

Small Engine Technology

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Small Engine Technology

CRYSTAL

Lehr- und Lernmittel,
Informationen, Beratung

Educational Aids
Literature, Consulting

Moyens didactiques,
Informations, Service-conseil

Material didáctico,
Informaciones, Asesoría

**Feedback: Thai-German Teaching Aid Centre
in cooperation with the
Technical College Nongkhai**



Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH

Introduction

What this Instruction Material wants:	What this Instruction Material does not want:
- to be easy understandable	- to replace a book
- to be job related	- to substitute the teacher
- to support the teacher in his work	- to teach unnecessary subject matter
- to create student activity	
Help to teach and learn efficiently	

- This instructional material is developed by the Thai-German Teaching Aid Centre in cooperation with the Technical College Nongkhai.
- The student should have preknowledge about the principle of 4-stroke internal combustion engine.
- The Information, specially about maintenance and repair-is based mainly on the Honda engines G 150 – G 200 and GX 120 – GX 160.
- The teaching method, which should be used, is the "questioning technique". Please do not only lecture!

The Instructional Material Package (IMP) contents the following elements:

1. List of objectives
2. Information sheets
3. Task sheets
4. Job sheets
5. Teaching aids (Transparencies, models, e.g.)
6. Solutions

1. A list of objectives shows the teacher what the student should know after the lesson.
2. Information sheets show pictures with short explanations of the subject matter. These information sheets should be given to the student after the lesson as a summary. Information about repair and maintenance should be given briefly before starting the work prescribed in the Job sheets.
3. Task sheets help the teacher to check the learning progress. They should be used at the end of one period. It is necessary to discuss the solutions with the students. Please do not use them as a test.
4. The Job sheets are showing the student the right sequence of working steps. The Information sheets about maintenance and repair can be used like a manual during work.
5. Teaching aids make the subject matter better understandable and motivate the students.
6. Solutions for the task sheets

Objectives

The student should be able to ...

1. Fuel system

1.1 Components of fuel system

1. Name various components and their functions of fuel system
2. Describe about fuel delivery from fuel tank to carburetter

1.2 Fuel tank

3. Tell components of fuel tank
4. Tell function of fuel tank

1.3 Fuel filter

5. Tell components of fuel filter
6. Tell functions of fuel filter

1.4 Air filter

7. Tell various types of air filter
8. Tell features and characteristics of the wet-type air filter
9. Explain principle of the wet-type air filter
10. Tell advantages and disadvantages of the wet-type air filter
11. Tell features and characteristics of the dry-type air filter
12. Explain principle of the dry-type air filter
13. Tell advantages and disadvantages of the dry-type air filter

1.5 Carburetter

14. Explain principle of carburetter
15. Tell various types of carburetter
16. Tell internal construction of the side draft carburetter
17. Tell functions and components of the floating circuit
18. Explain principle of the floating circuit
19. Tell functions and components of the idle circuit

20. Explain principle of idle circuit
21. Tell functions and components of full throttle circuit
22. Explain principle of full throttle circuit
23. Tell functions and components of choke unit
24. Explain principle of choke unit

1.6 Repair and maintenance

25. Inspect any leakage of the fuel tube
26. Clean fuel tank correctly
27. Clean air filter correctly
28. Dismantle and reassemble carburettor correctly
29. Inspect components of carburettor for wear
30. Set the float correctly
31. Adjust the idle mixture correctly
32. Adjust the idle speed correctly

2. Ignition system

2.1 Basic principle

1. Explain basic principle of ignition system used in small engines.
2. Tell various types of ignition system used in small engines

2.2 Contact breaker ignition system

3. Tell name and function of various parts of the contact breaker ignition system.
4. Explain principle of the contact breaker ignition system.

2.3 Capacitor discharge ignition system (CDI)

5. Tell name and function of various parts of the CDI system
6. Explain principle of the CDI system.
7. Tell advantages and disadvantages of the CDI system

2.4 Transistor ignition system

8. Tell name and function of various parts of the transistor ignition system.
9. Explain principle of transistor ignition system.
10. Tell advantages and disadvantages of the transistor ignition system.

2.5 Repair and maintenance

11. Remove and reassemble various parts of ignition system.
12. Check conditions of spark plug.
13. Clean and set electrode gap of spark plug correctly.
14. Check ignition coil correctly.
15. Check CDI and transistor ignition module correctly.
16. Check condenser correctly.
17. Set contacting point gap correctly.
18. Adjust ignition timing correctly.
19. Adjust clearance between ignition coil and magnetic flywheel correctly.

3. Speed control system

3.1 Governor

1. Tell the task of a governor

3.2 Types and function of governors

2. Tell various types of speed control systems.
3. Explain principle of pneumatic governor.
4. Explain principle of mechanical governor.

3.3 Repair and maintenance

5. Remove/refitting pneumatic and mechanical governor
6. Adjust pneumatic and mechanical governor

4. Valve mechanism

4.1 Functions of valve mechanism

1. Tell functions of valve mechanism.

4.2 Types and principle of valve mechanism

2. Tell various arrangements of valve.
3. Explain principle of overhead valve engine.
4. Tell advantages and disadvantages of the overhead valve engine.
5. Explain principle of side valve engine.
6. Tell advantages and disadvantages of side valve engine.

4.3 Compression–reduction mechanism

7. Tell purpose of compression–reduction mechanism
8. Tell various parts of compression–reduction mechanism.
9. Tell function of various parts of compression–reduction mechanism.
10. Explain principle of compression–reduction mechanism.

4.4 Repair and maintenance

11. Remove–reassemble cylinder head.
12. Remove–reassemble valves.
13. Measure length of valve spring.
14. Check squareness of valve spring.
15. Check strength of valve spring.
16. Measure diameter of valve stem.
17. Check straightness of valve stem.
18. Check valve face, margin and valve stem.
19. Measure width of valve seat.
20. Use valve seat cutter correctly.
21. Grind valve correctly.
22. Measure bore of the valve guide.
23. Remove and refit valve guide.
24. Adjust valve clearance correctly.

5. Crankshaft mechanism

5.1 Components and functions

1. Tell various parts of crankshaft mechanism
2. Tell various types of piston rings.
3. Tell functions of piston rings.
4. Tell functions and components of piston, connecting rod and crankshaft.

5.2 Repair and maintenance

5. Test compression, and tell their specification.
6. Remove and reassemble crankshaft mechanism.
7. Inspect piston, crankshaft and cylinder.
8. Inspect thickness and clearances of piston rings.
9. Arrange piston ring ends.
10. Measure sizes of gudgeon pin, hole and small-end connecting rod.

6. Lubrication system

6.1 Tasks of the lubrication system

1. Tell the Tasks of the lubrication system
2. Tell various parts that need lubrication.

6.2 Splash-type lubrication

3. Tell various parts of the splash-type lubrication.
4. Explain principle of the splash-type lubrication.
5. Tell advantages and disadvantages of the splash-type lubrication.

6.4 Repair and maintenance

6. Check and change oil.

7. Cooling system

1. Tell tasks of the cooling system.
2. Explain principle of air cooling system.
3. Tell components of air cooling system

7.1 Repair and maintenance

4. To remove-reassemble various components of cooling system.
5. To clean blower blade and its cover.

8. Starting system

8.1 Types of starting system

1. Tell types of starting systems.

8.2 Components of starting system

2. Tell components of starting unit.
3. Tell functions of components of starting unit.

8.3 Repair and maintenance

4. To remove/reassemble components of the starting unit.
5. To repair the starting unit.

9. Exhaust system

9.1 Purpose of exhaust system

1. Tell purposes of the exhaust system.

9.2 Components of exhaust system

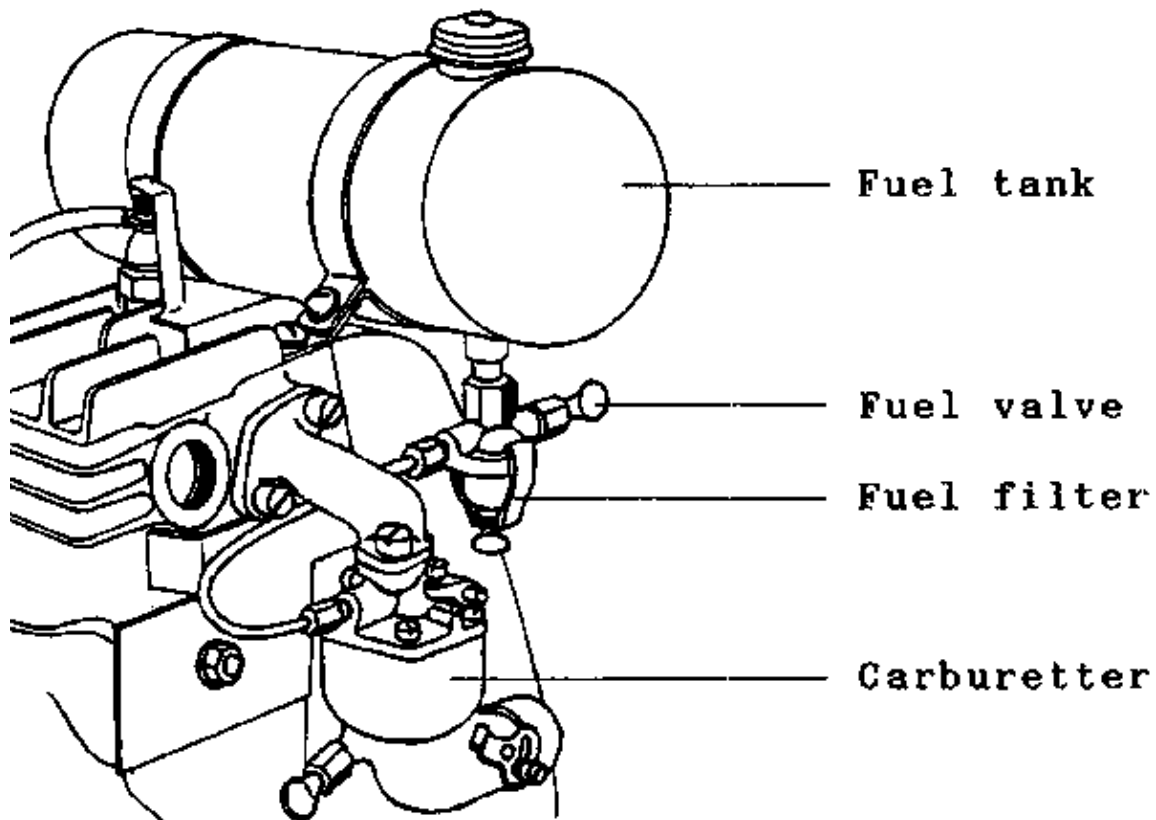
2. Tell components of the exhaust system.
3. Tell functions of the components of the exhaust system.

Information

1. Fuel system

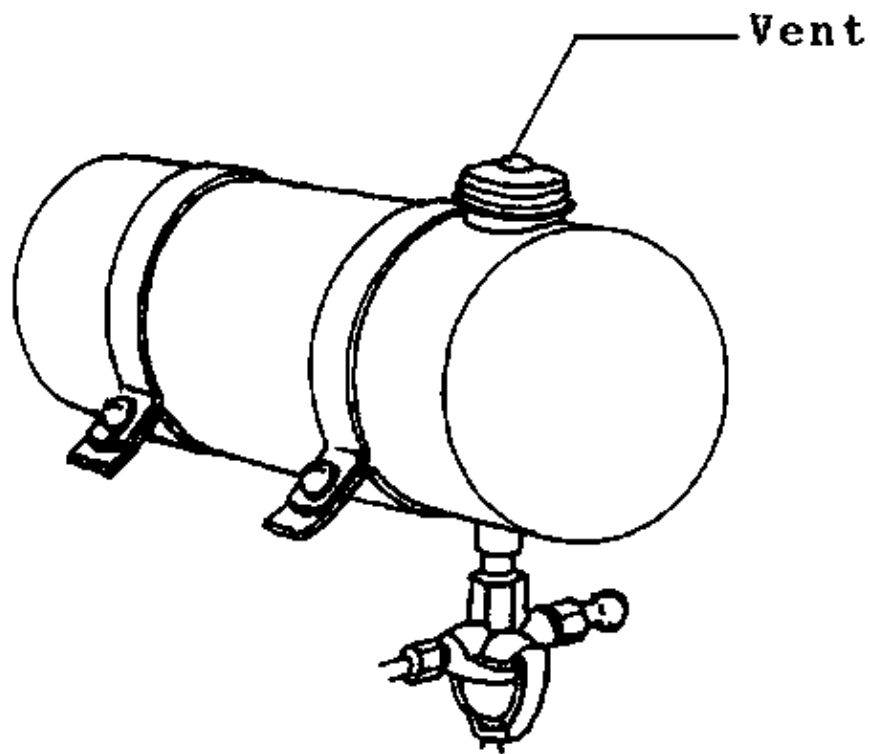
Information

1.1 Components of fuel system



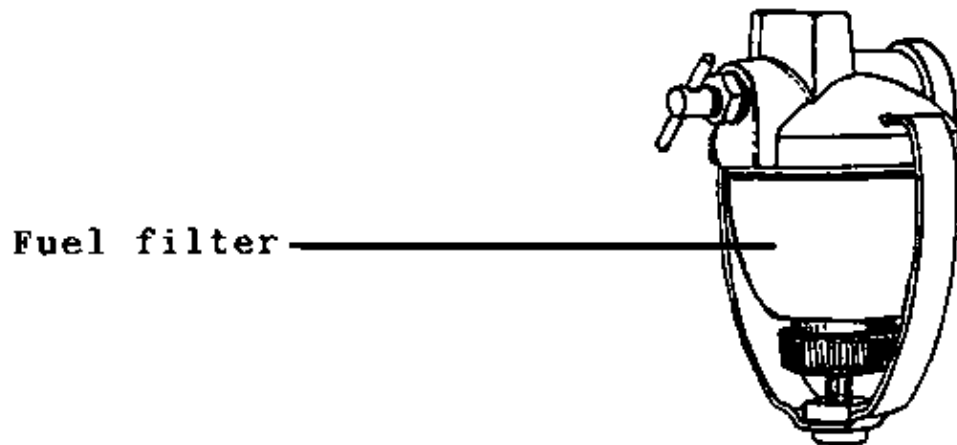
Fuel is delivered from the fuel tank into the carburettor by means of its gravity

1.2 Fuel tank



Vent: When fuel level decreases, air can enter into the fuel tank via the vent and fills up the decreased space of fuel.

1.3 Fuel filter

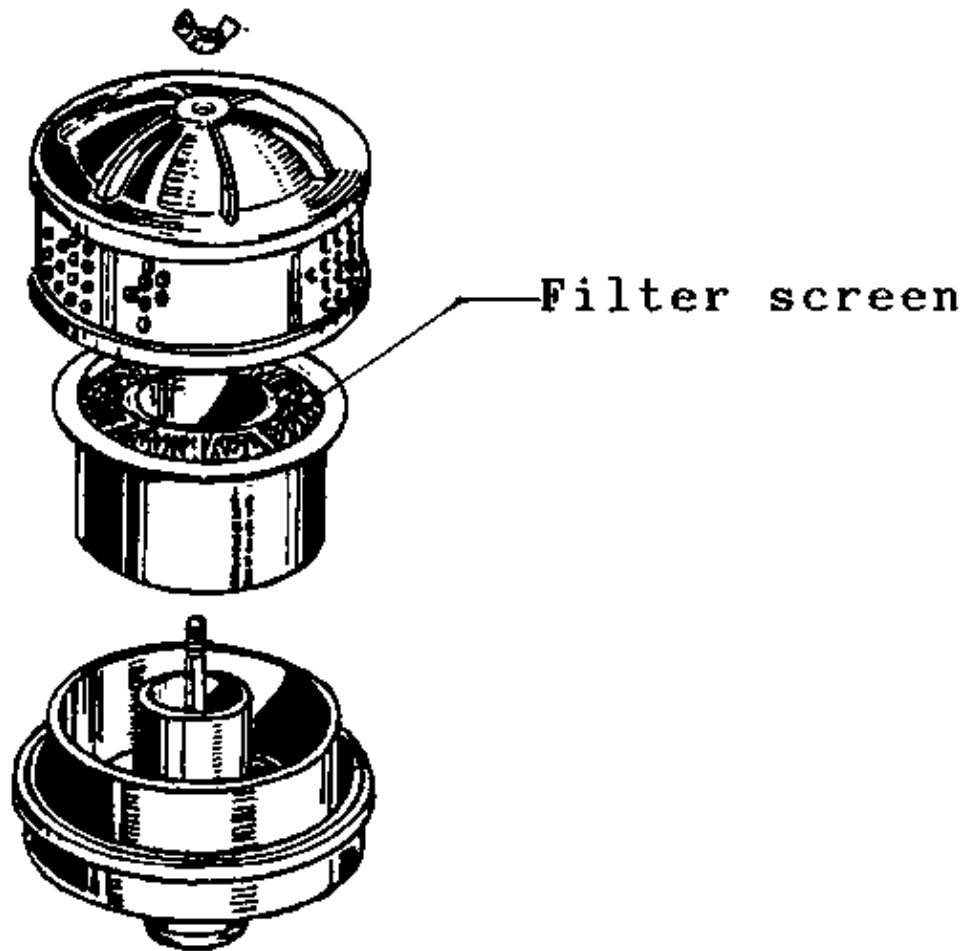


Fuel filter will trap impurities as contained in the fuel before the fuel is delivered into the carburettor.

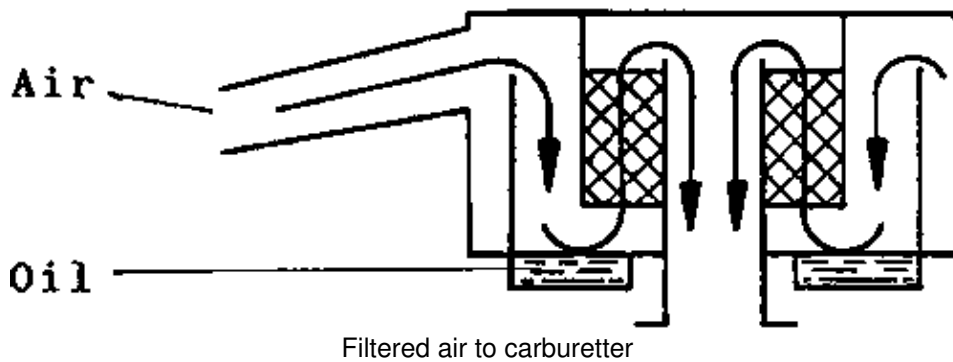
1.4 Air filter

If unfiltered air is entering the combustion chamber, then both, cylinder and piston will be worn rapidly.

1.4.1 Oil bath- or wet-type



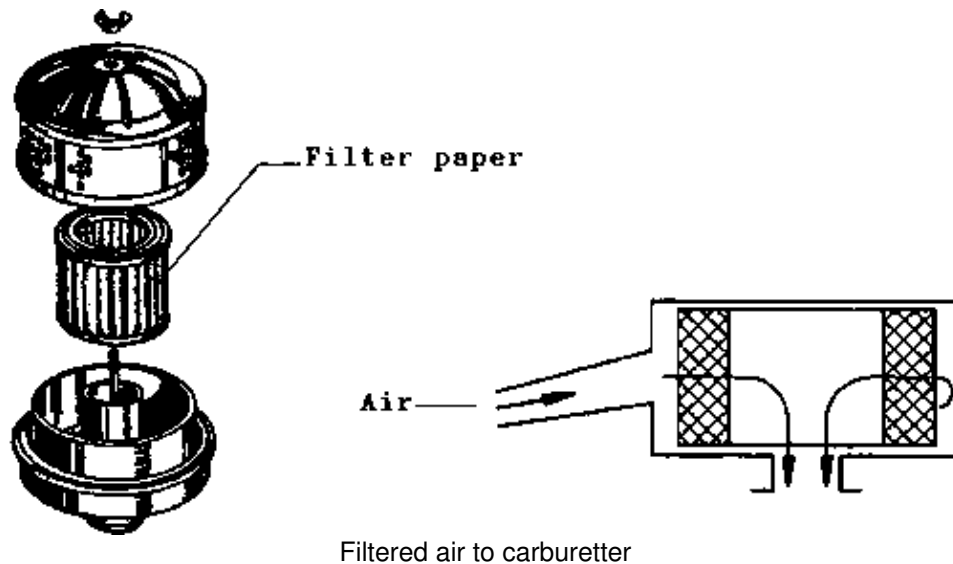
Oil will trap dust in the air.



Advantage: Filter screen can be washed by benzene

Disadvantage: dirty

1.4.2 Paper element type or dry type



Advantage: Easy to use and maintain, most use nowadays

Disadvantage: If the filter gets too dirty, it must be replaced.

Task sheet

1.1 to 1.4 Tank and Filters

Cross the correct statements!

- 1. Fuel from the fuel tank enters into the carburettor by means of its gravity.
- 2. In small engines, the fuel tank is mounted below the carburettor.
- 3. If the fuel tank vent is clogged, then the fuel cannot enter into the carburettor.
- 4. Fuel filter can trap water as contained in the fuel.
- 5. Engine without fuel filter will shorten life of its piston and piston rings.
- 6. Air filter can be classified, according to usage, into 2 types: wet and dry.
- 7. Wet type air filter uses oil to trap dust from intake air.
- 8. Clogged air filter will cause high fuel consumption.
- 9. Wet type air filter can be cleaned by benzene.
- 10. Nowadays, small engines employ the dry type air filter.

Task (Solution)

1.1 to 1.4 Tank and Filters

Cross the correct statements!

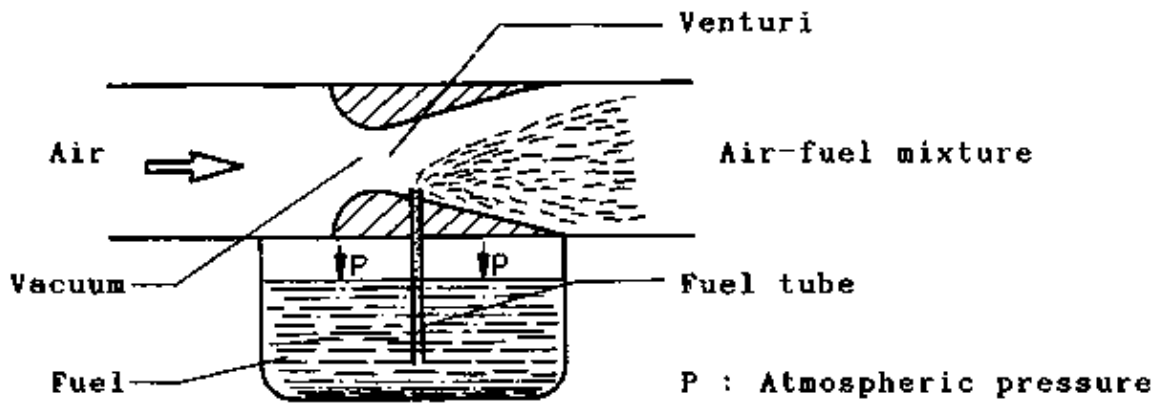
- ..X.. 1. Fuel from the fuel tank enters into the carburettor by means of its gravity.
- 2. In small engines, the fuel tank is mounted below the carburettor.
- ..X.. 3. If the fuel tank vent is clogged, then the fuel cannot enter into the carburettor.
- 4. Fuel filter can trap water as contained in the fuel.
- 5. Engine without fuel filter will shorten life of its piston and piston rings.

- ..X.. 6. Air filter can be classified, according to usage, into 2 types: wet and dry.
- ..X.. 7. Wet type air filter uses oil to trap dust from intake air.
- ..X.. 8. Clogged air filter will cause high fuel consumption.
- ..X.. 9. Wet type air filter can be cleaned by benzene.
- ..X.. 10. Nowadays, small engines employ the dry type air filter.

1.5 Carburettor

Information

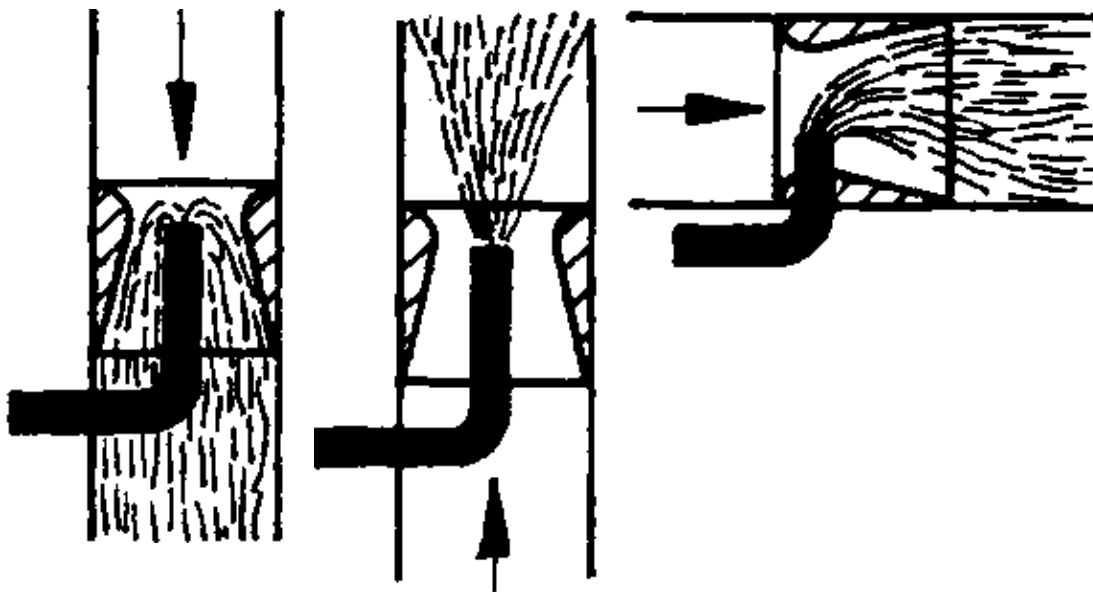
1.5.1 Principle of carburettor



As air rushes through the venturi, it will develop partial vacuum in that area. At the same time, atmospheric pressure will push fuel up by the fuel tube to mix with the rushing air.

1.5.2 Types of carburettor

They can be classified into three types according to suction methods:



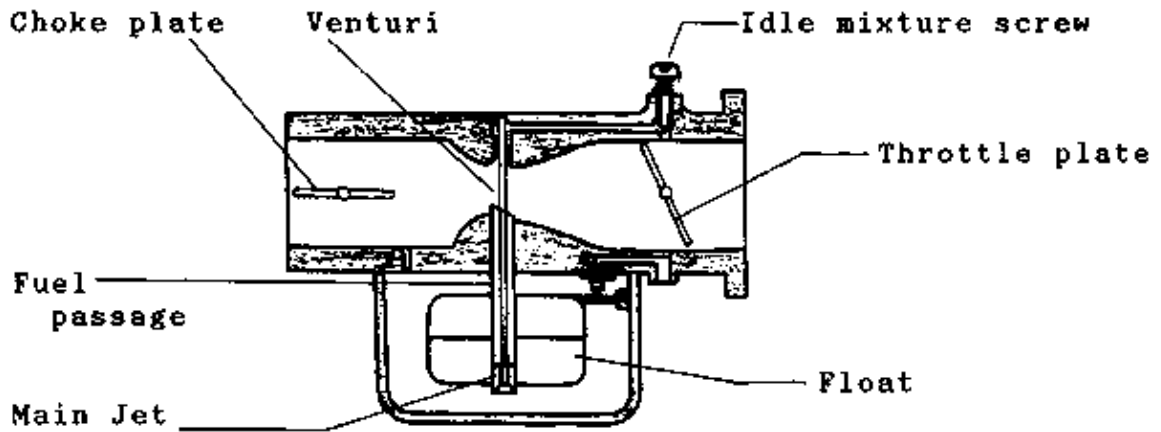
a) Down draft

b) Up draft

c) Side draft

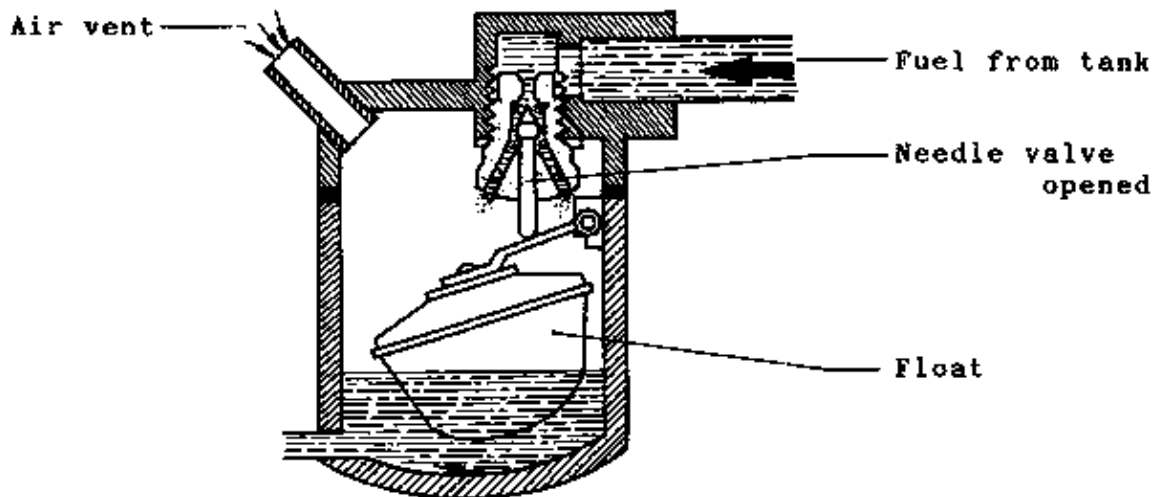
Remark: Most small engines use the side draft carburettors, and next the up draft ones.

1.5.3 Side draft carburettor

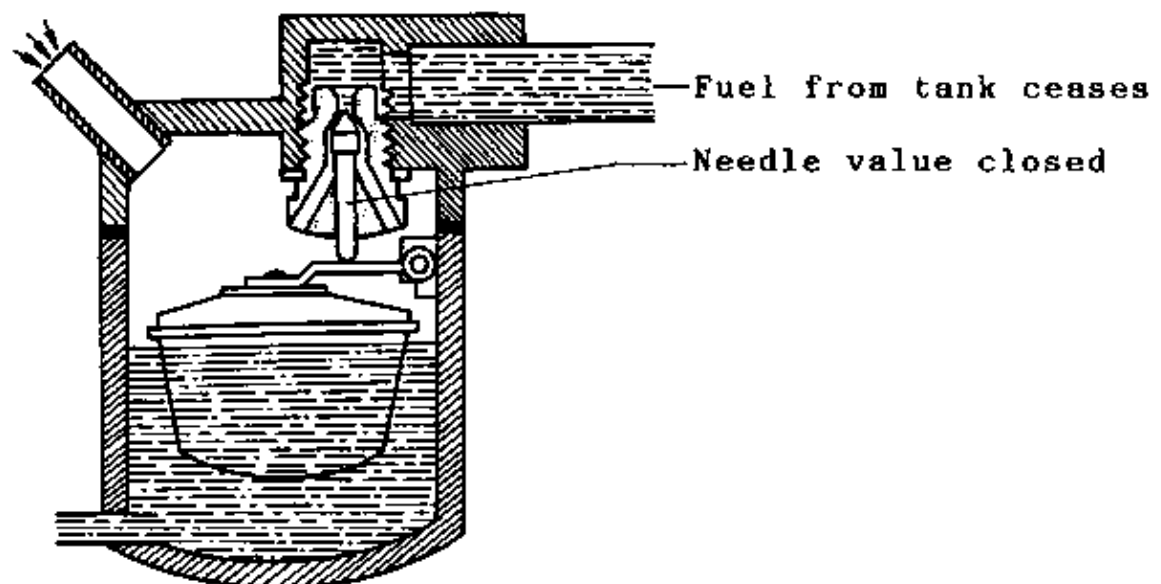


1.5.4 Floating circuit

Floating circuit is to control the amount of fuel entering the float chamber and maintain the fuel level in it.

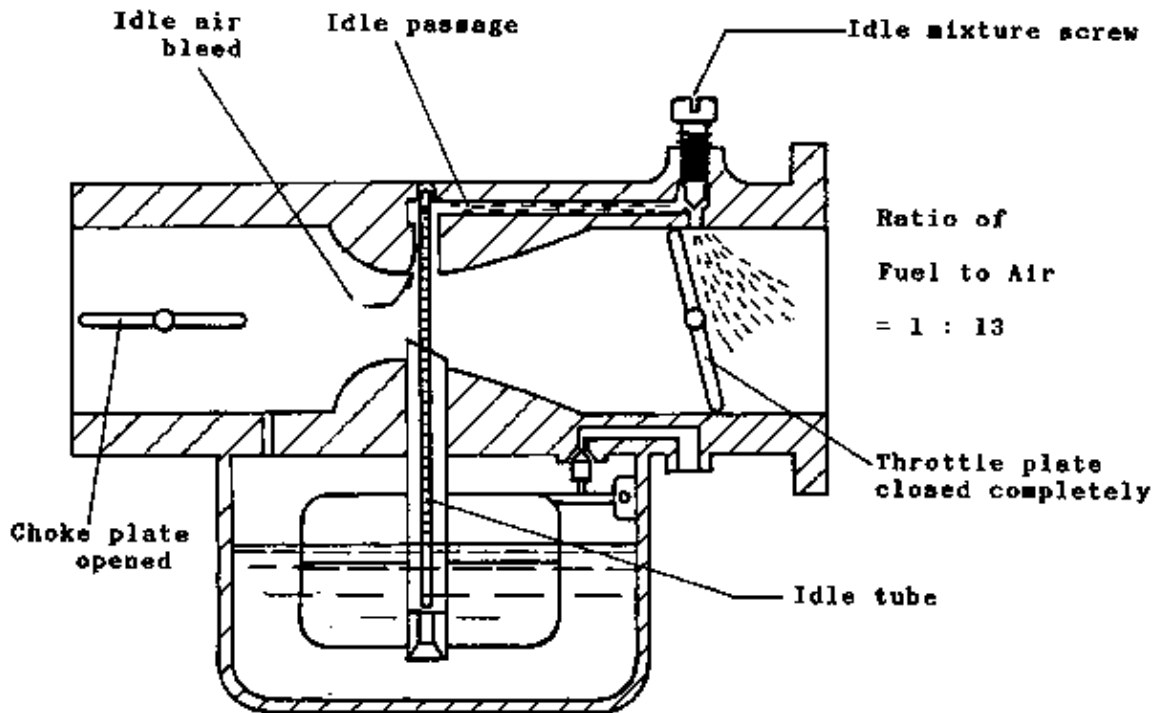


As the engine is running, a certain amount of fuel is used up causing the fuel level to decrease and thereby lowering the float which activates the needle valve to allow additional fuel to enter into the float chamber.



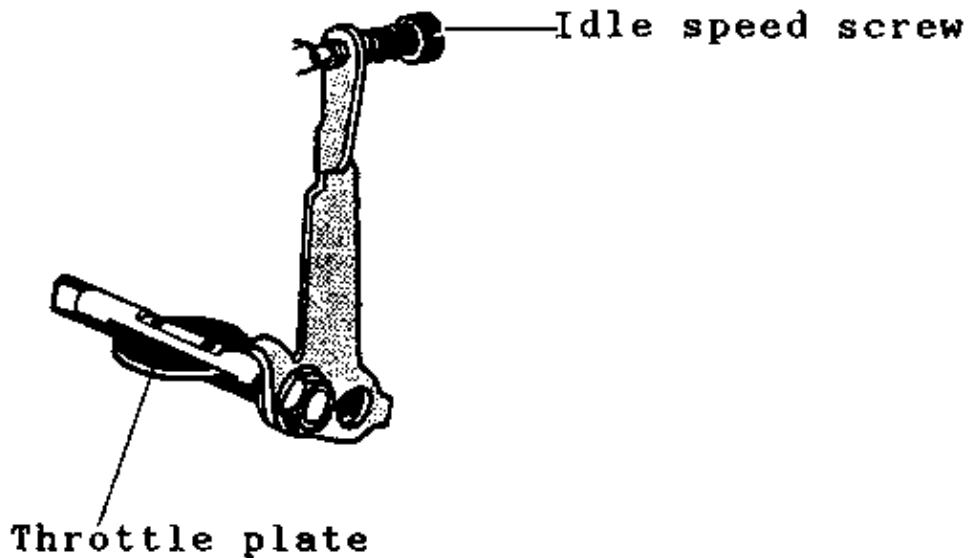
As additional fuel is entering into the float chamber, the float rises until a certain level the needle valve closes and fuel flow ceases. In this circumstance, the fuel level is maintained constantly.

1.5.5 Idle circuit



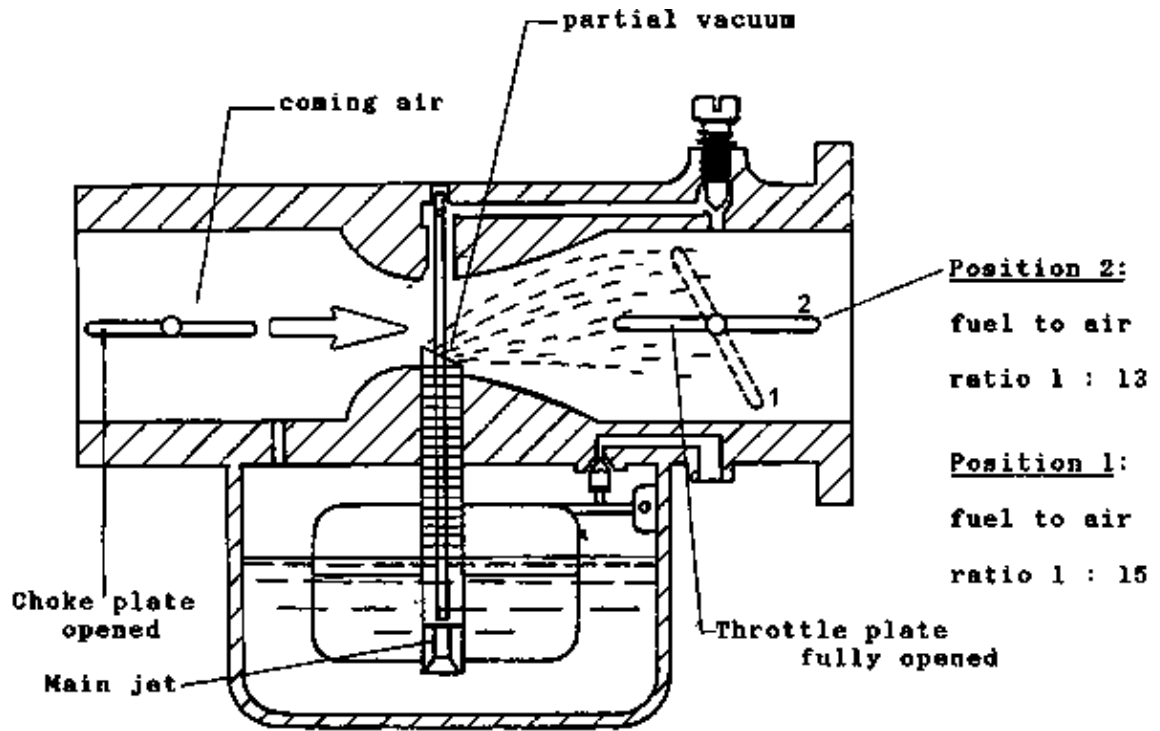
When the throttle plate closes completely, air is sucked via the idle air bleed and thereby sucks fuel from the float bowl to mix with it in the idle passage and comes out by the idle port.

Ratio of fuel to air can be adjusted by means of the idle mixture screw. Whereas the idle speed is adjusted by the idle speed screw.



1.5.6 Full throttle circuit

Full throttle circuit is for distributing sufficient amount of air-fuel mixture to the required increasing engine speed.

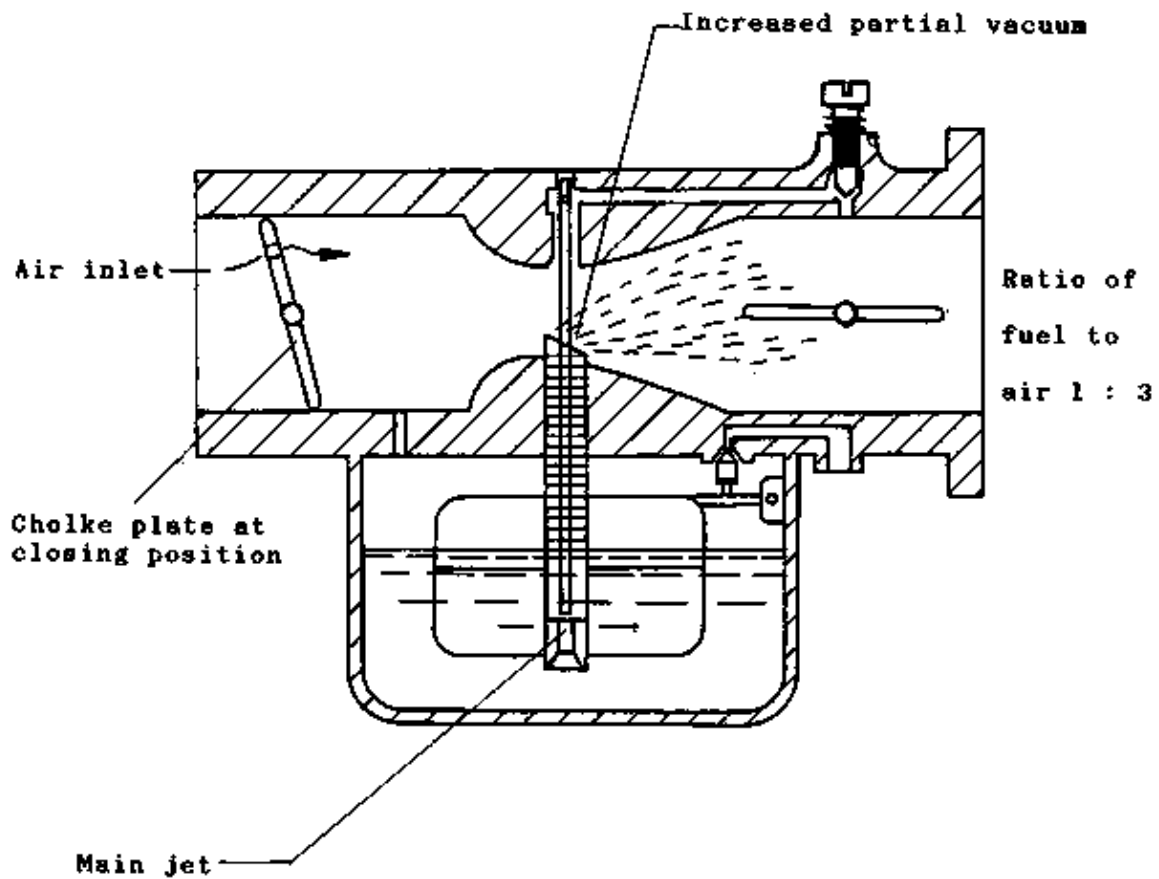


Pos. 1: When the throttle plate opens, air rushes over the venturi increasing the partial vacuum in that area and thereby sucks fuel via the main jet – Engine speed is thus increasing.

