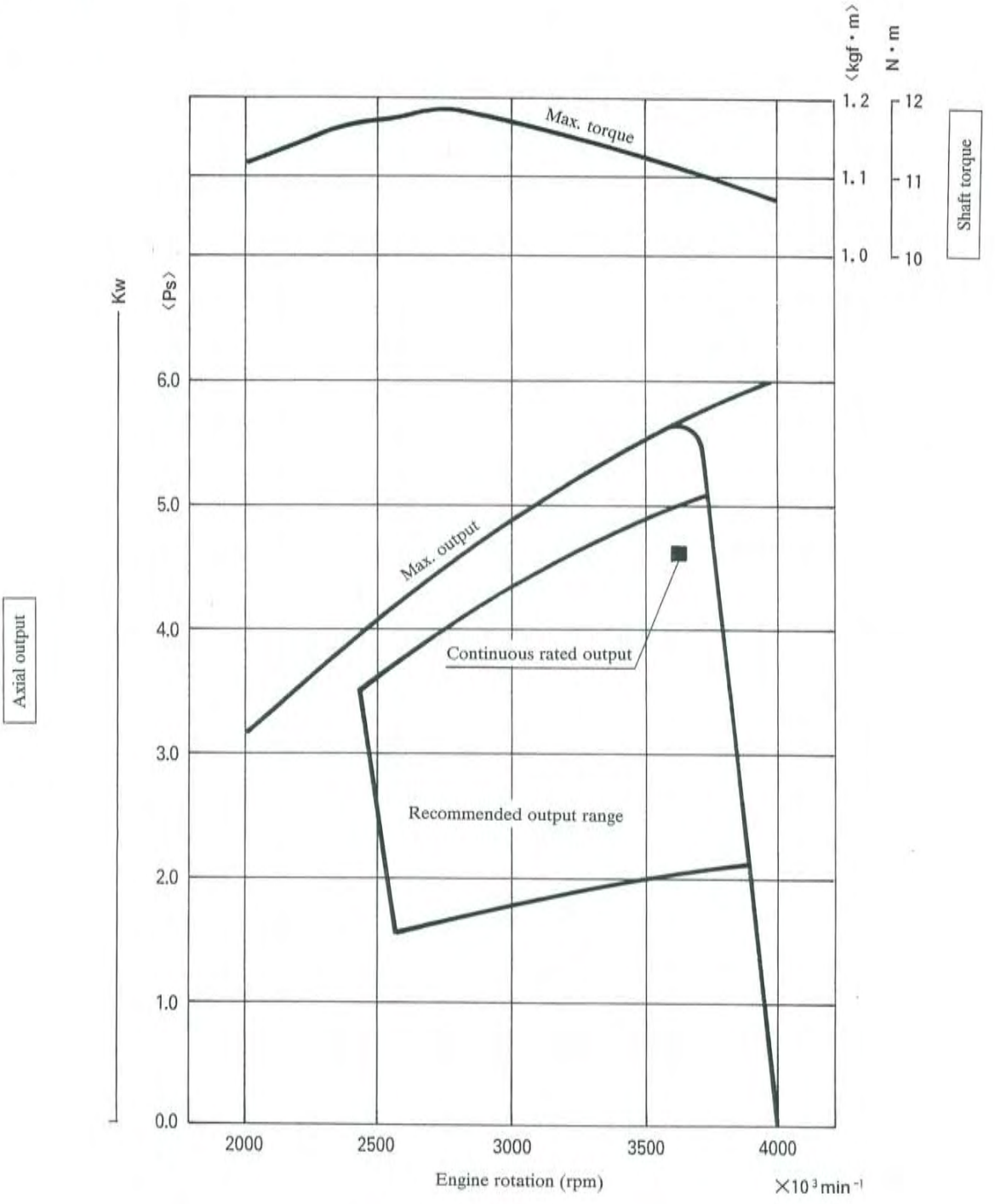
GM82

▶ GM132


〈kgf・m〉
N・m
0.9
0.8
0.7
9
8
7
Shaft torque
Max. torque
Kw
〈Ps〉
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Axial output
Max. output
Continuous rated output
Recommended output range
2000
2500
3000
3500
4000
Engine rotation (rpm)
×10³min⁻¹

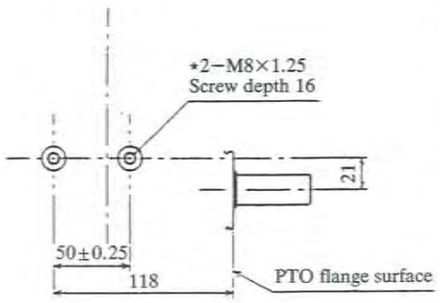
GM132

▶ **GM182**

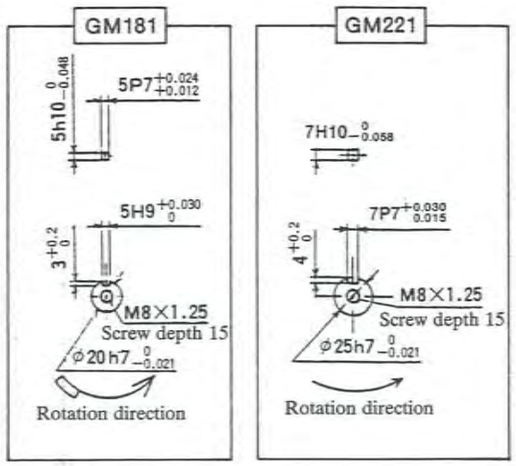

〈kgf・m〉
N・m
1.2
1.1
1.0
12
11
10
Shaft torque
Max. torque
Kw
〈Ps〉
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Axial output
Max. output
Continuous rated output
Recommended output range
2000
2500
3000
3500
4000
Engine rotation (rpm)
×10³min⁻¹

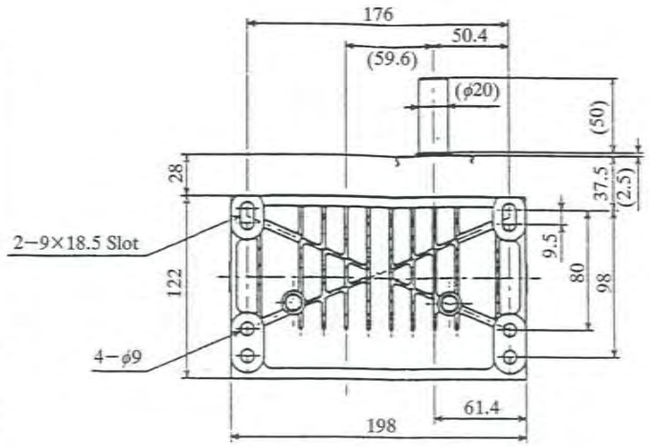
GM182

▶ **GM181, 221**

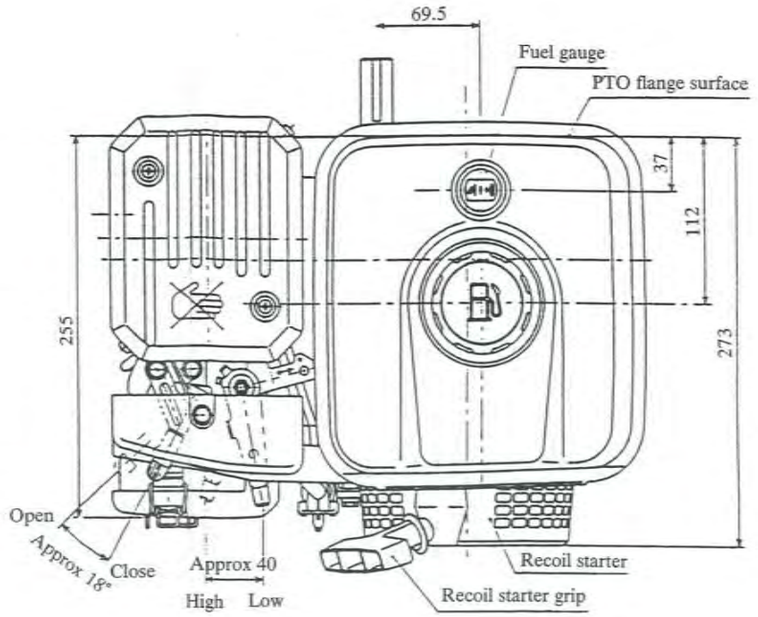


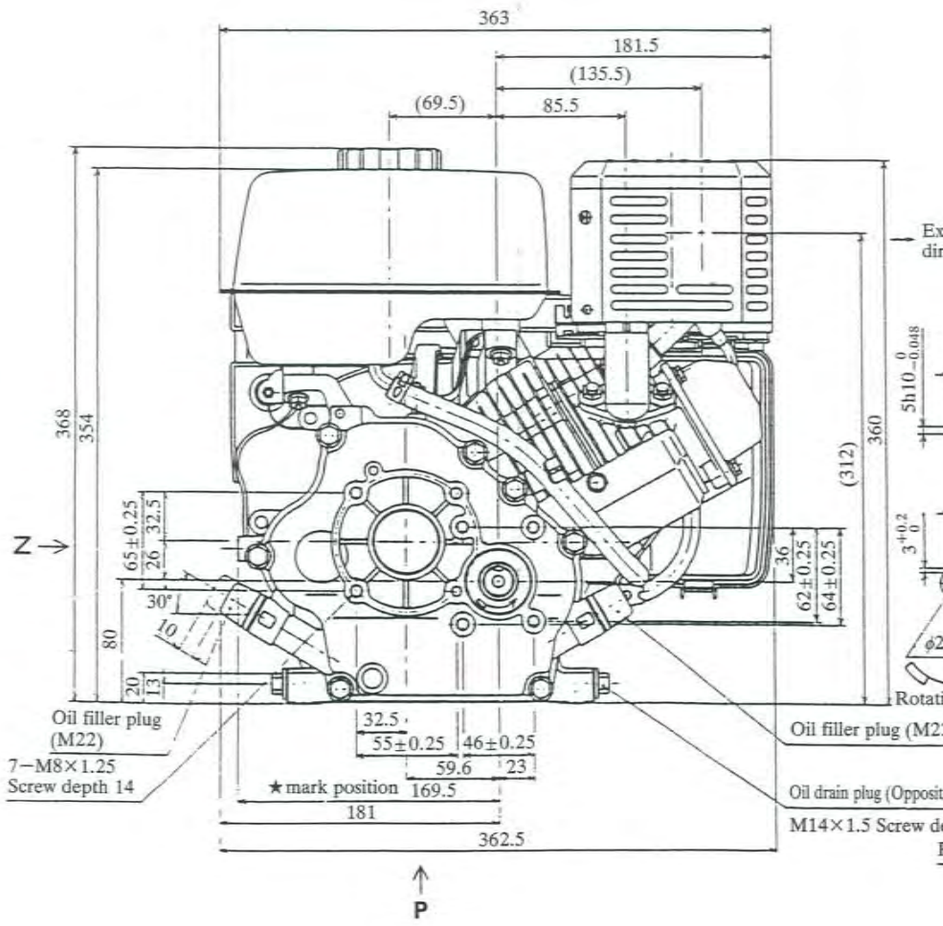
View from Z side

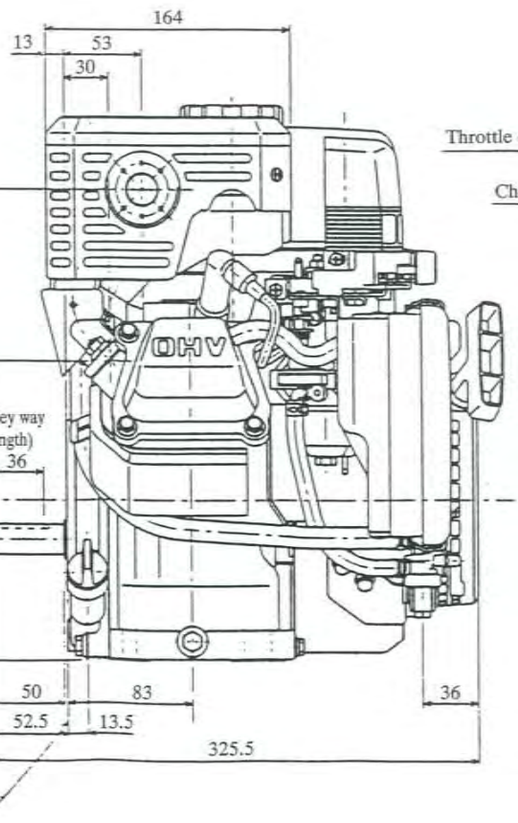


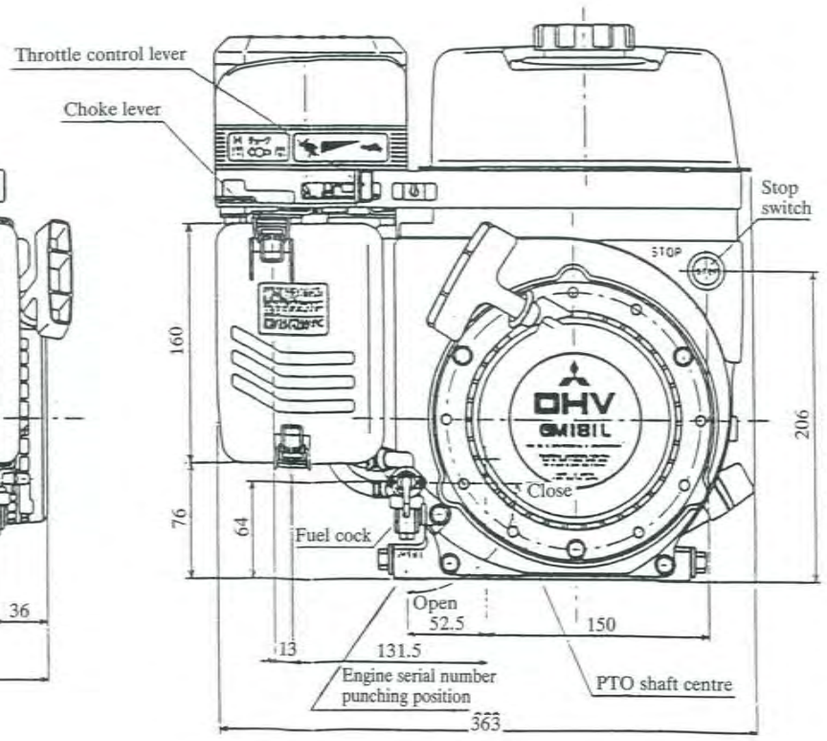


View from P side

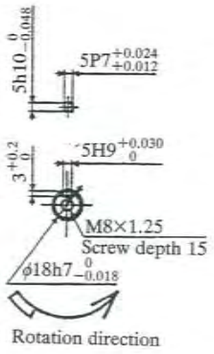


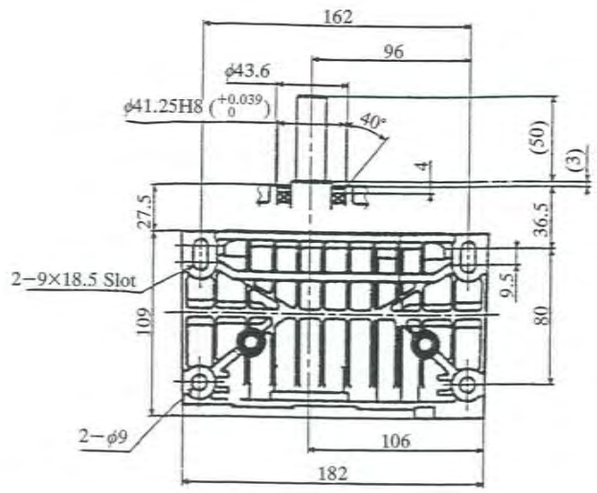




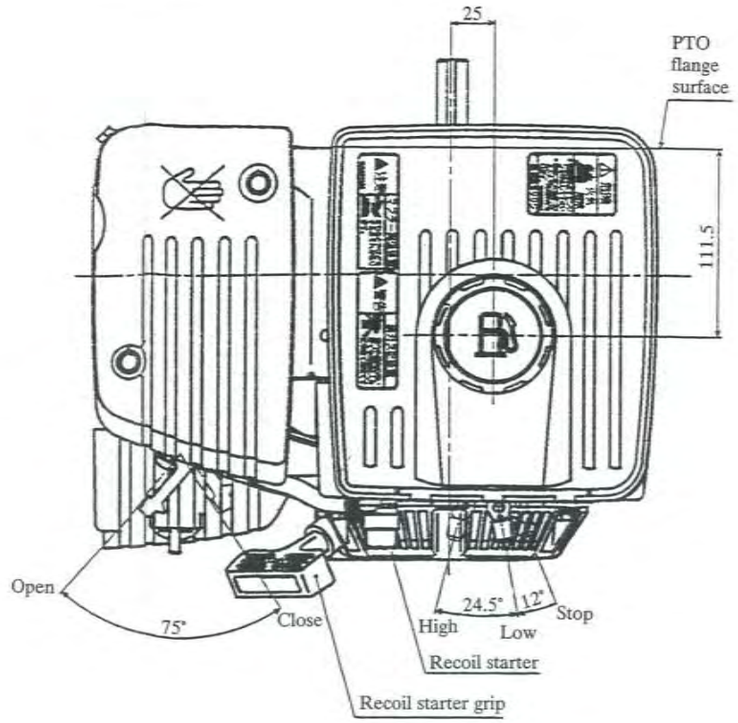


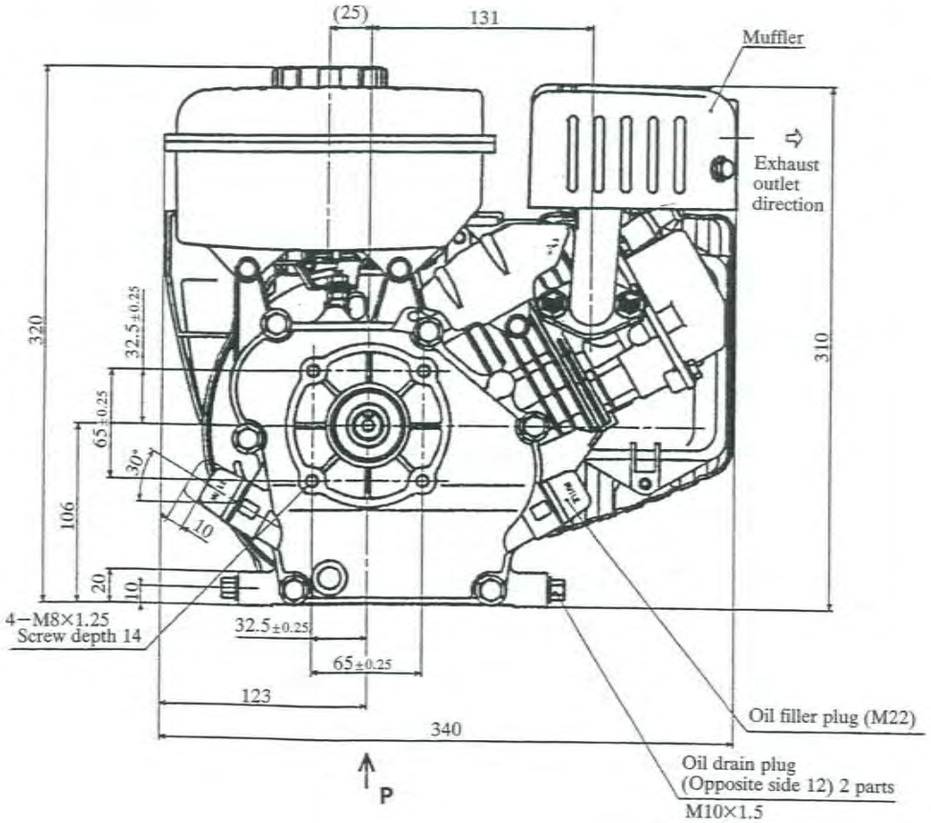
▶ GM132P

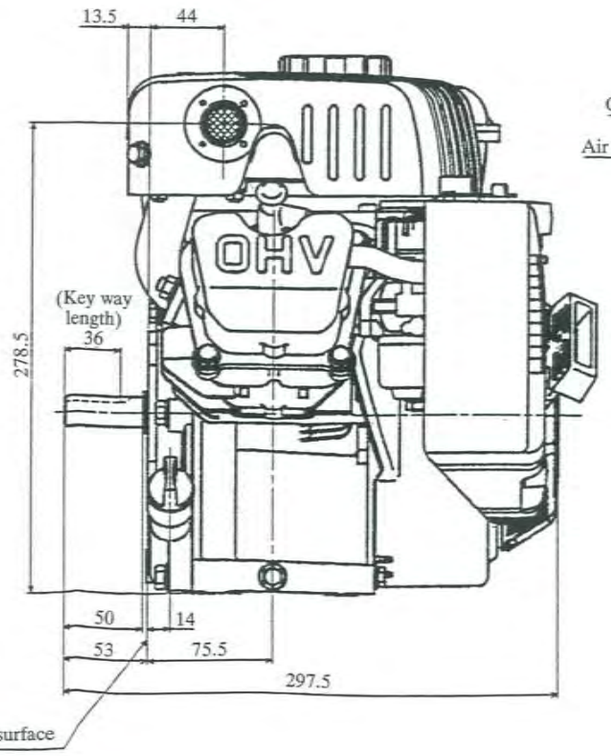


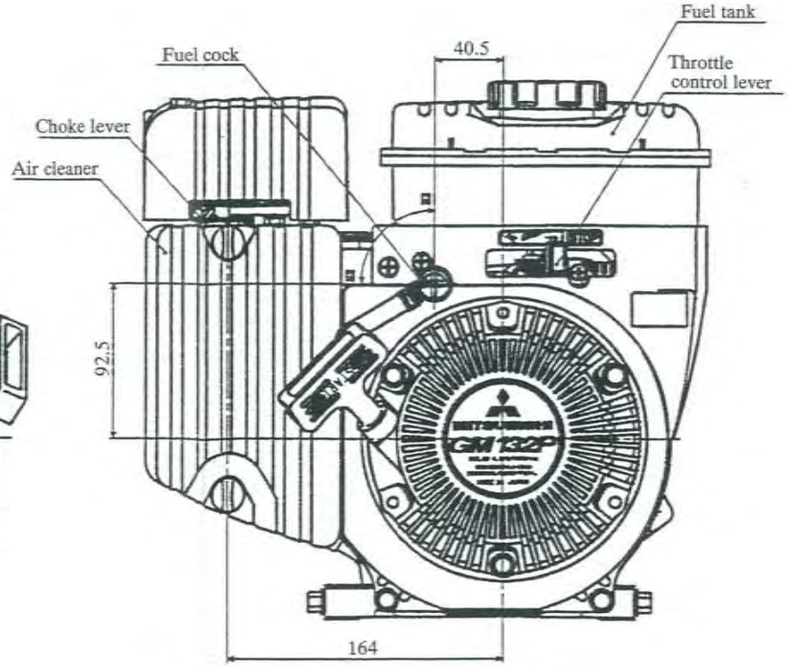


View from P side



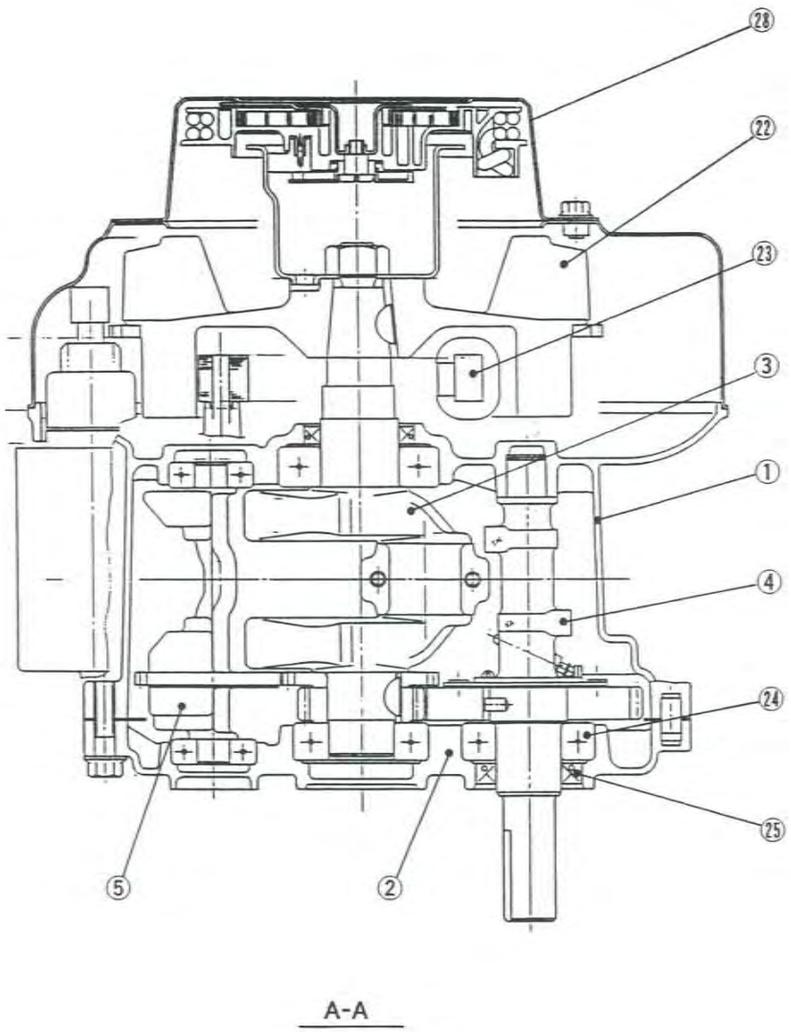




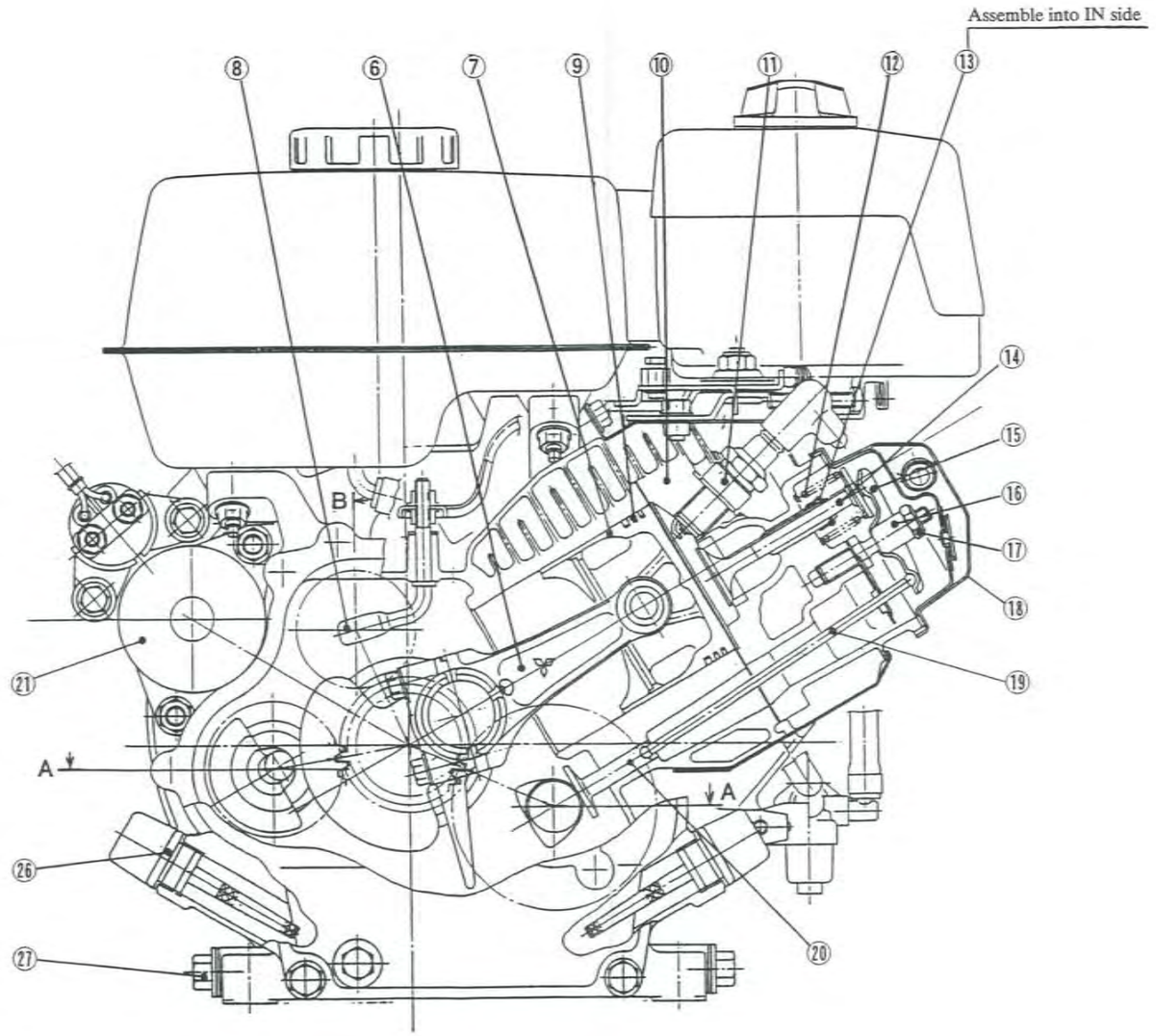


– 5 Cross-sectional diagram of engine

GM Series cross-sectional diagram

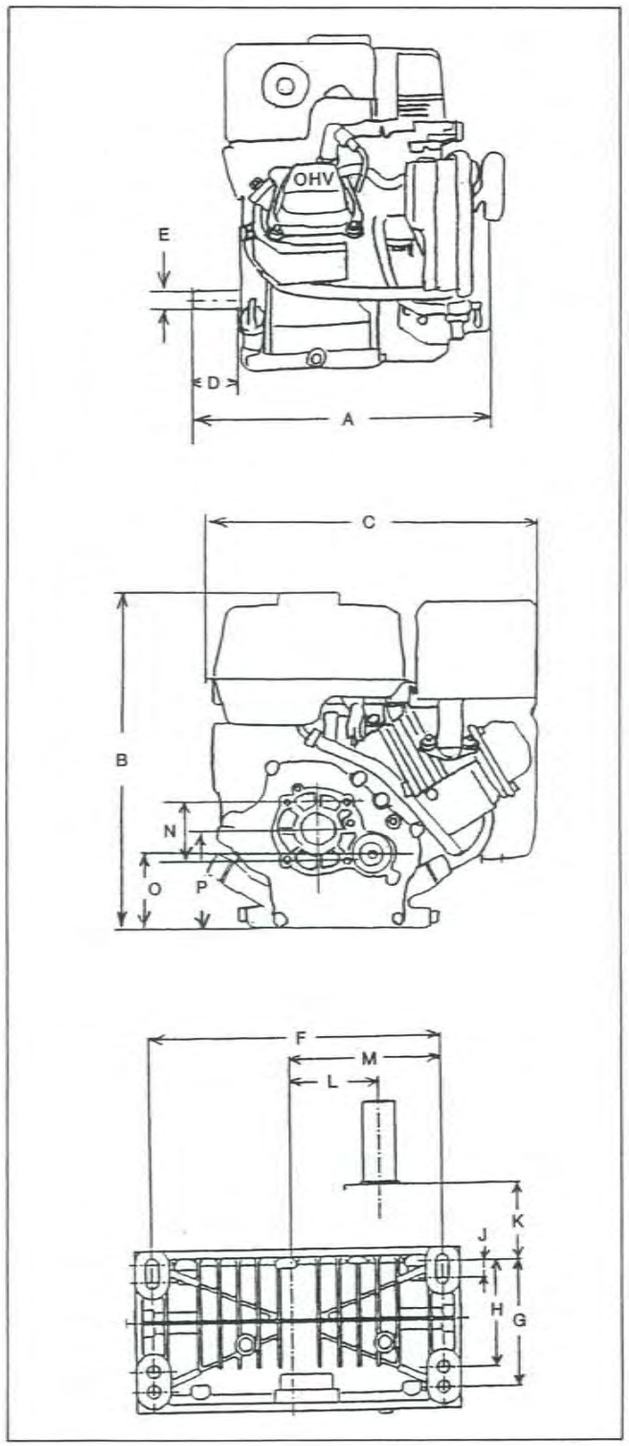


A-A



①	Cylinder block	②	Crank case cover	③	Crankshaft	④	Cam shaft	⑤	Balancer shaft	⑥	Con'rod
⑦	Piston	⑧	Govenor shaft	⑨	Piston ring	⑩	Cylinder head	⑪	Spark plug	⑫	Valve spring
⑬	Valve stem seal	⑭	Intake valve, Exhaust valve	⑮	Rocker arm	⑯	Pivot nut	⑰	Lock-nut	⑱	Cylinder head cover
⑲	Push rod	⑳	Tappet	㉑	Self starter	㉒	Flywheel	㉓	Charging coil	㉔	Bearing
㉕	Oil seal	㉖	Oil gauge	㉗	Drain plug	㉘	Recoil starter				

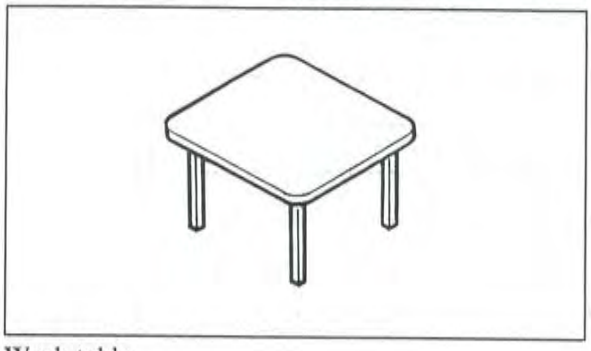
Table of GM Series appearance dimensions



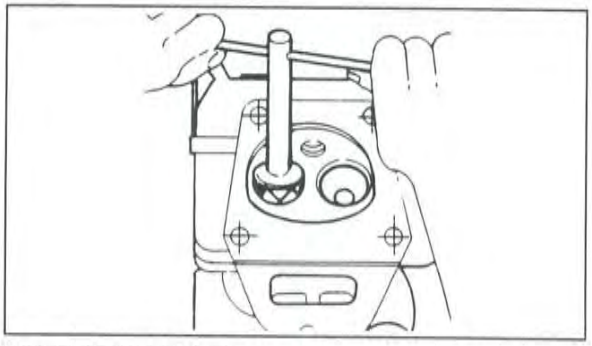
Part / Model	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
GM90	303.5	326	336.5	52.5	ϕ18	162	80	——	9.5	37	51.8	96	65	80	106
GM91	308	336	344.5	52.5	ϕ18	162	80	——	9.5	37	51.8	96	65	80	106
GM130	303.5	336	336.5	52.5	ϕ18	162	80	——	9.5	37	51.8	96	65	80	106
GM131	30.	336	344.5	52.5	ϕ18	162	80	——	9.5	37	51.8	96	65	80	106
GM180	325.5	363	361	52.5	ϕ20	176	98	80	9.5	37.5	59.6	110	65	80	106
GM181	325.5	368	363	52.5	ϕ20	176	98	80	9.5	37.5	59.6	110	65	80	106
GM220	335	363	361	62.5	ϕ25	176	98	80	9.5	37.5	59.6	110	65	80	106
GM221	325.5	368	363	52.5	ϕ25	176	98	80	9.5	37.5	59.6	110	65	80	106
GM231	338.5	419.5	375.5	62.5	ϕ25	195.5	96	——	13	44	59.6	105.1	70.7	107.5	133.5
GM290	370	426	426	62.5	ϕ25	220	95	——	13	58.5	67.1	110	70	100	133.5
GM291	370	431	431	62.5	ϕ25	220	95	——	13	58.5	67.1	110	70	100	133.5
GM300	370	426	426	62.5	ϕ25	220	95	——	13	58.5	67.1	110	70	100	133.5
GM301	370	431	431	62.5	ϕ25	220	95	——	13	58.5	67.1	110	70	100	133.5
GM391	462.5	466	463	65	ϕ25	195	103	——	17	124.5	68	105	70	133.5	133.5
GM401	462.5	466	463	65	ϕ25	195	103	——	17	124.5	68	105	70	133.5	133.5
GM82	277.5	294.5	299	52	ϕ15	162	80	——	5	41.5	——	96	65.1	——	100
GM132	297.5	320	340	52.5	ϕ18	162	80	——	9.5	37	52.5	95.9	65	80	106
GM182	309	353	354.5	52.5	ϕ20	162/176	98	80	9.5	37.5	60.1	110	65	80	106

Group II	Service date

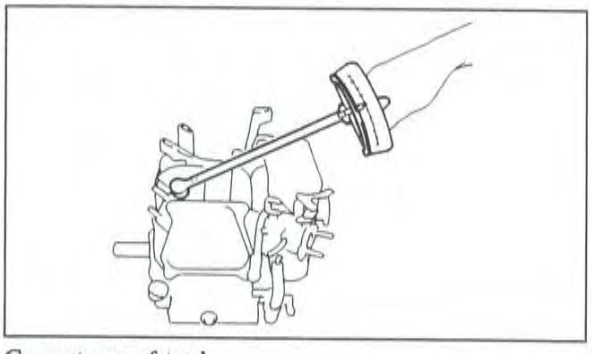
– 1 Precautions for maintenance



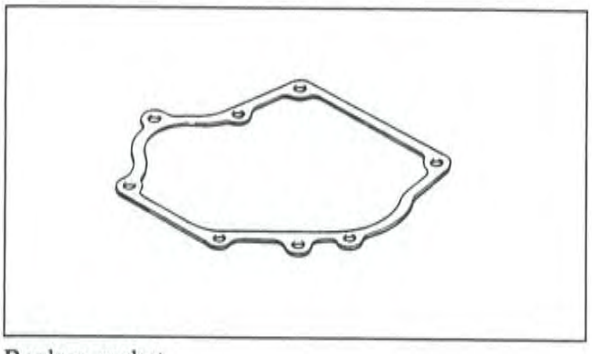
Work table



Use of exclusive tool



Correct use of tool



Replace gasket

- Prepare engine stand and table for arranging disassembled parts before disassembling, and by the parts on the table according to the procedures.
- Pay attention to the assembly marks and mark parts that do not have assembly parts so that they can be reassembled to the original status.
- Look for abnormalities before disassembling or cleaning as they may be unnoticable once disassembled.
- Always use exclusive or special tools when required.
- Use appropriate tools when disassembling and reassembling to avoid unnecessary breakage, and lubricate the parts as required in the course of assembling. Always use a torque wrench when tightening specified screws.

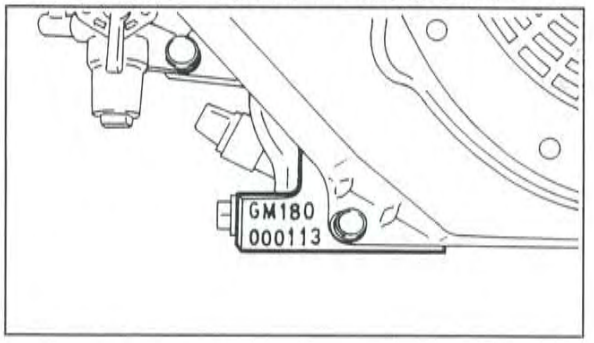
The [OO kgm] indicated under the nuts and bolts in the illustrations are the tightening torque.

- Replace the packing, gasket or O-ring when disassembling. Always use genuine or recommended parts and lubricants.

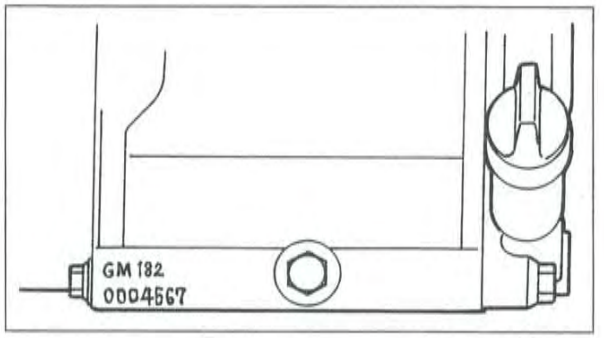
⚠ Precautions for Inspection and Maintenance

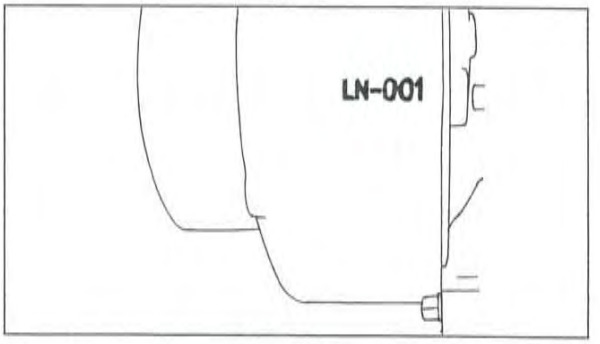
- Carry out the inspections and maintenance in a well-lighted, ventilated flat place.
- Avoid inspection and maintenance while the engine is running or immediately after stopping. Confirm that the engine has cooled down sufficiently before starting.
- If confirmations with operation are required, make sure never to place hands or heat near the moving or rotating sections.
- Remove the spark plug during the inspection and maintenance.
- Do not store or use gasoline or carry out inspections and maintenance near fire or devices with pilot fires or sparks such as heaters, furnaces or water boilers. Lit cigarettes are prohibited during inspection and maintenance.
- Do not inspect the sparks near the spark plug hole.
- Cautionary labels are attached for especially important cautions. If these are hard to read or have peeled off, replace them.

- Position of Punched serial number.
  Verify the serical number as it is necessary for making claims, ordering parts and making enquireis.

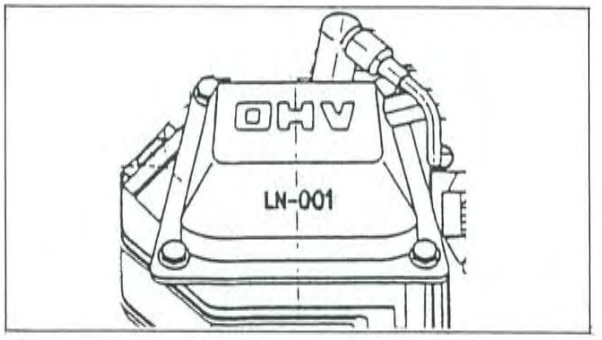


- Position of engine model number and serial number. Always verify.





- Position of the indication for customer's special specification. This is printed with indelible ink.



- Customer's special specification indication position Changed from production starting January 1994.

– 2 Regular inspection table

Procedures \ Frequency	Before operation	Every 25 hours	Every 50 hours	Every 100 hours
Check and tighten each bolt and nut	○			
Check and replenish engine oil	○			
Change engine oil		● First time only	○	
Check for fuel leaks and oil leaks	○			
Check and clean air cleaner	○			
Clean around the recoil starter	○			
Clean around the muffler cover	○			
Check and clean spark plug			◎	
Check and clean fuel cock			○	
Remove carbon on combustion chamber				◎
Check and adjust valve clearance				◎
Change fuel pipe	Every 3 years (Note that this must be changed as necessary.)			

Note:

Procedures marked as ◎ are only applicable on the first run. The every 100 hours inspection must be performed by the dealer as this requires special maintenance technics and tools.

– 3 List of servicing standards

Servicing item			GM90 ~ GM300		GM91 ~ GM301		GM391		GM401		GM82 ~ GM182	
			Standard dimensions	Serve limit	Standard dimensions	Service limit	Standard dimensions	Service limit	Standard dimensions	Service limit	Standard dimensions	Service limit
Compression (MPa/800 rpm)			0.8	0.5	0.8	0.5	0.8	0.5	0.8	0.5	0.8	0.5
Fuel consumption rate (g/kW·h)			–	40% increased by ~	–	40% increased by ~	–	40% increased by ~	–	40% increased by ~	–	40% increased by ~
Cylinder head gasket surface distortion			0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.2	0.3
Cylinder	Bore diameter		0 ~ +0.02	0.2	0 ~ +0.02	0.2	0 ~ +0.02	0.2	0 ~ +0.02	0.2	0 ~ +0.02	0.2
	Cylindrical gauge		0.010	–	0.010	–	0.01	–	0.01	–	0.01	–
	Boring dimension		0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–
Piston	Clearance between cylinder bore and piston skirt		0.04 ~ 0.08	0.2	0.04 ~ 0.08	0.2	0.04 ~ 0.08	0.2	0.04 ~ 0.08	0.2	0.04 ~ 0.08	0.2
	Clearance between piston (pin) hole and piston pin		0.002 ~ 0.018	0.06	0.002 ~ 0.018	0.06	0.002 ~ 0.018	0.06	0.002 ~ 0.018	0.06	0.002 ~ 0.018	0.06
	Clearance between piston ring and ring groove		0.03 ~ 0.07	0.20	0.03 ~ 0.07	0.20	0.03 ~ 0.07	0.20	0.03 ~ 0.07	0.20	0.03 ~ 0.07	0.20
	Piston's oversize		0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–	0.25, 0.50	–
Clearance between open ends of piston rings (Ring gap)			0.15 ~ 0.35	1.0	0.15 ~ 0.35	1.0	0.15 ~ 0.35	1.0	0.15 ~ 0.35	1.0	0.15 ~ 0.35	1.0
Con'rod	Rod small end hole diameter (Clearance between rod and piston pin)		0.004 ~ 0.023	0.08	0.004 ~ 0.023	0.08	0.004 ~ 0.023	0.08	0.004 ~ 0.023	0.08	0.004 ~ 0.023	0.08
	Big end hole diameter (Clearance between rod and crankshaft pin)		0.020 ~ 0.045	0.08	0.020 ~ 0.035	0.08	0.020 ~ 0.035	0.08	0.02 ~ 0.035	0.08	0.020 ~ 0.035	0.08
	Runout and bend		0.05/100	0.10/100	0.05/100	0.10/100	0.05/100	0.10/100	0.05/100	0.10/100	0.05/100	0.10/100
Camshaft	Outer diameter tolerance at axle	PTO Power take-off side	−0.016 ~ −0.034	−0.10	−0.016 ~ −0.034	−0.10	−0.016 ~ −0.034	−0.10	−0.016 ~ −0.034	−0.10	−0.016 ~ −0.034	−0.10
		FW Flywheel side	−0.016 ~ −0.034	−0.10	−0.010 ~ −0.020	−0.10	−0.010 ~ −0.020	−0.10	−0.01 ~ −0.02	−0.10	−0.01 ~ −0.02	−0.10
	Axial direction clearance		0.01 ~ 0.20	0.30	0.01 ~ 0.20	0.3	0.01 ~ 0.20	0.3	0.01 ~ 0.20	0.3	0.01 ~ 0.20	0.3
	Camlift (Length up to top surface)	~ GM130	27.20	26.5	~ GM131	27.20	26.5	32.75	32.0	32.75	32.0	GM82	25.5	24.8
		GM180	28.20	27.5	~ GM221	28.20	27.5	–	–	–	–	GM132	26.5	25.8
		GM290 ~	32.15	31.5	GM291 ~	32.15	31.5	–	–	–	–	GM182	28.54	27.84
Push-rod bend			0.05	0.20	0.05	0.20	0.05	0.20	0.05	0.20	0.05	0.20
Crank-shaft	Pin outer diameter tolerance		−0.005 ~ −0.020	−0.10	−0.005 ~ −0.010	−0.10	−0.005 ~ −0.010	−0.1	−0.005 ~ −0.010	−0.1	−0.005 ~ −0.010	−0.1
	Outer diameter tolerance at axle	PTO Power take-off side	−0.010 ~ −0.025	−1.0	−0.010 ~ −0.020	−0.10	−0.01 ~ −0.02	−0.1	−0.01 ~ −0.02	−0.1	−0.01 ~ −0.02	−0.1
		Flywheel side	−0.010 ~ 0.025	−0.10	−0.010 ~ −0.020	−0.10	−0.01 ~ −0.02	−0.1	−0.01 ~ −0.02	−0.1	−0.01 ~ −0.02	−0.1
	Clearance between con'rod side surface and pin part		0.3 ~ 0.8	1.5	0.3 ~ 0.8	1.5	0.3 ~ 0.8	1.5	0.3 ~ 0.8	1.5	0.3 ~ 0.8	1.5
	Axial direction clearance		0.01 ~ 0.20	0.30	0.01 ~ 0.20	0.30	0.01 ~ 0.20	0.3	0.01 ~ 0.20	0.3	0.01 ~ 0.20	0.3
Valve	Clearance between valve stem and valve guide		0.040 ~ 0.083	0.20	0.055 ~ 0.092	0.20	0.055 ~ 0.092	0.2	0.055 ~ 0.092	0.2	0.055 ~ 0.092	0.2
	Valve tapered length		1.75	0.8	1.75	0.8	1.75	0.8	1.75	0.8	1.75	0.8
	Valve seat's contact surface		1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5	1.0	1.5
Valve spring	Free length		29.0 ~ 31.2	–	28.0 ~ 31.6	–	37.8	–	37.8	–	25.46 ~ 28	–
	Squareness		35/1000	60/1000	35/1000	60/1000	35/1000	60/1000	35/1000	60/1000	35/1000	60/1000
Tappet	Clearance between tappet bore and push-rod		0.025 ~ 0.077	0.15	0.025 ~ 0.062	0.15	0.025 ~ 0.062	0.5	0.025 ~ 0.062	0.15	0.025 ~ 0.062	0.15
Valve clearance (Intake and exhaust when cold)			0.06 ~ 0.10	–	0.06 ~ 0.10	–	0.1 ~ 0.12	–	0.1 ~ 0.12	–	0.1 ~ 0.12	–
Spark plug	Electrode gap		0.6 ~ 0.7	–	0.6 ~ 0.7	–	0.6 ~ 0.7	–	0.6 ~ 0.7	–	0.6 ~ 0.7	–

Note) The GM231 clearance (both exhausts in cooled state) is 0.15 to 0.17.

– 4 List of tightening torques

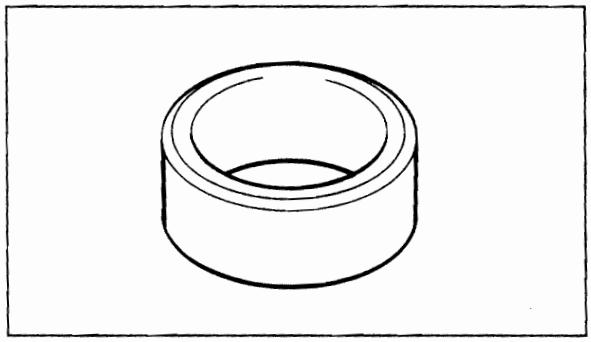
Item	Screw diameter	Tightening torque (N·m)	Remarks
Stop switch (Nut)	M4	1	
	M8	5	
Connecting rod	M6	10	~ GM231
	M8	20	GM291 ~
Crankcase cover	M6	20	GM82
	M8	20	
	M8	10	GM132, GM182
Muffler	M8	20	
Cylinder head bolt	M8	25	GM90 ~ GM231
	M8	25	GM82, 132, 182
	M10	35	GM291 ~ 301
	M10	45	GM391, 401
Flywheel nut	M12	45	GM82
	M14	60	GM90 ~ GM180
	M14	85	GM290 ~
Spark plug	M14	20	
Drain plug	M10	20	GM82, 132, 182
	M14	22	
Fuel cock	M10	8	
Cooling fan	5/16	10	
Pivot bolt	M8	20	
Rocker arm adjuster	M6	10	GM391, 401
General screws	M5	4	
	M6	5	
	M8	10	
CT bolt	M6	5	
	M8	10	
TP screw (coil)	M4.2	6	GM391, 401

Note:
CT bolt is the abbreviation of Cell Tap Bolt and this is to be screwed in tapping.
Always fit these bolts to the original holes when reassembling.
The CT bolt tightening torque is the same as the general screws when reassembling.

– 5 Exclusive tools and jigs

▶ **Special jig**

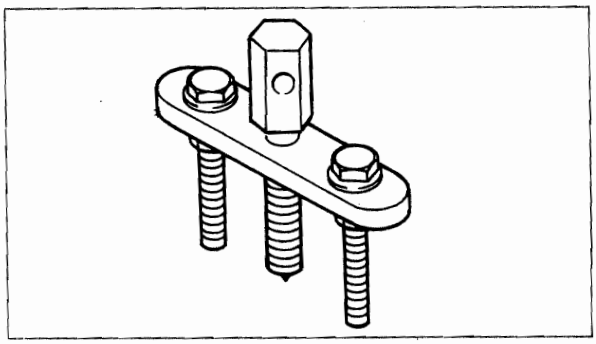
1. Piston insertion tool



▶ **Piston insertion tool**

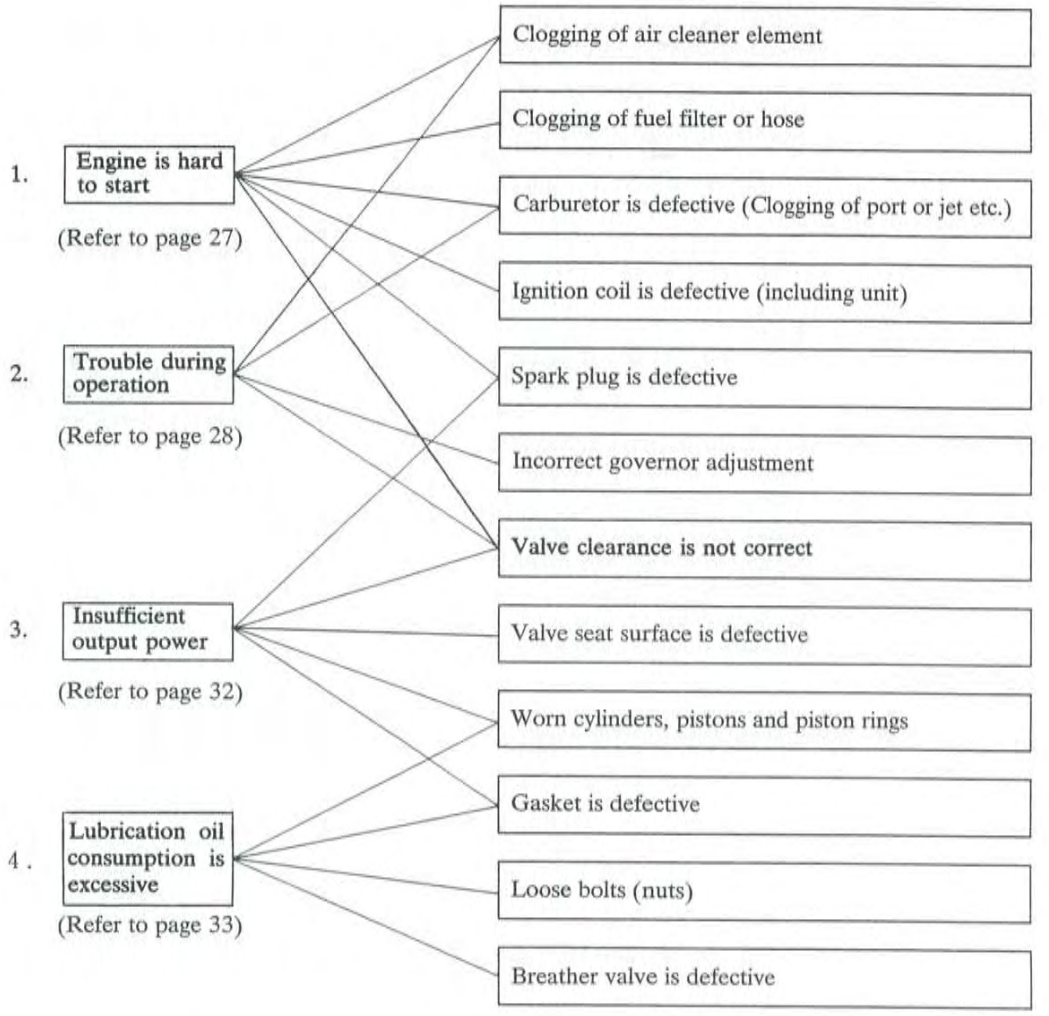
Model	Part No.
GM90, GM91, GM82	FR15122E
GM130, GM131, GM132	FR15122F
GM180, GM181, GM182	FR15122C
GM220, GM231	FR15122H
GM290, GM291 ~	FR15122G
GM391, GM401	FR15122T

2. Flywheel removal tool



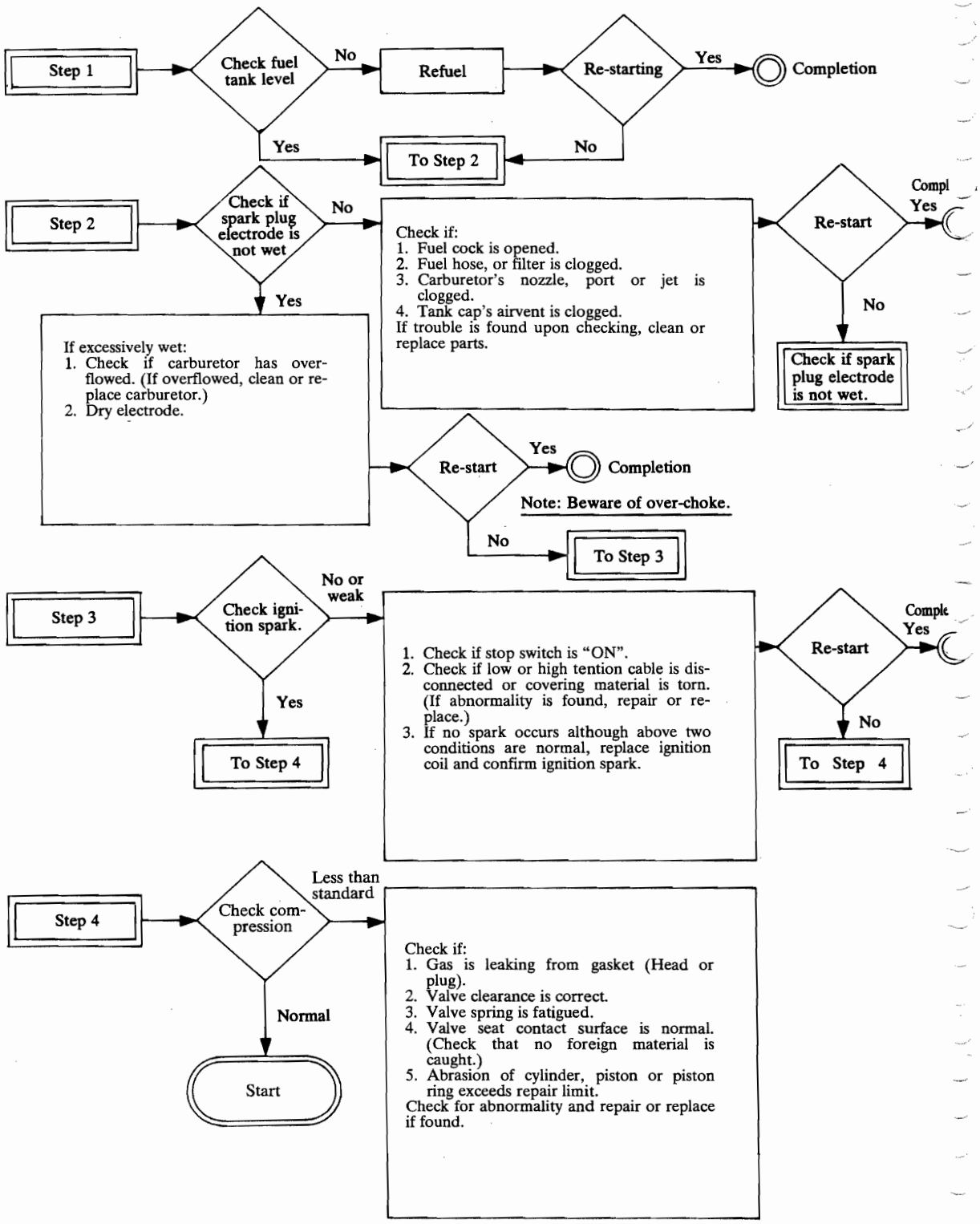
Model	Part No.
GM82, GM132, GM182	XKG09083A

► **Main symptom and its cause**

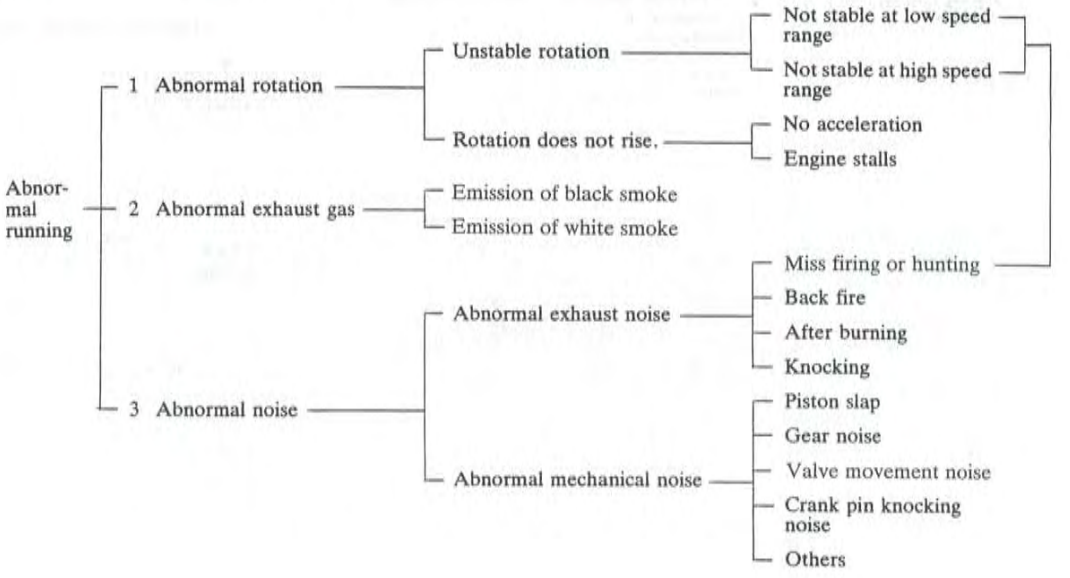


– 6 Trouble shooting

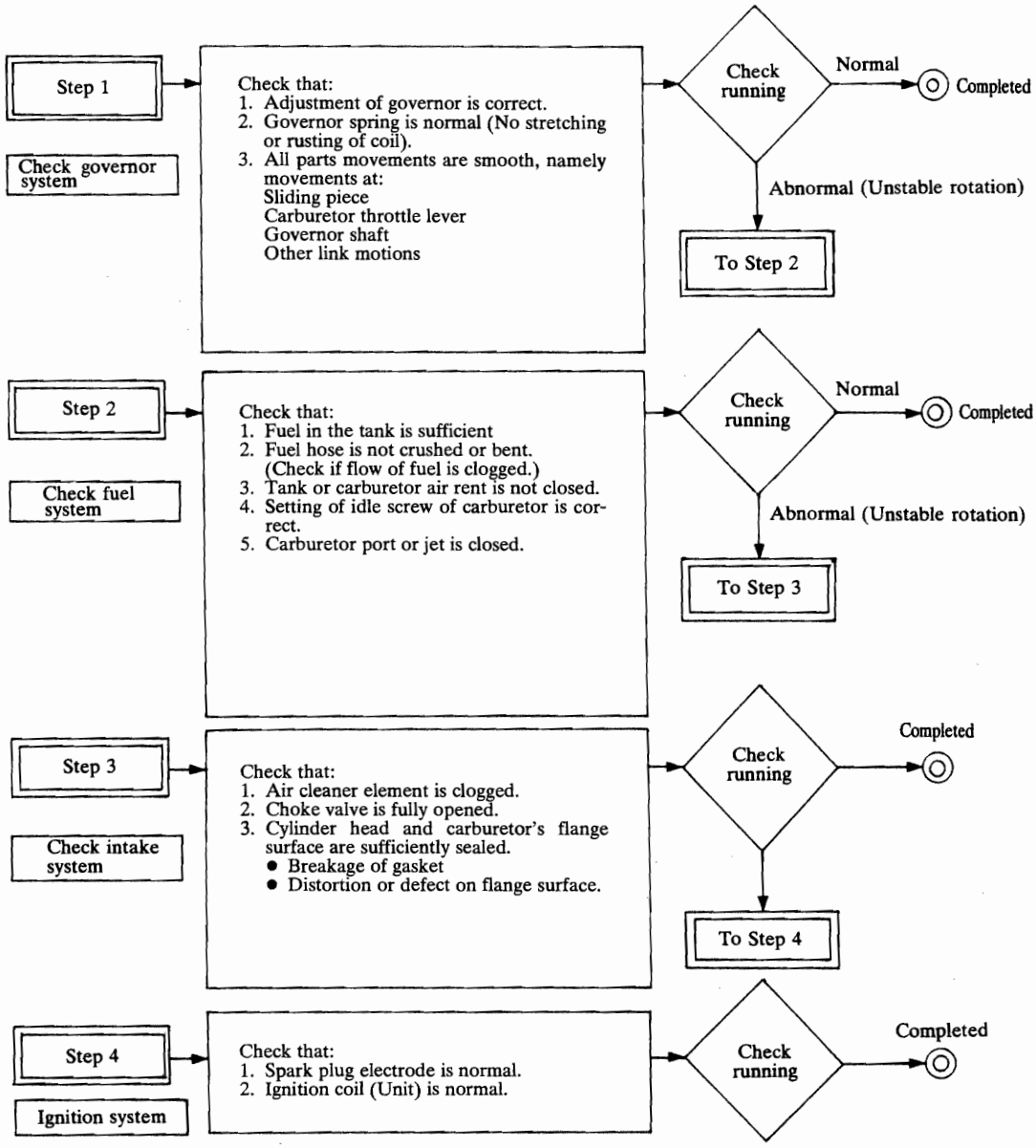
1. Troubleshooting when engine is hard to start



2. Troubleshooting during operation.
   1) General:
      Troubles explained in this section occur with various symptoms, but those can be diagnosed in three main groups of 1 Rotation, 2 Exhaust gas and 3 Noise trouble.
      In this section, descriptions are given for troubleshooting procedures and check items relating to these three symptoms.
   2) Main symptoms of abnormal operation:



2-1 Troubleshooting for abnormal operation (Abormal rotation).



Note:

1. **In every step, check each item in the boxes, and clean, repair or replace if abnormality is observed.**
2. **Perform test operation after completion of checking in each step.**

2-2 Troubleshooting for abnormal operation (Abnormal exhaust smoke colour).

1) If engine is emitting black smoke.
This is the symptom of imperfect combustion due to insufficient oxygen or excessive fuel.

► **Check and adjustment items:**
Check that:

1. **Choke valve is fully opened.**
2. **Air cleaner element is not clogged.**
3. **Carburetor is not over-flowing.**

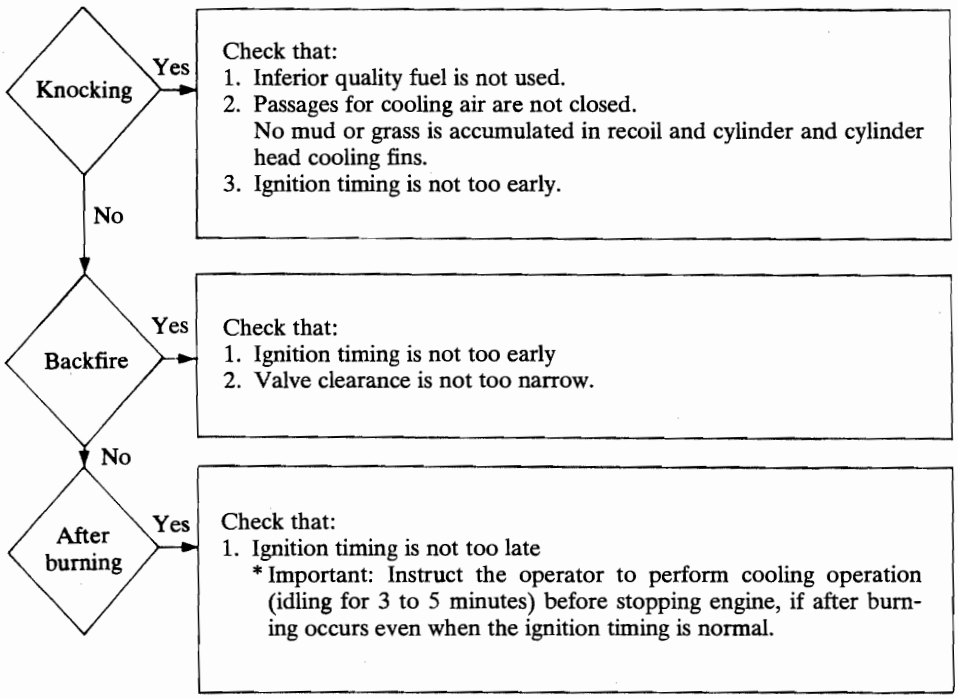
2) If engine is emitting white smoke.
This is the symptom of infiltration of excessive lubricant into combustion chamber.