Pos. 2: When the throttle plate opens fully, more air rushes over the venturi, thus higher partial vacuum is developed. The fuel is sucked more than in the previous position, thus the engine is running at maximum speed.

1.5.7 Choke Circuit

Choke circuit provides richer fuel mixture than normal especially, during the start of the engine.

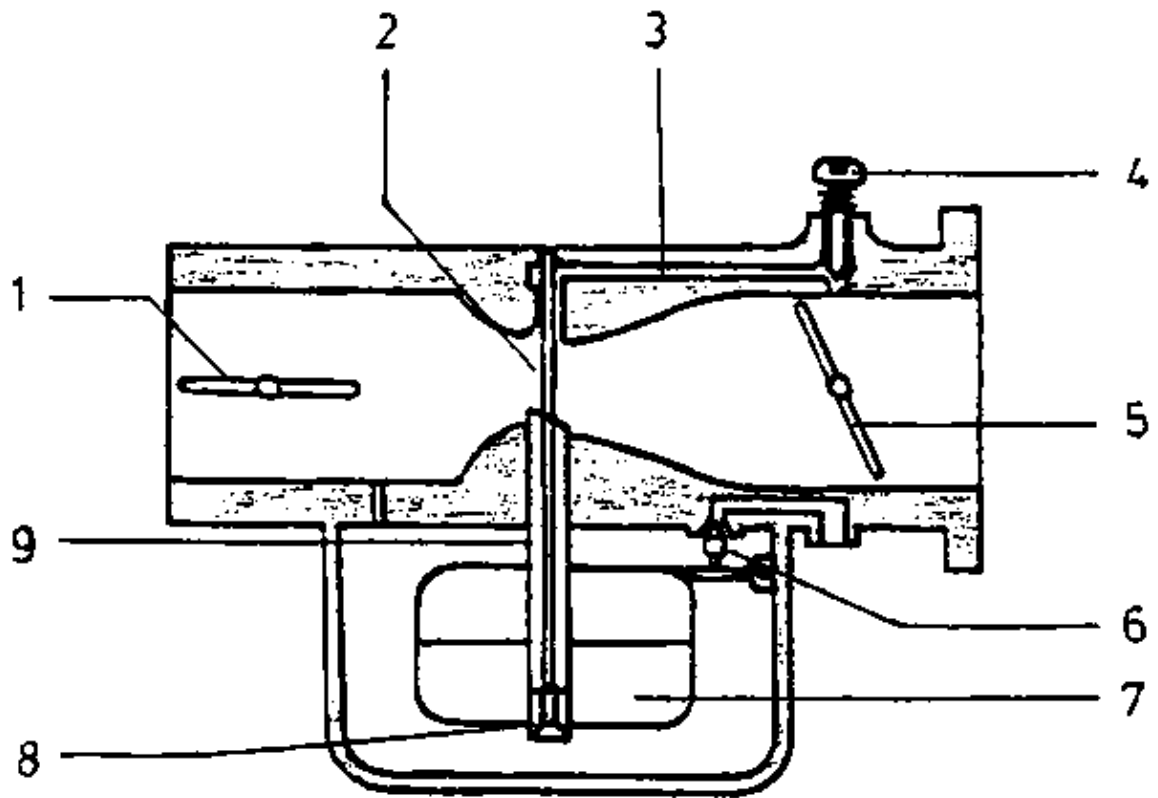


When the engine is started, its speed is still low. A small amount of air flows through the venturi and suck very limited amount of fuel. Increasing fuel is needed in this case by closing the choke plate which in turn increasing the partial vacuum over the venturi.

Task sheets

1.5 Carburettor (I)

1. Name the parts of the carburettor!



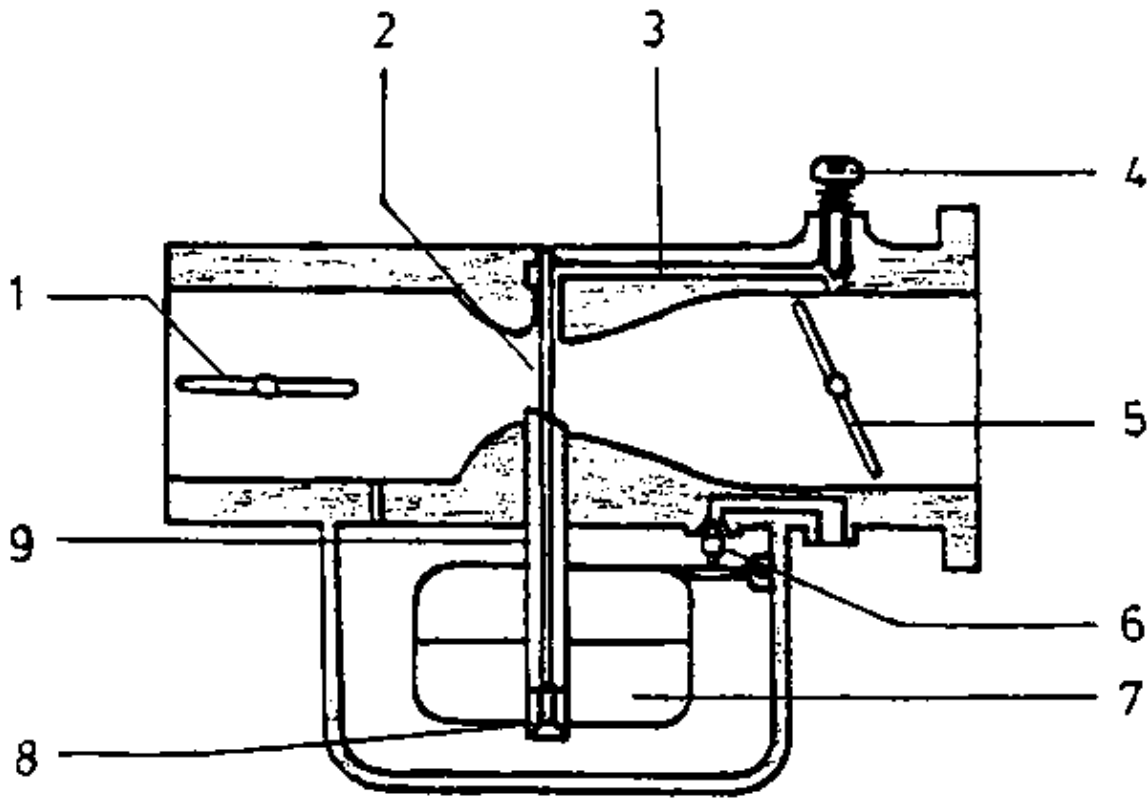
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____

2. As air is flowing through the venturi, the pressure at the venturi is –higher/lower– than the atmospheric pressure.
3. The pressure over the float chamber is –higher/lower– than the pressure at the main jet when air is flowing through the venturi.
4. Carburetters used in small engines can be classified, according to types of drafts, into ___ types; i.e. _____.
5. The most used carburetter for small engines is _____.
6. The float circuit is for _____.
7. If the fuel level in the float chamber is dropped, the needle valve will –close/open–.
8. The fuel to air ratio of the idle circuit is about ___: ___.
9. While the engine is idling, the throttle plate will be at –fully closing/fully opening– position.
10. The fuel to air ratio of the idle circuit can be adjusted by _____.

Task (Solution)

1.5 Carburetter (I)

1. Name the parts of the carburetter!



1. Choke plate
2. Venturi
3. Idle passage
4. Idle mixture screw
5. Throttle plate
6. Needle valve
7. Float
8. Main jet
9. Fuel passage

2. As air is flowing through the venturi, the pressure at the venturi is ~~higher~~/lower than the atmospheric pressure.

3. The pressure over the float chamber is ~~higher~~/lower than the pressure at the main jet when air is flowing through the venturi.

4. Carburetters used in small engines can be classified, according to types of drafts, into 3 types; i.e. down, up side.

5. The most used carburetter for small engines is side draft.

6. The float circuit is for control the amount of fuel in the carboretter.

7. If the fuel level in the float chamber is dropped, the needle valve will ~~close~~/open.

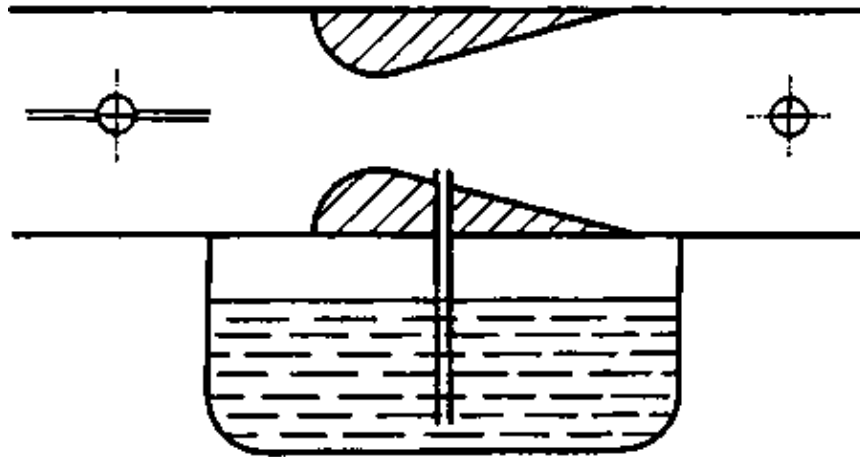
8. The fuel to air ratio of the idle circuit is about 1:13.

9. While the engine is idling, the throttle plate will be at ~~fully closing~~/fully opening position.

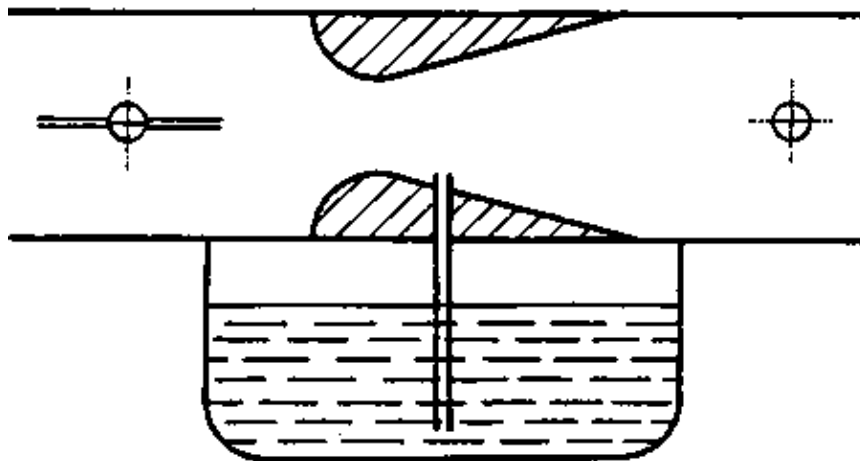
10. The fuel to air ratio of the idle circuit can be adjusted by the idle mixture screws.

1.5 Carburetter (II)

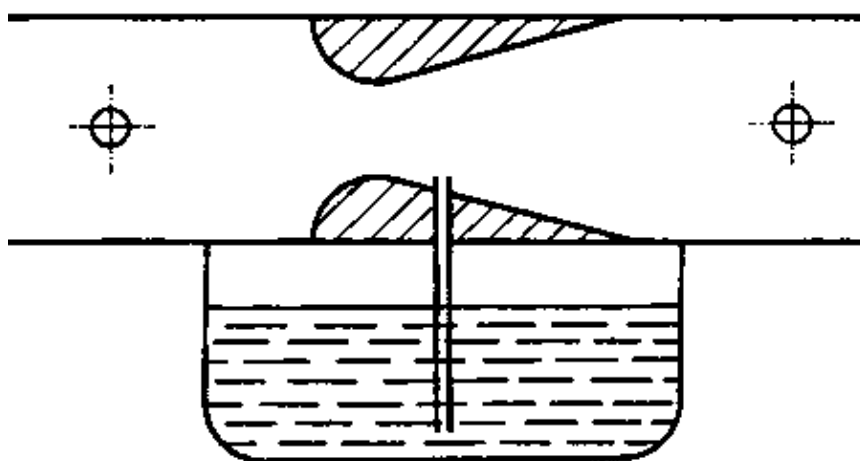
Picture 1: If little fuel is needed by the cylinder, (idle run) what will be the position of the throttle plate? (make a sketch!)



Picture 2: If more fuel is required by the cylinder, what will be the position of the throttle plate? (make a sketch!)



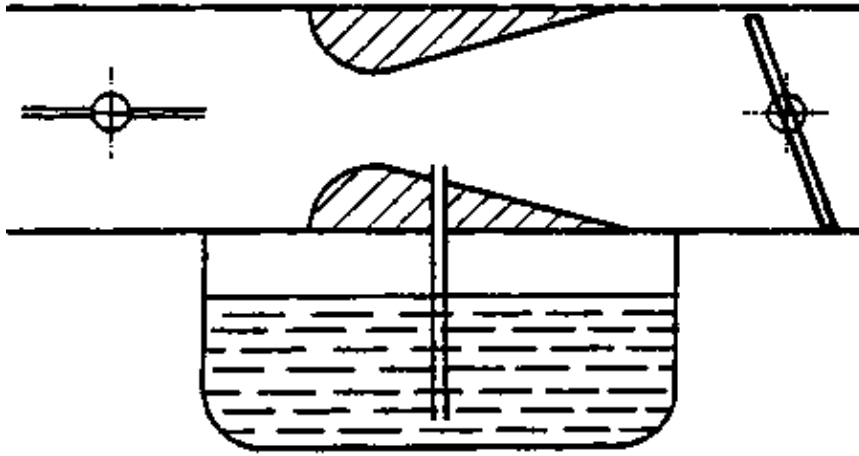
Picture 3: If maximum fuel is needed by the cylinder, what will be the positions of both, the choke plate and the throttle plate? (make a sketch!)



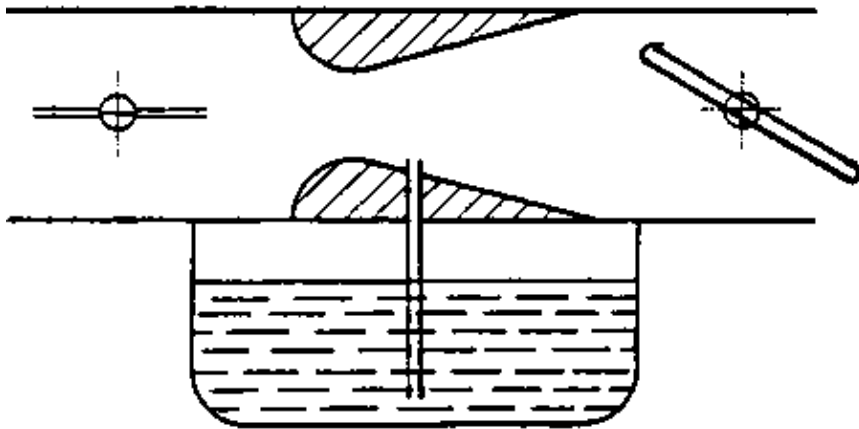
Task (Solution)

1.5 Carburetter (II)

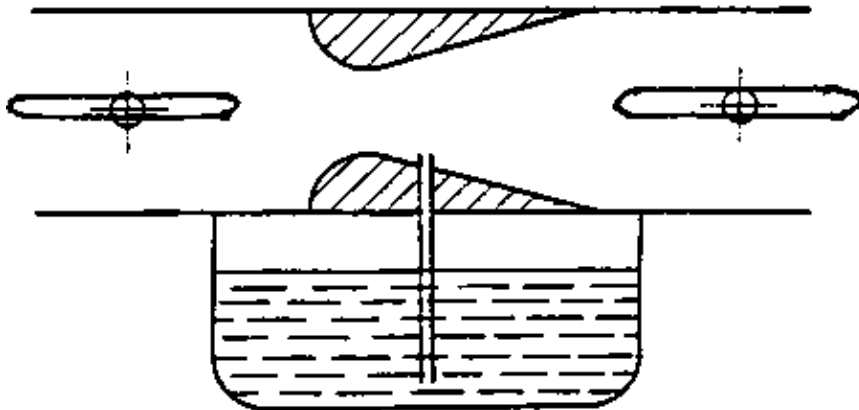
Picture 1: If little fuel is needed by the cylinder, (idle run) what will be the position of the throttle plate? (make a sketch!)



Picture 2: If more fuel is required by the cylinder, what will be the position of the throttle plate? (make a sketch!)



Picture 3: If maximum fuel is needed by the cylinder, what will be the positions of both, the choke plate and the throttle plate? (make a sketch!)



1.5 Carburetter (III)

Answer the following questions correctly!

1. In float setting, what will happen if the float is not set to the specified value?

1.1 In case the float is too low: _____

1.2 In case the float is too high _____

2. What will happen if the idle mixture screw is not adjusted to the specified value?

- 2.1 In case it is higher than the given standard: _____
2.2 In case it is lower than the given standard: _____

3. How can the size of the main jet effect the fuel consumption rate?

4. What will happen if the needle valve is worn?

1.5 **Carburetter (III)**

Task (Solution)

Answer the following questions correctly!

1. In float setting, what will happen if the float is not set to the specified value?

- 1.1 In case the float is too low: Fuel is overflowing
1.2 In case the float is too high Insufficient fuel

2. What will happen if the idle mixture screw is not adjusted to the specified value?

- 2.1 In case it is higher than the given standard: idle speed is to high
2.2 In case it is lower than the given standard: idle speed is to low

3. How can the size of the main jet effect the fuel consumption rate?

- Big bore ? high fuel consumption
Small bore ? low fuel consumption

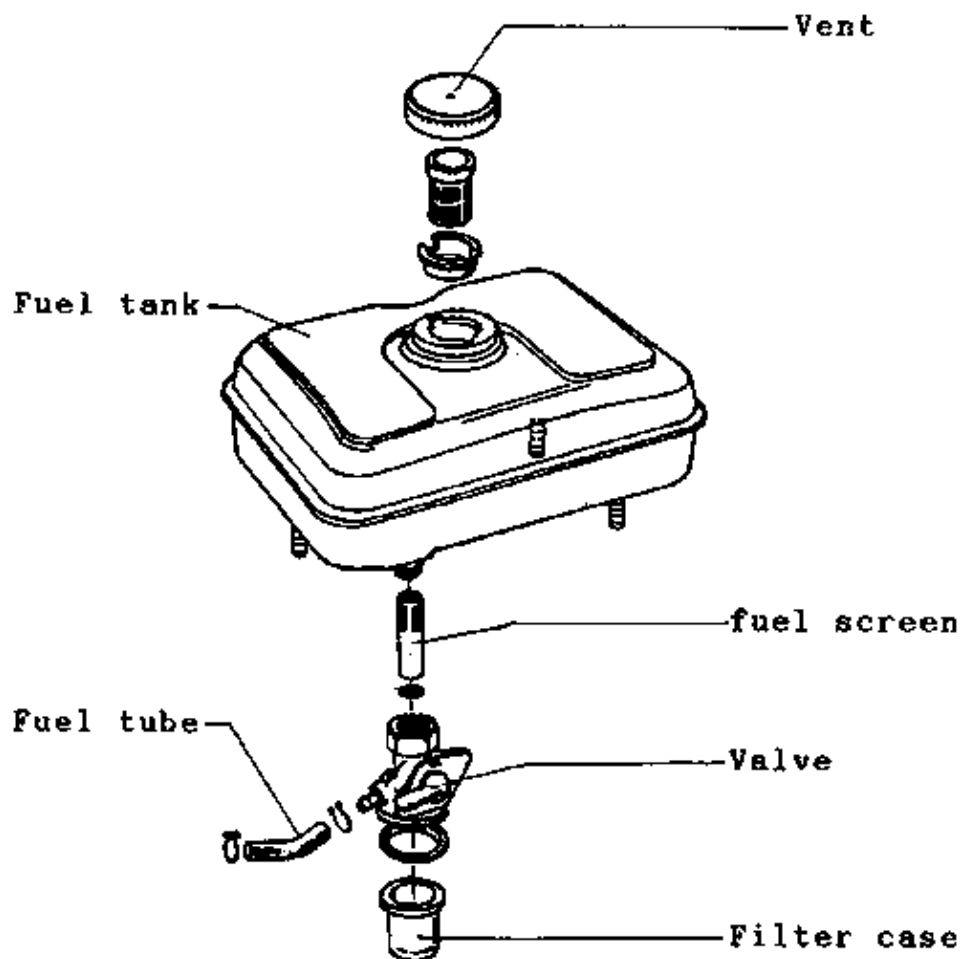
4. What will happen if the needle valve is worn?

- The carboretter will leak

1.6 **Repair and maintenance**

Information

1.6.1 **Servicing fuel tank**

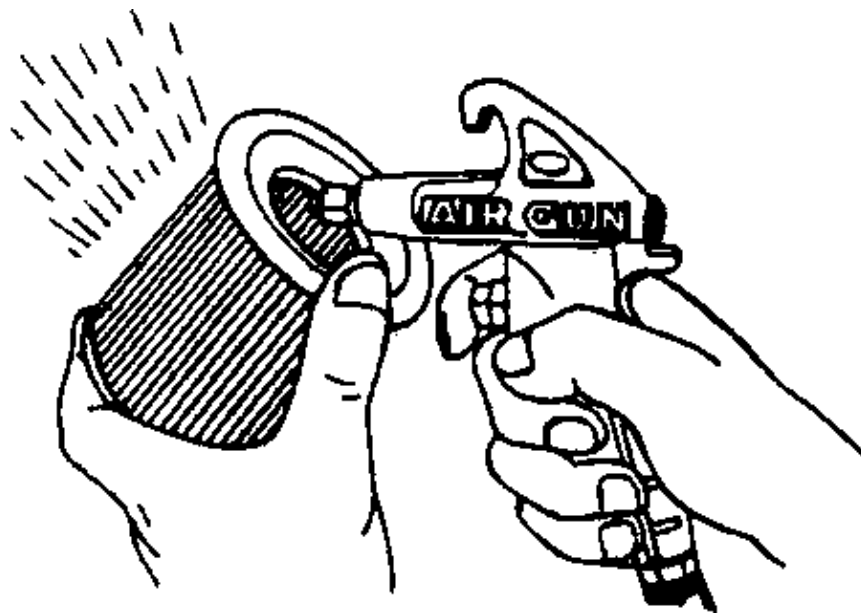


Caution: Fuel must be drained out completely prior removing the fuel tank.

Components	Services
1. Fuel cap	– Inspect the vent, it must be clean and clear. Use air gun to clean it.
2. Fuel tank	– Inspect for any puncture of the fuel tank. Clean inside of the tank.
3. Fuel screen	– Inspect for any blockage or wreckage.
4. Valve	– Clean it.
5. Fuel tube	– Inspect conditions like cracks.
6. Filter case	Clean the filter case in benzene.

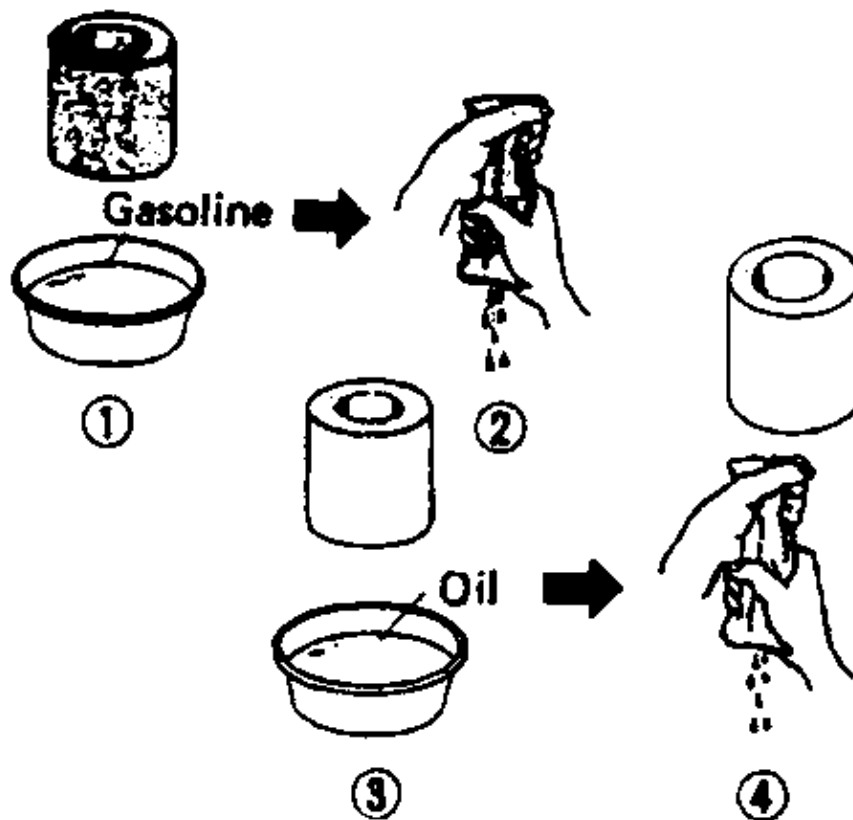
Caution: Be sure that no fuel leakage after reassemble.

1.6.2 Servicing dry-type air filter



Filter paper type

- Tap the filter rim gently or brush the paper.
- Blow out dirt from inside the filter with an air gun.

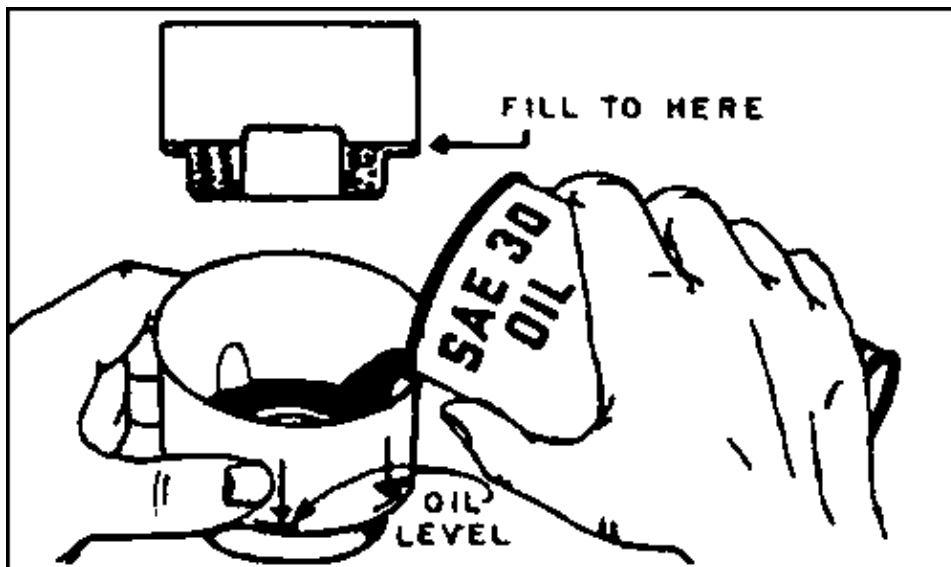


Filter sponge

- Clean the filter sponge in benzene, squeeze out dirt.
- Dry the filter sponge by squeezing and waving it.
- Dip the filter sponge into the pan of oil and benzene mixture of 1 to 10 ratio.
- Squeeze the sponge until wet dry.

Precaution: Do not twist the filter sponge, otherwise it will be torn off. Replace the damaged or ruin sponge.

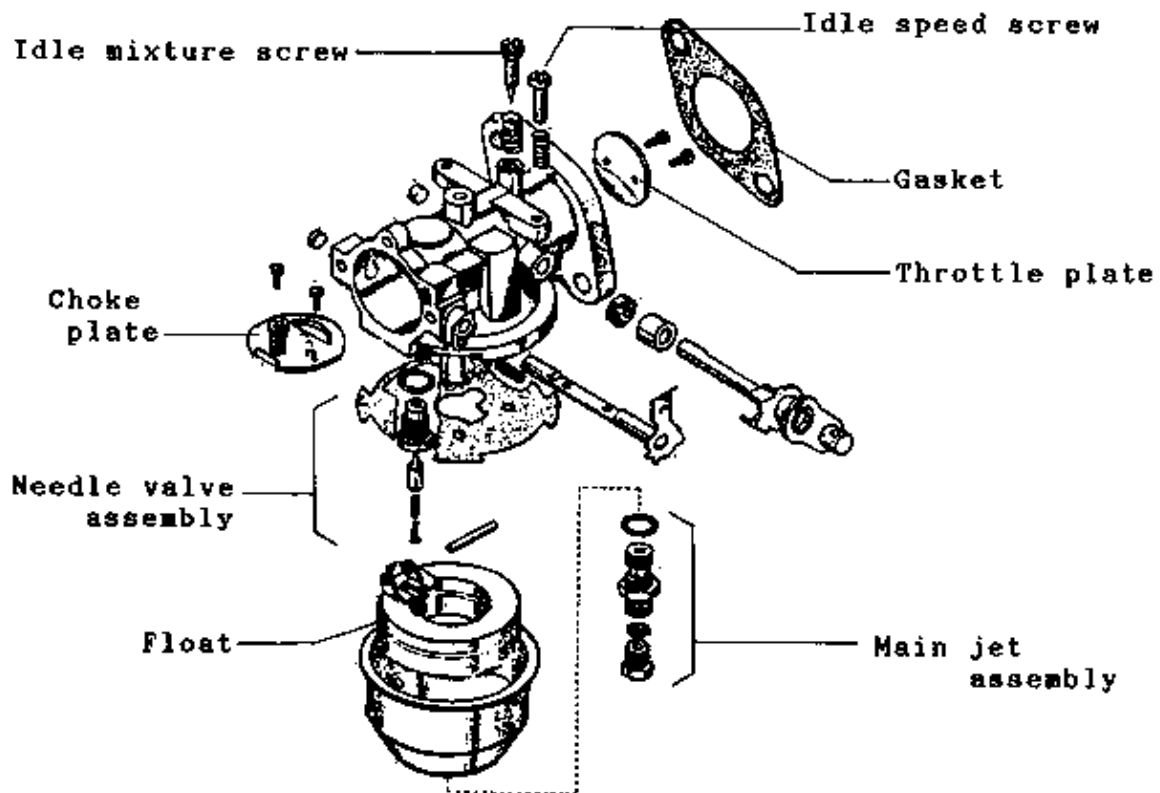
1.6.3 Servicing wet-type filter



- Remove the filter and stir it in a fuel pan.
- Clean the filter inside and outside.
- Refill the oil upto the marked level.

Precaution: Use the correct oil and refill according to the manufacturer's manual.

1.6.4 Dismantling Reassembling carburettor



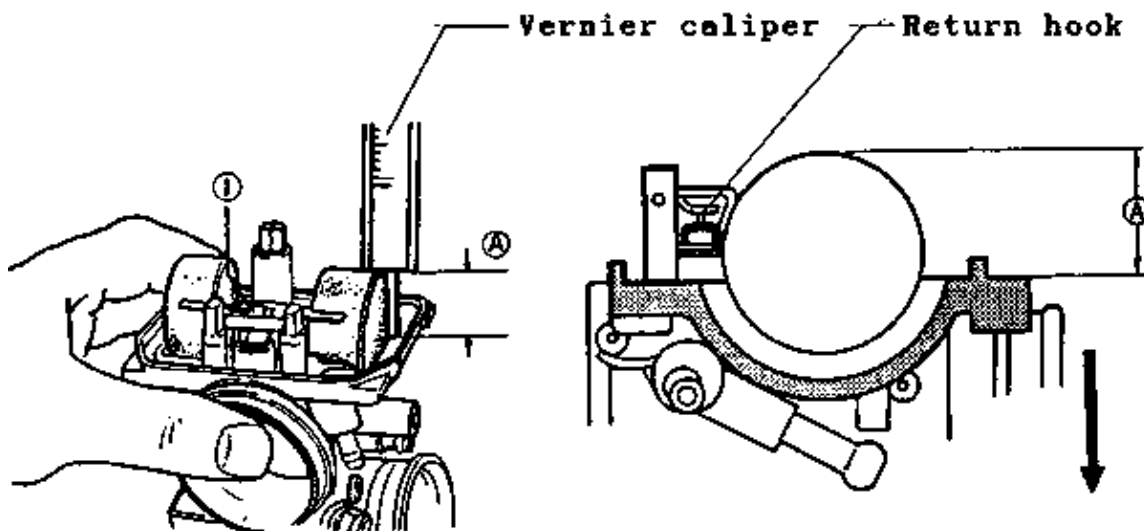
Components	Services
1. Float chamber	- Clean and blow with air gun
2. Float	

3. Main jet	– Blow with air gun
4. Needle	– Inspect for wear
5. Idle mixture screw	– Inspect for wear or damage on cone and thread
6. Carburetter body	– Clean and blow with air gun.

Remarks:

- In removing the carburetter assembly, unscrew and remove the float chamber, and drain out fuel residual.
- Before Inspection, clean all parts with benzene and brush, and blow until dry with air gun.

1.6.5 Float Setting



Measuring and setting:

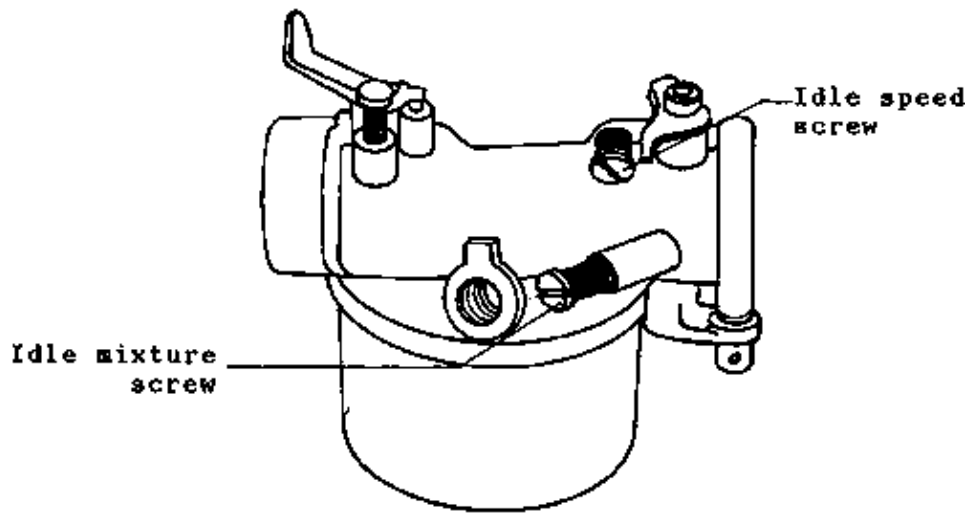
With the float cover placed horizontally, lift the float slowly with a finger (until the return hook is just lifting the float). Measure the height of the float at this position and compare the obtained value with that given in the manual.

If the obtained value is outside the manual value, then resetting is needed.

Example:

Standard value for height of float:	HONDA	G 150	8.2 mm
		G 200	8.0 mm
		GX 120	13.7 mm
		GX 160	13 mm

1.6.6 Idle mixture adjustment



Screw in the idle mixture screw completely and then unscrew it for the specified number of turns as given in the manual.

The specified number of turns of idle mixture screw:	HONDA	G 150	1 3/8 Turns
		G 200	3 1/4 Turns
		G x 120	2 5/8 Turns
		G x 160	2 1/8 Turns

Remark: If the specified number of turns is not known, then assumes for 1 1/2 to 2 turns or observe for the smoothest idling of the engine.

1.6.7 Idle speed setting

- Start the engine and allow it to idle.
- Adjust the idle speed screw inward or outward until the specified number of revolutions is obtained.

Standard idling speed	1,400 rev/min
-----------------------	---------------

1.6.8 Fault diagnosis oil engine as due to carburettor failure.

Symptom	Causes	Remedy
1. Wet spark plug	- Fuel flooded	- adjust float level
	- Worn float needle or dirty	- Clean, replace
2. Idle speed too high	- Incorrect idle speed	- Readjust idle mixture screw
	- Clogged idle circuit	- Clean, blow with air gun
	- Clogged fuel tube of idle circuit	
3. Poor acceleration	- Clogged fast idle main jet	- Clean, blow with air gun
	- Fuel level is too low in the float chamber	- Readjust the float level

	- Choke unit sticking	- Dismantle, clean
4. Engine will not start	- Float sticking, no fuel entering	- Clean
	- Choke unit sticking	- Dismantle, clean
	- Fuel flooded	- Readjust the float level

Job Sheets

1.2 to 1.4 Tank and Filters (I)

Tools: A set of wrenches, air gun with hose

Equipment: Benzen, Oil, Soft brush, cleaning pan, cloth

Manufacturer Model.....
 Type of air cleaner

Sequence of operations	Inspection	
1. Prepare tools and equipment		
2. Close fuel valve and disconnect hoses.	- Condition of fuel valve	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
	- Condition of hose	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
3. Remove fuel tank		
4. Empty the fuel tank	- Condition of fuel	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Deposited
	<input type="checkbox"/> Water contained	
	<input type="checkbox"/> Others	
5. Remove fuel valve and fuel cap	- Condition of fuel cap	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Blocked vent
6. Clean fuel valve and fuel filter	- Condition of fuel filter	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Clogged
	<input type="checkbox"/> Damaged	
7. Clean fuel tank with benzene	- Condition of fuel tank	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Rusty
	<input type="checkbox"/> Leaked	
8. Reassemble those components in reverse order.	Remarks:

1.2 to 1.4 Tank and Filters (II)

Sequence of operations	Inspection
------------------------	------------

Paper type air cleaner:	
1. Remove the air cleaner unit from the carburetter.	
2. Remove the filter for inspection	– Condition of the filter
	<input type="checkbox"/> Normal
	<input type="checkbox"/> Dirty, clogged
	<input type="checkbox"/> Damaged
	<input type="checkbox"/> Others
3. Blow the filter from inside	
4. Clean the air cleaner body with benzene	
5. Reassemble the air cleaner	Remarks:
Sponge type air cleaner:	
1. Remove the air cleaner unit from carburetter.	
2. Remove the filter for inspecting.	– Condition of filter
	<input type="checkbox"/> Normal
	<input type="checkbox"/> Dirty, clogged
	<input type="checkbox"/> Damaged
	<input type="checkbox"/> Others
3. Clean the filter with benzene	
4. Squeeze and wave the filter.	
5. Dip the filter in the fuel oil mixture (1: 10 ratio)	
6. Reassemble the air cleaner	Remarks:

1.2 to 1.4 Tank and Filters (III)

Sequence of operations	Inspection
Wet type air cleaner:	
1. Remove the air cleaner unit.	
2. Remove the filter for inspecting	– Condition of the filter
	<input type="checkbox"/> Normal
	<input type="checkbox"/> Dirty, clogged
	<input type="checkbox"/> Damaged
	<input type="checkbox"/> Others
3. Clean the filter and the air cleaner body.	
4. Refil oil into the air cleaner body upto the marked level.	– Amount of refill oil
 ccm
	Oil number
5. Reassemble the filter and the air cleaner.	
6. Clean and store tools and equipment used.	Remarks

1.5 Carburetter (I)

Tools: A set of wrenches, air gun with hose

Equipment: Benzen, soft brush, cleaning pan, cloth

Manufacturer..... Model

Type of carburetter Model

Standard float height mm

Standard number of turns of idle mixture screw

Standard idling speed..... rev/min

Standard number of main jet

Sequence of operation	Inspection
1. Prepare tools and equipment.	
2. Remove air cleaner.	- Type of filter
3. Close fuel valve and disconnect hose.	
4. Remove carburetter and related linkage and spring.	
Remark: Memorize linkages before removing.	
5. Clean outside of carburetter.	- Condition of leakage
	<input type="checkbox"/> Nil <input type="checkbox"/> leaked
6. Remove carburetter cover and empty fuel residual.	- Condition of float chamber
	<input type="checkbox"/> Normal <input type="checkbox"/> Dirty
Caution: Gasket may be torn off	- Condition of fuel
	<input type="checkbox"/> Normal <input type="checkbox"/> Dirty
	<input type="checkbox"/> Water contained
	<input type="checkbox"/> Others

1.5 Carburetter (II)

Sequence of operations	Inspection
7. Remove float and needle for inspection.	- Condition of float
	<input type="checkbox"/> Normal
	<input type="checkbox"/> Damaged
	- Condition of needle
	<input type="checkbox"/> Normal <input type="checkbox"/> Dirty
	<input type="checkbox"/> Worn <input type="checkbox"/> Others

8. Remove main jet assembly	- Condition of main jet bore

	<input type="checkbox"/> Normal	<input type="checkbox"/> Blocked
	<input type="checkbox"/> Worn	
	Number of main jet	
	<input type="checkbox"/> Original main jet	
	<input type="checkbox"/> New main jet	
9. Remove idle mixture screw	– Condition of idle mixture screw	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Dirty
	<input type="checkbox"/> Worn	<input type="checkbox"/> Others
	
10. Clean all components with benzene and dry with air gun.		
11. Set the height of float according to the manual.	– Height of float	
	Obtained value mm	
	<input type="checkbox"/> Normal	
	<input type="checkbox"/> Resetting	
12. Reassemble the carburetter in reverse order.		