► **Check and adjustment items:**
Check that:

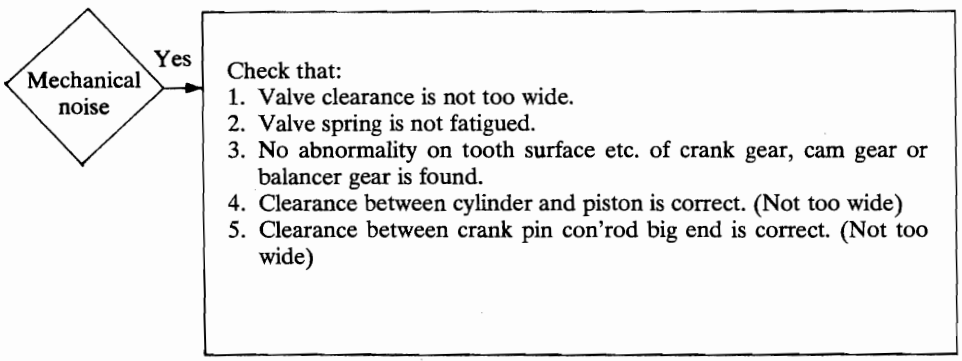
1. **Engine oil is not excessively supplied.**
2. **Breather valve function is normal.**
3. **Piston ring gap is aligned properly.**
4. **Piston ring is not adhered to the grooves or is not broken.**
5. **Abrasion of cylinder, piston or piston ring does not exceed tolerable limit.**

2-3 Troubleshooting for abnormal operation (Abnormal noise)

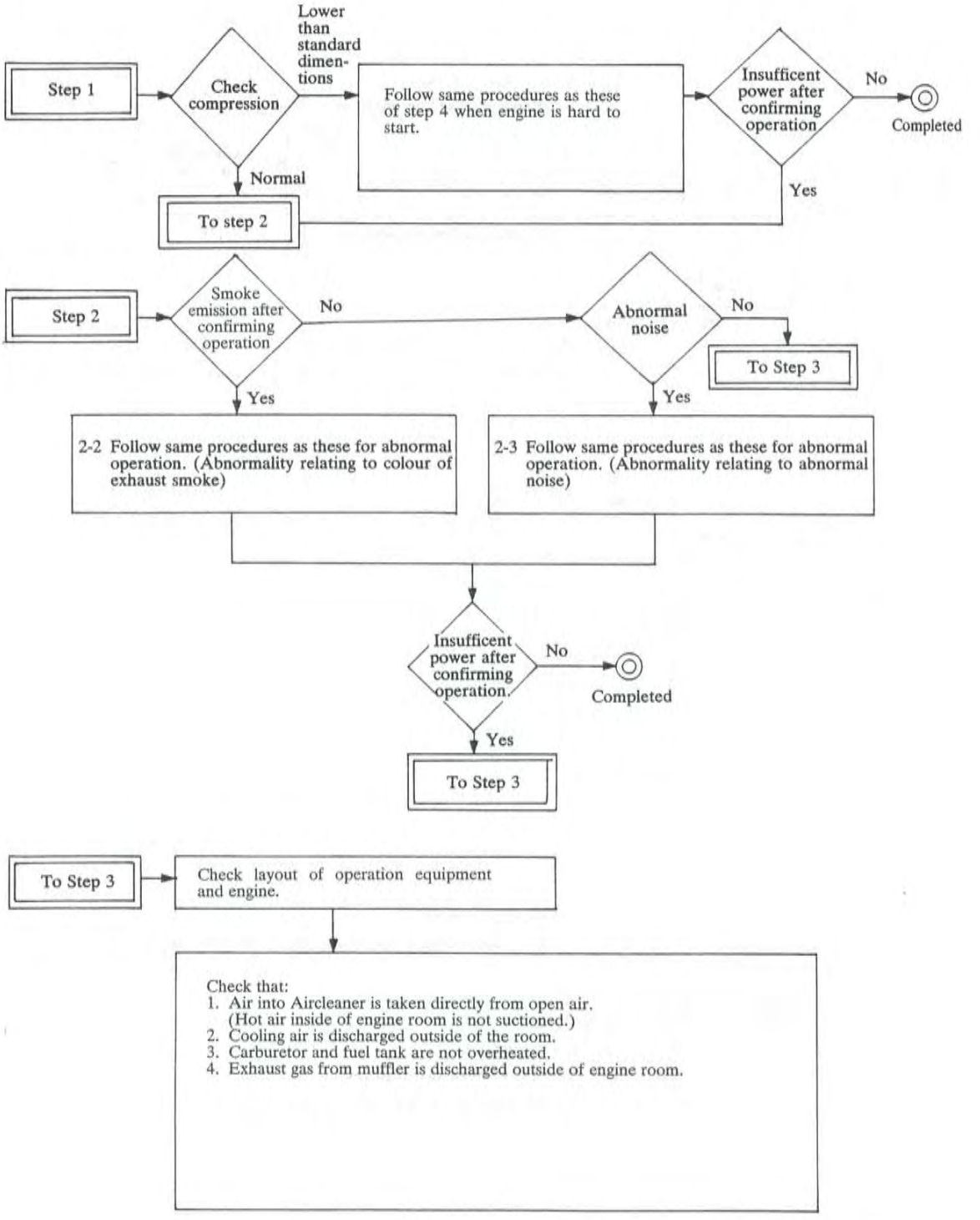
(1) Abnormal combustion noise



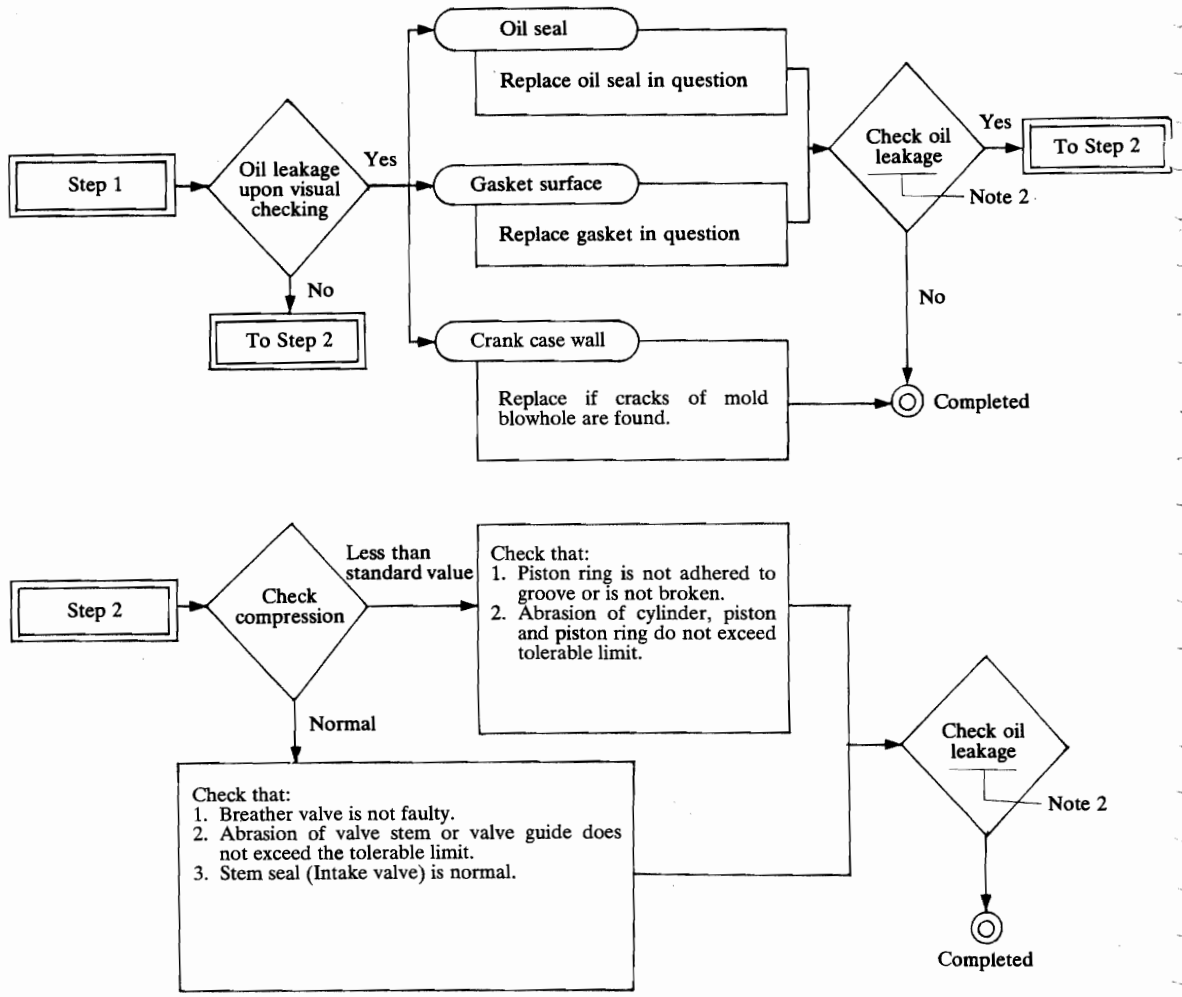
(2) Abnormal mechanical noise.



3. Troubleshooting for insufficient power.



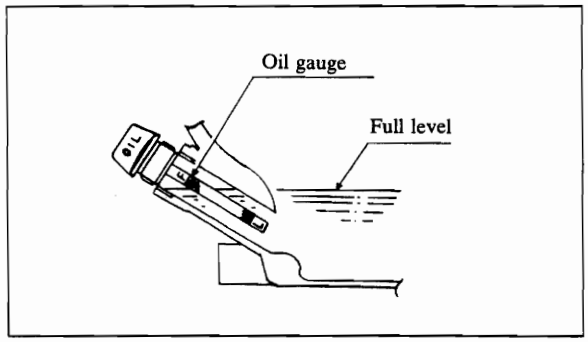
4. Troubleshooting for "Excessive oil consumption".



Note:

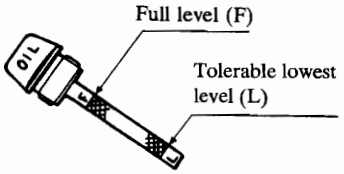
1. **Repair or replace if abnormalities are found when checking the items mentioned in the box for "Step 2".**
2. **How to check oil leakage:**
   - **(1) Refill engine oil to specified level.**
   - **(2) Wipe out the oil stains on engine surface.**
   - **(3) Operate the engine at high speed for 30 to 60 minutes.**
   - **(4) Leave the engine in place for several hours and check outside of engine for oil leaks.**

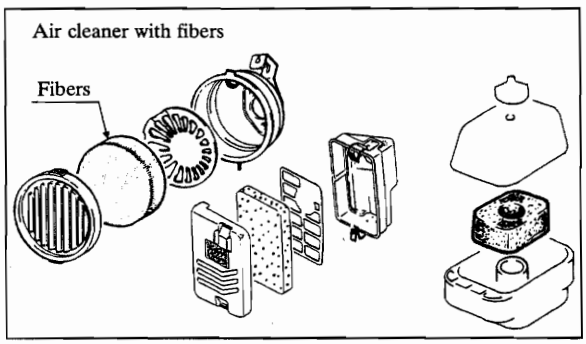
Group III	Inspection and adjustment procedures



Oil check

► **Oil level check** (Check without screwing in th gauge)
Daily inspection
Refill to full level (Quantity of oil: refer to pag 37)

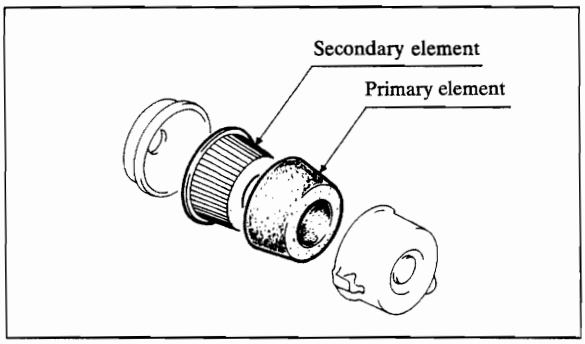




Semi-wet aircleaner

► **Cleaning of aircleaner** ⚠ Fire Prohibited
Daily inspcetion

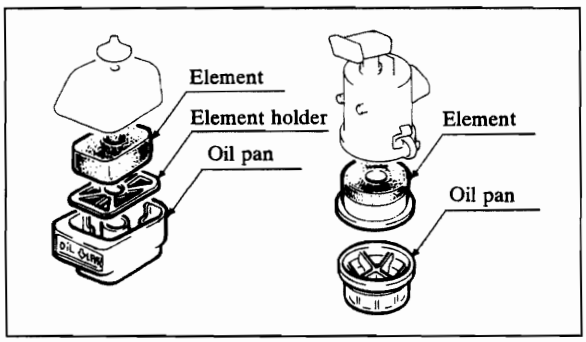
- Semi-wet type:
  If element is clogged with dust or dried up due to evaporation of oil, wash the element with gasoline, soak in engine oil and fit it after squeezing well.



Dry type

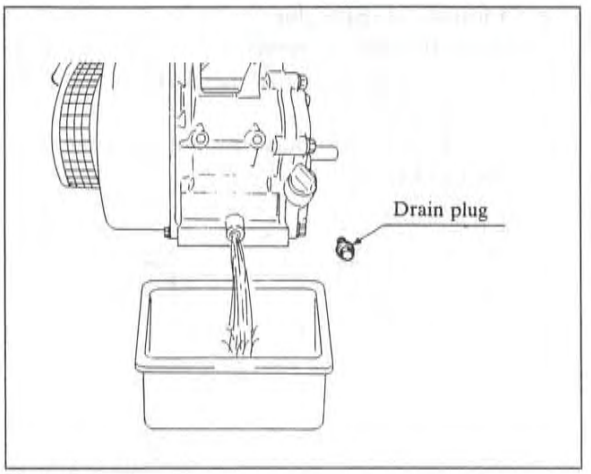
- Dry type:
  If element is clogged with dust, tap lightly or blow air inside of both primary and secondary elements to remove the dust. If clogging of secondary element is excessive, replace it.

Note:
Do not soak the elements in engine oil after cleaning



Oil bath type

- Oil bath type:
  If oil level is low, refill it to full level. If excessively dirty, clean both oil pan and element, and soak the element in engine oil and fit it after shaking off excessive oil or after squeezing tightly.

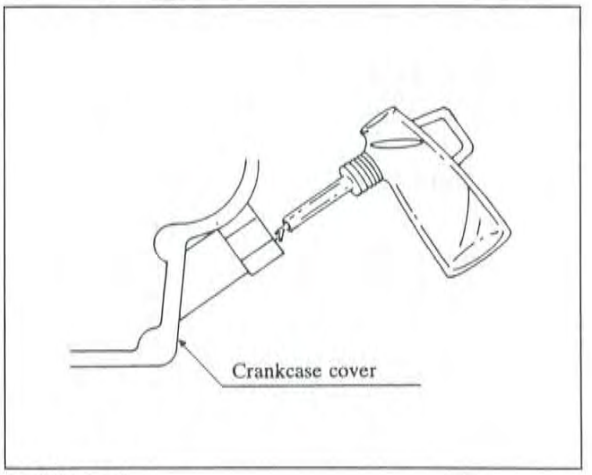


Draining oil

► **Engine oil change period**
When new: Every 25 hours of operation.
Normal: Every 50 hours of operation.

- Drain oil while engine is warm, and refill with new oil.

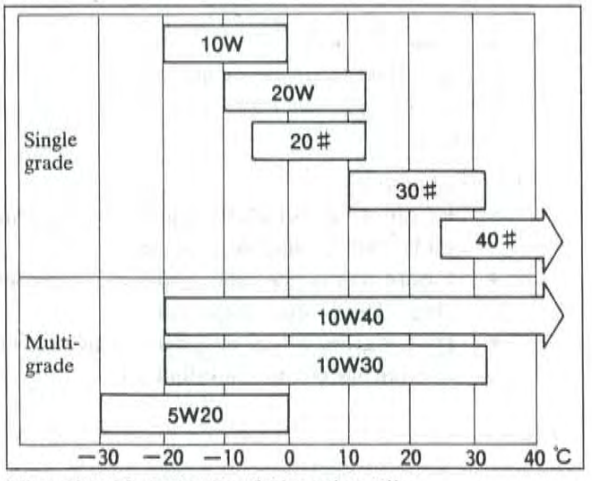
⚠ Take care against burns



Refilling oil

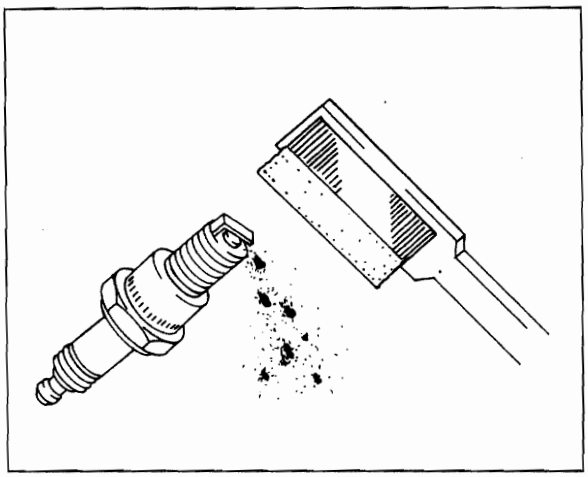
- Quantity of engine oil.

Model	Quantity (ℓ)
GM82	0.4
GM90~GM130, GM131	0.6
GM180, GM181	0.7
GM132, GM182	0.7
GM220, GM221	0.7
GM231	0.9
GM290 ~ GM300	1.2
GM291 ~ GM301	1.2
GM391 ~ GM401	1.2

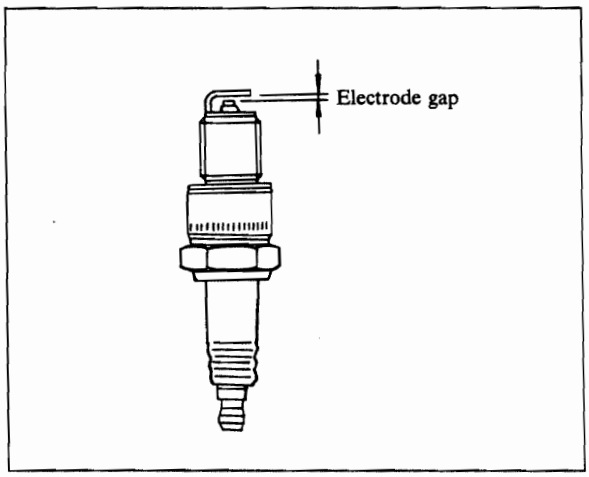


Viscosity of recommended engine oil

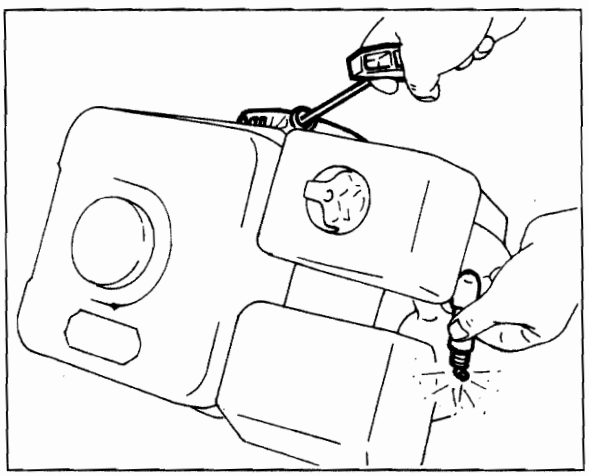
- Recommended engine oil
Use Mitusbishi Gold Oil, Diamond Motor Oil or oil equivalent to SD Class of API or higher, and use these properly according the temperature.



Cleaning of spark plug



Adjustment of eletrode gap



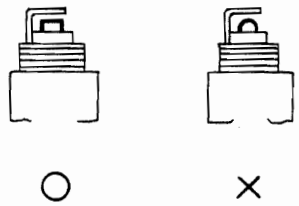
Inspection of ignition

► **Cleaning of spark plug**

Every 50 hours of operation

Remove carbon stuck to the electrode and polish with sand-paper.

Be careful to not round the end of the electrode when polishing.



○ ×

► **Adjustment of electrode gap**

	Standard value
Electrode gap	0.6 ~ 0.7

► **Standard spark plug**

	Model
Standard spark plug	BP5ES (NGK) W16EP (DENSO) N11YC (CHANPION)
GM82, GM132, GM182	BP6HS (NGK)
GM391, GM401	RC12YC (CHANPION)

How the electrode is affected by the combustion differs according to operation condition. If abnormal adhesion of carbon or excessive burning is found, replace with hot- or cold-type plugs, depending on the situation.

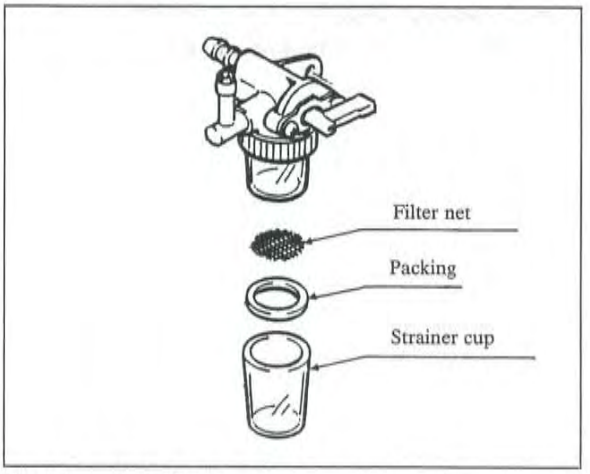
Note:
Do not use a different type of plug as this may damage the engine.

► **Inspection of ignition**

Check ignition after inspecting and adjusting the spark plug and confirming that the start switch "ON".

⚠ **Caution**

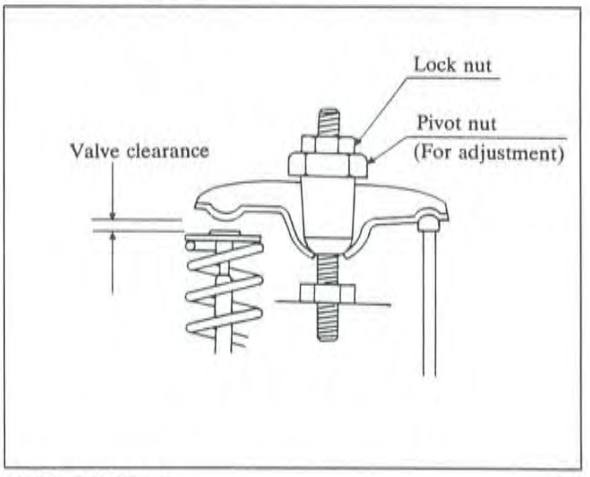
- **Be careful to not contacting the high tention cable while pulling the recoiler.**
- **Ensure that no gasoline is spilled around the plug. (The gasoline may ignite.)**
- **Do not ground near plug hole. (This may ignite the gas mixture in cylinder.)**



Cleaning of strainer

► **Cleaning of fuel strainer**

- Every 50 hours of operation
  Take off strainer cup and remove deposit as well as dust on filter net.



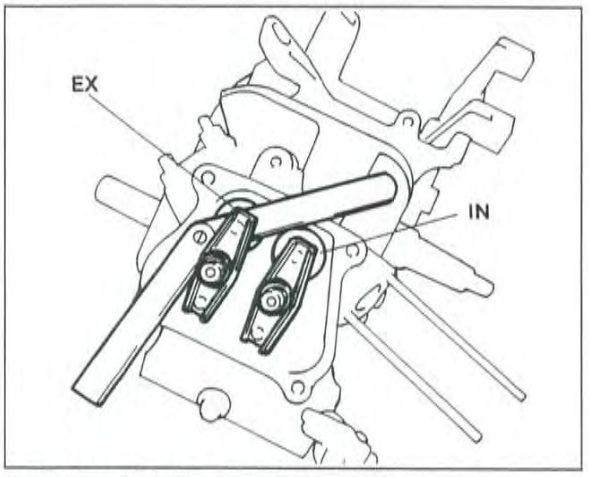
Valve clearance

► **Inspection of valve clearance**

- Every 100 hours of operation
- Inspect when engine is cool.
- Remove cylinder head cover and inspect at the upper dead center of compression stroke.

Model	Standard value
GM90 ~ GM301 (except GM82, GM132, GM182, GM231)	0.06 ~ 0.1 (Both Intake and Exhaust)
GM82, GM132, GM182, GM391, GM401	0.10 ~ 0.12 (Both Intake and Exhaust)
GM231	0.15 ~ 0.17 (Both Intake and Exhaust)

- Reconfirm the clearance by rotating crank shaft two times.



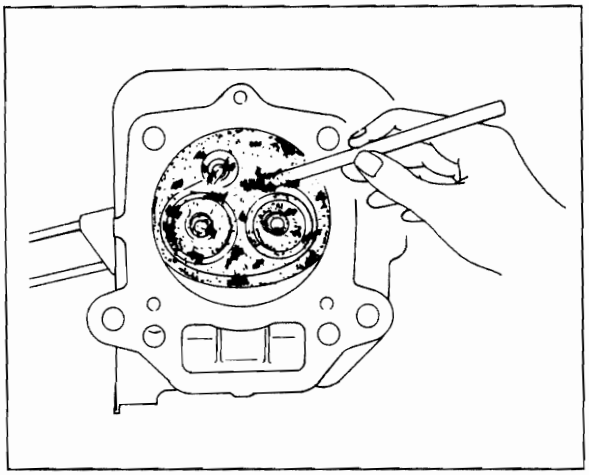
Inspection of valve clearance

► **How to find upper dead center of compression stroke.**

1. Remove cylinder head cover and spark plug.
2. Observe the valve movement while pulling recoil slowly.
3. Observe the movement of piston through plug hole just before the completion of the movement of intake valve. (*See below.)
4. Upper dead center of compression stroke is the point where the piston reaches the top.

*Note:
Touch the piston crown by contacting the tip of Phillips screwdriver after wiped off with cloth, etc.

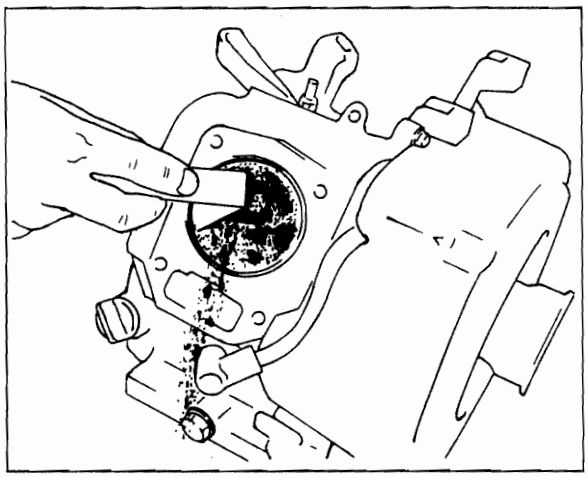
– 7 Cleaning of combustion chamber



Removing carbon on the cylinder head

► **Removing carbon**

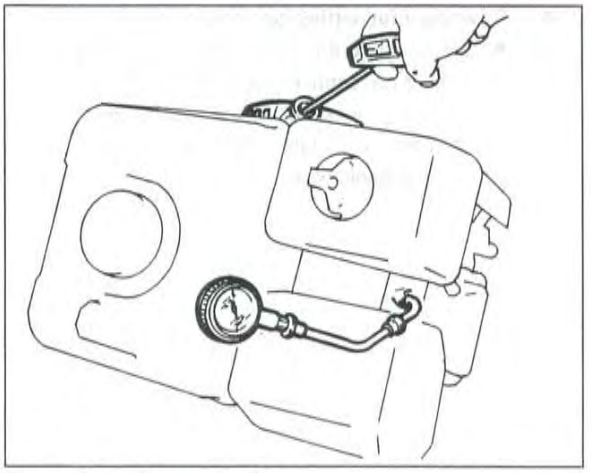
- Every 100 hours of operation.



Removing carbon on the cylinder crown.

- Remove the cylinder head and scrape the carbon stuck on the inside, around the valve and piston crown.

– 8 Inspection of compression

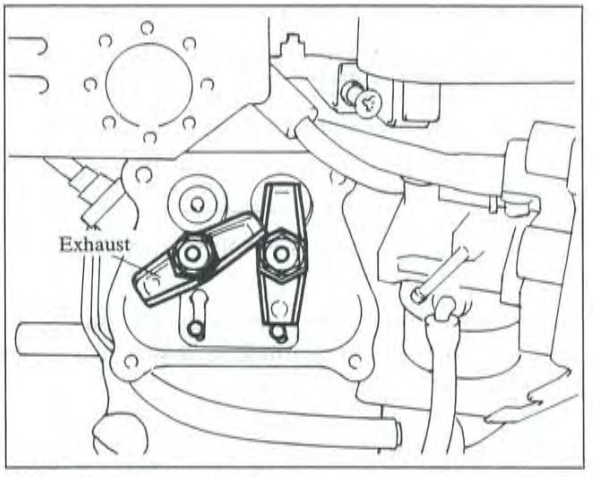


Inspection of compression

► **Inspection of compression**

Attach a pressure gauge on the plug hole and pull recoil starter with full power.

(As decompression mechanism will function, it will be difficult to compare with the servicing standards. Therefore, perform inspection after releasing decompression.)



Release of decompression

► **How to release decompression**

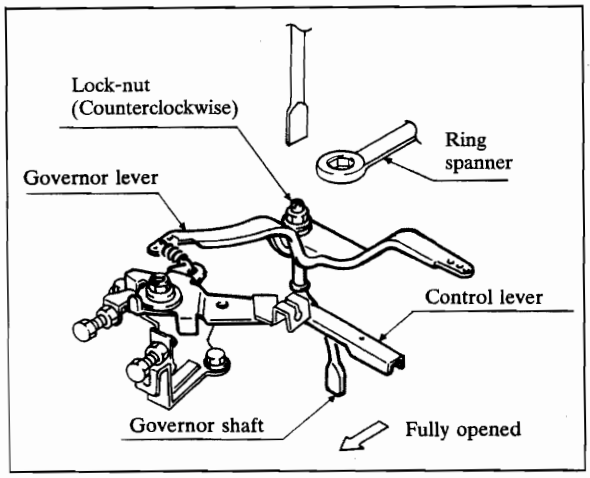
1 Remove cylinder head cover.
2 Lift the intake valve to the maximum (opened) state by pulling recoil slowly.
3 Pull out the push rod by pressing down and rotating exhaust rocker arm to the left (counter-clockwise).
4 Return the rocker arm to the normal position.

Note

- **Take care so that the valve spring retainer doesn't come off.**
- **The valve may drop into the cylinder if retainer is taken off.**

	Standard valve	Allowable limit
Compression Pressure (At 800 rpm)	0.8 MPa (8 kgf/cm^2)	0.5 MPa (5 kgf/cm^2)

– 9 Setting governor and rotation (Exclude GM82, GM132, GM182)



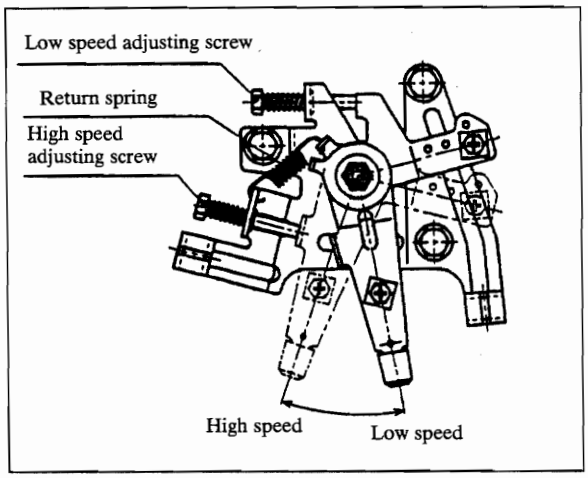
Setting governor

► **Procedure for setting governor**

- Set the governor after removing fuel tank.

1 Open the control lever completely.

2 Loosen lock-nut (counterclockwise), and tighten it while rotating governor shaft counterclockwise.



Setting speed

► **Setting rotation (Standard)**

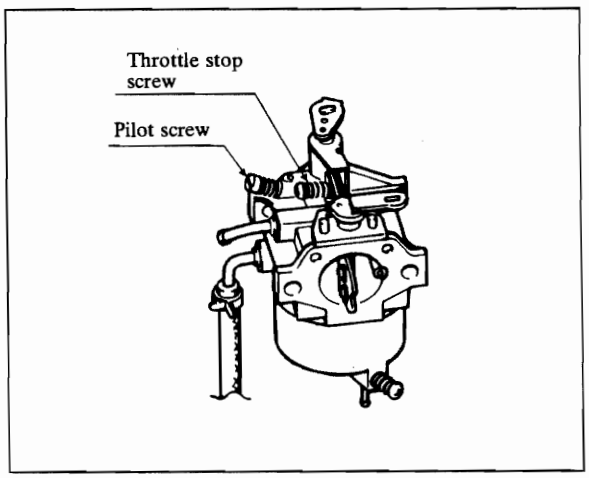
Maximum rotation	3900 rpm ± 100 rpm

- Adjust by rotating high speed adjusting screw.

Idling rotation	1400 rpm ± 100 rpm

- Adjust by rotating low speed adjusting screw.

Note:
Do not change the setting without reason as this has been set at the time of shipment. (Do not cut the seal if it is sealed.)



Adjusting carbuletor

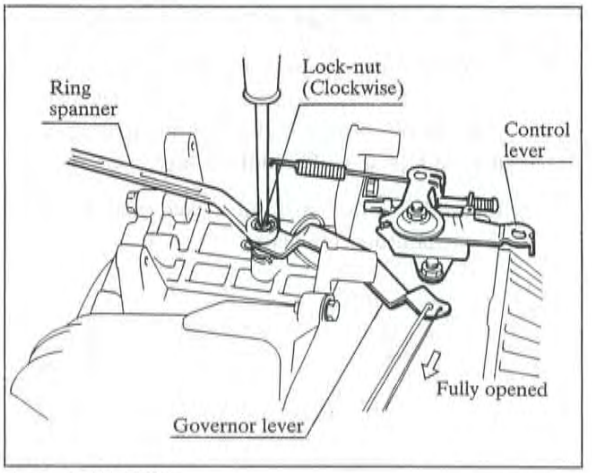
► **Adjusting the carburetor**

Pilot screw	Rotate 1 1/2 turn counter-clockwise

- Adjust at the best condition while idling.

Dead slow	1000 rpm (Target)

- Adjust by rotating throttle stop screw.

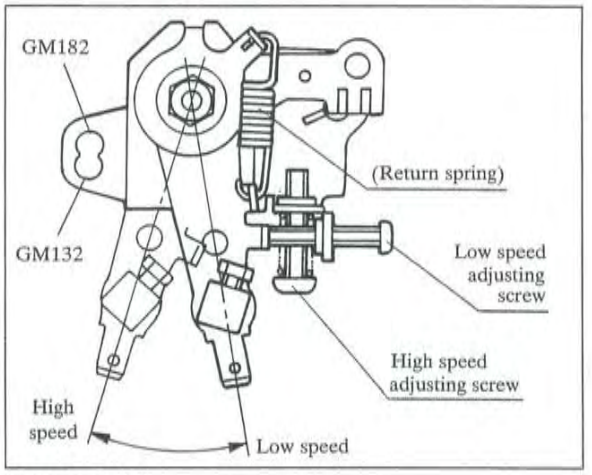


Setting governor

► **Procedure for setting governor**

- Set the governor after removing fuel tank.

1 Open the control lever completely.
2 Loosen lock-nut (clockwise), and tighten it while rotating governor shaft clockwise.



Setting speed

► **Setting rotation (Standard)**

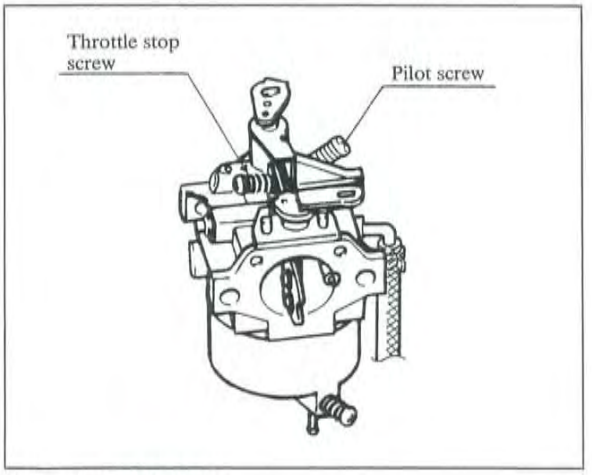
Maximum rotation	3900 rpm ± 100 rpm

- Adjust by rotating high speed adjusting screw.

Idling rotation	1400 rpm ± 100 rpm

- Adjust by rotating low speed adjusting screw.

Note:
Do not change the setting without reason as this has been set at the time of shipment. (Do not cut the seal if it is sealed.)



Adjusting carbuletor

► **Adjusting the carburetor**

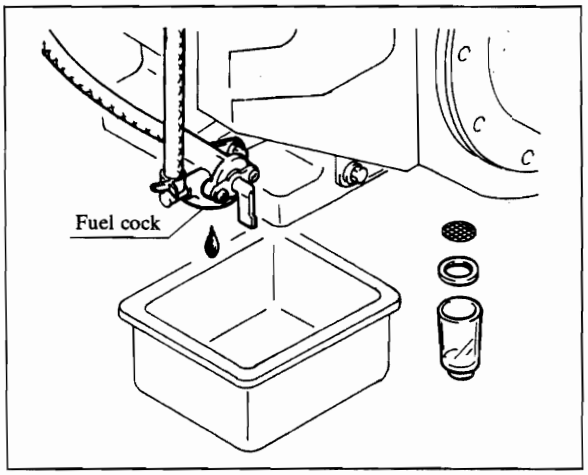
Pilot screw	Rotate GM82 1 1/2 turn GM132 2 turn GM182 1 3/4 turn counter-clockwise

- Adjust at the best condition while idling.

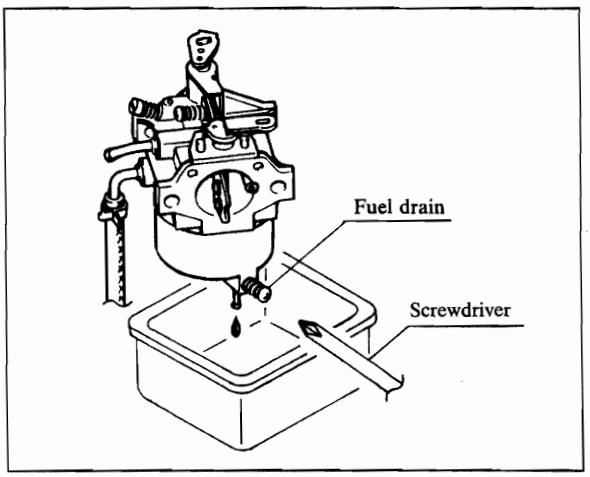
Dead slow	1100 ~ 1200 rpm (Target)

- Adjust by rotating throttle stop screw.

– 10 Long-term strage



Draining fuel



Draining carburetor

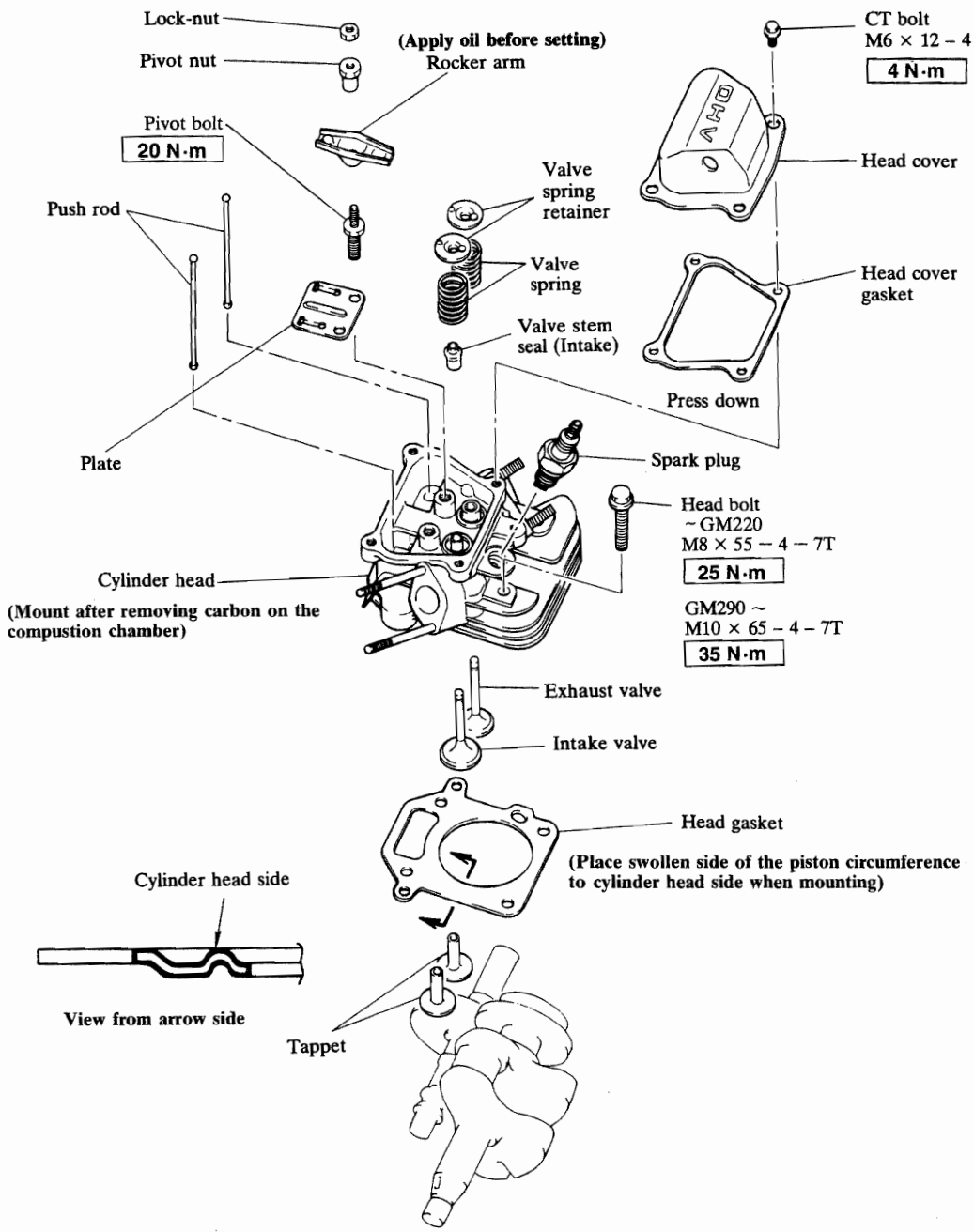
- Drain fuel in the fuel tank and the carburetor.
- Remove the spark plug and pour a small amour (about 10cc) of engine oil into the cylinder and pull the recoil rope slowly several times, then fi the spark plug, and hold the compression stroke.
- Clean the surface with oil soaked cloth and stor in the moisture free place.

⚠ Fire Prohibited

Group IV	Servicing procedures

– 1 Cylinder head (Moving valve)

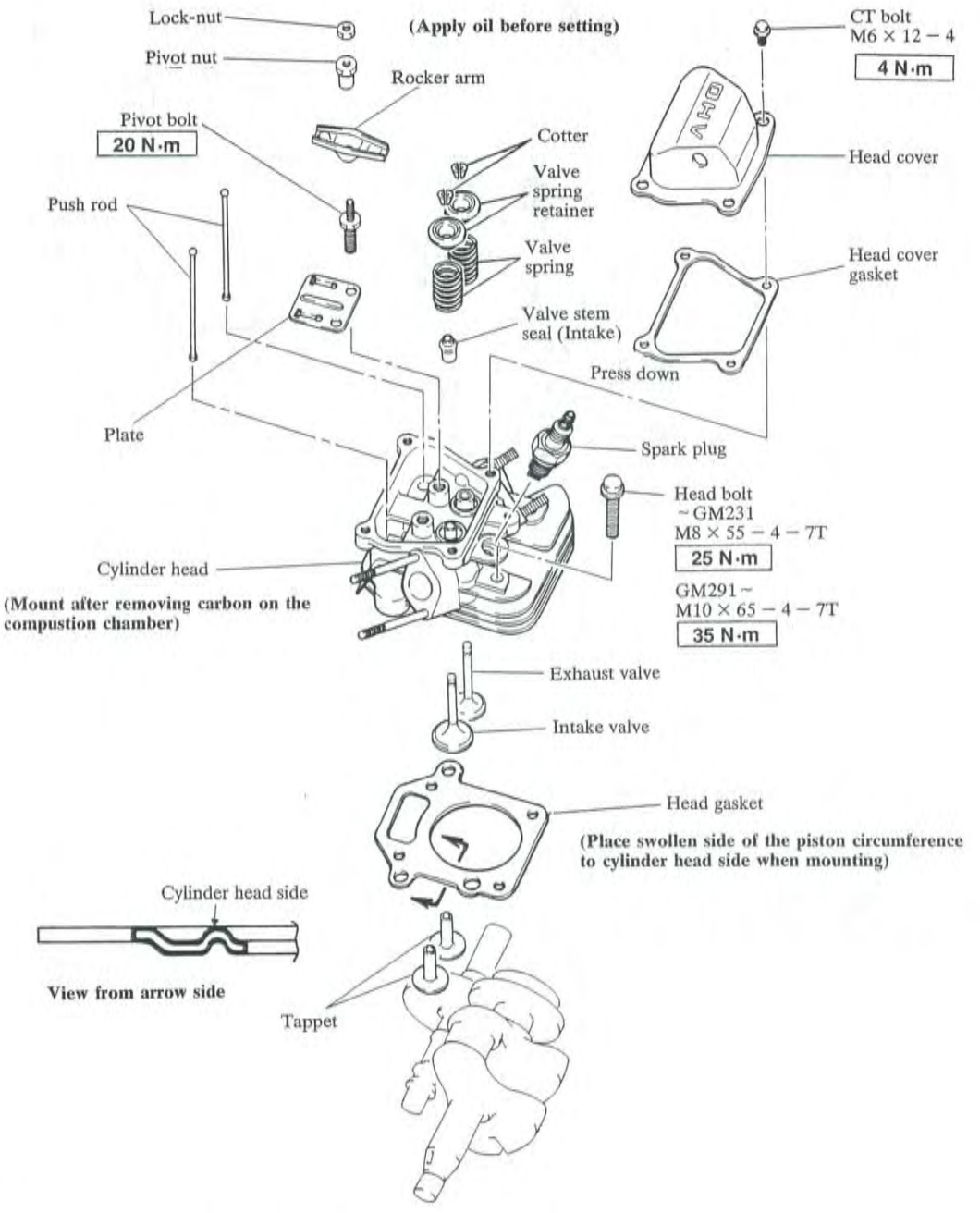
► **Outline** GM90, 130, 180, 220, 290, 300



Note:

Do not remove valve stem (Remove only when replacing)

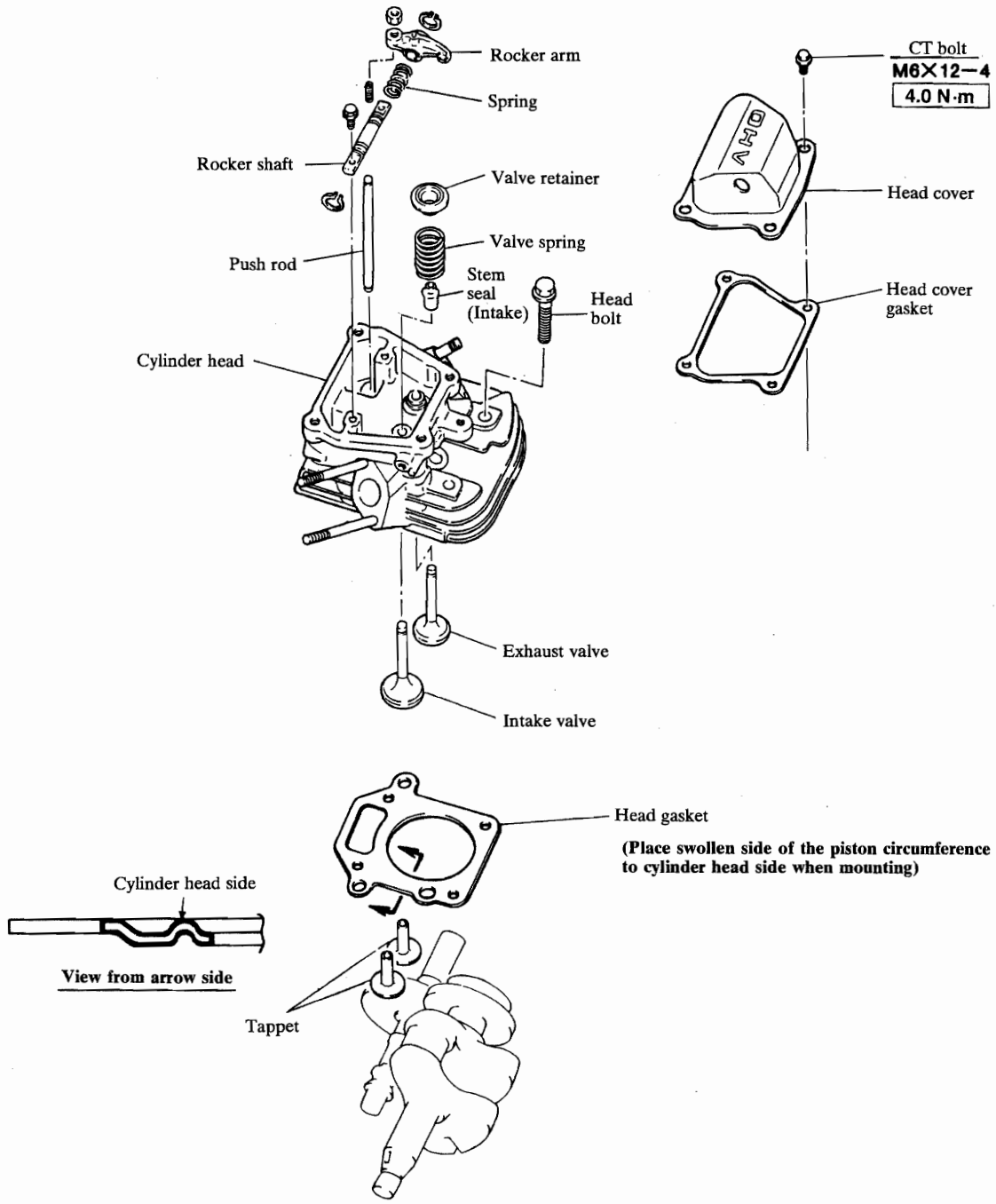
► **Outline** GM91, 131, 181, 221, 291, 301



Note:
Do not remove valve stem (Remove only when replacing)

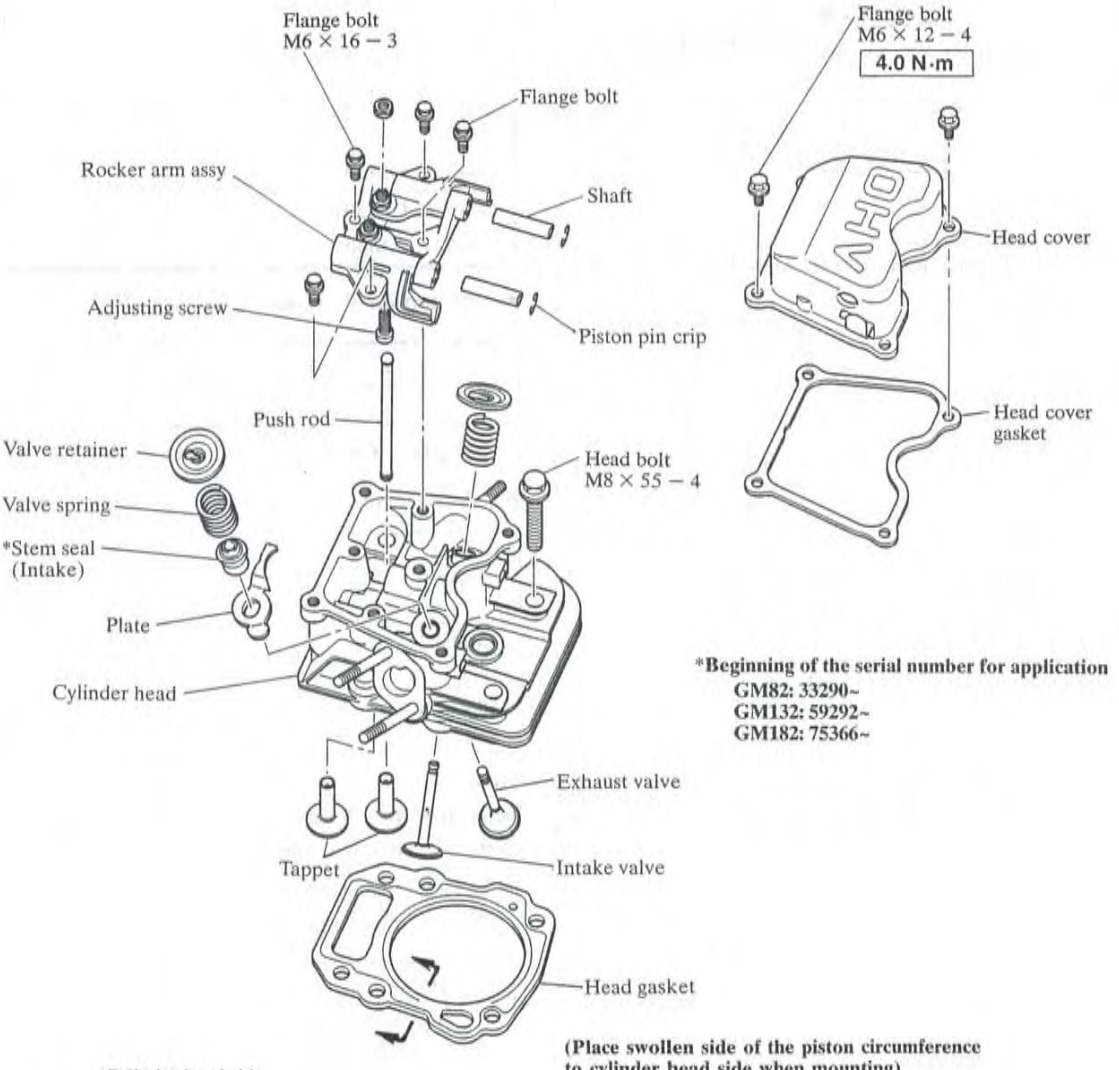
−1 Cylinder head

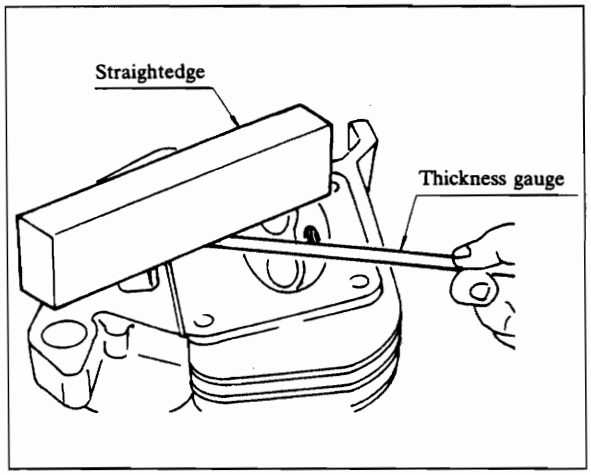
► **Outline** GM391, 401



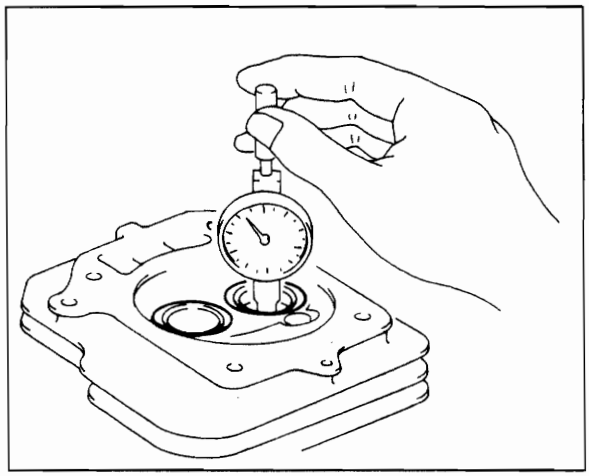
Note:
Do not remove valve stem (Remove only when replacing)

► **Outline** GM82, 132, 182

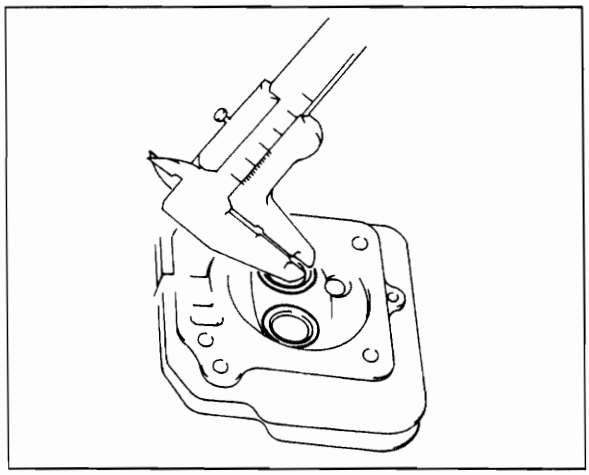




Measuring distortion of cylinder head mounting surface



Measuring valve guide inner diameter



Measuring valve seat width

► **Specifications**

Model	Volume of combustion chamber (cc)
GM82	11.5
GM90, GM91	11.4
GM130, GM131	16.2
GM132	16.1
GM180, GM181, GM182	23.4
GM220, GM221	27.4
GM231	27.0
GM290, GM291	40.8
GM300, GM301	38.3
GM391, GM401	50.3

► **Distortion of cylinder head mounting surface**

Standard Value	Allowable limit
0.2	0.3

Replace if defects are found on the mouting surface

► **Valve guide inner diameter**

Model	GM90, 91, 130, 131, 180, 181, 220, 221, 231, 290, 291, 300, 301, 391, 401	MG82, 132, 182
Standard Value	ϕ 6 H 7 $^{+0.015}_{0}$	ϕ 5.5 H 7 $^{+0.015}_{0}$
Allowable limit	See note below.	

Note:
Determine the allowable limit by the clearance measure... from the valve stem diameter.

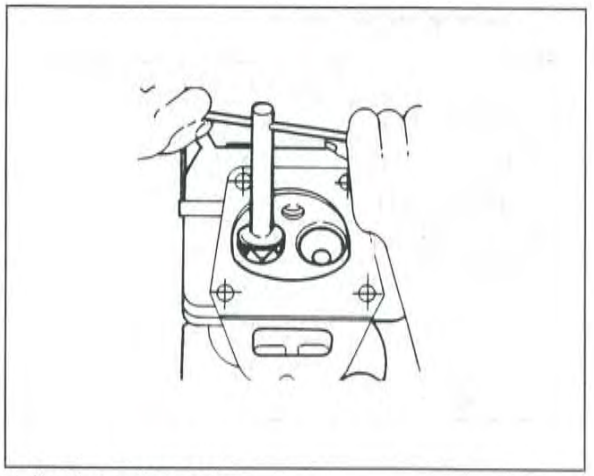
► **Valve seat width**

◊ See procedures for adjustment on the next page.

Standard Value	Allowable limit
0.86 ~ 1.26	1.8

(Valve seat diameter)

	GM82, GM132	GM90, GM91	GM130 ~221	GM182	GM231	GM290 ~301	GM39 GM401
IN	25	20.5	25.5	30	29.5	29.5	35.4
EX	23	16.5	21.5	26	27.5	27.5	30.5

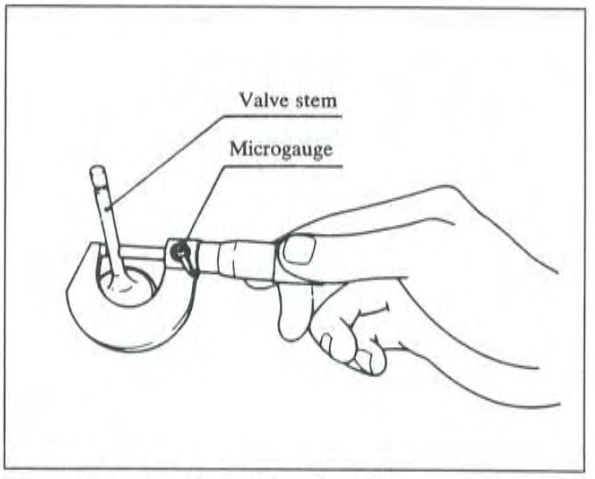


Adjusting valve seat

► **Adjustment of valve seat**

1. Place guide pin on the valve guide.
2. Place the cutter(45 degree) and grind the valve seat by rotating the handle with slight pressure.

Note:
If contact surface exceeds the allowable limit, grind with cutter (30 degree). To finish grind with compound.



Measuring valve stem outer diameter

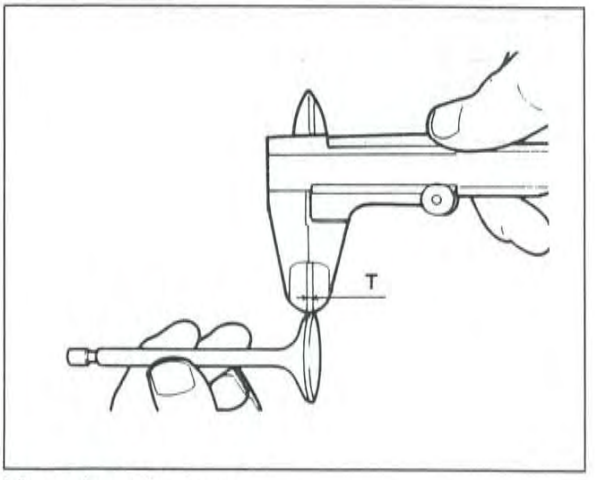
► **Valve system outer diameter**

Model	GM90, 91, 130, 131, 180, 181, 220, 221, 231, 290, 291, 300, 301, 391, 401	MG82, 132, 182
Standard Value	$\phi 6^{-0.040}_{-0.062}$	$\phi 5.5^{-0.040}_{-0.062}$
Allowable limit	See note below.	

Note:
Determine the allowable limit by the clearance measured from the valve guide inner diameter.

► **Clearance between valve guide and valve stem**

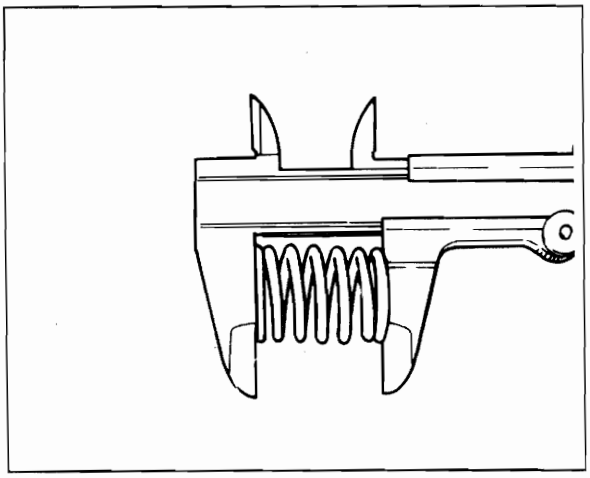
Standard value	Allowable limit
0.040 ~ 0.077	0.25



Measuring valve taper

► **Valve taper depth**

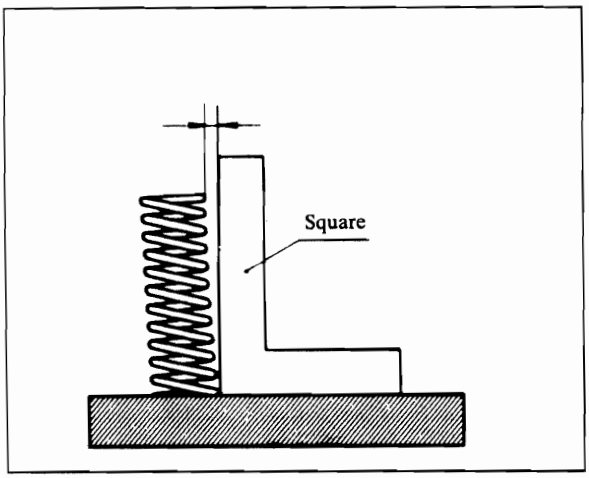
Standard value	Allowable limit
1.75	0.8



Measuring valve spring free length

► **Valve spring free length**

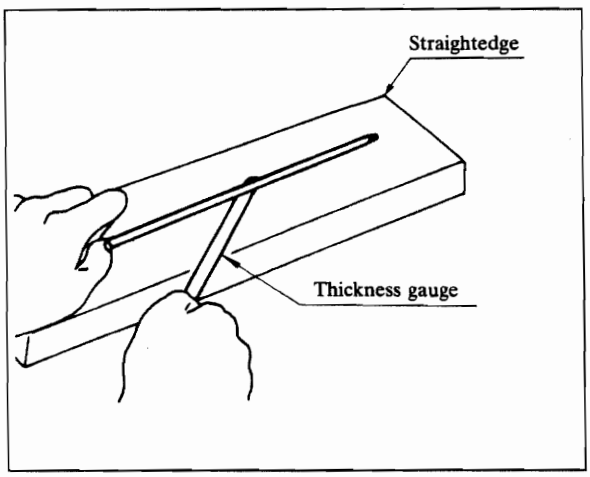
	Standard value	Allowable limit
GM90 ~ GM220	28.4	27.3
GM290 ~ GM330	31.2	30.0
GM91 ~ GM231	28.0	27.0
GM291 ~ GM301	31.6	30.4
GM391 ~ GM401	37.8	36.3
GM82	25.46	24.5
GM132	25.46	24.5
GM182	28.0	27.0



Measuring valve spring squareness

► **Valve spring rectangular accuracy**

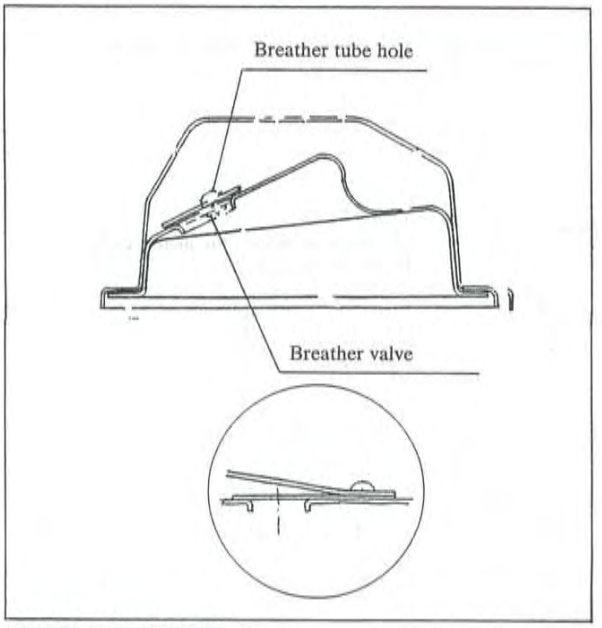
Standard value	Allowable limit
35/1000	60/1000



Measuring push rod bend

► **Push rod bend**

Allowable limit
0.20



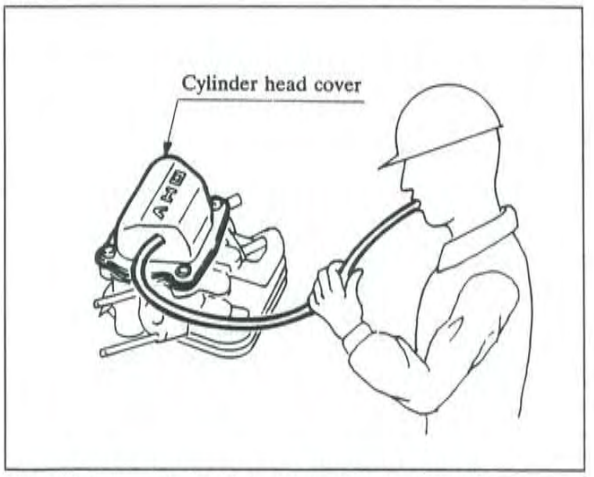
Cylinder head cover

► **Inspection of cylinder head cover**

Check if there is any defect or distortion on the mounting surface and replace it if it is faulty.

► **Breather**

The function of breather valve is to discharge the blow-by gas. This gas is to be conducted to the intake pipe and be recombusted.