1.5 Carburetter (III)

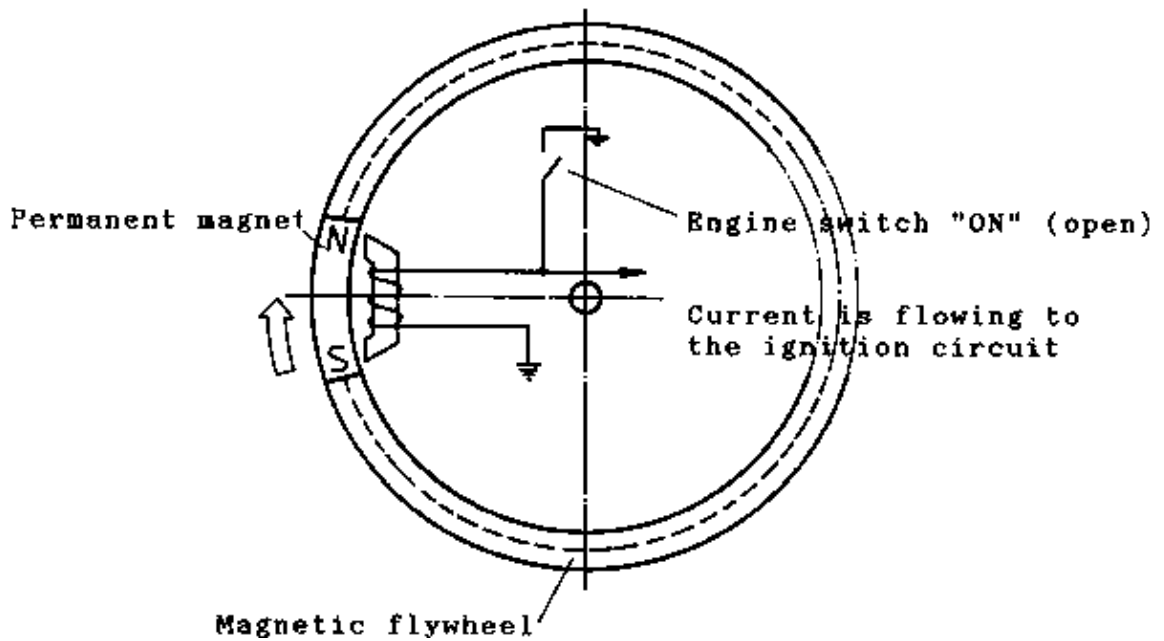
Sequence of operations	Inspection
13. Adjust the idle mixture screw according to the manual as specified.	– Number of turns
14. Start the engine and allow to idle.	– Performance of the engine
	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal
15. Adjust the idle speed screw according to manual.	– Idling speed as specified rev/min
16. Stop the engine	
17. clean tools and equipment and store it.	
Remarks:

2. Ignition system

Information

2.1 Basic principle

For small gasoline engines, magneto ignition system is generally used.



- The magnetic field of the permanent magnet, which rotates over the coil will generate current in the coil circuit.
- If the engine switch is at "OFF" position (closed), the generated current flows to the ground and cause no current flows in the ignition circuit.

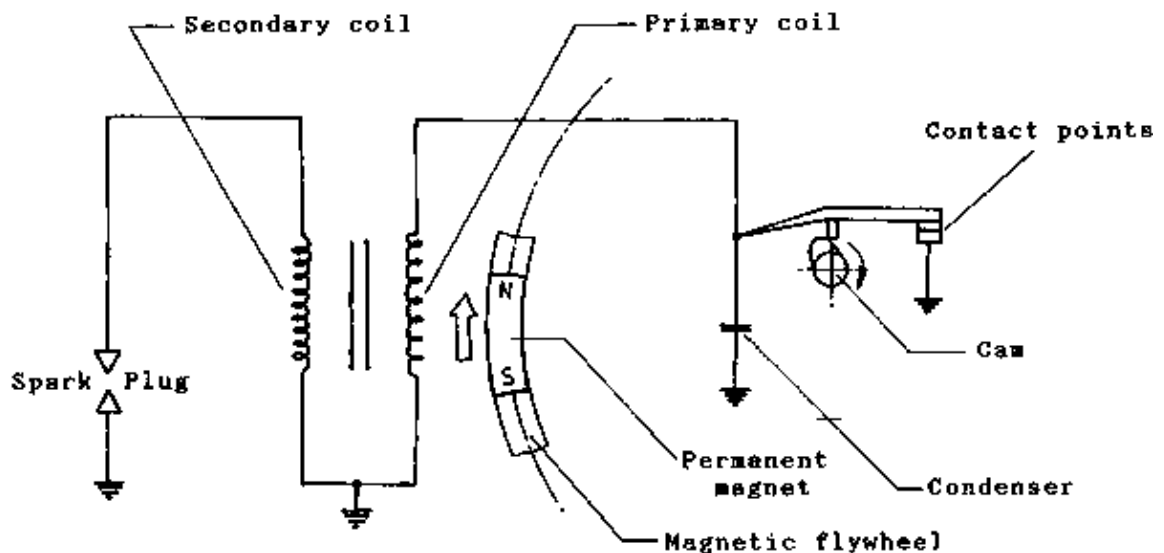
Magneto ignition system can be classified into 3 types:

1. Contact point ignition system.
2. Transistor ignition system
3. Capacitive discharge ignition system.

On the following pages the function of these systems is shown.

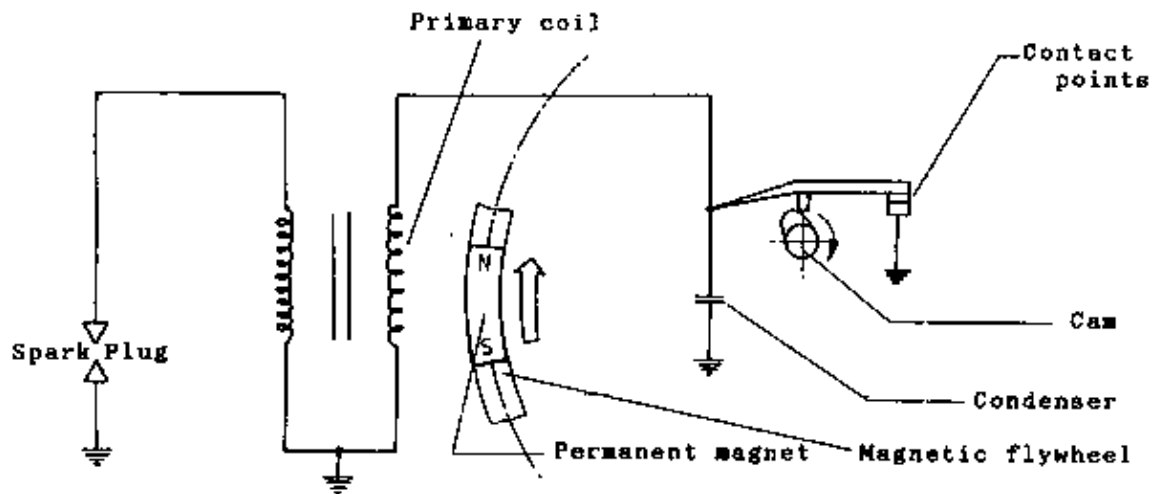
2.2 Contact point ignition system

2.2.1 Components of contact point ignition system and their function



Components	Functions
1. Magnetic fly wheel	– makes the permanent magnet rotates around the coil and thereby produces the current in the ignition circuit
2. Contact point	– switches on and off the current flowing from the primary coil
3. Cam	– open/closes the contact point at correct timing.
4. Condenser	– charges/discharges the current and to prevent arcing between the two contact points.
5. Ignition coil	– converts low current voltage to high current voltage, sufficient for arcing the spark plug.
6. Spark plug	– produces arcing and ignite the fuel mixture in cylinder.

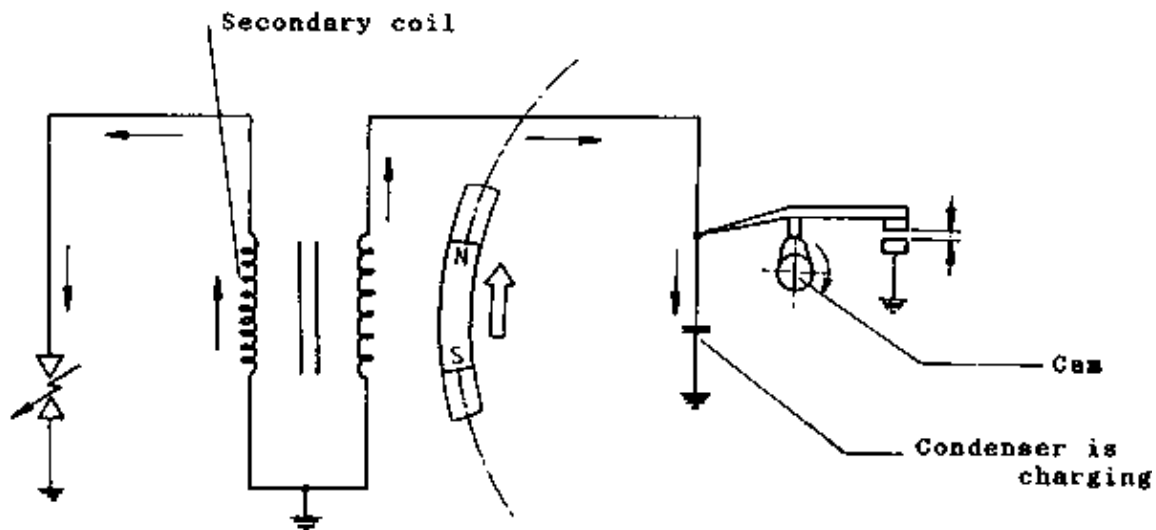
2.2.2 Function of contact point ignition system



– When the engine is starting, the magnetic flywheel rotates causing the magnetic field of permanent magnet to cut the primary coil, and thereby generates current flowing in the primary coil.

As the gap of contact point is closed, the generated current is flowing to the ground by the contact points.

At the ignition stroke, the gap is opened.



– At the ignition stroke, the cam mounted on the magnetic flywheel opens the gap of contact points. The current flowing to ground is impossible. The condenser is charging by the time the gap is opening. This will

prevent arcing between contact points.

– A sudden interruption of current flowing in the primary coil causes the magnetic field to collapse and cut the secondary coil.

– Thus, the high current voltage is generated in the secondary coil and enable arcing between the electrodes of the spark plug.

Task sheet

2.2 Contact point ignition system

Complete the sentences or underline the correct options.

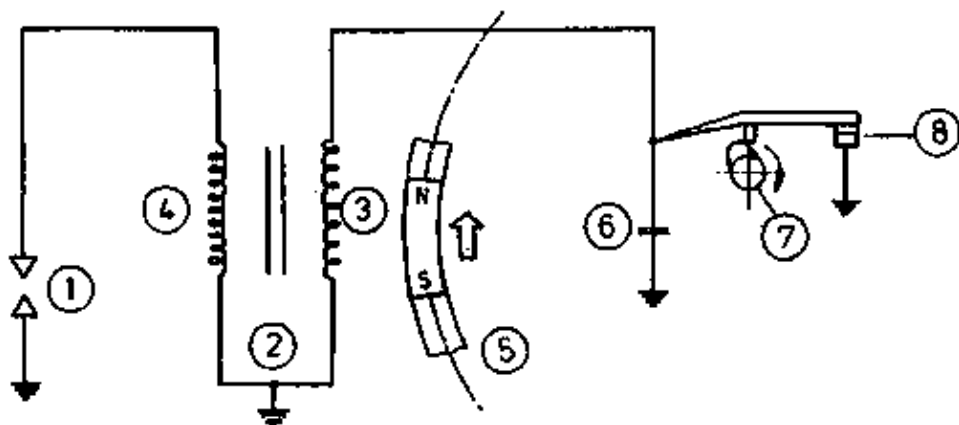
1. Ignition system generally used in small gasoline engine is

– battery/magneto type.

2. Current which flows in the ignition circuit is generated by _____.

3. Magneto ignition system is classified into _____ types, they are _____

4. Please name all parts of the ignition system.



1..... 5.....

2..... 6.....

3..... 7.....

4..... 8.....

5. Contact point is for _____.

6. The device that opens/closes the contact point is _____.

7. Condenser/ignition coil is for converting low current voltage to high current voltage.

8. The primary coil will be induced when the gap of contact point is closed/opened.

9. When the current flowing in the primary coil is interrupted suddenly, the magnetic field will _____.

10. The secondary coil shall generate high current voltage for the spark plug when the gap of contact is beginning to open/close.

Task (Solution)

2.2 Contact point ignition system

Complete the sentences or underline the correct options.

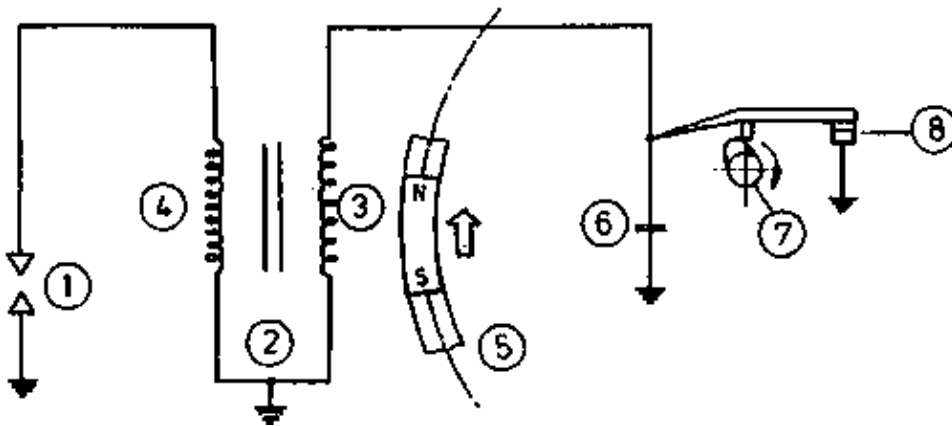
1. Ignition system generally used in small gasoline engine is

– battery/magneto type.

2. Current which flows in the ignition circuit is generated by magnetic flywheel.

3. Magneto ignition system is classified into 3 types, they are Contact point, Transistor and CDI.

4. Please name all parts of the ignition system.



1 Spark plug 5 Magnetic flywheel

2 Ignition coils 6 Condenser

3 Primary coil 7 Cam

4 Secondary coil 8 Contact points

5. Contact point is for interrupting current flows in primary coil.

6. The device that opens/closes the contact point is the cam.

7. Condenser/ignition coil is for converting low current voltage to high current voltage.

8. The primary coil will be induced when the gap of contact point is closed/opened.

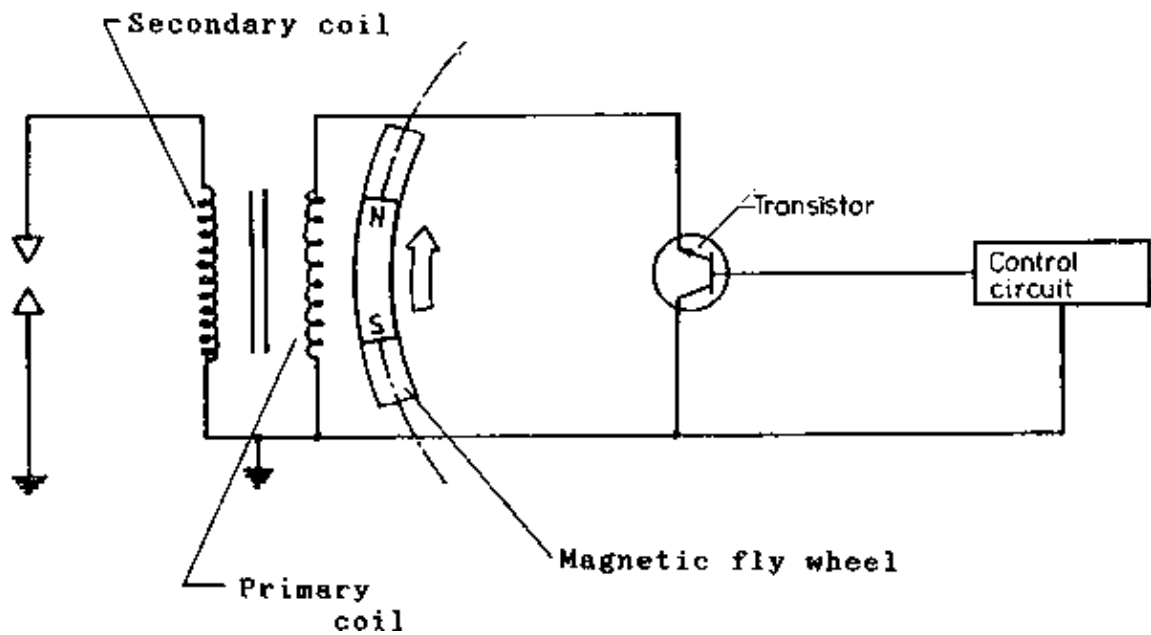
9. When the current flowing in the primary coil is interrupted suddenly, the magnetic field will collapse.

10. The secondary coil shall generate high current voltage for the spark plug when the gap of contact is beginning to open/close.

2.3 Transistor ignition system

Information

2.3.1 Components of transistor ignition system and their function



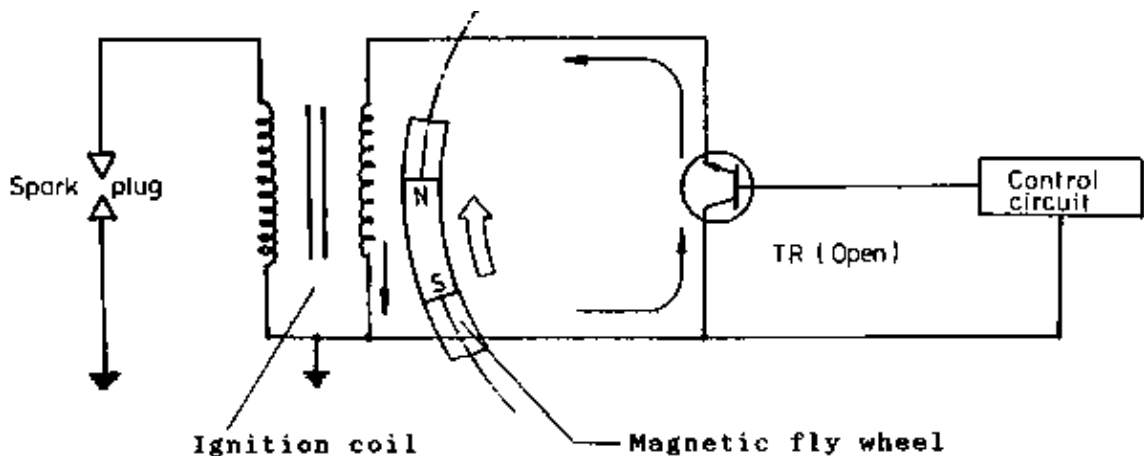
Transistor (TR)

– acts as on/off switch, like the contact points. But, a transistor can do the task contact-free.

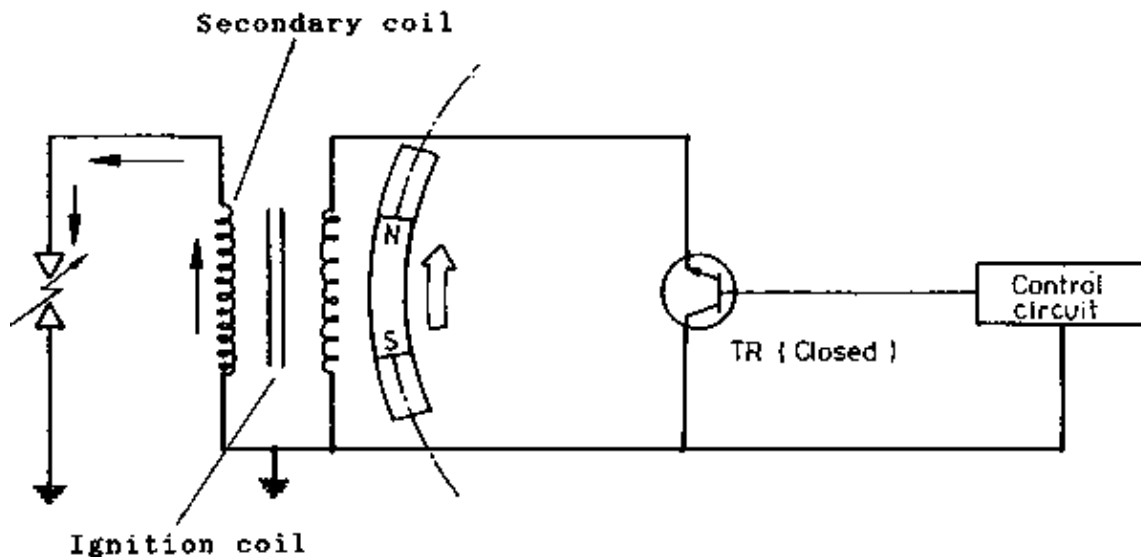
Control circuit

– acts like the cam in opening-closing the contact points, it controls the opening/closing of the transistor.

2.3.2 Function of transistor ignition system



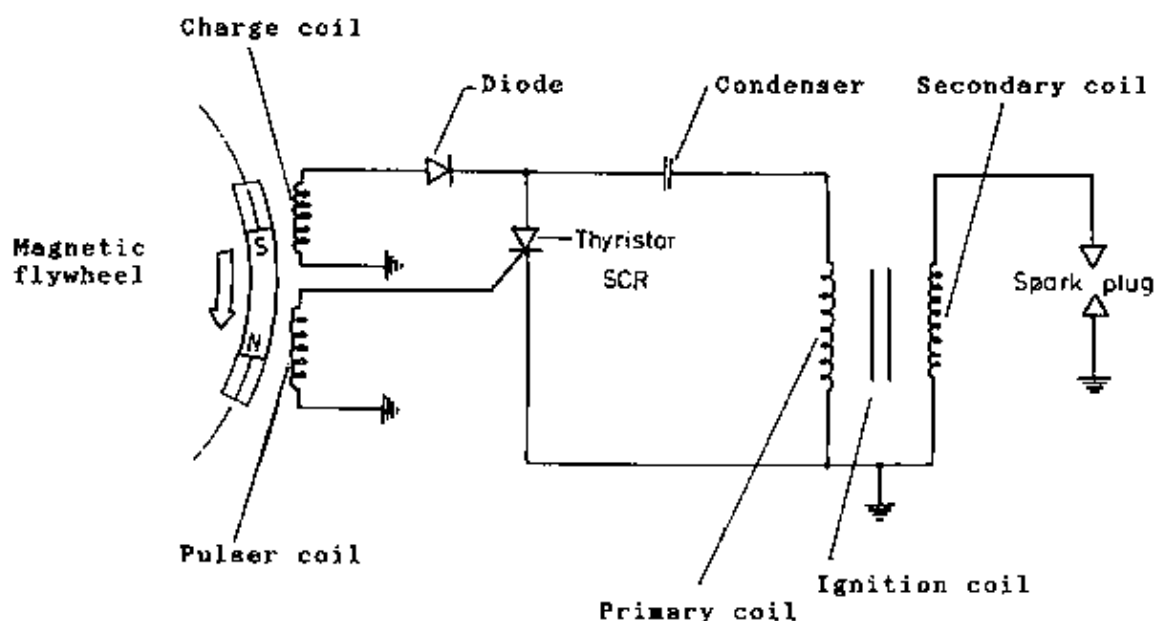
When starting the engine, magnetic fly wheel will rotate. As the magnetic field of permanent magnet is approaching the primary coil, current is induced and flowing through the transistor and thereby coming back to the primary coil, generating a magnetic field.



As the magnetic fly wheel turns until the ignition stroke, the induced voltage is increasing sufficiently for the control circuit to activate the Transistor to cut the flow of current to the primary coil. The magnetic field in the coil is, thus, collapsing and thereby inducing the high voltage current in the secondary coil, to flow to the spark plug.

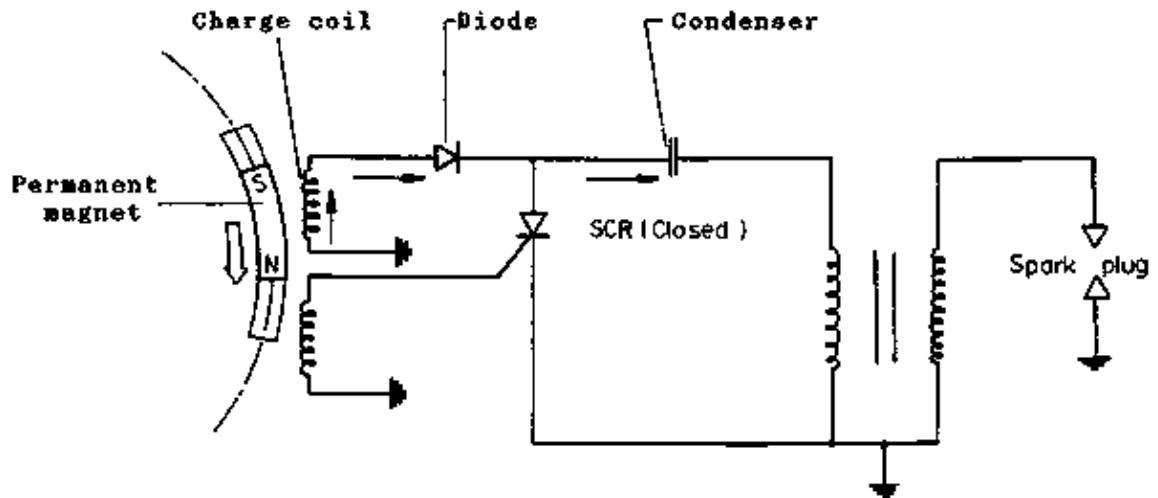
2.4 Capacitive discharge ignition system (CDI)

2.4.1 Components of capacitive discharge ignition system and their function



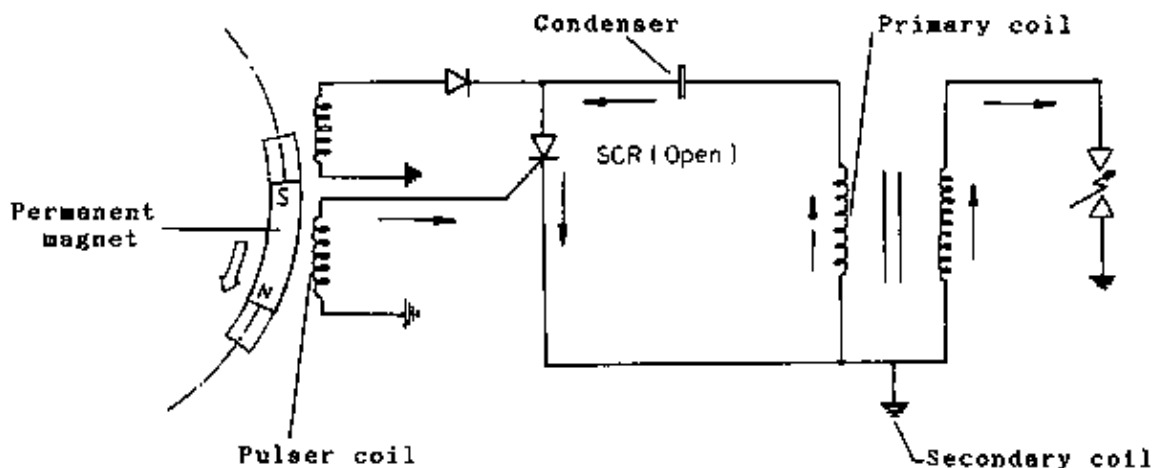
Components	Functions
1. Primary coil	– generates alternating current
2. Diode	– converts alternating current to direct current
3. Condenser	– charges and discharges current
4. Thyristor or SCR SCR = Silicon Control Rectifier	– closes/opens the circuit, acts like the contact points of the contact point ignition system. The current can flow from A to K only when G is activated.

2.4.2 Function of CDI ignition system



When starting the engine, the magnetic flywheel will rotate.

As the magnetic field of the permanent magnet cuts the charge coil, alternating current is induced and flows to the diode. The diode will rectify it into direct current and the condenser will store it.



As the magnetic flywheel turns until the ignition stroke, its magnetic field cuts the pulser coil and current is generated.

The generated current will trig the SCR, causing the condenser to discharge its stored current to flow through SCR and through the primary coil to ground. This will induce the high current voltage in the secondary coil which flows to the spark plug causing arcing between the electrodes of the spark plug.

2.5 Advantages and disadvantages of CDI and transistor ignition systems

Advantages:

1. Reduced maintenance, no need of adjustment
2. Prolong life of a spark plug
3. No wearing of contact points
4. Easy starting, because higher ignition voltage
7. Constant high performance over the working life.

Disadvantages:

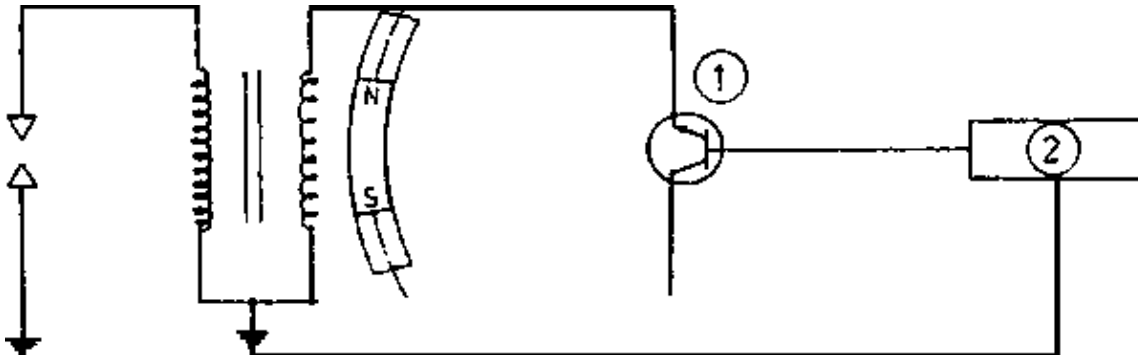
1. Expensive.
2. Electronic devices are not repairable.

Task sheets

2.3 and 2.4 Transistor and CDI ignition systems

Fill in the blanks and underline the correct answers.

1. Name various parts and complete the circuit diagramme of the transistor ignition system.



1.
2.

2. The Transistor is for

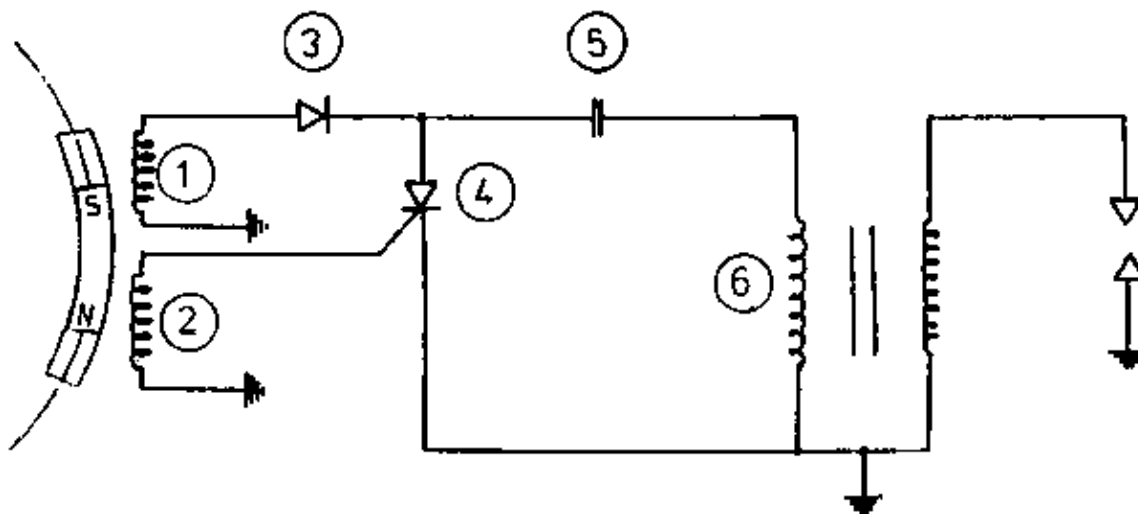
3. In a Transistor ignition system, the device which is equivalent to the cam is

4. The Control circuit will activate the Transistor to cut the current flow when the voltage is increasing/decreasing.

5. What happens, when the Transistor cuts the current flow to the primary coil?

.....

6. Name the parts of the CDI system.



- 1 4
- 2 5
- 3..... 6

7. The device in the CDI system, which performs the same function as the contact points is

8. The Pulser coil/Charge coil is producing the current that triggers the SCR to open the circuit.

9. From the circuit of item 6:

As the permanent magnet is moving past the coil 1,

–alternating/direct– current will be generated and flowing through the diode by which it is changed into –alternating/ direct– current and storing in

10. When the SCR opens the circuit, the current as released by the condenser will flow through

11. High voltage current will flow to the spark plug when the magnetic wheel is cutting– the charge coil/the pulser coil.

12. Advantages of both the CDI and transistor ignition systems are:

- 1. 3.....
- 2 4.....

13. Disadvantages of both the CDI and transistor ignition systems are:

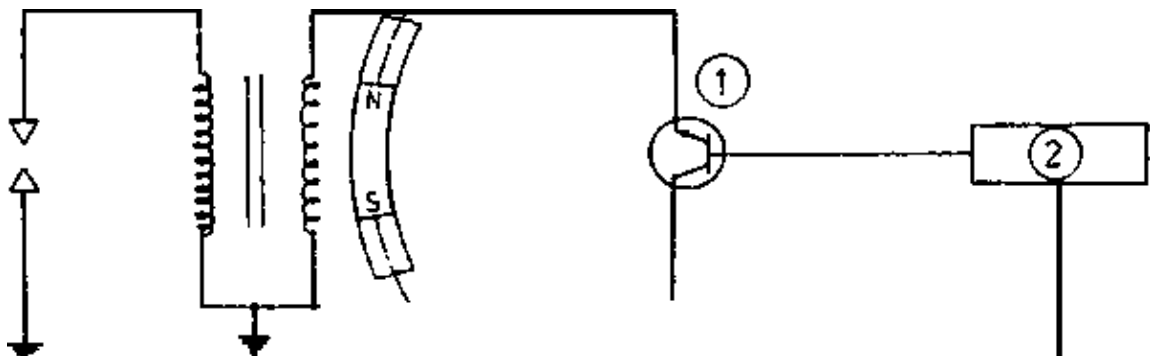
- 1.....
- 2.....

Task (Solution)

2.3 and 2.4 Transistor and CDI ignition systems

Fill in the blanks and underline the correct answers.

1. Name various parts and complete the circuit diagramme of the transistor ignition system.



- 1. Transistor
- 2. Control unit

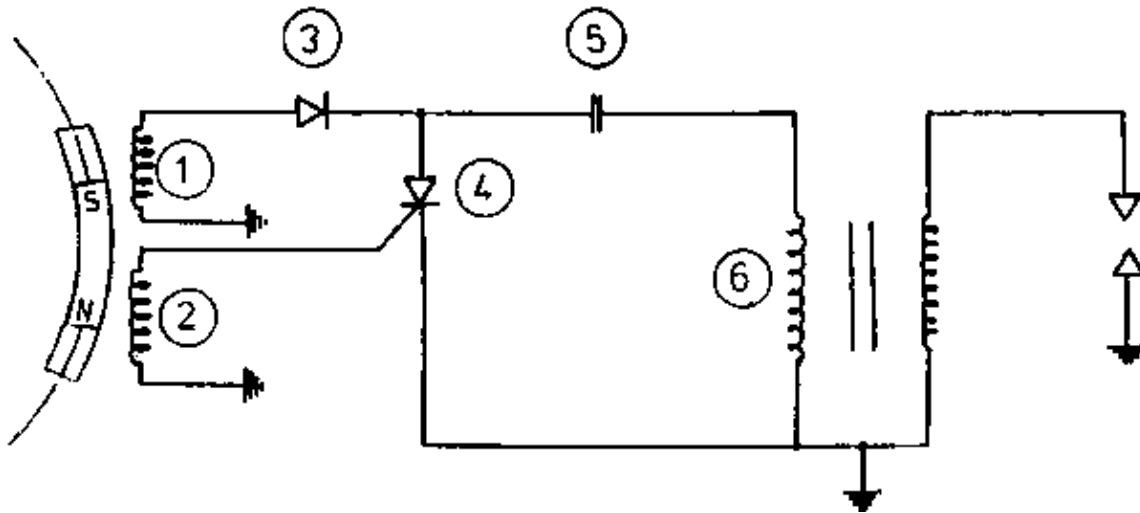
2. The Transistor is for opening/closing the current flow of primary coil

3. In a Transistor ignition system, the device which is equivalent to the cam is the Control unit

4. The Control circuit will activate the Transistor to cut the current flow when the voltage is increasing/decreasing.

5. What happens, when the Transistor cuts the current flow to the primary coil? The magnetic field is collapsing and generating high voltage in the secondary coil.

6. Name the parts of the CDI system.



1 Charge coil 4 Thyristor (SRC)

2 Pulser coil 5 Condenser

3 Diode 6 Primary coil

7. The device in the CDI system, which performs the same function as the contact points is the Transistor.

8. The Pulser coil/Charge coil is producing the current that triggers the SCR to open the circuit.

9. From the circuit of item 6:

As the permanent magnet is moving past the coil 1,

–alternating/direct– current will be generated and flowing through the diode by which it is changed into –alternating/direct– current and storing in the condenser.

10. When the SCR opens the circuit, the current as released by the condenser will flow through the primary coil.

11. High voltage current will flow to the spark plug when the magnetic wheel is cutting –the charge coil/the pulser coil.