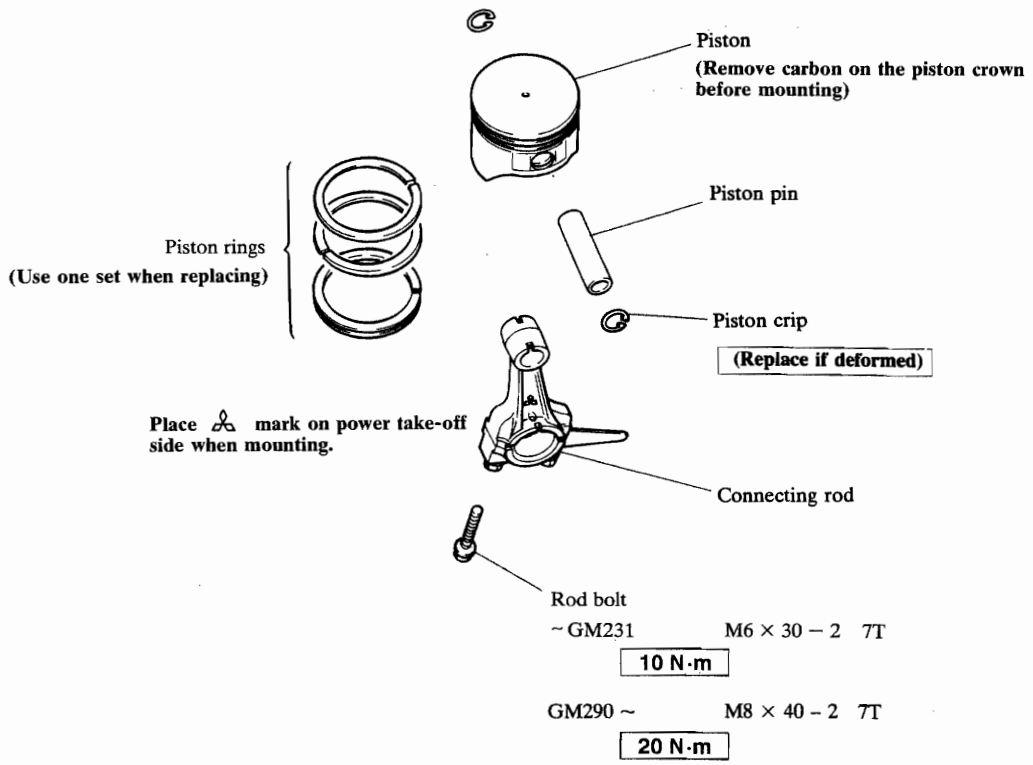
Checking breather valve (Simplified method)

► **How to check the breather valve function.**

1. As shown in the figure, confirm that:
   (1) You can breathe easily.
   (2) You cannot exhale easily.
2. If above conditions are not fullfilled, replace the cylinder head cover.

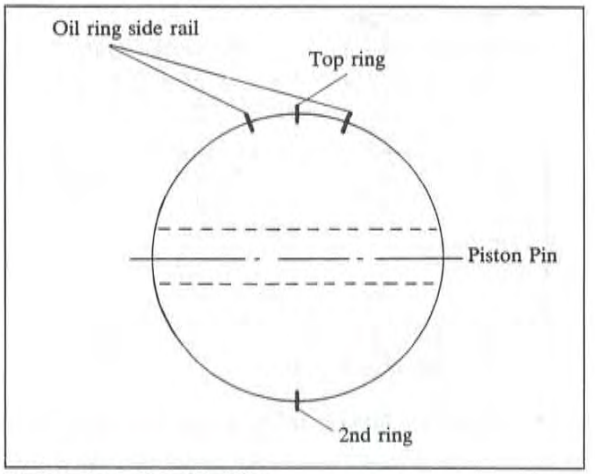
– 1 Piston, Connecting rod

► Outline



► Piston ring shape and mounting direction

Piston ring	Sectional shape	Remarks
Top ring	Punched mark (Note provided on some) Barrel	
2nd ring	Punched mark Taper	Mount by placing punched side on the piston crown.
Oil ring	Side rail 3 pieces Spacer	1 Spacer 2 First mount spacer then side rail (Upper and lower).

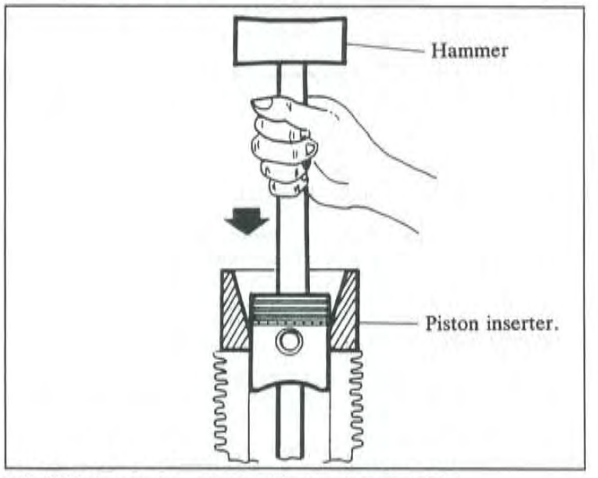


Piston ring gap direction

► **Piston ring gap direction**

- Mount as shown in the figure avoiding the piston pin direction.

Mount rings properly as aligned meshed ends may cause infiltration of oil or excessive blow-by gas.



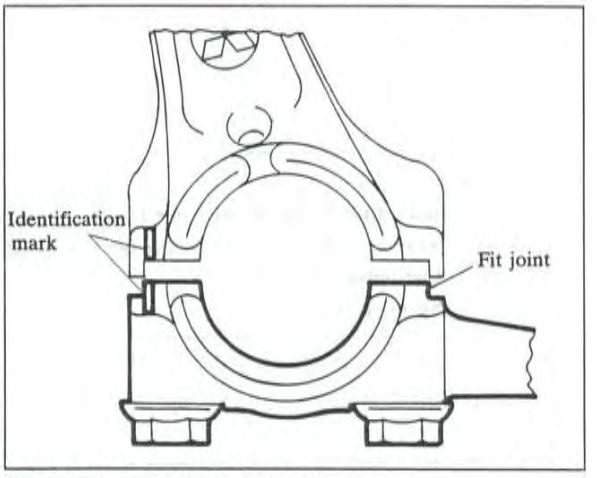
Mounting piston, connecting rod assembly

► **Mounting pistons, connecting rod assembly.**

- Insert the piston into the cylinder with the inserter while knocking lightly with the wooden handle of the hammer.

To avoid rising of the inserter, knock while holding the inserter with your left hand.

Be careful to not deform the side rail of oil ring as this may scratch the cylinder wall.



Mounting connecting rod cap

► **Mounting connecting rod cap**

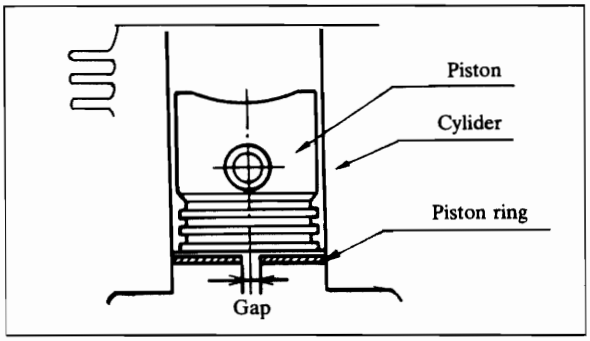
Rod bolt tightening torque

~ GM231 M6 × 30 − 2 7T

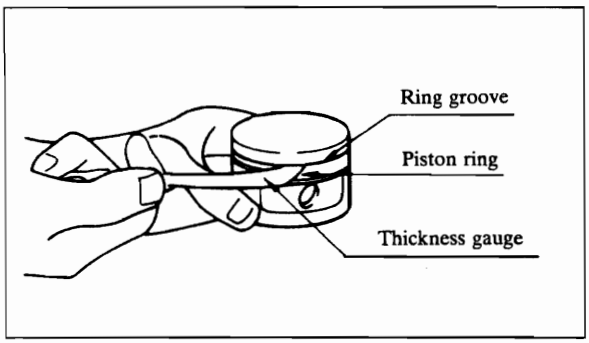
10 N·m

GM290, 291 ~ M8 × 40 − 2 7T

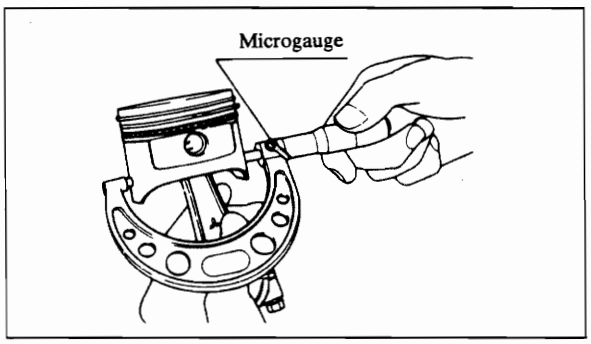
20 N·m



Measuring the piston ring gap



Measuring the clearance between the piston ring and the groove



Measuring piston outer diameter

► **Piston ring gap**

Measure the gap by inserting the ring horizontally in the cylinder's skirt (lower position). (Insert the ri... by using piston shown as the figure.)

Piston ring	Standard value	Allowable limit
Top ring	0.15 ~ 0.35	1.0
2nd ring		
Oil ring side rail	0.35 ~ 0.70	1.5

Replace rings as a set.

► **Clearance between the ring and the groove**

Piston ring	Standard value	Allowable limit
Top ring	0.03 ~ 0.07	0.20
2nd ring		

► **Piston skirt outer diameter**

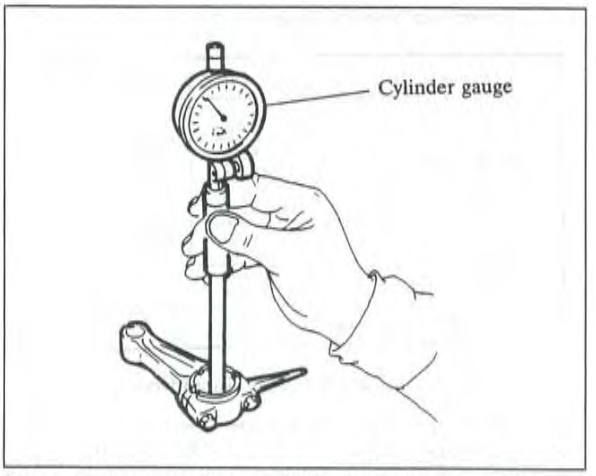
	Standard value	Allowable limi...
GM82, GM90, GM91	ϕ 52 $^{-0.040}_{-0.060}$	See note below.
GM130, GM131, GM132	ϕ 62 $^{-0.040}_{-0.060}$	
GM180, GM181, GM182	ϕ 68 $^{-0.040}_{-0.060}$	
GM220, GM221	ϕ 72 $^{-0.040}_{-0.060}$	
GM231	ϕ 72 $^{-0.015}_{-0.035}$	
GM290, GM300	ϕ 80 $^{-0.040}_{-0.060}$	
GM291, GM301		
GM391, GM401	ϕ 89 $^{-0.040}_{-0.060}$	

Note:

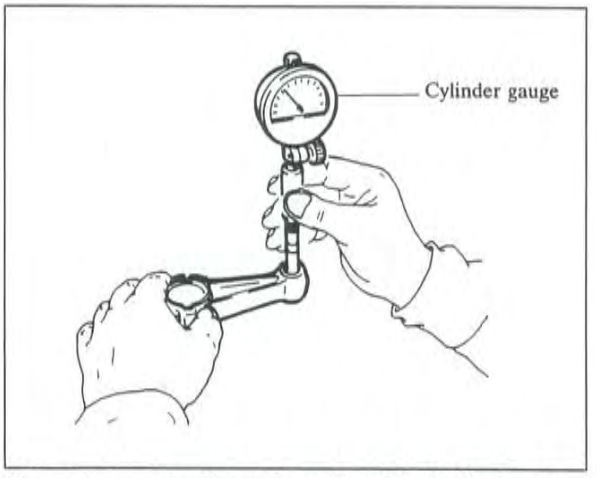
1. **Determine the allowable limit by the clearance between cylinder inner diameter and pist... skirt outer diameter.**
2. **Piston clearance**

	Standard value	Allowable limit
GM82 ~ 401	0.04 ~ 0.08	0.20
GM231	0.015 ~ 0.055	0.20

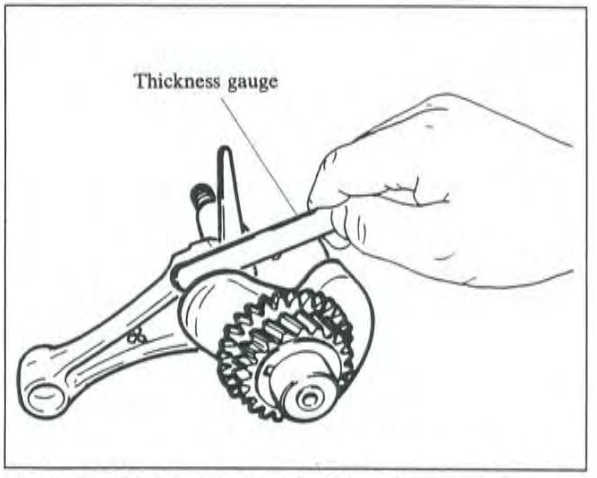
Piston over-size	0.25, 0.50



Measuring connecting rod big end hole diameter.



Measuring connecting rod small end hole diameter.



Measuring the side clearance between the connectiong rod and the crank shaft pin part.

► **Rod big end hole diameter**

	Standard value	Allowable limit
GM82	ϕ 23 $^{+0.025}_{+0.015}$	Determine the allowable limit by the clearance between the crank pin.
GM90 ~ GM131	ϕ 26 $^{+0.025}_{+0.015}$	
GM132	ϕ 27 $^{+0.025}_{+0.015}$	
GM180	ϕ 28 $^{+0.025}_{+0.015}$	
GM181, GM182	ϕ 30 $^{+0.025}_{+0.015}$	
GM220, 221	ϕ 28 $^{+0.025}_{+0.015}$	
GM290 ~ GM300	ϕ 32 $^{+0.025}_{+0.015}$	
GM291 ~ GM301	ϕ 34 $^{+0.025}_{+0.015}$	
GM231	ϕ 30 $^{+0.025}_{+0.015}$	
GM391, 401	ϕ 39 $^{+0.025}_{+0.015}$	

Clearance between crank pin and hole

Standard value		Allowable limit	
GM90 ~ 300	GM82 ~ 401	GM90 ~ 300	GM82 ~ 401
0.020 ~ 0.045	0.020 ~ 0.035	0.080	0.070

► **Rod small end hole diameter**

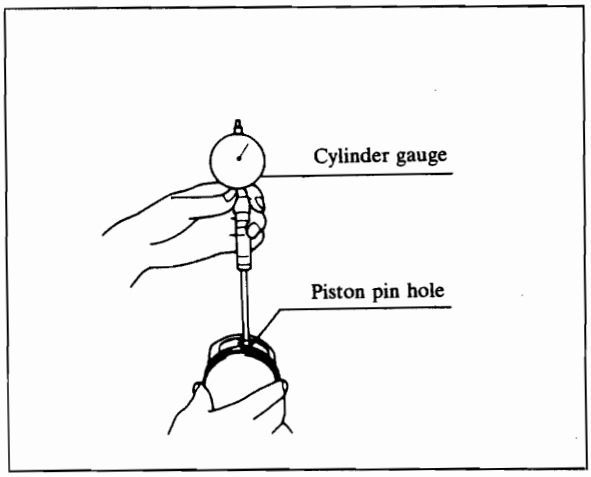
	Standard value	Allowable limit
GM82 ~ GM132	ϕ 14 $^{+0.015}_{+0.004}$	Determine the allowable limit by the clearance between the piston pin.
GM180, 181, 182	ϕ 16 $^{+0.015}_{+0.004}$	
GM220, 221	ϕ 16 $^{+0.015}_{+0.004}$	
GM290, 291	ϕ 18 $^{+0.015}_{+0.004}$	
GM231	ϕ 16 $^{+0.015}_{+0.004}$	
GM391, 401	ϕ 20 $^{+0.018}_{+0.007}$	

Clearance between piston pin and hole

Standard value	Allowable limit
0.004 ~ 0.023	0.080

► **Side clearance between the rod big end and crank shaft pin part.**

Standard value	Allowable limit
0.3 ~ 0.8	1.5



Measuring piston pin hole diameter

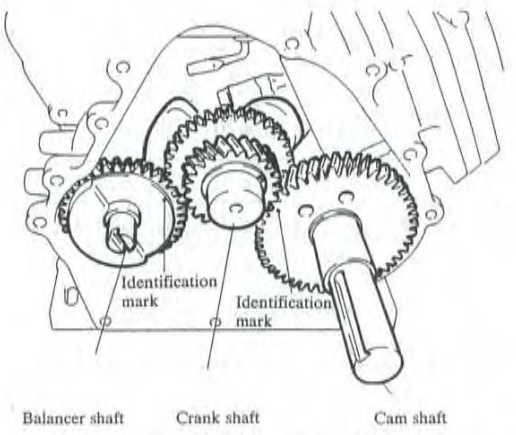
► **Piston pin hole diameter**

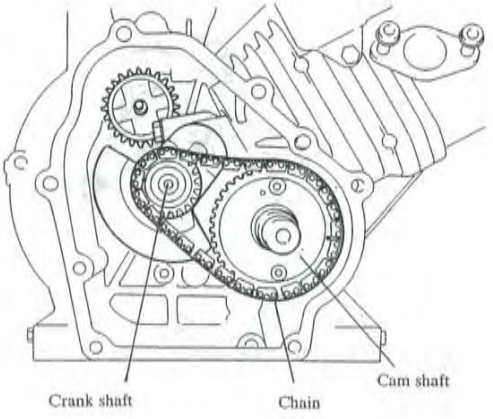
	Standard value	Allowable limit
GM82 ~ GM132	ϕ 14 $^{+0.010}_{+0.002}$	Determine the allowable limit by the clearance between the crank pin and piston pin hole.
GM180, 181, 182	ϕ 16 $^{+0.010}_{+0.002}$	
GM220, 221	ϕ 16 $^{+0.010}_{+0.002}$	
GM231	ϕ 16 $^{+0.010}_{+0.002}$	
GM290, 291	ϕ 18 $^{+0.010}_{+0.002}$	
GM391, 401	ϕ 20.33 $^{+0.015}_{+0.007}$	

Clearance between piston pin and hole

Standard value	Allowable limit
0.002 ~ 0.018	0.060

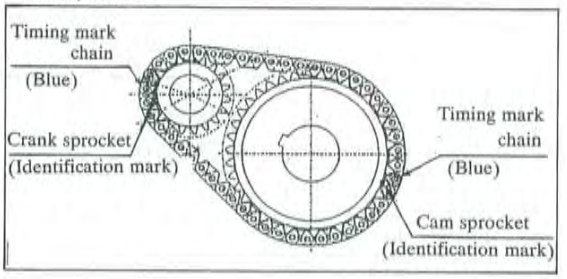
► **Outline**



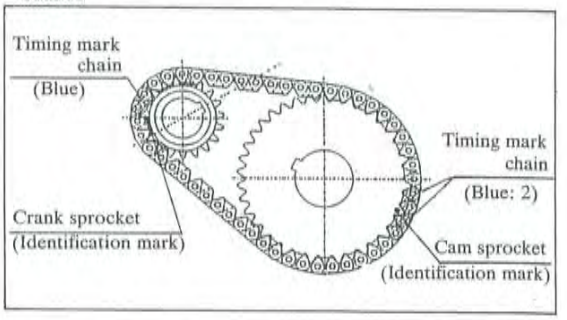


(OP except GM300, GM301, GM391 and GM401)

GM82, GM132



GM182



(Note) On the GM182 cam gear side, align the identification mark to the center of the two timing mark chain.

Assembly: Align each identification mark.

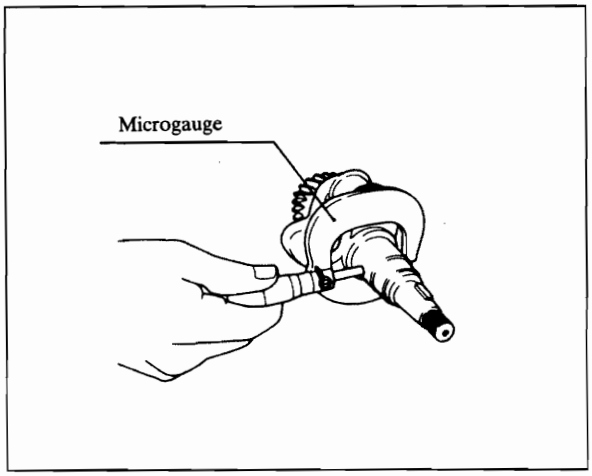
Measuring crank pin outer diameter

► **Crank shaft pin diameter tolerance**

	Standard value	Allowable limit
GM82	ϕ 23 $^{-0.005}_{-0.020}$	Determine allowable limlit by the clearance between connecting rod big end crank shaft pin. Refer to connecting rod section.
GM90 ~ GM131	ϕ 26 $^{-0.005}_{-0.020}$	
GM132	ϕ 27 $^{-0.005}_{-0.020}$	
GM180 ~ GM220	ϕ 28 $^{-0.005}_{-0.020}$	
GM181, GM182	ϕ 30 $^{-0.005}_{-0.020}$	
GM221	ϕ 28 $^{-0.005}_{-0.020}$	
GM290 ~ GM300	ϕ 32 $^{-0.005}_{-0.020}$	
GM291 ~ GM301	ϕ 34 $^{-0.005}_{-0.020}$	
GM231	ϕ 30 $^{-0.005}_{-0.020}$	
GM391, GM401	ϕ 39 $^{-0.005}_{-0.020}$	

Measure after removing the burn with sand paper if slight burns stick to the surface.

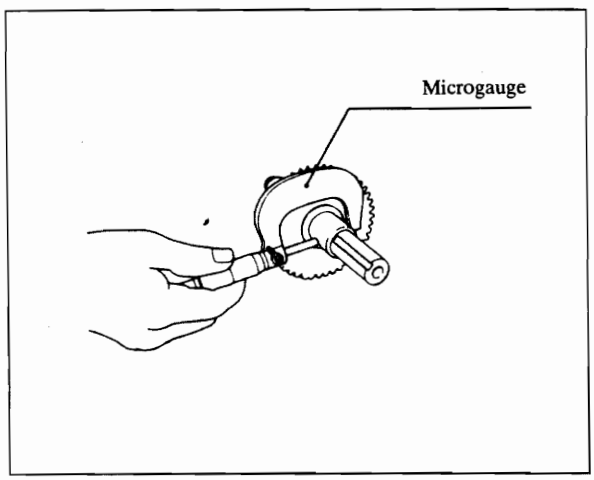
—1 Crank shaft, Cam shaft, Balancer shaft



Measuring crank shaft axle outer diameter

► **Crank shaft axle outer diameter tolerance**

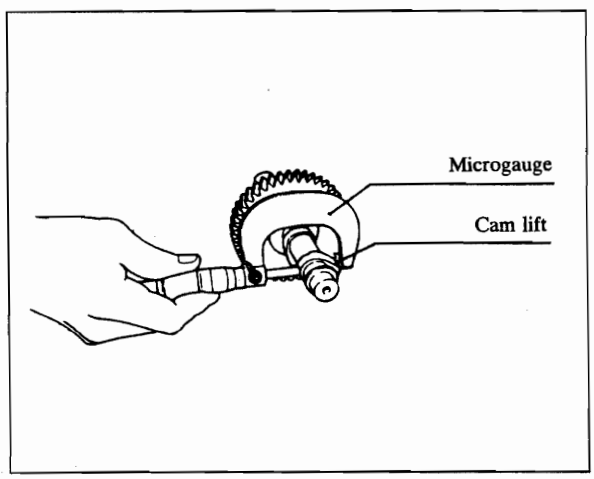
	Standard value		Allowable limit	
	Power take-off end	Flywheel end	Power take-off end	Flywhee. end
GM82	$\phi 17\ ^{-0.008}_{-0.018}$	$\phi 17\ ^{-0.008}_{-0.018}$	$\phi 16.9$	
GM90 ~ GM130, GM131	$\phi 20\ ^{-0.010}_{-0.020}$	$\phi 20\ ^{-0.010}_{-0.020}$	$\phi 19.9$	
GM132	$\phi 25\ ^{-0.010}_{-0.020}$	$\phi 20\ ^{-0.010}_{-0.020}$	$\phi 24.9$	$\phi 19.9$
GM180, 181	$\phi 25\ ^{-0.010}_{-0.020}$	$\phi 30\ ^{-0.010}_{-0.020}$	$\phi 24.9$	$\phi 29.9$
GM182	$\phi 25\ ^{-0.010}_{-0.020}$	$\phi 25\ ^{-0.010}_{-0.020}$	$\phi 24.9$	
GM220, 301	$\phi 30\ ^{-0.010}_{-0.020}$	$\phi 30\ ^{-0.010}_{-0.020}$	$\phi 29.9$	
GM391, 401	$\phi 35\ ^{-0.010}_{-0.020}$	$\phi 35\ ^{-0.010}_{-0.020}$	$\phi 34.9$	



Measuring cam shaft axle outer diameter

► **Camshaft axle outer diameter tolerance**

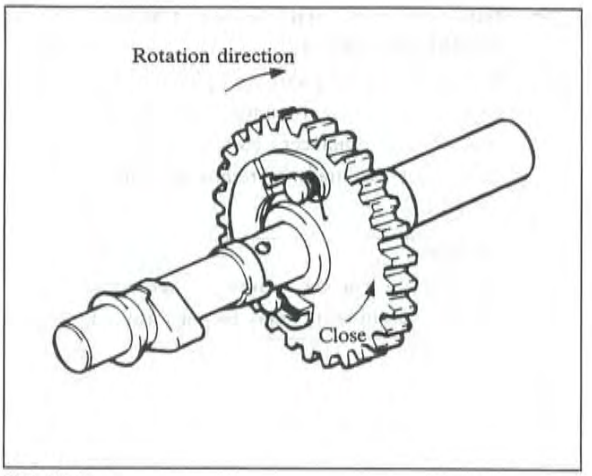
	Standard value		Allowable limit	
	Power take-off end	Flywheel end		
GM82	$\phi\ 13\ ^{-0.016}_{-0.034}$	$\phi\ 13\ ^{-0.016}_{-0.034}$	$\phi\ 12.9$	$\phi\ 12.9$
GM90 ~ GM132	$\phi\ 20\ ^{-0.010}_{-0.020}$	$\phi\ 15\ ^{-0.016}_{-0.034}$	$\phi\ 19.9$	$\phi\ 14.9$
GM180, 181, 182	$\phi\ 25\ ^{-0.010}_{-0.020}$	$\phi\ 15\ ^{-0.016}_{-0.034}$	$\phi\ 24.9$	$\phi\ 14.9$
GM220, 301	$\phi\ 30\ ^{-0.010}_{-0.020}$	$\phi\ 15\ ^{-0.016}_{-0.034}$	$\phi\ 29.9$	$\phi\ 14.9$
GM231	$\phi\ 28\ ^{-0.010}_{-0.020}$	$\phi\ 15\ ^{-0.016}_{-0.034}$	$\phi\ 27.9$	$\phi\ 14.9$
GM391, 401	$\phi\ 15\ ^{-0.010}_{-0.020}$	$\phi\ 15\ ^{-0.016}_{-0.034}$	$\phi\ 14.9$	$\phi\ 14.9$



Measuring cam lift

► **Cam lift**

Model	Standard value	Allowable limit
GM82	25.50	24.8
GM90 ~ GM131	27.20	26.5
GM132	27.00	26.30
GM180, 181	28.20	27.5
GM182	28.95	28.25
GM220, 221	29.15	28.5
GM231	29.15 (L) 28.15 (P)	28.15 (L) 27.5 (P)
GM290, 291	32.15	31.5
GM391, 401	32.75	32.0

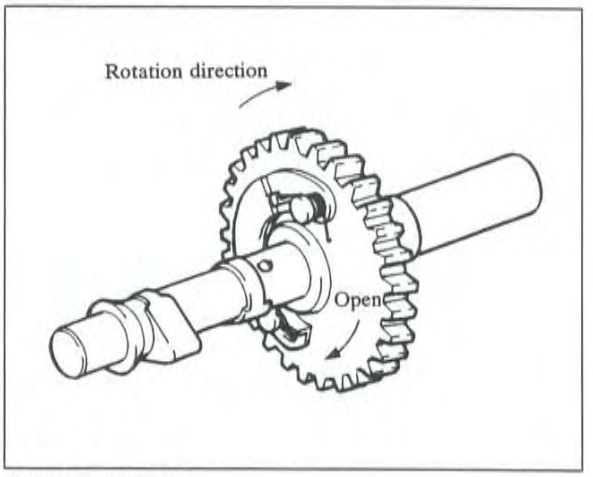


Starting

► **Decompression system**

- Starting

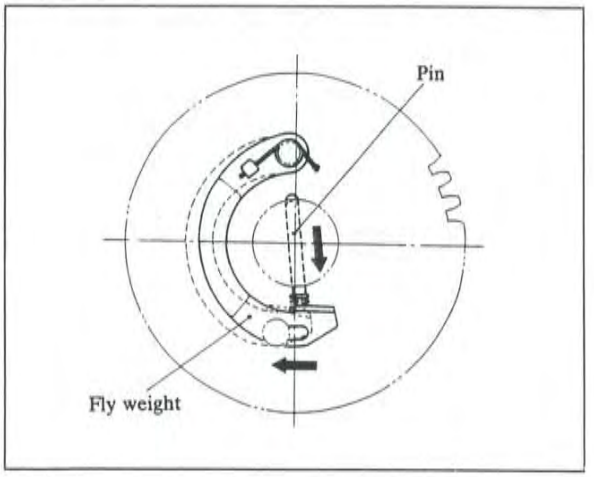
  Fly weight is drawn by the power of the return spring. Since the pin weight is supported by this weight and opposite side end surface protrudes from exhaust cam basic circle by approx. 1 mm, exhaust valve is lifted near upper dead center and compression is lost when recoil is pulled, thus recoil can be pulled more easily.



When operating

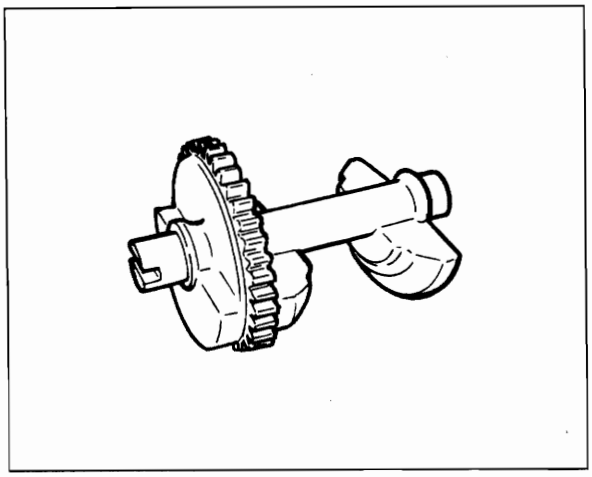
- During operation

  Once engine starts, decompression function is lost as fly weight overcomes return spring power by centrifugal force, and state of pin becomes free thus the power of lifting exhaust valve is lost.
  Rotation speed to reach this state is 900 rpm.



► **Inspection Check if:**

- Pin functions with its own weight when it opens fly weight.
- Opening and closing of fly weight is smooth.

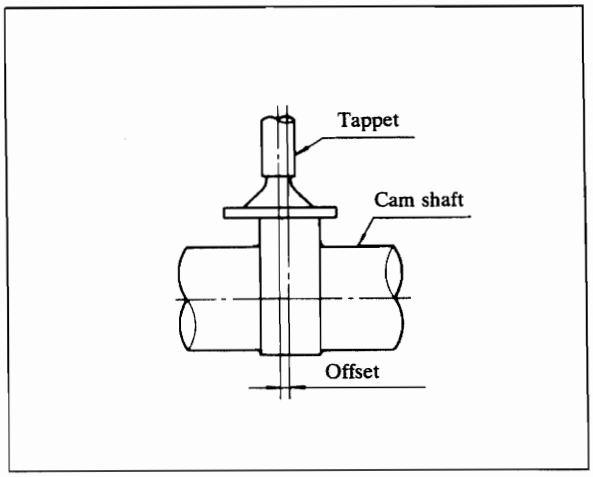


Balancer shaft

► **Balancer shaft. (OP except GM300, GM301, GM391 and GM401)**

Reciprocal inertia produced by the reciprocal movement of the piston is reduced to half by the crank shaft weight. Balancer shaft balances 100% vertically and horizontally by removing this half reciprocal inertia.

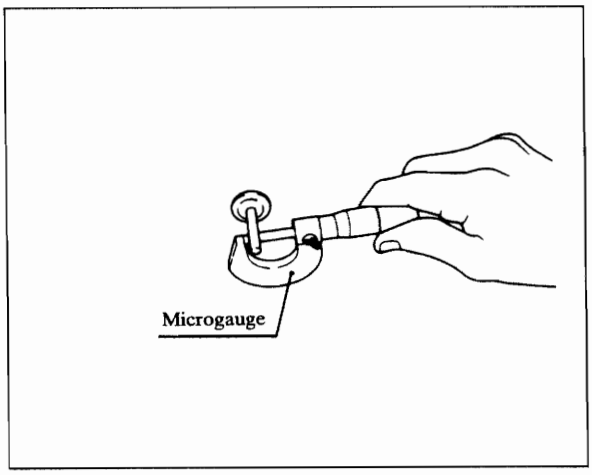
Caution
Failure to correct mount in accordance with identification marks may increase the vibration.



Tappet

► **Tappet**

Offset = To avoid skewed abrasion of tappet slide surface, centers of the cam and tappet are offset.



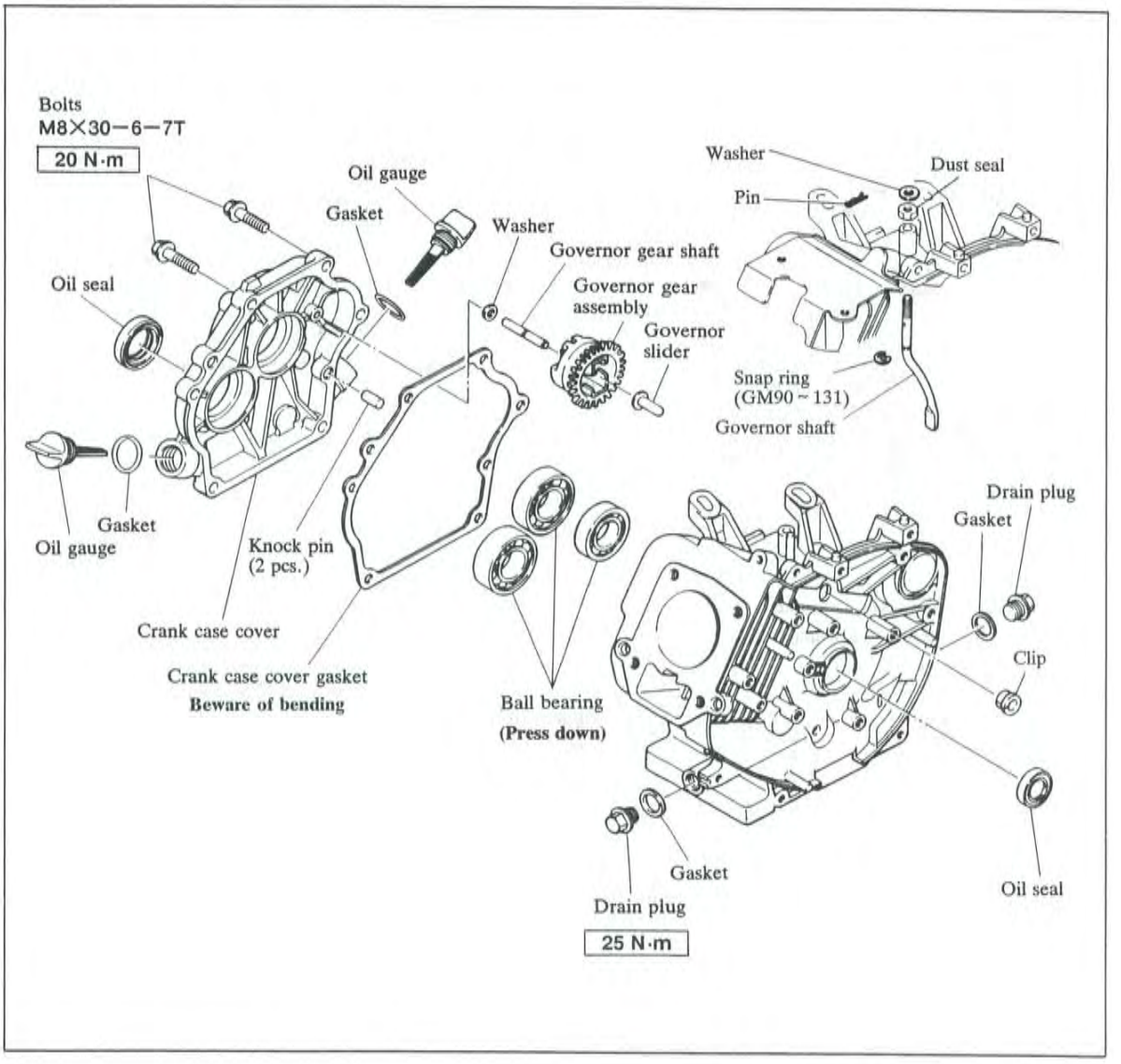
Measuring tappet outer diameter

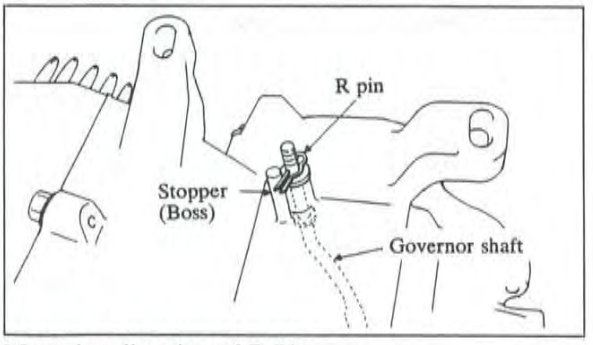
► **Tappet outer diameter and clearance between tappet hole**

Standard value		Allowable limit	
GM90 ~ 300	GM82 ~ 401	GM90 ~ 300	GM82 ~ 401
0.025 ~ 0.077	0.025 ~ 0.062	0.15	

Replace the cylinder block when the tappet hole worn.

► **Outline**



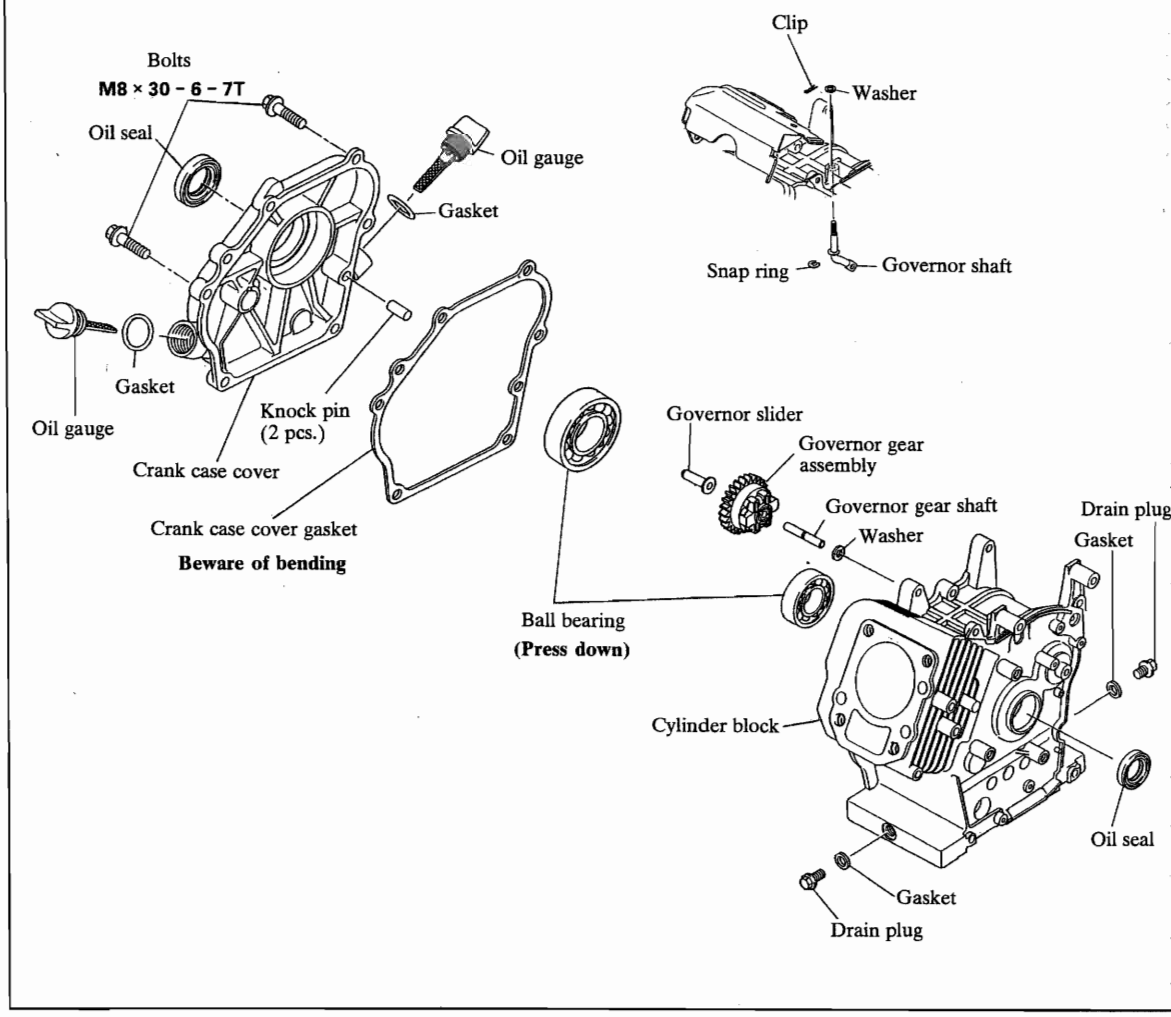


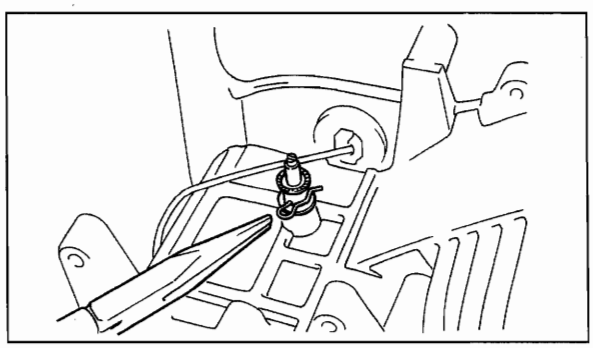
Mounting direction of R Pin

► **Mounting direction of R pin**

Mount R pin after confirming the direction of governor shaft as shown in the figure.

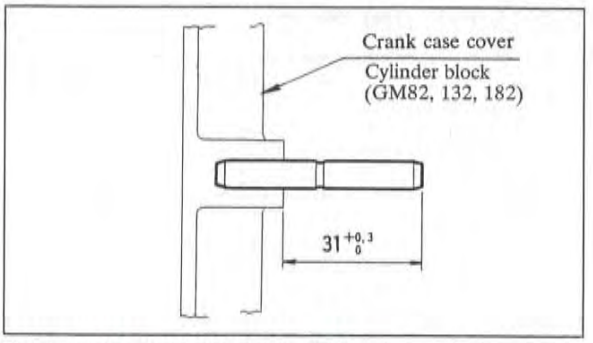
► **Outline** GM82, 132, 182





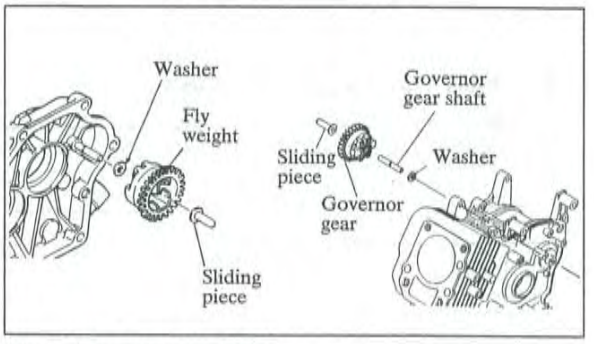
Mounting direction of R Pin

► **Mounting direction of R pin**
Mount R pin after confirming the direction governor shaft as shown in the figure.



Drive-in depth of governor shaft

► **Drive-in depth of governor shaft**



Mounting governor gear

► **Mounting governor gear**

Press down the governor gear into the governor shaft slot until it snaps.

- Ensure that the governor gear rotates smoothly.

► **Ball bearing, oil seal dimensions**

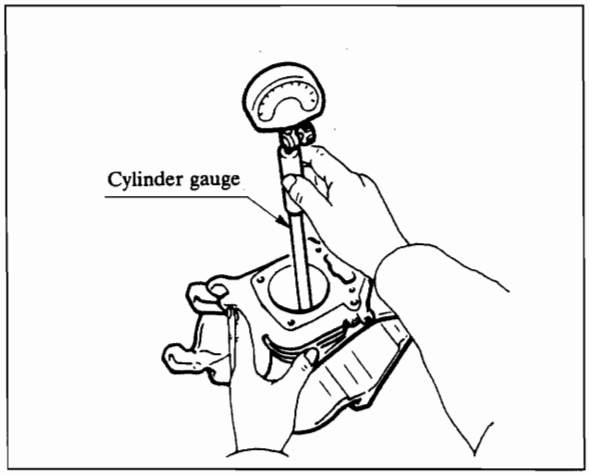
			GM82	GM90 ~GM130	GM91 ~GM131	GM132	GM180, GM181	GM182	GM220, GM221	GM231	GM290, GM291	GM300, GM301	GM391, GM401
	Mg end	Crank shaft	6203	6204		6204	6206	6205	6206	6206	6206	6206	6207
		Cam shaft	–	–		–	–	–	–	–	–	–	–
		Balancer shaft	–	–		–	OP(6201)	–	–	OP(6201)	OP(6203)	6203	–
	PTO end	Crank shaft	6303	6204		6305(P)/ 6303(L)	6205	6305(P)/ 6304(L)	6006	–	6206	6206	6207
		Cam shaft	6203(L)	6204(L)		6204(L)	6205(L)	6205(L)	6006(L)	62/28	6206	6206	6207(L)
		Balancer shaft	–	–		–	OP	–	–	OP	OP6203	6203	–
	Mg end	Crank shaft	TC17306	TC20328		TC20328	TC30428	TC25408	TC30428	TC30428	TC30428	TC30428	–
	PTO end	Crank shaft (P)	TC17306	TC2041256	TC2041258	TC2041256	TC2041258	TC2541256	TC30456	TC30456	TC30456	TC30456	–
		Cam shaft (L)	TC17306	TC2041256	TC2041258	TC2041256	TC2041258	TC2541256	TC30456	TC28	TC30456	TC30456	–

Measurement = Ball bearing

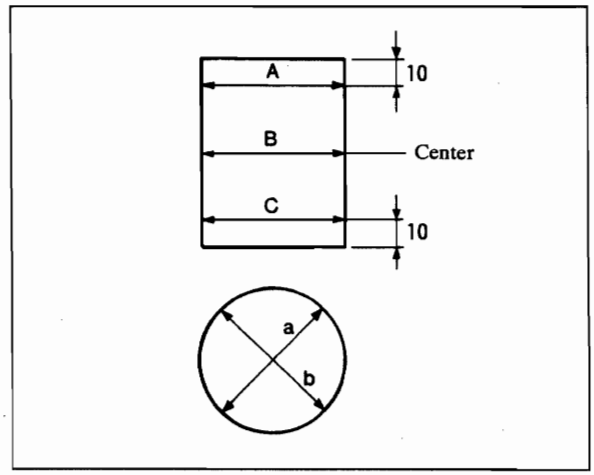
	Inner dia	Outer dia	Width
6203	ϕ17	ϕ40	12
6204	ϕ20	ϕ47	14
6205	ϕ25	ϕ52	15
6006	ϕ30	ϕ55	13
6206	ϕ30	ϕ62	16
6207	ϕ35	ϕ72	17
62/28	ϕ28	ϕ58	16

Oil seal TC = With heat resisting dust proof lip packing
Inner dia. × Outer dia. × width

—1 Cylinder block, Crank case cover



Measuring cylinder inner diameter



Measuring point for cylinder inner diameter

► **Cylinder inner diameter**

	Standard dimensions	Allowable limit
GM90, 91	$\phi 52\ ^{+0.02}_{0}$	Determine by the clearance between the piston outer diameter
GM130, 131	$\phi 62\ ^{+0.02}_{0}$	
GM180, 181	$\phi 68\ ^{+0.02}_{0}$	
GM220, 221, 231	$\phi 72\ ^{+0.02}_{0}$	
GM290, 291, 300, 301	$\phi 80\ ^{+0.02}_{0}$	
GM391, 401	$\phi 89\ ^{+0.02}_{0}$	

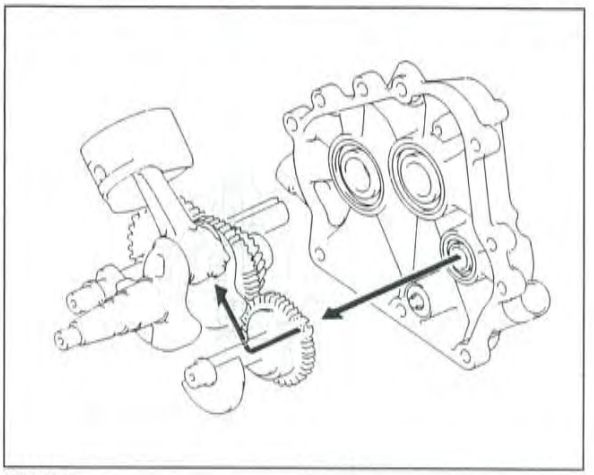
Measure the bore at 6 points as shown in the figure below. Perform boring if any of these points exceed the allowable limit.

► **Piston outer diameter and clearance**

Standard dimensions	Allowable limit
0.04 ~ 0.08	0.20

Cylinder boring measurement	0.25, 0.50

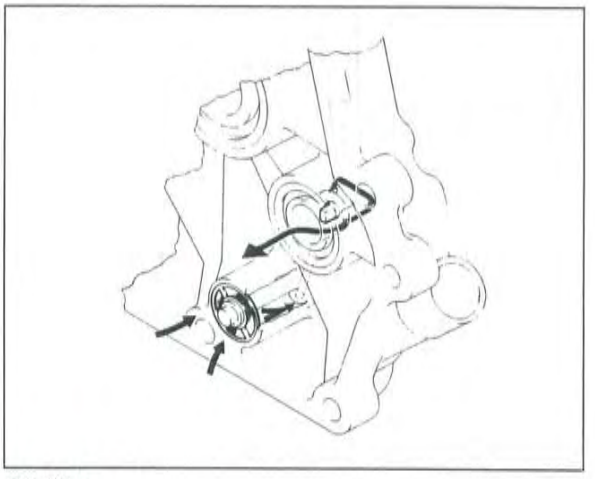
– 1 Oil pump (Only for GM300, 301, 391, 401)



Oil line

► **Oil line**

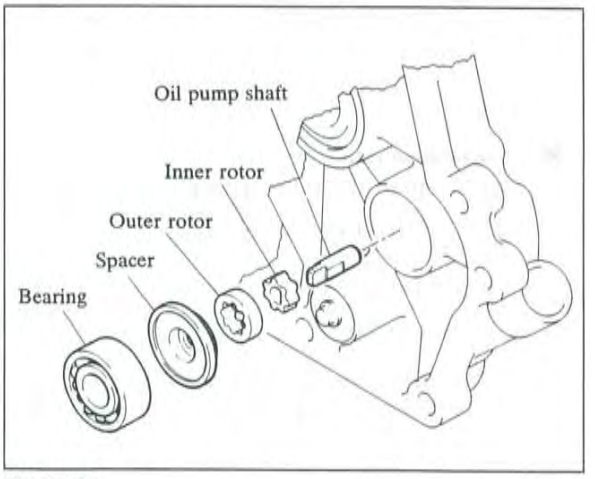
The oil filter is installed at the lower part of the crank case and oil pump is driven by the shaft inserted into the groove at the end of balancer shaft, thus oil is sprayed through the center hole of the balancer shaft.



Oil filter

► **Inspection of oil filter**

- Remove and clean if it is clogged.
- Replace when the mesh is broken.

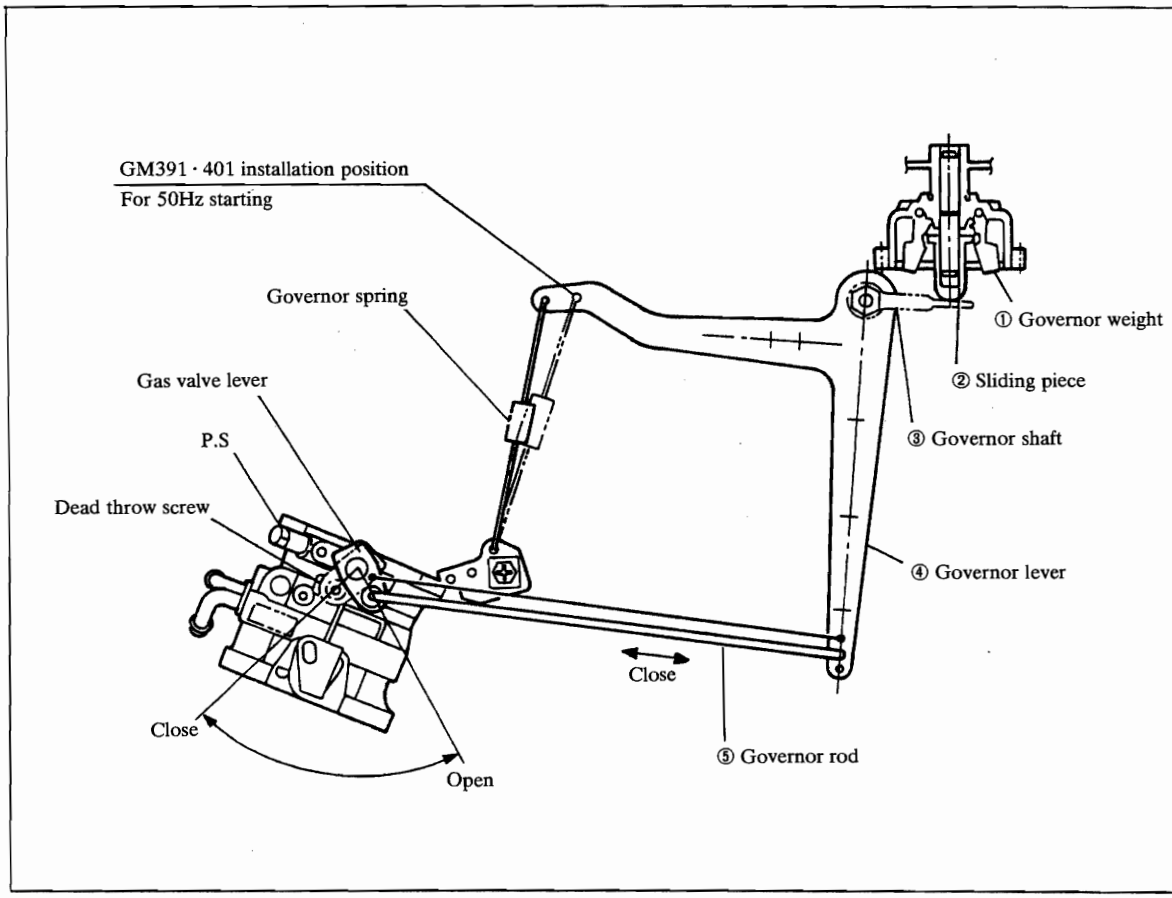


Oil pump

► **Oil pump**

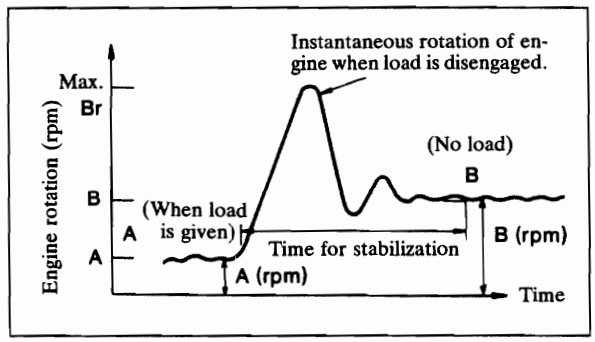
- Sintered metal trochoid pump
  Nominal diameter (Outer) ϕ 23
- Check for defects of cracks and ensure that it rotates smoothly by pump shaft.

▶ Mechanism



Centrifugal governor is used for this model to govern the rotation. If load is given from outside to the engine which is rotating at rated speed and rotation slows down, governor weight ① opened by the centrifugal force is slightly closed. The movement of the governor weight is transmitted to governor lever ④ through sliding piece ② and governor shaft ③, thus moves governor rod ⑤ in the direction of arrow.

With this movement, carburetor throttle ⑥ which interacts with this governor rod fully opens, thus reinstates the slowed down rotation of engine. On the other hand if the load is disengaged and the rotation of engine rises sharply, the rotation of engine is slowed down through the reverse action, thus stable rotation of engine can be always maintained.



Speed fluctuation

▶ Fluctutation ratio

Instantaneous speed fluctuation ratio

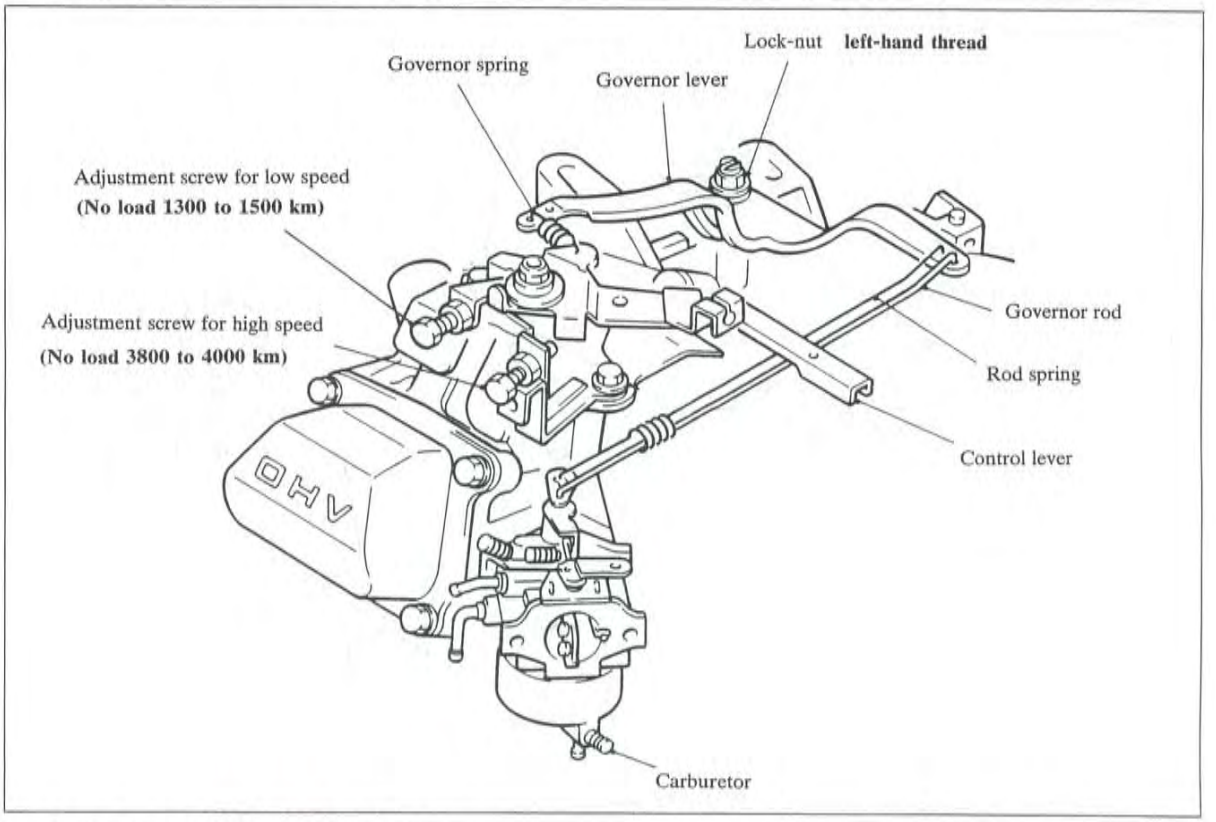
$$= \frac{Br - A}{A} \times 100\%$$

Stablilized speed fluctuation ratio

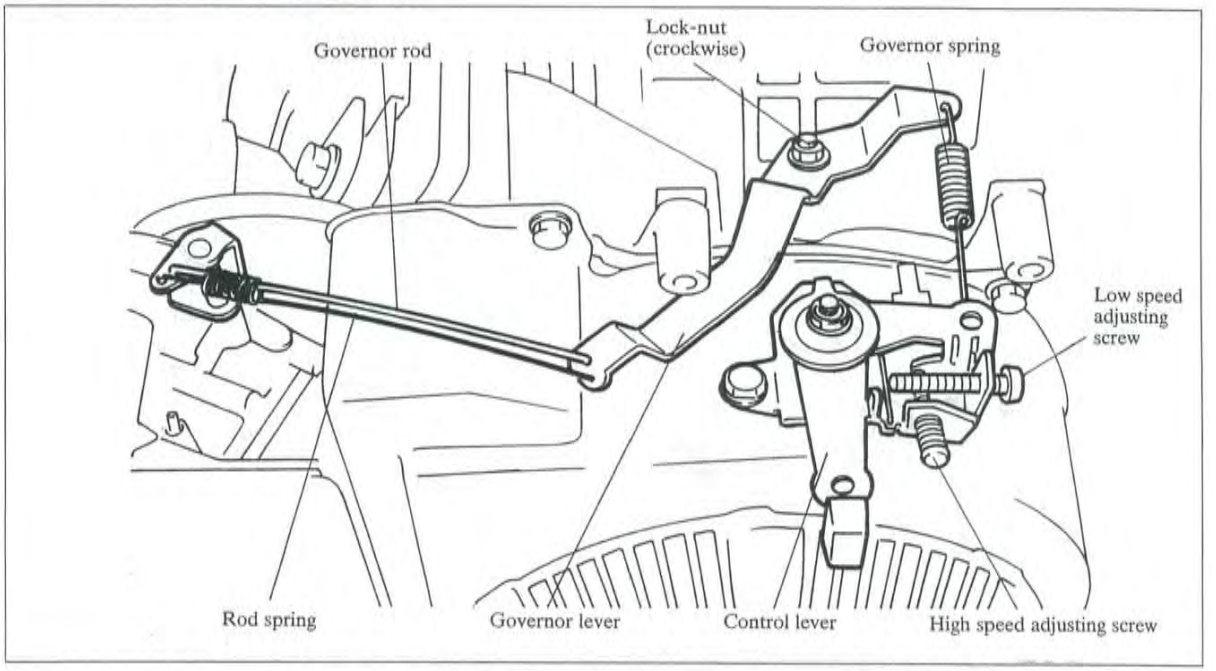
$$= \frac{B - A}{A} \times 100\%$$

Br: Instantaneous maximum speed (rpm)
B : Stablized speed after load is disengaged. (rpm)
A : Rated rotation (rpm)

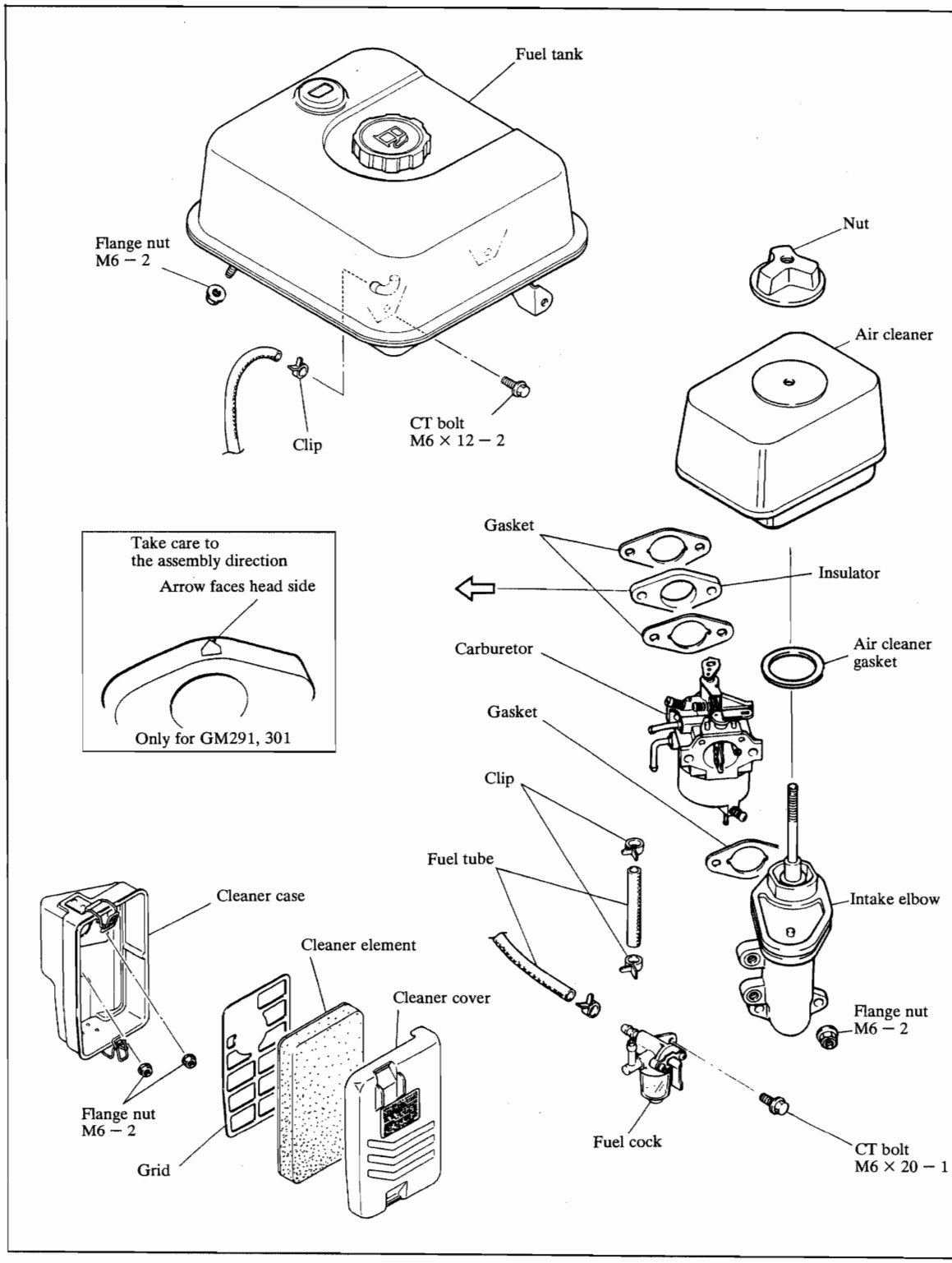
► Outline (Exclude GM82, GM132, GM182)



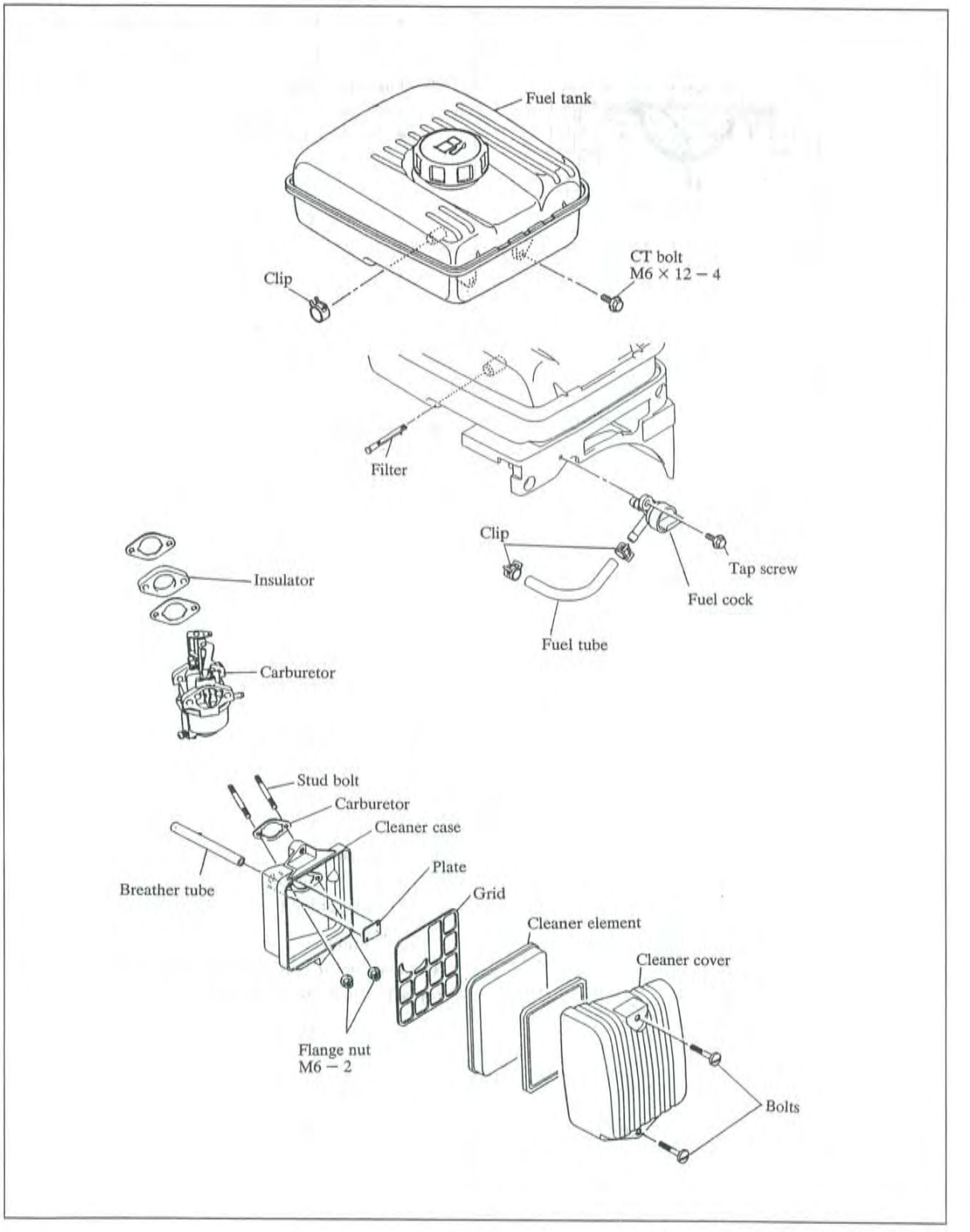
► Mechanism GM82, GM132, GM182

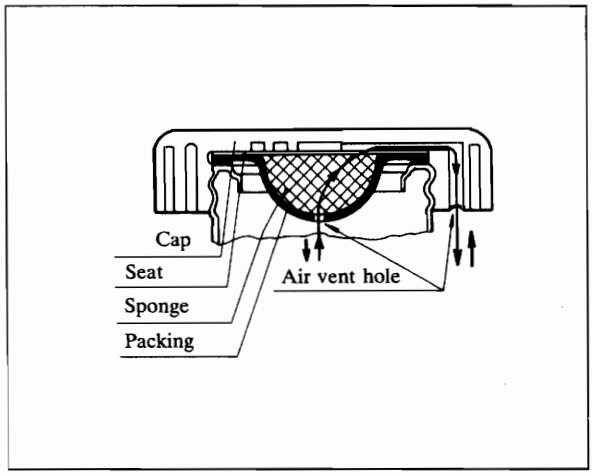


► Outline


Fuel tank
Flange nut
M6 – 2
Clip
CT bolt
M6 × 12 – 2
Nut
Air cleaner
Take care to
the assembly direction
Arrow faces head side
Only for GM291, 301
Gasket
Insulator
Carburetor
Air cleaner
gasket
Gasket
Clip
Fuel tube
Intake elbow
Cleaner case
Cleaner element
Cleaner cover
Flange nut
M6 – 2
Flange nut
M6 – 2
Grid
Fuel cock
CT bolt
M6 × 20 – 1

► **Outline**

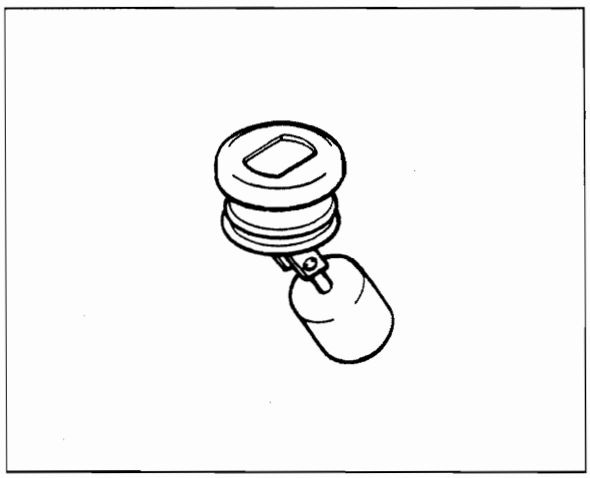

Fuel tank
Clip
CT bolt
M6 × 12 – 4
Filter
Clip
Tap screw
Fuel cock
Fuel tube
Insulator
Carburetor
Stud bolt
Carburetor
Cleaner case
Plate
Grid
Breather tube
Cleaner element
Cleaner cover
Flange nut
M6 – 2
Bolts



Tank cap filter

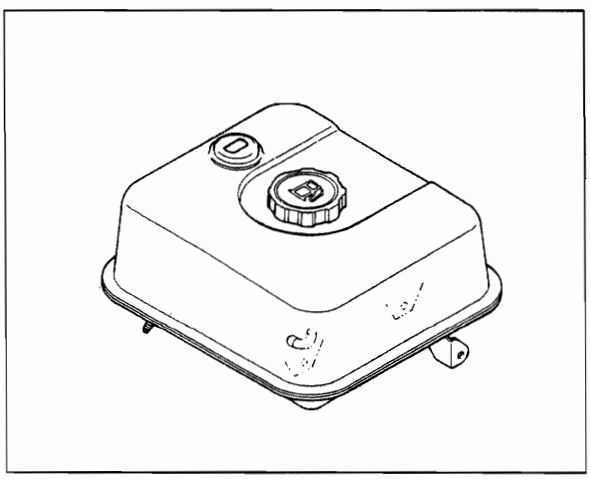
► **Tank cap**
- Check that air vent passage is not clogged, and replace if it is broken or deformed.