12. Advantages of both the CDI and transistor ignition systems are:

1. Reduced maintenance 3 No wearing of contact points

2 Longer live of spark plug 4 Easy starting

13. Disadvantages of both the CDI and transistor ignition systems are:

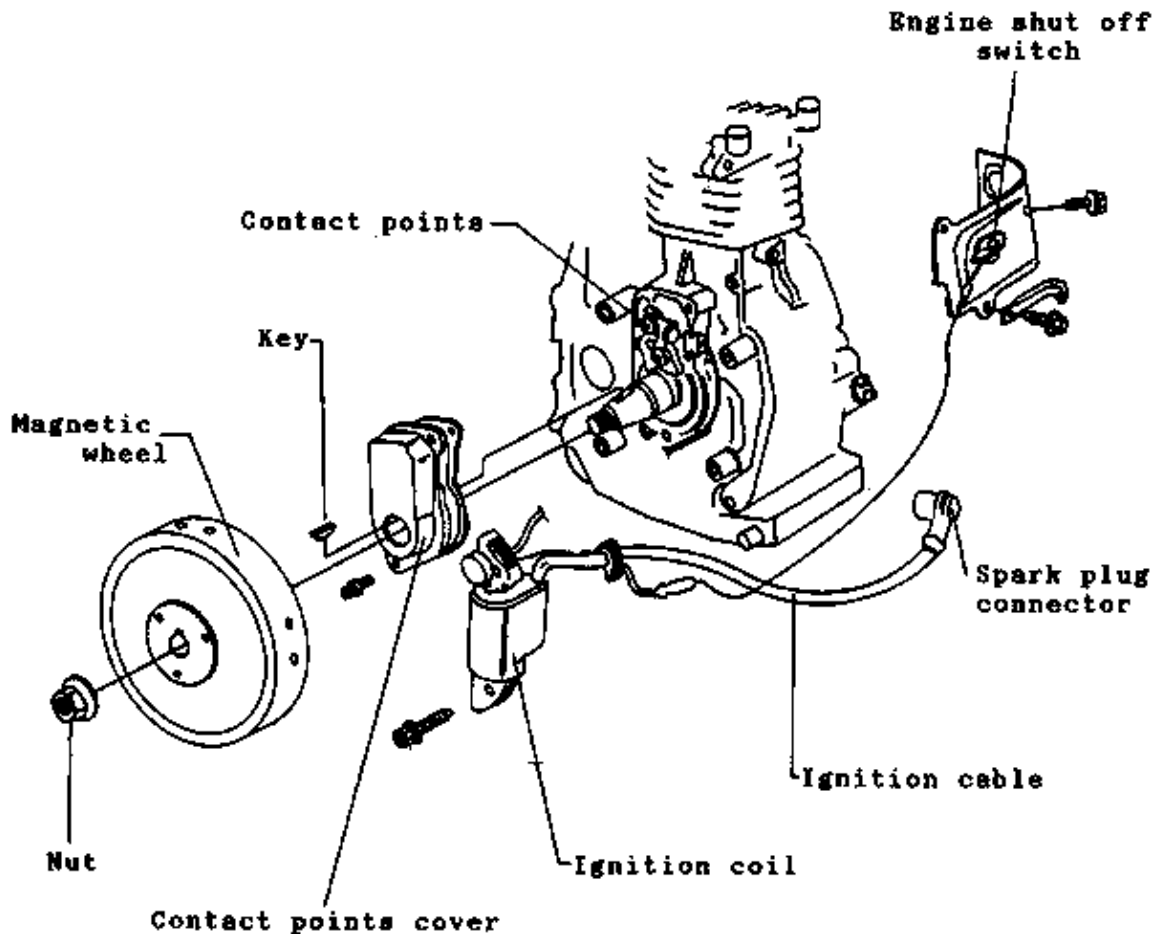
1 Expensive

2 Electronic devices not repairable

2.6 Maintenance and repair

Information

2.6.1 Assemble and disassemble the ignition system



- Removing:
- Special tool should be used to remove the magnetic wheel.
 - Do not hammer the magnetic wheel, otherwise it will be damaged or spoiled.
- Refitting:
- Clean the magnetic wheel completely before refitting.
- Remark:
- The magnetic wheel nut must be tighten with a torque wrench at the correct torque according to the manufacture's manual.
 - The specified torque = 6.0 – 7.0 kgm

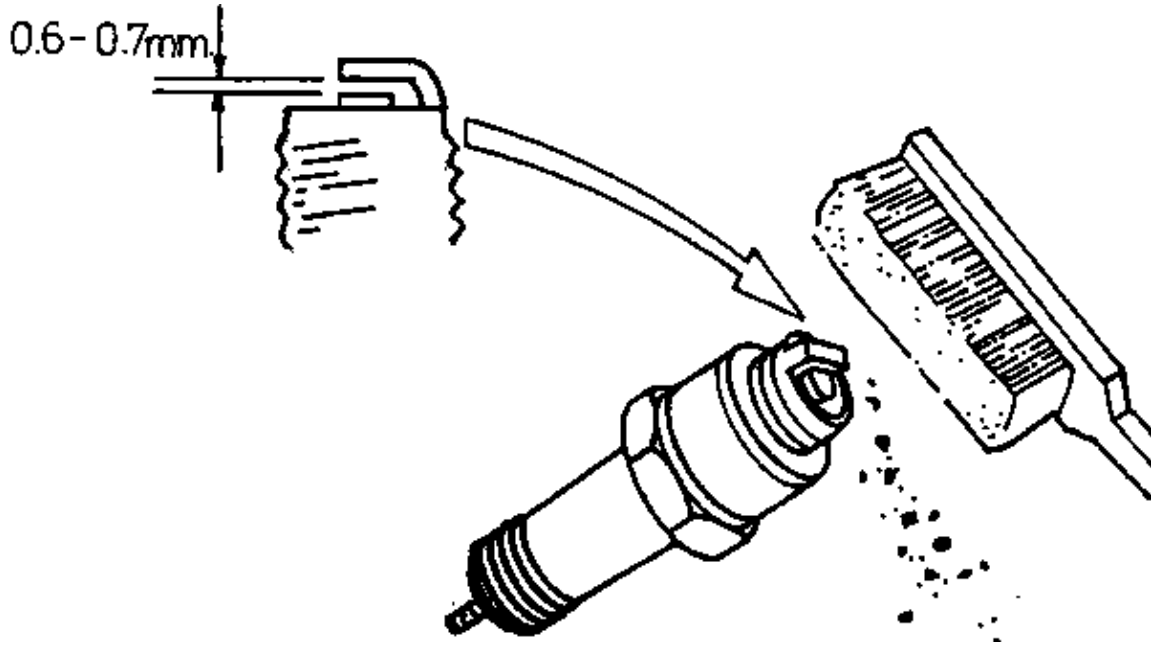
2.6.2 Inspect, clean and adjust spark plugs

Inspecting conditions of a spark plug:

Conditions of electrodes	Cause	Remedy
dry and light brown	– normal engine operation	
dry and black	– fuel mixture too rich	– readjust the idle mixture screw
		– inspect choke and air filter

	– wrong heat range	– switch to hotter plug, e.g. from BP 7 ES to BP 6 ES
wet and black	– Oil leaking into the combustion chamber may be caused by worn piston rings or others	– inspect and repair piston rings, piston and cylinder
burned and eroded	– wrong heat range	– switch to colder plug, e.g. from BP 6 ES to BP 7 ES
white spot deposit	– additive deposits from leaded fuel	– switch to hotter plug

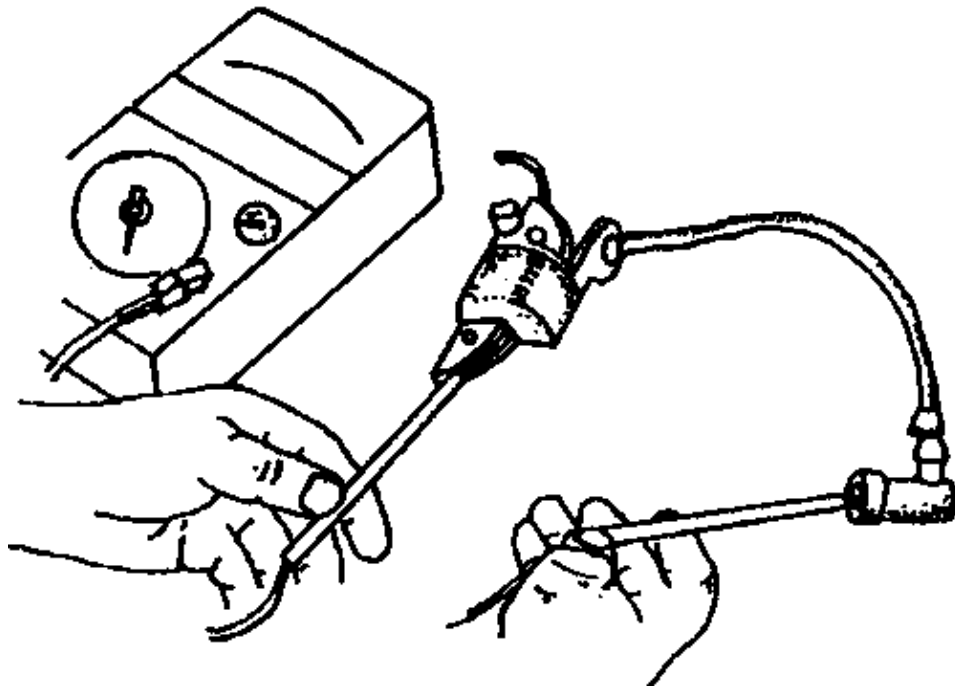
Cleaning and adjusting a spark plug:



- clean the electrodes with a steel brush.
- adjust the spark plug gap according to manual

(Standard spark plug gap = 0.6 – 0.7 mm)

2.6.3 Inspect the ignition coil

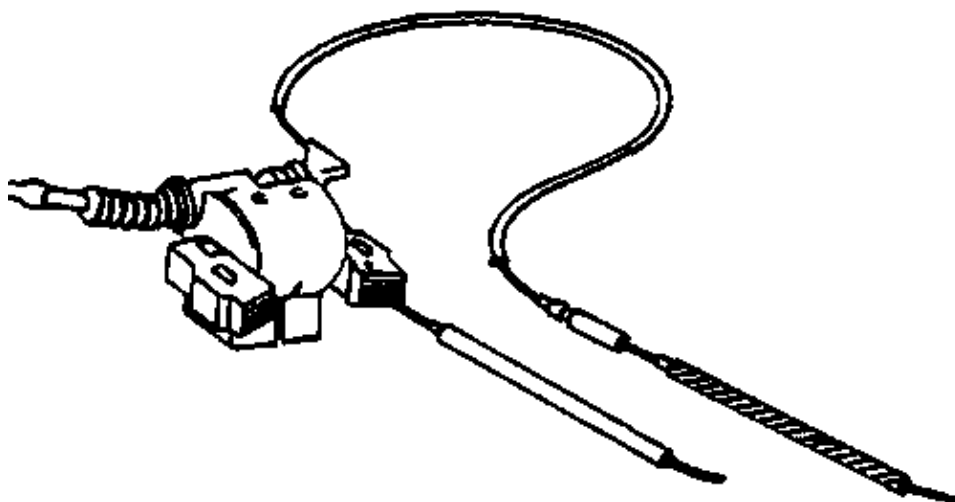


- disconnect the spark plug connector
- measure between the spark plug connector and the ignition coil base with an ohmmeter
standard resistance = 6.6 K?

Condition of ignition coil	Causes
Resistance of the primary coil is too low	- short circuit in coil 1
Resistance of the primary coil is too high	- dirty coil
Resistance of the secondary coil is too low	- short circuit in coil
Resistance of the secondary coil is too high	- dirty terminal

2.6.4 Inspect CDI and transistor ignition system

Primary coil:

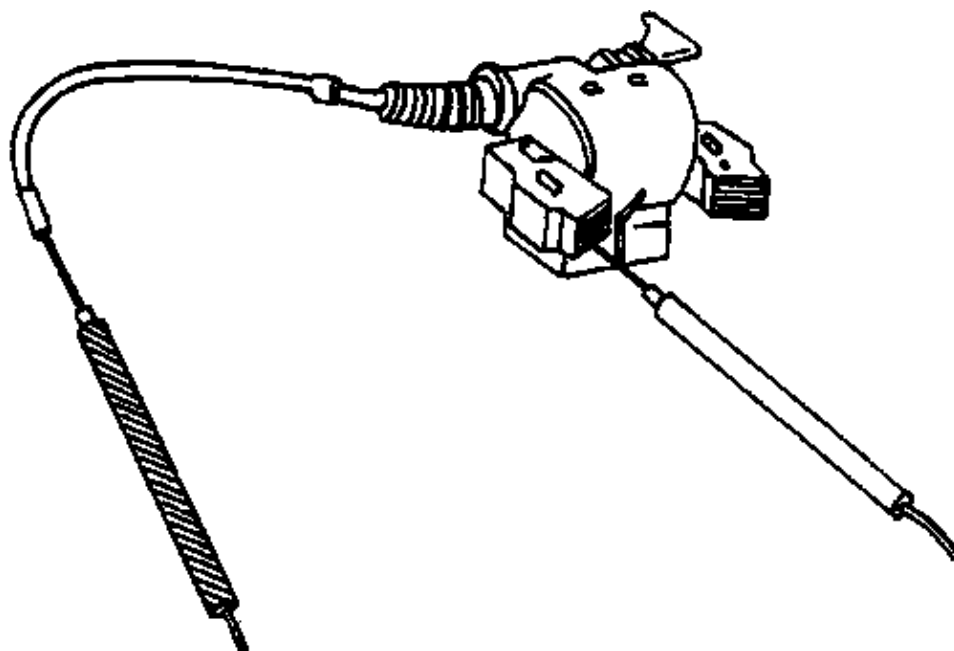


Use ohmmeter to check between the black cable (engine stop) and the core.

Standard resistance of primary coil:

for HONDA Model GX 110, 120, 140, 160	=	1.2 – 0.2 ?
For HONDA Model GX 240, 340	=	0.7 – 0.9 ?

Secondary coil:

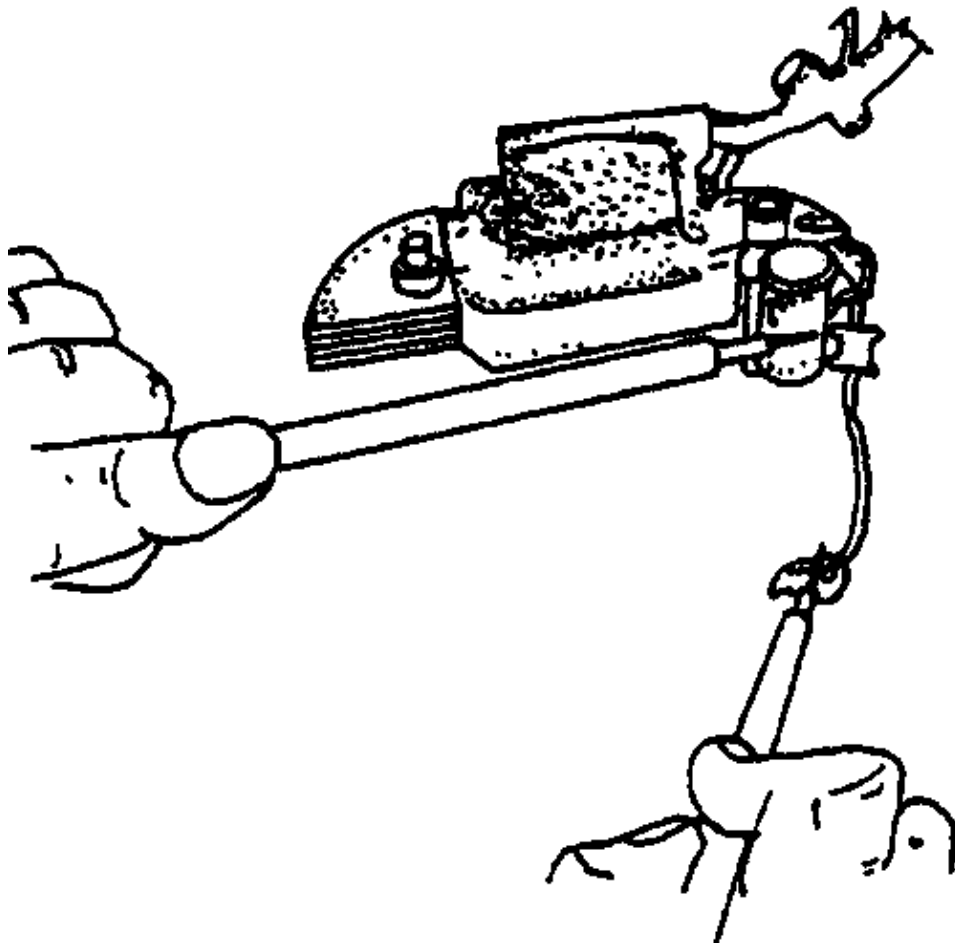


- Remove the spark plug lead.
- Use ohmmeter to check between the spark plug lead and the core.

Standard resistance of secondary coil:

for HONDA Model GX 110, 140	=	12 – 2 K?
for HONDA Model GX 120, 160	=	6.5 – 8 K?
for HONDA Model GX 240, 340	=	6.3 – 7.7 K?

2.6.5 Inspect condenser



- measure the resistance of the condenser between positive and negative terminals
- if the indicator rises a little and falls back, the condenser is alright
- if the indicator does not rise or fall, it is damaged

Standard capacitive = 0.24 μ F

Remark: If the contact points wear abnormally, then the condenser must be replaced.

Conditions of condenser	Faults
Too large capacitive	- Contact points are eroded
Too small capacitive	- Contact points are eroded

2.6.6 Inspect: and adjust contact points

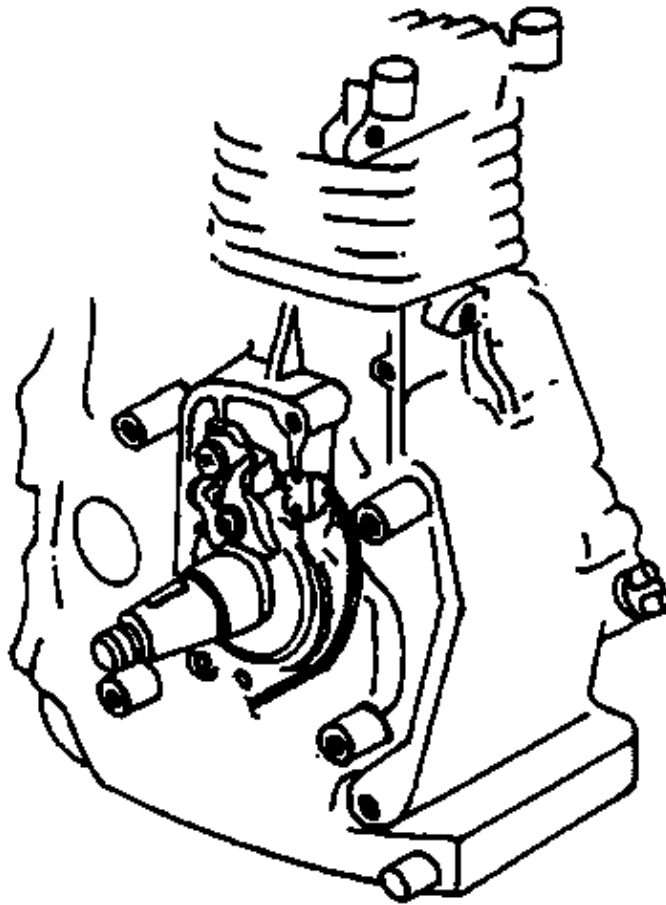
Conditions of contact points:



- Light gray contact points are normal.
- If burned, eroded or pitted, contact points must be replaced.
- If colour is normal and worn a little, then file them smooth.

Adjusting the contact points:

- Insufficient gap will cause contact points arcing and burning.
- Excessive gap will reduce the dwell angle of the contact points and thereby ceasing the ignition at high-speed.



Operating steps:

- Turn the crank shaft until the cam opens the contact points fully.
- Measure the gap by using feeler gauge.
- Readjust the gap if it is not correct according to the manual.
(Standard contact point gap = 0.4 – 0.5 mm)

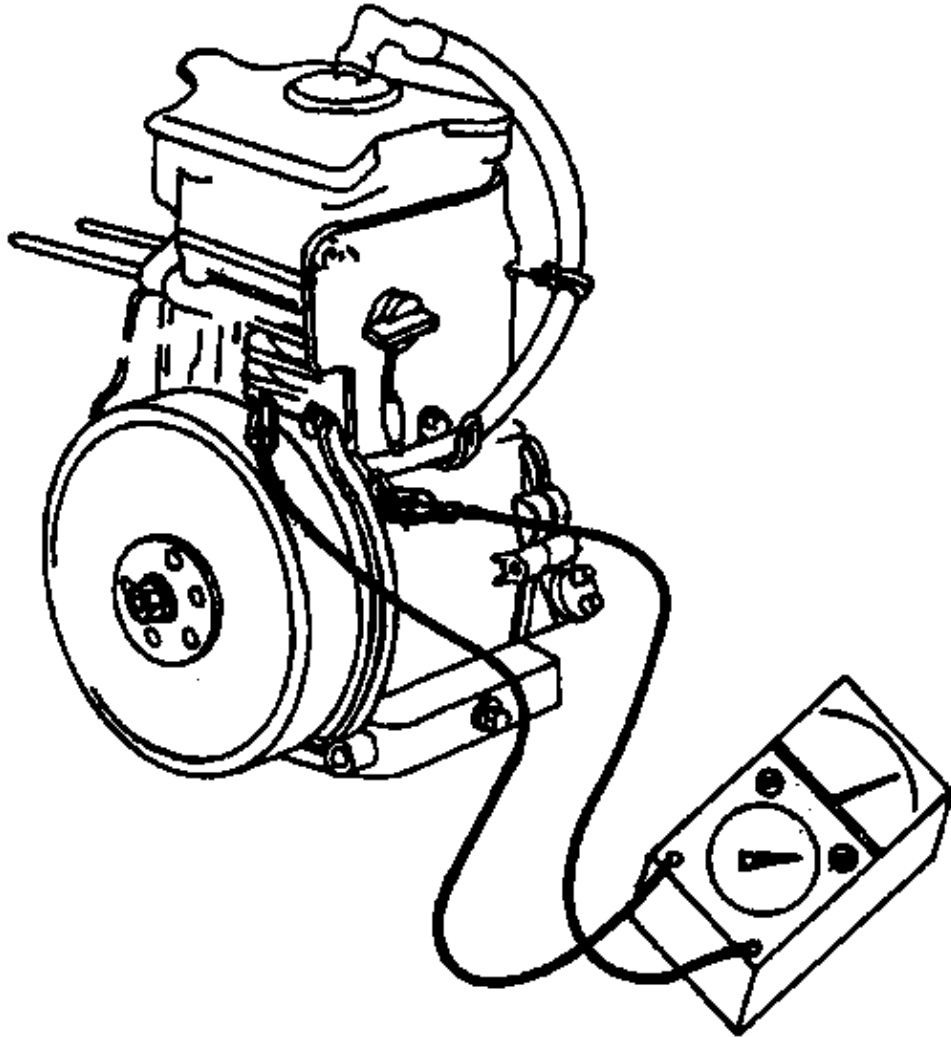
2.6.7 Adjust the ignition timing

Ignition timing	Faults
1. Advanced ignition	- Engine is knocking
	- Engine runs back
2. Retarded ignition	- Difficult to start
	- Engine lacks power
	- Engine is

overheated

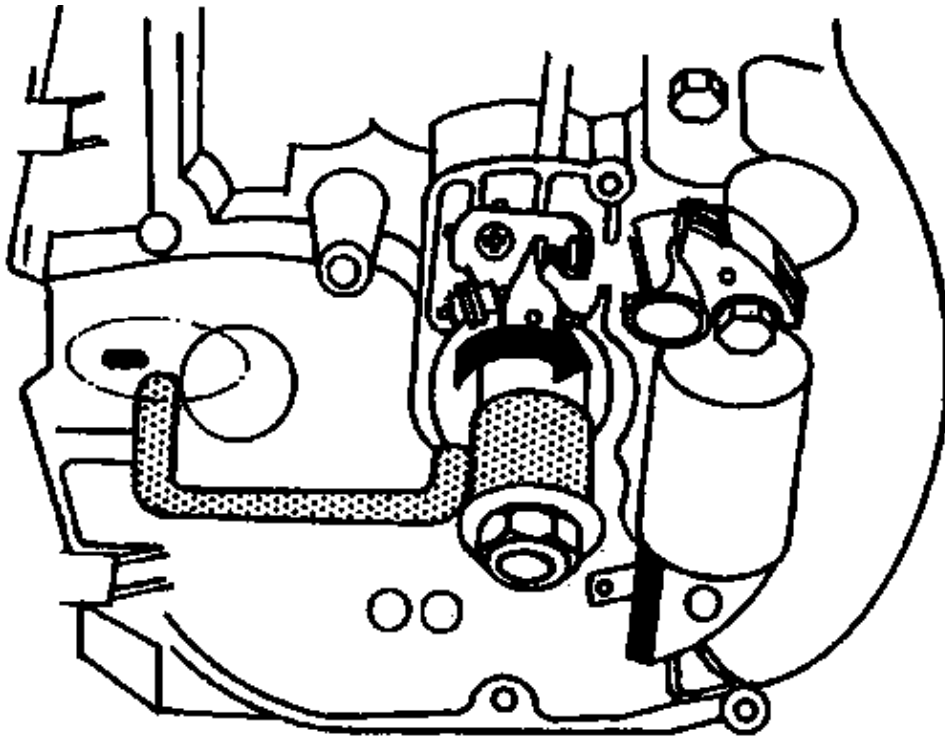
Adjusting the ignition timing:

a) by using timing tester



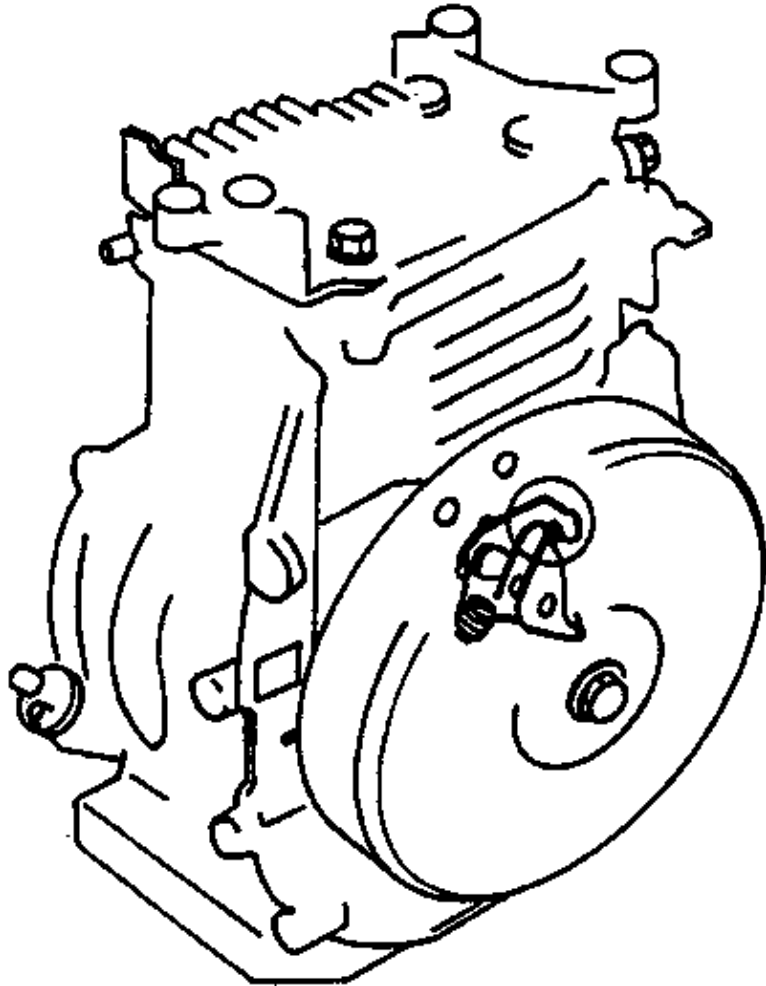
- Connect one lead of the timing tester to ground.
- Connect another lead of the timing tester to contact point terminal (ignition terminal of switch key)
- When the timing tester is switched on, sound should be heard if the contact points open, or vice versa.
- The position at which the contact points open, must be inlined with F, otherwise readjusting the ignition timing is needed.

b) by using special tool to identify the "F" mark



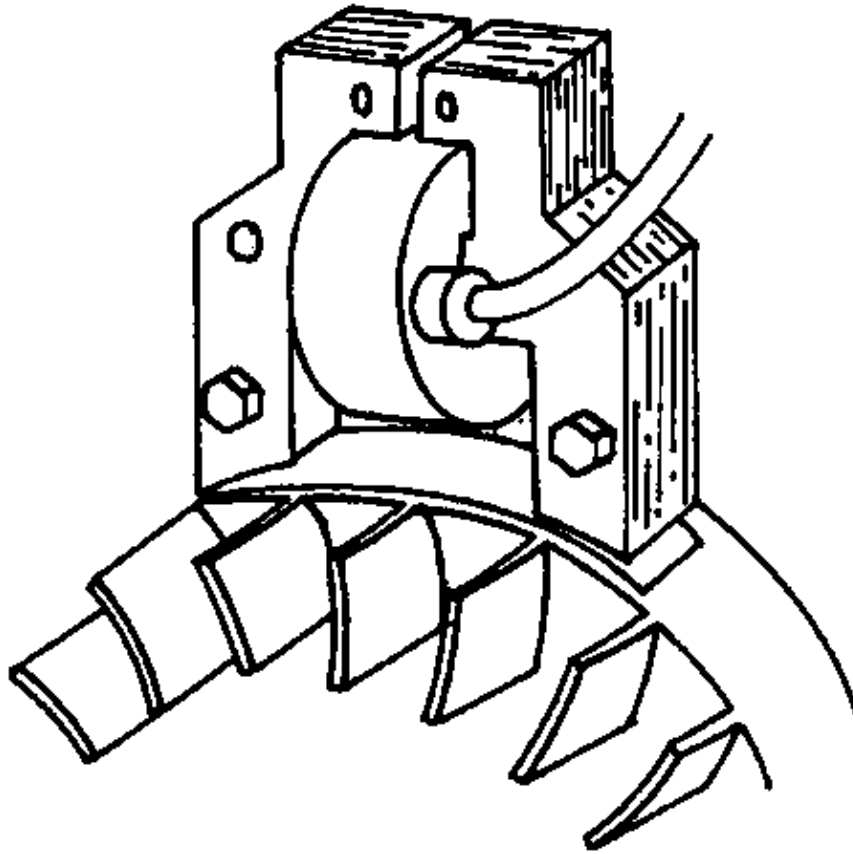
- Remove the magnetic wheel and the cover of contact points.
- Install the special tools to the crank shaft and tighten the nut.
- Turn the engine clockwise.
- At the position where the contact points open, the mark on the special tool must be inlined with the F mark.
- If it is out of inlined, then loosen the screw of the contact point base, and readjust it according to the mark.

c) Without using a special tool



- Remove the magnetic wheel and the contact point cover, then reassemble the magnetic wheel temporarily to its position.
- Now the opening – closing of the contact points can be seen.
- Turn the magnetic wheel clockwise, at the point where the contact points are opening, the F mark on the magnetic wheel must be inlined with the mark of the engine.

2.6.8 Adjust gap between ignition coil and magnetic wheel



- Turn the engine until the permanent magnet is underneath the ignition coil.
- Measure the gap by feeler gauge.

Standard gap = 0.4 – 0.2 mm.

If it is outside the standard value, then loosen the screw of the ignition coil and readjust the ignition coil up or down until the required gap is obtained.

2.6.9 Trouble shooting

Fault	Possible causes	Remedy
Engine cranks normally, but will not start	1. Low voltage circuit is broken.	- Inspect connections of ignition coil and contact points.
	2. Contact points sticking.	- Readjust.
	3. Burned contact points.	- Clean or replace.
	4. Incorrect ignition timing.	- Inspect and readjust the ignition timing.
	5. Damaged condenser.	- Replace the condenser.
	6. Damaged ignition coil	- Replace the ignition coil.
	7.	- Inspect ignition coil and spark plug cable.
	8. Fouled spark plug	- Clean and readjust or replace.
Engine lacks power	1. Incorrect ignition timing	- Inspect and readjust the ignition timing.
Engine is overheated	1. Retarded ignition timing	- Readjust the ignition timing.
Engine is back fired	1. Incorrect ignition timing	- Readjust the ignition timing.

	2. Wrong heat range of spark plug	– Use correct heat range.
Engine is knocking or pinging	1. Incorrect ignition timing	– Readjust the ignition timing.
	2. Incorrect contact point gap	– Readjust the contact points gap.

Job sheets

Tools: A set of wrenches, special tool for removing magnetic flywheel, Torque wrench, Filler gauge, Ohmmeter, Smooth file, Timing tester, a special tool for setting the position F, Air gun with hose

Equipment: Steel brush, Brass brush, Cleaning pan, Cloth

Manufacturer: Model.....

Type of ignition system:.....

Standard torque for magnetic flywheel: Nm

Standard resistance of ignition coil:.....

Standard inspection for C.D.I and transistor module:

- Primary coil:.....
- Secondary coil:

Standard capacitive of condenser:µF

Standard gap between ignition coil and magnetic flywheel mm

Standard gap between contact points..... mm

Sequence of operations	Inspection	
1. Prepare tools and equipment	Condition of spark plug.	
2. Remove spark plug.	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
3. Clean spark plug.	<input type="checkbox"/> Use steel brush	
4. Check and adjust electrode.	Obtained electrode gap	
5. Remove starting unit.	<input type="checkbox"/> Normal	
6. Remove blower cover and other obstruction.	<input type="checkbox"/> To be readjusted	
7. Remove magnetic flywheel.	Use of tools.	
	<input type="checkbox"/> Use special tools	
	<input type="checkbox"/> Others	
8. Remove all parts of ignition system.	Conditions of general parts.	
	<input type="checkbox"/> Perfect	<input type="checkbox"/> Imperfect
9. Check ignition coil.	Obtained reading	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged

10. Check CDI and transistor module.	Obtained reading	
	<input type="checkbox"/> Primary coil	
	<input type="checkbox"/> Secondary coil	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
11. Check condenser	Condition of condenser	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
12. Check contact points	Condition of contact points	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
13. Reassemble those parts in their reverse order.	Reassemble	
	<input type="checkbox"/> Complete	<input type="checkbox"/> Incomplete
14. Adjust clearance between ignition coil and magnetic flywheel.	Standard clearance mm.	
15. Adjust gap of contact point.	Standard gap of contact points mm.	
16. Adjust ignition timing.	Ignition timing adjustment	
	<input type="checkbox"/> Use timing tester	
	<input type="checkbox"/> Others	
17. Reassemble all parts.	Reassemble of all parts.	
	<input type="checkbox"/> Complete	<input type="checkbox"/> Incomplete
18. Clean and store tools–equipment.	<input type="checkbox"/> Complete	<input type="checkbox"/> Incomplete
Note:	
	

3. Speed control system

Information

3.1 Task of governor

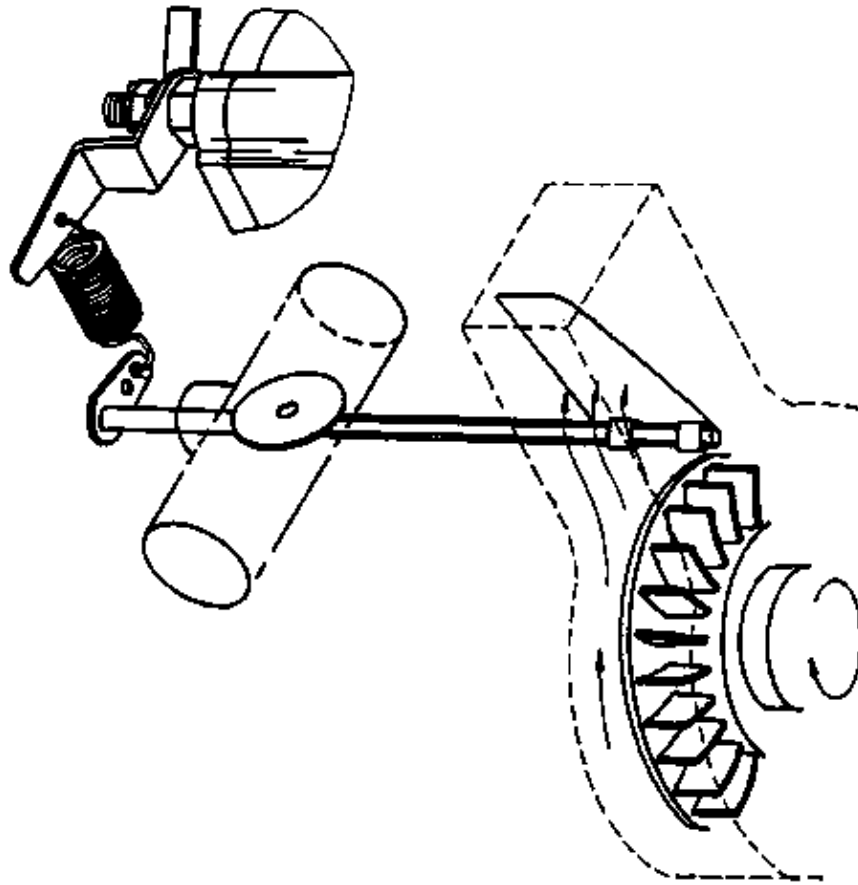
– to maintain constant engine speeds during running under varying loads.

3.2 Types and function of governor

Governors can be classified into 2 types:

3.2.1 Pneumatic governor

Constant engine speed is controlled by means of air flowing from the blower upon the blade of governor, which is connected to throttle plate mechanism.



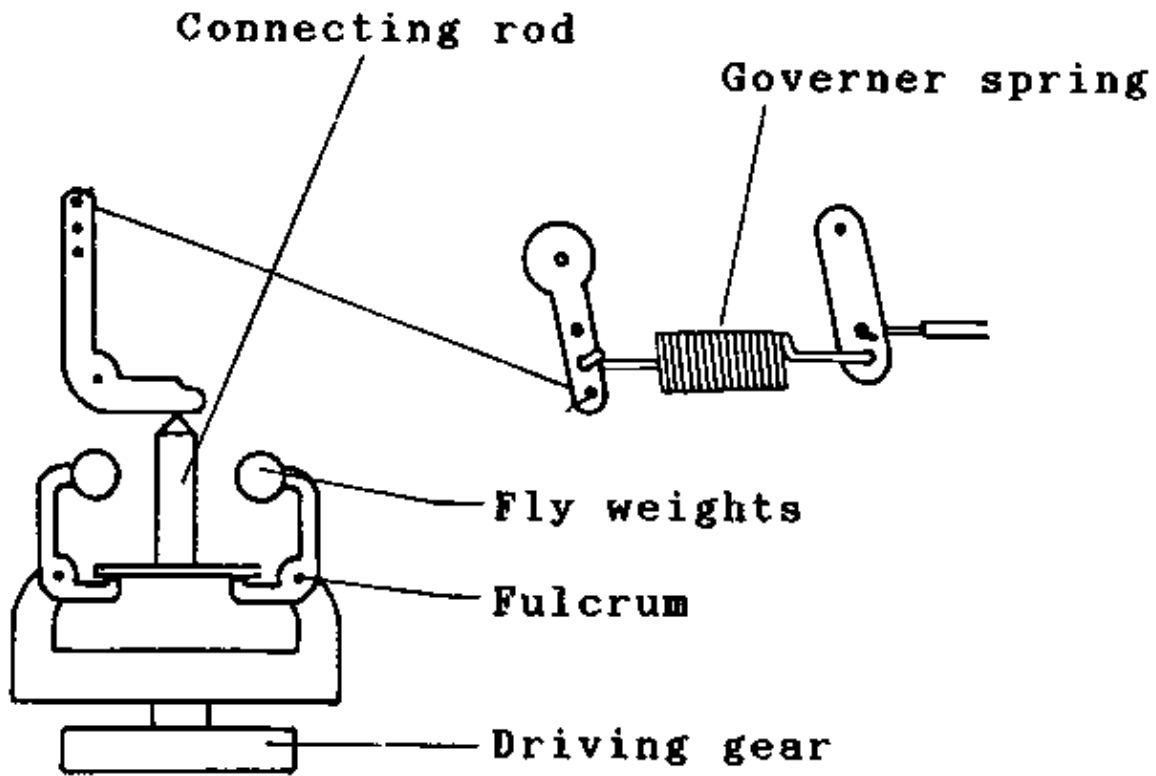
– As the engine speed increases, the flow of air is also increasing accordingly, and thereby turning the governor blade to turn the throttle plate in the direction to which the engine speed decreases until the throttle plate spring balances the force on the governor blade.

– When the engine is subjected to increasing load its speed will be decreasing. Thus, the air-force on the governor blade is also decreasing relatively, and surrendering to the force of throttle plate spring.

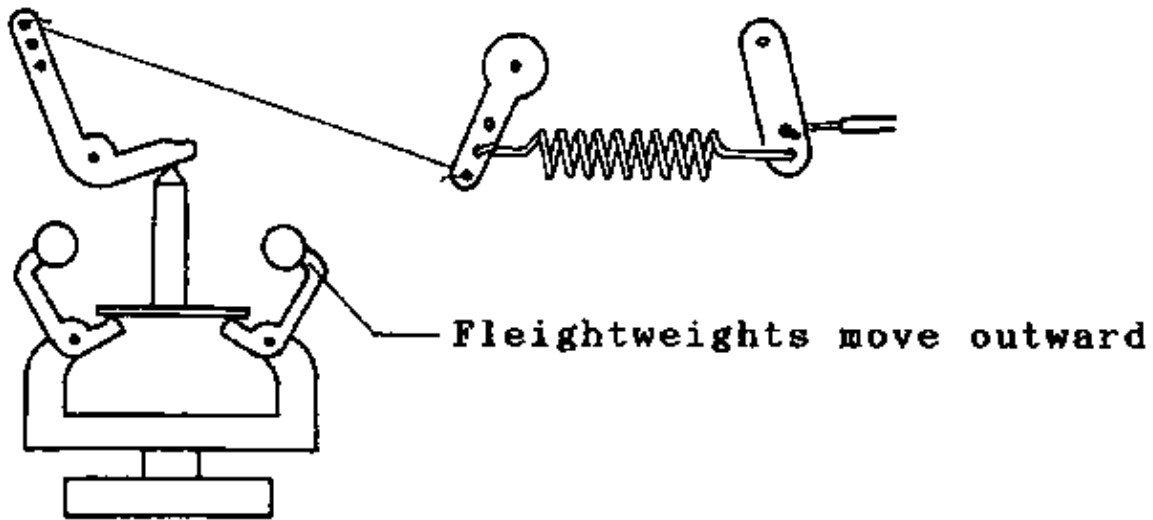
Therefore, the engine speed will be maintained constantly at every changing load.

3.2.2 Mechanical governor

This type of governor is operated by means of centrifugal force of the fly weights.



– As the engine speed decreases, the centrifugal forces of the flyweights are also decreasing, and thereby opens the linkage of the throttle plate further. Thus, the engine speed increases to match a particular load.



– As the engine speed increases, the fly weights move away further and thereby reducing the opening of the throttle plate. Thus, the engine speed is coming down. Therefore, the engine speed will be maintained constantly at every changing load.

Task sheet

Fill in the blanks and underline the correct answer.

1. Governor is for
2. Governor is classified into types, i.e.....
3. At the engine stops, the position of the throttle plate will be –fully opened/ fully closed–.

4. The tensioning force of spring will tend to ~~–increase/decrease–~~the engine speed.
5. Governor that has fly weights is of the type.
6. As the engine speed is on the increase, the flyweights will be ~~–retracted/expanded–~~.
7. When the centrifugal forces of the flyweights are reducing, the throttle plate will be progressively ~~–opened/closed–~~.

Task (Solution)

Fill in the blanks and underline the correct answer.