► **Fuel tank filter**
- Remove adhered dust.
- Replace if deformed or if hole appears.



Fuel gauge

► **Fuel gauge**
- Check that the function of gauge is normal and that no fuel leaks after mounting.

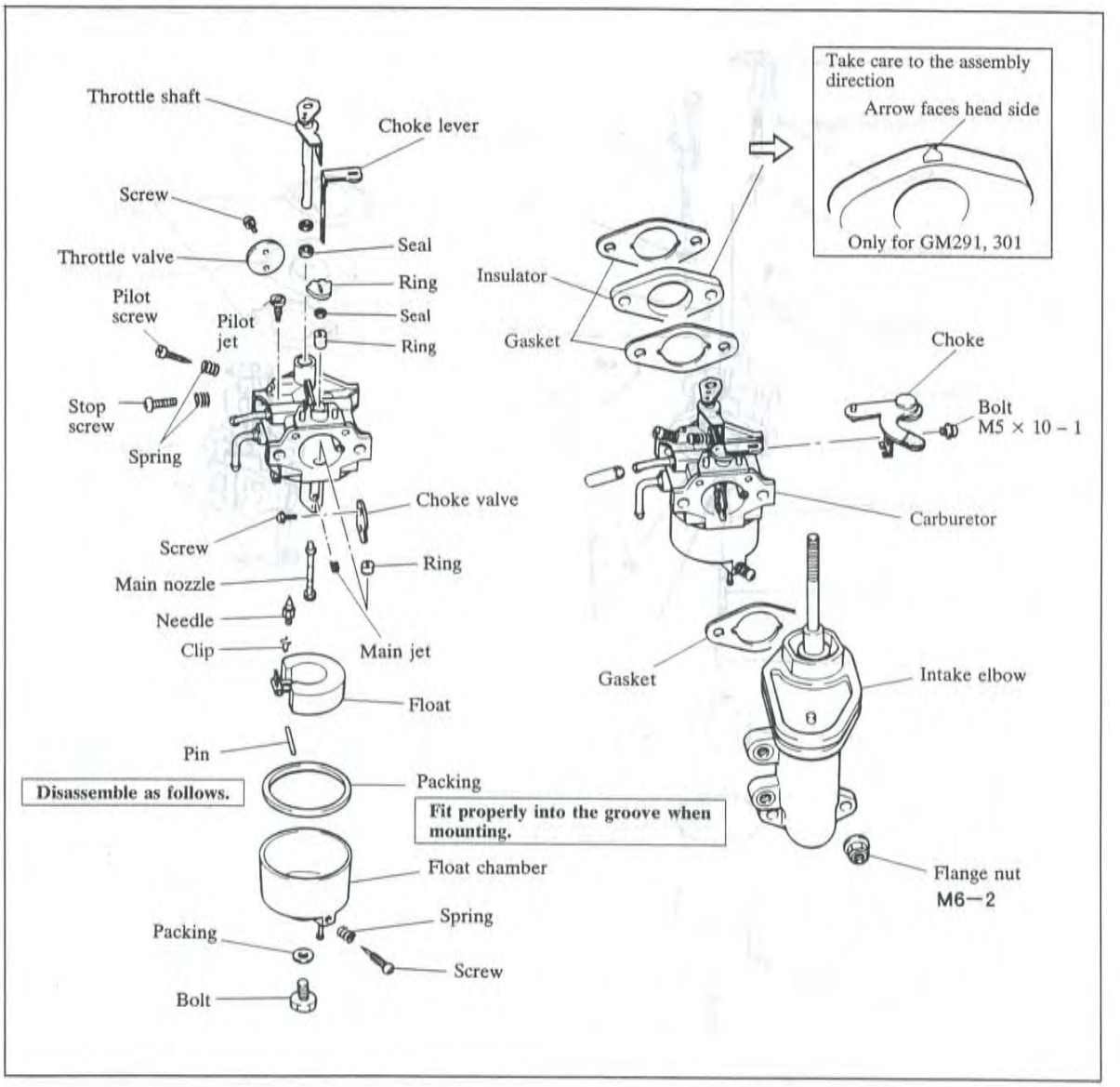


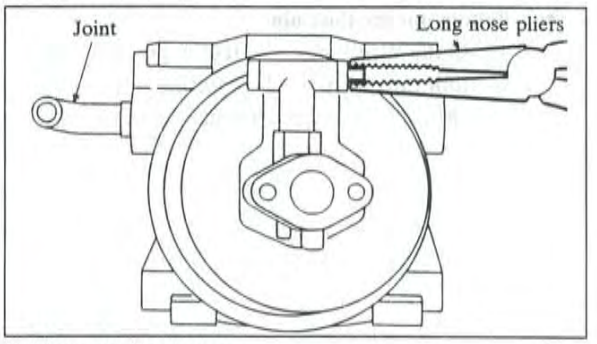
Fuel tank

► **Fuel tank**
- Clean the dust and discharge water accumulated at the bottom of tank.

⚠ **Caution**

The leakage of fuel will cause fire. Do not repair but replace if leakage is obersved.

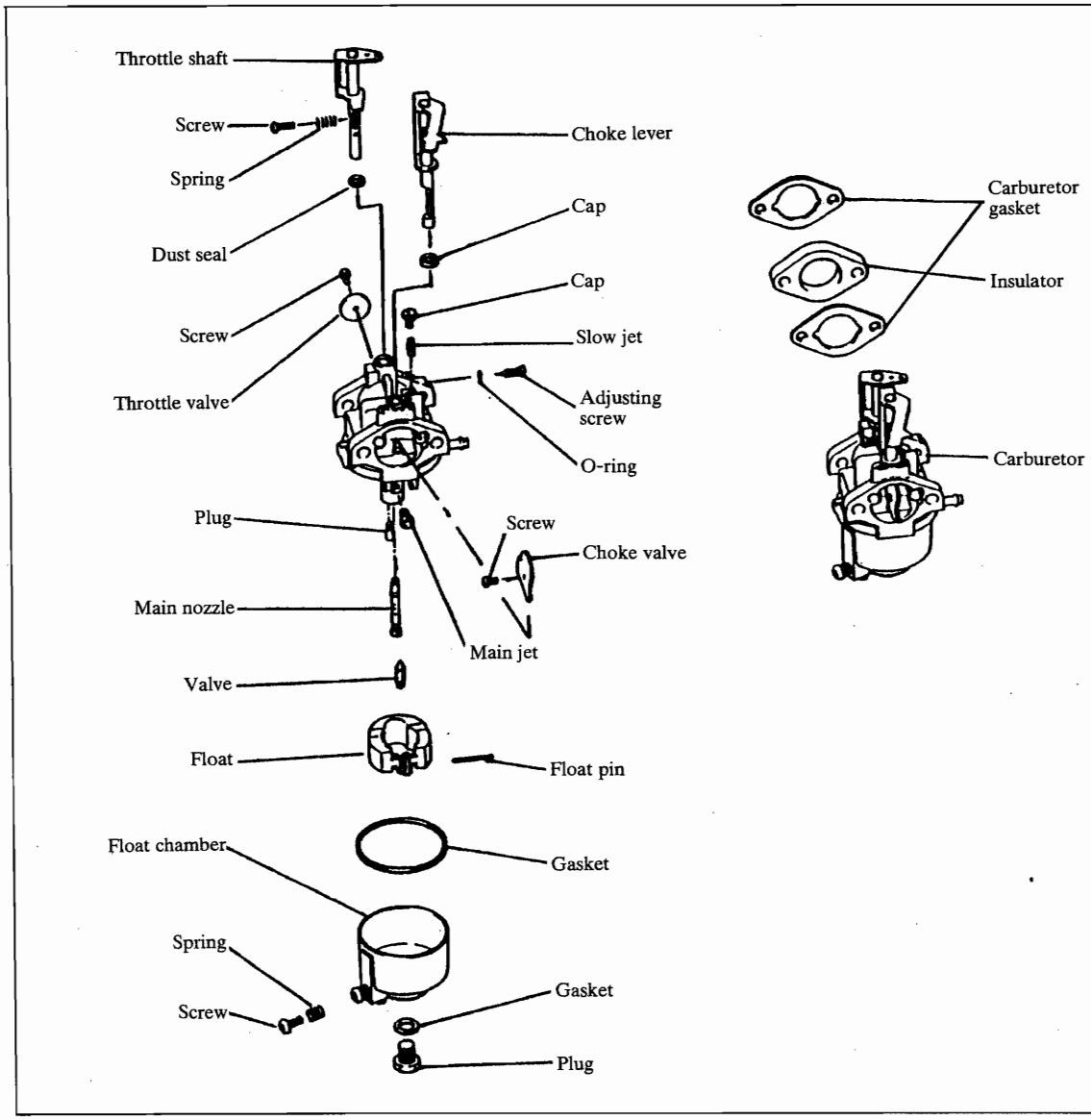


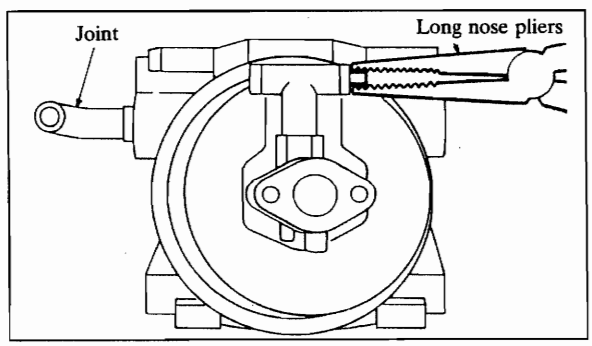


Pulling out float pin

► **Pulling out the float pin**

- As the float pin is inserted by pressure, pull out from the inserted side. Insertion direction
  GM90 ~ GM181 (except GM132)
  = Throttle valve side
  GM290 ~ = Opposite to the joint side.





Pulling out float pin

▶ **Pulling out the float pin**

- As the float pin is inserted by pressure, pull o from the inserted side. Insertion direction GM82, 132, 182 = Throttle valve side

1. Theory

The theory of a sprayer is applied to the carburetor. Gas is supplied to the combustion chamber by mixing different quality substances such as gas (air) and liquid (fuel) in suitable proportion to the condition of the engine operation. A dense gas is supplied when engine starts (1 g of fuel to air 1 to 2 g), and during operation, this varies according to the condition of the load, proportion of air becomes 8 to 20 g against 1 g of air.

In the fuel and air passages in the carburetor, jets are installed to regulate the flow. Since the jet system is mounted by the screw, this can be disassembled.

2. Function of main parts

(1) Float

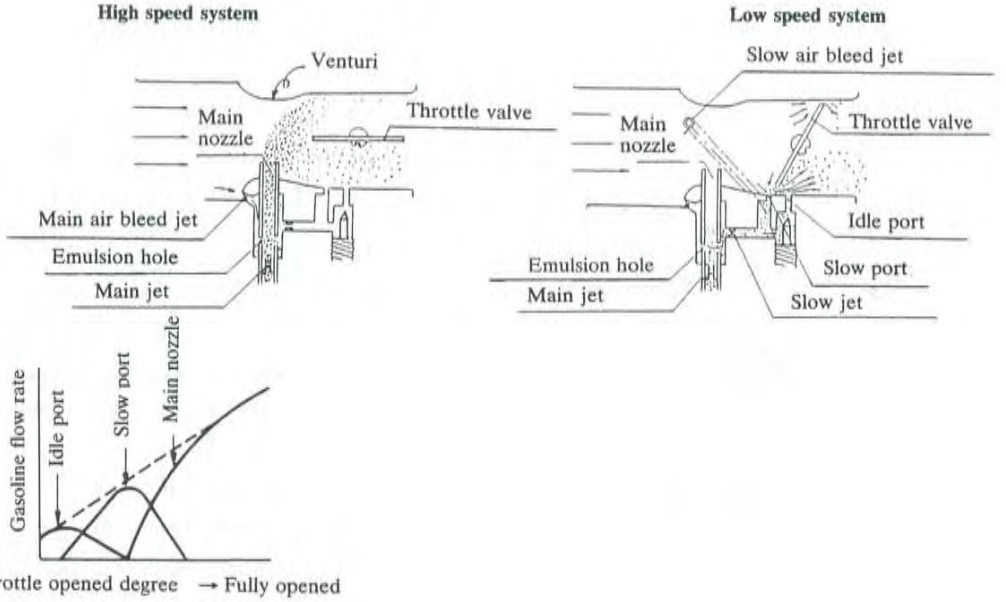
This is composed of float valve and float, and maintains specified level of fuel from the fuel tank. As float valve is connected with the float by the clip, the movement of the float is directly transmitted to the float valve.

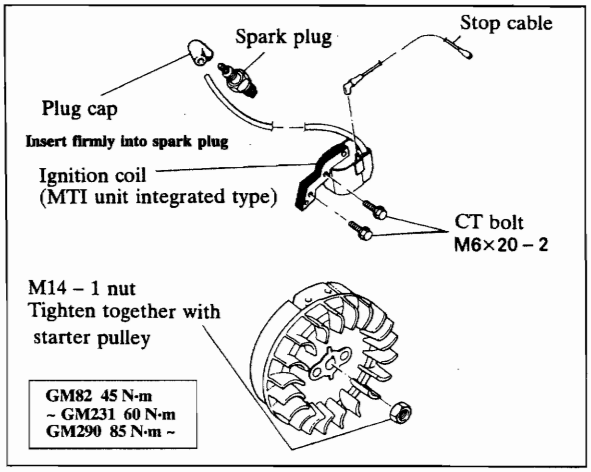
(2) High speed system

Fuel which is measured at the main jet sprays by the negative pressure produced by the flow of air through the venturi tube. Main nozzle has several emulsion holes and these form bubbles by mixing the fuel with the air which is suctioned from main air bleed in the main nozzle and supply the mixture gas corresponding to the load of the engine and helps to make the fuel a mist.

(3) Low speed system

As the passage through the throttle valve becomes narrower, the flow is decreased sharply, and if it becomes more narrower, the spray of fuel from the main nozzle stops. This is mainly due to the difference of the levels between float chamber and main nozzle port. To compensate the sharp decrease of fuel, low speed system is equipped.





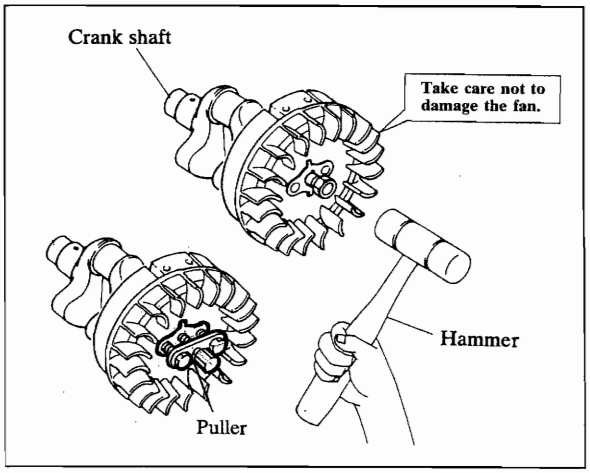
Flywheel magnet

► **Outline**

The electricity is generated in the ignition coil through the inflence of flux emitted from permanent magnet fitted to the flywheel.

MTI unit built in the coil functions when the generated electricity reaches maximum and enough voltage is generated to spark the plug.

(MTI is the abbreviation of Mitsubishi Transistor Igniter)



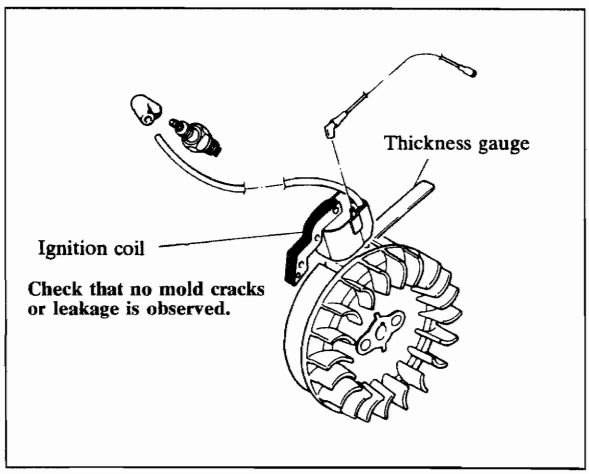
Removing flywheel

► **Removing flywheel**

Remove first the flywheel fixing nut and remove the starter pulley, then fit the nut to the flush with the surface of the crank, and remove the flywheel by tapping with the hammer.

Clean oil and dust on tapered part when mounting

With GM182, GM132 and GM82, however, remove with the dedicated pulley. (NEVER use a hammer to remove them.)



Air gap between ignition coil and flywheel

► **Adjustment of the air gap of ignition coil**

Install the ignition coil at the upper dead center, and adjust the gap between the field and circumference of the flywheel, then tighten the bolt.

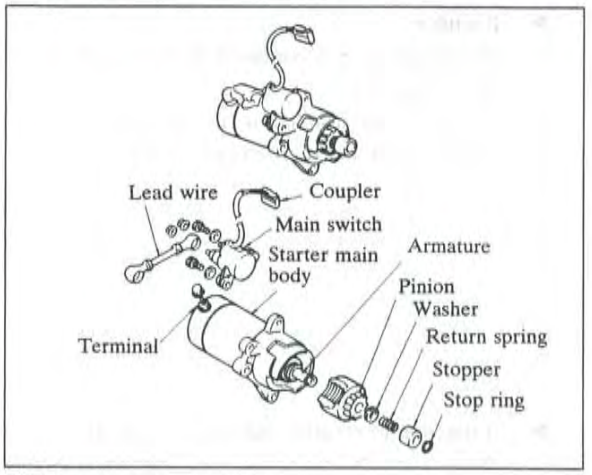
	Standard value
Air gap	0.3 ~ 0.5

Ensure no contact exists with the ignition coil by rotating the flywheel.

► **Inspection of ignition coil**

	Standard value
Three needle sparking gap	6 or more/300 rpm

– 4 Starting motor (E type)

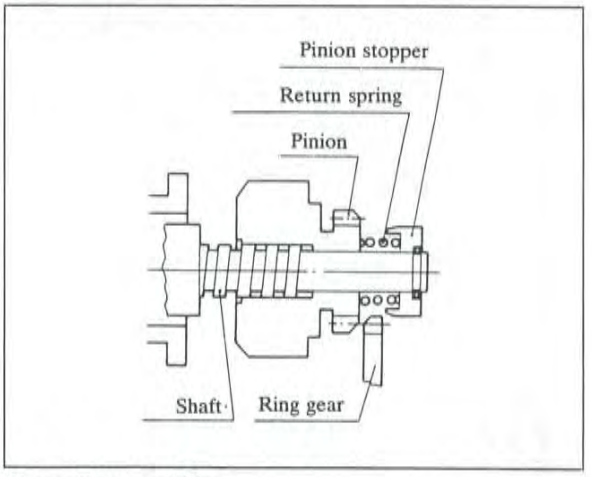


Self starter

► **Outline**

The circumference of the armature is tapped with make screw and inside of the pinion is tapped with female screw, thus these are meshed together with free rotation. Also the weight of the pinion is increased to increase the moment of inertia.

Upon turning the switch on, the armature rotates, and the pinion moves to the outside by inertia, thus mesh to the gear to start the engine. Upon turning the switch off after the start of the engine, the pinion returns by the moment of inertia, thus the armature is returned to the starter main body.



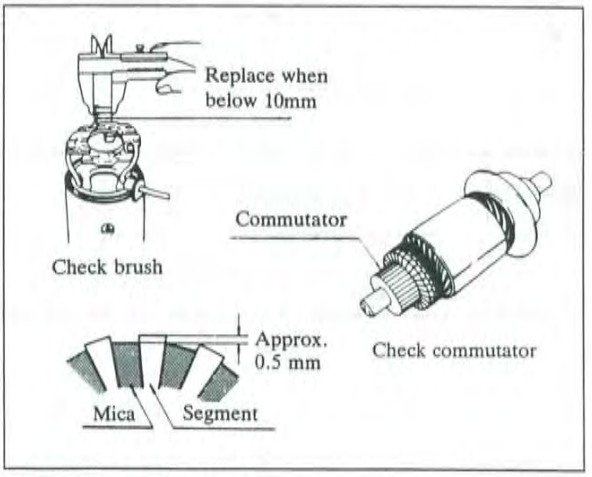
Movement of pinion

► **Operation**

- Switch must be on within 15 sec. and start again with an interval of at least 5 sec.

⚠ **Caution**

Do not operate starting during the running of the engine as this may break the ring gear.



Inspection of self starter

► **Inspection**

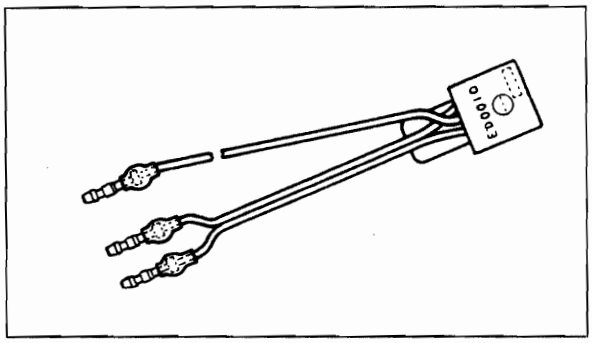
- Brush length

Allowable limit	5

- Commutator

Offset between the segment and the mica.	Repair limit
	0.7

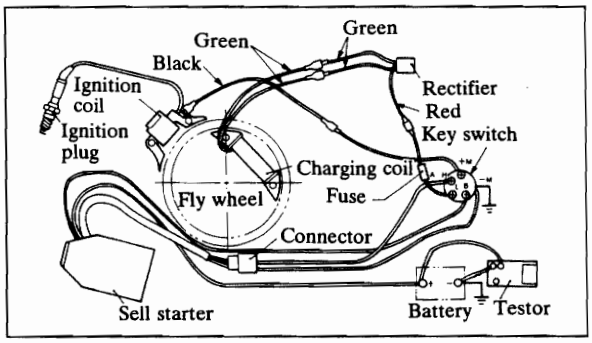
– 4 Rectifier, Key switch (Model E)



Rectifier (for 2A)

► **Rectifier**

1. Be careful to not confused between 2A and 4A when replacing.
2. Be careful of installation position as both has bridge circuit and is grounded to the body.



Inspection of rectifier

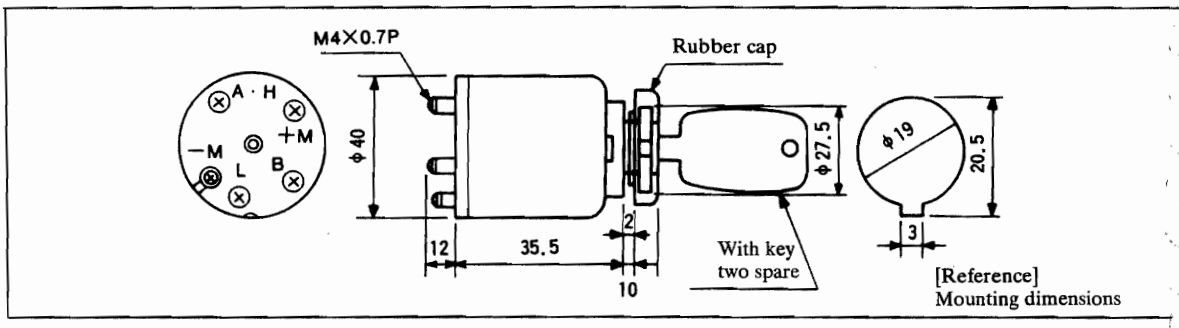
► **Inspection of rectifier (Simplified method)**

Wire correctly, then measure the voltage at ti battery terminal when engine is stopped. The measure the voltage at the battery terminal during the operation of engine at high speed (over 30 rpm).

Battery voltage	Allowable limit
	Less than 12.8V

Note:
When single battery is 12V

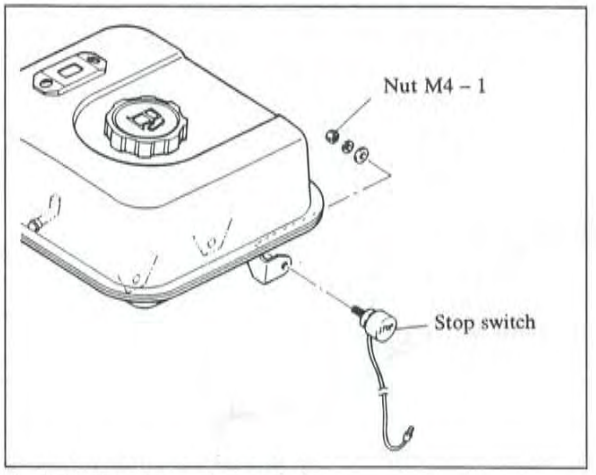
► **Key switch**



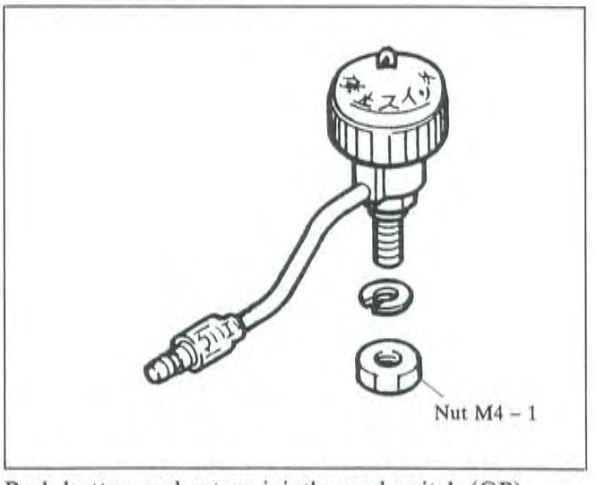
	– M	+M	B	L	A·H	
OFF	○	○				Stop
1			○	○		Running
2			○		○	Start

Note:
2 to 1 movement is effected by return spring.

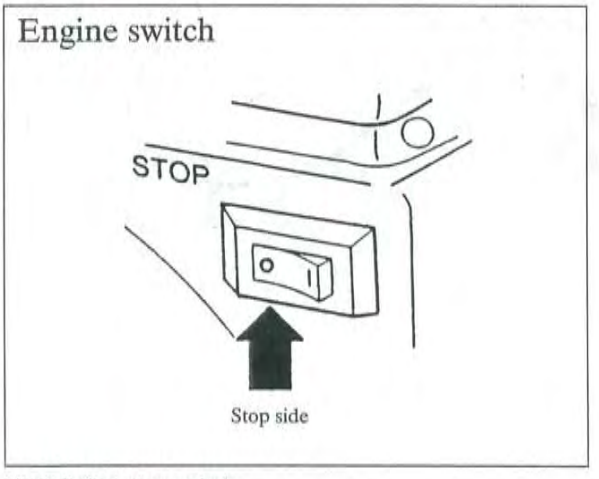
– 4 Stop switch



Push botton type stop switch



Push button and rotary jointly used switch (OP)



Undulation stop switch

► **Outline**

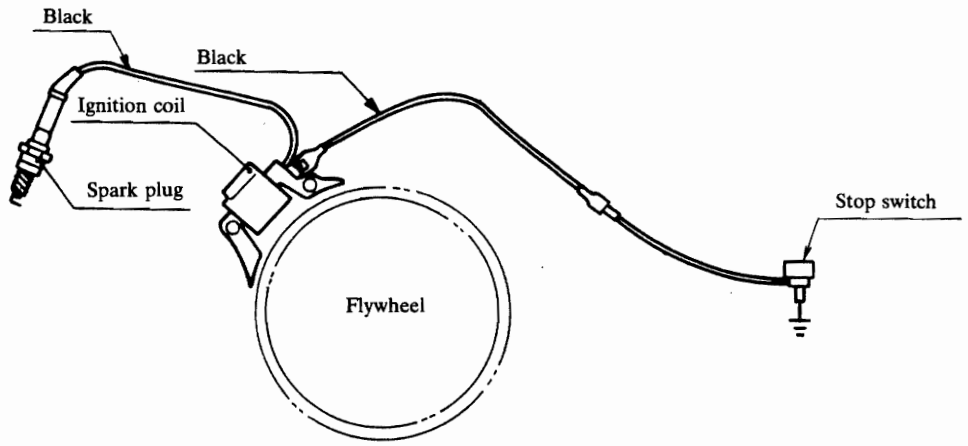
The push button types of stop switch are the standard, and push button and rotary jointly and one-touch type are also available. One-touch type stop switch is called as ESS, and this is equipped with built-in circuit which grounds the ignition coil for several seconds in the unit.

► **Inspection**

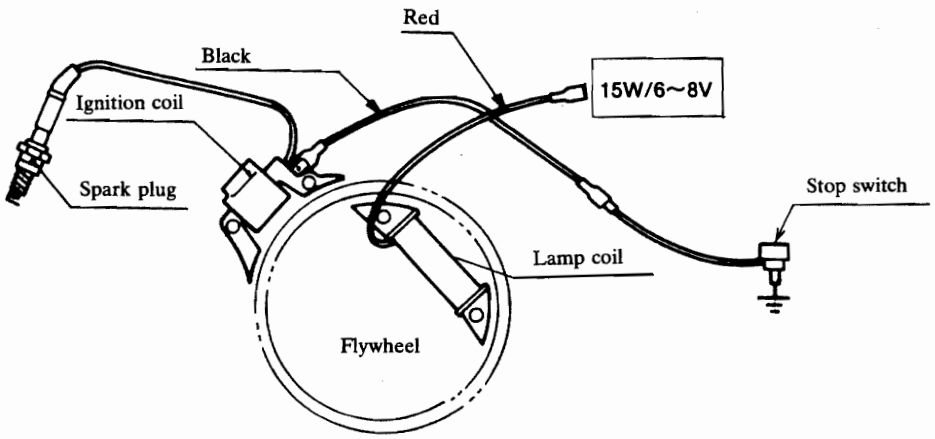
Check that:

- This is operable smoothly.
- There is no breakage of lead wire insulation or disconection of wire.
- There is no looseless or rust of terminal for jack.
- There is no rust or dirt on the tighening surface-(Fuel tank) of M4 nut.