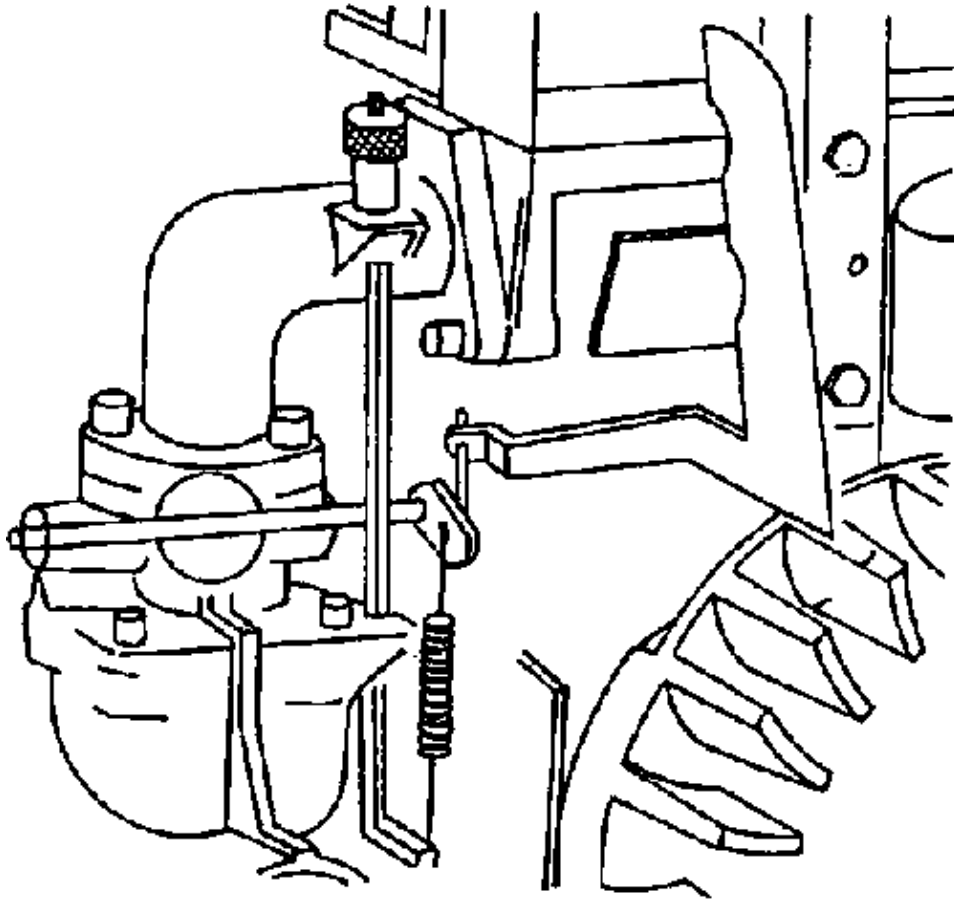
1. Governor is for maintaining constant engine speed
2. Governor is classified into 2 types, i.e Pneumatic governor a Mechanical governor
3. At the engine stops, the position of the throttle plate will be ~~–fully opened/~~ fully closed–.
4. The tensioning force of spring will tend to ~~–increase/decrease–~~the engine speed.
5. Governor that has fly weights is of the mechanical type.
6. As the engine speed is on the increase, the flyweights will be ~~–retracted/expanded–~~.
7. When the centrifugal forces of the flyweights are reducing, the throttle plate will be progressively ~~–opened/closed–~~.

3.3 Repair and maintenance

3.3.1 Adjusting the pneumatic governor

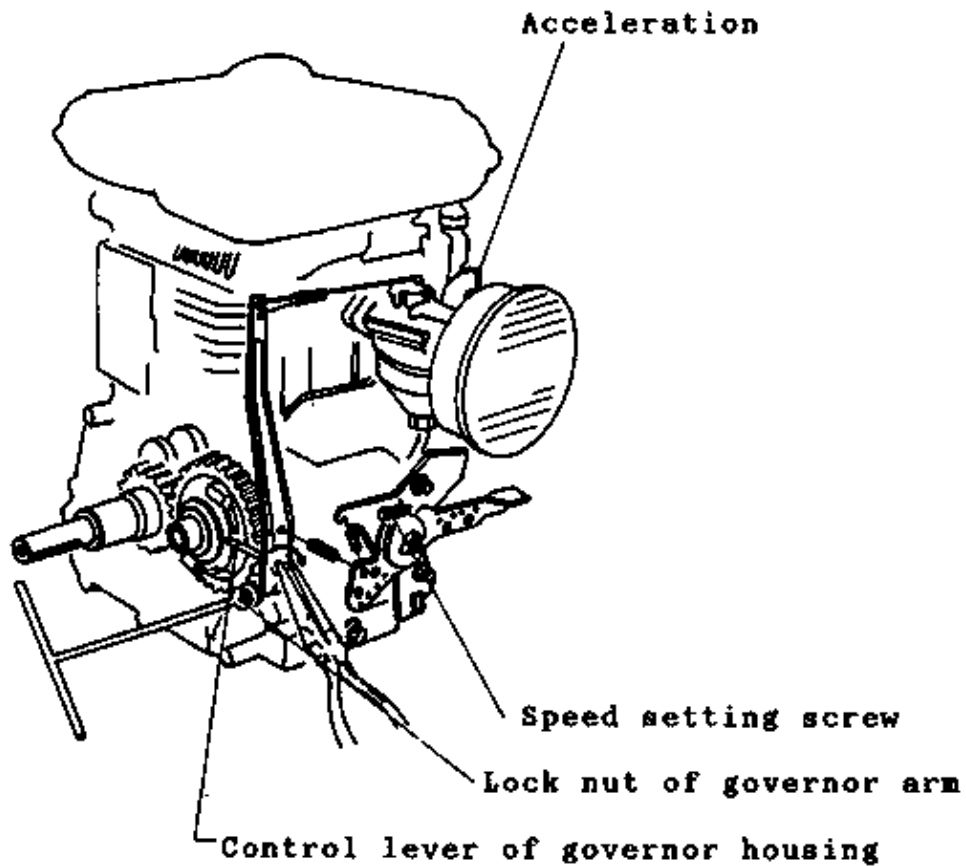
Sequence of operations:

1. Screw on the governor spring fully.
2. Start the engine.
3. Unscrew the governor spring gradually until the required engine speed is obtained.



- Remark:
- The further the screw is tightened the lower the engine speed.
 - The further the screw is loosened the higher the engine speed.

3.3.2 Adjusting the mechanical governor



- Push the governor arm to the maximum speed position and loosen the lock nut of the governor arm.
- Turn the control lever of the governor housing clockwise until stop (shut off position), then tighten the lock nut of the governor arm.
- Start the engine; adjust the speed setting screw until the maximum engine speed is obtained.

Standard maximum speed 4000 rev/min.

Job Sheet

Tools: a set of wrenches, air gun with hose

Equipment: Benzene, oil can, cleaning tray, cloth

a) Pneumatic governor

Manufacturer Model

Sequence of operations	Inspection
1. Remove the blower cover.	- Condition of blower cover
2. Remove the governor unit.	- Condition of governor spring
Caution: Be aware of mixing up positions of governor mechanism	Normal Weakened

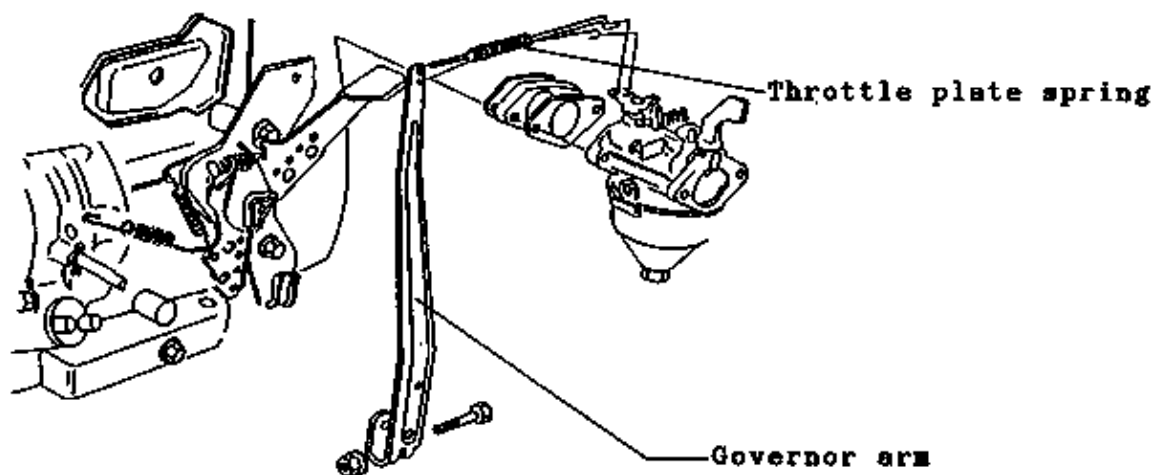
	Others
3. Reassemble in reverse order.	

b) Mechanical governer

Manufacturer Model

Sequence of operations	Inspection	
	– Tension of the throttle plate spring.	
Caution beware of benzene	Normal	Weakened
2. Remove governer unit from the carburetter.	– Straightness of the governer arm	
	Normal	Bent
3. Reassemble in reverse order		

Remember: The short end of the throttle plate spring is on the carburetter side.



4. Valve mechanism

Information

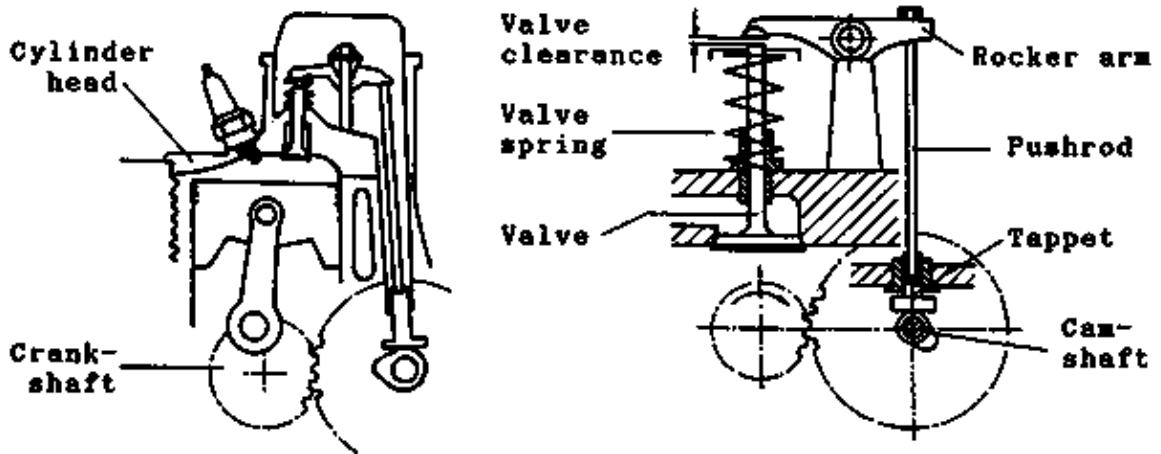
4.1 Task of valve mechanism

to open/close intake air–fuel mixture and exhaust gas in and out the cylinder, according to various strokes of engine.

4.2 Types and function

Valve mechanism is classified into 2 types:

4.2.1 Overhead valve



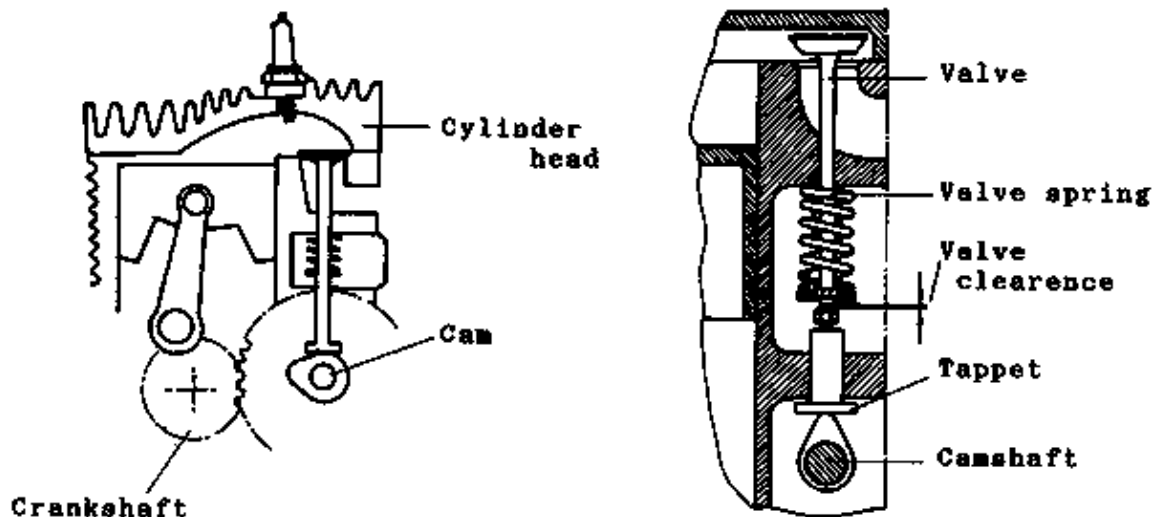
Crankshaft speed: Camshaft speed =2:1

As the camshaft is driven by the crankshaft gear, the tappet is lifted and thereby the push rod pushes the rocker arm. The valve is, thus, opened as the pushing force of the rocker arm prevails that of the spring. When the cam turns beyond its lift the valve is closed under the force of valve spring.

Opening/Closing of valves is timed according to various strokes of the engine.

Advantages	Disadvantages
1. Low intake flow resistance.	- Complicated cylinder head.
2. Improved engine power.	- Engine is tall.
3. Valve servicing is easy.	- High number of parts of valve mechanism.

4.2.2 Side Valve



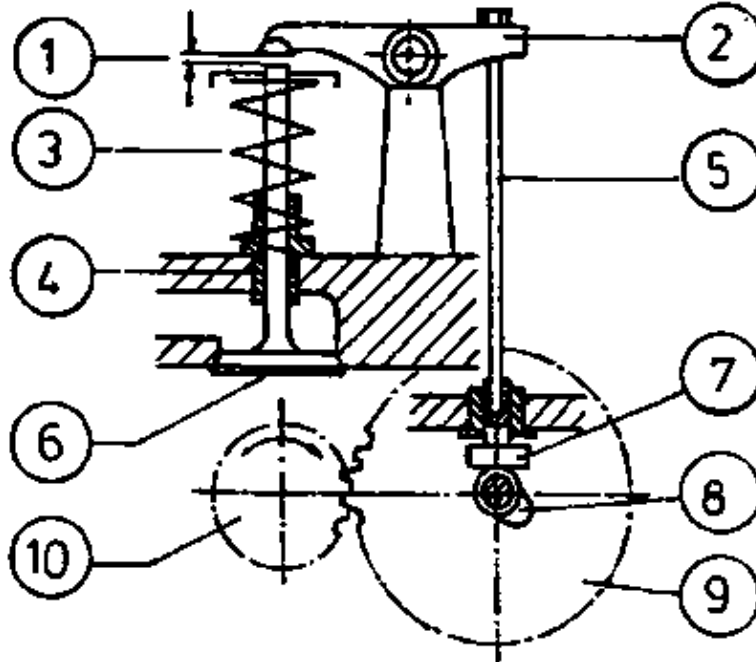
- As the camshaft is driven by the crankshaft gear, the valve is pushed to open by the cam via the tappet.

Advantages	Disadvantages
1. Valve arrangement is easy.	- High intake and exhaust flow resistance.
2. Small number of parts of valve mechanism.	- Combustion chamber is not compact.
	- Inefficient engine power.

Task sheet

Complete the statements.

1. Valve arrangement for 4 stroke small engines can be accomplished in ways, that is.....
2. Name various parts of the valve mechanism.



- | | |
|---------|----------|
| 1 | 6..... |
| 2 | 7 |
| 3 | 8 |
| 4..... | 9 |
| 5..... | 10 |

3. Crankshaft speed: camshaft speed =:
4. As the engine makes 1 complete turn, the intake valve will open and close for time whereas the exhaust valve does the same for time.
5. Both intake and exhaust valves can be opened or closed by means of.....
6. The advantages of the overhead valve engine are:
 - 1.....
 - 2.....
 - 3.....

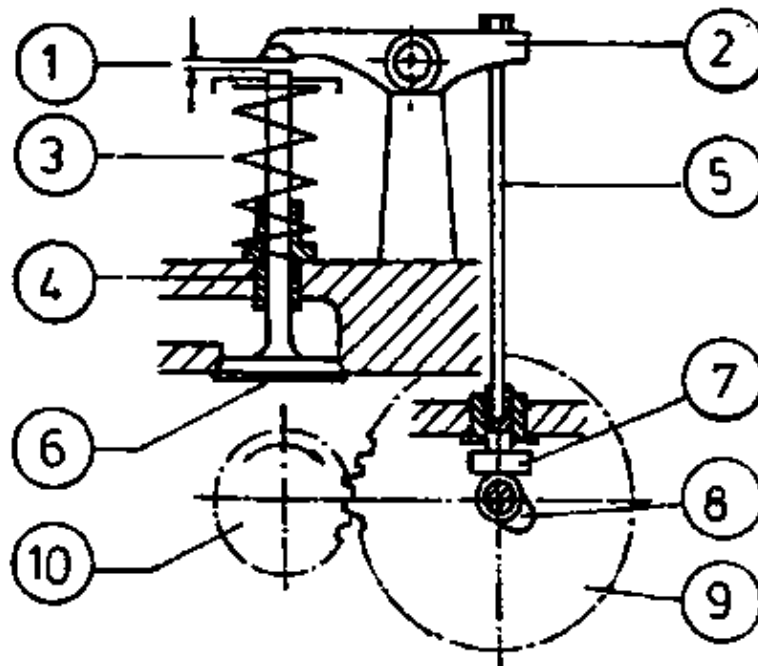
7. The advantages of the side valve engine are:
 - 1.....
 - 2.....

Task (Solution)

Complete the statements.

1. Valve arrangement for 4 stroke small engines can be accomplished in 2 ways, that is Side valve and overhead valve

2. Name various parts of the valve mechanism.



- | | |
|-------------------|-----------------------------|
| 1 Valve clearance | 6 Valve |
| 2 Rocker arm | 7 Tappet |
| 3 Valve spring | 8 Cam |
| 4 Valve guidance | 9 Timing gear (cam) |
| 5 Pushrod | 10 Timing gear (crankshaft) |

3. Crankshaft speed: camshaft speed = 2:1

4. As the engine makes 1 complete turn, the intake valve will open and close for 1 time whereas the exhaust valve does the same for 1 time.

5. Both intake and exhaust valves can be opened or closed by means of Cam, Tappet, Pushrod and Rocker arm

6. The advantages of the overhead valve engine are:

- 1 Low intake flow resistance
- 2 Improved engine power
- 3 Valve service is easy

7. The advantages of the side valve engine are:

- 1 Valve arrangements is easy
- 2 Small number of parts

4.3 Compression reduction mechanism

Information

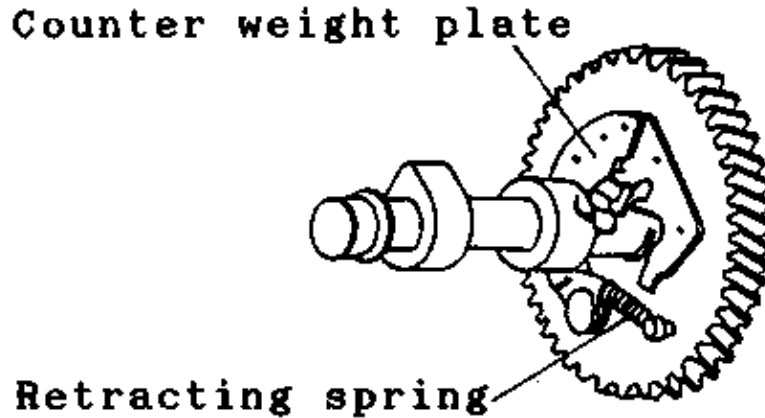
4.3.1 Purpose of compression reduction mechanism

To reduce compression in the cylinder during engine starting, thus, the power to start the engine is at minimum..

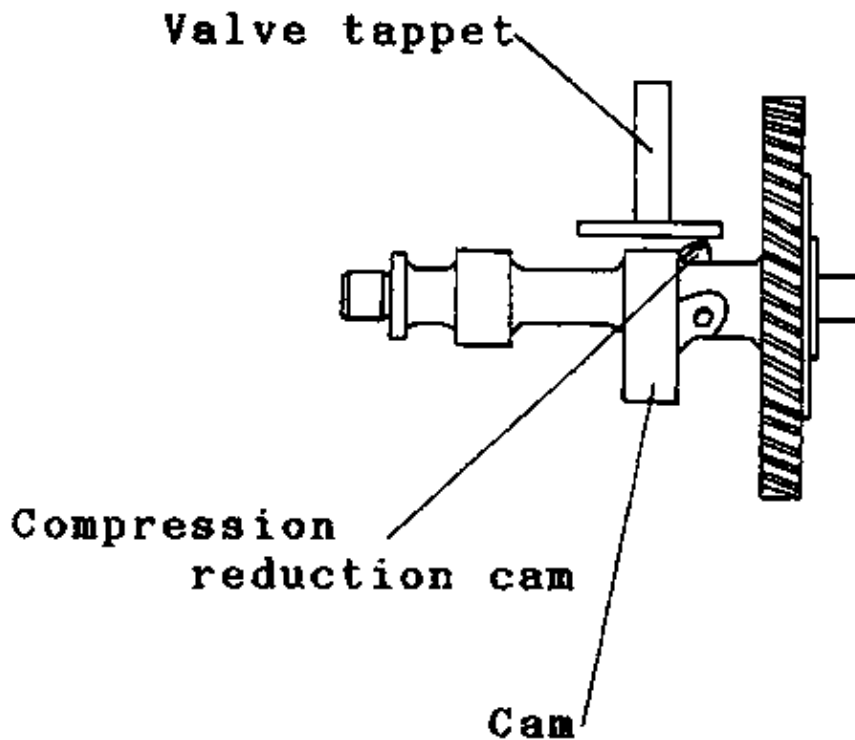
4.3.2 Components and function

This mechanism will open the exhaust valve during the starting string is pulled out.

a) When starting the engine



When the engine is at rest, the counter weight plate is kept in its original position by means of the retracting spring.

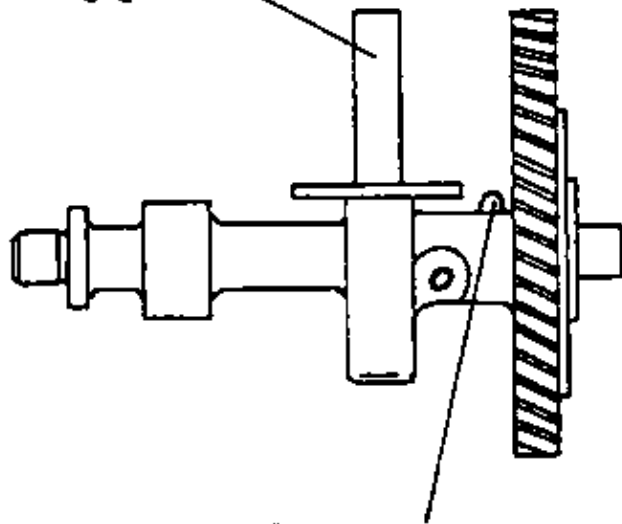


The compression reduction cam is on its peak which is above the heel of the cam.

When the starting string is pulled out, the compression reduction cam will slightly raise the valve tappet to reduce compression. This arrangement will ease the start of the engine due to the engine can run fast.

b) During engine running

Valve tappet



Compression reduction cam

When the engine is running at the speed of 800 rev/min, the counterweight plate is forced outward by the centrifugal force.

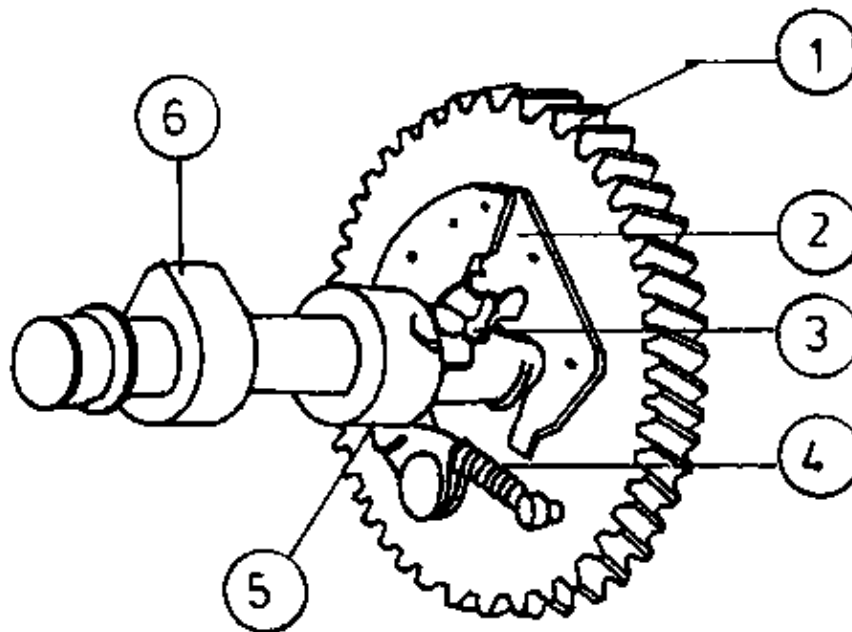
The compression reduction cam is thereby pulled down and away from the valve tappet.

Task sheet

4.3 Compression reduction mechanism

Complete the statements or underline the correct answers.

1. The purpose of compression–reduction is
2. Compression –reduction can be accomplished by –opening/closing–the valve.
3. Name various parts of the compression–reduction mechanism.



- 1.....
- 2.....

- 3.....
- 4.....
- 5.....
- 6.....

4. When the starting string is pulled, the will lift the tappet and the is opened to allow the exhaust gas to escape.

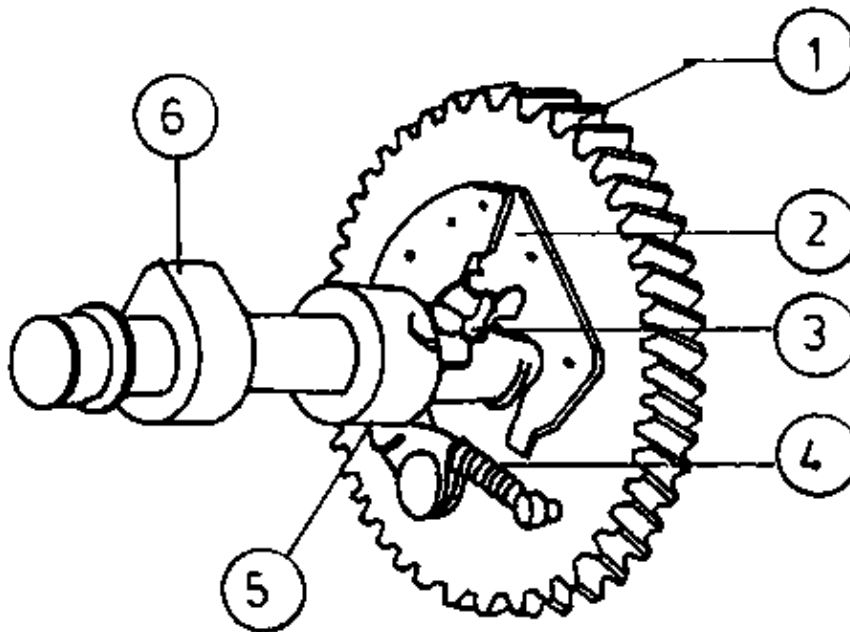
5. As the engine is running, the centrifugal force of the counterweights will be –increasing/decreasing– and causing them to –expand/retract.

Task (Solution)

4.3 Compression reduction mechanism

Complete the statements or underline the correct answers.

- 1. The purpose of compression–reduction is to reduce compression in the cylinder during engine start.
- 2. Compression –reduction can be accomplished by –opening/closing–the exhaust valve.
- 3. Name various parts of the compression–reduction mechanism.



- 1 Timing gear
- 2 Counter weight plate
- 3 Compression reduction cam
- 4 Retracting spring
- 5 Cam for exhaust valve
- 6 Cam for intake valve

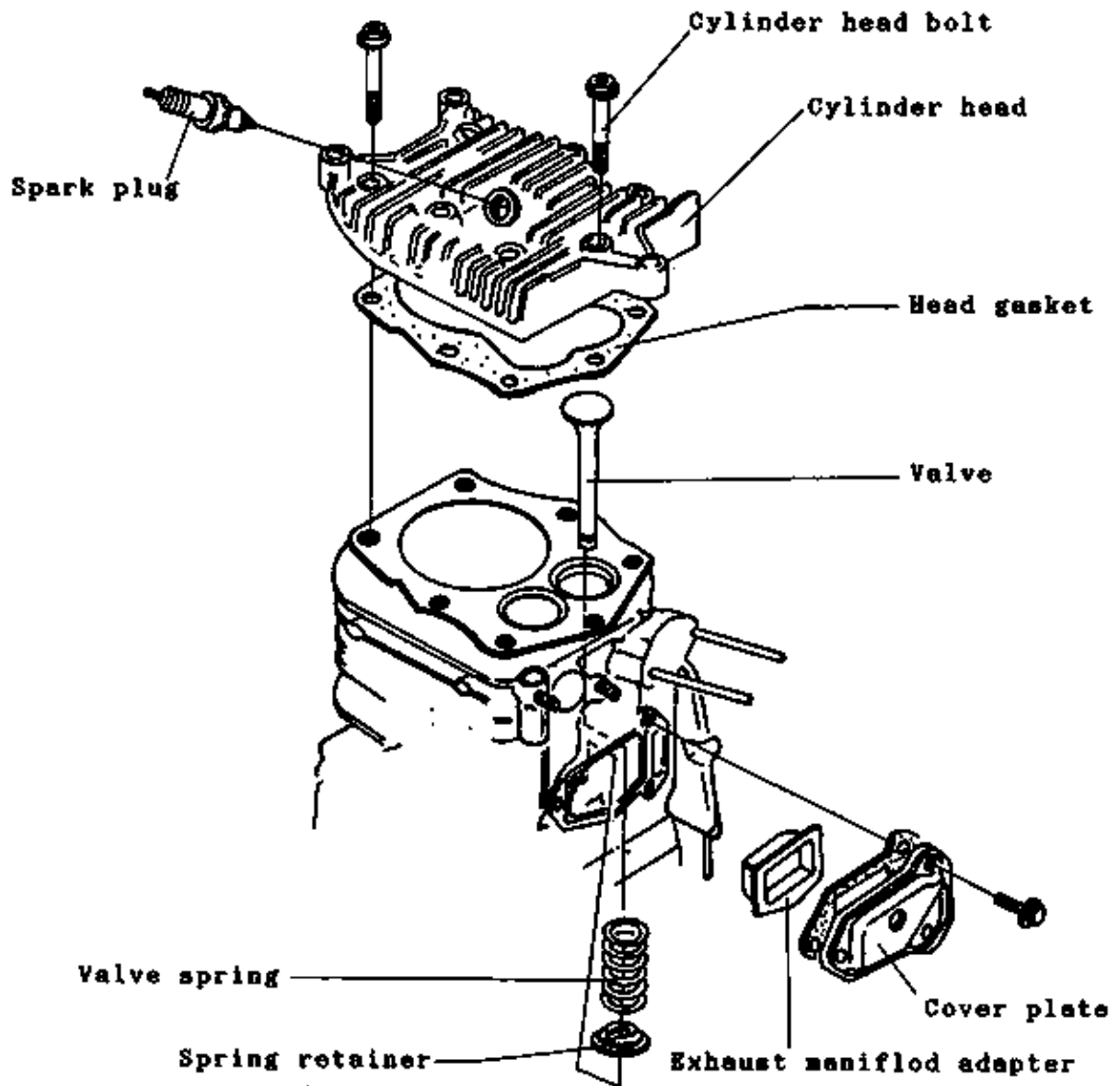
4. When the starting string is pulled, the compression redc. will lift the tappet and the exhaust valve is opened to allow the exhaust gas to escape.

5. As the engine is running, the centrifugal force of the counterweights will be –increasing/decreasing– and causing them to –expand/retract.

4.4 Repair and maintenance

Information

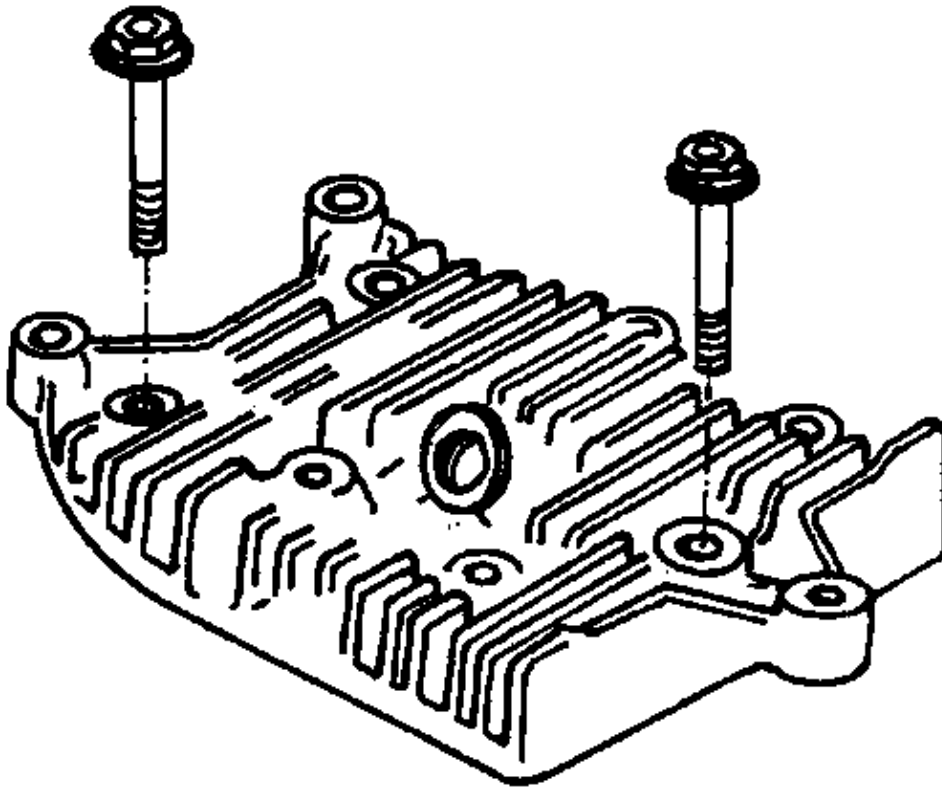
4.4.1 Removal and refitting of valve mechanism



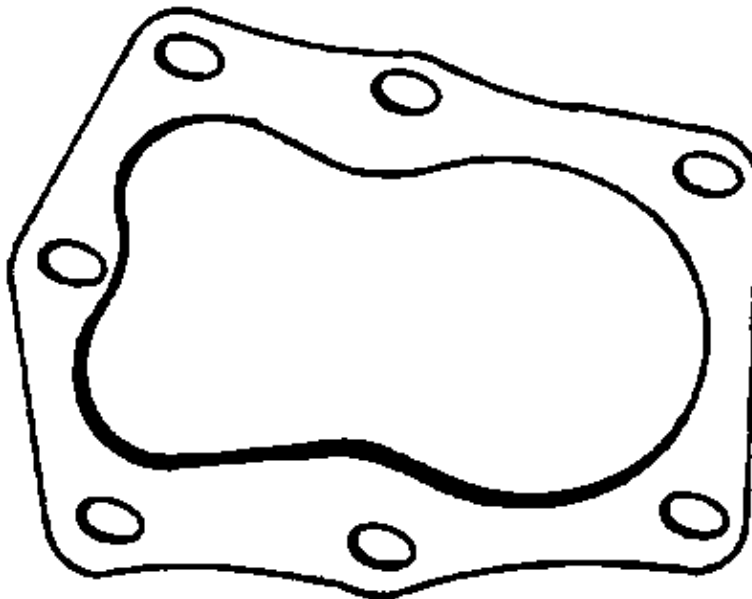
Remark: For valve mechanism removal, cylinder head and valves must be removed accordingly to the specified numbers and reassembled in their reverse order.

4.4.2 Removal/Reassemble of the cylinder head

a) Removing cylinder head

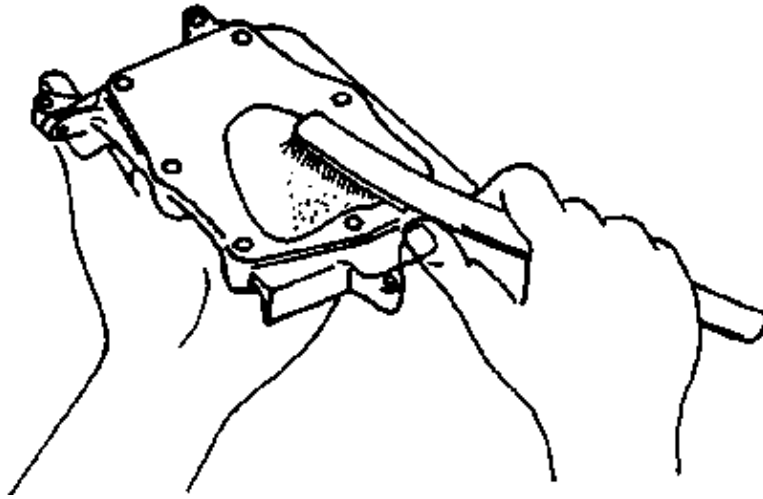


- Loosen all bolts in reverse order
- During loosening, gradual torque settings must be distributed over each bolt.



- Mating surface of the gasket, between the cylinder head and the cylinder block, must be cleaned and of no traces.

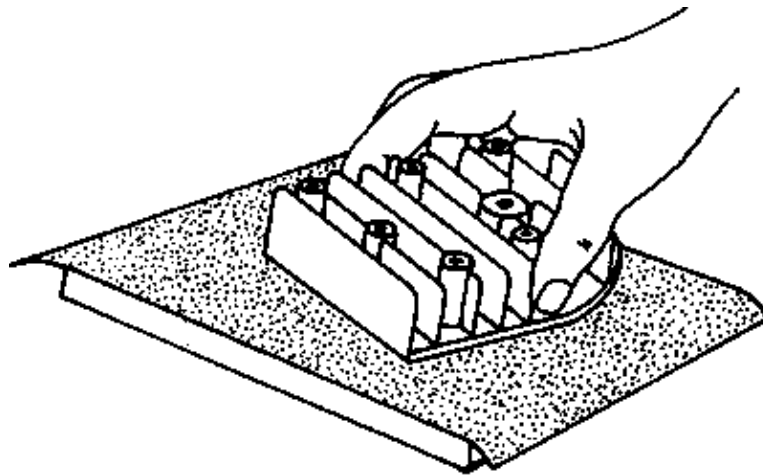
b) Cleaning cylinder head



– Decarbonize the combustion chamber and clean with benzene and dry with air gun.

Remark:

In removing carbon deposits, a broken piece of saw blade which is ground unsharp may be used.

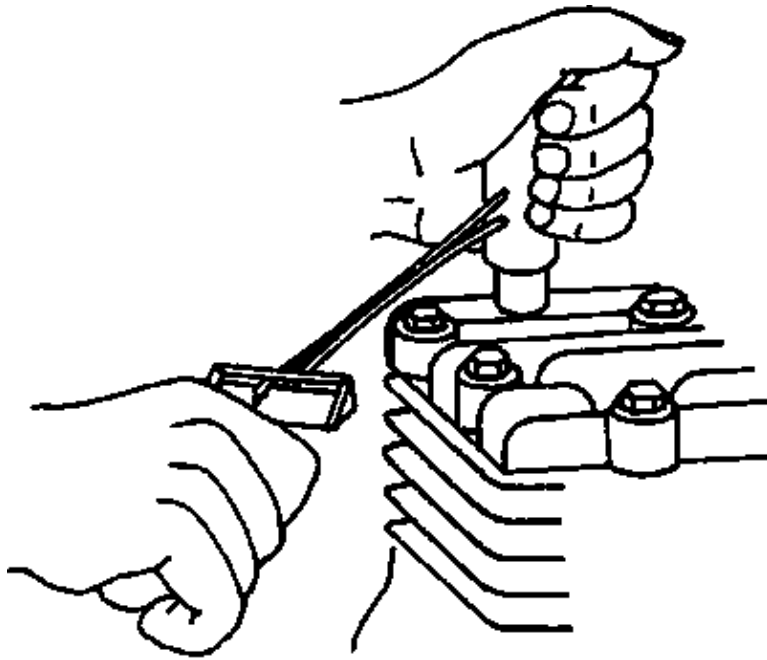


– In case, the cylinder head is distorted or bent, then grind its mating surface with fine grain sand paper (No. 400), which places on a smooth, flat surface level.

Remarks: – Contaminated dirt on fins of the cylinder head causes poor heat dissipation.

– After scraping and cleaning the fins, the cylinder head must be cleaned with benzene and dried with air gun.

c) Refitting the cylinder head

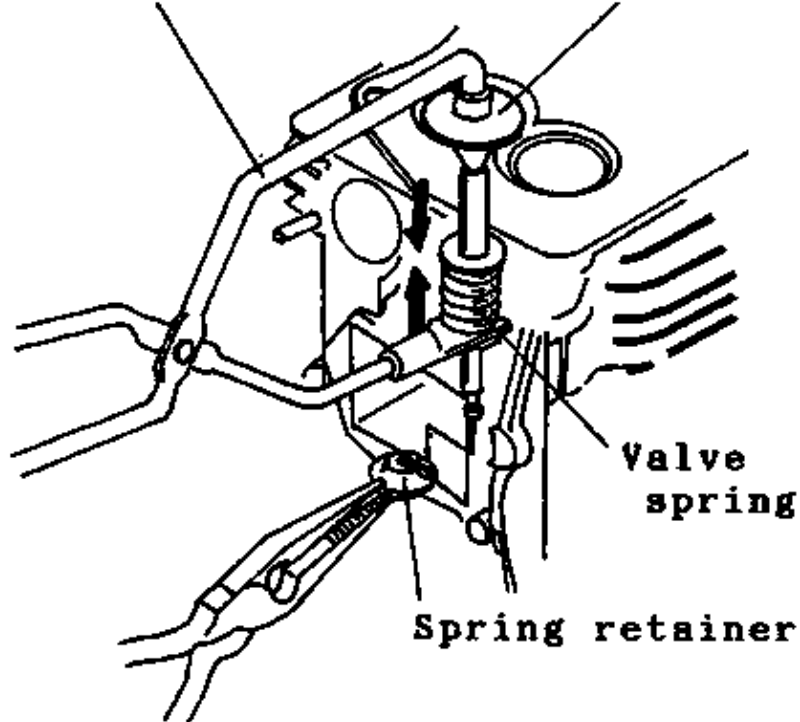


- Tighten the cylinder head bolts in their reverse sequence by using the torque wrench.
 - The required tightening torque must be distributed gradually over successive settings.
- Remark: Required tightening torque 24 – 26 Nm

4.4.3 Removal/Reassemble of the valves

**Pliers for valve
removal**

Valve



**Valve
spring**

Spring retainer

Removal:

Press the valve spring with pliers and remove the spring retainer, then release the pliers and remove valve and valve spring.

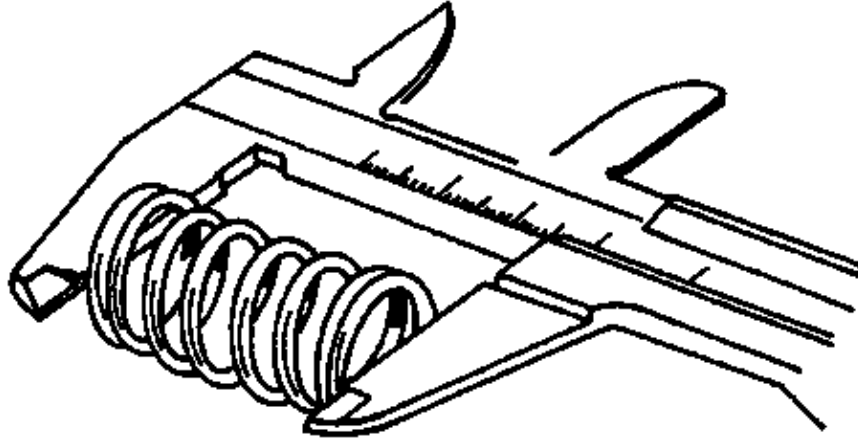
Reassemble:

Insert valve and valve spring, press the spring with pliers and insert the valve retainer.

Caution: Check, if the spring retainer is in the right position!

4.4.4 Valve spring

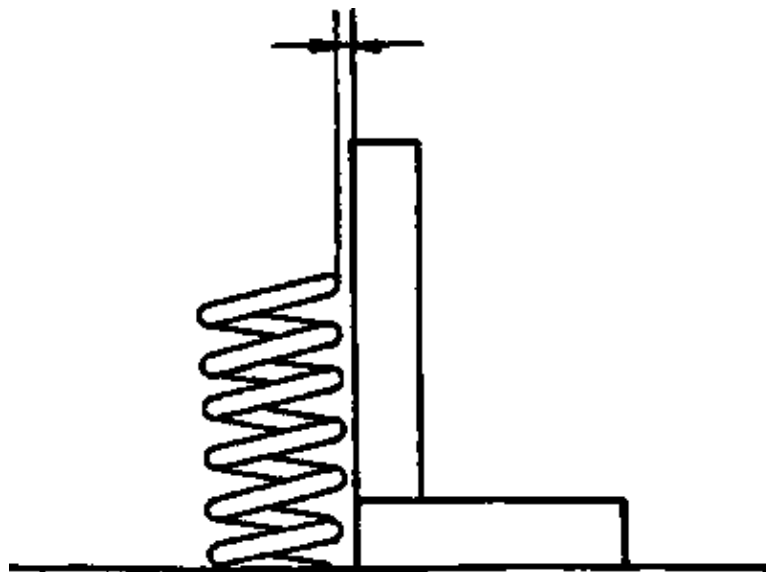
a) Measuring length of valve spring



– If the length of spring is shorter than the specification, then the spring is weakened.

Standard length	36.7 mm
Minimum length	35.2 mm

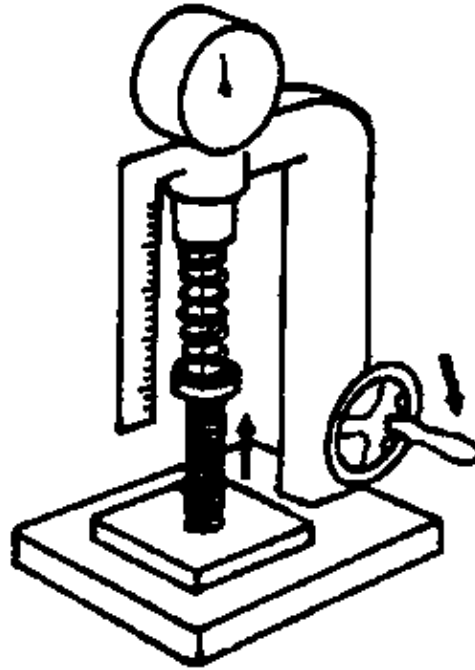
a) Checking squareness



– Turn the spring around itself against the square and observe any diviation.

Remark: Deviation should not exceed 2 mm

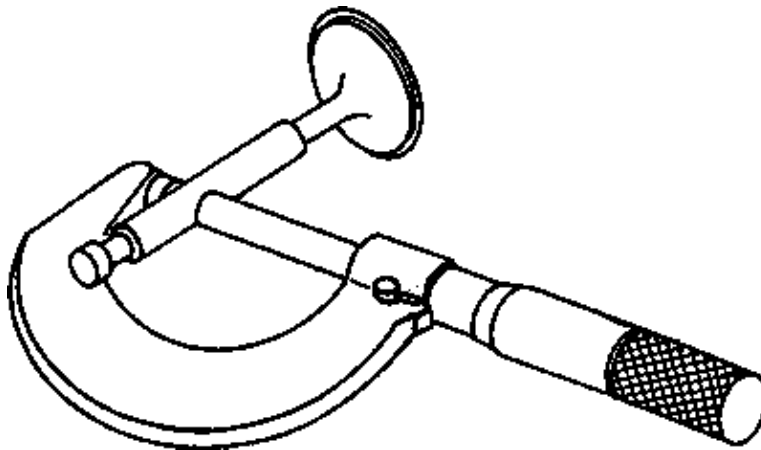
c) Checking strength of spring



– Set the height of the tester to the specification and read the obtained valve on the dial.

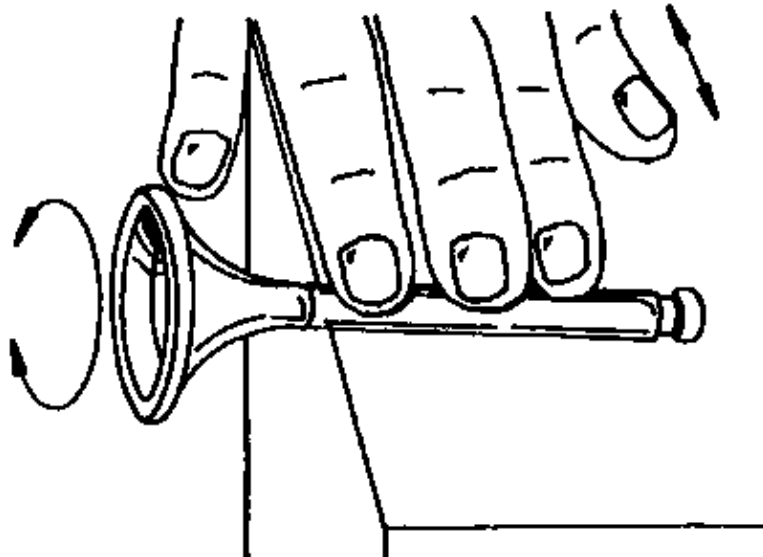
4.4.5 Valve

a) Measuring diameter of valve stem



– Compare the obtained reading with that of the manual.

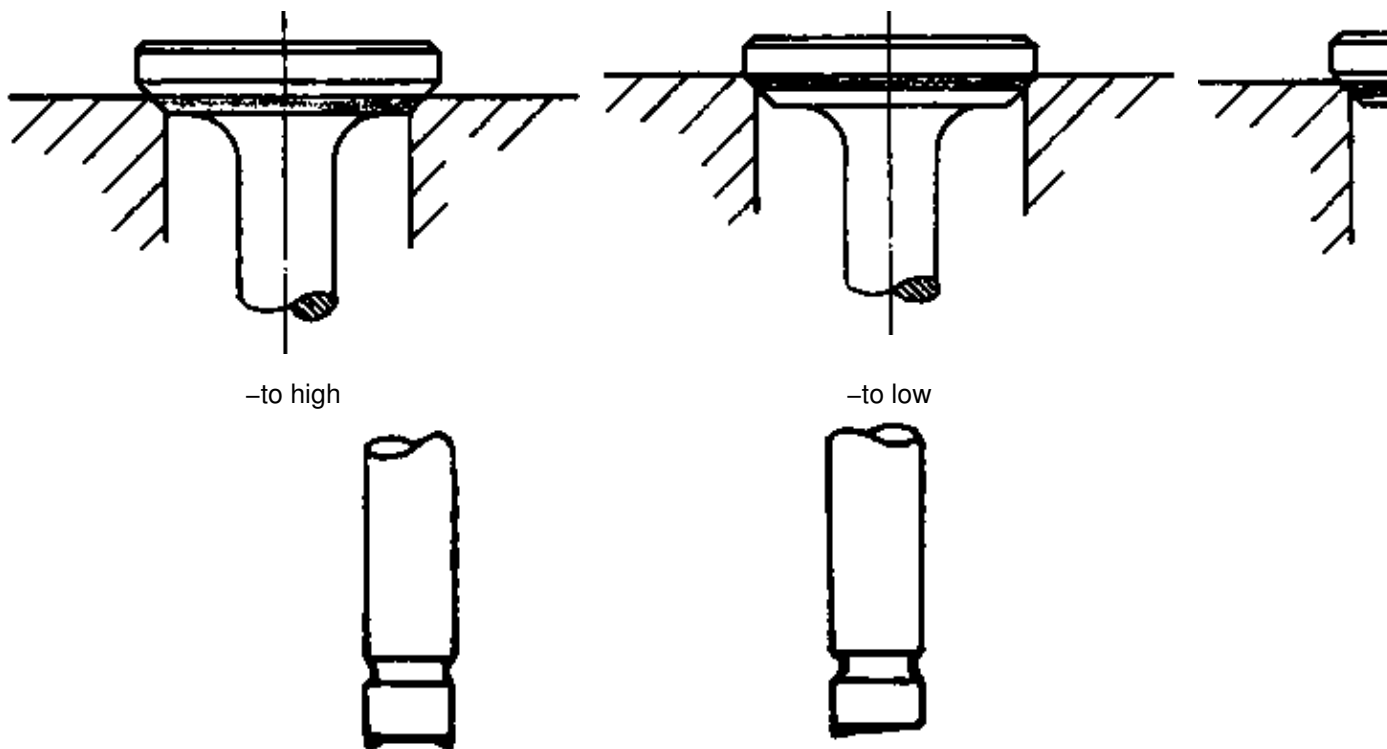
b) Checking straightness of the valve stem



– Roll the valve stem over the surface level, notice for any bending. Replace if it is bented.

c) Checking valve face, margin, and valve stem

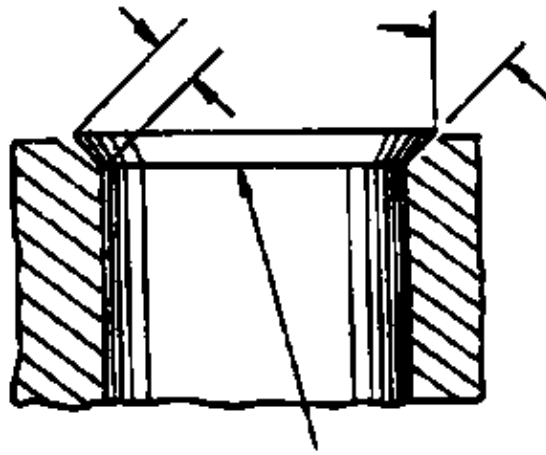
Valve margin ...



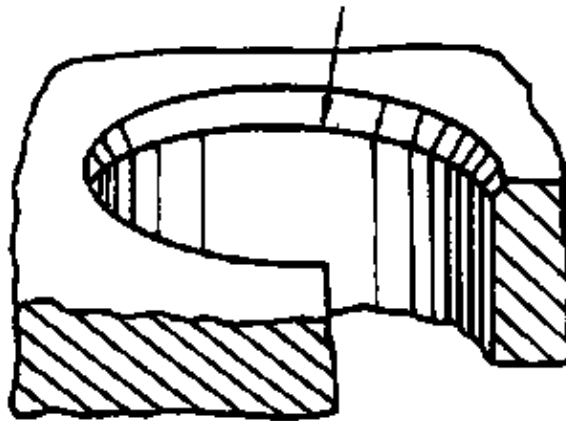
If valve foot is not smooth, then grind it with oil stone.

4.4.6 Valve seat

a) Measuring width of valve seat

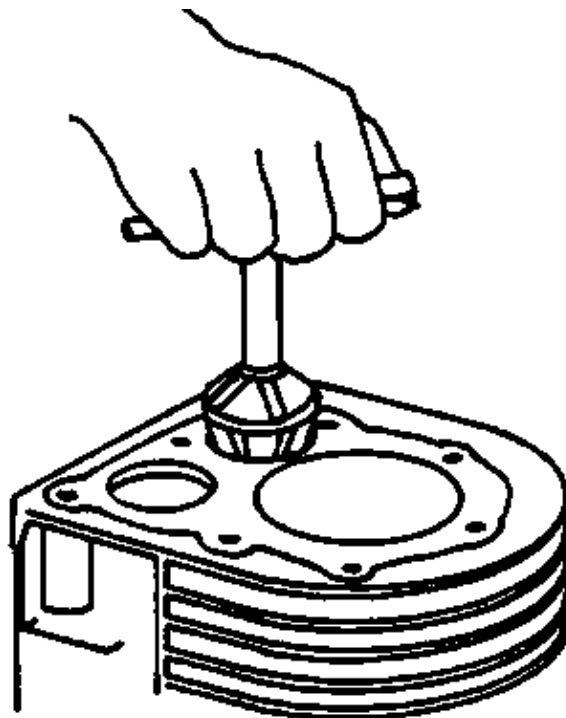


Valve seat



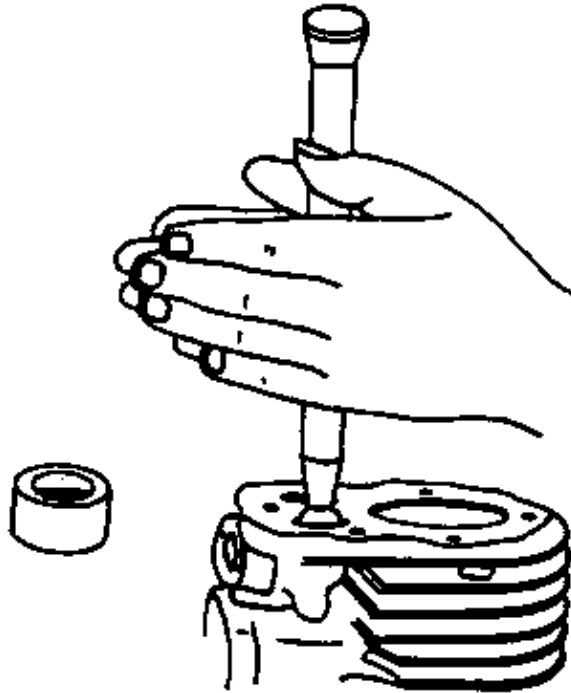
- Measure width of valve seat with vernier caliper.
- Recut the valve seat with the valve seat cutter, if its width is less than that of the specification.

a) Valve cutting



- cut the valve seat with 90 valve seat cutter.
- Recut the valve seat with the smooth cutter.
- Final cut with the 90 valve seat cutter.

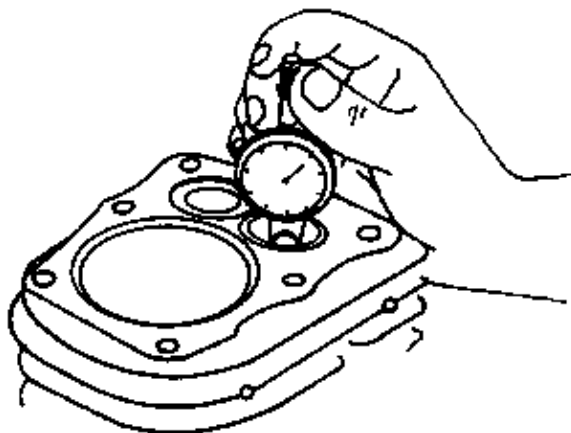
b) Valve grinding



- Smear the valve seat lightly with carborundum paste.
- Hold the valve by the rubber of the grinding tool. Turn the grinding tool to tub the valve face against valve seat.
- Clean the ground valve seat and valve face.

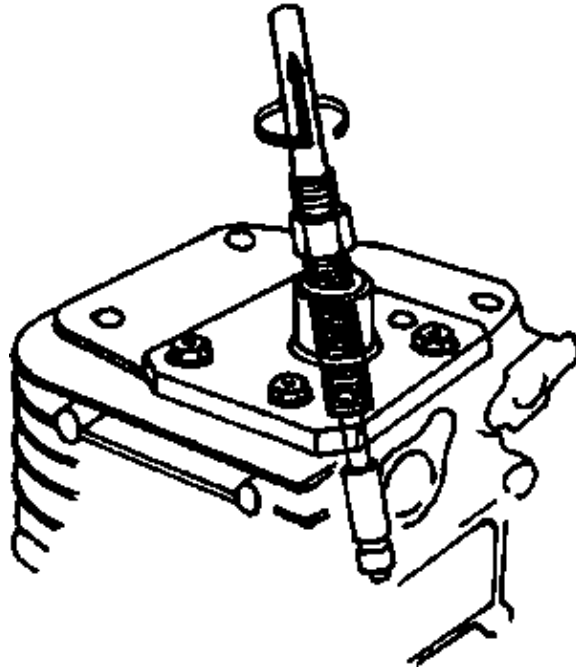
4.4.7 Valve guide

a) Measuring bore of the valve guide



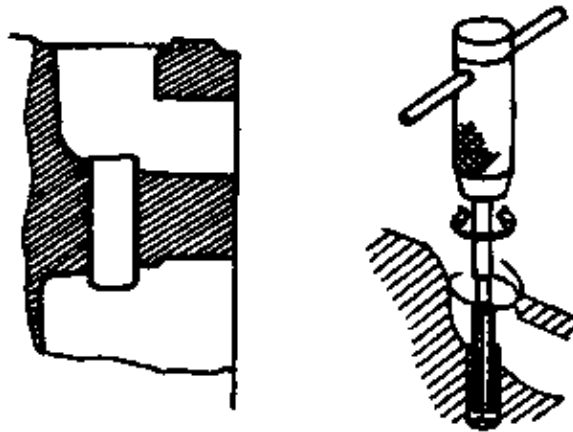
- Measure the bore with the dial indicator.
- Replace the valve guide if the obtained reading is beyond that of the specification.

b) Removing valve guide



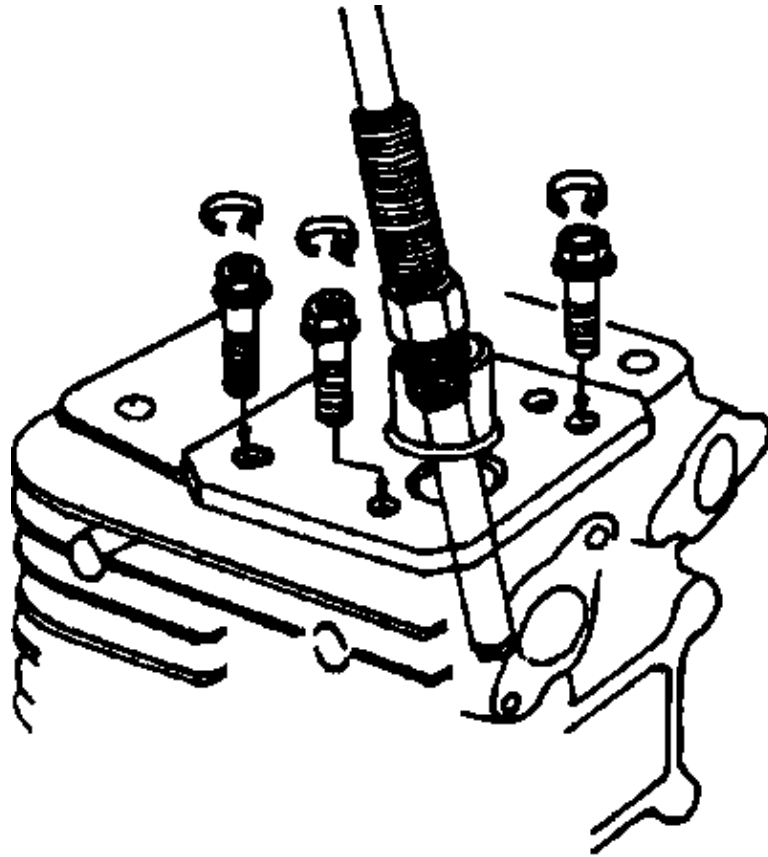
- Mount the special tool to the cylinder head by tightening 3 nuts.
- Screw in the valve guide extractor and screw on the nut underneath the valve guide.
- Unscrew the valve guide extractor until the valve guide is out.

c) Guide and its bore



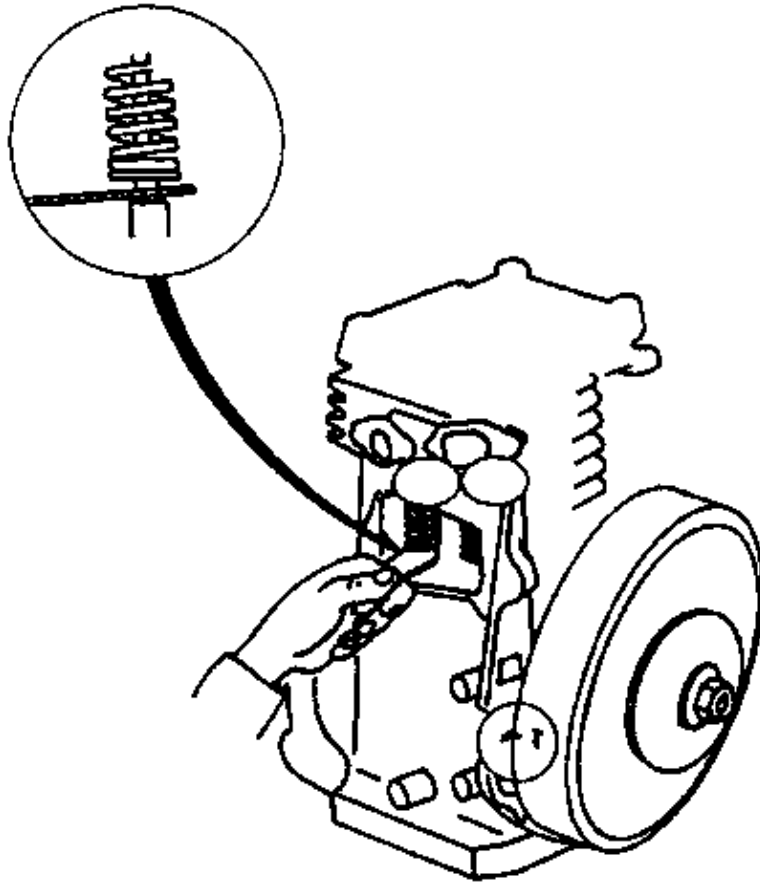
- Screw in the extractor to pull the valve guide.
- The valve guide must be pulled in and positioned correctly.
- Remove the nut and the extractor.

d) Reassembling valve guide



- Reverse the valve guide extractor.
- Fix the flange to the cylinder head and screw on the nut tightly.
- Insert the valve guide onto the extractor and hold it with the nut •
- Oil must be applied to the valve guide and its bore before reassembling.

4.4.8 Valve adjustment



- Turn the engine until the piston is at the top of compression stroke.
- Measure the valve clearance by the feeler gauge.
- Adjust the valve clearance to the specification.

Valve clearance specification 0.04–0.12 mm

- Excessive valve clearance: change valve or tappet
- Insufficient valve clearance: grind valve stem with oil stone.

Job sheets

Tools: a set of wrenches, Spark plug wrench, Torque wrench, Socket wrench and handle, Feeler gauge, Vernier caliper, Spring strength tester, dial indicator

Equipment: Benzene, Oil can, Cleaning pan, Cloth, Brass brush, Sand paper (400), broken saw blade, Oil stone

Manufacturer Model

Type of valve arrangement.....

Compression–reduction mechanism Yes No

Torque for cylinder head hold–down screwNm

Standard length of valve spring..... mm

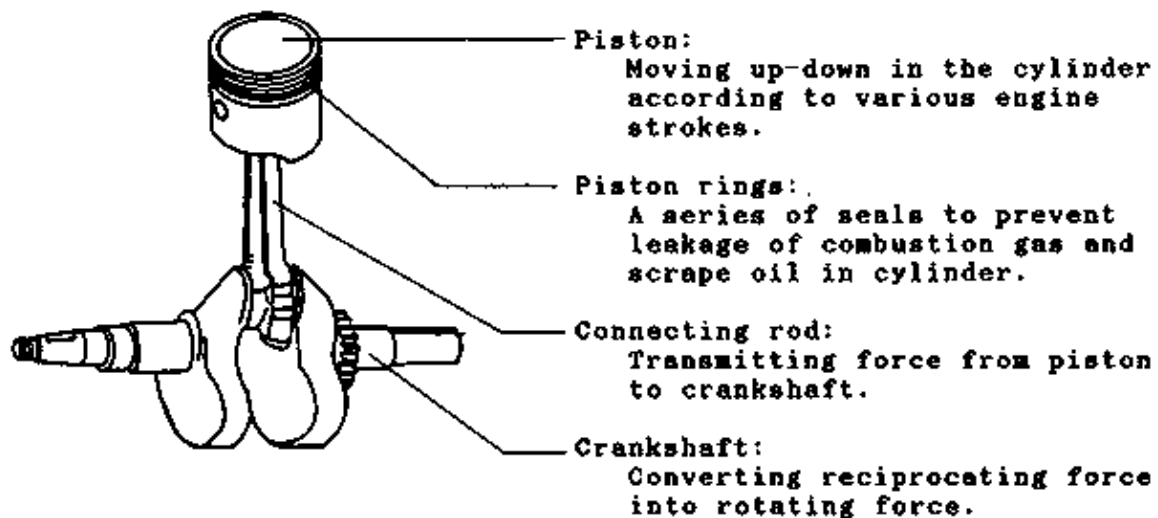
Limited deviation of valve spring squareness mm
 Standard strength of valve spring
 Standard diameter of valve stem mm
 Standard width of valve seat..... mm
 Standard bore of valve guide mm
 Standard valve clearance mm

Sequence of operations	Inspection	
1. Prepare tools and equipment.		
2. Close fuel valve and disconnect fuel hose.		
3. Remove fuel tank.		
4. Remove blower cover and any obstruction.		
5. Remove cylinder head by loosening from the outmost screw toward center.		
6. Remove head gasket.	– Condition of head gasket	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
7. Clean cylinder head.	– Condition of cylinder head	
Remark:	<input type="checkbox"/> Normal	<input type="checkbox"/> Dirty
If the cylinder head is bent or distorted, grind it with sand paper over the surface level.	<input type="checkbox"/> Cracked	<input type="checkbox"/> Bent, distorted
8. Remove carburetter.		
9. Remove side cover plate.		
10. Remove valve springs.		
11. Remove valves.		
12. Clean valve unit and valve seats and arrange them in good order.		
13. Check length of valve spring.	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
14. Check squareness of valve spring.	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Damaged
15. Check strength of valve spring.	– Correct to specification	
16. Measure diameter of valve	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Worn
17. Check straightness of valve	<input type="checkbox"/> Normal	<input type="checkbox"/> Distorted, bent
18. Check valve face.	<input type="checkbox"/> Normal	<input type="checkbox"/> Worn
19. Check margin of valve seat.	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Worn

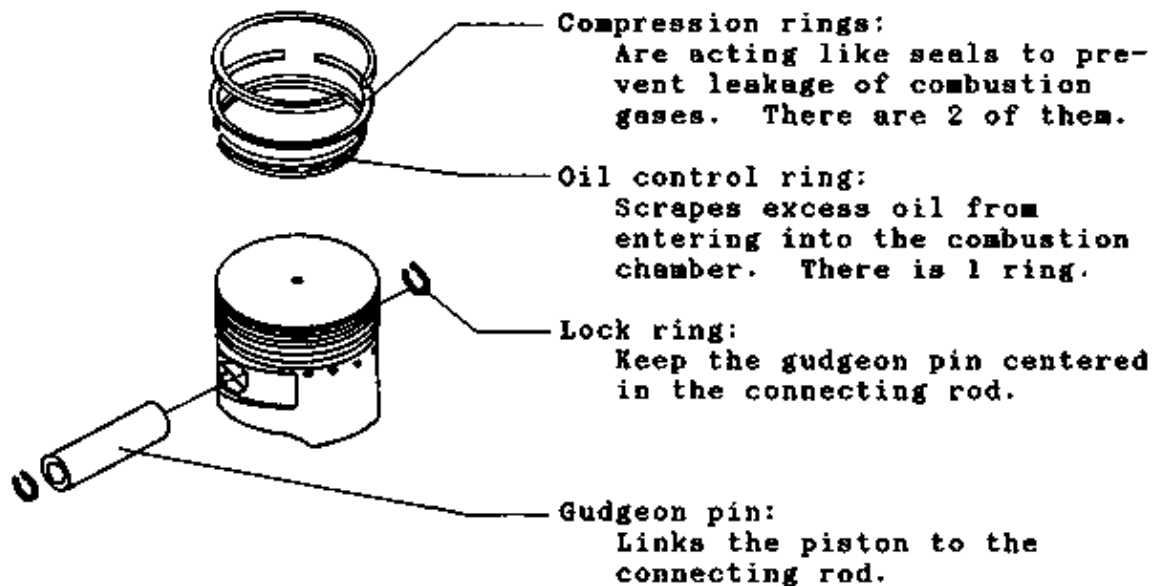
20. Check width of valve seat.	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Worn
Remark: If excessive wear on valve seats, then recut the valve seats and regrind it.		
21. Check bore of valve guide.	– Obtained reading mm.	
	<input type="checkbox"/> Normal	<input type="checkbox"/> Worn
Remark: If excessive wear on valve guides then remove and replace the valve guides by using the special tool.		
22. Reassemble all components in their reverse order.	Reassembling	
	<input type="checkbox"/> Complete	<input type="checkbox"/> Incomplete
23. Adjust valve clearance.	– Standard valve clearance mm	
24. Clean and store all tools and equipment.	Note:.....	

5. Crankshaft mechanism

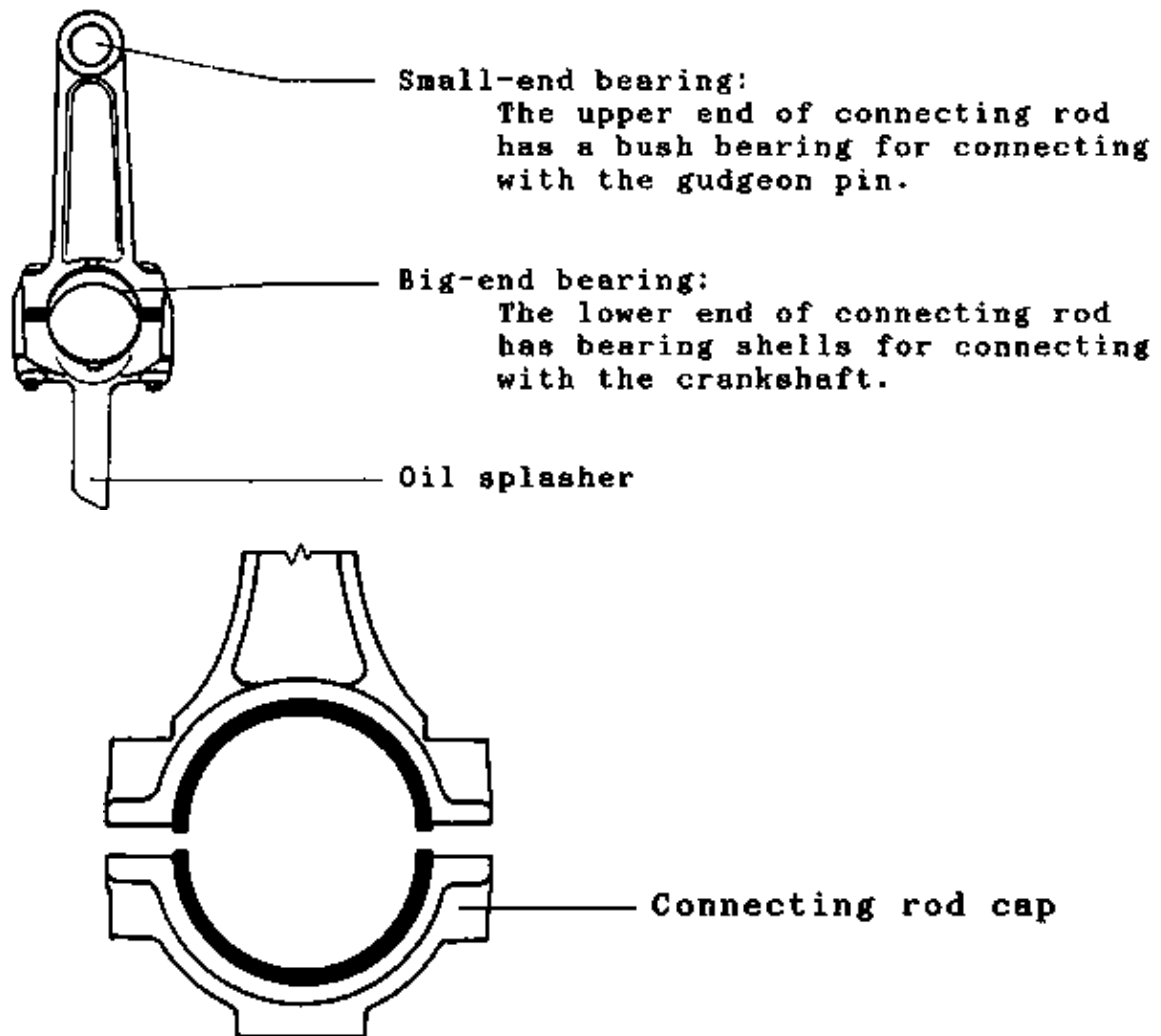
5.1 Components and functions of crankshaft mechanism



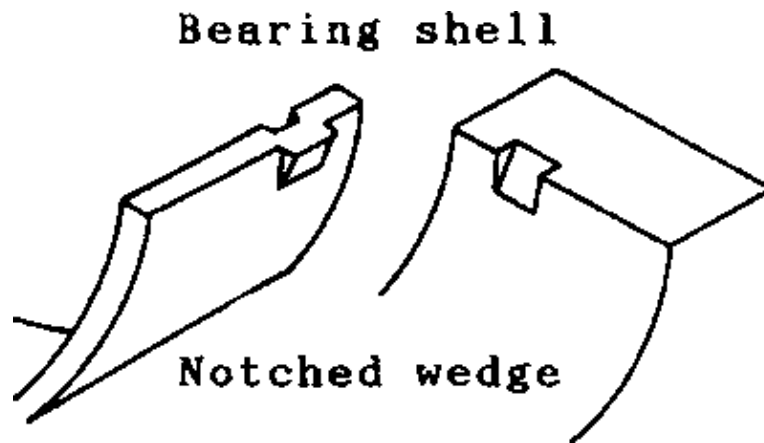
5.1.1 Piston and piston rings



5.1.2 Connecting rod and connecting rod bearings

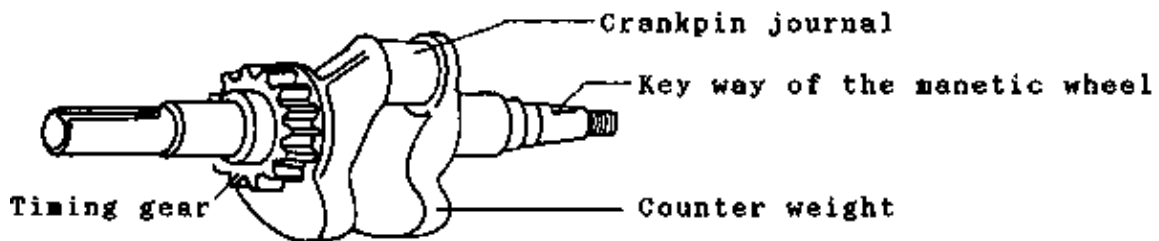


The big-end bearing shells split in two halves. The upper shell fixes with the connecting rod, the lower one with the connecting rod cap.



The bearing shells are positioned by the notched wedges and grooves on the connecting rod and connecting rod cap.

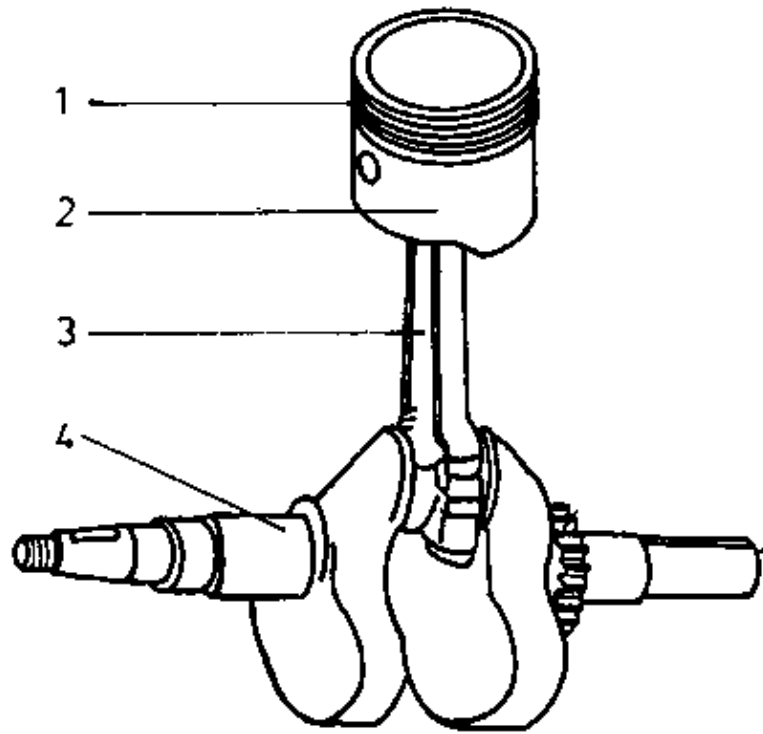
5.1.3 Crankshaft



- Crankpin journal is for connecting with the connecting rod.
- Timing gear is for driving the camshaft.
- Key way is for connecting with the magnetic wheel.
- Counterweight is for damping the engine vibration.

Task sheet

1. Name the parts of the crankshaft mechanism.



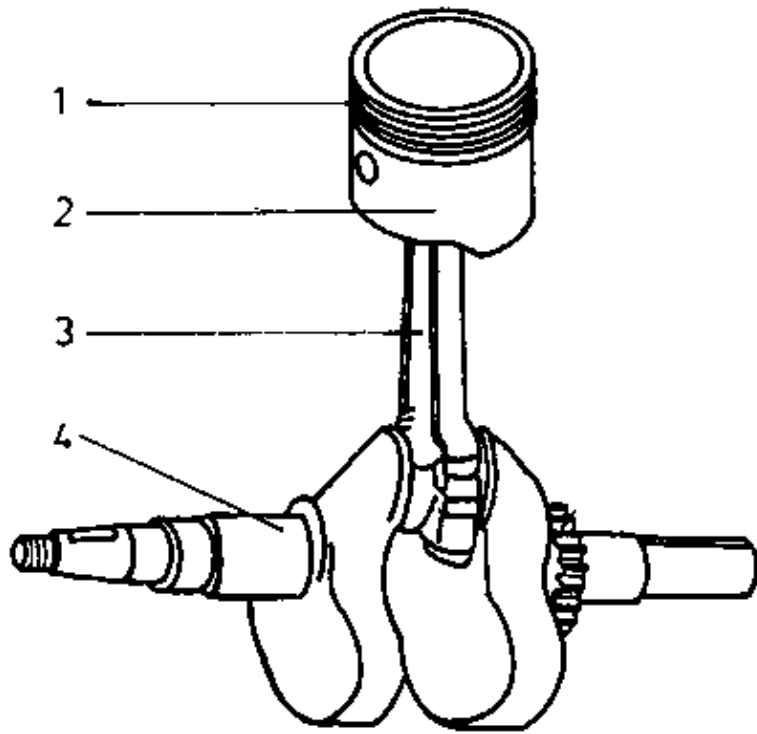
1.
2.
3.
4.

2. Make a cross in front of the correct statements

- ... 1. The part of the piston that bears the impact force mostly is the piston skirt.
- ... 2. Piston rings act as a series of seals to prevent leakage of combustion gases.
- ... 3. Compression rings and oil control ring are exchangeable.
- ... 4. Connecting rod transfers the force from piston to crankshaft.
- ... 5. Big-end bearing shells can be inserted to connecting rod with regardless of their positions.
- ... 6. Crankshaft converts reciprocating motion into rotary motion.
- ... 7. Timing gear of the crankshaft is for setting the ignition timing.