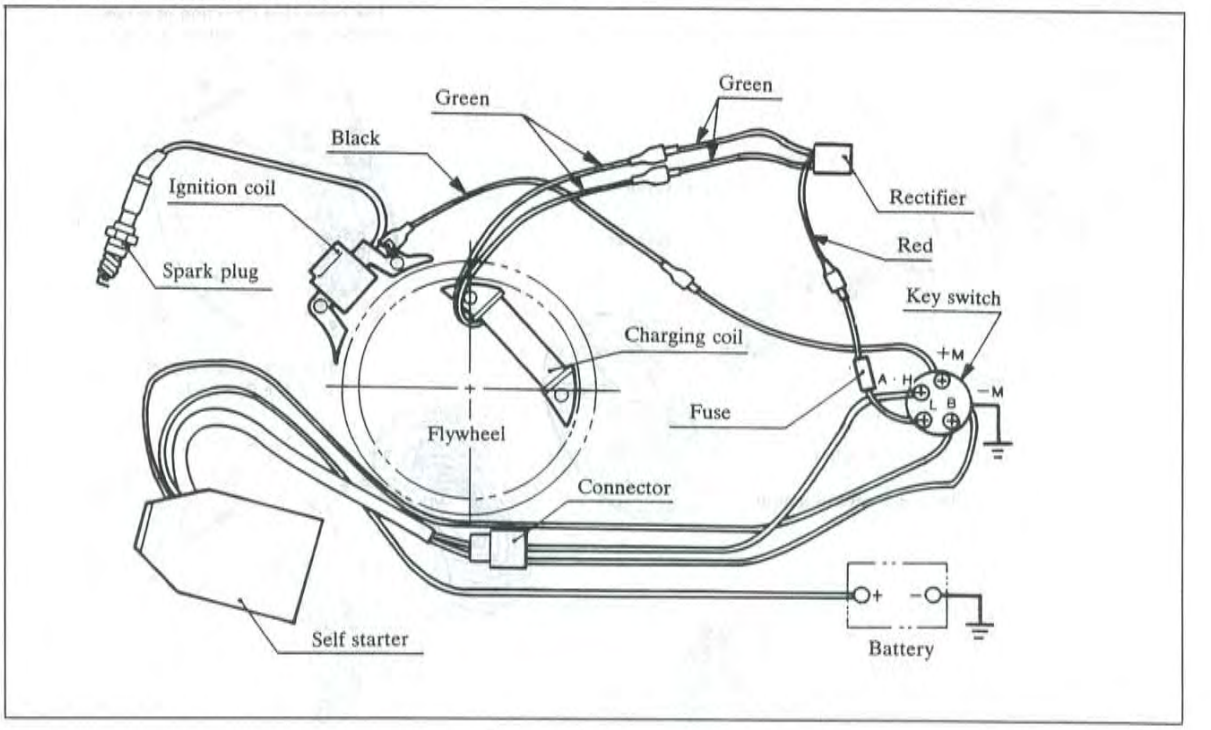
► **Standard**



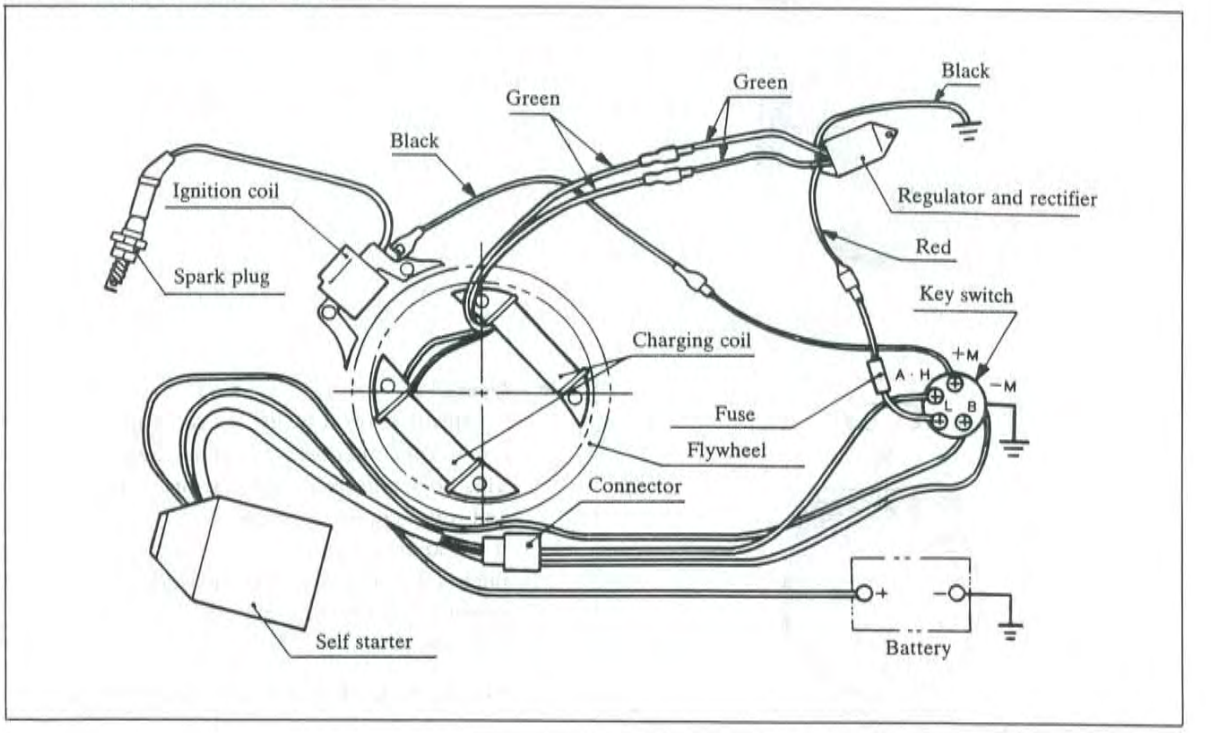
► **With lamp coil (OP)**



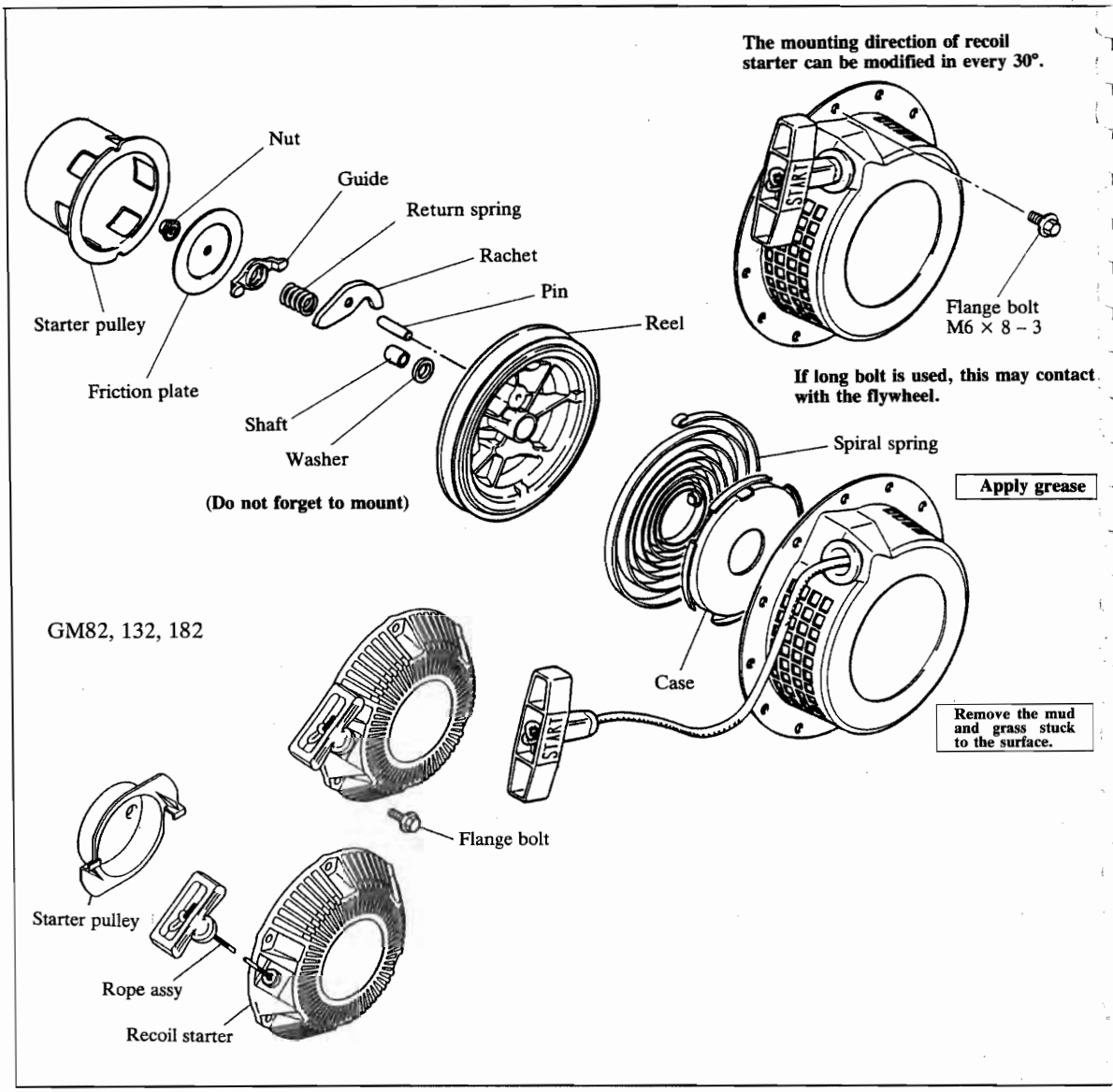
► **2A charge specification (OP)**

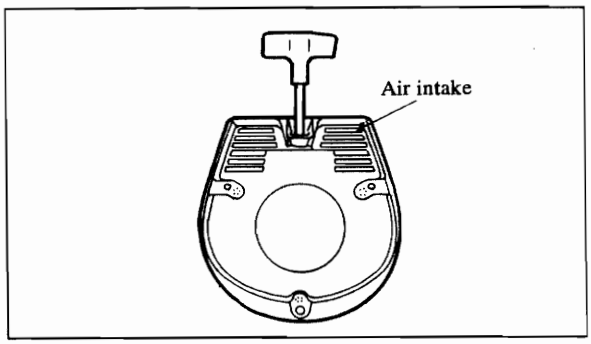


► **4A charge specification (OP)**



– 5 Recoil starter





Mud proof recoil starter (OP)

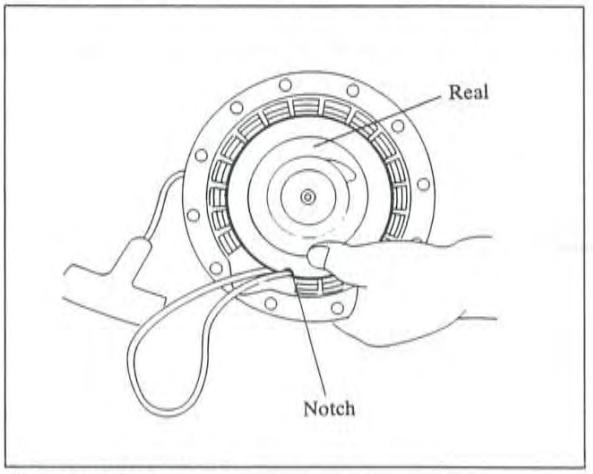
▶ **Operation**

When the knob is pulled the reel rotates and the the ratchet interlocked with the reel and opens This hooks the convexed part of the starter pulley and rotates the crank shaft.

If the knob is returned to the original position, the ratchet is disengaged from the starter pulley by the power of the return spring.

The rope is stored by the power of return spring.

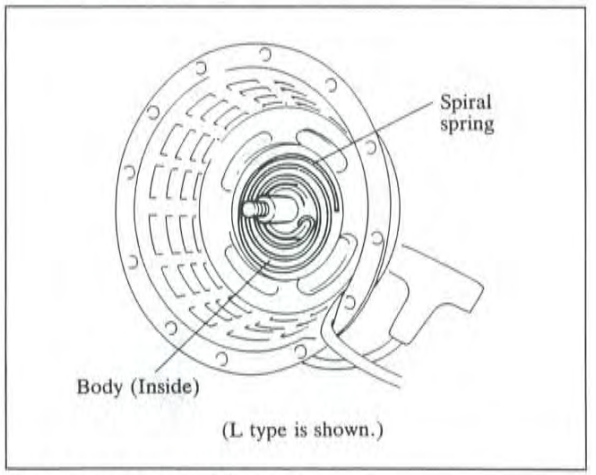
Return the knob slowly and without letting go.



Disassembly of recoil

► **Disassembly**

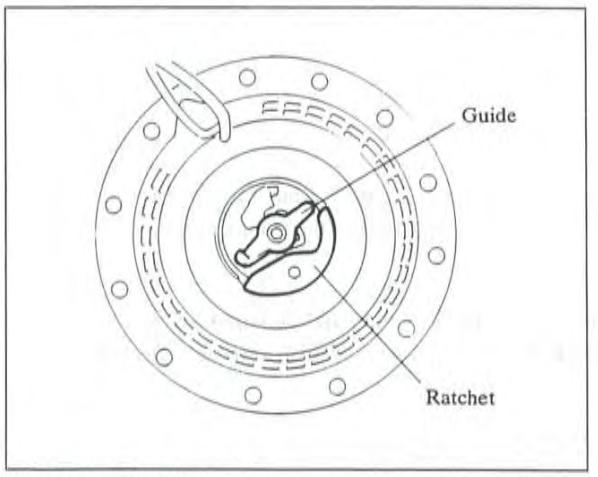
1) Pull out the rope about 50mm.
2) Pull out the rope while pressing the reel as shown in the figure, then discharge the tension of the spiral spring by inserting the rope into the notch.
3) Disassemble by loosening the nuts.



Spiral spring assembly

► **Assembly**

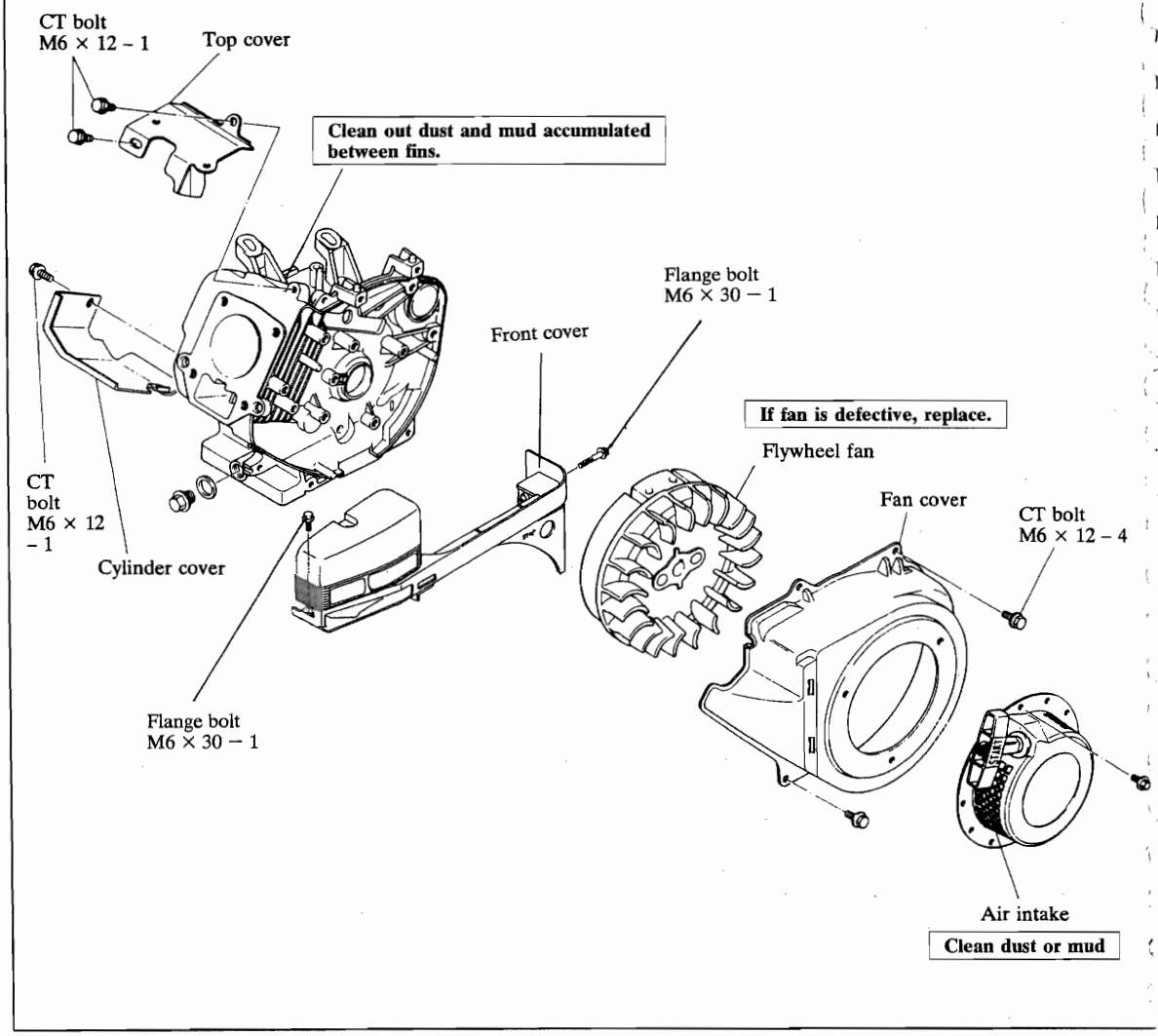
1) Do not mistake with the direction of spiral spring when mounting.
2) Set the hook part of the spiral spring as shown in the figure when inserting the spiral spring to the recoil starter body.
3) Mount the reel by aligning the four knotches on the circumference of the spring case.



Mounting ratchet

4) Mount the ratche while not overlapping with the guide and confirm functions after fixing it with the nut.
5) The tension of spiral spring is fixed by rotating 5 to 6 times (clockwise for L type and counter-clockwise for P type) in the reverse procedure of disassembling.

► **Cooling system relating to covers**

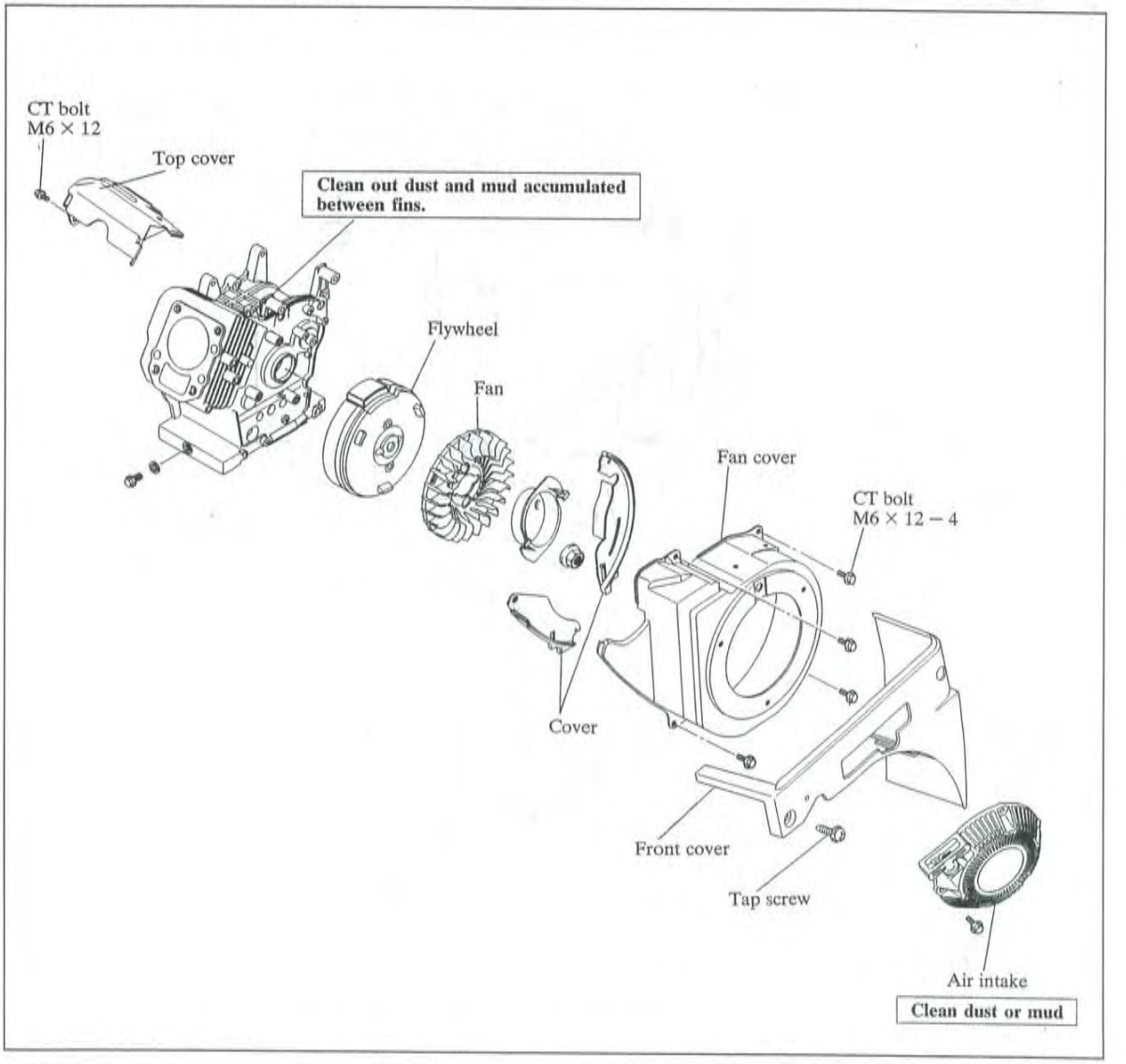


► **Cooling system**

This forced cooling system has 20 fans blades mounted on the circumference of the fly wheel. The air fuctioned in from the intake is distributed and passed through the fan cover, top cover and cylinder cover to cool the cylinder and cylinder head.

- **Be careful to not resuction the exhaust as this may cause poor cooling and poor power.**
- **Be careful to maintain the precise balance of flywheel, as abnormal vibration may be generated when even one part is damaged.**

► **Cooling system relating to covers**

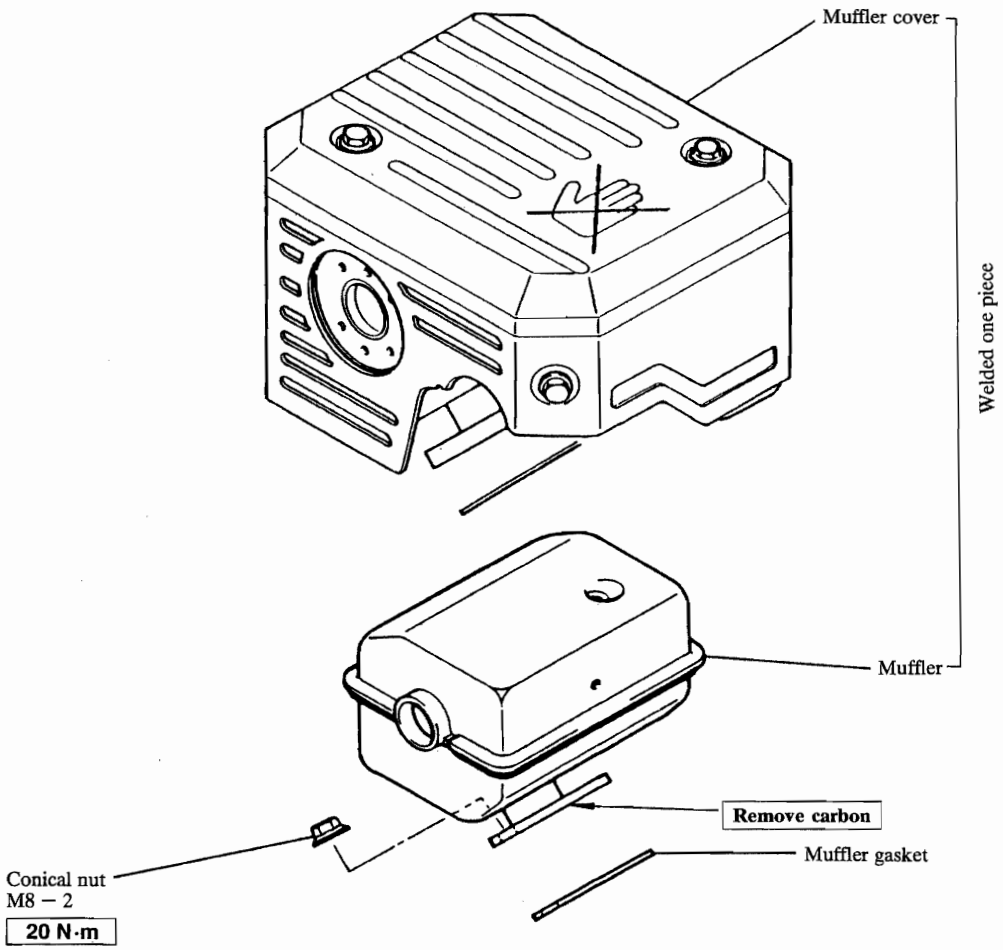


► **Cooling system**

The forced cooling system has 24 plastic fan blades mounted on the circumference on the flywheel. The air suctioned from the recoil starter air intake is distributed and passed through the fan cover, and top cover to cool the cylinder and cylinder cover.

- **Be careful to not resuction the exhaust as this may cause poor cooling and poor power.**
- **Be careful to maintain the precise balance of flywheel, as abnormal vibration may be generated when even one part is damaged.**

► **Muffler**

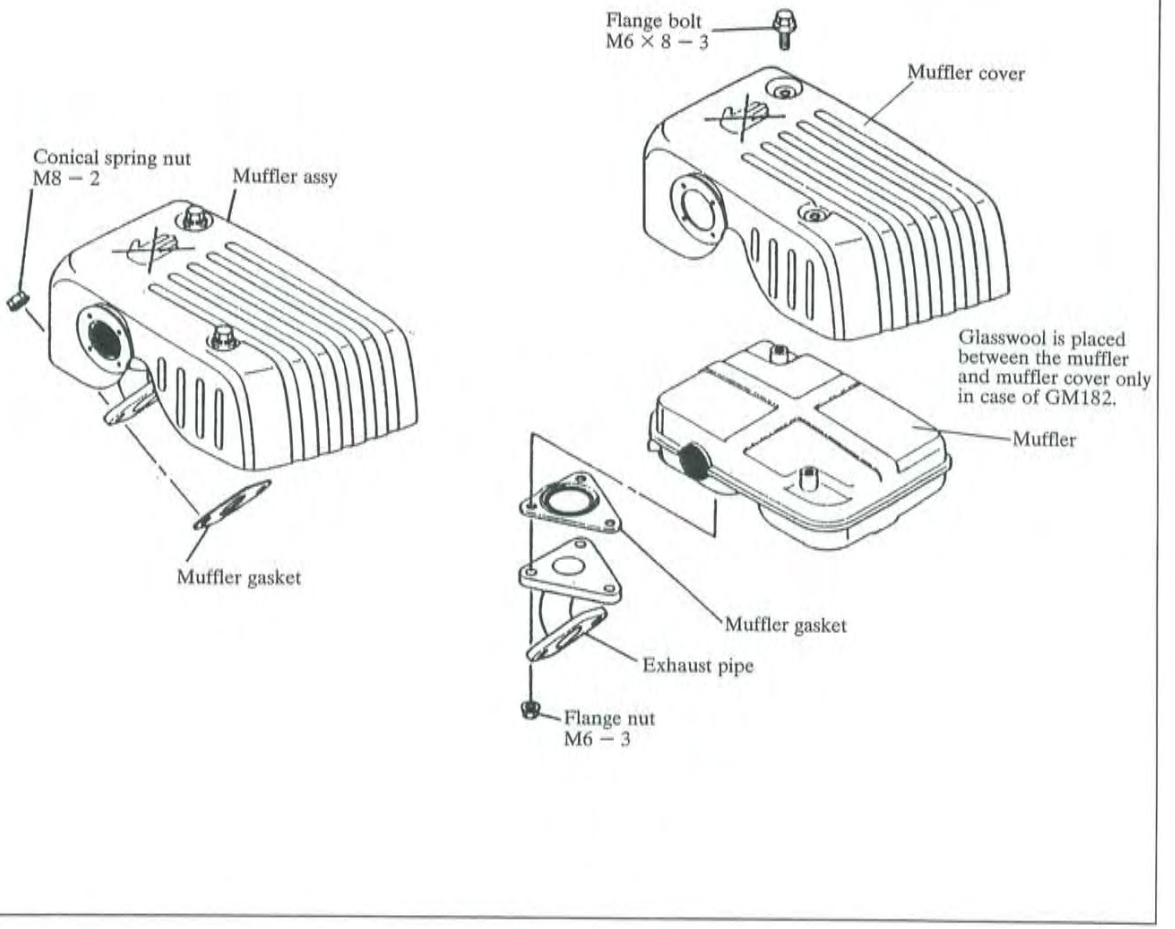


► **Muffler**

A type which can change the exhaust direction is also available.

⚠ **Do not place flammable material near to the muffler and exhaust.**

► **Muffler** GM82, 132, 182



⚠ **Do not place flammable material near to the muffler and exhaust.**

Group V

Disassembly, reassembly

−1 Procedures for disassembly (GM181LN)

No	Process	Notes	Tools	Remarks
1	Drain plug	After pulling out, loosen the plug	12 Box wrench	Tightening torque 25 N·m
2	Front cover	Remove the lead wire (Earth wire is on head side)	10 Box wrench	M6 × 30-1 M6 × 15-1
3	Muffler	Do not loose the gasket	12 Box wrench	M8-2
4	Air cleaner		10 Box wrench	M6-2
5	Fuel cock	Do not loose the spacer	10 Box wrench	M6 × 25-1
6	Fuel tank		10 Box wrench	M6 × 12-2 CT M6-2
7	Recoil starter	Disassembly unnecessary except for maintenance	10 Box wrench	M6 × 8-3
8	Fan cover	Tighten earth wire on upper side opposite head	10 Box wrench	M6 × 12-4 CT
9	Control panel	Take not to the governor spring catching position	10 Box wrench	M6 × 12-1
10	Top cover		10 Box wrench	M6 × 12-2 CT
11	Carburetor	① Governor rod ② Rod spring ③ Carburetor		
12	Governor lever	Take care to the left screw (Right screw for GM82, 132, and 182.)	10 Box wrench	M6-2 Gear tooth flange nut
13	Flywheel, pulley		21 Box wrench Hammer	M16-1
14	Key		(−) Screwdriver	
15	Ignition coil		10 Box wrench	M6 × 30-2 CT
16	Cylinder cover		10 Box wrench	M6 × 12-1 CT
17	Cylinder head cover		10 Box wrench	M6 × 12-4 CT
18	Rocker arm		14 Ring spanner 10 Spanner	Pivot nut Lock nut
19	Cylinder head	Do not loose the knock pin	12 Box wrench	M8 × 55-4
20	Crank case cover		12 Box wrench	M8 × 30-6 M8 × 30-1 CT
21	Balancer shaft	Option		
22	Cam shaft			
23	Tappet			
24	Connecting rod		10 Spanner	M6 × 30-2
25	Piston			

No	Process	Notes	Tools	Remarks
26	Piston pin	Take care to the piston pin clip	Long nose pliers	Clip
27	Piston ring			

–2 Procedures for reassembly (GM181LN)

No	Process	Notes	Tools	Remarks
1	Piston ring			Take care to the order No. and 2nd direction, and refer to page 53 to page 54.
2	Piston × Con'rod	Securely fit the clip onto the groove	Long nose pliers	
3	Cylinder × Crank shaft	Apply oil on the bearings and each sliding section		
4	Cylinder × Piston assembly	Take care to the distribution of the piston ring gap	Piston insertor	Refer to page 54.
5	Rod × Rod cap	Take care to the identification marks and torque	10 Spanner	Refer to page 54. Tightening torque: 10 N·m
6	Tappet × Cam shaft	Vertically stand the cylinder. Take care to the gear identification marks		Refer to page 58.
7	Crank case cover	Presence of knock pins Governor gear engagement	12 Box wrench	M8 × 30-6 M8 × 30-1 CT Tightening torque: 20 N·m
8	Cylinder head assembly	Set the convex section of the gasket's air cylinder circumference to the head side	12 Box wrench	M8 × 55-4 Tightening torque: 25 N·m Refer to page 45 to page 48.
9	Ignition coil	Air gap: 0.3 to 0.5	10 Box wrench	Make sure that the lead wire does not sag.
10	Flywheel	Oil at the taper section is prohibited	21 Box wrench	Tightening torque: 60 N·m
11	Push rod Rocker arm	Valve clearance at compression top when cooled: 0.06 to 0.1	14 Ring spanner 10 Box wrench	Refer to page 38.
12	Governor lever	Take care to the left screw (Right screw for GM82, 132, and 182.)	10 Box wrench	M6-2 Gear tooth flange nut
13	Cylinder head cover		10 Box wrench	M6 × 12-4 CT Tightening torque: 5 N·m
14	Cylinder cover		10 Box wrench	M6 × 12-1 CT
15	Top cover		10 Box wrench	M6 × 12-2 CT
16	Insulator	Take care to the direction for GM290, 291, 300, 301	There is one packing each on the inner and outer sides.	Refer to page 69 to page 72.
17	Carburetor	Lead in the secondary wire and align with trip cover's guide section	12 Box wrench	M8 × 55-4

No	Process	Notes	Tools	Remarks
20	Control panel	Align the carburetor's chock lever and control panel pin	10 Box wrench Align the pin and hole while operating the carburetor's chock lever.	M6 × 12-1
21	Governor rod Rod spring Governor spring	Assemble the governor spring into the control panel beforehand		
22	Air cleaner		10 Box wrench	M6-2
23	Governor set	Touch the governor shaft to the left with the carburetor throttle valve at the fully opened position. (Touch on the right in case of GM82, 132, and 182.)	10 Ring spanner (−) Screwdriver	Refer to page 41 to page 42.
24	Fan cover	Tighten earth wire on upper side opposite head	10 Box wrench	M6-12-4 CT
25	Recoil starter		10 Box wrench	M6-8-3
26	Fuel tank		10 Box wrench	M6-12-2 CT M6-2
27	Fuel cock		10 Box wrench	M6-25-1
28	Fuel pipe	Do not forget the clip	Long nose pliers	
29	Muffler	Do not forget the gasket	12 Box wrench	M8-2 Tightening torque: 20 N·m
30	Front cover	For the lead wire connection, the earth wire is connected to opposite the head	12 Box wrench	Tightening torque: 5 N·m
31	Engine oil	Up to F level at level state		Oil amount: 0.6L

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