Task (Solution)

1. Name the parts of the crankshaft mechanism.



- 1 Piston rings
- 2 Piston
- 3 Connecting rod
- 4 Crankshaft

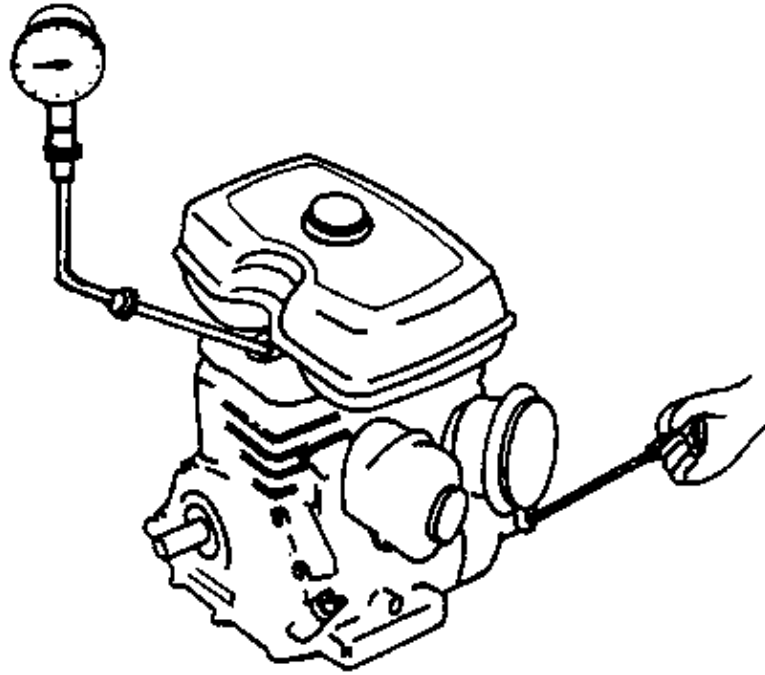
2. Make a cross in front of the correct statements

- ... 1. The part of the piston that bears the impact force mostly is the piston skirt.
- X 2. Piston rings act as a series of seals to prevent leakage of combustion gases.
- ... 3. Compression rings and oil control ring are interchangeable.
- X 4. Connecting rod transfers the force from piston to crankshaft.
- ... 5. Big-end bearing shells can be inserted to connecting rod with regardless of their positions.
- X 6. Crankshaft converts reciprocating motion into rotary motion.
- ... 7. Timing gear of the crankshaft is for setting the ignition timing.

5.2 Repair and maintenance

Information

5.2.1 Testing the compression



Sequence of operations:

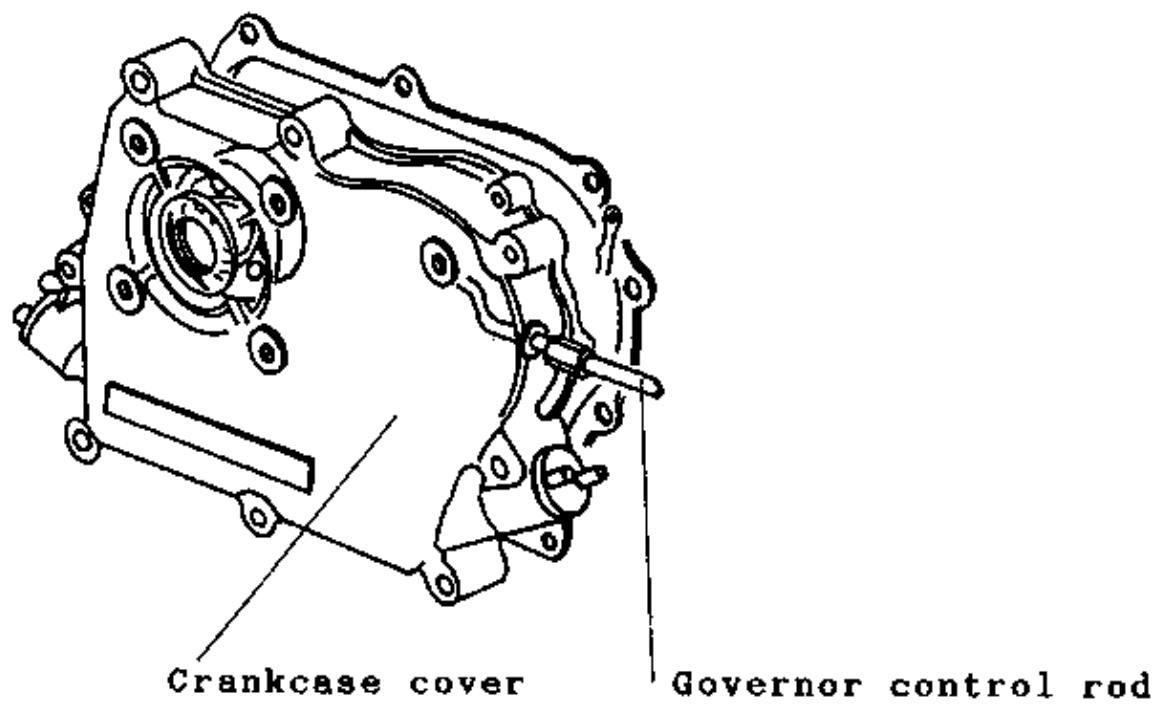
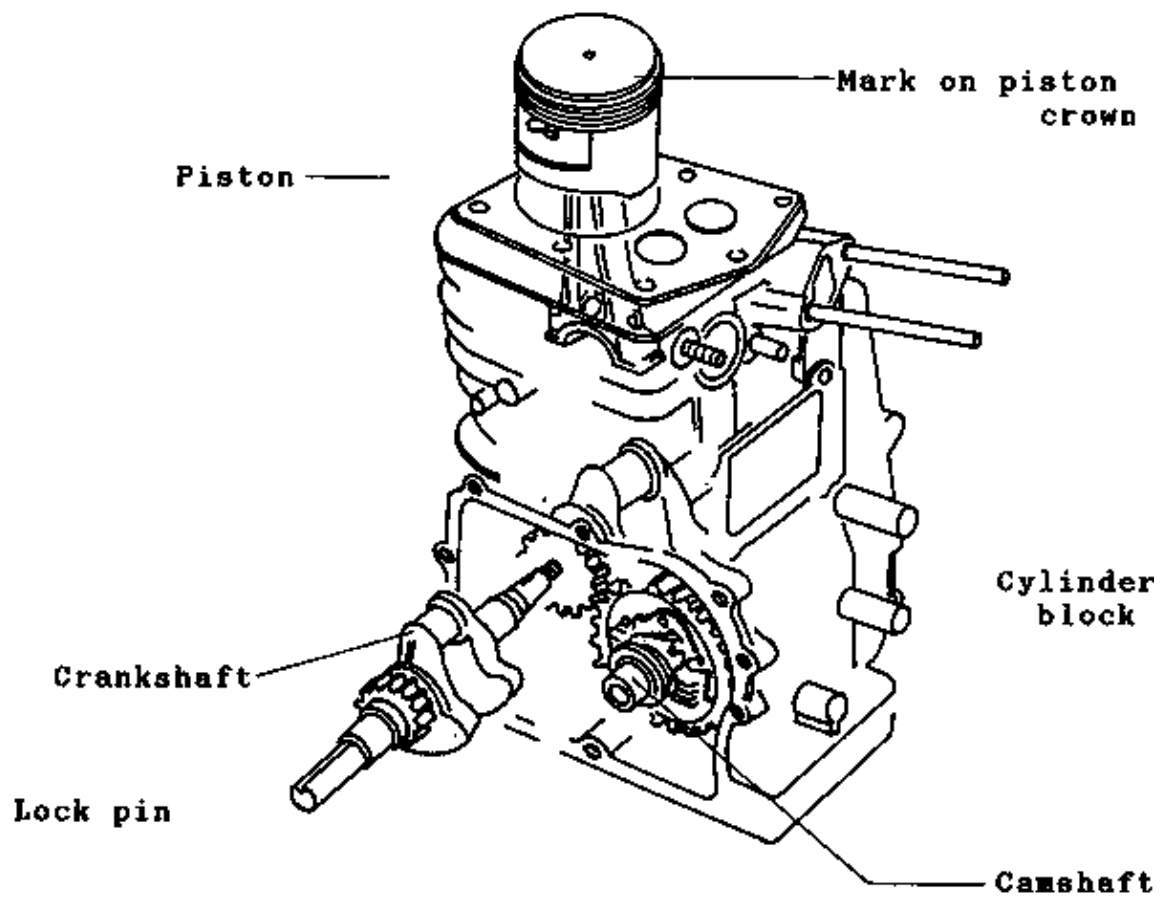
- Remove the spark plug.
- Install the pressure gauge in the spark plug hole.
- Pull the string to crank the engine hardly for several times, and read the pressure.

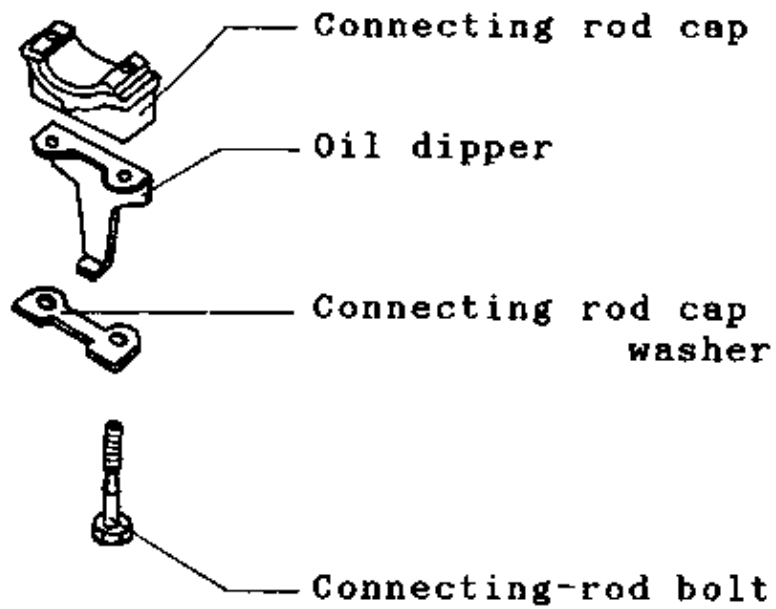
Standard minimum compression = 6 bar

Caution:

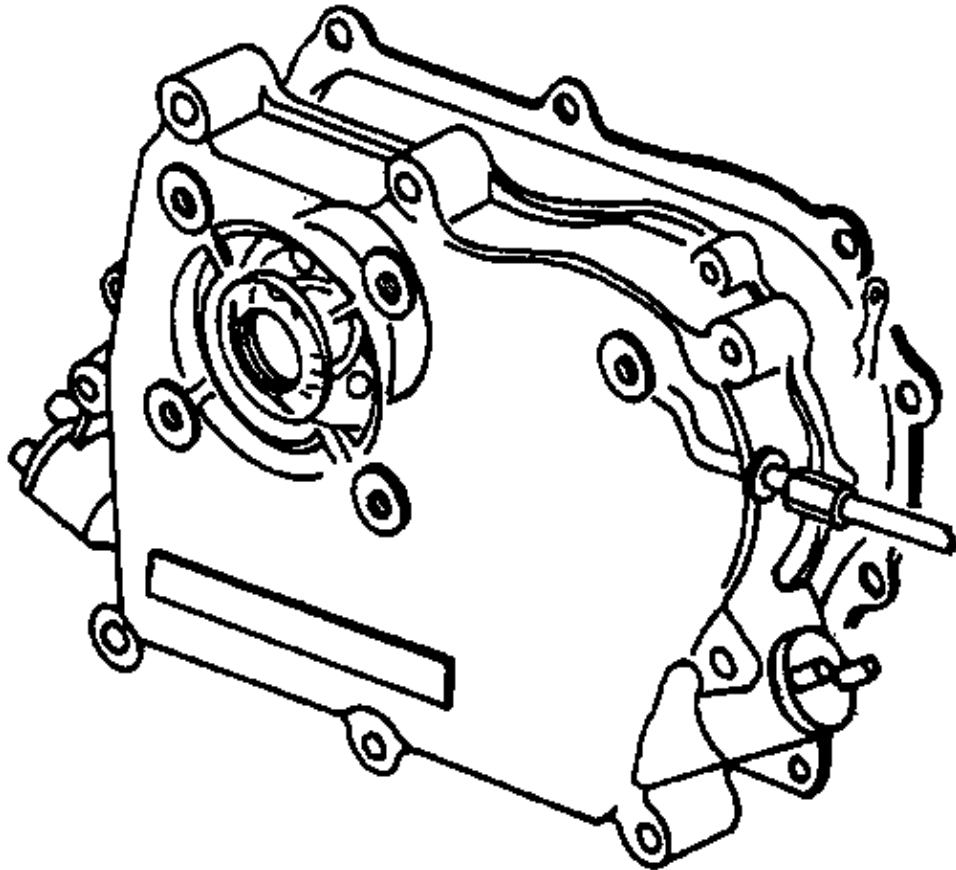
- During spark plug removal, be aware of dust falling into the cylinder.
- Pressure gauge should be cleaned before installing.

5.2.2 Dismantling-Reassembling components of engine





a) Crankcase cover

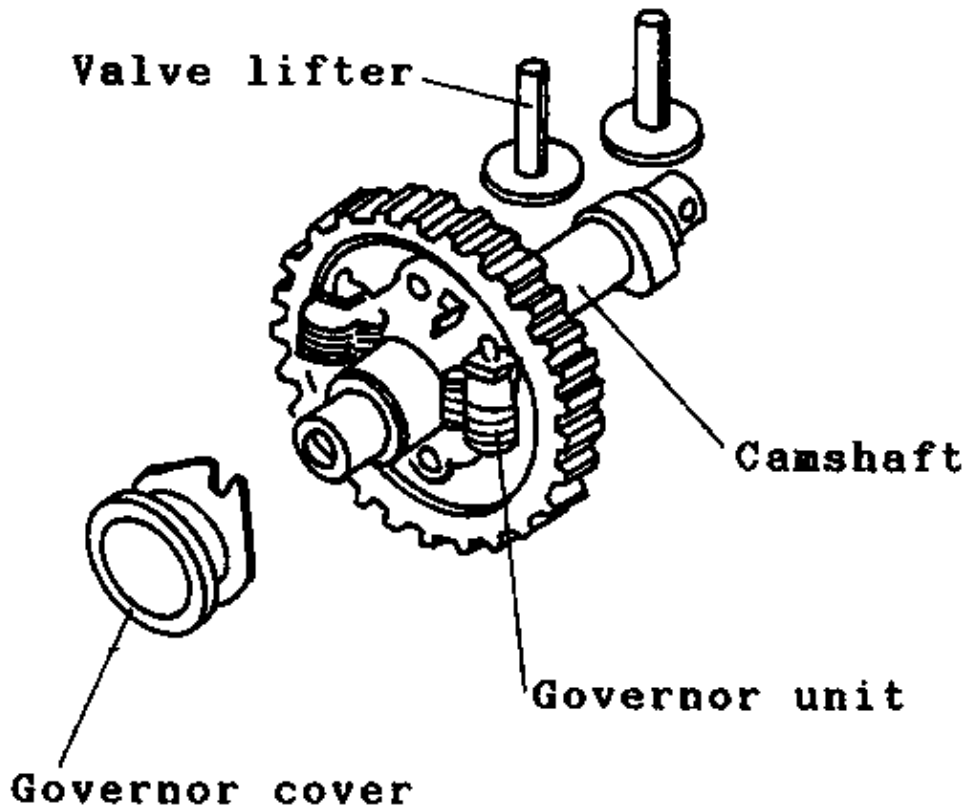


Removal:

1. Remove key on crankshaft if any.
2. Remove all screws of crankcase cover.
3. Tap the crankcase cover around gently with a plastic head hamer.
4. Remove the crankcase cover slowly.

Caution: Gasket may tear off and seal be damaged.

b) Camshaft

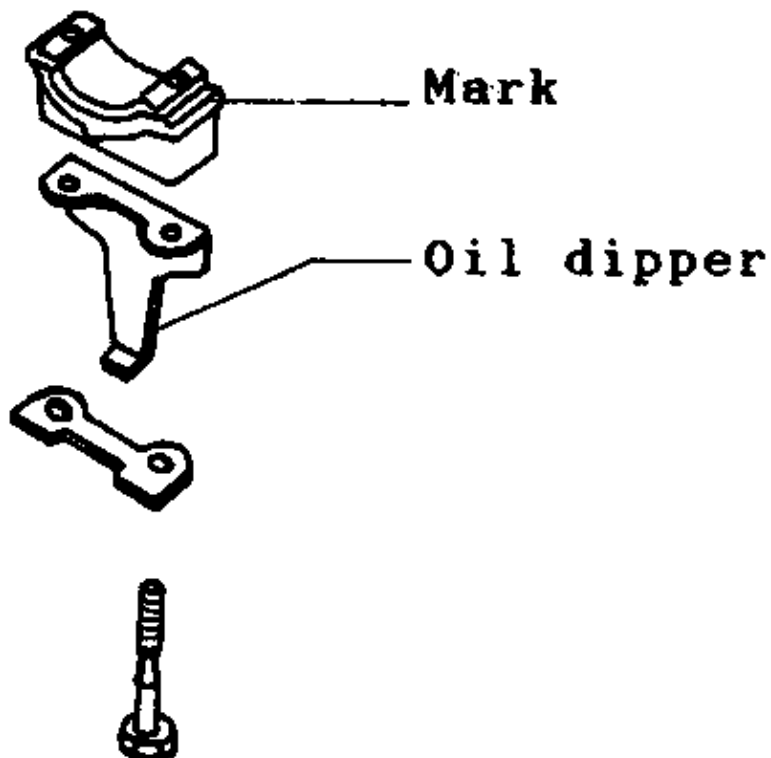


Removal:

1. Turn the crankshaft until the piston is at the top of the compression stroke.
2. Pull the camshaft assembly out.
3. Remove the valve lifters.

Remark: Governor unit is fixed to the camshaft assembly.

c) Connecting-rod cap



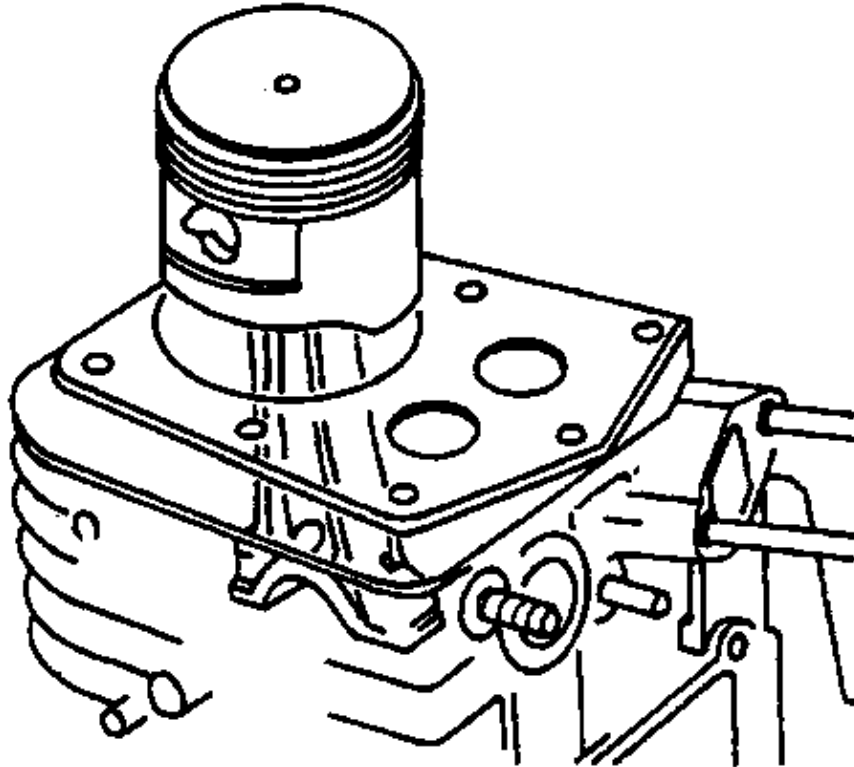
1. Make a mark onto the connecting-rod cap to prevent mixing up.
2. Unscrew the connecting rod bolts after flatten the cap washer.

Caution: position of oil dipper

3. Remove the connecting rod and cap.

Standard torque 9–11 Nm

d) Piston unit



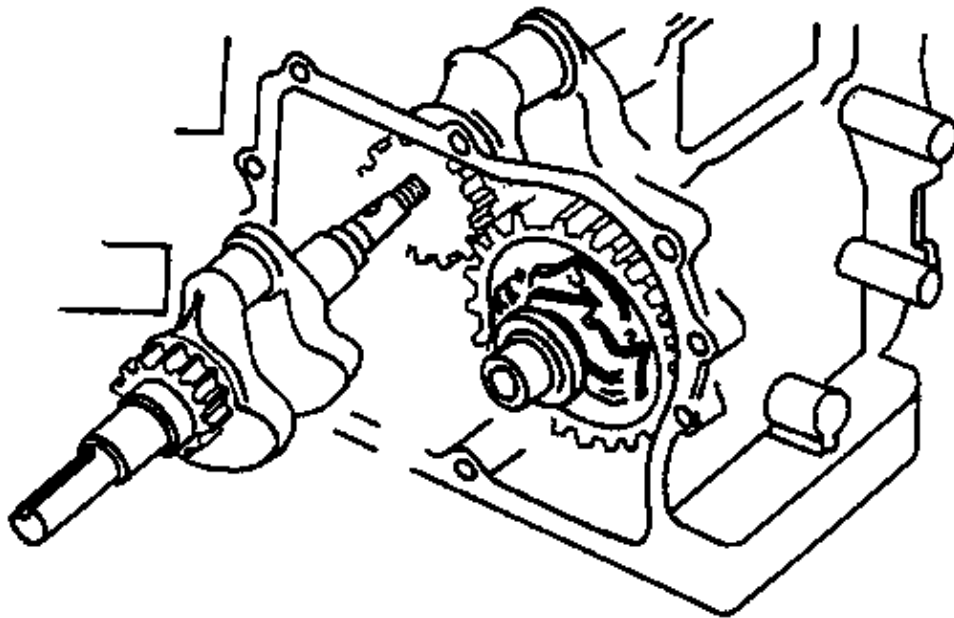
Removal:

Push the piston assembly upward

Reassemble:

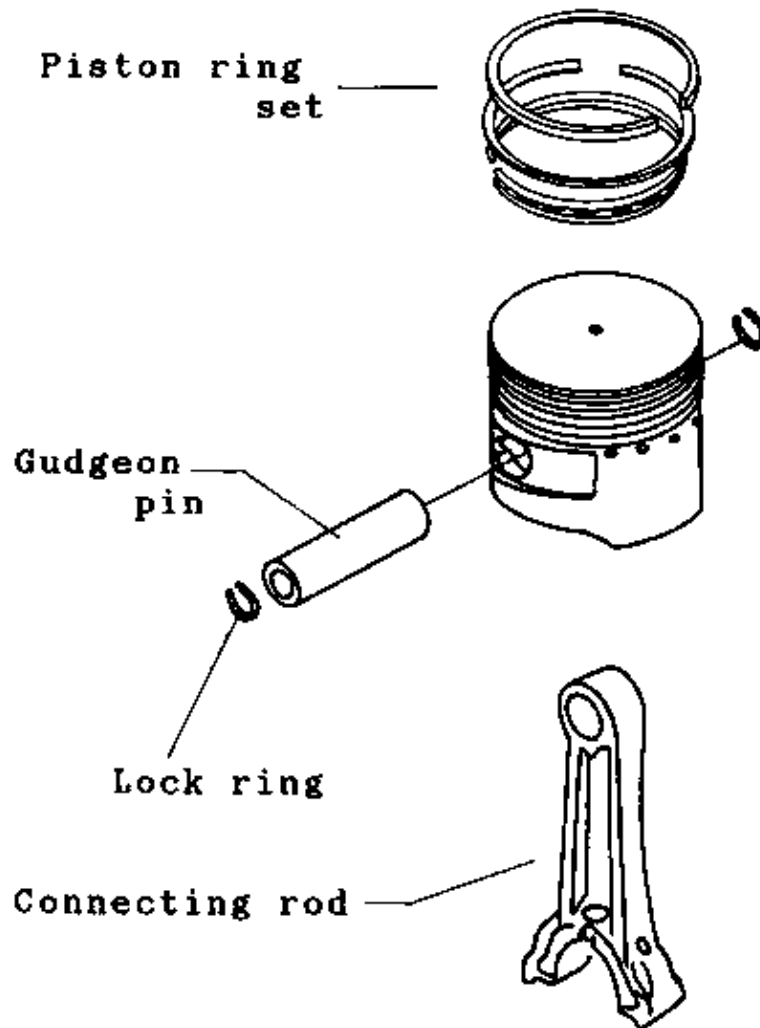
The arrow mark must be directed toward the valves.

e) Crankshaft unit



Caution: Do not drop the crankshaft.

f) Piston rings and gudgeon pin



Removal:

1. Remove piston rings with a special tool.
2. Take out one of the loc ring.
3. Push out the gudgeon pin by hand or with hammer.

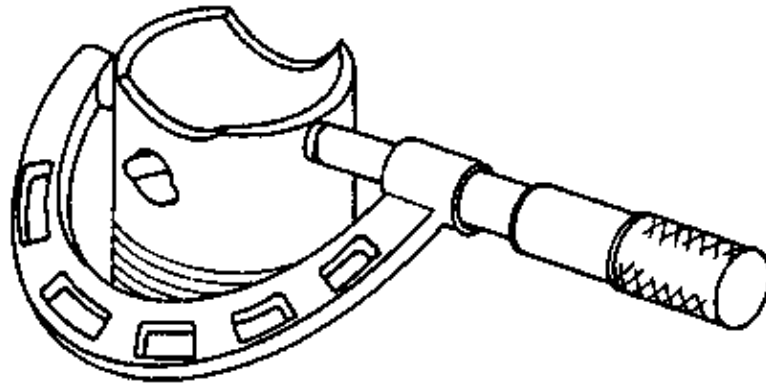
Remark: Remove piston rings before the gudgeon pin, otherwise, piston ring may brake

Reassembling: Install piston Gudgeon pin rings in correct order and arrange their ends at 120 offset.

Mark

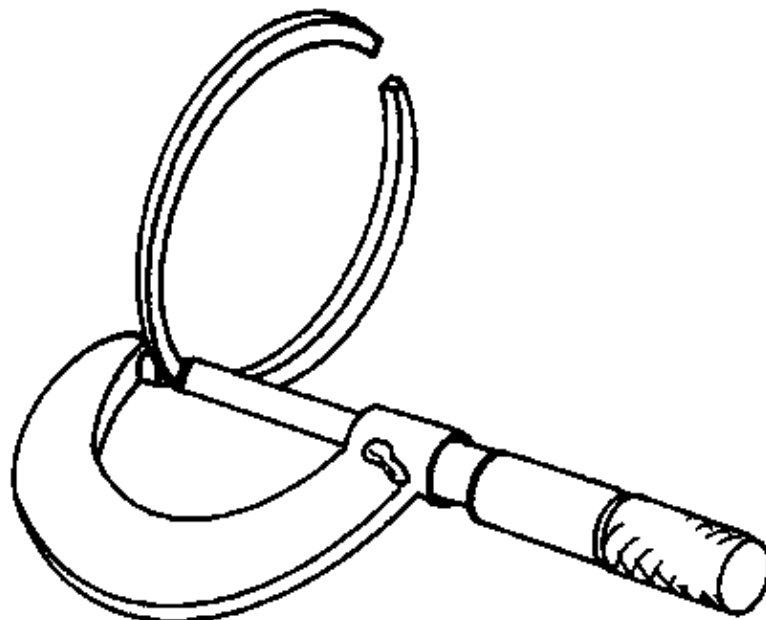
5.2.3 Inspecting the piston and piston rings

a) Measure diameter of the piston skirt



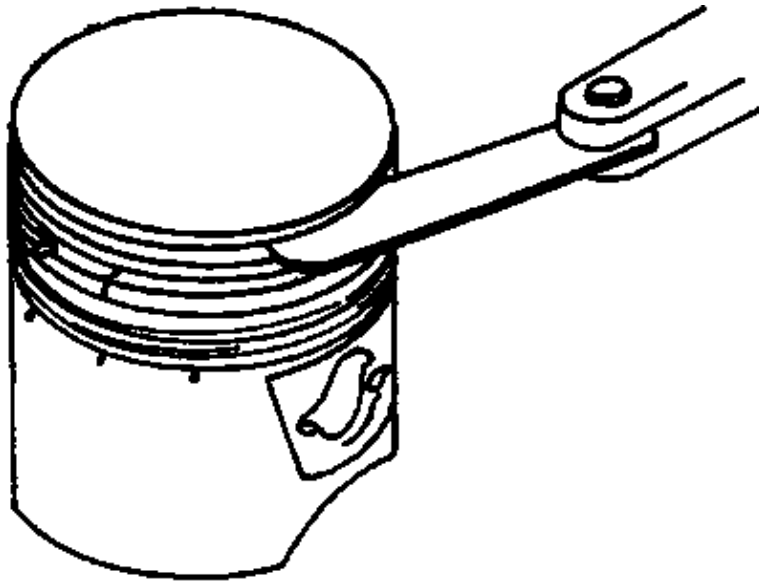
Model	Nom. size	Limited size
G150	64 mm	68.88 mm
G200	67 mm	66.88 mm

b) Measure thickness of compression rings and oil control ring



Nominal size	Limited size
Top compression ring 2 mm	1.87 mm
Second compr. ring 2 mm	1.87 mm
Oil control ring 2 mm	2.87 mm

c) Measure side clearance of piston ring

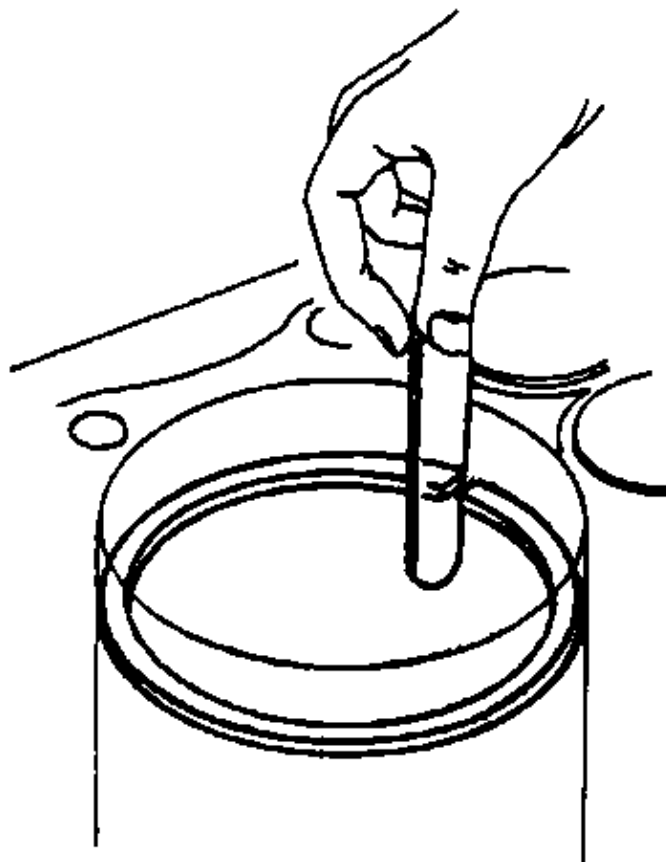


All piston rings must be installed correctly before measuring.

Nominal size	Limited size
all rings	
0.01–0.05 mm	0.15 mm

d) Check piston ring end gaps with feeler gauge

Insert all piston rings into the cylinder before measuring.



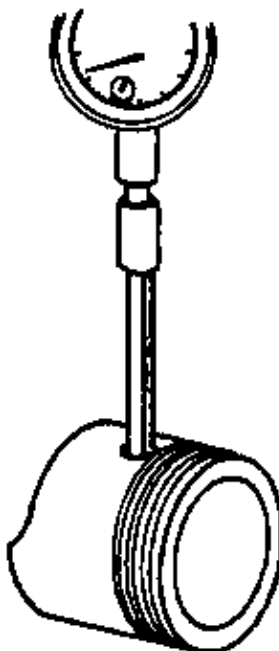
Nominal size	Limited size

all rings	
0.2–0.4 mm	1 mm

5.2.4 Checking gudgeon pin and gudgeon–pin hole

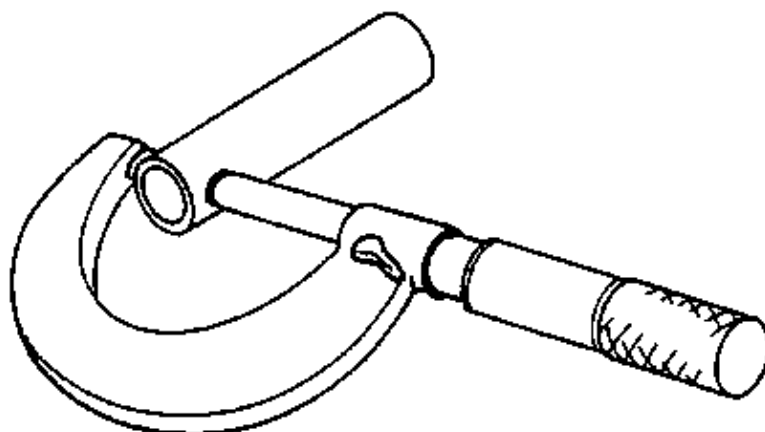
a) Check gudgeon–pin hole

Inside micrometer



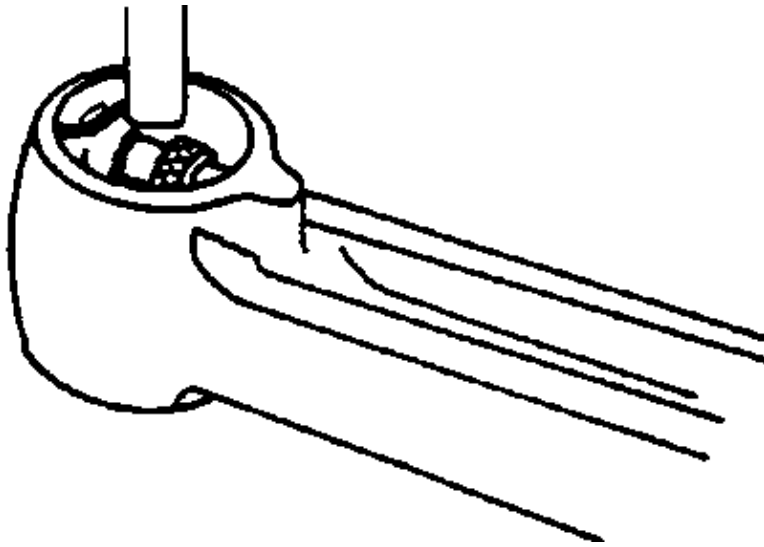
Nominal size	Limited size
15 mm	15.04 mm

b) Measure diameter of the gudgeon pin



Nominal size	Limited size
15 mm	14.954 mm

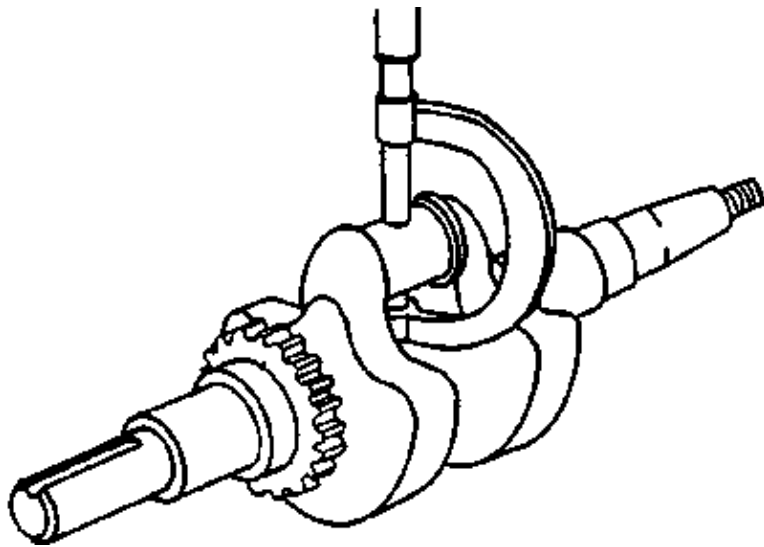
c) Measure bore of the small–end connecting rod



Nominal size	Limited size
15 mm	15.07 mm

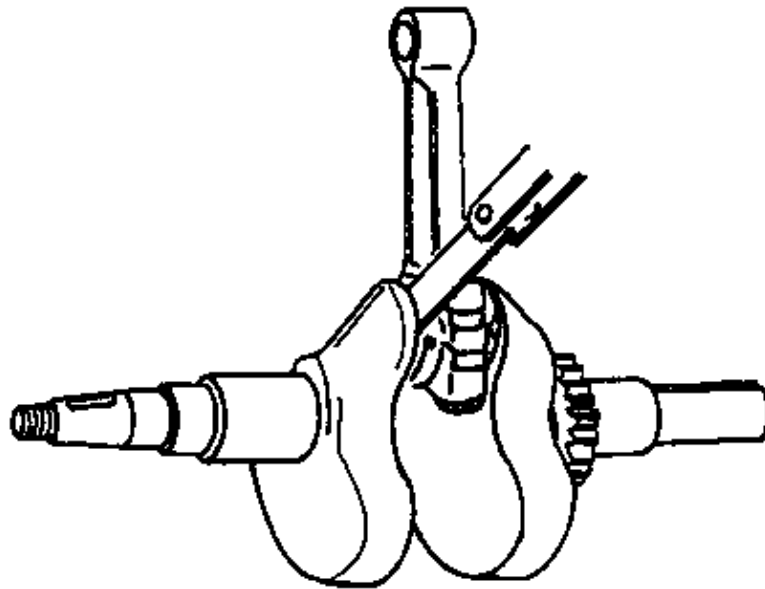
5.2.5 Checking crankshaft and crankshaft bearings

a) Measure diameter of crankpin journal



Nominal size	Limited size
26 mm	25.917 mm

- b) Inspect surface conditions of both, crankshaft and seals with eyes.
- c) Inspect condition of the big-end bearing shells with eyes for any sign of wear.
- d) Measure connecting rod side clearance with feeler gauge.

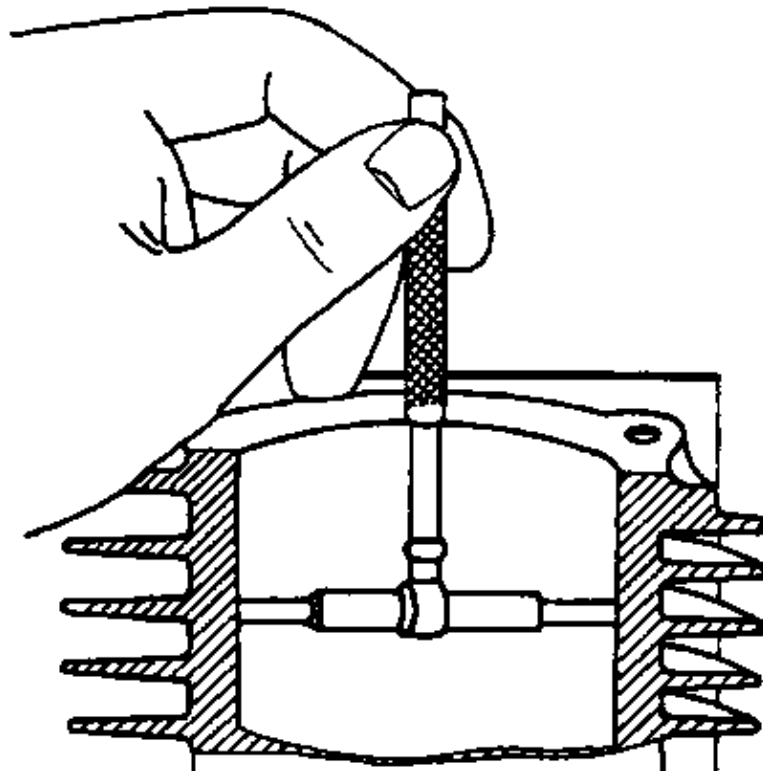


Nominal size	Limited size
0.1–0.8 mm	1.2 mm

Remark: Any parts of beyond the limited size it must be replaced.

5.2.6 Checking the cylinder

Measure diameter of cylinder with inside micrometer.



Nominal size	Limited size
G150 64.0 mm	64.165 mm

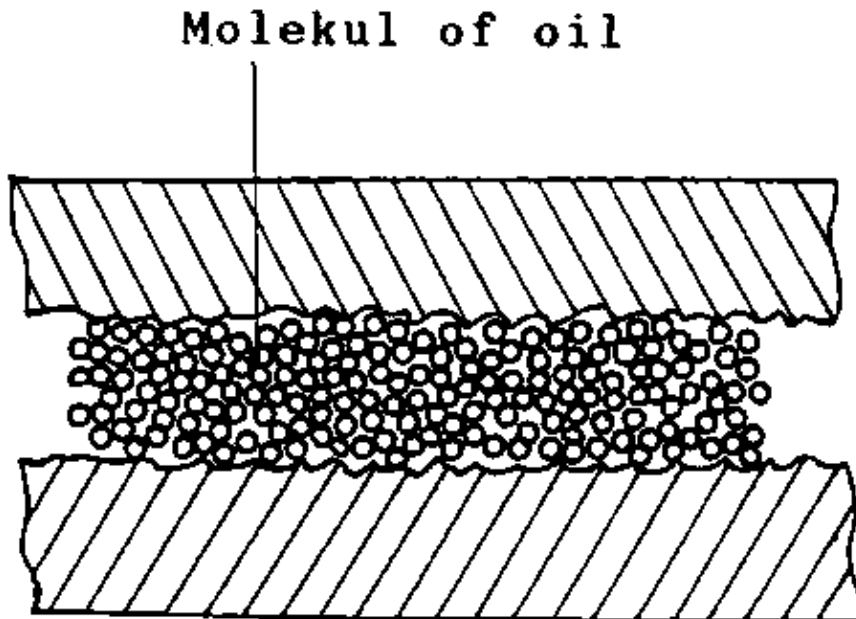
G200 67.0 mm	67.165 mm
--------------	-----------

Remark: Measuring should be carried out in several locations.

6. Lubrication system

Information

6.1 Tasks of the lubrication system



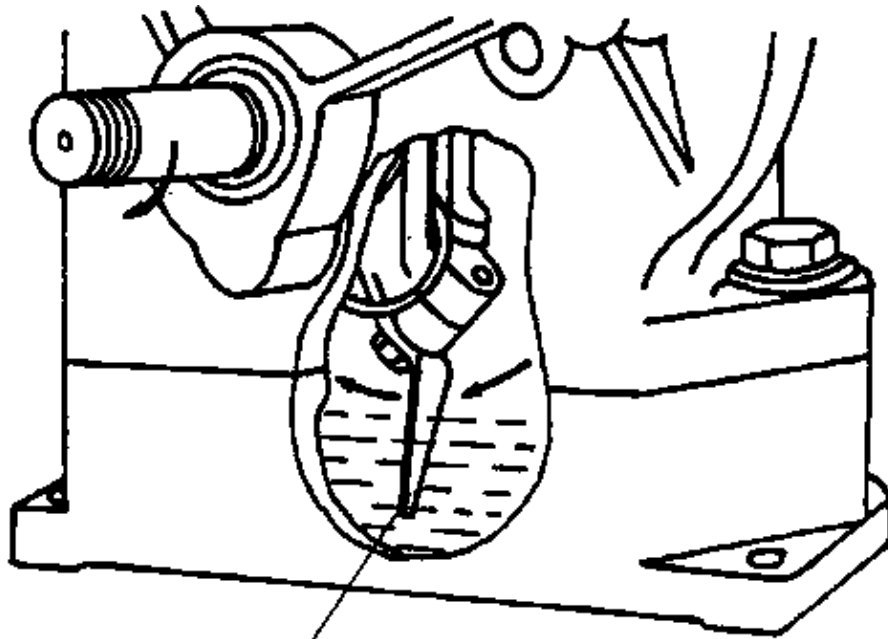
Lubrication system will supply oil to various moving parts of an engine, in order to ...

- reduce friction between moving parts,
- dissipate heat from various parts,
- absorb shock load between shaft and bush bearing,
- act like a sealing between piston rings and cylinder,
- act as cleaning agent.

6.2 Splash-type lubrication

This type of lubrication is mostly used in small engines, due to its simple construction and the simplest lubricating method.

6.2.1 Components and their function



Oil dipper

– Oil dipper will splash oil from the sump during the downward rotation of the crankshaft, to the cylinder wall and other parts.

Advantage:

– Small number of parts and simple construction

Disadvantage:

– Insufficient lubrication may occur to various part in case there is inadequate amount of oil in the sump.

Task sheet

Complete the statements!

1. Lubrication means.....

2. The tasks of the lubrication systems are:

1.
2.
3.
4.
5.

3. Parts of small engine which need lubrication are.....

4. Most used lubrication system in small engines is the type, because.....

5. Disadvantage of the lubrication system used in small engines:

.....
.....

Task (Solution)

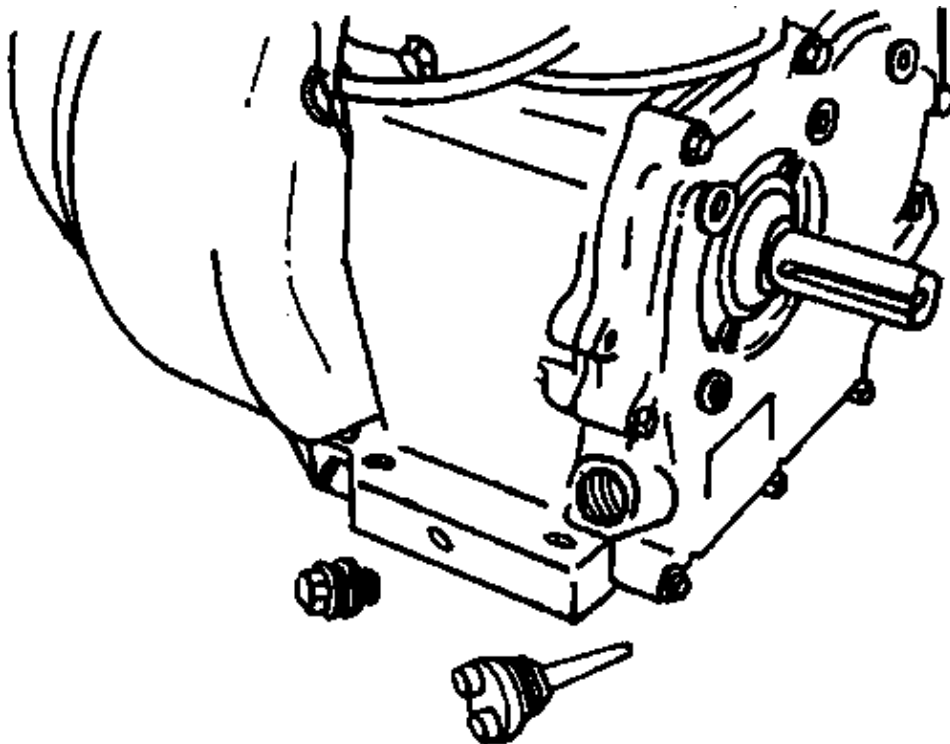
Complete the statements!

1. Lubrication means Supply oil to the moving parts of the engine.
2. The tasks of the lubrication systems are:
 - 1 reduce friction between moving parts
 - 2 dissipate heat from various parts
 - 3 absorb shock load between shaft and bush bearings
 - 4 act like a sealing between piston rings and cylinder
 - 5 act as cleaning agent
3. Parts of small engine which need lubrication are crankshaft, mechanism, valve mechanism and cylinder
4. Most used lubrication system in small engines is the splash type, because due simple construction
5. Disadvantage of the lubrication system used in small engines:
Insufficient lubrication when there is inadequate amount of oil in the sump

6.3 Repair and maintenance

Information

Inspecting/changing oil:

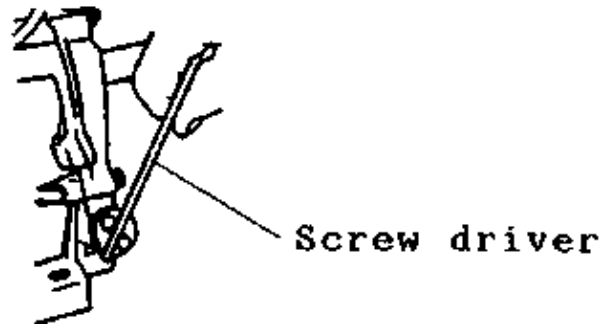
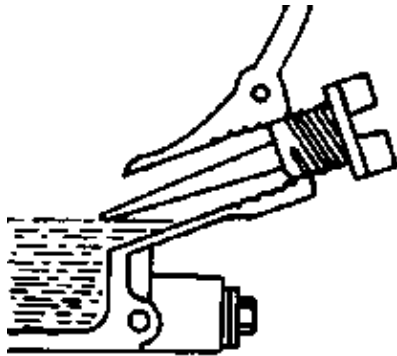


- Unscrew both the drain plug and oil refill screw plug to drain out old oil.
- Screw in the drain plug and refill with new oil upto the specified level.

Capacity of oil sump 0.7 litre

Recommended oil: SAE 2100 W-30

- The engine must be in horizontal position when checking oil level.
- Close the screw plug tightly with the aid of screw driver.



Job sheet

Tools: A set of wrenches

Equipment: Equipment tray, Cloth, Oil, Oil pan

Manufacturer Model

Oil grade

Capacity litre

Sequence of operation	Inspection
1. Prepare tools and equipment.	
2. Run the engine for 5 minutes.	
3. Stop the engine and drain oil.	- Condition of oil
4. Refil new oil upto the specified level.	- Capacity of oil litre
	- Grade
5. Start the engine and observe for oil leakage.	<input type="checkbox"/> Leakage <input type="checkbox"/> No leakage
6. Stop the engine and recheck oil level.	- Oil level
	<input type="checkbox"/> Correct <input type="checkbox"/> Incorrect
7. Clean and store tools and equipment.	- Tools
	<input type="checkbox"/> Complete <input type="checkbox"/> Incomplete

Note:.....

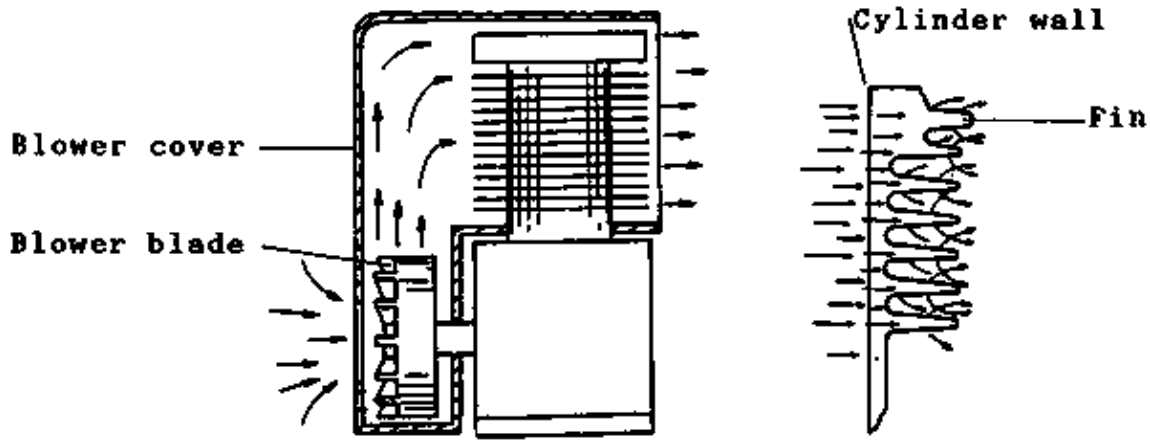
7. Cooling system

Information

Air cooling system....

is the most used system in small engines because it is easy to place, light in weight, has a small number of parts and low production costs. Its tasks are:

- to dissipate heat as generated by friction
- to control dissipating heat within certain range of working temperature for efficient engine performance



- The system uses air as a cooling medium to transfer heat from engine to surrounding air which has lower temperature.
- For engine with air cooling system, the exterior of cylinder will be in forms of fins and spaces which increases area of air contact.
- To be of efficient the blower cover is used to direct air blowing.
- As the engine runs, the blower blade attached on the flywheel will suck in cool air and blow it along the cover to cool down the cylinder wall.

Task sheet

Complete the statements!

1. The tasks of the cooling system are:

- 1
- 2

2. Small gasoline engines generally use cooling system, because

3. Small gasoline engines generally have their cylinder head and cylinder block made in the forms of

This is for

4. Components of cooling system of most small gasoline engines consist of

5. Blower cover is used for

Task (Solution)

Complete the statements!

1. The tasks of the cooling system are:

- 1 To dissipate heat as generated by friction
- 2 To control temperature within a certain range

2. Small gasoline engines generally use air cooling system, because it is easy to place, light in weight, has a small number of parts and low production costs.

3. Small gasoline engines generally have their cylinder head and cylinder block made in the forms of fins and spaces.

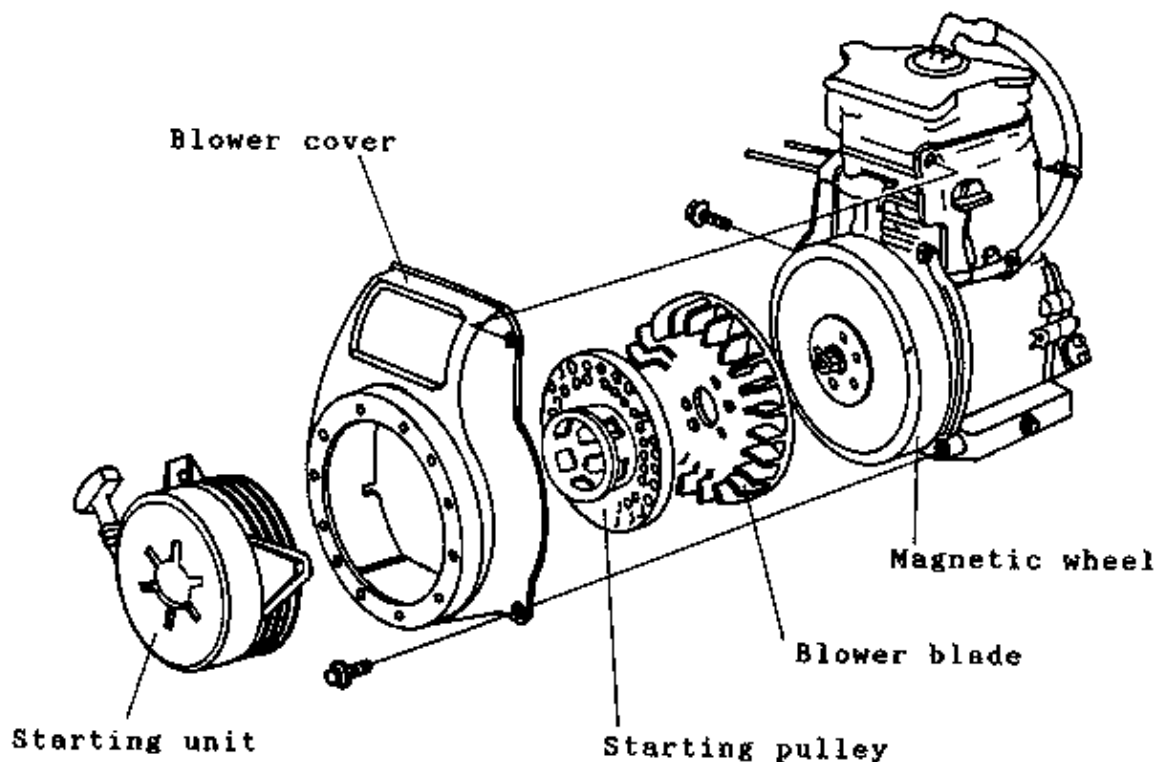
This is for increasing the area of air contact

4. Components of cooling system of most small gasoline engines consist of lower, lower-cover and fins

5. Blower cover is used to guide the air.

7.1 Repair and maintenance

Information



- The starting unit must be cleaned before assembling the blower cover.
- The blower blade must be fixed to the magnetic wheel at the correct position which is guided by the pilot pin of the magnetic wheel. Be aware of cracking the blower blade.

Job sheet

Tools: A set of wrenches

Equipment: Tray, cloth, benzene

Manufacturer..... Model

Type of cooling system.....

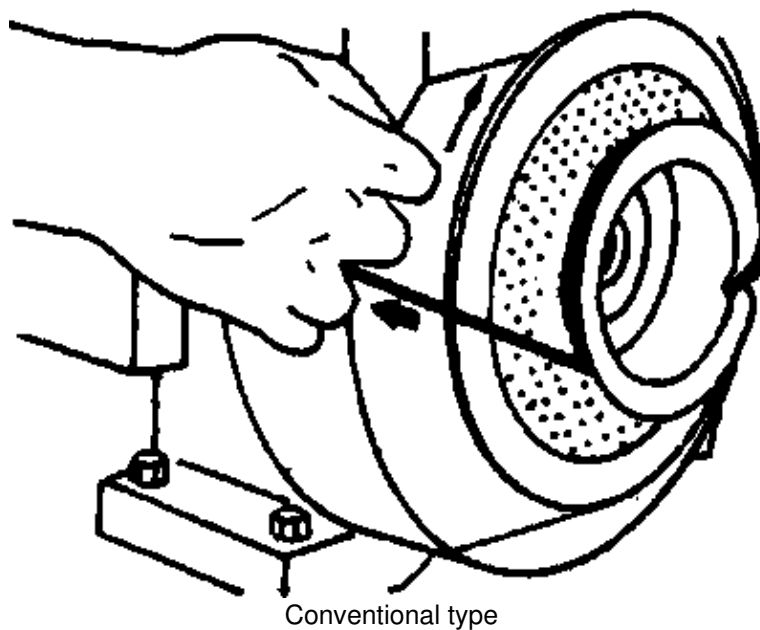
Sequence of operations	Inspection
1. Prepare tools and equipment.	
2. Close fuel valve, disconnect fuel hose and remove fuel tank.	
3. Remove starting unit.	
Remark: Notice the position of starting unit.	
4. Remove blower cover.	- Condition of blower cover
	<input type="checkbox"/> Normal <input type="checkbox"/> Damaged
5. Remove starting pulley.	
Remark: Notice the position of starting pulley.	
6. Remove blower blade.	- Condition of blower blade
	<input type="checkbox"/> Normal <input type="checkbox"/> Damaged
7. Clean blower blade, fins of cylinder head and cylinder block, and blower cover.	
8. Reassemble those components	
9. Clean and store tools and equipment.	- Tools-equipment
	<input type="checkbox"/> Complete <input type="checkbox"/> Incomplete

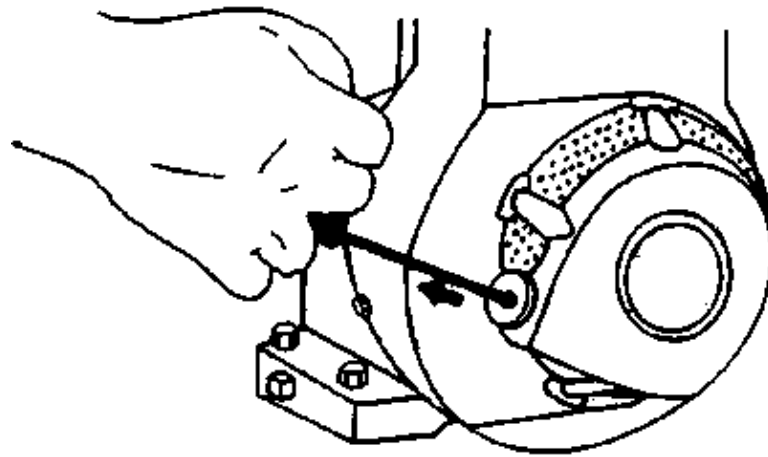
Note:

8. Starting system

Information

8.1 Types of starting systems

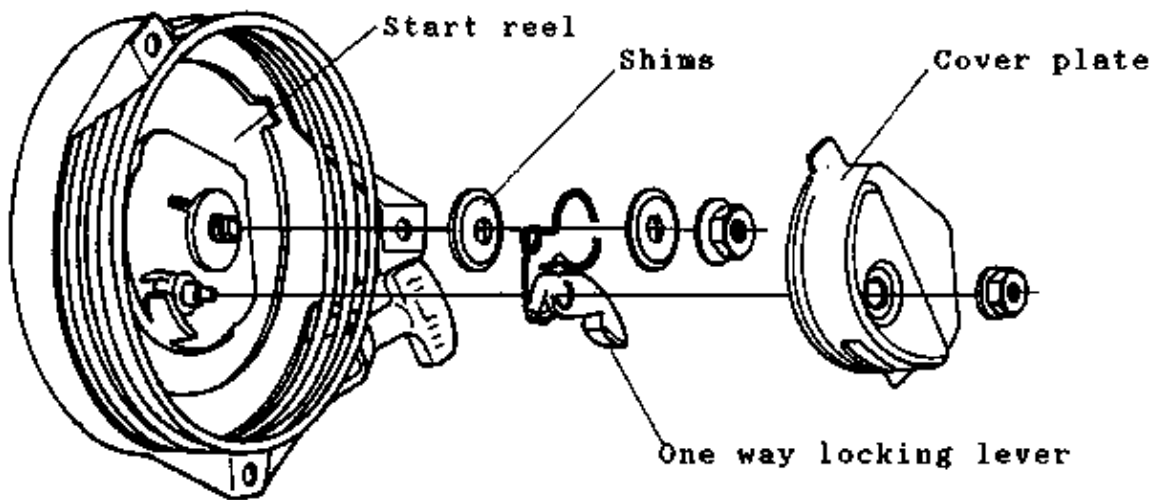




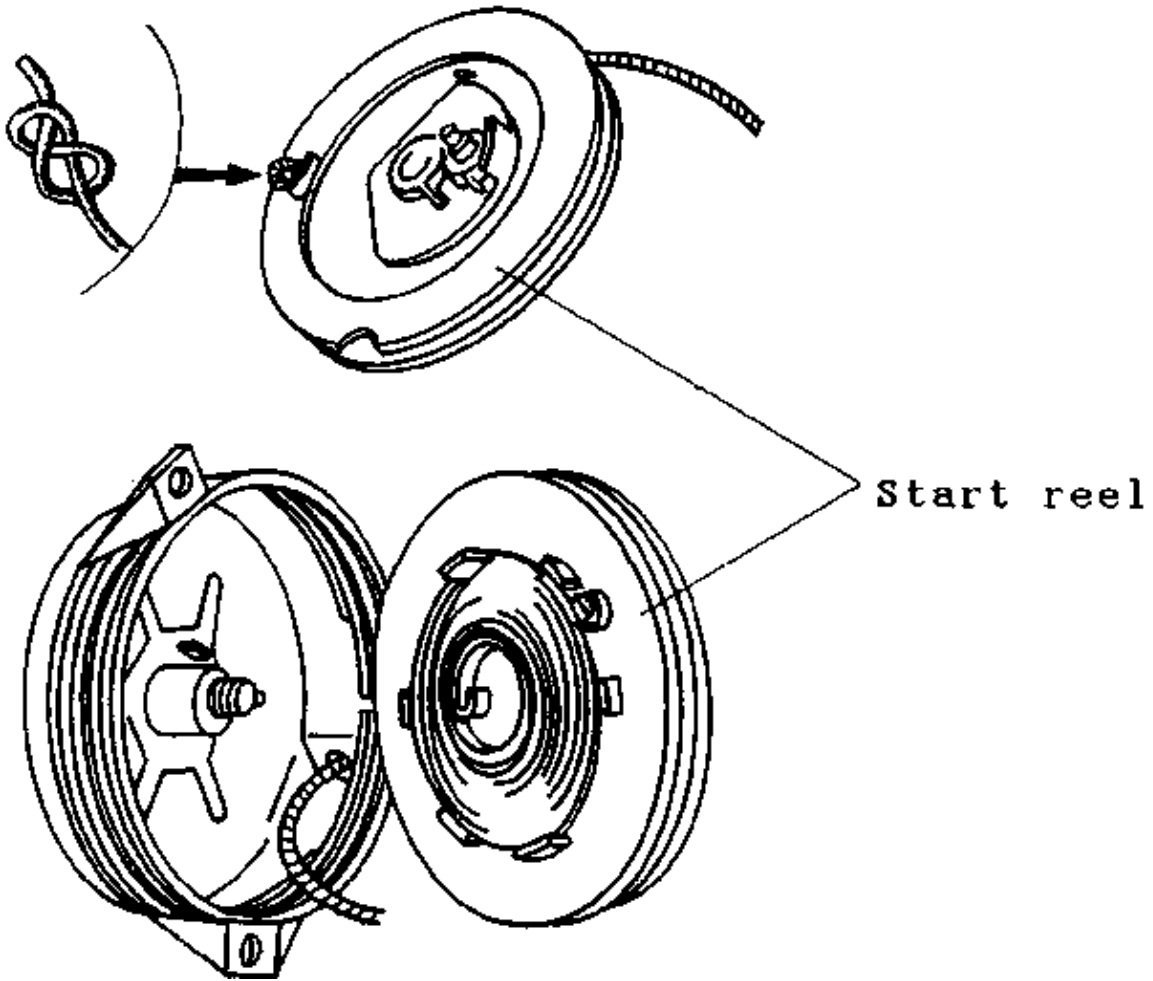
Built in starting unit

8.2 Repair and maintenance

a) Removal and reassemble starting unit



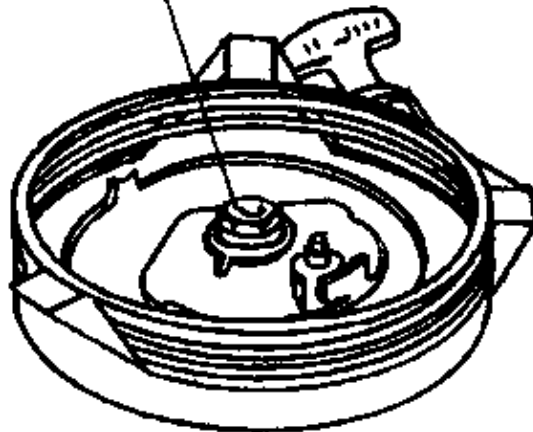
b) Assembling starting string



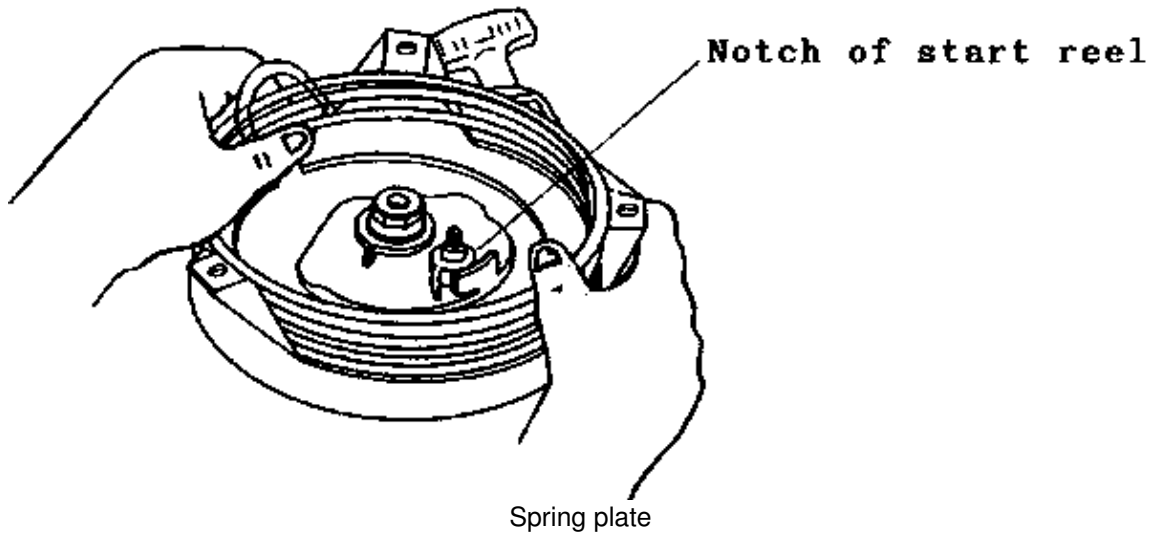
Starting spring housing

- Thread one end of the string through the hole of the start reel and make a knot.
- Wind the string on the start reel (in the direction of spring). Thread the other end of string through the spring housing. Refit the start reel to the spring housing.

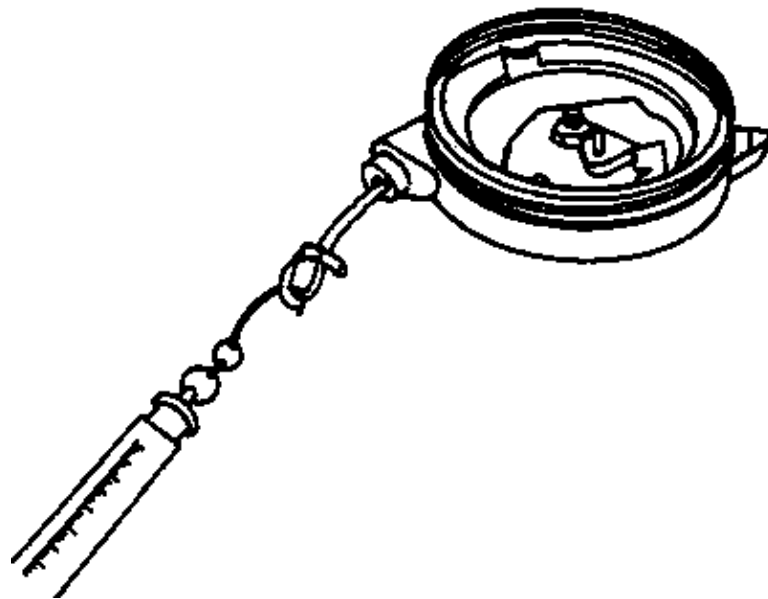
Lock nut



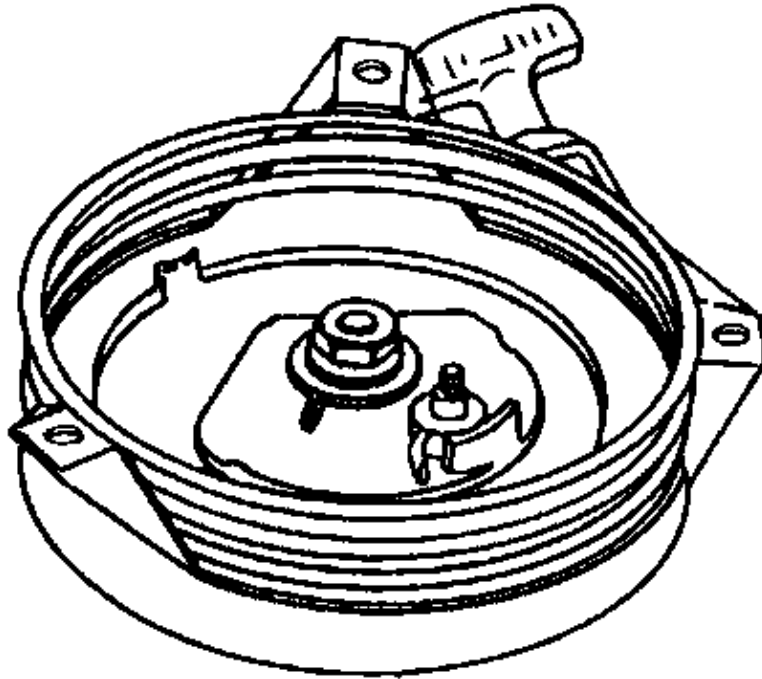
- Reassemble the spring plate and screw on the lack nut. Tighten it to the specified torque-



– Turn the start reel for about 1 1/2 turns to wind up the rest of string from the notch of the start reel.



– Check tensioning of the starting string by using a spring scale. The reading should be about 0.6–1.4 kg. Adjustment of tension can be accomplished by tightening or loosening the start reel.



- Refit the handle to the starting string and tie it. Assemble the spring to the ratchet of the start reel. Inspect function of the ratchet.
- Reinstall the start reel cover.

Job sheet

Tools: A set of wrenches

Equipment: Tray, cloth, grease

Manufacturer Model

Type of starting system

Sequence of operations	Inspection
1. Prepare tools and equipment.	
2. Remove starting unit from blower cover.	
3. Dismantle components of starting unit.	- check/replace parts
4. Clean all parts of the starting unit.	- grease moving parts
5. Reassemble components of the starting unit.	
6. Refit the starting unit	- check performance
7. Inspect its function	
8. Clean and store tools and equipment.	

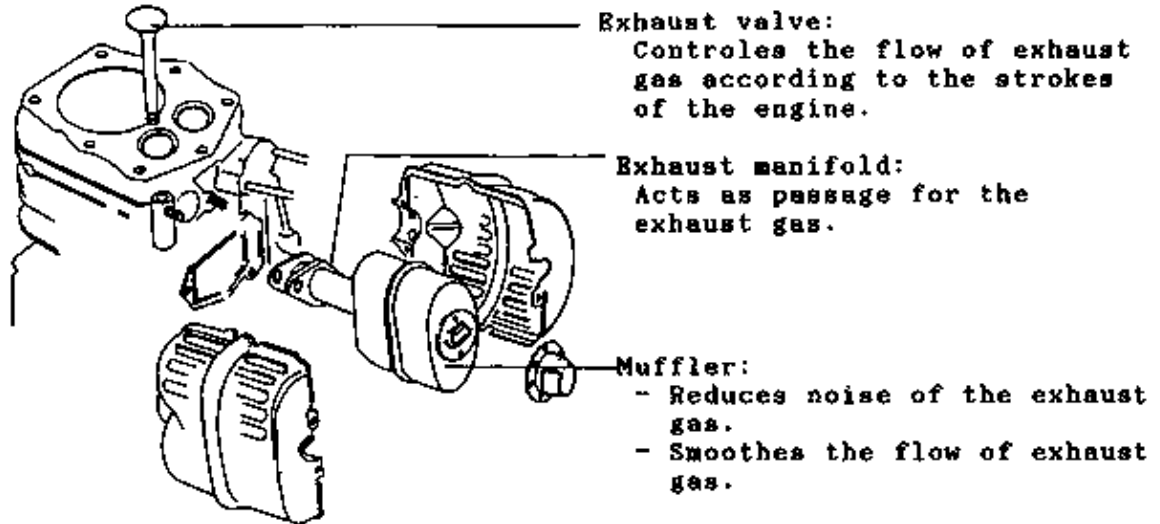
Note:

9. Exhaust system

9.1 Purposes of exhaust system

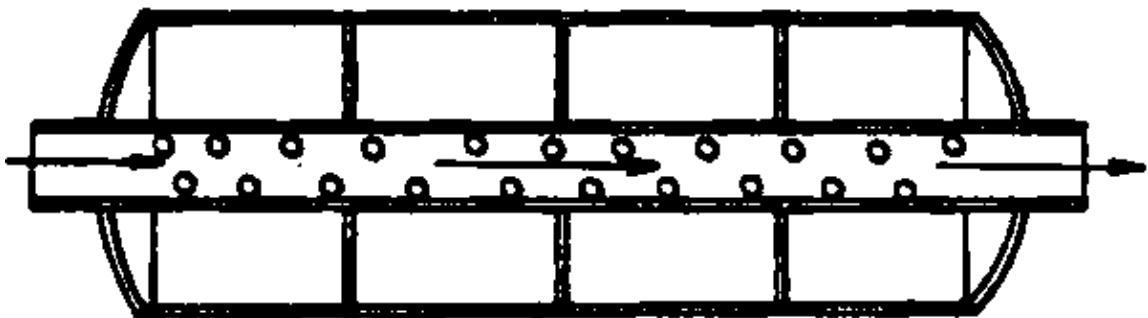
- a) To relief exhaust gas from the combustion chamber.
- b) To improve engine power.
- c) To reduce expanding noise of exhaust gas.

9.2 Components and their function



There are two kinds of mufflers:

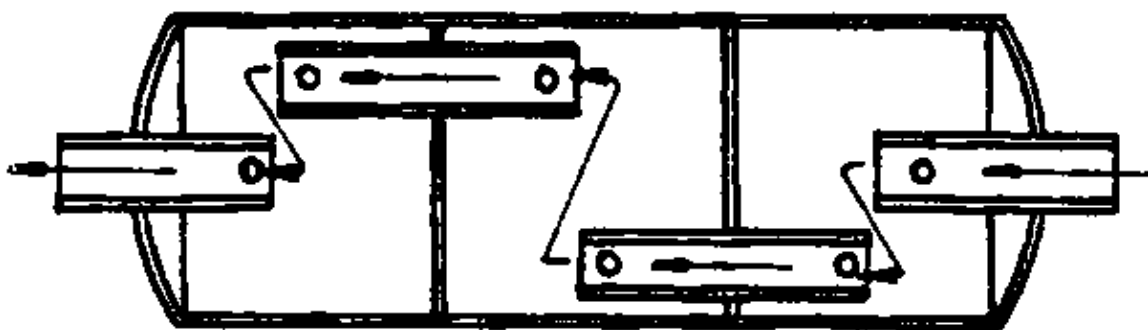
- a) Straight-through muffler



The exhaust gas flows like a stream both inside and outside the muffler, causing turbulence.

Hard flow of exhaust gas will reduce engine power.

- b) Reverse-flow muffler



The exhaust gas will expand inside each compartment of the muffler as it flows. This will minimize the level of noise considerably when it comes out to the atmosphere.

Turbulence of exhaust gas is reduced, thus, noise is also reduced.

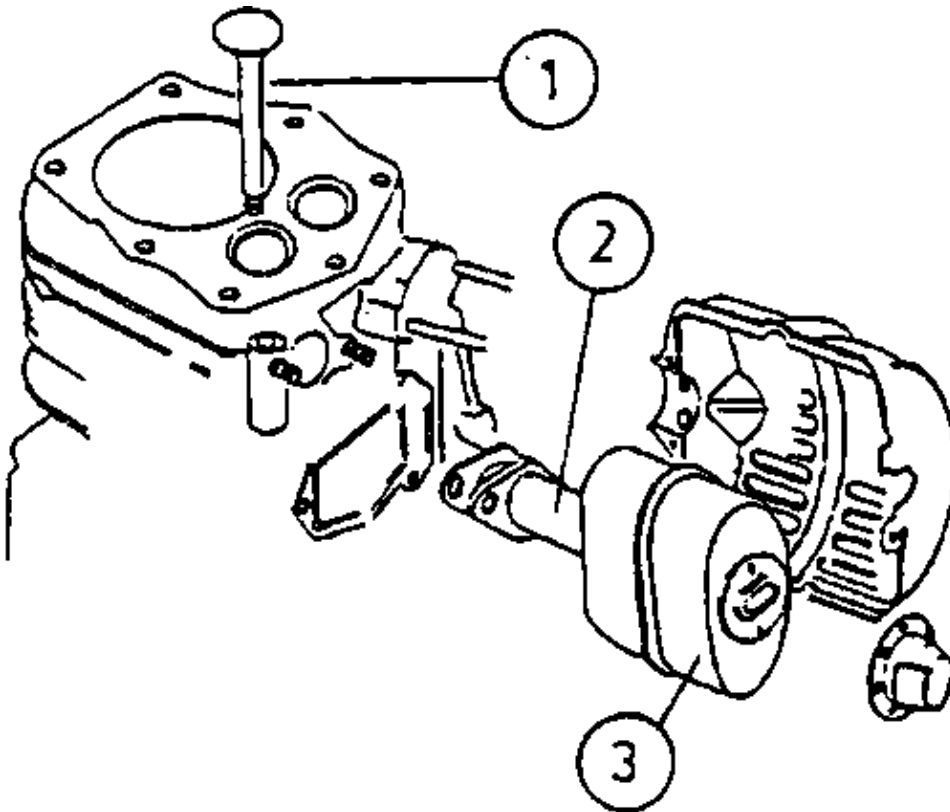
Task sheet

Complete the statements!

1. Purposes of exhaust system are:

- a)
- b)
- c)

2. Name various parts of the exhaust system.



- 1.....
- 2.....
- 3.....

3. The muffler can reduce noise of exhaust gas, due to

4. There are muffler–designs, which are

5. Small gasoline engines generally use the muffler–type, because

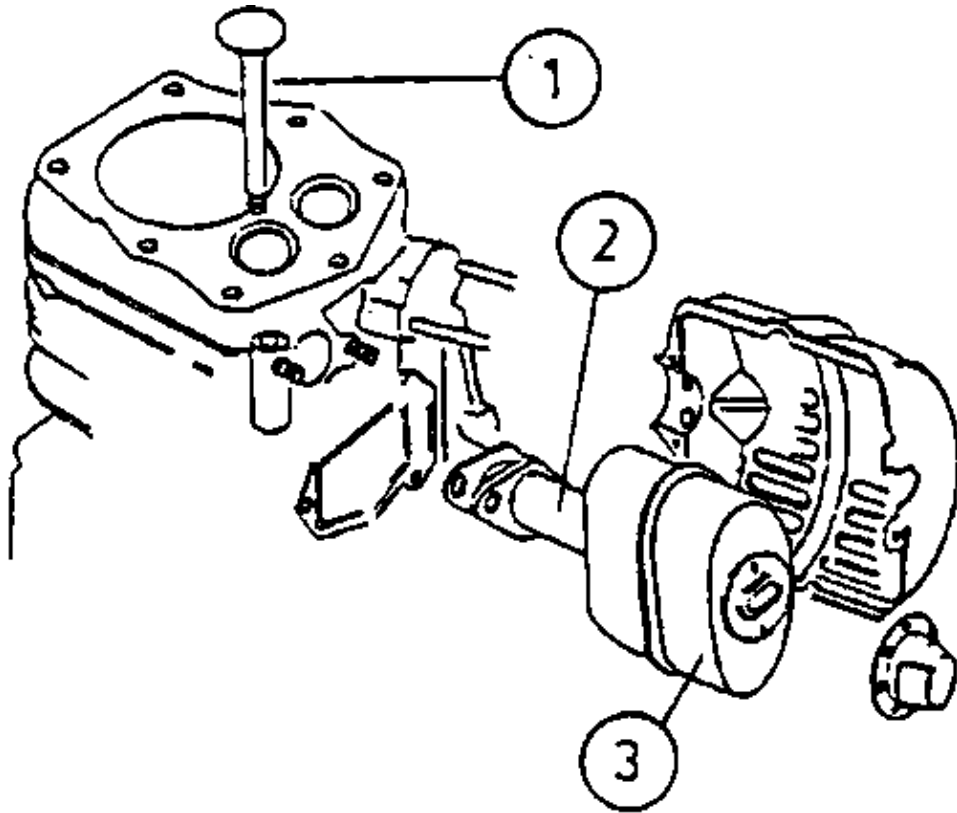
Task (Solution)

Complete the statements!

1. Purposes of exhaust system are:

- a) To relief exhaust gas from the combustion chambre
- b) To improve engine power
- c) To reduce expanding noise of exhaust gas

2. Name various parts of the exhaust system.



- 1 Exhaust valve
- 2 Exhaust manifold
- 3 Muffer

3. The muffer can reduce noise of exhaust gas, due to turbulence and expansion

4. There are 2 muffer–designs, which are Straight–through and Reverse–flow muffer

5. Small gasoline engines generally use the Reverse muffer–type, because noise is reduced and engine power improved.

